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0.1 Application

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Application

0.1

0.1.1 Introduction

[The Building \(Scotland\) Act 2003](#) gives Scottish Ministers the power to make building regulations to:

- secure the health, safety, welfare and convenience of persons in or about *buildings* and of others who may be affected by *buildings* or matters connected with *buildings*;
- further the conservation of fuel and power; and
- further the achievement of sustainable development.

This document gives guidance on how to comply with these regulations.

This is one of two Technical Handbooks, one covering *domestic buildings* and the other non-domestic *buildings*. These Technical Handbooks have been issued by Scottish Ministers for the purpose of providing practical guidance with respect to the requirements of the provisions of the building regulations under a notice given in accordance with Section 4(2) of the Building (Scotland) Act 2003. Each Handbook has seven sections. Section 0, this section, is identical in both Handbooks. It covers general issues and sets out how and when the regulations apply to *buildings* and *works*.

Both Handbooks are published in three forms, as printed loose leaf sheets with an A4 binder, on a single CD-rom, and on the Scottish Building Standards Agency web-site. It is quite acceptable to download and print off individual parts or sections of the Handbooks and all future amendments and updates will be included on the web-site.

Sections 1 to 6 give guidance on how to achieve the standards set by the regulations, and there are different sets for *domestic buildings* and non-domestic *buildings*. The six sections each cover a number of related standards. They are:

| | |
|-----------|-------------|
| Section 1 | Structure |
| Section 2 | Fire |
| Section 3 | Environment |
| Section 4 | Safety |
| Section 5 | Noise |
| Section 6 | Energy |

Each of the six sections consists of an introduction and then guidance on the standards within the section. In the printed version the standard and some introduction information is given on a yellow page, while the guidance on how to comply with the standard is given in the succeeding white pages.

At the end of the Handbook, after section 6, there are the following:

Appendix A: Defined terms.

Appendix B: List of standards and other publications.

A full index (hard copy only as the electronic version has a search facility)

The Technical Handbooks are supported by a Procedural Handbook, published separately, which clarifies the intent of the [Building \(Scotland\) Procedures Regulations 2004](#).

0.1.2 [The Building \(Scotland\) Regulations 2004](#)

This Technical Handbook gives guidance on achieving the standards set in the Building (Scotland) Regulations. The standards themselves can be found

in schedule 5 to regulation 9, and are in the form of ‘expanded functional standards’. That is, the standards describe the functions a *building* should perform, such as ‘providing resistance to the spread of fire’, and are an expanded and more detailed form of the previous building standards regulations.

The Building (Scotland) Regulations made by the Scottish Ministers are subject to approval by the Scottish Parliament. The content of the regulations, so far as it relates to technical specifications, is also scrutinised by the European Commission (EC). The EC checks with all the other countries that have adopted the [Construction Products Directive](#) (CPD) to ensure that no barriers to trade in *construction* products are created, either directly or indirectly by the way products are described.

To meet the requirements of the CPD, materials and *construction* methods must be described by use of suitable European Standards wherever these exist. As there is a rolling programme of change to these National and European Standards, which includes conversion to, and the further provision of, ENs and harmonised ENs, the Handbooks have been designed to be readily updated. An explanation of the relevance and status of specific European and British standards referred to in the Handbooks is in the section concerned. There is also a list of the publications referred to in the Handbooks provided in Appendix B.

The arrangement of the sections within Handbooks relates directly to the Essential Requirements of the CPD (as published by the EC), which *construction works* are expected to satisfy when they have been properly designed and *built*. The arrangement is as follows:

| | | |
|-----------|-------------|--|
| Section 1 | Structure | (EC - Mechanical resistance and stability) |
| Section 2 | Fire | (EC - Safety in case of fire) |
| Section 3 | Environment | (EC - Hygiene, health and the environment) |
| Section 4 | Safety | (EC - Safety in use) |
| Section 5 | Noise | (EC - Protection against noise) |
| Section 6 | Energy | (EC - Energy, economy and heat retention) |

0.1.3 The building standards system

The building regulations are enforced through the building standards system also established by the [Building \(Scotland\) Act 2003](#). This Act sets out the enabling powers that allow the Scottish Ministers to make, not only the building regulations, but also procedural regulations, fees regulations and the other supporting legislation needed to operate the system. The system is designed to ensure that new *buildings* and *works* achieve the objectives of *the Act* in terms of health, safety, welfare, convenience, conservation of fuel and power, and sustainable development.

The roles of those operating the building standards system are explained in detail in the guidance on the procedural regulations. Briefly, the duty to comply with the building regulations lies with the owner, or in some cases the client, for the *work*. Before *work* begins a building warrant must be obtained. For some simpler *works* a warrant is not required (see regulation 5 and schedule 3), but the regulations still apply. The owner or client again has the duty to comply. The role of issuing warrants and accepting completion certificates rests with verifiers, enforcement is by local authorities, and the system is overseen and updated by the Scottish Building Standards Agency

advised by the Building Standards Advisory Committee. This agency is an executive agency of the Scottish Executive Development Department; that is to say it is an integral part of the Scottish Executive and answers directly to the responsible Scottish Minister. These bodies are further explained in the guidance to the procedural regulations.

The building standards system is pre-emptive, ensuring so far as possible that the proposed *works* will comply with the regulations. It recognises that proposals can change during *construction*, so there are requirements for amendments to the proposals to be agreed and recorded. On completion, the owner or client must certify that the *works* have been *constructed* in accordance with the building warrant and the building regulations. The verifier will make reasonable inquiry to ensure the completion certificate is accurate before accepting the certificate. Usually an inspection of the *works* will be made, and on most projects some inspection of *work* in progress will also have been carried out. However verifiers cannot inspect all materials and *work* on every *building site*. It is the client that should put in place the contractual and practical arrangements needed to assure themselves that the desired quality of *work* has been achieved.

0.1.4 Status of Technical Handbooks

The regulations are mandatory, but the choice of how to comply lies with the *building* owner. This Technical Handbook has been issued by Scottish Ministers, through the Scottish Building Standards Agency, for the purpose of providing practical guidance with respect to the building regulations. If the guidance is followed in full then this should be accepted by the verifier as indicating that the building regulations have been complied with. However it is quite acceptable to use alternative methods of compliance provided they fully satisfy the regulations.

Failure to comply with the Technical Handbook does not render a person liable to civil or criminal procedures, but proof of compliance with the guidance may be relied on in any proceedings as tending to negative liability for an alleged contravention of the building regulations.

Following the advice in the Technical Handbooks is therefore likely to be the normal way of complying with the building regulations. However, a designer may put forward other ways of meeting the regulations, in the form of alternative solutions.

In due course other documents may be issued by Scottish Ministers to provide further guidance. Such guidance might deal with specific *building* types, or provide alternative methods of showing compliance with those provided in the Technical Handbooks.

0.1.5 Alternative solutions

The use of expanded functional standards, backed up by detailed guidance, provides a flexible system of control. Consideration of alternative solutions is assisted by the expansion of the functional standards previously used in the building standards regulations to clarify the necessary properties of each *building*. The need for a formal relaxation of standards is reduced as meeting the full details of given solutions is no longer mandatory. The professional judgment of the verifier, assisted by guidance on questions referred to Scottish Ministers, through the Scottish Building Standards Agency, decides whether a standard is met.

In considering alternative solutions, however, it is necessary to have regard to the details of this guidance. Where performance standards or policy statements are given, every part of the solution is expected to meet them. As a result, alternative solutions that appear suitable may not be acceptable in detail. For example, some of the solutions offered in relation to the English and Welsh building regulations, in the 'Approved Documents' (ADs), are not suitable because the levels of thermal insulation recommended are not the same. Similarly different approaches are taken to the control of fire size and the design of *compartmentation* which means that *constructions* meeting the AD on fire safety may not be acceptable. This will vary in time as both ADs and the Scottish Technical Handbooks are updated. Solutions based on other documents, such as British or European Standards, will have to be carefully evaluated to see if the Scottish standards are being met in an appropriate manner.

0.1.6 Domestic and non-domestic buildings

Where any *building* contains both domestic uses and non-domestic uses, the appropriate parts from each Technical Handbook will need to be used to ensure the standards are complied in full, for example a caretakers *flat* in an *office building*. However communal *rooms* or other areas in a block of *dwellings* that are exclusively associated with the *dwellings* should be considered using the domestic guidance. Examples of this might be a *room* used as an *office* for the operation of a *sheltered housing complex* or a lounge communal to a block of *dwellings*. It is also a general principle that where a *building* or part of a *building* might be seen as falling into more than one category it should be designed to meet the most stringent recommendations.

0.1.7 Latest changes

The following is a summary of the changes that have been introduced between 1 May 2006 and 30 April 2007. Very minor changes to text have not been included here.

| | |
|-------------------|---|
| regulations 1 & 2 | unchanged, but restyling of presentation |
| schedule 1 | rewording of type 1 to pick up new legislation |
| schedule 1 | rewording of exceptions to type 20 |
| clause 0.5.1 | improved guidance on the interpretation of schedule 3 |
| schedule 3 | rewording of exceptions to type 1 |
| schedule 3 | rewording of type 2 |
| schedule 3 | rewording of exceptions to type 5 |
| schedule 3 | rewording of exceptions to type 6 |
| schedule 3 | omission of exception to type 7 |
| schedule 3 | rewording of type 19 |
| schedule 4 | insertion of new clauses 2 and 3 in measurement of areas |
| schedule 4 | minor change to text in clause 4(a) |
| schedule 5 | several standards amended (see intro to each section) |
| schedule 6 | reworded: standards 6.1 & 6.9 do not apply to conversions |
| regulation 16 | now included in Technical Handbook |
| regulation 17 | new regulation to take account of EPBD |

0.1.8 Updating

It is intended that this Technical Handbook will be updated annually. At that time replacement pages will be published for any guidance which has been

altered. It is not expected that the standards themselves will change each year, and as these are set in the building regulations these can only be changed with Parliamentary approval. Therefore it is anticipated that it is only the white pages in sections 1-6, rather than the yellow pages, which will be replaced regularly. It is expected that many users will wish to download the placements from the Scottish Building Standards Agency web site (www.sbsa.gov.uk) where they will be available free of charge.

To facilitate such updating, the pages in this Handbook are not numbered and reference to particular parts is provided through the system of section and clause numbers. The section and standard numbers are identical for both the domestic and non-domestic Handbooks. The clause numbers differ between the two Handbooks.

Every page is provided with a header/footer which records:

- domestic/non-domestic;
- section;
- standard;
- date of issue;
- clause number.

By providing this on each page it should be possible to copy particular pages independently and still be certain of their place in the appropriate Handbook.

0.1.9 Arrangement of section 0

Section 0 is arranged to follow the actual regulations. This sub-section provides an introduction to the building standards system. Sub-section 0.2 covers regulations 1 and 2 which are the citation, commencement and interpretation. Sub-sections 0.3 to 0.15 cover the significant technical regulations with each sub-section setting out and discussing the regulation with the same number (sub-section 0.3 covering regulation 3 etc.). Regulation 16 establishes which regulations cannot ever be relaxed by Scottish Ministers. These are the regulations on citation and commencement, interpretation, exempted buildings, work not requiring a warrant and the methods of measurement. Regulation 17 is new and has been introduced to help with the implementation of the [Energy Performance of Buildings Directive](#).

0.2 Citation, commencement and interpretation

- 0.2.1 Explanation of regulation 1
- 0.2.2 Explanation of regulation 2

regulation

2

mandatory

Regulation 2 sets out the defined terms within the regulations. It is not reproduced in section 0; instead the terms have been incorporated in the list of defined terms which form Appendix A.

0.2.1 Explanation of regulation 1

Regulation 1 is not reproduced above but contains the citation and commencement of the building regulations. They apply to *buildings* and *works* as defined in the [Building \(Scotland\) Act 2003](#), other than *works* exempted by regulation 3, schedule 1. The full text is:

Regulation 1

These regulations may be cited as the Building (Scotland) Regulations 2004 and shall come into force on 1 May 2005.

The Act defines a *building* as any structure or erection, whether temporary or permanent. This is very wide, but there are exceptions in *the Act* for:

- any *public road*; (including any bridge on which the road is carried);
- any *private road*; (bridges on *private roads* are not excluded in *the Act*);
- any sewer or water main vested in Scottish Water;
- any aerodrome runway;
- any railway line;
- any large raised reservoir within the meaning of the Reservoirs Act 1975;
- any wires and cables, their supports above ground and other apparatus used for telephonic or telegraphic communications.

The term *building* is, subject to context, taken to include a prospective *building*, a part of a *building* and, for extensions, alterations and *conversions*, it can mean the extension alone or the part subject to alteration or *conversion*. *Works* in relation to a *building* is defined in *the Act* as including *works* carried out in relation to the enclosure and preparation of the *site*. *Works* therefore includes all *construction*, demolition and *conversion work*, the provision of services fittings and equipment, and any *work* carried out in relation to the *site*.

The [Building \(Scotland\) Regulations 2004](#) apply to all *buildings* and *works* where an application for warrant is made on or after 1 May 2005. Some *buildings* and *works* do not require a warrant but are still *works* to which the regulations apply (see regulation 5 and schedule 3 which explain the kind of *works* that falls into this category). Such *works* commenced on *site* on or after 1 May 2005 must meet these regulations subject to the Building (Scotland) Act 2003 (Commencement No. 1, Transitional Provisions and Savings) Order 2004.

Buildings and *works* related to earlier warrant applications or exempt *works* commencing before 1 May 2005 are subject to previous building standards and procedures regulations, in particular the time by when these *works* must be completed. Previously exempt *works*, in particular any no longer exempt, must have been completed by 2 September 2005, otherwise the exemption falls and a warrant for any outstanding *work* may be required.

On completion of the *works*, before the period specified in the building warrant expires, a completion certificate must be submitted. If a completion certificate is submitted for *work* done without a warrant, the regulations that are applicable are those in force at the time of submission of the certificate, which may well be more onerous than those which would have applied when the *work* started. Fuller details of the arrangements for submitting warrant applications and completion certificates will be given in the guidance on the procedure regulations.

The building regulations also incorporate requirements previously set in separate Building Operations Regulations (regulations 13-15). These cover the provision of protective *works*, clearing of footpaths and securing of unoccupied *buildings*. When an application is made to a verifier other than the local authority (for example if the *building* were a military installation and the verifier was a government department), then the verifier will be required by the procedure regulations to inform the local authority of the application so that the local authority may, if they wish, consider the proposed arrangements for protective *works*.

0.2.2 Explanation of regulation 2

Regulation 2 sets out the defined terms within the regulations. It is not reproduced in section 0, instead the terms have been incorporated in the list of defined terms which form Appendix A. The Appendix also includes definitions from the [Building \(Scotland\) Act 2003](#) and those used in these Technical Handbooks.

All of the terms defined above, including those from the regulations, are in italics throughout the Handbooks.

In the determination of the description of a *building*, any use which is ancillary to another use or which is of a minor nature should be disregarded and the *building* taken to be that of the principal description. Minor uses within the *curtilage* of a *dwelling* may also be disregarded, for example a single-room *office* for use by up to two people. Notwithstanding the above, parts of a *building* may be considered to be of a separate description where the context requires (for example a caretakers *flat* should be taken separately from any other part of the *building* in which it is located).

A *dwelling* may include any surgeries, consulting rooms, *offices* or other accommodation, of a floor area not exceeding in the aggregate 50 square metres, forming part of the *dwelling* and used by an occupant of the *dwelling* in a professional or business capacity. A *dwelling* may provide bed and breakfast facilities provided this does not exceed two double bedrooms and is not in use for more than half of the year.

Where further guidance on *building* types is needed to define the proposals for particular *buildings*, it is included in the relevant section.

0.3 Exempted buildings and services, fittings and equipment

0.3.1 Explanation

0.3.2 Schedule 1

| | |
|------------------|--|
| 3 | <p>regulation</p> <p>(1) Regulations 8 to 12 shall not apply to any <i>building</i> or any services, fittings and equipment the whole of which falls into any one or more of the exempted types described in schedule 1.</p> <p>(2) The provision of -</p> <p>(a) services, fittings and equipment to, or the demolition or removal of, exempted <i>buildings</i> is exempt;</p> <p>(b) services, fittings and equipment to, or the demolition of, exempted services, fittings and equipment is exempt.</p> <p>(3) For the purposes of this regulation, for the avoidance of doubt, each such exempted type does not include any of the exceptions expressed in relation to that type.</p> |
| <p>mandatory</p> | |

0.3.1 Explanation

Regulation 3 and schedule 1 set out what *buildings* and *work* are exempted from the building regulations. The general principles applied to establish exemption are that the regulations do not need to apply where:

- other legislation covers the *buildings* or *work* (types 1 - 3);
- the *buildings* or *work* are covered by another regulation (type 4);
- the *buildings* or *work* are not normally frequented by people (types 5 - 8);
- the *buildings* or *work* are so separated that the regulations are largely inappropriate, and are likely in any case to be supervised by specialists including civil engineers (types 9 - 12);
- the *buildings* or *work* are sufficiently minor that they have little or no impact on the public interest and it is not in the public interest to seek to enforce the regulations (types 13 - 15 and 17 - 21);
- the *buildings* or *work* are temporary (type 16).

Particular care is necessary where exempted *work* is in the vicinity of, or attached to, an existing *building*. The level of compliance of the existing *building* with building regulations should not be adversely affected when exempt *works* are undertaken.

Where exempt *work* requires that alteration is made to an existing *building* to maintain the level of compliance with building regulations, a building warrant may be required. For example where it is intended to *construct* a porch, which falls within type 18, over an accessible entrance and a new accessible entrance is required.

0.3.2 Schedule 1

Exempted buildings and services, fittings and equipment

| | Type | Description | Exception |
|---|------|---|---|
| Buildings etc. controlled by other legislation | 1. | Any <i>building</i> in which explosives are manufactured or stored under a licence granted under the Manufacture and Storage of Explosives Regulations 2005. | |
| | 2. | A <i>building</i> erected on a <i>site</i> which is subject to licensing under the Nuclear Installations Act 1965. | A <i>dwelling</i> , <i>residential building</i> , <i>office</i> , canteen or visitor centre. |
| | 3. | A <i>building</i> included in the schedule of monuments maintained under section 1 of the Ancient Monuments and Archaeological Areas Act 1979. | A <i>dwelling</i> or <i>residential building</i> . |
| Protective works | 4. | Protective <i>works</i> subject to control by regulation 13. | |
| Buildings or work not frequented by people | 5. | A <i>building</i> into which people cannot or do not normally go. | A <i>building</i> within 6 metres or the equivalent of its height (whichever is the less) of the <i>boundary</i> . A wall or fence. A tank, cable, sewer, drain or other pipe above or below ground for which there is a requirement in these regulations. |
| | 6. | Detached fixed plant or machinery or a detached <i>building</i> housing only fixed plant or machinery, the only normal visits to which are intermittent visits to inspect or maintain the fixed plant or machinery. | A <i>building</i> within 1 metre of a <i>boundary</i> . |
| Agricultural and related buildings | 7. | An <i>agricultural greenhouse</i> or other <i>building</i> of mainly translucent material used mainly for commercial growing of plants. | A <i>building</i> used to any extent for retailing (including storage of goods for retailing) or exhibiting. |
| | 8. | A single-storey detached <i>building</i> used for any other form of <i>agriculture</i> , fish farming or forestry. | A <i>building</i> used to any extent for retailing (including storage for retailing) or exhibiting. A <i>building</i> exceeding 280 square metres in area. A <i>building</i> within 6 metres or the equivalent of its height (whichever is the less) of a <i>boundary</i> . A <i>dwelling</i> , <i>residential building</i> , <i>office</i> , canteen or visitor centre. A dungstead or farm effluent tank. |

| | Type | Description | Exception |
|---|------|---|--|
| Works of civil engineering construction | 9. | A <i>work</i> of civil engineering <i>construction</i> , including a dock, wharf, harbour, pier, quay, sea defence work, lighthouse, embankment, river work, dam, bridge, tunnel, filter station or bed, inland navigation, reservoir, water works, pipe line, sewage treatment works, gas holder or main, electricity supply line and supports, any bridge embankment or other support to railway lines and any signalling or power lines and supports, and a fire practice tower. | A bridge or tunnel forming part of an <i>escape route</i> or an access route provided to meet a requirement of these regulations. A private sewage treatment works provided to meet a requirement of these regulations. |
| | 10. | A <i>building</i> essential for the operation of a railway including a locomotive or carriage shed, or for the operation of any other <i>work</i> of civil engineering contained in type 9 of this schedule and erected within the <i>curtilage</i> of such a railway or <i>work</i> . | A signalling and control centre for a railway or dock. A <i>building</i> to which the public is admitted, not being a <i>building</i> exempted by type 11 of this schedule. A <i>dwelling</i> , <i>residential building</i> , <i>office</i> , canteen, or warehouse. |
| Buildings of a specialist nature | 11. | A single- <i>storey</i> detached <i>road</i> or rail passenger shelter or a telephone kiosk which in so far as it is glazed complies with the requirements of regulation 9 and paragraph 4.8 of schedule 5. | A <i>building</i> having a floor area exceeding 30 square metres. A <i>building</i> containing a fixed combustion appliance installation. |
| | 12. | A caravan or mobile home within the meaning of the Caravan Sites and Control of Development Act 1960, or a tent, van or shed within the meaning of section 73 of the Public Health (Scotland) Act 1897. | Any <i>wastewater</i> disposal system serving a <i>building</i> of this type. |
| | 13. | A detached single- <i>storey building</i> having an area not exceeding 8 square metres. | A <i>dwelling</i> or <i>residential building</i> . A <i>building</i> ancillary to and within the <i>curtilage</i> of a <i>dwelling</i> . A <i>building</i> within 1 metre of a <i>boundary</i> . A <i>building</i> containing a fixed combustion appliance installation or <i>sanitary facility</i> . A wall or fence. |
| Small buildings | 14. | A <i>building</i> used only by people engaged in the <i>construction</i> , demolition or repair of any <i>building</i> or structure during the course of that <i>work</i> . | A <i>building</i> containing sleeping accommodation. |
| Construction & development buildings | | | |

| | Type | Description | Exception |
|--|-------------|--|---|
| Temporary buildings | 15. | A <i>building</i> used in connection with the letting or sale of any <i>building</i> under <i>construction</i> until such time as the letting or sale of all related <i>buildings</i> is completed. | A <i>building</i> containing sleeping accommodation. |
| | 16. | A <i>building</i> which, during any period of 12 months, is either erected or used on a <i>site</i> – a. for a period not exceeding 28 consecutive days; or b. for a number of days not exceeding 60, and any alterations to such <i>buildings</i> . | |
| Buildings ancillary to houses | 17. | A detached single- <i>storey building</i> ancillary to and within the <i>curtilage</i> of a <i>house</i> . | A <i>building</i> exceeding 8 square metres in area. A <i>building</i> within 1 metre of the <i>house</i> unless it is at least 1 metre from any <i>boundary</i> . A <i>building</i> containing sleeping accommodation. A <i>building</i> containing a <i>flue</i> , a fixed combustion appliance installation or <i>sanitary facility</i> . A wall or fence. |
| | 18. | A single- <i>storey building</i> attached to an existing <i>house</i> , which is ancillary to the <i>house</i> and consists of a <i>conservatory</i> or <i>porch</i> which insofar as it is glazed complies with the requirements of regulation 9 and paragraph 4.8 of schedule 5. | A <i>building</i> exceeding 8 square metres in area. A <i>building</i> containing a <i>flue</i> , a fixed combustion appliance installation or <i>sanitary facility</i> . A <i>building</i> within 1 metre of a <i>boundary</i> . |
| | 19. | A single- <i>storey building</i> which is detached, or is attached to an existing <i>house</i> and which is ancillary to the <i>house</i> and consists of a <i>greenhouse</i> , <i>carport</i> or <i>covered area</i> . | A <i>building</i> exceeding 30 square metres in area. A <i>building</i> containing a <i>flue</i> , a fixed combustion appliance installation or <i>sanitary facility</i> . |
| Buildings ancillary to flats or maisonettes | 20. | A detached single- <i>storey building</i> ancillary to and within the <i>curtilage</i> of a <i>flat</i> or <i>maisonette</i> . | A <i>building</i> exceeding 8 square metres in area. A <i>building</i> within 1 metre of the <i>flat</i> or <i>maisonette</i> or within 3 metres of any other part of the <i>building</i> containing the <i>flat</i> or <i>maisonette</i> . A <i>building</i> within 1 metre of a <i>boundary</i> . A <i>building</i> containing a <i>flue</i> , a fixed combustion appliance installation or <i>sanitary facility</i> . A wall or fence. A swimming pool deeper than 1.2 metres. |

| | Type | Description | Exception |
|--------------------|-------------|------------------------------|--|
| Paved areas | 21. | A paved area or hardstanding | A paved area or hardstanding exceeding 200 square metres in area. A paved area forming part of an access to meet a requirement of these regulations. |

0.4 Changes in the occupation or use of a building that cause the regulations to apply

- 0.4.1 Explanation
- 0.4.2 Schedule 2

regulation

4

mandatory

For the purposes of section 56(1) of *the Act* and these regulations, the changes in occupation or use of *buildings* set out in schedule 2 shall be *conversions* to the extent specified by regulation 12.

0.4.1 Explanation

The building regulations always apply where *construction* occurs, unless exempted by regulation 3, and *construction* includes alterations and extensions as well as entirely new *buildings*. When there is a *conversion* it will be necessary to seek a warrant and possibly to undertake *works* to improve the standards of the *building*, or part of the *building*, concerned.

Regulation 4 and schedule 2 set out what changes of occupation or use of a *building* are defined as *conversions* and for which the owner must obtain a warrant before making the change. The warrant for a *conversion* will only be granted if the standards set out in regulation 12 are achieved and this might well require *building works*.

Those changes of use or occupation listed in schedule 2 are those which are considered critical due to the risks involved. They relate to:

- a. *domestic buildings*, for example:
 - a hotel to a *dwelling* (type 1);
 - use of an attic space as a *room* within a *dwelling* (type 1);
 - use of a garage attached to a *dwelling* as a *room* (type 2);
 - sub-division of a *house* into two *flats* (type 3);
 - use of a *house* as *shared residential accommodation* (type 4);
- b. *residential buildings*, for example:
 - use of a hotel as *office* (type 5);
 - use of a hotel as a residential care home (type 6);
 - use of *offices* as a backpackers hostel (type 7);
- c. whether a *building* falls within the exemptions of schedule 1, for example:
 - use of a railway signal box as a *house* (type 8);
- d. public access to buildings, for example:
 - development of a retail trade in a storage *building* (type 9);
- e. division of a *building* into different occupancies, for example:
 - use of a single *shop* to provide space for two different occupancies (type 10).

Type 6 in schedule 2 refers to the significant alterations in the type and the number of expected occupants. A significant alteration of type could be considered to occur when there was a significant change in the mobility, the familiarity with *building*, or the awareness of danger, of the occupants. For example, significantly different types would include:

- patients receiving care and/or treatment in a residential care home/*hospital*;
- children in a residential institution or residential school;
- guest in a hotel;
- people held in lawful detention.

A significant alteration in number could be considered to occur where it amounted to an increase greater than 25%.

Type 9 in schedule 2 refers to allowing access by the general public where previously there was none. Access by the general public refers to permitting members of the general public to enter a *building* during opening hours and allowing them to access all parts of the *building*, other than those parts restricted to staff only.

For *conversions* it is the intention that the standards achieved in the *converted building* should be broadly similar to those achieved by entirely new *buildings*. Schedule 6 to regulation 12 guides the verifier as to where discretion is expected to be necessary. It identifies those standards where it is not expected to be *reasonably practicable* to have existing *buildings* fully comply. However for these standards improvement of the existing *building* is expected where it is *reasonably practicable*. This means that matters such as thermal insulation now have to be improved even if meeting the full standard is not practically achievable. Guidance on what is normally *reasonably practicable* is given in schedule 6 and in the individual sections. Guidance is also given on the treatment of historic *buildings*.

It is also relevant that the requirements of other legislation, for example regulations made under Health and Safety at Work or licensing legislation, will apply to changes of use, so that risk assessments of changed circumstances will provide protection to the occupants of *buildings*.

0.4.2 Schedule 2

Conversions to which the regulations apply

| Type | Conversion |
|------|---|
| 1. | Changes in the occupation or use of a <i>building</i> to create a <i>dwelling</i> or <i>dwellings</i> or a part thereof. |
| 2. | Changes in the occupation or use of a <i>building</i> ancillary to a <i>dwelling</i> to increase the area of human occupation. |
| 3. | Changes in the occupation or use of a <i>building</i> which alters the number of <i>dwellings</i> in the <i>building</i> . |
| 4. | Changes in the occupation or use of a <i>domestic building</i> to any other type of <i>building</i> . |
| 5. | Changes in the occupation or use of a <i>residential building</i> to any other type of <i>building</i> . |
| 6. | Changes in the occupation or use of a <i>residential building</i> which involve a significant alteration to the characteristics of the persons who occupy, or who will occupy, the <i>building</i> , or which significantly increase the number of people occupying, or expected to occupy, the <i>building</i> . |
| 7. | Changes in the occupation or use of a <i>building</i> so that it becomes a <i>residential building</i> . |
| 8. | Changes in the occupation or use of an exempt <i>building</i> (in terms of schedule 1) to a <i>building</i> which is not so exempt. |
| 9. | Changes in the occupation or use of a <i>building</i> to allow access by the public where previously there was none. |
| 10. | Changes in the occupation or use of a <i>building</i> to accommodate parts in different occupation where previously it was not so occupied. |

0.5 Buildings, work, services, fittings and equipment not requiring a warrant

0.5.1 Explanation

0.5.2 Schedule 3

regulation

5

mandatory

For the purposes of section 8(8) of *the Act*, any *work* which consists solely of a *building* or *conversion*, including the provision of services, fittings or equipment, of a kind specified in schedule 3, shall meet the standards required by regulations 8 to 12 but shall not, subject to the exceptions and conditions, require a warrant.

0.5.1 Explanation

Regulation 5 and schedule 3 specifies what *work* can be done without the need to obtain a building warrant. The categories of work permitted without warrant are generally more extensive than under previous Scottish building regulations. However such *work* must still comply with the regulations.

Building type 1

In particular, type 1 means considerably more *work* to or in *houses* does not need a warrant. This could include:

- *work* external to, but immediately adjoining, the *house* (e.g. patio, decking, wall, fence, steps or ramp);
- small penetrations of the *external walls* or roof (e.g. balanced flues, sanitary pipework, mechanical extract *ducts* or vent pipes);
- small attachments to the *external walls* (e.g. canopies or micro-renewables);
- erection, demolition or alteration of non-loadbearing partitions;
- electrical work;
- an en-suite bathroom or shower room (including associated drainage);
- a central heating system.

The exceptions are intended to safeguard against changes that might have significant effect, such as the removal of structural walls. The following list provides some examples of the various exceptions:

- increasing the floor area of the *house* (e.g. creation of a mezzanine floor or the infill of a stair well);
- demolition or alteration of the roof (e.g. forming a dormer window or *construction* of a masonry *chimney* through the roof);
- demolition or alteration of the *external walls* (e.g. slapping a new window or door, applying insulation to the *external wall* surface);
- demolition or alteration of an *element of structure* (e.g. removal of a loadbearing wall);
- *work* adversely affecting a *separating wall* (e.g. installing recessed electrical sockets);
- *work* involving a change to *wastewater* discharge (e.g. disconnection from the mains system).

The exception about increasing the floor area applies because there will be significant implications arising from such *work*. Other changes, such as the development of a *roof space* or a garage as habitable space are *conversions* in terms of regulation 4, a warrant is required and the standards also apply. Where a *roof space* has limited boarding inserted to allow access to services or to allow attic storage, or where the removal of a non-loadbearing wall creates a marginal increase in floor area these should not be considered as increasing the floor area.

Building type 2

Buildings, other than *domestic buildings* or *residential buildings*, where the public are not normally admitted are granted a similar concession in type 2, allowing many *offices* and factories for example, to make the kind of small

alterations necessary to accommodate changes in production or process. Again however, the *building work* done should be to the standard of the building regulations.

Thus, types 1 and 2 permit virtually any *work* to be carried out to 1 or 2 *storey houses* and to non-domestic *buildings* not more than 7.5 m high, other than the exceptions listed.

Building types 3 - 23

However the broad types described above are followed by types 3 to 23 covering more specific *work* that can be carried out to a wider range of *buildings* without restricting the *work* allowed by types 1 and 2. Types 3 to 23 begin with small *buildings*, particularly those within the *curtilage* of *dwellings* (types 4 and 5). Note that some of these may now be in the *curtilage* of *flats* or *maisonettes* provided they are a sufficient distance from the *dwellings*. A *sanitary facility* should not be considered to be a wet-floor shower room and such *work* is not intended to be covered by type 11.

Building types 24 - 26

Types 24 to 26 are different in that they cover work that is closer to a repair than new *work*. These replacements are therefore required to be to a standard no worse than the existing, rather than to the standard for completely new *work*.

Doors, windows and rooflights which are a complete replacement are not considered to be a repair and now have to meet the full requirements of the standards (see type 20). For historic *buildings*, where there is a specific need to match existing doors, windows or rooflights, the principle of 'like for like' may still be permitted.

0.5.2 Schedule 3

Description of building and work, including the provision of services, fitting and equipment, not requiring a warrant

| Type | Description | Exception |
|----------|---|---|
| A | on condition that types 1 – 23 in all respects and/or in the manner of their fitting meet any standards required by the regulations. | |
| 1. | Any <i>work</i> to or in a <i>house</i> . | Any <i>work</i> which increases the floor area of the <i>house</i> . Any demolition or alteration of the roof, <i>external walls</i> or <i>elements of structure</i> . Any <i>work</i> involving underpinning. Any <i>work</i> adversely affecting a <i>separating wall</i> . Any <i>work</i> involving a change in the method of <i>wastewater</i> discharge. <i>Work</i> , not being <i>work</i> of types 3 to 26 below, to a <i>house</i> having a <i>storey</i> , or creating a <i>storey</i> , at a height of more than 4.5 metres. |
| 2. | Any <i>work</i> to or in a non-residential <i>building</i> to which the public does not have access. | A non-residential <i>building</i> within which there is a <i>domestic</i> or <i>residential building</i> . Any <i>work</i> which increases the floor area of the <i>building</i> . Any demolition or alteration of the roof, <i>external walls</i> or <i>elements of structure</i> . Any <i>work</i> involving underpinning. Any <i>work</i> adversely affecting a <i>separating wall</i> . Any <i>work</i> involving a change in the method of <i>wastewater</i> discharge. <i>Work</i> , not being <i>work</i> of types 3 to 26 below, to a <i>building</i> having a <i>storey</i> , or creating a <i>storey</i> , at a height of more than 7.5 metres. |

| Type | Description | Exception |
|---|--|---|
| and, without prejudice to the generality of types 1 and 2 above, | | |
| 3. | A detached single-storey <i>building</i> , having an area exceeding 8 square metres but not exceeding 30 square metres. | A <i>dwelling</i> or <i>residential building</i> . A <i>building</i> ancillary to, or within the <i>curtilage</i> of, a <i>dwelling</i> . A <i>building</i> within 1 metre of a <i>boundary</i> . A <i>building</i> containing a fixed combustion appliance installation or <i>sanitary facility</i> . A swimming pool deeper than 1.2 metres |
| 4. | A detached single-storey <i>building</i> , having an area exceeding 8 square metres but not exceeding 30 square metres, ancillary to and within the <i>curtilage</i> of a <i>house</i> . | A <i>building</i> within 1 metre of the <i>house</i> unless it is at least 1 metre from any <i>boundary</i> . A <i>building</i> containing a fixed combustion appliance installation or <i>sanitary facility</i> . A swimming pool deeper than 1.2 metres. |
| 5. | A detached single-storey <i>building</i> , having an area exceeding 8 square metres but not exceeding 30 square metres, ancillary to and within the <i>curtilage</i> of a <i>flat</i> or <i>maisonette</i> . | A <i>building</i> within 1 metre of the <i>flat</i> or <i>maisonette</i> or within 3 metres of any other part of the <i>building</i> containing the <i>flat</i> or <i>maisonette</i> . A <i>building</i> within 1 metre of a <i>boundary</i> . A <i>building</i> containing a fixed combustion appliance installation or <i>sanitary facility</i> . A swimming pool deeper than 1.2 metres. |
| 6. | Any <i>work</i> associated with a combustion appliance installation or other part of a heating installation, not being <i>work</i> of types 7 or 8 below. | Any <i>work</i> associated with a solid fuel appliance having an output rating more than 50 kW, an oil-firing appliance with an output rating more than 45 kW or a gas-fired appliance having a <i>net input rating</i> more than 70 kW. Any <i>work</i> associated with a <i>chimney</i> , <i>flue-pipe</i> or <i>constructional hearth</i> . Any <i>work</i> associated with an oil storage tank with a capacity of more than 90 litres, including any pipework connecting the tank to a combustion appliance providing space or water heating or cooking facilities. Any <i>work</i> adversely affecting a <i>separating wall</i> or <i>separating floor</i> . |
| 7. | Any <i>work</i> associated with a balanced <i>flue</i> serving a <i>room-sealed appliance</i> . | |

| Type | Description | Exception |
|------|--|--|
| 8. | Any <i>work</i> associated with pipework, radiators, convector heaters and thermostatic controls for, or associated with, type 6 above. | |
| 9. | Any <i>work</i> associated with installing a <i>flue liner</i> . | |
| 10. | Any <i>work</i> associated with refillable liquefied petroleum gas storage cylinders supplying, via a fixed pipework installation, combustion appliances used principally for providing space heating, water heating, or cooking facilities. | |
| 11. | Any <i>work</i> associated with the provision of a single <i>sanitary facility</i> , together with any relevant branch soil or waste pipe. | Any <i>work</i> associated with a water closet, waterless closet or urinal. |
| 12. | Any <i>work</i> associated with the relocation within the same <i>room</i> or space of any <i>sanitary facility</i> , together with any relevant branch soil or waste pipe. | |
| 13. | Any <i>work</i> associated with the provision of an extractor fan. | |
| 14. | Any <i>work</i> associated with a stairlift within a <i>dwelling</i> . | |
| 15. | Any <i>work</i> associated with the provision of a notice or other fixture for which there is no requirement provided in these regulations. | |
| 16. | Any <i>work</i> associated with an outdoor sign that is the subject to the Town and Country Planning (Control of Advertisements)(Scotland) Regulations 1984. | |
| 17. | Any <i>work</i> associated with thermal insulating material to or within a wall, ceiling, roof or floor. | Any <i>work</i> associated with the application of thermal insulating material to the outer surface of an <i>external wall</i> . |
| 18. | A wall not exceeding 1.2 metres in height, or a fence not exceeding 2 metres in height. | |

| Type | Description | Exception |
|---|---|---|
| 19. | Any <i>work</i> associated with open raised external decking | Any decking at a height of more than 1.2 metres. Decking that forms part of any access provided to comply with the requirements in regulation 9 and paragraph 4.1 of schedule 5. Decking that forms any <i>escape route</i> other than from a flat or <i>maisonette</i> , provided to comply with the requirements in regulation 9 and paragraph 2.9 of schedule 5. |
| 20. | A door, window or rooflight when the <i>work</i> includes replacing the frame. | |
| 21. | A paved area or hardstanding exceeding 200 square metres in area. A paved area forming part of an access to meet a requirement of these regulations. | |
| 22. | An electrical installation, including a circuit for telecommunication, alarm purposes or for the transmission of sound, vision or data, which operates at extra-low voltage (not exceeding 50 volts alternating current or 120 volts direct current, measured between conductors or to earth) and which is not connected directly or indirectly to an electricity supply which operates at a voltage higher than either of those specified above. | |
| 23. | The construction of a ramp not exceeding 5 metres in length. | |
| B On condition that this work, service, fitting or equipment is to a standard no worse than at present | | |
| 24. | Any <i>work</i> associated with the replacement of a fitting or equipment, in whole or in part, by another of the same general type, including a <i>sanitary facility</i> (together with any relevant branch soil or waste pipe), rainwater gutter or downpipe, solid fuel combustion appliance, electrical fixture, ventilation fan, <i>chimney</i> or <i>flue</i> outlet fitting or terminal, fire hydrant or main, lift or escalator, solid waste chute or container, <i>kitchen</i> fitments or other fitted furniture and ironmongery. | Any door, window or rooflight. Any oil firing or gas boiler |

| Type | Description | Exception |
|-------------|--|------------------|
| 25. | Any <i>work</i> associated with the replacement in whole or in part, by material of the same general type, of flooring, lining, cladding, covering or rendering either internally or externally. | |
| 26. | Any <i>work</i> to a door, window or rooflight, including <i>glazing</i> which is not a complete replacement falling within type 20 above. | |

0.6 Limited life buildings

0.6.1 Explanation

regulation

6

mandatory

For the purposes of paragraph 3 of schedule 1 of *the Act* (which enables special provision to be made for *buildings* intended to have a limited life) a period of five years is hereby specified.

0.6.1 Explanation

Regulation 6 deals with *constructions* that are intended to have only a short life span on *site* and in view of this the mandatory standards and associated guidance give some concessions to such *buildings*. These concessions only apply to *buildings* which are not *dwellings*.

Standard 3.1 in schedule 5 allows a lesser standard for the treatment of the *site* of a *limited life building*, other than a *dwelling*.

Section 6: Energy, indicates that less demanding *U-values* can be adopted for the *insulation envelope* of certain types of *limited life buildings*, other than *dwellings* and *residential buildings*.

0.7 Measurements

- 0.7.1 Explanation
- 0.7.2 Schedule 4

regulation

7

mandatory

For the purpose of these regulations, measurements shall be made or calculated in accordance with schedule 4.

0.7.1 Explanation

Schedule 4 to regulation 7 specifies those methods of measurement that are necessary for the regulations themselves. In the Technical Handbooks certain additional measurements are also used, and references to additional methods of measurement specific to particular sections are included in the introductions to those sections.

0.7.2 Schedule 4

Measurements

Area

1. Measurement of area shall be taken to the innermost surfaces of enclosing walls or, on any side where there is no enclosing wall, to the outermost edge of the floor on that side.
2. A *room* excludes any built-in fixture extending from the floor to the ceiling.

In the case of a *dwelling*, a *room* excludes any part where the height is
3. less than 1.5 metres.

Height and depth

4. The height of -
 - a. a *building* shall be taken to be the height from the surface of the ground to the underside of the ceiling of the topmost *storey* or, if the topmost *storey* has no ceiling, one-half of the height of the roof above its lowest part; and
 - b. a *storey* above the ground or the depth of a *storey* below the ground shall be taken to be the vertical height or depth as the case may be from the ground to the upper surface of the floor of the *storey*, and the expressions “a *storey* at a height” and “a *storey* at a depth” shall be construed accordingly.
5. In the measurement of height or depth from ground which is not level the height or depth shall be taken to be the mean height or depth, except that –
 - a. for the purpose of types 1, 2, 3, 4, 5, 18 or 19 of schedule 3; and
 - b. for any other purpose where the difference in level is more than 2.5 metres,

the height or depth shall be taken to be the greatest height or depth.

General

6. Except where the context otherwise requires, measurements shall be horizontal and vertical.
-

0.8 Durability, workmanship and fitness of materials

- 0.8.1 Explanation
- 0.8.2 Durability
- 0.8.3 Workmanship
- 0.8.4 Fitness of materials

| | | |
|--|-----------------------|---|
| <p>regulation</p> <p>8</p> <p>mandatory</p> | <p>(1)</p> <p>(2)</p> | <p>Work to every <i>building</i> designed, <i>constructed</i> and provided with services, fittings and equipment to meet a requirement of regulation 9 to 12 must be carried out in a technically proper and workmanlike manner, and the materials used must be durable, and fit for their intended purpose.</p> <p>All materials, services, fittings and equipment used to comply with a requirement of regulations 9 to 12 must, so far as <i>reasonably practicable</i>, be sufficiently accessible to enable any necessary maintenance or repair <i>work</i> to be carried out.</p> |
|--|-----------------------|---|

0.8.1 Explanation

Regulation 8 requires that materials, fittings and components used in the *construction* of *buildings* should be suitable for their purpose, correctly used or applied, and sufficiently durable, taking account of normal maintenance practices, to meet the requirements of these regulations. For example, external timber cladding for low-rise *buildings* that is readily accessible and replaceable need not be as durable as that which is to be used at a higher level on medium-rise *buildings*.

It also implements the intention of the [Construction Products Directive](#), that specification of *construction* products should not be used to effectively bar the use of *construction* products or processes from other European countries. The relevant countries are those in the European Union, and those who in the European Economic Area Act of 1993 agreed to adopt the same standards

The guidance below details a variety of published standards and specifications recognised by the States within the European Economic Area which provide an acceptable standard of suitability and fitness. Traditional *constructions*, when supported by adequate technical descriptions, may also be appropriate.

The intention is to provide adequate flexibility to accommodate new techniques as well as proven traditional practices. This guidance ensures proper acceptance of products which satisfy the essential requirements of the [Construction Products Directive](#) and the [Fixing and Use of CE Marks Directive](#), to avoid barriers to trade. For example, products bearing a CE mark (European Mark of Conformity) must be accepted as meeting regulation requirements where the declared performance satisfies the requirement and the product is being correctly used. A verifier may only reject CE marked products if the declared performance on the accompanying declaration does not meet the regulation requirement or if the documentation is incomplete. If the verifier rejects a product the relevant trading standards officer must be notified (this is a requirement of the Construction Product Regulations). This will enable the UK government, where necessary, to notify the European Commission. A fuller explanation of CE marking is given in the booklet '[CE Marking under the Construction Products Directive](#)', published by the Department of the Environment Transport and the Regions (DETR) in 2001.

The Technical Handbooks are arranged to equate with the six Essential Requirements of the [Construction Products Directive](#). This should aid assessment of products against the regulation requirements. There may, however be other Directives applicable to certain products or *constructions*.

Marks showing compliance with these are for the purpose of that Directive, not to indicate compliance with the Essential Requirements, or our regulations. For example, a self contained *smoke alarm*, manufactured in accordance with the Electro Magnetic Compatibility Directive should be accepted as satisfying requirements only insofar as they relate to prevention of electromagnetic disturbances by, and prevention against disturbances to, such *smoke alarms*.

0.8.2 Durability

The EC is introducing durability requirements into European Standards (ENs) for *construction* products. Durability is not a term defined in this guidance, but it has been defined by the EC: the ability of a *building* material, fitting, component, or part thereof to perform its required function over a period of time and under influence of agents. 'Agents' are factors that may affect the durability of a product and include: exposure conditions, temperature, humidity, water, UV radiation, abrasion, chemical attack, biological attack, corrosion, weathering, frost, freeze-thaw, and fatigue.

Subject to normal maintenance, a product should enable properly designed and executed *works* to fulfill the Essential Requirements for an economically reasonable period of time (i.e. the working life of the product).

Durability is thus dependent on the intended use of the product and its service conditions. The assessment of durability can relate to the product as a whole or to its performance characteristics, insofar as these play a significant part with respect to the fulfillment of the Essential Requirements. In either case, the underlying assumption is that the performance will meet or exceed minimum acceptable values (thresholds) throughout its working life. The assessment of durability of *construction* products may use performance based methods, descriptive solutions, or a combination of both.

Levels of durability can in theory be set only by reference to criteria laid down in the harmonised test procedures. At present most harmonised ENs are prescriptive, giving for example a minimum thickness of material rather than a level of performance, e.g. that the product must last at least x number of years. The EC have the issue under consideration and it is likely that there will be a move towards performance standards. Until the EC have issued definitive guidance, reference can be made to BS 7543, which covers the durability of *building* elements, products, and components.

0.8.3 Workmanship

The term workmanship has been included so that references to methods of establishing workmanship can be included in the Technical Handbooks. For example, where performance depends on the *construction* being carried out with a crucial standard of workmanship, say in the *construction* of *dwelling separating walls*, it will prove useful to consider the information provided in the British Standard. It is not the intention that verifiers check workmanship generally, (certainly not of aesthetic matters such as finishes), but that where proper workmanship is essential to meeting the building standards verifiers have criteria against which it may be assessed.

Some methods of establishing workmanship are:

- compliance with BS 8000: Workmanship on building sites;
- compliance with an equivalent technical specification which may include a national technical specification of other Member States, which are contracting parties to the European Economic Area;

- the workmanship is specified for a material, fitting, or component covered by a national or European Certificate issued by a European Technical Approvals issuing body, and the conditions of use are in accordance with certificate;
- the workmanship may be covered by an equivalent technical approval (including a technical approval of another Member State of the Organisation for Technical Approval, EOTA), that provides an equivalent level or performance and the conditions of use are in accordance with terms of the technical approval;
- the workmanship is covered by a scheme, which complies with relevant recommendations of BS EN ISO 9000: Quality Management and quality assurance standards (there are also independent schemes of accreditation and registration of installers of materials and products that provide a means of ensuring that the *work* has been carried out by knowledgeable contractors to an appropriate standard);
- by use of past experience (where it can be shown by experience, such as a *building* in use, that the method of workmanship is capable of performing the function for which it is intended);
- by use of recognised test methods.

0.8.4 Fitness of materials

Subject to the paragraph below, it is recommended that the requirement of regulation 8 is met by using materials, fittings, and components, or parts thereof which comply with any of the following standards:

- a. the standard (whether British Standard or otherwise) specified in the Technical Handbooks;
- b. a relevant code of practice of a national standards institution or equivalent body of any Member State within the European Economic Area;
- c. a relevant international standard recognised in any Member State within the European Economic Area;
- d. a relevant specification acknowledged for use as a standard by a public authority of any Member State within the European Economic Area;
- e. traditional procedures of manufacture of a Member State within the European Economic Area where these are the subject of written technical description sufficiently detailed to permit assessment of materials, fittings, and components, or parts thereof for the use specified; or
- f. for materials, fittings, and components or parts thereof, of an innovative nature subject to an innovative process of manufacture and which fulfil the purpose provided for by the specified standard, a European Technical Approval or specification sufficiently detailed to permit assessment.

The standard code of practice, specification, technical description of European Technical Approval referred to in b to f above must provide in use levels of safety, suitability and fitness for purpose equivalent to those recommended in the Technical Handbooks, referred to in paragraph a, in so far as such levels are not inconsistent with the Essential Requirements set out in the CPD.

Where materials, fittings, and components are used on the basis of a standard, code of practice, specification, technical description or European Technical Approval, testing and sampling may be carried out as specified in or applicable to such standard, code of practice, specification, technical description or European Technical Approval.

Where testing is carried out within a Member State within the European Economic Area, such test shall be carried out by an appropriate organisation offering suitable and satisfactory evidence of technical and professional competence and independence. The requirements shall be satisfied if the organisation is accredited in a State within the European Economic Area in accordance with BS 7501 and BS 7502, and/or BS ENs: 17025, 45002, 45003, 45004, 45011, 45012, 45013, and 45014.

www.wrap.org.uk

The Waste and Resources Action Programme offers guidance on the use of recycled materials and products containing recyclate. It is acceptable to use such materials as a measure to further sustainable development provided that they are durable and fit for their intended purpose.

0.9 Building standards applicable to construction

0.9.1 Explanation

0.9.2 Schedule 5

regulation

9

mandatory

Construction shall be carried out so that the work complies with the applicable requirements of schedule 5.

0.9.1 Explanation

Regulation 9 and schedule 5 are the heart of the building standards system as they set out what must be achieved in *building work*. The standards are given in full along with the associated guidance on compliance in sections 1 – 6 of the Technical Handbooks. The sections relate directly to the Essential Requirements, as published by the EC, which *buildings* and *works* are expected to satisfy when they have been properly designed and *built*.

The six sections are:

| | | |
|-----------|-------------|--|
| Section 1 | Structure | (EC - Mechanical resistance and stability) |
| Section 2 | Fire | (EC - Safety in case of fire) |
| Section 3 | Environment | (EC - Hygiene, health and the environment) |
| Section 4 | Safety | (EC - Safety in use) |
| Section 5 | Noise | (EC - Protection against noise) |
| Section 6 | Energy | (EC - Energy, economy and heat retention) |

The Essential Requirements are also subject to overall requirements related to durability, which are covered in regulation 8.

The guidance on suitable provision to meet the building regulation standards is given without assurance that any other legislative or administrative requirement might apply more onerous standards.

In considering which standards apply, where more than one is relevant to any *building work* all the standards should be met.

0.9.2 Schedule 5

The mandatory standards in schedule 5 are given in the six sections of this Handbook (structure, fire safety, environment, safety, noise and energy) and are therefore not repeated here.

0.10 Building standards applicable to demolition

0.10.1 Explanation

regulation

10

mandatory

- (1) **Every *building* to be demolished must be demolished in such a way that all service connections to the *building* are properly closed off and any neighbouring *building* is left stable and watertight.**
- (2) **When demolition *work* has been completed and, where no further *work* is to commence immediately, the person who carried out that *work* shall ensure that the *site* is –**
- (a) **immediately graded and cleared; or**
 - (b) **provided with such fences, protective barriers or hoardings as will prevent access thereto.**

0.10.1 Explanation

Regulation 10 sets out the mandatory requirements when undertaking demolition *work*.

The building regulations do not control the method or process of demolition. This is the responsibility of the [Health and Safety Executive](#) and is covered under other legislation.

What the building regulations do seek to control is the area which is left after demolition has been completed, and the state of any surrounding *buildings* affected by the demolition. Any adjacent *buildings* must be left safe and watertight and all service connections must be properly sealed. Unless it is intended to *build* on the cleared *site* without delay, it must be left in a safe condition. This might be achieved by *site* clearance and grading, or by ensuring adequate perimeter enclosures.

**0.11 Building standards applicable to the provision of services,
fittings and equipment**

0.11.1 Explanation

regulation

11

mandatory

Every service, fitting or piece of equipment provided so as to serve a purpose of these regulations shall be so provided in such a way as to further those purposes.

0.11.1 Explanation

Regulation 11 requires that every service, fitting or piece of equipment provided so as to serve a purpose of the regulations should be designed, installed, and commissioned in such a way as to fulfill those purposes.

0.12 Building standards applicable to conversions

- 0.12.1 Explanation
- 0.12.2 Schedule 6

regulation

12

mandatory

Conversion shall be carried out so that the building as converted complies with the applicable requirements of schedule 6.

0.12.1 Explanation

Certain changes of use or occupation were defined as *conversions* in schedule 2 and are therefore subject to the building regulations. Regulation 12 requires that in these cases the *building* shall meet the requirements of schedule 6. However it is recognised that this is not *reasonably practical* in many existing *buildings*. Therefore the schedule also lists those standards where a lower level of provision may well be sufficient. It is essential to establish with the verifier where meeting the standards in full is not *reasonably practicable*, and early discussion will be necessary. The individual sections of the Handbooks give further details.

For historic *buildings*, the classification of the *building* should influence the extent to which improvement is required, depending on whether the classification is for the outside, the inside, all parts, etc.

0.12.2 Schedule 6

Every *conversion*, to which these regulations apply, shall meet the requirements of the following standards in schedule 5:

- a. standards 2.1, 2.3, 2.5, 2.9, 2.10, 2.11, 2.13, 2.14, 2.15 in section 2, fire;
- b. standards 3.5, 3.6, 3.7, 3.8, 3.9, 3.11, 3.12, 3.13, 3.14, 3.17, 3.18, 3.20, 3.21, 3.22, 3.23, 3.24, 3.25, 3.26, in section 3, environment;
- c. standards 4.5, 4.6, 4.7, 4.9, 4.11, 4.12 ; in section 4, safety and
- d. the standards in section 5, noise; and
- e. standards 6.7, 6.8, 6.10 in section 6, energy.

Every *conversion*, to which these regulations apply, shall meet the requirements of the following standards in schedule 5 in so far as is *reasonably practicable*, and in no case be worse than before the *conversion*:

- a. the standards in section 1, structure;
- b. standards 2.2, 2.4, 2.6, 2.7, 2.8, 2.12, in section 2, fire;
- c. standards 3.1, 3.2, 3.3, 3.4, 3.10, 3.15, 3.16, 3.19, in section 3, environment;
- d. standards 4.1, 4.2, 4.3, 4.4, 4.8, 4.10; in section 4, safety; and
- e. standards 6.2, 6.3, 6.4, 6.5, 6.6, in section 6, energy.

0.13 Provision of protective works

0.13.1 Explanation

regulation

13

mandatory

- (1) No person shall carry out *work* unless the following provisions of this regulation are complied with.
- (2) Subject to paragraph (3), where *work* is to be carried out on any *building site* or *building* which is within 3.6 metres of any part of a road or other place to which members of the public have access (whether or not on payment of a fee or charge) there shall, prior to commencement of the *work*, be erected protective works so as to separate the *building site* or *building* or that part of the *building site* or *building* on which *work* is to be carried out from that road or other place.
- (3) Nothing in paragraph (2) shall require the provision of protective *works* in any case where the local authority is satisfied that no danger to the public is caused, or is likely to be caused, by the *work*.
- (4) The protective *works* referred to in the preceding paragraphs are all or any of –
 - (a) providing hoardings, barriers or fences;
 - (b) subject to paragraph (5), where necessary to prevent danger, providing footpaths outside such hoardings, barriers or fences with safe and convenient platforms, handrails, steps or ramps, and substantial overhead coverings;
 - (c) any other protective *works* which in the opinion of the local authority are necessary to ensure the safety of the public, all of such description, material and dimensions and in such position as the local authority may direct.
- (5) Nothing in paragraph(4)(b) shall require the provision of a platform, handrail, step or ramp –
 - (a) where no part of the existing footpath is occupied by the protective *works* or in connection with the *work*;
or
 - (b) where that part of an existing footpath remaining unoccupied affords a safe means of passage for people, and is of a width of not less than 1.2 metres or such greater width as the local authority may direct.
- (6) Any protective *works* shall be so erected as to cause no danger to the public and shall be maintained to the satisfaction of the local authority.
- (7) Subject to paragraph (8), any protective *works* shall be removed –
 - (a) in the case of a *building* which has been *constructed* by virtue of a warrant, not more than 14 days or such longer period as the local authority may direct from the date of acceptance of the certificate of

- completion; and**
- (b) in any other case, on completion of the *work*.**
- (8) Nothing in paragraphs (1) to (7) of this regulation shall prohibit the removal of the protective *works* or any part thereof prior to the completion of the *work* where the local authority is satisfied that no danger to the public is caused or is likely to be caused as a result of their removal.**
- (9) Any protective *works* shall be illuminated, and any such *works* which project on to or over that part of a road which is not a pavement or footpath shall be provided with such markings, as in the opinion of the local authority are necessary to secure the safety of the public.**
- (10) Where *work* has been carried out without the provision of protective *works*, or where *work* on a *building site* has stopped or a *building site* has been abandoned, a local authority may require the *site owner* to carry out protective *works*.**

0.13.1 Explanation

Regulation 13 requires that *building sites* are fenced off in such a way as to protect the public. It also provides powers to deal with *building sites* where *work* has for any reason ceased and the Health and Safety at Work etc. Act provisions are no longer applicable.

0.14 Clearing of footpaths

0.14.1 Explanation

regulation

14

mandatory

Where any *work* is being carried out on a *building site* or *building*, any neighbouring footpath (including any footpath provided so as to form part of the protective *works*) shall be regularly cleaned and kept free of *building* debris and related materials by the person carrying out the *work*, to the satisfaction of the local authority.

0.14.1 Explanation

Regulation 14 requires the keeping free from mud or dust footpaths adjacent to *building sites*.

0.15 Securing of unoccupied and partially completed buildings

0.15.1 Explanation

regulation

15

mandatory

- (1) Subject to paragraph (2) a person carrying on *work* shall ensure that any *building* which is partly *constructed* or partly demolished or which has been completed but not yet occupied is, so far as *reasonably practicable*, properly secured or closed against unauthorised entry at all times when *work* thereon is not in progress.
- (2) Nothing in paragraph (1) shall apply to any *work* where the local authority is satisfied that adequate supervision of the *building* is being or will be maintained for the purpose of securing the *building*.

0.15.1 Explanation

Regulation 15 requires that all *building sites* where there are unfinished or partially complete *works* are kept safe and secure.

0.16 Relaxations

0.16.1 Explanation

regulation

16

mandatory

No direction may be given under section 3(2) of *the Act* in relation to regulations 1 to 3, 5 and 7.

0.16.1 Explanation

Regulation 16 sets out the regulations that cannot be relaxed.

0.17 Continuing requirements

- 0.17.1 Explanation
- 0.17.2 Implementation

| | |
|---|---|
| <p>regulation</p> <h1 style="font-size: 2em; margin: 0;">17</h1> <p>mandatory</p> | <p>(1) Subject to paragraph (2), the owners of <i>buildings</i> shall ensure that –</p> <p>(a) every air-conditioning system within a <i>building</i> is inspected at regular intervals; and</p> <p>(b) appropriate advice is given to the users of the <i>buildings</i> on reducing the energy consumption of such an air-conditioning system.</p> <p>(2) This regulation shall not apply to –</p> <p>(a) air-conditioning systems with a total effective output rating of less than 12 kW; or</p> <p>(b) air-conditioning systems solely for processes within a <i>building</i>.</p> <p>(3) In terms of section 2 of the Building (Scotland) Act 2003 the provisions of paragraph (1) are a designated provision in respect of which there is a continuing requirement imposed on the owners of <i>buildings</i>.</p> |
|---|---|

0.17.1 Explanation

Regulation 17 requires the owners of an air-conditioned *building* to have such plant regularly inspected and to provide advice to the users of the *building* on related energy efficiency improvement *work* and how to operate the system efficiently. This regulation implements the terms of Article 9 of [Directive 2002/91/EC](#) on the energy performance of buildings (EPBD).

Scope

The regulation relates only to larger, fixed air-conditioning systems and does not cover portable systems. It also relates to comfort cooling of people in a *building* but does not cover any other system, such as cooling solely used in a manufacturing, trade or mechanical process. For example, a system only cooling computer equipment would be exempt. A number of individual systems each 12 kW or less, but taken together totalling more than 12 kW, within one *building* or fire-separated part of a *building*, would only qualify for inspection if they are linked by way of a central control.

0.17.2 Implementation

Continuing requirement Relaxation direction

The regulation imposes a continuing requirement that means inspections are required not only throughout the life of a new *building*, but also for the life of an existing *building*, for as long as it has an air-conditioning system. In the early stages of implementation, it is proposed that relaxation directions will be used to manage phased introduction of inspections. The first of these directions will commence on the 1 May 2007. Such directions will be displayed on the SBSA website and referred to as the Building (Scotland) Act 2003 (Air-conditioning Systems) Relaxation Direction(s).

Inspection frequency

For completely new air-conditioning systems, the first inspection should be no later than 5 years after the acceptance of the completion certificate for the *building work*. For existing systems, inspection will normally be carried out at 3 yearly intervals. However, the accredited expert doing the inspection does have the discretion to extend that frequency up to 5 years, for existing systems that demonstrate excellent levels of efficiency.

Guidance on inspection Prior to the initial air-conditioning inspections being undertaken, in line with the frequency given in the paragraph above, the SBSA will provide guidance on the scope of the inspection and how the inspection-findings should be presented to the user of the *building*.

Contents

- 1.0 Introduction**
- 1.1 Structure**
- 1.2 Disproportionate collapse**
- Small Building Structural Guidance**
- 1.A General**
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1.0 Introduction

- 1.0.1 Background
- 1.0.2 Aims
- 1.0.3 Latest changes
- 1.0.4 Alternative approaches
- 1.0.5 Annexes

Introduction

1.0

1.0.1 Background

The structure of a *building* is fundamental to ensuring the safety of people in or around new and existing *buildings* and can be affected by a number of factors inside and outside the *building* including environmental factors. These factors should be considered to prevent the collapse, excessive deformation or the disproportionate collapse of *buildings*.

Climatic conditions

The climatic conditions in Scotland including temperature, snow, wind, driving rain and flooding and the impact of climate change should be carefully considered in the assessment of loadings and in the structural design of *buildings*.

Disproportionate collapse

The methodology for assessing the risk of disproportionate collapse and a framework of additional measures commensurate to the level of risk and consequences of such collapse to all *buildings* in accordance with the forthcoming Structural Eurocode BS EN 1991-1-7: 2006 Accidental Actions is set out in the following reports:

- a. '[Guidance on Robustness and Provision against Accidental Actions](#)' dated July 1999;
- b. '[Calibration of Proposed Revised Guidance on meeting Compliance with the Requirements of Building Regulation Part A3](#)'.

www.communities.gov.uk

These documents are available on the website of the Department for Communities and Local Government.

Standing Committee on Structural Safety (SCOSS)
www.scoss.org.uk

The Standing Committee on Structural Safety (SCOSS) which reports to the Presidents of the Institutions of Civil Engineers and Structural Engineers to identify in advance trends and developments which might contribute to increasing risks relating to structural safety has set up a UK wide reporting system on structural safety issues, Confidential Reporting on Structural Safety (CROSS).

[Appraisal of existing structures](#)

Guidance relevant to *conversions* to existing *buildings* is given in 'Appraisal of Existing Structures', 1996 published by the Institution of Structural Engineers. Where this report refers to 'design checks' the choice of various partial factors should be made to suit the individual circumstances of each case.

1.0.2 Aims

The intention of this section is to ensure that the structure of a *building* does not pose a threat to the safety of people in or around *buildings* and existing *buildings* as a result of:

- a. loadings;
- b. the nature of the ground;
- c. collapse or deformations;
- d. stability of the *building* and other *buildings*;
- e. climatic conditions;
- f. materials;
- g. structural analysis;
- h. details of *construction*;
- i. safety factors.

Loads used in structural calculations should take account of possible dynamic, concentrated and peak load effects that may occur.

1.0.3 Latest changes

There were no major changes made to this section between 1 May 2007 and 30 April 2008 but a few minor corrections have been made. A summary of these corrections can be found on the [2008 Technical Handbooks](#) website page.

1.0.4 Alternative approaches

Where alternative approaches to the structural design are proposed other than using the guidance contained in this section, the structural design should take account of all of the factors identified in clause 1.0.2 above. For example, care should be taken where alternative numerical values are placed on factors of safety as this may have a detrimental effect on the overall stability of the structure.

Structural Eurocodes in the UK

As part of the European Union's desire to remove technical barriers to trade, a series of European Codes of Practice in the field of civil and structural engineering known as Structural Eurocodes are being published by CEN, the Standards body for Europe. Like other harmonised European standards, each member of the European Union set their own 'Nationally Determined Parameters' (NDP's). Structural Eurocodes should only be used as an alternative to British Standards provided the National Annexes have been published.

There will be a period of co-existence during which time Structural Eurocodes and national codes (i.e. British Standards) should be considered equivalent. The period of co-existence will commence from the date the last package of standards (i.e. concrete, steel, timber, masonry, etc.) is made available from CEN to the British Standards Institution. It is anticipated that this period should commence in 2007 and end in 2010 when British Standards would be withdrawn and thereafter only the Structural Eurocodes would be referenced as guidance in meeting section 1: Structure.

Implementation of Structural Eurocodes

For more detailed guidance on the background and implementation of Eurocodes, see 'Implementation of Structural Eurocodes in the UK' (February 2003) produced by the Office of the Deputy Prime Minister (now Department for Communities and Local Government) on behalf of the United Kingdom and '[The National Strategy for Implementation of the Structural Eurocodes: Design Guidance](#)' (April 2004) produced by the Institution of Structural Engineers.

Scottish Ministers are planning to publish '[Guidance on Stone Masonry](#)' during 2007 which will give guidance in the use of stone masonry.

1.0.5 Annexes

The Small *buildings* structural guidance (SBSG) which provides structural guidance to designers of small *domestic buildings* is contained within the following annexes to this section:

| | |
|-----------|-------------------------|
| Annex 1.A | General |
| Annex 1.B | Stability |
| Annex 1.C | Foundations |
| Annex 1.D | Masonry walls |
| Annex 1.E | Timber frame walls |
| Annex 1.F | Timber floors and roofs |

1.1 Structure

- 1.1 Functional standard
- 1.1.0 Introduction
- 1.1.1 General
- 1.1.2 Loading
- 1.1.3 Design and construction
- 1.1.4 Nature of the ground
- 1.1.5 Stability of existing buildings

| | |
|--|--|
| <p style="text-align: center;">standard</p> <p style="text-align: center; font-size: 2em;">1.1</p> <p style="text-align: center;">mandatory</p> | <p>Every <i>building</i> must be designed and <i>constructed</i> in such a way that the loadings that are liable to act on it, taking into account the nature of the ground, will not lead to:</p> <p>(a) the collapse of the whole or part of the <i>building</i>;</p> <p>(b) deformations which would make the <i>building</i> unfit for its intended use, unsafe, or cause damage to other parts of the <i>building</i> or to fittings or to installed equipment; or</p> <p>(c) impairment of the stability of any part of another <i>building</i>.</p> |
|--|--|

1.1.0 Introduction

| | |
|--|---|
| Loadings | The effect of the loads acting on a <i>building</i> should be assessed both separately and in various combinations with each other to ensure the <i>building</i> can be designed to transmit these loads safely to the ground. |
| Nature of the ground | The stability of a <i>building</i> and other existing <i>buildings</i> in the vicinity can be affected by ground conditions which should be investigated and assessed to ensure that the ground can safely support the <i>building</i> . |
| Collapse | The collapse of the whole or part of a <i>building</i> is clearly a matter of the highest importance with respect to public safety. The design and <i>construction</i> of <i>buildings</i> should take into account all contributing factors such as loads, climatic conditions, partial safety factors for materials and loads and design methodology to ensure that it will have an acceptable probability that it will not collapse (ultimate limit state) during its design lifetime. |
| Deformations | Similarly deformations of <i>buildings</i> while not leading to an ultimate collapse can lead to public safety concerns particularly where they become unfit or unsafe for use. This can become apparent in several ways ranging from cracking, movement or springiness of floors, doors or windows not opening or closing, damage to pipes and other services within the <i>building</i> . The design and <i>construction</i> of a <i>building</i> should ensure that, by taking into account the factors set out above, the <i>building</i> does not fail in normal use (serviceability limit state). |
| Stability of existing <i>buildings</i> | The stability of existing <i>buildings</i> can be affected if the design and <i>construction</i> of a new <i>building</i> does not take into account any potential impacts on existing <i>buildings</i> . This could lead to a risk of collapse or damage to existing <i>buildings</i> with a consequent risk to public safety. Examples of potential impacts would be ground conditions or funnelling of wind. A new requirement has been added to the standard requiring this matter to be taken into account. |
| <i>Conversions</i> | In the case of <i>conversions</i> , as specified in regulation 4, the <i>building</i> as <i>converted</i> shall meet the requirements of this standard in so far as is <i>reasonably practicable</i> , and in no case be worse than before the <i>conversion</i> (regulation 12, schedule 6). |

1.1.1 General

In order to be safe, a *building* should be capable of resisting all loads acting on it as a result of its intended use and geographical location. To achieve this, the structure of a *building* should be designed with margins of safety to ensure that the mandatory functional standard has been met.

In clause (b), of standard 1.1 deformations are not intended to cover aesthetic damage such as shrinkage and other minor cracking.

Specialist advice

Specialist advice from chartered engineers or other appropriately qualified persons should be sought if the designer is in any doubt about the loads acting on a *building* or how these loads can be accommodated by the structure and safely transmitted to the ground.

Small *Buildings*
Structural Guidance

The Small *Buildings* Structural Guidance (SBSG) which is contained in Annexes 1.A-1.F has been prepared as the replacement to the Small *Buildings* Guide (Second Edition June 1994) to provide structural guidance to designers of small *domestic buildings* on how to comply with standard 1.1. The SBSG has been written for those with expertise in *building* design and *construction* but not necessarily in structural engineering design. Where the conditions or parameters fall outside the scope, then specialist advice should be sought from chartered engineers or other appropriately qualified persons.

Reference can be made to the updated wind and snow loading maps contained in the following Building Research Establishment reports:

- a. ['Wind loading on traditional dwellings-Amendment of simplified design guidance for the Scottish Office Small Buildings Guide' \(1999\) \(Project number CV4071\);](#)
- b. ['Proposed revision of the simplified roof snow load map for Scotland' \(2003\) \(Client report number 211-878\).](#)

Consideration should be given to guidance in other sections of the Technical Handbook that can influence the structural design of a *building*.

1.1.2 Loading

The loads to which a *building* will be subjected should be calculated in accordance with the following British Standards:

- a. for *dead loads* and *imposed loads* (excluding roof loads), BS 6399-1: 1996;
- b. for imposed roof loads, BS 6399-3: 1988;
- c. for *wind loads*, BS 6399-2: 1997;
- d. for loading of any *building* for *agriculture*, BS 5502-22: 2003;
- e. for earth retaining structures (e.g. basements), BS 8002: 1994;
- f. any greater load to which the *building* is likely to be subjected.

1.1.3 Design and construction

The structural design and *construction* of a *building* should be carried out in accordance with the following British Standards:

- a. for *foundations*, BS 8004: 1986;
- b. for structural *work* of reinforced, prestressed or plain concrete, BS 8110-1: 1997, BS 8110-2: 1985 and BS 8110-3: 1985;
- c. for structural *work* of steel, BS 5950-1: 2000, BS 5950-2: 2001, BS 5950-5: 1998, BS 5950-6: 1995, BS 5950-7: 1992 and BS 5950-8: 2003;
- d. for structural *work* of composite steel and concrete *construction*, BS 5950-3.1: 1990 and BS 5950-4: 1994;
- e. for structural *work* of aluminium, BS 8118-1: 1991 and BS 8118-2: 1991; for the purpose of section 7.2 of BS 8118-1: 1991, the structure should be classified as a safe-life structure;
- f. for structural *work* of masonry, BS 5628-1: 2005, BS 5628-2: 2005 and BS 5628-3: 2005;
- g. for structural *work* of timber, BS 5268-2: 2002, BS 5268-3: 2006 and BS 5268-6.1: 1996;
- h. for earth retaining structures (e.g. basements), BS 8002: 1994;
- i. for structural design of low rise *buildings*, BS 8103-1: 1995, BS 8103-2: 2005, BS 8103-3: 1996 and BS 8103-4: 1995.

1.1.4 Nature of the ground

The *foundations* of *buildings* should be designed to sustain and transmit the loadings to the ground in such a manner that there will be no ground movement which will impair the stability of the *building*. All aspects of the nature of the ground should be taken into consideration including ground movement caused by:

- swelling, shrinkage or freezing of the subsoil; or
- landslip or subsidence (other than subsidence arising from shrinkage).

There may be known or recorded conditions of ground instability, such as that arising from landslides, disused mines or unstable strata which, if ignored, could have an adverse effect on a *building*. Such conditions should be taken into account in the design and *construction* of the *building* and its *foundations*.

www.communities.gov.uk

Attention is drawn to Planning Policy Guidance Note 14 (PPG 14) [Development on unstable land](#). Although PPG 14 contains specific reference to England & Wales it does set out the broad planning and technical issues relating to development on unstable land.

www.bgs.ac.uk

Information on the scale and nature of problems arising from mining instability, natural underground cavities and adverse *foundation* conditions is available from the following:

www.coalminingreports.co.uk

- British Geological Survey, Murchison House, West Mains Road, Edinburgh, EH9 3LA;
- The Coal Authority, 200 Lichfield Lane, Mansfield, Nottinghamshire, NG18 4RG.

Information can also be obtained from local authorities who hold Building Standards Registers and other relevant records.

Where it is considered that a geotechnical investigation should be carried out, BS 5930: 1999 deals with the investigation of *sites* for the purpose of assessing their suitability for the *construction* of the *work* including obtaining information on the geotechnical conditions of the ground on the *site*. It provides recommendations on certain constraints or problems that can affect a *site*, including geotechnical aspects.

1.1.5 Stability of existing buildings

The stability of existing *buildings* may be affected by a new *building* located in its vicinity. The design and *construction* of the new *building* should take into account the effect on existing *buildings* in accordance with BS 8004:1986.

The following factors can also affect the stability of an existing *building* and should be taken into account:

- dead and *imposed loads* from the new *building*;
- *wind loads* including funnelling effects from the new *building*;
- pressure bulb extending below existing *building*;
- changes in groundwater level;
- loss of fines during pumping operations or climatic conditions.

1.2 Disproportionate collapse

- 1.2 Functional standard
- 1.2.0 Introduction
- 1.2.1 Disproportionate collapse
- 1.2.2 Determine building risk group
- 1.2.3 Assess additional measures
- 1.2.4 Design and construct additional measures
- 1.2.5 Other sources of guidance

standard

1.2

mandatory

Every *building* must be designed and *constructed* in such a way that in the event of damage occurring to any part of the structure of the *building* the extent of any resultant collapse will not be disproportionate to the original cause.

Ronan Point

1.2.0 Introduction

This standard was introduced in the United Kingdom following the disaster at Ronan Point on 16 May 1968. The scope of this standard which was previously restricted to *buildings* of 5 or more *storeys* was extended in 2005 to require designers to consider accidental overloading and the possibility of progressive collapse to all *buildings* and the guidance has now been expanded to provide guidance for all *buildings*.

Explanation of terms

Nominal length of load-bearing wall construction should be taken as:

- in the case of a reinforced concrete wall, the distance between lateral supports subject to a length not more than 2.25 x *storey* height;
- in the case of an external masonry wall, or timber or steel stud wall, the length measured between vertical lateral supports;
- in the case of an internal masonry wall, or timber or steel stud wall, a length not more than 2.25 x *storey* height.

Storey height is the distance from the underside of one floor to the underside of the floor immediately above.

Basement storey is a *storey* which is below the level of the ground *storey* and in the case of a sloping ground level is wholly below the lowest ground level around the *building* .

Key element is a structural member upon which the stability of the remainder of the structure depends and should be capable of sustaining an accidental design loading of 34 kN/m² applied in the horizontal and vertical directions (in one direction at a time) to the member and any attached components such as cladding, having regard to the ultimate strength of such components and their connections. Such accidental design loading should be assumed to act simultaneously with 1/3rd of all normal characteristic loading (i.e. wind and *imposed loading*).

Load bearing wall construction includes masonry cross-wall *construction* and walls comprising close centred timber or lightweight steel section studs.

Conversions

In the case of *conversions* , as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard in so far as is *reasonably practicable* , and in no case be worse than before the *conversion* (regulation 12, schedule 6).

1.2.1 Disproportionate collapse

A *building* which is susceptible to disproportionate collapse is one where the effects of accidents and, in particular, situations where damage to small areas of a structure or failure of single elements could lead to collapse of major parts of the structure.

Buildings should be provided with a level of robustness by adopting the principles of risk analysis, categorising *buildings*, taking into account both the risk of the hazard and its consequences and providing additional measures commensurate to the level of risk and consequences of such collapse of the *building*.

To ensure that *buildings* are designed and *constructed* to sustain a limited extent of damage or failure without a disproportionate level of collapse from an unspecified cause, the following procedure should be followed:

- determine *building* risk group;
- assess additional measures;
- design and *construct* additional measures.

1.2.2 Determine building risk group

The issues to be considered with respect to assessing the risk group of a *building* are its occupancy level, use, the number of *storeys* and floor areas.

The risk of an extreme event such as an explosion or other incident occurring would not be decreased simply by providing these measures and there is no certainty that demolition or *building* alteration would be carried out in accordance with good practice but the consequences of such an incident occurring would be considerably reduced.

| Risk group | Building type |
|------------|---|
| 1 | <i>Houses</i> not more than 4 <i>storeys</i> ; <i>Carpports, Conservatories and Greenhouses</i> ; Domestic garages and other small single leaf <i>buildings</i> not more than 1 <i>storey</i> . |
| 2A | 5 <i>storey houses</i> ; <i>Flats and maisonettes</i> not more than 4 <i>storeys</i> . |
| 2B | <i>Flats and maisonettes</i> more than 4 <i>storeys</i> but not more than 15 <i>storeys</i> . |
| 3 | Every <i>domestic building</i> not covered in Risk Groups 1, 2A and 2B. |

The nomenclature of the Risk Groups 1, 2A, 2B and 3 are synonymous with the consequence classes in Table A.1—Categorisation of consequence classes of BS EN 1991-1-7: 2006.

In determining the number of *storeys* in a *building*, basement *storeys* may be excluded provided such basement *storeys* fulfill the robustness of risk group 2B *buildings*.

For *buildings* intended for more than one type of use the risk group should be that pertaining to the most onerous Risk Group (e.g. 2 *storey flats* above 1 *storey shops* should be taken as 3 *storey shops* and fall within risk group 2A non-domestic).

1.2.3 Assess additional measures

The additional measures which should be provided vary extensively according to *building* type and use and the actual measures should be designed in accordance with the relevant sections of the design codes. For example, high rise hotels or *flats* or *assembly buildings* or grandstands require a different degree of protection than for low rise *buildings* or storage warehouses.

The additional measures which should be applied to *buildings* of the risk groups derived from the above table are set out below:

For risk group 1 *buildings*

Provided the *building* has been designed and *constructed* in accordance with the rules given in this Technical Handbook, or other guidance referenced under section 1, for complying with standard 1.1 in normal use, no additional measures are likely to be necessary.

For risk group 2A *buildings*

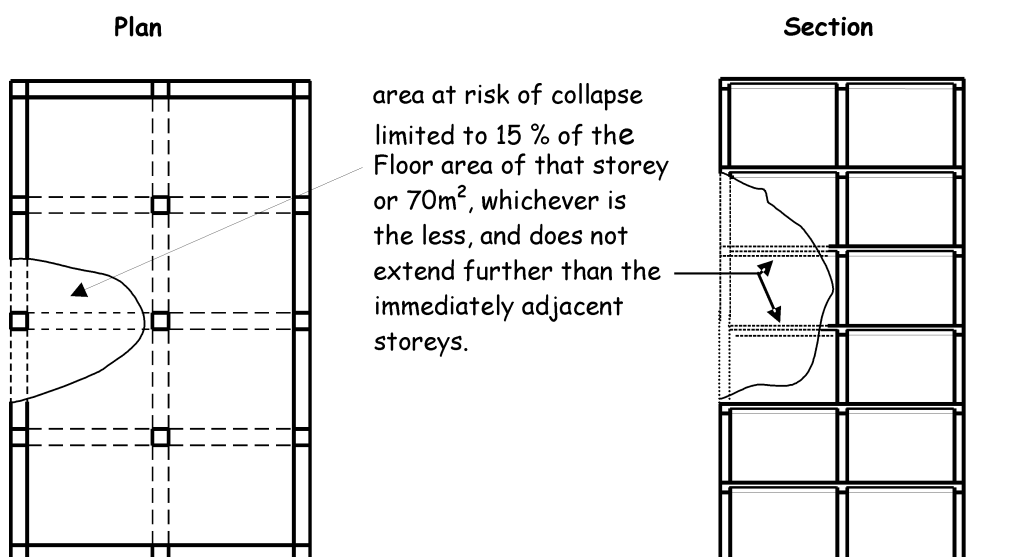
Provide effective horizontal ties, or effective anchorage of suspended floors to walls, for framed and load-bearing wall *construction*.

For risk group 2B *buildings*

Provide effective horizontal ties for framed and load-bearing wall *construction*, together with effective vertical ties, in all supporting columns and walls.

Alternatively, check that upon the notional removal of each supporting column and each beam supporting one or more columns, or any nominal length of load-bearing wall (one at a time in each *storey* of the *building*) the *building* should remain stable and that the area of floor at any *storey* at risk of collapse should be not more than 15% of the floor area of that *storey* or 70 m², whichever is the less and does not extend further than the immediate adjacent *storeys* (see diagram below).

Where the notional removal of such columns and lengths of walls would result in an extent of damage in excess of the above limit, then such elements should be designed as 'key elements'.



For risk group 3
buildings

A systematic risk assessment of the *building* should be carried out, taking into account all the normal hazards that can be foreseen as far as possible together with any abnormal hazards.

Critical situations for design should be selected that reflect the conditions that can be foreseen as far as possible during the life of the *building*.

The structural form and concept and any protective measures should then be chosen and the detailed design of the structure and its elements undertaken in accordance with the recommendations in the codes and standards in clause 1.2.4.

1.2.4 Design and construct additional measures

The structural design and *construction* to take account of the additional measures including horizontal and vertical ties and checking the integrity of the *building* following the notional removal of vertical members and the design of key elements, should be carried out in accordance with the following:

- a. for structural *work* of reinforced, prestressed or plain concrete, BS 8110-1: 1997 and BS 8110-2: 1985;
- b. for structural *work* of steel, BS 5950-1: 2000;
- c. for structural *work* of masonry, BS 5628-1: 2005, BS 5628-2: 2005 and BS 5628-3: 2005.

Note that the British Standards for concrete and timber are being updated to incorporate the risk based approach for disproportionate collapse.

1.2.5 Other sources of guidance

Additional guidance has been produced by organisations providing more detailed information on disproportionate collapse as follows:

- a. [Technical Guidance Note – ‘The Building Regulations 2004 Edition – England and Wales Requirement A3 – Disproportionate Collapse’](#), National House Building Council (NHBC);
- b. [Technical Bulletin Number 3 ‘Design Guidance for Disproportionate Collapse’](#), UK Timber Frame Association;
- c. [‘Masonry Design for Disproportionate Collapse Requirements under Regulation A3 of the Building Regulations \(England & Wales\)’](#), Brick Development Association;
- d. [‘Guidance on meeting the Robustness Requirements in Approved Document A’](#), Steel Construction Institute.

The above guidance is based on England & Wales Regulation A3 and should be interpreted in relation to standard 1.2. In particular, references to *building* classes should be risk groups and the *building* types and occupancy should be interpreted as the *building* types set out in the table to clause 1.2.2.

Annex

1.A General

- 1.A.0 Introduction
- 1.A.1 Scope
- 1.A.2 Latest changes
- 1.A.3 Explanation of terms

1.A.0 Introduction

The Small Buildings Structural Guidance (SBSG) replaces the Small Buildings Guide (second edition 1994) and provides structural guidance to designers of small domestic buildings and is subdivided into 6 annexes:

- Annex 1.A - General
- Annex 1.B - Stability
- Annex 1.C - Foundations
- Annex 1.D - Masonry walls
- Annex 1.E - Timber frame walls
- Annex 1.F - Timber floors and roofs

The *buildings* covered by this guidance are restricted in terms of construction type, size and subsoil conditions to those commonly occurring in Scotland. Following the guidance in the annexes will help designers meet standard 1.1.

This guidance has been written for those with expertise in *building* design and construction but not necessarily in structural engineering design. Where the conditions or parameters fall outside the scope then specialist advice should be sought from chartered engineers or other appropriately qualified persons.

Timber frame construction has been a significant form of construction for *domestic buildings* for over 20 years in Scotland, rising from 38% of new starts in 1984 in the volume housing market to over 73% in 2004, and a large proportion of the single build and extension market. Although the guidance in the Small Buildings Guide was restricted to traditional masonry construction as timber frame construction has been used and accepted for over 30 years, it was considered necessary to extend the scope of the guidance for small buildings to include timber frame walls.

1.A.1 Scope

This guidance covers the following types of buildings:

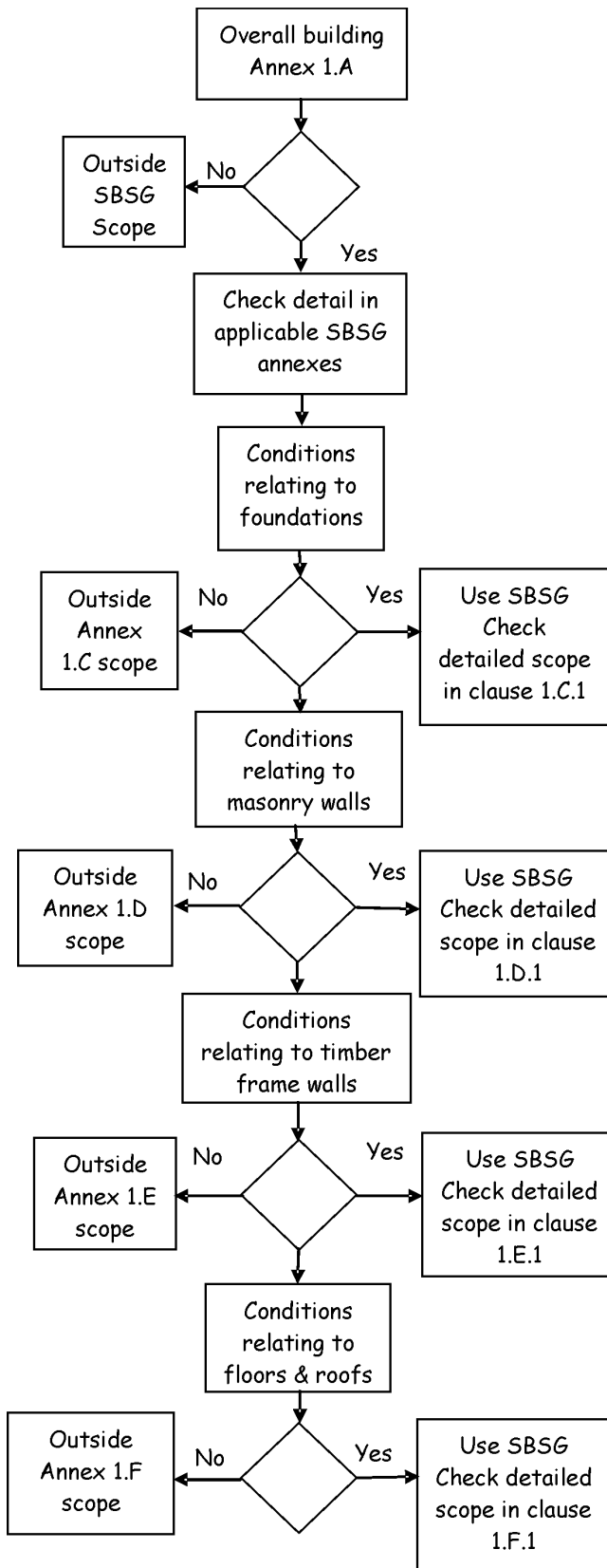
a. buildings with masonry walls:

- *domestic buildings* but restricted to houses not more than 3 storeys without basement storeys;
- extensions with eaves heights not more than 3 m to low rise *domestic* buildings including garages and outbuildings;
- single *storey*, single leaf buildings forming a garage or outbuilding within the *curtilage* of a *dwelling*.

b. buildings with timber frame walls:

- *domestic buildings* but restricted to houses not more than 2 storeys without basement storeys;
- extensions with eaves heights not more than 3 m to low rise domestic buildings.

The full description of the types of *buildings* and restrictions to which this guidance is applicable is set out within the scope of each of the annexes and it is recommended that prior to using the SBSG for particular works, the scope of the works should be checked against all of the limitations on its use to ensure that it is appropriate in the circumstances and in particular the items set out as follows:



Annex 1.A General

Experienced in design & construction Domestic buildings & extensions.

Annex 1.C Foundations

Geotechnical conditions.

Annex 1.D Masonry walls

Not more than 3 storeys;
 Maximum 15 m *building* height;
 Maximum 12 m length between supporting walls;
 Limitations of wind speed, topography, altitude and location;
 Limitations of floor areas surrounded by structural walls to 70 and 36 m²;
 Openings in walls not more than 3 m in length.

Annex 1.E Timber frame walls

Not more than 2 storeys;
 Maximum 10 m *building* height;
 Maximum 9 m length between supporting walls;
 Limitations of wind speed, topography, altitude and location;
 Limitations of floor areas surrounded by structural walls to 70 and 36 m² ;
 Openings in walls totalling not more than 30% of the wall area.

Annex 1.F Floors and roofs

Floor spans not more than 5.4 m;
 Roof spans not more than 6 m;
 Roofs should be either square or rectangular plan shape;
 Raised tie and collared roofs only for attic storage loading;
 Trussed rafters restricted to prefabricated duo or mono pitch fink trussed rafters;
 Roof members imposing point loads onto walls (e.g. hip and girder trusses) out with scope;
 Engineered timber I joists, concrete floors out with scope.

Design and construction should also comply with all other relevant building standards.

Annex 1.B provides guidance on stability which should be followed.

Annexes 1.C-1.F can be used independently of each other.

Where there is a minor departure from the recommendations within the SBSG this may be supported by calculations carried out by a specialist provided the design of that specialist is properly co-ordinated with the remainder of the design.

1.A.2 Latest changes

The Small Buildings Guide has been revised and updated to the Small Buildings Structural Guidance incorporating changes in construction practice specifically:

Loadings

- wind loading and snow loading.

Masonry walls

- more detailed guidance on openings;
- more detailed guidance on lateral support;
- differences in ground levels either sides of walls;
- stainless steel wall ties in all locations.

Timber Floors and Roofs

- guidance clarified and expanded for floor joists;
- timber span tables expanded to cover raised tie and collared roofs.

Timber frame construction

- new guidance on masonry clad timber frame walls.

1.A.3 Explanation of terms

The following terms are used in the SBSG in addition to the definitions and explanation of terms in Appendix A of the Technical Handbooks.

Buttressing wall means a wall designed and *constructed* to afford lateral support to another wall perpendicular to it, support being provided from the base to the top of the wall.

Cavity width means the horizontal distance between the 2 leaves of a cavity wall.

Pier means a member which forms an integral part of a wall, in the form of a thickened section at intervals along the wall so as to afford lateral support to the wall to which it is bonded or securely tied.

Centres means the distance between the longitudinal centres of any 2 adjacent members of the same type, measured in the plane of floor, ceiling or roof structure of which the members form a part.

Span means distance measured along the centre line of a member between the centres of any 2 adjacent bearings or supports. Note: The spans given in annex 1.E for Cripple Studs and Lintels and in annex 1.F for floor joists and roof joists are the clear spans (i.e. spans between the faces of the supports).

Supported wall means a wall to which lateral support is afforded by a combination of buttressing walls, piers or chimneys acting in conjunction with floors or roof.

Lateral support means support provided to a wall by another wall, pier etc. perpendicular to it which will restrict movement in the direction of the thickness of a wall from the base to the top of the wall.

Horizontal diaphragm means a floor or roof construction which acts to transfer the wind loads to the supporting walls.

Load bearing wall means a wall which carries vertical and/or lateral loads in addition to its self weight.

Annex
1.B Stability

- 1.B.0 Introduction
- 1.B.1 Stability recommendations
- 1.B.2 Timber roof bracing

1.B.0 Introduction

Buildings should be stable under the likely combinations of *dead load*, *imposed load* and *wind loading* terms of the individual structural elements, their interaction together and overall stability as a structure. This annex provides guidance on the principles of stability and provisions which should be taken with respect to all forms of *buildings* within the scope of the SBSG.

1.B.1 Stability recommendations

The following provisions should be made to ensure the stability of the *building*:

- a. the overall size and proportioning of the *building* should be limited in accordance with the specific guidance for each form of *construction*;
- b. a layout of internal walls and *external walls* forming a robust three dimensional box structure in plan should be *constructed* with restrictions on the maximum size of cells measured in accordance with the specific guidance for each form of *construction*;
- c. the internal walls and *external walls* should be connected by either masonry bonding or by using mechanical connections;
- d. the intermediate floors and roof should be of such *construction* and interconnection with the walls that they provide local support to the walls and also act as horizontal diaphragms capable of transferring the *wind loads* to buttressing elements of the *building*.

More detailed guidance is provided in annexes 1.C-1.F.

1.B.2 Timber roof bracing

Trussed rafter roofs should be braced in accordance with the recommendations of BS 5268-3: 2006. A traditional cut timber roof (i.e. using rafters, purlins and ceiling joists) generally has sufficient built-in resistance to instability and *wind loads* (e.g. from either hipped ends, tiling battens, rigid sarking etc.). However, diagonal rafter bracing, equivalent to that recommended in BS 5268-3: 2006 or annex H of BS 8103-3: 1996 for trussed rafter roofs, should be provided particularly for single-hipped and non-hipped roofs of more than 40 degree pitch to detached *houses*.

Annex

1.C Foundations

- 1.C.0 Introduction
- 1.C.1 Explanation of terms
- 1.C.2 Subsoil conditions
- 1.C.3 Design
- 1.C.4 Eccentric foundations
- 1.C.5 Extensions to existing buildings
- 1.C.6 Minimum width of strip foundations
- 1.C.7 Foundation loads

1.C.0 Introduction

The *dead loads*, *imposed loads* and *wind loads* are transmitted from the *building* to the subsoil by means of the *foundations* which should be designed taking into account the loadings and the subsoil conditions without undue settlement.

This annex provides guidance on the subsoil conditions on which *buildings* within the scope of the SBSG can be *constructed*, the precautions to be taken and guidance on strip *foundations* of plain concrete for such *buildings*.

Where the subsoil or *foundation* conditions or parameters fall outside the scope then specialist advice should be sought from chartered engineers or other appropriately qualified persons.

1.C.1 Explanation of terms

The following terms are used in annex 1.C in addition to the definitions and explanation of terms in Appendix A of the Technical Handbooks

Engineered fill means fill that is selected, placed and compacted to a specification that it will exhibit engineering behaviour. Normally the installation of such fill would not have taken place prior to development of the *site* allowing the necessary control to be exercised over the type of fill material and method of placement.

Non-engineered fill means fill that has arisen as a by-product of human activity, usually involving the disposal of waste materials. Normally such fill would occur on *sites* where uncontrolled filling has taken place and therefore no reliance can be placed on the type of fill material and method of placement and hence its ability to support *buildings*.

Bearing stratum means the formation level of the ground on to which the *foundation* of a *building* will be *constructed*.

1.C.2 Subsoil conditions

This guidance is limited to there being no:

- non-engineered fill or wide variation in type of subsoil within the loaded area; or
- peat within the loaded area; or
- weaker type of soil within the loaded area at such a depth below the soil on which the *foundation* rests or other conditions which could impair the stability of the *building*.
- subsoil below the *foundation*, or in the case of an extension below either the existing *building* or the extension outwith Types I-VI in the table to clause 1.C.6;
- subsoil below the *foundation*, or in the case of an extension below either the existing *building* or the extension, that has been subjected to ground improvement techniques (e.g. vibrocompaction, underpinning, soil replacement etc.);
- doubt about the ability of the ground to sustain loads transmitted to it;

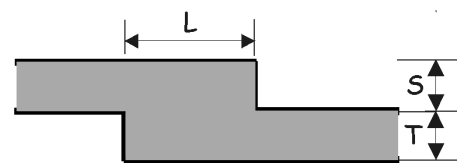
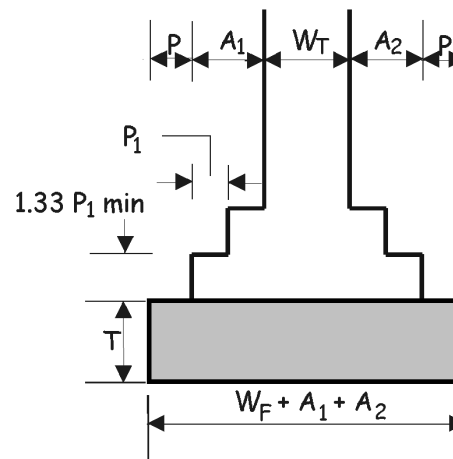
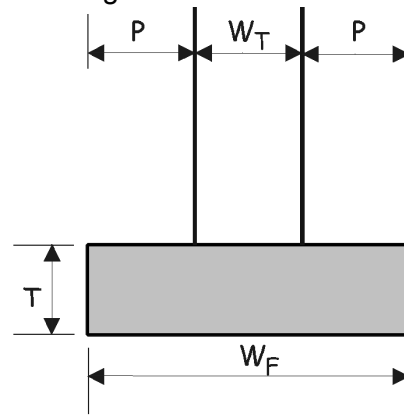
The minimum depth to the bearing stratum for the *foundations* should be determined by the greatest of:

- the depth to selected bearing stratum; or
- a depth of 450 mm to the underside of *foundations*. This should avoid damage from frost although this depth may have to be increased in areas which are subject to long periods of frost; or
- a depth of 600 mm to the underside of *foundations* where clay soils are present (more detailed guidance is provided in BRE Digests [240](#) and [241](#)); or
- the depth required in order to reach ground types I–VI in the table to clause 1.C.6.

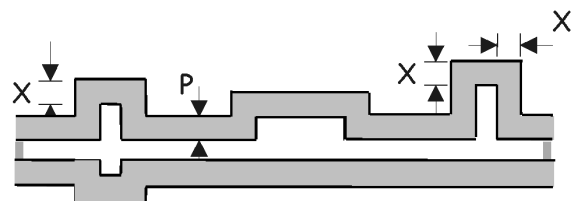
1.C.3 Design

The design of *foundations* should comply with all of the following:

- the *foundations* are situated centrally under the wall (except as in clause 1.C.4);
- the *foundations* are strip *foundations*;
- the *foundation* width should not be less than the dimension, W_F , in the table to 1.C.6 and at least as wide as the supported wall;
- concrete in chemically non-aggressive soils is composed of Portland cement to BS EN 197-1 & 2: 2000 and fine and coarse aggregate conforms to BS EN 12620: 2002 and the mix complies with one of the following recommendations:
 - in proportion of 50 kg of Portland cement to not more than 100 kg (0.05 m^3) of fine aggregate and 200 kg (0.1 m^3) of coarse aggregate; or
 - grade ST2 or grade GEN1 concrete to BS 8500-2: 2002;
- in chemically aggressive soils, follow the guidance provided in BS 8500-1: 2002 and [BRE Special Digest 1](#);
- the minimum thickness, T , of the concrete *foundation* is 150 mm or the scantment width, P , whichever is the greater, where P is derived using the table to clause 1.C.6 and the diagram opposite. Trench fill *foundations* may be used as an alternative to strip *foundations*;
- where footings have regular offsets these offsets should have a depth of at least 1.33 times the projection, P_1 , with the overall width not less than the sum of W_F (from the table to clause 1.C.6) plus the offset dimensions A_1 and A_2 and the walls should be central on the *foundation*;
- for *foundations* stepped in elevation:
 - height of steps, S , should be no more than the *foundation* thickness, T ; and
 - overlap, L , should be twice the step height, S , the *foundation* thickness, T , or 300 mm whichever is the greatest;
- foundations* for piers, buttresses and *chimneys* should project as shown in the diagram opposite, where X must be not less than P .



$$L = \text{greater of } 2 \times S, T, \text{ or } 300 \text{ mm}$$



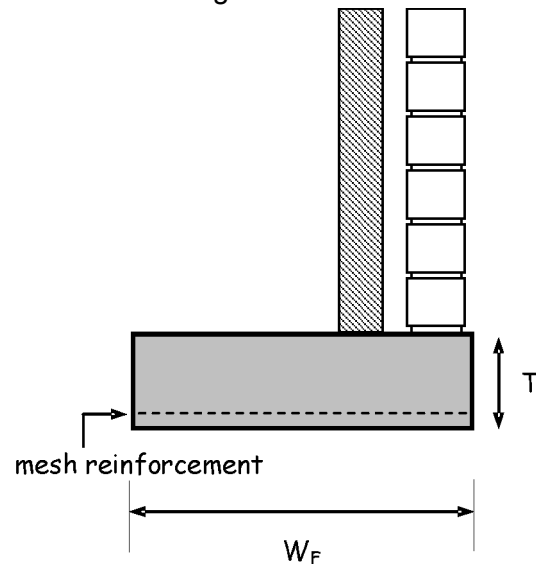
1.C.4 Eccentric foundations

This guidance is limited to:

- single *storey buildings* of 4.5 m maximum height where a wall is to be *constructed* either against a *boundary* or against an existing wall where it is not possible to *construct* the wall centrally on the *foundation* ;
- masonry cavity or timber frame walls with masonry outer leaf with either a flat or pitched roof;
- similar ground conditions to types I-VI from the table to clause 1.C.6 below both the existing and new *foundations* ;
- the *foundations* complying with all of the clauses of this annex.

The design of eccentric foundations should comply with all of the following:

- the minimum *foundation* width, W_F , should be read from the table to 1.C.6;
- the minimum *foundation* thickness, T , for the minimum *foundation* widths listed in the table to 1.C.6 should be at least 200 mm;
- steel mesh reinforcement (e.g. A142) should be placed with 50 mm cover from the base of the *foundation*;
- where the wall and its *foundation* is to be *constructed* against an existing wall then the *foundation* should also follow the guidance in clause 1.C.5.

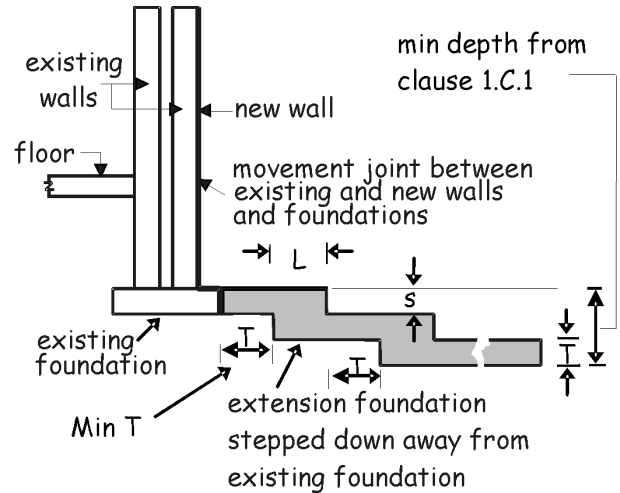


1.C.5 Extensions to existing buildings

This guidance is limited to:

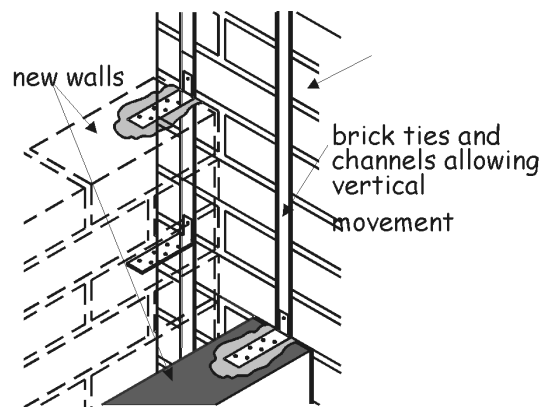
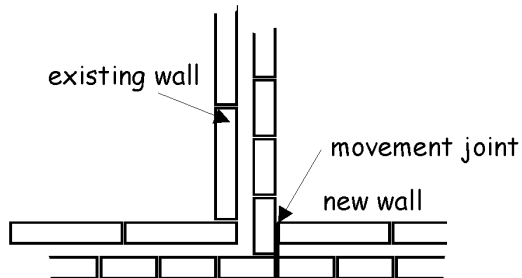
- extensions of not more than 2 storeys connected to existing buildings;
- masonry cavity or timber frame walls with masonry outer leaf with either a flat or pitched roof;
- similar ground conditions to types I-VI from the table to clause 1.C.6 below both the existing and new foundations ;
- extension foundations complying with all of the clauses of this annex.

Where the depth of the existing foundation is less than that in clause 1.C.2, the depth of the extension foundation should match the depth of the existing foundation at the interface and step down progressively to that in clause 1.C.2 as shown opposite. The initial step down in the underside of the new foundation should not commence until the horizontal distance from the vertical face of the existing foundation is at least the foundation thickness, T.



To minimise the risk of differential settlement occurring between the extension and the existing structure, the following should be considered:

- movement joints should be placed between the existing and new foundations and walls to accommodate any differential settlement ;
- for soil types I-III in the table to clause 1.C.6, the strip foundation widths listed in the table should be adopted;
- for soil types IV, V and VI in the table to clause 1.C.6, the strip foundation widths listed in the table should be increased by 25%;
- additional information is provided in [BRE GBG 53 'Foundations for low-rise building extensions'](#);
- where a new roof connects to an existing roof, the loads from the new roof should be carried down to the new foundation and no new loads should be carried by the existing structure.



1.C.6 Minimum width of strip foundations

The recommended widths of *foundations* set out in the table below may be used subject to:

- the subsoil conditions in clause 1.C.2; and
- the *foundation* design provisions in clause 1.C.3; and
- the type and condition of subsoil at the selected bearing stratum being Types I-VI below; and
- the loading at the base of the wall being within the limits set out below; and

An excavation may be required to establish the type and condition of the ground.

The table below is applicable only within the strict terms of the criteria described within it. Where the ground type is not covered by the table or where x appears specialist advice should be sought from chartered engineers or other appropriately qualified persons.

Minimum width of strip foundations

| Type of ground (including engineered fill) | Condition of ground | Field test applicable | Total load of load-bearing walling not more than (kN/m) | | | | | |
|---|--|---|---|-----|-----|-----|-----|-----|
| | | | 20 | 30 | 40 | 50 | 60 | 70 |
| | | | Minimum width of strip foundation, W_F (mm) | | | | | |
| I Rock | Not inferior to sandstone, limestone or firm chalk | Requires at least a pneumatic or other mechanically operated pick for excavation | At least equal to the width of the wall | | | | | |
| II Gravel or Sand | Medium dense | Requires pick for excavation. Wooden peg 50 x 50 mm in cross section, hard to drive beyond 150 mm | 250 | 300 | 400 | 500 | 600 | 650 |
| III Clay or Sandy clay | Stiff | Can be indented slightly by thumb | 250 | 300 | 400 | 500 | 600 | 650 |
| IV Clay or Sandy clay | Firm | Thumb makes impression easily | 300 | 350 | 450 | 600 | 750 | 850 |
| V Sand, Silty Sand or Clayey Sand | Loose | Can be excavated with a spade. Wooden peg 50 x 50 mm in cross section can be easily driven | 400 | 600 | x | x | x | x |
| VI Silt, Clay, Sandy clay or Silty clay | Soft | Finger pushed in up to 10 mm | 450 | 650 | x | x | x | x |
| VII Silt, Clay, Sandy clay or Silty clay | Very soft | Finger easily pushed in up to 25 mm | x | x | x | x | x | x |

1.C.7 Foundation loads

The table below gives indications of typical loads on *foundations*.

| Storeys No. | Wall type | Roof span (m) | Floor span (m) | Loading (kN/m) |
|------------------------|----------------------|--------------------------|---------------------------|---------------------------|
| 3 | Masonry cavity | 12 | 6 | 80 |
| 3 | Masonry cavity | 7.5 | 6 | 70 |
| 2 | Masonry cavity | 12 | 6 | 60 |
| 2 | Masonry cavity | 7.5 | 6 | 50 |
| 2 | Timber frame | 7.5 | 6 | 40 |
| 1 | Masonry cavity | 7.5 | 6 | 30 |
| 1 | Timber frame | 7.5 | 6 | 30 |
| 1 | Single leaf masonry | 5 | 5 | 20 |

Annex

1.D Masonry Walls

- 1.D.0 Introduction
- 1.D.1 Wall types
- 1.D.2 Conditions relating to the building of which the walls forms part
- 1.D.3 Maximum floor area
- 1.D.4 Imposed loads on roofs, floors and ceilings
- 1.D.5 General
- 1.D.6 Solid external walls, compartment walls and separating walls in coursed brickwork or blockwork
- 1.D.7 Solid external walls, compartment walls and separating walls in uncoursed stone, flints etc.
- 1.D.8 Cavity walls in coursed brickwork and blockwork
- 1.D.9 Walls providing vertical support to other walls
- 1.D.10 Internal loadbearing walls in brickwork or blockwork
- 1.D.11 Parapet walls
- 1.D.12 Single leaf external walls
- 1.D.13 Modular bricks and blocks
- 1.D.14 Maximum height of buildings based on wind loadings
- 1.D.15 Maximum allowable length and height of the wall
- 1.D.16 Rules of measurement for storeys, walls, panels and building heights
- 1.D.17 Wall ties
- 1.D.18 Brick and block construction
- 1.D.19 Compressive strength of masonry units
- 1.D.20 Compressive strength of masonry units (N/mm^2)
- 1.D.21 Compressive strength of clay and calcium silicate blocks (N/mm^2)
- 1.D.22 Compressive strengths of masonry units in walls
- 1.D.23 Mortar
- 1.D.24 Lintels for openings
- 1.D.25 Maximum span of floors
- 1.D.26 Other loading conditions
- 1.D.27 Vertical lateral restraint to walls
- 1.D.28 Criteria for buttressing walls
- 1.D.29 Criteria for piers and chimneys providing restraint
- 1.D.30 Openings, recesses, chases and overhangs
- 1.D.31 Dimensional criteria
- 1.D.32 Sizes of openings and recesses
- 1.D.33 Chases
- 1.D.34 Overhangs
- 1.D.35 Lateral support by roofs and floors
- 1.D.36 Gable wall strapping
- 1.D.37 Interruption of lateral support
- 1.D.38 Movement in masonry
- 1.D.39 Small single storey, single leaf buildings
- 1.D.40 Size and proportions of openings

continued

- 1.D.41 Wall thicknesses and piers
- 1.D.42 Horizontal lateral restraint at roof level
- 1.D.43 Proportions for masonry chimneys

1.D.0 Introduction

Small traditional masonry wall *buildings* can be designed to take into account loading conditions, limitations on dimensions, openings, subject to restraint conditions.

This annex provides guidance for traditional masonry wall *construction* for the following *building* types:

- a. *domestic buildings* of not more than 3 *storeys* where loading criteria for individual floors does not exceed those given in clause 1.D.4 and total limit of loading does not exceed that given in clause 1.D.26;
- b. single *storey*, single leaf extensions to *domestic buildings* including garages and outbuildings that do not exceed the dimensional criteria set out in clause 1.D.2b;
- c. single *storey*, single leaf *buildings* forming a garage or outbuilding within the *curtilage* of a *dwelling* that do not exceed the dimensional criteria set out in clause 1.D.2c.

1.D.1 Wall types

This annex provides guidance only for the types of wall extending to full *storey* height set out below:

- a. *domestic buildings* of up to 3 *storeys*:
 - *external walls*
 - internal load bearing walls
 - *separating walls*
- b. single *storey*, single leaf *domestic buildings* and extensions
 - *external walls*
 - internal load bearing walls

It also provides guidance on parapet walls.

This annex should be used in conjunction with annex 1.B and:

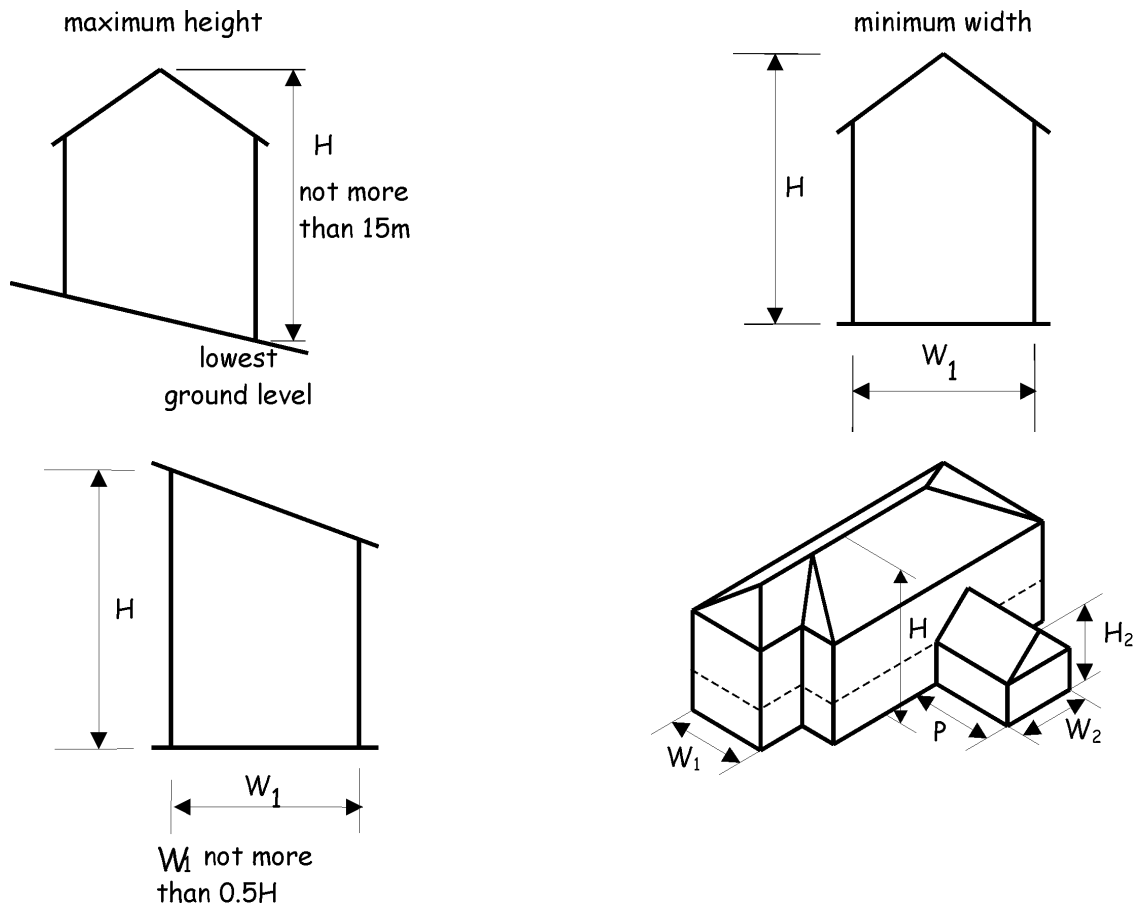
- a. if wall thickness is to be determined according to clauses 1.D.5-13 all the design conditions given in this annex should be satisfied;
- b. walls should be designed in accordance with the guidance in BS 5628-3: 2005, except as regards the conditions given in clauses 1.D.2- 4,1.D.14-42;
- c. in formulating the guidance of this annex, the worst combination of circumstances likely to arise was taken into account;
- d. if a requirement of this annex is considered too onerous in a particular case then adequacy by calculation should be shown in respect of the aspect of the wall which is subject to the departure rather than for the entire wall;
- e. where the conditions or parameters fall outside the scope of this annex then specialist advice should be sought from chartered engineers or other appropriately qualified persons;
- f. the guidance given in this annex is based upon unit compressive strengths of bricks and blocks being at least that indicated in the tables to clauses 1.D.20-21 and diagrams to clause 1.D.22;
- g. BS5628-1: 2005 gives design strengths for walls where the suitability for use of masonry units of other compressive strengths are being considered.

1.D.2 Conditions relating to the building of which the walls forms part

This annex applies only to *buildings* having proportions within the following limits and as shown on the diagrams below subject to the limits of clause 1.D.15:

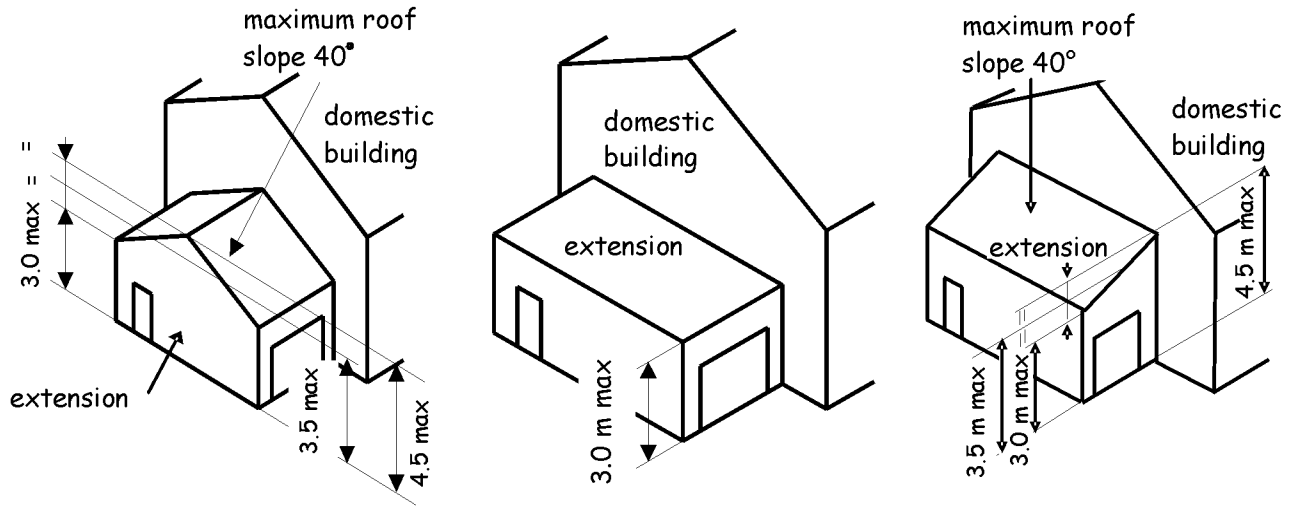
a. domestic buildings of not more than three storeys:

- the maximum height of the *building*, H , measured from the lowest finished ground level adjoining the *building* to the highest point of any wall or roof should be not more than 15 m;
- the height of the *building* H , should be not more than twice the least width of the *building* W_1 ;
- the height of the wing H_2 , should be not more than twice the least width of the wing W_2 when the projection P is more than twice the width W_2 .



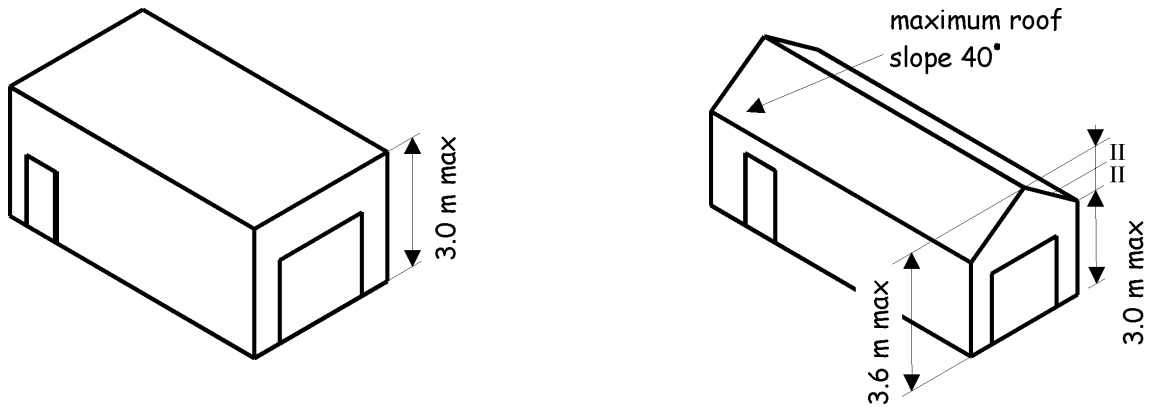
b. size of extensions to domestic buildings

For extensions, height H should be not more than the limits shown below where H is measured from the top of the *foundation* or from the underside of the floor slab where this provides effective lateral restraint.



c. size of single storey, single leaf buildings

For small single *storey*, single leaf *buildings*, the height H of the *building* should be not more than 3 m and the length should be not more than 9 m where H is measured from the top of the *foundation* or from the underside of the floor slab where this provides effective lateral restraint.

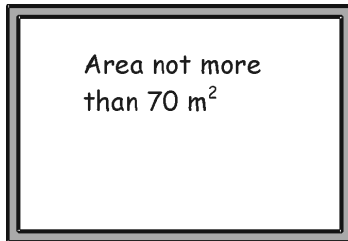


1.D.3 Maximum floor area

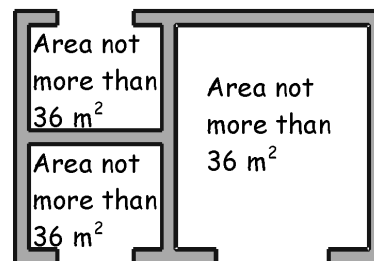
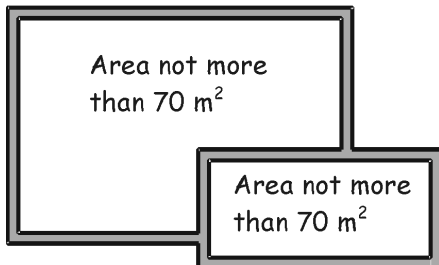
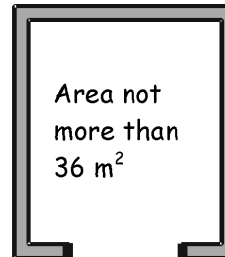
The guidance in this annex applies where:

- the areas of floors enclosed by structural walls on all sides are not more than 70 m^2 ;
- the areas of floors without a structural wall on one side are not more than 36 m^2 ;
- the openings and recesses are not more than set out in clause 1.D.31;
- the number of areas of floors as above which can be connected should be not more than 4.

Structural walls on all sides



Structural walls on 3 sides



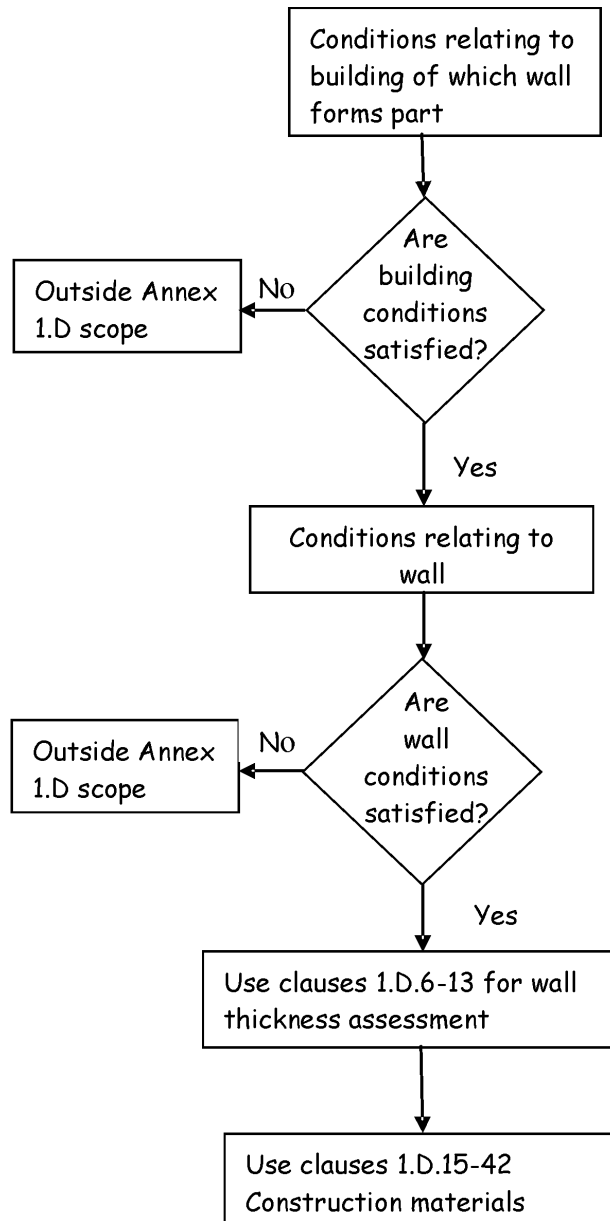
1.D.4 Imposed loads on roofs, floors and ceilings

The *imposed loads* on roofs, floors and ceilings should be not more than those in the table below:

| Element | Loading | |
|----------|-------------------|---|
| Roof | distributed load: | 1.00 kN/m^2 for spans of at least 12 m |
| | distributed load: | 1.50 kN/m^2 for spans of at least 6 m |
| Floors | distributed load: | 2.00 kN/m^2 together with a concentrated load of 1.4 kN |
| Ceilings | distributed load: | 0.25 kN/m^2 together with a concentrated load of 0.9 kN |

1.D.5 General

Wall thickness should be determined according to this annex provided the following conditions are met:



Building conditions

limitations on size and proportions of *building* and parts of *building* (clause 1.D.2);
 max allowable floor areas (clause 1.D.3);
 max *imposed loads* and *wind loads* (clauses 1.D.4 and 1.D.14).

Wall conditions

max allowable length and height of wall (clause 1.D.15);
construction materials (clauses 1.D.17-24);
 loading on walls (clauses 1.D.25-26);
 end restraints (clauses 1.D.27-29);
 openings, recesses, overhangs and chases (clauses 1.D.30-34);
 lateral support by floors and roofs (clauses 1.D.35-37);
 movement in masonry (clause 1.D.38);
 conditions relating to *external walls* of small single *storey buildings* and extensions (clauses 1.D.39-42).

1.D.6 Solid external walls, compartment walls and separating walls in coursed brickwork or blockwork

Solid walls *constructed* of coursed brickwork or blockwork should be at least as thick as 1/16 of the *storey* height and should follow the guidance in the table below.

| Height of wall | Length of wall | Minimum thickness of wall |
|---------------------------------------|--------------------------------------|--|
| not more than 3.5 m | not more than 12 m | 190 mm for the whole of its height |
| more than 3.5 m but not more than 9 m | not more than 9 m | 190 mm for the whole of its height |
| | more than 9 m but not more than 12 m | 290 mm from the base for the height of one <i>storey</i> and 190 mm for the rest of its height |
| more than 9 m but not more than 12 m | not more than 9 m | 290 mm from the base for the height of one <i>storey</i> and 190 mm for the rest of its height |
| | more than 9 m but not more than 12 m | 290 mm from the base for the height of two <i>storeys</i> and 190mm for the rest of its height |

1.D.7 Solid external walls, compartment walls and separating walls in uncoursed stone, flints etc.

The thickness of walls *constructed* in uncoursed stone or bricks or other burnt or vitrified material should be at least 1.33 times the thickness recommended in clause 1.D.6.

1.D.8 Cavity walls in coursed brickwork and blockwork

All cavity walls should have leaves at least 90 mm thick and structural cavities at least 50 mm wide. The wall ties should be at horizontal centres of 900 mm and at vertical centres of 450 mm, which is equivalent to 2.5 ties per square metre. Wall ties should be spaced not more than 300 mm apart vertically and within a distance of 225 mm from the vertical edges of all openings, movement joints and roof verges. For selection of wall ties for use in a range of cavity widths refer to the table to clause 1.D.17.

For *external walls, compartment walls and separating walls* in *cavity construction*, the combined thickness of the 2 leaves plus 10 mm should be at least the thickness required by clause 1.D.6 for a solid wall of the same height and length.

1.D.9 Walls providing vertical support to other walls

Irrespective of the materials used in the *construction*, a wall thickness should be at least that of any part of the wall to which it gives vertical support.

1.D.10 Internal loadbearing walls in brickwork or blockwork

With the exception of *separating walls*, internal loadbearing walls should have a thickness at least:

$$(\text{wall thickness from clause 1.D.6}) / 2 \text{ less } 5 \text{ mm}$$

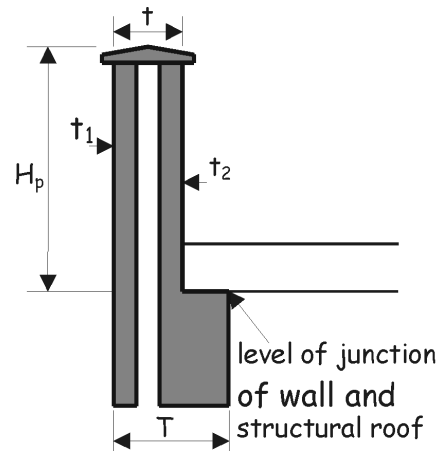
A wall in the lowest *storey* of a 3 *storey building* carrying load from both *upper storeys* however should have a thickness as determined by the above equation or 140 mm, whichever is more.

1.D.11 Parapet walls

The minimum thickness and maximum height of parapet walls should be as given in the tables and diagrams below only where access is limited (e.g. for occasional maintenance).

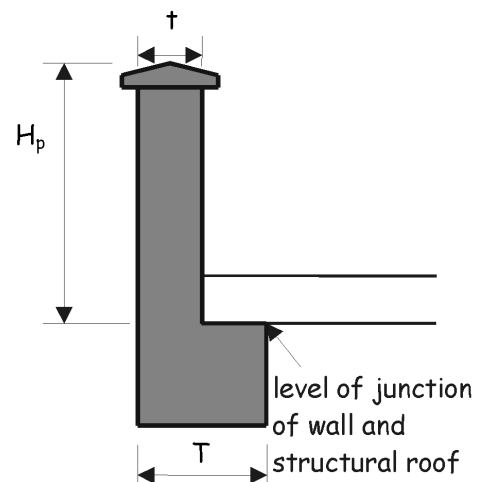
Cavity wall

| Max parapet height, H_p (mm) | Thickness (mm) |
|-----------------------------------|-------------------------------|
| 600 | $t_1 + t_2$ not more than 200 |
| 860 | $t_1 + t_2$ more than 200 |



Solid wall

| Max parapet height, H_p (mm) | Thickness (mm) |
|-----------------------------------|-------------------|
| 600 | $t = 150$ |
| 760 | $t = 190$ |
| 860 | $t = 215$ |



Note that t must not be more than T

1.D.12 Single leaf external walls

The single leaf of *external walls* to single storey single leaf *domestic buildings* and extensions should be at least 90 mm thick, provided the recommendations of clauses 1.D.39-42 are met.

1.D.13 Modular bricks and blocks

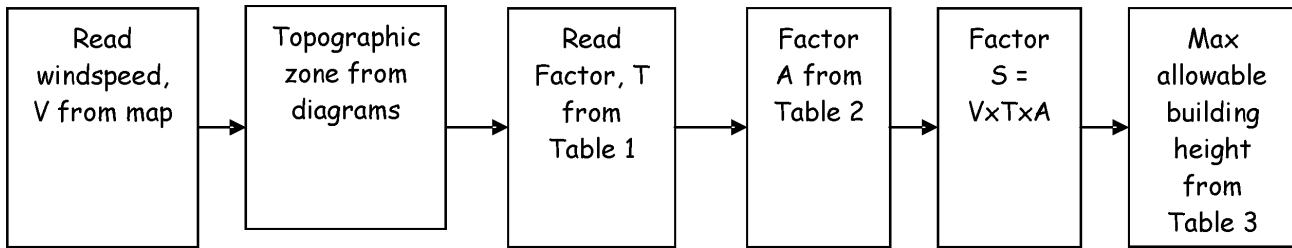
Where brick or block dimensions are based on BS 6649: 1985, wall thicknesses recommended in this annex should not be reduced by more than the tolerance from the work size permitted by a British Standard for equivalent sized bricks or blocks manufactured of the same material.

1.D.14 Maximum height of buildings based on wind loadings

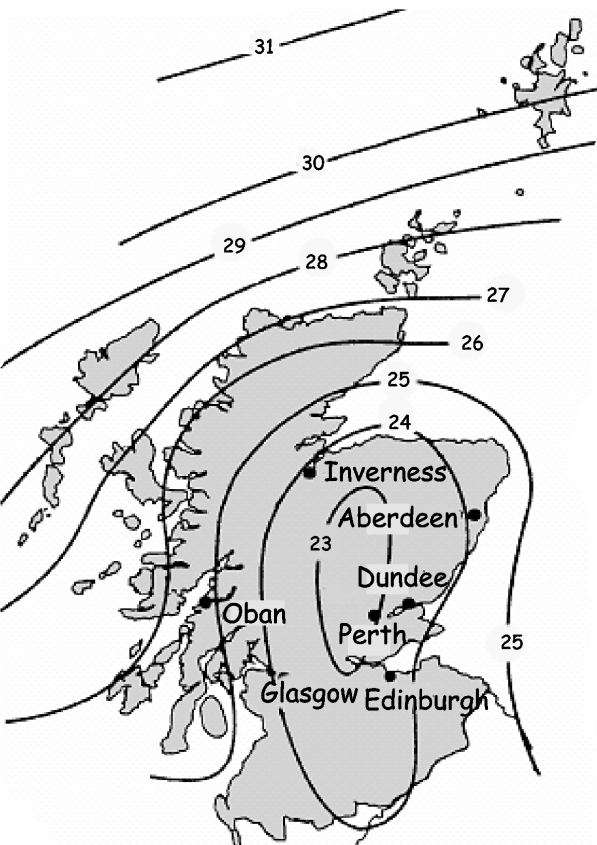
The maximum height of a *building* for the *site* exposure conditions and wind speed should be derived by following the procedure which is set out on the flow chart below using the wind speed map and topographic zone diagrams below and tables 1 and 2 opposite to enable the maximum height of *building* to be read off table 3 opposite.

This design guidance has been revised in accordance with 'Wind loading on traditional dwellings-Amendment of simplified design guidance for the Scottish Office Small Buildings Guide' (1999) (Project number CV4071) and is based on BS 6399-2: 1997 using hourly mean wind speeds. It should be noted that the wind speeds are derived from a different basis than in the former Small Buildings Guide and it is important that they are only applied to the methodology within this annex.

Flow chart for deriving maximum allowable building height



Map of wind speeds (m/sec)



Topographical zones for Table 1

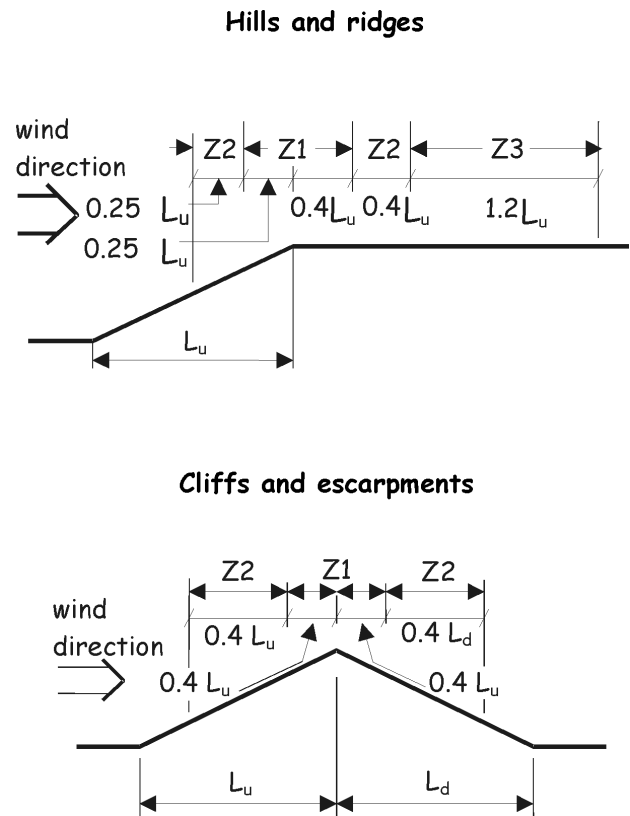


Table 1 - Factor T

| Type of terrain | Factor T | | |
|---|----------|--------|--------|
| | Zone 1 | Zone 2 | Zone 3 |
| Category 1: Nominally flat terrain, average slope not more than 1:20 | 1.00 | 1.00 | 1.00 |
| Category 2: Moderately steep terrain, average slope not more than 1:5 | 1.24 | 1.13 | 1.10 |
| Category 3: Steep terrain, average slope more than 1:5 | 1.36 | 1.20 | 1.15 |

Note that outside of these zones Factor T = 1.0

Table 2 - Factor A

| Site altitude (m) | Factor A |
|-------------------|----------|
| 0 | 1.00 |
| 50 | 1.05 |
| 100 | 1.10 |
| 150 | 1.15 |
| 200 | 1.20 |
| 300 | 1.30 |
| not more than 400 | 1.40 |

Table 3 - Maximum allowable building height (m)

| Factor S | Country Sites Distance to the coast[2] | | | Town Sites[1] Distance to the coast[2] | | |
|----------|---|-------------|--------|---|-------------|--------|
| | <10 km | 10 to 50 km | >50 km | <10 km | 10 to 50 km | >50 km |
| | 23 | 15 | 15 | 15 | 15 | 15 |
| 24 | 15 | 15 | 15 | 15 | 15 | 15 |
| 25 | 11 | 14.5 | 15 | 15 | 15 | 15 |
| 26 | 8 | 10.5 | 13 | 15 | 15 | 15 |
| 27 | 6 | 8.5 | 10 | 15 | 15 | 15 |
| 28 | 4.5 | 6.5 | 8 | 13.5 | 15 | 15 |
| 29 | 3.5 | 5 | 6 | 11 | 13 | 14.5 |
| 30 | 3 | 4 | 5 | 9 | 11 | 12.5 |
| 31 | x | 3.5 | 4 | 8 | 9.5 | 10.5 |
| 32 | x | 3 | 3.5 | 7 | 8.5 | 9.5 |
| 33 | x | x | 3 | 6 | 7.5 | 8.5 |
| 34 | x | x | x | 5 | 7 | 8 |
| 35 | x | x | x | 4 | 6 | 7 |
| 36 | x | x | x | 3 | 5.5 | 6 |
| 37 | x | x | x | x | 4.5 | 5.5 |
| 38 | x | x | x | x | 4 | 5 |
| 39 | x | x | x | x | 3 | 4 |
| 40 | x | x | x | x | x | 3 |

Notes:

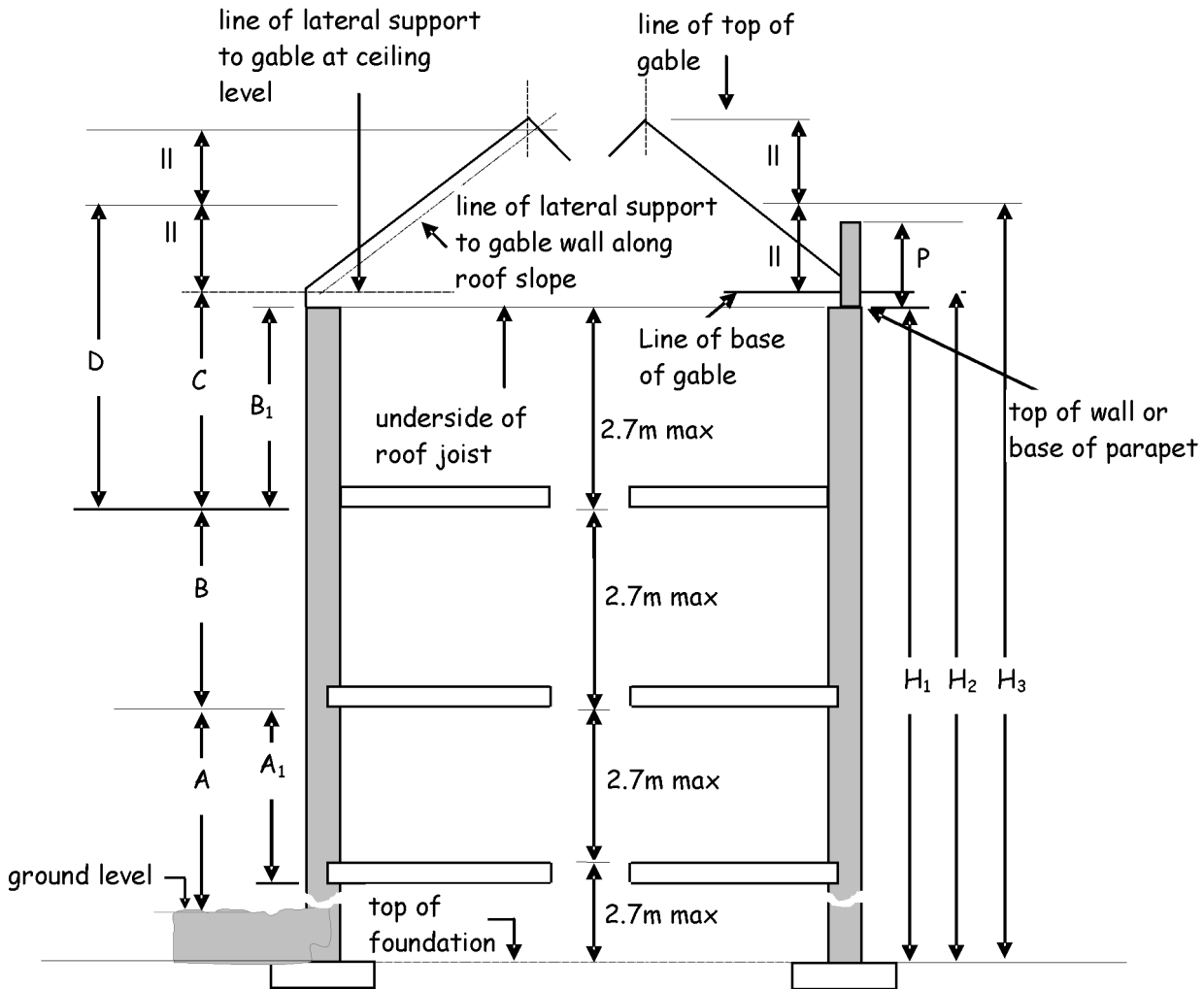
1. For *sites* on outskirts of towns not sheltered by other *buildings* use heights for country *sites*.
2. For *site* nearer than 1 km to inland area of water (e.g. tidal river or loch) which extends more than 1 km in direction of wind, distance to coast should be taken from edge of that inland area of water.
3. x indicates that the *building* height is outwith the scope of the SBSG.
4. The maximum allowable *building* heights may be interpolated within the figures in the table.

1.D.15 Maximum allowable length and height of the wall

This annex does not deal with walls more than 12 m in length, measured from centre to centre of buttressing walls, piers or *chimneys* providing restraint, or of walls more than 12 m in height (see also table to clauses 1.D.6 and 1.D.35).

1.D.16 Rules of measurement for storeys, walls, panels and building heights

The height of a wall or a storey should be measured in accordance with the following diagram.



Key

(a) Measuring storey heights

- A** is the *ground storey* height if the ground floor is a suspended timber floor or a structurally separate ground floor slab
- A₁** is the *ground storey* height if ground floor is a suspended concrete floor bearing on the *external wall*
- B** is the *intermediate storey* height
- B₁** is the *top storey* height for walls which do not include a gable
- C** is the *top storey* height where lateral support is given to gable at both ceiling level and along the roof slope
- D** is the *top storey* height for walls which include a gable where lateral support is given to the gable only along the roof slope

(b) Measuring wall heights

- H₁** is the height of a wall that does not include a gable
- H₂** is the height of a *separating wall* which may extend to the under side of the roof
- H₃** is the height for a wall (except a *separating wall*) which includes a gable
- P** is the height of a parapet. If the parapet height is more than 1.2 m add the height to H₁

(c) Measuring building heights

Building heights are measured from the lowest finished ground level to the highest point of the roof

These methods of measurement are unique to SBSG and distinct from schedule 4 to regulation 7.

1.D.17 Wall ties

Wall ties should follow the guidance in BS EN 845-1: 2003 and should be material references 1 or 3 in BS EN 845 Table A1 austenitic stainless steel or non-ferrous ties. Wall ties should be selected in accordance with the following table

Permissible type of cavity wall tie

| Normal cavity width (mm) [1] | Tie length (mm) [2] | BS EN 845-1: 2003 tie [4] |
|-------------------------------------|----------------------------|--|
| 50 to 75 | 220 | Types 1, 2, 3 or 4 to DD 140-2 [5] and selected on the basis of the design loading and design cavity width |
| 76 to 90 | 225 | |
| 91 to 100 | 225 [3] | |
| 101 to 125 | 250 | |
| 126 to 150 | 275 | |
| 151 to 175 | 300 | |
| 176 to 300 | [2] | |

Notes:

- Where face insulated blocks are used the cavity width should be measured from the face of the masonry unit.
- The embedment depth of the tie should be at least 50 mm in both leaves. For cavities wider than 180 mm, calculate the tie length as the structural cavity width plus 125 mm and select the nearest stock length.
- Double triangle ties having a strength to satisfy Type 2 of DD 140-2 [5] are manufactured. Specialist tie manufacturers should be consulted if 225 mm long double triangle format ties are needed for 91 to 100 mm cavities.
- Reference should also be made to DD 140-2 [5] for the selection of the type (i.e. types 1, 2, 3 or 4) which will achieve the performance levels given in DD140-2.
- Although DD 140-2 was withdrawn on 1 February 2005, the tie user classes (types) given in tables 1 and 3 of the latter document can continue to be used after this date.

1.D.18 Brick and block construction

Walls should be bonded and put together with mortar. Materials should be chosen from the following list based on their intended use and for the exposure conditions likely to prevail:

- clay bricks or blocks to BS 3921: 1985 or BS EN 771-1: 2003; or
- calcium silicate bricks to BS 187: 1978 or BS 6649: 1985; or BS EN 771-2: 2003; or
- concrete bricks or blocks to BS EN 771-3: 2003 or BS EN 771-4: 2003; or
- square dressed natural stone should follow the guidance in BS 5628-3: 2006 or BS EN 771-6: 2005; or
- manufactured stone to BS 6457: 1984 or BS EN 771-5: 2003.

1.D.19 Compressive strength of masonry units

The minimum compressive strengths of masonry units should be derived by obtaining the Condition (A, B or C) from the diagrams to clause 1.D.22 and reading the compressive strength from either the table to clause 1.D.20 or the table to clause 1.D.21.

Where the masonry units have brick dimensions (337.5 mm length x 112.5 mm height) or are blocks, the compressive strengths should be at least the values given in the table to clause 1.D.20.

Where clay and calcium silicate masonry units exceed brick dimensions, the normalised compressive strengths should be at least the values given in the table to clause 1.D.21.

Normalised compressive strengths for block sized clay and calcium silicate masonry units not to brick dimensional format are given in the table to clause 1.D.21.

1.D.20 Compressive strength of masonry units (N/mm²)

| Masonry unit | Clay masonry units to BS EN 771-1: 2003 | | Calcium silicate masonry units to BS EN 771-2: 2003 | | Aggregate concrete masonry units to BS EN 771-3: 2003 | Autoclaved aerated conc. masonry units to BS EN 771-4: 2003 | Manufactured stone masonry units BS EN 771-5: 2003 | |
|-----------------------|---|-----------------|---|-----------------|---|---|--|--|
| Condition A[6] | | | | | | | | |
| Brick[3] | Group 1 6.0 | Group 2 9.0 | Group 1 6.0 | Group 2 9.0 | 6.0 | x | Any unit following the guidance in BS EN 771-5 | |
| Block[4] | See clause 1.D.21 | | | | 2.9[7] | 2.9 | | |
| Condition B[6] | | | | | | | | |
| Brick[3] | Group 1 9.0 | Group 2 13.0 | Group 1 9.0 | Group 2 13.0 | 9.0 | x | | |
| Block[4] | See clause 1.D.21 | | | | 7.3[7] | 7.3 | | |
| Condition C[6] | | | | | | | | |
| Brick[3] | Group 1 18.0 | Group 2 25.0 | Group 1 18.0 | Group 2 25.0 | 18.0 | x | | |
| Block[4] | See clause 1.D.21 | | | | 7.3[7] | 7.3 | | |

Notes:

1. This table applies to group 1 and group 2 units.
2. The compressive strengths (N/mm²) for masonry units described in the BS EN 771 series of standards are mean values.
3. Brick: a masonry unit having work sizes not more than 337.5 mm in length or 112.5 mm in height.
4. Block: a masonry unit more than either of the limiting work sizes of a brick and with a minimum height of 190 mm. For blocks with smaller heights, excluding cuts or make up units, the strength requirements are as for brick except for solid *external walls* where the blocks should have a compressive strength of at least that shown for block for an inner leaf of a cavity wall in the same position.
5. Group 1 masonry units have not more than 25% formed voids (20% for frogged bricks). Group 2 masonry units have formed voids more than 25%, but not more than 55%.
6. Refer to clause 1.D.22 for locations of Conditions A, B and C.
7. Values marked [7] are dry strengths to BS EN 772-1: 2000.

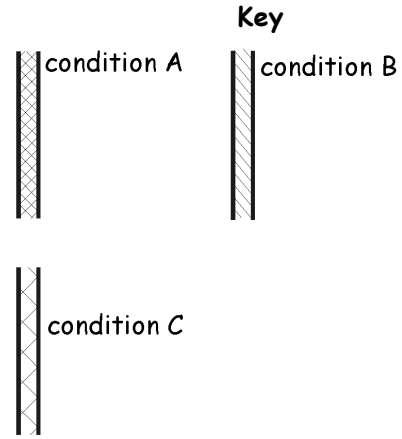
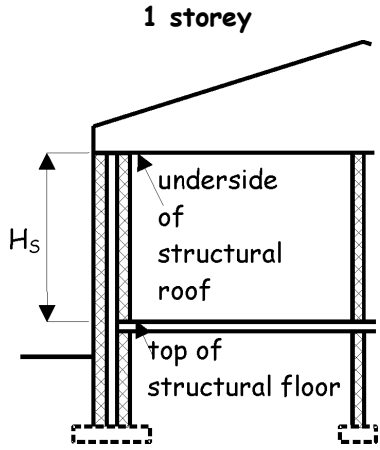
1.D.21 Compressive strength of clay and calcium silicate blocks (N/mm²)

| Standard | Condition | Group 1 masonry units[3] | Group 2 masonry units[4] |
|---|------------------|---------------------------------|---------------------------------|
| Clay masonry units to BS EN 771-1: 2003 and Calcium silicate masonry units to BS EN 771-2: 2003 | A | 5.0 | 8.0 |
| | B | 7.5 | 11.0 |
| | C | 15.0 | 21.0 |

Notes:

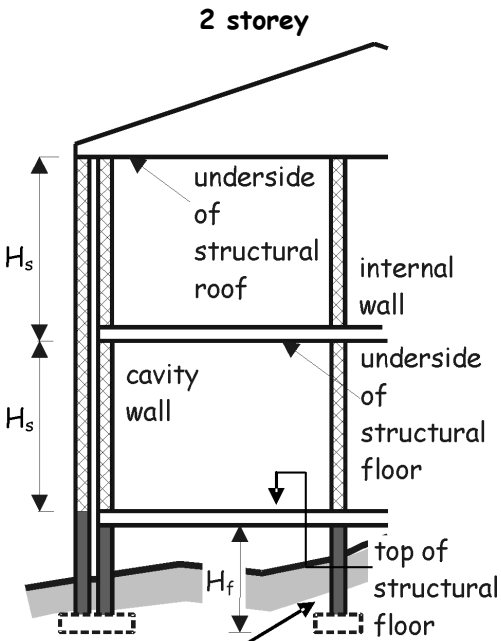
1. Values in this table are normalised compressive strengths (N/mm²). Compressive strengths of masonry units should be derived according to the guidance in BS EN 772-1: 2000.
2. The table applies to clay and calcium silicate block masonry units where the block size is more than 337.5 mm in length or 112.5 mm in height.
3. Group 1 masonry units have not more than 25% formed voids (20% for frogged bricks).
4. Group 2 masonry units have formed voids more than 25%, but not more than 55%.

1.D.22 Compressive strengths of masonry units in walls

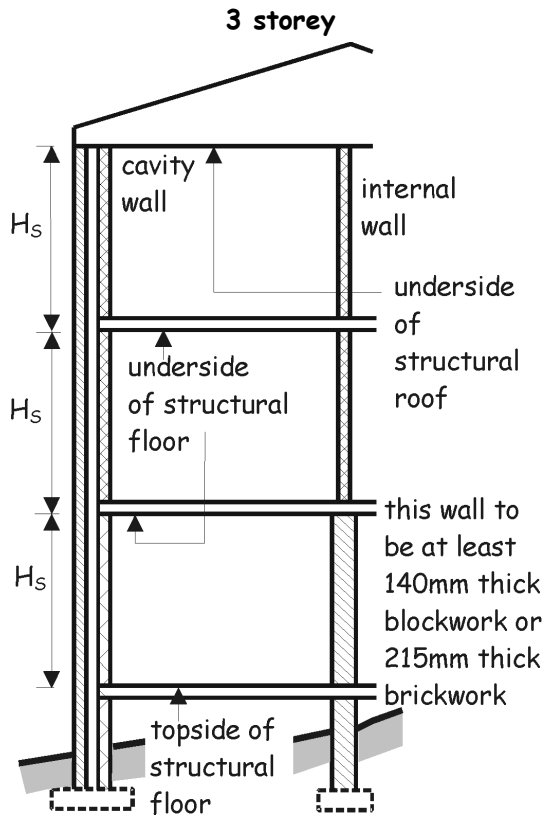


where H_f not more than 1m: condition A

where H_f more than 1m: condition B



this wall to be at least 140 mm thick in blockwork or 215 mm thick in brickwork below ground floor level if height H_f is more than 1m.



Notes:

1. If H_s is not more than 2.7 m, the compressive strength of bricks or blocks should be used in walls as indicated by the key.
2. If H_s is more than 2.7 m, the compressive strength of bricks or blocks used in the wall should be at least Condition B, or as indicated by the key whichever is the greater.
3. If the *external wall* is solid construction, the masonry units should have a compressive strength of at least that shown for the internal leaf of a cavity wall in the same position.

4. The guidance in the diagrams for walls of 2 or 3 *storey buildings* should only be used to determine the compressive strength of the masonry units where the roof *construction* is of timber.

1.D.23 Mortar

Mortar should be:

- Mortar designation (iii) according to BS 5628-3: 2005;
- Strength class M4 according to BS EN 998-2: 2003;
- 1:1:5 or 6 CEM 1, lime and fine aggregate measured by volume of dry materials.

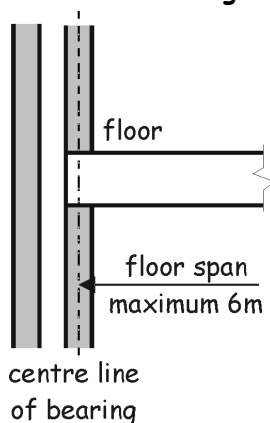
1.D.24 Lintels for openings

Proprietary steel or concrete lintels used with masonry cavity wall *construction* should be tested by a *notified body* or justified by calculations.

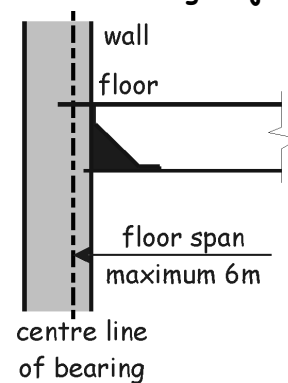
1.D.25 Maximum span of floors

The maximum span for any floor supported by a wall is 6 m, where the span is measured centre to centre of bearing as shown on the diagrams below.

Floor member bearing on wall



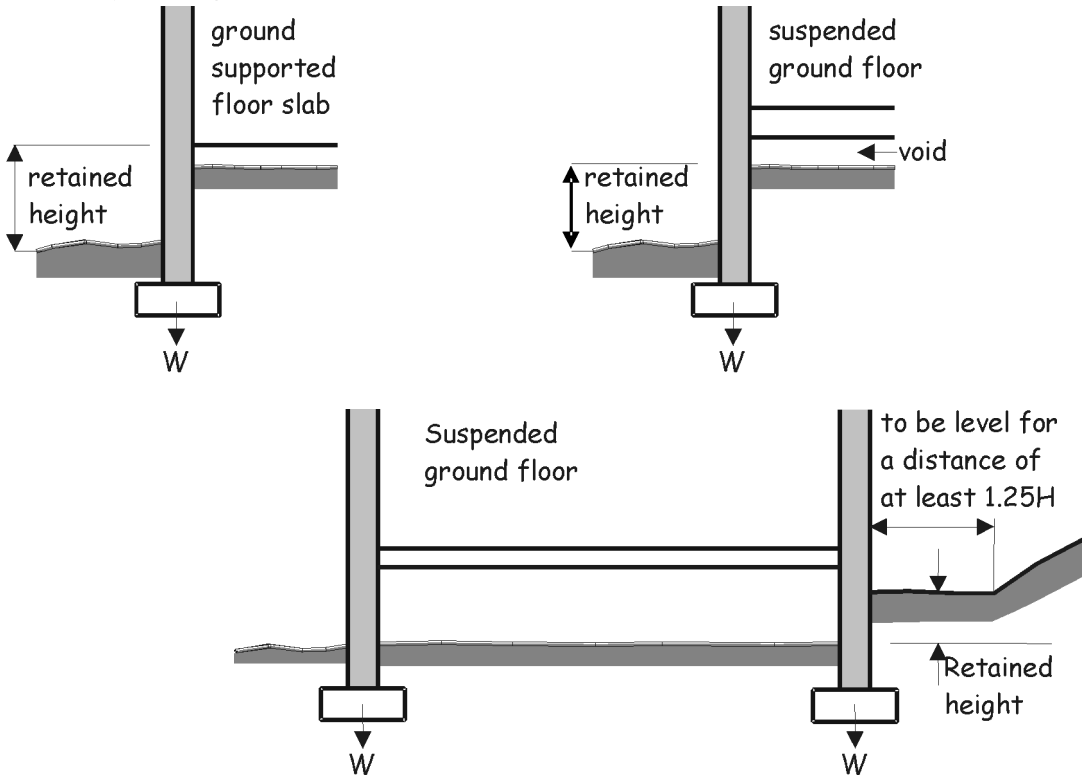
Floor member bearing on joist hanger



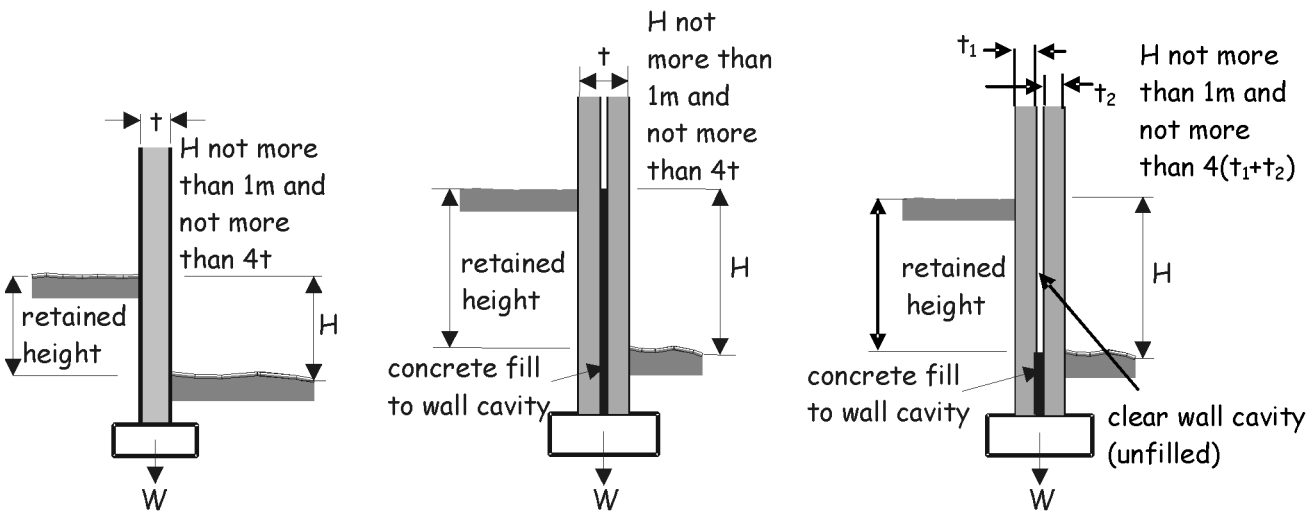
1.D.26 Other loading conditions

- Vertical loading on walls should be assumed for insitu concrete floor slabs, precast concrete floors and timber floors designed in accordance with annex 1.F and where the bearing length for lintels is at least 150 mm;
- Where a lintel has a clear span not more than 1.2 m, the bearing length may be reduced to 100 mm;
- Where lintels carry a concrete floor, the bearing length should be at least 150 mm or $L_s / 10$ whichever is the greater, where L_s is the span of the lintel;
- Differences in level of ground or other solid *construction* between one side of the wall and the other should be not more than four times the thickness of the wall;
- The combined *dead load* and *imposed load* should be not more than 70 kN/m at the base of wall as shown below provided there is a full *storey* height of masonry above the upper retained level.
- Walls should not be subject to lateral load other than from wind and that covered by clause 1.D.26b.

a. Examples of ground level differences



b. maximum differences in ground level



Notes:

1. Floor slabs in diagrams b have been omitted for clarity and may be on either side of the walls shown.
2. Cavity walls should be tied in accordance with the table to clause 1.D.17.
3. These recommendations apply only to circumstances where there is a full storey height of masonry above the upper retained level.

1.D.27 Vertical lateral restraint to walls

The ends of every wall should be bonded or otherwise securely tied throughout their full height to a buttressing wall, pier or chimney. Long walls may be provided with intermediate support dividing the wall into distinct lengths where each distinct length is a supported wall for the purposes of this annex. The buttressing wall, pier or chimney should provide support from the base to the full height of the wall.

1.D.28 Criteria for buttressing walls

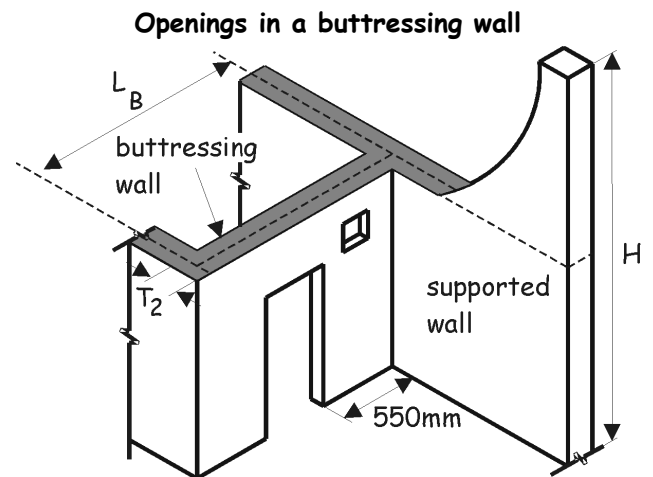
Buttressing walls are external masonry return walls or internal walls perpendicular to the supported wall.

The diagram below gives rules for buttressing walls. Additionally if the buttressing wall is not itself a supported wall, its thickness T_2 should be at least:

- half the thickness required by this annex for an *external wall* or *separating wall* of similar height and length, less 5 mm; or
- 75 mm if the wall forms part of a *dwelling* and is not more than 6 m in total height and 10 m in length; or
- 90 mm in any other case.

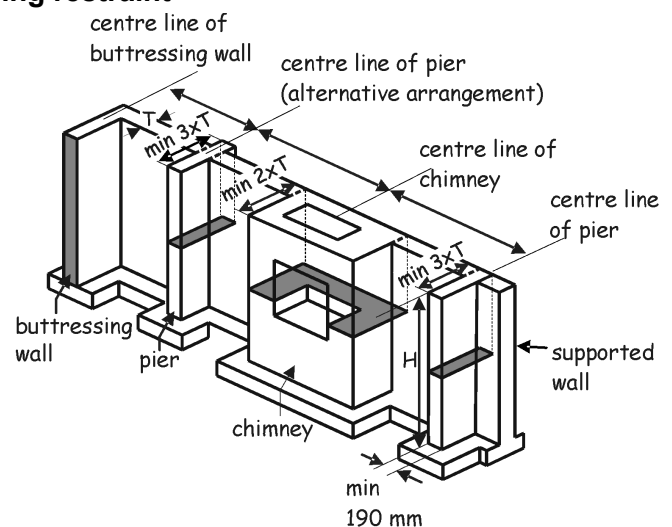
Notes:

- The buttressing wall should be bonded or securely tied to the supported wall and at the other end to a buttressing wall, pier or *chimney*.
- The length, L_B , of the buttressing wall should be at least $1/6$ of the overall height, H , of the supported wall.
- The position and shape of the openings should not impair the lateral support to be given by the buttressing wall.
- Openings or recesses in the buttressing wall more than 0.1 m^2 should be at least 550 mm from the supported wall.
- There may be only one opening or recess not more than 0.1 m^2 at any position within 550 mm of the supported wall.
- The opening height in a buttressing wall should be not more than 0.9 times the floor to ceiling height and the depth of lintel including any masonry over the opening should be not less than 150 mm.
- Refer to diagram to clause 1.D.16 for measuring the height of the supported wall.



1.D.29 Criteria for piers and chimneys providing restraint

- Piers should measure at least 3 times the thickness of the supported wall, and *chimneys* twice the thickness, measured at right angles to the wall. Piers should be at least 190 mm wide as shown opposite;
- The cross-sectional area on plan of *chimneys* (excluding openings for fireplaces) should be at least the area required for a pier in the same wall, and the overall thickness should be at least twice the thickness of the supported wall;
- The buttressing wall, pier or *chimney* should provide support to the full height of the wall from base to top of wall.



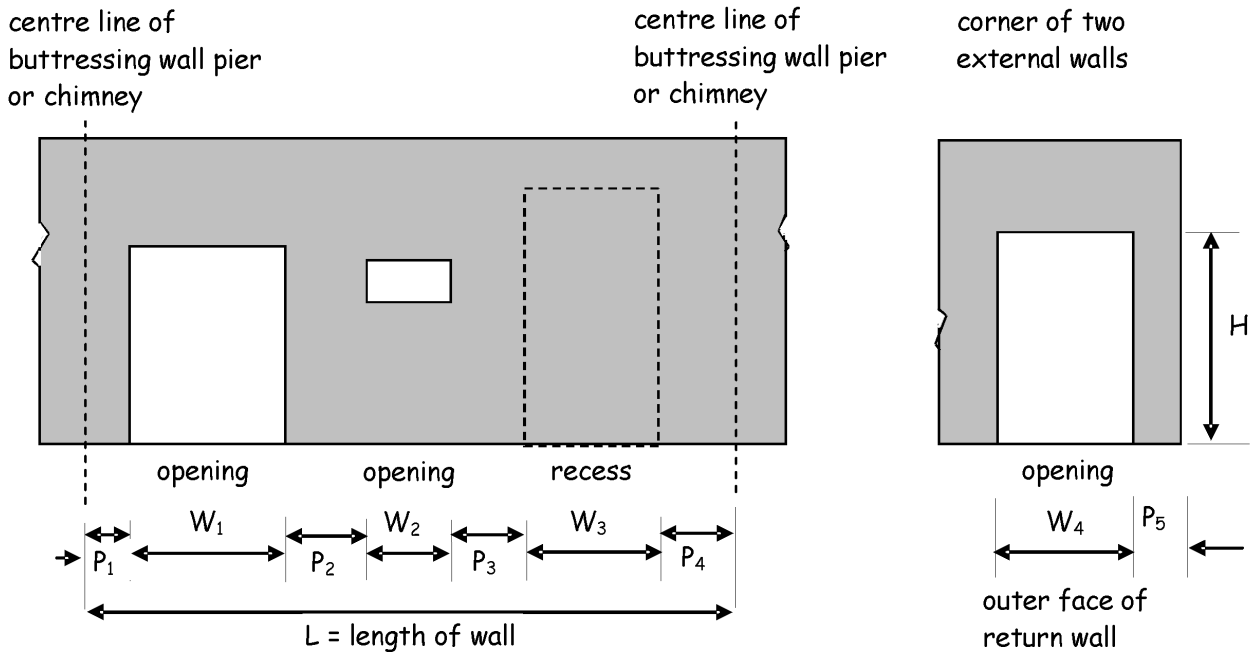
1.D.30 Openings, recesses, chases and overhangs

The number, size and position of openings and recesses should not impair the stability of a wall or the lateral support provided by a buttressing wall to a supported wall. *Construction* over openings and recesses should be supported.

1.D.31 Dimensional criteria

The dimensional criteria are given in the diagram and table below. Openings in walls below ground floor should be limited to small holes for services and ventilation etc. not more than 0.1 m² and at least 2 m apart.

1.D.32 Sizes of openings and recesses



Notes:

- $W_1 + W_2 + W_3$ should be not more than $2L/3$
- None of W_1, W_2 or W_3 should be more than 3 m
- P_1 should be at least W_1/X
- P_2 should be at least $(W_1+W_2)/X$
- P_3 should be at least $(W_2+ W_3)/X$
- P_4 should be at least W_3/X
- P_5 should be at least W_4/X but should be at least 665 mm
- The value of Factor X should be taken from the table below or can be given the value 6, provided the compressive strength of the bricks or blocks (in the case of a cavity wall, in the inner leaf) is not less than 7 N/mm².

Value of factor X

| Nature of roof span | Max roof span (mm) | Min thickness of inner leaf of wall (m) | Nature of floor span | | |
|-----------------------|--------------------|---|----------------------|----------------------------------|----------------------------------|
| | | | Parallel to wall | Perpendicular to wall, max 4.5 m | Perpendicular to wall, max 6.0 m |
| Parallel to wall | Non applicable | 100 | 6 | 6 | 6 |
| | | 90 | 6 | 6 | 6 |
| Perpendicular to wall | 9 | 100 | 6 | 6 | 5 |
| | | 90 | 6 | 4 | 4 |

1.D.33 Chases

Chases should not:

- a. if vertical, be deeper than 1/3 of wall thickness or in cavity walls, 1/3 of leaf thickness;
- b. if horizontal, be deeper than 1/6 of the thickness of the leaf or wall;
- c. be so positioned as to impair the stability of the wall.

Where hollow blocks are used, at least 15 mm thickness of block should be retained.

1.D.34 Overhangs

In *constructing* a corbelled overhang, the amount of any projection should not impair the stability of the wall. Minor overhangs may occur at the interfaces between different masonry materials which have minor differences in thickness provided this does not impair the stability of the wall.

1.D.35 Lateral support by roofs and floors

The walls in each *storey* of a *building* should extend to the full height of that *storey*, and have horizontal lateral supports to restrict movement of the wall at right angles to its plane.

Floors and roofs should:

- a. act to transfer lateral forces from walls to buttressing walls, piers or *chimneys*; and
- b. be secured to the supported wall by connections specified in clauses 1.D.35-36.

The lateral support of walls at roof and floor levels should follow the guidance in the table below and clauses 1.D.35-36.

Lateral support of walls

| Wall type | Wall length | Lateral support required |
|--|---------------|---|
| Solid or cavity: <i>external wall</i> , <i>separating wall</i> or <i>compartment wall</i> | any length | roof lateral support by every roof forming a junction with the supported wall |
| | more than 3 m | floor lateral support by every floor forming a junction with the supported wall |
| Internal load bearing wall (not being a <i>separating wall</i> or <i>compartment wall</i>) | any length | roof or floor lateral support at the top of each <i>storey</i> |

Walls should be strapped to floors above ground level by tension straps as shown below to

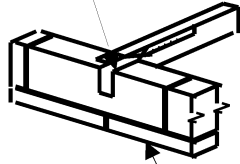
BS EN 845-1: 2003. For corrosion resistance purposes, the tension straps should be material reference 14 or 16.1 or 16.2 (galvanised steel) or other more resistant specifications including material references 1 or 3 (austenitic stainless steel). The declared tensile strength of tension straps should not be less than 8 kN.

The centres of tension straps should be not more than:

- a. 2 m for ground and first floors;
- b. 1.25 m above first floor level.

Tension strap detail 1

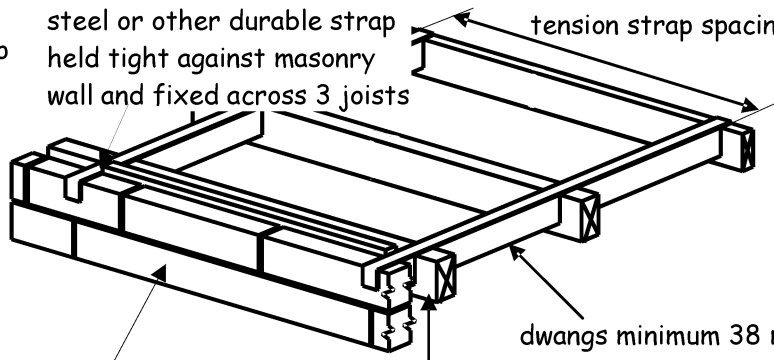
30x5 mm galvanised mild steel or other durable strap at least 1200mm long and held tight against masonry wall



internal leaf of external cavity wall with lateral restraint

Tension strap detail 2

30 x 5 mm galvanised mild steel or other durable strap held tight against masonry wall and fixed across 3 joists



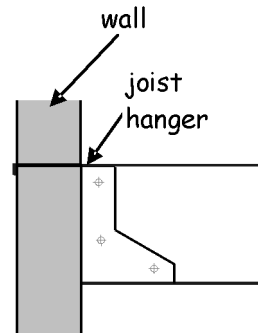
joist blocked to wall

dwangs minimum 38 mm width to extend at least 1/2 depth of joist

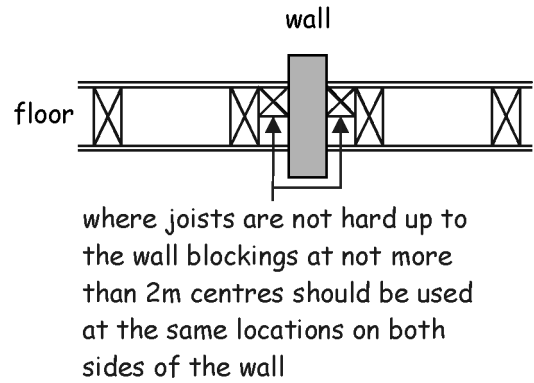
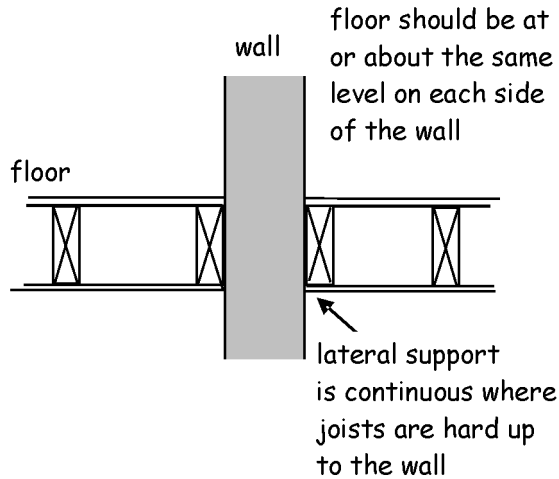
Tension straps need not be provided:

- a. in the longitudinal direction of joists in *domestic buildings* of not more than 2 storeys, if the joists are at not more than 1.2 m centres and have at least 90 mm bearing on the supported walls or 75 mm bearing on a timber wallplate at each end;
- b. in the longitudinal direction of joists in *domestic buildings* of not more than 2 storeys, if the joists are carried on the supported wall by joist hangers in accordance with BS EN 845-1: 2003 of the restraint type described in BS 5628-1: 2005 and shown opposite and are incorporated at not more than 2 m centres;
- c. where floors are at or about the same level on each side of a supported wall and contact between the floors and wall is either continuous or at intervals not more than 2 m. Where contact is intermittent, the points of contact should be in line or nearly in line on plan as shown on the diagrams below.

Restraint type joist hanger



Restraint of internal walls

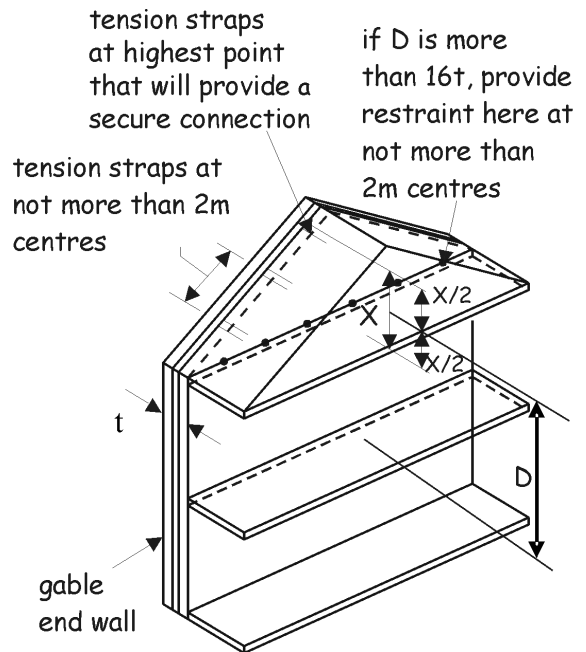


1.D.36 Gable wall strapping

Gable walls should be strapped to roofs by tension straps as shown in the diagram below.

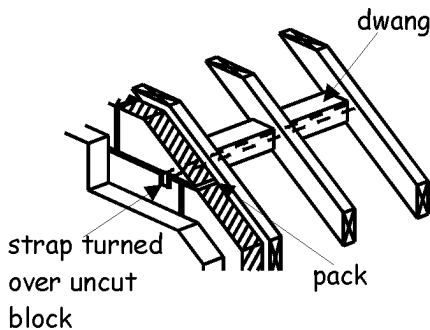
Vertical strapping at least 1 m long should be provided at eaves level at intervals not more than 2 m if the roof:

- a. has a pitch of not more than 15°; and
- b. is not tiled or slated; and
- c. is not of a type known by local experience to be resistant to wind gusts; and
- d. does not have main timber members spanning onto the supported wall at not more than 1.2 m centres.

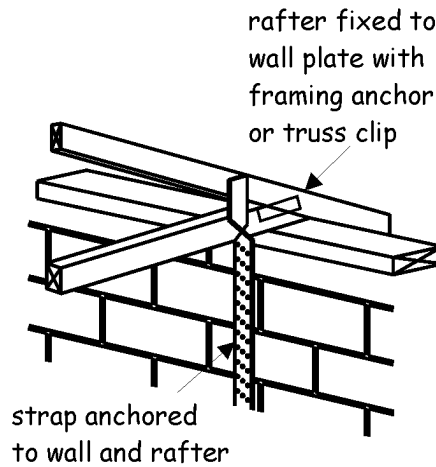


The wall thickness, t = sum of the thicknesses of the leaves + 10 mm.

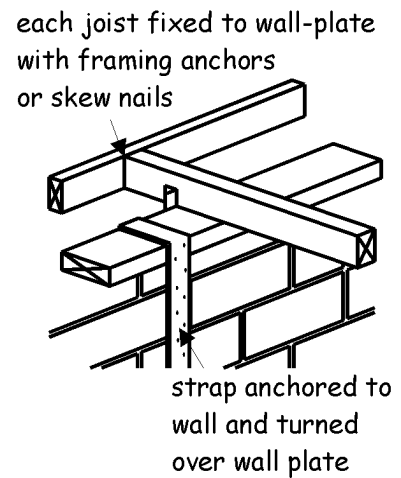
Effective strapping at gable wall



Vertical strapping at eaves of pitched roof



Vertical strapping at eaves of flat roof



1.D.37 Interruption of lateral support

Where a stair or other opening in a floor or roof is alongside a supported wall and interrupts the continuity of lateral support:

- the length of the opening should be not more than 3 m, measured parallel to the supported wall; and
- where a connection is provided by means other than by anchor, this should be provided throughout the length of each portion of the wall situated on each side of the opening; and
- where connection is provided by anchors, these should be spaced at not more than 2 m on each side of the opening to provide the same number of anchors as if there were no opening; and
- there should be no other interruption of lateral support.

1.D.38 Movement in masonry

Max centres of movement joints

| | |
|----------------------------------|---------------|
| Clay brickwork | 12 m centres |
| Calcium silicate brickwork | 7.5 m centres |
| Concrete brickwork and blockwork | 6 m centres |

Reference should be made to BS 8103-2: 2005, Annex B which provides general guidance for movement joints.

1.D.39 Small single storey, single leaf buildings

This guidance applies to the following:

- single storey, single leaf extensions to *domestic buildings* including garages and outbuildings
- single storey, single leaf *buildings* forming a garage or outbuilding within the *curtilage* of a *dwelling*

The guidance is subject to the following limitations:

- the floor area is not more than 36 m²; and
- the walls are solidly *constructed* in brickwork or blockwork using materials which comply with clauses 1.D.17-24; and
- where the floor area is more than 10 m², the walls have a mass of at least 130 kg/m² (Note: There is no surface mass limitation recommended for floor areas of not more than 10 m²); and
- access to the roof is only for the purposes of maintenance and repair; and
- the only lateral loads are *wind loads*; and
- the maximum length or width is not more than 9 m; and.
- the height of the *building* is not more than the dimensional criteria set out in clause 1.D.2c; and
- the height of the extension is not more than the dimensional criteria set out in clause 1.D.2b; and

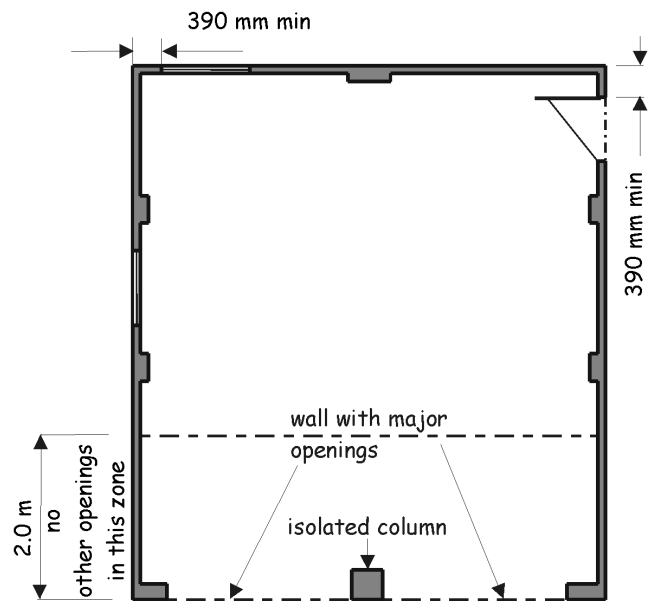
- i. the roof is braced at rafter level, horizontally at eaves level and at the base of any gable by roof decking, rigid sarking or diagonal timber bracing, as appropriate, in accordance with the guidance in BS 5268-3: 2006; and
- j. walls are tied to the roof structure vertically and horizontally in accordance with clauses 1.D.35-37 and with horizontal lateral restraint at roof level in accordance with clause 1.D.42; and
- k. the roof structure of an extension is secured to the structure of the main *building* at both rafter and eaves level.

1.D.40 Size and proportions of openings

Not more than two major openings are permitted in one wall of the *building* or extension where a major opening is defined as not more than 2.1 m in height with a width of not more than 5.0 m for either a single opening or the combined width of two openings.

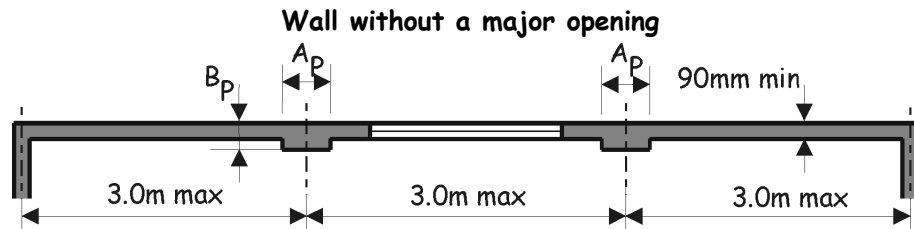
The only other openings permitted in a *building* or extension are for windows and a single leaf door. The size and location of these openings should be in accordance with the diagram opposite and as follows:

- a. there should be no other openings within 2.0 m of a wall containing a major opening; and
- b. the aggregate size of openings in a wall not containing a major opening should be not more than 2.4 m²; and
- c. there should not be more than 1 opening between piers; and
- d. the distance from a window or a door to a corner should be at least 390 mm unless there is a corner pier.

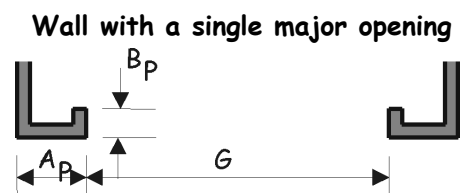


1.D.41 Wall thicknesses and piers

The walls should be at least 90 mm thick. The pier sizes ($A_P \times B_P$) should be at least 390 mm x 190 mm or 327 mm x 215 mm depending on the size of the masonry units. Isolated columns should be at least 325 mm x 325 mm ($C_C \times C_C$). Walls which do not contain a major opening but are more than 2.5 m in length or height should be bonded or tied to piers for their full height at not more than 3 m centres as shown in the diagram below.



Walls which contain 1 or 2 major openings should, in addition, have piers oriented as shown in the diagrams above, opposite and below. Where ties are used to connect piers to walls they should be flat, 20 mm x 3 mm in cross

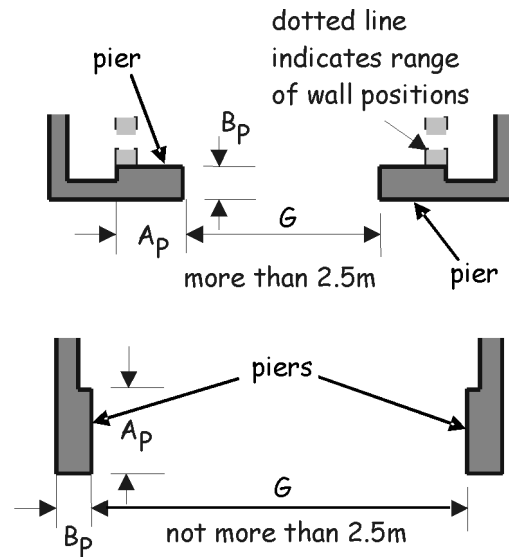


section in accordance with clause 1.D.17, be placed in pairs and be spaced at not more than 300 mm centres vertically.

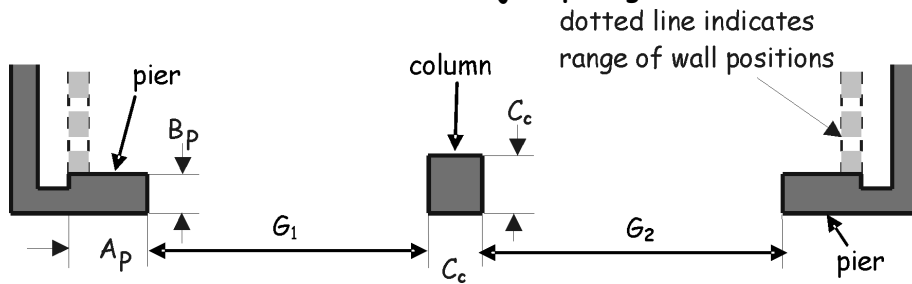
Key

- G Structural opening width
- A_p Pier width
- B_p Pier depth
- C_c Column width and depth

For walls with one or two major openings as shown below :
 G_1 or G_2 or $G_1 + G_2$ should be not more than 5 m.

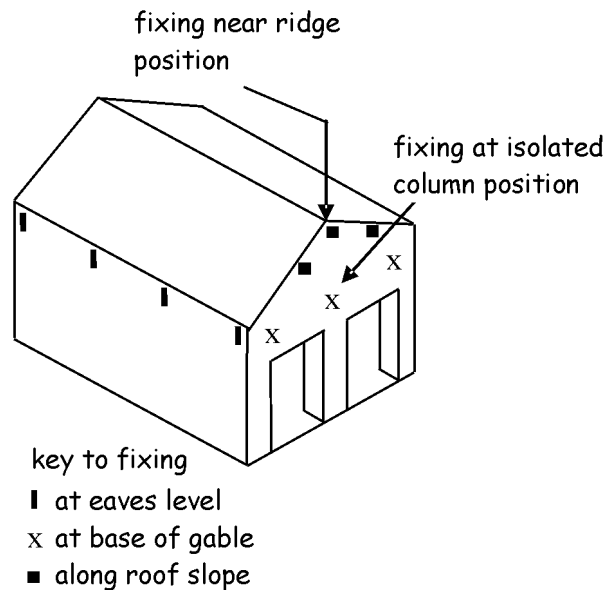


Wall with two major openings



1.D.42 Horizontal lateral restraint at roof level

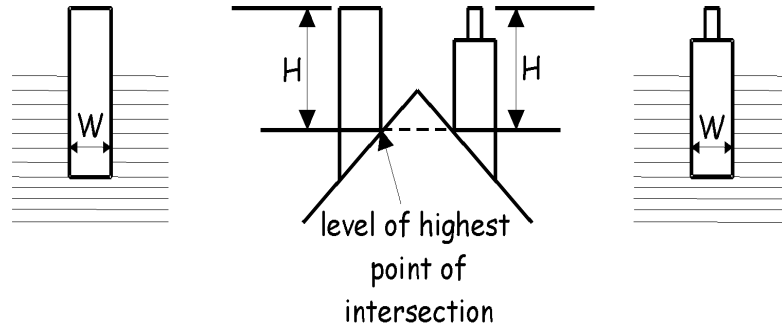
Walls should be tied horizontally to the roof structure at not more than 2 m centres with straps fixed in accordance with clauses 1.D.35-36. Where straps cannot pass through a wall they should be secured to the masonry using fixings and isolated columns should also be tied to the roof structure all as shown.



1.D.43 Proportions for masonry chimneys

Where a *chimney* is not supported by ties or securely restrained, its height, H , should be not more than $4.5 \times W$ where:

- W is the least horizontal dimension of the *chimney* measured at the same point of intersection; and
- H is measured to the top of any *chimney* pot or other *flue* terminal from the highest point of intersection with the roof surface, gutter, etc.;
- the density of the masonry is more than 1500 kg/m^3 .



Annex

1.E Timber frame walls

- 1.E.0 Introduction
- 1.E.1 Explanation of terms
- 1.E.2 Wall types
- 1.E.3 Conditions relating to the building of which the walls forms part
- 1.E.4 Maximum floor area
- 1.E.5 Imposed loads on roofs, floors and ceilings
- 1.E.6 Wall structure
- 1.E.7 Minimum thicknesses of external cavity walls
- 1.E.8 Walls providing vertical support to other walls
- 1.E.9 Timber frame wall sizing
- 1.E.10 Wall sheathing
- 1.E.11 Building data
- 1.E.12 Length/width ratio
- 1.E.13 Site data
- 1.E.14 Altitude/distance category
- 1.E.15 Racking loads
- 1.E.16 Masonry cladding arrangement
- 1.E.17 Percentage openings in racking
- 1.E.18 Panel sheathing and nailing
- 1.E.19 Use of internal walls for additional racking resistance
- 1.E.20 Wind loads
- 1.E.21 Vertical loads
- 1.E.22 Wall stud sizing
- 1.E.23 Cripple stud sizing
- 1.E.24 Lintel sizing
- 1.E.25 Example
- 1.E.26 Maximum allowable length of wall and building height
- 1.E.27 Rules of measurement for storeys, walls, panels and heights
- 1.E.28 Construction materials
- 1.E.29 Wall ties
- 1.E.30 Masonry Cladding
- 1.E.31 Brick and block construction
- 1.E.32 Mortar
- 1.E.33 Lintels for masonry cladding
- 1.E.34 Timber members
- 1.E.35 Wall sheathing
- 1.E.36 Fasteners
- 1.E.37 Fabrication
- 1.E.38 Composite action
- 1.E.39 Wall panel connections
- 1.E.40 Nailing and fixing schedule
- 1.E.41 Maximum span of floors
- 1.E.42 Other loading conditions
- 1.E.43 End restraint

- 1.E.44 Openings, notching and drilling
- 1.E.45 Framing of openings
- 1.E.46 Dimensional criteria for openings
- 1.E.47 Small unframed openings
- 1.E.48 Notching & drilling
- 1.E.49 Lateral support by roofs and floors
- 1.E.50 Differential movement

1.E.0 Introduction

Small timber frame *buildings* can be designed to take into account loading conditions, limitations on dimensions, openings, subject to restraint conditions.

The guidance for timber frame *construction* has been produced for use by those who have expertise in *building* design and *construction* but not necessarily in structural engineering design. Where the conditions or parameters fall outside the scope then specialist advice should be sought from chartered engineers or other appropriately qualified persons.

This guidance is based on the platform frame method of timber frame *construction* with external masonry cladding being the most common form of timber frame *construction* in Scotland. This consists of full height timber wall panels for each *storey* built on to the floor below with intermediate floors built on top of the wall panels. The roof is *constructed* on top of the top *storey* wall panels with the masonry cladding connected to the timber panels by wall ties.

It should be noted that the guidance within this annex only relates to section 1: Structure. There are other factors such as *cavity barriers*, breather membranes, thermal insulation, etc. which may be relevant and reference should be made to the Technical Handbooks.

This annex provides guidance for timber frame wall *construction* for *domestic buildings* of not more than 2 *storeys* where loading criteria for individual floors does not exceed those given in clause 1.E.5 and the total limit of loading does not exceed that given in clause 1.E.42.

There is guidance in annex 1.D: masonry walls which is relevant to this annex with respect to masonry cladding to timber frame walls.

1.E.1 Explanation of terms

The following terms are used in addition to the definitions and explanations in Appendix A of the Technical Handbooks

Composite action means where a timber frame wall acts together with other materials such as masonry cladding, sheathing or lining.

Cripple stud means the vertical member in a timber framed partition or wall which supports a lintel.

Racking resistance means the ability of a partition or wall panel to resist *wind loads* in the plane of the panel.

Timber frame wall means a wall *constructed* of timber studs acting as framing members, bracing and wall sheathing.

Wall sheathing means a manufactured sheet which is used to provide the wall panel stiffness to resist *wind loads*.

1.E.2 Wall types

This annex only provides guidance for the types of wall extending to full *storey* height for *domestic buildings* restricted to *houses* of not more than 2 *storeys* as follows:

- *external walls*
- internal load bearing walls
- *separating walls*

This annex should be used in conjunction with annexe 1.B; and

- a. if a timber wall structure is designed in accordance with the guidance in annex 1.E, all the design conditions in this annex should be satisfied;
- b. walls should comply with the relevant recommendations of BS 5268-6.1: 1996, except regarding the conditions given in this annex ;
- c. *buildings* should be rectangular or square shape in plan;
- d. in formulating the guidance of this annex, the worst combination of circumstances likely to arise was taken into account;
- e. if a recommendation of this annex is considered too onerous in a particular case then adequacy by calculation should be shown in respect of the aspect of the wall which is subject to the departure

- rather than for the entire wall;
- f. the guidance given in this annex is based upon the material strengths of timber, sheathing, plasterboard and masonry being not less than that indicated in clauses 1.E.28-40;
 - g. roof *construction* should be:
 - duo or mono pitch trussed rafters with 15-45 ° pitch and *dead load* not more than 1.04 kN/m² on the slope;
 - or *flat roofs* , raised tie or collared roofs in accordance with guidance in annex 1.F.
 - h. floor *dead load* should be not more than 0.5 kN/m²;
 - i. internal, party and *external wall dead loads* should be not more than 1.5 kN/m excluding masonry cladding;
 - j. panel heights should be not more than 2.7 m;
 - k. timber frame walls should act compositely with the masonry cladding, sheathing and inner plasterboard lining all contributing to the racking resistance.

The scope of this annex excludes *buildings* with point loads (e.g. from hipped ends to roofs with girder trusses and other types of cladding such as timber).

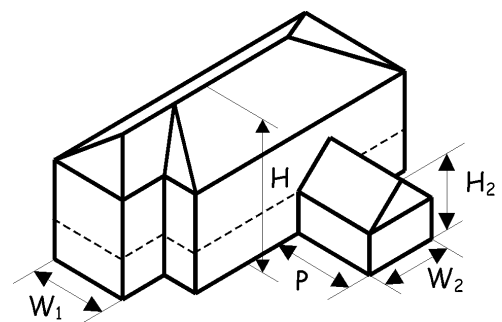
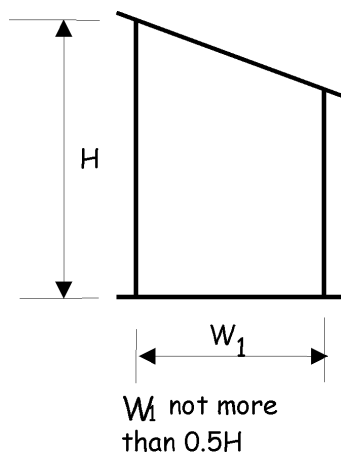
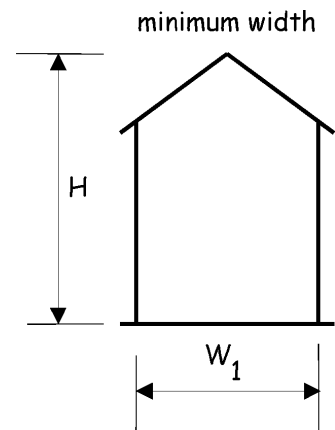
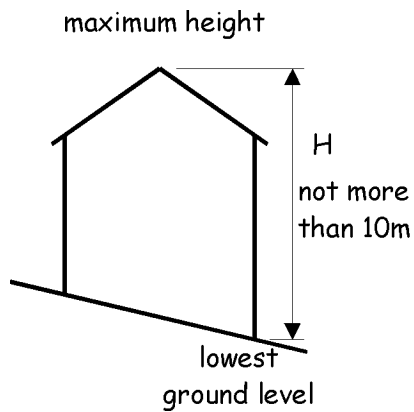
Where point loads onto walls are required, specialist advice should be sought from chartered engineers or other appropriately qualified persons.

Wall sheathing which provides the racking resistance to *wind loading* generally is the limiting factor and this aspect should be checked prior to carrying out the remainder of the design. It is unlikely that this guidance could be used with walls with openings more than 30% of the total wall area or for front gable *buildings* where there are large openings in the shorter length walls.

1.E.3 Conditions relating to the building of which the walls forms part

This annex applies only to *buildings* having proportions within the following limits and as shown on the diagrams below, subject to the limits of clause 1.E.26:

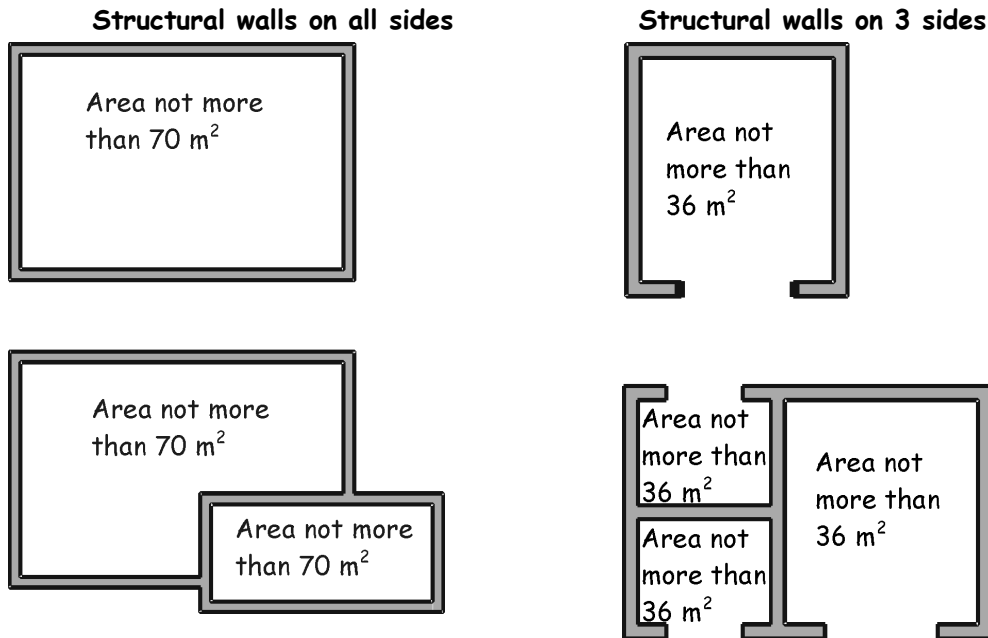
- a. the maximum height, H , of the *building* measured from the lowest finished ground level adjoining the *building* to the highest point of any wall or roof must not be more than:
 - 10 m for duo pitch roofs ;
 - 5.5 m for mono pitch or *flat roofs*.
- b. the height of the *building*, H , should not be more than twice the least width of the *building*, W_1 ;
- c. the height of the wing, H_2 , should not be more than twice the least width of the wing, W_2 , when the projection, P , is more than twice the width, W_2 .



1.E.4 Maximum floor area

The guidance in this annex applies where:

- the areas of floors enclosed by structural walls on all sides are not more than 70 m² ;
- the areas of floors without a structural wall on one side are not more than 36 m² ;
- the openings are not more than set out in clause 1.E.17;
- the number of areas of floors as above which can be connected together should be not more than 4.



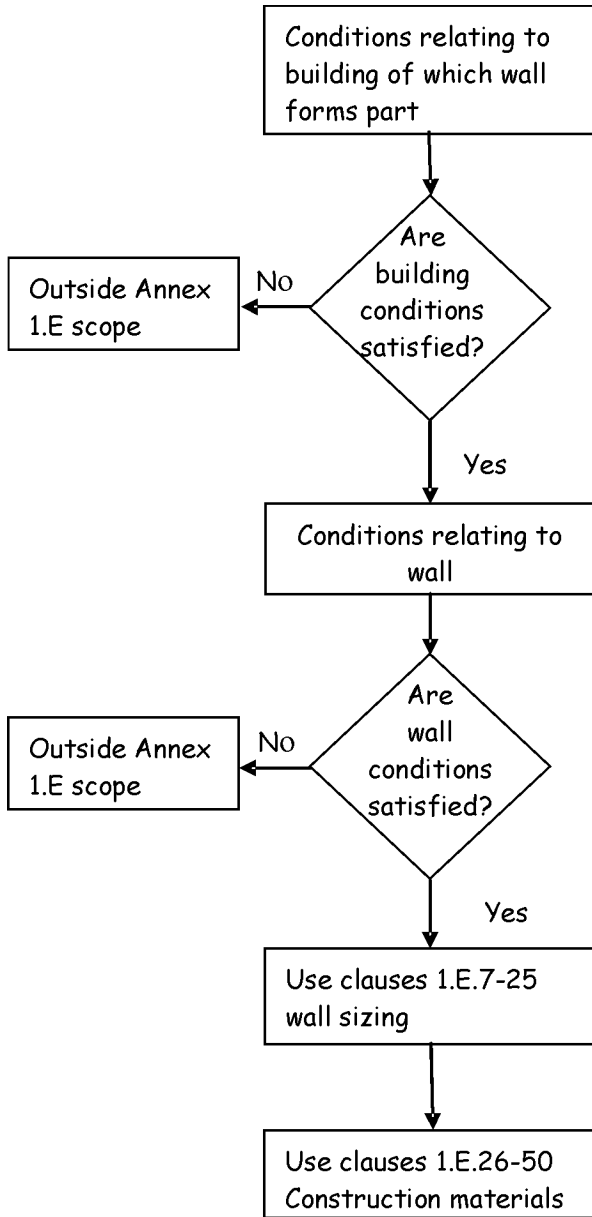
1.E.5 Imposed loads on roofs, floors and ceilings

The *imposed loads* on roofs, floors and ceilings should not exceed those given in the table below.

| Element | Loading | |
|----------|------------------|---|
| Roof | distributed load | 1.00 kN/m ² for spans up to 12 m 1.50 kN/m ² for spans up to 6 m |
| Floors | distributed load | 2.00 kN/m ² together with a concentrated load of 1.4 kN |
| Ceilings | distributed load | 0.25 kN/m ² together with concentrated load of 0.9 kN |

1.E.6 Wall structure

Wall structure should be determined according to this annex provided the following conditions are met:



Building Conditions

limitations on size and proportions of *building* (clause 1.E.3);
max allowable floor areas (clause 1.E.4);
max *imposed loads* and *wind loads* (clause 1.E.13).

Wall Conditions

max allowable length and height of wall (clause 1.E.26);
construction materials (clauses 1.E.28-40);
loading on walls (clauses 1.E.41-42);
end restraints (clause 1.E.43);
openings, notching and drilling (clauses 1.E.44-48);
lateral support by floors and roofs (clause 1.E.49);
differential movement (clause 1.E.50).

1.E.7 Minimum thicknesses of external cavity walls

Masonry clad, timber frame walls should comprise masonry cladding at least 100 mm thick, 50 mm nominal cavity width, 9 mm nominal sheathing thickness and timber studs at least 89 mm depth and inner wall lining. Wall ties should be nailed to the vertical studs and not to the sheathing at the following centres:

- a. brickwork cladding: horizontal centres of 600 mm and vertical centres of 375 mm;
- b. blockwork cladding: horizontal centres of 400 or 600 mm and vertical centres of 450 mm;
- c. wall ties should also be provided, at not more than 300 mm centres vertically, within a distance of 225 mm from the vertical edges of all openings, movement joints and roof verges;
- d. in exposed wind locations, the tie density would require to be increased in accordance with BS 5268-6.1: 1996;
- e. for cavity wall ties refer to clause 1.E.29.

1.E.8 Walls providing vertical support to other walls

Irrespective of the materials used, a wall should not be less in thickness than any part of the wall to which it gives vertical support.

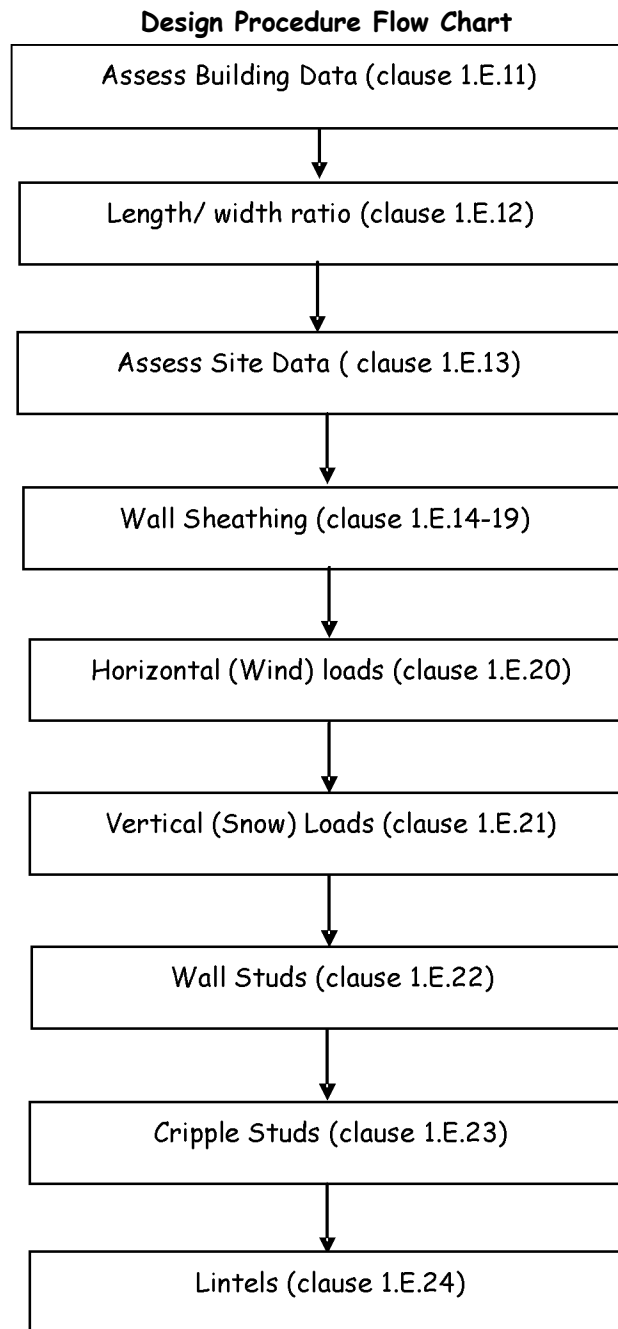
1.E.9 Timber frame wall sizing

Timber frame walls consist of vertical timber studs nailed to bottom and top rails to which plywood or OSB sheathing is nailed. Wall panels are nailed to each other, to floors below and above and the roof. Plasterboard is nailed or screwed to the studs as the internal wall lining. Openings for doors and windows are formed by additional vertical cripple studs at the open edges supporting timber lintels.

The timber frame walls are the load bearing parts of the walls and the individual parts act as follows:

- sheathing resists the *wind loads* which act on the walls facing the wind while the walls at right angles support these walls by means of the racking resistance of the sheathing (called racking or wind walls);
- walls studs support the vertical loads (snow, floor loads and self weight of the roof, floors and upper timber floors) and *wind loads*;
- cripple studs and lintels frame openings carrying the loads to the floor below;
- floors and roofs support the walls horizontally top and bottom;
- walls, roofs and floors act compositely as a robust 3 dimensional structural box giving overall stability to the *building*;
- masonry cladding provides secondary support to the sheathing;
- internal walls can give additional racking resistance provided they are sheathed in plywood or OSB rather than plasterboard.

The procedure which should be followed to determine the member sizing for timber frame wall *construction* is summarised in the flow chart opposite and explained in detail thereafter together with a worked example in clause 1.E.25.

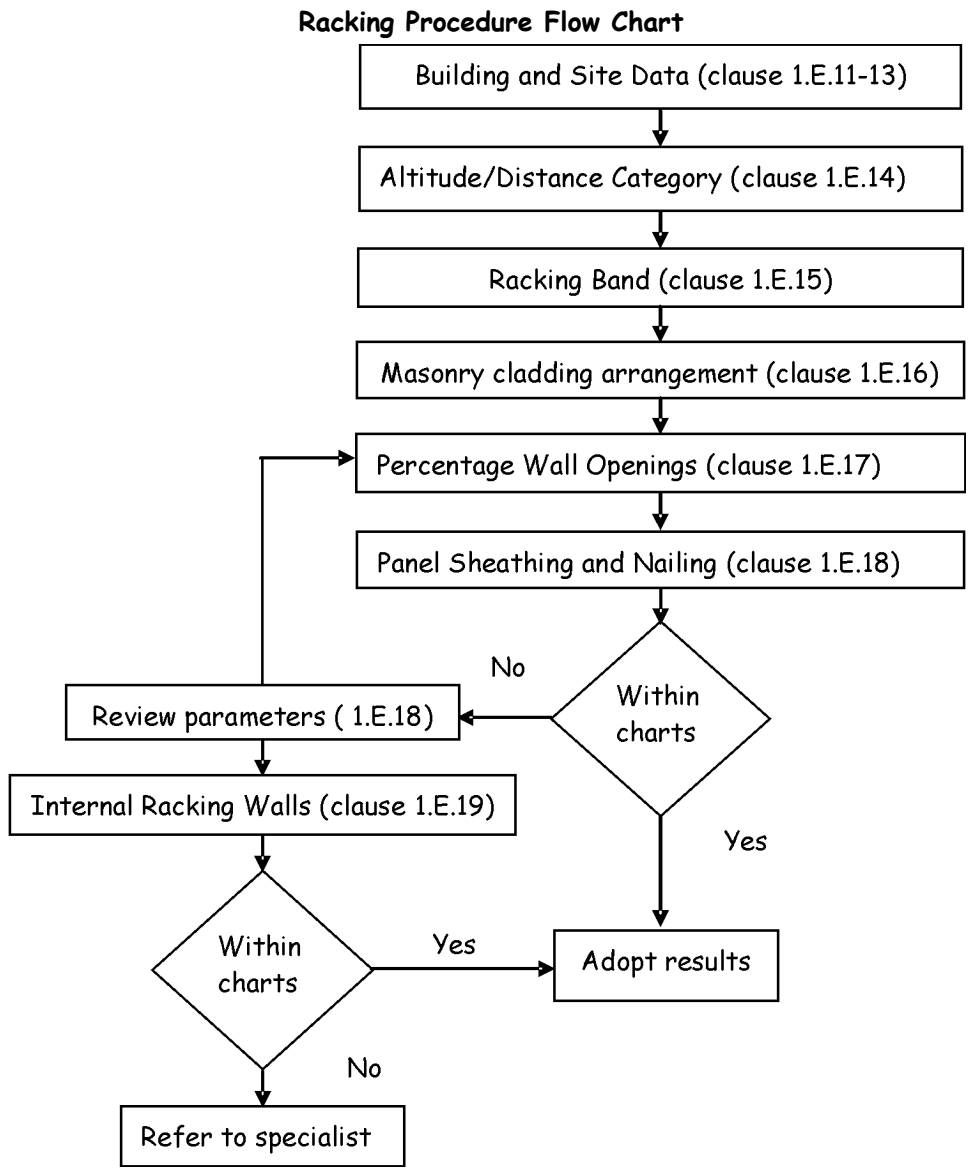


1.E.10 Wall sheathing

The *wind loads* are resisted and transferred to the base of the walls by the racking resistance of the racking (or wind) wall panels. This is achieved by the sheathing to the *external wall* panels although internal walls can also be used in certain circumstances.

Walls should only be considered to be racking walls and hence able to provide resistance to *wind loads* if they are designed in accordance with the following racking procedure and have at least one layer of plywood sheathing or OSB secured to the timber studs.

The flow chart below and the clauses referenced provide guidance on how to provide racking resistance.

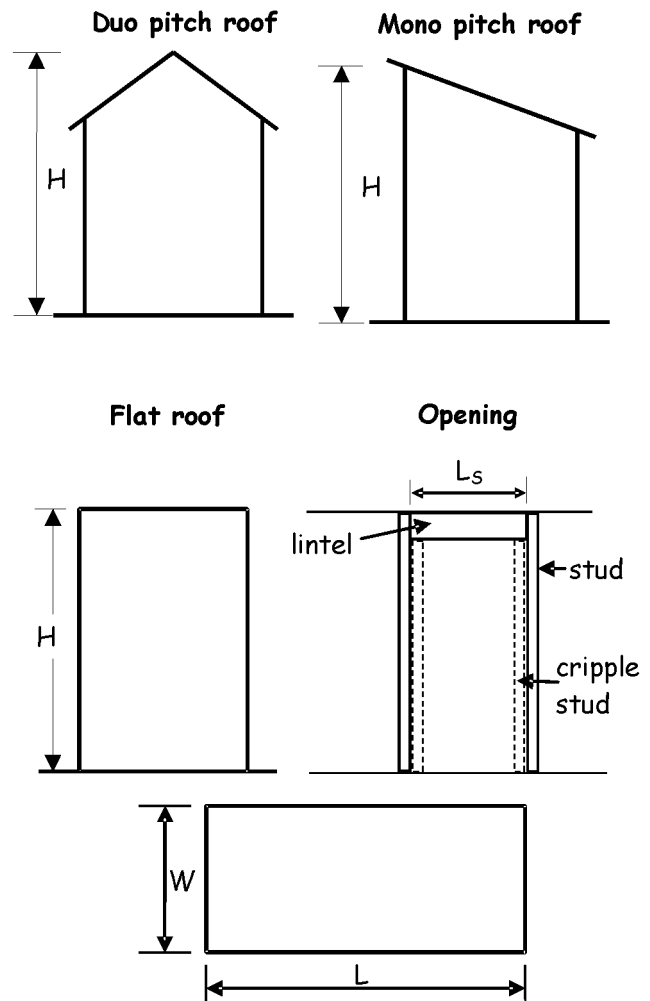


1.E.11 Building data

Establish the following dimensions for the *building*:

- overall outside plan width of the *building*, W ;
- overall outside plan length of the *building*, L ;
- overall *building* height from ground level to ridge, H ;
- panel height from underside of bottom rail to top of top rail, H ;
- number of *storeys*;
- roof shape: duopitch, monopitch or flat;
- spans of roof and floors;
- lintel clear span, L_s .

Building dimension



Note that the height should be measured from the lowest finished ground level adjoining the *building* to the highest point of any wall or roof.

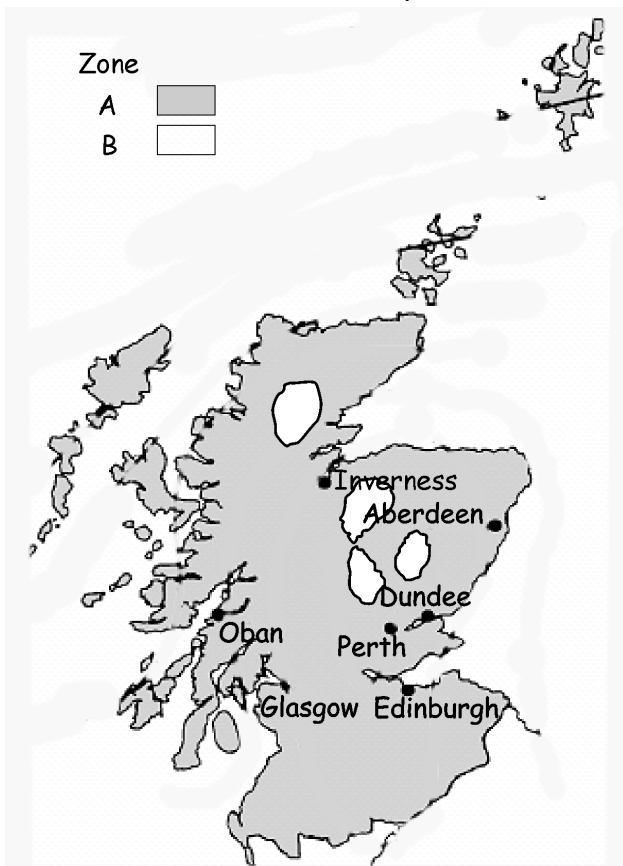
1.E.12 Length/width ratio

Determine the length/width ratio of the *building* plan area, $\beta=L/W$, where β should always be rounded up from the derived value to the nearest 0.5 and should not be less than 1.0. It is best practice to keep β as close to 1.0 as possible.

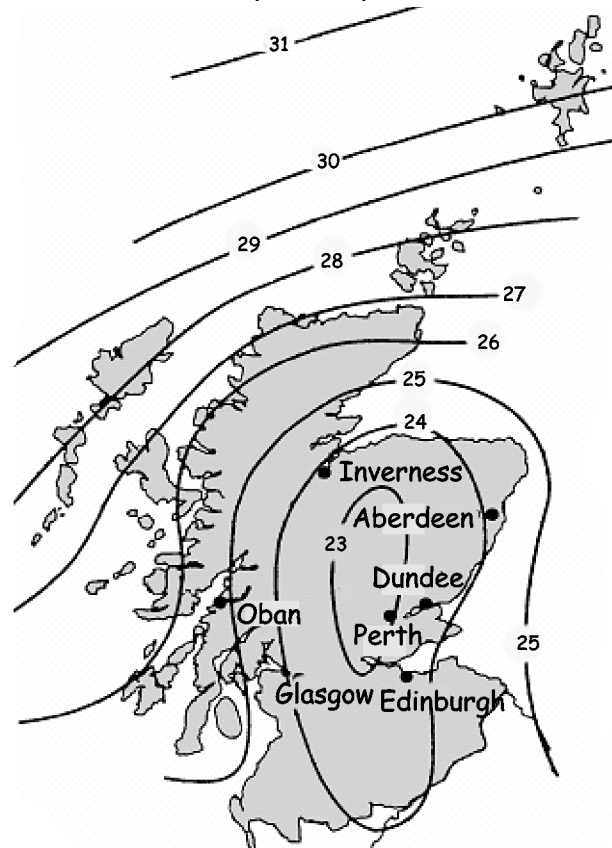
1.E.13 Site data

- determine the *site* location of the *building*;
- establish the distance of the *site* to the coast . (Where a *site* is nearer than 1 km to an inland area of water which extends more than 1 km in the wind direction, the distance to the coast should be taken as from the edge of the water);
- establish the altitude of the *site* above ordinance datum;
- establish the snow zone as A or B from the snow map below;
- establish the wind speed from the wind speed map below.

Snow zone map



Wind speed map (m/sec)



1.E.14 Altitude/distance category

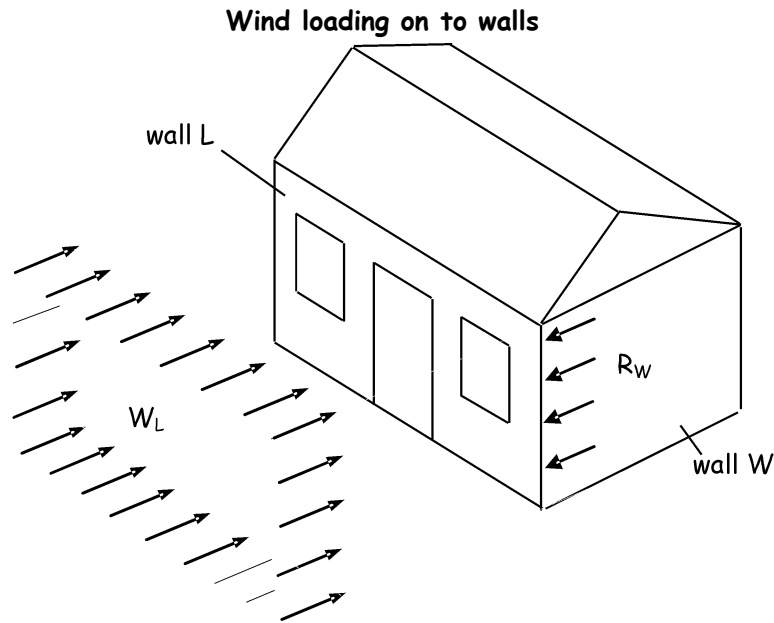
Using the *site* altitude and distance to the coast, read the altitude/distance category (AD1-AD6) from the table opposite.

Table Altitude/distance category

| Altitude (m) | Distance to the coast (km) | |
|--------------|----------------------------|-------|
| | ≤ 10 | ≤ 100 |
| 0 | AD1 | AD1 |
| ≤ 50 | AD1 | AD1 |
| ≤ 100 | AD2 | AD2 |
| ≤ 150 | AD3 | AD3 |
| ≤ 200 | AD4 | AD3 |
| ≤ 300 | AD5 | AD5 |
| ≤ 400 | AD6 | AD6 |

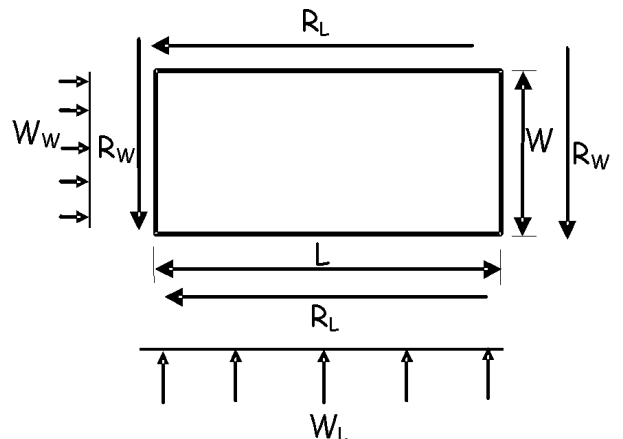
1.E.15 Racking loads

The *wind load* on an *external wall* is supported by the racking resistance of the *external walls* perpendicular to that wall. The racking resistance of the perpendicular walls are 50% of the *wind load* as shown in the diagrams below.



Key

- W_L : wind load on to long wall, L
- W_w wind load on to short wall, W
- :
- R_w racking resistance from wall W, supporting 50% of the total wind load, W_L , on wall L
- R_L racking resistance from wall L supporting 50% of the total wind load, W_w , on wall W



The racking resistance, R, which each wall should provide should be read from the following tables using the information derived above:

- overall *building* height from ground level to ridge, H;
- roof shape from clause 1.E.11;
- length/width ratio, β from clause 1.E.12;
- wind speed from clause 1.E.13;
- altitude/ distance category, AD, from clause 1.E.14.

Tables 1-4 provide racking resistance for duo pitch roofed *buildings* for overall heights, H of 5.5 and 10 m for wind speeds of 23-30 m/sec;

Tables 5-8 provide racking resistance for mono pitch roofed *buildings* for overall heights, H of 5.5 m for wind speeds of 23-30 m/sec;

Tables 9-12 provide racking resistance for *flat roofed buildings* for overall heights, H of 5.5 m for wind speeds of 23-30 m/sec.

Racking resistance for duo pitch roofs

Table 1 Wind speed = 23 m/sec

| β | Side | H = 5.5 m | | | | | | H = 10.0 m | | | | | |
|---------|------|---------------------------------|-----|-----|-----|-----|-----|---------------------------------|-----|-----|-----|-----|-----|
| | | Altitude/distance category (AD) | | | | | | Altitude/distance category (AD) | | | | | |
| | | AD1 | AD2 | AD3 | AD4 | AD5 | AD6 | AD1 | AD2 | AD3 | AD4 | AD5 | AD6 |
| 1.0 | W | R1 | R2 | R2 | R2 | R2 | R2 | R3 | R3 | R4 | R5 | R6 | R7 |
| | L | R1 | R1 | R2 | R2 | R2 | R2 | R4 | R4 | R5 | R5 | R6 | R7 |
| 1.5 | W | R3 | R3 | R4 | R4 | R5 | R5 | R8 | R9 | R9 | R11 | R11 | x |
| | L | R1 | R1 | R1 | R1 | R1 | R2 | R3 | R3 | R3 | R4 | R4 | x |
| 2.0 | W | R4 | R5 | R5 | R6 | R7 | R7 | R11 | R11 | x | x | x | x |
| | L | R1 | R1 | R1 | R1 | R1 | R1 | R2 | R2 | x | x | x | x |
| 2.5 | W | R5 | R6 | R6 | R7 | R8 | R9 | x | x | x | x | x | x |
| | L | R1 | R1 | R1 | R1 | R1 | R1 | x | x | x | x | x | x |
| 3.0 | W | R6 | R7 | R7 | R8 | R9 | R11 | x | x | x | x | x | x |
| | L | R1 | R1 | R1 | R1 | R1 | R1 | x | x | x | x | x | x |
| 3.5 | W | R7 | R7 | R8 | R9 | R11 | R11 | x | x | x | x | x | x |
| | L | R1 | R1 | R1 | R1 | R1 | R1 | x | x | x | x | x | x |

Table 2 Wind speed = 25 m/sec

| β | Side | H = 5.5 m | | | | | | H = 10.0 m | | | | | |
|---------|------|---------------------------------|-----|-----|-----|-----|-----|---------------------------------|-----|-----|-----|-----|-----|
| | | Altitude/distance category (AD) | | | | | | Altitude/distance category (AD) | | | | | |
| | | AD1 | AD2 | AD3 | AD4 | AD5 | AD6 | AD1 | AD2 | AD3 | AD4 | AD5 | AD6 |
| 1.0 | W | R2 | R2 | R2 | R2 | R3 | R3 | R4 | R4 | R5 | R6 | R7 | R9 |
| | L | R2 | R2 | R2 | R2 | R3 | R3 | R5 | R5 | R6 | R7 | R7 | R8 |
| 1.5 | W | R4 | R4 | R5 | R5 | R6 | R7 | R11 | R11 | R11 | x | x | x |
| | L | R1 | R1 | R1 | R2 | R2 | R2 | R3 | R4 | R4 | x | x | x |
| 2.0 | W | R5 | R6 | R7 | R7 | R8 | R9 | x | x | x | x | x | x |
| | L | R1 | R1 | R1 | R1 | R1 | R1 | x | x | x | x | x | x |
| 2.5 | W | R7 | R7 | R8 | R9 | R11 | R11 | x | x | x | x | x | x |
| | L | R1 | R1 | R1 | R1 | R1 | R1 | x | x | x | x | x | x |
| 3.0 | W | R8 | R8 | R9 | R11 | R11 | R11 | x | x | x | x | x | x |
| | L | R1 | R1 | R1 | R1 | R1 | R1 | x | x | x | x | x | x |
| 3.5 | W | R8 | R9 | R11 | R11 | R11 | x | x | x | x | x | x | x |
| | L | R1 | R1 | R1 | R1 | R1 | x | x | x | x | x | x | x |

Racking resistance for duo pitch roofs

Table 3 Wind speed = 27 m/sec

| β | Side | H = 5.5 m | | | | | | H = 10.0 m | | | | | |
|---------|------|---------------------------------|-----|-----|-----|-----|-----|---------------------------------|-----|-----|-----|-----|-----|
| | | Altitude/distance category (AD) | | | | | | Altitude/distance category (AD) | | | | | |
| | | AD1 | AD2 | AD3 | AD4 | AD5 | AD6 | AD1 | AD2 | AD3 | AD4 | AD5 | AD6 |
| 1.0 | W | R2 | R2 | R3 | R3 | R3 | R4 | R4 | R5 | R6 | R7 | R9 | R11 |
| | L | R2 | R2 | R2 | R3 | R3 | R3 | R6 | R6 | R7 | R8 | R9 | R11 |
| 1.5 | W | R5 | R5 | R6 | R6 | R7 | R8 | R11 | R11 | x | x | x | x |
| | L | R1 | R2 | R2 | R2 | R2 | R2 | R4 | R5 | x | x | x | x |
| 2.0 | W | R7 | R7 | R8 | R9 | R11 | R11 | x | x | x | x | x | x |
| | L | R1 | R1 | R1 | R1 | R2 | R2 | x | x | x | x | x | x |
| 2.5 | W | R8 | R9 | R11 | R11 | R11 | x | x | x | x | x | x | x |
| | L | R1 | R1 | R1 | R1 | R1 | x | x | x | x | x | x | x |
| 3.0 | W | R9 | R11 | R11 | R11 | x | x | x | x | x | x | x | x |
| | L | R1 | R1 | R1 | R1 | x | x | x | x | x | x | x | x |
| 3.5 | W | R11 | R11 | R11 | x | x | x | x | x | x | x | x | x |
| | L | R1 | R1 | R1 | x | x | x | x | x | x | x | x | x |

Table 4 Wind speed = 30 m/sec

| β | Side | H = 5.5 m | | | | | | H = 10.0 m | | | | | |
|---------|------|---------------------------------|-----|-----|-----|-----|-----|---------------------------------|-----|-----|-----|-----|-----|
| | | Altitude/distance category (AD) | | | | | | Altitude/distance category (AD) | | | | | |
| | | AD1 | AD2 | AD3 | AD4 | AD5 | AD6 | AD1 | AD2 | AD3 | AD4 | AD5 | AD6 |
| 1.0 | W | R3 | R3 | R3 | R4 | R4 | R5 | R5 | R6 | R8 | R9 | R11 | x |
| | L | R3 | R3 | R3 | R3 | R4 | R4 | R7 | R8 | R9 | R11 | R11 | x |
| 1.5 | W | R6 | R6 | R7 | R8 | R9 | R11 | x | x | x | x | x | x |
| | L | R2 | R2 | R2 | R3 | R3 | R3 | x | x | x | x | x | x |
| 2.0 | W | R8 | R9 | R11 | R11 | R11 | x | x | x | x | x | x | x |
| | L | R1 | R1 | R2 | R2 | R2 | x | x | x | x | x | x | x |
| 2.5 | W | R11 | R11 | R11 | x | x | x | x | x | x | x | x | x |
| | L | R1 | R1 | R1 | x | x | x | x | x | x | x | x | x |
| 3.0 | W | R11 | R11 | x | x | x | x | x | x | x | x | x | x |
| | L | R1 | R1 | x | x | x | x | x | x | x | x | x | x |
| 3.5 | W | R11 | x | x | x | x | x | x | x | x | x | x | x |
| | L | R1 | x | x | x | x | x | x | x | x | x | x | x |

Racking resistance for monopitch roofs

Table 5 Wind Speed = 23 m/sec

Table 6 Wind Speed = 25 m/sec

| β | Side | H = 5.5 m | | | | | | H = 5.5 m | | | | | |
|---------|------|---------------------------------|-----|-----|-----|-----|-----|---------------------------------|-----|-----|-----|-----|-----|
| | | Altitude/distance category (AD) | | | | | | Altitude/distance category (AD) | | | | | |
| | | AD1 | AD2 | AD3 | AD4 | AD5 | AD6 | AD1 | AD2 | AD3 | AD4 | AD5 | AD6 |
| 1.0 | W | R3 | R3 | R3 | R4 | R4 | R5 | R3 | R4 | R4 | R5 | R5 | R6 |
| | L | R1 | R1 | R2 | R2 | R2 | R2 | R2 | R2 | R2 | R2 | R3 | R3 |
| 1.5 | W | R5 | R6 | R6 | R7 | R8 | R9 | R7 | R7 | R8 | R9 | R10 | R11 |
| | L | R1 | R1 | R1 | R1 | R1 | R2 | R1 | R1 | R1 | R2 | R2 | R2 |
| 2.0 | W | R7 | R8 | R9 | R10 | R11 | R11 | R9 | R10 | R11 | R11 | x | x |
| | L | R1 | R1 | R1 | R1 | R1 | R1 | R1 | R1 | R1 | R1 | x | x |
| 2.5 | W | R9 | R9 | R10 | R11 | x | x | R11 | R11 | x | x | x | x |
| | L | R1 | R1 | R1 | R1 | x | x | R1 | R1 | x | x | x | x |
| 3.0 | W | R10 | R11 | R11 | x | x | x | R11 | x | x | x | x | x |
| | L | R1 | R1 | R1 | x | x | x | R1 | x | x | x | x | x |
| 3.5 | W | R11 | R11 | x | x | x | x | x | x | x | x | x | x |
| | L | R1 | R1 | x | x | x | x | x | x | x | x | x | x |

Table 7 Wind Speed = 27m/sec

Table 8 Wind Speed = 30 m/sec

| β | Side | H = 5.5 m | | | | | | H = 5.5 m | | | | | |
|---------|------|---------------------------------|-----|-----|-----|-----|-----|---------------------------------|-----|-----|-----|-----|-----|
| | | Altitude/distance category (AD) | | | | | | Altitude/distance category (AD) | | | | | |
| | | AD1 | AD2 | AD3 | AD4 | AD5 | AD6 | AD1 | AD2 | AD3 | AD4 | AD5 | AD6 |
| 1.0 | W | R4 | R5 | R5 | R6 | R6 | R7 | R5 | R6 | R6 | R7 | R8 | R8 |
| | L | R2 | R2 | R3 | R3 | R3 | R3 | R3 | R3 | R3 | R4 | R4 | R4 |
| 1.5 | W | R8 | R9 | R9 | R10 | R11 | x | R10 | R11 | R11 | x | x | x |
| | L | R1 | R2 | R2 | R2 | R2 | x | R2 | R2 | R2 | x | x | x |
| 2.0 | W | R11 | R11 | x | x | x | x | x | x | x | x | x | x |
| | L | R1 | R1 | x | x | x | x | x | x | x | x | x | x |
| 2.5 | W | x | x | x | x | x | x | x | x | x | x | x | x |
| | L | x | x | x | x | x | x | x | x | x | x | x | x |

Racking resistance for flat roofs

Table 9 Wind Speed = 23 m/sec

Table 10 Wind Speed = 25 m/sec

| β | Side | H = 5.5 m | | | | | | H = 5.5 m | | | | | |
|---------|------|---------------------------------|-----|-----|-----|-----|-----|---------------------------------|-----|-----|-----|-----|-----|
| | | Altitude/distance category (AD) | | | | | | Altitude/distance category (AD) | | | | | |
| | | AD1 | AD2 | AD3 | AD4 | AD5 | AD6 | AD1 | AD2 | AD3 | AD4 | AD5 | AD6 |
| 1.0 | W | R3 | R3 | R3 | R4 | R4 | R5 | R3 | R3 | R3 | R4 | R4 | R5 |
| | L | R3 | R3 | R3 | R4 | R4 | R5 | R3 | R3 | R3 | R4 | R4 | R5 |
| 1.5 | W | R6 | R6 | R7 | R7 | R8 | R9 | R6 | R6 | R7 | R7 | R8 | R9 |
| | L | R2 | R2 | R2 | R3 | R3 | R3 | R2 | R2 | R2 | R3 | R3 | R3 |
| 2.0 | W | R8 | R9 | R9 | R10 | R11 | R11 | R8 | R9 | R9 | R10 | R11 | R11 |
| | L | R1 | R1 | R2 | R2 | R2 | R2 | R1 | R1 | R2 | R2 | R2 | R2 |
| 2.5 | W | R9 | R10 | R11 | R11 | x | x | R9 | R10 | R11 | R11 | x | x |
| | L | R1 | R1 | R1 | R1 | x | x | R1 | R1 | R1 | R1 | x | x |
| 3.0 | W | R11 | R11 | x | x | x | x | R11 | R11 | x | x | x | x |
| | L | R1 | R1 | x | x | x | x | R1 | R1 | x | x | x | x |
| 3.5 | W | R11 | x | x | x | x | x | R11 | x | x | x | x | x |
| | L | R1 | x | x | x | x | x | R1 | x | x | x | x | x |

Table 11 Wind Speed = 27 m/sec




Table 12 Wind Speed = 30 m/sec

| β | Side | H = 5.5 m | | | | | | H = 5.5 m | | | | | |
|---------|------|---------------------------------|-----|-----|-----|-----|-----|---------------------------------|-----|-----|-----|-----|-----|
| | | Altitude/distance category (AD) | | | | | | Altitude/distance category (AD) | | | | | |
| | | AD1 | AD2 | AD3 | AD4 | AD5 | AD6 | AD1 | AD2 | AD3 | AD4 | AD5 | AD6 |
| 1.0 | W | R4 | R4 | R4 | R5 | R5 | R5 | R4 | R5 | R5 | R6 | R6 | R7 |
| | L | R4 | R4 | R4 | R5 | R5 | R5 | R4 | R5 | R5 | R6 | R6 | R7 |
| 1.5 | W | R7 | R7 | R8 | R9 | R9 | R10 | R9 | R9 | R10 | R11 | R11 | x |
| | L | R2 | R3 | R3 | R3 | R4 | R4 | R3 | R3 | R4 | R4 | R4 | x |
| 2.0 | W | R9 | R10 | R11 | R11 | x | x | R11 | R11 | x | x | x | x |
| | L | R2 | R2 | R2 | R2 | x | x | R2 | R2 | x | x | x | x |
| 2.5 | W | R11 | R11 | x | x | x | x | x | x | x | x | x | x |
| | L | R1 | R1 | x | x | x | x | x | x | x | x | x | x |

1.E.16 Masonry cladding arrangement

The extent to which masonry cladding contributes to the racking resistance of a timber frame wall depends on whether or not there are masonry buttressing walls providing lateral support to the wall cladding and the spacing of the buttressing.

Type 1 walls which are buttressed at both ends provide the best contribution through to type 3 walls with no returns the least. The type of masonry wall should be selected from the table below.

| Type 1 | Type 2 | Type 3 |
|--|---|--|
| Masonry walls with buttressing walls at least 550 mm in length and not more than 9 m centres . | Masonry walls with buttressing walls at one end at least 550 mm in length with the other end without buttressing walls not more than 550 mm length and wall length not more than 4.5 m. | Masonry walls without buttressing walls or with buttressing walls not more than 550 mm length. |
|  |  |  |

1.E.17 Percentage openings in racking

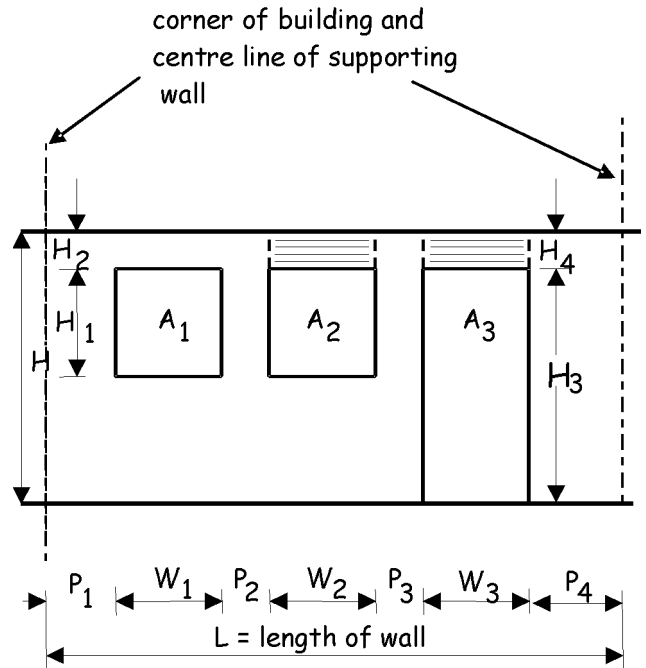
The actual percentage wall openings, %O_p, for each wall should be assessed as set out below.

External racking wall area of the ground floor for each wall, A_{EX} = W x H and L x H

Total opening area, A_o, of the ground floor for a wall = (sum of lengths x widths of all openings)
 $A_o = (W_1 \times H_1) + (W_2 \times H_2) + (W_3 \times H_3) + \dots$

The total area of openings in a wall which acts as a racking wall should be assessed as a percentage of the total area of that wall :

Actual percentage wall opening,
 $\%O_p = 100 \times A_o / A_{EX}$



Subject to the following:

where 2 framed openings are separated by not more than 300 mm and the heights of both openings are more than half the panel height, the area of opening should be taken as the rectangle that encloses both openings,

i.e. if $P_2 < 300$ mm then $(A_1 + A_2) = (W_1 + P_2 + W_2) \times H_1$

where there are limited areas of alternative cladding panels such as timber cladding above doors or windows (not exceeding 0.5 m²) these areas should be added to the areas of openings,

i.e. $A_2 = W_2 \times (H_1 + H_2)$ and $A_3 = W_3 \times (H_3 + H_4)$

where an opening is not more than 300 mm from the corner of a *building* and the depth of opening is more than half the panel height and then the length of that part of the wall should be disregarded when determining the total length of wall,

i.e. if $P_1 < 300$ mm and $H_1 > H/2$, then $L = (L - P_1)$

1.E.18 Panel sheathing and nailing

The wall sheathing in combination with the nailing of the sheathing to the wall studs provides the racking resistance in the plane of that wall as shown in the diagram in clause 1.E.15 and combinations of sheathing and nailing can be read from the charts below using the following information:

- racking resistance, R , from clause 1.E.15;
 - percentage openings, $\%O_p$, from clause 1.E.17;
 - masonry wall type from clause 1.E.16.
- a. select the appropriate chart below based on the wall type and number of storeys:
 - chart 1 provides wall sheathing for wall type 1 for 1 and 2 storey buildings;
 - chart 2 provides wall sheathing for wall type 2 for 1 and 2 storey buildings;
 - chart 3 provides wall sheathing for wall type 3 for 1 and 2 storey buildings;
 - b. read the walling detail options for each wall for racking resistance and percentage wall openings:
 - single sheathed with 100 mm nail centres;
 - single sheathed with 150 mm nail centres;
 - c. select the walling detail;
 - d. if the percentage openings and racking bands are outwith the charts;
 - reconsider the parameters particularly the percentage wall openings; or
 - consider introducing an internal racking wall (refer to clause 1.E.19); or
 - obtain specialist advice from chartered engineers with the appropriate skills and experience.

Chart 1 Wall Type 1 at 1 and 2 storey

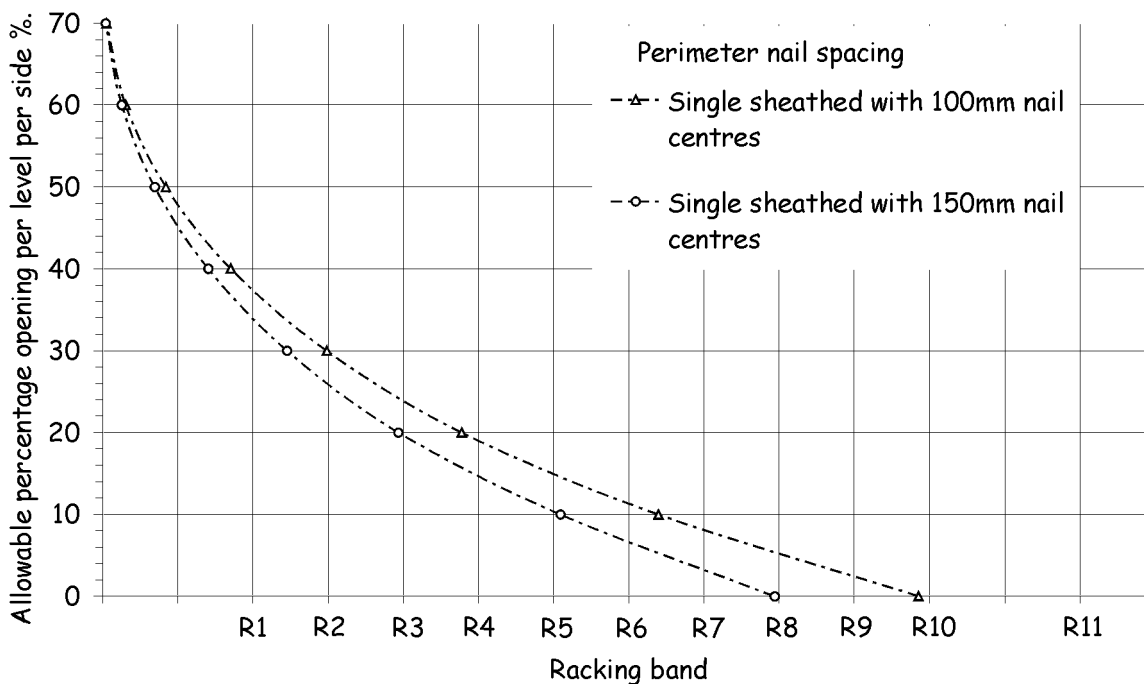


Chart 2 Wall Type 2 at 1 and 2 storey

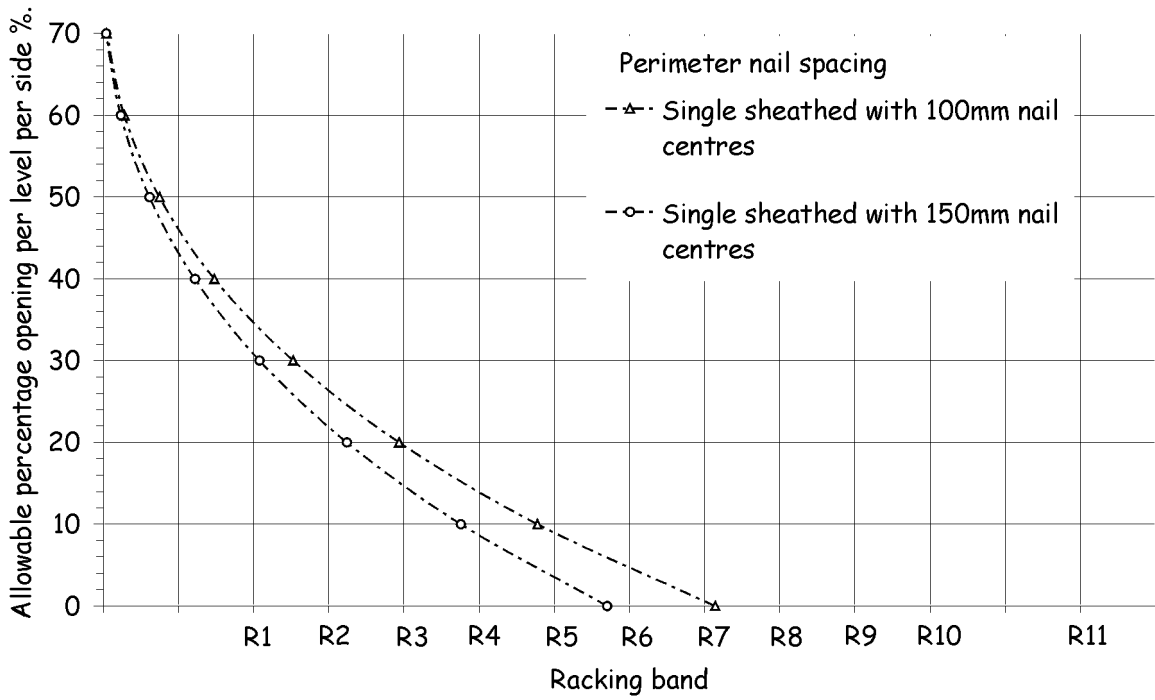
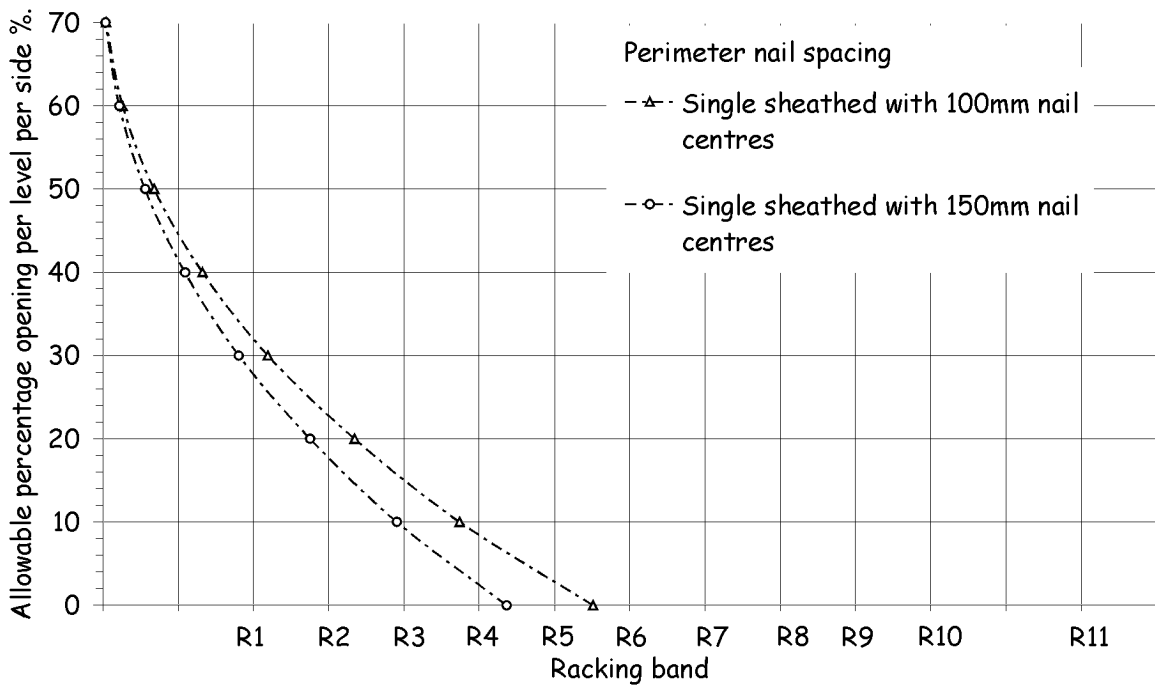


Chart 3 Wall Type 3 at 1 and 2 storey



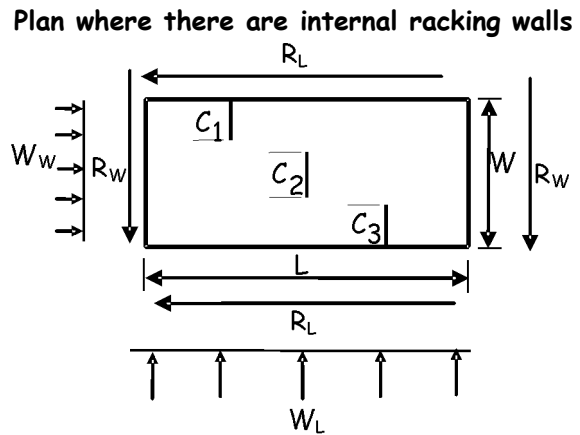
1.E.19 Use of internal walls for additional racking resistance

Internal walls can be used to provide additional racking resistance provided the following apply to such walls:

- support is provided by *foundations* at ground floor;
- fixity to the *foundations*, floor or roof diaphragms is in accordance with clauses 1.E.39-40;
- internal racking walls are sheathed as in clause 1.E.10;
- only segments of wall at least 600 mm in length are used;
- if the sum of the length of the racking walls varies between *storeys*, the length should be smallest sum.

Key

- W is the smaller dimension of the *building* plan
 L is the larger dimension of the *building* plan
 C is the sum of the lengths of the internal racking resisting walls ($C = C_1 + C_2 + C_3 + \dots$)



Determine the revised length/ width ratio of the building plan area, $\beta = L / (W + (0.5 \times C))$

Note that β should always be rounded up from the derived value to the nearest 0.5 and will be not less than 1.0 in any case.

Internal racking walls parallel to the length, L , of the *building* should be ignored in the calculation of β . However they can be used to enhance racking resistance in that direction to allow for an increased percentage of openings as follows:

- the internal racking wall area, A_{IN} , should be split equally between each of the external racking wall areas, A_{EX} , which are parallel to that internal wall, allowing the percentage of openings calculated from clause 1.E.17 to be increased using the following equations:
 - revised area of opening, $A_{OP} = (A_{EX} + (A_{IN} / 2)) \times \%O_p$
 - revised percentage of openings per *storey*, $\%O_p = (A_{OP} / A_{EX}) \times 100$
- read the walling detail options for each wall for racking resistance and revised percentage wall openings from the charts to clause 1.E.18;
- select the walling detail;
- if the percentage openings and racking bands are outwith the charts:
 - reconsider the parameters particularly the percentage wall openings; or
 - review internal racking wall arrangements; or
 - obtain specialist advice from chartered engineers or other appropriately qualified persons.

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1.E.20 Wind loads

The *wind loads* should be derived from the wind speed map and read from the table below using the information derived from above.

- overall *building* height, H from clause 1.E.11;
- distance to the coast, site altitude and wind speed from clause 1.E. 13.

Table of wind loads

| Building height (m) | Wind speed (m/s) | Site altitude, a (m) | | | | | | | |
|---------------------|------------------|----------------------------|-------|--------|-------|--------------|-------|---------------|-------|
| | | 0 | | a ≤ 50 | | 50 < a ≤ 100 | | 100 < a ≤ 150 | |
| | | Distance to the coast (km) | | | | | | | |
| | | ≤ 10 | ≤ 100 | ≤ 10 | ≤ 100 | ≤ 10 | ≤ 100 | ≤ 10 | ≤ 100 |
| ≤ 5.5 | 23 | H1 | H1 | H1 | H1 | H1 | H1 | H1 | H1 |
| | 25 | H1 | H1 | H1 | H1 | H1 | H1 | H1 | H1 |
| | 27 | H1 | H1 | H1 | H1 | H2 | H1 | H2 | H2 |
| | 30 | H2 | H1 | H2 | H2 | H2 | H2 | H3 | H2 |
| ≤ 10 | 23 | H1 | H1 | H1 | H1 | H1 | H1 | H1 | H1 |
| | 25 | H1 | H1 | H1 | H1 | H2 | H1 | H2 | H2 |
| | 27 | H2 | H1 | H2 | H1 | H2 | H2 | H2 | H2 |
| | 30 | H2 | H2 | H3 | H2 | H3 | H3 | H4 | H3 |

| Building height (m) | Wind speed (m/s) | Site altitude, a (m) | | | | | |
|---------------------|------------------|----------------------------|-------|---------------|-------|---------------|-------|
| | | 150 < a ≤ 200 | | 200 < a ≤ 300 | | 300 < a ≤ 400 | |
| | | Distance to the coast (km) | | | | | |
| | | ≤ 10 | ≤ 100 | ≤ 10 | ≤ 100 | ≤ 10 | ≤ 100 |
| ≤ 5.5 | 23 | H1 | H1 | H2 | H2 | H2 | H2 |
| | 25 | H2 | H2 | H2 | H2 | H3 | H3 |
| | 27 | H2 | H2 | H3 | H3 | H4 | H3 |
| | 30 | H3 | H3 | H4 | H4 | H5 | H4 |
| ≤ 10 | 23 | H2 | H2 | H2 | H2 | H3 | H3 |
| | 25 | H3 | H3 | H3 | H3 | H3 | H3 |
| | 27 | H3 | H3 | H4 | H3 | H5 | H4 |
| | 30 | H4 | H4 | H5 | H5 | H6 | H6 |

1.E.21 Vertical loads

The vertical loads should be derived from the snow zone map in clause 1.E.13 using the following information derived from above:

- roof and floor spans and the number of storeys from clause 1.E.11;
- snow zone and site altitude from clause 1.E.13.

a. the *imposed loads* (snow) in kN/m^2 is read from the table below:

Imposed roof loads (kN/m^2)

| Zone | Altitude below 100 m | Altitude between 100m and 200 m | Altitude between 200m and 260 m | Altitude between 260 m and 400m |
|------|----------------------|---------------------------------|---------------------------------|---------------------------------|
| A | 0.75 | 1.00 | Refer to BS 6399-3: 1988 | Refer to BS 6399-3: 1988 |
| B | 1.00 | 1.50 | 1.50 | Refer to BS 6399-3: 1988 |

b. Read the vertical snow load category (V1-V18) from the table below:

Vertical loads at heads of panels

| Maximum roof or floor span (m) [1] | Imposed loads (kN/m^2) | | | | | | | | |
|---------------------------------------|-----------------------------------|-----------|---------------------|----------|-----------|---------------------|----------|-----------|---------------------|
| | 0.75 | | | 1.00 | | | 1.50 | | |
| | Roof [2] | Floor [3] | Roof + 1 Storey [4] | Roof [2] | Floor [3] | Roof + 1 Storey [4] | Roof [2] | Floor [3] | Roof + 1 Storey [4] |
| 1.0 | V1 | V1 | V3 | V1 | V1 | V3 | V2 | V2 | V3 |
| 2.0 | V4 | V4 | V7 | V4 | V4 | V7 | V5 | V5 | V7 |
| 3.0 | V6 | V6 | V10 | V6 | V6 | V10 | V7 | V7 | V11 |
| 4.0 | V8 | V8 | V12 | V8 | V8 | V12 | V9 | V9 | V13 |
| 5.0 | V10 | V10 | V13 | V10 | V10 | V14 | V11 | V11 | V14 |
| 6.0 | V10 | V10 | V14 | V11 | V11 | V15 | V11 | V11 | V15 |
| 7.0 | V11 | V11 | V16 | V11 | V11 | V16 | V12 | V12 | V17 |
| 7.5 | V11 | V11 | V17 | V13 | V13 | V17 | V13 | V13 | V18 |

Notes:

1. Roof or Floor span is the clear span between supports for a roof or a floor;
2. *Imposed loads* for Roof are loads onto the wallhead of first floor wall of a 2 storey building from the roof or loads onto the wallhead of the ground floor wall of a 1 storey building from the roof;
3. *Imposed loads* for Floor are loads onto the wallhead of the ground floor wall of a 2 storey building from the first floor only where the roof does not span onto that wall;
4. *Imposed loads* for Roof + 1 Storey are the loads on to the wallhead of the ground floor of a 2 storey building from the roof and the first floor wall where the roof and floor span in the same direction.

1.E.22 Wall stud sizing

The wall studs carry the vertical and *wind loads* imposed on the timber frame panels and the sizes of studs should be selected using the tables below using the information derived from above:

- *wind loads* (H1-5) from clause 1.E.20;
- vertical (snow) loads (V1-V18) from clause 1.E.21.

The wall stud sizes, centres and timber grade for the wall panels should be selected from the tables below. Note that strength class C16 timber is generally used for wall studs.

Minimum wall stud sizes for timber class grade C16

Table 1 Wind load category H1

| Vertical load category | Timber size (mm x mm) | Centres (mm) |
|------------------------|-----------------------|--------------|
| V1 - V11 | 38 x 89 | 400 |
| V1 - V7 | | 600 |
| V1 - V18 | 38 x 114 | 400 |
| V1 - V14 | | 600 |
| V1 - V18 | 38 x 140 | 400 |
| V1 - V18 | | 600 |

Table 2 Wind load category H2

| Vertical load category | Timber size (mm x mm) | Centres (mm) |
|------------------------|-----------------------|--------------|
| V1 - V11 | 38 x 89 | 400 |
| V1 - V5 | | 600 |
| V1 - V18 | 38 x 114 | 400 |
| V1 - V12 | | 600 |
| V1 - V18 | 38 x 140 | 400 |
| V1 - V18 | | 600 |

Table 3 Wind load category H3

| Vertical load category | Timber size (mm x mm) | Centres (mm) |
|------------------------|-----------------------|--------------|
| V1 - V9 | 38 x 89 | 400 |
| V1 - V3 | | 600 |
| V1 - V17 | 38 x 114 | 400 |
| V1 - V12 | | 600 |
| V1 - V18 | 38 x 140 | 400 |
| V1 - V18 | | 600 |

Table 4 Wind load category H4

| Vertical load category | Timber size (mm x mm) | Centres (mm) |
|------------------------|-----------------------|--------------|
| V1 - V8 | 38 x 89 | 400 |
| V1 - V5 | | 600 |
| V1 - V16 | 38 x 114 | 400 |
| V1 - V10 | | 600 |
| V1 - V18 | 38 x 140 | 400 |
| V1 - V16 | | 600 |

Table 5 Wind load category H5

| Vertical load category | Timber size (mm x mm) | Centres (mm) |
|------------------------|-----------------------|--------------|
| V1 - V7 | 38 x 89 | 400 |
| none | | 600 |
| V1 - V16 | 38 x 114 | 400 |
| V1 - V9 | | 600 |
| V1 - V18 | 38 x 140 | 400 |
| V1 - V15 | | 600 |

Minimum wall stud sizes for timber class grade C24

Table 6 Wind load category H1

| Vertical load category | Timber size (mm x mm) | Centres (mm) |
|------------------------|-----------------------|--------------|
| V1 - V16 | 38 x 89 | 400 |
| V1 - V10 | | 600 |
| V1 - V18 | 38 x 114 | 400 |
| V1 - V17 | | 600 |
| V1 - V18 | 38 x 140 | 400 |
| V1 - V18 | | 600 |

Table 7 Wind load category H2

| Vertical load category | Timber size (mm x mm) | Centres (mm) |
|------------------------|-----------------------|--------------|
| V1 - V15 | 38 x 89 | 400 |
| V1 - V9 | | 600 |
| V1 - V18 | 38 x 114 | 400 |
| V1 - V16 | | 600 |
| V1 - V18 | 38 x 140 | 400 |
| V1 - V18 | | 600 |

Table 8 Wind load category H3

| Vertical load category | Timber size (mm x mm) | Centres (mm) |
|------------------------|-----------------------|--------------|
| V1 - V13 | 38 x 89 | 400 |
| V1 - V7 | | 600 |
| V1 - V18 | 38 x 114 | 400 |
| V1 - V14 | | 600 |
| V1 - V18 | 38 x 140 | 400 |
| V1 - V18 | | 600 |

Table 9 Wind load category H4

| Vertical load category | Timber size (mm x mm) | Centres (mm) |
|------------------------|-----------------------|--------------|
| V1 - V12 | 38 x 89 | 400 |
| V1 - V6 | | 600 |
| V1 - V18 | 38 x 114 | 400 |
| V1 - V13 | | 600 |
| V1 - V18 | 38 x 140 | 400 |
| V1 - V18 | | 600 |

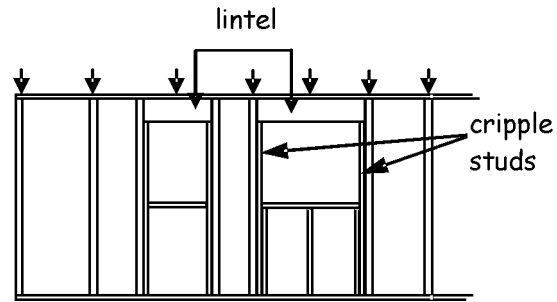
Table 10 Wind load category H5

| Vertical load category | Timber size (mm x mm) | Centres (mm) |
|------------------------|-----------------------|--------------|
| V1 - V12 | 38 x 89 | 400 |
| V1 - V5 | | 600 |
| V1 - V18 | 38 x 114 | 400 |
| V1 - V12 | | 600 |
| V1 - V18 | 38 x 140 | 400 |
| V1 - V18 | | 600 |

Wall studs to internal racking walls should be at least 38 x 89 size, grade C16 at 600 mm centres.

1.E.23 Cripple stud sizing

Cripple studs are connected to studs either side of an opening within a panel to provide support to a lintel above the openings as shown opposite. The sizes and numbers of cripple studs should be selected using the table below and using information derived from above:



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- lintel span from clause 1.E.11;
- vertical load (V1-V18) from clause 1.E.21;

Select the cripple stud sizes, numbers of sections and timber grade for the lintel spans from the tables below;

- the number of cripple studs from the table is the number of studs in addition to the wall studs on each side of the opening;
- all cripple studs should be of the same strength class and size;
- strength class C16 timber is generally used for cripple studs;
- x indicates that more than 3 cripple studs are needed and specialist advice should be obtained.

Minimum cripple stud sizes and numbers

Table 1 Timber of strength class grade C16

| Vertical load | Lintel span (m) | | | | | | | | |
|---------------------|-----------------|--------|--------|-------|--------|--------|-------|--------|--------|
| | 1.240 | | | 1.800 | | | 2.475 | | |
| Stud size (mm x mm) | 38x89 | 38x114 | 38x140 | 38x89 | 38x114 | 38x140 | 38x89 | 38x114 | 38x140 |
| V1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| V2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| V3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| V4 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| V5 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| V6 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 |
| V7 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 |
| V8 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 |
| V9 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 |
| V10 | 2 | 1 | 1 | 2 | 1 | 1 | 3 | 2 | 1 |
| V11 | 2 | 1 | 1 | 3 | 2 | 1 | 3 | 2 | 1 |
| V12 | 2 | 1 | 1 | 3 | 2 | 1 | x | 2 | 2 |
| V13 | 2 | 1 | 1 | 3 | 2 | 1 | x | 2 | 2 |
| V14 | 3 | 2 | 1 | x | 2 | 2 | x | 3 | 2 |
| V15 | 3 | 2 | 1 | x | 2 | 2 | x | 3 | 2 |
| V16 | 3 | 2 | 1 | x | 2 | 2 | x | 3 | 2 |
| V17 | 3 | 2 | 1 | x | 3 | 2 | x | 3 | 2 |
| V18 | 3 | 2 | 1 | x | 3 | 2 | x | 3 | 2 |

Table 2 Timber of strength class grade C24

| Vertical load | Lintel span (m) | | | | | | | | |
|------------------------|-----------------|--------|--------|-------|--------|--------|-------|--------|--------|
| | 1.240 | | | 1.800 | | | 2.475 | | |
| Stud size (mm x mm) | 38x89 | 38x114 | 38x140 | 38x89 | 38x114 | 38x140 | 38x89 | 38x114 | 38x140 |
| V1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| V2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| V3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| V4 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| V5 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| V6 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 |
| V7 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 |
| V8 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 |
| V9 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 |
| V10 | 2 | 1 | 1 | 2 | 1 | 1 | 3 | 1 | 1 |
| V11 | 2 | 1 | 1 | 3 | 1 | 1 | 3 | 2 | 1 |
| V12 | 2 | 1 | 1 | 3 | 2 | 1 | x | 2 | 2 |
| V13 | 2 | 1 | 1 | 3 | 2 | 1 | x | 2 | 2 |
| V14 | 3 | 2 | 1 | 3 | 2 | 2 | x | 3 | 2 |
| V15 | 3 | 2 | 1 | 3 | 2 | 2 | x | 3 | 2 |
| V16 | 3 | 2 | 1 | 3 | 2 | 2 | x | 3 | 2 |
| V17 | 3 | 2 | 1 | x | 3 | 2 | x | 3 | 2 |
| V18 | 3 | 2 | 1 | x | 3 | 2 | x | 3 | 2 |

1.E.24 Lintel sizing

Lintels provide support to openings and are supported by cripple studs at either end as shown on the diagram to clause 1.E.23. The sizes and numbers of sections for lintels should be selected using the table below using the information derived from above.

- lintel span from clause 1.E.11;
- vertical load (V1-V18) from clause 1.E.21.

Select the lintel sizes, numbers of sections and timber grade from the tables below:

- the lintel span is the clear distance between support points of the cripple studs;
- timber of strength class C24 is generally used for lintels;
- all lintels should be of the same strength class and size;
- 2 x 38 x 190 means 2 lintels 38 mm wide by 190 mm deep are required to satisfy the loading condition;
- x indicates that more than 3 sections are needed to make up a lintel, or steel inserts (e.g. fitch beams) and specialist advice should be obtained.

Minimum lintel sizes and numbers of sections

Table 1 Timber of strength class grade C16

| Vertical load | Lintel span (m) | | | | | | | | | | | | |
|------------------------|-----------------|------------|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| | 1.240 | | | | | 1.800 | | | | | 2.475 | | |
| Stud size (mm x mm) | 38x 140 | 38x 190 | 44 x 190 | 44x 220 | 44x 240 | 38x 190 | 44x 140 | 44x 190 | 44x 220 | 44x 240 | 44x 190 | 44x 220 | 44x 240 |
| V1 | 2 | | | | | 2 | | | | | x | 2 | |
| V2 | 2 | | | | | 2 | | | | | x | x | 2 |
| V3 | 2 | | | | | x | x | 2 | | | x | x | 2 |
| V4 | 2 | | | | | x | x | 2 | | | x | x | 2 |
| V5 | 2 | | | | | x | x | x | 2 | | x | 3 | x |
| V6 | 2 | | | | | x | x | x | 2 | | x | 3 | x |
| V7 | x | x | 2 | | | x | x | x | 2 | | x | x | 3 |
| V8 | x | x | 2 | | | x | x | x | 2 | | x | x | 3 |
| V9 | x | x | 2 | | | x | x | 3 | x | | x | x | 3 |
| V10 | x | x | 2 | | | x | x | 3 | x | | x | x | x |
| V11 | x | x | x | 2 | | x | x | x | x | 3 | x | x | x |
| V12 | x | x | x | 2 | | x | x | x | x | 3 | x | x | x |
| V13 | x | x | x | x | 2 | x | x | x | x | 3 | x | x | x |
| V14 | x | x | x | x | 3 | x | x | x | x | x | x | x | x |
| V15 | x | x | x | x | 3 | x | x | x | x | x | x | x | x |
| V16 | x | x | x | x | 3 | x | x | x | x | x | x | x | x |
| V17 | x | x | x | x | 3 | x | x | x | x | x | x | x | x |
| V18 | x | x | x | x | x | x | x | x | x | x | x | x | x |

Table 2 Timber of strength class grade C24

| Vertical load | Lintel span (m) | | | | | | | | | | | |
|---------------|-----------------|------------|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| | 1.240 | | | | | 1.800 | | | | 2.475 | | |
| | 38x 140 | 38x 190 | 44 x 190 | 44x 220 | 44x 240 | 44x 140 | 44x 190 | 44x 220 | 44x 240 | 44x 190 | 44x 220 | 44x 240 |
| V1 | 2 | | | | | 2 | | | | 2 | | |
| V2 | 2 | | | | | 2 | | | | 2 | | |
| V3 | 2 | | | | | 2 | | | | 2 | | |
| V4 | 2 | | | | | 2 | | | | 2 | | |
| V5 | 2 | | | | | 2 | | | | 2 | | |
| V6 | 2 | | | | | 2 | | | | 2 | | |
| V7 | x | 2 | | | | x | 2 | | | x | 2 | |
| V8 | x | 2 | | | | x | 2 | | | x | 2 | |
| V9 | x | 2 | | | | x | x | 2 | | x | 3 | |
| V10 | x | 2 | | | | x | x | 2 | | x | x | 2 |
| V11 | x | x | 2 | | | x | x | x | 2 | x | x | 3 |
| V12 | x | x | 2 | | | x | x | x | 2 | x | x | 3 |
| V13 | x | x | x | 2 | | x | x | x | 2 | x | x | x |
| V14 | x | x | 3 | x | | x | x | 3 | x | x | x | x |
| V15 | x | x | 3 | x | | x | x | x | 3 | x | x | x |
| V16 | x | x | 3 | x | | x | x | x | x | x | x | x |
| V17 | x | x | x | 3 | | x | x | x | x | x | x | x |
| V18 | x | x | x | 3 | | x | x | x | x | x | x | x |

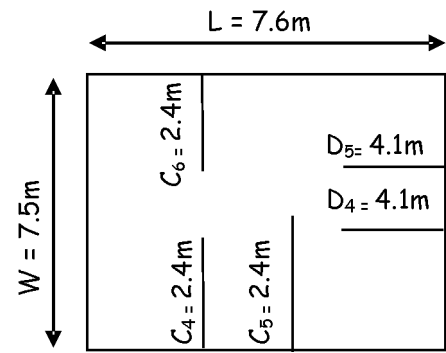
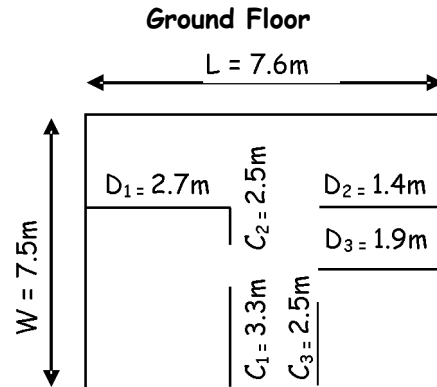
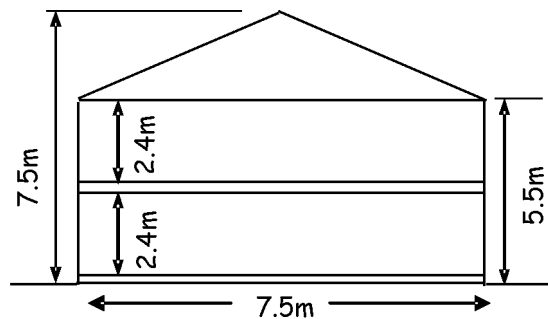
1.E.25 Example

Site Data

| | | |
|-------------------|--------|------|
| Distance to coast | km | 15 |
| Altitude, a | m | 150 |
| Snow zone | A or B | A |
| Wind speed | m/s | 23.5 |

Building Data

| | | |
|--------------------|---------------|-----|
| Width, W | m | 7.5 |
| Length, L | m | 7.6 |
| Height to eaves | m | 5.5 |
| Storeys | No | 2 |
| Building height, H | m | 7.5 |
| Roof shape | duo/mono/flat | duo |
| Panel height, H | m | 2.4 |



Racking

Wall type = 1

Number of storeys = 2

From table 1 to clause 1.E.14, altitude/distance category

= AD3

For ground floor:

internal racking wall, resisting wind onto *building* width, C

= C₁ + C₂ + C₃ = 8.3 m

internal racking wall, resisting wind onto *building* length, D

= D₁ + D₂ + D₃ = 6.0 m

For first floor:

internal racking wall, resisting wind onto *building* width, C

= C₄ + C₅ + C₆ = 7.2 m

internal racking wall, resisting wind onto *building* length, D

= D₄ + D₅ = 8.2 m

Adopt lesser values giving : C
D

= 7.2 m

= 6.0 m

Length/width ratio $\beta = L / (W + 0.5 \times C) = 7.6 / (7.5 + 3.6) = 0.68 < 1.0$. Therefore adopt $\beta = 1.0$

From table 1 for $\beta = 1.0$, AD3 category and wind speed of 23 m/sec,

Racking bands are : For side W = R4 and for side L = R5

From the above parameters the initial wall options are as shown in the table below (before allowing for the effect of internal racking walls)

| Side | Racking band | Wall options (From Chart 1 to clause 1.E.18) | Allowable % opening / level per side |
|------|--------------|---|---|
| W | R4 | 1. Single sheathed with 100 mm nail centres | 19 |
| | | 2. Single sheathed with 150 mm nail centres | 14 |
| L | R5 | 1. Single sheathed with 100 mm nail centres | 15 |
| | | 2. Single sheathed with 150 mm nail centres | 10 |

In accordance with clause 1.E.19, % openings in the *external walls* may be increased:

Width walls:

$$\text{Effective area of external racking wall, } A_{EX} = 7.5 \text{ m} \times 2.4 \text{ m} = 18 \text{ m}^2$$

$$\text{Effective area of internal racking walls, } A_{IN} = 7.2 \text{ m} \times 2.4 \text{ m} = 17.28 \text{ m}^2$$

$$\text{Area of allowable opening per level, } A_{OP} = (A_{EX} + (A_{IN} / 2)) \times \%O_p$$

For example, consider side W, option 1: single sheathed with 100 mm nail centres:

$$A_{OP} = (18 + (17.28/2)) \times 19 \%$$

$$A_{OP} = 5.1 \text{ m}^2$$

Therefore,

$$\%O_p = (5.1 / 18) \times 100 = 28 \%$$

Length walls:

$$A_{EX} = 7.6 \text{ m} \times 2.4 \text{ m} = 18.24 \text{ m}^2$$

$$A_{IN} = 6.0 \text{ m} \times 2.4 \text{ m} = 14.4 \text{ m}^2$$

$$A_{OP} = (A_{EX} + (A_{IN} / 2)) \times \%O_p$$

For example consider side L, option 5: single sheathed with 100 mm nail centres:

$$A_{OP} = (18.24 \text{ m}^2 + (14.4 \text{ m}^2 / 2)) \times 15 \%$$

$$A_{OP} = 3.82 \text{ m}^2$$

Therefore,

$$\%O_p = (3.82 / 18.24) \times 100 = 21 \%$$

The table can therefore be revised as follows allowing for internal racking walls effect.

| Side | Racking band | Wall options (From Chart 1 to clause 1.E.17) | Allowable % opening / level per side |
|------|--------------|---|---|
| W | R4 | 1. Single sheathed with 100 mm nail centres | 28 |
| | | 2. Single sheathed with 150 mm nail centres | 21 |
| L | R5 | 1. Single sheathed with 100 mm nail centres | 21 |
| | | 2. Single sheathed with 150 mm nail centres | 14 |

Wall studs

From table to 1.E.20, *wind load* category is H1

From table 1.E.21, *imposed load* = 1.00 kN/m² leading to vertical load category = V17

From table 1 to 1.E.22 select 38 x 140, grade C16 wall stud at 600 mm centres

Cripple studs

For load V17 and 1.2 m opening, table 1 to 1.E.23 gives 1 no. 38 x 140 cripple studs grade C16 each side of opening

Lintels

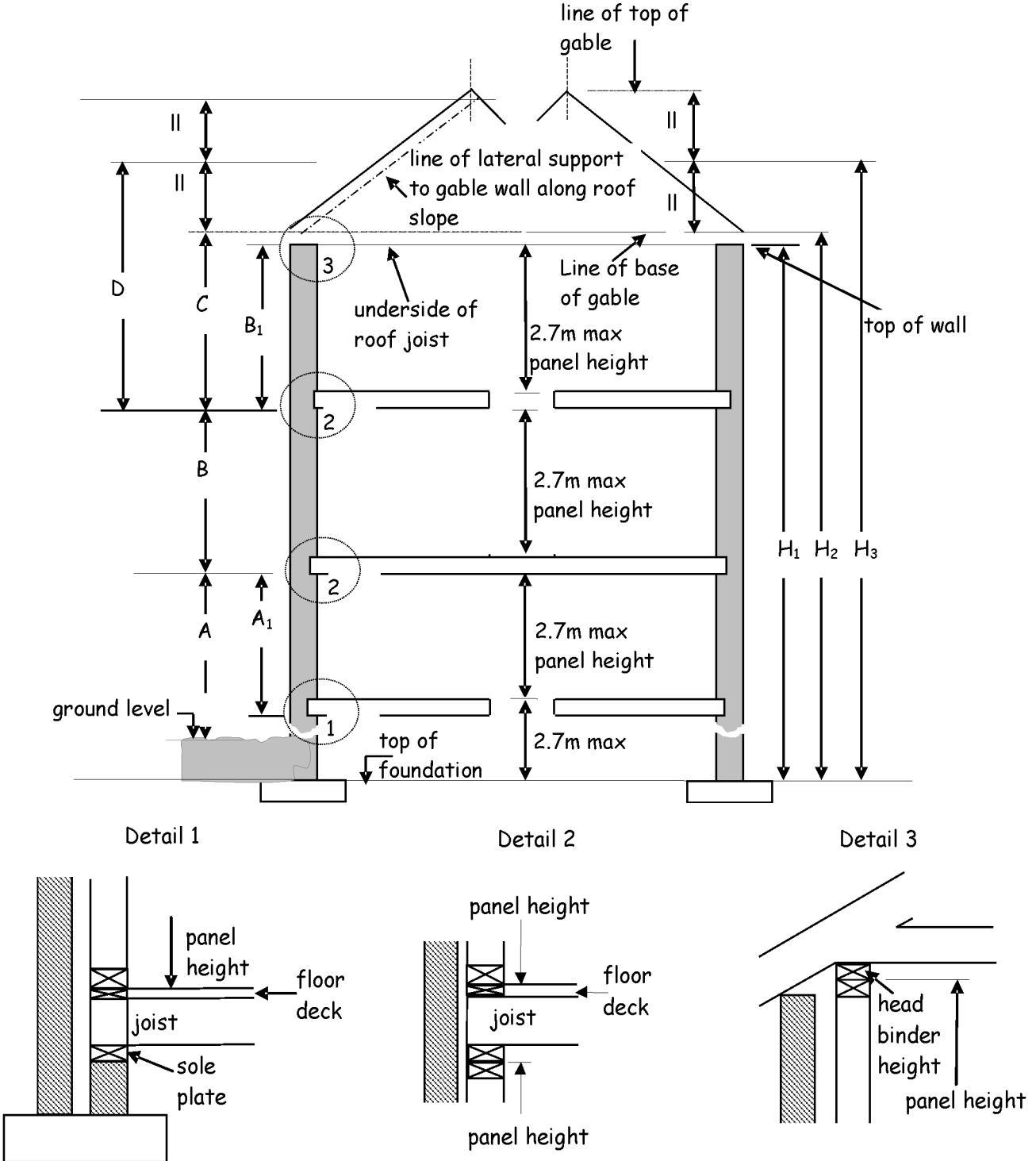
For load V17 and 1.2 m opening, table 2, to 1.E.24 gives 3 no 44 x 220, grade C24 lintels

1.E.26 Maximum allowable length of wall and building height

This annex does not deal with walls longer than 9 m, measured from centre to centre of buttressing walls, or of *buildings* with an overall height more than 10 m.

1.E.27 Rules of measurement for storeys, walls, panels and heights

The height of a wall or a *storey* should be measured in accordance with the following diagram.



Key

(a) Measuring storey heights

- A** is the *ground storey* height if the ground floor is a suspended timber floor or a structurally separate ground floor slab
- A₁** is the *ground storey* height if the ground floor is a suspended concrete floor bearing on the *external wall*
- B** is the intermediate *storey* height
- B₁** is the top *storey* height for walls which do not include a gable
- C** is the top *storey* height where lateral support is given to the gable at both ceiling level and along the roof slope
- D** is the top *storey* height for walls which include a gable where lateral support is given to the gable only along the roof slope

(b) Measuring wall heights

- H₁** is the height of a wall that does not include a gable
- H₂** is the height of a *separating wall* which may extend to the under side of the roof
- H₃** is the height for a wall (except a *separating wall*) which includes a gable

(c) Measuring timber panel heights

Panel heights are measured from the underside of the bottom rail to the top of the top rail

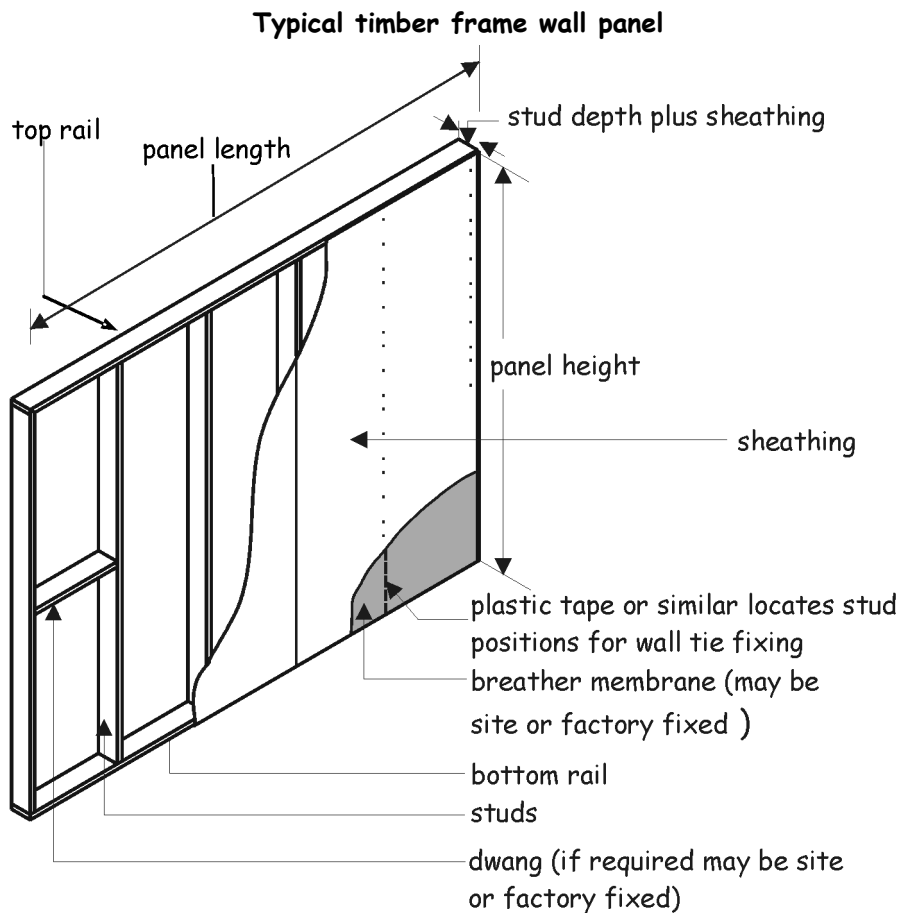
(d) Measuring building height

Building heights are measured from the lowest finished ground level to the highest point of the *roof*

Note that these methods of measurement are unique to SBSG and distinct from regulation 7.

1.E.28 Construction materials

The *construction* materials and methods are restricted to those materials, timber strength classes, specifications and dimensions which are most commonly used in Scotland for simple platform timber frame *buildings* as shown in the diagram below.



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1.E.29 Wall ties

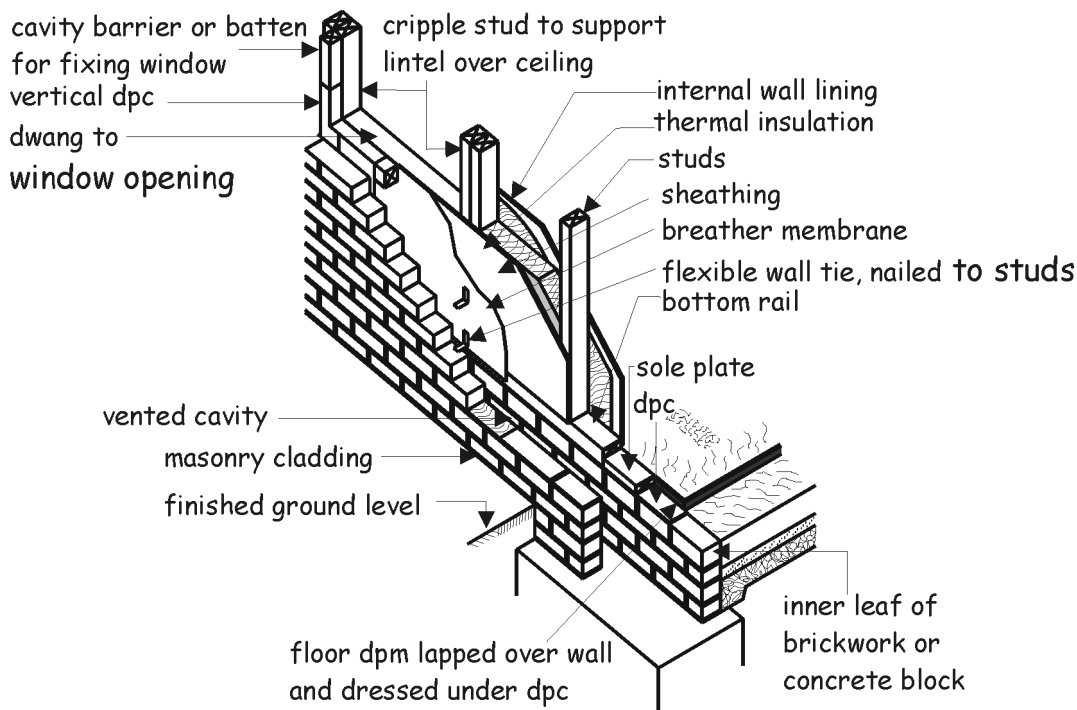
Wall ties should be in accordance with the guidance in BS EN 845-1: 2003 and be material references 1 or 3 in BS EN 845-1: 2003 Table A1 austenitic stainless steel.

The type of tie should be selected by reference to DD 140-2: 1987 type 5 (timber frame) or type 6 (timber frame high movement) to permit vertical downward movement of timber frame in relation to the masonry cladding of 6 mm/ storey height.

Reference should also be made to clause 1.D.17 for selection of wall ties regarding cavity width and embedment details.

1.E.30 Masonry Cladding

A typical masonry clad timber frame wall is illustrated below.



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1.E.31 Brick and block construction

Brick and block used as masonry cladding should be in accordance with annex 1.D and should be in accordance with the guidance in BS 5628-1: 2003, BS 5628-2: 2003 and BS 5628-3:2003, at least 100 mm thick with a minimum density of 7.36 kN/m³.

1.E.32 Mortar

Mortar used in masonry cladding should be in accordance with annex 1.D.

1.E.33 Lintels for masonry cladding

Proprietary steel or concrete lintels used with masonry cladding to timber frame *construction* should be tested by a *notified body* or justified by calculations. Under no circumstances should any part of the masonry walls be supported by the timber frame.

1.E.34 Timber members

All structural timber members should be dry graded and marked with the timber species and grade combinations to satisfy strength classes C16 or C24 to BS 5268-2: 2002.

Normally strength class C16 is used for all members except lintels which are normally strength class C24. Care should be taken where different strength class timber has been used in the design that the correct classes are used for the members specified.

The cross sectional dimensions given in this annex are:

- CLS or ALS sizes in accordance with BS EN 336: 2003, table NA.5 to tolerance class 2; or
- equivalent timbers with dimensions in accordance with BS EN 336: 2003, table NA.4 to tolerance class 2 (but should not have lesser dimensions to those in a. above).

Although 38 mm widths are provided in the tables above for studs, cripple studs and lintels 44 mm width timbers are commonly used to provide an increased width to which plasterboard can be fixed.

Bottom and top rails, sole plates and head binders should be the same cross sectional dimensions and strength classes as the wall studs.

1.E.35 Wall sheathing

Plywood used as sheathing to timber frame should be 9.5 mm minimum thickness of species and grade as defined in BS 5268-2: 2002, Bonding Class 2 or 3 to BS EN 314-2: 1993.

Oriented Strand Board used as sheathing to timber frame should be at least 9.0 mm thick, Type 3 (OSB3): load bearing boards for use in humid conditions to BS EN 300: 2006.

Plasterboard used as wall linings should be 12.5 mm minimum thickness for stud centres not more than 600 mm to BS 8212: 1995.

1.E.36 Fasteners

All structural fasteners should be corrosion resistant and checked for compatibility with preservative, treatments used and any other metalwork with which they are in contact. Nails should be manufactured from mild or stainless steel and be of round head or "D" head configuration to the diameter and length stated.

Ground floor fasteners should be stainless steel or galvanised.

1.E.37 Fabrication

Timber members in wall panels should be at least 38 mm × 89 mm rectangular section with linings fixed to the narrower face, with ends cut square.

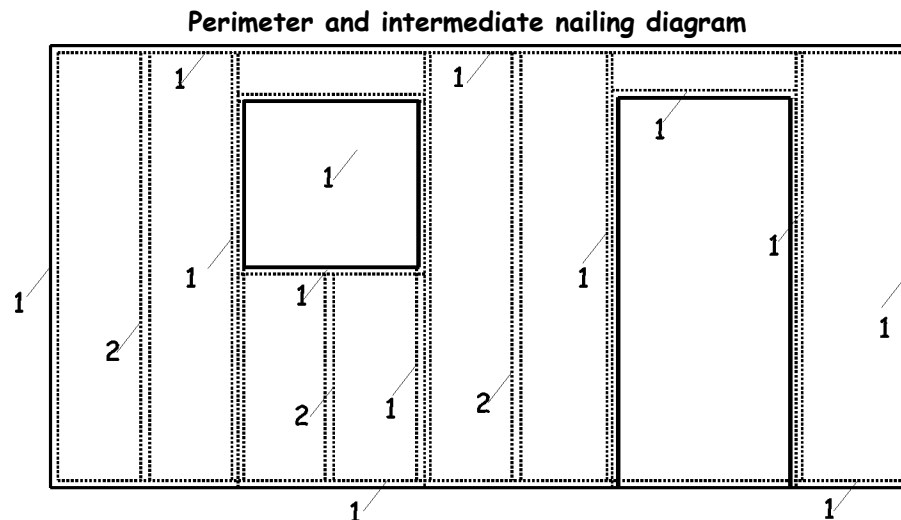
Wall studs should be spaced at not more than 600 mm centres and should be vertically aligned to coincide with the floor joists and roof trusses.

Masonry cladding should be *constructed* on to the *building foundation* and tied back to the timber frame structure with a cavity width of 50 mm between the inside face of the masonry cladding and the outer face of the timber frame wall.

1.E.38 Composite action

Timber frame walls should be considered to act compositely if they are *constructed* in accordance with clauses 1.E.37 and 1.E.39, ensuring that sheathings and linings are nailed to all perimeter and intermediate timber members as on the diagram below and as follows:

- a. sheathing edges should be backed by and nailed to timber framing at all edges; and
- b. where sheathing is nailed to studs, the nails should be at least 7 mm from the edge of the board or the face of the stud; and
- c. for plasterboard linings, nails should be at least 10 mm from formed board edges and at least 13 mm from ends of the board at centres not more than 150 mm; and
- d. internal walls which are lined with plasterboard should be connected to the wall studs at the same perimeter nail centres as for external sheathing material; and
- e. fixing of perimeter studs to sheathing, 1, should be at the centres derived from clauses 1.E.10-19; and
- f. fixing of intermediate studs to sheathing, 2, should be at not more than twice the centres of the perimeter nailing.



1.E.39 Wall panel connections

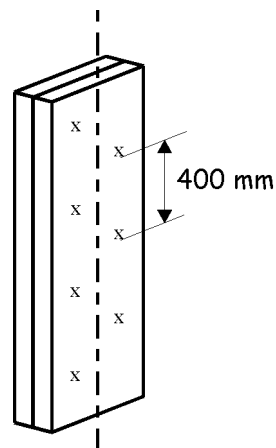
To ensure that wall panels are able to resist overturning forces they should be combined to form lengths of wall as follows:

- a. tops and bottoms of individual wall panels should be linked by head binders and sole plates respectively that are continuous across panel joints including at junctions of the same dimensions as the top and bottom rails as in clause 1.E.40; and
- b. sole plates should be secured to either the concrete floor slab or the header joists in the case of a timber ground floor or the header joists of the intermediate floor; and
- c. header plates should be secured to the header joists of the intermediate floor or the roof trusses; and
- d. faces of end studs of contiguous panels should be fixed such that any vertical shear is transferred as in clause 1.E.40; and
- e. all edges including those to openings for windows, doors, etc. other than at the bases of door openings and small openings should be supported by timber members having a thickness not less than the thickness of the studs; and
- f. where a secondary board is fixed on the same side of a wall as the primary sheathing then the nail lengths given in clause 1.E.40 should be increased to take account of the additional thickness; and
- g. panels above and below openings should be fixed such that the horizontal forces are transferred in the plane of the panel above and below openings by 3.35 mm nails of length 75 mm at 300 mm centres.

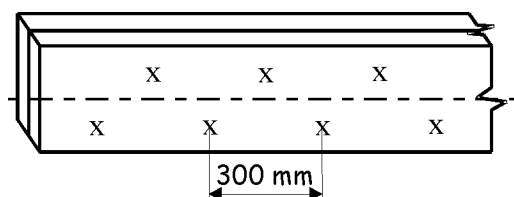
1.E.40 Nailing and fixing schedule

| Item | Recommended fixing |
|--|---|
| Foundations | |
| Sole plate to under building | Mechanical fixings at 600 mm centres rated at 4.7 kN shear resistance |
| Holding down straps providing at least 3.5 kN of resistance. | Stainless steel strap 30 mm x 2.5 mm attached to stud by 6 no. 3.36 mm x 65 mm ring shank nails at 2.4 m centres, at every opening and at the end studs of a wall attaching the strap to the stud and placing the L-shaped end of the strap under the masonry cladding creating the holding down resistance |
| Wall panels | |
| Top rail of panels to head binders | Tops of individual wall panel members linked by member continuous across panel joints secured with 4.0 mm x 90 mm galvanised wire nails, 2 nails between stud centres |
| Sole plate to ring beam/ joist | 4.0 mm x 90 mm galvanised wire nails, 2 nails between stud centres. |
| Bottom rail to sole plate | 4.0 mm x 90 mm galvanised wire nails, 2 nails between stud centres. |
| Wall panel stud to wall panel stud | 4.0 mm x 90 mm galvanised wire nails at 600 mm centres each side staggered. |
| Header plate to intermediate floor | 4.0 mm x 90 mm galvanised wire nails at 300 mm centres. Nails skewed externally through rimboard into headbinder and internally skewed through the headbinder into the joists . |
| Sheathing to perimeter studs | 3.1 mm x 50 mm wire nails at 100 or 150 mm centres as calculated |
| Intermediate studs to sheathing | 3.1 mm x 50 mm wire nails at twice perimeter centres |
| Studs to plasterboard | 2.65 mm x 40 mm smooth shanked galvanised flat round headed nails at 150 mm centres |
| Top and bottom rails to studs | 2 no 4.0 mm x 90 mm nails end fixed |
| Spandrel panels to wall panel head | 4.0 mm x 90 mm galvanised wire nails, 2 nails between stud centres. |

Multi-cripple studs should be secured to each other with 3.1 mm x 64 mm galvanised ringshank nails at 400 mm centres, staggered mid distance between edge and centreline, with no nail closer than 60 mm to end of studs.

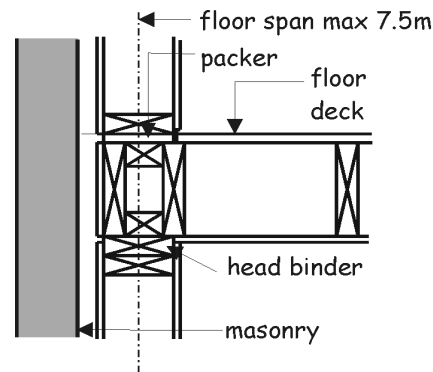


Lintels should be secured to each other with 3.1 mm x 75 mm galvanised screws or 3.1 mm x 75 mm galvanised ringshank nails at 300 mm centres, staggered mid distance between edge and centreline, with no screw closer than 60 mm to end of lintel.



1.E.41 Maximum span of floors

The maximum span for any floor supported by a wall should be 7.5 m, where the span is measured centre to centre of bearing as opposite. Where spans exceed 7.5 m intermediate load bearing walls can be used.



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1.E.42 Other loading conditions

- vertical loading on walls from timber floors and flat roofs designed in accordance with annex 1.F, timber roof trusses;
- combined *dead load* and *imposed load* should be not more than 70 kN/m at base of wall;
- timber frame walls should commence above ground level and therefore are not subject to lateral loads other than from wind.

1.E.43 End restraint

The *wind load* is resisted primarily by transfer directly to the *foundations* at the base of the wall and by the racking resistance of the timber frame supporting walls, the load having been transferred via the floor and ceiling diaphragms.

The ends of every wall should be securely tied throughout their full height to the walls which are providing the racking resistance.

The *external walls* which are perpendicular to the walls which are subject to the *wind load* provide lateral support and should be designed as racking walls.

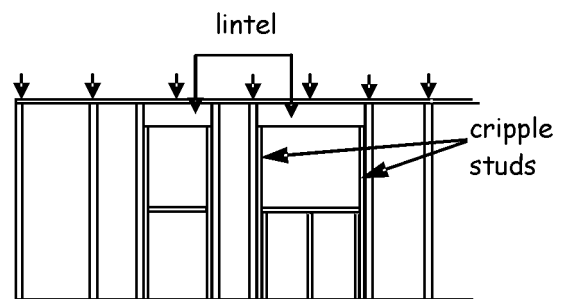
Internal walls can be used to provide additional racking resistance as in clause 1.E.19.

1.E.44 Openings, notching and drilling

The number, size and position of openings should not impair the stability of a wall or the lateral support afforded to a supported wall. *Construction* over openings should be supported.

1.E.45 Framing of openings

Loads over openings in timber frame wall panels are carried independently by timber lintels which should be supported by cripple studs as shown below.



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1.E.46 Dimensional criteria for openings

The dimensional criteria are given in the diagram to clause 1.E.17.

Openings in walls below ground floor should be limited to small holes for services and ventilation etc. not more than 0.1 m^2 and at least 2 m apart.

1.E.47 Small unframed openings

The size and position of small openings above ground floor level should be restricted as follows:

- not more than 250 mm in diameter or in length of side; and
- the clear distance between openings should be at least the greatest dimension of the openings; and
- the clear distance between the edge of sheathing and the edge of any opening should be at least the greatest dimension of the opening; and
- not more than one such opening should occur in any one 600 mm width of sheathing or lining.

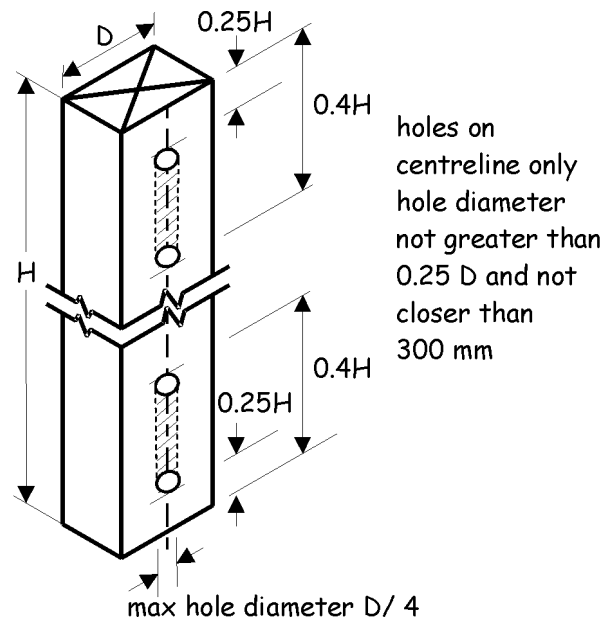
Smaller unframed openings may occur to a greater extent, but their aggregate opening area should be not more than the total area of opening given in item a. and the position of these openings should be as above.

1.E.48 Notching & drilling

Holes should be within the limits set out opposite and as follows:

- holes should be drilled at the neutral axis;
- holes should be at least 300 mm apart.

There should not be any notching of wall studs, cripple studs or lintels.



1.E.49 Lateral support by roofs and floors

The wall panels in each *storey* of a *building* should extend to the full height of that *storey*, and be connected to the floors and roofs to provide diaphragm action and transfer lateral forces from the walls to the racking walls and:

- the floor deck of intermediate floors should be fixed directly to the top faces of the joists; and
- for pitched roofs, the plasterboard ceiling of the top *storey* should be fixed directly under the roof, together with the roof bracing as recommended in clause 1.B.2; and
- be secured to the supported wall by connections recommended in clause 1.E.40;
- spandrel panels should be tied into roof bracing with dwangs placed between vertical elements of the spandrel at a level to accommodate the bracing elements fixed by at least $3.1 \text{ mm} \times 75 \text{ mm}$ screws (refer to clause 1.B.2).

1.E.50 Differential movement

Allowance should be made for differential movement between timber and masonry *construction* particularly vertical movement between timber frame walls and masonry cladding or stair enclosures. The allowances shown below are based upon:

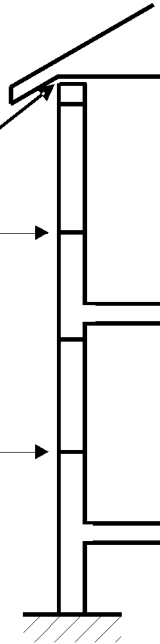
- a. conventional platform frame *construction*; and
- b. concrete ground floor; and
- c. intermediate floor joists not more than 200 mm depth; and
- d. installed timber moisture content of 20% drying to 10%.

allowance at eaves and verge

15 mm - two storeys
8 mm - single storey

11 mm at bottom of openings at first floor level

3 mm at bottom of openings at ground floor level



If timber ground floors are used, 8 mm should be added to all of the allowances shown above.

For a timber frame extension which is connected to an existing traditional masonry wall, the roof to the extension should be supported on a timber bearer connected to the existing wall to minimise the differential movement between the existing and new *construction*.

Annex

1.F Timber floors and roof members

- 1.F.0 Introduction
- 1.F.1 Explanation of terms
- 1.F.2 The use of this annex
- 1.F.3 Common species/grade combinations satisfying the strength classes
- 1.F.4 Notches and holes
- 1.F.5 Strutting to joists
- 1.F.6 Dead floor and roof loads
- 1.F.7 Imposed roof loads including snow
- 1.F.8 Spans, sizes and centres for timber members
- 1.F.9 Floor joists
- 1.F.10 Joists for flat roofs with access only for the purposes of maintenance or repair
- 1.F.11 Joists for flat roofs access not limited to maintenance or repair purposes
- 1.F.12 Raised tie roof
- 1.F.13 Collared roof
- 1.F.14 Connection details for raised tied and collared roofs
- 1.F.15 Openings for stairs
- 1.F.16 Supports to non load-bearing partitions

1.F.0 Introduction

This annex applies only to *domestic buildings* but restricted to *houses* of not more than 3 storeys.

1.F.1 Explanation of terms

The following terms are used in annex 1.F in addition to the definitions and explanation of terms in Appendix A of the Technical Handbooks

Trimming joist means a joist which for part or all of its length forms the edge of an opening (such as a stair well) and supports the end of a trimmer joist.

Trimmer joist means a joist supported at one or both ends by a trimming joist and supporting the ends of trimmed joists.

1.F.2 The use of this annex

This annex should be used in conjunction with annex 1.B. The guidance given in this annex assumes that:

- a. the *dead loads* and *imposed loads* to be supported by the floor, ceiling or roof of which the member forms part, are not more than the values given in the notes to the diagrams and tables; and
- b. the species and grade of timber for the strength class to which the table to clause 1.F.3 relates is either as in clause 1.F.3 for more common species, or as in the more comprehensive tables of BS 5268-2: 2002; and
- c. that floorboarding is in accordance with BS 1297: 1987 or moisture resistant wood chipboard type P5 in accordance with BS EN 312: 2003; and
- d. the strength classes, species, grades and species combinations are as defined in BS 5268-2: 2002; and
- e. the cross sectional dimensions are:
 - CLS or ALS sizes in accordance with BS EN 336: 2003, Table NA.5, tolerance class 2;
 - equivalent timbers to dimensions in accordance with BS EN 336: 2003, Table NA.4, tolerance class 2 but at least the dimensions above

The tables do not apply where these dimensions have been reduced in the case of the tables to clause 1.F.9 by planing and in the case of the tables to clause 1.F.10 by planing or regularising. For timber of North American origin the tables only apply as indicated to surfaced sizes unless the timber has been resawn to BS EN 336: 2003.

Bearing areas and workmanship should be in accordance with BS 5268-2: 2002. Refer also to clauses 1.D.35-37 or clause 1.E.49 respectively for masonry and timber frame walls.

Where trussed rafters are used, reference should be made to BS 5268-3: 2006 for design and bracing recommendations subject to the following:

- a. joints should be by means of punched metal plates with integral teeth; and
- b. rafter types should be restricted to prefabricated duo or mono pitch fink trussed rafters; and
- c. roof plan shape should be either square or rectangular; and
- d. the *roof space* is not for living accommodation; and
- e. roof members which impose point loads onto walls (e.g. hip and girder trusses) should not be used without specialist advice from chartered engineers or appropriately qualified persons; and
- f. members of trussed rafters should not be cut, trimmed, notched or otherwise altered.

1.F.3 Common species/grade combinations satisfying the strength classes

| Species | Origin | Grade rule | Grades to satisfy strength | |
|--|--------|---------------------------------------|---|---|
| | | | C16 | C24 |
| All species listed in this table | | BS EN 519: 1995 machine graded to C16 | machine graded to C24 | |
| Imported Redwood or Whitewood | | BS 4978: 1996 | GS | SS |
| Douglas Fir, Larch, British Pine, British Spruce | UK | BS 4978: 1996 | SS | x |
| Douglas Fir-Larch, Hem-Fir, Spruce-Pine-Fir, | Canada | BS 4978: 1996 | GS | SS |
| Sitka spruce | | | SS | x |
| Douglas Fir-Larch Hem-Fir Spruce-Pine-Fir | Canada | NLGA[2] | Joist & plank No 1 & 2 Structural L.F. No 1 & 2 | Joist & plank select Structural L.F. select |
| Sitka spruce | | | Joist & plank select Structural L.F. | x |
| Douglas Fir-Larch, Hem-Fir, Spruce-Pine-Fir | Canada | MSR[2] | 1450f-1.3E | 1800f-1.6E |
| | | | 1450f-1.3E | 1800f-1.6E |
| Douglas Fir-Larch Hem-Fir, Southern Pine, Spruce-Pine-Fir Western Whitewoods | USA | BS 4978: 1996 | GS | SS |
| | | | GS | SS |
| | | | GS | SS |
| | | | SS | x |
| Douglas Fir-Larch, Hem-Fir Spruce-Pine-Fir | USA | NGRDL[2] | Joist & plank No 1 & 2 Structural L.F. No 1 & 2 | Joist & plank select Structural L.F. select |
| Western Whitewoods | | | Joist & plank No 1 & 2 Structural L.F. No 1 & 2 | Joist & plank select Structural L.F. select |
| Southern Pine | | | Joist & plank select Structural L.F. | x |
| | | | Joist & plank No 3 Stud grade | Joist & plank select |
| Douglas Fir-Larch, Hem-Fir, Southern Pine, Spruce-Pine-Fir | USA | MSR[2] | 1450f-1.3E | 1800f-1.6E |

Notes:

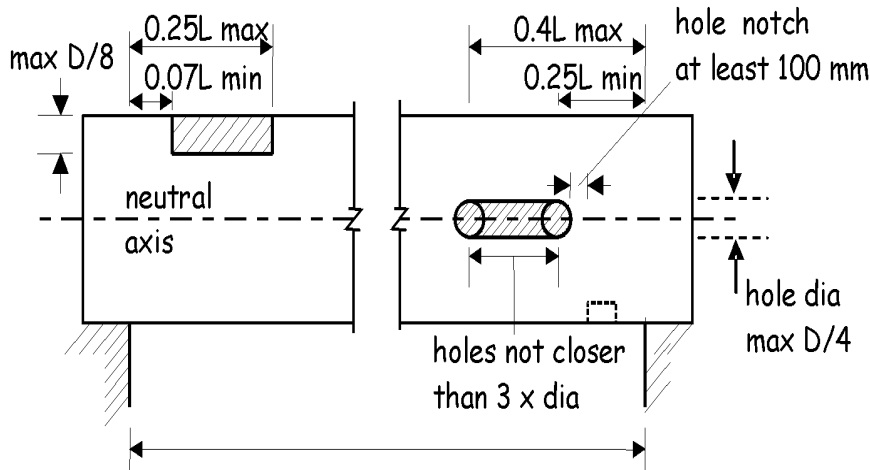
1. The species/grade combinations given in this table are for particular use with the other tables in this annex and for the cross section sizes given in those tables.
2. The grading rules for American and Canadian Lumber are those approved by the American Lumber Standards Board of Review and the Canadian Lumber Standards Accreditation Board respectively.
3. Comprehensive tables for species/grade combinations for strength classes are given in BS 5268-2: 2002

1.F.4 Notches and holes

Floor and flat roof joists

Notches and holes in simply supported floor and *flat roof* joists should be within the following limits:

- holes should only be drilled at the neutral axis; and
- notches and holes should be at least 100 mm apart horizontally; and
- notches may be at the top or bottom of a joist but not coinciding.



Raised tie and collared roof members

Notches and holes should not be cut in rafters, ties, collars or hangers.

Trussed rafter members

Members of trussed rafters should not be cut, trimmed, notched or otherwise altered.

1.F.5 Strutting to joists

Floor joists spanning more than 2.5 m should be strutted by one or more rows of solid timber strutting as listed in the following table. Solid timber strutting should be at least 38 mm thick extending at least 3/4 depth of joist.

| Joist span (m) | Number of rows of strutting | Position |
|----------------|-----------------------------|-------------|
| Less than 2.5 | none | N/A |
| 2.5 to 4.5 | 1 | at mid span |
| more than 4.5 | 2 | at 1/3 span |

1.F.6 Dead floor and roof loads

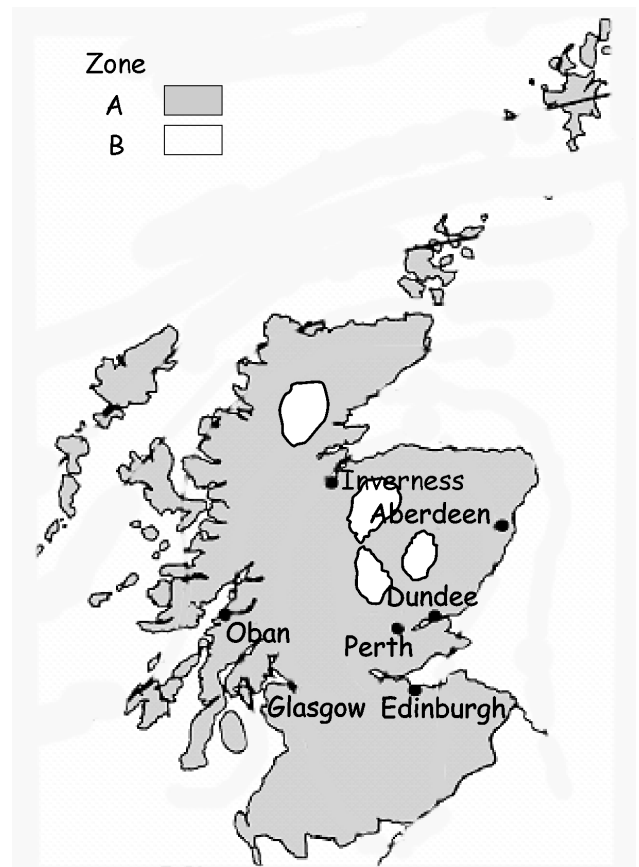
The table below gives indications of typical *dead loads* on floors and roofs.

| Construction | Dead load (kN/m ²) |
|--|--------------------------------|
| Floors | |
| Floor boards, 12.5 mm plasterboard | 0.22 |
| Floor boards, 19 mm plasterboard | 0.27 |
| Floating floor, 18 mm plywood deck, 100 mm quilt insulation, 12.5 mm plasterboard and 19 mm plasterboard | 0.66 |
| Flat roofs | |
| 3 layer felt, 120 mm rigid insulation, vapour layer, 18 mm plywood decking and 12.5 mm plasterboard | 0.38 |
| 13 mm chippings, 3 layer felt, 120 mm rigid insulation, vapour layer, 22 mm plywood decking and 12.5 mm plasterboard | 0.63 |
| Pitched roof | |
| Concrete tiles, battens and sarking | 0.75 |

Note that the above are based on 600 mm joist centres and excludes the weight of the joists, partitioning and rafters.

1.F.7 Imposed roof loads including snow

The map opposite indicates the zones within Scotland where the snow loading should be not more than the values in the table below, depending on geographical location and altitude.



This guidance applies only to pitched and *flat roofed* structures with the roof on one level only, within the limits set out on the tables to clauses 1.F.9-13, provided that there are no other *buildings* within 1.5 m of its perimeter but does not apply to trussed rafter roofs.

For all other circumstances, reference should be made to BS 6399-3: 1988.

Imposed roof loads (kN/m²)

| Zone | Altitude below 100 m | Altitude between 100m and 200 m | Altitude between 200 m and 260 m |
|------|----------------------|---------------------------------|----------------------------------|
| A | 0.75 | 1.00 | Refer to BS 6399-3: 1988 |
| B | 1.00 | 1.50 | 1.50 |

1.F.8 Spans, sizes and centres for timber members

The following table refers to further tables and diagrams with accompanying notes that give spans, sizes and centres for certain timber floor, *flat roof* and pitched roof members. In clauses 1.F.9-13 all spans, except those for floorboards, are measured as the clear dimensions between supports.

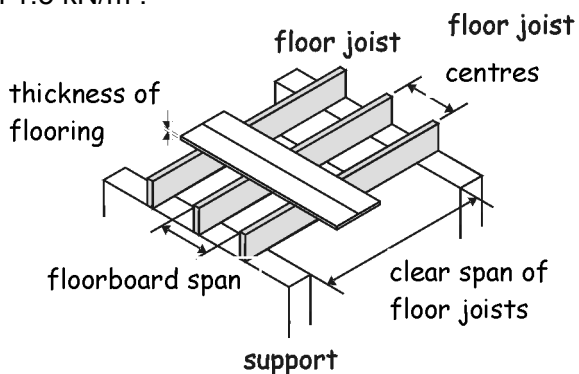
Key to tables relating to timber members

| Construction | Timber members | Table number for strength classes | |
|---|----------------|-----------------------------------|--------|
| | | C16 | C24 |
| Floors | Joists | 1.F.9 | 1.F.9 |
| <i>Flat roofs</i> - access for maintenance only | Joists | 1.F.10 | 1.F.10 |
| <i>Flat roofs</i> - full access allowed | Joists | 1.F.11 | 1.F.11 |
| Raised tie roofs | All | 1.F.12 | 1.F.12 |
| Collared roofs | All | 1.F.13 | 1.F.13 |

1.F.9 Floor joists

The tables below give sizes, centres and spans for floor joists which should support the *dead loads* given in the tables and an *imposed load* not more than 1.5 kN/m²:

- partition loads have not been allowed for (refer to clause 1.F.16);
- softwood tongued and grooved floorboards, if supported at joist centres of up to 450 mm, should be at least 16 mm thick; and if supported at wider centres not more than 600 mm, should be at least 19 mm thick;
- wood chipboard, type P5, if supported at joist centres of not more than 450 mm, should be at least 18 mm thick and if supported at wider centres up to 600 mm, should be at least 22 mm thick;
- floor joists selected from these tables may be used for intermediate floors in timber frame *construction* but will require header joists around the perimeter;
- T & G chipboard flooring should be fixed by 3.35 mm x 65 mm angular ring shank nails at 200 mm centres around the perimeter and 300 mm centres intermediately and glued with PVA adhesive between boards and joists to boards to prevent creaking (per BS 8103-3: 1996).



**Permissible clear spans, in metres, of joists supporting floors with no partitions
Timber strength class C16**

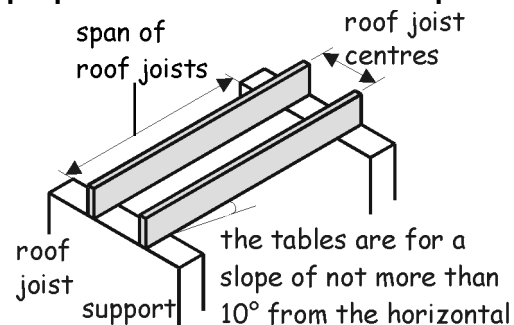
| Size of joist (mm x mm) | Dead load not more than 0.25 kN/m ² | | | Dead load more than 0.25 but not more than 0.50 kN/m ² | | | Dead load more than 0.50 but not more than 1.25 kN/m ² | | |
|----------------------------|--|------|------|---|------|------|---|------|------|
| | Joist centres (mm) | | | | | | | | |
| | 400 | 450 | 600 | 400 | 450 | 600 | 400 | 450 | 600 |
| BS EN 336: 2003 sizes | | | | | | | | | |
| 38 x 97 | 1.83 | 1.69 | 1.30 | 1.72 | 1.56 | 1.21 | 1.42 | 1.30 | 1.04 |
| 38 x 122 | 2.48 | 2.39 | 1.93 | 2.37 | 2.22 | 1.76 | 1.95 | 1.79 | 1.45 |
| 38 x 147 | 2.98 | 2.87 | 2.51 | 2.85 | 2.71 | 2.33 | 2.45 | 2.29 | 1.87 |
| 38 x 170 | 3.44 | 3.31 | 2.87 | 3.28 | 3.10 | 2.69 | 2.81 | 2.65 | 2.27 |
| 38 x 195 | 3.94 | 3.75 | 3.26 | 3.72 | 3.52 | 3.06 | 3.19 | 3.01 | 2.61 |
| 38 x 220 | 4.43 | 4.19 | 3.65 | 4.16 | 3.93 | 3.42 | 3.57 | 3.37 | 2.92 |
| 47 x 72 | 1.32 | 1.23 | 0.94 | 1.27 | 1.15 | 0.89 | 1.09 | 0.99 | 0.78 |
| 47 x 97 | 2.02 | 1.91 | 1.58 | 1.92 | 1.81 | 1.46 | 1.67 | 1.53 | 1.23 |
| 47 x 122 | 2.66 | 2.56 | 2.30 | 2.55 | 2.45 | 2.09 | 2.26 | 2.08 | 1.70 |
| 47 x 147 | 3.20 | 3.08 | 2.79 | 3.06 | 2.95 | 2.61 | 2.72 | 2.57 | 2.17 |
| 47 x 170 | 3.69 | 3.55 | 3.19 | 3.53 | 3.40 | 2.99 | 3.12 | 2.94 | 2.55 |
| 47 x 195 | 4.22 | 4.06 | 3.62 | 4.04 | 3.89 | 3.39 | 3.54 | 3.34 | 2.90 |
| 47 x 220 | 4.72 | 4.57 | 4.04 | 4.55 | 4.35 | 3.79 | 3.95 | 3.74 | 3.24 |
| 63 x 97 | 2.32 | 2.20 | 1.92 | 2.19 | 2.08 | 1.82 | 1.93 | 1.84 | 1.53 |
| 63 x 122 | 2.93 | 2.82 | 2.57 | 2.81 | 2.70 | 2.45 | 2.53 | 2.43 | 2.09 |
| 63 x 147 | 3.52 | 3.39 | 3.08 | 3.37 | 3.24 | 2.95 | 3.04 | 2.92 | 2.58 |
| 63 x 170 | 4.06 | 3.91 | 3.56 | 3.89 | 3.74 | 3.40 | 3.50 | 3.37 | 2.95 |
| 63 x 195 | 4.63 | 4.47 | 4.07 | 4.44 | 4.28 | 3.90 | 4.01 | 3.85 | 3.35 |
| 63 x 220 | 5.06 | 4.92 | 4.58 | 4.91 | 4.77 | 4.37 | 4.51 | 4.30 | 3.75 |
| 75 x 122 | 3.10 | 2.99 | 2.72 | 2.97 | 2.86 | 2.60 | 2.68 | 2.58 | 2.33 |
| 75 x 147 | 3.72 | 3.58 | 3.27 | 3.56 | 3.43 | 3.13 | 3.22 | 3.09 | 2.81 |
| 75 x 170 | 4.28 | 4.13 | 3.77 | 4.11 | 3.96 | 3.61 | 3.71 | 3.57 | 3.21 |
| 75 x 195 | 4.83 | 4.70 | 4.31 | 4.68 | 4.52 | 4.13 | 4.24 | 4.08 | 3.65 |
| 75 x 220 | 5.27 | 5.13 | 4.79 | 5.11 | 4.97 | 4.64 | 4.74 | 4.60 | 4.07 |
| CLS/ALS sizes | | | | | | | | | |
| 38 x 89 | 1.62 | 1.46 | 1.12 | 1.50 | 1.36 | 1.05 | 1.26 | 1.15 | 0.91 |
| 38 x 140 | 2.84 | 2.73 | 2.40 | 2.72 | 2.59 | 2.17 | 2.33 | 2.15 | 1.75 |
| 38 x 184 | 3.72 | 3.56 | 3.09 | 3.53 | 3.33 | 2.90 | 3.02 | 2.85 | 2.47 |
| 38 x 235 | 4.71 | 4.46 | 3.89 | 4.43 | 4.18 | 3.64 | 3.80 | 3.59 | 3.11 |

**Permissible clear spans, in metres, of joists supporting floors with no partitions
Timber strength class C24**

| Size of joist (mm x mm) | Dead load not more than 0.25 kN/m ² | | | Dead load more than 0.25 but not more than 0.50 kN/m ² | | | Dead load more than 0.50 but not more than 1.25 kN/m ² | | |
|----------------------------|--|------|------|---|------|------|---|------|------|
| | Joist centres(mm) | | | | | | | | |
| | 400 | 450 | 600 | 400 | 450 | 600 | 400 | 450 | 600 |
| BS EN 336: 2003 sizes | | | | | | | | | |
| 38 x 97 | 1.94 | 1.83 | 1.59 | 1.84 | 1.74 | 1.51 | 1.64 | 1.55 | 1.36 |
| 38 x 122 | 2.58 | 2.48 | 2.20 | 2.47 | 2.37 | 2.08 | 2.18 | 2.07 | 1.83 |
| 38 x 147 | 3.10 | 2.98 | 2.71 | 2.97 | 2.85 | 2.59 | 2.67 | 2.56 | 2.31 |
| 38 x 170 | 3.58 | 3.44 | 3.13 | 3.43 | 3.29 | 2.99 | 3.08 | 2.96 | 2.68 |
| 38 x 195 | 4.10 | 3.94 | 3.58 | 3.92 | 3.77 | 3.42 | 3.53 | 3.39 | 3.07 |
| 38 x 220 | 4.61 | 4.44 | 4.03 | 4.41 | 4.25 | 3.86 | 3.97 | 3.82 | 3.46 |
| 47 x 72 | 1.40 | 1.32 | 1.14 | 1.35 | 1.27 | 1.10 | 1.22 | 1.16 | 1.01 |
| 47 x 97 | 2.14 | 2.03 | 1.76 | 2.03 | 1.92 | 1.68 | 1.80 | 1.71 | 1.50 |
| 47 x 122 | 2.77 | 2.66 | 2.42 | 2.65 | 2.55 | 2.29 | 2.38 | 2.27 | 2.01 |
| 47 x 147 | 3.33 | 3.20 | 2.91 | 3.19 | 3.06 | 2.78 | 2.87 | 2.75 | 2.50 |
| 47 x 170 | 3.84 | 3.69 | 3.36 | 3.67 | 3.54 | 3.21 | 3.31 | 3.18 | 2.88 |
| 47 x 195 | 4.39 | 4.22 | 3.85 | 4.20 | 4.05 | 3.68 | 3.79 | 3.64 | 3.30 |
| 47 x 220 | 4.86 | 4.73 | 4.33 | 4.71 | 4.55 | 4.14 | 4.26 | 4.10 | 3.72 |
| 63 x 97 | 2.43 | 2.32 | 2.03 | 2.31 | 2.19 | 1.93 | 2.03 | 1.93 | 1.71 |
| 63 x 122 | 3.05 | 2.93 | 2.67 | 2.92 | 2.81 | 2.55 | 2.63 | 2.53 | 2.27 |
| 63 x 147 | 3.67 | 3.52 | 3.21 | 3.50 | 3.37 | 3.07 | 3.16 | 3.04 | 2.76 |
| 63 x 170 | 4.21 | 4.06 | 3.70 | 4.04 | 3.89 | 3.54 | 3.64 | 3.51 | 3.19 |
| 63 x 195 | 4.77 | 4.64 | 4.23 | 4.61 | 4.45 | 4.05 | 4.17 | 4.01 | 3.65 |
| 63 x 220 | 5.20 | 5.06 | 4.73 | 5.05 | 4.91 | 4.56 | 4.68 | 4.51 | 4.11 |
| 75 x 122 | 3.22 | 3.10 | 2.83 | 3.09 | 2.97 | 2.71 | 2.78 | 2.68 | 2.43 |
| 75 x 147 | 3.86 | 3.72 | 3.39 | 3.70 | 3.57 | 3.25 | 3.34 | 3.22 | 2.93 |
| 75 x 170 | 4.45 | 4.29 | 3.91 | 4.27 | 4.11 | 3.75 | 3.86 | 3.71 | 3.38 |
| 75 x 195 | 4.97 | 4.83 | 4.47 | 4.82 | 4.69 | 4.29 | 4.41 | 4.25 | 3.86 |
| 75 x 220 | 5.42 | 5.27 | 4.93 | 5.25 | 5.11 | 4.78 | 4.88 | 4.74 | 4.35 |
| CLS/ALS sizes | | | | | | | | | |
| 38 x 89 | 1.71 | 1.62 | 1.40 | 1.63 | 1.54 | 1.34 | 1.46 | 1.39 | 1.20 |
| 38 x 140 | 2.96 | 2.84 | 2.58 | 2.83 | 2.72 | 2.47 | 2.54 | 2.44 | 2.17 |
| 38 x 184 | 3.87 | 3.72 | 3.38 | 3.70 | 3.56 | 3.23 | 3.33 | 3.20 | 2.90 |
| 38 x 235 | 4.85 | 4.71 | 4.31 | 4.70 | 4.54 | 4.12 | 4.24 | 4.08 | 3.70 |

1.F.10 Joists for flat roofs with access only for the purposes of maintenance or repair

The tables below give sizes, centres and spans for *flat roof* joists designed for access only for maintenance which should support the *dead loads* given in the tables and an *imposed load* not more than 0.75 kN/m² or an imposed concentrated load of 0.9 kN.



Permissible clear spans, in metres, of joists for flat roofs with access only for maintenance or repair purposes

Timber strength class C16

| Size of joist (mm x mm) | Dead load not more than 0.25 kN/m ² | | | Dead load more than 0.25 but not more than 0.50 kN/m ² | | | Dead load more than 0.50 but not more than 1.25 kN/m ² | | |
|----------------------------|--|------|------|---|------|------|---|------|------|
| | Joist centres(mm) | | | | | | | | |
| | 400 | 450 | 600 | 400 | 450 | 600 | 400 | 450 | 600 |
| BS EN 336: 2003 sizes | | | | | | | | | |
| 38 x 97 | 1.74 | 1.72 | 1.67 | 1.67 | 1.64 | 1.58 | 1.61 | 1.58 | 1.51 |
| 38 x 122 | 2.37 | 2.34 | 2.25 | 2.25 | 2.21 | 2.11 | 2.16 | 2.11 | 2.01 |
| 38 x 147 | 3.02 | 2.97 | 2.85 | 2.85 | 2.80 | 2.66 | 2.72 | 2.66 | 2.51 |
| 38 x 170 | 3.63 | 3.57 | 3.37 | 3.41 | 3.34 | 3.17 | 3.24 | 3.17 | 2.98 |
| 38 x 195 | 4.30 | 4.23 | 3.86 | 4.03 | 3.94 | 3.63 | 3.81 | 3.72 | 3.45 |
| 38 x 220 | 4.94 | 4.76 | 4.34 | 4.64 | 4.49 | 4.09 | 4.38 | 4.27 | 3.88 |
| 47 x 72 | 1.27 | 1.26 | 1.23 | 1.23 | 1.21 | 1.18 | 1.19 | 1.18 | 1.13 |
| 47 x 97 | 1.92 | 1.90 | 1.84 | 1.84 | 1.81 | 1.74 | 1.77 | 1.74 | 1.65 |
| 47 x 122 | 2.60 | 2.57 | 2.47 | 2.47 | 2.43 | 2.31 | 2.36 | 2.31 | 2.19 |
| 47 x 147 | 3.30 | 3.25 | 3.12 | 3.12 | 3.06 | 2.90 | 2.96 | 2.90 | 2.74 |
| 47 x 170 | 3.96 | 3.89 | 3.61 | 3.72 | 3.64 | 3.40 | 3.53 | 3.44 | 3.23 |
| 47 x 195 | 4.68 | 4.53 | 4.13 | 4.37 | 4.28 | 3.89 | 4.14 | 4.04 | 3.70 |
| 47 x 220 | 5.28 | 5.09 | 4.65 | 4.99 | 4.81 | 4.38 | 4.75 | 4.58 | 4.17 |
| 63 x 97 | 2.19 | 2.16 | 2.09 | 2.09 | 2.06 | 1.97 | 2.01 | 1.97 | 1.87 |
| 63 x 122 | 2.95 | 2.91 | 2.79 | 2.79 | 2.74 | 2.61 | 2.66 | 2.61 | 2.47 |
| 63 x 147 | 3.72 | 3.66 | 3.44 | 3.50 | 3.43 | 3.25 | 3.33 | 3.26 | 3.07 |
| 63 x 170 | 4.44 | 4.35 | 3.97 | 4.16 | 4.07 | 3.74 | 3.95 | 3.85 | 3.56 |
| 63 x 195 | 5.14 | 4.96 | 4.54 | 4.86 | 4.69 | 4.28 | 4.61 | 4.47 | 4.07 |
| 63 x 220 | 5.77 | 5.57 | 5.10 | 5.46 | 5.27 | 4.82 | 5.21 | 5.02 | 4.59 |
| 75 x 122 | 3.17 | 3.12 | 3.00 | 3.00 | 2.94 | 2.80 | 2.86 | 2.80 | 2.65 |
| 75 x 147 | 3.98 | 3.92 | 3.64 | 3.75 | 3.67 | 3.44 | 3.56 | 3.48 | 3.27 |
| 75 x 170 | 4.74 | 4.58 | 4.19 | 4.44 | 4.33 | 3.96 | 4.21 | 4.11 | 3.77 |
| 75 x 195 | 5.42 | 5.23 | 4.79 | 5.13 | 4.95 | 4.53 | 4.89 | 4.72 | 4.31 |
| 75 x 220 | 6.00 | 5.87 | 5.38 | 5.76 | 5.56 | 5.09 | 5.50 | 5.30 | 4.85 |
| CLS/ALS sizes | | | | | | | | | |
| 38 x 89 | 1.54 | 1.53 | 1.48 | 1.48 | 1.46 | 1.41 | 1.43 | 1.41 | 1.35 |
| 38 x 140 | 2.84 | 2.79 | 2.68 | 2.68 | 2.63 | 2.51 | 2.56 | 2.51 | 2.37 |
| 38 x 184 | 4.01 | 3.94 | 3.64 | 3.76 | 3.68 | 3.43 | 3.56 | 3.48 | 3.25 |
| 38 x 235 | 5.27 | 5.08 | 4.63 | 4.98 | 4.79 | 4.36 | 4.73 | 4.56 | 4.14 |

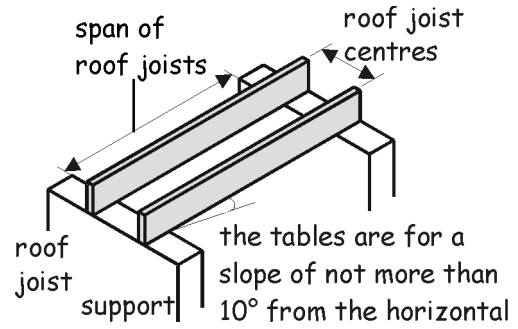
Permissible clear spans, in metres, of joists for flat roofs with access only for maintenance or repair purposes

Timber strength class C24

| Size of joist (mm x mm) | Dead load not more than 0.25 kN/m ² | | | Dead load more than 0.25 but not more than 0.50 kN/m ² | | | Dead load more than 0.50 but not more than 1.25 kN/m ² | | |
|----------------------------|--|------|------|---|------|------|---|------|------|
| | Joist centres (mm) | | | | | | | | |
| | 400 | 450 | 600 | 400 | 450 | 600 | 400 | 450 | 600 |
| BS EN 336: 2003 sizes | | | | | | | | | |
| 38 x 97 | 1.84 | 1.82 | 1.76 | 1.76 | 1.73 | 1.66 | 1.69 | 1.66 | 1.59 |
| 38 x 122 | 2.50 | 2.46 | 2.37 | 2.37 | 2.33 | 2.22 | 2.27 | 2.22 | 2.11 |
| 38 x 147 | 3.18 | 3.13 | 3.00 | 3.00 | 2.94 | 2.79 | 2.85 | 2.79 | 2.64 |
| 38 x 170 | 3.81 | 3.75 | 3.50 | 3.58 | 3.51 | 3.30 | 3.40 | 3.32 | 3.12 |
| 38 x 195 | 4.51 | 4.40 | 4.01 | 4.22 | 4.13 | 3.78 | 3.99 | 3.90 | 3.59 |
| 38 x 220 | 5.13 | 4.95 | 4.51 | 4.85 | 4.67 | 4.25 | 4.59 | 4.44 | 4.04 |
| 47 x 72 | 1.35 | 1.33 | 1.30 | 1.30 | 1.28 | 1.24 | 1.26 | 1.24 | 1.19 |
| 47 x 97 | 2.03 | 2.00 | 1.94 | 1.94 | 1.91 | 1.83 | 1.86 | 1.83 | 1.74 |
| 47 x 122 | 2.74 | 2.70 | 2.60 | 2.60 | 2.55 | 2.43 | 2.48 | 2.43 | 2.30 |
| 47 x 147 | 3.47 | 3.42 | 3.26 | 3.27 | 3.21 | 3.04 | 3.11 | 3.04 | 2.87 |
| 47 x 170 | 4.15 | 4.08 | 3.76 | 3.89 | 3.81 | 3.54 | 3.69 | 3.61 | 3.36 |
| 47 x 195 | 4.88 | 4.70 | 4.29 | 4.58 | 4.44 | 4.05 | 4.33 | 4.22 | 3.85 |
| 47 x 220 | 5.48 | 5.29 | 4.83 | 5.18 | 5.00 | 4.56 | 4.94 | 4.76 | 4.33 |
| 63 x 97 | 2.31 | 2.28 | 2.20 | 2.20 | 2.16 | 2.07 | 2.11 | 2.07 | 1.97 |
| 63 x 122 | 3.10 | 3.05 | 2.93 | 2.93 | 2.88 | 2.74 | 2.80 | 2.74 | 2.59 |
| 63 x 147 | 3.90 | 3.84 | 3.58 | 3.67 | 3.60 | 3.38 | 3.49 | 3.41 | 3.21 |
| 63 x 170 | 4.65 | 4.51 | 4.12 | 4.35 | 4.26 | 3.89 | 4.13 | 4.03 | 3.70 |
| 63 x 195 | 5.33 | 5.15 | 4.71 | 5.05 | 4.87 | 4.45 | 4.82 | 4.64 | 4.24 |
| 63 x 220 | 5.98 | 5.78 | 5.30 | 5.67 | 5.47 | 5.00 | 5.41 | 5.22 | 4.76 |
| 75 x 122 | 3.33 | 3.27 | 3.14 | 3.14 | 3.08 | 2.93 | 2.99 | 2.93 | 2.77 |
| 75 x 147 | 4.17 | 4.10 | 3.78 | 3.92 | 3.84 | 3.57 | 3.73 | 3.64 | 3.40 |
| 75 x 170 | 4.92 | 4.75 | 4.35 | 4.64 | 4.50 | 4.11 | 4.40 | 4.29 | 3.92 |
| 75 x 195 | 5.61 | 5.42 | 4.97 | 5.32 | 5.14 | 4.70 | 5.08 | 4.90 | 4.48 |
| 75 x 220 | 6.00 | 6.00 | 5.59 | 5.97 | 5.77 | 5.28 | 5.70 | 5.50 | 5.04 |
| CLS/ALS sizes | | | | | | | | | |
| 38 x 89 | 1.63 | 1.62 | 1.57 | 1.57 | 1.55 | 1.49 | 1.51 | 1.49 | 1.42 |
| 38 x 140 | 2.99 | 2.94 | 2.82 | 2.82 | 2.77 | 2.63 | 2.69 | 2.63 | 2.49 |
| 38 x 184 | 4.21 | 4.13 | 3.79 | 3.94 | 3.85 | 3.57 | 3.73 | 3.64 | 3.39 |
| 38 x 235 | 5.47 | 5.28 | 4.81 | 5.17 | 4.98 | 4.54 | 4.92 | 4.74 | 4.31 |

1.F.11 Joists for flat roofs access not limited to maintenance or repair purposes

The tables below give sizes, centres and spans for *flat roof* joists designed for access not limited to maintenance or repair purposes which should support the *dead loads* given in the Tables and an *imposed load* not more than 1.5 kN/m^2 or an imposed concentrated load of 1.8 kN .



Permissible clear spans, in metres, of joists for flat roofs with access not limited to maintenance or repair purposes

Timber strength class C16

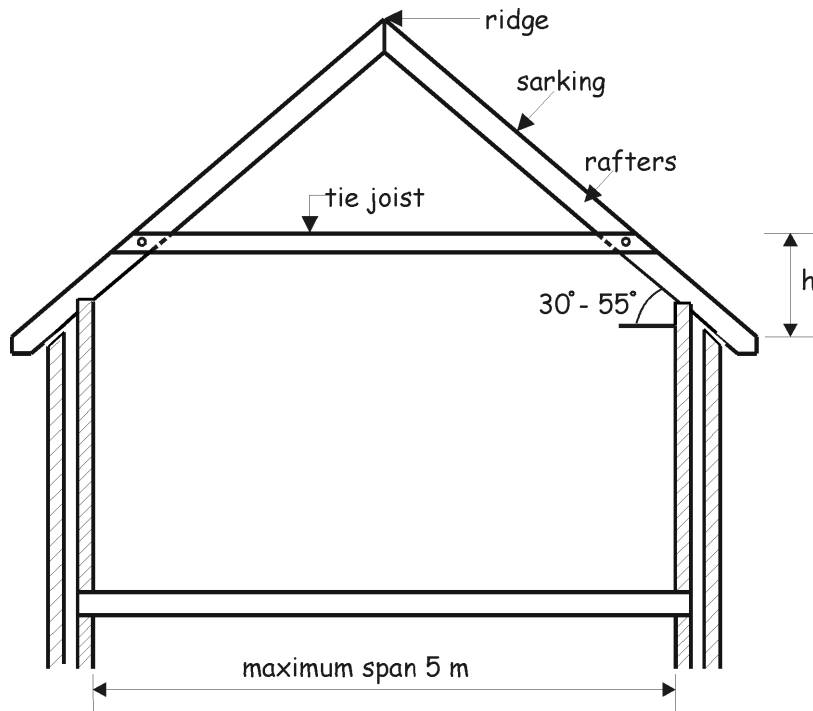
| Size of joist (mm x mm) | Dead load not more than 0.25 kN/m ² | | | Dead load more than 0.25 but not more than 0.50 kN/m ² | | | Dead load more than 0.50 but not more than 1.25 kN/m ² | | |
|----------------------------|--|------|------|---|------|------|---|------|------|
| | Joist centres(mm) | | | | | | | | |
| | 400 | 450 | 600 | 400 | 450 | 600 | 400 | 450 | 600 |
| BS EN 336: 2003 sizes | | | | | | | | | |
| 38 x 97 | 1.21 | 1.20 | 1.18 | 1.18 | 1.16 | 1.13 | 1.15 | 1.13 | 1.09 |
| 38 x 122 | 1.80 | 1.79 | 1.74 | 1.74 | 1.71 | 1.65 | 1.68 | 1.65 | 1.57 |
| 38 x 147 | 2.35 | 2.33 | 2.27 | 2.27 | 2.25 | 2.18 | 2.21 | 2.18 | 2.09 |
| 38 x 170 | 2.88 | 2.85 | 2.77 | 2.77 | 2.74 | 2.64 | 2.68 | 2.64 | 2.53 |
| 38 x 195 | 3.47 | 3.43 | 3.29 | 3.33 | 3.28 | 3.16 | 3.21 | 3.16 | 3.02 |
| 38 x 220 | 4.08 | 4.03 | 3.71 | 3.90 | 3.84 | 3.56 | 3.75 | 3.68 | 3.43 |
| 47 x 72 | 0.87 | 0.86 | 0.85 | 0.85 | 0.84 | 0.83 | 0.83 | 0.83 | 0.80 |
| 47 x 97 | 1.44 | 1.43 | 1.40 | 1.40 | 1.36 | 1.36 | 1.38 | 1.36 | 1.21 |
| 47 x 122 | 2.00 | 1.99 | 1.94 | 1.94 | 1.93 | 1.87 | 1.89 | 1.87 | 1.81 |
| 47 x 147 | 2.60 | 2.58 | 2.51 | 2.51 | 2.48 | 2.40 | 2.44 | 2.40 | 2.31 |
| 47 x 170 | 3.18 | 3.14 | 3.06 | 3.06 | 3.02 | 2.91 | 2.95 | 2.91 | 2.78 |
| 47 x 195 | 3.82 | 3.78 | 3.54 | 3.66 | 3.61 | 3.40 | 3.52 | 3.46 | 3.28 |
| 47 x 220 | 4.48 | 4.38 | 3.99 | 4.27 | 4.20 | 3.83 | 4.10 | 4.03 | 3.70 |
| 63 x 97 | 1.67 | 1.66 | 1.63 | 1.63 | 1.61 | 1.57 | 1.59 | 1.57 | 1.53 |
| 63 x 122 | 2.31 | 2.29 | 2.24 | 2.24 | 2.21 | 2.15 | 2.17 | 2.15 | 2.07 |
| 63 x 147 | 2.98 | 2.95 | 2.87 | 2.87 | 2.84 | 2.74 | 2.78 | 2.74 | 2.63 |
| 63 x 170 | 3.62 | 3.59 | 3.41 | 3.48 | 3.43 | 3.28 | 3.36 | 3.30 | 3.16 |
| 63 x 195 | 4.34 | 4.29 | 3.90 | 4.15 | 4.08 | 3.75 | 3.99 | 3.92 | 3.62 |
| 63 x 220 | 5.00 | 4.82 | 4.39 | 4.82 | 4.64 | 4.22 | 4.62 | 4.48 | 4.08 |
| 75 x 122 | 2.50 | 2.48 | 2.42 | 2.42 | 2.40 | 2.32 | 2.35 | 2.32 | 2.24 |
| 75 x 147 | 3.23 | 3.19 | 3.11 | 3.11 | 3.07 | 2.96 | 3.00 | 2.96 | 2.84 |
| 75 x 170 | 3.91 | 3.87 | 3.61 | 3.75 | 3.69 | 3.47 | 3.61 | 3.55 | 3.35 |
| 75 x 195 | 4.66 | 4.53 | 4.13 | 4.45 | 4.36 | 3.97 | 4.28 | 4.20 | 3.84 |
| 75 x 220 | 5.28 | 5.09 | 4.65 | 5.09 | 4.90 | 4.47 | 4.92 | 4.74 | 4.32 |
| CLS/ALS sizes | | | | | | | | | |
| 38 x 89 | 1.04 | 1.03 | 1.01 | 1.01 | 1.00 | 0.98 | 0.99 | 0.98 | 0.95 |
| 38 x 140 | 2.19 | 2.17 | 2.12 | 2.12 | 2.10 | 2.04 | 2.07 | 2.04 | 1.94 |
| 38 x 184 | 3.21 | 3.17 | 3.08 | 3.08 | 3.04 | 2.93 | 2.98 | 2.93 | 2.80 |
| 38 x 235 | 4.45 | 4.36 | 3.96 | 4.24 | 4.18 | 3.80 | 4.07 | 4.00 | 3.65 |

Permissible clear spans, in metres, of joists for flat roofs with access not limited to maintenance or repair purposes
Timber strength class C24

| Size of joist (mm x mm) | Dead load not more than 0.25 kN/m ² | | | Dead load more than 0.25 but not more than 0.50 kN/m ² | | | Dead load more than 0.50 but not more than 1.25 kN/m ² | | |
|----------------------------|--|------|------|---|------|------|---|------|------|
| | Joist centres (mm) | | | | | | | | |
| | 400 | 450 | 600 | 400 | 450 | 600 | 400 | 450 | 600 |
| BS EN 336: 2003 sizes | | | | | | | | | |
| 38 x 97 | 1.37 | 1.36 | 1.34 | 1.34 | 1.33 | 1.30 | 1.31 | 1.30 | 1.26 |
| 38 x 122 | 1.91 | 1.90 | 1.86 | 1.86 | 1.84 | 1.79 | 1.81 | 1.79 | 1.73 |
| 38 x 147 | 2.49 | 2.46 | 2.40 | 2.40 | 2.38 | 2.30 | 2.33 | 2.30 | 2.21 |
| 38 x 170 | 3.04 | 3.01 | 2.93 | 2.93 | 2.89 | 2.79 | 2.83 | 2.79 | 2.67 |
| 38 x 195 | 3.66 | 3.62 | 3.43 | 3.51 | 3.46 | 3.29 | 3.38 | 3.33 | 3.18 |
| 38 x 220 | 4.30 | 4.25 | 3.86 | 4.10 | 4.04 | 3.71 | 3.94 | 3.87 | 3.58 |
| 47 x 72 | 0.98 | 0.98 | 0.97 | 0.97 | 0.96 | 0.94 | 0.95 | 0.94 | 0.92 |
| 47 x 97 | 1.53 | 1.52 | 1.49 | 1.49 | 1.48 | 1.44 | 1.46 | 1.44 | 1.40 |
| 47 x 122 | 2.12 | 2.10 | 2.06 | 2.06 | 2.04 | 1.98 | 2.00 | 1.98 | 1.91 |
| 47 x 147 | 2.75 | 2.73 | 2.66 | 2.66 | 2.62 | 2.54 | 2.57 | 2.54 | 2.44 |
| 47 x 170 | 3.35 | 3.32 | 3.22 | 3.22 | 3.18 | 3.06 | 3.11 | 3.06 | 2.93 |
| 47 x 195 | 4.03 | 3.98 | 3.68 | 3.85 | 3.80 | 3.54 | 3.71 | 3.64 | 3.42 |
| 47 x 220 | 4.71 | 4.56 | 4.15 | 4.49 | 4.39 | 3.99 | 4.31 | 4.23 | 3.85 |
| 63 x 97 | 1.77 | 1.75 | 1.72 | 1.72 | 1.71 | 1.66 | 1.68 | 1.66 | 1.61 |
| 63 x 122 | 2.44 | 2.42 | 2.36 | 2.36 | 2.34 | 2.27 | 2.30 | 2.27 | 2.18 |
| 63 x 147 | 3.15 | 3.12 | 3.03 | 3.03 | 2.99 | 2.89 | 2.93 | 2.89 | 2.77 |
| 63 x 170 | 3.82 | 3.78 | 3.54 | 3.66 | 3.61 | 3.41 | 3.53 | 3.47 | 3.29 |
| 63 x 195 | 4.56 | 4.45 | 4.06 | 4.36 | 4.29 | 3.90 | 4.19 | 4.11 | 3.77 |
| 63 x 220 | 5.19 | 5.00 | 4.56 | 5.00 | 4.82 | 4.39 | 4.84 | 4.66 | 4.24 |
| 75 x 122 | 2.64 | 2.26 | 2.56 | 2.56 | 2.53 | 2.45 | 2.48 | 2.45 | 2.36 |
| 75 x 147 | 3.40 | 3.36 | 3.25 | 3.27 | 3.23 | 3.11 | 3.16 | 3.11 | 2.98 |
| 75 x 170 | 4.11 | 4.07 | 3.75 | 3.94 | 3.88 | 3.61 | 3.79 | 3.73 | 3.49 |
| 75 x 195 | 4.79 | 4.70 | 4.29 | 4.67 | 4.53 | 4.13 | 4.49 | 4.38 | 3.99 |
| 75 x 220 | 5.48 | 5.28 | 4.83 | 5.28 | 5.09 | 4.65 | 5.11 | 4.93 | 4.49 |
| CLS/ALS sizes | | | | | | | | | |
| 38 x 89 | 1.20 | 1.20 | 1.18 | 1.18 | 1.17 | 1.15 | 1.16 | 1.15 | 1.12 |
| 38 x 140 | 2.32 | 2.30 | 2.25 | 2.25 | 2.22 | 2.16 | 2.19 | 2.16 | 2.08 |
| 38 x 184 | 3.39 | 3.35 | 3.24 | 3.25 | 3.21 | 3.09 | 3.14 | 3.09 | 2.95 |
| 38 x 235 | 4.69 | 4.54 | 4.12 | 4.46 | 4.36 | 3.96 | 4.28 | 4.20 | 3.82 |

1.F.12 Raised tie roof

The tables below give member sizes for raised tie roofs designed for access limited to maintenance or repair purposes which should support *dead load* not more than 0.75 kN/m^2 and an *imposed load* not more than 1.5 kN/m^2 for truss centres of not more than 600 mm and a span not more than 5 m.



Timber of strength class C16

| Rafter size (mm x mm) | Tie joist size (mm x mm) | Max h (mm) |
|-----------------------|--------------------------|------------|
| 47 x 220 | 47 x 220 | 575 |
| 47 x 195 | 47 x 195 | 450 |
| 47 x 195 | 47 x 195 | 325 |

Timber of strength class C24 (TR26)

| Rafter size (mm x mm) | Tie joist size (mm x mm) | Max h (mm) |
|-----------------------|--------------------------|------------|
| 47 x 170 or 38 x 195 | 47 x 170 or 38 x 195 | 575 |
| 38 x 195 | 38 x 195 | 450 |
| 38 x 195 | 38 x 195 | 325 |

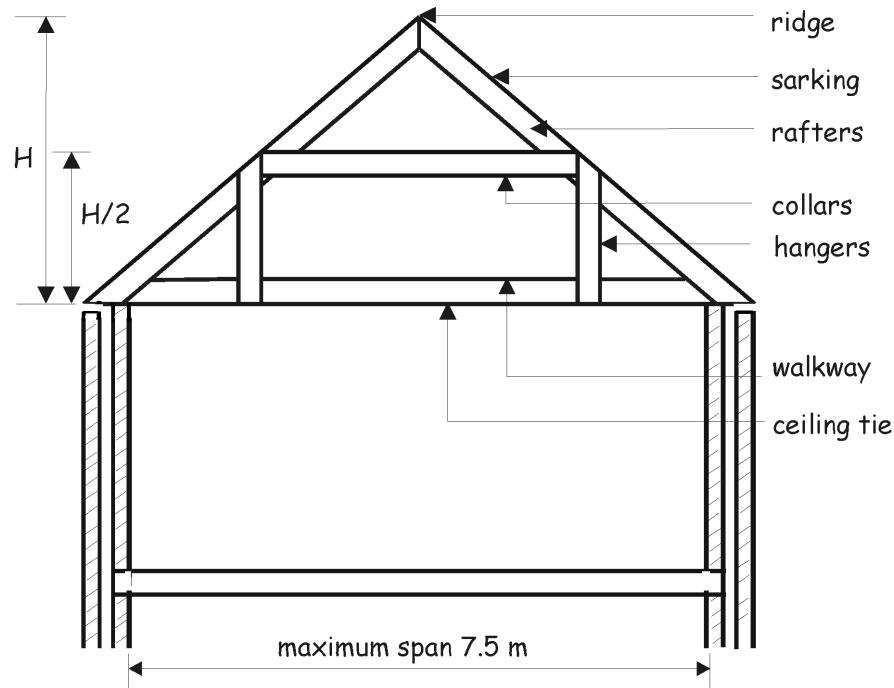
Notes:

1. roof bracing should be in accordance with BS 5268-3: 2006; and
2. masonry walls should be cavity walls in accordance with annex 1.D; and
3. connection details should be as in clause 1.F.14; and
4. rafters to be tied down to walls in accordance with clause 1.E.40.

1.F.13 Collared roof

The tables below give member sizes for collared roofs designed for access limited to maintenance or repair purposes which should support *dead loads* not more than 0.75 kN/m² and *imposed load* not more than 1.5 kN/m² for truss centres not more than 600 mm and a span not more than 7.5 m.

Roof space is for access only with an *imposed load* on to the ceiling ties of not more than 0.25 kN/m² together with a concentrated load of 0.9 kN and does not include for water tanks.



Timber of strength class C16

| Centres (mm) | Rafter size (mm x mm) | Ceiling tie (mm x mm) | Collar size (mm x mm) | Hanger size (mm x mm) |
|--------------|-----------------------|-----------------------|-----------------------|-----------------------|
| 400 | 47 x 147 | 47 x 147 | 47 x 97 | 47 x 97 |
| 450 | 47 x 195 | 47 x 195 | 47 x 122 | 47 x 122 |
| 600 | 47 x 220 | 47 x 220 | 47 x 147 | 47 x 147 |

Timber of strength class C24 (TR26)

| Centres (mm) | Rafter size (mm x mm) | Ceiling tie (mm x mm) | Collar size (mm x mm) | Hanger size (mm x mm) |
|--------------|-----------------------|-----------------------|-----------------------|-----------------------|
| 400 | 47 x 147 | 47 x 147 | 47 x 97 | 47 x 97 |
| 450 | 47 x 147 | 47 x 147 | 47 x 122 | 47 x 122 |
| 600 | 47 x 195 | 47 x 195 | 47 x 147 | 47 x 147 |

Notes:

1. roof bracing should be in accordance with BS 5268-3: 2006; and
2. masonry walls should be cavity walls in accordance with annex 1.D; and
3. connection details should be as in clause 1.F.14; and
4. trusses to be tied down to walls in accordance with clause 1.E.40.

1.F.14 Connection details for raised tied and collared roofs

Connections for raised and collared roofs should be:

- 450 mm rafter centres: 38 mm diameter double sided toothed connector and M10, grade 4.6 bolts should be used; or
- 600 mm rafter centres: 51 mm diameter double sided toothed connector and M12, grade 4.6 bolts should be used.

1.F.15 Openings for stairs

Where openings in floors are required for stairs:

- a. the perimeter of the opening should be supported on all sides by load bearing walls; or
- b. the floor joists should be strengthened by means of additional joists and trimmers as follows:
 - doubling up the trimming joists either side of the openings in floors parallel to the floor joists and connecting them together (e.g. nailed) over the full length of the joists and supporting similarly other joists at either end (i.e. using joist hangers or built-in);
 - installing trimmer joists perpendicular to floor joists comprising two joists (of similar size to the trimming joists) joined together and supported by means of joist hangers connected to the trimming joists.

The plan size of openings for stairs should be not more than 2.70 m parallel to the floor joists by 1.15 m perpendicular to the floor joists.

1.F.16 Supports to non load-bearing partitions

Provided lightweight partitions comprising timber studs lined on each side with 12.5 mm plasterboard are used the following should be provided:

- a. where the partition is parallel to the floor joists and directly above a floor joist, an additional joist should be used alongside the main joist;
- b. where the partition is parallel to the floor joists but not directly above a floor joist, an extra joist should be used below the partition;
- c. where the partition is perpendicular to the floor joists and the joists are at no more than 600 mm centres no additional supports are required.

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2.0 Introduction

- 2.0.1 Aims
- 2.0.2 Explanation of terms
- 2.0.3 Latest changes
- 2.0.4 Relevant legislation
- 2.0.5 Annexes
- 2.0.6 Alternative approaches

Introduction

2.0

2.0.1 Aims

Life safety is the paramount objective of fire safety. *Domestic buildings* should be designed and *constructed* in such a way that the risk of fire is reduced and, if a fire does occur, there are measures in place to restrict the growth of fire and smoke to enable the occupants to escape safely and for fire-fighters to deal with fire safely and effectively.

In the event of an outbreak of fire, it is important that the occupants are warned as soon as possible. The guidance to standard 2.11 provides recommendations for the installation of alarm and detection systems in *domestic buildings*.

Property protection is not covered by building regulations. However the added benefit of some life safety measures will provide a degree of property protection. The building regulations are concerned with the protection of people from the dangers inherent in *buildings*, rather than protecting the owners of *buildings* from any economic loss which might occur. Therefore it is important for designers and owners of *buildings* to understand that following this guidance will not necessarily provide sufficient fire protection from the total destruction of the *building* and the subsequent economic loss. Although beyond the scope of this guidance, the adoption of good fire safety practices should be encouraged to reduce the risk of fire occurring in the first place. Fire prevention will not only save lives but will reduce environmental pollution.

The standards and guidance in this section are designed to work together to provide a balanced approach for fire safety. Where a *building* element, material, component, or other part of a *building* is covered by more than one standard, the more demanding guidance should be followed.

In order to achieve these objectives, the *building* elements, materials, components or other parts of the *building* identified in the guidance should follow the appropriate performance levels that are recommended throughout the guidance.

Guidance in this Technical Handbook may not be appropriate for the following *buildings* or parts of a *building* as they are rarely designed and *constructed*:

- a. those containing a *basement storey* with a *storey* area more than 200 m²;
- b. those containing a *basement storey* at a depth of more than 4.5 m;
- c. those containing *flats* or *maisonettes* with a communal *room* more than 60 m²;
- d. those containing catwalks, openwork floors or escalators;
- e. those containing *places of special fire risk*;
- f. those with a *storey* at a height of more than 60 m.

In the case of sub-clauses a. to e. above and in the case of a mixed use *building* containing non-domestic and domestic accommodation, reference should be made to the Technical Handbook for non-domestic *buildings* as well as the guidance contained in this Handbook.

In the case of sub-clause f. above, the alternative approach described in clause 2.0.6 should be used.

2.0.2 Explanation of terms

Relevant authority in this section means a fire and rescue authority which is not specified in a scheme made under section 2(1) of the Fire (Scotland) Act 2005 or a joint fire and rescue board constituted by such a scheme.

Relevant authority

| | |
|--------------------------------------|--|
| <i>Flats or maisonettes</i> | For the purposes of this guidance a <i>flat</i> or <i>maisonette</i> entered only from the open air at ground level and with no <i>storey</i> at a height of more than 4.5 m should be regarded as a <i>house</i> and follow the guidance accordingly. |
| Protected routes of escape | Protected routes of escape includes: <i>flat roofs</i> and <i>access decks</i> (clause 2.9.6), <i>gallery</i> floors wholly or partly enclosed below (clause 2.3.1), <i>protected lobbies</i> (clause 2.9.19), <i>protected zones</i> (clause 2.9.20), <i>protected enclosures</i> (clause 2.9.21 and clause 2.9.31), <i>external escape stairs</i> (clause 2.9.22), <i>basements</i> (clause 2.9.23 and clause 2.9.28) and <i>alternative exits</i> (clause 2.9.32). This list is not exhaustive and is not intended to cover all parts of a <i>building</i> providing protected routes of escape. For example, <i>separating walls</i> and <i>separating floors</i> also protect routes of escape but are covered by the guidance to standard 2.2. |
| External areas | A roof, an external balcony or an enclosed courtyard open to the external air, where the area is more than 8 m ² and to which there is access for a purpose other than maintenance, should be regarded as a <i>room</i> . It is not intended that these external areas be treated as <i>apartments</i> which create <i>inner rooms</i> to <i> dwellings</i> . |
| Circulation areas | A circulation area in a <i>domestic building</i> is an area mainly used as a means of access between an <i>apartment</i> and an <i>exit</i> or an area forming an <i>unprotected zone</i> or an area in a <i>room</i> or space which provides access to an <i>exit</i> . |
| Rainscreen cladding and overcladding | In the guidance to standard 2.4 cavities, reference to ‘rainscreen cladding’ and ‘overcladding’ has been replaced by ‘ <i>external wall</i> and roof cladding’ where appropriate. |
| Sleeping deck | A sleeping deck within a <i>room</i> should be regarded as being part of that <i>room</i> . However, for the purposes of the guidance to standard 2.9, sleeping decks which do not fall within the definition of a <i>gallery</i> should be regarded as a separate <i>room</i> or <i>storey</i> as the case maybe. |
| Plant <i>storeys</i> | For the purpose of measurement, the height above ground to the top most <i>storey</i> excludes roof-top plant areas and any top <i>storeys</i> consisting exclusively of plant rooms. |

2.0.3 Latest changes

There were no major changes made to this section between 1 May 2007 and 30 April 2008 but a few minor corrections have been made. A summary of these corrections can be found on the [2008 Technical Handbooks](#) website page.

2.0.4 Relevant legislation

It is important to be aware that there is other legislation, apart from building regulations, imposing requirements for means of escape in case of fire and other fire safety measures that will come into force when the *building* is occupied. It is therefore recommended that consultation with those responsible for such legislation takes place before the application for building warrant is finalised. Any necessary fire precautions requiring additional *building work* can then be included in the application.

[Fire \(Scotland\) Act 2005 as amended](#)

The Fire (Scotland) Act 2005 includes requirements that a relevant authority (see clause 2.0.2) shall take all reasonable measures for securing that an adequate supply of water will be available for use, in the case of fire.

Part 3 of the 2005 Act introduces a fire safety regime which applies to non-domestic *buildings*. The regime does not generally apply to *domestic buildings* but may apply where staff are employed or members of the general public have access e.g. a dental surgery within a *dwelling*. The regime will also apply to *domestic buildings* which are licensed as Houses in Multiple Occupation and to some *domestic buildings* where certain care services are provided. Those domestic premises covered by Part 3 of the 2005 Act are defined in section 78 of the Act. Persons with obligations under the Act require to carry out a fire safety risk assessment which may require additional fire safety precautions to reduce the risk to life in case of fire. For example, measures to reduce the risk and spread of fire, means of escape, fire-fighting equipment, fire detection and warning, instruction and training. Other measures are prescribed by regulation. The risk assessment should be kept under review.

[www.infoscotland.com/
firelaw](http://www.infoscotland.com/firelaw)

There is (sector specific) guidance for various *building* uses on compliance with Part 3 of *the Act*. This guidance can be found using the link to the firelaw website.

In many premises, existing fire safety measures have been incorporated in accordance with building regulations, however, it is possible for a higher standard to be applied as a consequence of a fire safety risk assessment.

Section 71 of the 2005 Act makes it clear that terms, conditions or restrictions in licences, including statutory certification or registration schemes, are to have no effect if they relate to fire safety requirements or prohibitions which are or could be imposed under Part 3 of the 2005 Act.

[Fire Safety \(Scotland\) Regulations 2006](#)

The Fire Safety (Scotland) Regulations 2006 are made under the Fire (Scotland) Act 2005 and contain provisions which are part of the fire safety regime. These regulations must be considered along with Part 3 of the 2005 Act. The regulations contain further requirements in respect of fire safety risk assessment and obligations on dutyholders.

[The Construction \(Design and Management\) Regulations 1994](#)

The Construction (Design and Management) Regulations 1994 (currently under review) are intended to protect people *working* in *construction* and others who may be affected by their activities. The regulations require the systematic management of projects from concept to completion and throughout the life cycle of the structure, including eventual demolition. The CDM Regulations require designers and those who control or carry out *construction work* to identify hazards associated with their designs or *work* (including risk from fire) and plan to eliminate, reduce or control the risks.

[Construction \(Health, Safety and Welfare\) Regulations 1996](#)

The Construction (Health, Safety and Welfare) Regulations 1996 (currently under review) apply to the *construction* activity itself and to *construction sites*. The regulations require precautions to be taken to prevent injury from fire and suitable and sufficient arrangements to enable persons to reach a *place of safety* should a fire occur. To assist those involved in the *construction* activity to comply with the fire safety requirements of these regulations, the HSE has issued guidance '[Fire safety in construction work](#)' (HSG 168). The HSE has responsibility for enforcing these regulations unless the *construction* activity is in a *building* that remains occupied. In such circumstances, the enforcing authorities as defined in Fire (Scotland) Act 2005 has responsibility for enforcement..

For *construction* projects with lower fire risks such as low-rise *housing*

developments, guidance is provided in HSE Information sheet CIS51 'Construction fire safety'.

Civic Government
(Scotland) Act 1982
(Licensing of Houses in
Multiple Occupation)
Order 2000 as amended

The domestic Technical Handbook should be used for Houses in Multiple Occupation (HMOs) that are *dwelling*s and the non-domestic Technical Handbook should be used for all other HMOs. It should be noted that HMOs may also require to be licensed under the Civic Government (Scotland) Act 1982 - Order 2000. To be classified as a House in Multiple Occupation, the accommodation must be the only or principal residence of 3 or more people from different families. Guidance is provided in the publication '[Mandatory Licensing of Houses in Multiple Occupation: Guidance for Licensing Authorities, 2004](#)' which includes information on the licensing scheme and benchmark standards. HMOs which require a licence are also subject to Part 3 of the Fire (Scotland) Act 2005 .

Regulation of Care
(Scotland) Act 2001

The Scottish Commission for the Regulation of Care is responsible for regulating a diverse range of care services some of which are delivered in non-domestic *buildings* (e.g. care homes, nurseries, independent *hospitals*, hospices, residential schools, secure accommodation) and some in *domestic buildings* (e.g. childminding, supported accommodation, adult placement services). The services are inspected by the Commission against national care standards issued by Scottish Ministers some of which include physical standards for the premises. Where the applicant for a warrant intends to use or provide such a service, they should consult the Commission for advice.

2.0.5 Annexes

Annex 2.A: Additional guidance for high rise domestic buildings.

Due to the nature of *high rise domestic buildings* there are additional risks in the case of fire and guidance is given in annex 2.A. This is in addition and supplementary to the guidance to standards 2.1 to 2.15 where appropriate.

Annex 2.B: Resistance to fire

Resistance to fire is expressed in terms of fire resistance duration and reference throughout this document to a short, medium or long fire resistance duration, are explained in annex 2.B. The performance levels include properties such as loadbearing capacity, integrity and insulation.

Annex 2.C: Reaction to fire

Construction products are expressed as *non-combustible* low, medium, high or very high risk and explained in annex 2.C. The performance levels include properties such as the ease of ignition and the rate at which the product gives off heat when burning. This document does not give detailed guidance on other properties such as the generation of smoke, fumes and flaming droplets/particles.

Annex 2.D: Vulnerability of roof coverings

Roof coverings are expressed in terms of low, medium or high vulnerability and explained in annex 2.D. The performance levels relate to the capability of a roof to resist penetration from fire and flame spread when the external surface is exposed to radiation and flames.

2.0.6 Alternative approaches

Fire safety engineering

Fire safety engineering can provide an alternative approach to the fire safety measures contained in this Technical Handbook. It may be the only practical way to achieve a satisfactory level of fire safety in some large and complex *buildings*.

Fire safety engineering may also be suitable for solving a problem with any aspect of the design which otherwise follows the guidance in this Handbook. Alternative fire safety measures include for example, the use of automatic fire detection, suppression and ventilation systems in conjunction with passive fire protection. It is reasonable to demonstrate compliance with the functional standards by alternative means and in such cases, the verifier and the relevant authority (see clause 2.0.2) should be consulted early in the design process.

Existing *buildings*

It may be appropriate to vary the guidance contained in this Handbook when assessing the guidance against the constraints in existing *buildings* or in *buildings* which are listed in terms of their architectural or historic interest. In such cases, it would be appropriate to take into account a range of fire safety features, some of which are dealt with in this Handbook and some of which are not addressed in any detail.

BS 7974: 2001 and International Fire Engineering Guidelines, 2005

Fire engineering designs can be complex and many require extensive use of engineering judgment. The following documents are cited to ensure that the guidance given encompasses best practice worldwide:

- BS 7974: 2001 [Application of fire safety engineering principles to the design of buildings](#); or
- [International Fire Engineering Guidelines](#), 2005 (IFEG).

The use of either document assumes that those carrying out or assessing a fire engineering approach have sufficient technical training, knowledge and experience to understand fully the dangers involved.

The objectives of any fire safety strategy should be established first and may include for example that open plan living is the principal objective.

Designers and verifiers have to be aware of the importance of a sensitivity analysis. The analysis should include an assessment of any system failure. This will help to ensure that the fire safety objectives have been met.

Many owners and *occupiers* do not understand the long term effects on the *building* operations when a performance based design is accepted as an alternative to the guidance provided in the Technical Handbooks. BS 7974 and IFEG assume that all aspects of the fire engineering strategy are capable of being maintained and deployed over the lifetime of the *building*. If for example, alterations are found to be necessary due to changes to the *building* layout, the original strategy may need to be re-evaluated to ensure the fire safety provisions have not been compromised. For this reason, the fire strategy could form the basis of any fire safety risk assessment required under Part 3 of the Fire (Scotland) Act 2005.

Fire safety engineering involves the use of scientific based calculations and/or statistical information to demonstrate an adequate level of safety for a specific *building*, structure or installation. In this regard the fire safety strategy is based on performance rather than prescription. Therefore fire safety engineering is about the need to evaluate the fire hazard, assess the risks, understand the consequences and to offer fire safety strategies and designs to show how the objectives have been met. The 'tools' that support fire engineering can include calculation methods which are used to demonstrate that under a worst reasonable case (e.g. a fire in an atrium base where a smoke exhaust fan fails to operate) untenable conditions will not

occur during the evacuation period.

It is recognised that fire engineering is still a rapidly developing field and as such does not have the standardised codes for approaching and solving problems compared to other engineering disciplines. Both documents aim to provide a structured framework for assessing the interaction between, *buildings*, people and fire, and to facilitate innovation in design without compromising safety. They provide information on how to undertake a detailed analysis of specific aspects of fire safety engineering in *buildings*.

In practice, both frameworks provide a flexible but formalised engineering approach to fire safety which can be applied to new or existing *buildings* to show that the functional standards have been met.

BS 7974: 2001 Application of fire safety engineering principles to the design of buildings is supported by 8 published documents:

- Part 0: Guide to the design framework and fire safety engineering procedures;
- Part 1: Initiation and development of fire within the enclosure of origin;
- Part 2: Spread of smoke and toxic gases within and beyond the enclosure of origin;
- Part 3: Structural response and fire spread beyond the enclosure of origin;
- Part 4: Detection of fire and actuation of fire protection systems;
- Part 5: Fire service intervention;
- Part 6: Human factors: Life safety strategies – Occupant evacuation, behaviour and condition; and
- Part 7: Probabilistic risk assessment.

International Fire Engineering Guidelines have been developed for use in the fire engineering design and approval of *buildings*. The objectives of the guidelines are to:

- a. provide a link between the regulatory system and fire engineering;
- b. provide guidance for the process of engineering; and
- c. provide guidance on available methodologies.

The IFEG sub-systems bear a very close resemblance to the sub-systems used in BS 7974: 2001 and are set out below:

- fire initiation and development and control;
- smoke development and spread and control;
- fire spread and impact and control;
- fire detection, warning and suppression;
- occupant evacuation and control; and
- fire services intervention.

Clause 1.3.2 of IFEG states that “Typically, each building project is unique and similarly, each fire engineering evaluation is unique. It is not sensible, therefore, to set down detailed guidance on how the fire safety analysis should be undertaken. Instead, it is the responsibility of the fire engineer to plan the analysis for the particular project, based on the decisions taken during the preparation of the fire engineering brief as discussed in Chapter 1.2.”

2.1 Compartmentation

- 2.1 Functional standard
- 2.1.0 Introduction

standard

2.1

mandatory

Every *building* must be designed and *constructed* in such a way that in the event of an outbreak of fire within the *building*, fire and smoke are inhibited from spreading beyond the *compartment* of origin until any occupants have had the time to leave that *compartment* and any fire containment measures have been initiated.

Limitation:

This standard does not apply to *domestic buildings*.

2.1.0 Introduction

This standard does not apply to *domestic buildings*.

2.2 Separation

- 2.2 Functional standard
- 2.2.0 Introduction
- 2.2.1 Dwellings in different occupation
- 2.2.2 Dwellings with common occupation
- 2.2.3 Separation between domestic and non-domestic buildings
- 2.2.4 Solid waste storage accommodation
- 2.2.5 Garages
- 2.2.6 Lift wells
- 2.2.7 Combustibility
- 2.2.8 Supporting Structure
- 2.2.9 Openings and service penetrations
- 2.2.10 Junctions

standard
2.2
 mandatory

Every *building*, which is divided into more than one area of *different occupation*, must be designed and *constructed* in such a way that in the event of an outbreak of fire within the *building*, fire and smoke are inhibited from spreading beyond the area of occupation where the fire originated.

2.2.0 Introduction

In order to reduce the risk of fire spreading from one *dwelling* to another, fire *separation* should be provided between *dwellings* and between *dwellings* and any common spaces. Such *separation* should form a complete barrier to the products of combustion; smoke, heat and toxic gases. In semi-detached or terraced *houses*, or between *flats* or *maisonettes*, the barrier will normally be in the form of fire resisting walls and floors where appropriate.

The guidance in clause 2.2.9 (Openings and service penetrations) and clause 2.2.10 (Junctions) is common, not only to separation, but also to the relevant guidance in standard 2.4 cavities and standard 2.9 escape. To avoid duplication, these clauses are referred to throughout the Handbook and the reader is prompted to return to these common clauses whenever it is considered appropriate.

High rise domestic buildings

Increased height brings extra risk, both in the time needed for escape and the difficulties posed to the fire service in attempting to assist evacuation, effect rescue or fight fires. Therefore additional guidance is provided in Annex 2.A for *high rise domestic buildings* with any *storey* at a height of more than 18 m above the ground.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard in so far as is *reasonably practicable*, and in no case be worse than before the *conversion* (regulation 12, schedule 6).

2.2.1 Dwellings in different occupation

A *separating wall* or *separating floor* with medium fire resistance duration should be provided between adjoining *dwellings*.

2.2.2 Dwellings with common occupation

A *separating wall* or *separating floor* with medium fire resistance duration should be provided between a *dwelling* and any other part of the *building* in common occupation (see clause 2.2.4 for solid waste storage). A *protected zone* and a common access corridor should be considered as being in common occupation, however any *self-closing fire door* installed in these *separating walls* need only have a short fire resistance duration. For common external *escape stairs*, open access balconies or *access decks*, see the guidance to standard 2.9.

2.2.3 Separation between domestic and non-domestic buildings

A *separating wall* or *separating floor* with at least a medium fire resistance duration should be provided between a domestic and non-domestic *building*. Reference should also be made to the guidance for non-domestic *buildings* where appropriate.

2.2.4 Solid waste storage accommodation

A *separating wall* or *separating floor* with a short fire resistance duration should be provided between solid waste storage accommodation and the rest of the *building*.

2.2.5 Garages

There is a risk posed by the storage of combustible materials and other highly flammable substances in garages which are integral or attached to a *dwelling*.

A *separating wall* or *separating floor* with a short fire resistance duration therefore should be provided between an integral or attached garage and a *dwelling* in the same occupation. It is not necessary for a roofspace above the garage to be *separated* from the *dwelling* where the garage ceiling will serve as a *separating floor* with a short fire resistance duration (see annex 2.B).

2.2.6 Lift wells

Every lift well should be enclosed by *separating walls* with a medium fire resistance duration. Where the lift well does not extend the full height of the *building*, the lift well should form a junction with a *separating floor* with a medium fire resistance duration. A *separating wall* is not needed between a lift well and a *protected zone*. Where a lift is installed, the landing controls and lift car controls should be of a type that do not operate on heat or pressure resulting from a fire.

A platform lift *constructed* in accordance with the guidance in BS 6440: 1999 (see section 4: Safety), need not be enclosed by *separating walls* or *separating floors*.

For fire-fighting shafts containing lifts, see annex 2.a.

2.2.7 Combustibility

In a *building* with no *storey* at a height above 18 m, *separating walls* may be *constructed* from combustible materials provided the appropriate fire resistance duration is maintained.

To reduce the risk of a fire starting within a combustible *separating wall* or a fire spreading rapidly on or within the wall *construction*:

- insulation material exposed in a cavity should be *constructed* from materials which are *non-combustible* or of a low risk classification; and
- the internal wall linings should be *constructed* from materials which are *non-combustible* or of a low risk classification; and
- the wall should contain no pipes, wires or other services.

Where an opening is created to allow services to pass through the wall, the opening should be *constructed* in accordance with the guidance in clause 2.2.9.

Separating floors

In a *domestic building* with no *storey* at a height above 18 m, *separating floors* may be *constructed* from combustible material.

Where a *domestic building* also contains non-domestic accommodation, every part of a *separating floor* (other than a floor finish e.g. laminate flooring) should be *constructed* from *non-combustible* material. This is not necessary for a floor:

- between a *shop* or *office* and a *dwelling* above the *shop* or *office* in the same *occupation* where there is no other *dwelling* above the *shop* or *office*, and the area of the *shop* or *office* is not more than 1½ times the area of the *separating floor*; or
- above a *pend* where the floor has at least medium fire resistance duration and the ceiling of the *pend* is *constructed* of *non-combustible* material; or
- between a *domestic building* and a unit of *shared residential accommodation*.

For *high rise domestic buildings* with any *storey* at a height of more than 18 m, see annex 2.A.

2.2.8 Supporting Structure

Where an *element of structure* (see clause 2.3.0) provides support to a *non-combustible separating wall* or *separating floor*, the supporting *element of structure* should also be *constructed* from materials which are *non-combustible*.

Where an *element of structure* provides support to a *separating wall* or *separating floor* which attracts a higher fire resistance duration, the supporting *element of structure* should have at least the same fire resistance duration.

2.2.9 Openings and service penetrations

General

Separating walls and *separating floors* are intended to prevent fire passing from one part of the *building* to another part under *different occupation*. Openings and service penetrations through these walls or floors can compromise their effectiveness and should be kept to a minimum. The *solum* and *roof space* should not be forgotten. Openings and service penetrations should be carefully detailed and *constructed* to resist fire. This can be achieved by following the guidance below.

A self-closing fire door with the same fire resistance duration as the *separating wall* should be installed in accordance with the recommendations in the Building Hardware Industry Federation, Code of Practice, 'Hardware for Timber Fire and Escape Doors' Issue 1, November

2000. Whilst metal and plastic doors are excluded from this publication the same general principles could be applied. For metal doorsets, reference should be made to the 'Code of Practice for fire resisting metal doorsets' published by the Door and Shutter Manufacturers' Association, 1999.

In some instances a *self-closing fire door* with a short fire resistance duration may be installed. For example in a *separating wall* between a *dwelling* and a common space (see clause 2.2.2).

A *self-closing fire door* should not be fitted in a *separating wall* between 2 *dwellings* in *different occupation*.

For *self-closing fire doors* in *high rise domestic buildings*, see annex 2.A.

A lockable door to a cupboard or service *duct* with a floor area not more than 3 m² need not be self-closing.

Hold open devices

Self-closing fire doors can be fitted with hold open devices as specified in BS 5839: Part 3: 1988 provided the door is not an *emergency door*, a *protected door* serving the only *escape stair* in the *building* (or the only *escape stair* serving part of the *building*) or a *protected door* serving a fire-fighting shaft.

It is important that hold open devices deactivate on operation of the fire alarm therefore some *buildings* will need automatic fire detection to be installed. Electrically operated hold open devices should therefore deactivate on operation of:

- an automatic fire alarm system designed and installed in accordance with BS 5839: Part 1: 2002 (Category L5) determined on the basis of a risk assessment; and
- any loss of power to the hold open device, apparatus or switch; and
- a manually operated switch fitted in a position at the door.

An example of a Category L5 fire alarm system could be a system installed in the common corridor of *flats* incorporating only 2 smoke detectors, one installed on each side of the door and positioned not less than 500 mm and not more than 3 m from the door.

Additional guidance on the siting and coverage of fire detectors is contained in clause 22 of BS 5839: Part 1: 2002.

A chimney or flue-pipe should be *constructed* so that, in the event of a fire, the fire resistance duration of the *separating wall* or *separating floor* is maintained.

A service opening (other than a ventilating duct) which penetrates a *separating wall* or *separating floor* should be *fire-stopped* providing at least the appropriate fire resistance duration for the wall or floor. This may be provided by:

- a casing which has at least the appropriate fire resistance from the outside; or
- a casing which has at least half the appropriate fire resistance from each side; or
- an automatic heat activated sealing device that will maintain the appropriate fire resistance in respect of integrity for the wall or floor regardless of the opening size.

Fire stopping of the following services passing through a *separating wall* or *separating floor* need not be provided for:

- a pipe or a cable with a bore, or diameter, of not more than 40 mm; or
- not more than four 40 mm diameter pipes or cables that are at least 40 mm apart and at least 100 mm from any other pipe; or
- more than four 40 mm diameter pipes or cables that are at least 100 mm apart; or
- a pipe which has a bore of not more than 160 mm and is of iron, steel or copper, or of a material capable of withstanding 800° C without allowing flames or hot material to pass through the wall of the pipe; or
- a branch pipe of a bore of not more than 110 mm connected to a vertical drainage or water service pipe, constructed from aluminium, aluminium alloy, or uPVC to BS 4514: 1983 (1998).

Where a pipe connects to another pipe which attracts a more demanding fire resistance duration, and is within 1 m from the *separating wall* or *separating floor*, the pipe should be fire-stopped to the more demanding guidance.

A ventilating duct passing through a *separating wall* or *separating floor* should be *fire-stopped* in accordance with BS 5588: Part 9: 1999. Section 6 of BS 5588: Part 9: 1999 provides guidance on design and *construction* including fire resisting enclosures, fire resisting ductwork and the use and activation of fire dampers.

Fire-stopping

Fire-stopping may be necessary to close an imperfection of fit or design tolerance between *construction* elements and components, service openings and ventilation *ducts*. Proprietary *fire-stopping* products, including intumescent products, should be tested to demonstrate their ability to maintain the appropriate fire resistance duration under the conditions appropriate to their end use.

Minimal differential movement

Where minimal differential movement is anticipated, either in normal use or during fire exposure, proprietary *fire-stopping* products may be used. The following materials are also considered appropriate: cement mortar; gypsum based plaster; cement or gypsum based vermiculite/perlite mixes; mineral fibre; crushed rock and blast furnace slag or ceramic based products (with or without resin binders).

Greater differential movement

Where greater differential movement is anticipated, either in normal use or during fire exposure, proprietary *fire-stopping* products should be used.

Preventing displacement

To prevent displacement, materials used for *fire-stopping* should be reinforced with, or supported by, *non-combustible* materials where the unsupported span is more than 100 mm and where non-rigid materials are used. However, this is not necessary where it has been shown by test that the materials are satisfactory within their field of application.

2.2.10 Junctions

General

The basic principle is that junctions between *separating walls* and *separating floors* and other parts of the *building* should be designed and *constructed* in such a way to prevent a fire in one part of the *building* flanking the *separating wall* or *separating floor* and entering another part of the *building* under *different occupation*, including any solum space or *roof space*. Therefore, the *building* elements, materials or components should not be built into, or

carried through or across the ends of, or over the top of a *separating wall* in such a way as to impair the fire resistance between the relevant parts of the *building*.

Junctions with walls

Where a *separating wall* or *separating floor* forms a junction with an *external wall*, another *separating wall*, or a wall or screen used to protect routes of escape (see clause 2.0.2), the junction should maintain the fire resistance of the *separating wall* or *separating floor*.

Junctions with roofs

Where a *separating wall* forms a junction with a roof, the junction should maintain the fire resistance duration of the *separating wall* in accordance with the following:

- where the roof has a combustible substrate, the wall should project through the roof to a distance of at least 375 mm above the top surface of the roof; or
- where the wall is taken to the underside of a *non-combustible* roof substrate, the junction should be *fire-stopped* and the roof covering should be low vulnerability (see guidance to standard 2.8) for a distance of at least 1.7 m to each side of the centre-line of the wall; or
- in the case of a pitched roof covered by slates nailed directly to sarking and underlay, the junction between the sarking and wall-head should be *fire-stopped* as described in BRE Housing Defects Prevention Unit “[Defect Action Sheet \(Design\)](#)” February 1985 (DAS 8); or
- in the case of a pitched roof covered by slates or tiles fixed to tiling battens and any counter-battens, the junction between the tiles or slates and the underlay should be fully bedded in cement mortar (or other *fire-stopping* material, see clause 2.2.9) at the wall-head.

2.3 Structural protection

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- 2.3.0 Introduction
- 2.3.1 Elements of Structure
- 2.3.2 Combustibility
- 2.3.3 Supporting structure
- 2.3.4 Openings and service penetrations
- 2.3.5 Junctions

standard
2.3
mandatory

Every *building* must be designed and *constructed* in such a way that in the event of an outbreak of fire within the *building*, the load-bearing capacity of the *building* will continue to function until all occupants have escaped, or been assisted to escape, from the *building* and any fire containment measures have been initiated.

2.3.0 Introduction

In order to prevent the premature collapse of the load-bearing structural elements of a *building*, appropriate levels of fire resistance duration (see annex 2.B) should be provided to all *elements of structure*. The purpose of structural fire protection is:

- to minimise the risk to the occupants, some of whom may not evacuate the *building* immediately; and
- to reduce the risk to fire-fighters who may be engaged in fire-fighting or rescue operations.

It is essential that during a fire the *elements of structure* should continue to function. They should remain capable of supporting and retaining the fire protection to floors, *escape routes* and fire access routes, until all occupants have escaped, assisted to escape by staff or been rescued by the fire service.

The added benefit of structural fire protection means that the risk to people in the vicinity of the *building* or in adjoining *buildings* from collapse of the structure is reduced.

High rise domestic buildings

In practice, the fire service could remain in the *building* long after it has been evacuated. For this reason, an additional factor of safety is built into the guidance for *domestic buildings* that varies depending on the height of the topmost *storey* of the *building*. (see annex 2.A for *high rise domestic buildings* with any *storey* at a height of more than 18 m).

Elements of structure

An *element of structure* is part of a *building* which is part of a structural frame (beams and columns), load-bearing (other than part which is only self load bearing), a floor, or supports a floor. An example of part of the structure that is only self load-bearing could be a lintel in a non load-bearing wall. A roof structure should not be considered as an *element of structure* unless the roof provides support to an *element of structure* or which performs the function of a floor.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard (regulation 12, schedule 6).

2.3.1 Elements of Structure

An *element of structure* may perform more than one function and it is important that the appropriate guidance related to all the different functions, is followed.

Where every *storey* in a *building* is at a height of not more than 7.5 m above the ground, the *elements of structure* need only have at least a short fire resistance duration.

Where any *storey* in the *building* is at a height of more than 7.5 m and not more than 18 m, the *elements of structure* should have at least a medium fire resistance duration.

However, the following *elements of structure* need not be provided with any fire resistance for structural protection:

- an *element of structure* in a single *storey building* which does not form part of, or provide support to, a *separating wall*, a wall or screen used to protect routes of escape (see clause 2.0.2) or an *external wall* which attracts a fire resistance (see guidance to standard 2.6);
- a *gallery floor*, other than a *gallery floor* which is wholly or partly enclosed below;
- the lowest floor of a *building*.

2.3.2 Combustibility

An *element of structure* may be *constructed* from combustible material (i.e. material which is low, medium, high or very high risk, see annex 2.C) provided the *element of structure* has the appropriate fire resistance duration. For *high rise domestic buildings*, see annex 2.A.

Where an *element of structure* provides support to another *element of structure* which is *non-combustible* the supporting *element of structure* should also be *constructed* from materials which are *non-combustible* (see annex 2.C).

2.3.3 Supporting structure

Where an *element of structure* provides support to another *element of structure* which attracts a higher period of fire resistance, the supporting *element of structure* should have at least the same period of fire resistance.

2.3.4 Openings and service penetrations

In general, openings and service penetrations in *elements of structure* need not be protected from fire unless there is the possibility of structural failure. However, where a large opening or a large number of small openings are formed, careful detailing, particularly at the edge of the opening or service penetration, should be carried out in order to maintain the load-bearing capacity of the *element of structure*. If in doubt, edge protection should be provided.

2.3.5 Junctions

The detailing of junctions between relevant parts of a *building* is described in clauses 2.2.10, 2.4.7 and 2.9.27. *Fire-stopping* of all other junctions is generally not necessary. The important criteria to consider is the ability of the *element of structure* to maintain its load-bearing capacity in a fire in accordance with clause 2.3.1.

2.4 Cavities

- 2.4 Functional standard
- 2.4.0 Introduction
- 2.4.1 Cavity barriers
- 2.4.2 Dividing up cavities
- 2.4.3 Fire resisting ceilings as an alternative to cavity barriers
- 2.4.4 Combustibility
- 2.4.5 Supporting structure
- 2.4.6 Openings and service penetrations
- 2.4.7 Junctions

standard

2.4

mandatory

Every *building* must be designed and *constructed* in such a way that in the event of an outbreak of fire within the *building*, the unseen spread of fire and smoke within concealed spaces in its structure and fabric is inhibited.

2.4.0 Introduction

Fire and smoke spread in concealed spaces is particularly hazardous because fire can spread quickly throughout a *building* and remain undetected by the occupants of the *building* or by fire service personnel. Ventilated cavities generally promote more rapid fire spread around the *building* than unventilated cavities due to the plentiful supply of replacement air. *Buildings* containing sleeping accommodation pose an even greater risk to life safety and demand a higher level of fire precautions. For these reasons, it is important to control the size of cavities and the type of material in the cavity.

The guidance for protection to cavities should not be assessed in isolation and reference should be made to the guidance to standard 2.6 for spread to adjoining *buildings* and the guidance to standard 2.7 for fire spread on *external walls*.

Cavity

A cavity is a concealed space enclosed by elements of a *building* (including a suspended ceiling) or contained within a *building* element, but not a *room*, cupboard, circulation space, stair enclosure, lift well, *flue* or a space within a chute, *duct*, pipe or conduit. For the purposes of this guidance, a cavity includes a *roof space*, a service riser or any other space used to run services around the *building*.

Reference to surfaces in a cavity is intended to include the surface of the enclosing envelope of the cavity (including insulation material) but excludes timber roof trusses or lintols, joist ends, pipes, conduits or cables.

High rise domestic buildings

Increased height brings extra risk, both in the time needed for escape and the difficulties posed to the fire service in attempting to assist evacuation, effect rescue or fight fires. Therefore additional guidance is provided in annex 2.A for *high rise domestic buildings* with any *storey* at a height of more than 18 m.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard in so far as is *reasonably practicable*, and in no case be worse than before the *conversion* (regulation 12, schedule 6).

2.4.1 Cavity barriers

A *cavity barrier* means any *construction* provided to seal a cavity against the penetration of fire and smoke or to restrict its movement within the cavity.

In order to inhibit fire spread in a cavity, every cavity within a *building* should have *cavity barriers* with at least short fire resistance duration (see annex 2.B) installed around the edges of the cavity. This includes, for example, around the head, jambs and sill of an external door or window opening. A *cavity barrier* should also be installed between a *roof space* and any other *roof space* or between a cavity and any other cavity such as at the wall-head between a wall cavity and a *roof space* cavity.

However, *cavity barriers* are not necessary at a junction between 2 cavity walls each comprising 2 leaves of masonry or concrete at least 75 mm thick.

Sealing cavities can sometimes create difficulties, especially where *construction* techniques rely on through ventilation of the cavity (see section 3: Environment) or where the detailing should take into account the effect of thermal bridging (see section 6: Energy).

2.4.2 Dividing up cavities

Measurement Cavities should be measured either horizontally or vertically, as the case may be, along the centre-line of the cavity and not diagonally.

General Every cavity should be divided by *cavity barriers* so that the maximum distance between *cavity barriers* is not more than 20 m where the cavity has surfaces which are *non-combustible* or low risk materials, or 10 m where the cavity has surfaces which are medium, high or very high risk materials.

Exclusions *Cavity barriers* are not necessary to divide a cavity:

- formed by 2 leaves of masonry or concrete at least 75 mm thick; or
- in a ceiling void between a floor and a ceiling *constructed* in accordance with the guidance in clause 2.4.3; or
- between a roof and a ceiling *constructed* in accordance with the guidance in clause 2.4.3; or
- below a floor next to the ground where the cavity is either inaccessible or is not more than 1 m high; or
- formed by *external wall* or roof cladding, where the inner, outer or other exposed surfaces of the cladding are low risk materials or *non-combustible* attached to a masonry or concrete *external wall* or a concrete roof, and where the cavity contains only *non-combustible* material (see also the guidance to standard 2.7).

2.4.3 Fire resisting ceilings as an alternative to cavity barriers

Where a ceiling is provided as an alternative to *cavity barriers* as in clauses 2.4.2 b and 2.4.2 c, the ceiling should have a short fire resistance duration, and be *constructed* in accordance with the following recommendations:

- the ceiling should not be easily demountable;
- openings and service penetrations in the ceiling should be protected in accordance with clause 2.2.9;
- the ceiling lining should be *constructed* in accordance with the guidance to standard 2.5;
- the ceiling may contain an access hatch which, when closed, will maintain the fire resistance duration of the ceiling.

2.4.4 Combustibility

Cavity barriers and ceilings provided as an alternative to *cavity barriers* do not need to be *constructed* of *non-combustible* material unless they perform more than one function, such as a *cavity barrier* that is also a *non-combustible separating wall*.

2.4.5 Supporting structure

A *cavity barrier* should be fixed so that its performance is not affected by:

- movement of the *building* due to subsidence, shrinkage or thermal collapse in a fire of any services penetrating it;
- failure in a fire of its fixings;
- failure in a fire of any material or *element of structure* which it abuts.

However where a *cavity barrier* is installed in a *roof space*, there is no need to protect roof members that support the *cavity barrier*.

2.4.6 Openings and service penetrations

A *cavity barrier* and a ceiling provided as an alternative to a *cavity barrier* may contain a *self-closing fire door* (or a hatch in the case of a ceiling), or a *service opening constructed* in accordance with the guidance in clause 2.2.9.

2.4.7 Junctions

All *cavity barriers* should be tightly fitted to rigid *construction*. Where this is not possible as in the case of a junction with slates, tiles, corrugated sheeting or similar materials, the junction should be *fire-stopped*. See clause 2.2.10 for additional guidance on junctions and clause 2.2.9 for additional guidance on *fire-stopping* materials.

Where a wall, floor or other part of a *building* which has a fire resistance duration abuts a structure containing a cavity, a *cavity barrier* should be installed so as to extend the line of the structure. However, this is not necessary where the cavity is:

- formed by 2 leaves of masonry or concrete at least 75 mm thick;
- formed by *external wall* or roof cladding, where the inner, outer or other exposed surfaces of the cladding are *non-combustible* or low risk materials and attached to a masonry or concrete *external wall* or a concrete roof, and where the cavity contains only *non-combustible* or low risk material (see also the guidance to standard 2.7);
- in a wall which has a fire resistance duration for load-bearing capacity only.

2.5 Internal linings

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- 2.5.1 Internal linings
- 2.5.2 Assessment of linings
- 2.5.3 Plastic glazing
- 2.5.4 Thermoplastic material
- 2.5.5 Thermoplastic materials in ceilings
- 2.5.6 Thermoplastic materials in rooflights
- 2.5.7 Thermoplastic materials in light fittings with diffusers
- 2.5.8 Sandwich panels

standard

2.5

mandatory

Every *building* must be designed and *constructed* in such a way that in the event of an outbreak of fire within the *building*, the development of fire and smoke from the surfaces of walls and ceilings within the area of origin is inhibited.

2.5.0 Introduction

The *building* contents are likely to be the first items ignited in a fire and are beyond the scope of this guidance. Materials used in walls and ceilings can however, significantly affect the spread of fire and its rate of growth. Fire spread on internal linings in *escape routes* is particularly important because rapid fire spread in *protected zones* and *unprotected zones* could prevent the occupants from escaping.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard (regulation 12, schedule 6).

2.5.1 Internal linings

Wall and ceiling surfaces means the substrate or lining material including any treatment thereof to restrict flame spread, but excludes any decorative wallpaper or paints. Whilst it is accepted that such wallpaper or paints are not controlled by the guidance, multiple layers applied to face of wall or ceiling surface can increase flame spread and hence the fire growth rate. For this reason, multiple layers are not recommended when carrying out refurbishment *work* involving the re-decoration of wall and ceiling surfaces.

A *protected zone* should have wall and ceiling surfaces which are low risk or *non-combustible* (see annex 2.C).

A *room, unprotected zone* or *protected enclosure* should have wall and ceiling surfaces with a reaction to fire no worse than medium risk.

Limitations on higher risk surfaces

A *room* (other than a *kitchen*) not more than 4 m² may have wall and ceiling linings with a high risk classification. In a *room* (other than a *kitchen*) more than 4 m² the wall surfaces may also have a high risk classification subject to a maximum of 20 m² where the total area of the high risk surfaces is not more than half the floor area of the *room*.

2.5.2 Assessment of linings

Wall and ceiling linings should be assessed for their reaction to fire characteristics.

Wall linings

The following wall surfaces should be included in the assessment:

- *glazing* except *glazing* in doors; and
- any part of a ceiling which slopes at an angle of more than 70° to the horizontal.

However, the following surfaces need not be taken into account:

- doors and door frames; and
- window frames and frames in which *glazing* is fitted; and
- skirtings and facings, cover moulds, picture rails, and similar narrow members; and
- fireplace surrounds, mantle shelves and fitted furniture.

Ceiling linings

The following ceiling surfaces should be included in the assessment:

- the surface of *glazing*; and
- any part of a wall which slopes at an angle of 70° or less to the horizontal.

However, the following need not be taken into account:

- ceiling hatches and their frames; and
- the frames of windows or rooflights and the frames in which *glazing* is fitted; and
- facings, cover moulds, picture rails, and similar narrow members.

2.5.3 Plastic glazing

External windows and internal *glazing* to *rooms* (but not to *protected zones* or *unprotected zones*) may be fitted with plastic *glazing* materials which are:

- rigid solid PVC (uPVC); or
- polycarbonate rigid solid sheet at least 3 mm thick; or
- multi-skin polycarbonate sheet at least 10 mm thick overall which has a low or medium risk.

2.5.4 Thermoplastic material

Thermoplastic materials in ceilings, roof lights and lighting diffusers provide a significant hazard in a fire. Burning droplets can rapidly increase the fire growth rate and the smoke produced is normally dense and toxic which combine to produce extremely hazardous conditions. For these reasons, thermoplastic material should not be used in *protected zones* or fire-fighting shafts. However, thermoplastic materials may still be used with limited application for some ceilings (see clause 2.5.5), roof lights (see clause 2.5.6) or light fittings with diffusers (see clause 2.5.7).

A thermoplastic material means any synthetic material that has a softening point below 200° C when tested in accordance with Method 120A in BS 2782: Part 1: 1990. Thermoplastic materials can be further classified in to the 3 categories, TP(a) rigid, TP(a) flexible or TP(b) semi-rigid.

Rigid thermoplastic

TP(a) rigid means:

- rigid solid, (solid as distinct from double or multiple-skin) polycarbonate sheet at least 3 mm thick, or
- multi-skinned rigid sheet made from unplasticised pvc or polycarbonate which has a low or medium risk for reaction to fire, or
- any other rigid thermoplastic product, a specimen of which (at the thickness of the product as put on the market), when tested in accordance with Method 508A in BS 2782: 1970 (1974) performs so that the test flame extinguishes before the first mark, and the duration of flaming or afterglow does not exceed 5 seconds following removal of the burner.

Flexible thermoplastic

TP(a) flexible means:

flexible products not more than 1 mm thick which satisfy the Type C provisions of BS 5867: Part 2: 1980 (1993) when tested in accordance with Test 2 in BS 5438: 1989 (1995) with the flame applied to the surface of the specimens for 5, 15, 20 and 30 seconds respectively, but excluding cleansing procedure.

Semi-rigid thermoplastic

TP(b) semi-rigid means:

- a rigid solid polycarbonate sheet product not more than 3 mm thick, or multiple-skin polycarbonate sheet products which do not qualify as TP(a) by test or,
- other products which, when a specimen of the material more than 1.5 mm and not more than 3 mm thick is tested in accordance with Method 508A in BS 2782: 1970 (1974), has a rate of burning which is not more than 50 mm/minute.

2.5.5 Thermoplastic materials in ceilings

A ceiling *constructed* from thermoplastic materials, either as a suspended or stretched skin membrane with a TP(a) flexible classification should be supported on all its sides and not exceed 5 m². However, this does not apply to a ceiling which has been satisfactorily tested as part of a fire resisting ceiling system. A ceiling with a TP(a) flexible classification should not be installed in the ceiling of a *protected zone* or fire-fighting shaft (see annex 2.A).

Subject to the recommendations in clause 2.5.6 and clause 2.5.7, use of thermoplastic materials with a TP(a) rigid or TP(b) semi-rigid classification is unlimited.

2.5.6 Thermoplastic materials in rooflights

Thermoplastic materials (other than TP(a) flexible) may be used in rooflights subject to the recommendations in the table and diagram below.

Thermoplastic rooflights should also be *constructed* in accordance with the guidance to standard 2.8.

2.5.7 Thermoplastic materials in light fittings with diffusers

Thermoplastic materials may be used in light fittings with diffusers. Where the lighting diffuser forms an integral part of the ceiling, the size and disposition of the lighting diffusers should be installed in accordance with the table and diagram below.

However, where the lighting diffusers form an integral part of a fire-resisting ceiling which has been satisfactorily tested, the amount of thermoplastic material is unlimited.

Where light fittings with thermoplastic diffusers do not form an integral part of the ceiling, the amount of thermoplastic material is unlimited provided the lighting diffuser is designed to fall out of its mounting when softened by heat.

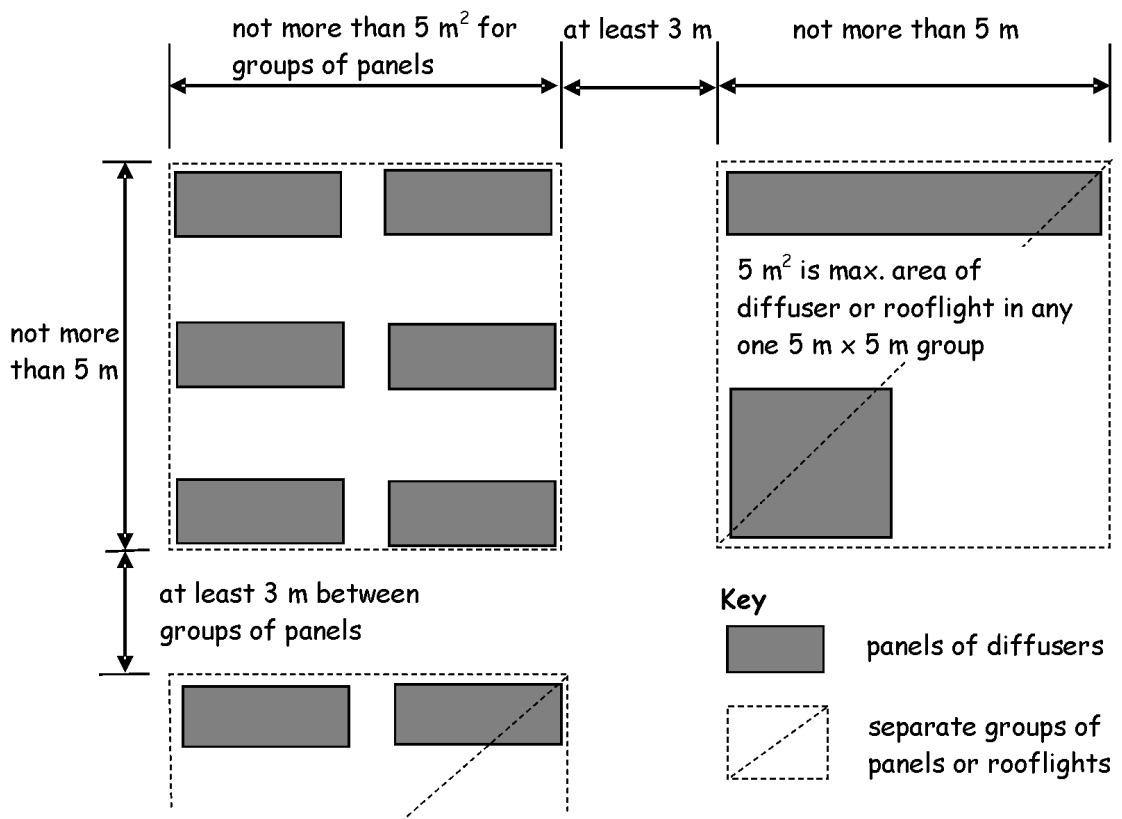
Thermoplastic rooflights and light fittings with diffusers

| Classification of lower surface | Protected zone or fire-fighting shaft | Unprotected zone or protected enclosure | | Room | |
|--|---------------------------------------|---|--------------------------|-------------|--------------------------|
| | | TP(a) rigid | TP(a) flexible and TP(b) | TP(a) rigid | TP(a) flexible and TP(b) |
| Maximum area of each diffuser panel or rooflight (m ²) | Not advised | No limit | 5 m ² | No limit | 5 m ² |
| Maximum total area of diffuser panels or rooflights as a percentage of the floor area of the space in which the ceiling is located (%) | Not advised | No limit | 15% | No limit | 50% |
| Minimum separation distance between diffuser panels or rooflights (m) | Not advised | No limit | 3 m | No limit | 3 m |

Notes:

- Smaller panels can be grouped together provided that the overall size of the group and the space between any others, satisfies the dimensions shown in the diagram below.
- The minimum 3 m separation in the diagram below should be maintained between each 5 m² panel. In some cases therefore, it may not be possible to use the maximum percentage quoted.
- TP(a) flexible is not recommended in rooflights.

Layout restrictions on thermoplastic rooflights and light fittings with diffusers



2.5.8 Sandwich panels

A sandwich panel is a factory-made non load-bearing component of a wall, ceiling or roof consisting of a panel having an insulated core filling the entire area between sheet metal outer facings, which may or may not have decorative and/or weatherproof coatings.

A sandwich panel used for internal walls or linings should be fully filled with a core of *non-combustible* material.

2.6 Spread to neighbouring buildings

- 2.6 Functional standard
- 2.6.0 Introduction
- 2.6.1 Fire resistance of external walls
- 2.6.2 Unprotected area
- 2.6.3 The simple geometry method
- 2.6.4 External wall cladding
- 2.6.5 Combustibility
- 2.6.6 Supporting structure

standard

2.6

mandatory

Every *building* must be designed and *constructed* in such a way that in the event of an outbreak of fire within the *building*, the spread of fire to neighbouring *buildings* is inhibited.

2.6.0 Introduction

In order to reduce the danger to the occupants of other *buildings*, one *building* should be isolated from another by either *construction* or distance. The distance between a *building* and its relevant *boundary* is dictated by the amount of heat that is likely to be generated in the event of fire. This will be influenced by the extent of openings, or other unprotected areas in the *external wall* of the *building*.

The guidance for fire spread to neighbouring *buildings* should not be assessed in isolation and reference should be made to the guidance to standard 2.4 for fire spread in cavities and the guidance to standard 2.7 for fire spread on *external walls*.

High rise domestic buildings

Increased height brings extra risk, both in the time needed for escape and the difficulties posed to the fire service in attempting to assist evacuation, effect rescue or fight fires. Therefore additional guidance is provided in annex 2.A for *high rise domestic buildings* with any *storey* at a height of more than 18 m.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard in so far as is *reasonably practicable*, and in no case be worse than before the *conversion* (regulation 12, schedule 6).

2.6.1 Fire resistance of external walls

Apart from unprotected areas, as described in clause 2.6.2, *external walls* should have:

- short fire resistance duration, if more than 1 m from the *boundary*; or
- medium fire resistance duration, if not more than 1 m from the *boundary*.

However, short fire resistance duration is sufficient even if not more than 1 m from the *boundary*, for the following:

- a detached *building* ancillary to a *dwelling* comprising a garden hut or store, or a *building* for keeping animals, birds or other livestock for *domestic* purposes;
- a *conservatory* or *porch* attached to a *dwelling*;
- a garage wall.

Fire resistance duration need not be provided for a *building* ancillary to a *dwelling*, comprising a *carport*, *covered area*, *greenhouse*, summerhouse, or swimming pool enclosure unless the *building* contains oil or liquefied petroleum gas fuel storage (see section 3 and section 4).

2.6.2 Unprotected area

An unprotected area means any part of an *external wall* (including a door or window opening), which does not attain the appropriate fire resistance duration as recommended in clause 2.6.1.

An unprotected area does not include a fixed unopenable window where the frame and *glazing* has the appropriate fire resistance duration. Any wallhead fascia, soffit or barge board, or any cavity vents or solum vents may also be excluded from the unprotected area calculation.

Up to 500 mm from *boundary*

Where the *external wall* of a *building* is not more than 500 mm from the *boundary* there should be no unprotected area, other than any wallhead fascia, soffit or barge board, or any cavity vents or solum vents.

500 mm to 1 m from *boundary*

Where the *external wall* of a *building* is more than 500 mm but not more than 1 m from the *boundary*, the level of unprotected area is limited to:

- the *external wall* of a *protected zone*;
- an area of not more than 0.1 m^2 , which are at least 1.5 m from any other unprotected area in the same wall;
- an area of not more than 1 m^2 , which are at least 4 m from any other unprotected area in the same wall (this 1 m^2 unprotected area may consist of 2 or more smaller areas which when combined do not exceed an aggregate area of 1 m^2).

2.6.3 The simple geometry method

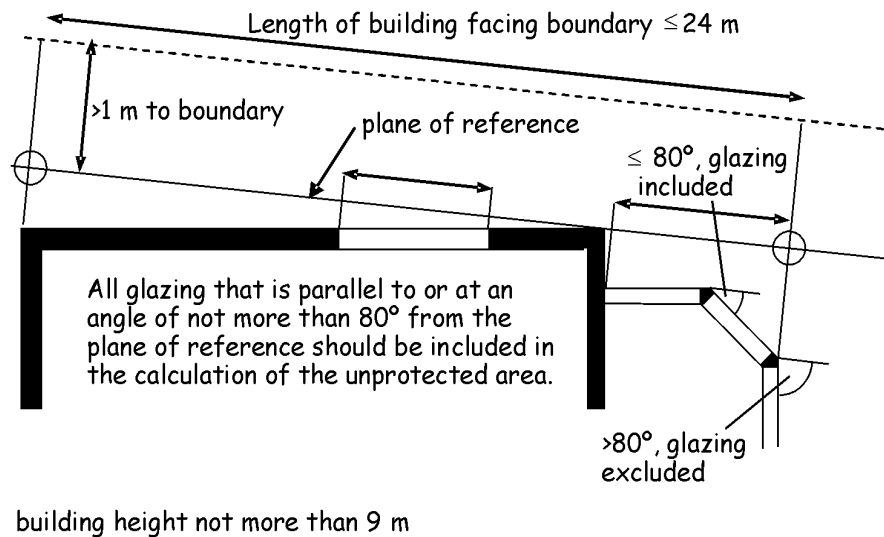
More than 1 m from *boundary*

Where the *external wall* of a *building* is more than 1 m from the *boundary* the amount of unprotected area (in square metres) may be equivalent to six times the distance (in metres) to the *boundary*. Therefore if the distance to the *boundary* is at least 1 m, the unprotected area should not exceed 6 m^2 , if the distance to the *boundary* is at least 2 m, the unprotected area is 12 m^2 , and so on.

Where the *external wall* of a *building* is more than 6 m from the *boundary*, the amount of unprotected area is unlimited.

The use of the simple geometry method described above is limited to *buildings* which are more than 1 m from the *boundary*, not more than 9 m in height, and the length of the side of the *building* facing the *boundary* is not

more than 24 m. Any external side of a *building* which makes an angle of more than 80° with the plane of reference can be ignored in the calculation of unprotected area. The diagram below provides a typical example of a *conservatory* attached to a *house*.



Where a *domestic building* exceeds these limits, reference could be made to the Enclosing Rectangle Method (Table B) contained in the non-domestic guidance document or the Building Research Establishment Report '[External fire spread: building separation and boundary distances](#)' (BR 187, 1991). In these cases, for the purpose of calculating the enclosing rectangle, a *separating wall* or *separating floor* should be regarded as a *compartment wall* or *compartment floor*.

2.6.4 External wall cladding

External wall cladding includes all non load-bearing *external wall* cladding systems attached to the structure, for example, clay or concrete tiles, slates, pre-cast concrete panels, stone panels, masonry, profiled metal sheeting including sandwich panels, weather boarding, thermally insulated *external wall* rendered systems, glazing systems and all other ventilated cladding systems.

External wall cladding (including any insulation core) not more than 1 m from a *boundary* should be *constructed* of *non-combustible* material.

Fire within the *building* may break out through a window or door opening and as a consequence, the cladding, once ignited, would contribute to the heat generated from the fire. Therefore where the cladding is more than 1 m from the *boundary* and is *constructed* from combustible material more than 1 mm thick that has a low, medium, high or very high risk, (as described in annex 2.C), the cladding should be included in the calculation of unprotected area.

However, combustible cladding need not be included in the calculation of unprotected area where:

- the combustible cladding is attached to the structure of the *building* and the *external wall* contains no openings other than the small openings described in clause 2.6.2b; and
- the wall behind the cladding (or the cladding itself) has the appropriate fire resistance duration from the inside.

In addition, a cavity formed by *external wall* cladding should be protected in accordance with the guidance to standard 2.4 and fire spread on *external walls* in accordance with the guidance to standard 2.7.

2.6.5 Combustibility

Every part of an *external wall* including *external wall* cladding (see clause 2.6.4) not more than 1 m from a *boundary* should be *constructed* of *non-combustible* material. This does not apply to insulation exposed in a cavity that is between 2 leaves of masonry or concrete at least 75 mm thick, and which has a *cavity barrier* around all openings in the wall and at the top of the wall-head.

However, a structural frame of combustible material which is low, medium, high or very high risk (see annex 2.C) may be used not more than 1 m from a *boundary* provided:

- no *storey* height is more than 18 m; and
- the recommendations in clauses 2.6.1 and 2.6.2 have been followed; and
- any *external wall* cladding is *constructed* from *non-combustible* material.

See the guidance to standard 2.7 for additional recommendations on *external wall* cladding and the alternative to the need for *non-combustibility* mentioned above.

2.6.6 Supporting structure

Where an *element of structure* provides support to an *external wall* (including *external wall* cladding) which has a fire resistance duration (as recommended in the guidance to clauses 2.6.1 and 2.6.2) the supporting *element of structure* should also have at least the same fire resistance duration.

2.7 Spread on external walls

- 2.7 Functional standard
- 2.7.0 Introduction
- 2.7.1 External wall cladding

standard

2.7

mandatory

Every *building* must be designed and *constructed* in such a way that in the event of an outbreak of fire within the *building*, or from an external source, the spread of fire on the *external walls* of the *building* is inhibited.

2.7.0 Introduction

There is a small risk of fire spread on the *external walls* of a *building*. For most *buildings* it is only necessary to consider this if the *external wall* is in close proximity to the *boundary*.

High rise domestic buildings

Increased height brings extra risk, both in the time needed for escape and the difficulties posed to the fire service in attempting to assist evacuation, effect rescue or fight fires. Therefore additional guidance is provided in annex 2.A for *high rise domestic buildings* with any *storey* at a height of more than 18 m.

The guidance for fire spread to adjoining *buildings* should not be assessed in isolation and reference should be made to the guidance to standard 2.4 for fire spread in cavities and the guidance to standard 2.6 for fire spread to neighbouring *buildings*.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard in so far as is *reasonably practicable*, and in no case be worse than before the *conversion* (regulation 12, schedule 6).

2.7.1 External wall cladding

External wall cladding includes all non load-bearing *external wall* cladding systems attached to the structure, for example, clay or concrete tiles, slates, pre-cast concrete panels, stone panels, masonry, profiled metal sheeting including sandwich panels, weather boarding, thermally insulated *external wall* rendered systems, *glazing* systems and all other ventilated cladding systems.

External wall cladding (including any insulation core) not more than 1 m from a *boundary* should be *constructed of non-combustible* material.

External wall cladding *constructed* from combustible material more than 1 mm thick which is low, medium, high or very high risk (see annex 2.C) and attached to the outside face of an *external wall* may be used provided the *external wall* is more than 1 m to the *boundary*.

Alternative guidance

BR 135, second edition, '[Fire Performance of external thermal insulation for walls of multi-storey buildings](#)' and BS 8414: Part 1: 2002 'Test method for non load-bearing external cladding systems applied to the face of the building' have been updated to include the most up-to-date research into fire spread on *external wall* cladding. The guidance provided in these publications may be appropriate as an alternative to *non-combustible external wall* cladding as described above and for materials exposed in a cavity, as described in clause 2.4.7.

2.8 Spread from neighbouring buildings

2.8 Functional standard

2.8.0 Introduction

2.8.1 Roof coverings

standard

2.8

mandatory

Every *building* must be designed and *constructed* in such a way that in the event of an outbreak of fire in a neighbouring *building*, the spread of fire to the *building* is inhibited.

2.8.0 Introduction

Buildings are at risk from fires starting beyond their *boundaries*. The area of greatest vulnerability is the roof and there may be a risk of ignition or penetration by burning brands, flames or heat. The degree of protection for roof coverings is dependent upon the distance to the *boundary*.

A roof covering consists of one or more layers of material such as felt, tiles, slates, sandwich panels etc, but is not intended to include the whole of the roof structure. Solar roof panels should be regarded as forming part of the roof covering and as such should be able to resist ignition from an external source. Most solar panels are *glazed* and their ability to inhibit fire spread can be determined by the thickness of *glass* which makes up the panel (see table to annex 2.D).

A roof covering or rooflight which forms part of an internal ceiling lining should also follow the guidance to standard 2.5 Internal linings.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard in so far as is *reasonably practicable*, and in no case be worse than before the *conversion* (regulation 12, schedule 6).

2.8.1 Roof coverings

The possibility of direct flame impingement from neighbouring *buildings* is greater where the roof covering of the *building* is close to the *boundary*. Whilst much will depend on the fire dynamics and the velocity and direction of the wind, burning brands are also likely to be more intense. For these reasons, the vulnerability of a roof covering is determined in relation to the distance of a *building* to the *boundary*.

Not more than 6 m from *boundary*

The roof of a *building*, including any rooflights, but excluding any wallhead fascia, flashing or trim, boxed gutters, soffit or barge boards, should have a low vulnerability if not more than 6 m from the *boundary*. Common materials that normally attain the criterion include slates, tiles, *glazing*, sandwich panels and certain plastic materials as described in the table to annex 2.D.

More than 6 m but not more than 24 m from *boundary*

The roof of a *building*, including any rooflights, but excluding any wallhead fascia, flashing or trim, boxed gutters, soffit or barge boards, should have a low or a medium vulnerability if more than 6 m but not more than 24 m from the *boundary*. Common materials that normally attain the criterion include felts and certain plastic materials as described in the table to annex 2.D.

More than 24 m from *boundary*

Where a *building* is more than 24 m from the *boundary*, the roof may be of any material, including materials of high vulnerability classification.

2.9 Escape

- 2.9 Functional standard
- 2.9.0 Introduction
- 2.9.1 Number of exits
- 2.9.2 Travel distance
- 2.9.3 Inner rooms
- 2.9.4 Escape windows
- 2.9.5 Destination of escape routes
- 2.9.6 Flat roofs and access decks
- 2.9.7 Obstacles
- 2.9.8 Headroom
- 2.9.9 Flats entered on the accommodation level
- 2.9.10 Flats entered from below the accommodation level
- 2.9.11 Flats entered from above the accommodation level
- 2.9.12 Maisonettes
- 2.9.13 Ducted warm air heating
- 2.9.14 Locks
- 2.9.15 Solid waste storage accommodation
- 2.9.16 Mixed use buildings
- 2.9.17 Smoke control in corridors
- 2.9.18 Temporary waiting spaces
- 2.9.19 Protected lobbies
- 2.9.20 Protected zones
- 2.9.21 Protected enclosures
- 2.9.22 External escape stairs
- 2.9.23 Basements
- 2.9.24 Combustibility
- 2.9.25 Supporting structure
- 2.9.26 Openings and service penetrations
- 2.9.27 Junctions
- 2.9.28 Basements - Houses
- 2.9.29 Inner rooms - Houses
- 2.9.30 Escape windows - Houses
- 2.9.31 Protected enclosures - Houses
- 2.9.32 Alternative exits - Houses

standard

2.9

mandatory

Every *building* must be designed and *constructed* in such a way that in the event of an outbreak of fire within the *building*, the occupants, once alerted to the outbreak of the fire, are provided with the opportunity to escape from the *building*, before being affected by fire or smoke.

2.9.0 Introduction

Life safety is the paramount objective of fire safety. Everyone within a *dwelling* should be provided with at least one means of escape from fire that offers a safe passage to a *place of safety* outside the *building*. This should be short enough for them to escape from the *dwelling* before being affected by fire or smoke. In certain circumstances however, a second route of escape will be necessary to provide the occupants an alternative means of escape from the *building* should the first fire escape become impassable. This will allow the occupants to turn away from the fire and make their escape in the other direction.

In *buildings* containing *flats* or *maisonettes*, it is important that once out of the *dwelling* the route to a *place of safety* is equally well protected. The occupants of adjoining *dwellings* should also be protected so they can either remain in their *dwellings*, or if necessary, escape themselves.

Guidance to this standard is divided into two parts:

- for *buildings* containing *flats* or *maisonettes*, see clauses 2.9.1 to 2.9.27;
- for *houses*, see clauses 2.9.28 to 2.9.32.

High rise domestic buildings

Increased height brings extra risk, both in the time needed for escape and the difficulties posed to the fire service in attempting to assist evacuation, effect rescue or fight fires. Therefore additional guidance is provided in annex 2.A for *high rise domestic buildings* with any *storey* at a height of more than 18 m.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard (regulation 12, schedule 6).

Buildings containing flats or maisonettes

2.9.1 Number of exits

There should be at least one *escape route* from:

- the main entrance door of every *flat* or *maisonette*; and
- the door of every communal *room*; and
- from every plant room.

2.9.2 Travel distance

Travel distance from a *flat* or *maisonette*, a communal *room*, or a plant room is the distance, measured along the shortest route of escape from the main entrance door to the nearest *protected door* giving direct access to an *escape stair* or *place of safety*, and should follow the guidance in the table below. In this case, the “nearest *protected door*” is not the entrance door to the *flat* or *maisonette*, communal *room* or plant room.

Recommended travel distance in building with flats or maisonettes

| Situation | travel distance (m) | |
|--|-------------------------|-----------------------------------|
| | One direction of travel | More than one direction of travel |
| a <i>storey</i> at a height of not more than 7.5 m | 7.5 [1] | 32 [1] |
| a <i>storey</i> at a height of more than 7.5 m | 7.5 [2] | 32 [1] |
| a <i>storey</i> at any height with an <i>access deck</i> or open access balcony serving the <i>dwellings</i> | 40 [1] | Unlimited |

Notes:

1. Unlimited where a *dwelling* on the *storey* has an *alternative exit*.
2. 32 m where a *dwelling* on the *storey* has an *alternative exit*.

2.9.3 Inner rooms

An *apartment* in a *storey* at a height of more than 4.5 m should not be an *inner room*.

2.9.4 Escape windows

The normal means of escape from a *dwelling* in the event of a fire will be by way of the internal stairs or other circulation areas.

In order to provide the occupants with early warning of the outbreak of fire, mains operated fire detection should be installed in circulation routes (see guidance to standard 2.11). The early detection of smoke should allow the occupants sufficient time to evacuate the *building* safely. However in some cases the circulation area may become impassable due to smoke or heat and openable windows large enough to escape through should be provided from every *apartment* from which the occupants could make their escape by lowering themselves from the window. The use of an escape window will be the last resort for the occupants and inevitably involves some risk.

An escape window should be provided in every *apartment* on an upper *storey* at a height of not more than 4.5 m. In addition, escape windows should also be provided in every *apartment* that is an *inner room* on any *storey* at a height of not more than 4.5 m.

Escape windows are not necessary from *apartments* where there are alternative routes from the *apartment* to circulation areas or other *rooms*. This will allow the occupants an alternative route from the *dwelling* without entering the *room* or space of fire origin.

Size Escape windows should be a window, or door (french window) situated in an *external wall* or roof; and having an unobstructed openable area that is at least 0.33 m² and at least 450 mm high and 450 mm wide (the route through the window may be at an angle rather than straight through). The bottom of the openable area should not be more than 1.1 m above the floor.

Hardware Locks and safety fittings for many types of windows continue to present practical difficulties. This is because the design of the fittings needs to consider child safety, safe cleaning and security as well as escape in the event of a fire. At present there is no guidance provided on the type of lock or fastening that can provide both security and escape, and the occupants of *dwellings* can choose to fit devices most suitable for their situation. Devices that should be prohibited are permanent obstructions such as fixed security grills. The intention is to assist escape, but not to prohibit the use of locks, restrictors or other safety devices.

Conservatories below escape windows

The location of *conservatories* also presents some difficulties in relation to escape windows. Where a *conservatory* is located below an escape window consideration should be given to the design of the *conservatory* roof to withstand the loads exerted from occupants lowering themselves onto the roof in the event of a fire. However, the choice to *construct* a more robust roof and frame is a matter of preference and the decision to do this should remain with the owner.

2.9.5 Destination of escape routes

An *escape route* from a *flat* or *maisonette* should lead to a *place of safety* or an *access deck*:

- directly; or
- by way of a *protected zone*; or
- by way of an *access deck* or open access balcony; or
- by way of an *exit* to an external *escape stair*; or
- by way of a *flat roof*, but only where there is more than 1 *escape route* from the *storey*.

2.9.6 Flat roofs and access decks

Where an *access deck*, open access balcony or *flat roof* forms part of an *escape route* :

- it should have a medium fire resistance duration for the width of the escape route and for a further 3 m on either side of the *escape route* where appropriate; and
- every wall not more than 2 m from either side of the *escape route* should have a short fire resistance duration up to a height of at least 1.1 m measured from the level of the *escape route*.

If it is a *flat roof* there should also be:

- no exhausts of any kind less than 2 m from the *escape route*; and
- a wall or protective barrier at least 1.1 m high should be provided on each side of the *escape route*.

Lateral fire and smoke spread

Where an *access deck* or open access balcony is more than 2 m wide, any soffit above it should have a down-stand on the line of *separation* between each *dwelling* extending the full width of the *access deck* or balcony at 90° to the face of the *building* and extending at least 300 mm below any beam or down-stand parallel to the face of the *building*.

An *access deck* or open access balcony should have an opening or openings to the external air extending over at least four-fifths of its length and at least one-third of its height.

2.9.7 Obstacles

An *escape route* should not be by way of a lift, or below a shutter, or by way of a sliding door.

A fixed ladder can be used if it provides access to a plant room (other than a *place of special fire risk*, covered in the Technical Handbook for non-domestic *buildings*) which is normally unoccupied other than for maintenance purposes. The fixed ladder should be *constructed* in accordance with the guidance in BS 5395: Part 3: 1985.

2.9.8 Headroom

An *escape route* should have a clear headroom of at least 2 m. In a doorway it may be reduced to not less than 1.9 m.

2.9.9 Flats entered on the accommodation level

A *flat* at a *storey* height of more than 4.5 m which is entered at the same level as the accommodation should be planned so that:

- an *alternative exit* is provided; or
- all *apartments* are entered directly from a *protected enclosure* (see clause 2.9.21) and the distance to be travelled from any door of an *apartment* to the *exit* is not more than 9 m; or
- the distance to be travelled from any point within the *flat* to the *exit* is not more than 9 m and the direction of travel is away from cooking facilities; or
- sleeping accommodation, and that part of the circulation area which serves the sleeping accommodation and the *exit* to the *flat*, is *separated* from any other *apartment* and *kitchen* by a *construction* with the fire resistance equivalent to that of a *protected enclosure* (see clause 2.9.21); and where that *flat* has a *storey* at a height of more than 7.5 m and the distance to be travelled from any point within the *flat* to the *exit* is more than 15 m, there is an *alternative exit* from the living accommodation.

2.9.10 Flats entered from below the accommodation level

A *flat* at a *storey* height of more than 4.5 m which is entered from a *storey* below the level of the accommodation should be planned so that:

- an *alternative exit* is provided; or
- all *apartments* are entered directly from a *protected enclosure* (see clause 2.9.21) and the distance to be travelled from any door of an *apartment* to the head of the *private stair* is not more than 9 m; or
- the distance to be travelled from any point within the *flat* to the head of the *private stair* is not more than 9 m, and the direction of travel is away from cooking facilities.

2.9.11 Flats entered from above the accommodation level

A *flat* at a *storey* height of more than 4.5 m which is entered from a *storey* above the level of the accommodation should be planned so that an *alternative exit* is provided from the lower *storey*.

2.9.12 Maisonettes

A *maisonette* with 1 or more *storeys* at a height of more than 4.5 m should be planned that:

- all *apartments* are entered directly from a *protected enclosure* (see clause 2.9.21); and
- where any *storey* is at a height of more than 7.5 m there is an *alternative exit* from each *storey* other than the entrance *storey*, or an *alternative exit* is provided from each *room* intended as sleeping accommodation.

2.9.13 Ducted warm air heating

Where a *flat* or *maisonette* has a *storey* at a height of more than 4.5 m, or a *basement storey*, and is provided with a system of *ducted* warm air heating:

- transfer grilles should not be fitted between any *room* and the entrance hall or stair; and
- supply and return grilles should be not more than 450 mm above floor level; and
- where warm air is *ducted* to an entrance hall or stair, the return air should be *ducted* back to the heater; and
- where a *duct* passes through any wall, floor, or ceiling of an entrance hall or stair, all joints between the *duct* and the surrounding *construction* should be sealed; and
- there should be a room thermostat in the living *room*, at a height more than 1370 mm and not more than 1830 mm, with an automatic control which will turn off the heater, and actuate any circulation fan should the ambient temperature rise to more than 35° C; and
- where the system recirculates air, smoke detectors should be provided in every extract *duct* to cause the recirculation of air to stop and direct all extract air to the outside of the *building* in the event of fire.

2.9.14 Locks

Where a door across an *escape route* has to be secured against entry when the *building* is occupied, it should be fitted only with a lock or fastening which is readily operated, without a key, from the side approached by people making an escape. It should also have a notice, on the inside, explaining the operation of the opening device.

Additional guidance on the types hardware for timber fire and escape doors can be obtained from the Building Hardware Industry Federation, Code of Practice, 'Hardware for Timber Fire and Escape Doors' Issue 1, November 2000. Whilst metal and plastic doors are excluded from this publication the same general principles could be applied. For metal doorsets, reference should be made to the 'Code of Practice for fire resisting metal doorsets', published by the Door and Shutter Manufacturers' Association, 1999.

2.9.15 Solid waste storage accommodation

Solid waste storage accommodation should not open directly off an *escape route*. Where this is unavoidable, there should be a *protected lobby* (see clause 2.9.19) between the solid waste storage accommodation and the *escape route*.

2.9.16 Mixed use buildings

An *escape stair* serving *flats* or *maisonettes* should not communicate directly with a non-domestic *building* or communal facilities for a group of *dwellings*. Where the *escape stair* is to be accessed from the common areas of the *building*, then that *escape stair* should be separated from the *dwellings* and

where it serves the non-domestic accommodation at each level (including the topmost *storey*) by a *protected lobby*. Where the *building* or part of the *building* has no *storey* at a height of more than 7.5 m and has only 1 *escape route* by way of an *escape stair* and there are no alternative *escape routes* from the *building*, *protected lobbies* should be provided at every level.

Where the *building* or part of the *building* has 2 or more *escape routes*, only 1 stair should communicate with both the domestic and non-domestic parts of the *building* and be provided with *protected lobbies*.

An *escape stair* which serves a *flat* or *maisonette* which is ancillary to a non-domestic *building*, may communicate with the non-domestic accommodation provided that:

- the *escape stair* is separated from the domestic and non-domestic accommodation by a *protected lobby* at every level; and
- where the *storey* height of the *flat* or *maisonette* is more than 7.5 m, an alternative *escape route* is available from the *flat* or *maisonette*; and
- an alarm and detection system which is designed in accordance with BS 5839: Part 1: 2002 is installed in the common areas.

In this context 'ancillary' includes caretakers', directors', supervisors' and similar *flats* or *maisonettes*.

2.9.17 Smoke control in corridors

Where a *building* has more than one *escape stair* and where a corridor, or part of a corridor, provides escape in only one direction, automatic opening *ventilators* should be provided in that part of the corridor which provides single direction escape. Such *ventilators* should:

- provide for exhaust at or near ceiling level and for supply at or near floor level with a combined aggregate area of at least 1.5 m²; and
- be activated by automatic smoke detection fixed to the ceiling of the corridor and fitted with a manual override for fire service use (detectors should be as in clause 2.9.19).

2.9.18 Temporary waiting spaces

A *protected zone* enclosing an *escape stair* and an external *escape stair* (see clause 2.9.22) should be provided with an unobstructed clear space capable of accommodating a wheelchair and measuring not less than 700 x 1200 mm on every *escape stair* landing to which there is access from a *storey*. However, a temporary waiting space need not be provided in a *protected zone* where the *storey* has level or ramped access to a *place of safety* or the *storey* is inaccessible to wheelchair users.

The intention is to allow wheelchair users to wait temporarily until it is safe to use the *escape stair*. The spaces are not intended to be used by people to await rescue from the fire service. The speed of evacuation of people with mobility problems can be much slower than able-bodied people and it is for this reason that temporary refuge is important on *escape stairs*. The added benefit to the inclusion of temporary waiting spaces allows any person with impaired mobility to use the space. The spaces should not be used for any form of storage.

2.9.19 Protected lobbies

A *protected lobby* means a lobby within a *protected zone* but separated from the remainder of the *protected zone* so as to resist the movement of smoke from the adjoining accommodation to the remainder of the *protected zone*.

A *protected lobby* should be *constructed* within a *protected zone* and the wall dividing the *protected lobby* from the rest of the *protected zone* should have at least a short fire resistance duration for integrity only and any door in the wall should be a *self-closing fire door* (see clause 2.2.9) with a short fire resistance duration.

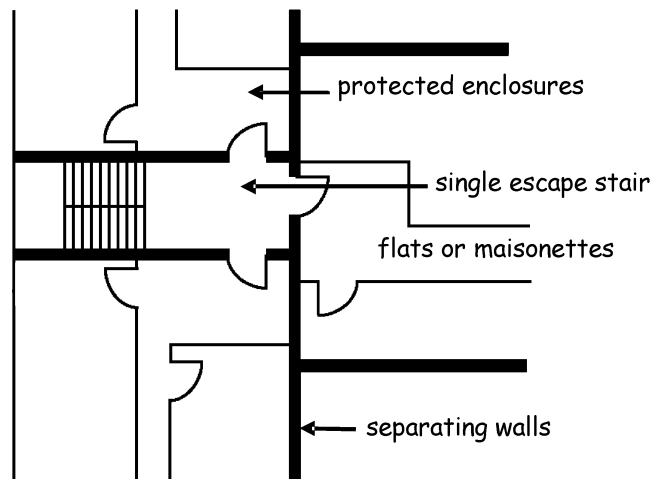
Single escape stair

Where *flats* or *maisonnettes* are served by only one *escape stair* and there is no alternative means of escape from the upper *storeys*, there should be a *protected lobby* with automatic opening *ventilators*, at each *storey* within the *protected zone* between the *escape stair* and the accommodation, including a parking garage and any other accommodation ancillary to the *dwelling*s (see second diagram below). The lobby protection should afford people who choose to evacuate the *building*, additional time to pass the fire floor in relative safety.

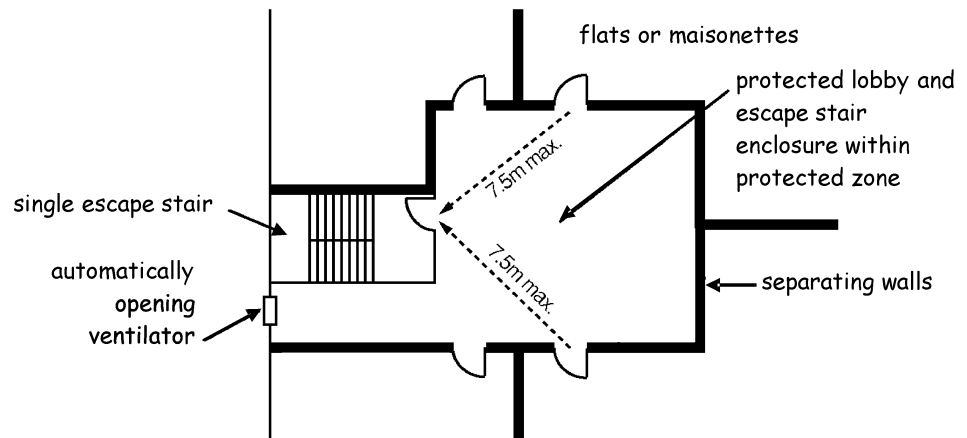
However, a ventilated *protected lobby* need not be provided:

- a. in relation to *flats* and *maisonnettes* entered from an open access balcony or *access deck* having an opening or openings to the external air extending over at least four-fifths of its length and at least one-third of its height;
- b. where the *protected zone* provides access to not more than 12 *dwelling*s in total and no *storey* is at a height of more than 7.5 m and there are not more than 4 *dwelling*s on each *storey* and each *dwelling* has within it, a *protected enclosure* (see first diagram below);
- c. at the topmost *storey*;
- d. where there is more than one *escape stair* serving each *dwelling*.

Single stair access to flats and maisonnettes with every storey at a height of not more than 7.5 m



Single stair access to flats and maisonettes with any storey at a height of more than 7.5 m but not more than 18 m



Automatic ventilators

Where automatic opening *ventilators* are recommended, they should:

- provide for exhaust at or near ceiling level and for supply at or near floor level with a combined aggregate area of at least 1.5 m²; and
- be activated by automatic smoke detection fixed to the ceiling of the *protected lobby* and fitted with a manual override for fire service use.

Detectors

Detectors should be evenly spaced and:

- not more than 20 m apart; and
- at least 500 mm from any side of the lobby or corridor; and
- with the detector-sensing element more than 35 mm and not more than 300 mm from the soffit of the ceiling; and
- with a detector situated not more than 5 m from any change of direction in the lobby or corridor exceeding 45°; and
- with any part of a lobby or corridor divided from any other part by a beam or other obstruction projecting more than 600 mm below the soffit of the ceiling shall be deemed to be a separate lobby or corridor.

2.9.20 Protected zones

A *protected zone* is that part of an *escape route* which is within a *building*, but not within a *room*, and to which access is only by way of a *protected door* and from which there is an *exit* directly to a *place of safety*, and which is enclosed by *separating walls* and *separating floors* (see clauses 2.2.2 and 2.2.3).

The enclosing structure of a *protected zone* should have at least a medium fire resistance duration and any door in the enclosing structure should be a *self-closing fire door* (see clause 2.2.9) with at least a short fire resistance duration. However, the floor of the lowest *storey* or an *external wall* (other than an *external wall* described below), need not be fire resistant.

See annex 2.A for *high rise domestic buildings* with any *storey* at a height of more than 18 m.

Each *escape stair* should be within a *protected zone*, except an external *escape stair* with a total rise of not more than 7.5 m which leads directly to a *place of safety*.

A *protected zone* enclosing an *escape stair* should not enclose any *room* including a *store room* or any other ancillary *rooms*.

External walls

Where any part of an *external wall* of a *protected zone* is not more than 2 m from, and makes an angle of not more than 135° with any part of an *external wall* of another part of the *building*, the *escape stair* should be protected by *construction* for a distance of 2 m with a:

- short fire resistance duration where every *storey* in the *building* is at a height of not more than 7.5 m above the ground; or
- medium fire resistance duration where any *storey* is at a height of more than 7.5 m.

2.9.21 Protected enclosures

Where a *protected enclosure* is *constructed* within a *dwelling*, the walls should have a short fire resistance duration, and any door in the wall should be a *self-closing fire door* with a short fire resistance duration. However where a wall between *sanitary accommodation* and an adjacent *room* has short fire resistance duration, any wall or door between the *sanitary accommodation* and the *protected enclosure* need not have fire resistance.

2.9.22 External escape stairs

External *escape stairs* present additional hazards to people evacuating a *building* in the case of fire. This is because the *escape stair* will be exposed to the possible effects of inclement weather. For this reason, an external *escape stair* should not serve a *building* where the topmost *storey* height exceeds 7.5 m.

An external *escape stair* should lead directly to a *place of safety* and be protected against fire from within the *building* in accordance with the guidance below. However, fire protection need not be provided to an external *escape stair* with a total rise not more than 1.6 m.

Every part of an *external wall* (including a door, window or other opening) within 2 m from the *escape stair*, should have short fire resistance duration other than a door opening from the top *storey* to the external *escape stair*. Fire protection below the *escape stair* should be extended to the lowest ground level. Due to the likely smoke dissipation to atmosphere, *service openings* including ventilation *ducts* not more than 2 m from the *escape stair* may be protected by heat activated sealing devices or systems (see clause 2.2.9).

2.9.23 Basements

Where an *escape stair* also serves a *basement storey*, the *protected zone* enclosing the *escape stair* in the *basement storey* should be separated from the *protected zone* containing the *escape stair* serving the rest of the *building*, by a wall or screen, with or without a door, at the *ground storey* floor level. The wall, screen and *self-closing fire door* (see clause 2.2.9) should have a medium fire resistance duration.

Escape from a basement storey

A *basement storey* which contains an *apartment* should be provided with either:

- an *alternative exit* from the *basement storey*, which provides access to the external air (below the adjoining ground) from which there is access to a *place of safety* at ground level; or
- an escape window (see clause 2.9.4) in every *basement apartment*.

Inner rooms

An *apartment* in a *basement* should not be in an *inner room* unless there is an escape window (see clause 2.9.4) in the *apartment* or there are alternative routes from the *apartment* to circulation areas or other *rooms*.

Protected enclosures

Where a *private stair* serves a *basement storey*, the *private stair* should be in a *protected enclosure* (see clause 2.9.21).

2.9.24 Combustibility

Every part of an *escape stair* (including the landing) and the floor of a *protected zone* or *protected lobby*, should be *constructed of non-combustible* material. However, this guidance does not apply to:

- any handrail, balustrade or protective barrier on an *escape stair*;
- a floor finish (e.g. laminate flooring) applied to the *escape stair* (including the landing) or applied to the floor of a *protected zone* or *protected lobby*.

2.9.25 Supporting structure

Where an *element of structure* provides support to a *non-combustible* protected route of escape (see clauses 2.0.2 and 2.9.24), the supporting *element of structure* should also be *constructed* from materials which are *non-combustible*.

Where an *element of structure* provides support to a protected route of escape (see clause 2.0.2) which attracts a higher period of fire resistance, the supporting *element of structure* should also have at least the same period of fire resistance.

2.9.26 Openings and service penetrations

Fire and smoke can easily pass through openings in protected routes of escape (see clause 2.0.2) which could prevent the occupants from escaping in the event of an outbreak of fire within the *building*. For this reason, the openings in protected routes of escape should be limited to openings such as *chimneys*, *flue-pipes*, *self-closing fire doors* and *service openings*. Fire shutters or dampers (other than for protection of *service openings*, including ventilation *ducts*) should not be installed in the enclosing structure of protected routes of escape. In order to inhibit the spread of fire and smoke, openings in protected routes of escape should be *fire-stopped* in accordance with clause 2.2.9.

2.9.27 Junctions

The junctions between protected routes of escape (see clause 2.0.2) and other parts of the *building* are particularly vulnerable to fire and smoke. This is because fire and smoke can penetrate weaknesses at junctions which could compromise the means of escape. The continuity of the *fire-stopping* should be designed and *constructed* in order to provide a complete barrier to fire between the relevant parts of the *building*. The designer should consider all possible detailing at junctions to inhibit fire and smoke spread into the protected route of escape.

Where part of a *building* is a protected route of escape and forms a junction with any other part of the *building* including for example, an *external wall* or a *separating wall* or *separating floor* the junction should maintain the fire resistance duration of the protected route of escape.

In order to inhibit the spread of fire and smoke, junctions should be protected in accordance with clause 2.2.10 and the guidance on *fire-stopping* materials in clause 2.2.9.

Houses

2.9.28 Basements - Houses

A *basement storey* which contains an *apartment* should be provided with either:

- an *alternative exit* from the *basement storey*, which provides access to the external air (below the adjoining ground) from which there is access to a *place of safety* at ground level, or
- an escape window (see clause 2.9.4) in every *basement apartment*.

An *apartment* in a *basement* should not be in an *inner room* unless there is an escape window (see clause 2.9.4) in the *apartment* or there are *alternative routes* from the *apartment* to circulation areas or other *rooms*.

In a *house* containing an *apartment* or *kitchen* on a *storey* at a height of more than 4.5 metres, where the *private stair* also serves a *basement storey*, the *protected enclosure* serving the *basement storey* should be separated from the *protected enclosure* (see clause 2.9.21) serving the remainder of the *house* by *construction* providing a short fire resistance duration.

2.9.29 Inner rooms - Houses

An *apartment* in a *storey* at a height of more than 4.5 m should not be an *inner room*.

2.9.30 Escape windows - Houses

An escape window (see clause 2.9.4) should be provided in every *apartment* in an upper *storey* at a height of not more than 4.5 m and in every *apartment* which is an *inner room* in a *storey* at a height of not more than 4.5 m. However this is not necessary if there are alternative routes from the *apartment* to circulation areas or other *rooms*.

2.9.31 Protected enclosures - Houses

In a *house* containing an *apartment* or *kitchen* in a *storey* at a height of more than 4.5 m, every stair should be in a *protected enclosure* (see clause 2.9.21). However this does not apply to a stair in a *house* with one *storey* at a height of more than 4.5 m where the topmost *storey* does not contain an *apartment* or a *kitchen*. The *protected enclosure* should also follow the guidance for supporting structure (see clause 2.9.25), openings (see clause 2.9.26) and junctions (see clause 2.9.27).

2.9.32 Alternative exits - Houses

In a *house* containing an *apartment* or *kitchen* in a *storey* at a height of more than 4.5 m, every *storey* at a height of more than 7.5 m should have an *alternative exit*. Where the *alternative exit* is by way of a *flat roof* the protected route of escape should follow the guidance in clause 2.9.6 and in the case of an external *escape stair*, in accordance with the guidance in clause 2.9.22.

2.10 Escape lighting

- 2.10 Functional standard
- 2.10.0 Introduction
- 2.10.1 Escape route lighting
- 2.10.2 Protected circuits
- 2.10.3 Emergency lighting

standard

2.10

mandatory

Every *building* must be designed and *constructed* in such a way that in the event of an outbreak of fire within the *building*, illumination is provided to assist in escape.

2.10.0 Introduction

In seeking to escape from a *building* the occupants will find it easier if the *escape routes* are illuminated. Specifically dedicated escape lighting is not necessary within *dwellings* as it is assumed the occupants will have a degree of familiarity with the layout, and *escape routes* only begin at the door to the *dwelling*. However in *buildings* containing *flats* and *maisonettes*, the common *escape routes* should be illuminated to assist the occupants of the *building* to make their way to a *place of safety*.

High rise domestic buildings

Increased height brings extra risk, both in the time needed for escape and the difficulties posed to the fire service in attempting to assist evacuation, effect rescue or fight fires. Therefore additional guidance is provided in annex 2.A for *high rise domestic buildings* with any *storey* at a height of more than 18 m.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard (regulation 12, schedule 6).

2.10.1 Escape route lighting

Escape route lighting utilises the artificial lighting within the *building*, but should be supplied by a fire protected circuit.

Every part of an *escape route* should have artificial lighting supplied by a protected circuit that provides a level of illumination not less than that recommended for emergency lighting (see clause 2.10.3). Where artificial lighting serves a *protected zone*, it should be via a protected circuit separate from that supplying any other part of the *escape route*.

Artificial lighting supplied by a protected circuit need not be provided if a system of emergency lighting is installed.

2.10.2 Protected circuits

A protected circuit is a circuit originating at the main incoming switch or distribution board, the conductors of which are protected against fire. Regardless of what system is employed, *escape routes* should be capable of being illuminated when the *building* is in use. In *conversions* for example, it may be easier to install self-contained emergency luminaires than to install a protected circuit to the existing lighting system.

2.10.3 Emergency lighting

Emergency lighting is lighting designed to come into, or remain in, operation automatically in the event of a local and general power failure.

Emergency lighting should be installed in *buildings* considered to be at higher risk. In a *building* containing *flats* or *maisonettes* emergency lighting should be provided in the following areas:

- an underground car park including any *protected zone* serving it, where less than 30% of the perimeter of the car park is open to the external air;
- a *protected zone* or *unprotected zone* serving a *basement storey*.

The emergency lighting should be installed in accordance with BS 5266: Part 1: 1999 as read in association with BS 5266: Part 7: 1999 (BS EN: 1838: 1999).

2.11 Communication

- 2.11 Functional standard
- 2.11.0 Introduction
- 2.11.1 Dwellings with no storey more than 200 m²
- 2.11.2 Smoke alarms
- 2.11.3 Dwellings with a storey more than 200 m²

standard
2.11
mandatory

Every *building* must be designed and *constructed* in such a way that in the event of an outbreak of fire within the *building*, the occupants are alerted to the outbreak of fire.

Limitation:

This standard applies only to a *building* which:

- (a) is a *dwelling*
- (b) is a *residential building*; or
- (c) is an enclosed shopping centre.

2.11.0 Introduction

If a fire does begin in a *dwelling* then early detection and warning to the occupants can play a vital role in increasing their chances of escape. This is particularly important as the occupants may well be asleep.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard (regulation 12, schedule 6).

2.11.1 Dwellings with no storey more than 200 m²

A *dwelling* where no *storey* is more than 200 m², should be provided with 1 or more *smoke alarms* located on each *storey* with a standby supply to BS 5446: Part 1: 2000 and installed in accordance with the guidance in clause 2.11.2.

2.11.2 Smoke alarms

Standby power supply

The standby power supply for the *smoke alarm* should take the form of a primary battery, a secondary battery or a capacitor. The capacity of the standby supply should be sufficient to power the *smoke alarm* when the mains power supply is off for at least 72 hours while giving a visual warning of mains power supply being off. There should remain sufficient capacity to provide a warning of smoke for a further 4 minutes. An audible warning should be given at least once every minute where the capacity of the standby power supply falls below the recommended standby duration when the mains power supply is on and persist for at least 30 days when the mains power supply is off.

Location

A *smoke alarm* should be ceiling mounted and located:

- in a circulation area which will be used as a route along which to escape, not more than 7 m from the door to a living *room* or *kitchen* and not more than 3 m from the door to a *room* intended to be used as sleeping accommodation, the dimensions to be measured horizontally;
- where the circulation area is more than 15 m long, not more than 7.5 m from another *smoke alarm* on the same *storey*;
- at least 300 mm away from any wall or light fitting, heater or air conditioning outlet;
- on a surface which is normally at the ambient temperature of the rest of the *room* or circulation area in which the *smoke alarm* is situated.

The above recommendations are broadly in line with the recommendations of BS 5839: Part 6: 2004 for a Grade D Type LD3 system.

Interconnection

Where more than 1 *smoke alarm* is installed in a *dwelling* they should be interconnected so that detection of a fire by any one of them operates the alarm signal in all of them.

Wiring

A *smoke alarm* should be permanently wired to a circuit. The mains supply to the smoke alarm should take the form of either:

- an independent circuit at the *dwelling's* main distribution board, in which case no other electrical equipment should be connected to this circuit (other than a dedicated monitoring device installed to indicate failure of the mains supply to the *smoke alarms*); or
- a separately electrically protected, regularly used local lighting circuit.

Smoke alarms may be interconnected by 'hard wiring' on a single final circuit.

Supported accommodation

Any *smoke alarm* in a *dwelling* which forms part of residential accommodation with a warden or supervisor, should have a connection to a central monitoring unit so that in the event of fire the warden or supervisor can identify the *dwelling* concerned, and the system should follow the guidance in BS 5839: Part 6: 2004 for a Grade C Type LD2 installation.

False alarms

In order to reduce the frequency of unwanted false alarms, guidance is provided in BS 5839: Part 6: 2004 on the types of sensor most appropriate for the circumstances.

2.11.3 Dwellings with a storey more than 200 m²

A *dwelling* with any *storey* area more than 200 m² should be provided with a fire detection and alarm system designed and installed in accordance with BS 5839: Part 6: 2004 for a Grade C Type LD2 installation.

2.12 Fire service access

- 2.12 Functional standard
- 2.12.0 Introduction
- 2.12.1 Vehicle access provision
- 2.12.2 Vehicle access routes
- 2.12.3 Operating spaces for high reach appliances
- 2.12.4 Access for fire service personnel

standard

2.12

mandatory

Every *building* must be accessible to fire appliances and fire service personnel.

2.12.0 Introduction

Vehicle access to the exterior of a *building* is needed to enable high reach appliances, such as turntable ladders and hydraulic platforms, to be used, and to enable pumping appliances to supply water and equipment for fire-fighting and rescue activities. The access arrangements increase with *building* size and height.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard in so far as is *reasonably practicable*, and in no case be worse than before the *conversion* (regulation 12, schedule 6).

2.12.1 Vehicle access provision

Access from a *public road* should be provided for the fire service to assist fire-fighters in their rescue and fire-fighting operations. Whilst the access will depend to some extent on the vehicles and equipment used by the relevant authority (see clause 2.0.2), assistance may be provided from adjoining authorities when the need arises. For this reason, the more demanding guidance for high reach appliances may be recommended by the relevant authority. This may have a significant impact on planning, and a feasibility study may be appropriate. Consultation with the relevant authority (see clause 2.0.2) at the earliest opportunity is strongly recommended.

Vehicle access should be provided to at least one elevation of all *domestic buildings* to assist in fire-fighting operations.

Flats or maisonettes

In the case of *flats* or *maisonettes* with a common entrance, a vehicle access route for fire-fighting vehicles from a *public road* should be provided not more than 45 m from the common entrance.

In addition, where dry fire mains are installed in a *building*, parking spaces should be provided for fire service vehicles a distance not more than 18 m from riser inlets. The intention is to assist fire service personnel connect a short length of hose between the pumping appliance and the inlets to the dry fire mains quickly and efficiently therefore saving operational time.

However, vehicle access routes to more than one elevation may not always be possible due to the constraints of the site, and pedestrian access for fire service personnel as described in clause 2.12.4 may be sufficient. In such cases, advice from the relevant authority (see clause 2.0.2) should be sought.

Houses

Every *house* should be provided with a vehicle access route for fire-fighting vehicles from a *public road* to not more than 45 m from any door giving direct access to the interior of the *dwelling*.

2.12.2 Vehicle access routes

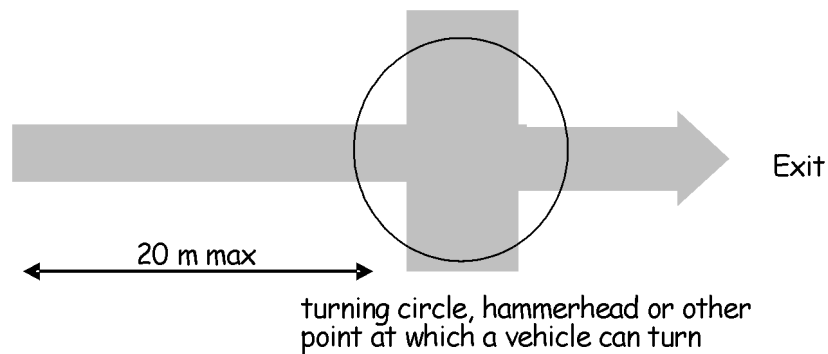
Access routes to *buildings* for fire service vehicles or personnel should not be assessed in isolation and the proposed access routes in effect will be dictated by need for water hydrants (see clause 2.0.4) and other fire-fighting facilities such as dry fire mains (see clause 2.14.2).

Dead end route

Fire service vehicles should not have to reverse more than 20 m from the end of an access road. Where any dead-end route is more than 20 m long turning facilities should be provided. This can be a turning circle or a hammerhead designed on the basis of the diagram and table below.

In rural areas, access from a *public road* may not be possible to within 45 m of an entrance to the *building*, and access from a *private road* will suffice provided the guidance in the table below has been followed. The vehicle access route assumes that access for pumping appliances will be sufficient for *houses*, but that provision for high reach appliances should be made to *buildings* containing *flats* or *maisonettes*. Where, in consultation with the relevant authority (see clause 2.0.2), access is only needed for pumping appliances, the smaller dimensions for a *house* may be used.

Turning Facilities



Access route for fire service vehicles

| Type of appliance | Flats and maisonettes | Houses |
|--------------------------------------|-----------------------|-------------|
| Minimum width of road between kerbs | 3.7 (m) | 3.7 (m) |
| Minimum width of gateways etc | 3.5 (m) | 3.5 (m) |
| Minimum clearance height | 4.0 (m) | 3.7 (m) |
| Minimum turning circle between kerbs | 26.0 (m) | 16.8 (m) |
| Minimum turning circle between walls | 29.0 (m) | 19.2 (m) |
| Minimum axle loading | 14 (tonnes) | 14 (tonnes) |

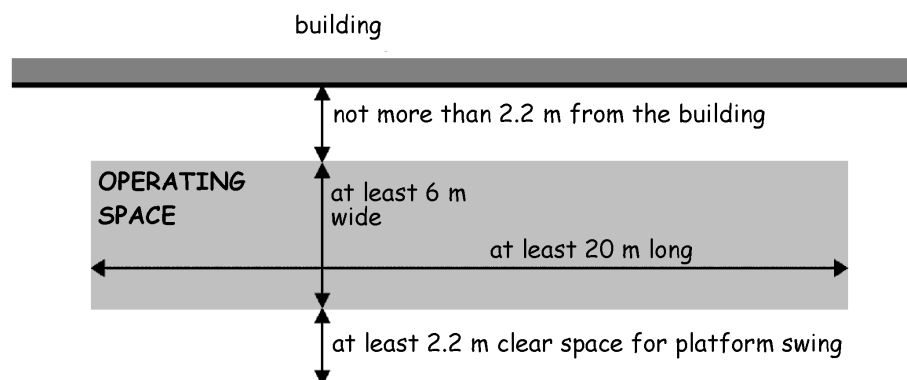
2.12.3 Operating spaces for high reach appliances

Following consultation with the relevant authority (see clause 2.0.2), if it is recommended that an operating space, or spaces, for a high reach appliance should be provided, the operating space(s) should:

- have a ground loading capacity of not less than 8.3kg/cm²; and
- be level or have a gradient not more than 1 in 12.

The operating space shown in the diagram below is suitable for either a hydraulic platform or a turntable ladder. Where the *building* has obstructions such as balconies or other projections, the *building* line should be taken to be the outer edge of the balconies or other projections.

Minimum dimensions for operating space for high reach appliances



2.12.4 Access for fire service personnel

It is common practice for fire service personnel to enter a *building* through the normal entrance and fight the fire head on. This is termed 'offensive fire-fighting'.

In order to allow unobstructed access to a *domestic building* for fire service personnel, a paved (or equivalent) footpath at least 900 mm wide (see also section 4: Safety) should be provided to the normal entrances of the *building*.

In addition, where vehicle access is not possible to within 18 m of the dry riser inlets (see clause 2.12.1), a footpath should also be provided to the riser inlets. This will allow the fire service to deploy portable pumps to relay water supplies to where the water is needed. Whilst this method of water distribution is quite common, it should be avoided for new developments because of the time delay in supplying water to the fire-fighters.

Every elevation which is provided with vehicle or pedestrian access for fire service personnel should have a door giving access to the interior of the *building*. Inward opening doors are preferable because this allows easier forced entry by fire service personnel should the need arise. However, an outward opening final *exit* door or *emergency door* should also be considered as providing suitable access.

2.13 Fire Service Water Supply

- 2.13 Functional standard
- 2.13.0 Introduction

standard

2.13

mandatory

Every *building* must be provided with a water supply for use by the fire service.

Limitation:

This standard does not apply to *domestic buildings*.

2.13.0 Introduction

This standard does not apply to *domestic buildings*.

The Fire (Scotland) Act 2005 includes requirements that a relevant authority (see clause 2.0.2) shall take all reasonable measures for securing that an adequate supply of water will be available for use, in the case of fire. It is therefore important to consult the fire service early in the design process to establish the extent of any water supplies for fire-fighting purposes.

2.14 Fire service facilities

- 2.14 Functional standard
- 2.14.0 Introduction
- 2.14.1 Facilities on escape stairs
- 2.14.2 Dry fire mains
- 2.14.3 Smoke clearance

standard

2.14

mandatory

Every *building* must be designed and *constructed* in such a way that facilities are provided to assist fire-fighting or rescue operations.

2.14.0 Introduction

Facilities should be designed and installed within common *escape stairs* to assist the fire service in carrying out their fire-fighting or rescue operations as efficiently as possible.

The intention is to provide facilities such as fire mains, fire-fighting shafts and lifts, smoke clearance capability and safe bridgeheads from which to commence operations within the *building* as quickly and efficiently as possible. These facilities increase with *building* size or *storey* height above the ground.

High rise domestic buildings

Increased height brings extra risk, both in the time needed for escape and the difficulties posed to the fire service in attempting to assist evacuation, effect rescue or fight fires. Therefore additional guidance is provided in annex 2.A for *high rise domestic buildings* with any *storey* at a height of more than 18 m.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard (regulation 12, schedule 6).

2.14.1 Facilities on escape stairs

Facilities should be designed and installed within the *building* to assist the fire service in carrying out their fire-fighting or rescue operations as efficiently as possible.

Where *flats* and *maisonettes* have only one *escape stair* and any *storey* is at a height of more than 7.5 m, a *protected lobby* should be provided within the *protected zone* on every *storey* and should have an area of at least 5 m². This is to provide a working area for fire service personnel. Within the *protected lobby* there should be an outlet from a dry fire main that will enable fire service personnel to attack the fire earlier.

Where *flats* or *maisonettes* have 2 or more *escape stairs* and any *storey* is at a height of more than 7.5 m, *protected lobbies* and dry fire mains should be provided to not less than 2 *escape stairs* positioned at least 20 m apart. No point on any *storey* should be further from a dry riser outlet than one *storey* height and 60 m measured along an unobstructed route for the fire hose.

2.14.2 Dry fire mains

A dry fire main is a pipe installed in a *building* for fire-fighting purposes which is normally dry but is capable of being charged with water by pumping from a fire service appliance. A dry fire main is commonly referred to as a 'dry riser'.

Location

Dry risers are normally located in *protected lobbies* within *protected zones*. The inlets to the risers should be located externally to the *building* and not more than 18 m from a parking space suitable for a pumping appliance. There should be a clear hose route between the appliance and the inlet. This will allow fire service personnel to connect the pumping appliance to the inlets quickly and efficiently saving operational time.

Dry risers should be installed in accordance with BS 5306: Part 1: 1976 (1988); and where there are:

- landing valves, they should conform to BS 5041: Part 2: 1987;
- inlet breachings, they should conform to BS 5041: Part 3: 1975 (1987);
- boxes for landing valves, they should conform to BS 5041: Part 4: 1975 (1987);
- boxes for dry risers, they should conform to BS 5041: Part 5: 1974 (1987).

2.14.3 Smoke clearance

Ventilation of the *escape stairs*, *protected lobbies* and common access corridors is important to assist fire service personnel during fire-fighting operations and for smoke clearance purposes after the fire has been extinguished. The efficiency of *ventilators* depends upon the prevailing wind and it is important that the fire service personnel can control the opening and closing of the *ventilators* on arrival at the *building*. An *escape stair* within a *protected zone* should have either:

- a *ventilator* of not less than 1 m² at the top of the stair; or
- an opening window at each *storey* with an openable area of 0.5 m².

Access corridors

Every access corridor or part of an access corridor, in a *building* containing *flats* or *maisonettes*, should be provided with openable *ventilators*. It should be noted that access corridors may also perform a different function. This is the case where the access corridor is also a *protected lobby* within a *protected zone* (see clause 2.9.19). The *ventilators* should provide exhaust at or near ceiling level and supply air at or near floor level with a combined aggregate opening area of at least 1.5 m². It is important that the *ventilators*

are capable of being opened or closed by fire service personnel including where automatic opening *ventilators* are recommended in clauses 2.9.17 and 2.9.19.

Open access balconies
and *access decks*

Where access to the *flats* or *maisonettes* is from an open access balcony or an *access deck*, openable *ventilators* need not be installed provided the balcony or *access deck* is open to the external air and the opening area extends over at least four-fifths of its length and at least one third of its height.

2.15 Automatic life safety fire suppression systems

- 2.15 Functional standard
- 2.15.0 Introduction
- 2.15.1 Automatic life safety fire suppression systems
- 2.15.2 Sheltered housing complex
- 2.15.3 High rise domestic buildings

standard
2.15
mandatory

Every *building* must be designed and *constructed* in such a way that, in the event of an outbreak of fire within the *building*, fire and smoke will be inhibited from spreading through the *building* by the operation of an automatic life safety fire suppression system.

Limitation:

This standard applies only to a *building* which:

- (a) is an enclosed shopping centre;
- (b) is a *residential care building*;
- (c) is a *high rise domestic building*; or
- (d) forms the whole or part of a *sheltered housing complex*.

2.15.0 Introduction

The term automatic life safety fire suppression system includes life safety sprinklers, but also provides the opportunity for designers to propose other systems which may be just as effective. The key characteristics of the system are:

- it must be automatic and not require people to initiate its activation;
- it must be designed primarily to protect lives, rather than property, this means it will normally be fitted with quick response sprinkler heads;
- it must be a fire suppression system, one designed specifically to deal with fires rather than other hazards.

High rise domestic buildings

Increased height brings extra risk, both in the time needed for escape and the difficulties posed to the fire service in attempting to assist evacuation, effect rescue or fight fires. Therefore additional guidance is provided in annex 2.A for *high rise domestic buildings* with any *storey* at a height of more than 18 m.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

2.15.1 Automatic life safety fire suppression systems

Automatic life safety fire suppression systems are required in 2 categories of *domestic buildings*:

- *high rise domestic buildings*; and
- *dwellings* which form part of a *sheltered housing complex*.

Water supply

For a suppression system to be effective it is essential that there is an appropriate and adequate water supply. Therefore designers need to discuss with the water authority what supply is likely to be available and what pressure can be expected. It is recognised that pressures will vary during the day, over the year and perhaps in future years. Therefore it is imperative that the system is designed on the basis of what the minimum pressure and flow is likely to be.

Maintenance

Auto-suppression systems require maintenance and it is essential that the systems, once installed, are regularly checked and maintained. It may be that the requirement to provide such maintenance is made a legal obligation on the owner by the addition of a Continuing Requirement when the completion certificate is accepted by the verifier (under Section 22 of the [Building \(Scotland\) Act 2003](#)). Failure to comply with such a Continuing Requirement could lead to enforcement proceedings being taken and might mean that the premises could not be legally occupied.

2.15.2 Sheltered housing complex

Flow rates

A *dwelling* forming the whole or part of a *sheltered housing complex* should have an automatic life safety fire suppression system designed and installed to DD 251: 2000 however, the system flow rate should be capable of providing at least 60 litres per minute through any single sprinkler and at least 42 litres per minute through each of 3 sprinklers operating simultaneously.

Components

Components of the system should be as specified and tested in accordance with DD 252: 2002. Sprinkler heads should be 'quick response type' with a response time index (RTI) of $50 \text{ (m.s)}^{1/2}$ and a conductivity factor (c) of not more than 1 (m/s)^2 . Concealed or recessed pattern sprinkler heads should only be used with the approval of the verifier.

Alternatives

There are many alternative or innovative fire suppression systems available including water-mist systems. Verifiers should satisfy themselves that such systems have been designed and tested for use in *domestic buildings* and are fit for their intended purpose (see Section 0).

2.15.3 High rise domestic buildings

A *high rise domestic building* with any *storey* at a height of more than 18 m above the ground should have an automatic life safety fire suppression system designed and installed in accordance with the guidance set out in annex 2.A.

Annex

2.A Additional guidance for high rise domestic buildings

- 2.A.0 Introduction
- 2.A.1 Separation
- 2.A.2 Structural protection
- 2.A.3 Cavities
- 2.A.4 Spread to neighbouring buildings
- 2.A.5 Spread on external walls
- 2.A.6 Escape lighting
- 2.A.7 Fire service facilities
- 2.A.8 Automatic life safety fire suppression systems

annex

2.A

2.A.0 Introduction

Occupants of *high rise domestic buildings* may not attempt to evacuate the *building* immediately. Initially they may not be aware that there is a fire in progress, or if there is a fire in progress, they may not immediately perceive themselves to be at risk. Due to the increased hazards associated with fires in *high rise domestic buildings* both to the occupants of the *building* and to fire-fighters, additional active and passive fire protection should be provided. Additional structural fire protection is necessary with increased height and automatic life safety fire suppression systems should be installed within every *dwelling*.

Additional recommendations are also provided for separation, cavities, spread to neighbouring *buildings*, spread on *external walls*, escape lighting, and fire service facilities.

Alternative guidance to
non-combustibility

BR 135, second edition, '[Fire Performance of external thermal insulation for walls of multi-storey buildings](#)' and BS 8414: Part 1: 2002 'Test method for non load-bearing external cladding systems applied to the face of the building' can be used as an alternative to the need for *non-combustibility* as recommended in clause 2.A.3, clause 2.A.4 and clause 2.A.5.

The following additional guidance is appropriate for all *high rise domestic buildings* with any *storey* at a height of more than 18 m above the ground.

2.A.1 Separation

Separating walls and *separating floors* should be *constructed* of *non-combustible* materials. *Separating walls* should have at least a medium fire resistance duration and any door in the *separating wall* should be a *self-closing fire door* with a medium fire resistance duration. *Separating floors* should have a long fire resistance duration.

2.A.2 Structural protection

Elements of structure should be provided with a long fire resistance duration. The additional structural protection and fire separation (see clause 2.A.1) is important in order to limit fire growth and will assist in protecting residents and fire-fighters during a prolonged evacuation of *high rise domestic buildings*.

Intermediate floors

However, an intermediate floor or floors within a *flat* or *maisonette* need only have short fire resistance duration provided the floor does not support or provide lateral restraint to any part of the structure with a long fire resistance duration.

2.A.3 Cavities

Material situated or exposed within a cavity or a cavity formed by *external wall* cladding, including thermal insulation material, should be *constructed* of *non-combustible* materials. This does not apply to insulation exposed in a cavity that is between 2 leaves of masonry or concrete at least 75 mm thick, and which has a *cavity barrier* around all openings in the wall and at the top of the wall-head.

2.A.4 Spread to neighbouring buildings

Every part of an *external wall* (including thermal insulation or *external wall* cladding) should be *constructed* of *non-combustible* material. This does not apply to insulation exposed in a cavity that is between 2 leaves of masonry or concrete at least 75 mm thick, and which has a *cavity barrier* around all openings in the wall and at the top of the wall-head.

2.A.5 Spread on external walls

External wall cladding should be *constructed* of *non-combustible* materials. Any wall insulation material situated or exposed within a cavity formed by *external wall* cladding, should also be *constructed* of *non-combustible* materials. This does not apply to insulation exposed in a cavity that is between 2 leaves of masonry or concrete at least 75 mm thick, and which has a *cavity barrier* around all openings in the wall and at the top of the wall-head.

2.A.6 Escape lighting

Every *protected zone* or *unprotected zone* should be provided with emergency lighting.

2.A.7 Fire service facilities

Where *flats* and *maisonettes* have only one *escape stair*, fire-fighting facilities on the *escape stair* should be provided by the following:

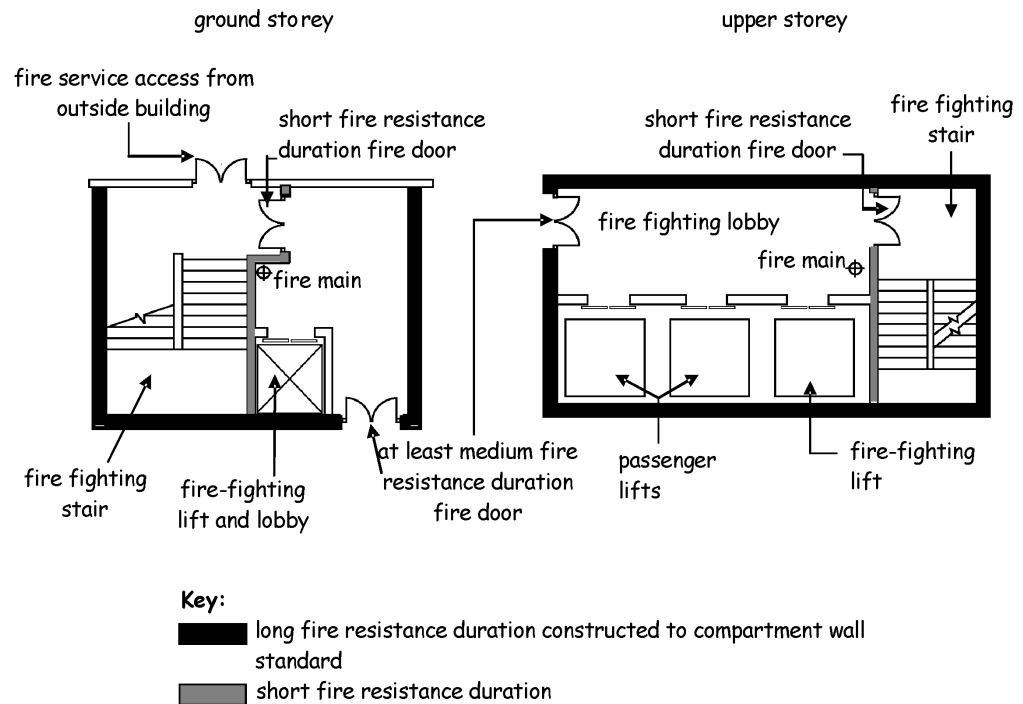
- a fire-fighting shaft;
- a fire-fighting lift; and
- a dry fire main with the outlet located in the fire-fighting lobby.

Where the *flats* or *maisonettes* have 2 or more *escape stairs*, the fire-fighting facilities described above should be provided to at least 2 *escape stairs* positioned at least 20 m apart.

No point on any *storey* should be further from a fire-fighting outlet than one *storey* height, and 60 m measured along an unobstructed route for fire hose.

Fire-fighting shafts

A fire-fighting shaft should be enclosed by walls forming the enclosing structure of a *protected zone* with a long fire resistance duration. A *self-closing fire door* in the enclosing structure of a fire-fighting shaft need only have medium fire resistance duration (see following diagram).



Bridgehead

The shaft should be provided with a ventilated fire-fighting lobby within the shaft, having not more than 1 door to the *room* or *storey* it serves. The lobby is intended to provide a safe bridgehead for the fire-fighters to work and it provides access from the *escape stair* to the accommodation and to any associated fire-fighting lift. The lobby should be *constructed* and ventilated in accordance with BS 5588: Part 5: 2004 or '[Smoke shafts protecting fire-fighting shafts: their performance and design](#)' (BRE, 2002) and in accordance with the diagram above.

A fire-fighting shaft should serve all *storeys* in a *building*. However a fire-fighting shaft serving an *upper storey* need not serve a *basement storey* and a fire-fighting shaft serving a *basement storey* need not serve an *upper storey*.

Fire-fighting lifts

A fire-fighting lift is a lift with additional protection, and with controls to enable it to be used under the direct control of the fire service when fighting a fire. The fire-fighting lift need not serve the top *storey* of a *building* where:

- a. the top *storey* is for service plant use only; and
- b. access to the plant room is from an *escape stair* from the *storey* below; and
- c. the foot of the *escape stair* is not more than 4.5 m from the fire-fighting lift; and
- d. a dry rising main is installed in the *protected lobby* of the *escape stair*.

A fire-fighting lift should be *constructed* in accordance with BS 5588: Part 5: 2004. However, the lift should only be entered from a fire-fighting lobby (having not more than one door to the *room* or *storey* it serves) or from an open access balcony or an *access deck*.

2.A.8 Automatic life safety fire suppression systems

Flats and *maisonettes* should have an automatic life safety fire suppression system designed and installed to DD 251: 2000 however the system flow rate should be capable of providing at least 60 litres per minute through any single sprinkler and at least 42 litres per minute through each of 3 sprinklers operating simultaneously.

Due to the high degree of fire *separation* between *dwelling*s, it may not be necessary, nor is it common practice, to evacuate *high rise domestic buildings* in their entirety during the outbreak of a fire. For this reason, automatic life safety fire suppression systems do not need to be installed in common spaces such as stairs, corridors, landings or communal facilities. On arrival, the fire service will assess the need for a complete or a partial evacuation of the *building*.

Components

Components of the system should be as specified and tested in accordance with DD 252: 2002. Sprinkler heads should be 'quick response type' with a response time index (RTI) of $50 \text{ (m.s)}^{1/2}$ and a conductivity factor (c) of not more than 1 (m/s)^2 . Concealed or recessed pattern sprinkler heads should only be used with the approval of the verifier.

Alternatives

There are many alternative or innovative fire suppression systems available including water-mist systems. Verifiers should satisfy themselves that such systems have been designed and tested for use in *domestic buildings* and are fit for their intended purpose (see section 0).

Annex

2.B Resistance to fire

- 2.B.0 Introduction
- 2.B.1 Fire resistance duration
- 2.B.2 British Standards and associated specifications
- 2.B.3 Harmonised European Standards

annex

2.B

2.B.0 Introduction

This annex provides guidance on how to establish the resistance to fire of a *building* element or component. Whilst it could be argued that occupants of a *building* only need minutes to reach relative safety such as a *protected zone*, it should be remembered that the fire tests used to establish fire resistance in terms of time, do not replicate a real fire. In order to ensure the safe evacuation of the *building* occupants and to ensure that fire-fighters are not placed at undue risk, it is necessary to apply certain factors of safety to the fire resistance for structural and non-structural fire protection.

2.B.1 Fire resistance duration

Fire resistance durations are established from the guidance to standards 2.1 to 2.15. Reference throughout this document to a short, medium or long fire resistance duration, will be satisfied by following the guidance in the table to this annex titled 'Fire resistance duration for common *building* elements or components'. The designer is free to choose materials or products which satisfy either the British Standard Tests or the Harmonised European Tests.

Transitional period

British and European fire tests will co-exist in use until the British Standard classifications are withdrawn.

2.B.2 British Standards and associated specifications

The recommended fire resistance duration can be attained where the *construction* follows the guidance in the Columns 3, 4 and 5 of the table below. The tests and specifications in either:

- a. Clause 10 of BS 476: Part 20: 1987, when read in conjunction with - for load-bearing elements, BS 476: Part 21: 1987, for non load-bearing elements, BS 476: Part 22: 1987, for components, BS 476: Part 23: 1987, for ventilation *ducts*, BS 476: Part 24: 1987;
- b. for *fire door* assemblies with non-metallic leaves, BS 8214: 1990: Sections 1 and 2;
- c. for structural steelwork, BS 5950: Part 8: 2003 or 'Fire Safe Design : A new approach to multi-storey steel framed buildings' published by The Steel Construction Institute (within the limitations described in the SCI Publication P288);
- d. in the case of structural use of timber, BS 5268: Part 4: Sections 4.1 and 4.2: 1990;
- e. in the case of structural use of concrete, BS 8110: Part 2: 1985: Section 4.3 Tabulated data (method 1);
- f. an appropriate specification given in the Building Research Establishment Report BR 128 '[Guidelines for the Construction of Fire Resisting Structural Elements](#)' (BRE 1988).

| Column 1 | Column 2 | Column 3 | Column 4 | Column 5 | Column 6 | Column 7 |
|---|--------------------------|------------------------------|------------------|-------------------|--------------------|--|
| Construction | Fire resistance duration | British Standards | | | European Standards | Test exposure |
| | | Load bearing capacity (mins) | Integrity (mins) | Insulation (mins) | | |
| 1. Structural frame, column or beam | Short | 30 | None | None | R 30 | Faces exposed on the inside |
| | Medium | 60 | None | None | R 60 | |
| | Long | 120 | None | None | R 120 | |
| 2. <i>Separating floor</i> , or any other floor, <i>flat roof</i> or <i>access deck</i> used as a protected route of escape (2.0.2) | Short | 30 | 30 | 30 | REI 30 | From the underside |
| | Medium | 60 | 60 | 60 | REI 60 | |
| | Long | 120 | 120 | 120 | REI 120 | |
| 3. Other than a floor in 2 or an intermediate floor within a <i>flat</i> or <i>maisonette</i> (see 2.A.3) | Short | 30 | None | None | R 30 | From the underside |
| | Medium | 60 | None | None | R 60 | |
| | Long | 120 | None | None | R 120 | |
| 4. <i>Separating wall</i> or an internal wall or screen used as a protected route of escape (2.0.2) [1, 2]. | Short | 30 [4] | 30 | 30 | REI 30 [4] | Each side separately |
| | Medium | 60 [4] | 60 | 60 | REI 60 [4] | |
| | Long | 120 [4] | 120 | 120 | REI 120 [4] | |
| 5. Load-bearing wall, other than a wall in 4 | Short | 30 | None | None | R 30 | Each side separately |
| | Medium | 60 | None | None | R 60 | |
| | Long | 120 | None | None | R 120 | |
| 6. <i>Fire door</i> in a wall in 4 | Short | None | 30 [6] | None | E 30 Sa [6] | Each side separately, when fitted in frame [7] |
| | Medium | None | 60 [6] | None | E 60 Sa [6] | |
| | Long | None | 120 [5, 6] | None | E 120 Sa [5, 6] | |
| 7. <i>External wall</i> more than 1m from a <i>boundary</i> [1, 2] | Short | 30 [4] | 30 | None | RE 30 [4] | From the inside only |
| | Medium | 60 [4] | 60 | 30 | RE 60 and I 30 [4] | |
| 8. <i>External wall</i> not more than 1m from a <i>boundary</i> [1, 2] | Short | 30 [4] | 30 | 30 | REI 30 [4] | From the inside only |
| | Medium | 60 [4] | 60 | 60 | REI 60 [4] | |
| 9. Horizontal <i>cavity barrier</i> [3] | Short | None | 30 | None | E 30 | From the underside |
| 10. Vertical <i>cavity barrier</i> [3] | Short | None | 30 | None | E 30 | Each side separately |
| 11. Ceiling in place of a <i>cavity barrier</i> (see 2.4.2b, 2.4.2c, 2.4.3) | Short | None | 30 | 30 | EI 30 | From the underside |

Notes:

1. An *external wall* includes any *external wall* used to protect routes of escape (see clause 2.0.2) but excludes an unprotected area calculated in accordance with clauses 2.6.1 to 2.6.4.

2. Any door in an *external wall*, which is not included in the calculation of unprotected area, should have the same fire resistance and the same test exposure as the *external wall*.
3. In a timber stud wall or partition the following will also be deemed to have a short fire resistance duration:
 - a. polythene sleeved mineral wool, or mineral wool slab, in either case under compression when installed; or
 - b. calcium silicate, cement based or gypsum based board at least 12 mm thick; or
 - c. steel at least 0.5 mm thick; or
 - d. timber at least 38 mm thick.
4. If the *construction* is non load-bearing, none in the case of column 3, and no load-bearing (R) in the case of column 6.
5. Medium fire resistance duration is sufficient for a *fire door* in the enclosing structure of a fire-fighting shaft.
6. Unless the *fire door* is in an *external wall* or a lift door or pressurisation techniques following the guidance in BS 5588: Part 4: 1998 are used, the *fire door* should also either:
 - a. in the case of column 4, have smoke seals fitted unless the leakage rate does not exceed $3\text{m}^3/\text{m}/\text{hour}$, head and jambs only, when tested at 25 Pa according to BS 476: Part 31: 1983 (Section 31.1) with AMD 8366/ November 1994; or
 - b. in the case of column 6, attain the additional classification of Sa when tested to BS EN 1634-3 2001.
7. A lift door need only be tested from the outside and a *fire door* in an *external wall* need only be tested from the inside.

2.B.3 Harmonised European Standards

The recommended fire resistance duration can be attained where the *construction* follows the guidance in Column 6 of the table below as specified in [Commission Decision 2000/367/EC of 3/5/2000](#) implementing Council Directive [89/106/EEC](#) as regards the classification of the resistance to fire of *construction products*, *construction works* and parts thereof. The tests and specifications are:

BS EN 13501-2: 2003, Fire classification of construction products and building elements, Part 2-Classification using data from fire resistance tests (excluding products for use in ventilation systems).

BS EN 1363-1: 1999, Fire resistance tests, Part 1-General requirements

BS EN 1363-2: 1999, Fire resistance tests, Part 2-Alternative and additional procedures

BS EN 1363-3: 1999, Fire resistance tests, Part 3-Verification of furnace performance

BS EN 1364-1: 1999, Fire resistance tests for non load-bearing elements-Part 1: Walls

BS EN 1364-2: 1999, Fire resistance tests for non load-bearing elements-Part 2: Ceilings

BS EN 1365-1: 1999, Fire resistance tests for load-bearing elements-Part 1: Walls

BS EN 1365-2: 1999, Fire resistance tests for load-bearing elements-Part 2:
Floors and roofs

BS EN 1365-3: 2000, Fire resistance tests for load-bearing elements-Part 3:
Beams

BS EN 1365-4: 1999, Fire resistance tests for load-bearing elements-Part 4:
Columns

BS EN 1366-1: 1999, Fire resistance tests for service installations-Part 1:
Ducts

BS EN 1366-2: 1999, Fire resistance tests for service installations-Part 2:
Fire dampers

BS EN 1634-1: 2000, Fire resistance tests for door and shutter
assemblies-Part 1: Fire doors and shutters

BS EN 1634-3: 2001, Fire resistance tests for door and shutter
assemblies-Part 3: Smoke control doors

Annex

2.C Reaction to fire

- 2.C.0 Introduction
- 2.C.1 Reaction to fire classification
- 2.C.2 British Standards and associated specifications
- 2.C.3 Harmonised European Standards

annex

2.C

2.C.0 Introduction

The performance criteria in terms of reaction to fire can be satisfied by either the fire test specified in British Standards terms or the European harmonised fire tests. The reaction to fire properties of *elements of structure, separating walls, separating floors, cavity barriers, linings, external walls, ceilings, external claddings and escape stairs* is provided throughout the handbook. Some materials are deemed intrinsically to be *non-combustible* and therefore do not need to be tested.

2.C.1 Reaction to fire classification

The level of risk is established from the guidance to standard 2.1 to 2.15. The guidance in the following table will be sufficient to attain the appropriate levels of performance (in terms of risk) identified throughout this handbook. The British Standard classifications do not automatically equate with the equivalent classifications in the European Standards column, therefore products cannot typically assume a European class, unless they have been tested accordingly. The designer is free to choose materials or products which satisfy either the British Standard Tests or the Harmonised European Tests.

Transitional period

British and European fire tests will co-exist in use until the British Standard classifications are withdrawn.

2.C.2 British Standards and associated specifications

Column 2 of the table sets out the performance criteria for 'reaction to fire'. The materials or components should be tested to the BS 476 series of test standards which are deemed to satisfy the level of risk set throughout this Technical Handbook.

2.C.3 Harmonised European Standards

In accordance with [Commission Decision 2000/147/EC of 8/2/2000](#) implementing Council Directive [89/106/EEC](#) as regards the classification of the reaction to fire of materials and components, column 3 of the table sets out the European performance criteria. Materials or components should be tested to the European Harmonised Tests listed in column 3 of the table which are deemed to satisfy the level of risk set throughout this guidance document. BS EN 13501-1: 2002 provides the reaction to fire classification procedure for all *construction* products within the scope of the *Construction Products Directive*.

Reaction to Fire

| Column 1 | Column 2 | Column 3 |
|------------------------|--|--|
| Risk | British Standards | European Standards (1) |
| <i>Non-combustible</i> | <p>The material is certified <i>non-combustible</i> according to the test specified in BS 476: Part 4: 1970 (1984) throughout; or</p> <p>The material does not flame or cause any rise in temperature on either the centre (specimen) or furnace thermocouples according to the test specified in BS 476: Part 11: 1982 (1988).</p> | <p>The material has achieved a classification of A1 when tested in accordance with BS EN ISO: 1182 and BS EN ISO: 1716; or</p> <p>The material has achieved a classification of A2-s3, d2 when tested in accordance with BS EN: 13823 and BS EN ISO: 1182 or BS EN ISO: 1716; or</p> <p>Products made from only 1 or more of the materials considered as Class A1 without the need for testing, as defined in Commission Decision 96/603/EC of 4th October 1996 establishing the list of products belonging to Class A1 “No contribution to fire” provided for in the Decision 94/611/EC implementing Article 20 of the Council Directive 89/106/EEC on the <i>construction products</i> . None of the materials contain more than 1.0% by weight or volume (whichever is the lower) of homogeneously distributed organic material.</p> |
| Low risk | The surface material (or where it is bonded throughout to a substrate, the surface material combined with the substrate) has a surface of Class 1 and, when tested in accordance with BS 476: Part 6: 1981 or BS 476: Part 6: 1989 has an index of performance (I) not more than 12 and a sub-index (i ₁) not more than 6. | The material has achieved a classification of B-s3, d2 or better when tested in accordance with BS EN: 13823 and BS EN ISO: 11925-2 |
| Medium risk | The material of the wall or ceiling when tested to BS 476: Part 7: 1987 (1993), attains a Class 1 surface spread of flame | The material has achieved a classification of C-s3, d2 or better when tested in accordance with BS EN: 13823 and BS EN ISO: 11925-2 |
| High risk | The material of the wall or ceiling when tested to BS 476: Part 7: 1987 (1993), attains a Class 2 or Class 3 surface spread of flame. | The material has achieved a classification of D-s3, d2 or better when tested in accordance with BS EN: 13823 and BS EN ISO: 11925-2 |
| Very high risk | A material which does not attain the recommended performance for high risk | |

Notes:

1. When a classification includes “s3, d2” this means that there is no limit set for smoke production and/ or flaming droplets/ particles.

Annex

2.D Vulnerability of roof coverings

- 2.D.0 Introduction
- 2.D.1 Vulnerability of roof coverings
- 2.D.2 British Standards and associated specifications
- 2.D.3 Harmonised European Standards

annex

2.D

2.D.0 Introduction

This annex provides guidance on the vulnerability of roof coverings and is concerned with the performance of roofs when exposed to fire from neighbouring *buildings*.

[Commission Decision of 22 November 2005](#) amending Decision 2001/671/EC establishing a classification system for the external fire performance of roofs and roof coverings allows the classification of performance by either:

- a. BS 476: Part 3: 2004 (National Test), External fire exposure roof tests; or
- b. BS EN 13501-5: 2005 (European Test), Fire classification of construction products and building elements, Part 5-Classification using test data from external fire exposure to roof tests.

2.D.1 Vulnerability of roof coverings

The level of vulnerability is established from the guidance to standard 2.1 to 2.15. Reference throughout this document to a low, medium or high vulnerability, will be satisfied by following the guidance in the tables. The British Standard classification does not automatically equate with the equivalent classifications in the European standards column, therefore products cannot typically assume a European class, unless they have been tested accordingly. The designer is free to choose materials or products, which satisfy either the British Standard Tests or the Harmonised European Tests.

Transitional period

British and European fire tests will co-exist in use until the British Standard classifications are withdrawn.

2.D.2 British Standards and associated specifications

The national test for roof coverings is BS 476: Part 3: 2004 which measures the capability of a roof to resist penetration from fire and flame spread when the external surface is exposed to radiation and flames.

BS 476: Part 3: 2004 sets out a classification system based on external penetration and flame spread as set out in the following table. The first letter of the designation indicates fire penetration performance i.e. the time at which any glowing or flaming [other than that from the gas pilot flame] appears on the underside of the specimen. The second letter of the designation indicates flame spread performance. The addition of the suffix 'X' indicates dripping from the underside of the specimen, any mechanical failure or development of holes in the specimen. The angle of the specimen in the test is designated by the prefix 'S' [slope] or 'F' [flat].

| Penetration | | Flame spread | |
|--------------------|--|---------------------|---|
| A | Those specimens which have not been penetrated within 60 minutes | A | Those specimens on which there is no spread of flame |
| B | Those specimens which are penetrated in not less than 30 minutes | B | Those specimens on which there is not more than 525 mm spread of flame |
| C | Those specimens which are penetrated in less than 30 minutes | C | Those specimens on which there is more than 525 mm spread of flame |
| D | Those specimens which are penetrated in the preliminary test | D | Those specimens which continue to burn for more than 5 minutes after the withdrawal of the test flame or spread of flame more than 375 mm across the region of burning in the preliminary test. |

2.D.3 Harmonised European Standards

The European test method has been published as DD ENV 1187: 2002, 'Test methods for external fire exposure to roofs', which specifies four methods for determining the performance of roofs to external fire exposure:

- Test 1 : with burning brands;
- Test 2 : with burning brands and wind;
- Test 3 : with burning brands, wind and supplementary radiant heat;
- Test 4 : two stage test method incorporating burning brands, wind and supplementary radiant heat.

Only test method 4 evaluates penetrability in a satisfactory way to satisfy the fire performance requirements in the United Kingdom. For this reason, (t4) has been added to the European test designations to add clarity.

The performance criteria in terms of vulnerability to external fire exposure can be satisfied where the roof covering follows the guidance in the following table. The classification methodology is contained in BS EN 13501-5: 2005.

| Classification for roofs / roof coverings exposed to external fire | |
|---|---|
| Roof (t4) | <ul style="list-style-type: none"> a. No penetration of roof system within 60 minutes b. In preliminary test, after withdrawal of the test flame, specimens burn for less than 5 minutes c. In preliminary test, flame spread less than 0.38 m across region of burning |
| Croof (t4) | <ul style="list-style-type: none"> a. No penetration of roof system within 30 minutes. b. In preliminary test, after withdrawal of the test flame, specimens burn for less than 5 minutes c. In preliminary test, flame spread less than 0.38 m across region of burning. |
| Droof (t4) | <ul style="list-style-type: none"> a. Roof system is penetrated within 30 minutes but is not penetrated in the preliminary test. b. In preliminary test, after withdrawal of the test flame, specimens burn for less than 5 minutes c. In preliminary test, flame spread less than 0.38 m across region of burning |
| Eroof (t4) | <ul style="list-style-type: none"> a. Roof system is penetrated within 30 minutes but is not penetrated in the preliminary test. b. Flame spread is not controlled |
| Froof (t4) | <ul style="list-style-type: none"> c. No performance determined. |

Vulnerability of roof coverings

| Column 1 | Column 2 | Column 3 |
|----------------------|---|--|
| Vulnerability | British Standards [1, 2, 3] | European Standards |
| Low | <p>a) designation AA, AB or AC when tested along with the substrate in accordance with BS 476: Part 3: 2004; or</p> <p>b) glass at least 4 mm thick; or</p> <p>c) a roof covering or rooflight of plastics materials which is in an open canopy or over a substantially open area such as a loading bay which is a single-skin polycarbonate sheet not more than 3 mm thick or multi-skin polycarbonate sheet, or a thermoplastic material (see clause 2.5.4): a specimen of which when tested in accordance with Method 508A in BS 2782: 1970 (1974), performs so that the test flame does not reach the second mark within 2 minutes, the specimen thickness to be more than 1.5 mm and not more than 3 mm; or</p> <p>d) a thermoplastic sheet with a low or medium risk (see table to annex 2.C) or a rigid solid PVC (uPVC), or a polycarbonate rigid solid sheet at least 3 mm thick, or a multiskin polycarbonate sheet at least 10 mm thick overall.</p> | <p>The material has achieved a classification of Broof(t4) in accordance with BS EN 13501-5: 2005 when tested to DD ENV 1187: 2002</p> |
| Medium | <p>a) designation BA, BB, BC, CA, CB or CC when tested along with the substrate in accordance with BS 476: Part 3: 2004; or</p> <p>b) a roof covering or rooflight of plastics materials which is a single-skin polycarbonate sheet not more than 3 mm thick or multi-skin polycarbonate sheet, or thermoplastic material, a specimen of which when tested in accordance with Method 508A in BS 2782: 1970 (1974), performs so that the test flame does not reach the second mark within 2 minutes, the specimen thickness to more than 1.5 mm and not more than 3 mm.</p> | <p>The material has achieved a classification of Croof(t4) and Droof(t4) in accordance with BS EN 13501-5: 2005 when tested to DD ENV 1187: 2002</p> |
| High | <p>Any designation other than low or medium vulnerability, including for example, timber shingles or thatch.</p> | <p>The material has achieved a classification of Eroof(t4) and Froof(t4) in accordance with BS EN 13501-5: 2005 when tested to DD ENV 1187: 2002</p> |

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3.0 Introduction

- 3.0.1 Background
- 3.0.2 Aims
- 3.0.3 Latest changes
- 3.0.4 Relevant legislation

Introduction

3.0

3.0.1 Background

Water, air and soil are intricately linked and all can be affected by various forms of pollution that affect our environment. Other issues such as condensation have been a constant threat to people and *buildings* for many years.

Industrial change and demographic shift during the 19th and 20th centuries resulted in large-scale re-organisation of our villages, towns and cities. Industries moved out or disappeared altogether leaving large, 'brownfield', gaps in our landscape. At the same time, changes in heating methods and the advent of the consumer society, have had a significant effect on the type and volume of refuse it has been necessary to dispose of to landfill. Inevitably, these changes have left behind a legacy of land contamination that in some cases, may be harmful. The Scottish government encourages the use of previously developed land (brownfield) and local authorities may wish to promote brownfield land in preference to greenfield land. Some of this land will be contaminated and will need to be made safe.

Climate is controlled by the long-term balance of energy of the Earth and its atmosphere. Natural events cause changes in climate but human activities can also change the climate. The accumulation of greenhouse gases in the atmosphere due to human activities will change the climate by enhancing the natural greenhouse effect, leading to an increase in the Earth's average surface temperature resulting in heavier rainfall.

Indoor air quality complaints are frequently precipitated by comfort issues: high or low temperatures, draughts, high or low humidity or poor lighting. However the incidence of real indoor pollution should not be ignored, it is surprisingly common. The *construction* quality of *dwellings* is improving with a resulting reduction of adventitious air infiltration producing fewer air changes. Inadequate ventilation, inefficient filtration and poor hygiene all contribute to poor indoor air quality.

Carbon monoxide (CO) gas has no smell, taste or colour and it kills dozens of people in their homes every year. Many more suffer debilitating illnesses often without anybody realising that they are being poisoned. CO gas is produced by combustion appliances such as fires, boilers and water heaters. Any appliance that burns solid fuel, gas or oil and that does not have a *room-sealed* balanced *flue* so that it is sealed off from the *room*, is capable of poisoning you if it is not properly installed, maintained and serviced. The highest incidence of CO poisoning occurs in *domestic buildings*.

Oil accounts for about a third of all reported pollution incidents in Scotland that are investigated by the [Scottish Environment Protection Agency](#) (SEPA). That means around 500 to 600 pollution incidents a year with about 10 to 12% being serious. It is an offence to cause pollution and courts now impose heavy fines. Although domestic pollution is low compared with commercial and industrial *buildings*, it is important to ensure standards are not lowered.

Disposal of *wastewater* and *surface water* needs to be carefully considered to prevent environmental pollution and uncontrollable runoff during periods of heavy rainfall leading to flooding. The incorporation of water conservation measures in *buildings* can reduce pressure on precious water resources by recycling water from certain types of appliance. Recycling can also reduce the reliance on mains water and limit the amount of water discharged thus alleviating the risk of flooding. The inclusion of 'green roofs' into *building*

design can also provide benefits to the environment and *building* owners alike. Although viewed as mainly a vernacular *building* practice renewed interest is being shown in this technique due to the diverse benefits that can be achieved, such as:

- run-off attenuation helping to reduce sewer surcharging;
- absorption of greenhouse gases;
- absorption of air pollution;
- protecting the roof finish from mechanical damage and ultra-violet radiation; and
- providing additional insulation.

Solid waste has increased enormously in the last couple of decades and disposal to landfill sites is creating severe problems. Recycling is now a priority.

3.0.2 Aims

The intention of this section is to ensure that, as far as is *reasonably practicable*, *buildings* do not pose a threat to the environment and *dwellings* and people in and around *dwellings* are not placed at risk as a result of:

- a. site conditions;
- b. hazardous and dangerous substances;
- c. the effects of moisture in various forms;
- d. an inadequate supply of air for human occupation of a *dwelling*;
- e. inadequate drainage from a *building* and from paved surfaces around a *dwelling*;
- f. inadequate and unsuitable *sanitary facilities*;
- g. inadequate accommodation and facilities in a *dwelling*;
- h. inadequately *constructed* and installed combustion appliances;
- i. inadequately *constructed* and installed oil storage tanks;
- j. inadequate facilities for the storage and removal of solid waste from a *dwelling*.

3.0.3 Latest changes

There were no major changes made to this section between 1 May 2007 and 30 April 2008 but a few minor corrections have been made. A summary of these corrections can be found on the [2008 Technical Handbooks](#) website page.

3.0.4 Relevant legislation

Listed below are some pieces of legislation that may be relevant and/or helpful to those using the guidance in this particular section.

[Gas Safety \(Installation and Use\) Regulations 1998](#)

The Gas Safety (Installations and Use) Regulations 1998 require that any person who installs, services, maintains, removes, or repairs gas fittings must be competent. It covers not only materials, workmanship, safety precautions and testing of gas fittings but also the safe installation of all aspects of gas fired appliance installations.

[Gas Appliance \(Safety\) Regulations 1995](#)

The Gas Appliance (Safety) Regulations 1995 cover all aspects of gas appliances and fittings and sets safe standards to satisfy the essential requirements set by the EU. It sets procedures and duties for demonstrating attestation of conformity.

[The Control of Pollution Act 1974](#)

The Control of Pollution Act 1974 covers, among others, duties and powers of SEPA to control and dispose of solid waste.

[The Environment Act](#)

The Environment Act 1995 covers, among others, duties and powers of the

| | |
|--|---|
| 1995 | Scottish Environment Protection Agency. |
| The Environmental Protection Act 1990 | The Environmental Protection Act 1990 covers, among others, management and enforcement of the collection, disposal and treatment of waste, control of hazardous substances, oil pollution and nature conservation. Part IIA covers contaminated land. |
| The Groundwater Regulations 1998 | The Groundwater Regulations 1998 were introduced to prevent ground water pollution and to manage groundwater resources in a sustainable way. |
| The Water Environment and Water Services (Scotland) Act 2003 | The Water Environment and Water Services (Scotland) Act 2003 sets up an integrated regime for water quality and quantity management. |
| The Water Byelaws 2004 | The Water Byelaws apply to any water fitting installed or used in buildings where water is supplied by Scottish Water other than where specifically exempted. |
| The Sewerage (Scotland) Act 1968 | The Sewerage (Scotland) Act 1968 covers, among others, duties and powers of the local authority to provide, construct and maintain public sewers and rights of connection and discharge. |
| CAR Regulations 2005 | The Water Environment (Controlled Activities)(Scotland) Regulations 2005 gives Ministers the power to introduce controls over a range of activities that have an adverse impact upon the water environment. |
| Oil Storage Regulations 2006 | The Water Environment (Oil Storage)(Scotland) Regulations 2006 were introduced to help reduce the incidence of oil pollution particularly from inadequate storage. |

3.1 Site preparation – harmful and dangerous substances

- 3.1 Functional standard
- 3.1.0 Introduction
- 3.1.1 Preparation of a site
- 3.1.2 Harmful or dangerous substances
- 3.1.3 Hazard identification and assessment
- 3.1.4 Development on land that may be contaminated
- 3.1.5 Land not initially identified as being contaminated
- 3.1.6 Risk management techniques
- 3.1.7 Housing on land affected by contamination
- 3.1.8 Re-development of industrial land

| | |
|--|---|
| <p>standard</p> <p>3.1</p> <p>mandatory</p> | <p>Every <i>building</i> must be designed and <i>constructed</i> in such a way that there will not be a threat to the <i>building</i> or the health of people in or around the <i>building</i> due to the presence of harmful or dangerous substances.</p> <p>Limitation: This standard does not apply to the removal of unsuitable material, including turf, vegetable matter, wood, roots and topsoil on the site of a <i>building</i> (other than a <i>dwelling</i>) intended to have a life not exceeding the period specified in regulation 6.</p> |
|--|---|

Environmental Protection Act 1990

3.1.0 Introduction

Land contamination is an unwanted legacy of Britain’s long industrial history. Part IIA of the Environmental Protection Act 1990 (inserted by section 57 of the [Environment Act 1995](#)) was introduced to enable the identification and remediation of contaminated land from which contamination currently represents an unacceptable risk. Risks associated with the land’s future use will continue to be dealt with under the planning and building standards system. Some functions of Part IIA, planning and building standards regimes may, at times, overlap.

Public registers

Part IIA adopts a ‘suitable for use approach’ that requires the current risks to be assessed and remediated as required, for a site’s existing use. The primary regulatory role for this rests with the local authorities. Local authorities and SEPA must establish public registers to record all prescribed regulatory action taken under Part IIA. The register will contain particulars relating to the remediation, as well as notifications of the identification, of contaminated land. The registers will expand as new information is identified.

Section 78A(2) of the Act (as amended) provides a specific definition of ‘contaminated land’ for the purpose of the Act. Land that is not ‘contaminated land’ as defined under the Act may still contain harmful or dangerous substances and the following guidance should be useful to the local authority in carrying out its other functions.

PAN 33

Land confirmed, or suspected of being contaminated is a material consideration when local authorities determine planning applications. The key role of the planning system is to ensure that all the ground included within the planning application is suitable for the proposed future use. Conditions may be added to any permission given to ensure the required remediation takes place. Planning Advice Note (PAN) 33 ‘[Development of Contaminated Land](#)’ explains further the role of planning and includes useful cross-references to other relevant publications and regimes.

Harmful or dangerous substances

Harmful or dangerous substances include deposits of faecal or animal matter and any substance, or mixture of substances, which is, or could become, corrosive, explosive, flammable, radioactive or toxic or which produces, or could produce, any gas likely to have any such characteristic.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard in so far as is *reasonably practicable*, and in no case be worse than before the *conversion*. (regulation 12, schedule 6).

3.1.1 Preparation of a site

'ground immediately adjoining'

Surface soil and vegetable matter can be detrimental to a *building's* structure if left undisturbed within the *building* footprint. Therefore, before any *work* can commence, unsuitable material including turf, vegetable matter, wood, roots and topsoil should be removed from the ground to be covered by the *building*, and the ground immediately adjoining the *building*, to a depth of at least that which will prevent later growth that could damage the *building*. The term 'ground immediately adjoining' is intended to cover ground that is disturbed as a direct result of the *works*.

The solum (prepared area within the containing walls of a *building*) should be treated to prevent vegetable growth and reduce the evaporation of moisture from the ground to the inner surface of any part of a *dwelling* that it could damage.

The solum should be brought to an even surface and any up filling should be of hard, inert material. See guidance to standard 3.4 relating to *building* elements adjacent to the ground.

To prevent water collecting under the *building*, the solum should be not lower than the highest level of the adjoining ground. However where this may not be possible, such as on sloping ground, the solum should be laid to fall to an outlet in the under *building* above the lowest level of the adjoining ground to prevent any water build up below the *building*. Any part of the under *building* that is in contact with the ground, such as on sloping ground, should be tanked. See clause 3.4.7.

Made ground

Where the *site* contains fill or made ground, consideration should be given to its compressibility and its collapse potential. Thought should be given to *foundation* design to prevent the damaging effect of differential settlement.

3.1.2 Harmful or dangerous substances

For the purposes of this Technical Handbook, clause 3.1.0 provides guidance on what harmful or dangerous substances may consist of. Because of their hazardous qualities, any ground below and immediately adjoining (see clause 3.1.1) a *building* should have them removed or made safe. Guidance on remedial action to deal with such substances is given in clause 3.1.5.

3.1.3 Hazard identification and assessment

A preliminary desk-top study should be carried out to provide information on the past and present uses of the proposed *building site* and surrounding area that may give rise to contamination. Examples of land likely to contain contaminants can include, but are not limited to:

- asbestos works;
- chemical works;
- gas works, coal carbonisation plants and ancillary by-products works;
- industries making or using wood preservatives;
- landfill and other waste disposal sites;
- metal mines, smelters, foundries, steel works and metal finishing works;
- munitions production and testing sites;
- nuclear installations;
- oil storage and distribution sites;
- paper and printing works;
- railway land, especially the larger sidings and depots;
- scrap yards;

- sewage works, sewage farms and sludge disposal sites;
- tanneries; and
- petrol filling stations.

During a walk-over of the area there may be signs of possible contaminants. The preliminary investigation can assist in the design of the exploratory and detailed ground investigation. A detailed ground investigation may be necessary and should provide sufficient information for the risk assessment and the design and specification of any remedial *work*.

Risk assessment should be specific to each *building site* and take into account the presence of source, pathways and receptors at a particular *building site*. Generic assessment criteria may provide an indication of where further consideration of risk to receptors is required. The selection of assessment criteria should take into account the specific circumstances of the *building site* and the receptors that may be exposed. Assessment criteria should be authoritative and scientifically based. Should a risk be indicated then further consideration would be warranted. This may involve collection and assessment of further information. Useful tools for undertaking detailed assessment of risk are available e.g. CONSIM and CLEA. Reference should be made to SEPA and DEFRA web sites which contain details of published and forthcoming guidance.

www.sepa.org.uk
www.defra.gov.uk

www.environment-agency.gov.uk

The Environment Agency manages an extensive research programme related to land contamination. This programme is ongoing and a check should be made to ensure that the most up-to-date guidance is used. The following are just some of the publications that may be of interest:

- assessment of risks to human health from land contamination, an overview of the development of soil guideline values: [CLR 7](#);
- priority contaminants report: [CLR 8](#);
- contaminants in soils, collation of toxicological data and intake values for humans: [CLR 9](#);
- contaminated land exposure assessment (CLEA) model, technical basis and algorithms: [CLR 10](#);
- land contamination risk assessment tools: an evaluation of some of the commonly used methods: [Technical Report P260](#);
-
- secondary model procedure for the development of appropriate soil sampling strategies for land contamination - R&D Technical Report P5;
- technical aspects of site investigation - [R&D Technical report P5](#).

3.1.4 Development on land that may be contaminated

Where the desk study, records or local knowledge of previous use identifies land that may contain, or give rise to, harmful or dangerous substances, planning permission will normally be subject to conditions. These conditions may be imposed to ensure that the development proposed for the land will not expose future users or occupiers, or any *building* or services, to hazards associated with the contaminants.

3.1.5 Land not initially identified as being contaminated

There may be occasions when land containing harmful or dangerous substances has not been identified at the planning stage, and the presence of contaminants is only suspected later. Some signs of the possible presence of contaminants are given in the table below together with the possible contaminant and the probable remedial action recommended.

Possible contaminants and actions

| Signs of possible contamination | Possible containment | Probable remedial action recommended |
|--|---|--|
| Vegetation (absence, poor or unnatural growth) | metals, metal compounds | none |
| | organic compounds, gases | removal or treatment |
| Surface materials (unusual colours and contours may indicate) | metals, metal compounds | none |
| | oil and tarry wastes | removal, filling, sealing or treatment |
| | asbestos (loose) | removal, filling, sealing or treatment |
| | other fibres | none |
| | organic compounds including phenols | removal, filling or treatment |
| | potentially combustible material including coal and coke dust | removal, inert filling or treatment |
| | refuse and waste | removal or treatment |
| Fumes and odours (may indicate organic chemicals at very low concentrations) | flammable, explosive, toxic and asphyxiating gases including methane and carbon dioxide | removal or treatment the <i>construction</i> is to be free from unventilated voids |
| | corrosive liquids | removal, filling, sealing or treatment |
| | faecal, animal and vegetable matter (biologically active) | removal, filling or treatment |
| Drums and containers (whether full or empty) | various | removal with all contaminated ground |

The verifier may require the removal of any of the contaminants in the table to clause 3.1.5, to be carried out by specialists.

If any signs of possible contaminants are present, the verifier should be told at once. If the presence of any of the contaminants listed in the table to clause 3.1.5 is confirmed, it is likely that some form of remedial action will be required. For guidance, the normal course of remedial action is listed against each contaminant. In all cases these courses of action assume that the ground to be covered by the *building* will have at least 100 mm of in-situ concrete cover. Expert advice may be required to provide an economical and safe solution to the hazards encountered especially where contaminants are present in large amounts or where there is imminent danger to health or safety.

3.1.6 Risk management techniques

The Construction Industry Research and Information Association (CIRIA) produces many useful guidance documents on the application of different risk management techniques.

There are a range of options for managing the risk of land that is contaminated. This can include removal or treatment of the contaminant source or breaking the pathway by which contaminants can present a risk to receptors:

Removal means that the contaminant itself and any contaminated ground to be covered by the *building* should be taken out to a depth of 1 m (or less if the verifier agrees) below the level of the lowest floor. The contaminant should then be taken away to a place to be named by the local authority;

Filling means that the ground to be covered by the *building* should be determined on a site specific basis but is normally to a depth of 1 m (or less if the verifier agrees) with a material which will not react adversely with any contaminant remaining and may be used for making up levels. The type of filling and the design of the ground floor should be considered together;

Inert filling means that the filling is wholly non-combustible and not easily changed by chemical reactions;

Sealing means that an impermeable barrier is laid between the contaminant and the *building* and sealed at the joints, around the edges and at the service entries. Note that polyethylene may not be suitable if the contaminant is a liquid such as a tarry waste or organic solvent.

Ground treatment may provide a more cost effective and environmentally sustainable solution. Treatment may be the only option where the presence of structures or services prevents excavation. Treatment processes can be biological, chemical or physical and be undertaken either in-situ (contaminants are treated in the ground) or ex-situ (contaminated material is excavated and then treated before being returned). The processes convert the contaminant into a neutral form or render it harmless. There are also solidification and stabilisation processes that can 'fix' contaminants in the soil so as to reduce the harm, and thermal processes that alter the contaminant by incineration or by volatilisation. The exact process to use will depend on the contaminant present and the soil type. Expert advice should be sought.

The CIRIA and the EA websites also contain useful data sheets on remedial treatment options.

www.ciria.org.uk
www.environment-agency.gov.uk

3.1.7 Housing on land affected by contamination

The National House Building Council (NHBC), together with the Environment Agency, has produced a guidance document 'Guidance for the Safe Development of Housing on Land Affected by Contamination'. The document aims to promote the adoption of good practice in the identification, investigation, assessment and remedial treatment of land affected by contamination, so that the development of *housing* on such land can be undertaken safely and with confidence that no unacceptable risks remain.

www.nhbc.co.uk

3.1.8 Re-development of industrial land

With the increasing re-development of former industrial land, attention is also drawn to BS 10175: 2001; 'Investigation of potentially contaminated sites, Code of Practice'. The British Standard provides guidance on, and recommendations for, the investigation of land that may be contaminated or land with naturally enhanced concentrations of potentially harmful materials, to determine or manage the ensuing risk. BS 5930: 1999, 'Code of Practice for Site Investigations' is also relevant. This CoP deals with the investigation of ground for the purpose of assessing their suitability for the *construction* of

the *work*. It provides recommendations on certain constraints or problems that can affect a *site*, such as geotechnical aspects and the legal aspects including the need for licences or permits.

3.2 Site preparation – protection from radon gas

- 3.2 Functional standard
- 3.2.0 Introduction
- 3.2.1 Radon affected areas
- 3.2.2 Protection from radon gas
- 3.2.3 Radon maps

standard

3.2

mandatory

Every *building* must be designed and *constructed* in such a way that there will not be a threat to the health of people in or around the *building* due to the emission and containment of radon gas.

3.2.0 Introduction

Radon is a naturally occurring, radioactive, colourless and odourless gas that is formed where uranium and radium are present. It can move through cracks and fissures in the subsoil, and so into *buildings*. Where this gas occurs under a *dwelling*, the external walls contain it and the containment of radon can build up inside the *dwelling* over the long term posing a risk to health.

Breathing in radon gas for long periods increases the risk of developing lung cancer and since people spend a high proportion of their time at home, concentration levels in *dwellings* are very important. Although the risk is relatively insignificant for people visiting or living for short periods in a *dwelling* with high levels of radon, long-term exposure can increase the risk to the point where preventative action is necessary. To reduce the risk, all new *dwellings*, extensions and alterations, built in areas where there might be radon concentration, may need to incorporate precautions against radon gas.

Health Protection
Agency

The National Radiological Protection Board (NRPB) became part of the Health Protection Agency (HPA) on 1 April 2005. Issues relating to radon can be accessed on HPA website at www.hpa.org.uk/radiation

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard in so far as is *reasonably practicable*, and in no case be worse than before the *conversion*. (regulation 12, schedule 6).

3.2.1 Radon affected areas

Action level

'Radon affected areas' have been designated by testing *dwelling*s. Where tests on existing *dwelling*s show that 1% of the *dwelling*s in that area are likely to have a radon concentration above 200 Bq/m³ (the action level) the area is designated as a 'radon affected area'. Two affected areas have been identified for Scotland, around Helmsdale in Highland Region and along Deeside in North-East Scotland. They are based on the National Radiological Protection Board document, Radon affected areas: Scotland and Northern Ireland, 1993. These 2 areas are illustrated in maps 1 and 2 in BRE publication BR376 – '[Radon: guidance on protective measures for new dwellings in Scotland](#)' and have been reproduced below.

Non-identified areas

There are other localised areas of Scotland that have not yet been included on the maps but are understood to be affected by radon. It is recommended that protection also be provided in these areas where they are identified. Further advice may be obtained from the verifier, Health Protection Agency or the Building Research Establishment.

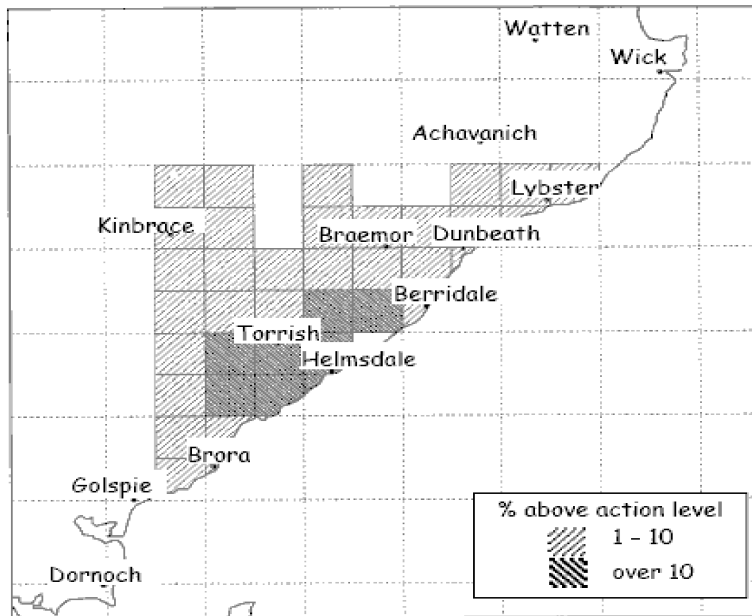
3.2.2 Protection from radon gas

If a *dwelling* is located on ground designated as a 'radon affected area' protective work should be undertaken to prevent excessive radon gas from entering the *dwelling*.

Radon protective measures should be provided in accordance with the guidance contained in BRE publication BR376 – '[Radon: guidance on protective measures for new dwellings in Scotland](#)'.

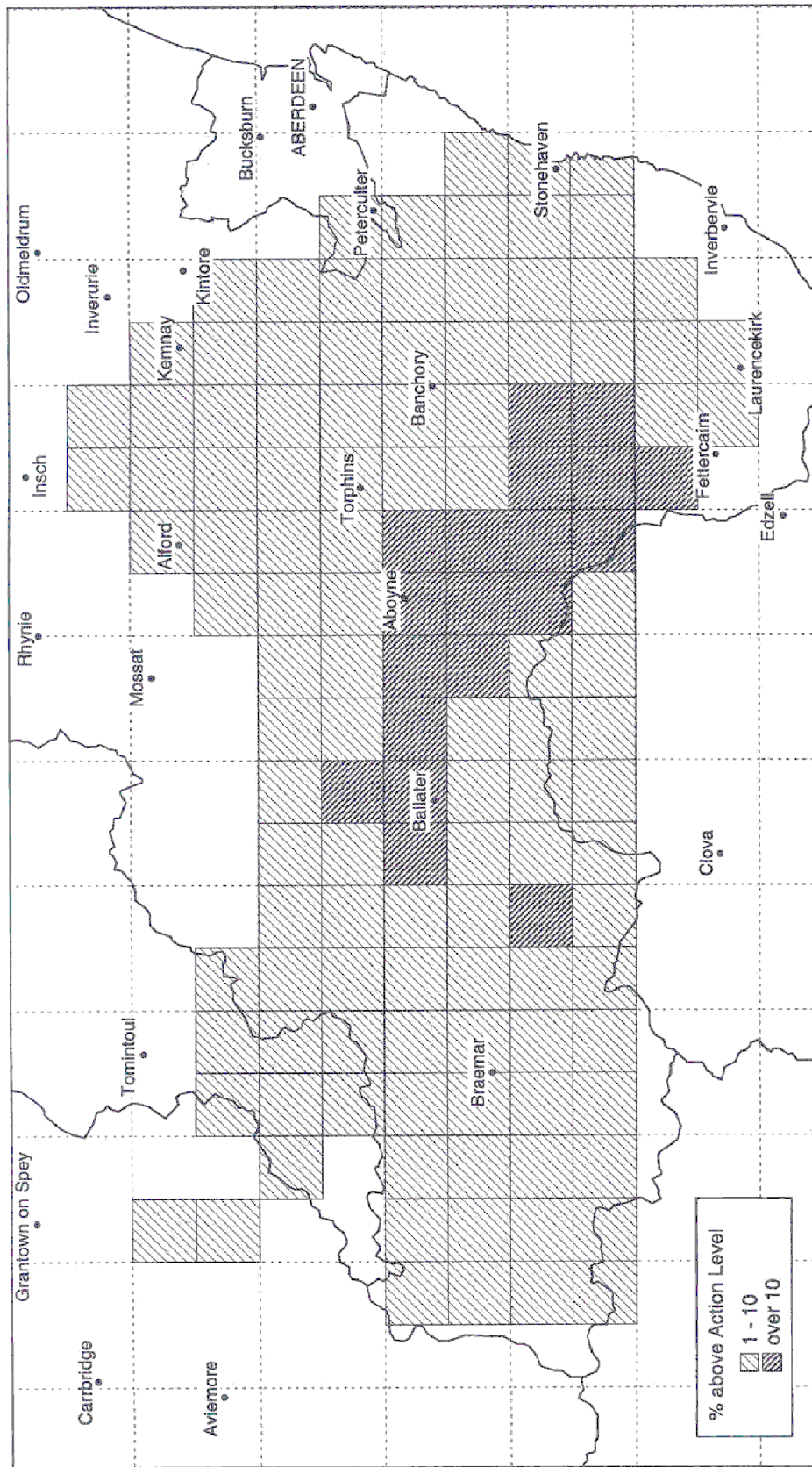
3.2.3 Radon maps

Highland Region



Estimated proportion of *dwelling*s exceeding the action level in each 5 km grid

North-East Scotland



Map 2 Estimated proportion of dwellings exceeding the Action Level in each 5 km grid shown: North-East Scotland

3.3 Flooding and ground water

- 3.3 Functional standard
- 3.3.0 Introduction
- 3.3.1 Ground liable to flooding
- 3.3.2 Construction in flood risk areas

standard

3.3

mandatory

Every *building* must be designed and *constructed* in such a way that there will not be a threat to the *building* or the health of the occupants as a result of flooding and the accumulation of ground water.

3.3.0 Introduction

Serious river and coastal flooding that has occurred in a number of areas in Scotland is, unfortunately, not entirely preventable. Pressure for land development may mean that development proposals could be given planning approval on land subject to some risk of flooding.

Where development is to take place on land assessed by the planning authority as having a flood risk, advice should be sought from sources such as the local planning authority, the Scottish Environment Protection Agency (SEPA) and those responsible for coastal defences. Further guidance may be obtained from the 'Scottish Planning Policy 7: Planning and Flooding, 2003' (SPP 7) and 'Planning Advice Note: Planning and Building Standards Advice on Flooding' (PAN 69). 'Development and Flood Risk – guidance for the construction industry' (C624) 2004 published by CIRIA provides guidance on carrying out flood risk assessment and suggests design considerations for developers.

Subsoil drainage of a *site* is required where necessary (e.g. where the water table can rise to within 250 mm of the lowest floor of a *building*) to help prevent the penetration of ground water and floodwater to the interior of a *building* and damage to the *building* fabric. Any existing drains that will be affected by the *construction* of a *building* should also continue to function properly and guidance is provided to standard 3.5.

Designers should be aware of the impact that climate change could have on the fabric of *buildings* through increased rainfall and temperatures. Consequential effects are increased driving rain, increased flood risk and increased drying of soils. Guidance on improving the flood resistance of domestic properties can be obtained from '[Preparing for Floods, 2003](#)'.

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard in so far as is *reasonably practicable*, and in no case be worse than before the *conversion*. (regulation 12, schedule 6).

www.sepa.org

SPP 7

PAN 69

CIRIA guidance C624

Climate change

www.planningportal.gov.uk/

Conversions

SPP 7

3.3.1 Ground liable to flooding

In general all proposed *building sites* should be appraised initially to ascertain the risk of flooding of the land and an assessment made as to what affects the development may have on adjoining ground. Scottish Planning Policy 7 (SPP 7): Planning and Flooding, 2003 provides guidance on such policy issues and explains the roles and responsibilities of the various stakeholders.

Ground below and immediately adjoining a *dwelling* that is liable to accumulate floodwater or ground water requires treatment to be provided against the harmful effects of such water. The ground immediately adjoining a *dwelling* means the area where any ground water would affect the structural stability of the *dwelling*. Treatment could include a field drain system.

The drainage of ground water may be necessary for the following reasons:

- to increase the stability of the ground;
- to avoid surface flooding;
- to alleviate subsoil water pressures likely to cause dampness to below-ground accommodation;
- to assist in preventing damage to *foundations of buildings*;
- to prevent frost heave of subsoil that could cause fractures to structures such as concrete slabs.

The selection of an appropriate drainage layout will depend on the nature of the subsoil and the topography of the ground. Field drains, where provided, should be laid in accordance with the recommendations in Clause 10 of BS 8301: 1985.

Surface water run-off to adjacent sites

With the removal of topsoil from a development *site*, developers should be aware of the dangers from possible *surface water* run-off from their *building site* to other properties. It is good practice to have procedures in place to overcome this occurrence. Depending on conditions, the formation of channels or small dams to divert the run-off or, where conditions are particularly serious, the installation of field drains or rubble drains may overcome the problem.

Design Guidance on
Flood Damage to
Dwellings 1996

3.3.2 Construction in flood risk areas

Where it is intended to develop in areas that may be at some risk of flooding, guidance on precautionary measures that can be taken is given in 'The Design Guidance on Flood Damage to Dwellings, 1996'. This document describes the likely effects of flooding on materials and elements of the *building* and assesses various forms of *construction* and measures to reduce the risk of flood damage in *dwellings*.

3.4 Moisture from the ground

- 3.4 Functional standard
- 3.4.0 Introduction
- 3.4.1 Treatment of building elements adjacent to the ground
- 3.4.2 Ground supported concrete floors
- 3.4.3 Suspended concrete floors
- 3.4.4 Suspended timber floors
- 3.4.5 Walls at or near ground level
- 3.4.6 Floors at or near ground level
- 3.4.7 Structures below ground, including basements

standard

3.4

mandatory

Every *building* must be designed and *constructed* in such a way that there will not be a threat to the *building* or the health of the occupants as a result of moisture penetration from the ground.

3.4.0 Introduction

Water is the prime cause of deterioration in *building* materials and *constructions* and the presence of moisture encourages growth of mould that is injurious to health. Ground water can penetrate *building* fabric from below, rising vertically by capillary action. The effects of this rising damp are immediately recognisable. There may be horizontal ‘tidemarks’ sometimes several feet above the floor; below it the wall is discoloured with general darkening and patchiness. There may also be loose wallpaper, signs of mould growth and deterioration of plaster. Hygroscopic salts brought up from the ground tend to concentrate in the ‘tidemark’.

Dwellings therefore, need to be *constructed* in such a way that rising damp neither damages the *building* fabric nor penetrates to the interior where it may constitute a health risk to occupants.

Climate change

Designers should be aware of the impact that climate change could have on the fabric of *buildings* through increased rainfall and temperatures. Higher wind speeds and driving rain should focus attention to improved design and quality of *construction* and to the protection of the *building* fabric from long term dampness.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard in so far as is *reasonably practicable*, and in no case be worse than before the *conversion*. (regulation 12, schedule 6).

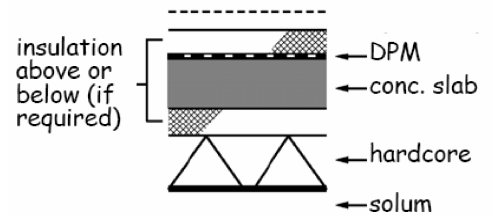
3.4.1 Treatment of building elements adjacent to the ground

A floor, wall or other *building* element adjacent the ground should prevent moisture from the ground reaching the inner surface of any part of a *dwelling* that it could damage.

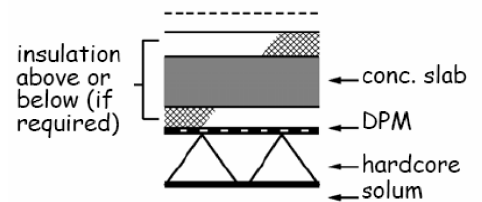
Floors, walls or other *building* elements adjoining the ground should be *constructed* in accordance with the following recommendations. The dimensions specified are the minimum recommended; greater dimensions may therefore be used.

3.4.2 Ground supported concrete floors

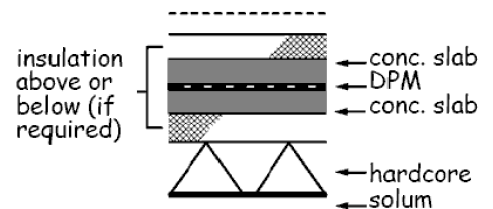
The solum is brought to a level surface. Hardcore bed 100 mm thick of clean broken brick or similar inert material free from fine material and water soluble sulphates in quantities which would damage the concrete; blinded with suitable fine material and *constructed* to form a level, crack-free surface.



Concrete slab 100 mm thick with insulation, if any, laid above or below the slab; with or without a screed or floor finish.

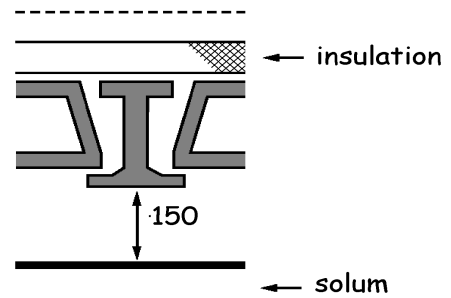


Damp-proof membrane above or below the slab or as a sandwich; jointed and sealed to the damp proof course or damp-proof structure in walls, columns and other adjacent elements in accordance with the relevant clauses in section 3 of CP 102: 1973.



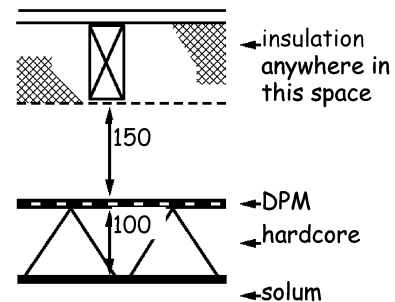
3.4.3 Suspended concrete floors

The solum is brought to an even surface; any up filling to be of hard, inert material. Suspended concrete floor of in-situ or precast concrete slabs or beams with concrete or clay infill units; with insulation, if any; with or without a screed or floor finish, or with boards. *Permanent ventilation* of the under floor space direct to the outside air by *ventilators* in 2 *external walls* on opposite sides of the *building* to provide an open area in each wall of 1500 mm² for at least every metre run of the wall, or 500 mm² for at least every square metre of floor area, this open area also being provided in internal sleeper walls or similar obstructions to maintain the under floor ventilation; the ventilated space to be 150 mm to the underside of the floor slab or beams.

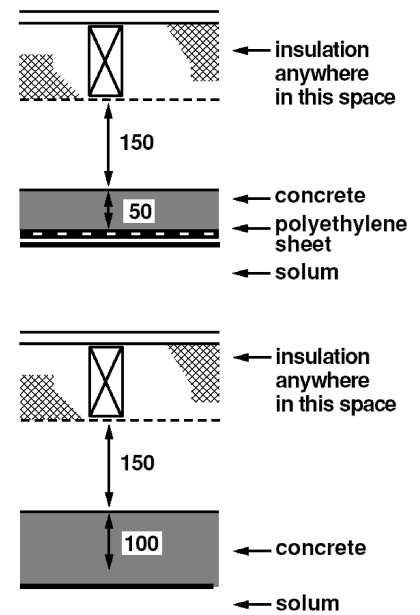


3.4.4 Suspended timber floors

The solum is brought to an even surface; any up filling to be of hard, inert material. Hardcore bed as for clause 3.4.2; with either a dpm in accordance with Section 3 of CP 102: 1973; or concrete 50 mm thick laid on 0.25 mm (1000 gauge) polyethylene sheet; or concrete 100 mm thick; so that in any case the top surface is not below that of the adjacent ground.



Suspended timber floor with or without insulation as required. Floor joists carried on wall-plates supported as necessary by sleeper walls with a dpc under the wall-plates. *Permanent ventilation* of the under floor space direct to the outside air by *ventilators* in 2 *external walls* on opposite sides of the *building* to provide an open area in each wall of either 1500 mm² for at least every metre run of the wall, or 500 mm² for at least every square metre of floor area, this open area also being provided in internal sleeper walls or similar obstructions to maintain the under floor ventilation; the ventilated space to be 75 mm in height from the site covering to the underside of any wall-plates and 150 mm to the underside of the floor joists.



3.4.5 Walls at or near ground level

Walls at or near ground level should be *constructed* in accordance with the recommendations of BS 8102: 1990.

3.4.6 Floors at or near ground level

Floors at or near ground level should be *constructed* in accordance with the recommendations in Clause 11 of CP 102: 1973. However the ventilation of the sub-floor as described in Clause 11.8.4 of CP 102: 1973 is not recommended but should be provided as described in clause 3.4.4 for suspended timber floors.

3.4.7 Structures below ground, including basements

Structures below ground, including basements, should be *constructed* in accordance with the recommendation of BS 8102: 1990.

3.5 Existing drains

- 3.5 Functional standard
- 3.5.0 Introduction
- 3.5.1 Existing drains
- 3.5.2 Re-routing of drains
- 3.5.3 Re-construction of drains
- 3.5.4 Drains passing through structures
- 3.5.5 Sealing disused drains

standard

3.5

mandatory

Every *building* must not be *constructed* over an existing drain (including a field drain) that is to remain active.

Limitation:

This standard does not apply where it is not *reasonably practicable* to reroute an existing drain.

3.5.0 Introduction

The purpose of this standard is to ensure that existing drains continue to function properly without causing harm to the *building* or to the health of the occupants.

Public sewers

Generally, public sewers are not permitted beneath *buildings*. Where it is proposed to *construct* a *building* over the line of an existing sewer, the sewer should be re-routed around the *building*. Permission will be required from the Water Authority for any work that is to be carried out to a public sewer.

Permission of Scottish Water

In exceptional circumstances, if it not possible to re-route an existing drain or sewer away from the *dwelling*, for instance if a gap *building site* in a terrace is being developed, the Water Authority may permit a *building* to be *constructed* over an existing public sewer. Where it is necessary to *build* over a public sewer, approval of the Water Authority will be required.

Disused drains and sewers offer ideal harbourage to rats and frequently offer a route for them to move between the drains and the surface. They can also collapse causing subsidence.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

3.5.1 Existing drains

A survey should be carried out to establish the geography and topography of the *building site* and ascertain whether there are any existing field drains. Where a *building site* requires that an existing drain (including a field drain) must remain active and be re-routed or retained, particular methods of *construction* and protection should be carefully considered. The guidance contained in clauses 3.5.2, 3.5.3 and 3.5.4 should be taken into account and any new drain should be *constructed* in accordance with the guidance to standards 3.6 and/or 3.7.

3.5.2 Re-routing of drains

Where a *building* is erected over a private drain, including a field drain that is to remain active, the drain should be re-routed if *reasonably practicable* or *re-constructed* in a manner appropriate to the conditions of the *site*.

3.5.3 Re-construction of drains

The condition of any private drain or sewer that is to be *built* over should be determined. If in poor condition and/or relatively shallow, then consideration should be given to *re-construction* if re-routing is not *reasonably practicable*.

The strength of a pipeline should be determined, decided or specified before *construction work* is undertaken. Drains should be designed and *constructed* in accordance with the recommendations described in BS EN 752-3: 1997 and BS EN 1295-1: 1998. During *construction*, it should be ensured that the assumptions made in the design are safeguarded or adapted to changed conditions.

Protection of drains

Every drain or sewer should be protected from damage by *construction* traffic and heavy machinery. Providing barriers to keep such traffic away from the line of the drain or sewer may be appropriate. Heavy materials should not be stored over drains or sewers.

It is recommended that manholes are not located within a *dwelling*.

3.5.4 Drains passing through structures

Where a drain or sewer passes through a structure, including a manhole or inspection chamber, a detail should be devised to allow sufficient flexibility to avoid damage of the pipe due to movement. A rigid connection however maybe appropriate if the drain or sewer and the structure are an integral *construction* on a rigid *foundation*. Where drains or sewers pass under or close to structures, similar precautions should be considered. Drains or sewers should be *constructed* and laid in accordance with the recommendations of BS EN 1610: 1998.

3.5.5 Sealing disused drains

Disused sewers or drains provide ideal nesting sites for rats. In order to prevent this, they should be disconnected from the drainage system as near as possible to the point of connection. This should be done in a manner that does not damage any pipe that is still in use and ensures that the sewer system is watertight. This may be carried out, for example, by removing the pipe from a junction and placing a stopper in the branch of the junction fitting. Where the connection is to a public sewer, the Water Authority should be consulted.

Sewers and drains less than 1.5 m from the surface and in open ground should be, as far as *reasonably practicable*, removed. Other pipes should be capped at both ends and at any point of connection, to ensure rats cannot gain entry.

3.6 Surface water drainage

- 3.6 Functional standard
- 3.6.0 Introduction
- 3.6.1 Surface water drainage from dwellings
- 3.6.2 Surface water drainage of paved surfaces
- 3.6.3 Surface water discharge
- 3.6.4 Sustainable Urban Drainage Systems
- 3.6.5 Soakaway serving single dwellings and small extensions
- 3.6.6 Surface water run-off from small paved areas
- 3.6.7 Rainwater harvesting
- 3.6.8 Traditional drainage systems
- 3.6.9 Discharges into a drainage system
- 3.6.10 Testing

| | |
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| <p>standard</p> <h1 style="margin: 0;">3.6</h1> <p>mandatory</p> | <p>Every <i>building</i>, and hard surface within the <i>curtilage</i> of a <i>building</i>, must be designed and <i>constructed</i> with a <i>surface water</i> drainage system that will:</p> <p>(a) ensure the disposal of <i>surface water</i> without threatening the <i>building</i> and the health and safety of the people in and around the <i>building</i>; and</p> <p>(b) have facilities for the separation and removal of silt, grit and pollutants.</p> |
|--|--|

3.6.0 Introduction

Climate change is expected to result in more rain in the future and it is essential that this is taken into account in today's *buildings*. It is essential that the *surface water* from *buildings* is removed quickly and safely without damage to the *building*, danger to people around the *building* and does not pose a risk to the environment by flooding or pollution.

It is essential that *surface water* is cleared quickly from all access routes to *buildings*, particularly with elderly and *disabled people* in mind. Ponding in winter can cause slippery surfaces that can be a hazard to pedestrians.

Controlled Activities Regulations

The discharge of *surface water* is a controlled activity under [The Water Environment \(Controlled Activities\) \(Scotland\) Regulations 2005](#). Under these regulations *surface water* discharges to ground or water (wetlands, *surface waters* or groundwater) must be authorised by [The Scottish Environment Protection Agency](#) (SEPA). Authorisation is risk related, with discharges from *buildings*, including hard standings within their *curtilage*, being classed as low risk if they are carried out in accordance with the General Binding Rules.

SEPA authorisation

Water conservation

In some localities there is growing pressure on water resources due to changes in the climate and increasing expectations of personal hygiene. The introduction of conservation measures, such as the collection of *surface water* for its reuse is strongly encouraged to reduce the reliance on mains water.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

3.6.1 Surface water drainage from dwellings

Every *building* should be provided with a drainage system to remove rainwater from the roof, or other areas where rainwater might accumulate, without causing damage to the structure or endangering the health and safety of people in and around the *building*. Where gutters and rainwater pipes are used, they should be *constructed* and installed in accordance with the recommendations described in BS EN 12056-3: 2000.

Eaves drop systems

Methods other than gutters and rainwater pipes may be utilised to remove rainwater from roofs. An eaves drop system will allow rainwater to drop freely to the ground. Where these are used, they should be designed taking into account the following:

- the protection of the fabric of the *dwelling* from ingress of water caused by water splashing on the wall;
- the need to prevent water from entering doorways and windows;
- the need to protect persons from falling water when around the *dwelling*;
- the need to protect persons and the *building* fabric from rainwater splashing on the ground or forming ice on access routes. The provision of a gravel layer or angled concrete apron or such like may be acceptable;
- the protection of the *building foundations* from concentrated discharges from gutters.

Gutters and rainwater pipes may be omitted from a roof at any height provided it has an area of not more than 8 m² and no other area drains onto it.

3.6.2 Surface water drainage of paved surfaces

Ponding of water on paved surfaces can be very dangerous, particularly in winter where ice can form. Paved surfaces therefore, that are accessible to pedestrians should be drained quickly and efficiently.

Every *domestic building* should be provided with a drainage system to remove surface water from paved surfaces, such as an access route that is suitable for *disabled people*, without endangering the *building* or the health and safety of people in and around the *dwelling*. The paved surface should be so laid as to ensure rainwater run-off is not close to the *building*. Drainage systems should be designed, *constructed* and installed, either:

- a. incorporating SUDS techniques as in clauses 3.6.3 and 3.6.4; or
- b. using a traditional piped drainage system as in clause 3.6.7.

Small paved areas

A paved surface, such as a car park, of less than 200 m² is unlikely to contribute to flooding problems and may be designed to have free-draining run-off in accordance with clause 3.6.6.

3.6.3 Surface water discharge

Surface water discharged from a *domestic building*, and a hard surface within the *curtilage* of a *domestic building* should be carried to a point of disposal that will not endanger the *building*, environment or the health and safety of people around the *building*.

Surface water discharge should be to:

- a. a SUDS system designed and *constructed* in accordance with clause 3.6.4; or
- b. a soakaway *constructed* in accordance with:
 - clause 3.6.5; or
 - the guidance in BRE Digest 365, '[Soakaway Design](#)'; or

- National Annex NG2 of BS EN 752-4: 1998; or
- c. a public sewer provided under the [Sewerage \(Scotland\) Act 1968](#); or
- d. an outfall to a watercourse, such as a river, stream or loch or coastal waters, that complies with any notice and/or consent by SEPA; or
- e. a storage container with an overflow discharging to either of the 4 options above.

Discharge from a soakaway should not endanger the stability of the *building*. Damage to the *foundations* is likely to occur where discharge is too close to the *building* and it is sensible to ensure that any water bearing strata directs water away from the *building*.

Location of soakaway

To prevent such damage therefore, every part of a soakaway should be located at least 5 m from a *building* and from a *boundary* in order that an adjoining plot is not inhibited from its full development potential. However the volume of *surface water* run-off, ground strata or permeability of the soil may influence this dimension and it may be reduced, or indeed may need to be increased, to preserve the structural integrity of the *building*.

3.6.4 Sustainable Urban Drainage Systems

SUDS are made up of 1 or more structures built to manage *surface water* run-off. They are used in conjunction with good management of the land to prevent pollution. There are 4 general methods of control:

- filter strips and swales;
- filter drains and permeable surfaces;
- infiltration devices;
- basins and ponds.

SUDS can be designed to fit into most urban settings, from hard-surfaced areas to soft landscaped features. The variety of design options available allows designers and planners to consider local land use, land take, future management and the needs of local people. SUDS often stretch beyond the confines of the *curtilage* of individual *buildings* but need to be considered as a whole.

A SUDS technique for *surface water* drainage should be provided in accordance with the guidance contained in '[Sustainable Urban Drainage Systems: design manual for Scotland and Northern Ireland](#)'.

Brownfield land

www.sepa.org.uk

Careful consideration should be given to the design of *surface water* drainage from brownfield land, particularly where contamination might be expected. SEPA provides guidance in their SUDS Advice Note – [Brownfield Sites](#), while the SUDS design manual for Scotland and Northern Ireland also gives guidance on what systems may be appropriate. Generally SUDS are designed to utilise natural processes and regular monitoring will be needed to ensure the system as conceived is operating as intended. Poor maintenance may restrict a SUDS operational efficiency and guidance is provided in Section 5 of SUDS: design manual for Scotland and Northern Ireland.

Maintenance responsibility

The maintenance of a SUDS system within the *curtilage* of a *building* is the responsibility of the *building* owner.

3.6.5 Soakaway serving single dwellings and small extensions

Soakaways have been the traditional method of disposal of *surface water* from *buildings* and paved areas where no mains drainage exists. A soakaway serving a single *dwelling* or an extension should be designed and

constructed in accordance with the following guidance:

- a. test the suitability of the ground in accordance with the percolation test method in clause 3.9.1. The trial holes and the finished soakaways should be a minimum of 5 m from the *dwelling* and the *boundary*. However this dimension may be reduced slightly on small *sites* where ground conditions allow, such as very well draining soil;
- b. there should be individual soakaways for each *dwelling*;

The soakaways may be sized using the following simplified formulae derived from [BRE Digest 365](#):

$$(A \times 0.0145) - (a \times f \times 900) = S$$

Where - A is the area to be drained in m²

- a is the internal surface area of the soakaway to 50% effective depth, excluding the base in m² This has to be assumed for initial calculation purposes.
- f is the soil infiltration rate, in m/s, determined in accordance with clause 3.9.1. This calculation produces Vp in secs/mm [conversion = (1/Vp) / 1000]
- S is the required storage in m³

3.6.6 Surface water run-off from small paved areas

Surface water run-off may be appropriate for small paved areas, such as access paths to small *buildings*. Run-off can be achieved by laying the surface to a fall, sufficient to avoid ponding. The *surface water* should be free draining to a pervious area, such as grassland, provided the soakage capacity of the ground is not overloaded. Also the discharge should not be adjacent to the *building* where it could damage the *foundations*.

3.6.7 Rainwater harvesting

Rainwater harvesting systems allow *surface water* run-off from *dwellings* or hardstanding areas to be collected, processed, stored and distributed thereby reducing the demand for potable water, the load on drainage systems and *surface water* run-off that can lead to incidents of flooding. There use of *surface water* therefore can produce benefits to the home owner and the environment and therefore is recommended.

Rain, as it falls on *buildings*, is soft, clear and largely free of contaminants. During collection and storage however there is potential for contamination. For this reason it is recommended that recycled *surface water* is used only for flushing water closets, car washing and garden taps as it is not possible to guarantee the necessary maintenance of complex filters that would be essential if it were used for consumption or personal hygiene.

Dwellings generally have a small rainwater catchment area it may not be environmentally or financially viable to install a rainwater harvesting system. Manufacturers of proprietary systems or guidance documents such as CIRIA C539 or '[Harvesting Rainwater for domestic use: an information guide](#)' published by the Environment Agency provides helpful guidance on design considerations.

Water Byelaws 2004
WRAS 9-02004

Where a rainwater harvesting system is to be installed it should be designed, *constructed* and installed in accordance with the Water Byelaws 2004, the recommendations of the Water Regulations Advisory Scheme (WRAS) Information and Guidance Notes No. 9-02-04 and 9-02-05, 1999 and the CIRIA publication CIRIA C539; 'Rainwater and greywater use in buildings: best practice guidance'. The approval of [Scottish Water](#) is needed before any such scheme is installed.

Filtration

Prior to the storage of water in a tank the rainwater should be filtered to remove leaves and other organic matter and dust or grit. Disinfection maybe required if the catchment area is likely to be contaminated with animal faeces, extensive bird droppings, oils or soil.

Water storage tanks should be *constructed* of materials such as GRP, high density polyethylene, steel or concrete and sealed and protected against the corrosive effects of the stored water and to prevent the ingress of groundwater if located underground.

Pipework identification

Water for use in the *dwelling* should be extracted from just below the water surface in the tank to provide optimum water quality. All pipework carrying rainwater for use in the *dwelling* should be identified as such in accordance with the WRAS guidance notes and great care should be taken to avoid cross-connecting reclaimed water and mains water. Tanks should be accessible to allow for internal cleaning and the maintenance of inlet valves, sensors, filters or submersible pumps. An overflow should discharge to a soakaway (see guidance to standard 3.9) or to mains drainage where it is not *reasonably practicable* to discharge to a soakaway. Backflow prevention devices should be incorporated to prevent contaminated water from entering the system.

3.6.8 Traditional drainage systems

There can be substantial advantages from the use of SUDS, but where a traditional piped system is required it should be designed and *constructed* in accordance with the guidance in National Annex NE of BS EN 752-4: 1998.

3.6.9 Discharges into a drainage system

Where a discharge into a traditional drainage system contains silt or grit, for example from a hard standing with car wash facilities, there should be facilities for the separation of such substances. Removable grit interceptors should be incorporated into the *surface water* gully pots to trap the silt or grit.

3.6.10 Testing

A *surface water* drainage system should be tested to ensure the system is laid and is functioning correctly. Testing should be carried out in accordance with the guidance in BS EN 1610: 1998.

3.7 Wastewater drainage

- 3.7 Functional standard
- 3.7.0 Introduction
- 3.7.1 Sanitary pipework
- 3.7.2 Sanitary appliances below flood level
- 3.7.3 Drainage system outside a building
- 3.7.4 Connection to a public sewer
- 3.7.5 Combined sewers
- 3.7.6 Conversions and extensions
- 3.7.7 Sewers intended for vesting
- 3.7.8 Ventilation of a drainage system
- 3.7.9 Testing
- 3.7.10 Wastewater discharge

standard
3.7
mandatory

Every *wastewater* drainage system serving a *building* must be designed and *constructed* in such a way as to ensure the removal of *wastewater* from the *building* without threatening the health and safety of the people in and around the *building*, and;

- (a) that facilities for the separation and removal of oil, fat, grease and volatile substances from the system are provided;
- (b) that discharge is to a public sewer or public *wastewater* treatment plant, where it is *reasonably practicable* to do so; and
- (c) where discharge to a public sewer or public *wastewater* treatment plant is not *reasonably practicable* that discharge is to a private *wastewater* treatment plant or septic tank.

Limitation:

Standard 3.7(a) does not apply to a *dwelling*.

3.7.0 Introduction

This guidance applies to *wastewater* systems that operate essentially under gravity. The guidance to this standard provides recommendations for the design, *construction* and installation of drains and sewers from a *building* to the point of connection to a public sewer or public sewage treatment works.

The guidance should also be used for all pipe work connecting to a private *wastewater* treatment plant or septic tank.

Treatment plants, septic tanks

Guidance on private *wastewater* treatment plants, septic tanks and infiltration fields is provided under standards 3.8 and 3.9.

Combined sewers

Some sewers, called combined sewers, carry *wastewater* and *surface water* in the same pipe. It may be appropriate to install a drainage system within the *curtilage* of a *building* as a separate system even when the final connection is to a combined sewer. This will facilitate the upgrading of the combined sewer at a later date.

Incorrect connections

The connection of *wastewater* drains to *surface water* drains is a common occurrence during *conversions* and extensions in urban areas served by separate drainage systems. Incorrect connections can cause chronic and severe pollution of watercourses and a careful check should be made before final connection is made to the appropriate drain.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

3.7.1 Sanitary pipework

Differences in plumbing within Europe have led to a variety of systems being developed. These have happened as a result of differences in the type and use of sanitary appliances in Member States. The European Standards describe the 4 main systems in use but it is expected that traditional practices will continue in the various countries. However care will need to be taken if different systems are used to ensure that the entire system operates satisfactorily and that the system designed and installed is compatible with, and suitable for, connection to existing *wastewater* systems.

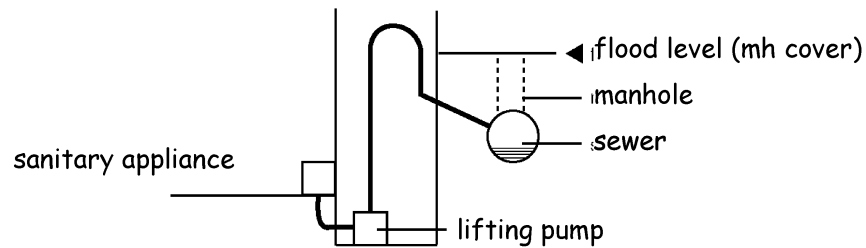
Sanitary pipe work should be *constructed* and installed in accordance with the recommendations in BS EN 12056-2: 2000. The BS EN describes 4 different systems as follows:

- | | |
|-----------------------|--|
| Traditional UK system | <ul style="list-style-type: none"> • System III (single discharge stack system with full bore branch discharge pipes) as described in Clause 4.2 of BS EN 12056-2: 2000 is the traditional system in use in the UK. |
| Low-flush system | <ul style="list-style-type: none"> • However low water and energy consumption is now a major consideration in any design solution. With this in mind, System II (single discharge stack system with small bore discharge branch pipes) may be appropriate. Careful consideration should be given to the design of the system where a low flush cistern is connected to an existing drain to ensure that blockages do not occur as a result of reduced flow rates. |
| European systems | <ul style="list-style-type: none"> • Systems I (single discharge stack system with partially filled branch discharge pipes) and IV (separate discharge stack system) have developed as a result of different types of sanitary appliances and technical traditions in the various European countries. These system types are unlikely to be appropriate for use in this country. |

Reducing the bore of a pipe in the direction of flow can lead to blockages and should not be considered as an acceptable method of *construction*. However, sanitary pipework may be reduced where it is connected to a pump installed in compliance with the conditions of certification by a *notified body*. These pumped systems are generally in use where the appliances are located in basement levels below the flood level of the drain. (see clause 3.7.2)

3.7.2 Sanitary appliances below flood level

The basements of approximately 500 *buildings* in Scotland are flooded each year when the sewers surcharge (the effluent runs back up the pipes because they are too small to take the required flow). *Wastewater* from sanitary appliances and floor gullies below flood level should be drained by *wastewater* lifting plants or, where there is unlikely to be a risk to persons such as in a car park, via an anti-flooding device. *Wastewater* lifting plants should be *constructed* in accordance with the requirements of BS EN 12056-4: 2000. *Wastewater* from sanitary appliances above flood level should not be drained through anti-flooding devices and only in special case, e.g. refurbishment, by a *wastewater* lifting plant.



3.7.3 Drainage system outside a building

A drainage system outside a *dwelling*, should be *constructed* and installed in accordance with the recommendations in BS EN 12056-1: 2000, BS EN 752-3: 1997 (amendment 2), BS EN 752-4: 1998 and BS EN 1610: 1998.

Reducing the bore of a drain in the direction of flow may lead to blockages and is not recommended.

Health and safety legislation requires that manual entry to a drain or sewer system is only undertaken where no alternative exists. Therefore use of remotely operated equipment will become the normal method of access. As well as the traditional inspection chambers used for depths of up to 1 m, remotely operated equipment is available for inspection, cleaning and removal of debris from deeper drains and sewers, without the need for personal entry.

3.7.4 Connection to a public sewer

Disconnecting chambers

Where a private drain discharges into a public sewer, normally at the *curtilage* of a *building*, some form of access should be provided for maintenance and to allow a satisfactory connection. The preferred method is by a disconnecting inspecting chamber for each *house* immediately inside the *curtilage*, although other methods and locations may be acceptable. Although access for maintenance purposes may be required by Scottish Water, design and *construction* of the chamber should be in accordance with the recommendations of BS EN 752-3: 1997. It is preferable that a chamber is provided for individual houses but where this is not practicable, a shared disconnecting chamber (or manhole where the depth is more than 1.2 m) should be provided in accordance with the requirements of Scottish Water in whom it is likely to be vested.

Disconnecting manholes

The disconnecting chamber, or manhole, for a block of individually owned *flats* or *maisonettes* should be located as close to the *building* as is *reasonably practicable* as the drain will become a public sewer once it passes out with the footprint of the *building*.

3.7.5 Combined sewers

Some sewers, called combined sewers, carry *wastewater* and *surface water* in the same pipe. These systems are not recommended today as they are more likely to surcharge during heavy rains. A separate drainage system carrying *wastewater* and *surface water* therefore should be *constructed* within the *curtilage* of a *building* even if it connects to a combined sewer to facilitate the upgrading of the combined sewer at a later date.

3.7.6 Conversions and extensions

Incorrect drainage connections, mostly related to *conversions* and extensions, whether *wastewater* to *surface water* or vice versa, is a common

occurrence and can cause severe pollution of watercourses or surcharging of drains also leading to pollution. A careful check should be made before breaking into an existing drain to ensure it is the correct one and a further test carried out after connection, such as a dye test, to confirm correct connection.

3.7.7 Sewers intended for vesting

Sewers for Scotland

Where it is intended that a private sewer (a sewer connecting 2 or more *buildings* that are privately owned and maintained) will be vested in the Water Authority, *construction* and installation should be in accordance with requirements in 'Sewers for Scotland'.

3.7.8 Ventilation of a drainage system

A *wastewater* drainage system serving a *dwelling* should be ventilated to limit the pressure fluctuations within the system and minimise the possibility of foul air entering the *building*. A system should be installed in accordance with the guidance in Sections 4, 5, 6 and National Annex ND of BS EN 12056-2: 2000.

Air admittance valves

Air admittance valves are another method of ventilating a drainage system as they allow air to enter the drainage system, but not to escape, thus limiting pressure fluctuations within the system. Care should be taken when installing these valves that they are located where they will operate effectively. Air admittance valves should be installed:

- a. accordance with the recommendations in BS EN 12380: 2002; or
- b. in compliance with the conditions of certification of a *notified body*.

3.7.9 Testing

A *wastewater* drainage system should be tested to ensure the system is laid and is functioning correctly. Testing should be carried out in accordance with the guidance in:

- a. National Annex NG of BS EN 12056-2: 2000, for sanitary pipework;
- b. BS EN 1610: 1998, for a drainage system under and around a *building*.

3.7.10 Wastewater discharge

A *wastewater* drainage system should discharge to a public sewer or public *wastewater* treatment plant provided under the Sewerage (Scotland) Act 1968, where it is *reasonably practicable* to do so. Where it is not possible to discharge to a public system, for example in the countryside where there is no public sewer, other options are available, as described in the guidance to standards 3.8 and 3.9: Private wastewater treatment systems.

3.8 Private wastewater treatment systems – treatment plants

- 3.8 Functional standard
- 3.8.0 Introduction
- 3.8.1 Treatment plants
- 3.8.2 Treatment plant covers
- 3.8.3 Inspection and sampling
- 3.8.4 Location of a treatment plant
- 3.8.5 Discharges from septic tanks and treatment plants
- 3.8.6 Access for desludging
- 3.8.7 Labelling

standard

3.8

mandatory

Every private *wastewater* treatment plant or septic tank serving a *building* must be designed and *constructed* in such a way that it will ensure the safe temporary storage and treatment of wastewater prior to discharge.

3.8.0 Introduction

A *wastewater* treatment system is an effective, economical way of treating *wastewater* from *buildings*. It consists of 2 main components, a watertight underground tank into which raw sewage is fed and a system designed to discharge the *wastewater* safely to the environment without pollution. This is normally an infiltration field through which *wastewater* is released to the ground, but when ground conditions are not suitable, a discharge to a watercourse or coastal waters may be permitted. The infiltration field provides secondary treatment and is often critical for protecting the environment from pollution. Not all treatment plants treat to the same standard, for example, biological treatment plants treat the *wastewater* to a much higher standard than septic tanks prior to release of the *wastewater* thus reducing pollution and permitting a smaller infiltration field. As there are many different types of treatment plants with varying degrees of efficiency, then the type chosen should be selected for the effluent standard required to protect the environment.

Although a septic tank is a basic form of treatment plant, it has been specifically mentioned in the guidance to clarify the recommendations.

Package treatment plant is the term applied to a range of systems engineered to treat a given hydraulic and organic load using prefabricated components that can be installed with minimal site work.

Guidance on the *construction* and installation of drains discharging into private *wastewater* treatment plants or septic tanks is covered in standard 3.7.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

3.8.1 Treatment plants

Where it is not *reasonably practicable* to connect to a public sewer or a public *wastewater* treatment plant then discharge should be to a private *wastewater* treatment plant or septic tank.

Treatment plants provide suitable conditions for the settlement, storage and partial decomposition of solids that need to be removed at regular intervals. The discharge can however still be harmful and will require great care when discharging to ground to ensure a suitable level of protection of the environment is achieved. A large number of small sewage treatment works in a limited area is undesirable. The guidance to standard 3.9 deals with the infiltration system that should be *constructed* as an integral part of the treatment plant or septic tank.

When sizing and selecting the *wastewater* treatment plant the designer should take full account of all population loadings, effluent treatment standard, and also where appropriate, any unusual pollution loads such as waste disposal units.

www.britishwater.co.uk

Domestic use of detergents and disinfectants is not detrimental but excessive use may have a harmful effect on the performance of the sewage treatment works. The British Water Code of Practice, Flows and Loads – 2, provides guidance on sizing criteria and treatment capacity for small (maximum 1000 population equivalent) *wastewater* treatment systems.

A private *wastewater* treatment plant and septic tank should be designed, *constructed* and installed in accordance with:

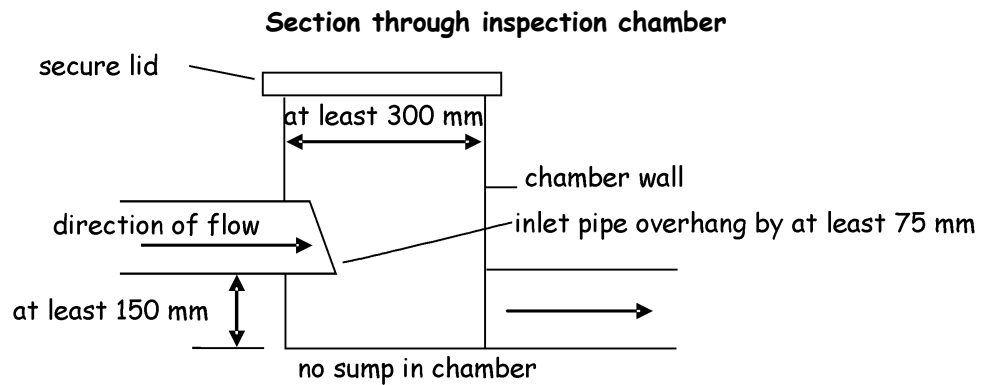
- a. the recommendations of BS EN 12566-1: 2000, for a prefabricated septic tank; or
- b. the recommendations of BS 6297: 1983; or
- c. the conditions of certification by a *notified body*.

3.8.2 Treatment plant covers

The settlement tank of a private *wastewater* plant and a septic tank should have a securely sealed, solid cover that is capable of being opened by 1 person using standard operating keys.

3.8.3 Inspection and sampling

A private *wastewater* plant and septic tank should be provided with a chamber for the inspection and sampling of the *wastewater* discharged from the tank. The owner should carry out inspection at regular intervals and SEPA may sample the effluent to ensure compliance with any discharge consent. A chamber should be provided in accordance with the following diagram:



3.8.4 Location of a treatment plant

Research has shown that there are no health issues that dictate a safe location of a treatment plant or septic tank relative to a *dwelling*. However damage to the *foundations* of a *dwelling* has been shown to occur where leakage from the tank has occurred. In the unlikely event of there being leakage, it is sensible to ensure that any water bearing strata directs any effluent away from the *dwelling*. To prevent any such damage therefore, every part of a private *wastewater* plant and septic tank should be located at least 5 m from a *dwelling*.

Every part of a private *wastewater* plant and septic tank should be located at least 5 m from a *boundary* in order that an adjoining plot is not inhibited from its full development potential.

3.8.5 Discharges from septic tanks and treatment plants

Where mains drainage is not available, it may be possible to discharge treated *wastewater* to ground via an infiltration system, as described in clause 3.9.2, or to a water course, loch or coastal waters.

SEPA consents

SEPA will require an authorisation, under the terms of the [Water Environment \(Controlled Activities\)\(Scotland\) Regulations 2005](#) to be applied for all discharges of sewage effluent whether to ground via an infiltration system or to a watercourse.

3.8.6 Access for desludging

Wastewater treatment plants should be inspected monthly to check they are working correctly. The effluent in the outlet from the tank should be free flowing. The frequency of desludging will depend upon the capacity of the tank and the amount of waste draining to it from the *dwelling* but further advice on desludging frequencies should be obtained from the tank manufacturer or the desludging contractor.

A private *wastewater* treatment plant and septic tank should be provided with an access for desludging. The desludging tanker should be provided with access to a working area that:

-
- will provide a clear route for the suction hose from the tanker to the tank; and
- is not more than 25 m from the tank where it is not more than 4 m higher than the invert level of the tank; and
- is sufficient to support a vehicle axle load of 14 tonnes.

3.8.7 Labelling

Every *dwelling* with a drainage system discharging to a private *wastewater* treatment plant or septic tank should be provided with a label to alert the occupiers to such an arrangement. The label should describe the recommended maintenance necessary for the system and should include the following:

‘The drainage system from this property discharges to a wastewater treatment plant (or septic tank, as appropriate). The owner is legally responsible for routine maintenance and to ensure that the system complies with any discharge consent issued by SEPA and that it does not present a health hazard or a nuisance’.

The label should be located adjacent to the gas or electricity consumer unit or the water stopcock.

3.9 Private wastewater treatment systems – infiltration systems

- 3.9 Functional standard
- 3.9.0 Introduction
- 3.9.1 Assessing the suitability of the ground
- 3.9.2 Design of infiltration fields
- 3.9.3 Greywater disposal
- 3.9.4 Location of infiltration fields – pollution
- 3.9.5 Location of infiltration fields – damage to buildings

standard

3.9

mandatory

Every private *wastewater* treatment system serving a *building* must be designed and *constructed* in such a way that the disposal of the *wastewater* to ground is safe and is not a threat to the health of the people in or around the *building*.

SEPA authorisation

3.9.0 Introduction

The intention of this standard is to ensure that non-mains drainage systems are designed and *constructed* to a standard so that the discharges from them do not contribute to environmental pollution and will achieve statutory environmental standards. Subject to discharge authorisation from SEPA, (see clause 3.8.5) *wastewater* from treatment systems can either discharge to land via an infiltration system or to watercourses, lochs or coastal waters. The guidance to this standard deals with discharges to land via infiltration systems. The infiltration method will form a critical part of the treatment system and care must be taken in the type, design and location chosen to avoid environmental pollution. The guidance to this standard should be used in conjunction with the guidance to standard 3.8 when designing *wastewater* treatment systems.

Several hundreds of *wastewater* treatment systems are thought to cause pollution problems every year. These problems occur mainly because of poor location, poor drainage field design or lack of maintenance.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

3.9.1 Assessing the suitability of the ground

An infiltration system serving a private *wastewater* treatment plant, septic tank or for *greywater* should be *constructed* in ground suitable for the treatment and dispersion of the *wastewater* discharged. This can be achieved by following the guidance below.

A ground assessment and soil percolation test should be carried out to determine the suitability of the ground. The following three step procedure should be followed:

Ground assessment

First, carry out a preliminary ground assessment. The following check list indicates the actions that should be taken and the type of information that should be collected:

- consult SEPA, verifier and the Environmental Health Officer as required;
- consult SEPAs latest groundwater protection policy;
- identification of the underlying geology and aquifers;
- whether the ground is liable to flooding;
- nature of the sub-soil and groundwater vulnerability;
- implication of plot size;
- proximity of underground services;
- ground topography and local drainage patterns;
- whether water is abstracted for drinking, used in food processing or farm dairies;
- implication for, and of, trees and other vegetation;
- location of *surface waters* and terrestrial ecosystems.

The preliminary assessment may indicate that the ground is unsuitable for the installation of an infiltration system, in which case an alternative disposal method should be considered.

Trial holes

Second, a trial hole should be dug to determine the position of the water table and soil conditions. This trial hole will enable the sub-soil type to be determined. The trial hole should be a minimum of 2 m deep, or a minimum of 1.5 m below the invert of the proposed distribution pipes. The trial hole should be left covered for a period of 48 hours before measuring any water table level. Subsoils that overlay bedrock allow water to move through the pore spaces between the grains of material of which they are composed. They are the first line of defence against pollution and act as a protecting filtering layer. Where these materials are unsaturated, pollution attenuation processes are often enhanced. Water flows through much of Scotland's bedrock via fissures. Attenuation of contaminants is limited in these cases. For safe and effective dispersal of the *wastewater*, the groundwater and bedrock should be at least 1 m below the bottom of the distribution pipes. It should also be noted that it is the seasonally highest level of the water table that should be determined for the infiltration area

Percolation tests

Third, to determine the type of infiltration system and the area of ground required, percolation tests should be carried out. These percolation tests should be carried out using either of the following methods:

- a. expert examination of the soil distribution analysis, using the method described in BS 1377: Part 2: 1990; or
- b. expert in-situ testing using either the Constant Head or Tube Permeameter as described in CEN /TR 12566–2–2005; or
- c. excavate a minimum of two percolation holes, not less than 5 m apart along the line of and below the proposed invert level of the effluent distribution pipe. Each hole should be 300 mm square to a depth of 300

mm. Where deep drains are necessary, the holes should conform to this shape at the bottom but may be enlarged above the 300 mm level to facilitate safe excavation. Fill the 300 mm square section of the holes to a depth of at least 300 mm with water and allow them to seep away overnight. It is important to saturate the soil surrounding the test holes to simulate day to day conditions in an operational drainage field. Next day, refill the test sections of the percolation holes with water to a depth of at least 300 mm and observe the time (t) in seconds, for the water to seep away from 75% to 25% full level. Divide this time by 150 mm. The answer gives the average time in seconds (Vp) required for the water to drop 1 mm. Take care when making the tests to avoid unusual weather conditions such as heavy rain, severe frost or drought. To obtain consistent results carry out the test at least 3 times for each percolation hole and take the average figure.

The floor area of a sub-surface drainage trench required to disperse effluent from treatment plants or septic tanks may be calculated from the following formula:

$$A = P \times V_p \times 0.25$$

A is the area of the sub-surface drainage trench, in m²

p is the number of persons served by the tank; and

Vp is the percolation value obtained, as described above, in secs/mm.

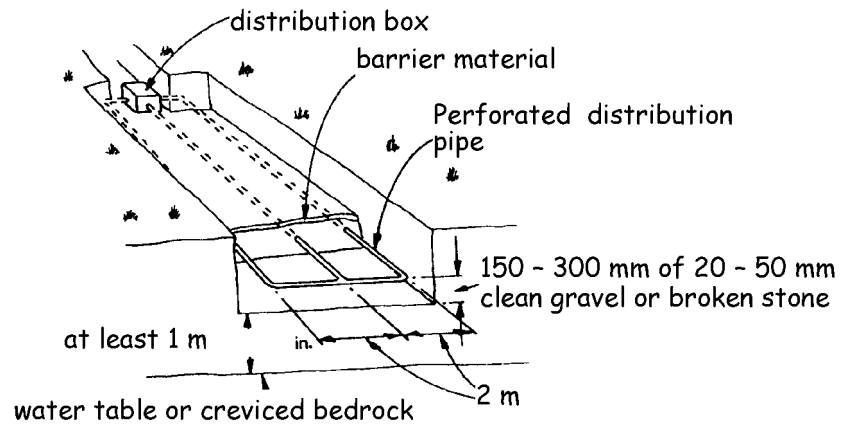
For *wastewater* that has received the benefit of secondary treatment followed by settlement, this area may be reduced by 20%, i.e.

$$A = P \times V_p \times 0.2$$

3.9.2 Design of infiltration fields

An infiltration system serving a private *wastewater* treatment plant or septic tank should be designed and *constructed* to suit the conditions as determined by the ground into which the treated *wastewater* is discharged. An infiltration system should be designed and *constructed* in accordance with the following guidance:

- | | |
|--------------------------|--|
| Fast percolation rates | Where the percolation value (as demonstrated by the percolation test) is not more than 15 secs/mm, in accordance with the requirements of SEPA; |
| Normal percolation rates | Where the percolation value (as demonstrated by the percolation test) is more than 15 secs/mm and not more than 100 secs/mm, as: <ol style="list-style-type: none"> a. a piped infiltration trench system in accordance with national annex NG.3 of BS EN 752-4: 1998, using perforated, rigid pipes with a smooth internal surface; or b. a piped infiltration bed system in accordance with the diagram below; or c. any system described under 'slow and very slow percolation rates'; |

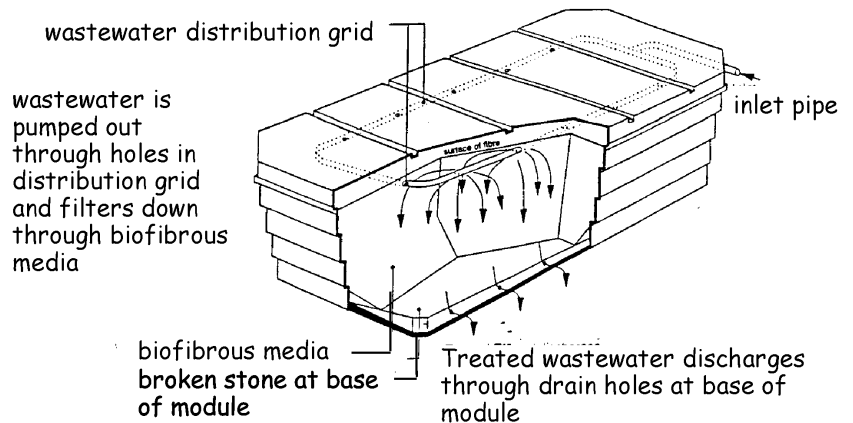


Slow percolation rates

Where the percolation value (as demonstrated by the percolation test) is more than 100 secs/mm and not more than 140 secs/mm, as:

- a reed bed complying with the requirements of the BRE, [Good Building Guide, GBG 42, Parts 1 and 2](#) together with a piped infiltration system described in Sub-clauses a and b with a normal percolation rate, or a suitable outfall; or
- a *constructed* wetland, other than a reed bed, to a professionally prepared design and *constructed* by specialist contractor(s); or
- a proprietary filtration system designed, *constructed* and installed in accordance with the conditions of a *notified body*; or
- any other equivalent filtration system designed by a specialist in this subject and *constructed* by specialist contractor(s);

Typical proprietary filtration system



Very slow percolation rates

Where the percolation value (as demonstrated by the percolation test) is more than 140 secs/mm:

- as a system described under 'slow percolation rate' that does not use an infiltration system for the final treated *wastewater*; or
- for domestic sized *buildings*, by designing and *constructing* a mound filter system in accordance with BR 478, '[Mound Filter Systems for the treatment of domestic wastewater](#)'.

3.9.3 Greywater disposal

The disposal of *greywater* (from baths, showers, washbasins, sinks and washing machines) may be accomplished by an infiltration field the area of which can be calculated from the following:

$$A = P \times V_p \times 0.2$$

A is the area of the sub-surface drainage trench, in m² ;

p is the number of persons served; and

V_p is the percolation value obtained, as described above, in secs /mm.

3.9.4 Location of infiltration fields – pollution

An infiltration system serving a private *wastewater* treatment plant or septic tank should be located to minimise the risk of pollution. An infiltration field should be located in accordance with the following guidance:

- a. at least 50 m from any spring, well or borehole used as a drinking water supply; and
- b. at least 10 m horizontally from any watercourse (including any inland or coastal waters), permeable drain, road or railway.

3.9.5 Location of infiltration fields – damage to buildings

Research has shown that there are no health issues that dictate a safe location of an infiltration field relative to a *building*. However damage to the *foundations* of a *building* is likely to occur where discharge is too close to the *building*. It is sensible to ensure that any water bearing strata directs any effluent away from the *building*.

To prevent any such damage therefore, every part of an infiltration system serving a private *wastewater* treatment plant or septic tank should be located at least 5 m from a *building*. An infiltration system should also be located at least 5 m from a *boundary* in order that an adjoining plot is not inhibited from its full development potential.

However the ground strata or permeability of the soil may influence this dimension and it may be reduced slightly where the strata directs any groundwater away from the *foundations* or if the soil is free draining. Indeed, to preserve the structural integrity of the *building*, it may be prudent to increase the dimension where ground conditions would allow *wastewater* to collect around the *building's foundations*.

3.10 Precipitation

- 3.10 Functional standard
- 3.10.0 Introduction
- 3.10.1 General provisions
- 3.10.2 Wall constructions (solid, masonry)
- 3.10.3 Wall constructions (cavity, masonry)
- 3.10.4 Conservatories and extensions
- 3.10.5 Wall constructions (framed)
- 3.10.6 Ventilation of wall cavities
- 3.10.7 Roof constructions (flat)
- 3.10.8 Roof constructions (pitched)

standard
3.10
 mandatory

Every *building* must be designed and *constructed* in such a way that there will not be a threat to the *building* or the health of the occupants as a result of moisture from precipitation penetrating to the inner face of the *building*.

Limitation:

This standard does not apply to a *building* where penetration of moisture from the outside will result in effects no more harmful than those likely to arise from use of the *building*.

3.10.0 Introduction

Rain penetration shows up as damp patches, usually after heavy rain, on the inside of *external walls*, around door or window openings or on ceilings. It can be difficult to pinpoint the exact route the rainwater is taking. For example, a damp patch on a ceiling could be the result of a faulty flashing or damaged felt on a flat roof some distance away from the damp patch. Similarly, unless they have adequate damp proof courses and flashings, materials in parapets and *chimneys* can collect rainwater and deliver it to other parts of the *dwelling* below roof level. Penetration occurs most often through walls exposed to the prevailing wet winds, usually south-westerly or southerly.

BR 302

There are numerous publications providing good practice guidance on methods of preventing rain penetration to internal surfaces of *buildings*. BRE book 'Roofs and Roofing – performance, diagnosis, maintenance, repair and the avoidance of defects' provides helpful guidance for *building* professionals to address these problematic issues.

Explanation of terms

The following terms are included to provide clarity to their meaning in the guidance to this standard.

A **vented cavity** means a cavity with openings to the outside air placed so as to allow some limited, but not necessarily through air movement. The openings are normally located at low level where they can also act as weep holes to drain water from the cavity.

A **ventilated cavity** means a cavity with openings to the outside air placed so as to promote through movement of air. The openings should be located at high and low level.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard in so far as is *reasonably practicable*, and in no case be worse than before the *conversion*. (regulation 12, schedule 6).

3.10.1 General provisions

A floor, wall, roof or other *building* element exposed to precipitation, or wind driven moisture, should prevent penetration of moisture to the inner surface of any part of a *dwelling* so as to protect the occupants and to ensure that the *building* is not damaged.

Some types of *buildings*, such as *carports* or storage of outdoor equipment, can be unaffected by damp penetration and the following guidance therefore may not be relevant.

When using any of the *constructions* below, the following general recommendations should be followed for walls or roofs, as appropriate:

- masonry walls of bricks and/or blocks incorporating damp-proof courses, flashings and other materials and components *constructed* in accordance with the relevant recommendations of BS 5628: Part 3: 2005. The *construction* used should suit the degree of exposure to wind and rain in accordance with Clause 21 and as described in BS 8104: 1992;
- masonry walls incorporating external rendering which conforms to the relevant recommendations of BS 5262: 1991, to suit the degree of exposure and the type of masonry;
- masonry walls of natural stone or cast stone blocks *constructed* in accordance with the relevant recommendations of Section 3 of BS 5390: 1976 (1984) and to suit the degree of exposure to wind and rain as described in BS 8104: 1992;
- masonry cavity walls incorporating insulation material, either as a complete or partial cavity fill, where the insulating material is the subject of a current certificate issued under the relevant conditions of an independent testing body. The walls should be *constructed* in accordance with the terms of the certificate and to suit the degree of exposure to wind and rain as described in BS 8104: 1992 and the relevant recommendations of the following British Standards:

Cavity wall insulation

| Materials or conditions | British Standards |
|---------------------------------|---------------------------------|
| Urea formaldehyde (UF) foam | BS 5617: 1985 and BS 5618: 1985 |
| Man-made mineral fibre (slabs) | BS 6676: Parts 1: 1986 |
| Assessment of walls for filling | BS 8208: Part 1: 1985 |

- roofs with copper, lead, zinc and other sheet metal roof coverings require provision for expansion and contraction of the sheet material. In 'warm deck' roofs, in order to reduce the risk of condensation and corrosion, it may be necessary to provide a ventilated air space on the cold side of the insulation and a high performance vapour control layer between the insulation and the roof structure. It may also be helpful to consult the relevant trade association.

- walls or roofs incorporating cladding materials *constructed* in accordance with the recommendations of the following British Standards or Codes of Practice:

Wall and roof cladding materials

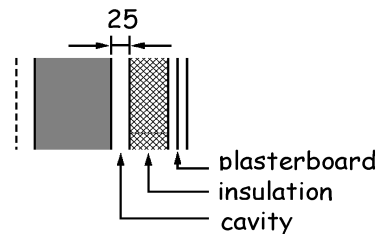
| Materials and conditions | Element | British Standards and Codes of Practice |
|--------------------------|--------------------|---|
| Aluminium | wall or roof | CP 143: Part 15: 1973 (1986) |
| Galv. corrugated steel | wall or roof | CP 143: Part 10: 1973 |
| Lead | wall or roof | BS 6915: 2001 |
| Copper | wall or roof | CP 143: Part 12: 1970 (1988) |
| Slates and tiles | wall or roof | BS 5534: Part 1: 2003 |
| Zinc | wall or roof | CP 143: Part 5: 1964 |
| Non-loadbearing walls | wall or steep roof | BS 8200: 1985 |
| PC concrete cladding | wall | BS 8297: 2000 |
| Natural stone cladding | wall | BS 8298: 1994 |
| <i>Flat roofs</i> | roof | BS 6229: 2003 |
| Bitumen felt | roof | BS 8217: 2005 |
| Mastic asphalt | roof | BS 8218: 1998 |

3.10.2 Wall constructions (solid, masonry)

The following sketches provide guidance on recommended methods of *construction* to prevent rain penetration to the inner surfaces of the *building*. The thickness and other dimensions quoted are the minimum recommended unless otherwise stated. Greater figures are therefore possible.

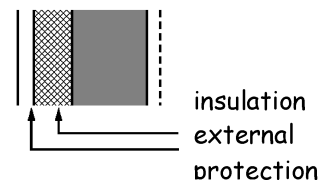
Wall type A
(solid wall with internal insulation)

Solid wall, 200 mm thick of bricks, blocks or slabs of clay, calcium silicate, concrete or cast stone. Wall rendered or unrendered externally. Insulation and plasterboard internally, with a cavity 25 mm wide.



Wall type B
(solid wall with external insulation)

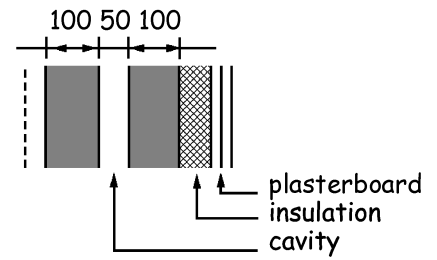
Solid wall as A. above. Insulation applied to the external surface of the wall; protected externally either by cladding (of sheets, tiles or boarding) with *permanent ventilation*, or by rendering. Wall with or without an internal surface finish of plaster or plasterboard.



3.10.3 Wall constructions (cavity, masonry)

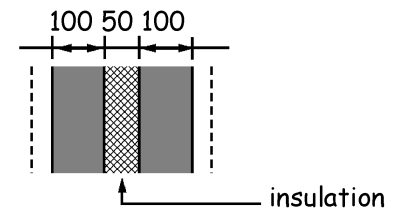
Wall type A
(cavity wall with internal insulation)

Cavity wall of 2 leaves of masonry separated by a 5 mm cavity; each leaf, 100 mm thick, of either bricks or blocks of clay, calcium silicate or concrete. Wall rendered or unrendered externally. Insulation applied as a lining to the internal surface of the wall and plasterboard.



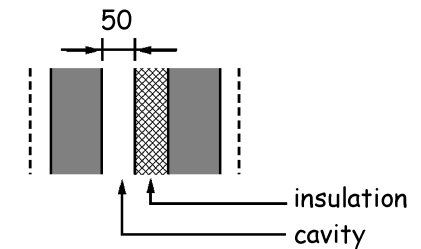
Wall type B
(cavity wall with cavity fill insulation)

Cavity wall as A. above. Wall rendered or unrendered externally. Insulation applied as a cavity fill. Wall with or without an internal surface finish of plaster or plasterboard. This construction is only recommended for sheltered conditions.



Wall type C
(cavity wall with partial fill insulation)

Cavity wall as A. above. Wall rendered or unrendered externally. Insulation applied to either leaf as a partial cavity fill so as to preserve a residual space of 50 mm wide. Wall with or without an internal surface finish of plaster or plasterboard.



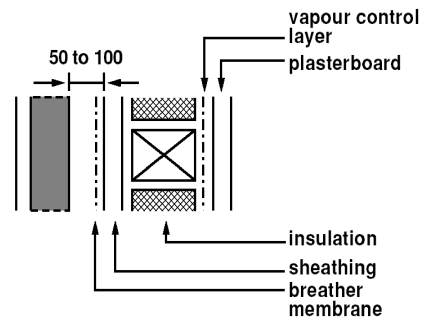
3.10.4 Conservatories and extensions

Careful consideration should be given to the detailing of an existing wall of a *building* when a *conservatory* or extension is added. The outer leaf of a previously *external wall* will become an internal wall and any moisture that enters the cavity could collect and cause serious damage to the *building*. Where the *dwelling* is located in an exposed location or where the existing *construction* might allow the passage of rain either through facing brick or a poorly rendered masonry wall, the use of a cavity tray along the line of the roof of the *conservatory* or extension may be appropriate. However in sheltered situations or where the detailing can prevent damage to the *building* as a result of rain penetration a ragged flashing (chased into the wall) may be sufficient.

3.10.5 Wall constructions (framed)

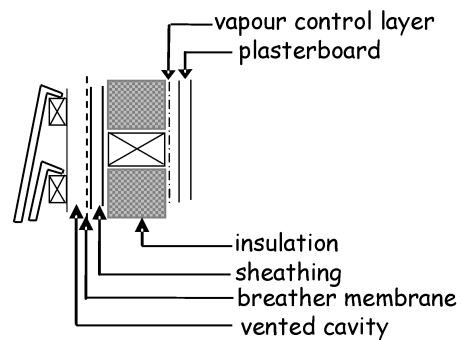
Wall type A
(masonry cladding)

Framed wall of timber studs and dwangs, with a vapour permeable sheathing to the framing covered with a breather membrane. Masonry external cladding of 100 mm thick clay brick or block, concrete or calcium silicate brick or block, dense in-situ concrete, lightweight concrete or autoclaved aerated concrete, with an externally ventilated cavity in accordance with the guidance in clause 3.10.6 . Masonry cladding rendered or unrendered externally. Insulation applied as an infill to the framing. The framing lined internally with a vapour control layer and plasterboard.



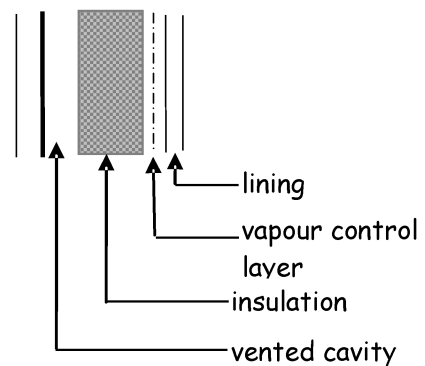
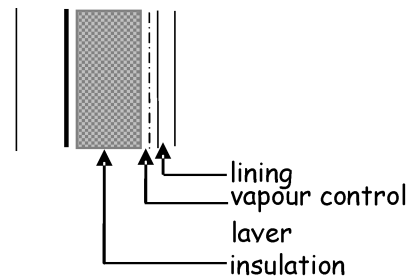
Wall type B
(weatherboarding, tile or slate cladding)

Framed wall of timber studs and dwangs with a breather membrane. Cladding material, on battens and counter battens as required, of timber weather boarding, tile or slate. Insulation and internal lining as A. above.



Wall type C
(sheet or panel cladding with/without ventilated cavity)

Framed wall of timber or metal studs and dwangs. Sheet or panel cladding material of fibre cement, plastic, metal, GRP or GRC. Insulation applied either to the internal face of the framing with *permanent ventilation* behind any impervious cladding, or as an infill to the framing; in either case the wall lined internally with a vapour control layer and a lining.



3.10.6 Ventilation of wall cavities

Ventilation of *external wall* cavities is necessary to prevent the build-up of excessive moisture that could damage the fabric of a *building*. Ventilation holes can also be used to drain excess water from the cavity that has entered through the outer leaf.

Timber frame

Interstitial condensation is one of the major problems that need to be addressed in timber framed *buildings*. To reduce the amount of interstitial condensation to a level that will not harm the timber frame or sheathing, a cavity of at least 50 mm wide should be provided between the sheathing and the cladding. Where timber, slate or tile cladding is used, the width of the cavity should be measured between the sheathing and the inner face of the cladding, ignoring the battens and counter battens.

Where the outer leaf is of timber, slate or tile clad *construction*, a vented cavity should be provided. A ventilated cavity should be provided for extra protection in severely exposed areas. Where necessary refer to BS 8104: 1992. Due to the air gaps inherent between the components of a timber, slate or tile clad wall, no proprietary *ventilators* should be necessary and a 10 mm free air space should be sufficient.

Cavity barriers

Where the wall cavity is sub-divided into sections by the use of *cavity barriers* e.g. at mid-floor level in a 2 storey house, the *ventilators* should be provided to the top and bottom of each section of the cavity. Care should be taken with rendered walls to prevent blockage of the *ventilators*.

Masonry outer leaf

Where the outer leaf is of masonry *construction*, venting of the cavity is normally sufficient. Cavities should be vented to the outside air by installing *ventilators* with at least 300 mm² free opening area at 1.2 m maximum centres. Precipitation can penetrate the outer leaf of an external wall and cavities are normally drained through weep holes. These weep holes can also provide the necessary venting.

3.10.7 Roof constructions (flat)

The following sketches provide guidance on recommended methods of *construction* to prevent rain penetration to the inner surfaces of a *building*.

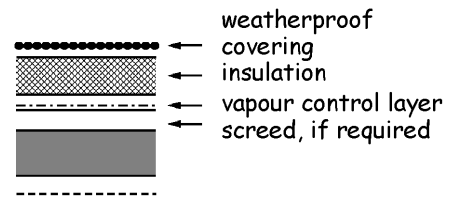
There is evidence to suggest that condensation in cold deck *flat roofs* is a problem and should be avoided. Both the warm deck and warm deck inverted roof *constructions*, where the insulation is placed above the roof deck, are considered preferable. Further guidance is given to standard 3.15, Condensation

The following British Standards give recommendations on the design and *construction of flat roofs*:

- BS 6229: 2003 – CoP for flat roofs with continuously supported coverings
- BS 6915: 2001 – CoP Design and construction of fully supported lead sheet roof and wall cladding
- BS 8217: 2005 – CoP for reinforced bitumen membranes
- BS 8218: 1998 – CoP for mastic asphalt roofing
- CP 143 - 12: 1970 – CoP for sheet and wall coverings

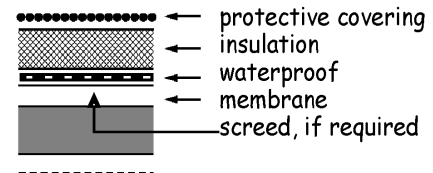
Roof type A
(concrete – warm roof)

Flat roof structure of in-situ or precast concrete with or without a screed; with or without a ceiling or soffit. External weatherproof covering; with insulation laid on a vapour control layer between the roof structure and the weatherproof covering. [Note 1]



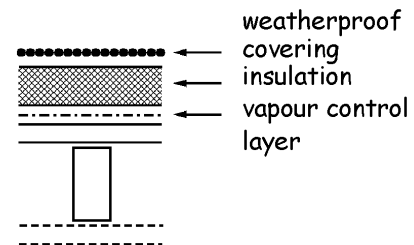
Roof type B
(concrete – inverted roof)

Flat roof structure as A. above. External protective covering; with low permeability insulation laid on a waterproof membrane between the roof structure and the external covering.



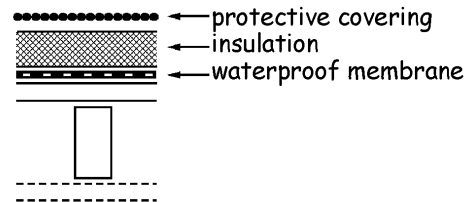
Roof type C
(timber or metal frame – warm roof)

Flat roof structure of timber or metal-framed construction with a board decking 19 mm thick; with or without a ceiling or soffit. External weatherproof covering, insulation and vapour control layer as A. above. [Note 1]



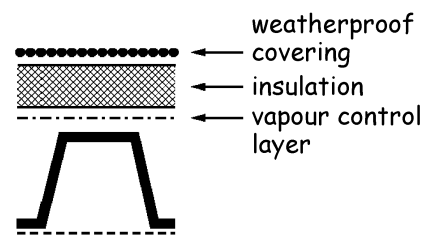
Roof type D
(timber or metal frame – inverted roof)

Flat roof structure as C. above. External protective covering, insulation and waterproof membrane as B. above.



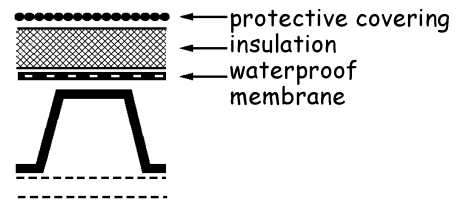
Roof type E
(troughed metal decking – warm roof)

Flat roof structure of timber or metal framed construction with a troughed metal decking; with or without a ceiling or soffit. External weatherproof covering and insulation and vapour control layer as A. above. [Note 1]



Roof type F
(troughed metal decking – inverted roof)

Flat roof structure as E. above. External protective covering, insulation and waterproof membrane as B. above.



Note 1

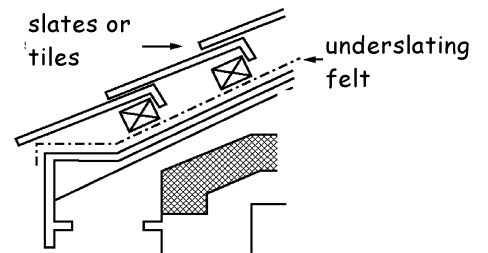
Roof types A, C and E are not suitable for sheet metal coverings that require joints to allow for thermal movement. See also sub-clause f of clause 3.10.1.

3.10.8 Roof constructions (pitched)

BS 5534: 2003 gives recommendations on the design, materials, installation and performance of slates, tiles and shingles including, amongst others, information on rain and wind resistance. The British Standard also provides a comprehensive list of other British Standards covering other less common pitched roof coverings.

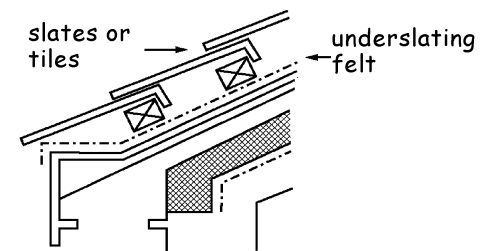
Roof type A
(slates or tiles – insulation on a level ceiling)

Pitched roof structure of timber or metal framed *construction*. External weatherproof covering of slates or tiles on under slating felt with or without boards or battens.



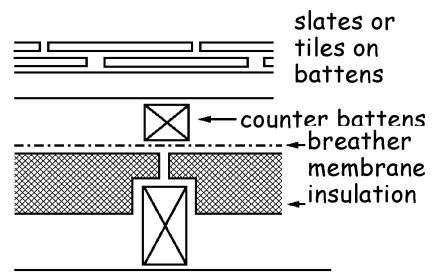
Roof type B
(slates or tiles – insulation on a sloping ceiling)

Pitched roof structure as A. above. External weatherproof covering as A.



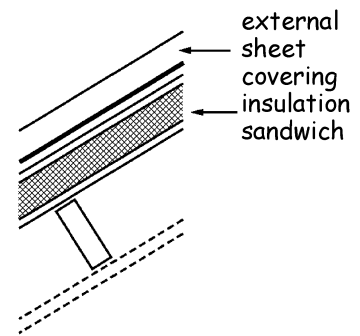
Roof type C
(slates or tiles – insulation as decking)

Pitched roof structure as A. above with a decking of low permeability insulation fitted to and between the roof framing. External weatherproof covering of slates or tiles, with tiling battens and counter battens (located over roof framing), and a breather membrane laid on the insulation decking; with a sloping ceiling.



Roof type D
(metal or fibre cement
sheet – sandwich
insulation)

Pitched roof structure as A. above.
External weatherproof covering of
metal or fibre cement sheet
sandwich *construction* laid on
purlins; with insulation sandwiched
between the external and soffit
sheeting; and with or without a
ceiling. [Note 2]



Note 2

Roof type D. is not suitable for sheet metal coverings that require joints to allow for thermal movement. See also sub-clause f of clause 3.10.1.

3.11 Facilities in dwellings

- 3.11 Functional standard
- 3.11.0 Introduction
- 3.11.1 Apartments
- 3.11.2 Enhanced apartment
- 3.11.3 Kitchens
- 3.11.4 Height of activity spaces
- 3.11.5 Alterations and extensions
- 3.11.6 Drying of washing

| | |
|--|---|
| <p style="text-align: center;">standard</p> <h1 style="text-align: center;">3.11</h1> <p style="text-align: center;">mandatory</p> | <p>Every <i>building</i> must be designed and <i>constructed</i> in such a way that:</p> <p>(a) the size of any <i>apartment</i> or <i>kitchen</i> will ensure the welfare and convenience of all occupants and visitors; and</p> <p>(b) an accessible space is provided to allow for the safe, convenient and sustainable drying of washing.</p> <p>Limitation: This standard applies only to a <i>dwelling</i>.</p> |
|--|---|

3.11.0 Introduction

Guidance on design of *dwellings* recommends that the size of individual *rooms* should be dictated by the way a *room* should function and the activities that are to be accommodated rather than by arbitrary rule of thumb areas. This design philosophy was included in a report by Sir Parker Morris in the 1960s and is still relevant today.

Liveability

Extending standards to address 'liveability' and the needs of occupants supports the Scottish Executive's aim of promoting a more inclusive *built* environment and will better address the changing needs of occupants over time. This approach to the design of *dwellings* ensures that Scotland's *housing* stock can respond to the needs of our population, now and in the future.

The provision, on one level, of an enhanced *apartment*, and *kitchen* under this standard, together with accessible *sanitary accommodation* (standard 3.12) and improvement to circulation spaces (standard 4.2) will assist in creating more sustainable homes.

The guidance in this standard and standard 3.12, together with the guidance in section 4, Safety relating to accessibility, has been based around, and developed from, issues that are included in '[Housing for Varying Needs](#)' and the [Lifetime Homes](#) concept developed by the Joseph Rowntree Foundation.

Drying of washing

From 1963 to 1986 the building regulations included a requirement for the provision of drying facilities. This was removed in response to increased ownership of specialised appliances and the vandalism of common drying areas in blocks of *flats*. The re-introduction of space to allow washing to be dried other than by a tumble drier is intended to encourage the use of more sustainable methods and thereby reduce carbon dioxide emissions.

Recycling

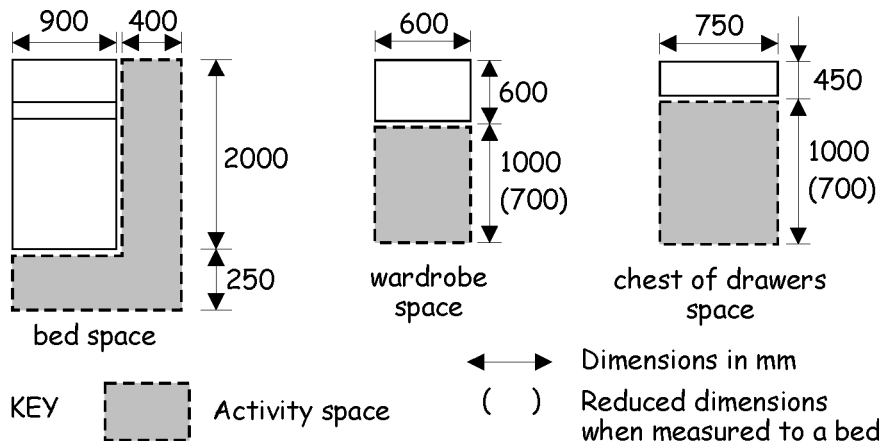
Designers should be aware of local authority initiatives on the recycling of solid waste and useful cross-references are provided in the guidance to standard 3.25, Solid waste storage. Such initiatives may affect storage provision in a *dwelling*.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

3.11.1 Apartments

Every *apartment* should be of a size that will accommodate at least a bed, a wardrobe and a chest of drawers, this being the minimum furniture provision that may be expected in such a *room*. Associated activity spaces for each item of furniture should be shown as in the diagram below. A door swing may open across an activity space.



Notes:

1. Activity spaces for furniture may overlap
2. A built-in wardrobe space of equal size may be provided as an option to a wardrobe.

3.11.2 Enhanced apartment

Smaller *apartments* or those with an unusual shape may limit how space within can be used. Where all *apartments* within a *dwelling* are designed in this way, this will present problems for occupants, particularly if affecting the main living spaces.

Therefore, at least one *apartment* on the principal living level of a *dwelling* should be of a size and form that allows greater flexibility of use. This enhanced *apartment* should:

- have a floor area of at least 12 m² and a length and width at least 3.0 m. This area should exclude any space less than 1.8 m in height and any portion of the *room* designated as a *kitchen*; and
- contain a unobstructed manoeuvring space of at least a 1.5 m by 1.5 m square or an ellipse of at least 1.4 m by 1.8 m, which may overlap with activity spaces recommended in clause 3.11.1. A door may open over this space; and
- have unobstructed access, at least 800 mm wide, to the controls of any openable window or any heating appliance and between doors within the *apartment*.

3.11.3 Kitchens

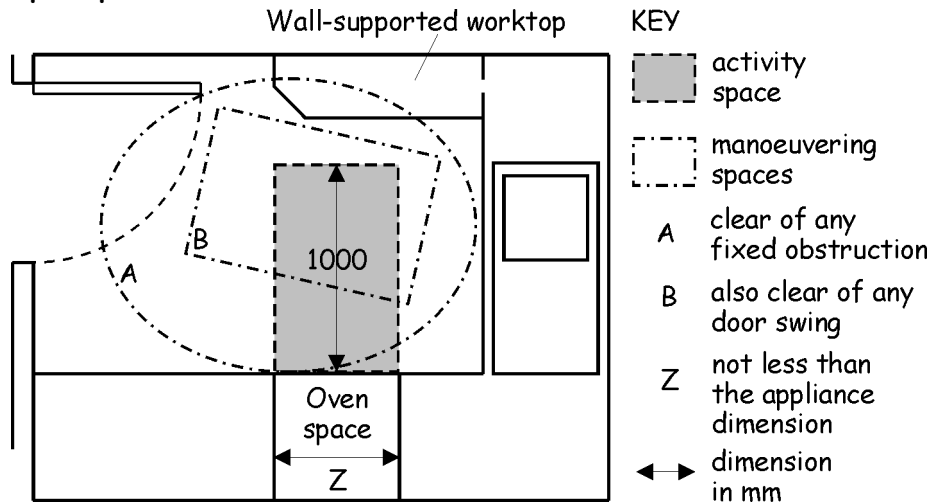
A *dwelling* should have a *kitchen* and, to be accessible, this should be on the principal living level. Space should be provided within the *kitchen* to both assist in use by a person with mobility impairment and offer flexibility in future alteration.

The layout should include an unobstructed manoeuvring space of at least a 1.5 m by 1.5 m square or an ellipse of 1.4 m by 1.8 m. A door may open across this manoeuvring space but a clear space of at least 1.1 m long by

800 mm wide, oriented in the direction of entry into the *room*, should remain unobstructed, to allow an occupant to enter and close the door.

A wall-supported worktop or similar obstruction, the underside of which is at least 750 mm above floor level, may overlap the manoeuvring space by not more than 300 mm.

Space provision within a kitchen



Where a *kitchen* is within the same *room* as an *apartment*, the area of the *kitchen* should be defined by a rectangle enclosing any floor-standing units, appliances and worktops. In such cases, manoeuvring space for the *kitchen* may project into the *apartment* but should not overlap with the separate manoeuvring space of an enhanced *apartment*.

A *kitchen* should be provided with space for a gas, electric or oil cooker or with a solid fuel cooker designed for continuous burning. The space should accommodate such piping, cables or other apparatus as will allow the appliance to operate. A cooker should have an activity space to allow access to, and safe use of, an oven, as shown in the diagram above. An activity space need not be provided in front of a hob or microwave oven.

Kitchen storage of at least 1 m³ should be provided either within or adjacent to the *kitchen*. Additional storage may be required depending on the local authority's recycling policy.

3.11.4 Height of activity spaces

Reduced headroom, such as beneath a sloping ceiling, can cause problems in use of both facilities and furniture, particularly if a person has difficulty in bending or has a visual impairment.

Activity spaces within the enhanced *apartment* or *kitchen* should therefore have an unobstructed height of at least 1.8 m.

3.11.5 Alterations and extensions

Where *works* to alter or extend are proposed, physical constraints in the size of an extension or the form of an existing *building* may mean that meeting recommendations in guidance is not always possible. Accordingly:

- where alteration or extension of a *building* includes *work* to, or provision of a new, *apartment* on the principal living level of the *dwelling*, and there is not already an enhanced *apartment* on that level, guidance in clause 3.11.2 should be met as far as is *reasonably practicable*.

- where altering an existing *kitchen* , guidance on manoeuvring space given in clause 3.11.3 should be met as far as is *reasonably practicable*.

3.11.6 Drying of washing

Drying washing indoors can produce large amounts of water vapour that needs to be removed before it can damage the *building* fabric or generate mould growth that can be a risk to the health of occupants. The tendency to build 'tighter' *buildings* could increase these risks by trapping the moisture in the *building* . Providing dedicated drying areas either outside or inside the *dwelling* should discourage householders from using non-sustainable methods of drying washing and should encourage the adoption of alternative practices that limit the production of greenhouse gases and the depletion of material resources.

Outdoor drying space

Drying washing outside will avoid the problems of high relative humidity in the home and where it is *reasonable practicable* , an accessible space for the drying of washing should be provided for every *house* on ground immediately adjacent to, and in the same occupation as, the *house* . The area provided should allow space for at least 1.7 m of clothes line per *apartment* .

Indoor drying space

Since weather is unreliable in Scotland, a designated space for the drying of washing should be provided in every *dwelling* , in addition to the external space.

The designated space may be either:

- capable of allowing a wall mounted appliance which may, for example be fixed over a bath; or
- capable of allowing a ceiling-mounted pulley arrangement; or
- a floor space in the *dwelling* on which to set out a clothes horse.

The designated space should have a volume of at least 1 m³ and should have no dimension less than 700 mm. The designated space should allow space for at least 1.7 m of clothes line per *apartment* .

The location of the designated space should not restrict access to any other area or appliance within the *dwelling* nor obstruct the swing of any door.

Guidance to standard 3.14 provides information on the ventilation of indoor spaces designated for the drying of washing.

3.12 Sanitary facilities

- 3.12 Functional standard
- 3.12.0 Introduction
- 3.12.1 Sanitary provision
- 3.12.2 Waterless closets
- 3.12.3 Accessible sanitary accommodation
- 3.12.4 Access to sanitary accommodation
- 3.12.5 Alteration and extensions

standard
3.12
 mandatory

Every *building* must be designed and *constructed* in such a way that *sanitary facilities* are provided for all occupants of, and visitors to, the *building* in a form that allows convenience of use and that there is no threat to the health and safety of occupants or visitors .

3.12.0 Introduction

Sanitary accommodation that is more immediately accessible and offers both adaptability and flexibility of layout gives a more sustainable solution that will simplify modifications to the design and layout of *dwellings* , helping to reduce cost and disruption and better enabling people to remain in their home as their circumstances change.

Although not recommending that *sanitary facilities* on the principal living level of a *dwelling* be designed to an optimum standard for wheelchair users, it should be possible for most people to use these facilities unassisted and in privacy.

Extending standards to address ‘liveability’ and the needs of occupants supports the Scottish Executive’s aim of promoting a more inclusive built environment and will better address the changing needs of occupants over time. This approach to the design of *dwellings* ensures that Scotland’s *housing* stock can respond to the needs of our population, now and in the future.

The guidance in this standard and standard 3.11, together with the guidance in section 4, Safety relating to accessibility, has been based around, and developed from, issues that are included in ‘[Housing for Varying Needs](#)’ and the [Lifetime Homes](#) concept developed by the Joseph Rowntree Foundation.

The provision, on one level, of accessible *sanitary accommodation* under this standard, together with an enhanced *apartment*, and *kitchen* (standard 3.11) and improvement to circulation spaces (standard 4.2) will assist in creating more sustainable homes.

Lead in water

www.scottishwater.co.uk
www.snipef.co.uk

The human body absorbs lead easily from drinking water and this can have a negative effect on the intellectual development of young children. Although mains water supplies do not contain significant levels of lead, recent research studies have shown that leaded solder plumbing fittings, normally used for heating systems, have been used on drinking water pipework in contravention of the [Scottish Water Byelaws 2004](#) . Further guidance can be obtained from Scotland and Northern Ireland Plumbing Employers Federation (SNIPEF) and Scottish Water.

Conversions

In the case of *conversions* , as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

3.12.1 Sanitary provision

Every *dwelling* should have *sanitary facilities* comprising at least 1 watercloset (WC), or waterless closet, together with 1 wash hand basin per WC, or waterless closet, 1 bath or shower and 1 sink. It is normal for the sink to be located in a *kitchen* .

To allow for basic hygiene, a wash hand basin should always be close to a WC or waterless closet, either within a *toilet* , or located in an adjacent space providing the sole means of access to the *toilet* .

There should be a door separating a space containing a WC, or waterless closet, from a *room* or space used for the preparation or consumption of food, such as a *kitchen* or dining room.

3.12.2 Waterless closets

If a waterless closet is installed it should be to a safe and hygienic design such as:

- a. [National Sanitation Foundation](#) Certification to Standard NSF 41: 'wastewater recycling/reuse and water conservation devices'; or
- b. NFS International Standard NSF/ANSI 41-1999: 'non-liquid saturated treatment systems'; or
- c. to the conditions of a certification by a *notified body* .

Although some European countries manufacture waterless closets, they have not as yet been tested to any recognised standard. This does not mean that they are unacceptable, just that care should be taken in their choice to ensure they are both safe and hygienic in use.

3.12.3 Accessible sanitary accommodation

Bathrooms and *toilets* designed to minimum space standards can often create difficulties in use. As the ability of occupants can vary significantly, *sanitary accommodation* should be both immediately accessible and offer potential for simple alteration in the future.

A *dwelling* should have at least 1 accessible WC, or waterless closet, and wash hand basin and at least 1 accessible shower or bath.

These *sanitary facilities* should be located on the principal living level of a *dwelling* and be of a size and form that allows unassisted use, in privacy, by almost any occupant. This should include use by a person with mobility impairment or who uses a wheelchair, albeit with limited manoeuvring space within the *sanitary accommodation* .

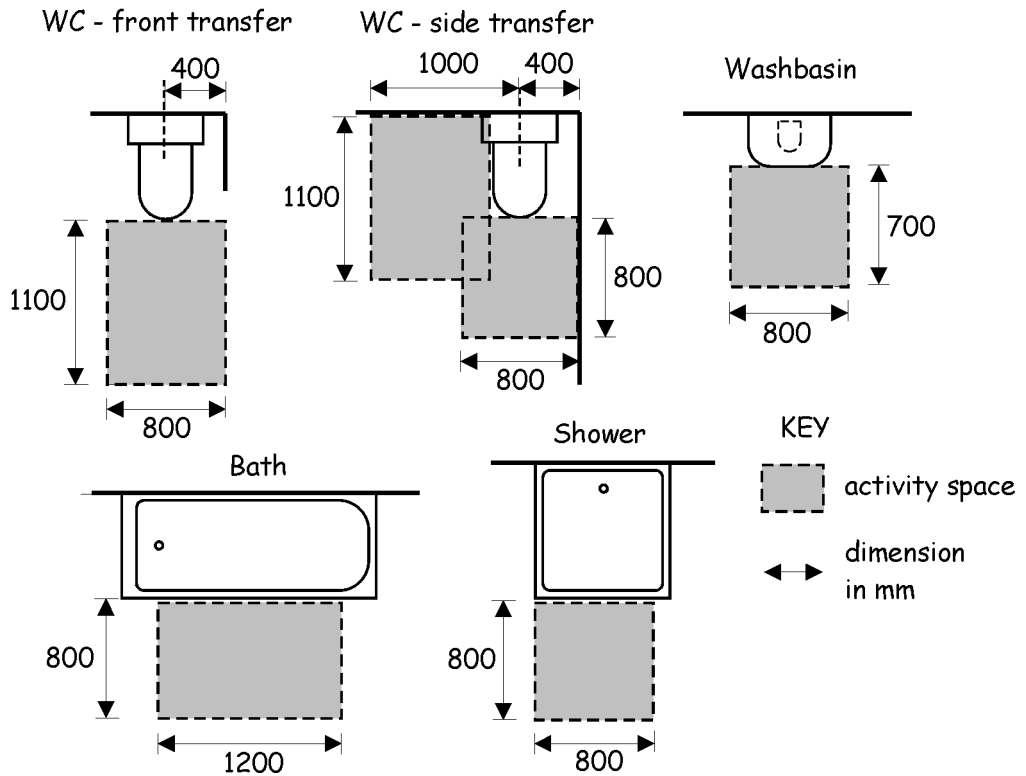
An additional accessible *toilet* may be needed on the entrance level of a *dwelling* where this is not also the principal living level (see clause 4.2.10).

Accessible *sanitary accommodation* should have:

- a manoeuvring space that will allow a person to enter and close the door behind them. This should be at least 1.1 m long by 800 mm wide, oriented in the direction of entry, and clear of any door swing or other obstruction; and
- except where reduced by projection of a wash hand basin, unobstructed access at least 800 mm wide to each *sanitary facility* ; and
- an activity space for each *sanitary facility* , as noted in the diagram below. These may overlap with each other and with the manoeuvring space noted above. A door may open over an activity space; and

- an unobstructed height above each activity space and above any bath or shower of at least 1.8 m above floor level; and
- walls adjacent to any *sanitary facility* that are of robust *construction* that will permit secure fixing of grab rails or other aids; and
- where incorporating a WC, space for at least one recognised form of unassisted transfer from a wheelchair to the WC.

Activity spaces for accessible sanitary facilities



Notes:

1. Though commonly as shown, the activity space in front of a WC need not be parallel with the axis of the WC.
2. Where allowing side transfer, a small wall-hung wash hand basin may project up to 300 mm into the activity space in front of the WC.
3. The projecting rim of a wash hand basin may reduce the width of a route to another sanitary facility to not less than 700 mm.
4. A hand-rinse basin should only be installed within a toilet and only if there is a full-size wash hand basin elsewhere in the dwelling.

Accessible bathroom

An accessible bathroom should be of a size that will accommodate a 1.7 m x 700 mm bath (or equivalent). The activity space in front of a bath may be at any position along its length. Within an accessible bathroom, it should be possible to replace the bath with an accessible shower without adversely affecting access to other *sanitary facilities*.

Accessible shower room

An accessible shower room should be of a size that will accommodate either a level-access floor shower with a drained area of not less than 1.0 m x 1.0 m (or equivalent) or a 900 mm x 900 mm shower tray (or equivalent). The drained area of a level-access floor shower may overlap with activity or manoeuvring spaces where access to other *sanitary facilities* is not across the drained area.

Alternative - space for future shower

Where a *dwelling* has a bathroom or shower room on another level, which is not en suite to a bedroom, some occupants may not require the immediate provision for bathing on the principal living level. Where this is the case, the principal living level may instead have a separate, enclosed space of a size that, alone or by incorporation with the accessible *toilet*, will permit formation of an accessible shower room (as described above) at a future date. This space can, instead, offer useful storage space.

This space should have a drainage connection, positioned to allow installation of either a floor shower or raised shower tray, sealed and terminated either immediately beneath floor level under a removable access panel or at floor level in a visible position. The structure and insulation of the floor in the area identified for a future floor shower should allow for the depth of an inset tray installation (all floors) and a 'laid to fall' installation (solid floors only). If not adjacent to an accessible *toilet* and separated by an easily demountable partition, a *duct* to the external air should be provided to allow for later installation of mechanical ventilation.

3.12.4 Access to sanitary accommodation

Where an *apartment* is intended for use solely as a bedroom, it is considered a private space. To ensure that privacy can be maintained, the only accessible *sanitary accommodation* in a *dwelling* should not be en suite, reached through such an *apartment*.

3.12.5 Alteration and extensions

Additional *sanitary facilities*

Additional *sanitary facilities* need not be provided as part of an extension to, or alteration of, a *dwelling*. However, an additional accessible *toilet* may be needed under the circumstances set out in clause 4.2.10, if one does not exist on the entrance level of a *dwelling*.

New *sanitary facilities*

If it is intended to install a new *sanitary facility* on the principal living level or entrance *storey* of a *dwelling* and there is not already an accessible *sanitary facility* of that type within the *dwelling*, the first new facility should be in accordance with the guidance given in clauses 3.12.3 and 3.12.4.

In the case of alterations within an existing *dwelling*, the new *sanitary facility* should be in accordance with guidance given in clause 3.12.3 as far as is *reasonably practicable*. This recognises that it may not always be possible, within the confines of an existing building, for accessible *sanitary facility* to be in accordance with guidance and that the provision of a facility that is usable by most occupants will still improve amenity.

Alteration of existing facilities

If altering existing *sanitary accommodation* on the principal living level or entrance *storey* of a *dwelling* which meets the guidance in clause 3.12.3 or the previous guidance for an accessible *toilet* (see below), any changes should at least maintain the level of compliance present before alterations.

Existing *sanitary accommodation* which meets the guidance in clause 3.12.3 or the previous guidance for an accessible *toilet* (see below) should only be removed or relocated where facilities at least equivalent to those removed will still be present within the *dwelling*.

Removal of existing facilities

A *sanitary facility* that is not an accessible facility may be altered or removed where the minimum provision for a *dwelling*, set out in clause 3.12.1, is maintained.

Accessibility of existing facilities

However, where activity spaces for existing *sanitary facilities* come close to meeting either the current recommendations in clause 3.12.3 or the previous guidance for an accessible *toilet*, they will still offer greater amenity to a wide range of people and should be treated in the same way as accessible *sanitary facilities* when considering altering or relocating as noted above.

The previous guidance for an accessible *toilet* sought an activity space, clear of any door swing, of 800 mm wide x 750 mm deep in front of, but not necessarily centred on, the WC. A small wall-hung wash hand basin could project into this activity space.

3.13 Heating

- 3.13 Functional standard
- 3.13.0 Introduction
- 3.13.1 Heating recommendations
- 3.13.2 Alternative heating systems

standard
3.13
mandatory

Every *building* must be designed and *constructed* in such a way that it can be heated and maintain temperatures at a level that will not endanger the health of the occupants.

Limitation:

This standard applies only to a *dwelling*

3.13.0 Introduction

Heating in a *building* is necessary to provide suitable conditions in which to live. Heating, ventilation and thermal insulation should be considered as part of a total design that takes into account all heat gains and losses. Failure to do so can lead to inadequate internal conditions, e.g. condensation and mould and the inefficient use of energy due to overheating.

Whole *house* 'central heating' is now almost universal, particularly in new *buildings* and is regarded as almost essential in combating problems such as condensation and mould growth.

Normal activities within a *dwelling* add both heat and water vapour to the air. If the heating maintains comfort levels in the whole *building* at all times, condensation problems will be minimised, but costs will be high. A reasonable compromise needs to be given to heating and ventilation to reduce the possibility of such problems and guidance is provided for both these issues in this sub-section. Section 6, Energy, provides guidance on the third issue, thermal insulation.

This guidance covers *dwelling*s only as the heating of *buildings* other than *dwelling*s is covered by the Workplace (Health, Safety and Welfare) Regulations.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

3.13.1 Heating recommendations

The layout of a *dwelling*, the size and orientation of the windows, the thermal mass, level of insulation, airtightness, and ventilation can have a significant affect on the demand for heat. The performance of a heating system will also have a major affect on energy efficiency. Section 6, Energy provides guidance on these issues

Heating a *dwelling* will normally be tailored to personal comfort taking cost into consideration. However, in addition to comfort, the heating should reflect the combined effects of occupancy pattern, ventilation provision, *building* mass and insulation to reduce the possibility of producing excess condensation that might damage the *building* fabric.

Every *dwelling* should have some form of fixed heating system, or alternative that is capable of maintaining a temperature of 21° C in at least 1 *apartment* and 18° C elsewhere, when the outside temperature is minus 1° C.

There is no need to maintain these temperatures in storage rooms with a floor area of not more than 4 m².

3.13.2 Alternative heating systems

Alternative heating systems may involve a holistic design approach to the *dwelling* and can include the use of natural sources of available energy such as the sun, wind and the geothermal capacity of the earth. Passive design, such as use of the orientation of glazing for solar gain and of the *building* mass to store heat with controlled heat release may only need minor supplementation from a lower output fixed heating system. Active heating systems, such as heat pumps that extract heat from ground, air, water or geo-thermal sources, can limit emissions of carbon dioxide and reduce the use of fossil fuels. Complementary systems can also be used, to heat water using solar energy or generate electricity using solar or wind power.

Elderly and infirm

Where there are elderly or infirm occupants in a *dwelling* the capability of the heating system to maintain an *apartment* at a temperature higher than 21° C is a sensible precaution. Since it is not possible to determine the occupants at design stage the heating system should be designed with the capability of being easily upgraded at a later date.

Upgrade

If an existing heating system is to be upgraded to provide higher temperatures the boiler size may not need to be replaced, provided it was correctly sized originally. The upgrading may necessitate the replacement of some pipes and radiator in one or two *rooms* and accessibility will need to be considered. Such modification could result in a small increase in the recovery time of the hot water supply for bathing and washing.

3.14 Ventilation

- 3.14 Functional standard
- 3.14.0 Introduction
- 3.14.1 Ventilation generally
- 3.14.2 Ventilation of dwellings
- 3.14.3 Ventilation of conservatories
- 3.14.4 Ventilation of areas designated for drying of washing
- 3.14.5 Trickle ventilators
- 3.14.6 Passive stack ventilation systems
- 3.14.7 Conservatories and extensions built over existing windows
- 3.14.8 Mechanical ventilation
- 3.14.9 Control of legionellosis
- 3.14.10 Mechanical aids to ventilation
- 3.14.11 Ventilation of garages

standard

3.14

mandatory

Every *building* must be designed and *constructed* in such a way that the air quality inside the *building* is not a threat to the health of the occupants or the capability of the *building* to resist moisture, decay or infestation.

3.14.0 Introduction

Ventilation of a *dwelling* is required to prevent the accumulation of moisture that could lead to mould growth, and pollutants, originating from within the *building* that could become a risk to the health of the occupants. Ventilation can have a significant affect on energy consumption and a thorough assessment of natural, as against mechanical ventilation, should be made, as the decision could significantly affect the energy efficiency of the *building*. (see section 6, Energy). Where natural ventilation is used, inside air quality can only be as good as outside air quality.

Ventilation should not adversely affect comfort and where necessary, designers might wish to consider security issues and protection against rain penetration when windows are partially open to provide background ventilation.

Improved insulation and ‘tighter’ *construction* of *buildings* will reduce the number of natural air changes and can increase the risk of condensation, particularly in *dwellings*. The guidance recommended for the ventilation of moisture producing areas is the minimum necessary to combat condensation but both design and workmanship will have an affect on the ventilation arrangements and the *building* as a whole.

Heat recovery units are becoming more popular for domestic use as they can maximise air quality and produce energy savings by recovering waste heat. They can be designed for whole *house* or single *room* installation.

Occupants should have the opportunity to dry washing other than by a tumble dryer which uses a considerable amount of energy. Drying of washing internally can generate large quantities of moisture that must be removed before it damages the *building*.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

3.14.1 Ventilation generally

A *dwelling* should have provision for ventilation by either:

- a. natural means; or
- b. mechanical means; or
- c. a combination of natural and mechanical means.

Ventilation should have the capability of:

- providing outside air to maintain indoor air quality sufficient for human respiration;
- removing excess water vapour from areas where it is produced in significant quantities, such as *kitchens*, utility rooms, bathrooms and shower rooms to reduce the likelihood of creating conditions that support the germination and growth of mould, harmful bacteria, pathogens and allergens;
- removing pollutants that are a hazard to health from areas where they are produced in significant quantities, such as non-*flued* combustion appliances;
- rapidly diluting pollutants and water vapour, where necessary, that are produced in *apartments* and *sanitary accommodation*.

Additional ventilation provision

This guidance relates to the provision of air for human respiration and is in addition to, and should be kept separate from, any air supply needed for the smoke ventilation of *escape routes* in the case of fire (section 2, Fire) and for the safe operation of combustion appliances (see standards 3.21 and 3.22).

Small *rooms*

There is no need to ventilate a room with a floor area of not more than 4 m². This is not intended to include a *kitchen* or utility room where ventilation should be in accordance with the recommendations in table to clause 3.14.3.

Ventilation should be to the outside air. However clauses 3.14.5 and 3.14.7 explain where ventilators and *trickle ventilators* may be installed other than to the external air.

Calculation of volume

For ventilation purposes, a *storey* should be taken as the total floor area of all floors within that *storey*, including the floor area of any *gallery* or openwork floor. Where an air change rate is recommended, the volume of the space to be ventilated may be required. The volume of any space is the internal cubic capacity of the space. Any volume more than 3 m above any floor level in that space may be disregarded.

3.14.2 Ventilation of dwellings

All *buildings* leak air to a greater or lesser extent. However, the movement of uncontrolled air (fortuitous air) through the fabric of a *building* can cause draughts and has an affect on the energy efficiency of the *building* as a whole. By improving *building* techniques it is possible to reduce fortuitous air movement to levels that can improve energy efficiency and *building* 'tighter' *buildings* assists compliance with section 6, Energy. Older *building* techniques do not provide very 'tight' *buildings* and this fortuitous air movement was taken into account in the ventilation provision. Therefore by *building* tighter there will need to be a reciprocal increase in designed ventilation openings to make up for the shortfall in fortuitous air movement. Further guidance on this is given in section 6, Energy.

Most *dwellings* are naturally ventilated and ventilation should be provided in accordance with the following table. Where the designer intends to use low fabric infiltration rates (less than 10m³/h/m²) in the SAP calculations (see

section 6) the area of *trickle ventilation* should be increased to the areas shown in column 4 of the table.

Recommended ventilation of a dwelling

| Ventilation recommendations | | Trickle ventilation >10m ³ /h/m ² | Trickle ventilation <10m ³ /h/m ² |
|---|--|--|--|
| <i>Apartment</i> | A <i>ventilator</i> with an opening area of at least 1/30 th of the floor area it serves | 8000 mm ² | 12000 mm ² |
| <i>Kitchen</i> | either: a. mechanical extraction capable of at least 30 l/sec (intermittent) above a hob [4]; or b. mechanical extraction capable of at least 60 l/sec (intermittent) if elsewhere [4]; or c. a passive stack ventilation system [5]. | 4000 mm ² | 10000 mm ² |
| <i>Utility room</i> | either: a. mechanical extraction capable of at least 30 l/sec (intermittent) above a hob [4]; or b. a passive stack ventilation system [5]. | 4000 mm ² | 10000 mm ² |
| <i>Bathroom or shower-room (with or without a WC)</i> | either: a. mechanical extraction capable of at least 15 l/sec (intermittent); or b. a passive stack ventilation system [5]. | 4000 mm ² | 10000 mm ² |
| <i>Toilet</i> | either: a. a <i>ventilator</i> with an opening area of at least 1/30 th of the floor area it serves; or b. mechanical extraction capable of at least 3 air changes per hour. | 4000 mm ² | 10000 mm ² |

Notes:

1. The trickle ventilation rates recommended relate to the infiltration rate of the building fabric which can be used in SAP calculations in section 6.
2. Where the trickle ventilator is ducted, the recommended areas in the table should be doubled. (see clause 3.14.5)
3. The overall provision of *trickle ventilation* in a *dwelling* may be provided at an average of 6000 mm² per *room*, with a minimum provision of 4000 mm² in each *apartment*. Where an infiltration rate of less than 10 m³/h/m² is used for design purposes the average area of *trickle ventilation* should be 11000 mm² per *room* with a minimum of 10000 mm² for each *apartment*.
4. Refer to guidance to standard 3.17 and OFTEC Technical Information Sheet [TI/112](#) where an extract fan is fitted in a building containing an open-*flued* combustion appliance. Extract rates should be reduced.

5. Refer to section 2: Fire where a passive stack ventilation system is installed in a *building* containing *flats* and *maisonettes*.
6. Long *duct* runs, flexible ducting and bends can seriously reduce fan performance and should be carefully considered during design.

Height of ventilator

To reduce the effects of stratification of the air in a *room*, some part of the opening *ventilator* should be at least 1.75 m above floor level.

3.14.3 Ventilation of conservatories

With large areas of *glazing*, *conservatories* attract large amounts of the sun's radiation that can create unacceptable heat build-up. Efficient ventilation therefore is very important to ensure a comfortable environment. A *conservatory* should have a *ventilator* or *ventilators* with an opening area of at least 1/5th of the floor area it serves. Although this is the minimum recommended area a greater area can provide more comfortable conditions particularly in sunny weather.

Notwithstanding the recommended opening height of 1.75 m for *ventilators*, roof *ventilators* are best placed to reduce stratification. It is recommended therefore that at least 30% of the *ventilator* area provision is located on the roof or at as high a level as possible to minimise the effects of heat build-up.

3.14.4 Ventilation of areas designated for drying of washing

Where clothes are dried naturally indoors large quantities of moisture can be released and this will need to be removed before it can damage the *building*. Normally a utility room or bathroom is used and mechanical extract is the usual method of removing moisture. Where a space other than a utility room or bathroom is designated, that space should be provided with either:

- mechanical extraction capable of at least 15 l/s intermittent operation. The fan should be connected through a humidistat set to activate when the relative humidity is between 50 and 65%; or
- a passive stack ventilation system provided in accordance with the recommendations in clause 3.14.6.

Guidance to standard 3.11 gives information on the space recommended for the drying of washing.

3.14.5 Trickle ventilators

A *trickle ventilator*, sometimes called background ventilation, is a small ventilation opening, mostly provided in the head of a window frame, but not always, and is normally provided with a controllable shutter. They should be provided in naturally ventilated areas to allow fine control of air movement. The area recommendations in the table to clause 3.14.2 may, in some situations, be difficult to achieve in the window frame and other options may need to be considered. A *permanent ventilator* is not recommended since occupants like control over their environment and uncontrollable ventilators are usually permanently sealed up to prevent draughts.

Because *dwellings* produce so many variables and differing life styles, ventilation of such *buildings* is not an exact science. The recommended areas in the table to clause 3.14.2 therefore are based on the geometric method (actual size of the opening formed in the window frame, in the case of a slot vent) as being a simple method that will satisfy most conditions.

Where the *trickle ventilator* has to be ducted, e.g. to an internal *room*, the geometric area of the trickle ventilator should be increased to double that shown in the table to clause 3.14.2, to compensate for the reduced air flow caused by friction. This may over-provide ventilation in some cases but can be regulated by the fine control.

Non-proprietary *trickle ventilators*

Fitting proprietary *trickle ventilators* is the preferred method of fine tuning *room* ventilation. However, in some cases it may be acceptable for background ventilation to be provided through small windows, such as top hoppers, but other issues need to be considered if this method is to be adopted:

- A partially open window on a night latch is a possible point of forced entry to a *dwelling* even when the window is locked in position and because of this it is less likely to be left open at night or when the *dwelling* is empty, even for short periods. Small, upper floor windows in a well lit, open location that are difficult to access may be appropriate;
- It tends to be windier where *flats* and *maisonettes* are at high level and windows on night latches do not have fine adjustment to reduce draughts. They are therefore more likely to be kept closed;
- Manufacturers will need to show that the opening area when on the night latch is to the recommended sizes in the table to clause 3.14.2;
- Some windows might be too small to incorporate the recommended size of *trickle ventilator* in the frame and careful thought will need to be given to the design and location of *trickle ventilators* in the window itself or additional *trickle ventilators* through the *external wall*;
- *Trickle ventilators* supply replacement air for mechanical extract and passive stack ventilation systems and routes for extracting air provided by mechanical input air systems. It is recommended that proprietary *trickle ventilators* are used in *rooms* where such systems are installed since it is more likely that they, rather than windows, will be left open.

Height of *trickle ventilators*

A *trickle ventilator* should be so positioned that a part of it is at least 1.75 m above floor level. This will allow at least some movement of air within the *dwelling* and reduce stratification.

Although ventilation should normally be to the external air, a *trickle ventilator* serving a bathroom or shower room may open into an area that does not generate moisture, such as a bedroom or hallway, provided the area is fitted with a *trickle ventilator* in accordance with the guidance in clause 3.14.2.

A *trickle ventilator* should be provided in an area fitted with mechanical extraction to provide replacement air and ensure efficient operation when doors are closed. This will prevent moist air being pulled from other 'wet areas'. The *trickle ventilator* should be independent of the mechanical extract so that replacement air can be provided when the extract fan is operating. Consideration should be given to the location of the *ventilator* and the fan so as to prevent short-circuiting of the air.

3.14.6 Passive stack ventilation systems

A passive stack ventilation system uses a *duct* running from a ceiling (normally in a *kitchen* or shower room) to a terminal on the roof to remove any moisture-laden air. It operates by a combination of natural stack effect, i.e. the movement of air due to the difference in temperature between inside and outside temperatures and the effect of wind passing over the roof of the *building*.

A passive stack ventilation system should be installed in full compliance with BRE Information Paper BRE IP 13/94. These systems are most suited for use in a *building* with a height of not more than 4 *storeys* (about 8 m maximum length of stack) as the stack effect will diminish as the air cools.

Every passive stack ventilation system should:

- a. incorporate a ceiling mounted automatic humidity sensitive extract grille that will operate when the relative humidity is between 50 and 65%; and
- b. be insulated with at least 25 mm thick material having a thermal conductivity of 0.04 W/mK where it passes through a *roof space* or other unheated space or where it extends above the roof level. This will prevent the walls of the *duct* from becoming too cold thus inhibiting the stack effect and reducing the likelihood of condensation forming inside the duct.

The *flue* of an open-*flued* combustion appliance may serve as a passive stack ventilation system provided that either:

- a. the appliance is a solid fuel appliance and is the primary source of heating, cooking or hot water production; or
- b. the *flue* has an unobstructed area equivalent to a 125 mm diameter *duct* and the appliance's combustion air inlet and dilution air inlet are permanently open, i.e. there is a path with no control dampers which could block the flow, or the ventilation path can be left open when the appliance is not in use; or
- c. the appliance is an oil firing appliance which is a continually burning vapourising appliance (only) such as a cooker or room heater and the *room* is fitted with a ventilator with a minimum free area of 10000 mm².

Non-combustibility

A *duct* or casing forming a passive stack ventilation system serving a *kitchen* should be *non-combustible*. However this is not necessary where it passes through a *roof space*.

3.14.7 Conservatories and extensions built over existing windows

Constructing a *conservatory* or extension over an existing window, or *ventilator*, will effectively result in an internal room, restrict air movement and could significantly reduce natural ventilation to that *room*. Reference should be made to clause 3.16.2 relating to natural lighting, and to the guidance to standards 3.21 and 3.22 on the ventilation of combustion appliances, as this also may be relevant. There are other recommendations in section 2: Fire relating to escape from *inner rooms*.

Conservatories

A *conservatory* may be *constructed* over a *ventilator* serving a *room* in a *dwelling* provided that the ventilation of the *conservatory* is to the outside air and has an opening area of at least 1/30th of the total combined floor area of the internal *room* so formed and the *conservatory*. The *ventilator* to the internal *room* should have an opening area of at least 1/30th of the floor area of the *room*. *Trickle ventilators* should also be provided relevant to the overall areas created.

Extensions

An extension may also be built over a *ventilator* but a new *ventilator* should be provided to the *room*. Where this is not practicable, e.g. where there is no *external wall*, the new extension should be treated as part of the existing *room* rather than the creation of a separate internal *room* because the extension will be more airtight than a *conservatory* and therefore the rate of air change will be compromised. The opening area between the 2 parts of the *room* should be not less than 1/15th of the total combined area of the existing *room* and the extension.

Moisture-producing areas

If the *conservatory* or extension is *constructed* over an area that generates moisture, such as a *kitchen*, bathroom, shower room or utility room, mechanical extract, via a *duct* if necessary, or a passive stack ventilation system should be provided direct to the outside air. Any existing system disadvantaged by the *work* may require to be altered to ensure supply and extracted air is still to the outside air.

3.14.8 Mechanical ventilation

Where a *dwelling* is mechanically ventilated it should be provided in accordance with the recommendations of Section 3, Requirements of [CIBSE Guide B2: 2001, Ventilation and air conditioning](#).

Mechanical ventilation provided in line with this guidance should be to the outside air but it may be via a *duct* or heat exchanger.

Where a mechanical ventilation system serves more than 1 *dwelling* it should have a duplicate motor and be separate from any other ventilation system installed for any other purpose. Where the mechanical ventilation system gathers extracts into a common *duct* for discharge to an outlet, no connections to the system should be made between any exhaust fan and the outlet. The use of non-return valves is not recommended.

Open-flued appliances

Care should be taken when installing mechanical extract systems where there is an open-flued combustion appliance in the *dwelling*. Further guidance is provided in clause 3.17.8.

3.14.9 Control of legionellosis

An inlet to, and an outlet from, a mechanical ventilation system should be installed such that their positioning avoids the contamination of the air supply to the system. The system should be *constructed* and installed in accordance with the recommendations in [Legionnaires' Disease: The control of legionella bacteria in water systems – approved code of practice and guidance - HSE L8](#), in order to ensure, as far as is *reasonably practicable*, the avoidance of contamination by legionella.

3.14.10 Mechanical aids to ventilation

A mechanical ventilation system should be designed, installed and commissioned to perform in a way that is not detrimental to the health of the occupants of the building and when necessary, is easily accessible for regular maintenance. Very few *dwellings* are air-conditioned but the use of continuously operated balanced supply and extract mechanical ventilation systems, or heat recovery units, are becoming more popular as a result of the government's initiative to energy conservation and the reduction in the production of harmful greenhouse gases such as carbon dioxide. As *buildings* are *constructed* ever more tightly, effective ventilation is needed to provide a healthy living environment.

Simpler and more efficient systems are steadily being introduced that augment, complement and/or improve the natural ventilation of *dwellings*. The following is a list of acceptable mechanical systems that will aid ventilation in a *dwelling*:

- a. continuously operating balanced supply and extract mechanical ventilation (with or without heat recovery) installed in accordance with the guidance in [BRE Digest 398](#). In hot weather windows can be opened to cool the *dwelling* while the system is operating. Openable windows may also be needed for fire escape purposes;

| | |
|-----------------------|---|
| | <p>b. continuously operating mechanical extract ventilation installed in accordance with the guidance in BRE Digest 398;</p> <p>c. mechanical extract ventilation units (extract fans), either window or wall mounted, in <i>rooms</i> where there is likely to be high humidity such as <i>kitchens</i>, bathrooms and shower rooms installed in accordance with the recommendations in clause 3.14.2. Fans can be switched manually or automatically via a humidistat control. Humidistat control is not recommended for <i>rooms</i> containing a watercloset as odours may not be removed;</p> |
| Positive input air | <p>d. Mechanical input air ventilation systems have been successfully installed in existing <i> dwellings</i> with the objective of overcoming problems of surface condensation and mould growth. They can also improve air quality and remove musty odours. The general principle of <i>building</i> tighter to reduce the amount of uncontrolled air movement through the <i>building</i> fabric may have a detrimental effect on the operation of input air ventilation systems and therefore they may not be appropriate for installation in new <i> dwellings</i>. Further information should be obtained from the product manufacturer.</p> |
| <i>Houses</i> | <ul style="list-style-type: none"> • In <i>houses</i> air is supplied to the hall via a low speed fan unit located in the <i>roof space</i> where it is allowed to circulate throughout the <i>house</i> before being extracted to the outside normally through the <i>building</i> fabric or <i>trickle ventilators</i>. |
| <i>Flats</i> | <ul style="list-style-type: none"> • In <i>flats</i> and <i>maisonettes</i> the air is drawn direct from the outside through the fan unit before being discharged into the <i>dwelling</i>. The air supplied will normally have a lower relative humidity than the air in the <i>dwelling</i> thus removing harmful surface condensation and eliminating mould growth. |
| Product certification | <ul style="list-style-type: none"> • Where an input air ventilation system is proposed it should be installed in accordance with the conditions of certification by a <i> notified body</i>. |

3.14.11 Ventilation of garages

The principal reason for ventilating garages is to protect the *building* users from the harmful effects of toxic emissions from vehicle exhausts. Where a garage is attached to a *dwelling*, the separating *construction* should be as air tight as possible. Where there is a communicating door airtight seals should be provided or a lobby arrangement may be appropriate.

| | |
|-----------------------|---|
| Large garages | Few domestic garages over 60 m ² in area are <i>constructed</i> but guidance on such structures is provided in the non-domestic Technical Handbook. |
| Small garages | Garages of less than 30 m ² do not require the ventilation to be designed. It is expected that a degree of fortuitous ventilation is created by the imperfect fit of 'up and over' doors or pass doors. With such garages, it is inadvisable for designers to attempt to achieve an airtight construction. |
| Open-flued appliances | Although not considered good practice, open-flued combustion appliances are installed in garages. Ventilation should be provided in accordance with the guidance to standards 3.21 and 3.22. |
| Natural ventilation | <p>A garage with a floor area of at least 30 m² but not more than 60 m² used for the parking of motor vehicles should have provision for natural or mechanical ventilation. Ventilation should be provided in accordance with the following guidance:</p> <p>a. where the garage is naturally ventilated, by providing at least 2 <i>permanent ventilators</i>, each with an open area of at least 1/3000th of the floor area they serve, positioned to encourage through ventilation with one of the <i>permanent ventilators</i> being not more than 600 mm above floor level, or</p> |

- Mechanical ventilation
- b. where the garage is mechanically ventilated, by providing a system:
 - capable of continuous operation, designed to provide at least 2 air changes per hour; and
 - independent of any other ventilation system; and
 - *constructed* so that two-thirds of the exhaust air is extracted from outlets not more than 600 mm above floor level.

3.15 Condensation

- 3.15 Functional standard
- 3.15.0 Introduction
- 3.15.1 Condensation
- 3.15.2 Control of humidity
- 3.15.3 Control of condensation in roofs
- 3.15.4 Surface condensation – thermal bridging
- 3.15.5 Interstitial condensation
- 3.15.6 Roof constructions (flat)
- 3.15.7 Roof constructions (pitched)

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|--|--|
| <p style="text-align: center;">standard</p> <h1 style="text-align: center;">3.15</h1> <p style="text-align: center;">mandatory</p> | <p>Every <i>building</i> must be designed and <i>constructed</i> in such a way that there will not be a threat to the <i>building</i> or the health of the occupants as a result of moisture caused by surface or interstitial condensation.</p> <p>Limitation: This standard applies only to a <i>dwelling</i>.</p> |
|--|--|

3.15.0 Introduction

Condensation can occur in *dwelling*s when water vapour, usually produced by the occupants and their activities, condenses on exposed *building* surfaces (surface condensation) where it supports mould growth, or within *building* elements (interstitial condensation). Condensation and mould problems are widespread, affecting about 15% of homes in the UK.

The occurrence of condensation is governed by complex interrelationships between heating, ventilation, moisture production, *building* layout and properties of materials. Condensation need not always be a problem, for example it regularly occurs on the inner surface of the outer leaf of a cavity wall which receives very much more water from driving rain. However excess condensation can damage the *building* fabric and contents and the dampness associated with mould growth can be a major cause of respiratory allergies. For this reason the control of condensation is an important consideration in *building* design and *construction*.

Climate change

It has been predicted that climate change may exacerbate problems of condensation in *buildings* due to higher relative humidity. Higher winter temperatures combined with increased vapour pressures could result in more severe problems, particularly in *roof spaces*. Very careful consideration of the issues is essential and the correct detailing will therefore be critical.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard in so far as is *reasonably practicable*, and in no case be worse than before the *conversion*. (regulation 12, schedule 6).

3.15.1 Condensation

A *dwelling* should be *constructed* to reduce the risk of both interstitial and surface condensation in order to prevent damage to the fabric and harmful effects on the health of people using the *dwelling*. The guidance given in BS 5250: 2002 'Code of Practice for the control of condensation in buildings' is helpful in preventing both interstitial and surface condensation.

3.15.2 Control of humidity

If the average relative humidity within a *room* stays at or above 70% for a long period of time, the localised relative humidity at *external wall* surfaces will be higher and is likely to support the germination and growth of moulds.

The fundamental principle of designing to control humidity is to maintain a balance between, the thermal and vapour properties of the structure, heat input and ventilation rate. The thermal and vapour properties of the structure are covered in standard 3.15 and heat input in section 6, Energy.

The *kitchen*, bathroom and utility are the 3 areas in a *dwelling* where most moisture is generated. Control of this moisture can be by active or passive means. Guidance to standard 3.14 provides various methods of controlling humidity in high humidity areas.

3.15.3 Control of condensation in roofs

Section 8.4 of BS 5250: 2002 provides guidance on the control of condensation in the principal forms of roof *construction*. Clause 8.4.1 of BS 5250 lists various issues that should be considered in the design of roofs to reduce the possibility of excess condensation forming that might damage the *building* and endanger the health of the occupants. However cold, level deck roofs should be avoided because interstitial condensation is likely and its effect on the structure and insulation can be severe and many instances of failure in such systems have been recorded. It is considered that more reliable forms of *construction* are available. Both the warm deck and warm deck inverted roof *constructions*, where the insulation is placed above the roof deck, are considered preferable. However fully supported metal roof finishes including aluminium, copper, lead stainless steel and zinc are regularly used in *conversion work*, and they should have a ventilated airspace on the cold side of the insulation in addition to a high performance vapour control layer near the inner surface. Further information may be obtained from the relevant metal associations.

Fully supported metal roofs

3.15.4 Surface condensation – thermal bridging

Thermal bridging occurs when the continuity of the *building* fabric is broken by the penetration of an element allowing a significantly higher heat loss than its surroundings. These 'bridges' commonly occur around openings such as lintels, jambs and sills and at wall/roof junctions, wall/floor junctions and where internal walls penetrate the outer fabric. Thermal bridges provide a ready passage of heat transfer to the outside air and allow a heat flow entirely disproportionate to their surface area resulting in excessive heat losses. Condensation may occur on the inner surfaces that can damage the *dwelling* or threaten the health of the occupants.

To minimise the risk of condensation on any inner surface, cold bridging at a floor, wall, roof or other *building* element should be avoided. Detailing should be in accordance with the recommendations in Section 8 of BS 5250: 2002.

Also, to maintain an adequate internal surface temperature and thus minimise the risk of surface condensation, it is recommended that the thermal transmittance (*U-value*) of any part and at any point of the external fabric does not exceed $1.2 \text{ W/m}^2\text{K}$.

BR 262

Further guidance on acceptable thermal insulation may be obtained from BRE Report, BR 262, Thermal insulation: avoiding risks.

3.15.5 Interstitial condensation

A floor, wall, roof or other *building* element should minimise the risk of interstitial condensation in any part of a *dwelling* that it could damage. Walls, roofs and floors should be assessed and/or *constructed* in accordance with Section 8 and Annex D of BS 5250: 2002.

3.15.6 Roof constructions (flat)

Cold deck roofs

For the control of condensation in roofs, including cold deck roofs, BS 5250: 2002 provides guidance on the principal forms of *construction*. There is evidence that suggests that condensation in cold deck *flat roofs* is a problem. They should be avoided therefore because interstitial condensation is likely and its effect on the structure and insulation can be severe. Many instances of failure in such systems have been recorded and it is considered that more reliable forms of *construction* are available. However fully supported metal roof finishes including aluminium, copper, lead stainless steel and zinc are regularly used in *conversion work*, and they should have a ventilated airspace on the cold side of the insulation in addition to a high performance vapour control layer near the inner surface. Further information may be obtained from the relevant metal associations.

Warm deck roofs

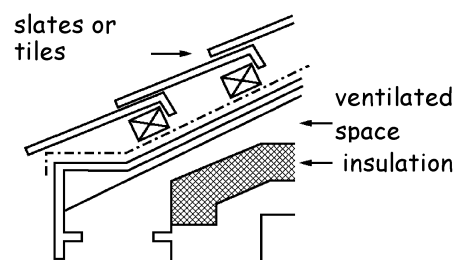
Both the warm deck and warm deck inverted roof *constructions*, where the insulation is placed above the roof deck, are considered preferable.

3.15.7 Roof constructions (pitched)

Ventilation is vital for preventing excessive build-up of condensation in cold, pitched *roof spaces*. Where the insulation is at ceiling level the *roof space* should be cross ventilated. Special care should be taken with ventilation where ceilings following the roof pitch. The recommendations in BS 5250: 2002 should be followed.

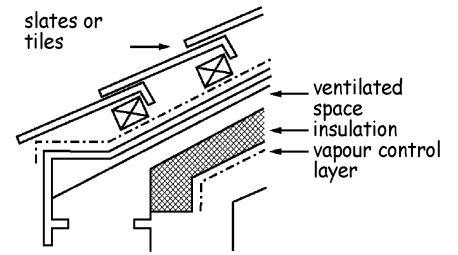
Roof type A
insulation on a level
ceiling

Pitched roof structure of timber or metal framed *construction*. External weatherproof covering of slates or tiles on under slating felt with or without boards or battens. Insulation laid on a level ceiling with a ventilated space between the insulation and the roof structure.



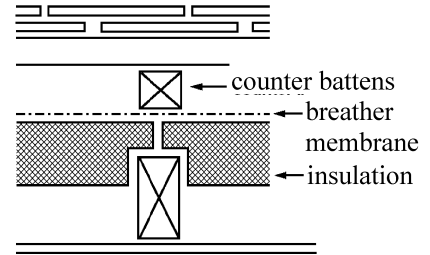
Roof type B
insulation on a sloping
ceiling

Pitched roof structure as A. above. External weatherproof covering as A. Insulation and vapour control layer laid on a sloping ceiling, with a ventilated air space 50 mm in depth between the insulation and the boards of the pitched roof covering.



Roof type C
insulation on decking

Pitched roof structure as A. above with a decking of low permeability insulation fitted to and between the roof framing. External weatherproof covering of slates or tiles, with tiling battens and counter battens (located over roof framing), and a breather membrane laid on the insulation decking; with a sloping ceiling.



3.16 Natural lighting

- 3.16 Functional standard
- 3.16.0 Introduction
- 3.16.1 Natural lighting provision
- 3.16.2 Conservatories
- 3.16.3 Extensions

standard

3.16

mandatory

Every *building* must be designed and *constructed* in such a way that natural lighting is provided to ensure that the health of the occupants is not threatened.

Limitation:

This standard applies only to a *dwelling*.

3.16.0 Introduction

The purpose of this standard is primarily to ensure that an adequate standard of day lighting is attained in habitable *rooms* in *dwellings* to allow domestic activities to be carried out conveniently and safely. A *kitchen* or *toilet* is not deemed to be a habitable *room* in terms of the building regulations.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* must be improved to as close to the requirement of that standard as is *reasonably practicable*, and in no case worse than before the *conversion* (regulation 12, schedule 6).

3.16.1 Natural lighting provision

Every *apartment* should have a translucent *glazed* opening, or openings, of an aggregate *glazed* area equal to at least 1/15th of the floor area of the *apartment* and located in an *external wall* or roof or in a wall between the *apartment* and a *conservatory*.

3.16.2 Conservatories

A *conservatory* may be *constructed* over a translucent *glazed* opening to a *room* in a *dwelling* provided that the area of the *glazed* opening of the internal *room* so formed is at least 1/15th of the floor area of the internal *room*. There are other recommendations relating to ventilation in clause 3.14.7 and the size of windows in section 6, Energy.

3.16.3 Extensions

An extension however, *constructed* over a glazed opening to a *room*, because of its greater solidity, can seriously restrict daylight from entering the *dwelling* and the existing *room* and extension should be treated a single *room*. The area of the translucent glazed opening to the extension should be at least 1/15th of the combined floor area of the existing *room* and the extension. A new translucent *glazed* opening should be provided to the existing *room* but, where this is not practicable, the wall separating the 2 *rooms* should be opened up to provide a single space. To ensure sufficient 'borrowed light' is provided, the opening area between the existing *room* and the extension should be not less than 1/10th of the total combined area of the existing *room* and the extension. Clause 3.14.7, covering ventilation, also recommends that the existing *room* and extension are treated as a single space.

3.17 Combustion appliances – safe operation

- 3.17 Functional standard
- 3.17.0 Introduction
- 3.17.1 Combustion appliance installations generally
- 3.17.2 Large combustion appliance installations
- 3.17.3 Small combustion appliance installations
- 3.17.4 Solid fuel appliance installations
- 3.17.5 Oil-firing appliance installations
- 3.17.6 Gas-fired appliance installations
- 3.17.7 Labelling
- 3.17.8 Extract fans

standard

3.17

mandatory

Every *building* must be designed and *constructed* in such a way that each fixed combustion appliance installation operates safely.

3.17.0 Introduction

The guidance to this standard covers general issues and should be read in conjunction with standards 3.18 to 3.22 that are intended to reduce the risk from combustion appliances and their *flues* from:

- endangering the health and safety of persons in or around a *building*;
- compromising the structural stability of a *building*;
- causing damage by fire.

The incorrect installation of a heating appliance or design and installation of a *flue* can result in situations leading directly to the dangers noted above.

The installation of mechanical extract fans is not in itself dangerous but guidance on their use has been included under this standard as their use with open-*flued* appliances can cause problems. Extract fans lower the pressure in a *building* and this can cause the spillage of combustion products from open-*flued* appliances. This can occur even if the appliance and the fan are in different rooms. Combustion appliances therefore should be capable of operating safely whether or not any fan is running.

There is other legislation that relates to gas fittings, appliances, installations and their maintenance and to the competency of persons who undertake such work. See clause 3.17.6.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

3.17.1 Combustion appliance installations generally

This guidance has been prepared mainly with domestic sized installations in mind, such as those comprising space and water heating or cooking facilities, including their *flues*. The guidance also includes *flueless* appliances such as gas cookers.

The guidance to standards 3.17 to 3.22 therefore applies to solid fuel appliances with an output rating not more than 50 kW, oil-firing appliances with an output rating not more than 45 kW and gas-fired appliances with a *net input rating* not more than 70 kW.

3.17.2 Large combustion appliance installations

It is expected that specialists will design non-domestic sized combustion appliance installations in accordance with general standards provided in the Practice Standards produced by the British Standards Institution (BS EN or BS) and the [Institution of Gas Engineers](#) or the Design Guide produced by the [Chartered Institution of Building Service Engineers](#) (CIBSE). A few large *dwellings* may require such installations.

The following guidance therefore, may not be relevant to solid fuel appliances with an output rating more than 50 kW, oil-firing appliances with an output rating more than 45 kW and gas-fired appliances with a *net input rating* more than 70 kW.

3.17.3 Small combustion appliance installations

An installation is only as good as its weakest part and it is necessary to ensure that the entire installation is safely *constructed* and installed.

Where a combustion appliance installation is intended to operate with more than one type of fuel, for example a gas appliance as a stand-by to a solid fuel appliance, each component should be *constructed* and installed to meet the most onerous requirement of the relevant fuel.

3.17.4 Solid fuel appliance installations

www.hetas.co.uk

The Heating Equipment Testing and Approval Scheme (HETAS) is an independent organisation for setting standards of safety, efficiency and performance for testing and approval of solid fuels, solid mineral fuel and wood burning appliances and associated equipment and services for the UK solid fuel domestic heating industry. It operates a registration scheme for competent Engineers and Companies working in the domestic solid fuel market. The [Official Guide to Approved Solid Fuel Products and Services](#) published by HETAS Ltd contains a list of Registered Heating Engineers deemed competent in the various modules listed, e.g. for the installation, inspection and maintenance of solid fuel appliances.

There are other organisations representing the solid fuel industry but neither they nor HETAS have a mandatory status.

Solid fuel appliance installations should be *constructed* and installed carefully to ensure that the entire installation operates safely. Installations should be *constructed* and installed in accordance with the requirements of BS 8303: Parts 1 to 3: 1994.

Appliances should be fit for purpose and for the type of fuel burnt. They should be selected from the 'Official Guide to Approved Solid Fuel Products and Services' published by HETAS, and *constructed* and installed in accordance with the guidance provided in BS 8303: Parts 1 to 3: 1994.

www.oftec.org.uk

3.17.5 Oil-firing appliance installations

The Oil Firing Technical Association (OFTEC) sets equipment standards, installation practice and technician competence within the oil-firing industry. It publishes technical guidance, operates a registration scheme for competent technicians and companies and an equipment testing and approval scheme. OFTEC schemes and technical advice only have mandatory status when specifically referred to in legislation.

Oil-firing appliances should be *constructed*, installed, commissioned and serviced carefully to ensure that the entire installation operates safely. Oil firing equipment should be suitable for its purpose and the class of oil used in the installation. Oil-firing equipment should comply with the relevant OFTEC standard and should be installed in accordance with the recommendations in BS 5410: Parts 1 and 2.

Fire valves

Fire valves should be fitted so as to cut off the supply of oil remotely from the combustion appliance in the event of a fire starting in or around the appliance. The valve should be located externally to the *dwelling*. The valve should be fitted in accordance with the recommendations in Section 8.3 of BS 5410: Part 1: 1997 and OFTEC Technical Information Sheet [TI/138](#).

3.17.6 Gas-fired appliance installations

The Gas Safety
(Installations & Use)
Regulations 1998

www.corgi-gas.com

www.hse.gov.uk

In addition to the functional standards, gas-fired appliance installations must also comply with the Gas Safety (Installation and Use) Regulations 1998. These regulations require that, amongst others, gas-fired installations are installed by a competent person. Guidance on the individual competency required is given in the Health and Safety Commission's Approved Code of Practice '[Standards of Training in Safe Gas Installations](#)'. The Council for Registered Gas Installers (CORGI) operates a registration scheme for gas businesses and individual gas operatives to ensure that they carry out their *work* in a competent manner. It is the only scheme recognised by the Health and Safety Executive (HSE) that complies with the Gas Safety (Installation and Use) Regulations 1998.

The Gas Safety (Installations and Use) Regulations 1998 regulates gas installations while the Gas Appliance (Safety) Regulations 1995 address the product safety of appliances.

3.17.7 Labelling

Where a hearth, fireplace (including a *flue* box), or system *chimney* is provided, extended or altered, information essential to the correct application and use of these facilities should be permanently posted in the *dwelling* to alert future workmen to the specification of the installed system. This also applies to cases where a *flue* liner is provided as part of refurbishment *work*.

The labels should be indelibly marked and contain the following information:

- a. the location of the hearth, fireplace (or *flue* box) or the location of the beginning of the *flue*;
- b. a *chimney* designation string in accordance with BS EN 1443: 2003 (see clause 3.18.2) for products whose performance characteristics have been assessed in accordance with a European Standard and that has been supplied and marked with a designation as described in the relevant European Standard;
- c. the category of the *flue* and generic types of appliance that can safely be accommodated;

- d. the type and size of the *flue* (or its liner);
- e. the installation date.

Labels should be located in a position that will not easily be obscured such as adjacent to:

- the gas or electricity meter; or
- the water supply stopcock; or
- the *chimney* or hearth described.

A label, should be provided similar to the example below:

| IMPORTANT SAFETY INFORMATION This label must not be removed or covered | |
|---|--|
| Property address | <i>20 Main Street New Town</i> |
| The fireplace opening located in the..... Is at the base of a chimney with a designation string... | <i>name of room designation string</i> |
| and, for example, is suitable for a | <i>dfe gas fire</i> |
| Chimney liner | <i>xx mm diameter</i> |
| Installed on | <i>date</i> |
| Any other information (optional)..... | |

3.17.8 Extract fans

Extract fans lower the pressure in a *dwelling* and may cause the spillage of combustion products from open-*flued* appliances. This can occur even if the appliance and the fan are in different *rooms*. Ceiling fans produce currents and hence local depressurisation that can also cause the spillage of *flue* gases. The presence of some fans may be obvious, such as those on view in *kitchens*, but others may be less obvious. Fans installed in appliances such as tumble dryers or other open-*flued* combustion appliances can also contribute to depressurisation. Fans may also be provided to draw radon gas out of the under *building*.

In *dwellings* where it is intended to install open-*flued* combustion appliances and extract fans, the combustion appliances should be able to operate safely whether or not the fans are running.

The installation of extract fans should be in accordance with the guidance below, and should be tested to show that combustion appliances operate safely whether or not fans are running:

Solid fuel appliances

- a. for solid fuel appliances, extract ventilation should not generally be installed in the same *room* or alternatively seek further guidance from HETAS. However, in certain cases, such as large *rooms* where there is free flowing replacement air, a fan may be fitted provided a satisfactory spillage test is carried out in accordance with BRE Paper [IP 7/94](#);

Oil-firing appliances

- b. for oil-firing appliances, limit fan capacities as described in OFTEC Technical Information Sheet [TI/112](#) and then carry out *flue* draught interference tests as described in TI/112 or BS 5410: Part 1: 1997;

Gas-fired appliances

- c. for a gas-fired appliance, where a *kitchen* contains an open-*flued* appliance, the extract rate of the fan should not exceed 20 litres/second. To check for safe operation of the appliance(s) the recommendations in clause 5.3.2.3 of BS 5440: Part 1: 2000 should be followed.

3.18 Combustion appliances – protection from combustion products

- 3.18 Functional standard
- 3.18.0 Introduction
- 3.18.1 Chimneys generally
- 3.18.2 Chimney designations
- 3.18.3 Masonry chimneys
- 3.18.4 Metal chimneys
- 3.18.5 Flue-pipes
- 3.18.6 Flue liners

standard
3.18
 mandatory

Every *building* must be designed and *constructed* in such a way that any component part of each fixed combustion appliance installation used for the removal of combustion gases will withstand heat generated as a result of its operation without any structural change that would impair the stability or performance of the installation.

3.18.0 Introduction

The fire service attends many calls to *chimney* fires and other fires where a *chimney* defect has allowed fire spread into a *building*. Whilst the guidance to this standard cannot prevent fires, the structural precautions recommended help to limit the damage to *flues* and thus prevent fire from spreading into the *building*.

It is essential that *flues* continue to function effectively when in use without allowing the products of combustion to enter the *building*. *Chimneys* and *flue-pipes* are now tested to harmonised European standards to establish their characteristics relative to safe operation.

Very low *flue*-gas temperatures are achieved by modern, high efficiency appliances, particularly during night conditions, thus causing condensation. Materials need to withstand these aggressive situations.

Explanation of terms

The following terms are included to provide clarity to their meaning in this Technical Handbook.

Chimney – a structure enclosing 1 or more *flues* , but not a *flue-pipe* , and including any openings for the accommodation of a combustion appliance, but does not include a *chimney* terminal;

Custom-built chimney – *chimney* that is installed or *built* on-site using a combination of compatible *chimney* components that may be from 1 or different sources;

Double-walled chimney – *chimney* consisting of a *flue* liner and an outer wall;

Factory-made chimney – see system *chimneys*;

Flue – passage for conveying the products of combustion to the outside atmosphere;

Flue-block – factory-made *chimney* components with 1 or more *flues* ;

Flue liner – wall of a *chimney* consisting of components the surface of which is in contact with products of combustion;

Flue-pipe – (correctly termed ‘connecting *flue-pipe*’) is a pipe, either single walled (insulated or non-insulated) or double-walled, that connects a combustion appliance to a *flue* in a *chimney*.

Single-walled chimney – *chimney* where the *flue* liner is the *chimney* ;

System chimneys – (factory-made *chimney*) *chimney* that is installed using a combination of compatible *chimney* components, obtained or specified from one manufacturing source with product responsibility for the whole *chimney* .

Some of these terms are explained in greater depth later in the guidance to this standard.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

3.18.1 Chimneys generally

Combustion appliances are very often changed after the original installation. Unless an appliance is supplied to be used with a specified system *chimney* or with an integral *duct* assembly, e.g. balanced *flue*, it is desirable, and sometimes more economical, to cater initially for the most severe conditions as regards the danger of fire, generally a traditional open fire, and to ensure that all components are compatible.

Combustion appliances, other than *flueless* appliances such as gas cookers, should incorporate, or be connected to, a *flue-pipe* and/or a *chimney* that will withstand the heat generated by the normal operation of the appliance. A *chimney* of a higher specification than the designation strings given (see clause 3.18.2) may be used if required, such as a *chimney* generally suitable for use with an open-*flued* solid fuel appliance may be used with an open-*flued* gas-fired appliance.

www.nace.org.uk

The National Association of Chimney Engineers (NACE) was set up to ensure the safety of all fuel users who depend upon a *chimney* or *flue* for the operation of a heating appliance. They provide a register of competent and qualified *chimney* engineers for all types of *chimney work*. Advice is also available from the British Flue and Chimney Manufacturers' Association (BFCMA). These organisations do not have a mandatory status.

www.feta.co.uk/bfcma

Sweeping *chimneys*

The process of burning will naturally cause deposits of soot in the *flue*. *Chimneys* and *flue-pipes* therefore should be swept at least annually if smokeless solid fuel is burnt and more often if wood, peat and/or other high volatile solid fuel such as bituminous coal is burnt. Mechanical sweeping with a brush is the recommended method of cleaning.

Every *chimney* should have such capacity, be of a height and location and with an outlet so located that the products of combustion are discharged freely and will not present a fire hazard.

A *flue* should be free from obstructions. The surface of the *flue* should be essentially uniform, gas-tight and resistant to corrosion from combustion products. *Chimneys* should be *constructed* in accordance with:

- a. the recommendations of BS 6461: Part 1: 1984 for masonry *chimneys*; or
- b. the recommendations of BS 7566: Parts 1 - 4: 1992 for metal system *chimneys*; or
- c. BS 5410: Part 1: 1997 and OFTEC Technical Information Sheets [TI/129](#), [TI/132](#) and [TI/135](#), where serving an oil-firing appliance; or
- d. BS 5440: Part 1: 2000, where serving a gas-fired appliance.

3.18.2 Chimney designations

Designations for *chimneys*, according to BS EN 1443: 2003, are dependant on the fuel to be used, the type of appliance and the operating conditions. The designation string prescribes limiting values or categories for temperature, pressure, condensate resistance, corrosion resistance, soot fire resistance and distance to combustibles. Values for which the *chimney* is suitable are specified by the system *chimney* manufacturer or the designer of a custom built or re-lined *chimney*. For a new *chimney* installation the *chimney* designation should be chosen to suit the intended appliance installation. For an existing *chimney* the appliance performance should be chosen to match the designation of the *chimney*. Advice on the appropriate *chimney* specification should be sought from the appliance manufacturer.

Solid fuel

The recommended designation for *chimneys* and *flue-pipes* for use with natural draught, solid fuel appliances is T400 N2 D 3 Gxx.

The recommended designation for *chimneys* and *flue-pipes* for use with forced draught solid fuel appliances that have a positive pressure at the outlet of the appliance is T400 P2 D 3 Gxx.

The pressure designation P2 is regarded as the default specification. However, the *chimney* can often generate an adequate natural draught, so that the appliance can be safely used with *chimneys* and *flue-pipes* with the negative pressure designation even if the appliance is fanned. The draught generated in a *chimney* may be calculated according to BS EN 13384-1: 2002. If there is any doubt, and/or unless the appliance manufacturer specifies N2, the designation P2 should apply.

Oil-firing

Recommended designation for chimneys and flue-pipes for use with oil-firing appliances with a flue gas temperature not more than 250° C

| Appliance type | Fuel oil | Designation |
|---|----------|-----------------|
| Boiler including combination boiler – pressure jet burner | Class C2 | T250 N2 D 1 Oxx |
| Cooker – pressure jet burner | Class C2 | T250 N2 D 1 Oxx |
| Cooker and room heater – vaporising burner | Class C2 | T250 N2 D 1 Oxx |
| Cooker and room heater – vaporising burner | Class D | T250 N2 D 2 Oxx |
| Condensing pressure jet burner appliances | Class C2 | T160 N2 W 1 Oxx |
| Cooker – vaporising burner appliances | Class D | T160 N2 W 2 Oxx |

Note:

The pressure designation N2 is regarded as the most likely specification to apply in the oil industry for both vaporising and pressure jet appliances. Most pressure jet appliances only generate adequate pressure to overcome flow resistance within the appliance so that the products of combustion entering the *chimney* will be at a negative pressure with respect to the atmosphere. Thus the appliance can be safely used with *chimneys* and *flue-pipes* with negative pressure designation. In the event that an appliance design produces a positive pressure at the outlet of the appliance, it is the manufacturer's responsibility to inform the installer that a *chimney* with a positive designation should be used. If there is any doubt, the more onerous designation P2 should apply.

The appliance manufacturer's instructions should always be checked. They may specify a higher designation.

Gas fired

Recommended designation for chimneys and flue-pipes for use with gas appliances

| Appliance | Type | Minimum designation |
|-----------------------------|--------------------------------|---------------------|
| Boiler - <i>open-flued</i> | natural draught | T250 N2 D 1 Oxx |
| | fanned draught | T250 P2 D 1 Oxx [1] |
| | condensing | T160 P2 W 1 Oxx [1] |
| Boiler - <i>room-sealed</i> | natural draught | T250 N2 D 1 Oxx |
| | fanned draught | T250 P2 D 1 Oxx [1] |
| Gas fire | radiant/convector, ILFE or DFE | T250 N2 D 1 Oxx |
| Air heater | natural draught | T250 N2 D 1 Oxx |
| | fanned draught | T200 P2 D 1 Oxx [1] |
| | SE duct | T450 N2 D 1 Oxx |

Note:

The pressure designation P2 is regarded as the default specification. However, the *chimney* can often generate an adequate natural draught, so that the appliance can be safely used with *chimneys* and *flue-pipes* with the negative pressure designation even for many fanned draught gas appliances, including condensing boilers that may otherwise have positive pressure at the outlet to the *flue*. The draught generated in a *chimney* may be calculated according to BS EN 13384-1: 2002. If there is any doubt, and/or unless the appliance manufacturer specifies N2, the designation P2 should apply.

3.18.3 Masonry chimneys

A new masonry *chimney*, usually custom-built on site, and normally with an outer wall of brick, block or stone, should be well *constructed* and in corporate a *flue* liner, or *flue-blocks*, of either clay material or precast concrete. A masonry *chimney* should be *constructed* in accordance with the recommendations in BS 6461: Part 1: 1984. If an outer wall is *constructed* of concrete it should be *constructed* in accordance with BS EN 12446: 2003.

It is a complex operation to upgrade the *chimney* at a later date to serve a new appliance that needs a higher classification of *chimney* to operate safely, thus a *chimney* designed for solid fuel will also serve for oil or gas. See clause 3.18.6 for guidance on *flue* liners.

Chimneys can also be *constructed* of prefabricated block components, designed for quick *construction*. *Chimney* components such as cappings, offsets and precast fireplace components are available with this type of system. Some *flue-blocks* are specially designed for gas-fired appliances only. *Flue-blocks* should be *constructed* and installed in accordance with recommendations in:

- a. BS EN 1858: 2003, for a precast concrete *flue-block chimney*;
- b. BS EN 1806: 2000, for a clay *flue-block chimney*.

3.18.4 Metal chimneys

Metal *chimneys* may be either single-walled or double-walled. Each of these types is commonly factory-made by one manufacturer as sets of components for easy assembly on site (although they can be supplied as 1 unit) and is thus a system *chimney*. A choice of fittings such as bends, brackets, and terminals are available.

Some metal *chimneys* are specifically designed for use with gas-fired appliances and should not be used for solid fuel appliances because of the higher temperatures and greater corrosion risk.

Metal system *chimneys*, with the following designations, should be *constructed* in accordance with the recommendations in BS EN 1856-1:

- a. T400 N1 D V3 (or Vm - Lxxxxx) Gxx, for solid fuel appliances;
- b. T400 P2 D V3 (or Vm - Lxxxxx) Gxx where it serves an oil-firing appliance producing a *flue* gas temperature of not more than 400° C, e.g. burning Class D oil (gas oil);
- c. T250 N2 D V2 (or Vm - Lxxxxx) Oxx where it serves an oil-firing appliance producing a *flue* gas temperature of not more than 250° C, e.g. burning Class C2 oil (kerosene);
- d. T250 N2 D V1 (or Vm - Lxxxxx) Oxx where it serves a gas appliance.

Corrosion resistance

The corrosion resistance may be specified, according to BS EN 1856-1, by:

- a. a corrosion test method, which leads to a value of either V1, V2 or V3; or
- b. by a material specification code Vm - Lxxxxx where the first 2 digits represent a material type as quoted in BS EN 1856-1, Table 4 and the last 3 digits represent the material thickness.

Acceptable material specifications may be taken from the national Annex to BS EN 1856-1. For example, an acceptable material code for solid fuel, oil or gas, would be Vm - L50040 representing a material type 50 with a thickness of 0.40 mm.

A metal *chimney* should not pass through a *compartment wall*, *compartment floor*, *separating wall* or *separating floor*. However they may if the *chimney*, or a *non-combustible* casing totally enclosing the *chimney*, is *constructed* in such a way that, in the event of a fire, the fire resistance of the *compartment wall*, *compartment floor*, *separating wall* or *separating floor* is maintained. (see section 2, Fire)

A metal *chimney* should only pass through a storage space, cupboard or *roof space* provided any flammable material is shielded from the *chimney* by an impermeable casing. Also where the *chimney* passes through the *roof space*, such as an attic, it should be surrounded by a rigid mesh that will prevent vermin from *building* a nest beside the warm *chimney*. Mesh should prevent an 8 mm diameter sphere from passing.

There should be no joints within any wall, floor or ceiling that make accessing the *chimney* for maintenance purposes difficult.

3.18.5 Flue-pipes

A *flue-pipe* should be of a material that will safely discharge the products of combustion into the *flue* under all conditions that will be encountered. A *flue-pipe* serving a solid fuel appliance should be *non-combustible* and of a material and *construction* capable of withstanding the effects of a *chimney* fire without any structural change that would impair the stability and performance of the *flue-pipe*.

Flue-pipes should be manufactured from the materials noted below:

- a. cast iron pipe to BS 41: 1973 (1988);
- b. mild steel at least 3 mm thick, to Section 1.1 of BS 1449: Part 1: 1991;
- c. vitreous enamelled steel to BS 6999: 1989;
- d. stainless steel designated Vm - L50100, in accordance with BS EN 1856-2: 2005 or Vm - Lxxxxx for oil or gas applications;

- e. any other material approved and tested under the relevant conditions of a *notified body*.

Flue-pipes should have the same diameter or equivalent cross sectional area as that of the appliance *flue* outlet and should be to the size recommended by the appliance manufacturer. It should be noted that oversized *flue-pipes* can cause condensation problems in modern, highly efficient oil and gas fired boilers.

A *flue-pipe* connecting a solid fuel appliance to a *chimney* should not pass through:

- a. a *roof space*;
- b. an internal wall, although it is acceptable to discharge a *flue-pipe* into a *flue* in a *chimney* formed wholly or partly by a *non-combustible* wall;
- c. a ceiling or floor. However it is acceptable for a *flue-pipe* to pass through a ceiling or floor where they are *non-combustible* and the *flue-pipe* discharges into a *chimney* immediately above.

3.18.6 Flue liners

A *flue* liner is the wall of the *chimney* that is in contact with the products of combustion. It can generally be of concrete, clay, metal or plastic depending on the designation of the application.

All new *chimneys* will have *flue* liners installed and there are several types, as follows:

- rigid sections of clay or refractory liner;
- rigid sections of concrete liner;
- rigid metal pipes.

Flue liners suitable for solid fuel appliances, and therefore generally suitable for other fuels, should have a performance at least equal to that corresponding to the designation T400 N2 D 3 G as described in BS EN 1443: 2003 and manufactured from the following materials:

- a. clay *flue* liners with rebates or sockets for jointing and meeting the requirements for Class A1 N2 or Class A1 N1 as described in BS EN 1457: 1999; or
- b. concrete *flue* liners meeting the requirements for the classification Type A1, Type A2, Type B1 or Type B2 as described in BS EN 1857: 2003; or
- c. any other material approved and tested under the relevant conditions of a *notified body*.

Stainless steel flexible *flue* liners meeting BS EN 1856-2: 2005 may be used for lining or relining *flues* for oil and gas appliances, and for lining *flues* for solid fuel applications provided that the designation is in accordance with the intended application. These should be installed in accordance with their manufacturer's instructions.

Single skin, stainless steel flexible *flue* liners may be used for lining *flues* for gas and oil appliances. These should be installed in accordance with their manufacturer's instructions.

Double skin, stainless steel flexible *flue* liners for multi-fuel use should be installed in accordance with their manufacturer's instructions.

Existing *chimneys*

Existing custom-built masonry *chimneys* may be lined or re-lined by one of the following *flue* liners:

- flexible, continuous length, single-skin stainless steel for lining or re-lining *chimney flues* for C2 oil and gas installations designated T250;
- flexible, continuous length, double-skin stainless steel for lining or re-lining systems designated T400 for multi-fuel installations;
- insulating concrete pumped in around an inflatable former;
- spray-on or brush-on coating by specialist.

Existing *chimneys* for solid fuel applications may also be relined using approved rigid metal liners or single-walled *chimney* products, an approved cast-insitu technique or an approved spray-on or brush-on coating. Approved products are listed in the [HETAS Guide](#).

Masonry liners for use in existing *chimneys* should be installed in accordance with their manufacturer's instructions. Appropriate components should be selected to form the *flue* without cutting and to keep joints to a minimum. Bends and offsets should only be formed with factory-made components. Liners should be placed with the sockets or rebate ends uppermost to contain moisture and other condensates in the *flue*. In the absence of specific liner manufacturer's instructions to the contrary, the space between the lining and the surrounding masonry could be filled with a weak insulating concrete.

Corrosion resistance

The corrosion resistance of a metal liner may be specified, according to BS EN 1856-1, by either:

- a. a corrosion test method, which leads to a value of either V1, V2 or V3; or
- b. by a material specification code Vm - Lxxxxx where the first 2 digits represent a material type as quoted in BS EN 1856-1, Table 4 and the last 3 digits represent the material thickness.

Acceptable material specifications may be taken from the national Annex to BS EN 1856-1. For example, an acceptable material code for solid fuel, oil or gas, would be Vm - L50040 representing a material type 50 with a thickness of 0.40 mm.

3.19 Combustion appliances – relationship to combustible materials

- 3.19 Functional standard
- 3.19.0 Introduction
- 3.19.1 Relationship of masonry chimneys to combustible material
- 3.19.2 Relationship of system chimneys to combustible material
- 3.19.3 Relationship of metal chimneys to combustible material
- 3.19.4 Relationship of flue-pipes to combustible material
- 3.19.5 Relationship of solid fuel appliance to combustible material
- 3.19.6 Relationship of oil-firing appliances to combustible material
- 3.19.7 Relationship of gas-fired appliance to combustible material
- 3.19.8 Relationship of hearths to combustible materials
- 3.19.9 Fireplace recesses

standard

3.19

mandatory

Every *building* must be designed and *constructed* in such a way that any component part of each fixed combustion appliance installation will not cause damage to the *building* in which it is installed by radiated, convected or conducted heat or from hot embers expelled from the appliance.

3.19.0 Introduction

Combustion appliances and their component parts, particularly solid fuel appliance installations, generate or dissipate considerable temperatures. Certain precautions need to be taken to ensure that any high temperatures are not sufficient to cause a risk to people and the *building*. The characteristics of solid fuel and some older style oil-firing appliances are more onerous than modern oil and gas-fired appliances.

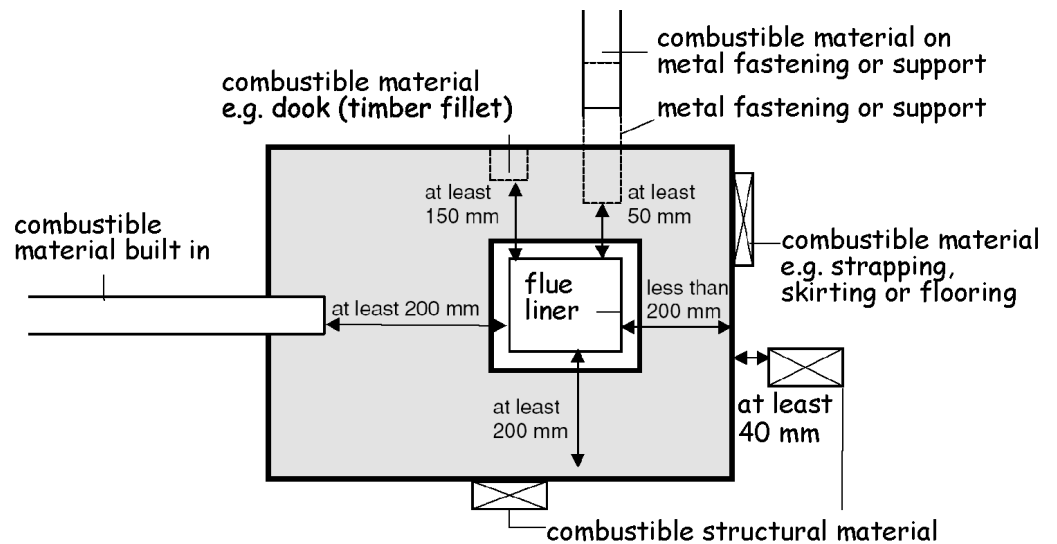
Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard in so far as is *reasonably practicable*, and in no case be worse than before the *conversion*. (regulation 12, schedule 6).

3.19.1 Relationship of masonry chimneys to combustible material

Combustible material should not be located where the heat dissipating through the walls of fireplaces or *flues* could ignite it. All combustible materials therefore should be located at least 200 mm from the surface surrounding a *flue* in a masonry *chimney*. However some combustible materials will not be a risk and do not need a 200 mm separation distance nor do the *flue* gases generated from some appliances reach a sufficiently high temperature to require it. The following materials may be located closer than 200 mm to the surface surrounding a *flue* in a *chimney*:

- a damp proof course(s) firmly bedded in mortar;
- small combustible fixings may be located not less than 150 mm from the surface of the *flue*;
- combustible structural material may be located not less than 40 mm from the outer face of a masonry *chimney*;
- flooring, strapping, sarking, or similar combustible material may be located on the outer face of a masonry *chimney*;



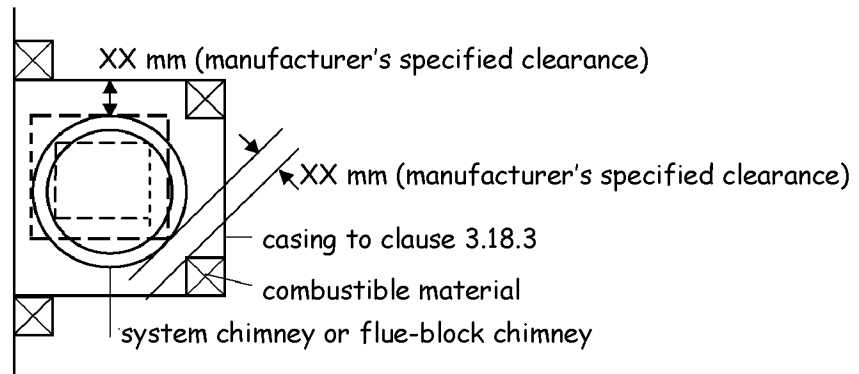
Plan view of masonry chimney

Any metal fastening in contact with combustible material, such as a joist hanger, should be at least 50 mm from the surface surrounding a *flue* to avoid the possibility of the combustible material catching fire due to conduction.

BS EN 1806: 2000 relates to clay *flue-block chimneys* but does not give a value for distances to combustible materials. These types of *chimneys* therefore should be regarded as custom built *chimneys* and the minimum values in clause 3.19.1 or clause 3.19.2 should be used and declared.

3.19.2 Relationship of system chimneys to combustible material

System *chimneys* do not necessarily require to be located at such a distance from combustible material. It is the responsibility of the *chimney* manufacturer to declare a distance 'XX', as stipulated in BS EN 1856-1: 2003 and BS EN 1858: 2003 as being a safe distance from the *chimney* to combustible material. At this distance, the temperature of adjacent combustible materials during operation of the appliance at its rated output should not exceed 85° C when related to an ambient temperature of 20° C.

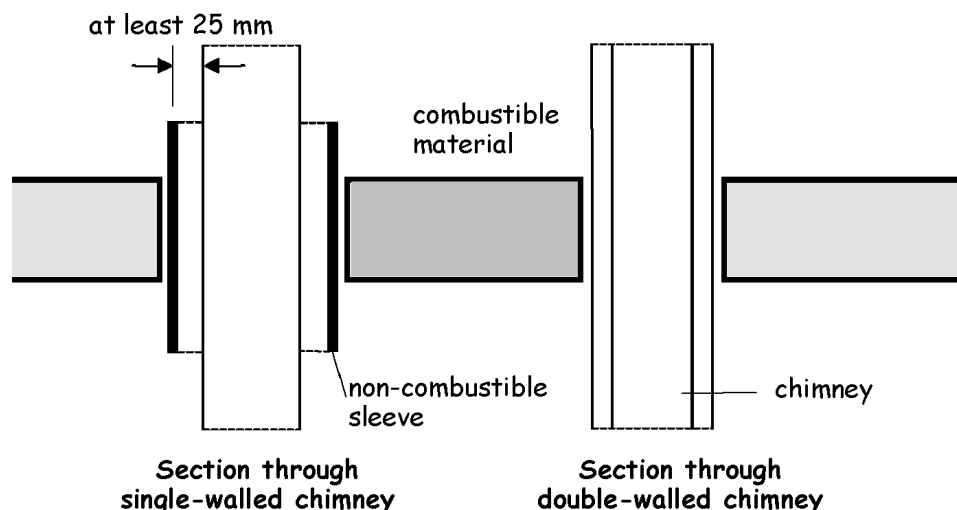


Plan of casing round a factory-made chimney

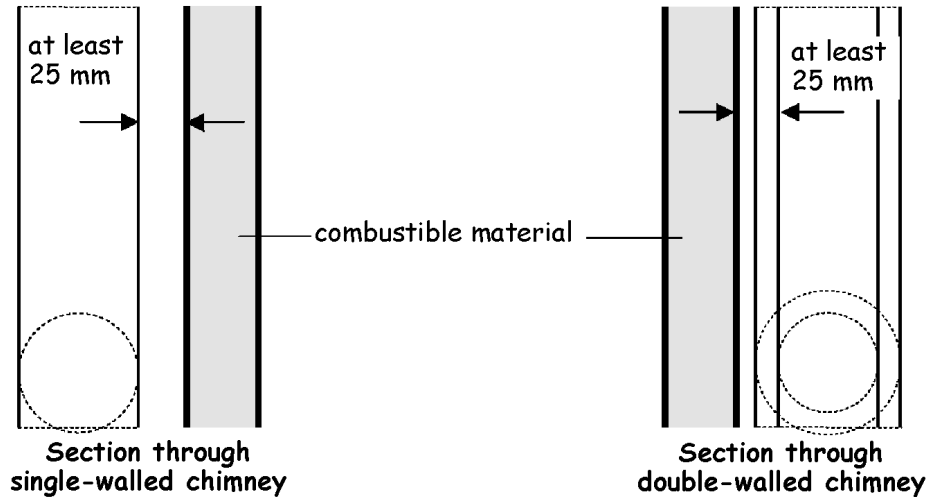
BS EN 1806: 2000 relates to clay *flue-block chimneys* but does not give a value for distances to combustible materials. These types of *chimneys* therefore should be regarded as custom built *chimneys* and the recommended values in clause 3.19.1 or clause 3.19.2 should be used and declared.

3.19.3 Relationship of metal chimneys to combustible material

There should be a separation distance where a metal *chimney* passes through combustible material. This is specified, as part of the designation string for a system *chimney* when used for oil or gas, as (Gxx), where xx is the distance in mm. Where no data is available, the separation distance for oil or gas applications with a *flue* gas temperature limit of T250 or less should be 25 mm from the outer surface of a single-walled *chimney* to combustible material. The 25 mm should be measured from the surface of the inner wall of a double-walled *chimney*. There is no need for a separation distance if the *flue* gases are not likely to exceed 100° C.



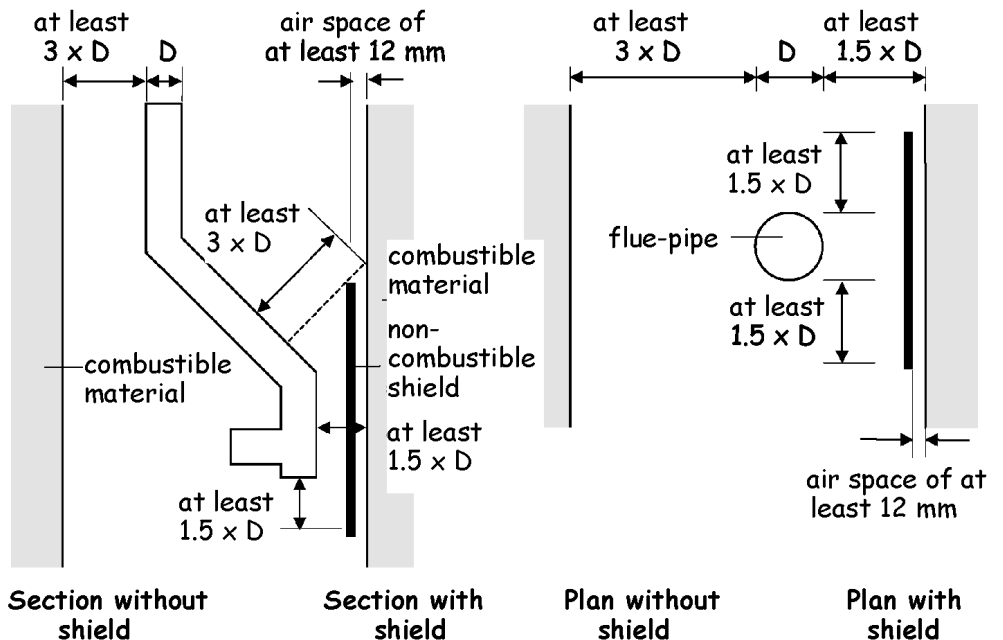
There should also be a separation distance where the metal *chimney* runs in close proximity to combustible material. The separation distance should be 25 mm from the outer surface of a single-walled *chimney* to combustible material. The 25 mm should be measured from the surface of the inner wall of a double-walled *chimney*. There is no need for a separation distance if the *flue* gases are not likely to exceed 100° C.



3.19.4 Relationship of flue-pipe to combustible material

To prevent the possibility of radiated heat starting a fire, a *flue-pipe* should be separated from combustible material by:

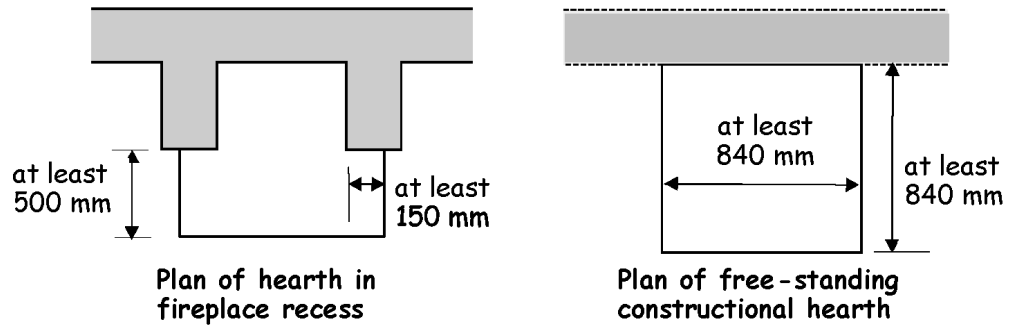
- a. a distance according to the designation of the connecting *flue-pipe* in accordance with BS EN 1856-2: 2005; or
- b. a distance equivalent to at least 3 times the diameter of the *flue-pipe*. However this distance may be reduced:
 - to 1.5 times the diameter of the *flue-pipe*, if there is a *non-combustible* shield provided in accordance with the following sketch; or
 - to 0.75 times the diameter of the *flue-pipe*, if the *flue-pipe* is totally enclosed in *non-combustible* material at least 12 mm thick with a thermal conductivity of not more than 0.065 W/mK.



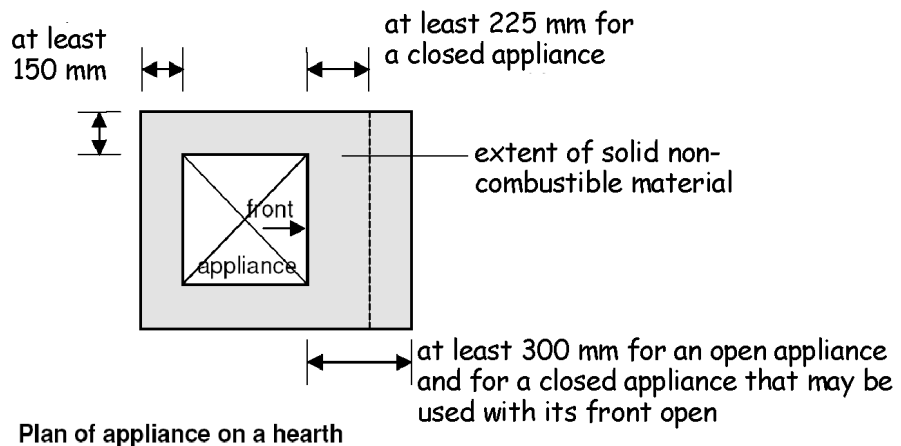
3.19.5 Relationship of solid fuel appliance to combustible material

A solid fuel appliance should be provided with a solid, *non-combustible* hearth that will prevent the heat of the appliance from igniting combustible materials. A hearth should be provided to the following dimensions:

- a. a *constructional* hearth at least 125 mm thick and with plan dimensions in accordance with the following sketches; or
- b. a free-standing, solid, *non-combustible* hearth at least 840 x 840 mm minimum plan area and at least 12 mm thick, provided the appliance will not cause the temperature of the top surface of the hearth on which it stands to be more than 100° C.

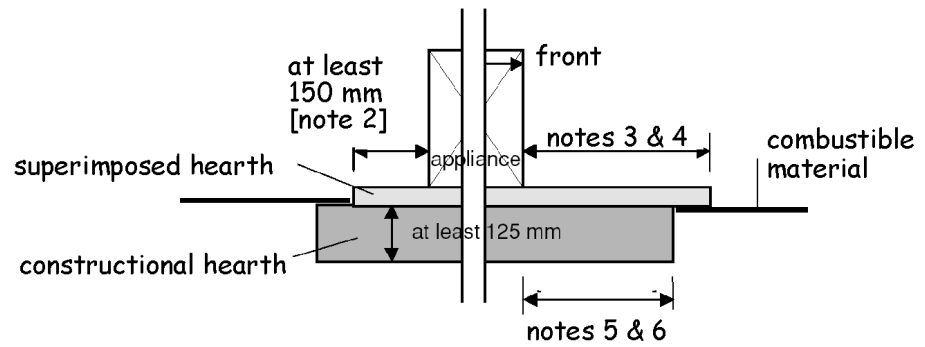


Not only should a solid fuel appliance sit on a hearth, but the appliance itself should also be located on the hearth such that protection will be offered from the risk of ignition of the floor by direct radiation, conduction or falling embers. The solid fuel appliance should be located on a hearth in accordance with the following diagram:



The 150 mm does not apply where the appliance is located in a fireplace recess, nor does it apply where the back or sides of the hearth either abut or are carried into a solid, *non-combustible* wall complying with clause 3.19.8.

A solid fuel appliance may sit on a superimposed hearth provided the hearth is positioned partly or wholly on a *constructional* hearth. The superimposed hearth should be of solid, *non-combustible* material, usually decorative, and be at least 50 mm thick in accordance with the following diagram:



Section through superimposed hearth

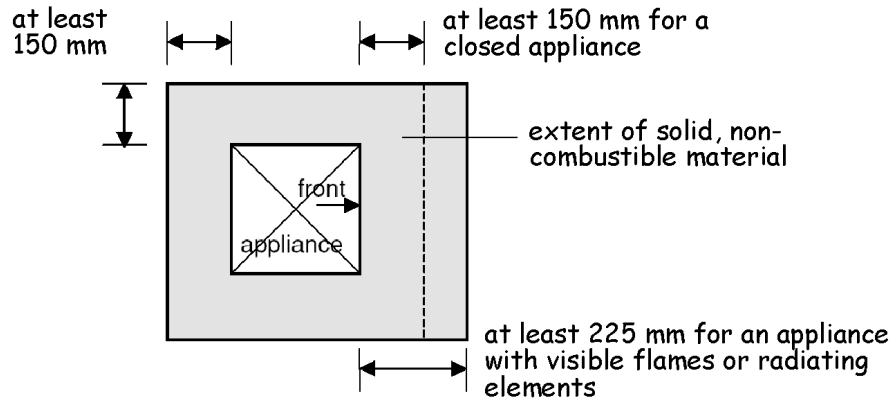
Notes:

1. SUPERIMPOSED HEARTH means a finish of solid, *non-combustible* material, usually decorative, at least 50 mm thick and positioned on a *constructional* hearth.
2. There need not be a 150 mm separation where the appliance is located in a fireplace recess, nor where the back or sides of the hearth either abut or are carried into a solid, *non-combustible* wall complying with clause 3.19.8.
3. At least 225 mm for a closed appliance.
4. At least 300 mm for an open appliance and for a closed appliance that may properly be used with its front open.
5. No part of the appliance should project over any edge of the constructional hearth.
6. At least 150 mm to combustible material, measured horizontally.

3.19.6 Relationship of oil-firing appliances to combustible material

A hearth is not required beneath an oil-firing appliance if it incorporates a full-sized, rigid *non-combustible* base and does not raise the temperature of the floor beneath it to more than 100° C under normal working conditions. The base may be provided separately from the appliance. In other cases the appliance should stand on a hearth *constructed* and installed in accordance with the guidance for a solid fuel appliance.

A floor-standing, oil-firing appliance should be positioned on the hearth in such away as to minimise the risk of ignition of any part of the floor by direct radiation or conduction. An oil-firing appliance should be located on a hearth in accordance with the following diagram:



Plan of appliance on a hearth

The 150 mm does not apply where the appliance is located in a fireplace recess, nor does it apply where the back or sides of the hearth either abut or are carried into a solid, *non-combustible* wall complying with clause 3.19.8.

An oil-firing appliance should be separated from any combustible material if the temperature of the back, sides or top of the appliance is more than 100° C under normal working conditions. Separation may be by:

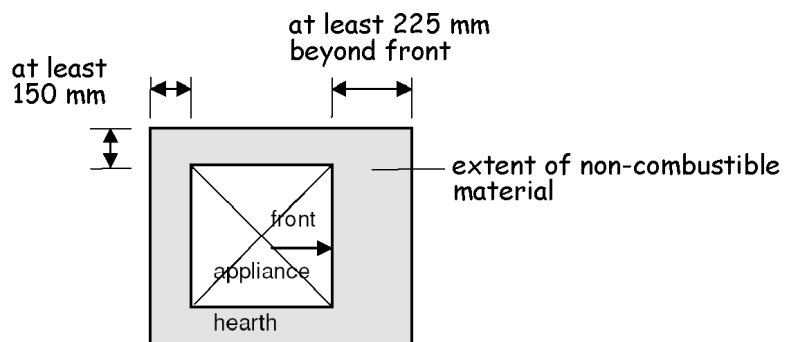
- a shield of *non-combustible* material at least 25 mm thick; or
- an air space of at least 75 mm.

OFTEC Standard [OFS A100](#) for boilers, [OFS A101](#) for cookers and [OFS A102](#) for room heaters defines suitable tests for measuring the temperature of the back, sides and top of an oil-firing appliance.

3.19.7 Relationship of gas-fired appliance to combustible material

A gas-fired appliance should be provided with a hearth in accordance with the following recommendations:

- Clause 12 of BS 5871: Part 1: 2005, for a gas fire, convector heater and fire/back boiler;
- Clause 12 of BS 5871: Part 2: 2005, for an inset live fuel-effect gas appliance;
- Clause 11 of BS 5871: Part 3: 2005, for a *decorative fuel-effect gas appliance*;
- for any other gas-fired appliance, by a solid, heat resistant, *non-combustible*, non-friable material at least 12 mm thick and at least the plan dimension shown in the diagram to this specification:



Plan of appliance on a hearth

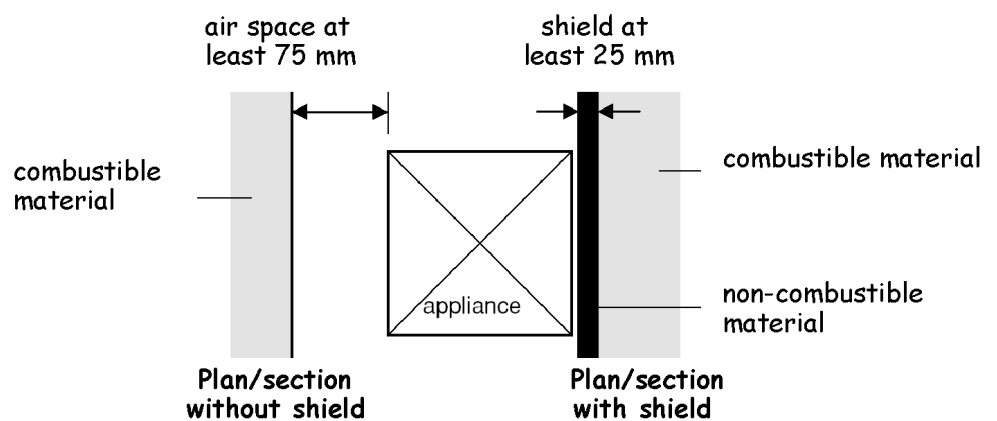
The 150 mm does not apply where the appliance is located in a fireplace recess, nor does it apply where the back or sides of the hearth either abut or are carried into a solid, *non-combustible* wall complying with clause 3.19.8.

However a hearth need not be provided:

- a. where every part of any flame or incandescent material in the appliance is at least 225 mm above the floor; or
- b. where the appliance is designed not to stand on a hearth, such as a wall mounted appliance or a gas cooker.

A gas-fired appliance should be separated from any combustible material if the temperature of the back, sides or top of the appliance is more than 100° C under normal working conditions. Separation may be by:

- a. a shield of *non-combustible* material at least 25 mm thick; or
- b. an air space of at least 75 mm.



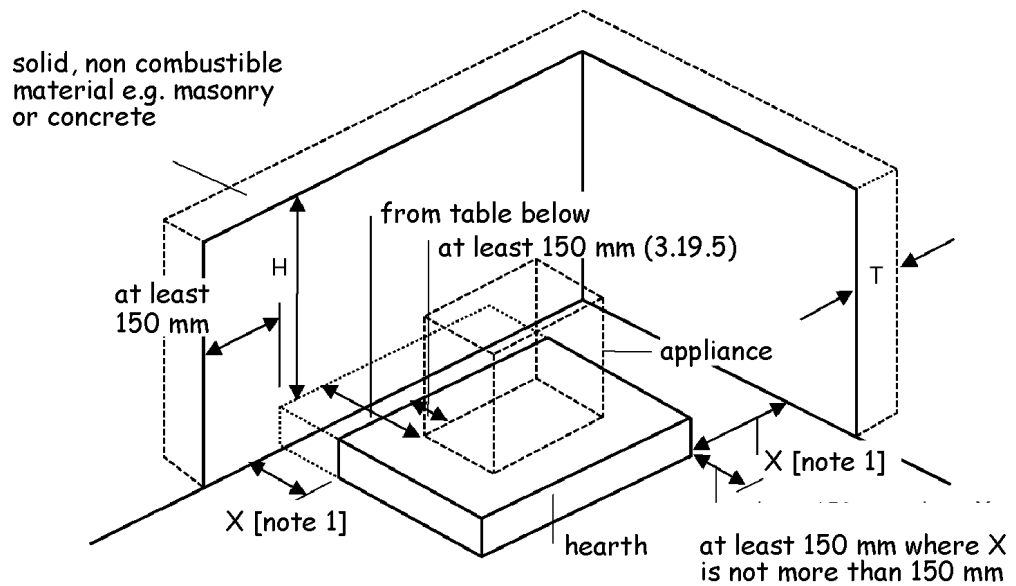
A gas-fired appliance with a CE marking and installed in accordance with the manufacturer's written instructions may not require this separation.

3.19.8 Relationship of hearths to combustible materials

Walls that are not part of a fireplace recess or a prefabricated appliance chamber but are adjacent to hearths or appliances should also protect the *dwelling* from catching fire. This is particularly relevant to timber-framed *buildings*. Any part of a *dwelling* therefore that abuts or is adjacent to a hearth, should be *constructed* in such a way as to minimise the risk of ignition by direct radiation or conduction from a solid fuel appliance located upon the hearth. This recommendation does not relate to floors, as an appliance should stand on a suitable hearth described in clauses 3.19.5, 3.19.6 and 3.19.7.

The building elements adjacent to combustion appliances should be *constructed* in accordance to the following recommendations:

- the hearth located in a fireplace recess in accordance with BS 8303: Part 1: 1994; or
- any part of the *dwelling*, other than the floor, not more than 150 mm from the hearth, *constructed* of solid, *non-combustible* material in accordance with the diagram and table to this specification



Hearth and appliance adjacent to any part of a building

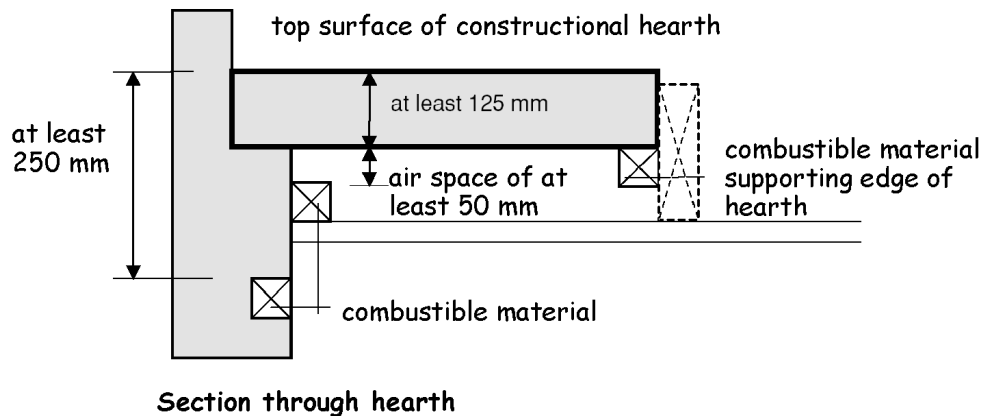
| Location of hearth or appliance | Thickness (T) of solid, non-combustible material | Height (H) of solid non-combustible material. |
|---|--|---|
| where the hearth abuts a wall and the appliance is not more than 50 mm from the wall | 200 mm | at least 300 mm above the appliance or 1.2 m above the hearth whichever is the greater. |
| where the hearth abuts a wall and the appliance is more than 50 mm but not more than 300 mm from the wall | 75 mm | at least 300 mm above the appliance or 1.2 m above the hearth whichever is the greater. |
| where the hearth does not abut a wall and is not more than 150 mm from the wall | 75 mm | at least 1.2 m above the hearth. |

Notes:

1. There is no requirement for protection of the wall where X is more than 150 mm

All combustible material under a *constructional* hearth should be separated from the hearth by an air space of at least 50 mm. However an air space is not necessary where:

- a. the combustible material is separated from the top surface of the hearth by solid, *non-combustible* material of at least 250 mm; or
- b. the combustible material supports the front and side edges of the hearth.



3.19.9 Fireplace recesses

A fireplace recess should be constructed of solid, *non-combustible* material in accordance with the recommendations in Clauses 7 and 8 of BS 8303:Part 1: 1994 and to the minimum thickness shown in Figure 2 to BS 8303:Part 3: 1994. The recess should incorporate a *constructional* hearth.

An alternative is to use a prefabricated appliance chamber of solid concrete components. These components should be:

- a. supplied by the same manufacturer, with pre-made jointing arrangements, assembled on site using a cement specified for the purpose by the manufacturer; and
- b. of insulating concrete with a density of between 1200 and 1700 kg/m³; and
- c. installed on a *constructional* hearth; and
- d. of components having a minimum thickness shown in the table below:

Thickness of solid fuel appliance chamber components

| Component | Minimum thickness (mm) |
|-------------------------|------------------------|
| Base | 50 |
| Sides | 75 |
| Back panel and top slab | 100 |
| Hood and bar lintels | 100 |

3.20 Combustion appliances – removal of products of combustion

- 3.20 Functional standard
- 3.20.0 Introduction
- 3.20.1 Chimneys & flue-pipes serving appliances burning any fuel
- 3.20.2 Chimneys and flue-pipes serving solid fuel appliances
- 3.20.3 Chimneys and flue-pipes serving oil-firing appliances
- 3.20.4 Chimneys and flue-pipes serving gas-fired appliances
- 3.20.5 Oil-firing appliances in bathrooms and bedrooms
- 3.20.6 Gas-fired appliances in bathrooms and bedrooms
- 3.20.7 Protection of metal chimneys
- 3.20.8 Size of flues – solid fuel appliances
- 3.20.9 Size of flues - oil-firing appliances
- 3.20.10 Size of flues – gas-fired appliances
- 3.20.11 Design of flues
- 3.20.12 Openings in flues
- 3.20.13 Access to flues
- 3.20.14 Location of metal chimneys
- 3.20.15 Terminal discharges at low level
- 3.20.16 Terminal discharge from condensing boilers
- 3.20.17 Solid fuel appliance flue outlets
- 3.20.18 Oil-firing appliance flue outlets
- 3.20.19 Gas-fired appliance flue outlets

standard
3.20
mandatory

Every *building* must be designed and *constructed* in such a way that the products of combustion are carried safely to the external air without harm to the health of any person through leakage, spillage, or exhaust nor permit the re-entry of dangerous gases from the combustion process of fuels into the *building*.

3.20.0 Introduction

Fire fighters attend approximately 3400 *chimney* fires per year in Scotland.

Heating and cooking appliances fuelled by solid fuel, oil or gas all have the potential to cause carbon monoxide (CO) poisoning if they are poorly installed or commissioned, inadequately maintained or incorrectly used. Inadequate ventilation or a lack of the correct maintenance of appliances, *flues* and *chimneys* are the main causes of CO poisoning. Some incidents are also due to incorrect installation or deterioration of the structure of the *chimney*. Poisonous CO gas is produced when fuel does not burn properly. There are still a few deaths and permanent injuries in Scotland each year from CO poisoning that can be directly attributed to combustion appliance installations.

Incorrect sizing of *flues* can also have serious repercussions. If a *flue* is too small, an insufficient volume of air will pass through it and this may lead to spillage of combustion gases. Too large a *flue* will slow down the flow of combustion gases and this may also lead to spillage.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

3.20.1 Chimneys & flue-pipes serving appliances burning any fuel

A *chimney* or *flue-pipe* serving any appliance should be suitable for use with the type of appliance served. A *chimney* should be manufactured using products in accordance with the following standards:

- a. BS EN 1858: 2003, for concrete *chimney* blocks; or
- b. BS EN 1806: 2000, for clay *chimney* blocks; or
- c. BS EN 1857: 2003, for purpose made concrete *flue* linings; or
- d. BS EN 1457: 1999, for purpose made clay *flue* linings; or
- e. BS EN 1856 -1: 2003, for a factory-made metal *chimney*; or
- f. a lining accepted for the purpose after testing of the *chimney* under the relevant conditions by a *notified body*.

3.20.2 Chimneys and flue-pipes serving solid fuel appliances

A *flue* in a *chimney* should be separated from every other *flue* and extend from the appliance to the top of the *chimney*. Every *flue* should be surrounded by *non-combustible* material that is capable of withstanding the effects of a *chimney* fire, without any structural change that would impair the stability or performance of the *chimney*. However, the *chimney* may include a damp proof course (or courses) of combustible material.

3.20.3 Chimneys and flue-pipes serving oil-firing appliances

A *chimney* or *flue-pipe* serving an oil-firing appliance should be *constructed* to the recommendations of BS 5410: Part 1: 1997 or OFTEC Technical Information Sheets [TI/132](#), [TI/135](#) and OFTEC Standard [OFS E106](#) as appropriate.

Satisfactory specification of *chimneys* and *flue-pipes* depends upon the gas temperature to be expected in normal service. *Flue* gas temperatures depend upon appliance types and the age of their design. Older appliances are likely to produce *flue* gas temperatures greater than 250° C while modern boilers that bear the CE mark indicating compliance with the Boiler (Efficiency) Regulations will normally have *flue* gas temperatures less than 250° C. Information for individual appliances should be sought from manufacturer's installation instructions, from the manufacturers themselves or from OFTEC. Where this is not available, *flues* should be *constructed* for an assumed *flue* gas temperature of more than 250° C.

Boiler (Efficiency) Regulations 1993

High *flue* gas temperatures

Where the *flue* gas temperatures are more than 250° C, under normal working conditions, custom-built *chimneys*, system *chimneys* and *flue-pipes* should be designed and *constructed* for use with a solid fuel appliance.

Low *flue* gas temperatures

Where the *flue* gas temperatures are not more than 250° C, under normal working conditions, *chimneys* and *flue-pipes* may be of a lower specification as follows:

- a. in accordance with the guidance in clauses 3.18.3, 3.18.4, 3.18.5, relating to gas; and
- b. where the oil-firing appliance burns Class D fuel, the inner surfaces of the *chimney* or *flue-pipe* should not be manufactured from aluminium.

The *flue* gas temperatures are quoted in manufacturer's product data and can be measured in accordance with OFTEC Appliance Standard [OFS A100](#) for boilers, [OFS A101](#) for cookers or [OFS A102](#) for room heaters.

3.20.4 Chimneys and flue-pipes serving gas-fired appliances

A *chimney* or *flue-pipe* should be *constructed* and installed in accordance with the following recommendations:

- a. BS 5440-1: 2000;
- b. 'IGE/UP/7: Edition 2, 'Gas installations in timber framed and light steel framed buildings', where the *chimney* or *flue-pipe* is in a framed *building*;
- c. the appropriate recommendations of the combustion appliance manufacturer, where the *flue-pipe* is supplied as an integral part of the combustion appliance.

3.20.5 Oil-firing appliances in bathrooms and bedrooms

There is an increased risk of carbon monoxide poisoning in bathrooms, shower rooms or *rooms* intended for use as sleeping accommodation, such as bed-sitters. Because of this, open-*flued* oil-firing appliances should not be installed in these *rooms* or any cupboard or compartment connecting directly with these *rooms*. Where locating a combustion appliance in such *rooms* cannot be avoided, the installation of a *room-sealed appliance* would be appropriate.

3.20.6 Gas-fired appliances in bathrooms and bedrooms

Regulation 30 of the Gas Safety (Installations and Use) Regulations 1998 has specific requirements for *room-sealed appliances* in these locations.

Gas Safety (Installations & Use Regulations

3.20.7 Protection of metal chimneys

Metal *chimneys* should be guarded if there could be a risk of damage or if they present a risk to people that is not immediately apparent such as when they traverse intermediate floors out of sight of the appliance.

Where the metal *chimney* passes through a *room* or accessible space such as a walk-in cupboard it should be protected in accordance with the recommendations of:

- a. BS EN 12391-1: 2003 for solid fuel appliances;
- b. BS 5410: Part 1: 1997, for oil-firing appliances;
- c. BS 5440: Part 1: 2000, for gas appliances.

It is not necessary to provide protection where a system *chimney* runs within the same space as the appliance served.

3.20.8 Size of flues – solid fuel appliances

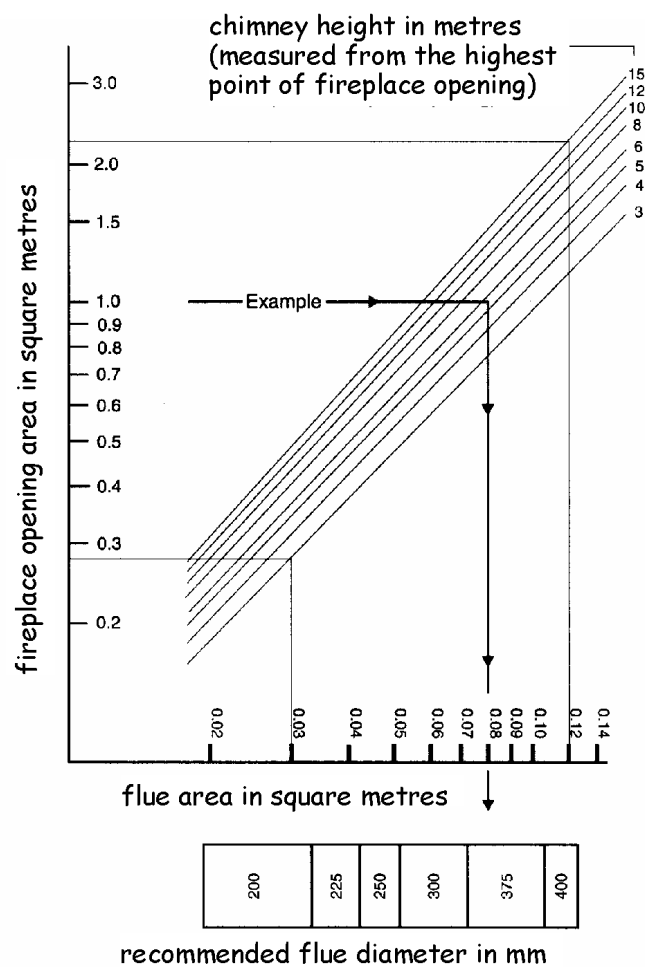
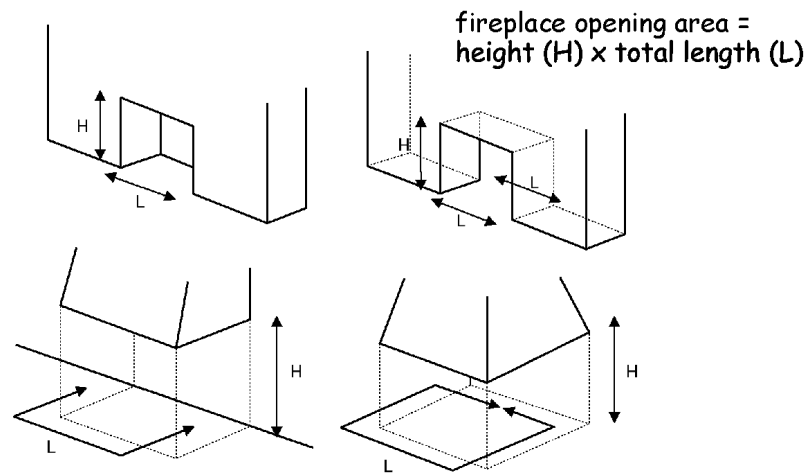
The size of a *flue* serving a solid fuel appliance should be at least the size shown in the table below and not less than the size of the appliance *flue* outlet or that recommended by the appliance manufacturer.

Minimum area of flues

| Appliance | Minimum flue size [3] |
|---|---|
| Fireplace with an opening more than 500 mm x 550 mm, or a fireplace exposed on 2 or more sides | a. 15% of the total face area of the fireplace opening(s) [4]; or b. in accordance with the diagram to clause 3.20.7 [5] |
| Fireplace with an opening not more than 500 mm x 550 mm | 200 mm diameter or rectangular/square <i>flues</i> having the same cross sectional area and a minimum diameter not less than 175 mm. |
| Closed appliance with rated output more than 30 kW but not more than 50 kW, burning any fuel | 175 mm diameter or rectangular/square <i>flues</i> having the same cross sectional area and a minimum diameter not less than 150 mm. |
| Closed appliance with rated output not more than 30 kW burning any fuel | 150 mm diameter or rectangular/square <i>flues</i> having the same cross sectional area and a minimum diameter not less than 125 mm. |
| Closed appliance with rated output not more than 20 kW that burns smokeless or low volatiles fuel | 125 mm diameter or rectangular/square <i>flues</i> having the same cross sectional area and a minimum diameter not less than 100 mm for straight <i>flues</i> or 125 mm for <i>flues</i> with bends or offsets. |

Notes:

1. CLOSED APPLIANCE includes cookers, stoves, room heaters and boilers.
2. SMOKELESS FUEL means solid mineral fuel that produces combustion products containing particulate matter that does not exceed a specified low amount.
3. Any *chimney* pot or open-topped terminal must maintain the same cross-sectional area as the *flue*. Any covered terminal should have side outlets with a total free area twice that of the *flue*.
4. Specialist advice should be sought when proposing to construct *flues* with an area of more than 120000 mm² or 15% of the total face area of the fireplace opening.
5. The diagram to clause 3.20.7 should only be used for the range of sizes shown within the shaded area.
6. Fire size is related to the free opening area at the front of the fireplace opening.



3.20.9 Size of flues - oil-firing appliances

The cross sectional area of a *flue* serving an oil-firing appliance should be in accordance with the recommendations in BS 5410: Part 1: 1997 and should be the same size as the appliance *flue* spigot.

3.20.10 Size of flues – gas-fired appliances

The area of a *flue* serving a gas-fired appliance should have a size to ensure safe operation. A *flue* should be provided in accordance with the following recommendations:

- a. Clause 9 of BS 5871: Part 3: 2005, for a *decorative fuel-effect gas appliance* ;
- b. BS 5871: Part 2: 2005, for an inset live fuel-effect gas appliance;
- c. BS 5440: Part 1: 2000, for any other gas-fired appliance.

3.20.11 Design of flues

A combustion appliance should be connected to a *chimney* that discharges to the external air. However there are some combustion appliances that are designed not to discharge direct to the external air, such as *flueless* cookers. An opening window, extract fan or passive stack ventilation system may be sufficient to ventilate a *kitchen* but where other types of *flueless* appliances are installed, the manufacturer’s instructions should be followed.

Solid Fuel

Every solid fuel appliance should be connected to a separate *flue* .

Oil-firing

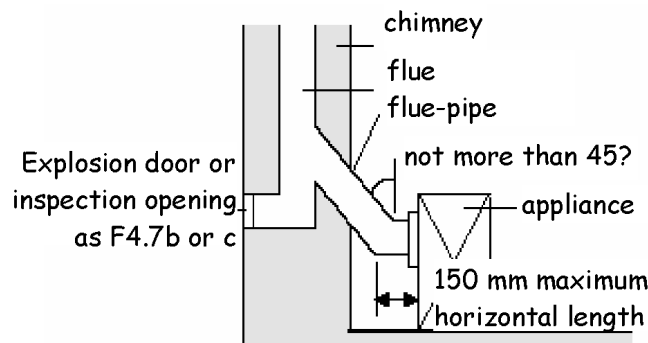
Every oil-firing appliance should be connected to a separate *flue*. However this is not necessary where all the appliances have pressure jet burners and are connected into a shared *flue*.

Gas-fired

Every gas-fired appliance that requires a *flue* should connect into a separate *flue*. However, in certain instances, appliances can be connected to shared *flues* , if they are installed in accordance with the recommendations in BS 5440: Part 1: 2000.

The *flue* of a natural draught appliance, such as a traditional solid fuel appliance, should offer the least resistance to the passage of combustion gases. Resistance can be minimised by restricting the number of bends and horizontal runs should only be incorporated on back-entry appliances.

The horizontal length of the back-entry *flue-pipe* at the point of discharge from the appliance should be not more than 150 mm.



Section through appliance and flue-pipe

Where bends are essential, they should be angled at not more than 45° to the vertical

3.20.12 Openings in flues

The *flue* should have no intermediate openings. However it is acceptable to provide a draught stabiliser or draft diverter on the *chimney* provided it is in the same *room* or space as the appliance being served. An explosion door may also be provided.

3.20.13 Access to flues

Access should be provided for inspection and cleaning of the *flue* and the appliance and therefore an opening that is fitted with a *non-combustible*, rigid, gas-tight cover would be acceptable.

3.20.14 Location of metal chimneys

To minimise the possibility of condensation in a metal *chimney*, it should not be fixed externally to a *building*, but should be routed inside the *building*. However a metal *chimney* may be fixed externally if it is insulated and *constructed* of a material that can be used externally, such as stainless steel or, in the case of gas, aluminium, so long as they conform to the specifications of the National Annex to BS EN 1856-1: 2003.

3.20.15 Terminal discharges at low level

Combustion gases at the point of discharge can be at a high temperature. Therefore *flues* discharging at low level where they may be within reach of people should be protected with a terminal guard.

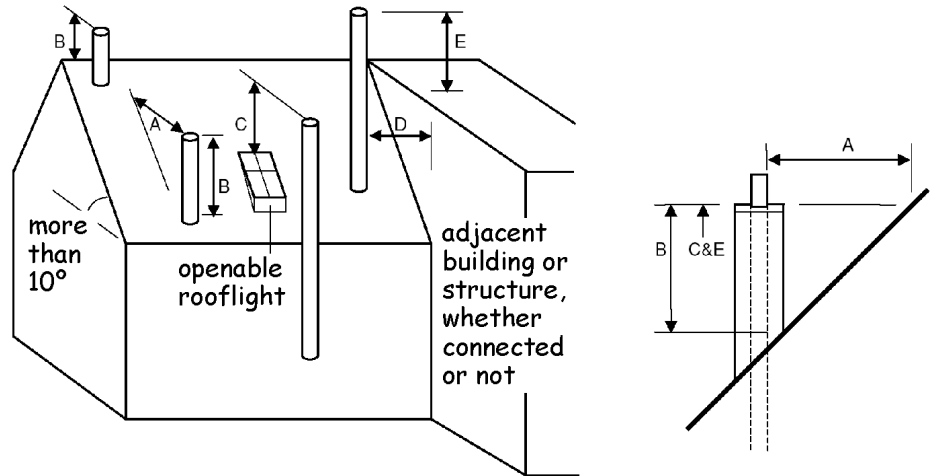
A *flue* terminal should be protected with a guard if a person could come into contact with it or if it could be damaged. If the *flue* outlet is in a vulnerable position, such as where the *flue* discharges within reach of the ground, or a balcony, veranda or window, it should be designed to prevent the entry of matter that could obstruct the flow of gases.

3.20.16 Terminal discharge from condensing boilers

The condensate plume from a condensing boiler can cause damage to external surfaces of a *building* if the terminal location is not carefully considered. The manufacturer's instructions should be followed.

3.20.17 Solid fuel appliance flue outlets

The outlet from a *flue* should be located externally at a safe distance from any opening, obstruction or flammable or vulnerable materials. The outlets should be located in accordance with the following diagram:



Minimum dimension to flue outlets

- A 2.3 m horizontally clear of the weather skin.

- B 1.0 m provided A is satisfied; or 600 mm where above the ridge. However, where the roof is thatch or shingles, the dimensions should be as diagram 2 to clause 3.20.17.

- C 1.0 m above the top of any *flat roof* ; and 1.0 m above any openable rooflight, dormer or ventilator , etc. within 2.3 m measured horizontally.

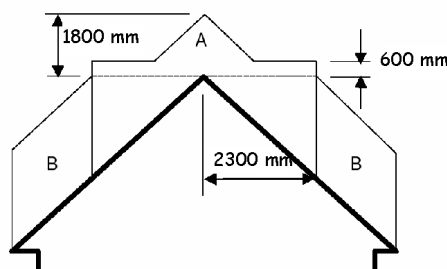
- D/E where D is not more than 2.3 m, E must be at least 600 mm.

Notes:

1. Horizontal dimensions are to the surface surrounding the *flue*.
2. Vertical dimensions are to the top of the *chimney* terminal.

Combustible roof coverings

Flue terminals in close proximity to roof coverings that are easily ignitable, such as thatch or shingles, should be located outside Zones A and B in the following diagram:



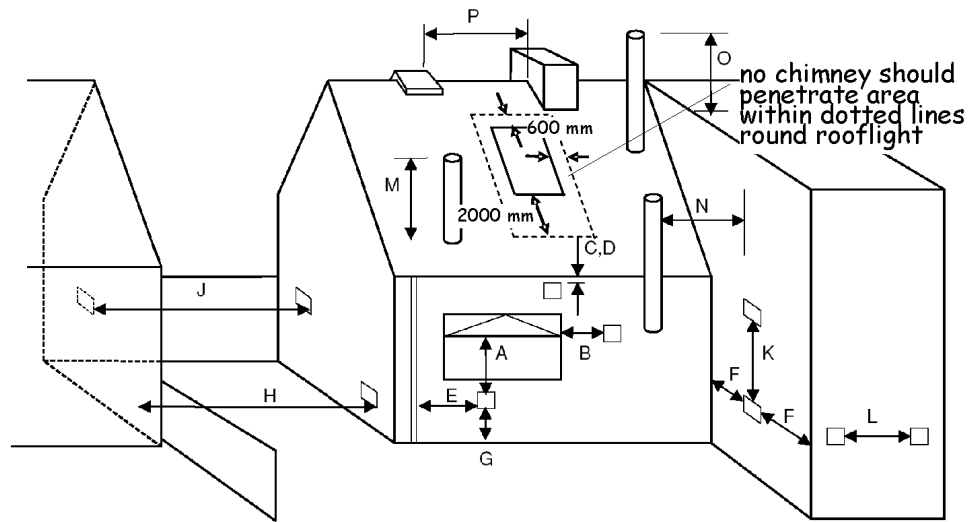
Location of flue terminals relative to easily ignitable roof coverings

- Zone A** At least 1.8 m vertically above the weather skin; and at least 600 mm above the ridge.

- Zone B** At least 1.8 m vertically above the weather skin; and at least 2.3 m horizontally from the weather skin.

3.20.18 Oil-firing appliance flue outlets

The outlet from a *flue* should be located externally at a safe distance from any opening, obstruction or combustible material. The outlets should be located in accordance with the following diagram:



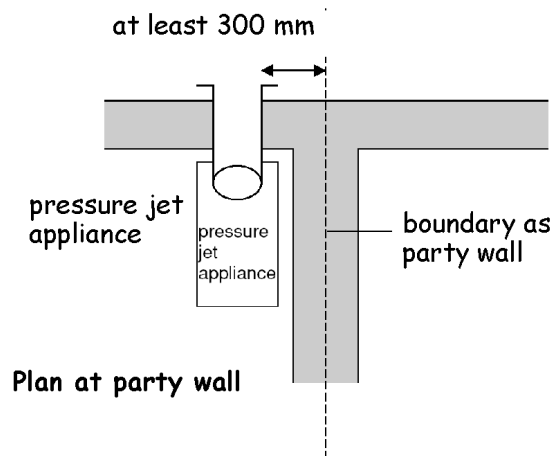
| Location | Minimum distance to terminal (mm) | |
|---|-----------------------------------|-------------|
| | pressure jet | vapourising |
| A Directly below an opening, air brick, opening window etc | 600 | Not allowed |
| B Horizontally to an opening, air brick, opening window etc | 600 | Not allowed |
| C Below a gutter, eaves or balcony with protection | 75 | Not allowed |
| D Below a gutter, eaves or balcony without protection | 600 | Not allowed |
| E From vertical sanitary pipework | 300 | Not allowed |
| F From an internal or external corner | 300 | Not allowed |
| G Above ground or balcony level | 300 | Not allowed |
| H From a surface or <i>boundary</i> facing the terminal | 600 [6] | Not allowed |
| J From a terminal facing the terminal | 1200 | Not allowed |
| K Vertically from a terminal on the same wall | 1500 | Not allowed |
| L Horizontally from a terminal on the same wall | 750 | Not allowed |
| M Above the highest point of an intersection with the roof | 600 [1] | 1000 [7] |
| N From a vertical structure to the side of the terminal | 750 [1] | 2300 |
| O Above a vertical structure not more than 750 mm from the side of the terminal | 600 [1] | 1000 [7] |
| P From a ridge terminal to a vertical structure on the roof | 1500 | Not allowed |

Notes:

1. Appliances burning Class D oil should discharge the *flue* gases at least 2 m above ground level.
2. Terminating positions M, N, and O for vertical balanced *flues* should be in accordance with manufacturer's instructions.
3. Vertical structure in N, O and P includes tank or lift rooms, parapets, dormers etc.
4. Terminating positions A to L should only be used for appliances that have been approved for low-level *flue* discharge when tested in accordance with BS EN 303-1: 1999, [OFS A100](#) or [OFS A101](#).
5. Terminating positions should be at least 1800 mm from an oil storage tank unless a wall with

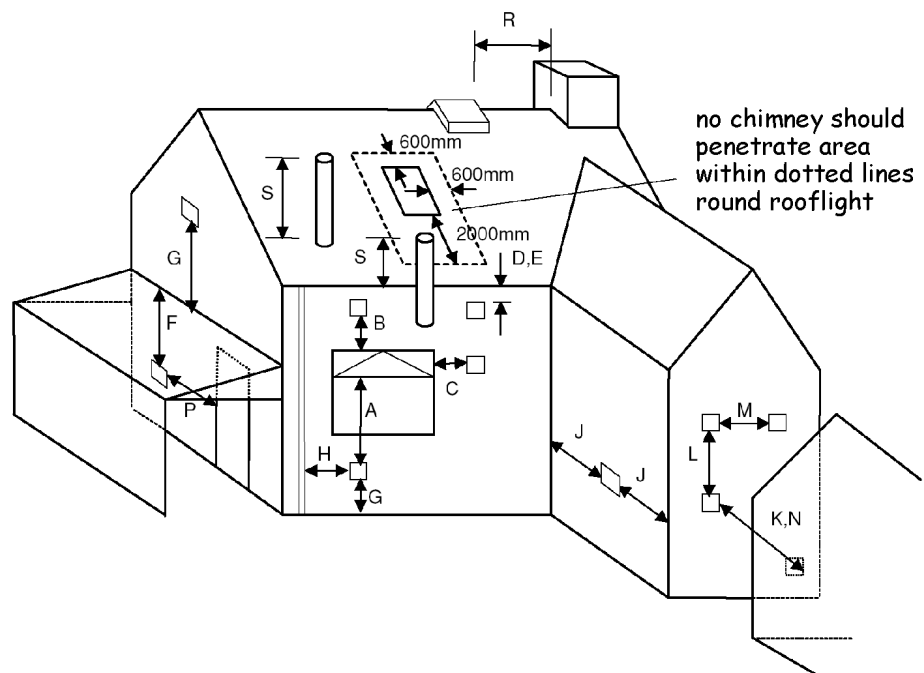
a *non-combustible construction* type 7, short duration (see table to 2B1) and more than 300 mm higher and wider each side than the tank is provided between the tank and the terminating position.

6. Where a *flue* terminates not more than 600 mm below a projection and the projection is plastic or has a combustible finish, then a heat shield of at least 750 mm wide should be fitted.
7. The distance from an appliance terminal installed at right angles to a *boundary* may be reduced to 300 mm in accordance with diagram 2 to clause 3.20.16.
8. Where a terminal is used with a vaporising burner, a horizontal distance of at least 2300 mm should be provided between the terminal and the roof line.
9. Notwithstanding the dimensions above, a terminal should be at least 300 mm from combustible material.



3.20.19 Gas-fired appliance flue outlets

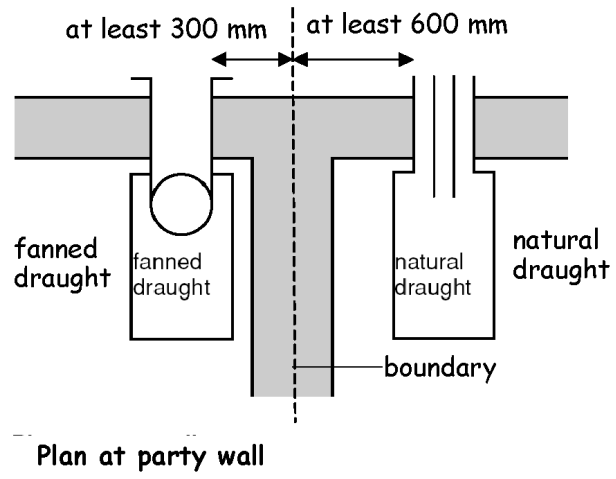
The outlet from a *flue* should be located externally at a safe distance from any opening, obstruction or combustible material. The outlets should be located in accordance with the following diagram:



| Location | | Minimum distance to terminal in millimetres | | | |
|----------|--|--|----------------|-----------------|----------------|
| | | Balanced flue, room-sealed appliance | | Open flue | |
| | | Natural draught | Fanned draught | Natural draught | Fanned draught |
| A | Directly below an opening, air brick, opening window, etc | (0-7 kW) 300 (>7-14 kW) 600 (>14-32 kW) 1500 (>32-70 kW) 2000 | 300 | n/all | 300 |
| B | Above an opening, air brick, opening window, etc | (0-32 kW) 300 (>32-70 kW) 600 | 300 | n/all | 300 |
| C | Horizontally to an opening, air brick, opening window, etc | (0-7 kW) 300 (>7-14 kW) 400 (>14-70 kW) 600 | 300 | n/all | 300 |
| D | Below a gutter, or sanitary pipework | 300 [2] | 75 [1] | n/all | 75 [1] |
| E | Below the eaves | 300 [2] | 200 | n/all | 200 |
| F | Below a balcony or <i>carport</i> roof | 600 | 200 | n/all | 200 |
| G | Above ground, roof or balcony level | 300 | 300 | n/all | 300 |
| H | From vertical drain/soil pipework | 300 | 150 [3] | n/all | 150 |
| J | From an internal or external corner | 600 | 300 | n/all | 200 |
| K | From a surface or <i>boundary</i> facing the terminal [4] | 600 | 600 [5] | n/app | 600 |
| L | Vertically from terminal on same wall | 1500 | 1500 | n/app | 1500 |
| M | Horizontally from terminal on same wall | 300 | 300 | n/app | 300 |
| N | From a terminal facing the terminal | 600 | 1200 [6] | n/app | 1200 |
| P | From an opening in a <i>carport</i> (e.g. door, window) into the <i>building</i> | 1200 | 1200 | n/app | 1200 |
| R | From a vertical structure on the roof [7] | n/app | n/app | [Note 8] | n/app |
| S | Above an intersection with the roof | n/app | [Note 9] | [Note 10] | 150 |

Notes:

- Notwithstanding the dimensions in the table, a terminal serving a natural draught and fanned draught appliance of more than 3 kW heat input, should be at least 300 mm and 150 mm respectively from combustible material.
- Where a natural draught *flue* terminates not more than 1m below a plastic projection or not more than 500 mm below a projection with a painted surface, then a heat shield at least 1 m long should be fitted.
- This dimension may be reduced to 75 mm for appliances of up to 5 kW heat input.
- The products of combustion should be directed away from discharging across a *boundary*.
- The distance from a fanned draught appliance terminal installed at right angles to a *boundary* may be reduced to 300 mm in accordance with diagram 2 to clause 3.20.17
- The distance of a fanned *flue* terminal located directly opposite an opening in a *dwelling* should be at least 2 m.
- Vertical structure includes a *chimney-stack*, dormer window, tank room, lift motor room or parapet.
- 1500 mm if measured to a roof terminal, otherwise as Table 2 in BS 5440-1: 2000.
- To manufacturer's instructions.
- As Table 2 in BS 5440-1: 2000
- n/all = not allowed. n/app = not applicable.



3.21 Combustion appliances – air for combustion

- 3.21 Functional standard
- 3.21.0 Introduction
- 3.21.1 Supply of air for combustion generally
- 3.21.2 Supply of air for combustion to solid fuel appliances
- 3.21.3 Supply of air for combustion to oil-firing appliances
- 3.21.4 Supply of air for combustion to gas-fired appliances

standard

3.21

mandatory

Every *building* must be designed and *constructed* in such a way that each fixed combustion appliance installation receives air for combustion and operation of the *chimney* so that the health of persons within the *building* is not threatened by the build-up of dangerous gases as a result of incomplete combustion.

3.21.0 Introduction

All combustion appliances need ventilation to supply them with oxygen for combustion. This air, which must be replaced from outside the *dwelling*, generally comes from the *room* in which the combustion appliance is located although many appliances are now located in specially *constructed* cupboards or *appliance compartments*. Ventilation of these cupboards or *appliance compartments* is essential to ensure proper combustion. Ventilation is also needed to ensure the proper operation of *flues*, or in the case of *flueless* appliances, to ensure the products of combustion are safely dispersed to the outside air.

Failure to provide adequate replacement air to a room can result in the accumulation of poisonous carbon monoxide fumes.

Conservatories

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

3.21.1 Supply of air for combustion generally

A room containing an open-flued appliance may need permanently open air vents. An open-flued appliance needs to receive a certain amount of air from outside dependant upon its type and rating. Infiltration through the *building* fabric may be sufficient but above certain appliance ratings permanent openings are necessary.

Ventilators for combustion should be located so that occupants are not provoked into sealing them against draughts and noise. Discomfort from draughts can be avoided by placing vents close to appliances e.g. floor *ventilators*, by drawing air from intermediate spaces such as hallways or by ensuring good mixing of incoming air. Air vents should not be located within a fireplace recess except on the basis of specialist advice. Noise attenuated *ventilators* may be needed in certain circumstances.

Appliance compartments *Appliance compartments* that enclose open-flued appliances should be provided with vents large enough to admit all the air required by the appliance for combustion and proper *flue* operation, whether the compartment draws air from the *room* or directly from outside.

The installation of a mechanical extract system should be checked against the recommendations in clause 3.17.8.

3.21.2 Supply of air for combustion to solid fuel appliances

A solid fuel appliance installed in a *room* or space should have a supply of air for combustion by way of *permanent ventilation* either direct to the open air or to an adjoining space (including a sub-floor space) that is itself *permanently ventilated* direct to the open air. An air supply should be provided in accordance with the following table:

Supply of air for combustion

| Type of appliance | Minimum ventilation opening sizes [2] |
|-------------------------------------|---|
| Open appliance without a throat [1] | A permanent air entry opening or openings with a total free area of 50% of the cross-sectional area of the <i>flue</i> . |
| Open appliance with a throat [1] | a permanent air entry opening or openings with a total free area of 50% of the throat opening area. |
| Any other solid fuel appliance | a permanent air entry opening or openings with a total free area of 550 mm ² for each kW of combustion appliance rated output more than 5 kW. (A combustion appliance with an output rating of not more than 5 kW has no minimum requirement, unless stated by the appliance manufacturer) |

Notes:

1. THROAT means the contracted part of the *flue* lying between the fireplace opening and the main *flue*.
2. Where a draught stabiliser is fitted to a solid fuel appliance, or to a *chimney* or *flue-pipe* in the same *room* as a solid fuel appliance, additional ventilation opening should be provided with a free area of at least 300 mm²/kW of solid fuel appliance rated output.
3. Nominal fire size is related to the free opening width at the front of the fireplace opening.

3.21.3 Supply of air for combustion to oil-firing appliances

An oil-firing appliance installed in a *room* or space should have a supply of air for combustion by way of *permanent ventilation* either direct to the open air or to an adjoining space which is itself *permanently ventilated* direct to the open air. This also includes a sub-floor space. However this may not be necessary if it is a *room-sealed appliance*. An air supply should be provided in accordance with the recommendations in BS 5410: Part 1: 1997 or OFTEC Technical Information Sheets [TI/112](#) and [TI/132](#).

3.21.4 Supply of air for combustion to gas-fired appliances

A gas-fired appliance installed in a *room* or space should have a supply of air for combustion. An air supply should be provided in accordance with the following recommendations:

- a. BS 5871: Part 3: 2005, for a *decorative fuel-effect gas appliance*;
- b. BS 5871: Part 2: 2005, for an inset live fuel-effect gas appliance;
- c. BS 5440: Part 2: 2000, for any other gas-fired appliance.

3.22 Combustion appliances – air for cooling

- 3.22 Functional standard
- 3.22.0 Introduction
- 3.22.1 Appliance compartments
- 3.22.2 Supply of air for cooling to oil-firing appliances
- 3.22.3 Supply of air for cooling to gas-fired appliances

standard
3.22
mandatory

Every *building* must be designed and *constructed* in such a way that each fixed combustion appliance installation receives air for cooling so that the fixed combustion appliance installation will operate safely without threatening the health and safety of persons within the *building*.

3.22.0 Introduction

In some cases, combustion appliances may need air for cooling in addition to air for combustion. This air will keep control systems in the appliance at a safe temperature and/or ensure that casings remain safe to touch.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

3.22.1 Appliance compartments

Where appliances require cooling air, appliance compartments should be large enough to enable air to circulate and high and low level vents should be provided.

3.22.2 Supply of air for cooling to oil-firing appliances

An oil-firing appliance installed in an *appliance compartment* should have a supply of air for cooling by way of *permanent ventilation*, in addition to air for combustion, either direct to the open air or to an adjoining space. This also includes a sub-floor space. Air for cooling should be provided in accordance with the recommendations in BS 5410: Part 1: 1997 and in OFTEC Technical Information Sheet [TI/132](#) for an oil-firing appliance located in an *appliance compartment*.

3.22.3 Supply of air for cooling to gas-fired appliances

A gas-fired appliance installed in an *appliance compartment* should have supply of air for cooling. Air for cooling should be provided in accordance with the recommendations in BS 5440: Part 2: 2000 for a gas-fired appliance located in an *appliance compartment*.

3.23 Fuel storage – protection from fire

- 3.23 Functional standard
- 3.23.0 Introduction
- 3.23.1 Separation of oil tanks from buildings and boundaries
- 3.23.2 Additional fire protection
- 3.23.3 Storage within a building
- 3.23.4 Bulk storage of woody biomass fuel

standard
3.23
mandatory

Every *building* must be designed and *constructed* in such a way that:

- (a) an oil storage installation, incorporating oil storage tanks used solely to serve a fixed combustion appliance installation providing space heating or cooking facilities in a *building*, will inhibit fire from spreading to the tank and its contents from within, or beyond, the *boundary*.
- (b) a container for the storage of woody biomass fuel will inhibit fire from spreading to its contents from within, or beyond the *boundary*.

Limitation:

This standard does not apply to portable containers.

3.23.0 Introduction

The guidance on oil relates only to its use solely where it serves a combustion appliance providing space heating or cooking facilities in a *building*. There is other legislation covering the storage of oils for other purposes. Heating oils comprise Class C2 oil (kerosene) or Class D oil (gas oil) as specified in BS 2869: 2006.

It is considered unlikely that a fire will originate from the stored oil. It is the purpose of this guidance therefore, to ensure that a fire that may originate from a *building*, or other external source, is not transferred to the tank contents, or if a fire does occur, its effects are limited.

Woody biomass

The acceptance of climate change and the environmental policies put in place to mitigate its impacts are pushing the commercial introduction of renewable energy technologies to displace the use of fossil fuels and the related combustion emissions of greenhouse gases. Woody biomass can be used as an alternative to fossil fuels and in some EU countries biomass fuel is the principal source of renewable energy for heating applications. The carbon dioxide emitted when biomass is burnt can be considered to be offset by the carbon dioxide absorbed as trees grow. Whilst this does not compensate for the energy used in processing the wood for fuel, the carbon dioxide emissions are considerably less than those of fossil fuels.

The use of woody biomass, in the form of wood chips, wood pellets, and logs may offer a viable alternative to fossil fuels, particularly in areas not served by the gas grid, although the supply and distribution of chips and pellets is, as yet, still developing with increasingly more suppliers available .

www.sbsa.gov.uk

Information of the different types of woody biomass fuel can be found on the SBSA web site under: '[Storage of woody biomass fuel for heating equipment](#)'

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

3.23.1 Separation of oil tanks from buildings and boundaries

Every fixed oil tank with a capacity of more than 90 litres should be located at a distance from a *building* to reduce the risk of the fuel that is being stored from being ignited if there is a fire in the *building*. Some fire protection to, or for, the *building* is required if the oil tank is located close to the *building*. Further guidance may be obtained from OFTEC Technical Information Sheet [TI/136](#), Fire protection of oil storage tanks.

Precautions should also be taken when an oil storage tank is located close to a *boundary*. The installation of a tank should not inhibit full development of a neighbouring plot.

Large tanks

An oil tank with a capacity of more than 3500 litres should be located in accordance with the recommendations in BS 5410: Part 2: 1978.

Small tanks

An oil tank with a capacity of not more than 3500 litres should be located in accordance with the following table:

Location of oil storage tank not more than 3500 litres capacity

| Location of tank | Protection recommended | |
|---|--|---|
| | Buildings without openings | Buildings with openings |
| Not more than 1.8 m from any part of any building | <i>non-combustible</i> base; and any part of the eaves not more than 1.8 m from the tank and extending 300 mm beyond each side of the tank must be <i>non-combustible</i> ; and, either: a. any part of a <i>building</i> not more than 1.8 m from the tank should be of <i>non-combustible construction</i> type 7, short duration [2], or b. a barrier [1] | <i>non-combustible</i> base; and any part of the eaves not more than 1.8 m from the tank and extending 300 mm beyond each side of the tank must be <i>non-combustible</i> ; and a barrier between the tank and any part of a <i>building</i> not more than 1.8 m from the tank. |
| More than 1.8 m from any <i>building</i> | <i>non-combustible</i> base | |
| Not more than 760 mm from a <i>boundary</i> | <i>non-combustible</i> base, and a barrier, or a wall with a <i>non-combustible construction</i> type 7, short duration [2]. | |
| More than 760 mm from a <i>boundary</i> | <i>non-combustible</i> base | |
| Externally, wholly below ground | no protection required | |

Notes:

1. BARRIER means an imperforate, *non-combustible* wall or screen at least 300 mm higher and extending 300 mm beyond either end of the tank, *constructed* so as to prevent the passage of direct radiated heat to the tank.
2. see section 2: Fire, annex 2.B.1

3.23.2 Additional fire protection

The fuel feed system from the storage tank to the combustion appliance is also a potential hazard in the event of fire. The fire valve on the fuel feed, should be fitted in accordance with Clause 8.3 of BS 5410: Part 1: 1997 and OFTEC Technical Information Sheet [TI/138](#).

Oil pipelines located inside a *building* should be run in copper or steel pipe. The recommendations of Clause 8.2 of BS 5410: Part 1: 1997 should be followed.

Fire can also spread to an oil storage tank along the ground. Provision should therefore be made to prevent the tank becoming overgrown such as a solid, *non-combustible* base in full contact with the ground. A base of concrete at least 100 mm thick or of paving slabs at least 42 mm thick that extends at least 300 mm beyond all sides of the tank would be appropriate. However, where the tank is within 1 m of the *boundary* and not more than 300 mm from a barrier or a wall of *non-combustible construction* type 7, short duration (see table to section 2: Fire, annex 2.B.1), the base need only extend as far as the barrier or wall.

3.23.3 Storage within a building

Where a storage tank is located inside a *building*, additional safety provisions should be made including the following:

- a. the place where the tank is installed should be treated as a place of special fire risk; and
- b. the space should be ventilated to the external air; and
- c. the space should have an outward opening door that can be easily opened without a key from the side approached by people making their escape; and
- d. there should be sufficient space for access to the tank and its mountings and fittings; and
- e. a catchpit as described in standard 3.24.

Guidance on protection from spillage is provided to standard 3.24.

Further guidance may be obtained from OFTEC Technical Information Sheet [TI/127](#): Garage installations.

3.23.4 Bulk storage of woody biomass fuel

By its very nature woody biomass fuel is highly combustible and precautions need to be taken to reduce the possibility of the stored fuel igniting. To ensure maximum energy from the fuel, storage should be designed to be damp free and improve or maintain the moisture content of the fuel at time of delivery. To inhibit the spread of fire to the contents, bulk storage for wood fuels should be in containers in accordance with following table:

Bulk storage of woody biomass fuel

| Location of store | Protection recommended |
|---|---|
| External and not more than 1.8 m from any part of any <i>building</i> | a. any part of the building eaves not more than 1.8 m from the container or storage space and extending 300 mm beyond each side of the container or storage space should be <i>non-combustible</i> ; and b. a barrier [1] |
| External not more than 1 m from any <i>boundary</i> . | the container or storage frame should be <i>constructed</i> to have short fire resistance duration to its <i>boundary</i> walls. |
| Within a <i>building</i> | a. separated from the <i>building</i> with internal wall <i>constructions</i> providing short fire resistance duration type 4 [2]; and b. any door to be outward opening providing short fire resistance duration type 6 [2]; and c. separated from the <i>building</i> with floor <i>constructions</i> providing short fire resistance duration type 2 [2]; and d. <i>external walls constructed</i> that provide short fire resistance duration type 7 or type 8 [2] as appropriate. |

Notes:

1. BARRIER means an imperforate, *non-combustible* wall or screen at least 300 mm higher than and extending 300 mm beyond either end of the container or storage space *constructed* so as to prevent the passage of direct radiated heat.
2. see section 2: Fire, annex 2.B.1

Protection for pellets

Wood pellets can be damaged during delivery thus producing dust that can cause an explosion and precautions need to be taken to reduce this risk. Once a year any dust that has collected in the store should be removed.

Storage containers for wood pellets, where they are to be pumped from a transporter to the container, should include a protective rubber mat over the wall to reduce damage to the pellets when they hit the wall. Containers should have an outward opening door incorporating containment to prevent the pellets escaping when the door is opened.

Automated supply

To maintain fire proof storage and prevent back-burning there should be an interruption to the fuel transport system normally by use of a star-feeder or chute for the fuel to fall into the boiler. The installation should be in accordance with the safety standards described in BS EN 303-5: 1999.

Small installations

Delivery of woody biomass fuel in bags would only be economical for small installations such as the suggestion in the guidance to standard 6.2 for the use of a small woody biomass stove or boiler as secondary heating providing 10% of the annual heating demand. The woody biomass fuel should be stored separately from the boiler that the fuel feeds for fire safety reasons.

3.24 Fuel storage – containment

- 3.24 Functional standard
- 3.24.0 Introduction
- 3.24.1 Construction of oil storage tanks
- 3.24.2 Installation of oil storage tanks
- 3.24.3 Secondary containment
- 3.24.4 Storage containers for solid woody biomass fuel

standard
3.24
mandatory

Every *building* must be designed and *constructed* in such a way that:

(a) an oil storage installation, incorporating oil storage tanks used solely to serve a fixed combustion appliance installation providing space heating or cooking facilities in a *building* will: reduce the risk of oil escaping from the installation; contain any oil spillage likely to contaminate any water supply, ground water, watercourse, drain or sewer; and permit any spill to be disposed of safely;

(b) the volume of woody biomass fuel storage allows the number of journeys by delivery vehicles to be minimised.

Limitation:

This standard does not apply to portable containers.

3.24.0 Introduction

Oil is a common and highly visible form of water pollution. Because of the way it spreads, even a small quantity can cause a lot of harm to the aquatic environment. Oil can pollute rivers, lochs, groundwater and coastal waters killing wildlife and removing vital oxygen from the water.

Groundwater directive

Oil is a 'List I' substance within the meaning of the [EC Groundwater Directive \(80/68/EEC\)](#). The UK government is required by this directive to prevent List I substances from entering groundwater and to prevent groundwater pollution by List II substances.

Storage of oil authorisation

The storage of oil is a controlled activity under the [Water Environment \(Controlled Activities\)\(Scotland\) Regulations 2005](#) and will be deemed to be authorised if it complies with [The Water Environment \(Oil Storage\)\(Scotland\) Regulations 2006](#). Enforcement is by SEPA.

Explanation of terms

The following terms are included below to provide clarity to their meaning in this Technical Handbook.

Catchpit means a pit, without a drain, which is capable of containing 110% of the containers storage capacity with base and walls that are impermeable to water and oil.

Integrally bunded tank means a tank together with a catchpit manufactured as a self-contained unit.

Woody biomass storage
www.sbsa.gov.uk

Woody biomass fuel is unlikely to be locally sourced, except for chopped firewood, and for large installations is likely to be delivered in bulk. If the storage container is too small, the number of journeys by delivery vehicles will make unnecessary use of diesel fuel. Wood chips tend to be used in large boilers supplying heat to district heating systems rather than to individual *houses*. Information on woody biomass fuel can be found on the SBSA web site under: '[Storage of woody biomass fuel for heating equipment](#)'.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

3.24.1 Construction of oil storage tanks

Fixed oil storage tanks between 90 and 2500 litres and the fuel feed system connecting them to a combustion appliance should be strong enough to resist physical damage and corrosion so that the risk of oil spillage is minimised. Tanks should be *constructed* in accordance with:

- a. the recommendations of BS 799: Part 5: 1987, for a steel tank; or
- b. the recommendations of OFTEC Technical Standard [OFS T200](#), for a steel tank, with or without integral bunding; or
- c. the recommendations of OFTEC Technical Standard [OFS T100](#), for a polyethylene tank with or without integral bunding; or
- d. a European harmonised product standard and assessed by a *notified body*.

3.24.2 Installation of oil storage tanks

Large tanks

Tanks of more than 2500 litres, and their associated pipework must be installed in accordance with the requirements of Regulation 6 of [The Water Environment \(Oil Storage\)\(Scotland\) Regulations 2006](#). Oil storage containers up to 2500 litres serving domestic buildings will be deemed to be authorised if they comply with the building regulations.

Small tanks

Tanks with a capacity of more than 90 litres but not more than 2500 litres and the fuel feed system connecting them to a combustion appliance should be installed in accordance with the recommendations of BS 5410: Part 1: 1997.

Underground tanks

Reference should be made to the [Scottish Executive Code of Practice, Underground Storage Tanks for Liquid Hydrocarbons \(2003/27\)](#). This CoP provide guidance on underground and partially buried oil storage tanks. The CoP is currently being updated to be consistent with [The Water Environment \(Controlled Activities\)\(Scotland\) Regulations 2005](#) and will be issued by SEPA. SEPA also provide guidance in [PPG 27](#), (Installation, Decommissioning and Removal of Underground Storage Tanks).

Care should be taken to prevent leakage from pipework. Pipework should be run so as to provide the most direct route possible from the tank to the burner. Joints should be kept to a minimum and the use of plastic coated malleable copper pipe is recommended. Pipework should be installed in accordance with the recommendations in BS 5410: Parts 1: 1997 and Part 2: 1978 and OFTEC [Technical Book 3](#).

3.24.3 Secondary containment

Externally located, above ground, oil tanks with a capacity of not more than 2500 litres serving a *domestic building* should be provided with a catchpit or be integrally bunded if subject to any of the hazards described below:

- tank located within 10 m of the water environment (i.e. rivers, lochs, coastal waters);
- tank located where spillage could run into an open drain or to a loose fitting manhole cover;
- tank within 50 m of a borehole or spring;
- tank over ground where conditions are such that oil spillage could run-off into a watercourse;
- tank located in a position where the vent pipe outlet is not visible from the fill point;
- any other potential hazard individual to the site.

OFTEC publication [T14](#) (Domestic Oil Storage Tank Spillage and Fire 3.24.1 – 3.24.3 Assessment) provides a simple and helpful crosscheck to the above list.

A catchpit or integrally bunded tank should be provided in accordance with the recommendations of OFTEC Standard [OFS T100](#) and [OFS T200](#); and Clause 6.5 of BS 5410: Part 1: 1997.

Secondary containment should also be provided where a tank is within a *building* or wholly below ground.

3.24.4 Storage containers for solid woody biomass fuel

In order to best exploit the advantages achieved through the use of woody biomass as low carbon technology it is recommended that wood fuel storage provision is of a size that will ensure deliveries need not be made at intervals of less than 3 months for bulk storage and 6 months for small installations

Deliveries of wood pellets may be less frequent than deliveries of wood chips because pellets can have three times the calorific value of dry wood chips. Alternatively, the storage volume can be smaller for the same energy capacity.

The following table provides recommended size of storage for a variety of different *dwelling* types that will permit a large enough volume to be delivered whilst minimising vehicle movements. Advice on the sizing of storage for woody biomass fuel for larger *buildings* is given in the non-domestic Technical Handbook.

Bulk woody biomass fuel storage: 100% heating (primary) and DHW

| Dwelling size | Wood pellets | Wood chips | Logs - stacked |
|------------------------|--------------------|--------------------|------------------|
| < 80 m ² | 1.5 m ³ | 3.5 m ³ | 3 m ³ |
| 80 -160 m ² | 2 m ³ | 5 m ³ | 4 m ³ |
| > 160 m ² | 3 m ³ | 6 m ³ | 5 m ³ |

Notes:

- The figures in the table relate to deliveries made every 3 months.

The guidance to standard 6.2 suggests that to achieve the carbon emissions target, designers and developers may use on-site renewable energy technologies to supply up to 10% of the annual heating demand, rather than adopting slightly more demanding insulation standards for walls. A small woody biomass stove or boiler could provide this level of heating.

Secondary heating

The following table provides recommended size of storage for secondary heating for a variety of *dwelling* types:

Woody biomass fuel storage: secondary heating

| Dwelling size | Wood pellets | Wood chips | Logs - stacked |
|-------------------------|------------------------------|--------------------|--------------------|
| < 80 m ² | 0.3 m ³ (9 bags) | 1 m ³ | 0.5 m ³ |
| 80 - 160 m ² | 0.5 m ³ (13 bags) | 1.5 m ³ | 1 m ³ |
| > 160 m ² | 0.7 m ³ (16 bags) | 2 m ² | 1 m ³ |

Notes:

- The figures in the table relate to deliveries made every 6 months.

3.25 Solid waste storage

- 3.25 Functional standard
- 3.25.0 Introduction
- 3.25.1 Solid waste storage point
- 3.25.2 Enclosed storage
- 3.25.3 Solid waste collection point
- 3.25.4 Provision for washing down
- 3.25.5 Security against vermin

| | |
|--|---|
| <p style="text-align: center;">standard</p> <h1 style="text-align: center;">3.25</h1> <p style="text-align: center;">mandatory</p> | <p>Every <i>building</i> must be designed and <i>constructed</i> in such a way that accommodation for solid waste storage is provided which:</p> <p>(a) permits access for storage and for the removal of its contents;</p> <p>(b) does not threaten the health of people in and around the <i>building</i>; and</p> <p>(c) does not contaminate any water supply, ground water or <i>surface water</i>.</p> <p>Limitation: This standard applies only to a <i>dwelling</i>.</p> |
|--|---|

3.25.0 Introduction

The [Environmental Protection Act, 1990](#) gives powers to the waste collection authority to stipulate the type and number of containers to be used. The Act also empowers the waste collection authority to designate a collection point for removal of the waste and this is normally at the *curtilage* of the *dwelling*.

Since 1990, there has been a change in waste management initiatives. Huge amounts of solid waste are disposed of to landfill sites each year squandering valuable resources and contaminating the environment. The EU Landfill Directive sets ambitious targets for reducing the disposal of municipal waste to landfill and to fulfil its responsibilities, Scotland published the National Waste Plan in 1999. The aim of the Plan is to minimise the impact of waste on the environment, to improve resource use efficiency in Scotland and to remedy environmental injustices suffered by those who have to live with the consequences of a wasteful society. It sets out the basis for a fundamental shift in the way Scotland's resources are managed and establishes the direction of the Scottish Executive's policies for sustainable waste management to 2020. Some of the objectives are to:

- provide widespread segregated kerbside waste collection across Scotland;
- achieve 25% recycling and composting of municipal waste by 2006 and 55% by 2020 (35% recycling and 20% composting);
- reduce landfilling of municipal waste from around 90% to 30%;

Area Waste Plans set out the way that waste will be handled in 11 areas across Scotland. Implementation will be built around a working partnership between the Scottish Executive, SEPA, local government, industry and the community. Householders have a crucial part to play as waste producers and as consumers and they will need encouragement to allow these ambitious targets to be achieved. Several trials are already in operation and designers need to be aware of these local initiatives and make suitable provision in their designs. Two or more containers may be needed to store different types of waste and this could increase the spatial requirements for the storage area inside and outside the *dwelling*.

National Waste Plan

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

3.25.1 Solid waste storage point

Every *dwelling* should be provided with a solid, washable hard-standing large enough to accommodate a waste container (or containers) such as a wheeled bin or some other container as specified by the waste collection authority. The hard-standing and access to the contents of the container should be readily accessible to allow removal.

3.25.2 Enclosed storage

Where enclosures, compounds or storage rooms are provided they should allow space for filling and emptying and provide a clear space of at least 150 mm between and around the containers. Communal enclosures with a roof that are also accessible to people should be at least 2 m high while individual enclosures of wheeled bins only need to be high enough to allow the lid to open.

3.25.3 Solid waste collection point

The hard-standing may be a collection point designated by the waste collection authority where the container can be removed or emptied. If the hard-standing is not the collection point then there should be an accessible route along which the container can be transported to the collection point. Over a short distance in an urban area it would be reasonable to use the access to the *dwelling*. Over longer distances in the country, the container could be dropped off at the collection point using a vehicle as is normal for farms.

3.25.4 Provision for washing down

Where communal solid waste storage is located within a *building*, such as where a refuse chute is utilised, the storage area should have provision for washing down and draining the floor into a *wastewater* drainage system. Gullies should incorporate a trap that maintains a seal even during periods of disuse. Walls and floors should be of an impervious surface that can be washed down easily and hygienically. The enclosures should be *permanently ventilated* at the top and bottom of the wall.

3.25.5 Security against vermin

Any enclosure for the storage of waste should be so designed as to prevent access by vermin unless the waste is to be stored in secure containers with close fitting lids, such as wheeled bins. The enclosure should not permit a sphere of 15 mm diameter to pass through at any point.

3.26 Dungsteads and farm effluent tanks

- 3.26 Functional standard
- 3.26.0 Introduction
- 3.26.1 Construction of dungsteads and farm effluent tanks
- 3.26.2 Location of dungsteads and farm effluent tanks
- 3.26.3 Safety of dungsteads and farm effluent tanks

standard

3.26

mandatory

Every *building* must be designed and *constructed* in such a way that there will not be a threat to the health and safety of people from a dungstead and farm effluent tank.

3.26.0 Introduction

Silage effluent is the most prevalent cause of point source water pollution from farms in Scotland. A high portion of serious pollution incidents occur each year through failure to contain or dispose of effluent satisfactorily.

Collection, storage and disposal of farm effluent and livestock wastes are all stages when pollution can occur. These materials are generally classified by type of stock and physical form. This may be solid, semi-solid or liquid. Solids are stored in dungsteads that must be properly drained and the effluent collected in a tank while liquids are stored in tanks above or belowground. The container must be impermeable.

[Prevention of Environmental Pollution from Agricultural Activity](#)

The Code of Good Practice for the Prevention of Environmental Pollution from Agricultural Activity is a practical guide for farmers, growers, contractors and others involved in agricultural activities, on whom there is a statutory obligation to avoid causing pollution to the environment. The Code provides helpful guidance on the planning, design, *construction* management and land application of slurries and silage effluent that can give rise to pollution of water, air or soil environments. SEPA is the body responsible for enforcing these regulations.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

3.26.1 Construction of dungsteads and farm effluent tanks

Every dungstead or farm effluent tank, including a slurry or silage effluent tank should be *constructed* in such a manner so as to prevent the escape of effluent through the structure that could cause ground contamination or environmental pollution.

The *construction* should also prevent seepage and overflow that might endanger any water supply or watercourse.

3.26.2 Location of dungsteads and farm effluent tanks

Every dungstead or farm effluent tank, including a slurry or silage effluent tank should be located at a distance from a *dwelling* so as not to prejudice the health of people in the *dwelling*. The dungstead or farm effluent tank should be located at least 15 m from the *dwelling*.

3.26.3 Safety of dungsteads and farm effluent tanks

Where there is the possibility of injury from falls, a dungstead or farm effluent tank should be covered or fenced to prevent people from falling in. Covers or fencing should be in accordance with the relevant recommendations of Section 8 of BS 5502: Part 50: 1993.

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- 4.0 Introduction**
- 4.1 Access to buildings**
- 4.2 Access within buildings**
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- 4.4 Pedestrian protective barriers**
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- 4.6 Electrical fixtures**
- 4.7 Aids to communication**
- 4.8 Danger from accidents**
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- 4.10 Fixed seating**
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4.0 Introduction

- 4.0.1 Background
- 4.0.2 Aims
- 4.0.3 Latest changes
- 4.0.4 Relevant legislation

Introduction

4.0

4.0.1 Background

Safety has been defined by the International Standards Organisation as ‘a state of freedom from unacceptable risks of personal harm’. This recognises that no activity is absolutely safe or free from risk. No *building* can be absolutely safe and some risk of harm to users may exist in every *building*. Building standards seek to limit risk to an acceptable level by identifying hazards in and around *buildings* that can be addressed through the Building (Scotland) Regulations.

Deaths and serious injury to people in and around *buildings* occur in significant numbers from accidents involving falls, collisions, entrapment, scalding, electrocution or malfunction of fittings. Designers need to consider all aspects of design carefully to minimise risks inherent in any *building*.

Safety - good practice
www.rospa.com

Not all issues relating to good practice are covered in this Technical Handbook. Publications by organisations including the Royal Society for Prevention of Accidents (RoSPA) may offer further information relevant to the safety of occupants of, and visitors to, *buildings*.

Accessibility

Buildings should be designed to consider safety and the welfare and convenience of *building* users. An inclusive environment is one within which everyone, regardless of age, disability or circumstance, can make use of safely, conveniently and without assistance to the best of their ability. *Buildings* that consider future flexibility of use also contribute to the creation of a more sustainable housing stock, simplifying alterations. This can allow people to remain longer in their home, through changing circumstances, with the minimum of disruption and inconvenience.

The guidance in this section, together with the guidance in section 3, Environment relating to accessibility, has been based around, and developed from, issues that are included in ‘[Housing for Varying Needs](#)’ and the [Lifetime Homes](#) concept developed by the Joseph Rowntree Foundation.

[Access statements](#)

Promoted by the implementation of the Disability Discrimination Act, which applies to most non-domestic *buildings*, many designers and developers are becoming familiar with the use of an access statement as a means of assisting in the delivery of more inclusive *buildings*. This records how access issues have been considered and developed from project inception, through all stages of development, through to the final use of a *building*.

Where design proposals vary from guidance within this Handbook or, in the case of a *conversion* where a standard is to be met as far as is *reasonably practicable*, relevant information extracted from a project access statement may assist in determining compliance.

4.0.2 Aims

The intention of this section is to give recommendations for the design of *buildings* that will ensure access and usability and reduce the risk of accident. The standards within this section:

- ensure accessibility to and within *buildings* and that areas presenting risk through access are correctly guarded; and
- reduce the incidence of slips, trips and falls, particularly for those users most at risk; and
- ensure that electrical installations are safe in terms of the hazards likely to arise from defective installations, namely fire and loss of life or injury from electric shock or burns; and

- prevent the creation of dangerous obstructions, ensure that *glazing* can be cleaned and operated safely and to reduce the risk of injury caused by collision with *glazing* ; and
- safely locate hot water and steam vent pipe outlets, and minimise the risk of explosion through malfunction of unvented hot water storage systems and prevent scalding by hot water from *sanitary facilities* ; and
- ensure the appropriate location and *construction* of storage tanks for liquefied petroleum gas.

4.0.3 Latest changes

The following is a summary of the changes that have been introduced between 1 May 2006 and 30 April 2007

- 4.1 standard includes *houses* without *apartment* at entrance level
 - 4.1.1 revised guidance on accessible parking spaces
 - 4.1.2 introduction of guidance on car parking to a single *dwelling*
 - 4.1.3 introduction of guidance on complementary steps; further guidance on access to single *houses*
 - 4.1.4 additional guidance on tactile paving on accessible routes
 - 4.1.6 revised guidance on widths on accessible routes
 - 4.1.7 revised guidance on provisions at accessible entrances
 - 4.1.8 revised guidance on common entrances; addition of guidance on weather protection and door entry systems
 - 4.1.10 guidance on alterations now a separate clause
- 4.2 standard includes convenient access throughout a *dwelling*
 - 4.2.1 revised guidance on corridor widths in common areas
 - 4.2.2 introduction of guidance on floor surfaces within common areas
 - 4.2.3 revised guidance on size of lobbies within common areas
 - 4.2.4 revised guidance on doors within common areas
 - 4.2.5 clarification of when a passenger lift should be provided; additional guidance on lift provisions
 - 4.2.6 revised guidance now applied to all *storeys* of a *dwelling*
 - 4.2.7 clarification of means of access between *storeys*
 - 4.2.8 introduction of guidance on provision for future stair lifts
 - 4.2.9 revised guidance on split-level *storeys*
 - 4.2.10 introduction of guidance where accessible accommodation is not on the entrance level
 - 4.2.11 revised guidance on alteration and extension
- 4.3.3 revised guidance and clarification on width of stairs
- 4.3.6 guidance on stair landings consolidated
- 4.3.7 introduction of guidance on tactile paving at external steps
- 4.3.10 correction removing reference to centreline going on spiral stairs
- 4.3.11 revised guidance on ramps; guidance on sloping surfaces
- 4.3.12 revised guidance on width of ramps
- 4.3.13 revised guidance on length of ramp landings
- 4.3.14 revised guidance on handrails to *private stairs*
- 4.4.1 addition of guidance on changes of direction on a raised access route and clarification on form of guarding
- 4.4.2 clarification of barrier height in specific locations
- 4.4.3 guidance on guarding to ramp *flights* moved from standard 4.3

- 4.6 standard now includes health, safety and convenience
- 4.6.2 introduction of guidance on lighting in common areas
- 4.6.3 introduction of guidance seeking door entry system to any common entrance
- 4.6.4 revised guidance on provision of socket outlets
- 4.8 standard now includes manual controls for windows and electrical fixtures
- 4.8.1 improved guidance on guarding of obstructions
- 4.8.2 additional guidance on collision with *glazing*
- 4.8.3 clarification of guidance on safe cleaning of windows
- 4.8.5 introduction of guidance on height of controls to windows and rooflights and height of controls to electrical fixtures

4.0.4 Relevant legislation

Listed below are some pieces of legislation that may be relevant and/or helpful to those using the guidance in this particular Section.

[Electricity Safety, Quality & Continuity Regulations 2002](#)

The Electricity Safety, Quality & Continuity Regulations 2002 define the duties of any party supplying electricity to premises with regard to matters such as supply, equipment, protection and provision of earthing.

[The Gas Safety \(Installation and Use\) Regulations 1998](#)

The Gas Safety (Installations and Use) Regulations 1998 require that any person who installs, services, maintains, removes, or repairs gas fittings should be competent. It covers not only materials, workmanship, safety precautions and testing of gas fittings but also the safe installation of all aspects of gas-fired combustion appliance installations.

4.1 Access to buildings

- 4.1 Functional standard
- 4.1.0 Introduction
- 4.1.1 Accessible car parking to flats or maisonettes
- 4.1.2 Car parking within the curtilage of a dwelling
- 4.1.3 Accessible routes
- 4.1.4 Surfaces to accessible routes
- 4.1.5 Length of accessible routes
- 4.1.6 Width of accessible routes
- 4.1.7 Accessible entrances
- 4.1.8 Common entrances
- 4.1.9 Accessible thresholds
- 4.1.10 Alteration and extension

standard

4.1

mandatory

Every *building* must be designed and *constructed* in such a way that all occupants and visitors are provided with safe, convenient and unassisted means of access to the *building*.

Limitation:

There is no requirement to provide access for a wheelchair user to:

- (a) a *house*, between either the point of access to or from any car parking within the *curtilage* of a *building* and an entrance to the *house* where it is not *reasonably practicable* to do so; or
- (b) a common entrance of a *domestic building* not served by a lift, where there are no *dwellings* entered from a common area on the entrance *storey*.

4.1.0 Introduction

An inclusive approach to design should be taken to ensure that *buildings* are as accessible to as wide a range of people as possible. Solutions should be integral to a design rather than an afterthought added in order to meet duties under building standards or other legislation

Inclusive Design

Inclusive design is not just relevant to *buildings* . It applies throughout any internal or external environment, where people go about everyday activities.

It should be a continuous process, through all stages of the development of a *building* and involve potential users. Advice on this topic is available in the joint SBSA/Scottish Executive Planning Division Planning Advice Note [PAN 78: 'Inclusive Design'](#) which promotes the merits of an inclusive approach to the design of the *built* environment.

Whilst the guidance to this standard reflects general good practice, certain issues remain outwith the scope of the building regulations. There are numerous publications offering additional guidance on accessibility and inclusive design, including those listed below.

- BS 8300: 2001, as amended – ‘Design of buildings and their approaches to meet the needs of disabled people – code of practice’.
- [Housing for Varying Needs, Parts 1 & 2](#) – Communities Scotland.
- [Inclusive Mobility](#) – Department of Transport, 2002.
- ‘[Guidance on the Use of Tactile Paving Surfaces](#)’, published jointly by The Scottish Office and the Department for the Environment, Transport and the Regions (DETR).

Conversions

In the case of *conversions* , as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard in so far as is *reasonably practicable* , and in no case be worse than before the *conversion* (regulation 12, schedule 6).

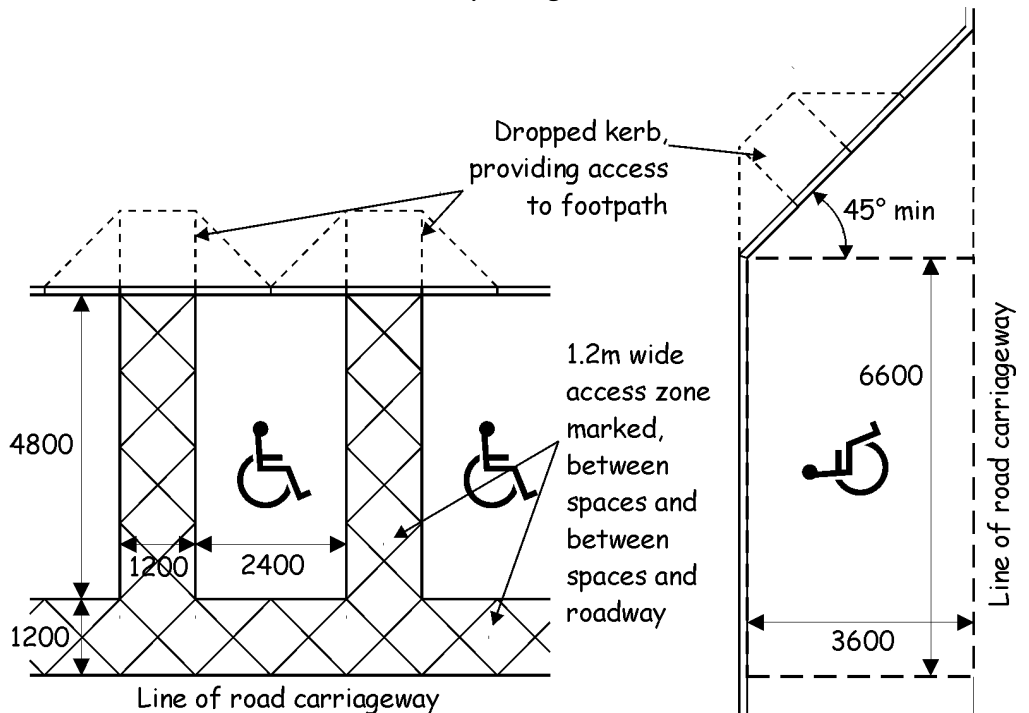
4.1.1 Accessible car parking to flats or maisonettes

The need for car parking serving a *domestic building* will commonly be determined by a developer and may also be a condition of planning permission. Where car parking is provided within the curtilage of a *building* containing *flats* or *maisonettes*, it should include accessible spaces.

A proportion of car parking spaces should be designed to be accessible to a person with mobility impairment, including a wheelchair user, and designated for use as such. These parking spaces should be:

- provided at a ratio of at least 1 per 20 parking spaces, or part thereof; and
- located on a *road* surface that is level (with a gradient of not more than 1 in 50); and
- not more than 45 m from a common entrance; and
- clearly marked with the international symbol of access; and
- provided with a dropped kerb access to an accessible route; and
- where perpendicular or at an angle to a *road*, at least 4.8 m long x 2.4 m wide, outwith which a delineated access zone at least 1.2 m wide to each long side and between the end of the bay and any *road* is shown; or
- where parallel to a *road*, at least 6.6 m long by 3.6 m wide, as shown below.

Off- and on-street accessible car parking



4.1.2 Car parking within the curtilage of a dwelling

Where car parking is provided within the *curtilage* of a *dwelling*, a person should be able to alight from a vehicle directly onto the firm surface of an accessible route to the *dwelling*.

Where a driveway or car parking space forms part of an accessible route to a *dwelling*, it should be at least 3.3 m wide to allow a 900 mm wide pedestrian route past a parked car. That portion of the driveway surface should be in accordance with the recommendations in clause 4.1.4.

4.1.3 Accessible routes

Regardless of how they arrive within the *curtilage* of a *building*, a person should then be able to travel conveniently and without assistance to an entrance of a *building*. Routes to a *building* that are too steep, too narrow or poorly surfaced, or that contain steps or other obstructions, will make access difficult or impossible for many people. To prevent this, a route to an entrance should be provided that is accessible to everyone.

An accessible route should contain no barriers, such as kerbs, steps or similar obstructions that may restrict access. Street furniture can present a hazard, particularly to a wheelchair user or a person with a visual impairment and should be located outwith the width of an accessible route. Use of low-level bollards or chain-linked posts, for example, can be particularly hazardous.

There should be an accessible route to the accessible entrance of a single *dwelling* from:

- a *road*; and
- any car parking within the *curtilage* of the *dwelling*.

There should be an accessible route to the common entrance of a *building* containing *flats* or *maisonettes* and to an accessible entrance of any *dwelling* not reached through a common entrance, from:

- a *road*; and
- any accessible car parking (see clause 4.1.1) within the *curtilage* of the *building*.

Gradient of accessible route

As steeper gradients are more difficult to negotiate, level or gently sloping routes should be used wherever possible, in preference to ramps. An accessible route should be:

- level, which for the purpose of this guidance is a gradient of not more than 1 in 50; or
- gently sloping, which for the purpose of this guidance is a gradient of more than 1 in 50 and not more than 1 in 20; or
- ramped, with a gradient of more than 1 in 20 and not more than 1 in 12.

The cross-fall on any part of an accessible route should not exceed 1 in 40.

Gently sloping gradients

Gently sloping gradients should be provided with level rest points of not less than 1.5 m in length, at intervals dependent on the gradient of the sloping surface. This should follow the same relationship given for ramp *flights*, e.g. up to 20 m apart for a slope of 1 in 30, 30 m for a slope of 1 in 40 and so on.

Recommendations for ramps are provided in the guidance to standard 4.3.

Complimentary steps

Ramps are not necessarily safe or convenient for an ambulant person with mobility impairment, and can be more difficult and dangerous to negotiate than steps. Therefore, on a route serving more than 1 *dwelling*, any ramped access having a rise of more than 300 mm should be complemented by an alternate, stepped means of access.

Stepped access to a single *house*

There may be stepped access to a route serving a single *house* where it is not *reasonably practicable* to construct an accessible route, such as on a steeply sloping *site*. As a guideline, if a ramp to an accessible entrance can be formed within the *curtilage* of the *dwelling* with one change in direction between the bottom of the ramp and the top landing, access should be considered *reasonably practicable*.

Where an accessible route cannot be provided from a *road*, it may still be practicable to *construct* an accessible route by providing a car parking space within the *curtilage* of the *dwelling*. It is only where it is not *reasonably practicable* to *construct* an accessible route from either a *road* or from car parking within the *curtilage* of the *dwelling* that a stepped access solution may be proposed.

4.1.4 Surfaces to accessible routes

For safety and convenience in use, the surface of an accessible route should be firm, uniform and of a material and finish that will permit ease in manoeuvring. It should provide a degree of traction that will minimise the possibility of slipping. This should take into account both anticipated use and environmental conditions.

The surface of an accessible route, whether composed of modular paving units, formless materials such as tarmac, or another durable material, should have a profile that will not offer a trip hazard or result in standing water. It should be installed in accordance with a code of practice relevant to the material, where such exists.

Surface elements such as drainage gratings and manhole covers should be of a type that will not create a trip or entrapment hazard. Uneven surfaces, such as cobbles, or loose-laid materials, such as gravel, will present difficulties to many people and should not be used.

Tactile paving

At a location where the footpath is level with a *road* surface, such as at a dropped kerb, tactile paving should be used to warn a person with a visual impairment of the presence of a vehicular route. This need not apply to a route within the *curtilage* of a single *dwelling*. Information on use of tactile paving on footpaths is given in '[Guidance on the Use of Tactile Paving Surfaces](#)'.

4.1.5 Length of accessible routes

The longer a pedestrian route, the greater difficulty it can present to many people. Therefore, in addition to minimising gradients where possible, as recommended in clause 4.1.3, the length of an accessible route to an accessible entrance of a *building* should be limited to 45 m.

4.1.6 Width of accessible routes

The width of a pedestrian route to a *building* should reflect how it will be used. For example, most public footpaths are at least 1.8 m wide, which allows two-way traffic under most circumstances.

The clear and unobstructed surface width of an accessible route should generally be at least 1.8 m, unless:

- giving access to not more than 10 *dwellings*, where the minimum surface width may be not less than 1.2 m. This will accommodate any person where traffic is in a single direction of travel. To allow for passing, localised widening of any route less than 1.8 m wide to at least 1.8 m should be made at any junction and change of direction and, where the whole length of the route is not visible, also at not more than 10 m intervals along the route; or
- giving access to a single *dwelling*, where effective width may be not less than 900 mm, recognising reduced levels of traffic.

On an accessible route serving more than one *dwelling*, a level footpath of not less than 1.0 m in width should be maintained to the rear of the slope of any dropped kerb.

Any gate across an accessible route should offer a clear opening width of at least 850 mm.

4.1.7 Accessible entrances

Each common entrance to a *domestic building* and at least one entrance to a *dwelling* should be an accessible, designed to present as little restriction to passage as possible.

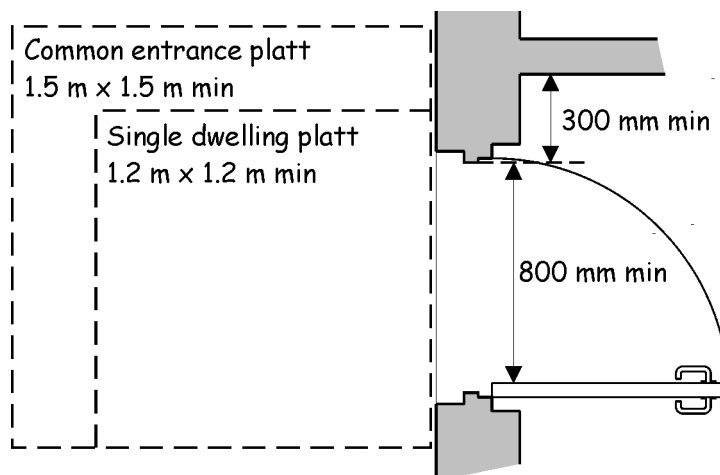
Whilst an accessible entrance to a *house* is commonly the front or main entrance, an alternate entrance may be designated as the accessible entrance where this provides a more convenient or practical route into the *dwelling*.

An accessible entrance to a *building* should:

- have an unobstructed entrance platt of at least 1.2 m by 1.2 m, with a crossfall of not more than 1 in 50, if required to prevent standing water; and
- have a means of automatic illumination above or adjacent to the door; and
- have an accessible threshold; and
- have a door leaf giving a clear opening width of at least 800 mm in accordance with the diagram below; and
- if fitted with a door closing device, be operable with an opening force of not more than 30 N (for first 30° of opening) and 22.5 N (for remainder of swing) when measured at the leading edge of any door leaf; and
- if not a powered door, have an unobstructed space to the opening face of the door, next to the leading edge, of at least 300 mm.

However, where there is not an accessible route to a single *house*, the guidance in subclauses a. and c. above need not be followed.

Accessible entrance door



Clear opening width

The projection of ironmongery which extends across the width of a door leaf, such as an emergency push bar for escape or a horizontal grab rail, should be subtracted when calculating the clear opening width.

4.1.8 Common entrances

In addition to the recommendations in clause 4.1.7, a common entrance to a *domestic building* should have:

- an unobstructed entrance platt, measuring at least 1.5 m by 1.5 m, with a crossfall of not more than 1 in 50 if required to prevent standing water; and
- a canopy, recessed entrance or similar means of protecting people entering the *building* from exposure to the elements; and
- a *glazed* vision panel, as described below; and
- a door entry system.

Weather protection

The form that weather protection should take will vary with location and exposure of the *building*. However, an example of minimum provision might be a canopy or recess, 750 mm deep, across the width of the entrance platt, with an underside not more than 2.3 m above entrance level. It is recognised that there are circumstances where provision of weather protection may not be practicable or may be constrained by other permissions.

Glazed vision panels

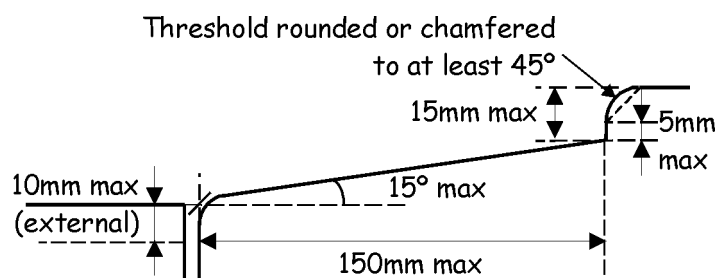
To assist in preventing collisions, a clear *glazed* vision panel or panels to a door should give a zone of visibility from a height of not more than 500 mm to at least 1.5 m above finished floor level. This may be interrupted by a solid element between 800 mm and 1.15 m above floor level. A vision panel is not needed to a powered door controlled by automatic sensors or where adjacent *glazing* offers an equivalent clear view to the other side of a door.

Guidance relevant to specific door types such as revolving doors or powered doors is given in the non-domestic Technical Handbook.

4.1.9 Accessible thresholds

To be accessible, a door should not present unnecessary barriers to use, such as a step or raised profile at a threshold that might present difficulties to a wheelchair user or be an entrapment or trip hazard to an ambulant person, whether or not using a walking aid.

Generic Threshold Profile



An accessible threshold should meet the following criteria:

- thresholds should be designed to prevent the ingress of rain. Details in the DETR publication '[Accessible Thresholds in New Housing](#)' gives guidance on how this might be achieved.
- externally, the surface of the platt should be not more than 10 mm below the leading edge of any sill, with any exposed edge chamfered or rounded;
- an external sill or internal transition unit should be at an angle of not more than 15° from the horizontal and, if sloping, be not more than 150 mm in length;
- the threshold should either be level or of a height and form that will neither

impede unassisted access by a wheelchair user nor create a trip hazard. A threshold piece should have a height of not more than 15 mm, with any vertical element of more than 5 mm height being pencil-rounded or chamfered to an angle of not more than 45° from the horizontal;

- if the finished internal floor level is more than 15 mm below the top of the threshold, an internal transition unit, of not more than 15° to the horizontal, finishing not more than 5 mm above the internal floor surface may be used, in accordance with the guidance above. In new *buildings*, this should normally only be needed to allow flexibility in subsequent fitting of differing thickness of floor coverings.

4.1.10 Alteration and extension

Where a *dwelling* is altered or extended, this *work* should not adversely affect an existing accessible entrance

Where a *dwelling* does not have an accessible entrance, one need not be provided to the existing *dwelling*, or to the extension, as this will not result in the *building* failing to meet the standard to a greater degree.

Where an accessible entrance exists, any *works* should ensure that the existing entrance remains accessible. If this is not possible, a new accessible entrance should be provided elsewhere into the *dwelling*. Such an entrance should also maintain accessibility within the *dwelling*, as set out in guidance to standard 4.2.

4.2 Access within buildings

- 4.2 Functional standard
- 4.2.0 Introduction
- 4.2.1 Horizontal circulation in common areas of domestic buildings
- 4.2.2 Floor surfaces in common areas of domestic buildings
- 4.2.3 Lobbies in common areas of domestic buildings
- 4.2.4 Doors within common areas of a domestic building
- 4.2.5 Vertical circulation in common areas of domestic buildings
- 4.2.6 Accessibility within a storey of a dwelling
- 4.2.7 Access between storeys in a dwelling
- 4.2.8 Unassisted access between storeys in a dwelling
- 4.2.9 Split level storeys
- 4.2.10 Dwellings with limited entrance storey accommodation
- 4.2.11 Alterations and extensions

standard
4.2
mandatory

Every *building* must be designed and *constructed* in such a way that:

- (a) in non-domestic *buildings*, safe, unassisted and convenient means of access is provided throughout the *building*;
- (b) in *residential buildings*, a proportion of the *rooms* intended to be used as bedrooms must be accessible to a wheelchair user;
- (c) in *domestic buildings*, safe and convenient means of access is provided within common areas and to each *dwelling*;
- (d) in *dwellings*, safe and convenient means of access is provided throughout the *dwelling*; and
- (e) in *dwellings*, unassisted means of access is provided to, and throughout, at least one level.

Limitation:

There is no requirement to provide access for a wheelchair user:

- (a) in a non-domestic *building* not served by a lift, to a *room*, intended to be used as a bedroom, that is not on an entrance *storey*; or
- (b) in a *domestic building* not served by a lift, within common areas and to each *dwelling*, other than on an entrance *storey*.

4.2.0 Introduction

Circulation areas within a *building* should allow occupants to move around freely and without difficulty, to the best of their ability. Lack of space can make movement around a *building* difficult for many people and hamper activities such as carrying or moving large items.

The design process should consider how the *building* can be used by as wide a range of people as possible, including use by a person in a wheelchair, though it is recognised that this may not be to the optimum standard that can be achieved within purpose-built *dwellings*.

Improvement to circulation within *dwellings* under this standard, together with the provision, on one level, of an enhanced *apartment*, and *kitchen* (standard 3.11) and accessible *sanitary accommodation* (standard 3.12) will assist in creating more sustainable homes.

Whilst the guidance to this standard reflects general good practice, certain issues remain outwith the scope of the building regulations. There are numerous publications offering additional guidance on accessibility and inclusive design, including those listed below.

- BS 8300: 2001, as amended – ‘Design of buildings and their approaches to meet the needs of disabled people – code of practice’.
- [Housing for Varying Needs, Parts 1 & 2](#) – Communities Scotland.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard in so far as is *reasonably practicable*, and in no case be worse than before the *conversion* (regulation 12, schedule 6).

4.2.1 Horizontal circulation in common areas of domestic buildings

The common areas of *domestic buildings* containing *flats* or *maisonettes*, though often secured against unauthorised entry, remain in effect a public or shared area. As an enclosed space, it is important that provisions made on the approach to the *building* are maintained within these areas.

There should be level or ramped access within the common areas of a *domestic building*:

- from a common entrance to the entrance of any *dwelling* or communal facilities on the entrance *storey* and to any passenger lift; and
- where a passenger lift is installed, from the passenger lift to any *dwelling* and to any communal facilities on an upper *storey*.

Circulation routes within common areas should allow safe and convenient passage and provide space for manoeuvring at junctions and when passing through doorways. All corridors therefore should have a minimum width of at least 1.2 m.

To allow manoeuvring space for both people and furniture, routes should be widened locally, at changes of direction, junctions and at the landing of any lift, to accommodate, clear of any obstruction, a 1.5 m turning circle.

Obstructions

Other than on a wall opposite a doorway, or in the areas noted above, an obstruction such as a radiator may project up to 100 mm, reducing corridor width to not less than 1.1 m, over a maximum length of 900 mm.

Gently sloping surfaces

Within a *building*, unidentified gradients may disorient *building* users and the need for gently sloping surfaces on circulation routes should be considered carefully before use. Level rest points on gently sloping routes should be provided as recommended in clause 4.1.3. Where not extending across the full width of a *room* or corridor, guarding should be provided to any exposed edge of such an area as for a ramp *flight*, as noted in the guidance to standard 4.4.

4.2.2 Floor surfaces in common areas of domestic buildings

Floor surfaces within common areas should be uniform, permit ease in manoeuvring and be of a material and finish that, when clean and dry, will provide a level of traction that will minimise the possibility of slipping.

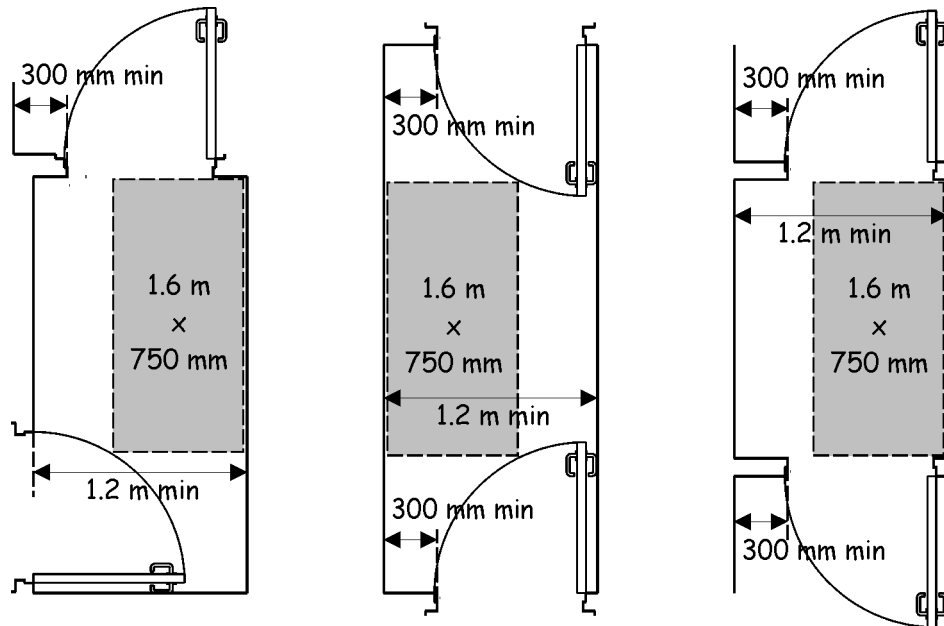
Where there is a change in the characteristics of materials on a circulation route, such as from a tile to carpet finish, transition should be level and, where *reasonably practicable*, differing surfaces should contrast visually to identify the change in material and reduce the potential for trips.

4.2.3 Lobbies in common areas of domestic buildings

Use of a lobby can reduce the effect of external conditions on the interior of a *building* and may also contribute to fire safety. However, where two sets of doors are in close proximity, this can present a hazard and a potential barrier to access.

Any lobby at the entrance to or within the common areas of a *domestic building* should allow a person to pass through whilst remaining clear of the swing of doors. A rectangular area, outwith any door swing, of at least 1.6 m long by 750 mm wide will permit safe passage of, for example, a person in a wheelchair and a companion.

Accessible lobby dimensions



Where either door can be secured by a locking device, a lobby should be not less than 1.5 m wide. This will permit a wheelchair or pram to be turned around should passage be denied.

4.2.4 Doors within common areas of a domestic building

Doors within the common areas of a domestic *building* should present as little restriction to passage as practicable and be *constructed* in a manner that does not present a hazard or a potential barrier to access.

A door located within the common areas of a *domestic building* should:

- a. if fitted with a threshold, have an accessible threshold; and
- b. have a door leaf giving a clear opening width in accordance with the table below; and
- c. where across a circulation route or giving access to communal facilities, have a *glazed* vision panel in any opening leaf, as described in clause 4.1.8; and
- d. have a door leaf that, if fitted with a door closing device, be operable with an opening force of not more than 30 N (for first 30° of opening) and 22.5 N (for remainder of swing) when measured at the leading edge of the leaf; and
- e. if not a powered door, have an unobstructed space to the opening face of the door, next to the leading edge, of at least 300 mm.

Width of doors

| Minimum corridor width at door (mm) | Minimum clear opening width (mm) [1] |
|-------------------------------------|--------------------------------------|
| 1500 | 800 |
| 1200 | 825 [2] |
| 900 [3] | 850 [2] |

Notes:

1. The projection of any ironmongery that extends across the width of a door leaf, such as an emergency push bar to a fire exit or horizontal grab rail, should be subtracted when calculating the clear opening width.
2. the clear opening width may be 800 mm where a door is approached head-on.
3. A corridor width of less than 1.2 m should not be present within new *buildings* but may be found within some existing *buildings*.

A door should not open onto a circulation route in a manner that creates an obstruction, other than a door to a cupboard or duct enclosure that is normally locked in a closed position.

4.2.5 Vertical circulation in common areas of domestic buildings

Stairs in common areas should be designed to be accessible to a person with reduced mobility, as described in guidance to standard 4.3. There should be an accessible stair between each level of a *building*.

Level access, or access by a stair or ramp device should be provided to any *storey*, or part of a *storey*. However, it is recognised that it may not be necessary or, in some cases, *reasonably practicable* to provide full access to all parts of a *building*. Consequently, such access need not be provided to any *storey*, or part of a *storey*:

- containing only fixed plant or machinery, the only normal visits to which are intermittent, for inspection or maintenance purposes; or
- where access is restricted to suitably trained persons for health and safety reasons, such as to walkways giving access only to machinery or to catwalks and working platforms, reached by industrial ladder.

Passenger lifts

Installation of a passenger lift will allow all *dwelling*s on upper *storeys* to be reached from a common entrance level. However, it is recognised that it may not always be *reasonably practicable* to provide lift access within all *domestic buildings*.

Therefore, a *building* containing *flats* or *maisonettes* may be constructed without a passenger lift where not more than 4 *storeys* in height and where there is no *dwelling* with a principal living level at more than 10 m above either a common entrance level or the level of the lowest *storey*.

In any *building* above this height, or where there are communal facilities on a level other than a common entrance level, there should be a means of unassisted access. This should serve each level of the *building* that contains a common entrance, an entrance to a *dwelling* or communal facilities. Unassisted access between *storeys* should be by passenger lift, with the installation meeting the recommendations of BS EN 81-70: 2003.

- Any passenger lift should be designed and installed to include the following:
- a. a clear landing at least 1.5 m x 1.5 m in front of any lift entrance door; and
 - b. automatic lift door(s), with a clear opening width of at least 800 mm, fitted with sensors that will prevent injury from contact with closing doors; and
 - c. a lift car at least 1.1 m wide by 1.4 m deep; and
 - d. within the overall dimensions of the lift car, a horizontal handrail, of a size and section that is easily gripped, 900 mm above the floor on each wall not containing a door; and
 - e. within a lift car not offering through passage, a mirror on the wall facing the doors, above handrail height, to assist a wheelchair user if reversing out; and
 - f. within the lift car, tactile *storey* selector buttons and, in a lift serving more than 2 *storeys*, visual and voice indicators of the *storey* reached; and
 - g. controls on each level served, between 900 mm and 1.1 m above the landing, and within the lift car on a side wall between 900 mm and 1.1 m above the car floor and at least 400 mm from any corner; and
 - h. on the landing of each level served, tactile call buttons and visual and tactile indication of the *storey* level; and
 - i. lift doors, handrails and controls that contrast visually with surrounding surfaces; and
 - j. a signalling system which gives notification that the lift is answering a landing call; and
 - k. a system which permits adjustment of the dwell time after which the lift doors close, once fully opened, to suit the level of use; and
 - l. a means of two way communication, operable by a person with a hearing impairment, that allows contact with the lift if an alarm is activated, together with visual indicators that an alarm has been sounded and received.

4.2.6 Accessibility within a storey of a dwelling

To ensure facilities within a *dwelling* can be reached and used by occupants, each *storey* within a *dwelling* should be designed to be accessible. There should be safe and convenient access to and throughout each *storey* other than to a level which comprises solely of storage and/or such accommodation as may be accessed via a 600 mm wide stair.

Each accessible level or *storey* within a *dwelling* should have:

- a. corridors with an unobstructed width of at least 900 mm wide. This may be reduced to 800 mm over a maximum length of 900 mm by permanent obstructions, such as radiators, except on a wall opposite a doorway; and
- b. corridors that are large enough to accommodate an unobstructed area of 1.1 m by 800 mm which, where a door being used opens into the corridor, is oriented in the direction of entry and is clear of the door swing; and
- c. doors with a minimum clear opening width in accordance with the following table to each *room*, including any *apartment*, *kitchen* or *sanitary facility*

Width of doors

| Minimum corridor width at door (mm) | Minimum clear opening width (mm) |
|-------------------------------------|----------------------------------|
| 1050 | 775 |
| 900 | 800 [1] |

Notes:

1. the opening width may reduce to 775 mm where a door is approached head-on.

Principal living level

In addition, there should be unassisted access to the basic accommodation needed in any *dwelling*. The principal living level of a *dwelling*, normally also the entrance *storey*, should contain at least one enhanced *apartment* (see clause 3.11.2), a *kitchen* (see clause 3.11.3) and accessible *sanitary accommodation* (see clause 3.12.3). This accommodation should be either on one level or, if on different levels within a storey, accessible without a stepped change of level.

4.2.7 Access between storeys in a dwelling

Where a *dwelling* has accommodation on more than one level, the levels containing accommodation should be connected by a stair or ramp within the *dwelling* following the guidance given under standard 4.3.

However, the guidance under standard 4.3 need not be applied to a fixed means of access leading only to a *storey* or level containing storage, though access to such a level must still meet standard 4.3 and offer safe passage.

4.2.8 Unassisted access between storeys in a dwelling

Not everyone can use stairs unassisted. This may mean that the upper levels of a *dwelling* are not accessible to some occupants. Guidance elsewhere considers situations where occupants, incapacitated for a short period of time, might live within one *storey*. However, this is not generally appropriate for longer term illness or infirmity, where a more permanent, inclusive, solution is required.

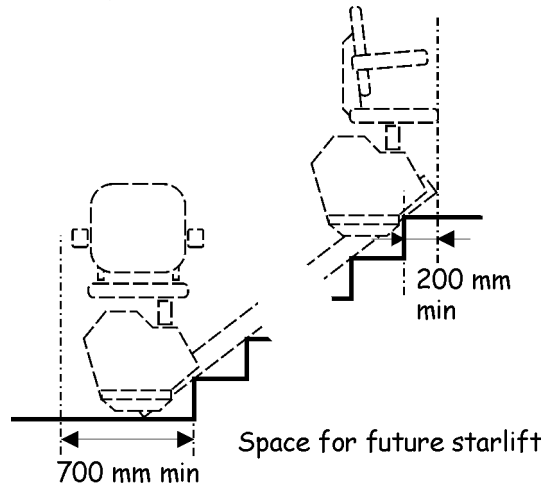
Provision should be made for future installation of a means of unassisted access, both within a *storey* and between *storeys*.

Future installation of a stairlift

To allow for future installation of a stair lift, any stair giving access to a principal living level or to accommodation greater than may be accessed via a 600mm wide stair (see clause 4.3.3) should:

- have an area of wall not less than 700 mm in length, or an equivalent space, adjacent to the bottom riser of a stair and clear of any obstruction, fitting or doorway, to allow for parking of a stairlift at rest position. This space should be not less than 400 mm in depth; and
- have a similar area of not less than 200 mm in length, on the same side of the *flight*, at landing level adjacent to the top nosing of the stair, to assist in transfer at the upper level, allowing for projection of a stair lift track.

Future provision for unassisted access



4.2.9 Split level storeys

Any change of level within a *storey* should not compromise access to facilities within the principal living level of a *dwelling*.

A *storey* may be split level provided a stepped change of level does not divide the accommodation forming the principal living level of a *dwelling* (see clause 4.2.6). In addition, if a stepped change of level is proposed on an entrance *storey* containing the principal living level, the route from the accessible entrance of the *dwelling* to the accommodation forming the principal living level should be without a stepped change of level.

4.2.10 Dwellings with limited entrance storey accommodation

Where a *dwelling*, such as a townhouse or upper villa *flat*, contains no, or only limited, accommodation on the entrance *storey*, this can make access to the basic facilities within the *dwelling* more difficult for many people.

Where the entrance *storey* of a *dwelling* is not also the principal living level, the first *storey* above or below entrance *storey* which contains an enhanced *apartment*, *kitchen* and accessible *sanitary accommodation* is considered to be the principal living level.

Where there is not level or ramped access from the accessible entrance of a *dwelling* to the principal living level, the principal living level should be made accessible to as wide a range of occupants as possible and, accordingly:

- a. a stair, from an accessible entrance to the principal living level, should follow the guidance on rise, going and pitch for 'any other stair' given in clause 4.3.2; and
- b. provision for installation of a stairlift should be made as described in clause 4.2.8; and
- c. entrance level accommodation should contain an area of at least 800 mm wide by 1.1 m long that would permit storage of a wheelchair or pram. This should be outwith the minimum corridor width noted in clause 4.2.6 and clear of any door way, door swing, stair landing or space identified for a future stairlift installation.

Where the entrance level of such a *dwelling* contains 2 or more *apartments*, there should also be an accessible *toilet* on the entrance level in accordance with the guidance in clause 3.12.3. This is in addition to accessible *sanitary facilities* on the principal living level. There should be level or ramped access from the accessible entrance of the *dwelling* to this accessible *toilet* and at

least 1 of the *apartments* on the entrance *storey* .

4.2.11 Alterations and extensions

Where accommodation within a *dwelling* meets the recommendations in clauses 4.2.6 to 4.2.10, any *works* to the *dwelling* should maintain compliance.

Altering an existing *dwelling*

Where alteration of a *building* includes *work* to, or provision of, a new circulation area, guidance should be followed as far as is *reasonably practicable* . This recognises that physical constraints within an existing *building* may mean compliance with space provision is not always possible.

Consequential alterations

Where existing accommodation does not meet the provisions set out in guidance, it need not be altered to comply except for consequential *work* , needed to ensure compliance with another standard. An example would be where an accessible entrance has been relocated and alterations are required to circulation space to maintain accessibility within the *building* .

4.3 Stairs and ramps

- 4.3 Functional standard
- 4.3.0 Introduction
- 4.3.1 Measurement for stairs
- 4.3.2 Rise, going, tread and pitch of stairs
- 4.3.3 Width of stair flights and landings
- 4.3.4 Number of rises in a flight
- 4.3.5 Risers and treads
- 4.3.6 Stair landings
- 4.3.7 Warning surfaces to landings of external steps
- 4.3.8 Stair landings serving outward opening fully glazed doors
- 4.3.9 Stair flights consisting of both straight and tapered treads
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- 4.3.11 Pedestrian ramps
- 4.3.12 Width of ramps flights
- 4.3.13 Ramp landings
- 4.3.14 Handrails to stairs and ramps
- 4.3.15 Height of handrails
- 4.3.16 Headroom on stairs and ramps
- 4.3.17 Industrial stairs and fixed ladders

standard

4.3

mandatory

Every *building* must be designed and *constructed* in such a way that every level can be reached safely by stairs or ramps.

4.3.0 Introduction

Half of all accidents involving falls within and around *buildings* occur on stairways, with young children and elderly people being particularly at risk. This risk can be greatly reduced by ensuring that any change in level incorporates basic precautions to guard against accident and falls.

Stairs and ramps should be *constructed* to be within limits recognised as offering safe and convenient passage and designed so that any person who is likely to use them can do so comfortably and safely, with the minimum amount of difficulty. Design should also address the issue of appropriate guarding, where a level change is made, and seek to eliminate any possible trip hazards.

Explanation of terms

The following terms are explained to provide clarity to their meaning in the Technical Handbooks.

Private stair means a stair wholly within a *dwelling*. It may also apply to any stair within the *curtilage* of a single *dwelling*, which is not accessible to the public. This might include, for example, a stair from a *dwelling* to a private garden, or a stair providing access to or within a domestic garage. It should not, however, include any external stair that forms a part of an accessible route to the *dwelling*.

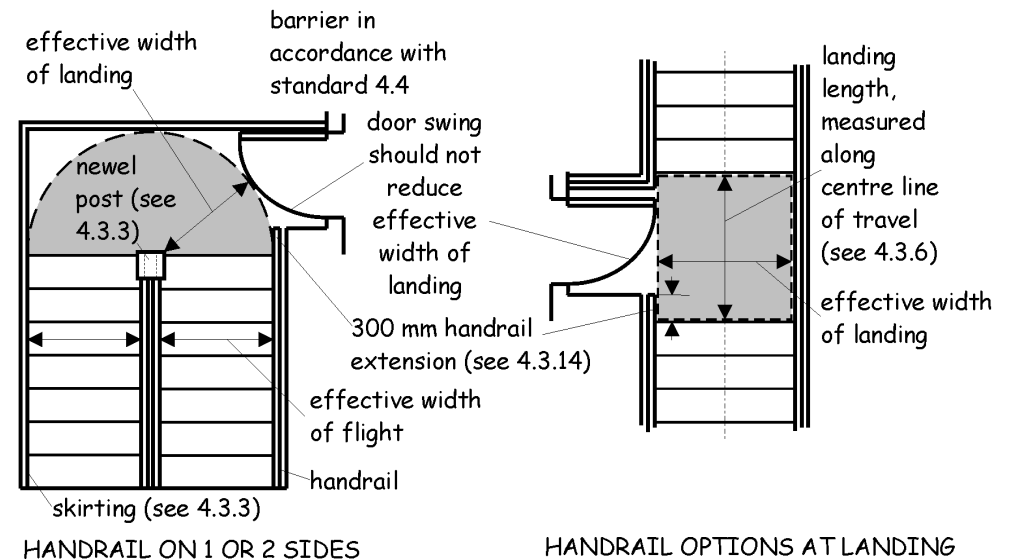
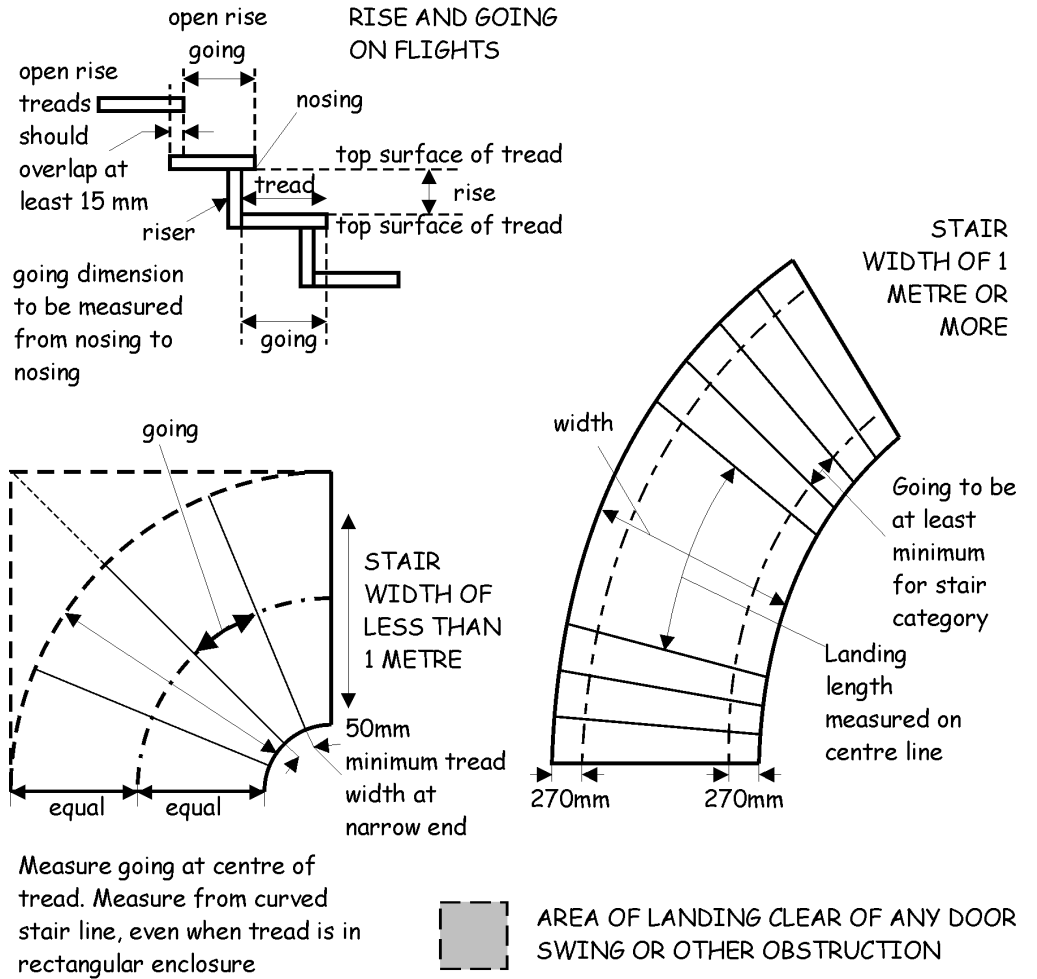
Tapered tread means a stair tread in which the nosing is not parallel to the nosing of the tread or landing next above.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard in so far as is *reasonably practicable*, and in no case be worse than before the *conversion* (regulation 12, schedule 6).

4.3.1 Measurement for stairs

Measurement for stairs



4.3.2 Rise, going, tread and pitch of stairs

The geometry of a stair *flight* can have a significant effect on the ability of people to use a stair safely and conveniently and limits should be placed on the rise and going of a stair, and steepness of pitch.

The pitch of a *private stair flight* may be steeper than that of a public *flight* (any other stair) in recognition that users, as occupants, will be more familiar with the stair through frequent use .

To provide safe and convenient access, the rise, going, tread and pitch of a *flight* in a stair should be in accordance with the following table:

Stair geometry – private stair

| Minimum rise (mm) | Maximum rise (mm) | Minimum going (mm) | Tread | Maximum pitch |
|-------------------|-------------------|--------------------|---------------------|---------------|
| 100 | 220 | 225 | not less than going | 42° |

Stair geometry – Any other stair, including to a domestic building or within the common area of a building containing flats or maisonettes

| Minimum rise (mm) | Maximum rise (mm) | Minimum going (mm) | Tread | Maximum pitch |
|-------------------|-------------------|--------------------|---------------------|---------------|
| 100 | 170 | 250 | not less than going | 34° |

Notes:

1. all rises in a *flight* should be of uniform height;
2. in a straight *flight*, or in a part of a *flight* that is straight, measurement should be uniform along the centreline of the *flight*;
3. where a *flight* consists partly of straight and partly of tapered treads, the going of the tapered treads should be uniform and should not be less than the going of the straight treads;
4. the going measured at the narrow end of a tapered tread should be at least 50 mm (see diagram to clause 4.3.1);
5. the aggregate of the going and twice the rise should be at least 550 mm and not more than 700 mm. For example, stairs provided with the minimum going of 250 mm would result in rises of at least 150 mm;
6. the maximum rise and minimum going on a *private stair* should not be used together as this will result in a pitch greater than the recommended maximum;
7. clause 4.2.10 should be referred to for exceptions where a *private stair* should meet the above recommendations for 'any other stair'.

The most comfortable combination of rise and going varies between individuals but in general, a going in excess of a minimum value, resulting in a figure in the upper end of the range in note 5, above, will increase both safety and amenity.

4.3.3 Width of stair flights and landings

The clear, or effective, width of a stair should allow users to move up and down unhindered and, on stairs giving access to a *dwelling* or *domestic building* , permit people to pass on a *flight* .

The effective width should be measured between handrails or, where there is no handrail present, between any walls or protective barriers. It should be clear of obstructions, as described in the diagram to clause 4.3.1. The effective width of a stair should be in accordance with the recommendations of the following table:

Effective widths of flights and landings

| Private Stair | Any other stair |
|---|--|
| 900 mm [1], such as from one <i>storey</i> to another or connecting levels within a <i>storey</i> ; or | 1.0 m generally, such as to an external <i>flight</i> to a <i>domestic building</i> or a common access within a <i>building</i> containing <i>flats</i> or <i>maisonettes</i> ; or |
| 600 mm where serving only <i>sanitary accommodation</i> and/or one <i>room</i> , other than accessible <i>sanitary accommodation</i> , a <i>kitchen</i> or an enhanced <i>apartment</i> . | 900 mm to an external <i>flight</i> serving a single <i>dwelling</i> , to which the public have access. |

Notes:

1. the effective width of a *private stair* may be 800 mm where a continuous handrail is fitted to both sides of a *flight*.

The projection of any stringer or newel post into this width should be not more than 30 mm.

Stair lifts

A stair lift may be fitted to a *private stair* and may project into the effective width of the stair. However, in such cases, at least 1 handrail should be present as described in clause 4.3.14 and, when not in use, the installation should:

- a. permit safe passage on the stair *flight* and any landing; and
- b. not obstruct the normal use of any door, doorway or circulation space.

Clause 4.2.8 gives guidance on the space to be provided adjacent to a stair *flight* to accommodate a future stair lift installation.

4.3.4 Number of rises in a flight

The act of climbing stairs can be tiring to many people. Whilst landings can provide a safe resting point, the *flight* itself is not intended to do so. The maximum number of rises between landings should therefore be limited.

Generally, a *flight* should have not more than 16 rises.

Below a minimum number of steps, it becomes difficult to signal a change of level, which can contribute significantly to a trip hazard.

Generally, a *flight* should have at least 3 rises .

However, people tend to take greater care at certain locations, such as at an external door, and a single step or 2 steps may be appropriate under certain circumstances. There may be less than 3 rises:

- a. other than at an accessible entrance, between an external door of a *building* and the ground or a balcony, *conservatory* , *porch* or private garage; or
- b. wholly within an *apartment* other than where affecting provisions within an enhanced apartment (see clause 3.11.2); or
- c. wholly within *sanitary accommodation* , other than accessible *sanitary accommodation* (see clause 3.12.3); or
- d. between a landing and an adjoining level where the route of travel from the adjoining level to the next *flight* changes direction through 90° (i.e. on a quarter landing as the first step).

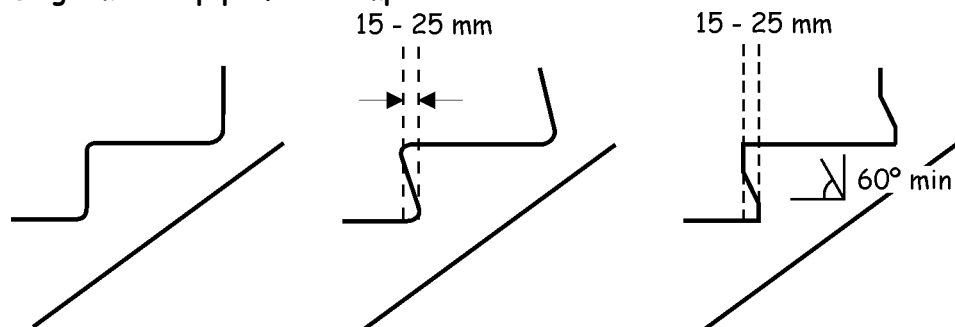
4.3.5 Risers and treads

All stairs providing access to and within *buildings* should be designed to be accessible by most persons with reduced mobility .

Open risers on a *flight* can be a hazard. When ascending a stair, people may be at risk of trapping the toes of shoes beneath projecting nosings, and of tripping as a result. In addition, many may feel a sense of insecurity when looking through spaces present between treads.

A stair should have contrasting nosings to assist in identifying the position of treads and risers should be profiled to minimise tripping as shown below. Open rises should not be used unless a stair is intended for descent only, such as in a dedicated *escape stair* on an *escape route* .

Diagram - Step profile examples



However, a *private stair* may be *constructed* with open risers and without contrasting nosings as occupants will be more familiar with the stair through frequent use.

Small children can climb or fall through gaps in stair treads and the size of such gaps should be limited to prevent this. In a *flight* with open risers, the treads should overlap by at least 15 mm. Any opening between adjacent treads in a *flight* should be small enough to prevent the passage of a 100 mm sphere.

4.3.6 Stair landings

Clear space is needed to the head and foot of any stair *flight* to allow people to move between a *flight* and an adjacent level surface safely. People may also wish to pause on stairs, particularly during ascent, and any intermediate landing should provide a temporary respite and be of a size to allow this whilst still permitting others to pass safely.

A stair landing should:

- be provided at the top and bottom of every *flight*. A single landing may be common to 2 or more *flights*; and
- be level except, in external locations, for any minimal crossfall necessary to prevent standing water; and
- have an effective width of not less than the effective width of the stair *flight* it serves; and
- be clear of any door swing or other obstruction, other than to a *private stair* , as noted below.

Length of a landing

The minimum length of a stair landing, measured on the centreline of travel, should be either 1.2 m or the effective width of the stair, whichever is less. However where, on an intermediate landing, a change of direction of 90° or more occurs, the centreline length need not be measured if the effective

width of the stair is maintained across the landing.

On landings to external stair *flights*, where tactile paving is used, the minimum length of landing should be 1.2 m.

Flights not needing a landing

Other than at an accessible entrance, a landing need not be provided to a *flight* of steps between the external door of:

- a *dwelling* and the ground, balcony, *conservatory*, *porch* or private garage, where the door slides or opens in a direction away from the *flight* and the total rise is not more than 600 mm; or
- a *dwelling*, or *building* ancillary to a *dwelling*, and the ground, balcony, *conservatory*, or *porch*, where the change in level is not more than 170 mm, regardless of method of door operation.

Obstructions

On a *private stair*, other than on an intermediate landing, common to 2 *flights*:

- a door to a cupboard or duct may open onto a top landing if, at any angle of swing, a clear space of at least 400 mm deep is maintained across the full width of the landing.
- a door may open on to a bottom landing, if, at any angle of swing, a clear space of at least 400 mm deep is maintained across the full width of the landing and the door swing does not encroach within space designated for future installation of a stair lift (see clause 4.2.8).

4.3.7 Warning surfaces to landings of external steps

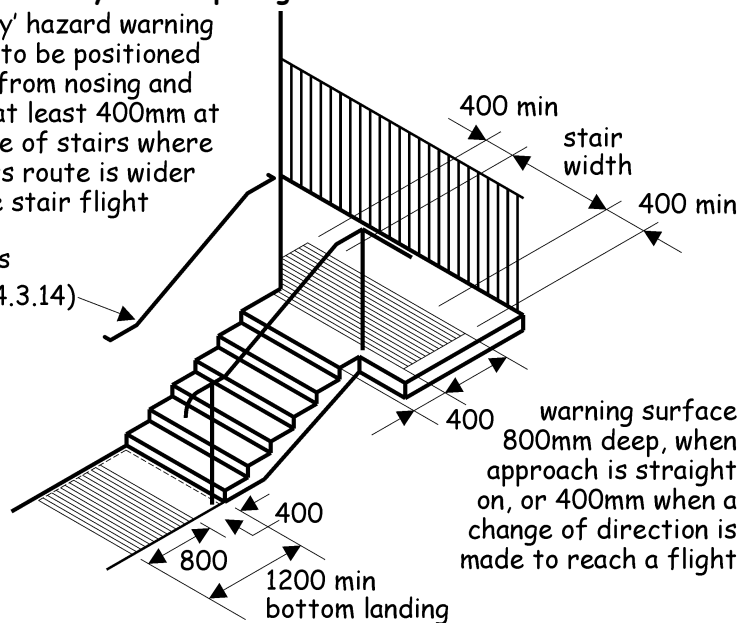
A sudden and unguarded change of level on an access route can present a hazard to a person with a visual impairment. Therefore, on external routes serving more than one *dwelling*, tactile paving should be used to alert people to the presence of a *flight* of steps.

The use of 'corduroy' tactile paving identifies this hazard and advises users to 'proceed with caution'. It should be provided at the head and foot of any *flight* of external steps, forming a strip 800 mm deep, positioned 400 mm from the first step edge, as noted below.

Use of corduroy tactile paving

'corduroy' hazard warning surface to be positioned 400mm from nosing and extend at least 400mm at each side of stairs where an access route is wider than the stair flight

handrails
(clause 4.3.14)



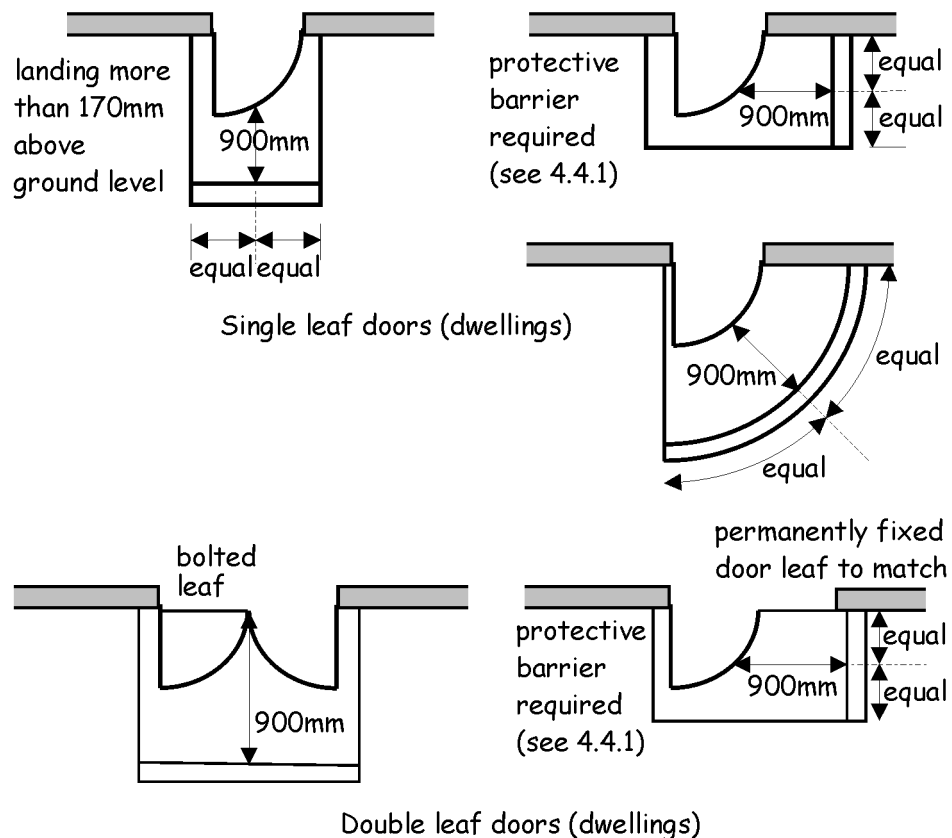
On any landing mutual to a *flight* of steps and a ramp, tactile paving should lie outwith the landing area of any ramp *flight*, to prevent possible confusion which might lead to injury

General information on use of tactile paving, including options on intermediate landings, is given in '[Guidance on the Use of Tactile Paving Surfaces](#)'.

4.3.8 Stair landings serving outward opening fully glazed doors

Conservatories and similar extensions are an increasingly prevalent addition to many *dwellings*. If the *conservatory* or extension is intended to be the accessible entrance, the guidance to standard 4.1 should be followed. If the entrance is not the accessible entrance and has an outward opening fully *glazed* door, a landing, of a length shown in the following diagram should be in accordance with the guidance in clause 4.3.6. These recommended landing lengths may also be appropriate for fully *glazed* doors leading from a *dwelling* directly into a *conservatory*.

Landings serving outward-opening fully glazed doors



4.3.9 Stair flights consisting of both straight and tapered treads

On that part of a *flight* consisting of tapered treads, the going of the tapered treads should be uniform and should not be less than the going of the straight treads. At the inner end of the tread, the going should be at least 50 mm. Tapered treads on a stair should be *constructed* in accordance with BS 585: Part 1: 1989, Appendices B1 and B3, irrespective of material or whether it contains open rises. However, guarding should be in accordance with the guidance in clause 4.4.2.

In a *flight* less than 1 m wide the going should be measured at the centre line of the *flight* as described in clause 4.3.1. In a *flight* 1 m wide or more the going should be measured at 2 points, 270 mm from each end of the tread, as described in clause 4.3.1 and the minimum going should be at least the going of the straight treads.

4.3.10 Stair flights consisting wholly of tapered treads

Stairs formed from tapering treads, particularly where forming a spiral, can present greater difficulties in use for many people than straight *flights*. There should be an appropriate level of safety and amenity on such stairs, particularly where used as a primary means of access.

A *flight* consisting wholly of tapered treads, forming a helix or spiral, should be *constructed* to give safe passage. To achieve this, it should be *constructed* in accordance with the guidance in BS 5395: Part 2: 1984, but account should be taken of the following guidance clauses:

- minimum and maximum rise should be as recommended in clause 4.3.2; and
- the effective width should be as recommended in clause 4.3.3; and
- the maximum number of rises on a *flight* should be as recommended in clause 4.3.4; and
- other than on a *private stair*, risers and treads should be as recommended in clause 4.3.5; and
- handrails should be as recommended in clauses 4.3.14 and 4.3.15; and
- protective barriers should be as recommended in clause 4.4.2.

4.3.11 Pedestrian ramps

Surfaces with a gradient of 1 in 20 to not more than 1 in 12 are considered to be ramps and recommendations are made on such surfaces to ensure the safety and amenity of users. Gradients of more than 1 in 12 are considered too steep to negotiate safely and are not recommended.

Steep gradients require both greater effort to ascend and more care when descending. As a general principle, the steeper the gradient of a ramp, the shorter the *flight* should be. A pedestrian ramp should be *constructed* in accordance with the following table:

Gradient, length and rise of a flight in a pedestrian ramp

| Maximum gradient of <i>flight</i> | Maximum length of <i>flight</i> | Maximum rise |
|--------------------------------------|------------------------------------|-----------------|
| 1 in 20 | 10 m | 500 mm |
| 1 in 15 | 5 m | 333 mm |
| 1 in 12 | 2 m | 166 mm |
| More than 1 in 12 | Not recommended | not recommended |

Notes:

1. The maximum *flight* length for a particular gradient can be interpolated as follows: 3 m long for a gradient of 1 in 13, 4 m long for a gradient of 1 in 14, and so on.

4.3.12 Width of ramps flights

The width of a ramp should relate to the intensity of use. For example, an unobstructed width of 1.8 m is the minimum that will allow two wheelchair users to pass safely. As a ramp *flight* will normally be enclosed between flanking handrails or guarding, it is important that this width still offers safe and convenient passage.

The effective width of a ramp *flight* should be at least 1.0 m. Effective width is measured between handrails, or where there are no handrails, the protective barrier or inside face of any wall or guarding kerb, and should be clear of any obstructions.

4.3.13 Ramp landings

Clear space is needed to the head and foot of any ramp *flight* to allow people to move between a *flight* and an adjacent level surface safely. This should permit manoeuvring of a wheelchair without obstructing passage or the need to encroach into circulation routes or onto a ramp *flight* .

A ramp landing should:

- be provided at the top and bottom of every *flight*. A single landing may be common to 2 or more *flights*; and
- be level except, in external locations, for any minimal crossfall necessary to prevent standing water ; and
- have an effective width not less than the effective width of the *flight* it serves; and
- be clear of any door swing or other obstruction.

The unobstructed length of a landing should be not less than 1.5 m, to allow space for wheelchairs or prams to stop after travelling down a *flight* and to provide manoeuvring space.

Where the entire length of a series of ramp *flights* is not visible from either the top or bottom landing, intermediate landings should have an effective width of not less than 1.8 m, to provide passing places during ascent or descent.

4.3.14 Handrails to stairs and ramps

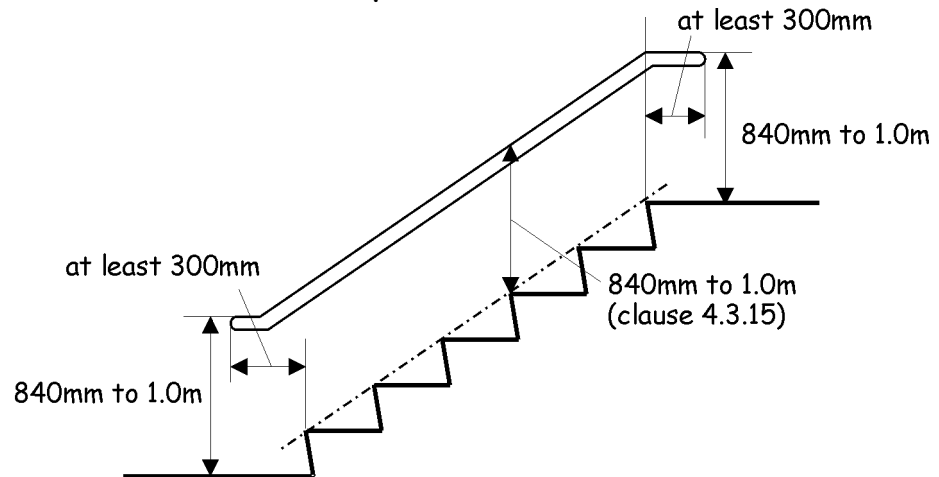
Handrails to a stair and ramp *flights* will provide support and assist safe passage. As the full width of a *flight* may be used, either by people passing or by person who favours one side, a handrail should generally be provided to both sides of a stair or ramp *flight* .

A handrail should be provided to both sides of any *flight* where there is a change of level of more than 600 mm, or where the *flight* on a ramp is longer than 2 m. However:

- handrails may be omitted to the *flight* of a ramp, serving a single *dwelling* , where the change in level is less than 600mm; and
- a handrail need only be provided to one side on a *flight* of a *private stair* .

Where a handrail is provided to only one side of a *private stair flight* , the side on which a handrail is not fixed should permit installation of a second handrail at a future date. A second handrail will provide additional support to a person using the stair and may be installed provided a clear width of 800 mm is maintained.

Handrails to stairs and ramps



The extension of a handrail at landings allows an individual to steady themselves before ascending or descending. For a person with impaired vision, the change in slope of the handrail and its return into a wall can also signal the start or finish of a *flight*.

A handrail on a stair or ramp *flight* should:

- extend at least 300 mm beyond the top and bottom of the *flight* as shown in the diagram above. However the 300 mm extension may be omitted where the handrail abuts a newel post; and
- have a profile and projection that will allow a firm grip; and
- end in a manner, such as a scrolled or wreathed end, that will not present a risk of entrapment to users; and
- contrast visually with any adjacent wall surface.

However, only sub clause b. need be provided on a *private stair* or to a ramp providing access within a single *dwelling*, as users are likely to be familiar with the layout and use of the *flight*.

A stair or ramp that is more than 2.3 m wide should be divided by a handrail, or handrails, in such a way that each section is at least 1.1 m and not more than 1.8 m wide. This does not apply to a stair between an entrance door to a *building* and ground level, where not forming part of an *escape route*.

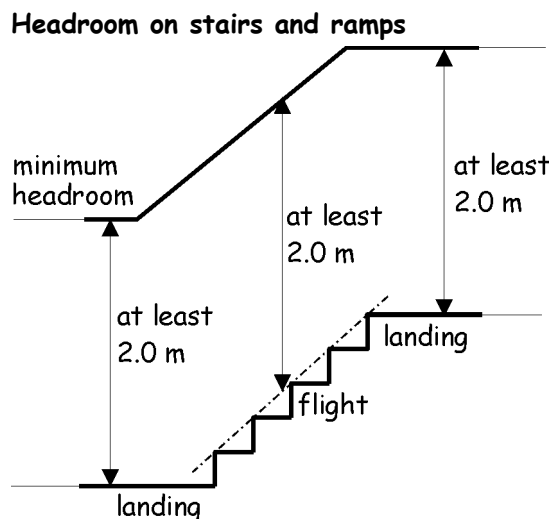
4.3.15 Height of handrails

A handrail should be fixed at a height of at least 840 mm and not more than 1.0 m, measured vertically above the pitch line of a *flight* on a stair or ramp and on a landing where a handrail is provided.

4.3.16 Headroom on stairs and ramps

A *flight* or landing on a stair or ramp should have clear headroom of at least 2.0 m extending over the whole of the effective width. Height should be measured vertically from the pitch line of the *flight* or from the surface of the landing.

In a *dwelling* where any portion of a *flight* or landing lies outwith the area needed to maintain the effective width of a *flight* or landing, a reduction in headroom may be considered, provided that no dangerous obstructions or projections are created.



4.3.17 Industrial stairs and fixed ladders

An industrial stair or fixed ladder serving an area in any *building* to which only limited access is provided should be *constructed* so as to offer safe passage. This method of access is not for public use and would only be expected to be provided in places such as plant-rooms. A stair or ladder should be *constructed* in accordance with:

- a. BS 5395: Part 3: 1985 or BS 4211: 2005, as appropriate; or
- b. BS 5395: Part 2: 1984 where the stair is a spiral or helical stair.

4.4 Pedestrian protective barriers

- 4.4 Functional standard
- 4.4.0 Introduction
- 4.4.1 Location of pedestrian protective barriers
- 4.4.2 Design of pedestrian protective barriers
- 4.4.3 Guarding to the edge of ramps.

standard

4.4

mandatory

Every *building* must be designed and *constructed* in such a way that every sudden change of level that is accessible in, or around, the *building* is guarded by the provision of pedestrian protective barriers.

Limitation:

This standard does not apply where the provision of pedestrian protective barriers would obstruct the use of areas so guarded.

4.4.0 Introduction

Protective barriers are necessary to prevent people in and around *buildings* from an accidental fall at an unguarded change of level.

In assessing the type of barrier to be used, the likely hazards, the use of the *building* and the risks to the people that may be present should all be considered. Any barrier should minimise the risk of persons falling or slipping through gaps in the barrier. This is particularly important in all *domestic buildings* , where children will generally be present.

The height and form of a barrier are both important, particularly to prevent a fall resulting from an intentional act, such as climbing. Young children are often adept at climbing anything within their reach. It is important therefore that barriers are designed to minimise potential hand and footholds within *dwellings* , and within common areas and on access routes to *domestic buildings* .

Conversions

In the case of *conversions* , as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard in so far as is *reasonably practicable* , and in no case be worse than before the *conversion* (regulation 12, schedule 6).

4.4.1 Location of pedestrian protective barriers

In the interests of safety, protective barriers should be provided where there is a sudden change in level and the possibility of severe injury from a fall.

At a change of direction on an access route, a drop of any height can be a hazard, particularly to a wheelchair user or a person with a visual impairment. A protective barrier should be provided where a significant drop occurs and in locations where a smaller change of level may increase the risk of injury.

It is not practical to provide a barrier at every change in level, but a protective barrier for pedestrians should be provided at the edge of:

- a. every floor, stair, ramp, landing, raised floor or other raised area to which people have access, where there is a difference in level of 600 mm or more; and
- b. any change in direction on an access or circulation route which is raised above the level of the surrounding surfaces.

However, there is no need to provide a protective barrier in a location which would prevent intended access or be incompatible with the normal use of an area, such as to the edge of a loading bay.

A wall, partition or area of fixed *glazing*, *constructed* in accordance with the recommendations of clause 4.4.2, may act as a protective barrier.

To ensure a person can be aware of the presence of a protective barrier it should, unless within a *dwelling* or forming part of a wall or partition, contrast visually with surrounding surfaces. If a barrier is principally *glazed*, the recommendations for marking given in clause 4.8.2 should be followed.

4.4.2 Design of pedestrian protective barriers

In and around *domestic buildings*, gaps in any protective barrier should not be large enough to permit a child to pass through.

To ensure this, openings in a protective barrier should prevent the passage of a 100 mm diameter sphere. However, the space between a rise in a stair and the lowest edge of the protective barrier may be larger than 100 mm, provided the lowest edge of the barrier is not more than 50 mm above, and parallel to, the pitch line of the stair.

A protective barrier, and any wall, partition or fixed *glazing* accepted instead of a barrier should be secure, capable of resisting loads calculated in accordance with BS 6399: Part 1: 1996 and be of a height as follows:

Height of pedestrian protective barriers

| Location | Minimum height (mm) [1] |
|--|-------------------------|
| at the edge of a floor in front of walls, partitions and fixed <i>glazing</i> incapable of withstanding the loads specified in BS 6399: Part 1: 1996 | 800 |
| in front of an openable window | 800 [2] |
| on a stair or ramp <i>flight</i> wholly within a <i>dwelling</i> | 840 [3] |
| on a stair or ramp <i>flight</i> outwith a <i>dwelling</i> | 900 [3] |
| to a <i>gallery</i> , landing or raised area within a <i>dwelling</i> | 900 |
| all other locations | 1100 |

Notes:

1. A handrail provided in accordance with clauses 4.3.14 and 4.3.15 may form the top of a protective barrier if the heights in this table are met;
2. Protective barriers should be installed where the opening window has:
 - a. a sill that is less than 800 mm above finished floor level; and
 - b. an operation that will allow the possibility of falling out; and
 - c. a difference in level between the floor level and the ground level of more than 600 mm.

At 2 storeys or more above ground level, reference should be made to clause 4.8.4. where external *glazing* is cleanable from within the *building*.
3. Where a handrail forming the top of a protective barrier to a *flight* meets a protective barrier to a landing, the height of the latter may be reduced for a distance not more than 300 mm to permit a smooth junction.

4.4.3 Guarding to the edge of ramps.

Where a continuous pedestrian protective barrier is not provided to the edge of a ramp *flight* , a kerb upstand of at least 100 mm high should be provided to any open side of the *flight* where there is a drop of any height. However, the use of an upstand kerb alone in open landscaping is not recommended as it may present a potential trip hazard.

Alternatively, an external ramp *flight* may be provided with a landscaped margin, level with the edge or the ramp for a distance of 600 mm before any grading.

4.5 Electrical safety

- 4.5 Functional standard
- 4.5.0 Introduction
- 4.5.1 Electrical installations
- 4.5.2 Extra-low voltage installations
- 4.5.3 Installations operating above low voltage
- 4.5.4 Socket outlets in bathrooms and rooms containing a shower

standard
4.5
mandatory

Every *building* must be designed and *constructed* in such a way that the electrical installation does not:

- (a) threaten the health and safety of the people in, and around, the *building* ; and
- (b) become a source of fire.

Limitation:

This standard does not apply to an electrical installation:

- (a) serving a *building* or any part of a *building* to which the Mines and Quarries Act 1954 or the Factories Act 1961 applies; or
- (b) forming part of the works of an undertaker to which regulations for the supply and distribution of electricity made under the Electricity Act 1989 .

4.5.0 Introduction

The hazards posed by unsafe electrical installation are injuries caused by contact with electricity (shocks and burns) and injuries arising from fires in *buildings* ignited through malfunctioning or incorrect installations.

Concern has been expressed that risks have been increasing in recent years due to:

- the increasing prevalence and variety of electrical systems in *buildings* and the demands being made on them;
- the reduction in subscription to voluntary industry self-regulation schemes.

The intention of this standard is to ensure that electrical installations are safe in terms of the hazards likely to arise from defective installations, namely fire, electric shock and burns or other personal injury. Installations should:

- safely accommodate any likely maximum demand; and
- incorporate appropriate automatic devices for protection against overcurrent or leakage; and
- provide means of isolating parts of the installation or equipment connected to it, as are necessary for safe working and maintenance.

The standard applies to fixed installations in *buildings*. An installation consists of the electrical wiring and associated components and fittings, including all permanently secured equipment, but excluding portable equipment and appliances.

Appendix 6 of BS 7671: 2001 (The Wiring Regulations) provides specimen certificates that may be completed by the person responsible for the installation. These can be issued to the person ordering the *works* as evidence of compliance with the recommendations of the British Standards.

Socket outlet

‘Socket outlet’ means a fixed device containing contacts for the purpose of connecting to a supply of electricity the corresponding contacts of a plug attached to any current-using appliance.

Conversions

In the case of *conversions* , as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

4.5.1 Electrical installations

Electricity, when properly used, is a safe and convenient source of energy for heat, light and power within *buildings*. However, misuse may lead to significant harm to individuals and *buildings* alike.

Risk of fire from an electrical installation should be minimised. In normal operation, taking into account the surroundings, it should not create the risk of fire, burns, shock or other injury to people.

An electrical installation should be designed, *constructed*, installed and tested such that it is in accordance with the recommendations of BS 7671: 2001, as amended.

4.5.2 Extra-low voltage installations

To avoid the risk of harm, any circuit which is designed to operate at or below extra-low voltage should be protected against both direct and indirect contact with any other circuit operating at higher than extra-low voltage.

Extra-low voltage is defined as not more than 50 volts alternating current or 120 volts direct current, measured between conductors or to earth. This might include installations for alarm or detection purposes, or for transmission of sound, vision, data or power.

Any such installation should be designed, *constructed*, installed and tested such that it is in accordance with the recommendations of BS 7671: 2001, as amended.

4.5.3 Installations operating above low voltage

To avoid the risk of harm, any circuit which is designed to operate at a voltage higher than low voltage should be provided with a cut-off switch for use in emergency in accordance with the recommendations of BS 7671: 2001, as amended. Such installations are not usual in *domestic buildings*.

Low voltage is defined as not more than 1000 volts alternating current or 1500 volts direct current, measured between conductors or not more than 600 volts alternating current or 900 volts direct current between conductors and earth.

A fireman's switch, in a conspicuous position, should be provided to any circuit supplying exterior electrical installations or internal discharge lighting installations (including luminous tube signage) operating at a voltage exceeding low voltage.

4.5.4 Socket outlets in bathrooms and rooms containing a shower

In a bathroom or shower room, an electric shaver power outlet, complying with BS EN 60742: 1996 may be installed. Other than this, there should be no socket outlets and no means for connecting portable equipment.

Rooms containing a shower

Where a shower cubicle is located in a *room*, such as a bedroom, any socket-outlet should be installed at least 3 m from the shower cubicle.

4.6 Electrical fixtures

- 4.6 Functional standard
- 4.6.0 Introduction
- 4.6.1 Lighting
- 4.6.2 Lighting in common areas of domestic buildings
- 4.6.3 Door entry systems
- 4.6.4 Socket outlets

standard

4.6

mandatory

Every *building* must be designed and *constructed* in such a way that electric lighting points and socket outlets are provided to ensure the health, safety and convenience of occupants and visitors.

Limitation:

This standard applies only to *domestic buildings* where a supply of electricity is available.

4.6.0 Introduction

Visual perception increases with the level of light falling on the surface of an object. It is important to avoid hazardous situations that may be created by the nature of the lighting itself including insufficient light sources, glare, gloom and shadows.

During daylight, lighting levels within a *building* are generally much less than those outdoors. In lobby areas, transitional lighting will assist the eye in adjusting quickly between exterior and interior lighting conditions. Careful design of lighting can also play an important part in emergency situations, to ensure the safe and effective evacuation of people in an emergency.

Section 2 (Fire) includes guidance on *escape route* lighting and emergency lighting, whilst section 6 (Energy) covers energy efficient design of lighting.

Aside from the specific issues noted above and in guidance to this standard, general guidance on lighting in *buildings* remains outwith the scope of the Technical Handbook. There are, however, numerous publications offering guidance on use of lighting in *buildings* for safety and amenity, including those listed below.

- [Code for Lighting](#) – CIBSE (2002)
- [Building Sight](#) - Royal National Institute for the Blind (1995)

The provision of an entryphone system to a communal entrance will enhance both the amenity and the security of occupants within a *building*.

Today, with ever more electrical appliances being used in homes, an adequate provision of power points reduces the possibility of both overloading of individual sockets, risking fire, and the creation of trip hazards from use of extension cabling

Conversions

In the case of *conversions*, as specified in regulation 4, the *building as converted* shall meet the requirement of this standard (regulation 12, schedule 6).

4.6.1 Lighting

A *dwelling* should have an electric lighting system providing at least one lighting point to every circulation space, *kitchen*, bathroom, *toilet* and other space having a floor area of 2 m² or more.

Any lighting point serving a stair should have controlling switches at, or in the immediate vicinity of, the stair landing on each *storey*.

4.6.2 Lighting in common areas of domestic buildings

In communal areas and particularly on stairs and ramps within a *building*, the possibility of slips, trips and falls and of collision with obstacles should be minimised. Lighting conditions play an important part in this.

Common areas should have artificial lighting capable of providing a uniform lighting level, at floor level, of not less than 100 lux on stair *flights* and landings and 50 lux elsewhere within circulation areas. Lighting should not present sources of glare and should avoid creation of areas of strong shadow that may cause confusion or miss-step. A means of automatic control should be provided to ensure that lighting is operable during the hours of darkness.

4.6.3 Door entry systems

Entry to *buildings* containing *flats* or *maisonettes* is often controlled to maintain the security of a private space and to prevent vandalism. Similarly, the principal entrance to a *sheltered housing complex* may have an access control system for the general security and safety of residents.

Where a common entrance door, intended as a principal means of access to a *building*, is fitted with a locking device, a door entry system should be installed. This should comprise of a remote door release and intercom at the point of entry and a call unit within each *dwelling* served by that entrance.

Any unit at a common entrance should be positioned between 900 mm and 1.2 m above floor level. It should include an inductive coupler compatible with the 'T' setting on a personal hearing aid, together with a visual indicator that a call made has been received. Controls should contrast visually with surrounding surfaces and any numeric keypad should follow the 12-button telephone convention, with an embossed locator to the central '5' digit.

4.6.4 Socket outlets

Current lifestyle places a greater demand on electrical installations, with the increase in use of electrical appliances. Connection of multiple appliances into a socket outlet through an adapter can lead to overheating and the risk of fire. Similarly, use of extension leads can create a trip hazard.

To reduce these risks, a *dwelling* should be provided with at least the following number of 13A socket outlets:

- 4 within each *apartment*; and
- 6 within the *kitchen*, at least 3 of which should be situated above worktop level in addition to any outlets provided for floor-standing white goods or built-in appliances; and
- an additional 4 anywhere in the *dwelling*, including at least 1 within each circulation area on a level or *storey*.

Sockets may be installed as single or double outlets, to give the recommended number of outlets in each space.

4.7 Aids to communication

- 4.7 Functional standard
- 4.7.0 Introduction

standard

4.7

mandatory

Every *building* must be designed and *constructed* in such a way that it is provided with aids to assist those with a hearing impairment.

Limitation:

This standard does not apply to *domestic buildings*.

4.7.0 Introduction

This standard does not apply to *domestic buildings* .

4.8 Danger from accidents

- 4.8 Functional standard
- 4.8.0 Introduction
- 4.8.1 Collision with projections
- 4.8.2 Collision with glazing
- 4.8.3 Cleaning of windows and rooflights
- 4.8.4 Guarding of windows for cleaning
- 4.8.5 Access to manual controls

standard
4.8
mandatory

Every *building* must be designed and *constructed* in such a way that:

- (a) people in and around the *building* are protected from injury that could result from fixed *glazing* , projections or moving elements on the *building* ;
- (b) fixed *glazing* in the *building* is not vulnerable to breakage where there is the possibility of impact by people in and around the *building* ;
- (c) both faces of a window and rooflight in a *building* are capable of being cleaned such that there will not be a threat to the cleaner from a fall resulting in severe injury;
- (d) a safe and secure means of access is provided to a roof; and
- (e) manual controls for ventilation and for electrical fixtures can be operated safely.

Limitation:

Standards 4.8(d) does not apply to *domestic buildings* .

4.8.0 Introduction

This standard covers several unrelated safety issues that do not lend themselves to inclusion in other standards although glass and *glazing* do figure prominently.

Collision or entrapment accidents result in a significant numbers of deaths and injuries to people in and around *buildings* every year. The majority of these accidents occur during normal use and involve *building* features such as doors, windows and areas of fixed *glazing* , with the risk of injury increased where vulnerable glass is involved. Collisions with *glazing* are very common as it can, if transparent, be difficult to see and may create confusing lighting effects, presenting particular difficulties for a person with a visual or cognitive impairment.

Falls still result in deaths and serious injury to people while cleaning windows. Whether windows are cleaned professionally or by the *building* owner, provision should be made to permit *glazing* to be cleaned safely.

Natural ventilation in *dwellings* is provided by openable windows or rooflights. People may encounter difficulty and a hazard may arise in operating controls which are poorly sited. Similarly, location of electrical sockets, switches and other controls can, if not considered carefully, affect safe and convenient use.

Conversions

In the case of *conversions* , as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard in so far as is *reasonably practicable* , and in no case be worse than before the *conversion* (regulation 12, schedule 6).

4.8.1 Collision with projections

Fixtures that project into, or open onto any place to which people have access can be a hazard. Any element of a *building* capable of projecting into a circulation route or space should be positioned, secured or guarded so that it does not present a risk to *building* users.

The simple way to avoid risk is to ensure that obstructions do not encroach into such spaces. However, where a *building* element does project into a circulation route or space, and any part of the obstruction is less than 2.0 m above the ground, guarding should be provided to both highlight the hazard and prevent collision with the *building* element.

Guarding should be provided to:

- any moveable projection, such as a door leaf or window frame, that opens across a circulation route or into a circulation space; or
- any permanent projection of more than 100 mm into a circulation route or space that begins at a height of more than 300 mm above the ground, or the projection of which increases with height by more than 100 mm; or
- any accessible area where headroom reduces to less than 2.0 m, such as beneath a stair *flight* .

Guarding should comprise of a continuous horizontal rail, at a height of between 900 mm and 1.1 m above ground level and a solid element, such as kerb upstand or rail, positioned approximately 100 mm above ground level, to assist in detection by a visually impaired person using a cane.

There should be visual contrast between guarding rails and surrounding surfaces. Consideration should be given to positioning of guarding to direct a person away from the hazard, further reducing the risk of a collision.

Additional guarding may be needed to prevent collision with, or entrapment by, a powered door leaf (see clause 4.1.8).

Within a *dwelling* , guarding is not needed. A door swing may open into a circulation space provided no obstructions occur within the unobstructed area on a stair landing (see clause 4.3.6), on a ramp landing or that would prevent future installation of a stair lift (see clause 4.2.8).

4.8.2 Collision with glazing

Glazing in certain locations is more vulnerable to human impact. Care should be taken in the selection of *glazing* at low level in screens, walls and partitions or in areas surrounding doors, particularly where *glazed* side panels may be mistaken for doors.

To reduce the risk of injuries from accidental human impact in these locations, designers should either:

- fit *glazing* of a type, thickness and pane size that will be resistant to impact, which either does not break or breaks safely; or
- provide protection in the form of guarding to vulnerable *glazing* .

Glazing should be designed to resist human impact as set out in BS 6262: Part 4: 2005, where all, or part, of a pane is:

- within 800 mm of floor level; or
- part of a door leaf; or
- within 300 mm of a door leaf and within 1.5 m of floor level.

Glazing manifestation Large areas of transparent *glazing*, in fixed screens or partitions or where forming doors, can be difficult to identify and may be a particular hazard to a person with a visual impairment. *Glazing* in a *building*, positioned where accidental collision may be likely, should be made apparent by some form of manifestation (marking). Differences in the design of manifestation used can also assist in identifying the position of doors within a *glazed* screen.

Manifestation should be of a size and form that is immediately obvious. It should, as far as is *reasonably practicable*, contrast visually with backgrounds viewed through the *glazing* by a person approaching from either side. Forms might include broken or solid lines, patterns or logos and may be a continuous element or at appropriate horizontal intervals. Manifestation should be present within 2 height ranges, between 850 mm and 1.0 m, and between 1.4 m and 1.6 m above floor level. It should be permanent, e.g. screen printed or opaque etching or a durable applied material which is not easily removed.

Unframed *glazed* doors In addition, any unframed *glazed* door which operates on a pivot action should have any exposed vertical edge highlighted to contrast visually with surroundings, to assist in identifying the door edge when opening or in an open position. This is particularly important on powered doors.

Manifestation or highlighting of door edges need only be provided within *dwelling*s where *glazing* installations are unusual. Familiar elements such as patio doors should not usually attract marking.

4.8.3 Cleaning of windows and rooflights

Falls account for most window cleaning accidents, and generally occur from loss of balance through over-extension of reach or due to breakage of part of the *building* fabric through improper use or access. It is therefore important that transparent or translucent *glazing* should be designed so that it may be cleaned safely.

There is, however, no need to provide for the safe cleaning of any *glazed* element that is opaque and does not allow the passage of light.

Any window or rooflight, all or part of which is more than 4 m above adjacent ground or internal floor level, should be *constructed* so that any external and internal *glazed* surfaces can be cleaned safely from:

- a. inside the *building* in accordance with the recommendations of Clause 8 of BS 8213: Part 1: 2004; or
- b. a loadbearing surface, such as a balcony or catwalk, large enough to prevent a person falling further; or
- c. a window access system, such as a cradle or travelling ladder, mounted on the *building*, as described in Annex C3 of BS 8213: Part 1: 2004.

Rooflights in *dwelling*s However, within a *dwelling*, any rooflight, all of which is more than 1.8 m above both adjacent ground and internal floor level, need not be *constructed* so that it may be safely cleaned.

Glazing in common areas In addition to the above three options, any window or rooflight within a common area of a *domestic building* may be cleaned from a ladder sited on adjacent ground or from an adjacent loadbearing surface which has unobstructed space large enough to allow safe use of a ladder and which will contain a person from falling further. However, a ladder should not be used to access any external or internal *glazed* surface more than 9 m above the surface on which the ladder is sited. General guidance on the safe use of

ladders may be found in HSE information sheet MISC613 '[Safety in window cleaning using portable ladders](#)'.

| | |
|-------------------------------------|--|
| Roof access hatches | <i>Glazing</i> within a roof access hatch, located within a <i>roof space</i> , need not be <i>constructed</i> so that it may be safely cleaned. |
| Cleaning from inside | When cleaning a window from inside, a person should not have to sit or stand on a window sill or use other aids to reach the external face of the window. The criterion of safety is the ability to reach all points on the surface of the external <i>glazing</i> with only the arm projecting outside the line of the window whilst remaining standing on the floor. |
| 'Safe reach' | Ergonomic statistics on reach capabilities for the UK adult population are given in Annex A of BS 8213: Part 1: 2004. As reach may safely be increased to some degree by use of cleaning implements, it would still be considered reasonable to apply a safe limit to downward reach of 610 mm and a safe limit to lateral and vertical reach as an arc with a radius of 850 mm measured from a point not more than 1.3 m above floor level. |
| Cleaning from a loadbearing surface | Where the window is to be cleaned from a loadbearing surface listed in sub-clause b. to this clause, there should be: <ul style="list-style-type: none">• a means of safe access, and• a protective barrier not less than 1.1 m high to any edge of the surface or access to the surface which is likely to be dangerous. This method of cleaning is only appropriate where no part of the <i>glazing</i> is more than 4 m above the loadbearing surface. |
| Alternative methods | Where there is a need for safe cleaning of <i>glazing</i> , it may be appropriate to consider alternate methods of cleaning, in addition to those listed in guidance, where an equivalent level of safety can be demonstrated. |

4.8.4 Guarding of windows for cleaning

For openable windows on the ground and first floor of a *building*, or where the outside face of the *glazing* will not be cleaned from inside the *building*, no guarding need be provided for the purpose of cleaning *glazing*. However, the general guidance for provision of protective barriers given in clause 4.4.2 should be followed.

At greater heights, 2 storeys or more above ground level, where it is intended to clean the outside face of the *glazing* from inside the *building*, the increased risk from a fall should be recognised and guarding provided to a height of at least 1.1 m above floor level.

Where guarding is provided, it should be designed to conform to BS 6180: 1999. All guarding should be permanently fixed, should not be detachable to permit windows to open and should be designed so that it is not easily climbable by children.

Guarding to a window is not needed where the open window gives access to a fully guarded balcony.

4.8.5 Access to manual controls

The location of a manual control device can have a significant effect on both the ease of operation of the device and safety in use. Positions that are inaccessible present a greater risk of accident when bending or reaching. Any control that is intended for operation by the occupants of a *building*

should be installed in position that allows safe and convenient use

This guidance is applicable to manual controls to openable *ventilators* , including windows and rooflights and to controls and outlets of electrical fixtures located on a wall or other vertical surface. Unless incorporating a restrictor or other protective device for safety reasons, controls should be operable with one hand.

Windows, rooflights
and *ventilators*

An openable window or rooflight, that provides natural ventilation to meet standard 3.14, should have controls for opening, positioned at least 350 mm from any internal corner, projecting wall or similar obstruction and at a height of:

- not more than 1.7 m above floor level, where access to controls is unobstructed; or
- not more than 1.5 m above floor level, where access to controls is limited by a fixed obstruction of not more than 900 mm high which projects not more than 600 mm in front of the position of the controls, such as a *kitchen* base unit. Where obstruction is greater, a remote means of opening, in an unobstructed location, should be provided; or
- not more than 1.2 m above floor level, in an unobstructed location, within an enhanced *apartment* (see clause 3.11.2) or within accessible *sanitary accommodation* (see clause 3.12.3) not provided with mechanical ventilation.

The above guidance does not apply to windows or rooflights openable only for cleaning or maintenance purposes or that are controlled by an automatic system, or to *trickle ventilators* .

Electrical Fixtures

Outlets and controls of electrical fixtures and systems should be positioned at least 350 mm from any internal corner, projecting wall or similar obstruction and, unless the need for a higher location can be demonstrated, not more than 1.2 m above floor level. This would include fixtures such as sockets, switches, fire alarm call points and timer controls or programmers. Within this height range:

- light switches should be positioned at a height of between 900 mm and 1.1 m above floor level.
- standard switched or unswitched socket outlets and outlets for other services such as telephone or television should be positioned at least 400 mm above floor level. Above an obstruction, such as a worktop, fixtures should be at least 150 mm above the projecting surface.

Where socket outlets are concealed, such as to the rear of white goods in a *kitchen* , separate switching should be provided in an accessible position, to allow appliances to be isolated.

4.9 Danger from heat

- 4.9 Functional standard
- 4.9.0 Introduction
- 4.9.1 Installation of unvented hot water storage systems
- 4.9.2 Specification of small unvented hot water storage systems
- 4.9.3 Discharge from unvented hot water storage systems
- 4.9.4 Discharge of steam or hot water
- 4.9.5 Hot water discharge from sanitary fittings

standard

4.9

mandatory

Every *building* must be designed and *constructed* in such a way that protection is provided for people in, and around, the *building* from the danger of severe burns or scalds from the discharge of steam or hot water.

4.9.0 Introduction

Guidance is given under this standard on a number of issues relating to hot water safety.

Unvented hot water storage systems

Guidance is given to minimise the risk of explosion due to malfunction of an unvented hot water vessel by:

- ensuring that such installations are carried out by appropriately qualified personnel, and
- requiring a minimum range of safety devices be fitted to any such installation to prevent the temperature of the stored water exceeding 100° C.

It is not intended that this guidance should be applied to storage systems with a capacity of less than 15 litres, to systems used solely for space heating or to any system used for an industrial or commercial process.

Guidance is given on systems of up to 500 litres storage capacity, where power input does not exceed 45kW. Installations above this size are not usual in *domestic buildings*. It is unlikely that many larger installations will be installed in *dwelling*s but if required, additional guidance on such installations is provided to standard 4.9 of the non-domestic Technical Handbook.

Hot water overflows

Guidance is given on provision for the safe removal of the discharge created by the normal operation of safety devices in such an installation and on ensuring discharge of hot water and steam from any installation, unvented or otherwise, to a safe and visible location.

Sanitary facilities

Measures to prevent scalding from hot water are now addressed for certain *sanitary facilities* used for personal hygiene.

Maintaining safety devices

Safety devices installed to protect from hazards such as scalding or the risk of explosion of unvented systems should be maintained to ensure correct operation. Guidance on maintenance can be provided by both manufacturers and installers of such devices.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

4.9.1 Installation of unvented hot water storage systems

Installation of an unvented hot water storage system should be carried out by a person with appropriate training and practical experience.

Competence of installers This might include current membership of a registration scheme operated by a recognised professional body. This could include those administered by the Scottish and Northern Ireland Plumbing Employers Federation (SNIPPEF) and the Construction Industry Training Board (CITB) or an equivalent body.

The following points should be noted in relation to installation of an unvented hot water storage system:

- the installer should be a competent person and, on completion, the labelling of the installation should identify the installer;
- the installed system should meet the recommendations of BS 7206: 1990 or be the subject of an approval by a *notified body* and incorporate the safety devices outlined in clause 4.9.2 ;
- certification of the unit or package should be recorded by permanent marking and a warning label which should be visible after installation. A comprehensive installation/user manual should be supplied;
- the tundish and discharge pipework should be correctly located and fitted by the installer and the final discharge point should be visible and safely positioned where there is no risk from hot water discharge.

The operation of the system under discharge conditions should be tested to ensure provision is adequate.

4.9.2 Specification of small unvented hot water storage systems

An unvented hot water storage system should be designed and installed to prevent the temperature of the stored water at any time exceeding 100° C and to provide protection from malfunctions of the system.

An unvented hot water storage system should be in the form of a proprietary unit or package which is in accordance with the recommendations of BS 7206: 1990 or the subject of approval by a *notified body* to an equivalent level of safety and performance.

Pressure safety devices A unit or package should have fitted:

- a check valve to prevent backflow; and
- a pressure control valve to suit the operating pressure of the system; and
- an expansion valve to relieve excess pressure; and
- an external expansion vessel or other means of accommodating expanded heated water.

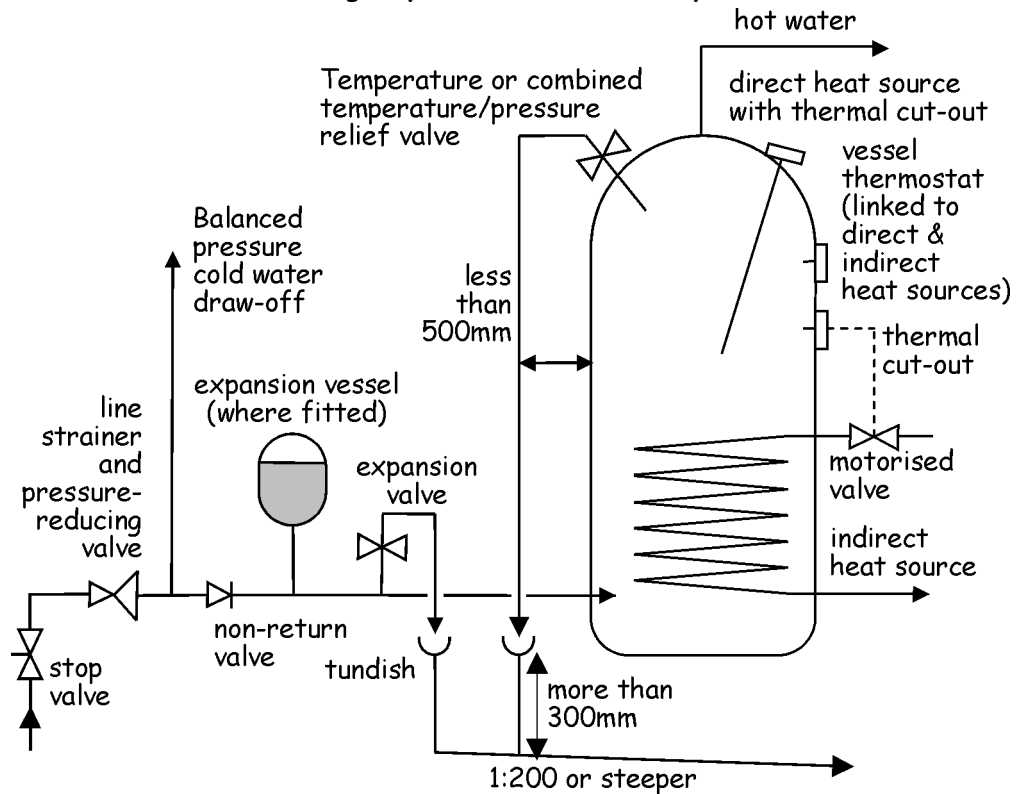
These devices are factory-fitted (unit) or supplied for fitting by the installer (package).

Temperature activated safety devices A unit or package should have a minimum of 2 temperature-activated devices operating in sequence comprising:

- a non self-resetting thermal cut-out; and
- a temperature relief valve.

These devices should be in addition to any thermostatic control that is fitted to maintain the temperature of the stored water at around 60° C.

Unvented hot water storage System - indirect example



Thermal cut-out

A temperature-operated, non self-resetting, energy cut-out complying with BS 3955: 1986 should be fitted to the vessel. In the event of thermostat failure, heating to the water in the vessel should stop before the temperature rises to the critical level required for operation of the temperature relief valve.

In indirectly heated vessels, the non self-resetting thermal cut-out should operate a motorised valve, or other similar device, to shut off the flow from the heat source.

On directly heated vessels or where an indirectly heated vessel has an alternative direct method of water heating fitted, a non self-resetting thermal cut-out device should be provided for each direct source.

Temperature relief valve

The temperature relief valve should be located directly on the storage vessel. Generally, a combined temperature and pressure valve is fitted. The relief valve should comply with BS 6283 Part 2: 1991 for temperature relief valves or BS EN 1490: 2000 for combined temperature and pressure relief valves which are set to open at temperatures not normally exceeding 90° C.

The relief valve should have a discharge capacity rating at least equal to the rate of energy (power in kilowatts) input to the heat source. In the case of an indirectly heated unit or package, the valve should be tested to discharge water at a rate not less than 500 kg/h for systems up to 45 kW. The discharge pipework should accommodate this flow rate.

4.9.3 Discharge from unvented hot water storage systems

The removal of discharges of water from the system can be considered in three parts:

Relief valve to tundish

Each valve should discharge into a metal pipe not less than the nominal outlet size of the valve. The discharge pipe should have an air-break, such as a tundish, not more than 500 mm from the vessel relief valve and located in an easily visible location within the same enclosure. Discharge pipes from more than one relief valve may be taken through the same tundish.

Pipework should be installed so that any discharge will be directed away from electrical components should the discharge outlet become blocked.

Tundish to final discharge point

The presence of this air break results in the pressure of the final discharge being no higher than that of a vented system.

The discharge pipe from the tundish to final discharge point should be of a material, usually copper, capable of withstanding water temperatures of up to 95° C and be at least one pipe size larger than the outlet pipe to the relief valve. A vertical section of pipe, at least 300 mm long, should be provided beneath the tundish before any bends to the discharge pipe; thereafter the pipe should be appropriately supported to maintain a continuous fall of at least 1 in 200 to the discharge point.

The pipework should have a resistance to the flow of water no greater than that of a straight pipe 9 m long unless the pipe bore is increased accordingly. Guidance on sizing of pipework from the tundish to the final discharge point is shown in the following table:

Size of discharge pipework

| Valve outlet size | Minimum size of discharge pipe to tundish | Minimum size of discharge pipe from tundish | Maximum resistance allowed, expressed as a length of straight pipe i.e. no elbows or bends | Equivalent resistance created by the addition of each elbow or bend |
|-------------------|---|---|--|---|
| G ½ | 15 mm | 22 mm | Up to 9 m | 0.8 m |
| | | 28 mm | Up to 18 m | 1.0 m |
| | | 35 mm | Up to 27 m | 1.4 m |
| G ¾ | 22 mm | 28 mm | Up to 9 m | 1.0 m |
| | | 35 mm | Up to 18 m | 1.4 m |
| | | 42 mm | Up to 27 m | 1.7 m |
| G 1 | 28 mm | 35 mm | Up to 9 m | 1.4 m |
| | | 42 mm | Up to 18 m | 1.7 m |
| | | 54 mm | Up to 27 m | 2.3 m |

Annex D to BS 6700: 1997 'Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages' also gives guidance on pipe sizing for water distribution systems.

Discharge pipe termination

The pipe termination should be in a visible location and installed so that discharge will not endanger anyone inside or outside the *building*.

Ideally, the final discharge point should be above the water seal to an external gully and below a fixed grating. Other methods for terminating the final discharge point would include:

- a. up to 100 mm above external surfaces such as car parks, grassed areas, or hard standings; a wire cage or similar guard should be provided to both prevent contact with discharge and protect the outlet from damage, whilst maintaining visibility;
- b. at high level into a hopper and downpipe of a material, such as cast iron, appropriate for a hot water discharge with the end of the discharge pipe clearly visible;
- c. onto a *flat roof* or pitched roof clad in a material capable of withstanding high temperature discharges of water, such as slate/clay/concrete tiles or metal sheet, with the discharge point a minimum of 3 m from any plastic guttering system that would collect such discharges.

Discharge at high level may be possible if the discharge outlet is terminated in such a way as to direct the flow of water against the external face of a wall. However, evidence of the minimum height of the outlet above any surface to which people have access and the distance needed to reduce the discharge to a non-scalding level should be established by test or otherwise.

4.9.4 Discharge of steam or hot water

Any vent or overflow pipe of a hot water system should be positioned so that any discharge will not endanger anyone inside or outside the *building*.

The discharge point of such pipework should be provided in accordance with the guidance given for termination in clause 4.9.3

4.9.5 Hot water discharge from sanitary fittings

Guidance to the Water Byelaws recommends that, to prevent the development of Legionella or similar pathogens, hot water within a storage vessel should be stored at a temperature of not less than 60° C and distributed at a temperature of not less than 55° C.

If water is supplied at high temperature, from any source, there is a danger of scalding to *building* users. Risk of severe injury increases proportionally with increase in temperature and with extent of contact.

[Guidance to the Water Byelaws](#)

Facilities used for personal hygiene

To prevent scalding, the temperature of hot water, at point of delivery to a bath or bidet, should not exceed 48° C

A device or system limiting water temperature should not compromise the principal means of providing protection from the risk of Legionella. It should allow flexibility in setting of a delivery temperature, up to a maximum of 48° C, in a form that is not easily altered by *building* users. This will allow reduction of temperature where, for example, facilities are used by those more at risk from injury, such as elderly people or unsupervised children.

www.tmva.org.uk

Where both hot and cold water are supplied to a facility, the above may be achieved by use of a thermostatic mixing valve (TMV) or fitting complying with BS EN 1111: 1999 or BS EN 1287: 1999, fitted as close to the point of delivery as practicable. Guidance on the installation, use and maintenance of thermostatic mixing valves and fittings can be found in BRE information

Paper [IP 14/03](#) and from the Thermostatic Mixing Valve Association (TMVA).

Provision within an existing *building*

Where a *dwelling* is altered or extended, but not *converted*, and new *sanitary facilities* are provided, some primary heat sources, such as older combination boilers, may not be suited to temperature control in the manner given above. In such cases, advice should be sought from equipment manufacturers on compatible means of limiting hot water temperature to controlled facilities.

Health & Safety legislation

The non-domestic Handbook should be referred to for duties under Health & Safety legislation relevant to any part of a *dwelling* used as a place of work.

4.10 Fixed seating

4.10 Functional standard

4.10.0 Introduction

standard

4.10

mandatory

Every *building*, which contains fixed seating accommodation for an audience or spectators, must be designed and *constructed* in such a way that a number of level spaces for wheelchairs are provided proportionate to the potential audience or spectators.

Limitation:

This standard does not apply to *domestic buildings*.

4.10.0 Introduction

This standard does not apply to *domestic buildings*.

4.11 Liquefied petroleum gas storage

- 4.11 Functional standard
- 4.11.0 Introduction
- 4.11.1 LPG storage installations
- 4.11.2 LPG storage – fixed tanks
- 4.11.3 LPG storage - cylinders

standard

4.11

mandatory

Every *building* must be designed and *constructed* in such a way that each liquefied petroleum gas storage installation, used solely to serve a combustion appliance providing space heating, water heating, or cooking facilities, will:

- (a) be protected from fire spreading to any liquefied petroleum gas container; and
- (b) not permit the contents of any such container to form explosive gas pockets in the vicinity of any container.

Limitation:

This standard does not apply to a liquefied petroleum gas storage container, or containers, for use with portable appliances.

4.11.0 Introduction

This guidance deals with domestic supply installations where liquefied petroleum gas (LPG) is stored under pressure at ambient temperatures in fixed vessels larger than 75 kg LPG capacity.

Guidance is also given on the storage of LPG within grouped cylinders, when connected to a supply installation.

The intention of the guidance to this standard is to minimise both the risk of fire spreading to the tank and of the contents of the tank forming explosive gas pockets in the vicinity of any LPG storage container.

All persons concerned with the storage and use of LPG should be aware of the following characteristics and potential hazards:

- the two forms of liquefied petroleum gases that are generally available in the UK are commercial butane and commercial propane;
- LPG is stored as a liquid under pressure. It is colourless and its weight as a liquid is approximately half that of the equivalent volume of water;
- LPG vapour is denser than air, commercial butane being about twice as heavy as air. Therefore the vapour may flow along the ground and into drains, sinking to the lowest level of the surroundings and may therefore be ignited at a considerable distance from the source of the leakage. In still air, vapour will disperse slowly;
- when mixed with air, LPG can form a flammable mixture;
- leakage of small quantities of the liquefied gas can give rise to large volumes of vapour/air mixture and thus cause considerable hazard;
- owing to its rapid vaporisation and consequent lowering of temperature, LPG, particularly in liquid form, can cause severe frost burns if brought into contact with the skin;
- a container that has held LPG and is 'empty' may still contain LPG in vapour form and is thus potentially dangerous.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

www.lpga.co.uk
www.hse.gov.uk

4.11.1 LPG storage installations

The type, size and location of an LPG storage installation will determine the factors that should be addressed in the *construction* of the facility, to comply with health and safety requirements.

The Liquefied Petroleum Gas Association (LPGA) produces and maintains Codes of Practice which give guidance on achieving levels of risk appropriate to compliance with health and safety legislation for the design, *construction* and operation of LPG installations. These Codes have been produced in consultation with the Health and Safety Executive (HSE).

The operation of properties where LPG is stored or is in use are subject to legislation enforced by both the HSE and by the Local Authority.

4.11.2 LPG storage – fixed tanks

A liquefied petroleum gas storage tank, together with any associated pipework connecting the system to a combustion appliance providing space or water heating, or cooking facilities, should be designed, *constructed* and installed in accordance with the requirements set out in the LPGA Code of Practice 1: 'Bulk LPG Storage at Fixed Installations'.

Above-ground tanks should be in accordance with Part 1 – 'Design, Installation and Operation of Vessels Located Above Ground', as amended.

Below-ground tanks should be in accordance with Part 4 – 'Buried/ Mounded LPG Storage Vessels', as amended .

For propane installations, above or below-ground, of not more than 2 tonnes (4500 litres) overall capacity, reference may be made to the simplified guidance given in the LPGA Code of Practice 1: 'Bulk LPG Storage at Fixed Installations': Part 2 – 'Small Bulk Propane Installations for Domestic and Similar Purposes', as amended.

Guidance given in this clause is relevant for all tanks, though specific criteria are noted for tanks below 4 tonnes (9000 litres) LPG capacity. LPG storage tanks in excess of 4 tonnes LPG capacity are uncommon in domestic applications. Guidance for larger installations is contained within the relevant Part of the Code of Practice.

Every tank should be separated from a *building*, *boundary*, or fixed source of ignition, to:

- a. in the event of fire, reduce the risk of fire spreading to the tank; and
- b. enable safe dispersal in the event of venting or leaks.

Tanks should be situated outdoors, in a position that will not allow accumulation of vapour at ground level. Ground features such as open drains, manholes, gullies and cellar hatches, within the separation distances given in column A of the table overleaf should be sealed or trapped to prevent the passage of LPG vapour.

Tanks should be separated from *buildings*, *boundaries* or fixed sources of ignition in accordance with the table overleaf:

Separation distances for liquefied petroleum gas storage tanks

| Maximum capacity (in tonnes) | | Minimum separation distance for above ground tanks (in metres) | | |
|---------------------------------|-----------------------------|--|-------------------------|------------------|
| of any single tank | of any group of tanks | From a building, boundary or fixed source of ignition to the tank | | between tanks |
| | | A no fire wall [1] | B with fire wall [1] | |
| 0.25 | 0.8 | 2.5 | 0.3 [2] | 1.0 |
| 1.1 | 3.5 | 3.0 | 1.5 [2] | 1.0 |
| 4.0 | 12.5 | 7.5 | 4.0 | 1.0 |

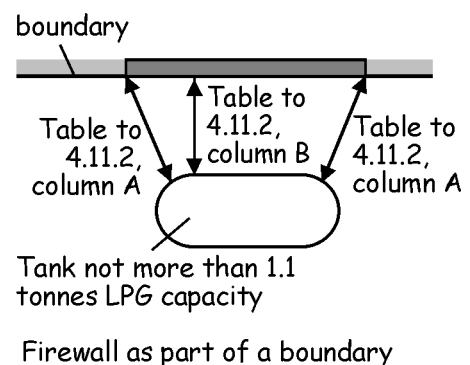
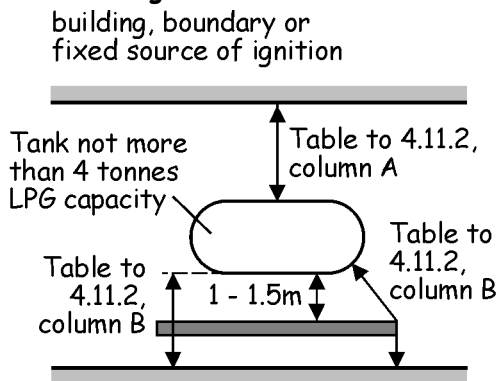
Notes:

1. Fire wall means a wall or screen meeting the guidance for an *external wall* with a fire resistance of short duration (section 2, Fire) within 1 m of the *boundary*, and located between 1 m and 1.5 m from the tank and extending:
 - a. longitudinally: so that the distance specified above without the fire wall is maintained when measured around the ends of the fire wall; and
 - b. vertically: 2 m or the height to the top of the pressure relief valve, whichever is greater.
2. For vessels up to 1.1 tonnes capacity, the fire wall need be no higher than the top of the pressure relief valve and may form part of the *site boundary*.

For vessels up to 1.1 tonnes capacity located closer to a *building* than the separation distance in column A of the above table, the fire wall should form part of the wall of the *building* in accordance with the diagram below. Where part of the *building* is used as a *dwelling* (or for residential accommodation), such a fire wall should meet the guidance for an *external wall* with a fire resistance of medium duration (section 2, Fire)

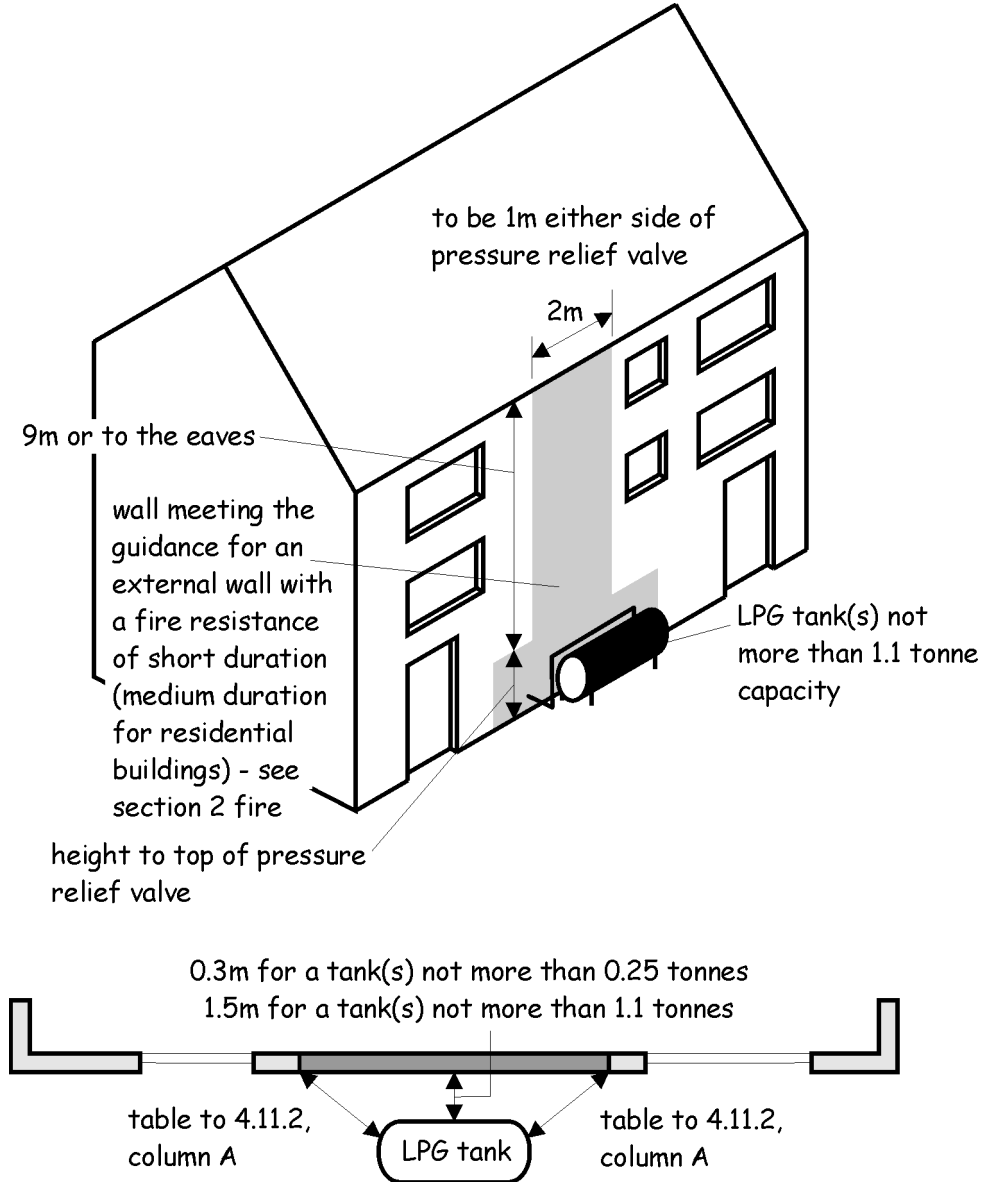
Where a group of tanks are sited together, the number of tanks in a group should not exceed 6 and the total storage capacity of the group should not exceed that given for any group of tanks in the table above.

Separation or shielding of a LPG tank from a building, boundary or fixed source of ignition



Plan view with and without firewall

Small LPG tank close to a building



Vehicular parking areas

Motor vehicles under the control of a *site occupier* should be parked at least 6 m from LPG tanks or the separation distance in column A of the table to this clause, whichever is the smaller. This does not apply to the loading/unloading of vehicles. Motor vehicles not under *site* control (e.g. those belonging to members of the public) should be parked no closer than the separation distance in column A of the table to this clause.

4.11.3 LPG storage - cylinders

Where an LPG storage installation consists of a set of cylinders, the installation should be in accordance with the LPGA Code of Practice 24: 'Use of LPG cylinders': Part 1 - 'The Use of Propane in Cylinders at Residential Premises'.

Use of cylinders in a domestic installation commonly takes the form of 2 sets of paired cylinders connected to a manifold, with supply provided from one pair of cylinders at any one time. This allows continuous supply to be maintained when changing empty cylinders.

Any installation should enable cylinders to stand upright, secured by straps or chains against a wall outside the *building*.

Cylinders should be positioned on a firm, level base such as concrete at least 50 mm thick or paving slabs bedded on mortar, and located in a well-ventilated position at ground level, so that the cylinder valves will be:

- a. at least 1 m horizontally and 300 mm vertically from openings in the *buildings* or from heat source such as *flue* terminals or tumble dryer vents;
- b. at least 2 m horizontally from untrapped drains, unsealed gullies or cellar hatches unless an intervening wall not less than 250 mm high is present.

Cylinders should be readily accessible, reasonably protected from physical damage and located where they do not obstruct *exit* routes from the *building* .

4.12 Vehicle protective barriers

- 4.12 Functional standard
- 4.12.0 Introduction
- 4.12.1 Vehicle protective barriers

standard

4.12

mandatory

Every *building* accessible to vehicular traffic must be designed and *constructed* in such a way that every change in level is guarded.

4.12.0 Introduction

Where vehicles are introduced into a *building*, measures should be taken to protect people from any additional risks presented. Where areas subject to vehicular traffic are at a level higher than adjacent areas, such as on ramps or platforms, precautions should be taken to ensure that vehicles can not fall to a lower level.

In the assessment of the type of barrier to be provided, the designer should give consideration to the likely hazards, the *building* use and the risks to *building* users.

Conversions

In the case of conversions, as specified in regulation 4, the building as converted shall meet the requirement of this standard (regulation 12, schedule 6).

4.12.1 Vehicle protective barriers

If vehicles have access to a floor, roof or ramp that forms part of a *building*, a vehicle protective barrier should be provided to the edge of any such area that is above the level of any adjoining floor, ground or any other route for vehicles.

When designing barriers to resist vehicular impact, an estimate of the characteristic mass of the vehicle should be made. Ideally, this should be determined statistically. If this is not possible, the characteristic mass should be taken to be equal to the maximum mass anticipated. Further information on estimation of equivalent static forces for a given characteristic mass and displacement can be obtained in Annex A to BS 6180: 1999

The designer should, wherever possible, avoid introducing projections on the vehicular face of the barrier and should also consider methods of redirecting vehicles in such a way as to cause minimum damage after impact

A vehicle protective barrier should be:

- a. capable of resisting loads calculated in accordance with BS 6399: Part 1: 1996, and
- b. of a height at least that given in the table below:

Height of vehicle protective barriers

| Location | Minimum height in mm |
|--------------------|----------------------|
| Floor or roof edge | 400 |
| Ramp edge | 600 |

The minimum height for these barriers relates to the height at which imposed load is applied as described in BS 6399, Part 1: 1996.

In locations used by both vehicles and pedestrians, such as parking areas, additional barrier criteria may apply to edges and changes in level as described in clauses 4.4.1 and 4.4.2.

Contents

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Annexes

5.A Method for calculating mass in relation to specified constructions

5.B Methods for selection of resilient materials used for soft coverings

5.C Performance testing

5.0 Introduction

- 5.0.1 Background
- 5.0.2 Aims
- 5.0.3 Latest changes
- 5.0.4 Relevant legislation
- 5.0.5 Annexes

introduction

5.0

5.0.1 Background

Noise is unwelcome sound. Noise transmitted to *dwellings* can detract from people's quality of life by disrupting sleep, causing annoyance, or disturbing everyday activities. In particular, sleep deprivation can lead to stress-related illness and affect performance at school or work.

Noise transmission between *dwellings* is a common cause of tension between neighbours. The [1996 Scottish House Condition Survey](#) by Scottish Homes found that 19% of households (403,000) were bothered by noise when indoors. The most common sources of noise were traffic and people outside, but a great many people complained of noise transmission through *separating walls* or *separating floors* .

The guidance in this section relates to the reduction of noise transmission to *dwellings* by controlling *building construction* and offers guidance on alternative approaches to design in the form of specified *constructions* , performance testing or, for new *buildings* only, the scheme operated by Robust Details Ltd. (see clause 5.1.13). There are requirements for *separating walls* and *separating floors* between a *dwelling* and other parts of the same *building* or adjoining *buildings* , for flanking *constructions* , and for some walkways or accessible roofs above *dwellings* .

5.0.2 Aims

The purpose of section 5 is to protect the residents of a *dwelling* from noise in other areas of the same *building* or an attached *building* . Recurrent noise can adversely affect the health of residents and inconvenience them by disrupting their everyday activities. In view of this, measures should be incorporated to reduce the transmission of the sounds of normal conversation, television, radio, music and domestic activities.

It is important to recognise that following the guidance in this section will not guarantee freedom from the transmission of all types of disturbing noise. Firstly, it does not address sound transmission between parts of the same *dwelling* . Secondly, it does not suggest that the *construction* should insulate against excessive noise from sources such as power drills, saws, or sanders, noise from a hi-fi system inconsiderately played at full volume, or wall-mounted 'surround sound' flat panel loudspeakers. Lastly, it does not address external sources of noise, such as aircraft, railways, road traffic, or industry.

Noise transmission to *buildings* or parts of *buildings* other than *dwellings* is not controlled by the Scottish building regulations.

[www.scotland.gov.uk/
about/Planning/](http://www.scotland.gov.uk/about/Planning/)

Although noise transmission from external sources into a *dwelling* is not controlled by the Scottish building regulations, it may be managed through the land use planning system. Advice can be found in PAN 56 'Planning Advice Note: Planning and Noise', 1999.

Detailed guidance on noise issues relating to *construction sites* can be found in BS 5228 'Noise control on construction and open sites.'

[www.scotland.gov.uk/
library3/environment/](http://www.scotland.gov.uk/library3/environment/)

Advice to consumers on dealing with noise problems is given in 'Sound advice on Noise: don't suffer in silence', 2001.

www.bpc.napier.ac.uk/sound/hsi

The Building Performance Centre at Napier University publishes guidance on good practice in improving sound insulation 'Housing and sound insulation: Improving existing attached dwellings and designing for conversions', 2006.

5.0.3 Latest changes

There have been no technical changes to this section between 1st May 2006 and 30th April 2007. However, some minor formatting which has not been listed has been carried out.

5.0.4 Relevant legislation

Listed below are some items of legislation that may be relevant to those using the guidance in this section.

[Construction \(Design and Management\) Regulations 1994](#)

Designers and specifiers should consider the health and safety implications of using mass to limit sound transmission.

[Manual Handling Operations Regulations 1992](#)

Buildings should be designed to avoid repetitive manual handling of excessively heavy blocks and boards. HSE advises on the assessment of manual handling operations.

5.0.5 Annexes

There are three annexes to this section:

Annex 5.A gives procedures to calculate the mass of materials for the specified *constructions* described in clauses 5.1.4-5.1.6 and 5.1.8-5.1.9.

Annex 5.B gives methods for the selection of resilient materials used in the specified *constructions* for *separating floors* described in 5.1.8 and 5.1.10.

Annex 5.C gives test procedures for the field sound tests referred to in 5.1.12.

5.1 Resisting sound transmission to dwellings

- 5.0 Functional standard
- 5.1.0 Introduction
- 5.1.1 General application to dwellings
- 5.1.2 Flanking transmission
- 5.1.3 Specified constructions
- 5.1.4 Specified wall constructions (Solid masonry)
- 5.1.5 Specified wall constructions (Cavity masonry)
- 5.1.6 Specified wall constructions (Solid masonry between isolated panels)
- 5.1.7 Specified wall constructions (Timber frames with absorbent curtain)
- 5.1.8 Specified floor constructions (Concrete base with soft covering)
- 5.1.9 Specified floor constructions (Concrete base with floating layer)
- 5.1.10 Specified floor constructions (Timber base with floating layer)
- 5.1.11 Specified floor constructions (Timber base with independent ceiling)
- 5.1.12 Performance testing
- 5.1.13 Scheme operated by Robust Details Ltd.

standard

5.1

mandatory

Every *building* must be designed and *constructed* in such a way that each wall and floor separating one *dwelling* from another, or one *dwelling* from another part of the *building*, or one *dwelling* from a *building* other than a *dwelling*, will limit the transmission of noise to the *dwelling* to a level that will not threaten the health of the occupants of the *dwelling* or inconvenience them in the course of normal domestic activities provided the source noise is not in excess of that from normal domestic activities.

Limitation

This standard does not apply to:

- (a) fully detached *houses*; or
- (b) roofs or walkways with access solely for maintenance, or solely for the use, of the residents of the *dwelling* below.

5.1.0 Introduction

There are requirements for appropriate sound insulation to apply to *separating walls* and *separating floors* between *dwellings*, between a *dwelling* and other parts of the same *building* and between *dwellings* and other adjoining *buildings*. Other internal and *external walls* are controlled, but only to the extent necessary to reduce flanking sound transmission. *Dwellings* directly below a walkway or a roof that is accessible other than for maintenance should be protected by sound resisting *construction*.

Some terms relating to noise that are used in this section only are explained below:

Explanation of terms

Airborne sound is sound which is propagated from a noise source through the medium of air. An example of this is speech.

Airborne sound transmission is direct transmission of airborne sound through *separating walls* or *separating floors*. When sound energy is created in a *room*, for instance by conversation, some of the energy is reflected or absorbed by *room* surfaces but some may set up vibrations in the walls and floor. Depending on both the amount of energy and the type of *construction*, this can result in sound being transmitted to adjacent *dwellings*.

An **air path** is a void in *construction* elements, which adversely affects the performance of sound resisting *construction*. Examples of air paths include incomplete mortar joints, porous *building* materials, gaps round pipes and shrinkage cracks.

Direct transmission refers to the path of either airborne or impact sound through a separating element of *construction* (see the diagrams to clause 5.1.1). Only direct transmission is measured in laboratory tests.

Flanking transmission refers to the path of either airborne or impact sound through adjacent *construction* (see the diagrams to clause 5.1.2). Field tests measure both direct and flanking sound transmission.

Impact sound is sound which is spread from a noise source in direct contact with a *building* element. An example of this is footsteps.

Isolation is a strategy to limit the number and type of rigid connections in a sound resisting element of *construction*.

Mass is a physical quantity that expresses the amount of matter in a body. Walls and floors may be described in terms of the surface density (mass per unit area, kg/m^2) of the wall face or the floor surface, which is the sum of the surface densities of each component of the *construction*. The density of materials is expressed as mass per unit volume, kg/m^3 .

Measures to reduce the transmission of sound

Measures to reduce the transmission of sound vary according to the type of *construction* and its reaction to sound energy. The most important factors which affect the behaviour of *separating walls* and *separating floors* are mass, cavities, isolation, and absorption.

More energy is required to set up vibrations in a dense structure than in a light one, making a massive structure less likely to transmit sound. Mass is particularly important in limiting the transmission of low frequency airborne sound, such as bass notes from a music system, but the interaction of linings and structure is also significant. The mass of a masonry *construction* depends on the mass and thickness of components and the jointing between them. The mass of a lighter weight structure, for instance timber floors, can be increased by deafening (or pugging), the process of filling between joists with high density material such as sand or gypsum based board.

Cavities aid the reduction of sound transmission, in part by isolating the components of elements of *construction*. The level of sound transmitted is reduced at each interface in a cavity wall and the wider the cavity, the greater the reduction in transmission. Very small cavities can create an unwelcome 'drum effect'. Any structural coupling of the leaves increases transfer by vibration: fewer and less stiff connections reduce sound transmission. Isolation is one of the means to reduce the transmission of mid to higher frequency sound, such as speech and the noise of domestic appliances.

Components which absorb sound energy by friction reduce sound transmission through the structure. For instance, absorptive material may be hung in a wall cavity.

Relationship to other sections

Consideration should be given to guidance in other sections which can influence the performance of sound resisting *construction*, including:

- Section 1: Structure: can affect the isolation of constituent parts of sound resisting *construction*
- Section 2: Fire: can affect the isolation of constituent parts of sound-resisting *construction* and absorption by internal surfaces
- Section 6: Energy: can affect the mass of sound resisting *construction* at junctions with exterior walls.

Alternative approaches to design

The guidance gives three alternative approaches to the design of sound resisting *construction* for *separating walls* and *separating floors*. These are:

- specified *constructions* (clauses 5.1.3 – 5.1.11);
- performance testing (clause 5.1.12);
- scheme operated by Robust Details Ltd. (see clause 5.1.13).

Specified *construction* and performance testing may be used for new *construction*, alterations or *conversions*. The Robust Standards Details Scheme only covers new *buildings*.

In addition to the guidance given here, there may be other approaches. For instance, if an identical block of *dwellings* has been tested and shown to meet the performance values, a building warrant can be given on that evidence. Care should be taken to ensure that the test results are equally applicable and that the critical aspects of the design are replicated, including specification, room size, shape, and relationships between *dwellings*. For instance, a *construction* giving good results in a stepped elevation or a staggered plan may not perform well in a straight terrace block of *dwellings*, due to flanking transmission. Also, checks should be made to ensure that the blocks are *built* to the same standards of workmanship as the block tested.

Conversion

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

5.1.1 General application to *dwelling*s

Section 5 applies to *dwelling*s other than those that are totally detached.

When determining how the guidance for resistance to transmission of sound applies to other types of *dwelling* configurations, recognition should be given to the following:

- a. airborne sound resisting *separating walls* and *separating floors* should be provided between *dwelling*s. Each *dwelling* is to be protected from noise emanating from the other one.
- b. airborne sound resisting *separating walls* and *separating floors* should be provided between *dwelling*s and non-domestic *buildings*. The *dwelling* is to be protected from noise emanating from the non-domestic *building*.
- c. airborne sound resisting *separating walls* and *separating floors* should be provided between *dwelling*s and other parts of a *building*. The *dwelling* is to be protected from noise emanating from the other parts, such as common stair enclosures and passages, solid waste disposal chutes, lift shafts, plant rooms, communal lounges, and car parking garages.
- d. impact sound resisting *separating floors* should be provided between *dwelling*s. The lower *dwelling* should be protected from sound emanating from the upper *dwelling*.
- e. impact sound resisting *separating floors* should be provided between a *dwelling* and other parts of a *building* that contains *dwelling*s. The *dwelling* below should be protected from sound emanating from other parts of the *building* above.
- f. impact sound resisting *construction* should be provided between a *dwelling* and a roof that acts as a floor or a walkway directly above the *dwelling*. The *dwelling* below is to be protected from sound emanating from the roof or walkway above. Examples of roofs that act as floors are *access decks*, car parking, *escape routes* and roof gardens.

Additional guidance relating to specific situations

The guidance given in a. to f. above is summarised in the following diagrams. It should be read in conjunction with additional guidance that relates to specific situations:

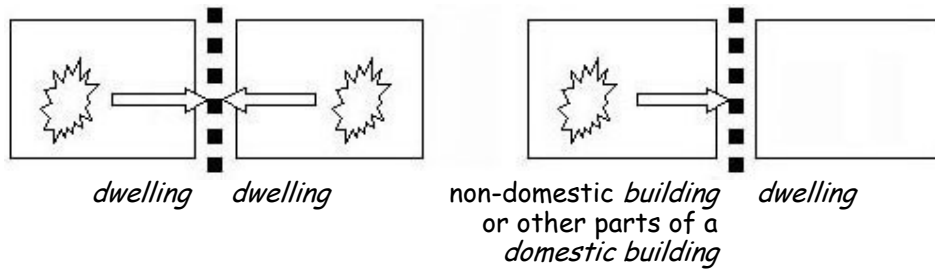
- where 2 *houses* are linked only by an imperforate *separating wall* between their ancillary garages, it is not necessary for the wall to be airborne sound resisting;
- where the wall between a *dwelling* and another part of the *building* is substantially open to the external air, it is not necessary for the wall to resist airborne sound transmission; an example of this would be the wall between a *dwelling* and an *access deck*;
- where the wall between a *dwelling* and another part of the *building* incorporates a *fire door*, it is not necessary for the door to be airborne sound resisting;
- when a roof or walkway is providing access solely for the purpose of maintenance or is solely for the use of the residents of the *dwelling* directly below, it is not necessary to provide impact sound resisting *construction*;
- in the case of a *separating wall* or *separating floor* between a *dwelling* and a private garage or a private waste storage area which is ancillary to the same *dwelling*, it is not necessary for the wall or floor to be airborne or impact sound resisting.

Additional guidance to *building* owners and tenants

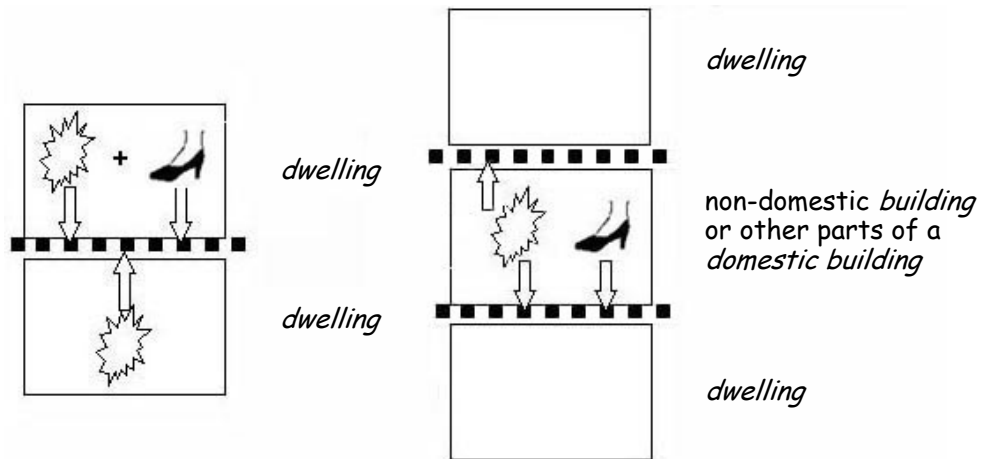
While floor coverings are not part of the building regulations, it should be noted that panelled floor finishes, including laminated flooring, may severely reduce the impact sound insulation for *separating floors*, and specialist advice should be considered.

The following diagrams show only direct transmission paths. Flanking transmission is also an important consideration. (see clause 5.1.2)

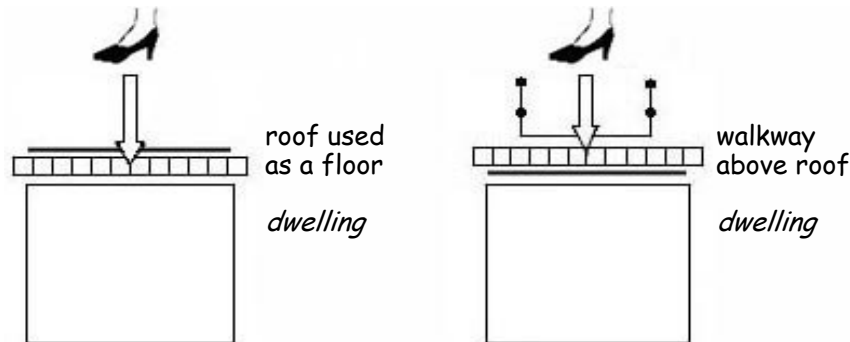
Airborne sound:
separating walls
(viewed in plan or section)








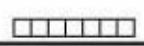
Airborne and impact sound:
separating floors
(viewed in section)



Impact sound:
roofs and walkways
over *dwellings*
(viewed in section)



Sound resisting *construction* is not necessary if the roof or walkway only provides access for maintenance or is solely for the use of the residents of the *dwelling* directly below.

| LEGEND | | | |
|---|---------------------------------|--|---|
|  | noise source: airborne sound |  | <i>separating wall or separating floor</i> |
|  | noise source: impact sound |  | roof over impact sound resisting <i>construction</i> |
|  | direct transmission |  | sound resisting <i>construction</i> over roof |

5.1.2 Flanking transmission

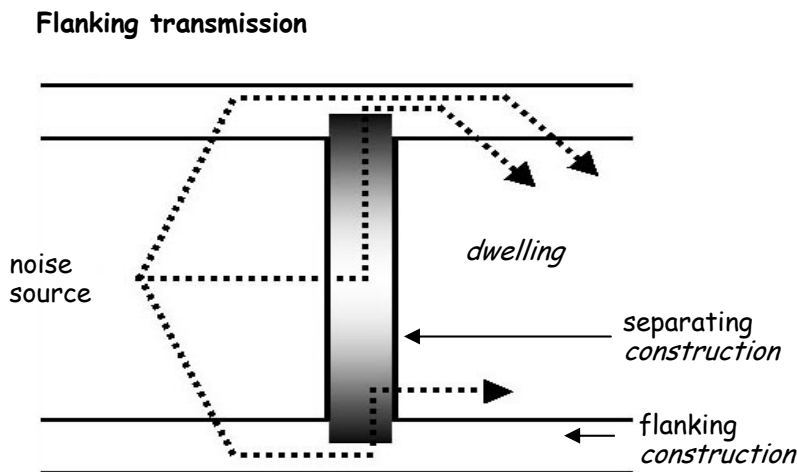
A specification for a sound resisting *separating wall* or *separating floor* is incomplete without measures to avoid flanking transmission.

Flanking transmission occurs when there is a path for sound to travel along elements adjacent to *separating walls* or *separating floors*. If the flanking *construction* and its connections with the separating structure are not correctly detailed, flanking transmission can equal or even exceed sound levels perceived as a result of direct transmission.

Flanking transmission can occur, for instance, when a wall of low mass is continuous between a space and the *dwelling* below, such as the inner leaf of a cavity wall where the floor is not built into the inner leaf. Similarly, where a *separating wall* abuts the inner leaf of an external cavity wall, and the walls are insufficiently tied or bonded together, noise can travel along the path of the inner leaf.

Typical routes

(viewed in either plan or section)



5.1.3 Specified constructions

One of the possible approaches to standard 5.1 is to use specified *constructions*. The *specified constructions* presented in this guidance use common *building* techniques and materials. Quality of workmanship is critical in achieving protection from sound transmission when using these details.

Thickness, mass, and other dimensions are suggested minimum values. Timber sizes refer to actual sizes. Where the mass per unit area (kg/m^2) is given, it refers to the wall surface area, or to the floor surface on plan. Annex 5.A gives a method for calculating mass in relation to the specified *constructions*.

Workmanship

Research commissioned by the Scottish Executive suggests that particular care should be taken with certain wall and floor types in order to achieve satisfactory resistance to sound transmission (see www.scotland.gov.uk/development/bc/insulation.pdf).

Updated advice is offered for the wall types which use gypsum based board fixed to solid or cavity masonry. Updated advice is also offered for each of the floor types, including guidance on resilient materials which has been adjusted to reflect common practice.

When *dwelling*s are created by *conversion*, the existing walls and floors should be checked to determine whether use of the specified *constructions* is appropriate.

The following constraints apply to the specified *constructions*.

Separating walls

No opening should be provided except a doorway with a *fire door* in accordance with section 2, Fire, where the doorway is either:

- between a *dwelling* and a common stairway or common passage in the same *building*; or
- between a *dwelling* and a stairway or passage in an area of another use which is in the same occupation as the *dwelling*.

No service pipes or *ducts* should pass between a *dwelling* and a common stairway, common passage or a services enclosure unless the pipes and *ducts* are protected as recommended by section 2 Fire.

Custom built and *system chimneys* should not be built into timber frame *separating walls*, including wall type 4. Only masonry *chimneys* (including *chimneys* built of precast concrete *flue blocks*) should be *built* into other types of *separating wall*.

Separating floors

In any *separating floor* being built to one of the specified *constructions*, no openings should be formed, apart from openings for service *ducts*, pipes, or *chimneys* which are protected as recommended by section 2, Fire and section 3, Environment, and are enclosed above and below the floor as described in the notes on floor penetrations for each of the recommended floor *constructions*. Guidance on the installation of down lighters has been added for floor type 4.

No specific guidance is given on how to achieve resistance to impact sound for walkways and roofs that act as floors, where they are directly above *dwelling*s. In some instances, where only light traffic is involved, e.g. a rooftop patio, it may be possible to adapt one of the specified *constructions*. In other cases e.g. rooftop car parking, it is recommended that specialist advice is sought. In all cases guidance on weather protection, given in section 3, Environment, should be considered.

Loudspeakers

The development of flat panel loudspeakers and loudspeakers integrated within floor *constructions* has introduced an additional neighbour noise concern. No loudspeaker should be fitted within a *separating floor* or *separating wall*. Also, it should be noted that the specified *constructions* and performance test standards cannot provide sufficient sound reduction to prevent nuisance if 'surround sound' loudspeakers are mounted directly onto *separating walls* or *separating floors*.

Information relevant to other standards

The specified *constructions* do not show all the information that relates to the other building standards. For example, there is no consideration of the structural bracing of floors.

It is important that the specified *constructions* should be used with due regard for the *fire-stopping* guidance in section 2, Fire, and any other relevant standards.

5.1.4 Specified wall constructions

Wall type 1: Solid masonry

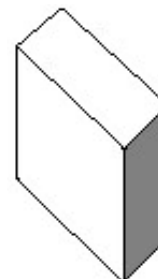
The resistance to airborne sound transmission depends mainly on the mass of the wall.

Wall type 1
Points to
watch

Fill masonry joints with mortar in order to achieve the mass and avoid air paths. Limit the pathways around the wall (to reduce flanking transmission).

Chases for services may be provided if:

- the depth of any horizontal chase does not exceed one-sixth of the thickness of the leaf;
- the depth of any vertical chase does not exceed one-third of the thickness;
- chases are not back to back.

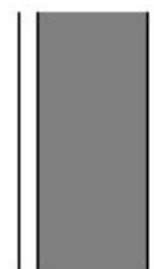


Constructions – wall type 1

Five recommended solid masonry wall *constructions* (A-E) are described below, including details of junctions to limit flanking transmission.

Wall type 1A

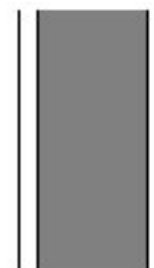
Brick, plastered both sides
Mass including plaster 375 kg/m².
13 mm plaster each side.
Lay bricks in a bond which includes headers and with frogs uppermost.
Example: 215 mm brick, 75 mm coursing, brick density 1610 kg/m³; lightweight plaster.



section

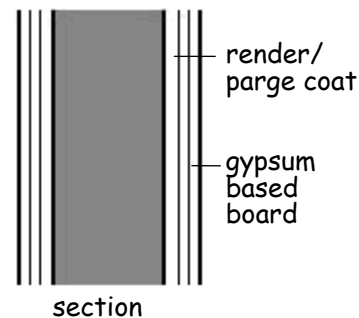
Wall type 1B

Concrete block, plastered both sides
Mass including plaster 415 kg/m².
13 mm plaster each side.
Use blocks which extend to the full thickness of the wall.
Two leaves of block side by side are not recommended
Example: 215 mm block, 110 mm coursing, block density of 1840 kg/m³; lightweight plaster.

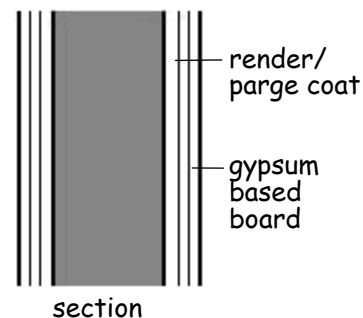


section

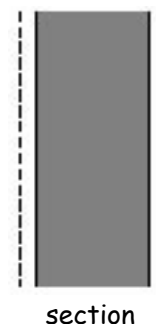
Wall type 1C Brick, parged both sides, gypsum based board both sides.
 Mass of brick and gypsum based board 375 kg/m^2 .
 13 mm internal render (parge coat) both sides, should not be smoothed or float finished. Minimum mass per unit area of internal render 18 kg/m^2 , both sides.
 Typical internal render mix: cement: lime : sand $1 : \frac{1}{2} : 4$, by dry volume, in accordance with BS 5492: 1990.
 12.5 mm gypsum based board each side, minimum mass per unit area 8.5 kg/m^2 , both sides, fixed with plaster dabs, not battens.
 Lay bricks in a bond which includes headers and frogs uppermost.
 Example: 215 mm brick, 75 mm coursing, brick density 1610 kg/m^3 .



Wall type 1D Concrete block, parged both sides, gypsum based board both sides.
 Mass of masonry alone 415 kg/m^2 .
 13 mm internal render (parge coat) both sides, should not be smoothed or float finished.
 Minimum mass per unit area of internal render 18 kg/m^2 , both sides.
 Typical internal render mix: cement : lime : sand $1 : \frac{1}{2} : 4$, by dry volume, in accordance with BS 5492: 1990.
 12.5 mm gypsum based board each side, minimum mass per unit area 8.5 kg/m^2 , both sides, fixed with plaster dabs, not battens.
 Use blocks which extend to the full thickness of the wall.
 Two leaves of block side by side are not recommended.
 Example: 215 mm block, 150 mm coursing, block density 1840 kg/m^3 .



Wall type 1E In-situ concrete or large concrete panel
 Minimum density 1500 kg/m^3 , plaster optional.
 Mass (including plaster if used) 415 kg/m^2 .
 Fill joints between panels with mortar.
 Example: 190 mm thick unplastered wall, density 2200 kg/m^3 .



Junctions at roof, ceilings, floors

Guidance in sections 1, 2 and 6 should be considered.

Wall type 1

Fire-stop the joint between wall and roof (see section 2, Fire).

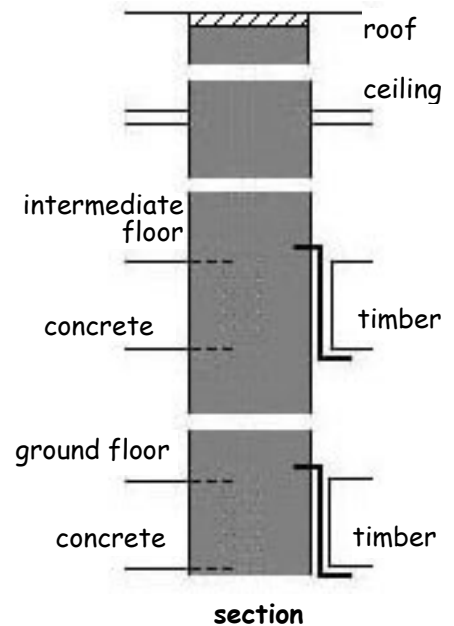
Where there is a heavy ceiling with sealed joints (12.5 mm gypsum based board or board material of equivalent mass), the mass of the wall above the ceiling may be reduced to 150 kg/m².

If lightweight aggregate blocks are used to reduce mass, seal one side with cement paint or plaster skim.

With a timber floor, use joist hangers instead of building joists into *separating walls*.

With a concrete floor the wall should be carried through, unless the concrete floor has a mass of 365 kg/m² or more.

See clause 5.1.3 for guidance on openings, pipes and *ducts*, and *chimneys*.



Junctions at external walls

The outer leaf of a cavity wall adjacent to a type 1 wall may be of any *construction*.

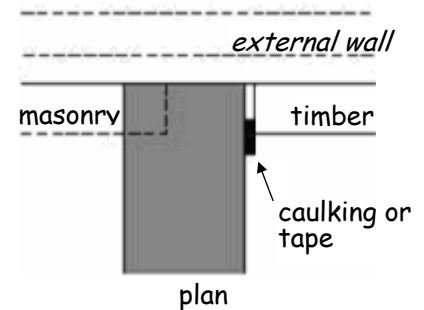
Wall type 1

Where a cavity wall has an inner leaf of masonry, or where the *external wall* is of solid masonry:

- a. the masonry of the *separating wall* should:
 - be bonded together with the masonry of the inner leaf or the solid *external wall*; or
 - abut the masonry of the *external wall* and be tied to it with ties at no more than 300 mm centres vertically; and
- b. the masonry should have a mass of 120 kg/m² unless the length of the *external wall* is limited by openings:
 - of 1 m high, and
 - on both sides of the *separating wall* at every *storey*, and
 - within 700 mm of the face of the *separating wall* on both sides (a short length of wall does not vibrate excessively at low frequencies to give flanking transmissions).

Where a cavity wall has an inner leaf of timber *construction* it should:

- abut the *separating wall*; and
- be tied to it with ties at no more than 300 mm centres vertically; and
- have the joints sealed with tape or caulking.



Wall type 2

5.1.5 Specified wall constructions Wall type 2: Cavity masonry

The resistance to airborne sound transmission depends on the mass of the leaves and on the degree of isolation achieved.

Points to watch

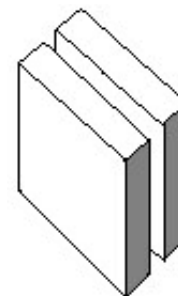
Fill masonry joints with mortar in order to achieve the mass and avoid air paths. Maintain the cavity up to the underside of the roof.

Connect the leaves only where necessary for structural reasons.

Use only butterfly pattern ties, as described in BS 1243: 1978, spaced no further apart than 900 mm horizontally and 450 mm vertically (BS 5628: Part 3: 2001 limits this tie type and spacing to cavities of 50 mm to 75 mm with a minimum masonry leaf thickness of 90 mm). Cavities should be kept clear of mortar droppings, which can reduce acoustic performance by creating a bridge between the 2 leaves.

50 mm cavities are acceptable for wall types 2A, 2B, and 2C, but 75 mm cavities make it is easier to avoid this problem.

If *external walls* are to be filled with an insulating material, other than loose fibre, the insulating material should be prevented from entering the cavity in the *separating wall*.



Chases for services can be provided if:

- the depth of any horizontal chase does not exceed one-sixth of the thickness of the leaf;
- the depth of any vertical chase does not exceed one-third of the thickness;
- chases are not back to back.

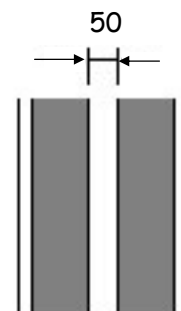
Constructions – wall type 2

Four recommended cavity wall *constructions* (A-D) are described below, including details of junctions to limit flanking transmission. Two of the specified *constructions* are only intended for use between *houses* with a step in elevation and / or a stagger in plan at the *separating wall* (C & D).

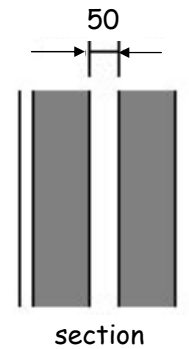
Wall type 2A

Two leaves of brick with 50 mm cavity, plastered on both *room* faces. Mass including plaster 415 kg/m². 13 mm plaster each face.

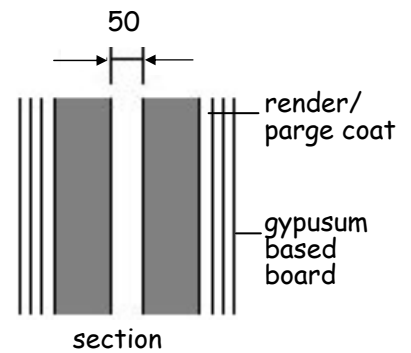
Example: 102 mm leaves laid frogs uppermost, 75 mm coursing, brick density 1970 kg/m³; lightweight plaster.



Wall type 2B Two leaves of concrete block with 50 mm cavity, plastered on both *room* faces
 Mass including plaster 415 kg/m². 13 mm plaster each face.
 Example: 100 mm leaves, 225 mm coursing, block density 1990 kg/m³; lightweight plaster.

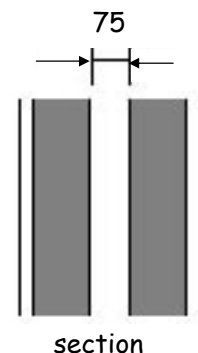


Wall type 2C Two leaves of concrete block with 50 mm cavity, both leaves parged, gypsum based board on both *room* faces.
 Mass of masonry alone 415 kg/m².
 12.5 mm gypsum based board each side, minimum mass per unit area 8.5 kg/m², both sides, fixed with plaster dabs.
 13 mm internal render (parge coat) both leaves; should not be smoothed or float finished.
 Minimum mass per unit area of internal render 18 kg/m², both leaves.
 Typical internal render mix:
 cement : lime : sand 1 : ½ : 4, by dry volume, in accordance with BS 5492: 1990.
 Example: 100 mm leaves, 225 mm coursing; block density of 1990 kg/m³ gives the required mass.



Adjacent *dwellings* using wall type 2C should be stepped and/or staggered by at least 300 mm.

Wall type 2D Two leaves of lightweight aggregate concrete block with 75 mm cavity, plastered on both *room* faces.
 Maximum block density 1500 kg/m³.
 Mass including plaster 250 kg/m².
 13 mm plaster each face.
 Seal the face of the blockwork, with cement paint or plaster, through the full width and depth of any intermediate floor.
 Example: 100 mm leaves, 225 mm coursing, block density 1105 kg/m³; lightweight plaster.



Adjacent *dwellings* using wall type 2D should be stepped and/or staggered by at least 300 mm.

Junctions at roof, ceilings, floors

Guidance in Sections 1, 2 and 6 should be considered.

Wall type 2

Fire-stop the joint between wall and roof (see section, 2 Fire).

Where there is a heavy ceiling with sealed joints (12.5 mm gypsum based board or board material of equivalent mass), the mass of the wall above the ceiling may be reduced to 150 kg/m².

The cavity should still be maintained.

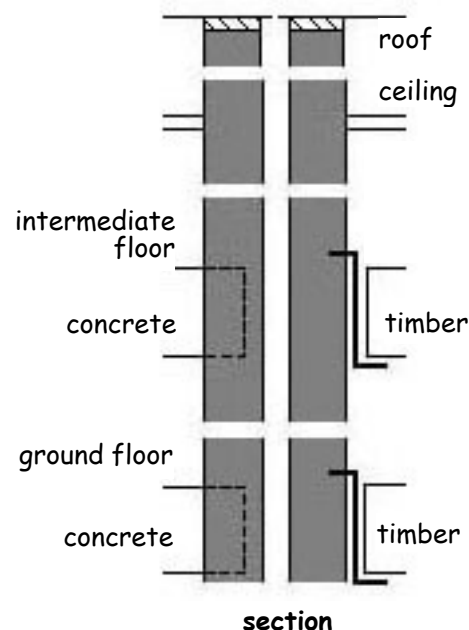
If lightweight aggregate blocks are used to reduce mass, one face of the wall should be sealed with cement paint or plaster skim.

With a timber floor, use joist hangers for any joists supported on the wall.

With a concrete intermediate or suspended ground floor the floor may be carried through, only to the cavity face of each leaf.

A concrete slab on the ground may be continuous.

See clause 5.1.3 for guidance on openings, pipes and *ducts*, and *chimneys*.



Junctions at external walls

The outer leaf of a cavity wall adjacent to a type 2 wall may be of any *construction*.

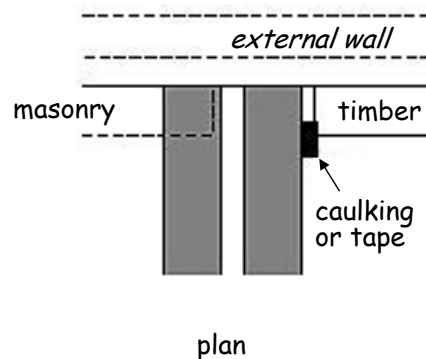
Wall type 2

Where a cavity wall has an inner leaf of masonry:

a. the masonry of the *separating wall* should:

- be bonded together with the masonry of the inner leaf of the *external wall* to create a homogeneous unit; or
- abut the masonry of the *external wall* and be tied to it with ties at no more than 300 mm centres vertically; and

b. the masonry should have a mass of 120 kg/m² except where *separating wall* type 2B is used, when there is no minimum appropriate mass.



Where a cavity wall has an inner leaf of timber *construction* it should:

- abut the *separating wall*; and
- be tied to it with ties at no more than 300 mm centres vertically; and
- have the joints sealed with tape or caulking.

The cavity in the *separating wall* should only be sealed in accordance with the guidance in section 2, Fire.

Wall type 3

5.1.6 Specified wall constructions

Wall type 3: Solid masonry between isolated panels

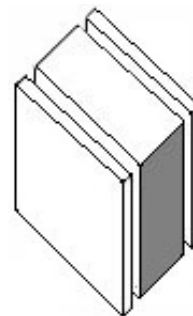
The resistance to airborne sound transmission depends on the mass and type of core, and on the isolation and mass of the panels.

Points to watch

Fill masonry joints with mortar in order to achieve the mass and avoid air paths. To achieve isolation, support the panels only from floor and ceiling, without fixing or tying to the core.

Cavity barriers between the masonry core and isolated panels should be the minimum necessary to follow the guidance in section, 2 Fire, and should be of a flexible type, to maintain the isolation.

Services may penetrate the free-standing panels but any gaps should be sealed with tape or caulking.



Wall type 3

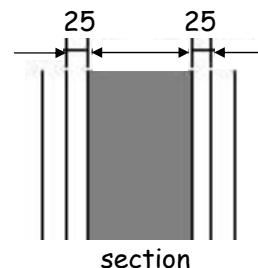
Constructions – wall type 3

Four recommended masonry cores (A - D) and two panels (P1 & P2) are described below, including details of junctions to limit flanking transmission. Any of the masonry cores may be used in combination with either of the panels.

Basic construction

A masonry core, with an isolated panel on each side.

Minimum air space between panels and core 25 mm. Framing should be kept clear of the masonry core by at least 10 mm.



Core A

Masonry cores

Brick. Mass 300 kg/m².

Example: 215 mm core, laid with frogs uppermost, 75 mm coursing; brick density 1290 kg/m³.

Core B

Concrete block. Mass 300 kg/m².

Example: 140 mm core, 110 mm coursing, block density 2200 kg/m³.

Core C

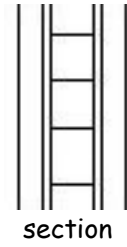
Lightweight aggregate concrete block.

Mass 200 kg/m². Maximum density 1500 kg/m³.

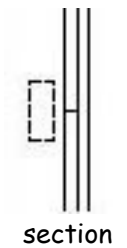
Examples: 140 mm core, 225 mm coursing; block density 1405 kg/m³. 215 mm core, 150 mm coursing; block density 855 kg/m³.

Core D Autoclaved aerated concrete block. Mass 160 kg/m^2
 Examples: 200 mm core, 225 mm coursing; block density 730 kg/m^3 . 215 mm core, 150 mm coursing; block density 855 kg/m^3 .

Panel P1 **Isolated panels**
 Two sheets of gypsum based board joined by cellular core.
 Mass (including plaster finish if used) 18 kg/m^2
 Fit to ceiling and floor only.
 Tape joints between panels.

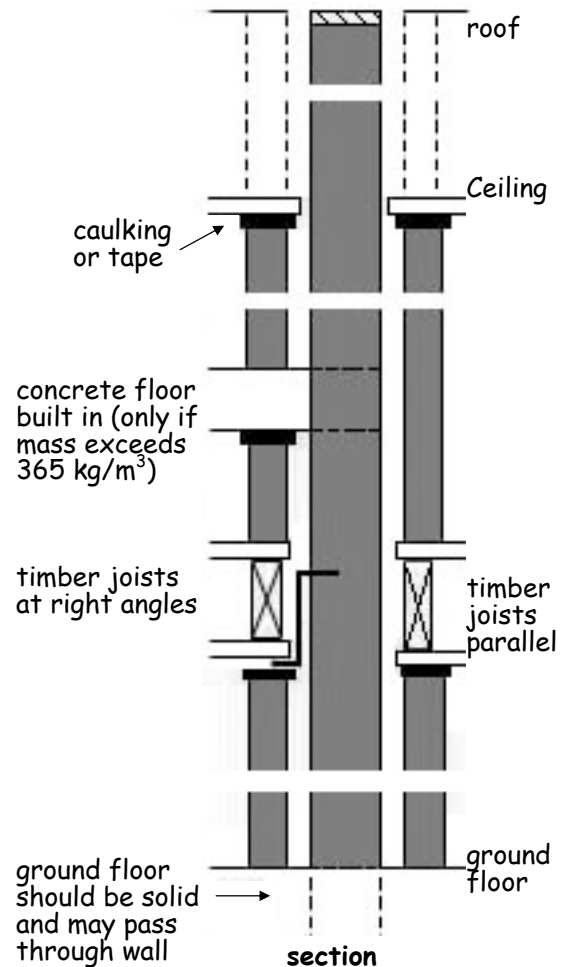


Panel P2 Two sheets of gypsum based board with joints staggered.
 Mass (including plaster finish if used) 18 kg/m^2
 Thickness of each sheet 12.5 mm if a supporting framework is used, or total thickness of 30 mm if no framework is used.



Junctions at roof, ceilings, floors
 Guidance in sections 1, 2 and 6 should be considered.

Wall type 3 *Fire-stop* the joint between masonry core and roof (see section, 2 Fire).
 Where there is a heavy ceiling with sealed joints (12.5 mm gypsum based board or board material of equivalent mass), the free-standing panels may be omitted in the *roof space* and mass of the core above the ceiling may be reduced to 150 kg/m^2 .
 If lightweight aggregate blocks are used to reduce mass, seal one side with cement paint or plaster skim.
 Seal the junction between ceiling and free-standing panels with tape or caulking.
 With a timber intermediate floor use joist hangers for any joists supported on the wall and seal the spaces between joists with full depth timber dwangs.
 With a concrete intermediate floor the floor base may only be carried through where it has a mass of 365 kg/m^2 .
 Seal the junction between ceiling and panel with tape or caulking.
 The ground floor should be a solid slab, laid on the ground to prevent air paths.



Junctions at external walls

The outer leaf of a cavity wall adjacent to a type 3 wall may be of any *construction*.

Wall type 3

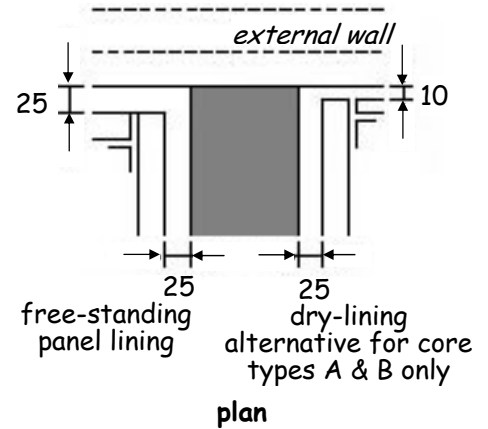
The inner leaf of a cavity wall should have an internal finish of isolated panels as specified for the *separating wall*.

This is not necessary where the *separating wall* has core A or B, in which case plaster or dry-lining with joints sealed with tape or caulking may be used.

A layer of insulation may be added to such internal finish provided the 25 mm and 10 mm gaps shown in the diagram are maintained. The inner leaf may be of any *construction* if it is lined with isolated panels.

If the inner leaf is dry-lined it should be masonry with a mass of 120 kg/m², butt jointed to the *separating wall* core with ties at no more than 300 mm centres, vertically.

See clause 5.1.3 for guidance on openings, pipes and *ducts*, and *chimneys*.



Junctions at partitions

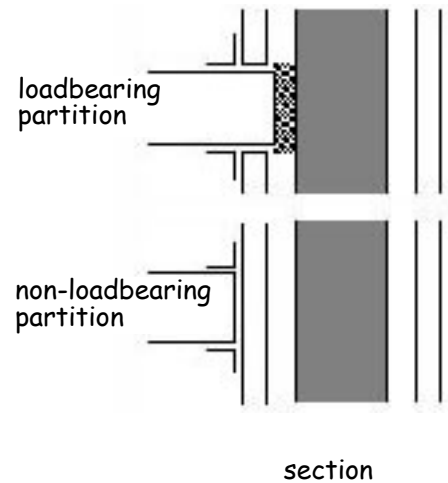
Wall type 3

Partitions abutting a type 3 *separating wall* should not be of masonry *construction*.

Other loadbearing partitions should be fixed to the masonry core through a continuous pad of mineral fibre quilt.

Non-loadbearing partitions should be tight butted to the isolated panels.

All joints between partitions and panels should be sealed with tape or caulking.



Wall type 4 **5.1.7 Specified wall constructions**

Wall type 4: Timber frames with absorbent curtain

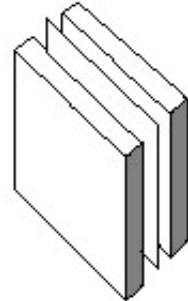
The resistance to airborne sound transmission depends on the isolation of the frames plus absorption in the air space between them. Section 2 Fire limits the *storey* height at which this type may be used.

Points to watch

Only connect frames if necessary for structural reasons, and then use as few ties as possible. These should not be more than 14-16 gauge (40 mm x 3 mm) metal straps fixed at or just below ceiling level, 1.2 m apart.

Where *cavity barriers* are needed in the cavity between frames they should either be flexible or fixed to only one frame.

Services should not be contained in the wall. This is a structural fire precaution but also limits the creation of air paths through the lining.

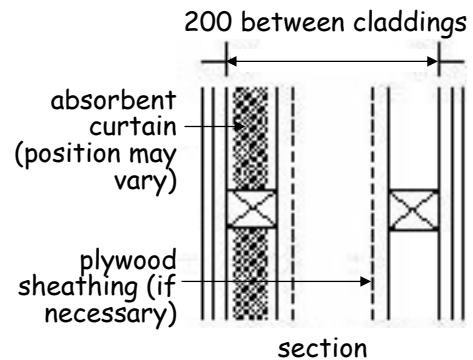


Wall type 4 **Constructions – wall type 4**

Two recommended timber frame *constructions* (A & B) are given, together with details for cladding and absorbent curtains, and for junctions to limit flanking transmission.

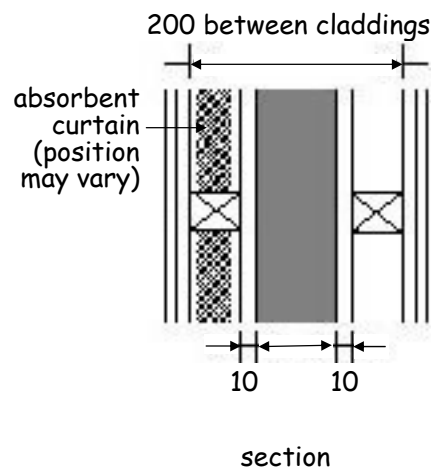
Wall type 4A **Basic construction**
Timber frames plus absorbent curtain in cavity.

200 mm between claddings.
Plywood sheathing may be used in the cavity as necessary for structural reasons.



Wall type 4B Timber frames, masonry core, plus absorbent curtain in a cavity.
200 mm between claddings (ignore core).
Framing should be clear of core by 10 mm.
The masonry core is not considered as part of the means of providing sound resistance, but it may be useful for structural support and/or easing the transition to external masonry cladding in stepped or staggered situations.

There are no restrictions on the type of masonry but the core may be connected to only one of the frames.



Cladding

On each side: 2 or more layers of gypsum based board, combined thickness 30 mm, joints staggered to avoid air paths.

Absorbent curtain

Unfaced mineral fibre quilt (which may be wire reinforced), density 12-36 kg/m³, thickness 25 mm if suspended in the cavity between frames, 50 mm if fixed to one frame, or 25 mm per quilt if one fixed to each frame.

Wall type 4

Junctions at roof, ceilings, floors

Guidance in sections 1, 2 and 6 should be considered.

Roof

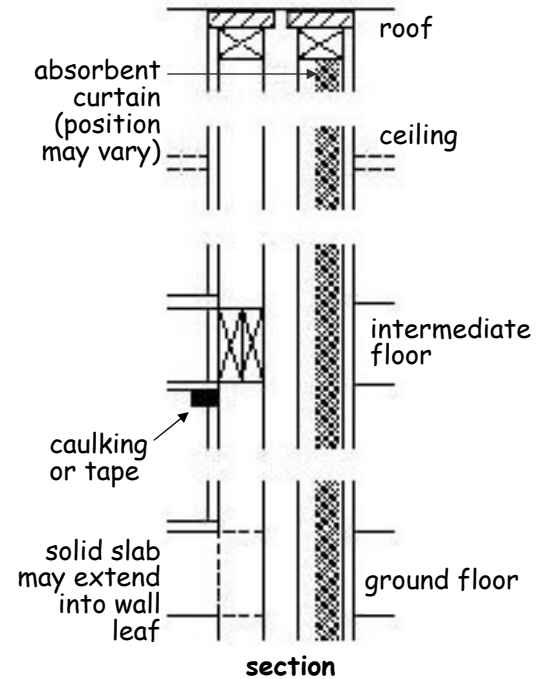
Fire-stop the joint between masonry core and roof (see section 2, Fire).

Ceiling and roof space

Carry the complete *construction* through to the underside of the roof.
Provision of a ceiling of any type is optional.

Intermediate floor and ground floor

Block the air path to the wall cavity either by carrying the cladding through the floor or by using a solid timber edge to the floor.
Where the joists are at right angles to the wall, seal spaces between joists with full depth timber dwangs.
See clause 5.1.3 for guidance on openings, pipes and *ducts*, and *chimneys*.



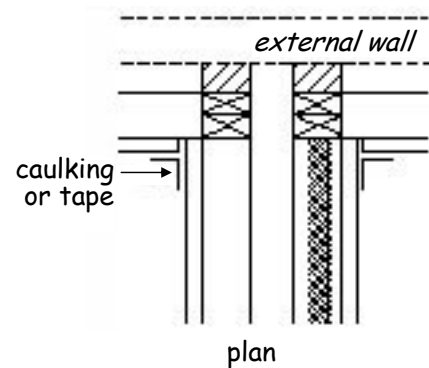
Junctions at external walls

Wall type 4

There are no restrictions on a traditional timber framed wall but if the wall is of cavity *construction*, the cavity should be sealed between the ends of the *separating wall* and the outer leaf to prevent air paths.

The internal finish of the external wall should be 12.5 mm gypsum based board or other equally heavy material having a mass of at least 10 kg/m² (thermal insulation may be incorporated within the framing).

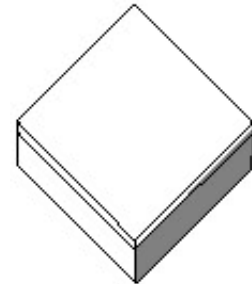
Where there is an adjacent separating floor, an additional layer of 12.5 mm gypsum based board should be mounted on the inner leaf of the external wall. See also section 2, Fire.



Floor type 1 **5.1.8 Specified floor constructions**
Floor type 1: Concrete base with soft covering

The resistance to airborne sound transmission depends on the mass of the concrete base and on eliminating air paths. The resistance to impact sound transmission depends on the soft covering.

Points to watch Fill all joints between parts of the floor to avoid air paths.
 Limit pathways around the floor to reduce flanking transmission.
 Workmanship and detailing should be given special attention at the perimeter and wherever the floor is penetrated by a pipe or duct, to reduce flanking transmission and to avoid air paths.



Floor type 1 **Constructions – floor type 1**
 Four floor bases (A-D) are described below, together with details for soft coverings which increase resistance to impact sound transmission, and for junctions to limit flanking transmission.

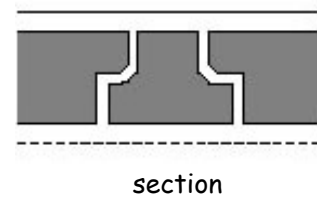
Base A **Floor bases**
 Solid concrete slab, cast in-situ.
 Floor screed and/or ceiling finish optional.
 Mass (including any screed and/or ceiling finish) 365 kg/m².



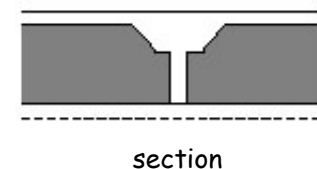
Base B Solid concrete slab, cast in-situ, with permanent shuttering.
 Floor screed and/or ceiling finish optional.
 Mass 365 kg/m² including shuttering only if it is solid concrete or metal, and including any screed and/or ceiling finish.



Base C Concrete beams with infilling blocks
 Floor screed and/or structural topping should be used.
 Ceiling finish optional.
 Mass 365 kg/m² including beams, blocks, any structural topping, screed, and any ceiling finish.



Base D Concrete planks (solid or hollow)
 Floor screed and/or structural topping should be used.
 Ceiling finish optional.
 Mass 365 kg/m², including planks, any structural topping and screed, including any ceiling finish.



Soft covering

Soft covering, fully bonded to the floor base:

- a resilient material, or material with a resilient base, with an overall uncompressed thickness of at least 4.5 mm; or
- a material with a weighted reduction in impact sound pressure level (ΔL_w) of at least 17 dB when measured in accordance with annex 5.B.

It is not suitable as a means to limit impact transmission to a *dwelling* below a walkway or a roof that acts as a floor.

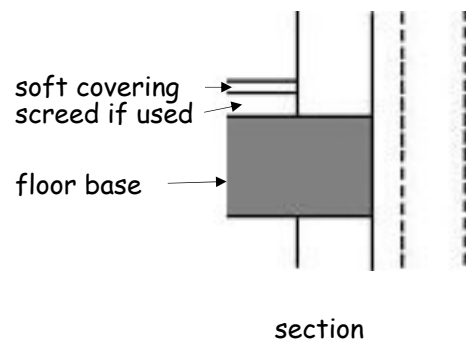
Floor type 1

Junctions at walls at external or cavity separating walls

Guidance in sections 1, 2 and 6 should be considered.

The mass of the wall leaf adjoining the floor should be 120 kg/m^2 , including any plaster. This is not necessary where the area of openings in the *external wall* exceeds 20% of its area: there is no recommendation for the minimum mass of such a wall.

The floor base, excluding any screed, should pass through the leaf whether spanning parallel to, or at right angles to, the wall. The cavity should not be bridged.

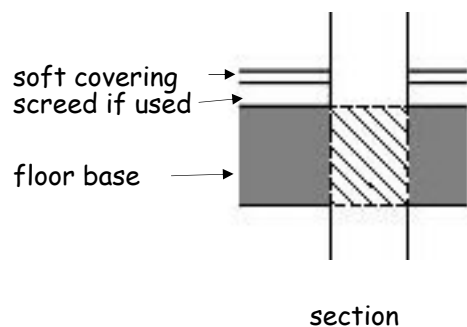


Floor type 1

Junctions at walls at internal or solid separating wall

If the wall mass is less than 355 kg/m^2 including any plaster then the floor base excluding any screed should pass through. If the wall mass is more than 355 kg/m^2 including any plaster, either the wall or the floor base excluding any screed may pass through.

Where the wall does pass through, tying the floor base to the wall and grouting the joint, is recommended.



Floor type 1

Floor penetrations

No openings should be formed, apart from openings for service *ducts*, pipes, or *chimneys* which are protected as recommended by section 2, Fire and section 3, Environment.

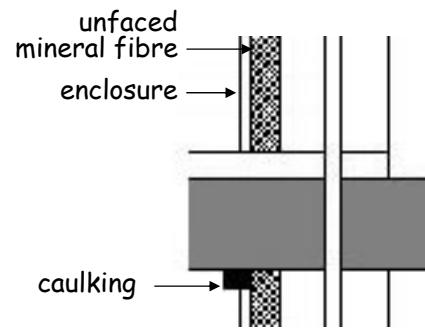
Ducts or pipes that penetrate the floor should be in an enclosure, both above and below the floor.

Either line the enclosure, or wrap the *duct* or pipe within the enclosure, with 25 mm unfaced mineral fibre.

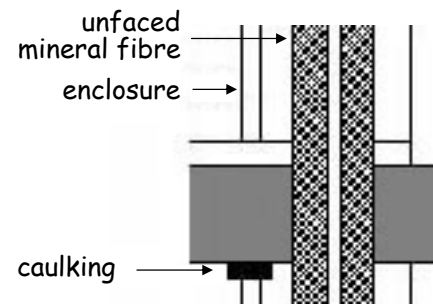
The material of the enclosure should have a mass of 15 kg/m².

Penetrations of a *separating floor* by *ducts* and pipes should have fire protection in accordance with section 2, Fire.

Where there is no conflict with advice in section 3, Environment, a *flue-pipe* may penetrate the floor, provided that it discharges either into a masonry *chimney* carried by the floor or any other type of *chimney* enclosed within a *non-combustible duct* that is lined with absorbent mineral fibre.



section



section

Floor type 2

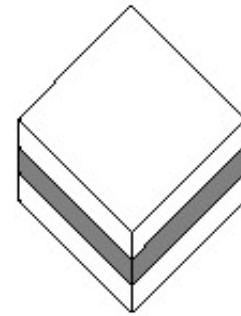
5.1.9 Specified floor constructions
Floor type 2: Concrete base with floating layer

The resistance to airborne sound transmission depends mainly on the mass of the concrete base and partly on the mass of the floating layer. The resistance to impact sound depends on the resilient layer to isolate the floating layer from the base and from the surrounding *construction*.

In some cases resistance to impact sound is not necessary (see clause 5.1.1) however, the full *construction* should still be used, to avoid a detrimental effect on resistance to airborne sound transmission.

Points to watch

Fill all joints between parts of the floor base to avoid air paths.
 Limit the pathways around the floor to reduce flanking transmission.
 Workmanship and detailing should be given special attention at the perimeter and wherever the floor is penetrated, to reduce flanking transmission and to avoid air paths.
 Take care not to create a bridge between the floating layer and the base, surrounding walls, or adjacent screeds.
 With bases C and D a screed is used to accommodate surface irregularities and prevent reduced resistance to noise transmission at joints.



Floor type 2

Constructions – floor type 2

Four floor bases (A-D) are described below, together with details for two floating layer constructions (F1 & F2). Any of these can be used in combination. Details for junctions to limit flanking transmission are also described below.

Base A

Floor bases
 Solid concrete slab, cast in-situ, with shuttering removed.
 Floor screed and/or ceiling finish optional.
 Mass (including any screed and/or ceiling finish) 300 kg/m².



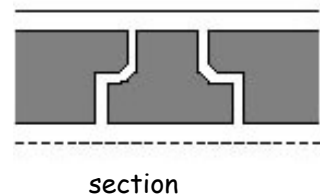
Base B

Solid concrete slab, cast in-situ, with permanent shuttering.
 Floor screed and/or ceiling finish optional.
 Mass 300 kg/m², including shuttering only if it is solid concrete or metal, and including any screed and/or ceiling finish.

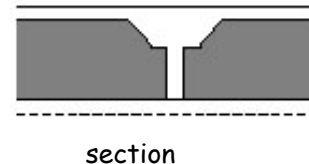


Base C

Concrete beams with infilling blocks
 Floor screed should be used; ceiling finish is optional but recommended to limit air paths at joints.
 Mass 300 kg/m² including beams, blocks, any structural topping including screed, and any ceiling finish.

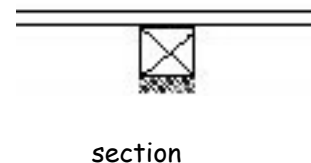


Base D Concrete planks (solid or hollow)
 Floor screed should be used; ceiling finish is optional but recommended to limit air paths at joints.
 Mass 300 kg/m², including planks, any structural topping including screed and any ceiling finish.

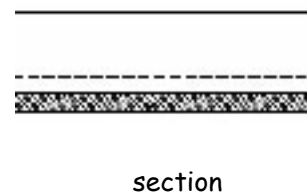


Floating layer constructions

Floating layer F1 Timber raft
 Timber boarding or wood based board, minimum 18 mm thick, with tongued and grooved edges, fixed to minimum 45 x 45 mm (nominal) timber battens with a bonded integral resilient polymer-based layer.
 Polymer-based layers include foams, man-made fibres and elastomers.
 Resilient flanking strips at least 5 mm thick should be fitted between floor edge and wall/skirting junction.
 Floating floor treatment to demonstrate a weighted reduction in impact sound pressure level (ΔL_w) of at least 25 dB when measured in accordance with annex 5.B.
 Follow manufacturer's instructions for installation of proprietary systems.



Floating layer F2 Screed over resilient layer
 Cement sand screed, 65 mm thick with mesh underlay to protect the resilient layer while the screed is being laid.
 Resilient layer of extruded closed cell polyethylene foam, 12.5 mm thick, density 30-45 kg/m³.
 To protect the material from puncture it should be laid over a levelling screed.
 Lay with taped joints.
 The resilient layer should be faced with a membrane to prevent screed entering the layer.
 Lay the material tightly butted and turned up at the edges of the floating layer.



Floor type 2 **Junctions at walls at external or cavity separating walls**

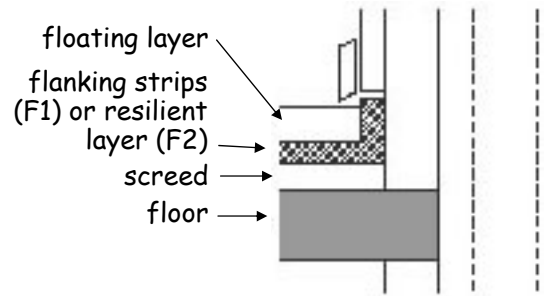
Guidance in Sections 1, 2 and 6 should be considered.

The mass of the leaf adjoining the floor should be 120 kg/m^2 , including any plaster. This is not necessary where the area of openings in the *external wall* exceeds 20% of its area: there is no recommendation for the minimum mass of such a wall. The floor base, excluding any screed, should pass through the wall whether spanning parallel to, or at right angles to, the wall.

The cavity should not be bridged. Carry the resilient layer up at all edges to isolate the floating layer.

Leave a 5 mm gap between skirting and floating layer or turn resilient layer under skirting.

Where a seal is necessary for the purposes of section 6, it should be flexible.

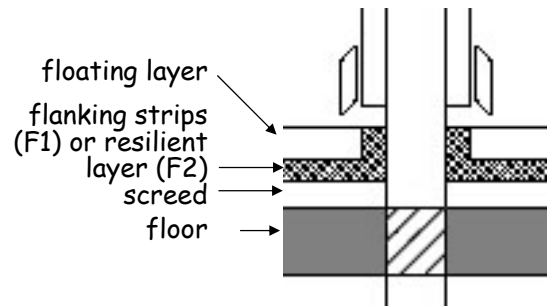


section

Floor type 2 **Junctions at walls at internal or solid separating wall**

If the wall mass is less than 355 kg/m^2 including any plaster then the floor base excluding any screed should pass through. If the wall mass is more than 355 kg/m^2 including any plaster either the wall or the floor base excluding any screed may pass through.

Where the wall does pass through tying the floor base to the wall and grouting the joint, is recommended.



section

Floor type 2

Floor penetrations

No openings should be formed, apart from openings for service *ducts*, pipes, or *chimneys* which are protected as recommended by section 2, Fire and section 3, Environment.

Ducts or pipes that penetrate the floor should be in an enclosure, both above and below the floor.

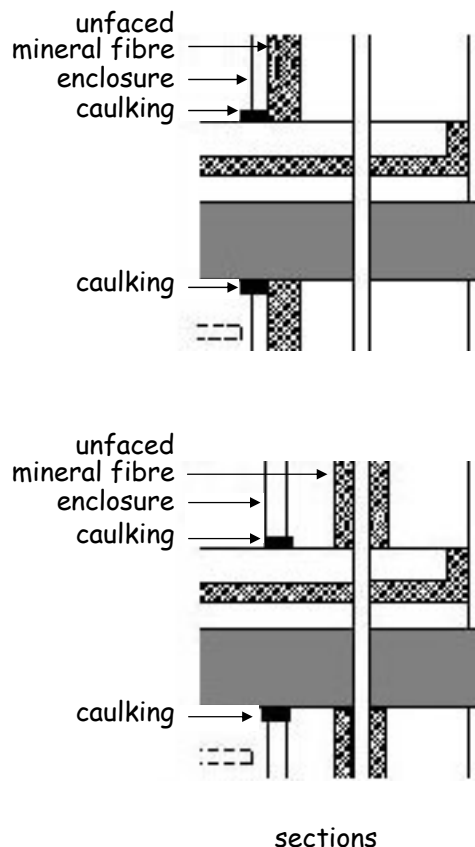
Either line the enclosure, or wrap the *duct* or pipe within the enclosure, with 25 mm unfaced mineral fibre.

The material of the enclosure should have a mass of 15 kg/m².

Penetrations of a *separating floor* by *ducts* and pipes should have fire protection in accordance with section 2, Fire.

Leave a 5 mm gap between enclosure and floating layer and seal with acrylic caulking or neoprene.

Where there is no conflict with advice in section 3, Environment, a *flue-pipe* may penetrate the floor, provided that it discharges either into a masonry *chimney* carried by the floor or any other type of *chimney* enclosed within a *non-combustible duct* that is lined with absorbent mineral fibre.



Floor type 3

5.1.10 Specified floor constructions

Floor type 3: Timber base with floating layer

The resistance to airborne sound transmission depends partly on the structural floor plus absorbent blanket or deafening, and partly on the floating layer. Resistance to impact sound transmission depends on the resilient layer to isolate the floating layer from the base and the surrounding *construction*.

Section 2, Fire places limits on the *storey* height at which this type may be used.

This *construction* could be used where *dwellings* are created by *conversion*, provided the existing walls and floors are suitable and it is used with appropriate adjoining walls (see 'junctions' below). Floor types 3A and 3C-b should only be used for conversions.

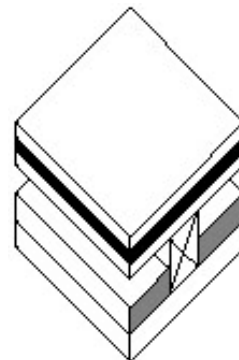
Points to watch

Limit the pathways around the floor to reduce flanking transmission.

Workmanship and detailing should be given special attention at the perimeter and wherever the floor is penetrated, to reduce flanking transmission and to avoid air paths.

In order to maintain isolation:

- carefully select materials for the resilient layer, see annex 5.B;
- take care not to bridge between the floating layer and the base or surrounding walls (e.g. with services or fixings which penetrate the resilient layer);
- allow for movement of materials e.g. expansion of chipboard after laying (to maintain isolation).



Floor type 3

Constructions – floor type 3

Three complete *constructions* (A-C) are described below, together with details for junctions to limit flanking transmission. Note that there are alternatives within some *constructions*. There are also four *constructions* (A-DL, B-DL, C-a-DL, C-b-DL) for use with down lighters.

Floor type 3A

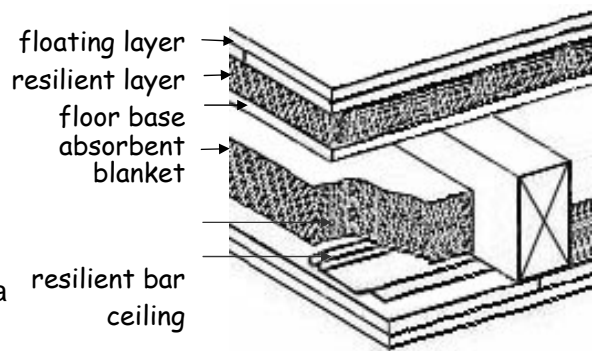
Floor base with floating layer

Platform floor with absorbent blanket (for use in conversions only)

Floating layer

Two types of floating layer may be used:

- a. timber or wood based board, 18 mm thick with tongued and grooved edges and all joints glued, spot bonded to substrate of gypsum based board with a minimum mass of 13.5 kg/m²; or
- b. a floating layer of 2 thicknesses of cement bonded particleboard with joints staggered, glued and screwed together, total thickness 24 mm.



Resilient layer

Resilient layer of a material with a weighted reduction in impact sound pressure level (ΔL_w) of at least 14 dB when measured in combination with the floating layer in accordance with annex 5.B. Resilient flanking strips at least 5 mm thick should be fitted between floor edge and wall skirting junction. Follow manufacturer's instructions for installation of proprietary systems.

Floor base

Floor base of 12 mm timber boarding or wood-based board nailed to timber joists.

Ceiling

Resilient ceiling bars fixed perpendicular to joist direction at 400 mm centres. Absorbent blanket of 100 mm mineral fibre, density 10-33 kg/m³, laid on ceiling between joists. Ceiling of 2 or more layers of gypsum based board with joints staggered, overall minimum mass 24 kg/m², or total thickness 30 mm.

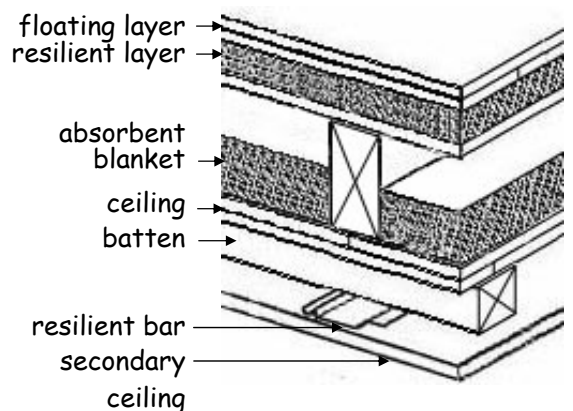
Floor type 3A-DL

Down lighters

A secondary ceiling should be fitted if down lighters are to be installed in a separating floor, to avoid penetration of the main ceiling layers.

The ceiling layers should be fixed directly to the joists.

Secondary ceiling: 50 mm x 50 mm battens, resilient ceiling bars perpendicular to battens, and 12.5 mm gypsum based board.



Floor type
3B

Ribbed floor with absorbent blanket

Floating layer

Floating layer of timber or wood based board, minimum 18 mm thick with tongued and grooved edges and all joints glued, spot bonded to, and fixed through, a substrate of gypsum based board (minimum mass 13.5 kg/m²) to minimum 45 x 45 mm nominal timber battens with a bonded integral resilient polymer-based layer. Polymer-based layers include foams, man-made fibres and elastomers.

Resilient flanking strips at least 5 mm thick should be fitted between floor edge and wall/skirting junction.

Floating floor treatment to demonstrate a weighted reduction in impact sound pressure level (ΔL_w) of at least 14 dB when measured in accordance with annex 5.B.

Follow manufacturer's instructions for installation of proprietary systems.

Floor base

Floor base of 45 mm wide timber joists.

Structural bracing is not shown.

Ribbed floors are routinely built with an additional sub-deck board (not shown) over the joists to provide safe access before fixing of the floating layer.

Such boarding should not introduce noise problems but does not add to the sound insulation.

The sub-deck board should be level and should not sag between joists.

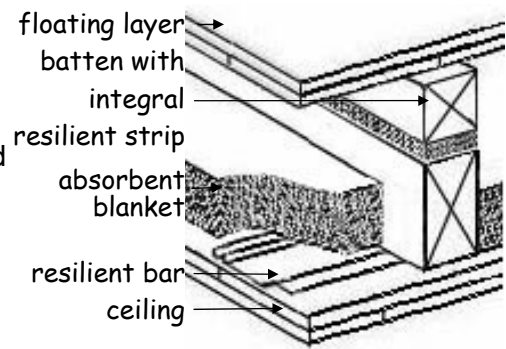
When such boarding is used, the battens may either be laid in line with, or at 90° to the joists.

Ceiling

Resilient ceiling bars fixed perpendicular to joist direction at 400 mm centres.

Absorbent blanket of 100 mm mineral fibre, density 10-33 kg/m³, laid on ceiling between joists.

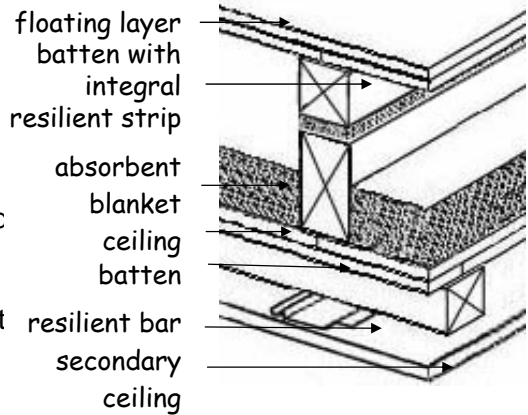
Ceiling of 2 or more layers of gypsum based board with joints staggered, overall minimum mass 24 kg/m², or total thickness 30 mm.



Floor type
3B-DL

Down lighters

If down lighters are to be installed in a separating floor, the lights should be fitted within the depth of a secondary ceiling, to avoid the creation of air paths by penetration of the main ceiling layers. In this case, the ceiling layers should be fixed directly to the joists. Secondary ceiling: 50 mm x 50 mm battens fixed through to joist Resilient ceiling bars perpendicular to battens; 12.5 mm gypsum based board. See also note above on floor base.



Floor type
3C

Ribbed floor with heavy deafening (pugging)

Floating layer, deafening between joists.

Floor type
3C-a

Floating layer

Two floating layer constructions are described. The second should only be used in conversions.

a. Battens along top of joists

Floating layer of timber or wood based board, minimum 18 mm thick with tongued and grooved edges and all joints glued, fixed to minimum 45 x 45 mm (nominal) timber battens with a bonded integral resilient polymer-based layer.

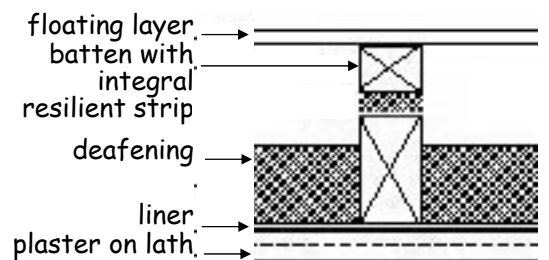
Polymer-based layers include foams, man-made fibres and elastomers.

Battens placed on top of the joists, in the same direction as the joists.

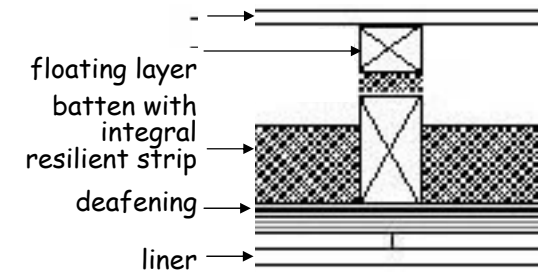
Resilient flanking strips at least 5 mm thick should be fitted between floor edge and wall/skirting junction.

Floating floor treatment to demonstrate a weighted reduction in impact sound pressure level (ΔL_w) of at least 14 dB when measured in accordance with annex 5.B.

Follow manufacturer's instructions for installation of proprietary systems.



section
lath and plaster ceiling option



section
plywood ceiling
board ceiling option

Floor base

Floor base of 45 mm wide timber joists.

Structural bracing is not shown.

Ribbed floors are routinely built with an additional sub-deck board over the joists to provide safe access before fixing of the floating layer.

Such boarding should not introduce noise problems but does not add to the sound insulation. The sub-deck board should be level and should not sag between joists. When such boarding is used, the battens may either be laid in line with, or at 90° to the joists.

Floor type
3C-b

- b. Battens between joists (only for use in conversions)
 Floating layer of timber or wood based board, 18 mm thick with tongued and grooved edges and all joints glued, nailed to 45 x 45 mm timber battens; floating layer placed onto resilient strip on top of joists, laid along their length.
 Resilient strips of a material with a weighted reduction in impact sound pressure level (ΔL_w) of at least 17 dB when measured in accordance with annex 5.B.

Structural bracing is not shown.

Ceiling

- 19 mm dense plaster on expanded metal lath; or
- 6 mm plywood fixed under the joists plus 2 layers of gypsum based board with joints staggered, total thickness 25 mm.

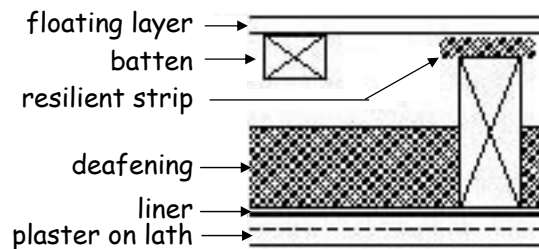
Deafening

Both types of ceiling to have deafening (pugging) of mass 80 kg/m² laid on a polyethylene layer.

Deafening may be of the following types. Figures in brackets show approximate thickness to provide 80 kg/m²:

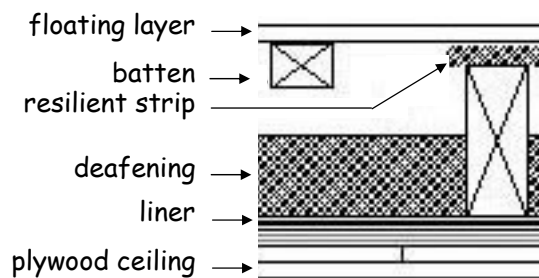
- traditional ash (75 mm), or
- 2-10 mm limestone chips (60 mm), or
- 2-10 mm whin aggregate (60 mm), or
- dry sand (50 mm).

The water retentive properties of sand make it inappropriate for use in *kitchens*, *bathrooms*, *shower-rooms* or *toilets*.



section

lath and plaster ceiling option



section

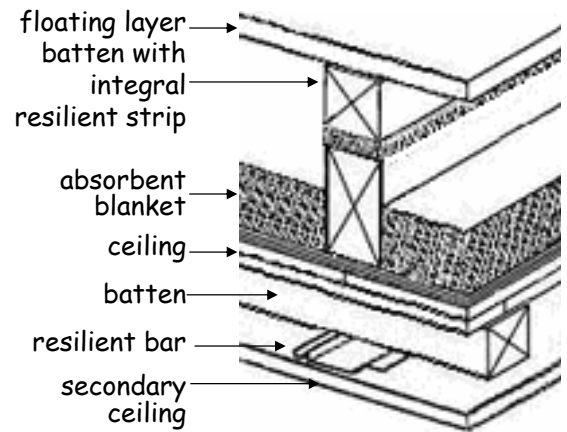
board ceiling option

Floor types
3C-a-DL

Downlighters

If down lighters are to be installed in a separating floor, the lights should be fitted within the depth of a secondary ceiling, to avoid the creation of air paths by penetration of the main ceiling layers. In this case, the ceiling layers should be fixed directly to the joists.
 Secondary ceiling:
 50 mm x 50 mm battens fixed through to joists;
 Resilient ceiling bars perpendicular to battens; and 12.5 mm gypsum based board.

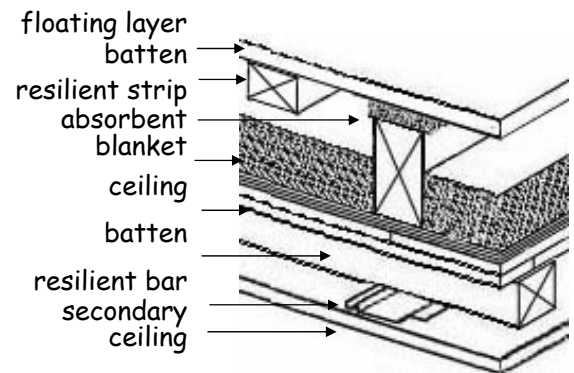
This *construction* could be used with an existing lath and plaster ceiling.



section, floor type 3C-a-DL board ceiling option

3C-b-DL

See also note on floor base for floor type 3Ca.

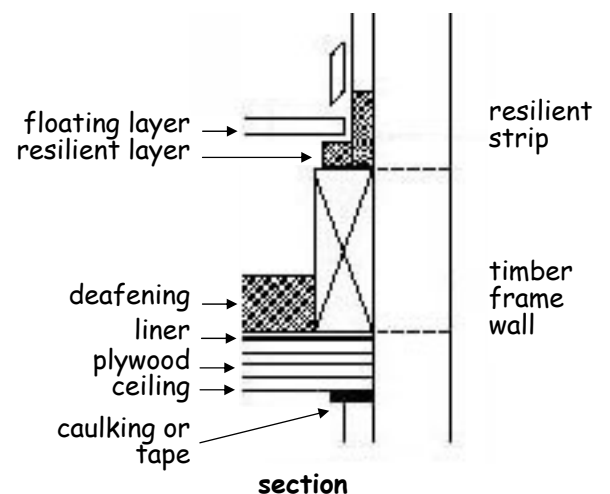


section, floor type 3C-b-DL board ceiling option

Floor type 3 **Junctions at timber frame wall**

Guidance in sections 1, 2 and 6 should be considered.

Seal the gap between wall and floating layer with a resilient strip glued to the wall. Leave a 5 mm gap between skirting and floating layer. Where a seal is necessary for the purposes of section 6, it should be flexible. Block air paths between the floor base and the wall, including the space between joists when joists are at right angles to the wall. Seal the junction of ceiling and wall with tape or caulking.



Floor type 3 **Junctions at heavy masonry leaf**

Mass of leaf 355 kg/m², including any plaster, both above and below floor.

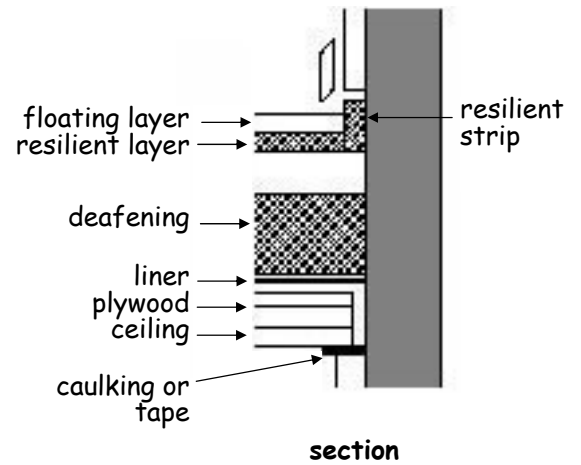
Seal the gap between wall and floating layer with a resilient strip glued to the wall.

Leave a 5 mm gap between skirting and floating layer.

Where a seal is necessary for the purposes of section 6, it should be flexible.

Use any normal method of connecting floor base to wall.

Seal the junction of ceiling and wall lining with tape or caulking.



Floor type 3 **Junctions at light masonry leaf**

A free-standing panel as specified in wall type 3 should be used if the mass, including any plaster, is less than 355 kg/m².

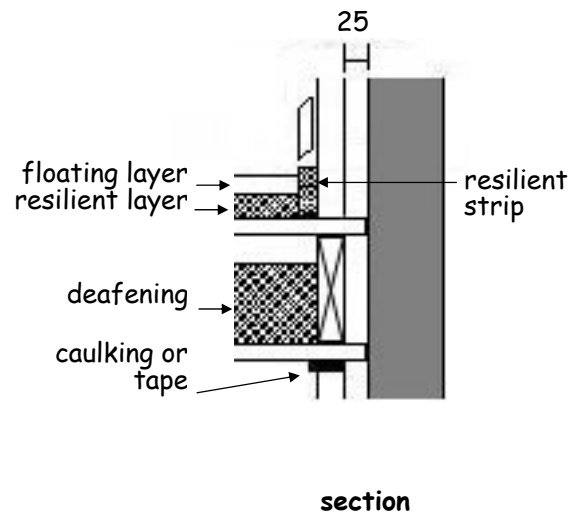
Seal the gap between wall and floating layer with a resilient strip glued to the free-standing panel.

Leave a 5 mm gap between skirting and floating layer.

Where a seal is necessary for the purposes of section 6, it should be flexible.

Use any normal method of connecting floor base to wall but block air paths between floor and wall cavities.

Take ceiling through to masonry, seal junction with free-standing panel with tape or caulking.



Floor type 3 **Floor penetrations**

No openings should be formed, apart from openings for service *ducts*, pipes, or *chimneys* which are protected as recommended by section 2, Fire and section 3, Environment.

Ducts or pipes that penetrate the floor should be in an enclosure both above and below the floor.

Either line the enclosure, or wrap the *duct* or pipe within the enclosure, with 25 mm unfaced mineral fibre.

The material of the enclosure should have mass of 15 kg/m².

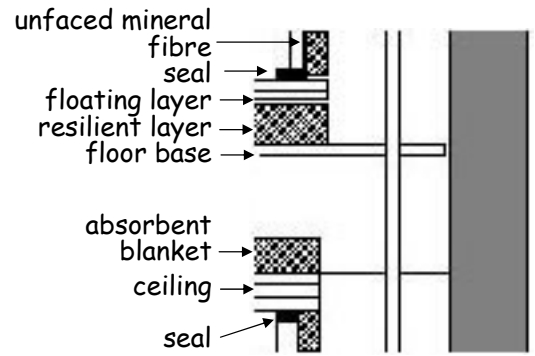
Leave a 5 mm gap between enclosure and floating layer, seal with acrylic caulking or neoprene.

Enclosure may go down to the floor base if *construction A* is used, but care must be taken to isolate the enclosure from the floating layer.

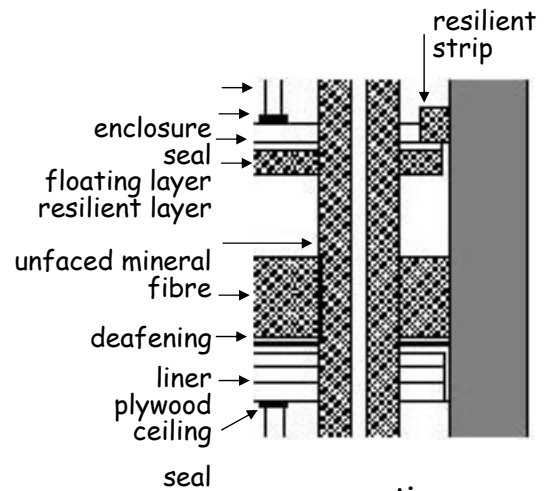
Where there is no conflict with advice in section 3, Environment, a *flue-pipe* may penetrate the floor, provided that it discharges either into a masonry *chimney* carried by the floor or any other type of *chimney* enclosed within a *duct* that is lined with absorbent mineral fibre.

Seal the junction of ceiling and enclosure with tape or caulking.

Penetrations of a *separating wall* by *ducts* and pipes should have fire protection in accordance with section, 2 Fire.



section



section

5.1.11 Specified floor constructions

Floor type 4: Timber base with independent ceiling

The resistance to airborne and impact sound depends mainly on the mass and isolation of the independent ceiling, and partly on the mass of the floor base.

Section 2, Fire places limits on the *storey* height at which this type may be used. It should only be used with heavy masonry walls.

Points to watch

Limit the pathways around the floor, especially at the edges of the independent ceiling, to reduce flanking transmission and to avoid air paths.

Workmanship and detailing should be given special attention wherever the floor is penetrated.

Take care not to create bridges between the floor base and the independent ceiling.



Floor type 4

Construction – floor type 4

One floor with independent ceiling is described below, together with details for junctions to limit flanking transmission.

Floor type 4 **Timber floor, incorporating deafening:**
 Timber boarding or wood based board, 18 mm thick with tongued and grooved edges or 3.2 mm hardboard over the whole floor to seal gaps.

45 mm thick joists

Deafening of mass 80 kg/m²

Intermediate ceiling of either:

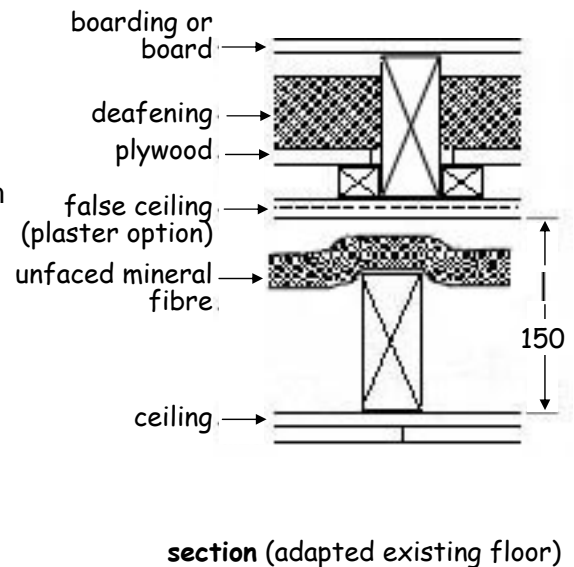
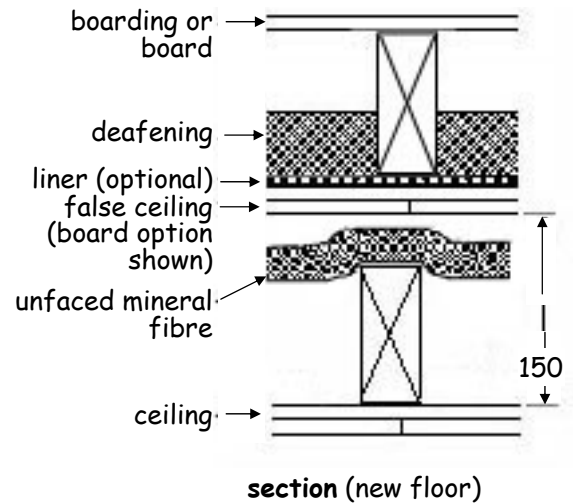
- 19 mm dense plaster on lath; or
- 2 or more layers of gypsum based board with joints staggered, overall minimum mass 24 kg/m², or total thickness 30 mm.

In existing floors deafening may be on boards between joists; in new *separating floors* use 6 mm plywood fixed to underside of joists. A polyethylene liner may be used if desired.

Independent ceiling:

Absorbent blanket of 25 mm unfaced mineral fibre, density 12-36 kg/m³, draped over 45 mm thick joists supported independently of the floor.

Ceiling of two layers of gypsum based board with joints staggered, total thickness 30 mm. Keep ceiling 150 mm away from the underside of the intermediate ceiling.



Floor type 4 **Junctions at walls**

Guidance in sections 1, 2 and 6 should be considered.

External or cavity separating walls

Mass of leaf should be 355 kg/m², including any plaster, both above and below the floor, on at least 3 sides.

Leaf on fourth side should be at least 180 kg/m².

Use bearers on walls to support the edges of the ceiling and to block air paths.

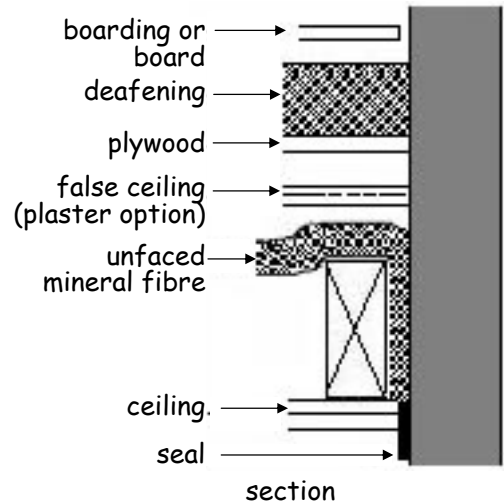
Seal the junction of ceiling and wall with tape or caulking.

Internal wall

If masonry, mass should be 180 kg/m².

There is no recommendation for the mass of stud partitions.

Support and seal as for *external walls*.



Floor type 4

Floor penetrations

Ducts or pipes that penetrate the floor should be in an enclosure both above and below the floor.

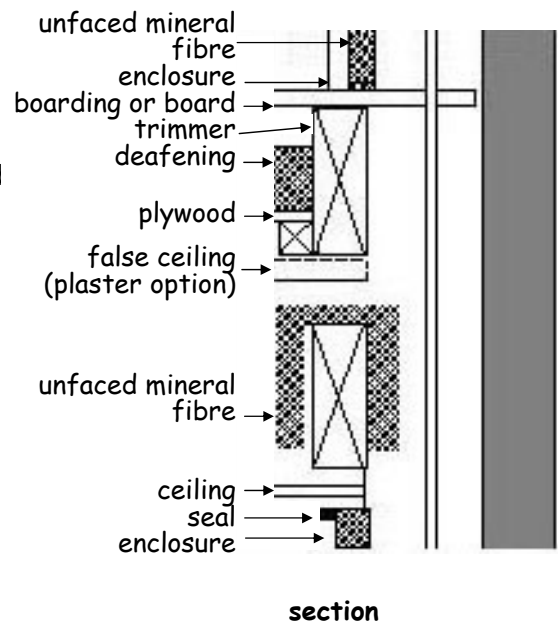
Either line the enclosure, or wrap the *duct* or pipe within the enclosure, with 25 mm unfaced mineral fibre.

The material of the enclosure should have a mass of 15 kg/m².

Penetrations of a *separating floor* by *ducts* and pipes should have fire protection in accordance with section 2, Fire.

Where there is no conflict with advice in section 3, Environment, a *flue-pipe* may penetrate the floor, provided that it discharges either into a masonry *chimney* carried by the floor or any other type of *chimney* enclosed within a *duct* that is lined with absorbent mineral fibre.

Seal the junction of ceiling and enclosure with tape or caulking.



5.1.12 Performance testing

Use of performance testing is one of the possible approaches to standard 5.1. This clause sets minimum values for performance testing.

The performance testing approach is particularly useful where the separating or flanking *construction* is of innovative design and for *conversions* where flanking transmission may be significant.

It should be noted that testing to establish the performance values of *construction* is carried out on completed *buildings* and that rectification of poorly performing *construction* can be difficult at that stage. It may therefore be advisable to seek advice at the design stage from an acoustics consultant.

Annex 5.C describes methods of measurement and test procedures.

Acoustic parameters

Performance values are given in terms of 2 acoustic parameters, 1 related to airborne sound, the other related to impact sound.

Airborne sound insulation

The airborne sound insulation characteristics of a wall or floor are identified by measuring the sound pressure level difference between the source *room* (the *room* with the noise source) and the receiving *room* (to which the noise is transmitted). The larger the difference, the higher the level of airborne sound insulation. Recommended levels are given as minimum values of the acoustic parameter $D_{nT,w}$.

Impact sound insulation

Impact sound insulation is quantified by measuring the sound pressure level in the receiving *room*, rather than a difference in levels between *rooms*. Thus, a lower weighted sound pressure level represents a higher level of impact sound insulation. Recommended levels are given as maximum values of the acoustic parameter $L'_{nT,w}$.

Performance values

Recommended performance values for *separating walls* and *separating floors* are given below. Tests should be performed after *construction*, using the procedures given in annex 5.C.

Airborne Sound (minimum values)

Minimum values of weighted standardised level difference ($D_{nT,w}$), as defined in BS EN ISO 717-1: 1997:

| | Mean Value (dB) | Individual Value (dB) |
|--------|-----------------|-----------------------|
| Walls | 53 | 49 |
| Floors | 52 | 48 |

Impact Sound (maximum values)

Maximum values of weighted standardised impact sound pressure level ($L'_{nT,w}$) as defined in BS EN ISO 717-2: 1997

| | Mean Value (dB) | Individual Value (dB) |
|--------|-----------------|-----------------------|
| Floors | 61 | 65 |

5.1.13 Scheme operated by Robust Details Ltd

It is possible that use of the scheme operated by [Robust Details Ltd](#) may offer a suitable approach to standard 5.1. However, full details of the scheme had not been fully reviewed in relation to construction practice in Scotland at the time of publication and notes on the use of the scheme, including consideration of the requirements of other sections, may be added or published separately.

Annex

5.A Method for calculating mass in relation to specified constructions

- 5.A.1 Expression of mass
- 5.A.2 Mass of masonry wall leaves
- 5.A.3 Mortar joints
- 5.A.4 In-situ concrete, screeds, slabs and composite floor bases

annex 5.A

Method for calculating mass in relation to specified constructions

5.A.1 Expression of mass

Where a mass is specified for walls or floors, it is expressed in kg/m².

5.A.2 Mass of masonry wall leafs

To calculate the mass of a leaf of masonry the formulae in the table below should be used.

Densities of bricks or blocks (at 3% moisture content) may be taken from a current certificate issued by a *notified body* or from the manufacturer's literature, in which case the verifier may ask for confirmation e.g. that the measurement was done by an accredited test house. Note that the quoted density of bricks or blocks is normally the apparent density, i.e. the weight divided by the volume including perforations, voids or frogs. This is the density appropriate to the formulae.

For co-ordinating course heights other than those given in the table use the formula for the nearest height. Include any finish of plaster, render or dry lining in calculating the mass unless otherwise stated in the specified *construction*.

Formulae for wall leaf mass

| Co-ordinating height of masonry course in mm | Appropriate formulae |
|--|---|
| 75 | $M = T(0.79D + 380) + NP$ or $D \left[\frac{M-NP}{T} - 380 \right] 0.79$ |
| 100 | $M = T(0.86D + 255) + NP$ or $D \left[\frac{M-NP}{T} - 255 \right] 0.86$ |
| 150 | $M = T(0.92D + 145) + NP$ or $D \left[\frac{M-NP}{T} - 145 \right] 0.92$ |
| 200 | $M = T(0.93D + 125) + NP$ or $D \left[\frac{M-NP}{T} - 125 \right] 0.93$ |

M = Mass of 1 m² of leaf in kg/m²

T = Thickness of masonry in metres (i.e. unplastered thickness)

D = Density of masonry units in kg/m³ (at 3% moisture content)

N = Number of finished faces (i.e. N = 0 for no finish, 1 if finish on one side and 2 if finish on both sides)

P = Mass of 1 m² of wall finish in kg/m² (see next page)

Mass of finish in kg/m² at assumed thickness of 13 mm

| | |
|---------------------|----|
| Cement render | 29 |
| Gypsum plaster | 17 |
| Lightweight plaster | 10 |
| Gypsum based board | 10 |

5.A.3 Mortar joints

5.A.1 assumes a mortar joint of 10 mm and a dry, set mortar density of 1800 kg/m³. Values should vary by no more than 10%.

5.A.4 In-situ concrete, screeds, slabs and composite floor bases

For in-situ concrete or screeds calculate the mass by multiplying the density (kg/m³) by the thickness (m).

For slabs or composite floor bases divide the total mass of the element (kg) by the plan area of the element (m²).

Annex

5.B Methods for selection of resilient materials

5.B.0 Introduction

5.B.1 BS EN ISO 140-8: 1998 and BS EN ISO 717-2: 1997.

5.B.2 Standardised core tests for impact sound reduction of soft coverings

annex 5.B

Methods for selection of resilient materials used for soft coverings

5.B.0 Introduction

Resilient materials used for soft coverings must achieve a reduction in the weighted impact sound pressure level, appropriate to the specified construction. The reduction should be determined by use of 1 of the following methods.

5.B.1 BS EN ISO 140-8: 1998 and BS EN ISO 717-2: 1997

Measurement and calculation of the weighted reduction in impact sound pressure level (L_w) in accordance with BS EN ISO 140-8: 1998 and BS EN ISO 717-2: 1997.

5.B.2 Standardised core tests for impact sound reduction of soft coverings

The reduction is determined by comparing 2 tests ($\Delta L_w = \text{Test 1} - \text{Test 2}$) using specified core floors:

Test 1: Weighted sound pressure level ($L_{n,w}$) for the core floor;

Test 2: Weighted sound pressure level ($L_{n,w}$) for the core floor with the floating floor treatment applied to the core floor surface.

Test facility

The test facility must have UKAS Accreditation (or EC equivalent) for the measurement of sound insulation in the laboratory for impact sound transmission. The test measurement should be undertaken in accordance with BS EN ISO 140-6: 1998 and the performance of each measurement rated in accordance with BS EN ISO 717-2: 1997. The measurements should be undertaken in a laboratory with suppressed flanking transmission and in accordance with BS EN ISO 140-1: 1998 and BS EN ISO 140-2: 1991.

Core floors

Testing should be undertaken on a core floor which consists of one of the following constructions, as appropriate to the specified construction used:

- a. Concrete core floor (for testing soft covering for use with Floor type 1 and resilient strip for use in timber raft option for Floor type 2):
150 mm hollow-core precast concrete plank of mass per unit area 295-305 kg/m², with hollow segments located at regular centres and distributed over a minimum of 80% of the plank width.

The precast concrete hollow-core planks should be mounted in the test aperture to cover the entire test aperture area. The planks should be tightly abutted and all joints should be filled with grout including top and bottom joints. No voids should remain at the floor perimeter junction with the test aperture border. The 10 mm cement based screed with bonding agent should be applied such that it is directly bonded to the entire floor surface of the planks. No additional ceiling layers should be applied.

- b. Timber core floor (for testing resilient layer for use with Floor types 3A, 3C-b)::
15 mm OSB timber decking board (or equivalent timber based board) with mass per unit area of 10-11 kg/m².
235 mm x 50 mm solid timber joists SC3 grade timber.
100 mm glass based mineral wool insulation with a density of 10-11 kg/m³.
Two layers of 12.5 mm gypsum based board with a mass per unit area for each layer of 8-8.5 kg/m².

The timber joists should be mounted on joist hangers at 450 mm centres and the glass based mineral wool insulation should be placed in the cavities between the joists and also between the cavities formed between the joists and the test aperture border. The floor decking should be mounted on the timber joists with screws at 300 mm centres. All junctions between the floor surface perimeter and test aperture should be sealed with a flexible or acoustic mastic sealant.

The ceiling layers should be mounted with joints staggered and the first layer (inner layer) should be fixed to the underside of the joists with screws, at 300 mm centres within the field of the boards and at 150 mm centres at the board ends. The second layer (outer layer) should be fixed with screws, at 230 mm centres within the field of the boards and at 150 mm centres at the board ends. The perimeter of the ceiling should be sealed with flexible or acoustic mastic sealant and all joints and screw heads taped with self adhesive tape.

Floating floor treatment

The floating floor treatment should cover the entire test area of the core floor surface and should be constructed in accordance with the manufacturer's instructions. Flanking strips, which are required for the specified *constructions* to isolate the edge of the floor board from the perimeter walls, should be used in the laboratory measurements.

Expression of results

The impact sound transmission performance of the floating floor treatment should be expressed as a weighted reduction in impact sound pressure level (ΔL_w) as a result of the application of the floating floor treatment to the core floor.

Annex
5.C Procedures for performance testing

- 5.C.0 Introduction
- 5.C.1 Test procedures

annex 5.C

Performance testing

5.C.0 Introduction

This annex covers field-testing of *separating walls* and *separating floors* for *dwellings*. Such tests should only be carried out on a *building* that is complete. It is most important that floor, wall and ceiling linings are complete and that doors, access hatches and windows are fitted.

5.C.1 Test procedures

Location of tests

For each wall or floor which is to be tested take 4 sets of measurements or as close to 4 as possible, given the following recommended constraints:

- for each set of measurements use a pair of *rooms* if possible; and
- use a pair consisting of a *room* and some other space only where necessary to make up the 4 sets; and
- use a pair consisting of spaces other than *rooms* only where no other measurement is possible; and
- take only one set of measurements between each pair.

Test conditions

The tests should be done in completed but unfurnished *dwellings*. Doors and windows should be closed.

When measuring between a pair of *rooms* which are of unequal area, the sound source should be in the larger *room*.

When measuring between a *room* and some other space, the sound source should be in the other space.

Walls and floors

In a *building* every wall or floor, or part of a wall or floor, which requires sound resistance and is of nominally identical *construction*, can be considered as forming part of a single wall or floor. For instance, wherever the *flat* plans are nominally identical in a block of *flats*, a wall rising through several *storeys* may be regarded as a single wall, and floors over a whole *storey* may be regarded as a single floor.

A wall which changes *construction* only in a *roof space* can be considered as a single wall.

In any group of *dwellings* covered by one building warrant, the walls and floors of nominally identical *dwelling* types which are similarly situated in regard to adjoining *buildings* may all be regarded as meeting the performance standard if the ones selected for test meet the standard.

| | |
|----------------------------------|--|
| Test methods | <p>Carry out the tests for airborne sound in accordance with BS EN ISO 140-4: 1998 and for impact sound in accordance with BS EN ISO 140-7: 1998.</p> <p>The tests will determine the standardised level differences (D_{nT}) for airborne sound transmission and the standardised impact sound pressure levels (L'_{nT}) for impact sound transmission.</p> <p>For each set of measurements calculate the weighted standardised level difference ($D_{nT,w}$) in accordance with BS EN ISO 717-1: 1997 or the weighted standardised impact sound pressure level ($L'_{nT,w}$) in accordance with BS EN ISO 717-2: 1997.</p> |
| Evaluation of test results | <p>The calculated value from each set of measurements should be no worse than the recommended 'Individual Value' in the table to clause 5.1.12.</p> <p>The mean of the 4 calculated values should be no worse than the recommended 'Mean Value' in the table to clause 5.1.12. If only 2 or 3 sets of measurements are possible the mean should still be reached, and if only one set is possible the value achieved should not be worse than the mean value.</p> |
| Concession for <i>fire doors</i> | <p><i>Separating walls</i> in some situations may incorporate a doorway, protected by a <i>fire door</i> (see section 2, Fire), but there is no requirement for resistance to sound transmission by doors and door sets. The acoustic performance of a <i>separating wall</i> could be prejudiced by such a doorway. If a <i>separating wall</i> is to be tested, but incorporates such a doorway, it would be acceptable to temporarily infill the doorway, in order to obtain an indicative measurement of the performance of the wall <i>construction</i>.</p> |
| Application of test procedures | <p>Note that the test procedure described above is intended only to provide evidence that a particular wall or floor achieves the recommended performance values in the following situations:</p> <ul style="list-style-type: none">• if it is not <i>built</i> to a specified <i>construction</i>; or• if it is not <i>built</i> under the scheme operated by Robust Details Ltd, but see clause 5.1.13; or• if a verifier is not satisfied that a specified <i>construction</i> has been <i>built</i> in accordance with the warrant and standard 5.1. |

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6.0 Introduction

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Introduction

6.0

6.0.1 Background

Over the years changes have been made to the Scottish building regulation requirements for energy conservation. A brief history of the drivers for these changes is as follows:

- in the 1960s health was the main focus and minimising the occurrence of damp and mould in *housing* and other *residential buildings*;
- in the 1970s tackling the fuel crises was the main issue and the scope of the regulations was extended to cover all heated *buildings*;
- in the 1980s to early 1990s cost effectiveness identified a need for heating controls and these were introduced for non-domestic *buildings*;
- from the late 1990s to the present, 'greenhouse gas emissions' in particular carbon dioxide and 'global warming' have been the drivers for regular changes;
- in this century the European Union has influenced the way that energy standards of the Member States are set through the Directive on the energy performance of *buildings* (EPBD).

The *construction* industry has a major role to play in the conservation of fuel and power and the consequential reduction of carbon emissions. Carbon dioxide emissions from the burning of fossil fuels are contributing to climate change and energy use in *buildings* is a significant source of emissions. Rising temperatures, an increased risk of flooding and sea level rise are some of the expected impacts of climate change on Scotland and the UK, but some of the worst impacts of climate change can be avoided if action is taken to reduce reliance on fossil fuels. Increased energy efficiency and promotion of renewable energy are an important element of Scotland's strategy to tackle the threat of climate change.

6.0.2 Aims

The intention of section 6 is to ensure that effective measures for the conservation of fuel and power are incorporated in *dwellings* and *buildings* consisting of *dwellings*. In addition to energy conservation provisions for the *building* fabric and the *building* services it contains, a carbon dioxide emissions standard obliges a designer of new *dwellings* to consider *buildings* in an holistic way. In view of this, localised or building-integrated low and zero carbon technologies (LZCT) (e.g. photovoltaics, active solar water heating, combined heat and power and heat pumps) can be used as a contribution towards meeting this standard. Although the focus is primarily on lowering carbon dioxide emissions from *dwellings* in use, the measures within this section will also address fuel poverty issues to a certain degree.

The standards and guidance given in this section are intended to achieve an improvement of around 18-25% fewer emissions than the previous standards, however nothing here prevents a *domestic building* from being designed and *constructed* to be even more energy efficient and make greater use of LZCT. Where this occurs, both the monetary and environmental savings will be improved.

This section should be read in conjunction with all the guidance to the Building (Scotland) Regulations 2004 but in particular section 3: Environment has a close affiliation with energy efficiency, regarding:

- heating of *dwellings*;
- ventilation of *domestic buildings*;
- condensation;
- natural lighting;

- combustion air and cooling air for combustion appliances;
- drying facilities;
- storage of woody biomass.

6.0.3 General guidance

This section covers the energy guidance for *domestic buildings*, namely *houses*, *flats* and *maisonettes*. When determining how the Technical Handbook guidance for energy efficiency applies to *domestic buildings*, recognition should be given to the following:

- a. this guidance applies irrespective of the lifespan or relocatability of the *dwelling* or block of *dwellings*;
- b. all parts of a *dwelling* should be within an *insulation envelope*;
- c. design of ancillary and subsidiary accommodation to *dwellings* (some of which could be *stand-alone buildings*) that are to be heated (disregarding heating rated at a maximum of 25 W/m² floor area, installed solely for the purpose of frost protection);
- d. *stand-alone buildings* that are heated (see paragraph below);
- e. *work on existing buildings* (see paragraph below).

Heated *stand-alone buildings*

The EU Directive on the energy performance of *buildings* [2002/91/EC](#) has introduced the category of ‘*stand-alone building*’ and within Appendix A of the Technical Handbooks a definition has been provided. The Directive exempts such *buildings* that are less than 50 m² in floor area from both the need to use a methodology for compliance with energy standards and also, the need to have an energy performance certificate, standards 6.1 and 6.9, respectively. The defined term not only includes detached *buildings*, but also enables thermally divided parts of a *building* with separate heating shut-down control, to be included. For *stand-alone buildings* that are less than 50 m² in floor area, compliance with standards 6.2 to 6.8 and 6.10 must still be met. The guidance to standard 6.2 recommends that the *insulation envelope* achieves the level of performance applicable to an extension. There are no exemptions for those which are 50 m² or greater.

Examples

Common examples of *stand-alone domestic buildings* that could be less than 50 m² and which would therefore be eligible for exemption are: a heated stair enclosure which is associated with a block of *flats*; a heated summerhouse ancillary to a *dwelling*; and a *conservatory* (attached to either a new or an existing *dwelling*).

Work on existing buildings

In general, as for the other standards within Scottish building regulations, the energy standards apply to *conversions* and also *work on existing buildings*, such as; extensions, *conservatories*, alterations and replacements. For certain situations however, it is either inappropriate that they apply, or the guidance to the standards is different and this is usually to meet the constraints of the existing *building*. It is advisable in the first instance to check the functional standard as sometimes a limitation removes certain classes of this type of *work*. A standard that does apply, will apply in full to the new *work on the existing building*, the exception to this could be where the standards are brought into effect by *conversion* and this is identified in the introduction to the guidance supporting each standard. Where the guidance that supports a functional standard varies from that for new *buildings*, this is identified towards the end of the guidance for each standard.

6.0.4 U-values

Thermal transmittance (*U-value*) is a measure of how much heat will pass through one square metre of a structure when the temperatures on either side differ by one degree Celsius. It is expressed in units of Watts per square metre per degree of temperature difference (W/m^2K).

Measurements of *U-values* should be made in accordance with BS EN ISO: 8990:1996. In calculation thermal bridging may be disregarded where the difference in thermal resistance between bridging and bridged material is less than $0.1 m^2K/W$. Normal mortar joints need not be taken into account in calculations for brickwork, but should be taken into account for lightweight insulating blockwork, for example.

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Taking into account guidance from BRE publication BR 443 (2006 Edition) '[Conventions for U-value calculations](#)', individual *U-values* of *building* elements forming the *insulation envelope* should be established:

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- a. by using insulation to a thickness derived from manufacturers' data relating to thermal conductivities ($W/m \cdot K$) and thermal transmittances (*U-values*: W/m^2K) certified by a *notified body*;
- b. by using insulation to a thickness derived from the tables in Part A of the [SBSA Technical Guide: 'U-values'](#);
- c. by calculation taking into account thermal bridging effects of, e.g. timber joists, structural and other framing and normal bedding mortar, by using the Combined Method set out in BS EN ISO 6946:1997 or [CIBSE Guide Section A3](#), 2006 Edition (for worked examples see Part B of the SBSA Technical Guide: 'U-values');
- d. for floors adjacent to the ground and basements, by using the method outlined in Part C of the SBSA Technical Guide: 'U-values' and set out fully in BS EN ISO 13370: 1998 or CIBSE Guide Section A3, 2006 Edition;
- e. for windows, doors and rooflights, by using BS EN ISO 10077-1: 2000 or BS EN ISO 10077-2: 2003, for rooflights BS EN ISO 12567-2:2005, or the tables in Part A of the SBSA Technical Guide: 'U-values'.

6.0.5 Thermal conductivity

The thermal conductivity (the λ -value) of a material is a measure of the rate at which that material will transmit heat and is expressed in units of Watts per metre per degree of temperature difference ($W/m.K$). Establishing the thermal conductivity of materials in a *building* element forming part of the *insulation envelope* will enable the thermal transmittance of the element to be calculated.

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Measurements of thermal conductivity should be made in accordance with BS EN 12664: 2001, BS EN 12667: 2001 or BS 12939: 2001. SBSA Technical Guide: 'U-values' gives the thermal conductivity of some common *construction* materials, but where available, preference should be given to values that are certified by a notified body. The additional guidance given in BRE publication [BR 443](#) should also be followed.

6.0.6 Insulation envelope where u-value should be ignored

Thermal transmittance through *separating walls* or *separating floors* between 2 *dwellings* or between a *dwelling* and other heated parts of the same *building* (e.g. between a *flat* and a *protected zone* with space heating) should be ignored. The accommodation on both sides of the separating element is expected to be at a similar temperature when the *dwellings* or *building* are occupied.

6.0.7 Buffering effects on the insulation envelope

If a *dwelling* or part of a *building* consisting of *dwellings* is separated from an unheated enclosed area, (e.g. solid waste storage accommodation, a *porch*, garage, *protected zone* or underground car park) the *U-values* of the walls/floors (including doors and translucent *glazing*) may be calculated by:

- a. disregarding the buffering effects and treating the element as if it is directly exposed to the outside;
- b. using the formulae in clause 3.3 of SAP 2005;
- c. following the procedure in BS EN ISO 6946: 1997; or
- d. following the procedure in BS EN ISO 13789: 1999.

6.0.8 Roofs that perform the function of a floor

A roof of a *dwelling* or *building* consisting of *dwellings* that also performs the function of a floor or similar loadbearing surface (e.g. an *access deck*, *escape route*, roof garden or car park), should be considered as a roof.

6.0.9 Conservatories and atria

A *conservatory* allows natural light and natural ventilation to be 'borrowed' through *glazing* and *ventilators* into adjacent *rooms* of a *dwelling*. In view of this, a large area of translucent material is required in the *conservatory* fabric to ensure that such *rooms* are not adversely affected. It is important to read the definition of *conservatory* given in the Technical Handbooks in conjunction with the SAP 2005 document. Further guidance is given on how the standards apply to *conservatories* in clauses 6.1.7, 6.2.12, and 6.3.13.

In a *dwelling* with an atrium, it should be assumed that the atrium is to gain heat transfer from the surrounding *building*. The continuity of the *insulation envelope* occurs at the roof level (usually predominantly *glazed* with translucent material) and the atrium is considered to be a heated part of the *dwelling*.

6.0.10 Annexes to guidance

At the back of this section are annexes. These give guidance in respect of calculation procedures, and energy certificates.

6.0.11 Calculation of areas

When calculating areas for the purposes of this section and in addition to regulation 7, schedule 4, the following should be observed:

- a. all areas should be measured in m², unless stated otherwise in this guidance;
- b. the area of a floor, wall or roof is to be measured between finished internal faces of the *insulation envelope*, including any projecting bays and in the case of a roof, in the plane of the insulation;
- c. floor areas are to include stairwells within the *insulation envelope* and also non-useable space (for example service *ducts*);
- d. the area of an opening (e.g. window or door) should be measured internally from in-go to in-go and from head to sill or threshold.

6.0.12 Latest changes

There were no major changes made to this section between 1 May 2007 and 30 April 2008 but a few minor corrections have been made. A summary of these corrections can be found on the [2008 Technical Handbooks](http://www.bre.co.uk/2008-Technical-Handbooks) website page.

[EU Directive
2006/32/EC](#)

6.0.13 Relevant legislation

Reference should be made to UK legal requirements enforcing article 13 of the Energy End-Use Efficiency and Energy Services Directive 2006/32/EC. When *building work* is carried to an existing *building* with a floor area of more than 1000 m² or a new *building* is *constructed*, the energy supply companies providing services to such *buildings* should be notified.

6.1 Carbon dioxide emissions

- 6.1 Functional standard
- 6.1.0 Introduction
- 6.1.1 Dwellings
- 6.1.2 Setting the target carbon dioxide emissions level
- 6.1.3 Calculating carbon dioxide emissions for the proposed dwelling
- 6.1.4 Buildings with multiple dwellings
- 6.1.5 Common areas in buildings with multiple dwellings
- 6.1.6 A simplified approach
- 6.1.7 Conservatories and stand-alone buildings

standard
6.1
mandatory

Every *building* must be designed and constructed in such a way that:

- (a) the energy performance is calculated in accordance with a methodology which is asset based, conforms with the European Directive on the Energy Performance of Buildings 2002/91/EC and uses UK climate data; and
- (b) the energy performance of the *building* is capable of reducing carbon dioxide emissions.

Limitation:

This standard does not apply to:

- (a) alterations and extensions to buildings;
- (b) conversions of buildings;
- (c) non-domestic buildings and buildings that are ancillary to a *dwelling* that are *stand-alone* having an area less than 50 square metres;
- (d) buildings, which will not be heated or cooled other than by heating provided solely for the purpose of frost protection; or
- (e) limited life buildings which have an intended life of less than 2 years.

6.1.0 Introduction

Standard 6.1 focuses on the reduction of carbon dioxide emissions arising from the use of heating, hot water, and lighting in a new *dwelling*. The guidance sets an overall level for maximum carbon dioxide emissions in buildings by use of a methodology which incorporates a range of parameters which will influence energy use. This means that for new dwellings a designer is obliged to consider energy as a complete package rather than looking only at individual elements such as insulation or boiler efficiency. In other words standard 6.1 involves a 'whole *dwelling* approach' to energy. Such an approach offers a good degree of design flexibility and favours the use of localised or building-integrated low and zero carbon technologies (LZCT).

For the majority of new buildings, standard 6.1 has the greatest influence on design for energy performance, standards 6.2 to 6.10 in the main recommend only base minimum levels or back-stops to be achieved for the individual elements. To reach compliance with standard 6.1, it is usual to go beyond these back-stop levels by incorporating additional energy efficiency measures.

Conversions

In the case of conversions, as specified in Regulation 4, this standard does not apply.

6.1.1 Dwellings

| | |
|--|--|
| Objective | The calculated carbon dioxide emissions (measured in kilograms per square metre of floor area per annum) for the proposed <i>dwelling</i> should be less than or equal to the target carbon dioxide emissions for a 'notional <i>dwelling</i> '. |
| Summary of procedure | In order to establish the target carbon dioxide emissions rate (TER) for the 'notional <i>dwelling</i> ' (i.e. a <i>dwelling</i> of the same size, shape and 'living area fraction' as the proposed), the dimensions and 'living area fraction' of the proposed <i>dwelling</i> and a set of standard values are inputted into the methodology. To calculate the emissions for the proposed <i>dwelling</i> (DER) a second calculation is carried out where the proposed values are inputted into the methodology. An alternative way of meeting standard 6.1 which avoids the use of the calculation methodology is to design to the set of values used for the 'notional <i>dwelling</i> '. This elemental type approach is described in clause 6.1.6. |
| www.bre.co.uk/sap | The Government's Standard Assessment Procedure for Energy Rating of Dwellings (SAP 2005) is a calculation tool which may be used with the methodology which conforms with the European Directive 2002/91/EC and is recommended to calculate the energy performance and the carbon dioxide emissions of an individual <i>dwelling</i> . At all stages the conventions in the SAP document should be read in conjunction with the specific guidance given in the clauses to this section. |
| Non-domestic use within dwellings | Some new dwellings may incorporate surgeries, consulting rooms, offices or other accommodation of a floor area not exceeding in the aggregate 50 m ² , used by an occupant of the <i>dwelling</i> in a professional or business capacity. Where this occurs, the accommodation should be considered as a part of the <i>dwelling</i> . |

6.1.2 Setting the target carbon dioxide emissions level

| | |
|--|--|
| | To set the target carbon dioxide emissions level, (i.e. the level that should not be exceeded, the TER), refer to the table to this clause. The package of measures for the fuel type which is to be used for the main space heating of the proposed <i>dwelling</i> is selected. This package of measures is used in the methodology and no improvement factors are applied. In addition this 'notional <i>dwelling</i> ' is to have the same size, shape (including floor, roof, exposed wall areas and <i>storey</i> heights) and 'living area fraction' as the proposed <i>dwelling</i> . These terms are explained in SAP 2005. |
| www.bre.co.uk | Software vendors providing BRE approved SAP 2005 software will incorporate a function that with 'Scotland' selected automatically generates the target CO ₂ emissions level when the fuel type is selected and the 'notional <i>dwelling</i> ' dimensions and 'living area fraction' have been inputted into the programme. |

Measures to calculate target carbon dioxide emissions for the 'notional dwelling'

| Element or system | Main space heating system fuel | | | | | |
|---|---|---|---|---------------------------------------|---|---|
| | Gas (Package 1) | LPG (Package 2) | Oil (Package 3) | Electricity (Package 4) | Biomass [1] (Package 5) | Solid fuel (Package 6) |
| Walls | U = 0.25 | U = 0.25 | U = 0.25 | U = 0.25 | U = 0.25 | U = 0.20 |
| Floors | U = 0.22 | U = 0.22 | U = 0.20 | U = 0.22 | U = 0.22 | U = 0.20 |
| Roofs | U = 0.16 | U = 0.16 | U = 0.16 | U = 0.16 | U = 0.16 | U = 0.16 |
| Openings [2] | U = 1.8 | U = 1.8 | U = 1.7 | U = 1.8 | U = 1.8 | U = 1.5 |
| Allowance for thermal bridging | 0.08 x total exposed surface area [3] | 0.08 x total exposed surface area [3] | 0.08 x total exposed surface area [3] | 0.08 x total exposed surface area [3] | 0.08 x total exposed surface area [3] | 0.06 x total exposed surface area |
| Open flues | None | One | One | None | One | One |
| Heating system (pump in heated space) | Gas boiler roomsealed fan flued 90% efficiency | LPG boiler roomsealed fan flued 90% efficiency | Oil boiler roomsealed fan flued 93% efficiency | Air to water heat pump | Wood pellet boiler HETAS approved | Anthracite boiler autofeed in heated space HETAS approved |
| Heating system controls | Programmer +room thermostat +TRVs +Boiler interlock | Programmer +room thermostat +TRVs +Boiler interlock | Programmer +room thermostat +TRVs +Boiler interlock +weather compensation | Programmer +room thermostat | Programmer +room thermostat +TRVs | Programmer +room thermostat +TRVs |
| Hot water (HW) system (not applicable if combi-boiler) | Stored HW (from boiler) separate time control for space and water heating | Stored HW (from boiler) separate time control for space and water heating | Stored HW (from boiler) separate time control for space and water heating | Stored HW by electric immersion | Stored HW (from boiler) separate time control for space and water heating | Stored HW by dual electric immersion and solar |
| Secondary space heating | 10% electric | 10% closed wood log-burning room heater [4] | 10% closed wood log-burning room heater [4] | 10% electric | 10% electric | 10% electric |
| Solar panel evacuated tube - collector efficiency n=0.6, a1=3 | none | none | none | none | none | 4 m ² panel between SE and SW, not more than 45° pitch, no overshadowing |

For the 'notional dwelling' in addition all of the following applies in every fuel type:

| | |
|---|---|
| Windows, doors, and rooflights | area 25% of total floor area [5] |
| Orientation | all <i>glazing</i> orientated east/west |
| Shading | average overshadowing |
| Number of sheltered sides | 2 |
| Chimneys | none |
| Ventilation system | natural ventilation with intermittent extract fans, 4 for dwellings with floor area more than 80 m ² 3 for smaller dwellings |
| Air permeability | 10 m ³ /m ² h at 50 Pa |
| Hot water cylinder (not applicable if combi boiler) (for solar water heating a combined cylinder with solar store 75 litre, no solar powered pump) | 150 litre cylinder insulated with 50 mm of factory applied foam (cylinder in heated space) cylinder temperature controlled by thermostat |
| Primary water heating losses (not applicable to combi-boiler or immersion) | primary pipework insulated |
| Low energy light fittings | 50% of fixed outlets |

Notes:

1. The biomass column should be used not only where biomass fuel is to be used but also for biogas, large scale waste combustion from boilers and waste heat from power stations. It does not however include dual or multi-fuel which should be taken under the 'solid fuel' column.
2. U is the average *U-value* of all openings (windows, doors, rooflights) based on one opaque door 1.85 m² of U=1.8, any other doors fully glazed. For windows, doors etc a frame factor of 0.7, light transmittance 0.80 and solar energy transmittance 0.72 for U greater than or equal to 1.7, 0.63 for U less than 1.7 are assumed.
3. Construction using '[Accredited Construction Details \(Scotland\)](#)' is considered to correspond to the default figure of 0.08 for thermal bridging (refer clause 6.2.3).
4. Under secondary heating the closed wood log-burning room heater is capable of burning wood only, not multi-fuel.
5. If total exposed façade area is less than 25% of the floor area, the area of windows, doors and roofs should be taken as the area of the total exposed façade area.

6.1.3 Calculating carbon dioxide emissions for the proposed dwelling

The second calculation involves establishing the carbon dioxide emissions for the proposed *dwelling* (DER). To do this the values proposed for the *dwelling* should be used in the methodology i.e. the U-values, air permeability, heating system, etc.

The exceptions to inputting the *dwelling* specific values are:

- a. it may be assumed that all *glazing* is orientated east/west;
- b. average overshadowing may be assumed if not known. 'Very little' shading should not be inputted;
- c. 2 sheltered sides should be assumed if not known. More than 2 sheltered sides should not be inputted;
- d. 50% low energy light fittings should be inserted (even if more than 50% low energy fittings are proposed);
- e. if secondary heating is not proposed, 10% electric heating should always be assumed. However if a *chimney* or *flue* is present but no appliance installed the worst case should be assumed i.e. a *decorative fuel-effect gas appliance* with 20% efficiency. If there is no gas point, an open fire with 37% efficiency should be assumed, burning solid mineral fuel for *dwelling*s outwith a smokeless zone and smokeless solid mineral fuel for those that are within such a zone.

These values can be varied, but before inputting values into the methodology, the designer is advised to check:

- the back-stop U-values are met (see standard 6.2), and;
- the other guidance supporting standards 6.3 to 6.6.

6.1.4 Buildings with multiple dwellings

Where a *building* contains more than one *dwelling* (such as a block of flats or terrace of houses) the average carbon dioxide emissions for the proposed block or terrace (DER) may be compared to the average target CO₂ emissions (TER) for the 'notional block or terrace'.

The average emissions for the block or terrace is the floor-area-weighted average for all the individual emissions i.e. $\{(emissions_1 \times floor\ area_1) + (emissions_2 \times floor\ area_2) + (emissions_3 \times floor\ area_3) + \dots\} \div \{(floor\ area_1 + floor\ area_2 + floor\ area_3) + \dots\}$

The degree of flexibility which is provided by averaging out *building* emissions should be used carefully. It is not intended that one or more dwellings are super-insulated (in a *building* consisting of dwellings) so that another may be constructed with a high percentage of *glazing*.

6.1.5 Common areas in buildings with multiple dwellings

Heated communal rooms or other areas in blocks of dwellings (which are exclusively associated with the dwellings) should be assessed using the guidance for non-domestic buildings. Another approach would be to ensure that the *glazing* does not exceed 25% of the total communal floor area of the *building*; and the *u-values*, thermal bridging, air infiltration values equal or better those given for the gas 'notional *dwelling*' (package 1 in the table to clause 6.1.2). Where the common area is less than 50 m² these rooms or areas may be treated as a *stand-alone building* and are not therefore subject to standard 6.1.

6.1.6 A simplified approach

Where a *dwelling* is designed to one of the packages of measures in the table to clause 6.1.2, it will reduce carbon dioxide emissions to the same level as by use of the methodology.

In using a package of measures east/west orientation, average overshadowing and 2 sheltered sides may be assumed for the proposed *dwelling*.

The simplified approach may still be used where there are minor deviations of input values that will clearly achieve the same or a better level of emissions.

For example:

- a boiler with a higher SEDBUK efficiency;
- a ground source heat pump instead of an air source heat pump;
- a secondary space heating system of equal or better performance (e.g. a room-sealed gas fire with fan assisted *flue* or a closed biomass room heater instead of electric);
- area of openings between 20% and 25% of total floor area (windows, doors, rooflights, and roof windows);
- air permeability lower than $10 \text{ m}^3/\text{m}^2\text{h}$ at 50 Pa as established by air-tightness testing;
- a hot water cylinder with a declared heat loss figure (BS 1566 :1-2002) not exceeding 2.11 kWh/day.

This simplified approach should not be used where there is any deviation from values in the table which will result in higher CO₂ emissions. An example is if the *dwelling* has more than 4 extract fans or windows of a poorer *U-value*. Likewise, if some elements offer poorer performance and others offer higher performance, the simplified approach should not be used. This approach should also not be used where there is a likelihood of high internal temperature in hot weather or where air-conditioning is proposed. Reference should be made to the guidance to standard 6.6.

6.1.7 Conservatories and stand-alone buildings

Conservatories less than 50 m² in area are stand-alone buildings and therefore the *dwelling* should be assessed using the methodology as if there was no *conservatory* proposed. For conservatories and other ancillary stand-alone buildings of 50 m² or more the guidance and methodology for non-domestic buildings should be followed.

6.2 Building insulation envelope

- 6.2 Functional standard
- 6.2.0 Introduction
- 6.2.1 Maximum U-values
- 6.2.2 Areas of windows, doors, and rooflights
- 6.2.3 Resisting heat loss through thermal bridging
- 6.2.4 Limiting air infiltration
- 6.2.5 Air-tightness testing
- 6.2.6 Conversion of unheated buildings
- 6.2.7 Conversion of heated buildings
- 6.2.8 Conversion of historic buildings
- 6.2.9 Extensions to the insulation envelope
- 6.2.10 Thermal bridging and air infiltration for existing buildings
- 6.2.11 Alterations to the insulation envelope
- 6.2.12 Conservatories
- 6.2.13 Stand-alone buildings

standard
6.2
mandatory

Every *building* must be designed and constructed in such a way that an *insulation envelope* is provided which reduces heat loss.

Limitation:

This standard does not apply to:

- (a) non-domestic buildings which will not be heated, other than heating provided solely for the purpose of frost protection;
- (b) communal parts of domestic buildings which will not be heated, other than heating provided solely for the purposes of frost protection; or
- (c) buildings which are ancillary to dwellings, other than conservatories, which are either unheated or provided with heating which is solely for the purpose of frost protection.

6.2.0 Introduction

The levels set out in the guidance to this standard are robust back-stops and these are necessary for the following reasons:

- to prevent inefficient use of some of the more mature low and zero carbon energy generating technologies (LZCT); and
- to ensure that a good level of fabric insulation is incorporated, especially to construction elements that would be difficult and costly to upgrade in the future.

Thermal bridging at the junctions of *building* elements and round openings in the *building* structure have now been quantified and embedded in SAP 2005. (see clause 6.1.1). The principal reason for this is that the heat loss through such junctions, if poorly designed and constructed can contribute as much as 10% to the overall heat loss through the *insulation envelope*.

As fabric insulation levels improve, the heat lost through air infiltration becomes proportionally greater. For example, in a typical 1960s *house* with non-draughtstripped windows 20% of the total heat could be lost through air infiltration and ventilation. If the same *house* was upgraded to 2002 levels of fabric insulation but no attempt made to upgrade the air infiltration measures then the ventilation heat losses could represent up to 40% of total heat losses. Limiting air infiltration whilst providing controlled ventilation are therefore important aspects of energy efficiency and good indoor air quality.

Conversions

In the case of conversions, as specified in regulation 4, the *building* as converted shall meet the requirements of this standard in so far as is *reasonably practicable*, and in no case be worse than before the conversion (regulation 12, schedule 6).

6.2.1 Maximum U-values

Area-weighted average U-values

Column (a) of the table below sets out robust backstop measures. In most cases standard 6.1 will effect even better levels of thermal insulation unless the design of a *dwelling* involves extensive use of building-integrated or localised low and zero carbon technologies (LZCT).

Individual element U-values

Localised areas of the same type of element may be designed to give poorer performance. These in turn will need to be compensated by the rest of the element being designed to a more demanding level. An example of this would be a meter box set into an *external wall*. These areas should not be any worse than the figures given in column (b) of the table below. This is particularly important with regard to condensation control matters (see section 3: Environment). N.B. 'Repeating' thermal bridges (e.g. timber studs in a timber frame wall) are already taken in account in a BS EN ISO 6946: 1997 *U-value* calculation and should not be considered as individual element U-values.

Common areas

For communal areas refer to clause 6.2.13.

Maximum U-values for building elements of the insulation envelope

| Type of element | (a) Area-weighted average U-value (W/m ² K) for all elements of the same type | (b) Individual element U-value (W/m ² K) |
|----------------------------|--|---|
| Wall [1] | 0.30 | 0.70 |
| Floor [1] | 0.25 | 0.70 |
| Roof | 0.20 | 0.35 |
| Windows, doors, rooflights | 2.2 | 3.3 |

Notes:

1. Excluding separating walls and separating floors where thermal transmittance should be ignored.

6.2.2 Areas of windows, doors, and rooflights

Due to the carbon dioxide emission standard 6.1, there is no guidance on minimum or maximum area for windows, doors, rooflights and roof windows in dwellings. The use of a methodology for establishing compliance with standard 6.1 addresses conflicting energy issues of heat loss, natural lighting, and artificial lighting. In certain cases where there is a desire to have a large proportion of glass it will be difficult to demonstrate compliance with standard 6.2. In such cases innovative solutions will need to be looked at. All relevant standards and guidance should be considered, including standard 6.6.

Common areas

For communal areas refer to clause 6.2.13.

6.2.3 Resisting heat loss through thermal bridging

The *insulation envelope* of the *dwelling* or *building* consisting of dwellings should be *constructed* in such a way that there are no substantial thermal bridges or gaps where the layers of insulation occur. Significant in-use energy consumption can occur, through incorrect detailing at both the design stage or poor construction work. The key areas of concern are:

- within *building* elements;
- at the junction between *building* elements;

- at the edges of *building* elements where openings in the structure are formed.

SAP 2005, referred to in the guidance to standard 6.1, takes account of thermal bridges, giving:

- onerous default figures for 'no information';
- less onerous default figures for designs that follow '[Accredited Construction Details \(Scotland\)](#)'; or
- accurate figures from 'numerical modelling'.

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6.2.4 Limiting air infiltration

All *building* fabric will allow a certain degree of air leakage. It is widely recognised that it is impossible to make the *insulation envelope* 100% airtight. Where it is desirable to either vent or ventilate the *building* fabric to the outside air (to allow moisture due to either precipitation or condensation to escape), this should be designed into the construction. Reliance on fortuitous ventilation should be avoided. Measures should be introduced however, to reduce unwanted air leakage and thereby prevent an increase in energy use within the heated part of the *building*.

The guidance given here should not be used to compromise ventilation required for:

- health of the occupants of the *building* (section 3);
- any smoke control system (section 2);
- combustion appliances (section 3).

The main principle of limiting air infiltration is to provide a continuous barrier to air movement around the *insulation envelope* and thereby reduce external air paths into each of the following:

- the inside of the *dwelling* or *building* consisting of dwellings;
- the internal *building* elements;
- the 'warm' side of the insulation;
- spaces between the component parts of exposed *building* elements, where such parts contribute significantly to the thermal performance of the element.

Correct *cavity barrier* design for the purposes of structural fire precautions, with airtight materials can often contribute to achieving this objective. One approach to addressing these issues would be to design and build to '[Accredited Construction Details \(Scotland\)](#)'.

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Common areas

In buildings consisting of dwellings, other areas that need consideration are common stair entrances and shafts which extend through most of the floors (e.g. lift and common stair enclosures).

Air-tightness

The move to methodology based energy standards for new buildings means that improving the air-tightness of a *building* can allow greater design flexibility using other traditional energy performance measures while meeting the carbon dioxide standard in 6.1.

6.2.5 Air-tightness testing

An air-tightness testing industry is not yet fully established. In order to allow testing procedures in Scotland to develop at a rate that is manageable to industry, the guidance below recommends that testing need only be carried out when better than routine air-tightness levels are declared at the *building* warrant application stage.

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The following points will assist in establishing if air-tightness testing should be carried out:

- if the *dwelling* is designed and built following the guidance in ‘[Accredited Construction Details \(Scotland\)](#)’ the input data to the methodology (see clause 6.1.3) should be taken as air permeability $10\text{m}^3/\text{m}^2\text{h}$ at 50 Pa and air-tightness testing is considered unnecessary;
- if the *dwelling* is not designed and built following the guidance in ‘Accredited Construction Details (Scotland)’ the input data to the methodology (see clause 6.1.3) should be taken as air permeability $15\text{m}^3/\text{m}^2\text{h}$ at 50 Pa and air-tightness testing is considered unnecessary. However if the designer does not wish to default to a figure of $15\text{m}^3/\text{m}^2\text{h}$ air-tightness testing can be used to justify the input data; or
- if the input data to the methodology (see clause 6.1.3) for the proposed *dwelling* is that the air permeability will be less than $10\text{m}^3/\text{m}^2\text{h}$ at 50 Pa, air-tightness testing should be carried out to justify that this more demanding level is being achieved on *site*.

Frequency of testing dwellings

Where air-tightness testing is to be carried out, the verifier should select the dwelling(s) to be tested. The frequency of test on completion of *work*, should be 1 in 20 dwellings, however where there are less than 20 at least 1 *dwelling* should be tested.

6.2.6 Conversion of unheated buildings

A *building* that was originally designed to be unheated in most instances has the greatest void to fill in terms of energy efficiency. Heating such buildings will adversely affect energy efficiency and because of this, the most demanding of measures are recommended when conversion occurs. Where conversion of a unheated *building* (e.g. a barn) or part of a *dwelling* is to be carried out, the *building* should be treated as if it were an extension to the *insulation envelope* of a *domestic building* by following the guidance in clauses 6.2.9 and 6.2.10. This category also includes conversion of buildings with heating rated at a maximum of $25\text{W}/\text{m}^2$ floor area and installed solely for the purposes of frost protection.

Conversion of part of a *dwelling*

Examples of *work* which involve conversion of part of a *dwelling* are; changing a roof space, an unheated garage or a deep solum space into an *apartment*:

- in the case of a *roof space*, this will usually involve extending the *insulation envelope* to include, the gables, the collars, a part of the rafters and the oxters, as well as any new or existing dormer construction. The opportunity should be taken at this time to upgrade any remaining poorly performing parts of the roof which are immediately adjacent to the conversion, for example, insulation to parts of the ceiling ties at the eaves;
- in the case of an unheated garage, this will usually involve extending the *insulation envelope* to include, the existing floor, perimeter walls and the roof/ceiling to the new habitable part;
- in the case of a deep solum space, this will usually involve extending the *insulation envelope* to include, the solum/existing floor and perimeter walls to the new habitable part.

6.2.7 Conversion of heated buildings

In the case of a *building* that was previously designed to be heated, the impact on energy efficiency as a result of the conversion, may be either negligible, none whatsoever or in some circumstances even an improvement.

In view of this, a less demanding approach is recommended which at the same time still ensures that some overall improvements are being made to the existing *building* stock.

Where an extension or *conservatory* is formed and/or alterations are being made to the *building* fabric at the same time as the conversion, the guidance given in clauses 6.2.9 to 6.2.12 should also be followed.

U-values

Where conversion of a heated *building* is to be carried out, the *insulation envelope* should be examined and upgraded (if necessary) following the table below:

Maximum U-values for building elements of the insulation envelope

| Type of element | Area-weighted average U-value (W/m ² K) for all elements of the same type |
|--|--|
| Wall [1][3] | 0.70 |
| Floor [1][3] | 0.70 |
| Roof [1] | 0.35 |
| New and replacement windows, doors, rooflights [2] | 1.8 |

Notes:

1. Where upgrading work is necessary to achieve the recommended U-values, reference should be made to 'Reconstruction of elements' in clause 6.2.11 and more demanding U-values achieved, where *reasonably practicable*.
2. The total area of windows, doors and rooflights, should not exceed 25% of the floor area of the *dwelling* created by conversion.
3. Excluding separating walls and separating floors where thermal transmittance should be ignored

6.2.8 Conversion of historic buildings

With historic buildings, the energy efficiency improvement measures that should be invoked by conversion can be more complex. The number of these types of buildings in the country is finite. The majority of them have visual features that are not only worth preserving but the industry of today can have difficulty in replicating such construction.

No specific guidance is given here on this subject. Each case will have to be dealt with on its own merits. Any improvements to the fabric insulation of the *building* will often depend on whether or not the installation *work* can be carried out using a non-disruptive method. For example, insulating the ceiling of an accessible *roof space*. In certain cases, buildings are given historic status because of the features that exist on one particular *façade* and in these circumstances it may be possible to make some improvements to other less critical elevations or areas. In all cases the 'do nothing' approach should not be considered initially. Innovative but sympathetic and practical solutions on energy efficiency, which are beyond the scope of this guidance, can often result in an alternative package of measures being developed for a historic *building*. This could consist of reducing carbon dioxide emissions through improvements to the heating system (refer to standards 6.3, 6.4), the lighting system (refer to standard 6.5) or incorporation of LZCT (including biomass boilers and heat pumps). Consultation on such matters at an early stage with both the verifier and the development control officer of the relevant local authority is advisable.

6.2.9 Extensions to the insulation envelope

The majority of the *construction* for an extension will be new and seldom will there be the need to *construct* to a lesser specification as is sometimes the case for alteration *work*. For example to allow the transition occur proprietary metal ‘wall starter’ ties may be used where the existing brickwork stops and new cavity blockwork begins. Other *building* standards should still be met with regard to the transitional construction.

U-values

Where the *insulation envelope* of a *dwelling* or a *building* consisting of *dwelling*s is extended the new *building* fabric should be designed in accordance with the table below:

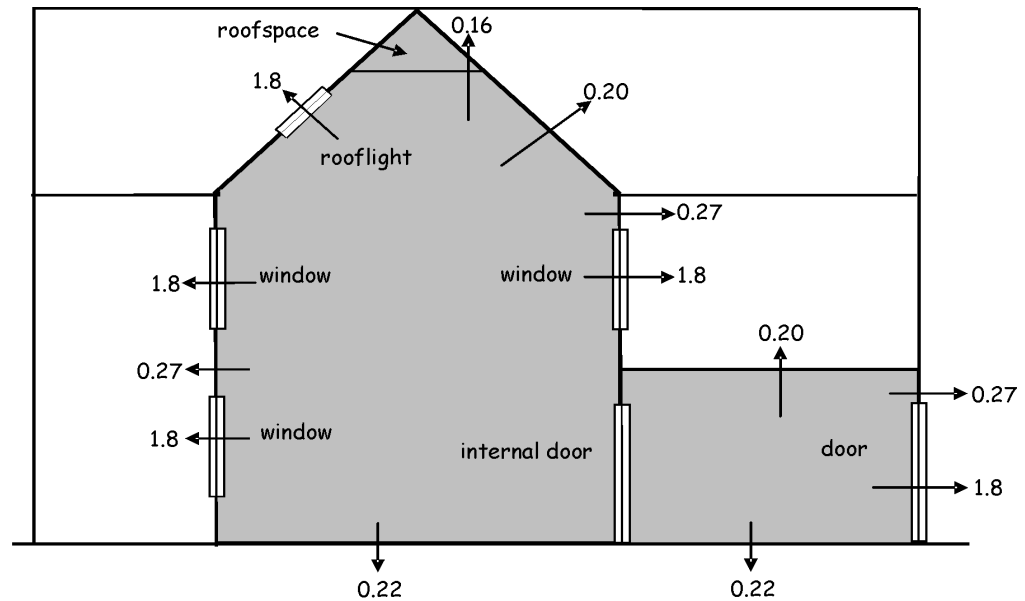
Maximum U-values for building elements of the insulation envelope

| Type of element | (a) Area-weighted average U-value (W/m ² K) for all elements of the same type | (b) Individual element U-value (W/m ² K) |
|---|--|---|
| Wall | 0.27 [2] | 0.70 |
| Floor | 0.22 [2] | 0.70 |
| Pitched roof (insulation between ceiling ties or collars) | 0.16 | 0.35 |
| Flat roof or pitched roof (insulation between rafters or roof with integral insulation) | 0.20 | 0.35 |
| Windows, doors, rooflights | 1.8 [1] | 3.3 |

Notes:

1. Window energy rating band D is acceptable as an alternative to *U-value* 1.8. (www.bfrc.org)
2. Excluding separating walls and floors where thermal transmittance should be ignored

The U-values (area weighted average u-values) in the table to this clause are summarised in the diagram below. The extension is the shaded portion, the existing dwelling is in elevation behind.



Area of windows, doors, rooflights

Where the *insulation envelope* of a *domestic building* is extended the area of windows, doors, rooflights and roof windows should be limited to 25% of the floor area of the extension (the equivalent area of openings built over and removed as a result of the extension *work* can be incorporated in addition to this percentage). The 25% may be varied if the compensatory approach below is adopted.

Varying U-values - 'Compensatory approach'

The U-values for the elements involved in the *work* may be varied provided that the area-weighted overall *U-value* of all the elements in the extension is no greater than that of a 'notional' extension. The 'notional' extension should be the same size and shape as one designed to the elemental U-values in the table above with the area of windows, doors and rooflights taken as 25% of the total extension floor area (plus equivalent area of 'built over openings'). An example of this approach is given in annex 6B.

6.2.10 Thermal bridging and air infiltration for existing buildings

The elements involved/affected by the *work* should follow the guidance in clauses 6.2.3 and 6.2.4. In addition Building Research Establishment (BRE) Report 262 '[Thermal insulation, avoiding risks](#)' 2002 edition can be followed.

It should be noted that the methodology (SAP 2005 calculation tool) does not apply to this type of *work* and air-tightness testing is not necessary.

6.2.11 Alterations to the insulation envelope

For alterations it is more than likely that the existing construction will be from a different era, in *building* regulation terms. In many instances each *building* will need to be considered on its own merits. Some of the guidance given in this clause is written in specific terms, but in certain cases (e.g. historic buildings), it may be necessary to adopt alternative energy efficiency measures which relate to the amount of alteration work being undertaken.

| | |
|--|---|
| Extending the <i>insulation envelope</i> | Alterations that involve increasing the floor area and/or bringing parts of the existing <i>building</i> that were previously outwith the <i>insulation envelope</i> into the heated part of the <i>dwelling</i> are considered as extensions and/or conversions (regulation 4, schedule 2). |
| Infill of small openings | The infill of an existing opening of approximately 4 m ² or less in the <i>building</i> fabric should have a <i>U-value</i> which matches at least that of the remainder of the surrounding element. In the case of a wall or floor however, it should not be worse than 0.70 W/m ² K, and for a roof, not worse than 0.35 W/m ² K. |
| Infill of large openings | The infill of an existing opening of greater area (than approximately 4 m ²) in the <i>building</i> fabric should have a <i>U-value</i> which achieves those in column (a) of the table to clause 6.2.9. Another way would be to follow the guidance in the paragraph above, but compensate for the energy efficiency deficit by improving the overall <i>U-value</i> of other parts of the <i>insulation envelope</i> . |
| <i>Insulation envelope</i> formed from internal elements | Where the alteration causes an existing internal part or other element of a <i>building</i> to form the <i>insulation envelope</i> , that part of the <i>building</i> (including any infill construction) should have <i>U-values</i> which achieve those in column (a) of the table to clause 6.2.9. This will most likely occur where a part of a <i>building</i> is permanently removed as a phase of the alteration <i>work</i> . Another approach would be to follow the guidance given for 'infill of small openings' above, but compensate for the energy efficiency deficit by improving the overall <i>U-value</i> of other parts of the <i>insulation envelope</i> . Where this occurs at a <i>boundary</i> , no upgrading need be carried out if the element is a wall that is exclusively the property of the adjoining <i>building</i> . |
| Windows, doors, rooflights | Where windows, doors and rooflights are being created or replaced, they should achieve the <i>U-value</i> recommended in column (a) of the table to clause 6.2.9. A compensating approach may be used and an example of this is given in annex 6A. For secondary <i>glazing</i> , an existing window, after alteration should achieve a <i>U-value</i> of about 3.5 W/m ² K. Where the <i>work</i> relates only to 1 or 2 replacement windows or doors, to allow matching windows or doors be installed, the frame may be disregarded for assessment purposes, provided that the centre pane <i>U-value</i> for each glazed unit is 1.2 W/m ² K or less. |
| Area of windows, doors, rooflights | Where additional windows, doors and rooflights are being created, the overall total area (including existing) should not exceed 25% of the total <i>dwelling</i> floor area. In the case of a heated communal <i>room</i> or other area (exclusively associated with the dwellings), it should not exceed 25% of the total floor area of these rooms/areas. |
| Reconstruction of elements | Where the build-up of an element forming part of the <i>insulation envelope</i> is to be altered or dismantled and rebuilt, the opportunity should be taken to improve the level of thermal insulation. Column (a) of the table to clause 6.2.9 gives benchmark <i>U-values</i> and in many cases these can be achieved without technical risk, within the constraints of the existing construction. It is recognised however that certain constructions are easier to upgrade than others. A <i>building</i> that was in a ruinous state should, after renovation, be able to achieve almost the level expected of new construction. It may not however be <i>reasonably practicable</i> for a <i>dwelling</i> , which is in a habitable condition, to have its internal space significantly reduced in area or height in order to accommodate insulation; or for excessive enabling alterations to be caused by the fitting of external thermal insulation, unless the owner/ <i>occupier</i> of the <i>dwelling</i> intends that these changes are to be made. Other <i>building</i> |

standards and the impact that they will have when upgrading thermal insulation should be taken into account. In the majority of cases however, after an alteration of this nature to the *insulation envelope*, a roof should be able to achieve at least an average *U-value* of 0.35 and in the case of a wall or floor, 0.70 W/m²K.

www.est.org.uk/bestpractice

Further guidance on this subject can be found in the Energy Efficiency Best Practice in Housing publication, 'Effective use of insulation in dwellings' Ref CE23 – September 2003.

Thermal bridging and air infiltration

When alterations are carried out, attention should still be paid to limiting thermal bridging at junctions and around windows, doors and rooflights and limiting air infiltration (see clause 6.2.10). As far as alterations are concerned, only the *work* that forms the alteration and the impact of that *work* on the existing *building* need be considered.

6.2.12 Conservatories

U-values

Although *conservatories* are attached to *dwellings* they are *stand-alone buildings*. For the *glazing* to *conservatories* of less than 50 m² floor area, a maximum *U-value* of 2.2 is recommended and for those 20 m² or less a maximum *U-value* of 3.3. Non-*glazed* elements should follow the guidance in the table to clause 6.2.9. Some smaller *conservatories* can be exempt from both building warrant and the standards (see section 0). *Conservatories* of 50 m² or more are subject to standard 6.1.

Dividing elements

A *conservatory* should be thermally divided from the *insulation envelope* of the *dwelling*. The dividing elements (wall, door, window and on the rare occasion floor) should have *U-values* equal or better than the corresponding exposed elements in the rest of the *dwelling*.

Thermal bridging and air infiltration
conservatories

In order to limit air infiltration and thermal bridging at junctions and around windows, doors and rooflights, the guidance in BR 262 may be followed. If using the [SBSA Technical Handbook: 'Conservatories'](#), these issues will be considered to have been taken into account. Draught stripping for windows and doors which are part of the thermal division between the *conservatory* and the *dwelling* should be of a similar standard as the exposed windows and doors elsewhere in the *dwelling*.

6.2.13 Stand-alone buildings

For *stand-alone buildings* of less than 50 m² the guidance in the table to clause 6.2.9 and guidance clause 6.2.10 should be followed. *U-value* recommendations should be met, but the percentage *glazing* is unrestricted. (Thermal division from the remainder of the *dwelling* is explained in the clause above). *Stand-alone buildings* of 50 m² or more are subject to standard 6.1.

Common areas

Where the area of a communal *room* or other heated accommodation associated with a block of dwellings is less than 50 m², these rooms or accommodation may be treated as a stand-alone building. Elements (including dividing elements) should have *U-values* equal to or better than those chosen for the rest of the *building*, as determined in conjunction with the methodology in standard 6.1. In these rooms or accommodation, the area of windows, doors, rooflights and roof windows should be limited to 25% of the total floor area of these parts.

6.3 Heating system

- 6.3 Functional standard
- 6.3.0 Introduction
- 6.3.1 Gas and oil wet central heating efficiency
- 6.3.2 Solid fuel wet central heating efficiency
- 6.3.3 Electric wet central heating efficiency
- 6.3.4 Heat pump systems efficiency (warm and hot water)
- 6.3.5 Dry central heating systems efficiency
- 6.3.6 Solar water heating efficiency
- 6.3.7 Micro combined heat and power efficiency
- 6.3.8 Controls for wet space heating and hot water systems
- 6.3.9 Controls for dry space heating and hot water systems
- 6.3.10 Controls for combined warm air and hot water systems
- 6.3.11 Controls for solar water heating
- 6.3.12 Work on existing buildings
- 6.3.13 Conservatories

standard

6.3

mandatory

Every *building* must be designed and constructed in such a way that the heating and hot water service systems installed are energy efficient and are capable of being controlled to achieve optimum energy efficiency.

Limitation:

This standard does not apply to:

- (a) buildings which do not use fuel or power for controlling the temperature of the internal environment;
- (b) heating provided solely for the purpose of frost protection; or
- (c) individual solid-fuel or oil-firing stoves or open-fires, gas or electric fires or room heaters (excluding electric storage and panel heaters) provided as secondary heating in domestic buildings.

6.3.0 Introduction

In the design of domestic buildings, the energy efficiency of the heating plant is an important part of the package of measures which contributes to the overall *dwelling* carbon dioxide emissions. In practice the backstop levels given in this guidance for appliance efficiencies and controls will normally be exceeded to achieve compliance with standard 6.1 for new buildings.

This guidance refers to main heating systems for dwellings. Both the primary heating and secondary heating systems are taken account of in [SAP 2005](#).

When the guidance in section 3 on heating requirements for dwellings is considered along with standard 6.1, central heating (rather than using several individual appliances as primary heating) will usually be the most practical way to satisfy the standards.

Conversions

In the case of conversions, as specified in regulation 4, the *building* as converted shall meet the requirements of this standard in so far as is *reasonably practicable*, and in no case be worse than before the conversion (regulation 12, schedule 6).

6.3.1 Gas and oil wet central heating efficiency

Boilers and appliances installed in a *dwelling* or *building* consisting of dwellings should have minimum appliance efficiencies as set out below:

| Heating system | Efficiency |
|--|--|
| Gas and oil central heating boilers (natural gas or LPG) | SEDBUK [1] 86% i.e. condensing boiler |
| Gas or oil (twin burner) range cooker central heating boilers (www.rangeefficiency.org.uk) | SEDBUK [1] 75% |
| Gas fired fixed independent space heating appliances used as primary space heating | 58% gross |
| Oil fired fixed independent space heating appliances used as primary space heating | 60% gross |

Notes:

1. Seasonal Efficiency of Domestic Boilers in the UK.
(www.sedbuk.com www.boilers.org.uk)

Vented copper hot water storage vessels associated with the system should meet the heat loss and heat exchanger requirements in BS 1566: 2002.

www.hetas.co.uk

6.3.2 Solid fuel wet central heating efficiency

The appliance efficiency should be at least that required for its category as designated by the Heating Equipment Testing Approval Scheme (HETAS) as given in the table below:

| Category | Appliance type | Efficiency (gross calorific value) |
|----------|--|--|
| D | Open fires with high output boilers | 63% (trapezium) 65% (rectangle) |
| F | Room heaters and stoves with boilers | 67% |
| G | Cookers with boilers | 50% (not more than 3.5 kW) 60% (3.5 -7.5 kW) |
| J | Independent boilers (including pellet and log boilers) | 65% (batch fed) 70-75% (automatic anthracite) |

Vented copper hot water storage vessels associated with the system should meet the heat loss and heat exchanger requirements in BS 1566-1: 2000 or BS 3198: 1981.

6.3.3 Electric wet central heating efficiency

Electric flow boilers should be constructed to meet the requirements of the Low Voltage Directive and Electromagnetic Compatibility Directive, preferably shown by a third party electrical approval e.g. British Electrotechnical Approvals Board (BEAB) or similar. Vented copper hot water storage vessels associated with the system should meet BS 1566: 2002 or BS 3198: 1981.

For the most efficient use of electrical supplies it is recommended that an electric flow boiler is used to provide space heating alone, with the bulk of the hot water demand of the *dwelling* being supplied by a directly heated water heater utilising 'off-peak' electricity tariffs.

6.3.4 Heat pump systems efficiency (warm and hot water)

All heat pumps are at their most efficient when the source temperature is as high as possible, the heat distribution temperature is as low as possible and pressure losses are kept to a minimum. If radiators are used they should be high efficiency radiators with high water volume. Supply water temperatures should be in the range 40° C to 55° C to radiators, 30° C to 40° C to an underfloor heating system and 35° C to 45° C to fan coil units.

Electrically driven heat pumps should have a coefficient of performance of not less than 2.0 when operating at the heating system design condition. Reference can be made to the [DEFRA/Carbon Trust Energy Technology List](#). The water distribution system should be arranged for reverse return operation.

6.3.5 Dry central heating systems efficiency

Gas fired warm air systems

For a new gas-fired warm air system, the appliance should meet the recommendations of BS EN 778: 1998 or BS EN 1319: 1999, depending on the design of the appliance. The system should be installed in accordance with the recommendations in BS 5864: 2004. Where a gas-fired circulator is incorporated in the warm-air unit to provide domestic hot water, it should be of a type that is able to deliver full and part load efficiency at least equal to that recommended by BS EN 483: 2000.

Heat pump warm air systems

Refer to guidance in clause 6.3.4 on warm water systems. Minimum clearances adjacent to all airflow paths, as recommended by the manufacturer should be maintained. For ground to air and water to air systems constant water flow should be maintained through the heat pump.

6.3.6 Solar water heating efficiency

Solar water heating has low or zero carbon dioxide emissions and low or no associated running costs and is inherently energy efficient. Reference may be made to BS EN 12975 -1: 2006/2:2006 for information on collector performance for indirect systems. Location and orientation for optimum energy efficiency and to avoid overshadowing should be considered and SAP 2005 takes account of these issues in order to meet standard 6.1.

6.3.7 Micro combined heat and power efficiency

[www.bre.co.uk/sap 2005](http://www.bre.co.uk/sap2005)

Appendix N of SAP 2005 takes account of micro-CHP efficiency in order to meet standard 6.1.

6.3.8 Controls for wet space heating and hot water systems

Independent time and temperature control of heating and hot water circuits should be provided along with a boiler interlock (refer to table below) to ensure that the boiler and pump only operate when there is a demand for heat.

small dwellings
large dwellings

Zone controls are not considered necessary for single apartment dwellings. For large dwellings with a floor area over 150 m² independent time and temperature control of multiple space heating zones is recommended. Each zone (not exceeding 150 m²) should have a room thermostat, and a single multi-channel programmer or multiple heating zone programmers. For hot water systems in large dwellings, more than one hot water circuit each with independent time and temperature control should be provided.

Hot water systems

A hot water system (other than for combi boilers with storage capacity 15 litres or less) should have controls that will switch off the heat when the water temperature required by the occupants has been achieved and during periods when there is no demand for hot water. For hot water central heating systems this thermostat should be interconnected with the other controls which are needed to form a boiler interlock.

Wet gas, oil, electric and solid fuel systems

The following tables summarise minimum recommendations for controls for space and hot water gas, oil, electric and solid fuel 'wet' central heating systems (radiators, convectors):

Controls for combis, CPSU boilers, electric boilers

| Type of control | Means to achieve |
|--------------------------|---|
| Boiler control | Boiler interlock Automatic bypass valve [1][2] |
| Time control | Time switch (7 day for space heating) Full programmer for electric |
| Room temperature control | TRV's (all radiators except in rooms with room thermostats or where 'heat bleed' required), Room thermostat(s) |

Notes:

- As advised by boiler manufacturer in conjunction with any requirements for a minimum pipe length.
- An electric flow boiler should be fitted with a flow temperature control and be capable of modulating the power input to the primary water depending on space heating conditions.

Controls for other boilers

| Type of control | Means to achieve |
|--------------------------|--|
| Boiler control | Boiler interlock (for solid fuel as advised by manufacturer) Automatic bypass valve [1] |
| Time control | Full programmer (7 day for space and hot water) [2] |
| Room temperature control | as above table |
| Cylinder control | Cylinder thermostat plus 2 port valves or a 3 port valve [3] Separately controlled circuits to cylinder and radiators with pumped circulation |
| Pump control | Pump overrun timing device as required by manufacturer |

Notes:

- As note 1 to first table.
- For solid fuel the level of sophistication of time controls should be selected to be compatible with the appliance. The highest levels should only be used for appliances with automatic ignition.
- A zone valve is not recommended for a thermal store.

Boiler management systems

An alternative to the controls shown in the tables above would be a boiler management control system.

www.est.org.uk/bestpractice
www.bre.co.uk/sap 2005

Definitions and explanations of the various controls and heating types can be found in Good Practice Guide 302 (Energy Efficiency Best Practice in Housing) and in SAP 2005.

Hot water systems

Solid fuel boilers

These should be thermostatically controlled to reduce the burning rate of the fuel, by varying the amount of combustion air to the fire. For safety reasons, a suitable heat bleed (slumber circuit) from the system should be formed, for example a gravity fed radiator without a TRV or a hot water cylinder that is connected independent of any controls. For hot water systems, unless the cylinder is forming the slumber circuit, a thermostatically controlled valve should be fitted, provided that the appliance manufacturer’s requirements for dealing with excess heat created during a pump over-run are met.

Gas or oil (twin burner) range cooker central heating boilers

An appliance with 2 independently controlled burners (one for cooking and one for the boiler) is recommended.

Gas and oil fired fixed independent space heating appliances

Each appliance should be capable of providing independent temperature control in areas with different heating needs. This could be independent or in conjunction with room thermostats or other appropriate temperature sensing devices.

System temperature controls

Hot water underfloor heating

The controls described below should be fitted to ensure safe system operating temperatures:

- a. a separate flow temperature high limit thermostat should be used for warm water systems connected to any high water temperature heat supply; and
- b. mixed systems containing both radiators and underfloor heating, connected to a common high water temperature supply operating at more than 60° C should be provided with a separate means of reducing the water temperature to the underfloor heating system.

Minimum recommendations for *room* temperature, time and boiler controls are:

Controls for underfloor heating

| Type of control | Means to achieve |
|--------------------------|---|
| Room temperature control | Thermostats for each <i>room</i> (adjacent rooms with similar functions may share [1]) Weather compensating controller |
| Time control | Automatic setback of <i>room</i> temperature during unoccupied periods/at night time |
| Boiler control | Boiler interlock |

Notes:

- 1. Bathrooms or en-suites which share a heating circuit with an adjacent bedroom provide heat only when the bedroom thermostat is activated. In such cases, the bathroom or ensuite areas should be fitted with an independent towel rail or radiator.

| | |
|------------------------------------|--|
| Unit controls | <p>Heat pumps hot water systems</p> <p>Heat pump unit controls should include:</p> <ol style="list-style-type: none">control of water temperature for the distribution system;control of water pumps (integral or otherwise);defrost control of external airside heat exchanger (for air to water units);control of outdoor fan operation (for air to water units);protection for water flow failure;protection for high water temperature;protection for high refrigerant pressure; andprotection for external air flow failure (on air to water units). |
| External controls | <p>Controls which are not integral to the unit should include:</p> <ul style="list-style-type: none">room thermostat to regulate the space temperature and interlocked with the heat pump unit operation; andtimer to optimise operation of the heat pump. |
| Small dwellings Large dwellings | <p>6.3.9 Controls for dry space heating and hot water systems</p> <p>Zone controls are not considered necessary for single <i>apartment</i> dwellings. For large dwellings with a floor area over 150 m², independent time and temperature control of multiple space heating zones is recommended. Each zone (not exceeding 150 m²) should have a room thermostat, and a single multi-channel programmer or multiple heating zone programmers.</p> <p>Electric storage heaters</p> <p>Electric storage heater controls should include:</p> <ol style="list-style-type: none">Charge control: there should be automatic control of input charge, able to detect the internal or external temperature and adjust the charging of the heater accordingly; andTemperature control: heaters should have manual controls for adjusting the rate of heat release from the appliance. This may take the form of an adjustable damper or some other thermostatically controlled means. <p>Panel heaters</p> <p>Time and temperature control should be provided using:</p> <ol style="list-style-type: none">a programmable time switch and thermostat integral to the appliance; ora separate time switch and separate room thermostats. <p>Electric warm air systems</p> <p>Time and temperature control should be provided either integral to the heater or external, using either:</p> <ol style="list-style-type: none">a time switch/programmer and room thermostat; ora programmable room thermostat. <p>Gas fired warm air systems (without water heating)</p> <p>Time and temperature control should be provided using:</p> <ol style="list-style-type: none">controls outwith the heater: time switch/programmer and room thermostat, or programmable room thermostat; orcontrols integrated with heater: time-switch/programmer and room temperature sensor linked to heater firing and fan speed control. |

Electric underfloor heating

The guidance relating to hot water underfloor heating should be followed (disregarding the boiler interlock). For electric storage, direct acting systems and under-tile systems programmable room timer/thermostats with manual over-ride feature *room* controls are recommended for all heating zones, with air and floor (or floor void) temperature sensing capabilities to be used individually or combined. A storage system should have anticipatory controllers installed controlling low tariff input charge with external temperature sensing and floor temperature sensing. A manual override facility should be available for better user control. Controls for storage systems with room timer/thermostats should take advantage of low tariff electricity except where the system has anticipatory controllers controlling low tariff input charge with external temperature and floor temperature sensing.

Heat pumps warm air systems

In addition to the controls that are not integral to the unit for heat pump hot water systems (refer above clause) and the controls b-h for such systems, warm air system controls should include:

- control of *room* air temperature (integral or otherwise); and
- control for secondary heating (if fitted) (on air to air systems).

6.3.10 Controls for combined warm air and hot water systems

The first paragraph of the above clause provides guidance on zones for small and large dwellings. However the following controls should be provided in all cases:

- a. independent time control of both the heating and hot water circuits (achieved by means of a cylinder thermostat and a timing device, wired such that when there is no demand for hot water both the pump and circulator are switched off);
- b. pumped primary circulation to the hot water cylinder;
- c. a hot water circulator interlock (achieved by means of a cylinder thermostat and a timing device, wired such that when there is no demand from the hot water both the pump and circulator are switched off); and
- d. time control by the use of either:
 - a full programmer with separate timing to each circuit;
 - two or more separate timers providing timing control to each circuit;
 - a programmable room thermostat(s) to the heating circuit(s); or
 - a time switch/programmer (two channel) and room thermostat.

6.3.11 Controls for solar water heating

A means of control should be provided to:

- a. optimise the useful energy gain from the solar collectors into the system's dedicated storage vessel(s);
- b. minimise the accidental loss of stored energy by the solar hot water system, whether originating from solar collectors, cold intake or auxiliary heat sources;
- c. ensure that hot water produced by auxiliary heat sources is not used when adequate grade solar pre-heated water is available;
- d. provide a means of control consistent with the solar system being inherently secure against the adverse affects of excessive primary temperatures and pressures; and
- e. the inlet temperature of any separate domestic hot water heating appliance where provided (such as a combi boiler) should be limited as necessary.

6.3.12 Work on existing buildings

The guidance in the above clauses also relates to:

Conversions, extensions and complete systems

- space heating/hot water system alterations or installations (including new or replacement appliances) for conversions and extensions to the *insulation envelope*; and
- where alterations are being made to an existing heating/hot water system or a new or replacement heating/hot water system is being installed in an existing *dwelling* (or *building* consisting of dwellings).

e.g. TRVs should be installed to all new radiators in an extension even when the heating is from an existing boiler.

Part systems

If a heating and/or hot water system is being replaced in part, the guidance in the above clauses should be followed but only as it affects the new or replaced components of the system. Such alterations should not allow the heating system as a whole to be downgraded in terms of energy efficiency or compromised from a safety point of view.

Condensing boilers

There may be exceptional circumstances which make it impractical or uneconomic to install a condensing boiler as recommended in the guidance to clause 6.3.1. This can be shown by following the criteria set out in the '[Guide to Condensing boiler Installation Assessment Procedure for dwellings \(Scotland\)](#)'. Where this occurs the minimum SEDBUK efficiencies are: mains natural gas 78%, LPG 80%, oil 85%, oil combi 82%. Alternatively a replacement back boiler with a SEDBUK of 3 percentage points less than the above recommended figures may be installed. In addition existing gas and oil systems with semi-gravity circulation should be converted to fully pumped systems.

www.sbsa.gov.uk

Historic buildings

For historic buildings the guidance in the above clauses should be referred to taking into account circumstances. In many cases heating system improvements will be more feasible than any other energy efficiency measures such as improving wall insulation. Therefore systems which go beyond these minimum backstop levels may help offset the deficiency in other areas of energy efficiency and in carbon dioxide emissions terms.

6.3.13 Conservatories

As a *conservatory* which is heated will be inefficient in energy terms, the general guidance to occupiers is that they should be heated as little as possible. In view of the fact that heating is often desired particularly at the start and end of the heating season any *conservatory* with heating installed should have controls that regulate it from the rest of the *dwelling* e.g. a TRV to the radiator.

6.4 Insulation of pipes, ducts and vessels

- 6.4 Functional standard
- 6.4.0 Introduction
- 6.4.1 Insulation of pipes and ducts
- 6.4.2 Insulation of vessels
- 6.4.3 Work on existing buildings

standard

6.4

mandatory

Every *building* must be designed and constructed in such a way that temperature loss from heated pipes, ducts and vessels, and temperature gain to cooled pipes and ducts, is resisted.

Limitation:

This standard does not apply to:

- (a) buildings which do not use fuel or power for heating or cooling either the internal environment or water services;
- (b) buildings, or parts of a *building*, which will not be heated, other than heating provided solely for the purpose of frost protection;
- (c) pipes, ducts or vessels that form part of an isolated industrial or commercial process; or
- (d) cooled pipes or ducts in domestic buildings.

6.4.0 Introduction

Thermal insulation to heating pipes and ducts and hot water storage vessels will improve energy efficiency by preventing:

- uncontrolled heat loss from such equipment;
- an uncontrolled rise in the temperature of the parts of the *building* where such equipment is situated.

Conversions

In the case of conversions, as specified in regulation 4, the *building* as converted shall meet the requirements of this standard in so far as is *reasonably practicable*, and in no case be worse than before the conversion (regulation 12, schedule 6).

6.4.1 Insulation of pipes and ducts

Warm air ducts and hot water pipes serving a space heating system should be thermally insulated against heat loss unless the use of such pipes or ducts always contribute to the heating demands of the *room* or space. In some cases this will not be necessary where pipe and *duct* runs occur just behind the internal wall or ceiling linings of the *insulation envelope*. This will not only address energy conservation issues but will also assist with frost protection. Further information on this subject is contained in BR 262.

www.bre.co.uk

Hot water pipes to appliances

Pipes that are used to supply hot water to appliances within a *domestic building* should be insulated against heat loss. This is to conserve heat in the hot water pipes between frequent successive draw-offs. All pipes of a solar water heating primary system should be insulated.

www.bsi-global.com

Insulation for such pipes and ducts may be provided by following the guidance for 'environmental thickness' given in BS 5422: 2001 'Methods for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range 40° C to +700° C'.

The *building* design should be considered at an early stage to ensure complete insulation of pipes and ducts, where such services pass through or around structural *building* components, floor joists, for example.

6.4.2 Insulation of vessels

A hot water storage vessel should be insulated against heat loss. This can be achieved by following the guidance given for 'environmental thickness' in BS 5422: 2001. The pipes that connect to the vessel, the vent pipe and primary flow and return, for example, should also be insulated to a distance of about 1 m back from their points of connection (in addition to the guidance above on pipe insulation).

Unvented hot water systems

Where an unvented hot water system is installed, additional insulation should be considered to reduce the heat loss that can occur from the safety fittings and pipework. Such insulation should not compromise the safe operation of the system, including the visibility of warning discharges.

6.4.3 Work on existing buildings

Where a new or replacement boiler or hot water storage vessel is installed, or where existing systems are extended, new or existing pipes that are accessible or exposed as part of the *work* should be insulated as for new systems. Replacement hot water storage vessels should be insulated as for a new vessel.

It is recognised that complete insulation will sometimes not be possible, where such services pass through or around structural *building* components, floor joists, for example.

6.5 Artificial and display lighting

- 6.5 Functional standard
- 6.5.0 Introduction
- 6.5.1 Artificial lighting

standard

6.5

mandatory

Every *building* must be designed and *constructed* in such a way that the artificial or display lighting installed is energy efficient and is capable of being controlled to achieve optimum energy efficiency.

Limitation:

This standard does not apply to:

- (a) process and emergency lighting components in a *building*;
- (b) communal areas of *domestic buildings*; or
- (c) alterations in *dwellings*.

6.5.0 Introduction

Artificial lighting can account for a substantial proportion of the electricity used within a *building*. Appropriate lighting design (including use of natural daylight) can reduce carbon dioxide emissions and running costs, and can also reduce internal heat gains.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard (regulation 12, schedule 6).

6.5.1 Artificial lighting

A minimum of 50% of the fixed light fittings and lamps installed in a *dwelling* should be low energy type.

The fittings may be either:

- dedicated fittings which will have a separate control gear and will only take fluorescent lamps (pin based lamps); or
- fittings including lamps with integrated control gear (bayonet or Edison screw base lamps).

e.g. tubular fluorescent and compact fluorescent fittings (CFL's) with luminous efficacy at least 40 lumens/circuit watt.

In this guidance:

- a minimum of 50% of fixed light fittings means at least 1 in a *dwelling* which has 2 fittings, 2 where there are 3, 2 of 4, 3 of 5 etc;
- fixed light fittings include only the main light sources to a *room*; not display or feature lighting such as picture lights, *kitchen* wall cupboard lights, over mirror lights. A light fitting may contain one or more lamps and a group of lamps operated by the same switch could be counted as one fitting, e.g. a pair of wall lights;
- low energy light fittings include the provision of lamps/bulbs.

6.6 Mechanical ventilation and air conditioning

- 6.6 Functional standard
- 6.6.0 Introduction
- 6.6.1 Form and fabric of the building

standard
6.6
mandatory

Every *building* must be designed and *constructed* in such a way that:

- (a) the form and fabric of the *building* minimises the use of mechanical ventilating or cooling systems for cooling purposes; and
- (b) in non-domestic *buildings*, the ventilating and cooling systems installed are energy efficient and are capable of being controlled to achieve optimum energy efficiency.

Limitation:

This standard does not apply to *buildings* which do not use fuel or power for ventilating or cooling the internal environment.

6.6.0 Introduction

It is not desirable that *dwellings* or *buildings* consisting of *dwellings* have air-conditioning systems or use mechanical ventilation systems for cooling purposes, as this leads to increased energy use and higher carbon dioxide emissions. In view of this the guidance is intended to prevent the need for such systems in *dwellings* and no information is provided on the efficiency of these systems.

Standard 6.6(a) can be now applied to *domestic buildings* because the [SAP 2005](#) document provides a method for estimating uncontrolled heat build up through solar gains which can lead to 'high internal temperature in hot weather'.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard in so far as is *reasonably practicable*, and in no case be worse than before the *conversion*(regulation 12, schedule 6).

6.6.1 Form and fabric of the building

Reducing overheating
[CE 129 EST](#)

In order to minimise any need for mechanical ventilation for cooling or air-conditioning due to high internal temperatures in hot weather the following issues should be considered with regard to the form and the fabric of the *dwelling*:

- a. proportion of translucent *glazing* taking into account the need for daylighting and artificial lighting (section 3 and standard 6.5);
- b. orientation of translucently *glazed* areas;
- c. solar shading or other solar control measures where areas of the external *building* fabric are susceptible to solar gain;
- d. natural ventilation (including night cooling);
- e. thermal mass.

Poor cross ventilation
or a lot of translucent
glazing

Where a *dwelling* has little or no cross ventilation (e.g. *flats* with all external windows/rooflights on one southerly elevation which is orientated between due east and due west) or a high proportion of translucent *glazing*:

- a. the *dwelling* should be designed to avoid high internal temperature (refer advice above);
- b. then it should be shown by calculation that the 'likelihood of high internal temperature in hot weather' in the *dwelling* is 'not significant, slight or medium'. The recommended method to assess this is Appendix P to SAP 2005. The intention is to avoid the situation where a *dwelling occupier* installs mechanical cooling or air-conditioning at a later date.

[www.bre.co.uk/sap 2005](http://www.bre.co.uk/sap2005)

Cooling system

Where a cooling system is proposed for a *dwelling*:

- a. the *dwelling* should be designed to avoid any need for a cooling system (refer to advice above);
- b. then the 'likelihood of high internal temperature in hot weather' should be assessed using Appendix P.

If the 'likelihood of high internal temperature' is 'not significant, slight or medium' an air-conditioning system should not be installed.

6.7 Commissioning building services

- 6.7 Functional standard
- 6.7.0 Introduction
- 6.7.1 Inspection and commissioning

standard

6.7

mandatory

Every *building* must be designed and *constructed* in such a way that energy supply systems and *building* services which use fuel or power for heating, lighting, ventilating and cooling the internal environment and heating the water, are commissioned to achieve optimum energy efficiency.

Limitation:

This standard does not apply to:

- (a) major power plants serving the National Grid;
- (b) the process and emergency lighting components of a *building*;
- (c) heating provided solely for the purpose of frost protection; or
- (d) energy supply systems used solely for industrial and commercial processes, leisure use and emergency use within a *building*.

6.7.0 Introduction

Commissioning in terms of this section means, raising the *building* services systems (covered by this guidance) from a level of static completion to full working order and achieving the levels of energy efficiency that the component manufacturers expect from their product(s). Commissioning however, should also be carried out with a view to ensuring the safe operation of the system.

Although there is no requirement within section 6 for minimum efficiency levels of either, building-integrated or localised energy supply systems (e.g. diesel generators, micro wind turbines or photovoltaic arrays), there is a need for commissioning to be carried out to ensure efficient use, unless they are exempt under schedule 1, regulation 3. Major power plants which serve a number of *buildings* (e.g. *housing* estates) and only export surplus electricity to the National Grid will also need to be commissioned, unless exempt in terms of schedule 1, regulation 3.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

6.7.1 Inspection and commissioning

A heating, hot water service, ventilating or cooling system and any decentralised equipment for power generation in a *dwelling* or other area of a *building* consisting of *dwellings* should be inspected and commissioned in accordance with manufacturers' instructions to ensure optimum energy efficiency.

6.8 **Written information**

- 6.8 Functional standard
- 6.8.0 Introduction
- 6.8.1 Written information
- 6.8.2 Work on existing buildings

standard
6.8
mandatory

The *occupiers* of a *building* must be provided with written information by the owner:

- (a) on the operation and maintenance of the *building* services and energy supply systems; and
- (b) where any air-conditioning system in the *building* is subject to regulation 17, stating a time-based interval for inspection of the system.

Limitation:

This standard does not apply to:

- (a) major power plants serving the National Grid;
- (b) *buildings* which do not use fuel or power for heating, lighting, ventilating and cooling the internal environment and heating the water supply services;
- (c) the process and emergency lighting components of a *building*;
- (d) heating provided solely for the purpose of frost protection;
- (e) lighting, ventilation and cooling systems in a *domestic building*; or
- (f) energy supply systems used solely for industrial and commercial processes, leisure use and emergency use within a *building*.

6.8.0 Introduction

Correct use and maintenance of *building* services equipment is essential if the benefits of enhanced energy efficiency are to be realised from such equipment. The intention of this standard is to make the information that will help achieve this, available to the *occupier* of the *building*.

Although there is no requirement within section 6 for minimum efficiency levels of either, building-integrated or localised energy supply systems (e.g. diesel generators, micro wind turbines or photovoltaic arrays), there is a need for user and maintenance instructions to ensure efficient use, unless they are exempt under schedule 1, regulation 3. Major power plants which serve a number of *buildings* (e.g. *housing* estates) and only export surplus electricity to the National Grid will also need to have user and maintenance instructions, unless exempt in terms of schedule 1, regulation 3.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

6.8.1 Written information

Written information should be made available for the use of the *occupier* on the operation and maintenance of the heating and hot water service system and any decentralized equipment for power generation to encourage optimum energy efficiency. If an air-conditioning system is installed in a *dwelling* the guidance to regulation 17 should be followed.

6.8.2 Work on existing buildings

Where alterations are carried out to *building* services on a piecemeal basis, the alterations may not result in optimum energy efficiency being attained for the whole system. In this case a list of recommendations which would improve the overall energy efficiency of the system should be provided.

6.9 Energy performance certificates

- 6.9 Functional standard
- 6.9.0 Introduction
- 6.9.1 Calculating the carbon dioxide emissions for a certificate
- 6.9.2 Information to be provided for dwellings
- 6.9.3 Location of an energy performance certificate
- 6.9.4 Conservatories and other stand-alone buildings

standard

6.9

mandatory

Every *building* must be designed and constructed in such a way that:

- (a) **an energy performance certificate for the *building* is affixed to the *building*, indicating the approximate annual carbon dioxide emissions and energy usage of the *building* based on a standardised use of the *building*;**
- (b) **the energy performance for the certificate is calculated in accordance with a methodology which is asset-based, conforms with the European Directive 2002/91/EC and uses UK climate data; and**
- (c) **the energy performance certificate is displayed in a prominent place within the *building*.**

Limitation:

- (a) This standard does not apply to *buildings* which do not use fuel or power for controlling the temperature of the internal environment;
- (b) this standard does not apply to non-domestic *buildings* and *buildings* that are ancillary to a dwelling that are stand-alone having an area less than 50 square metres;
- (c) this standard does not apply to *conversions*, alterations and extensions to *buildings* other than alterations and extensions to *stand-alone buildings* having an area less than 50 square metres that would increase the area to 50 square metres or more, or alterations to *buildings* involving the fit-out of the shell which the subject of a continuing requirement;
- (d) this standard does not apply to *limited life buildings* which have an intended life of less than 2 years;
- (e) Standard 6.9(c) only applies to *buildings* with a floor area of more than 1000 square metres, which are occupied by public authorities and institutions providing public services, which can be visited by the public.

6.9.0 Introduction

Article 7 of EU Directive ([2002/91/EC](#)) on the energy performance of *buildings* requires energy performance certificates (EPCs) to be made available to prospective owners and tenants when *dwellings* are *constructed*. Standard 6.9 achieves this by making EPCs fixtures within *buildings*.

It is intended that Scottish Ministers will direct local authorities to apply standard 6.9 to all existing *buildings* using Section 25 (2) of the Building (Scotland) Act 2003. The direction will limit the description of dwelling to which it applies to those that are being sold or rented out. It is proposed that guidance leaflets will be produced explaining the action that building owners need to take in order to comply.

Conversions

In the case of *conversions*, as specified in regulation 4 standard 6.9 does not apply.

6.9.1 Calculating the carbon dioxide emissions for a certificate

The EU Directive allows energy performance to be reflected in one or more numeric indicators. For this to be done in a transparent manner that is meaningful in terms of Scottish building regulations, the measure to be used is carbon dioxide.

Simplified approach

The certification should be carried out using the Directive compliant methodology and the calculation tool which was used to assess compliance with standard 6.1. In most cases [SAP 2005](#) will have been used for the new *dwelling*. However, if the simplified approach referred to in clause 6.1.6 has been adopted for the new *dwelling*, the construction specification is well enough defined to allow the certificate to be generated using the simplified approach embedded in SAP software.

Use of actual values

For the purpose of establishing a rating for the energy performance certificate for a new *dwelling* the values and specifications used to obtain a building warrant (as varied by any subsequent amendments to warrant) should be adopted. Where a *domestic building* contains multiple dwellings a rating is required for each individual *dwelling*. However for certification purposes the rating may be recalculated with the percentage of low energy lighting and the type of heating as installed. Note, there will be no need to assume 10% electric secondary heating if secondary heating is not present.

Non-domestic use within dwellings

Accommodation up to 50 m² used by an occupant of a *dwelling* in their professional or business capacity should be considered as a part of the *dwelling*.

6.9.2 Information to be provided for dwellings

The energy performance certificate should display the following information:

- the postal address of the *building* for which the certificate is issued;
- *building* type;
- the name of the SBSA protocol organisation issuing the certificate (if applicable) and may include the member's membership number;
- the date of the certificate;
- the conditioned floor area of the *dwelling*;
- the main type of heating and fuel;
- the calculation tool used for certification;
- a specific indication of current CO₂ emissions and an indication of potential emissions;
- a seven band scale in different colours representing the following bands of carbon dioxide emissions; A, B, C, D, E, F and G, where A = excellent and G = very poor;
- the approximate energy use expressed in kWh per m² of floor area per annum;
- a list of cost-effective improvements (lower cost measures); and
- a statement to the effect of 'N.B. THIS CERTIFICATE MUST BE AFFIXED TO THE BUILDING AND NOT BE REMOVED UNLESS IT IS REPLACED WITH AN UPDATED VERSION'.

www.sbsa.gov.uk

A model form for an energy performance certificate for a *dwelling* is given on the SBSA website.

Cost-effective improvements

There are only limited cost-effective, low-cost, energy efficiency improvements that can be made to a new *dwelling* (when no other *work* is proposed) such as upgrade insulation in an accessible roof space or fit low energy lamps throughout the *dwelling*. Measures presented on the certificate must meet Scottish building regulations, should be technically feasible and specific to the individual *dwelling*.

Additional advice

A piece of advice that is worthwhile including is that a *conservatory* (where one is installed) is only an energy efficiency benefit to the *dwelling* if it remains unheated and is not mechanically cooled. Certificates may give additional advice on projected energy costs and improvements that are cost-effective only when additional *work* is being carried out e.g. providing insulation when replacing *flat roof* coverings. Some experts providing certificates may wish to add extra value and give additional advice to their clients on improvements that are aspirational (e.g. photovoltaics). All of this is welcome, but in every case, such information should only be provided as an appendix to the certificate and be accompanied by advice on relevant warrants and building regulations.

6.9.3 Location of an energy performance certificate

The energy performance certificate should be indelibly marked and located in a position that is readily accessible, protected from weather and not easily obscured. A suitable location could be in a cupboard containing the gas or electricity meter or the water supply stopcock.

6.9.4 Conservatories and other stand-alone buildings

For conservatories and for other ancillary stand-alone buildings of less than 50 m² floor area, an energy performance certificate need not be provided. For those buildings of a floor area of 50 m² or more, the guidance in the non-domestic Technical Handbook should be followed and an additional certificate supplementing the one for the *dwelling* should be provided.

6.10 Metering

- 6.10 Functional standard
- 6.10.0 Introduction

standard

6.10

mandatory

Every *building* must be designed and *constructed* in such a way that each part of a *building* designed for *different occupation* is fitted with fuel consumption meters.

Limitation:

This standard does not apply to:

- (a) *domestic buildings*;
- (b) communal areas of *buildings* in *different occupation* ;
- (c) district or block heating systems where each part of the *building* designed for *different occupation* is fitted with heat meters ; or
- (d) heating fired by solid fuel or biomass.

6.10.0 Introduction

This standard does not apply to *domestic buildings* as fuel providers e.g. gas companies, provide meters to *dwellings* to enable correct charging for fuel used by the customer.

Annex

6.A Compensating U-values for windows, doors and rooflights

6.A.0 Introduction

6.A.1 Example of trade-off between windows, doors and rooflights

annex

6.A

6.A.0 Introduction

This annex gives guidance on how to calculate the average *U-values* for windows, doors, and rooflights and supports the guidance to standards 6.1 and 6.2. It may be used with the elemental methods provided and in particular:

- the simplified approach in the guidance to standard 6.1, where it is not possible to input the individual *U-values* for all the windows, doors and rooflights for the proposed new *dwelling* into the methodology (usually [SAP 2005](#)); and
- for *work* on existing *domestic buildings*, namely, *conversions*, extensions, replacements, alterations, and *conservatories* (clauses 6.2.6 to 6.2.12).

Individual windows, doors or rooflights may have *U-values* that exceed the *U-values* in these clauses provided that the average *U-value* for all the windows, doors and rooflights is no greater than the value in the relevant table or text.

The example that follows illustrates how this trade-off can be done.

6.A.1 Example of trade-off between windows, doors and rooflights

A semi-detached *house* has a total window area of 16.9 m² (including frames) and a total door area of 3.8 m². It is proposed to use 2 external quality timber finished 'fire' doors with a *U-value* of 2.0 W/m²K. In order to follow the guidance to standards 6.1 and 6.2, the additional heat loss due to the use of the external doors should be compensated for by more demanding *U-values* in the windows and/or rooflights so that the average overall *U-value* of such elements does not exceed 1.8 W/m²K.

Windows with a *U-value* of 1.7 W/m²K can achieve this requirement, as shown in the following table and subsequent calculation:

Average U-value calculation

| Element | Area (m ²) | | U-value (W/m ² K) | | Rate of heat loss (W/K) |
|------------|------------------------|---|------------------------------|---|-------------------------|
| Windows | 16.9 | x | 1.7 [1] | = | 28.73 |
| Doors | 3.8 | x | 2.0 | = | 7.60 |
| Rooflights | 0.9 | x | 1.9 [1] | = | 1.71 |
| Total | <u>21.6</u> | | | | <u>38.04</u> |

Notes:

1. These *U-values* correspond to double-glazed windows or rooflights with a wood or plastic frame, with a 16 mm argon-filled space between the panes and a soft low-emissivity coating on the glass. Note that although the windows and rooflights have the same design the rooflight *U-value* is 0.2 W/m²K higher than the window *U-value*.

This gives an average *U-value* of 38.04÷21.6, or 1.76 W/m²K. The windows, doors and rooflights can therefore be considered to follow the objectives of the requirement for the *insulation envelope*.

Annex

6.B Compensatory approach - heat loss example

- 6.B.0 Introduction
- 6.B.1 Alteration to create rooms in a roof space
- 6.B.2 Proposed attic
- 6.B.3 'Notional attic'
- 6.B.4 The comparison
- 6.B.5 Additional insulation work

annex

6.B

6.B.0 Introduction

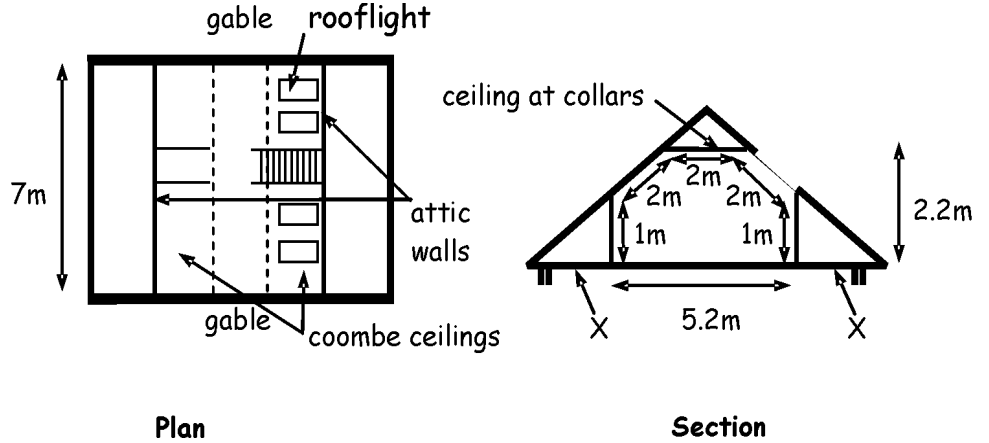
This annex gives an example of the compensatory approach for use in the design of *conversions*, extensions and alterations. This is likely to be of use where there is a need to specify one or more *constructions* with a *U-value* higher than the recommended maximum area-weighted average *U-values* given in column (a) of the table to clause 6.2.9. The example given in this instance is for an attic *conversion*, however the same principles apply to extensions and substantial alterations.

6.B.1 Alteration to create rooms in a roof space

First the internal exposed surface areas of all the elements with different area-weighted *U-values* are calculated. Then the heat loss for the proposed attic development is calculated. One or more *U-values* may be higher or lower than those recommended in column (a) of the table to clause 6.2.9 and the percentage windows/doors/rooflight area as proposed may be greater or less than 25%. After that the heat loss for a 'notional attic' development (i.e. an attic the same size and shape as the proposed and with its area of window/doors/rooflights taken as 25% of its floor area) is calculated using the *U-values* in the table to clause 6.2.9. Finally, the heat loss calculated for the proposed attic should be less than or equal to that for the 'notional' one.

Compensatory approach example

It is proposed to form 2 rooms in the *roof space* of an existing single storey dwelling. The extra floor area created (including opening for stairway) will be 36.4 m². A plan and section of the proposed layout is shown in the figure below. A key part of the design is to create as much headroom as possible below the new coombe ceilings. The existing rafters are only 150 mm deep therefore it is difficult to achieve the recommended elemental *U-value* of 0.20 (see column (a) in the table to clause 6.2.9), without using branders or having an excessive thickness of insulated ceiling lining. The principal compensatory measure will be to highly insulate the attic walls that occur directly below the lowest part of the coombes. The existing gables will be provided with insulated internal wall lining to improve the *U-value* where the *insulation envelope* now occurs. The four no. 1.5 m² rooflights installed have timber frames. The floor that will be formed at the line of the existing ceiling ties is wholly within the *insulation envelope* and is therefore disregarded for the purposes of this calculation.



6.B.2 Proposed attic

Then calculate the rate of heat loss from the proposed attic as follows:

Data for proposed attic alteration

| Exposed element | Exposed surface area (m ²) | | U-value (W/m ² K) | | Rate of heat loss (W/K) |
|--------------------------------|--|---|------------------------------|---|-------------------------|
| Gables | 19.0 | x | 0.40 | = | 7.60 |
| Attic walls | 14.0 | x | 0.20 | = | 2.80 |
| Ceiling at collars | 14.0 | x | 0.16 | = | 2.24 |
| Coombe ceiling | 22.0 | x | 0.35 | = | 7.70 |
| Rooflights | 6.0 (16.5%) | x | 1.8 | = | 10.8 |
| Total rate of heat loss | | | | | = 31.14 |

6.B.3 'Notional attic'

Then calculate the rate of heat loss from the 'notional attic' as follows:

Data for 'notional' attic alteration

| Exposed element | Exposed surface area (m ²) | | U-value (W/m ² K) | | Rate of heat loss (W/K) |
|--------------------------------|--|---|------------------------------|---|-------------------------|
| Gables | 19.0 | x | 0.27 | = | 5.13 |
| Attic walls | 14.0 | x | 0.27 | = | 3.78 |
| Ceiling at collars | 14.0 | x | 0.16 | = | 2.24 |
| Coombe ceiling | 18.9 | x | 0.20 | = | 3.78 |
| Rooflights | 9.1 (25%) | x | 1.8 | = | 16.38 |
| Total rate of heat loss | | | | | = 31.31 |

6.B.4 The comparison

The rate of heat loss from the proposed attic is less than that from the 'notional attic'.

6.B.5 Additional insulation work

The existing *dwelling* is of an age where there was no insulation provided in the *roof space* at the time of the original *construction*. Clause 6.2.11 advises that additional *work* should be carried out to upgrade the *U-values* of parts of the roof which are immediately adjacent to the alterations. In this example, there is no technical or other reason which prevents the level ceiling at the eaves of the roof (see X on the section) being upgraded to achieve a *U-value* of 0.16 as given in column (a) of the table to clause 6.2.9.