0

general

Contents

0.1 Introduction and application

contents

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 introductory information is given on a yellow page, while the guidance on how comply with the standard is given in the succeeding white pages.

In Section 0 Regulations 1 and 2 are considered together and then each successive regulation is considered in turn.

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.
Appendix C : Cross-reference to the 6th Amendment of the Technical Standards.
A full index.

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 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 by 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 judgement 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 *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 Building (Scotland) Act 2003 replaced the Building (Scotland) Act 1959 and these Technical Handbooks replace the Technical Standards to the Building (Scotland) Regulations 1990 as amended (6th Amendment 2002). The form and status of this guidance is very different from the previous Technical Standards. Before it was only possible to satisfy the Regulations by compliance with Technical Standards. This meant they were mandatory rather than guidance.

Although this Technical Handbook has a very different status from the Technical Standards the technical recommendations are very similar and this handbook has been prepared as an almost level transposition from the previous Technical Standards. There has been significant updating of detailed issues and the introduction of additional advice and explanation, but there has been relatively little change in the technical specifications. Where significant change has occurred this is recorded in the introductions to the six sections.

This guidance appears very different because of the re-arrangement of sections to follow the six Essential Requirements of the CPD. A general summary of the re-arrangement is given below:

Technical Standards	**Technical Handbooks**
Part A General	Section 0 General (Regs 1 – 7 and 9 – 12)
Part B Materials and Workmanship etc.	Section 0 General (Reg 8)
Part C Structure	Section 1 Structure
Part D Structural fire precautions	Section 2 Fire
Part E Means of escape from fire etc.	Section 2 Fire
Parts F Combustion appliances etc.	Section 3 Environment and Section 4 Safety
Part G Preparation of sites etc.	Section 3 Environment
Part H Resistance to transmission of sound	Section 5 Noise
Part J Conservation of fuel and power	Section 6 Energy
Part K Ventilation of Buildings	Section 3 Environment
Part M Drainage and sanitary facilities	Section 3 Environment
Part N Electrical installations etc.	Section 4 Safety
Part P Miscellaneous hazards	Section 4 Safety
Part Q Facilities for dwellings etc.	Section 3 Environment and Section 4 Safety
Part R Storage of waste	Section 3 Environment
Part S Access to and movement etc.	Section 4 Safety
Building Operations Regulations	Section 0 (Regs 13 – 15)

The numbers of the transposed Technical Standards are included in brackets in each guidance clause to permit easy reference back to the older documents. Where no cross reference exists this is new or additional guidance.

Appendix C provides a listing showing where each standard in the 6th Amendment to the Technical Standards has now been located.

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 Section 1-6, rather than the yellow pages, which will be replaced regularly. It is expected that many users will wish to download the replacements from the Scottish Building Standards Agency web site where they will be available free of charge.

The Scottish Building Standards Agency web site is: www.sbsa.gov.uk

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. 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.). The final two regulations (16 and 17) are not discussed in separate sub-sections as they are essentially procedural. Regulation 16 establishes which regulations cannot ever be relaxed by Scottish Ministers. These are the regulations on citation and commencement, exempted *buildings*, *work* not requiring a warrant and the methods of measurement. Regulation 17 concerns revocations and savings and ensures that *buildings* for which an application for a warrant was made before the date of coming into force of the system are considered under the old regulations. The full text of Regulations 16 and 17 can obviously be found in the Building (Scotland) Regulations 2004.

0.2 Citation, commencement and interpretation

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

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 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 and Schedule 1.

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*;
- any *private road*. However 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 (c.23);
- 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*, 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 include all *construction*, demolition and *conversion work*, the provision of services, fittings and equipment, and any *work* carried out in relation to the *site*.

This issue of the regulations applies to all *buildings* and *works* where a warrant is required and 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* explain the kind of *works* that falls into this category). Such *works* commenced on *site* on or after 1 May 2005 must meet this issue of the regulations. Transitional arrangements are provided in the procedural regulations and supporting documents.

Buildings and *works* related to earlier warrant applications or 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 be completed within four months, otherwise the exemption falls and a warrant for any additional *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 that 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 procedural 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 procedural 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

contents

regulation **3** mandatory	**(1) Regulations 8 to 12 shall not apply to any *building* or any services, fittings and equipment the whole of which falls into any one or more of the exempted types described in Schedule 1.** **(2) The provision of –** **(a) services, fittings and equipment to, or the demolition or removal of, exempted *buildings* is exempt;** **(b) services, fittings and equipment to, or the demolition of, exempted services, fittings and equipment is exempt.** **(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.**

0.3.1 Explanation

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

- other legislation covers the *buildings* or *work* (Types 1 – 4)
- the *buildings* or *work* are not normally frequented by people (Types 5 – 8)
- the *buildings* or *work* are so specialised 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 exiting *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.

Schedule 1

Exempted *buildings* and services, fittings and equipment

	Type	Description	Exception
Buildings or *work* controlled by other legislation	1.	A detached *building* the *construction* of which is subject to regulations made under the Explosives Act 1875.	
	2.	A *building* erected on a *site* which is subject to licensing under the Nuclear Inspections Act 1965.	A *dwelling*, *residential building*, *office*, canteen or visitor centre.
	3.	A *building* included in the schedule of monuments maintained under section 1 of the Ancient Monuments and Archaeological Areas Act 1979.	A *dwelling* or *residential building*.
Protective *works*	4.	Protective *works* subject to control by Regulation 13.	
Buildings or *work* not frequented by people	5.	A *building* into which people cannot or do not normally go.	A *building* within 6 metres or the equivalent of its height (whichever is the less) of the *boundary*. 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 *building* 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 *building* within 1 metre of a *boundary*.
Agricultural and related *buildings*	7.	An *agricultural greenhouse* or other *building* of mainly translucent material used mainly for commercial growing of plants.	A *building* used to any extent for retailing (including storage of goods for retailing) or exhibiting.
	8.	A single-storey detached *building* used for any other form of *agriculture*, fish farming or forestry.	A *building* used to any extent for retailing (including storage for retailing) or exhibiting. A *building* exceeding 280 square metres in area. A *building* within 6 metres or the equivalent of its height (whichever is the less) of a *boundary*. A *dwelling*, *residential building*, *office*, canteen or visitor centre. A dungstead or farm effluent tank.

Works of civil engineering *construction*	9.	A *work* of civil engineering *construction*, 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 *escape route* 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.
Buildings of a specialised nature	10.	A *building* essential for the operation of a railway including a locomotive or carriage shed, or for the operation of any other *work* of civil engineering contained in type 9 and erected within the *curtilage* of such a railway or *work*.	A signalling and control centre for a railway or dock. A *building* to which the public is admitted, not being a *building* exempted by type 11 of this schedule. A *dwelling*, *residential building*, *office*, canteen, or warehouse.
	11.	A single-storey detached *road* 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 *building* having a floor area exceeding 30 square metres. A *building* 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 wastewater disposal system serving a *building* of this type.
Small *buildings*	13.	A detached single-storey *building* having an area not exceeding 8 square metres.	A *dwelling* or *residential building*. A *building* ancillary to and within the *curtilage* of a *dwelling*. A *building* within 1 metre of a *boundary*. A *building* containing a fixed combustion appliance installation or *sanitary facility*. A wall or fence.
Construction and development *buildings*	14.	A *building* used only by people engaged in the *construction*, demolition or repair of any *building* or structure during the course of that *work*.	A *building* containing sleeping accommodation.

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

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

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 the *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 *building 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:

- *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);
  use of a *house* as *offices* (type 5);
- *residential buildings*, for example:
  use of a hotel as a residential care home (type 6);
  use of *offices* as a backpackers hostel (type 7);
- whether a *building* falls within the exemptions of Schedule 1, for example:
  use of a railway signal box as a *house* (type 8);
- public access to *buildings*, for example:
  development of a retail trade in a storage *building* (type 9);
- 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 school;
- guest in a hotel; and
- people held in lawful detention.

A significant alteration in number could be considered to occur where it amounted to an increase or decrease 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*.

Schedule 2

Conversions to which the regulations apply

1. Changes in the occupation or use of a *building* to create a *dwelling* or *dwellings* or a part thereof.

2. Changes in the occupation or use of a *building* ancillary to a *dwelling* to increase the area of human occupation.

3. Changes in the occupation or use of a *building* which alters the number of *dwellings* in the *building*.

4. Changes in the occupation or use of a *domestic building* to any other type of *building*.

5. Changes in the occupation or use of a *residential building* to any other type of *building*.

6. Changes in the occupation or use of a *residential building* which involve a significant alteration of the characteristics of the persons who occupy, or who will occupy, the *building*, or which significantly increase the number of people occupying, or expected to occupy, the *building*.

7. Changes in the occupation or use of a *building* so that it becomes a *residential building*.

8. Changes in the occupation or use of an exempt *building* (in terms of Schedule 1) to a *building* which is not so exempt.

9. Changes in the occupation or use of a *building* to allow access by the public where previously there was none.

10. Changes in the occupation or use of a *building* 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

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.

In particular Type 1 means more *work* in *houses* is freed from the need to obtain a warrant. The exceptions to this freedom are intended to safeguard against changes that might have significant effect, such as the removal of structural walls. The exception about increasing the floor area is intended to apply where there will be structural implications arising from such *work*. Examples are the creation of a mezzanine floor or the infill of a stairwell. (Note that other changes, such as the development of a roofspace or a garage as habitable space are *conversions* in terms of regulation 4 and the standards again apply.) Where a roofspace 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 should not be considered as increasing the floor area.

Buildings, other than *domestic* or *residential buildings*, where the public are not normally admitted are granted a similar concession in Type 2, allowing many factories for example to make the kind of small alterations necessary to accommodate changes in production or process. Again however, the *work* done should be to the standard of the building regulations.

The broad types described above are followed by more specific *works* that do not require a warrant. These begin with small *buildings* (Type 3), 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*. The list continues with minor *works* related to *building* services, minor fittings and notices, and continues with small *works* in gardens, limited in ways to prevent significant impact on others.

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*. Replacement windows, doors and rooflights now have to meet the full requirements of the standards. There is no 'like for like' replacement. For historic *buildings* however, where there is a need to match the existing, the principle of 'like for like' may be permitted, as it is considered that such *work* might be treated as a repair.

Schedule 3

Descriptions of *building* and *work*, including the provision of services, fittings 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 relevant requirement of the regulations.**	
1.	Any *work* to or in a *house*.	Any *work* which increases the floor area of the *house*. Any demolition or alteration of the roof, *external walls* or *elements of structure*. Any *work* adversely affecting a *separating wall*. Any change in the *wastewater* disposal system. *Work*, not being *work* of types 3 to 26 below, to a *house* having a *storey*, or creating a *storey*, at a height of more than 4.5 metres.
2.	Any *work* to a non-residential *building* to which the public does not have access.	A non-residential *building* within which there is a *domestic* or *residential building*. Any *work* which increases the floor area of the *building*. Any demolition or alteration of the roof, *external walls* or *elements of structure*. Any *work* adversely affecting a *separating wall*. Any change in the *wastewater* disposal system. *Work*, not being *work* of types 3 to 26 below, to a *building* having a *storey*, or creating a *storey*, at a height of more than 7.5 metres.

and, without prejudice to the generality of types 1 and 2 above,

3.	A detached single-storey *building*, having an area exceeding 8 square metres but not exceeding 30 square metres.	A *dwelling* or *residential building*. A *building* ancillary to, or within the *curtilage* of, a *dwelling*. A *building* within 1 metre of a *boundary*. A *building* containing a fixed combustion appliance installation or *sanitary facility*. A swimming pool deeper than 1.2 metres.
4.	A detached single-storey *building*, having an area exceeding 8 square metres but not exceeding 30 square metres, ancillary to and within the *curtilage* of a *house*.	A *building* within 1 metre of the *house* unless it is at least 1 metre from any *boundary*. A *building* containing a fixed combustion appliance installation or *sanitary facility*. A swimming pool deeper than 1.2 metres.
5.	A detached single-storey *building*, having an area exceeding 8 square metres but not exceeding 30 square metres, ancillary to and within the *curtilage* of a *flat* or *maisonette*.	A *building* within 3 metres of the *flat* or *maisonette* or within 3 metres of any other part of the *building* containing the *flat* or *maisonette*. A *building* containing a fixed combustion appliance installation or *sanitary facility*. A swimming pool deeper than 1.2 metres.
6.	Any *work* associated with a fixed combustion appliance installation or other part of a heating installation not being *work* of types 7 or 8 below.	Any *work* associated with a solid fuel appliance having an output rating more than 50kW, an oil-firing appliance with an output rating more than 45kW or a gas-fired appliance having a *net input rating* more than 70 kW. Any *work* associated with a *chimney*, *flue pipe* or hearth. 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 *work* adversely affecting a *separating wall.*
7.	Any *work* associated with a balanced *flue* serving a *room-sealed appliance*.	Any *work* associated with a balanced *flue* which passes through combustible material.
8.	Any *work* associated with pipework, radiators, convector heaters and thermostatic controls for, or associated with, type 6 above.	
9.	Any *work* associated with installing a *flue* liner.	

10.	Any *work* 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 *work* associated with the provision of a single *sanitary facility*, together with any relevant branch soil or waste pipe.	Any *work* associated with a watercloset, waterless closet or urinal.
12.	Any *work* associated with the relocation within the same *room* or space of any *sanitary facility*, together with any relevant branch soil or waste pipe.	
13.	Any *work* associated with the provision of an extractor fan.	
14.	Any *work* associated with a stairlift within a *dwelling*.	
15.	Any *work* associated with the provision of a notice or other fixture for which there is no requirement provided in these regulations.	
16.	Any *work* associated with an outdoor sign that is subject to the Town and Country Planning (Control of Advertisements) (Scotland) Regulations 1984.	
17.	Any *work* associated with thermal insulating material to or within a wall, ceiling, roof or floor.	Any *work* associated with the application of thermal insulating material to the outer surface of an *external wall*.
18.	A wall not exceeding 1.2 metres in height, or a fence not exceeding 2 metres in height.	
19.	Any *work* associated with open raised external decking that does not form part of the access provided to comply with the requirement in regulation 9 and paragraph 4.1 of Schedule 5.	Any decking at a height of more than 1.2 metres.
20.	A door, window, or rooflight when the *work* 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 *work* associated with the replacement of a fitting or equipment, in whole or in part, by another of the same general type, including a *sanitary facility* (together with any relevant branch soil or waste pipe), rainwater gutter or downpipe, solid fuel combustion appliance, electrical fixture, ventilation fan, *chimney* or *flue* outlet fitting or terminal, fire hydrant or main, lift or escalator, solid waste chute or container, *kitchen* fitments or other fitted furniture and ironmongery.	Any door, window or rooflight. Any oil-firing or gas fired boiler.
25.	Any *work* 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 *work* to a door, window or rooflight, including *glazing* which is not a complete replacement falling within type 20 above.	

0.6 Limited life buildings

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

regulation 7 mandatory	**For the purposes 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.

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.

Height and depth

2. 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;
   (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.

3. 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 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

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

0.8 Durability, workmanship and fitness of materials

contents

regulation 8 mandatory	
	(1) *Work* to every *building* designed, *constructed* and provided with services, fittings and equipment to meet a requirement of regulations 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.
	(2) All materials, services, fittings and equipment used to comply with a requirement of the regulations 9 to 12 must, so far as *reasonably practicable*, be sufficiently accessible to enable any necessary maintenance or repair *work* to be carried out.

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 fulfil 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 fulfilment 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 Handbbooks. 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, insofar 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.

0.9 Building standards applicable to construction

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* the more onerous requirement should be met.

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

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

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 fulfil those purposes.

0.12 Building standards applicable to conversions

contents

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 5. However as 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.

Schedule 6

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

- standards 2.1, 2.3, 2.5, 2.9, 2.10, 2.11, 2.13, 2.14, 2.15, in section 2, fire safety;
- 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;
- standards 4.5, 4.6, 4.7, 4.9, 4.11, 4.12 ; in section 4, safety and
- the standards in section 5, noise;
- standards 6.1, 6.7, 6.8, in section 6 energy.

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

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

0.13 Provision of protective works

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

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

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.

1

structure

Contents

1.0 Introduction

contents

introduction

1.0

1.0.1 Aims

The intention of this section is to ensure that the structure of a *building* is safe. The safety of a structure depends on several factors and the following criteria are relevant in all cases:

a. the nature of the ground;
b. loading;
c. materials;
d. structural analysis;
e. details of *construction*;
f. safety factors.

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

Fitness and durability

Fitness and durability of materials and workmanship is covered by Regulation 8 of the Building Standards (Scotland) Regulations 2004 and the associated guidance is contained in section 0.

1.0.2 Latest changes

It was the intention that this Technical Handbook would be a level transfer of the technical requirements in the previous Parts of the Technical Standards. However certain recommendations have either been clarified, updated or become obsolete over the last few years. It was felt necessary therefore to include these changes in this new technical handbook.

The following is a summary of the changes that have been introduced since the 6th amendment to the Technical Standards came into force on 4th March 2002.

1.0.3 Reference to Structural Eurocodes updated

1.0.3 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 1.0.1 above. For example, care should be taken where alternative numerical values are placed on factors of safety as this may have a detrimental affect on the overall stability of the structure.

Structural Eurocodes

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 is being published by CEN, the Standards body for Europe. Like other harmonised European standards, each member of the European Union can set their own "nationally determined parameters". This means that the use of Structural Eurocodes within the United Kingdom should only be considered as an alternative to the traditional British Standards where the "National Annex" which contains these parameters, has been agreed and published.

There will be a period of transition during which time Structural Eurocodes and national codes (e.g. British Standards) should be considered equally acceptable. This period of co-existence should last not more than 5 years 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. This is known as 'the date of availability' and on expiry of the 5 year period from this date, it is expected that the existing national standards will be withdrawn.

Implementation of Structural Eurocodes in the UK

For more detailed guidance on the use of Eurocodes, see 'Implementation of Structural Eurocodes in the UK' (February 2003) produced by the Office of the Deputy Prime Minister on behalf of the United Kingdom.

1.1 Structure

standard **1.1** mandatory	**Every *building* must be designed and *constructed* in such a way that the loadings that are liable to act on it will not lead to:** **(a) the collapse of the whole or part of the *building*; or** **(b) deformations which would make the *building* unfit for its intended use, unsafe, or cause damage to other parts of the *building* or to fittings or to installed equipment.**

1.1.0 Introduction

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

Structural and Civil Engineers

Specialist advice from chartered engineers with the appropriate skills and experience 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 Guide

The Small Buildings Guide (Second Edition June 1994) is a separate publication from this guidance document and can be obtained from The Stationery Office, ISBN 0 11 495246 9. It is intended to assist designers of small *buildings* of traditional masonry *construction* to take advantage of common practice and can be used as an alternative to following the guidance in clause 1.1.1. Reference can be made to the updated wind and snow loading maps contained in the following British 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).

The small buildings guide provides guidance for any *building* comprising a *dwelling* or *dwellings* where the *building* is not more than:

- 3 *storeys* in height; or
- in the case of an annexe, not more than 3 m in height.

Consideration should be given to guidance in other sections that can influence the structural design of a *building*; section 2, Fire is of particular importance.

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 this standard as is *reasonably practicable*, and in no case worse than before the *conversion* (Regulation 12 Schedule 6).

1.1.1 Structure

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

a. for *dead loads* and *imposed loads* (excluding roof loads), BS 6399: Part 1: 1996;
b. for imposed roof loads, BS 6399: Part 3: 1988;
c. for *wind loads* ;BS 6399: Part 2: 1997, or CP 3: Chapter V :Part 2: 1972 (in no case shall S3 be taken as less than 1);
d. for loading of any *building* for *agriculture*, BS 5502: Part 22: 1993;
e. any greater load to which the *building* is likely to be subjected.

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

a. for *foundations*, BS 8004: 1986;
b. for structural *work* of reinforced, prestressed or plain concrete, BS 8110: Part 1: 1997, BS 8110: Part 2 and Part 3: 1985;
c. for structural *work* of steel BS 449: Part 2: 1969, or BS 5950: Part 1: 2000, BS 5950: Part 2: 2001, BS 5950: Part 5: 1998, BS 5950: Part 6: 1995, BS 5950: Part 7: 1992, BS 5950: Part 8: 2003.
d. for structural *work* of composite steel and concrete *construction*, Section 3.1 of BS 5950: Part 3:1990, and BS 5950: Part 4: 1994;
e. for structural *work* of aluminium, BS 8118: Parts 1 and 2: 1991; for the purpose of section 7.2 of Part 1 of that code, the structure must be classified as a safe-life structure;
f. for structural *work* of masonry, BS 5628: Part 1: 1992, BS 5628: Part 2: 1995, and BS 5628: Part 3: 2001;
g. for structural *work* of timber, BS 5268: Part 2: 1996, BS 5268: Part 3: 1998, and section 6:1 of BS 5268: Part 6: 1996;
h. for structural design of low rise *buildings*, BS 8103: Part 1: 1995, BS 8103: Part 2: 1996, BS 8103: Part 3: 1996, and BS 8103: Part 4: 1995.

1.2 Disproportionate collapse

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.**

1.2.0 Introduction

This standard was introduced in the United Kingdom following the disaster at Ronan Point on 16 May 1968. Disproportionate collapse does not normally apply to *domestic buildings* however, designers should consider accidental overloading and the possibility of progressive collapse in *domestic buildings* of five or more *storeys*.

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 this standard as is *reasonably practicable*, and in no case worse than before the *conversion* (Regulation 12 Schedule 6).

1.2.1 Disproportionate collapse

Buildings with 5 or more *storeys*

The structural design and *construction* of a *building* having five or more *storeys* should take account of the recommendations on ties and on the effect of misuse or accident, in accordance with the following:

a. for structural *work* of reinforced, prestressed or plain concrete, BS 8110: Part 1: 1997 and BS 8110: Part 2: 1985;
b. for structural *work* of steel, BS 5950: Part 1: 1990 (the accidental loading referred to in clause 2.4.5.5 of the British Standard shall be chosen having particular regard to the importance of the key elements and the consequences of failure, and the key element shall always be capable of withstanding a load of at least 34 kN/m^2 applied from any direction);
c. for structural *work* of masonry, BS 5628: Part 1: 1992 and BS 5628: Part 2: 1995.

Maximum area of collapse

When applying the recommendations given in the British Standards mentioned in a, b, and c above, the maximum area of collapse in a *building* with 5 or more *storeys* should be restricted to the lesser of:

- 70 m^2 in any *storey* and 70 m^2 in each of the adjoining *storeys* above and below; or
- 15% of the area of any *storey* and 15% of the area in each of the adjoining *storeys* above and below.

2

fire

Contents

2.0 Introduction

contents

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 m^2;
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 m^2;
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

Flats or *maisonettes*

For the purposes of this guidance a *flat* or *maisonette* entered only from the open air at ground level and with no *storey* at a height of more than 4.5 m should be regarded as a *house* and follow the guidance accordingly.

Protected routes of escape

Protected routes of escape includes: *flat roofs* and *access decks* (see clause 2.9.6), *gallery* floors wholly or partly enclosed below (see below and clause 2.3.1), *protected lobbies* (see clause 2.9.19), *protected zones* (see clause 2.9.20), *protected enclosures* (see clauses 2.9.21 and 2.9.31), external *escape stairs* (clause 2.9.22), *basements* (see clauses 2.9.23 and 2.9.28) and *alternative exits* (see clause 2.9.32). This list is not exhaustive and is not intended to cover all parts of a *building* providing protected routes of escape. For example, *separating walls* and *floors* 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 *room*. It is not intended that these external areas be treated as *apartments* which create *inner rooms* to *dwellings.*

Circulation areas

A circulation area in a *domestic building* is an area mainly used as a means of access between an *apartment* and an *exit* or an area forming an *unprotected zone* or an area in a *room* or space which provides access to an *exit.*

Rainscreen cladding and overcladding

In the guidance to standard 2.4 for cavities, reference to 'rainscreen cladding' and 'overcladding' has been replaced by 'external wall and roof cladding' where appropriate.

Galleries

A *gallery* or sleeping deck wholly within a *room* or space should be regarded as being part of that *room* or space. For the purposes of the guidance to standard 2.9, *galleries* or sleeping decks which are wholly or partly enclosed below or do not fall within the definition of *gallery* contained in Appendix A, should be regarded as a separate *room* / *storey*. In such cases, the *gallery* floor should have a short fire resistance duration (see Annex 2.B).

2.0.3 Latest changes

It was the intention that this Technical Handbook would be a level transfer of the technical requirements in the previous Parts of the Technical Standards. However certain recommendations have either been clarified, updated or become obsolete over the last few years. It was felt necessary therefore to include these changes in this new Technical Handbook.

The following is a summary of the changes that have been introduced since the 6th amendment to the Technical Standards came into force on 4th March 2002.

- 2.6.1 sprinklers removed in relation to unprotected areas
- 2.6.2 guidance simplified for *external walls* in relation to *boundaries*
- 2.7.1 alternative guidance for fire spread on *external walls* not more than 1 m from a *boundary*
- 2.9.4 additional guidance on locks to escape windows and location of *conservatories* below escape windows
- 2.9.18 temporary waiting spaces on external *escape stairs* included
- 2.9.19 number of *dwellings* accessed from a *protected zone* clarified

2.9.20 fire resistance duration of *external walls* in relation to *protected zones* enclosing escape stairs amended
2.9.22 external *escape stairs* increased from 6 m to 7.5 m above ground level
2.9.26 shutters not recommended in the enclosing structure of a *protected zone*
2.11.2 guidance updated on fire alarms in *dwellings* more than 200 m^2
2.12.1 access route for fire service appliances clarified
2.12.4 access door for fire service personnel clarified
2.13 application of fire service water supply to *dwellings* clarified (E10.2, E10.3)
2.14.1 fire-fighting facilities on *escape stairs* clarified
2.14.3 guidance on size of window opening introduced for smoke clearance
2.15 new standard and guidance for automatic life safety fire suppression systems

Annexes
2.A.14 *self-closing fire doors* with a medium fire resistance duration included for fire-fighting shafts
2.B fire test exposure updated to inside only for *external walls* less than 1 m to the *boundary*
2.B insulation criteria clarified for external protected routes of escape
2.B guidance on smoke seals to *fire doors* clarified

2.0.4 Relevant legislation

Fire Services Act 1947

The Fire Services Act 1947 includes requirements that a fire authority should take all reasonable measures for ensuring the provision of an adequate supply of water, and for securing that it will be available for use, in the case of fire.

The Civic Government (Scotland) Act 1982 Order 2000 as amended

The domestic guidance document should be used for Houses in Multiple Occupation (HMOs) that are *dwellings* and the non-domestic guidance document should be used for all other HMOs. HMOs also require to be licensed under the Civic Government (Scotland) Act 1982 - Order 2000. To be classified as an HMO, the accommodation must be the only or principal residence of 3 or more people from different families. The Stationery Office publication, 'Guidance on the Mandatory Licensing of Houses in Multiple Occupation, 2000', provides guidance on the licensing scheme including the tenancy management standards and the benchmark standards (currently under review).

Construction (Health, Safety and Welfare) Regulations 1996

The Construction (Health, Safety and Welfare) Regulations 1996 apply to the *construction* activity itself. In respect of fire safety, they require both adequate precautions to be taken to prevent 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 have issued Information sheet CIS51 'Construction fire safety' specifically for *construction* projects with lower fire risks such as low-rise housing developments.

2.0.5 Annexes

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

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

2.B: Resistance to fire
2.C: Reaction to fire
In order to comply with the *construction products directive* (CPD), European harmonised fire tests are specified for *construction* products in Annex 2.B and Annex 2.C. Use of British and European fire tests will coexist until the British Standard classifications are withdrawn.

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: Resistance to fire.

Construction materials that are *non-combustible* are expressed in terms of low, medium, high or very high risk, are explained in Annex 2.C: Reaction to fire. The performance levels include properties such as the ease of ignition and the rate at which the material 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.

Fire safety engineering

2.0.6 Alternative approaches

Fire safety engineering can provide an alternative approach to the fire safety measures contained in this Technical Handbook.

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 fire authority should be consulted early in the design process.

BS 7974: 2001

BS 7974: 2001 'Application of fire safety engineering principles to the design of *buildings*' provides a framework to identify and define one or more fire safety design issues to be addressed using fire safety engineering. It is supported by the PD 7974 series of Published Documents 0 to 7 that contain guidance and information on how to undertake a detailed analysis of specific aspects of fire safety engineering in *buildings*.

It may also 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 document and some of which are not addressed in any detail. An assessment should be carried out of the fire safety strategy on offer against the hazard and risk unique to the particular case.

2.0.7 Method of measurement

Some of the measurements referred to in this section have been taken directly from the rules set out in Regulation 7 and listed in section 0. The intention is to collate all the rules of measurement appropriate to this section without the need to refer back to section 0.

General

a. except where the context otherwise requires, measurements shall be horizontal and vertical;
b. measurements 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;
c. any measurement of parts of a *building* in *different occupation* should be taken separately.

Area

The area of a *storey* should be taken to be the total area of all floors within that *storey*, including the floor area of any *gallery*.

Height and depth

a. the height of 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;
b. the height of a *storey* above 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;
c. 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:
   - for the purpose of types 3, 4, 5, 18 or 19 of Schedule 3; and
   - 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.

Plant *storeys* excluded

d. for the purposes of the measurements in b. and c. above, the height above ground to the topmost *storey* excludes roof-top plant areas and any top *storeys* consisting exclusively of plant *rooms*.

2.1 Compartmentation

This standard does not apply to domestic buildings.

2.2 Separation

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 2.4 cavities and 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* must be improved to as close to the requirement of this standard 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* (D5.1a)

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

2.2.2 *Dwellings* with common occupation (D5.1b)

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 deck*s, see the guidance to standard 2.9.

2.2.3 Separation between *domestic* and non-domestic *buildings* (D5.1c)

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 (D5.2a)

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 (D5.2b)

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 *roof space* 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 (D3.12, D3.13)

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 (D5.6, D5.7)

Separating walls

In a *building* with no *storey* at a height above 18m, *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 18m, *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 (D3.14. D4.7. D5.8)

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 a 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 m^2 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^{o} 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 demonstrated 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 (D3.14. D3.15. D 3.16. D4.8. D5.9. D5.10. D5.11)

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 centreline 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

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 to 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 requirement of this standard (Regulation 12, Schedule 6).

2.3.1 *Elements of Structure* (D2.1)

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 over 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 (D2.3, D8.2)

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 (D2.2, D2.3)

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

contents

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* must be improved to as close to the requirement of this standard as is *reasonably practicable*, and in no case be worse than before the *conversion* (Regulation 12, Schedule 6).

2.4.1 *Cavity barriers* (D6.1)

A *cavity barrier* mans 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 two 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 (D6.2)

Measurement

Cavity barriers should be measured either horizontally or vertically, as the case may be, along the centre line of the cavity, and not diagonally.

General guidance

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:

a. formed by 2 leaves of masonry or concrete at least 75 mm thick; or
b. in a ceiling void between a floor and a ceiling *constructed* in accordance with the guidance in clause 2.4.3; or
c. between a roof and a ceiling *constructed* in accordance with the guidance in clause 2.4.3; or
d. below a floor next to the ground where the cavity is either inaccessible or is not more than 1 m high; or
e. 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* (D6.6)

Where a ceiling is provided as an alternative to *cavity barriers* as in clauses 2.4.2b and 2.4.2c, 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 (D6.6)

Cavity barriers and ceilings provided as an alternative to *cavity barriers* but 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 (D6.10)

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 (D6.7)

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 (D6.8, D6.9)

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 two 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

contents

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 wall 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* 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 requirement of this standard (Regulation 12, Schedule 6).

2.5.1 Internal linings (D7.1)

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 m^2 may have wall and ceiling linings with a high risk classification. In a *room* (other than a *kitchen*) more than 4 m^2 the wall surfaces may also have a high risk classification subject to a maximum of 20 m^2 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 70^0 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 70^0 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 Plastics *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 3mm thick; or

- multi-skin polycarbonate sheet at least 10mm thick overall which has a low or medium risk.

2.5.4 Thermoplastic material (D7.2)

Thermoplastic materials in ceilings, rooflights 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), rooflights (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^o C when tested in accordance with Method 120A in BS 2782: Part 1: 1990. Thermoplastic materials can be further classified into 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 1mm 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 m^2. 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 (D7.2)

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 (D7.2)

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 if 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.

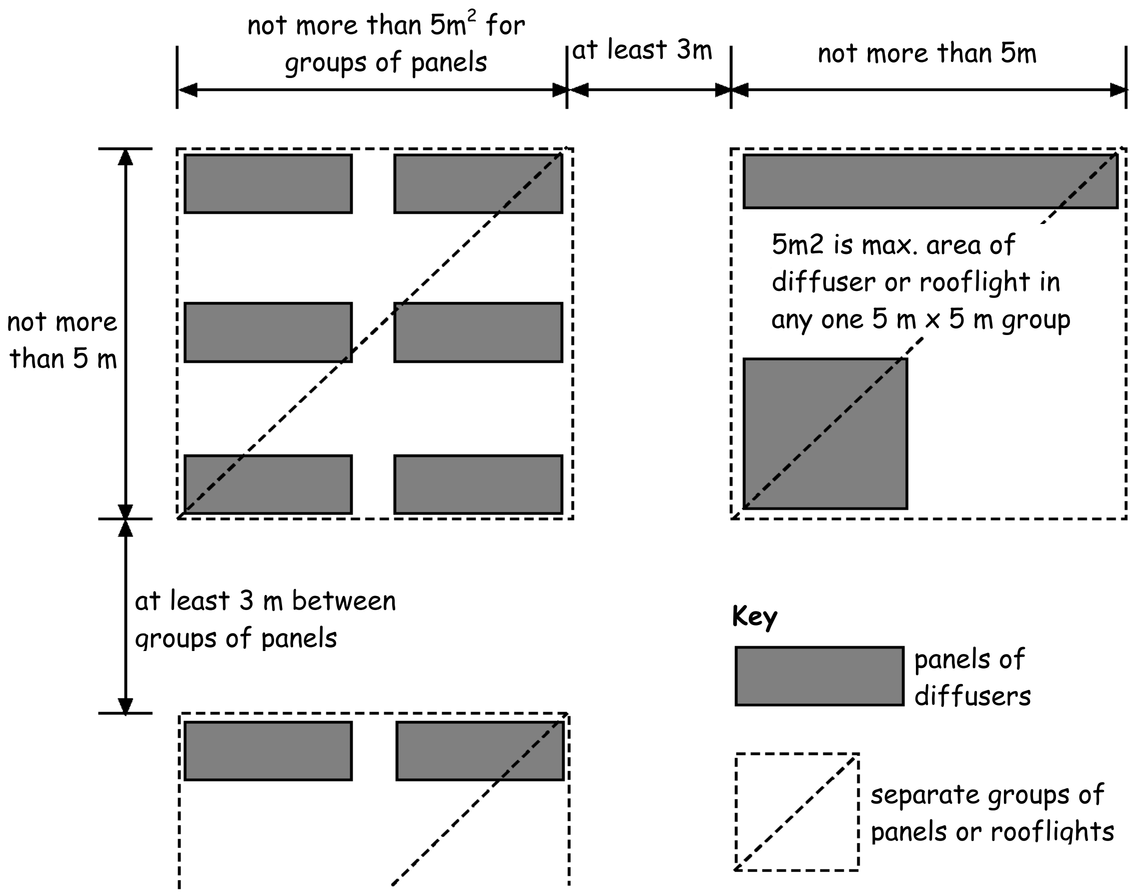
Thermoplastic rooflights and light fittings with diffusers

	Protected zone* or *fire-fighting shaft	***Unprotected zone* or *protected enclosure***		***Room***	
Classification of lower surface	**Any thermo-plastic**	**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:

1. 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.
2. The minimum 3 m separation in the diagram below should be maintained between each 5 m^2 panel. In some cases therefore, it may not be possible to use the maximum percentage quoted.
3. TP(a) flexible is not recommended in rooflights.

Layout restrictions on thermoplastic rooflights and light fittings with diffusers (D7.2b, c)



2.5.8 Sandwich panels (D7.3, D7.4)

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.

domestic	fire	spread on external walls	2005

2.6 Spread to neighbouring buildings

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* must be improved to as close to the requirement of this standard 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* (D8.1)

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 of 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 (D8.1)

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:

a. the *external wall* of a *protected zone*;
b. 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;
c. 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 two or more smaller areas which when combined do not exceed an aggregate area of 1 m^2).

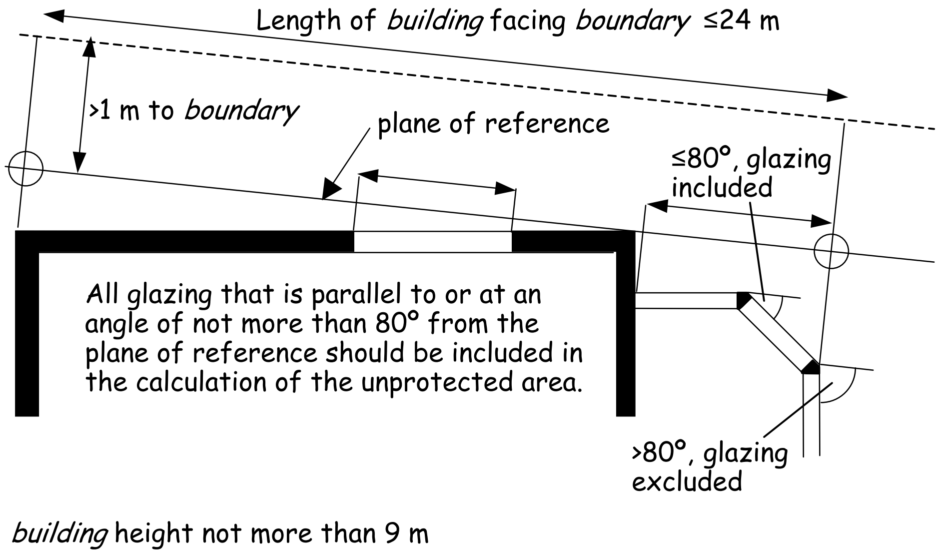
2.6.3 The simple geometry method

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 may be 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 80^0 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 A) 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 (D8.1, D8.2)

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 (D8.2)

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.

domestic	fire	spread on external walls	2005

2.7 Spread on external walls

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* must be improved to as close to the requirement of this standard as is *reasonably practicable*, and in no case be worse than before the *conversion* (Regulation 12, Schedule 6).

2.7.1 *External wall* cladding (D8.2, D10.1)

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

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 roofs is dependent upon the distance to the *boundary*.

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 this standard as is *reasonably practicable*, and in no case be worse than before the *conversion* (Regulation 12, Schedule 6).

2.8.1 Roofs (D9.1)

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 clause 2.8.2.

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 clauses 2.8.2 and 2.8.3.

Where a *building* is more than 24 m from the *boundary*, the roof may be of any material, including materials of high vulnerability classification.

A roof covering or rooflight which is exposed within the *building* should also be in accordance with of the guidance to standard 2.5.

2.8.2 Low vulnerability classification

- designation AA, AB or AC when tested along with the substrate in accordance with BS 476: Part 3: 1958; or
- glass at least 4 mm thick; or
- 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 definition of thermoplastic materials in 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
- a thermoplastic sheet with a low or medium risk 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.

2.8.3 Medium vulnerability classification

- designation BA, BB, BC, CA, CB or CC when tested along with the substrate in accordance with BS 476: Part 3: 1958; or
- 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.

2.8.4 High vulnerability classification

Any designation other than low or medium vulnerability, including for example, timber shingles or thatch.

2.9 Escape

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 defined in Regulation 4, the *building* as *converted* shall meet the requirement of this standard (Regulation 12, Schedule 6).

Buildings* containing *flats* or *maisonettes

2.9.1 Number of *exits* **(E2.1)**

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 **(E2.15)**

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*.

Maximum travel distance in a *building* containing *flats* or *maisonettes* related to available directions of travel

Situation	Maximum travel distance (m)	
	One direction of travel	**More than one direction of travel**
a *storey* at a height of not more than 7.5 m	7.5 [1]	32 [1]
a *storey* at a height of more than 7.5 m	7.5 [2]	32 [1]
a *storey* at any height with an *access deck* or open access balcony serving the *dwellings*	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* **(E2.16)**

An *apartment* in a *storey* at a height of more than 4.5m should not be an *inner room*.

2.9.4 Escape windows **(E2.17)**

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 m^2 and at least 450 mm high and 450 mm wide (the route through the window maybe at an angle rather than straight through). The bottom of the openable area should not be more than 1100 mm 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* (E2.2. D11.11)

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* (E2.13, D11.8, D11.9, D11.11)

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 degrees 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 (E2.4)

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 (E2.3)

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 (E2.20)

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 (E2.21)

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 (E2.22)

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* **(E2.23)**

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 **(E2.24)**

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^{o} 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 **(E2.5)**

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 **(E2.6)**

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* **(E2.14)**

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 7.5m, 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 (E2.12)

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 m^2; 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 (E2.9)

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 mm 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* (E2.11)

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.

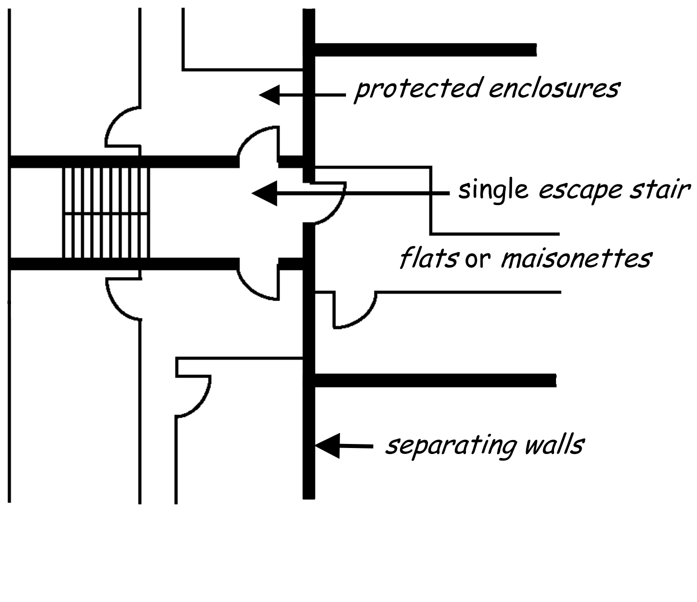
Single *escape stair*

Where *flats* or *maisonettes* 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 *dwellings* (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:

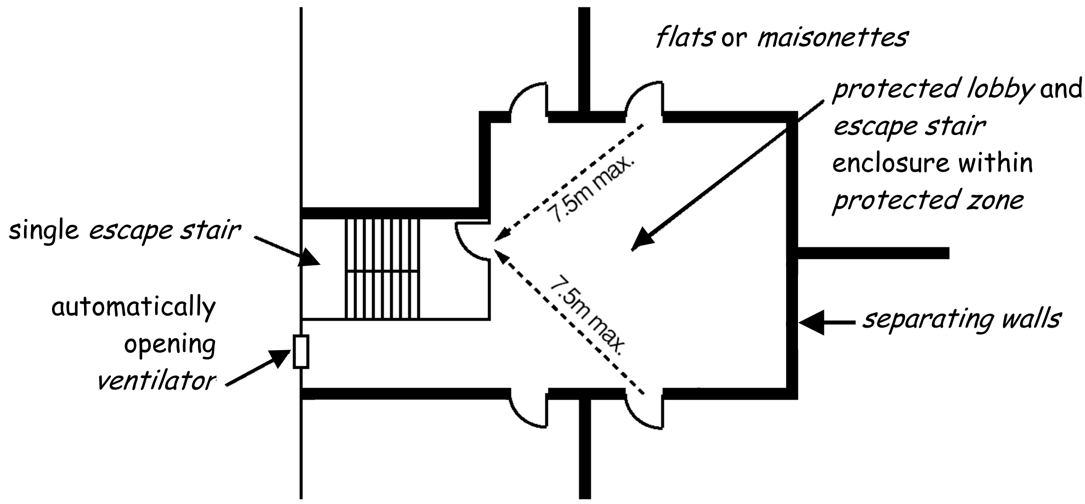
a. in relation to *flats* and *maisonettes* entered from an open access balcony or *access deck* having an opening or openings to the external air extending over at least four-fifths of its length and at least one-third of its height;
b. where the *protected zone* provides access to not more than 12 *dwellings* in total and no *storey* is at a height of more than 7.5 m and there are not more than 4 *dwellings* 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 *maisonettes* with every *storey* at a height of not more than 7.5 m



2.9.19

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 m^2; 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* **(E2.8, D11.10)**

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 an *protected zone* is not more than 2 m from, and makes an angle of not more than 135 degrees 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* (E6.6, D11.7, D11.8)

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.

External walls

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 (E2.10, E2.16, E2.18, E2.19)

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 (D11.12)

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 (D2.2, D2.3)

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 out break 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 (E3.1, E3.3, E3.6)

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* (E3.1)

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 (E3.2)

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 4.5m and in every *apartment* which is an *inner room* in a *storey* at a height of not more than 4.5m. However this is not necessary if there are alternative routes from the *apartment* to circulation areas or other *rooms*.

2.9.31 *Protected enclosures* (E3.4)

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* (E3.5, E3.7)

In a *house* containing an *apartment* or *kitchen* in a *storey* at a height of more than 4.5m, every *storey* at a height of more than 7.5 m should have an *alternative exit*. Where the *alternative exit* 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

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 requirement of this standard (Regulation 12, Schedule 6).

2.10.1 *Escape route* lighting (E9.1)

Escape route lighting utilises the normal lighting within the *building*, but should be supplied by a fire protected circuit (see clause 2.10.2).

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.

Where the artificial lighting serves a *protected zone*, it should be via a protected circuit separate from that supplying any other part of the *escape route*, unless 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 luminaries than to install a protected circuit to the existing lighting system.

2.10.3 Emergency lighting (E9.2)

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 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

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 requirement of this standard (Regulation 12, Schedule 6).

2.11.1 *Dwellings* with no *storey* greater than 200 m^2 (E11.1a)

A *dwelling* where no *storey* is greater than 200 m^2, 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: 1995 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: 1995 for a Grade C Type LD3 installation.

False alarms

In order to reduce the frequency of unwanted false alarms, guidance is provided in BS 5839: Part 6: 1995 on the types of sensor most appropriate for the circumstances.

2.11.3 *Dwellings* with a *storey* greater than 200 m^2 (E11.1b)

A *dwelling* with any *storey* area greater than 200 m^2 should be provided with a fire detection and alarm system designed and installed in accordance with BS 5839: Part 6: 1995 for a Grade B Type LD2 installation.

2.12 Fire service access

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* must be improved to as close to the requirement of this standard as is *reasonably practicable*, and in no case be worse than before the *conversion* (Regulation 12, Schedule 6).

2.12.1 Vehicle access provision (E10.1)

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 fire authority, assistance may be provided from adjoining fire authorities when the need arises. For this reason, the more demanding guidance for high reach appliances may be recommended by the fire authority. This may have a significant impact on perhaps *site* planning and even feasibility studies, so it is important to consult the fire authority at the earliest opportunity.

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 to within 45 m of 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 fire authority should be sought.

Houses

Every *house* should be provided with a vehicle access route for fire-fighting vehicles from a *public road* to within 45 m of any door giving direct access to the interior of the *dwelling*.

2.12.2 Vehicle access routes

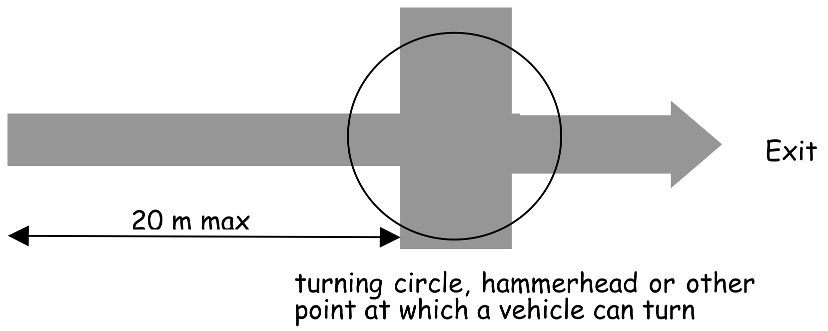
Access routes to *buildings* for fire service vehicles or personnel should not be assessed in isolation and the proposed access routes in effect will be dictated by need for water hydrants (see clause 2.0.4) and other fire-fighting facilities such as dry fire mains (see clause 2.14.2).

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 fire authority, 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)

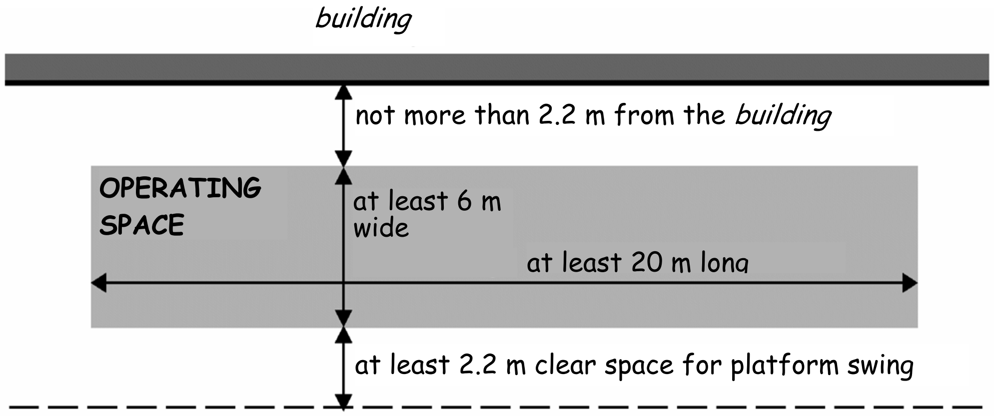
2.12.3 Operating spaces for high reach appliances

Following consultation with the fire authority, if it is recommended that an operating space, or spaces, for a high reach appliance should be provided, the operating spaces(s) should:

- have a ground loading capacity of not less than 8.3kg/cm^2; 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 (see clause 2.0.4) 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

This standard does not apply to domestic buildings.

2.14 Fire service facilities

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* must meet the requirements of this standard (Regulation 12).

2.14.1 Facilities on *escape stairs* **(E10.4)**

Facilities should be designed and installed within the *building* at assist the fire service in carrying our 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 7.5m, a *protected lobby* should be provided within the *protected zone* on every *storey* and should have an area of at least 5 m^2. 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 **(E10.8)**

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* with in *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 **(E10.13, E10.14)**

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 1m^2 at the top of the stair; or
- an opening window at each *storey* with an openable area of 0.5m^2.

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 m^2. 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 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.

2.14.3

2.15 Automatic life safety fire suppression systems

contents

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

www.scottishwater.co.uk

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 Scottish Water 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 $(m.s)^{1/2}$ 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

annex 2.A Additional guidance for *high rise domestic buildings*

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 the *dwelling* or *dwellings*.

Additional recommendations are also provided for separation, cavities, spread to adjoining *buildings*, spread on *external walls*, escape lighting, and fire service facilities.

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. To link them directly with the standards, they have been numbered in the same manner.

2.A.2 Separation (D5.6, D5.1)

The *separating walls* and *separating floors* should be *constructed* of *non-combustible* materials. *Separating walls* should have at least a medium fire resistance duration (see clause 2.A.3 for *separating floors* and clause 2.A.14 for fire-fighting shafts) and any door in the *separating wall* should be a *self-closing fire door* with a medium fire resistance duration.

2.A.3 Structural protection (D2.1)

Elements of Structure should be provided with a long fire resistance duration. The additional structural protection and fire separation is important in order to limit fire growth and will assist in protecting residents and firefighters 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.4 Cavities

Combustibility (D8.2)

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 (See also clauses 2.A.6 and 2.A.7).

2.A.6 Spread to adjoining *buildings*

Combustibility (D8.2)

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 (see also clauses 2.A.4 and 2.A.7).

2.A.7 Spread on *external walls*

***External wall* cladding (D10.1, D10.2, D8.2)**

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.

Guidance to standard 2.7 provides alternative guidance to the need for *non-combustibility* as recommended above and in clauses 2.A.4 and 2.A.6.

2.A.10 Escape Lighting (E9.2)

Every *protected zone* or *unprotected zone* should be provided with emergency lighting.

2.A.14 Fire service facilities

Facilities on *escape stairs* **(E10.4)**

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 **(E10.9, E10.10)**

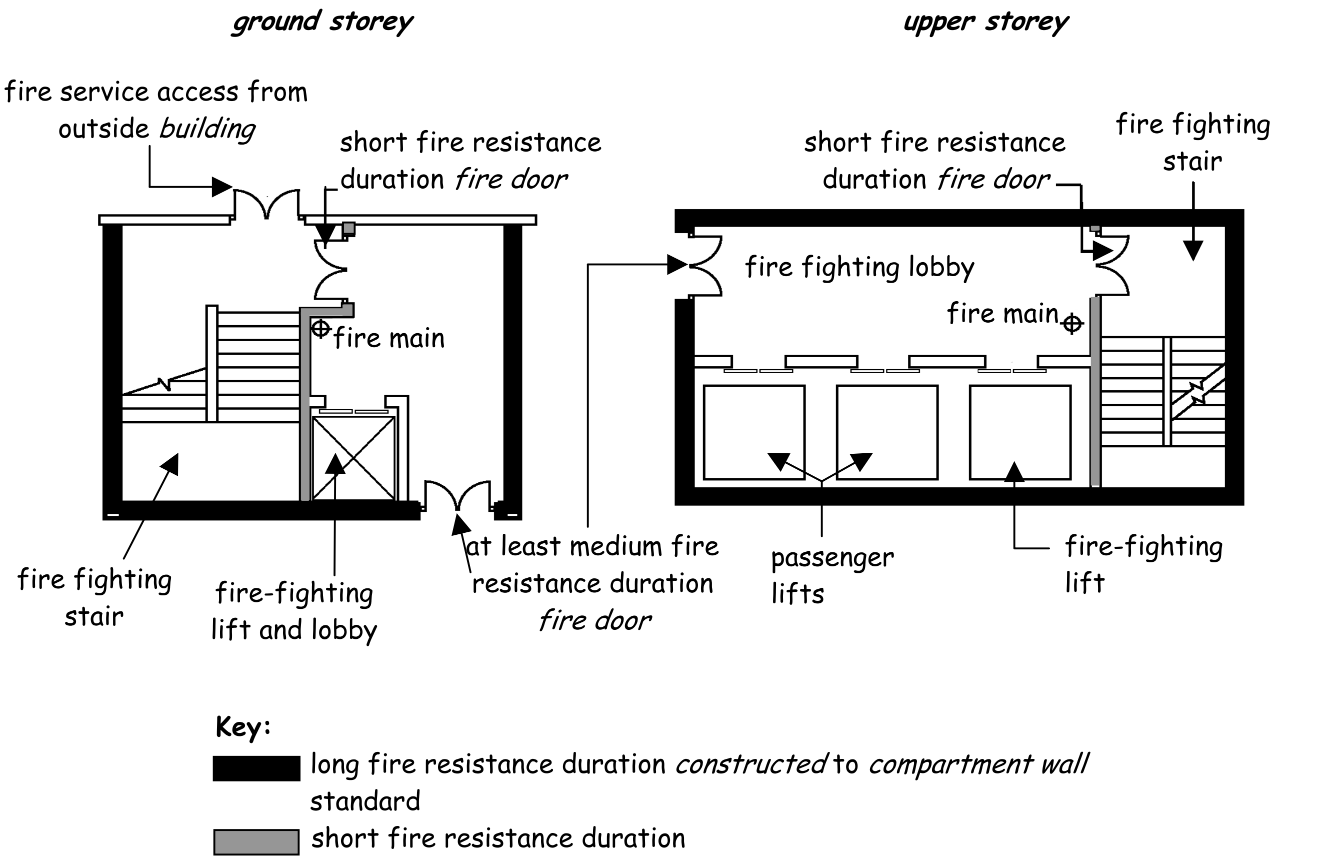
A fire-fighting shaft should be enclosed by walls forming the enclosing structure of a *protected zone* with a long fire resistance duration. A *self-closing fire door* in the enclosing structure of a fire-fighting shaft need only have medium fire resistance duration (see diagram below).

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 provides 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* in accordance with Clause 6 of BS 5588: Part 5: 1991 and in accordance with the diagram below. In addition, the shaft should be provided with smoke control in accordance with the recommendations in Clause 8 of BS 5588: Part 5: 1991 or 'Smoke shafts protecting fire-fighting shafts: their performance and design' (BRE, 2002).

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*.

The following diagrams provide typical examples showing different design layouts.



Fire-fighting lifts **(E10.11)**
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. dry rising mains are installed in the *protected lobbies* of the *escape stair*.

A fire-fighting lift should be *constructed* in accordance with Sections 3 and 4 of BS 5588: Part 5: 1991. It should be entered only 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.15 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 *dwellings*, 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 $(m.s)^{1/2}$ 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 *residential buildings* and are fit for their intended purpose (see Section 0).

Annex 2.B Resistance to fire

annex

2.B Resistance to fire

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.0

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 coexist 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: 1990 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).

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: 1999, 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

Resistance to fire for common *building* elements or components

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. *Separating floor*, or any other floor, *flat roof* or *access deck* 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 *flat* or *maisonette* (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. *Separating wall* 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. *Fire door* 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. *External wall* more than 1m from a *boundary* [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. *External wall* not more than 1m from a *boundary* [1, 2]	Short	30 [4]	30	30	REI 30 [4]	From the inside only
	Medium	60 [4]	60	60	REI 60 [4]	
9. Horizontal *cavity barrier* [3]	Short	None	30	None	E 30	From the underside
10. Vertical *cavity barrier* [3]	Short	None	30	None	E 30	Each side separately
11. Ceiling in place of a *cavity barrier* (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 (see clause 2.A.14)
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 $3m^3$/m/hour, head and jambs only, when tested at 25Pa 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.Table

Annex 2.C Reaction to fire

annex

2.C

Reaction to fire

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.0

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 table below 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 coexist in use until the British Standard classifications are withdrawn.

2.C.2 British Standards and associated specifications

Column 2 of the table below 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 below sets out the European performance criteria. Materials or components should be tested to the European Harmonised Tests listed in column 3 of the table below 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)**
Non-combustible	The material is certified *non-combustible* according to the test specified in BS 476: Part 4: 1970 (1984) throughout; or 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).	The material has achieved a classification of A1 when tested in accordance with BS EN ISO: 1182 and BS EN ISO: 1716; or 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 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 *construction products*. None of the materials contain more than 1.0% by weight or volume (whichever is the lower) of homogeneously distributed organic material.
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.

2.C.Table

3

environment

Contents

3.0 Introduction

contents

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* also needs to be carefully considered to prevent environmental pollution and uncontrollable runoff during periods of heavy rainfall leading to flooding.

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;
j. inadequately *constructed* and installed oil storage tanks;
k. inadequate facilities for the storage and removal of solid waste from a *dwelling*.

3.0.3 Latest changes

It was the intention that this Technical Handbook would be a level transfer of the technical requirements in the previous Parts of the Technical Standards. However certain recommendations have either been clarified, updated or become obsolete over the last few years. It was felt necessary therefore to include these changes in this new technical handbook.

The following is a summary of the changes that have been introduced since the 6th amendment to the Technical Standards came into force on 4th March 2002.

3.1.3 guidance on hazard identification
3.1.5 additional remediation options for ground contamination
3.1.6 guidance on treatment of ground contamination
3.1.7 additional guidance from NHBC on ground contamination
3.1.8 replacement of out-of-date guidance
3.3.1 good practice guidance on *surface water* run-off
3.2.3 inclusion of radon maps
3.3.1 warning about surface water run-off from land under development
3.5.3 guidance on *re-construction* of drains
3.5.4 guidance on drains passing through structures
3.5.5 guidance on sealing of disused drains
3.6.1 guidance on eaves drop systems
3.6.5 guidance on SUDS for single *dwellings* and extensions
3.7.1 guidance on European standards for sanitary pipework systems
3.7.4 clarification on provision of disconnecting manholes
3.11.4 clarification on height of activity spaces
3.12.1 revised provision for water closets in *dwellings*
3.12.5 guidance on alterations and extensions
3.14.5 guidance on non-proprietary *trickle ventilators*
3.14.7 guidance on *conservatories* and extensions
3.14.9 guidance on mechanical aids to ventilation

3.16.2 guidance on natural lighting affected by the *construction* of *conservatories* and extensions
3.17.1 change to rating of oil-firing combustion appliances
3.17.2 change to rating of oil-firing combustion appliances
3.17.5 guidance on provision of safety valves on oil-firing appliances
3.17.7 change to labelling of combustion components
3.18.0 changes to *chimney* terminology
3.18.1 guidance on the sweeping of *chimneys*
3.18.2 new guidance on *chimney* designation strings
3.18.4 additional guidance on suitable metal *chimneys*
3.18.6 new guidance on *flue* liners
3.19.6 new reference to standards for oil-firing *room* heaters
3.20.8 table on minimum area of *flues* clarified
3.20.18 guidance on terminal distance to rooflight added
3.20.19 changes to table on gas terminal locations
3.20.19 removal of table 2 to diagram to (F6.10)
3.24.0 guidance on forthcoming legislation on oil storage
3.24.1 guidance on plastic storage tanks
3.25.2 guidance on enclosed storage for solid waste

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 (Installations 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.

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 and control discharges to controlled waters.

Environment Act 1995

The Environment Act 1995 covers, among others, duties and powers of the Scottish Environment Protection Agency.

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 groundwater pollution and to manage groundwater resources in a sustainable way.

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.

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.

3.1 Site preparation – harmful and dangerous substances

standard **3.1** mandatory	**Every *building* must be designed and *constructed* in such a way that there will not be a danger to the *building* nor a threat to the health of people in and around the *building* due to the presence of harmful or dangerous substances.** **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 *building* (other than a *dwelling*) intended to have a life not exceeding the period specified in regulation 6.

3.1.0 Introduction

Environmental Protection Act 1990

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 that is 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 that is 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* must be improved to as close to the requirement of that standard 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* **(G2.3, G2.5)**

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*.

'ground immediately adjoining'

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 upfilling 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 underbuilding above the lowest level of the adjoining ground to prevent any water build up below the *building*. Any part of the underbuilding 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 **(G2.1)**

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 **(Appendix to G)**

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: CLR9;
- contaminated land exposure assessment (CLEA) model, technical basis and algorithms: CLR10;
- 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 (G2.1)

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 (Appendix)

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 *construction* 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 (Appendix to G)

www.ciria.org.uk

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.

www.ciria.org.uk
www.environment-agency.gov.uk

The CIRIA and the EA websites also contain useful data sheets on remedial treatment options.

3.1.7 Housing on land affected by contamination

www.nhbc.co.uk

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.

3.1.8 Re-development of industrial land (G2.1)

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' (supersedes DD 175: 1988). 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

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 *dwelling*s 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.

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 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 *dwellings*. Where tests on existing *dwellings* show that 1% of the *dwellings* in that area are likely to have a radon concentration above 200 Bq/m^3 (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 Dee-side 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, National Radiological Protection Board or the Building Research Establishment.

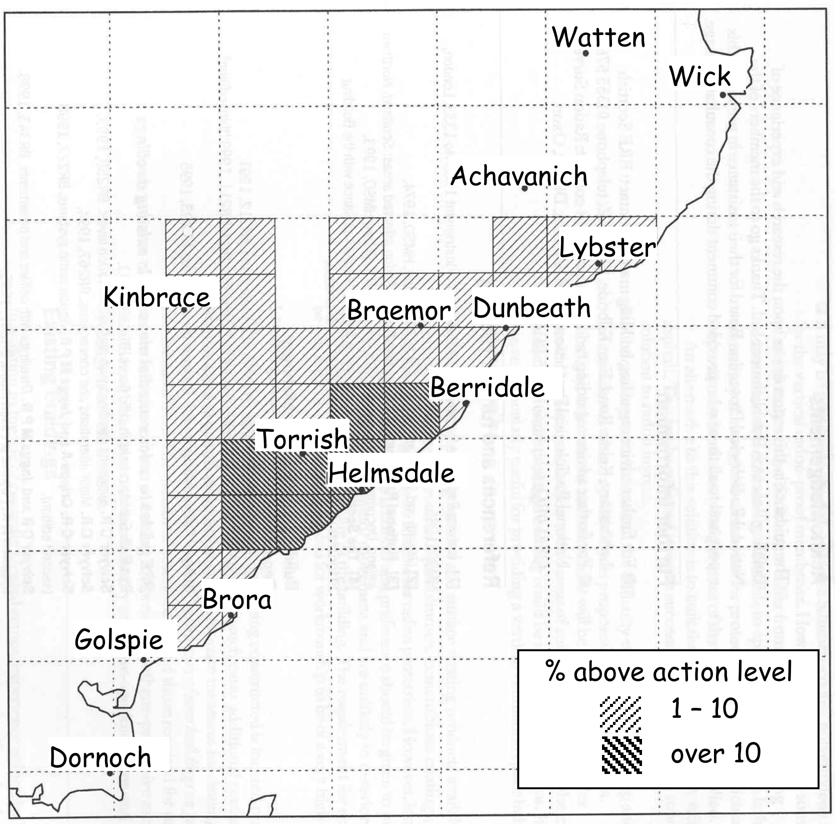
3.2.2 Protection from radon gas (G2.1)

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'.

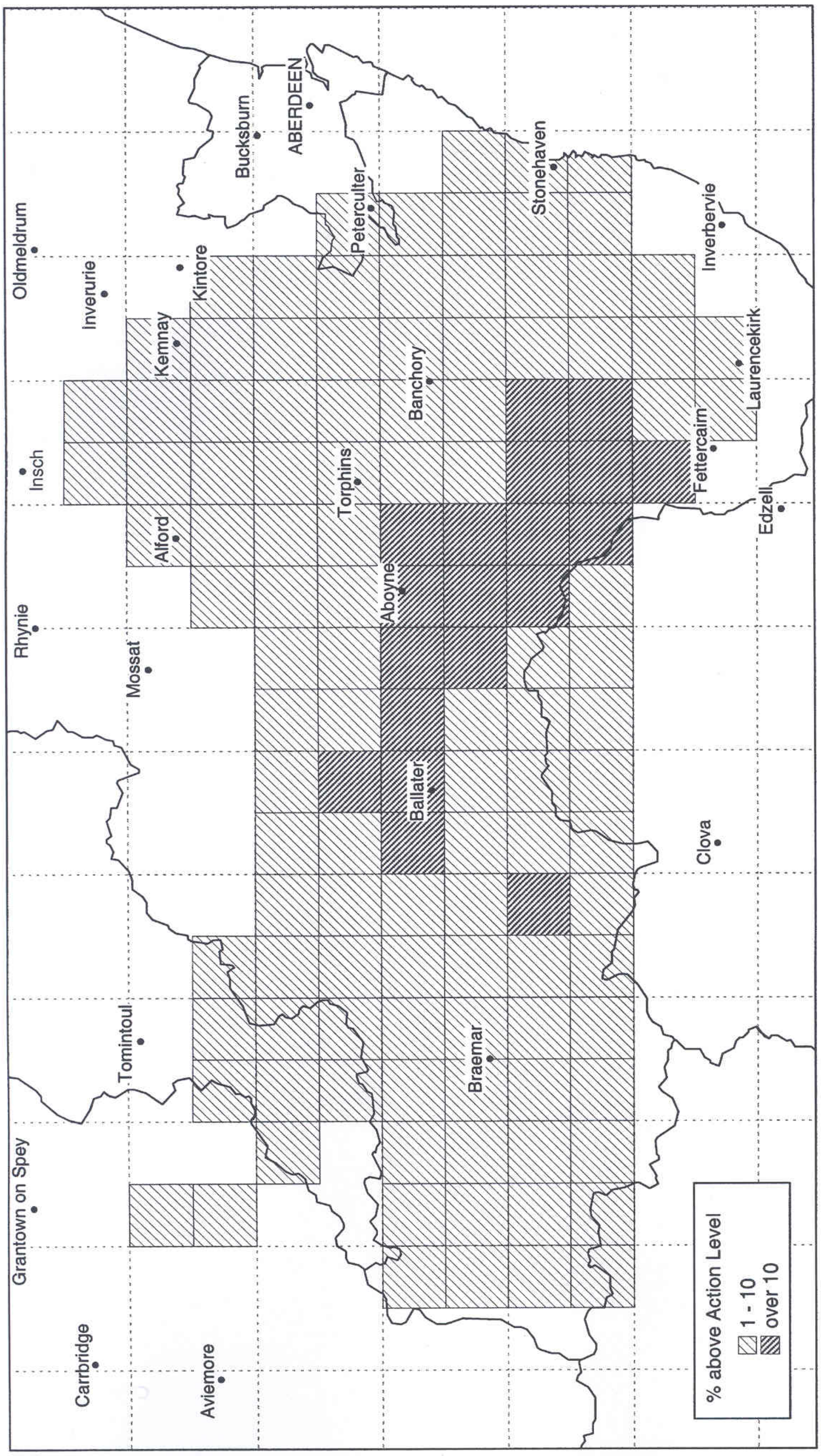
3.2.3 Radon maps

Highland Region



Estimated proportion of *dwellings* exceeding the action level in each 5 km grid

North-East Scotland



Estimated proportion of *dwellings* exceeding the action level in each 5 km grid

3.3 Flooding and ground water

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.

www.sepa.org

SPP 7

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). 'Development and Flood Risk' due for publication in 2004 by CIRIA will provide 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 under standard 3.5.

Climate change

www.safety.odpm.gov.uk/bregs/index.htm

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'.

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 be worse than before the *conversion* (Regulation 12, Schedule 6)

3.3.1 Ground liable to flooding (G2.2)

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.

SPP 7

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.

3.3.2 *Construction* in flood risk areas

Design Guidance on Flood Damage to Dwellings, 1996

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

contents

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* must be improved to as close to the requirement of that standard as is *reasonably practicable*, and in no case be worse than before the *conversion* (Regulation 12, Schedule 6)

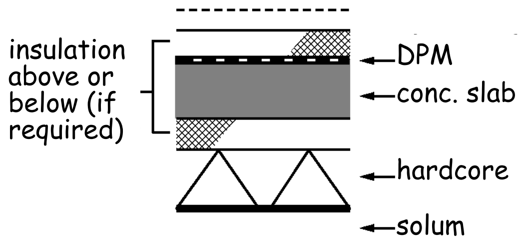
3.4.1 Treatment of *building* elements adjacent to the ground (G2.6)

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.

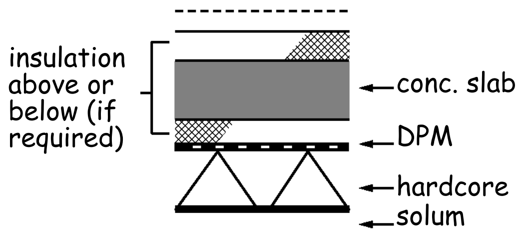
Floors, walls or other *building* elements adjoining the ground should be *constructed* in accordance with the following recommendations. The dimensions specified are the minimum recommended; greater dimensions may therefore be used.

3.4.2 Ground supported concrete floors (G2.3)

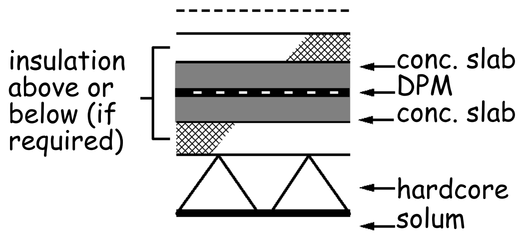
The solum is brought to a level surface. Hardcore bed 100 mm thick of clean broken brick or similar inert material free from fine material and water soluble sulphates in quantities which would damage the concrete; blinded with suitable fine material and *constructed* to form a level, crack-free surface.



Concrete slab 100 mm thick with insulation, if any, laid above or below the slab; with or without a screed or floor finish.

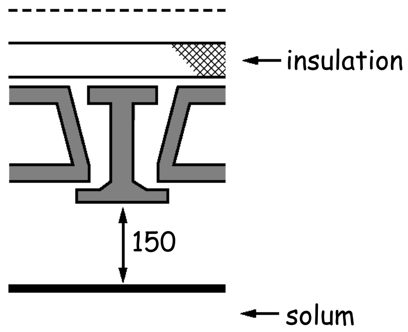


Damp-proof membrane above or below the slab or as a sandwich; jointed and sealed to the damp-proof course or damp-proof structure in walls, columns and other adjacent elements in accordance with the relevant clauses in section 3 of CP 102: 1973



3.4.3 Suspended concrete floors (G2.3)

The solum is brought to an even surface; any upfilling 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.



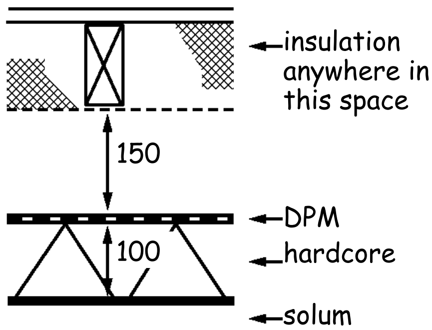
Ventilation of the underbuilding

Permanent ventilation of the underfloor 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 mm^2 for at least every metre run of the wall, or 500 mm^2 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 underfloor ventilation; the ventilated space to be 150 mm to the underside of the floor slab or beams.

3.4.4 Suspended timber floors (G2.3)

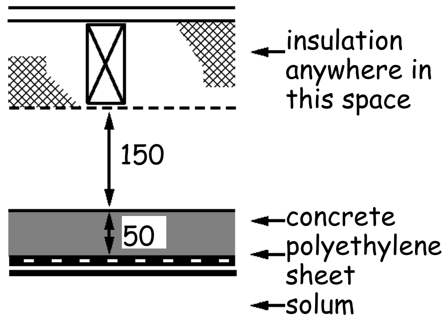
The solum is brought to an even surface; any upfilling to be of hard, inert material. Hardcore bed as for clause 3.4.2; with either a dpm in accordance with Section 3 of CP 102: 1973; or concrete 50 mm thick laid on 0.25 mm (1000 gauge) polyethylene sheet; or concrete 100 mm thick; so that in any case the top surface is not below that of the adjacent ground.

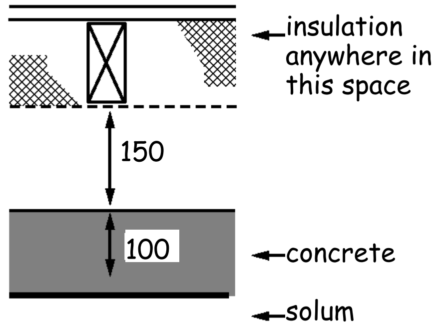
Level of solum



Ventilation of the underbuilding

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 underfloor 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 mm^2 for at least every metre run of the wall, or 500 mm^2 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 underfloor 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 (G2.6)

Walls at or near ground level should be *constructed* in accordance with the recommendations in Clause 10 of CP 102: 1973.

3.4.6 Floors at or near ground level (G2.6)

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 (G2.6)

Structures below ground, including basements, should be *constructed* in accordance with the recommendation in the relevant Clauses in Section 2 of CP 102: 1973.

3.5 Existing drains

contents

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 re-route 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.

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 (G2.4)

Permission of the Water Authority

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.

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

In exceptional circumstances, if it not possible to re-route an existing drain or sewer away from the *dwelling* as described in clause 3.5.2, 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.

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 may be 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

contents

standard **3.6** mandatory	**Every *building*, and hard surface within the *curtilage* of a *building*, must be designed and constructed with a surface water drainage system that will:** **(a) ensure the disposal of *surface water* without threatening the *building* and the health and safety of the people in and around the *building*; and** **(b) have facilities for the separation and removal of silt, grit and pollutants.**

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.

SUDS

Conventional piped *surface water* drainage systems can cause flooding and pollution and disrupt the water cycle to the detriment of water resources and the natural environment. An alternative approach is needed to reach a more sustainable solution. Sustainable drainage is a concept that focuses decisions about drainage on the environment and people. The concept takes account of the quantity and quality of *surface water* run-off and the amenity value of *surface water* in the urban environment. Sustainable Urban Drainage Systems (SUDS) are physical structures that are designed to store, treat and control *surface water* run-off making provision for the concept for sustainable drainage. *Surface water* drainage methods, inspired by natural processes therefore, are being promoted by SEPA and local planning authorities. The approach to the disposal of *surface water* from within the *curtilage* of a *dwelling* clearly needs to be considered at the earliest stage in the design development of a project. (See also the Scottish Executive Development Department's Planning Advice Note No. PAN 61 - Planning and Sustainable Urban Drainage Systems).

PAN 61

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* (M2.2)

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 m^2 and no other area drains onto it.

3.6.2 *Surface water* drainage of paved surfaces (M2.2)

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 m^2 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 (M2.9)

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 NG 2 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. if the *surface water* is from a *dwelling*, to 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 (M2.2a, M2.4a.ii)

SUDS are made up of 1 or more structures built to manage *surface water* runoff. 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 sites

www.sepa.org.uk/publications/leaflets/suds/brownfield.pdf

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.

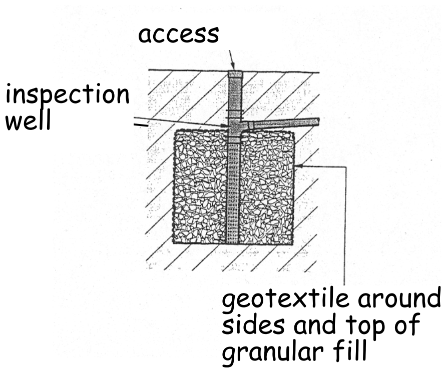
Maintenance responsibility

The maintenance of a SUDS system within the *curtilage* of a *building* is the responsibility of the *building* owner.

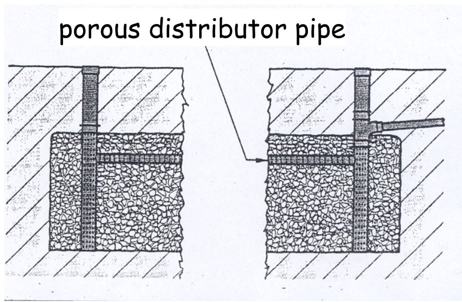
3.6.5 Soakaway serving single *dwellings* and extensions

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*;
c. soakaways should be *constructed* in accordance with the following diagrams:



Cross section through soakaway



Long section through soakaway

The soakaways may be sized using the following simplified formulae derived from BRE Digest 365:

$(A \times 0.0145) - (a \times f \times 15 \times 60) = S$

Where – A is the area to be drained in m^2

a is the internal surface area of the soakaway to 50% effective depth, excluding the base in m^2 (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 (note that this calculation produces mm/s)

S is the required storage in m^3

3.6.6 *Surface water* run-off from small paved surface 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 Traditional drainage systems (M2.4ai)

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.

3.6.8 Discharges into a drainage system (M2.6)

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.

3.6.9 Testing (M2.5)

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

contents

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 pipework 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 (M2.1a, M2.4b)

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 pipework 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 sanitary pipework systems

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 systems

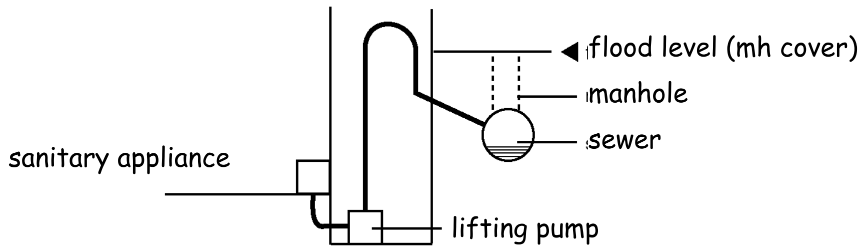
However low water and energy consumption is now a major consideration in any design solution. With this in mind, System II (single discharge stack system with small bore discharge branch pipes) may be appropriate. Careful consideration should be given to the design of the system where a low flush cistern is connected to an existing drain to ensure that blockages do not occur as a result of reduced flow rates.

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 may not be appropriate for use in this country.

Reducing the bore of a pipe in the direction of flow may lead to blockages and is not recommended. 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 (M2.4c)

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.



Diagrammatic section through a pumped system in a basement

3.7.3 Drainage system outside a *building* (M2.1b, M2.4b)

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

Disconnecting manholes

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 753-3: 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.

The disconnecting chamber, or manhole, for a block of individually owned flats or maisonettes should be located as close to the *building* as is practicable as the drain will become a public sewer once it passes outwith the footprint of the *building*.

3.7.5 *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.

3.7.6 Sewers intended for vesting (M2.1c)

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'.

3.7.7 Ventilation of a drainage system (M2.3)

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. in accordance with the recommendations in BS EN 12380: 2002; or
b. in compliance with the conditions of certification of a *notified body*.

3.7.8 Testing (M2.5)

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*.

3.7.9 *Wastewater* discharge (M2.8a)

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 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 & 3.9: Private *wastewater* treatment systems.

3.8 Private wastewater treatment systems – treatment plants

contents

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 is often critical for protecting the environment from pollution. 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. There are many different types of treatment plants with varying degrees of efficiency.

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 under 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 (M3.1a)
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.

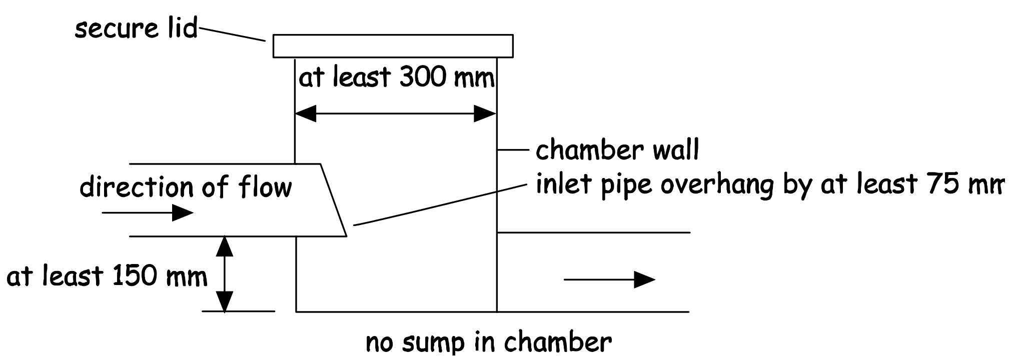
The designer should make provision, where appropriate, for unusual pollution loads such as waste disposal units. Domestic use of detergents and disinfectants is not detrimental but excessive use may have a harmful effect on the performance of the sewage treatment works.

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 (M3.1b)
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 (M3.1c)
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 (M3.1d & e)

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 (M3.2)

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 a consent (or authorisation) under the Control of Pollution Act 1974 (as amended) for:

- all discharges to *surface water*;
- all discharges to ground via an infiltration system when the discharge is from a population equivalent of 15 or more.

For discharges to ground via an infiltration system from a population equivalent of less than 15, SEPA does not generally require a consent, so long as the ground assessment is carried out in accordance with clause 3.9.1 and the infiltration system is *constructed* in accordance with clauses 3.9.2 and 3.9.4. In the unusual circumstances where SEPA considers there to be a high risk of pollution of ground water, SEPA may still require a consent.

Future legislation

It is expected that new Regulations under the Water Environment and Water Services (Scotland) Act 2003 will be implemented in September 2005. This will require registration for all discharges to ground and it is therefore recommended that SEPA is contacted for updated advice at that time.

3.8.6 Access for desludging (M3.3)

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:

a. will provide a clear route for the suction hose from the tanker to the tank; and
b. 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
c. is sufficient to support a vehicle axle load of 14 tonnes.

3.8.7 Labelling (M3.4)

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

contents

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 and around the *building*.**

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. *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 drainage field is often an integral part of the 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 (M3.5)

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 percolation test should be carried out to determine the suitability of the ground. The following method 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;
- SEPAs groundwater protection policy;
- 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 overly 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 area of ground required for the construction of an infiltration system, a percolation test should be carried out within, and to be representative of, the proposed infiltration area. The percolation test 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. excavation of a percolation hole 300 mm square to a depth 300 mm below the proposed invert level of the effluent distribution pipe. Where

deep drains are necessary, the hole should conform to this shape at the bottom but may be enlarged above the 300 mm level to enable safe excavation to be carried out. Fill the 300 mm square section of the hole to a depth of at least 300 mm with water and allow it to seep away overnight. It is important to saturate the soil surrounding the test hole to simulate day to day conditions in an operational drainage field. Next day, refill the test section 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 test to avoid unusual weather conditions such as heavy rain, severe frost or drought. Carry out the test at least 3 times and take the average figure. At least 2 percolation holes, not less than 5 m apart, should be dug and tested 3 times each to obtain consistent results.

The floor area of a sub-surface drainage trench required to disperse effluent from septic tanks may be calculated from:

A = p x Vp x 0.25

where A is the area of the sub-surface drainage trench, in m^2;
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 secondary treatment followed by settlement, this area may be reduced by 20%, i.e.

A = p x Vp x 0.2

3.9.2 Design of infiltration fields (M3.6)

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

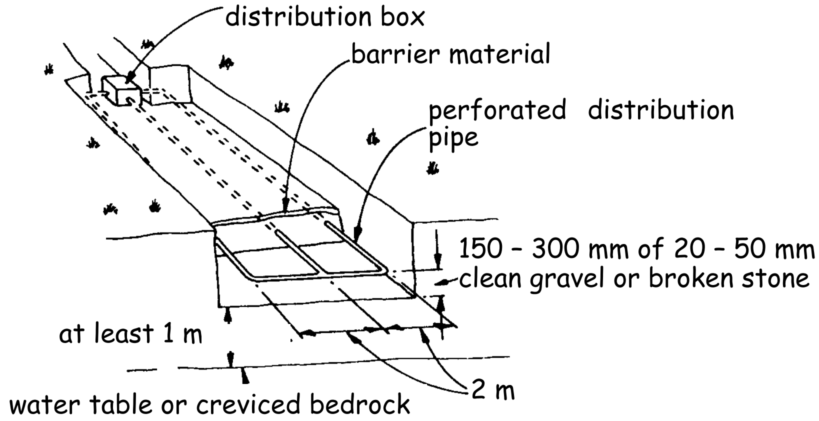
Where the percolation value (as demonstrated by the percolation test) is not more than 15 secs/mm, in accordance with the requirements of SEPA;

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:

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’;

Piped infiltration bed system

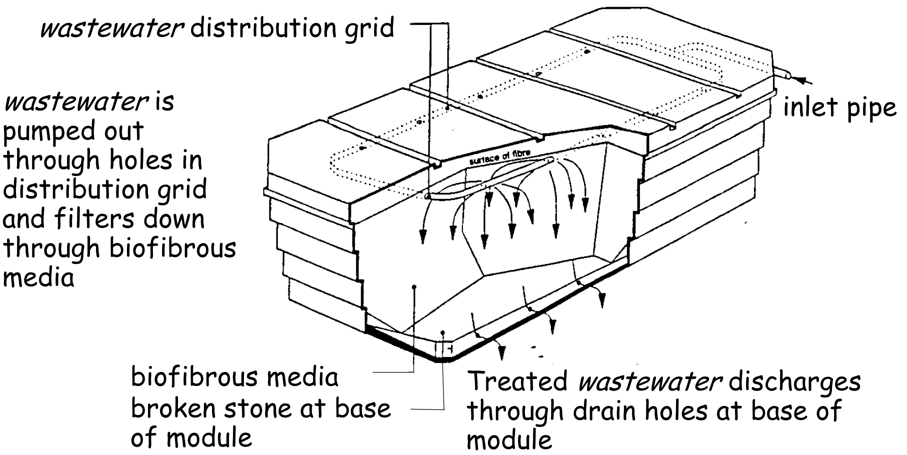


Slow percolation rates

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. 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
b. a *constructed* wetland, other than a reed bed, to a professionally prepared design and *constructed* by specialist contractor(s); or
c. a proprietary filtration system designed, *constructed* and installed in accordance with the conditions of a *notified body*; or

Typical proprietary filter module



d. any other equivalent filtration system designed by a specialist in this subject and *constructed* by specialist contractor(s);

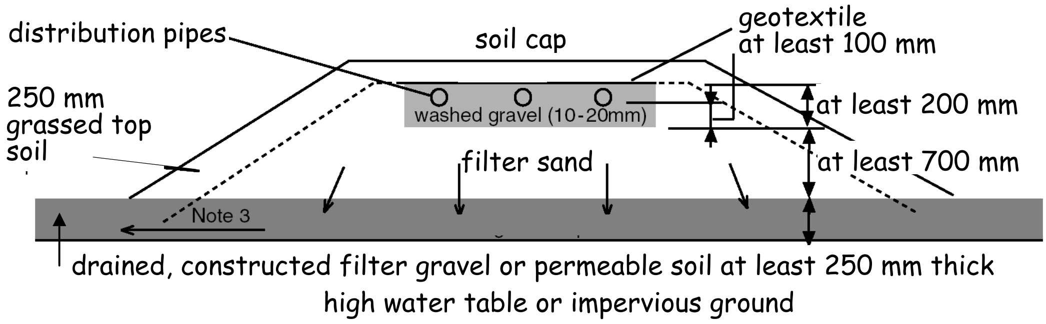
Very slow percolation rates

Where the percolation value (as demonstrated by the percolation test) is more than 140 secs/mm:

a. as a system described under 'slow percolation rate' that does not use an infiltration system for the final treated *wastewater*; or
b. where the piped infiltration system connects to a private *wastewater* treatment plant or septic tank serving not more than 1 *dwelling*, by designing and *constructing* the infiltration system using a specialist

contractor, within a mound filter system in accordance with the following diagram:

Typical soil covered mound filter system serving a single *dwelling*



Notes:

1. Notional percolation times should be determined for filter sand (e.g. in accordance with sand test in BRE, Good Building Guide 42, Part 2) and the area of washed gravel calculated from the formula given in clause 3.9.1.
2. To provide venting of the filter, the upstream ends of the distribution pipes may be extended vertically above mound level and capped with a cowl or grille.
3. *Surface water* run-off and uncontaminated seepage from the surrounding soil may be cut off by shallow interceptor drains and diverted away from the mound. There should be no seepage of *wastewater* to such an interceptor drain.
4. Where the permeable soil is slow draining and overlaid on an impervious layer, the mound filter system should be *constructed* on a gently sloping site.

3.9.3 *Greywater* disposal (M3.5)

Because it is now permissible to install waterless closets in *dwellings*, the disposal of *greywater* from baths, showers, washbasins, sinks and washing machines may be accomplished by passing the *greywater* through a readily accessible, washable filter prior to final discharge to an infiltration field. The area of the field can be calculated from the following:

A = p x Vp x 0.2

where A is the area of the sub-surface drainage trench, in m^2;
p is the number of persons served; and
Vp is the percolation value obtained, as described above, in secs/mm.

Solid waste products from waterless closets should be retained in a container until such time as it can be disposed of safely.

3.9.4 Location of infiltration fields – pollution (M3.7)

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* (M3.7c)

Research has shown that there are no health issues that dictate a safe location of an infiltration field relative to a *dwelling*. However damage to the *foundations* of a *dwelling* is likely to occur where discharge is too close to the *dwelling*. 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 an infiltration system serving a private *wastewater* treatment plant or septic tank should be located at least 5 m from a *dwelling*. 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 ground water 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

contents

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.

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 be worse than before the *conversion* (Regulation 12, Schedule 6)

3.10.1 General provisions (G3.1)

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 car ports 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:

a. 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: 2001. 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;
b. 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;
c. 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;
d. 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 & 2: 1986
Assessment of walls for filling	BS 8208: Part 1: 1985

e. 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
Flat roofs	roof	BS 6229: 2003
Bitumen felt	roof	BS 8217: 1994
Mastic asphalt	roof	BS 8218: 1998

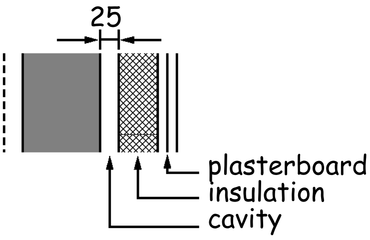
f. roofs with copper, lead, zinc and other sheet metal roof coverings require provision for expansion and contraction of the sheet material. In 'warm deck' roofs, in order to reduce the risk of condensation and corrosion, it may be necessary to provide a ventilated air space on the cold side of the insulation 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.

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.

3.10.2 Wall *constructions* (solid, masonry) (G3.1)

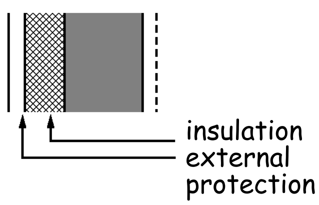
Wall type A
(solid wall with internal insulation)

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)

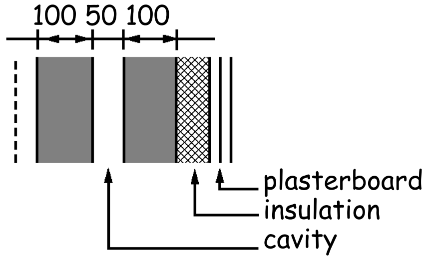
Solid wall as A. above.
Insulation applied to the external surface of the wall; protected externally either by cladding (of sheets, tiles or boarding) with *permanent ventilation*, or by rendering. Wall with or without an internal surface finish of plaster or plasterboard.



3.10.3 Wall *constructions* (cavity, masonry) (G3.1)

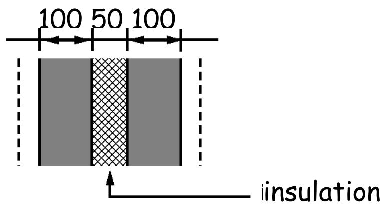
Wall type A
(cavity wall with internal insulation)

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.



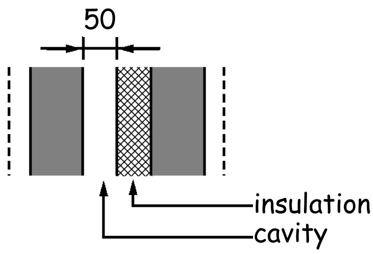
Wall type B
(cavity wall with cavity fill insulation)

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.



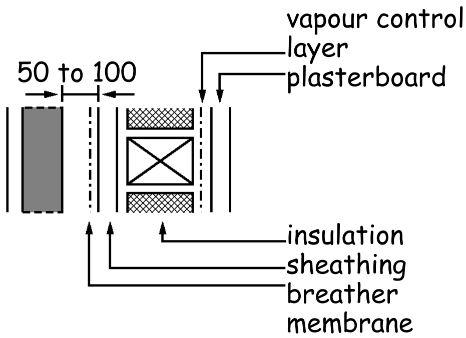
3.10.4 *Conservatories* and extensions

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 render, the use of a cavity tray along the line of the roof of the *conservatory* or extension may be appropriate. However in sheltered situations a raggled flashing (chased into the wall) may be sufficient.

3.10.5 Wall *constructions* (framed) (G3.1)

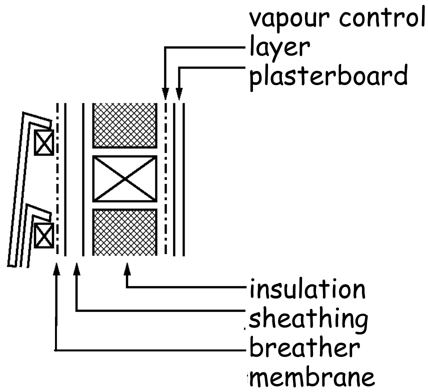
Wall type A
(masonry cladding)

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 of 50 mm but not more than 100 mm wide between the cladding and the framing, the cavity ventilated to the outside by means of one open perpend joint for at least every 1.2 m run at the top and bottom of the wall. 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.



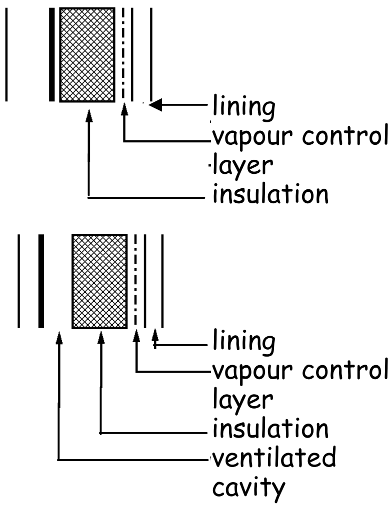
Wall type B
(weatherboarding, tile or slate cladding)

Framed wall of timber studs and dwangs with a breather membrane. Cladding material, on battens and counter battens as required, of timber weatherboarding, 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 Roof *constructions* (flat) (G3.1)

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.

Cold deck roofs

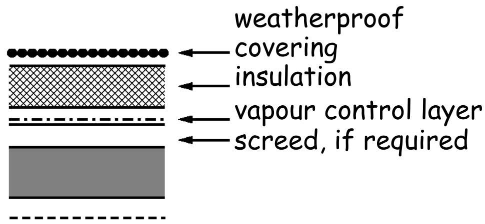
They should be avoided therefore because interstitial condensation is likely and its effect on the structure and insulation can be severe. Many instances of failure in such systems have been recorded and it is considered that more reliable forms of *construction* are available. However fully supported metal roof finishes including aluminium, copper, lead stainless steel and zinc are regularly used in *conversion work*, and they should have a ventilated air space 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.

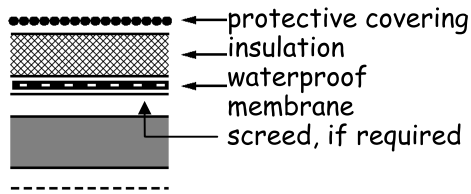
Roof type A (concrete – warm roof)

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]



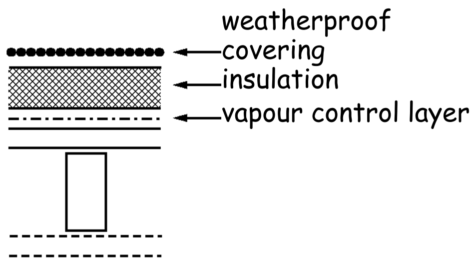
Roof type B (concrete – inverted roof)

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.



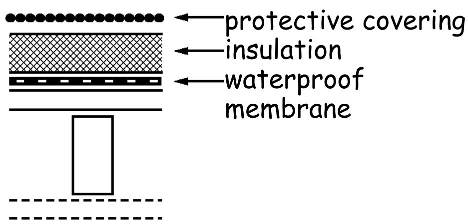
Roof type C (timber or metal frame – warm roof)

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]



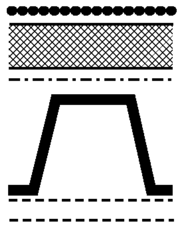
Roof type D (timber or metal frame – inverted roof)

Flat roof structure as C. above. External protective covering, insulation and waterproof membrane as B. above.



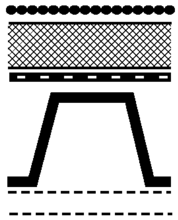
Roof type E
(troughed metal decking – warm roof)

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

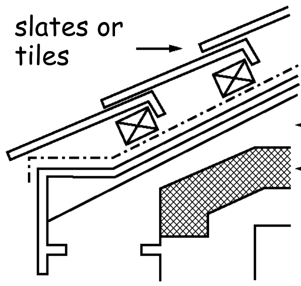
Roof types A, C and E are not suitable for sheet metal coverings that require joints to allow for thermal movement. See also sub-clause f of clause 3.10.1.

3.10.7 Roof *constructions* (pitched) (G3.1)

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.

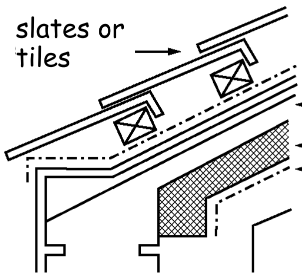
Roof type A
(slates or tiles – insulation on a level ceiling)

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.
Insulation laid on a level ceiling with a ventilated space between the insulation and the roof structure.



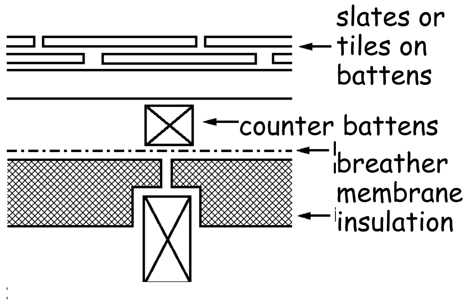
Roof type B
(slates or tiles – insulation on a sloping ceiling)

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.



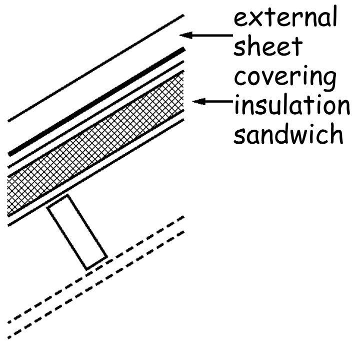
Roof type C
(slates or tiles – insulation as decking)

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

contents

standard 3.11 mandatory	**Every *dwelling* must be designed and *constructed* in such a way that the size of any *apartments* or *kitchens* and the access to other *rooms* does not threaten the health of the occupants.** **Limitation** This standard applies only to a *dwelling.*

3.11.0 Introduction

Guidance is provided on recommended provision within *dwellings* as being appropriate to suitable sizing of *rooms* and access to specific types of *rooms*.

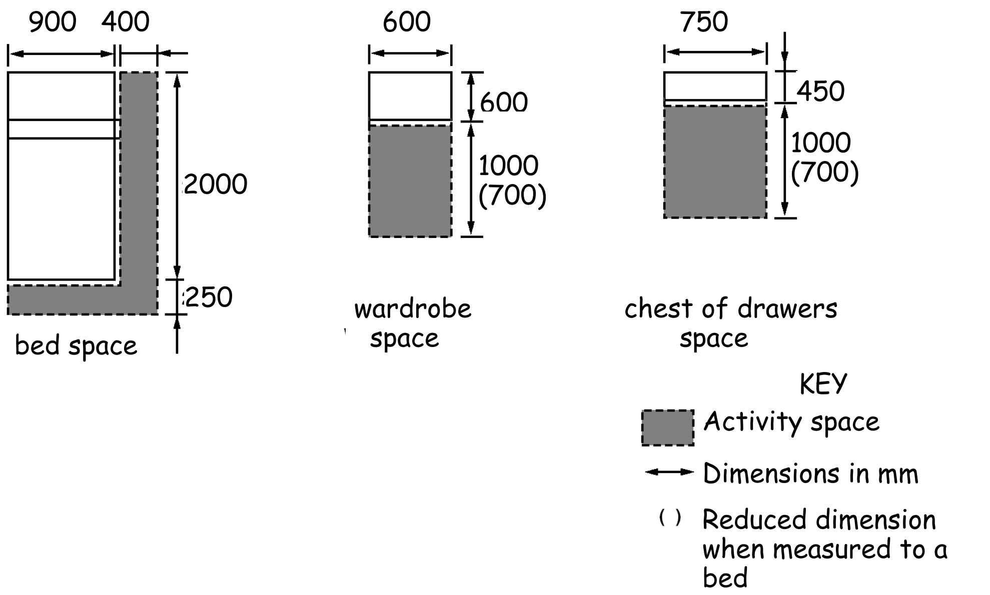
Designers should be aware of local authority initiatives on the recycling of solid waste and such initiatives may affect storage provision in a *dwelling*.

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).

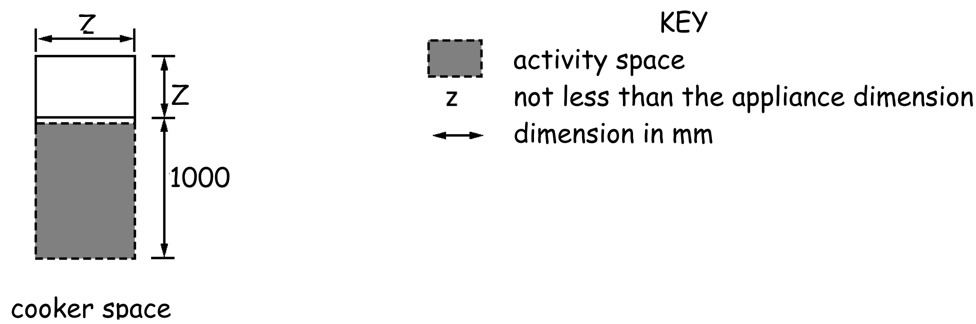
3.11.1 *Apartments* **(Q3.1)**
Every *apartment* in a *dwelling* should be capable of accommodating at least 1 bed, 1 wardrobe and 1 chest of drawers.

Each piece of furniture should also have an activity space as shown in the following diagrams, however a built-in wardrobe of equal size may be provided as an option to the wardrobe space.



3.11.2 *Kitchens* **(Q3.3, Q3.4)**
A *dwelling* should have a *kitchen*, provided with a solid fuel cooker designed for continuous burning, or a space for a gas, electric or oil cooker. The space should be sufficiently large to include such piping, cables or other apparatus as will enable the appliance to be used.

Each appliance should also have its own activity space as shown in the following diagram:



Kitchen storage of at least 1 m^3 should be provided either within or adjacent to the *kitchen.* Additional storage may be required depending on the local authority's recycling initiative.

3.11.3 Area of *rooms* **(Regulation 8)**
The area of a *room* excludes any built-in fixtures extending from the floor to the ceiling and any part of the *room* where the height is less than 1.5 m.

3.11.4 Activity spaces (Q3.1)

An activity space should be measured at floor level and one activity area may overlap only another activity area, but not a piece of furniture.

Where an activity space is designated accessible for use by *disabled people,* as recommended in section 4, the clear height across the full extent of the activity space should be not less than 1.8 m.

3.11.5 Access to other *rooms* (Q3.2)

Each bedroom should be located so that it is not necessary to pass through another bedroom in order to reach a bathroom, *toilet* or circulation space.

3.12 Sanitary facilities

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* and that there is no threat to the health and safety of occupants or visitors.**

3.12.0 Introduction

Since April 2000 there has been a requirement for all *dwellings*, to be accessible to *disabled people*, unless it is not *reasonably practicable* to provide such access. The intention is that people are more able to invite *disabled people* to visit them, without needing assistance, in their homes.

Visitability standard

Accessible requirements for new *dwellings* include a step-free approach to an entrance, a level threshold at the entrance, suitable corridor and door widths to permit wheelchair circulation on the entrance *storey*, and the provision of a WC on the entrance *storey*.

The provision of a fully accessible wheelchair accessible WC is not always practicable, particularly in small *dwellings* but the space requirements will allow the majority of *disabled people* to use the facilities. It should be noted that the internal requirements apply even if a level access is not practicable. Although not specifically aimed at the needs of the elderly it is hoped that the requirements will allow homeowners to be able to remain in their own homes longer despite increasing age-related infirmity. They also cater for those who may become temporarily disabled.

Access to *houses* for disabled visitors is limited to the ground or entrance *storey* at present, because of the difficulty of ensuring safe escape for *disabled people* from *upper storeys* in the event of fire.

Water Byelaws
www.snipef.co.uk
www.scottishwater.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. 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 (M4.1)

Every *dwelling* should be provided with *sanitary facilities*. The minimum facilities acceptable would be 1 watercloset, or waterless closet together with 1 washbasin per watercloset, or waterless closet, 1 bath or shower and 1 sink. It would be normal for the sink to be located in the *kitchen*.

In larger *dwellings* where there will be accommodation for 5 or more persons, it would be preferable to provide an additional watercloset, or waterless closet, to achieve a more convenient arrangement.

3.12.2 Waterless closets (M4.2)

Where it is reasonably practicable to connect to a public sewer or a public *wastewater* treatment plant then this should be the first option. However, where it is not possible to connect a domestic *wastewater* drainage system to a public sewerage system (for example, if the distance is too far or an expensive pumped *wastewater* system would be needed) a waterless closet may be installed.

Waterless closets

If a waterless closet is installed it should be to a safe and hygienic design such as:

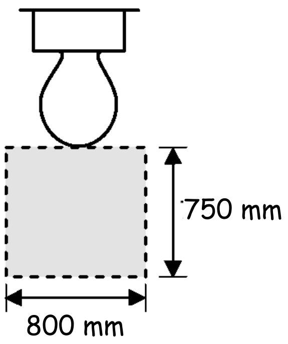
a. National Sanitation Federation Certification to Standard NFS 41: '*wastewater* recycling/reuse and water conservation devices; or
b. NFS International Standard ANSI/NSF 41-1999: 'non-liquid saturated treatment systems'; or
c. to the conditions of a certification by a *notified body*.

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 *toilet* (M4.3)

A *toilet* should be accessible for visitors who may have a disability, i.e. it should be accessed directly from a public space and not via a bedroom. Every *dwelling* therefore, should have at least 1 watercloset, or waterless closet on the accessible entrance *storey*.

There should also be an activity space clear of any door swing, of at least 750 mm long x 800 mm wide in front of, but not necessarily centred on, the watercloset, or waterless closet in accordance with the following diagram. Further guidance on the height of an activity space is provided to standard 3.11. A small, wall-hung washbasin may project into the activity space without restricting the space too much.



The accessible *toilet* should be accessible from public areas in a *dwelling* and should not be provided en-suite.

However, if access for *disabled people* is not provided to a *dwelling* because, say, the main entrance level is on an upper level, *sanitary facilities* should still be provided, either:

a. on the *storey* accessible to *disabled people*; or
b. where there are no *apartments* on the *storey* accessible to *disabled people*, on the first *storey* above or below this *storey* containing an *apartment*.

3.12.4 Washbasin provision (M4.10b)

There should always be a washbasin provided close to a watercloset, or waterless closet. This washbasin should either be located in the *toilet* itself, or in an adjacent space providing the sole means of access to the *toilet*.

There should also be a door separating the watercloset, or waterless closet, from a *room* or space used for the preparation or consumption of food, normally the *kitchen* or dining *room*.

3.12.5 Alterations and extensions

The provision of an additional *toilet* or the alteration to an existing *toilet* should be considered in relation to the other *sanitary accommodation* available in the *dwelling*. For example, if an alteration or small extension is being undertaken, such as the provision of a new bedroom that will increase the number of persons in a *dwelling*, the guidance in clause 3.12.1 may be appropriate.

New *toilet*

The provision of additional *toilets* should be considered in relation to the other *sanitary accommodation* available in the *dwelling*. Where a new *toilet* is to be *installed*, then:

a. if a *toilet* already exists on the entrance *storey* that has been designed as an accessible *toilet* (see clauses 3.12.3, and 4.2.2), the new *toilet* need not meet these recommendations; but
b. if there is no accessible *toilet*, then the new *toilet,* if located on the accessible *storey*, should be designed as an accessible *toilet*.

Existing *toilet*

When an existing *toilet* is to be altered, then:

a. if the *toilet* has been designed as an accessible *toilet*, it should remain as such after the alteration; but
b. if it has not been designed as an accessible *toilet*, it need not be altered to function as such, unless the alterations include the door position or the activity space layout. When this occurs the new door and/or activity space should be designed to the recommendations for an accessible *toilet*.

Relocating an accessible *toilet*

Where it is intended to relocate an existing accessible *toilet* (meeting the guidance in clause 3.12.3), from the entrance *storey* to another *storey*, then a replacement accessible *toilet* should be provided on the entrance *storey*. This is because the *dwelling* would have failed to meet the guidance to a greater degree as a result of the alteration.

Relocating a non-accessible *toilet*

However, if it is intended to relocate an existing *toilet* that is not in accordance with the guidance in clause 3.12.3 from the entrance *storey* to another *storey*, then some discretion should be given to the existing *toilet*.

Where the existing *toilet* just fails to meet the guidance in clause 3.12.3, for example, if the edge of the door projects approximately 75 mm into the activity space, then it might still be accessible to many *disabled people.* Either it should not be removed or another accessible *toilet* should be provided in its place. However if the existing *toilet* fails substantially to meet the guidance in clause 3.12.3, thus restricting its usefulness to most *disabled people*, then it would be unreasonable to provide a replacement accessible *toilet* on the entrance *storey*. In this case the *dwelling* would not have failed to meet the guidance to a greater degree.

3.13 Heating

contents

standard **3.13** mandatory	**Every *building* must be designed and *constructed* in such a way that it can be heated.** **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 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.

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 requirement (Q3.6)

Heating will normally be tailored to personal comfort in the *dwelling* taking cost into consideration. However, in addition, for condensation control, the heating should reflect the combined effects of occupancy pattern, ventilation provision, *building* mass and insulation. The following is the minimum provision that is appropriate, but consideration should be given to the possibility of condensation and mould growth in poorly heated *buildings*.

Every *dwelling* should have some form of fixed heating system capable of:

a. maintaining a temperature of 18º C in at least 1 *apartment* when the outside temperature is minus 1º C; or
b. making available at least 3 kW of heating in at least 1 *apartment*.

3.14 Ventilation

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 have the capability of:

- removing excess water vapour from areas where it is produced in significant quantities, such as *kitchens* and bathrooms;
- 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*;
- making available over long periods, a minimum supply of outside air for occupants and to disperse, where necessary, residual water vapour.

Ventilation should not significantly 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.

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 (K1.3, 2.1)

A *dwelling* should have provision for ventilation by either:

- natural means; or
- mechanical means; or
- a combination of natural and mechanical means.

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).

There is no need to ventilate a *room* with a floor area of not more than 4 m^2. 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. The volume of any space used for vehicle parking 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 Control of humidity (K2.1)

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 minimise condensation as a result of high 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. Guidance on control of humidity is provided below.

Increasing insulation and *constructing* 'tighter' *dwellings* can reduce the number of natural air changes and increase the risk of condensation, particularly in *dwellings.* The guidance that is provided for the ventilation in moisture producing areas is the minimum necessary for combating condensation. The effect of these recommendations will be determined by design and workmanship both of the ventilation arrangements and the *dwelling* as a whole.

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. Clauses 3.14.6 and 3.14.9 lists various methods of controlling humidity in high humidity areas.

3.14.3 Natural ventilation (K2.1a & b, K4.1, K4.2)

Most *dwellings* are naturally ventilated and ventilation should be provided in accordance with the following recommendations:

Recommended ventilation provision in a *dwelling*

Space	Ventilation recommendations	*Trickle ventilation*
Apartment	A *ventilator* with an opening area of at least 1/30th of the floor area it serves	8000 mm^2
Kitchen	either: a. mechanical extraction capable of at least 30 l/sec (intermittent) above a hob [2]; or b. mechanical extraction capable of at least 60 l/sec (intermittent) if elsewhere [2]; or c. a passive stack ventilation system [3].	4000 mm^2
Utility room	either: a. mechanical extraction capable of at least 30 l/sec (intermittent) [2]; or b. a passive stack ventilation system [3].	4000 mm^2
Bathroom or shower-room (with or without a WC)	either: a. mechanical extraction capable of at least 15 l/sec (intermittent); or b. a passive stack ventilation system [3].	4000 mm^2
Toilet	either: a. a *ventilator* with an opening area of at least 1/30th of the floor area it serves; or b. mechanical extraction capable of at least 3 air changes per hour.	4000 mm^2

Notes:

1. The overall provision of *trickle ventilation* in a *dwelling* may be provided at an average of 6000 mm^2 per *room,* with a minimum provision of 4000 mm^2 in each *apartment.*
2. 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.
3. Refer to Section 2: Fire where a passive stack ventilation system is installed in a *building* containing *flats* and *maisonettes*.
4. Long duct runs, flexible ducting and bends can seriously reduce fan performance and should be carefully considered during design.

Stratification

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.

3.14.4 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. Roof vents are best placed to reduce stratification.

A *ventilator,* or *ventilators,* with an opening area of at least 1/30th of the floor area of the *conservatory* should be provided.

3.14.5 *Trickle ventilators* (K4.1b, K4.2)

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. A *permanent ventilator* is not recommended since occupants like control over their environment and uncontrollable *ventilators* are usually permanently sealed up to prevent draughts.

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:

Non-proprietary *trickle ventilators*

- A partially open window 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.
- High elevations tend to be windier and windows on night latches cannot be adjusted to reduce draughts. It is more likely that they will be kept closed.
- Manufactures will need to show that the opening area when on the night latch is to the recommended sizes in the table to clause 3.14.3.
- 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 location of additional *trickle ventilators* on the *external wall*.
- *Trickle ventilators* supply replacement air for mechanical extract, mechanical input and passive stack ventilation 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 ventilator*

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 *room* is fitted with a *trickle ventilator* in accordance with the guidance in clause 3.14.3.

A *trickle ventilator* should be provided in an area containing a mechanical extract 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 (K2.1c, K4.3, K4.4, K4.5)

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, with manual override, that will operate when the air reaches a predetermined humidity level (normally around 40% but can be adjusted to individual requirements); 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.

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 vent with a minimum free area of 1000 mm^2.

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*.

Conservatory

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*.

Extension

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.

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 (K2.1, K4.6, 7, 8, 9, 10)

Where a *dwelling* is mechanically ventilated it should be provided in accordance with the recommendations of:

a. BS 5720: 1979; or
b. Section B2 of CIBSE Guide B: 1986.

Mechanical ventilation provided in line with this guidance should be to the outside air but it may be via a *duct* or heat exchanger.

Cross contamination

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.

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 mechanical ventilation system should be installed in accordance with the recommendations in Clause 2.3.3 of BS 5720: 1979. The system should also be *constructed* to ensure, as far as is *reasonably practicable*, the avoidance of contamination by legionalla. The system should be installed in accordance with the recommendations in paragraphs 70 to 84 of 'The Control of Legionellosis including legionnaires'

Control of Legoinellosis

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.

Open-flued appliances

3.14.9 Mechanical aids to ventilation (K2.1)

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*:

- continuously operating balanced supply and extract mechanical ventilation with 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. Opening windows may also be needed for fire escape purposes;
- continuously operating mechanical extract ventilation installed in accordance with the guidance in BRE Digest 398;
- mechanical extract ventilation units, either window or wall mounted, in *rooms* where there is likely to be high humidity such as *kitchens*, bathrooms and shower rooms installed in accordance with the recommendations in clause 3.14.3;
- mechanical input air ventilation for supplementing the natural ventilation to a *building*. These systems may be suitable for lowering humidity in a *dwelling* and thus reducing condensation. They should only be used for small domestic sized *buildings* as the system has been principally developed for *dwellings*. It may not be necessary to *duct* the outside air to the plant. Further information should be obtained from the manufacturer.

3.14.10 Ventilation of small garages (K3.2)

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 *building*, designers may wish to consider making the separating *construction* as air tight as possible. Where there is a communicating door, a lobby arrangement could be considered.

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*. 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.

Open-flued appliances

A garage with a floor area of at least 30 m^2 but not more than 60 m^2 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:

Natural ventilation

a. where the garage is naturally ventilated, by providing at least 2 *permanent ventilators*, 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 *permanent ventilators* being not more than 600 mm above floor level, or

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.

3.14.11 Ventilation of large garages (K3.1)

A garage with a floor area more than 60 m^2 for the parking of motor vehicles should have provision for natural or mechanical ventilation on every *storey*. Ventilation should be provided in accordance with the following guidance:

a. section B2 of the CIBSE Guide 1986:
   - to give carbon monoxide concentrations of not more than 50 parts per million averaged over an eight hour period; and
   - to restrict peak concentrations of carbon monoxide at areas of traffic concentration such as ramps and *exits* to not more than 100 parts per million for periods not exceeding 15 minutes; or

b. section 4 of the Association for Petroleum and Explosive Administration's "Code of practice for ground floor, multi-*storey* and underground car parks" and CIBSE Guide B, 1986, Section B2; or

c. by providing openings in the walls on every *storey* of at least 1/20th of the floor area of that *storey* with at least half of such area in opposite walls to promote extract ventilation, if the garage is naturally ventilated; or

d. by providing mechanical ventilation system capable of at least 6 air changes per hour and at least 10 air changes per hour where traffic concentrations occur; or

e. where it is a combined natural/mechanical ventilation system, by providing:
   - openings in the walls on every *storey* of at least 1/40th of the floor area of that *storey* with at least half of such area in opposite walls; and
   - a mechanical system capable of at least 3 air changes per hour.

3.15 Condensation

contents

standard **3.15** 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 caused by surface or interstitial condensation.** **Limitation** This standard applies only to a *dwelling*.

3.15.0 Introduction

Condensation can occur in *dwellings* 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* must be improved to as close to the requirement of that standard as is *reasonably practicable*, and in no case be worse than before the *conversion* (Regulation 12, Schedule 6)

3.15.1 Condensation (G4.1, G4.2)

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 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.

Fully supported metal roofs

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 air space 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.

3.15.3 Surface condensation – thermal bridging (G4.2)

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 W/m^{2}K.

BR 262
Thermal insulation: avoiding risks

Further guidance on acceptable thermal insulation may be obtained from BRE Report, BR 262, Thermal insulation: avoiding risks.

3.15.4 Interstitial condensation (G4.1)

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.

3.16 Natural lighting

contents

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 regulation is primarily to ensure that an adequate standard of daylighting 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*.

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 (Q3.5)

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* and extensions

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.

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

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 and around a *building*;
- compromising the structural stability of a *building*; and
- 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. (see clause 3.17.8)

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 Large combustion appliance installations (F2.1)
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.

3.17.2 Combustion appliance installations generally (F3.2)
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.

3.17.3 Small combustion appliance installations (F3.2)
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 (F3.1, F4.1, F4.2)

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.

3.17.5 Oil-firing appliance installations (F5.1, F5.2,)

www.oftec.org.uk

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 (F6.1, F6.2)

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 in 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 (F3.12)

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...	*20 Main Street* *New Town*
The fireplace opening located in the…………………… Is at the base of a chimney with a designation string…	*name of room* *designation string*
and, for example, is suitable for a……………………...	*dfe gas fire*
Chimney liner...	*xx mm diameter*
Installed on..	*date*
Any other information (optional)………………………..	

3.17.8 Extract fans **(F3.10, F3.11)**

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 underbuilding.

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 Information 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 *kitchen* extract 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 products of combustion

contents

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 in this sub-section 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.

The following terms relating to *chimney* and *chimney* components are included below to provide clarity to their meaning in this Technical Handbook.

Explanation of terms

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*') a pipe 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 this sub-section of the Technical Handbook.

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 (F3.8)

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

www.feta.co.uk/bfcma

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.

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, sootfire 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

Minimum designations for *chimneys* and *flue-pipes* for use with natural draught, solid fuel appliances is T400 N2 D 3 Gxx.

Minimum designations 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

Minimum designation for *chimneys* and *flue-pipes* for use with oil-firing appliances with a *flue* gas temperature not more than 250º C

Appliance type	Fuel oil	Minimum designation
Boiler including combination boiler – pressure jet burner	Class C2	T250 N2 D 1 O_{xx}
Cooker – pressure jet burner	Class C2	T250 N2 D 1 O_{xx}
Cooker and room heater – vaporising burner	Class C2	T250 N2 D 1 O_{xx}
Cooker and room heater – vaporising burner	Class D	T250 N2 D 2 O_{xx}
Condensing pressure jet burner appliances	Class C2	T160 N2 W 1 O_{xx}
Cooker: vaporising burner appliances	Class D	T160 N2 W 2 O_{xx}

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

Minimum designation for *chimneys* and *flue-pipes* for use with gas appliances

Appliance	Type	Minimum designation
Boiler: *open-flued*	natural draught	T250 N2 D 1 O_{xx}
	fanned draught	T250 P2 D 1 O_{xx} [1]
	condensing	T160 P2 W 1 O_{xx} [1]
Boiler: *room-sealed*	natural draught	T250 N2 D 1 O_{xx}
	fanned draught	T250 P2 D 1 O_{xx} [1]
Gas fire:	radiant/convector, ILFE or DFE	T250 N2 D 1 O_{xx}
Air heater	natural draught	T250 N2 D 1 O_{xx}
	fanned draught	T200 P2 D 1 O_{xx} [1]
	SE *duct*	T450 N2 D 1 O_{xx}

Note:

1. 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* (F3.5)

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 incorporate 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* (F3.5c, F3.6, F3.7, F6.11, F6.12)

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 400º 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 250º 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-I, 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 a removable, imperforate casing. Also where the *chimney* passes through the *roof space*, such as an attic, it should be surrounded be 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* **(F4.12, F4.13)**

A *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*.

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: 2004 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 refactory 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 *certified body*.

Stainless steel flexible *flue* liners meeting BS EN 1856-2: 2004 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-I, 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

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.

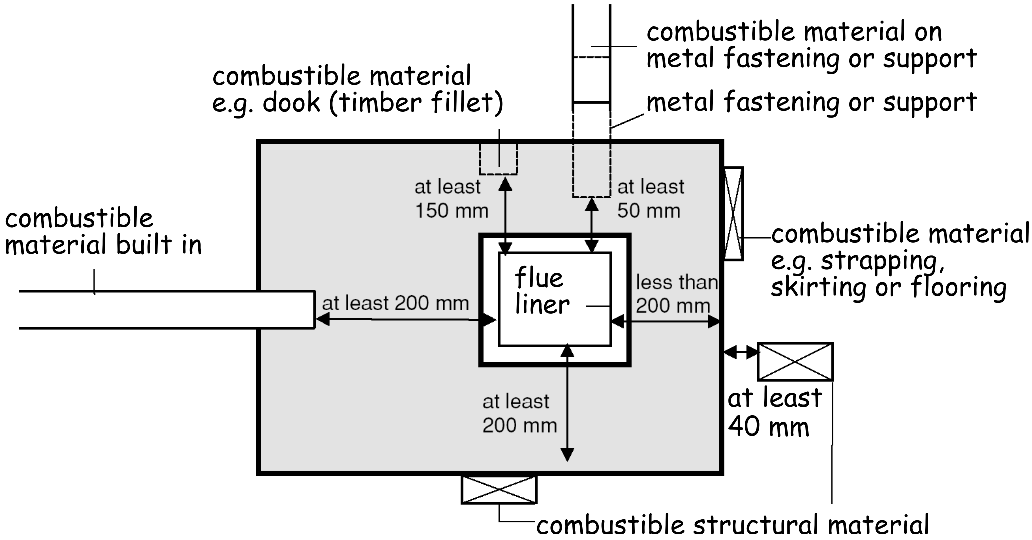
Conversions

In the case of *conversions*, as specified in Regulation 4, the *building* as *converted* must be improved to as close to the requirement of that standard 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 materials (F4.15, F4.16)

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 *non-combustible* material may be located on the outer face of a masonry *chimney*;



Plan view of masonry chimney

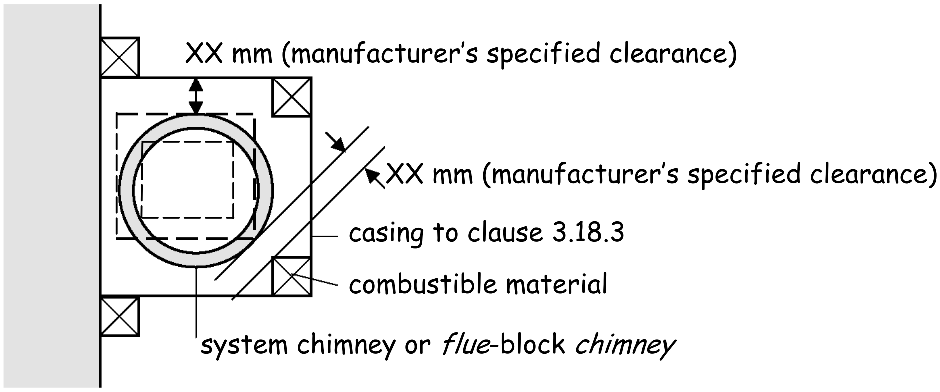
Any metal fastening in contact with combustible material, such as a joist hanger, should be at least 50 mm from the surface surrounding a *flue* to avoid the possibility of the combustible material catching fire due to conduction.

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 materials (F3.9)

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 85º C when related to an ambient temperature of 20º C.

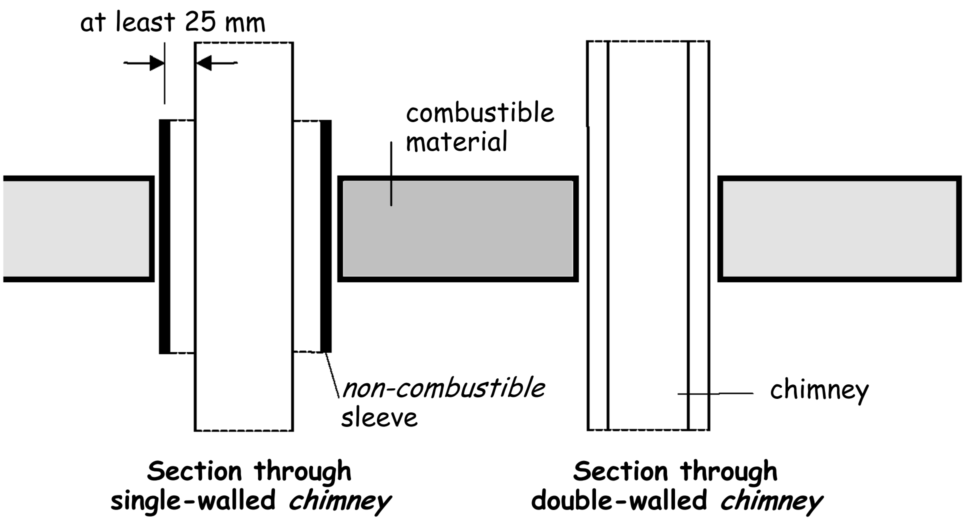


Plan of casing round a factory-made *chimney*

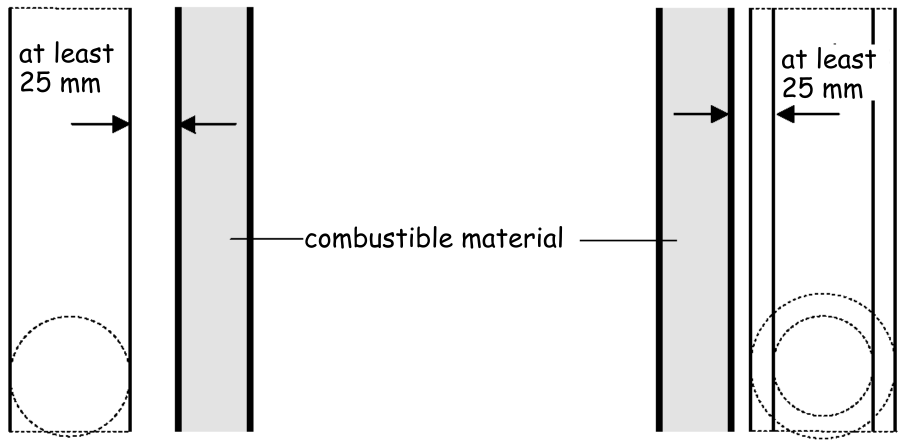
BS EN 1806: 2000 relates to clay *flue*-block *chimneys* but does not give a value for distances to combustible materials. These types of *chimneys* therefore should be regarded as custom built *chimneys* and the minimum values in clause 3.19.1 or clause 3.19.2 should be used and declared.

3.19.3 Relationship of metal *chimneys* to combustible materials (F6.14, F6.15)

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 100º 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 100º C.



Section through single-walled *chimney*

Section through double-walled *chimney*

3.19.4 Relationship of *flue-pipes* to combustible materials (F4.14)

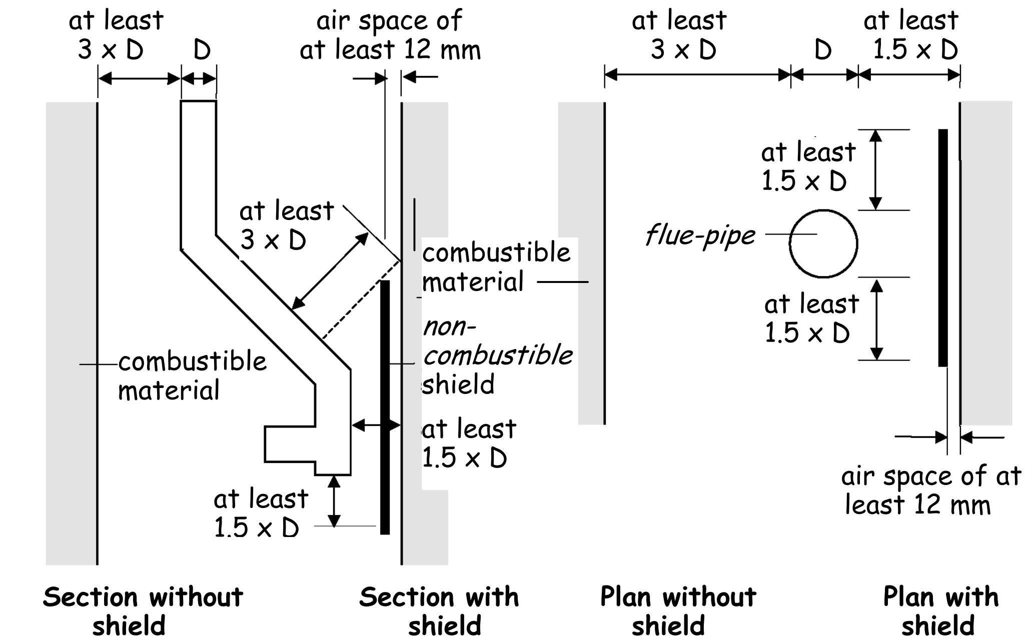
To prevent the possibility of radiated heat starting a fire, a *flue-pipe* should be separated from combustible material by:

a a distance according to the designation of the connecting *flue-pipe* in accordance with BS EN 1856-2: 2004; 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.

Relationship of *flue-pipes* to combustible materials

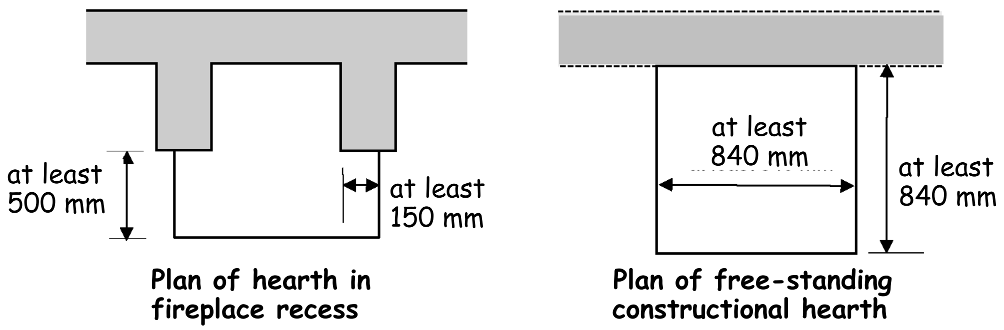


3.19.5 Relationship of solid fuel appliances to combustible materials (F4.17, F4.18)

Hearth *Construction*

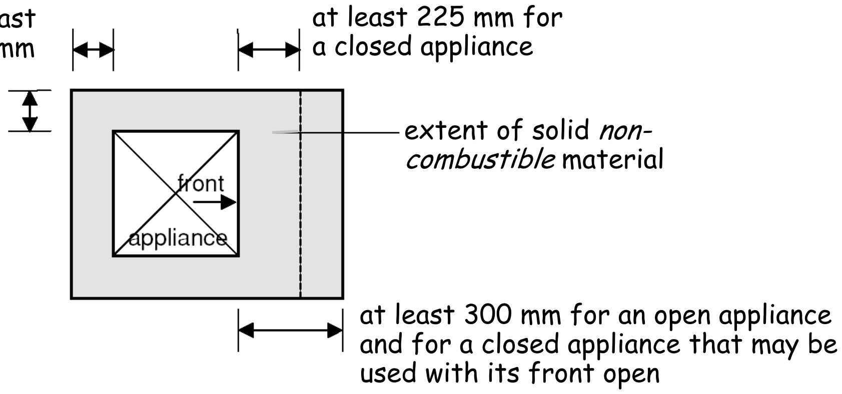
A solid fuel appliance should be provided with a solid, *non-combustible* hearth that will prevent the heat of the appliance from igniting combustible materials. A hearth should be provided to the following dimensions:

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 100º C.



Appliance location

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.

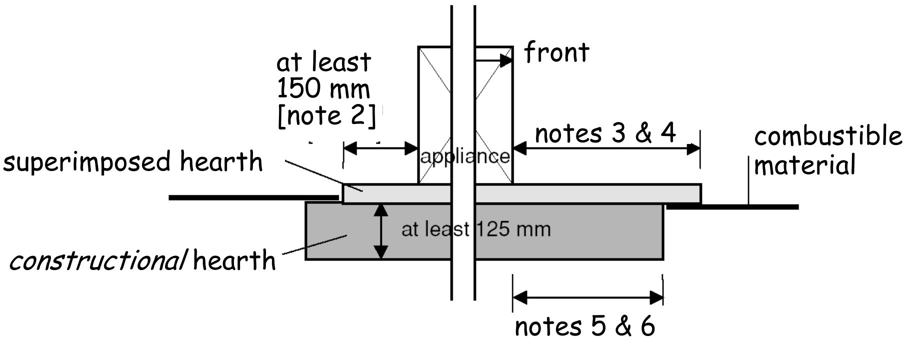


Plan of appliance on a hearth

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.

Superimposed hearths

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

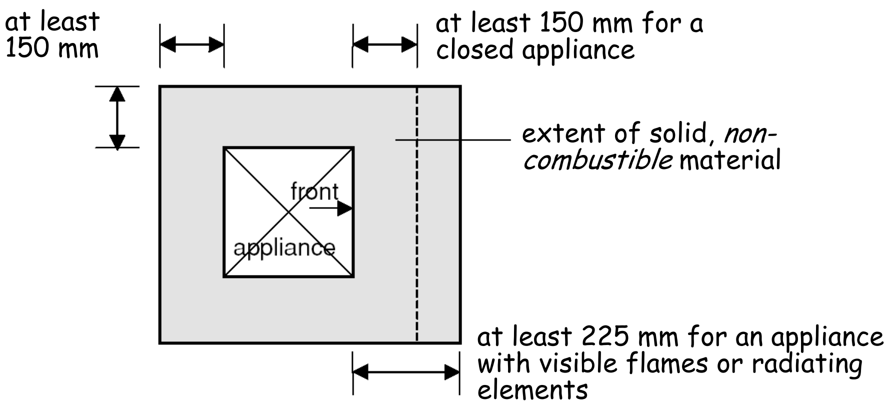
Notes:
In this specification –
1. SUPERIMPOSED HEARTH means a finish of solid, *non-combustible* material, usually decorative, at least 50 mm thick and positioned on a *constructional* hearth.
2. There need not be a 150 mm separation where the appliance is located in a fireplace recess, nor where the 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 materials (F5.11, F5.12, F5.13)

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 100º 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.

Hearth location

A floor-standing, oil-firing appliance should be positioned on the hearth in such a way 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.

Separation

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 100º 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.

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 appliances to combustible materials (F6.16, F6.17)

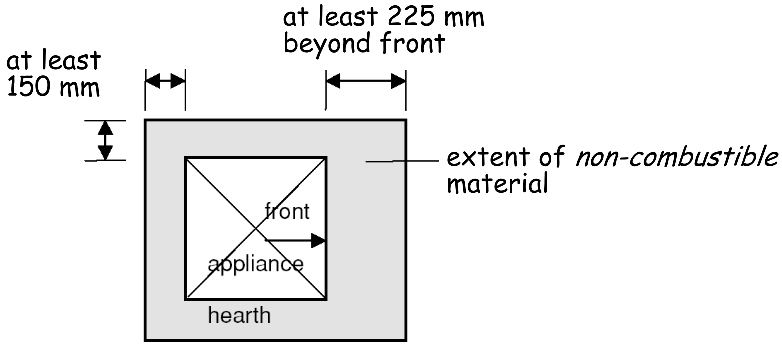
Hearth *construction*

A gas-fired appliance should be provided with a hearth in accordance with the following recommendations:

a. Clause 12 of BS 5871: Part 1: 2001, for a gas fire, convector heater and fire/back boiler;
b. Clause 12 of BS 5871: Part 2: 2001, for an inset live fuel-effect gas appliance;
c. Clause 11 of BS 5871: Part 3: 2001, for a *decorative fuel-effect gas appliance*;

Hearth location

d. 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.

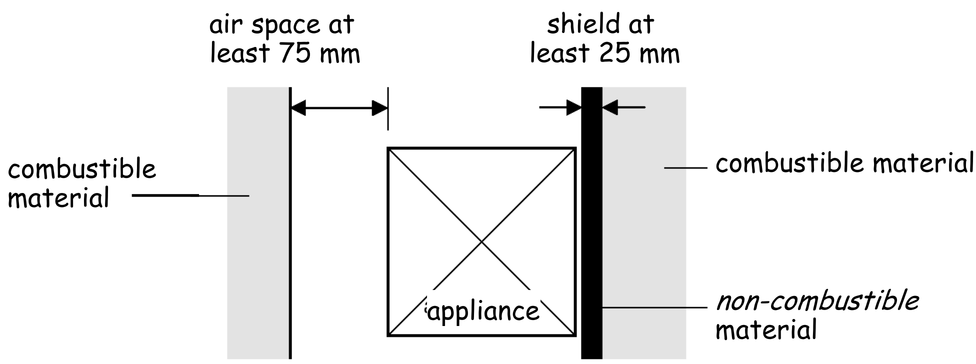
However a hearth need not be provided:

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.

Separation

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 100º 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.



Plan/section without shield **Plan/section with shield**

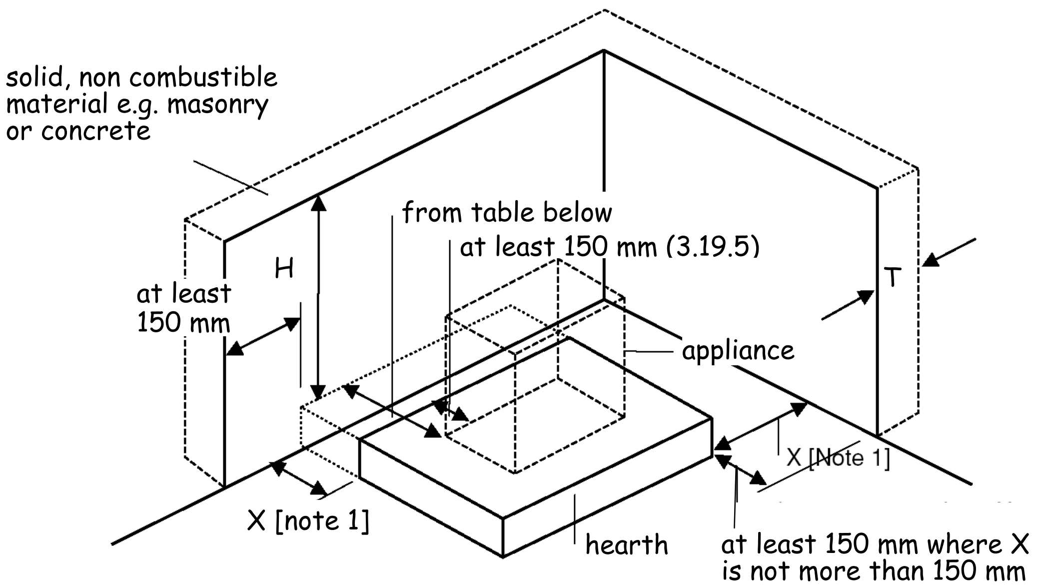
A gas-fired appliance with a CE marking and installed in accordance with the manufacturer's written instructions may not require this separation.

3.19.8 Relationship of hearths to combustible materials (F4.19, F4.20)

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:

a. the hearth located in a fireplace recess in accordance with BS 8303: Part 1: 1994; or
b. 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*

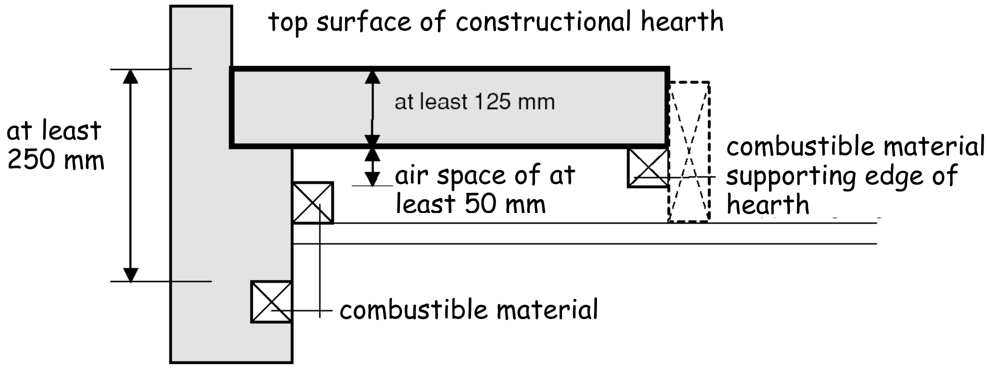
Location of hearth or appliance	Thickness (T) of solid, *non-combustible* material	Height (H) of solid *non-combustible* material.
where the hearth abuts a wall and the appliance is not more than 50 mm from the wall	200 mm	at least 300 mm above the appliance or 1.2 m above the hearth whichever is the 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.

Note:
1. There is no requirement for protection of the wall where X is more than 150 mm.

3.19.8

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.



Section through hearth

3.19.9 Fireplace recesses (F4.21)

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/m^3; 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

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* and *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 (F4.11)

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 (F5.7 F5.8)

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.

Boiler (Efficiency) Regulations 1993

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 250º C while modern boilers that bear the CE mark indicating compliance with the Boiler (Efficiency) Regulations (1993) will normally have *flue* gas temperatures less than 250º 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 250º C.

High *flue* gas temperatures

Where the *flue* gas temperatures are more than 250º 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 250º 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 (F6.6)

A *chimney* or *flue-pipe* should be *constructed* and installed in accordance with the following recommendations:

a. BS 5440-1: 2000;
b. Section 8 of publication 'IGE/UP/7: 'Gas Installation in Timber Framed Buildings', where the *chimney* or *flue-pipe* is in a timber frame *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 (F5.6)

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

Gas Safety (Installations & Use) Regulations

Regulation 30 of the Gas Safety (Installations & Use) Regulations 1998 has specific requirements for *room-sealed appliances* in these locations.

3.20.7 Protection of metal *chimneys* (F6.13)

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 (F4.5)

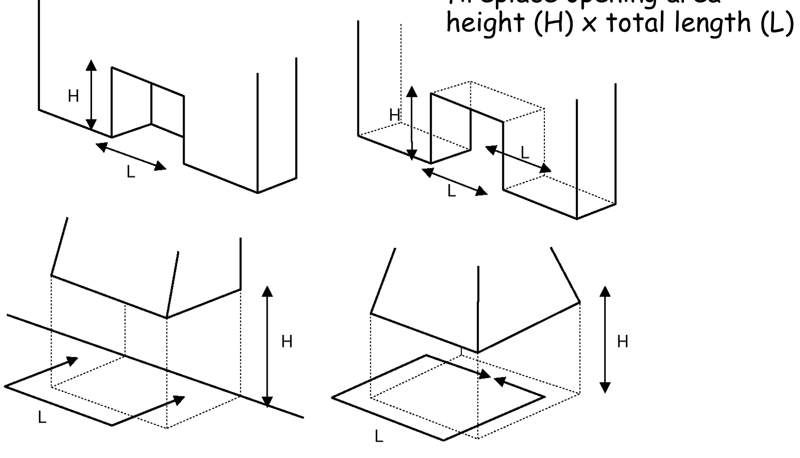
The size of a *flue* serving a solid fuel appliance should be at least the size shown in the table below and not less than the size of the appliance *flue* outlet or that recommended by the appliance manufacturer.

Minimum area of *flues*

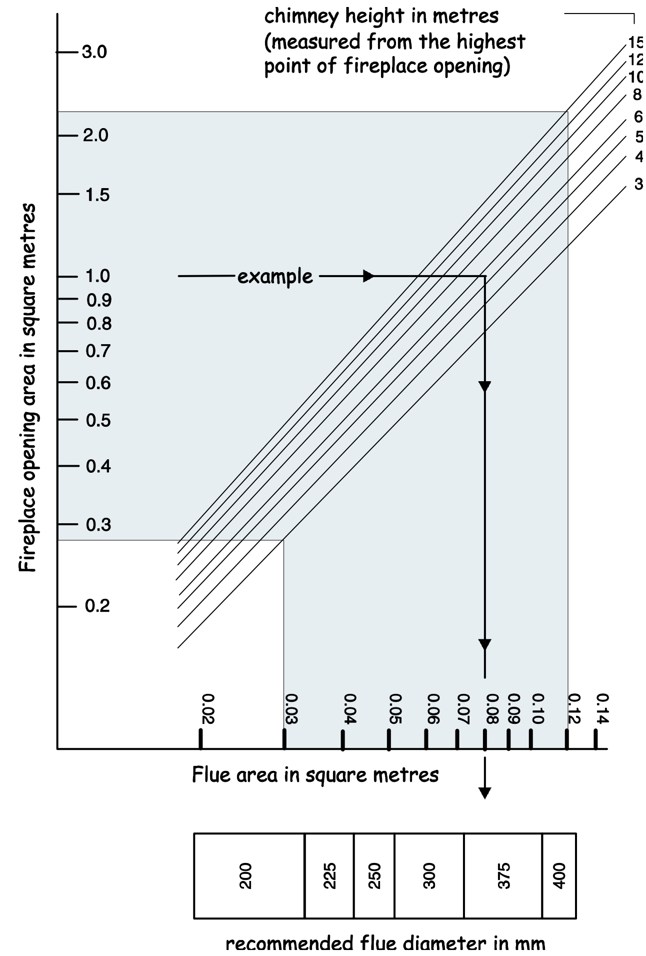
Appliance	Minimum *flue* size [2]
Fireplace with an opening more than 500 mm x 550 mm, or a fireplace exposed on 2 or more sides	a. 15% of the total face area of the fireplace opening(s) [3]; or b. in accordance with the diagram to clause 3.20.7. [4]
Fireplace with an opening not more than 500 mm x 550 mm	200 mm diameter or rectangular/square *flues* having the same cross sectional area and a minimum dimension 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 *flues* having the same cross sectional area and a minimum dimension not less than 150 mm.
Closed appliance with rated output not more than 30 kW burning any fuel	150 mm diameter or rectangular/square *flues* having the same cross sectional area and a minimum dimension 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 *flues* having the same cross sectional area and a minimum dimension not less than 100 mm for straight *flues* or 125 mm for *flues* with bends or offsets.

Notes:
1. In the table:
   Closed appliance includes cookers, stoves, room heaters and boilers.
   Smokeless fuel means solid mineral fuel that produces combustion products containing particulate matter that does not exceed a specified low amount.
2. 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*.
3. Specialist advice should be sought when proposing to *construct flues* with an area of more than 120000 mm^2 or 15% of the total face area of the fireplace opening.
4. The diagram to clause 3.20.7 should only be used for the range of sizes shown within the shaded area.
5. Fire size is related to the free opening area at the front of the fireplace opening.

Fireplace opening areas



***Flue* sizing for larger solid fuel open fires**



3.20.9 Size of *flues* – oil-firing appliances (F5.7)

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 (F6.7)

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: 2001, for a *decorative fuel-effect gas appliance*;
b. BS 5871: Part 2: 2001, 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* (F3.3, F4.4, F4.6, F5.5, F5.9, F6.5)

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*.

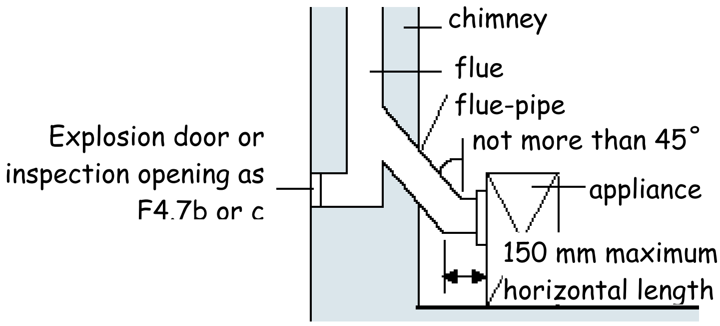
Gas-fired

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.

Flue-pipe connection to back-entry solid fuel appliance



Section through appliance and flue-pipe

Where bends are essential, they should be angled at not more than 45º to the vertical.

3.20.12 Openings in *flues* **(F4.7a & b, F6.8)**

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* **(F4.7c, F4.8, F6.8)**

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* **(F4.9, F6.9)**

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 (F3.4)

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.

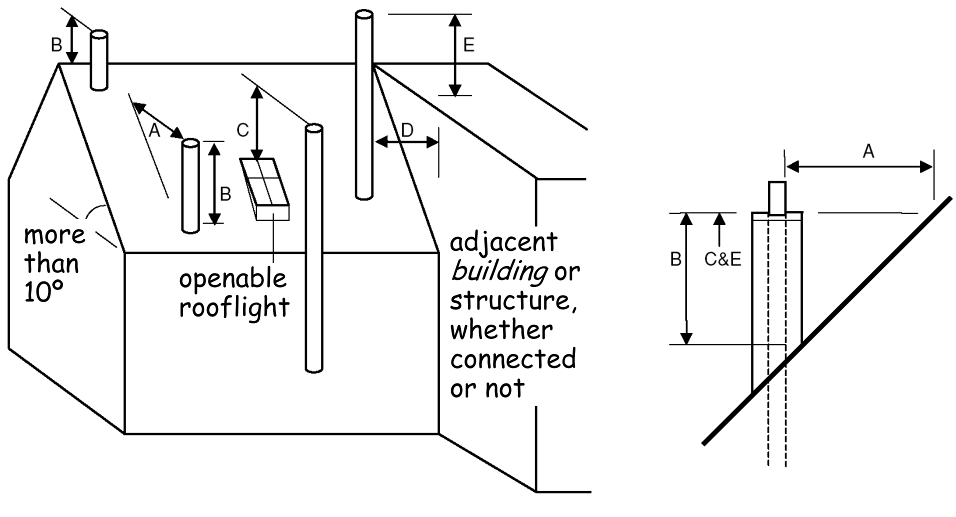
A *flue* terminal should be protected with a guard if a person could come into contact with it or if it could be damaged. If the *flue* outlet is in a vulnerable position, such as where the *flue* discharges within reach of the ground, or a balcony, veranda or window, it should be designed to prevent 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 (F4.10)

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:



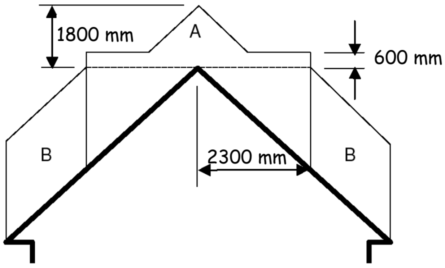
Minimum dimension to *flue* outlets

A	2300 mm horizontally clear of the weather skin.
B	1000 mm 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	1000 mm above the top of any *flat roof*; and 1000 mm above any openable rooflight, dormer or *ventilator,* etc. within 2 300 mm measured horizontally.
D/E	where D is not more than 2300 mm, 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:

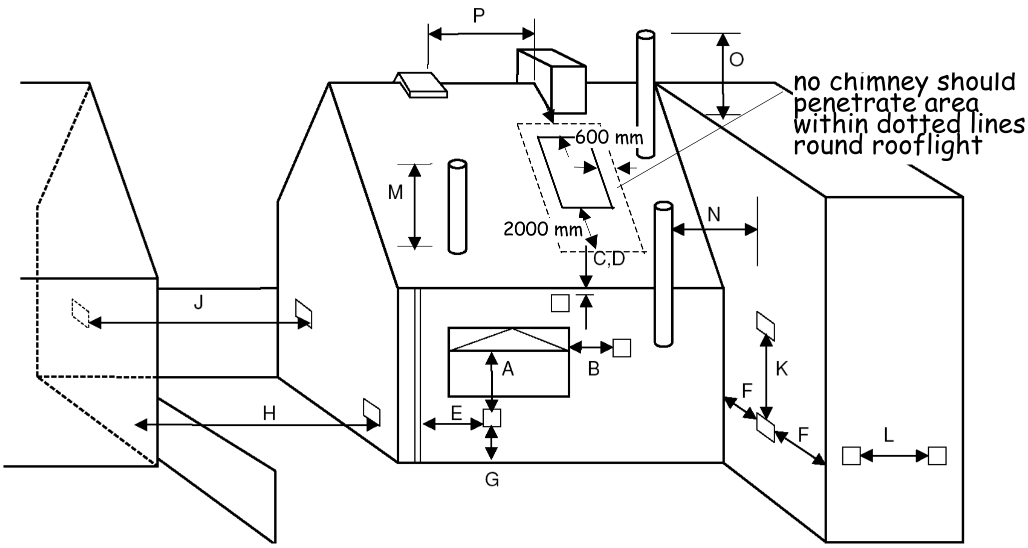


Location of *flue* terminals relative to easily ignitable roof coverings

Zone A	At least 1800 mm vertically above the weather skin; and at least 600 mm above the ridge.
Zone B	At least 1800 mm vertically above the weather skin; and at least 2300 mm horizontally from the weather skin.

3.20.18 Oil-firing appliance *flue* outlets (F5.10)

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:



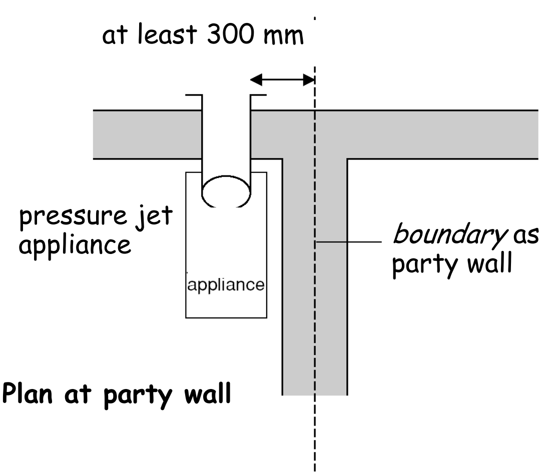
***Flue* terminal positions for oil-firing appliances**

Location		Minimum distance to terminal (mm)	
		pressure jet	**vaporising**
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 *boundary* 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.
2. Vertical structure in N, O and P includes tank or lift rooms, parapets, dormers etc.
3. 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, OFS A100 or OFS A101.
4. 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.
5. 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.
6. 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.
7. 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.
8. Notwithstanding the dimensions above, a terminal should be at least 300 mm from combustible material.

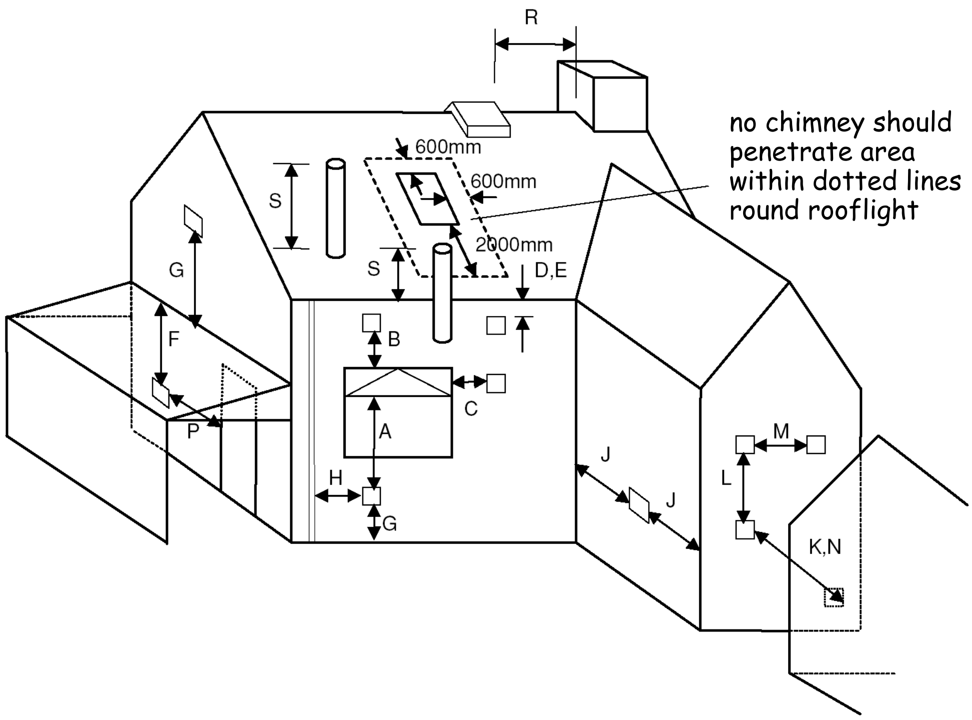
Separation between a *boundary* and terminal at right angles



3.20.18

3.20.19 Gas-fired appliance *flue* outlets (F6.10)

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:



***Flue* terminal positions for gas-fired appliances**

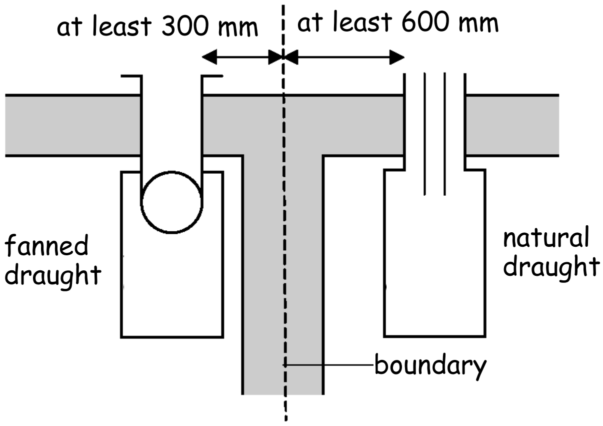
Location		Minimum distance to terminal in millimetres			
		Balanced *flue*, *room-sealed appliance*		Open *flue*	
		Natural draught	Fanned draught	Natural draught	Fanned draught
A	Directly below an opening, air brick, opening window, etc	(0-7 kW) 300 (>7-14 kW) 600 (>14-32 kW) 1500 (>32-70 kW) 2000	300	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 *carport* 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 *boundary* 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 *carport* (e.g. door, window) into the *building*	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

1. 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.
2. 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 1m long should be fitted.
3. This dimension may be reduced to 75 mm for appliances of up to 5 kW heat input.
4. The products of combustion should be directed away from discharging across a *boundary*.
5. 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
6. The distance of a fanned flue terminal located directly opposite an opening in a *dwelling* should be at least 2 m.
7. Vertical structure includes a *chimney-stack,* dormer window, tank room, lift motor room or parapet.
8. 1500 mm if measured to a roof terminal, otherwise as Table 2 in BS 5440-1: 2000.
9. To manufacturer's instructions.
10. As Table 2 in BS 5440-1: 2000
11. n/all = not allowed. n/app = not applicable.

3.20.19

Separation between a *boundary* and terminal at right angles



Plan at party wall

3.21 Combustion appliances – air for combustion

contents

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.

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).

3.21.1 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 vents, 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 (F4.3)

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 *flue*.
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. In the table:
   THROAT means the contracted part of the *chimney flue* lying between the fireplace opening and the main *chimney 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 mm^2/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 (F5.3)
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 (F6.3)
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: 2001, for a *decorative fuel-effect gas appliance*;
b. BS 5871: Part 2: 2001, 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

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 (F5.4)

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 (F6.4)

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 Oil storage – protection from fire

contents

standard **3.23** mandatory	**Every *building* must be designed and *constructed* in such a way that 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*.** **Limitation** This standard does not apply to portable containers.

3.23.0 Introduction

The following guidance relates only to oil used solely to serve 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: 1998.

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.

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* (F7.2)

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 required**	
	***Building* without openings**	***Building* with openings**
Not more than 1.8 m from any part of any *building*	*non-combustible* 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 *non-combustible*; and either: a. any part of a *building* not more than 1.8 m from the tank should be of *non-combustible construction* type 7, short duration (see table to 2B1), or b. a barrier.	*non-combustible* 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 *non-combustible*; and a barrier between the tank and any part of a *building* not more than 1.8 m from the tank.
More than 1.8 m from any *building*	*non-combustible* base.	
Not more than 760 mm from a *boundary*	*non-combustible* base, and a barrier, or a wall with a *non-combustible construction* type 7, short duration (see table to 2B1).	
More than 760 mm from a *boundary*	*non-combustible* base.	
Externally, wholly below ground	no protection required.	

Notes:
In the table:
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;

3.23.2 Additional fire protection (F7.3)

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 2B1), the base need only extend as far as the barrier or wall.

3.23.3 Storage within a *building* (F7.2b)

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.

3.24 Oil storage – protection from spillage

contents

standard **3.24** mandatory	**Every *building* must be designed and *constructed* in such a way that 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:** **(a) reduce the risk of oil escaping from the installation;** **(b) contain any oil spillage likely to contaminate any water supply, ground water, watercourse, drain or sewer; and** **(c) permit any spill to be disposed of safely.** **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. Large quantities of water are taken from rivers and groundwater for use as drinking water and for irrigation. Oil contamination can make water unfit for these purposes.

Oil accounts for about a third of all reported pollution incidents in Scotland that are investigated by SEPA each year. 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.

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.

Oil storage controls

Legislative controls on oil storage are due to come into force in 2005 and will cover the storage of oil in commercial and industrial *buildings* and *domestic buildings* where the storage is more than 2500 litres. Designers and installers should be alert to the introduction of these controls as they will take precedence over the guidance in this handbook.

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 (F7.1a)

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 (F7.1b)

Large tanks

Tanks with a capacity more than 3500 litres and the fuel feed system connecting them to a combustion appliance should be installed in accordance with the recommendations of BS 5410: Part 2: 1978

Small tanks

Tanks with a capacity of more than 90 litres but not more than 3500 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 Code of Practice for the Owners and Operators of Petrol Stations and Other Fuel Dispensing/Storage Facilities Involving Underground Storage Tanks. This CoP provides guidance on underground and partially buried oil storage tanks. The Scottish Executive has also produced a code of practice for owners and operators of underground storage tanks under the Groundwater Regulations.

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 Information Sheet TI/134

3.24.3 Secondary containment (F7.2c)

It is necessary for a wide variety of possible hazards to be considered as to whether a catchpit (bund) is required or not. BS 5410: Part 1: 1997 highlights 2, as the size of the tank and its proximity to a watercourse. However other potential hazards should be borne in mind and a risk assessment should be carried out for each installation. It is preferable for installers to keep a record of this and OFTEC publication TI/133 provides a simple crosscheck. The full list of potential hazards listed by OFTEC are:

Risk assessment

a. tank within 10 m of a watercourse;
b. tank located where spillage could run into an open drain or to a loose fitting manhole cover;
c. tank within 50 m of a borehole or spring;
d. tank over ground where conditions are such that oil spillage could run-off into a watercourse;
e. tank located in a position where the vent pipe outlet is not visible from the fill point;
f. any other potential hazard individual to the site.

Catchpit (bund)

If any of the above conditions apply, the oil storage tank should be provided with a catchpit. A catchpit means a pit, without a drain, which is capable of containing the contents of the tank, plus 10%.

Integrally bunded tanks

An integrally bunded tank is a tank, together with a catchpit, manufactured as a self-contained unit complete with a removable lid and designed to contain the escape of any liquid escaping from the tank in an overfill situation.

A catchpit or integrally bunded tank should be provided in accordance with the recommendations of OFTEC Standard OFS T100 and OFS T200; and

a. for tanks with a capacity of more than 3500 litres, Clause 45.3 of BS 5410: Part 2: 1978;
b. for tanks with a capacity of not more than 3500 litres, Clause 6.5 of BS 5410: Part 1: 1997.

A catchpit should also be provided in the following situations:

Provision of catchpits

Location of tank	Catchpit or integrally bunded tank
Within a *building*	required
External, above ground (2500 litres or less)	in accordance with clause 3.24.3
External, wholly below ground	not required

3.25 Solid waste storage

contents

standard **3.25** mandatory	**Every *building* must be designed and *constructed* in such a way that accommodation for solid waste storage is provided which:** **(a) permits access for storage and for the removal of its contents;** **(b) does not threaten the health of people in and around the *building*; and** **(c) does not contaminate any water supply, ground water or *surface water.*** **Limitation** This standard applies only to a *dwelling*.

3.25.0 Introduction

The Environmental Protection Act, 1990

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*.

National Waste Plan

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*.

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 **(R2.1)**

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 metres 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 **(R2.2)**

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 **(R2.3)**

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

contents

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 below ground. 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 (R3.1)

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 (R3.1)

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 (R3.2)

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.

4

safety

Contents

4.0 Introduction

contents

Introduction

4.0

4.0.1 Background

The guidance in this handbook is appropriate for *domestic buildings*. It is relevant to both *dwellings* and to common areas within *buildings* comprising of *dwellings*.

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*.

Death and serious injury to people in and around *buildings* occur in significant numbers from accidents involving falls, collisions, entrapment or malfunction of fittings. Considerations at the design stage of a project can assist in minimising risks inherent in any *building*.

Accessibility

The subject of access to *buildings* is also covered and encompasses issues of both safety and the amenity of the *building* users. An accessible environment is one in which everyone, regardless of disability, age or circumstance, can make use of safely, conveniently and without assistance.

Good practice

www.rospa.com

A number of issues relating to good practice are not covered in this Technical Handbook. Publications by organisations, such as the Royal Society for Prevention of Accidents (RoSPA), provide additional information on further good practice when considering safety in *dwellings*.

4.0.2 Aims

The intention of this section is to give recommendations for the design of *buildings* that will reduce the risk of accidents that could otherwise arise from inherent hazards or from the malfunction of mechanical equipment. The standards are intended to:

- ensure accessibility to and within *buildings* and that areas presenting risk through access are correctly guarded;
- reduce the incidence of slips, trips and falls, particularly for those users most at risk;
- 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;
- prevent the creation of dangerous obstructions, ensure that windows can be cleaned and operated safely and to reduce the risk of injury caused by collision with glass;
- safely locate hot water and steam vent pipe outlets, and minimise the risk of explosion through malfunction of unvented hot water storage systems;
- ensure the appropriate location and *construction* of storage tanks for liquefied petroleum gas.

4.0.3 Latest changes

It was the intention that this Technical Handbook would be a level transfer of the technical requirements in the previous Parts of the Technical Standards. However certain recommendations have either been clarified, updated or become obsolete over the last few years. It was felt necessary therefore to include these changes in this new technical handbook.

The following is a summary of the changes that have been introduced since the 6th amendment to the Technical Standards came into force in March 2002.

4.1.1 guidance included on dimensions for parking spaces for *disabled people*, if provided
4.1.2 introduction of guidance on provision of drop kerbs
4.1.8 additional guidance on common entrances
4.1.8 clarification of guidance on accessible thresholds
4.2.2 revised guidance on when a lift should be provided
4.2.4 additional guidance on accessible lobbies
4.3.2 additional guidance on application of term '*private stair*'.
4.3.2 additional guidance given on provision of a stairlift to a *private stair*.
4.3.3 revised guidance on minimum step rise
4.3.7 more appropriate method of measuring landing length on stairs
4.3.8 additional guidance on length of landings in relation to fully *glazed* doors
4.3.9 additional guidance on cupboard doors at landings
4.3.13 revised guidance for ramp edge guarding
4.3.14 clarification of guidance on ramp widths
4.3.16 revised guidance on landing length of ramps
4.3.18 revised guidance on handrails to wide stairs
4.8.3 clarification on size of working areas provided
4.8.4 clarification on size of working areas provided

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 defines 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

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 wheelchair users to: (a) a *house,* where there are no *apartments* on the entrance *storey*; (b) a *house,* where it is not *reasonably practicable* to *construct* a level or ramped access route between the point of access to, or from any car parking within, the *curtilage* of a *building* and an entrance to the *house*; or (c) 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

Inclusive design

The issue of access should be considered an integral part of any project from inception and an inclusive approach should be taken to design to ensure accessibility. One method of assisting this process may be the production of an access strategy, which can be developed and refined as the design evolves.

Consideration should be given to the wide variety of people that may use a *building* and to access for the resident or visitor, considering factors such as:

- disability – e.g. wheelchair user, visually impaired; or
- age – e.g. infant or elderly; or
- circumstance – e.g. laden with shopping, pushing a pram.

Good practice

A number of issues relating to good practice are outwith the scope of this Technical Handbook. Designers may refer to the following publications for additional information on good practice over and above the guidance in this Handbook:

- BS 8300 : 2001 – 'Design of buildings and their approaches to meet the needs of disabled people - Code of practice'
- 'Housing for Varying Needs' Parts 1 and 2 - Communities Scotland
- '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* must be improved to as close to the requirement of this standard as is *reasonably practicable*, and in no case be worse than before the *conversion* (Regulation 12, Schedule 6)

4.1.1 Car parking to *buildings* containing *flats* or *maisonettes*

Parking spaces for *disabled people*

The provision of car parking to *domestic buildings* may be subject to planning legislation and is not a matter covered by the building regulations.

However, where car parking is provided to *buildings* containing *flats* and *maisonettes*, designers may wish to consider provision of parking spaces suitable for *disabled people*, to an extent similar to that given in the guidance for non-domestic *buildings*. This proposes that car parking spaces designated suitable for *disabled people* should be:

a. provided at a ratio of at least 1 car parking space per 20 parking spaces, or part thereof; and
b. not more than 45 m from the common entrance of the *building*; and
c. clearly marked as parking for *disabled people*; and
d. at least 4.8 x 2.4 m with a clear space at least 1.0 m wide along one long side which may be shared between 2 car parking spaces.

4.1.2 Approach to *buildings* containing *flats* or *maisonettes* (Q2.1, Q2.4)

The approach to a *building* containing *flats* or *maisonettes* should allow unassisted access for everyone. It is recommended that the approach should be level but where this is not practicable, access may incorporate a ramp suitable for wheelchair users. Guidance on ramps is given under standard 4.3.

Within the *curtilage* of a *building*, a level or ramped access suitable for wheelchair users should be provided to the common entrance of the *building* from a *road* and from any car parking provided for *disabled people*.

Obstructions

Care should be taken to ensure there are no barriers, such as kerbs, steps or other obstructions, restricting access. A dropped kerb should be provided between any *road* or car parking provided for *disabled people*, and the access route to a *building*. It is important to consider how to avoid restrictions or other hazards that may cause injury on an approach to a *building*. Low level bollards or chain-linked posts, for example, are particularly hazardous to people with a visual impairment.

Surface materials

It is important that the surface of an access route should be firm and permit ease in manoeuvring. Surfaces should be uniform and of a material and finish that, taking into account anticipated use and environmental conditions, provides a level of traction that will minimise the possibility of slipping.

Surfaces to an access route appropriate for wheelchair users, include:

a. 50 mm concrete slabs bedded on granular material; or
b. 30 mm tarmacadam to BS 4987: Parts 1 and 2: 2001 laid on 100 mm of consolidated hardcore bottoming or
c. 50 mm clay or calcium silicate pavers to BS 6677: Part 1: 1986, laid in accordance with BS 7533: Part 2 : 2001; or
d. 60 mm concrete paving blocks to BS 6717: 2001, laid in accordance with BS 7533: Part 2 : 2001.

The above list does not preclude the use of other materials where appropriate performance, permanence and durability can be demonstrated. Loose laid materials, such as gravel are not appropriate.

4.1.3 Length of access route to *buildings* containing *flats* or *maisonettes* (Q2.2)

It is important to recognise that some *building* users can tire quickly, particularly where an access route is not level. There should be a limit to the distance they should have to travel, from a point within the *curtilage*, to reach a *building*.

The length of the access route from a *road,* or from any car parking space provided for disabled people, to the common entrance to a *building* containing *flats* or *maisonettes* should not exceed 45 m.

4.1.4 Width of approach to *buildings* containing *flats* or *maisonettes* (Q2.3)

The width of an access route should provide sufficient space for people travelling in opposite directions to pass and to carry out any necessary manoeuvres. Provisions for people requiring the use of a wheelchair or crutches should be considered, particularly at changes of direction. To ensure this can be achieved, the unobstructed width of an access route should be at least 1.2 m.

By restricting the maximum length of approach, it is unlikely that wheelchair users would require to pass at the same time. However, where this is assessed as more likely, consideration should be given to increasing the width of the access route.

4.1.5 Approach to *houses* (Q2.1)

The approach to a *house* should allow unassisted access for everyone.

Level or ramped access suitable for wheelchair users should be provided to at least one entrance to a *house*, from a *road* and from any car parking within the *curtilage* of the *building*. This need not necessarily be the front or main entrance, permitting flexibility in the choice of accessible entrance. Clause 4.1.2 gives guidance on surfaces to such routes.

Stepped access

However, level or ramped access need not be provided on an access route serving a single *house* where:

a. there are no *apartments* on the accessible entrance *storey*, or
b. it is not *reasonably practicable* to *construct* such an access route in accordance with clause 4.4.1, such as on a steeply sloping *site*.

Reasonably practicable

If ramped access to a *dwelling* can be achieved with one change in direction between the bottom of the ramp and the top landing, this may be considered to be a *reasonably practicable* solution.

Alterations and extensions

Where a *dwelling* is extended, or the external facade is altered, there is no need to alter the existing access to the *dwelling*. However, where an accessible entrance exists, the extension or alteration should not reduce the level of access provision to the *dwelling.*

For example, where an extension is *built* over an existing accessible entrance or renders it unsuitable, then another accessible entrance should be provided either elsewhere to the existing *building* or to the extension. In such cases, any new entrance should also maintain the level of access previously existing within the entrance *storey*.

4.1.6 Length of access route to *houses* **(Q2.2)**

The length of the access route from a *road* and from any car parking space within the *curtilage* of the *building* should not exceed 45 m.

4.1.7 Width of approach to *houses* **(Q2.3)**

Elderly and *disabled people* need more space to negotiate stairs and ramps. Wheelchair users particularly can have difficulty in controlling their ascent and descent on ramps.

The clear and unobstructed width of a level access should be at least:

a. 900 mm where it serves 1 or 2 *dwellings*;
b. 1200 mm where it serves more than 2 *dwellings*;

The effective width of a stair or ramped access, measured between handrails, should be at least:

a. 1000 mm, where it serves 1 or 2 *dwellings*;
b. 1200 mm where it serves more than 2 *dwellings*.

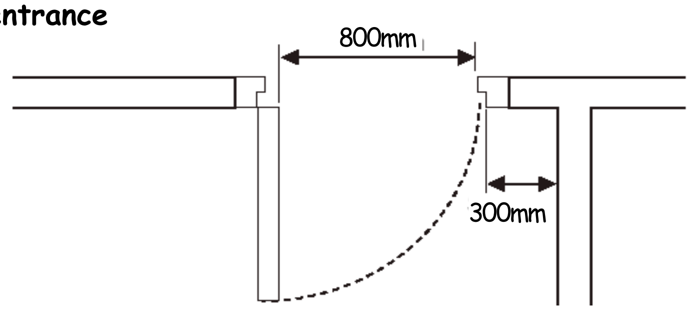
4.1.8 Common entrance to *buildings* containing *flats* or *maisonettes* **(Q2.5, Q2.6, Q2.7)**

Unless suitably designed, the principal entrance to a *building* can often present a barrier to access. The doorway and door leaf(s) should present as little restriction to passage as is *reasonably practicable*.

The common entrance to a *building* containing *flats* or *maisonettes* should be accessible to all persons and should have:

a. a platt, level except for any nominal slope for drainage, at least 1.2 m x 1.2 m; and
b. a threshold that will not be a trip hazard and will permit unassisted access to people in a wheelchair; and
c. a door leaf which provides a clear opening width of at least 800 mm in accordance with the diagram below; and
d. a clear *glazed* panel or panels giving a zone of visibility from a height of not more than 900 mm to at least 1.5 m above finished floor level; and
e. an unobstructed space on the side next to the leading edge of at least 300 mm, in accordance with the diagram below. However this need not be provided where the door is opened by automatic control; and
f. where it comprises a revolving door, an adjacent side hinged door in accordance with the points noted above.

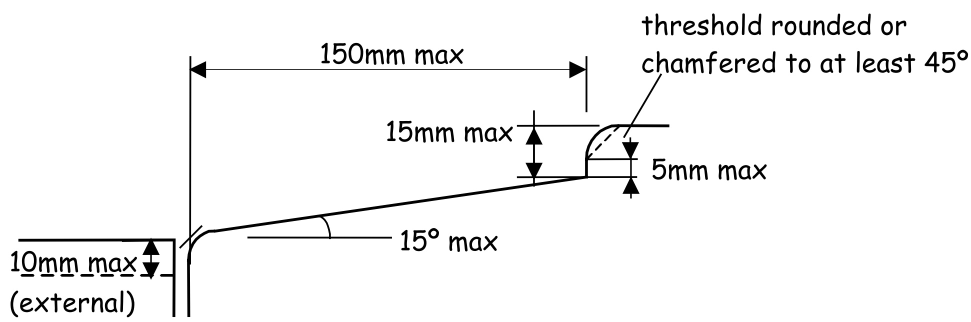
Common entrance



Protection from the elements

For the convenience of people entering a *building*, designers should consider providing protection from the elements to any accessible entrance, e.g. a canopy or covered recess.

Generic threshold profile



Accessible threshold

Care should be taken with the design of an accessible threshold. The following criteria should be taken into account:

- 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;
- any external sill or internal transition unit should be at a angle of not more than 15º to the horizontal and, if sloping, no more than 150 mm in length;
- the threshold should either be level or of a height and form that will neither impede access by an unassisted wheelchair user or create a trip hazard. Any threshold piece should have a height of no more than 15 mm, with any vertical element of more than 5 mm height being pencil-rounded or chamfered to an angle of no more than 45º to the horizontal;
- where it is unavoidable that the finished internal floor level is more than 15 mm below the top of the threshold, an internal transition unit finishing not more than 5 mm above the internal floor surface may be provided, in accordance with the guidance above.

The design of level thresholds should prevent the ingress of rain. The details in DETRs publication 'Accessible Thresholds in New Housing' provide helpful guidance on how this might be achieved.

4.1.9 Accessible entrance to *houses* (Q2.6, Q2.7)

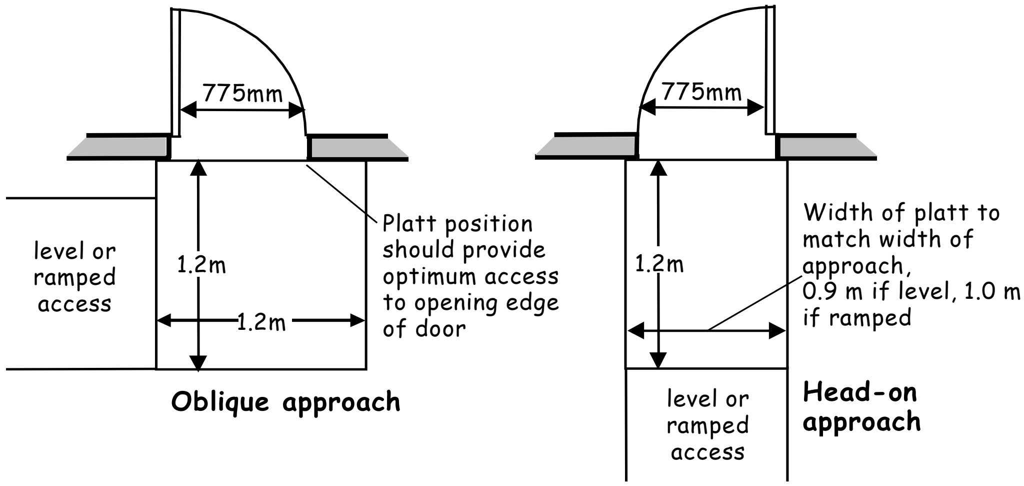
At least one entrance to a *house* should be accessible to all and have:

a. a platt, level except for any nominal slope for drainage, at least 1.2 m long x 1.2 m wide. Where approach to the entrance is head on, the platt width may be reduced to 0.9 m if the approach is level, or to 1.0m if the approach is a ramp, as shown below; and
b. a threshold that will permit unassisted wheelchair access. Reference should be made to clause 4.1.8 for details of accessible thresholds; and
c. an entrance door with a clear opening width of at least 775 mm measured in accordance with clause 4.1.8.

The above also applies to entrance doors to *flats* and *maisonettes* from common areas within a *domestic building.*

Where wheelchair access is not provided to a single *house*, as described in clause 4.1.5, this guidance need not be followed.

Entrance platt to single houses



4.2 Access within buildings

contents

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 *domestic buildings*, safe and convenient means of access is provided to each *dwelling* and throughout the common areas;

(c) in *residential buildings*, a proportion of the *rooms* intended to be used as bedrooms must be accessible to wheelchair users;

(d) in *dwellings*, safe means of access is provided for occupants throughout the *dwelling*; and

(e) in *dwellings*, safe and unassisted means of access is provided for visitors throughout at least one *storey* and to *sanitary facilities.*

Limitation

There is no requirement to provide access suitable for wheelchair users:

(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, to common areas, other than on an entrance *storey*.

4.2.0 Introduction

Access within a *dwelling* should provide a 'visitability standard', where persons with reduced mobility - be it through age, permanent disability of temporary incapacitation - may, if visiting a *dwelling*, make reasonable use of facilities within.

The guidance to this standard is relevant to all *dwellings* regardless of whether or not access suitable for *disabled people* is provided to the *dwelling.*

Good practice

Whilst this guidance is not intended to create *dwellings* that, from the outset, permit independent living for all *disabled people,* designers are encouraged to consider further improvement to the provision of access within *dwellings.*

A number of issues relating to good practice are outwith the scope of this Technical Handbook. Designers may find the following publications helpful in providing additional guidance:

- BS 8300 : 2001 – 'Design of buildings and their approaches to meet the needs of disabled people - Code of practice'
- 'Housing for Varying Needs' Parts 1 & 2, published by Communities Scotland

Conversions

In the case of *conversions*, as defined by Regulation 4, the *building* as *converted* must be improved to as close to the requirement of this standard as is *reasonably practicable*, and in no case be worse than before the *conversion* (Regulation 12, Schedule 6)

4.2.1 Access between *storeys* (Q2.13, S3.1)

Where a *dwelling* has accommodation on more than one *storey*, the *storeys* containing accommodation should be connected by a stair or ramp *constructed* in one of the following ways:

a. a straight *flight* in accordance with clauses 4.3.1 to 4.3.8;
b. a *flight* consisting partly of straight and partly of tapered treads in accordance with clause 4.3.9;
c. a *flight* consisting wholly of tapered treads in accordance with clause 4.3.10;
d. a pedestrian ramp in accordance with clauses 4.3.11 to 4.3.15.

This guidance is not relevant to stairs providing access only to storage.

4.2.2 Common access to *dwellings* within *buildings* containing *flats* and *maisonettes* (Q2.8, Q2.9)

Where access from the common entrance of a *building* to the entrance *storey* of a *dwelling* is by way of a common access, the corridor should have an unobstructed width of at least 1.2 m.

Stairs in common areas should be designed to be accessible by ambulant *disabled people* (see guidance to standard 4.3). However it is recognised that it is not *reasonably practicable* for all areas to be accessible to *disabled people* and such access need not be provided to:

a. a *storey* containing only fixed plant or machinery, the only normal visits to which are intermittent and to inspect or maintain the fixed plant or machinery; or
b. any catwalk, racking or openwork floor.

Passenger Lifts

A *building* containing *flats* or *maisonette* of up to 4 *storeys* in height may be *constructed* without the provision of a passenger lift. In such *buildings*, access for wheelchair users need only be provided to, and within, common areas of the principal entrance *storey.*

However, where the entrance to any *dwelling* is more than 10 m above or below the principle entrance level, a lift should be provided to serve all *storeys*. In such a situation, corridors on all *storeys* should have an unobstructed width of at least 1.2 m.

Where a lift is provided, every *flat* and *maisonette* in the block should have at least one entrance accessible to *disabled people* in accordance with clause 4.1.9. A passenger lift should be designed and installed to provide the following:

a. a clear landing at least 1.5 x 1.5 m in front of the lift entrance door or doors; and
b. lift door or doors with a clear opening width of at least 800 mm; and
c. a lift car at least 1.1 x 1.4 m; and
d. within the lift car, a horizontal rail 900 mm above the floor on 3 sides or, if the lift car has 2 doors, on 2 sides; and
e. controls on each level served, sited between 900 mm and 1.2 m above the landing, and within the lift car on a side wall between 900 mm and 1.2 m above the car floor and at least 400 mm from the corner; and
f. tactile call buttons and visual and tactile indication of the *storey* level on each *storey* served; and

g. 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
h. a signalling system which gives a 5 second notification that the lift is answering a landing call
i. a signalling system which gives a dwell time of 5 seconds before the lift doors close after they are fully open.
This may be reduced to 3 seconds where the door closing system is over-ridden by a door re-activating device which relies on photo-eye or infra-red methods, but not a door edge pressure system.

When the *storey* height exceeds 18 m and a passenger lift doubles as a fire-fighting lift, reference should be made to Annex A of Section 2 (Fire).

4.2.3 Accessible *storeys* (Q2.11, Q2.12)

It is not the intention that all *houses* should be designed to permit independent living by people with a disability. They should, however be provided with a degree of accessibility that permits *disabled people* to visit a dwelling and make reasonable use of facilities on at least one *storey*.

The following guidance is relevant to every *dwelling,* whether or not access for *disabled people* is provided to the principal entrance *storey* or not.

Every *dwelling* should have a *storey* accessible to *disabled people* on either:
a. the principal entrance *storey* of the *dwelling*; or
b. where there are no *apartments* on this *storey*, the first *storey* above or below the principal entrance *storey* of the d*welling*.

An accessible *storey* should allow *disabled people* to gain access to all *apartments* and to an accessible *toilet* unaided. The accessible *storey* should have:
a. level or ramped access throughout the *storey*; and
b. corridors of at least 900 mm wide, although this may be reduced to 750 mm over a maximum length of 2 m for such fixtures as a radiator, provided the reduced corridor width does not conflict with sub-clause c; and
c. an accessible *toilet*, as described in clause 3.12.3; and
d. minimum clear opening door widths in accordance with the following table to each *apartment*, *kitchen* and to an accessible *toilet*:

Width of internal doors

Minimum corridor width at door (mm)	Minimum clear opening width (mm)
1200	750
1050	775 [1]
900	800 [1]

Note:
1. the opening width may reduce to 750mm if door is approached head-on.

Where a split-level is proposed within a *storey* which is also the accessible *storey*, a stair within the *storey* may be installed provided that there is level or ramped from the entrance to the *dwelling* to at least 1 *apartment* and to an accessible *toilet*, in accordance with the guidance above.

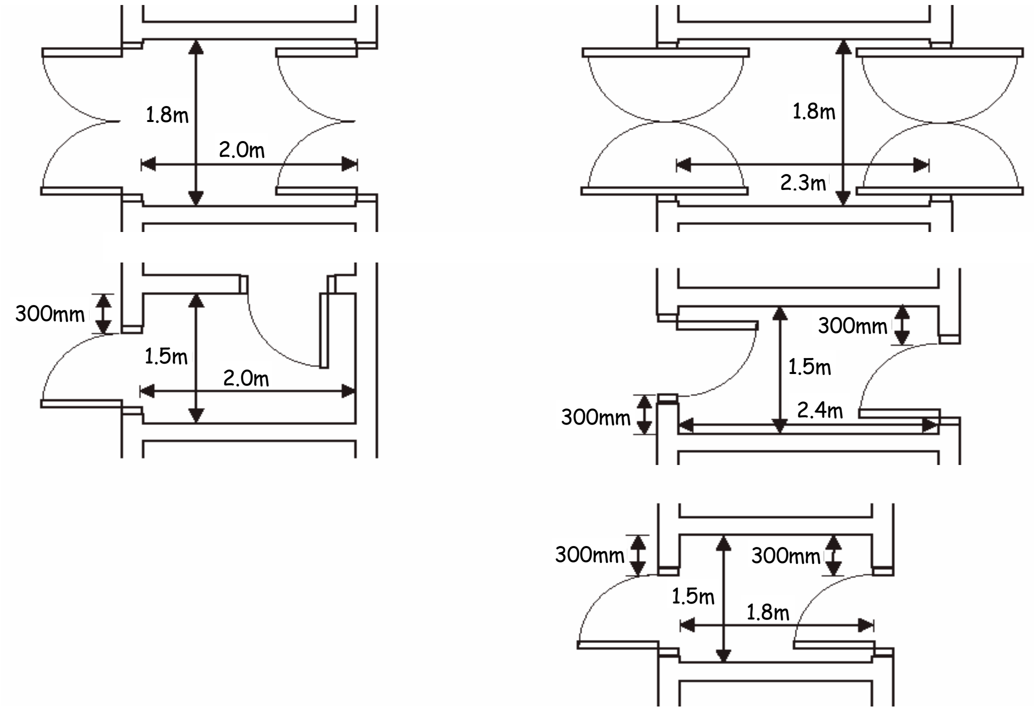
4.2.4 Accessible lobbies (S2.5, S2.9)

An entrance or internal lobby accessible to *disabled people* should be of a size that will:

a. provide space for a person or persons to pass through conveniently; and
b. permit a wheelchair user to clear the swing of one door before using the next; and
c. allow for someone assisting the wheelchair user.

Glazing to lobby doors should be provided in accordance with the guidance in clause 4.1.8.

Accessible lobbies



4.2.5 Alterations and extensions

New corridors and doorways in an extension should be *constructed* in accordance with the guidance in clause 4.2.3 where access for *disabled people* is provided, between:

- an *apartment* and an accessible *toilet*; or
- an *apartment* and an accessible entrance to the *dwelling*.

This will also apply to alteration *work* within an existing *building*, where corridors are altered or new doorways are being formed.

Small extensions

In some extensions, particularly those involving very short corridors and/or 1 or 2 doors, the benefits of providing full accessibility as described in clause 4.2.3, may be of little value if existing access to the extension from within the *dwelling*, is not already accessible to *disabled people*. In these instances, application of the guidance given in clause 4.2.3 may not be appropriate.

However, such a decision would have to be considered against the specific situation in a particular extension or alteration, and take into account the potential benefit provided to disabled occupants or visitors.

4.3 Stairs and ramps

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

Stairs and ramps should be 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.

Half of all accidents involving falls within and around *buildings* occur on stairways, with young children and the elderly being particularly at risk. Risk can be greatly reduced by ensuring that changes in level are designed in such a manner that all stairs, ramps and protective barriers forming part of a *building* incorporate the basic criteria of safety, which are:

- that stair and ramp design must be within limits recognised as offering safe passage (guidance given under this standard); and
- that protective barriers are designed to reduce the risk of injury from falling to a lower level (refer to the guidance to standard 4.4); and
- to protect people from vehicles, where vehicles have access to a *building* (refer to the guidance to standard 4.12).

Tapered tread

Tapered tread means a stair tread in which the nosing is not parallel to the nosing of the tread or landing next above.

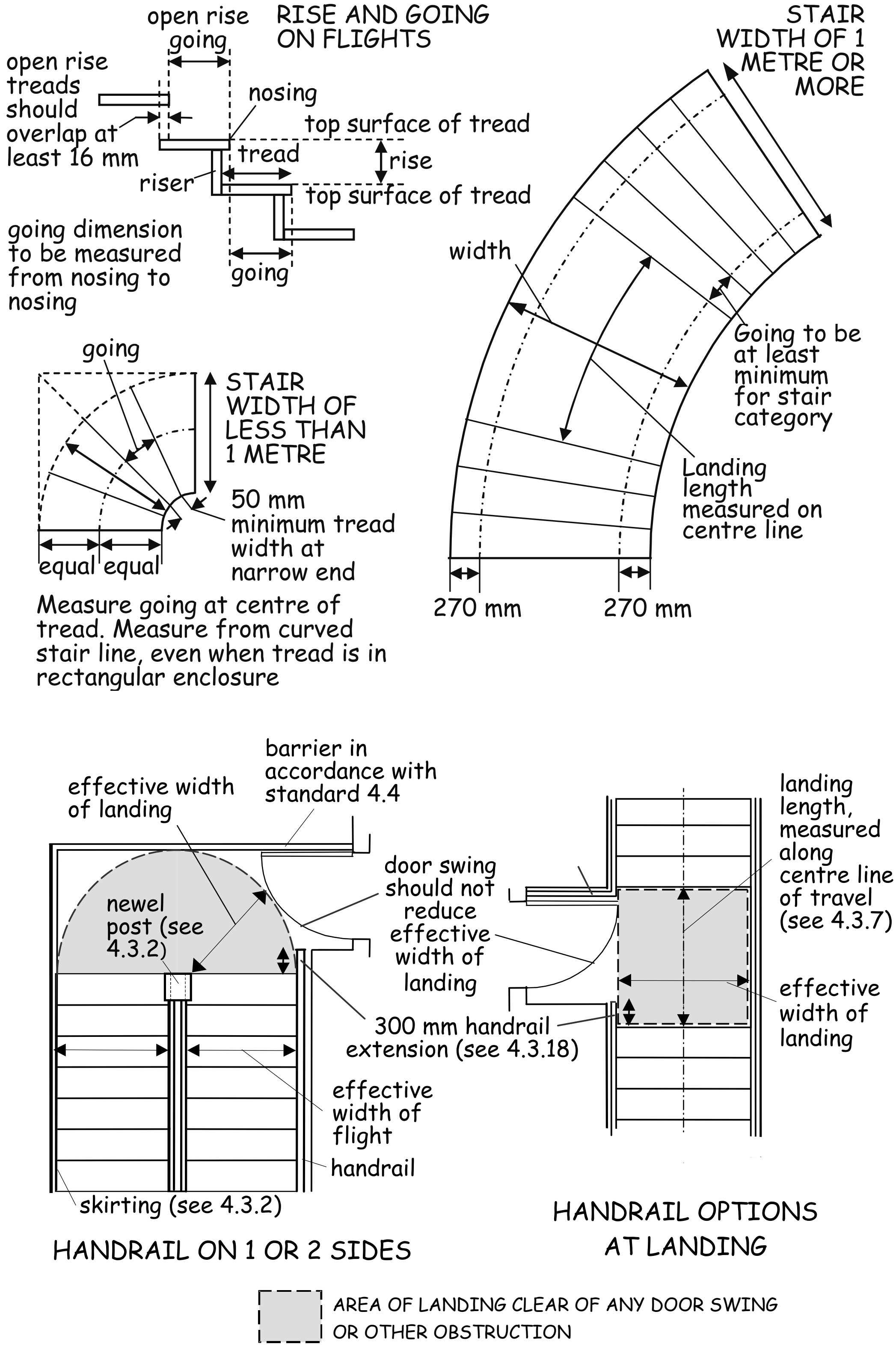
Conversions

In the case of *conversions*, as specified in Regulation 4, the *building* as *converted* must be improved to as close to the requirement of this standard as is *reasonably practicable*, and in no case be worse than before the *conversion* (Regulation 12, Schedule 6)

4.3.1 Measurement for stairs (S3.2)

A stair should be measured in accordance with the diagram shown below.

Measurement for stairs



4.3.2 Width of stair *flights* (S3.4)

The clear, or effective, width of a stair should allow users to move up and down unhindered.

Measurement of the effective width should be between handrails, or any wall or protective barrier where there is no handrail present, and should be clear of obstructions as described in the diagram to clause 4.3.1. The effective width of a stair should be at least:

Widths of *flight*

Private stair	**Any other stair**
a. 900 mm where it is within the *accessible storey*, such as a split level; or b. 600 mm where it serves only *sanitary accommodation* and/or one *room*, other than a living room or *kitchen*; or c. 800 mm elsewhere, such as from one *storey* to another.	at least 1 m, such as an external *flight* to a *domestic building* or in a common access in a *building* containing *flats* or *maisonettes*.

'private stair'

The term '*private stair*' should also apply to an internal stair used for domestic purposes wholly within a *building* ancillary to a *dwelling* and not accessible to the public, for example, a stair to an area within a domestic garage.

The position of stringers and newel posts should not encroach adversely into the effective width of a stair. This may be achieved by limiting any such projection to not more than 30 mm.

chair stairlifts

A chair stair lift may be fitted to a *private stair* and may project into the effective width of the stair. However, in such cases, handrail provision should be maintained as noted in clause 4.3.18 and, when at rest, the installation should:

a) permit safe passage on the stair and any landing; and
b) not form an obstruction to the normal use of any door or doorway.

4.3.3 Rise, going, tread and pitch of stairs (S3.3, S3.5, S3.6, S3.7, S3.9)

The rise, going, tread and pitch of a *flight* in a stair should be in accordance with the following table:

Stair* geometry – stairs 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	34º

Stair* geometry – *private stair

Minimum rise (mm)	Maximum rise (mm)	Minimum going (mm)	Tread	Maximum pitch
100	220	225	not less than going	42º

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.
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.

Stair pitch

The pitch of a *private stair flight* may be steeper than that of a public *flight* (any other stair) as occupants will be more familiar with the stair through frequent use. However, a maximum pitch should still be avoided where possible.

The most comfortable combination of rise and going varies between individuals but in general, a going in excess of the minimum, resulting in a figure in the upper end of the range in note 5, above, will increase safety.

If an overhanging nosing is present, the length of the tread of a step will exceed that of the going. Where this occurs, the profile of any stair, other than a *private stair,* should be *constructed* in accordance with the guidance given in clause 4.3.5.

Minimum rise

A step with a small rise is less prominent and may result in an increase likelihood of tripping, especially where the rise is less than 100 mm. Steps with a rise of less than this height should therefore be avoided.

4.3.4 Number of rises in a *flight* (S3.10)

The act of climbing stairs can be tiring to many people. Whilst landings can provide a safe resting point, the flight itself does not. 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 significantly contribute to a trip hazard.

Generally, a *flight* should have at least 3 rises.

Flights of less than 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. between an external door of a *building*, not being an accessible entrance under clause 4.1.8 or 4.1.9, and the ground, balcony, *conservatory*, *porch* or private garage; or
b. wholly within an *apartment*; or
c. wholly within *sanitary accommodation*, other than in an accessible *toilet* (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 90º (i.e. on a quarter landing as the first step).

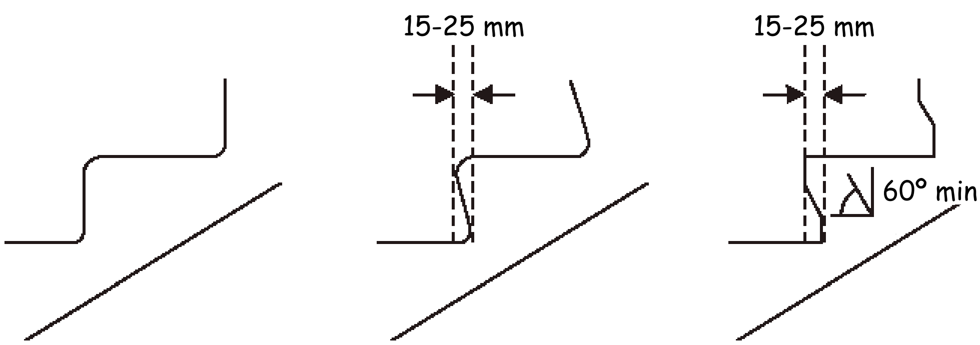
4.3.5 Guidance for risers and treads (S3.8, S3.11)

Stairs providing access to and within the common areas of *domestic buildings* should be designed to be accessible by ambulant *disabled people*. Clause 4.2.2 provides guidance on the areas that should be fully accessible to *disabled people*.

Open risers can be a hazard. When ascending a stair, some people are at risk of trapping the toes of their shoes beneath projecting nosings, and of tripping as a result. In addition, some may feel a sense of insecurity when looking through spaces between the treads

Any stair providing access for *disabled people* should have contrasting nosings to assist those with a visual impairment. 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*.

Step profile examples



Use of open risers

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.

Where open risers are used, special consideration should be given to their design. Small children can climb or fall through them and the size of gaps should be designed to prevent this. In a *flight* with open rises, the treads should overlap by at least 16 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 (S3.18)

A landing should be provided at the top and bottom of every *flight*.

A single landing may be common to 2 or more *flights* and it should be level or, if open to the elements, have a nominal crossfall that should prevent standing water.

Other than at an accessible entrance, a landing need not be provided to a *flight* 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 aggregate rise is not more than 600 mm; or
- a *dwelling* or private garage ancillary to a *dwelling* and the ground, balcony, *conservatory*, or *porch*, where the change in level is not more than 170 mm.

4.3.7 Length of stair landings (S3.19)

Many people will often wish to pause on stairs, particularly during ascent. A landing can be used as a temporary respite and it should therefore be of a size to allow this to be done safely and conveniently whilst still permitting other people to pass.

The minimum length of a stair landing, measured along the centreline of travel, should be either 1200 mm, or the effective width of the stair, whichever is least.

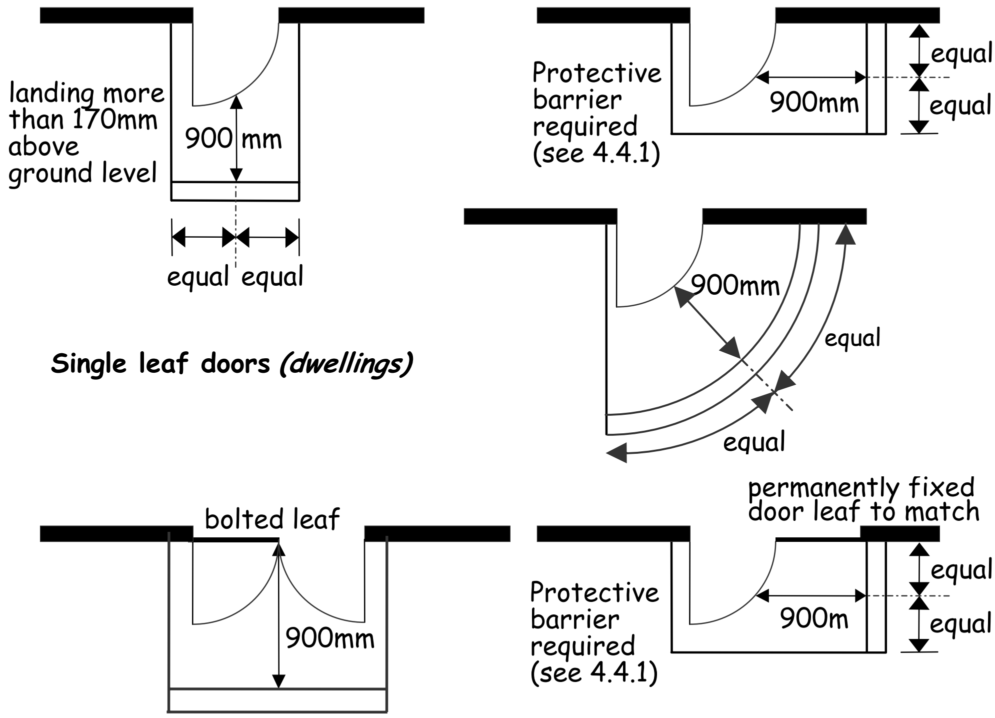
However, where, on an intermediate landing, a change of direction of 90º or more occurs, the calculation of centreline length may be ignored provided the effective width of the stair is maintained across the landing.

The landing area should be clear of any door swing or other obstruction as described in diagram 4.3.1.

4.3.8 Landings serving outward opening fully *glazed* doors

Conservatories and 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 external access is not the accessible entrance and has an outward opening fully *glazed* door, a landing, of a length shown in the diagram below should be provided 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



Double leaf doors *(dwellings)*

4.3.9 Width of stair landings (S3.4a, S3.19c)

The effective width of a landing should not be less than the effective width of the stair *flight* as described in clause 4.3.2.

Measurement of the effective width should be taken between handrails, or protective barrier where there is no handrail. Where there are no handrails or protective barriers, measurement should be to the edge of the wall or outside face of the stringer. The effective width of the landing should be clear of any door swing or other obstruction.

A door may open on to the bottom landing of a *flight* such that at any angle of swing a clear length of at least 400 mm is left across the full width of the landing.

A door to a cupboard or *duct* may open onto a landing to the top of a *flight* of a *private stair* such that at any angle of swing a clear space of at least 400 mm is maintained across the full width and length of the landing.

4.3.10 *Flights* consisting partly of straight and partly of tapered treads (S3.12, S3.13, S3.14)

In 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 provided 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 the 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.

4.3.11 *Flights* consisting wholly of tapered treads (S3.15)

Stairs formed from tapering treads, particularly where forming a spiral, can present greater difficulties in use than straight *flights*. There should be an appropriate level of safety and amenity on such stairs, particularly where used as a means of primary access.

A *flight* consisting wholly of tapered treads should be *constructed* to give safe passage. To achieve this, a *flight* consisting wholly of tapered treads, forming a helix or spiral, should be *constructed* in accordance with the guidance in BS 5395: Part 2: 1984, but account should be taken of the following guidance clauses:

- the effective width should be as recommended in clause 4.3.2; and
- minimum rise, maximum rise and minimum centreline going 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 on a *private stair*, risers and treads should be as recommended in clause 4.3.5; and
- handrails should be provided as recommended in clauses 4.3.18 and 4.3.19; and
- protective barriers should be as recommended in clause 4.4.2.

4.3.12 Pedestrian ramps (S3.16)

When specifying ramps, gradients should be as low as practicable. Steep gradients require both greater effort to ascend and more awareness when descending. As a general principle, the steeper the gradient of a ramp *flight*, the shorter the *flight* should be.

A gradient less than 1 in 20 is not considered to be present any additional hazard and for the purposes of this guidance is deemed level. Steeper gradients up to 1 in 12 should be considered as ramps and designed as such. Gradients more than 1 in 12 are considered too steep to negotiate safely and are not recommended. A pedestrian ramp should be *constructed* in accordance with the following table:

Length and gradient of a *flight* in a pedestrian ramp

Gradient of *flight*	Maximum length of *flight*
1 in 20 to not more than 1 in 15	10 m
1 in 15 to not more than 1 in 12	5 m
More than 1 in 12	not recommended

Ramps are also not necessarily safe or convenient for ambulant *disabled people* who may find them more difficult to negotiate than a stair. Where a ramp is proposed, an adjacent, stepped access should also be considered

4.3.13 Guarding to the edge of pedestrian ramps (S3.17b)

Precautions should be taken to prevent the possibility of a fall where there is a difference in level between the edge of a ramp and the adjacent ground. Such precautions may include:

a. a kerbed upstand at least 100 mm high, on the open side of the ramp; or
b. appropriate guarding in accordance with clause 4.4.1 and 4.4.2; or
c. a landscaped margin, level with the edge or the ramp for a distance of 300 mm before starting to gradually fall away.

A kerb upstand may be used without additional guarding to a ramp serving a single *dwelling* where the change in level is no more than 600 mm. Reference should, however, be made to guarding guidance given in clauses 4.4.1 and 4.4.2 to ensure that appropriate protective measures are undertaken.

The use of a kerb upstand alone is not recommended for a ramp in open landscaping, as it presents a potential trip hazard, particularly for visually impaired or ambulant *disabled people*.

4.3.14 Width of ramp *flights* (S3.17a)

The effective width of a *flight* in a ramp should be at least 1 m. Measurement should be taken between handrails, or where there are no handrails, the protective barrier or inside face of the kerb, and be clear of any obstructions.

In practice, the choice of ramp width should relate to the intensity of use. For example, an unobstructed width of 1800 mm is the minimum that will permit 2 wheelchair users to pass one another safely.

4.3.15 Ramp landings (S3.18)

A landing should be provided at the top and bottom of every ramp *flight*. A single landing may be common to 2 or more *flights* and it should be level or, if open to the elements, have a nominal cross fall sufficient to prevent standing water.

4.3.16 Length of ramp landings (S3.19)

Wheelchair users should be provided with space to stop on landings, to open and pass through doors without the need to reverse into circulation routes or manoeuvre on the ramp *flight*.

The length of a landing on a ramp, clear of any door swing or other obstruction should be not less than:

a. 1.2 m; or
b. 1.0 m where it serves 1 or 2 *dwellings* only.

On heavily travelled routes, increasing the length of intermediate landings to 1.5 m should be considered, so that they can serve as passing places.

Where a landing serves the head of both a stair and a ramp, consideration should be given to increasing the effective length of the landing, across the width of the stair, to provide additional manoeuvring space for wheelchair users.

4.3.17 Width of ramp landings (S3.4)

The effective width of a landing in a ramp should be not less than the effective width of the *flight.* Measurement should be taken between handrails, or where there are no handrails, the protective barriers or inside face of the kerb, and be clear of any obstructions.

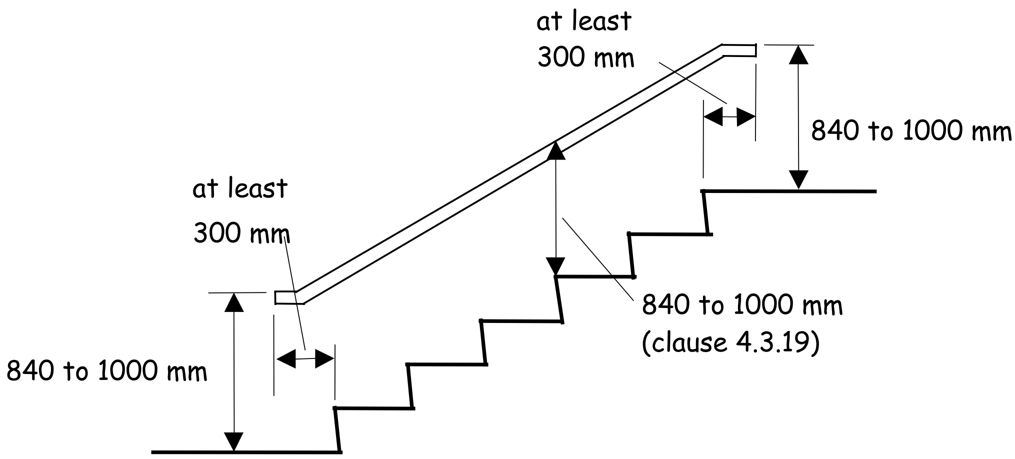
4.3.18 Handrails to stairs and ramps (S3.20, S3.21, S3.23, S3.24)
To provide support and assist safe passage, handrails should be provided on all stair and ramp *flights*.

It should be recognised that the full width of a *flight* may be used by people passing and that a person using a stair or ramp may be weaker on one side. To ensure adequate support, a handrail should therefore be provided on each side of a *flight* to a ramp or stair.

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:

a. a handrail may be omitted to the *flight* of a ramp serving a single *dwelling*, where the change in level is less than 600mm; or
b. a handrail may be provided to one side only on a *private stair*.

Handrails to stairs and ramps



The extension of a handrail at landings allows an individual to steady or brace themselves before ascending or descending. For a person with impaired vision the change in slope of the handrail and its return into a wall will signal the start or finish of the *flight*.

A handrail on a stair or ramp should:

a. extend at least 300 mm beyond the top and bottom of a *flight* in accordance with the diagram above. However the 300 mm extension may be omitted where the handrail abuts a newel post or where it is continuous round the inner side of the stair at an intermediate landing, and
b. have a profile and projection that will allow a firm grip
c. be scrolled or wreathed when not forming part of a protective barrier.

These 3 criteria need not be provided on a stair or ramp providing access to, or within, a single *dwelling* as users are likely to be familiar with the layout.

Division of wide *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 not forming part of an *escape route*.

4.3.19 Height of handrails (S3.22)

A handrail should be fixed at a height of at least 840 mm and not more than 1000 mm, measured vertically above the pitch line of a *flight* on a stair or ramp and on a landing where a handrail is provided.

For guidance on height of barriers, see clause 4.4.2.

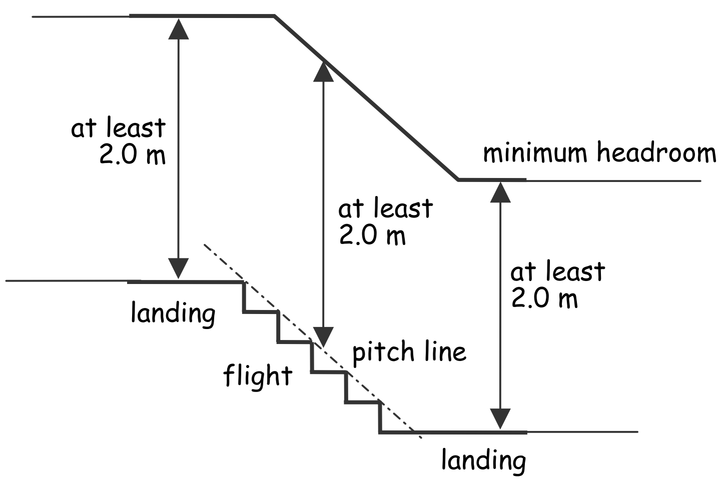
4.3.20 Headroom on stairs and ramps (S3.25)

A *flight* or landing on a stair or ramp should have a clear headroom of at least 2 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.

Reference should be made to the guidance given in clause 4.8.1.

Headroom on stairs and ramps



4.3.21 Industrial stairs and fixed ladders (S3.26)

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: 1994, as appropriate; or
b. BS 5395: Part 2: 1984 where the stair is a type A spiral or helical stair.

4.4 Pedestrian protective barriers

contents

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

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.

The barrier adopted should be designed so as to minimise the risk of persons falling, rolling, sliding or slipping through gaps in the barrier.

Studies have shown that once children are about 4 years old they can climb almost any barrier with a height of up to 1100 mm. Designers should therefore consider barrier design carefully, to protect the very young within both *dwellings* and the common areas of *domestic buildings*.

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 this standard 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 (S4.1)

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. Any drop where a wheelchair user has to turn can be a potential hazard.

It would be unrealistic 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, 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 landing where the route of travel from the adjoining level to the next *flight* changes direction, such as on a platt at an accessible entrance.

However there is no need to provide a protective barrier where the barrier would be incompatible with the normal use of an area, though such instances will be extremely rare within *domestic buildings.*

A wall, partition or fixed *glazing constructed* in accordance with the recommendations of clause 4.4.2 is considered to be an appropriate barrier.

4.4.2 Design of pedestrian protective barriers (S4.2, S4.3)

In and around *domestic buildings*, gaps in a barrier should not be large enough to permit a child's head to pass through. To protect against 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 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 *glazing* incapable of withstanding the loads specified in BS 6399: Part 1: 1996	800
in front of an openable window [2]	800
on a stair or ramp wholly within a *dwelling*	840 [3]
on a stair or ramp outwith a *dwelling*	900 [3]
a *gallery*, landing or raised area within a *dwelling*	900
all other locations	1100

Notes:

1. A handrail provided in accordance with clauses 4.3.16 and 4.3.17 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;
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.

4.5 Electrical safety

contents

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 (N2.1)

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 within such *rooms*.

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 2500 mm from the shower cubicle.

4.6 Electrical fixtures

contents

standard 4.6 mandatory	**Every *building* must be designed and *constructed* in such a way that electric lighting points and socket outlets are provided.** **Limitation** This standard applies only to *domestic buildings* where a supply of electricity is available.

4.6.0 Introduction

Lighting is an extremely important environmental factor in and around *buildings*. It supports vision and thus enables people both to see where they are going and to detect any obstacles or hazards to safe movement.

Visual perception increases with the level of light falling on, or incident to, the surface or area of interest. Hazardous situations may thus be created by the nature of the lighting itself, including insufficient light sources, glare, gloom and shadows. For certain tasks, such as walking down stairs, an appropriate level of illumination should be provided for users to avoid slips, trips and falls. Inadequate lighting is also likely to increase the likelihood of collisions with obstacles or *building* features.

Lighting levels indoors are likely to be much less than those outdoors and, at certain times of day, natural daylight may need to be supplemented by artificial light to maintain a safe level of lighting. An additional safety consideration is the adaptation, or adjustment made by the eye on entering or leaving *buildings*. This adjustment is an important factor in slip, trip and fall accidents due to poor lighting conditions. In some cases the lighting on stairs may throw a high contrast shadow across steps. This can cause mis-steps when users fail to identify the edge of the tread. In emergency situations the nature of lighting may be particularly critical in ensuring effective escape.

An adequate provision of power points reduces the possibility of both overloading of individual sockets and the creation of trip hazards from use of extension cabling. It is an often overlooked element in the general amenity of a *dwelling.*

Section 2, Fire, includes additional guidance on *escape route* lighting and emergency lighting.

Section 6, Energy, includes additional guidance on lighting and its efficient use.

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 (Q3.7, Q3.8)

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 m^2 or more.

Any lighting point serving a stair should have controlling switches at a convenient location on each *storey*.

4.6.2 Light switches in common areas of *domestic buildings* (Q2.10b)

Any light switch in a common access corridor or stair or other communal area should be accessible to, and operable by, *disabled people*.

Light switches that are positioned between 900 mm and 1.2 m above the floor would be appropriate.

4.6.3 Entryphone systems (Q2.10a)

Doors can create a significant barrier to access particularly external doors that are required to be kept locked for security reasons. Entry to *buildings* containing *flats* or *maisonettes* is often locked against vandals or the principal entrance to sheltered *housing* may have access control for general security.

Where such doors need to be locked, it is normal to provide a door entry system such as an entryphone. An entryphone system, where fitted, should be accessible to, and operable by, *disabled people*.

An entryphone system that is positioned 900 mm and 1.2 m above the entrance platt would be appropriate.

4.6.4 Socket outlets (Q3.9)

Current lifestyle places a greater demand on electrical installations through the increase in the 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.

A *dwelling* should be provided with at least:

- 6 13A socket outlets within the *kitchen*;
- 4 13A socket outlets within each *apartment*;
- 4 additional 13A socket outlets anywhere else in the *dwelling*.

The sockets may be installed as single or multiple outlets, provided the recommended number of points is provided.

4.7 Aids to communication

This standard does not apply to domestic buildings

4.8 Danger from accidents

contents

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 windows and rooflights can be operated safely.** **Limitation** Standards 4.8(d) and 4.8(e) do not apply to *domestic buildings.*

4.8.0 Introduction

The intention of the guidance to this standard is to reduce the risk of accidents that could otherwise arise from the malfunction of mechanical equipment or from inherent hazards in and around a *building.* It brings together several safety issues that do not lend themselves to inclusion in other parts of the Technical Handbook.

Collision or entrapment accidents result in a significant numbers of deaths and injuries to *building* users every year. The majority of these accidents occur during normal use and involve *building* and *construction* features such as doors, windows and areas of fixed *glazing*, with risk of injury increased where vulnerable glass is involved.

The guidance is intended to prevent the creation of dangerous obstructions, such as windows opening on to pedestrian routes at body height, to reduce the risk of injury caused by collision with *glazing* and to prevent the *construction* and location of windows and rooflights such that *glazed* surfaces cannot be cleaned safely.

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 this standard as is *reasonably practicable*, and in no case be worse than before the *conversion* (Regulation 12, Schedule 6)

4.8.1 Collision with projections (P2.1)

Fixtures or projections that open on, to, or over any place to which the public has access can be a hazard or obstruction.

Any projection on a *building,* and any part of a *building* capable of being projected, should be positioned and secured so that it does not cause a dangerous obstruction to people in circulation spaces outside or inside the *building*.

A door that swings both ways across a route of passage should be *glazed* or have a vision panel. The minimum size for vision panels is covered in clause 4.1.8.

4.8.2 Collision with *glazing* (P2.2)

Many human impact injuries are due to failure to take safety precautions appropriate to the materials used. Materials such as glass, which can break under impact and cause injury, can be difficult to see in some situations and a person's ability to perceive this potential risk and cope with it can vary.

Accident statistics show that *glazing* in some locations within *buildings* is more vulnerable to human impact than others. These areas are:

- in and around doors, particularly large side panels that may be mistaken for doors; and
- at low levels in walls, barriers and partitions.

Glazing in such areas should be designed to resist human impact as set out in BS 6262 Part 4: 1994

Glazing manifestation

Large areas of transparent *glazing* can be confusing and may be a particular hazard to people with visual impairment. Therefore, *glazing* in a *building*, positioned where accidental collision with it is likely, should be made apparent by some form of manifestation (marking) as recommended in BS 6262: Part 4: 1994.

The manifestation employed should be of a size that is immediately obvious. Forms include broken or solid lines, patterns or logos, which should be positioned between 600mm and 1500mm above floor level at appropriate horizontal intervals. It should preferably be permanent, e.g. etching, but alternatively, may be of a durable applied material, not easily removed.

Manifestation need only be provided within *dwellings* where *glazing* installations are unusual enough to merit marking. Familiar elements such as patio doors should not usually attract manifestation.

4.8.3 Cleaning of windows and rooflights (P2.3, P2.4)

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, all or part of which is more than 4 m above the 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 10 of BS 8213 : Part 1 : 1991; or
b. from 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*. A system installed in accordance with Clause 9 of BS 8213: Part 1: 1991 would be appropriate.

Glazing in common areas

In addition, any window or rooflight within a common area of a *domestic building* may be cleaned from a ladder sited on adjacent ground or an adjacent loadbearing surface which has unobstructed space appropriate for the use of such a ladder and is large enough to 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.

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 of the external glass with only the arm projecting outside the line of the window whilst remaining standing on the floor.

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 provided:

- a means of safe access, and
- a protective barrier not less than 1.1 m high to any edge of the surface or access which is likely to be dangerous.

This method of cleaning is only appropriate where no part of the *glazing* is more than 4 m above the loadbearing surface.

Alternative methods

Where there is a requirement for safe cleaning of *glazing*, it may be appropriate to consider alternate methods of cleaning, in addition to those listed in the guidance, where an equivalent level of safety can be demonstrated.

Roof access hatches

Safe cleaning of rooflight within a roof access hatch, located within a *roof space* need not be provided.

4.8.4 Guarding of windows for cleaning (P2.3, P2.4)

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 windows. However, the general guidance for provision of protective barriers given in clause 4.4.2 should be followed.

On the second floor and above, where it is intended to clean the outside face of the *glazing* from inside the *building*, guarding height should be 1.1 m above floor level, as recommended in Clause 10.4 of BS 8213: Part 1: 1991.

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 may be omitted where window gives access to a fully guarded balcony.

4.9 Danger from heat

contents

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

This guidance is intended 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 ºC

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.

This section gives guidance 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 premises. It is unlikely that many larger installations will be installed in dwellings but if required, additional guidance on such installations is provided to standard 4.9 of the non-domestic Technical Handbook.

Guidance is also given on the 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.

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 (P3.1)

Installation of an unvented hot water storage system should be carried out by a person with appropriate training and practical experience.

Competence of installers

One method of demonstrating competence might be for the installer to have current membership of a registration scheme operated by a recognised professional body. This could include those administered by the Scottish & Northern Ireland Plumbing Employers Federation (SNIPEF) 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 be 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 unvented hot water storage systems of up to 500 litres capacity and 45kW power input. (P3.1)

An unvented hot water storage system should be designed and installed to prevent the temperature of the stored water at any time exceeding 100º 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
- A pressure control valve to suit the operating pressure of the system
- An expansion valve to relieve excess pressure
- 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).

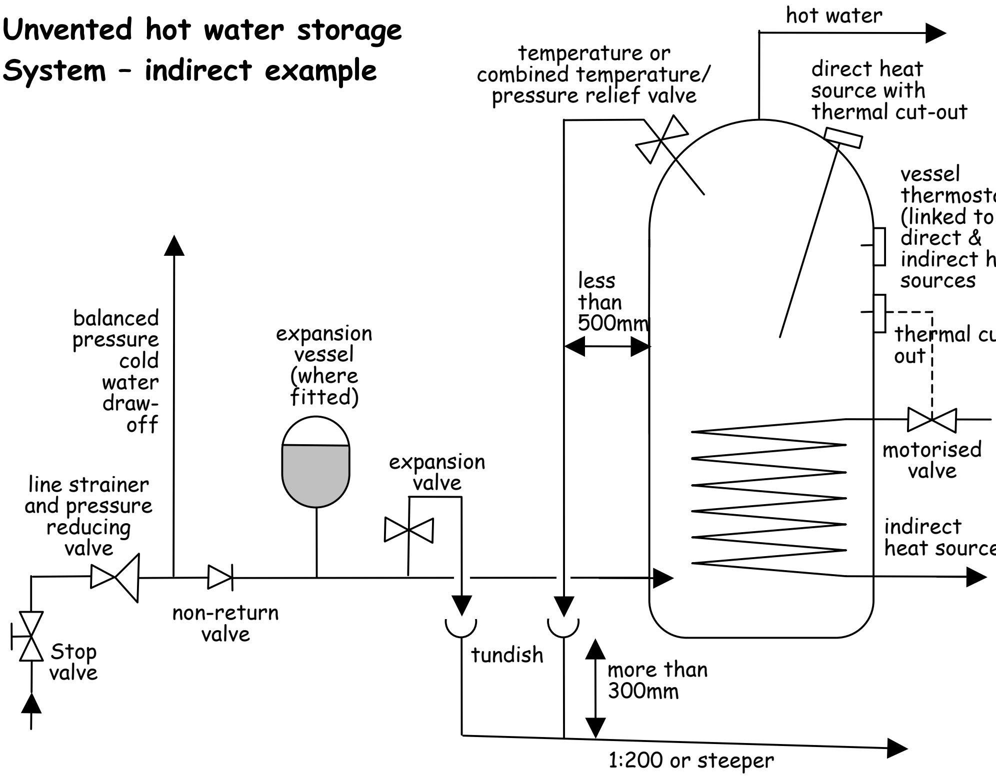
Temperature activated safety devices

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 two devices should be in additional to any thermostatic control that is fitted to maintain the temperature of the stored water at around 60º 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 Part 3: 1991 for combined temperature and pressure relief valves which are set to open at temperatures not normally exceeding 90 ºC.

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 (P3.1)
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 95ºC 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* 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 (P2.6)
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

4.10 Fixed seating

This standard does not apply to domestic buildings

4.11 Liquefied petroleum gas storage

contents

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 75kg 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).

4.11.1 LPG storage installations (F7.4)

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.

www.lpga.co.uk

www.hse.gov.uk

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 & 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 (F7.4, F7.5)

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 follow Part 1 – 'Design, Installation and Operation of Vessels Located Above Ground', as amended.

Below-ground tanks should follow 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

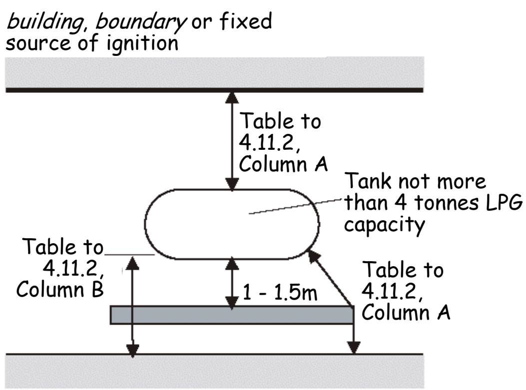
Maximum capacity (in tonnes)		Minimum separation distance for above ground tanks (in metres)		
		From a *building*, *boundary* or fixed source of ignition to the tank		
of any single tank	of any group of tanks	A no fire wall [1]	B with fire wall [1]	between tanks
0.25	0.8	2.5	0.3 [2]	1.0
1.1	3.5	3.0	1.5 [2]	1.0
4.0	12.5	7.5	4.0	1.0

Notes:

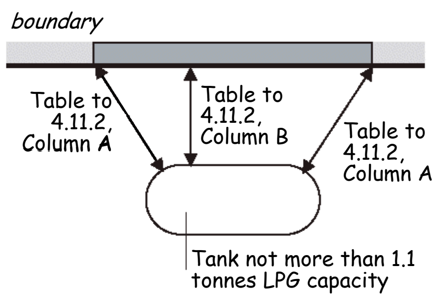
1. Fire wall means a wall or screen meeting the guidance for an *external wall* with a fire resistance of short duration (Section 2, Fire) within 1 m of the *boundary*, and located between 1 m and 1.5 m from the tank and extending:
   a. longitudinally: so that the distance specified above without the 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 six 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

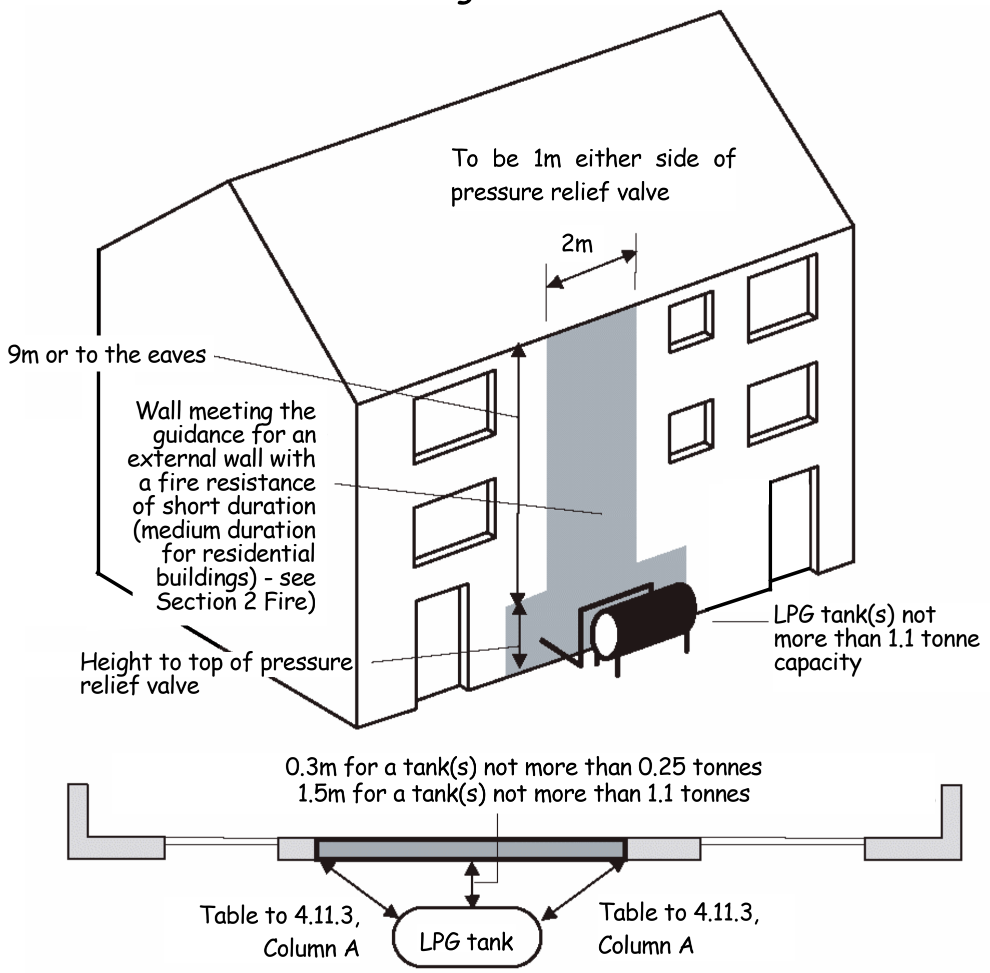


Plan view with and without a firewall



Firewall as part of a *boundary*

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 (F7.5)

Where an LPG storage installation consists of a set of cylinders, a way of meeting the standard would be for the installation to 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 that 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

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 (S4.4, S4.5)

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.

5

noise

Contents

5.0 Introduction

contents

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/

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/

Advice to consumers on dealing with noise problems is given in 'Sound advice on Noise: don't suffer in silence,' 2001.

5.0.3 Latest changes

It was the intention that this Technical Handbook would be a level transfer of the technical requirements in the previous Parts of the Technical Standards. However certain recommendations concerning noise transmission have either been clarified, updated or become obsolete over the last few years and it was felt necessary to include these changes in this new technical handbook. The following is a summary of the changes that have been introduced since the 6th amendment to the Technical Standards.

Throughout:	Substitution of 'gypsum based board' for 'plasterboard'.
5.1.3	Additional advice concerning building integration or mounting of certain types of loudspeakers.
5.1.4, 5.1.5	Addition of parge coat and use of dabs not battens. (wall types 1C, 1D and 2C)
5.1.6, 5.1.7	Increased clearance between masonry core and framing of isolated panels. (wall types 3, 4B)
5.1.6	Additional advice on *cavity barriers* between masonry cores and isolated panels, on penetration of isolated panels by services, and on the mass of isolated panels P2. (wall type 3)
5.1.7	Additional advice on junctions with external walls that are adjacent to a *separating floor.* (wall type 4)
5.1.8–5.1.10	Clarification of constraints on penetration of sound resisting *separating floors* by *chimneys.* (floor types 1, 2, 3)
5.1.8	Additional advice on use of resilient materials for soft covering, use of panelled floor finishes. (floor type 1)
5.1.9	Increased clearance between skirting and floating layer; clarification of requirement for screed for bases C and D; removal of mineral fibre option for resilient layer under battens, additional advice for floating layer F1; removal of option of pre-compressed expanded polystyrene board as resilient layer under screed, updated advice for floating layer F2. (floor type 2)
5.1.10	Removal of mineral fibre options for resilient materials, updated advice on resilient materials; addition of guidance on installation of down lighters. (floor type 3)
5.1.10	Recommendation for floor types 3A and 3C-b only to be used in conversions; addition of resilient bars for types 3A and 3B, updated advice for types 3A and 3B about floating layers, absorbent blanket and ceiling layers; notes on use of additional sub-deck board for ribbed floor types. (floor type 3).
5.1.13	Possible use of the scheme operated by Robust Details Ltd.
Annex 5.B	Additional advice on selection of resilient materials used for soft coverings.
Annex 5.C	Additional advice on test procedures in situations where *separating walls* incorporate *fire doors*.

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

contents

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.

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 *dwellings* (H1.2, H1.3, H1.4)

Section 5 applies to *dwellings* 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 *dwellings*. 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 *dwellings* 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 *dwellings* 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 *dwellings*. 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 *dwellings*. 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

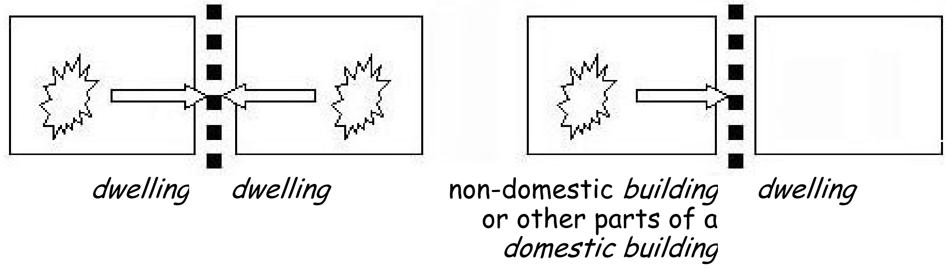
The guidance given in a. to f. above is summarised in the following diagrams. It should be read in conjunction with additional guidance that relates to specific situations:

- where two *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.

The following diagrams show only direct transmission paths. Flanking transmission is also an important consideration. (see clause 5.1.2)

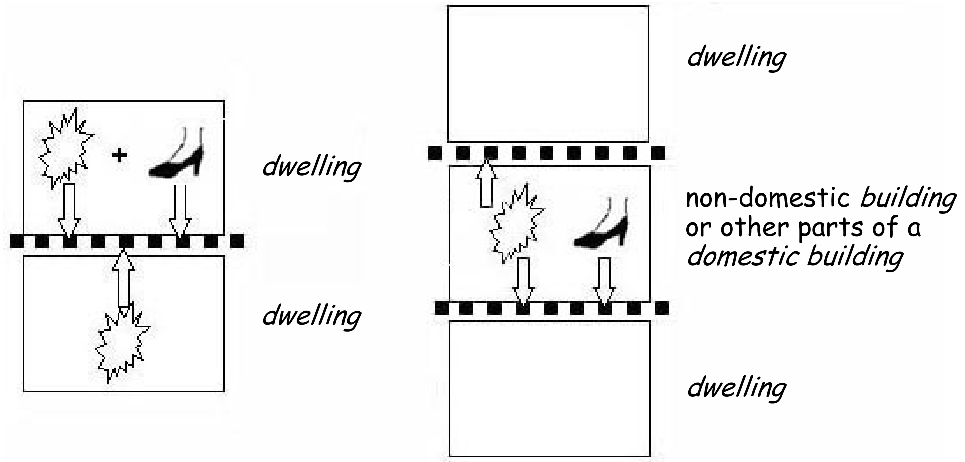
Airborne sound: *separating walls*

(viewed in plan or section)



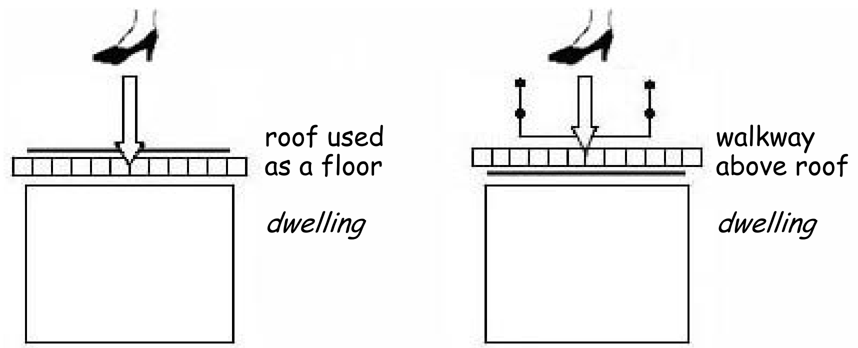
Airborne and impact sound: *separating floors*

(viewed in section)

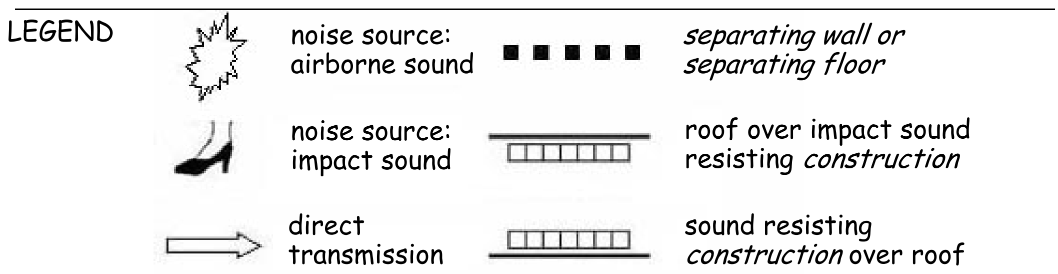


Impact sound: roofs and walkways over *dwellings*

(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.



5.1.2 Flanking transmission

A specification for a sound resisting *separating wall or separating floor* is incomplete without measures to avoid flanking transmission.

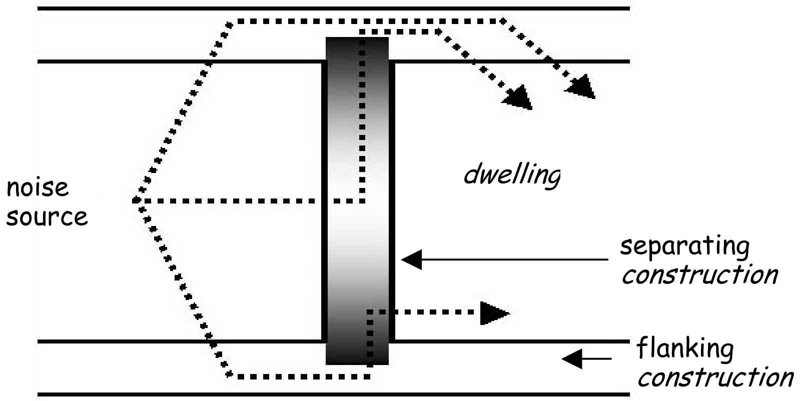
Flanking transmission occurs when there is a path for sound to travel along elements adjacent to *separating walls or separating floors*. If the flanking *construction* and its connections with the separating structure are not correctly detailed, flanking transmission can equal or even exceed sound levels 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)

Flanking transmission



5.1.3 Specified *constructions* (H2.1, H2.2, H2.3, DTS points 1 to 3 and 8 to 17)

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 *dwellings* 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 *dwellings*. 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 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 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.

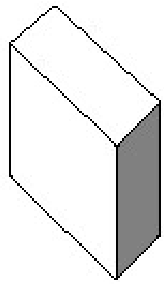
5.1.4 Specified wall constructions (DTS point 10)

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:

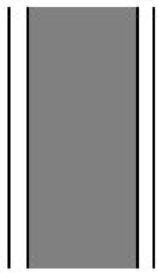
- the depth of any horizontal chase does not exceed one-sixth of the thickness of the leaf;
- the depth of any vertical chase does not exceed one-third of the thickness;
- chases are not back to back.

***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

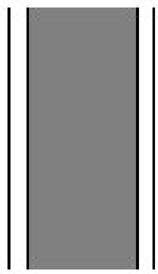
Brick, plastered both sides
Mass including plaster 375 kg/m^2.
13 mm plaster each side.
Lay bricks in a bond which includes headers and with frogs uppermost.
Example: 215 mm brick, 75 mm coursing, brick density 1610 kg/ m^3; lightweight plaster.



section

Wall type 1B

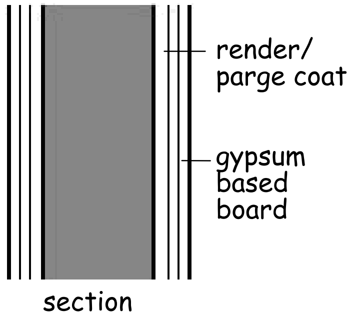
Concrete block, plastered both sides
Mass including plaster 415 kg/m^2.
13 mm plaster each side.
Use blocks which extend to the full thickness of the wall.
N.B. Two leaves of block side by side are not recommended
Example: 215 mm block, 110 mm coursing, block density of 1840 kg/m^3; lightweight plaster.



section

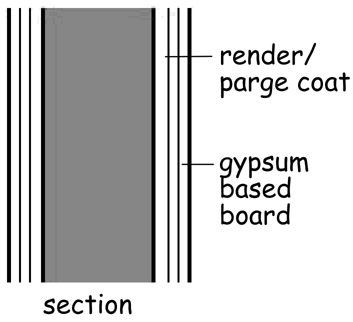
Wall type 1C

Brick, parged both sides, gypsum based board both sides.
Mass of brick and gypsum based board 375 kg/m^2.
13mm 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 : ½ : 4, by dry volume, in accordance with BS 5492: 1990.
12.5mm 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.



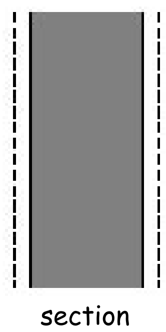
Wall type 1D

Concrete block, parged both sides, gypsum based board both sides.
Mass of masonry alone 415 kg/m^2.
13mm 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 : ½ : 4, by dry volume, in accordance with BS 5492: 1990.
12.5mm 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.
N.B. Two leaves of block side by side are not recommended.
Example: 215 mm block, 150 mm coursing, block density 1840 kg/m3.



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: 190mm thick unplastered wall, density 2200 kg/m^3.

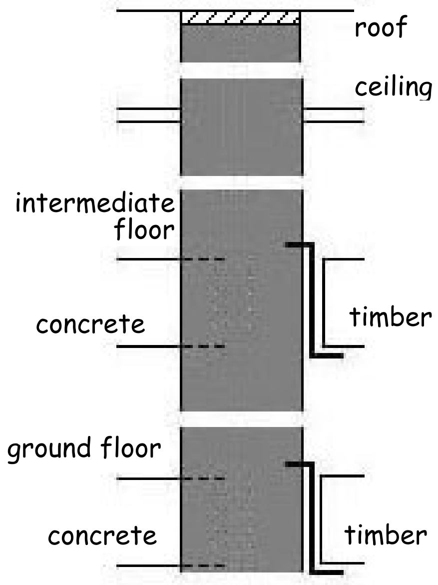


Junctions at roof, ceilings, floors

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/m^2. 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/m^2 or more.
See 5.1.3 for guidance on openings, pipes and ducts, and chimneys.



section

Junctions at *external walls*

The outer leaf of a cavity wall adjacent to a type 1 wall may be of any *construction*.

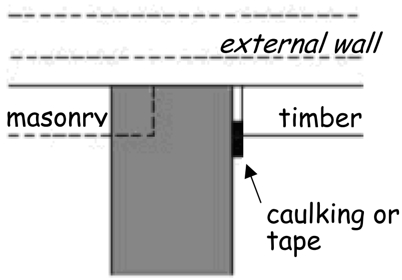
Wall type 1

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/m^2 unless the length of the *external wall* is limited by openings:
   - of 1 metre 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.



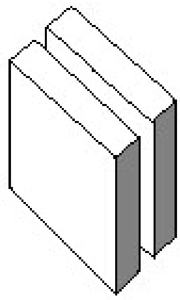
plan

Wall type 2

5.1.5 Specified wall constructions (DTS point 11)
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 900mm 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 two 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:

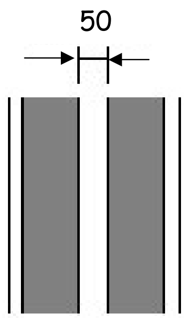
- the depth of any horizontal chase does not exceed one-sixth of the thickness of the leaf;
- the depth of any vertical chase does not exceed one-third of the thickness;
- chases are not back to back.

***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).

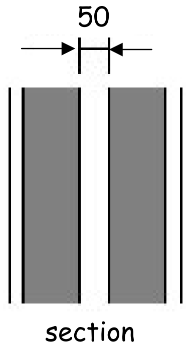
Wall type 2A

Two leaves of brick with 50 mm cavity, plastered on both *room* faces
Mass including plaster 415 kg/m^2. 13 mm plaster each face.
Example: 102 mm leaves laid frogs uppermost, 75 mm coursing, brick density 1970 kg/m^3; lightweight plaster.



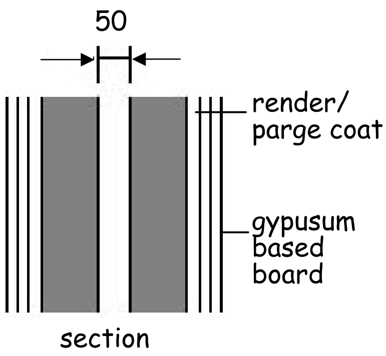
Wall type 2B

Two leaves of concrete block with 50 mm cavity, plastered on both *room* faces
Mass including plaster 415 kg/m^2. 13 mm plaster each face.
Example: 100 mm leaves, 225 mm coursing, block density 1990 kg/m^3; lightweight plaster.



Wall type 2C

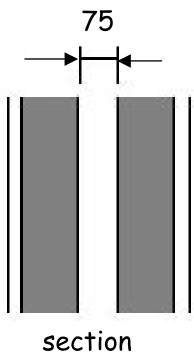
Two leaves of concrete block with 50 mm cavity, both leaves parged, gypsum based board on both *room* faces.
Mass of masonry alone 415 kg/m^2.
12.5mm gypsum based board each side, minimum mass per unit area 8.5kg/m^2, both sides, fixed with plaster dabs.
13 mm internal render (parge coat) both leaves; should not be smoothed or float finished.
Minimum mass per unit area of internal render 18kg/m^2, both leaves. Typical internal render mix: cement : lime : sand 1 : ½ : 4, by dry volume, in accordance with BS5492:1990.
Example: 100 mm leaves, 225 mm coursing; block density of 1990 kg/m^2 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/m^3.
Mass including plaster 250 kg/m^2.
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/m^3; lightweight plaster.

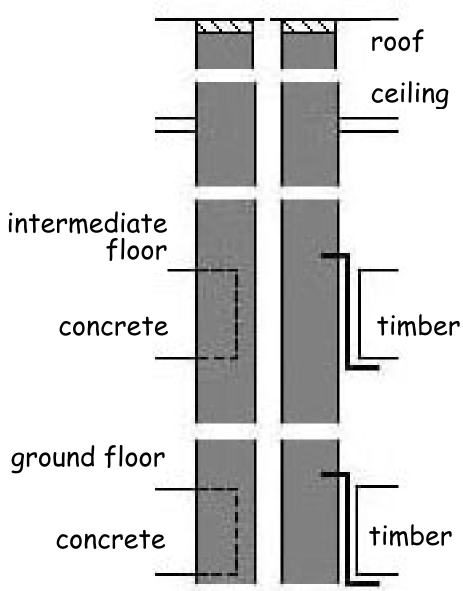


Adjacent *dwellings* using wall type 2D should be stepped and/or staggered by at least 300 mm.

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/m^2.
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 5.1.3 for guidance on openings, pipes and ducts, and chimneys.



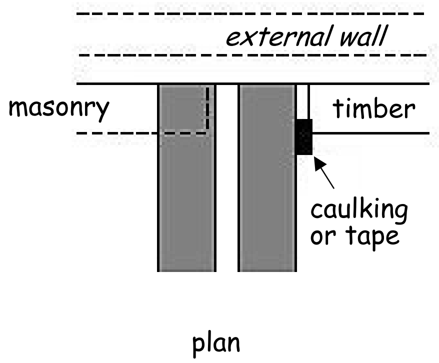
section

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/m^2 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.

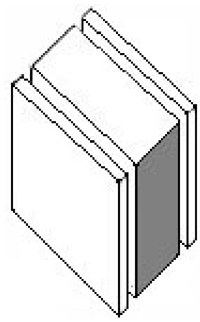
Wall type 3

5.1.6 Specified wall constructions (DTS point 12)
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.

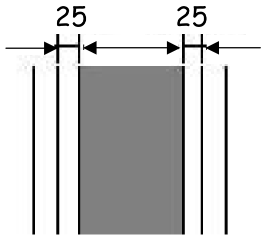


Wall type 3

***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.



section

Masonry cores

Core A
Brick. Mass 300 kg/m^2.
Example: 215 mm core, laid with frogs uppermost, 75 mm coursing; brick density 1290 kg/m^3.

Core B
Concrete block. Mass 300 kg/m^2.
Example: 140 mm core, 110 mm coursing, block density 2200 kg/m^3.

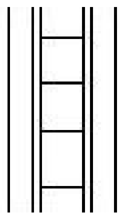
Core C
Lightweight aggregate concrete block.
Mass 200 kg/m^2. Maximum density 1500 kg/m^3.
Examples: 140 mm core, 225 mm coursing; block density 1405 kg/m^3. 215 mm core, 150 mm coursing; block density 855 kg/m^3.

Core D
Autoclaved aerated concrete block. Mass 160 kg/m^2

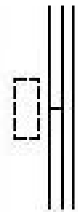
Examples: 200 mm core, 225 mm coursing; block density 730 kg/m^3. 215 mm core, 150 mm coursing; block density 855 kg/m^3.

Isolated panels

Panel P1
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.


section

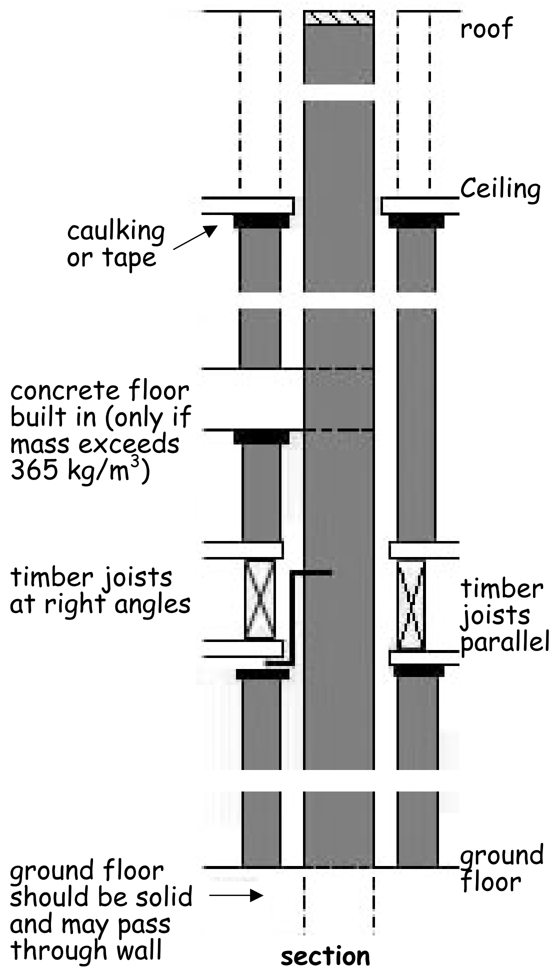
Panel P2
Two sheets of gypsum based board with joints staggered.
Mass (including plaster finish if used) 18 kg/m^2
Thickness of each sheet 12.5 mm if a supporting framework is used, or total thickness of 30 mm if no framework is used.


section

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.

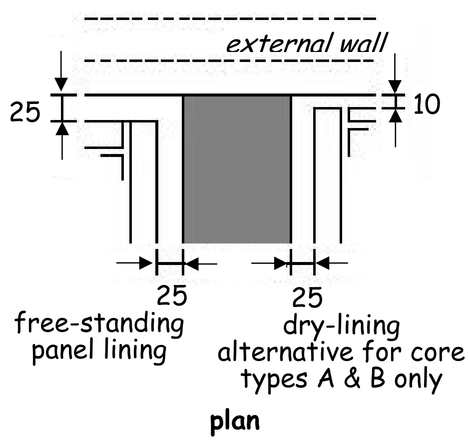


Junctions at *external walls*

The outer leaf of a cavity wall adjacent to a type 3 wall may be of any *construction*.

Wall type 3

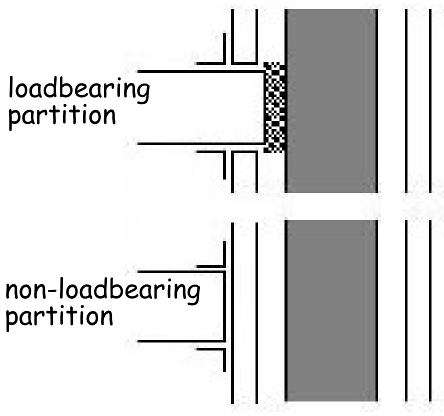
The inner leaf of a cavity wall should have an internal finish of isolated panels as specified for the *separating wall*. This is not necessary where the *separating wall* has core A or B, in which case plaster or dry-lining with joints sealed with tape or caulking may be used.
A layer of insulation 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/m^2, butt jointed to the *separating wall* core with ties at no more than 300 mm centres, vertically.
See 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.



section

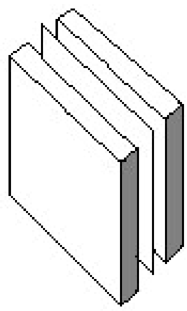
Wall type 4

5.1.7 Specified wall constructions (DTS point 13)
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

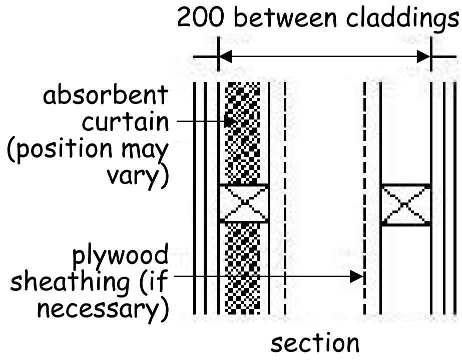
***Constructions* – wall type 4**

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

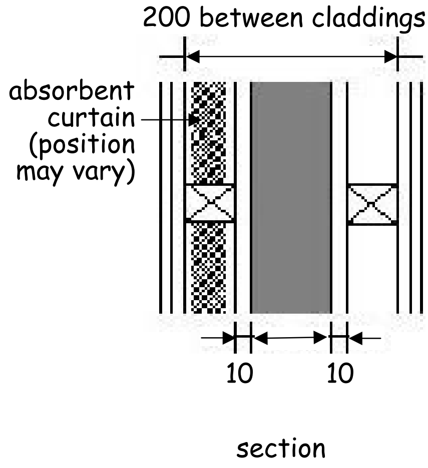
Basic *construction*

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: two or more layers of gypsum based board, combined thickness 30 mm, joints staggered to avoid air paths.

Absorbent curtain

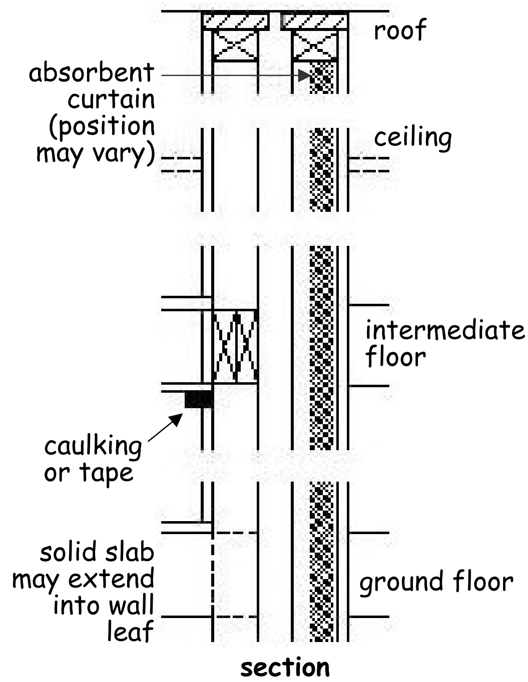
Unfaced mineral fibre quilt (which may be wire reinforced), density 12-36 kg/m^3, thickness 25 mm if suspended in the cavity between frames, 50 mm if fixed to one frame, or 25 mm per quilt if one fixed to each frame.

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).



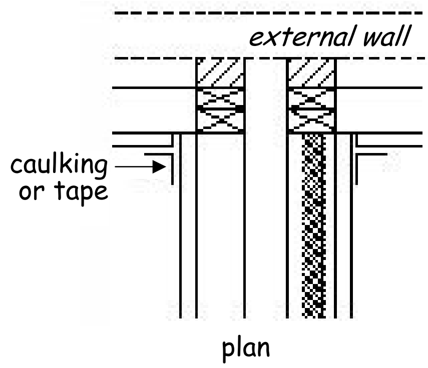
Ceiling and *roof space*
Carry the complete *construction* through to the underside of the roof. Provision of a ceiling of any type is optional.

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 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/m^2 (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.

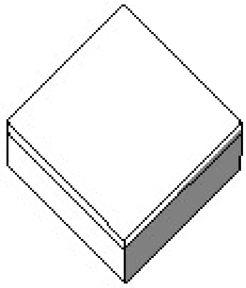
Floor type 1

5.1.8 Specified floor *constructions* (DTS point 14)
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

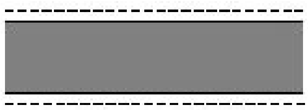
***Constructions* – floor type 1**

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.

Floor bases

Base A

Solid concrete slab, cast in-situ.
Floor screed and/or ceiling finish optional.
Mass (including any screed and/or ceiling finish) 365 kg/m^2.



section

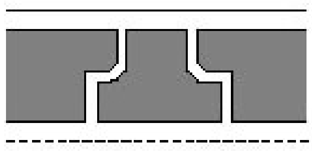
Base B

Solid concrete slab, cast in-situ, with permanent shuttering.
Floor screed and/or ceiling finish optional.
Mass 365 kg/m^2 including shuttering only if it is solid concrete or metal, and including any screed and / or ceiling finish.

section

Base C

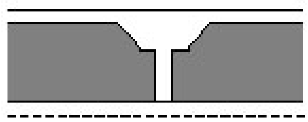
Concrete beams with infilling blocks
Floor screed and/or structural topping should be used.
Ceiling finish optional.
Mass 365 kg/m^2 including beams, blocks, any structural topping, screed, and any ceiling finish.



section

Base D

Concrete planks (solid or hollow)
Floor screed and/or structural topping should be used.
Ceiling finish optional.
Mass 365 kg/m^2, including planks, any structural topping and screed, including any ceiling finish.



section

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 (ΔLw) of at least 17 dB when measured in accordance with Annex 5.B.

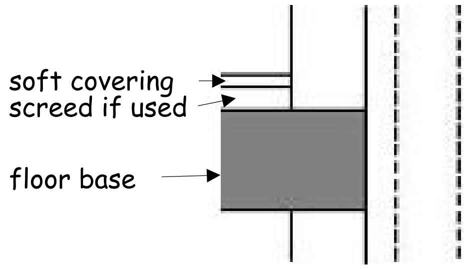
NB This floor construction is not suitable for use under panelled floor finishes, including laminated flooring, which severely reduce the impact sound insulation provided by the soft covering. It is also not suitable as a means to limit impact transmission to a dwelling below a walkway or a roof that 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.

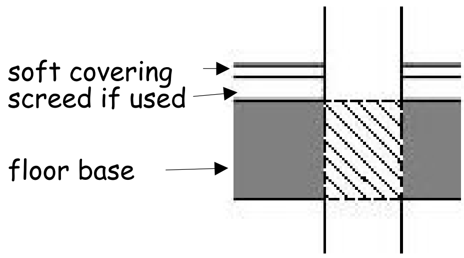


section

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.



section

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.

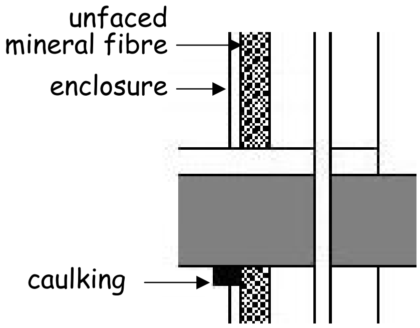
Ducts or pipes that penetrate the floor should be in an enclosure, both above and below the floor.

Either line the enclosure, or wrap the *duct* or pipe within the enclosure, with 25 mm unfaced mineral fibre.

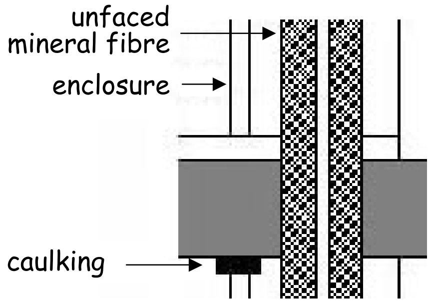
The material of the enclosure should have a mass of 15 kg/m^2.

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 (DTS point 15)

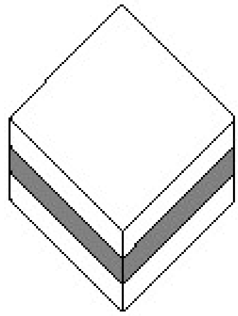
Floor type 2: Concrete base with floating layer

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 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

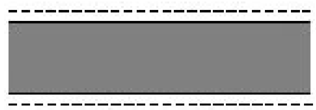
Constructions – floor type 2

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.

Floor bases

Base A

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/m^2.



section

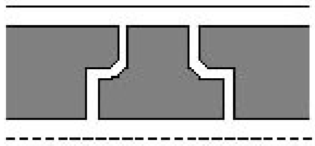
Base B

Solid concrete slab, cast in-situ, with permanent shuttering.
Floor screed and/or ceiling finish optional.
Mass 300 kg/m^2, including shuttering only if it is solid concrete or metal, and including any screed and / or ceiling finish.

section

Base C

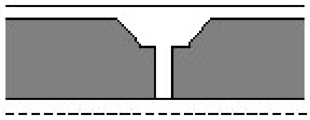
Concrete beams with infilling blocks
Floor screed should be used; ceiling finish is optional but recommended to limit air paths at joints.
Mass 300 kg/m^2 including beams, blocks, any structural topping including screed, and any ceiling finish.



section

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/m^2, including planks, any structural topping including screed and any ceiling finish.

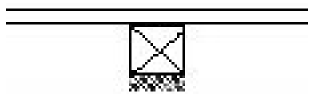


section

Floating layer constructions

Floating layer F1

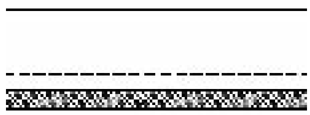
Timber raft
Timber boarding or wood based board, 18 mm thick, with tongued and grooved edges, fixed to 45 x 45 mm timber battens with an integral resilient polymer-based strip bonded to the underside.
The polymer-based strip should have a deflection of 9 mm under an intensity of distributed load of 0.6 kilo-Pascals or 60 kg/m^2.
Resilient flanking strips should be fitted between floor edge and wall / skirting junction.



section

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/m^3.
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.



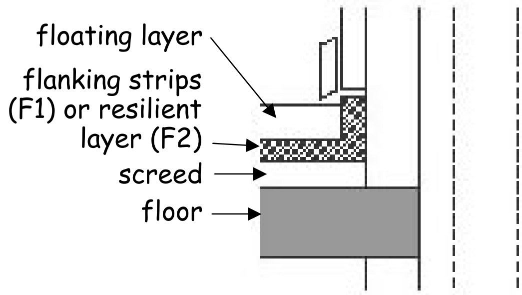
section

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.

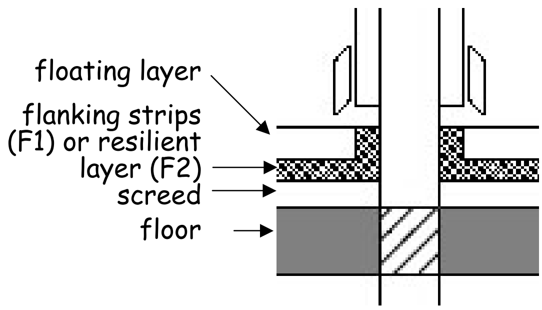


section

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.

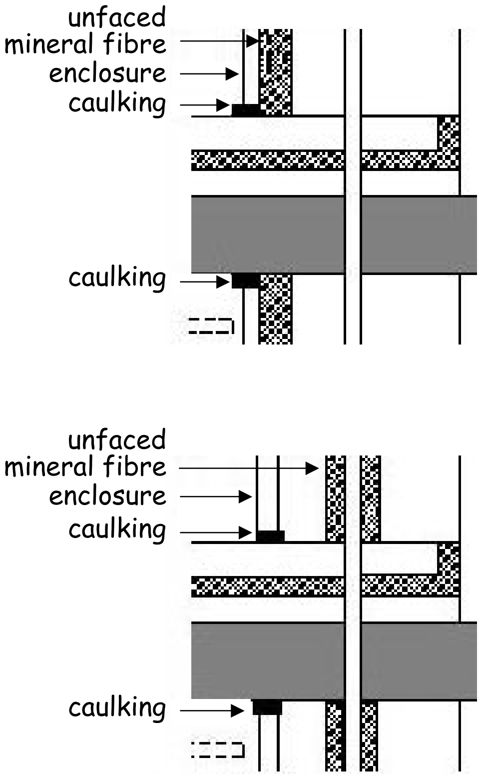


section

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/m^2.
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.



sections

Floor type 3

5.1.10 Specified floor constructions (DTS point 16)
Floor type 3: Timber base with floating layer

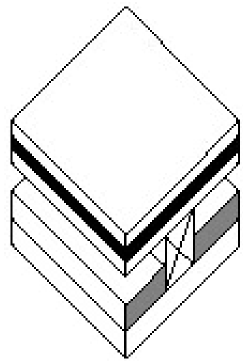
The resistance to airborne sound transmission depends partly on the structural floor plus absorbent blanket or deafening, and partly on the floating layer. Resistance to impact sound transmission depends on the resilient layer to isolate the floating layer from the base and the surrounding *construction*.

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

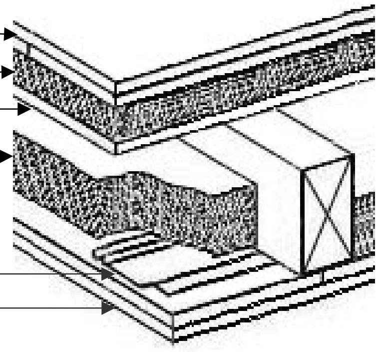
***Constructions* – floor type 3**

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 19 mm gypsum based board; or
b. a floating layer of two 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 (ΔLw) of at least 17 dB when measured in accordance with Annex 5.B.

Floor base

Floor base of 12 mm timber boarding or wood-based board nailed to timber joists.

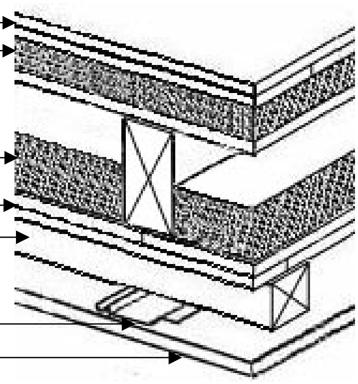
Ceiling

Resilient ceiling bars fixed perpendicular to joist direction at 400 mm centres.
Absorbent blanket of 100 mm mineral fibre, density 10-33 kg/m^3, laid on ceiling between joists.
Ceiling of two or more layers of gypsum based board with joints staggered, overall minimum mass 24 kg/m^2, 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.

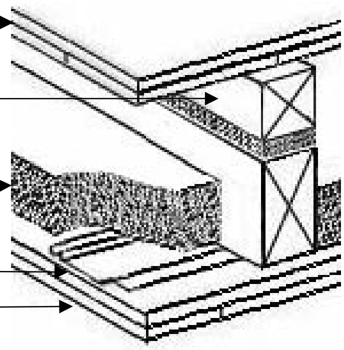


Floor type 3B

Ribbed floor with absorbent blanket

Floating layer

Floating layer of timber or wood based board, 18 mm thick with tongued and grooved edges and all joints glued, spot bonded to substrate of 19 mm gypsum based board nailed to 45 x 45 mm timber battens with an integral resilient foam strip bonded to the underside. The polymer-based strip should have a deflection of 9 mm under an intensity of distributed load of 0.6 kilo-Pascals or 60 kg/m^2. Resilient flanking strips should be fitted between floor edge and wall / skirting junction.



Floor base

Floor base of 45 mm wide timber joists.
NB 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.

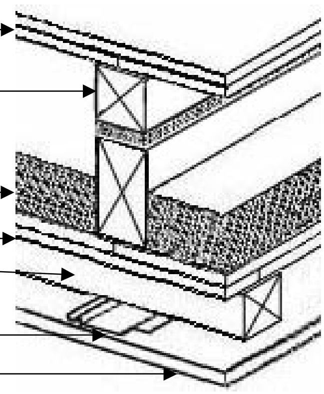
Ceiling

Resilient ceiling bars fixed perpendicular to joist direction at 400 mm centres.
Absorbent blanket of 100 mm mineral fibre, density 10-33 kg/m^3, laid on ceiling between joists.
Ceiling of two or more layers of gypsum based board with joints staggered, overall minimum mass 24 kg/m^2, 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 joists;
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.

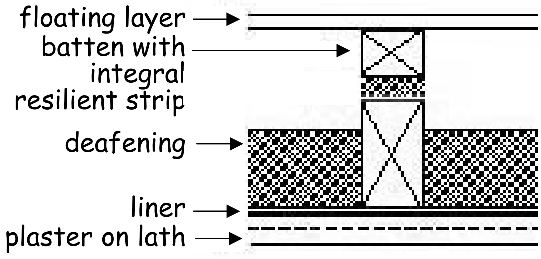
a. Battens along top of joists

Floating layer of timber or wood based board, 18 mm thick with tongued and grooved edges and all joints glued, nailed to 45 x 45 mm timber battens with an integral resilient foam strip bonded to the underside.

The polymer-based strip should have a deflection of 9 mm under an intensity of distributed load of 0.6 kilo-Pascals or 60 kg/m^2.

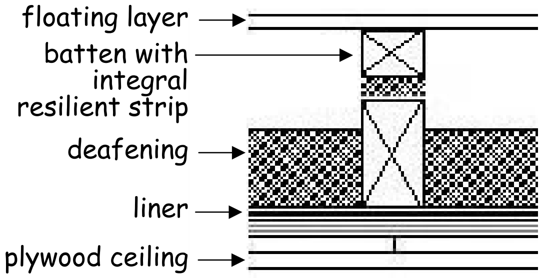
Battens placed on top of the joists, in the same direction as the joists.

Resilient flanking strips should be fitted between floor edge and wall / skirting junction.



section

lath and plaster ceiling option



section

board ceiling option

Floor base

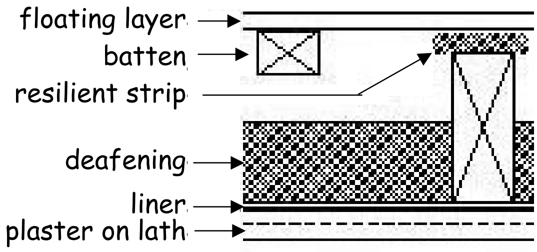
Floor base of 45 mm wide timber joists.

NB Structural bracing is not shown.

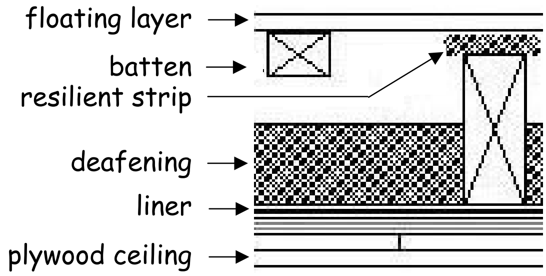
Ribbed floors are routinely built with an additional sub-deck board over the joists to provide safe access before fixing of the floating layer. Such boarding should not introduce noise problems but does not add to the sound insulation. The sub-deck board should be level and should not sag between joists. 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 (ΔLw) of at least 17 dB when measured in accordance with Annex 5.B.



section
lath and plaster ceiling option



section
board ceiling option

NB Structural bracing is not shown.

Ceiling

- 19 mm dense plaster on expanded metal lath; or
- 6 mm plywood fixed under the joists plus two 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/m^2 laid on a polyethylene layer.
Deafening may be of the following types. Figures in brackets show approximate thickness to provide 80 kg/m^2:

- 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).

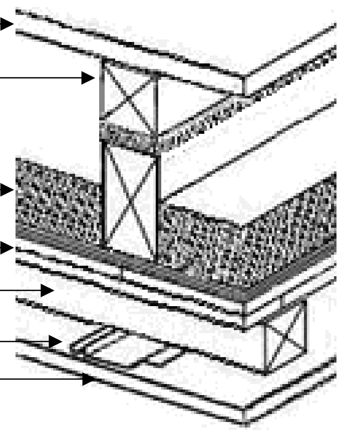
The water retentive properties of sand makes it inappropriate for use in *kitchens*, bathrooms, shower-rooms or *toilets*.

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.

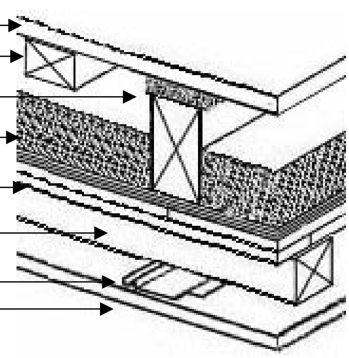
This construction could be used with an existing lath and plaster ceiling.



section, floor type 3C-a-DL board ceiling option

3C-b-DL

See also note on floor base for floor type 3Ca.



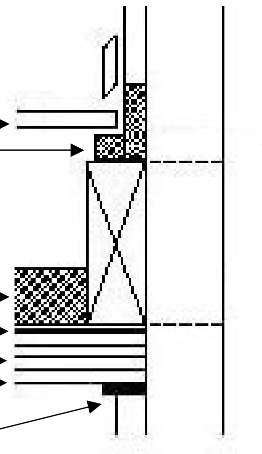
section, floor type 3C-b-DL board ceiling option

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.

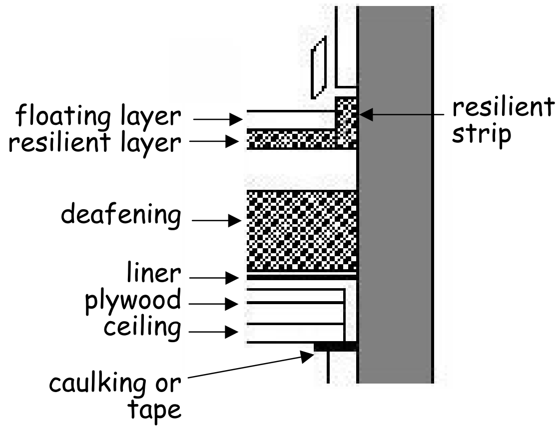


section

Floor type 3

Junctions at heavy masonry leaf

Mass of leaf 355 kg/m^2, 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.

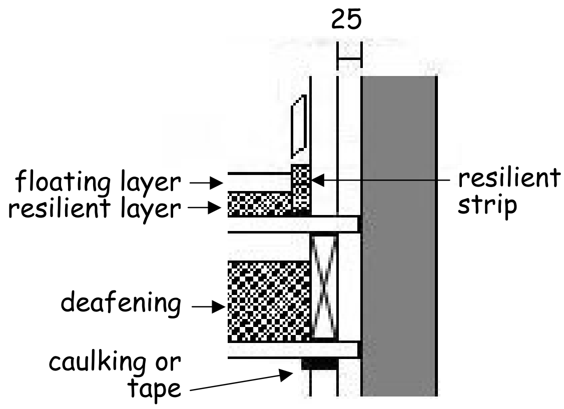


section

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/m^2.
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.



section

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/m^2.

Leave a 5 mm gap between enclosure and floating layer, seal with acrylic caulking or neoprene.

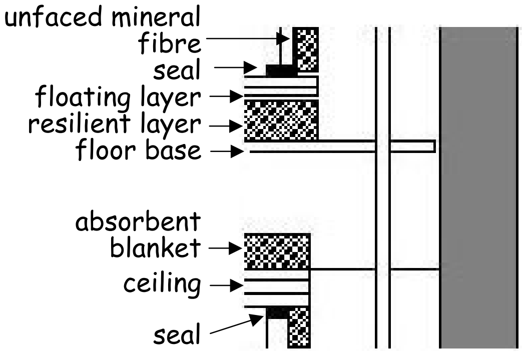
Enclosure may go down to the floor base if *construction* A is used, but care must be taken to isolate the enclosure from the floating layer.

Where there is no conflict with advice in Section 3

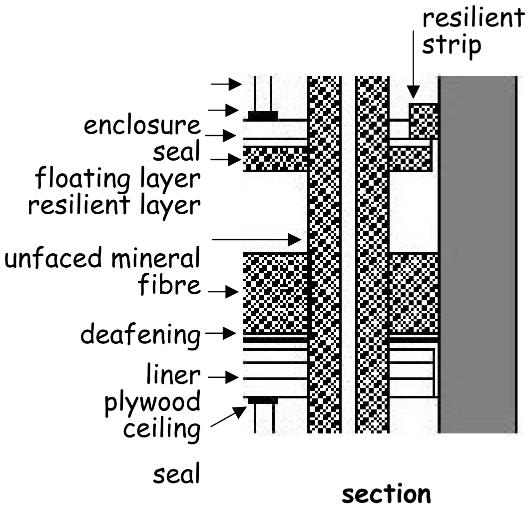
Environment, a *flue-pipe* may penetrate the floor, provided that it discharges either into a masonry *chimney* carried by the floor or any other type of *chimney* enclosed within a *duct* that is lined with absorbent mineral fibre.

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 (DTS point 17)
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.

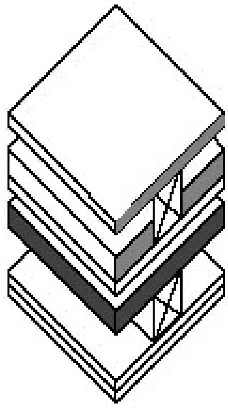
Section 2 Fire places limits on the *storey* height at which this type may be used. It should only be used with heavy masonry walls.

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.

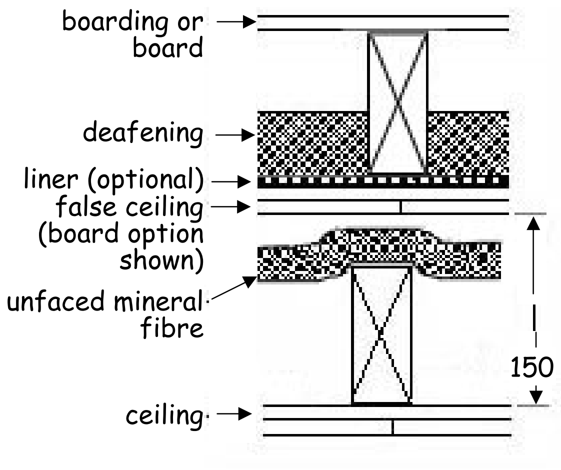
45 mm thick joists
Deafening of mass 80 kg/m^2
Intermediate ceiling of either:

- 19 mm dense plaster on lath; or
- two or more layers of gypsum based board with joints staggered, overall minimum mass 24 kg/m^2, or total thickness 30 mm.

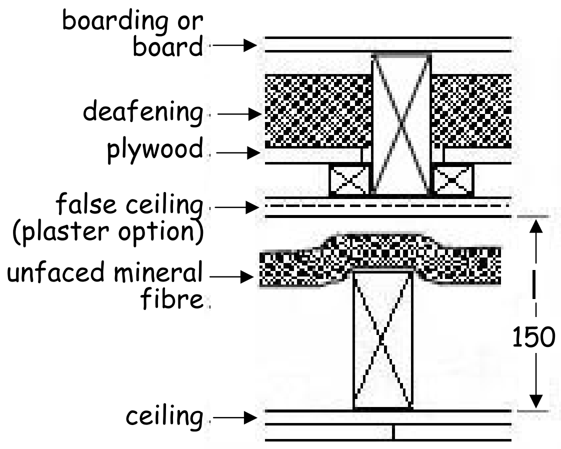
In existing floors deafening may be on boards between joists; in new *separating floors* use 6 mm plywood fixed to underside of joists. A polyethylene liner may be used if desired.

Independent ceiling:
Absorbent blanket of 25 mm unfaced mineral fibre, density 12-36 kg/m^3, 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.



section (new floor)



section (adapted existing floor)

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/m^2, including any plaster, both above and below the floor, on at least 3 sides. Leaf on fourth side should be at least 180 kg/m^2.

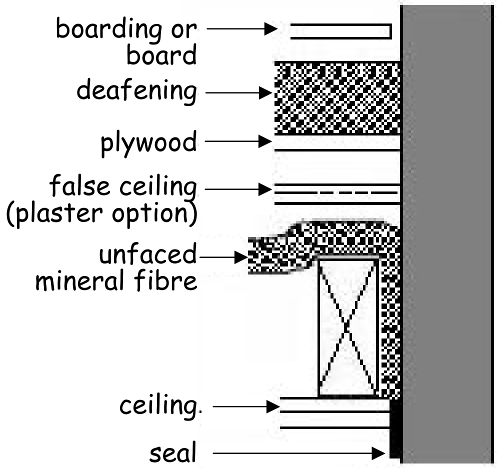
Use bearers on walls to support the edges of the ceiling and to block air paths.

Seal the junction of ceiling and wall with tape or caulking.

Internal wall

If masonry, mass should be 180 kg/m^2. There is no recommendation for the mass of stud partitions.

Support and seal as for *external walls*.



section

Floor penetrations

Floor type 4

Ducts or pipes that penetrate the floor should be in an enclosure both above and below the floor.

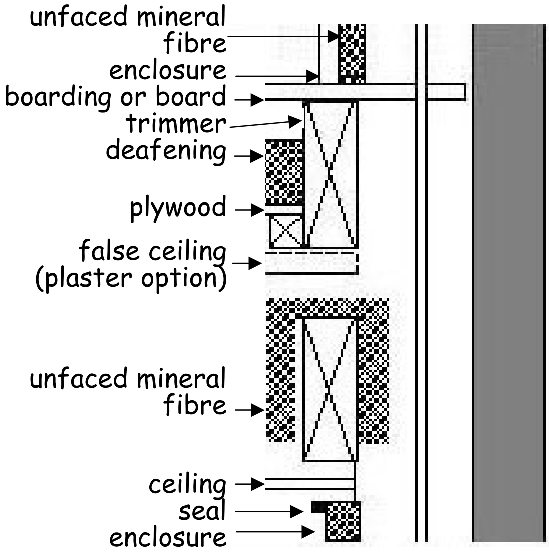
Either line the enclosure, or wrap the *duct* or pipe within the enclosure, with 25 mm unfaced mineral fibre.

The material of the enclosure should have a mass of 15 kg/m^2.

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.



section

5.1.12 Performance testing (H2.1, H2.2) (DTS point 18)

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 two acoustic parameters, one 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

5.1.13

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

contents

annex 5.A

Method for calculating mass in relation to specified constructions (DTS points 4 to 7)

5.A.1 Expression of mass

Where a mass is specified for walls or floors, it is expressed in kg/m^2.

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 $D = \frac{\left(\frac{M-NP}{T} - 380\right)}{0.79}$
100	$M = T(0.86D + 255) + NP$ or $D = \frac{\left(\frac{M-NP}{T} - 255\right)}{0.86}$
150	$M = T(0.92D + 145) + NP$ or $D = \frac{\left(\frac{M-NP}{T} - 145\right)}{0.92}$
200	$M = T(0.93D + 125) + NP$ or $D = \frac{\left(\frac{M-NP}{T} - 125\right)}{0.93}$

M = Mass of 1 m^2 of leaf in kg/m^2
T = Thickness of masonry in metres (i.e. unplastered thickness)
D = Density of masonry units in kg/m^3 (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 m^2 of wall finish in kg/m^2 (see next page)

Mass of finish in kg/m^2 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/m^3. 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/m^3) 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 (m^2).

Annex 5.B Methods for selection of resilient materials

contents

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 one 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 (Lw) 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 two tests (ΔLw = Test 1 – Test 2) using specified core floors:

Test 1: Weighted sound pressure level (Ln,w) for the core floor;

Test 2: Weighted sound pressure level (Ln,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: 1997 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):
   25 mm sand cement screed
   150 mm hollow-core precast concrete plank of mass per unit area 295-305 kg/m^2, 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 25 mm sand cement levelling screed 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/m^2.
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/m^3.
Two layers of 12.5 mm gypsum based board with a mass per unit area for each layer of 8 – 8.5 kg/m^2.

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 (ΔLw) as a result of the application of the floating floor treatment to the core floor.

Annex 5.C Procedures for performance testing

contents

annex

5.C

Performance testing **(DTS points 19 to 29)**

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 four sets of measurements or as close to four 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 four 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.

Definitions

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

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.

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.

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.

Evaluation of test results

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.

The mean of the four calculated values should be no worse than the recommended ‘Mean Value’ in the table to clause 5.1.12. If only two or three 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.

Concession for *fire doors*

Separating walls in some situations may incorporate a doorway, protected by a *fire door* (see Section 2 Fire), but there is no requirement for resistance to sound transmission by doors and door sets. The acoustic performance of a *separating wall* could be prejudiced by such a doorway. If a *separating wall* 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 *construction*.

Application of test procedures

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:

- if it is not built to a specified *construction*; or
- if it is not built under the scheme operated by Robust Details Ltd., but see clause 5.1.13; or
- if a verifier is not satisfied that a specified construction has been built in accordance with the warrant and standard 5.1.

6

energy

Contents

6.0 Introduction

contents

introduction
6.0

6.0.1 Background

The *construction* industry has a major role to play in the conservation of fuel and power. 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.

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*. It contains energy conservation provisions for the *building* fabric and the *building* services. By reducing energy consumption in such *buildings*, not only will carbon dioxide emissions be lowered, but also fuel poverty issues will be addressed to a certain degree. The guidance given in this Section will go some way to achieving this, however nothing here prevents a *domestic building* from being designed and *constructed* to be even more energy efficient and consequently, both the monetary and environmental savings will be improved.

All *buildings* that are not exempted by either Regulation 3, Schedule 1 or the Limitations, Regulation 9, Schedule 5, relating to this Section, are required to conform to standards for energy efficiency. For *building* fabric insulation, there is a variety of guidance, ranging from the simple calculation of the heat losses through each *building* element, to more sophisticated methods that give greater flexibility to designers. The energy efficiency of heating systems, their controls and finally their commissioning should also be taken into account.

This Section should be read in conjunction with all the appropriate 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

6.0.2 General guidance for *domestic buildings* (Reg 22)

This Section covers the energy efficiency 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*. This is not necessary for *buildings* which are ancillary to a *dwelling*, see clause 6.0.2c below;
c. Design of ancillary *buildings* for *dwellings*, which are not exempted (see Section 0) should be considered using this Section, if they are intended to be heated. This includes, *conservatories* (see Annex 6.M), *porches*, garages and summerhouses. Heating rated at a maximum of 25 W/m² of floor area and installed for the purposes of frost protection should be disregarded however, for the purposes of this guidance;
d. Design of subsidiary accommodation for *buildings* consisting of *dwellings*, which is not exempt should be considered using this Section, if it is intended to be heated. This includes, *protected zones*, solid waste storage accommodation, underground car-parks, etc. Heating rated at a maximum of 25 W/m² of floor area and installed for the purposes of frost protection should be disregarded however, for the purposes of this guidance.

6.0.3 Thermal conductivity (J2.1)

The thermal conductivity (the λ-value) of a material is a measure of the rate at which that material will pass 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 an exposed *building* element will enable the thermal transmittance of the element to be calculated. For clarity the term 'exposed' in relation to a *building* element in this Section includes; an element directly exposed to the outside air or directly in contact with the ground or a floor directly in contact with a solum space.

Exposed elements

Measurements of thermal conductivity should be made in accordance with BS EN 12664 or BS EN 12667. Annex 6.A 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 by the Building Research Establishment (BRE) publication BR 443 – 'Conventions for U-value calculations' can also be followed.

www.bsi-global.com

www.bre.co.uk

6.0.4 Thermal transmittance and the *insulation envelope* (J2.1)

Thermal transmittance (the *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, and is expressed in units of Watts per square metre per degree of temperature difference (W/m^{2}K).

Measurements of thermal transmittance should be made in accordance with BS EN ISO: 8990. 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.

Taking into account guidance as appropriate from BRE publication BR 443 'Conventions for U-value calculations', individual *U-values* of exposed *building* elements forming the *insulation envelope* should be established:

a. by using insulation to a thickness derived from manufacturers' data relating to thermal conductivities (W/m·K) and thermal transmittances (*U-values*: W/m^2K) certified by a *notified body*; or
b. by using insulation to a thickness derived from the tables in Annex 6.A; or
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 or CIBSE Guide Section A3, 1999 Edition (for worked examples see Annex 6.B); or
d. for floors adjacent to the ground and basements, by using the method outlined in Annex 6.C and set out fully in BS EN ISO 13370 or CIBSE Guide Section A3, 1999 Edition; or
e. for windows, doors and rooflights, by using BS EN ISO 10077-1 or BS EN ISO 10077-2 or the tables in Annex 6.A.

6.0.5 Buffering effects of certain structures on the *insulation envelope* (J2.3)

If a *dwelling* or part of a *building* consisting of *dwellings* is separated from an enclosed area that is not heated, (e.g. a garage, solid waste storage accommodation in a *building*, *protected zone* or underground car-park) the *separating walls* and *separating floors* should have fabric insulation. This can be achieved in 1 of 4 ways by:

a. disregarding the "buffering" effects of the area and treating the *U-value* of the separating/dividing element as if it were directly exposed to the external air; or
b. using the formulae in Clause 3.3 of SAP 2001 (the first formula is used for modifying a *U-value* established by clause 6.0.4 c. above and the second formula is used in conjunction with clause 6.0.4 b. above.); or
c. following the procedure in BS EN ISO 6946; or
d. following the procedure in BS EN ISO 13789.

www.projects.bre.co.uk/sap2001

Note that doors or windows that occur in such separating elements should achieve the *U-values* specified in Column A of Table 1 (see 6.2.1 Elemental Method) unless the separating element forms a part of a Target *U-value* or Carbon Index Method calculation.

The above procedures also apply to a floor or wall (including doors and translucent *glazing*) dividing a *dwelling* and ancillary accommodation that is not heated, a *conservatory* or *porch*, for example. Further guidance on *conservatories* is given in Annex 6.M.

6.0.6 *Insulation envelope* where thermal transmittance is considered to be zero (J2.4)

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. This is appropriate on the basis that 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 Roofs that perform the function of a floor (J2.2)

For the purposes of establishing the exposed *building* element status, 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.

6.0.8 Atria (J2.3)

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*.

6.0.9 Annexes to guidance

At the back of this Section are Annexes. These have a dual role. Some give guidance in respect of calculation procedures. Others however show how the guidance should be applied to *domestic buildings* in the form of, alterations, extensions, *conservatories*, historic *buildings* and also *conversions*.

6.0.10 Calculation of areas (J2.5)

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 m^2, 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 ingo to ingo and from head to sill or threshold.

6.0.11 Latest changes

It was the intention that this Technical Handbook would be a level transfer of the technical requirements in the previous Parts of the Technical Standards. However certain recommendations have either been clarified, updated or become obsolete over the last few years. It was felt necessary therefore to include these changes in this new technical handbook.

The Circular referred to in Standard 6.1 is required due to the change from mandatory Technical Standards to guidance.

Building fabric – All parts of a *dwelling* are required to be within an *insulation envelope*, with an option for *buildings* ancillary to *dwellings*, depending on whether or not they are heated.

Annex 6.H on alterations and extensions is provided to help designers and verifiers determine an appropriate approach to dealing with *work* to existing *buildings* that are currently less than ideal in terms of energy efficiency. One significant addition is that levels of SEDBUK are now given for gas and oil central heating boilers, where new heating systems or replacement boilers are installed.

Annex 6.N on *conversions* is provided to help designers and verifiers determine an appropriate approach to dealing with *conversions* to existing *buildings* that are currently less than ideal in terms of energy efficiency. One significant addition is that *buildings* that are *converted* (Regulation 4, Schedule 2), and also which were heated in their existing state) should meet certain levels of fabric insulation.

6.1 Policy

contents

standard 6.1 mandatory	**Every *building* must be designed and *constructed* in such a way that provision is made for energy conservation in accordance with the Building Standards Circular on Energy, 2004.**

6.1.0 Introduction

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 1960's health was the main focus and minimising the occurrence damp and mould in housing and other *residential buildings*;
- in the 1970's, tackling the fuel crises was the main issue and the scope of the regulations was extended to cover all heated *buildings*;
- in the 1980's to early1990's cost effectiveness identified a need for heating controls and these were introduced for non-domestic *buildings*;
- from the late 1990's to the present, 'greenhouse gas emissions' and 'global warming' have been the drivers for change. Space heating and air conditioning efficiency are two of the latest requirements of the standards.

The Building Standards Circular on Energy, 2004 provides a benchmark against which the standards for energy conservation can be calibrated. Standards 6.2 to 6.8 define the areas where the Circular applies and detailed recommendations are made as to how these standards can be satisfied. These standards are intended to provide a level transposition from the 6th Amendment to the 1990 Building Standards Regulations and therefore the Circular is fixed at the level achieved by the 6th Amendment. This is a 25% improvement on the energy performance of *buildings* as required under the 5th Amendment. The date given in the Circular is the last date on which it was possible to apply for a building warrant under the 5th Amendment (3 March 2002). It is estimated that by designing to this level, each new *dwelling* will make savings of around 0.15 tonnes of carbon per year, than previously. For non-domestic *buildings*, savings will be in a similar proportion. The total savings in terms of carbon emissions will depend on the volume and type of *work* that takes place. However it was estimated in 2001 that the introduction of this standard would lead to total carbon savings by 2010 of 60,000 tonnes of carbon from the effects of the standard on new build property, with an additional benefit arising from other *work*.

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).

6.1.1 Building Standards Circular on Energy, 2004

One of the purposes of the Building (Scotland) Act 2003 is the furtherance of conservation of fuel and power. It is the intention of the Scottish Executive to maximise the contribution that the building standards can make to the conservation of fuel and power and the consequent reduction in emissions of CO_2.

New *buildings*, *conversions*, extensions to *buildings* and alterations should therefore be designed and *constructed* so that the energy performance is 25% more efficient than would have been the case if the *construction* or *conversion* had been under the standards in force on 3 March 2002.

6.2 Building insulation envelope

contents

standard **6.2** mandatory	**In order to comply with standard 6.1 every *building* must be designed and *constructed* in such a way that the *insulation envelope* resists thermal transfer.** **Limitation** This standard does not apply to: (a) *buildings*, other than *dwellings,* which will not be heated nor cooled, other than heating provided for the purpose of frost protection; or (b) *buildings* which are ancillary to a *dwelling* which will not be heated, other than heating provided for the purpose of frost protection.

6.2.0 Introduction (J3.1)

The guidance (clauses 6.2.1 to 6.2.3) gives three alternative approaches to the design of the *insulation envelope* of a new *dwelling* or a new *building* consisting of *dwellings*. These methods are presented in the following order:

- Elemental Method
- Target *U-value* Method
- Carbon Index Method

www.boilers.org.uk

www.projects.bre.co.uk/sap2001

Each approach takes the heating systems into consideration to a greater or lesser degree and involves the SEDBUK of certain types of central heating boiler. SEDBUK is the Seasonal Efficiency of a Domestic Boiler in the UK, defined in 'The Government's Standard Assessment Procedure for the Energy Rating of Dwellings 2001 Edition' (SAP 2001). This allows a reduced performance in the thermal transmittance of an *insulation envelope*, in exchange for heating with improved energy efficiency. To attain a degree of equitability, it is appropriate that the energy efficiency of the main heat-producing appliance determines the energy efficiency of the *building* fabric

Energy efficiency in *dwellings* can be achieved with a degree of design flexibility. If this is to be done, the methods given in this guidance should be considered in the following order, Carbon Index Method, Target *U-value* Method and Elemental Method. The merits of each approach are given in the preamble to each Method.

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 this standard as is *reasonably practicable*, and in no case be worse than before the *conversion* (Regulation 12, Schedule 6).

6.2.1 Elemental Method (J3.2, J3.3)

This is the simplest approach for designing the *insulation envelope* of a *dwelling* or a *building* consisting of *dwellings*. It is contained in this guidance principally for *work* that cannot be realistically designed using a method that is integrated with solar heat gains or alternatively if the flexibility of compensatory *U-values* in the *insulation envelope* are not needed. However it also serves the purpose of giving benchmark *U-values*, which may be useful as a comparison for those who wish to use either the Carbon Index or Target *U-value* Methods in this guidance. If a *conservatory* is to be built at the same time as a *dwelling*, the guidance given in Annex 6.M should be read in conjunction with this Method.

Conservatories

Objective

To use the Elemental Method, individual exposed *building* elements and other elements forming the *insulation envelope* of a *dwelling* or a *building* consisting of *dwellings* should have *U-values* which do not exceed the numerical value given in Table 1.

Heating system influence

There are two levels of *U-value*, Column A and Column B. Column selection generally depends on the type of heating system to be installed in a *dwelling* and whether or not it has a central heating boiler with a SEDBUK of at least the percentages given in Table 2. The less demanding *U-values* in Column A of Table 1 can be selected when the central heating system uses a gas or oil boiler with a SEDBUK equal to or greater than the percentages given in Table 2.

Blocks of *dwellings*

Blocks of *dwellings* containing communal *rooms* or other areas which are exclusively associated with the *dwellings*, should also use Column A of Table 1 to establish the *U-values* for the *insulation envelope* that does not form part of a *dwelling*.

Selection of more demanding *U-values*

The more demanding *U-values* in Column B of Table 1 should be selected when:

a. the type of heating system has not been decided upon at the building warrant application stage; or,
b. there is no central heating; or,
c. the central heating system uses gas or oil-fired boilers with a SEDBUK of less than the percentages given in Table 2; or,
d. the central heating uses solid fuel or is a warm-air system; or,
e. the heating is electric.

Table 1: Maximum *U-values* for *building* elements using the Elemental Method

Elements forming part of the *insulation envelope*		**Column A**	**Column B**
Pitched roof	With insulation between rafters	0.20	0.18
	With insulation between ceiling ties or collars	0.16	0.16
Flat roof or roof (including pitched) with integral insulation		0.25	0.22
Exposed wall, *external wall* or wall referred to in clause 6.0.5		0.30	0.27
Exposed floor or floor referred to in clause 6.0.5		0.25	0.22
Windows, doors and rooflights (including translucent *glazing* and doors located in walls referred to in clause 6.0.5)	Metal frames (area-weighted average)	2.2	2.0
	Wood or plastic frames (area-weighted average)	2.0	1.8

When reading Table 1, above, the following points should be taken into account:

- a wall excludes any translucent *glazing* (including windows), doors and their associated frames;
- a roof excludes any translucent *glazing* and associated frames (including roof windows and rooflights);
- a roof includes *glazing* which provides daylight to a *roof space* only, where the thermal insulation material is located between the ceiling ties or collars;
- individual *U-values* for windows, doors and rooflights may vary however the average *U-value* for all windows, doors and rooflights should not be more than the figure shown. Trade-off should only occur between elements in the same frame classification: i.e. (1) wood and plastic or (2) metal. For method of calculation see Annex 6.E;
- metal-framed windows have slimmer frames and therefore give a passive solar benefit and this justifies a less demanding level of *U-value*.

Table 2: Minimum boiler SEDBUK which allows *U-values* in Column A of Table 1 to be used

Central heating system fuel and boiler type	**Minimum SEDBUK (%)**
Mains natural gas (all boiler types)	78
LPG (all boiler types)	80
Oil (combination boilers)	82
Oil (all other types of boilers)	85

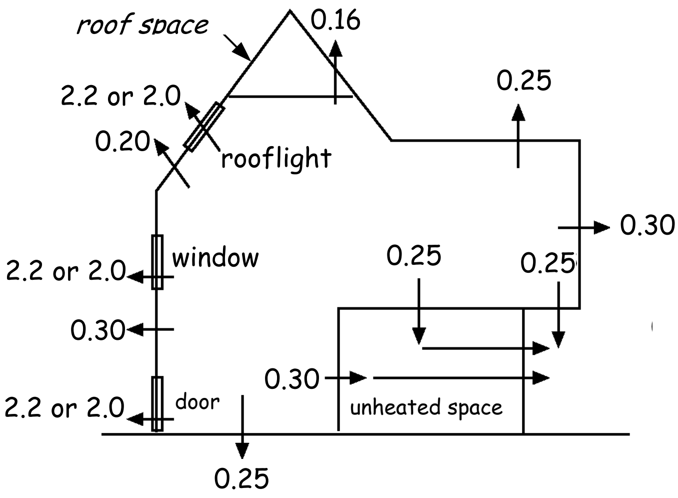
6.2.1

www.boilers.org.uk

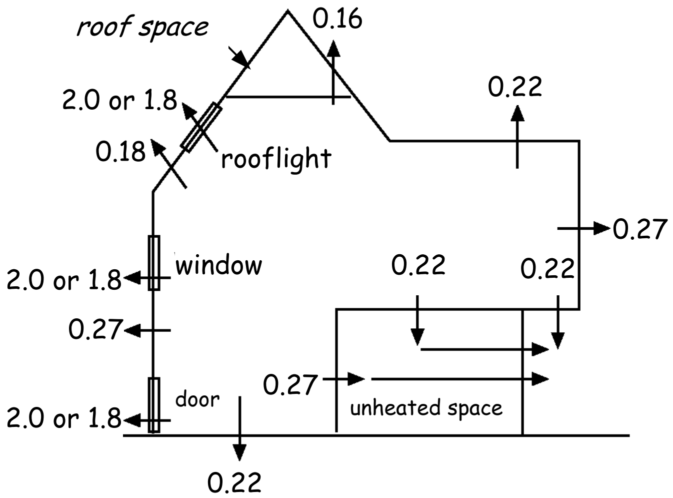
www.projects.bre.co.uk/sap2001

When considering Table 2 above, it should be recognised that not all boiler manufacturers participate in the SEDBUK database. When specific values are not available the generic values in Table 4b of SAP 2001 can be used.

The *U-values* in Table 1 to clause 6.2.1 are summarised in the diagrams below:



***U-value* summary diagram**
(less demanding values, from Column A)



***U-value* summary diagram**
(more demanding values, from Column B)

Area of windows, doors and rooflights – *dwellings*

When using the Elemental Method guidance, the total area of windows, doors and rooflights (including their frames) in the *insulation envelope* should not exceed 25% of the total floor area of the *dwelling*. The floor area of any *conservatory* is excluded from this calculation but other ancillary *buildings* that are accessed from the *dwelling* and heated should be included. The guidance given in Section 3: Environment recommends the minimum amount of natural lighting to a *dwelling*.

Area of windows, doors and rooflights – other areas

Communal *rooms* or other areas in blocks of *dwellings* (which are exclusively associated with the *dwellings* and heated) should also have the percentage of translucent *glazing* and doors in the *insulation envelope* limited to 25% of the total floor area of the communal room or other area.

Next stages

Once the *insulation envelope* has been established by this method, the following issues should be considered:

- limiting the effect of thermal bridging at junctions and around openings that occur in the *insulation envelope* (see clause 6.2.4);
- limiting air infiltration through/into the *insulation envelope* (see clause 6.2.5);
- energy efficiency of *building* services (see standards 6.3, 6.4, 6.7 and 6.8).

6.2.2 Target *U-value* Method (J3.4 to J3.10, J3.12)

This method allows greater flexibility than the Elemental Method. The aim is to achieve a level of energy efficiency broadly equivalent to that obtained through the Elemental Method. This is done by comparing the average fabric *U-value* of the proposed *dwelling* or *building* consisting of *dwellings* with a Target *U-value* obtained from one of the formulae in either a. or b. or c. on the following page.

Calculation for entire blocks of *dwellings*

One of the main advantages that this method has over the Carbon Index Method is that the calculation can be used for an entire *building* consisting of *dwellings* or a row of terraced *houses*, for example. This degree of flexibility however, should be used carefully to ensure that the *insulation envelope* of the individual *dwellings* is not unduly disadvantaged. It is not intended that 1 *dwelling* (in a *building* consisting of *dwellings*) is super-insulated and another is *constructed* with its *insulation envelope* only just achieving the maximum *U-values* in Table 2 to clause 6.2.2.

Calculation for individual *dwellings* and heated subsidiary accommodation

If the Target *U-value* Method is used for each of the individual *dwellings* that form part of a block and there are other areas that are to be heated, for example a communal lounge or common stair, the Elemental Method should be used to consider the insulation of these areas. Column A of Table 1 to clause 6.2.1 is the appropriate level of *U-value* to use.

A further benefit with this method is that it enables a fast-track trade-off. This is done without the need to create a notional *building* of the same size and shape as one which is designed to the Elemental Method in this guidance. Solar gain as a benefit, can also

Conservatories

be taken into consideration when using this method as an aid to design. If a *conservatory* is to be built at the same time as a *dwelling*, the guidance given in Annex 6.M should be read in conjunction with this Method.

When designing the *building* fabric using this particular method, it may be helpful as a starting point to refer to:

- Table 1 to clause 6.2.1, which gives benchmark elemental *U-values*;
- Table 2 to clause 6.2.2, which gives maximum *U-values* for the *insulation envelope*;
- The guidance given in Section 3: Environment, which recommends the minimum amount of *glazing* for natural lighting to a *dwelling*. This should be considered before attempting to reduce *glazing* areas when following the Target *U-value* Method.

Examples

Annex 6.F contains examples of how to use the Target *U-value* Method.

Objective

The area-weighted average *U-value* of the exposed *building* elements and other elements described in clause 6.0.5 which form part of the *insulation envelope* of a *dwelling* or *building* consisting of *dwellings* should not exceed the appropriate Target *U-value*. The base Target *U-value* is dependent on the roof type of the *building* and is modified as appropriate for the proposed method of heating and any solar gains. In the first instance, to determine the Target *U-value*, use one of the following formulae:

a. Pitched roof (with insulation between ceiling ties or collars):

$$U_T = 0.3-0.14(A_R/A_T)-0.05(A_{GF}/A_T)+0.425(A_F/A_T)$$

b. Pitched roof (with insulation between rafters):

$$U_T = 0.3-0.1(A_R/A_T)-0.05(A_{GF}/A_T)+0.425(A_F/A_T)$$

c. *Flat roof* or roof with integral insulation:

$$U_T = 0.3-0.05(A_R/A_T)-0.05(A_{GF}/A_T)+0.425(A_F/A_T)$$

Where:

U_T is the base Target *U-value* prior to adjustment for heating system performance or solar gain;

Areas measured in m^2

A_R is the roof area (in the plane of the insulation and excluding rooflights);

A_{GF} is the exposed floor area (including floor in clause 6.0.5);

A_F is the total floor area (all *storeys*);

A_T is the total area of exposed *building* elements and elements referred to in clause 6.0.5 of the *dwelling* or *building* consisting of *dwellings*.

Mixed roof types

When selecting one of the above formulae, in a situation where mixed roof types occur, it is considered appropriate to use the formula that represents the roof type that covers the greatest area of the roof.

Heating system influence

All the formulae above are based on a boiler SEDBUK that is equal to or greater than the percentages shown in Table 1 below. If the boiler has a SEDBUK of less than these percentages, the Target *U-value* should be made to be more demanding by multiplying it by the factor f_e, given by the formula below:

$$f_e = \frac{\text{Proposed boiler SEDBUK (\%)}}{\text{Reference boiler SEDBUK (\%)}}$$

Table 1: Reference boiler SEDBUK which allows Target *U-value* to remain unmodified

Central heating system fuel and boiler type	Minimum SEDBUK (%)
Mains natural gas (all boiler types)	78
LPG (all boiler types)	80
Oil (combination boilers)	82
Oil (all other types of boilers)	85

www.boilers.org.uk

www.projects.bre.co.uk/sap2001

When considering Table 1 above, it should be recognised that not all boiler manufacturers participate in the SEDBUK database. When such a rating is not available the generic values in Table 4b of SAP 2001 can be used.

There is the potential for a higher CO_2 emission rate to occur if the *dwelling* has any one of the following arrangements:

a. the type of heating system has not been decided upon at the building warrant application stage; or,
b. there is no central heating; or,
c. the central heating uses solid fuel or is a warm-air system; or,
d. the heating is electric.

When a, b, c or d above prevails the base Target *U-value* should be divided by 1.15.

Optional Window/rooflight frame material influence

If the *dwelling* or *building* consisting of *dwellings* have metal framed windows/rooflights (including any with thermally-broken frames), the base Target *U-value* can be made to be less demanding by multiplying it by 1.03. This is optional but gives cognisance to the additional solar gain given by the greater proportion of translucent *glazing*.

Optional solar heat gain influence

For simplicity, the base Target *U-value* formulae assume that the distribution of translucent *glazing* (windows and rooflights, for example) on the north and south elevations are equal. The Target *U-value* can again be made to be less demanding if the area of such *glazing*, including frames, on the south elevations is greater than that on the north. This is optional but the benefit of solar heat gains will be taken into account by adding:

$0.04[(A_S - A_N) \div A_{TG}]$ onto the Target *U-value*

Where:

- A_S is the total area (m^2) of *glazed* openings facing south;
- A_N is the total area (m^2) of *glazed* openings facing north;
- A_{TG} is the total area (m^2) of all *glazed* openings.

Facing north is defined as north plus or minus 30 degrees; and

Facing south is defined as south plus or minus 30 degrees.

If adjustments to the Target *U-value* are to be made for either the heating system or metal window/rooflight frames, as well as any for solar gain, the adjustment for solar gain should be applied last.

Maximum *U-values*

As the Target *U-value* Method allows a trade-off between elements, it is possible to achieve lower levels of *U-values* in some parts of the *construction* than would be possible with the Elemental Method. To reduce the incidence of technical issues such as condensation occurring, Table 2 should be used in the design to reduce the risk. Other measures to reduce condensation risk can be found in clause 6.2.4 and Section 3: Environment.

Table 2: Maximum *U-values* for *building* elements of the *insulation envelope* when using the Target *U-value* Method

***Building* element**	**Maximum *U-value***
Roof	0.35
Wall or floor (except where thermal transmittance is considered as zero)	0.70

Next stages

Once the *insulation envelope* has been established by this method, the following issues should be considered:

- limiting the effect of thermal bridging at junctions and around openings that occur in the *insulation envelope* (see clause 6.2.4);
- limiting air infiltration through/into the *insulation envelope* (see clause 6.2.5);
- energy efficiency of *building* services (see standards 6.3, 6.4, 6.7 and 6.8).

6.2.3 Carbon Index Method (J3.11, J3.12)

This method allows much greater flexibility than either the Elemental Method or the Target *U-value* Method while still achieving an overall performance similar to that obtained through the Elemental Method. The Carbon Index adopted in this Method is that defined in SAP 2001 and is calculated using the SAP worksheet or by using BRE-approved computer software.

www.projects.bre.co.uk/sap2001

One of the main advantages that this method has over either the Elemental Method or the Target *U-value* Method is that it acknowledges the energy efficiency benefits of community heating systems, solar water heating, heat pump systems, etc. Another benefit is that the Carbon Index is derived from the SAP calculation, which is necessary for every newly-created *dwelling*. It is only a relatively short step beyond this calculation, to ascertain the Carbon Index. The Carbon Index Method is the most all-embracing approach in this guidance for achieving energy efficiency in a *dwelling*.

Heated subsidiary accommodation

The Carbon Index Method can only be used for individual *dwellings*. The Elemental Method should be used to consider other areas that are to be heated in the *building*, for example a communal lounge or common stair, the Elemental Method should be used to consider these areas. Column A of Table 1 to clause 6.2.1 is the appropriate level of *U-value* to use. If a *conservatory* is to be built at the same time as a *dwelling*, the guidance given in Annex 6.M should be read in conjunction with this method.

Conservatories

Objective

For a *dwelling* using this method, a Carbon Index of 8.0 or more should be achieved. Examples of *dwellings* with Carbon Index of 8.0 or more are given in Annex 6.G.

When designing the *building* fabric using this particular method, it may be helpful as a starting point to refer to:

- Table 1 to clause 6.2.1, which gives benchmark elemental *U-values*;
- the table below, which gives maximum *U-values* for the *insulation envelope*;
- the guidance given in Section 3: Environment recommends the minimum amount of *glazing* for natural lighting to a *dwelling*. This should be considered before attempting to reduce *glazing* areas when following the Carbon Index Method.

Maximum *U-values*

As the Carbon Index Method allows trade-off between elements, it is possible to achieve lower levels of *U-values* in some parts of the *construction* than would be possible with the Elemental Method. To reduce the incidence of technical issues such as condensation occurring, the table below should be used in the *building* design to reduce the risk. Other measures to reduce condensation risk can be found in clause 6.2.4 and Section 3: Environment.

Maximum *U-values* for *building* elements of the *insulation envelope* when using the Carbon Index Method.

***Building* element**	**Maximum *U-value***
Roof	0.35
Wall or floor (except where thermal transmittance is considered as zero)	0.70

Next stages

Once the *insulation envelope* has been established by this method, the following issues should be considered:

- limiting the effect of thermal bridging at junctions and around openings that occur in the *insulation envelope* (see clause 6.2.4);
- limiting air infiltration through/into the *insulation envelope* (see clause 6.2.5);
- energy efficiency of *building* services (see standards 6.3, 6.4, 6.7 and 6.8).

6.2.4 Limiting the effect of thermal bridging at junctions and around openings (J4.1)

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 the design stage or poor *construction* on site. The key areas of concern are:

a. within *building* elements;

b. at the junction between *building* elements;
c. at the edges of *building* elements where openings in the structure are formed.

www.bre.co.uk

One approach to addressing these issues would be to follow the advice given in the Building Research Establishment (BRE) Report 262 – 'Thermal insulation, avoiding risks' 2002 edition. Another way, could be to demonstrate equivalent performance by calculation. Annex 6.D gives a procedure for establishing condensation risk and heat loss at the edges of openings.

6.2.5 Limiting air infiltration (J5.1)

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.

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).

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 follow the advice given in the Building Research Establishment (BRE) Report 262 – "Thermal insulation, avoiding risks" 2002 edition, including the following:

a. sealing the gaps; at *roof space* openings, between dry linings and masonry walls at the edges of window and door openings, and at the junctions between walls, floors and ceilings.
b. sealing vapour control membranes in timber framed and other framed panel *constructions*.
c. sealing at service penetrations of the fabric or around boxing/ducting for services.

d. fitting draught seals to the openable parts of windows, doors, access hatches and rooflights.
e. using joist-hangers or sealing around joist ends built into the inner leaf of external cavity walls.

BR 262 gives other examples of appropriate design details and *construction* practice.

6.3 Heating system

standard 6.3 mandatory	**In order to comply with standard 6.1 every *building* must be designed and *constructed* in such a way that the heating and hot water service systems are designed, installed, and capable of being controlled to achieve optimum energy efficiency, having regard to the thermal transfer of the *insulation envelope*.** **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) *buildings*, or parts of a *building*, which will not be heated, other than heating provided for the purpose of frost protection; (c) heating provided for the purpose of frost protection; or (d) individual, solid-fuel stoves or open-fires, gas or electric fires or room heaters (excluding electric storage and panel heaters) provided in *domestic buildings*.

6.3.0 Introduction

This part of the guidance covers the energy-efficiency of heating and hot water systems in *dwellings*. In the design of new *domestic buildings*, the energy efficiency of the heating plant is closely linked to the performance of the *insulation envelope*. Consequently the guidance that relates to such installations only considers controls. For replacement boilers in existing *dwellings* however there is guidance given for appropriate SEDBUK efficiencies in Annex 6.H.

If the Carbon Index Method is used (see clause 6.2.3), the heating controls which are specified to achieve the Carbon Index in the calculation, should also be taken into consideration in both the *dwelling* design and *construction*.

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 this standard as is *reasonably practicable*, and in no case be worse than before the *conversion* (Regulation 12, Schedule 6).

6.3.1 Controls for space heating systems (J6.1)

In a *dwelling* or other area of a *building* consisting of *dwellings*, controls should be installed to ensure energy-efficient use of space heating systems. Zone controls, timing controls and other controls exclusive to boilers are commonly adopted. This guidance does not apply however to individual, solid-fuel stoves or open-fires, gas or electric fires or room heaters. An electric storage heater can be considered to have appropriate control if there is an automatic charge control that detects the internal *building* temperature or the external temperature and adjusts the charging of the heater accordingly.

Zone controls

Each part of a *dwelling* that has a different heating regime should be fitted with zone controls, areas for sleeping and areas for general living, for example. This is not necessary however, for single-*apartment dwellings*. For small *dwellings* with wet central heating systems, this will usually be by a room thermostat and thermostatic radiator valves (TRVs). For large *dwellings* with wet central heating systems, this will usually be by room thermostats (see timing controls below) and TRVs. For fan or damper controlled electric storage heaters and electric panel heaters, this will usually be achieved by room thermostats and/or appliance integrated thermostats.

Timing controls

Automatic timing controls should be installed to enable the *occupier* to determine when the space heating and water heating should operate. Timing controls should allow different settings for the 7 individual days of the week. At least 1 time switch or full programmer is recommended for all *dwellings*. For large *dwellings* with a floor area over 150 m^2, the recommendation is that these arrangements should be extended to enable independent time and temperature control of multiple space heating zones, no zone exceeding 150 m^2 and each zone also governed by a room thermostat. In addition, there should be independent time control of the water heating, unless the system has a combination or solid-fuel boiler.

Additional controls for systems with boilers

For gas and oil fired boilers, sufficient system controls should be installed in an arrangement which switches off the boiler when there is no demand for heat to the radiators and hot water storage vessels (where they are installed). This is commonly referred to as a boiler interlock. A pump over-run timing device may be fitted, as required by the boiler manufacturer. Solid-fuel boilers 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 however, a slumber circuit for such boilers should be formed, which is independent of any controls.

www.est.org.uk/bestpractice

Good Practice Guide 302 (Energy Efficiency Best Practice in Housing) gives examples of appropriate controls and their use in *dwellings*. A system that is designed to the guidance given in the above paragraphs or follows the advice in GPG 302 (together with 7-day timing devices, as appropriate) can be considered to have achieved appropriate space heating control.

6.3.2 Hot water service system controls (J6.2)

Combination boilers

A hot water service system 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. This guidance is not appropriate if the system uses combination boilers or storage combination boilers where the storage capacity in each case is 15 litres or less.

Systems other than those with solid fuel boilers

www.bsi-global.com

If the system does not incorporate a solid fuel boiler, consideration should be given to the following:

- the heat exchanger in the storage vessel should have sufficient heating capacity, such as one manufactured in accordance with BS 1566: Part 1: 2002 or Part 2: 1984 (1990) or BS 3198: 1981. In particular it should follow the recommendations in these standards for the surface area of heat exchangers (i.e. pipe diameter and number of coils);
- a thermostat should be fitted which switches off the heat when the storage temperature required by the occupants has been achieved. In the case of hot water central heating systems this thermostat should be interconnected with the other controls which are needed to form a boiler interlock;
- a manually adjustable 7-day automatic timing device should be installed to control the periods of operation. This can be either as a part of the central heating system or as an independent device.

Solid fuel boilers

With a solid-fuel fired system however, where the cylinder is not 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.

6.4 Insulation of pipes, ducts and vessels

contents

standard

6.4

mandatory

In order to comply with standard 6.1 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 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* must be improved to as close to the requirement of this standard 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* (J6.3)

Warm air *ducts* and hot pipes serving a space heating system should be insulated against heat loss unless the use of such pipes or *ducts* always contribute to the heating demands of the *room* or space. In most instances this will be where pipe and *duct* runs occur outwith the *insulation envelope* of the *building*. This will not only address energy conservation issues but will also assist with frost protection. Further information on this subject is contained in the 2002 edition of the BRE Report: Ref 262: Thermal insulation, avoiding risks

www.bre.co.uk

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.

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. A balanced approach will be needed with carefully thought out routes for services to ensure that buildability is achieved.

A way of achieving insulation for such pipes and *ducts* is to follow 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^{O}C to +700^{O}C’.

www.bsi-global.com

6.4.2 Insulation of vessels (J6.4)

A hot water storage vessel should be insulated against heat loss. This can be achieved by following the guidance for ‘environmental thickness’ given 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.

6.5 Artificial and display lighting

This standard does not apply to domestic buildings

6.6 Mechanical ventilation and air conditioning

This standard does not apply to domestic buildings

6.7 Commissioning building services

contents

standard 6.7 mandatory	**In order to comply with standard 6.1 every *building* must be designed and *constructed* in such a way that 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) the process and emergency lighting components of a *building*; (b) heating provided for the purpose of frost protection; or (c) lighting, ventilation and cooling systems in a *domestic 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.

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 (J6.5)

A heating and hot water service system 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

contents

standard

6.8

mandatory

In order to comply with standard 6.1 the *occupiers* must be provided by the owner with written information on the operation and maintenance of the *building* services and a forecast of the energy consumption of the *building*.

Limitation

This standard does not apply to:

(a) *buildings* which do not use fuel or power for heating, lighting, ventilating and cooling the internal environment and heating the water supply services;

(b) the process and emergency lighting components of a *building*;

(c) heating provided for the purpose of frost protection; or

(d) lighting, ventilation and cooling systems in a *domestic building.*

6.8.0 Introduction

Correct use and appropriate 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*.

The previous legislation required that newly-created *dwellings* were provided with an energy rating, calculated in accordance with 'The Government's Standard Assessment Procedure for Energy Rating of Dwellings' (SAP). This is still required by the Building (Procedure) (Scotland) Regulations 2004. The principal difference is that the SAP rating is now to be submitted to the verifier upon completion of the *dwelling* or *conversion* into 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).

6.8.1 Written information (J6.6)

Operation and maintenance 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 to encourage optimum energy efficiency.

Forecast of energy consumption

An energy rating, calculated in accordance with 'The Government's Standard Assessment Procedure for Energy Rating of Dwellings' (SAP 2001 edition) is required by the Building (Procedure) (Scotland) Regulations 2004 and should be submitted to the verifier upon completion of the *dwelling* or *conversion* into a *dwelling.* A copy of the rating should also be made available to the occupier.

Annex 6.A Tables of U-values and thermal conductivity

contents

annex

6.A

Tables of U-values and thermal conductivity

(Appendix A)

6.A.0 Introduction

The *U-value* tables in this Annex give a “ready reckoner” approach to establishing the *U-values* of *construction* elements. If the designer considers that a more accurate calculation is appropriate for the design of the *building* then, for roofs, walls and floors, the procedures in Annexes 6.B and 6.C can be used. When using the *U-value* tables, the following should be borne in mind:

a. the values in these tables have been derived using the Combined Method, taking into account the effects of thermal bridging where appropriate;

b. intermediate values can be obtained from the tables by linear interpolation.

The last table of this Annex gives thermal conductivities of some common *building* materials. If however certified test values are available, these should be used in preference to those given in the table.

Windows, rooflights and doors

Full details about calculating the *U-value* of a window or door are given in BS EN ISO 10077-1. This Annex provides indicative *U-values* for windows, rooflights and doors. Table 6.A.1 applies to windows (and rooflights) with wood or plastic frames. Table 6.A.2 applies to windows with metal frames, for which the adjustments (for thermal breaks and/or rooflights) in Table 6.A.3 should be applied.

Low-E coatings

The *U-value* of a window or rooflight containing low-E *glazing* is influenced by the emissivity, ε_n, of the low-E coating. Low-E coatings are of two principal types, known as ‘hard’ and ‘soft’. Hard coatings generally have emissivities in the range 0.15 to 0.2, and the data for ε_n = 0.2 should be used for hard coatings, if the emissivity is not specified or if the *glazing* is stated to be low-E but the type of coating is not specified. Soft coatings generally have emissivities in the range 0.05 to 0.1. The data for ε_n = 0.1 should be used for a soft coating if the emissivity is not specified.

When available, manufacturers’ *U-values*, certified by a *notified body*, for windows, or rooflights or doors should be used in preference to the data given in these tables.

Table 6.A.1: Indicative *U-values* (W/m²K) for windows, rooflights, doors with wood or plastic frames [1]

		Gap between panes			Adjustment for rooflights [Note 5]
		6 mm	12 mm	16 mm or more	
Single-glazing	4.8				+ 0.3
Double-glazing (air filled)		3.1	2.8	2.7	+ 0.2
Double-glazing (low-E, ε_n = 0.2) [Note 2]		2.7	2.3	2.1	
Double-glazing (low-E, ε_n = 0.15)		2.7	2.2	2.0	
Double-glazing (low-E, ε_n = 0.1)		2.6	2.1	1.9	
Double-glazing (low-E, ε_n = 0.05)		2.6	2.0	1.8	
Double-glazing (argon filled) [Note 3]		2.9	2.7	2.6	
Double-glazing (low-E, ε_n = 0.2, argon filled)		2.5	2.1	2.0	
Double-glazing (low-E, ε_n = 0.15, argon filled)		2.4	2.0	1.9	
Double-glazing (low-E, ε_n = 0.1, argon filled)		2.3	1.9	1.8	
Double-glazing (low-E, ε_n = 0.05, argon filled)		2.3	1.8	1.7	
Triple-glazing (air filled)		2.4	2.1	2.0	
Triple-glazing (low-E, ε_n = 0.2)		2.1	1.7	1.6	
Triple-glazing (low-E, ε_n = 0.15)		2.0	1.7	1.5	
Triple-glazing (low-E, ε_n = 0.1)		2.0	1.6	1.5	
Triple-glazing (low-E, ε_n = 0.05)		1.9	1.5	1.4	
Triple-glazing (argon filled)		2.2	2.0	1.9	
Triple-glazing (low-E, ε_n = 0.2, argon filled)		1.9	1.6	1.5	
Triple-glazing (low-E, ε_n = 0.15, argon filled)		1.8	1.5	1.4	
Triple-glazing (low-E, ε_n = 0.1, argon filled)		1.8	1.4	1.3	
Triple-glazing (low-E, ε_n = 0.05, argon filled)		1.7	1.4	1.3	
Solid wooden door [Note 4]	3.0				N/A

Notes:

1. The *U-values* in this table are based on the frame comprising 30% of the total window area.
2. The emissivities quoted are normal emissivities. (Corrected emissivity is used in the calculation of *glazing U-values*.) Uncoated glass is assumed to have a normal emissivity of 0.89.
3. The gas mixture is assumed to consist of 90% argon and 10% air.
4. For doors which are half-glazed the *U-value* of the door is the average of the appropriate window *U-value* and that of the non-glazed part of the door (e.g. 3.0 W/m²K for a wooden door).
5. No adjustment need be applied to rooflights, other than those within a *dwelling*.

Table 6.A.2: Indicative *U-values* (W/m²K) for windows with metal frames (4 mm thermal break) [Notes 1 and 2]

	gap between panes		
	6 mm	**12 mm**	**16 mm or more**
Single-glazing	5.7		
Double-glazing (air filled)	3.7	3.4	3.3
Double-glazing (low-E, ε_n = 0.2)	3.3	2.8	2.6
Double-glazing (low-E, ε_n = 0.15)	3.3	2.7	2.5
Double-glazing (low-E, ε_n = 0.1)	3.2	2.6	2.4
Double-glazing (low-E, ε_n = 0.05)	3.1	2.5	2.3
Double-glazing (argon filled)	3.5	3.3	3.2
Double-glazing (low-E, ε_n = 0.2,argon filled)	3.0	2.6	2.5
Double-glazing (low-E, ε_n = 0.15,argon filled)	3.0	2.5	2.4
Double-glazing (low-E, ε_n = 0.1, argon filled)	2.9	2.4	2.3
Double-glazing (low-E, ε_n = 0.05, argon filled)	2.8	2.3	2.1
Triple-glazing (air filled)	2.9	2.6	2.5
Triple-glazing (low-E, ε_n = 0.2)	2.6	2.1	2.0
Triple-glazing (low-E, ε_n = 0.15)	2.5	2.1	2.0
Triple-glazing (low-E, ε_n = 0.1)	2.5	2.0	1.9
Triple-glazing (low-E, ϵ_n = 0.05)	2.4	1.9	1.8
Triple-glazing (argon-filled)	2.8	2.5	2.4
Triple-glazing (low-E, ε_n = 0.2, argon filled)	2.4	2.0	1.9
Triple-glazing (low-E, ε_n = 0.15, argon filled)	2.3	1.9	1.8
Triple-glazing (low-E, ε_n = 0.1, argon filled)	2.2	1.9	1.7
Triple-glazing (low-E, ε_n = 0.05, argon filled)	2.2	1.8	1.7

Notes:

1. The *U-values* in this table are based on the frame comprising 20% of the total window area.
2. For windows (or rooflights) with metal frames incorporating a thermal break other than 4 mm, the adjustments given in Table 6.A.3 should be made to the *U-values* given in Table 6.A.2.

Table 6.A.3: Adjustments to U-values in Table 6.A.2 for frames with thermal breaks

Thermal break (mm)	**Adjustment to *U-value* (W/m²K)**	
	Window or rooflight (other than a rooflight in a *dwelling*)	**Rooflight in a *dwelling*** [see Note]
0 (no break)	+ 0.3	+ 0.7
4	+ 0.0	+ 0.3
8	- 0.1	+ 0.2
12	- 0.2	+ 0.1
16	- 0.2	+ 0.1

Note:

Where applicable, adjustments for both thermal break and rooflight should be made. For intermediate thicknesses of thermal breaks, linear interpolation may be used.

Roofs

Table 6.A.4: Base thickness of insulation between ceiling ties/collars or rafters

	Design *U-value* (W/m^2K)	Thermal conductivity of insulant (W/m·K)						
		0.020	**0.025**	**0.030**	**0.035**	**0.040**	**0.045**	**0.050**
		Base thickness of insulating material (mm)						
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**
1	0.15	371	464	557	649	742	835	928
2	0.20	180	224	269	314	359	404	449
3	0.25	118	148	178	207	237	266	296
4	0.30	92	110	132	154	176	198	220
5	0.35	77	91	105	122	140	157	175
6	0.40	67	78	90	101	116	130	145

Table 6.A.5: Base thickness of insulation between and over ceiling ties/collars or rafters

	Design *U-value* (W/m^2K)	Thermal conductivity of insulant (W/m·K)						
		0.020	**0.025**	**0.030**	**0.035**	**0.040**	**0.045**	**0.050**
		Base thickness of insulating material (mm)						
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**
1	0.15	161	188	217	247	277	307	338
2	0.20	128	147	167	188	210	232	255
3	0.25	108	122	137	153	170	187	205
4	0.30	92	105	117	130	143	157	172
5	0.35	77	91	103	113	124	136	148
6	0.40	67	78	90	101	110	120	130

Note:
Tables 6.A.4 and 6.A.5 are derived for roofs with the proportion of timber at 8%, corresponding to 48 mm wide timbers at 600 mm centres, excluding dwangs. For other proportions of timber the *U-value* can be calculated using the procedure in Annex 6.B.

Table 6.A.6: Base thickness for continuous insulation

	Design *U-value* (W/m^2K)	Thermal conductivity of insulant (W/m·K)						
		0.020	**0.025**	**0.030**	**0.035**	**0.040**	**0.045**	**0.050**
		Base thickness of insulating material (mm)						
	A	B	C	D	E	F	G	H
1	0.15	131	163	196	228	261	294	326
2	0.20	97	122	146	170	194	219	243
3	0.25	77	97	116	135	154	174	193
4	0.30	64	80	96	112	128	144	160
5	0.35	54	68	82	95	109	122	136
6	0.40	47	59	71	83	94	106	118

Table 6.A.7: Allowable reductions in thickness for common roof components

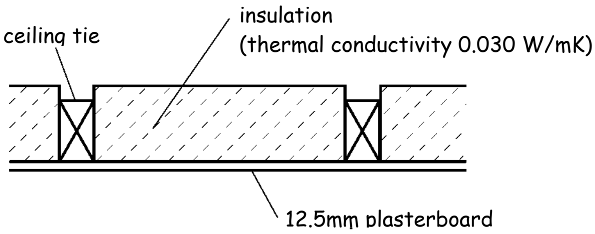
	Concrete slab density (kg/m³)	Thermal conductivity of insulant (W/m·K)						
		0.020	**0.025**	**0.030**	**0.035**	**0.040**	**0.045**	**0.050**
		Reduction in base thickness of insulating material (mm) for each 100 mm of concrete slab						
	A	B	C	D	E	F	G	H
1	600	10	13	15	18	20	23	25
2	800	7	9	11	13	14	16	18
3	1100	5	6	8	9	10	11	13
4	1300	4	5	6	7	8	9	10
5	1700	2	2	3	3	4	4	5
6	2100	1	2	2	2	3	3	3
	Other materials and components	**Reduction in base thickness of insulating material (mm)**						
	A	B	C	D	E	F	G	H
7	9.5 mm plasterboard	1	2	2	2	3	3	3
8	12.5 mm plasterboard	2	2	2	3	3	4	4
9	13 mm sarking board	2	2	3	3	4	4	5
10	12 mm calcium silicate liner board	1	2	2	2	3	3	4
11	*Roof space* (pitched)	4	5	6	7	8	9	10
12	*Roof space* (flat)	3	4	5	6	6	7	8
13	19 mm roof tiles	0	1	1	1	1	1	1
14	19 mm asphalt (or 3 layers of felt)	1	1	1	1	2	2	2
15	50 mm screed	2	3	4	4	5	5	6

Example 1

Pitched roof with insulation between ceiling ties/collars or between rafters

Determine the thickness of the insulation layer that will achieve a *U-value* of 0.20 W/m^{2}K if insulation is between the ceiling ties, and 0.25 W/m^{2}K if insulation is between the rafters.

For insulation placed between ceiling ties (*U-value* 0.20 W/m^{2}K)



Using Table 6.A.4:

From **column D, row 2** of the table, the appropriate base thickness of insulation is **269 mm**.

The base thickness may be reduced by taking account of the other materials as follows:

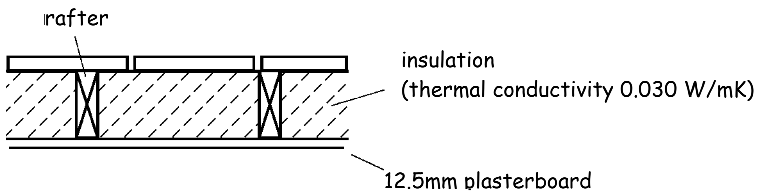
From Table 6.A.7:

19 mm roof tiles	**column D, row 13**	= 1 mm
Roof space (pitched)	**column D, row 11**	= 6 mm
12.5 mm plasterboard	**column D, row 8**	= 2 mm
Total reduction		= **9 mm**

To achieve a *U-value* of 0.20 W/m^{2}K the minimum thickness of the insulation layer between the ceiling ties is therefore:

Base thickness less **total reduction** i.e. 269 – 9 = **260 mm.**

For insulation placed between rafters (*U-value* 0.25 W/m²K)



Using Table 6.A.4:

From **column D, row 3** in the table, the appropriate base thickness of insulation is **178 mm**.

The reductions in the base thickness are obtained as follows:

From Table 6.A.7:

19 mm roof tiles	**column D, row 13**	= 1 mm
12.5 mm plasterboard	**column D, row 8**	= 2 mm
Total reduction		= 3 mm

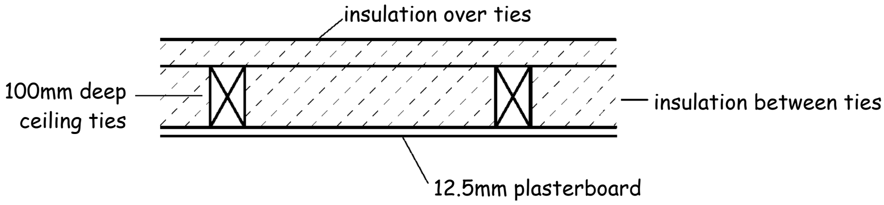
To achieve a *U-value* of 0.25 W/m^{2}K the minimum thickness of the insulation layer between the rafters is therefore:

Base thickness less **total reduction** i.e.178 - 3 = **175 mm.**

Example 2

Pitched roof with insulation between and over ceiling ties/collars

Determine the thickness of the insulation layer above the ceiling ties that will achieve a *U-value* of 0.20 W/m²K for the roof *construction* shown below:



It is proposed to use mineral fibre insulation between and over the ties with a thermal conductivity of 0.040 W/m·K. Using Table 6.A.5:

From **column F, row 2** of the table, the base thickness of insulation layer is **210 mm**.

The base thickness may be reduced by taking account of the other materials as follows:

From Table 6.A.7:

19 mm roof tiles	**column F, row 13**	= 1 mm
Roof space (pitched)	**column F, row 11**	= 8 mm
12.5 mm plasterboard	**column F, row 8**	= 3 mm
Total reduction		= **12 mm**

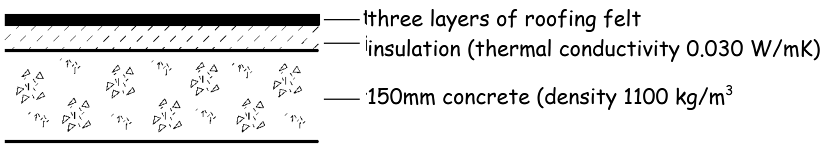
To achieve a *U-value* of 0.20 W/m^{2}K the minimum thickness of the insulation layer over the joists, in addition to the 100 mm insulation between the joists, is therefore:

Base thickness less **total reduction** i.e. 210 - 100 - 12 = **98 mm**.

Example 3

Concrete deck roof

Determine the thickness of the insulation layer that will achieve a *U-value* of 0.25 W/m²K for the roof *construction* shown below.



Using Table 6.A.6:

From **column D, row 3** of the table, the base thickness of the insulation layer is **116 mm**.

The base thickness may be reduced by taking account of the other materials as follows:

From Table 6.A.7:

3 layers of felt	**column D, row 14**	= 1 mm
150 mm concrete deck	**column D, row 3**	
adjusted for 150 mm thickness (1.5 x 8)		= 12 mm
Total reduction		= **13 mm**

To achieve a *U-value* of 0.25 W/m^{2}K, the minimum thickness of the insulation layer is therefore:

Base thickness less **total reduction** i.e. 116 - 13 = **103 mm**.

Walls

Table 6.A.8: Base thickness of insulation layer

	Design *U-value* (W/m^2K)	Thermal conductivity of insulant (W/m·K)						
		0.020	**0.025**	**0.030**	**0.035**	**0.040**	**0.045**	**0.050**
		Base thickness of insulating material (mm)						
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**
1	0.20	97	121	145	169	193	217	242
2	0.25	77	96	115	134	153	172	192
3	0.30	63	79	95	111	127	142	158
4	0.35	54	67	81	94	107	121	134
5	0.40	47	58	70	82	93	105	117
6	0.45	41	51	62	72	82	92	103

Table 6.A.9: Allowable reductions in base thickness for common components

	Component	Thermal conductivity of insulant (W/m·K)						
		0.020	**0.025**	**0.030**	**0.035**	**0.040**	**0.045**	**0.050**
		Reduction in base thickness of insulating material (mm)						
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**
1	Cavity (25 mm or greater)	4	5	5	6	7	8	9
2	Outer leaf brick	3	3	4	5	5	6	6
3	13 mm plaster	1	1	1	1	1	1	1
4	13 mm lightweight plaster	2	2	2	3	3	4	4
5	9.5 mm plasterboard	1	2	2	2	3	3	3
6	12.5 mm plasterboard	2	2	2	3	3	4	4
7	Air space behind plasterboard dry lining	2	3	4	4	5	5	6
8	9 mm sheathing ply	1	2	2	2	3	3	3
9	20 mm cement render	1	1	1	1	2	2	2
10	13 mm tile hanging	0	0	0	1	1	1	1

Table 6.A.10: Allowable reductions in base thickness for concrete components

	Density (Kg/m³)	Thermal conductivity of insulant (W/m·K)						
		0.020	0.025	0.030	0.035	0.040	0.045	0.050
		Reduction in base thickness of insulation (mm) for each 100 mm of concrete						
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**
Concrete inner leaf								
1	600	9	11	13	15	17	20	22
2	800	7	9	10	12	14	16	17
3	1000	5	6	8	9	10	11	13
4	1200	4	5	6	7	8	9	10
5	1400	3	4	5	6	7	8	8
6	1600	3	3	4	5	6	6	7
7	1800	2	2	3	3	4	4	4
8	2000	2	2	2	3	3	3	4
9	2400	1	1	2	2	2	2	3
Concrete outer leaf or single leaf wall								
10	600	8	11	13	15	17	19	21
11	800	7	9	10	12	14	15	17
12	1000	5	6	7	8	10	11	12
13	1200	4	5	6	7	8	9	10
14	1400	3	4	5	6	6	7	8
15	1600	3	3	4	5	5	6	7
16	1800	2	2	3	3	3	4	4
17	2000	1	2	2	3	3	3	4
18	2400	1	1	2	2	2	2	3

Table 6.A.11: Allowable reductions in base thickness for insulated timber framed walls

	Thermal conductivity of insulation within frame (W/m·K)	Thermal conductivity of insulant (W/m·K)						
		0.020	0.025	0.030	0.035	0.040	0.045	0.050
		Reduction in base thickness of insulation material (mm) for each 100 mm of frame (mm)						
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**
1	0.035	39	49	59	69	79	89	99
2	0.040	36	45	55	64	73	82	91

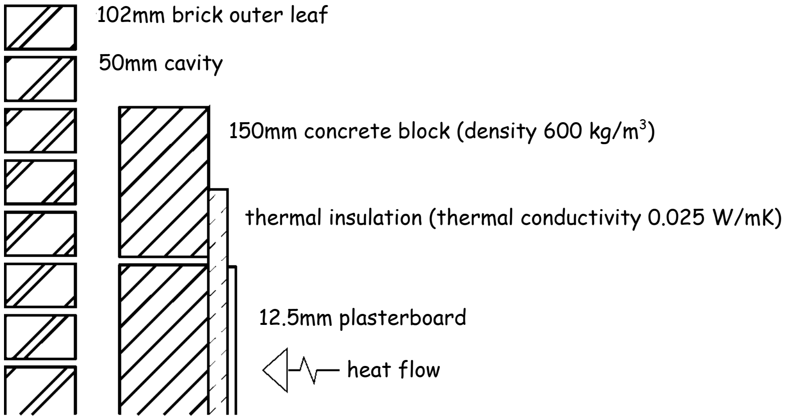
Note:
The table above is derived for walls in which the proportion of timber is 15%, and this corresponds to 38 mm wide studs at 600 mm centres (see BR 443). For other proportions of timber the *U-value* can be calculated using the procedure in Annex 6.B.

Example 4

Masonry cavity wall with internal insulation

(For *buildings* where sound resisting *separating floors* and *separating walls* are provided, this *construction* may not provide appropriate resistance to flanking sound transmission)

Determine the thickness of the insulation layer that will achieve a *U-value* of 0.35 W/m^{2}K for the wall *construction* shown below.



Using Table 6.A.8:

From **column C, row 4** of the table, the base thickness of the insulation layer is **67 mm**.

The base thickness may be reduced by taking account of the other materials as follows:

From Table 6.A.9:

Brick outer leaf	**column C, row 2**	= 3 mm
Cavity	**column C, row 1**	= 5 mm
Plasterboard	**column C, row 6**	= 2 mm

And from table 6.A.10

Concrete block	**column C, row 1**	
adjusted for 150 mm block thickness (1.5 x 11)		= 17 mm
Total reduction		= **27 mm**

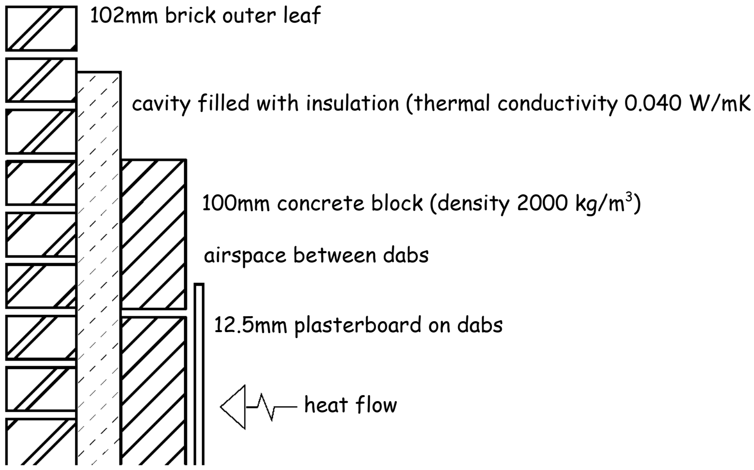
To achieve a *U-value* of 0.35 W/m²K, the minimum thickness of the insulation layer is therefore:

Base thickness less **total reduction** i.e. 67 – 27 = **40 mm**

Example 5

Masonry cavity wall filled with insulation with plasterboard on dabs

Determine the thickness of the insulation layer that will achieve a *U-value* of 0.35 W/m²K for the wall *construction* shown below. (This calculation assumes the effect of wall ties to be negligible).



Using Table 6.A.8:

From **column F, row 4** of the table, the base thickness of the insulation layer is **107 mm**.

The base thickness may be reduced by taking account of the other materials as follows:

From Table 6.A.9:

Brick outer leaf	**column F, row 2**	= 5 mm
Plasterboard	**column F, row 6**	= 3 mm
Air space behind plasterboard	**column F, row 7**	= 5 mm

And from Table 6.A.10:

Concrete block	**column F, row 8**	= 3 mm
Total reduction		= **16 mm**

To achieve a *U-value* of 0.35 W/m²K the minimum thickness of the insulation layer is therefore:

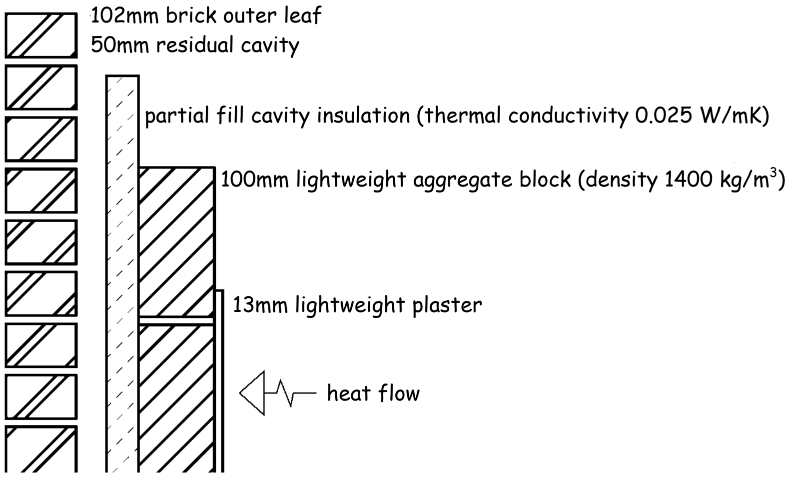
Base thickness less **total reduction** i.e. 107 – 16 = **91 mm**

Example 5

Example 6

Masonry wall with partial cavity-fill

Determine the thickness of the insulation layer that will achieve a *U-value* of 0.30 W/m^{2}K for the wall *construction* shown below.



Using Table 6.A.8:

From **column C, row 3** of the table, the base thickness of the insulation layer is **79 mm**.

The base thickness may be reduced by taking account of the other materials as follows:

From Table 6.A.9:

Brick outer leaf	**column C, row 2**	= 3 mm
Cavity	**column C, row 1**	= 5 mm
Lightweight plaster	**column C, row 4**	= 2 mm

And from Table 6.A.10:

Concrete block	**column C, row 5**	= 4 mm
Total reduction		= **14 mm**

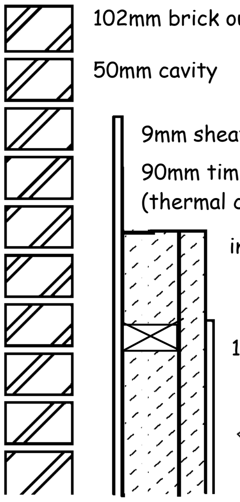
To achieve a *U-value* of 0.30 W/m²K, the minimum thickness of the insulation layer is therefore:

Base thickness less **total reduction** i.e. 79 – 14 = **65 mm**

Example 7

Timber-frame wall

Determine the thickness of the internal insulation layer that will achieve a *U-value* of 0.30 W/m²K for the wall *construction* shown below. (Note this *construction* may be inappropriate where the wall should have a level of fire resistance.)



Using Table 6.A.8:

From **column D, row 3** of the table, the base thickness of the internal insulation layer is **95 mm**.

The base thickness may be reduced by taking account of the other materials as follows:

From Table 6.A.9:

Brick outer leaf	**column D, row 2**	= 4 mm
Cavity	**column D, row 1**	= 5 mm
Sheathing ply	**column D, row 8**	= 2 mm
Plasterboard	**column D, row 6**	= 2 mm

And from Table 6.A.11:

Timber frame	**column D, row 1**	
adjusted for 90mm thick frame (0.9 x 59 mm)		= 53 mm
Total reduction		= **66 mm**

To achieve a *U-value* of 0.30 W/m²K the minimum thickness of the internal insulation layer is therefore:

Base thickness less **total reduction** i.e. 95 – 66 = **29 mm**

Ground floors

Note: In using the tables for floors, the **P/A** ratio should be calculated first, where **P** is the floor perimeter length in metres; and **A** is the floor area in square metres.

Table 6.A.12: Insulation thickness for ground supported solid floors

		Thermal conductivity of insulant (W/m·K)						
	P/A	**0.020**	**0.025**	**0.030**	**0.035**	**0.040**	**0.045**	**0.050**
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**
		Insulation thickness (mm) for *U-value* of 0.20 W/m²K						
1	1.00	81	101	121	142	162	182	202
2	0.90	80	100	120	140	160	180	200
3	0.80	78	98	118	137	157	177	196
4	0.70	77	96	115	134	153	173	192
5	0.60	74	93	112	130	149	167	186
6	0.50	71	89	107	125	143	160	178
7	0.40	67	84	100	117	134	150	167
8	0.30	60	74	89	104	119	134	149
9	0.20	46	57	69	80	92	103	115
		Insulation thickness (mm) for *U-value* of 0.25 W/m²K						
10	1.00	61	76	91	107	122	137	152
11	0.90	60	75	90	105	120	135	150
12	0.80	58	73	88	102	117	132	146
13	0.70	57	71	85	99	113	128	142
14	0.60	54	68	82	95	109	122	136
15	0.50	51	64	77	90	103	115	128
16	0.40	47	59	70	82	94	105	117
17	0.30	40	49	59	69	79	89	99
18	0.20	26	32	39	45	52	58	65
		Insulation thickness (mm) for *U-value* of 0.30 W/m²K						
19	1.00	48	60	71	83	95	107	119
20	0.90	47	58	70	81	93	105	116
21	0.80	45	56	68	79	90	102	113
22	0.70	43	54	65	76	87	98	108
23	0.60	41	51	62	72	82	92	103
24	0.50	38	47	57	66	76	85	95
25	0.40	33	42	50	59	67	75	84
26	0.30	26	33	39	46	53	59	66
27	0.20	13	16	19	22	25	28	32

Note:
P/A is the ratio of floor perimeter (m) to floor area (m²).

Table 6.A.13: Insulation thickness for suspended timber ground floors

		Thermal conductivity of insulant (W/m·K)						
	P/A	**0.020**	**0.025**	**0.030**	**0.035**	**0.040**	**0.045**	**0.050**
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**
		Insulation thickness (mm) for *U-value* of 0.20 W/m²K						
1	1.00	127	145	164	182	200	218	236
2	0.90	125	144	162	180	198	216	234
3	0.80	123	142	160	178	195	213	230
4	0.70	121	139	157	175	192	209	226
5	0.60	118	136	153	171	188	204	221
6	0.50	114	131	148	165	181	198	214
7	0.40	109	125	141	157	173	188	204
8	0.30	99	115	129	144	159	173	187
9	0.20	82	95	107	120	132	144	156
		Insulation thickness (mm) for *U-value* of 0.25 W/m²K						
10	1.00	93	107	121	135	149	162	176
11	0.90	92	106	119	133	146	160	173
12	0.80	90	104	117	131	144	157	170
13	0.70	88	101	114	127	140	153	166
14	0.60	85	98	111	123	136	148	161
15	0.50	81	93	106	118	130	142	154
16	0.40	75	87	99	110	121	132	143
17	0.30	66	77	87	97	107	117	127
18	0.20	49	57	65	73	81	88	96
		Insulation thickness (mm) for *U-value* of 0.30 W/m²K						
19	1.00	71	82	93	104	114	125	135
20	0.90	70	80	91	102	112	122	133
21	0.80	68	78	89	99	109	119	129
22	0.70	66	76	86	96	106	116	126
23	0.60	63	73	82	92	102	111	120
24	0.50	59	68	78	87	96	104	113
25	0.40	53	62	70	79	87	95	103
26	0.30	45	52	59	66	73	80	87
27	0.20	28	33	38	42	47	51	56

Note:
P/A is the ratio of floor perimeter (m) to floor area (m²). The table is derived for suspended timber floors for which the proportion of timber is 12%, which corresponds to 48 mm wide timbers at 400 mm centres.

Table 6.A.14: Insulation thickness for suspended concrete beam and block ground floors

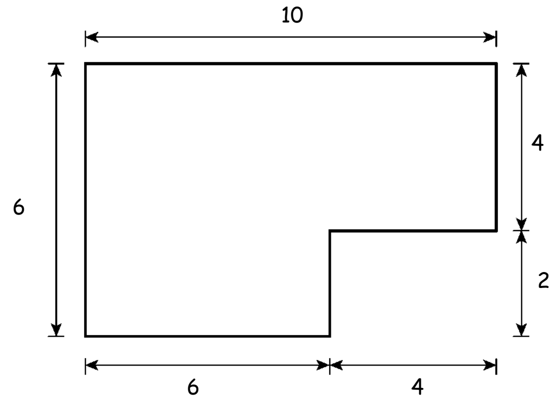
		Thermal conductivity of insulant (W/m·K)						
	P/A	**0.020**	**0.025**	**0.030**	**0.035**	**0.040**	**0.045**	**0.050**
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**
		Insulation thickness (mm) for *U-value* of 0.20 W/m²K						
1	1.00	82	103	123	144	164	185	205
2	0.90	81	101	122	142	162	183	203
3	0.80	80	100	120	140	160	180	200
4	0.70	79	99	118	138	158	177	197
5	0.60	77	96	116	135	154	173	193
6	0.50	75	93	112	131	150	168	187
7	0.40	71	89	107	125	143	161	178
8	0.30	66	82	99	115	132	148	165
9	0.20	56	69	83	97	111	125	139
		Insulation thickness (mm) for *U-value* of 0.25 W/m²K						
10	1.00	62	78	93	109	124	140	155
11	0.90	61	76	92	107	122	138	153
12	0.80	60	75	90	105	120	135	150
13	0.70	59	74	88	103	118	132	147
14	0.60	57	71	86	100	114	128	143
15	0.50	55	68	82	96	110	123	137
16	0.40	51	64	77	90	103	116	128
17	0.30	46	57	69	80	92	103	115
18	0.20	36	45	54	62	71	80	89
		Insulation thickness (mm) for *U-value* of 0.30 W/m²K						
19	1.00	49	61	73	85	97	110	122
20	0.90	48	60	72	84	96	108	120
21	0.80	47	59	70	82	94	105	117
22	0.70	45	57	68	80	91	102	114
23	0.60	44	55	66	77	88	98	109
24	0.50	41	52	62	72	83	93	104
25	0.40	38	48	57	67	76	86	95
26	0.30	33	41	49	57	65	73	81
27	0.20	22	28	33	39	44	50	56

Note:
P/A is the ratio of floor perimeter (m) to floor area (m²).

Example 8

Solid floor in contact with the ground

Determine the thickness of the insulation layer that will achieve a *U-value* of 0.30 W/m^{2}K for the ground floor slab shown below.



It is proposed to use insulation with a thermal conductivity of 0.025 W/m·K.

The overall perimeter length of the slab is: (10 + 4 + 4 + 2 + 6 + 6) = 32 m.

The floor area of the slab is : (6 x 6) + (4 x 4) = 52 m^2.

The ratio: $\frac{\text{perimeter length}}{\text{floor area}} = \frac{32}{52} = 0.6$

Using Table 6.A.12, **column C, row 23** indicates that **51 mm** of insulation is appropriate.

Example 9

Suspended timber floor

If the floor shown above was of suspended timber *construction*, the perimeter length and floor area would be the same, yielding the same ratio of:

$$\frac{\text{perimeter length}}{\text{floor area}} = \frac{32}{52} = 0.6$$

To achieve a *U-value* of 0.30 W/m^2·K, using insulation with a thermal conductivity of 0.040 W/m·K, Table 6.A.13 **column F, row 23** indicates that the insulation thickness between the joists should be not less than **102 mm**.

Upper floors

Table 6.A.15: Upper floors of timber *construction*

		Thermal conductivity of insulant (W/m·K)						
Design Uvalue (W/m^2K)		0.020	0.025	0.030	0.035	0.040	0.045	0.050
		Base thickness of insulation between joists to achieve design *U-value*						
	A	B	C	D	E	F	G	H
1	0.20	167	211	256	298	341	383	426
2	0.25	109	136	163	193	225	253	281
3	0.30	80	100	120	140	160	184	208

Note:
Table 6.A.15 is derived for floors with the proportion of timber at 12% which corresponds to 48 mm wide timbers at 400 mm centres. For other proportions of timber the *U-value* can be calculated using the procedure in Annex 6.B.

Table 6.A.16: Upper floors of concrete *construction*

		Thermal conductivity of insulant (W/m·K)						
Design *U-value* (W/m^2K)		0.020	0.025	0.030	0.035	0.040	0.045	0.050
		Base thickness of insulation to achieve design *U-value*						
	A	B	C	D	E	F	G	H
1	0.20	95	119	142	166	190	214	237
2	0.25	75	94	112	131	150	169	187
3	0.30	62	77	92	108	123	139	154

Table 6.A.17: Upper floors: allowable reductions in base thickness for common components

		Thermal conductivity of insulant (W/m·K)						
		0.020	0.025	0.030	0.035	0.040	0.045	0.050
Component		Reduction in base thickness of insulation material (mm)						
	A	B	C	D	E	F	G	H
1	9.5 mm plasterboard	1	2	2	2	3	3	3
2	19 mm timber flooring	3	3	4	5	5	6	7
3	50 mm screed	2	3	4	4	5	5	6

Table 6.A.18: Thermal conductivity of some common *construction* materials

		Density (kg/m³)	Conductivity (W/m·K)
Walls	Brickwork (outer leaf)	1700	0.77
	Brickwork (inner leaf)	1700	0.56
	Lightweight aggregate concrete block	1400	0.57
	Autoclaved aerated concrete block	600	0.18
	Concrete (medium density)	1800	1.13
		2000	1.33
		2200	1.59
	Concrete (high density)	2400	1.93
	Reinforced concrete (1% steel)	2300	2.3
	Reinforced concrete (2% steel)	2400	2.5
	Mortar (protected)	1750	0.88
	Mortar (exposed)	1750	0.94
	Gypsum	600	0.18
		900	0.30
		1200	0.43
	Sandstone	2600	2.3
	Limestone (soft)	1800	1.1
	Limestone (hard)	2200	1.7
	Timber framing in prefabricated wall panels	480	0.12
	Timber (softwood, plywood, chipboard)	500	0.13
	Timber (hardwood)	700	0.18
Surface finishes	Plasterboard	700	0.21
	Fibreboard	400	0.1
	Tiles (ceramic)	2300	1.3
	External rendering	1300	0.57
	Plaster (dense)	1300	0.57
	Plaster (lightweight)	600	0.18
Roofs	Aerated concrete slab	500	0.16
	Asphalt	2100	0.70
	Felt/bitumen layers	1100	0.23
	Screed	1200	0.41
	Stone chippings	2000	2.0
	Tiles (clay)	2000	1.0
	Tiles (concrete)	2100	1.5
	Wood wool slab	500	0.10

Table 6.A.18 (continued)		Density (kg/m³)	Conductivity (W/m·K)
Floors	Cast concrete	2000	1.35
	Metal tray (steel)	7800	50.0
	Screed	1200	0.41
	Timber (hardwood)	700	0.18
	Timber (softwood, plywood, chipboard)	500	0.13
Insulation	Expanded polystyrene (EPS) slab	15	0.040
	Mineral wool quilt	12	0.042
	Mineral wool batt	25	0.038
	Phenolic foam board	30	0.025
	Polyurethane board	30	0.025

Note:
If available, certified test values should be used in preference to those in the table.

Annex 6.B Worked examples of U-value calculations using the combined method

contents

annex 6.B Worked examples of U-value calculations using the Combined Method (Appendix B)

6.B.0 Introduction

For *building* elements which contain repeating thermal bridges, such as timber ceiling ties or joists between insulation in a roof or floor, timber studs in a wall, or mortar joints in lightweight blockwork, the effect of thermal bridges should be taken into account when calculating the *U-value*. The calculation method, known as the Combined Method, is set out in BS EN ISO 6946 and the following examples illustrate the use of the method for typical wall, roof and floor designs.

www.bsi-global.com

In cases where the ceiling ties, studs or joists in roof, wall or floor *constructions* project beyond the surface of the insulation the depths of these components should be taken to be the same as the thickness of insulation for the purposes of the *U-value* calculation (as specified in BS EN ISO 6946).

It is acceptable to ignore non-metal wall ties, cavity trays and movement joints. The calculation should take account of metal wall ties and other metal fixings, air gaps between and around insulation slabs, and any metal members that bridge an insulation layer.

www.cibse.org

Conductivity values for common *building* materials can be obtained from the CIBSE Guide Section A3 or from BS EN 12524. For specific insulation products, however, data should be obtained from manufacturers. Table 6.A.18 (Annex 6.A) gives typical thermal conductivities for some common *construction* materials.

www.bre.co.uk

The procedure in this Annex does not address elements containing metal connecting paths. For establishing *U-values* for light steel frame *construction*, BRE Digest 465 may be used. For built-up sheet metal walls and roofs, the following may be used:

- BRE IP 10/02, Metal cladding: assessing the thermal performance of built-up systems which use Z-spacers;
- P312 Metal Cladding: *U-value* calculation: Assessing thermal performance of built-up metal roof and wall cladding systems using rail and bracket spacers, Steel Construction Institute 2002.

www.steel-sci.org

www.c-a-b.org.uk

For curtain walling, the reader is directed to the CAB publication 'Guide for assessment of the thermal performance of aluminium curtain wall framing' (September 1996).

For ground floors and basements the reader is directed to Annex 6.C.

6.B.1 The procedure

The *U-value* is calculated by applying the following steps:

a. Calculate the upper resistance limit (R_{upper}) by combining in parallel the total resistances of all possible heat-flow paths (i.e. sections) through the plane *building* element.

b. Calculate the lower resistance limit (R_{lower}) by combining in parallel the resistances of the heat flow paths of each layer separately and then summing the resistances of all layers of the plane *building* element.

c. Calculate the *U-value* of the element from $U = 1 / R_T$,

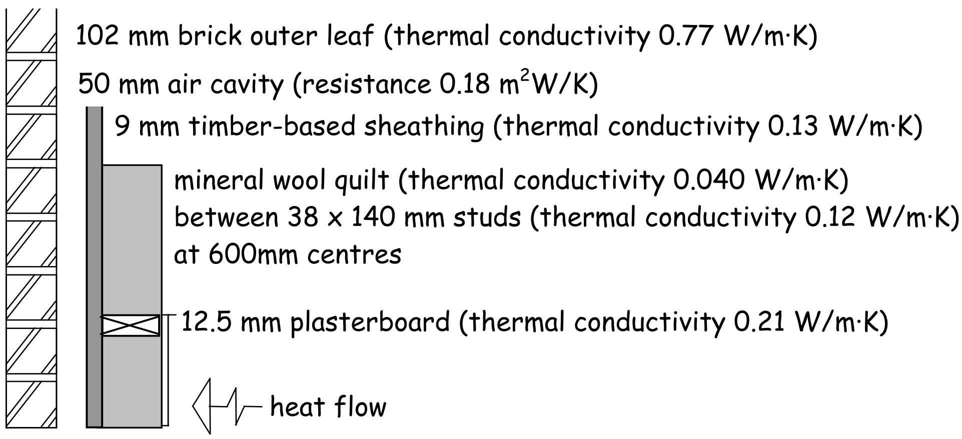
where $$R_T = \frac{R_{upper} + R_{lower}}{2}$$

d. Where appropriate, add a correction for air gaps and mechanical fasteners (including wall ties) as described in BS EN ISO 6946 Appendix D.

6.B.2 Timber framed wall example

In this example there is a single bridged layer in the wall, involving insulation bridged by timber studs. The *construction* consists of outer leaf brickwork, an air cavity, 9 mm timber-based sheathing, 38 x 140 mm timber framing with 140 mm of mineral wool quilt insulation between the timber studs and plasterboard 12.5 mm thick. See additional notes at end of example.

Section through Timber framed wall



(Total thickness: 313.5 mm; *U-value*: 0.30 W/m^{2}K)

The thicknesses of each layer, together with the thermal conductivities of the materials in each layer, are shown below. The internal and external surface resistances are those appropriate for wall *constructions*. Layer 4 is thermally bridged and two thermal conductivities are given for this layer, one for the unbridged part and one for the bridging part of the layer. For each homogeneous layer and for each section through a bridged layer, the thermal resistance is calculated by dividing the thickness (in metres) by the thermal conductivity.

Calculation of thermal resistance (timber frame)

Layer	Material	Thickness (mm)	Thermal conductivity (W/m·K)	Thermal resistance (m²K/W)
	external surface	-	-	0.040
1	outer leaf brick	102	0.77	0.132
2	air cavity	50	-	0.180
3	sheathing	9	0.13	0.069
4(a)	mineral wool quilt between timber studs	140	0.042	3.500
4(b)	timber framing occupying 15% of the wall area	140	0.12	1.167
5	plasterboard	12.5	0.21	0.060
	internal surface	-	-	0.130

Both the upper and the lower limits of thermal resistance are calculated by combining the alternative resistances of the bridged layer in proportion to their respective areas, as illustrated below. The method of combining differs in the two cases.

Upper resistance limit

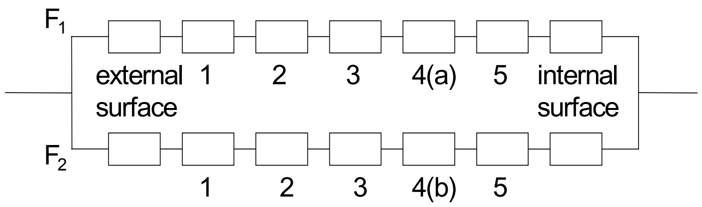
When calculating the upper limit of thermal resistance, the *building* element is considered to consist of two thermal paths (or sections). The upper limit of resistance is calculated from:

$$R_{upper} = \frac{1}{\frac{F_1}{R_1} + \frac{F_2}{R_2}}$$

where F_1 and F_2 are the fractional areas of the two sections (thermal paths) and R_1 and R_2 are the total resistances of the two sections.

The method of calculating the upper resistance limit is illustrated conceptually below:

Conceptual illustration of how to calculate the upper limit of thermal resistance



Resistance through the section containing insulation

External surface resistance	= 0.040
Resistance of bricks	= 0.132
Resistance of air cavity	= 0.180
Resistance of sheathing	= 0.069
Resistance of mineral wool (85%)	= 3.500
Resistance of plasterboard	= 0.060
Internal surface resistance	= 0.130
Total (R_1)	= 4.111 m²K/W

Fractional area F_1 = 0.85 (85%)

Resistance through the section containing timber stud

External surface resistance	= 0.040
Resistance of bricks	= 0.132
Resistance of air cavity	= 0.180
Resistance of sheathing	= 0.069
Resistance of timber framing (15%)	= 1.167
Resistance of plasterboard	= 0.060
Internal surface resistance	= 0.130
Total (R_2)	= 1.778 m²K/W

Fractional area F_2 = 0.15 (15%)

The upper limit of resistance is then:

$$R_{upper} = \frac{1}{\frac{F_1}{R_1} + \frac{F_2}{R_2}} = \frac{1}{\frac{0.850}{4.111} + \frac{0.150}{1.778}} = 3.435 \text{ m}^2\text{K/W}$$

Lower resistance limit

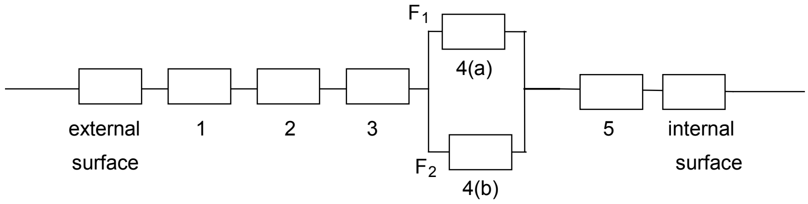
When calculating the lower limit of thermal resistance, the resistance of a bridged layer is determined by combining in parallel the resistances of the unbridged part and the bridged part of the layer. The resistances of all the layers in the element are then added together to give the lower limit of resistance.

The resistance of the bridged layer is calculated using:

$$R = \frac{1}{\frac{F_{insul}}{R_{insul}} + \frac{F_{timber}}{R_{timber}}}$$

The method of calculating the lower limit of resistance is illustrated conceptually below.

Conceptual illustration of how to calculate the lower limit of thermal resistance



The lower limit of resistance is then obtained by adding up the resistances of all the layers:

External surface resistance	= 0.040
Resistance of bricks	= 0.132
Resistance of air cavity	= 0.180
Resistance of sheathing	= 0.069
Resistance of bridged layer = $\dfrac{1}{\dfrac{0.850}{3.500}+\dfrac{0.150}{1.167}}$	= 2.692
Resistance of plasterboard	= 0.060
Internal surface resistance	= 0.130
Total (R_{lower})	= 3.304 m²K/W

Total resistance of wall (not allowing for air gaps around the insulation)

The total resistance of the wall is the average of the upper and lower resistance limits:

$$R_T = \frac{R_{upper} + R_{lower}}{2} = \frac{3.435 + 3.304}{2} = 3.369 \text{ m}^2\text{K/W}$$

Correction for air gaps

If there are small air gaps penetrating the insulating layer a correction should be applied to the *U-value* to account for this. The correction for air gaps is ΔU_g where

$\Delta U_g = \Delta U'' \times (R_I / R_T)^2$

and where R_I is the thermal resistance of the layer containing gaps, R_T is the total resistance of the element and ΔU" is a factor which depends upon the way in which the insulation is installed. In this example R_I is 2.692 m²K/W, R_T is 3.369 m²K/W and ΔU" is 0.01 (i.e. correction level 1). The value of ΔU_g is then:

$\Delta U_g = 0.01 \times (2.692 / 3.369)^2 =$ **0.006 W/m²K**

U-value of the wall

The effect of air gaps or mechanical fixings should be included in the *U-value* unless they lead to an adjustment in the *U-value* of less than 3%.

$U = 1 / R_T + \Delta U_g$ (if ΔU_g is not less than 3% of $1 / R_T$)

$U = 1 / R_T$ (if ΔU_g is less than 3% of $1 / R_T$)

In this case ΔU_g = 0.006 W/m²K and $1 / R_T$ = 0.297 W/m²K. Since ΔU_g is less than 3% of $(1 / R_T)$,

$U = 1 / R_T = 1 / 3.369 =$ **0.30 W/m²K.**

Notes:

1 The timber fraction in this particular example is 15%. This corresponds to 38mm wide studs at 600mm centres and includes full-depth dwangs, etc. and the effects of additional timbers at junctions and around openings.

2. In this example correction level 1 is appropriate. This is because air gaps are likely to exist, in some cases, between the insulation and the timber framing.

3. BS EN ISO 6946 states that if the insulation is installed in such a way that no air circulation is possible on the warm side of the insulation then ΔU'' is set to 0.01 W/m²K. If, on the other hand, air circulation is possible on the warm side then it should be set to 0.04 W/m²K. The possible correction levels and correction factors are summarised as follows:

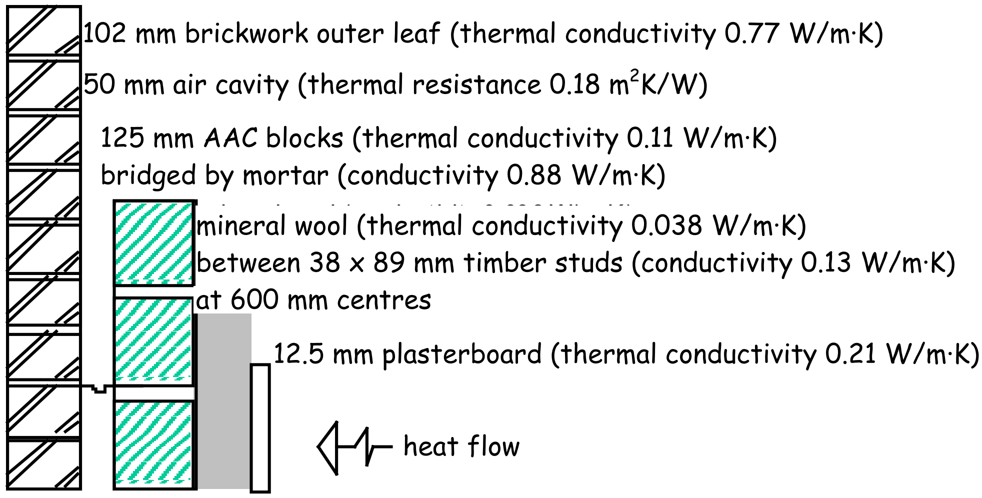
Correction for air gaps

Description of air gap	**Correction level**	**ΔU'' W/m²K**
Insulation installed in such a way that no air circulation is possible on the warm side of the insulation. No air gaps penetrating the entire insulation layer.	0	0.00
Insulation installed in such a way that no air circulation is possible on the warm side of the insulation. Air gaps may penetrate the insulation layer.	1	0.01
Air circulation possible on the warm side of the insulation. Air gaps may penetrate the insulation.	2	0.04

6.B.3 Cavity wall with lightweight masonry leaf and insulated dry-lining example

In this example there are two bridged layers - insulation bridged by timber and lightweight blockwork bridged by mortar. The *construction* consists of outer leaf brickwork, a clear cavity, 125 mm AAC blockwork, 38 x 89 mm timber studs (600 mm centre-to-centre spacing) with insulation between the studs and one sheet of 12.5 mm plasterboard. See additional notes at end of example.

Section through wall with two bridged layers



(Total thickness: 378.5 mm; *U-value*: 0.30 W/m^{2}K)

The thicknesses of each layer, together with the thermal conductivities of the materials, are shown below, with appropriate internal and external surface resistances, these being, for a wall, 0.13 m²K/W and 0.04 m²K/W. Layers 3 and 4 are both thermally bridged and two thermal conductivities are given for each layer to reflect the bridged part and the bridging part in each case. For each homogeneous layer and for each section through a bridged layer the thermal resistance is calculated by dividing the thickness (expressed in metres) by the thermal conductivity.

Calculation of thermal resistance (cavity wall)

Layer	Material	Thickness (mm)	Thermal conductivity (W/m·K)	Thermal resistance (m²K/W)
	external surface	-	-	0.040
1	outer leaf brick	102	0.77	0.132
2	air cavity	50	-	0.180
3(a)	AAC blocks (93.3%)	125	0.11	1.136
3(b)	mortar (6.7%)	(125)	0.88	0.142
4(a)	mineral wool (88.2%)	89	0.038	2.342
4(b)	timber studs (11.8%)	(89)	0.13	0.685
5	plasterboard	12.5	0.21	0.060
	internal surface	-	-	0.130

Both the upper and lower limits of thermal resistance are calculated by combining the alternative resistances of the bridged layer in proportion to their respective areas, as illustrated below. The method of combining differs in the two cases.

Upper resistance limit

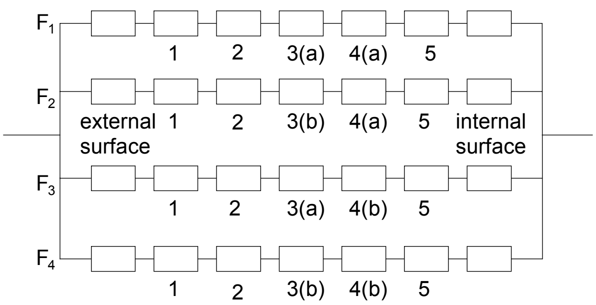
When calculating the upper limit of thermal resistance, the *building* element is considered to consist of a number of thermal paths (or sections). In this example there are four sections (or paths) through which heat can pass. The upper limit of resistance, R_{upper}, is given by

$$R_{upper} = \frac{1}{\frac{F_1}{R_1} + \frac{F_2}{R_2} + \frac{F_3}{R_3} + \frac{F_4}{R_4}}$$

where F_1, F_2, F_3 and F_4 are the fractional areas of sections 1, 2, 3 and 4 respectively and R_1, R_2, R_3 and R_4 are the corresponding total thermal resistances of the sections.

A conceptual illustration of the method of calculating the upper limit of resistance is shown in the figure below:

Conceptual illustration of how to calculate the upper limit of thermal resistance



Resistance through section containing AAC blocks and mineral wool

External surface resistance	= 0.040
Resistance of bricks	= 0.132
Resistance of air cavity	= 0.180
Resistance of AAC blocks (93.3%)	= 1.136
Resistance of mineral wool (88.2%)	= 2.342
Resistance of plasterboard	= 0.060
Internal surface resistance	= 0.130
Total thermal resistance (R_1)	= 4.020 m^2K/W

Fractional area F_1 = 0.823 (93.3% x 88.2%)

Resistance through the section containing mortar and mineral wool

External surface resistance	= 0.040
Resistance of bricks	= 0.132
Resistance of air cavity	= 0.180
Resistance of mortar (6.7%)	= 0.142
Resistance of mineral wool (88.2%)	= 2.342
Resistance of plasterboard	= 0.060
Internal surface resistance	= 0.130
Total thermal resistance (R_2)	= 3.026 m^2K/W

Fractional area F_2 = 0.059 (6.7% x 88.2%)

Resistance through section containing AAC blocks and timber

External surface resistance	= 0.040
Resistance of bricks	= 0.132
Resistance of air cavity	= 0.180
Resistance of AAC blocks (93.3%)	= 1.136
Resistance of timber (11.8%)	= 0.685
Resistance of plasterboard	= 0.060
Internal surface resistance	= 0.130
Total thermal resistance (R_3)	= 2.363 m²K/W

Fractional area F_3 = 0.110 (93.3% x 11.8%)

Resistance through section containing mortar and timber

External surface resistance	= 0.040
Resistance of bricks	= 0.132
Resistance of air cavity	= 0.180
Resistance of mortar (6.7%)	= 0.142
Resistance of timber (11.8%)	= 0.685
Resistance of plasterboard	= 0.060
Internal surface resistance	= 0.130
Total thermal resistance (R_4)	= 1.369 m²K/W

Fractional area F_4 = 0.008 (6.7% x 11.8%)

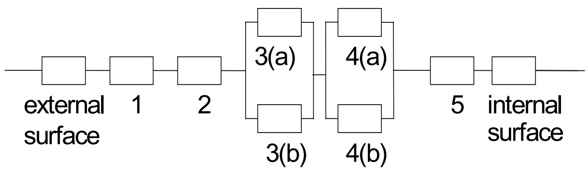
Combining these resistances we obtain:

$$R_{upper} = \frac{1}{\frac{F_1}{R_1} + \frac{F_2}{R_2} + \frac{F_3}{R_3} + \frac{F_4}{R_4}} = \frac{1}{\frac{0.823}{4.020} + \frac{0.059}{3.026} + \frac{0.110}{2.363} + \frac{0.008}{1.369}} = 3.617\ m^2K/W$$

Lower resistance limit

When calculating the lower limit of thermal resistance, the resistance of a bridged layer is determined by combining in parallel the resistances of the unbridged part and the bridged part of the layer. The resistances of all the layers in the element are then added together to give the lower limit of resistance. A conceptual illustration of the method of calculating the lower limit of resistance is shown below:

Conceptual illustration of how to calculate the lower limit of thermal resistance



The resistances of the layers are added together to give the lower limit of resistance. The resistance of the bridged layer consisting of AAC blocks and mortar is calculated using:

$$R_{first} = \frac{1}{\frac{F_{blocks}}{R_{blocks}} + \frac{F_{mortar}}{R_{mortar}}}$$

and the resistance of the bridged layer consisting of insulation and timber is calculated using:

$$R_{second} = \frac{1}{\frac{F_{insul}}{R_{insul}} + \frac{F_{timber}}{R_{timber}}}$$

The lower limit of resistance is then obtained by adding together the resistances of all the layers:

External surface resistance	= 0.040
Resistance of bricks	= 0.132
Resistance of air cavity	= 0.180
Resistance of first bridged layer $R_{first} = \frac{1}{\frac{0.933}{1.136} + \frac{0.067}{0.142}}$	= 0.773
Resistance of second bridged layer $R_{second} = \frac{1}{\frac{0.882}{2.342} + \frac{0.118}{0.685}}$	= 1.821
Resistance of plasterboard	= 0.060
Internal surface resistance	= 0.130
Total (R_{lower})	= 3.136 m²K/W

Total resistance of wall

The total resistance of the wall is the average of the upper and lower resistance limits:

$$R_T = \frac{R_{upper} + R_{lower}}{2} = \frac{3.636 + 3.136}{2} = 3.376 \text{ m}^2\text{K/W}$$

Correction for air gaps between the timber studs

Since the insulation is entirely between studs (i.e. there is no continuous layer of insulation) a correction should be applied to the *U-value* in order to account for air gaps. The overall *U-value* of the wall should include a term ΔU_g, where

$$\Delta U_g = \Delta U'' \times (R_I / R_T)^2$$

and where $\Delta U'' = 0.01$ (referred to in BS EN ISO 6946 as correction level 1), R_I is the thermal resistance of the layer containing the gaps and R_T is the total resistance of the element. ΔU_g is therefore:

$$\Delta U_g = 0.01 \times (1.820 / 3.386)^2 = 0.003 \text{ W/m}^2\text{K}$$

U-value of the wall

The effect of air gaps or mechanical fixings should be included in the *U-value* unless they lead to an adjustment in the *U-value* of less than 3%.

$U = 1 / R_T + \Delta U_g$ (if ΔU_g is not less than 3% of $1 / R_T$)

$U = 1 / R_T$ (if ΔU_g is less than 3% of $1 / R_T$)

In this case $\Delta U_g = 0.003$ W/m²K and $1 / R_T = 0.296$ W/m²K. Since ΔU_g is less than 3% of $(1 / R_T)$,

$$U = 1 / 3.376 = 0.30 \text{ W/m}^2\text{K}.$$

Notes:

1. For *buildings* where sound resisting *separating floors* and *separating walls* are provided, this *construction* may not provide appropriate resistance to flanking sound transmission.
2. Since the cavity wall ties do not penetrate any insulation no correction need be applied to the U-value to take account of them.
3. In the above calculation it is assumed that the dwangs do penetrate the whole of the insulation. If the dwangs do not penetrate the whole of the insulation thickness they can be excluded as part of the timber percentage used in the calculation.

Annex 6.C U-values of ground floors and basements

contents

annex

6.C

U-values of ground floors and basements

(Appendix C)

6.C.0 Introduction

Insulation not necessary

For *dwellings* a ground floor should not have a *U-value* exceeding 0.25 W/m^{2}K, or 0.22 W/m^{2}K depending on the heating system, if the Elemental Method is to be used. For the former, this can normally be achieved without the need for insulation if the perimeter to area ratio is less than 0.12 m/m^2 for solid ground floors or less than 0.09 m/m^2 for suspended floors. However, some ground floor insulation will be needed for the majority of *buildings*. For basement floors the Elemental *U-value* should also not exceed 0.25 W/m^{2}K (or 0.22 W/m^{2}K) but for basement walls it is 0.30 W/m^{2}K (or 0.27 W/m^{2}K). For upper exposed floors and for floors over unheated spaces the reader is referred to Annex 6.B.

www.bsi-global.com

www.cibse.org

Full details about how to calculate the *U-value* of a ground floor, a basement floor or a basement wall are given in BS EN ISO 13370 and in CIBSE Guide Section A3 (1999 edition). This Annex gives a summary of how to determine the *U-value* which will suffice for most common *constructions*.

Soil type

For ground floors and basements the *U-value* depends upon the type of soil beneath the *building*. Where the soil type is unknown, clay soil should be assumed as this is the most typical soil type in the UK. The tables which follow refer to this soil type. Where the soil is not clay or silt, the *U-value* should be calculated using the procedure in BS EN ISO 13370.

Calculation of areas

Extensions

Floor dimensions should be measured in accordance with clause 6.0.10. In the case of semi-detached or terraced premises, blocks of *flats* and similar, the floor dimensions can either be taken as those of the dwellings themselves, or of the whole *building*. When considering extensions to existing *buildings* the floor dimensions may be taken as those of the complete *building* including the extension.

www.bre.co.uk

Care should be taken to avoid thermal bridging at the floor edge. See BRE Report BR262 "Thermal insulation: avoiding risks".

Areas outwith the *insulation envelope*

Unheated spaces outside the insulated fabric, such as attached garages or porches, should be excluded when determining the perimeter and area but the length of the wall between the heated *building* and the unheated space should be included when determining the perimeter.

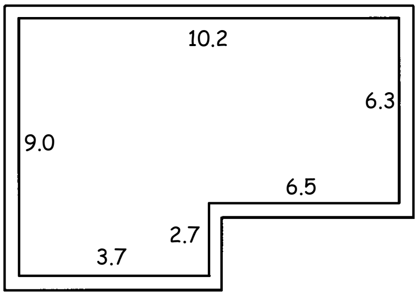
Interpolation

The following tables have been derived from BS EN ISO 13370. For the purposes of Section 6 it will be sufficient to derive the *U-values* from the tables using linear interpolation where appropriate.

6.C.1 Example of how to obtain *U-values* from the tables

The following example shows how to use Table 1 for a solid ground floor and serves as an illustration of how to use the tables supplied in this Annex, interpolating between appropriate rows or columns.

A proposed *building* has a perimeter of 38.4 m and a ground floor area of 74.25 m^2. The floor *construction* consists of a 150 mm concrete slab, 75 mm of rigid insulation (thermal conductivity 0.040 W/mK) and a 65 mm screed. Only the insulation layer is included in the calculation of the thermal resistance.



The perimeter to area ratio is equal to 38.4 ÷ 74.25 = 0.517 m/m^2. Table 1 gives values for perimeter/area ratios of 0.50 and 0.55 but not for any values between 0.50 and 0.55. In this case, the *U-value* corresponding to a perimeter to area ratio of 0.50 should be used since 0.517 is closer to 0.50 than to 0.55.

The thermal resistance of the insulation is obtained by dividing the thickness (in metres) by the conductivity. The resistance is then 0.075 ÷ 0.04 = 1.875 m^2K/W.

Extract from the relevant part of Table 1 is shown below:

	Thermal resistance (m^2K/W)	
Perimeter/Area	**1.5**	**2.0**
0.50	0.33	0.28

The *U-value* corresponding to a thermal resistance of 1.875 m^2K/W is obtained by linear interpolation as below:

$$U = 0.33 \times \frac{2.0 - 1.875}{2.0 - 1.5} + 0.28 \times \frac{1.875 - 1.5}{2.0 - 1.5}$$
$$= 0.33 \times 0.25 + 0.28 \times 0.75$$
$$= 0.29\ W/m^2K$$

The *U-value* of this ground floor is therefore **0.29 W/m²K**.

Note: In the example for Table 1 the appropriate row was chosen and interpolation was carried out between the appropriate columns. For all of the other tables, however, the appropriate column in the table should be selected and interpolation should be carried out between the appropriate rows.

6.C.2 Solid ground floors

Ground floors with all-over insulation or no insulation

Solid ground floors are taken to mean ground floors in which there is no significant air layer separating the *building* from the ground. Listed in the table below are *U-values* for solid ground floors. *U-values* are given in the following table for various perimeter-to-area ratios for a range of insulation levels. Where the floor is uninsulated the column corresponding to a thermal resistance of 0 should be used.

Table 1: *U-values* for solid ground floors (W/m²K)

	Thermal resistance of all-over insulation (m²K/W)						
Perimeter/Area	**0**	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**
0.05	0.13	0.11	0.10	0.09	0.08	0.08	0.07
0.10	0.22	0.18	0.16	0.14	0.13	0.12	0.11
0.15	0.30	0.24	0.21	0.18	0.17	0.15	0.14
0.20	0.37	0.29	0.25	0.22	0.19	0.18	0.16
0.25	0.44	0.34	0.28	0.24	0.22	0.19	0.18
0.30	0.49	0.38	0.31	0.27	0.23	0.21	0.19
0.35	0.55	0.41	0.34	0.29	0.25	0.22	0.20
0.40	0.60	0.44	0.36	0.30	0.26	0.23	0.20
0.45	0.65	0.47	0.38	0.32	0.27	0.23	0.21
0.50	0.70	0.50	0.40	0.33	0.28	0.24	0.22
0.55	0.74	0.52	0.41	0.34	0.28	0.25	0.22
0.60	0.78	0.55	0.43	0.35	0.29	0.25	0.23
0.65	0.82	0.57	0.44	0.35	0.30	0.26	0.23
0.70	0.86	0.59	0.45	0.36	0.30	0.26	0.23
0.75	0.89	0.61	0.46	0.37	0.31	0.27	0.24
0.80	0.93	0.62	0.47	0.37	0.32	0.27	0.24
0.85	0.96	0.64	0.47	0.38	0.32	0.28	0.24
0.90	0.99	0.65	0.48	0.39	0.32	0.28	0.24
0.95	1.02	0.66	0.49	0.39	0.33	0.28	0.25
1.00	1.05	0.68	0.50	0.40	0.33	0.28	0.25

Note:
As an alternative to the above table, the methods described in BS EN ISO 13370 may be used.

Ground floors with edge insulation

Where horizontal or vertical edge insulation is used instead of all-over floor insulation, the *U-value* of the uninsulated floor (obtained from the column corresponding to thermal resistance of 0 in Table 1) is adjusted by adding $\Psi \times P/A$ to account for the effects of edge insulation, where P/A is the perimeter (m) to area (m^2) ratio and Ψ is the edge insulation factor obtained from either Table 2 or 3 below. As $\Psi \times P/A$ is negative, the effect of this addition will be a reduction in the *U-value*.

Table 2: Edge insulation factor (Ψ) for horizontal edge insulation

Insulation width (m)	Thermal resistance of insulation (m²K/W)			
	0.5	**1.0**	**1.5**	**2.0**
0.5	-0.13	-0.18	-0.21	-0.22
1.0	-0.20	-0.27	-0.32	-0.34
1.5	-0.23	-0.33	-0.39	-0.42

Table 3: Edge insulation factor (Ψ) for vertical edge insulation

Insulation depth (m)	Thermal resistance of insulation (m²K/W)			
	0.5	**1.0**	**1.5**	**2.0**
0.25	-0.13	-0.18	-0.21	-0.22
0.50	-0.20	-0.27	-0.32	-0.34
0.75	-0.23	-0.33	-0.39	-0.42
1.00	-0.26	-0.37	-0.43	-0.48

Note:
When floors incorporate both all-over and edge insulation, the procedure in BS EN ISO 13370 may be used.

6.C.3 Suspended ground floors

Ground floors with no insulation

The following table gives *U-values* of uninsulated suspended floors for various perimeter to area ratios and for two levels of ventilation (expressed in m^2/m) below the floor deck. The data applies to a floor deck at a height of not more than 0.5 m above the external ground level where the wall surrounding the underfloor space is uninsulated.

Table 4: *U-values* of uninsulated suspended floors

Perimeter to area ratio	Ventilation opening area per unit perimeter of underfloor space (m²/m)	
	0.0015 m²/m	**0.0030 m²/m**
0.05	0.15	0.15
0.10	0.25	0.26
0.15	0.33	0.35
0.20	0.40	0.42
0.25	0.46	0.48
0.30	0.51	0.53
0.35	0.55	0.58
0.40	0.59	0.62
0.45	0.63	0.66
0.50	0.66	0.70
0.55	0.69	0.73
0.60	0.72	0.76
0.65	0.75	0.79
0.70	0.77	0.81
0.75	0.80	0.84
0.80	0.82	0.86
0.85	0.84	0.88
0.90	0.86	0.90
0.95	0.88	0.92
1.00	0.89	0.93

Note: As an alternative to the above table, the methods described in BS EN ISO 13370 may be used.

Suspended floors with insulation

The *U-value* of an insulated suspended floor should be calculated using:

$$U = 1 / [(1/U_0) – 0.2 + R_f]$$

where U_0 is the *U-value* of an uninsulated suspended floor obtained from Table 4, above or another approved method. R_f, the thermal resistance of the floor deck, is determined from U_f, the *U-value* of the floor deck, where:

$$R_f = \frac{1}{U_f} - 0.17 - 0.17$$

and where U_f is calculated using the Combined Method, as described in BS EN ISO 6946, assuming thermal resistances of 0.17 m^2K/W for both the upper and lower surfaces of the floor deck.

6.C.4 Basement floors

Basement floors with no insulation

The *U-value* of an uninsulated basement floor should be calculated by using Table 5 below, or the methods described in BS EN ISO 13370.

Table 5: *U-values* of uninsulated basement floors

Perimeter to area ratio	Basement depth (m)				
	0.5	**1**	**1.5**	**2**	**2.5**
0.1	0.20	0.19	0.18	0.17	0.16
0.2	0.34	0.31	0.29	0.27	0.26
0.3	0.44	0.41	0.38	0.35	0.33
0.4	0.53	0.48	0.44	0.41	0.38
0.5	0.61	0.55	0.50	0.46	0.43
0.6	0.68	0.61	0.55	0.50	0.46
0.7	0.74	0.65	0.59	0.53	0.49
0.8	0.79	0.70	0.62	0.56	0.51
0.9	0.84	0.73	0.65	0.58	0.53
1.0	0.89	0.77	0.68	0.60	0.54

Basement floors with insulation

Determine the *U-value* of an insulated basement floor from:

$U = 1 / [(1/U_0) + R_{ins}]$

where U_0 is the *U-value* determined from Table 5 (or other approved method) for uninsulated basements and R_{ins} is the thermal resistance of the insulation in m^2K/W. The value of R_{ins} may be calculated from the thickness of the insulation divided by its conductivity.

6.C.5 Basement walls

Table 6 below gives the *U-value* of a basement wall for a given basement depth and basement wall resistance.

Table 6: *U-values* of basement walls

Basement wall resistance (m^2K/W)	Basement depth (m)				
	0.5	**1**	**1.5**	**2**	**2.5**
0.2	1.55	1.16	0.95	0.81	0.71
0.5	0.98	0.78	0.66	0.58	0.52
1.0	0.61	0.51	0.45	0.40	0.37
2.0	0.35	0.30	0.27	0.25	0.24
2.5	0.28	0.25	0.23	0.21	0.20

Annex
6.D Thermal bridges at the edges of openings

annex
6.D

Thermal bridges at the edges of openings
(Appendix D)

6.D.0 Introduction
This Annex gives a procedure for establishing whether:

a. there is an unacceptable risk of condensation at the edges of openings; and/or
b. the heat losses at the edges of openings are significant.

The procedure involves the assessment of the minimum thermal resistance between inside and outside surfaces at the edges of openings. Minimum thermal resistance paths should be identified, and their thermal resistance calculated, taking into account the effect of thin layers such as metal lintels.

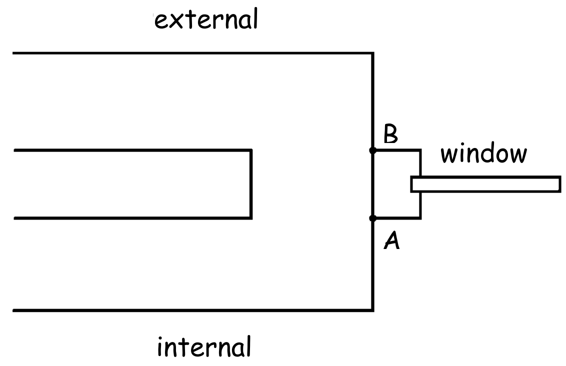
These minimum thermal resistances are then compared with satisfactory performance criteria to see whether corrective action is indicated.

6.D.1 Calculation method

Minimum thermal resistance path

The minimum thermal resistance path through a thermal bridge is that path from internal surface to external surface which has the smallest thermal resistance, R_{min}. Diagram 1 illustrates this for a section through a window jamb.

Diagram 1: Minimum thermal resistance path



The minimum resistance path in this case is from the internal surface at A to the external surface at B. R_{min} is equal to the total length from inside to outside (AB) divided by the thermal conductivity of the material of the jamb. An example calculation is given on the following page.

Additional calculation for thin layers such as metal lintels

For details containing thin layers of thickness not exceeding 4 mm (such as metal lintels), a second modified calculation of minimum thermal resistance (R_{mod}) is made wherein the effective thermal conductivity of the thin layer is taken as the largest of 0.1 W/mK or the thermal conductivities of the materials immediately on either side of it. An example of this more complex calculation is given in BRE IP 12/94: ‘Assessing condensation risk and heat loss at thermal bridges around openings’.

Risk of surface condensation

The risk of surface condensation and mould growth at the edges of openings can be assumed to be negligible if:

a. for edges containing thin layers of thickness not exceeding 4 mm;

- R_{min} (rounded to two decimal places) is at least 0.10 m^2K/W; and
- R_{mod} (rounded to two decimal places) is at least 0.45 m^2K/W; or

b. for other edge designs;

R_{min} (rounded to two decimal places) is at least 0.20 m^2K/W.

Note: These criteria do not apply to cases where internal surface projections are used to avoid surface condensation, e.g. curtain walling.

In the event of an unacceptable risk being identified, marginal cases could be more rigorously analysed using numerical calculation methods, but in any case modification to improve the design should be considered.

Additional heat loss

For the purposes of Section 6, the additional heat losses at the edges of openings may be ignored if:

a. for edges containing thin layers of thickness not exceeding 4 mm;

   R_{mod} (rounded to two decimal places) is at least 0.45 m^2K/W; or

b. for other edge designs;

   R_{min} (rounded to two decimal places) is at least 0.45 m^2K/W.

Compensating for additional heat loss

Where the additional heat losses around the edges of openings cannot be ignored they can be taken into account in calculations. The Target *U-value* method could be used with the average *U-value* increased by the following amount:

$$\frac{0.3 \text{ x total length of relevant opening surrounds}}{\text{total exposed surface area}} \quad (W/m^2K)$$

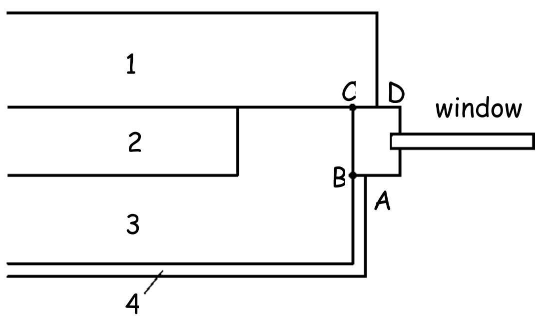
Compensating measures, such as reducing the *U-value* of one of the *building* elements, should then be incorporated so that the average *U-value* does not exceed the Target *U-value*.

Example

6.D.2 Example

Diagram 2 shows a window jamb in a masonry cavity wall with the blockwork returned towards the outer leaf at the reveal. By inspection it can be seen that ABCD is the minimum resistance path.

Diagram 2: Window jamb in cavity wall with blockwork cavity closer



Note: Numbers denote materials in Table 1 that follows.

Table 1: Thermal conductivity of materials in Diagram 2

Material		Conductivity (W/m·K)
1	Brick outer leaf	0.77
2	Insulation (70mm thick)	0.035
3	Medium weight concrete block inner leaf	0.61
4	Lightweight plaster	0.16

Calculation of R_{min}

Using the thermal conductivities from Table 1, Table 2 gives the resistance **R** for each segment of the path ABCD. **R** for each segment is obtained by dividing the length of the path segment in metres by its thermal conductivity in W/mK. $\mathbf{R_{min}}$ is the sum of the resistances of each path segment.

Avoidance of the risk of surface condensation and mould growth

Referring to paragraph "Risk of surface condensation", $\mathbf{R_{min}}$ in this example is greater than 0.20 m^2K/W and so the risk of surface condensation and mould growth is acceptably low.

Table 2: Thermal resistance path in Diagram 2

Path segments	Length (m)	Conductivity (W/m·K)	R (m^2K/W)
AB	0.015	0.16	0.094
BC	0.070	0.61	0.115
CD	0.023	0.77	0.177
		Minimum Resistance R_{min} =	**0.386**

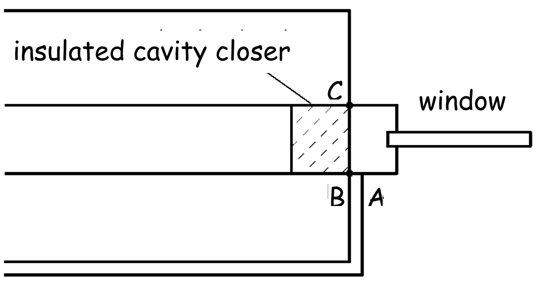
Additional heat loss at the edge detail

Referring to paragraph "Additional heat loss", $\mathbf{R_{min}}$ in this example is less than 0.45 m^2K/W, and so the additional heat loss at this edge should not be ignored.

Improving the edge design

Instead of returning the blockwork at the reveal the cavity could be closed using an insulated cavity closer, as in Diagram 3.

Diagram 3: Window jamb – cavity closed with an insulated closer



The revised calculation of the minimum resistance is shown in Table 3. $\mathbf{R_{min}}$ is now greater than 0.45 m^2K/W and so the additional heat loss can be ignored.

Table 3: Minimum resistance path with insulated cavity closer

Path segments	Length (m)	Conductivity (W/m·K)	R (m^2K/W)
AB	0.015	0.16	0.094
BC	0.070	0.04	1.750
		Minimum resistance R_{min} =	**1.844**

Alternative method

A heat loss factor for a particular detail could be obtained by a numerical method and used to modify the calculation of the average *U-value* or the total rate of heat loss. A calculation procedure for deriving such loss factors is given in BRE IP 12/94: 'Assessing condensation risk and heat loss at thermal bridges around openings'.

Annex 6.E Compensating U-values for openings

contents

annex

6.E

Compensating U-values for openings

(Appendix E)

6.E.0 Introduction

Within the Elemental Method it is possible to have windows, doors or rooflights with *U-values* that exceed the Elemental *U-values* in Table 1 to clause 6.2.1. Where an energy efficient gas or oil-fired boiler is installed, the average U-value of all of the windows, doors and rooflights taken together should not exceed 2.0 or 2.2, depending on the frame material. However where another type of heating is used in the *dwelling*, the *U-values* are even more demanding at 1.8 and 2.0, for timber/plastic frames and metal frames, respectively. The example that follows illustrates how this average can be established.

6.E.1 Example of trade-off for windows, doors and rooflights in the Elemental Method

A semi-detached *house* is to have a total window area of 16.9 m^2 (including frames) and a total door area of 3.8 m^2. It is proposed to use solid wooden doors with a *U-value* of 3.0 W/m^2K. In order to use the Elemental Method, the additional heat loss due to the use of solid timber 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 2.0 W/m^2K.

Windows with a *U-value* of 1.7 W/m^2K can achieve this requirement, as shown in the following table and subsequent calculation:

Average *U-value* calculation

Element	**Area (m²)**	***U-value* (W/m²K)**	**Rate of heat loss per degree (W/K)**
Windows	16.9	1.7 [Note]	28.73
Doors	3.8	3.0	11.4
Rooflights	0.9	1.9 [Note]	1.71
Total	21.6		41.84

Note:
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/m^2K higher than the window *U-value*.

This gives an average *U-value* of 41.84 ÷ 21.6, or 1.94 W/m^2K, which is below 2.0 W/m^2K. The windows, doors and rooflights can therefore be considered to follow the objectives of the Elemental Method.

Annex 6.F Worked examples of the Target *U-value* Method

annex

6.F Examples illustrating the use of the Target U-value Method

(Appendix F)

6.F.0 Introduction

For a *dwelling* or *building* consisting of *dwellings*, the Target *U-value* is given by one of the following formulae:

a. Pitched roof (with insulation between ceiling ties or collars):

$U_T = 0.3 - 0.14(A_R/A_T) - 0.05(A_{GF}/A_T) + 0.425(A_F/A_T)$

b. Pitched roof (with insulation between rafters):

$U_T = 0.3 - 0.1(A_R/A_T) - 0.05(A_{GF}/A_T) + 0.425(A_F/A_T)$

c. *Flat roof* or roof with integral insulation:

$U_T = 0.3 - 0.05(A_R/A_T) - 0.05(A_{GF}/A_T) + 0.425(A_F/A_T)$

where U_T is the target *U-value* prior to any adjustment for heating system performance or solar gain, A_R is the exposed roof area (in the plane of the insulation and excluding rooflights), A_{GF} is the exposed floor area (including floor referred to in clause 6.0.5), A_F is the total floor area (all *storeys*) and A_T is the total area of exposed elements and elements referred to in clause 6.0.5.

Mixed roof types

In a situation where mixed roof types occur, the formula that represents the roof type that covers the greatest area of the roof should be selected.

Objective

A *dwelling* or *building* consisting of *dwellings* can be considered to follow the Target *U-value* Method if the Target *U-value* is not less (worse) than the average *U-value*, where the average *U-value* is the area-weighted average *U-value* of *building* elements of the *insulation envelope*. Elements here include walls, roofs, floors, windows and doors, that are exposed, including elements adjacent to unheated spaces.

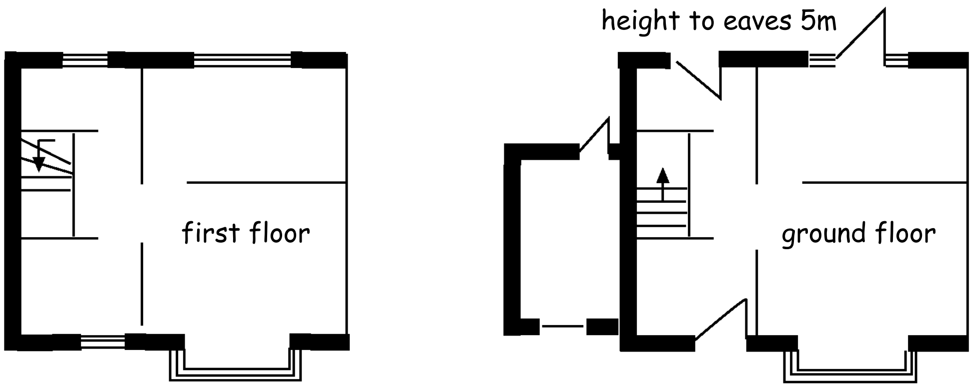
In this Annex, there are two examples given. The first is for new-build *construction* (a semi-detached *house*) and the second demonstrates how this method can be applied to an attic alteration to form *rooms* in the *roof space* of a detached *house*.

Example 1

6.F.1 Semi-detached *house*

The following table gives the proposed surface areas and *U-values*. It is proposed to adopt the Target *U-value* Method with the *U-value* of the walls a little higher (i.e. worse) than would be required in the Elemental Method. The *external walls* are to have a *U-value* of 0.35 W/m^2K and the *separating wall* is ignored in terms of heat loss (see clause 6.0.6.) The area of windows and doors is equal to 25% of the total internal floor area and the efficiency of the gas boiler is 85%. The total area of North-facing translucent *glazed* openings is 6.82 m^2 and the total area of South-facing translucent *glazed* openings is 8.88 m^2. The windows have frames made of timber.

Plans of the semi-detached *house*



Data for the semi-detached *house*

Exposed element	Exposed surface area	*U-value*	Rate of heat loss per degree
wall	80.3	0.35	28.10
roof	44.4	0.20	8.88
ground floor	44.4	0.25	11.10
windows	18.4	2.2	40.48
doors	3.8	2.2	8.36
Total	**191.3**	**-**	**96.92**

The *house* has a pitched roof with insulation between the ceiling ties so the **base Target *U-value*** is:

$U_T = 0.3 – 0.14(44.4/191.3)– 0.05(44.4/191.3)+0.425(88.8/191.3 = 0.453$

Heating system influence

The heating system uses a gas-fired boiler (oil-firing is also acceptable) so it is not necessary to divide the base Target *U-value* by 1.15. Also, since the proposed boiler SEDBUK is greater than the reference boiler SEDBUK the base Target *U-value* is not adjusted for boiler efficiency.

Optional window and rooflight frame material influence

There is no *glazing* with metal frames in this example so the Target *U-value* should not be multiplied by 1.03.

Optional solar heat gain influence

Since the area of *glazed* openings on the South elevations exceeds that on the North, the benefit of solar heat gains can be taken into account to ease the target *U-value* by adding:

$0.04 \times [(A_S – A_N) / A_{TG}]$ to the target *U-value* and

A_S = Area of *glazed* openings facing south;
A_N = Area of *glazed* openings facing north;
A_{TG} = Total area of all *glazed* openings in the *building*;

So 0.04 x [(8.88 – 6.82) / 18.4], or 0.004, is added to the Target *U-value*, giving a **final Target *U-value* of 0.457** W/m²K.

Assessing the average *U-value* of the proposed *dwelling*

The average *U-value* is given by:

$$U_{avg} = \frac{\text{Total rate of heat loss by degree}}{\text{Total external surface area}}$$

These values are calculated in the above table, and in this case the **average *U-value*** is:

$$U_{avg} = \frac{96.92}{191.3}$$

U_{avg} = 0.507 W/m²K

Comparison

Since the average *U-value* is greater than the Target *U-value* the proposed design does not follow the guidance and modifications should be made to the design. The Target *U-value* method may still be used, however, if the average *U-value* is reduced.

1st way to modify the design – reduce area of openings

If the total area of windows and doors is reduced from 25% of the floor area to 19% of the floor area the average *U-value* will be reduced by (6% of 88.8) x (2.2 – 0.35) / 191.3, or 0.052 W/m²K, which is sufficient to reduce the average *U-value* to below the Target *U-value*. Before taking steps to reduce the area of *glazing* the natural lighting provisions should be considered (see Section 3: Environment).

Final average *U-value* = 0.507 – 0.052 = **0.455** W/m²K

Comparison

Since the final average *U-value* is less than the final Target *U-value*, the Target *U-value* Method has been used successfully.

2nd way to modify the design – specify lower *U-values* for openings

Using windows and doors with a *U-value* of 1.7 W/m²K instead of 2.2 W/m²K will reduce the average *U-value* by (2.2 – 1.7) x (18.4 + 3.8) / 191.3, or 0.058 W/m²K. This is sufficient to reduce the final average *U-value* to below the final Target *U-value*.

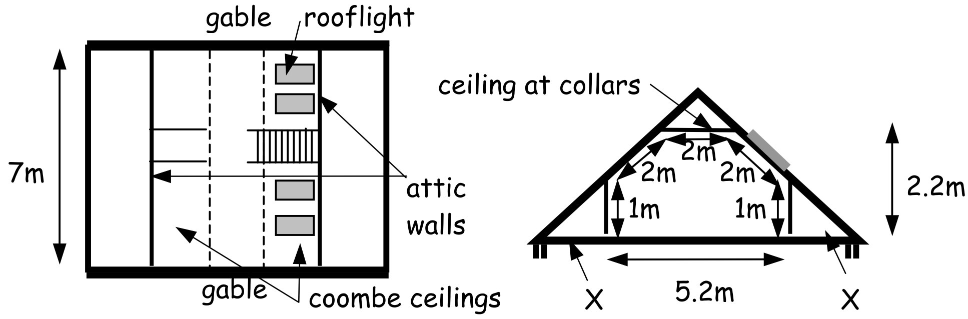
Final average *U-value* = 0.507 – 0.058 = **0.449** W/m²K

Comparison

Since the final average *U-value* is less than the final Target *U-value*, the Target *U-value* Method has been used successfully.

6.F.2 Alteration to create *rooms* in a *roof space*

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 36.4m^2. A plan and section of the proposed layout is shown in the figure below. The existing *house* is heated using electric storage heaters and there is no intention to upgrade the heating system. One key part of the design is to create as much headroom as possible below the new coombe ceilings. The existing rafters are only 150mm deep but the maximum *U-value* of 0.35 (see Table 2 to clause 6.2.2) is still possible, without using branders or having an excessive thickness of insulated ceiling lining. The principal compensatory measure will be to 'super-insulate' the attic walls that occur directly below the lowest part of the coombes. The existing gables will be cavity-filled with blown mineral-fibre and also provided with insulated internal wall lining to improve the *U-value* where the *insulation envelope* now occurs. The 4 No. 1.5m^2 rooflights installed, have frames of timber and all face north.



Plan **Section**

Data for attic alteration

Exposed element	Exposed surface area (m^2)	*U-value*	Rate of heat loss per degree
gables	19.0	0.30	5.70
attic walls	14.0	0.17	2.38
ceiling at collars	14.0	0.17	2.38
coombe ceiling	22.0	0.35	7.70
rooflights	6.0 (16.5% floor)	1.9	11.40
Total	**75.0**	**-**	**29.56**

The greatest area of roof to the *insulation envelope* is that part which has the coombe ceiling. In other words, it is a "pitched roof with insulation between rafters". The appropriate Target *U-value* formula to use is:

$U_T = 0.3 – 0.1(A_R/A_T) – 0.05(A_{GF}/A_T)+0.425(A_F/A_T)$

$U_T = 0.3 – 0.1(36/75) – 0.05(0/75)+0.425(36.4/75)$

Note: No exposed floor occurs in this situation and a figure of zero is used in this equation for A_{GF}. It should also be borne in mind that the total floor (A_F) only relates to the area created by the alteration.

$U_T = 0.3 – 0.1(0.48) – 0.05(0)+0.425(0.485)$

U_T = 0.3 – 0.048 – 0 + 0.206 = **0.458**

Heating system influence

As the *dwelling* has electric storage heating, the Target *U-value* should be made to be more demanding by dividing the base Target *U-value* by 1.15:

0.458 / 1.15 = **0.398**

Optional rooflight frame influence

If the rooflights have metal frames, the Target *U-value* can be made to be less demanding by multiplying it by 1.03. In this instance the frames are of timber and no adjustment should be made.

Optional solar gain influence

Since there are no *glazed* openings in the alterations which face South, there is no possibility of easing the Target *U-value*.

Establishing the average *U-value*

From the data table above, the average *U-value* can be determined:

U_{AVG} = Total rate of heat loss per degree / Total exposed surface area

U_{AVG} = 29.56 / 75 = **0.394**

Comparison

The final average *U-value* of 0.394 is less than the final Target *U-value* of 0.398 and the design of the attic alteration is satisfactory in terms of the Target *U-value* Method.

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*. Annex 6.H 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 Table 1 to clause 6.2.1.

Annex 6.G The SAP Energy Rating and the Carbon Index

contents

annex

6.G The SAP Energy Rating and the Carbon Index

(Appendix G)

6.G.0 Introduction

The SAP energy rating method is the Government's chosen method for producing an energy cost rating for a *dwelling*, based on calculated annual energy cost for space and water heating, assuming a standard occupancy pattern, derived from the measured floor area of the *dwelling*, and a standard heating pattern. The Carbon Index is derived from the SAP procedure, but measures the annual carbon output of the heating system and fuel selected. Both the SAP rating and the Carbon Index are adjusted for floor area so that the size of the *dwelling* does not affect the results, which are expressed on a scale of SAP rating 1 to 120 and CI 0.0 to 10.0: the higher the number the better the level achieved.

www.bre.co.uk/sap2001

The full procedure is described in 'The Government's Standard Assessment Procedure for energy rating of dwellings - 2001 edition' (SAP 2001), published by the Building Research Establishment (BRE). This sets out the method of calculating the SAP rating and the CI in the form of a worksheet, accompanied by a series of tables. A calculation may be carried out by completing, in sequence, the numbered boxes in the worksheet, using the data in the tables as indicated. Alternatively, and more usually, a computer program approved for SAP/CI calculations by BRE may be used.

6.G.1 The SAP Energy Rating, the Carbon Index and the Scottish building regulations

The Building (Procedure) (Scotland) Regulations 2004, require all newly-created *dwellings* to have an energy rating calculated in accordance with the Government's Standard Assessment Procedure (SAP). The guidance given does not recommend a particular level of SAP rating but the rating, whether good or bad, should be notified to the verifier, with a copy made available to the occupier. SAP ratings were removed from the former Technical Standards a number of years ago. They still do not play a part in this Handbook, but currently achieving a CI of 8.0 is one of the ways that can be considered as following the guidance for design of *dwellings* in Section 6.

Conventions for building warrant applications

Recognition should be given to the following points when calculating SAP ratings for Building (Procedure) (Scotland) Regulations purposes and the CI for Building Standards (Scotland) Regulations' Technical Handbook purposes:

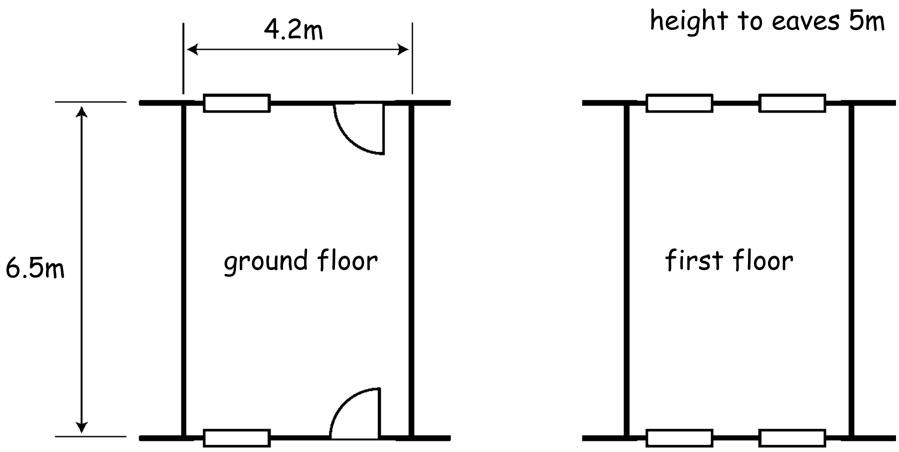
a. The data used in calculations should be obtained from the tables in SAP 2001. The fuel cost data (for the SAP rating) will be revised in future editions.
b. It is unlikely that the heating system is unknown when the dwelling design uses the Carbon Index Method and a building warrant application is submitted. However, if this is the case, it should be calculated assuming a main system of electric room heaters and a secondary system of electric heaters, both systems using on-peak electricity. It should be noted that achieving a CI of 8.0 will be very difficult with this form of heating.
c. When undertaking Carbon Index calculations for designs not intended for specific *building sites* (e.g. Scottish Type Approval Scheme) the following assumptions should be made:
    - two sides of the *dwelling* will be sheltered; and
    - the windows, doors and roof windows are all on the east and west elevations; and
    - the solar access factor is 1.0 (average).
d. Where a housing development involves large numbers of *dwellings* it is appropriate for the worst case in that development to be identified and for a SAP energy rating to be calculated for that *dwelling* only.

www.sabsm.co.uk

The pages that follow give some sketch floor plans and outlines of *construction* specifications. The intention is to give approximate indications for the SAP and CI levels that can be expected.

Example

Two bedroom mid-terrace *house*

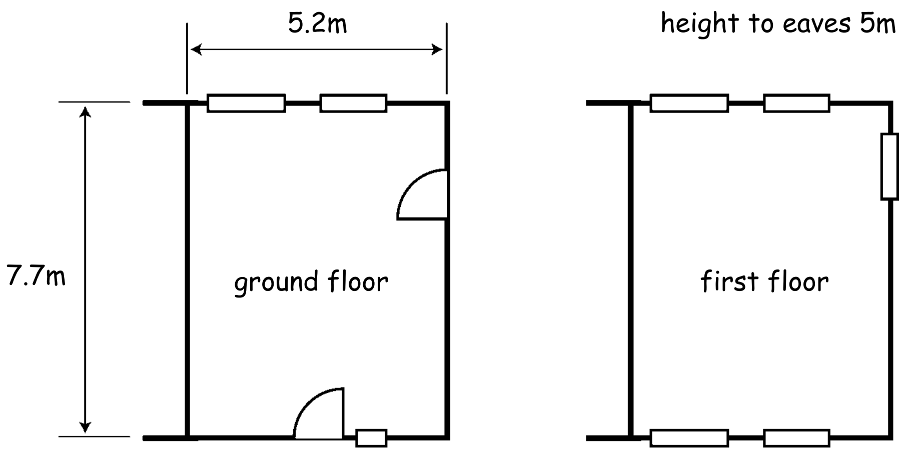


Specification for the two bedroom mid-terrace *house* with conventional gas boiler

***Construction* element**	**Description**	**Area**	***U-value***
Wall	Brick/cavity/dense block with cavity insulation	28.3	0.30
Roof	Pitched roof, insulation between and on top of ceiling ties	27.3	0.16
Ground floor	Suspended timber, sealed and insulated	27.3	0.25
Windows and doors	Double-glazed low-E, wooden frame	13.7	2.0
Heating	Central heating with conventional room-sealed, natural draught gas boiler (SEDBUK 78%)		
Heating controls	Room thermostat, programmer and thermostatic radiator valves		
		SAP energy rating =	**100**
		CI =	**8.0**

Example

Three bedroom semi-detached *house*

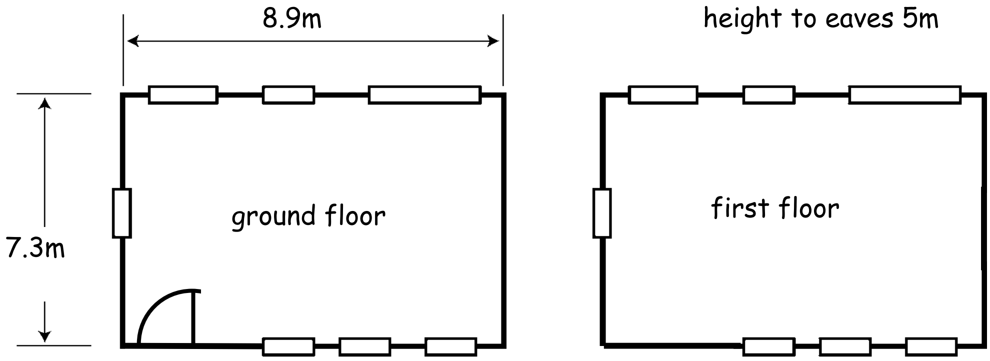


Specification for three bedroom semi-detached *house* with gas condensing boiler

***Construction* element**	**Description**	**Area**	***U-value***
Wall	Brick/cavity/dense block with cavity insulation	70.5	0.30
Roof	Pitched roof, insulation between and on top of ceiling ties	40	0.16
Ground floor	Solid concrete, insulated	40	0.25
Windows and doors	Double-glazed, low-E, PVC-U frame	20	2.0
Heating	Central heating with condensing, room-sealed, fanned draught gas boiler (SEDBUK 85%)		
Heating controls	Room thermostat, programmer and thermostatic radiator valves		
		LPG	**Gas**
	SAP energy rating =	**64**	**100**
	CI =	**7.1**	**8.0**

Example

Four bedroom detached *house*

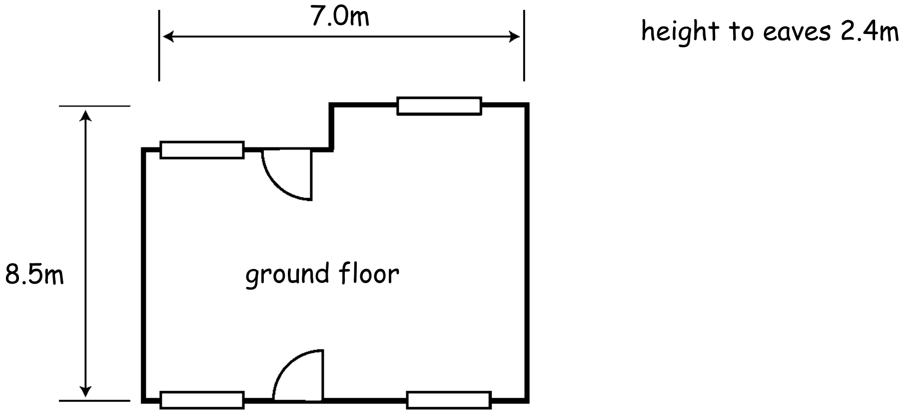


Specification for the four bedroom detached *house* with gas condensing boiler

***Construction* element**	**Description**	**Area**	***U-value***
Wall	Brick/partial cavity fill/medium density block with insulated plasterboard	129.5	0.30
Roof	Pitched roof, insulation between and on top of ceiling ties	65	0.16
Ground floor	Suspended timber, sealed and insulated	65	0.25
Windows and doors	Double-glazed low-E, wood frame	32.5	2.0
Heating	Central heating with condensing, room-sealed, fanned draught gas boiler (SEDBUK 89%)		
Heating controls	Time and temperature zone control		
		SAP energy rating =	**101**
		CI =	**8.0**

Example

Two bedroom detached bungalow



Specification for the two bedroom bungalow with gas condensing boiler

***Construction* element**	**Description**	**Area**	***U-value***
Wall	Brick/cavity/aerated concrete block with insulated plasterboard	60.2	0.30
Roof	Pitched roof, insulation between and on top of ceiling ties	56.7	0.16
Ground floor	Concrete suspended beam and medium density block, insulated	56.7	0.25
Windows and doors	Double-glazed, low-E, PVC-U frame	14.2	2.0
Heating	Central heating with condensing, room-sealed, fanned draught gas boiler (SEDBUK 89%)		
Heating controls	Time and temperature zone control		
		SAP energy rating =	**100**
		CI =	**8.0**

Annex 6.H Alterations and extensions

contents

annex 6.H Alterations and extensions

6.H.0 Introduction

This Annex relates to existing *domestic buildings*.

Extensions

In the case of extensions, the majority of the *construction* will be new-build and seldom will there be the need to *construct* to a lesser specification than for a completely new *building*. At the interface of the existing and new *construction* however, it may be appropriate to build to a slightly lower specification to allow the transition to occur. An example of this would be the use of proprietary metal 'wall starter' ties where existing brickwork stops and new cavity blockwork begins. It will still be necessary to ensure that the other building standards are met with regard to the transitionary *construction*.

Alterations

Historic *buildings*

The situation for alterations is somewhat different. It is more than likely that the existing *construction* will be from a different era, in building regulation terms. In many instances it will be appropriate to consider each *building* on its own merits. Some of the guidance given in this Annex is written in specific terms, but in certain cases (e.g. historic *buildings*), it may be necessary to adopt alternative energy efficiency measures which are appropriate to the amount of alteration *work* being undertaken.

6.H.1 Alterations to the *building* fabric

Reference should be made to the guidance on extensions (6.H.2) for alterations that involve increasing the floor area and/or bringing parts of the existing *building* that were previously outwith the *insulation envelope* into the habitable part of the *dwelling* or *building* consisting of *dwellings*.

Establishing the level of *U-value*

Alterations to the *insulation envelope* of a *dwelling* or a *building* consisting of *dwellings* should be considered using the guidance in the following paragraphs. Where reference is made to Table 1 to clause 6.2.1, the installed heating system should be used for establishing the appropriate level of *U-value*.

Infill of small openings

The infill of an existing opening of approximately 4 m^2 or less in the *building* fabric should have a *U-value* 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^2K and for a roof, no worse than 0.35 W/m^2K.

Infill of large openings

The infill of an existing opening of greater area (than approximately 4 m^2) in the *building* fabric should have a *U-value* which achieves those in Table 1 to clause 6.2.1. Another way would be to follow the guidance in the paragraph above, but compensate for the energy efficiency deficit by improving the overall *U-value* of other parts of the *insulation envelope*.

Insulation envelope formed from internal elements

Where the alteration causes an existing internal part or other element of a *building* to form the *insulation envelope*, that part of the *building* (including any infill *construction*) should have *U-values* which achieve those in Table 1 to clause 6.2.1. This will most likely occur where a part of a *building* is permanently removed as a phase of the alteration *work*. 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 *U-value* of other parts of the *insulation envelope*. Where this occurs at a *boundary*, no upgrading is necessary if the element is a wall that is exclusively the property of the adjoining *building*.

Windows, doors and rooflights

Where windows, doors and rooflights are being created or replaced, they should achieve the appropriate level of *U-value* specified in Table 1 to clause 6.2.1. For secondary *glazing* however, an existing window, after alteration should achieve a *U-value* of about 3.5 W/m^2K.

Percentage areas of openings

Where additional windows, doors and rooflights are being created, the overall total area (including existing) should not exceed 25% of the total *dwelling* floor area. Or in the case of a heated communal *room* or other area (exclusively associated with the *dwellings*) 25% of the total floor area of these *rooms*/areas.

Reconstruction of elements

Where the build-up of an element forming part of the *insulation envelope* is to be altered or dismantled and rebuilt, the opportunity should be taken to improve the level of thermal insulation. Table 1 to clause 6.2.1 gives benchmark *U-values* 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* lend themselves better than others as 'candidates' for upgrading. A *building* that was in a ruinous state should, after renovation, be nearly able to achieve the level expected of new *construction*. It is inappropriate for a *dwelling*, which is in a habitable condition, to have its internal space significantly reduced in area or height, unless the owner (or possibly *occupier*) of the *dwelling* intends that these changes are to be made. Similarly, fitting external thermal insulation should not cause excessive enabling alterations, unless the owner (or possibly *occupier*) of the *dwelling* intends that these changes are to be made. Consideration should also be given to the other building standards and the impact that they will have when upgrading thermal insulation. There are not that many cases however, where after an alteration of this nature to the *insulation envelope*, a roof cannot achieve an average *U-value* of 0.35 and in the case of a wall or floor, 0.70 W/m^{2}K. 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

www.est.org.uk/bestpractice

Limiting thermal bridging and air infiltration

When alterations are carried out, attention should still be paid to limiting thermal bridging at junctions and around openings (see clause 6.2.4) and also limiting air infiltration (see clause 6.2.5). As far as alterations are concerned, it should be acknowledged that it is only appropriate to consider the *work* that forms the alteration and also the impact of that *work* on the existing *building*.

6.H.2 Extensions (J2.5d)

Where a *dwelling* or a *building* consisting of *dwellings* is extended, the new *building* fabric should be designed in accordance with either the Elemental Method, the Target *U-value* Method or the Carbon Index Method. In each case, the person responsible for the design will need to know the type of heating system that is installed in the *dwelling*.

The merits of each method when considering new *buildings* are set out in the preamble to clauses 6.2.1, 6.2.2 and 6.2.3, but for extensions the following should also be taken into account:

Elemental Method

a. When using the Elemental Method, Table 1 to clause 6.2.1 gives the *U-values* that should be achieved. When calculating the maximum permitted area of windows, doors and rooflights for an extension to a *dwelling*, the floor area of the whole *dwelling* may be used and the overall area of openings of the extended *dwelling* should not exceed 25%. Alternatively, the percentage calculation can be made using only the windows, doors and rooflights and the floor area in the extension.

Target *U-value* Method

b. With the Target *U-value*, zero thermal transmittance should be considered at the interface of the existing *insulation envelope* and the extended part of the *building*. This method can be used theoretically for all extensions but in practice, designs involving small and complex shapes may prevent it being used effectively. If this occurs, it will be appropriate to revert to the Elemental Method.

Carbon Index Method

c. Use the Carbon Index Method for the entire *dwelling*, as extended. In application, this approach will be suitable for only a very small proportion of existing *dwellings* and most likely only those built originally in accordance with the guidance to standards 6.0 to 6.8.

Conservatories

When a *conservatory* is attached to an existing *dwelling*, the guidance given in 6.M.2 or 6.M.3 of Annex 6.M should be followed.

Alterations that extend the *insulation envelope*

Alterations that involve increasing the *dwelling* floor area and/or bringing parts of the existing *building* that were previously outwith the *insulation envelope* (or where the *insulation envelope* would be expected to exist) into the habitable part of the *dwelling* should be considered in the same way as extensions. Examples of such *work* 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 alterations, 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.

Note: An example of the use of the Target *U-value* Method for a *roof space* development is given in Annex 6.F.

6.H.3 Alterations to *building* services

Complete heating systems

Where an entirely new or complete replacement space-heating/hot water system is being installed in an existing *dwelling* or in an existing *building* consisting of *dwellings*, the guidance to standards 6.3, 6.4, 6.7 and 6.8 (maintenance and users instructions only), should be followed. A system that uses a gas or oil fired boiler should also follow the guidance that relates to the table below.

Part heating systems

If a heating and/or hot water system is being replaced in part, the guidance to standards 6.3, 6.4, 6.7 and 6.8 (maintenance and users instructions only), 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. It is recognised that some alterations to *building* services, because they are done on a piecemeal basis, will not result in optimum energy efficiency being attained for the entire system. Where this occurs, the person responsible for the commissioning of that part of the system should make available to the owner and *occupier*, a list of recommendations that will improve the overall energy efficiency of the system. Again, a system that uses a gas or oil-fired boiler should also follow the guidance that relates to the table below.

Gas or oil-fired boilers

www.boilers.org.uk

Where a gas or oil-fired boiler is being replaced or installed for the first time in an existing *dwelling*, the new appliance should have a SEDBUK of at least that in the table below. This is not necessary where the *dwelling* has only two *apartments* or less.

Minimum boiler SEDBUK for alterations to *building* services

Central heating system fuel and boiler type	**Minimum SEDBUK (%)**
Mains natural gas (all boiler types)	78
LPG (all boiler types)	80
Oil (combination boilers)	82
Oil (all other types of boilers)	85

Where a back-boiler is installed, it is appropriate that the SEDBUK is 3 percentage points less than the figures quoted in the table above.

Annex
6.J Heat Loss Method example and worksheet 6.J.4

This Annex does not apply to domestic buildings

Annex
6.K Example of lighting calculations

This Annex does not apply to domestic buildings

Annex
6.L Performance assessment method for offices

This Annex does not apply to domestic buildings

Annex 6.M Conservatories

annex

6.M

Conservatories

(J7.1 Building regulation note 2/2002)

6.M.0 Introduction

When reading this Annex, particular attention should be given to the definition of *conservatory* (Appendix A) and the scale of exemption (see Section 0). Any predominantly translucently *glazed* structure attached to a *dwelling*, but which is 'open' (i.e. there is no dividing door) to the *dwelling*, should not be considered as a *conservatory*. Such structures should be treated as an integral part of the *dwelling*. The guidance given here is the relationship of the Elemental Method (clause 6.2.1), Target *U-value* Method (clause 6.2.2) and Carbon Index Method (clause 6.2.3) to the *conservatory* structure. Consideration should also be given to:

- limiting the effect of thermal bridging at junctions and around openings that occur in the *insulation envelope* (see clause 6.2.4);
- limiting air infiltration at the *insulation envelope* (see clause 6.2.5).

6.M.1 *Conservatories* with heating attached to new *dwellings*

Dividing elements

A *conservatory* that is heated should form a part of the *insulation envelope* of the *dwelling*. In view of this, the dividing elements (e.g. wall, door, window or on the rare occasion floor) between the *dwelling* and *conservatory* do not need any level of thermal performance.

Large *conservatories*

A heated *conservatory* that has a floor area exceeding 30 m^2 is not given any concessions by this guidance and the translucently *glazed* exposed elements should achieve the *U-values* for windows, doors and rooflights in Table 1 to clause 6.2.1 when using the Elemental Method.

Small *conservatories*

The translucent *glazing* and frames of a heated *conservatory* however, that has a floor area not exceeding 30 m^2 can have a *U-value* of 3.3 W/m^2K when using the Elemental Method.

In conjunction with the above, one of the following approaches should be considered for a heated *conservatory* attached to a new *dwelling*:

a. Using either the Target *U-value* Method or the Carbon Index Method for the whole *dwelling* (including *conservatory*), the *conservatory* heat-loss can be absorbed within these calculations and the fabric insulation for the *conservatory* can have the less demanding *U-values* in accordance with Table 2 to clause 6.2.2 and the table to clause 6.2.3. It is most likely that other exposed elements of the *dwelling* will have to be 'super-insulated' and that favourable solar heat gains and energy-efficient central heating boilers will probably also be a prerequisite for creating an appropriate overall *construction*. For the purposes of the Building (Procedure) (Scotland) Regulations, a SAP rating will be needed, which should include both the *dwelling* and the *conservatory*. The verifier will require this upon completion. If the Carbon Index Method has been used to create an appropriate overall *construction*, the SAP rating established in the calculation will be suitable for this purpose.

b. Using either the Target *U-value* Method or the Carbon Index Method, the *conservatory* can be excluded from these calculations and zero heat-loss is then assumed at the dividing elements (wall, floor, door or window) between the *dwelling* and the *conservatory*. The fabric insulation for the *conservatory* can then be established using the Elemental Method, taking the SEDBUK of any central heating boiler in the *dwelling* into account. Although a SAP calculation in order to determine the Carbon Index of the *dwelling* will have been carried out (if this is the chosen method of following the guidance), this will not be suitable for notification of the SAP rating of the property to the verifier, upon completion. For the purposes of the Building (Procedure) (Scotland) Regulations, a recalculation will be needed, which should include both the *dwelling* and the *conservatory*.

c. Using the Elemental Method for both the *dwelling* and *conservatory*. In this approach the maximum percentage of windows, doors and rooflights, should only be applied to the *dwelling* and the dividing elements and not the *conservatory*. The SEDBUK of any central heating boiler should be taken into account when establishing the *U-values* of elements. For the purposes of the Building (Procedure) (Scotland) Regulations, a SAP rating will be needed, which should include both the *dwelling* and the *conservatory*. The verifier will require this upon completion.

6.M.2 *Conservatories* with heating attached to existing *dwellings*

Dividing elements

A *conservatory* that is heated (and not exempt) should form a part of the *insulation envelope* of the *dwelling*. In view of this, the dividing elements (e.g. wall, door, window or on the rare occasion floor) between the *dwelling* and *conservatory* do not need any level of thermal performance.

Large *conservatories*

A heated *conservatory* that has a floor area exceeding $30m^2$ is not given any concessions by this guidance and the translucently *glazed* exposed elements should achieve the *U-values* for windows, doors and rooflights in Table 1 to clause 6.2.1 when using the Elemental Method.

Small *conservatories*

The translucent *glazing* and frames of a heated *conservatory* however, that has a floor area not exceeding $30m^2$ can have a *U-value* of 3.3 W/m^2K when using the Elemental Method.

In conjunction with the above, one of the following approaches should be considered for a heated *conservatory* attached to an existing *dwelling*:

a. Using either the Carbon Index Method or the Target *U-value* Method for the whole *dwelling* (including *conservatory*), the *conservatory* heat-loss can be absorbed within these calculations and the fabric insulation for the *conservatory* can have the less demanding *U-values* in accordance with either Table 2 to clause 6.2.2 and the table to clause 6.2.3. It is most likely that other exposed elements of the *dwelling* will have to be 'super-insulated' and that favourable solar heat gains and energy-efficient central heating boilers will probably also be a prerequisite for creating an appropriate overall *construction* (either when the *dwelling* was *constructed* or by upgrade). In application, this approach will be suitable for a very small proportion of *dwellings* and most likely only those built originally in accordance with the current guidance given in Section 6.
b. Using the Elemental Method for the *conservatory* (the *dwelling* is existing and it is not necessary to upgrade the thermal performance of any of the original fabric that remains unaltered). The SEDBUK of any central heating boiler should be taken into account when establishing the *U-values* of elements. In view of the minimum translucent *glazing* area presented by the *conservatory* definition (see Appendix A), the maximum percentage of windows, doors and rooflights, for the *dwelling* should not be applied to the *conservatory*.

6.M.3 *Conservatories* without heating attached to *dwellings*

Dividing elements

A *conservatory* that is not heated is exempt from standard 6.2 but the *U-values* of any new dividing elements should be calculated in accordance with clause 6.0.5. Similar arrangements apply when the Target *U-value* or Carbon Index Methods are being used for *dwellings* but the *U-value* for the dividing elements can have more flexibility (subject to Table 2 to clause 6.2.2 and the table to clause 6.2.3).

Annex 6.N Conversions

contents

annex

6.N

Conversions

6.N.0 Introduction

The criteria for when *conversion* occurs are outlined in Section 0. However the guidance for energy efficiency measures is split into 3 further categories of *building* and these are unheated, heated and historic.

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 for *conversions*. In some instances, it may even be more worthwhile demolishing these *buildings* and rebuilding with new *construction*.

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.

With historic *buildings*, the energy efficiency improvement measures that should be invoked by *conversion* are less straightforward. The remaining 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*. For these *buildings* the least demanding measures apply, however it is a rare occurrence that no improvement in energy efficiency can be made.

6.N.1 *Conversion* of unheated *buildings*

Where *conversion* of a *building* that was previously designed to be unheated is to be carried out, it is appropriate to treat the *building* as a new *domestic building* and follow the guidance to standards 6.0 to 6.8. This category includes *conversion* of *buildings* with heating rated at a maximum of 25 W/m^2 floor area and installed for the purposes of frost protection.

6.N.2 *Conversion* of heated *buildings*

Where *conversion* of a *building* that was previously designed to be heated is to be carried out, it is appropriate to examine the *insulation envelope* and the *building* services and upgrade (if necessary) as follows:

a. The average *U-value* of a roof should not be worse than 0.35 (see notes below); and
b. The average *U-value* of any wall or floor should not be worse than 0.7, except where thermal transmittance is considered to be zero, see clause 6.0.6 (see notes below); and
c. Where the windows, doors or rooflights are being replaced, the average *U-value* of the replacements should not be worse than 1.8 for those with plastic or timber frames or 2.0 for those with metal frames; and
d. The total area of windows, doors and rooflights, should not exceed 25% of the floor area of the *dwelling* created by *conversion*; and
e. Thermal bridging need only be taken into account where the *U-value* of an existing element of *building* fabric is being improved. For guidance on condensation see Section 3: Environment; and
f. Limiting air infiltration need only be taken into account where the *U-value* of an existing element of *building* fabric is being improved and then only to those components which are being altered; and
g. Where an extension or *conservatory* is formed and/or alterations are being made to the *building* fabric or the *building* services (see notes below) at the same time as the *conversion*, the guidance given in Annexes 6.H and 6.M should be followed.

Notes:

- Where upgrading *work* is necessary to achieve the *U-values* specified in sub-clauses a. and b. above, reference should be made to 'Reconstruction of elements' in 6.H.1 of Annex 6.H. and more demanding *U-values* achieved, where appropriate.
- If replacement of heating occurs at the same time as the *conversion* and the system does not use a gas or oil-fired boiler that follows the guidance in 6.H.3 of Annex 6.H, the *U-values* specified in sub-clauses a. and b. above, should be no worse than 0.3 and 0.6, respectively.

6.N.3 *Conversion* of historic *buildings*

No specific guidance is given here on this subject. Each case will have to be dealt with on its own merits. In some instances, only an improvement in the heating system will be possible, but where this occurs, the most energy efficient measures within that area should be sought. Best practice should be adopted, rather than just good practice. For example, install a 90% instead of a 78% SEDBUK boiler and fit a 7 day programmable room thermostat instead of a 7 day timer.

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*. Consultation on such matters at an early stage with both the verifier and the development control officer of the relevant local authority is advisable.

Annex
6.P Elemental U-values for limited life buildings

This Annex does not apply to domestic buildings