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general

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0.1 Introduction and application

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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 Building Standards Agency Scottish 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 *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 be accepted by the verifier as indicating that the building regulations have been complied with. However it is quite acceptable to use alternative methods of compliance provided they fully satisfy the regulations.

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

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

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

0.1.5 Alternative solutions

The use of expanded functional standards, backed up by detailed guidance, provides a flexible system of control. Consideration of alternative solutions is assisted by the expansion of the functional standards previously used in the

building standards regulations to clarify the necessary properties of each *building*. The need for a formal relaxation of standards is reduced as meeting the full details of given solutions is no longer mandatory. The professional 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

- 0.2 Regulation 1
- 0.2 Regulation 2
- 0.2.1 Explanation of Regulation 1
- 0.2.2 Explanation of Regulation 2

<p>regulation</p> <p>1</p> <p>mandatory</p>	<p>These Regulations may be cited as the Building (Scotland) Regulations 2004 and shall come into force on 1 May 2005.</p>
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<p>regulation</p> <p>2</p> <p>mandatory</p>	<p>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.</p>
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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* 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 than those which would have applied when the *work* started. Fuller details of the arrangements for submitting warrant applications and completion certificates will be given in the guidance on the 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

0.3 Regulation 3

0.3.1 Explanation

Schedule 1: Exempted buildings and services, fittings and equipment

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 existing *building* with Building Regulations should not be adversely affected when exempt *works* are undertaken.

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

Schedule 1

Exempted *buildings* and services, fittings and equipment

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

Works of civil engineering construction

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

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Paved areas

21. A paved area or hardstanding.

A paved area or hardstanding exceeding 200 square metres in area. A paved area forming part of an access to meet a requirement of these regulations.

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

0.4 Regulation 4

0.4.1 Explanation

Schedule 2: Conversions to which the regulations 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

0.5 Regulation 5

0.5.1 Explanation

Schedule 3: Descriptions of building and work, including the provision of 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	<p>On condition that types 1 – 23 in all respects and/or in the manner of their fitting meet any relevant requirement of the regulations.</p>	
	1. Any <i>work</i> to or in a <i>house</i> .	<p>Any <i>work</i> which increases the floor area of the <i>house</i>. Any demolition or alteration of the roof, <i>external walls</i> or <i>elements of structure</i>. Any <i>work</i> adversely affecting a <i>separating wall</i>. Any change in the <i>wastewater</i> disposal system. <i>Work</i>, not being <i>work</i> of types 3 to 26 below, to a <i>house</i> having a <i>storey</i>, or creating a <i>storey</i>, at a height of more than 4.5 metres.</p>
	2. Any <i>work</i> to a non-residential <i>building</i> to which the public does not have access.	<p>A non-residential <i>building</i> within which there is a <i>domestic</i> or <i>residential building</i>. Any <i>work</i> which increases the floor area of the <i>building</i>. Any demolition or alteration of the roof, <i>external walls</i> or <i>elements of structure</i>. Any <i>work</i> adversely affecting a <i>separating wall</i>. Any change in the <i>wastewater</i> disposal system. <i>Work</i>, not being <i>work</i> of types 3 to 26 below, to a <i>building</i> having a <i>storey</i>, or creating a <i>storey</i>, at a height of more than 7.5 metres.</p>

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

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

- | | |
|---|--|
| <p>10. Any <i>work</i> associated with refillable liquefied petroleum gas storage cylinders supplying, via a fixed pipework installation, combustion appliances used principally for providing space heating, water heating, or cooking facilities.</p> | |
| <p>11. Any <i>work</i> associated with the provision of a single <i>sanitary facility</i>, together with any relevant branch soil or waste pipe.</p> | <p>Any <i>work</i> associated with a watercloset, waterless closet or urinal.</p> |
| <p>12. Any <i>work</i> associated with the relocation within the same <i>room</i> or space of any <i>sanitary facility</i>, together with any relevant branch soil or waste pipe.</p> | |
| <p>13. Any <i>work</i> associated with the provision of an extractor fan.</p> | |
| <p>14. Any <i>work</i> associated with a stairlift within a <i>dwelling</i>.</p> | |
| <p>15. Any <i>work</i> associated with the provision of a notice or other fixture for which there is no requirement provided in these regulations.</p> | |
| <p>16. Any <i>work</i> associated with an outdoor sign that is subject to the Town and Country Planning (Control of Advertisements) (Scotland) Regulations 1984.</p> | |
| <p>17. Any <i>work</i> associated with thermal insulating material to or within a wall, ceiling, roof or floor.</p> | <p>Any <i>work</i> associated with the application of thermal insulating material to the outer surface of an <i>external wall</i>.</p> |
| <p>18. A wall not exceeding 1.2 metres in height, or a fence not exceeding 2 metres in height.</p> | |
| <p>19. Any <i>work</i> 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.</p> | <p>Any decking at a height of more than 1.2 metres.</p> |
| <p>20. A door, window, or rooflight when the <i>work</i> includes replacing the frame.</p> | |

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

- 0.6 Regulation
- 0.6.1 Explanation

regulation

6

mandatory

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

0.6.1 Explanation

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

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

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

0.7 Measurements

- 0.7 Regulation
- 0.7.1 Explanation
- Schedule 4: 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.
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0.8 Durability, workmanship and fitness of materials

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

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

Some methods of establishing workmanship are:

- compliance with BS 8000: Workmanship on building sites;
- compliance with an equivalent technical specification which may include a national technical specification of other Member States, which are contracting parties to the European Economic Area;
- the workmanship is specified for a material, fitting, or component covered by a national or European Certificate issued by a European Technical Approvals issuing body, and the conditions of use are in accordance with certificate;
- the workmanship may be covered by an equivalent technical approval (including a technical approval of another Member State of the Organisation for Technical Approval, EOTA), that provides an equivalent level or performance and the conditions of use are in accordance with terms of the technical approval;
- the workmanship is covered by a scheme, which complies with relevant recommendations of BS EN ISO 9000: Quality Management and quality assurance standards (there are also independent schemes of accreditation and registration of installers of materials and products that provide a means of ensuring that the *work* has been carried out by knowledgeable contractors to an appropriate standard);
- by use of past experience (where it can be shown by experience, such as a *building* in use, that the method of workmanship is capable of performing the function for which it is intended);
- by use of recognised test methods.

0.8.4 Fitness of materials

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

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

The standard code of practice, specification, technical description of European Technical Approval referred to in b to f above must provide in use levels of safety, suitability and fitness for purpose equivalent to those recommended in the Technical Handbooks, referred to in paragraph a, 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

0.9 Regulation

0.9.1 Explanation

Schedule 5: Building standards applicable to construction

<p>regulation</p> <p>9</p> <p>mandatory</p>	<p>Construction shall be carried out so that the work complies with the applicable requirements of schedule 5.</p>
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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

- 0.10 Regulation
- 0.10.1 Explanation

regulation

10

mandatory

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

0.10.1 Explanation

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

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

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

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

- 0.11 Regulation
- 0.11.1 Explanation

regulation

11

mandatory

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

0.11.1 Explanation

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

0.12 Building standards applicable to conversions

0.12 Regulation

0.12.1 Explanation

Schedule 6: Building standards applicable to conversions

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 *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

- 0.13 Regulation
- 0.13.1 Explanation

regulation

13

mandatory

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

no danger to the public is caused or is likely to be caused as a result of their removal.

- (9) Any protective *works* shall be illuminated, and any such *works* which project on to or over that part of a *road* which is not a pavement or footpath shall be provided with such markings, as in the opinion of the local authority are necessary to secure the safety of the public.
- (10) Where *work* has been carried out without the provision of protective *works*, or where *work* on a *building site* has stopped or a *building site* has been abandoned, a local authority may require the *site* owner to carry out protective *works*.

0.13.1 Explanation

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

0.14 Clearing of footpaths

- 0.14 Regulation
- 0.14.1 Explanation

regulation

14

mandatory

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

0.14.1 Explanation

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

0.15 Securing of unoccupied and partially completed buildings

- 0.15 Regulation
- 0.15.1 Explanation

regulation

15

mandatory

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

0.15.1 Explanation

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

1

structure

Contents

- 1.0 Introduction**
- 1.1 Structure**
- 1.2 Disproportionate collapse**

1.0 Introduction

- 1.0.1 Aims
- 1.0.2 Latest changes
- 1.0.3 Alternative approaches

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 the 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 safety at sports grounds updated and structural guidance referred to for temporary demountable structures
- 1.0.4 Reference to Structural Eurocodes updated

1.0.3 Relevant legislation

When designing or verifying sports grounds, reference should be made to the Guide to Safety at Sports Grounds (Fourth Edition 1997). The guide has no statutory force but many of its recommendations will be given force of law at individual grounds by their inclusion in safety certificates issued under the Safety of Sports Grounds Act 1975 or the Fire Safety and Safety of Places of Sport Act 1987.

[Safety of Sports Grounds Act 1975](#)

[Fire Safety and Safety of Places of Sport Act 1987](#)

[Guide to Safety at Sports grounds \(Fourth Edition 1997\)](#)

Chapter 4 and 14 of the Guide to Safety at Sports Grounds (Fourth Edition 1997) provides guidance on permanent and temporary structures at sports grounds and makes recommendations for designers to follow including minimising the risk of disproportionate collapse and designing stadia on the basis of risk assessments having regard to the likely hazards, for example, if the stadium is intended to be used as a venue for pop concerts.

Dynamic performance and testing of grandstands

Guidance on the '[Dynamic performance requirements for permanent grandstands subject to crowd action](#)' November 2001 and [Dynamic testing of grandstands and seating decks](#), June 2002 has been published by the Institution of Structural Engineers as a supplement to the fourth edition of the Guide to Safety at Sports Grounds.

Section 89 of the
[Civic Government
\(Scotland\) Act 1982](#)

Section 89 of the Civic Government (Scotland) Act 1982 requires that no person shall use or permit the use of a raised structure for seating or standing accommodation unless such use has been approved by the local authority. Certain raised structures are exempt from this including any structure that has been granted a *building warrant*.

Temporary
demountable
structures

The Institution of Structural Engineers has published guidance on the '[Procurement, design and use of Temporary demountable structures](#)' (Second Edition 1999) such as grandstands, marquees and stage structures. Towers and masts to support media facilities are also included. The guidance is intended to assist event organisers, venue owners, local authorities, contractors and suppliers of demountable structures and for competent persons who are responsible for their design.

1.0.4 Alternative approaches

Where alternative approaches to the structural design are proposed other than using the guidance contained in this section, the structural design should take account of all of the factors identified in clause 1.0.1 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

- 1.1 Functional standard
- 1.1.0 Introduction
- 1.1.1 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. The guide can be applied to any single *storey* non-residential *building* and is intended to assist designers of small *buildings* of traditional masonry *construction* to take advantage of common practice 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).

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: 2000, and BS 5628: Part 3: 2001;
- g. for structural *work* of timber, BS 5268: Part 2: 2002, 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

- 1.2 Functional standard
- 1.2.0 Introduction
- 1.2.1 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 most non-domestic *buildings* however, designers should consider accidental overloading and the possibility of progressive collapse in non-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).

Buildings with 5 or more storeys

1.2.1 Disproportionate collapse

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/m² 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 m² in any *storey* and 70 m² 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

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- 2.0.7 Method of measurement

Introduction

2.0**2.0.1 Aims**

Life safety is the paramount objective of fire safety. Non-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 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 *buildings* where people may be asleep or where there is a particularly high risk.

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* as they are rarely designed and *constructed*:

- *buildings* with a *storey* at a height of more than 60 m;
- enclosed shopping centres with malls on 3 or more *storeys*.

In such cases, the alternative approach as described in clause 2.0.6 should be followed.

Mixed-use *buildings*

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

Buildings accessible to the general public

2.0.2 Explanation of terms

Buildings accessible to the general public is intended to include *buildings* where members of the public can enter during normal opening hours and are allowed to access all parts of the *building*, other than those parts restricted to staff only.

Protected routes of escape	Protected routes of escape include: <i>escape routes</i> in a central core (clause 2.9.13), fire and smoke control in corridors (clause 2.9.16), <i>flat roofs</i> and <i>access decks</i> (clause 2.9.17), <i>galleries</i> with <i>rooms</i> enclosed below (clause 2.9.18), openings in floors (clause 2.9.19), <i>places of special fire risk</i> (clause 2.9.20), <i>protected lobbies</i> (clause 2.9.21), <i>protected zones</i> (see clause 2.9.22), <i>rooms</i> and <i>toilets</i> and washrooms in <i>protected zones</i> (clause 2.9.23), external <i>escape stairs</i> (clause 2.9.24), <i>escape stairs</i> in <i>basements</i> (clause 2.9.26) and auditoria (clause 2.9.27). This list is not exhaustive and is not intended to cover all parts of a <i>building</i> providing protected routes of escape. For example, <i>compartment walls</i> and <i>compartment floors</i> also protect routes of escape but are covered by the guidance to standard 2.1.
External areas	A roof, an external balcony, or an enclosed courtyard open to the external air, where the area is more than 8 m ² and to which there is access for a purpose other than maintenance, should be regarded as a <i>room</i> .
Circulation areas	Circulation areas in non-domestic <i>buildings</i> include <i>unprotected zones</i> or areas in a <i>rooms</i> or spaces which provide access to an <i>exit</i> and may be permanently demarcated from any space intended for human occupation.
Rainscreen cladding and overcladding	In the guidance to standard 2.4 for cavities, reference to ‘rainscreen cladding’ and ‘overcladding’ has been replaced by ‘ <i>external wall</i> and roof cladding’ where appropriate.

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.

- 2.0.7 additional guidance on rules of measurement for open work floors;
- 2.1.1 purpose groups replaced by *building uses*;
- 2.1.2 *compartmentation* in storage *buildings* (Class 1) changed, guidance on *compartmentation* between single-storey and multi-storey *buildings* included, long fire resistance duration included for *basements* and *compartmentation* in *residential buildings* (other than *residential care buildings* and *hospitals*) clarified;
- 2.1.10 *self-closing fire doors* with a medium fire resistance duration included for fire-fighting shafts;
- 2.1.15 fire shutters not recommended in the enclosing structure of a *protected zone* and additional guidance provided on remote activation of fire shutters;
- 2.1.17 guidance on fire resisting ceilings consolidated;
- 2.2.2 guidance on multi-occupied *buildings* included;
- 2.7.1 alternative guidance provided for fire spread on *external walls*;
- 2.9.22 fire resistance duration of *external walls* in relation to *protected zones* enclosing *escape stairs* amended;
- 2.9.23 size of *rooms* inside *protected zones* introduced;
- 2.9.24 external *escape stairs* increased from 6 m to 7.5 m above ground level;
- 2.9.25 temporary waiting spaces on external *escape stairs* included;

- 2.12.1 vehicle access provision for fire service appliances clarified;
- 2.12.4 type of access door for fire service personnel clarified;
- 2.14.1 fire-fighting facilities on *escape stairs* clarified;
- 2.14.5 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.D fire test exposure changed to inside only for *external walls* less than 1 m to the *boundary*;
- 2.D insulation criteria clarified for external protected routes of escape;
- 2.D guidance on smoke seals to *fire doors* clarified.

2.0.4 Relevant legislation

It is important to be aware that there is other legislation, apart from *building* regulations, imposing requirements for means of escape in case of fire and other fire safety measures that will come into force when the *building* is occupied. It is therefore recommended that consultation with those responsible for such legislation takes place before the application for *building* warrant is finalised. Any necessary fire precautions requiring *building work* can then be included in the application. The relevant authorities include the fire authority and the [Health and Safety Executive](#) (HSE).

It should be noted however, that much of the following legislation in relation to fire safety is currently under review and it is anticipated that the legislation will be updated and consolidated in due course.

[The 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 Fire Precautions Act 1971](#)

The Fire Precautions Act 1971 and associated designated orders also apply to non-domestic *buildings*. The fire authority do not normally as a condition of issuing a fire certificate, make requirements for structural or other alterations to the fire precautions that have been the subject of a *building* warrant. However, if the fire authority is satisfied that the fire precautions are inadequate by reason of matters that were not subject to *building* warrant approval, then the fire authority is not barred from making requirements.

[Fire Precautions \(Workplace\) Regulations 1997](#)

The Fire Precautions (Workplace) Regulations were amended in 1999 so as to apply to a wider range of premises, including those already subject to the Fire Precautions Act. These regulations apply when the *building* is occupied and impose a duty on every employer to provide adequate precautions in the workplace in case of fire. The regulations establish the principles of risk assessment which should take account of fire fighting equipment, fire detection, emergency routes and *exits* and their maintenance. The employer should also include in their assessment, employees and visitors who may have special needs or may be unfamiliar with the evacuation strategy or the *escape routes*. This requirement applies to any workplace and includes *buildings* where the general public have access.

The fire authority is responsible for both the enforcement of the above Act and the Regulations.

[Health and Safety at Work etc Act 1974](#)

The Health and Safety at Work etc Act 1974 also covers fire safety.

[The Management of Health and Safety at Work Regulations 1999](#)

The Management of Health and Safety at Work Regulations 1999 require all employers to assess the risks to workers and any others who may be affected by their work or business. The objective is to identify preventative and protective measures and implement corrective action as appropriate. The approved code of practice 'Management of health and safety at work' published by the HSE, provides guidance on risk assessments and the competency of persons carrying them out.

[The Health and Safety \(Safety Signs and Signals\) Regulations 1996](#)

The Health and Safety (Safety Signs and Signals) Regulations 1996 impose requirements in relation to fire exit and directional signs. In addition, the Fire Precautions (Workplace) Regulations 1997 (as amended) require emergency routes and *exits* to be indicated by signs. Advice on fire safety signs is given in the HSE publication, '[Safety signs and signals: Guidance on Regulations – The Health and Safety \(Safety Signs and Signals\) Regulations 1996](#)'. Guidance is also available in BS 5499: Part 1: 2002, and BS 5499: Part 4: 2000 on graphical symbols, fire safety signs and *escape route* signing.

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

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

[The Fire Certificates \(Special Premises\) Regulations 1976](#)

The Fire Certificates (Special Premises) Regulations 1976 apply to certain industrial premises where the fire risk is particularly severe. Examples of such premises could include premises where large quantities of dangerous substances could be present, such as refineries and chemical works. Other examples include licensed explosives factories and magazines, nuclear sites and *buildings* at *construction* sites used in connection with their work.

[Dangerous Substances and Explosive Atmosphere Regulations 2002](#)

Dangerous Substances and Explosive Atmosphere Regulations 2002 require the risks from substances with flammable, explosive or oxidizing properties to be properly controlled. This can include particular requirements in respect of design and *construction* in which substances are present or in the vicinity. The regulations covering such substances are enforced by the HSE, or for certain types of premises, the local authority, and in relation to general fire precautions, the fire authority.

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

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 guidance '[Fire safety in construction work](#)' (HSG 168).

The HSE has responsibility for enforcing these regulations unless the *construction* activity is in a *building* that remains occupied. In such circumstances, the fire authority will also have responsibility for enforcing the regulations in respect of arrangements to enable persons to reach a *place of safety* in the event of a fire.

Safety of Sports Grounds Act 1975 and the Fire Safety and Safety of Places of Sport Act 1987.

When designing or verifying sports grounds, it is appropriate to use the [guide to Safety at Sports Grounds](#) (Fourth Edition 1997). The guide has no statutory force but many of its recommendations will be given force of law at individual grounds by their inclusion in safety certificates issued under the Safety of Sports Grounds Act 1975 or the Fire Safety and Safety of Places of Sport Act 1987.

The Licensing (Scotland) Act 1976

The Licensing (Scotland) Act 1976 contains provisions relating to applications for new liquor licences. The types of licence are: public house; off-sale; hotel; restricted hotel; restaurant; refreshment and entertainment licences. The licensing authority need to assess the suitability of the premises for its intended purpose before a licence is granted. The licensing authority consult appropriate bodies such as planning, building control, food hygiene, the fire authority and the police before making their decision.

Civic Government (Scotland) Act 1982

The Civic Government (Scotland) Act 1982 contains provisions for public entertainment licences. Similarly to liquor licences, the appropriate bodies are consulted before a license is granted.

Civic Government (Scotland) Act 1982 Order 2000 as amended

The domestic Technical Handbook should be used for Houses in Multiple Occupation (HMOs) that are *dwelling*s and the non-domestic Technical Handbook should be used for all other HMOs. It should be noted that HMOs may also require to be licensed under the Civic Government (Scotland) Act 1982 - Order 2000. To be classified as a house in multiple occupation, the accommodation must be the only or principal residence of 3 or more people from different families. 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).

Regulation of Care (Scotland) Act 2001

The Scottish Commission for the Regulation of Care is responsible to register and inspect a diverse range of care services (e.g. care homes, independent hospitals, hospices, childcare, supported accommodation etc) against national care standards issued by Scottish Ministers. These standards also include some physical standards for the premises. Where the applicant for a warrant intends to provide such a service, they should consult the Commission for advice.

2.0.5 Annexes

2.A: Addition guidance for residential care buildings

2.B: Additional guidance for hospitals

2.C: Additional guidance for enclosed shopping centres

Certain types of *buildings* pose particular risks and require particular solutions. Additional guidance for three specific *building* types are grouped in three annexes; *residential care buildings* in Annex 2.A; *hospitals* in Annex 2.B and enclosed shopping centres in Annex 2.C. The intention is to help designers and verifiers find the information they require quickly when designing or vetting such *buildings*. However, it is important to remember

that the guidance in the annexes is in addition and supplementary to the guidance to standard 2.1 to 2.15.

The additional guidance in Annex 2.C is unique to the design and *construction* of enclosed shopping centres with malls on 1 or 2 *storeys*. The alternative approach described in clause 2.0.6 should be used where the enclosed shopping centre has malls on 3 or more *storeys*.

2.D: Resistance to fire

2.E: 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.D and Annex 2.E. 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 Handbook to a short, medium or long fire resistance duration, are explained in Annex 2.D: Resistance to fire.

Construction materials that are *non-combustible*, are expressed in terms of low, medium, high or very high risk and are explained in Annex 2.E: 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.

2.0.6 Alternative approaches

Fire safety
engineering

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

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.

Places of lawful
detention

Places of lawful detention, such as prisons, present particular problems. The guidance contained in this Handbook can be supplemented by reference to the '[Fire Safety Technical Standards](#)' and associated fire related design standards published by the Scottish Prison Service. Due to the unique nature of the design of prisons, it may be necessary to use fire safety engineering as an alternative approach in some cases.

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 Handbook 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 should 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* or in *different compartments* should be taken separately, except for the purposes of calculating the total floor area of an enclosed shopping centre with a mall.

Area

The area of:

- a. a *compartment* should be taken to be the total floor area of all *storeys* within that *compartment*;
- b. an enclosed shopping centre with a mall should be taken to be the total floor area of all *storeys* within that enclosed shopping centre;
- c. a *storey* should be taken to be the total area of all floors within that *storey*, including the floor area of any *gallery* or openwork floor.

An openwork floor is a floor with an open mesh decking which allows smoke to pass through. It is common to *construct* multi-level openwork floors around high bay racking systems. In such cases, the total *storey* area should be taken to be the total area of all openwork floors within that *storey*, including the floor area taken up by the racking system. Therefore, each level should be measured independently to the innermost surface of the enclosing walls and then added together to give the total *storey* area.

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;

- Plant *storeys* excluded
- 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.
 - d. for the purposes of the measurements in a. and b. 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

- 2.1 Functional standard
- 2.1.0 Introduction
- 2.1.1 Building use
- 2.1.2 Maximum compartment areas
- 2.1.3 Automatic fire suppression
- 2.1.4 Smoke and heat exhaust ventilation systems
- 2.1.5 Buildings with different uses
- 2.1.6 Residential buildings
- 2.1.7 High rise buildings
- 2.1.8 Basements
- 2.1.9 Places of special fire risk
- 2.1.10 Fire-fighting shafts
- 2.1.11 Smoke venting shafts
- 2.1.12 Lift wells
- 2.1.13 Combustibility
- 2.1.14 Supporting structure
- 2.1.15 Openings and service penetrations
- 2.1.16 Junctions
- 2.1.17 Fire resisting ceilings

standard
2.1
mandatory

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

Limitation

This standard does not apply to *domestic buildings*.

2.1.0 Introduction

The aim of *compartmentation* is to inhibit rapid fire spread within the *building* by reducing the fuel available in the initial stages of a fire. The intention is to limit the severity of the fire which in turn should help the occupants to evacuate the *building* and assist fire service personnel with fire-fighting and rescue operations. This is achieved by dividing the *building* into a series of fire tight boxes termed *compartments* which will form a barrier to the products of combustion; smoke, heat and toxic gases.

The use of a *building*, the height of the topmost *storey*, the inclusion of automatic fire suppression systems and the fire resistance duration will determine the maximum area of the *compartments* within a *building*. Designers may also choose to *construct compartments* based on client and aesthetic needs. For example, the designer may use *compartmentation* to classify the *building* into different uses (see clause 2.1.1) or use *compartmentation* to reduce travel distances (see clause 2.9.2).

Common guidance

The guidance in clauses 2.1.15 (Openings and service penetrations), 2.1.16 (Junctions) and 2.1.17 (Fire resisting ceilings) is common, not only to *compartmentation*, but also to the relevant guidance in standard 2.2 separation, 2.4 cavities, 2.9 escape and the relevant guidance contained in the Annexes. 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.

Annexes

Due to the special fire precautions within *residential care buildings*, *hospitals* and enclosed shopping centres, additional guidance is grouped in the Annexes. The intention is to help designers and verifiers find the information they require quickly when designing or vetting such *buildings*. However, it is important to remember that the guidance in the annexes is in addition and supplementary to the guidance to standard 2.1 to 2.15. For additional guidance on:

- *residential care buildings*, see Annex 2.A;
- *hospitals*, see Annex 2.B;
- enclosed shopping centres, see Annex 2.C.

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).

2.1.1 Building use

The following guidance refers to generic uses of *buildings* some of which are defined (see Appendix A of the Technical Handbook). The previous classification of the *buildings* used in the Building Standards (Scotland) Regulations 1990 (as amended) are given in brackets at the end of each line as appropriate.

Assembly building	(PG 5B)
Entertainment building	(PG 5A)
Hospital	(PG 2A)
Office	(PG 3)
Open sided car park	(PG 7C)
Residential building (other than a <i>residential care building</i> and <i>hospital</i>)	(PG 2B)
Residential care building	(PG 2A)
Shop	(PG 4)

Storage Building (Class 1) (PG 7A)

Any storage *building* containing hazardous goods or materials, and any storage of vehicles containing hazardous goods or materials, including: any compressed, liquefied or dissolved gas, any substance which becomes dangerous by interaction with either air or water, any liquid substance with a flash point below 65^o Celsius including whisky or other spirituous liquor, any corrosive substance, any substance capable of emitting poisonous fumes, any oxidising agent, any substance liable to spontaneous combustion, any substance that changes or decomposes readily giving out heat when doing so, any combustible solid substance with a flash point less than 120^o Celsius, any substance likely to spread fire by flowing from one part of a *building* to another.

Storage Building (Class 2) (PG 7B and PG 7C)

Any storage *building* other than a storage *building* (Class 1), including car parks, parking garages designed to admit or accommodate only passenger or other light goods vehicles not more than 2500 kilograms gross mass, other than *open sided car parks*.

Factory (Class 1) (PG 6A)

Any factory involved in manufacturing, processing, repairing, cleaning, washing, breaking up or otherwise treating any substance comprising or used in association with: adhesives, asphalt and bituminous products, chemical and allied industries, cleaners and solvents, clothing and footwear (excluding laundering), coal and petroleum products, cork products, dry cleaning, dye-stuffs and pigments, fertilisers, grains and cereals, inks, insulated wires and cables, leather, sheepskin and fur, linoleum, magnetic tape, oils and greases, paints, paper, printing and publishing (excluding paper manufacturing), pharmaceutical products, photographic materials and products, plastics, polishes, rubber and synthetic rubber, soaps and detergents, spirit distilling, surgical bandages and plasters, synthetic resins, textiles, timber, joinery, furniture, brushes and brooms, *toilet* preparations, upholstery, weedkillers and pesticides.

Factory (Class 2) (PG 6B)

Any factory other than a factory (Class 1), including *buildings* used for generating or supplying power or slaughtering livestock

2.1.2 Maximum compartment areas (D3.1)

A *building*, or part of a *building*, with a total *storey* area more than the limits given in the tables below should be sub-divided by *compartment walls* and, where appropriate, *compartment floors*. The minimum fire resistance duration (see Annex 2.D) can be obtained from the tables below (see also clause 2.1.5).

In most cases, a single-storey *building* poses less of a life risk to the occupants or to fire service personnel than a multi-storey *building*, therefore a greater *compartment* size can be *constructed*.

Single-storey buildings and compartmentation between single-storey and multi-storey buildings where appropriate

Building use	Maximum total area of any compartment (m²)	Minimum fire resistance duration for compartmentation (if any)
<i>Assembly building</i>	6,000 [1]	Long
<i>Entertainment building</i>	2,000 [1]	Medium
Factory (Class 1)	33,000 [1]	Long [3]
Factory (Class 2)	93,000 [1]	Long [3]
<i>Office</i>	4,000 [1]	Medium
<i>Open sided car park</i>	Unlimited	Not relevant
<i>Residential care building, hospital</i>	1,500	Medium
<i>Residential building (other than a residential care building and hospital)</i>	2,000	Medium
<i>Shop</i>	2,000 [2]	Long
Storage building (Class 1)	1,000 [1]	Long
Storage building (Class 2)	14,000 [1]	Long [3]

Notes:

1. Areas may be doubled where there is an automatic fire suppression system (see clause 2.1.3);
2. Unlimited provided there is an automatic fire suppression system (see clause 2.1.3);
3. A medium fire resistance duration *compartment wall or floor* may be provided between the single-storey part and the multi-storey part provided the multi-storey part does not exceed the limitations for medium fire resistance duration in the following table covering multi-storey *buildings* (see also clause 2.1.5).

Multi-storey buildings

Building use	Maximum total area of any compartment (m ²)	Maximum area of an individual storey within a compartment (m ²)	Minimum fire resistance duration for compartmentation and elements of structure (see standard 2.3) where appropriate			
			Basements	The topmost storey of a building is at a height of not more than 7.5 m above ground	The topmost storey of a building is at a height of not more than 18 m above ground	The topmost storey of a building is at a height of more than 18 m above ground
Assembly building	1,500 [1]	1,500 [1]	Medium	Short	Medium	Long [2]
	3,000 [1]	3,000 [1]	Medium	Medium	Medium	Long [2]
	6,000 [1]	3,000 [1]	Long	Long	Long	Long
Entertainment building	1,000 [1]	1,000 [1]	Medium	Short	Medium	Long [2]
	2,000 [1]	2,000 [1]	Medium	Medium	Medium	Long [2]
	4,000 [1]	2,000 [1]	Long	Long	Long	Long
Factory (Class 1)	500 [1]	500 [1]	Medium	Medium	Medium	Long [2]
	6,000 [1]	3,000 [1]	Long	Long	Long	Long
Factory (Class 2)	2,000 [1]	2,000 [1]	Medium [4]	Medium [4]	Medium [4]	Medium [4]
	15,000 [1]	7,500 [1]	Long	Long	Long	Long
Office	2,000 [1]	2,000 [1]	Medium [4]	Short	Medium [4]	Long [2]
	4,000 [1]	4,000 [1]	Medium [4]	Medium [4]	Medium [4]	Long [2]
	8,000 [1]	4,000 [1]	Long	Long	Long	Long
Open sided car park	Unlimited	Unlimited	Medium	Short	Short	Medium
Residential care building, hospital	1,500	1,500	Medium	Medium	Medium	Long [2]
Residential building (other than a residential care building and hospital)	1,000	1,000	Medium	Short	Medium	Long [2]
	2,000	2,000	Medium	Medium	Medium	Long [2]
Shop	500 [1]	500 [1]	Medium [4]	Short	Medium [4]	Long [2]
	1,000 [1]	1,000 [1]	Medium [4]	Medium [4]	Medium [4]	Long [2]
	2,000 [3]	1,000 [3]	Long	Long	Long	Long
Storage building (Class 1)	200 [1]	200 [1]	Medium	Medium	Medium	Long [2]
	1,000 [1]	500 [1]	Long	Long	Long	Long
Storage building (Class 2)	500 [1]	500 [1]	Medium [4]	Medium [4]	Medium [4]	Medium [4]
	5,000 [1]	2,500 [1]	Long	Long	Long	Long

Notes:

1. Areas may be doubled where there is an automatic fire suppression system (see clause 2.1.3);
2. Medium fire resistance duration for *compartment walls*;
3. Unlimited provided there is an automatic fire suppression system (see clause 2.1.3)
4. See *buildings* with different uses (clause 2.1.5)

2.1.3 Automatic fire suppression

Where it is intended to install automatic fire suppression systems, guidance can be obtained in the following publications:

- BS 5306: Part 2: 1990, for sprinkler systems;
- BS 5306: Part 4: 1986; for carbon dioxide systems;
- BS 5306: Part 6: Section 6.1: 1988 for low expansion foam systems;
- BS 5306: Part 6: Section 6.2: 1989 for medium and high expansion foam systems; and
- BS 5306: Part 7: 1988 for powder systems.

Selection of system is discussed in BS 5306: Part 0: 1986. BS 5306: Part 2: 1990 should be read in conjunction with the Technical Bulletins contained in the '[Rules for Automatic Sprinkler Installations](#)' LPC 1994.

2.1.4 Smoke and heat exhaust ventilation systems (D3.6, D3.7)

Enclosed shopping centres

A smoke and heat exhaust ventilation system (SHEVS) should be installed in the mall of an enclosed shopping centre and in *shops* with a *storey* area more than 1,300 m². Guidance on SHEVS is provided in clause 2.C.1 of Annex 2.C.

Large *shops*

Similarly, large shops (other than in enclosed shopping centres), with a *compartment* area more than 5,600 m² should also be provided with SHEVS. Whilst Annex 2.C relates to enclosed shopping centres, the guidance in clause 2.C.1 of Annex 2.C may also be used for large shops.

2.1.5 Buildings with different uses (D5.1a,c,d)

Buildings with different uses (see clause 2.1.1) should be divided by *compartment walls* and *compartment floors*. However, *compartmentation* need not be provided if the overall *building* attains the highest of the performance levels described in the guidance to standards 2.1, 2.3 and 2.6. The intention is to allow design flexibility without reducing the risk to life safety. This is done by removing the need for *compartmentation* in a *building* or parts of a *building* where the overall *building* follows the more demanding guidance. For example, a *compartment wall* between a production area in a factory and part of the *building* used for storage need not be provided where an assessment of the overall *building* has been carried out for both uses and:

- the limits for *compartmentation* have not been exceeded (see clause 2.1.2); and
- the most demanding fire resistance duration of the *elements of structure* has been followed (see clause 2.3.1); and
- the most severe minimum distance to the relevant *boundary* has been followed (see guidance to standard 2.6).

However, certain *buildings* are considered to present a lower level of risk to life safety and as a result, are given special consideration even where *compartmentation* between different uses is necessary. The *buildings* referred to are *offices*, *shops*, factories (Class 2) as defined in clause 2.1.1 or storage *buildings* (Class 2) as defined in clause 2.1.1. Where the affected parts of the *building* are in the same occupation (see clause 2.2.2), short fire resistance duration is sufficient in lieu of medium fire resistance duration provided an automatic fire suppression system (see clause 2.1.3) is installed on both sides of the *compartment wall*, or on the *storeys* above and below the *compartment floor* where appropriate.

2.1.6 Residential buildings (D3.5)

In a *residential building*, every *upper storey* and every *basement storey* should form a separate *compartment*.

2.1.7 High rise buildings

Every floor at a *storey* height of more than 18 m above the ground should be a *compartment floor*.

2.1.8 Basements (D3.3. D3.4)

Where a *building* has a *basement storey*, the floor of the *ground storey* should be a *compartment floor*. However, where the *building* comprises one *basement storey* and not more than 2 other *storeys*, and no *storey* has an area more than 280 m², a *compartment floor* need not be provided.

Where a *building* has a *basement storey* at a depth of more than 10 m, every *basement storey* should form a separate *compartment*.

2.1.9 Places of special fire risk (D3.8. D3.9)

Paint spraying

A *place of special fire risk* should be enclosed by *compartment walls* with a medium fire resistance duration. However, this does not apply to a paint spray booth or to a *room* where cellulose or other flammable liquid spray is used, having a floor area not more than 100 m², *constructed* of prefabricated factory-made panels and is *constructed* in accordance with the recommendations in the Health and Safety Executive Guidance Note PM25 '[Vehicle finishing units fire and explosion hazards](#)'.

Hazardous liquids

Where a *place of special fire risk* contains any appliance or equipment using hazardous liquid, any opening in a wall or floor dividing it from the remainder of the *building* should be *constructed* in such a manner that, in the event of any liquid spillage, the *room* will contain all the liquid in the appliance or equipment, plus 10%. See Section 3, Environment for guidance on catchpits (bunds) for the storage of oil within a *building*.

2.1.10 Fire-fighting shafts (D3.10)

A fire-fighting shaft is an enclosure protected from fire in adjoining accommodation and contains an *escape stair*, a fire-fighting lobby at every *storey* at which the fire-fighting shaft can be entered from the accommodation. The shaft may also contain a fire-fighting lift together with its machine room (see clause 2.14.4).

These shafts are used in high *buildings*, deep *buildings* and in certain *shops* or storage *buildings* to assist fire service personnel to carry out fire-fighting and rescue operations.

The enclosing structure of a fire-fighting shaft should have a long fire resistance duration. However, where the *elements of structure* in a *building* have a medium fire resistance duration, then the fire-fighting shaft need only have a medium fire resistance duration. A *self-closing fire door* in the enclosing structure of a fire-fighting shaft need only attain a medium fire resistance duration (see diagram to clause 2.14.3).

2.1.11 Smoke venting shafts (D3.11)

A smoke venting shaft should be enclosed by *compartment walls* with a medium fire resistance duration, other than at the smoke inlets and smoke outlets to the shaft.

2.1.12 Lift wells (D3.12, D3.13)

A lift well should be enclosed by *compartment walls* with a medium fire resistance duration and, where the lift well is not the full height of the *building*, a *compartment floor* with a medium fire resistance duration (see also capping systems in clause 2.1.16). A *compartment 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.

Platform lifts

A platform lift following the guidance in BS 6440:1999 (see Section 4: Safety), need not be enclosed by *compartment walls* or *compartment floors*.

2.1.13 Combustibility (D5.6, D5.7)

A *compartment wall* or *compartment floor* can be *constructed* of combustible materials having a low, medium, high or very high risk (see Annex 2.E) provided the *compartment wall* or *compartment floor* has the appropriate fire resistance duration. However *compartment walls* and *compartment floors* in *hospitals* (see Annex 2.B), should be *constructed* from materials which are *non-combustible*.

2.1.14 Supporting structure (D2.2)

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

2.1.15 Openings and service penetrations (D3.14, D4.7, D5.8)**General**

Compartment walls and *compartment floors* (including a fire resisting ceiling) are intended to prevent fire passing from one compartment to another. 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 *compartment wall* should be installed in accordance with the recommendations in the Building Hardware Industry Federation, Code of Practice, 'Hardware for Timber Fire and Escape Doors' Issue 1, November 2000. Whilst metal and plastic doors are excluded from this publication the same general principles could be applied. For metal doorsets, reference should be made to the 'Code of Practice for fire resisting metal doorsets' published by the Door and Shutter Manufacturers' Association, 1999.

In some instances a *self-closing fire door* with a short fire resistance duration may be installed. For example, a *self-closing fire door* with a medium fire resistance duration may be installed in the enclosing structure of a fire-fighting shaft with a long fire resistance duration (see clause 2.1.10).

A lockable door to a cupboard or service *duct* where the cupboard or the service *duct* have a floor area not more than 3 m², need not be self-closing.

Hold open devices

Self-closing fire doors can be fitted with hold open devices as specified in BS 5839: Part 3: 1988 provided the door is not an *emergency door*, a *protected door* serving the only *escape stair* in the *building* (or the only *escape stair* serving part of the *building*) or a *protected door* serving a fire-fighting shaft.

It is important that hold open devices deactivate on operation of the fire alarm therefore some *buildings* will need automatic fire detection to be installed. Electrically operated hold open devices should therefore deactivate on operation of:

- an automatic fire alarm system designed and installed in accordance with BS 5839: Part 1: 2002 (Category L5) determined on the basis of a risk assessment (see clauses 2.0.4); 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 incorporate 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.

As an alternative to the above hold open device, an acoustically activated door release mechanism and floor plate complying with BS EN 1155: 1997 may be installed on a risk assessment basis (see clause 2.0.4). An example of this could be in the case of *residential care building* or *hospital* where the residents rely on walking aids to move around the *building*.

However, this type of hold open device is not suitable for use in the following circumstances where:

- the door is 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; or
- a Category M fire alarm system as defined in BS 5839: Part 1: 2002 is installed in the *building*; or
- the initial fire alarm warning signal is intended to alert staff only.

Additional guidance on the siting and coverage of fire detectors is contained in clause 22 of BS 5839: Part 1: 2002.

Automatically motorised fire shutters

Fire shutters should not be installed in the enclosing structure of a *protected zone* (see also clauses 2.9.7 and 2.9.31). However they may be used for the protection of *service openings* and ventilation *ducts*. Automatic motorised fire shutters should be fitted with audible and visual warning devices that operate on fire detection prior to activation of the fire shutter. However, this is only necessary where there is a risk of people moving under the shutter in the event of an outbreak of fire within the *building*.

The visual warning devices should be fitted on both sides of the opening where the movement of people below the shutter is possible from both directions. Sensors should also be fitted that, when activated, temporarily halt the activation of the shutter. Automatic fire shutters should not be activated by a fire alarm signal from a remote location or out-with the fire alarm zone.

Fire shutters in compartment walls

A fire shutter which is not motorised may be fitted in a *compartment wall* provided the shutter has the same fire resistance duration as the

compartment wall (see table to Annex 2.D). Since a shutter activated by a fusible link or other heat sensitive device is not considered to be a threat to the occupants, warning devices need not be fitted.

Fire shutters in *compartment floors*

Where an opening in a *compartment floor* contains a stair (but not an *escape stair*) and not more than 2 escalators:

- a horizontal fire shutter may be installed which maintains the fire resistance duration of the *compartment floor* and is activated by a fusible link or other heat-sensitive device positioned to detect fire in the lower *compartment*; or
- vertical fire shutters may be installed at each floor level (other than the topmost *storey*) which maintains the fire resistance duration of the *compartment floor* and are activated by smoke detection positioned to detect smoke in the lower *compartment*.

Escalators

Where an escalator passes through the opening, it should come to a controlled halt before the fire shutter is activated.

A chimney or flue-pipe should be *constructed* so that, in the event of a fire, the fire resistance duration of the *compartment wall* or *compartment floor* is maintained.

A service opening (other than a ventilating duct) which penetrates a *compartment wall* or *compartment 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 *compartment wall* or *compartment floor* need not be provided for:

- a pipe or a cable with a bore, or diameter, of not more than 40 mm; or
- not more than four 40 mm diameter pipes or cables that are at least 40 mm apart and at least 100 mm from any other pipe; or
- more than four 40 mm diameter pipes or cables that are at least 100 mm apart; or
- a pipe which has a bore of not more than 160 mm and is of iron, steel or copper, or of a material capable of withstanding 800° C without allowing flames or hot material to pass through the wall of the pipe; or
- a branch pipe of a bore of not more than 110 mm connected to a vertical drainage or water service pipe, *constructed* from aluminium, aluminium alloy, or uPVC to BS 4514: 1983 (1998).

Where a pipe connects to another pipe which attracts a more demanding fire resistance duration, and is within 1 m from the *compartment wall* or *compartment floor*, the pipe should be fire stopped to the more demanding guidance.

A ventilating duct passing through a *compartment wall* or *compartment floor* should be *fire-stopped* in accordance with BS 5588: Part 9: 1999. Section 6

of BS 5588: Part 9: 1999 provides guidance on design and *construction* including fire resisting enclosures, fire resisting ductwork and the use and activation of fire dampers.

Fire-stopping

Fire-stopping may be necessary to close an imperfection of fit or design tolerance between *construction* elements and components, *service openings* and ventilation *ducts*. Proprietary *fire-stopping* products including intumescent products, should be tested to demonstrate their ability to maintain the appropriate fire resistance 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, the use of proprietary fire-stopping products may 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.

2.1.16 Junctions (D3.14, D3.15, D3.16, D4.8, D5.9, D5.10, D5.11)

General

The basic principle is that junctions between *compartment walls* and *compartment floors* (including fire resisting ceilings, see clause 2.1.17) and other parts of the *building* should be designed and *constructed* to prevent a fire in one *compartment* flanking the wall, floor or ceiling and entering another *compartment* at the junctions including any solum space or *roof space* (see Annex 2.B for additional guidance on *hospitals*).

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 *compartment wall* in such a way as to impair the fire resistance between the relevant parts of the *building*.

Junctions with walls

Where a *compartment wall* or *compartment floor* (including a fire resisting ceiling, see clause 2.1.17) forms a junction with an *external wall*, a *separating wall*, another *compartment 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 *compartment wall* or *compartment floor*.

Junctions with roofs

Where a *compartment wall* forms a junction with a roof, the junction should maintain the fire resistance duration of the *compartment 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 2.1.15) at the wall-head.

Junctions with fire resisting ceilings

Where a *compartment wall* (or *sub-compartment wall*) does not extend to the full height of the *building*, the wall should form a junction with a *compartment floor*.

Non-full height walls

However, this may not always be the most practical solution. At the topmost *storey* of a *building* for example it is possible for the *compartment wall* (or *sub-compartment wall*) to form a junction with a fire resisting ceiling (see clause 2.1.17), (including a suspended ceiling) or a localised capping system, provided the fire resistance duration is maintained and the junction between the wall and ceiling is *fire-stopped*.

Capping system

To ensure that occupants will be protected during evacuation and to protect fire service personnel during fire-fighting and rescue operations, a localised capping system could be *constructed* at the head of a *protected zone* or a lift shaft. The system should be fire protected on both sides and be sufficiently robust to protect against premature collapse of the roof structure. There is currently no fire test from the top-side of a capping system, the assumption being that if the test satisfies the fire resistance duration from the underside then it will also satisfy the same criteria from the top-side using the same *construction*.

2.1.17 Fire resisting ceilings (D1.3)

Where a fire resisting ceiling, including a suspended ceiling, contributes to the fire resistance duration of a *compartment floor* or is part of a *construction* as described in clause 2.1.16, the ceiling should 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 2.1.15;
- junctions with the ceiling should follow the guidance in clause 2.1.16;
- the ceiling lining should follow 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.

However, the guidance in this clause should not be applied to fire resisting ceilings protecting the load-bearing capacity of a floor only. In such cases, the *compartment wall* should be taken through the ceiling and floor to form a continuous and complete barrier to fire between the relevant *compartments*.

2.2 Separation

- 2.2 Functional standard
- 2.2.0 Introduction
- 2.2.1 Separating walls and separating floors
- 2.2.2 Buildings in different occupation
- 2.2.3 Buildings with common occupation
- 2.2.4 Combustibility
- 2.2.5 Supporting structure
- 2.2.6 Openings and service penetrations
- 2.2.7 Junctions

<p style="text-align: center;">standard</p> <h1 style="text-align: center;">2.2</h1> <p style="text-align: center;">mandatory</p>	<p>Every <i>building</i>, which is divided into more than one area of <i>different occupation</i>, must be designed and <i>constructed</i> in such a way that in the event of an outbreak of fire within the <i>building</i>, fire and smoke are inhibited from spreading beyond the area of occupation where the fire originated.</p>
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2.2.0 Introduction

Buildings or parts of a *building* in *different occupation* pose particular problems in terms of fire safety. This is because one occupier usually does not have any control over the activities or working practices of their co-occupiers and in such cases, *separating walls* and *separating floors* are recommended.

The intention of separation is to limit fire growth and thereby give adjoining occupiers more time to escape before they are threatened by fire or smoke.

Enclosed shopping centres

Due to the special fire precautions within enclosed shopping centres, additional guidance is grouped in the Annex 2.C. The intention is to help designers and verifiers find the information they require quickly when designing or vetting such *buildings*. However, it is important to remember that the guidance in the annexes is in addition and supplementary to the guidance to standards 2.1 to 2.15.

Conversions

In the case of *conversions*, as specified in Regulation 4, the *building* as *converted* must be improved to as close to 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 **Separating walls and separating floors**

Separating walls and *separating floors* should have a medium fire resistance duration (see Annex 2.D). However, there are some situations where the wall or floor will demand a greater fire resistance. For example, where the *separating floor* is also an *element of structure* in a *building* where the topmost *storey* is at a height of more than 18 m, long fire resistance duration would be necessary in most cases (see clause 2.1.2).

2.2.2 **Buildings in different occupation** (D5.1c)

A *separating wall* or *separating floor* should be provided between parts of a *building* where they are in *different occupation*.

Multi-occupied *building*

However, it is possible to have no *separating walls* or *separating floors* between the *different occupiers* of a multi-occupied *building* when the *building* is under a single management regime. For example, multi-occupied *offices* with a shared reception and *sanitary facilities* may be regarded as being in the same occupation. In such cases, the *building* should have a common fire alarm system / evacuation strategy and the same occupancy profile (see clause 2.9.3). This philosophy is in effect very similar to individual departments within one large organisation. However, where each unit is under the control of an individual tenant, employer or self-employed person, *separating walls* and *separating floors* should be provided between the areas intended for *different occupation*.

Speculative development

Where a speculative development is intended to be multi-occupied but the extent of management control is not known, the *building* should be regarded as being *occupied by different persons*.

2.2.3 **Buildings with common occupation** (D5.1b, D5.5b)

A *separating wall* or *separating floor* with a medium fire resistance duration should be provided between parts of a *building* where one part is in single occupation and the other is in communal occupation. However this is not necessary between:

- part of a *building* in single occupation and a common external stair, access balcony or deck;
- a *shop* and a mall (see Annex 2.C).

2.2.4 **Combustibility** (D5.6, D5.7)

Exclusions from *non-combustibility*

Every part of a *separating wall* or *separating floor* (other than a floor finish such as laminate flooring) should be of materials that are *non-combustible*. However, this is not necessary where the *building* does not have any *storey* at a height of more than 18 m and the separation is 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
- units of *shared residential accommodation*; or
- a *dwelling* and a unit of *shared residential accommodation*.

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 of low risk or *non-combustible* materials (see Annex 2.E); and

- the internal wall lining should be *constructed* from material which is low risk or *non-combustible*; and
- the wall should contain no pipes, wires or other services.

2.2.5 Supporting structure (D2.2, D2.3)

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 *non-combustible* materials.

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

2.2.6 Openings and service penetrations (D5.8)

Guidance on the fire protection of openings and service penetrations is provided in clause 2.1.15. However *self-closing fire doors* should not be installed in *separating walls* other than in the situation described in clause 2.2.3 or where the *building* is in the same occupation but in different *building* use as defined in clause 2.1.1. A fire shutter should not be installed in a *separating wall* or *separating floor*.

2.2.7 Junctions (D5.9, D5.10)

Where a *separating wall* or *separating floor* meets an *external wall*, another *separating wall*, a *compartment wall* or any other wall or screen used to protect routes of escape (see clause 2.0.2), the junction should maintain the fire resistance duration of the *separating wall* or *separating floor*. Where a *separating wall* forms a junction with a roof or a fire resisting ceiling (see clause 2.1.17), the junction should be *constructed* in accordance with the recommendations in clause 2.1.16.

2.3 Structural protection

- 2.3 Functional standard
- 2.3.0 Introduction
- 2.3.1 Elements of structure
- 2.3.2 Combustibility
- 2.3.3 Supporting structure
- 2.3.4 Openings and service penetrations
- 2.3.5 Junctions

<p>standard 2.3 mandatory</p>	<p>Every <i>building</i> must be designed and <i>constructed</i> in such a way that in the event of an outbreak of fire within the <i>building</i>, the load-bearing capacity of the <i>building</i> will continue to function until all occupants have escaped, or been assisted to escape, from the <i>building</i> and any fire containment measures have been initiated.</p>
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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.D) 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, been 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.

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.

The *elements of structure* in a *building* should have at least the fire resistance duration as set out in the tables to clause 2.1.2.

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*, *compartment wall*, a *sub-compartment wall* in a *residential care building* or *hospital*, a wall or screen used to protect routes of escape (see clause 2.0.2) or an *external wall* which attracts a fire resistance (as in the guidance to standard 2.6);
- a floor consisting of removable panels situated directly above a floor which is an *element of structure*;
- a *gallery* floor other than a *gallery* floor which is wholly or partly enclosed below (see clause 2.9.18);
- an openwork floor;
- a catwalk (including a lighting bridge);
- the lowest floor of a *building*.

2.3.2 **Combustibility** (D2.3)

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.E) provided the element of structure has the appropriate fire resistance duration.

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.E).

2.3.3 **Supporting structure** (D2.2)

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 2.1.16, 2.1.17, 2.2.7, 2.4.9 and 2.9.32. *Fire-stopping* of 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 the fire resistance duration set out in the tables to clause 2.1.2 (see also Annex 2.D).

2.4 Cavities

- 2.4 Functional standard
- 2.4.0 Introduction
- 2.4.1 Cavity barriers
- 2.4.2 Dividing up cavities
- 2.4.3 Roof space cavities above undivided spaces
- 2.4.4 Cavities above ceilings in residential buildings (other than residential care buildings and hospitals)
- 2.4.5 Fire resisting ceilings as an alternative to cavity barriers
- 2.4.6 Combustibility
- 2.4.7 Supporting structure
- 2.4.8 Openings and service penetrations
- 2.4.9 Junctions

standard

2.4

mandatory

Every *building* must be designed and *constructed* in such a way that in the event of an outbreak of fire within the *building*, the unseen spread of fire and smoke within concealed spaces in its structure and fabric is inhibited.

2.4.0 Introduction

Fire and smoke spread in concealed spaces is particularly hazardous because fire can spread quickly throughout a *building* and remain undetected by the occupants of the *building* or by fire service personnel. Ventilated cavities generally promote more rapid fire spread around the *building* than unventilated cavities due to the plentiful supply of replacement air. *Buildings* containing sleeping accommodation pose an even greater risk to life safety and demand a higher level of fire precautions. For these reasons, it is important to control the size of cavities and the type of material in the cavity.

Large air plenums present difficulties due to the very nature of their design and an alternative approach (see clause 2.0.6) may be the only viable alternative.

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 neighbouring *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, conduits or cables.

Residential care buildings and hospitals

Due to the special fire precautions within *residential care buildings* and *hospitals*, additional guidance is grouped in the Annexes. The intention is to help designers and verifiers find the information they require quickly when designing or vetting such *buildings*. However, it is important to remember that the guidance in the annexes is in addition and supplementary to the guidance to standard 2.1 to 2.15. For additional guidance on:

- *residential care buildings*, see Annex 2.A;
- *hospitals*, see Annex 2.B.

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* means any *construction* provided to seal a cavity against the penetration of fire and smoke or to restrict its movement within the cavity.

In order to inhibit fire spread in a cavity, every cavity within a *building* should have *cavity barriers* with at least a short fire resistance duration (see Annex 2.D) installed around the edges of the cavity. This includes for example, around the head, jambs and cill 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. However, for *roof space* cavities above an undivided space the guidance in clause 2.4.3 should be followed. Additional guidance for *buildings* containing a sleeping risk (other than *residential care buildings* and *hospitals*) is also provided in clause 2.4.4.

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 2.4.5; or
 - c. between a roof and a ceiling *constructed* in accordance with the guidance in clause 2.4.5; 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); or
 - f. between a floor which is an *element of structure* (see clause 2.3.0), and a raised floor consisting of removable panels.

2.4.3 Roof space cavities above undivided spaces (D6.3)

Undivided spaces

The need to provide *cavity barriers* in a *roof space* above undivided (or open plan) spaces is less important than that in clause 2.4.2. This is because *roof spaces* are regarded as having a low fire risk and the occupants in an

undivided (or open plan) space should be aware of any fire developing. In such cases, the occupants should be able to make their escape in the early stages of the fire growth. However, where there is sleeping accommodation, the material exposed in the cavity and the size of a cavity, should be controlled due to the nature of the risk. In such cases the limits set in the table below should not be exceeded.

Combination of divided and undivided spaces

It is also possible to install *cavity barriers* in *roof spaces constructed* in accordance with a combination of the guidance for divided and undivided spaces. For example, *rooms* adjoining a large open plan *room* can be separated from the open plan *room* by installing *cavity barriers* in the *roof space* between the two spaces. This will allow the two *roof spaces* to be assessed independently.

Maximum distance between *cavity barriers* in *roof spaces* above undivided spaces (m)

	Where surfaces are <i>non-combustible</i> or <i>low risk materials</i> (m)	Where surfaces are <i>medium, high or very high risk materials</i> (m)
Intended for sleeping	20	15
Not intended for sleeping	No limit [1]	20

Notes:

1. Limit of 20 m should be applied in *residential care buildings* and *hospitals*.

A ceiling *constructed* in accordance with the guidance in clause 2.4.5 may be provided as an alternative to installing *cavity barriers*.

2.4.4 Cavities above ceilings in *residential buildings* (other than *residential care buildings* and *hospitals*) (D6.4)

Divided spaces with a sleeping risk

Where a *roof space* cavity or a ceiling void cavity extends over a *room* intended for sleeping, or over such a *room* and any other part of the *building*, *cavity barriers* should be installed on the same plane as the wall. The intention is to contain the fire within the *room* of fire origin allowing occupants in other parts of the *building* to make their escape once the fire alarm has activated (see guidance to standard 2.11). However, in cases where this is not the most practical solution, a fire resisting ceiling can be installed as an alternative to *cavity barriers* (see clause 2.4.5).

The risk of fire spread above ceilings in *residential care buildings* and *hospitals* is covered by the additional guidance for *sub-compartmentation* in Annex 2.A and Annex 2.B.

2.4.5 Fire resisting ceilings as an alternative to *cavity barriers* (D6.6)

Where a fire resisting ceiling is provided as an alternative to *cavity barriers* as in clauses 2.4.2b, 2.4.2c, 2.4.3 and 2.4.4, the ceiling should have at least short fire resistance duration and be *constructed* in accordance with the guidance in clause 2.1.17.

2.4.6 Combustibility (D6.6, D8.2, D10.2)

Cavity barriers and ceilings provided as an alternative to *cavity barriers* generally 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*.

High rise *buildings*

In a *building* with a *storey* height of more than 18 m, thermal insulation material situated or exposed within an *external wall cavity*, or in a cavity formed by *external wall* cladding, should be *constructed* of *non-combustible* materials (see Annex 2.E). However, this does not apply to insulation 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 the guidance to standard 2.6 and standard 2.7).

2.4.7 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*.

2.4.8 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 2.1.15.

2.4.9 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 2.1.16 for additional guidance on junctions and clause 2.1.15 for additional guidance on *fire-stopping* materials.

Where a wall, floor or other part of a *building* with a fire resistance duration abuts a structure containing a cavity, a *cavity barrier* should be installed so as to extend the line of the structure. However, this is not necessary where the cavity is:

- formed by 2 leaves of masonry or concrete at least 75 mm thick;
- formed by an *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

- 2.5 Functional standard
- 2.5.0 Introduction
- 2.5.1 Internal linings
- 2.5.2 Assessment of linings
- 2.5.3 Plastic glazing
- 2.5.4 Thermoplastic material
- 2.5.5 Thermoplastic materials in ceilings
- 2.5.6 Thermoplastic materials in rooflights
- 2.5.7 Thermoplastic materials in light fittings with diffusers
- 2.5.8 Sandwich panels

standard

2.5

mandatory

Every *building* must be designed and *constructed* in such a way that in the event of an outbreak of fire within the *building*, the development of fire and smoke from the surfaces of walls and ceilings within the area of origin is inhibited.

2.5.0 Introduction

The *building* contents are likely to be the first items ignited in a fire and are beyond the scope of this guidance. Materials used in walls and ceilings can however, significantly affect the spread of fire and its rate of growth. Fire spread on internal linings in *escape routes* is particularly important because rapid fire spread in *protected* 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 mean 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 the face of a 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.

Every room, fire-fighting shaft, *protected zone* or *unprotected zone*, should have wall and ceiling surfaces with a reaction to fire which follows the guidance in the table below.

Reaction to fire of wall and ceiling surfaces (see Annex 2.E)

Building	Residential care buildings and hospitals	Shops	All other buildings
<i>Room</i> not more than 30 m ²	Medium risk [2]	High risk	High risk
<i>Room</i> more than 30 m ²	Low risk [3]	Medium risk [4]	Medium risk
<i>Unprotected zone</i>	Low risk	Low risk [5]	Medium risk
<i>Protected zone</i> and fire-fighting shaft [1]	Low risk	Low risk	Low risk

Notes:

1. Including any *toilet* or washroom within a *protected zone*.
2. High risk in a *room* not greater than 4 m²
3. Ceilings may be medium risk.
4. Low risk in storage *buildings* (Class 1) as defined in clause 2.1.1.
5. In an enclosed shopping centre, structural timbers supporting *glazing* that forms part of a *shop* front, unit signs and stallboard risers can be *constructed* of materials which are low, medium or high risk provided they are not more than 20% in total, of the area of the *shop* front.

Limitations on higher risk surfaces

In a *room*, any part of the wall may be of one risk category higher than that recommended in the table above, but not very high risk, where the total area of those parts in any one *room* is not more than half the floor area of the *room*. This is subject to a maximum of 20 m² in *residential buildings* and 60 m² in *non-residential buildings*.

In a *building* solely housing livestock, the surfaces of *unprotected zones* may have any level of reaction to fire, except very high risk.

2.5.2 Assessment of linings

Wall and ceiling linings should be assessed for their reaction to fire characteristics.

Wall linings

The following wall surfaces should be included in the assessment:

- *glazing* except *glazing* in doors; and
- any part of a ceiling which slopes at an angle of more than 70° to the horizontal.

However the following surfaces need not be taken into account:

- doors and door frames;
- window frames and frames in which *glazing* is fitted;
- 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*;
- any part of a wall which slopes at an angle of 70° or less to the horizontal.

However the following surfaces need not be taken into account:

- ceiling hatches and their frames;
- the frames of windows or rooflights and the frames in which *glazing* is fitted;
- facings, cover moulds, picture rails, and similar narrow members.

2.5.3 Plastic glazing

External windows and internal *glazing* to rooms (but not to *protected zones* or *unprotected zones*) may be fitted with plastic *glazing* materials which are:

- rigid solid PVC (UPVC); or
- polycarbonate rigid solid sheet at least 3 mm thick; or
- multiskin polycarbonate sheet at least 10 mm thick overall which has 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° 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 low or medium risk for reaction to fire; or
- any other rigid thermoplastic product, a specimen of which (at the thickness of the product as put on the market), when tested in accordance with Method 508A in BS 2782: 1970 (1974) performs so that the test flame extinguishes before the first mark, and the duration of flaming or afterglow does not exceed 5 seconds following removal of the burner.

Flexible thermoplastic

TP(a) flexible means:

flexible products not more than 1 mm thick which satisfy the Type C provisions of BS 5867: Part 2: 1980 (1993) when tested in accordance with Test 2 in BS 5438: 1989 (1995) with the flame applied to the surface of the specimens for 5, 15, 20 and 30 seconds respectively, but excluding cleansing procedure.

Semi-rigid thermoplastic

TP(b) semi-rigid means:

- a rigid solid polycarbonate sheet product not more than 3 mm thick, or multiple-skin polycarbonate sheet products which do not qualify as TP(a) by test; or
- other products which, when a specimen of the material more than 1.5 mm and not more than 3 mm thick is tested in accordance with Method 508A in BS 2782: 1970 (1974), has a rate of burning which is not more than 50 mm/minute.

2.5.5 Thermoplastic materials in ceilings (D7.2)

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 sides and should not exceed 5 m². However, this does not apply to a ceiling which has been satisfactorily tested as part of a fire resisting ceiling system. A ceiling with a TP(a) flexible classification should not be installed in the ceiling of a *protected zone* or fire-fighting shaft.

Subject to clauses 2.5.6 and 2.5.7, the 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 of the lighting diffusers should be in accordance with the table and diagram below.

However, where the lighting diffusers forms an integral part of a fire resisting ceiling system which has been satisfactorily tested, the amount of thermoplastic material is unlimited.

Where light fittings with thermoplastic diffusers do not form an integral part of the ceiling, the amount of thermoplastic material is unlimited provided the lighting diffuser is designed to fall out of its mounting when softened by heat.

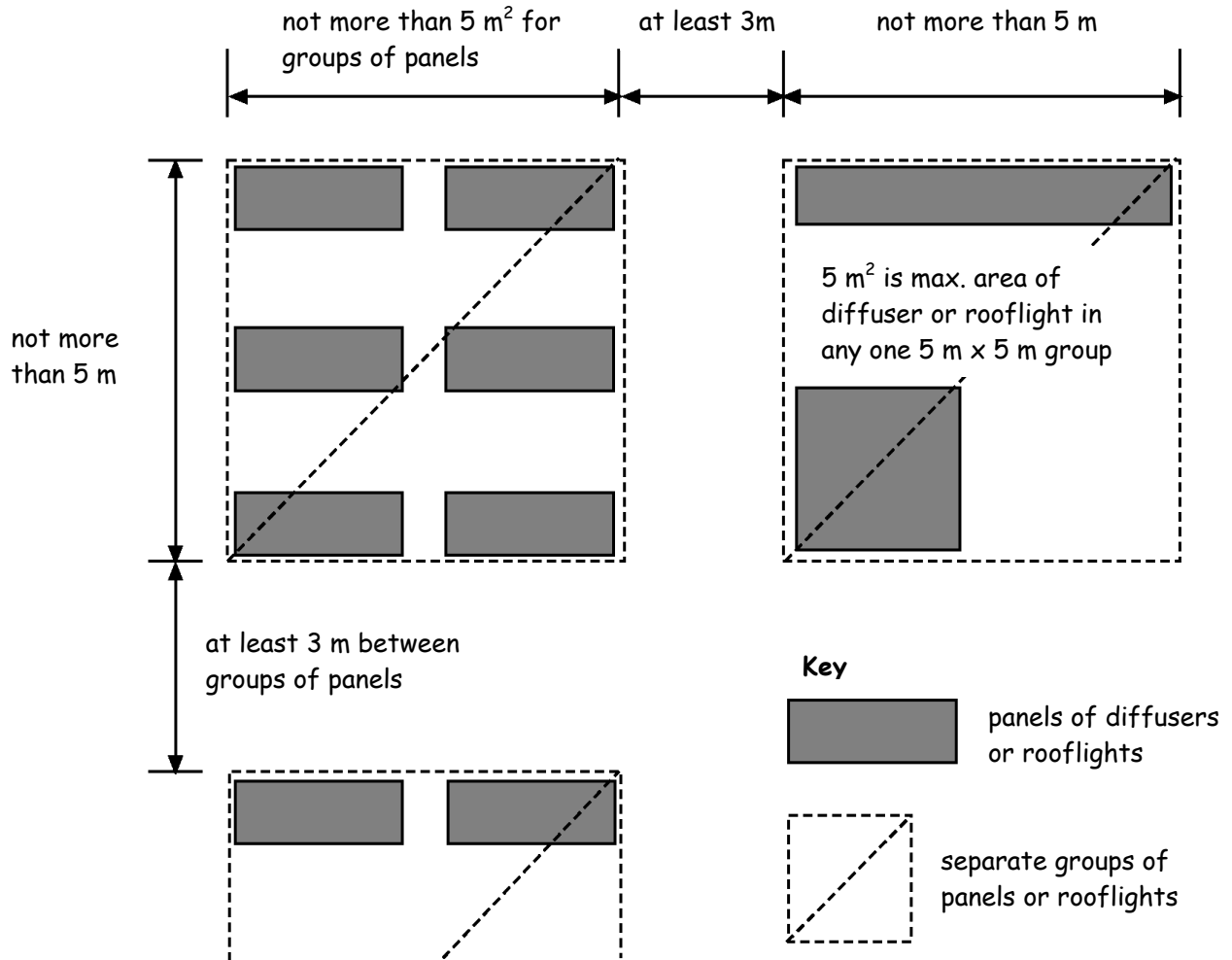
Thermoplastic rooflights and light fittings with diffusers

Classification of lower surface	<i>Protected zone or fire-fighting shaft</i>	<i>Unprotected zone</i>		<i>Room</i>	
	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:

- Smaller panels can be grouped together provided that the overall size of the group and the space between any others satisfies the dimensions shown in the diagram below.
- The minimum 3 m separation in the diagram below should be maintained between each 5 m² panel. In some cases therefore, it may not be possible to use the maximum percentage quoted.
- TP(a) flexible is not recommended in rooflights.

Layout restrictions on thermoplastic rooflights and light fittings with diffusers (D7.2b and 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 in a *residential building* should be fully filled with a core of *non-combustible* material.

A sandwich panel used for internal walls or linings in a *non-residential building* should be designed and installed in accordance with chapter 8 of 'Design, Construction, Specification and Fire Management of Insulated Envelopes for Temperature Controlled Environments', International Association of Cold Storage Contractors (European Division), 1999.

2.6 Spread to neighbouring buildings

- 2.6 Functional standard
- 2.6.0 Introduction
- 2.6.1 Fire resistance of external walls
- 2.6.2 Unprotected area
- 2.6.3 The enclosing rectangle method
- 2.6.4 External wall cladding
- 2.6.5 Detached buildings in the same occupation
- 2.6.6 Combustibility
- 2.6.7 Supporting structure

standard

2.6

mandatory

Every *building* must be designed and *constructed* in such a way that in the event of an outbreak of fire within the *building*, the spread of fire to neighbouring *buildings* is inhibited.

2.6.0 Introduction

In order to reduce the danger to the occupants of other *buildings*, one *building* should be isolated from another by either *construction* or distance. The distance between a *building* and its relevant *boundary* is dictated by the amount of heat that is likely to be generated in the event of fire. Generally, this will be influenced by how the *building* is used as defined in clause 2.1.1, *compartmented* (see guidance to standard 2.1), *separated* (see guidance to standard 2.2) and the extent of any 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*.

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)

External walls should have at least the fire resistance duration as shown in the table below, apart from the amount of unprotected area set out in clause 2.6.2. For guidance on automatic fire suppression systems, see clause 2.1.3.

The installation of an automatic fire suppression system greatly reduces the amount of radiant heat flux from a fire through an unprotected opening and this is recognised in the table to clause 2.6.1 and in the guidance to clause 2.6.2.

Minimum fire resistance duration of external walls (see Annex 2.D)

Use of <i>building</i> (see clause 2.1.1)	not more than 1 m of the <i>boundary</i>		more than one 1 m from the <i>boundary</i>	
	no fire suppression system	fire suppression system	no fire suppression system	fire suppression system
<i>Assembly building</i>	Medium	Medium [2c]	Medium [1, 2c]	None
<i>Entertainment building</i>	Medium	Medium [2b]	Medium [2b]	Medium [1]
Factory and <i>Storage building</i>	Medium	Medium	Medium [3]	Medium [1, 4]
<i>Residential building</i> (other than a <i>residential care building</i> or <i>hospital</i>)	Medium	Medium [2b]	Medium [1] [2b]	None
<i>Residential care building and hospital</i>	Medium	Medium	Medium	None
<i>Shop</i>	Medium	Medium [2a]	Medium [2a]	Medium [1]
<i>Office</i>	Medium	Medium [2d]	Medium [1, 2d]	None
<i>Open sided car park</i>	Short	Short	None	None

Notes:

- Short fire resistance duration is sufficient where the *building* is single-storey.
- Short fire resistance duration is sufficient where the *building* is a multi-storey *building* and the area of any *compartment* does not exceed: (a) 500 m² (b) 1000 m² (c) 1500 m² (d) 2000 m² (e) 3000 m² and (f) 4000 m².
- Short fire resistance duration is sufficient where the *building* is a factory (Class 2), as defined in clause 2.1.1, and is single-storey.
- No fire resistance duration is necessary where the *building* is a factory (Class 2) as defined in clause 2.1.1.

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 recommended in the table to clause 2.6.1.

An unprotected area does not include a fixed unopenable window where the frame and *glazing* has the appropriate fire resistance duration. Any wallhead fascia, soffit or barge board, or any cavity vents or solum vents may also be excluded from the unprotected area calculation.

Up to 500 mm from *boundary*

Where the *external wall* of a *building* is not more than 500 mm from the *boundary* there should be no unprotected area, other than any wallhead fascia, soffit or barge board, or any cavity vents or solum vents.

500 mm to 1 m from boundary

Where the *external wall* of a *building* is more than 500 mm but not more than 1 m from the *boundary*, the level of unprotected area is limited to:

- the *external wall* of a *protected zone*;
- an area of not more than 0.1 m², which is at least 1.5 m from any other unprotected area in the same wall;
- an area of not more than 1 m², which is at least 4 m from any other unprotected area in the same wall (the 1 m² unprotected area may consist of two or more smaller areas which when combined do not exceed an aggregate area of 1 m²).

More than 1 m from boundary

Where the *external wall* of a *building* is more than 1 m from the *boundary*, the minimum distance to the *boundary* may vary with the amount of unprotected area. This is derived from the use of the *building* and can be calculated by:

- the Enclosing Rectangle (Geometric) Method as set out in clause 2.6.3; or
- the Building Research Establishment Report ‘[External fire spread: building separation and boundary distances](#)’ (1991, BR 187); or
- if the *building* is a factory (Class 2 as defined in clause 2.1.1), a *residential building*, an *assembly building* or an *office* and is not more than 9 m in height and the length of any side facing the *boundary* is not more than 24 m, the unprotected area (in square metres) is six times the distance (in m) to the *boundary*. For example, if the unprotected area is 6 m², the distance to the *boundary* should be at least 1 m and if the unprotected area is 12 m², the distance should be at least 2 m and so on. If the distance to the *boundary* is 6 m or more the amount of unprotected area is unlimited.

The Simple Geometry Method

2.6.3 The Enclosing Rectangle Method

The enclosing rectangle method can be applied to a *building* or *compartment* more than 1 m from the *boundary* using the “Step by Step Guide” below. The minimum distance from the *boundary* may be arrived at by interpolation between the percentages shown in the tables.

Table A should be used for storage *buildings* as defined in clause 2.1.1, factories (Class 1) as defined in clause 2.1.1, *shops*, and *entertainment buildings*.

Table B should be used for *residential buildings*, *offices*, *assembly buildings*, and factories (Class 2) as defined in clause 2.1.1. Table B should also be used for *domestic buildings* which exceed the limitations described in clause 2.6.3 of the Technical Handbook for *domestic buildings*.

Where the *building* is a *shop*, *entertainment building*, factory (Class 1) as defined in clause 2.1.1 or a storage *building* as defined in clause 2.1.1, Table B may be used instead of Table A provided the *building*:

Automatic fire suppression system

- is located more than 1 m from the relevant *boundary*; and
- an automatic fire suppression system is installed (see clause 2.1.3) within the *building*.

Open sided car parks

There is no limitation on the amount of unprotected area for an *open sided car park* provided the *external wall* is more than 1 m from the *boundary*.

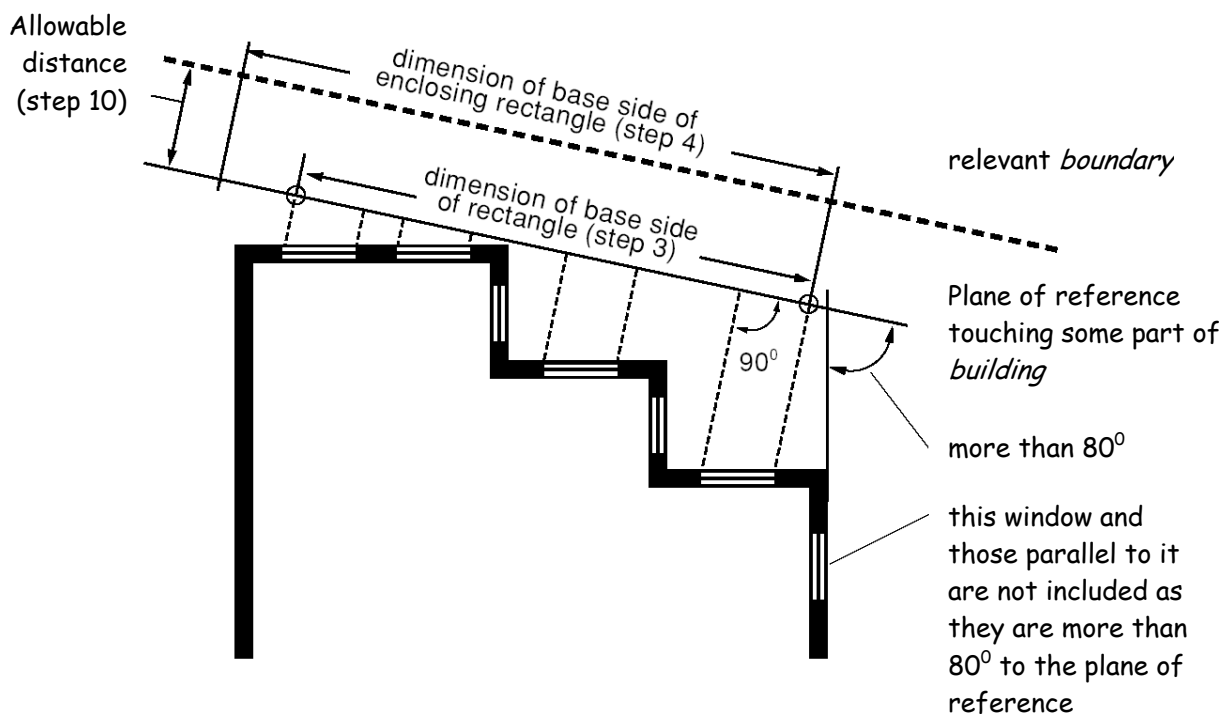
Step by step guide to enclosing rectangle method

Step 1

Establish a plane of reference which is the most favourable for the side of the *building* under consideration and which:

- a. touches all or part of the side;
- b. however far extended, does not pass within the *building*, but may pass through projections such as a balcony or coping; and
- c. does not cross the relevant *boundary*.

Normally it will be best for the plane of reference to be roughly parallel to the relevant *boundary*. Where the *boundary* distance has not been set, an assumed relationship with the relevant *boundary* should be made.



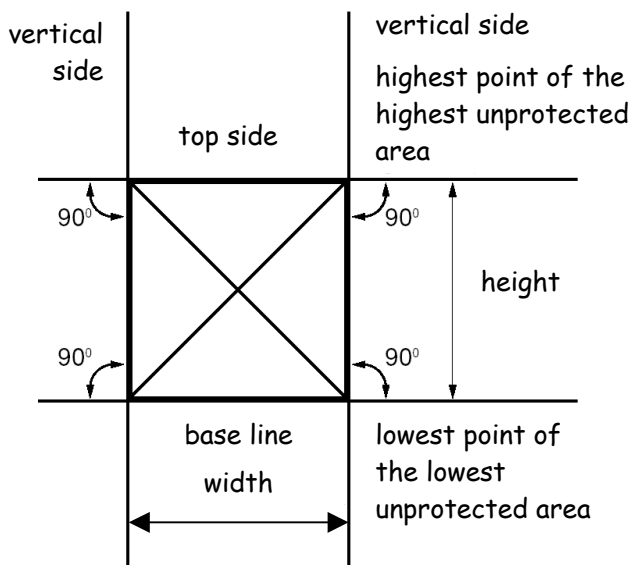
Step 2

On the plane of reference, and at right angles to it, project lines marking those proposed unprotected areas which are 80° or less to the plane of reference. Any external side of a *building* which makes an angle of more than 80° with the plane of reference can be ignored in the calculation of unprotected area.

Step 3

Construct a rectangle which encloses all the unprotected areas projected on to the plane of reference following the diagrams below. See also clause 2.6.3 for combustible cladding

diagram 2A shows the essentials in constructing the rectangle (shown by diagonal lines) enclosing the unprotected areas

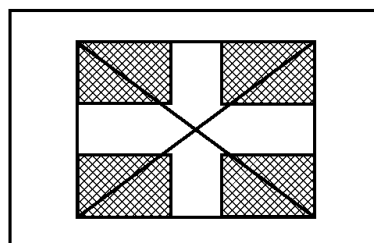


horizontal distance between outermost lines of unprotected areas as projected on to the plane of reference on plan

2A Setting rectangle

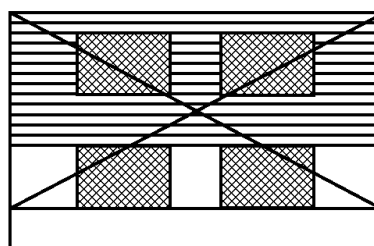
diagrams 2B-2D show how the wall construction determines the size of the rectangle.

in the diagrams the relevant boundary is assumed as parallel with the wall face and the plane of reference to coincide with the wall face. But this will not always be so



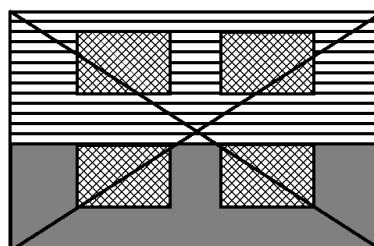
the whole of the solid wall area has the appropriate fire resistance duration

2B



the wall area behind the combustible cladding does not have the required fire resistance duration however the unclad wall area has the appropriate fire resistance duration

2C



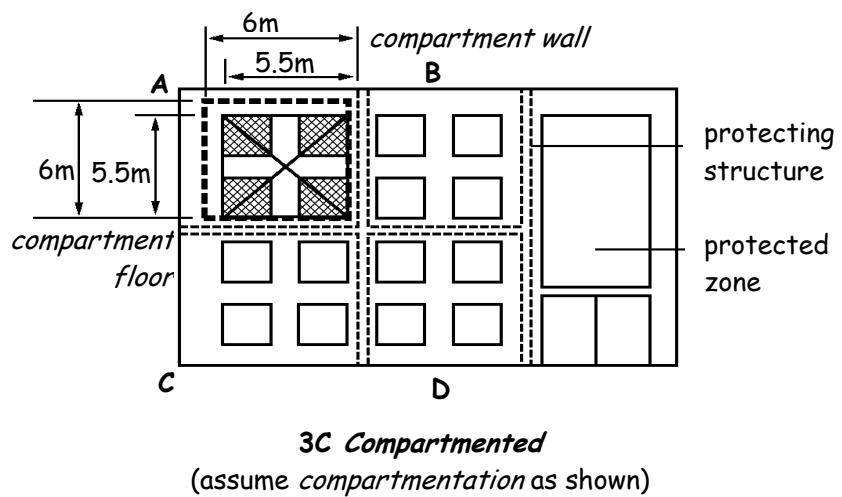
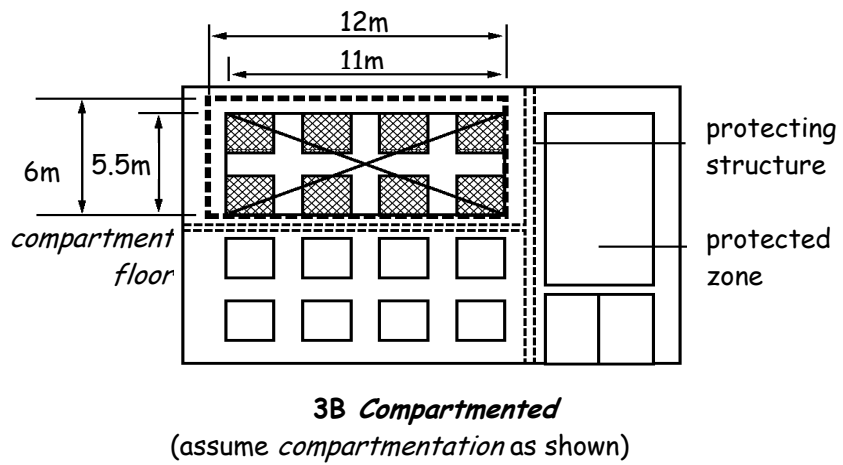
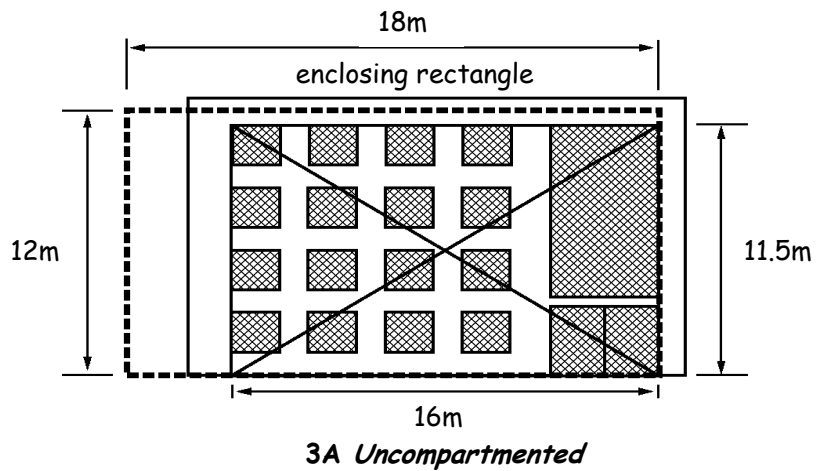
whole of the wall area behind and below the combustible cladding does not have the appropriate fire resistance duration

2D

For combustible cladding see 2.6.4

Step 4

From the relevant table according to the use of the *building* or *compartment*, select an enclosing rectangle which is equal to, or next greater in both height and width to, the rectangle *constructed* under step 3. *Compartmentation* of the *building* can reduce the size of the enclosing rectangle in accordance with the diagrams below. The tables provide for enclosing rectangles of 3, 6, 9, 12, or 15m high, with widths in steps from 3m to no limit.



Step 5

From the unprotected areas projected under step 2:

- a. calculate their total area; and
- b. express this total area as a percentage of the enclosing rectangle. This gives the unprotected percentage.

- Step 6 Proceed to steps 7 to 9 where the *boundary* distance has been set, or steps 10 to 12 where it has not.
- To find the maximum unprotected area for a given *boundary* position:
- Step 7 From the tables below find the unprotected percentage allowed for the distance from the relevant *boundary*. This distance relates to the plane of reference and not the side of the *building*, unless they coincide.
- Step 8 Where the proposed total unprotected area relative to the size of the enclosing rectangle exceeds the allowable unprotected percentage for that distance, the design should be modified until an allowable unprotected percentage is established.
- Step 9 Repeat the process for all sides of the *building* situated more than 1 m from any point on the relevant *boundary*.
- To find the nearest position of the *boundary* for a given *building*:
- Step 10 From the tables below, find the minimum allowable distance for the unprotected percentage. This distance relates to the plane of reference and not the side of the *building*, unless they coincide.
- Step 11 Repeat the process for all sides of the *building*.
- Step 12 Where these minimum distances are superimposed upon a plan of the *building*, a zone around the *building* is established upon which a *boundary* should not encroach.

Table A: storage buildings, factories (Class 1), shops and entertainment buildings

Height of enclosing rectangle (m)	Width of enclosing rectangle (m)	Minimum distance from relevant boundary (m) for unprotected percentage not more than -								
		20%	30%	40%	50%	60%	70%	80%	90%	100%
3	3	1.0	1.5	2.0	2.0	2.5	2.5	2.5	3.0	3.0
	6	1.5	2.0	2.5	3.0	3.0	3.5	3.5	4.0	4.0
	9	1.5	2.5	3.0	3.5	4.0	4.0	4.5	5.0	5.0
	12	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	5.5
	15	2.0	2.5	3.5	4.0	4.5	5.0	5.5	6.0	6.0
	18	2.0	2.5	3.5	4.0	5.0	5.0	6.0	6.5	6.5
	21	2.0	3.0	3.5	4.5	5.0	5.5	6.0	6.5	7.0
	24	2.0	3.0	3.5	4.5	5.0	5.5	6.0	7.0	7.5
	27	2.0	3.0	4.0	4.5	5.5	6.0	6.5	7.0	7.5
	30	2.0	3.0	4.0	4.5	5.5	6.0	6.5	7.5	8.0
	40	2.0	3.0	4.0	5.0	5.5	6.5	7.0	8.0	8.5
	50	2.0	3.0	4.0	5.0	6.0	6.5	7.5	8.0	9.0
	60	2.0	3.0	4.0	5.0	6.0	7.0	7.5	8.5	9.5
	80	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	9.5
	no limit	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
6	3	1.5	2.0	2.5	3.0	3.0	3.5	3.5	4.0	4.0
	6	2.0	3.0	3.5	4.0	4.5	5.0	5.5	5.5	6.0
	9	2.5	3.5	4.5	5.0	5.5	6.0	6.0	7.0	7.0
	12	3.0	4.0	5.0	5.5	6.5	7.0	7.5	8.0	8.5
	15	3.0	4.5	5.5	6.0	7.0	7.5	8.0	9.0	9.0
	18	3.5	4.5	5.5	6.5	7.5	8.0	9.0	9.5	10.0
	21	3.5	5.0	6.0	7.0	8.0	9.0	9.5	10.0	10.5
	24	3.5	5.0	6.0	7.0	8.5	9.5	10.0	10.5	11.0
	27	3.5	5.0	6.5	7.5	8.5	9.5	10.5	11.0	12.0
	30	3.5	5.0	6.5	8.0	9.0	10.0	11.0	12.0	12.5
	40	3.5	5.5	7.0	8.5	10.0	11.0	12.0	13.0	14.0
	50	3.5	5.5	7.5	9.0	10.5	11.5	13.0	14.0	15.0
	60	3.5	5.5	7.5	9.5	11.0	12.0	13.5	15.0	16.0
	80	3.5	6.0	7.5	9.5	11.5	13.0	14.5	16.0	17.5
	100	3.5	6.0	8.0	10.0	12.0	13.5	15.0	16.5	18.0
120	3.5	6.0	8.0	10.0	12.0	14.0	15.5	17.0	19.0	
no limit	3.5	6.0	8.0	10.0	12.0	14.0	16.0	18.0	19.0	

Note:

The minimum distance from the boundary may be arrived at by interpolation between the percentages shown.

Table A: storage buildings, factories (Class 1), shops and entertainment buildings

Height of enclosing rectangle (m)	Width of enclosing rectangle (m)	Minimum distance from relevant <i>boundary</i> (m) for unprotected percentage not more than -								
		20%	30%	40%	50%	60%	70%	80%	90%	100%
9	3	1.5	2.5	3.0	3.5	4.0	4.0	4.5	5.0	5.0
	6	2.5	3.5	4.5	5.0	5.5	6.0	6.5	7.0	7.0
	9	3.5	4.5	5.5	6.0	6.5	7.5	8.0	8.5	9.0
	12	3.5	5.0	6.0	7.0	7.5	8.5	9.0	9.5	10.5
	15	4.0	5.5	6.5	7.5	8.5	9.5	10.0	11.0	11.5
	18	4.5	6.0	7.0	8.5	9.5	10.0	11.0	12.0	12.5
	21	4.5	6.5	7.5	9.0	10.0	11.0	12.0	13.0	13.5
	24	5.0	6.5	8.0	9.5	11.0	12.0	13.0	13.5	14.5
	27	5.0	7.0	8.5	10.0	11.5	12.5	13.5	14.5	15.0
	30	5.0	7.0	9.0	10.5	12.0	13.0	14.0	15.0	16.0
	40	5.5	7.5	9.5	11.5	13.0	14.5	15.5	17.0	17.5
	50	5.5	8.0	10.0	12.5	14.0	15.5	17.0	18.5	19.5
	60	5.5	8.0	11.0	13.0	15.0	16.5	18.0	19.5	21.0
	80	5.5	8.5	11.5	13.5	16.0	17.5	19.5	21.5	23.0
	100	5.5	8.5	11.5	14.5	16.5	18.5	21.0	22.5	24.5
12	120	5.5	8.5	11.5	14.5	17.0	19.5	21.5	23.5	26.0
	no limit	5.5	8.5	11.5	15.0	17.5	20.0	22.5	24.5	27.0
12	3	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	5.5
	6	3.0	4.0	5.0	5.5	6.5	7.0	7.5	8.0	8.5
	9	3.5	5.0	6.0	7.0	7.5	8.5	9.0	9.5	10.5
	12	4.5	6.0	7.0	8.0	9.0	9.5	11.0	11.5	12.0
	15	5.0	6.5	8.0	9.0	10.0	11.0	12.0	13.0	13.5
	18	5.0	7.0	8.5	10.0	11.0	12.0	13.0	14.0	14.5
	21	5.5	7.5	9.0	10.5	12.0	13.0	14.0	15.0	16.0
	24	6.0	8.0	9.5	11.5	12.5	14.0	15.0	16.0	16.5
	27	6.0	8.0	10.5	12.0	13.5	14.5	16.0	17.0	17.5
	30	6.5	8.5	10.5	12.5	14.0	15.0	16.5	17.5	18.5
	40	6.5	9.5	12.0	14.0	15.5	17.5	18.5	20.0	21.0
	50	7.0	10.0	13.0	15.0	17.0	19.0	20.5	23.0	23.0
	60	7.0	10.5	13.5	16.0	18.0	20.0	21.5	23.5	25.0
	80	7.0	11.0	14.5	17.0	19.5	21.5	23.5	26.0	27.5
	100	7.5	11.5	15.0	18.0	21.0	23.0	25.5	28.0	30.0
12	120	7.5	11.5	15.0	18.5	22.0	24.0	27.0	29.5	31.5
	no limit	7.5	12.0	15.5	19.0	22.5	25.0	28.0	30.5	34.0

Note:

The minimum distance from the *boundary* may be arrived at by interpolation between the percentages shown.

Table A: storage buildings, factories (Class 1), shops and entertainment buildings

Height of enclosing rectangle (m)	Width of enclosing rectangle (m)	Minimum distance from relevant <i>boundary</i> (m) for unprotected percentage not more than -								
		20%	30%	40%	50%	60%	70%	80%	90%	100%
15	3	2.0	2.5	3.5	4.0	4.5	5.0	5.5	6.0	6.0
	6	3.0	4.5	5.5	6.0	7.0	7.5	8.0	9.0	9.0
	9	4.0	5.5	6.5	7.5	8.5	9.5	10.0	11.0	11.5
	12	5.0	6.5	8.0	9.0	10.0	11.0	12.0	13.0	13.5
	15	5.5	7.0	9.0	10.0	11.5	12.5	13.5	14.5	15.0
	18	6.0	8.0	9.5	11.0	12.5	13.5	14.5	15.5	16.5
	21	6.5	8.5	10.5	12.0	13.5	14.5	16.0	16.5	17.5
	24	6.5	9.0	11.0	13.0	14.5	15.5	17.0	18.0	19.0
	27	7.0	9.5	11.5	13.5	15.0	16.5	18.0	19.0	20.0
	30	7.5	10.0	12.0	14.0	16.0	17.0	18.5	20.0	21.0
	40	8.0	11.0	13.5	16.0	18.0	19.5	21.0	22.5	23.5
	50	8.5	12.0	15.0	17.5	19.5	21.5	23.0	25.0	26.0
	60	8.5	12.5	15.5	18.0	21.0	23.5	25.0	27.0	28.0
	80	9.0	13.5	17.0	20.0	23.0	25.5	28.0	30.0	31.5
	100	9.0	14.0	18.0	21.5	24.5	27.5	30.0	32.5	34.5
	120	9.0	14.0	18.5	22.5	25.5	28.5	31.5	34.5	37.0
	no limit	9.0	14.5	19.0	23.0	27.0	30.0	34.0	36.0	39.0

Note:

The minimum distance from the *boundary* may be arrived at by interpolation between the percentages shown.

Table B: residential buildings, offices, assembly buildings, and factories (Class 2)

Height of enclosing rectangle (m)	Width of enclosing rectangle (m)	Minimum distance from relevant <i>boundary</i> (m) for unprotected percentage not more than -									
		20%	30%	40%	50%	60%	70%	80%	90%	100%	
3	3	1.0	1.0	1.0	1.5	1.5	1.5	2.0	2.0	2.0	
	6	1.0	1.0	1.5	2.0	2.0	2.0	2.5	2.5	3.0	
	9	1.0	1.0	1.5	2.0	2.5	2.5	3.0	3.0	3.5	
	12	1.0	1.5	2.0	2.0	2.5	3.0	3.0	3.5	3.5	
	15	1.0	1.5	2.0	2.5	2.5	3.0	3.5	3.5	4.0	
	18	1.0	1.5	2.0	2.5	2.5	3.0	3.5	4.0	4.0	
	21	1.0	1.5	2.0	2.5	3.0	3.0	3.5	4.0	4.5	
	24	1.0	1.5	2.0	2.5	3.0	3.5	3.5	4.0	4.5	
	27	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.0	4.5	
	30	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.0	4.5	
	no limit	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.0	5.0	
	6	3	1.0	1.0	1.5	2.0	2.0	2.0	2.5	2.5	3.0
		6	1.0	1.5	2.0	2.5	3.0	3.0	3.5	4.0	4.0
		9	1.0	2.0	2.5	3.0	3.5	4.0	4.5	4.5	5.0
12		1.5	2.5	3.0	3.5	4.0	4.5	5.0	5.0	5.5	
15		1.5	2.5	3.0	4.0	4.5	5.0	5.5	5.5	6.0	
18		1.5	2.5	3.5	4.0	4.5	5.0	5.5	6.0	6.5	
21		1.5	2.5	3.5	4.0	5.0	5.5	6.0	6.5	7.0	
24		1.5	2.5	3.5	4.5	5.0	5.5	6.0	7.0	7.0	
27		1.5	2.5	3.5	4.5	5.0	6.0	6.5	7.0	7.5	
30		1.5	2.5	3.5	4.5	5.0	6.0	6.5	7.0	8.0	
40		1.5	2.5	3.5	4.5	5.5	6.5	7.0	8.0	8.5	
50		1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.0	9.0	
60		1.5	2.5	3.5	5.0	5.5	6.5	7.5	8.5	9.5	
80		1.5	2.5	3.5	5.0	6.0	7.0	7.5	8.5	9.5	
no limit	1.5	2.5	3.5	5.0	6.0	7.0	8.0	8.5	10.0		

Note:

The minimum distance from the *boundary* may be arrived at by interpolation between the percentages shown.

Table B: residential buildings, offices, assembly buildings, and factories (Class 2)

Height of enclosing rectangle (m)	Width of enclosing rectangle (m)	Minimum distance from relevant <i>boundary</i> (m) for unprotected percentage not more than -								
		20%	30%	40%	50%	60%	70%	80%	90%	100%
9	3	1.0	1.0	1.5	2.0	2.5	2.5	3.0	3.0	3.5
	6	1.0	2.0	2.5	3.0	3.5	4.0	4.5	4.5	5.0
	9	1.5	2.5	3.5	4.0	4.5	5.0	5.5	5.5	6.0
	12	1.5	3.0	3.5	4.5	5.0	5.5	6.0	6.5	7.0
	15	2.0	3.0	4.0	5.0	5.5	6.0	6.5	7.0	7.5
	18	2.0	3.5	4.5	5.0	6.0	6.5	7.0	8.0	8.5
	21	2.0	3.5	4.5	5.5	6.5	7.0	7.5	8.5	9.0
	24	2.0	3.5	5.0	5.5	6.5	7.5	8.0	9.0	9.5
	27	2.0	3.5	5.0	6.0	7.0	7.5	8.5	9.5	10.0
	30	2.0	3.5	5.0	6.0	7.0	8.0	9.0	9.5	10.5
	40	2.0	3.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5
	50	2.0	4.0	5.5	6.5	8.0	9.0	10.0	11.5	12.5
	60	2.0	4.0	5.5	7.0	8.0	9.5	11.0	11.5	13.0
	80	2.0	4.0	5.5	7.0	8.5	10.0	11.5	12.5	13.5
	100	2.0	4.0	5.5	7.0	8.5	10.0	11.5	12.5	14.5
	12	120	2.0	4.0	5.5	7.0	8.5	10.0	11.5	12.5
no limit		2.0	4.0	5.5	7.0	8.5	10.5	12.0	12.5	15.0
12	3	1.0	1.5	2.0	2.0	2.5	3.0	3.0	3.5	3.5
	6	1.5	2.5	3.0	3.5	4.0	4.5	5.0	5.0	5.5
	9	1.5	3.0	3.5	4.5	5.0	5.5	6.0	6.5	7.0
	12	1.5	3.5	4.5	5.0	6.0	6.5	7.0	7.5	8.0
	15	2.0	3.5	5.0	5.5	6.5	7.0	8.0	8.5	9.0
	18	2.5	4.0	5.0	6.0	7.0	7.5	8.5	9.0	10.0
	21	2.5	4.0	5.5	6.5	7.5	8.5	9.0	10.0	10.5
	24	2.5	4.5	6.0	7.0	8.0	8.5	9.5	10.5	11.5
	27	2.5	4.5	6.0	7.0	8.0	9.0	10.5	11.0	12.0
	30	2.5	4.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5
	40	2.5	5.0	6.5	8.0	9.5	10.5	12.0	13.0	14.0
	50	2.5	5.0	7.0	8.5	10.0	11.0	13.0	14.0	15.0
	60	2.5	5.0	7.0	9.0	10.5	12.0	13.5	14.5	16.0
	80	2.5	5.0	7.0	9.0	11.0	13.0	14.5	16.0	17.0
	100	2.5	5.0	7.5	9.5	11.5	13.5	15.0	16.5	18.0
	12	120	2.5	5.0	7.5	9.5	11.5	13.5	15.0	17.0
no limit		2.5	5.0	7.5	9.5	12.0	14.0	15.5	17.0	19.0

Note:

The minimum distance from the *boundary* may be arrived at by interpolation between the percentages shown.

Table B: residential buildings, offices, assembly buildings, and factories (Class 2).

Height of enclosing rectangle (m)	Width of enclosing rectangle (m)	Minimum distance from relevant <i>boundary</i> (m) for unprotected percentage not more than -								
		20%	30%	40%	50%	60%	70%	80%	90%	100%
15	3	1.0	1.5	2.0	2.5	2.5	3.0	3.5	3.5	4.0
	6	1.5	2.5	3.0	4.0	4.5	5.0	5.5	5.5	6.0
	9	2.0	3.0	4.0	5.0	5.5	6.0	6.5	7.0	7.5
12	12	2.0	3.5	5.0	5.5	6.5	7.0	8.0	8.5	9.0
	15	2.0	4.0	5.5	6.5	7.0	8.0	9.0	9.5	10.0
	18	2.5	4.5	6.0	7.0	8.0	8.5	9.5	10.5	11.0
	21	2.5	5.0	6.5	7.5	8.5	9.5	10.5	11.0	12.0
24	24	3.0	5.0	6.5	8.0	9.0	10.0	11.0	12.0	13.0
	27	3.0	5.5	7.0	8.5	9.5	10.5	11.5	12.5	13.5
	30	3.0	5.5	7.5	8.5	10.0	11.0	12.0	13.5	14.0
40	40	3.0	6.0	8.0	9.5	11.0	12.5	13.5	15.0	16.0
	50	3.5	6.0	8.5	10.0	12.0	13.5	15.0	16.5	17.5
	60	3.5	6.5	8.5	10.5	12.5	14.0	15.5	17.0	18.0
80	80	3.5	6.5	9.0	11.0	13.5	15.0	17.0	18.5	20.0
	100	3.5	6.5	9.0	11.5	14.0	16.0	18.0	19.5	21.5
120	120	3.5	6.5	9.0	11.5	14.0	16.5	18.5	20.5	22.5
	no limit	3.5	6.5	9.0	12.0	14.5	17.0	19.0	21.0	23.0

Note:

The minimum distance from the *boundary* may be arrived at by interpolation between the percentages shown.

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 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.

A 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 a *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.E), 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 Detached buildings in the same occupation (D8.3)

Notional *boundary*

There may be a risk of fire spread between *buildings* even when on land in the same occupation. A notional *boundary* therefore is used to determine the safe distance between *buildings* or *compartments* in this situation. In order to establish whether a notional *boundary* calculation is necessary, the size of the opposing *buildings* or *compartments* should be established first (see diagram below).

For example, in the diagram, where the combined area of *building* A plus *building* B exceeds the maximum allowable area of any *compartment* as set in the tables to clause 2.1.2, then a notional *boundary* calculation is necessary. The designer is free to set this notional *boundary* at any point between the 2 *buildings* under consideration and this distance will determine the amount of unprotected area. The *buildings* should be separated by a distance not less than the sum of the distances calculated in respect of each *building* relative to a notional *boundary* in accordance with clauses 2.6.1 and 2.6.2, as if the notional *boundary* were a *boundary* (see diagram below).

Opposing *compartments*

A notional *boundary* is also necessary in the case of a single *building* having opposing *compartments* externally.

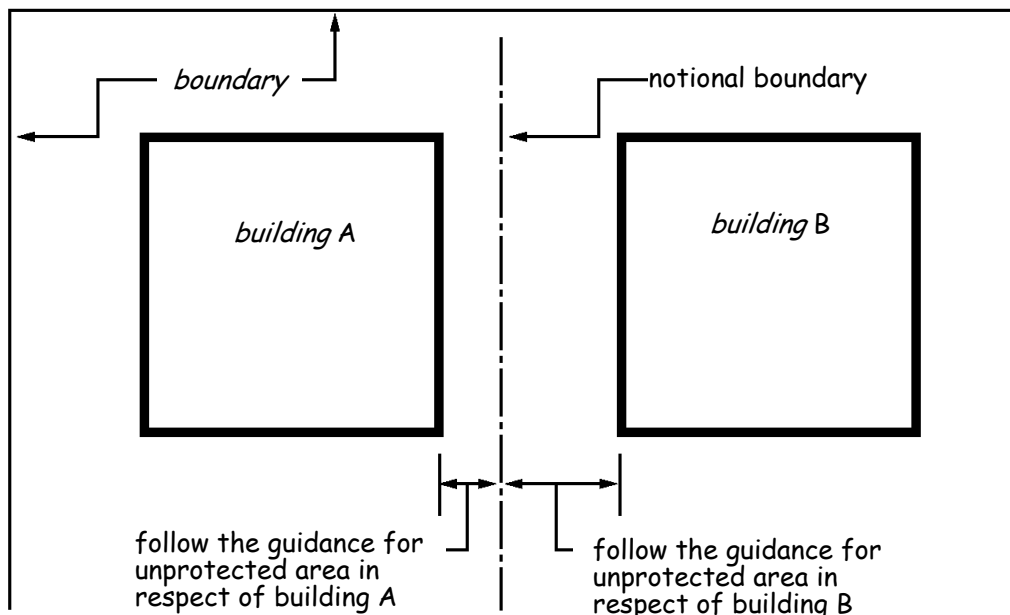
Roofs

The roofs of the *buildings* should be separated by a distance not less than the sum of the distances provided in relation to the notional *boundary* in accordance with the guidance to standard 2.8 in respect of each roof.

New and existing *buildings*

Where a notional *boundary* described above is to be established between 2 *buildings*, one of which is an existing *building*, for the purposes of this guidance, the existing *building* should be regarded as if it were a new *building*.

Notional boundaries



2.6.6 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.

Also, in *shared residential accommodation*, a structural frame of combustible material which is low, medium, high or very high risk 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 to 2.6.3 have been followed; and
- any *external wall* cladding (see clause 2.6.4) 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.

2.6.7 Supporting structure

(D2.2)

Where an *element of structure* provides support to an *external wall* (including *external wall* cladding) which has a fire resistance duration (as recommended in the guidance to clauses 2.6.1 and 2.6.2) the supporting *element of structure* should also have at least the same fire resistance duration.

2.7 Spread on external walls

- 2.7 Functional standard
- 2.7.0 Introduction
- 2.7.1 External wall cladding
- 2.7.2 Wall insulation material in high rise buildings

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 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*.

Entertainment and *assembly buildings* are given special consideration because of the higher risk of wilful fire-raising against the *external walls* (as in the Summerland fire, 1973).

Residential care buildings and *hospitals* also present a greater risk because the mobility, awareness and understanding of the occupants could be impaired and as a consequence, full evacuation immediately a fire is discovered may not be the most appropriate course of action.

High rise *buildings*

In high rise *buildings*, there is a need to take further precautions as external fire spread could involve a large number of floors thus presenting greater risk both to the occupants of the *building* and to fire fighters. The reaction to fire characteristics of cladding materials are therefore more demanding the higher the *building*.

The guidance for fire spread on *external walls* of *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 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 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.

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.E), the cladding should be *constructed* from materials with a reaction to fire in accordance with the following table.

Reaction to fire of external wall cladding more than 1 m from a boundary

Building height	Building	Location	Maximum level of risk
Not more than 18 m above the ground	<i>Entertainment and assembly buildings</i>	Not more than 10 m above the ground (or above a roof or any part of the <i>building</i> to which the general public have access)	Low risk
		10 – 18 m above the ground	Very high risk
	<i>Residential care buildings and hospitals</i>	Any	Low risk
	All other <i>buildings</i>	Any	Very high risk
more than 18 m above the ground	Any	Any	Low risk

A cavity formed by *external wall* cladding should be protected in accordance with the guidance to standard 2.4 and fire spread to neighbouring *buildings* accordance with the guidance to standard 2.6.

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* or low risk classifications (as described in clauses 2.7.1 and 2.7.2) and for materials exposed in a cavity, as described in clause 2.4.6.

2.7.2 Wall insulation material in high rise buildings (D10.2)

In a *building* with any *storey* at a height of more than 18 m above the ground, any insulation material situated or exposed in a cavity formed by *external wall* cladding should be *non-combustible*. However combustible insulation may be installed in a cavity formed between 2 leaves of masonry or concrete at least 75 mm thick, and which has *cavity barriers* around all openings in the wall and at the top of the wall head.

2.8 Spread from neighbouring buildings

- 2.8 Functional standard
- 2.8.0 Introduction
- 2.8.1 Roofs
- 2.8.2 Low vulnerability classification
- 2.8.3 Medium vulnerability classification
- 2.8.4 High vulnerability classification

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 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 is 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

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- 2.9.32 Junctions

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 *building* 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 *building* before being affected by fire or smoke. In certain circumstances, for example, where the travel distance is excessive, a second means of escape should be provided. This will allow the occupants to turn away from the fire and make their escape in the other direction. There may be up to four stages in the process of escape:

- escape from the *room* of fire origin or escape from the fire where only one direction is possible;
- escape from the *compartment* of origin or until the safety of a fire resisting wall is reached;
- escape from the floor of origin to *protected zones* and *escape stairs*; and
- escape from the *building* to a *place of safety* at ground level.

Annexes

Due to the special fire precautions within *residential care buildings*, *hospitals* and enclosed shopping centres, additional guidance is grouped in the Annexes. The intention is to help designers and verifiers find the information they require quickly when designing or vetting such *buildings*. However, it is important to remember that the guidance in the annexes is in addition and supplementary to the guidance to standard 2.1 to 2.15. For additional guidance on:

- *residential care buildings*, see Annex 2.A;
- *hospitals*, see Annex 2.B;
- enclosed shopping centres, see Annex 2.C.

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).

2.9.1 Number of exits (E4.1, E4.2, E4.3)

The number and distribution of fire *exits* and *escape routes* throughout a *building* should provide all *building* users with the opportunity to escape safely from the *building* in the event of an outbreak of fire.

The number of *room exits*, *storey exits* and *escape routes* from *room exits* to *storey exits* relates to:

- the use and occupancy profile within the *building*;
- the occupancy capacity;
- the height of a *storey* above the ground or the depth below ground; and
- the travel distance involved.

In *hospitals*, the number of *storey exits* increase in proportion to the number of patient beds (see Annex 2.B).

Room exits

The minimum number of *exits* from a *room* (which is not a whole *storey*) is derived from the occupancy capacity of the *room* as per the table below. For the purposes of this guidance, reference to a *room* shall include reference to a *gallery*, *catwalk* or *openwork floor*.

Minimum number of room exits

Occupancy capacity	Minimum number of room exits
Not more than 60	1
61-600	2
More than 600	3

Storey exits

The minimum number of *storey exits* is derived from the occupancy capacity of the *storey* as per the table below. *Escape stair* widths are calculated on the basis of the total number of available *storey exits* (see clause 2.9.10). When calculating the occupancy capacity of a *storey*, there is no need to include adjoining parts of the *building* where the adjoining part does not communicate with the part under consideration.

Minimum number of storey exits

Occupancy capacity	Minimum number of storey exits
Not more than 60	1 [1, 2, 3]
61-600	2
More than 600	3

Notes:

1. At least 2 *storey exits* should be provided from any *storey* at a height of more than 7.5 m.
2. At least 2 *storey exits* should be provided from any *storey* in a *residential care building* or *hospital*.
3. At least 2 *storey exits* should be provided from a *basement storey* at a depth of more than 4.5 m or in the case of a *basement storey* at a depth of not more than 4.5 m where the *storey* is intended to be used by members of the general public (other than for access to *sanitary accommodation*).

Room exits to storey exits

Where a *room* is located on a *storey* requiring 2 or more *storey exits* the *escape routes* from the *room exits* to the *storey exits* should be designed as follows:

- a. where the occupancy capacity of a *room* is not more than 100, the *room*

- exits* may give access to the same space provided the rules for alternative directions of escape in clause 2.9.5 have been followed;
- b. where the occupancy capacity of a *room* is more than 100, the *room exits* may also give access to the same space provided:
 - the rules for alternative directions of escape in clause 2.9.5 have been followed; and
 - both *escape routes* are separated in the adjoining space by *construction* including a *self-closing fire door*, providing a short fire resistance duration;
 - c. where only 1 *exit* is necessary from a *room*, then this should also lead to 2 independent *storey exits*. However, this does not apply to:
 - any *room* inside a *protected zone* enclosing an *escape stair* (see clause 2.9.23); or
 - to any *room* on a *storey* at a height of not more than 7.5 m where the *escape route* provides access to a place of safety as described in clause 2.9.6 and the travel distance does not exceed that specified in the table to clause 2.9.3 for one direction of travel;
 - d. it is possible to design a *building* with part of an *upper storey* at a height of not more than 7.5 m to have only one *escape route* where the remainder of the *storey* has two *escape routes*. In cases, where escape is by way of a single *escape stair*, access to the stair should be by way of a *protected lobby* (see clause 2.9.21).

2.9.2 Occupancy capacity

The occupancy capacity of a *room* or space without fixed seating is obtained by dividing the area in square metres by the relevant occupancy load factor (see table below). The occupancy capacity of a *building* or *storey* which is divided into *rooms* or spaces is in the case of:

- a *residential building* which is not open to the general public (e.g. a restricted hotel) and which contains both day *rooms* and sleeping *rooms*, the sum of the occupancy capacity of either the day *rooms* or the sleeping *rooms* whichever is the greater; or
- any other *building*, the sum of the occupancy capacities of the *rooms*.

Where a *room* or space is likely to be put to more than one use, the greater or greatest relevant occupancy capacity should be used.

In the case of a fractional number, the occupancy capacity should be taken as the next lowest whole number.

Where a *room* or space contains fixed seating, the minimum occupancy capacity should be based on the number of available seats and in the case of an *entertainment building* or *assembly building*, should include the number of spaces available for wheelchair users.

Where the occupancy capacity cannot be established using the occupancy load factors listed in the table below, a written statement of the occupancy numbers should be submitted to the verifier who may wish to confirm the figures.

Occupancy capacity in rooms and spaces without fixed seating

Description of <i>room</i> or space	Occupancy load factor
Standing spectators' area	0.3
Amusement arcade, assembly hall (including a general-purpose place of assembly), bar (public area), bingo hall	0.5
Concourse, dance floor, queuing area	0.7
Committee <i>room</i> , common <i>room</i> , conference <i>room</i> , dining <i>room</i> , licensed betting <i>office</i> (public area), lounge (other than a lounge bar), meeting <i>room</i> , reading <i>room</i> , restaurant, staff <i>room</i> , waiting <i>room</i>	1.0
Exhibition hall	1.5
<i>Shop</i> sales area (2a)	2.0
Art gallery, dormitory, factory production area, museum, workshop	5.0
<i>Office</i>	6.0
<i>Kitchen</i> , library, <i>shop</i> sales area (2b)	7.0
Bedroom or study bedroom	8.0
Bed-sitting <i>room</i> , billiards <i>room</i>	10.0
Car park, storage and warehouse accommodation	30.0

Notes:

1. The occupancy capacity in enclosed shopping centres should be calculated in accordance with clause 2.C.9 of Annex 2.C.
2. *Shop* sales areas are classified as follows:
 - (a) *shop* sales areas other than those listed in sub-clause 2(b) including supermarkets and department stores (all sales areas), *shops* for personal services such as hairdressing and *shops* for the delivery or uplift of goods for cleaning, repair or other treatment or for members of the general public themselves carrying out such cleaning, repair or other treatment.
 - (b) *shop* sales areas in *shops* trading predominately in furniture, floor coverings, cycles, perambulators, large domestic appliances or other bulky goods or trading on a wholesale self-selection basis.
3. The descriptions; arcade, hall, gallery and *room* used in the table do not indicate a particular design or configuration of *building*.
4. For additional information on enclosed shopping centres, see Annex 2.C.

2.9.3 Travel distance (E5.1, E5.2, E5.3, E5.4, E5.5, E5.6)

The maximum travel distance from any point on a *storey* is related to the occupancy profile of the *building* users. The available directions of travel given in the following table and the recommendations on travel distance reflect this philosophy.

See Annexes for additional guidance for *residential care buildings*, *hospitals* and enclosed shopping centres.

Maximum travel distance related to available directions of travel

Occupancy profile	Building use [1] (see clause 2.1.1)	Maximum travel distance (m)	
		One direction of travel	More than one direction of travel
Very slow evacuation	<i>Residential care buildings</i> (e.g. nursing homes and residential schools for children etc). <i>Buildings</i> primarily for <i>disabled people</i> , or people with learning difficulties. Swimming pools in air supported structures.	9 [2]	18 [2]
Slow evacuation	<i>Residential buildings</i> (other than <i>residential care buildings</i> and <i>hospitals</i>) (e.g. hotels, hostels etc), <i>entertainment buildings</i> , <i>assembly buildings</i> , <i>shops</i> , <i>room</i> or auditorium with provision for fixed seating.	15	32
Medium evacuation	<i>Offices</i> , <i>storage buildings</i> [3], <i>open sided car parks</i> and factories.	18 [4]	45
Other	From a roof top plant <i>room</i> in the open air.	60	100
	Within plant <i>rooms</i> or within roof top plant <i>rooms</i> .	18	45
	Within a <i>place of special fire risk</i> .	18	18
	Within a <i>protected zone</i> to a <i>place of safety</i> .	100	unlimited

Notes:

1. For *hospitals*, see Annex 2.B
2. In *buildings* with a very slow evacuation which also contain a *room* or auditorium with provision for fixed seating, the more demanding travel distances should be applied
3. In a storage *building* (Class 1) as defined in clause 2.1.1, other than a bonded warehouse containing spirituous liquors, the distances are as for slow evacuation
4. In a silage or grain store on a farm where the material is handled primarily by mechanical plant, the distance is 30 m

2.9.4 Method of measuring travel distance

Travel distance is the distance measured along the actual route of escape from any point within a *storey*:

- to the nearest *protected door* giving direct access to an *escape stair* or a *place of safety* (however, in the case of a *building* or part of a *building* where there are at least two available directions of travel, the travel distance may be measured to any *protected door*); or
- to a door in a *sub-compartment wall* as described in Annex 2.A and Annex 2.B

Where the travel distance is measured to a *protected door* in a *compartment wall*, there should be no fire shutter in the *compartment wall* and the adjoining *compartment* should have at least 1 other *escape route* which is not through a further *compartment*. However, see Annex 2.A for additional guidance on *residential care buildings* and Annex 2.B for *hospitals*.

Where the travel distance is measured to a *protected door* in a *compartment wall* in a *building*, or part of a *building*, either:

- the area of the adjoining *compartment* is at least the sum, in m², of the occupancy capacities of both *compartments* multiplied by 0.3; or
- the *escape route* width available from the adjoining *compartment* is sufficient for the sum of the occupancy capacities of both *compartments*.

Obstructions

Where a floor is divided by fixed seating or other fixed obstructions, the travel distance should be measured by way of the shortest route along open seatways, gangways or circulation areas.

Escape stairs not in *protected zones*

Where a measurement of travel distance includes an internal *escape stair* not in a *protected zone* (see clause 2.9.22), the travel distance should be measured along the pitch line from the centre of the nosing of the topmost tread to the lower landing, including the length of any intermediate landings.

2.9.5 Alternative directions of escape (E5.7)

Where more than one *exit* is provided, the directions of travel from any point within the *storey* or from any point within the *room* should:

- diverge at an angle of at least 45°; or
- be combined for a distance not more than that allowed for one direction of travel and then diverge to two *exits* at an angle of at least 45° plus 2½° for every metre travelled in one direction (see table to clause 2.9.3).

To avoid 2 *room exits* becoming impassable due to fire or smoke in the early stages of fire growth, the distance between the *exits* from the *room* should be more than twice the distance travelled in one direction.

2.9.6 Destination of escape routes (E5.9, E6.9)

An *escape route* should give access to a *place of safety* or to another *compartment* (see clause 2.9.4):

- a. directly; or
- b. by way of a *protected zone* or *unprotected zone*; or
- c. by way of an *unprotected zone* to a *protected zone*; or
- d. by way of a *flat roof* or *access deck* (see clause 2.9.17); or
- e. by way of an *exit* to an external *escape stair* (see clause 2.9.24); or
- f. in the case of escape from an *inner room* not intended to be used as sleeping accommodation, by way of one other *room*, other than a *place of special fire risk*; the *escape route* from that other *room* should be in accordance with the guidance in a, b, c, d or e above; or
- g. in *residential care buildings*, or those parts of a *hospital* that have patient access, in accordance with the guidance in Annex 2.A and Annex 2.B.

Every *escape stair* should give access directly to:

- a *place of safety*; or
- an *escape route* across a *flat roof* or access deck (see clause 2.9.17); or
- a *hospital street* (see Annex 2.B); or
- a mall in an enclosed shopping centre (see Annex 2.C).

2.9.7 Obstacles (E5.11)

An *escape route* should not be by way of:

- a lift; or
- an escalator; or
- a turnstile, other than a suitably designed and installed turnstile unit with an emergency break out facility enabling the entire unit to open in the direction of escape; or
- a fire shutter or any other shutter; other than one which is installed for security purposes across a *shop* front and which does not close automatically in the event of fire; or
- a manual sliding door, other than one to which the general public does not have access.

Fixed ladders

A fixed ladder can only be used if it provides access to a plant *room* (not being a *place of special fire risk*) which is normally unoccupied other than for maintenance purposes. The fixed ladder should follow the guidance in BS 5395: Part 3: 1985.

Revolving and Automatic doors

Revolving doors and automatic doors can obstruct the passage of persons escaping. Accordingly they should not be placed across *escape routes* unless they are designed in accordance with BS 7036: 1996 and are either:

- a. arranged to fail safely to outward opening from any position of opening or;
- b. provided with a monitored fail-safe system for opening the door from any position in the event of mains supply failure and also in the event of failure of the opening sensing device; and
- c. opens automatically from any position in the event of actuation of any fire alarm in the fire alarm zone within which the door is situated; and
- d. permits easy manual opening from any position.

2.9.8 Headroom (E5.12)

An *escape route* and circulation area 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 Escape route widths (E5.13, 14, 15, 16, 17, E5.21, E5.22)

Individual widths

The unobstructed width of each individual *escape route* from a *room* or *storey* should be at least 1200 mm. However:

- where the *room* or *storey* is inaccessible to wheelchair users the width may be reduced to not less than 1100 mm; and
- where the occupancy capacity of the *room* or *storey* is not more than 100 and it is inaccessible to wheelchair users the width may be reduced to not less than 1000 mm.

Aggregate widths

The aggregate unobstructed width in mm of all *escape routes* from a *room*, or *storey*, should be at least 5.3 x the occupancy capacity of the *room* or *storey*. This does not apply in an enclosed shopping centre which follows the guidance in Annex 2.C.

This guidance on the width of *exits* assumes a unit width of 530 mm per person and a rate of discharge of 40 persons per minute. Clearly this unit width and discharge rate are not realistic values in all *buildings*. For example, in a *hospital* with bed patients where staff will move the bed patients into a safe area within the *building*. Additional guidance on *hospitals* is in Annex 2.B.

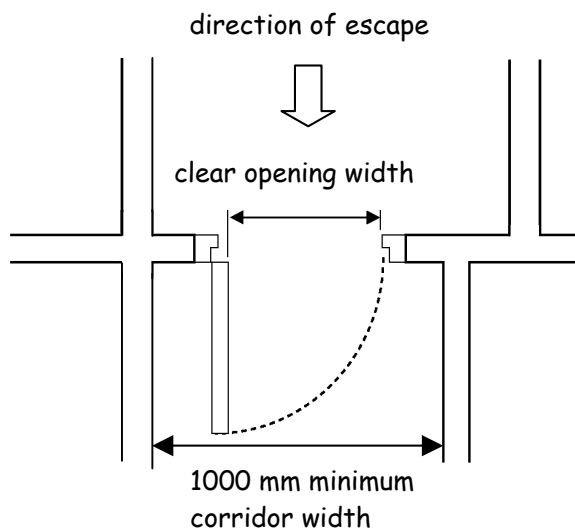
Doorway widths

Doorways can reduce the width of *escape routes* by 150 mm. This nominal reduction allows for the *construction* of door frames, however:

- where the number of people using the *escape route* is not more than 225, the clear opening width of the doorway should be at least 850 mm; and
- where the number of people using the *escape route* is not more than 100, the clear opening width of the doorway should be at least 750 mm.

The clear opening width at doorways is measured in accordance with the diagram below. There is further guidance on construction of doors in section 4, Safety that may be relevant.

Corridor inaccessible to wheelchair users



Constancy of width

An *escape route* should not narrow in the direction of escape. However an *escape route* may pass through a wider circulation area leading to a narrower circulation area provided the latter is of a width at least that recommended for the *escape route*. Width of escape stairs is covered in clauses 2.9.10 and 2.9.11.

Storage areas

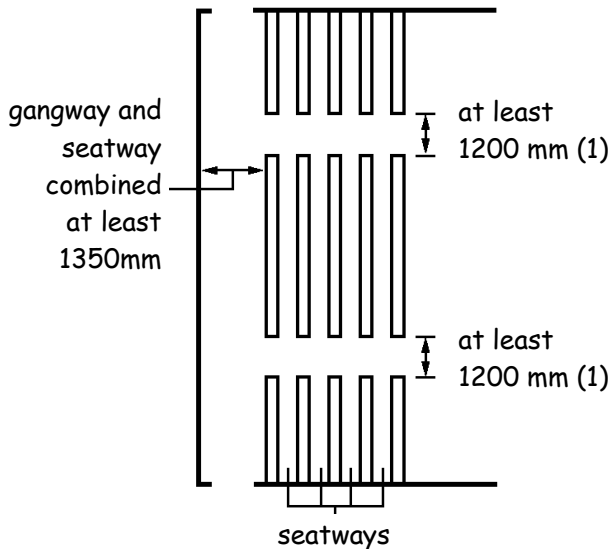
In the storage area of a *building* the width of gangways between fixed obstructions (including fixed racking or shelving and high-bay storage) should be not less than 530 mm. In a store for the bulk storage of spirituous liquor, gangways may be reduced to not less than 400 mm.

Fixed seating and other fixed obstructions

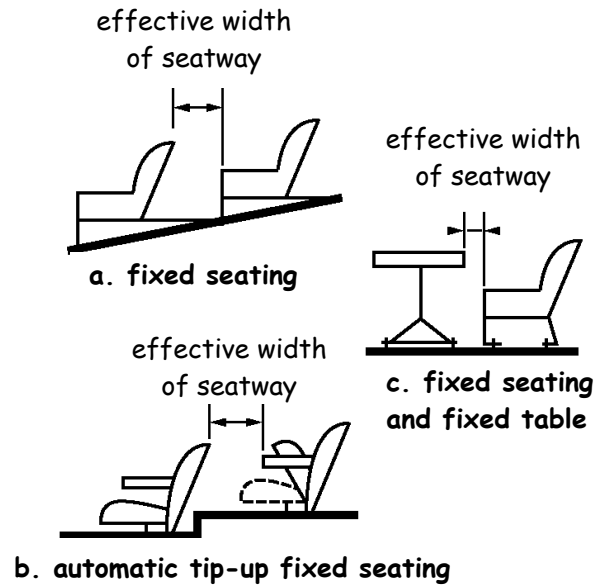
In a *building*, or part of a *building*, with fixed seating or fixed seating and fixed tables or other floor fixtures, there should be access to an *exit* by way of a gangway or a seatway, or a seatway directly to an *exit*; or a circulation area in accordance with the table and diagram below, and:

- in the case of a *room* in an auditorium that has more than 1 *exit*, at least 1 *exit* should be provided not less than two-thirds of the distance from any stage, screen or performing area to the back of the *room*; and
- a gangway or *exit* door should be provided at each end of a row of more than 12 fixed seats; and
- in the case of *shops* where the *room*, or part of the *room*, has an occupancy capacity of more than 100, the minimum width of a circulation

area should follow the guidance in this clause as if the circulation area were an *escape route*.



plan of *room* with provision for fixed seating



method of measuring seatway widths

Minimum width of gangways & seatways in a <i>room</i> with fixed seating			
Situation	Number of seats in row		Minimum width or effective width (mm)
	Gangway one side	Gangway on both sides	
Gangway	Not applicable	Not applicable	1200 [1]
Gangway and seatway combined	Not applicable	Not applicable	1350
Seatway	2	2-4	Not applicable
	3-7	5-14	300
	8	15, 16	325
	9	17, 18	350
	10	19, 20	375
	11	21, 22	400
	12	23, 24	425
	-	25, 26	450
	-	27, 28	475
	-	More than 28 (limited by travel distance)	500

Note:

1. May be reduced to 900 mm where the occupancy capacity of the *room* is not more than 60.

2.9.10 Escape stair widths (E6.1, E6.2, E6.3, E6.4, E6.5)

Individual widths

The effective width of an *escape stair* should be at least the width of any *escape route* giving access to it. However where the number of people using the *escape route* is not more than:

- 225, it may be reduced to not less than 1100 mm; and
- 100, it may be reduced to not less than 1000 mm.

The effective width of an *escape stair* is measured between handrails and clear of obstructions.

Aggregate width

Where the *escape routes* from a *storey* consist solely of *escape stairs*, and the *storey* has 2 or more *escape stairs*, the effective width of every *escape stair* in mm from that *storey* should be at least 5.3 times the appropriate capacity divided by the number of such stairs, less one.

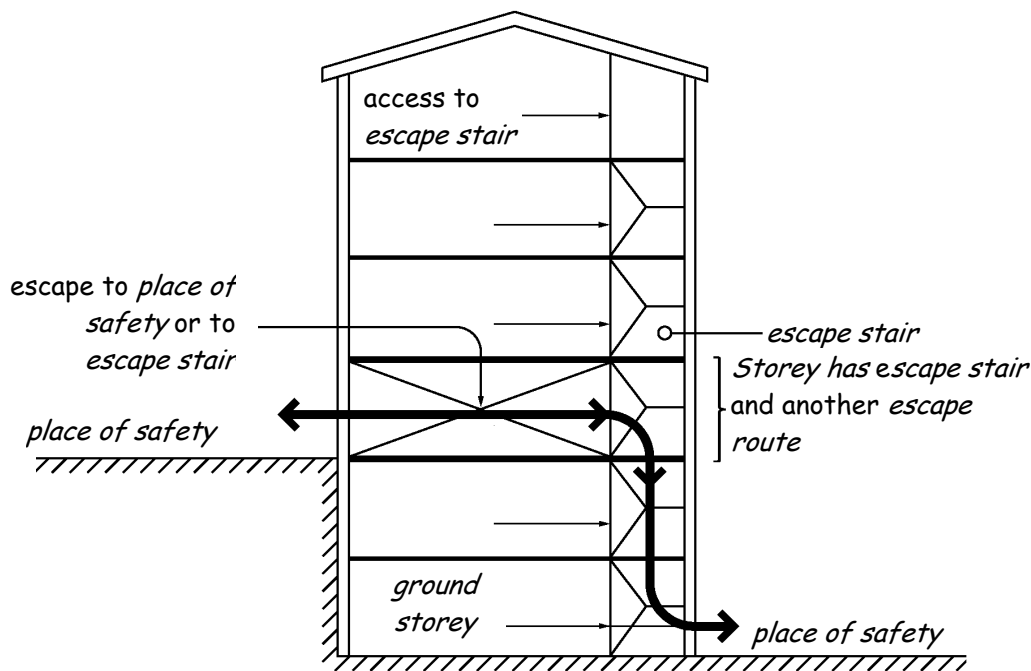
Where there is a *protected lobby* between each *escape stair* in a *protected zone* and any part of the *building* at any *storey* from which there is access to the *escape stair*, there is no need to deduct one *escape stair* from the calculation. However, where the *escape stair* contains an escalator or any of the *rooms* listed in clause 2.9.23 which have an openable window (see note 5 to the table in Annex 2.D), the *escape stair* should be discounted. A *protected lobby* is not necessary on the topmost *storey* unless recommended in the table to clause 2.14.1.

Constancy of width

An *escape stair* should not narrow in the direction of escape.

Fixed ladders

A fixed ladder may be used if it provides access to a *plant room* (not being a *place of special fire risk*) which is normally unoccupied other than for maintenance purposes. See section 4: Safety for guidance on fixed ladders.



Combined *escape routes*

Where *escape routes* from a *storey* consist of a combination of *escape stairs* and other *escape routes* (see diagram above) the effective width of any *escape stair* from that *storey* should be designed to take into account that proportion of the number of occupants on that *storey* who may escape by way of the other *escape routes*.

Where the *escape route* from an *escape stair* is also the *escape route* from the ground and/or *basement storey*, the width of that *escape route* should be increased to take account of that proportion of the occupancy capacity from the ground and/or *basement storeys*.

2.9.11 Appropriate capacity

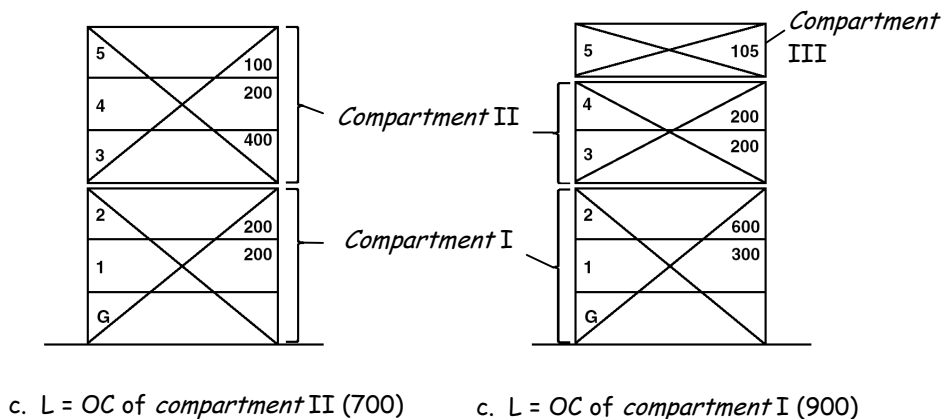
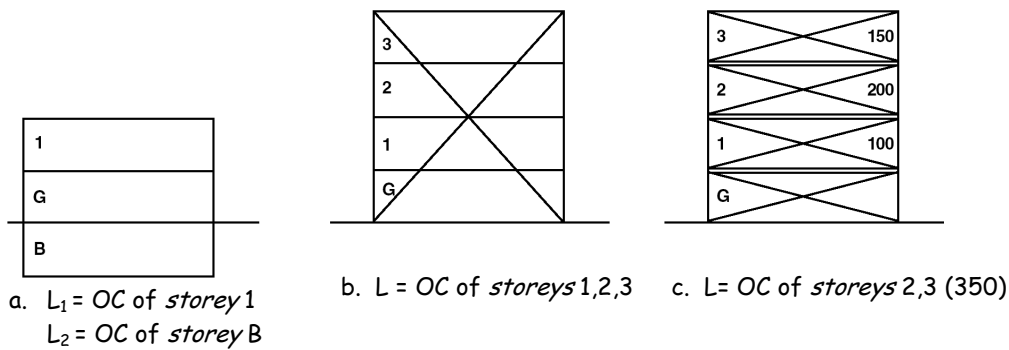
The appropriate capacity in relation to an *escape stair* at any *storey* above or below the *place of safety* is calculated by one of the following methods and in accordance with the diagrams below:

- a. the occupancy capacity of the part of the *storey* or *room* served by the *escape stair*, provided the *escape stair* does not also serve the next *storey* or *room* above or, in the case of a *basement storey*, the next *storey* below (see diagram a below: no *compartmentation*);
- b. where the *escape stair* serves 2 or more *storeys* including any *rooms*, or part of a *building*, which is not divided by *compartment floors*, the occupancy capacity of the part of each *storey*, including any *room*, served at, and above or below as the case may be, the *escape stair*, less 20% (20% represents standing capacity within the *protected zone* containing the *escape stair*). At each *storey* level the appropriate capacities should be accumulated in respect of those *storeys* which at that level have been served by the *escape stair*. The total appropriate capacity for all the *storeys* served by the *escape stair* should be taken into account at the *storey* level where the *escape route* leads to a *place of safety* (see diagram b below: no *compartmentation*);
- c. In a *building*, or part of a *building*, which is divided by one or more *compartment floors*, the total occupancy capacity, less 20%, of:
 - each of the 2 adjacent *upper storeys*, one or both of which may be a *room*, served by the *escape stair*, or in the case of an *escape stair* serving a *basement storey*, the 2 adjacent *basement storeys* served by that *escape stair*, having in either case the greatest combined occupancy capacity; or
 - the *compartment* either above or below ground level served by the *escape stair* having the greatest occupancy capacity, discounting the occupancy capacity of any *storey* within the *compartment* which is not served by the *escape stair*.

The greatest appropriate capacity should be used in respect of c. above. (see diagram c below: *building compartmented*);

In the case of c. above, where a *building* or part of a *building* is designed on the basis of vertically phased evacuation, consideration should be given to the installation of an automatic fire detection and voice alarm system as recommended in BS 5839: Part 1: 2002 to Category L3 and BS 5839: Part 8: 1998.

Where the *escape routes* from a *storey* consist of a combination of *escape stairs* and other *escape routes*, the appropriate capacity of the *storey* is that proportion of the occupancy capacity of the *storey* which the aggregate width of *escape routes* discharging to the stairs bears to the aggregate width of all *escape routes* from the *storey*.

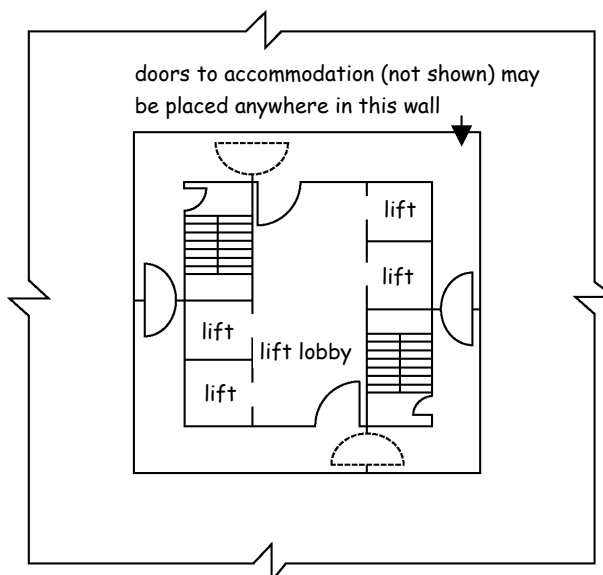


2.9.12 Independence of escape stairs (E4.4) (E6.10)

Where 2 *protected zones* enclosing *escape stairs* share a common wall, any access between them should be by way of a *protected lobby* (see guidance in clause 2.9.21). However, where a *room* or *storey* needs two or more *escape stairs* (see clause 2.9.1), it should be possible to reach 1 *escape stair* without passing through the other.

2.9.13 Escape routes in a central core (E6.11)

To reduce risk of smoke spread to more than one *escape stair*, corridor or lobby a *building* with more than 1 *escape route* contained in a central core should be planned so that the *exits* from the *storey* are remote from one another, and so that no 2 *exits* are approached from the same lift hall, common lobby or undivided corridor or linked by any of these other than through *fire doors*. (see diagram below)



Note: the lift lobby may also serve washrooms, services etc

2.9.14 Direction of door openings (E5.18)

A side-hung door across an *escape route* may open against the direction of escape where the occupancy capacity in the *building*, or part of the *building* is sufficiently low. In the case of a factory or storage *building* where the occupancy capacity is 10 or more, and in any other *building* where the occupancy capacity is 60 or more, the door should open the direction of travel. However, if the door is an *emergency door* or a door serving a *place of special fire risk*, the side-hung door should open in the direction of escape regardless of occupancy levels.

2.9.15 Locks (E5.19, E5.20)

Locks on *exits* doors or locks on doors across *escape routes* present difficulties when assessing the need for security against the need to allow safe egress from a *building* in the event of a fire.

Security measures should not compromise the ability of the occupants to escape from a *building* in the case of fire, however it is not intended to prohibit the use of locks (including key operated locks) to secure a *room*, *storey* or *building* when the *building* or part of the *building* is unoccupied. It is recommended that consultation with the relevant authorities responsible for *buildings* in use, takes place before the application for *building warrant* is finalised (see clause 2.0.4).

Hardware

Guidance on the types of 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 products, reference should be made to the ‘[Code of Practice for fire resisting metal doorsets](#)’ published by the Door and Shutter Manufacturers’ Association, 1999.

Where an *exit* door from a *room*, *storey* or a door across an *escape route* has to be secured against entry when the *building* or part of the *building* is occupied, it should only be fitted with a lock or fastening which is readily operated, without a key, from the side approached by people making their escape. Similarly, where a secure door is operated by a code, combination, swipe or proximity card, biometric data or similar means, it should also be capable of being overridden from the side approached by people making their escape (see also electrically operated locks).

Emergency exits

Different groups of users will have differing needs to enable them to escape quickly and easily from a *building* in the case of fire and this should be reflected in the type of lock chosen. For example, in *buildings* frequented by the general public it is important that the locks can be released by people who may be unfamiliar with the *building* and have received no training in the emergency procedures or the types of *exit* devices used in the *building*. In these cases, panic *exit* devices operated by a horizontal bar to BS EN: 1125: 1997 should be installed. These devices are designed to operate on body pressure alone and require no knowledge of their operation to enable safe and effective evacuation of the *building*.

Emergency *exit* devices operated by a lever handle or push pad to BS EN: 179: 1998, can be installed in *buildings* which are inaccessible to the general public or, where the *building* is accessible to the general public, the aggregate occupancy capacity of the *rooms* or *storeys* served by the door should not exceed 60 persons. Staff in such areas will need to be trained

Electrically powered locks

both in the emergency procedures and in the use of the specific emergency devices fitted (see clause 2.0.4).

Electrically powered locks should not be installed on 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 or on any door which provides the only route of escape from the *building* or part of the *building*.

Electrically powered locks on *exit* doors and doors across *escape routes* may be installed in *buildings* which are inaccessible to the general public or, when the *building* is accessible to the general public, the aggregate occupancy capacity of the *rooms* or *storeys* served by the door should not exceed 60 persons. Staff in such areas will need to be trained both in the emergency procedures and in the use of the specific emergency devices fitted (see clause 2.0.4).

Electrically powered locks should return to the unlocked position:

- on operation of the fire alarm system;
- on loss of power or system error;
- on activation of a manual door release unit (Type A) to BS EN 54: Part 11: 2001 positioned at the door on the side approached by people making their escape and where the door provides escape in either direction, a unit should be installed on both sides of the door.

Where a locking mechanism is designed to remain locked in the event of a power failure or system error, the mechanism should not be considered appropriate for use on *exit* doors and doors across *escape routes*.

The guidance in this clause is not relevant to a place of lawful detention.

Buildings that feature electrically powered locks in some cases will need a fire alarm system installed, the design of which should be determined by a fire risk assessment (see clause 2.0.4).

Additional guidance on the type of fire alarm system most appropriate to the circumstances is contained in BS 5839: Part 1: 2002.

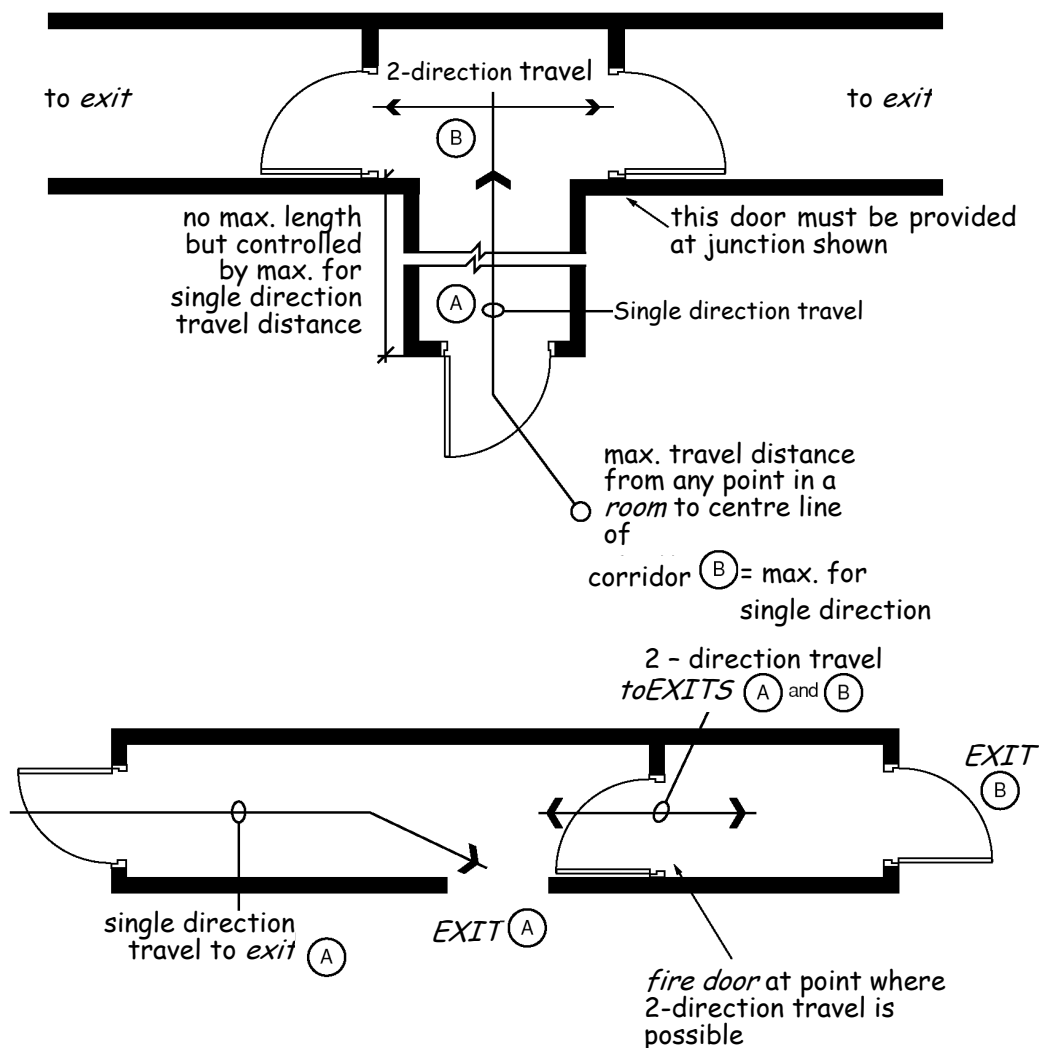
2.9.16 Fire and smoke control in corridors (D4.6, E5.23, D11.4)

For purposes of smoke control, a corridor should be subdivided with a wall or screen with a short fire resistance duration (insulation criteria need not be applied) and any door in the wall or screen should be a *self-closing fire door* as in clause 2.1.15 and:

- where the corridor is a dead end more than 4.5 m long and provides access to a point from which more than 1 direction of escape is possible, it should be divided at that point or points, as shown in the diagram below; and
- where the corridor provides at least 2 directions of escape and is more than 12 m in length between the *exits* it serves, it should be divided in the middle third of the corridor.

This does not mean that the corridor should be subdivided into 12 m lengths.

Alternatively, in a *building*, other than a *residential care building* or *hospital*, the corridor can be designed with a smoke control system employing pressure differentials in accordance with BS 5588: Part 4: 1998, but assuming a minimum pressure of 25 Pa based on a wind speed of 22 m/sec.



residential building (other than a residential care building and hospital)

In a residential building, other than a residential care building and hospital (for these see Annex 2.A and 2.B), every room intended for use as sleeping accommodation (including any en-suite sanitary accommodation where provided) should be separated from an escape route by a wall providing short fire resistance duration and any door in the wall should be a suitable self-closing fire door with a short fire resistance duration (see Annex 2.D).

2.9.17 Flat roofs and access decks (D11.11)

Escape across flat roofs and access decks can be hazardous because the surface can be exposed to adverse weather conditions and in the case of flat roofs, may also have obstructions or no edge protection. Therefore, escape routes over flat roofs should only be used where the building or part of the building is inaccessible to the general public and there is more than 1 escape route from the room or storey leading to the flat roof. However where the room or storey consists of a roof top plant room (other than a place of special fire risk), 1 escape route over the flat roof may be sufficient (see clause 2.9.3).

In order to protect evacuees from fire, a flat roof or an access deck forming part of an escape route 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. 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*.

In addition, there should 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* or along the edge of the *access deck* as appropriate (see section 4: Safety).

2.9.18 Galleries (E5.24, D11.6)

A *gallery* is a raised floor or platform, including a raised storage floor, which is open to the *room* or space into which it projects and which:

- a. has every part of its upper surface not less than 1.8 m above the surface of the main floor of the said *room* or space; and
- b. occupies (or, in the case of there being more than one *gallery*, together occupy), not more than one-half of the floor area of the said *room* or space.

To ensure the safety of those using a *gallery* or *rooms* off it, the *gallery* should be open above and below to the *room* into which it projects and should not give access to any other *room*, other than a *room* with a means of escape independent of the *gallery*. The *gallery* may be wholly or partly enclosed below, where:

- the floor of the *gallery* has a short fire resistance duration; and
- at least 1 route of escape from the *gallery* is by way of a *protected zone* (see clause 2.9.22), an external *escape stair* (see clause 2.9.24) or to another *compartment* (see clause 2.9.6).

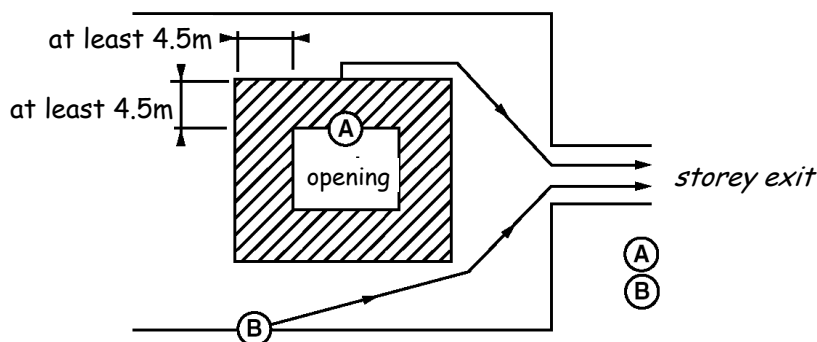
2.9.19 Openings in floors (E5.25)

In the event of a fire, smoke and possibly flames rising through an opening in a floor may impede evacuees from leaving the *building*. Evacuees should be able to move directly away from the opening or a safe distance away from the edge of the opening.

In a *building* where there is an opening in any floor, not being a *compartment floor* or *separating floor* (for these, see guidance to standards 2.1 and 2.2):

- escape from any point on the floor, not more than 4.5 m from the opening, should be directly away from the opening (see route A below); and
- the route from any point on the *storey*, more than 4.5 m from the opening, should pass no closer to the opening than 4.5 m (see route B below).

However, this does not apply where two or more routes of escape are provided and at least one route is 4.5 m or more away from the edge of the opening.



2.9.20 Places of special fire risk (E5.26)

A *place of special fire risk* should only be accessed from a *protected zone* by way of a *protected lobby* (see clause 2.9.21).

2.9.21 Protected lobbies (E6.13, E6.14, D11.2)

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*.

Single *escape stair*

Where a *building*, or part of a *building* has only one *escape route* by way of an *escape stair*, access to the *escape stair* should be by way of a *protected lobby*. The lobby protection should afford people making their escape additional time to pass the fire floor in relative safety. However, *protected lobbies* need not be provided to:

- the topmost *storey* of a non-domestic *building* not being the *escape stair exit storey*; or
- *shared residential* accommodation.

However reference should also be made to clause 2.1.14 where in certain cases, *protected lobbies* are necessary on the topmost *storey* to assist the fire service in their fire-fighting and rescue operations.

High rise *buildings*

Where an *escape stair* serves a *storey* at a height of more than 18 m, access to the *protected zone* containing the *escape stair* should be by way of a *protected lobby*.

Dividing wall

The wall dividing a *protected lobby* from the remainder of the *protected zone* may have a short fire resistance duration for integrity only and any door in the wall should be a *self-closing fire door* (see clause 2.1.15) with a short fire resistance duration.

2.9.22 Protected zones (E6.6, D11.1, D11.10)

A *protected zone* is that part of an *escape route* within a *building*, but not a 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 *constructed* as a *compartment*. The enclosing structure should of a *protected zone* have at least a medium fire resistance duration and any door in the enclosing structure should be a *self-closing fire door* (see clause 2.1.15) with at least a medium 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.

Shared residential accommodation

In the case of a *protected zone* in *shared residential accommodation*, short fire resistance duration is sufficient.

Enclosure of *escape stairs*

An *escape stair* should be within a *protected zone*. However, this is not necessary in the following situations:

- an *escape stair* which connects 2 or more levels within a single-storey where the difference in level between the highest and lowest level is not more than 1.8 m;
- where the *escape stair* is a fixed ladder as in clauses 2.9.7 and 2.9.10; or
- an external *escape stair* with a total rise of not more than 1.6 m; or
- an external *escape stair constructed* in accordance with clause 2.9.24.

Galleries, catwalks (including lighting bridges), or openwork floors

- an *escape stair* from a *gallery*, catwalk or openwork floor where they have:
 - a. an occupancy capacity of not more than 60; or
 - b. an occupancy capacity of 61 to 100 and at least 1 route of escape is by way of a *protected zone* (see clause 2.9.22), an external *escape stair* (see clause 2.9.24) or to another *compartment* (see clause 2.9.6).

Where a *gallery*, catwalk or openwork floor is provided in the case of a. or b. above and serves more than 1 level within the *room*, an unenclosed *escape stair* may be provided between the floor of the *room* and the lowest *gallery*, catwalk or openwork floor only.

External walls

Where any part of a *protected zone* enclosing an *escape stair* 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 for a distance of 2 m, by *construction* with a:

- a. short fire resistance duration where every *storey* in the *building* is at a height of not more than 7.5m above the ground; or
- b. medium fire resistance duration where any *storey* is at a height of more than 7.5 m.

Final *exit*

However, where the *external wall* of the *protected zone* is used to protect the *escape stair*, it is not sufficient to use the final *exit* door as a barrier between the evacuees and the fire. In such cases, the *external wall* adjoining the *protected zone* at the final *exit* level should be protected as recommended in sub-clauses a. and b. directly above.

2.9.23 Rooms, toilets and washrooms in protected zones

(E6.8, D11.5)

Certain small *rooms* as described below and *toilets* and washrooms may be sited within *protected zones* enclosing *escape stairs* because the fire risk is considered to be low. However, all parts of the *building* served by the *escape stair* should have at least one other *escape route*. This allows the occupants in other parts of the *building* to evacuate without the need to enter the *protected zone* enclosing the *escape stair*. The type of *room* referred to, include:

- a. a reception *room* having a floor area of not more than 10 m²;
- b. an *office* having a floor area of not more than 10 m²;
- c. a general store *room* having a floor area of not more than 10 m²; or
- d. a cleaners cupboard not more than 3 m².

More than 1 *toilet*, washroom or cleaners cupboard may be located in a *protected zone* enclosing an *escape stair* however only 1 of each of the *rooms* listed in sub-clauses a to c above may be within the *protected zone*. The wall separating the *rooms* / cupboard from the *protected zone* should have a short fire resistance duration and any door in the wall should be a *self-closing fire door* (see clause 2.1.15). A door to a cleaner's cupboard should have a short fire resistance duration but need not be self-closing provided it is lockable. The walls / doors separating the *toilets* or washrooms from the *protected zone* need not have a fire resistance duration.

Escalators

Escalators may also be located within a *protected zone* provided all parts of the *building* served by the *escape stair* have at least one other *escape route*.

2.9.24 External escape stairs (E6.6, D11.7, D11.8)

External *escape stairs* present additional hazards to people evacuating a *building* in the event of fire. This is because the *escape stair* will be exposed to the possible effects of inclement weather and people who are unfamiliar with the *escape routes* can feel less confident using an unenclosed stair high above the ground.

For these reasons, an external *escape stair* should only serve a *building* where:

- the topmost *storey* height is not more than 7.5 m; and
- the *building* or part of the *building* is accessible to the general public; and
- in the case of a *residential care building* or a *hospital*, the stair is intended to be used by staff only.

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 wall

Every part of an *external wall* (including a door, window or other opening) not more than 2 m from the *escape stair*, should have short fire resistance duration. However, this does not apply to a door opening from the top *storey* to the external *escape stair*. Fire protection below an *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 2.1.15).

2.9.25 Temporary waiting spaces (E6.7)

The speed of evacuation of people with mobility problems can be much slower than able bodied people and they should be provided with space to wait temporarily until it is safe to use the *escape stair*. The spaces should not be used for any form of storage.

A *protected zone* enclosing an *escape stair* and an external *escape stair* (see clause 2.9.24) 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 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 egress to a *place of safety* or the *storey* is inaccessible to wheelchair users. Fire evacuation in a *hospital* (see Annex 2.B) is based on progressive horizontal evacuation and therefore temporary waiting spaces in *escape stairs* need not be provided.

The safe evacuation of people with disabilities is the responsibility of the employer or other person having control of the *building* and not that of the fire authority. Therefore, people with impaired mobility should not be directed to remain in these spaces awaiting the arrival of the fire service. The employer or other responsible person should therefore make the necessary arrangements for the safe evacuation of people with disabilities from the temporary waiting spaces (see clause 2.0.4).

The Management of Health and Safety at Work Regulations 1999

The Management of Health and Safety at Work Regulations 1999 require all employers to assess the risks to workers and any others who may be affected by their work or business. The objective is to identify preventative and protective measures and implement corrective action as appropriate. For example, staff may require training in moving and handling people with disabilities, including the use of specially designed evacuation chairs.

The Fire Precautions (Workplace) Regulations 1997

The Fire Precautions (Workplace) Regulations 1997 were amended in 1999. These regulations impose a duty on every employer to provide adequate precautions in the workplace in case of fire. The regulations make explicit the risk assessment requirement mentioned above. The assessments should take account of fire-fighting equipment, any fire detection, emergency routes and *exits* and their maintenance. The employer should also include in their assessment, employees and visitors who may have special needs or may be unfamiliar with the evacuation strategy or the *escape routes*. This requirement applies to any workplace and includes *buildings* where the general public have access.

The employer is also required to arrange any necessary contacts with external emergency services, particularly with regard to rescue work and fire-fighting. The Fire Precautions (Workplace) Regulations 1997 are enforced by the fire authority.

2.9.26 Escape stairs in basements (E6.12)

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 2.1.15) where provided, should have a medium fire resistance duration.

2.9.27 Auditoria (E4.5, D11.13, D11.14, D11.15)

In a *building* containing an auditorium, the ventilation system should be designed to ensure that the direction of air movement in the event of fire is from the auditorium towards the stage. Clause 20 of Section 6 in BS 5588: Part 6: 1991 provides relevant guidance.

Safety curtain

In a *building* containing an auditorium having an occupancy capacity of more than 500, any separated stage and stage area should be separated from the remainder of the *building* by a wall with medium fire resistance duration, other than at the proscenium opening, provided there is a safety curtain which conforms with Clause 13 of Section 5 of BS 5588: Part 6: 1991. Escape from that part of the stage behind the curtain should be independent of that from the auditorium.

A separated stage means a stage which is separated from the auditorium other than at the proscenium opening. A stage area includes any scenery dock, workshop, under-stage area, staff or orchestra *room*, and any other part ancillary to the stage.

Smoke exhaust

Where a separated stage and stage area in a *building* containing an auditorium is equipped with a safety curtain, a high level outlet over the separated stage and stage area is essential for the safety curtain system to operate properly and to allow the escape of smoke and hot gases in the event of a fire on the stage.

The smoke exhaust system over an open stage should be sized to keep the auditorium relatively clear of smoke during the period of evacuation. The size and performance of the exhaust system will depend upon the size of the stage. Unless determined otherwise by a fire engineering calculation, exhaust ventilators over an open stage should have a combined total aerodynamic free area of at least 10% of the area of the stage.

2.9.28 Air supported structures (E5.27)

An air supported structure is a structure which has a space-enclosing, single-skin membrane anchored to the ground and kept in tension by internal air pressure so that it can support applied loading.

An air supported structure should be designed and *constructed* so that:

- travel distance in one direction is not more than 9 m; and
- every *exit* is at least 3 m, or one quarter of the smallest plan dimension, whichever is less, from any corner of the structure; and
- every *exit* has a rigid supporting framework; and
- inflation equipment includes a standby power system which will start up automatically on any failure of the main power supply, is independent of the main power supply, and includes weather protected, non-return dampers in the *ducts*, outside the structure; and
- where the occupancy capacity exceeds 100, or in the case of a swimming pool 50, an emergency support system is provided which will support the membrane in a deflated state under short term loading conditions, to ensure *escape routes* have a clear headroom of at least 2.5 m for at least 10 m adjacent to every *exit*; and
- where it covers a swimming pool, egress steps from the water are adjacent to an *exit* from the *building*.

2.9.29 Combustibility (D11.12)

Every part of an *escape stair* (including landings) and the floor of a *protected zone* or *protected lobby*, should be *constructed* of *non-combustible* material. However, this guidance does not apply to:

- an *escape stair* in *shared residential accommodation*;
- any handrail, balustrade or protective barrier on an *escape stair*;
- an *escape stair* which connects 2 or more levels within a single-storey where the difference in height between the highest and lowest level is not more than 1.8 m;
- an *escape stair* from a *gallery*, catwalk or openwork floor *constructed* in accordance with the guidance in clause 2.9.22;
- a floor finish (e.g. laminate flooring) applied to the *escape stair* (including landings) or to the floor of a *protected zone* or *protected lobby*.

2.9.30 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 2.9.29), 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.

2.9.31 Openings and service penetrations

Fire and smoke can easily pass through openings and service penetrations in protected routes of escape (see clause 2.0.2) thus preventing the occupants from escaping in the event of an outbreak of fire within the *building*. For this reason, any openings or service penetrations in protected routes of escape should be limited to *chimneys, flue-pipes, self-closing fire doors* and *service openings*. Fire shutters or dampers other than for the protection of *service openings* (including ventilation *ducts*) should not be installed in the enclosing structure of a *protected zone*. In order to inhibit the spread of fire and smoke, the openings should be *fire-stopped* in accordance with clause 2.1.15.

2.9.32 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*.

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*, a *separating wall*, another *compartment wall* or any other wall or screen forming a protected route of escape, the junction should maintain the fire resistance duration of the more demanding guidance.

In order to inhibit the spread of fire and smoke, junctions should be protected in accordance with clause 2.1.16. For additional guidance on *fire-stopping* materials, see clause 2.1.15.

2.10 Escape lighting

- 2.10 Functional standard
- 2.10.0 Introduction
- 2.10.1 Escape route lighting
- 2.10.2 Protected circuits
- 2.10.3 Emergency lighting

standard

2.10

mandatory

Every *building* must be designed and *constructed* in such a way that in the event of an outbreak of fire within the *building*, illumination is provided to assist in escape.

2.10.0 Introduction

Escape routes should be illuminated to aid the safe evacuation of a *building* in an emergency.

[Fire Precautions
\(Workplace\)
Regulations 1997](#)

Emergency lighting and *exit* signage are required under the Fire Precautions (Workplace) Regulations 1997, as amended, and the designer is advised to consult the fire authority early in the design process.

[Cinematography
\(Safety\) \(Scotland\)
Regulations 1955](#)

Reference should be made to Part 1 of the Cinematography (Safety) (Scotland) Regulations 1955 for *buildings* such as cinemas where there are specific requirements for lighting.

Annexes

Due to the special fire precautions within *residential care buildings*, *hospitals* and enclosed shopping centres, additional guidance is grouped in the Annexes. The intention is to help designers and verifiers find the information they require quickly when designing or vetting such *buildings*. However, it is important to remember that the guidance in the annexes is in addition and supplementary to the guidance to standard 2.1 to 2.15. For additional guidance on:

- *residential care buildings*, see Annex 2.A;
- *hospitals*, see Annex 2.B;
- enclosed shopping centres, see Annex 2.C.

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.

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 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 luminaires 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. It should be installed in *buildings* considered to be at higher risk, such as in high rise *buildings*, *buildings* with *basements* or in *rooms* where the number of people is likely to exceed 60.

Emergency lighting should be installed in *buildings* or parts of a *building* considered to be at higher risk such as:

- a. in a *protected zone* and an *unprotected zone* in a *building* with any *storey* at a height of more than 18 m;
- b. in a *room* with an occupancy capacity of more than 60, or in the case of an *inner room*, the combined occupancy capacity of the *inner room* plus the adjoining *room* (and any *protected zone* or *unprotected zone* serving these *rooms*) is more than 60;
- c. in an underground car park including any *protected zone* or *unprotected zone* serving it where less than 30% of the perimeter of the car park is open to the external air;
- d. in a *protected zone* or *unprotected zone* serving a *basement storey*;
- e. in a *place of special fire risk* (other than one requiring access only for the purposes of maintenance) and any *protected zone* or *unprotected zone* serving it;
- f. in any part of an air supported structure;
- g. in a *protected zone* or *unprotected zone* serving a *storey* which has at least 2 *storey exits* in the following *buildings*:
 - *entertainment, assembly, factory, shop, multi-storey storage* (Class 1) as defined in clause 2.1.1, *single-storey storage* (Class 1) as defined in clause 2.1.1 with a floor area more than 500 m²;
 - a *protected zone* or *unprotected zone* serving a *storey* in a multi-storey non-residential school;
 - a *protected zone* or *unprotected zone* serving any *storey* in an *open sided car park*.

Emergency lighting in places of entertainment such as, cinemas, bingo halls, ballrooms, dance halls and bowling alleys, should be in accordance with CP1007: 1955. Emergency lighting in any other *building* should be in accordance with BS 5266: Part 1: 1999 as read in association with BS 5266: Part 7: 1999 (BS EN 1838: 1999).

In the case of a *building* with a smoke and heat exhaust ventilation system, the emergency lighting should be sited below the smoke curtains or installed so that it is not rendered ineffective by smoke filled reservoirs.

2.11 Communication

- 2.11 Functional standard
- 2.11.0 Introduction
- 2.11.1 Residential buildings (other than residential care buildings and hospitals)
- 2.11.2 Residential care buildings
- 2.11.3 Hospitals
- 2.11.4 Enclosed shopping centres

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

It is recommended that automatic fire detection is installed in *residential buildings* and enclosed shopping centres. The risk to life is far greater in *residential buildings* as the occupants may be asleep or in the case of enclosed shopping centres, large numbers of the public may be present who could be unfamiliar with the *building* and may need to travel long distances in order to leave the *building* safely. Automatic fire detection systems need not be installed in all other *buildings* other than:

- to compensate for some departure from the guidance elsewhere in this handbook;
- as part of the operating system for some fire protection systems, such as pressure differential systems (see clause 2.9.16), automatic door release devices (see clause 2.1.15) or electrically operated locks (see clause 2.9.15);
- a *building* designed on the basis of phased evacuation (see clause 2.9.11).

False alarms

Around 97% of all automatic calls received by the fire service result in unnecessary attendance due to false alarms. This is normally attributed to poor design, installation or maintenance of automatic fire detection and alarm systems. Guidance on how to reduce false alarms is provided in BS 5839: Part 1: 2002.

Annexes

Due to the special fire precautions within *residential care buildings*, *hospitals* and enclosed shopping centres, additional guidance is grouped in the Annexes. The intention is to help designers and verifiers find the information they require quickly when designing or vetting such *buildings*. However, it is important to remember that the guidance in the annexes is in addition and supplementary to the guidance to standard 2.1 to 2.15. For additional guidance on:

- *residential care buildings*, see Annex 2.A;
- *hospitals*, see Annex 2.B;
- enclosed shopping centres, see Annex 2.C.

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 **Residential buildings (other than residential care buildings and hospitals) (E11.2b)**

Residential buildings present particular problems in the event of an outbreak of fire because the occupants may be asleep and will not be aware that their lives may be at risk. A higher level of automatic fire detection coverage is recommended in *residential care buildings* and *hospitals* to give occupants and staff the earliest possible warning of an outbreak of fire and allow time for assisting occupants to evacuate the *building* in an emergency (see Annex 2.A and Annex 2.B).

Early means of warning of fire in *residential buildings* increases significantly the level of safety of the occupants. For this reason, *residential buildings* (other than *residential care buildings* and *hospitals*) should be provided with an automatic fire detection and alarm system installed in accordance with following recommendations:

- automatic detection is installed to at least Category L2 in BS 5839: Part 1: 2002;
- manual fire alarm call points as specified in BS EN 54: Part 11: 2001 (Type A) should be sited in accordance with BS 5839: Part 1: 2002;
- the fire alarm is activated upon the operation of manual call points, automatic detection or the operation of any automatic fire suppression system installed;
- the audibility level of the fire alarm sounders follows the guidance in BS 5839: Part 1: 2002.

Shared residential accommodation

In the case of *shared residential accommodation* designed to provide sleeping accommodation for not more than 6 persons and having no sleeping accommodation below ground level or above first floor level, a domestic system comprising *smoke alarms* with a standby supply, to BS 5446: Part 1: 2000 may be installed in accordance with the domestic Technical Handbook.

2.11.2 **Residential care buildings**

For guidance on *residential care buildings*, see Annex 2.A

2.11.3 **Hospitals**

For guidance on *hospitals*, see Annex 2.B.

2.11.4 **Enclosed Shopping Centres**

In enclosed shopping centres, the distance people need to travel to reach a *protected zone* or a *place of safety* has been extended due to their unique design. Alternative life safety systems should be installed (see Annex 2.C) as a means of providing compensation for the extended travel distances and the lack of *compartmentation* within the *building*. Automatic fire detection systems in enclosed shopping centres form an integral part of the overall life safety strategy in such *buildings* and should be compatible with, and interact with, other mechanical and electrical equipment.

For additional guidance on enclosed shopping centres, see Annex 2.C

2.12 Fire service access

- 2.12 Functional standard
- 2.12.0 Introduction
- 2.12.1 Vehicle access provision
- 2.12.2 Vehicle access routes
- 2.12.3 Operating spaces for high reach appliances
- 2.12.4 Access for fire service personnel

standard

2.12

mandatory

Every *building* must be accessible to fire appliances and fire service personnel.

2.12.0 Introduction

Vehicle access to the exterior of a *building* is needed to enable high reach appliances, such as turntable ladders and hydraulic platforms, to be used, and to enable pumping appliances to supply water and equipment for fire fighting and rescue activities. The access arrangements increase with *building* size and height.

Conversions

In the case of *conversions*, as specified in Regulation 4, the *building* as *converted* 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.

Vehicle access should be provided to at least one elevation of all *buildings* to assist in fire-fighting operations. The vehicle access route should be provided to the elevation or elevations where the principal entrance, or entrances, are located.

Vehicle access is recommended to other elevations of a *building* where:

- the *building* is a *hospital*; or
- the area of any *compartment* in a non-domestic *building* is more than 900 m²; or
- the *building* footprint has a perimeter more than 150 m.

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.

To assist fire service personnel connect a short length of hose between the pumping appliance and dry riser inlets (see guidance to standard 2.14) quickly and efficiently, parking spaces should be provided at a distance not more than 18 m from riser inlets.

Consultation

Vehicle access may have a significant impact on planning and a feasibility study may be appropriate and consultation with the fire authority at the earliest opportunity is strongly recommended.

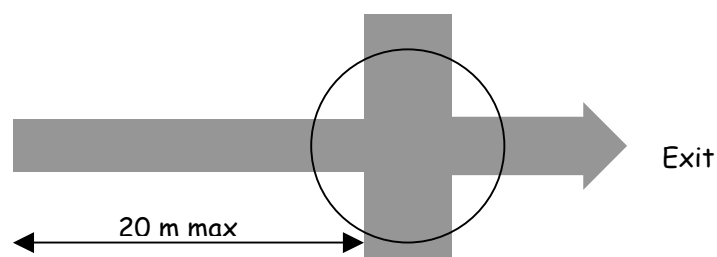
2.12.2 Vehicle access routes (E10.1)

Access routes to *buildings* for fire service vehicles or personnel should not be assessed in isolation and the proposed vehicle access routes will in effect, be dictated by need for water hydrants (see clause 2.13.1) and 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.

Turning Facilities



turning circle, hammerhead or other point at which a vehicle can turn

Access route for fire-service vehicles

	High reach appliance	Pumping appliance only [1]
Minimum width of <i>road</i> between kerbs	3.7 m	3.7 m
Minimum width of <i>gateways</i> 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

Notes

- Where, in consultation with the fire authority, access is needed for pumping appliances, only the smaller dimensions may be used.

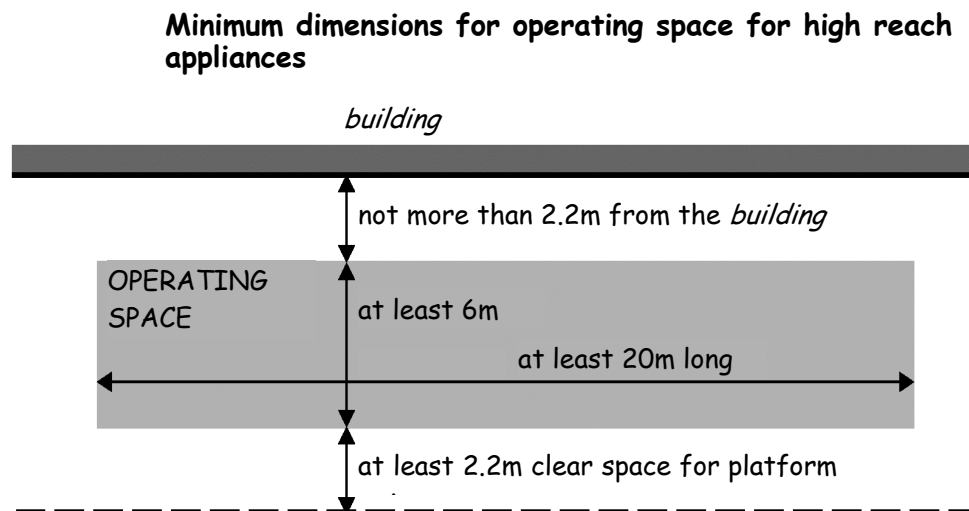
2.12.3 Operating spaces for high reach appliances (E10.1)

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 8.3 kg/cm²; and
- be level or not have a gradient more than 1 in 12.

The operating space shown in the diagram below is suitable for either a hydraulic platform or turntable ladder.

Where a *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.



2.12.4 Access for fire service personnel

It is common practice for fire service personnel to enter a *building* through the normal entrances and fight the fire head on. This is termed 'offensive fire-fighting'.

In order to allow unobstructed access to a *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 principal entrance, or entrances, of a *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.

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* (see clause 2.9.14) should also be considered as providing suitable access.

2.13 Fire service water supply

- 2.13 Functional standard
- 2.13.0 Introduction
- 2.13.1 Water hydrants
- 2.13.2 Alternative water supply

standard 2.13 mandatory	Every <i>building</i> must be provided with a water supply for use by the fire service. Limitation This standard does not apply to <i>domestic buildings</i> .
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2.13.0 Introduction

Fire-fighting operations depend on a sufficient supply of water in order to control fire growth and assist in effective rescue operations.

Consult Fire and Water Authorities

Insufficient water supplies may have a significant impact on the planning therefore early consultation with the fire and water authorities is essential and a feasibility study for the development is likely to be necessary.

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).

2.13.1 Water hydrants (E10.2, E10.3)

A *building* with a *compartment* area more than 280 m² should be provided with at least one water hydrant. However, where no piped water supply is available, an alternative source of supply should be provided (clause 2.13.2).

Positioning of hydrants The water hydrants should be positioned externally, for each *building* or where common to more than one *building*:

- not more than 60 m from at least one normal entrance to the *building*; and
- distributed around the *building* so that every external elevation of the *building* is within 60 m from a hydrant; and
- so that hydrants are at least 6 m from the *building*; and
- located adjacent to a parking space for a pumping appliance; and
- where a parking space is provided for a fire appliance in accordance with clause 2.14.2 (dry fire mains), the water hydrant should be located adjacent to that parking space; and
- so as to be accessible for use at all times; and
- so that there is a clear route for the fire hose between the hydrant and the *building*; and
- the hydrants are *constructed* in accordance with BS 750: 1984.

Performance criteria A hydrant should be connected to a water service pipe capable of delivering water at a flow rate of at least 1500 litres per minute, provided by a water main vested in a public water authority or a supply provided under the Fire Services Act 1947. Alternative arrangements, including private supplies, should be agreed with the verifier, fire authority and water authority, where relevant.

Whilst it is desirable to achieve 1500 litres per minute flow rate, it is accepted that the flow rates in the water mains may not achieve this. Localised areas throughout Scotland may not be supplied by mains water or, where mains water is available, the pressure and flow rates in the main may not be sufficient for fire-fighting operations. Skilled pump operators can regulate the water supplies to the fire-fighters and take care not to overdraw the mains especially where the mains pressure and flow rates are poor.

Portable pumps In some cases, where there are insufficient water hydrants distributed around existing *buildings*, it is normal practice to deploy portable pumps to relay water supplies to where the water is needed. Whilst this method of water distribution is quite common, it should be avoided for new developments because of the time delay in supplying water to the fire-fighters.

2.13.2 Alternative water supply (E10.2)

Where no piped water supply is available, or there is insufficient pressure and flow in the water main, or an alternative arrangement is proposed, the alternative source of supply should be provided in accordance with the following recommendations:

- a charged static water tank of at least 45,000 litre capacity; or
- a spring, river, canal, loch or pond capable of providing or storing at least 45,000 litres of water at all times of the year, to which access, space and a hard standing are available for a pumping appliance (see clause 2.12.2); or
- any other means of providing a water supply for fire-fighting operations considered appropriate by the fire authority.

2.14 Fire service facilities

- 2.14 Functional standard
- 2.14.0 Introduction
- 2.14.1 Facilities on escape stairs
- 2.14.2 Dry fire mains
- 2.14.3 Fire-fighting shafts
- 2.14.4 Fire-fighting lifts
- 2.14.5 Smoke clearance
- 2.14.6 Fire shutters
- 2.14.7 Venting of heat and smoke from basements
- 2.14.8 Smoke outlets from basements

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 may be necessary within some *buildings* to assist fire service personnel to effect rescue or fight fire. The facilities compliment the need for good vehicle and personnel access (see guidance to standard 2.12) and the need for sufficient water supplies (see guidance to standard 2.13).

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 or *storey* depth below the adjoining ground.

Annexes

Due to the special fire precautions within *hospitals* and enclosed shopping centres, additional guidance is grouped in the Annexes. The intention is to help designers and verifiers find the information they require quickly when designing or vetting such *buildings*. However, it is important to remember that the guidance in the annexes is in addition and supplementary to the guidance to standard 2.1 to 2.15. For additional guidance on:

- *hospitals*, see Annex 2.B;
- enclosed shopping centres, see Annex 2.C.

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).

2.14.1 Facilities on escape stairs

Facilities should be designed and installed within *buildings* to assist the fire service in carrying out their fire-fighting or rescue operations as efficiently as possible. In complex *buildings* or high rise *buildings* fire service personnel should not only be provided with good access and water supplies, but also safe bridgeheads from which to work. Such bridgeheads might be linked to specially protected lifts and dry rising mains. This will enable fire service personnel to attack the fire earlier. There may also be a need for the fire-fighters to take control of the ventilation plant, or control plant, during fire-fighting or smoke clearing operations.

Bridgeheads

Where a *building* has two or more *escape stairs*, fire-fighting facilities should be provided to at least 2 *escape stairs* in accordance with the table below and are positioned at least 20 m apart. No point on any *storey* should be further from a dry riser outlet than 1 *storey* height and 60 m measured along an unobstructed route for a fire hose.

Single stair *building*

Where there is only one *escape stair* in the *building*, then fire-fighting facilities need only be provided to that stair.

Interpretation of table below

Fire-fighting facilities should be established based on the topmost *storey* height of the *building*. Once established, fire-fighting facilities recommended at that height should be applied throughout the *escape stair*. Similarly, the lowest *basement storey* sets the level of facilities recommended throughout the *basement stories*.

Any deviation from the table below should be agreed in consultation with the verifier and the fire authority.

Fire-fighting facilities on escape stairs

Storey height and depth of buildings	All buildings (other than those listed in column 3).	Shops, storage buildings and open sided car parks where the area of any storey is more than 900m² [4]
<i>Basements</i> at a depth more than 10 m	Fire-fighting shaft [1]; Fire-fighting lift; Dry fire main (outlet located in fire-fighting lobby).	
<i>Basements</i> at a depth not more than 10 m	No provision	Fire-fighting shaft [1]; Dry fire main (outlet located in fire-fighting lobby).
Topmost <i>storey</i> height not more than 7.5 m	No provision	<i>Protected lobby</i> ; Dry fire main (outlet located in <i>protected lobby</i>) [2].
Topmost <i>storey</i> height not more than 18 m	<i>Protected lobby</i> ; Dry fire main (outlet located in <i>protected lobby</i>) [2].	
Topmost <i>storey</i> height not more than 60 m	Fire-fighting shaft [1]; Fire-fighting lift [3]; Dry fire main (outlet located in fire-fighting lobby).	

Notes:

1. Smoke control should be provided in accordance with Clause 8 of BS 5588: Part 5: 1991 or ‘Smoke shafts protecting fire-fighting shafts: their performance and design’ (BRE, 2002).
2. The *protected lobby* should have an area of at least 5 m².
3. A 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*.
4. For *open sided car parks*, the dry fire main may be located in the *protected zone* enclosing the *escape stair*.

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* within *protected zones*. The inlets to the risers should be located externally to the *building* and not more than 18 m from a parking space suitable for a pumping appliance. There should be a clear hose route between the appliance and the inlet. This will allow fire service personnel to connect the pumping appliance to the inlets quickly and efficiently saving operational time.

Dry risers should be installed in accordance with BS 5306: Part 1: 1976 (1988); and where there are:

- landing valves, they should conform to BS 5041: Part 2: 1987;

- inlet breachings, they should conform to BS 5041: Part 3: 1975 (1987);
- boxes for landing valves, they should conform to BS 5041: Part 4: 1975 (1987);
- boxes for dry risers, they should conform to BS 5041: Part 5: 1974 (1987).

2.14.3 Fire-fighting shafts (E10.9, E10.10)

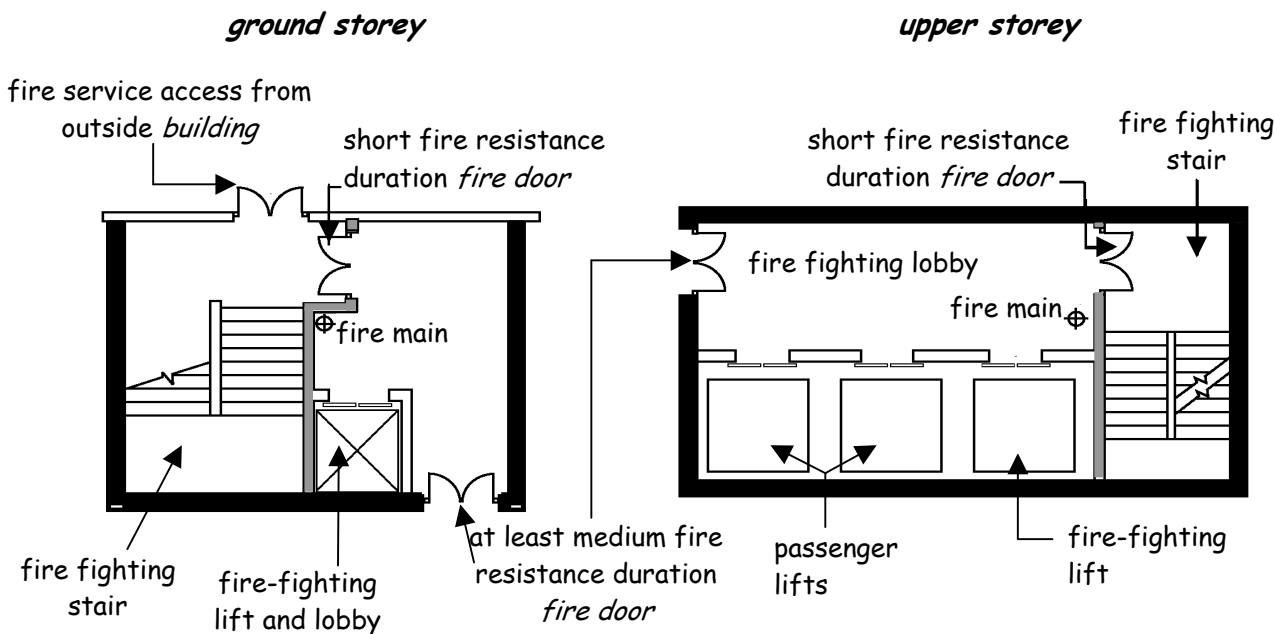
A fire-fighting shaft should be protected from fire spreading from adjoining spaces and contains an *escape stair*, a fire-fighting lobby at every *storey* at which the fire-fighting shaft can be entered and, if provided, a fire-fighting lift together with its machine room.

The enclosing structure of a fire-fighting shaft should have a long fire resistance duration. However, where the *elements of structure* in a *building* have a medium fire resistance duration, the fire-fighting shaft need only have a medium fire resistance duration. A *self-closing fire door* in the enclosing structure of a fire-fighting shaft need only attain a medium fire resistance duration.

The shaft should be provided with a ventilated fire-fighting lobby within the shaft, with only 1 door to the *room* or *storey* it serves. The lobby is intended to provide a safe bridgehead for the fire-fighters to work and it provides access from the *escape stair* to the accommodation and to any associated fire-fighting lift. The lobby should be *constructed* 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 ventilation or 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).

The following diagrams provide typical examples showing different design layouts.

Ventilated fire-fighting lobby



- Key:**
- long fire resistance duration (see also clause 2.1.10)
constructed to compartment wall standard
 - short fire resistance duration

2.14.4 Fire-fighting lifts (E10.11)

A fire-fighting lift should be located within a fire fighting shaft and have controls to enable it to be used under the direct command of the fire service. The lift should be *constructed* in accordance with Sections 3 and 4 of BS 5588: Part 5: 1991. However, the lift should be entered only from:

- a fire-fighting lobby having not more than 1 door to the *room* or *storey* it serves; or
- an open access balcony or an *access deck*.

2.14.5 Smoke clearance (E10.13, E10.14)

Ventilation of *escape stairs* is important to assist fire service personnel during fire-fighting operations and for smoke clearance purposes after the fire has been extinguished. The efficiency of *ventilators* depends upon the prevailing wind and it is important that the fire service personnel can control the opening and closing of the *ventilators* on arrival at the *building*. An *escape stair* within a *protected zone* should have either:

- a *ventilator* of not less than 1 m² at the top of the stair; or
- an opening window at each *storey* with an openable area of 0.5 m².

2.14.6 Fire shutters (E10.16)

All fire shutters in *compartment walls* (see clause 2.1.15) should be capable of being opened and closed manually by fire service personnel.

2.14.7 Venting of heat and smoke from basements (E10.15)

A *basement storey* is any *storey* below the *ground storey*. Ventilation should be provided to assist fire-fighting operations and to allow smoke clearance after the fire. Smoke outlets, communicating directly with the external air, should be provided from every *basement storey*, and where the *basement storey* is divided into *compartments*, from every *compartment*. However, smoke outlets need not be provided:

- in *open sided car parks*; or
- where the floor area of the *basement storey* is not more than 200 m²; or
- where the *basement storey* is at a depth of not more than 4.5 m; or
- where a window or windows opening direct to the external air have a total area not less than 1% of the floor area; or
- where the *basement storey* or part of the *basement storey* is used as a *strong room*; or
- where the *basement storey* has an automatic fire suppression system (which conforms to BS 5306: Part 2: 1990) and is ventilated by a mechanical smoke and heat extraction system incorporating a powered smoke and heat exhaust *ventilator* which has a capacity of at least 10 air changes per hour and conforms to BS 7346: Part 2: 1990 with a class D level of performance or BS EN 12101-3: 2002 Class F300.

2.14.8 Smoke outlets from basements

Smoke outlets should be designed as follows:

- sited at ceiling level within the *room* they serve; and
- having an aggregate cross-sectional area of at least 2.5% of the floor area of the *room* they serve; and
- evenly distributed around the perimeter of the *building*; and
- discharge directly to the open air at a point at least 2 m, measured horizontally, from any part of an *escape route* or *exit*; and
- have a sign stating '**Smoke outlet from basement, do not obstruct**' fixed adjacent to each external outlet point; and
- where they serve a *place of special fire risk*, they are separate from smoke outlets from other areas; and

- discharge by means of windows, panels or pavement lights which are readily accessible to fire service personnel and which can be opened or knocked out if necessary; and
- where appropriate, enclosed by a smoke venting shaft as specified in clause 2.1.11; and
- where there are smoke venting shafts from different parts of the same *basement storey*, or from different *basement storeys*, they are separated; and
- covered with a metal grille or louvre.

2.15 Automatic life safety fire suppression systems

- 2.15 Functional standard
- 2.15.0 Introduction
- 2.15.1 Automatic life safety fire suppression systems
- 2.15.2 Residential care buildings
- 2.15.3 Enclosed shopping centres

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 should be automatic and not require people to initiate its activation;
- it should be designed primarily to protect lives, rather than property, this means it will normally be fitted with quick response sprinkler heads;
- it should be a fire suppression system, one designed specifically to deal with fires rather than other hazards.

Annexes

Due to the special fire precautions within *residential care buildings* and enclosed shopping centres, additional guidance is grouped in the Annexes. The intention is to help designers and verifiers find the information they require quickly when designing or vetting such *buildings*. However, it is important to remember that the guidance in the annexes is in addition and supplementary to the guidance to standard 2.1 to 2.15. For additional guidance on:

- *residential care buildings*, see Annex 2.A;
- enclosed shopping centres, see Annex 2.C.

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 two categories of non-domestic *buildings*:

- *residential care buildings*; and
- enclosed shopping centres.

Water supplies

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For a suppression system to be effective it is essential that there is an appropriate 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 Residential care buildings

A *residential care building* should have an automatic life safety fire suppression system designed and installed in accordance with guidance set out in Annex 2.A.

2.15.3 Enclosed shopping centres

An enclosed shopping centre should have an automatic life safety fire suppression system designed and installed in accordance with guidance set out in Annex 2.C.

Annex

2.A Additional guidance for residential care buildings

- 2.A.0 Introduction
- 2.A.1 Compartmentation
- 2.A.4 Cavities
- 2.A.9 Escape
- 2.A.10 Escape lighting
- 2.A.11 Communication
- 2.A.15 Automatic life safety fire suppression systems

annex 2.A

Additional guidance for *residential care buildings*

2.A.0 Introduction

The recommendations contained in this Annex are in addition to the guidance to standards 2.1 to 2.15 and are unique to *residential care buildings*.

A *residential care building* is a *building* used, or to be used, for the provision of:

- a. a care home service; or
- b. a school accommodation service;

and for these purposes, the expressions mentioned in sub-paragraphs a and b above, have the same meaning as in the [Regulation of Care \(Scotland\) Act 2001](#).

All *residential buildings* pose special problems because the occupants may be asleep when a fire starts. In *residential care buildings* the problems are greater as the mobility, awareness and understanding of the occupants may also be impaired.

The intention of sub-compartmentation and the enclosure of fire hazard rooms is to provide physical barriers to a fire. Automatic fire suppression is intended to limit the development of a fire to the room or space of fire origin and automatic detection provides the early warning of the outbreak of fire. The combination of active and passive fire protection should afford staff and occupants the additional time necessary to evacuate the *building* safely.

Additional recommendations are provided for *compartmentation*, cavities, escape, escape lighting, communication and automatic fire suppression. In order to link them directly with the standards, they have been numbered in the same manner.

Diversity of *Residential care buildings*

Residential care buildings are quite diverse and can be used by a variety of occupants, each requiring different types of care to suit their specific needs. Whilst the guidance in this Annex is suitable for most *residential care buildings*, it is accepted that a degree of flexibility should be applied when designing for specialised conditions such as children's homes or care homes where the occupants suffer from dementia. Any departure from this guidance should be carried out on a risk-based approach and early consultation with the verifier and fire authority is essential.

Fire safety in *residential care buildings* is also dependent upon the way a *building* is furnished, staffed and managed. Designers of *residential care buildings* may need to make reference to the relevant documents which comprise '[NHS Scotland Firecode](#)'.

Maximum *compartment* size **2.A.1 Compartmentation** (D3.5)
 Every *compartment* in a *residential care building* should be limited to a maximum area of 1500 m². In addition, every *upper storey* and every *basement storey* should form a separate *compartment*.

Maximum *sub-compartment* size **Sub-compartmentation** (D4.1) (E5.10)
Sub-compartmentation and the enclosure of fire hazard *rooms* is to provide physical barriers to a fire, thus affording the staff and occupants additional time to evacuate the *building* safely. Every *compartment* in a *residential care building* should be divided into at least two *sub-compartments* by a *sub-compartment wall* with a short fire resistance duration, so that each *sub-compartment* is not greater than 750 m².

Fire hazard rooms (D4.2)
 In order to contain a fire in its early stages, the following *rooms* are considered to be hazardous and should be enclosed by walls with a short fire resistance duration:

- chemical stores;
- cleaners' *rooms*;
- clothes storage;
- day *rooms* with a floor area greater than 20 m²;
- smoking *rooms*;
- disposal *rooms*;
- lift motor *rooms*;
- linen stores;
- bedrooms;
- *kitchens*;
- laundry *rooms*;
- staff changing and locker *rooms*; and
- store *rooms*.

Combustibility (D5.6, D5.7)
 A *sub-compartment wall* can be *constructed* with combustible material (i.e. material that is low, medium, high or very high risk provided the wall has short fire resistance duration).

Junctions with external walls (D10.3)
 Where a lower roof abuts an *external wall*, the roof should provide a medium fire resistance duration for a distance of at least 3 m from the wall.

2.A.4 Cavities
 Where *cavity barriers* are installed between a roof and a ceiling above an undivided space, *cavity barriers* should be installed not more than 20 m apart (see clause 2.4.3).

2.A.9 Escape
Number of exits
 At least 2 *exits* should be provided from any *storey* in a *residential care building*. However, additional *exits* may be needed in accordance with clause 2.9.1. Each *sub-compartment* should be provided with at least 2 *exits* by way of *protected zones* and *unprotected zones* to adjoining, but separate, *compartments* or *sub-compartments*.

Assess risks

Locks (E5.19, E5.20)

Residential care buildings can present difficulties when assessing the risks associated with security against the need to evacuate the *building* safely in the case of fire. Some *residential care buildings* are a home to people who might put themselves at risk. An example would be a 2 storey residential home for the elderly, mentally infirm, where there is concern about residents falling down stairs. In such cases, variation in the guidance in clause 2.9.14 would be entirely appropriate where the risk of death or injury from falls is assessed against the hazards associated with fire. The security measures proposed should therefore take account of these hazards and extra emphasis may need to be placed on management control and / or any automated life safety systems to ensure the safe evacuation of the *building*.

Travel Distance (E5.8)

Travel distance may be measured to a *protected door* in a *sub-compartment*. The maximum travel distance from any point within a *compartment* should be not more than 64 m to:

- each of 2 adjoining *compartments*; or
- an adjoining *compartment* and an *escape stair* or a final *exit*; or
- an adjoining *compartment* and a final *exit*; or
- an *escape stair* and a final *exit*.

Horizontal evacuation

In *residential care buildings*, occupants may need to be evacuated horizontally through a *protected door* into an adjoining *compartment*. In such cases, each *compartment* should be capable of holding the occupancy capacity of that *compartment* and the occupancy capacity of the largest adjoining *compartment*.

Where the travel distance is measured to a *protected door* in a *compartment wall* or *sub-compartment wall* in a *residential care building*, the *escape route* should not pass through any of the fire hazard *rooms* listed in clause 2.A.1.

Occupancy of bedrooms (D4.3)

No *room* intended for sleeping should be used by more than 4 people.

2.A.10 Escape lighting

Emergency lighting should be installed in:

- a *room* with an occupancy capacity of more than 10 and any *protected zone* or *unprotected zone* serving such a *room*;
- a *protected zone* or *unprotected zone* serving a *storey* which has 2 *exits*, other than a *storey* in a *building* not more than 2 *storeys* high with a combined floor area of not more than 300 m² and an occupancy capacity of not more than 10;
- a *protected zone* or *unprotected zone* in a single stair *building* of 2 *storeys* or more and an occupancy capacity of 10 or more.

2.A.11 Communications (E11.2a, E11a)

An automatic fire detection and alarm system should be installed in every *residential care building* to ensure that staff and residents are given the earliest possible warning of the outbreak of fire anywhere in the *building*. This early warning should allow the staff and residents sufficient time to evacuate the *building*, if necessary.

The automatic fire detection and alarm system should be designed and installed in accordance with the guidance in BS 5839: Part 1: 2002 Category L1 and in accordance with the recommendations below:

- a. detection need not be provided in the following locations:
 - *sanitary accommodation*;
 - a lockable cupboard with a plan area not more than 1 m²;
 - in a void and *roof space* which contain only mineral insulated wiring, or wiring laid on metal trays, or in metal conduits, or metal /plastic pipes used for water supply, drainage or ventilating *ducting*;
- b. manual fire alarm call points manufactured to BS EN 54: Part 11: 2001 (Type A) should be installed and sited in accordance with BS 5839: Part 1: 2002;
- c. the fire alarm should be activated on the operation of manual call points, automatic detection or the operation of the automatic life safety fire suppression system;
- d. the *building* should be divided into detection zones not extending beyond a single *compartment*;
- e. the audibility level of the fire alarm sounders should follow the guidance in BS 5839: Part 1: 2002 except in a place of lawful detention including prisons, the alarm need not be sounded throughout the entire *building*;
- f. a fire alarm control panel should be provided at the main entrance, or a suitably located entrance to the *building* agreed with the fire authority.
- g. on the actuation of the fire alarm, a signal should be transmitted automatically to the fire service, either directly or by way of a remote centre, designed and operated in accordance with BS 5979: 1993.

In the case of a *residential care building* designed to accommodate not more than 10 residents, the fire detection and alarm system may be installed in accordance with clause 2.11.1 for *residential buildings* (other than *residential care buildings* and *hospitals*).

2.A.15 Automatic life safety fire suppression systems

Residential care buildings should have an automatic life safety fire suppression system designed and installed in accordance with the recommendations for 'residential occupancies' contained in DD 251: 2000.

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.

Alternative systems

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 Additional guidance for hospitals

- 2.B.0 Introduction
- 2.B.1 Compartmentation
- 2.B.4 Cavities
- 2.B.9 Escape
- 2.B.10 Escape lighting
- 2.B.11 Communications
- 2.B.14 Fire service facilities

annex
2.B
guidance

Additional guidance for *hospitals*

2.B.0 Introduction

The recommendations contained in this Annex are in addition to the guidance contained in standards 2.1 to 2.15 and are unique to *hospitals*.

Hospital

A *hospital* is a *building* used for the treatment of persons suffering from an illness or mental or physical disability or handicap. Whilst all *residential buildings* pose special problems because the occupants may be asleep when a fire starts, in *hospitals* the problems are greater as the mobility, awareness and understanding of the occupants may also be impaired. It may not be safe to evacuate them to the outside and in some cases it may even be harmful to move them within the *building*.

Horizontal evacuation

The staffing levels in *hospitals* tend to be higher than *residential care buildings* therefore the fire safety strategy is normally based on the progressive horizontal evacuation of the patients. The object is to move the patients into adjoining *compartments* or sub-*compartments* within a short distance where further evacuation can be made if necessary depending on the severity of the risk.

Additional guidance is provided for *compartmentation*, cavities, escape, escape lighting, communication and fire service facilities. To link them directly with the standards, they have been numbered in the same manner.

Fire safety in *hospitals* is also dependent upon the way a *building* is furnished, staffed and managed. Designers of *hospitals* may need to make reference to the relevant documents which comprise 'NHS Scotland Firecode'.

2.B.1 Compartmentation (D3.5, D5.1)

Maximum *compartment* size Every *compartment* in a *hospital* should be limited to a maximum area of 1500m². In addition, every *upper storey* and every *basement storey* should form a separate *compartment*.

Sub-compartmentation (D4.1) (E5.10)

Maximum *sub-compartment* size To assist in the safe horizontal evacuation of the occupants in a *hospital*, every *compartment* should be divided into at least two *sub-compartments* by a *sub-compartment wall* with short fire resistance duration, so that no *sub-compartment* is greater than 750 m². By providing a series of barriers, it is intended that patients or residents will be able to remain in the *building* and avoid the need for complete evacuation.

Minimum storey areas (E8.1, E8.2)

Every *storey* at a height of more than 7.5 m containing departments to which patients have access, should either:

- comprise at least 4 *compartments*, each of which should have an area of at least 500 m²; or
- have a *hospital street* (see clause 2.B.9) and at least 3 other *compartments*.

In a *hospital*, every *storey* at a height of more than 18 m containing departments to which patients have access, should either:

- comprise at least 4 *compartments*, each of which should have an area of at least 500 m²; or
- have a *hospital street* (see 2.B.9) and at least 3 other *compartments* each of which should have an area of at least 500 m².

Fire hazard departments (D5.3, D5.4)

A *compartment wall* with a medium fire resistance duration should be provided between:

- different *hospital* departments; and
- between a *hospital* department and a *protected zone*.

However, short fire resistance duration is sufficient in a single-storey *hospital*.

The departments in list A should:

- never be directly below, nor directly adjoin, the operating theatres, intensive therapy units or special care baby units; and
- be provided with a fire suppression system (as in clause 2.1.3) where they are directly below, or directly adjoin, any other *hospital* department to which patients have access.

LIST A

- Boiler house
- Central stores
- Commercial enterprises
- Flammable stores
- Laundry
- Main electrical switchgear
- Main *kitchens*
- Refuse collection and incineration
- Works department

A *hospital* department in list B should be provided with an automatic fire suppression system (as in clause 2.1.3) where they are directly below, or directly adjoin, operating theatres, intensive therapy units, or special care baby units.

LIST B

Central staff change
 Central sterile supplies
Hospital sterilising and disinfecting unit
 Health records
 Pathology
 Manufacturing pharmacy

Intensive therapy units

(D4.4, D4.5)

Every intensive therapy unit should be divided into at least 2 sub-*compartments* by *sub-compartment walls* with short fire resistance duration.

Every entrance to an intensive therapy unit should be either:

- a. from a *hospital street* (see clause 2.B.9); or
- b. through a lobby, enclosed with the same fire resistance duration as that recommended for a *sub-compartment*.

Fire hazard rooms

(D4.2)

In order to contain a fire in its early stages, the following *rooms* are considered to be hazardous and should be enclosed by walls providing a short fire resistance duration (see Annex 2.D):

- a. chemical stores;
- b. cleaners' *rooms*;
- c. clothes storage;
- d. day *rooms* with a floor area greater than 20 m²;
- e. smoking *rooms*;
- f. disposal *rooms*;
- g. laboratories;
- h. lift motor rooms;
- i. linen stores;
- j. bedrooms where they are used by:
 - elderly people, or
 - those suffering with mental illness, or
 - people with learning difficulties;
- k. *kitchens* (other than separate *hospital* departments);
- l. laundry *rooms*;
- m. staff changing and locker *rooms*;
- n. store *rooms*;
- o. X-ray film and record stores; and
- p. all *rooms* within a main laundry in which delivery, sorting, processing packing and storing are carried out.

Combustibility

(D5.6, D5.7)

Compartment walls or *compartment floors* in a *hospital* should be *constructed* of *non-combustible* material. However, a *sub-compartment wall* can be *constructed* with combustible material (i.e. material that is low, medium, high or very high risk) provided the wall has short fire resistance duration.

Junction with external walls (D5.11, D10.3, D3.17)

Where a *compartment wall* or *sub-compartment wall* meets an *external wall*, there should be a 1 m wide strip of the *external wall* which has the same level of fire resistance duration as the *compartment wall* or *sub-compartment wall*, to prevent lateral fire spread.

Where a lower roof abuts an *external wall*, the roof should provide a medium fire resistance duration for a distance of at least 3 m from the wall.

2.B.4 Cavities (D6.2)

Cavity barriers need not be provided to divide a cavity above an operating theatre and its ancillary *rooms*.

Where *cavity barriers* are installed between a roof and a ceiling above an undivided space, the maximum limit of 20 m should be applied (see clause 2.4.3)

2.B.9 Escape**Number of exits**

The number of *exits* in a *hospital* should be calculated in accordance with clause 2.9.1 subject to the additional criteria below.

Storey exits

A minimum of 2 *storey exits* should be provided from a *hospital*. The number of *storey exits* increases in proportion to the number of patient beds. For example:

- any *storey* with more than 100 patient beds should have at least 3 *storey exits*;
- any *storey* with more than 200 patient beds should have at least 4 *storey exits*;
- any *storey* with more than 300 patient beds should have at least 5 *storey exits*.

Compartment exits (E8.3)

In a *hospital* where a *storey* is divided into 3 or more *compartments*, each *compartment* should have *exits* to:

- a *compartment* and a *hospital street*; or
- a *compartment* and an *escape stair*; or
- a *compartment* and a final *exit*.

Sub-compartment exits

Each *sub-compartment* should be provided with at least 2 *exits* by way of *protected zones* and *unprotected zones* to adjoining, but separate, *compartments* or *sub-compartments*.

Travel Distance (E5.8)

Travel distance in a *hospital* should not exceed 15 m in one direction of travel and 32 m in more than one direction. Travel distance may be measured to a *protected door* in a *compartment wall* or a *sub-compartment wall* however, the *escape route* should not pass through any of the fire hazard *rooms* listed in Annex 2.B.1.

In addition, the maximum travel distance from any point within a *compartment* should be not more than 64 m to:

- each of 2 adjoining *compartments*; or

- an adjoining *compartment* and an *escape stair* or a final *exit*; or
- an adjoining *compartment* and a final *exit*; or
- an *escape stair* and a final *exit*.

Occupants may need to be evacuated horizontally through a *protected door* into an adjoining *compartment*. In such cases, each *compartment* should be capable of holding the occupancy capacity of that *compartment* and the occupancy capacity of the largest adjoining *compartment*.

Hospital streets

(E8.8,E8.9,E8.10)

A *hospital street* is a *protected zone* in a *hospital* provided to assist in facilitating circulation and horizontal evacuation, and to provide a fire-fighting bridgehead. A *hospital street* should have an unobstructed width of at least 3 m. It should be divided into at least 3 sub-*compartments* and not contain a *shop* or other commercial enterprise.

At *ground storey* level, a *hospital street* should have at least 2 final *exits*. At *upper storey* level there should be access to at least 2 *escape stairs* accessed from separate sub-*compartments*, located such that:

- the distance between *escape stairs* is not more than 64 m; and
- the distance of single direction of travel within the *hospital street* is not more than 15 m; and
- the distance from a *compartment exit* to an *escape stair* is not more than 32 m.

A door from a *hospital street* to an adjoining *compartment* should:

- be located so that an alternative independent means of escape from each *compartment* is available; and
- not be located in the same sub-*compartment* as a door to a *protected zone* containing a stairway or lift.

Every *escape stair* opening into the *hospital street* should be located so that the travel distance from an *escape stair exit* to a door leading directly to a *place of safety* is not more than 64 m.

Destination of escape routes

(E8.4)

An *escape route* from a *hospital* department to which patients have access should be to:

- a *place of safety*; or
- a *protected zone*; or
- an *unprotected zone* in another *compartment* or sub-*compartment*.

Bed-patients may be moved to another ward in a different *compartment* or sub-*compartment*.

Escape route width

(E8.5)

The unobstructed width of every *escape route* intended for bed-patient evacuation should be at least 1500 mm. Doors should be designed to accommodate bed-patient evacuation.

Mattress evacuation stair

(E8.6)

In patient sleeping accommodation, an *escape stair* width should be not less than 1300 mm and designed so as to facilitate mattress evacuation. The landing configuration should also follow the guidance in the table below in

order to assist the evacuation of bed patients. The additional 200 mm for the landing width allows for the return of the balustrade between stair *flights*. In a straight through stair, the landing width need only be the same as the effective width of the stair.

Stair and landing configuration for mattress evacuation in mm

Stair width	Minimum landing width	Minimum landing depth
1300	2800	1850
1400	3000	1750
1500	3200	1550
1600	3400	1600
1700	3600	1700
1800	3800	1800

Locks

(E5.19, E5.20)

Hospitals can present difficulties when assessing the risks associated with security against the need to evacuate the *building* safely in the case of fire. Some parts of *hospitals* could have patients who might put themselves at risk. An example could be a patients ward on an upper floor providing accommodation for the elderly or mentally infirm, where there is concern about residents falling down stairs. In such cases, variation in clause 2.9.15 would be entirely appropriate where the risk of death or injury from falls is assessed against the hazard associated with fire. The security measures proposed should therefore take account of these hazards and extra emphasis may need to be placed on management control and / or any automated life safety systems to ensure the safe evacuation of the *building*.

Assess risks

Protected lobbies

(E8.7)

Where an *escape stair* in a *protected zone* serves an *upper storey* containing a department to which patients have access, access to the *protected zone* should be by way of a *protected lobby* (as described in clause 2.9.21), or, in the case of a *storey* at a height of not more than 18 m, by way of the *hospital street* (see clause 2.B.9).

2.B.10 Escape lighting

Essential lighting circuits should be installed throughout a *hospital* and designed to provide not less than 30 percent of the normal lighting level. In an area where a 15 second response time would be considered hazardous, (e.g. a stairway), emergency lighting should be provided by battery back-up giving a response time of not more than 0.5 seconds.

The distribution boards for essential and non-essential circuits may be in the same location but should be in separate cabinets.

2.B.11 Communications

(E11.2a, E11a)

An automatic fire detection and alarm system should be installed in every *hospital* to ensure that staff and patients are given the earliest possible warning of the outbreak of fire anywhere in the *building*. This will allow staff to initiate progressive horizontal evacuation procedures in the early stages of fire growth.

The automatic fire detection system should be designed and installed in accordance with the guidance in BS 5839: Part 1: 2002 Category L1 and in accordance with the recommendations below:

- a. detection need not be provided in the following locations:
 - *sanitary accommodation*;
 - a lockable cupboard with a plan area not more than 1 m²;
 - in a void and *roof space* which contain only mineral insulated wiring, or wiring laid on metal trays, or in metal conduits, or metal /plastic pipes used for water supply, drainage or ventilating *ducting*;
- b. manual fire alarm call points manufactured to BS EN 54: Part 11: 2001 (Type A) should be installed and sited in accordance with BS 5839: Part 1: 2002;
- c. the fire alarm should be activated on the operation of manual call points, automatic detection or the operation of any automatic fire suppression system installed;
- d. the *building* should be divided into detection zones not extending beyond a single *sub-compartment*;
- e. the audibility level of the fire alarm sounders should follow the guidance in BS 5839: Part 1: 2002. However, in a *hospital* department to which patients have access, the audibility need only be 55dB(A) or 5dB(A) above the level of background noise, whichever is greater.
- f. a main fire alarm control panel is provided at:
 - the main entrance, or a suitably located secondary entrance to the *building*; and
 - repeater panels should be provided at all other fire service access points.
- g. on the actuation of the fire alarm, a signal should be transmitted automatically to the fire service, either directly or by way of a remote centre, designed and operated in accordance with BS 5979: 1993.

In the case of a *hospital* designed to accommodate not more than 10 residents, the fire detection and alarm system may be installed in accordance with clause 2.11.1 for *residential buildings* (other than *residential care buildings* and *hospitals*).

2.B.14 Fire service facilities

Facilities on escape stairs

The additional guidance in this clause applies to a *hospital* with *hospital streets*. Otherwise, the recommendations in the guidance to standard 2.14 should be followed.

Where a *hospital* with a *hospital street* has 2 or more *escape stairs*, facilities should be provided in accordance with the table below (other than where agreed with the verifier and fire authority) to not less than 2 *escape stairs* positioned at least 20 m apart. For fire hose, 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.

Different fire-fighting facilities should not be provided throughout the varying *storey* heights of a *building*. Once the topmost *storey* height of a *building* has been established, the intention is that fire-fighting facilities recommended at that height should be applied throughout the *escape stair*. Similarly, where a *building* contains a *basement*, the recommendations become more demanding the greater the depth.

Facilities on escape stairs in hospitals with hospital streets

Storey height and depth of hospital	Facilities on escape stairs
<i>Basements</i> at a depth more than 10 m	Fire-fighting lift; Fire-fighting shaft [1]; Dry fire main (outlet located at every departmental entrance).
<i>Basements</i> at a depth not more than 10 m	Dry fire main (outlet located at every departmental entrance).
Topmost <i>storey</i> height not more than 18 m	Dry fire main (outlet located at every departmental entrance).
Topmost <i>storey</i> height not more than 60 m	Fire-fighting shaft [1]; Fire-fighting lift [2]; Dry fire main (outlet located at every departmental entrance).

Notes:

1. Smoke control should be provided in accordance with Clause 8 of BS 5588: Part 5: 1991 or '[Smoke shafts protecting fire-fighting shafts: their performance and design](#) (BRE, 2002)'.
2. A fire-fighting lift need not serve the top *storey* of a *building* where:
 - the top *storey* is for service plant use only; and
 - access to the plant *room* is from an *escape stair* from the *storey* below; and
 - the foot of the *escape stair* is not more than 4.5 m from the fire-fighting lift; and
 - dry rising mains are installed in the *protected lobbies* of the *escape stair*.

Horizontal dry fire mains

(E10.5)

Every single-storey *hospital* with a *hospital street* should be provided with a dry fire main. The outlet should be located in the *hospital street* at every *hospital* departmental entrance. However, a dry fire main need not be provided where no point within the *storey* (not being a *protected zone*) is more than 60 m measured along an unobstructed route for the fire hose, from the access point or points.

Annex

2.C Additional guidance for enclosed shopping centres

- 2.C.0 Introduction
- 2.C.1 Compartmentation
- 2.C.2 Separation
- 2.C.9 Escape
- 2.C.10 Escape lighting
- 2.C.11 Communication
- 2.C.14 Fire service facilities
- 2.C.15 Automatic life safety fire suppression systems

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Additional guidance for enclosed shopping centres

2.C.0 Introduction

Enclosed shopping centres can be extremely complex to design. There are large fire loads and large numbers of people all within a complicated series of spaces where most people only know one way in or out.

More complex shopping centres

The recommendations contained in this Annex are in addition to the guidance to standards 2.1 to 2.15 and are unique to enclosed shopping centres with malls on 1 or 2 *storeys*. The alternative approach described in clause 2.0.6 should be used where the enclosed shopping centre has malls on 3 or more *storeys*.

Additional guidance is provided for *compartmentation*, *separation*, escape, escape lighting, communication and fire service facilities. To link them directly with the standards, they have been numbered in the same manner.

Uses other than *shops*

For the purposes of the guidance in this Annex (other than in clause 2.C.9b), reference to a *shop* includes all *building* uses (see clause 2.1.1) with a frontage to the mall, for example; cafes, banks or other use tenancies.

2.C.1 **Compartmentation**

The *compartmentation* in an enclosed shopping centre is unlimited, provided an automatic fire suppression system is installed in accordance with clause 2.C.15.

Smoke and Heat Exhaust Ventilation Systems (D3.6, D3.7)

A smoke and heat exhaust ventilation system (SHEVS) should be installed in the mall of an enclosed shopping centre and in *shops* with a *storey* area more than 1,300 m².

SHEVS should be designed in accordance with the principles set out in the Building Research Establishment Report, BR 368, '[Design methodologies for smoke and heat exhaust ventilation](#)' (1999), as read in association with [CIBSE Technical Memorandum 19](#) (1995) and in accordance with the following where appropriate:

- a. the underside of the mall roof should be divided into smoke reservoirs, each of which should be not more than 2000 m² in area and at least 1.5 m deep measured to the underside of the roof or to the underside of any high level plant or *ducts* within the smoke reservoir or the underside of an imperforate suspended ceiling;
- b. the smoke reservoirs should be formed by fixed or automatically descending smoke curtains which are no greater than 60 m apart, measured along the direction of the mall, and follow the guidance in BS 7346: Part 1:1990;
- c. smoke should not be allowed to descend to a height of less than 3 m above any floor level;
- d. each smoke reservoir should be provided with the necessary number of smoke *ventilators* or extract fans to extract the calculated volume of smoke produced, spaced evenly throughout the reservoir;
- e. where mechanical extraction is used, there should be spare fan capacity equivalent to the largest single fan in the reservoir which will operate automatically on the failure of any one of the fans, or which runs concurrently with the fans;
- f. any fans, *ducts* and reservoir screens provided should be designed to operate at the calculated maximum temperature of the smoke within the reservoir in which they are located, but rated to a minimum of 300° C for 30 minutes, in accordance with BS 7346: 1990 or BS EN 12101-3: 2003;
- g. structures supporting any fans, *ducts* or reservoir screens should have the same performance level as the component to be supported;
- h. the fans or *ventilators* within the affected smoke reservoirs should operate:
 - on the actuation of any automatic fire suppression system; or
 - or actuation of the smoke detection system within the reservoir; or
 - on the operation of more than one smoke detector anywhere in the shopping centre; or
 - following a delay not exceeding 4 minutes from initiation of the first fire alarm signal anywhere in the shopping centre;
- i. replacement air should be provided automatically on the operation of the ventilation or exhaust system at a level at least 0.5 m below the calculated level of the base of the smoke layer;
- j. any power source provided to any elements of the smoke and heat exhaust ventilation system should be connected by mineral insulated cables or by cables which are code A category specified in BS 6387: 1994 or by cables protected from damage to the same level;

- k. an automatically switched standby power supply provided by a generator should be connected to any fans provided as part of the smoke and heat ventilation system capable of simultaneously operating the fans in the reservoir affected and any of the two adjacent reservoirs;
- l. simple manual overriding controls for all smoke exhaust, ventilation and air input systems should be provided at all fire service access points and any fire control *room* provided;
- m. where outlets are provided with weather protection, they should open on the activation of the fan(s) or *ventilators*;
- n. smoke from areas adjoining the smoke reservoirs should only be able to enter one reservoir;
- o. where there is an openwork ceiling, the free area of the ceiling should not be less than 25% of the area of the smoke reservoir, or, for natural ventilation, 1.4 times the free area of the roof mounted fire *ventilator* above (3 times where the height from floor to roof *ventilator* is more than 12 m), whichever free area is the greater, and be evenly distributed to prevent an unbalanced air flow into the reservoir; and
- p. when a natural ventilation system is used and the smoke reservoir includes a suspended ceiling, other than an openwork ceiling, the free area of the *ventilator* opening in the suspended ceiling, or any *ventilator* grille in the ceiling, should not be:
 - less than 1.4 times (3 times where the height from floor to roof *ventilator* is more than 12 m) that of the roof mounted fire *ventilator* above in the case of a *ventilator* opening; or
 - 2 times (3.5 times where the height from floor to roof *ventilator* is more than 12 m) for any *ventilator* grille.

2.C.2 Separation (D5.1)

Minimum width of mall

A *separating wall* is not necessary between a *shop* and a mall. However, this exemption does not apply to *shops* having mall-level *storey* areas more than 2000 m² that are located opposite each other. In such cases, at least 1 *shop* should be separated from the mall by a *separating wall*. Opposing *shop* frontages are those which make an angle of less than 80 degrees with each other.

The mall width should at no point be less than 6 m. However, hard mall seating or similar controlled furniture can be ignored when measuring the minimum width of the mall.

2.C.9 Escape (E5.1, E5.2, E7.1,)

General guidance for escape

An enclosed shopping centre should be so designed that:

- from every part of the mall and from every mall-level *shop* there should be at least 2 directions of travel leading to a *place of safety* without passing through any space in single occupation. However, this does not apply to a kiosk of not more than 25 m² and in which either the general public are not admitted, or the depth the kiosk from the mall is not greater than 5 m;
- each *shop* having a frontage to the mall should be provided with an alternative *escape route* that is not through the mall;
- the travel distances in the mall should be limited to 9 m in one direction of travel and 45 m in more than one direction of travel.
- in a *shop*, the travel distance is 15 m in one direction and 32 m in more than one direction. The travel distance from a mall-level *storey* of a *shop* may be measured to the mall;

- in the case of an *upper storey* in a *shop*, an *escape stair* may lead to the mall provided an alternative *escape route* is provided from that level which is not through the mall.

Occupancy Capacity

(Reg.7, sch.4)

The occupancy capacity is obtained by dividing the area in square metres by the relevant occupancy load factor. The calculation necessary to provide the occupancy capacity of a shopping centre with a mall should take account of sub-clauses a. and b. below:

a. Occupancy capacity of the entire shopping centre

When calculating the occupancy capacity of the entire shopping centre, all mall areas up to a maximum width of 6 m should be calculated using an occupancy load factor of 0.7. All remaining areas beyond the 6 m should use an occupancy load factor of 2.0. Food courts forming part of the mall should use an occupancy load factor of 1.0. An additional factor of safety is also applied when calculating the occupancy capacity of the entire shopping centre and a nominal occupancy loading is applied to all non-mall areas. For example, the occupancy load factor for *shops* and all other use tenancies should be taken as 4.0. Once established, all the figures should be added together to give the overall occupancy capacity of the entire shopping centre;

b. Occupancy capacity of shops

When calculating the occupancy capacity of the individual *shops* (or other use tenancies) the occupancy load factors in the table to clause 2.9.2 should be used as appropriate.

Mall escape widths

(E7.2, E7.4)

The aggregate unobstructed width, in mm, of all *escape routes* from a mall should be at least 2.65 multiplied by the occupancy capacity of the entire shopping centre as described above.

A *shop* of more than 1300 m² in area at mall level, where the means of escape has been designed independently of the mall, need not be included in this calculation. Similarly, a kiosk not exceeding 25 m² which is not accessible to the general public, or the depth the kiosk from the mall is not more than 5 m, need not be included in the calculation.

The unobstructed width of each individual *exit* from the mall should be at least 1.8 m wide. However, the designer of the shopping centre should take account of localised areas where the occupancy levels will be higher than in other parts of the shopping centre. In such cases, a wider *exit* would be appropriate in those parts of the shopping centre. In addition, it is recommended that the entrances accessible to the general public are designed with the greatest *escape route* width as evacuees will tend to use the access and egress routes with which they are most familiar.

Shop escape width

(E7.3, E7.5)

The aggregate unobstructed *exit* width, in mm, from each *shop* and the unobstructed *exit* width of a route, or routes, which do not enter the mall should be at least 5.3 x the occupancy capacity of the *shop*. An occupancy load factor of 2.0 should be applied to *shops*. In the case of all other use tenancies listed in clause 2.1.1, the occupancy load factors in the relevant table to clause 2.9.2 should be followed.

A *shop* with a *storey* area at mall level more than 1300 m² where the means of escape has been designed independently of the mall need not be included in this calculation. Similarly, a kiosk not exceeding 25 m² which is not accessible to the general public, or the depth the kiosk from the mall is not more than 5 m, need not be included in the calculation.

Service corridors (E7.6, E7.7)

Where a service corridor is used for means of escape directly from a *shop* or *shops*, the unobstructed width should be based on the total number of occupants of the largest *shop* that evacuates into the corridor, plus (other than at column positions) an additional width of 1 m to allow for goods in transit. Where a service corridor is used as an *escape route*, it should not be used for any form of storage.

Crèches (E7.8)

Every crèche provided within an enclosed shopping centre should be designed so that it is:

- at ground level or *exit* level; and
- not sited on a *storey* higher than those where parents or guardians may be located, unless escape is via the *upper storey* itself; and
- located adjacent to an *external wall* and has at least 2 *exits*, one of which should be directly to a *place of safety*.

2.C.10 Escape lighting

An enclosed shopping centre should be provided with emergency lighting in all mall areas and all *protected zones* and *unprotected zones*. Emergency lighting should be installed so that it is not rendered ineffective by smoke filled reservoirs.

2.C.11 Communication (E11.3)

Automatic fire detection and alarm systems in enclosed shopping centres can increase significantly the level of safety of the occupants.

An enclosed shopping centre, should be provided with an automatic fire detection and alarm system, designed and installed in accordance with the guidance in BS 5839: Part 1: 2002 Category L1 and in accordance with the following recommendations:

- a. the fire alarm should be activated upon the operation of the sprinklers; or
- b. manual call points as specified in BS EN 54: Part 11: 2001 (Type A); or
- c. on the activation of the alarm in a *shop*, evacuation may be restricted to the *shop* concerned for a grace period of not more than 4 minutes, unless during that time there is further detection in the mall, in which case the evacuation of the shopping centre should be commenced. Notwithstanding this grace period, immediately upon activation of the alarm a message should be sent to an appropriate fire station or manned agency; or
- d. in the case of the activation of the alarm anywhere other than in an individual *shop*, or on activation of sprinklers anywhere within the shopping centre, evacuation should be commenced immediately and there is no grace period;
- e. all areas of the shopping centre, including *shops*, should be alerted using a voice alarm system which follows the guidance in BS 5839: Part 8: 1998, however, individual *shops* may use conventional sounders within the *shop* itself;

- f. the fire alarm system should be interfaced with other fire safety systems, to operate automatically in the correct zones. On the operation of the fire alarm:
- all escalators should come to a controlled halt and lifts should return to the *ground storey* (or *exit* level);
 - all systems within the mall or *shops* which play amplified music are silenced;
 - any smoke dampers installed to prevent the siphoning of smoke are activated; and
 - subject to the 4 minute grace period where appropriate, all air-moving systems, mains and pilot gas outlets, combustion air blowers and gas, electrical and other heating appliances in the reservoir are shutdown;
- g. the main fire alarm system control panel is installed within the control *room* and indicator (or repeater) panels are provided at each of the fire-fighting access points.

2.C.14 Fire service facilities

Fire control rooms

(E10.12)

An enclosed shopping centre should have a fire control *room*:

- *constructed* as a separate *compartment* (see guidance to standard 2.1); and
- have access points away from the discharge points for the general public; and
- be provided with an alternative means of escape; and
- be located adjacent to a fire service access point and accessible from the open air.

Horizontal dry fire main

(E10.6)

Every single-storey enclosed shopping centre should be provided with a dry fire main with an outlet located not more than 5 m from a fire service access point or points. However, a dry fire main need not be provided where no point within the *storey* (not being a *protected zone*) is more than 60 m measured along an unobstructed route for the fire hose, from the access point or points.

2.C.15 Automatic life safety fire suppression systems

An automatic life safety fire suppression system should be installed in an enclosed shopping centre and cover the entire area, other than:

- a mall or part of a mall with a ceiling height more than 10 m; and
- a stairway enclosure; and
- a car park; and
- every area where sprinklers would prove to be a hazard (e.g. main electrical switchgear).

The level of fire suppression should be appropriate to the occupancies within the enclosed shopping centre and should be determined on the basis of a risk assessment. The system should be designed and installed in accordance with the '[Rules for Automatic Sprinkler Installations](#)' LPC 1994, including all additional life safety recommendations. The type of sprinkler head should be a 'quick response' type with a response time index (RTI) of not more than 50 (m.s)^{1/2}.

Annex
2.D Resistance to fire

- 2.D.0 Introduction
- 2.D.1 Fire resistance duration
- 2.D.2 Single-storey steel portal frame buildings
- 2.D.3 Steel framed open sided car parks
- 2.D.4 British Standards and associated specifications
- 2.D.5 Harmonised European Standards

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Resistance to fire

2.D.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 duration 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 duration for structural and non-structural fire protection. For example, in a large intense fire, a British or European Standard 30 minute *fire door* may not last for more than the few minutes necessary to evacuate the *building*.

Transitional period

2.D.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.

British and European fire tests will coexist in use until the British Standard classifications are withdrawn.

2.D.2 Single-storey steel portal frame buildings

In the case of a single-storey steel portal frame *building constructed* in accordance with the guidance in clause 2.3.1, the columns of the portal frame should be designed with fixed column base connections. Alternatively, the portal frame may be designed in accordance with the publication '[Single storey steel framed buildings in fire boundary conditions](#)' published in October 2002 by The Steel Construction Institute (SCI-P313).

A steel portal frame member supporting or forming part of a *separating wall* or *compartment wall*, the enclosing structure of a *protected zone* or an *external wall* requiring a fire resistance duration (as in the guidance to standard 2.6), should also be fire resisting. The fire resistance duration should only be applied to that part of the member built into or directly supporting the wall up to the underside of the haunch or the underside of the rafter where there is no haunch, and shall not apply to any other part notwithstanding that it is part of the same portal frame.

Where a gable steel portal frame member attracts a fire resistance duration because of its proximity to the *boundary* (see guidance to standard 2.6), the entire portal frame should have the same fire resistance duration.

2.D.3 Steel framed open sided car parks

Where the topmost *storey* of a steel framed *open sided car park* is at a height of not more than 18 m above ground, the following alternative guidance to standard 2.1 could be use for the structural frame, columns and beams:

- a. beams supporting concrete floors, each beam having a maximum $H_p/A = 230 \text{ m}^{-1}$; and
- b. free standing columns, each having a maximum $H_p/A = 180 \text{ m}^{-1}$; and
- c. wind bracing and struts, each having a maximum $H_p/A = 210 \text{ m}^{-1}$.

Where H_p = heated perimeter of the section in m, and
 A = gross cross-sectional area of the section in m^2 .

2.D.4 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 are:

- 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,
 - for *fire door* assemblies with non-metallic leaves, BS 8214: 1990, Sections 1 and 2;

- b. 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);
- c. for the structural use of timber, BS 5268: Part 4: Sections 4.1 and 4.2: 1990;
- d. for the structural use of concrete, BS 8110: Part 2: 1985, Section 4.3 'Tabulated data (method 1)';
- e. an appropriate specification given in the Building Research Establishment Report BR 128 '[Guidelines for the Construction of Fire Resisting Structural Elements](#)' (BRE 1988).

2.D.5 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

Fire resistance duration 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. <i>Compartment floor, separating floor</i> or a floor, <i>flat roof</i> or <i>access deck</i> protecting routes of escape (see clause 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. Floor, other than a floor in 2.	Short	30	None	None	R 30	From the underside
	Medium	60	None	None	R 60	
	Long	120	None	None	R 120	
4. Fire shutter in a <i>compartment floor</i> (see clause 2.1.15)	Short	None	30	None	E 30	From the underside when fitted in frame
	Medium	None	60	None	E 60	
	Long	None	120	None	E 120	
5. <i>Compartment wall, sub-compartment wall, separating wall</i> , or an internal wall or screen used as a protected route of escape (see clause 2.0.2)	Short	30 [4]	30	30 [5]	REI 30 [4,5]	Each side separately
	Medium	60 [4]	60	60	REI 60 [4]	
	Long	120 [4]	120	120	REI 120 [4]	
6. Load-bearing wall, other than a wall in 5	Short	30	None	None	R 30	Each side separately
	Medium	60	None	None	R 60	
	Long	120	None	None	R 120	
7. <i>Fire door</i> in a wall in 5	Short	None	30 [6]	None	E 30 Sa [6]	Each side separately, when fitted in frame [8]
	Medium	None	60 [6]	None	E 60 Sa [6]	
	Long	None	120 [6, 7]	None	E 120 Sa [6, 7]	
8. Fire shutter in a <i>compartment wall</i> (see clause 2.1.15) or in a wall or screen protecting routes of escape (see clause 2.0.2)	Short	None	30	30 [9]	EI 30 [9]	Each side separately, when fitted in frame [8]
	Medium	None	60	60 [9]	EI 60 [9]	
	Long	None	120	120 [9]	EI 120 [9]	
9. <i>External wall</i> more than 1 m from a <i>boundary</i> [1, 2]	Short	30 [4]	30	None	RE 30 [4]	From the inside only
	Medium	60 [4]	60	30	RE 60 & I 30 [4]	
10. <i>External wall</i> not more than 1 m from a <i>boundary</i> [1, 2]	Short	30 [4]	30	30	REI 30 [4]	From the inside only
	Medium	60 [4]	60	60	REI 60 [4]	

Continued overleaf

fire resistance duration for common *building* elements or components (continued)

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Construction	Fire resistance duration	British Standards			European Standards	Test exposure
		LBC (mins)	Integrity (mins)	Insulation (mins)		
11. Horizontal <i>cavity barrier</i> [3]	Short	None	30	None	E 30	From the underside
12. Vertical <i>cavity barrier</i> [3]	Short	None	30	None	E 30	Each side separately
13. Ceiling dispensing with a <i>cavity barrier</i> (see clauses 2.4.2b, 2.4.2c, 2.4.3 and 2.4.4)	Short	None	30	30	EI 30	From the underside
14. Roof against an <i>external wall</i> (see Annex 2.A.1)	Medium	None	60	60	EI 60	From the inside

Notes:

1. An *external wall* includes an *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 shutter or door in an *external wall*, which is not included in the calculation of unprotected area, should have the same fire resistance duration and the same test exposure as the *external wall*.
3. In a timber or metal 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. None in the case of column 5 and E30 in the case of column 6 for a single openable window not more than 1 m² in:
 - a. a fire hazard *room* as described in Annex 2.A and Annex 2.B; or
 - b. a *room, toilet* or washroom in a *protected zone* as described in clause 2.9.23.
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 3m³/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. Medium fire resistance duration is sufficient for a *fire door* in the enclosing structure of a fire-fighting shaft (see clause 2.1.10).
8. 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.
9. None in the case of column 5, and no insulation (I) in the case of column 6, where;
 - a. the width of the fire shutter or the aggregate width of any fire shutters in the wall or part of the wall is not more than one-quarter of the length of the relevant part of the wall; or
 - b. people or vehicle circulation routes are clearly marked and will prevent any fire load adjacent to the shutter (e.g. at stairs, escalators, lifts and corridors).

2.D.Table

Annex
2.E Reaction to fire

- 2.E.0 Introduction
- 2.E.1 Reaction to fire classification
- 2.E.2 British Standards and associated specifications
- 2.E.3 Harmonised European Standards

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Reaction to fire

2.E.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 expressed in terms of risk throughout the handbook. Some materials are deemed intrinsically to be *non-combustible* and therefore do not need to be tested.

2.E.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 reaction to fire (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.

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.

Transitional period

British and European fire tests will coexist in use until the British Standard classifications are withdrawn.

2.E.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.E.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* and *building* elements within the scope of the *construction products directive*.

Reaction to Fire

Column 1	Column 2	Column 3
Risk	British Standards	European Standards [1]
<i>Non-combustible</i>	<p>The material is certified <i>non-combustible</i> throughout according to the test specified in BS 476: Part 4: 1970 (1984); or</p> <p>The material does not flame or cause any rise in temperature on either the centre (specimen) or furnace thermocouples according to the test specified in BS 476: Part 11: 1982 (1988).</p>	<p>The material has achieved a classification of A1 when tested in accordance with BS EN ISO: 1182 and BS EN ISO: 1716; or</p> <p>The material has achieved a classification of A2-s3, d2 when tested in accordance with BS EN: 13823 and BS EN ISO: 1182 or BS EN ISO: 1716; or</p> <p>Products made from 1 or more of the materials considered as Class A1 without the need for testing, as defined in Commission Decision 96/603/EC of 4th October 1996 establishing the list of products belonging to Class A1 “No contribution to fire” provided for in the Decision 94/611/EC implementing Article 20 of the Council Directive 89/106/EEC on the <i>construction products</i>. None of the materials contain more than 1.0% by weight or volume (whichever is the lower) of homogeneously distributed organic material.</p>
Low risk	The surface material or where it is bonded throughout to a substrate, the surface material combined with the substrate) has a surface of Class 1 and, when tested in accordance with BS 476: Part 6: 1981 or BS 476: Part 6: 1989 has an index of performance (I) not more than 12 and a sub-index (i ₁) not more than 6.	The material has achieved a classification of B-s3, d2 or better when tested in accordance with BS EN: 13823 and BS EN ISO: 11925-2
Medium risk	The material of the wall or ceiling when tested to BS 476: Part 7: 1987 (1993), attains a Class 1 surface spread of flame	The material has achieved a classification of C-s3, d2 or better when tested in accordance with BS EN: 13823 and BS EN ISO: 11925-2
High risk	The material of the wall or ceiling when tested to BS 476: Part 7: 1987 (1993), attains a Class 2 or Class 3 surface spread of flame.	The material has achieved a classification of D-s3, d2 or better when tested in accordance with BS EN: 13823 and BS EN ISO: 11925-2
Very high risk	A material which does not attain the recommended performance for high risk	

Notes

1. When a classification includes “s3, d2” this means that there is no limit set for smoke production and/or flaming droplets/ particles.

2.E.Table

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- 3.15 Condensation (does not apply to buildings other than domestic buildings)
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- 3.17 Combustion appliances – safe operation**
- 3.18 Combustion appliances – protection from products of combustion**
- 3.19 Combustion appliances – relationship to combustible materials**
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- 3.23 Oil storage – protection from fire**
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- 3.26 Dungsteeds and farm effluent tanks**

3.0 Introduction

- 3.0.1 Background
- 3.0.2 Aims
- 3.0.3 Latest changes
- 3.0.4 Relevant legislation

introduction

3.0**3.0.1 Background**

Water, air and soil are intricately linked and all can be affected by various forms of pollution that affect our environment. Other issues such as condensation have been a constant threat to people and *buildings* for many years.

Industrial change and demographic shift during the 19th and 20th centuries resulted in large-scale re-organisation of our villages, towns and cities. Industries moved out or disappeared altogether leaving large, 'brownfield', gaps in our landscape. At the same time, changes in heating methods and the advent of the consumer society, have had a significant effect on the type and volume of refuse it has been necessary to dispose of to landfill. Inevitably, these changes have left behind a legacy of land contamination that in some cases, may be harmful. The Scottish government encourages the use of previously developed land (brownfield) and local authorities may wish to promote brownfield land in preference to greenfield land. Some of this land will be contaminated and will need to be made safe.

Climate is controlled by the long-term balance of energy of the Earth and its atmosphere. Natural events cause changes in climate but human activities can also change the climate. The accumulation of greenhouse gases in the atmosphere due to human activities will change the climate by enhancing the natural greenhouse effect, leading to an increase in the Earth's average surface temperature resulting in heavier rainfall.

Indoor air quality complaints are frequently associated with 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 *buildings* 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 land fill 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 *buildings*, and people in and around *buildings* 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 *building*;
- e. inadequate drainage from a *building* and from paved surfaces around a *building*;
- f. inadequate and unsuitable *sanitary facilities*;
- g. inadequately *constructed* and installed combustion appliances;
- h. inadequately *constructed* and installed oil storage tanks;

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 additional guidance provided on hazard identification
- 3.1.5 additional guidance on treatment of ground contamination
- 3.1.7 additional guidance on land contamination produced by NHBC
- 3.1.8 replacement of out-of-date guidance with relevant references
- 3.2.0 advice on regulations on radon gas in the workplace
- 3.3.1 warning about *surface water* run-off from land under development
- 3.5.3 guidance on *re-construction* of existing 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 soakaways for small *buildings*
- 3.7.1 guidance on European sanitary pipework systems
- 3.7.4 clarification on provision of disconnecting manholes
- 3.14.4 guidance on extensions built over existing windows
- 3.17.1 change to rating of oil-firing combustion appliances
- 3.17.3 change to rating of oil-firing combustion appliances
- 3.17.6 requirement for safety valves on oil-firing appliances
- 3.17.8 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 oil storage tanks

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.

[Workplace, \(Health, Safety and Welfare\) Regulations 1992](#)

The Workplace, (Health, Safety and Welfare) Regulations 1992 cover the key issues for inspection and enforcement by local authorities on matters relating to the physical characteristics of the workplace such as: temperature, lighting, cleanliness and sanitary conveniences.

[Control of Pollution Act 1974](#)

The Control of Pollution Act 1974 covers, among others, duties and powers of the local authority to control and dispose of solid waste and control discharges to controlled waters.

[Clean Air Act 1993](#)

The Clean Air Act 1993 control emissions from domestic premises and from certain industrial processes which fall outwith the provisions of the Environmental Protection Act.

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

[The Ionising Radiations Regulations 1999](#)

The Ionising Radiations Regulations 1999 cover, among others, general principles and procedures, the arrangements for the management of radiation protection and the duties of employers.

[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

- 3.1 Functional standard
- 3.1.0 Introduction
- 3.1.1 Preparation of a site
- 3.1.2 Harmful or dangerous substances
- 3.1.3 Hazard identification and assessment
- 3.1.4 Development on land that may be contaminated
- 3.1.5 Land not initially identified as contaminated
- 3.1.6 Risk management techniques
- 3.1.7 Land affected by contamination
- 3.1.8 Re-development of industrial land

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.

Environmental Protection Act 1990

3.1.0 Introduction

Land contamination is an unwanted legacy of Britain’s long industrial history. Part IIA of the [Environmental Protection Act 1990](#) (inserted by section 57 of the Environment Act 1995) was introduced to enable the identification and remediation of contaminated land from which contamination currently represents an unacceptable risk. Risks associated with the land’s future use will continue to be dealt with under the planning and building standards system. Some functions of Part IIA, planning and building standards regimes may, at times, overlap.

Public registers

Part IIA adopts a ‘suitable for use approach’ that requires the current risks to be assessed and remediated as required, for a site’s existing use. The primary regulatory role for this rests with the local authorities. Local authorities and SEPA must establish public registers to record all prescribed regulatory action taken under Part IIA. The register will contain particulars relating to the remediation, as well as notifications of the identification of contaminated land. The registers will expand as new information is identified.

Section 78A(2) of the Act (as amended) provides a specific definition of ‘contaminated land’ for the purpose of the Act. Land that is not ‘contaminated land’ as defined under the Act may still contain harmful or dangerous substances and the following guidance should be useful to the local authority in carrying out its other functions.

PAN 33

Land 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)

‘ground immediately adjoining’

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*.

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 *building* 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 <i>construction</i> is to be free from unventilated voids
	corrosive liquids	removal, filling, sealing or treatment
	faecal, animal and vegetable matter (biologically active)	removal, filling or treatment
Drums and containers (whether full or empty)	various	removal with all contaminated ground

The verifier may require the removal of any of the contaminants in the table to clause 3.1.5, to be carried out by specialists.

If any signs of possible contaminants are present, the local authority 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.

www.ciria.org.uk

3.1.6 Risk management techniques

(Appendix to G)

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 covered 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 a impermeate 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

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

3.1.7 Land affected by contamination

The National House Building Council (NHBC), together with the Environment Agency, has produced a guidance document 'Guidance for the Safe Development of Housing on Land Affected by Contamination'. Although relating primarily to *dwelling*s, the document provides useful guidance for all *building* types. It aims to promote the adoption of good practice in the identification, investigation, assessment and remedial treatment of land affected by contamination, so that the development of housing on such land can be undertaken safely and with confidence that no unacceptable risks remain.

www.nhbc.co.uk

3.1.8 Re-development of industrial land

(Appendix to G)

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

- 3.2 Functional standard
- 3.2.0 Introduction
- 3.2.1 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 *buildings*, the *external walls* contain it and the containment of radon can build up inside the *buildings* over the long term posing a risk to health.

Exposure to high levels of radon for long periods increases the risk of developing lung cancer. To reduce the risk, all new *buildings*, extensions and *conversions*, built in areas where there might be radon concentration, may need to incorporate precautions against radon.

Occupational exposure to natural radiation sources, including radon gas, is now the subject of regulatory control. This is in line with the most recent revision to the Euratomic Basic Safety Standards Directive ([Council Directive 96/29/EURATOM](#)) that establishes a common basis for radiation protection legislation in all European Member States. Regulation 3 of the Ionising Radiations Regulations 1999 (SI 1999/3232) sets a national reference level for radon gas in workplaces of 400 Bq/m³ averaged over any 3 month period. An employer or self-employed person responsible for a workplace is required to measure radon levels in the workplace on being directed to do so.

If radon levels are found to be in excess of the reference level, the regulations require that measures be taken to safeguard the health of workers. These are:

- a. the employer must evaluate whether remedial measures to reduce the radon levels in the workplace should be undertaken;
- b. where this evaluation shows that radon remedial measures are justified the employer must implement such measures as soon as practicable;
- c. where remedial measures are shown to be justified, or where they fail to bring levels below the reference level, the employer must apply radiation protection measures. Such measures might, for example include:
 - organisation of work schedules to reduce exposure;
 - making and keeping of exposure records;
 - medical surveillance;
 - controlling access to parts of the workplace where radon levels have been shown to be high.

Ionising Radiations
Regulations 1999

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 Protection from radon gas (G2.1)

‘ground immediately adjoining’

Although a *site*, and ground immediately adjoining a *site*, should have radon gas made safe so that it is not allowed to be contained in a *building* at levels that are considered harmful to health, little research has been carried out on protection measures to *buildings* other than *dwellings*. The term ‘ground immediately adjoining’ is intended to cover ground that is disturbed as a direct result of the *works*.

Workplaces are less of a risk than *dwellings* because, generally speaking, people spend less time at work than at home and workplaces generally have better ventilation provision.

national reference level

Large *buildings* tend to be mechanically ventilated and this will result in the dilution of radon gas. The national reference level of 400 Bqm³ in workplaces makes it easier to stay within the level than the lower action level of 200 Bqm³ for *dwellings*. Although research into the protection of large *buildings* is needed, it is reasonable to conclude that an impervious membrane with securely welted joints laid over the full area of the *building* will help reduce radon ingress into the *building*. More appropriate guidance may be obtained from the Building Research Establishment at East Kilbride and the pamphlet ‘[Radon at Work](#)’ produced by the National Radiological Protection Board may also be of help.

www.bre.co.uk

www.nrpb.org

Radon protective measures, as explained and detailed in BRE publication BR376 – ‘[Radon: guidance on protective measures for new dwellings in Scotland](#)’, has been produced mainly for new *dwellings* but the guidance can also be useful for protecting any small *building*.

3.3 Flooding and ground water

- 3.3 Functional standard
- 3.3.0 Introduction
- 3.3.1 Ground liable to flooding
- 3.3.2 Construction in flood risk areas

<p>standard 3.3 mandatory</p>	<p>Every <i>building</i> must be designed and <i>constructed</i> in such a way that there will not be a threat to the <i>building</i> or the health of the occupants as a result of flooding and the accumulation of ground water.</p>
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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.uk

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 small, domestic sized 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)

SPP 7

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.

Ground below and immediately adjoining a *building* 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 *building* means the area where any ground water would affect the structural stability of the *building*. 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 land

With the removal of topsoil from a development site, developers should be aware of the dangers from possible *surface water* run-off from their *building site* to other properties. It is good practice to have procedures in place to overcome this occurrence. Depending on conditions, the formation of channels or small dams to divert the run-off or, where conditions are particularly serious, the installation of field drains or rubble drains may overcome the problem.

Design Guidance on Flood Damage to Dwellings 1996

3.3.2 Construction in flood risk areas

Where it is intended to develop in areas that may be at some risk of flooding, guidance on precautionary measures that can be taken is given in 'The Design Guidance on Flood Damage to Dwellings 1996'. Although primarily intended for *dwellings*, 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.

3.4 Moisture from the ground

- 3.4 Functional standard
- 3.4.0 Introduction
- 3.4.1 Treatment of building elements adjacent to the ground
- 3.4.2 Ground supported concrete floors
- 3.4.3 Suspended concrete floors
- 3.4.4 Suspended timber floors
- 3.4.5 Walls at or near ground level
- 3.4.6 Floors at or near ground level
- 3.4.7 Structures below ground, including basements

standard

3.4

mandatory

Every *building* must be designed and *constructed* in such a way that there will not be a threat to the *building* or the health of the occupants as a result of moisture penetration from the ground.

3.4.0 Introduction

Water is the prime cause of deterioration in *building* materials and *constructions* and the presence of moisture encourages growth of mould that is injurious to health. Ground water can penetrate *building* fabric from below, rising vertically by capillary action. The effects of this rising damp are immediately recognisable. There may be horizontal ‘tidemarks’ sometimes several feet above the floor; below it the wall is discoloured with general darkening and patchiness. There may also be loose wallpaper, signs of mould growth and deterioration of plaster. Hygroscopic salts brought up from the ground tend to concentrate in the ‘tidemark’.

Buildings 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
Conversions

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 adjoining the ground should prevent moisture from the ground reaching the inner surface of any part of a *building* that it could damage.

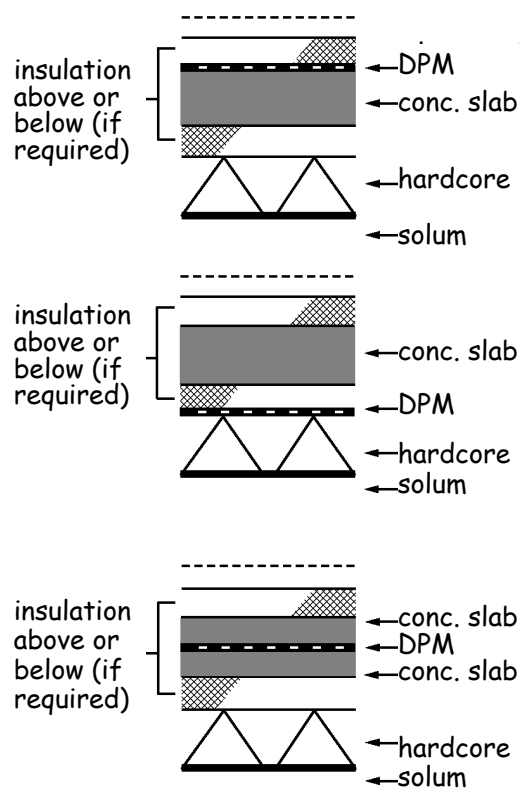
Floors, walls or other *building* elements adjoining the ground should be *constructed* in accordance with the following recommendations. The dimensions specified are the minimum recommended; greater dimensions may therefore be used.

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

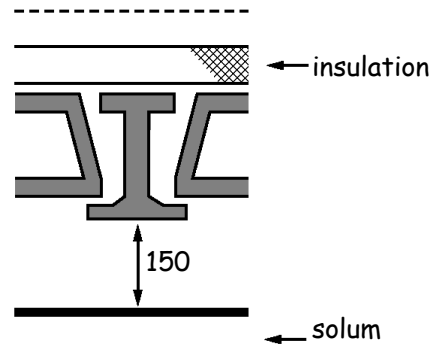


3.4.3 Suspended concrete floors

(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.

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 mm² for at least every metre run of the wall, or 500 mm² for at least every square metre of floor area, this open area also being provided in internal sleeper walls or similar obstructions to maintain the underfloor ventilation; the ventilated space to be 150 mm to the underside of the floor slab or beams.

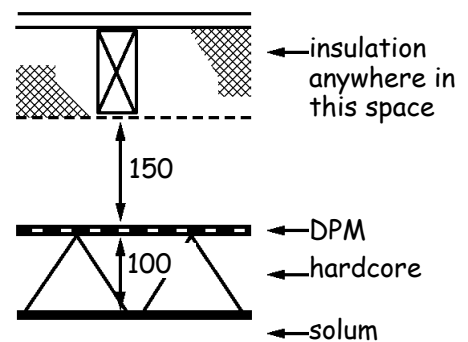


Ventilation of the underbuilding

3.4.4 Suspended timber floors

(G2.3)

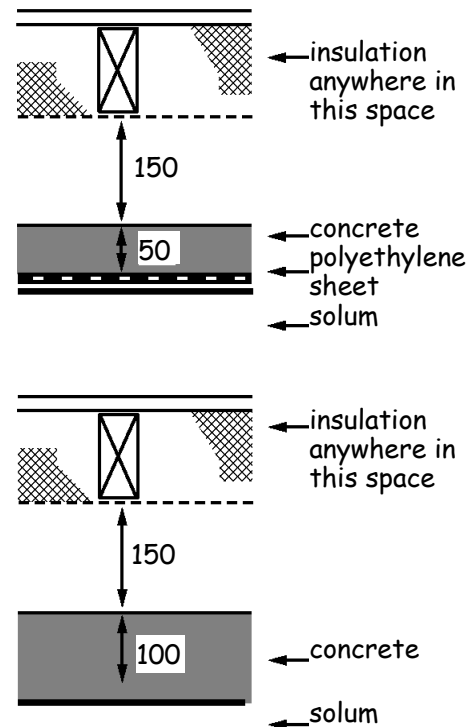
The solum is brought to an even surface; any upfilling to be of hard, inert material. Hardcore bed as for clause 3.4.2; with either a dpm in accordance with Section 3 of CP 102: 1973; or concrete 50 mm thick laid on 0.25 mm (1000 gauge) polyethylene sheet; or concrete 100 mm thick; so that in any case 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 mm² for at least every metre run of the wall, or 500 mm² for at least every square metre of floor area, this open area also being provided in internal sleeper walls or similar obstructions to maintain the 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 3.4.5 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

- 3.5 Functional standard
- 3.5.0 Introduction
- 3.5.1 Existing drains
- 3.5.2 Re-routing of drains
- 3.5.3 Re-construction of drains
- 3.5.4 Drains passing through structures
- 3.5.5 Sealing disused drains

standard

3.5

mandatory

Every *building* must not be *constructed* over an existing drain (including a field drain) that is to remain active.

Limitation

This standard does not apply where it is not *reasonably practicable* to 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
Scottish Water

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*.

It would be unreasonable for drains to be re-routed around a limited-life *building*, but care should be taken that no undue loading is transmitted to the drain that might cause damage.

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 *building* 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 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.

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 places for rats. In order to prevent this, they should be disconnected from the drainage system as near as possible to the point of connection. This should be done in a manner that does not damage any pipe that is still in use and ensures that the sewer system is watertight. This may be carried out, for example, by removing the pipe from a junction and placing a stopper in the branch of the junction fitting. Where the connection is to a public sewer, the Water Authority should be consulted.

Sewers and drains less than 1.5 m from the surface and in open ground should be, as far as *reasonably practicable*, removed. Other pipes should be capped at both ends and at any point of connection, to ensure rats cannot gain entry.

3.6 Surface water drainage

- 3.6 Functional standard
- 3.6.0 Introduction
- 3.6.1 Surface water drainage from buildings
- 3.6.2 Surface water drainage of paved surface areas
- 3.6.3 Surface water discharge
- 3.6.4 Sustainable urban drainage systems
- 3.6.5 Soakaways serving small buildings
- 3.6.6 Surface water run-off from small paved surfaces
- 3.6.7 Traditional piped drainage systems
- 3.6.8 Discharge into a drainage system
- 3.6.9 Testing

<p style="text-align: center;">standard</p> <h1 style="text-align: center;">3.6</h1> <p style="text-align: center;">mandatory</p>	<p>Every <i>building</i>, and hard surface within the <i>curtilage</i> of a <i>building</i>, must be designed and constructed with a surface water drainage system that will:</p> <p>(a) ensure the disposal of <i>surface water</i> without threatening the <i>building</i> and the health and safety of the people in and around the <i>building</i>; and</p> <p>(b) have facilities for the separation and removal of silt, grit and pollutants.</p>
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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.

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 *building* 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).

SUDS

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 buildings (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 *building* 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 *building*;
- 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 would be acceptable;
- the protection of the *building foundations* from concentrated discharges from gutters.

Gutters and rainwater pipes may be omitted from a roof at any height provided it has an area of not more than 8 m² and no other area drains onto it.

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

Ponding of 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 *building* should be provided with a drainage system to remove *surface water* from paved surfaces, such as a car park or an access route that is suitable for *disabled people*, without endangering the *building* or the health and safety of people in and around the *building*. The paved surface should be so laid as to ensure rainwater run-off is not close to the *building*. Drainage systems should be designed, *constructed* and installed, either:

- a. incorporating SUDS techniques as in clauses 3.6.3 and 3.6.4; or
- b. using a traditional piped drainage system as in clause 3.6.7.

Small paved areas

A paved surface, such as a car park, of less than 200 m² is unlikely to contribute to flooding problems and may be designed to have free-draining run off in accordance with clause 3.6.6.

3.6.3 Surface water discharge (M2.9)

Surface water discharged from a *building* and a hard surface within the *curtilage* of a *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 6.3.4;

- 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 *building*, 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.

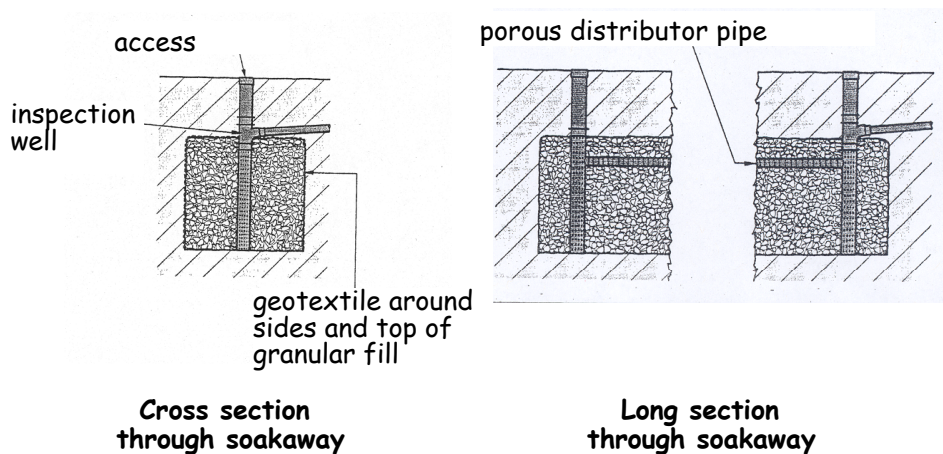
Maintenance responsibility

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

3.6.5 Soakaway serving small buildings

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 small *building*, 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 *building* 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 *building*;
- c. soakaways should be *constructed* in accordance with the following diagram:



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 m²

a is the internal surface area of the soakaway to 50% effective depth, excluding the base in m² (this has to be assumed for initial calculation purposes)

f is the soil infiltration rate, in m/s, determined in accordance with clause 3.9.1 (note that this calculation produces mm/s)

S is the required storage in m³

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, M2.7)

Silt and grit

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.

Oil, grease or volatile substances

Where a discharge into a drainage system contains oil, grease or volatile substances, for example from a vehicle repair garage, there should be facilities for the separation and removal of such substances. The recommendations in the following draft European Standards should be followed:

- a. BS EN 858-1: 2002 for light liquids such as oil or petrol;
- b. BS EN 1825-2: 2002 for grease.

The use of emulsifiers to break up any oil or grease in the drain is not recommended as they can cause problems further down the system.

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

- 3.7 Functional standard
- 3.7.0 Introduction
- 3.7.1 Sanitary pipework
- 3.7.2 Sanitary appliances below flood level
- 3.7.3 Drainage systems outside a building
- 3.7.4 Connections to a public sewer
- 3.7.5 Conversions and extensions
- 3.7.6 Sewers intended for vesting
- 3.7.7 Ventilation of a drainage system
- 3.7.8 Discharges into a drainage system
- 3.7.9 Testing
- 3.7.10 Wastewater discharge

standard

3.7

mandatory

Every *wastewater* drainage system serving a *building* must be designed and *constructed* in such a way as to ensure the removal of *wastewater* from the *building* without threatening the health and safety of the people in and around the *building*, and;

- (a) that facilities for the separation and removal of oil, fat, grease and volatile substances from the system are provided;
- (b) that discharge is to a public sewer or public *wastewater* treatment plant, where it is *reasonably practicable* to do so; and
- (c) where discharge to a public sewer or public *wastewater* treatment plant is not *reasonably practicable* that discharge is to a private *wastewater* treatment plant or septic tank.

Limitation

Standard 3.7(a) does not apply to a *dwelling*.

3.7.0 Introduction

This guidance applies to *wastewater* systems that operate essentially under gravity. The guidance to this standard provides recommendations for the design, *construction* and installation of drains and sewers from a *building* to the point of connection to a public sewer or public sewage treatment works.

The guidance should also be used for all 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 system

System III (single discharge stack system with full bore branch discharge pipes) as described in Clause 4.2 of BS EN 12056-2: 2000 is the traditional system in use in the UK.

Low-flush system

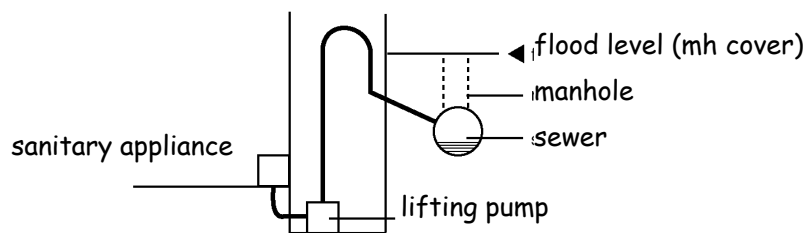
However low water and energy consumption is now a major consideration in any design solution. With this in mind, System II (single discharge stack system with small bore discharge branch pipes) may be appropriate. Careful consideration should be given to the design of the system where a low flush cistern 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 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 *building*, 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

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. A disconnecting chamber (or manhole where the depth is more than 1.2 m) should be provided in accordance with the requirements of Scottish Water in whom it is likely to be vested.

Disconnecting chambers

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)

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 the requirements of '[Sewers for Scotland](#)'.

Sewers for Scotland

3.7.7 Ventilation of a drainage system (M2.3)

A *wastewater* drainage system serving a *building* 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 Discharges into a drainage system (M2.7)

Where a discharge into a drainage system contains oil, fat, grease or volatile substances, for example from a commercial *kitchen*, there should be facilities for the separation and removal of such substances. Separator systems are used in a wide variety of situations to fulfil a number of different requirements. It is important to establish why a separator system is needed and what specific function it is expected to fulfil before selecting the appropriate size and type of installation.

Separators should be *constructed* and installed in accordance with the following draft European Standards:

- a. BS EN 858-1: 2002 for light liquids such as oil or petrol;
- b. BS EN 1825-2: 2002 for fat or grease.

The use of emulsifiers to break up any oil or grease in the drain is not recommended as they can cause problems further down the system.

3.7.9 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*.

3.7.10 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.

Sewerage (Scotland) Act 1968

3.8 Private wastewater treatment systems – treatment plants

- 3.8 Functional standard
- 3.8.0 Introduction
- 3.8.1 Treatment plants
- 3.8.2 Treatment plant covers
- 3.8.3 Inspection and sampling
- 3.8.4 Location of a treatment plant
- 3.8.5 Discharges from septic tanks and treatment plants
- 3.8.6 Access for desludging
- 3.8.7 Labelling

<p>standard 3.8 mandatory</p>	<p>Every private <i>wastewater</i> treatment plant or septic tank serving a <i>building</i> must be designed and <i>constructed</i> in such a way that it will ensure the safe temporary storage and treatment of <i>wastewater</i> prior to discharge.</p>
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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. Occasional 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:

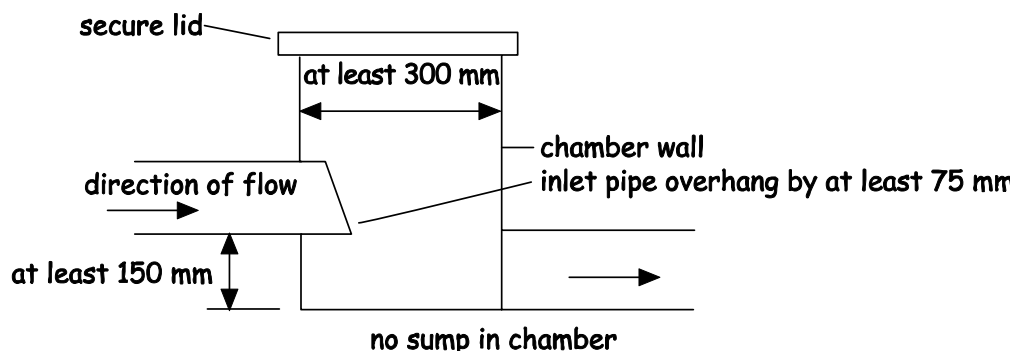
- a. the recommendations of BS EN 12566-1: 2000, for a prefabricated septic tank: or
- b. the recommendations of BS 6297: 1983; or
- c. the conditions of certification by a *notified body*.

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 can 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 *building*. However damage to the *foundations* of a *building* 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 liquid away from the *building*. 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 *building*.

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 consent

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 *building* 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 *building* with a drainage system discharging to a private *wastewater* treatment plant or septic tank should be provided with a label to alert the *occupiers* to such an arrangement. The label should describe the recommended maintenance necessary for the system and should include the following:

‘The drainage system from this property discharges to a wastewater treatment plant (or septic tank, as appropriate). The owner is legally responsible for routine maintenance and to ensure that the system complies with any discharge consent issued by SEPA and that it does not present a health hazard or a nuisance’.

The label should be located adjacent to the gas or electricity consumer unit or the water stopcock.

3.9 Private wastewater treatment systems – infiltration systems

- 3.9 Functional standard
- 3.9.0 Introduction
- 3.9.1 Assessing the suitability of the ground
- 3.9.2 Design of infiltration fields
- 3.9.3 Greywater disposal
- 3.9.4 Location of infiltration fields – pollution
- 3.9.5 Location of infiltration fields – damage to buildings

<p style="text-align: center;">standard</p> <h1 style="text-align: center;">3.9</h1> <p style="text-align: center;">mandatory</p>	<p>Every private <i>wastewater</i> treatment system serving a <i>building</i> must be designed and <i>constructed</i> in such a way that the disposal of the <i>wastewater</i> to ground is safe and is not a threat to the health of the people in and around the <i>building</i>.</p>
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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;
- SEPA's 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:

$$A = p \times Vp \times 0.25$$

where A is the area of the sub-surface drainage trench, in m²;

p is the number of persons served by the tank; and

Vp is the percolation value obtained, as described above, in s/mm

For *wastewater* that has received secondary treatment followed by settlement, this area may be reduced by 20%, i.e.

$$A = p \times Vp \times 0.2$$

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

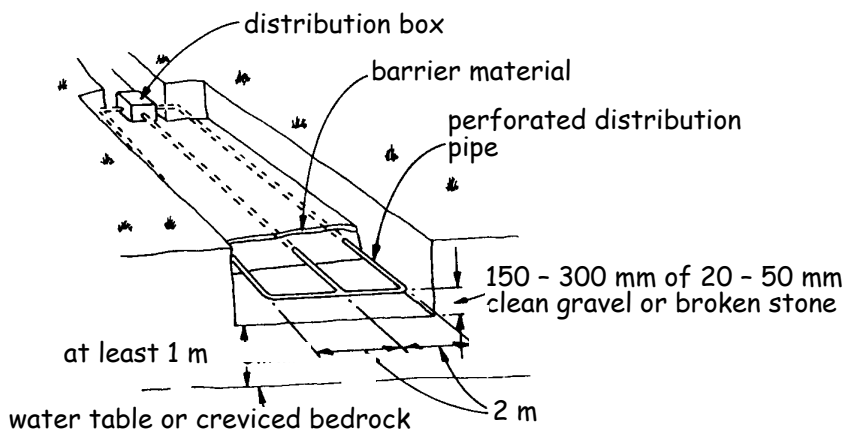
Where the percolation value (as demonstrated by the percolation test) is not more than 15 secs/mm, in accordance with the requirements of SEPA;

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 rate';

Piped infiltration bed system

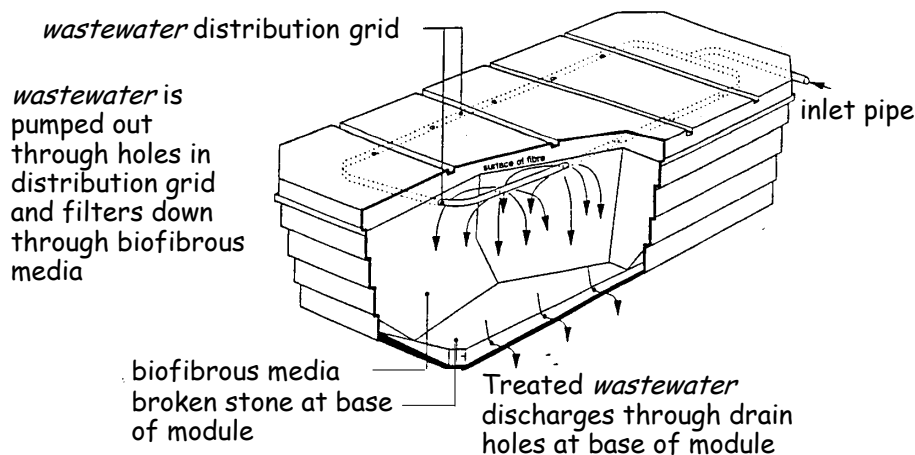


Slow percolation rates

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);

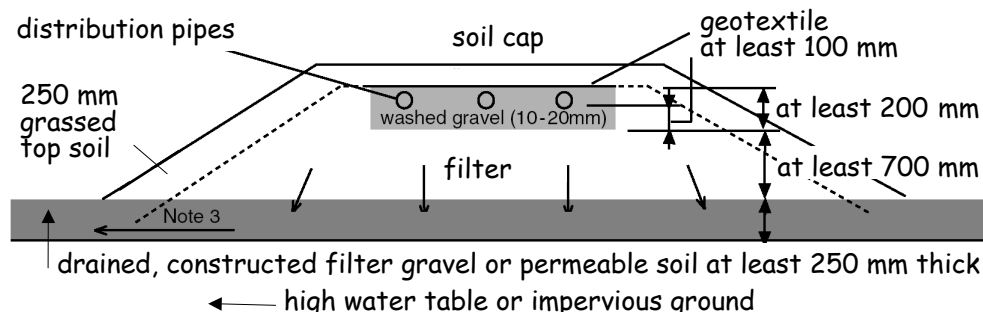
Very slow percolation rates

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 domestic-sized *building*, by designing and *constructing* the infiltration system using a

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

Typical soil covered mound filter system serving a small building



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 ground.

3.9.3 Greywater disposal (M3.5)

The disposal of *greywater* (from baths, showers, washbasins, sinks and washing machines) may be accomplished by an infiltration field the area of which can be calculated from the following:

$$A = p \times V_p \times 0.2$$

where A is the area of the sub-surface drainage trench, in m²;
 p is the number of persons served by the tank; and
 V_p is the percolation value obtained, as described above, in secs/mm.

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 *building*. However damage to the *foundations* of a *building* is likely to occur where discharge is too close to the

building. It is sensible to ensure that any water bearing strata directs any effluent away from the *building*.

To prevent any such damage therefore, every part of an infiltration system serving a private *wastewater* treatment plant or septic tank should be located at least 5 m from a *building*. An infiltration system should also be located at least 5 m from a *boundary* in order that an adjoining plot is not inhibited from its full development potential.

However the ground strata or permeability of the soil may influence this dimension and it may be reduced slightly where the strata directs any 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

- 3.10 Functional standard
- 3.10.0 Introduction
- 3.10.1 General provisions
- 3.10.2 Wall constructions (solid, masonry)
- 3.10.3 Wall constructions (cavity, masonry)
- 3.10.4 Extensions
- 3.10.5 Wall constructions (framed)
- 3.10.6 Roof constructions (flat)
- 3.10.7 Roof constructions (pitched)

standard
3.10
 mandatory

Every *building* must be designed and *constructed* in such a way that there will not be a threat to the *building* or the health of the occupants as a result of moisture from precipitation penetrating to the inner face of the *building*.

Limitation

This standard does not apply to a *building* where penetration of moisture from the outside will result in effects no more harmful than those likely to arise from use of the *building*.

3.10.0 Introduction

Rain penetration shows up as damp patches, usually after heavy rain, on the inside of *external walls*, around door or window openings or on ceilings. It can be difficult to pinpoint the exact route the rainwater is taking. For example, a damp patch on a ceiling could be the result of a faulty flashing or damaged felt on a *flat roof* some distance away from the damp patch. Similarly, unless they have adequate damp proof courses and flashings, materials in parapets and *chimneys* can collect rainwater and deliver it to other parts of the *building* 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 *building* 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
<i>Flat roofs</i>	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.

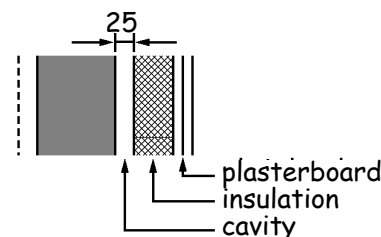
The following sketches provide guidance on recommended methods of *construction* to prevent rain penetration to the inner surfaces of the *building*. The thickness and other dimensions quoted are the minimum recommended unless otherwise stated. Greater figures are therefore possible.

3.10.2 Wall constructions (solid, masonry)

(G2.5)

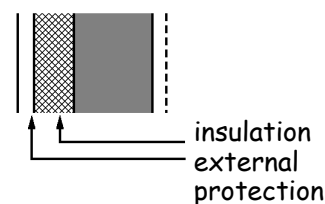
Wall type A
(solid wall with internal insulation)

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.

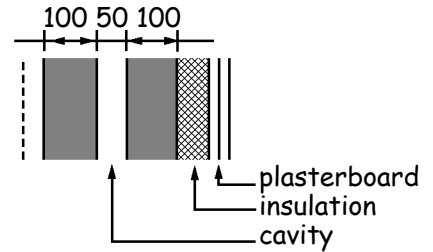


3.10.3 Wall constructions (cavity, masonry)

(G2.5)

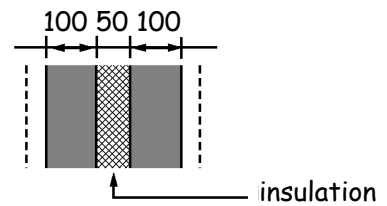
Wall type A
(masonry cladding)

Cavity wall of 2 leaves of masonry separated by a 50 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.



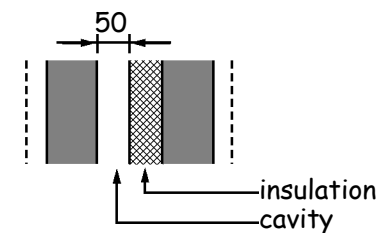
Wall type B
(cavity wall with cavity fill insulation)

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 Extensions

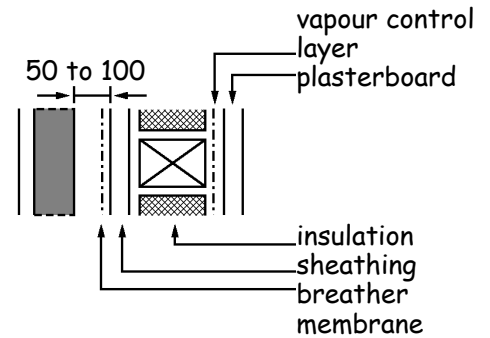
Careful consideration should be given to the detailing of an existing wall of a *building* when an extension is added. The outer leaf of a previously *external wall* will become an internal wall and any moisture that enters the cavity could collect and cause serious damage to the *building*. Where the *building* 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 extension may be appropriate. However in sheltered situations a ragged flashing (chased into the wall) may be sufficient.

3.10.5 Wall constructions (framed)

(G2.5)

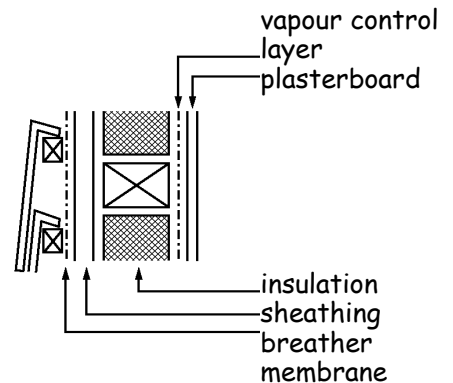
Wall type A
(masonry cladding)

Framed wall of timber studs and dwangs (framing members), 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.



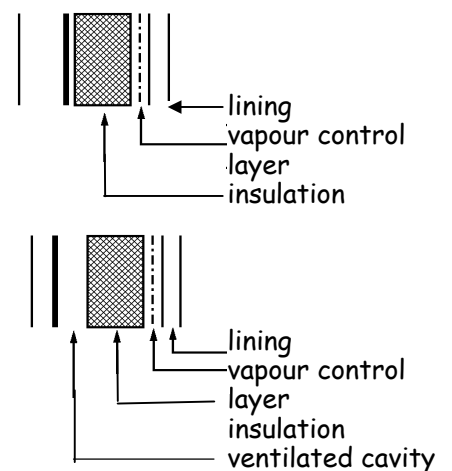
Wall type B
(weatherboarding, tile or slate cladding)

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)

Cold deck roofs

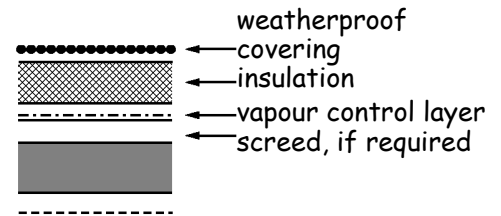
For the control of condensation in roofs, including cold deck roofs, BS 5250: 2002 provides guidance on the principal forms of *construction*. There is evidence that suggests that condensation in cold deck *flat roofs* is a problem. They should be avoided therefore because interstitial condensation is likely and its effect on the structure and insulation can be severe. Many instances of failure in such systems have been recorded and it is considered that more reliable forms of *construction* are available. However fully supported metal roof finishes including aluminium, copper, lead stainless steel and zinc are regularly used in *conversion work*, and they should have a ventilated 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.

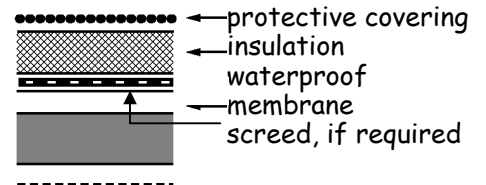
Roof type A
(concrete – warm roof)

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]



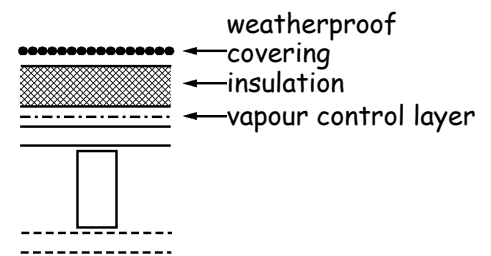
Roof type B
(concrete – inverted roof)

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.



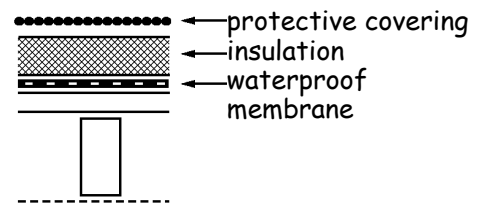
Roof type C
(timber or metal frame – warm roof)

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]



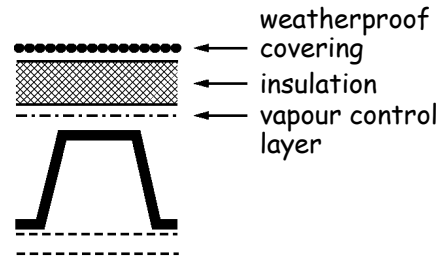
Roof type D
(timber or metal frame – inverted roof)

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



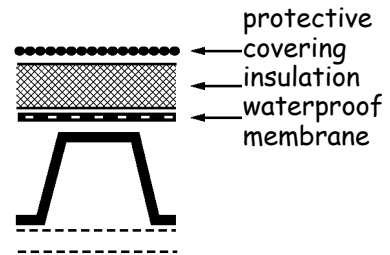
Roof type E
(troughed metal decking – warm roof)

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.

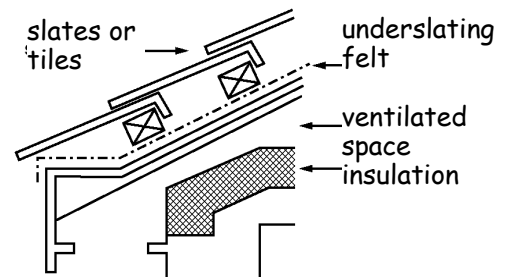
3.10.7 Roof constructions (pitched)

(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.

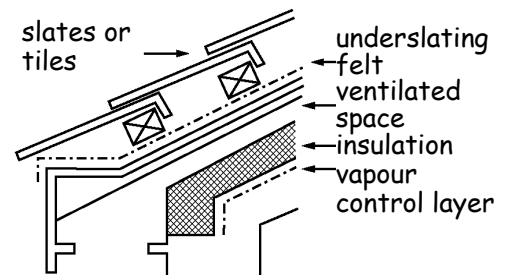
Roof type A
(slates or tiles – insulation on a level ceiling)

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.



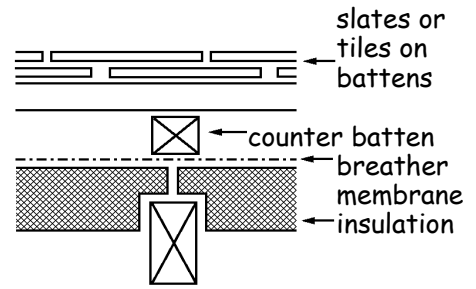
Roof type B
(slates or tiles – insulation on a sloping ceiling)

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.



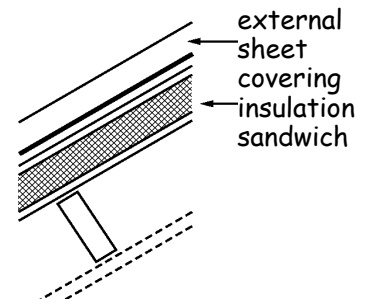
Roof type C
(slates or tiles –
insulation as decking)

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

This standard does not apply to *buildings* other than *dwellings*

3.12 Sanitary facilities

- 3.12 Functional standard
- 3.12.0 Introduction
- 3.12.1 Number of sanitary facilities
- 3.12.2 Provision for staff
- 3.12.3 Provision in residential accommodation
- 3.12.4 Provision for the public, in shops and shopping malls
- 3.12.5 Provision for the public in entertainment and assembly buildings
- 3.12.6 General provision for toilets
- 3.12.7 Sanitary facilities suitable for disabled people
- 3.12.8 Sanitary facilities suitable for ambulant disabled people
- 3.12.9 Watercloset cubicles
- 3.12.10 Changing cubicles
- 3.12.11 Distance to accessible sanitary accommodation

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

In principal, appropriate *sanitary accommodation* should be available to all. In general, this means that there should be *sanitary accommodation* suitable for wheelchair users, ambulant *disabled people* and, where appropriate, travellers with large bags and people of either sex with babies and small children. Provision should be sufficient to prevent unacceptable queuing, other than in exceptional circumstances.

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 Number of sanitary facilities (M4.4)

Numbers of *sanitary facilities* for males and females should be calculated from the maximum number of persons the *building* is likely to accommodate in use at any specific time. The numbers should reflect the normal use of the *building*. A written statement of the numbers should be submitted to the relevant verifier who may wish to substantiate the figures.

Schools It is appropriate that the numbers of *sanitary facilities* in schools are provided in accordance with the tables in the [School Premises \(General Requirements and Standards\) \(Scotland\) Regulations 1967](#). BS 6465: Part 1: 1994 may also be helpful. However sanitary provision for *disabled people* should be provided in accordance with the guidance to this standard.

Small businesses Separate *sanitary facilities* for male and female staff need not be provided where fewer than 6 people are employed. A unisex facility therefore should be satisfactory.

In a restaurant, café or similar food outlet, *sanitary facilities* provided for the staff should be reserved for their sole use. However in small *buildings*, where *sanitary facilities* accessible to wheelchair users might be too onerous because of the area requirements, provision suitable for ambulant *disabled people* may be more appropriate.

In the tables it has been assumed that there will be a 50% male and 50% female split, unless otherwise stated. For different proportions the accommodation levels will have to be adjusted.

Accessible *sanitary accommodation* The various tables below provide recommended minimum numbers of *sanitary facilities* suitable for *disabled people*. A greater provision may be required dependent upon the distance between *sanitary facilities*. Clause 3.12.11 provides guidance on the recommended maximum travel distance to accessible *sanitary accommodation*.

3.12.2 Provision for staff (M4.4)

Every *building* should be provided with *sanitary facilities* for all staff members. Provision should be in accordance with the following table:

Minimum number of sanitary facilities for staff

	Staff Numbers	WC	WHB	urinals	Sanitary facilities for disabled people
Male	1 to 15	1	1	1	Where access for <i>disabled people</i> is required by standard 4.2, <i>sanitary facilities</i> for <i>disabled people</i> should be provided within the overall number of facilities required, as follows: 1-20 staff: at least 1 watercloset in accordance with diagram to clause 3.12.8. Over 20 staff, either: a. at least 1 unit (wc and washbasin) of unisex <i>sanitary accommodation</i> in accordance with diagram to clause 3.12.7, and accessed independently of any other <i>sanitary accommodation</i> ; or b. where provided integrally within separate <i>sanitary accommodation</i> for males and females, at least 1 unit (wc and washbasin) of unisex <i>sanitary accommodation</i> for each sex in accordance with diagram to clause 3.12.7.
	16 to 30	2	2	1	
	31 to 45	2	2	2	
	46 to 60	3	3	2	
	61 to 75	3	3	3	
	76 to 90	4	4	3	
	91 to 100	4	4	4	
	Over 100	1 additional watercloset, urinal and washbasin for every additional 50 males or part thereof			
Female (also male where no urinals provided)	1 to 5	1	1		
	6 to 25	2	2		
	Over 25	1 additional watercloset and washbasin for every additional 25 females (or males), or part thereof			

A greater provision may be required dependent upon the distance between *sanitary facilities*. (see clause 3.12.11)

3.12.3 Provision in residential accommodation (M4.8)

Residential accommodation is intended to include all accommodation, other than *dwellings*, where sleeping provision is provided. Provision should be in accordance with table 3 in BS 6465: Part 1: 1994.

In residential accommodation, at least 1 bedroom in 20, or part thereof, should be provided with *sanitary accommodation* accessible to, and suitable for, wheelchair users. However this ratio may be increased to not more than 1 in 100 in a place of lawful detention.

Where serving a single bedroom, the accessible *sanitary accommodation* should be en-suite, but where serving more than 1 bedroom, it should be accessible from a circulation area that is exclusive to the bedrooms.

3.12.4 Provision for the public, in shops and shopping malls (M4.5)

Sanitary accommodation should be easily accessible and situated on the entrance floor, and on alternate floors in large *shops*, such as over 4000 m². *Sanitary facilities* should be provided in accordance with the following table:

Minimum number of sanitary facilities for people, other than staff, in shops

Building type		Sales area of shop	waterclosets	urinals	Sanitary facilities for disabled people
Shops (Class 1) and shopping malls	Unisex male	500m ² -1000m ²	1		Where access for disabled people is required by standard 4.2, sanitary facilities for disabled people should be provided within the overall number of facilities required, as follows: at least 1 unit (wc and washbasin) of unisex sanitary accommodation in accordance diagram to clause 3.12.7, and accessed independently of any other sanitary accommodation. A greater provision may be required dependant upon the distance between facilities. (see clause 3.12.11)
		1001m ² -2000m ²	1	1	
	2001m ² -4000m ²	1	2		
	over 4000m ²	plus 1 wc for each additional 2000 m ² of sales area, or part thereof	plus 1 urinal for each additional 2000 m ² of sales area, or part thereof		
female	1000m ² -2000m ²	2			
	2001m ² -4000m ²	5			
	over 4000m ²	plus 2 wc for each additional 2000 m ² of sales area, or part thereof			
Shops (Class 2) and shopping malls	Unisex male	over 1000m ²	1		
		1000m ² -4000m ²	1	1	
	over 4000m ²	plus 1 wc for each additional 3000 m ² of sales area, or part thereof	plus 1 urinal for each additional 3000 m ² of sales area, or part thereof		
	female	1000m ² -2000m ²	1		
		2001m ² -4000m ²	3		
		over 4000m ²	plus 1 wc for each additional 3000 m ² of sales area, or part thereof		

Notes

- For the purposes of this guidance, *shop* sales areas are classified as:
 - Class 1: (other than those listed under Class 2): supermarkets and department stores (all sales areas); *shops* for personal services such as hairdressing; *shops* for the delivery or uplift of goods for cleaning, repair or other treatment or for members of the public themselves carrying out such cleaning, repair or other treatment.
 - Class 2: *shop* sales areas in *shops* trading predominantly in furniture, floor coverings, cycles, perambulators, large domestic appliances or other bulky goods or trading on a wholesale self-selection basis.
- 1 washbasin should be provided for each watercloset, plus 1 washbasin per 5 urinals, or part thereof.
- For shopping malls, the sum of the sales areas of all the *shops* in the mall should be calculated and used with this table. *Sanitary facilities* provided within a *shop* may be included in the overall calculation.
- Baby-changing facilities should be provided.
- If a *shop* has a restaurant, additional *sanitary facilities* to serve the restaurant should be provided.

3.12.5 Provision for the public in entertainment & assembly buildings (M4.5)

It is not realistic to include every type of entertainment and *assembly building* in the table below. Basic assumptions and reasonable deductions have to be made that best apply to the development under consideration. Provision should be in accordance with the following table:

Minimum number of sanitary facilities for the public in entertainment and assembly buildings

Building type [2-5]		Number of people	Number of waterclosets [1]	Number of urinals	Sanitary facilities for disabled people
Buildings used for public entertainment (e.g. single-screen cinemas, theatres, concert halls and other premises without licensed bars)	male	1-100	1	2	Where access for <i>disabled people</i> is required by standard 4.2, <i>sanitary facilities</i> for <i>disabled people</i> should be provided within the overall number of facilities required, as follows: 1-20 people: at least 1 watercloset in accordance with diagram to clause 3.12.8 Over 20 people: at least 1 unit (wc and washbasin) of unisex <i>sanitary accommodation</i> in accordance with diagram to clause 3.12.7 and accessed independently of any other <i>sanitary accommodation</i> . A greater provision may be required dependant upon the distance between <i>sanitary facilities</i> . (see clause 3.12.11)
	[6]	101-200	1	plus 1 for each	
		201-250	1	each	
		over 250	plus 1 for each additional 500 males, or part thereof	additional 80 males, or part thereof, over 100	
	female	1-40	3		
	[6]	41-70	4		
	71-100	5			
	over 100	plus 1 for each additional 35 females, or part thereof			
Restaurants, cafés, canteens and fast food outlets (where seating is provided)	male	1-400 [7]	1 for every 100, or part thereof, plus 1 for each additional 250 males, or part thereof	1 per 50 males, or part thereof	
		over 400			
	female	1-20 [7]	2		
		21-50	3		
		51-100	4		
		101-150	5		
		151-200	6		
	over 200	plus 1 for each additional 100 females, or part thereof			
Public houses and licensed bars [9, 10]	male	1-75	1	2	
	[8]	76-150	1	3	
		over 150	plus 1 for each additional 150 males, or part thereof	plus 1 for each additional 75 males, or part thereof	
	female	1-10	1		
[8]	11-25	2			
	over 25	plus 1 for each additional 20 females, or part thereof			
Swimming pools (bathers only) [11]	male	1-100	2	1 per 20 males	
		over 100	plus 1 for each additional 100 males, or part thereof		
	female	1-25	2		
	over 25	plus 1 for each additional 25 females, or part thereof			

Notes:

1. 1 washbasin should be provided for each watercloset, plus 1 washbasin per 5 urinals, or part thereof.
2. In multi-use *buildings* each function should be treated separately for calculating overall provision.
3. Where members of the public are permitted to use *sanitary facilities* provided for staff, a separate calculation should be made for each group and the total number of *sanitary facilities* provided accordingly.
4. There is no requirement to provide *sanitary facilities* for people other than staff in *offices*, industrial or storage *buildings*, but where they are, they should be readily accessible to the public, e.g. off the entrance hall or foyer.
5. Baby-changing facilities should be provided in *buildings* used for public entertainment, restaurants, cafés and fast food outlets where seating is provided.
6. In cinema-multiplexes and similar premises where the use of *sanitary facilities* will be spread through the opening hours, the level of *sanitary facilities* should normally be based upon 75% of total capacity. For single-screen cinemas 100% occupancy is assumed.
7. In the case of works and *office* canteens, the scale of provision may be reduced proportionally where there are readily accessible workplace *sanitary facilities* close to the canteen.
8. Number of customers should be calculated at the rate of 4 persons per 3 m² of effective drinking area (i.e. the total space of those parts of those *rooms* to which the public has access).
9. Public houses with restaurants should be provided with *sanitary facilities* as for licensed bars.
10. Public houses with public music, singing and dancing licenses should be as for licensed bars. The licensed area for public music, singing and dancing should be separated for calculation of numbers of persons and the provision of *sanitary facilities* for this area should be in accordance with *buildings* used for public entertainment.
11. *Sanitary facilities* for spectators should be provided in accordance with *buildings* used for public entertainment.

3.12.6 General provision for *toilets* (M4.10)

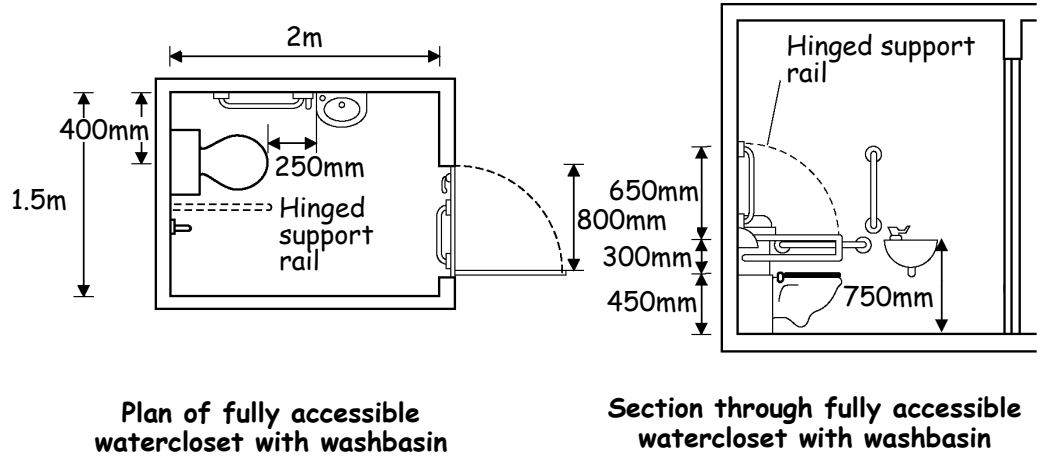
Every *toilet* should have a washbasin within either the *toilet* itself or in an adjacent space providing the sole means of access to the *toilet*. Every *toilet* should be separated by a door from any *room* or space used wholly or partly for the preparation or consumption of food. This recommendation does not apply to *toilets* in a place of lawful detention, such as integral *sanitary facilities* in a prison cell.

3.12.7 *Sanitary facilities* suitable for *disabled people* (M4.4)

The space requirements for *sanitary accommodation* accessible to *disabled people* are generally driven by the needs of wheelchair users, although it is recognised that the facilities may also be used by people with other disabilities, such as visually impaired people. The suitability of *sanitary accommodation* depends on the extent to which wheelchair users and ambulant *disabled people* are able to approach, transfer to and use *sanitary facilities*. The relationship of watercloset to wash basin and other facilities, and to the space required for manoeuvring, should enable *disabled people* to adopt various transfer techniques that allow independent or assisted use.

Sanitary accommodation normally takes the form of a unisex accessible *toilet* or, an enlarged cubicle in separate-sex *toilet* washrooms. In *sanitary accommodation* for staff use only however, independently accessed facilities for males and females may be provided. Sometimes a watercloset compartment is provided specifically for ambulant *disabled people*.

Fully accessible *sanitary accommodation* should have plan dimensions of at least 2 m x 1.5 m. Access should be via an outward opening or sliding door providing a clear opening width of at least 800 mm because of the restricted manoeuvring space in the *room*. The accommodation should contain a WC, washbasin and support rails arranged as shown in the diagram below:

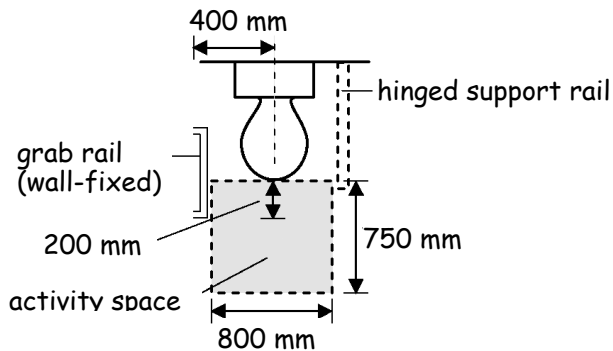


3.12.8 Sanitary facilities suitable for ambulant disabled people (M4.4)

In small *buildings* it may not be reasonable to provide *sanitary facilities* that are accessible to all *disabled people*. The area of such a facility in, say a small café of 4 or 5 tables, (up to a total of 20 persons, staff and public) might render the enterprise uneconomic. In such cases, *sanitary facilities* that are suitable for ambulant *disabled people* would be acceptable. In such a *toilet* therefore there should be an activity space in front of, but not necessarily centred on, the watercloset pan.

Two handrails should also be provided on either side of the watercloset and at least 1 of them should be wall hung.

People who require greater manoeuvring space should be able to enter the cubicle and close the door unhindered. The door swing therefore, should not inhibit the full use of the activity space. A small, wall-hung washbasin may project into the space, as it will not restrict the usable floor space.

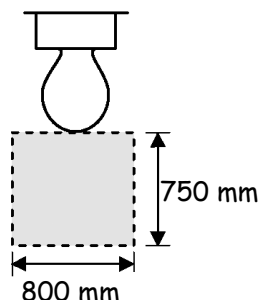


Accessible sanitary facilities for ambulant disabled people

3.12.9 Watercloset cubicles (M4.6)

In a large *building*, where there is a range of watercloset cubicles, there should be provision for people who need more room to manoeuvre. They should be able to enter the cubicle and close the door unhindered. The door swing therefore, should not inhibit the full use of the activity space, but a small wall-hung washbasin may project into the space.

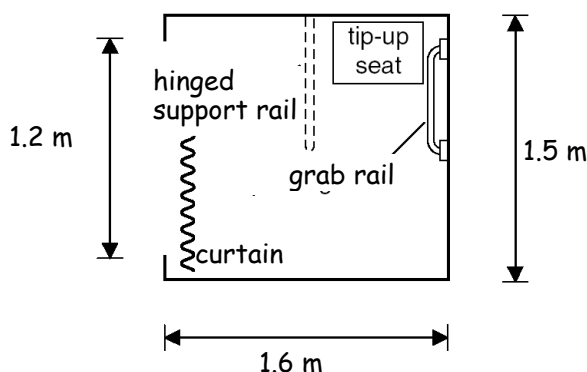
Where there are 4 or more cubicles in a range then at least 1 should have an activity space in front of, but not necessarily centred on, the watercloset pan. An activity space should be provided in accordance with the diagram below:



Activity space in watercloset cubicles

3.12.10 Changing cubicles (M4.7)

Where changing cubicles are provided in a *building*, there should be provision for people who need more room to manoeuvre. At least 1 cubicle in 20, or part thereof, should be designed to allow greater ease of movement within the cubicle in accordance with the diagram below:



Accessible changing cubicle

3.12.11 Distance to accessible sanitary accommodation (M4.9)

Disabled people may need to use the *toilet* more frequently than other users. The time taken to reach an accessible *toilet* is therefore an important factor to be considered when locating such accommodation. The total horizontal distance to be travelled from any accessible point to the *sanitary accommodation*, accessible to and suitable for *disabled people*, should be not more than 45 m.

It may be reasonable in specialised *buildings*, such as large superstores, where there are no obstructions, such as doors, for this distance to be extended by up to about 20 m.

3.13 Heating

This standard does not apply to *buildings* other than *dwellings*

3.14 Ventilation

- 3.14 Functional standard
- 3.14.0 Introduction
- 3.14.1 Ventilation generally
- 3.14.2 Natural ventilation
- 3.14.3 Trickle ventilators
- 3.14.4 Extensions built over existing windows
- 3.14.5 Mechanical ventilation
- 3.14.6 Ventilation of sanitary accommodation
- 3.14.7 Ventilation of small garages
- 3.14.8 Ventilation of large garages

standard
3.14
mandatory

Every *building* must be designed and *constructed* in such a way that the air quality inside the *building* is not a threat to the health of the occupants or the capability of the *building* to resist moisture, decay or infestation.

3.14.0 Introduction

Ventilation of a *building* 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). Where natural ventilation is provided, 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 *rooms* containing processes that generate harmful contaminants and rest rooms where smoking is permitted;
- rapidly diluting pollutants and water vapour, where necessary, that are produced in habitable *rooms* 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. 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.

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, K2.1)

A *building* 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. a store room used only for storage requiring a controlled temperature, such as a cold storage room; and
- b. a *room* with a floor area of not more than 4 m². This is not intended to include a domestic-sized *kitchen* or utility room where ventilation should be in accordance with the recommendations in table to clause 3.14.5.

Ventilation should be to the external air. However clause 3.14.3 explains where *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 is the internal cubic capacity of the space. Any space, other than for vehicle parking, where the volume is more than 6 m above any floor level in that space may be disregarded. Where the space is for vehicle parking, any volume more than 3 m above any floor level in that space may be disregarded.

3.14.2 Natural ventilation

(K2.1a & b, K4.1, K4.2)

Natural ventilation of a *room* or *building* should be provided in accordance with the following recommendations:

- a. for a *room*, by the provision of a *ventilator* with an opening area of at least 1/30th of the floor area of the *room* it serves, and
 - a *trickle ventilator* with an opening area of at least 4000 mm², if the area of the *room* is not more than 10 m²; or
 - a *trickle ventilator* with an opening area of 400 mm² for each square metre of *room* area, if the area of the *room* is more than 10 m²; or
- b. for a *toilet* with an area of not more than 10 m²:
 - by the provision of a *ventilator* with an opening area of at least 1/30th of the floor area of the *room* it serves, and a *trickle ventilator* with an opening area of at least 4000 mm²; (see also clause 3.14.6) or
 - mechanical extract in accordance with the table to clause 3.14.5;
- c. for any *building*, by following the guidance in:
 - Section 3 of BS 5925: 1991 (1995); or
 - CIBSE Guide A: 1999, Design data, section A4, Air infiltration and natural ventilation.

The options in sub-clause c provide more flexible solutions but may require complex calculations.

Wet areas

Where a *building* is naturally ventilated, all moisture producing areas such, as bathrooms and shower rooms, should have the additional facility for removing such moisture before it can damage the *building*. Additional mechanical ventilation to such areas should be provided in accordance with the table to clause 3.14.5.

Where rapid ventilation is provided, such as an opening window or windows, some part of the opening should be at least 1.75 m above floor level. This will reduce the problems of stratification of air.

3.14.3 *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 to prevent draughts.

The *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 *building* 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 3.14.2.

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.

3.14.4 *Extensions built over existing windows*

Constructing an extension over an existing window, or *ventilator*, will effectively result in an internal *room*, will restrict air movement and could significantly reduce natural ventilation to that *room*. Reference should be made to the guidance to standards 3.21 and 3.22 on the ventilation of combustion appliances, as this may be relevant. There are other recommendations in Section 2: Fire relating to escape from *inner rooms*.

A new *ventilator* should be provided to the *room* but, 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 an extension will be relatively airtight, 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 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, 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 are still to the outside air.

3.14.5 Mechanical ventilation (K2.1d & c, 4.6, 4.7, 4.9, 4.10)

A mechanical ventilation or air conditioning system should be designed, installed and commissioned to perform in a way that is not detrimental to the health of the occupants of a *building* and when necessary should be easily accessible for regular maintenance.

Mechanical extract should be provided in *rooms* where the cubic space per occupant is not more than 3 m³, and where the *rooms* have low ceilings and are occupied by large numbers of people.

Mechanical ventilation should be provided in accordance with the following:

- a. compliance with the guidance in BS 5720: 1979; or
- b. compliance with the guidance in CIBSE Guide B: 2001, Installation and equipment data, section B2, Ventilation and air-conditioning (requirements); or
- c. for occupiable *rooms*, where a mechanical air supply is provided at a rate of at least 8 litres/second of fresh air per occupant based on sedentary occupants and the absence of other requirements such as the removal of moisture. This assumes that the provision is for a 'no smoking room'. It is generally recognised there is no safe level of protection from tobacco smoke and it is recommended that designers consult current guidelines issued by the Health and Safety Executive. Where smoking is permitted in a *building*, the recommendations in clause 3.2.1.4 of the CIBSE Guide: Section B2: 2001 may be reasonable.
- d. for domestic-sized *rooms* where moisture is produced, such as *kitchens*, *bathrooms* and *sanitary accommodation*, rapid ventilation and *trickle ventilation* should be provided in accordance with the guidance in the following table:

Mechanical ventilation of domestic-sized *kitchens*, *bathrooms* and *toilets*

Space	Ventilation provision [2]	Trickle Ventilation
<i>Kitchen</i>	either; a. mechanical extraction capable of at least 30 litres/sec (intermittent) above a hob [1]; b. mechanical extraction capable of at least 60 litres/sec (intermittent) if elsewhere [1];	4000 mm ²
Utility room or washroom	mechanical extraction capable of at least 30 litres/sec (intermittent) [1].	4000 mm ²
Bathroom or shower-room (with or without a WC)	mechanical extraction capable of at least 15 litres/sec (intermittent).	4000 mm ²
<i>Toilet</i>	mechanical extraction capable of at least 3 air changes per hour.	4000 mm ²

Note:

- 1. 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.
- 2. Long duct runs, flexible ducting and bends can seriously reduce fan performance and should be carefully considered during design.

Continuous mechanical ventilation For smaller, domestic sized developments, a mechanical ventilation system complying with [BRE Digest 398](#), 'Continuous mechanical ventilation in dwellings: design, installation and operation' may be appropriate.

Input air Mechanical input air ventilation is another option for supplementing the ventilation to a *building*. However it may only be suitable for small domestic sized *buildings* as the system has been principally developed for the domestic market. Further information should be obtained from the manufacturer.

Where a mechanical ventilation system gathers extracts into a common *duct* for discharge to an outlet, no connection to the system should be made between any exhaust fan and the outlet.

Mechanical ventilation should be to the outside air. However it may be via a *duct* or heat exchanger.

Care should be taken when installing mechanical extract systems where there is an *open-flued combustion appliance* in the same *room* or close by. Guidance is given in clause 3.17.9, extract fans.

Cross contamination An inlet to, and an outlet from, a mechanical ventilation system should be installed so as to avoid contamination of the air supply to the system. The inlet to, and the outlet from, the mechanical ventilation system should be installed in accordance with the recommendations in Clause 2.3.3 of BS 5720: 1979.

Control of Legionellosis A mechanical ventilation system should be *constructed* to ensure, as far as is *reasonably practicable*, the avoidance of contamination by legionella. The ventilation system should be *constructed* in accordance with the recommendations of Paragraphs 70 to 84 of [The Control of Legionellosis including Legionnaires' Disease](#).

There are additional recommendations in Section 2: Fire where mechanical ventilation systems pass through *compartment* and *separating walls* and *separating floors*.

3.14.6 Ventilation of sanitary accommodation

Any *room* containing *sanitary facilities* should be well ventilated, so that offensive odours do not linger. Measures should be taken to prevent odours entering other *rooms*. This may be achieved by, for example, providing a ventilated area between the *sanitary accommodation* and the other *room*. Alternatively it may be possible to achieve it by mechanical ventilation or, if the *sanitary accommodation* is well sealed from a workroom and has a door with an automatic closer, by good natural ventilation.

However, no *room* containing *sanitary facilities* should communicate directly with a *room* for the preparation or consumption of food. This does not apply to places of lawful detention, such as integral sanitation in prison cells.

3.14.7 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 m² 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*.

A garage with a floor area of at least 30 m² but not more than 60 m² used for the parking of motor vehicles should have provision for natural or mechanical ventilation. Ventilation should be in accordance with the following guidance:

- 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
- 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.

3.14.8 Ventilation of large garages (K3.1)

A garage with a floor area more than 60 m² for the parking of motor vehicles should have provision for natural or mechanical ventilation on every *storey*. Ventilation should be in accordance with the following guidance:

- a. section B2 of the CIBSE Guide 2001:
 - 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

This standard does not apply to *buildings* other than *dwellings*

3.16 Natural lighting

This standard does not apply to *buildings* other than *dwellings*

3.17 Combustion appliances – safe operation

- 3.17 Functional standard
- 3.17.0 Introduction
- 3.17.1 Large combustion appliance installations
- 3.17.2 Incinerators
- 3.17.3 Combustion appliance installations generally
- 3.17.4 Small combustion appliance installations
- 3.17.5 Solid fuel appliance installations
- 3.17.6 Oil-firing appliance installations
- 3.17.7 Gas-fired appliance installations
- 3.17.8 Labelling
- 3.17.9 Extract fans

standard
3.17
mandatory

Every *building* must be designed and *constructed* in such a way that each fixed combustion appliance installation operates safely.

3.17.0 Introduction

The guidance to this standard covers general issues and should be read in conjunction with standards 3.18 to 3.22 which 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 3.17.9.

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 Services Engineers (CIBSE).

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 Incinerators (F3.13)

An incinerator, together with any associated *chimney*, *flue-pipe* and hearth should be *constructed* and installed, irrespective of the type of fuel used, in accordance with the guidance for solid fuel appliances. Although the igniting fuel may be gas for example, the material that may be incinerated could impose temperature and corrosion loads on the appliance and *chimney* that are similar to those of solid fuel. Specialist guidance may be needed to ensure safe *construction* and installation.

3.17.3 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.

3.17.4 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.

3.17.5 Solid fuel appliance installations (F3.1, F4.1, F4.2)

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.

3.17.6 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 *building*. 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](#).

3.17.7 Gas-fired appliance installations (F6.1, F6.2)

[The Gas Safety \(Installations & Use\) Regulations 1998](#)

www.corgi-gas.com

In addition to the functional standards, gas-fired appliance installations must also comply with the Gas Safety (Installation and Use) Regulations 1998. These regulations require that, amongst others, gas-fired installations are installed by a competent person. Guidance on the individual competency required is given in the Health and Safety Commission’s Approved Code of Practice ‘[Standards of Training in Safe Gas Installations](#)’. The Council for Registered Gas Installers (CORGI) operates a registration scheme for gas businesses and individual gas operatives to ensure that they carry out their *work* in a competent manner. It is the only scheme recognised by the [Health and Safety Executive](#) (HSE) that complies with the Gas Safety (Installation and Use) Regulations 1998.

www.hse.gov.uk

The Gas Safety (Installations and Use) Regulations 1998 regulates gas installations while the [Gas Appliance \(Safety\) Regulations 1995](#) address the product safety of appliances.

3.17.8 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 *building* to

alert future workmen to the specification of the installed system. This also applies to cases where a *flue* liner is provided as part of refurbishment *work*.

The labels should be indelibly marked and contain the following information:

- a. the location of the hearth, fireplace (or *flue* box) or the location of the beginning of the *flue*;
- b. a *chimney* designation string in accordance with BS EN 1443: 2003 (see clause 3.18.2) for products whose performance characteristics have been assessed in accordance with a European Standard and that has been supplied and marked with a designation as described in the relevant European Standard.
- c. the category of the *flue* and generic types of appliance that can safely be accommodated;
- d. the type and size of the *flue* (or its liner);
- e. the installation date.

Labels should be located in a position that will not easily be obscured such as adjacent to:

- the gas or electricity meter; or
- the water supply stopcock; or
- the *chimney* or hearth described.

A label, should be provided similar to the example below:

IMPORTANT SAFETY INFORMATION	
This label must not be removed or covered	
Property address.....	<i>20 Main Street New Town</i>
The fireplace opening located in the..... Is at the base of a chimney with a designation string...	<i>name of room designation string</i>
and, for example, is suitable for a.....	<i>dfe gas fire</i>
Chimney liner.....	<i>xx mm diameter</i>
Installed on.....	<i>date</i>
Any other information (optional).....	

3.17.9 Extract fans (F3.10, F3.11)

Extract fans lower the pressure in a *building* 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 *buildings* 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 <i>room</i> or alternatively seek further guidance from HETAS. However, in certain cases, such as large <i>rooms</i> 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 <i>flue</i> 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 <i>kitchen</i> contains an <i>open-flued appliance</i> , the extract rate of the <i>kitchen</i> 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

- 3.18 Functional standard
- 3.18.0 Introduction
- 3.18.1 Chimneys generally
- 3.18.2 Chimney designations
- 3.18.3 Masonry chimneys
- 3.18.4 Metal chimneys
- 3.18.5 Flue-pipes
- 3.18.6 Flue liners

standard
3.18
 mandatory

Every *building* must be designed and *constructed* in such a way that any component part of each fixed combustion appliance installation used for the removal of combustion gases will withstand heat generated as a result of its operation without any structural change that would impair the stability or performance of the installation.

3.18.0 Introduction

The fire service attends many calls to *chimney* fires and other fires where a *chimney* defect has allowed fire spread into a *building*. Whilst the guidance 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

The National Association of Chimney Engineers (NACE) was set up to ensure the safety of all fuel users who depend upon a *chimney* or *flue* for the operation of a heating appliance. They provide a register of competent and qualified *chimney* engineers for all types of *chimney work*. Advice is also available from the British Flue and Chimney Manufacturers' Association (BFCMA). These organisations do not have a mandatory status.

www.feta.co.uk/bfcma

Sweeping *chimneys*

The process of burning will naturally cause deposits of soot in the *flue*. *Chimneys* and *flue-pipes* therefore should be swept at least annually if smokeless solid fuel is burnt and more often if wood, peat and/or other high volatile solid fuel such as bituminous coal is burnt. Mechanical sweeping with a brush is the recommended method of cleaning.

Every *chimney* should have such capacity, be of a height and location and with an outlet so located that the products of combustion are discharged freely and will not present a fire hazard.

A *flue* should be free from obstructions. The surface of the *flue* should be essentially uniform, gas-tight and resistant to corrosion from combustion products. *Chimneys* should be *constructed* in accordance with:

- a the recommendations of BS 6461: Part 1: 1984 for masonry chimneys; or
- b the recommendations of BS 7566: Parts 1 - 4: 1002 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 250° 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: <i>open-flued</i>	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: <i>room-sealed</i>	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 <i>duct</i>	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 400° C, e.g. burning Class D oil (gas oil);
- c. T250 N2 D V2 (or Vm - Lxxxxx) Oxx where it serves an oil-firing appliance producing a *flue* gas temperature of not more than 250° C, e.g. burning Class C2 oil (kerosene);
- d. T250 N2 D V1 (or Vm - Lxxxxx) Oxx where it serves a gas appliance.

Corrosion resistance

The corrosion resistance may be specified, according to BS EN 1856-1, by:

- a. a corrosion test method, which leads to a value of either V1, V2 or V3; or
- b. by a material specification code Vm - Lxxxxx where the first 2 digits represent a material type as quoted in BS EN 1856-1, Table 4 and the last 3 digits represent the material thickness.

Acceptable material specifications may be taken from the national Annex to BS EN 1856-1. For example, an acceptable material code for solid fuel, oil or gas, would be Vm - L50040 representing a material type 50 with a thickness of 0.40 mm.

A metal *chimney* should not pass through a *compartment wall*, *compartment floor*, *separating wall* or *separating floor*. However they may if the *chimney*, or a *non-combustible* casing totally enclosing the *chimney*, is *constructed* in such a way that, in the event of a fire, the fire resistance of the *compartment wall*, *compartment floor*, *separating wall* or *separating floor* is maintained. (see Section 2, Fire)

A metal *chimney* should only pass through a storage space, cupboard or *roof space* provided any flammable material is shielded from the *chimney* by a removable, imperforate casing. Also where the *chimney* passes through the *roof space*, such as an attic, it should be surrounded by a rigid mesh that will prevent vermin from *building* a nest beside the warm *chimney*. Mesh should prevent an 8 mm diameter sphere from passing.

There should be no joints within any wall, floor or ceiling that make accessing the *chimney* for maintenance purposes difficult.

3.18.5 *Flue-pipes*

(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 refractory liner;
- rigid sections of concrete liner;
- rigid metal pipes;

Flue liners suitable for solid fuel appliances, and therefore generally suitable for other fuels, should have a performance at least equal to that corresponding to the designation T400 N2 D 3 G as described in BS EN 1443: 2003 and manufactured from the following materials:

- a. clay *flue* liners with rebates or sockets for jointing and meeting the requirements for Class A1 N2 or Class A1 N1 as described in BS EN 1457: 1999; or
- b. concrete *flue* liners meeting the requirements for the classification Type A1, Type A2, Type B1 or Type B2 as described in BS EN 1857: 2003; or
- c. any other material approved and tested under the relevant conditions of a *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-in-situ technique or an approved spray-on or brush-on coating. Approved products are listed in the [HETAS Guide](#).

Masonry liners for use in existing *chimneys* should be installed in accordance with their manufacturer's instructions. Appropriate components should be selected to form the *flue* without cutting and to keep joints to a minimum. Bends and offsets should only be formed with factory-made components. Liners should be placed with the sockets or rebate ends uppermost to contain moisture and other condensates in the *flue*. In the absence of specific liner manufacturer's instructions to the contrary, the space between the lining and the surrounding masonry could be filled with a weak insulating concrete.

Corrosion resistance

The corrosion resistance of a metal liner may be specified, according to BS EN 1856-1, by either:

- a. a corrosion test method, which leads to a value of either V1, V2 or V3; or
- b. by a material specification code Vm - Lxxxxx where the first 2 digits represent a material type as quoted in BS EN 1856-1, Table 4 and the last 3 digits represent the material thickness.

Acceptable material specifications may be taken from the national Annex to BS EN 1856-1. For example, an acceptable material code for solid fuel, oil or gas, would be Vm - L50040 representing a material type 50 with a thickness of 0.40 mm.

3.19 Combustion appliances – relationship to combustible materials

- 3.19 Functional standard
- 3.19.0 Introduction
- 3.19.1 Relationship of masonry chimneys to combustible materials
- 3.19.2 Relationship of system chimneys to combustible materials
- 3.19.3 Relationship of metal chimneys to combustible materials
- 3.19.4 Relationship of flue-pipes to combustible materials
- 3.19.5 Relationship of solid fuel appliances to combustible materials
- 3.19.6 Relationship of oil-firing appliances to combustible materials
- 3.19.7 Relationship of gas-fired appliances to combustible materials
- 3.19.8 Relationship of hearths to combustible materials
- 3.19.9 Fireplace recesses

standard
3.19
mandatory

Every *building* must be designed and *constructed* in such a way that any component part of each fixed combustion appliance installation will not cause damage to the *building* in which it is installed by radiated, convected or conducted heat or from hot embers expelled from the appliance.

3.19.0 Introduction

Combustion appliances and their component parts, particularly solid fuel appliance installations, generate or dissipate considerable temperatures. Certain precautions need to be taken to ensure that any high temperatures are not sufficient to cause a risk to people and the *building*. The characteristics of solid fuel and some older style oil-firing appliances are more onerous than modern oil and gas-fired appliances.

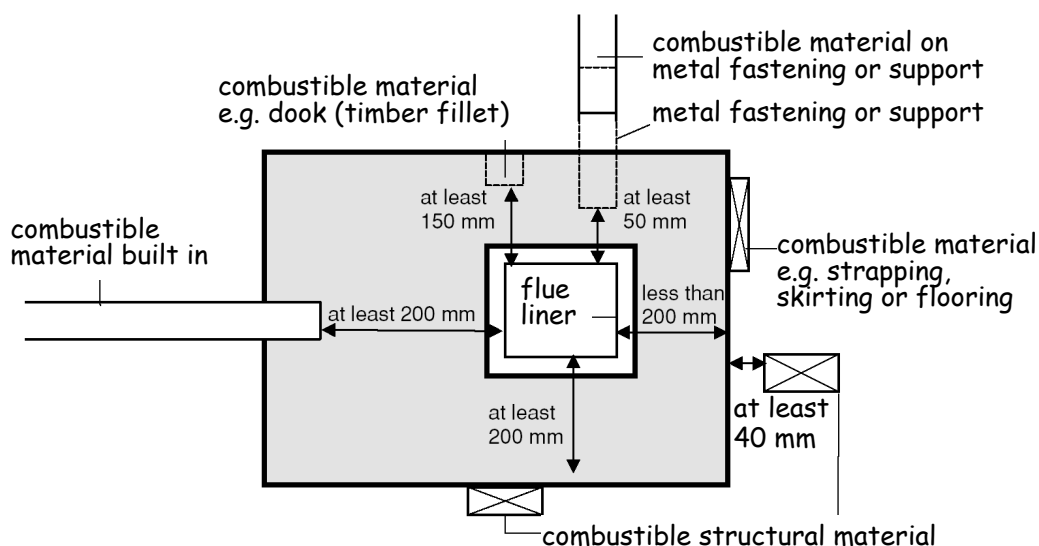
Conversions

In the case of *conversions*, as specified in Regulation 4, the *building* as *converted* 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)

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* gasses 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

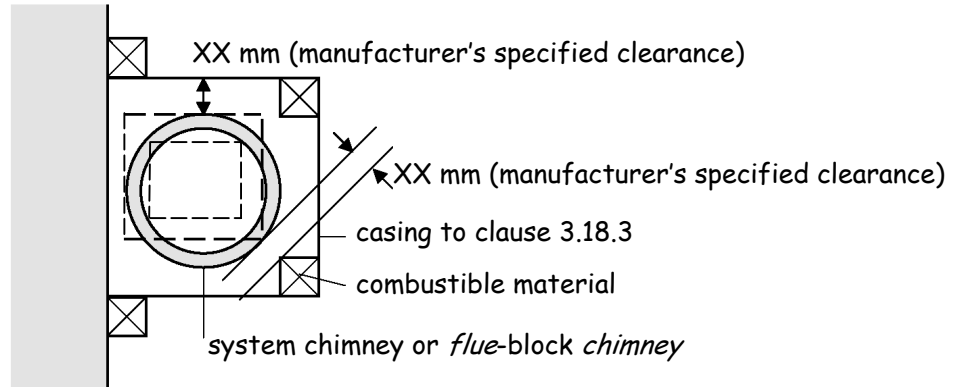
Any metal fastening in contact with combustible material, such as a joist hanger, should be at least 50 mm from the surface surrounding a *flue* to avoid the possibility of the combustible material catching fire due to conduction.

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 this 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 85° C when related to an ambient temperature of 20° C.



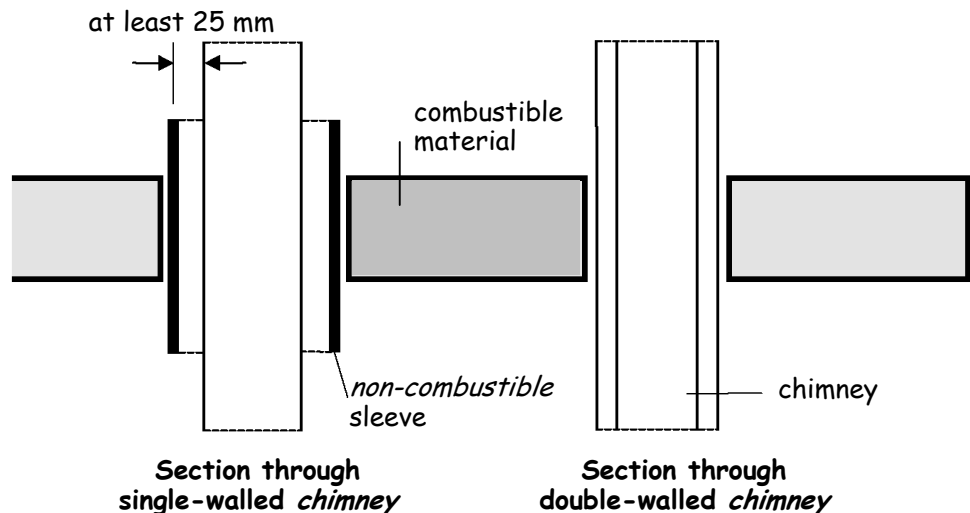
Plan of casing round a factory-made *chimney*

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

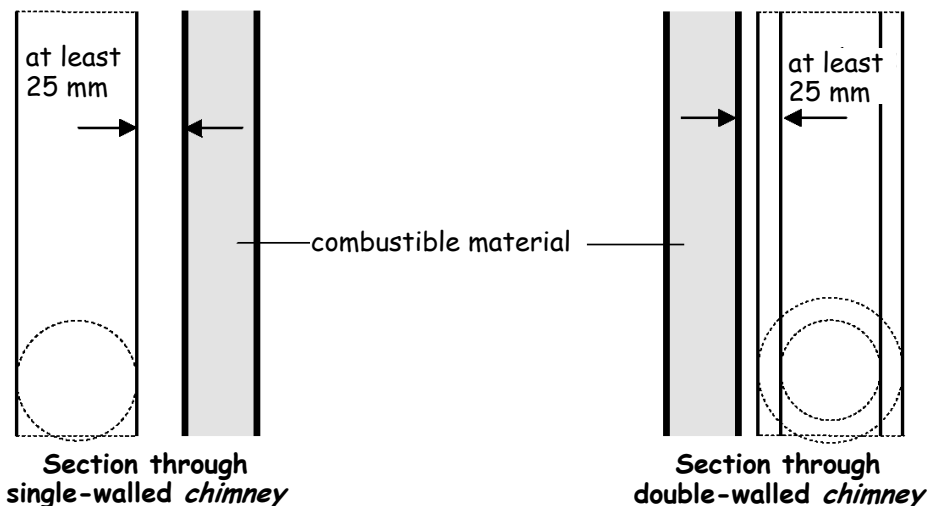
3.19.3 Relationship of metal *chimneys* to combustible materials

(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 100° C.



There should also be a separation distance where the metal *chimney* runs in close proximity to combustible material. The separation distance should be 25 mm from the outer surface of a single-walled *chimney* to combustible material. The 25 mm should be measured from the surface of the inner wall of a double-walled *chimney*. There is no need for a separation distance if the *flue* gases are not likely to exceed 100° C.

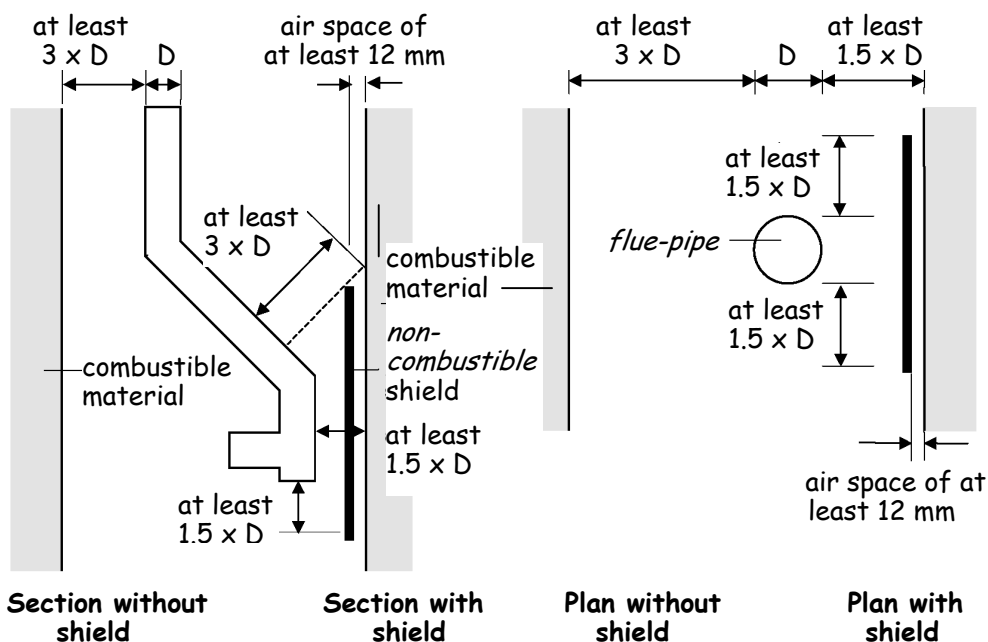


3.19.4 Relationship of *flue-pipes* to combustible materials (F4.14)

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



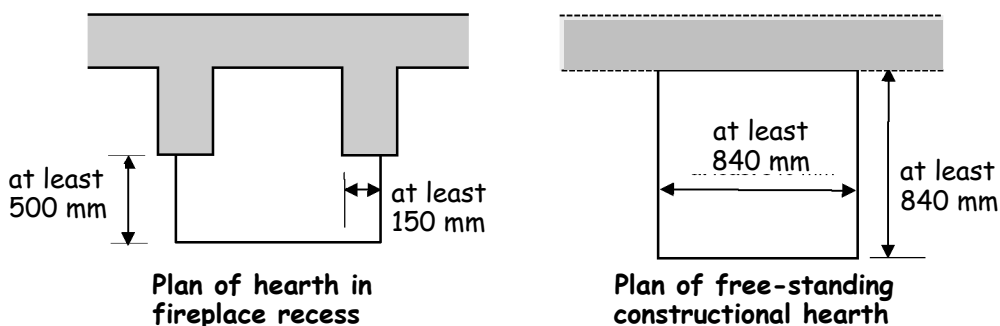
3.19.5 Relationship of solid fuel appliances to combustible materials

(F4.17, F4.18)

Hearth construction

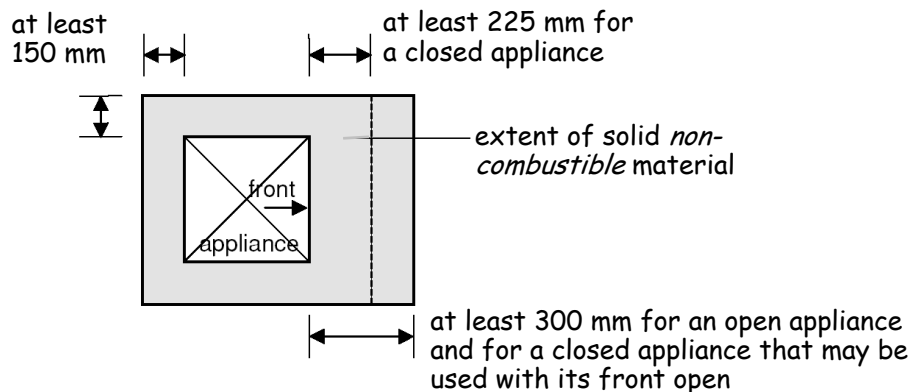
A solid fuel appliance should be provided with a solid, *non-combustible* hearth that will prevent the heat of the appliance from igniting combustible materials. A hearth should be provided to the following dimensions:

- a *constructional* hearth at least 125 mm thick and with plan dimensions in accordance with the following sketches; or
- a free-standing, solid, *non-combustible* hearth at least $840 \times 840 \text{ mm}$ minimum plan area and at least 12 mm thick, provided the appliance will not cause the temperature of the top surface of the hearth on which it stands to be more than 100°C .



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.

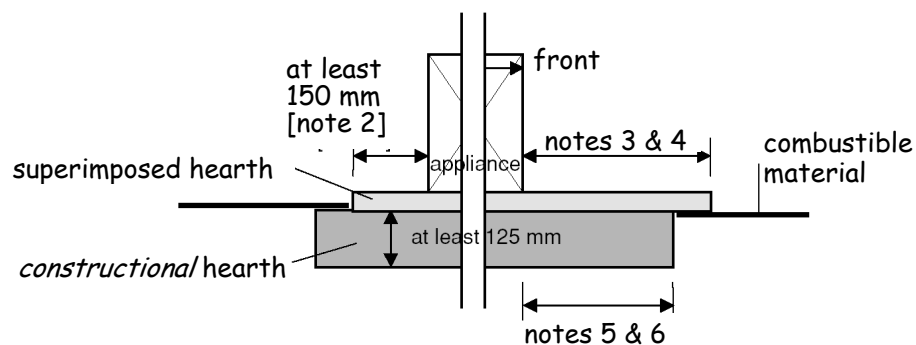


Plan of appliance on a hearth

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 –

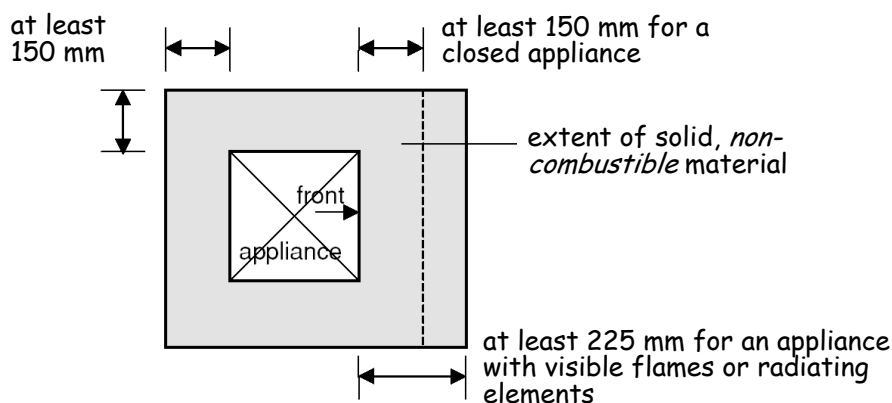
1. SUPERIMPOSED HEARTH means a finish of solid, *non-combustible* material, usually decorative, at least 50 mm thick and positioned on a *constructional* hearth.
2. There need not be a 150 mm separation where the appliance is located in a fireplace recess, nor where the back or sides of the hearth either 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 100°C under normal working conditions. The base may be provided separately from the appliance. In other cases the appliance should stand on a hearth *constructed* and installed in accordance with the guidance for a solid fuel appliance.

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 100° C under normal working conditions. Separation may be by:

- a. a shield of *non-combustible* material at least 25 mm thick; or
- b. an air space of at least 75 mm.

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)

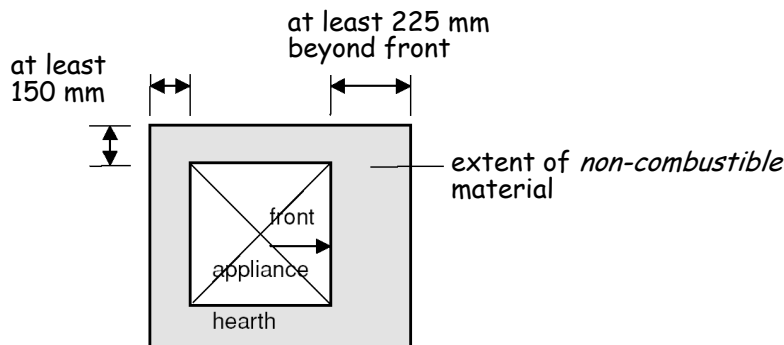
Hearth *construction*

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.

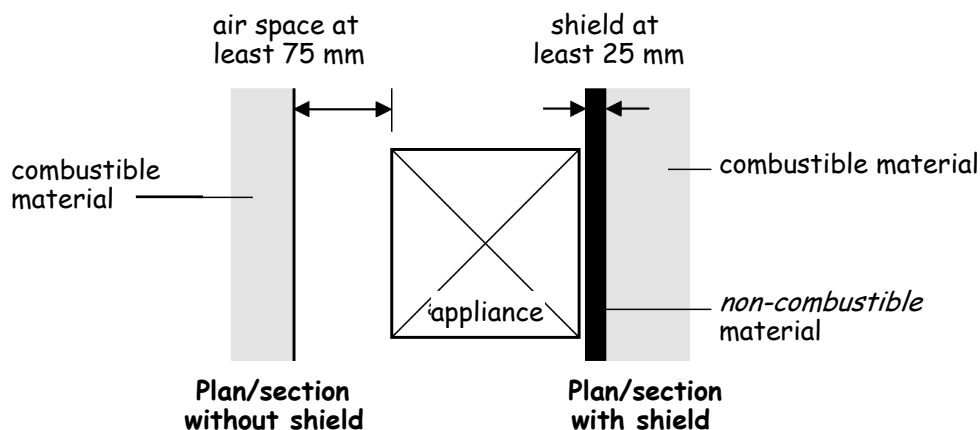
However a hearth need not be provided:

- 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 100° C under normal working conditions. Separation may be by:

- a. a shield of *non-combustible* material at least 25 mm thick; or
- b. an air space of at least 75 mm.



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

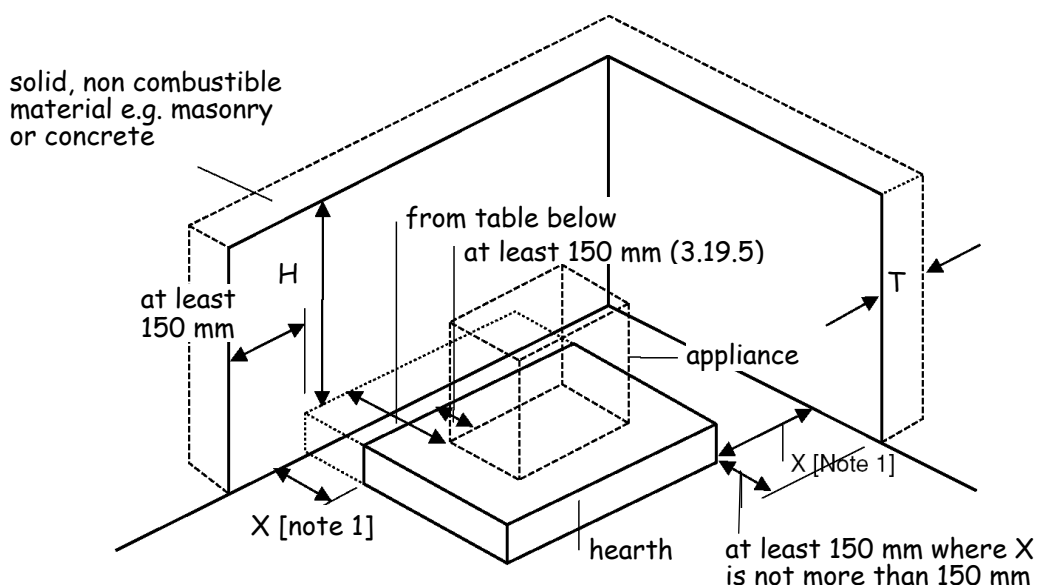
3.19.8 Relationship of hearths to combustible materials (F4.19, F4.20)

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 *building* from catching fire. This is particularly relevant to timber-framed

buildings. Any part of a *building* 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 *building*, 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*

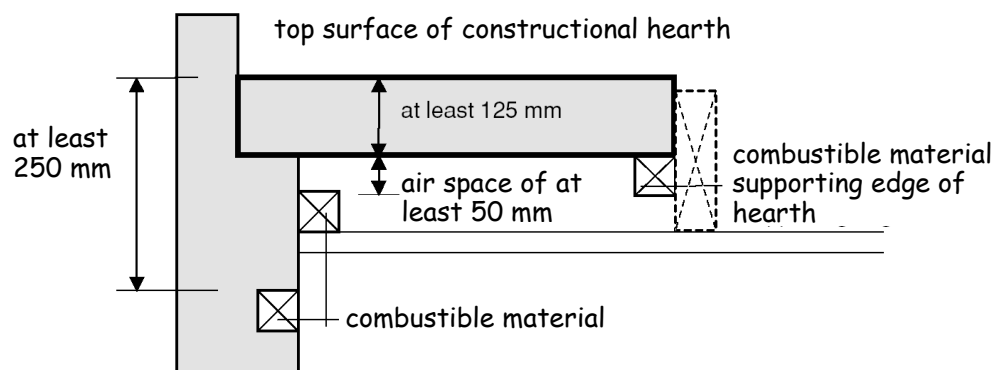
Location of hearth or appliance	Thickness (T) of solid, <i>non-combustible</i> material	Height (H) of solid <i>non-combustible</i> material.
where the hearth abuts a wall and the appliance is not more than 50 mm from the wall	200 mm	at least 300 mm above the appliance or 1.2 m above the hearth whichever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

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/m³; and
- c. installed on a *constructional* hearth; and
- d. of components having a minimum thickness shown in the table below:

Thickness of solid fuel appliance chamber components

Component	Minimum thickness (mm)
Base	50
Sides	75
Back panel and top slab	100
Hood and bar lintels	100

3.20 Combustion appliances – removal of products of combustion

- 3.20 Functional standard
- 3.20.0 Introduction
- 3.20.1 Chimneys and flue-pipes serving appliances burning any fuel
- 3.20.2 Chimneys and flue-pipes serving solid fuel appliances
- 3.20.3 Chimneys and flue-pipes serving oil-firing appliances
- 3.20.4 Chimneys and flue-pipes serving gas-fired appliances
- 3.20.5 Oil-firing appliances in bathrooms and bedrooms
- 3.20.6 Gas-fired appliances in bathrooms and bedrooms
- 3.20.7 Protection of metal chimneys
- 3.20.8 Size of flues – solid fuel appliances
- 3.20.9 Size of flues – oil-firing appliances
- 3.20.10 Size of flues – gas-fired appliances
- 3.20.11 Design of flues
- 3.20.12 Openings in flues
- 3.20.13 Access to flues
- 3.20.14 Location of metal chimneys
- 3.20.15 Terminal discharges at low level
- 3.20.16 Terminal discharge from condensing boilers
- 3.20.17 Solid fuel appliances flue outlets
- 3.20.18 Oil-firing appliances flue outlets
- 3.20.19 Gas-fired appliances flue outlets

standard
3.20
 mandatory

Every *building* must be designed and *constructed* in such a way that the products of combustion are carried safely to the external air without harm to the health of any person through leakage, spillage, or exhaust nor permit the re-entry of dangerous gases from the combustion process of fuels into the *building*.

3.20.0 Introduction

Fire fighters attend approximately 3400 *chimney* fires per year in Scotland.

Heating and cooking appliances fuelled by solid fuel, oil or gas all have the potential to cause carbon monoxide (CO) poisoning if they are poorly installed or commissioned, inadequately maintained or incorrectly used. Inadequate ventilation or a lack of the correct maintenance of appliances, *flues* and *chimneys* are the main causes of CO poisoning. Some incidents are also due to incorrect installation or deterioration of the structure of the *chimney*. Poisonous CO gas is produced when fuel does not burn properly. There are still a few deaths and permanent injuries in Scotland each year from CO poisoning that can be directly attributed to combustion appliance installations.

Incorrect sizing of *flues* can also have serious repercussions. If a *flue* is too small, an insufficient volume of air will pass through it and this may lead to spillage of combustion gases. Too large a *flue* will slow down the flow of combustion gases and this may also lead to spillage.

Conversions

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

3.20.1 **Chimneys 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.

Satisfactory specification of *chimneys* and *flue-pipes* depends upon the gas temperature to be expected in normal service. *Flue* gas temperatures depend upon appliance types and the age of their design. Older appliances are likely to produce *flue* gas temperatures greater than 250° C while modern boilers that bear the CE mark indicating compliance with the Boiler (Efficiency) Regulations (1993) will normally have *flue* gas temperatures less than 250° C. Information for individual appliances should be sought from manufacturer's installation instructions, from the manufacturers themselves or from OFTEC. Where this is not available, *flues* should be *constructed* for an assumed *flue* gas temperature of more than 250° C.

Boiler (Efficiency) Regulations 1993

High *flue* gas temperatures

Where the *flue* gas temperatures are more than 250° C, under normal working conditions, custom-built *chimneys*, *system chimneys* and *flue-pipes* should be designed and *constructed* for use with a solid fuel appliance.

Low *flue* gas temperatures

Where the *flue* gas temperatures are not more than 250° C, under normal working conditions, *chimneys* and *flue-pipes* may be of a lower specification as follows:

- a. in accordance with the guidance in clauses 3.18.3, 3.18.4, 3.18.5, relating to gas; and
- b. where the oil-firing appliance burns Class D fuel, the inner surfaces of the *chimney* or *flue-pipe* should not be manufactured from aluminium.

The *flue* gas temperatures are quoted in manufacturer's product data and can be measured in accordance with OFTEC Appliance Standard [OFS A100](#) for boilers, [OFS A101](#) for cookers or [OFS A102](#) for *room* heaters.

3.20.4 **Chimneys and flue-pipes serving gas-fired appliances (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**

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.

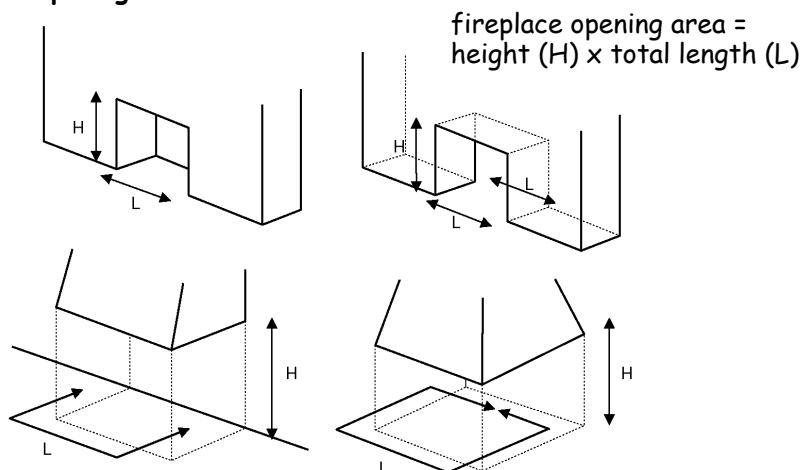
Minimum area of flues

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.

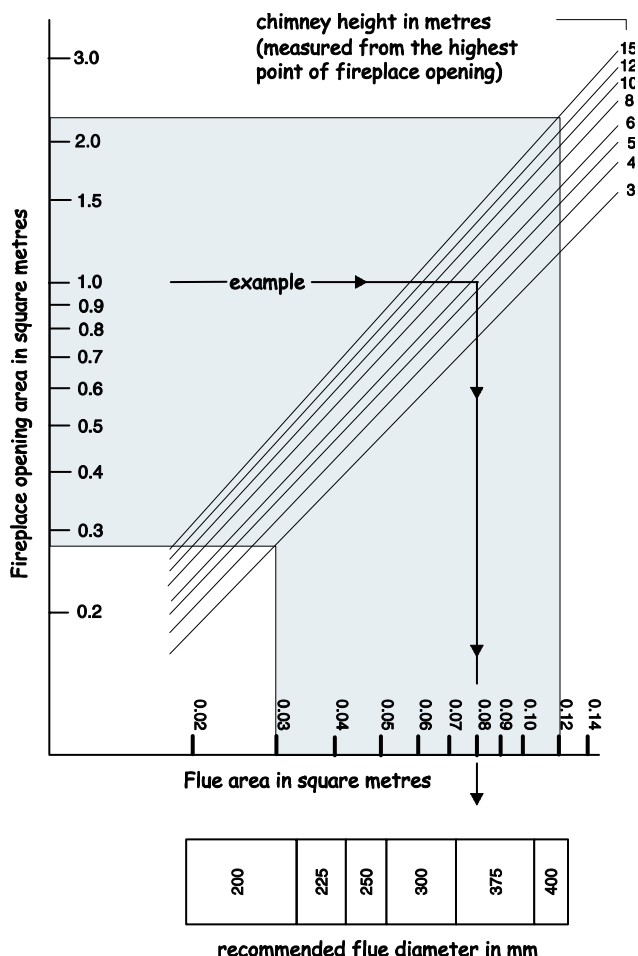
Notes:

- 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.
- 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.
- Specialist advice should be sought when proposing to construct flues with an area of more than 120000 mm² or 15% of the total face area of the fireplace opening.
- The diagram to clause 3.20.7 should only be used for the range of sizes shown within the shaded area.
- 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:

- Clause 9 of BS 5871: Part 3: 2001, for a decorative fuel-effect gas appliance;
- BS 5871: Part 2: 2001, for an inset live fuel-effect gas appliance;
- 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

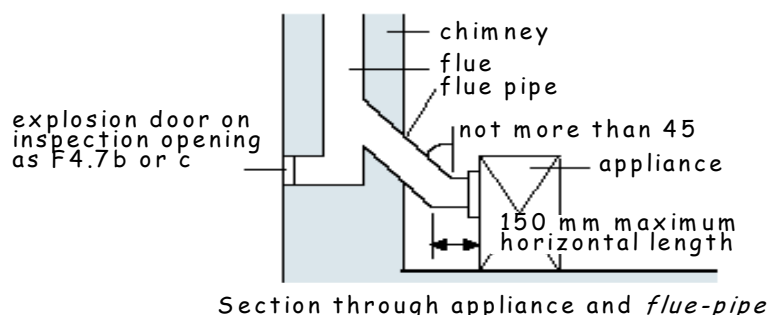
sufficient to ventilate a *kitchen* but where other types of flueless appliances are installed, the manufacturer's instructions should be followed.

- 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



Where bends are essential, they should be angled at not more than 45° 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 gasses 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.

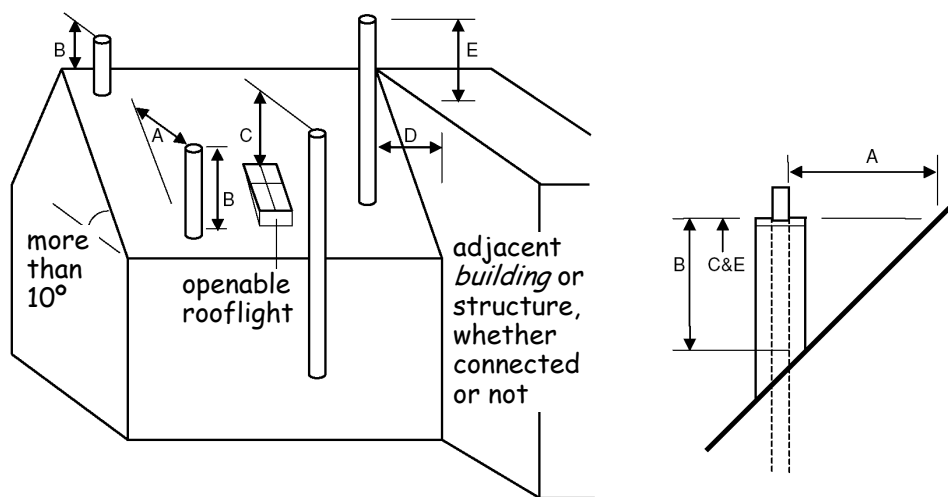
A *flue* terminal should be protected with a guard if a person could come into contact with it or if it could be damaged. If the *flue* outlet is in a vulnerable position, such as where the *flue* discharges within reach of the ground, or a balcony, veranda or window, it should be designed to prevent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

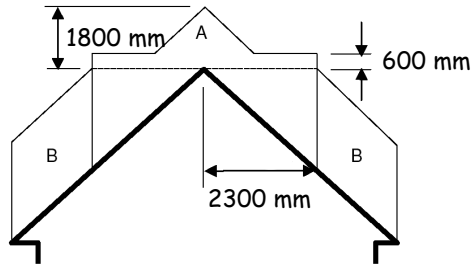
A	2300 mm horizontally clear of the weather skin.
B	1000 mm provided A is satisfied; or 600 mm where above the ridge. However, where the roof is thatch or shingles, the dimensions should be as diagram 2 to clause 3.20.17.
C	1000 mm above the top of any <i>flat roof</i> , and 1000 mm above any openable rooflight, dormer or <i>ventilator</i> , 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

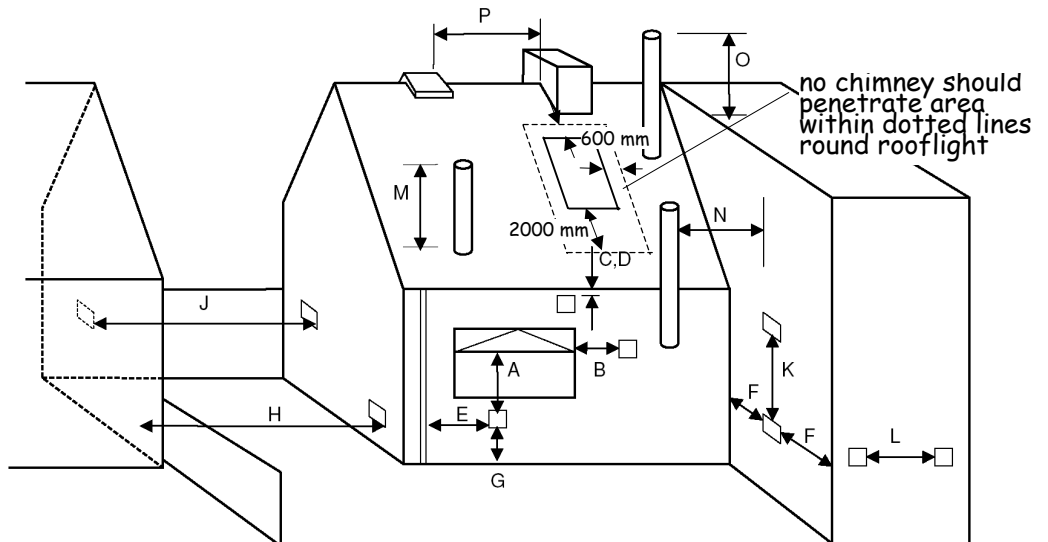
Zone A At least 1800 mm vertically above the weather skin; and at least 600 mm above the ridge.

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:



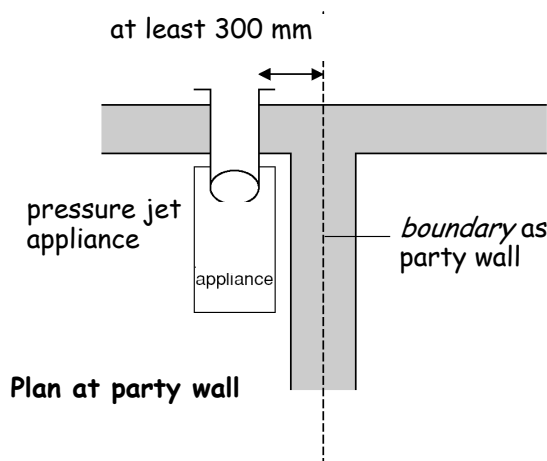
***Flue* terminal positions for oil-firing appliances**

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 <i>boundary</i> facing the terminal	600 [6]	Not allowed
J From a terminal facing the terminal	1200	Not allowed
K Vertically from a terminal on the same wall	1500	Not allowed
L Horizontally from a terminal on the same wall	750	Not allowed
M Above the highest point of an intersection with the roof	600 [1]	1000 [7]
N From a vertical structure to the side of the terminal	750 [1]	2300
O Above a vertical structure not more than 750 mm from the side of the terminal	600 [1]	1000 [7]
P From a ridge terminal to a vertical structure on the roof	1500	Not allowed

Notes:

1. Appliances burning Class D oil should discharge the flue gases at least 2 m above ground level.
2. Terminating positions M, N, and O for vertical balanced *flues* should be in accordance with manufacturer's instructions.
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.

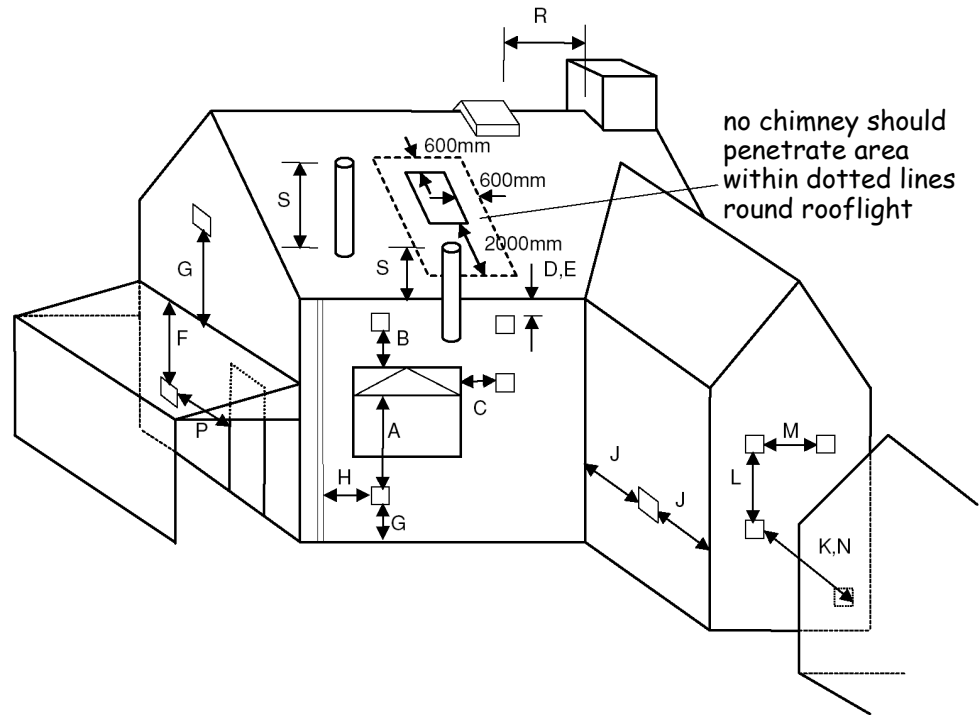
Separation between a *boundary* and terminal at right angles



3.20.19 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:



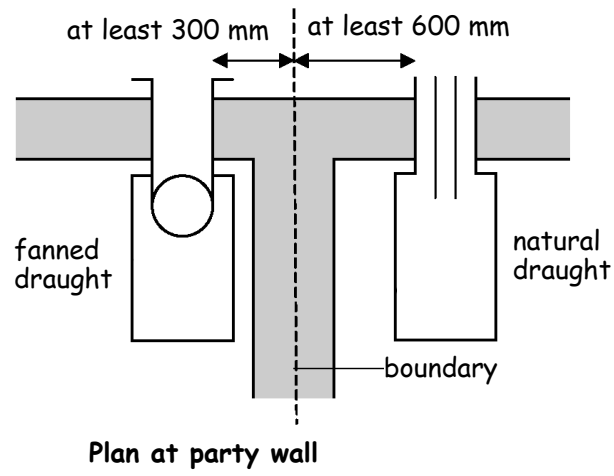
Flue terminal positions for gas-fired appliances

Location	Minimum distance to terminal in millimetres				
	Balanced <i>flue</i> , room-sealed appliance		Open <i>flue</i>		
	Natural draught	Fanned draught	Natural draught	Fanned draught	
A	Directly below an opening, air brick, opening window, etc	(0-7 kW) 300 (>7-14 kW) 600 (>14-32 kW) 1500 (>32-70 kW) 2000	300	n/all	300
B	Above an opening, air brick, opening window, etc	(0-32 kW) 300 (>32-70 kW) 600	300	n/all	300
C	Horizontally to an opening, air brick, opening window, etc	(0-7 kW) 300 (>7-14 kW) 400 (>14-70 kW) 600	300	n/all	300
D	Below a gutter, or sanitary pipework	300 [2]	75 [1]	n/all	75 [1]
E	Below the eaves	300 [2]	200	n/all	200
F	Below a balcony or <i>carport</i> roof	600	200	n/all	200
G	Above ground, roof or balcony level	300	300	n/all	300
H	From vertical drain/soil pipework	300	150 [3]	n/all	150
J	From an internal or external corner	600	300	n/all	200
K	From a surface or <i>boundary</i> facing the terminal [4]	600	600 [5]	n/app	600
L	Vertically from terminal on same wall	1500	1500	n/app	1500
M	Horizontally from terminal on same wall	300	300	n/app	300
N	From a terminal facing the terminal	600	1200 [6]	n/app	1200
P	From an opening in a <i>carport</i> (e.g. door, window) into the <i>building</i>	1200	1200	n/app	1200
R	From a vertical structure on the roof [7]	n/app	n/app	[Note 8]	n/app
S	Above an intersection with the roof	n/app	[Note 9]	[Note 10]	150

Notes

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 *building* 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.

Separation between a *boundary* and terminal at right angles



3.21 Combustion appliances – air for combustion

- 3.21 Functional standard
- 3.21.0 Introduction
- 3.21.1 Supply of air for combustion generally
- 3.21.2 Supply of air for combustion to solid fuel appliances
- 3.21.3 Supply of air for combustion to oil-firing appliances
- 3.21.4 Supply of air for combustion to gas-fired appliances

standard
3.21
mandatory

Every *building* must be designed and *constructed* in such a way that each fixed combustion appliance installation receives air for combustion and operation of the *chimney* so that the health of persons within the *building* is not threatened by the build-up of dangerous gases as a result of incomplete combustion.

3.21.0 Introduction

All combustion appliances need ventilation to supply them with oxygen for combustion. This air, which must be replaced from outside the *building*, 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 3.17.9.

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 <i>flue</i> .
Open appliance with a throat [1]	a permanent air entry opening or openings with a total free area of 50% of the throat opening area.
Any other solid fuel appliance	a permanent air entry opening or openings with a total free area of 550 mm ² for each kW of combustion appliance rated output more than 5 kW. (A combustion appliance with an output rating of not more than 5 kW has no minimum requirement, unless stated by the appliance manufacturer)

Notes:

- In the table:
THROAT means the contracted part of the *chimney flue* lying between the fireplace opening and the main *chimney flue*.
- Where a draught stabiliser is fitted to a solid fuel appliance, or to a *chimney* or *flue-pipe* in the same *room* as a solid fuel appliance, additional ventilation opening should be provided with a free area of at least 300 mm²/kW of solid fuel appliance rated output.
- 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

- 3.22 Functional standard
- 3.22.0 Introduction
- 3.22.1 Appliance compartments
- 3.22.2 Supply of air for cooling to oil-firing appliances
- 3.22.3 Supply of air for cooling to gas-fired appliances

standard
3.22
mandatory

Every *building* must be designed and *constructed* in such a way that each fixed combustion appliance installation receives air for cooling so that the fixed combustion appliance installation will operate safely without threatening the health and safety of persons within the *building*.

3.22.0 Introduction

In some cases, combustion appliances may need air for cooling in addition to air for combustion. This air will keep control systems in the appliance at a safe temperature and/or ensure that casings remain safe to touch.

Conversions

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

3.22.1 *Appliance compartments*

Where appliances require cooling air, *appliance compartments* should be large enough to enable air to circulate and high and low level vents should be provided.

3.22.2 *Supply of air for cooling to oil-firing appliances* (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

- 3.23 Functional standard
- 3.23.0 Introduction
- 3.23.1 Separation of oil tanks from buildings and boundaries
- 3.23.2 Additional fire protection
- 3.23.3 Storage within a building

<p style="text-align: center;">standard</p> <h1 style="text-align: center;">3.23</h1> <p style="text-align: center;">mandatory</p>	<p>Every <i>building</i> must be designed and <i>constructed</i> in such a way that 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 <i>building</i>, will inhibit fire from spreading to the tank and its contents from within, or beyond, the <i>boundary</i>.</p> <p>Limitation This standard does not apply to portable containers.</p>
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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 tanks not more than 3500 litres capacity

Not more than 1.8 m from any part of any <i>building</i>	<i>non-combustible</i> base; and any part of the eaves not more than 1.8 m from the tank and extending 300 mm beyond each side of the tank must be <i>non-combustible</i> ; and either: a. any part of a <i>building</i> not more than 1.8 m from the tank should be of <i>non-combustible construction</i> type 7, short duration (see table to 2B1), or b. a barrier.	<i>non-combustible</i> base; and any part of the eaves not more than 1.8 m from the tank and extending 300 mm beyond each side of the tank must be <i>non-combustible</i> ; and a barrier between the tank and any part of a <i>building</i> not more than 1.8 m from the tank.
More than 1.8 m from any <i>building</i>	<i>non-combustible</i> base.	
Not more than 760 mm from a <i>boundary</i>	<i>non-combustible</i> base, and a barrier, or a wall with a <i>non-combustible construction</i> type 7, short duration (see table to 2B1).	
More than 760 mm from a <i>boundary</i>	<i>non-combustible</i> 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 Section 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 need to be made including:

- 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 required by The Control of Pollution (Oil Storage) (Scotland) Regulations 2003.

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

- 3.24 Functional standard
- 3.24 0 Introduction
- 3.24.1 Construction of oil tanks
- 3.24.2 Oil storage installations
- 3.24.3 Secondary containment

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)

Risk assessment
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:

- 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 banded tanks An integrally banded 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 banded 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 banded tank
Within a <i>building</i>	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

This standard does not apply to *buildings* other than *domestic buildings*

3.26 Dungsteads and farm effluent tanks

- 3.26 Functional standard
- 3.26.0 Introduction
- 3.26.1 Construction of dungsteads and farm effluent tanks
- 3.26.2 Location of dungsteads and farm effluent tanks
- 3.26.3 Safety of dungsteads and farm effluent tanks

<p>standard 3.26 mandatory</p>	<p>Every <i>building</i> must be designed and <i>constructed</i> in such a way that there will not be a threat to the health and safety of people from a dungstead and farm effluent tank.</p>
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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 premises used wholly or partly for the preparation or consumption of food so as not to prejudice the health of people in the food premises. The dungstead or farm effluent tank should be located at least 15 m from the food premises.

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

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- 4.0 Introduction**
- 4.1 Access to buildings**
- 4.2 Access within buildings**
- 4.3 Stairs and ramps**
- 4.4 Pedestrian protective barriers**
- 4.5 Electrical safety**
- 4.6 Electrical fixtures (does not apply to non-domestic buildings)
- 4.7 Aids to communication**
- 4.8 Danger from accidents**
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- 4.10 Fixed seating**
- 4.11 Liquefied petroleum gas storage**
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4.0 Introduction

- 4.0.1 Background
- 4.0.2 Aims
- 4.0.3 Latest changes
- 4.0.4 Relevant legislation

introduction

4.0

4.0.1 Background

The guidance in this handbook is appropriate for all non-domestic *buildings*.

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. Thus no *building* can be absolutely safe and some risk of harm to users may exist in every *building*.

Deaths 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.

The Disability
Discrimination Act
1995

Other legislation has a bearing on access to *buildings*. The Disability Discrimination Act 1995 (DDA) could have a significant affect on the design of access to, and within, *buildings*.

The Act makes it unlawful to discriminate against a person on the grounds of that person’s disability. The Act applies generally, with some limited exclusions, to all non-domestic *buildings*, including places of employment (Part 2 of the Act), any *building* offering a service to the public (Part 3 of the Act) and to places of education (Part 4 of the Act).

www.drc-gb.org

Designers, clients and developers should consider the specific duties imposed under this Act and are recommended to study the legislation and the Codes of Practice that support the Act. These Codes of Practice are produced by the Disability Rights Commission (DRC) and are available on their website.

DDA Part 3

Of particular relevance is the [Code of Practice for Part 3 – Rights of Access, Goods, Facilities, Services and Premises](#). Part 3 of the DDA requires that, for 1 October 2004, service providers should have considered any requirements to make ‘reasonable adjustments’ in relation to the features of their premises to overcome physical barriers to access.

Where a physical feature of a premises places a disabled person at a disadvantage, the Act imposes a duty to take all reasonable steps to remedy the situation. Amongst options to consider would be the alteration or removal of any such physical barriers to access. ‘Disabled person’ has a different definition under the DDA than it has as a defined term under the [Building \(Scotland\) Regulations 2004](#).

Under Part 3 of the Act, a limited exemption to the above is granted to elements in a *building* that are carried out in compliance with a Warrant that was issued under the 5th or 6th Amendment of the Technical Standards. In such cases, it is unlikely to be reasonable for a service provider to be required to make further adjustment to such elements for a period of 10 years from the date that the *work* was completed.

www.sbsa.gov.uk

At the time of production of this document, it was not known if this exemption would be extended to include a similar provision under the Building (Scotland) Regulations 2004. Information on this topic, once available, will be made available on our website.

It should be noted that any exemption relates only to elements specifically covered by the Technical Standards. Those with a duty under the DDA should be aware that their responsibility to observe 'good practice' extends beyond matters covered by the Building Regulations.

BS 8300: 2001

Designers are directed to BS 8300: 2001 – 'Design of buildings and their approaches to meet the needs of disabled people - Code of practice' for additional information on good practice. This document also provides guidance on matters not covered within the remit of the building regulations

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 or unsafe access to, and on, roofs;
- 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 on 4 March 2002.

- 4.1.1 additional guidance on set-down points
- 4.1.2 additional guidance on unobstructed approach
- 4.1.3 additional guidance on large numbers of parking spaces for *disabled people*
- 4.1.5 clarification of guidance on accessible thresholds
- 4.2.1 revised guidance on access for *disabled people*
- 4.2.2 revised guidance on access for *disabled people*.
- 4.2.3 additional guidance on provision of both ramp and stair in some locations
- 4.2.4 revised guidance on exclusion of places of lawful detention

- 4.3.3 revised guidance on minimum step rise
- 4.3.4 removal of reference to stepped ramps from current S3.10
- 4.3.5 revised guidance permitting open riser stairs if used for descent only
- 4.3.7 more appropriate method of measuring landing lengths on stairs
- 4.3.7 deletion of guidance allowing doors opening onto bottom landing
- 4.3.12 revised guidance for ramp edge protection
- 4.3.13 clarification of guidance on ramp widths
- 4.3.15 revised guidance on landing length of ramps
- 4.3.17 revised guidance on handrails to wide stairs
- 4.3.22 additional guidance on stepped and ramped gangways within areas of fixed seating
- 4.8.1 revised guidance for places of lawful detention
- 4.8.3 clarification on size of working areas provided
- 4.8.8 expanded guidance on access to roofs

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.

[Disability Discrimination Act 1995](#)

The Disability Discrimination Act 1995 sets out measures intended to end discrimination against people with disabilities in the areas of employment, access to goods, facilities and services, in the management, buying or renting of land or property, in education and in public transport.

[Workplace \(Health, Safety and Welfare\) Regulations 1992](#)

The Workplace, (Health, Safety and Welfare) Regulations 1992 cover the key issues for inspection and enforcement by local authorities on matters relating to the physical characteristics of the workplace such as temperature, lighting, cleanliness and sanitary conveniences.

[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 Electricity at Work Regulations 1989](#)

The Electricity at Work Regulations 1989 defines the duties of an employer to ensure and maintain a safe working environment with respect to any electrical installation within a *building*.

[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 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 combustion appliance installations

4.1 Access to buildings

- 4.1 Functional standard
- 4.1.0 Introduction
- 4.1.1 Car parking
- 4.1.2 Approach to buildings
- 4.1.3 Length of access route
- 4.1.4 Width of approach to buildings
- 4.1.5 Principal entrances

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*.

Inclusive design

4.1.0 Introduction

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 appropriate access, considering factors such as:

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

Disability
Discrimination Act
1995

Other legislation has a bearing on access to, and within, *buildings*. In particular, due regard should be taken of the recommendations in the supporting Codes of Practice to the Disability Discrimination Act 1995, as explained in clause 4.0.1.

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 cited in this Handbook:

- BS 8300 : 2001 – ‘Design of buildings and their approaches to meet the needs of disabled people - Code of practice’
- ‘[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).

Escape from a *building*

This section is limited to the provision of access to, and within, *buildings*. It does not cover means of escape in the event of fire, for which reference should be made to Section 2, Fire.

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)

Parking spaces for <i>disabled people</i>	<p>4.1.1 Car parking (S2.1 & S2.2)</p> <p>When parking is provided within the <i>curtilage</i> of a non-domestic <i>building</i>, a proportion of spaces should be designated for use by <i>disabled people</i>. Additional space should be provided to assist in entering or leaving the vehicle. Car parking spaces designated suitable for <i>disabled people</i> should be:</p> <ol style="list-style-type: none"> a. provided on 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 principal entrance of the <i>building</i>; and c. clearly marked as parking for <i>disabled people</i>; 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.
Planning guidance: SPP 17	<p>Designers should be aware of requirements for parking for <i>disabled people</i> under planning legislation. The recommendations of SPP 17: 'Planning for Transport' may be relevant if more onerous provision is recommended than noted in sub-clause a. above.</p> <p>Not everyone arrives at a destination in their own transport. The provision of a setting-down point on a level surface, close to the principal entrance should be considered, where practical to do so within the <i>curtilage</i> of the <i>building</i>.</p>
Obstructions	<p>4.1.2 Approach to buildings (S2.3a & c)</p> <p>The access route to a <i>building</i> 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.</p> <p>Within the <i>curtilage</i> of a <i>building</i>, a level or ramped access, appropriate for wheelchair users, should be provided to the principal entrance of a <i>building</i> from a <i>road</i> and from any car parking provided for <i>disabled people</i>.</p> <p>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 <i>road</i> or car parking provided for <i>disabled people</i>, and the access route to a <i>building</i>. It is important to consider how to avoid restrictions or other hazards that may cause injury on an approach to a <i>building</i>. Low level bollards or chain-linked posts, for example, are particularly hazardous to people with a visual impairment.</p>
Surface materials	<p>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.</p> <p>Surfaces to an access route appropriate for wheelchair users, include:</p> <ol style="list-style-type: none"> 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. <p>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.</p>

4.1.3 Length of access route (S2.1b)

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 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 principal entrance of a *building* should not exceed 45 m.

Specialised
buildings

It is recognised that in some projects, such as sports stadia or large superstores, where a large number of parking spaces for *disabled people* is provided it may not be possible for every such space to be within the 45 metre distance to the principal entrance

4.1.4 Width of approach to buildings (S2.3b)

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 Principal entrances (S2.4)

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*.

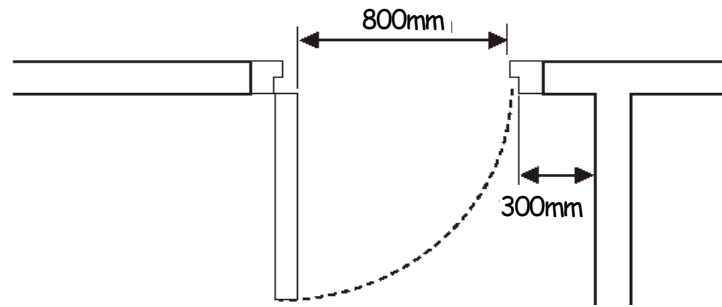
The principal entrance to a *building* should be accessible to everyone and should have:

- a. a threshold that will not be a trip hazard and will permit unassisted access to people in a wheelchair; and
- b. a door leaf which provides a clear opening width of at least 800 mm in accordance with the diagram below; and
- c. 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
- d. 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
- e. where it comprises a revolving door, an adjacent side hinged door in accordance with the points noted above.

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.

Principal entrance



Accessible threshold

Care should be taken with the design of a threshold to ensure it does not present a barrier to access. 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 not 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 45° to the horizontal.

4.2 Access within buildings

- 4.2 Functional standard
- 4.2.0 Introduction
- 4.2.1 Access between storeys
- 4.2.2 Accessibility to storeys
- 4.2.3 Accessibility within storeys
- 4.2.4 Internal doors
- 4.2.5 Accessible lobbies

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

Safe and unassisted means of access for everyone should be provided throughout any non-domestic *building*. However it is recognised some areas need not be fully accessible to *disabled people*. Guidance is provided to this standard.

The Disability
Discrimination Act

Other legislation has a bearing on access within *buildings*. In particular, due regard should be taken of the provisions and supporting Code of Practice of the Disability Discrimination Act 1995 (see introduction to standard 4.1).

Good practice

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’
- ‘[Guide to Safety at Sports Grounds](#)’, published by The Stationery Office. This provides further guidance on steps or ramps associated with gangways of shallow pitch in *assembly buildings*, such as sports stadia, arenas, theatres and cinemas

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)

4.2.1 Access between storeys (S2.6)

Buildings should be accessible to everyone including elderly people, *disabled people* and people with prams or small children. They should be able to gain access to and throughout *buildings* without assistance. Every *storey* of a *building* should be fully accessible. However it is recognised that it is not *reasonably practicable* for all areas to be accessible to *disabled people* and the following list provided further guidance:

Accessibility:
disabled people

Access for *disabled people* need not be provided to the following areas:

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

Accessibility:
wheelchair users

Access for wheelchair users need not be provided to the following areas:

- a. to a *storey*, other than the principal entrance *storey*, or *gallery* in a *building* of not more than 2 *storeys* where the *storey* or *gallery* is not more than 280 m² excluding vertical circulation, *sanitary accommodation* and plant rooms; or
- b. to a *storey*, other than the principal entrance *storey*, or *gallery* in a *building* of more than 2 *storeys* where the *storey* or *gallery* is not more than 200 m² excluding vertical circulation, *sanitary accommodation* and plant rooms; or
- c. to a bedroom not provided with *sanitary facilities* accessible to wheelchair users, in a *residential building*, such as a hotel, that is not provided with a lift; or
- d. within an area having fixed seating where wheelchair spaces and associated access are provided in accordance with clause 4.10.1; or
- e. to a *storey* in a car park or parking garage, such as multi-*storey* car parking, where car parking for *disabled people* is not provided.

Accessibility:
bars & restaurants

Access for wheelchair users should be provided to more than half the public area of a bar or restaurant, together with access to the counter in a bar and to any self-service counter in a restaurant.

4.2.2 Accessibility to storeys (S2.6)

All *storeys* above and below the principal entrance *storey* should be fully accessible, other than those areas listed in clause 4.2.1. A way of providing this would be for a passenger lift to serve the relevant *storeys*.

Passenger lifts

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.

Accessible stair

Although it is not proposed to provide full wheelchair access to all areas, as noted in clause 4.2.1, access should still be provided for ambulant *disabled people*. An accessible stair (see guidance to Standard 4.3) should be provided to all areas other than:

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

Existing *buildings*

In some circumstances, particularly in *conversions* or within existing *buildings*, the installation of a passenger lift may prove problematic. In certain cases where travel is between 2 storeys only, it may be appropriate to consider the installation of a platform lift, in accordance with BS 6440: 1983 as an alternative to a full passenger lift.

4.2.3 Accessibility within storeys (S2.7)

Corridors and passageways should be wide enough to allow wheelchair users access to adjacent *rooms* and spaces and to turn through 180°. All corridors that are accessible to *disabled people* should be at least 1.2m wide. This width is the minimum for escape as recommended in section 2 - Fire.

A change in level within a *storey* to which access for *disabled people* is provided (see clause 4.2.1) should be accomplished by:

- a. a ramp; or
- b. a stair, together with a means of providing unassisted movement between levels for wheelchair users. This could include a wheelchair platform stairlift provided in accordance with BS 5776: 1996, or a powered lifting platform provided in accordance with BS 6440: 1983.

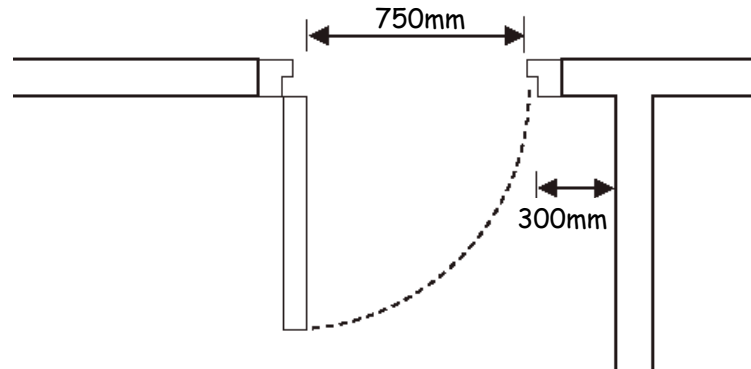
Not all ambulant *disabled people* find it as easy to use ramps as they do stairs. It may therefore not be appropriate to provide a ramp as the only access to a change in level in certain situations.

4.2.4 Internal doors (S2.8)

An internal door accessible to *disabled people* should:

- a. contain a leaf which provides a clear opening width of at least 750 mm; and
- b. have an unobstructed space on the side, next to the leading edge, of at least 300 mm in accordance with the diagram overleaf. However this unobstructed space is not needed where the door is opened by automatic control; and
- c. where the door is across a corridor or passageway, have a clear *glazed* panel or panels giving a zone of visibility from a height of no more than 900 mm to at least 1.5 metres above finished floor level.
Note that provision of a vision panel may not be appropriate in certain circumstances within places of lawful detention.

Internal doors



4.2.5 Accessible lobbies

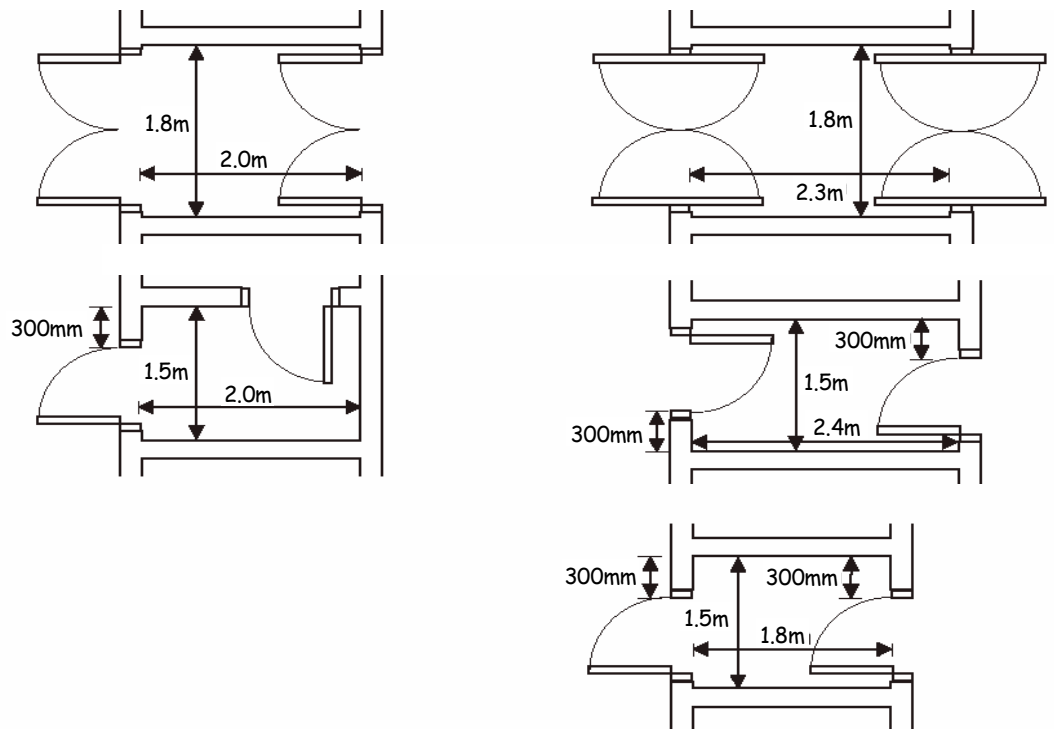
(S2.5, S2.9)

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 constructed in accordance with the guidance given in clause 4.1.5

Accessible lobbies



4.3 Stairs and ramps

- 4.3 Functional standard
- 4.3.0 Introduction
- 4.3.1 Measurement for stairs
- 4.3.2 Width of stair flights
- 4.3.3 Rise, going, tread and pitch of stairs
- 4.3.4 Number of rises in a flight
- 4.3.5 Guidance for risers and treads
- 4.3.6 Stair landings
- 4.3.7 Length of stair landings
- 4.3.8 Width of stair landings
- 4.3.9 Flights consisting partly of straight and partly of tapered treads
- 4.3.10 Flights consisting wholly of tapered treads
- 4.3.11 Pedestrian ramps
- 4.3.12 Guarding to the edge of pedestrian ramps
- 4.3.13 Width of ramp flights
- 4.3.14 Ramp landings
- 4.3.15 Length of ramp landings
- 4.3.16 Width of ramp landings
- 4.3.17 Handrails to stairs and ramps
- 4.3.18 Height of handrails
- 4.3.19 Headroom on stairs and ramps
- 4.3.20 Industrial stairs and fixed ladders
- 4.3.21 Stairs and fixed ladders in agricultural buildings
- 4.3.22 Stepped or ramped gangways within areas of fixed seating.

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 standard 4.4); and
- to protect people from vehicles, where vehicles have access to a *building* (refer to standard 4.12).

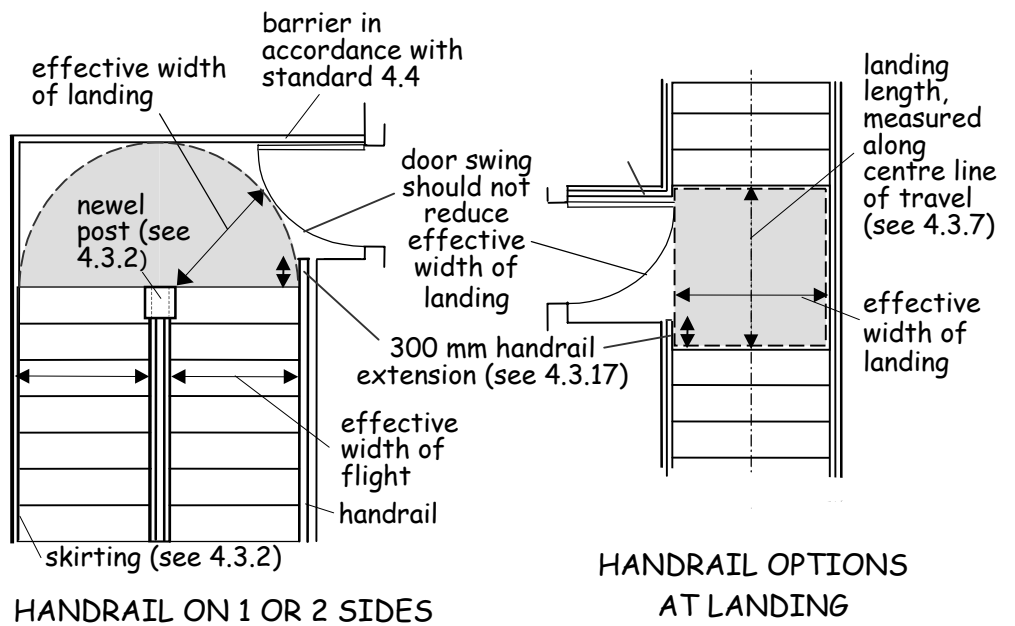
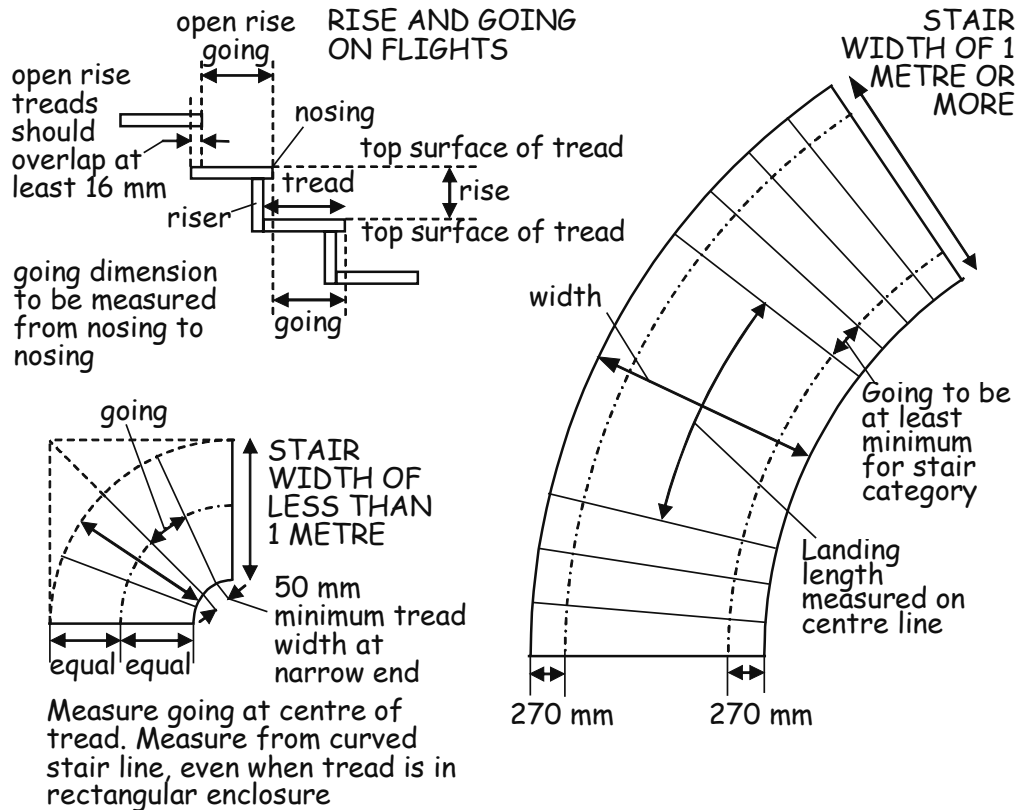
Conversions

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



AREA OF LANDING CLEAR OF ANY DOOR SWING OR OTHER OBSTRUCTION

Note: The number of treads shown is indicative only.

4.3.2 Width of stair flights (S3.4)

The clear or effective width of a stair should be sufficient to 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

Stair wholly within shared residential accommodation	Any other stair
a. 900 mm where it is within the accessible <i>storey</i> , such as a split level; or	At least the width recommended for any <i>escape route</i> giving access to it. However, where the number of people using the <i>escape route</i> is not more than: a. 225, it may be reduced to not less than 1.1 m; and b. 100, it may be reduced to not less than 1 m.
b. 600 mm where it serves only <i>sanitary accommodation</i> and/or one <i>room</i> , other than a living room or <i>kitchen</i> ; or	
c. 800 mm elsewhere, such as from one <i>storey</i> to another.	

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.

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 or within a non-domestic building

Minimum rise (mm)	Maximum rise (mm)	Minimum going (mm)	Tread	Maximum pitch
100	170	250	not less than the going	34°

Notes:

- all rises in a *flight* should be of uniform height;
- in a straight *flight*, or in a part of a *flight* that is straight, measurement should be uniform along the centreline of the *flight*;
- 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;
- the going measured at the narrow end of a tapered tread should be at least 50 mm (see diagram to clause 4.3.1);
- the aggregate of the going and twice the rise should be at least 550 mm and not more than 700 mm.
- In a stair, wholly within *shared residential accommodation*, maximum rise may be 220mm, minimum going may be 225mm and maximum pitch may be 42°.

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 stair wholly within *shared residential accommodation*, should be *constructed* in accordance with the guidance 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:

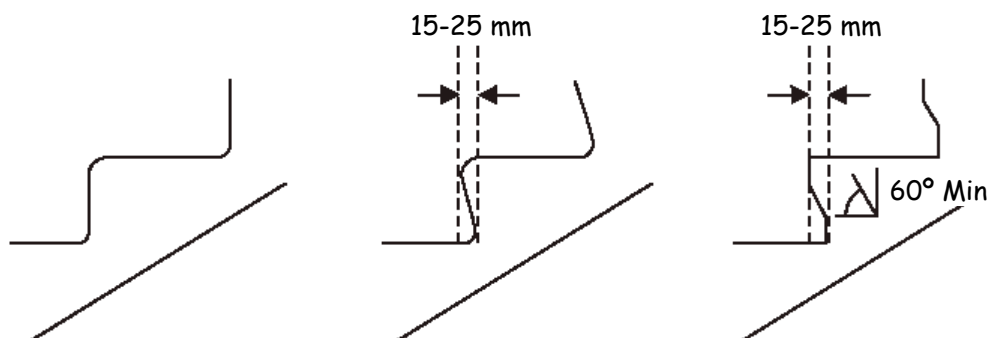
- a. between an external door of a *building* (not the principal entrance) and the ground; or
- b. between a landing and an adjoining level where the route of travel from the adjoining level to the next *flight* changes direction through 90° (i.e. a quarter landing as the first step).

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

All stairs providing access to and within *buildings* should be designed to be accessible by ambulant *disabled people*. Clause 4.2.1 provided 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, many may feel a sense of insecurity when looking through spaces present between the treads

Step profile examples



Any stair providing access for *disabled people* should have contrasting nosings to assist users with a visual impairment. Risers should be profiled to minimise tripping as shown below. Open risers should not be used unless a stair is intended for descent only, such as in a dedicated *escape stair* on an *escape route*.

Open risers

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 risers, 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 cross fall that should prevent standing water.

Other than where access is provided for *disabled people*, a landing need not be provided to a *flight* between the external door of a *building* and the ground, provided that:

- the door slides or opens in a direction away from the *flight*; and
- the aggregate rise is not more than 600 mm.

4.3.7 Length of stair landings (S3.19a)

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 1200mm or the effective width of the stair, whichever is least.

However, where, on an intermediate landing, a change of direction of 90° 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 Width of stair landings (S3.4a)

The effective width of a landing should be 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.

4.3.9 **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 shown in clause 4.3.1. In a *flight* 1 m wide or more the going should be measured at the two points, 270 mm from each end of the tread, as shown in clause 4.3.1 and the minimum going should be at least the going of the straight treads.

4.3.10 **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 than on a stair wholly within a unit of *shared residential accommodation*, risers and treads should be as recommended in clause 4.3.5; and
- handrails should be provided as recommended in clauses 4.3.17 and 4.3.18; and
- protective barriers should be as recommended in clause 4.4.2.

4.3.11 **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, 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 <i>flight</i>	Maximum length of <i>flight</i>
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.

4.3.12 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 of the ramp for a distance of 300 mm before starting to gradually fall away.

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*.

4.3.13 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.

4.3.14 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.

4.3.15 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 1.2 m.

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.

4.3.16 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*.

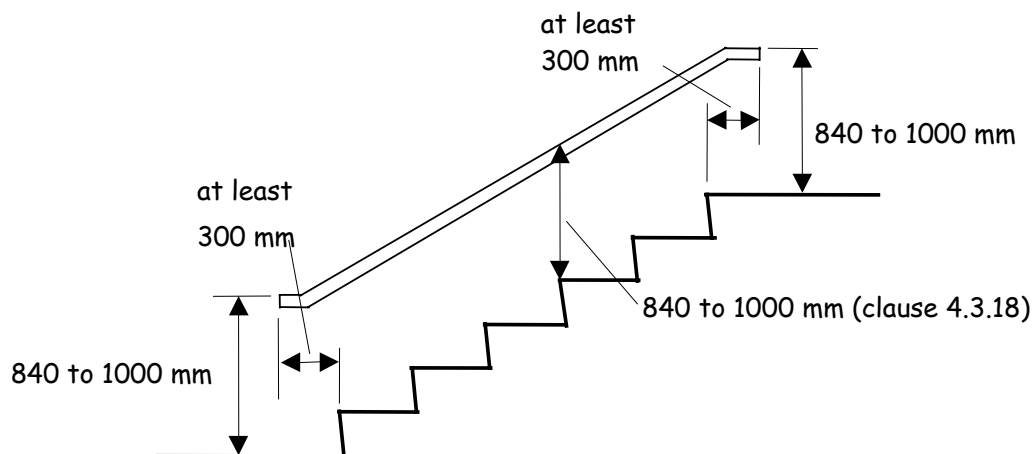
Measurement should be taken between handrails, or where there are no handrails, the protective barrier or inside face of the kerb, and be clear of any obstructions.

4.3.17 Handrails to stairs and ramps (S3.20 - 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 allow suitable support, a handrail should be provided on each side of a *flight* to a ramp or stair.

Handrails to stairs and ramps



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.

The extension of a handrail at landings allows an individual to steady or brace themselves before ascending or descending. For an individual 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.

Division of
wide *flights*

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*.

4.3.18 Height of handrails (S3.22)

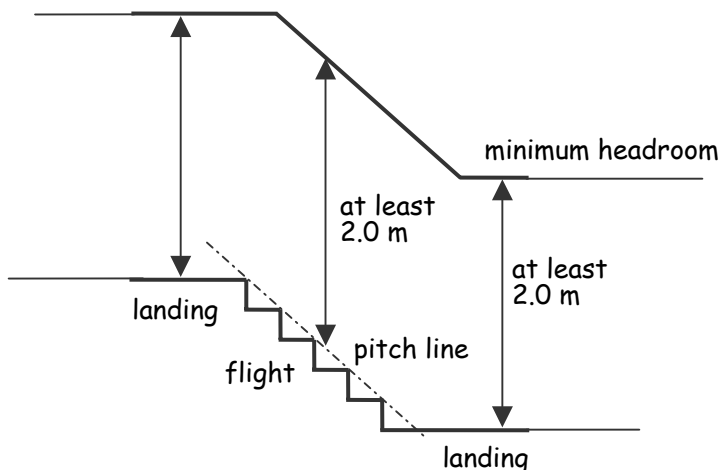
A handrail should be fixed at a height of at least 840 mm and not more than 1000 mm, measured vertically above the pitch line of a *flight* on a stair or ramp and on a landing where a handrail is provided.

For guidance on height of barriers, see clause 4.4.2.

4.3.19 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 width. Height should be measured vertically from the pitch line of the *flight* or from the surface of the landing.

Headroom on stairs & ramps



4.3.20 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.

4.3.21 Stairs and fixed ladders in agricultural buildings (S3.27)

A stair or fixed ladder in an agricultural *building* should be *constructed* to offer safe passage. Such a stair or fixed ladder should be *constructed* in accordance with BS 5502: Part 80: 1990.

4.3.22 Stepped or ramped gangways within areas of fixed seating.

In *buildings* designed for assembly and recreation where areas of fixed seating are provided to accommodate spectators, access to seating is commonly provided by gangways separating areas of seating.

To maintain sight lines for spectators, it is common for seating areas to be formed on a rake, either as a continuous gradient or following a rising parabolic curve. In the latter, steps following the curve may be provided if the variation in step rises is uniform within a *flight*.

The design of radial gangways – those running ‘at right angles’ to seating rows – should allow safe access and minimise possible hazards to users.

Where a stepped or ramped gangway provides access within an area of fixed seating, it should be in accordance with the general guidance set out in standard 4.3. However, it is not necessary to provide:

- a) a handrail where the edge of a stepped or ramped gangway is adjacent to fixed seating or an appropriate barrier. Where the side of a gangway is remote from seating, appropriate guarding should be provided as described in clauses 4.4.1 and 4.4.2;
- b) a landing in accordance with clause 4.3.7 at the foot of a stepped gangway where this gives direct access only to fixed seating, e.g. at a balcony, and where a protective barrier is provided as described in clauses 4.4.1 and 4.4.2.

Where fixed seating is installed, intermediate steps between tiers of seating should be positioned to minimise projection of any riser into the clearway zone at the end of each row. This may result in treads of differing lengths. A regular step rhythm should be maintained in all cases.

4.4 Pedestrian protective barriers

- 4.4 Functional standard
- 4.4.0 Introduction
- 4.4.1 Location of pedestrian protective barriers
- 4.4.2 Design of pedestrian protective barriers

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 *buildings* where the presence of children can be anticipated.

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 such barrier would be incompatible with the normal use of an area, e.g. at a loading bay.

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 any *non-domestic building* where the presence of unsupervised children is anticipated, gaps in any protective 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 <i>glazing</i> 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	900 [3]
in front of, or behind fixed seating	800 [4]
all other locations	1100

Notes:

1. A handrail provided in accordance with clauses 4.3.16 & 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. The barrier height may be reduced to 750 mm where it has an overall width at the top of at least 250 mm;

4.5 Electrical safety

- 4.5 Functional standard
- 4.5.0 Introduction
- 4.5.1 Electrical installations
- 4.5.2 Extra-low voltage installations
- 4.5.3 Installations operating above low voltage
- 4.5.4 Socket outlets in bathrooms and rooms containing a shower

standard

4.5

mandatory

Every *building* must be designed and *constructed* in such a way that the electrical installation does not:

- (a) threaten the health and safety of the people in, and around, the *building*; and**
- (b) become a source of fire.**

Limitation

This standard does not apply to an electrical installation:

- (a) serving a *building* or any part of a *building* to which the Mines and Quarries Act 1954 or the Factories Act 1961 applies; or
- (b) forming part of the works of an undertaker to which regulations for the supply and distribution of electricity made under the Electricity Act 1989.

4.5.0 Introduction

The hazards posed by unsafe electrical installation are injuries caused by contact with electricity (shocks and burns) and injuries arising from fires in *buildings* ignited through malfunctioning or incorrect installations.

Concern has been expressed that risks have been increasing in recent years due to:

- the increasing prevalence and variety of electrical systems in *buildings* and the demands being made on them;
- the reduction in subscription to voluntary industry self-regulation schemes.

The intention of this standard is to ensure that electrical installations are safe in terms of the hazards likely to arise from defective installations, namely fire, electric shock and burns or other personal injury. Installations should:

- safely accommodate any likely maximum demand; and
- incorporate appropriate automatic devices for protection against overcurrent or leakage; and
- provide means of isolating parts of the installation or equipment connected to it, as are necessary for safe working and maintenance.

The standard applies to fixed installations in *buildings*. An installation consists of the electrical wiring and associated components and fittings, including all permanently secured equipment, but excluding portable equipment and appliances.

Appendix 6 of BS 7671: 2001 (The Wiring Regulations) provides specimen certificates that may be completed by the person responsible for the installation. These can then be issued to the person ordering the *works* as guidance of compliance with the recommendations of the British Standard.

Socket outlets

‘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.

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

This standard does not apply to non-domestic buildings

4.7 Aids to communication

- 4.7 Functional standard
- 4.7.0 Introduction
- 4.7.1 Aids to communication

standard

4.7

mandatory

Every *building* must be designed and *constructed* in such a way that it is provided with aids to assist those with a hearing impairment.

Limitation

This standard does not apply to *domestic buildings*.

4.7.0 Introduction

The intention of this standard is to assist people with a hearing impairment in communication where this is made more difficult by the physical conditions or layout within a *building*.

Different types of hearing enhancement systems are available. These include induction loops and infrared or radio transmission systems. General information on factors to consider in selection of an appropriate system is given in BS 8300: 2001 – ‘Design of buildings and their approaches to meet the needs of disabled people - Code of practice’. The type and performance of the system should be considered at an early stage in the design process.

Such aids are particularly important in larger areas, where a sound source can be attenuated by both distance and through reverberation, or in locations where a physical barrier is present between speaker and listener.

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).

4.7.1 Aids to communication (N2.2)

People with hearing impairment should be able to access facilities in a *building* and to participate fully in activities such as conferences, meetings and entertainments.

Aids for people with a hearing impairment should be provided in:

- a. auditoria and conference halls with a floor area more than 100 m²; and
- b. situations where the public is separated from a vendor or service provider by a *glazed* screen (e.g. ticket kiosk, bank counter).

The installation of a system providing an aid to hearing should enhance the signal to a hearing aid by 20dB whilst suppressing reverberation and audience or other environmental noise.

4.8 Danger from accidents

- 4.8 Functional standard
- 4.8.0 Introduction
- 4.8.1 Collision with projections
- 4.8.2 Collision with glazing
- 4.8.3 Cleaning of windows and rooflights
- 4.8.4 Guarding of windows for cleaning
- 4.8.5 Emergency stopping of escalators and passenger conveyors
- 4.8.6 Access to manual controls
- 4.8.7 Roof access
- 4.8.8 Working on roofs

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 Handbooks.

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.

Roofwork continues to be an activity with a high accident rate. Almost 1 in 5 *construction* deaths occur in this sphere of *work*. Roofwork therefore should be recognised as a high-risk activity and high safety standards should be actively promoted by all those who are involved. Casual roof access should be discouraged but where access is provided, such as for inspection and maintenance, this should ensure safe access, giving protection against falls. Use of fragile roof materials should be discouraged wherever possible.

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 clauses 4.1.5 and 4.2.4. It may not be appropriate to provide a vision panel to certain doors within places of lawful detention.

Places of lawful detention

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.

4.8.3 Cleaning of windows and rooflights (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 all transparent or translucent *glazing* should be designed so that it may be cleaned safely.

There is, however, no need to provide for the safe cleaning of any *glazed* element that is opaque and does not allow the passage of light.

Any window or rooflight, all or part of which is more than 4 m above 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; or
- d. a ladder sited on the 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 falling further. However, this option is only appropriate where no part of any external or internal *glazed* surface is 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 other aid to reach the external face of a 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 noted in subclause (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 (P2.4)

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 and should not be detachable to permit windows to open. Where the presence of children can be anticipated within a *building*, guarding should be designed so that it is not easily climbable.

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

4.8.5 Emergency stopping of escalators and passenger conveyors (P2.5)

Escalators and passenger conveyors should be provided with devices capable of being readily operated that, when activated, can bring the equipment to a controlled halt in such a way that passengers will be able to maintain their balance.

The location of the devices and the stopping of the equipment should meet the recommendations of BS EN 115: 1995.

4.8.6 Access to manual controls (P2.7)

A manual control for operating a window or rooflight should be positioned so that the device can be operated without endangering the user of the control.

4.8.7 Roof access (P2.8)

Working on roofs can be dangerous. Falls account for more deaths and serious injuries in the construction industry than any other cause. Any fall from a roof inevitably involves, at least, serious injury - the risks are substantial.

A means of safe and secure access should be provided to a roof of a *building*. One method of providing such access would be the installation of a stair, ladder or walkway meeting BS 5395: Part 3: 1985.

Access as described above need not be provided to a roof having eaves that, at any part, are at a height of less than 4.5 m above the adjacent ground.

Alternative access

Where access may occur on a very infrequent basis, it may not be appropriate to provide permanent access. In such cases, alternative access options might include a mobile platform or zip-up scaffolding in accordance with the guidance in HSE publications.

Unauthorised access

Where fixed access ladders are provided and could be accessible to the public, it would be appropriate to make the lowest section of the ladder (up to 4.5 m) demountable to prevent unauthorised access.

4.8.8 Working on roofs (P2.8)

Where access to roofs is provided, precautions should be taken to limit the hazards presented by fragile roof surfaces.

There should be a warning visibly identifying any part of a roof that is not capable of bearing a concentrated load of 0.9 kN on a 130 mm square. The visible warning should include the relevant hazard sign to BS 5499: Part 5: 2002.

4.9 Danger from heat

- 4.9 Functional standard
- 4.9.0 Introduction
- 4.9.1 Installation of unvented hot water storage systems
- 4.9.2 Specification of unvented hot water storage systems of up to 500 litres capacity and 45kW power input.
- 4.9.3 Specification of unvented hot water storage systems of more than 500 litres capacity.
- 4.9.4 Discharge from unvented hot water storage systems

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 °C

It is not intended that this guidance should be applied to storage systems with a capacity of less than 15 litres, to systems used solely for space heating or to any system used for an industrial or commercial process.

Guidance is also given on the provision for the safe removal of the discharge created by the normal operation of safety devices in such an installation 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 100° C and to provide protection from malfunctions of the system.

An unvented hot water storage system should be in the form of a proprietary unit or package which is in accordance with the recommendations of BS 7206: 1990 or the subject of approval by a *notified body* to an equivalent level of safety and performance.

Pressure safety devices

A unit or package should have fitted:

- A check valve to prevent backflow
- 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).

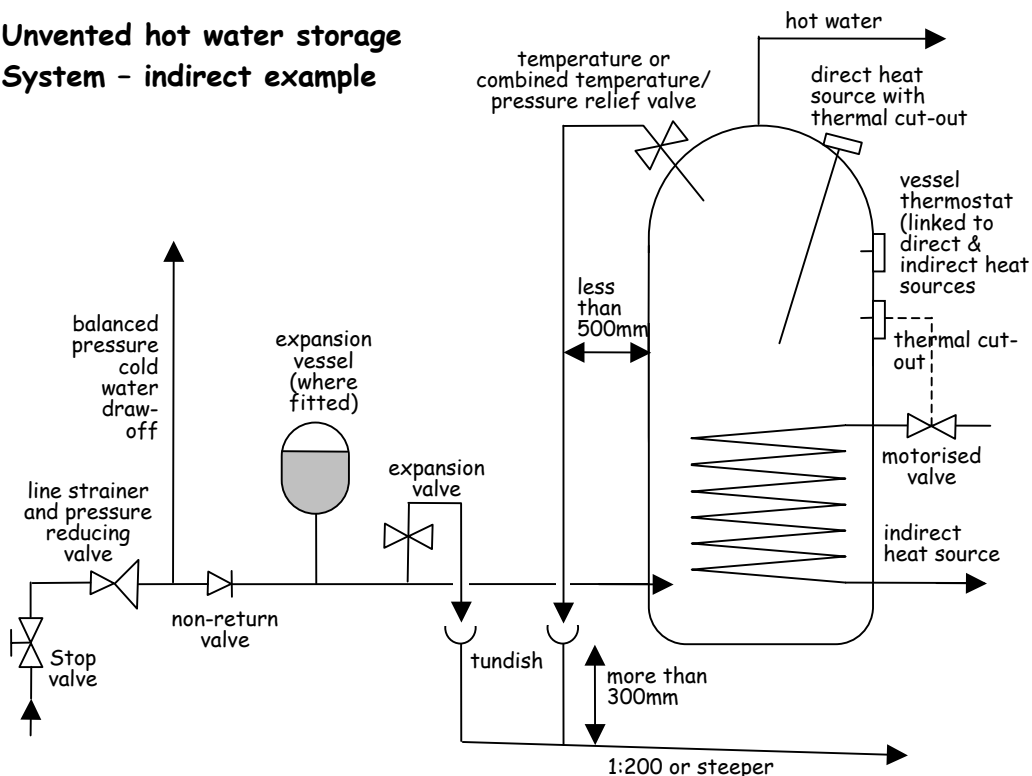
Temperature-activated safety devices

A unit or package should have a minimum of two 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 addition to any thermostatic control that is fitted to maintain the temperature of the stored water at around 60°C.

Unvented hot water storage System - indirect example



Thermal cut-out

A temperature-operated, non self-resetting, energy cut-out complying with BS 3955: 1986 should be fitted to the vessel. In the event of thermostat failure, heating to the water in the vessel should stop before the temperature rises to the critical level required for operation of the temperature relief valve.

In indirectly heated vessels, the non self-resetting thermal cut-out should operate a motorised valve, or other similar device, to shut off the flow from the heat source.

On directly heated vessels or where an indirectly heated vessel has an alternative direct method of water heating fitted, a non self-resetting thermal cut-out device should be provided for each direct source.

Temperature relief valve

The temperature relief valve should be located directly on the storage vessel. Generally, a combined temperature and pressure valve is fitted. The relief valve should comply with BS 6283 Part 2: 1991 for temperature relief valves or Part 3: 1991 for combined temperature and pressure relief valves which are set to open at temperatures not normally exceeding 90 °C.

The relief valve should have a discharge capacity rating at least equal to the rate of energy (power in kilowatts) input to the heat source. In the case of an indirectly heated unit or package, the valve should be tested to discharge water at a rate not less than 500 kg/h for systems up to 45 kW. The discharge pipework should accommodate this flow rate.

4.9.3 Specification of unvented hot water storage systems of more than 500 litres capacity. (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 100° C and to provide protection from malfunctions of the system.

Installations of this size will generally be specified to individual designs rather than supplied as proprietary units. The provision of evidence of compliance with safety requirements equivalent to the level set out in clause 4.9.2 should be the responsibility of the designer of the system.

Where the system has a power input of less than 45kW, safety devices should be provided in accordance with the recommendations of clause 2.4.2 of BS 6700:1997

Where the system has a power input greater than 45 kW, safety devices should include an appropriate number of temperature or combined temperature/pressure relief valves:

- to BS 6283 Part 2: 1991 or Part 3: 1991, or
- of equivalent suitability marked with the activation temperature (in °C), pressure (if relevant) and the discharge rating (in kW), measured in accordance with Appendix F of BS 6283 Part 2: 1991 or with Appendix G of BS 6283 Part 3 : 1991

Relief valves should provide a combined discharge rating at least equal to the power input of the system.

Provision of thermal cut-outs appropriate to the installation heat source(s) should be provided as noted in clause 4.9.2.

Discharge pipework should be provided as noted in clause 4.9.4, noting that the size of piping should be designed to accommodate the required discharge capacity and may exceed the guidance given in the table to clause 4.9.4.

4.9.4 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 95°C and be at least one pipe size larger than the outlet pipe to the relief valve.

A vertical section of pipe, at least 300 mm long, should be provided beneath the tundish before any bends to the discharge pipe; thereafter the pipe should be appropriately supported to maintain a continuous fall of at least 1 in 200 to the discharge point.

The pipework should have a resistance to the flow of water no greater than that of a straight pipe 9 m long unless the pipe bore is increased accordingly. Guidance on sizing of pipework from the tundish to the final discharge point is shown in the following table:

Size of discharge pipework

Valve outlet size	Minimum size of discharge pipe to tundish	Minimum size of discharge pipe from tundish	Maximum resistance allowed, expressed as a length of straight pipe i.e. no elbows or bends	Equivalent resistance created by the addition of each elbow or bend
G ½	15 mm	22 mm	Up to 9 m	0.8 m
		28 mm	Up to 18 m	1.0 m
		35 mm	Up to 27 m	1.4 m
G ¾	22 mm	28 mm	Up to 9 m	1.0 m
		35 mm	Up to 18 m	1.4 m
		42 mm	Up to 27 m	1.7 m
G 1	28 mm	35 mm	Up to 9 m	1.4 m
		42 mm	Up to 18 m	1.7 m
		54 mm	Up to 27 m	2.3 m

Annex D to BS 6700: 1997 "Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages" also gives guidance on pipe sizing for water distribution systems.

Discharge pipe termination

The pipe termination should be in a visible location and installed so that discharge will not endanger anyone inside or outside the *building*.

Ideally, the final discharge point should be above the water seal to an external gully and below a fixed grating. Other methods for terminating the final discharge point would include:

- a. up to 100 mm above external surfaces such as car parks, grassed areas, or hard standings; a wire cage or similar guard should be provided to both prevent contact with discharge and protect the outlet from damage, whilst maintaining visibility;
- b. at high level into a hopper and downpipe of a material, such as cast iron, appropriate for a hot water discharge with the end of the discharge pipe clearly visible;
- c. onto a *flat* 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.

4.10 Fixed seating

- 4.10 Functional standard
- 4.10.0 Introduction
- 4.10.1 Fixed seating

standard
4.10
mandatory

Every *building*, which contains fixed seating accommodation for an audience or spectators, must be designed and *constructed* in such a way that a number of level spaces for wheelchairs are provided proportionate to the potential audience or spectators.

Limitation

This standard does not apply to *domestic buildings*.

4.10.0 Introduction

The aim is for all people to have access to, and use of, all the facilities provided within *buildings*. They should be able to participate in the proceedings at lecture/conference facilities and at entertainment or leisure and social venues.

Where permanent or removable seating is provided as part of the design, allowance should be made for *disabled people* to have a choice of seating location at spectator events. It should also be possible for this to be accommodated without obstructing clear sightlines of other seating.

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)

4.10.1 Fixed seating (S2.10)

Where there is a *storey* accessible to *disabled people* with fixed seating for spectators or an audience, spectators in wheelchairs should be able to sit next to companions who may or may not be wheelchair users.

Wheelchair users should be provided with spaces into which they can manoeuvre easily, and which offer them a clear view of an event. A choice of sitting arrangements should be available, not provided as a single area or large blocks but dispersed through the seated area to allow wheelchair users to sit with family and friends.

In a *storey* that contains fixed seating for spectators, or an audience, that is accessible to wheelchair users (see clause 4.2.1), accessible level spaces for wheelchair users should be provided in accordance with the table below and which:

- a. are each at least 1.4 m x 900 mm; and
- b. are dispersed among the remainder of the seating; and
- c. enable wheelchair users to be located next to companions using the wheelchairs or the seating provided; and
- d. are arranged to avoid the extra height of wheelchair users from obstructing sightlines; and
- e. are kept clear specifically for wheelchair users or are fitted with seating which can be readily removed if the space is to be occupied by a wheelchair user.

Wheelchair space provision in areas of audience and spectator fixed seating

Seated capacity	Number of wheelchair spaces
up to 200	2
201 – 10 000	2 + 1 per 100 above 200
10 001 – 20 000	100 + 5 per 1 000 above 10 000
20 001 – 40 000	150 + 3 per 1 000 above 20 000
more than 40 000	210 + 2 per 1 000 above 40 000

4.11 Liquefied petroleum gas storage

- 4.11 Functional standard
- 4.11.0 Introduction
- 4.11.1 LPG storage installations
- 4.11.2 LPG storage - fixed tanks
- 4.11.3 LPG storage - cylinders

standard
4.11
 mandatory

Every *building* must be designed and *constructed* in such a way that each liquefied petroleum gas storage installation, used solely to serve a combustion appliance providing space heating, water heating, or cooking facilities, will:

- (a) be protected from fire spreading to any liquefied petroleum gas container; and
- (b) not permit the contents of any such container to form explosive gas pockets in the vicinity of any container.

Limitation

This standard does not apply to a liquefied petroleum gas storage container, or containers, for use with portable appliances.

4.11.0 Introduction

This guidance deals with non-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

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).

www.hse.gov.uk

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 LPG capacity (9000 litres). For guidance for larger installations, in excess of 4 tonnes LPG capacity, reference should be made to the relevant Part of the Code of Practice.

Every tank should be separated from a *building, boundary*, or fixed source of ignition, to:

- a. in the event of fire, reduce the risk of fire spreading to the tank; and
- b. enable safe dispersal in the event of venting or leaks.

Tanks should be situated outdoors, in a position that will not allow accumulation of vapour at ground level. Ground features such as open drains, manholes, gullies and cellar hatches, within the separation distances given in column A of the table overleaf should be sealed or trapped to prevent the passage of LPG vapour.

Tanks should be separated from *buildings, boundaries* or fixed sources of ignition in accordance with the table overleaf:

Separation distances for liquefied petroleum gas storage tanks

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

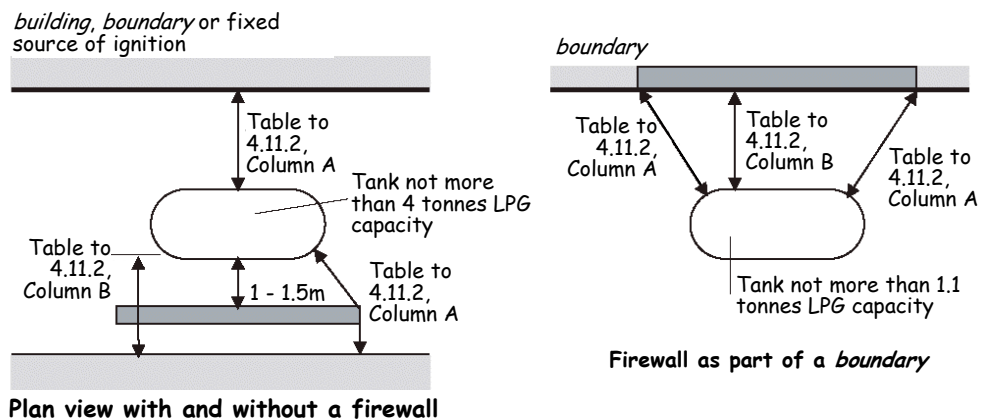
Notes:

1. Fire wall means a wall or screen meeting the guidance for an *external wall* with a fire resistance of short duration (Section 2, Fire) within 1 m of the *boundary*, and located between 1 m and 1.5 m from the tank and extending:
 - a. longitudinally: so that the distance specified above without the fire wall is maintained when measured around the ends of the fire wall; and
 - b. vertically: 2 m or the height to the top of the pressure relief valve, whichever is greater
2. For vessels up to 1.1 tonnes capacity, the fire wall need be no higher than the top of the pressure relief valve and may form part of the *site boundary*.

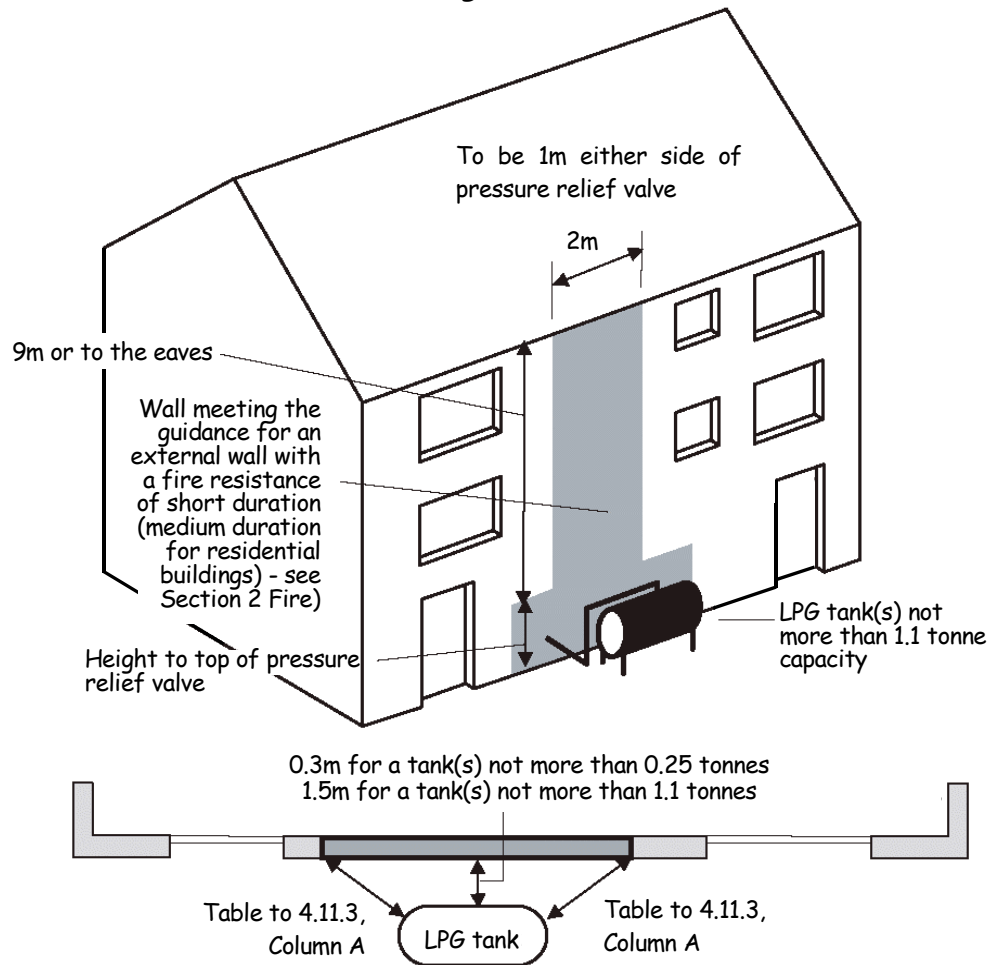
For vessels up to 1.1 tonnes capacity located closer to a *building* than the separation distance in column A of the above table, the fire wall should form part of the wall of the *building* in accordance with the diagram below. Where part of the *building* is used for residential accommodation (or as a *dwelling*), 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 be more than six and the total storage capacity of the group should not be more than 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



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 & Part 6 - 'The Use of Propane in Cylinders at Commercial and Industrial Premises'

Use of cylinders in such an installation commonly takes the form of 2 sets of paired cylinders connected to a manifold, with supply provided from one pair of cylinders at any one time. This allows continuous supply to be maintained when changing empty cylinders.

Any installation should enable cylinders to stand upright, secured by straps or chains against a wall outside the *building*.

Cylinders should be positioned on a firm, level base such as concrete at least 50 mm thick or paving slabs bedded on mortar, and located in a well-ventilated position at ground level, so that the cylinder valves will be:

- a. at least 1 m horizontally and 300 mm vertically from openings in the *buildings* or from heat source such as *flue* terminals or tumble dryer vents;
- b. at least 2 m horizontally from untrapped drains, unsealed gullies or cellar hatches unless an intervening wall not less than 250 mm high is present.

Cylinders should be readily accessible, reasonably protected from physical damage and located where they do not obstruct *exit* routes from the *building*.

4.12 Vehicle protective barriers

- 4.12 Functional standard
- 4.12.0 Introduction
- 4.12.1 Vehicle protective barriers

standard
4.12
mandatory

Every *building* accessible to vehicular traffic must be designed and constructed in such a way that every change in level is guarded.

4.12.0 Introduction

Where vehicles are introduced into a *building*, measures should be taken to protect people from any additional risks presented. Where areas subject to vehicular traffic are at a level higher than adjacent areas, such as on ramps or platforms, precautions should be taken to ensure that vehicles can not fall to a lower level.

In the assessment of the type of barrier to be provided, the designer should give consideration to the likely hazards, the *building* use and the risks to *building* users.

Conversions

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

4.12.1 Vehicle protective barriers (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 to changes in level as described in clauses 4.4.1 and 4.4.2.

5

noise

Contents

- 5.0** Introduction
- 5.1** Resisting sound transmission to dwellings

5.0 Introduction

5.0.1 Background

5.0.1 Background

There are currently no Building Standards to protect the occupants or users of a non-domestic *building* from noise but the need may arise for such standards at a later date.

Standard 5.1 is included here because there are situations in which it is necessary for a non-domestic *building* or part of a *building* to have a *separating wall* or *separating floor* that resists the transmission of sound to an adjacent *dwelling*.

5.1 Resisting sound transmission to dwellings

5.1.1 Application of requirements

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.

5.1.1 Application of requirements

Standard 5.1 is included here because there are situations in which it is necessary for a non-domestic *building* to have a *separating wall* or *separating floor* that resists the transmission of sound to a *dwelling*.

In most cases this will be very obvious as a *dwelling* will be created at the same time as the non-domestic *building* and the guidance in ‘Domestic Buildings – Section 5: Noise’ will be followed as a matter of course.

Occasionally the need for sound-resisting *construction* may be less obvious. An example of this would be where a new shop is built onto the side of an existing *domestic building* and the existing external wall to the *domestic building* becomes a *separating wall*. This new *separating wall* would need to be resistant to the transmission of sound. Note that for the purposes of this example, it is assumed that there is a legal right to utilise this existing wall. In such situations and similar situations the guidance in ‘Domestic buildings – Section 5: Noise’ should be used.

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

energy

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6.0 Introduction

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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 a *building*. It contains energy conservation provisions for the *building* fabric and the *building* services. In 2001 the UK Government introduced the Climate Change Levy on non-domestic energy use. By reducing energy consumption in such *buildings*, the impact of this tax will be lowered. The guidance given in this Section will go some way to achieving this, however nothing here prevents a *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 *building* services, their controls and finally their commissioning must 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:

- ventilation of *buildings*;
- combustion air and cooling air for combustion appliances.

6.0.2 General guidance for non-domestic buildings

(Reg 22(2)a, CRD141)

This Section covers the energy efficiency for non-domestic *buildings*. Such *buildings* include; factories, *offices*, *shops*, warehousing, hotels, *hospitals*, hostels, and also those used for assembly and entertainment. When determining how the Technical Handbook guidance for energy efficiency applies to non-domestic *buildings*, recognition should be given to the following:

- a. an *insulation envelope* is only appropriate to those parts of a *building* that are intended to be heated or cooled. Heating rated at a maximum of 25 W/m² of floor area and installed for the purposes of frost protection should be disregarded, for the purposes of this guidance;
- b. some concessions in terms of the *insulation envelope* are given to *limited life buildings* that do not contain sleeping accommodation (see clauses 6.0.4 f., 6.0.5 c. and Annex 6.P);
- c. a single storey portable *building* with a floor area of not more than 30 m² and first erected before 1 May 2005 can be relocated within Scotland until 30 April 2015 without further upgrading in respect of energy performance.

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 when available, preference should be given to values that are certified by a *notified body*. The additional guidance given in 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, CRD141)

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/m²K).

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 m²K/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 ($W/m\cdot K$) 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; however
- f. for *limited life buildings* which do not contain sleeping accommodation, elements containing repeating thermal bridges may be calculated in accordance with the proportional method set out in CIBSE Design Guide A: 1980, Section A3.

6.0.5 Buffering effects of certain structures on the *insulation envelope* (J2.3, CRD141)

The following should be considered where a non-domestic *building* (or part) is separated or divided from an enclosed area that:

- is neither heated nor cooled; or
- is heated or cooled to a significantly different level.

Examples of such areas could be in the first instance, an enclosed, unheated car parking garage which is adjacent to *office* accommodation and for the second case, a cold store which is adjacent to a space heated part of a factory. In such cases the *separating walls* and *separating floors* or dividing walls and floors should have fabric insulation. This can be achieved by one of the following ways:

- a. by 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. by following the procedure in BS EN ISO 13789;
- c. for *limited life buildings* which do not contain sleeping accommodation, by adopting a *U-value* of $0.6 W/m^2K$ for such an element, which may need adjustment for a high carbon intensity heating system (see clause 6.3.2).

Note that doors or windows that occur in such elements should achieve the levels specified in Table 1 to 6.2.1 – (Elemental Method) unless the separating/dividing element forms a part of either the Heat Loss or Carbon Emissions Calculation Method, or needs to be adjusted for a high carbon intensity heating system (see clause 6.3.2).

For guidance on atria, see clause 6.0.8 below.

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 units in *different occupation* should be ignored, if it is likely that both parts will be heated or cooled to a similar degree.

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 *building* that also performs the function of a floor or similar load-bearing 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 *building* with an atrium, the guidance given in clause 6.0.5 above, only applies if the atrium is unheated and totally divided from the remainder of the *building* by, translucent *glazing* and doors and if appropriate, walls and floors. In addition to this, it should not be intended that the atrium is to gain heat transfer from the surrounding *building*. In other situations involving atria, where none of this occurs, the *insulation envelope* is at roof level (usually predominantly *glazed* with translucent material) and the atria is considered to be a part of the main *building*.

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 *buildings* in the form of, alterations, extensions, historic *buildings* and *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 m², unless stated otherwise in the 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.

Heating system – Standard 6.3. The previous Technical Standards only permitted heating systems with a higher carbon intensity (e.g. electric

resistance heating) in a *building* by way of a tortuous route through the Carbon Emissions Calculation Method. Clause 6.3.2 now gives a trade-off against *building* fabric and can be used with either the Elemental Method or the Heat Loss Method.

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 instead of heating systems with a higher carbon intensity being prevented from being installed in an existing *building*, it is now possible to compensate by upgrading the fabric insulation.

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

- 6.1 Functional standard
- 6.1.0 Introduction
- 6.1.1 Building Standards Circular on Energy, 2004

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 early 1990'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 CO₂.

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

- 6.2 Functional standard
- 6.2.0 Introduction
- 6.2.1 Elemental Method
- 6.2.2 Heat Loss Method
- 6.2.3 Carbon Emissions Calculation Method
- 6.2.4 Limiting the effect of thermal bridging at junctions and around openings
- 6.2.5 Limiting air infiltration

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

(J8.1)

The guidance in clauses 6.2.1 to 6.2.3 gives three alternative approaches to the design of the *insulation envelope* of a new non-domestic *building*.

These are:

- Elemental Method
- Heat Loss Method
- Carbon Emissions Calculation Method

With the Elemental Method and Heat Loss Method a *building* fabric improvement is allowed against heating systems which have a high carbon intensity (see clause 6.3.2), but in general the energy efficiency of the *building* services are considered as separate issues. The Carbon Emissions Calculation Method offers the most design flexibility. The principal advantages of each approach are given in the preamble to each method. It is important to refer to the Elemental Method in the first instance. This is because the “trade-off” arrangements which are allowed by either the Heat Loss or the Carbon Emissions Calculation Methods use a notional *building* designed to the Elemental Method as a comparison.

Conversions

In the case of *conversions*, as specified in Regulation 4, the *building* as *converted* shall 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 (J8.2, J8.3, J8.4, CRD141)

This approach to designing the *insulation envelope* is the most basic and it involves assessing the thermal transmittance through each element of the *building*. As stated previously, with the Heat Loss or the Carbon Emissions Calculation Methods, a notional *building* which is designed to the Elemental Method, will be used as a comparison. The main benefit of using this basic method is that there are a reduced number of calculations to be carried out.

At an early stage a check should be done to ensure that the form and fabric does not result in excessive cooling being needed for the *building* (see clause 6.6.1). Also, if the heating system has a high carbon intensity the *U-values* will need to be improved (see clause 6.3.2).

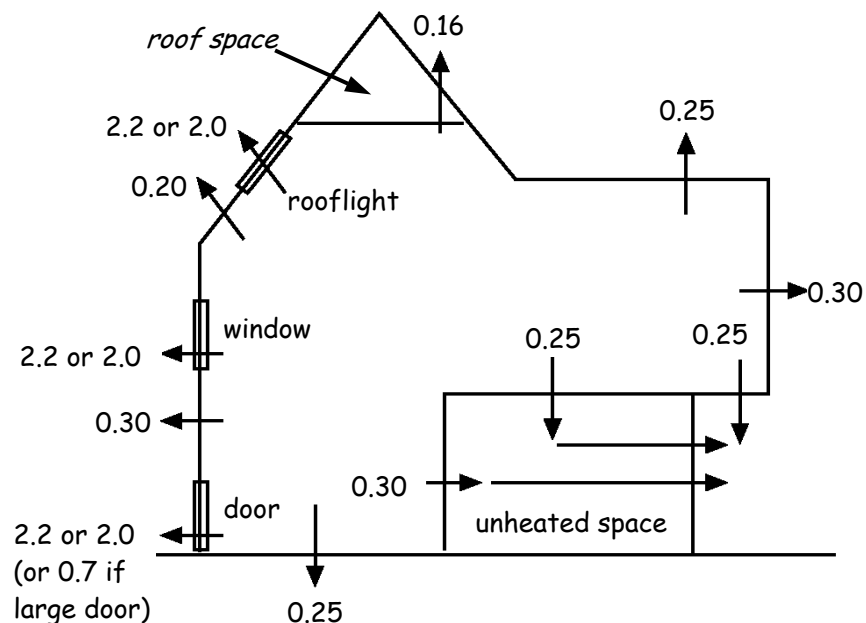
High carbon intensity heating systems

Where heating type is unknown

If the type of heating system for a *building* is not known at the time of making the building warrant application, for example a staged warrant application, a high carbon intensity for the system should be assumed. *U-values* that have been modified by following the guidance in clause 6.3.2 should be adopted.

Objective

To use the Elemental Method, individual exposed *building* elements and other elements forming the *insulation envelope* of a *building* should have *U-values* which do not exceed the numerical value given in Table 1. Also the percentage areas of windows, doors and rooflights should not exceed those indicated in Table 2. It should be noted that Annex 6.P can be used instead of Table 1, if the *building* is of limited life and does not contain sleeping accommodation.



Summary diagram indicating *U-values* for Table 1 (before any modification for high carbon intensity heating systems)

Table 1: Maximum *U-values* for *building* elements using the Elemental Method

Pitched roof	With insulation between rafters	0.20
	With insulation between ceiling ties or collars	0.16
<i>Flat roof</i> or roof (including pitched) with integral insulation		0.25
Exposed wall, <i>external wall</i> or wall referred to in clause 6.0.5		0.30
Exposed floor or floor referred to in clause 6.0.5		0.25
Vehicle access and similar large doors. (Including doors located in walls referred to in clause 6.0.5)		0.7
Windows, other doors and rooflights (including translucent <i>glazing</i> and doors located in walls referred to in clause 6.0.5)	Metal frames (area-weighted average)	2.2
	Wood or plastic frames. (area-weighted average)	2.0

When reading Table 1, above, the following points should be taken into account:

- a. a wall excludes any translucent *glazing* (including windows), doors and their associated frames;
- b. a roof excludes any translucent *glazing* and associated frames (including roof windows and rooflights);
- c. 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;
- d. 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.
- e. metal-framed windows have slimmer frames and therefore give a passive solar benefit and this justifies a less demanding level of *U-value*;
- f. no maximum *U-value* necessary for vehicle access and similar large doors which for operational reasons, have to be left open when the *building* is in use;
- g. no maximum *U-value* necessary for shop-entrances and shop-display windows which are situated at an access level.

Table 2: Maximum percentage areas of windows, doors and rooflights in the *insulation envelope*

Types of <i>building</i>	Windows and doors expressed as a % of the <i>insulation envelope</i> wall area (excluding separating walls that follow 6.0.6)	Rooflights expressed as a % of the roof area
Residential (non-domestic)	30	20
<i>Offices, shops and buildings</i> for entertainment and assembly purposes	40	20
Industrial and storage <i>buildings</i>	15	20

When reading Table 2, above, it should be noted that the minimum percentage areas are measured over the entire wall or roof area (including openings) but do not include:

- Vehicle access and other similar large doors; and
- Shop-entrances and shop-display windows at an access level; for which there is no limit.

Next stages

Once the *U-values* for the *insulation envelope* have 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 the space heating and hot water system, including any improvement in the average *U-value* due to the high carbon intensity of the heating system (see standards 6.3 and 6.4);
- energy efficiency of the artificial lighting (see standard 6.5);
- energy efficiency of any air conditioning or mechanical ventilation system (see standard 6.6);
- commissioning of the *building* services (see standard 6.7);
- written information (see standard 6.8).

6.2.2 Heat Loss Method

(J8.5, J8.6)

This approach allows greater flexibility with the design of the *insulation envelope* than is given with the Elemental Method. The principal benefit of using this Method is that it allows the higher *U-values* for parts of the *insulation envelope* to be compensated by lower *U-values* for other parts of the *construction*. A worked example of this calculation is given in Annex 6.J. Similar to the Elemental Method, at an early stage a check should be done to ensure that the form and fabric does not result in excessive cooling being needed for the *building* (see clause 6.6.1). Also, if the heating system has a high carbon intensity, the *U-values* will need to be improved (see clause 6.3.2). This adjustment is done by using more demanding *U-values* in the notional *building* that is formed as a part of the calculation process.

High carbon intensity heating systems

Objective To use the Heat Loss Method, the *insulation envelope* of a non-domestic *building* should have a total rate of heat loss which is not greater than that which would occur from a notional *building* (of the same size and shape) which follows the guidance given for the Elemental Method.

Proposed *building* In the first instance, use a copy of Worksheet 6.J.4 (see Annex 6.J) and in conjunction with the table below, establish by calculation the total rate of heat loss from the proposed *building*.

Maximum *U-values* when trading off between *building* elements in Heat Loss Method

<i>Building</i> element forming part of <i>insulation envelope</i>	Maximum <i>U-value</i> (W/m²K) (subject to paragraph below)
Roof	0.45
Wall or floor (except where thermal transmittance is considered as zero)	0.70
Windows, doors and rooflights	No limit

Notional *building* After the total rate of heat loss has been established for the proposed *building*, this process should be repeated but this time demonstrating the total rate from the notional *building*. To do this, the appropriate *U-values* obtained from Table 1 to clause 6.2.1 (or if appropriate Annex 6.P) should be inserted into a further copy of Worksheet 6.J.4.

Where heating type is unknown When the type of heating system for a *building* is not known at the time of making the building warrant application, for example a staged warrant application, a high carbon intensity for the system should be assumed. The *U-values* inserted into Worksheet 6.J.4 should be those, that have been modified by following the guidance in clause 6.3.2.

When creating the notional *building insulation envelope* for comparison purposes, the maximum percentage area for windows and doors in Table 2 to clause 6.2.1 should be used. In establishing the total rate of heat loss from the notional *building*, the following constraints should be applied:

- a. the *insulation envelope* of the notional *building* is to be the same size and shape as that for the proposed *building*;
- b. vehicle access/similar large doors which for operational reasons, have to be left open when the *building* is in use and also shop-entrances and shop-display windows at an access level should be of the same area and *U-value* as those in the proposed *building*. This is principally because the percentage area of such openings and their *U-value* are unrestricted in the Elemental Method;
- c. if, with no added insulation, the *U-value* of a floor next to the ground in the proposed *building* is less than the value given in Table 1 to clause 6.2.1 (or if appropriate Annex 6.P), then that lower value should be used for the notional *building*. This prevents an inequitable trade off being obtained, which would be based solely on the fortuitous “footprint” size of the *building*;
- d. if the total area of windows, doors and rooflights in the proposed *building* is less than the total maximum area in Table 2 to clause 6.2.1, then the average *U-value* of the roof, wall or floor should not exceed the appropriate value given in Table 1 to

clause 6.2.1 by more than 0.02 W/m²K. Annex 6.P can be used instead of Table 1 to clause 6.2.1, if the *building* is of limited life and does not contain sleeping accommodation. This simple constraint helps to reduce the incidence of *buildings* being designed without regard to natural daylight and the energy efficiency implications from excessive use of artificial lighting.

- e. if the area of rooflights in the proposed *building* is less than that permitted by Table 2 to clause 6.2.1, the amount of rooflight area in the notional *building* should be taken as:

$$RL_{\text{prop}} + 0.5(RL_{\text{allow}} - RL_{\text{prop}})$$

Where:

RL_{prop} is the percentage rooflight area in the proposed *building*, and RL_{allow} is the percentage rooflight area given in Table 2 to clause 6.2.1. If the percentage area of rooflights in the proposed *building* is greater than that in Table 2 to clause 6.2.1, then the percentage given in Table 2 should be adopted for the notional *building*.

Comparison

The total rates of heat loss from both the proposed and the notional *buildings*, should be compared. If the proposed *building* total rate is less than or equal to the notional *building*, the design is satisfactory.

Next stages

Once the *U-values* for the *insulation envelope* have 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 the space heating and hot water system, including any improvement in the average *U-value* due to the high carbon intensity of the heating system (see standards 6.3 and 6.4);
- energy efficiency of the artificial lighting (see standard 6.5);
- energy efficiency of any air conditioning or mechanical ventilation system (see standard 6.6);
- commissioning of the *building* services (see standard 6.7);
- written information (see standard 6.8).

6.2.3 Carbon Emissions Calculation Method (J8.7, J8.8, J8.9)

This method allows most flexibility in the design of the *building* and enables the energy efficiency of the *building* services to be taken into consideration. The annual carbon emissions for the proposed *building* are compared with those from a notional *building*. This method can be used to take advantage of solar heat gains and electricity generated from low carbon technologies that are either *building* integrated or perhaps exclusive to the *building* or group of *buildings*, photovoltaic cladding or wind turbines, for example. An integrated approach can be adopted and the following parts of this guidance may be ignored for the design of the proposed *building*:

- energy efficiency of the space heating and hot water system (see standards 6.3 and 6.4);
- energy efficiency of the artificial lighting (see standard 6.5);
- energy efficiency of any air conditioning or mechanical ventilation system (see standard 6.6).

Objective To use the carbon emissions calculation method, the annual carbon emissions of a non-domestic *building* should be no greater than that which would occur from a notional *building*. This notional *building* should comply with the Elemental Method and also the guidance given on energy efficiency of the *building* services systems. It should also be of the same size and shape as the proposed *building*.

Proposed *building* Although this method allows greater freedom of design, there are constraints placed on the *insulation envelope* and these are:

- the guidance in this Section for limiting thermal bridging at junctions and around openings and for limiting air infiltration should be applied;
- the *U-values* in the table below should not be exceeded.

Maximum *U-values* when trading off between *building* elements in the Carbon Emissions Calculation Method

<i>Building</i> element forming part of <i>insulation envelope</i>	Maximum <i>U-value</i> (W/m²K)
Roof	0.45
Wall or floor (except where thermal transmittance is considered to as zero)	0.70
Windows, doors and rooflights	No limit

Notional *building* The following constraints should be applied to the notional *building* created using the Elemental Method:

- a. the *insulation envelope* of the notional *building* is to be the same size and shape as that for the proposed *building*;
- b. vehicle access/similar large doors which for operational reasons, have to be left open when the *building* is in use and also shop-entrances and shop-display windows at an access level should be of the same area and *U-value* as those in the proposed *building*. This is principally because the percentage area of such openings and their *U-value* are unrestricted in the Elemental Method;
- c. if, with no added insulation, the *U-value* of a floor next to the ground in the proposed *building* is less than 0.25 W/m²K, then that lower value should be used for the notional *building*. This prevents an inequitable trade off being obtained, which would be based on the fortuitous “footprint” size of the *building*.

Calculation procedure The Carbon Emissions Calculation Method can be carried out by using a calculation procedure that:

- a. has been tested satisfactorily against available benchmark tests as described in CIBSE Application Manual ‘[Building Energy and Environmental Modelling](#)’, AM11, 1998; and
- b. has been accepted by the submitting organisation as having satisfied their in-house quality assurance procedures, for example by submitting with the calculations a completed and signed copy of Annex B to AM11: ‘Checklist for choosing BEEM software’, showing that the software used is appropriate for the purpose to which it has been applied.

Next stages

Once the *U-values* for the *insulation envelope* and the energy efficiency of the *building services* have 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);
- commissioning of the *building services* (see standard 6.7);
- written information (see standard 6.8).

6.2.4 Limiting the effect of thermal bridging at junctions and around openings (J9.1)

The *insulation envelope* of the non-domestic *building* 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 careless *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.

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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 (J10.1)

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 or cooled 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 *building*;
- 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.

Other areas of the *building* that need consideration are entrances to the *building* and shafts which extend through most of the floors (e.g. lift or 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 BR 448 – 2002 edition – ‘[Airtightness in Commercial and Public Buildings](#)’.

BR 448 gives examples of appropriate design details and *construction* practice. It also gives additional advice for building owners and designers about levels of airtightness and testing arrangements, but note that within the Building (Scotland) Regulations 2004 there is no requirement, mandatory or otherwise to test buildings.

6.3 Heating system

- 6.3 Functional standard
- 6.3.0 Introduction
- 6.3.1 Methods of demonstrating efficiency
- 6.3.2 Heating systems with higher carbon intensities
- 6.3.3 Space heating controls
- 6.3.4 Hot water service system controls

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

The heating system of a *building* should be designed and installed to make efficient use of energy for the conservation of fuel and power. Where this is not possible the *U-value* of the *insulation envelope* should be improved (see clause 6.3.2).

Conversions

In the case of *conversions*, as specified in Regulation 4, the *building* as *converted* shall 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 Methods of demonstrating efficiency (J11.1)

In the case of liquid or gaseous-fuelled boilers, one way of demonstrating this would be to achieve compliance with the [Boiler Efficiency Regulations 1993](#) and 1994.

For all types of boilers or other primary heat sources, a way of demonstrating this would be to ensure the rating-weighted average carbon intensity of the boiler or other primary heat source is in accordance with Table 1, below:

Table 1: Maximum carbon intensities of heating systems

Fuel	Maximum carbon intensities (kgC/kWh) [Notes 1-3]	
	at design capacity	at 30% of design capacity
Mains natural gas	0.068	0.065
Other fuels	0.091	0.088

Notes:

- The carbon intensity of the heating plant is based on the carbon emitted per useful kWh of heat output and applies to boilers, heat pump systems and electrical heating, and is given by:

A = B ÷ C (Equation 1)

where:

- A is the carbon intensity of the heating system (kgC/kWh of useful heat); and
- B is the carbon emission factor of the fuel (kgC/kWh of delivered fuel) obtained from Table 2; and
- C is the gross thermal efficiency of the heating system (kWh of heat divided by kWh of delivered fuel).

Table 2: Carbon emission factors

Fuel type	Carbon emission factor (kgC/kWh)
Mains natural gas	0.053
LPG	0.068
Biogas	0.0
Oil (all grades of fuel oil)	0.074
Coal	0.086
Biomass	0.0
Electricity (grid-supplied)	0.113

- Where a combined heat and power system (CHP) is proposed, the carbon intensity of the CHP can take account of the benefit of the on-site generation in reducing emissions from power stations feeding the national grid by using the following equation;

A = (B ÷ D) – (F ÷ E) (Equation 2)

where:

- A is the carbon intensity of the heating system (kgC/kWh of useful heat);

Carbon intensity of heating plant

Combined heat and power (CHP)

- B is the carbon emission factor of the fuel (kgC/kWh of delivered fuel) obtained from Table 2 to this specification;
- D is the heat output ratio of the CHP engine (kWh of heat per kWh of delivered fuel);
- E is the electrical output ratio of the engine (kWh of electricity per kWh of delivered fuel);
- F is the carbon emission factor for grid supplied electricity (kgC/kWh). This should be taken as the factor for new generating capacity that might otherwise be built if the CHP had not been provided, i.e. the intensity of a new generation gas-fired station at 0.123 kg/kWh.

This adjusted carbon intensity can then be used in equation 1 to determine the carbon intensity of the overall heating system at 100% and 30% of heating system output.

- CHP heat dumping
3. Where the CHP has no facility for heat dumping, the gross thermal efficiency is the CHP heat output divided by the energy content of the fuel burned. Where the CHP includes facilities for heat dumping, the gross thermal efficiency should be based on an estimate of the useful heat supplied to the *building*, i.e. the heat output from the CHP minus the heat dumped.

If the carbon intensity of the system is too high, the guidance in clause 6.3.2 should be followed or the Carbon Emissions Calculation Method adopted for the whole *building*.

6.3.2 Heating systems with higher carbon intensities

There may be certain cases where the use of a heating system with a high carbon intensity is unavoidable, for example, grid-supplied electric direct-acting panel heaters. In such circumstances it is appropriate for the *U-values* of the *insulation envelope* to be improved to offset the potential increase in carbon emissions. The improved *U-values* are determined by dividing the individual *U-values* (in Table 1 to clause 6.2.1 or table 6.P.1) by 1.15 and rounding down the revised figure to 2 decimal places.

The guidance can then be considered to be followed if:

- a. these *U-values* are adopted as the maximum for the proposed *building*, when using the Elemental Method (clause 6.2.1); or
- b. these *U-values* are adopted for the 'design' of the notional *building*, when using the Heat Loss Method (clause 6.2.2) or the Carbon Emissions Calculation Method (clause 6.2.3).

6.3.3 Space heating controls (J11.2, J11.3, J11.4)

Good control of space heating is essential for conservation of energy in *buildings*, as without it, the potential of energy-efficient heating plant cannot be realised. Generally the system should have sufficient zone, time and temperature controls to ensure that the heating system only provides the desired temperature when the *building* is occupied. Such operating controls can be overridden however, when heating is needed to protect the *building's* structure, services or contents from frost or condensation damage.

Frost and condensation protection

Room temperature control

Where *rooms* or other areas are designed to have different temperatures during the hours of occupation, the space heating system should

incorporate either thermostatic radiator valves (TRVs) or room thermostats/sensors.

Time controls	<p>Where the space heating is to be intermittent and does not make use of off-peak electricity, the system should only operate when the <i>building</i> is normally occupied or is about to be occupied:</p> <ul style="list-style-type: none"> • systems with an output of more than 50kW should have optimum start and stop controls. These ensure that the <i>building</i> or zone reaches its occupation temperature at the appropriate time but can override the time control during mild weather and comfort is not compromised by energy efficiency; • systems with an output of not greater than 50kW should have manually adjustable automatic 7 day programmers or timers that can be set to suit the occupation of the <i>building</i> or zone.
Weather compensation for wet systems	<p>A weather compensation function should be installed in a wet heating system, which is linked to an outside sensor. This will automatically reduce the boiler flow temperature, in line with an increase in the external temperature.</p>
Electric storage Heaters	<p>Electric storage heaters should incorporate an automatic charge control which is linked to a sensor. The sensor will adjust the electrical charge to the appliance according to the <i>room</i>, area or zone temperature. When this temperature is high the charge is reduced and visa-versa. Heat output control should be given to the occupant of the <i>building</i> by incorporating a damper or fan in the heater.</p>
Boiler inhibit controls	<p>Boiler inhibit controls should be installed to prevent the gas or oil-fired boilers operating when there is no demand for heat, but a pump overrun may also have to be fitted as required by the manufacturers. In the case of a solid fuel boiler, it should be thermostatically controlled to reduce the burning rate of the fuel. For safety reasons a slumber circuit for such boilers should be formed. Generally for all boilers a bypass circuit should be fitted if the boiler manufacturer requires one or specifies a minimum flow rate whilst the boiler is firing. An automatic bypass valve should be used where the system comprises a substantial number of TRVs.</p>
Solid fuel boilers	
Boilers generally	
Sequence control for boilers/CHP	<p>If the system comprises two or more gas or oil-fired boilers, a sequence control should be installed to match the number of boilers operating to the heating demand for the <i>building</i>. As this minimises the number of boilers firing, it also avoids short-cycling of burner operation and overall energy efficiency is improved.</p> <ul style="list-style-type: none"> • if there is a mixture of condensing and ordinary boilers installed, the condensing boiler should operate first; • if combined heat and power (CHP) is installed in conjunction with the boilers, the CHP should be the lead heat source.
www.actionenergy.org.uk	<p>Good Practice Guide 132 published by Action Energy gives examples of appropriate controls for wet heating systems and their use in non-domestic <i>buildings</i>. An appropriate system of space heating controls is one that is designed to the above guidance and also follows the advice in GPG 132.</p>

6.3.4 Hot water service system controls (J11.5)

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.

Boilers
(not solid fuel)

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 for effective control, 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 combined space heating and hot water systems this thermostat should be interconnected with the other controls which are needed to form the boiler inhibit;
- 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 combined space heating and hot water 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 installed.

Instantaneous water heaters

Where an instantaneous water heater is installed which is local to the point of use, no additional controls are needed other than those supplied with the appliance.

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[Good Practice Guide 132](#) published by Action Energy gives additional advice and examples of appropriate controls for wet heating systems and their use in non-domestic *buildings*. An appropriate arrangement of hot water service system controls is one that is designed to the above guidance and also follows the advice in GPG 132.

6.4 Insulation of pipes, ducts and vessels

- 6.4 Functional standard
- 6.4.0 Introduction
- 6.4.1 Insulation of pipes and ducts
- 6.4.2 Insulation of vessels

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 cooling and heating pipes and *ducts* and hot water storage vessels will improve energy efficiency by preventing:

- uncontrolled heat gain or loss to or from such equipment;
- an uncontrolled rise or fall in the temperature of the parts of the *building* where such equipment is situated.

Conversions

In the case of *conversions*, as specified in Regulation 4, the *building* as *converted* shall 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 (J11.6)

Space heating pipes and ducts at low level
 Pipes and ducts used for space heating and space cooling (including pipes carrying chilled water and refrigerants) should be thermally insulated to reduce heat loss in the case of the former and heat gain in the case of the latter. This will not be necessary where the pipes or ducts always contribute to the heating or cooling demands of the room or space and the pipes or ducts are located at a height of 3 m or less above the floor.

Hot water supply
 Pipes that are used to supply hot water within a 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.

www.bsi-global.com
 A way of achieving insulation for such pipes and ducts is to follow the guidance given for “environmental thickness” in BS 5422: 2001 “Methods for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range –40°C to +700°C”.

Industrial and commercial process
 It is not necessary to follow any of the above guidance on pipe and duct insulation if the installation is part of a stand-alone system that serves only an industrial or commercial process.

6.4.2 Insulation of vessels (J11.7)

Industrial and commercial process
 A hot water storage vessel should be insulated against heat loss. This can be achieved by following the guidance given for “environmental thickness” in BS 5422: 2001. This will not be necessary if the vessel is part of a stand-alone system that serves only an industrial or commercial process.

Unvented HW 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

- 6.5 Functional standard
- 6.5.0 Introduction
- 6.5.1 Artificial lighting
- 6.5.2 Display lighting
- 6.5.3 Controls for artificial and display lighting

standard

6.5

mandatory

In order to comply with standard 6.1 every *building* must be designed and *constructed* in such a way that artificial or display lighting must operate and be capable of being controlled to achieve optimum energy efficiency.

Limitation

This standard does not apply to:

- (a) process and emergency lighting components of a *building*; or
- (b) *domestic buildings*.

6.5.0 Introduction

Artificial and display lighting can account for a substantial proportion of the electricity used within a *building*. Appropriate lighting design (including use of natural daylight) can not only reduce such emissions and associated running costs, but also reduce internal heat gains and lessen any need for air conditioning.

Conversions

In the case of *conversions*, as specified in Regulation 4, the *building* as *converted* shall 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).

Emergency lighting and specialist process lighting

6.5.1 Artificial lighting (J12.1)

A *building* with a floor area of more than 100 m² and installed with artificial lighting should have general purpose artificial lighting systems which are designed to be energy efficient. It is not necessary for this to apply to either emergency lighting (see Section 2: Fire) or specialist process lighting which is intended to illuminate specialist tasks within a space, rather than the space itself. Examples of specialist process lighting are, theatre spotlights, lighting used for the recording process in TV studios and lighting in *hospital* operating theatres.

Paragraphs, a. b. and c. below, give three alternative ways of achieving the objectives of the guidance:

- a. Where 95% of the artificial lighting capacity in circuit Watts (i.e. the power consumed by lamps, their associated control gear and power factor correction equipment) is provided by lighting fittings using lamps with luminous efficacies not less than those of the types listed in the table below:

Artificial lighting

Light Source	Types and ratings
High pressure sodium	All types and ratings
Metal halide	All types and ratings
Induction lighting	All types and ratings
Triphosphor or Multi-phosphor tubular fluorescent	All 26 mm diameter (T8) lamps, and 16 mm diameter (T5) lamps rated above 11 W, fitted with low-loss or high frequency control gear. All 38 mm diameter (T12) linear fluorescent lamps 2400 mm long.
Compact fluorescent	All ratings above 11 W.
Other	Any type and rating with an efficiency greater than 65 lumens per circuit Watt.

Note:

A worked example of this approach can be found in Annex 6.K

- b. Where the installed lighting capacity comprises lighting fittings with lamps having an average initial (100 hour) efficacy of not less than 65 lumens per circuit Watt. The lamp lumen output tables are usually obtainable from the manufacturers' published data.
Note: A worked example of this approach can be found in Annex 6.K
- c. Where the design has been completed in accordance with the advice and guidance given in the [Society of Light and Lighting](#) (CIBSE) Code for Lighting 2002.

6.5.2 Display lighting (J12.2)

A display lighting system installed in a *building* with a floor area of more than 100 m² should be designed to be energy efficient.

Display lighting is artificial lighting that:

- highlights a merchandising display (e.g. in retail premises);
- highlights an exhibit (e.g. in a museum or art gallery);
- is used in spaces intended for public entertainment (e.g. dance halls, auditoria and cinemas), but excludes any specialist process lighting within the space

Due to the nature and purpose of display lighting, it is often not possible to achieve the levels of energy efficiency that can be reached with general purpose artificial lighting. Paragraphs, a. and b. below however, give two alternative ways of achieving the objectives of the guidance:

- a. where the installed lighting capacity comprises lighting fittings with lamps having an average initial (100 hour) efficacy of not less than 15 lumens per circuit Watt;
- b. where at least 95% of the display lighting capacity in circuit Watts (i.e. the power consumed by lamps, their associated control gear and power factor correction equipment) is provided by lighting fittings using the following lamps:
 - compact and tubular fluorescent;
 - metal halide;
 - tungsten halogen;
 - high pressure sodium;
 - lamps of any type and rating with an efficacy greater than 15 lumens per circuit Watt.

6.5.3 Controls for artificial and display lighting (J12.3)

Every artificial lighting system in a *building* with a floor area of more than 100 m² should have controls which encourage the maximum use of daylight and minimise the use of artificial lighting during the times when *rooms* or spaces are unoccupied. It is not necessary for this to apply to either emergency lighting (see Section 2: Fire) or specialist process lighting (see clause 6.5.1 above).

Artificial lighting controls

Alternative ways (or a combination of ways) that can be considered as achieving the objectives of the guidance for general artificial lighting are:

- a. where local manually operated switches are to be used the distance measured directly on plan from a switch to the furthest light fitting it controls should not be more than 8 m or the equivalent of 3 times the height of the light fitting above the finished floor level if that is the greater distance. Such switches should be readily accessible (e.g. located on circulation routes);
- b. switches can be operated by ultrasonic, infra-red or other remote control handsets;
- c. if lighting rows are located adjacent to windows, they can be controlled by photocells which monitor daylight and adjust the level of artificial lighting accordingly, either by switching or dimming;
- d. automatic switching which turns the lighting on or off when it senses the presence or absence of occupants;
- e. *buildings* used for industrial, retail, assembly, entertainment or other

similar uses and in areas where continuous lighting is required by the occupants of the *building* during hours of operation, the control can be by way of time switching or daylight-linked photo-electric switching. For managed spaces in these buildings centralised manual switching can be considered. Examples of managed spaces include: cinema/theatre, sports hall, restaurant, passenger terminal, museum/gallery, foyer, large kitchen and *shop*.

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[Good Practice Guide 160](#) published by Action Energy gives additional advice and examples of these electric lighting controls and their use in non-domestic *buildings*.

www.cibse.org

Another way that can be considered as achieving the objectives of the guidance for general artificial lighting is to install switching in accordance with the advice and guidance given in the [Society of Light and Lighting \(CIBSE\) Code for Lighting 2002](#).

Display lighting controls

When considering energy efficient switching for display lighting, dedicated circuits should be provided, that can be switched off at times when people will not be inspecting exhibits or merchandise or occupying the spaces used for public entertainment. In a retail store, for example, this could be achieved by timers to switch off the display lighting outwith opening hours, or possibly at a later time of the day for displays which are intended to be viewed from outside the *building*.

6.6 Mechanical ventilation and air conditioning

- 6.6 Functional standard
- 6.6.0 Introduction
- 6.6.1 Form and fabric in relation to ACMV
- 6.6.2 Efficiency of ACMV equipment
- 6.6.3 Control of ACMV equipment

standard
6.6
mandatory

In order to comply with standard 6.1 every *building* must be designed and *constructed* in such a way that the form and fabric of the *building* minimises the use of mechanical ventilating or cooling systems for cooling purposes, and the ventilating and cooling systems are designed, installed, and capable of being controlled to achieve optimum energy efficiency.

Limitation:

This standard does not apply to:

- (a) *domestic buildings*; or
- (b) *buildings* which do not use fuel or power for ventilating or cooling the internal environment.

6.6.0 Introduction

Mechanical ventilation is a primary energy intensive process, and air conditioning is even more so. When considering the installation of air conditioning and mechanical ventilation (ACMV), attention should therefore be given to:

- form and fabric of the *building*;
- energy efficiency of the equipment;
- control of the equipment.

Conversions

In the case of *conversions*, as specified in Regulation 4, the *building* as *converted* shall 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).

6.6.1 Form and fabric in relation to ACMV (J13.1a)

The form and fabric of the *building* should not result in a need for excessive installed capacity of mechanical ventilation and cooling equipment. Particular attention should be paid to limiting overheating, by ensuring that areas of the external *building* fabric which are susceptible to solar gain, have appropriate areas of translucent *glazing* and/or solar shading. A ventilation strategy that incorporates night cooling and the thermal mass of a *building* can also be used for effective control.

6.6.2 Efficiency of ACMV equipment (J13.1b)

Fans (other than individual fans that serve a small number of *rooms* in an otherwise naturally ventilated *building*), pumps, refrigeration equipment and other components should be appropriately sized and efficient, having no more capacity for demand and standby than is needed. Ways that can be considered as following the guidance are:

Office buildings

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Other non-domestic *buildings*

- a. in the case of an *office building*, by achieving a Carbon Performance Index (CPI) of at least 100. The CPI relates the performance of the proposed *building* to a benchmark based on the measured consumption data contained in [ECON 19](#) 'Energy use in offices - Energy Consumption Guide 19', DETR, 1998, available from Action Energy. Annex 6.L describes the CPI calculation procedure and gives a worked example;
- b. in the case of other *buildings*, by installing air conditioning or mechanical ventilation with a total specific fan power or SFP (i.e. the design power of all fans in the distribution system divided by the design ventilation rate through the *building*) of not greater than 1.5 W/litres/second. Consideration should be given to allowing greater SFP where specialist processes occur or if the external air is more heavily polluted, as better air filtration or cleaning may be appropriate.

6.6.3 Control of ACMV equipment (J13.1c)

Appropriate ways should be provided to manage, control and monitor the operation of the equipment and systems that are installed in the *building*.

6.7 Commissioning building services

- 6.7 Functional standard
- 6.7.0 Introduction
- 6.7.1 Inspection and commissioning

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 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).

6.7.1 Inspection and commissioning (J14.1)

A *building* services installation in a non-domestic *building* should be inspected and commissioned in accordance with manufacturers' instructions to ensure optimum energy efficiency. The *building* and services should have appropriate specifications to enable testing and commissioning to be carried out.

www.cibse.org

www.bsria.co.uk

One way that can be considered as following the guidance would be to certify the commissioning has been done in accordance with CIBSE Commissioning Codes and BSRIA Commissioning Guides.

6.8 Written information

- 6.8 Functional standard
- 6.8.0 Introduction
- 6.8.1 Written information

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*.

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

(J14.2)

The person responsible for the commissioning should make the following information available to the occupier of the non-domestic *building*:

Operation and
maintenance
information

- a schedule of the floor areas for each of the *building* zones categorised by environmental servicing type (e.g. air-conditioned, naturally ventilated);
- the purpose of the individual *building* services systems;
- the location of the relevant plant and equipment;
- the installed capacities (input power and output rating) of the services plant;
- simple descriptions of the operational and control strategies of the energy consuming services in the *building*;
- operating and maintenance instructions that include provisions enabling the specified performance to be sustained during occupation;
- a forecast of the annual energy consumption for the *building*.

Forecast of energy
consumption

Building logbook

One way of presenting this information would be to form a logbook and retain it in the building.

Annex
6.A Tables of U-values and thermal conductivity

6.A.0	Introduction
6.A.1–3	Tables of windows, rooflights and doors
6.A.4–7	Tables of roofs (example calculations 1–3)
6.A.8–11	Tables of walls (example calculations 4–7)
6.A.12–14	Tables of ground floors (example calculations 8–9)
6.A.15–17	Tables of upper floors
6.A.18	Table of thermal conductivity of building materials

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 $\epsilon_n = 0.2$ 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 $\epsilon_n = 0.1$ 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 and doors with wood or plastic frames [Note 1]

	Gap between panes		
	6 mm	12 mm	16 mm or more
Single-glazing	4.8		
Double-glazing (air filled)	3.1	2.8	2.7
Double-glazing (low-E, $\epsilon_n = 0.2$) [Note 2]	2.7	2.3	2.1
Double-glazing (low-E, $\epsilon_n = 0.15$)	2.7	2.2	2.0
Double-glazing (low-E, $\epsilon_n = 0.1$)	2.6	2.1	1.9
Double-glazing (low-E, $\epsilon_n = 0.05$)	2.6	2.0	1.8
Double-glazing (argon filled) [Note 3]	2.9	2.7	2.6
Double-glazing (low-E, $\epsilon_n = 0.2$, argon filled)	2.5	2.1	2.0
Double-glazing (low-E, $\epsilon_n = 0.15$, argon filled)	2.4	2.0	1.9
Double-glazing (low-E, $\epsilon_n = 0.1$, argon filled)	2.3	1.9	1.8
Double-glazing (low-E, $\epsilon_n = 0.05$, argon filled)	2.3	1.8	1.7
Triple-glazing (air filled)	2.4	2.1	2.0
Triple-glazing (low-E, $\epsilon_n = 0.2$)	2.1	1.7	1.6
Triple-glazing (low-E, $\epsilon_n = 0.15$)	2.0	1.7	1.5
Triple-glazing (low-E, $\epsilon_n = 0.1$)	2.0	1.6	1.5
Triple-glazing (low-E, $\epsilon_n = 0.05$)	1.9	1.5	1.4
Triple-glazing (argon filled)	2.2	2.0	1.9
Triple-glazing (low-E, $\epsilon_n = 0.2$, argon filled)	1.9	1.6	1.5
Triple-glazing (low-E, $\epsilon_n = 0.15$, argon filled)	1.8	1.5	1.4
Triple-glazing (low-E, $\epsilon_n = 0.1$, argon filled)	1.8	1.4	1.3
Triple-glazing (low-E, $\epsilon_n = 0.05$, argon filled)	1.7	1.4	1.3
Solid wooden door [Note 4]	3.0		

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).

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, $\epsilon_n = 0.2$)	3.3	2.8	2.6
Double-glazing (low-E, $\epsilon_n = 0.15$)	3.3	2.7	2.5
Double-glazing (low-E, $\epsilon_n = 0.1$)	3.2	2.6	2.4
Double-glazing (low-E, $\epsilon_n = 0.05$)	3.1	2.5	2.3
Double-glazing (argon filled)	3.5	3.3	3.2
Double-glazing (low-E, $\epsilon_n = 0.2$, argon filled)	3.0	2.6	2.5
Double-glazing (low-E, $\epsilon_n = 0.15$, argon filled)	3.0	2.5	2.4
Double-glazing (low-E, $\epsilon_n = 0.1$, argon filled)	2.9	2.4	2.3
Double-glazing (low-E, $\epsilon_n = 0.05$, argon filled)	2.8	2.3	2.1
Triple-glazing (air filled)	2.9	2.6	2.5
Triple-glazing (low-E, $\epsilon_n = 0.2$)	2.6	2.1	2.0
Triple-glazing (low-E, $\epsilon_n = 0.15$)	2.5	2.1	2.0
Triple-glazing (low-E, $\epsilon_n = 0.1$)	2.5	2.0	1.9
Triple-glazing (low-E, $\epsilon_n = 0.05$)	2.4	1.9	1.8
Triple-glazing (argon-filled)	2.8	2.5	2.4
Triple-glazing (low-E, $\epsilon_n = 0.2$, argon filled)	2.4	2.0	1.9
Triple-glazing (low-E, $\epsilon_n = 0.15$, argon filled)	2.3	1.9	1.8
Triple-glazing (low-E, $\epsilon_n = 0.1$, argon filled)	2.2	1.9	1.7
Triple-glazing (low-E, $\epsilon_n = 0.05$, 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 <i>U</i> -value (W/m ² K)
	Window or rooflight in a non-domestic <i>building</i>
0 (no break)	+ 0.3
4	+ 0.0
8	- 0.1
12	- 0.2
16	- 0.2

Note:

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 <i>U</i> -value (W/m ² K)	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 <i>U</i> -value (W/m ² K)	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 <i>U</i> -value (W/m ² K)	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

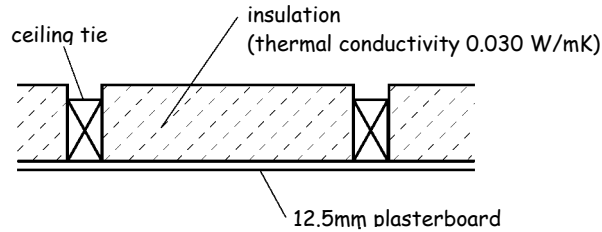
	Concrete slab density (kg/m ³)	Thermal conductivity of insulant (W/m·K)						
		0.020	0.025	0.030	0.035	0.040	0.045	0.050
		Reduction in base thickness of insulating material (mm) for each 100 mm of concrete slab						
	A	B	C	D	E	F	G	H
1	600	10	13	15	18	20	23	25
2	800	7	9	11	13	14	16	18
3	1100	5	6	8	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/m²K if insulation is between the ceiling ties, and 0.25 W/m²K if insulation is between the rafters.

For insulation placed between ceiling ties (*U-value* 0.20 W/m²K)



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:

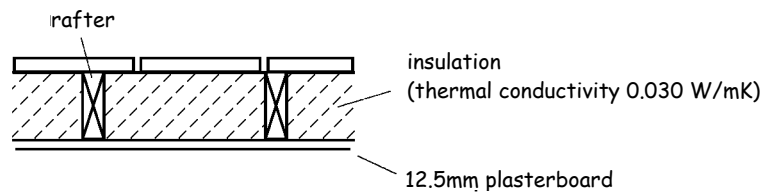
From Table 6.A.7:

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	= <u>2 mm</u>
Total reduction		= 9 mm

To achieve a *U-value* of 0.20 W/m²K 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	= <u>2 mm</u>
Total reduction		= 3 mm

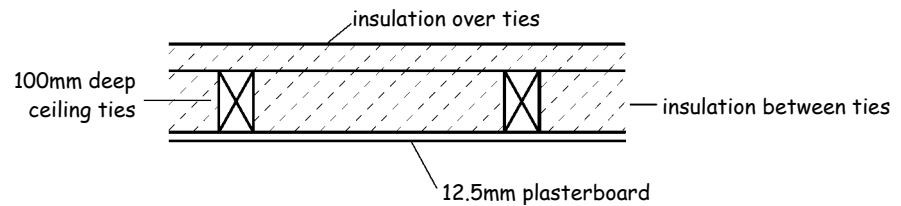
To achieve a *U-value* of 0.25 W/m²K the minimum thickness of the insulation layer between the rafters is therefore:

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 0.04 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	= <u>3 mm</u>
Total reduction		= 12 mm

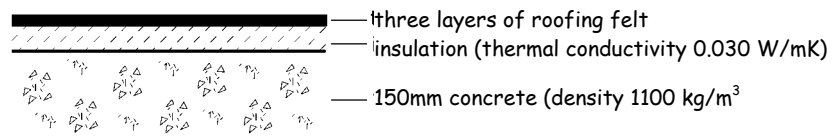
To achieve a *U-value* of 0.20 W/m²K the minimum thickness of the insulation layer over the joists, in addition to the 100 mm insulation between the joists, is therefore:

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)		= <u>12 mm</u>
Total reduction		= 13 mm

To achieve a *U-value* of 0.25 W/m²K, 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 <i>U</i> -value (W/m ² K)	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/m ³)	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:

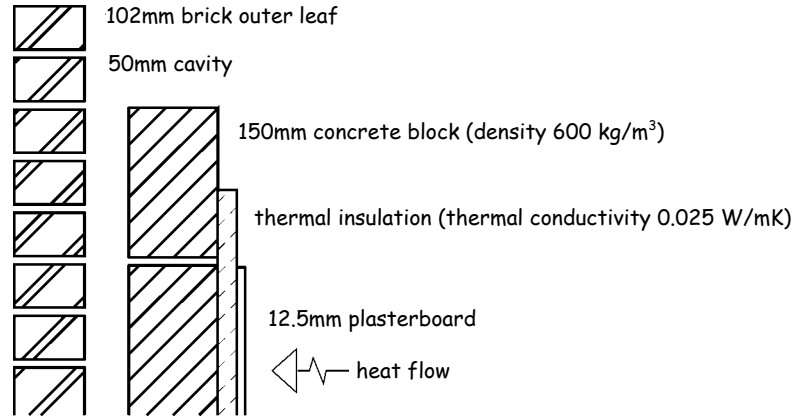
The table above is derived for walls in which the proportion of timber is 15%, and this corresponds to 38 mm wide studs at 600 mm centres (see BR 443). For other proportions of timber the *U-value* can be calculated using the procedure in Annex 6.B.

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/m²K 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)		= <u>17 mm</u>
Total reduction		= 27 mm

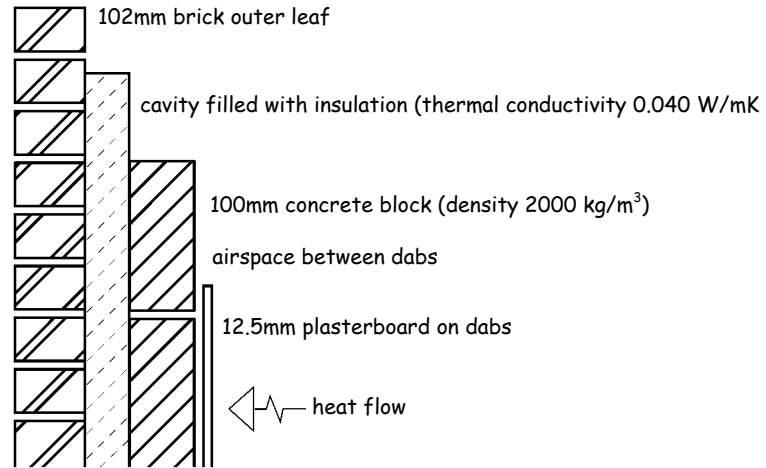
To achieve a *U-value* of 0.35 W/m²K, the minimum thickness of the insulation layer is therefore:

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	= <u>3 mm</u>
Total reduction		= 16 mm

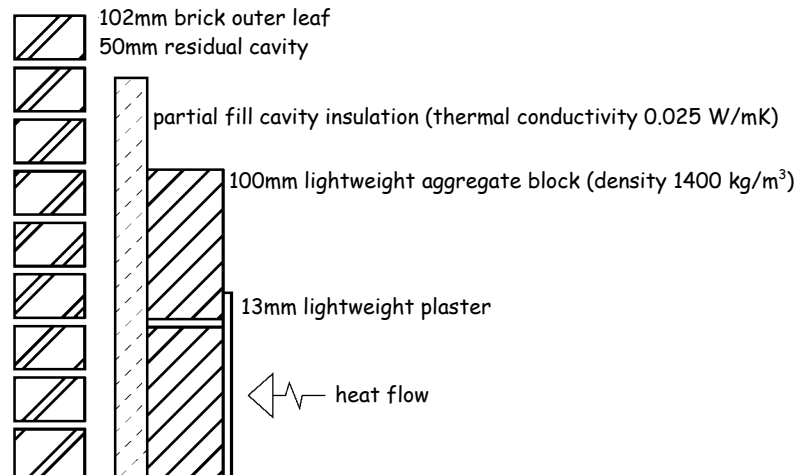
To achieve a *U-value* of 0.35 W/m²K the minimum thickness of the insulation layer is therefore:

Base thickness less total reduction i.e. 107 – 16 = **91 mm**

Example 6

Masonry wall with partial cavity-fill

Determine the thickness of the insulation layer that will achieve a *U-value* of 0.30 W/m²K 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

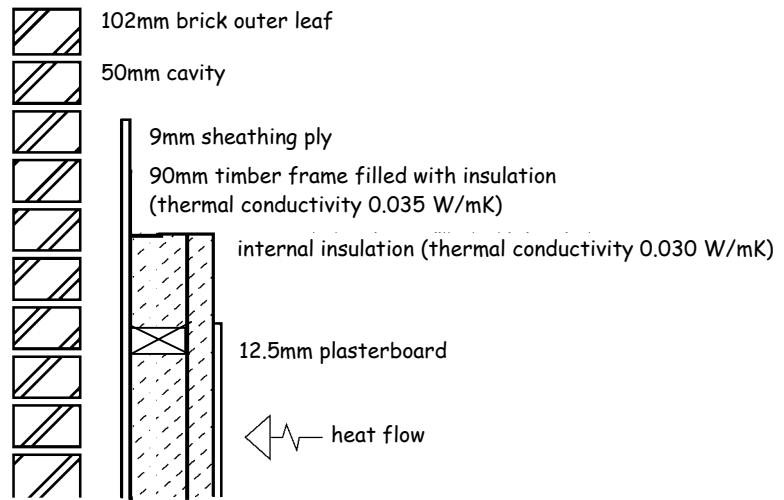
To achieve a *U-value* of 0.30 W/m²K, the minimum thickness of the insulation layer is therefore:

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)		= <u>53 mm</u>
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/m ² K						
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/m ² K						
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/m ² K						
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

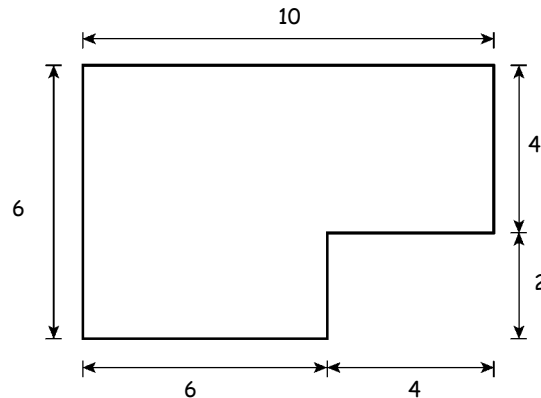
		Thermal conductivity of insulant (W/m·K)						
	P/A	0.020	0.025	0.030	0.035	0.040	0.045	0.050
	A	B	C	D	E	F	G	H
		Insulation thickness (mm) for U-value of 0.20 W/m²K						
1	1.00	82	103	123	144	164	185	205
2	0.90	81	101	122	142	162	183	203
3	0.80	80	100	120	140	160	180	200
4	0.70	79	99	118	138	158	177	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/m²K 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 m².

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/m²·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 ² K)		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 ² K)		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/m ³)	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

- 6.B.0 Introduction
- 6.B.1 The procedure
- 6.B.2 Timber framed wall example
- 6.B.3 Cavity wall with lightweight masonry leaf and insulated dry-lining example

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.

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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.

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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:

www.steel-sci.org

- [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.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 $U = 1 / R_T$,

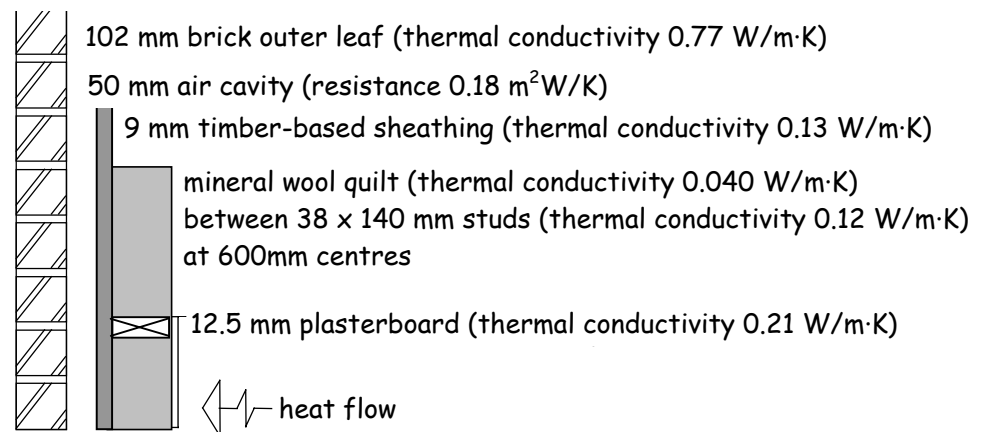
$$\text{where } R_T = \frac{R_{upper} + R_{lower}}{2}$$

- 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/m²K)

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

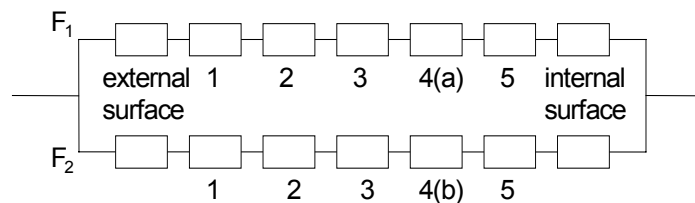
When calculating the upper limit of thermal resistance, the *building* element is considered to consist of two thermal paths (or sections). The upper limit of resistance is calculated from:

$$R_{\text{upper}} = \frac{1}{\frac{F_1}{R_1} + \frac{F_2}{R_2}}$$

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



6.B.2

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	= <u>0.130</u>
	Total (R_1)	= <u>4.111</u> m ² K/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	= <u>0.130</u>
	Total (R_2)	= <u>1.778</u> m ² K/W

Fractional area $F_2 = 0.15$ (15%)

The upper limit of resistance is then:

$$R_{\text{upper}} = \frac{1}{\frac{F_1}{R_1} + \frac{F_2}{R_2}} = \frac{1}{\frac{0.850}{4.111} + \frac{0.150}{1.778}} = 3.435 \text{ m}^2\text{K/W}$$

Lower resistance limit

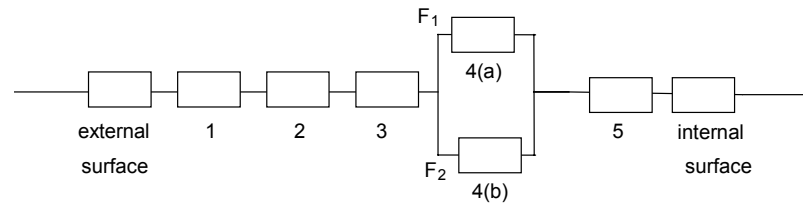
When calculating the lower limit of thermal resistance, the resistance of a bridged layer is determined by combining in parallel the resistances of the unbridged part and the bridged part of the layer. The resistances of all the layers in the element are then added together to give the lower limit of resistance.

The resistance of the bridged layer is calculated using:

$$R = \frac{1}{\frac{F_{\text{insul}}}{R_{\text{insul}}} + \frac{F_{\text{timber}}}{R_{\text{timber}}}}$$

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 = $\frac{1}{\frac{0.850}{3.500} + \frac{0.150}{1.167}}$	= 2.692
Resistance of plasterboard	= 0.060
Internal surface resistance	= <u>0.130</u>
Total (R_{lower})	= <u>3.304</u> m ² K/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 $\Delta U''$ 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 $\Delta U''$ is 0.01 (i.e. correction level 1). The value of ΔU_g is then:

$$\Delta U_g = 0.01 \times (2.692 / 3.369)^2 = \mathbf{0.006 \text{ W/m}^2\text{K}}$$

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%.

$$U = 1 / R_T + \Delta U_g \quad (\text{if } \Delta U_g \text{ is not less than } 3\% \text{ of } 1 / R_T)$$

$$U = 1 / R_T \quad (\text{if } \Delta U_g \text{ is less than } 3\% \text{ of } 1 / R_T)$$

In this case $\Delta U_g = 0.006 \text{ W/m}^2\text{K}$ and $1 / R_T = 0.297 \text{ W/m}^2\text{K}$. Since ΔU_g is less than 3% of $(1 / R_T)$,

$$U = 1 / R_T = 1 / 3.369 = \mathbf{0.30 \text{ W/m}^2\text{K}}.$$

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 $\Delta U''$ is set to $0.01 \text{ W/m}^2\text{K}$. If, on the other hand, air circulation is possible on the warm side then it should be set to $0.04 \text{ W/m}^2\text{K}$. The possible correction levels and correction factors are summarised as follows:

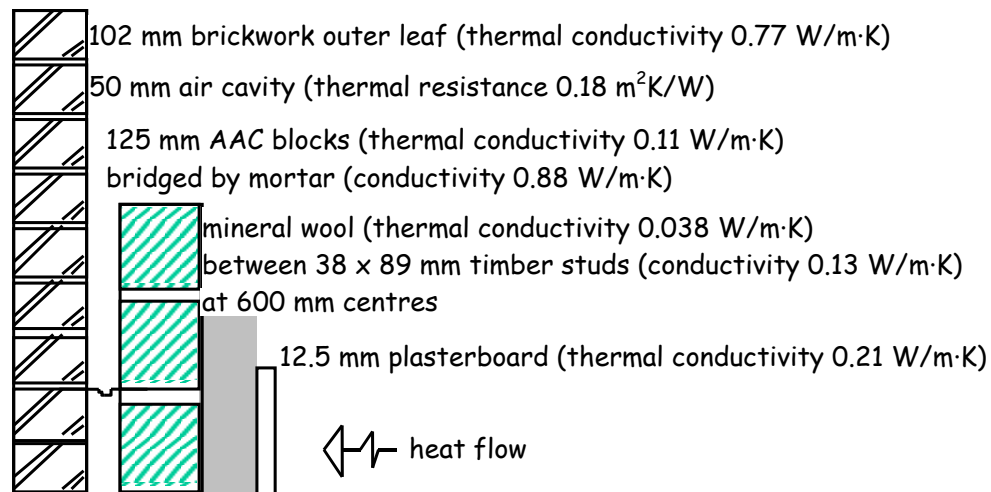
Correction for air gaps

Description of air gap	Correction level	$\Delta U''$ W/m ² K
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/m²K)

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 (m ² K/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

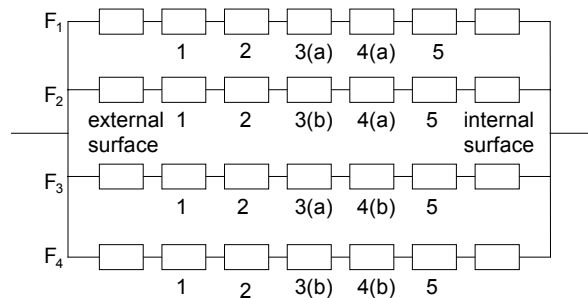
When calculating the upper limit of thermal resistance, the *building* element is considered to consist of a number of thermal paths (or sections). In this example there are four sections (or paths) through which heat can pass. The upper limit of resistance, R_{upper} , is given by

$$R_{upper} = \frac{1}{\frac{F_1}{R_1} + \frac{F_2}{R_2} + \frac{F_3}{R_3} + \frac{F_4}{R_4}}$$

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	= <u>0.130</u>
Total thermal resistance (R_1)	= <u>4.020</u> m ² K/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	= <u>0.130</u>
Total thermal resistance (R_2)	= <u>3.026</u> m ² K/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	= <u>0.130</u>
Total thermal resistance (R_3)	= <u>2.363</u> m ² K/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	= <u>0.130</u>
Total thermal resistance (R_4)	= <u>1.369</u> m ² K/W

Fractional area $F_4 = 0.008$ (6.7% x 11.8%)

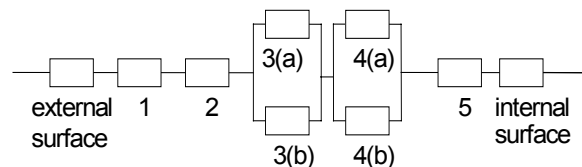
Combining these resistances we obtain:

$$R_{upper} = \frac{1}{\frac{F_1}{R_1} + \frac{F_2}{R_2} + \frac{F_3}{R_3} + \frac{F_4}{R_4}} = \frac{1}{\frac{0.823}{4.020} + \frac{0.059}{3.026} + \frac{0.110}{2.363} + \frac{0.008}{1.369}} = 3.617 \text{ m}^2\text{K/W}$$

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. 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:

$$R_{\text{first}} = \frac{1}{\frac{F_{\text{blocks}}}{R_{\text{blocks}}} + \frac{F_{\text{mortar}}}{R_{\text{mortar}}}}$$

and the resistance of the bridged layer consisting of insulation and timber is calculated using:

$$R_{\text{second}} = \frac{1}{\frac{F_{\text{insul}}}{R_{\text{insul}}} + \frac{F_{\text{timber}}}{R_{\text{timber}}}}$$

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

$$R_{\text{first}} = \frac{1}{\frac{0.933}{1.136} + \frac{0.067}{0.142}} = 0.773$$

Resistance of second bridged layer

$$R_{\text{second}} = \frac{1}{\frac{0.882}{2.342} + \frac{0.118}{0.685}} = 1.821$$

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:

$$R_T = \frac{R_{\text{upper}} + R_{\text{lower}}}{2} = \frac{3.636 + 3.136}{2} = 3.376 \text{ m}^2\text{K/W}$$

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%.

$$U = 1 / R_T + \Delta U_g \quad (\text{if } \Delta U_g \text{ is not less than 3\% of } 1 / R_T)$$

$$U = 1 / R_T \quad (\text{if } \Delta U_g \text{ is less than 3\% of } 1 / R_T)$$

In this case $\Delta U_g = 0.003 \text{ W/m}^2\text{K}$ and $1 / R_T = 0.296 \text{ W/m}^2\text{K}$. 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

- 6.C.0 Introduction
- 6.C.1 Example of how to use tables
- 6.C.2 Solid ground floors
- 6.C.3 Suspended ground floors
- 6.C.4 Basement floors
- 6.C.5 Basement walls

annex 6.C

U-values of ground floors and basements (Appendix C)

6.C.0 Introduction

A ground floor of a non-domestic *building* should not have a *U-value* exceeding $0.25 \text{ W/m}^2\text{K}$, if the Elemental Method is to be used (subject to the carbon intensity of the heating). 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 $0.25 \text{ W/m}^2\text{K}$ but for basement walls it is $0.30 \text{ W/m}^2\text{K}$ (again both of these figures are subject to the carbon intensity of the heating system). For exposed floors and for floors over unheated spaces the reader is referred to Annex 6.B.

Insulation not necessary

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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 and similar, for example a row of industrial units, the floor dimensions can either be taken as those of the premises 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.

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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.

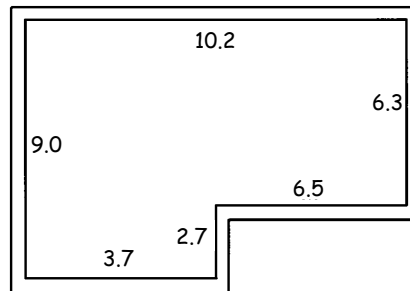
Interpolation

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 m². 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 $38.4 \div 74.25 = 0.517 \text{ m/m}^2$. 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 $0.075 \div 0.04 = 1.875 \text{ m}^2\text{K/W}$.

Extract from the relevant part of Table 1 is shown below:

Perimeter/Area	Thermal resistance (m ² K/W)	
	1.5	2.0
0.50	0.33	0.28

The *U-value* corresponding to a thermal resistance of 1.875 m²K/W is obtained by linear interpolation as below:

$$\begin{aligned}
 U &= 0.33 \times \frac{2.0 - 1.875}{2.0 - 1.5} + 0.28 \times \frac{1.875 - 1.5}{2.0 - 1.5} \\
 &= 0.33 \times 0.25 + 0.28 \times 0.75 \\
 &= 0.29 \text{ W/m}^2\text{K}
 \end{aligned}$$

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.

Ground floors with all-over insulation or no insulation

6.C.2 Solid ground floors

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)

Perimeter/Area	Thermal resistance of all-over insulation (m²K/W)						
	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 (m^2K/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 (m^2K/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.

Ground floors with no insulation

6.C.3 Suspended ground floors

The following table gives *U-values* of uninsulated suspended floors for various perimeter to area ratios and for two levels of ventilation (expressed in m²/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 (m ² /m)	
	0.0015 m ² /m	0.0030 m ² /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.

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 m²K/W for both the upper and lower surfaces of the floor deck.

Suspended floors with insulation

Basement floors
with no insulation

6.C.4 Basement floors

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

- 6.D.0 Introduction
- 6.D.1 Calculation method
- 6.D.2 Example

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.

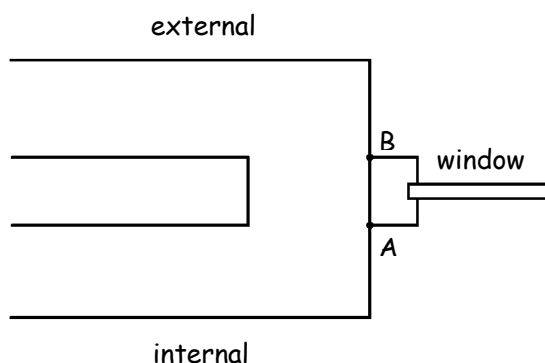
These minimum thermal resistances are then compared with satisfactory performance criteria to see whether corrective action is indicated.

Minimum thermal resistance path

6.D.1 Calculation method

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 m²K/W, and
 - R_{mod} (rounded to two decimal places) is at least 0.45 m²K/W; or
- b. for other edge designs:

R_{min} (rounded to two decimal places) is at least 0.20 m²K/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 m²K/W, or
- b. for other edge designs:
 - R_{min} (rounded to two decimal places) is at least 0.45 m²K/W.

Compensating for additional heat loss For non-domestic *buildings*, where the additional heat losses around the edges of openings cannot be ignored they can be taken into account in calculations. The calculation procedure could be used with the rate of heat loss from the proposed *building* increased by the following amount:

$$0.3 \times \text{total length of relevant opening surrounds (W)}$$

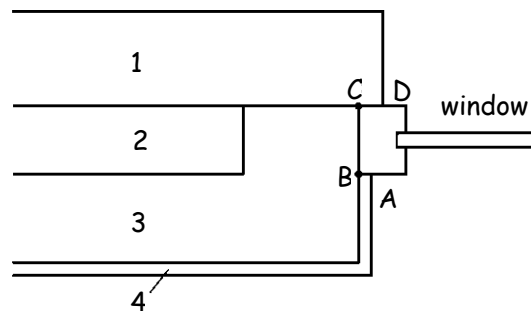
Compensating measures, such as reducing the *U-value* of one of the *building* elements, should then be incorporated so that the rate of heat loss from the proposed *building* does not exceed that of the notional *building*.

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. 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”, R_{min} in this example is greater than 0.20 m²K/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 ² K/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

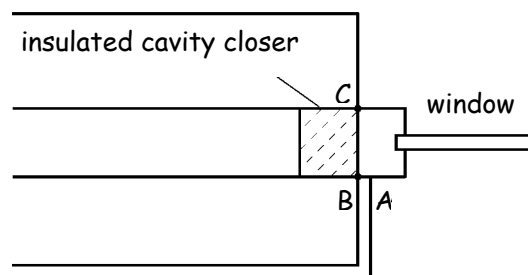
Additional heat loss at the edge detail

Referring to paragraph “Additional heat loss”, R_{min} in this example is less than 0.45 m²K/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. R_{min} is now greater than 0.45 m²K/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 ² K/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

- 6.E.0 Introduction
- 6.E.1 Example of trade-off for windows, doors and rooflights in the Elemental Method

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. The average U-value however of all of the windows, doors and rooflights taken together should not exceed 2.0 or 2.2 depending on the type of frame (also subject to the carbon intensity of the heating system). The example that follows illustrates how this can be done.

6.E.1 Example of trade-off between windows, doors and rooflights in the Elemental Method

A *building* is to have a total window area of 16.9 m² (including frames) and a total door area of 3.8 m². It is proposed to use solid wooden doors with a *U-value* of 3.0 W/m²K. 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/m²K.

Windows with a *U-value* of 1.7 W/m²K can achieve this requirement, as shown in the following table and subsequent calculation:

Average *U-value* calculation

Element	Area (m ²)	<i>U-value</i> (W/m ² K)	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/m²K higher than the window *U-value*.

This gives an average *U-value* of 41.84 ÷ 21.6, or 1.94 W/m²K, which is below 2.0 W/m²K. The windows, doors and rooflights can therefore be considered to follow the objectives of the Elemental Method.

Annex
6.F Worked examples of Target U-value Method

This Annex does not apply to non-domestic buildings

Annex
6.G SAP Energy Rating and Carbon Index

This Annex does not apply to non-domestic buildings

Annex

6.H Alterations and extensions

- 6.H.0 Introduction
- 6.H.1 Alterations to building fabric
- 6.H.2 Extensions
- 6.H.3 Alterations to building services

annex

6.H

Alterations and extensions

6.H.0 Introduction

This Annex relates to existing *buildings*.

Extensions

In the case of extensions, the majority of the *construction* will be new-build and seldom will there be the need to build 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 transitional *construction*.

Alterations

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.

Historic *buildings*

6.H.1 Alterations to *building* fabric

Reference should be made to the guidance on extensions (6.H.2) for alterations that involve increasing the non-domestic *building* floor area and/or bringing parts of the existing *building* that were previously outwith the *insulation envelope* into the heated or cooled part of the *building*.

Alterations to the *insulation envelope* of a non-domestic *building* should be considered using the guidance in the following paragraphs.

Infill of small openings	The infill of an existing opening of approximately 4 m ² or less in the <i>building</i> fabric should have a <i>U-value</i> which matches at least that of the remainder of the surrounding element. In the case of a wall or floor however, it should not be worse than 0.70 W/m ² K and for a roof, no worse than 0.35 W/m ² K.
Infill of large openings	The infill of an existing opening of greater area (than approximately 4 m ²) in the <i>building</i> fabric should have a <i>U-value</i> which achieves those in 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 <i>U-value</i> of other parts of the <i>insulation envelope</i> .
<i>Insulation envelope</i> formed from internal elements	Where the alteration causes an existing internal part or other element of a <i>building</i> to form the <i>insulation envelope</i> , that part of the <i>building</i> (including infill <i>construction</i>) should have <i>U-values</i> which achieve those in Table 1 to clause 6.2.1. This will most likely occur where a part of a <i>building</i> is permanently removed as a phase of the alteration <i>work</i> . Another approach would be to follow the guidance given for “infill of small openings” above, but compensate for the energy efficiency deficit by improving the overall <i>U-value</i> of other parts of the <i>insulation envelope</i> . Where this occurs at a <i>boundary</i> , no upgrading is necessary if the element is a wall that is exclusively the property of the adjoining <i>building</i> .
Windows, doors and rooflights	Where windows, doors and rooflights are being created or replaced, they should achieve the appropriate level of <i>U-value</i> specified in Table 1 to clause 6.2.1. For secondary <i>glazing</i> however, an existing window, after alteration should achieve a <i>U-value</i> of about 3.5 W/m ² K.
Percentage areas of openings	Where additional windows, doors and rooflights are being created, the overall total area (including existing) should not exceed the percentage areas given in Table 2 to clause 6.2.1.
Solar gain	Where additional translucent <i>glazing</i> is being created in the external <i>building</i> fabric, the impact of any solar gain should be considered in relation to any mechanical ventilation or air conditioning system in the <i>building</i> .
Reconstruction of elements	Where the build-up of an element forming part of the <i>insulation envelope</i> is to be altered or dismantled and rebuilt, the opportunity should be taken to improve the level of thermal insulation. 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 *building*, which is currently in a useable condition and its heated or cooled status is not being altered, (e.g. unheated to being heated) to have its internal space significantly reduced in area or height, unless the owner of the *building* (or possibly occupier) 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 *building* 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/m²K.

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

Where a non-domestic *building* is extended, the new *building* fabric should be designed in accordance with either the Elemental Method, the Heat Loss Method or the Carbon Emissions Calculation Method.

It should be noted that the Carbon Emissions Calculation Method is a holistic approach and the *building* services systems will need to be taken into account.

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 (or Annex 6.P) gives the *U-values* that should be achieved. When calculating the maximum permitted area of windows, doors and rooflights for an extension to a *building*, the percentage areas in Table 2 to clause 6.2.1 should be applied only to the walls and roof of the extension.

Heat Loss Method

b. with the Heat Loss Method, zero thermal transmittance should be considered at the interface of the existing *insulation envelope* and the extended part of the *building*. This is not appropriate where the situation described in clause 6.0.5 applies.

Carbon Emissions Calculation Method

c. the Carbon Emissions Calculation Method can be used for the extension alone, where the energy efficiency of the *building* services systems can be considered in isolation from the

existing non-domestic *building*. In other cases, the entire *building*, as extended will need to be assessed. In application, this approach will only be suitable when detailed knowledge exists of the original *construction* and the *building services* systems in the existing *building*.

Alterations that extend the *insulation envelope*

Alterations that involve increasing the non-domestic *building* 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 heated or cooled part of the non-domestic *building* should be considered in the same way as extensions. Examples of such *work* are, changing a *roof space*, part of an unheated warehouse or a deep solum space into *office accommodation*:

- 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 warehouse, this will usually involve extending the *insulation envelope* to include, the existing floor, perimeter walls and the roof/ceiling to the new *office* area.
- 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 *office* area.

6.H.3 Alterations to *building services*

First time heating or cooling

Where the *building* was previously not designed to be heated or cooled, and heating and/or cooling equipment is introduced into the *building* (excluding heating of 25 W/m² of floor area, for frost protection purposes) the guidance to standards 6.2 to 6.8 should be followed.

Entirely new or complete replacement systems

Where an entirely new or replacement *building services* installation is installed in an existing heated and/or cooled non-domestic *building*, including an extension to the *building*, the guidance to standards 6.3 to 6.8 (also, see sub-clauses a, b, c and d. below) should be followed, as appropriate to the type of *building service*.

Part replacement of systems

If a *building services* installation is being replaced in part, the guidance to standards 6.3 to 6.6 should be followed and where possible standards 6.7 and 6.8 (see sub-clause d. below) but only as it affects the new or replaced components of the installation. Such alterations should not allow the installation as a whole to be downgraded in terms of energy efficiency or be 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.

Other issues which should be taken into consideration when carrying out alterations to *building* services are given in a,b,c and d, below:

- | | | |
|---|----|---|
| High carbon intensity heating systems | a. | where an entirely new or complete replacement installation of a heating system with a higher carbon intensity is unavoidable (see clauses 6.3.1 and 6.3.2), an evaluation of the <i>U-values</i> of the existing <i>insulation envelope</i> of the <i>building</i> should be made. The elemental values that are obtained should be improved by dividing them by 1.15 and rounding down the revised figure to 2 decimal places. For example: an existing wall <i>U-value</i> of 0.70 will become 0.60 and an existing roof <i>U-value</i> of 0.35 will become 0.30. The resulting improvement should then be effected to the <i>building</i> fabric, but such an adjustment should only be made once to an existing building under this current guidance; |
| ACMV in <i>office buildings</i> | b. | where an entirely new or complete replacement mechanical ventilation or air conditioning system is installed in an <i>office building</i> , the Carbon Performance Index (CPI) referred to in clause 6.6.2a. should be at least equal to that of any existing system but not less than 90; |
| ACMV in other non-domestic <i>buildings</i> | c. | where an entirely new or complete replacement mechanical ventilation or air conditioning system is installed in a non-domestic <i>building</i> (other than an <i>office building</i>), the total specific fan power or SFP (i.e. the design power of all fans in the distribution system divided by the design ventilation rate through the <i>building</i>) of not greater than 1.5 W/litres/second. |
| <i>Building</i> logbook | d. | the <i>building</i> logbook referred to in clause 6.8.1 should be amended to take account of the alterations to the services, however it is not necessary to provide a forecast of energy consumption. Where such a logbook does not exist, (e.g. due to the age of the <i>building</i>), the record of the alteration <i>work</i> carried out, including any recommendations to the owner/occupier, the user and maintenance instructions, should form the basis for a logbook. |

Annex

6.J Heat Loss Method example and worksheet 6.J.4

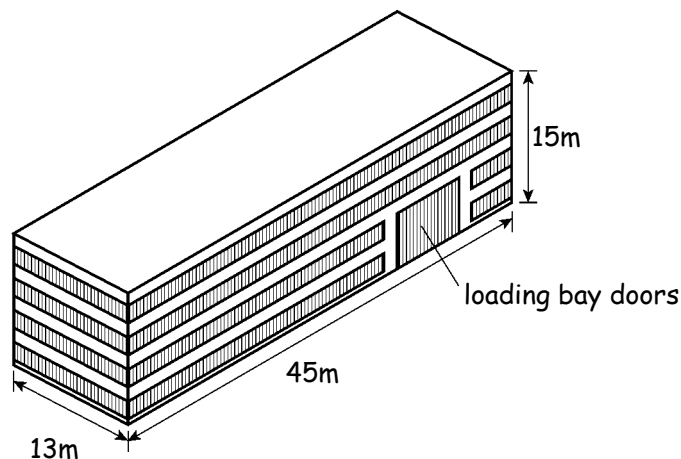
- 6.J.0 Introduction
- 6.J.1 Proposed building
- 6.J.2 Notional building
- 6.J.3 Comparison
- 6.J.4 Worksheet 6.J.4

annex 6.J

Heat Loss Method example and worksheet 6.J.4 (Appendix H J8.5 dts)

6.J.0 Introduction

A detached, four storey office building 45 m x 13 m in plan and height of 15 m is to be constructed with translucent glazing occupying 48% of the external wall area, using plastic framed windows with a measured *U-value* of 1.8 W/m²K. The personnel doors are plastic framed but with a *U-value* of 2.0 W/m²K. No rooflight glazing is proposed. The exposed walls and the roof are to have *U-values* of 0.30 W/m²K and 0.20 W/m²K respectively, with the ground floor being insulated with 65 mm expanded polystyrene with thermal resistance of all-over floor insulation 1.76 m²KW, giving a *U-value* of 0.20 W/m²K (Annex 6.C). The loading bay doors do not remain in the open position when the building is in use and they have a *U-value* of 0.70 W/m²K



6.J.1 Proposed building

First calculate the areas of each building element:

area of roof (45 x 13)	= 585.0 m ²
area of elevations (45 + 45 + 13 + 13) x 15	= 1740.0 m ²
area of windows (48% of 1740 m ²)	= 835.2 m ²
area of personnel doors	= 14.0 m ²
area of vehicle loading bay doors	= 27.0 m ²
area of exposed wall (1740 – 835 – 14 – 27)	= 863.8 m ²
area of floor (45 x 13)	= 585.0 m ²

Then calculate the rate of heat loss from the proposed *building* as follows:

Building element	Area (m²)	U-value (W/m²K)	Rate of heat loss (W/K)
Roof	585.0	0.20	117.0
Exposed walls	863.8	0.30	259.1
Windows	835.2	1.8	1503.4
Personnel doors	14.0	2.0	28.0
Vehicle loading bay doors	27.0	0.70	18.9
Ground floor	585.0	0.20	117.0
Total rate of heat loss			2043.4

6.J.2 Notional building

The area of window and door openings in the proposed *building* is more than the basic allowance in Table 2 to clause 6.2.1. The basic area allowance of 40% of the exposed wall area from Table 2 should be used for the notional *building*. The area of rooflights proposed is less than the basic allowance in Table 2 to clause 6.2.1. The area of rooflights in the notional *building* should be established from the following:

$$RL_{prop} + 0.5(RL_{allow} - RL_{prop})$$

Where:

RL_{prop} is the percentage rooflight area in the proposed *building*, and
 RL_{allow} is the percentage rooflight area given in Table 2 to clause 6.2.1.

In this case the percentage to be taken is 10%.

First calculate the areas of each *building* element:

area of rooflights (10% of 585 m ²)	= 58.5 m ²
area of roof (45 x 13) – 58.5	= 526.5 m ²
area of elevations (45 + 45 + 13 + 13) x 15	= 1740.0 m ²
area of windows and personnel doors (40% of 1740 m ²)	= 696.0 m ²
area of vehicle loading bay doors	= 27.0 m ²
area of exposed wall (1740 – 696 – 27)	= 1017.0 m ²
area of floor (45 x 13)	= 585.0 m ²

Then calculate the rate of heat loss from the notional *building* as follows:

Building element	Area (m²)	U-value (W/m²K)	Rate of heat loss (W/K)
Rooflights	58.5	2.0	117.0
Roof	526.5	0.25	131.6
Exposed walls	1017.0	0.30	305.1
Windows and personnel	696.0	2.0	1392.0
Vehicle loading bay doors	27.0	0.7	18.9
Ground floor	585.0	0.25	146.3
Total rate of heat loss			2110.9

6.J.3 The comparison

The rate of heat loss from the proposed *building* is less than that from the notional *building* and therefore the guidance in clause 6.2.2 has been followed.

6.J.4 Worksheet (J8.5)

The following worksheet may be photocopied and used to assist with the Heat Loss Method calculation.

Calculated total rate of heat loss through the *insulation envelope* Proposed/Notional *building*

Element	Gross Area in m ²	Openings in m ²	Net Area in m ²	U-value (W/m ² K)	Area x U-value
Pitched roofs – With insulation between rafters	-	=	x	=	
Pitched roofs – With insulation between ceiling ties or collars	-	=	x	=	
<i>Flat roofs</i> or roofs with integral insulation	-	=	x	=	
Exposed wall, <i>external wall</i> or wall referred to in clause 6.0.5	-	=	x	=	
Exposed floor or floor referred to in clause 6.0.5	-	=	x	=	
				Total A	=
Windows, personnel doors and rooflights, translucent <i>glazing</i> in metal frames. (Including <i>glazing</i> and personnel doors located in walls referred to in clause 6.0.5)			x	=	
Windows, personnel doors and rooflights, translucent <i>glazing</i> in wood or plastic frames. (Including <i>glazing</i> and personnel doors located in walls referred to in clause 6.0.5)			x	=	
Vehicle and similar large access doors			x	=	
Vehicle access/similar large doors which for operational reasons, have to be left open when the <i>building</i> is in use and also shop-entrances and shop-display windows at an access level			x	=	
				Total B	=
Total rate of heat loss (Total A + Total B)					=

Annex
6.K Example lighting calculations

- 6.K.0 Introduction
- 6.K.1 Example following guidance in clause 6.5.1 a.
- 6.K.2 Example following guidance in clause 6.5.1 b.

annex
6.K

Example lighting calculations
(Appendix J)

6.K.0 Introduction

The examples in this annex show two ways of providing energy efficient lighting to *buildings*. The first is for an extension to an existing *building* and the second is for a new *building*. These approaches are not however exclusive to the type of *work* referred to in this Annex, i.e. the first example could be adopted for new build and the second, for an extension. Where the *work* consists of an alteration or replacement these methods can be used, but only where a completely new system of lighting is to be provided.

6.K.1 Lighting calculation to show that 95% of installed circuit power is comprised of lamps listed in the table to 6.5.1a.

A new hall and changing *rooms* are to be added to an existing community centre. The proposed lighting scheme incorporates lamps that are listed in the table to clause 6.5.1 a. except for some low voltage tungsten halogen downlighters which are to be installed in the entrance area with local controls. A check therefore has to be made to show that the low voltage tungsten halogen lamps comprise less than 5% of the overall installed capacity of the lighting installation.

Main hall specification Twenty wall mounted uplighters with 250 W high pressure Sodium lamps are to provide general lighting needs. The uplighters are to be mounted 7 m above the floor. On plan, the furthest light is 20.5 m from its switch, which is less than three times the height of the light above the floor. It is also proposed to provide twenty 18 W compact fluorescent lights as an additional system enabling instant background lighting whenever needed.

Specification for changing *rooms*, corridors and entrance Ten 58 W, high frequency fluorescent light fittings are to be provided in the changing *rooms* and controlled by occupancy detectors. Six more 58 W fluorescent light fittings are to be located in the corridors and the entrance areas and switched locally. Additionally, in the entrance area there are to be the six 50 W tungsten halogen downlighters noted above.

A schedule of light fittings is prepared as follows:

Position	Number	Description of light source	Circuit Watts per lamp	Total circuit Watts (W)
Main hall	20	250 W SON	286 W	5720
Main hall	20	18 W compact fluorescent	23 W	460
Entrance, changing <i>rooms</i> and corridors	16	58 W HF fluorescent	64 W	1024
Entrance	6	50 W low voltage tungsten halogen	55 W	330
Total =				7534 W

From the schedule of light fittings above, the total circuit Watts of the lamps in the installation is 7534 W.

Calculation The percentage of circuit Watts consumed by lamps not listed in the table to clause 6.5.1a:

$$= \frac{330}{7534} \times 100 = 4.4\%$$

Therefore, more than 95% of the installed lighting capacity, in circuit Watts, is from light sources listed in the table to clause 6.5.1a. The switching arrangements follow the guidance in clause 6.5.3. The lighting scheme can therefore be considered as following the guidance in Section 6.

6.K.2 Lighting calculation to show average circuit efficacy follows the guidance in clause 6.5.1b.

General specification A lighting scheme is proposed for a new public house comprising a mixture of concealed perimeter lighting using high frequency fluorescent fittings and supplementary compact fluorescent lamps in the dining area. Lights in the dining and lounge areas are to be switched locally from behind the bar. Lighting to *kitchens* and *toilets* is to be switched locally.

The table below shows a schedule of the light sources proposed.

Position	Number	Description	Circuit Watts (W) per lamp	Lumen output (lm) per lamp	Total circuit Watts (W)	Total lamp lumen output (lm)
Over tables	20	11 W compact fluorescent	16	900	320	18,000
Concealed perimeter and bar lighting	24	32 W T8 fluorescent high frequency ballast	36	3300	864	79,200
<i>Toilets</i> and circulation	6	18 W compact fluorescent with mains frequency ballast	23	1200	138	7,200
<i>Kitchens</i>	6	50 W, 1500 T8 fluorescent with high frequency ballast	56	5200	336	31,200
				Totals	1658	135,600

From the schedule of light fittings above, the total lumen output of the lamps in the installation is 135,600 lumens.

Calculation

The total circuit Watts of the installation is 1658 Watts. Therefore, the average circuit efficacy is:

$$= \frac{135,600}{1658} = 81.8 \text{ lumens/Watt}$$

The proposed lighting scheme can be considered as following the guidance in Section 6.

Note: If 60 W tungsten lamps were used in the dining area instead of the 11 W compact fluorescent lamps actually proposed, the average circuit efficacy would drop to 51.9 lumens/W, which would not be following the guidance in clause 6.5.2b.

Annex

6.L Performance assessment methods for office buildings

- 6.L.0 Introduction
- 6.L.1 Carbon Performance Index
- 6.L.2 Example CPI calculation

annex 6.L

Performance assessment methods for office buildings (Appendix K)

6.L.0 Introduction

The efficiencies of *buildings*, and of the services systems that produce the indoor conditions required by occupants, can be compared provided that a consistent system is used to describe the *buildings* and their energy use.

Performance
benchmarks

Applying such a consistent approach to *buildings* in the *office* sector has allowed energy consumption benchmarks to be developed with which the performance of existing *buildings*, or the likely performance of new designs, can be compared. The benchmarks result from information obtained from surveys of operational *buildings*, and are included in DETR's Energy Consumption Guide 19 "Energy use in offices" (ECON 19).

www.actionenergy.org.uk

Design assessment

The information contained in [ECON 19](#) provides benchmarks for the energy consumed by air conditioning and mechanical ventilation (ACMV), heating and lighting services, together with benchmark information describing the hours of use of the equipment. Benchmarks also describe the energy consumed by the additional equipment appropriate to support use of the *building* for typical *office* activities. The benchmarks refer to *office buildings* described as representing 'typical' and 'good practice' for the sector.

The annual energy likely to be consumed by a particular service can be estimated as the product of the total installed input power rating of the plant installed to provide the service and the annual hours of use of that plant at the equivalent of full load. The annual hours of use can be considered to be the result of combining a benchmark value for the 'typical' hours of use of the service with a management factor that acts to reduce or increase this value. The management factor is a number related to the provisions that the design incorporates that have the potential to help the occupier control and manage the use of the plant.

The Carbon Performance Index (CPI) referred to in 6.L.1 is a technique for assessing the likely performance of *building* services systems using this design information. It uses benchmarks consistent with ECON19 and is intended to estimate the potential for efficient operation of *building* services systems using information available at the design or *construction* stage.

Performance
assessment

The inclusion of meters improves the confidence with which occupiers may assess their *buildings'* performance by estimating the energy consumed by servicing plant and additional equipment used for the full operation of the *building*.

A technique of estimating and measuring operational energy consumption, and comparing the achieved performance of *buildings* with the ECON19 benchmarks, has been developed to assess the achieved performance of *office buildings*. This method is described in CIBSE Technical Memoranda

www.cibse.org

office buildings. This method is described in [CIBSE Technical Memoranda TM22](#) “Energy Assessment and Reporting Methodology: Office Assessment Method”.

A means of comparing the design of services with benchmarks of installed load and energy use is described in CIBSE Guide “[Energy Efficiency in Buildings](#)”, 1998.

The results of ongoing performance assessment could be used to provide valuable information from which to maintain and improve performance benchmarks, and hence the CPI method, and to inform the design process.

6.L.1 The carbon performance index (CPI)

The assessment for mechanical ventilation is based on the calculation of a Carbon Performance Index using the following relationship:

CPI for mechanical ventilation – $CPI_{(MV)}$

$$CPI_{(MV)} = \frac{MV}{(PD \times HD \times CD \times FD)}$$

Where the value of the factor **MV = 800** has been set so that the design is considered to represent appropriate practice where the result of the calculation is 100 or greater (however see Annex 6.H for alteration or replacement *work*).

For the system installed to provide mechanical ventilation, the factors **PD**, **HD**, **CD** and **FD** are as defined below:

PD is the total installed capacity (sum of the input kW ratings) of the fans installed to provide mechanical ventilation divided by the relevant treated area (square metres);

HD is the typical annual equivalent hours of full load operation, and is taken as 3700 hours per year;

CD is the conversion factor relating the emissions of carbon to the fuel used, here electricity, in kgC/kWh. (see Table 1 below);

FD is a factor which depends on the provisions that are made to control and manage the installed plant and which could act to improve the annual efficiency of the plant above that of the typical installation, or to reduce the effective annual hours of use. (See Table 2 below).

The assessment for air conditioning is based on the calculation of a Carbon Performance Index using the following relationship:

CPI for air-conditioning – $CPI_{(ACMV)}$

$$CPI_{(ACMV)} = \frac{ACMV}{(PD \times HD \times CD \times FD) + (PR \times HR \times CR \times FR)}$$

The value of the factor **ACMV = 1200** has been set so that the design is considered to represent appropriate practice where the result of the calculation is 100 or greater (however see Annex 6.H for alteration or replacement *work*).

For the distribution system transferring cooled medium to the conditioned spaces, the factors **PD**, **HD**, **CD** and **FD** are as defined below:

- PD** is the total installed capacity (sum of the input kW ratings) of the fans and pumps installed to distribute air and/or cooled media around the *building* divided by the relevant treated area (square metres);
- HD** is the typical annual equivalent hours of full load operation, and is taken as 3 700 hours per year;
- CD** is the conversion factor relating the emissions of carbon to the fuel used, here electricity, in kgC/kWh. (see Table 1 below);
- FD** is a factor which depends on the provisions that are made to control and manage the installed plant and which could act to improve the annual efficiency of the plant above that of the typical installation, or to reduce the effective annual hours of use. (See Table 3 below).

For the refrigeration system, the factors **PR**, **HR**, **CR** and **FR** are as defined below:

- PR** is the total installed capacity (sum of the input kW ratings) of the plant installed to provide the cooling or refrigeration function divided by the relevant treated area (square metres);
- HR** is the typical annual equivalent hours of full load operation of the refrigeration plant, and is taken as 1000 hours per year;
- CR** is the conversion factor relating the emissions of Carbon to the fuel used, here most frequently electricity, sometimes gas, in kgC/kWh, from Table 1 below;
- FR** is a factor which depends on the provisions that are made to control and manage the installed plant and which could act to improve the annual efficiency of the plant above that of the typical installation, or to reduce the effective annual hours of use. (See Table 4 below).

Table 1: Carbon emission factors

Delivered energy	Carbon emission factor (kgC/kWh)
Gas	0,053
Oil	0.074
Coal	0.086
Electricity (average)	0.113

Plant control and management factors

Tables 2, 3 and 4 below itemise a number of control and management features which could act to improve the annual efficiency of the relevant plant above that of the typical installation, or to reduce the effective annual hours of use. Values to be associated with each feature are obtained from column A, B or C as appropriate and the resultant factor is obtained by multiplying together all of the individual values obtained. Values are selected from columns A, B and C of the table depending on the extent to which facilities for monitoring and reporting are provided, as follows:

- Column C No monitoring provided.
- Column B Provision of energy metering of plant and/or metering of plant hours run, and/or monitoring of internal temperatures in zones.
- Column A Provision as B above, plus the ability to draw attention to 'out of range' values.

Table 2: To obtain factor (FD) for the air distribution system

Plant management features	Values		
	A	B	C
a. Operation in mixed mode with natural ventilation	0.85	0.9	0.95
b. Controls which restrict the hours of operation of distribution system	0.9	0.93	0.95
c. Efficient means of controlling air flow rate	0.75	0.85	0.95
Column product (FD)			

The plant management features for Table 2 are more fully described below:

- a. Mixed mode operation available as a result of including sufficient openable windows to provide the desired internal environment from natural ventilation when outdoor conditions permit. This may only apply where the perimeter zone is greater than 80% of the treated floor area.
- b. Control capable of limiting plant operation to occupancy hours with the exceptions noted below in which operation outside the hours of occupancy forms an essential part of the efficient use of the system:

- for control of condensation;
 - for optimum start/stop control; or
 - as part of a ‘night cooling’ strategy.
- c. Air flow rate controlled by a variable motor speed control which efficiently reduces input power at reduced output; variable pitch fan blades. (damper, throttle or inlet guide vane controls do not attract this factor).

Table 3: To obtain factor (FD) for the cooling distribution system

Plant management features	Values		
	A	B	C
a. Operation in mixed mode with natural ventilation	0.85	0.9	0.95
b. Controls which restrict the hours of operation of distribution system	0.9	0.93	0.95
c. Efficient means of controlling air flow rate	0.75	0.85	0.95
Column product (FD)			

The plant management features for Table 3 are more fully described below:

- a. Mixed mode operation available as a result of including sufficient openable windows to provide the desired internal environment from natural ventilation when outdoor conditions permit. This may only apply where the perimeter zone is greater than 80% of the treated floor area. This factor is credited only where interlocks are provided to inhibit the air conditioning supply in zones with opened windows.
- b. are as described for Table 2 above for mechanical ventilation;
- c. are as described for Table 2 above for mechanical ventilation.

Table 4: To obtain factor (FR) for the refrigeration plant

Plant management features	Values		
	A	B	C
a. Free cooling from cooling tower	0.9	0.93	0.95
b. Variation of fresh air using economy cycle or mixed mode operation	0.85	0.9	0.95
c. Controls to restrict hours of operation	0.85	0.9	0.95
d. Controls to prevent simultaneous heating and cooling in the same zone	0.9	0.93	0.95
e. Efficient control of plant capacity, including modular plant	0.9	0.93	0.95
f. Partial ice thermal storage	1.8	1.86	1.9
g. Full ice thermal storage	0.9	0.93	0.95
Column product (FR)			

The plant management features for Table 4 are more fully described below:

- a. systems that permit cooling to be obtained without the operation of refrigeration equipment when conditions allow. (e.g., ‘strainer cycle’; ‘thermosyphon’.);
- b. systems that incorporate an economy cycle in which the fresh air and recirculated air mix is controlled by dampers, or where mixed mode operation as defined below Table 3;
- c. controls that are capable of limiting plant operation to the hours of occupancy of the *building*, with the exceptions noted below in which operation outside the hours of occupancy forms an essential part of the efficient use of the system:
 - for control of condensation;
 - for optimum start/stop control; or
 - as part of a strategy to pre-cool the *building* overnight using outside air;
- d. controls that include an interlock or dead band capable of precluding simultaneous heating and cooling in the same zone;
- e. refrigeration plant capacity controlled on-line by means that reduce input power in proportion to cooling demand and maintain good part load efficiencies (e.g. modular plant with sequence controls; variable speed compressor). (Hot gas bypass control does not attract this factor).
- f. partial ice storage in which the chiller is intended to operate continuously, charging the store overnight and supplementing its output during occupancy.
- g. full ice storage in which the chiller operates only to recharge the thermal store overnight and outside occupancy hours.

6.L.2 Example CPI calculation for an *office* proposal which includes air conditioning

In this example it is intended to include an air conditioning system in a new *office building*. The relevant details from the proposal are that:

- the total area to be treated by the system is 3000 m²;
- cooling will be provided by two speed-controlled electrically powered compressors, with a total rated input power of 150 kW;
- the refrigeration compressor energy consumption will be metered;
- the fans used to distribute cooled air to treated spaces have a total rated input power of 35 kW;
- the fan energy consumption will be metered;
- a time clock control is to be provided so that the operation of the cooling system (refrigeration and air distribution) may be restricted to occupancy hours;
- windows in treated areas will be openable so that natural ventilation may be used, and the cooling system turned off, when appropriate.

The CPI calculation for air conditioning is:

$$\text{CPI}_{(\text{ACMV})} = \frac{1200}{(\text{PD} \times \text{HD} \times \text{CD} \times \text{FD}) + (\text{PR} \times \text{HR} \times \text{CR} \times \text{FR})}$$

In this proposal, for the cooling distribution system:

PD is the total installed capacity (sum of the input kW ratings) of the fans divided by the relevant treated area (square metres)
 = **0.0117** (35/3000)

HD = **3700** hours per year

CD is the carbon conversion factor for electricity, in kgC/kWh.
 (Table 1) = **0.113**

FD = **0.84**, determined from Table 3 as follows:

As the major plant will be metered, factors from Column B of the table are used. Then:

Factor for including the opportunity for natural ventilation (mixed mode operation) = 0.9;

Factor for including provision to restrict the hours of use of the system (time control) = 0.93;

Column product (**FD**) = **0.84**. (0.9 x 0.93)

And, for the refrigeration system:

PR = the total installed capacity (sum of the input kW ratings) of the refrigeration plant divided by the treated area (square metres),
 = **0.05** (150/3000).

HR = **1000** hours per year.

CR = the carbon conversion factor for electricity, in kgC/kWh.
(Table 1), = **0.113**.

FR = **0.75**, determined from Table 4 as follows:

As the major plant will be metered, factors from Column B of the table are used. Then:

Factor for including the opportunity for natural ventilation (mixed mode operation) = 0.9;

Factor for including provision to restrict the hours of use of the system (time control) = 0.9;

Factor for providing efficient means of controlling plant capacity = 0.93;

Column product (**FR**) = **0.75**. (0.9 x 0.9 x 0.93)

The CPI calculation is then:

$$\text{CPI}_{(\text{ACMV})} = \frac{1200}{(0.0117 \times 3700 \times 0.113 \times 0.84) + (0.05 \times 1000 \times 0.113 \times 0.75)}$$

$$= \mathbf{144}$$

The proposal achieves a calculated index of 144, which is better than the target CPI of 100 and can therefore be considered as following the Section 6 guidance.

[The index of 144 indicates that, under similar patterns of occupancy and use, the system proposed would be likely to cause about 20% less carbon emission than would be caused by the use of air conditioning in the typical air conditioned *building* defined in ECON 19].

Annex
6.M Conservatories

This Annex does not apply to non-domestic buildings

Annex
6.N Conversions

- 6.N.0 Introduction
- 6.N.1 Conversion of unheated buildings
- 6.N.2 Conversion of heated buildings
- 6.N.3 Conversion of historic buildings

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. It is inevitable that heating such *buildings* will adversely affect energy efficiency and because of this, the most demanding 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 and it will be heated after conversion, it is appropriate to treat the *building* as a new non-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/m² of 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 and the *building* is still to be heated, 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 the percentage values in Table 2 to clause 6.2.1; 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 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 Annex 6.H 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 a system with a high carbon intensity is unavoidable (see clause 6.3.2), 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, review the carbon intensity of the heating system and install an efficient condensing boiler or even consider CHP if the *building* is large enough and provided there is sufficient demand for heat. Plant that uses biomass may be particularly appropriate for a historic *building* in a rural location.

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 facade and in these cases, 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 (without sleeping accommodation)

6.P.0 Introduction

6.P.1 Table of recommended U-values

annex
6.P

**Elemental U-values for limited life buildings
(without sleeping accommodation)
(Class Relaxation Direction 141)**

6.P.0 Introduction

The table in this Annex is referred to in “General guidance for non-domestic *buildings*” (clause 6.0.2b). It is considered appropriate for use in the design of non-domestic *limited life buildings* (which do not contain sleeping accommodation) instead of Table 1 to clause 6.2.1. This is because these *buildings* only have a short “on-site” lifespan, which is currently set at five years. It is also possible for the table below to be used for the design of a notional *building*, which is used for comparison purposes in both the Heat loss Method and the Carbon Emissions Calculation Method.

Limited life buildings that contain sleeping accommodation (e.g. *hospital wards* and *hostels*) should use the Table 1 to clause 6.2.1. There are two principle reasons for this:

- the residential nature of such *buildings*;
- to promote an ongoing improvement in the stock of portable *buildings* (where these are used for limited life purposes).

6.P.1 Maximum *U-values* of *building* elements when using the Elemental Method for non-domestic *limited life buildings* (without sleeping accommodation) (CRD 141)

<i>Building element</i>	Maximum <i>U-value</i> (W/m²K)
Pitched roof - with insulation between rafters [Note 4]	0.45
Pitched roof - with insulation between joists [Note 4]	0.25
Pitched roof – with integral insulation [Note 4]	0.45
<i>Flat roof</i> [Note 4]	0.45
<i>External wall</i> [Note 2]	0.45
Floor	0.45
Semi-exposed walls [Notes1 and 2] and floors [Note 1]	0.6
Windows, personnel doors and rooflights (area weighted average for the whole <i>building</i>) [Note 3]	3.3
Vehicle access and similar large doors [Note 5]	0.7

Notes:

1. Semi-exposed in this table means an element between a *building* to which Section 6 applies and a *building* or part of a *building* to which it does not apply.
2. Solid area of element only (i.e. excluding windows and doors).
3. For methods of calculation, see Annex 6.A and Annex 6.E
4. Solid area of element only (i.e. excluding rooflights).
5. No maximum *U-value* necessary where for operational reasons, doors have to be left open when *building* is in use.
6. *U-values* for elements containing repeating thermal bridges should be calculated in accordance with CIBSE Design Guide A: 1980, Section A3.