Main Changes in the 2004 Edition

This edition of Approved Document A, Structure, replaces the 1992 Edition (with 1994 and 2000 amendments edition). The main changes are:

Use of Guidance

a. **Eurocodes**: an announcement is given regarding the forthcoming introduction of the Structural Eurocodes and their National Annexes.

b. **House construction**: reference is made to the intended publication of guidance by industry of alternative forms of house construction to that of traditional masonry.

A1 and A2

Traditional dwellings

c. The guidance on the sizing of timber floors and roofs for traditional house construction has been removed as the Timber Tables are now published by TRADA. However, the TRADA Tables are referenced under Section 2B.

d. A revised map of basic wind speeds in accordance with BS6399:Part 2 replaces the superseded map which was based on BS CP3 Chapter V.

e. Stainless steel cavity wall ties have been specified to all houses regardless of their location.

f. The guidance on masonry walls to dwellings has been extended to enable the rules to be applicable when using either the appropriate British Standards or the emerging BS EN CEN Standards.

g. The guidance on concrete foundations to houses has been revised to align with the recommendations given in the British Standards and other authoritative guidance. Recommendations on minimum foundation depths have also been included to counter the impact of predicted climate changes.

h. The guidance on the design and construction of domestic garages has been extensively updated to reflect modern practice.

A3

i. Disproportionate collapse: the Application Limit to the Requirement (ie. the 5 storey limit) has been removed so as to bring all buildings under control of the A3 Requirement.

The modified guidance has been developed from commissioned research and consideration of the recommendations given in the forthcoming Eurocode N1991-1-7 on Accidental Actions.

This printing incorporates corrections to text and diagrams made since 2003.

Main changes made by the 2010 amendments

This 2004 edition incorporating the 2010 amendments reflects the changes made as a result of the Building Regulations 2010 and Building (Approved Inspectors etc) Regulations 2010. The changes mainly reflect regulation number changes as a result of re-ordering. There have been no amendments to the substantive requirements in Schedule 1 (i.e. Parts A to P) of the Building Regulations.

Please note the simplification of the definition of ‘room for residential purposes’ in regulation 2 of the Building Regulations 2010. Please also note that L1(c) has now become regulation 40.
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Use of guidance

The approved documents
This document is one of a series that has been approved by the First Secretary of State for the purpose of providing practical guidance with respect to the requirements of Schedule 1 to and Regulation 7 of the Building Regulations 2010 (SI 2010/2214) for England and Wales.

At the back of this document is a list of all the documents that have been approved and issued by the Secretary of State for this purpose.

Approved Documents are intended to provide guidance for some of the more common building situations. However, there may well be alternative ways of achieving compliance with the requirements. Thus there is no obligation to adopt any particular solution contained in an Approved Document if you prefer to meet the relevant requirement in some other way.

Other requirements
The guidance contained in an Approved Document relates only to the particular requirements of the Regulations which that document addresses. The building work will also have to comply with the requirements of any other relevant paragraphs in Schedule 1 to the Regulations. There are Approved Documents which give guidance on each of the parts of Schedule 1 and on Regulation 7.

Limitation on requirements
In accordance with regulation 8, the requirements in Parts A to K and N of Schedule 1 to the Building Regulations do not require anything to be done except for the purpose of securing reasonable standards of health and safety for persons in or about the buildings.

Materials and workmanship
Any building work which is subject to the requirements imposed by Schedule 1 to the Building Regulations shall be carried out in accordance with regulation 7. Guidance on meeting these requirements on materials and workmanship is contained in Approved Document 7.

Building Regulations are made for specific purposes, primarily the health and safety, welfare and convenience of people and for energy conservation. Standards and other technical specifications may provide relevant guidance to the extent that they relate to these considerations. However, they may also address other aspects of performance or matters which, although they relate to health and safety etc., are not covered by the Building Regulations.

When an Approved Document makes reference to a named standard, the relevant version of the standard to which it refers is the one listed at the end of the publication. However, if this version has been revised or updated by the issuing standards body, the new version may be used as a source of guidance provided it continues to address the relevant requirements of the Regulations.

The workplace (health, safety and welfare) regulations 1992

The Workplace (Health, Safety and Welfare) Regulations 1992 apply to the common parts of flats and similar buildings if people such as cleaners and caretakers are employed to work in these common parts. Where the requirements of the Building Regulations that are covered by this Part do not apply to dwellings, the provisions may still be required in the situations described above in order to satisfy the Workplace Regulations.

Other forms of house construction

This Approved Document includes guidance on structural elements of residential buildings of traditional masonry construction. It is recognised, however, that there are other suitable forms of construction in use in the housing sector some of which (e.g. timber framed) have been in common use for a number of years and have demonstrated an adequate performance in compliance with the A1 requirement. Such alternative forms include prefabricated timber, light steel and precast concrete framed construction.

A number of guidance documents relating to these alternative forms are presently being developed by industry. The intention is to reference these in this Approved Document as soon as they become available and are approved by the Secretary of State.

Eurocodes

The British Standards Institution will shortly be publishing a series of Structural Eurocodes, together with their National Annexes. These Eurocodes are CEN Standards comprising many Parts which, when used in conjunction with their National Annexes and when approved by the Secretary of State, are intended to be referenced in this Approved Document as practical guidance on meeting the Part A Requirements.
Loading and ground movement:
The Requirements A1/2

This Approved Document deals with the following Requirements which are contained in the Building Regulations 2010.

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<tr>
<td><strong>A1.</strong> (1)</td>
<td>The building shall be constructed so that the combined dead, imposed and wind loads are sustained and transmitted by it to the ground:</td>
</tr>
<tr>
<td></td>
<td>(a) safely; and</td>
</tr>
<tr>
<td></td>
<td>(b) without causing such deflection or deformation of any part of the building, or such movement of the ground, as will impair the stability of any part of another building.</td>
</tr>
<tr>
<td>(2) In assessing whether a building complies with sub paragraph (1) regard shall be had to the imposed and wind loads to which it is likely to be subjected in the ordinary course of its use for the purpose for which it is intended.</td>
<td></td>
</tr>
<tr>
<td><strong>Ground movement</strong></td>
<td></td>
</tr>
<tr>
<td><strong>A2.</strong> The building shall be constructed so that ground movement caused by:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(a) swelling, shrinkage or freezing of the subsoil; or</td>
</tr>
<tr>
<td></td>
<td>(b) land-slip or subsidence (other than subsidence arising from shrinkage, in so far as the risk can be reasonably foreseen), will not impair the stability of any part of the building.</td>
</tr>
</tbody>
</table>
Introduction

0.1 In the Secretary of State’s view the requirements of A1 and A2 will be met by following the recommendations given in the documents listed in Section 1 or by adopting the guidance in Sections 2-4:

(a) Section 1 is relevant to all building types and lists Codes, Standards and other references for structural design and construction but, where they do not give precise guidance, consideration should be given to paragraph 0.2.

(b) Section 2 give sizes of structural elements for certain residential buildings and other small buildings of traditional construction.

(c) Section 3 gives guidance on the support and fixing of wall cladding.

(d) Section 4 gives guidance where roofs are to be re-covered as a material alteration as defined in the Regulations.

0.2 The safety of a structure depends on the successful combination of design and completed construction, particularly:

(a) The design should be based on identification of the hazards to which the structure is likely to be subjected and assessment of the risks. The selection of relevant critical situations for design should be made reflecting the conditions that can reasonably be foreseen during future use.

(b) Loading. Dead load, imposed load and wind load should be in accordance with the current Codes of Practice referred to in Section 1 of this document.

(c) Properties of materials.

(d) Detailed design and assembly of the structure.

(e) Safety factors.

(f) Workmanship.

The numeric values of safety factors, whether expressed explicitly or implicitly in design equations, or design values, should be derived from considerations of the above aspects of design and construction as a whole. A change in any one of these aspects may disturb the safety of the structure.

Loads used in calculations should allow for possible dynamic, concentrated and peak load effects that may occur.

0.3 Grandstands and structures erected in places of public assembly may need to sustain the synchronous or rhythmic movement of numbers of people. It is important to ensure that the design of the structure takes these factors into account so as to avoid the structure being impaired or causing alarm to people using the structure.

Interim guidance on the design of grandstands may be found in ‘Dynamic performance requirements for permanent grandstands subject to crowd action, Interim Guidance on assessment and design’ published by the Institution of Structural Engineers, November 2001.

Supplementary advice on the dynamic testing of grandstands and seating decking has been published in an Advisory Note by the Institution of Structural Engineers, June 2002.
Section 1: Codes, standards and references for all building types

Introduction
1.1 This section is relevant to all building types and lists codes, standards and other references for structural design and construction.

References
1.2

Loading:
(a) Dead and imposed loads
(b) Wind loads
(c) Imposed roof loads

1.3

Structural work of timber:

1.4

Structural work of masonry:
1.5 **Structural work of reinforced, pre-stressed or plain concrete:**

1.6 **Structural work of steel:**
BRE Digest 437 Industrial platform floors: mezzanine and raised storage.

1.7 **Structural work of aluminium:**

1.8 **Foundations:**

**Ground movement (Requirement A2b)**
1.9 There may be known or recorded conditions of ground instability, such as that arising from landslides, disused mines or unstable strata which, if ignored, can have a devastating effect on the safety of a building and its environs. Such conditions should be taken into account in the design of the building and its foundations. Attention is drawn to DOE Planning Policy Guidance Note 14 Development on unstable land (obtainable from The Stationery Office), which sets out the broad planning and technical issues relating to development on unstable land.
The Department has also sponsored a series of reviews aimed at determining the scale and nature of problems arising from mining instability, natural underground cavities and adverse foundation conditions. Databases of both subsidence incidents and subsidence potential produced from these reviews are available from the following licence holders:

British Geological Survey, Sir Kingsley Dunham Centre, Keyworth, Nottingham NG12 5GG.
Landmark, 7 Abbey Court, Eagle Way, Exeter, Devon EX2 7HY.
Peter Brett Associates, 16 Westcote Road, Reading, Berkshire RG20 2DE.
Catalytic Data Ltd, The Spinney, 19 Woodlands Road, Bickley, Kent BR1 2AD.

The reports from these reviews, which include 1:250,000 scale maps showing the distribution of the physical constraints, are available from the following organisations:

Obtainable from Arup Geotechnics, Bede House, All Saints, Newcastle-upon-Tyne NE1 2EB.
Obtainable from Kennedy & Donkin Ltd, 14 Calthorpe Road, Edgbaston, Birmingham B15 1TH.
Obtainable from ESNR International Ltd, 16 Frogmore Road, Hemel Hempstead, Hertfordshire HP3 9RW.

**Existing buildings**

1.10 Compliance with Part A (Structure) is required in certain classes of change of use of a building, subject to the control of Regulations 5 and 6. Guidance relevant to structural appraisals related to ‘change of use’ is given in the following documents:

(a) BRE Digest 366: Structural Appraisal of Existing Buildings for Change of Use.

(b) The Institution of Structural Engineers Report Appraisal of Existing Structures, 1996.

**Note:** With reference to the item ‘design checks’ in the above mentioned Institution of Structural Engineers report the choice of various partial factors should be made to suit the individual circumstances of each case.
Section 2: Sizes of structural elements for certain residential buildings and other small buildings of traditional construction

General

2.1 This section is presented as follows:

Section 2A
Basic requirements for stability.

Section 2B
Sizes of certain timber members in floors and roofs for dwellings.

Areas at risk from house longhorn beetle.

Section 2C
Thickness of masonry walls in certain residential buildings of not more than three storeys, small single-storey non-residential buildings and annexes.

Section 2D
Proportions for masonry chimneys.

Section 2E
Foundations of plain concrete.

2.2 Section 2A gives general rules which must be observed in following Sections 2B and 2C. Sections 2B to 2E may be used independently of each other. Throughout this section the diagrams are only illustrative and do not show all the details of construction.

Definitions

2.3 The following meanings apply to terms throughout this section:

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

Cavity width The horizontal distance between the two leaves of a cavity wall.

Compartment wall A wall constructed as a compartment wall to meet the requirements of regulation B3(2).

Dead load The load due to the weight of all walls, permanent partitions, floors, roofs and finishes including services, and all other permanent construction.

Imposed load The load assumed to be produced by the intended occupancy or use, including the weight of movable partitions, distributed, concentrated, impact, inertia and snow loads, but excluding wind loads.

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

Separating wall A wall or part of a wall which is common to adjoining buildings, and constructed to meet the requirements of regulation B3(2).
Spacing  The distance between the longitudinal centres of any two adjacent timber members of the same type, measured in the plane of floor, ceiling or roof structure.

Span  The distance measured along the centre line of a member between the centres of any two adjacent bearings or supports.

Supported wall  A wall to which lateral support is afforded by a combination of buttressing walls, piers or chimneys acting in conjunction with floor(s) or roof.

Wind load  The load due to the effect of wind pressure or suction.
Section 2A: Basic requirements for stability

2A1 This section must be used in conjunction with sections 2B and 2C and its principles relate to all forms of low-rise residential buildings.

2A2 Adequate provision shall be made to ensure that the building is stable under the likely imposed and wind loading conditions. This will commonly necessitate meeting the following requirements:

(a) That the overall size and proportioning of the building are limited in accordance with the specific guidance for each form of construction.

(b) That a suitable layout of walls (both internal and external) forming a robust 3 dimensional box structure in plan is constructed with restriction on the maximum size of cells measured in accordance with the specific guidance for each form of construction.

(c) That the internal and external walls are adequately connected either by masonry bonding or by using mechanical connections.

(d) That the intermediate floors and roof are of such construction and interconnection with the walls that they provide local support to the walls and also act as horizontal diaphragms capable of transferring the wind forces to buttressing elements of the building.

Note: A traditional cut timber roof (i.e. using rafters, purlins and ceiling joists) generally has sufficient built in resistance to instability and wind forces (e.g. from hipped ends, tiling battens, rigid sarking or the like). However, the need for diagonal rafter bracing equivalent to that recommended in BS 5268-3:1998 or Annex H of BS 8103-3:1996 for trussed rafter roofs should be considered especially for single-hipped and non-hipped roofs of greater than 40° pitch to detached houses.
Section 2B: Sizes of certain timber members in floors and roofs for dwellings. Areas at risk from house longhorn beetle

Sizing of members


House longhorn beetle

2B2 In the geographical areas specified in Table 1, softwood timber for roof construction or fixed in the roof space, including ceiling joists within the void spaces of the roof, should be adequately treated to prevent infestation by the house longhorn beetle (Hylotrupes bajulus L.). Guidance on suitable preservative treatments is given within the British Wood Preserving and Damp-Proofing Association’s Manual (2000 revision), available from 1 Gleneagles House, Vernongate, South Street, Derby DE1 1UP.

Table 1 Areas at risk from house longhorn beetle

<table>
<thead>
<tr>
<th>Geographical area</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the Borough of Bracknell Forest the parishes of Sandhurst and Crowthorne.</td>
</tr>
<tr>
<td>The Borough of Elmbridge</td>
</tr>
<tr>
<td>In the District of Hart, the parishes of Hawley and Yateley</td>
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<tr>
<td>The District of Runnymede</td>
</tr>
<tr>
<td>The Borough of Spelthorne</td>
</tr>
<tr>
<td>The Borough of Surrey Heath</td>
</tr>
<tr>
<td>In the Borough of Rushmoor, the area of the former district of Farnborough</td>
</tr>
<tr>
<td>The Borough of Woking</td>
</tr>
</tbody>
</table>
Section 2C: Thickness of walls in certain small buildings

Application
2C1 This section applies to the following building types:
(a) residential buildings of not more than three storeys;
(b) small single-storey non-residential buildings;
(c) small buildings forming annexes to residential buildings (including garages and outbuildings).

Wall types
2C2 Only the types of wall given in Table 2, which must extend to the full storey height, and parapet walls are considered in this section.

The use of this section
2C3 When using this section it should be noted that:
(a) this section must be used in conjunction with Section 2A;
(b) if wall thickness is to be determined according to paragraphs 2C5 to 2C13, all appropriate design conditions given in this section must be satisfied;
(c) walls should comply with the relevant requirements of BS 5628: Part 3: 2001, except as regards the conditions given in paragraphs 2C4 and 2C14 to 2C38;
(d) in formulating the guidance of this section the worst combination of circumstances likely to arise was taken into account. If a requirement of this part is considered too onerous in a particular case it may be appropriate to consider a minor departure on the basis of judgement and experience, or to show adequacy by calculation in respect of the aspect of the wall which is subject to the departure rather than for the entire wall;
(e) the guidance given is based upon the compressive strengths of bricks and blocks being not less than indicated in Tables 6 and 7.

BS 5628-1:1992 gives design strengths for walls where the suitability for use of masonry units of other compressive strengths is being considered.

Table 2 Wall types considered in this section

<table>
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<th>Residential buildings of up to three storeys</th>
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<td>External walls</td>
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<td>Internal load-bearing walls</td>
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<tr>
<td>Compartment walls</td>
</tr>
<tr>
<td>Separating walls</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Small single-storey non-residential buildings and annexes</th>
</tr>
</thead>
<tbody>
<tr>
<td>External walls</td>
</tr>
<tr>
<td>Internal load-bearing walls</td>
</tr>
</tbody>
</table>
Conditions relating to the building of which the wall forms part

2C4 This Section applies only to buildings having proportions within the following parameters (see Diagrams 1 and 2):

(a) **residential buildings of not more than three storeys:**

(i) the maximum height of the building measured from the lowest finished ground level adjoining the building to the highest point of any wall or roof should not be greater than 15m, subject to the limits of paragraph 2C16;

(ii) the height of the building H should not exceed twice the least width of the building W1;

(iii) the height of the wing H2 should not exceed twice the least width of the wing W2 where the projection P exceeds twice the width W2;

(b) **small single-storey non-residential buildings:** height H should not exceed 3m and W (being the greatest length or width of the building) should not exceed 9m (see Diagram 2), subject to the limits of paragraph 2C16;

(c) **annexes:** height H as variously indicated in Diagram 2 should not exceed 3m, subject to the limits of paragraph 2C16.

Diagram 1 **Size and proportion of residential buildings of not more than three storeys**
Thickness of walls

2C5 General wall thickness may be determined according to this section provided:
(a) conditions relating to the building of which the wall forms part
   (see paragraphs 2C4, 2C14 to 2C16, 2C38); and
(b) conditions relating to the wall (see paragraphs 2C17 to 2C37) are met.
(See Diagram 3.)

2C6 Solid external walls, compartment walls and separating walls in coursed
brickwork or blockwork: Solid walls constructed of coursed brickwork or
blockwork should be at least as thick as 1/16 of the storey height. Further
requirements are given in Table 3.

2C7 Solid external walls, compartment walls and separating walls in
uncoursed stone, flints, etc.: The thickness of walls constructed in
uncoursed stone, flints, clunches, bricks or other burnt or vitrified material
should not be less than 1.33 times the thickness determined by paragraph 2C6.

2C8 Cavity walls in coursed brickwork or blockwork: All cavity walls should
have leaves at least 90mm thick and cavities at least 50mm wide. The wall
ties should have a horizontal spacing of 900mm and a vertical spacing of
450mm, which is equivalent to 2.5 ties per square metre. Wall ties should also
be provided, spaced not more than 300mm apart vertically, within a distance
of 225mm from the vertical edges of all openings, movement joints and roof
verges. For selection of wall ties for use in a range of cavity widths refer to
Table 5. For specification of cavity wall ties refer to paragraph 2C19.

For external walls, compartment walls and separating walls in cavity
construction, the combined thickness of the two leaves plus 10mm should not
be less than the thickness determined by paragraph 2C6 and Table 3 for a
solid wall of the same height and length.

2C9 Walls providing vertical support to other walls: Irrespective of the material
used in the construction, a wall should not be less in thickness than any part of
the wall to which it gives vertical support.

2C10 Internal load-bearing walls in brickwork or blockwork (except
compartment walls or separating walls): All internal load-bearing walls should
have a thickness not less than:

\[
\frac{2}{\text{(specified thickness from Table 3)}} - 5\text{mm}
\]

except for a wall in the lowest storey of a three storey building, carrying load
from both upper storeys, which should have a thickness as determined by the
equation or 140mm whichever is the greatest.
Diagram 2 Size and proportion of non-residential buildings and annexes

See para 2C4b and 2C4c

a. Non-residential buildings

- Flat roof buildings
- Pitched roof buildings

b. Annexes

- Flat roof annexes
- Pitched roof annexes (type 1)
- Pitched roof annexes (type 2)

Note
Height H should be measured from top of the foundation or from the underside of the floor slab where this provides effective lateral restraint.
Table 3 Minimum thickness of certain external walls, compartment walls and separating walls

<table>
<thead>
<tr>
<th>Height of wall</th>
<th>Length of wall</th>
<th>Minimum thickness of wall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not exceeding 3.5m</td>
<td>Not exceeding 12m</td>
<td>190mm for whole of its height</td>
</tr>
<tr>
<td>Exceeding 3.5m but not exceeding 9m</td>
<td>Not exceeding 9m</td>
<td>190mm for whole of its height</td>
</tr>
<tr>
<td></td>
<td>Exceeding 9m but not exceeding 12m</td>
<td>290mm from the base for the height of one storey and 190mm for the rest of its height</td>
</tr>
<tr>
<td>Exceeding 9m but not exceeding 12m</td>
<td>Not exceeding 9m</td>
<td>290mm from the base for the height of one storey and 190mm for the rest of its height</td>
</tr>
<tr>
<td></td>
<td>Exceeding 9m but not exceeding 12m</td>
<td>290mm from the base for the height of two storeys and 190mm for the rest of its height</td>
</tr>
</tbody>
</table>
2C11 **Parapet walls:** The minimum thickness and maximum height of parapet walls should be as given in Diagram 4.

2C12 **Single leaves of certain external walls:** The single leaf of external walls of small singlestorey non-residential buildings and of annexes need be only 90mm thick, notwithstanding paragraphs 2C38.

2C13 **Modular bricks and blocks:** Where walls are constructed of bricks or blocks having modular dimensions derived from BS 6649:1985, wall thicknesses prescribed in this section which derive from a dimension of brick or block may be reduced by an amount not exceeding the deviation from work size permitted by a British Standard relating to equivalent sized bricks or blocks made of the same material.

2C14 **Maximum floor area:** The guidance of this section assumes that no floor enclosed by structural walls on all sides exceeds 70m², and that no floor without a structural wall on one side exceeds 36m². (See Diagram 5.)

2C15 **Imposed loads on roofs, floors and ceilings:** The design considerations given in this section are intended to be adequate for the imposed loads given in Table 4.

2C16 **Maximum height of buildings:** The design guidance in this section is based on BS 6399-2:1997. The maximum heights of buildings given in Table c of Diagram 7 correlate to various site exposure conditions and wind speeds. A map showing wind speeds is given in Figure 1 of Diagram 6.

---

**Diagram 4 Parapet walls: height**

<table>
<thead>
<tr>
<th>Wall type</th>
<th>Thickness (mm)</th>
<th>Parapet height $H_p$ to be not more than (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type A cavity wall</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level of junction of wall and structural roof</td>
<td>$t_1 + t_2$ equal or less than 200</td>
<td>600</td>
</tr>
<tr>
<td>$t_1 + t_2$ greater than 200 equal or less than 250</td>
<td>860</td>
<td></td>
</tr>
<tr>
<td><strong>Type B solid wall</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level of junction of wall and structural roof</td>
<td>$t$ equal or less than 150</td>
<td>600</td>
</tr>
<tr>
<td>$t = 190$</td>
<td>760</td>
<td></td>
</tr>
<tr>
<td>$t = 215$</td>
<td>860</td>
<td></td>
</tr>
</tbody>
</table>

Note: $t$ should be less than or equal to $T$
Conditions relating to the wall

2C17 Maximum allowable length and height of the wall: This section does not deal with walls longer than 12m, measured from centre to centre of buttressing walls, piers or chimneys providing restraint, or with walls exceeding 12m in height (see also Table 3).

2C18 Rules of measurement for heights of walls and storeys: The height of a wall or a storey should be measured in accordance with the rules in Diagram 8.

Diagram 5 Maximum floor area enclosed by structural walls
Table 4 Imposed loads

<table>
<thead>
<tr>
<th>Element</th>
<th>Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof</td>
<td>Distributed loads</td>
</tr>
<tr>
<td></td>
<td>1.00kN/m² for spans not exceeding 12m</td>
</tr>
<tr>
<td></td>
<td>1.5kN/m² for spans not exceeding 6m</td>
</tr>
<tr>
<td>Floors</td>
<td>Distributed load: 2.00kN/m²</td>
</tr>
<tr>
<td>Ceilings</td>
<td>Distributed load: 0.25kN/m² together with concentrated load: 0.9kN</td>
</tr>
</tbody>
</table>

**Construction materials and workmanship**

2C19 **Wall ties:** Wall ties should either comply with BS 1243, DD 140, or BS EN 845-1 and should be material references 1 or 3 in BS EN 845 Table A 1 austenitic stainless steel. Wall ties should be selected in accordance with Table 5 of this Approved Document.

2C20 **Masonry units:** Walls should be properly bonded and solidly put together with mortar and constructed of masonry units conforming to:

- (a) clay bricks or blocks to BS 3921:1985 or BS 6649:1985 or BS EN 771-1;
- (b) calcium silicate bricks to BS 187:1978 or BS 6649:1985 or BS EN 771-2;
- (c) concrete bricks or blocks to BS 6073-1:1981 or BS EN 771-3 or -4;
- (d) square dressed natural stone to the appropriate requirements described in BS EN 771-6 or BS 5628-3:2001;
- (e) manufactured stone to BS 6457:1984 or BS EN 771-5.

2C21 **Compressive strength of masonry units:** Minimum compressive strength requirements for masonry units according to BS EN Standards are given in Diagram 9, where the masonry units indicated for Conditions A, B and C should have declared compressive strengths of not less than the values given in Table 6. Normalised compressive strengths for block sized clay and calcium silicate masonry units not complying with brick dimensional format are given in Table 7.
Diagram 6 Map showing wind speeds in m/s for maximum height of buildings

Figure 1 Map of wind speeds (V) in m/s

Figure 2 Topographic zones for Factor T

Lu – is slope on upwind side
Ld – is slope on downwind side
Diagram 7 Maximum height of buildings

Table a Factor T

<table>
<thead>
<tr>
<th>Topographic category and average slope of whole hillside, ridge, cliff or escarpment</th>
<th>Factor T</th>
<th>Zone 1</th>
<th>Zone 2</th>
<th>Zone 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category 1: Nominally flat terrain, average slope &lt; 1/20</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Category 2: Moderately steep terrain, average slope &lt; 1/5</td>
<td>1.24</td>
<td>1.13</td>
<td>1.10</td>
<td></td>
</tr>
<tr>
<td>Category 3: Steep terrain, average slope &gt; 1/5</td>
<td>1.36</td>
<td>1.20</td>
<td>1.15</td>
<td></td>
</tr>
</tbody>
</table>

Note: Outside these zones factor T = 1.0

Table b Factor A

<table>
<thead>
<tr>
<th>Site altitude (m)</th>
<th>Factor A</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.00</td>
</tr>
<tr>
<td>50</td>
<td>1.05</td>
</tr>
<tr>
<td>100</td>
<td>1.10</td>
</tr>
<tr>
<td>150</td>
<td>1.15</td>
</tr>
<tr>
<td>200</td>
<td>1.20</td>
</tr>
<tr>
<td>300</td>
<td>1.30</td>
</tr>
<tr>
<td>400</td>
<td>1.40</td>
</tr>
</tbody>
</table>

Table c Maximum allowable building height (m)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Country sites</th>
<th>Town sites*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Distance to the coast</td>
<td>Distance to the coast</td>
</tr>
<tr>
<td></td>
<td>&lt; 10km</td>
<td>10–50km</td>
</tr>
<tr>
<td>24</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>25</td>
<td>11.5</td>
<td>14.5</td>
</tr>
<tr>
<td>26</td>
<td>8</td>
<td>10.5</td>
</tr>
<tr>
<td>27</td>
<td>6</td>
<td>8.5</td>
</tr>
<tr>
<td>28</td>
<td>4.5</td>
<td>6.5</td>
</tr>
<tr>
<td>29</td>
<td>3.5</td>
<td>5</td>
</tr>
<tr>
<td>30</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>31</td>
<td>3.5</td>
<td>4</td>
</tr>
<tr>
<td>32</td>
<td>3</td>
<td>3.5</td>
</tr>
<tr>
<td>33</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>34</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>35</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>36</td>
<td>3</td>
<td>5.5</td>
</tr>
<tr>
<td>37</td>
<td>4.5</td>
<td>5.5</td>
</tr>
<tr>
<td>38</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>39</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>40</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* For sites on the outskirts of towns not sheltered by other buildings use the values for country sites
Diagram 8 **Measuring storey and wall heights**

See para 2C18

---

**Key**

(a) **Measuring storey heights**

A is the ground storey height if the ground floor provides effective lateral support to the wall, i.e. is adequately tied to the wall or is a suspended floor bearing on the wall.  

A1 is the ground storey height if the ground floor does not provide effective lateral support to the wall.  

Note: If the wall is supported adequately and permanently on both sides by suitable compact material, the base of the wall for the purposes of the storey height may be taken as the lower level of this support. (Not greater than 3.7m ground storey height.)  

B is the intermediate storey height.  

B1 is the top storey height for walls which do not include a gable.  

C is the top storey height where lateral support is given to the gable both at ceiling level and along the roof slope.  

D is the top storey height for the external walls which include a gable where lateral support is given to the gable only along the roof slope.

(b) **Measuring wall heights**

H1 is the height of an external wall that does not include a gable.  

H2 is the height of an internal or separating wall which is built up to the underside of the roof.  

H3 is the height of an external wall which includes a gable.  

H5 is the height of a parapet (see Diagram 4). If H5 is more than 1.2m add to H5 to H1.
Table 5: Cavity wall ties

<table>
<thead>
<tr>
<th>Nominal cavity width mm (Note 1)</th>
<th>Tie length mm (Note 2)</th>
<th>Tie shape in accordance with BS 1243*</th>
<th>Permissible type of tie</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 to 75</td>
<td>200</td>
<td>Butterfly, double triangle or vertical twist</td>
<td>Types 1, 2, 3 or 4 DD 140-2* and selected on the basis of the design loading and design cavity width.</td>
</tr>
<tr>
<td>76 to 90</td>
<td>225</td>
<td>Double triangle or vertical twist</td>
<td></td>
</tr>
<tr>
<td>91 to 100</td>
<td>225</td>
<td>Double triangle (Note 3) or vertical twist</td>
<td>*Although BS 1243 and DD 140-2 were due to be withdrawn on 1 February 2005, the tie user classes (types) given in Tables 1 and 3 of the latter document can continue to be used after this date.</td>
</tr>
<tr>
<td>101 to 125</td>
<td>250</td>
<td>Vertical twist</td>
<td></td>
</tr>
<tr>
<td>126 to 150</td>
<td>275</td>
<td>Vertical twist</td>
<td></td>
</tr>
<tr>
<td>151 to 175</td>
<td>300</td>
<td>Vertical twist</td>
<td></td>
</tr>
<tr>
<td>176 to 300</td>
<td>(See Note 2)</td>
<td>Vertical twist style</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. Where face insulated blocks are used the cavity width should be measured from the face of the masonry unit.
2. The embedment depth of the tie should not be less than 50mm in both leaves. For cavities wider than 180mm calculate the length as the structural cavity width plus 125mm and select the nearest stock length.
3. Double triangle ties of this shape having a strength to satisfy Type 2 of DD 140-2* are manufactured. Specialist tie manufacturers should be consulted if 225mm long double triangle format ties are needed for 91 to 100mm cavities.
4. Where BS EN 845-1 ties are used reference needs to be made additionally to DD 140-2* for the selection of the type (i.e. type 1, 2, 3 or 4) relevant to the performance levels given in DD 140-2.

Table 6: Declared compressive strength of masonry units complying with BS EN 771-1 to -5 (N/mm²)

<table>
<thead>
<tr>
<th>Masonry unit</th>
<th>Clay masonry units to BS EN 771-1</th>
<th>Calcium silicate masonry units to BS EN 771-2</th>
<th>Aggregate concrete masonry units to BS EN 771-3</th>
<th>Autoclaved aerated conc. masonry units to BS EN 771-4</th>
<th>Manufactured stone masonry units to BS EN 771-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition A (See Diagram 9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brick</td>
<td>Group 1 6.0</td>
<td>Group 2 9.0</td>
<td>6.0</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Block</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>2.9*</td>
<td>2.9</td>
<td></td>
</tr>
<tr>
<td>Condition B (See Diagram 9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brick</td>
<td>Group 1 9.0</td>
<td>Group 2 13.0</td>
<td>9.0</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Block</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>7.3*</td>
<td>7.3</td>
<td></td>
</tr>
<tr>
<td>Condition C (See Diagram 9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brick</td>
<td>Group 1 18.0</td>
<td>Group 2 25.0</td>
<td>18.0</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Block</td>
<td>See Table 7</td>
<td>See Table 7</td>
<td>7.3*</td>
<td>7.3</td>
<td></td>
</tr>
</tbody>
</table>

* These values are dry strengths to BS EN 772-1

Notes:
1. This table applies to Group 1 and Group 2 units.
2. For the EN 771 series of standards for masonry units the values of declared compressive strengths (N/mm²) given in Table 6 are mean values.
3. Brick: a masonry unit having work sizes not exceeding 337.5mm in length or 112.5mm in height.
4. Block: a masonry unit exceeding either of the limiting work sizes of a brick and with a minimum height of 190mm. For blocks with smaller heights, excluding cuts or make up units, the strength requirements are as for brick except for solid external walls where the blocks should have a compressive strength at least equal to that shown for block for an inner leaf of a cavity wall in the same position.
5. Group 1 masonry units have not more than 25% formed voids (20% for frogged bricks). Group 2 masonry units have formed voids greater than 25%, but not more than 55%.
Diagram 9 Declared compressive strength of masonry units

Notes
1. If $H_s$ is not greater than 2.7m, the compressive strength of bricks or blocks should be used in walls as indicated by the key.
2. If $H_s$ is greater than 2.7m, the compressive strength of bricks or blocks used in the wall should be at least Condition B, or as indicated by the key, whichever is the greater.
3. If the external wall is solid construction, the masonry units should have a compressive strength of at least that shown for the internal leaf of a cavity wall in the same position.
4. The guidance given in the diagram for walls of two and three storey buildings should only be used to determine the compressive strength of the masonry units where the roof construction is of timber.
Table 7 Normalised compressive strength of masonry units of clay and calcium silicate blocks complying with BS EN 771-1 and 2 (N/mm²)

<table>
<thead>
<tr>
<th>Standard</th>
<th>Condition (See Diagram 9)</th>
<th>Group 1 masonry units</th>
<th>Group 2 masonry units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay masonry units to BS EN 771-1</td>
<td>A</td>
<td>5.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Calcium silicate masonry units to BS EN 771-2</td>
<td>B</td>
<td>7.5</td>
<td>11.0</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>15.0</td>
<td>21.0</td>
</tr>
</tbody>
</table>

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

2C22 Mortar: Mortar should be:

(a) Mortar designation (iii) according to BS BS 5628-3:2001.
(b) Strength class M4 according to BS EN 998-2.
(c) 1:1:5 or 6 CEM 1, lime and fine aggregate measured by volume of dry materials, or
(d) of equivalent or greater strength and durability to the specification in a. above.

Loading on walls
2C23 Maximum span of floors: The maximum span for any floor supported by a wall is 6m where the span is measured centre to centre of bearing (see Diagram 10).

2C24 Other loading conditions:

(a) Vertical loading on walls should be distributed. This may be assumed for concrete floor slabs, precast concrete floors, and timber floors designed in accordance with section 2B, and where the bearing length for lintels is 150mm or greater. Where a lintel has a clear span of 1200mm or less the bearing length may be reduced to 100mm.
(b) Differences in level of ground or other solid construction between one side of the wall and the other should be less than 4 times the thickness of the wall as shown in Diagram 11.
(c) The combined dead and imposed load should not exceed 70kN/m at base of wall (see Diagram 11).
(d) Walls should not be subjected to lateral load other than from wind, and that covered by paragraph 2C24(b).
2C25 **Vertical Lateral Restraint to Walls**

The ends of every wall should be bonded or otherwise securely tied throughout their full height to a buttressing wall, pier or chimney. Long walls may be provided with intermediate buttressing walls, piers or chimneys dividing the wall into distinct lengths within each storey; each distinct length is a supported wall for the purposes of this section. The intermediate buttressing walls, piers or chimneys should provide lateral restraint to the full height of the supported wall, but they may be staggered at each storey.

2C26 **Buttressing Walls**

If the buttressing wall is not itself a supported wall its thickness T2 should not be less than:

(a) half the thickness required by this section for an external or separating wall of similar height and length less 5mm; or

(b) 75mm if the wall forms part of a dwelling house and does not exceed 6m in total height and 10m in length; and

(c) 90mm in other cases.

The length of the buttressing wall should be at least 1/6 of the overall height of the supported wall and be bonded or securely tied to the supporting wall and at the other end to a buttressing wall, pier or chimney.

The size of any opening in the buttressing wall should be restricted as shown in Diagram 12.

2C27 **Design criteria for piers and chimneys providing restraint:**

(a) piers should measure at least 3 times the thickness of the supported wall and chimneys twice the thickness, measured at right angles to the wall. Piers should have a minimum width of 190mm (see Diagram 13);

(b) the sectional area on plan of chimneys (excluding openings for fireplaces and flues) should be not less than the area required for a pier in the same wall, and the overall thickness should not be less than twice the required thickness of the supported wall (see Diagram 13).
## Diagram 11 Differences in ground levels

**a. Situations where differences in level may occur**

- **i)** Ground supported floor slab
- **ii)** Suspended ground floor
- **iii)** Combined dead and imposed load $W$ should not exceed 70kN/m at base of wall

For value of $H$ see (b) below

**b. Maximum differences in permitted level**

- **i)**
- **ii)** Clear wall cavity (unfilled)
- **iii)**

$H$ should be less than or equal to $1m$ and less than or equal to $4t$

Notes

1. Floor slabs in figure b have been omitted for clarity and may be on either side of the walls shown.
2. Cavity walls should be tied in accordance with Table 5.
3. These recommendations apply only to circumstances where there is a full storey height of masonry above the upper retained level.
Openings, recesses, overhangs and chases

2C28 General:

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

2C29 Dimensional criteria for openings and recesses:

The dimensional criteria are given in Diagram 14 and Table 8.

No openings should be provided in walls below ground floor except for small holes for services and ventilation, etc. which should be limited to a maximum area of 0.1m² at not less than 2m centres.

Notes

1 The buttressing wall should be bonded or securely tied to the supported wall and at the other end to a buttressing wall, pier or chimney.

2 Openings or recesses in the buttressing wall should be as shown – the position and shape of the openings should not impair the lateral support to be given by the buttressing wall.

3 Refer to Diagram 8 for the rules for measuring the height of the supported wall.
2C30 Chases:
(a) vertical chases should not be deeper than 1/3 of the wall thickness or, in cavity walls, 1/3 of the thickness of the leaf;
(b) horizontal chases should not be deeper than 1/6 of the thickness of the leaf of the wall;
(c) chases should not be so positioned as to impair the stability of the wall, particularly where hollow blocks are used.

2C31 Overhangs:
The amount of any projection should not impair the stability of the wall.

Diagram 13 Buttressing

Lateral support by roofs and floors
2C32 A wall in each storey of a building should extend to the full height of that storey, and have horizontal lateral supports to restrict movement of the wall at right angles to its plane.

2C33 Floors and roofs should:
(a) act to transfer lateral forces from walls to buttressing walls, piers or chimneys; and
(b) be secured to the supported wall by connections specified in paragraphs
The requirements for lateral restraint of walls at roof and floor levels are given in Table 9 and guidance on satisfying the requirements is given in paragraphs 2C35 and 2C36.

Walls should be strapped to floors above ground level, at intervals not exceeding 2m and as shown in Diagram 15 by tension straps conforming to BS EN 845-1. For corrosion resistance purposes, the tension straps should be material reference 14 or 16.1 or 16.2 (galvanised steel) or other more resistant specifications including material references 1 or 3 (austenitic stainless steel). The declared tensile strength of tension straps should not be less than 8kN.

Tension straps need not be provided:

(a) in the longitudinal direction of joists in houses of not more than 2 storeys, if the joists are at not more than 1.2m centres and have at least 90mm bearing on the supported walls or 75mm bearing on a timber wall-plate at each end, and

(b) in the longitudinal direction of joists in houses of not more than 2 storeys, if the joists are carried on the supported wall by joist hangers in accordance with BS EN 845-1 of the restraint type described in BS 5628-1 and shown in Diagram 15(c), and are incorporated at not more than 2m centres, and

(c) when a concrete floor has at least 90mm bearing on the supported wall (see Diagram 15(d)), and

(d) where floors are at or about the same level on each side of a supported wall, and contact between the floors and wall is either continuous or at intervals not exceeding 2m. Where contact is intermittent, the points of contact should be in line or nearly in line on plan (see Diagram 15(e)).
Table 8 Value of Factor ‘X’

(see Diagram 14)

<table>
<thead>
<tr>
<th>Nature of roof span</th>
<th>Maximum roof span (m)</th>
<th>Minimum thickness of wall inner (mm)</th>
<th>Span of floor parallel to wall max 4.5m</th>
<th>Span of timber floor into wall max 6.0m</th>
<th>Span of concrete floor into wall max 4.5m</th>
<th>Value of factor ‘X’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof spans parallel to wall</td>
<td>Not applicable</td>
<td>100</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Timber roof spans into wall</td>
<td>9</td>
<td>100</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 9 Lateral support for walls

<table>
<thead>
<tr>
<th>Wall type</th>
<th>Wall length</th>
<th>Lateral support required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid or cavity: external compartment separating</td>
<td>Any length</td>
<td>Roof lateral support by every roof forming a junction with the supported wall</td>
</tr>
<tr>
<td></td>
<td>Greater than 3m</td>
<td>Floor lateral support by every floor forming a junction with the supported wall</td>
</tr>
<tr>
<td>Internal load-bearing wall (not being a compartment or separating wall)</td>
<td>Any length</td>
<td>Roof or floor lateral support at the top of each storey</td>
</tr>
</tbody>
</table>

2C36 Gable walls should be strapped to roofs as shown in Diagram 16(a) and (b) by tension straps as described in 2C35.

Vertical strapping at least 1m in length should be provided at eaves level at intervals not exceeding 2m as shown in Diagram 16(c) and (d). Vertical strapping may be omitted if the roof:

(a) has a pitch of 15° or more, and
(b) is tiled or slated, and
(c) is of a type known by local experience to be resistant to wind gusts, and
(d) has main timber members spanning onto the supported wall at not more than 1.2m centres.
Diagram 15 Lateral support by floors

**Interruption of lateral support**

**2C37** Where an opening in a floor or roof for a stairway or the like adjoins a supported wall and interrupts the continuity of lateral support, the following conditions should be satisfied for the purposes of Section 2C:

(a) the maximum permitted length of the opening is to be 3m, measured parallel to the supported wall, and

(b) where a connection is provided by means other than by anchor, this should be provided throughout the length of each portion of the wall situated on each side of the opening, and

(c) where a connection is provided by mild steel anchors, these should be spaced closer than 2m on each side of the opening to provide the same number of anchors as if there were no opening, and

(d) there should be no other interruption of lateral support.
Small single-storey non-residential buildings and annexes

2C38 Size and proportion

(i) General

The guidance given applies in the following circumstances:

(a) The floor area of the building or annexe does not exceed 36m².

(b) The walls are solidly constructed in brickwork or blockwork using materials which comply with paragraphs 2C19 to 2C22.

(c) Where the floor area of the building or annexe exceeds 10m² the walls have a mass of not less than 130kg/m².

Note: There is no surface mass limitation recommended for floor areas of 10m² or less.

(d) Access to the roof is only for the purposes of maintenance and repair.

(e) The only lateral loads are wind loads.

Diagram 16 Lateral support at roof level
(f) The maximum length or width of the building or annexe does not exceed 9m.
(g) The height of the building or annexe does not exceed the lower value derived from Diagram 2.
(h) The roof is braced at rafter level, horizontally at eaves level and at the base of any gable by roof decking, rigid sarking or diagonal timber bracing, as appropriate, in accordance with BS 5268-3.
(i) Walls are tied to the roof structure vertically and horizontally in accordance with paragraphs 2C32 to 2C36 and with horizontal lateral restraint at roof level in accordance with paragraph (iv) below.
(j) The roof structure of an annexe is secured to the structure of the main building at both rafter and eaves level.

Diagram 17 Size and location of openings

Notes
1 Major openings should be restricted to one wall only. Their aggregate width should not exceed 5.0m and their height should not be greater than 2.1m.
2 There should be no other openings within 2.0m of a wall containing a major opening.
3 The aggregate size of openings in a wall not containing a major opening should not exceed 2.4m².
4 There should not be more than one opening between piers.
5 Unless there is a corner pier the distance from a window or a door to a corner should not be less than 390mm.
(ii) Size and location of openings

One or two major openings not more than 2.1m in height are permitted in one wall of the building or annexe only. The width of a single opening or the combined width of two openings should not exceed 5m.

The only other openings permitted in a building or annexe are for windows and a single leaf door. The size and location of these openings should be in accordance with Diagram 17.

Diagram 18 Wall thickness

See para 2C38

a. Wall without a major opening

b. Wall with a single major opening

Orientation of piers with opening width G not greater than 2.5m

Orientation of piers with opening width G greater than 2.5m

c. Wall with two major openings

Notes

1 In all cases the minimum pier size ($A_p \times B_p$) should be 390mm x 190mm or 327mm x 215mm depending on the size of the masonry units.

2 Isolated column (Case c) to be 325mm x 325mm minimum ($C_c \times C_c$).
(iii) Wall thickness and recommendations for piers
The walls should have a minimum thickness of 90mm.
Walls which do not contain a major opening but exceed 2.5m in length or height should be bonded or tied to piers for their full height at not more than 3m centres as shown in Diagram 18a. Walls which contain one or two major openings should in addition have piers as shown in Diagrams 18b and 18c. Where ties are used to connect piers to walls they should be flat, 20mm x 3mm in cross section, be in stainless steel in accordance with clause 2C19, be placed in pairs and be spaced at not more than 300mm centre vertically.

(iv) Horizontal lateral restraint at roof level Walls
Should be tied horizontally at no more than 2m centres to the roof structure at eaves level, base of gables and along roof slopes as shown in Diagram 19 with straps fixed in accordance with paragraphs 2C35 and 2C36. Where straps cannot pass through a wall they should be adequately secured to the masonry using suitable fixings. Isolated columns should also be tied to the roof structure (see Diagram 19).

Diagram 19 Lateral restraint at roof level

See para 2C38

Key
| denotes fixings at eaves level.  
X | denotes fixings at base of gable.  
| denotes fixings along roof slope.  

Note: Fixings should be in accordance with Diagram 17.
Section 2D: Proportions for masonry chimneys above the roof surface

Height to width relationship

2D1 Where a chimney is not adequately supported by ties or securely restrained in any way, its height if measured from the highest point of intersection with the roof surface, gutter, etc. should not exceed 4.5W, provided the density of the masonry is greater than 1500kg/m³, where:

- W is the least horizontal dimension of the chimney measured at the same point of intersection, and
- H is measured to the top of any chimney pot or other flue terminal (see Diagram 20).

Diagram 20 Proportions for masonry chimneys
Section 2E: Foundations of plain concrete

Conditions relating to the ground
2E1 There should not be:
   (a) non-engineered fill (as described in BRE Digest 427) or wide variation in ground conditions within the loaded area; nor
   (b) weaker or more compressible ground at such a depth below the foundation as could impair the stability of the structure.

Design provisions
2E2 The following design provisions relate to foundations:
   (a) the foundations should be situated centrally under the wall;
   (b) for foundations in chemically aggressive soil conditions guidance in BS 8500-1 and BRE Special Digest 1 should be followed. In non-aggressive soils, concrete should be composed of Portland cement to BS EN 197-1 and -2 and fine and coarse aggregate conforming to BS EN 12620 and the mix should comply with one of the following recommendations:
      (i) in proportion of 50kg of Portland cement to not more than 200kg (0.1m3) of fine aggregate and 400kg (0.2m3) of coarse aggregate; or
      (ii) grade ST2 or grade GEN I concrete to BS 8500-2;
   (c) minimum thickness $T$ of concrete foundation should be 150mm or $P$, whichever is the greater where $P$ is derived using Table 10 and Diagram 23. Trench fill foundations may be used as an acceptable alternative to strip foundations;
   (d) foundations stepped on elevation should overlap by twice the height of the step, by the thickness of the foundation, or 300mm, whichever is greater (see Diagram 21). For trench fill foundations the overlap should be twice the height of the step or 1m, whichever is greater;
   (e) steps in foundations should not be of greater height than the thickness of the foundation (see Diagram 21);
   (f) foundations for piers, buttresses and chimneys should project as indicated in Diagram 22 and the projection $X$ should never be less than the value of $P$ where there is no local thickening of the wall.

Minimum width of strip foundations
2E3 The recommended minimum widths of foundations given in Table 10 may be used.
**Diagram 21** Elevation of stepped foundation

Foundations should unite at each change in level

Minimum overlap \( L = \) twice height of step, or thickness of foundation or 300mm, whichever is greater

\( S \) should not be greater than \( T \)

(For trench fill foundations, minimum overlap \( L = \) twice height of step, or 1m, whichever is greater)

**Diagram 22** Piers and chimneys

Projection \( X \) should not be less than \( P \)

**Diagram 23** Foundation dimensions

Wall should be central on foundation

The minimum thickness of the foundation \( (T) \) should either be \( P \) or 150mm, whichever is greater

Foundation width should be not less than the appropriate dimension in Table 10

Trench fill foundations may be used as an alternative to strip foundations.
### Table 10 Minimum width of strip footings

<table>
<thead>
<tr>
<th>Type of ground (including ground engineered fill)</th>
<th>Condition of ground</th>
<th>Field test applicable</th>
<th>Total load of load-bearing walling not more than (kN/linear metre)</th>
<th>Minimum width of strip foundations (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Rock</td>
<td>Not inferior to sandstone, limestone or firm chalk</td>
<td>Requires at least a pneumatic or other mechanically operatedpick for excavation</td>
<td>In each case equal to the width of wall</td>
<td></td>
</tr>
<tr>
<td>II Gravel or sand</td>
<td>Medium dense</td>
<td>Requires pick for excavation. Wooden peg 50mm square in cross section hard to drive beyond 150mm</td>
<td>250 300 400 500 600 650</td>
<td></td>
</tr>
<tr>
<td>III Clay Sandy clay</td>
<td>Stiff</td>
<td>Can be indented slightly by thumb</td>
<td>250 300 400 500 600 650</td>
<td></td>
</tr>
<tr>
<td>IV Clay Sandy clay</td>
<td>Firm</td>
<td>Thumb makes impression easily</td>
<td>300 350 450 600 750 850</td>
<td></td>
</tr>
<tr>
<td>V Sand Sandy clay</td>
<td>Loose</td>
<td>Can be excavated with a spade. Wooden peg 50mm square in cross section can be easily driven</td>
<td>400 600</td>
<td></td>
</tr>
<tr>
<td>VI Silt Clay or silt</td>
<td>Soft</td>
<td>Finger pushed in up to 10mm</td>
<td>450 650</td>
<td></td>
</tr>
<tr>
<td>VII Silt Clay or silt</td>
<td>Very soft</td>
<td>Finger easily pushed in up to 25mm</td>
<td>Refer to specialist advice</td>
<td></td>
</tr>
</tbody>
</table>

The table is applicable only within the strict terms of the criteria described within it.

### Minimum depth of strip foundations

2E4 Except where strip foundations are founded on rock, the strip foundations should have a minimum depth of 0.45m to their underside to avoid the action of frost. This depth, however, will commonly need to be increased in areas subject to long periods of frost or in order to transfer the loading onto satisfactory ground.

In clay soils subject to volume change on drying (‘shrinkable clays’, with Plasticity Index greater than or equal to 10%), strip foundations should be taken to a depth where anticipated ground movements will not impair the stability of any part of the building taking due consideration of the influence of vegetation and trees on the ground. The depth to the underside of foundations on clay soils should not be less than 0.75m, although this depth will commonly need to be increased in order to transfer the loading onto satisfactory ground.
Section 3: Wall cladding

General
3.1 Wall cladding presents a hazard if it becomes detached from the building. This section provides guidance on the support and fixing of wall cladding. An acceptable level of safety can be achieved by different means depending on the type and location of the cladding. The guidance given relates to all forms of cladding, including curtain walling and glass facades. It is not intended to provide guidance concerning the weather resistance of wall cladding which is included in Approved Document C, Site preparation and resistance to moisture, or guidance on resistance to spread of fire which is included in Approved Document B, Fire safety, or guidance in relation to sound insulation, which is included in Approved Document E, Resistance to the passage of sound.

Technical approach
3.2 The cladding will meet the safety requirement if:
   (a) the cladding is capable of safely sustaining and transmitting to the supporting structure of the building all dead, imposed and wind loads, and
   (b) the cladding is securely fixed to and supported by the structure of the building. This shall comprise both vertical support and horizontal restraint, and
   (c) provision is made, where necessary, to accommodate differential movement of the cladding and the supporting structure of the building, and
   (d) the cladding and its fixings (including any support components) are of durable materials; the design life of the fixings being not less than that of the cladding. Fixings shall be corrosion resistant and of a material type appropriate for the local environment.

Loading
3.3 Wind loading on the cladding should be derived from BS 6399-2:1997 with due consideration given to local increases in wind suction arising from funnelling of the wind through gaps between buildings. Guidance on funnelling effects is given in BRE Digest 436 Wind loading on buildings – Brief guidance for using BS 6399-2:1997 available from BRE, Bucknalls Lane, Garston, Watford, Herts WD2 7JR.
3.4 Where the cladding is required to support other fixtures, e.g. handrails, and fittings, e.g. antennae and signboards, account should be taken of the loads and forces arising from such fixtures and fittings.
3.5 Where the wall cladding is required to function as pedestrian guarding to stairs, ramps, vertical drops of 600mm or greater or as a vehicle barrier, then account should be taken of the additional imposed loading, as stipulated in Approved Document K, Protection from falling, collision and impact.
3.6 Where the wall cladding is required to safely withstand lateral pressures from crowds, an appropriate design loading is given in BS 6399 Part 1 and the Guide to Safety at Sports Grounds (4th Edition, 1997).
Fixings

3.7 The selection of fixings for supporting cladding should be determined from a consideration of the proven performance of the fixing and the risks associated with the particular application. In this regard applications should be designated as being either non-redundant (where the failure of a single fixing could lead to the detachment of the cladding) or redundant (where failure or excessive movement of one fixing results in load sharing by adjacent fixings) and the required reliability of the fixing determined accordingly.

**Note:** Attention is drawn to the availability of anchors with an ETA (European Technical Approval) gained in accordance with the requirements of ETAG 001 Guideline for European Technical Approval Metal Anchors for use in Concrete Parts 1-5, which cover both redundant and non-redundant applications, and Part 6 which covers ‘Anchors for multiple use in non-structural applications’ and which can effectively be regarded as covering redundant use. The UK definition of ‘multiple use’ is contained in an annexe to the ETAG Part 6 and is framed in such a way that all applications can be validated as to whether or not they conform to this category without calculation. All ETAG parts may be downloaded in English from www.eota.be.

3.8 The strength of fixings should be derived from tests using materials representative of the material into which the fixing is to be anchored, taking account of any inherent weaknesses that may affect the strength of the fixing, e.g. cracks in concrete due to shrinkage and flexure, or voids in masonry construction. The design loads will generally be available from the manufacturer’s test data determined from a European Technical Approval (ETA) or an extant British Standard.

**Note:** ETAS are available which cover use either in both cracked and non-cracked concrete or in non-cracked concrete only. Those which cover both cracked and non-cracked concrete allow higher loads for use in non-cracked than in cracked concrete. Guidance on how to determine whether a particular concrete section may be regarded as cracked or non-cracked without reverting to stress calculations is contained in ‘Use of anchors with European Technical Approvals. UK Guidance – Distinction between cracked and non-cracked concrete’. This is available on the BBA website www.bbacerts.co.uk click tab ‘ETA’.

Further guidance

3.9 The use of large panels of glass in cladding of walls and roofs where the cladding is not divided into small areas by load-bearing framing requires special consideration. Guidance is given in the following documents:

The Institution of Structural Engineers’ Report on ‘Structural use of glass in buildings’ dated 1999, available from 11 Upper Belgrave Street, London SW1X 8BH.

‘Nickel sulfide in toughened glass’ published by the Centre for Window Cladding and Technology dated 2000.

3.10 Further guidance on cladding is given in the following documents:


BS 8298:1994 Code of practice for the design and installation of natural stone cladding and lining.

3.11 Additional guidance on fixings is given in the following documents:

ETAG No. 001 1997 Guideline for European Technical Approvals of Metal Anchors for use in Concrete, European Organisation for Technical Approvals (EOTA), Brussels. All EOTA parts may be downloaded in English from www.eota.be.

English version published by the British Board of Agreement, PO Box 195, Bucknalls Lane, Garston, Watford, Hertfordshire WD25 9BA.

Part 1 Anchors in general.
Part 2 Torque controlled anchors.
Part 3 Undercut anchors.
Part 4 Deformation controlled anchors.
Part 5 Bonded anchors.
Part 6 Metal anchors for redundant use in concrete for lightweight systems.


CIRIA Report RP 566 Cladding Fixings: Good practice guidance, available from 6 Storey’s Gate, London SWIP 3AU.

CIRIA Reports C579 and C589 Retention of masonry facades – Best practice guide.

Guidance notes published by the Construction Fixings Association, c/o Institute of Spring Technology, Henry Street, Sheffield, South Yorks S3 7EQ.


Guidance Note: Fixings for Brickwork and Blockwork (1997).
Section 4: Roof covering

Materials

4.1 All materials used to cover roofs, including transparent or translucent materials, but excluding windows of glass in residential buildings with roof pitches of not less than 15°, shall be capable of safely withstanding the concentrated imposed loads upon roofs specified in BS 6399: Part 3.

Re-covering of roofs

4.2 The re-covering of roofs is commonly undertaken to extend the useful life of buildings. Roof structures may be required to carry underdrawing or insulation provided at a time later than their initial construction. This section provides guidance on determining whether such work to a roof constitutes a material alteration under the Building Regulations.

4.3 Where the work involves a significant change in the applied loading the structural integrity of the roof structure and the supporting structure should be checked to ensure that upon completion of the work the building is not less compliant with Requirement A1 than the original building.

4.4 A significant change in roof loading is when the loading upon the roof is increased by more than 15%.

4.5 Where such checking of the existing roof structure indicates that the construction is unable to sustain any proposed increase in loading (e.g. due to overstressed members or unacceptable deflection leading to ponding), appropriate strengthening work or replacement of roofing members should be undertaken. This is classified as a material alteration.

4.6 In carrying out the checks mentioned in paragraph 4.3 an increase of stress in a structural member arising from increased loading does not necessarily indicate that the roof structure is less compliant than the original roof provided an adequate factor of safety is maintained.

4.7 Where work will significantly decrease the roof dead loading, the roof structure and its anchorage to the supporting structure should be checked to ensure that an adequate factor of safety is maintained against uplift of the roof under imposed wind loading.
Disproportionate collapse: The Requirement A3

This Approved Document deals with the following Requirements which are contained in the Building Regulations 2010.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Limits on application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disproportionate collapse</td>
<td></td>
</tr>
<tr>
<td>A3. The building shall be constructed so that in the event of an accident the building will not suffer collapse to an extent disproportionate to the cause.</td>
<td></td>
</tr>
</tbody>
</table>
Guidance

Performance
In the Secretary of State’s view the Requirement of A3 will be met by an appropriate choice of measures to reduce the sensitivity of a building to disproportionate collapse should an accident occur.

Introduction
0.1 The guidance in Section 5 deals with the means of meeting this performance criterion.
Section 5: Reducing the sensitivity of the building to disproportionate collapse in the event of an accident

5.1 The requirement will be met by adopting the following approach for ensuring that the building is sufficiently robust to sustain a limited extent of damage or failure, depending on the class of the building, without collapse.

(a) Determine the building class from Table 11.

(b) For Class 1 buildings – Provided the building has been designed and constructed in accordance with the rules given in this Approved Document, or other guidance referenced under Section 1, for meeting compliance with requirement A1 and A2 in normal use, no additional measures are likely to be necessary.

(c) For Class 2A buildings – Provide effective horizontal ties, or effective anchorage of suspended floors to walls, as described in the Codes and Standards listed under paragraph 5.2 for framed and load-bearing wall construction (the latter being defined in paragraph 5.3 below).

Table 11 Building classes

<table>
<thead>
<tr>
<th>Classes</th>
<th>Building type and occupancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Houses not exceeding 4 storeys</td>
</tr>
<tr>
<td></td>
<td>Agricultural buildings</td>
</tr>
<tr>
<td></td>
<td>Buildings into which people rarely go, provided no part of the building is closer to another building, or area where people do go, than a distance of 1.5 times the building height</td>
</tr>
<tr>
<td>2A</td>
<td>5 storey single occupancy houses</td>
</tr>
<tr>
<td></td>
<td>Hotels not exceeding 4 storeys</td>
</tr>
<tr>
<td></td>
<td>Flats, apartments and other residential buildings not exceeding 4 storeys</td>
</tr>
<tr>
<td></td>
<td>Offices not exceeding 4 storeys</td>
</tr>
<tr>
<td></td>
<td>Industrial buildings not exceeding 3 storeys</td>
</tr>
<tr>
<td></td>
<td>Retailing premises not exceeding 3 storeys of less than 2000m² floor area in each storey</td>
</tr>
<tr>
<td></td>
<td>Single-storey educational buildings</td>
</tr>
<tr>
<td></td>
<td>All buildings not exceeding 2 storeys to which members of the public are admitted and which contain floor areas not exceeding 2000m² at each storey</td>
</tr>
<tr>
<td>2B</td>
<td>Hotels, flats, apartments and other residential buildings greater than 4 storeys but not exceeding 15 storeys</td>
</tr>
<tr>
<td></td>
<td>Educational buildings greater than 1 storey but not exceeding 15 storeys</td>
</tr>
<tr>
<td></td>
<td>Retailing premises greater than 3 storeys but not exceeding 15 storeys</td>
</tr>
<tr>
<td></td>
<td>Hospitals not exceeding 3 storeys</td>
</tr>
<tr>
<td></td>
<td>Offices greater than 4 storeys but not exceeding 15 storeys</td>
</tr>
<tr>
<td></td>
<td>All buildings to which members of the public are admitted which contain floor areas exceeding 2000m² but less than 5000m² at each storey</td>
</tr>
<tr>
<td></td>
<td>Car parking not exceeding 6 storeys</td>
</tr>
<tr>
<td>3</td>
<td>All buildings defined above as Class 2A and 2B that exceed the limits on area and/or number of storeys</td>
</tr>
<tr>
<td></td>
<td>Grandstands accommodating more than 5000 spectators</td>
</tr>
<tr>
<td></td>
<td>Buildings containing hazardous substances and/or processes</td>
</tr>
</tbody>
</table>

Notes:
1. For buildings intended for more than one type of use the Class should be that pertaining to the most onerous type.
2. In determining the number of storeys in a building, basement storeys may be excluded provided such basement storeys fulfil the robustness requirements of Class 2B buildings.
(d) **For Class 2B buildings** – Provide effective horizontal ties, as described in the Codes and Standards listed under paragraph 5.2 for framed and load-bearing wall construction (the latter being defined in paragraph 5.3 below), together with effective vertical ties, as defined in the Codes and Standards listed under paragraph 5.2, in all supporting columns and walls.

Alternatively, check that upon the notional removal of each supporting column and each beam supporting one or more columns, or any nominal length of load-bearing wall (one at a time in each storey of the building), the building remains stable and that the area of floor at any storey at risk of collapse does not exceed 15% of the floor area of that storey or 70m², whichever is smaller, and does not extend further than the immediate adjacent storeys (see Diagram 24).

Where the notional removal of such columns and lengths of walls would result in an extent of damage in excess of the above limit, then such elements should be designed as a 'key element' as defined in paragraph 5.3 below.

(e) **For Class 3 buildings** – A systematic risk assessment of the building should be undertaken taking into account all the normal hazards that may reasonably be foreseen, together with any abnormal hazards.

Critical situations for design should be selected that reflect the conditions that can reasonably be foreseen as possible during the life of the building. The structural form and concept and any protective measures should then be chosen and the detailed design of the structure and its elements undertaken in accordance with the recommendations given in the Codes and Standards given in paragraph 5.2.

5.2 Details of the effective horizontal and vertical ties, together with the design approaches for checking the integrity of the building following the notional removal of vertical members and the design of key elements, are available in the following Codes and Standards:


5.3 Definitions

**Nominal length of load-bearing wall**

The nominal length of load-bearing wall construction referred to in 5.1d should be taken as follows:

- in the case of a reinforced concrete wall, the distance between lateral supports subject to a maximum length not exceeding 2.25H.
- in the case of an external masonry wall, or timber or steel stud wall, the length measured between vertical lateral supports.
- in the case of an internal masonry wall, or timber or steel stud wall, a length not exceeding 2.25H.
- where H is the storey height in metres.
Key elements
A ‘key element’, as referred to in paragraph 5.1d, should be capable of sustaining an accidental design loading of 34kN/m2 applied in the horizontal and vertical directions (in one direction at a time) to the member and any attached components (e.g. cladding etc.) having regard to the ultimate strength of such components and their connections. Such accidental design loading should be assumed to act simultaneously with 1/3 of all normal characteristic loading (i.e. wind and imposed loading).

Load-bearing construction
For the purposes of this Guidance the term ‘load-bearing wall construction’ includes masonry cross-wall construction and walls comprising close centred timber or lightweight steel section studs.

Alternative approach
5.4 Alternatively, for any building which does not fall into the classes listed under Table 11 or for which the consequences of collapse may warrant particular examination of the risks involved, the performance may be met by the recommendations given in the following Reports:
Both of the above documents are available on the following ODPM website www.odpm.gov.uk

Diagram 24 Area at risk of collapse in the event of an accident
Standards referred to

A1/2

**BS 187:1978**

**BS 1243:1978**

**BS 5080-1:1993**

**BS 5268-3:1998**

**BS 5628-1:1992**

**BS 5628-2:2000**

**BS 5628-3:2001**

**BS 5950-1:2000**

**BS 5950-2:2001**

**BS 5950-3-1:1990**

**BS 5950-4:1994**

**BS 6399-1:1996**
Appendix: Standards referred to

**BS 6399-2:1997**

**BS 6399-3:1998**

**BS 8002:1994**

**BS 8004:1986**
Code of practice for foundations.

**BS 8103-1:1995**

**BS 8103-2:1996**
Structural design of low-rise buildings. Code of practice for masonry walls for housing. (Superseded but remains current by BS 8103-2:2005 Structural design of low rise buildings. Code of practice for masonry walls for housing, but remains current.)

**BS 8103-3:1996**

**BS 8103-4:1995**

**BS 8110-1:1997**

**BS 8110-2:1985**

**BS 8110-3:1995**

**BS 8118-1:1991**

**BS 8118-2:1991**

**BS 8297:2000**

**BS 8298:1994**
Code of practice for design and installation of natural stone cladding and lining.
BS 8500-1:2002

BS 8500-2:2002

BS EN 197-1:2000

BS EN 197-2:2000
Cement. Conformity evaluation.

BS EN 771-1:2003

BS EN 771-2:2001

BS EN 771-3:2003
Specification for masonry units. Aggregate concrete masonry units (dense and light-weight aggregates).

BS EN 771-4:2001

BS EN 771-5:2003

BS EN 771-6:2001
Specification for masonry units. Natural stone masonry units. (Withdrawn and superseded by BS EN 771-6:2005 Specification for masonry units. Natural stone masonry units.)

BS EN 845-1:2001

BS EN 845-2:2001

BS EN 845-3:2001
BS EN 998-2:2002

BS EN 12620:2002

DD 140-1:1986

DD 140-2:1987

A3
BS 5628-1:1992


BS 5950-1:2000

BS 8110-1:1997

BS 8110-2:1985