Building Regulations 1997

Technical Guidance Document A

Structure

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ARNA FHOILSIÚ AG OIFIG AN tSOLÁTHAIR

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Amendments issued since publication

Technical Guidance Document A - Structure

Amd. No.	*Text Affected*
A(i)	Transitional Arrangements:- Replace 1 January 1998 with 1 July 1998
A(ii)	**1.0.1**, last sentence : replace with : "Wind loads should be in accordance with CP3 : Chapter V : Part 2, using wind speeds based on Diagram 15 of this Technical Guidance Document or BS 6399: Part 2 using wind speeds based on Diagram 15A of this Technical Guidance Document."
A(iii)	**1.2.1**, Loading: insert between BS 6399: Parts 1 and 3 : "BS 6399 : Part 2 (For wind loads and using the wind speed map in Diagram 15A)"
A(iv)	**Diagram 15** : additional Diagram 15A included.
A(v)	**Standards and other references**, insert : "BS 6399 : Loading for buildings Part 2 : Code of Practice for wind loads."
A(vi)	Reference to I.S. 1:1991 in the following sections is hereby replaced by: **- Design provisions.** item 1.1.5.2(c). cement (type CEM 1) I.S. EN 197 - 1: 2001 **- Standards and other references.** I.S. EN 197 - 1: 2001
A(vii)	**Standards and other references**:- Replace I.S. EN 197 Part 1 and 2 with I.S. EN 197 - 1: 2001
A(viii)	**Diagram 15** : Wind speeds map updated.

Contents

Building Regulations, 1997
Technical Guidance Document A
Structure

Introduction
This document has been published by the Minister for the Environment under article 7 of the Building Regulations, 1997. It provides guidance in relation to Part A of the Second Schedule to the Regulations. The document should be read in conjunction with the Building Regulations, 1997, and other documents published under these Regulations.

In general, Building Regulations apply to the construction of new buildings and to extensions and material alterations to buildings. In addition, certain parts of the Regulations apply to existing buildings where a material change of use takes place. Otherwise, Building Regulations do not apply to buildings constructed prior to 1 June, 1992.

Transitional Arrangements
In general, this document applies to works, or buildings in which a material change of use takes place, where the works or the change of use commence or takes place, as the case may be, on or after 1 July, 1998. Technical Guidance Document A - **Structure**, dated 1991, also ceases to have effect from that date. However, the latter document may continue to be used in the case of works, or buildings in which a material change of use takes place -

- where the works or the change of use commence or takes place, as the case may be, before 1 July, 1998,

- in respect of which a Fire Safety Certificate under the Building Control Regulations, 1991 to 1994, has been granted, where the works or change of use commence or takes place, as the case may be, not later than 31 December, 2002.

The Guidance
The materials, methods of construction, standards and other specifications (including technical specifications) which are referred to in this document are those which are likely to be suitable for the purposes of the Regulations. Where works are carried out in accordance with the guidance in this Document, this will, prima facie, indicate compliance with Part A of the Second Schedule to the Building Regulations. However, the adoption of an approach other than that outlined in the guidance is not precluded provided that the relevant requirements of the Regulations are complied with. Those involved in the design and construction of a building may be required by the relevant building control authority to provide such evidence as is necessary to establish that the requirements of the Building Regulations are being complied with.

Existing Buildings
In the case of material alterations or changes of use of existing buildings, the adoption without modification of the guidance in this document may not, in all circumstances, be appropriate. In particular, the adherence to guidance, including codes, standards or technical specifications, intended for application to new work may be unduly restrictive or impracticable. Buildings of architectural or historical interest are especially likely to give rise to such circumstances. In these situations, alternative approaches based on the principles contained in the document may be more relevant and should be considered.

Technical Specifications
Building Regulations are made for specific purposes, e.g. to provide, in relation to buildings, for the health, safety and welfare of persons, the conservation of energy and access for disabled persons. Technical specifications (including harmonised European Standards, European Technical Approvals, National Standards and Agrément Certificates) are relevant to the extent that they relate to these considerations. Any reference to a technical specification is a reference to so much of the specification as is relevant in the context in which it arises. Technical specifications may also address other aspects not covered by the Regulations.

A reference to a technical specification is to the latest edition (including any amendments, supplements or addenda) current at the date of publication of this Technical Guidance Document. However, if this version of the technical specification is subsequently revised or updated by the issuing body, the new version may be used as a source of guidance provided that it continues to address the relevant requirements of the Regulations.

Materials and Workmanship
Under Part D of the Second Schedule to the Building Regulations, building work to which the Regulations apply must be carried out with proper materials and in a workmanlike manner. Guidance in relation to compliance with Part D is contained in Technical Guidance Document D.

Interpretation
In this document, a reference to a section, sub-section, part, paragraph or diagram is, unless otherwise stated, a reference to a section, sub-section, part, paragraph or diagram, as the case may be, of this document. A reference to another Technical Guidance Document is a reference to the latest edition of a document published by the Minister for the Environment under article 7 of the Building Regulations, 1997. Diagrams are used in this document to illustrate particular aspects of construction - they may not show all the details of construction.

Building Regulations - The Requirement

Part A of the Second Schedule to the Building Regulations, 1997, provides as follows:

Loading.	A1	(1)	A building shall be designed and constructed, with due regard to the theory and practice of structural engineering, so as to ensure that the combined dead, imposed and wind loads are sustained and transmitted to the ground - (a) safely, and (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.
		(2)	In assessing whether a building complies with sub-paragraph (1), regard shall be had to the imposed loads 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.
Ground movement.	A2		A building shall be designed and constructed, with due regard to the theory and practice of structural engineering, so as to ensure that movements of the subsoil caused by subsidence, swelling, shrinkage or freezing will not impair the stability of any part of the building.
Disproportionate collapse.	A3	(1)	A multi-storey building shall be designed and constructed, with due regard to the theory and practice of structural engineering, so as to ensure that in the event of an accident the structure will not be damaged to an extent disproportionate to the cause of the damage.
		(2)	For the purposes of sub-paragraph (1), where a building is rendered structurally discontinuous by a vertical joint, the building on each side of the joint may be treated as a separate building whether or not such joint passes through the substructure.
Definitions for this Part.	A4		In this Part - "dead load" means the force due to the static mass of all walls, permanent partitions, floors, roofs and finishes including all other permanent construction and services equipment affixed to the building; "imposed load" means the load assumed to be produced by the intended occupancy or use of the building including distributed, concentrated, impact, inertia and snow loads and the force due to the static mass of moveable partitions, but excluding wind loads; "multi-storey building" means a building comprising or including five or more storeys, a basement storey being regarded as a storey; "storey" means any of the parts into which a building is divided horizontally above or below ground level but excluding any part of a building situated above the level of the roof or in the roofspace, or below the level of the lowest floor, which is intended for the protection of a water tank, or lift motor, or similar use and is not intended for, or adapted to be used for habitable purposes, or as a work room, or as a store room; "wind load" means all loads due to the effect of wind pressure or suction.

Section 1
Structure - Loading and Ground Movement

This Technical Guidance Document is divided into two sections.

Section 1 relates to the requirements in A1 and A2.

Section 2 relates to the requirement in A3.

Section 1
Structure - Loading and Ground Movement

Loading.	A1	(1)	A building shall be designed and constructed, with due regard to the theory and practice of structural engineering, so as to ensure that the combined dead, imposed and wind loads are sustained and transmitted to the ground -
			(a) safely, and
			(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.
		(2)	In assessing whether a building complies with sub-paragraph (1), regard shall be had to the imposed loads 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.
Ground movement.	A2		A building shall be designed and constructed, with due regard to the theory and practice of structural engineering, so as to ensure that movements of the subsoil caused by subsidence, swelling, shrinkage or freezing will not impair the stability of any part of the building.

Introduction

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

(a) loading,

(b) properties of materials,

(c) design analysis,

(d) details of construction,

(e) safety factors,

(f) workmanship.

As regards (a), dead and imposed loads, other than imposed roof loads, should be in accordance with BS 6399: Part 1. Imposed roof loads should be in accordance with BS 6399 : Part 3, using the snow load map shown in Diagram 14 of this Technical Guidance Document. Wind loads should be in accordance with CP3 : Chapter V : Part 2, using wind speeds based on Diagram 15 of this Technical Guidance Document or BS 6399: Part 2 using wind speeds based on Diagram 15A of this Technical Guidance Document.

1.0.2 This Section is comprised of three sub-sections:

Sub-section 1 of the document applies to small buildings with walls of traditional masonry construction and with timber first floors and roofs. It gives sizes for certain elements in houses with not more than two floors including the ground floor. This sub-section also applies to domestic garages and other annexes attached to such houses.

The sub-section is arranged in five parts as follows:

Part 1 - Basic requirements for stability.

Part 2 - Sizes of certain timber floor, ceiling and roof members in houses with not more than two floors including the ground floor.

Part 3 - Thickness of masonry walls in houses with not more than two floors including the ground floor.

Part 4 - Proportions for masonry chimneys above the roof surface.

Part 5 - Strip foundations of plain concrete.

Part 1 gives general rules which must be observed in using Parts 2 and 3. Parts 2 to 5 may be used independently of each other.

Sub-section 2 is relevant to all building types and lists standards for structural design and construction but, where these do not give precise guidance, regard should be had to par. 1.0.1.

Sub-section 3 provides guidance for recovering of existing roof structures and the structural safety of external wall cladding.

1.0.3 Other approaches - If other approaches are adopted, it is essential to have regard to par. 1.0.1 and to the following:-

(a) The numerical values of safety factors, whether expressed explicitly or implicitly in design equations or design values, should be derived from considerations of the aspects of design and construction given in par. 1.0.1 as a whole. A change in any one of these aspects may affect the safety of the structure.

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

1.0.4 Definitions - The following definitions apply to sub-sections 1 to 3:

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 Part B of the Second Schedule to the Building Regulations - Fire Safety.

Pier - A member which forms an integral part of a wall, in the form of a thickened section, 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 Part B of the Second Schedule to the Building Regulations - Fire Safety.

Spacing - The distance between the longitudinal centres of any two adjacent members of the same type, measured in the plane of floor, ceiling, roof, or other part of the structure of which members form a part.

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

Note: The spans given in Part 2 of sub-section 1 of this Section for floor joists, rafters, purlins and ceiling joists are as defined in SR 11 : 1988.

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.

Sub-section 1
Sizes for Certain Structural elements for Houses and other small buildings

Part 1 - Basic requirements for stability

1.1.1.1 This Part must be used in conjunction with Parts 2 and 3 of this sub-section.

1.1.1.2 Trussed rafter roofs should be braced to the recommendations of I.S. 193 : 1986. Where, due to its form of construction, a traditionally framed roof (i.e. using rafters, purlins and ceiling joists) does not have sufficient built-in resistance to instability, for example from hipped returns, then bracing is required.

1.1.1.3 If the roof structure is braced as described above and adequately anchored to the structure beneath and the walls are designed and restrained in accordance with the requirements of Part 3 of this sub-section, no special provision should be needed to take account of loads due to the effect of wind pressure or suction. However, par. 1.1.3.26 gives details of situations in which additional ties may be required.

Part 2 - Sizes of certain timber floor, ceiling and roof members in houses

Application

1.1.2.1 This Part applies only to houses with not more than two floors including the ground floor.

The use of this Part

1.1.2.2 This Part must be used in conjunction with Part 1 of this sub-section.

1.1.2.3 The guidance given in this Part assumes that:

(a) the dead and imposed loads to be sustained by the floor, ceiling or roof of which the member forms part do not exceed the values given in SR 11 : 1988,

(b) the species and grade of timber are those given in SR 11 : 1988, and

(c) floorboarding complying with BS 1297: 1987 is used.

1.1.2.4 Except where indicated, the cross sectional dimensions given in SR 11 : 1988 are basic sawn sizes as defined in BS 4471 : Part 1 : 1987. SR 11 : 1988 does not apply where these basic sawn dimensions have been reduced by regularising or planing. For timber of North American origin, SR 11 : 1988 applies only as indicated to surfaced sizes unless the timber has been resawn to BS 4471 requirements.

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

(a) notches should be no deeper than 0.125 times the depth of a joist and should not be cut closer to the support than 0.07 times the span, nor further away than 0.25 times the span,

(b) holes should be no greater diameter than 0.25 times the depth of the joist, should be drilled at the neutral axis, should be not less than three diameters (centre to centre) apart and should be located between 0.25 and 0.4 times the span from the support, and

(c) the horizontal distance between any hole and any notch should not be less than the depth of the joist.

1.1.2.6 Bearing areas and workmanship should comply with the relevant requirements of BS 5268: Part 2 : 1989. Refer also to pars. 1.1.3.22 to 1.1.3.25 of this document.

1.1.2.7 Timber joists, rafters and purlins may be designed in accordance with SR 11 : 1988.

Part 3 - Thickness of masonry walls in houses with not more than two floors including the ground floor

Application

1.1.3.1 This Part applies to houses with not more than two floors including the ground floor, with walls of traditional masonry construction, with timber upper floors and with roofs covered with normal lightweight covering including clay or concrete pantiles. It also applies to domestic garages and other annexes attached to such houses.

The use of this Part

1.1.3.2 This Part must be used in conjunction with Part 1 of this sub-section. All appropriate design conditions given in this part must be satisfied. Walls should comply with the relevant requirements of I.S. 325: Part 2: 1995. The wall types given in par. 1.1.3.3 may be constructed as described in par. 1.1.3.4 using the materials described in par. 1.1.3.5 and subject to the requirements of pars. 1.1.3.6 to 1.1.3.27.

Wall Types

1.1.3.3 This Part applies to external walls and internal walls (including compartment walls and separating walls).

1.1.3.4 Wall Construction

External walls

(a) Cavity walls constructed using two leaves composed of either, solid concrete blocks or bricks of not less than 100 mm thickness, or of clay bricks, tied together with wall ties appropriate to the width of cavity. The inner leaf may be constructed using 100 mm thick lightweight solid concrete blocks.

(b) Cavity block walls constructed using 215 mm hollow concrete blocks.

Internal load bearing walls

(a) Internal load bearing walls composed of solid or lightweight solid concrete blocks or bricks.

(b) Separating walls composed of 215 mm thick solid concrete blocks or bricks (refer to Technical Guidance Document E for guidance on sound insulation).

(c) Separating walls of cavity construction composed of two leaves of solid or lightweight solid concrete blocks or bricks of not less than 100 mm thickness, or of clay bricks (refer to Technical Guidance Document E for guidance on sound insulation).

Materials

1.1.3.5 The materials used should meet the following minimum designations, strengths and other qualities -

Solid concrete blocks	Should have thickness required by par. 1.1.3.4 and conform to the requirements of designation S5 in accordance with I.S. 20: 1987 Concrete Building Blocks Part 1: Normal Density Blocks.
Lightweight solid concrete blocks	Should have thickness required by par. 1.1.3.4 and conform to the requirements of designation B3 in accordance with I.S. 20:1974 Concrete Building Blocks.
Hollow concrete blocks	Should have thickness required by par. 1.1.3.4 and conform to the requirements of designation H3 in accordance with I.S. 20: 1987 Concrete Building Blocks Part 1: Normal Density Blocks.
Clay bricks	Should have a thickness of 103 mm, be frost resistant and have 7 N/mm^2 strength in accordance with I.S. 91: 1983 Clay Building Bricks.
Other masonry units	Should have strength and thickness equivalent to those listed above.
Lintels	Should be designed for the loads and spans occurring where they are employed and should be installed strictly in accordance with the manufacturers' instructions. Prestressed concrete lintels should be manufactured in accordance with I.S. 240: 1980.

Mortar Should conform to the requirements of designation (iii) of I.S. 406: 1987 (nominally a 1:1:6 mixture of Portland cement, lime and fine aggregate).

Wall ties Should comply with I.S. 268: 1987 Metal Wall Ties for Masonry Walls.

Maximum Loads

1.1.3.6 Vertical loads - The vertical imposed loads should not exceed the following:

Element	**Loading**
Roof	Distributed load 0.75 kN/m^2.
Floors	Distributed load 1.50 kN/m^2.
Ceilings	Distributed load 0.75 kN/m^2.

1.1.3.7 Wind loads - Diagram 1 shows Ireland divided into three wind zones, A, B and C. The divisions between the zones relate roughly to the 44 m/s and 47 m/s gust speed contours of the map issued by Met Eireann.

The design wind speed (Vs) determined in accordance with CP3: Chapter V: Part 2:1972 as amended in 1986 should not exceed 44 m/s. This condition will normally be satisfied if the building site is located in:

Zone A: On normal or slightly sloping sites in any terrain.

Zone B: On normal or slightly sloping sites in open country side with scattered windbreaks or in country with many windbreaks or in towns or cities.

Zone C: In country with many windbreaks or in towns or cities.

Note: For more detailed guidance on these terrains, see CP3: Chapter V: Part 2: Section 5.5.

Where more exposed terrain is involved or where there is reason to believe that design wind speeds in excess of 44 m/s may be appropriate, a separate design check in accordance with CP3: Chapter V: Part 2 should be carried out using the wind speeds in Diagram 15 of this Technical Guidance Document. Part 3 of this Technical Guidance Document is not applicable if the design wind speed determined in this manner exceeds 44 m/s.

1.1.3.8 Retained earth - Differences in level of ground or other solid construction between one side of the wall and the other must be less than four times the thickness of the wall.

Limitations on Building Geometry

1.1.3.9 Residential buildings (see Diagram 2)

(a) No part of any wall or roof should be more than 10 m above the lowest adjacent ground level.

(b) The width of the building should not be less than half the height of the building.

(c) The width of a wing should not be less than half the height of the wing when the projection P exceeds twice the width W2.

1.1.3.10 Floors should be as described below:

(a) Ground floors -
Timber floors or ground supported concrete floors or suspended concrete floors of maximum span 5 m.

(b) Upper floors -
Traditional timber floors of maximum span 5 m.

1.1.3.11 The floor to floor and ceiling to ceiling heights should not exceed 2.7 m.

1.1.3.12 The roof span should not exceed 12 m.

Lateral Support and End Restraint

1.1.3.13 The ends of every load-bearing wall should be bonded or otherwise securely tied throughout their full height to a buttressing wall pier or chimney. The maximum length of wall between vertical supports should not exceed 9 m. Longer walls should be provided with intermediate support, dividing the wall into distinct lengths, by buttressing walls, piers or chimneys, which provide support throughout the full height of the wall.

Diagram 1 **Wind zones** ***Par. 1.1.3.7***

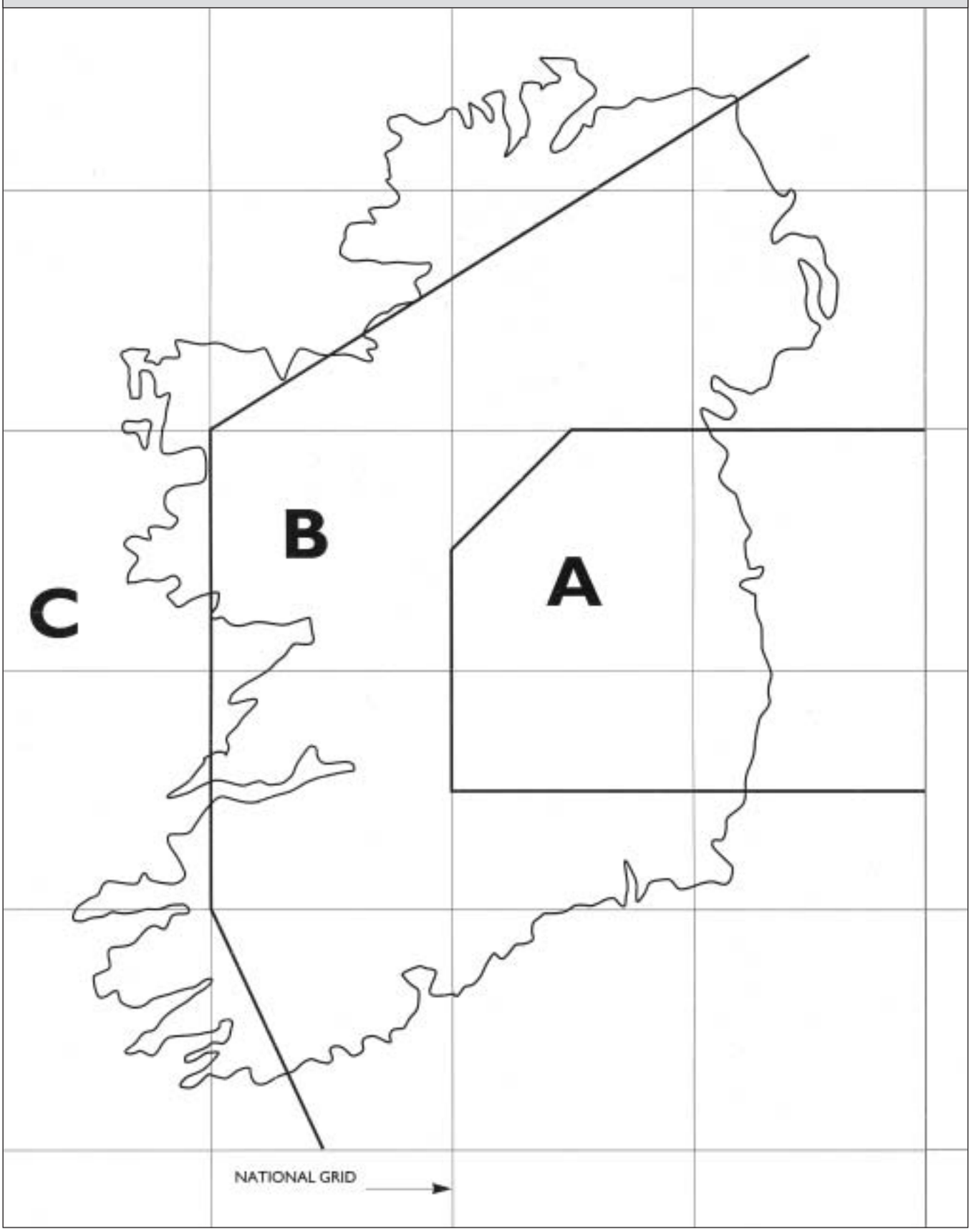


Diagram 2 **Size and proportion of buildings** *Par.1.1.3.9*

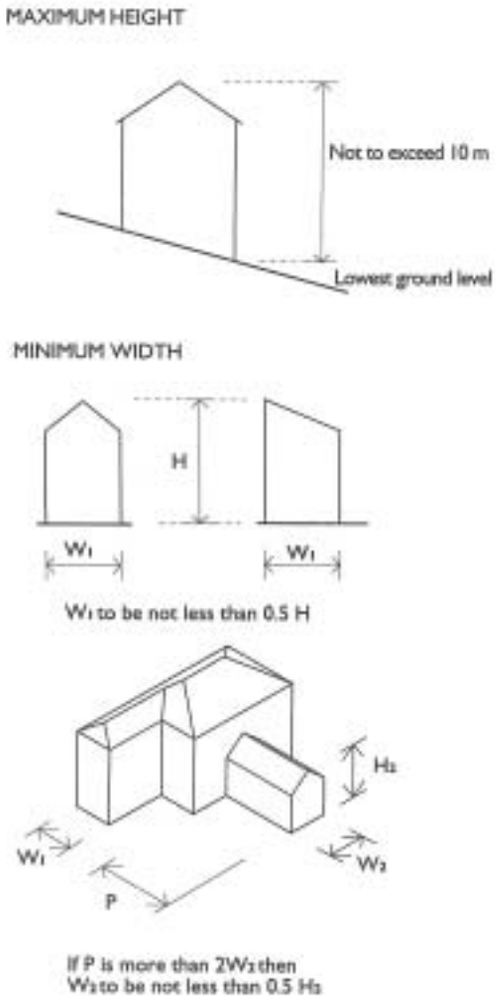
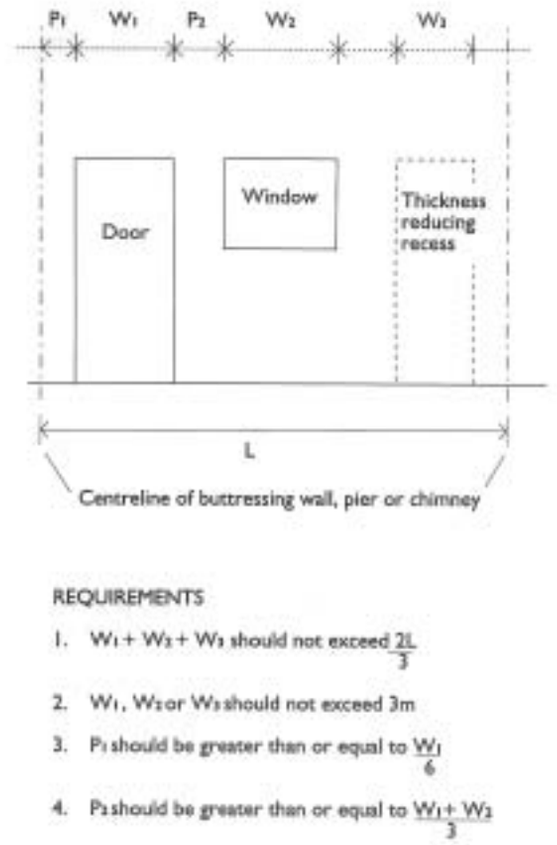


Diagram 3 **Size of openings and recesses** *Par. 1.1.3.14*



1.1.3.14 Buttressing

The thickness of the buttressing should not be less than 100 mm. Diagram 3 gives details of the limiting dimensions of openings and recesses in walls, including buttressing walls.

1.1.3.15 Piers in solid walls should be not less than 190 mm in width and not less than 490 mm thick. Piers in hollow block walls should be not less than 190 mm in width and not less than 590 mm thick. Chimneys should be not less than 490 mm thick and be composed of units not less than 100 mm thick (see Diagram 4).

1.1.3.16 Internal buttressing to walls in upper floors may be provided by stud partitions not less than 1.2 m long constructed from 35 mm x 75 mm kiln dried timber with studs at not more than 400 mm centres and two rows of noggings. The end stud of the partition should be fixed to the wall using drilled screw fixings at the top and at each of the noggings.

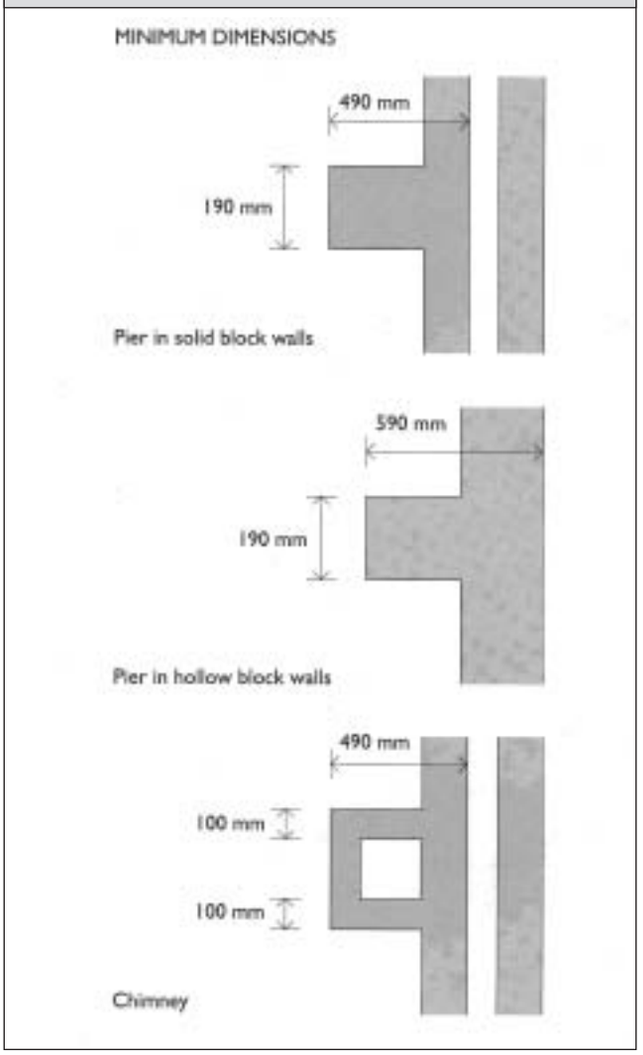
1.1.3.17 Notwithstanding the rules in pars. 1.1.3.13 to 1.1.3.16, a supported wall may contain an unbuttressed section adjoining an opening as shown in Diagram 5 where -

(a) the opening is in the ground storey of an external buttressing wall,

(b) the opening does not exceed 2.4 m in height,

(c) the supported wall is restrained at first floor level or, where the building is a single storey building, at roof level,

Diagram 4 **Piers and chimneys** *Par. 1.1.3.15*



(d) the supported wall is properly bonded to the buttressing wall below the ground floor level,

(e) the supported wall is bonded to the buttressing wall above the opening by a beam or lintel spanning the opening in the buttressing wall,

(f) the buttressing wall is properly bonded to a storey height wall, pier or chimney at the opposite side of the opening to the supported wall,

(g) the supported wall is properly bonded to a storey height wall not more than 5.5 m from its unbuttressed section,

(h) the beam or lintel described in (e) above is provided at each end with a bearing length of 400 mm or is supported on a padstone having a length of 400 mm.

Openings and Chases in Walls

1.1.3.18 The number, size and position of openings should not impair the stability of a wall or the lateral support provided by a buttressing wall to a supported wall. Construction over openings and recesses should be adequately supported and the ends of lintels and beams should be provided with adequate bearing. All window and door lintels should have a minimum bearing length of 150 mm. In certain circumstances e.g. beam bearings, it may be necessary to provide padstones or longer bearings.

1.1.3.19 The maximum length of an opening or thickness-reducing recess in any wall should not exceed 3 m. Other dimensional criteria are given in Diagram 3 (see also par. 1.1.3.21).

1.1.3.20 Openings and thickness-reducing recesses in walls should not exceed 2.4 m in height (see also par. 1.1.3.21).

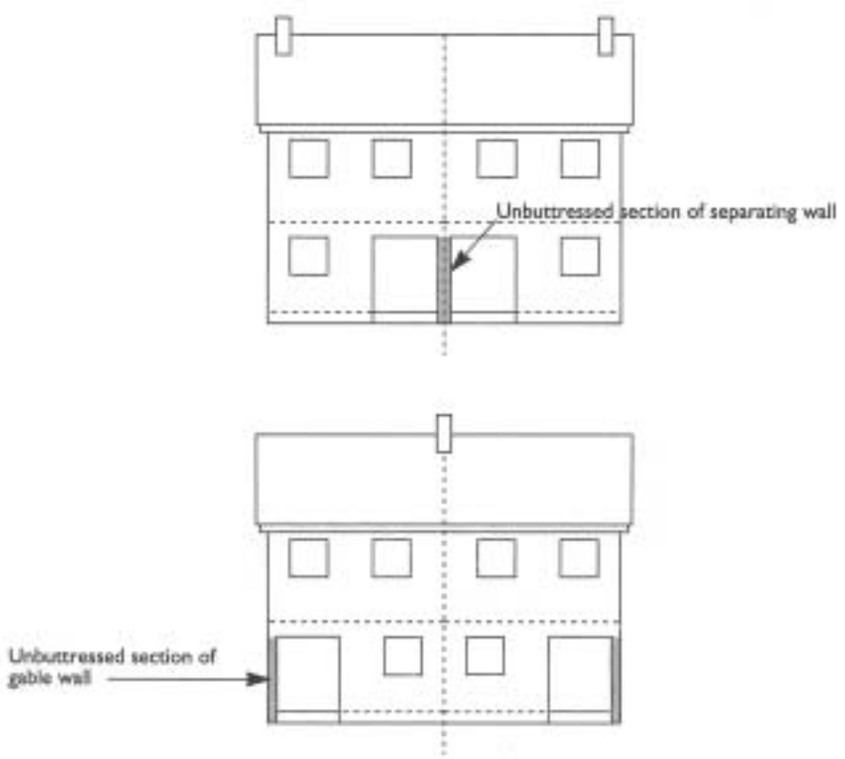
1.1.3.21 Dimensional criteria for chases -

(a) Chases should not impair the stability of the wall. Chases are not allowed when using hollow blocks.

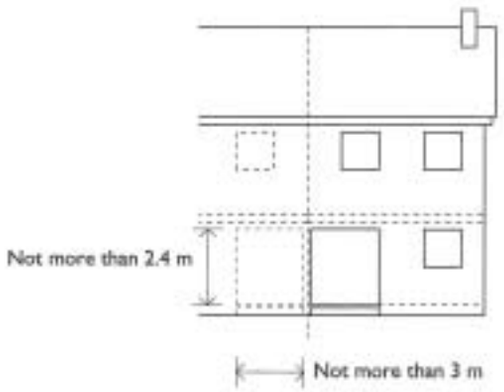
(b) Horizontal chases should not be deeper than 1/6 of the thickness of the leaf.

(c) Vertical chases should not be deeper than 1/3 of the thickness of the leaf.

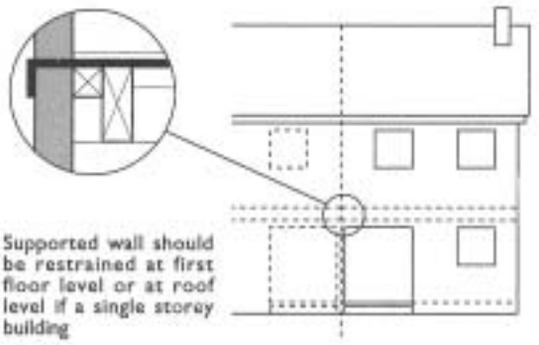
Diagram 5 **Unbuttressed wall sections** *Par.1.1.3.17*



5(a) EXAMPLES OF UNBUTTRESSED WALL SECTIONS

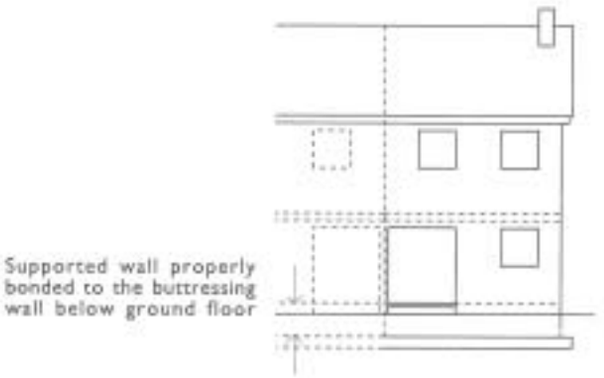


5(b) DIMENSIONAL LIMITATIONS OF UNBUTTRESSED SECTIONS

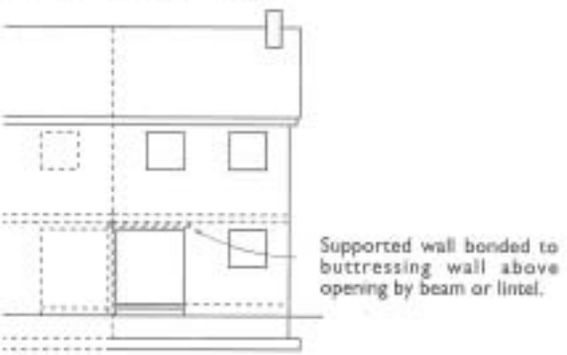


5(c) RESTRAINT AT FIRST FLOOR LEVEL

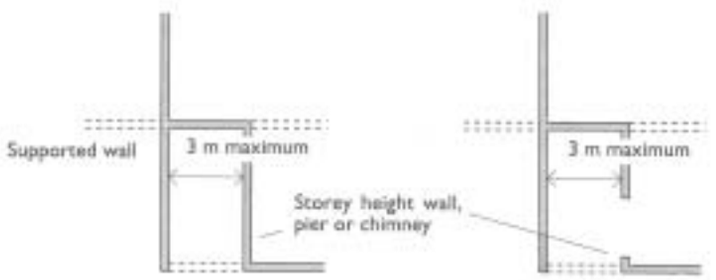
Diagram 5 **Unbuttressed wall sections**



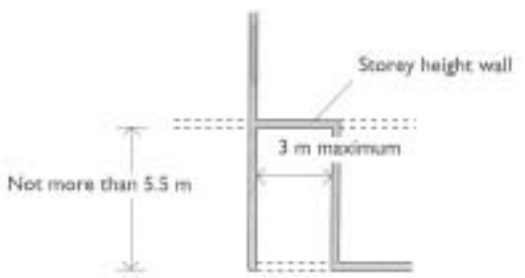
5(d) BONDING OF SUPPORTED WALL BELOW GROUND FLOOR LEVEL



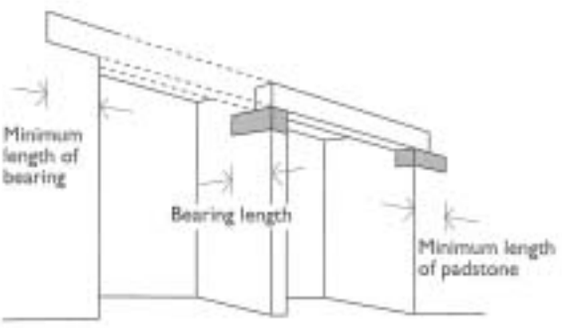
5(e) BONDING OF SUPPORTED WALL ABOVE GROUND STOREY OPE



5(f) BONDING OF BUTTRESSING WALL AT OTHER SIDE OF OPE



5(g) SUPPORTED WALL BONDED TO A STOREY HEIGHT WALL NOT MORE THAN 5.5 m FROM ITS UNBUTTRESSED SECTION



5(h) BEARING LENGTHS FOR BEAMS OR LINTELS

Interaction of Elements

1.1.3.22 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 at right angles to its plane.

1.1.3.23 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 pars. 1.1.3.24 and 1.1.3.25.

1.1.3.24 Walls should be strapped to floors at first floor level at intervals not exceeding 2 m by galvanised mild steel or stainless steel straps which have a minimum 30 mm x 5 mm section as shown in Diagram 6 (a) and (b).

Straps need not be provided -

(a) in the longitudinal direction of joists, if the joists are at not more than 800 mm centres and have at least

  (i) 90 mm bearing on the supported walls, or

  (ii) 75 mm bearing on a timber wall plate at each end,

(b) where the joists are carried on the supported wall by joist hangers of the restraint type described in I.S. 325 and shown in Diagram 6 (c), at not more than 800 mm centres,

(c) where floors are at or about the same level on each side of a supported wall as shown in Diagram 6 (d) and contact between floors and wall is continuous or at intervals not exceeding 2 m. Where contact is intermittent, the point of contact should be in line or nearly in line.

1.1.3.25 Walls should be strapped to roofs as shown in Diagrams 7 (a) and (b) by galvanised mild steel straps which have a minimum 30 mm x 5 mm section. Vertical strapping should be provided at eaves level at intervals not exceeding 2 m as shown in Diagram 7 (c). Additional vertical straps may be necessary where the roof -

(a) has a pitch of less than 15°, and

(b) is in wind zone C.

1.1.3.26 Where an opening in a floor or roof, such as that required for a stairway (Diagram 8), adjoins a supported wall and interrupts the continuity of lateral support, the following conditions should be satisfied -

(a) the length of opening should not exceed 3 m measured parallel to the supported wall, and

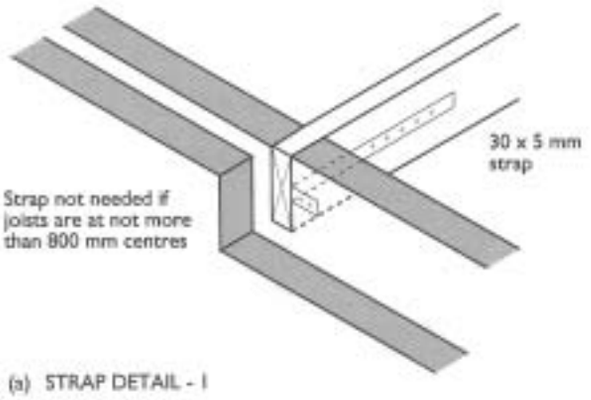
(b) where a connection is provided other than by anchor, this should be provided throughout the length of each portion of the wall situated on each side of the opening, and

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

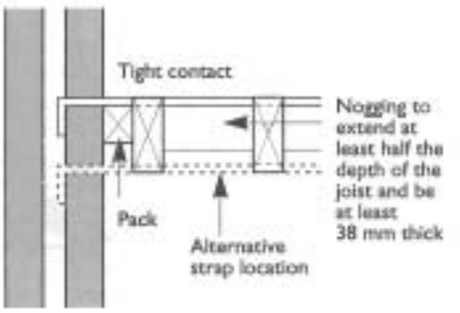
(d) no other interruption of lateral support is permissible.

1.1.3.27 Wall ties should be provided in cavity walls. In conditions of severe exposure, austenitic stainless steel or suitable non-ferrous ties should be used. The minimum quantity of ties provided should be 2.5 per square metre for cavities of 50 - 75 mm width and 3 per square metre for cavities of 76 - 110 mm. Extra wall ties are required at the jambs of openings as shown in Diagram 9 (for definitions of severe exposure and for use of ties in other cavity widths, see I.S. 325: Part 2).

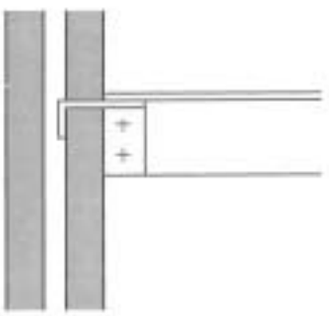
Diagram 6 **Lateral support by floors** *Par. 1.1.3.24*



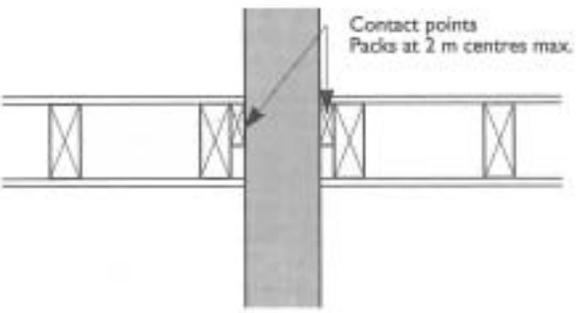
(a) STRAP DETAIL - 1



(b) STRAP DETAIL - 2



(c) RESTRAINT TYPE JOIST HANGER



(d) RESTRAINT OF INTERNAL WALLS

Diagram 7 **Lateral support at roof level** *Par. 1.1.3.25*

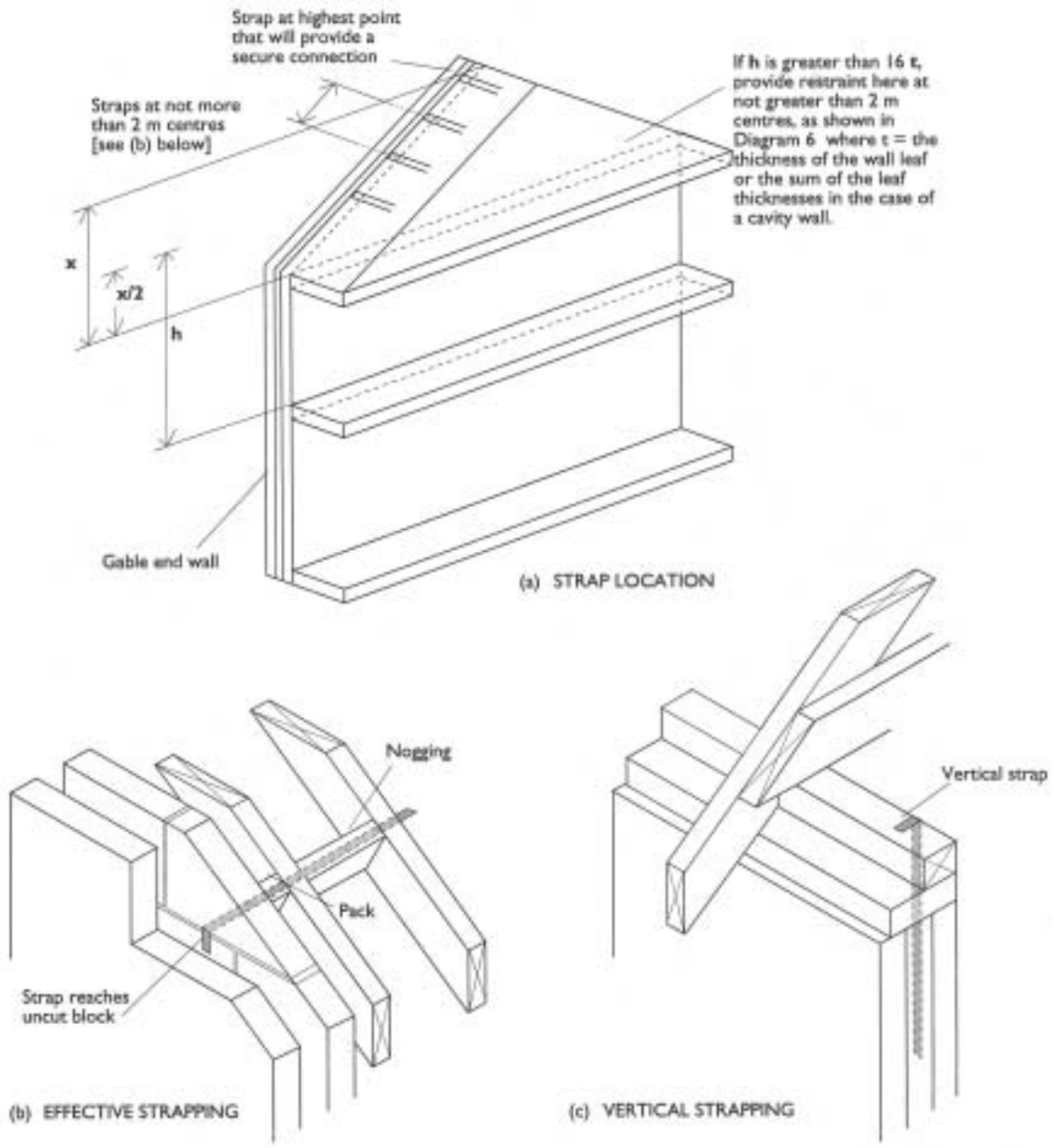
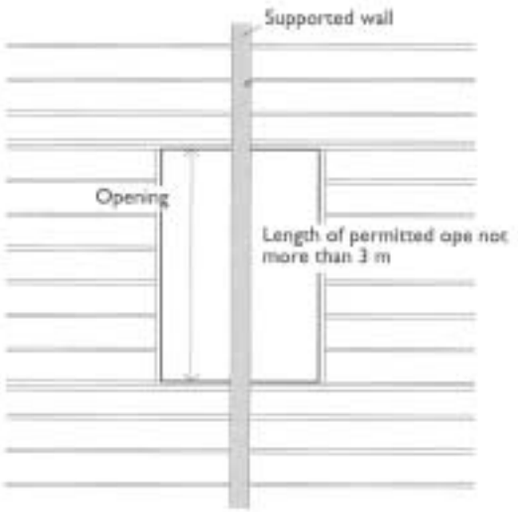
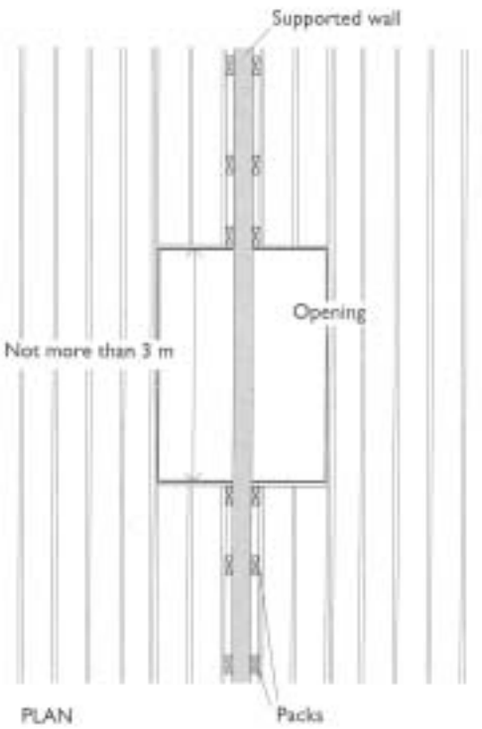


Diagram 8 **Interruption of lateral support** *Par. 1.1.3.26*



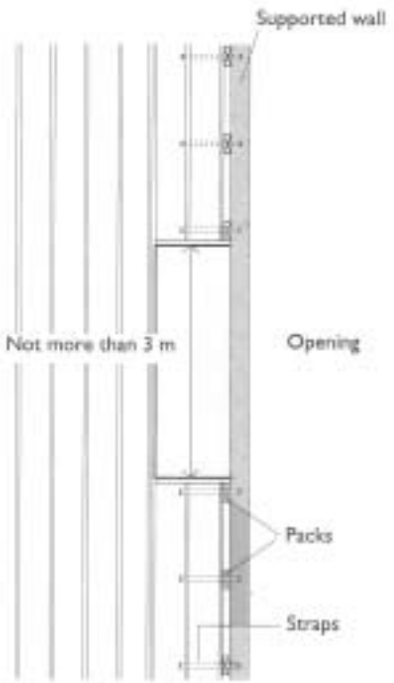
PLAN

Connection provided by timber bearing on wall or by restraint type joist hanger.



PLAN

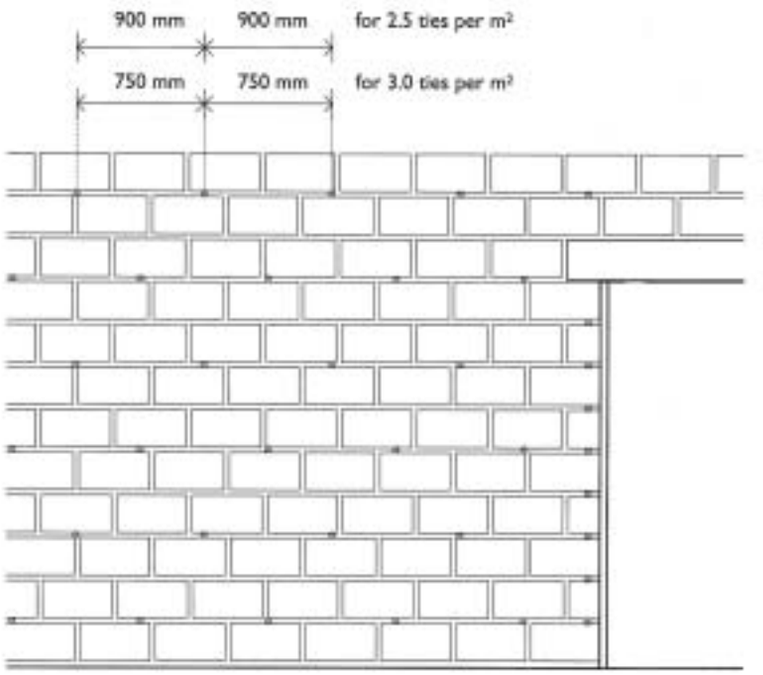
Intermittent connection provided by packs. Additional packs required near opes.



PLAN

Intermittent connection provided by straps. Additional straps required near opes.

Diagram 9 **Spacing of wall ties** *Par. 1.1.3.27*



Part 4 - Proportions for masonry chimneys above the roof surface

Height to width relationship

1.1.4.1 Where a chimney is not supported by adequate ties or otherwise made secure, its height (H), measured from the level of the highest point of intersection with the roof surface, gutter or other part of the building and including any flue pot or terminal, should not be more than X times W where:

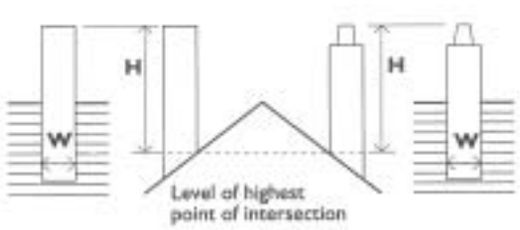
X	=	4.5 in wind zone A
X	=	4.0 in wind zone B
X	=	3.5 in wind zone C.

W is the least horizontal dimension of the chimney measured at the same point of intersection (see Diagram 10).

Notes:
The zones are described in Diagram 1.

The proportions given in this paragraph are intended for general application. More slender chimneys may be built if they can be shown by calculation to be stable in the particular wind environment of the building.

Diagram 10 **Proportions for masonry chimneys** *Par. 1.1.4.1*



Part 5 - Strip foundations of plain concrete

Conditions relating to the Subsoil

1.1.5.1 There should not be -

(a) made ground or wide variation in type of subsoil within the loaded area, or

(b) weaker type of soil at such a depth below the soil on which the foundation rests as could impair the stability of the structure.

Design provisions

1.1.5.2 The following design provisions relate to foundations -

(a) the foundations should be situated centrally under the wall,

(b) strip foundations should have minimum widths in accordance with par. 1.1.5.3,

(c) concrete should be composed of cement I.S. EN 197 - 1:2001 and fine and coarse aggregate conforming to I.S. 5: 1990 and be one of the following grades -

(i) in accordance with Table 3.4 of I.S. 326: 1995 for reinforced foundations, or

(ii) Grade 15N (characteristic 28 day strength of 15 N/mm^2) with minimum cement content 200 kg/m^3 and maximum water cement ratio 0.85 for plain concrete unreinforced foundations (when volumetric mixing is required for small projects, a 1:7 cement/aggregate mix may be used),

(d) minimum thickness T of concrete foundation should be 200 mm or P, whichever is the greater, where P is derived using Table 1 (see Diagram 11),

(e) foundations stepped on elevation should overlap by

(i) twice the height of the step, or

(ii) the thickness of the foundation, or

(iii) 300 mm,

whichever is greater (see Diagram 12),

(f) steps in foundations should not be of greater height than twice the thickness of the foundation and should course with walling material (see Diagram 12),

(g) foundation of piers, buttresses and chimneys should project as indicated in Diagram 13 and the projection X should never be less than P.

Diagram 11 **Foundation dimensions** *Par. 1.1.5.2.*

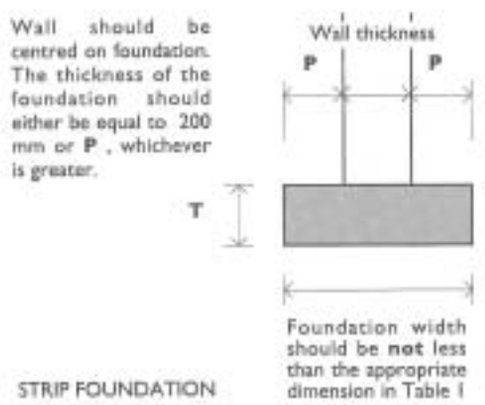


Diagram 12 **Elevation of stepped foundation** *Par. 1.1.5.2*

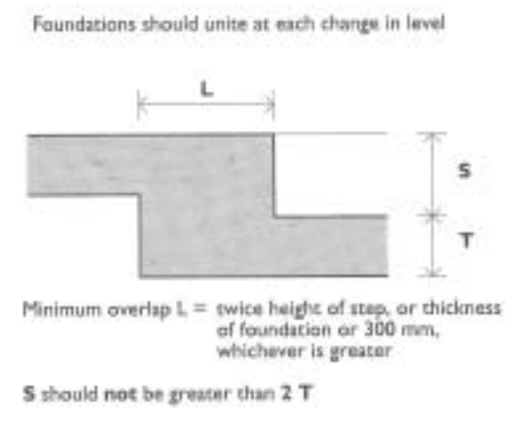
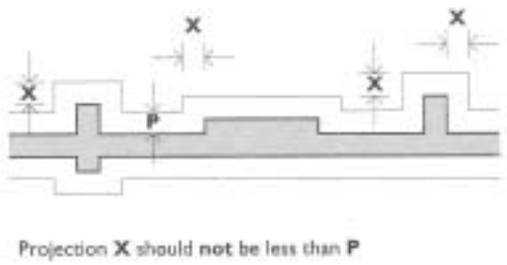


Diagram 13 **Piers and chimneys** *Par. 1.1.5.2*



1.1.5.3 Minimum width of strip foundations - Providing the previous conditions relating to the subsoil (par. 1.1.5.1) and design provisions relating to the foundations (par. 1.1.5.2) are observed and the type and condition of subsoil is known and loading at the base of the wall is within acceptable limits, the recommended widths of foundations given in Table 1 may be used.

Table 1 **Minimum width of strip foundations**

Type of subsoil	Condition of subsoil	Field test applicable	Total load of load-bearing walling not more than (kN/linear metre) 30	40	50	60	70
			Minimum width of strip foundation (mm)				
I rock	not inferior to sandstone, limestone or firm chalk	requires at least a pneumatic or other mechanically operated pick for excavation	In each case the width (wt) of wall plus 150 mm				
II gravel sand	compact compact	requires pick for excavation. A wooden peg 50 mm square in cross section hard to drive beyond 150 mm	400	400	500	600	650
III clay sandy clay boulder clay	stiff stiff stiff	cannot be moulded with the fingers and requires a pick or pneumatic or other mechanically operated spade for its removal	400	400	500	600	650
IV clay sandy clay boulder clay	firm firm firm	can be moulded by substantial pressure with the fingers and can be excavated with a spade	400	450	500	600	650
V sand silty sand clayey sand boulder clay	loose loose loose loose	can be excavated with a spade. A wooden peg 50 mm square in cross section can be easily driven					
VI silt clay sandy clay silty clay	soft soft soft soft	fairly easily moulded in the fingers and readily excavated	Note: Where there is any doubt as to the condition of the subsoil, and always in the case of subsoil types V, VI and VII, an appropriate site investigation, on which the foundation design can be based, is essential.				
VII silt clay sandy clay silty clay	very soft very soft very soft very soft	natural sample in winter conditions exudes between fingers when squeezed in fist					

In no case should the width of the foundation be less than the total width of the wall plus 75 mm on each side.

Sub-section 2
Design and Construction of all Building Types - Codes, Standards and References

Introduction

1.2.1 - The following Codes, Standards and References are appropriate for all buildings and may be used to meet Requirements A1 and A2 provided that -

- the design and construction of a structure is in accordance with the relevant recommendations of the Codes, Standards and References, and

- where alternative Codes and Standards have been listed, the whole of the design for the same material should normally be based on one of the codes only.

Where reference is made to an Irish or British Code of Practice it should be noted that Eurocodes covering the same topic which have been issued by CEN as provisional Euronorms may be used subject to the requirements of the Irish National Application Document for the relevant Eurocode.

Codes, Standards and References

Loading

BS 6399 : Part 1 (For dead and imposed loads, other than imposed roof loads)

BS 6399: Part 2 (For wind loads and using the wind speed map in diagram 15 A)

BS 6399 : Part 3 (For imposed roof loads and using the snow load map in Diagram 14)

CP 3: Chapter V: Part 2: 1972 (For wind loads (although in no case shall the factor S3 be taken at less than 1) and using the appropriate basic wind speed shown on the map in Diagram 15) supplemented, as appropriate, by BRE Digest 346.

Note:
Exceptionally, where the actual load is greater than the BS 6399: Part 1: 1984 design loads, the actual load should be used, having regard to par. 1.0.3 of this Technical Guidance Document.

Foundations - general
BS 8004: 1986

Structural work of reinforced, prestressed or plain concrete
I.S. 326: 1995

Structural work of composite steel and concrete construction
BS 5950: Part 3: Section 3.1: 1990

Structural work of steel
BS 5950: Part 1: 1990
BS 5950: Part 2: 1992
BS 5950: Part 4: 1994
BS 5950: Part 5: 1987

Structural work of aluminium
CP 118: 1969 using one of the principal or supplementary aluminium alloys designated in Section 1.1 of that code, and for the purposes of Section 5.3 of that code, the structure should be classified as a safe-life structure.

BS 8118: Part 1: 1991, for the purposes of Section 7 of that standard, the structure should be designed to provide a safe life.

BS 8118: Part 2: 1991

Structural work of masonry
I.S. 325 Part 1: 1986
I.S. 325 Part 2: 1995
BS 5628: Part 2: 1985

Structural work of timber
I.S. 193: 1986
SR 11 : 1988
BS 5268: Part 2: 1991

Structural work of glass
BS 6262: 1982
BS 6262: Part 4: 1994

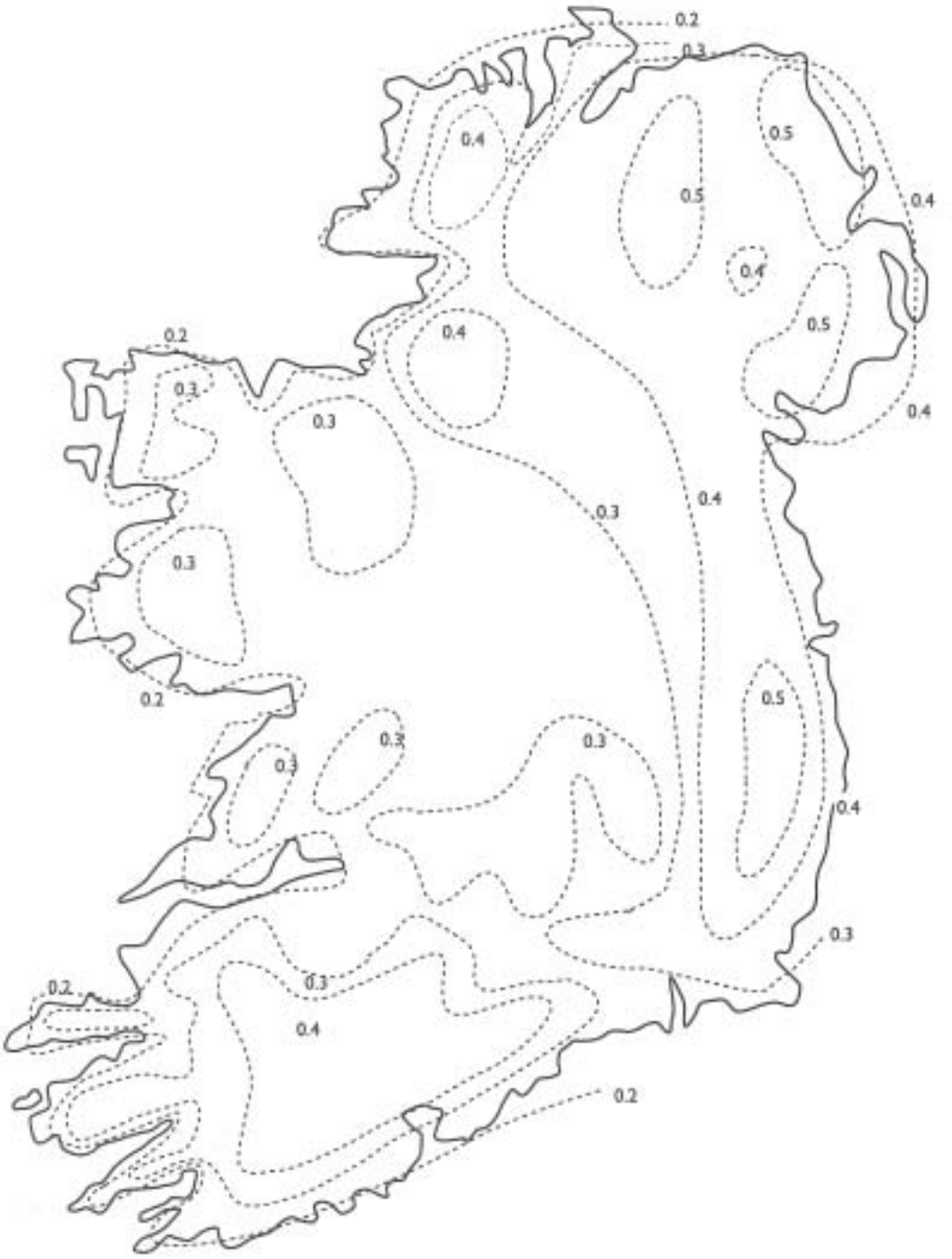
Appraisal of existing buildings
In the case of material alterations and changes of use the following provide guidance on the appraisal of existing buildings including multi-storey buildings.

Institution of Structural Engineers: Appraisal of existing structures, 1980.

Building Research Establishment Digest 366: Structural appraisal of existing buildings for change of use.

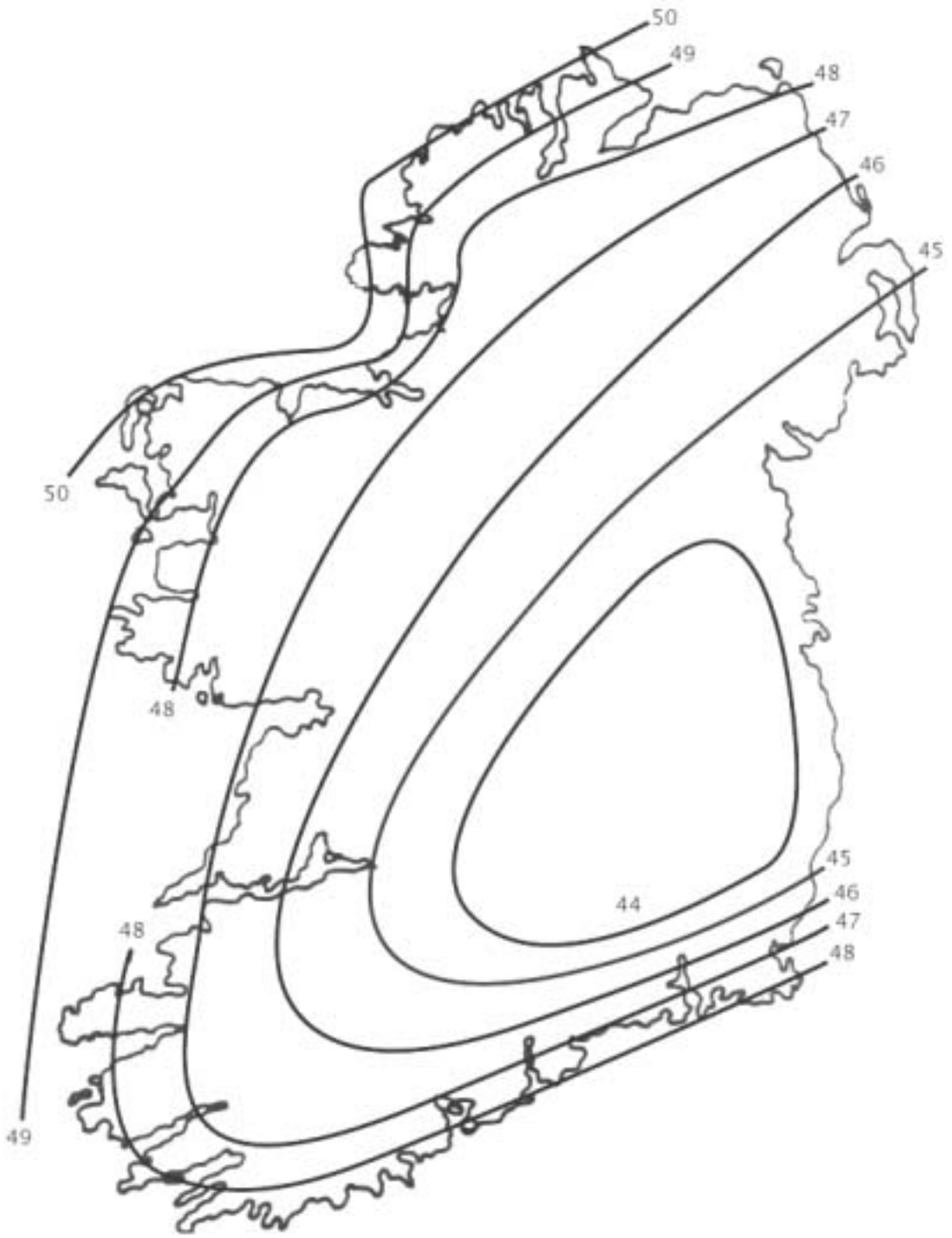
Construction Industry Research and Information Association. Structural Renovation of Traditional Buildings, Report 111, 1986.

Diagram 14 **Basic snow load on the ground in kN/m^2** *Par. 1.0.1*



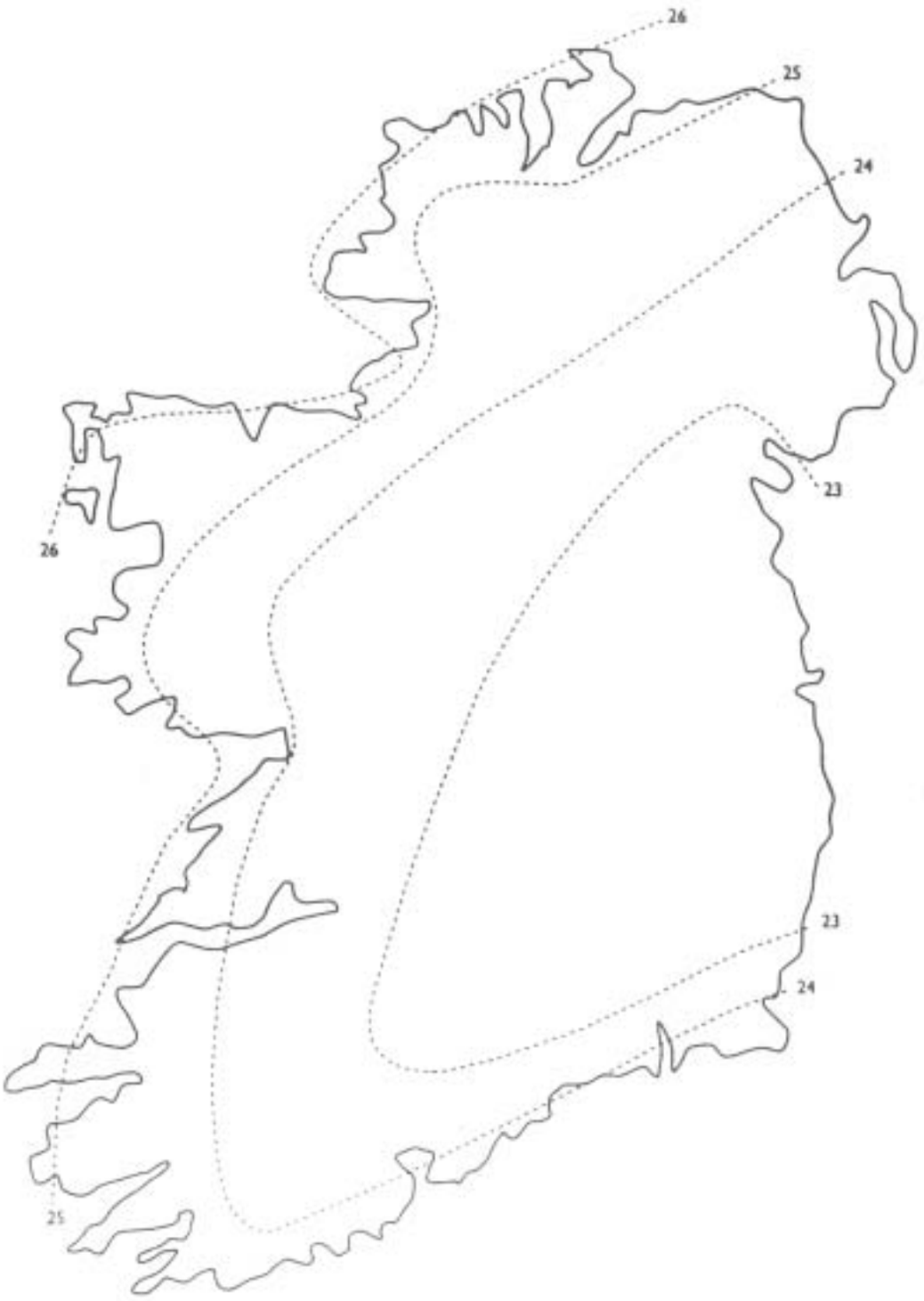
Ground Level assumed to be 100 m above mean sea level
(produced on the basis of snow depth data supplied by Met Eireann)

Diagram 15 **Wind Speeds** *Par. 1.0.1*



Estimated maximum gust speed (m/s) with return period 50 years.
Valid for a height of 10 m above open level country.
Note: For sites on the south, west and north coasts increase by 2%
(Data supplied by Met Eireann).

Diagram 15A **Wind Speed** *Par. 1.0.1*



Estimated maximum 60-minute wind speed (m/s) with return period 50 years. Valid for a height of 10m above terrain of category 11 (farmland with boundary hedges, occasional small form structures, houses or trees).
Data supplied by met Eireann.

Sub-section 3
Recovering of Existing Roof Structures and Structural Safety of External Wall Cladding

Recovering of existing roof structures

1.3.1 Where new roof coverings would impose higher loads on the roof structure or where the new material would be lighter than the original material, strengthening measures may be required. The following procedure is recommended:

(a) arrange for a thorough structural survey of the existing roof structure and the vertical restraints,

(b) check the dry mass per unit area of the proposed roof covering and compare it with that of the existing roof covering,

(c) make allowance for the increase in load due to water absorption, e.g. 0.3% for oven dry slates and up to 10.5% for clay plain tiles and concrete tiles,

(d) check if the roof structure is capable of sustaining the increased load or if the vertical restraints provided to the roof structure are adequate for the wind uplift (the uplift may result due to the use of lighter roofing material and/or provision of new underlay),

(e) provide appropriate strengthening measures such as:

  (i) replacement of defective members and vertical restraints,

  (ii) additional structural members such as trusses, rafters, bracings, or purlins, etc., required to sustain increased loading,

  (iii) restraining straps, additional ties and fixings to the walls to resist wind uplift.

Structural safety of external wall cladding

General

1.3.2 The remainder of this sub-section includes guidance for the design and construction of external wall cladding. The guidance is applicable to cladding which by reason of weight or height would present a hazard if it became detached from the building. For the purposes of this section, cladding is deemed to include glazed curtain walling but not windows.

1.3.3 These provisions are not intended to provide guidance concerning the weather resistance of wall cladding which is included in Technical Guidance Document C.

1.3.4 Wall cladding should be capable of safely sustaining and transmitting to the supporting structure of the building all dead, imposed and wind loads.

1.3.5 Wall cladding should be securely fixed to and supported by the supporting structure of the building. This should comprise both vertical support and hold back restraint.

1.3.6 Provision should be made, where necessary, to accommodate differential movement of the cladding and the supporting structure of the building.

1.3.7 The cladding and its fixings should be of durable materials, the anticipated life of the fixings being not less than that of the cladding. Where the fixings are not readily accessible for inspection and maintenance, particular care will be required in the choice of materials and standard of workmanship to be achieved (see Technical Guidance Document D).

Technical approach

1.3.8 Loading - Wind loading on the wall cladding should be derived from CP 3: Chapter V: Part 2: 1972, supplemented, as appropriate, by BRE Digest 346, using Class A building size for determining ground roughness factor S2. In no case should the factor S3 be taken as less than 1. Forces imposed on wall cladding by ladders or access cradles for the purpose of maintenance should be derived from a consideration of the equipment likely to be used.

1.3.9 Where the wall cladding is required to support other fixtures, e.g. antennae, signboards, etc., full account should be taken of the loads and forces arising from such fixtures.

1.3.10 Where the wall cladding is required to function as pedestrian guarding to a stairway, ramp, vertical drop or vehicle barrier, then account should be taken of the additional imposed loading, as stipulated in Technical Guidance Document K.

1.3.11 For sports stadia, imposed loading should be that stipulated in Table 3 of BS 6180, where the wall cladding is required to function as pedestrian guarding.

1.3.12 Fixings - For design purposes, the strength of a fixing should be derived from tests using materials representative of the base material of the structure into which the fixing is to be anchored. Account should also be taken of any inherent weaknesses in the base material of the structure that may affect the strength of the fixing, e.g. cracks due to shrinkage or flexure.

1.3.13 For the purpose of such tests the following Standards and Reference may be used:

BS 5080: Part 1: 1993 and BS 5080: Part 2: 1986 (1993).

UEAtc Technical Guide on Anchors for use in cracked and non-cracked concrete. MOAT No 49.

BS 5427: 1976

1.3.14 Where expanding bolt type fixings are provided, their safe working shear and tensile loads should not exceed the lower of the following values -

(a) A factor of safety of 3 applied to: the mean shear or tensile failure test load less 3 times the standard deviation derived from the tests.

(b) The mean of the loads which cause a displacement of 0.1 mm under direct tension and 1.0 mm under direct shear.

The design of certain resin bonded fixings should take account of their rapid loss of strength at temperatures above 50°C.

The component parts of mechanical fixings should be lockable or be otherwise mechanically fixed together to prevent unintended slippage between the parts.

1.3.15 Movement - Guidance is given in BS 8200: 1985 and I.S. 325: Part 2: 1995 on the means of providing for the differential movement of the wall cladding and the supporting structure of the building.

Codes and Standards

1.3.16 The following Codes and Standards may be used in designing wall cladding:

General
BS 8200: 1985

Loading
CP 3: Chapter V: Part 2: 1972 Wind loads supplemented as appropriate by BRE Digest 346, (although in no case shall the factor S3 be taken as less than 1).

Stone and concrete cladding
I.S. 326: 1995
BS 8297: 1995
BS 8298: 1994

Masonry cladding
I.S. 325: Part 1: 1986
I.S. 325: Part 2: 1995
BS 5628: Part 2: 1995

Steel cladding
BS 5950: Part 1: 1990
BS 5950: Part 5: 1987

Aluminium cladding
CP 118: 1969
BS 8118: Part 1: 1991

Timber cladding
BS 5268: Part 2: 1991

Profiled sheet cladding
BS 5427: 1976

Glass cladding
BS 5516: 1991

Section 2
Disproportionate Collapse

Disproportionate collapse.	A3	(1)	A multi-storey building shall be designed and constructed, with due regard to the theory and practice of structural engineering, so as to ensure that in the event of an accident the structure will not be damaged to an extent disproportionate to the cause of the damage.
		(2)	For the purposes of sub-paragraph (1), where a building is rendered structurally discontinuous by a vertical joint, the building on each side of the joint may be treated as a separate building whether or not such joint passes through the substructure.

Codes and Standards

2.1 The following Codes and Standards may be used in designing to meet the Requirement A3 provided the recommendations on ties and the recommendations on the effect of misuse or accident are followed.

Structural work of reinforced, prestressed or plain concrete

I.S. 326 : 1995

Structural work of steel

BS 5950: Part 1: 1990 (The accidental loading referred to in Clause 2.4.5.5 should be chosen having particular regard to the importance of the key element and the consequences of failure, and the key element should always be capable of withstanding a load of at least 34 kN/m^2 applied from any direction).

Structural work of masonry
I.S. 325 : Part 1: 1986
I.S. 325 : Part 2: 1995

Additional information

2.2 Structural failure of any member not designed as a protected key element or member in any one storey should not result in failure of the structure beyond the immediately adjacent storeys or beyond an area within those storeys of:

(a) 70 m^2, or

(b) 15 per cent of the area of the storey,

whichever is less. Protected key elements or members are single structural elements on which large parts of the structure rely (i.e. supporting a floor or roof area of more than 70 m^2 or 15 per cent of the area of the storey, whichever is less). Their design, which should take their importance into account, and the least loadings they have to withstand are described in the Codes and Standards listed above.

Standards and other references

I.S. EN 197 - 1:2001

I.S. 5: 1990 Aggregates for Concrete

I.S. 20: 1974 Concrete Building Blocks

I.S. 20: Part 1: 1987 Concrete Building Blocks, Part 1 Normal Density Blocks

I.S. 91: 1983 Clay Building Bricks

I.S. 189: 1974 Concrete Building Bricks

I.S. 190: 1974 Calcium Silicate Building Bricks

I.S. 193: 1986 Timber Trussed Rafters for Roofs

I.S. 240: 1980 Precast Prestressed Concrete Units for use in Composite Lintels

I.S. 268: 1986 Metal Wall Ties for Masonry Walls

I.S. 325: Code of Practice for Use of Masonry Part 1: 1986 Structural Use of Unreinforced Masonry

I.S. 325: Code of Practice for Use of Masonry Part 2: 1995 Masonry Construction

I.S. 326: 1995 Concrete

I.S. 406: 1987 Masonry Mortars

SR 11: 1988 Structural Timber for Domestic Construction

BS 1297: 1987 Specification for tongued and grooved softwood flooring

BS 4471: 1987 Specification for sizes of sawn and processed softwood AMD 8901

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UEAtc Technical Guide on Anchors for use in Cracked and Non-cracked Concrete. MOAT No. 49