Technical Handbook - Domestic

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Structure

1.0 Introduction

1.0.1 Background

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

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

The Standing Committee on Structural Safety (SCOSS) is an independent body supported by the Institution of Civil Engineers, the Institution of Structural Engineers and the Health and Safety Executive to maintain a continuing review of building and civil engineering matters affecting the safety of structures. The prime function of SCOSS is to identify in advance those trends and developments that might contribute to an increasing risk to structural safety. The collation and dissemination of information relating to matters of structural concern is a vital element of achieving safe structures. SCOSS has established a UK wide confidential reporting system (CROSS) to gather data on structural problems.

Appraisal of existing buildings - conversions to existing buildings present particular problems and an appraisal of the existing structure for its new occupation or use should be undertaken to ensure that appropriate measures are taken to meet the requirements of regulation 12. Guidance on how a structural appraisal may be undertaken is given in 'Appraisal of Existing Structures', 1996 published by the Institution of Structural Engineers.

Procurement - the contractual arrangements used by clients to procure a building can have important consequences for the reliability of the design and the adequacy of the construction. Frequently, building design procurement will involve the appointment of a number of designers who may be employed by more than one organisation. Detailed design of individual structural details and components can be passed to specialist contractors. In these circumstances the client should appoint a lead designer or other appropriately experienced and qualified person to oversee the design process.

1.0.2 Aims

The intention of this section is to ensure that the structure of a building shall be designed and executed in such a way that, during its intended life, it will not pose a threat to the safety of people in and around the building with an appropriate degree of reliability. To achieve a structure with adequate structural resistance, serviceability and durability the following should be taken into account:

a. the loadings (actions) on the building

b. nature of the ground

c. collapse or deformations

d. stability of the building and other buildings

e. climatic conditions

f. materials

g. structural analysis, and

h. details of construction.

The actions on the building will comprise a set of loads applied directly to the structure that will include dynamic, concentrated and peak load effects, together with a set of imposed deformations caused for example by temperature changes or uneven settlement.

1.0.3 Latest changes

The following is a summary of the changes made to this section since 1 May 2009.

1.0.1 reference to SCOSS updated

1.0.1 guidance for clients on procurement added

1.0.2 aims re-written to reflect Structural Eurocodes

1.0.4 guidance on relevant legislation added for CDM regulations

1.0.5 guidance on alternative approaches added including the use of withdrawn British Standards

1.0.7 clause on certification introduced

1.1.1 reference to guidance on fixings and stone masonry added

1.1.2 reference to Structural Eurocodes added for loadings

1.1.3 reference to Structural Eurocodes added for design and construction

1.1.4 reference to BS EN 1997-2:2007 added for geotechnical investigation of the site

1.1.5 reference to BS EN 1997-1:2004 added for design of foundations adjacent to existing buildings

1.2.1 guidance in relation to disproportionate collapse updated to align with Structural Eurocodes, and

1.A. Annex A - list of structural Eurocodes and corresponding British Standards to be withdrawn added.

The previous annexes forming the Small Buildings Structural Guidance (SBSG) have been removed from the Technical Handbook and are now referenced in clause 1.0.5.

Minor alterations and corrections have also been made. A full list of changes to this edition of the Technical Handbooks is available on the Building Standards website.

1.0.4 Relevant legislation

The Construction (Design and Management) Regulations 2007 are intended to protect people working in construction and others who may be affected by their activities. The regulations require the systematic management of projects from concept to completion and throughout the life cycle of the structure, including eventual demolition. Clients have a duty to ensure that competent people are employed to do the work, that sufficient time is allocated for the work to be undertaken and that the various members of the design and construction teams co-operate and exchange information.

1.0.5 Alternative approaches

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

The British Standards Institution (BSI) agreement with the European Committee for Standardisation (CEN) obliges it to withdraw UK national standards after a harmonised European Standard with the same scope and field of application has been produced. Withdrawal of a standard implies that while documents will still be available there will be no support or five-year review by a BSI committee to consider the currency of the standard and to decide whether it should be confirmed, revised or withdrawn. BSI, in line with this commitment, will be 31 March 2010 replace the British Standards relating to loading and structural design with the European Standards and associated National Annexes listed in Sections 1.1.2 and 1.1.3 of this guidance.

Whilst other guidance documents or international standards, including withdrawn national standards might be used in alternative approaches to satisfy building regulations, designers, verifiers, or in the case of certified projects, the approved certifiers of design (building structures) will need to satisfy themselves that the use of such guidance is appropriate for a specific project. Care should be exercised, particularly with withdrawn standards, in relation to wind and snow loadings (actions) where the effects of climate change may render these unsafe.

Where alternative approaches use design methods or codes other than those listed in this guidance then these must be used within the context of the assumptions set out in Section 1.1.3. Designs must be checked in order to deliver similar levels of design reliability.

The Small Buildings Structural Guidance (SBSG) provides structural guidance to designers of small domestic buildings on how to comply with Standard 1.1. The guidance was published in Section 1 (Annexes 1.A to 1.F) of the Technical Handbooks in May 2005 (updated in 2007) and based on British Standards which have now been withdrawn. The SBSG, together with research on the impact of the Structural Eurocodes on masonry construction, is available on the Building Standards Division website http://www.scotland.gov.uk/Topics/Built-Environment/Building/Building-standards. The SBSG has been written for those with expertise in building design and construction but not necessarily in structural engineering design. Where the conditions or parameters fall outside the scope of the guidance, then specialist advice should be sought from approved certifiers of design, chartered engineers or other appropriately qualified persons.

1.0.6 Annex

A list of structural Eurocodes and corresponding British Standards to be withdrawn is contained in Annex 1A.

1.0.7 Certification

Scottish Ministers can, under Section 7 of the Building (Scotland) Act 2003, approve schemes for the certification of design or construction for compliance with the mandatory functional standards. Such schemes are approved on the basis that the procedures adopted by the scheme will take account of the need to co-ordinate the work of various designers and specialist contractors. Individuals approved to provide certification services under the scheme are assessed to ensure that they have the qualifications, skills and experience required to certify compliance for the work covered by the scope of the scheme. Checking procedures adopted by Approved Certifiers will deliver design or installation reliability in accordance with legislation.

The Certification of Design (Building Structures) scheme has been approved by Scottish Ministers to confirm compliance with Standards 1.1 and 1.2. Details are available on the Building Standards Division website http://www.scotland.gov.uk/Topics/Built-Environment/Building/Building-standards.

1.1 Structure

Mandatory Standard

Standard 1.1

Every building must be designed and constructed in such a way that the loadings that are liable to act on it, taking into account the nature of the ground, will not lead to:

a. **the collapse of the whole or part of the building**

b. **deformations which would make the building unfit for its intended use, unsafe, or cause damage to other parts of the building or to fittings or to installed equipment, or**

c. **impairment of the stability of any part of another building.**

1.1.0 Introduction

The loadings on the building will comprise actions that may be applied both separately and in various combinations.

The stability of a building and other existing buildings in the vicinity can be affected by ground conditions which should be investigated and assessed to ensure that the ground can safely support the building.

The collapse of the whole or part of a building is clearly a matter of the highest importance with respect to public safety. The design and construction of buildings should take into account all contributing factors such as loadings, climatic conditions, partial safety factors for materials and loadings, and design methodology to ensure that there is an acceptable probability that the building will not collapse (ultimate limit state) during its design lifetime.

Similarly deformations of buildings while not leading to an ultimate collapse can lead to public safety concerns particularly where they become unfit or unsafe for use. This can become apparent in several ways ranging from cracking, movement or springiness of floors, doors or windows not opening or closing, damage to pipes and other services within the building. The design and construction of a building should ensure that, by taking into account the factors set out above, the building does not fail in normal use (serviceability limit state).

The stability of existing **buildings** can be affected if the design and construction of a new building does not take into account any potential impacts on existing buildings. This could lead to a risk of collapse or damage to existing buildings with a consequent risk to public safety.

Conversions - in the case of conversions, as specified in regulation 4, the building as converted shall meet the requirements of this standard in so far as is reasonably

practicable, and in no case be worse than before the conversion (regulation 12, schedule 6).

1.1.1 General

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

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

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

Fixings - the SCOSS committee has expressed concern that safety critical fixings do not always receive the attention that they deserve. Fixings are important structural components. Designers must be satisfied that fixings receive the same consideration as other aspects of the design in terms of their selection, design, installation, inspection and testing. A SCOSS ALERT “The Selection and Installation of Construction Fixings” has been issued and can be found on the SCOSS website http://www.cross-structural-safety.org.

Stone Masonry - the Scottish Stone Liaison Group publication ‘natural stone masonry in modern Scottish construction’ provides guidance in the use of natural stone in new construction. Guidance includes information on stone and mortar selection, soiling of facades and design details for structures and moisture control http://www.scotland.gov.uk/Topics/Built-Environment/Building/Building-standards.

1.1.2 Loading

Any reference to European Standards for Structure (Structural Eurocodes) in this section must be taken to include reference to the relevant UK National Annex.

The loadings to which a building will be subjected should be calculated in accordance with the appropriate Structural Eurocodes:

a. for densities, self-weight and imposed loadings, BS EN 1991-1-1: 2002 (Eurocode 1)

b. for snow loadings, BS EN 1991-1-3:2003 (Eurocode 1)

c. for wind loadings, BS EN 1991-1-4:2005 (Eurocode 1)

d. for earth retaining structures, BS EN 1997-1:2004 (Eurocode 7)

e. any greater loadings to which the building is likely to be subjected.

1.1.3 Design and construction

Any reference to European Standards for Structure (Structural Eurocodes) in this section must be taken to include reference to the relevant UK National Annex.

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

a. for foundations, BS EN 1997-1:2004 (Eurocode 7)

b. for structural work of reinforced, pre-stressed or plain concrete, BS EN 1992-1-1:2004 (Eurocode 2)

c. for structural work of steel, BS EN 1993-1-1:2005 (Eurocode 3)

d. for structural work of cold form, thin gauge steel members and sheeting BS EN 1993-1-3:2006 (Eurocode 3)

e. for structural work of composite steel and concrete construction, BS EN 1994-1-1:2004 (Eurocode 4)

f. for structural work of aluminium, BS EN 1999-1-1:2007 (Eurocode 9)

g. for structural work of masonry, BS EN 1996-1-1:2005 or BS EN 1996-3:2006 Simplified calculation rules for masonry structures (Eurocode 6)

h. for structural work of timber, BS EN 1995-1-1:2004 (Eurocode 5) or in the case of floors and roofs to domestic buildings of not more than three storeys BS 8103 Part 3 - 2009

i. for earth retaining structures BS EN 1997-1:2004 (Eurocode 7).

The reliability of designs carried out in accordance with these codes is based on a number of assumptions set out in BS EN 1990:2002 that include:

- the choice of the structural system and the design of the structure is made by appropriately qualified and experienced personnel
- the design and construction is carried out by personnel having the appropriate skill and experience
- adequate supervision and quality control is provided during execution of the work
- the construction materials and products are used as specified in BS EN 1990 or in BS EN 1991 to BS EN 1999 or in the relevant execution standards, or reference material or product specifications
- the structure will be adequately maintained, and
- the structure will be used in accordance with the design assumptions.

Those responsible for procuring the design and construction of buildings based on Structural Eurocodes should be aware of these assumptions and should ensure that they have employed individuals with the necessary qualifications, skills and experience and that appropriate procedures for checking designs have been adopted.

1.1.4 Nature of the ground

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

- swelling, shrinkage or freezing of the subsoil, or
- landslip, or
- subsidence such as that arising from the collapse of abandoned mineral workings or quarrying operations.

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

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

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

- British Geological Survey, Murchison House, West Mains Road, Edinburgh, EH9 3LA http://www.bgs.ac.uk
- The Coal Authority, 200 Lichfield Lane, Mansfield, Nottinghamshire, NG18 4RG http://www.coalminingreports.co.uk

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

Where new foundations are to be constructed or existing foundations altered it will generally be necessary to undertake a geotechnical investigation of the site. This should be carried out using the methods described in BS EN 1997-2: 2007.

1.1.5 Stability of existing buildings

The stability of existing buildings may be affected by a new building located in their vicinity. Care must be taken to avoid undermining the foundations or otherwise affect the stability of existing buildings. The design of foundations adjacent to existing buildings should be carried out in accordance with the recommendations of BS EN 1997-1:2004.

Factors that can also affect the stability of an existing building and should be taken into account include:

- additional or new loads arising from the construction of the new building
- increased or new wind loads arising from the construction of the new building
- pressure bulb extending below existing building
- changes in groundwater level
- loss of fines during pumping operations or climatic conditions.

1.2 Disproportionate Collapse

Mandatory Standard

Standard 1.2

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

1.2.0 Introduction

All buildings must be designed to accommodate unforeseen or accidental actions in such a way as to prevent the extent of any resulting collapse being disproportionate to the cause of the collapse. Buildings should be designed so that they are robust which is defined in BS EN-1991-1-7:2006 as the ability of a structure to withstand events like fire, explosions, impact or the consequences of human error without being damaged to an extent disproportionate to the original cause.

Explanation of terms

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

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

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

Key element is a structural member upon which the stability of the remainder of the structure depends and should be capable of sustaining an accidental design loading of $34kN/m^2$ applied in the horizontal and vertical directions (in one direction at a time) to the member and any attached components such as cladding, having regard to the ultimate strength of such components and their connections. Such accidental design loading should be assumed to act simultaneously with 1/3rd of all normal characteristic loading.

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

Fire - the protection to be afforded to the structure of a building when it is exposed to the action of fire is dealt with by mandatory Standard 2.3. The guidance within Section 2 refers to relevant codes that should be used for the design of the structure in a fire.

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

1.2.1 Disproportionate collapse

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

Buildings should be provided with a level of robustness by adopting the principles of risk analysis, categorising buildings, taking into account both the risk of the hazard and its consequences and providing additional measures commensurate to the level of risk and consequences of such collapse of the building. The risk level and accidental actions that should be considered when undertaking the structural design of a building for disproportionate collapse should be in accordance with the recommendations of BS EN 1991-1-7:2006 or the method set out below.

Any reference to European Standards for Structure (Structural Eurocodes) in this section must be taken to include the relevant UK National Annex.

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

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

1.2.2 Determine building risk group

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

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

Table 1.1 Determine building risk group

Risk Group	Building Type
1	Houses not more than 4 storeys
	Carports, Conservatories and Greenhouses
	Domestic garages and other small single leaf buildings not more than 1 storey
2A	5 storey houses
	Flats and maisonettes not more than 4 storeys
2B	Flats and maisonettes more than 4 storeys but not more than 15 storeys
3	Every domestic building not covered in Risk Groups 1, 2A and 2B

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

In determining the number of storeys in a building, basement storeys may be excluded provided such basement storeys fulfil the robustness of Risk Group 2B buildings.

For buildings intended for more than one type of use the Risk Group should be that pertaining to the most onerous Risk Group.

1.2.3 Assess additional measures

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

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

Risk Group 1 buildings - no additional measures are likely to be necessary when the building has been designed and constructed in accordance with the rules given in this

Technical Handbook, or other guidance referenced under Section 1, for complying with Standard 1.1 in normal use.

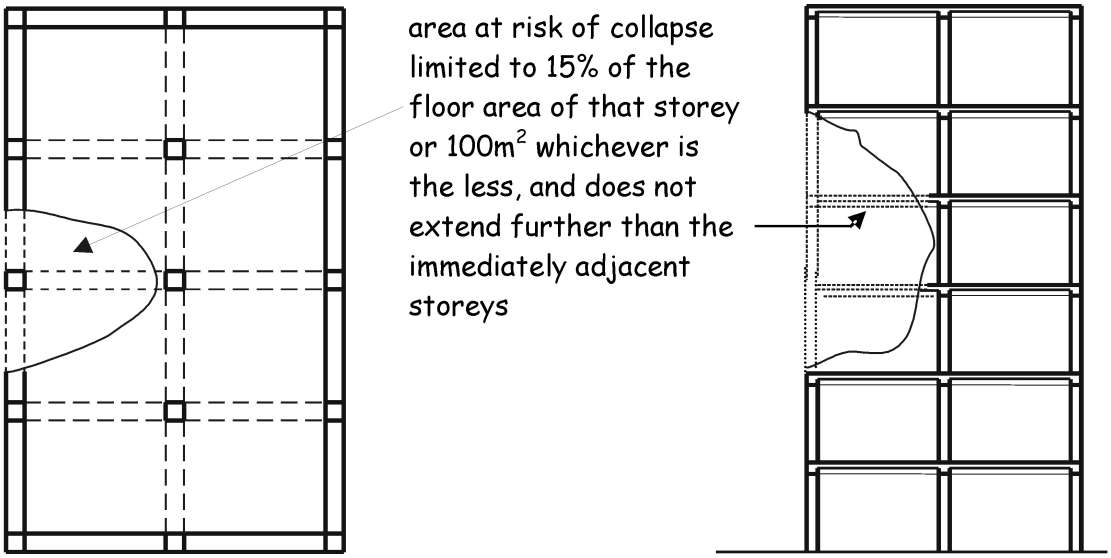
Risk Group 2A buildings - provide effective horizontal ties, or effective anchorage of suspended floors to walls, for framed and load-bearing wall construction.

Risk Group 2B buildings - provide effective horizontal ties for framed and load-bearing wall construction, together with effective vertical ties, in all supporting columns and walls.

Alternatively, check that upon the notional removal of each supporting column and each beam supporting one or more columns, or any nominal length of load-bearing wall (one at a time in each storey of the building) the building should remain stable and that the area of floor at any storey at risk of collapse should be not more than 15% of the floor area of that storey or $100m^2$, whichever is the less and does not extend further than the immediate adjacent storeys (see diagram below).

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

Figure 1.1 Floor collapse limit



Risk Group 3 buildings - a systematic risk assessment of the building should be carried out, taking into account all the normal hazards that can be foreseen as far as possible together with any abnormal hazards.

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

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

1.2.4 Design and construct additional measures

The structural design and construction to take account of the additional measures including horizontal and vertical ties where appropriate and checking the integrity of the building following the notional removal of vertical members and the design of key elements, should be carried out in accordance with the design recommendations contained in Annex A of BS EN 1991-1-7:2006.

1.2.5 Other sources of guidance

More detailed information has been produced by organisations on disproportionate collapse as follows:

a. Technical Guidance Note ‘The Building Regulations 2004 Edition – England and Wales Requirement A3 – Disproportionate Collapse’, National House Building Council (NHBC)

b. Technical Bulletin Number 3 ‘Design Guidance for Disproportionate Collapse’, UK Timber Frame Association

c. ‘Masonry Design for Disproportionate Collapse Requirements under Regulation A3 of the Building Regulations (England & Wales)’, Brick Development Association

d. 'Guidance on meeting the Robustness Requirements in Approved Document A', Steel Construction Institute

e. 'How to design concrete buildings to satisfy disproportionate collapse requirements' http://www.concretecentre.com/

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

Annex 1.A Structural Design Standards

1.A.0 Introduction

The British Standards Institution (BSI) agreement with the European Committee for Standardisation (CEN) obliges it to withdraw UK national standards after a harmonised European Standard with the same scope and field of application has been produced. BSI, in line with this commitment, will by 31 March 2010 replace the British Standards relating to loading and structural design with the European Standards and associated National Annexes listed in the tables below:

1.A.1 Structural Design Standards [1]

Table 1.2 Eurocode: Basis of structural design

Eurocode: Basis of structural design	Corresponding BS to be withdrawn
BS EN 1990: 2002 Basis of structural design	
Note: Some sections of EN 1990 correspond with BS 5268-2, BS 5628-1, BS 5950-1 and BS 8110-1 and 2. BS 5400-1 which is not referred to in Section 1: Structure also has some content that corresponds to EN 1990.	

Table 1.3 Eurocode 1: Actions on structures

Eurocode 1: Actions on structures	Corresponding BS to be withdrawn
BS EN 1991-1-1: 2002 Actions on structures. General actions. Densities, self-weight, imposed loads for buildings	BS 6399-1, BS 6399-3, BS 648
BS EN 1991-1-2: 2002 Actions on structures. General actions. Actions on structures exposed to fire	
BS EN 1991-1-3: 2003 Actions on structures. General actions. Snow loads	BS 6399-3

Eurocode 1: Actions on structures	Corresponding BS to be withdrawn
BS EN 1991-1-4: 2005 Actions on structures. General actions. Wind actions	BS 6399-2, BS 5400-2
BS EN 1991-1-5: 2003 Actions on structures. General actions. Thermal actions **Note:** Some sections of EN 1991-1-5 relating to bridges correspond to BS 5400-2	
BS EN 1991-1-6: 2005 Actions on structures. General actions. Actions during execution	
BS EN 1991-1-7: 2006 Actions on structures. General actions. Accidental actions	Minimal guidance in BS 6399-1. Some sections of EN 1991-1-7 correspond with BS 6399-1, BS 5268-1, BS 5628-1, BS 5950-1, BS 8110-1 and 2 and BS 5400-3
BS EN 1991-2: 2003 Actions on structures. Traffic loads on bridges	BS 5400-2
BS EN 1991-3: 2006 Actions on structures. Actions induced by cranes and machines	
BS EN 1991-4: 2006 Actions on structures. Silos and tanks	

Table 1.4 Eurocode 2: Design of concrete structures

Eurocode 2: Design of concrete structures	Corresponding BS to be withdrawn
BS EN 1992-1-1: 2004 Design of concrete structures. General rules and rules for buildings	BS 8110-1, BS 8110-2, BS 8110-3
BS EN 1992-1-2: 2004 Design of concrete structures. General rules. Structural fire design	BS 8110-1, BS 8110-2
BS EN 1992-2: 2005 Design of concrete structures. Concrete bridges. Design and detailing rules	BS 5400-4, BS 5400-7, BS 5400-8
BS EN 1992-3: 2006 Design of concrete structures. Liquid retaining and containing structures	BS 8007

Table 1.5 Eurocode 3: Design of steel structures

Eurocode 3: Design of steel structures	Corresponding BS to be withdrawn
BS EN 1993-1-1: 2005 Design of Steel structures. General rules and rules for buildings	BS 5950-1, BS 5400-3
BS EN 1993-1-2: 2005 Design of steel structures. General rules. Structural fire design	BS 5950-8
BS EN 1993-1-3: 2006 Design of steel structures. General rules. Supplementary rules for cold-formed members and sheeting	BS 5950-5, BS 5950-6, BS 5950-9
BS EN 1993-1-4: 2006 Design of steel structures. General rules. Supplementary rules for stainless steels	
BS EN 1993-1-5: 2006 Design of steel structures. Plated structural elements	BS 5950-1, BS 5400-3

Eurocode 3: Design of steel structures	Corresponding BS to be withdrawn
BS EN 1993-1-6: 2007 Design of steel structures. General. Strength and stability of shell structures	
BS EN 1993-1-7: 2007 Design of steel structures. Plated structures subject to out of plane loading	
BS EN 1993-1-8: 2005 Design of steel structures. Design of joints	BS 5950-1 BS 4604-1, BS 4604-2, BS 5400-3
BS EN 1993-1-9: 2005 Design of steel structures. Fatigue	BS 5950-1, BS 5400-10
BS EN 1993-1-10: 2005 Design of steel structures. Material toughness and through-thickness properties	BS 5950-1, BS 5400-3
BS EN 1993-1-11: 2006 Design of steel structures. Design of structures with tension components	
BS EN 1993-1-12: 2007 Design of steel structures. Additional rules for the extension of EN 1993 to steel grades S700	BS 5950-1
BS EN 1993-2: 2006 Design of steel structures. Steel bridges	BS 5400-3
BS EN 1993-3-1: 2007 Design of steel structures. Towers, masts and chimneys. Towers and masts	BS 8100-1, BS 8100-2, BS 8100-3, BS 8100-4
BS EN 1993-3-2: 2008 Design of steel structures. Towers, masts and chimneys. Chimneys	BS 4076
BS EN 1993-4-1: 2007 Design of steel structures. Silos, tanks and pipelines. Silos	
BS EN 1993-4-2: 2007 Design of steel structures. Silos, tanks and pipelines. Tanks	
BS EN 1993-4-3: 2007 Design of steel structures. Silos, tanks and pipelines. Pipelines	
BS EN 1993-5: 2007 Design of steel structures. Piling	BS 5950-1
BS EN 1993-6: 2007 Design of steel structures. Crane supporting structures	BS 5950-1, BS 2853

Table 1.6 Eurocode 4: Design of composite steel and concrete structures

Eurocode 4: Design of composite steel and concrete structures	Corresponding BS to be withdrawn
BS EN 1994-1-1: 2004 Design of composite steel and concrete structures. General rules and rules for buildings	BS 5950-3.1, BS 5950-4
BS EN 1994-1-2: 2005 Design of composite steel and concrete structures. General rules. Structural fire design	BS 5950-8
BS EN 1994-2: 2005 Design of composite steel and concrete structures. General rules and rules for bridges	BS 5400-5

Table 1.7 Eurocode 5: Design of timber structures

Eurocode 5: Design of timber structures	Corresponding BS to be withdrawn
BS EN 1995-1-1: 2004 Design of timber structures. General. Common rules and rules for buildings	BS 5268-2, BS 5268-3, BS 5268-6.1, BS 5268-6.2, BS

Eurocode 5: Design of timber structures	Corresponding BS to be withdrawn
	5268-7.1, BS 5268-7.2, BS 5268-7.3, BS 5268-7.4, BS 5268-7.5, BS 5268-7.6, BS 5268-7.7
BS EN 1995-1-2: 2004 Design of timber structures. General. Structural fire design	BS 5268-4.1, BS 5268-4.2
BS EN 1995-2: 2004 Design of timber structures. Bridges	

Table 1.8 Eurocode 6: Design of masonry structures

Eurocode 6: Design of masonry structures	Corresponding BS to be withdrawn
BS EN 1996-1-1: 2005 Design of masonry structures. General rules for reinforced and unreinforced masonry structures	BS 5628-1, BS 5628-2
BS EN 1996-1-2: 2005 Design of masonry structures. Structural fire design	BS 5628-3
BS EN 1996-2: 2006 Design of masonry structures. Design considerations, selection of materials and execution of masonry	BS 5628-3
BS EN 1996-3: 2006 Design of masonry structures. Simplified calculation methods for unreinforced masonry structures	

Table 1.9 Eurocode 7: Geotechnical design

Eurocode 7: Geotechnical design	Corresponding BS to be withdrawn
BS EN 1997-1: 2004 Geotechnical design. General rules	BS 8002, BS 8004, BS 8006, BS 8081
BS EN 1997-2: 2007 Geotechnical design. Ground investigation and testing	

Table 1.10 Eurocode 8: Design of structures for earthquake resistance

Eurocode 8: Design of structures for earthquake resistance	Corresponding BS to be withdrawn
BS EN 1998-1: 2004 Design of structures for earthquake resistance. General rules. Seismic actions for buildings	
BS EN 1998-2: 2005+Amendment 1: 2009 Design of structures for earthquake resistance. Bridges	
BS EN 1998-3: 2005 Design of structures for earthquake resistance. Assessment and retrofitting of buildings	
BS EN 1998-4: 2006 Design of structures for earthquake resistance. Silos tanks and pipelines	
BS EN 1998-5: 2004 Design of structures for earthquake resistance. Foundations, retaining structures and geotechnical aspects	
BS EN 1998-6: 2005 Design of structures for earthquake resistance. Towers masts and chimneys	

Table 1.11 Eurocode 9: Design of aluminium structures

Eurocode 9: Design of aluminium structures	Corresponding BS to be withdrawn [1]
BS EN 1999-1-1: 2007 Design of aluminium structures. General rules	BS 8118-1, BS 8118-2
BS EN 1999-1-2: 2007 Design of aluminium structures. General. Structural fire design	
BS EN 1999-1-3: 2007 Design of aluminium structures. Additional rules for structures susceptible to fatigue	BS 8118-1
BS EN 1999-1-4: 2007 Design of aluminium structures. Supplementary rules for trapezoidal sheeting	
BS EN 1999-1-5: 2007 Design of aluminium structures. Supplementary rules for shell structures	BS 8118-1

Additional Information. **Note 1**: Many of these standards are not directly, or are not currently referenced in Section 1: Structure. Some may not be applicable to Section 1 Structure such as, BS 5400 for bridges, or are applicable to other parts of the technical handbooks.