

SINGAPORE STANDARD

Eurocode 1 : Actions on structures

– Part 1-7 : General actions – Accidental actions

(This national standard is the identical implementation of EN 1991-1-7 : 2006 and is adopted with permission of CEN, Avenue Marnix 17, 1000 Brussels)

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National Foreword

This Singapore Standard was prepared by the Technical Committee on Building Structure and Sub-structure under the direction of the Building and Construction Standards Committee.

This SS EN is the identical implementation of EN 1991-1-7 : 2006 ‘Eurocode 1 – Actions on structures – Part 1-7: General actions – Accidental actions’ and is adopted with permission of CEN, Rue de Stassart 36, B-1050 Brussels.

Attention is drawn to the following:

- The comma has been used throughout as a decimal marker whereas in Singapore Standards, it is a practice to use a full point on the baseline as the decimal marker.
- The Singapore Standards which implement international or European publications referred to in this document may be found in the SS Electronic Catalogue at:
<http://www.singaporestandardseshop.sg>
- Where the following road category terminologies appear in the standard, they should be read in the Singapore context as follows:

EN 1991-1-7	SS EN 1991-1-7
Motorways and country national and main roads	Expressways and semi-expressways
Motorways, trunk and principal roads	

‘Country roads in rural area’ and ‘Roads in urban area’ in the EN 1991-1-7 are not applicable to Singapore.

The EN gives values with notes indicating where national choices may be made. Where a normative part of the EN allows for national choice to be made, the range and possible choice will be given in the normative text, and a note will qualify it as a Nationally Determined Parameter (NDP). NDPs can be a specific value for a factor, a specific level or class, a particular method or a particular application rule if several are proposed in the EN.

The requirements of this SS EN 1991-1-7 : 2009 are to be read in conjunction with the Singapore National Annex (NA) to SS EN 1991-1-7 : 2009 which contains information on the Singapore Nationally Determined Parameters and is published separately.

National choice is allowed in EN 1991-1-7 through the following clauses:

– 2 (2)	– 4.3.2 (3)	– 4.6.1 (3)
– 3.1 (2)	– 4.4 (1)	– 4.6.2 (1)
– 3.2 (1)	– 4.5 (1)	– 4.6.2 (2)
– 3.3 (2)	– 4.5.1.2 (1)	– 4.6.2 (3)
– 3.4 (1)	– 4.5.1.4 (1)	– 4.6.2 (4)
– 3.4 (2)	– 4.5.1.4 (2)	– 4.6.3 (1)
– 4.1 (1)	– 4.5.1.4 (3)	– 4.6.3 (3)
– 4.3.1 (1)	– 4.5.1.4 (4)	– 4.6.3 (4)
– 4.3.1 (2)	– 4.5.1.4 (5)	– 4.6.3 (5)
– 4.3.1 (3)	– 4.5.1.5 (1)	– 5.3 (1)P
– 4.3.2 (1)	– 4.5.2 (1)	– A.4 (1)
– 4.3.2 (2)	– 4.5.2 (4)	

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English Version

Eurocode 1 - Actions on structures - Part 1-7: General actions - Accidental actions

Eurocode 1 - Actions sur les structures - Partie 1-7: Actions
générales - Actions accidentelles

Eurocode 1 - Einwirkungen auf Tragwerke - Teil 1-7:
Allgemeine Einwirkungen - Außergewöhnliche
Einwirkungen

This European Standard was approved by CEN on 9 January 2006.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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Foreword

This European Standard (EN 1991-1-7:2006) has been prepared on behalf of Technical Committee CEN/TC250 "Structural Eurocodes", the Secretariat of which is held by BSI.

CEN/TC 250 is responsible for all Structural Eurocodes.

This European Standard supersedes ENV 1991-2-7:1998.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2007 and conflicting national standards shall be withdrawn at the latest by March 2010.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Background of the Eurocode programme

In 1975, the Commission of the European Community decided on an action programme in the field of construction, based on Article 95 of the Treaty. The objective of the programme was the elimination of technical obstacles to trade and the harmonisation of technical specifications.

Within this action programme, the Commission took the initiative to establish a set of harmonised technical rules for the design of construction works which, in a first stage, would serve as an alternative to the national rules in force in the Member States and, ultimately, would replace them.

For fifteen years, the Commission, with the help of a Steering Committee with Representatives of Member States, conducted the development of the Eurocodes programme, which led to the first generation of European codes in the 1980s.

In 1989, the Commission and the Member States of the EU and EFTA decided, on the basis of an agreement¹ between the Commission and CEN, to transfer the preparation and the publication of the Eurocodes to CEN through a series of Mandates, in order to provide them with a future status of European Standard (EN). This links de facto the Eurocodes with the provisions of all the Council's Directives and/or Commission's Decisions dealing with European standards (e.g. the Council Directive 89/106/EEC on construction products – CPD - and Council Directives 93/37/EEC, 92/50/EEC and 89/440/EEC on public works and services and equivalent EFTA Directives initiated in pursuit of setting up the internal market).

The Structural Eurocode programme comprises the following standards generally consisting of a number of parts:

EN 1990	Eurocode	Basis of structural design
EN 1991	Eurocode 1:	Actions on structures
EN 1992	Eurocode 2:	Design of concrete structures
EN 1993	Eurocode 3:	Design of steel structures

¹ Agreement between the Commission of the European Communities and the European Committee for Standardisation (CEN) concerning the work on Eurocodes for the design of building and civil engineering works (BC/CEN/03/89).

EN 1994	Eurocode 4:	Design of composite steel and concrete structures
EN 1995	Eurocode 5:	Design of timber structures
EN 1996	Eurocode 6:	Design of masonry structures
EN 1997	Eurocode 7:	Geotechnical design
EN 1998	Eurocode 8:	Design of structures for earthquake resistance
EN 1999	Eurocode 9:	Design of aluminium structures

Eurocode standards recognise the responsibility of regulatory authorities in each Member State and have safeguarded their right to determine values related to regulatory safety matters at a national level where these continue to vary from State to State.

Status and field of application of Eurocodes

The Member States of the EU and EFTA recognise that Eurocodes serve as reference documents for the following purposes:

- as a means to prove compliance of building and civil engineering works with the essential requirements of Council Directive 89/106/EEC, particularly Essential Requirement N°1 – Mechanical resistance and stability – and Essential Requirement N°2 – Safety in case of fire;
- as a basis for specifying contracts for construction works and related engineering services;
- as a framework for drawing up harmonised technical specifications for construction products (ENs and ETAs).

The Eurocodes, as far as they concern the construction works themselves, have a direct relationship with the Interpretative Documents² referred to in Article 12 of the CPD, although they are of a different nature from harmonised product standards³. Therefore, technical aspects arising from the Eurocodes work need to be adequately considered by CEN Technical Committees and/or EOTA Working Groups working on product standards with a view to achieving a full compatibility of these technical specifications with the Eurocodes.

The Eurocode Standards provide common structural design rules for everyday use for the design of whole structures and component products of both a traditional and an innovative nature. Unusual forms of construction or design conditions are not specifically covered and additional expert consideration will be required by the designer in such cases.

National Standards implementing Eurocodes

The National Standards implementing Eurocodes will comprise the full text of the Eurocode (including any annexes), as published by CEN, which may be preceded by a National title page and National foreword, and may be followed by a National Annex (informative).

² According to Article 3.3 of the CPD, the essential requirements (ERs) shall be given concrete form in interpretative documents for the creation of the necessary links between the essential requirements and the mandates for hENs and ETAGs/ETAs.

³ According to Article 12 of the CPD the interpretative documents shall:

- a) give concrete form to the essential requirements by harmonising the terminology and the technical bases and indicating classes or levels for each requirement where necessary;
- b) indicate methods of correlating these classes or levels of requirement with the technical specifications, e.g. methods of calculation and of proof, technical rules for project design, etc.;
- c) serve as a reference for the establishment of harmonised standards and guidelines for European technical approvals.

The Eurocodes, de facto, play a similar role in the field of the ER 1 and a part of the ER 2.

The National Annex (informative) may only contain information on those parameters which are left open in the Eurocode for national choice, known as Nationally Determined Parameters, to be used for the design of buildings and civil engineering works to be constructed in the country concerned, i.e.:

- values and/or classes where alternatives are given in the Eurocode;
- values to be used where a symbol only is given in the Eurocode;
- country specific data (geographical, climatic, etc) e.g. snow map;
- procedure to be used where alternative procedures are given in the Eurocode.

It may also contain:

- decisions on the application of informative annexes;
- references to non contradictory complementary information to assist the user to apply the Eurocode.

Links between Eurocodes and harmonised technical specifications (ENs and ETAs) for products

There is a need for consistency between the harmonised technical specifications for construction products and the technical rules for works⁴. Furthermore, all the information accompanying the CE marking of the construction products which refer to Eurocodes shall clearly mention which Nationally Determined Parameters have been taken into account.

Additional information specific to EN 1991-1-7

EN 1991-1-7 describes Principles and Application rules for the assessment of accidental actions on buildings and bridges. The following actions are included:

- impact forces from vehicles, rail traffic, ships and helicopters,
- actions due to internal explosions,
- actions due to local failure from an unspecified cause.

EN 1991-1-7 is intended for use by:

- clients (e.g. for the formulation of their specific requirements on safety levels),
- designers,
- constructors, and
- relevant authorities.

EN 1991-1-7 is intended to be used with EN 1990, the other parts of EN 1991 and EN 1992 – 1999 for the design of structures.

National Annex

This standard gives alternative procedures, values and recommendations for classes with notes indicating where national choices may have to be made. Therefore the National Standard implementing EN 1991-1-7 should have a National Annex containing all Nationally Determined Parameters to be used for the design of buildings and civil engineering works to be constructed in the relevant country.

⁴ See Article 3.3 and Article 12 of the CPD, as well as clauses 4.2, 4.3.1, 4.3.2 and 5.2 of ID 1.

The National choice is allowed in EN 1991-1-7 through clauses⁵:

Paragraph	Item
2 (2)	Classification of accidental actions
3.1(2)	Strategies for accidental design situations
3.2(1)	Level of risk
3.3(2)P	Notional accidental action
3.3(2)P	Limit of local failure
3.3(2)P	Choice of strategies
3.4(1)	Consequences classes
3.4(2)	Design approaches
4.1(1)	Definition of lightweight structures
4.1(1)	Transmission of impact forces to foundations
4.3.1(1)	Values of vehicle impact forces
4.3.1(1)	Impact force as a function of the distance from traffic lanes
4.3.1(1)	Types or elements of structure subject to vehicular collision
4.3.1(2)	Alternative impact rules
4.3.1(3)	Conditions of impact from road vehicles
4.3.2(1)	Clearances and protection measures and design values
4.3.2(1)	Reduction factor r_F
4.3.2(1)	Impact actions on underside of bridge decks
4.3.2(2)	Use of F_{dy}
4.3.2(3)	Dimension and position of impact areas
4.4(1)	Value of impact forces from forklift trucks
4.5(1)	Type of rail traffic
4.5.1.2(1)	Structures to be included in each exposure class
4.5.1.2(1)	Classification of temporary structures and auxiliary construction works
4.5.1.4(1)	Impact forces from derailed traffic
4.5.1.4(2)	Reduction of impact forces
4.5.1.4(3)	Point of application of impact forces
4.5.1.4(4)	Equivalent static forces
4.5.1.4(5)	Impact forces for speeds greater than 120 km/h
4.5.1.5(1)	Requirements for Class B structures
4.5.2(1)	Areas beyond track ends

⁵ It is proposed to add to each clause of the list what will be allowed for choice: value, procedures, classes.

4.5.2(4)	Impact forces on end walls
4.6.1(3)	Classification of ship impacts
4.6.2(1)	Values of frontal and lateral forces from ships
4.6.2(2)	Friction coefficients
4.6.2(3)	Application area of impact
4.6.2(4)	Impact forces on bridge decks from ships
4.6.3(1)	Dynamic impact forces from seagoing ships
4.6.3(3)	Friction coefficients
4.6.3(4)	Dimension and position of impact areas
4.6.3(5)	Forces on superstructure
5.3 (1)P	Procedures for internal explosion
A.4 (1)	Details of effective anchorage

Section 1 General

1.1 Scope

(1) EN 1991-1-7 provides strategies and rules for safeguarding buildings and other civil engineering works against identifiable and unidentifiable accidental actions.

(2) EN 1991-1-7 defines:

- strategies based on identified accidental actions,
- strategies based on limiting the extent of localised failure.

(3) The following subjects are dealt with in this part of EN 1991:

- definitions and symbols (Section 1);
- classification of actions (Section 2);
- design situations (Section 3);
- impact (Section 4);
- explosions (Section 5);
- design for consequences of localised failure in buildings from an unspecified cause (informative Annex A);
- information on risk assessment (informative Annex B);
- dynamic design for impact (informative Annex C);
- internal explosions (informative Annex D).

(4) Rules on dust explosions in silos are given in EN 1991-4.

(5) Rules on impact from vehicles travelling on the bridge deck are given in EN 1991-2.

(6) EN 1991-1-7 does not specifically deal with accidental actions caused by external explosions, warfare and terrorist activities, or the residual stability of buildings or other civil engineering works damaged by seismic action or fire, etc.

NOTE See also 3.1.

1.2 Normative references

(1) This European Standard incorporates by dated or undated reference provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to, or revisions of, any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies (including amendments).

NOTE The Eurocodes were published as European Prestandards. The following European Standards which are published or in preparation are cited in normative clauses or in NOTES to normative clauses.

EN 1991-1-7:2006 (E)

EN 1990	Eurocode: Basis of structural design
EN 1991-1-1	Eurocode 1: Actions on structures Part 1-1: Densities, self-weight, imposed loads for buildings.
EN 1991-1-6	Eurocode 1: Actions on structures Part 1-6: Actions during execution
EN 1991-2	Eurocode 1: Actions on structures Part 2: Traffic loads on bridges
EN 1991-4	Eurocode 1 : Actions on structures Part 4: Silos and tanks
EN 1992	Eurocode 2: Design of concrete structures
EN 1993	Eurocode 3: Design of steel structures
EN 1994	Eurocode 4: Design of composite steel and concrete structures
EN 1995	Eurocode 5: Design of timber structures
EN 1996	Eurocode 6: Design of masonry structures
EN 1997	Eurocode 7: Geotechnical design
EN 1998	Eurocode 8: Design of structures for earthquake resistance
EN 1999	Eurocode 9: Design of aluminium structures