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

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

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Contents

Page

FOREWORD **4**

BACKGROUND OF THE EUROCODE PROGRAMME 4
STATUS AND FIELD OF APPLICATION OF EUROCODES 5
NATIONAL STANDARDS IMPLEMENTING EUROCODES 5
LINKS BETWEEN EUROCODES AND HARMONISED TECHNICAL SPECIFICATIONS (ENS AND ETAS) FOR PRODUCTS 6
ADDITIONAL INFORMATION SPECIFIC TO EN 1991-1-7 6
NATIONAL ANNEX 6

SECTION 1 GENERAL **9**

1.1 SCOPE 9
1.2 NORMATIVE REFERENCES 9
1.3 ASSUMPTIONS 10
1.4 DISTINCTION BETWEEN PRINCIPLES AND APPLICATION RULES 10
1.5 TERMS AND DEFINITIONS 10
1.6 SYMBOLS 12

SECTION 2 CLASSIFICATION OF ACTIONS **14**

SECTION 3 DESIGN SITUATIONS **15**

3.1 GENERAL 15
3.2 ACCIDENTAL DESIGN SITUATIONS – STRATEGIES FOR IDENTIFIED ACCIDENTAL ACTIONS 16
3.3 ACCIDENTAL DESIGN SITUATIONS – STRATEGIES FOR LIMITING THE EXTENT OF LOCALISED FAILURE 17
3.4 ACCIDENTAL DESIGN SITUATIONS – USE OF CONSEQUENCE CLASSES 17

SECTION 4 IMPACT **19**

4.1 FIELD OF APPLICATION 19
4.2 REPRESENTATION OF ACTIONS 19
4.3 ACCIDENTAL ACTIONS CAUSED BY ROAD VEHICLES 20
4.3.1 Impact on supporting substructures *20*
4.3.2 Impact on superstructures *22*
4.4 ACCIDENTAL ACTIONS CAUSED BY FORK LIFT TRUCKS 24
4.5 ACCIDENTAL ACTIONS CAUSED BY DERAILED RAIL TRAFFIC UNDER OR ADJACENT TO STRUCTURES 25
4.5.1 Structures spanning across or alongside operational railway lines *25*
4.5.2 Structures located in areas beyond track ends *27*
4.6 ACCIDENTAL ACTIONS CAUSED BY SHIP TRAFFIC 27
4.6.1 General *27*
4.6.2 Impact from river and canal traffic *28*
4.6.3 Impact from seagoing vessels *29*
4.7 ACCIDENTAL ACTIONS CAUSED BY HELICOPTERS 30

SECTION 5 INTERNAL EXPLOSIONS **31**

5.1 FIELD OF APPLICATION 31
5.2 REPRESENTATION OF ACTION 31
5.3 PRINCIPLES FOR DESIGN 32

ANNEX A (INFORMATIVE) DESIGN FOR CONSEQUENCES OF LOCALISED FAILURE IN BUILDINGS FROM AN UNSPECIFIED CAUSE **33**

A.1 SCOPE AND FIELD OF APPLICATION 33
A.2 INTRODUCTION 33
A.3 CONSEQUENCES CLASSES OF BUILDINGS 33
A.4 RECOMMENDED STRATEGIES 34
A.5 EFFECTIVE HORIZONTAL TIES 36

A.5.1 Framed structures *36*
A.5.2 Load-bearing wall construction *37*
A.6 EFFECTIVE VERTICAL TIES 39
A.7 NOMINAL SECTION OF LOAD-BEARING WALL 39
A.8 KEY ELEMENTS 39

ANNEX B (INFORMATIVE) INFORMATION ON RISK ASSESSMENT 40

B.1 INTRODUCTION 40
B.2 DEFINITIONS 41
B.3 DESCRIPTION OF THE SCOPE OF A RISK ANALYSIS 41
B.4 METHODS OF RISK ANALYSIS 42
B.4.1 Qualitative risk analysis *42*
B.4.2 Quantitative risk analysis *42*
B.5 RISK ACCEPTANCE AND MITIGATING MEASURES 43
B.6 RISK MITIGATING MEASURES 44
B.7 MODIFICATION 44
B.8 COMMUNICATION OF RESULTS AND CONCLUSIONS 45
B.9 APPLICATIONS TO BUILDINGS AND CIVIL ENGINEERING STRUCTURES 45
B.9.1 General *45*
B.9.2 Structural risk analysis *46*
B.9.3 Modelling of risks from extreme load events *47*
B.9.4 Guidance for application of risk analysis related to impact from rail traffic *50*

ANNEX C (INFORMATIVE) DYNAMIC DESIGN FOR IMPACT 52

C.1 GENERAL 52
C.2 IMPACT DYNAMICS 52
C.2.1 Hard Impact *52*
C.2.2 Soft Impact *53*
C.3 IMPACT FROM ABERRANT ROAD VEHICLES 54
C.4 IMPACT BY SHIPS 57
C.4.1 Ship impact on inland waterways *57*
C.4.2 Ship impact for sea waterways *58*
C.4.3 Advanced ship impact analysis for inland waterways *58*
C.4.4 Advanced ship impact analysis for sea waterways *61*

ANNEX D (INFORMATIVE) INTERNAL EXPLOSIONS 62

D.1 DUST EXPLOSIONS IN ROOMS, VESSELS AND BUNKERS 62
D.2 NATURAL GAS EXPLOSIONS 64
D.3 EXPLOSIONS IN ROAD AND RAIL TUNNELS 64

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 agreement[1] 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 Documents[2] referred to in Article 12 of the CPD, although they are of a different nature from harmonised product standards[3]. 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).

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[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 works[4]. 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 clauses[5]:

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 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

1.3 Assumptions

(1)P The general assumptions given in EN 1990, 1.3 apply to this part of EN 1991.

1.4 Distinction between Principles and Application rules

(1) P The rules given in EN 1990, 1.4 apply to this part of EN 1991.

1.5 Terms and definitions

(1) For the purposes of this European Standard, general definitions are provided in EN 1990, 1.5. Additional definitions specific to this part are given below.

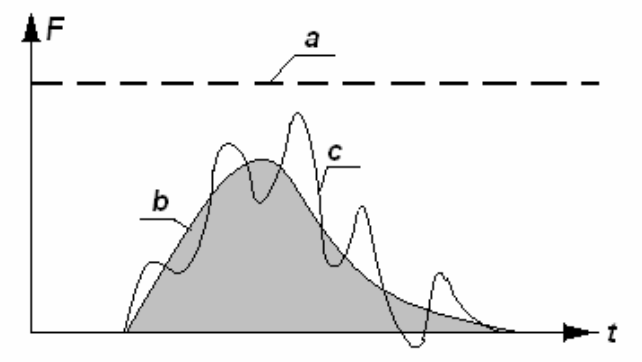
1.5.1
burning velocity
rate of flame propagation relative to the velocity of the unburned dust, gas or vapour that is ahead of it.

1.5.2
consequence class
classification of the consequences of failure of the structure or part of it.

1.5.3
deflagration
propagation of a combustion zone at a velocity that is less than the speed of sound in the unreacted medium.

1.5.4
detonation
propagation of a combustion zone at a velocity that is greater than the speed of sound in the unreacted medium.

1.5.5
dynamic force
force that varies in time and which may cause significant dynamic effects on the structure; in the case of impact, the dynamic force represents the force with an associated contact area at the point of impact (see Figure 1.1).



Key :
a : equivalent static force
b : dynamic force
c : structural response

Figure 1.1

1.5.6
equivalent static force
an alternative representation for a dynamic force including the dynamic response of the structure (see Figure 1.1).

1.5.7
flame speed
speed of a flame front relative to a fixed reference point.

1.5.8
flammable limit
minimum or maximum concentration of a combustible material, in a homogeneous mixture with a gaseous oxidiser that will propagate a flame.

1.5.9
impacting object
the object impacting upon the structure (i.e. vehicle, ship, etc).

1.5.10
key element
a structural member upon which the stability of the remainder of the structure depends.

1.5.11
load-bearing wall construction
non-framed masonry cross-wall construction mainly supporting vertical loading. Also includes lightweight panel construction comprising timber or steel vertical studs at close centres with particle board, expanded metal or alternative sheathing.

1.5.12
localised failure
that part of a structure that is assumed to have collapsed, or been severely disabled, by an accidental event.

1.5.13
risk
a measure of the combination (usually the product) of the probability or frequency of occurrence of a defined hazard and the magnitude of the consequences of the occurrence.

1.5.14
robustness
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.

1.5.15
substructure
that part of a building structure that supports the superstructure. In the case of buildings this usually relates to the foundations and other construction work below ground level. In the case of bridges this usually relates to foundations, abutments, piers and columns etc.

1.5.16
superstructure
that part of a building structure that is supported by the substructure. In the case of buildings this usually relates to the above ground construction.In the case of bridges this usually relates to the bridge deck.

1.5.17
venting panel
non-structural part of the enclosure (wall, floor, ceiling) with limited resistance that is intended to relieve the developing pressure from deflagration in order to reduce pressure on structural parts of the building.

1.6 Symbols

(1) For the purpose of this European Standard, the following symbols apply (see also EN 1990).

Latin upper case letters

F	collision force
F_{dx}	horizontal static equivalent or dynamic design frontal force
F_{dy}	horizontal static equivalent or dynamic design lateral force
F_R	frictional impact force
K_G	deflagration index of a gas cloud
K_{St}	deflagration index of a dust cloud
P_{max}	maximum pressure developed in a contained deflagration of an optimum mixture
P_{red}	reduced pressure developed in vented enclosure during a vented deflagration
P_{stat}	static activation pressure that activates a vent opening when the pressure is increased slowly

Latin lower case letters

a	height of the application area of a collision force
b	width of an obstacle (*e*.g. bridge pier)

h	clearance height from roadway surfacing to underside of bridge element; height of a collision force above the level of a carriageway
ℓ	ship length
r_F	reduction factor
s	distance from structural element to centre-line of road or track
m	Mass
v_v	Velocity

Greek lower case letters

μ	friction coefficient