



**SLOVENSKI STANDARD**  
**SIST ENV 1991-2-7:2004**  
**01-september-2004**

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Eurocode 1: Basis of design and actions on structures - Part 2-7: Actions on structures - Accidental actions due to impact and explosions

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 (standard is not published)

Eurocode 1: Bases de calcul et actions sur les structures - Partie 2-7: Actions sur les structures - Actions accidentelles dues aux chocs et explosions

**Ta slovenski standard je istoveten z: <sup>SIST ENV 1991-2-7:2004</sup> ENV 1991-2-7:1998**  
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**ICS:**

91.010.30      V^@ã}ãããã      Technical aspects

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ICS 91.010.30

Descriptors: buildings, civil engineering, accident prevention, explosion proofing, shock resistance, collisions, computation

English version

**Eurocode 1: Basis of design and actions on structures - Part 2-7: Actions on structures - Accidental actions due to impact and explosions**

This European Prestandard (ENV) was approved by CEN on 23 May 1997 as a prospective standard for provisional application.

The period of validity of this ENV is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the ENV can be converted into a European Standard.

CEN members are required to announce the existence of this ENV in the same way as for an EN and to make the ENV available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the ENV) until the final decision about the possible conversion of the ENV into an EN is reached.

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EUROPEAN COMMITTEE FOR STANDARDIZATION  
COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

**Central Secretariat: rue de Stassart, 36 B-1050 Brussels**

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## Foreword

### Objectives of the Eurocodes

- (1) The "Structural Eurocodes" comprise a group of standards for the structural and geotechnical design of buildings and civil engineering works.
- (2) They cover execution and control only to the extent that is necessary to indicate the quality of the construction products and the standard of the workmanship needed to comply with the assumptions of the design rules.
- (3) Until the necessary set of harmonised technical specifications for products and for methods of testing their performance are available, some of the Structural Eurocodes cover some of these aspects in informative annexes.

### Background to the Eurocode programme

- (4) The Commission of the European Communities (CEC) initiated the work of establishing a set of harmonised technical rules for the design of buildings and civil engineering works which would initially serve as an alternative to the different rules in force in the various member states and would ultimately replace them. These technical rules became known as the "Structural Eurocodes".
- (5) In 1990, after consulting their respective member states, the CEC transferred the work of further development, issue and updating of the Structural Eurocodes to CEN, and the EFTA Secretariat agreed to support the CEN work.
- (6) CEN Technical Committee CEN/TC250 is responsible for all Structural Eurocodes.

### Eurocode programme

- (7) Work is in hand on the following Structural Eurocodes, each generally consisting of a number of parts:

EN 1991	Eurocode 1	Basis of design and actions on structures
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 alloy structures

(8) Separate Sub-Committees have been formed by CEN/TC250 for the various Eurocodes listed above.

(9) This Part of Eurocode 1 is being published as a European Prestandard (ENV) with an initial life of three years.

(10) This Prestandard is intended for experimental application and for the submission of comments.

(11) After approximately two years CEN members will be invited to submit formal comments to be taken into account in determining future actions.

(12) Meanwhile feedback and comments on this Prestandard should be sent to the Secretariat of CEN/TC250/SC1 at the following address:

SIS / BST  
Box 490 44  
S- 100 28 Stockholm  
SWEDEN

or to your National Standards Organisation.

#### **National Application Documents (NADs)**

(13) In view of the responsibilities of authorities in member countries for safety, health and other matters covered by the essential requirements of the Construction Products Directive (CPD), certain safety elements in this ENV have been assigned indicative values which are identified by  or [ ] ("boxed values"). The authorities in each member country are expected to review the "boxed values" and may substitute alternative definitive values for these safety elements for use in national application.

(14) Some of the supporting European or international standards may not be available by the time this Prestandard is issued. It is therefore anticipated that a National Application Document (NAD) giving any substitute definitive values for safety elements, referencing compatible supporting standards and providing guidance on the national application of this Prestandard, will be issued by each member country or its Standards Organisation.

(15) It is intended that this Prestandard is used in conjunction with the NAD valid in the country where the building or civil engineering works is located.

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**Matters specific to this Prestandard**

(16) The scope of Eurocode 1 is defined in clause 1.1.1 and the scope of this Part of Eurocode 1 is defined in clause 1.1.2. Additional Parts of Eurocode 1 which are planned are indicated in clause 1.1.3.

(17) This Part is complemented by three informative annexes.

(18) Accidental actions are described in different parts of Eurocode 1. In particular, ENV 1991-3 includes accidental actions due to impact on structural elements of bridges. In the relevant sections of ENV 1991-3 design values are listed, which have to be taken into account for the design situations of impact.

This Part and ENV 1991-3 are consistent with regard to the design values.

(19) Design situations endangered by accidental actions may be categorised. The categorisation may follow national traditions and preferences. The categorisation will be a matter for relevant authorities.

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## Section 1 General

### 1.1 Scope

#### 1.1.1 Scope of ENV 1991 - Eurocode 1

(1)P ENV 1991 provides general principles and actions for the structural design of buildings and civil engineering works including some geotechnical aspects and shall be used in conjunction with ENVs 1992-1999.

(2) It may also be used as a basis for the design of structures not covered in ENVs 1992-1999 and where either other materials or other structural design actions are involved.

(3) ENV 1991 also covers structural design during execution and structural design for temporary structures. It relates to all circumstances in which a structure is required to give adequate performance.

(4) ENV 1991 is not directly intended for the structural appraisal of existing construction, in developing the design of repairs and alterations or for assessing changes of use.

(5) ENV 1991 does not completely cover special design situations which require unusual reliability considerations, such as nuclear structures, for which specified design procedures should be used.

#### 1.1.2 Scope of ENV 1991-2-7 Accidental actions due to impact and explosions

(1)P This Part describes the possible safety strategies in case of general accidental situations and it covers in detail the accidental actions due to impact and internal explosions. Consideration of accidental actions described in this Part includes actions caused by human activities but excludes actions arising from external explosions, warfare and sabotage. Also, this Part does not refer to some events, which are generally considered as accidents, but which do not result in structural damage (e.g. persons falling through roof claddings).

(2) Accidental actions arising from the natural phenomena such as tornadoes, extreme erosion or falling rocks are not included. However, they may be incorporated in design using principles similar to those contained in this Part.

(3)P Structures exposed to fire shall be designed in accordance with ENV 1991-2-2 "Actions on structures exposed to fire" in conjunction with the relevant fire design Parts of ENVs 1992 to 1996 and ENV 1999.

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(4)P Structures exposed to seismic events shall be designed according to ENV 1998 "Earthquake resistant design of structures".

(5)P This Part defines the general principles that can be used in the analysis of accidental design situations and describes:

- the procedure for a risk analysis to identify extreme events, the causes and consequences of undesired events;

- the safety precautions required to maintain a safety level which complies with the acceptance criteria, by using adequate measures to reduce the probability or the consequences of the extreme events.

(6) In particular this Part specifies:

- recommended design models for the most common cases of accidental actions arising from impact and explosions;
- detailing provisions which may be used as alternatives to design verifications.

(7) Accidental actions given in Section 4 are related to impacts and collisions from the following sources:

- vehicles;
- derailed trains;
- ships;
- the hard landing of helicopters on roofs.

(8) Three informative annexes are included :

- Annex A describes an advanced impact design concept;
- Annex B includes an advanced explosion design concept;
- Annex C gives additional guidance for design.

### 1.1.3 Further Parts of ENV 1991

(1) Further Parts of ENV 1991 which, at present, either are being prepared or are planned, are given in clause 1.2.

## 1.2 Normative references

(1) This European Prestandard incorporates by either dated or undated reference, provisions from other standards. These normative references are cited in the appropriate places in the text and are listed below.

ISO 3898 1987	Basis of design for structures. Notations. General symbols.
ISO DP 10252	Accidental actions due to human activities.
ISO 6184-a	Explosion protection systems - Part 1: Determination of explosion indices of combustible dusts in air.
UIC SC 7J	Report 777/2R (May 1996): Structures built over railway lines.

NOTE: The following European Prestandards which either are published or are in preparation are cited at the appropriate places in the text and are listed below.

ENV 1991-1	Eurocode 1 : Basis of design and actions on structures Part 1 : Basis of design
ENV 1991-2-1	Eurocode 1 : Basis of design and actions on structures Part 2.1 : Densities, self-weight and imposed loads
ENV 1991-2-2	Eurocode 1 : Basis of design and actions on structures Part 2.2 : Actions on structures exposed to fire
ENV 1991-2-3	Eurocode 1 : Basis of design and actions on structures Part 2.3 : Snow loads
ENV 1991-2-4	Eurocode 1 : Basis of design and actions on structures Part 2.4 : Wind loads
ENV 1991-2-5	Eurocode 1 : Basis of design and actions on structures Part 2.5 : Thermal actions
ENV 1991-2-6	Eurocode 1 : Basis of design and actions on structures Part 2.6 : Actions during execution
ENV 1991-3	Eurocode 1 : Basis of design and actions on structures Part 3 : Traffic loads on bridges
ENV 1991-4	Eurocode 1 : Basis of design and actions on structures Part 4 : Actions in silos and tanks
ENV 1991-5	Eurocode 1 : Basis of design and actions on structures Part 5 : Actions induced by cranes and machinery
ENV 1992	Eurocode 2 : Design of concrete structures
ENV 1993	Eurocode 3 : Design of steel structures
ENV 1994	Eurocode 4 : Design of composite steel and concrete structures
ENV 1995	Eurocode 5 : Design of timber structures
ENV 1996	Eurocode 6 : Design of masonry structures
ENV 1997	Eurocode 7 : Geotechnical design
ENV 1998	Eurocode 8 : Earthquake resistant design of structures
ENV 1999	Eurocode 9 : Design of aluminium alloy structures

### 1.3 Distinction between principles and application rules

- (1) Depending upon the character of the individual clauses, distinction is made in this Part 2-7 of ENV 1991 between principles and application rules.
- (2) The principles comprise:
  - general statements and definitions for which there is no alternative, as well as;
  - requirements and analytical models for which no alternative is permitted unless specifically stated.
- (3) The principles are identified by the letter P following the paragraph number.
- (4) The application rules are generally recognised rules which follow the principles and satisfy their requirements.
- (5) It is permissible to use alternative rules different from the application rules given in this Eurocode, provided it is shown that the alternative rules accord with the relevant principles and have at least the same reliability.
- (6) In this Part 2-7 of ENV 1991 the application rules are identified by a number in brackets, e.g. as this clause.

### 1.4 Definitions

For the purposes of this Prestandard, a basic list of definitions is provided in ENV 1991-1; and the additional definitions given below are specific to this Part of ENV 1991.

**1.4.1 Accidental actions:** Action, usually of short duration, which is unlikely to occur with a significant magnitude over a period of time under consideration during the design working life.

**1.4.2 Explosion:** Rapid chemical reaction of dust or gas in air. It results in high temperatures and high overpressures. Explosion pressures propagate as pressure waves.

**1.4.3 Deflagration:** Explosion where the continuation of the chemical reaction is caused by the transport of heat. The flame front travels through the mixture at a subsonic speed, in the order of 100 m/s. The pressure waves travel with the local speed of sound. Peak pressure values may vary from 10 to 1 500 kN/m<sup>2</sup>.

**1.4.4 Detonation:** Explosion where the continuation of the chemical reaction is caused by a pressure shock wave travelling at a supersonic speed generally more than 1 000 m/s. A typical value for the pressure is 2 000 kN/m<sup>2</sup> but the peak duration is very short (10 ms).

**1.4.5 Key element:** An element of the structure, essential for the overall stability of the structure, the failure of which would cause disproportionate damage and/or collapse of the structure.

**1.4.6 Risk:** Risk is expressed in terms of possible consequences of the event and the associated probability.

**1.4.7 Risk reducing measures:** Risk reducing measures consist of measures to reduce the probability of the accident and measures to reduce the consequence, including contingency plans, of an accident.

**1.4.8 Hazard scenarios:** Events caused by natural phenomena or human activities which may endanger the structural safety. A hazard scenario is characterised by one predominant action.

## 1.5 Symbols

(1) For the purpose of this Prestandard, the following symbols apply.

NOTE: The notation used is based on ISO 3898:1987.

(2) A basic list of notations is provided in ENV 1991-1, "Basis of design" and the additional notations below are specific to this Part.

### *Latin upper case letters*

$A_v$	the area of venting components
$F$	impact or collision force
$F_{d,x}$	horizontal static equivalent impact load in direction of normal travel
$F_{d,y}$	horizontal static equivalent impact load perpendicular to the direction of normal travel
$V$	Volume of room
$W$	weight of a loaded truck

### *Latin lower case letters*

$d$	diameter or equivalent diameter
$f$	friction coefficient
$h$	height
$l$	length
$m$	mass
$p$	probability
$p_d$	nominal equivalent static pressure
$p_v$	uniformly distributed static pressure
$r$	a multiplication factor
$s$	distance

### *Greek lower case letters*

$\alpha_Q$	adjustment factor
$\theta$	angle of hit