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Eurocode 1: Actions on structures – Part 2: Traffic loads on bridges

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EUROPEAN STANDARD

EN 1991-2

NORME EUROPÉENNE

EUROPÄISCHE NORM

September 2003

ICS 91.010.30; 93.040

Supersedes ENV 1991-3:1995

English version

Eurocode 1: Actions on structures - Part 2: Traffic loads on bridges

Eurocode 1: Actions sur les structures - Partie 2: Actions sur les ponts, dues au trafic

Eurocode 1: Einwirkungen auf Tragwerke - Teil 2: Verkehrslasten auf Brücken

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Foreword

This document (EN 1991-2:2003) has been prepared by Technical Committee CEN/TC 250 "Structural Eurocodes", the secretariat of which is held by BSI.

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of an identical text or by endorsement, at the latest by March 2004, and conflicting national standards shall be withdrawn at the latest by December 2009.

This document supersedes ENV 1991-3:1995.

CEN/TC 250 is responsible for all Structural Eurocodes.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, 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).

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).

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
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 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.

² According to Art. 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 harmonised ENs and ETAGs/ETAs.

³ According to Art. 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 ER 2.

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.

The National Annex 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 should clearly mention which Nationally Determined Parameters have been taken into account.

Additional information specific to EN 1991-2

EN 1991-2 defines models of traffic loads for the design of road bridges, footbridges and railway bridges. For the design of new bridges, EN 1991-2 is intended to be used, for direct application, together with Eurocodes EN 1990 to 1999.

The bases for combinations of traffic loads with non-traffic loads are given in EN 1990, A2.

⁴ see Art.3.3 and Art.12 of the CPD, as well as clauses 4.2, 4.3.1, 4.3.2 and 5.2 of ID 1 (Interpretative Document Nr. 1).

Complementary rules may be specified for individual projects :

- when traffic loads need to be considered which are not defined in this Part of Eurocode 1 (*e.g.* site loads, military loads, tramway loads) ;
- for bridges intended for both road and rail traffic ;
- for actions to be considered in accidental design situations ;
- for masonry arch bridges.

For road bridges, Load Models 1 and 2, defined in 4.3.2 and 4.3.3, and taken into account with adjustment factors α and β equal to 1, are deemed to represent the most severe traffic met or expected in practice, other than that of special vehicles requiring permits to travel, on the main routes of European countries. The traffic on other routes in these countries and in some other countries may be substantially lighter, or better controlled. However it should be noted that a great number of existing bridges do not meet the requirements of this EN 1991-2 and the associated Structural Eurocodes EN 1992 to EN 1999.

It is therefore recommended to the national authorities that values of the adjustment factors α and β be chosen for road bridge design corresponding possibly to several classes of routes on which the bridges are located, but remain as few and simple as possible, based on consideration of the national traffic regulations and the efficiency of the associated control.

For railway bridges, Load Model 71 (together with Load Model SW/0 for continuous bridges), defined in 6.3.2, represent the static effect of standard rail traffic operating over the standard-gauge or wide-gauge European mainline-network. Load Model SW/2, defined in 6.3.3, represents the static effect of heavy rail traffic. The lines, or sections of lines, over which such loads shall be taken into account are defined in the National Annex (see below) or for the individual project.

Provision is made for varying the specified loading to cater for variations in the type, volume and maximum weight of rail traffic on different railways, as well as for different qualities of track. The characteristic values given for Load Models 71 and SW/0 may be multiplied by a factor α for lines carrying rail traffic which is heavier or lighter than the standard.

In addition two other load models are given for railway bridges :

- load model "unloaded train" for checking the lateral stability of single track bridges and
- load model HSLM to represent the loading from passenger trains at speeds exceeding 200 km/h.

Guidance is also given on aerodynamic actions on structures adjacent to railway tracks as a result of passing trains and on other actions from railway infrastructure.

Bridges are essentially public works, for which :

- the European Directive 89/440/EEC on contracts for public works is particularly relevant, and
- public authorities have responsibilities as owners.

Public authorities may also have responsibilities for the issue of regulations on authorised traffic (especially on vehicle loads) and for delivery and control dispensations when relevant, *e.g.* for special vehicles.

EN 1991-2 is therefore intended for use by :

- committees drafting standards for structural design and related product, testing and execution standards ;
- clients (*e.g.* for the formulation of their specific requirements on traffic and associated loading requirements) ;
- designers and constructors ;
- relevant authorities.

Where a Table or a Figure are part of a NOTE, the Table or the Figure number is followed by (n) (*e.g.* Table 4.5(n)).

National Annex for EN 1991-2

This Standard gives alternative procedures, values and recommendations for classes with notes indicating where national choices have to be made. Therefore the National Standard implementing EN 1991-2 should have a National Annex containing all Nationally Determined Parameters to be used for the design of bridges to be constructed in the relevant country.

National choice is allowed in EN 1991-2 through the following clauses :

Section 1 : General	
1.1(3)	Complementary rules for retaining walls, buried structures and tunnels.

Section 2 : Classification of actions	
2.2(2) NOTE 2	Use of infrequent values of loading for road bridges
2.3(1)	Definition of appropriate protection against collisions
2.3(4)	Rules concerning collisions forces from various origins

Section 3 : Design situations	
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Section 1 General

1.1 Scope

(1) EN 1991-2 defines imposed loads (models and representative values) associated with road traffic, pedestrian actions and rail traffic which include, when relevant, dynamic effects and centrifugal, braking and acceleration actions and actions for accidental design situations.

(2) Imposed loads defined in EN 1991-2 are intended to be used for the design of new bridges, including piers, abutments, upstand walls, wing walls and flank walls etc., and their foundations.

(3) The load models and values given in EN 1991-2 should be used for the design of retaining walls adjacent to roads and railway lines.

NOTE For some models only, applicability conditions are defined in EN 1991-2. For the design of buried structures, retaining walls and tunnels, provisions other than those in EN 1990 to EN 1999 may be necessary. Possible complementary conditions may be defined in the National Annex or for the individual project.

(4) EN 1991-2 is intended to be used in conjunction with EN 1990 (especially A2) and EN 1991 to EN 1999.

(5) Section 1 gives definitions and symbols.

(6) Section 2 defines loading principles for road bridges, footbridges (or cycle-track bridges) and railway bridges.

(7) Section 3 is concerned with design situations and gives guidance on simultaneity of traffic load models and on combinations with non-traffic actions.

(8) Section 4 defines :

- imposed loads (models and representative values) due to traffic actions on road bridges and their conditions of mutual combination and of combination with pedestrian and cycle traffic (see section 5) ;
- other actions specifically for the design of road bridges.

(9) Section 5 defines :

- imposed loads (models and representative values) on footways, cycle tracks and footbridges ;
- other actions specifically for the design of footbridges.

(10) Sections 4 and 5 also define loads transmitted to the structure by vehicle restraint systems and/or pedestrian parapets.