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Evrokod 3: Projektiranje jeklenih konstrukcij - 6 del: Žerjavne proge

Eurocode 3 - Design of steel structures - Part 6: Crane supporting structures

Eurocode 3 - Bemessung und Konstruktion von Stahlbauten - Teil 6: Kranbahnen

Eurocode 3 - Calcul des structures en acier - Partie 6: Chemins de roulement

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Eurocode 3 - Design of steel structures - Part 6: Crane supporting structures

Eurocode 3 - Calcul des structures en acier - Partie 6: Chemins de roulement

Eurocode 3 - Bemessung und Konstruktion von Stahlbauten - Teil 6: Kranbahnen

This European Standard was approved by CEN on 12 June 2006.

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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 CEN Management Centre has the same status as the official versions.

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Foreword

This European Standard EN 1993-6, “Eurocode 3: Design of steel structures: Part 6 Crane supporting srtuctures”, has been prepared by Technical Committee CEN/TC250 « Structural Eurocodes », the Secretariat of which is held by BSI.
CEN/TC250 is responsible for all Structural Eurocodes.

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of an identical text or by endorsement, at the latest by October 2007, and conflicting National Standards shall be withdrawn at latest by March 2010.

This Eurocode supersedes ENV 1993-6.

According to the CEN-CENELEC Internal Regulations, the National Standard Organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, 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 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 1980’s.

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 the 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
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.

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[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).

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 standard[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.

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,

the procedure to be used where alternative procedures are given in the Eurocode,

– references to non-contradictory complementary information to assist the user to apply the Eurocode.

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[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 hENs 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.

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

Additional information specific to EN 1993-6

EN 1993-6 is one of the six parts of EN 1993 "Design of Steel Structures" and gives principles and application rules for the safety, serviceability and durability of crane supporting structures.

EN 1993-6 gives design rules that supplement the generic rules in EN 1993-1.

EN 1993-6 is intended for clients, designers, contractors and public authorities.

EN 1993-6 is intended to be used with EN 1990, EN 1991 and EN 1993-1. Matters that are already covered in those documents are not repeated.

Numerical values for partial factors and other reliability parameters are recommended as basic values that provide an acceptable level of reliability. They have been selected assuming that an appropriate level of workmanship and quality management applies.

National Annex for EN 1993-6

This standard gives alternative procedures, values and recommendations for classes with notes indicating where national choices may be made. So the National Standard implementing EN 1993-6 should have a National Annex containing all Nationally Determined Parameters to be used for the design of crane-supporting members in steel structures to be constructed in the relevant country.

National choice is allowed in EN 1993-6 through:

2.1.3.2(1)P	Design working life.
2.8(2)P	Partial factor $\gamma_{F,test}$ for crane test loads.
3.2.3(1)	Lowest service temperature for indoor crane supporting structures.
3.2.3(2)P	Selection of toughness properties for members in compression.
3.2.4(1) table 3.2	Requirement Z_{Ed} for through-thickness properties.
3.6.2(1)	Information on suitable rails and rail steels.
3.6.3(1)	Information on special connecting devices for rails.
6.1(1)	Partial factors γ_{Mi} for resistance for ultimate limit states.
6.3.2.3(1)	Alternative assessment method for lateral-torsional buckling
7.3(1)	Limits for deflections and deformations.
7.5(1)	Partial factor $\gamma_{M,ser}$ for resistance for serviceability limit states.
8.2(4)	Crane classes to be treated as "high fatigue".
9.1(2)	Limit for number of cycles C_0 without a fatigue assessment.
9.2(1)P	Partial factors γ_{Ff} for fatigue loads.
9.2(2)P	Partial factors γ_{Mf} for fatigue resistance.
9.3.3(1)	Crane classes where bending due to eccentricity may be neglected.
9.4.2(5)	Damage equivalence factors λ_{dup} for multiple crane operation.

[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.

1 General

1.1 Scope

(1) This Part 6 of EN 1993 provides design rules for the structural design of runway beams and other crane supporting structures.

(2) The provisions given in Part 6 supplement, modify or supersede the equivalent provisions given in EN 1993-1.

(3) It covers overhead crane runways inside buildings and outdoor crane runways, including runways for:

a) overhead travelling cranes, either:

- supported on top of the runway beams;
- underslung below the runway beams;

b) monorail hoist blocks.

(4) Additional rules are given for ancillary items including crane rails, structural end stops, support brackets, surge connectors and surge girders. However, crane rails not mounted on steel structures, and rails for other purposes, are not covered.

(5) Cranes and all other moving parts are excluded. Provisions for cranes are given in EN 13001.

(6) For seismic design, see EN 1998.

(7) For resistance to fire, see EN 1993-1-2.

1.2 Normative references

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).

EN 1090 *Execution of steel structures and aluminium structures:*

Part 2 *Technical requirements for steel structures;*

EN 1337 *Structural bearings;*

EN ISO 1461 *Hot dip galvanised coatings on fabricated iron and steel articles – specifications and test methods;*

EN 1990 *Eurocode: Basis of structural design;*

EN 1991 *Eurocode 1: Actions on structures:*

Part 1-1 *Actions on structures – Densities, self-weight and imposed loads for buildings;*

Part 1-2 *Actions on structures – Actions on structures exposed to fire;*

Part 1-4 *Actions on structures – Wind loads;*

Part 1-5 *Actions on structures – Thermal actions;*

Part 1-6 *Actions on structures – Construction loads;*

Part 1-7 *Actions on structures – Accidental actions;*

Part 3 *Actions on structures – Actions induced by cranes and machinery;*

EN 1993 *Eurocode 3: Design of steel structures:*

Part 1-1 *General rules and rules for buildings;*

Part 1-2 *Structural fire design;*

Part 1-4 *Stainless steels;*

Part 1-5 *Plated structural elements;*

Part 1-8: *Design of joints;*

Part 1-9: *Fatigue;*

Part 1-10: *Material toughness and through thickness properties;*

EN 1998 *Eurocode 8: Design provisions for earthquake resistance of structures;*

EN 10164 *Steel products with improved deformation properties perpendicular to the surface of the product - Technical delivery conditions;*

ISO/DIS 11660 *Cranes - Access, guards and restraints:*

Part 5 *Bridge and gantry cranes.*

TS 13001 *Cranes - General design;*

Part 3.3 *Limit states and proof of competence of wheel/rail contacts;*

1.3 Assumptions

(1) In addition to the general assumptions of EN 1990 the following assumptions apply:

– fabrication and erection complies with EN 1090-2.

1.4 Distinction between principles and application rules

(1) See 1.4 in EN 1990.

1.5 Terms and definitions

(1) See 1.5 in EN 1993-1-1.

(2) Supplementary to EN 1991-3, for the purposes of this Part 6 the following terminology applies:

1.5.1 crane surge Horizontal dynamic actions due to crane operation, acting longitudinally and/or laterally to the runway beams.

NOTE: The transverse actions induced by cranes apply lateral forces to the runway beams.

1.5.2 elastomeric bearing pad Resilient reinforced elastomeric bedding material intended for use under crane rails.

1.5.3 surge connector Connection that transmits crane surge from a runway beam, or a surge girder, to a support.

1.5.4 surge girder Beam or lattice girder that resists crane surge and carries it to the supports.

1.5.5 structural end stop. Component intended to stop a crane or hoist reaching the end of a runway.

1.6 Symbols

(1) The symbols are defined in EN 1993-1-1 and where they first occur in this EN 1993-6.

NOTE: The symbols used are based on ISO 3898: 1987.

2 Basis of design

2.1 Requirements

2.1.1 Basic requirements

(1) See 2.1.1 of EN 1993-1-1.

2.1.2 Reliability management

(1) See 2.1.2 of EN 1993-1-1.

2.1.3 Design working life, durability and robustness

2.1.3.1 General

(1) See 2.1.3.1 of EN 1993-1-1.

2.1.3.2 Design working life

(1)P The design working life of a crane supporting structure shall be specified as the period during which it is required to provide its full function. The design working life should be documented (for example in the maintenance plan).

> **NOTE:** The National Annex may specify the relevant design working life. A design working life of 25 years is recommended for runway beams, but for runways that are not intensively used, 50 years may be appropriate.

(2)P For temporary crane supporting structures, the design working life shall be agreed with the client and the public authority, taking account of possible re-use.

(3) For structural components that cannot be designed to achieve the total design working life of the crane supporting structure, see **4(6)**.

2.1.3.3 Durability

(1)P Crane supporting structures shall be designed for environmental influences, such as corrosion, wear and fatigue by appropriate choice of materials, see EN 1993-1-4 and EN 1993-1-10, appropriate detailing, see EN 1993-1-9, structural redundancy and appropriate corrosion protection.

(2)P Where replacement or realignment is necessary (e.g. due to expected soil subsidence) such replacement or realignment shall be taken into account in the design by appropriate detailing and verified as a transient design situation.

2.2 Principles of limit state design

(1) See 2.2 of EN 1993-1-1.

2.3 Basic variables

2.3.1 Actions and environmental influences

(1)P The characteristic values of crane actions shall be determined by reference to EN 1991-3.

> **NOTE 1**: EN 1991-3 gives rules for determining crane actions in accordance with the provisions in EN 13001-1 and EN 13001-2 to facilitate the exchange of data with crane suppliers.
>
> **NOTE 2**: EN 1991-3 gives various methods to determine reliable actions, depending upon whether or not full information on crane specifications are available at the time of design of crane supporting structures.

(2)P Other actions on crane supporting structures shall be determined by reference to EN 1991-1-1, EN 1991-1-2, EN 1991-1-4, EN 1991-1-5, EN 1991-1-6 or EN 1991-1-7 as appropriate.

(3)P Partial factors and combination rules shall be taken from Annex A of EN 1991-3.

(4) For actions during erection stages see EN 1991-1-6.

(5) For actions from soil subsidence see 2.3.1(3) and (4) of EN 1993-1-1.

2.3.2 Material and product properties

(1) See 2.3.2 of EN 1993-1-1.

2.4 Verification by the partial factor method

(1) See 2.4 of EN 1993-1-1.

(2) For partial factors for static equilibrium and uplift of bearings see Annex A of EN 1991-3.

2.5 Design assisted by testing

(1) See 2.5 of EN 1993-1-1.

2.6 Clearances to overhead travelling cranes

(1) The clearances between all overhead travelling cranes and the crane supporting structure, and the dimensions of all access routes to the cranes for drivers or for maintenance personnel, should comply with ISO/DIS 11660-5.

2.7 Underslung cranes and hoist blocks

(1) Where the flange of a runway beam directly supports wheel loads from an underslung crane or hoist block, a serviceability limit state stress check, see **7.5**, should be carried out.

(2) The ultimate limit state resistance of this flange should also be verified as specified in **6.7.**

2.8 Crane tests

(1) Where a crane or a hoist block is required to be tested after erection on its supporting structure, a serviceability limit state stress check, see **7.5**, should be carried out on the supporting members affected, using the relevant crane test loads from 2.10 of EN 1991-3.

(2)P The ultimate limit state verifications specified in **6** shall also be satisfied under the crane test loads, applied at the positions affected. A partial factor $\gamma_{F,test}$ shall be applied to these test loads.

NOTE: The numerical value for $\gamma_{F,test}$ may be defined in the National Annex. The value of 1,1 is recommended.