

RAUDTEEALASED RAKENDUSED. RÖÖBASTEE.
BETOONLIIPRID JA PÖÖRMEPRUSSID. OSA 6:
KAVANDAMINE JA KONSTRUEERIMINE

Railway applications - Track - Concrete sleepers and
bearers - Part 6: Design

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN 13230-6:2020 sisaldab Euroopa standardi EN 13230-6:2020 ingliskeelset teksti.	This Estonian standard EVS-EN 13230-6:2020 consists of the English text of the European standard EN 13230-6:2020.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 29.04.2020.	Date of Availability of the European standard is 29.04.2020.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

ICS 91.100.30, 93.100

Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardikeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardikeskusega:
Koduleht www.evs.ee; telefon 605 5050; e-post info@evs.ee

The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation.

If you have any questions about copyright, please contact Estonian Centre for Standardisation:

Homepage www.evs.ee; phone +372 605 5050; e-mail info@evs.ee

EUROPEAN STANDARD

EN 13230-6

NORME EUROPÉENNE

EUROPÄISCHE NORM

April 2020

ICS 91.100.30; 93.100

English Version

Railway applications - Track - Concrete sleepers and bearers - Part 6: Design

Applications ferroviaires - Voie - Traverses et supports en béton - Partie 6 : Conception

Bahnanwendungen - Oberbau - Gleis- und Weichenschwellen aus Beton - Teil 6: Bemessung

This European Standard was approved by CEN on 8 April 2019.

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

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Contents	Page
European foreword.....	4
Introduction	5
1 Scope.....	6
2 Normative references.....	6
3 Terms, definitions and symbols.....	6
4 General requirements	9
4.1 General process for determination of bending moments	9
4.1.1 General.....	9
4.1.2 Empirical method.....	9
4.1.3 Theoretical method.....	10
4.1.4 Combined method.....	11
4.2 Crack formation in concrete sleepers or bearers.....	11
4.2.1 Cracks under rail seat.....	11
4.2.2 Cracks at centre part (prestressed monoblock sleepers or bearers)	12
4.2.3 Cracks for tests for negative bending under rail seat or positive bending at centre part.....	12
4.3 Section design of sleeper	12
4.4 Durability of sleeper	12
5 Design parameters.....	12
5.1 Maintenance.....	12
5.1.1 Track and rolling stock quality	12
5.1.2 Distribution of the vertical load in the longitudinal direction	13
5.1.3 Distribution of ballast reaction along the length of the sleeper	13
5.2 Track laying conditions	13
5.2.1 Mass of sleeper	13
5.2.2 Length of sleeper	13
5.2.3 Depth of sleeper.....	13
5.2.4 Track installation methods	13
5.3 Track components design	14
5.3.1 Rail profile and sleeper spacing	14
5.3.2 Fastening system.....	14
5.3.3 Track stability	14
5.4 Impact of traffic characteristics and track alignment	15
5.4.1 Axle load	15
5.4.2 Maximum speed.....	15
5.4.3 Curving load	15
6 Design method	15
6.1 Specific aspects for design and testing.....	15
6.1.1 Railway experience for exceptional or accidental impact loads.....	15
6.1.2 Flexural tensile strength of concrete	15
6.1.3 Losses of prestressing	16
6.1.4 Experience for track work	16
6.2 Design calculation.....	16
6.2.1 General.....	16

6.2.2	Calculation of dynamic rail seat load P_k under normal service conditions.....	16
6.2.3	Calculation of the characteristic bending moments for rail seat of sleepers	16
6.2.4	Calculation of the characteristic bending moments for centre part of sleepers	17
6.2.5	Calculation of the characteristic bending moments for bearers.....	18
6.2.6	Checking of stresses in concrete	18
6.2.7	Determination of test bending moments for first crack formation.....	18
Annex A (informative) Design methods and factors for sleepers		20
A.1	General	20
A.1.1	Introduction	20
A.1.2	Determination of characteristic bending moments.....	20
A.1.3	Load levels and corresponding bending moments	21
A.2	Rail seat load.....	22
A.2.1	Normal service increment for the dynamic wheel load.....	22
A.2.2	Distribution of vertical loads in longitudinal direction.....	22
A.2.3	Effects of elastic rail pads	25
A.2.4	Calculation of dynamic rail seat load	25
A.3	Characteristic bending moments.....	25
A.3.1	General	25
A.3.2	Rail seat section.....	26
A.3.3	Sleeper centre section.....	27
A.4	Factors for test loads and acceptance criteria	33
A.4.1	General	33
A.4.2	Factor for first crack formation.....	33
A.4.3	Factors for exceptional loads	34
A.4.4	Factors for accidental loads	35
A.4.5	Factor for fatigue test.....	35
A.5	Checking of stresses for Serviceability Limit State (for prestressed sleepers only).....	35
A.6	Design examples	36
A.6.1	General	36
A.6.2	Example 1: 1 435 mm gauge waisted sleeper with elastic beam on elastic foundation calculation.....	38
A.6.3	Example 2: 1 435 mm gauge rectangular sleeper using simplified method	46
A.6.4	Example 3: 1 668 mm gauge waisted sleeper.....	52
Annex B (informative) Design methods and factors for turnout bearers		56
Annex ZA (informative) Relationship between this European standard and the Essential Requirements of EU Directive 2008/57/EC aimed to be covered		59
Bibliography		61

European foreword

This document (EN 13230-6:2020) has been prepared by Technical Committee CEN/TC 256 "Railway applications", the secretariat of which is held by DIN.

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 2020, and conflicting national standards shall be withdrawn at the latest by October 2020.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 2008/57/EC.

For relationship with EU Directive 2008/57/EC, see informative Annex ZA, which is an integral part of this document.

This European Standard is one of the EN 13230 series, *Railway applications – Track – Concrete sleepers and bearers*, which consist of the following parts:

- *Part 1: General requirements;*
- *Part 2: Prestressed monoblock sleepers;*
- *Part 3: Twin-block reinforced sleepers;*
- *Part 4: Prestressed bearers for switches and crossings;*
- *Part 5: Special elements;*
- *Part 6: Design.*

This European Standard can be used as a technical basis between contracting parties (purchaser – supplier).

Annexes A and B are informative; they can be used as normative requirements by completion of a contract, if agreed by the contracting parties.

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

Introduction

This document covers the design of concrete sleepers and bearers and is used in conjunction with the following parts:

- *Part 1: General requirements;*
- *Part 2: Prestressed monoblock sleepers;*
- *Part 3: Twin-block reinforced sleepers;*
- *Part 4: Prestressed bearers for switches and crossings;*
- *Part 5: Special elements.*

Concrete sleepers and bearers are safety critical components for railway applications. They are not covered by any other European Standard.

As safety critical components, an agreement is needed between purchaser and supplier to operate a factory Quality System.

1 Scope

This document provides particular design guidance in the following areas:

- derivation of characteristic loads and test loads;
- calculation of characteristic and test bending moments.

The aim of this document is to give guidance for the preparation of all data to be given by the purchaser to the supplier in accordance with Parts 1 to 5 of EN 13230. It applies to gauges 1 000 mm, 1 435 mm, 1 668 mm as well as to all lengths of sleepers and bearers.

This document gives special criteria for the design of concrete sleepers and bearers as track components. The design methods in the Eurocode do not apply to these concrete elements.

All track parameters to be taken into account for the design of sleepers and bearers are detailed in this document. Information is given on these parameters so that they can be used as inputs for the design calculation process. It is the responsibility of the purchaser to calculate or determine all track parameters used in this document.

This document gives guidance for the design calculation process. It explains how experience and calculation can be combined to use design parameters.

This document gives examples of numerical data that can be used when applying Clauses 4 to 6 according to the state of the art.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 13146-3, *Railway applications – Track – Test methods for fastening systems – Part 3: Determination of attenuation of impact loads*

EN 13146-5, *Railway applications – Track – Test methods for fastening systems – Part 5: Determination of electrical resistance*

EN 13146-10, *Railway applications – Track – Test methods for fastening systems – Part 10: Proof load test for pull-out resistance*

EN 13230-1:2016, *Railway applications – Track – Concrete sleepers and bearers – Part 1: General requirements*

3 Terms, definitions and symbols

For the purposes of this document, the terms and definitions given in EN 13230-1:2016 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>