DIN EN 13230-6:2020-09 (E)

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

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 Pk 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