

DIN EN 1990



ICS 91.010.30

Supersedes  
DIN EN 1990:2010-12

**Eurocode: Basis of structural design;  
English version EN 1990:2002 + A1:2005 + A1:2005/AC:2010,  
English translation of DIN EN 1990:2021-10**

Eurocode: Grundlagen der Tragwerksplanung;  
Englische Fassung EN 1990:2002 + A1:2005 + A1:2005/AC:2010,  
Englische Übersetzung von DIN EN 1990:2021-10

Eurocodes structuraux –  
Eurocodes: Bases de calcul des structures;  
Version anglaise EN 1990:2002 + A1:2005 + A1:2005/AC:2010,  
Traduction anglaise de DIN EN 1990:2021-10

Document comprises 121 pages

Translation by DIN-Sprachendienst.

In case of doubt, the German-language original shall be considered authoritative.

*A comma is used as the decimal marker.*

## **National foreword**

This document (EN 1990:2002 + A1:2005 + A1:2005/AC:2010) has been prepared by Technical Committee CEN/TC 250 “Structural Eurocodes” (Secretariat: BSI, United Kingdom). CEN/TC 250 is responsible for all Eurocodes for structural engineering. The responsibility for all matters of structural and geotechnical design has been assigned to CEN/TC 250 of CEN.

The responsible German body involved in its preparation was *DIN-Normenausschuss Bauwesen* (DIN Standards Committee Building and Civil Engineering), Working Committee NA 005-51-01 AA “Basis of structural design (national mirror committee for CEN/TC 250/WG 2, WG 6 and CEN/TC 250/SC 10)”.

The present corrigendum concerns corrections in the German language version only. The start and finish of text introduced or altered by amendment is indicated in the text by tags  .

The application of this standard is valid in Germany in conjunction with the National Annex DIN EN 1990/NA:2010-12 and the associated amendment DIN EN 1990/NA/A1:2012-08.

For current information on this document, please go to DIN’s website ([www.din.de](http://www.din.de)) and search for the document number in question.

## **Amendments**

This standard differs from DIN V ENV 1991-1:1995-12 as follows:

- a) The comments received from the national standards bodies have been taken into account and the text of the standard has been completely revised.

This standard differs from DIN EN 1990:2002-10, DIN EN 1990/A1:2006-04, DIN EN 1990/A1 Corrigendum 1:2010-05 and DIN 1055-100:2001-03 as follows:

- a) it has been changed to the European design concept;
- b) superseding notes have been corrected;
- c) the preceding standard has been consolidated with Corrigendum 1 to A1 and A1;
- d) the standard has been editorially revised.

Compared with DIN EN 1990:2010-12, the following corrections have been made to the German version only:

- a) the German language version is being re-translated to make linguistic improvements and correct translation errors;
- b) in particular, corrections have been made to Formulae (6.7), (6.9b), (6.10a), (6.10b), (6.11a), (6.11b), (6.12a), (6.14a), (6.14b), (6.15a) and (6.16a).

**Previous editions**

DIN V ENV 1991-1-1: 1995-12

DIN 1055-100: 2001-03

DIN EN 1990: 2002-10, 2010-12

DIN EN 1990/A1: 2006-04

DIN EN 1990/A1 Corrigendum 1: 2010-05

— This page is intentionally blank —

English Version

**Eurocode —  
Basis of structural design**

Eurocodes structuraux —  
Eurocodes: Bases de calcul des structures

Eurocode —  
Grundlagen der Tragwerksplanung

EN 1990 was approved by CEN on 2001-11-29 and Amendment A1:2005 on 2004-10-14 and Corrigendum AC on 2010-04-21.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for inclusion of this amendment into the relevant 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 amendment 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**

| <b>Contents</b>                                                                                      | <b>Page</b> |
|------------------------------------------------------------------------------------------------------|-------------|
| <b>FOREWORD .....</b>                                                                                | <b>5</b>    |
| <b>FOREWORD EN 1990:2002/A1:2005 .....</b>                                                           | <b>6</b>    |
| BACKGROUND OF THE EUROCODE PROGRAMME .....                                                           | 7           |
| STATUS AND FIELD OF APPLICATION OF EUROCODES .....                                                   | 8           |
| NATIONAL STANDARDS IMPLEMENTING EUROCODES .....                                                      | 8           |
| LINKS BETWEEN EUROCODES AND HARMONISED TECHNICAL SPECIFICATIONS (ENs AND ETAs) FOR<br>PRODUCTS ..... | 9           |
| ADDITIONAL INFORMATION SPECIFIC TO EN 1990 .....                                                     | 9           |
| NATIONAL ANNEX FOR EN 1990 .....                                                                     | 10          |
| <b>SECTION 1   GENERAL .....</b>                                                                     | <b>13</b>   |
| 1.1 SCOPE .....                                                                                      | 13          |
| 1.2 NORMATIVE REFERENCES .....                                                                       | 13          |
| 1.3 ASSUMPTIONS .....                                                                                | 14          |
| 1.4 DISTINCTION BETWEEN PRINCIPLES AND APPLICATION RULES .....                                       | 14          |
| 1.5 TERMS AND DEFINITIONS .....                                                                      | 15          |
| 1.5.1 Common terms used in EN 1990 to EN 1999 .....                                                  | 15          |
| 1.5.2 Special terms relating to design in general .....                                              | 16          |
| 1.5.3 Terms relating to actions .....                                                                | 19          |
| 1.5.4 Terms relating to material and product properties .....                                        | 22          |
| 1.5.5 Terms relating to geometrical data .....                                                       | 22          |
| 1.5.6 Terms relating to structural analysis .....                                                    | 23          |
| 1.6 SYMBOLS .....                                                                                    | 24          |
| <b>SECTION 2   REQUIREMENTS .....</b>                                                                | <b>27</b>   |
| 2.1 BASIC REQUIREMENTS .....                                                                         | 27          |
| 2.2 RELIABILITY MANAGEMENT .....                                                                     | 28          |
| 2.3 DESIGN WORKING LIFE .....                                                                        | 29          |
| 2.4 DURABILITY .....                                                                                 | 30          |
| 2.5 QUALITY MANAGEMENT .....                                                                         | 30          |
| <b>SECTION 3   PRINCIPLES OF LIMIT STATES DESIGN .....</b>                                           | <b>31</b>   |
| 3.1 GENERAL .....                                                                                    | 31          |
| 3.2 DESIGN SITUATIONS .....                                                                          | 31          |
| 3.3 ULTIMATE LIMIT STATES .....                                                                      | 32          |
| 3.4 SERVICEABILITY LIMIT STATES .....                                                                | 32          |
| 3.5 LIMIT STATE DESIGN .....                                                                         | 33          |
| <b>SECTION 4   BASIC VARIABLES .....</b>                                                             | <b>34</b>   |
| 4.1 ACTIONS AND ENVIRONMENTAL INFLUENCES .....                                                       | 34          |
| 4.1.1 Classification of actions .....                                                                | 34          |
| 4.1.2 Characteristic values of actions .....                                                         | 34          |
| 4.1.3 Other representative values of variable actions .....                                          | 36          |
| 4.1.4 Representation of fatigue actions .....                                                        | 36          |
| 4.1.5 Representation of dynamic actions .....                                                        | 36          |
| 4.1.6 Geotechnical actions .....                                                                     | 37          |
| 4.1.7 Environmental influences .....                                                                 | 37          |
| 4.2 MATERIAL AND PRODUCT PROPERTIES .....                                                            | 37          |
| 4.3 GEOMETRICAL DATA .....                                                                           | 38          |
| <b>SECTION 5   STRUCTURAL ANALYSIS AND DESIGN ASSISTED BY TESTING .....</b>                          | <b>39</b>   |
| 5.1 STRUCTURAL ANALYSIS .....                                                                        | 39          |
| 5.1.1 Structural modelling .....                                                                     | 39          |
| 5.1.2 Static actions .....                                                                           | 39          |
| 5.1.3 Dynamic actions .....                                                                          | 39          |

|                                                                                                               |           |
|---------------------------------------------------------------------------------------------------------------|-----------|
| 5.1.4 Fire design.....                                                                                        | 40        |
| 5.2 DESIGN ASSISTED BY TESTING .....                                                                          | 41        |
| <b>SECTION 6 VERIFICATION BY THE PARTIAL FACTOR METHOD.....</b>                                               | <b>42</b> |
| 6.1 GENERAL.....                                                                                              | 42        |
| 6.2 LIMITATIONS .....                                                                                         | 42        |
| 6.3 DESIGN VALUES.....                                                                                        | 42        |
| 6.3.1 Design values of actions .....                                                                          | 42        |
| 6.3.2 Design values of the effects of actions .....                                                           | 43        |
| 6.3.3 Design values of material or product properties.....                                                    | 44        |
| 6.3.4 Design values of geometrical data .....                                                                 | 44        |
| 6.3.5 Design resistance.....                                                                                  | 45        |
| 6.4 ULTIMATE LIMIT STATES .....                                                                               | 46        |
| 6.4.1 General.....                                                                                            | 46        |
| 6.4.2 Verifications of static equilibrium and resistance .....                                                | 47        |
| 6.4.3 Combination of actions (fatigue verifications excluded).....                                            | 47        |
| 6.4.3.1 General.....                                                                                          | 47        |
| 6.4.3.2 Combinations of actions for persistent or transient design situations (fundamental combinations) .... | 48        |
| 6.4.3.3 Combinations of actions for accidental design situations.....                                         | 49        |
| 6.4.3.4 Combinations of actions for seismic design situations.....                                            | 49        |
| 6.4.4 Partial factors for actions and combinations of actions.....                                            | 49        |
| 6.4.5 Partial factors for materials and products .....                                                        | 50        |
| 6.5 SERVICEABILITY LIMIT STATES.....                                                                          | 50        |
| 6.5.1 Verifications .....                                                                                     | 50        |
| 6.5.2 Serviceability criteria .....                                                                           | 50        |
| 6.5.3 Combination of actions.....                                                                             | 50        |
| 6.5.4 Partial factors for materials.....                                                                      | 51        |
| <b>ANNEX A1 (NORMATIVE) APPLICATION FOR BUILDINGS.....</b>                                                    | <b>52</b> |
| A1.1 FIELD OF APPLICATION .....                                                                               | 52        |
| A1.2 COMBINATIONS OF ACTIONS .....                                                                            | 52        |
| A1.2.1 General .....                                                                                          | 52        |
| A1.2.2 Values of $\psi$ factors.....                                                                          | 52        |
| A1.3 ULTIMATE LIMIT STATES .....                                                                              | 53        |
| A1.3.1 Design values of actions in persistent and transient design situations .....                           | 53        |
| A1.3.2 Design values of actions in the accidental and seismic design situations.....                          | 56        |
| A1.4 SERVICEABILITY LIMIT STATES.....                                                                         | 57        |
| A1.4.1 Partial factors for actions .....                                                                      | 57        |
| A1.4.2 Serviceability criteria.....                                                                           | 57        |
| A1.4.3 Deformations and horizontal displacements.....                                                         | 57        |
| A1.4.4 Vibrations.....                                                                                        | 59        |
| <b>ANNEX A2 (NORMATIVE) APPLICATION FOR BRIDGES .....</b>                                                     | <b>60</b> |
| A2.1 FIELD OF APPLICATION .....                                                                               | 62        |
| A2.2 COMBINATIONS OF ACTIONS .....                                                                            | 62        |
| A2.2.1 General .....                                                                                          | 62        |
| A2.2.2 Combination rules for road bridges.....                                                                | 64        |
| A2.2.3 Combination rules for footbridges.....                                                                 | 65        |
| A2.2.4 Combination rules for railway bridges .....                                                            | 66        |
| A2.2.5 Combinations of actions for accidental (non seismic) design situations .....                           | 66        |
| A2.2.6 Values of $\psi$ factors.....                                                                          | 67        |
| A2.3 ULTIMATE LIMIT STATES .....                                                                              | 71        |
| A2.3.1 Design values of actions in persistent and transient design situations .....                           | 71        |
| A2.3.2 Design values of actions in the accidental and seismic design situations.....                          | 76        |
| A2.4 SERVICEABILITY AND OTHER SPECIFIC LIMIT STATES .....                                                     | 77        |
| A2.4.1 General .....                                                                                          | 77        |
| A2.4.2 Serviceability criteria regarding deformation and vibration for road bridges.....                      | 78        |
| A2.4.3 Verifications concerning vibration for footbridges due to pedestrian traffic.....                      | 78        |
| A2.4.3.1 Design situations and associated traffic assumptions.....                                            | 78        |
| A2.4.3.2 Pedestrian comfort criteria (for serviceability).....                                                | 79        |

|                                                                                                |            |
|------------------------------------------------------------------------------------------------|------------|
| A2.4.4 Verifications regarding deformations and vibrations for railway bridges .....           | 79         |
| A2.4.4.1 General .....                                                                         | 79         |
| A2.4.4.2 Criteria for traffic safety .....                                                     | 80         |
| A2.4.4.3 Limiting values for the maximum vertical deflection for passenger comfort .....       | 84         |
| <b>ANNEX B (INFORMATIVE) MANAGEMENT OF STRUCTURAL RELIABILITY FOR CONSTRUCTION WORKS .....</b> | <b>87</b>  |
| B1 SCOPE AND FIELD OF APPLICATION .....                                                        | 87         |
| B2 SYMBOLS .....                                                                               | 87         |
| B3 RELIABILITY DIFFERENTIATION .....                                                           | 88         |
| B3.1 Consequences classes .....                                                                | 88         |
| B3.2 Differentiation by $\beta$ values .....                                                   | 88         |
| B3.3 Differentiation by measures relating to the partial factors .....                         | 89         |
| B4 DESIGN SUPERVISION DIFFERENTIATION .....                                                    | 89         |
| B5 INSPECTION DURING EXECUTION .....                                                           | 90         |
| B6 PARTIAL FACTORS FOR RESISTANCE PROPERTIES .....                                             | 91         |
| <b>ANNEX C (INFORMATIVE) BASIS FOR PARTIAL FACTOR DESIGN AND RELIABILITY ANALYSIS .....</b>    | <b>92</b>  |
| C1 SCOPE AND FIELD OF APPLICATIONS .....                                                       | 92         |
| C2 SYMBOLS .....                                                                               | 92         |
| C3 INTRODUCTION .....                                                                          | 93         |
| C4 OVERVIEW OF RELIABILITY METHODS .....                                                       | 93         |
| C5 RELIABILITY INDEX $\beta$ .....                                                             | 94         |
| C6 TARGET VALUES OF RELIABILITY INDEX $\beta$ .....                                            | 95         |
| C7 APPROACH FOR CALIBRATION OF DESIGN VALUES .....                                             | 96         |
| C8 RELIABILITY VERIFICATION FORMATS IN EUROCODES .....                                         | 98         |
| C9 PARTIAL FACTORS IN EN 1990 .....                                                            | 99         |
| C10 $\psi_0$ FACTORS .....                                                                     | 100        |
| <b>ANNEX D (INFORMATIVE) DESIGN ASSISTED BY TESTING .....</b>                                  | <b>102</b> |
| D1 SCOPE AND FIELD OF APPLICATION .....                                                        | 102        |
| D2 SYMBOLS .....                                                                               | 102        |
| D3 TYPES OF TESTS .....                                                                        | 103        |
| D4 PLANNING OF TESTS .....                                                                     | 104        |
| D5 DERIVATION OF DESIGN VALUES .....                                                           | 106        |
| D6 GENERAL PRINCIPLES FOR STATISTICAL EVALUATIONS .....                                        | 107        |
| D7 STATISTICAL DETERMINATION OF A SINGLE PROPERTY .....                                        | 107        |
| D7.1 General .....                                                                             | 107        |
| D7.2 Assessment via the characteristic value .....                                             | 108        |
| D7.3 Direct assessment of the design value for ULS verifications .....                         | 109        |
| D8 STATISTICAL DETERMINATION OF RESISTANCE MODELS .....                                        | 110        |
| D8.1 General .....                                                                             | 110        |
| D8.2 Standard evaluation procedure (Method (a)) .....                                          | 110        |
| D8.2.1 General .....                                                                           | 110        |
| D8.2.2 Standard procedure .....                                                                | 111        |
| D8.3 Standard evaluation procedure (Method (b)) .....                                          | 115        |
| D8.4 Use of additional prior knowledge .....                                                   | 115        |
| <b>BIBLIOGRAPHY .....</b>                                                                      | <b>117</b> |

## **Foreword**

This document (EN 1990:2002) 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 October 2002, and conflicting national standards shall be withdrawn at the latest by March 2010.

This document supersedes ENV 1991-1:1994.

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, Spain, Sweden, Switzerland and the United Kingdom.

## **Foreword EN 1990:2002/A1:2005**

This European Standard (EN 1990:2002/A1:2005) has been prepared by Technical Committee CEN/TC 250 “Structural Eurocodes”, the secretariat of which is held by BSI.

This Amendment to the EN 1990:2002 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2006, and conflicting national standards shall be withdrawn at the latest by June 2006.

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