

DIN EN 1992-1-1: 2011-01(E)

Eurocode_2: Design of concrete structures_ - Part_1-1: General rules and rules for buildings (includes Corrigendum AC:2010)

Contents List

Foreword to EN 1992-1-1:2004 + AC:2010

- 1. General
 - 1.1 Scope
 - 1.1.1 Scope of Eurocode 2
 - 1.1.2 Scope of Part 1-1 of Eurocode 2
 - 1.2 Normative references
 - 1.2.1 General reference standards
 - 1.2.2 Other reference standards
 - 1.3 Assumptions
 - 1.4 Distinction between principles and application rules
 - 1.5 Definitions
 - 1.5.1 General
 - 1.5.2 Additional terms and definitions used in this Standard
 - 1.5.2.1 Precast structures
 - 1.5.2.2 Plain or lightly reinforced concrete members
 - 1.5.2.3 Unbonded and external tendons
 - 1.5.2.4 Prestress
 - 1.6 Symbols
- 2. Basis of design
 - 2.1 Requirements
 - 2.1.1 Basic requirements
 - 2.1.2 Reliability management
 - 2.1.3 Design working life, durability and quality management
 - 2.2 Principles of limit state design
 - 2.3 Basic variables
 - 2.3.1 Actions and environment influences
 - 2.3.1.1 General
 - 2.3.1.2 Thermal effects
 - 2.3.1.3 Differential settlements/movements
 - 2.3.1.4 Prestress
 - 2.3.2 Material and product properties
 - 2.3.2.1 General
 - 2.3.2.2 Shrinkage and creep
 - 2.3.3 Deformations of concrete
 - 2.3.4 Geometric data
 - 2.3.4.1 General
 - 2.3.4.2 Supplementary requirements for cast in place piles
 - 2.4 Verification by the partial factor method
 - 2.4.1 General
 - 2.4.2 Design values
 - 2.4.2.1 Partial factor for shrinkage action
 - 2.4.2.2 Partial factors for prestress
 - 2.4.2.3 Partial factor for fatigue loads
 - 2.4.2.4 Partial factors for materials
 - 2.4.2.5 Partial factors for materials for foundations
 - 2.4.3 Combinations of actions
 - 2.4.4 Verification of static equilibrium - EQU

- 2.5 Design assisted by testing
- 2.6 Supplementary requirements for foundations
- 2.7 Requirements for fastenings
- 3. Materials
 - 3.1 Concrete
 - 3.1.1 General
 - 3.1.2 Strength
 - 3.1.3 Elastic deformation
 - 3.1.4 Creep and shrinkage
 - 3.1.5 Stress-strain relation for non-linear structural analysis
 - 3.1.6 Design compressive and tensile strengths
 - 3.1.7 Stress-strain relations for the design of cross-sections
 - 3.1.8 Flexural tensile strength
 - 3.1.9 Confined concrete
 - 3.2 Reinforcing steel
 - 3.2.1 General
 - 3.2.2 Properties
 - 3.2.3 Strength
 - 3.2.4 Ductility characteristics
 - 3.2.5 Welding
 - 3.2.6 Fatigue
 - 3.2.7 Design assumptions
 - 3.3 Prestressing steel
 - 3.3.1 General
 - 3.3.2 Properties
 - 3.3.3 Strength
 - 3.3.4 Ductility characteristics
 - 3.3.5 Fatigue
 - 3.3.6 Design assumptions
 - 3.3.7 Prestressing tendons in sheaths
 - 3.4 Prestressing devices
 - 3.4.1 Anchorages and couplers
 - 3.4.1.1 General
 - 3.4.1.2 Mechanical properties
 - 3.4.1.2.1 Anchored tendons
 - 3.4.1.2.2 Anchored devices and anchorage zones
 - 3.4.2 External non-bonded tendons
 - 3.4.2.1 General
 - 3.4.2.2 Anchorages
- 4. Durability and cover to reinforcement
 - 4.1 General
 - 4.2 Environmental conditions
 - 4.3 Requirements for durability
 - 4.4 Methods of verifications
 - 4.4.1 Concrete cover
 - 4.4.1.1 General
 - 4.4.1.2 Minimum cover, c_{min}
 - 4.4.1.3 Allowance in design for deviation

- 5. Structural analysis
 - 5.1 General
 - 5.1.1 General requirements
 - 5.1.2 Special requirements for foundations
 - 5.1.3 Load cases and combinations
 - 5.1.4 Second order effects
 - 5.2 Geometric imperfections
 - 5.3 Idealisation of the structure
 - 5.3.1 Structural models for overall analysis
 - 5.3.2 Geometric data
 - 5.3.2.1 Effective width of flanges (all limit states)
 - 5.3.2.2 Effective span of beams and slabs in buildings
 - 5.4 Linear elastic analysis
 - 5.5 Linear elastic analysis with limited redistribution
 - 5.6 Plastic analysis
 - 5.6.1 General
 - 5.6.2 Plastic analysis for beams, frames and slabs
 - 5.6.3 Rotation capacity
 - 5.6.4 Analysis with strut and tie models
 - 5.7 Non-linear analysis
 - 5.8 Analysis of second order effects with axial load
 - 5.8.1 Definitions
 - 5.8.2 General
 - 5.8.3 Simplified criteria for second order effects
 - 5.8.3.1 Slenderness criterion for isolated members
 - 5.8.3.2 Slenderness and effective length of isolated members
 - 5.8.3.3 Global second order effects in buildings
 - 5.8.4 Creep
 - 5.8.5 Methods of analysis
 - 5.8.6 General method
 - 5.8.7 Method based on nominal stiffness
 - 5.8.7.1 General
 - 5.8.7.2 Nominal stiffness
 - 5.8.7.3 Moment magnification factor
 - 5.8.8 Method based on nominal curvature
 - 5.8.8.1 General
 - 5.8.8.2 Bending moments
 - 5.8.8.3 Curvature
 - 5.8.9 Biaxial bending
 - 5.9 Lateral instability of slender beams
 - 5.10 Prestressed members and structures
 - 5.10.1 General
 - 5.10.2 Prestressing force during tensioning
 - 5.10.2.1 Maximum stressing force
 - 5.10.2.2 Limitation of concrete stress
 - 5.10.2.3 Measurements
 - 5.10.3 Prestress force
 - 5.10.4 Immediate losses of prestress for pre-tensioning

- 5.10.5 Immediate losses of prestress for post-tensioning
 - 5.10.5.1 Losses due to the instantaneous deformation of concrete
 - 5.10.5.2 Losses due to friction
 - 5.10.5.3 Losses at anchorage
- 5.10.6 Time dependent losses of prestress for pre- and post-tensioning
- 5.10.7 Consideration of prestress in analysis
- 5.10.8 Effects of prestressing at ultimate limit state
- 5.10.9 Effects of prestressing at serviceability limit state and limit state of fatigue
- 5.11 Analysis for some particular structural members
- 6. Ultimate limit states (ULS)
 - 6.1 Bending with or without axial force
 - 6.2 Shear
 - 6.2.1 General verification procedure
 - 6.2.2 Members not requiring design shear reinforcement
 - 6.2.3 Members requiring design shear reinforcement
 - 6.2.4 $\overline{\sigma}_c$ Shear between web and flanges $\overline{\sigma}_c$
 - 6.2.5 Shear at the interface between concretes cast at different times
 - 6.3 Torsion
 - 6.3.1 General
 - 6.3.2 Design procedure
 - 6.3.3 Warping torsion
 - 6.4 Punching
 - 6.4.1 General
 - 6.4.2 Load distribution and basic control perimeter
 - 6.4.3 Punching shear calculation
 - 6.4.4 Punching shear resistance of slabs and column bases without
 - 6.4.5 Punching shear resistance of slabs and column bases with shear reinforcement
 - 6.5 Design with strut and tie models
 - 6.5.1 General
 - 6.5.2 Struts
 - 6.5.3 Ties
 - 6.5.4 Nodes
 - 6.6 Anchorages and laps
 - 6.7 Partially loaded areas
 - 6.8 Fatigue
 - 6.8.1 Verification conditions
 - 6.8.2 Internal forces and stresses for fatigue verification
 - 6.8.3 Combination of actions
 - 6.8.4 Verification procedure for reinforcing and prestressing steel
 - 6.8.5 Verification using damage equivalent stress range
 - 6.8.6 Other verifications
 - 6.8.7 Verification of concrete under compression or shear
- 7. Serviceability limit states (SLS)
 - 7.1 General
 - 7.2 Stress limitation
 - 7.3 Crack control
 - 7.3.1 General considerations
 - 7.3.2 Minimum reinforcement areas
 - 7.3.3 Control of cracking without direct calculation
 - 7.3.4 Calculation of crack widths
 - 7.4 Deflection control
 - 7.4.1 General considerations
 - 7.4.2 Cases where calculations may be omitted
 - 7.4.3 Checking deflections by calculation

- 8 Detailing of reinforcement and prestressing tendons - General
 - 8.1 General
 - 8.2 Spacing of bars
 - 8.3 Permissible mandrel diameters for bent bars
 - 8.4 Anchorage of longitudinal reinforcement
 - 8.4.1 General
 - 8.4.2 Ultimate bond stress
 - 8.4.3 Basic anchorage length
 - 8.4.4 Design anchorage length
 - 8.5 Anchorage of links and shear reinforcement
 - 8.6 Anchorage by welded bars
 - 8.7 Laps and mechanical couplers
 - 8.7.1 General
 - 8.7.2 Laps
 - 8.7.3 Lap length
 - 8.7.4 Transverse reinforcement in the lap zone
 - 8.7.4.1 Transverse reinforcement for bars in tension
 - 8.7.4.2 Transverse reinforcement for bars permanently in compression
 - 8.7.5 Laps for welded mesh fabrics made of ribbed wires
 - 8.7.5.1 Laps of the main reinforcement
 - 8.7.5.2 Laps of secondary or distribution reinforcement
 - 8.8 Additional rules for large diameter bars
 - 8.9 Bundled bars
 - 8.9.1 General
 - 8.9.2 Anchorage of bundles of bars
 - 8.9.3 Lapping bundles of bars
 - 8.10 Prestressing tendons
 - 8.10.1 Arrangement of prestressing tendons and ducts
 - 8.10.1.1 General
 - 8.10.1.2 Pre-tensioned tendons
 - 8.10.1.3 Post-tension ducts
 - 8.10.2 Anchorage of pre-tensioned tendons
 - 8.10.2.1 General
 - 8.10.2.2 Transfer of prestress
 - 8.10.2.3 **AC** Anchorage of tendons for the ultimate limit state **AC**
 - 8.10.3 Anchorage zones of post-tensioned members
 - 8.10.4 Anchorages and couplers for prestressing tendons
 - 8.10.5 Deviators
- 9. Detailing of members and particular rules
 - 9.1 General
 - 9.2 Beams
 - 9.2.1 Longitudinal reinforcement
 - 9.2.1.1 Minimum and maximum reinforcement areas
 - 9.2.1.2 Other detailing arrangements
 - 9.2.1.3 Curtailment of longitudinal tension reinforcement
 - 9.2.1.4 Anchorage of bottom reinforcement at an end supports
 - 9.2.1.5 Anchorage of bottom reinforcement at intermediate supports
 - 9.2.2 Shear reinforcement
 - 9.2.3 Torsion reinforcement
 - 9.2.4 Surface reinforcement
 - 9.2.5 Indirect supports

- 9.3 Solid slabs
 - 9.3.1 Flexural reinforcement
 - 9.3.1.1 General
 - 9.3.1.2 Reinforcement in slabs near supports
 - 9.3.1.3 Corner reinforcement
 - 9.3.1.4 Reinforcement at the free edges
 - 9.3.2 Shear reinforcement
- 9.4 Flat slabs
 - 9.4.1 Slab at internal columns
 - 9.4.2 Slab at edge and corner columns
 - 9.4.3 Punching shear reinforcement
- 9.5 Columns
 - 9.5.1 General
 - 9.5.2 Longitudinal reinforcement
 - 9.5.3 Transverse reinforcement
- 9.6 Walls
 - 9.6.1 General
 - 9.6.2 Vertical reinforcement
 - 9.6.3 Horizontal reinforcement
 - 9.6.4 Transverse reinforcement
- 9.7 Deep beams
- 9.8 Foundations
 - 9.8.1 Pile caps
 - 9.8.2 Column and wall footings
 - 9.8.2.1 General
 - 9.8.2.2 Anchorage of bars
 - 9.8.3 Tie beams
 - 9.8.4 Column footing on rock
 - 9.8.5 Bored piles
- 9.9 Regions with discontinuity in geometry or action
- 9.10 Tying systems
 - 9.10.1 General
 - 9.10.2 Proportioning of ties
 - 9.10.2.1 General
 - 9.10.2.2 Peripheral ties
 - 9.10.2.3 Internal ties
 - 9.10.2.4 Horizontal ties to columns and/or walls
 - 9.10.2.5 Vertical ties
 - 9.10.3 Continuity and anchorage of ties
- 10. Additional rules for precast concrete elements and structures
 - 10.1 General
 - 10.1.1 Special terms used in this section
 - 10.2 Basis of design, fundamental requirements
 - 10.3 Materials
 - 10.3.1 Concrete
 - 10.3.1.1 Strength
 - 10.3.1.2 Creep and shrinkage
 - 10.3.2 Prestressing steel
 - AC 10.3.2.1 AC Technological properties of prestressing steel

- 10.5 Structural analysis
 - 10.5.1 General
 - 10.5.2 Losses of prestress
- 10.9 Particular rules for design and detailing
 - 10.9.1 Restraining moments in slabs
 - 10.9.2 Wall to floor connections
 - 10.9.3 Floor systems
 - 10.9.4 Connections and supports for precast elements
 - 10.9.4.1 Materials
 - 10.9.4.2 General rules for design and detailing of connections
 - 10.9.4.3 Connections transmitting compressive forces
 - 10.9.4.4 Connections transmitting shear forces
 - 10.9.4.5 Connections transmitting bending moments or tensile forces
 - 10.9.4.6 Half joints
 - 10.9.4.7 Anchorage of reinforcement at supports
 - 10.9.5 Bearings
 - 10.9.5.1 General
 - 10.9.5.2 Bearings for connected (non-isolated) members
 - 10.9.5.3 Bearings for isolated members
 - 10.9.6 Pocket foundations
 - 10.9.6.1 General
 - 10.9.6.2 Pockets with keyed surfaces
 - 10.9.6.3 Pockets with smooth surfaces
 - 10.9.7 Tying systems
- 11. Lightweight aggregate concrete structures
 - 11.1 General
 - 11.1.1 Scope
 - 11.1.2 Special symbols
 - 11.2 Basis of design
 - 11.3 Materials
 - 11.3.1 Concrete
 - 11.3.2 Elastic deformation
 - 11.3.3 Creep and shrinkage
 - 11.3.4 Stress-strain relations for non-linear structural analysis
 - 11.3.5 Design compressive and tensile strengths
 - 11.3.6 Stress-strain relations for the design of sections
 - 11.3.7 Confined concrete
 - 11.4 Durability and cover to reinforcement
 - 11.4.1 Environmental conditions
 - 11.4.2 Concrete cover and properties of concrete
 - 11.5 Structural analysis
 - 11.5.1 Rotational capacity
 - 11.6 Ultimate limit states
 - 11.6.1 Members not requiring design shear reinforcement
 - 11.6.2 Members requiring design shear reinforcement
 - 11.6.3 Torsion
 - 11.6.3.1 Design procedure
 - 11.6.4 Punching
 - 11.6.4.1 Punching shear resistance of slabs or column bases without shear reinforcement
 - 11.6.4.2 Punching shear resistance of slabs or column bases with shear reinforcement
 - 11.6.5 Partially loaded areas
 - 11.6.6 Fatigue

- 11.7 Serviceability limit states
- 11.8 Detailing of reinforcement - General
 - 11.8.1 Permissible mandrel diameters for bent bars
 - 11.8.2 Ultimate bond stress
- 11.9 Detailing of members and particular rules
- 11.10 Additional rules for precast concrete elements and structures
- 11.12 Plain and lightly reinforced concrete structures
- 12. Plain and lightly reinforced concrete structures
 - 12.1 General
 - 12.3 Materials
 - 12.3.1 Concrete: additional design assumptions
 - 12.5 Structural analysis: ultimate limit states
 - 12.6 Ultimate limit states
 - 12.6.1 Design resistance to bending and axial force
 - 12.6.2 Local failure
 - 12.6.3 Shear
 - 12.6.4 Torsion
 - 12.6.5 Ultimate limit states induced by structural deformation (buckling)
 - 12.6.5.1 Slenderness of columns and walls
 - 12.6.5.2 Simplified design method for walls and columns
 - 12.7 Serviceability limit states
 - 12.9 Detailing of members and particular rules
 - 12.9.1 Structural members
 - 12.9.2 Construction joints
 - 12.9.3 Strip and pad footings

Annexes

- | | |
|-----------------|--|
| A (informative) | Modification of partial factors for materials |
| B (informative) | Creep and shrinkage strain |
| C (normative) | Properties of reinforcement suitable for use with this Eurocode |
| D (informative) | Detailed calculation method for prestressing steel relaxation losses |
| E (informative) | Indicative strength classes for durability |
| F (informative) | Tension reinforcement expressions for in-plane stress conditions |
| G (informative) | Soil structure interaction |
| H (informative) | Global second order effects in structures |
| I (informative) | Analysis of flat slabs and shear walls |
| J (informative) | Detailing rules for particular situations |