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 ▌〈AC〉 Shear between web and flanges 〈AC〉▐
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