

DIN EN 1996-1-1:2013-02 (E)

Eurocode 6: Design of masonry structures - Part 1-1: General rules for reinforced and unreinforced masonry structures (includes Amendment 1:2012)

Contents	Page
Foreword	6
Background to the Eurocode programme	6
Status and field of application of Eurocodes	7
National Standards implementing Eurocodes	8
Links between Eurocodes and harmonised technical specifications (ENs and ETAs) for products	8
Section 1 General	10
1.1 Scope	10
1.1.1 Scope of Eurocode 6	10
1.1.2 Scope of Part 1-1 of Eurocode 6	10
1.2 Normative references	11
1.2.1 General	11
1.2.2 Reference standards	11
1.3 Assumptions	13
1.4 Distinction between principles and application rules	13
1.5 Terms and Definitions	13
1.5.1 General	13
1.5.2 Terms relating to masonry	13
1.5.3 Terms relating to strength of masonry	13
1.5.4 Terms relating to masonry units	14
1.5.5 Terms relating to mortar	15
1.5.6 Terms relating to concrete infill	16
1.5.7 Terms relating to reinforcement	16
1.5.8 Terms relating to ancillary components	16
1.5.9 Terms relating to mortar joints	16
1.5.10 Terms relating to wall types	17
1.5.11 Miscellaneous terms	18
1.6 Symbols	18
Section 2 Basis of design	24
2.1 Basic requirements	24
2.1.1 General	24
2.1.2 Reliability	24
2.1.3 Design working life and durability	24
2.2 Principles of limit state design	24
2.3 Basic variables	25
2.3.1 Actions	25
2.3.2 Design values of actions	25
2.3.3 Material and product properties	25
2.4 Verification by the partial factor method	25
2.4.1 Design values of material properties	25
2.4.2 Combination of actions	25
2.4.3 Ultimate limit states	25
2.4.4 Serviceability limit states	26
2.5 Design assisted by testing	26

Section 3 Materials	27
3.1	Masonry Units 27
3.1.1	Types and grouping of masonry units 27
3.1.2	Properties of masonry units -compressive strength 28
3.2	Mortar 29
3.2.1	Types of masonry mortar 29
3.2.2	Specification of masonry mortar 29
3.2.3	Properties of mortar 29
3.3	Concrete infill 30
3.3.1	General 30
3.3.2	Specification for concrete infill 30
3.3.3	Properties of concrete infill 30
3.4	Reinforcing steel 30
3.4.1	General 30
3.4.2	Properties of reinforcing steel bars 31
3.4.3	Properties of bed joint ~~~~deleted textTMTMTM reinforcement 31
3.5	Prestressing steel 31
3.6	Mechanical properties of masonry 31
3.6.1	Characteristic compressive strength of masonry 31
3.6.2	Characteristic shear strength of masonry 35
3.6.3	Characteristic shear strength of the interface between masonry and prefabricated lintel . 37
3.6.4	Characteristic flexural strength of masonry 37
3.6.5	Characteristic anchorage strength of reinforcement 39
3.7	Deformation properties of masonry 40
3.7.1	Stress-strain relationship 40
3.7.2	Modulus of elasticity 41
3.7.3	Shear modulus 41
3.7.4	Creep, moisture expansion or shrinkage and thermal expansion 41
3.8	Ancillary components 42
3.8.1	Damp proof courses 42
3.8.2	Wall ties 42
3.8.3	Straps, hangers and brackets 42
3.8.4	Prefabricated lintels 42
3.8.5	Prestressing devices 43
Section 4 Durability	43
4.1	General 43
4.2	Classification of environmental conditions 43
4.3	Durability of masonry 43
4.3.1	Masonry units 43
4.3.2	Mortar 43
4.3.3	Reinforcing steel 43
4.3.4	Prestressing steel 45
4.3.5	Prestressing devices 45
4.3.6	Ancillary components and support angles 46
4.4	Masonry below ground 46
Section 5 Structural analysis	46
5.1	General 46
5.2	Structural behaviour in accidental situations (other than earthquakes and fire) 47
5.3	Imperfections 47
5.4	Second order effects 47
5.5	Analysis of structural members 48
5.5.1	Masonry walls subjected to vertical loading 48
5.5.2	Reinforced masonry members subjected to vertical loading 53
5.5.3	Masonry shear walls subjected to shear loading 56
5.5.4	Reinforced masonry members subjected to shear loading 58
5.5.5	Masonry walls subjected to lateral loading 58

Section 6 Ultimate Limit State	59
6.1 Unreinforced masonry walls subjected to mainly vertical loading	59
6.1.1 General	59
6.1.2 Verification of unreinforced masonry walls subjected to mainly vertical loading	60
6.1.3 Walls subjected to concentrated loads	63
6.2 Unreinforced masonry walls subjected to shear loading	65
6.3 Unreinforced masonry walls subjected to lateral loading	66
6.3.1 General	66
6.3.2 Walls arching between supports	67
6.3.3 Walls subjected to wind loading	68
6.3.4 Walls subjected to lateral loading from earth and water	68
6.3.5 Walls subjected to lateral loading from accidental situations	68
6.4 Unreinforced masonry walls subjected to combined vertical and lateral loading	69
6.4.1 General	69
6.4.2 Method using factor	69
6.4.3 Method using apparent flexural strength	69
6.4.4 Method using equivalent bending moment coefficients	69
6.5 Ties	69
6.6 Reinforced masonry members subjected to bending, bending and axial loading, or axial loading	70
6.6.1 General	70
6.6.2 Verification of reinforced masonry members subjected to bending and/or axial loading ...	70
6.6.3 Flanged Reinforced Members	73
6.6.4 Deep beams	74
6.6.5 Composite lintels	76
6.7 Reinforced masonry members subjected to shear loading	77
6.7.1 General	77
6.7.2 Verification of reinforced masonry walls subjected to horizontal loads in the plane of the wall	77
6.7.3 Verification of reinforced masonry beams subjected to shear loading	78
6.7.4 Verification of deep beams subjected to shear loading	79
6.8 Prestressed masonry	79
6.8.1 General	79
6.8.2 Verification of Members	80
6.9 Confined masonry	81
6.9.1 General	81
6.9.2 Verification of members	81
Section 7 Serviceability Limit State	81
7.1 General	81
7.2 Unreinforced masonry walls	81
7.3 Reinforced masonry members	82
7.4 Prestressed masonry members	82
7.5 Confined masonry members	82
7.6 Walls subjected to concentrated loads	83
Section 8 Detailing	83
8.1 Masonry details	83
8.1.1 Masonry materials	83
8.1.2 Minimum thickness of wall	83
8.1.3 Minimum area of wall	83
8.1.4 Bonding of masonry	83
8.1.5 Mortar joints	84
8.1.6 Bearings under concentrated loads	85
8.2 Reinforcement details	85
8.2.1 General	85
8.2.2 Cover to reinforcing steel	85
8.2.3 Minimum area of reinforcement	86

8.2.4	Size of reinforcing steel	86
8.2.5	Anchorage and laps	86
8.2.6	Restraint of compression reinforcing steel	89
8.2.7	Spacing of reinforcing steel	90
8.3	Prestressing details	90
8.4	Confined masonry details	90
8.5	Connection of walls	91
8.5.1	Connection of walls to floors and roofs	91
8.5.2	Connection between walls	92
8.6	Chases and recesses on walls	92
8.6.1	General	92
8.6.2	Vertical chases and recesses	93
8.6.3	Horizontal and inclined chases	93
8.7	Damp proof courses	94
8.8	Thermal and long term movement	94
Section 9 Execution		94
9.1	General	94
9.2	Design of structural members	95
9.3	Loading of masonry	95
Annex A (informative) Consideration of partial factors relating to Execution		96
Annex B (informative) Method for calculating the eccentricity of a stability core		97
Annex C (informative) A simplified method for calculating the out-of-plane eccentricity of loading on walls		99
Annex D (informative) Determination of 3 and 4		103
Annex E (informative) Bending moment coefficients, η, in single leaf laterally loaded wall panels of thickness less than or equal to 250 mm		104
Annex F (informative) Limiting height and length to thickness ratios for walls under the serviceability limit state		109
Annex G (informative) Reduction factor for slenderness and eccentricity		111
Annex H (informative) Enhancement factor as given in 6.1.3		113
Annex I (informative) Adjustment of lateral load for walls supported on three or four edges subjected to out-of-plane horizontal loading and vertical loading		114
Annex J (informative) Reinforced masonry members subjected to shear loading: enhancement of η		115