

DIN EN 1991-1-4:2010-12 (E)

Eurocode 1: Actions on structures – Part 1-4: General actions – Wind actions
(includes Amendment A1:2010 + Corrigendum AC:2010) English translation of DIN EN 1991-1-4:2010-12

Contents	Page
Foreword to EN 1991-1-4:2005	5
A1) Foreword to EN 1991-1-4:2005/A1:2010	5
Section 1 General	10
1.1 Scope	10
1.2 Normative references	11
1.3 Assumptions	11
1.4 Distinction between Principles and Application Rules	11
1.5 Design assisted by testing and measurements	11
1.6 Definitions	11
1.7 Symbols	12
Section 2 Design situations	17
Section 3 Modelling of wind actions	18
3.1 Nature	18
3.2 Representations of wind actions	18
3.3 Classification of wind actions	18
3.4 Characteristic values	18
3.5 Models	18
Section 4 Wind velocity and velocity pressure	19
4.1 Basis for calculation	19
4.2 Basic values	19
4.3 Mean wind	20
4.3.1 Variation with height	20
4.3.2 Terrain roughness	20
4.3.3 Terrain orography	22
4.3.4 Large and considerably higher neighbouring structures	22
4.3.5 Closely spaced buildings and obstacles	23
4.4 Wind turbulence	23
4.5 Peak velocity pressure	23
Section 5 Wind actions	25
5.1 General	25
5.2 Wind pressure on surfaces	25
5.3 Wind forces	26
Section 6 Structural factor $c_s c_d$	29
6.1 General	29
6.2 Determination of $c_s c_d$	29
6.3 Detailed procedure	29
6.3.1 Structural factor $c_s c_d$	29
6.3.2 Serviceability assessments	31
6.3.3 Wake buffeting	31
Section 7 Pressure and force coefficients	32
7.1 General	32
7.1.1 Choice of aerodynamic coefficient	32
7.1.2 Asymmetric and counteracting pressures and forces	33
7.1.3 Effects of ice and snow	33
7.2 Pressure coefficients for buildings	34
7.2.1 General	34
7.2.2 Vertical walls of rectangular plan buildings	35
7.2.3 Flat roofs	38
7.2.4 Monopitch roofs	41
7.2.5 Duopitch roofs	44
7.2.6 Hipped roofs	48
7.2.7 Multispan roofs	49
7.2.8 Vaulted roofs and domes	51

7.2.9	Internal pressure	52
7.2.10	Pressure on walls or roofs with more than one skin	54
7.3	Canopy roofs	55
7.4	Free-standing walls, parapets, fences and signboards	62
7.4.1	Free-standing walls and parapets	62
7.4.2	Shelter factors for walls and fences	64
7.4.3	Signboards	64
7.5	Friction coefficients	65
7.6	Structural elements with rectangular sections	66
7.7	Structural elements with sharp edged section	68
7.8	Structural elements with regular polygonal section	68
7.9	Circular cylinders	70
7.9.1	External pressure coefficients	70
7.9.2	Force coefficients	72
7.9.3	Force coefficients for vertical cylinders in a row arrangement	75
7.10	Spheres	75
7.11	Lattice structures and scaffoldings	77
7.12	Flags	79
7.13	Effective slenderness λ and end-effect factor ψ_λ	81
Section 8	Wind actions on bridges	83
8.1	General	83
8.2	Choice of the response calculation procedure	86
8.3	Force coefficients	86
8.3.1	Force coefficients in x-direction (general method)	86
8.3.2	Force in x-direction – Simplified Method	89
8.3.3	Wind forces on bridge decks in z-direction	90
8.3.4	Wind forces on bridge decks in y-direction	91
8.4	Bridge piers	92
8.4.1	Wind directions and design situations	92
8.4.2	Wind effects on piers	92
Annex A (informative)	Terrain effects	93
A.1	Illustrations of the upper roughness of each terrain category	93
A.2	Transition between roughness categories 0, I, II, III and IV	94
A.3	Numerical calculation of orography coefficients	96
A.4	Neighbouring structures	101
A.5	Displacement height	102
Annex B (informative)	Procedure 1 for determining the structural factor $c_s c_d$	103
B.1	Wind turbulence	103
B.2	Structural factor	104
B.3	Number of loads for dynamic response	106
B.4	Service displacement and accelerations for serviceability assessments of a vertical structure	106
Annex C (informative)	Procedure 2 for determining the structural factor $c_s c_d$	109
C.1	Wind turbulence	109
C.2	Structural factor	109
C.3	Number of loads for dynamic response	110
C.4	Service displacement and accelerations for serviceability assessments	110
Annex D (informative)	$c_s c_d$ values for different types of structures	112
Annex E (informative)	Vortex shedding and aeroelastic instabilities	115
E.1	Vortex shedding	115
E.1.1	General	115
E.1.2	Criteria for vortex shedding	115
E.1.3	Basic parameters for vortex shedding	116
E.1.4	Vortex shedding action	119
E.1.5	Calculation of the cross wind amplitude	119
E.1.6	Measures against vortex induced vibrations	129
E.2	Galloping	130
E.2.1	General	130

E.2.2 Onset wind velocity	130
E.2.3 Classical galloping of coupled cylinders	132
E.3 Interference galloping of two or more free standing cylinders	134
E.4 Divergence and Flutter	135
E.4.1 General	135
E.4.2 Criteria for plate-like structures	135
E.4.3 Divergency velocity	135
Annex F (informative) Dynamic characteristics of structures	137
F.1 General	137
F.2 Fundamental frequency	137
F.3 Fundamental mode shape	142
F.4 Equivalent mass	144
F.5 Logarithmic decrement of damping	144
Bibliography	147