

# Appendix B: List of symbols

Note: symbols that are specific to particular wind loading codes and standards described in [Chapter 15](#), are not listed in this appendix.

$a$	(i) Coriolis acceleration ( <a href="#">Chapter 1</a> ) (ii) scale factor ( <a href="#">Chapter 2</a> ) (iii) empirical constant (Equation 3.9) (iv) modal (generalized) coordinate (v) parameter in wide-band fatigue (Equation 5.53)
$a_s$	speed of sound
$b$	(i) cross-wind breadth of bluff body (ii) parameter in wide-band fatigue (Equation 5.54) (iii) diameter of antenna dish ( <a href="#">Chapter 14</a> )
$c$	(i) ground clearance of elevated hoarding (ii) damping constant (iii) scale factor in Weibull distribution (iv) distance of solar panel from roof edge ( <a href="#">Chapter 14</a> )
$d$	(i) effective diameter of rod-type objects ( <a href="#">Chapter 1</a> ) (ii) along-wind dimension of building or bluff body, chord of bridge deck (iii) stand-off of solar panel from roof surface ( <a href="#">Chapter 14</a> ) (iv) depth of antenna dish (v) diameter of pole ( <a href="#">Appendix E</a> )
$d( )$	drag force per unit length
$e$	(i) eccentricity (ii) eaves overhang (iii) wall thickness of pole ( <a href="#">Appendix E</a> )
$f$	(i) Coriolis parameter ( $= 2\Omega \sin \lambda$ ) (ii) force per unit length (iii) focal length of parabolic antenna dish ( <a href="#">Chapter 14</a> )
$f( )$	probability density function
$f(\phi)$	function of mode shape (Equation 11.17)
$g$	(i) gravitational constant (ii) peak factor
$h$	height of building or bluff body
$h_c$	height of canopy ( <a href="#">Chapter 14</a> )
$h_e$	height to eaves
$i, j$	indices

$k$	(i) $(\rho_a C_F) / (2 \rho_m \ell)$ (Chapter 1) (ii) shape factor in generalized extreme value distribution (Chapter 2, Appendix C) (iii) von Karman's constant (Chapter 3) (iv) constant for type of topographic feature (v) spring stiffness (vi) average surface roughness height (Chapter 4) (vii) shape factor in Weibull distribution (viii) orifice constant (Chapter 6) (ix) mode shape parameter (Equation 11.15) (x) parameter (Equation 14.8) (xi) parameter in generalized Pareto distribution (Appendix C)
$k_x$	exponent (Equation 9.18)
$k_y$	exponent (Equation 9.19)
$\ell$	(i) characteristic dimension for compact objects (ii) correlation length (iii) length of tornado path (Chapter 13) (iv) length of solar panel (Chapter 14)
$\ell(\ )$	lift (cross-wind) force per unit length (Chapter 11)
$m$	(i) mass or mass per unit length (ii) exponent in fatigue $s$ - $N$ relationship (iii) exponent (Equation 9.14) (iv) parameter in lognormal distribution (Appendix C)
$n$	(i) frequency (ii) stress cycle (iii) number of events, e.g. number of tornado occurrences in a region (Chapter 13) (iv) exponent (Equation 9.13)
$n_c$	characteristic frequency for internal pressure fluctuations
$n_s$	vortex shedding frequency
$p$	(i) pressure (ii) probability (Chapter 2)
$p_o$	(i) central pressure of a tropical cyclone (Chapter 1) (ii) ambient (static) pressure
$p_f$	probability of failure (Chapter 2)
$p_n$	(i) atmospheric pressure at the edge of a storm (Chapter 1) (ii) net pressure (Chapter 14)
$p_L$	leeward face pressure
$p_w$	windward face pressure
$q$	dynamic pressure
$r$	(i) radius of curvature – of isobars (Chapter 1), or square section (Chapter 4) (ii) risk (Chapter 2) (iii) radius in downburst (Equation 3.13) (iv) general structural response, or load effect (v) ratio $A_L/A_w$ (Chapter 6) (vi) roughness factor ( $\approx 2I_u$ ) (vii) radius of gyration (Chapter 12) (viii) rate of intersection of tornadoes with a transmission line
$s$	(i) position factor (Equation 3.33)

	(ii) stress
	(iii) height for calculation of load effects
	(iv) span length of a transmission line ( <a href="#">Chapter 13</a> )
	(v) clear space under bridge ( <a href="#">Chapter 14</a> )
	(vi) skewness ( <a href="#">Appendix C</a> )
$t$	(i) time
	(ii) thickness of sheet objects ( <a href="#">Chapter 1</a> )
	(iii) parameter for interference factor (Equation 14.8)
$u, v, w$	orthogonal velocity components
$u$	mode of extreme value distribution ( <a href="#">Chapter 2</a> )
$u_o$	wind speed level ( <a href="#">Chapter 2</a> )
$u^*$	friction velocity ( <a href="#">Chapter 3</a> )
$v_m$	velocity of flying debris
$w$	width of building ( <a href="#">Figure 14.12</a> )
$w_a$	average width of tower ( <a href="#">Appendix E</a> )
$w_b$	base width of tower ( <a href="#">Appendix E</a> )
$w_c$	width of canopy ( <a href="#">Chapter 14</a> )
$w_o$	assumed wind load per unit height (Equation 7.10)
$x, y, z$	Cartesian coordinate system ( $z$ is vertical)
$x(t)$	random process, structural response
$x_i$	distance to inner boundary layer
$z$	variable of integration, or transformed random variable ( <a href="#">Appendix C</a> )
$z_h$	zero-plane displacement
$z_o$	roughness length
$z^*$	characteristic height (Equation 3.13)
$A$	(i) scaling parameter (Equation 1.10)
	(ii) reference or frontal area
	(iii) parameter in cross-wind response (Equation 11.19)
	(iv) area of a region ( <a href="#">Chapter 13</a> )
$A_i$	flutter derivative for rotational motion ( <a href="#">Chapters 5, 12</a> )
$A_i^*$	normalised flutter derivative for rotational motion ( <a href="#">Chapter 12</a> )
$A_L$	area of openings on leeward wall
$A_W$	area of openings on windward wall
$B$	(i) exponent (Equation 1.10)
	(ii) background factor (also $B_s$ )
	(iii) bandwidth parameter (Equation 11.18)
$C$	(i) decay constant (Equation 3.30)
	(ii) modal damping
$C_d$	coefficient of drag force per unit length
$C_D$	drag coefficient
$C_f$	coefficient of aerodynamic force per unit length
$C_F$	aerodynamic force coefficient
$C_k$	equivalent glass design coefficient
$C_M$	moment coefficient
$C_N$	normal force coefficient
$C_p$	pressure coefficient
$C_p^*$	effective peak pressure coefficient (Equation 9.7)
$C_{pn}$	net pressure coefficient ( <a href="#">Chapter 14</a> )
$C_{ps}$	equivalent pressure coefficient for glass loading (Equation 9.16)

$C_T$	torque coefficient
$C_X$	coefficient of $X$ force
$C_Y$	coefficient of $Y$ force
$C_Z$	coefficient of $Z$ force
$Co( )$	co-spectral density
$D$	(i) damage index ( <a href="#">Chapter 1</a> ) (ii) drag (iii) nominal dead load ( <a href="#">Chapter 2</a> ) (iv) accumulated damage ( <a href="#">Chapters 5, 9</a> )
$D_a$	antenna drag ( <a href="#">Chapter 14</a> )
$D_e$	effective tower drag with antenna attached ( <a href="#">Chapter 14</a> )
$D_t$	tower drag ( <a href="#">Chapter 14</a> )
$E$	(i) Young's Modulus (ii) non-dimensional spectral density ( <a href="#">Chapter 11</a> )
$E( )$	expected (average) value
$F$	(i) force (ii) non dimensional parameter ( <a href="#">Section 11.4</a> )
$F( )$	cumulative probability distribution function
$F_i$	parameter in along-wind response ( <a href="#">Chapter 11</a> )
$G$	(i) generalised mass (ii) shear modulus (iii) gust factor, gust response factor
$G( )$	complementary cumulative probability distribution ( <a href="#">Appendix C</a> )
$H_i$	flutter derivative for vertical motion ( <a href="#">Chapters 5, 12</a> )
$H_i^*$	normalised flutter derivative for vertical motion ( <a href="#">Chapter 12</a> )
$H( )$	dynamic amplification factor; square root of mechanical admittance
$I$	(i) fixing strength integrity parameter ( <a href="#">Chapter 1</a> ) (ii) influence coefficient (iii) mass moment of inertia ( <a href="#">Chapters 7, 12</a> ) (iv) second moment of area
$I_u, I_v, I_w$	turbulence intensities
$Je$	Jensen number
$K$	(i) $\frac{1}{2} \frac{\rho_a}{\rho_m} \frac{U^2 \ell}{gl t}$ ( <a href="#">Chapter 1</a> ) (ii) modal stiffness (iii) constant in fatigue $s-N$ relationship (iv) bulk modulus ( <a href="#">Chapter 6</a> ) (v) constant ( <a href="#">Equation 7.1</a> ) (vi) constant ( <a href="#">Equation 9.14</a> ) (vii) mode shape factor ( <a href="#">Equation 11.16</a> )
$K_{ao}$	parameter for negative aerodynamic damping ( <a href="#">Equation 11.19</a> )
$K_i$	interference factor
$K_p$	porosity factor
$K_A$	bulk modulus of air ( <a href="#">Chapter 6</a> )
$K_B$	bulk modulus of building ( <a href="#">Chapter 6</a> )
$K_w$	correlation length factor ( <a href="#">Equation 11.16</a> )
$K_\theta$	wind incidence factor ( <a href="#">Equation 11.5</a> )
$L$	(i) lifetime of a structure ( <a href="#">Chapter 2</a> )

	(ii) lift (cross-wind) force
	(iii) general length ( <a href="#">Chapter 7</a> )
	(iv) length of a transmission line ( <a href="#">Chapter 13</a> )
$L_N$	parameter to calculate frequency of lattice tower ( <a href="#">Appendix E</a> )
$L_S$	span of bridge ( <a href="#">Appendix E</a> )
$M$	moment
$M_b$	base bending moment
$M_t$	topographic multiplier
$N$	(i) number of wind direction sectors ( <a href="#">Chapters 2, 13</a> )
	(ii) cycles to failure by fatigue
	(iii) number of samples of a random variable ( <a href="#">Appendix C</a> )
$Q$	(i) generalized force
	(ii) volume flow rate
$R$	(i) return period
	(ii) structural resistance
	(iii) characteristic radius (Equation 3.13)
	(iv) resonant response factor
	(v) radius of liquid damper ( <a href="#">Chapter 9</a> )
	(vi) rise of arch ( <a href="#">Figure 10.4</a> )
$R_c$	combined return period for winds from more than one storm type
$R_j$	structural response (load effect) due to unit modal coordinate, in mode, $j$
$Re$	Reynolds number
$S$	(i) structural load effect ( <a href="#">Chapter 2</a> )
	(ii) size factor
	(iii) span of arch
$S( )$	spectral density
$Sc$	Scruton number
$St$	Strouhal number
$T$	(i) time of flight of missile
	(ii) time period
$U$	wind speed
$U_f$	wind speed for threshold of flight of debris
$U_R$	wind gust speed corresponding to return period, $R$
$V$	wind speed (in some code notations – <a href="#">Chapter 15</a> )
$V_o$	internal volume
$W$	(i) nominal wind load ( <a href="#">Chapter 2</a> )
	(ii) weighting factor
$X$	general random variable ( <a href="#">Appendix C</a> )
$X(t)$	deflection of a structure

#### *Superscripts:*

-	mean (time averaged) value
'	fluctuating value
.	differentiation with respect to time

#### *Subscripts:*

$a$	air
$b$	base of building, tower or pole

<i>c</i>	canopy, cable, conductor
<i>d</i>	drag force per unit length (antenna) dish
<i>e</i>	(i) external (ii) eaves (iii) effective ( <a href="#">Chapter 6</a> )
<i>eff</i>	effective
<i>env</i>	envelope
<i>f</i>	(i) flight speed ( <a href="#">Chapter 1</a> ) (ii) failure ( <a href="#">Chapter 2</a> )
<i>g</i>	geostrophic ( <a href="#">Chapter 3</a> )
<i>i</i>	(i) index of position or wind direction (ii) internal
<i>j</i>	index of mode of vibration
<i>ℓ</i>	lift (cross-wind) force per unit length
<i>lat</i>	lateral
<i>m</i>	(i) missile ( <a href="#">Chapter 1</a> ) (ii) model ( <a href="#">Chapter 7</a> ) (iii) bending moment ( <a href="#">Chapter 11</a> )
<i>max</i>	maximum
<i>min</i>	minimum
<i>n</i>	net (pressure)
<i>ni</i>	normal to face <i>i</i> ( <a href="#">Chapter 11</a> )
<i>p</i>	(i) peak (ii) prototype ( <a href="#">Chapter 7</a> )
<i>q</i>	shearing force
<i>r</i>	ratio of model to prototype value ( <a href="#">Chapter 7</a> )
<i>s</i>	(i) structure, (ii) shedding, (iii) sloshing
<i>t</i>	top of building, tower or pole
<i>x</i>	<i>x</i> -direction response
<i>y</i>	<i>y</i> -direction response
<i>B</i>	(i) background response (ii) barrier ( <a href="#">Figure 7.4</a> )
<i>D</i>	drag force
<i>F</i>	flutter ( <a href="#">Chapter 12</a> )
<i>H</i>	Helmholtz resonance
<i>L</i>	leeward, lift (cross-wind) force
<i>pl</i>	patch load ( <a href="#">Equation 11.23</a> )
<i>R</i>	resonant response
<i>T</i>	(i) top of wind tunnel ( <a href="#">Figure 7.3</a> ) (ii) torsional (frequency) ( <a href="#">Chapter 12</a> )
<i>TL</i>	turbulent length scale ( <a href="#">Equation 11.24</a> )
<i>V</i>	vertical bending (frequency) ( <a href="#">Chapter 12</a> )
<i>w</i>	windward
<i>1</i>	first mode of vibration

*Greek symbols:*

$\alpha$	(i) angle of attack (ii) span reduction factor ( <a href="#">Chapter 13</a> )
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	(iii) roof pitch angle
$\alpha_j$	coefficient for influence of resonant mode, $j$ , on a structural load effect
$\beta$	(i) safety index
	(ii) angle of intersection of tornado path width with transmission line (Chapter 13)
	(iii) angle of solar panel to roof surface (Figure 14.12)
$\gamma$	ratio of specific heats
$\delta$	solidity of porous body
$\varepsilon$	(i) characteristic height (Equation 3.13)
	(ii) spectral bandwidth parameter (Equation 5.55)
	(iii) load effect (Chapter 11)
$\phi$	upwind slope of topographic feature
$\phi( )$	mode shape
$\gamma$	ratio of specific heats of air (Chapter 6)
$\gamma_D$	dead load factor
$\gamma_w$	wind load factor
$\eta$	ratio of damping to critical
$\psi$	(i) resistance factor (Chapter 2)
	(ii) wall porosity (Chapter 6)
	(iii) phase angle (Chapter 11)
	(iv) transmission line direction (Chapter 13)
$\kappa$	surface drag coefficient
$\lambda$	(i) angle of latitude (Chapter 1)
	(ii) crossing rate (Chapter 2)
	(iii) scaling factor (Equation 3.13)
	(iv) parameter in wide-band fatigue (Equation 5.52)
	(v) factor for guyed mast response (Equation 11.24)
	(vi) parameter in Poisson distribution (Appendix C)
	(vii) parameter for pole frequency calculation (Appendix E)
$\mu$	(i) dynamic viscosity
	(ii) moment of spectral density (Chapter 5)
$\pi$	(i) ratio of circumference to diameter of a circle
	(ii) (with subscript) non-dimensional group
$\theta$	(i) angular rotation
	(ii) angle of incidence
	(iii) angle of downburst path to transmission line (Chapter 13)
$\rho$	correlation coefficient
$\rho(n)$	normalised co-spectral density
$\rho_a$	air density
$\rho_b$	average building density
$\sigma$	(i) scale factor (Chapter 2)
	(ii) standard deviation
	(iii) parameter in lognormal distribution (Appendix C)
	(iv) parameter in generalized Pareto distribution (Appendix C)
$\tau$	(i) equilibrium, or response, time for internal pressure (Chapter 6)
	(ii) averaging time (Chapter 7)
$\tau_o$	surface shear stress
$\nu$	(i) kinematic viscosity of air
	(ii) cycling rate of a random process

$\omega$	(iii) rate of occurrence of tornadoes per unit area ( <a href="#">Chapter 13</a> ) circular frequency
$\Delta$	mean deflection ( <a href="#">Figure 9.1</a> )
$\Phi( )$	cumulative distribution function of a normal (Gaussian) random variable (zero mean and unit standard deviation)
$\Gamma( )$	Gamma function
$\Omega$	angular velocity of rotation of the earth
$\Pi$	repeated multiplication
$\Sigma$	repeated summation
$\chi^2(n)$	aerodynamic admittance