Wind Actions to AS 1170.2-2021

Rev 0, Created 10 September 2021

AS 1170.2-2021 Wind Actions involves the following key changes relating to Structural Toolkit:

- Change of nomenclature of Cfig to Cshp
- The introduction of a climate change factor (Mc) in the calculation of site wind speed (Clause 2.2)
- Wind region changes including new region A0 covering central Australia and revision to Md values
- Removal of Fc and Fd factors for cyclonic regions
- Changes to the terrain height multiplier (Mz) for Category 1 and the removal of Category 1.5
- The requirement to use Mz of Category 2 for all structures in region A0
- Shielding reduction is now limited to structures ≤ 25m and there restrictions for upwind buildings on a slope
- The introduction of area reduction factors for windward and leeward walls
- Internal pressure coefficients as a result of large openings are now multiplied by ka and kl as well as a multiplier/reduction factor kv based on the volume of the building

All code reference changes (e.g. clause and table numbers) have been updated on all relevant Structural Toolkit V5.5 modules.

Climate change factor

The climate change multiplier is provided in Clause 3.4 which allows for possible changes in climate affecting extreme winds during the life of structures and is applied to the Vsit,β (Eq 2.2). The value of Mc may be adjusted in future amendments allowing for uncertainty of climate change. Currently the value for Mc is 1.0 for all regions apart from regions B2, C and D where Mc = 1.05. The factors Fc and Fd which previously applied to the wind speeds of regions C and D have been removed in the new standard. These changes are now reflected in the new Wind Loads V5.01 module.

Table 3.3 — Climate change multiplier (M_c)

Region	M_c
A (0 to 5)	1.0
B1	1.0
B2	1.05
C	1.05
D	1.05
NZ (1 to 4)	1.0

NOTE The climate change multiplier allows for possible changes in climate affecting extreme winds during the life of structures designed by this Standard. Values of M_c may be adjusted in future amendments, depending on observed or predicted trends.

Wind Regions

The wind regions have changed throughout Australia and New Zealand with Regions A0-A5, B1, B2, C and D throughout Australia (Fig 3.1(A)) and NZ1-NZ4 throughout New Zealand (Fig 3.1(B)).

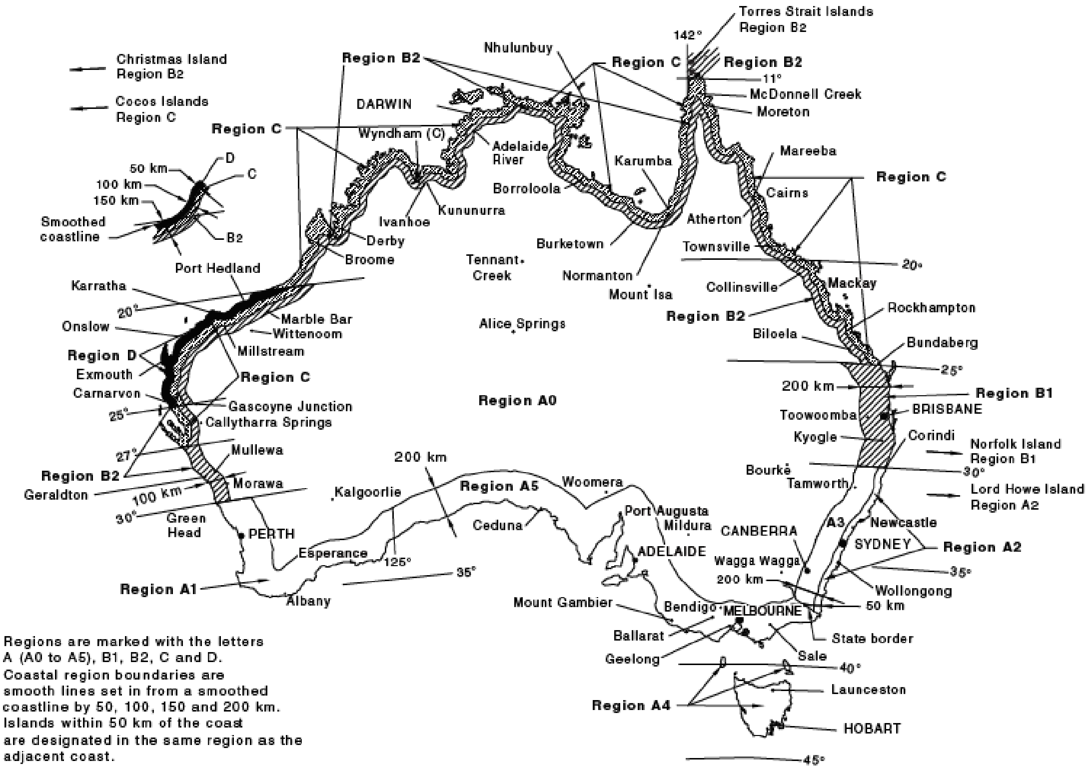

Figure 3.1(A) — Wind regions — Australia

The Regional Wind Speeds in Table 3.1 are the same except for the removal of the Fc and Fd factors, however, in combination with updated values for the wind direction multipliers (Md) given in Tables 3.2(A) & (B), and potential change to Mz,cat for Region A0 and building heights, there will be an impact on the directional design wind pressures.

Melbourne no longer has its own unique region (70km from GPO), being part of a common redefined southern coastal Region A5. The predominate west wind remains the same, however, there are variations to the other directions (increased from the south west and decreased or same otherwise).

Adelaide shifts from Region A1 to A5. The primary wind directions are the same, with some slight variations (increased from the south west and decreased or same otherwise).

Perth remains in Region A1. The wind pressures are generally the same with an increase in pressure in the east direction.

Darwin has a reduction in VR with the removal of Fc and a reduction in Md resulting in a reduction of $[(66*0.9)/(69*0.95)]^2$ = 82% of the previous standards wind pressure.

Brisbane shifts from Region B to B1. As a result of moving from a uniform Md of 0.95 to directional values, there is reductions to wind pressures from the north, east and north east directions.

Sydney remains in Region A2 with some minor adjustments to the direction multipliers. This results in the same pressures in the primary wind directions, but slight reductions to the north east direction.

Canberra remains in Region A3 with adjustments to most of the direction multipliers. This results in the same pressure from the predominate west direction, but changes to most of the other directions.

Hobart shifts from Region A3 to A4 with adjustments to the direction multipliers including higher south west direction. This results in the same pressure from the predominate west direction, and the same to north and east, but an increase to the south as a result of the increased south west multiplier.

These changes can be seen within the Wind Loads V5.01 module.

Additional requirements for Region A0

In region A0 (Central Australia typically greater than 200km from coast) there is a requirement to use Mz,cat 2 (Terrain Category 2) for structures less than or equal to 100m in height, and an Mz,cat = 1.24 for structures between 100 and 200m in height for all terrains (Table 4.1 – Note 1). This change is reflected in the new Wind Loads V5.01 and Wind Terrain Changes V5.02 modules.

NOTE 1 In Region A0, use $M_{z,cat\ 2}$ for all $z \leq 100$ m in all terrains. For 100 m < $z \leq 200$ m, take $M_{z,cat}$ as 1.24 in all terrains.

NOTE 2 For all other regions, for intermediate terrains use linear interpolation.

NOTE 3 For intermediate values of height z, use linear interpolation.

The topographical multiplier (Mt) for Region A0 is given as Mt = 0.5 + 0.5*Mh (Eq. 4.4(2)) where Mh is given in clause 4.4.2.

Terrain Categories

Terrain Category 1 has been redefined to include all over-water surfaces. Terrain category 1.5 has also been removed from the descriptions given in Cl 4.2.1 with all water surfaces being identified in Terrain category 1. The description of Terrain category 2.5 has also been redefined.

Values in Table 4.1 for Mz,cat have been updated in the new standard. This change is reflected in the new Wind Loads V5.01 and Wind Terrain Changes V5.02 modules. The effect of these revised values will depend on the terrain category, the height (z) of the building and also if its within region A0.

Shielding

The shielding multiplier (Ms) has been updated to be limited to structures up to and including 25m in height Cl 4.3.1. An error is flagged (see below) if the height exceeds this value. A restriction has been added for the use of buildings upwind of the structure under assessment if the slope has a gradient exceeding 0.2 (20% or 1 in 5) unless the overall height above a common datum exceeds the subject building height.

Site wind data for non-cyclonic areas with APE of 1:500 years   Error - Ms=1.0 for structures over 25m tall. Cl 4.3.1

Dir (b)	Md (*1)	VR*Mc*Md m/s	Ave. Ht (z) m	Cat	Mz,cat	Ms	Mt	Vsit,β m/s	Wu.sit kPa
N	0.95	42.8	26	3	0.98	0.90	1.00	37.6	0.85

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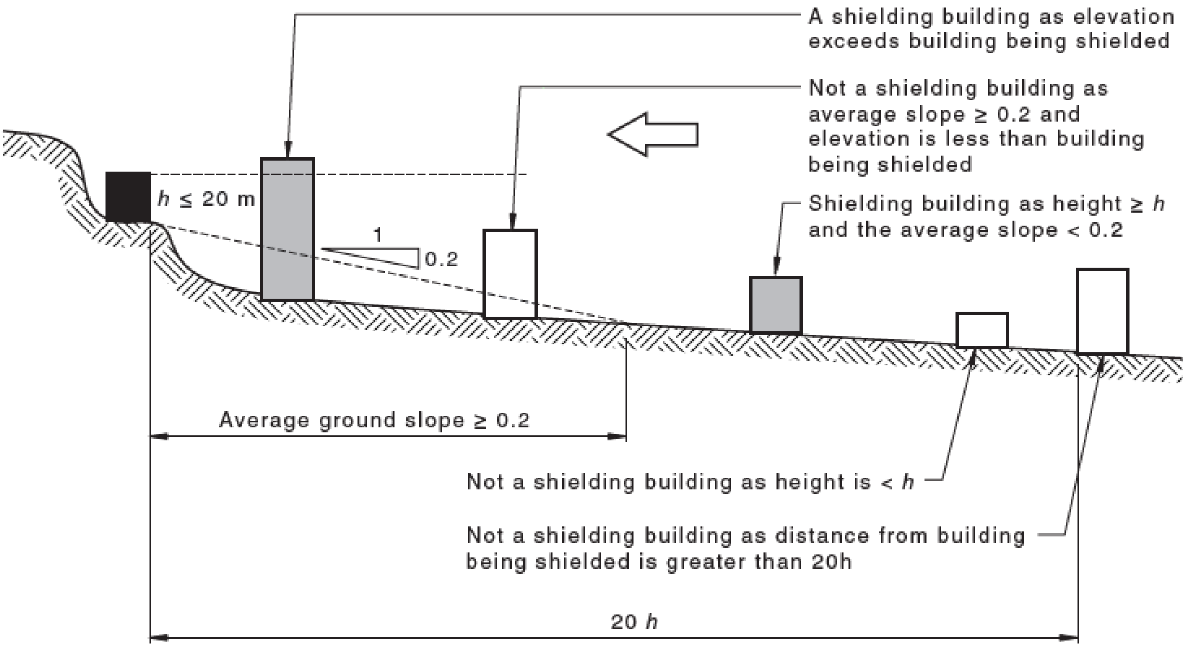


Figure 4.2 — Upwind buildings on a slope

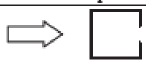
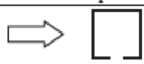
Lee Multiplier

The lee multiplier Cl 4.4.3 has been redefined in the new standard with a comprehensive list of values for New Zealand given in Table 4.4. These values can be applied to the Wind Terrain V5.02 module.

Internal Pressures

Where buildings have a ratio of openings on one surface to the total open area on the roof or other wall surfaces being greater than or equal to 2 there is an addition of Ka (Cl 5.4.2) and Kl (Cl 5.4.4) in the calculation of Cpi (Table 5.1(B)).

Table 5.1(B) — Internal pressure coefficients ($C_{p,i}$) for buildings with openings greater than 0.5 % of the area of the corresponding wall or roof

Ratio of area of openings on one surface to the sum of the total open area (including permeability) of other wall and roof surfaces	Largest opening on windward wall	Largest opening on leeward wall	Largest opening on side wall	Largest opening on roof
0.5 or less	−0.3, 0.0	−0.3, 0.0	−0.3, 0.0	−0.3, 0.0
1	−0.1, 0.2	−0.3, 0.0	−0.3, 0.0	−0.3, 0.0
2	0.7 $K_a K_\ell C_{p,e}$	$K_a K_\ell C_{p,e}$	$K_a K_\ell C_{p,e}$	$K_a K_\ell C_{p,e}$
3	0.85 $K_a K_\ell C_{p,e}$	$K_a K_\ell C_{p,e}$	$K_a K_\ell C_{p,e}$	$K_a K_\ell C_{p,e}$
6 or more	$K_a K_\ell C_{p,e}$	$K_a K_\ell C_{p,e}$	$K_a K_\ell C_{p,e}$	$K_a K_\ell C_{p,e}$
	t5-1(b)-1			

NOTE 1 $C_{p,e}$ is the relevant external pressure coefficient at the location of the largest opening. For example, in Column 2, $C_{p,e}$ means the windward wall pressure coefficient obtained from Table 5.2(A); in Column 3, $C_{p,e}$ means the leeward wall pressure coefficient obtained from Table 5.2(B), in Column 5, $C_{p,e}$ means the roof pressure coefficient for that part of the roof containing the opening.

NOTE 2 K_a is the area reduction factor related to the total area of the opening(s), A, on the surface under consideration treating the "tributary area" as the area of the opening. See Clause 5.4.2.

NOTE 3 K_ℓ is the local pressure factor, based on the area and location of the opening on the surface under consideration, treating the "Area, A" as the area of the opening. See Clause 5.4.4.

NOTE 4 Surfaces with openings have a ratio of total open area, A, to the total area of that surface related to the internal volume (Vol) under consideration, greater than 0.5 %.

Internal Pressures - volume factor (Kv)

Cshp for internal pressures (Eq. 5.1(1)) is also impacted by a new open air/internal volume factor (Kv) given in Cl 5.3.4. Where the area of the largest opening in a building is on a wall and the open area is greater than the sum of the total open area on the roof or other wall surfaces by a factor or six or more, the factor Kv can act to reduce or increase Cshp depending on the area of the opening and the internal volume of the building.

When the largest opening in a building is on a wall, and the open area is greater than the sum of the total open area on the roof and other wall surfaces by a factor of six or more, then the following Equation 5.3(1) applies:

$$K_v = 1.01 + 0.15\left[\log_{10}\left(100\frac{A^{3/2}}{Vol}\right)\right] \text{ for } 0.09 \le \left(100\frac{A^{3/2}}{Vol}\right) \le 3 \qquad 5.3(1)$$

$$K_v = 0.85, \text{ for } \left(100\frac{A^{3/2}}{Vol}\right) < 0.09$$

$$K_v = 1.085, \text{ for } \left(100\frac{A^{3/2}}{Vol}\right) > 3$$

where A is the open area on the wall and Vol is the internal volume.

For all other cases, K_v shall be taken as 1.0.

Area reduction factor (Ka)

Ka is an area reduction factor for roofs and walls. Previously Ka only applied to roofs and side walls (walls perpendicular to the direction of wind). In the latest standard, windward and leeward walls are included in Table 5.4. These new values can be applied within the new Steel Mullion V5.03 and Timber Mullion V5.06 modules.

Table 5.4 — Area reduction factor (K_a)

Tributary area (A), m^2	Roofs and side walls (K_a)	Windward walls (K_a) $h < 25$ m	Leeward walls (K_a) $h < 25$ m
≤ 10	1.0	1.0	1.0
25	0.9	0.95	1.0
≥ 100	0.8	0.9	0.95

Local pressure factors for cladding

There has been an addition of a RC2 reference in Table 5.6/Figure 5.3 for downwind corners of a roof with pitch ≥ 10 degrees. However, this is not relevant in Structural Toolkit. The value of "a" has changed for roofs and is now defined as the minimum of 0.2b or 0.2d if h/b or h/d ≤0.2; or 2h if both h/b and h/d < 0.2. These changes are included within the Purlin & Girt Loads V5.07 module.

Table 5.6 — Local pressure factor (K_ℓ)

Design case	Figure 5.3 reference case	Building aspect ratio (r)	Area (A)	Proximity to edge	$K\ell$
Positive pressures					
Windward wall	WA1	All	$A \leq 0.25a^2$	Anywhere	1.5
All other areas	—	All	—	—	1.0
Negative pressures					
Upwind corners of roofs with pitch < 10°	RC1	All	$A \leq 0.25a^2$	< a from two edges	3.0
AND					
Downwind corners of roofs with pitch ≥ 10°	RC2			< a from both roof edge and ridge	3.0