Wind Load Standards: Key Changes in AS/NZS 1170.2:2021 vs. AS/NZS 1170.2:2011

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Abstract

Wind loading is an essential factor to consider in structural design, as it impacts the safety, performance and longevity of buildings and infrastructure. Previously, Aspec published an article discussing the history of changes made to AS/NZS 1170.2, from CA 34.2 which was the first modern wind loading code published in 1971 to the 2011 edition (Cipressi, 2018). The release of the AS/NZS 1170.2:2021 standard provides updates to the guidelines governing wind action, superseding the previous AS/NZS 1170.2:2011 version and its amendments. This article delves into the key changes introduced in the 2021 revision and their implications for structural wind loads.

1. Introduction

The need for changes to AS/NZS 1170.2 was prompted by several severe weather events and ongoing wind tunnel testing and research. Two notable events included the following, which prompted specific changes to the standard:

- In April 2011, Tropical Cyclone Seroja crossed the mid-west coast of Western Australia, near Port Gregory, which caused vast damage to buildings in coastal and inland towns. The maximum wind speed recorded over land in Kalbarri was 166 to 184 km/h, which is 80 to 90% of the design wind speed for houses (Boughton et al., 2021). The storm caused significant structural damage to buildings due to non-conservative internal suction factors in AS1170.2:2011.
- A similar event occurred in November 2014, when Brisbane experienced severe hail, strong winds (141 km/h gusts), and local flooding. Despite wind speeds being below design values, damage was severe due to outdated building standards that did not account for pressure changes from openings on the windward wall (Parackal et al, 2015).

2. Revisions to the Standard

A revision of the standard was released in 2021, implementing several changes and improvements, with key changes summarised as follows (for a comprehensive list of the changes please refer to the preface section of AS/NZS 2021:2021).

Table 1 – Parameter changes AS/NZ1170.2 between 2011 and 2021

Parameters	AS/NZS 1170.2:2021	AS/NZS 1170.2:2011	Comments
Wind Speed Calculations	$V_{sit,\beta} = V_R M_C M_d \times (M_{z,cat} M_s M_t)$ Addition of climate change factor.	$V_{sit,\beta} = V_R M_d \times (M_{z,cat} M_s M_t)$	
Wind Regions	Regions were redefined, with the addition of region A0, B1 and B2. Linear interpolation for regional wind speeds is allowed for Regions C and D, based on relative distance from the smooth coastline.		Region A0 covers inland Australia, B1 which is south-east Queensland, which is dominated by thunderstorms and extends 200km west and Region B2 is where tropical cyclones are common.
Climate Change Multiplier, M_C / Uncertainty factors, F_C and F_D	Removed F_C and F_D. Added Climate Change factor $M_C = 1.05$ for cyclonic regions, B2, C and D.	Uncertainty factors, F_C (1.05) and F_D (1.1) for cyclonic regions C and D respectively.	
Shielding Multiplier, M_S	The shielding multiplier shall be 1.0 for structures with *h* greater than 25m. Restricted definitions for buildings on steep hills.	Shielding multiplier should be 1.0, when average ground upwind is greater than 0.2.	Wind tunnel testing found that the upwind buildings increase wind loads on other tall buildings.
Topographical Factor, M_t	Addition of formula for region A0: $M_t = 0.5 + 0.5M_h$	Location outside of Tasmania and New Zealand, the larger value out of M_h (Hill shape factor) and M_{lee} (Lee multiplier).	Effect of topography is not as significant in the downburst winds that are present in Region A0 (Central Australia), in comparison to winds in the boundary layer (Holmes, 2021).

Parameters	AS/NZS 1170.2:2021	AS/NZS 1170.2:2011	Comments
Terrain/Height Multiplier, $M_{z,cat}$	Terrain classifications were redefined. Terrain category 2.5 was added. Values for TC 01 were updated.	Terrain Category 1.5 was removed.	
Wind Direction Multiplier, M_d	For regions B, C & D: 0.90 for major structural elements/overturing. 1.0 for cladding and immediate supporting structure (as defined in Clause 5.4.4) on buildings in Regions B2, C and D. 1.0 for circular or polygonal chimneys, tanks, poles. Md values in regions A0-5 and B1 were updated in table 3.2 (A).	For all directions in regions B, C & D: 0.95 for major structural elements/overturing 1.0 for all other cases (including cladding and immediate supporting members). Values in region A1-7 and W vary with direction (Table 3.2).	
Internal Pressure Coefficients	Revised coefficients for calculating internal pressure, $C_{p,e} \cdot K_a \cdot K_l$ for relevant openings. New clause 5.3.4 added – open area volume factor, K_v.	Windward wall pressure coefficient, $C_{p,e}$.	
Area Reduction Factor, K_a	Area reduction factor, K_a < 1.0, for windward and leeward walls for buildings with *h < 25m.* Action Combination Factor, K_c, no longer effective.	Area reduction factor was applicable to roofs and sidewalls only.	
Local Pressure Factor, K_l	Local pressure factor, K_l, additional case RC2 added at ridge-downward corner of pitched gable roofs. Definition of variable $'a'$ changed for very large roofs.	If both (h/b) and (h/d) are less than 0.2, the value of a becomes h.	2011 standard not conservative for the inner part of a large low pitch roof.

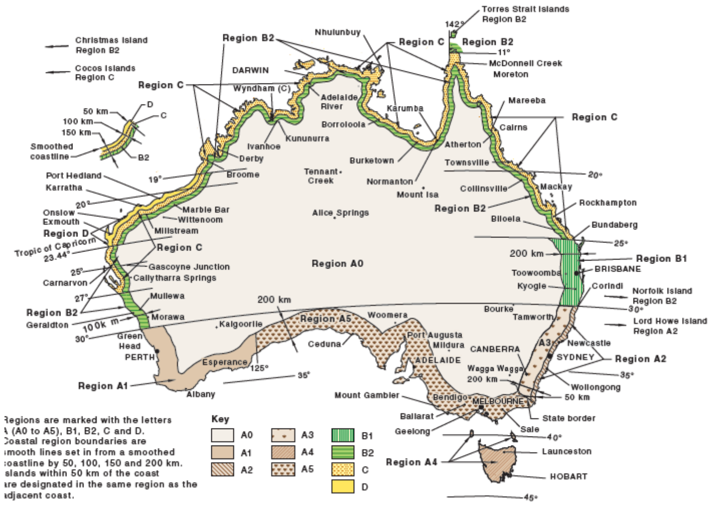

Figure 1 - Wind Regions according to AS/NZS 1170.2:2021 and 2:2024

3. Application of Changes

An example of the impact of these code changes on determining the wind actions on a hypothetical industrial structure are summarized in Table 2. The results show the significant difference in results obtained between the two code revisions.

Table 2 - Example wind speed calculations of Regions B, C and D in Terrain Category 2 and 3 according to 2011 and 2021 codes with revised factors (P = 1/500, MS = 1.0, Height = 15m)

Region	B2*		C		D	
Terrain Category	T2	T3	T2	T3	T2	T3
2011 Wind Speed $V_{sit,\beta}$ (m/s)	57	48	69	59	88	74
2021 Wind Speed $V_{sit,\beta}$ (m/s)	57	52	65	56	79	73
Δ *Wind Speed*	-0%	8%	-6%	-6%	-11%	-2%
Δ *Wind Force*	-1%	+15%	-11%	-11%	-22%	-3%

*Region B2 has an updated description from the 2021 code, which correlates with Region B from the 2011 code.

4. Terrain/Height Multiplier

These changes can be further understood by observing the difference between multipliers from the 2011 to 2021 versions. The graph below shows the percentage difference between terrain/height multiplier, $M_{z,cat}$, with respect to the 2011 code values.

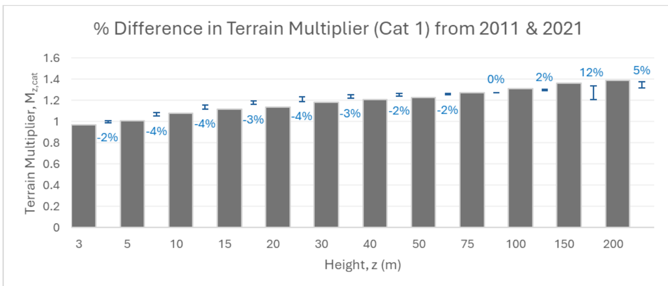

Figure 2 - Wind Regions according to AS/NZS 1170.2:2021 and 2:2024

5. Western Australia Region

One area where these changes have had a significant practical impact, is Wind Region D, which is unique to Western Australia and stretches across a 50km wide band along the northwest coast. The current version of AS/NZS 1170.2 reduces the wind speed in wind Region D due to the removal of the F_d (1.1), implementation of the M_c factor (1.05) and reduction in the M_d values 0.95 to 0.9.

This change prompted a Western Australia State variation to the National Construction Code (NCC) 2022, which aimed to retain wind speeds similar to 2011 version for wind Region D. The NCC refers to a table of annual probability of exceedance which has been increased for houses in wind Region D north of the Tropic of Capricorn (Government of Western Australia, 2022).

Ultimately, it is useful to understand what changes have been implemented in the standard and the rationale behind them. There will be future amendments made to the AS/NZS 1170.2:2021, as more areas of improvement are highlighted.

6. References

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