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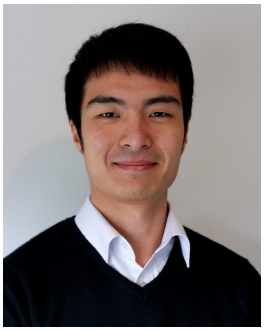

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David Zhang - Multinail Structural Engineer

WIND SPEED IN BUILDING DESIGN

There are two main Australian Standards cover wind actions on structures, which are AS/NZS1170.2 Structural design actions Part 2: Wind actions and AS4055 Wind loads for housing. AS4055 defines wind classes for both non-cyclonic and cyclonic regions with N1 to N6 and C1 to C4 respectively.

However, AS4055 has some specified limitations on building geometries, which are:

- The distance from ground level to the underside of eaves shall not exceed 6.0 m. The distance from ground level to the highest point of the roof, not including chimneys, shall not exceed 8.5 m
- The width (W) including roofed verandas, excluding eaves, shall not exceed 16.0 m, and the length (L) shall not exceed five times the width.
- The roof pitch shall not exceed 35°.

Once a building is outside the limitations of AS4055, we have to adopt AS/NZS1170.2 to determine the design wind speed and pressure coefficients.

It was also clearly stated in AS4055 that AS1170.2 and AS4055 shall not be cross referenced. It means if wind loads on buildings are determined using one of two Standards, all design parameters shall be derived from that particular Standard only.

To obtain the design/site wind speed from AS1170.2, we need quite a lot of information provided by the engineers such as building importance level, regional wind speed, terrain category, shielding and topographic multipliers, etc.

The equation for site wind speed ($V_{sit,\beta}$) is listed in AS/NZS 1170.2, which is:

$$V_{sit,\beta} = V_R * M_d * (M_{z,cat} * M_s * M_t)$$

Regional wind speed is determined from the location of the building itself and average recurrence interval which depends on building importance level. For example, wind ultimate limit state design of a building with Importance Level 2 (such as house), regional wind speed shall be taken as V_{500} assuming average recurrence interval is 500 years, while a building with Importance Level 3 (such as offices or mid-rise residential buildings) regional wind speed shall be taken as V_{1000} assuming average recurrence interval is 1000 years.

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Terrain shall be assessed on the basic of the following category descriptions:

- Category 1 – Exposed open terrain with few or no obstructions and water surfaces at serviceability wind speeds. For examples, flat, treeless, rivers and lakes and enclosed bays extending less than 10km in the wind direction.
- Category 2 – Water surfaces, open terrain, grassland with few, well-scattered obstructions having heights generally from 1.5 m to 10 m. For examples, farmland and cleared subdivisions with isolated trees & uncut grass.
- Category 3 – Terrain with numerous closely spaced obstructions 3 m to 5 m high, such as areas of suburban housing. For example, suburban housing or light industrial estates.
- Category 4 – Terrain with numerous large, high (10 m to 30 m high) and closely spaced obstructions. For example, large city centres and well-developed industrial complexes.

Shielding and Topographic multipliers are normally provided on engineering drawings if they are either less or greater than 1.0.

It's not uncommon to received plans stating incorrect wind speeds. It normally happens when N2 or N3 classifications are specified in a commercial building design which is outside the scope of AS4055.

For buildings outside the scope of AS4055, one of the main multipliers is the terrain and height multiplier $M_{z,cat}$ which must be taken into account. As illustrated below, all the buildings could be in the same Region but the wind speeds are going to be much greater at the top of a tall building compared to a 2 story house.

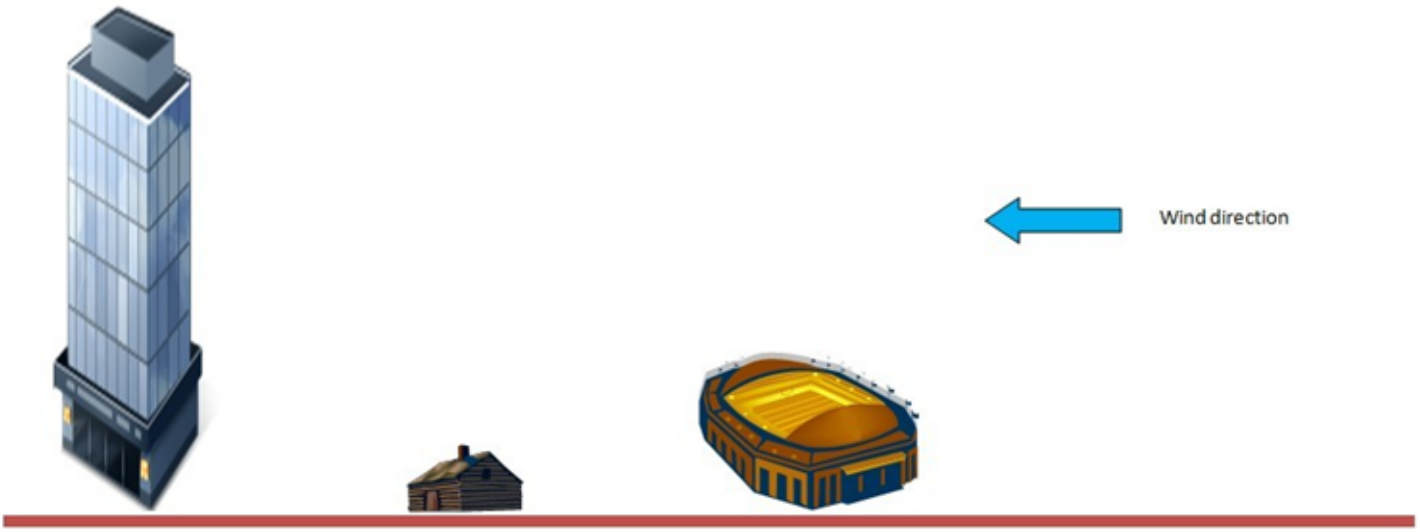


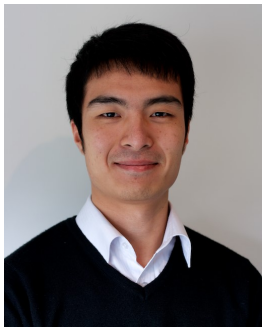
Table below gives the $M_{z,cat}$ values from AS/NZS1170.2 Table 4.1(A)

Height (z) m	Terrain/height multiplier ($M_{z,cat}$)			
	Terrain category 1	Terrain category 2	Terrain category 3	Terrain category 4
≤ 3	0.99	0.91	0.83	0.75
5	1.05	0.91	0.83	0.75
10	1.12	1.00	0.83	0.75
15	1.16	1.05	0.89	0.75
20	1.19	1.08	0.94	0.75
30	1.22	1.12	1.00	0.80
40	1.24	1.16	1.04	0.85
50	1.25	1.18	1.07	0.90
75	1.27	1.22	1.12	0.98
100	1.29	1.24	1.16	1.03
150	1.31	1.27	1.21	1.11
200	1.32	1.29	1.24	1.16

The Height (z) in the table represents the average height of a house or building. It can be seen from the table that higher terrain category are, lower terrain multiplier will be.

Another common mistake made by roof truss or frame detailers is taking regional wind speed (V_{R--}) as design wind speed. It will either underestimate or overestimate the wind load in design software.

In summary, we need to be careful when determining the wind speed for building in design. Be sure to apply wind classes like N1, N2, etc. for residential buildings which are within the limitation of AS4055. Be sure to apply a proper design wind speed rather than regional wind speed for buildings which are outside the limitation of AS4055. If in doubt or not having enough information, please do seek help from architects and engineers to clarify the fact.



This edition of FTMA Tech Talk was written by David Zhang, Structural Engineer of our Gold Sponsor, Multinail.

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