GN GUIDELINES NO.233

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Wind beam design: part 2

In Part 1 we looked at the benefits of utilising wind beams in the construction of timber framed external load bearing walls, adjacent to floor voids. We will now look at the specifics of how wind beams can be designed.

A deeper look at the design of wind beams

Up until recently there was no published design methodology in the Australian Standards for the design of wind beams, but that has changed with the release of AS1720.3-2016, specifically clause 3.5 which details design loads and deflection limits for wind beams. Wind beams, along with every other structural member within a wall frame, must be designed to have adequate structural capacity (moment and shear) when exposed to ultimate limit state design loads, specifically a 1/500 year wind event for residential wind beams. Wind beams must also conform to prescribed maximum deflection limits when exposed to serviceability limit state design loads.

Determination of Ultimate UDL

Wind beams as stipulated in AS1720.3-2016 are to be designed for horizontal wind loads only. Vertical loads such as roof weight, wall weight and self-weight are assumed to transfer directly through the wind beam from the upper storey frame to the lower storey wall frame.

The design equation to determine the ultimate wind load (kN/m) in which the wind beam must have sufficient structural capacity, is provided in the next column:

> We will look at the specifics of how wind beams can be designed.

$$W_{uw}=q_u\, C_{ptw}\left(\frac{H_1+H_2}{2}\right)$$

Where:

q_u = free stream dynamic gust pressure for the ultimate limit state (kPA), provided in Appendix A Table A2 of AS1720.3, dependent on wind classification (ie, N1, N2, N3 etc)

C_{ptw} = net pressure coefficient for walls, provided in Table 3.5.2.2, dependent on the wind classification

H_1 = height of upper storey wall, in metres

H_2 = height of lower storey wall, in metres

Explaining this equation further, by looking at the wall frame in Figure 1, all we are doing is calculating a wind pressure $q_u\, C_{ptw}$ (kPA) (dependent on site wind speed) and multiplying that pressure by the load width in metres supported by the wind beam $\left(\frac{H_1+H_2}{2}\right)$, in order to calculate the uniformly distributed load kN/m along the length of the wind beam.

Once W_{uw} has been calculated, the simplest method of evaluating the structural capacity of the wind beam is by inputting the design load into up-to-date beam design software. The alternative method, which takes somewhat longer, is to manually evaluate the design moment and design shear capacity using relevant engineering formulae for simply supported beams.

The required restraining/bracing force at the ends of the wind beam also needs to be calculated. This again can be carried out using beam design software, or can be manually calculated using the following equation. An illustration of where the wind beam needs to be restrained is provided in Figure 2.

Design restraining force required at ends of wind beam R (kN) = $W_{uw}\left(\frac{\text{Span of wind beam}}{2}\right)$

The wind beam will also need to be checked to ensure the deflections meet the serviceability requirements. The calculation of the design load to assess the deflection of the

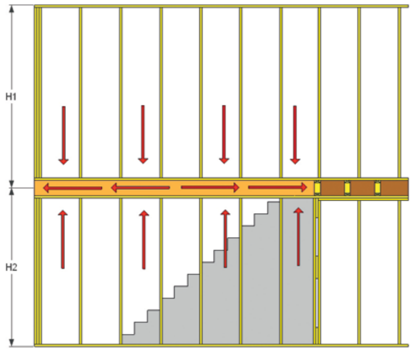

Figure 1

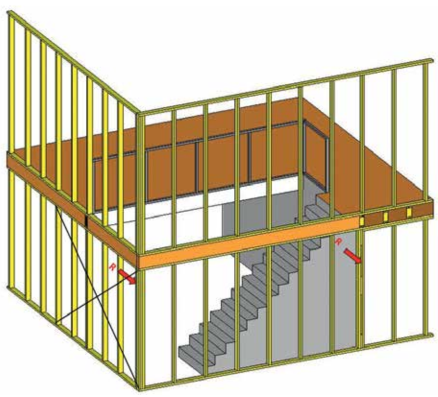

Figure 2

wind beam uses essentially the same equation as equation 1, except that q_u is replaced by q_s and C_{ptw}= 0.9 for all wind speeds.

Where:

q_s = free stream dynamic gust pressure for the serviceability limit state (kPA), provided in Appendix A Table A2 of AS1720.3, dependent on wind classification.

If accessibility to relevant design software and evaluation of equations is limited, then the wind beam span table over the page may be used for quoting purposes.

Wind Speed N1/N2, Max Wall Height = 5.6m				
Wind Beam Length (m)	**Wind Beam Size**	**Modulus of Elasticity (MPa)**	**Lateral Deflection of Wind Beam (mm)**	**Bracing force req'd at ends of wind beam (kN)**
3	4/45x90 MGP10	10000	9.95	3.63
3.5	6/45x90 MGP12	12700	9.68	4.23
4	8/45x90 ebeam + (LVL)	14000	11.23	4.84
4	89x89x5 SHS C350L0	200000	9.5	4.84
4.5	250 PFC	200000	7.57	5.44
5	300 PFC	200000	10.39	6.05

Wind Speed N3/C1, Max Wall Height = 5.6m				
Wind Beam Length (m)	**Wind Beam Size**	**Modulus of Elasticity (MPa)**	**Lateral Deflection of Wind Beam (mm)**	**Bracing force req'd at ends of wind beam (kN)**
3	5/45x90 MGP12	12700	9.32	5.67
3.5	8/45x90 ebeam+ (LVL)	14000	9.79	6.62
4	89x89x6 SHS C350 L0	200000	12.42	7.56
4.5	300 PFC	200000	10.14	8.51
5	380 PFC	200000	9.64	9.45

Notes on table

1. Deflection values stated in the table have been generated from Serviceability Wind Pressures. Max deflection for wind beam under serviceability wind action is to be the lesser of Span/200 or 15mm max.
2. Where the wind beam has been constructed from several laminations, the laminations should be nailed together in accordance with the Horizontal Nail Lamination – for Wall Plates, provided in AS1684.2 -2010.
3. The wind beam must be restrained from moving at its ends in order for the deflection values to be true and accurate.

If you would like any further assistance with wind beam designs please do not hesitate to contact your nearest nail plate engineering office. T

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