Interim Advice: Townhouse Bracing

Design of bracing for residential structures outside of NZS 3604 up to three stories

This is placeholder interim advice pending further research and guidance development as summarised in Residential Design Roadmap (2026). It will be superseded once a calibrated reliability basis for P21-derived capacities is established.

1. P21 Ratings Are Not Limit State Design Values

P21 ratings are mean values, not characteristic values. A published Bracing Unit (BU) rating is the average of three test specimens, capped and adjusted per BRANZ Technical Paper P21 (2010). This is not equivalent to the characteristic (typically 5th-percentile) strength used elsewhere in limit state design under B1/VM1 (e.g. NZS 3603, NZS 3404, NZS 3101).

P21 is valid only within NZS 3604 Acceptable Solution. NZS 3604 Clause C5.1.3 confirms BU ratings rely on the redundancy and load-sharing inherent to typical NZS 3604 construction, and notes that reduction factors may be appropriate where P21 results are used in specific engineering design (SED) outside that scope.

Where P21 capacities are used in SED, a strength reduction factor of Ø = 0.5 should be applied. This factor is applied to the published P21 capacity (BU rating, or equivalent force value) to bring it to a reliability basis broadly consistent with limit state design of other structural materials.

> ***Interim status***
> *Ø = 0.5 is a placeholder value designed to achieve similar capacity to international Standards and improve performance in line with NZBC expectations. It has not been derived from measured P21 population variability. Further research is planned to confirm a calibrated value. This advice will be updated when that work is complete.*

2. Specific Advice for Three Storey Residential Buildings

Use specific engineering design (SED). Buildings that fall outside the scope of NZS 3604 require the lateral system to be specifically designed, with the designer taking ownership of the lateral force resisting system. Derive seismic and wind demands in accordance with AS/NZS 1170 (NZS 1170.5 for earthquake; AS/NZS 1170.2 for wind using site-specific assessment, not regional maps). Designers are reminded that it is their responsibility to demonstrate compliance with the NZBC to the BCA, this interim advice is intended to inform and assist.

Appropriate use of Plasterboard bracing. For three storey construction, plasterboard bracing should only be used on the top two stories. Ground floor should be stiffer and stronger than the floors above. Plasterboard bracing should not be used to support heavy (concrete and/or masonry block) walls out of plane.

If P21 rated bracing elements are used as part of SED, a reduction factor is needed. A Ø = 0.5 factor should be applied to the P21-derived capacity of that element. Use of these elements is an alternative solution. There are two options for bracing design as follows.

<u>Option A – Plasterboard only for upper storeys</u>

For a storey braced with plasterboard walls only, demand may be derived adopting ductility μ =2, and S_p=0.7. Each direction should be considered separately, and the maximum percentage of storey shear braced by plasterboard walls should be according to Table 1.

Table 1. Option A – Plasterboard walls only - Max % of storey shear forces resisted by plasterboard in a three storey building.

Storey	Max % Storey Shear
2nd (top floor)	100
1st	100
Ground floor	0

Option B – Plasterboard and ply in combination for upper storeys

For a storey braced with plasterboard and plywood walls in combination, demand may be derived adopting ductility μ =3, and S_p=0.7. Each direction should be considered separately, and the maximum percentage of storey shear braced by plasterboard walls should be according to Table 2.

Note: There should be a balanced spatial distribution of the plasterboard and ply panels resisting shear in any storey.

Table 2. Option B – Plasterboard & plywood walls - Max % of storey shear forces resisted by plasterboard in a three storey building

Storey	Max % Storey Shear
2^{nd} (top floor)	80
1^{st}	60
Ground floor	0

Load path. Every bracing element requires a continuous, verified load path for shear, hold-down and overturning forces through to the foundation. The engineer must verify this load path explicitly using specific engineering design.

Hold Downs. P21 ratings assume the hold-down and support conditions used in the test and are valid only where those conditions are reproduced in the building. The uplift generated at an element's rated capacity is uplift (kN) = 0.05 × design BU/m rating × wall height (m) with Ø=1, where the design rating is the published rating after adjustment for wall height. This force shall be resisted by the specified hold-down where one is required, and in all cases transferred through a verified load path to the storey below or the foundation, including the capacity of supporting floor framing, with consideration of cumulative effects. The same derived demands with Ø =1 can be applied for the design of other capacity design protected elements like diaphragms and foundations.

Diaphragms require careful consideration. Particularly where the building has overhangs, offsets, or floor voids (e.g. stairwells) that interrupt a direct wall-to-wall load path. Diaphragms in these conditions must be engineer designed, with chords and collectors explicitly resolved. Plasterboard ceiling diaphragms should not be relied upon as transfer diaphragms.

Further Information

Further information can be found:

- Residential Design RoadMap report
- P21 test information
- BRANZ Study Report SR337
- American Wood Council Special Design Provisions for Wind and Seismic
- Canadian Wood Council Engineering Guide for Wood Frame Construction