DESIGN RIGHT

Calculating bracing when renovating

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A question frequently asked by readers is how do you compensate for the bracing that is removed when demolishing an internal wall during a renovation or refurbishment? We have some advice.

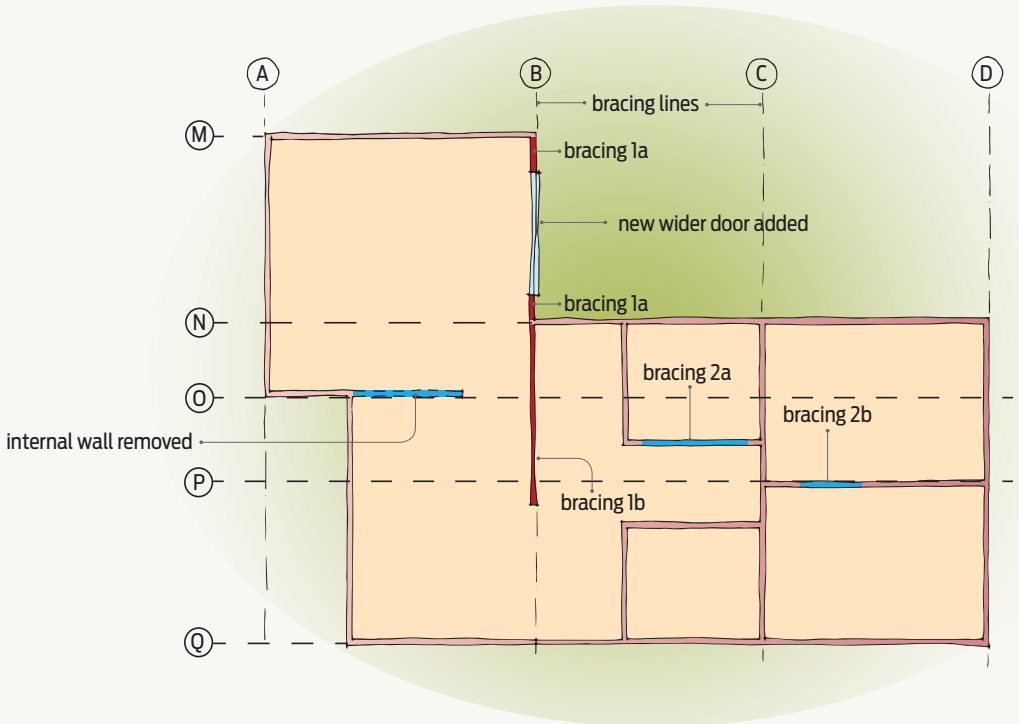
WHEN AN INTERNAL WALL of an existing building is to be removed, the bracing capacity of the remaining building is likely to be reduced, whatever the age of the building and whether or not the existing bracing has been formally designed. For this reason, most BCAs will require some assurance that the remaining (or additional new) structure will still comply with the Building Code. To compensate for the loss of the wall, its contribution to the structure must be assessed, and that contribution must be replaced somewhere else.

NZS 3604:2011 bracing basics

To determine what replacement bracing is required, some knowledge of NZS 3604:2011 *Timber-framed buildings* bracing design concepts is required.

Bracing lines

A fundamental principle of wall bracing requirements in NZS 3604:2011 is that lateral loads must be evenly distributed across a number of relatively closely spaced building elements arranged along bracing lines. These are imaginary lines allocated in two directions to run along and across the full length and width of a building parallel to the external walls. Although they have



Scenarios:
1. When a new wider door is added on bracing line B, replacement bracing could be added:
   - on both sides of the door (1a)
   - to the internal wall also on bracing line B (1b).
2. When an internal wall is removed on bracing line O, replacement bracing could be added on a parallel bracing line less than 2 m away (2a or 2b).

Figure 1 **Bracing can be located in internal walls on bracing lines.**

no physical significance, they determine the locations of the bracing.

Bracing units

Bracing unit (BU) is a term for a bracing rating that both quantifies wall bracing elements and provides a measure of the wall bracing element racking performance. A building must contain bracing units allocated in the bracing lines in both directions. How many bracing units are required depends on construction, size, layout and location of the building.

Section 5 of NZS 3604:2011 gives guidance on how to calculate the required bracing demand capacity or rating for light timber-framed buildings.

Working out bracing lines for existing construction

Bracing lines can be used to determine where replacement bracing should go if a wall that has bracing is removed from an existing building. Bracing lines should be applied to the existing building following the same criteria as a new building.

They should align with the external walls of the building, then be allocated to align with internal walls and evenly distributed throughout the building. Rules for laying out bracing lines to ensure good seismic performance include:

- they must run in two orthogonal directions
- they should be as evenly spaced as practical – generally, there should be more bracing lines rather than fewer to make the distribution rules easier to apply
- where two walls are parallel to one another and:
  - up to 2 m apart, a single bracing line may be placed between them and the bracing elements in both walls will contribute to the total BUs on the bracing line
  - more than 2 m apart, an extra bracing line should be inserted to facilitate the distribution of the BUs – an additional bracing line will not affect the number of BUs required as the bracing demand is not increased
- bracing elements can be located anywhere on a bracing line.

Locating new braced wall elements

Once the locations of existing bracing have been identified and bracing lines allocated accordingly, the location of a new braced wall element can be determined. Generally, the new braced wall element should be located on the same bracing line as the bracing element that was removed.

If a new door or window opening is cut into a braced wall and the remaining wall cannot provide the required bracing, additional bracing may be installed elsewhere on the bracing line (Figure 1). If this is not possible, the new bracing element may be able to be located on a bracing line less than 2.0 m from where the bracing element was removed.

Manufacturer bracing ratings for new work

Manufacturers usually give the bracing rating in BUs for their proprietary wall systems. Ratings are calculated using the P21 test, developed by BRANZ to evaluate the bracing capacity of wall systems.

However, the test was developed for new building work so it is generally not applicable to existing construction and cannot be used in situations where renovation work is being carried out.

Another approach is needed when determining bracing requirements for renovations.

BRANZ help to determine old bracing ratings

The details of an existing wall can be confirmed during the deconstruction of the wall. To assist this process, a BRANZ study determined bracing ratings (BUs) by testing a range of older generic wall construction types including:

- lath and plaster
- fibrous plaster
- plasterboard (on one and both sides)
- tempered hardboard-lined wall (one side only)
- vertical and horizontal corrugated steel
- horizontal-boarded walls
- different types of let-in bracing.

The results are rounded and simplified in Table 1 (from *Build* 144, *Bracing ratings*) and were published in BRANZ Study Report SR305 *Bracing ratings for non-proprietary bracing walls*. They can be applied to provide the equivalent or better bracing in renovations.

Adding values from different systems

SR305 also determined that bracing values from different systems may be added together as long as the bracing is combined in one element.

For example, for a wall lined with plasterboard that also has a diagonal brace, the bracing rating of the wall is the sum of both bracing systems. For a wall lined on both sides with plasterboard, the bracing rating is twice the sum of a wall lined on one side only.

Always reinstall at least equivalent bracing

Not all renovation work requires a building consent. However, even if a consent is not required, whenever bracing is removed, at least an equivalent amount of bracing must be installed to replace it. This needs to comply, as much as possible, with the bracing distribution rules of NZS 3604:2011.

For more **BRANZ Study Report SR305 is available to download for free at www.branz.co.nz/study_reports.**

Table 1

SUMMARY OF BRACING RATINGS OF GENERIC OR HISTORICAL CONSTRUCTION

BRACING SYSTEM	WALL LENGTH (M)	NOGS	STRENGTHENING	FIXING TYPE	FIXING PATTERN	RECOMMENDED BRACING RATING – WIND AND EARTHQUAKE
150 × 25 mm let-in brace at 45º	2.4	No	No	75 × 3.15 mm galvanised FH nails	Two nails to each stud and three to each plate	40 BUs/brace
90 × 45 mm double brace cut between studs			No	75 × 3.15 mm bright JH nails	Two nails each end of braces	40 BUs/brace pair
			Strap brace between top plate and end stud			60 BUs/brace pair
Dogleg brace	0.6	@ 600 mm	No	75 × 3.15 mm bright JH nails	Two nails each end of braces	15 BUs/brace
45 × 6 mm lath and plaster, no horse hair	2.4	No		25 × 2.5 mm galvanised FH clouts	Laths fixed with a single nail	30 BUs/m
200 × 10 mm horizontal board	1.2			40 × 2.8 mm galvanised FH nails	Two nails at each board/stud intersection	20 BUs/m
140 × 20 mm bevel-back weatherboard	2.4	Yes		60 × 3.15 mm bright JH nails	Weatherboards fixed to studs with a single nail at 40 mm from the bottom of each board	5 BUs/m
Standard plasterboard one side	1.2			30 × 2.5 mm galvanised FH nails	A nail at each corner and at 300 mm centres to all studs and plates	15 BUs/m
Standard plasterboard two sides						40 BUs/m
3.2 mm tempered hardboard one side	1.2		No	30 × 1.6 mm plated panel pins	A fastener at each corner and then at 200 mm centres to all studs and plates	25 BUs/m
			Add 30 × 2.5 mm nails	30 × 2.5 mm galvanised FH nails		55 BUs/m
			Add 30 × 2.5 mm nails and 100% rocking restraint			85 BUs/m
Horizontal corrugated steel	2.4		No	60 × 3.5 mm bright shank leadhead nails	Nails every second ridge to studs, except third ridge one side of lap	35 BUs/m
Vertical corrugated steel	2.4				Nails every second ridge to nogs and plates, except third ridge one side of lap	25 BUs/m