BRANZ Appraised
Appraisal No. 899 [2015]

USG BORAL BRACING SYSTEMS

Appraisal No. 899 (2015)
Amended 23 September 2019

BRANZ Appraisals
Technical Assessments of products for building and construction.

USG Boral Building Products NZ
PO Box 11-155
Ellerslie
Auckland 1542
Tel: 0800 874 267
Fax: 0800 332 123
Web: www.usgboral.com
Email: info.nz@usgboral.com

BRANZ
1222 Moonshine Rd,
RD1, Porirua 5381
Private Bag 50 908
Porirua 5240,
New Zealand
Tel: 04 237 1170
branz.co.nz

Product

1.1 USG Boral Bracing Systems are a range of wall bracing systems based on the use of USG Boral Sheetrock® Ceiling and Wall, USG Boral Multistop™ 2 and Multistop™ 4, and USG Fiberock® Aqua-Tough™. USG Boral Bracing Systems are used to resist earthquake and wind loads on timber frame buildings designed and constructed in accordance with NZS 3604: 2011. The USG Boral BRACE+™ bracing calculator provides an electronic means of calculating bracing demand and resistance.

Scope

2.1 USG Boral Bracing Systems have been appraised for use as interior wall bracing systems in buildings within the scope limitations of NZS 3604: 2011.

Building Regulations

New Zealand Building Code (NZBC)

3.1 **In the opinion of BRANZ, USG Boral Bracing Systems, if designed, used, installed and maintained in accordance with the statements and conditions of this Appraisal, will meet the following provisions of the NZBC:**

Clause B1 STRUCTURE: Performance B1.3.1, B1.3.2 and B1.3.4. USG Boral Bracing Systems meet the requirements for loads arising from self-weight, earthquake, wind and impact [i.e. B1.3.3 (a), (f), (h) and (j)]. See Paragraphs 8.1 – 8.9.

Clause B2 DURABILITY: Performance B2.3.1 (a) not less than 50 years. USG Boral Bracing Systems meet this requirement. See Paragraphs 9.1 – 9.4.

Clause F2 HAZARDOUS BUILDING MATERIALS: Performance F2.3.1. USG Boral Bracing Systems meet this requirement and will not present a health hazard to people.

3.2 The bracing demand calculation and bracing distribution rules published in the USG Boral Bracing Calculator are in accordance with Section 5 of NZS 3604: 2011. Bracing resistance is provided by bracing element ratings determined in accordance with NZS 3604: 2011, Paragraph 8.3.1.2.

3.3 NZS 3604: 2011 is an **Acceptable Solution** for compliance with New Zealand Building Code Clause B1 Structure.

Technical Specification

4.1 The USG Boral Plasterboards and accessories used with USG Boral Bracing Systems and supplied or specified by USG Boral Building Products NZ are as follows:

USG Boral Plasterboards

USG Boral Sheetrock® Ceiling and Wall

- USG Boral Sheetrock® Ceiling and Wall is a paper-bound, gypsum-plaster core sheet lining material. It is available in 10 and 13 mm sheet thicknesses and sheet widths of 1200 mm and 1350 mm. Sheets are available in various edge profiles and lengths from 2400 mm to 6000 mm. Refer to Table 1. The nominal sheet weight is 5.9 kg/m² for 10 mm sheet thickness and 7.2 kg/m² for 13 mm sheet thickness. USG Boral Sheetrock® Ceiling and Wall face paper is buff in colour.

Table 1: USG Boral Sheetrock® Ceiling and Wall Available Sheet Sizes

Sheet Thickness (mm)	Sheet Edge Profile	Sheet Width (mm)	Sheet Length (mm)						
			2400	2700	3000	3600	4200	4800	6000
10 mm	RE/RE	1200	✓	✓	✓	✓	✓	✓	✓
10 mm	RE/SE	1200	✓	✓	✓	✓	✓	✓	✓
10 mm	RE/SE	1350				✓		✓	✓
13 mm	RE/RE	1200	✓	✓	✓	✓	✓	✓	✓

RE = recessed edge, SE = square edge

USG Boral Multistop™ 2 and Multistop™ 4

- USG Boral Multistop™ 2 and Multistop™ 4 are paper-bound, gypsum-plaster core sheet lining materials. They are available in 10 and 13 mm sheet thicknesses and sheet widths of 1200 mm and 1350 mm. Sheets are available in various edge profiles and lengths from 2400 mm to 4800 mm. The nominal sheet weight is 9.7 kg/m² for 10 mm sheet thickness and 11.8 kg/m² for 13 mm sheet thickness

USG Fiberock® Aqua-Tough™

- USG Fiberock® Aqua-Tough™ is a paper-less, gypsum-plasterboard reinforced with cellulose fibre. It is available in 13 and 16 mm sheet thicknesses and a sheet width of 1200 mm. Sheets are only available with a recessed edge profile and lengths of 2700 mm and 3000 mm. The nominal sheet weight is 12 kg/m² for 13 mm thick sheets and 15 kg/m² for 16 mm thick sheets. USG Fiberock® Aqua-Tough™ is off-white in colour.

USG Boral Accessories and USG Boral Jointing Compounds

- As specified in the Technical Literature.

Board Substitutions

4.2 In certain situations, properties additional to bracing may be required of the plasterboard lining. Table 2 lists suitable substitute boards.

Table 2: Allowable Substitute Boards in USG Boral Bracing Systems

Specified Board	Fiberock® Aqua-Tough™		Firestop®		Multistop™ 2 Multistop™ 4			Soundstop™		Sheetrock®
	13 mm	16 mm	13 mm	16 mm	10 mm	13 mm	16 mm	10 mm	13 mm	13 mm
10 mm Sheetrock®	✓[1]	✓[2]	✓	✓[2]	✓	✓	✓[2]	✓	✓	✓
10 mm Multistop™	✓[1]	✓[2]			n/a	✓				
13 mm Fiberock® Aqua-Tough™	n/a	✓[2]								

1. Use 41 mm x 6 g screws
2. Use 51 mm x 7 g screws

Ceiling Diaphragm Components

4.3 USG Boral components used in ceiling diaphragms are as follows:

- PC24 – 24 x 29 mm steel perimeter channel
- FC37 – 23 mm deep steel ceiling batten
- DJ4040 – 40 x 40 mm metal angle
- DF37-S – 97 mm long x 90 mm wide direct fix brackets for ceiling batten
- DF37-L – 193 mm long x 90 mm wide direct fix brackets for ceiling batten

Components and Accessories

4.4 System components and accessories for USG Boral Bracing Systems, which are supplied by the building contractor are:

Fasteners

- 32 mm or 41 mm x 6 g, or 51 mm x 7 g drywall, gold passivated, bugle head, coarse thread screw with an 8 mm head for fixing to timber framing.
- 25 mm x 6 g gold passivated, bugle head, fine thread screw with an 8 mm head for fixing plasterboard to steel ceiling battens.

Adhesive

- Adhesive must comply with AS 2753 for adhering plasterboard to timber framing.

Plywood

- Plywood must be a minimum of 7 mm thick complying with AS/NZS 2269 D-D Grade Structural.
- Plywood fixings are 50 x 2.8 mm hot-dipped galvanised steel flat-head nails.

Fasteners, Anchors and Connections

- Pryda Bracing Anchor – galvanised steel 87 mm high x 85 mm long x 50 mm wide x 4 mm thick angle bracket. The bracket is supplied with 7 Type 17 screws 5.5 x 35 mm.
- Coach screws 12 mm x 150 mm and 50 x 50 x 3 mm washer hot-dipped galvanised for fixing to timber floors.
- Cast-in bolts M12 x 150 mm minimum and 50 x 50 x 3 mm washers for fixing to concrete floors.
- Proprietary fixings with a minimum characteristic strength of 15 kN may be used, instead of cast-in bolts.
- Shot fired fasteners for fixing internal line bracing systems to concrete slabs. Refer to fastener proprietor for specifications.
- Galvanised or stainless steel strap 25 x 0.9 mm top and bottom plate connections.
- Strap fixings 30 x 2.5 mm hot-dipped galvanised or stainless steel flat-head nails.
- 10 g x 30 mm drill point wafer head screws for fixing FC37 ceiling battens to timber blocking.
- 10 g x 16 mm drill point wafer head screws for fixing FC37 ceiling battens to DJ4040 blocking.
- 6 g x 40 mm screws for fixing DJ4040 blocking to timber ceiling framing.
- Ceiling Batten Bracket Fixings - 30 x 2.5 mm hot-dipped galvanised clouts or 25 mm x 8 g wafer head screws.

Note: For corrosion protection requirements refer to NZS 3604: 2011 Section 4.

Ceiling Battens

- Timber ceiling battens as specified in NZS 3604: 2011.

Handling and Storage

5.1 The best results are achieved when USG Boral Plasterboards are treated as a finishing material and protected from damage. Sheets must be stacked flat and kept dry at all times. For limits on stack heights see the Technical Literature. Sheets must be carried on edge and not dragged.

5.2 All accessories must be kept dry.

Technical Literature

6.1 Refer to the Appraisals listing on the BRANZ website for details of the current Technical Literature for USG Boral Bracing Systems. The Technical Literature must be read in conjunction with this Appraisal. All aspects of design, use, installation and maintenance contained in the Technical Literature and within the scope of this Appraisal must be followed.

Design Information

General

7.1 The tabulated bracing ratings given in Table 3 of this Appraisal are for manual calculations which have been rounded and are conservative. NZS 3604: 2011 provides methods to distribute the bracing units in walls to resist forces and a method for modifying the wall bracing capacity for alternative wall heights. The use of ceiling diaphragms is defined in the Technical Literature.

7.2 USG Boral Bracing Systems are for use in dry, internal situations only.

7.3 USG Boral Plasterboards must not be exposed to temperatures of 52°C or greater for prolonged periods. Refer to appliance and fitting manufacturers for installation details.

USG Boral BRACE+™ bracing calculator

7.4 The USG Boral BRACE+™ bracing calculator contains design procedures and an electronic calculation method for bracing demand calculated in accordance with NZS 3604: 2011, Section 5. Floor loadings can be selected in accordance with either NZS 3604: 2011 Bracing Demand Tables 5.5 – 5.10 for 2 kPa floor loads or less, or Tables 14.1 – 14.3 for 3 kPa floor loads.

7.5 The USG Boral BRACE+ bracing calculator calculates wind and earthquake demand based on the building parameters entered. Resulting bracing demand calculations are project specific and can differ from values manually derived using NZS 3604: 2011 wind and earthquake demand tables. The USG Boral BRACE+™ bracing calculator has been assessed as part of this Appraisal.

Framing

7.6 Timber framing grade, spacing and construction must comply with NZS 3604: 2011. Timber treatment must comply with NZBC Acceptable Solution B2/AS1.

7.7 USG Boral Building Products NZ recommends the use of kiln-dried stress-graded framing timber. The minimum actual framing dimensions are 90 x 45 mm for external walls and 75 x 45 mm for internal walls.

7.8 Joints in the top plates of bracing panels must be tied together with 3 kN and 6 kN top plate connectors using 25 x 0.9 mm galvanised mild steel strap, 3 nails each side of joint for 3 kN and 6 nails each side of joint for 6 kN.

Board Substitutions

7.9 On occasions, properties additional to bracing may be required of the plasterboard lining. Refer to Table 2.

Structure

Bracing

8.1 The bracing units (wind and earthquake) published for manual calculations in USG Boral Bracing Systems are given in Table 3.

8.2 The bracing unit ratings embedded in the USG Boral BRACE+™ bracing calculator are less conservative and vary with wall length.

8.3 The Technical Literature provides comprehensive construction and panel hold-down details. These include bottom plate fixings using bolts (concrete) or coach screws (timber) and the Pryda Bracing Anchor or nailed stud-to-plate straps.

8.4 The bracing units are derived from the BRANZ P21 test method based on a wall height of 2.4 m. For greater wall heights the bracing rating is calculated by multiplying the appropriate value shown in Table 3 by a factor f=2.4 and divided by the wall height in metres. Walls lower than 2.4 m shall be rated as if they were 2.4 m high.

Table 3: USG Boral Bracing Systems Bracing Ratings

Type	Minimum length (m)	Maximum Length (m)	Lining	Other Requirements	BU/m	
					Wind	Earthquake
10mm USG Boral Sheetrock® Ceiling and Wall						
UB1S	0.4	6.0	10 mm Sheetrock® Ceiling and Wall one side	n/a	55	50
UB2S	0.4	4.8	10 mm Sheetrock® Ceiling and Wall both sides		65	60
10 mm USG Boral Multistop™ 2 or Multistop™ 4						
UB1M	0.4	1.2	10 mm Multistop™ 2 or Multistop™ 4 one side	Panel hold-downs	85	85
	1.2	2.4			100	85
UBSM	0.6	2.4	10 mm Multistop™ 2 or Multistop™ 4 one side, 10 mm Sheetrock® Ceiling and Wall the other		130*	125*
UBMP	0.4	0.6	10 mm Multistop™ 2 or Multistop™ 4 one side, 7 mm plywood the other		90	110
	0.6	1.2			120*	130*
	1.2	2.4			150*	150*
13 mm USG Fiberock® Aqua-Tough™						
UB1FR	0.4	1.2	13 mm Fiberock® Aqua-Tough™ one side	Panel hold-downs	105	125*
	1.2	4.8			145*	140*
UB2FR	0.4	1.2	13 mm Fiberock® Aqua-Tough™ both sides		115	130*
	1.2	2.4			150*	150*
UBFRP	0.4	1.2	13 Fiberock® Aqua-Tough™ one side, 7mm plywood the other		105	130*
	1.2	2.4			150*	150*

Notes:

Where linings are specified on both faces, each face must be fastened as a bracing element.

* Timber Floors – A limit of 120 BU/m applies to NZS 3604: 2011 timber floors.

* Concrete Floors - A limit of 150 BU/m applies to NZS 3604:2011 concrete floors.

Ceiling Diaphragms

8.5 USG Boral Plasterboard ceiling diaphragms are used to space bracing lines further apart than 6 m. The basic shape of a ceiling diaphragm must be square or rectangular and the length must not exceed twice the width.

8.6 For ceiling diaphragms not steeper than 15° and not exceeding 7.5 m in length, any USG Boral Plasterboard listed in Table 2 (except 10 mm USG Boral Sheetrock® Ceiling and Wall) may be used provided the diaphragm boundary is fixed at 150 mm centres to framing and 300 mm centres to intermediate battens.

Openings in Bracing Elements

8.7 Small openings of 90 x 90 mm or less may be placed anywhere except within 90 mm of the edge of the bracing element. Holes of a maximum diameter of 125 mm may be placed in the body of the sheet a minimum of 300 mm from the edge of the bracing element.

Water-splash Areas

8.8 USG Boral Bracing Systems must not be located in shower cubicles or behind baths and the like. USG Boral Bracing Systems may be used in water-splash areas provided they are protected as required by NZBC Clause E3.

Impact Resistance

8.9 USG Boral Plasterboards provide adequate resistance to soft body impact, based upon experience of use in domestic and light commercial applications.

Durability

9.1 USG Boral Bracing Systems, including linings and their fixings have a serviceable life of at least 50 years. The ability of the systems to remain durable is dependent on them remaining dry in service, and being maintained in accordance with this Appraisal.

Maintenance

9.2 The building must be maintained weatherproof and USG Boral Plasterboard must be protected from external and internal moisture in accordance with NZBC Clauses E2 and E3.

9.3 Holes resulting from damage to the lining, up to 100 x 100 mm square, will have no significant effect on the performance of the bracing panel. Such holes may be repaired by patching, stopping and finishing as appropriate. Independent expert advice must be sought to assess the effect and repair of larger areas of damage.

9.4 Bracing elements require no ongoing maintenance, apart from decoration and the repair of any damage.

Prevention of Fire Occurring

10.1 Separation or protection must be provided to USG Boral Plasterboard from heat sources such as fire places, heating appliances, flues and chimneys. Part 7 of NZBC Acceptable Solutions C/AS1 – C/AS2 and NZBC Verification Method C/VM1 provide methods for separation and protection of combustible materials from heat sources.

Fire Affecting Areas Beyond the Fire Source

Internal Surface Finishes

11.1 Table 4 shows the Material Group Numbers for USG Boral Plasterboards without applied paint or wallpaper finishes. When an applied finish is used over USG Boral Plasterboards, the Material Group Number must be obtained from the manufacturer of the finish product or system, for the complete lining system. USG Boral Plasterboards can be used as internal surface linings where permitted by NZBC Performance Clause C3.4 (a).

11.2 In all Risk Groups, where foamed plastics building materials or combustible insulating materials form part of a wall system, the complete system including the internal lining and finishes must achieve a Group Number of not more than three.

11.3 In buildings with a SH Risk Group classification, there are no internal surface finish requirements for USG Boral plasterboards (with or without an applied finish), unless foamed plastics building materials or combustible insulating materials form part of the wall system.

Table 4: Surface Finish Properties

Product	Material Group Number
USG Boral Firestop®	1-S
USG Boral Multistop™	1-S
USG Boral Sheetrock® Ceiling and Wall	1-S
USG Boral Wet Area Board	1-S
USG Fiberock® Aqua-Tough™	1-S

Internal Moisture

12.1 USG Boral Plasterboard must be used in dry internal situations, and must not be used where likely to be exposed to liquid water, or where extended exposure to humidity above 90% RH is expected, e.g. such as may be expected in sauna rooms, commercial kitchens and the like.

Installation Information

Installation Skill Level Requirement

13.1 Installation of USG Boral Bracing Systems must be completed by, or under the supervision of a Licensed Building Practitioner with the relevant Licence Class, in accordance with the Technical Literature and this Appraisal.

General

14.1 USG Boral Bracing Systems must be installed in accordance with the Technical Literature. For inspection, reference must be made to the Technical Literature.

Framing

14.2 To achieve an acceptable decorative finish, the Technical Literature specifies that walls must not be lined unless the moisture content of timber framing is less than 18%. USG Boral Building Products NZ recommend a moisture content of 8–18% where buildings are to be air conditioned or centrally heated.

Cutting

14.3 USG Boral Plasterboards are easily cut by scoring the face paper with a sharp short-bladed trimming knife, and then snapping the plasterboard away from the cut face and cutting the back paper, or by sawing. Use of a metal straightedge facilitates clean straight cuts. Cut edges can be tidied up by using a knife. Paper dags should be removed.

14.4 USG Fiberock® Aqua-Tough™ is stronger than paper-faced plasterboard, but can still be cut by scoring and snapping. The sheets may also be cut with a hand saw or a power saw fitted with a dust extraction system. Cut edges may be smoothed with a sanding block or rasp.

Sheet Fixing

14.5 Corner fixings must be 50 mm away from the sheet corner. Fixings must be no closer than 12 mm from the paper-bound sheet edge of plasterboards or recessed edges of USG Fiberock® Aqua-Tough™, and no closer than 18 mm from a cut edge on plasterboards or sheet ends on USG Fiberock® Aqua-Tough™. Fixings must be driven at right angles to the sheet until the head is seated in a slight dimple just below the surface of the paper liner or the board surface in the case of USG Fiberock® Aqua-Tough™. Fixings must not be over-driven.

14.6 USG Boral wall bracing sheets are fixed at 150 mm centres around the perimeter framing of the bracing element. At the corners of the wall bracing elements, a special fastening pattern is required in both directions with fasteners spaced at 50 mm, 100 mm, 150 mm, 225 mm and 300 mm from the corner and there-after at 150 mm centres. Fixing to other framing is either mechanical or by using plasterboard adhesive.

14.7 The USG Boral Bracing Systems requirements for horizontal or vertical sheet installation must be met. Full sheets must be used wherever possible.

14.8 Plywood is nail fixed at 150 mm centres around the perimeter of each sheet and at 300 mm centres to intermediate framing. The minimum edge distance for fixings is 7 mm.

Ceiling Diaphragms

14.9 All USG Boral Plasterboard ceiling diaphragms require fixings around the perimeter of the diaphragm boundary at 150 mm centres and at 300 mm centres to intermediate battens. See Paragraphs 8.5 to 8.6 and refer to the Technical Literature.

Jointing and Finishing

14.10 All bracing element sheet joints must be reinforced with paper tape and finished in accordance with the USG Boral Bracing Systems Technical Literature.

Health and Safety

14.11 Dust resulting from the sanding of stopping and finishing compounds may be a respiratory irritant, and the use of a suitable facemask is recommended.

Basis of Appraisal

The following is a summary of the technical investigations carried out:

Tests

15.1 Bracing tests were carried out by SCION in accordance with BRANZ Technical Paper P21 to determine the performance of USG Boral Bracing Systems when the building is subjected to lateral wind or earthquake loading. SCION's test facilities, procedures and results have been reviewed by BRANZ and found to be satisfactory.

15.2 USG Fibrerock® Aqua-Tough™ and the plasterboard liner papers have been subject to an accelerated aging regime by BRANZ to access their long term properties.

Investigations

16.1 The USG Boral BRACE+™ bracing calculator has been assessed by BRANZ and found to be satisfactory.

16.2 The USG Boral Bracing Systems Technical Literature has been examined by BRANZ and found to be satisfactory.

16.3 Site visits were carried out by BRANZ to assess the practicability of the installation of the systems, and to view completed installations.

16.4 An assessment was made of the durability of the systems by BRANZ technical experts and found to be satisfactory.

16.5 USG Boral Plasterboards have been assessed for the following properties: MOR, MOE, nail pull resistance, edge hardness, hard and soft body impact resistance and humidified deflection.

Quality

17.1 The manufacturing process of the Australian manufacturer USG Boral Building Products Pty Ltd and details of the quality and composition of the materials, have been examined by BRANZ and found to be satisfactory.

17.2 The quality management systems of USG Boral Building Products Pty Ltd have been assessed and registered by SAI Global as meeting the requirements of ISO 9001, Registration No. QEC0400.

17.3 The manufacture of USG Fiberock® Aqua-Tough™ has not been examined by BRANZ, but details regarding the quality and composition of the materials used were obtained by BRANZ and found to be satisfactory. BRANZ has taken note of product certification covering quality aspects associated with the product. BRANZ also undertakes an ongoing review of product quality on an inwards goods basis.

17.4 USG Boral Building Products NZ is responsible for the quality of the product supplied.

17.5 The quality of the application and finish on-site is the responsibility of the installation, stopping and finishing contractors.

17.6 Designers are responsible for the design of buildings.

17.7 Building owners are responsible for the maintenance in accordance with the instructions of USG Boral Building Products NZ.

Sources of Information

- AS/NZS 2269: 2012 Plywood - Structural.
- AS/NZS 2588: 1998 Gypsum plasterboard.
- BRANZ Technical Paper P21: 2010 A wall bracing test and evaluation procedure.
- NZS 3604: 2011 Timber-framed buildings.
- Ministry of Business, Innovation and Employment Record of Amendments for Compliance Documents and Handbooks.
- The Building Regulations 1992.

Amendments

Amendment No 1, dated 30 May 2017.

This Appraisal has been amended to include bracing systems based on 10 mm Multistop™ 4 and to omit 10 mm Fiberock® Aqua-Tough™, plus other minor amendments.

Amendment No 2, dated 24 November 2017.

This Appraisal has been amended to update the fixing requirements for ceiling diaphragms.

Amendment No 3, dated 23 September 2019

This Appraisal has been amended to update the bracing calculator to USG Boral BRACE+™, to add USG Boral Multistop™ 2, to update available sheet sizes and to reflect changes made in NZBC Acceptable Solutions C/AS2 - C/AS6.

BRANZ

In the opinion of BRANZ, USG Boral Bracing Systems are fit for purpose and will comply with the Building Code to the extent specified in this Appraisal provided they are used, designed, installed and maintained as set out in this Appraisal.

The Appraisal is issued only to USG Boral Building Products NZ, and is valid until further notice, subject to the Conditions of Appraisal.

Conditions of Appraisal

1. This Appraisal:
   a) relates only to the product as described herein;
   b) must be read, considered and used in full together with the Technical Literature;
   c) does not address any Legislation, Regulations, Codes or Standards, not specifically named herein;
   d) is copyright of BRANZ.
2. USG Boral Building Products NZ:
   a) continues to have the product reviewed by BRANZ;
   b) shall notify BRANZ of any changes in product specification or quality assurance measures prior to the product being marketed;
   c) abides by the BRANZ Appraisals Services Terms and Conditions.
   d) Warrants that the product and the manufacturing process for the product are maintained at or above the standards, levels and quality assessed and found satisfactory by BRANZ pursuant to BRANZ's Appraisal of the product.
3. BRANZ makes no representation or warranty as to:
   a) the nature of individual examples of, batches of, or individual installations of the product, including methods and workmanship;
   b) the presence or absence of any patent or similar rights subsisting in the product or any other product;
   c) any guarantee or warranty offered by USG Boral Building Products NZ.
4. Any reference in this Appraisal to any other publication shall be read as a reference to the version of the publication specified in this Appraisal.
5. BRANZ provides no certification, guarantee, indemnity or warranty, to USG Boral Building Products NZ or any third party.

For BRANZ

Chelydra Percy
Chief Executive

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