Armstrong®
CEILING SOLUTIONS

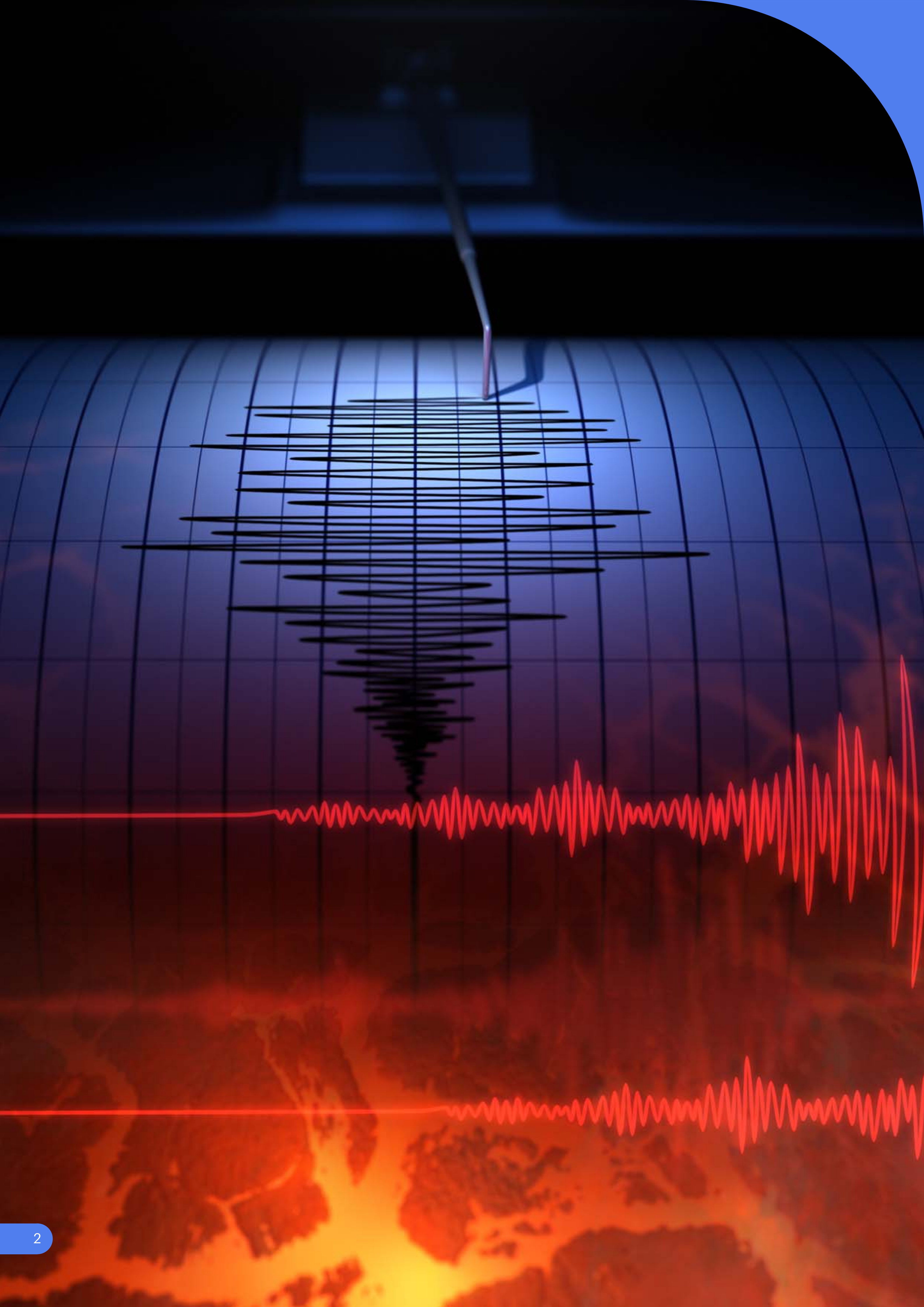
Seismic Design & Installation Guide

Suspended Ceiling System

SEISMIC

Australia and New Zealand

2021:V12



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Preface

BVT Engineering has been engaged by Armstrong Ceiling Solutions to assist in the production of this guide, which has been prepared with consideration of the Australian and New Zealand Standards, listed on Page 5.

Testing of the Armstrong Ceiling Grid Systems was undertaken to determine the compression and tension capacities. Testing of the perimeter fixings and bracing was also undertaken. The values from this testing have been used in this guide.

What Causes Seismic Activity?

The earth's surface is made up of a series of (Tectonic) plates that move in relation to each other. The lines where these plates meet are called fault lines and movement and stresses at these points can send shock waves through the ground. These shock waves are known as seismic waves and result in vibrations that at their most severe can cause immense damage to buildings and other structures, communication networks and indeed lives.

Tectonic Plates

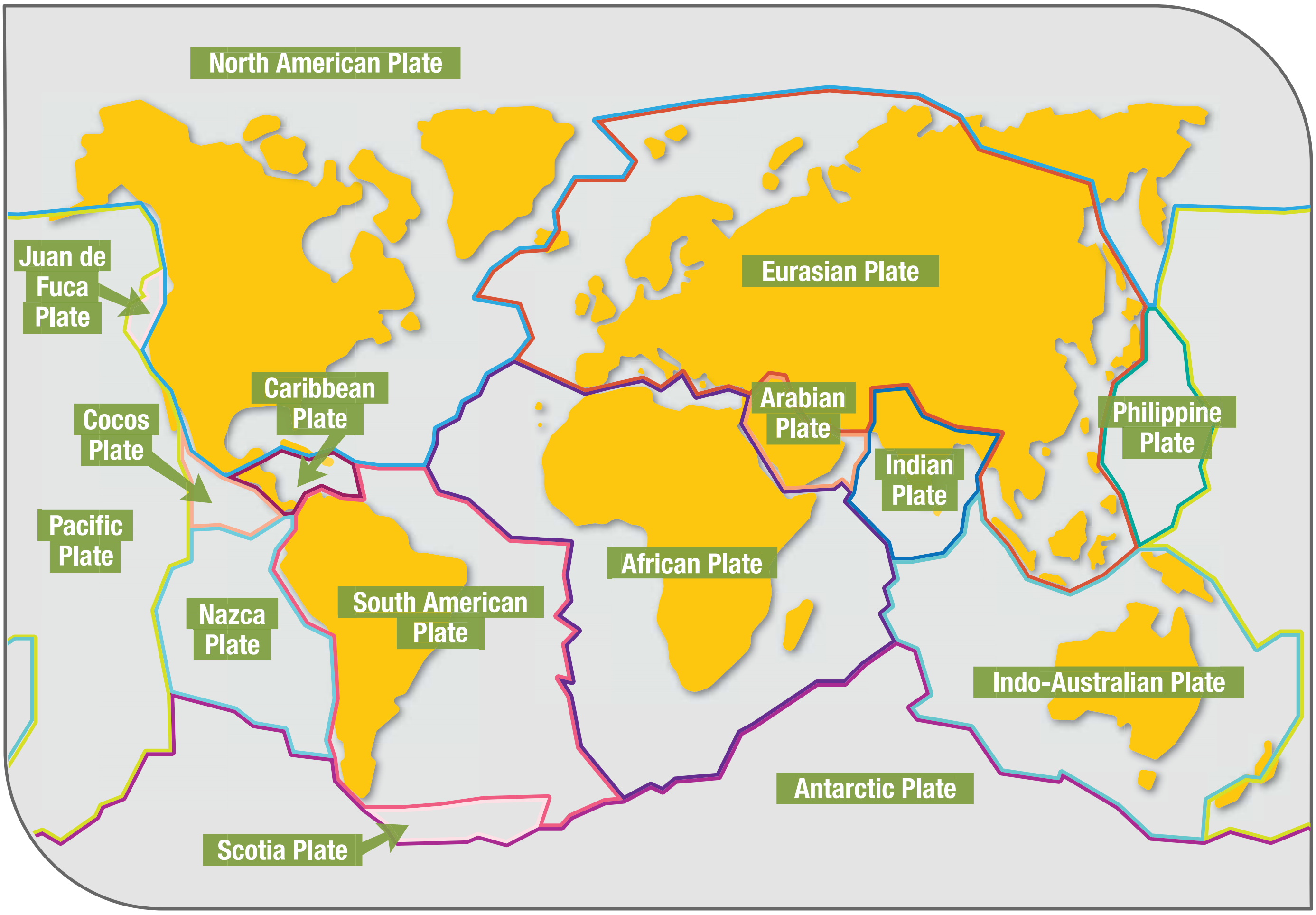
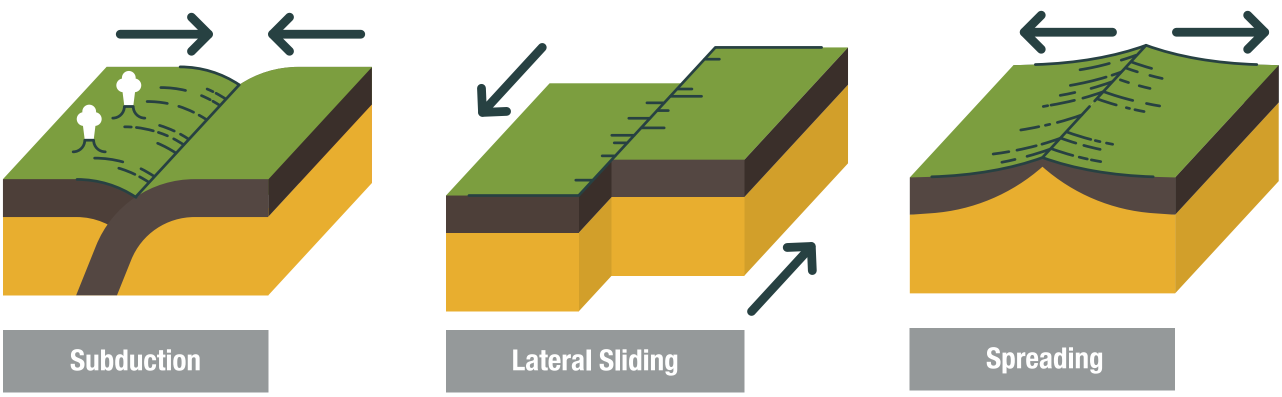


Plate Tectonics



About This Guide

The purpose of this guide is to provide preliminary information to support the application of Armstrong suspended grid and panel ceiling systems as per the requirements of NZS 1170.5 and AS 1170.4 – Structural Design Actions – Earthquake actions.

The failure of suspended ceilings that are not designed to seismic standards, as a result of earthquake activity can have catastrophic consequences, such as:

- Significant threat of injury or loss of life due to:
  - Blocked evacuation paths
  - Falling services
  - Live loose electrical wires
- Extensive delays in recommencing business even though the rest of the building structure may not have sustained damage.

A University of Canterbury report on the Performance of Ceilings in the February 2011 Christchurch Earthquake states:

"In buildings that suffered severe structural damage, ceilings and other non-structural components (rather expectedly) failed, but even in buildings with little damage to their structural systems, ceilings were found to be severely damaged. The extent of ceiling damage, where the ceilings were subject to severe shaking, depended on the type of the ceiling system, the size and weight of the ceilings and the interaction of ceilings with other elements." [1]

Wider Applications

In addition to earthquakes, there are several other industries with associated risks (e.g. Blast protection) where the use of correct seismic design will provide additional protection for the ceiling. These include:

- Power generation facilities
- Defence establishments
- Chemical installations
- Transport installations (with intermittent vibrations)

The design of Armstrong suspended ceiling grid systems, bracing and fixing types shown in this guide are developed in accordance with the following standards:

- **AS/NZ 2785: 2020 Suspended Ceiling – Design and installation**
- **AS1170.4: 2007 Structural Design Actions – Earthquake actions in Australia**
- **AS1170.5: 2009 Structural Design Actions – Earthquake actions in New Zealand**
- **NZS 4219: 2009 Seismic Performance Of Engineering Systems In Buildings**

1. Rajesh P. Dhakal, Greg A. MacRae, and Keith Hogg — "PERFORMANCE OF CEILINGS IN THE FEBRUARY 2011 CHRISTCHURCH EARTHQUAKE" (p. 379). *BULLETIN OF THE NEW ZEALAND SOCIETY FOR EARTHQUAKE ENGINEERING, Vol. 44, No. 4, December 2011*

Seismic Design

The Design Process

The design team should be responsible for coordinating the design and installation of all sub trade equipment in the plenum and ceiling. The preferred approach, to ensure optimal coordination and productive use of resources, is for seismic design of non-structural components to be completed prior to the project going out to tender. The design team needs to specify the seismic grade of the ceiling and the associated seismic restraint requirements in the tender documents along with:

- **Bracing Layout**
- **Edge/Perimeter details**
- **Service Integration**
- **Suspension points identified that are clear of services.**

Design Coordination

Many view a suspended ceiling as a finished surface only and are unware of the potential complexity of the design in the plenum. Consequently, they may not be aware of the possible true cost of a suspended ceiling that has been designed to withstand a Seismic event.

Designers of other components in the plenum may not have full understanding as to the requirements of the suspended ceiling system. Design coordination is possibly the single biggest issue that faces suspended ceiling installation. Seismic Design coordination of mechanical services and other plenum located elements, including lights, air conditioning, cable trays, fire suppression systems etc, with the suspended ceiling is essential. Refer to the drawing and technical detail on Page 22 for more information. In general, the coordination of proper seismic design prior to issuing tender documents will result in:

- **More accurate costing being achieved**
- **Better installation process**
- **Fewer site variations**
- **Lower overall cost**
- **Less time delays during installation**
- **Fewer site conflicts**

Designing with confidence using Armstrong Ceiling Systems

Armstrong PeakForm™, Blue Tongue™ and U-Profile Ceiling Systems, including Axiom Pelmets, when installed in conformance with this guide can withstand the forces associated with significant seismic activity or other severe events. An Armstrong PeakForm System provides additional security required for seismic resistance using specifically designed and independently tested elements for minimised installation complexity with maximum performance.

Seismic Testing – Armstrong PeakForm™ Ceiling Systems

Armstrong Ceiling Solutions has partnered with The University at Buffalo in testing the PeakForm Prelude XL 24mm™ and Suprafine 15mm Systems for seismic performance using:

- **Dynamic Testing – Seismic Qualification by Shake Table Testing**
- **Static Testing – Vertical, Compression, and Tension Loads**

The University at Buffalo's (UB) Structural Engineering and Earthquake Simulation Laboratory (SEESL) is a key equipment site and provides research and engineering collaboration services for the National Science Foundation's George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES), The Multidisciplinary Centre for Earthquake Engineering Research (MCEER), the Department of Civil, Structural and Environmental Engineering (CSEE). Furthermore, the SEESL facility also provides Research & Development services for industry and has been instrumental in the development of the Armstrong PeakForm Seismic Grid solutions.

Structural Engineering and Earthquake Simulation Laboratory – SEESL

SEESL's twin re-located shake tables

Seismic Testing – Armstrong Blue Tongue and U-Profile Ceiling Systems

Independent Static Testing has been conducted on Blue Tongue Aluminium and U-Profile Grid Systems. Vertical, compression and tension load capacities have been determined for these systems and are available as input data for seismic designs.

Limitations and Assumptions

Limitations

- This Guide takes into consideration the following Armstrong Suspended Ceiling Grid Systems: PeakForm, Blue Tongue and U-Profile, including Axiom Pelmets, installed in a typical horizontal plane.
- The Armstrong Preliminary Seismic Design does not constitute a producer statement PS-1 Engineering design (NZ), Form 15 or equivalent certified engineered design (Australia).
- Partition walls must not be braced to the ceiling grid.
- The Braced Ceiling solutions illustrated in this Guide are indicative only, showing fixed rectangular grid configurations. Guidance from a qualified structural engineer should be sought for rooms with complex geometry.
- The 'Back Braced' diagrams (Page 17 and following) do not apply to narrow corridors or rooms with only one main tee present. Guidance from a qualified structural engineer should be sought for such applications.

Assumptions

- The ceiling grid is classified Part Category P3, (ULS) for NZ.
- The ceiling system has a period of less than 0.75 seconds.
- The near Fault Factor Maximum of 1.0 has been used for NZ.
- The ceiling system has a structural ductility of 1.25 for NZ.
- A service load of 3kg/m2 is present as per AS/NZ 2785 Section 2.2.2(c)
- All individual objects weighing over 7.5kg shall independently suspended and braced and are not to break the Tees.
- The 'Fixed and Floating' diagram (Page 12) assumes a room in which the grid runs at right angles to the wall.
- Where a fixed perimeter is specified, the structure is capable of withstanding the line load applied by the ceiling.
- Where back bracing is specified, back braces are installed in accordance with manufacturer's recommendations.
- Design and installation of all systems must be in accordance with details provided in this brochure and other Armstrong suspension brochures.
- Ensure stud wall has noggins installed at ceiling height, this is required for fixing BERC2 clips. Alternatively, an Armstrong Seismic Shadow Line Wall Angle (Item ALSWA6) can be used where there are no noggins installed at ceiling height.

Considerations

- Ceilings should not be attached to two opposite walls unless there is a seismic gap between them. This is due of the forces that can be induced in the ceiling grid if differential displacements occur between the perimeter structures.
- Ceilings should not be braced to both a wall and the roof/structure above due to differential movement.
- If the building is importance level 4 (hospital, police station etc.) a qualified structural engineer must be consulted in the design of the ceiling.

Seismic Design Form

Armstrong Ceilings and BVT Engineering have developed a Seismic Design Calculator to assist with preliminary seismic designs. This calculator is based on AS 1170.4 2007 and NZ 1170.5 2009 Section 8.

Information to complete the Seismic Design Form

To access this service simply complete our Seismic Design Form (Page 10) and submit along with:

1. **Determination of the hazard factor (Z), which will be identified on the construction drawing. If not noted, refer to Pages 25-26 to select hazard factor based on the location of the project**
2. **Determination of the Site Sub Soil, which will be identified on the construction drawings**
3. **Building Importance Level will be on the construction drawings. If not available, refer to Pages 23-24.**
4. **Building heights**
5. **Ceiling heights**
6. **Panel type**
7. **Panel weight /m²**
8. **Grid type**
9. **Grid module**
10. **Direction of Main Runners: This is important as it will effect the Seismic design**
11. **Services: Ensure you ask the builder if all services, duct work, table trays, sprinklers are being seismically installed, if not, the installation of a ceiling to Seismic Standards will be ineffective and unsuitable**
12. **Sectional drawings and RCP's required in both CAD and PDF**

Notes:

1. To optimise seismic design, consideration should be given to engage a certified structural engineer.
2. The Armstrong Preliminary Seismic Design does not constitute a producer statement PS-1 Engineering design (NZ), Form 15 or equivalent certified design (Australia) and cannot be used to support a PS-1, Form 15 or equivalent certified design without consultation with a certified structural engineer.
3. Please contact your local Armstrong Ceilings representative or your local Armstrong Ceilings office for a digital copy of the Seismic Design Form.
4. Submissions of completed Seismic Design Forms and other required data to be made to your local Armstrong Representative.

IT IS THE RESPONSIBILITY OF THE PROJECT ENGINEER TO CHECK ALL INFORMATION SUPPLIED WITH THE ARMSTRONG PRELIMINARY SEISMIC DESIGN TO ENSURE IT IS CURRENT AND REMAINS RELEVANT FOR THE PROJECT.

Seismic Design Form

AS1170.4 Section 8 6 September 2021 – v1

Date

- **Contractor Name**
- **Telephone**
- **Email Address**
- **Builders Name**
- **Project Name**
- **Project Stage**
- Hazard factor (Z)
- Site Sub-Soil Class
- Building importance level
- Internal Wind Pressures (per level) as supplied by Structural Engineers
- Height of the structure
- Typical storey height
- Ceiling height
- **Exposed Grid and Panel**
- Ceiling Grid type
- Ceiling Panel Size
- Ceiling Panel Type
- Ceiling Panel Weight (kg/m^2)
- Ceiling type as per drawing legend
- Weight of light fixtures
- Weight of A/C grills
- Weight of insulation
- Are all services being seismically installed?
- Copy of RCP in Cad and PDF
- Copy of building Elevations PDF
- **Drywall Grid**
- DGS Module Size: 1200x600mm only
- Plasterboard Type / weight per m^2

Contact us

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Seismic Bracing: Layout Options

There are three different options for bracing the ceiling against lateral loading.

Options 1 and 2 require Fixed and Floating connection details to the perimeter. and Option 3 involves bracing back to the structure above.

Option 1: Fixed and Floating Perimeter with BERC2 Clips

(Perimeter fixing on adjacent edges)

BERC2 Clips are used to fix the ceiling to the perimeter on two adjacent sides as shown in Fig 1. BERC 2 Clips are also installed on opposite sides, creating a seismic sliding connection. Lateral loads are transferred from the ceiling to the perimeter through BERC2 perimeter fixing. Ensure stud wall has noggins located at ceiling height, as this is required for attaching BERC2 clips. *(See Note below).

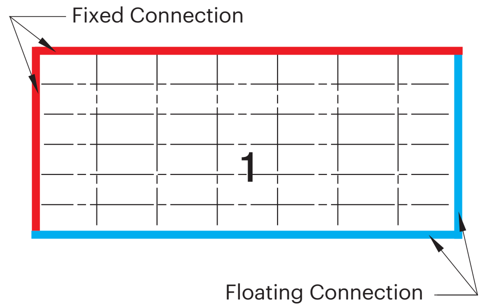


Fig 1 **BERC2 Clips applied at all ceiling to perimeter connections as shown**

Option 2: Fixed Perimeter with BERC2 Clips

(Perimeter fixing on all edges)

The ceiling is split up into smaller sections using seismic joints, as illustrated in Fig 2.

The ceiling should be fixed to the perimeter on all sides with BERC2 Clips. Lateral loads are transferred from the ceiling to the perimeter via BERC2 Clips. Ensure all stud walls have noggins installed at the ceiling height, as this is required for attaching BERC2 clips. *(See Note below).

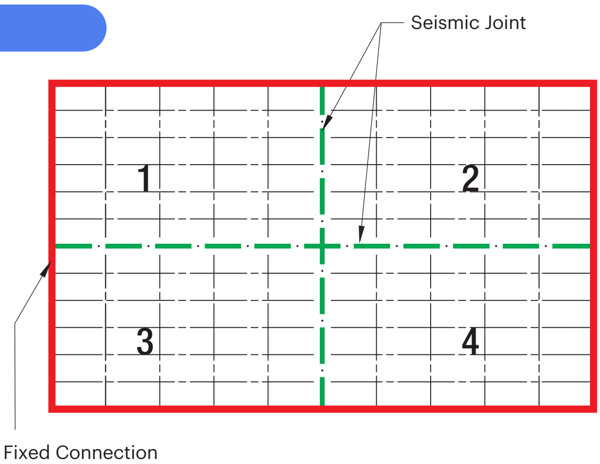


Fig 2 **Ceiling Grid to have a 20mm Seismic Joint installed to Main Bar and Cross runners. Refer to page 14 and 15**

Option 3: Back Braced with Floating Perimeter

The ceiling is braced back to the structure above with compression struts and tension wire braces or diagonal tension/compression struts. A Seismic Floating connection is required around the entire perimeter is required as the ceiling should not be braced to both the structure above and the perimeter.

For back bracing options refer to pages 17, 18 and 19

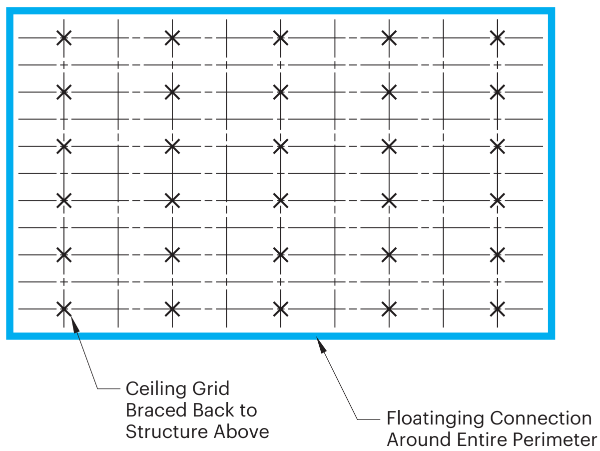


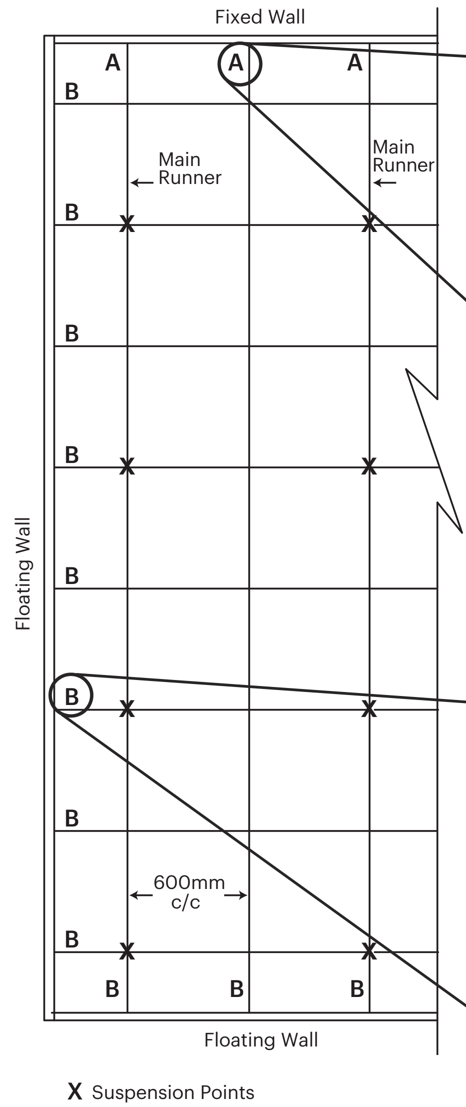
Fig 2 **Ceiling Back Bracing, with Sliding Perimeter Connections**

*** Note:** Alternatively, an Armstrong Seismic Shadow Line Wall Angle (Item ALSWA6) can be used where there are no noggins installed in the wall at ceiling height.

Seismic Perimeter Solution for Options 1 and 2

An Armstrong Seismic PeakForm Grid Solution requires consideration of the following three details at the perimeter:

1. Seismic Perimeter Trim (see Page 16 for options).
2. BERC2 Clip - applied as per Option 1 or 2 on Page 13. The BERC2 Clip also assists the ceiling grid to stay on module during a seismic event, preventing the ends of Cross Tees and Main Runners from spreading apart and panels being dislodged.
3. Seismic Clearance & Overlap for Sliding Connections: A 19mm clearance between the end of the Grid and the vertical leg of the Perimeter Trim, combined with a 6mm overlap of Grid on the Perimeter Trim is required on two adjacent sides of the ceiling. See Fig 6 below and Fig 7 on Page 13 for details of the sliding joint created by the BERC2 Clip.



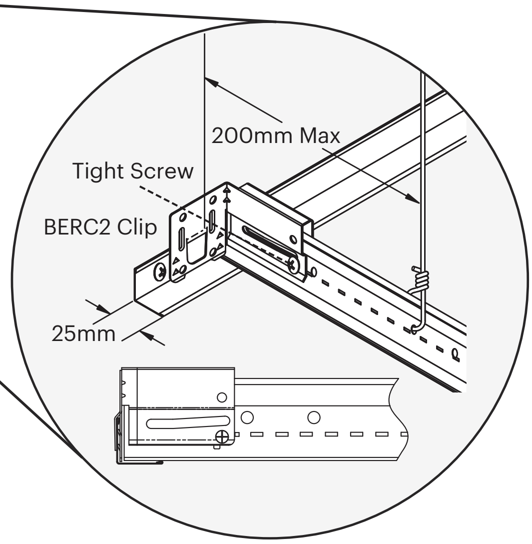


Fig 4 **Fixed Ceiling-Wall Connection with BERC2 Clips. (See also Fig. 7 on Page 13)**

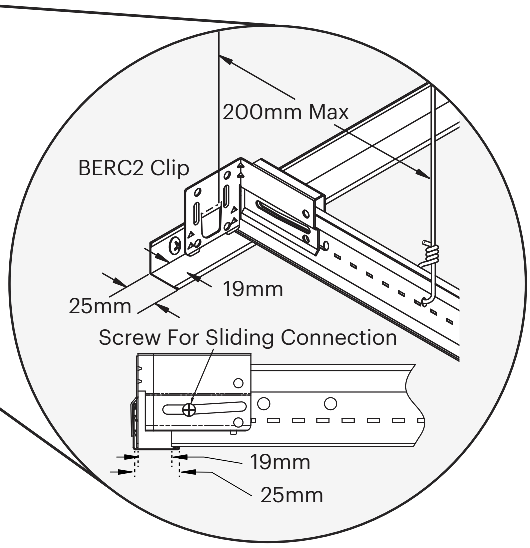


Fig 5 **Floating (Sliding) Ceiling-Wall Connection with BERC2 Clips (See also Fig 6. on Page 13)**

Seismic Perimeter Solution for Options 1 and 2

Fig 6 **Floating (Sliding) Ceiling-Wall Connection With BERC2 Clips**

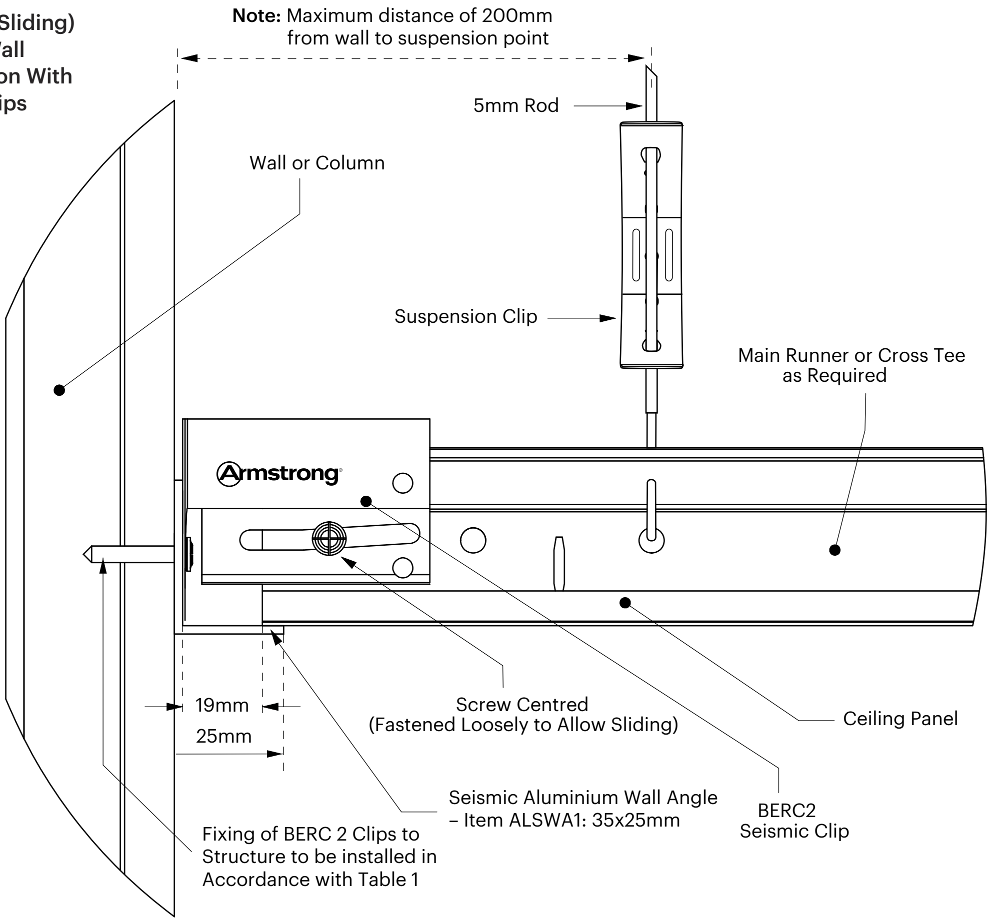


Fig 7 **Fixed Ceiling-Wall Connection With BERC2 Clips**

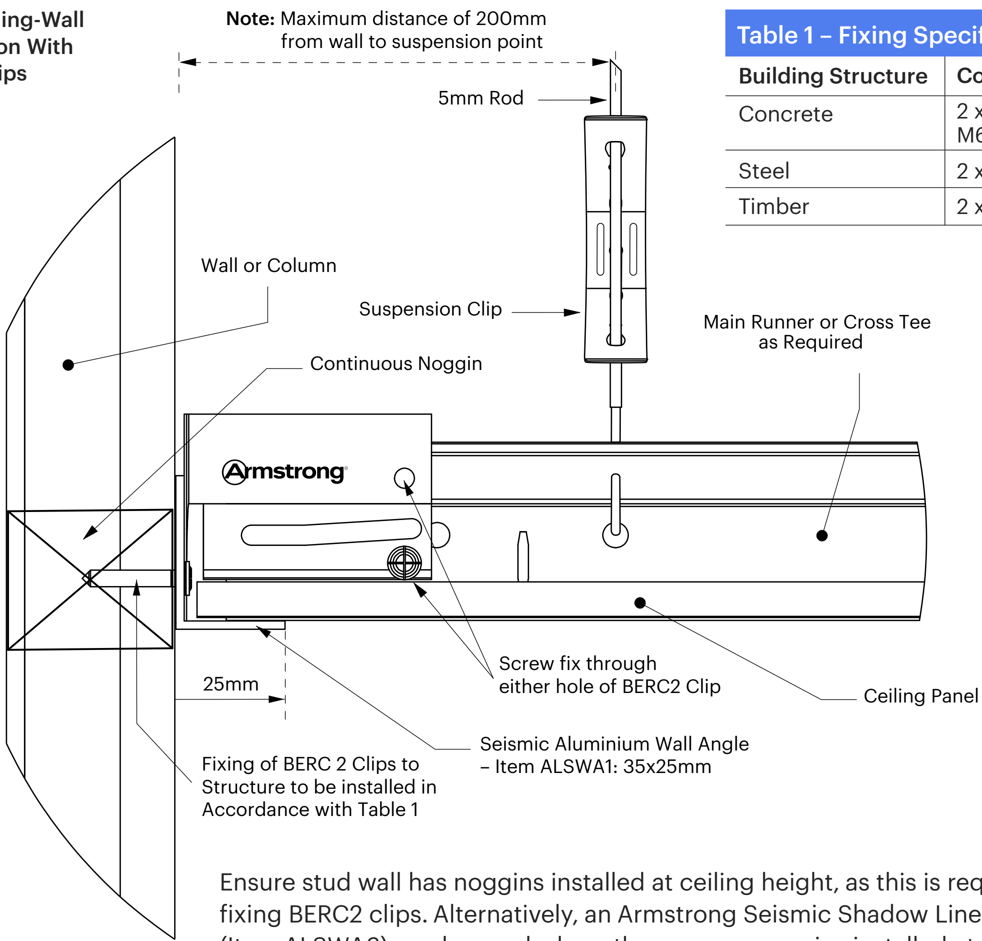


Table 1 – Fixing Specification

Building Structure	Connection Type
Concrete	2 x HILTI HUS-3 M6 x 40 Anchors
Steel	2 x 10g Tek Screws
Timber	2 x No.8 x 51 Screws

Ensure stud wall has noggins installed at ceiling height, as this is required for fixing BERC2 clips. Alternatively, an Armstrong Seismic Shadow Line Wall Angle (Item ALSWA6) can be used where there are no noggins installed at ceiling height.

PeakForm Main Runner Seismic (Separation) Joint Clip – Installation

Option 2: Fixed Perimeter Seismic Solution (Page 11)

Involves the installation of a continuous line of 20mm Main Runner Seismic Joints (Fig.9). The seismic design will determine the location of the Seismic Separation Joints. Installation of the Seismic Joint is an easy process as per the following steps:

Step 1: Install the PeakForm Grid System completely. Follow typical procedures as per the Installation Guide, except that all Main Runner joints must line up across the ceiling space. See Fig 9. below.

Step 2: Prepare the Main Runner joint to receive the separation Joint Clip by cutting off the Superlock clip (end detail or tag) from the left side of the connection and removing 20mm from the end of the Main Runner on the right.

Step 3: Install the clip using screws provided. Screws #1 and #2 install through the holes in the clip and into the right hand Main Runner.

Step 4: Align the indexing nib with the lower hole on the left hand Runner and insert screws #3 and #4 into the upper holes.

Step 5: Snap the Expansion Sleeve over the gap at the face of the Main Runner and crimp the four corners with a pair of pliers.

Fig 8 **Installing a PeakForm Main Runner Seismic Joint Clip**

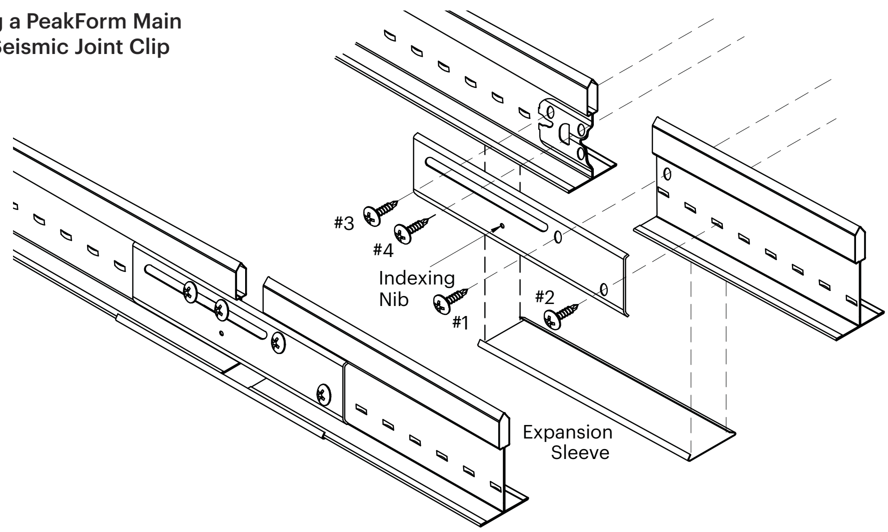
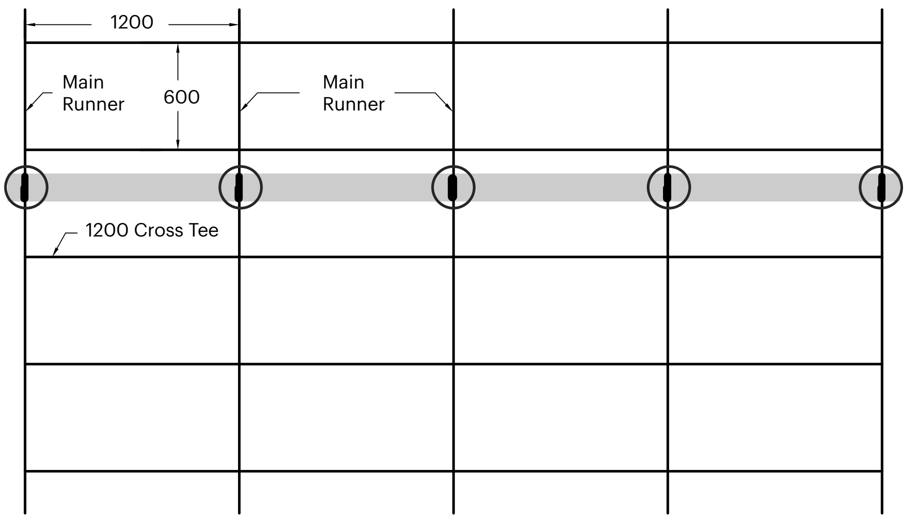


Fig 9 **Location of row of PEAKFORM Main Runner Seismic Joint Clips as per Seismic Design**



PeakForm Cross Tees Seismic (Separation) Joint Clip – Installation

Option 2: Fixed Perimeter Seismic Solution (Page 11)

Involves the installation of a continuous line of Cross Tee Seismic Joints. The seismic design will determine the location of these Seismic Separation Joints. Installation of the Seismic Joints is an easy process as per the following steps:

Step 1: Install the PeakForm Grid System completely. Follow typical procedures as per the Installation Guide.

Step 2: Determine which run of Main Runners to create the seismic separation joint.

NOTE: The Seismic Joint Clip allows for Cross Tees to move back and forth along their axis during a seismic event.

Step 3: Attach two adjacent sides of each section of the divided ceiling to the perimeter. Where these sections touch the wall the attachment may be by means of the BERC2 clip with a tight screw. Sections that do not touch walls on two adjacent sides must be braced to structure.

Step 4: At each Cross Tee – Main Runner intersection, designated for the seismic separation, remove the Cross Tee clips (end locking tabs) by cutting with tin snips from above.

NOTE: This should be done one intersection at a time or the grid system will fall apart.

Step 5: Asemble the two sides of joint clip into one unit.

Step 6: Snap completed assembly over the bulb of the Main Runner at the intersection of the Cross Tees.

Step 7: Insert a 6mm long M6 screw through slot in clip, into the upper XL[2] clip stake hole. Use vertical stamp mark below the horizontal slot to properly position the screw within the clip. Install one screw from each side of the assembled clip to hold the proper shape.

Do not allow screw threads to strip out the stake hole.

Fig 10 Location of row of PEAKFORM Cross Tee Seismic Joint Clips as per Seismic Design

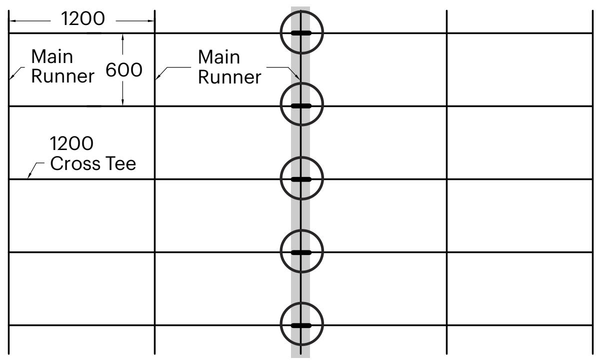


Fig 11 Installing a PEAKFORM Cross Tee Seismic Joint Clip

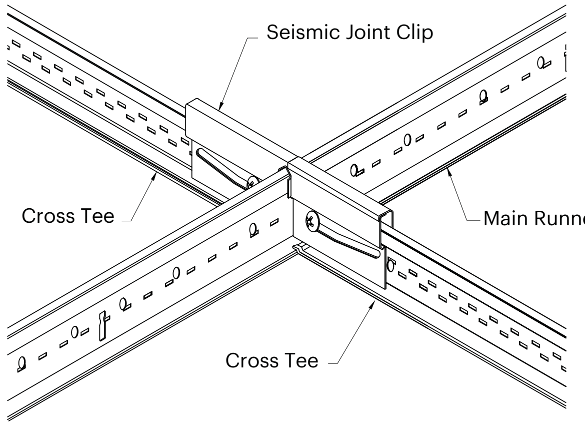
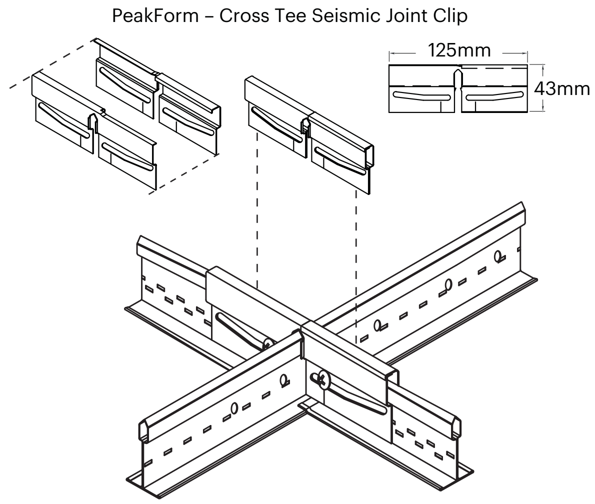
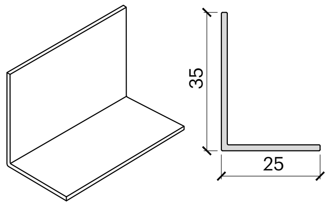


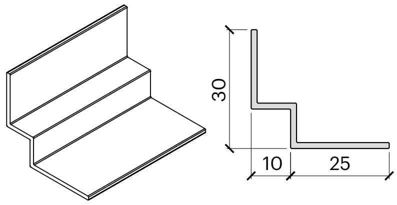
Fig 12 (Step 5-7) Assembly and attachment of the Cross Tee Seismic Joint Clip

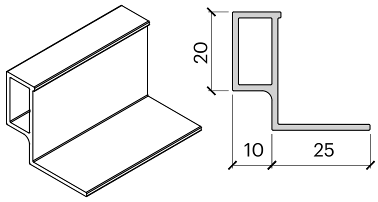


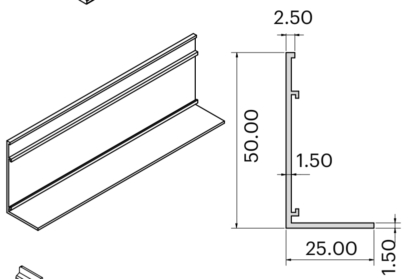
Seismic Perimeter Trims and Accessories

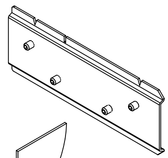
Item No	Description	Dimensions Length (mm)	Quantity/ Carton
ALSWA1	Seismic Aluminium Wall Angle 35 x 25mm	3600	20
ALSWA4	Seismic Aluminium Shadow Line Wall Angle 30 x 35mm	3600	20
ALSWA6	Seismic Aluminium Shadow Line Wall Angle 30 x 35mm (no lip)	3600	20
PM50	Floating Perimeter Trim 50 x 25mm	3600	20
ARM-017	Perimeter Trim Joining Clip		20
ARM-058	Roll-In-Clip		20
BPGM1245B	BERC2 Clip		100
BPGM1247	PeakForm Cross Tee Seismic Joint Clip (24mm)		200
BPGM1246	PeakForm Main Runner Seismic Joint Clip (24mm)		100
BPGM1248	Expansion Sleeve 15mm		100
BPGM1249	Expansion Sleeve 24mm		100

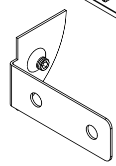


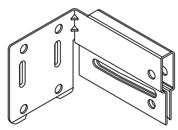


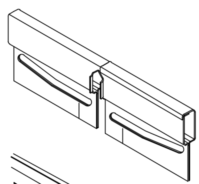


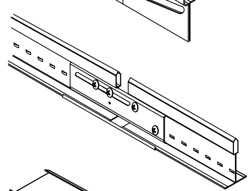


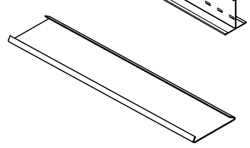












Back Bracing Options

This section is to be used only for bracing where the grid is braced back to the structure above. This option is required when the forces in the grid are too high to allow perimeter fixing. Choose a brace type from the options below.

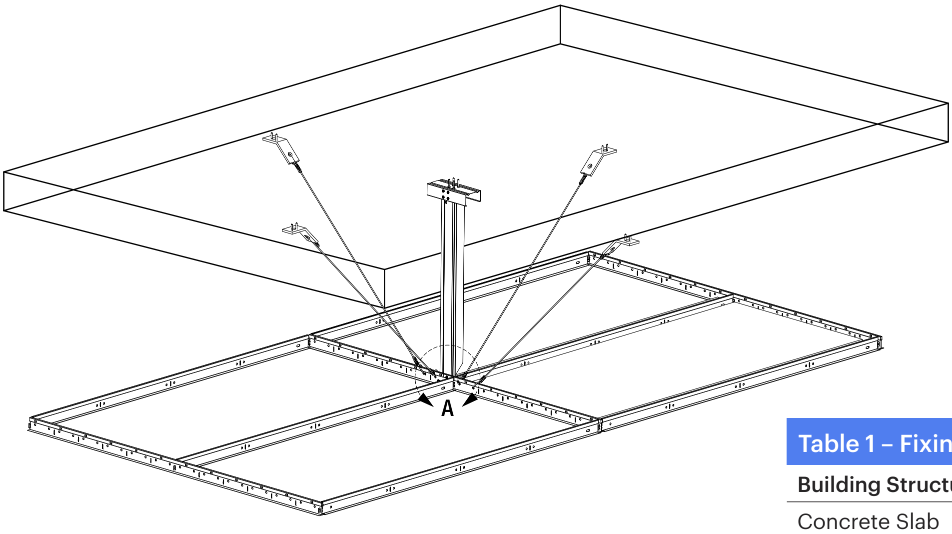
Installation of Bracing

It is important that once the brace type has been chosen, it is essential that it is properly installed as per the following guidelines and manufacturers instructions. The following criteria must be met when installing the brace.

- The compression strut must be connected to the Main Runner within 50mm of a Cross Tee connection.
- Diagonal wires/ stud are to be angled at no more than 45 degrees from the ceiling plane.
- Braces to be spaced @ 1200mm centres, typically a drawing shall be provided to show locations.
- A ceiling may not be both back braced and fixed to perimeter.
- Tension wires to have a minimum of 3 turns.

Bracing Type

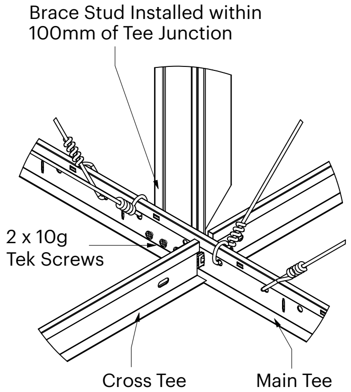
Brace A – Rondo 64x0.50 BMT Stud Strut with 4/2.5 dia wire diagonals.



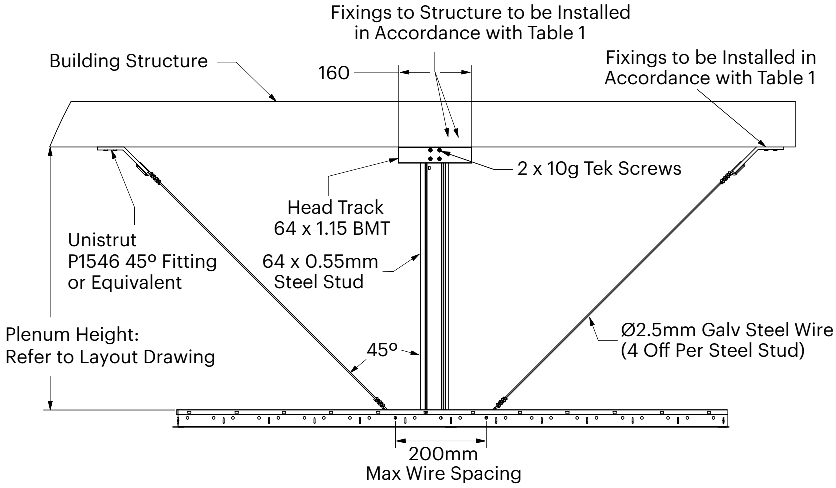
Seismic Brace – Pictorial View

Table 1 – Fixing Specification

Building Structure	Connection Type
Concrete Slab	2 x HILTI HUS-3 M6x40 Anchors
Steel Purlins	2 x 10g Tek Screws
Timber Joists	2 x No.8 x 51 Screws



Seismic Brace A – Detail A

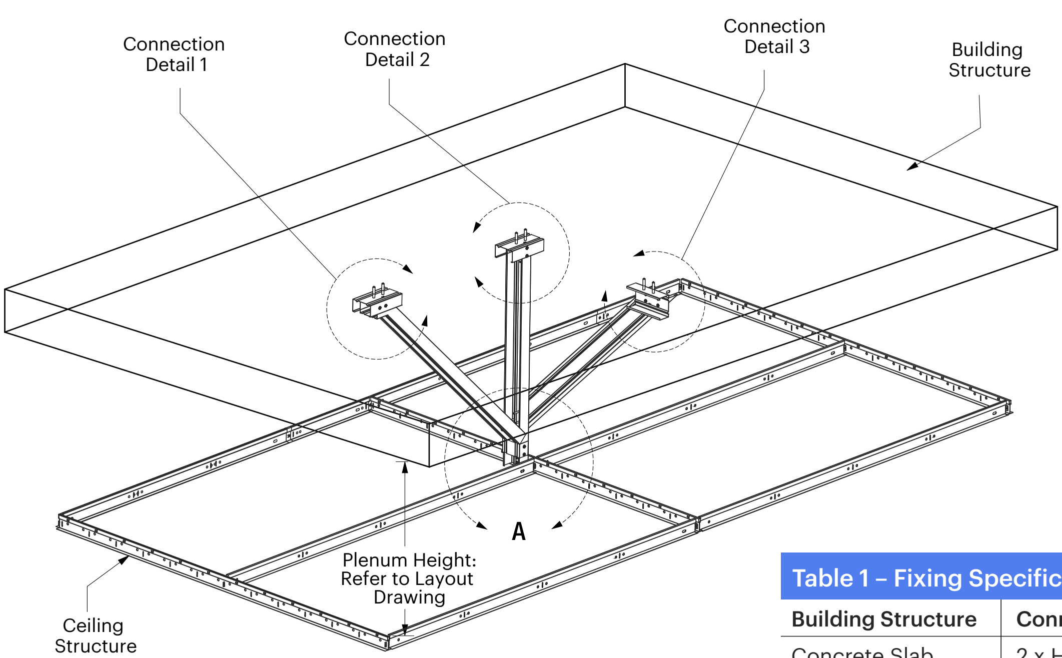


Seismic Brace Construction Details

Back Bracing Options

Bracing Type

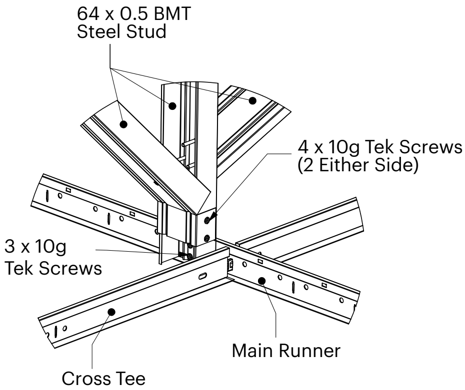
Brace B – Rondo 64x0.50 BMT Strut with 2/64x0.50 BMT Stud diagonals.



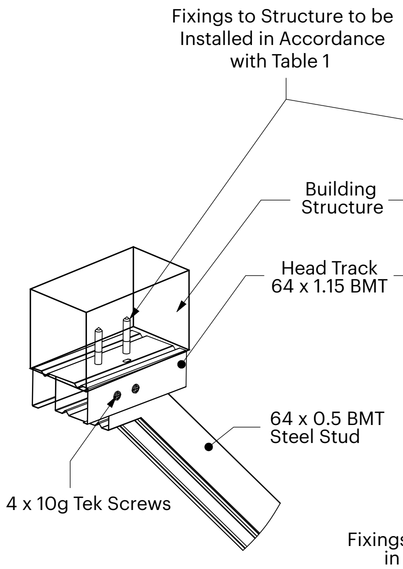
Seismic Brace B – Pictorial View

Table 1 – Fixing Specification

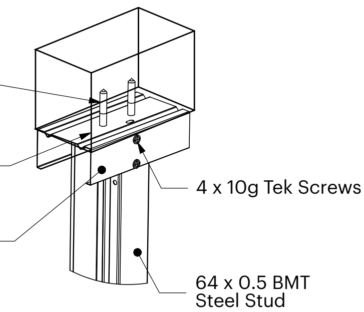
Building Structure	Connection Type
Concrete Slab	2 x HILTI HUS-3 M6x40 Anchors
Steel Purlins	4 x 10g Tek Screws
Timber Joists	4 x No.8 x 51 Screws



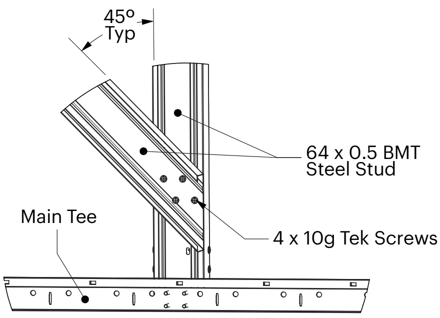
Seismic Brace B – Construction Detail A Front View



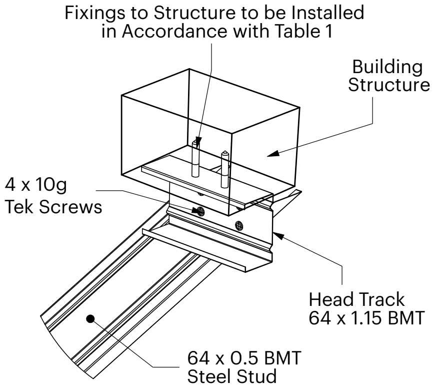
Connection Detail 1



Connection Detail 2



Seismic Brace B – Construction Detail A Rear View

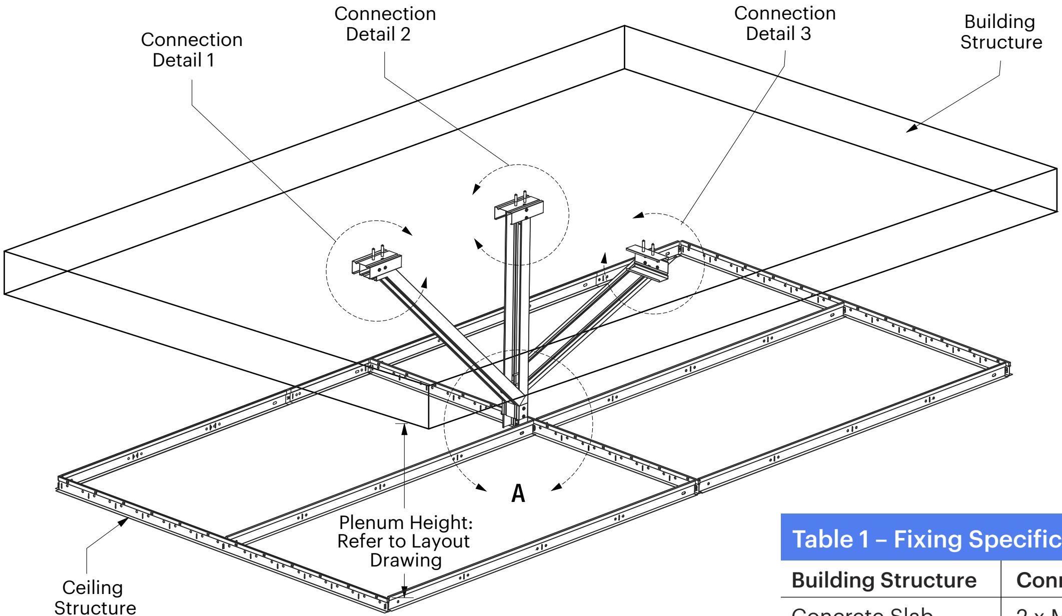


Connection Detail 3

Back Bracing Options

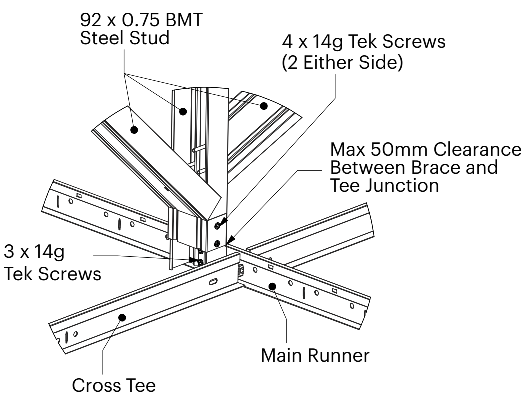
Bracing Type

Brace C – Rondo 92x0.75 BMT Strut with 2/92x0.75 BMT Stud diagonals.

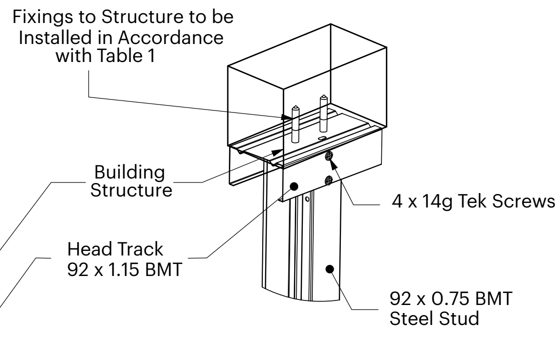


Seismic Brace C – Pictorial View

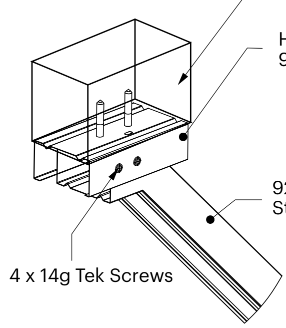
Table 1 – Fixing Specification	
Building Structure	**Connection Type**
Concrete Slab	2 x M6x30 Dynabolt Anchors
Steel Purlins	4 x 14g Tek Screws
Timber Joists	4 x No.8 x 51 Screws



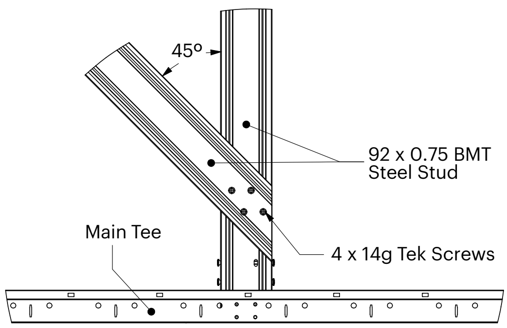
Seismic Brace C – Construction Detail A Front View



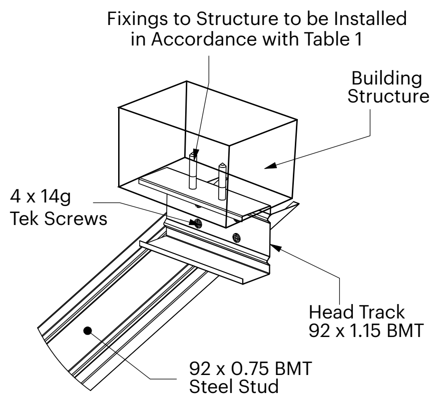
Connection Detail 2



Connection Detail 1



Seismic Brace C – Construction Detail A Rear View



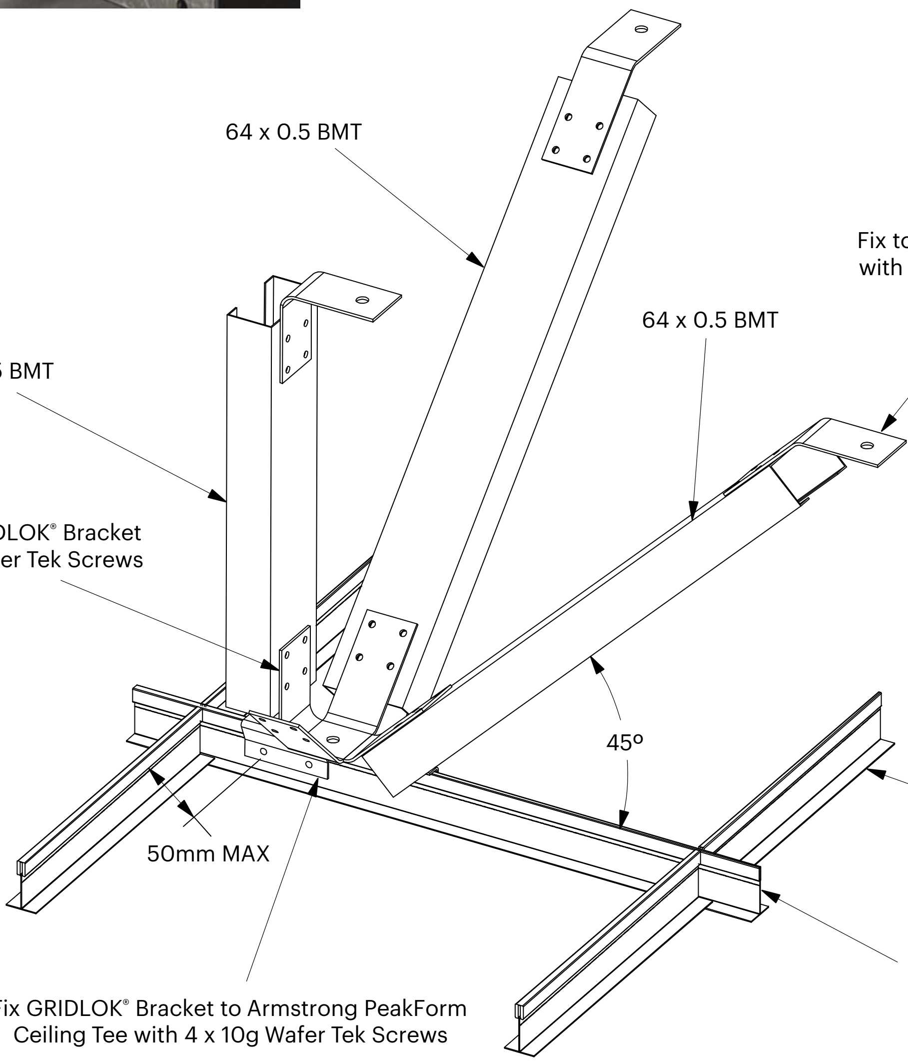
Connection Detail 3

Back Bracing with Gridlock®

Gridlok Bracing components have been designed and tested by BVT Engineering for application with Armstrong PeakForm™ Grid Systems, providing consistent brace capacity, saving labor and installation time.

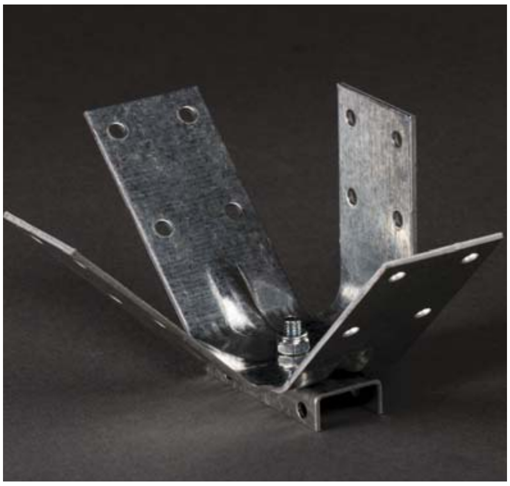
Gridlock® with PeakForm™

Designed and tested to provide a consistent maximum 280kg/f of bracing capacity to the higher profile Armstrong PeakForm and DRYWALL Grid Systems. Simple click fit and screw off process dramatically reduces time required to complete back bracing, saving cost to project. Plenum height chart provides guidance on steel stud BMT required fo bracing arms (Refer GRIDLOK® brochure for details). Features the ability to rotate the unit though 360° minimising service clashes. CODE: GRD-10P

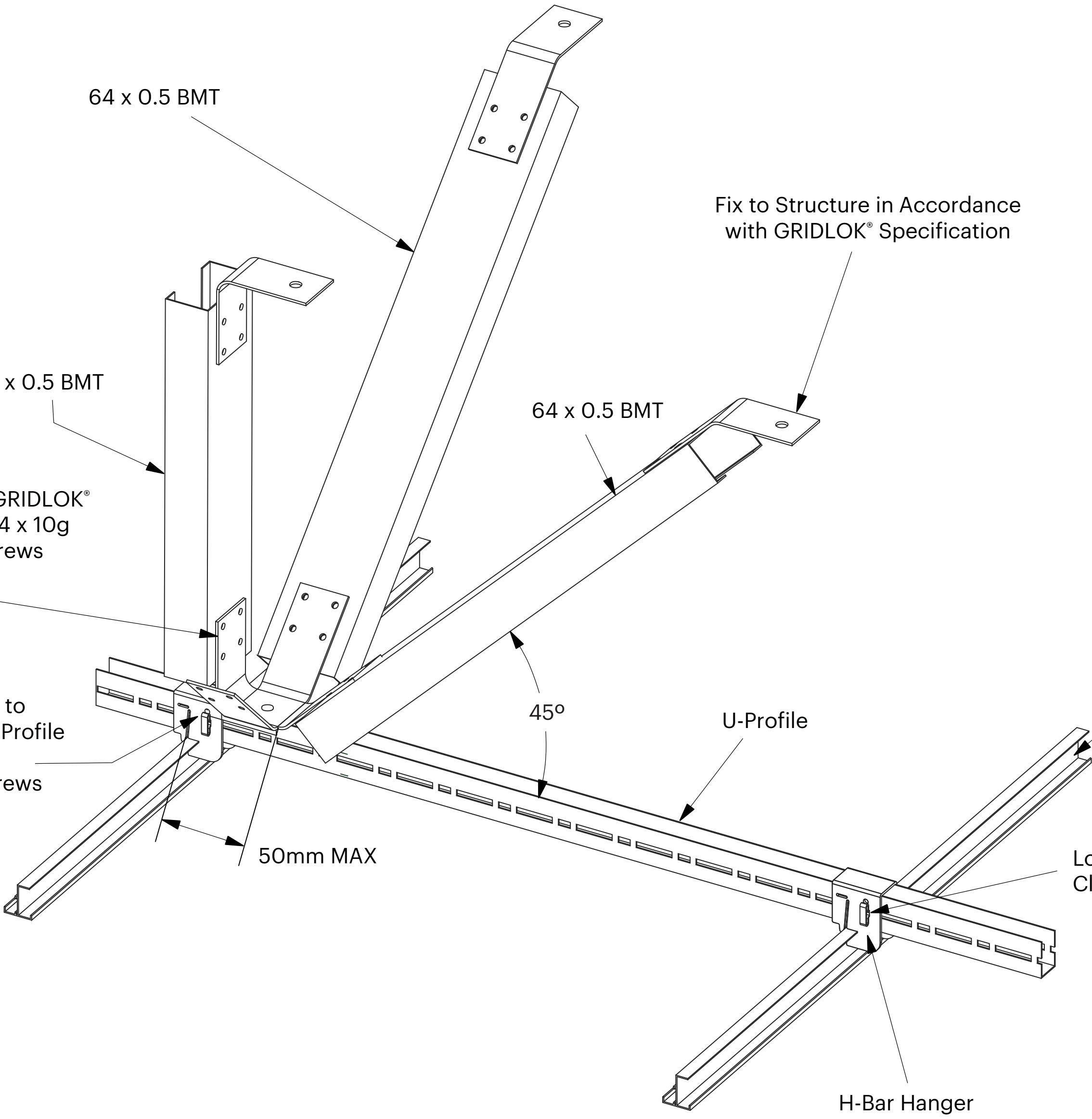


Back Bracing with Gridlock®

Gridlock® with U-Profile

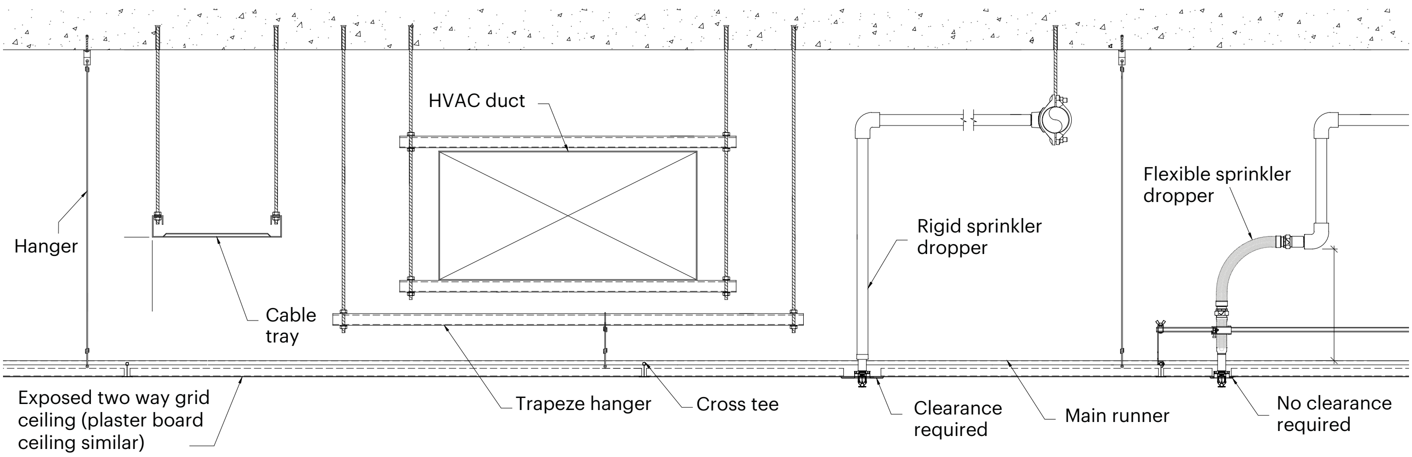


Designed and tested to provide a consistent maximum 280kg/f of bracing capacity to the Armstrong U-PROFILE system. Consistency in load capabilities is the key feature, while the ease of installation will dramatically reduce install times. Plenum height chart provide guidance on steel stud BMT required for bracing arms (Refer GRIDLOK® brochure for details). Get a better result in less time. Features the ability to rotate the unit though 360° minimising service clashes. CODE: GRD-10U



Service Integration and Clearances

Clearances for laterally unrestrained services in accordance with AS/NZ 2785:2020



Clearances

Services within the ceiling can be either braced or unbraced. Different clearances are required between braced or unbraced services. When ceiling bracing is required (as per Option 3 from Page 11), it is essential that the bracing layout and services should be coordinated.

Condition Being Considered	Minimum Horizontal	Clearance (mm) Vertical
Unrestrained component to unrestrained component	250	25
Unrestrained component to restrained component	100	25
Restrained component to restrained component	35	25
Sprinkler heads with Flexible droppers	25	NIL

NOTE: Ceiling hangers and braces are considered to be restrained components for the purposes of this table.

Reference Guides

Building Importance Levels

The Building Code defines the significance of a building by its Importance Level (IL), which is related to the consequences of failure. There are five levels of importance, considered by the importance of the building to society.

Importance Level	Description of Building Type	Specific Structure
Importance level 1	Buildings posing low risk to human life or the environment, or a low economic cost, should the building fail. These are typically small non-habitable buildings, such as sheds, barns, and the like, that are not normally occupied, though they may have occupants from time to time.	• Ancillary buildings not for human habitation • Minor storage facilities • Backcountry huts
Importance level 2	Buildings posing normal risk to human life or the environment, or a normal economic cost, should the building fail. These are typical residential, commercial, and industrial buildings.	• All buildings and facilities except those listed in importance levels 1, 3, 4, and 5
Importance level 3	Buildings of a higher level of societal benefit or importance, or with higher levels of risk-significant factors to building occupants. These buildings have increased performance requirements because they may house large numbers of people, vulnerable populations, or occupants with other risk factors, or fulfil a role of increased importance to the local community or to society in general.	• Buildings where more than 300 people congregate in 1 area • Buildings with primary school, secondary school, or daycare facilities with a capacity greater than 250 • Buildings with tertiary or adult education facilities with a capacity greater than 500 • Health care facilities with a capacity of 50 or more residents but not having surgery or emergency treatment facilities • Jails and detention facilities • Any other building with a capacity of 5,000 or more people • Buildings for power generating facilities, water treatment for potable water, wastewater treatment facilities, and other public utilities facilities not included in importance level 4 • Buildings not included in importance level 4 or 5 containing sufficient quantities of highly toxic gas or explosive materials capable of causing acutely hazardous conditions that do not extend beyond property boundaries

Reference Guides

Building Importance Levels

The Building Code defines the significance of a building by its Importance Level (IL), which is related to the consequences of failure. There are five levels of importance, considered by the importance of the building to society.

Importance Level	Description of Building Type	Specific Structure
Importance level 4	Buildings that are essential to post-disaster recovery or associated with hazardous facilities.	• Hospitals and other health care facilities having surgery or emergency treatment facilities • Fire, rescue, and police stations and emergency vehicle garages • Buildings intended to be used as emergency shelters • Buildings intended by the owner to contribute to emergency preparedness, or to be used for communication, and operation centres in an emergency, and other facilities required for emergency response • Power generating stations and other utilities required as emergency backup facilities for importance level 3 structures • Buildings housing highly toxic gas or explosive materials capable of causing acutely hazardous conditions that extend beyond property boundaries • Aviation control towers, air traffic control centres, and emergency aircraft hangars • Buildings having critical national defence functions • Water treatment facilities required to maintain water pressure for fire suppression • Ancillary buildings (including, but not limited to, communication towers, fuel storage tanks or other structures housing or supporting water or other fire suppression material or equipment) required for operation of importance level 4 structures during an emergency
Importance level 5	Buildings whose failure poses catastrophic risk to a large area (eg, 100 km2) or a large number of people (eg, 100 000)	• Major dams • Extremely hazardous facilities

Determination of Site Sub-Soil Class

The site sub-soil classes shall be defined as follows:

(a) Class Ac – Strong rock

(b) Class Bc – Rock

(c) Class Cc – Shallow soil

(d) Class Dc – Deep or soft soil

(e) Class Ec – Very soft soil

Australian Locations Hazard Factor (Z)

The Z factor is the seismic hazard factor that is applied to a location. It is a fundamental value used to determine the design seismic actions for buildings.

City / Town	Z	City / Town	Z	City / Town	Z
Adelaide	0.10	Geraldton	0.09	Port Augusta	0.11
Albany	0.08	Gladstone	0.09	Port Lincoln	0.10
Albury/Wodonga	0.09	Gold Coast	0.08	Port Hedland	0.12
Alice Springs	0.08	Gosford	0.09	Port Macquarie	0.08
Ballarat	0.08	Grafton	0.08	Port Pirie	0.10
Bathurst	0.08	Gippsland	0.10	Robe	0.10
Bendigo	0.09	Goulburn	0.09	Rockhampton	0.08
Brisbane	0.08	Hobart	0.08	Shepparton	0.09
Broome	0.12	Karratha	0.12	Sydney	0.08
Bundaberg	0.11	Katoomba	0.09	Tamworth	0.08
Burnie	0.08	Latrobe Valley	0.10	Taree	0.08
Cairns	0.08	Launceston	0.08	Tennant Creek	0.13
Camden	0.09	Lismore	0.08	Toowoomba	0.08
Canberra	0.08	Lorne	0.10	Townsville	0.08
Carnrvon	0.09	Mackay	0.08	Tweed Heads	0.08
Coffs Harbour	0.08	Maitland	0.10	Uluru	0.08
Cooma	0.08	Melbourne	0.08	Wagga Wagga	0.09
Dampier	0.12	Mittagong	0.09	Wangaratta	0.09
Darwin	0.09	Morisset	0.10	Whyalla	0.09
Derby	0.09	Newcastle	0.11	Wollongong	0.09
Dubbo	0.08	Noosa	0.08	Woomera	0.08
Esperance	0.09	Orange	0.09	Wyndham	0.09
Geelong	0.10	Perth	0.08	Wyong	0.10
Meekering region					
Ballidu	0.15	Goomalling	0.16	Wongan Hills	0.15
Corrigin	0.14	Kellererrin	0.14	Wickepin	0.15
Cunderdin	0.22	Meekering	0.20	York	0.14
Dowerin	0.20	Northam	0.14		
Islands					
Christmas Islands	0.15	Lord Howe Isalnd	0.08		
Cocos Islands	0.08	Macquarie Island	0.60		
Heard Island	0.10	Norfolk Island	0.08		

New Zealand Locations Hazard Factor (Z)

The Z factor is the seismic hazard factor that is applied to a location. It is a fundamental value used to determine the design seismic actions for buildings.

City / Town	Z	City / Town	Z	City / Town	Z
Akaroa	0.30	Mangakino	0.21	Ruatoria	0.33
Alexandra	0.21	Manukau City	0.13	Seddon	0.40
Arrowtown	0.30	Marton	0.30	Springs Junction	0.45
Arthurs Pass	0.60	Masterton	0.42	St Arnaud	0.36
Ashburton	0.20	Matamata	0.19	Stratford	0.18
Auckland	0.13	Mataura	0.17	Taihape	0.33
Balclutha	0.13	Milford Sound	0.54	Takaka	0.23
Blenheim	0.33	Morrinsville	0.18	Taumarunui	0.21
Bluff	0.15	Mosgiel	0.13	Taupo	0.28
Bulls	0.31	Motueka	0.26	Tauranga	0.20
Cambridge	0.18	Mount Maunganui	0.20	Te Anau	0.36
Cheviot	0.40	Mt Cook	0.38	Te Aroha	0.18
Christchurch	0.396*	Murchison	0.34	Te Awamutu	0.17
Cromwell	0.24	Murupara	0.30	Te Kuiti	0.18
Dannevirke	0.42	Napier	0.38	Te Puke	0.22
Darfield	0.396*	Nelson	0.27	Temuka	0.17
Dargaville	0.13	New Plymouth	0.18	Thames	0.16
Dunedin	0.13	Ngaruawahia	0.15	Timaru	0.15
Eastbourne-Point Howard	0.40	Oamaru	0.13	Tokoroa	0.21
Fairlie	0.24	Oban	0.14	Turangi	0.27
Feilding	0.37	Ohakune	0.27	Twizel	0.27
Fox Glacier	0.44	Opotiki	0.30	Upper Hutt	0.42
Foxton/Foxton Beach	0.36	Opunake	0.18	Waihi	0.18
Franz Josef	0.44	Otaki	0.40	Waikanae	0.40
Geraldine	0.19	Otira	0.60	Waimate	0.14
Gisborne	0.36	Otorohanga	0.17	Wainuiomata	0.40
Gore	0.18	Paeroa	0.18	Waiouru	0.29
Greymouth	0.37	Pahiatua	0.42	Waipawa	0.41
Hamilton	0.16	Paihia/Russell	0.13	Waipukurau	0.41
Hanmer Springs	0.55	Palmerston North	0.38	Wairoa	0.37
Harihari	0.46	Palmerston	0.13	Waitara	0.18
Hastings	0.39	Paraparaumu	0.40	Waiuku	0.13
Hawera	0.18	Patea	0.19	Wanaka	0.30
Hokitika	0.45	Picton	0.30	Wanganui	0.25
Huntly	0.15	Porirua	0.40	Ward	0.40
Hutt Valley	0.40	Pukekohe	0.13	Warkworth	0.13
Inglewood	0.18	Putaruru	0.21	Wellington	0.40
Invercargill	0.17	Queenstown	0.32	Wellington CBD	0.40
Kaikohe	0.13	Raetihi	0.26	Westport	0.30
Kaikoura	0.42	Rangiora	0.4356*	Whakatane	0.30
Kaitaia	0.13	Reefton	0.37	Whangarei	0.13
Kawerau	0.29	Riverton	0.20	Winton	0.20
Levin	0.40	Rotorua	0.24	Woodville	0.41

* Denotes Z value has been adjusted to account for higher return period required in these areas.

Green Building Council Australia
Member 2021-2022

SEISMIC

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