INT&RIOR SYSTEMS

Guiding Design · Informed Interiors

NON-STRUCTURAL

SEISMIC DESIGN

Book a CPD seminar on Acoustics and/or Seismic Design at your office/practice:
0800 666 556
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These Guidelines are intended to provide a reliable basis for the seismic design of seismic ceilings and partition walls based on the present state of knowledge, laboratory and analytical research, and the engineering judgments of persons with substantial knowledge in the design and seismic behaviour of suspended ceilings. When properly implemented, these Guidelines should permit design of suspended ceilings and partition wall restraint that is capable of seismic performance equivalent or superior to that attainable by design in accordance with present Building Code provisions.

NEW ZEALAND INSTITUTE OF
ARCHITECTS
INCORPORATED
APPROVED CPD PROVIDER

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Welcome:

T&R Interior Systems specialises in the supply of quality interior building and acoustic products fully backed by extensive technical support and friendly service. We offer expert interior acoustic solutions and are passionate about correctly engineered seismic design for suspended ceilings.

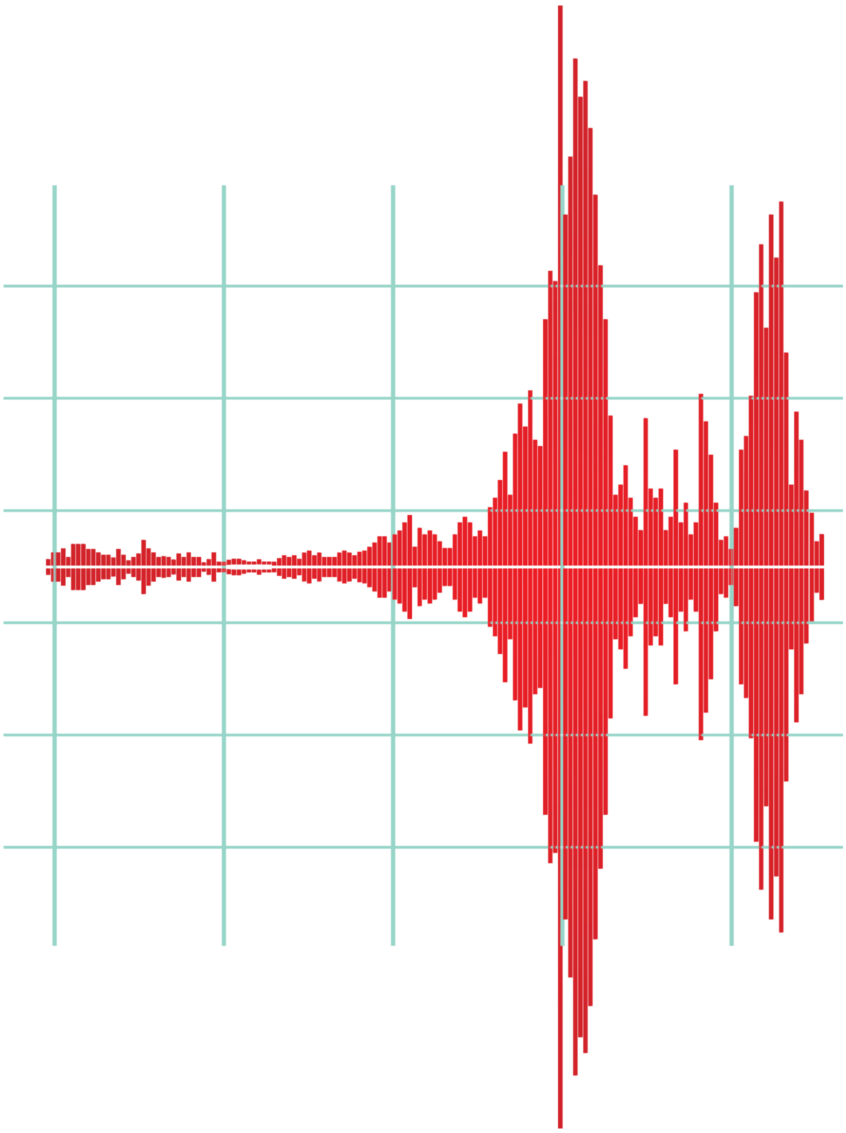
We specialise in systems. The T&R Interior Systems range of products include:

- Eclipse Aluminium Partitioning Suite
- Daiken Mineral Fibre Ceiling Tiles
- C Max High Performance Acoustic Glass Wool Tiles
- Innovative Acoustic Wall and Ceiling Panels
- CBI Heavy Duty Suspended Ceiling Grid

We also supply other acoustic products, insulation, steel studs and battens.

We offer a friendly personalised service with branches in Auckland, Christchurch and the Head Office based in Wellington.

We welcome your enquiries and are more than happy to assist with your design decisions.



CONTENTS

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lifetime systems 30 year warrantee

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Seismic Design Theory

Introduction

The industry is under increasing pressure to assure seismic compliance for non-structural elements on current and future construction projects.

Full compliance with seismic requirements will limit damage, reduce repair costs and reduce the time to re-occupy post event. Furthermore it is a legislative requirement for Code of Compliance Certificates and Health and Safety Laws. The HSW, affect those who are upstream from the workplace (for example designers, engineers, manufacturers, suppliers or installers). Specifically they have a duty to ensure, so far as is reasonably practicable, that the work they do or the things they provide to the workplace don't create health and safety risks.

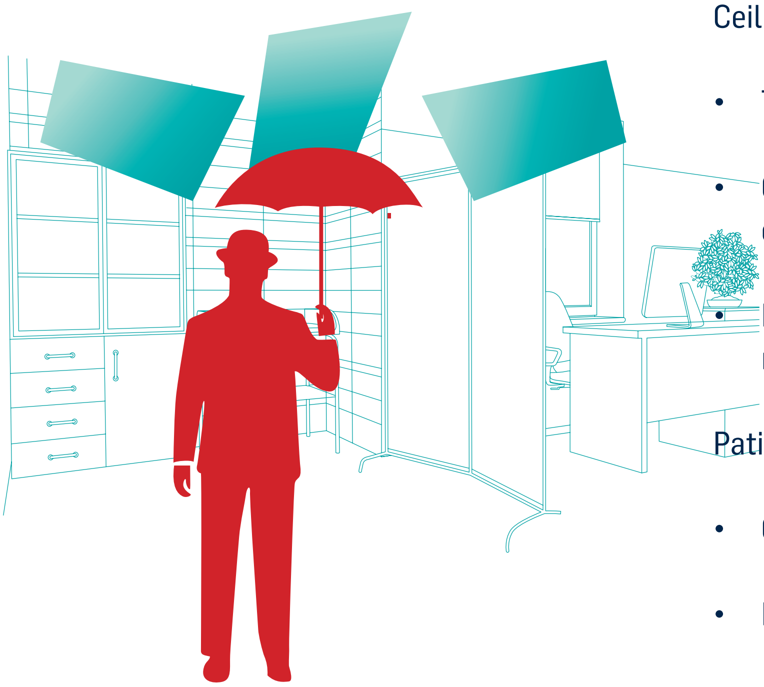
Because every building is different, there is no standard seismic restraint solution to address site, location, form and function. The scope of seismic restraint and related engineering work that will be required will not be known until the ceiling, services and partition design is completed.

The T&R Seismic System will provide a solution for buildings with an Importance Level of 3 and below. A suitably qualified Chartered Professional Engineer will be required for Importance Levels 4 & 5. Design by a Chartered Professional Engineer may also be appropriate in buildings of IL3 and below.

It is imperative that mechanical services, sprinkler systems, electrical and suspended ceiling design are all co-ordinated at appropriate stages.

Seismic Design Considerations

- Codes: AS/NZS 2785:(Updated version released in 2020) and NZS 1170.5: 2004
- Grid Weight and strenght
- Edge Details (wall to ceiling junction)
- Tile profile (Diaphragm Concept)
- Services
- Partition Walls
- Bracing types



Ceiling failure:

- Tiles Popping Out
- Cascade failure where large sections of the grid collapse
- Destruction of ceilings resulting from failure of other non-structural elements (services) in the plenum

Patition Wall Failure:

- Glazing popping out of aluminium
- Plasterboard cracking
- Walls falling over

Relevant Codes

Clause B1 Structure of the Building Code requires that all building elements must have a low probability of failure when exposed to loads likely to be experienced within their lifetime.

For suspended ceiling installations in New Zealand, seismic loads need to be considered to comply with AS/NZS 2785: 2020 - Suspended Ceilings, Design and Installation and AS/NZS 1170: 2002.

Ceilings, partitions and services must comply with the New Zealand Building Code and with all legislative requirements. Regardless of past industry practice it is not acceptable to treat seismic restraints and related structural engineering design, monitoring and certification as if they were optional.

Part Categories

The NZ earthquake standard (NZS 1170.5:2004 -Structural design actions – Part 5: Earthquake actions – New Zealand) was amended in September 2016 as a result of the Canterbury Earthquakes. There is now more guidance around the seismic bracing design of non-strcutural elements.

Non-structural elements are classified as "parts" as per NZS 1170.5. The "part" classification of an element is important as it determines the seismic bracing required.

Design Working Life	Importance Level	Annual Probability of exceedance for ULS for EQs	Annual probability of exceedance for SLS2
50 Years	1 2 3 4	1/100 1/500 1/1000 1/2500	- 1/100 1/250 1/500

Category	Criteria	Part risk factor R_p	Structure limit state[1]
P.1	Represents a hazard to human life within the structure. [2,3]	1.0	ULS
P.2 and P.3	Represents a hazard to human life within the structure. [2,3]	1.0	ULS
P.4	Required for the continuing function of the evacuation (after earthquake) and human life support systems within the structure.	1.0	ULS
P.5	IL4 buildings: Required to maintain operational continuity [4,6] and/or All buildings: Required.to be operational/ functional for the building to be occupied. [5,6]	1.0	SLS2
P.6	Where the consequential damage caused by its failure is disproportionately great.	2.0 R_u [4]	SLS1
P.7	All other parts	1.0	SLS1

The vagueness in the previous standard surrounding weight led to confusion.

Supporting comments provided in the amended version of NZS 1170.5 resolves this confusion. The new standard lowers the weight threshold for ultimate limit state design to 7.5kg, and makes it clear that the total weight of the ceiling system needs to be considered - tiles, grid, luminaires and any other supported services. It is no longer possible to define ceilings as P7 simply because the weight of the individual components is below 7.5kg. Except for exceptionally small ceilings, they all now need to be designed for ultimate limit state events or SLS2 where applicable.

Importance Levels

The importance level of the structure shall be determined in accordance with its occupancy and use, as given below. The Table describes, in general terms, five categories of structure and gives some examples of each. For those buildings not specifically mentioned, the designer will need to exercise judgment in assigning the appropriate level.

Structures that have multiple uses shall be assigned the highest importance level applicable for any of those uses. For any given project, the primary contractor, architect, structural engineer or project manager should be able to specify the importance level of the building.

The T&R Seismic System design guide is intended for use with structures of Importance Level (IL) 2 or 3. An engineer should be engaged for Building Importance Levels of 4 & 5. Design by a Chartered Professional Engineer may also be appropriate in buildings of IL3 and below if the Building Consent Authority requires it.

Building Importance Levels

IL	Building Type
1	Buildings posing low risk to human life or the environment or a low economic cost should the building fail. These are typically small inhabitable buildings, such as sheds, barns and the like that are not normally occupied.
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.
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. (Airport terminals, principal railway stations, larger day-care, schools and colleges and healthcare facilities, correctional institutions, assembly buildings, theatres, cinemas, large retail and buildings with a gross area of more than 10,000m^2)
4	Buildings that are essential to post-disaster recovery or associated with hazardous facilities. (Civil Defence, Medical Emergency, Fire, Police and buildings containing hazardous materials)
5	Buildings whose failure poses catastrophic risk to a large area (eg. 100km^2) or a large number of people (eg. 100,000) such as Dams.

Annual Exceedance Levels

The ULS or SLS state of a ceiling determines the level of seismic activity that the ceiling must withstand. A structure shall be designed and constructed in such a way that it will, during its design working life (with appropriate degrees of reliability) sustain all seismic activity that is likely to occur.

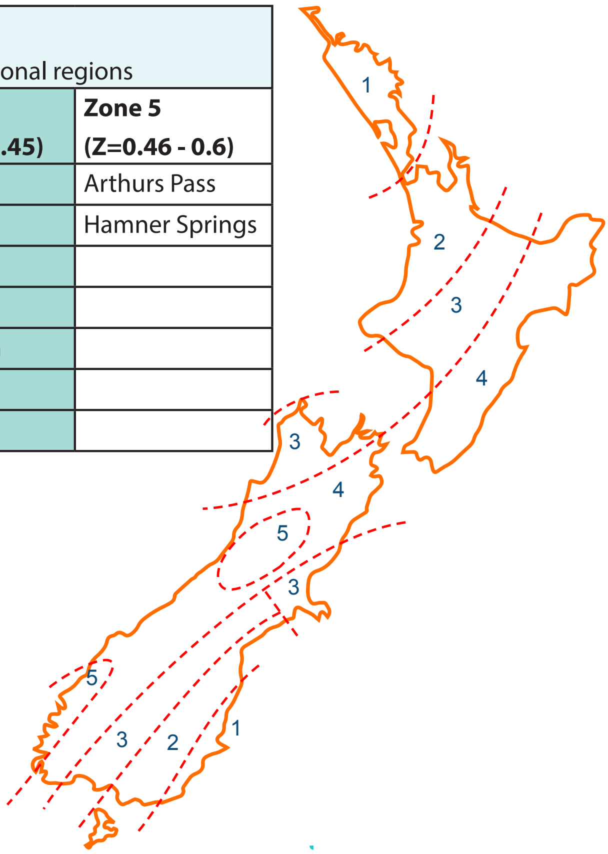
ULS = Specifically, for earthquake actions this shall mean avoidance of collapse of the structural system or parts of the structure representing a hazard to human life inside and outside the structure necessary for the building evacuation. Relates to the strength of the system

SLS - The structure and the non-structural components do not require repair after the seismic event. Relates to the flexibility of the system

Hazard Factor

The diagram below shows the seismic zone factor maps of the structural design standard (NZS1170.5). The very high hazard estimates near the most active faults are well in excess of values that have been considered in previous New Zealand codes. These numbers are a simplification of the values in NZS1170.5 and include other parameters.

Zone Table Refer to zone factors in NZS 1170.5, Table 3.3 for additional regions				
Zone 1 (Z=0 - 0.15)	**Zone 2 (Z=0.16 - 0.25)**	**Zone 3 (Z=0.26 - 0.35)**	**Zone 4 (Z=0.36 - 0.45)**	**Zone 5 (Z=0.46 - 0.6)**
Auckland	Tauranga	Christchurch	Wellington	Arthurs Pass
Northland	Hamilton	Nelson	Gisbourne	Hamner Springs
Timaru	Rotorua	Queenstown	Napier	
Dunedin	New Plymouth	Taupo	Hastings	
	Invercargill	Blenheim	Greymouth	
			Kaikoura	
			Masterton	



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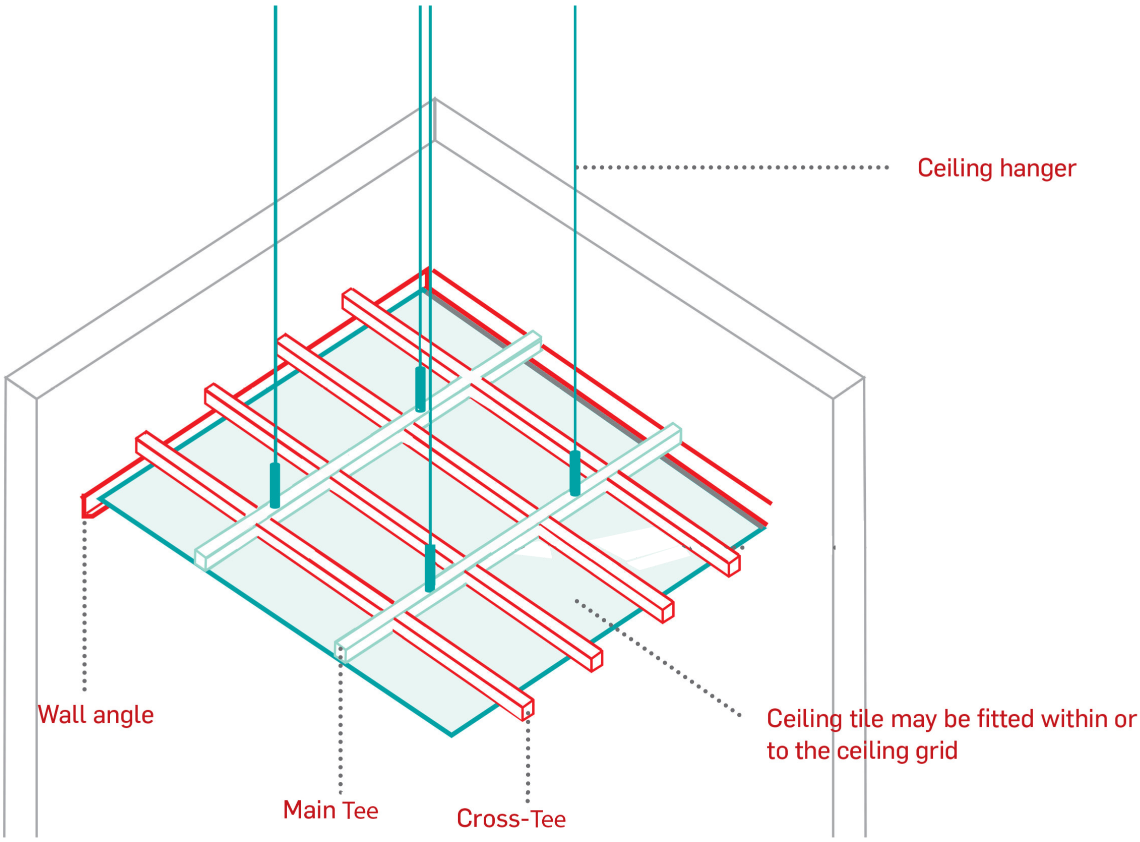
Design - Suspended Ceilings

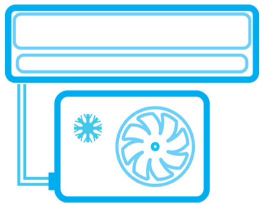
The design process shall consider all aspects of the ceiling systems, including the capacity of the primary structure to provide the necessary support to the ceiling and the function of the building.
The design of suspended ceilings, including assessment of wind and seismic actions, should be undertaken by a competent person with experience in ceiling design for all actions. If a supplier's generic seismic and/or wind design guide is used, it should be submitted with the tender showing how it conforms with the project requirements.
The design of the ceiling shall ensure all items interacting with the ceiling do not compromise the ceiling design.
The ceiling system design specification shall be verified as being able to resist seismic and wind actions by the provision of specific test data. For seismic actions, the design shall include details and locations of any bracing, fixed and free joints, seismic clips to join secondary framing if necessary, together with all fasteners that will meet the requirements for seismic design.
The ceiling system layout shall be designed such that the primary rails or main runners are orientated perpendicular to the primary structural elements (i.e. roof purlins in the case of steel roofs)



Two way exposed/concealed Grid

The main tees will generally run perpendicular to the structural members above (where applicable).

Services



The Building Code requires that all non-structural building components must be properly restrained against seismic movement to prevent them collapsing on people, cutting off exit routes from the building, being damaged or damaging other property.

It is critical that all building components in the plenum do not impede or interfere with one another and in most cases; it is not possible to support these elements with the grid. Additional structure will be required. Refer to NZS4219 for further details.

Any services that are supported independently and that penetrate through the ceiling grid must be provided with sufficient clearance for relative movement. This is especially true for sprinkler heads. Penetrations shall have a 50mm oversize ring, sleeve or adapter through a ceiling tile to allow free movement of 50mm if NZS4219 is being used as the verification method. Flexible dropper design that can accommodate free movement shall be permitted as an alternative.

Failure to provide adequate clearance could result in the ceiling collapsing during a seismic event. During the Canterbury Earthquakes, ceiling failures caused by services in the plenum were commonplace.

Separation of components is required by code and allows for relative movements between services and ceiling during an earthquake.

Clearances

When Bracing is required, the bracing layout and services should be coordinated. Services within the ceiling can be either braced or unbraced. Different clearances are required between braced and unbraced services

NZS 4219: 2009 is the standard specifically concerned with the seismic restraint of mechanical systems in buildings.

Condition being considered	Minimum Clearance (mm)	
	Horizontal	Vertical
Unrestrained component to unrestrained component	250	50
Unrestrained component to restrained component	150	50
Restrained component to restrained component	50	50
Penetration through structure (such as walls and floor)	50	50
NOTE - Ceiling hangers and braces are considered to be restrained components for the purposes of this table		

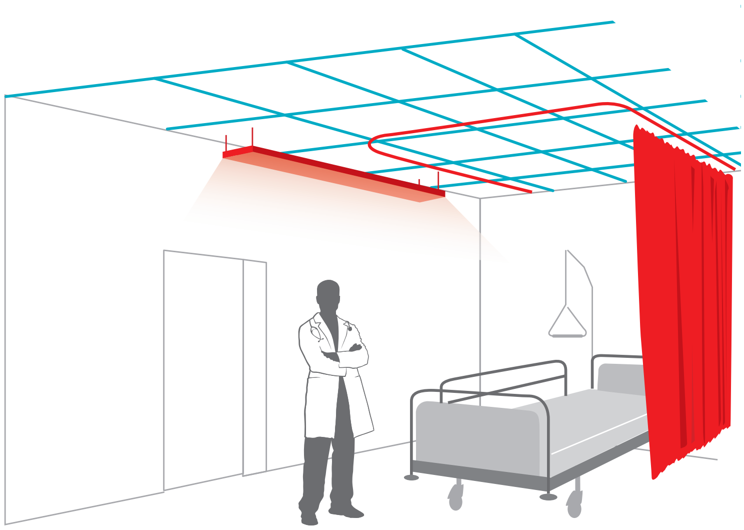
Flexible connections within the service pipes may allow penetration clearances to be reduced.

Partition Walls

When partition walls or glazing lines are attached to the suspended ceiling, the horizontal deflection of these elements during a seismic event can cause the ceiling to collapse.

Partition walls and glazing lines need to be independently braced at all times. At a minimum of 30kg/m2 these walls have the weight to create catastrophic failure when horizontal deflection occurs.

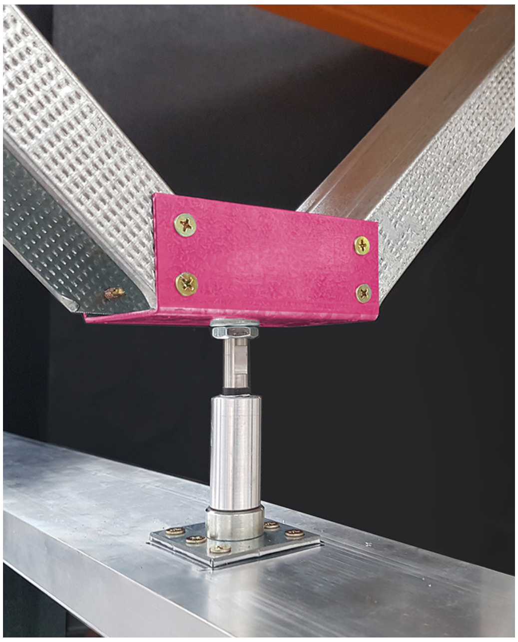
Partitions under ceilings should be braced through the ceiling with sufficient seismic gaps to allow for calculated ceiling actions.



VertiBrace

As well as lateral restraint, most multi-level buildings need their partitions to allow for vertical movement. This movement can cause irreversible damage to partition walls and may endanger occupants if not designed for.

The VertiBrace ensures that during a seismic event, the interior walls will not be crushed or pulled apart. It will prevent interior glazing from popping out of the aluminium pockets and support safe egress. More routinely, once the floors are loaded and move by say 5mm, there is no downward pressure experienced by the partition.



T&R Products and Systems

CBI GRID

Recommended Use:

- CBI is our grid of choice for our ceiling seismic design
- Heavy duty configuration with a 38mm web height to both Main and Cross Tees.
- Main Tees punched at 100mm centres with first punch at 50mm.
- Convenient punch out to both Web and Bulb for ease of suspension.
- Seismically tested and proven to meet current NZ Standards.
- Compatible with seismic separation joint and Cetram T Bar lighting.
- High quality Italian design and manufacture.
- PS1 and PS4 are available from our consulting Engineer as required.
- Site specific ceilings will be designed to both ultimate and serviceability limit state to meet current NZ Code.

The CBI GRID is the primary element, which holds the design of most T&R ceiling tiles.

Talk to us about non- structural seismic suspended ceiling design.

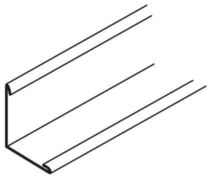
NOTE: Install main tees so that they are parallel (up/down the incline) with the slope of a raked ceiling. Do not install the main tees perpendicular to the incline as this may lead to grid failure.

We import our CBI Grid directly from Italy

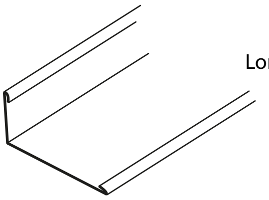
CBI Grid and Related Components

CBI grid.

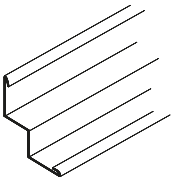
Wall and Column Trims



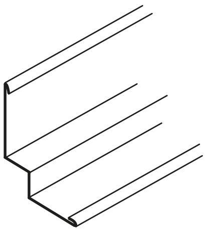
Standard Wall Angle



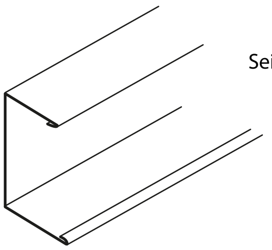
Long Leg Wall Angle



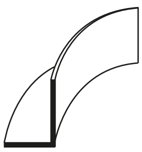
Shadowline Wall Angle (Short Leg)



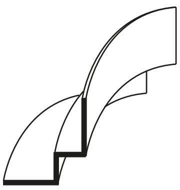
Shadowline Wall Angle (Long Leg)



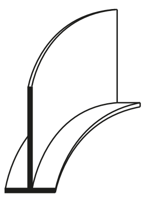
Seismic Wall Channel



Aluminium Column and Radius Angle Trim

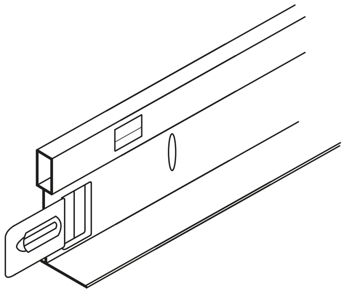


Aluminium Shadowline Column and Radius Trim

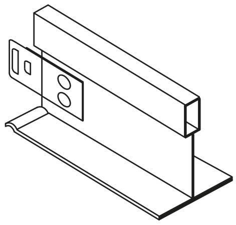


Aluminium Column and Radius "T" Trim

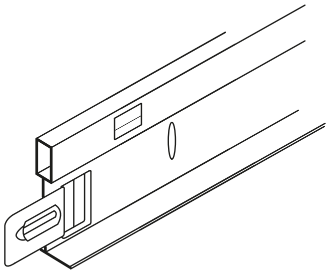
Support Members + Main Tees + Cross Tees



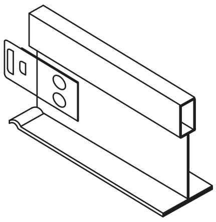
Main Tee 24mm



Cross Tee 24mm

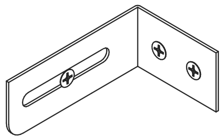


Main Tee 15mm

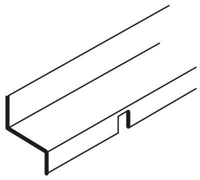


Cross Tee 15mm

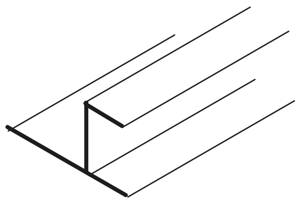
Seismic



Seismic Floating Wall Clip

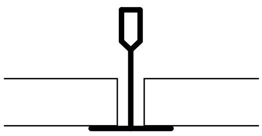


T&R Z Rail

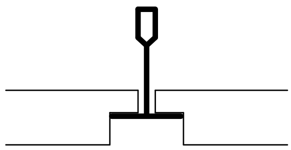


Seismic Separation Joint

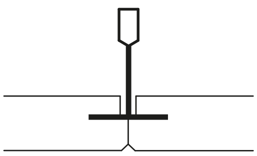
Ceiling Tile Edge Details



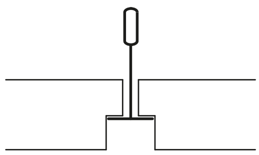
24mm Grid (Square Edge)



24mm Grid (Rebated Edge)

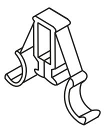


Concealed

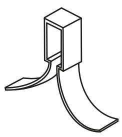


15mm Grid (Rebated Edge)

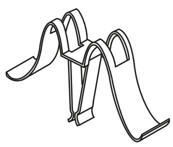
Accessories: Hold Down Clips



PVC Clip



CBI Clip



W - Clip

Main Tee The Main Tee is manufactured from hot dipped galvanised steel in a double web, balanced tee design, in 3700mm lengths. It is finished with a pre-painted steel cap. The Main Tee is conveniently punched at 100mm centres and includes suspension points in both the bulb and web. Main tees extend from wall to wall and are the primary ceiling support. End splices allow for greater lengths. Slots along the runner side allow cross tee to connect. Hold down clips are available as required.

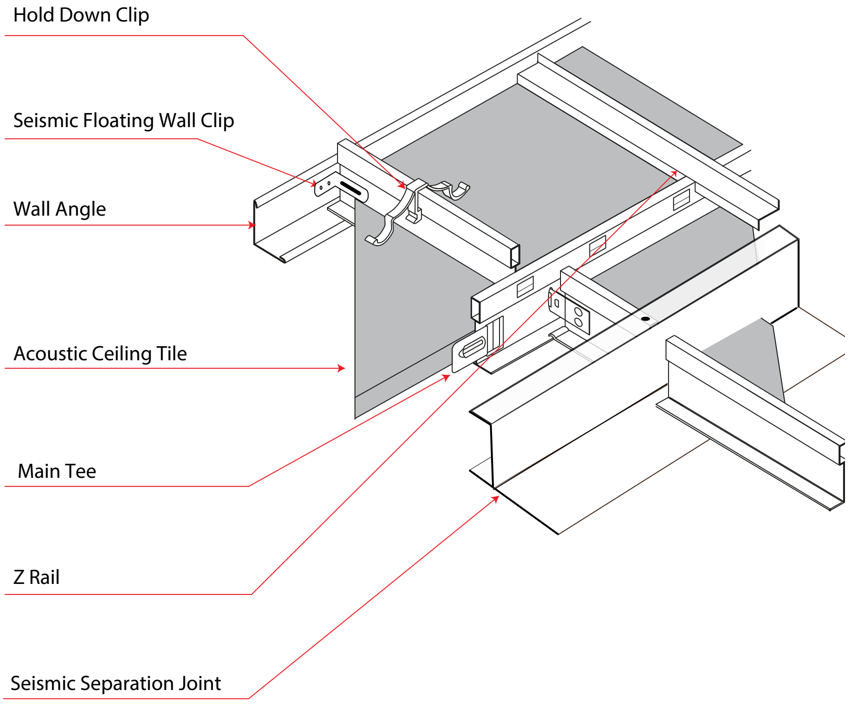
Cross Tee The Cross Tees are manufactured in the same configuration in 1200mm and 600mm lengths. Lay on edge detail for neatness of installation coupled with resistance to twist. They connect between main tees using interlocking tabs. The high tensile clips ensure a positive locking system for quick installation

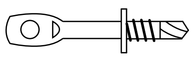
Wall angle L-shaped pieces that fasten to the wall and support or conceal the ends of the main runners and cross tees.

Z Rail A seismic support that suspends the edge of the grid without relying on the perimeter.

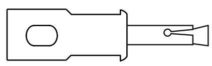
Seismic Wall Angle A support bracket that allows the grid to move, creating a floating edge.

Border Cut Panels around the perimeter of the room. They should be greater than half of a tile to maintain balance and add visual appeal.



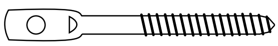


Steel Purlin
1.8mm BMT steel (wire or rod)

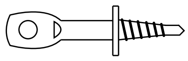


Concrete
Masonry Sleeve anchor
(wire or rod)

Eye Screws

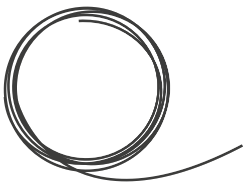


Timber
75mm, fast embedding eye screw (wire or rod)

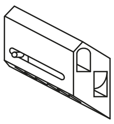


Metal Deck
0.8mm to 1.2mm BMT (wire only)

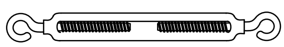
Suspension Components



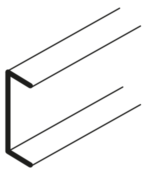
Galvanised/Braided Wire



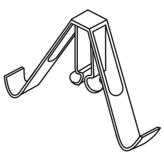
Zip Lock



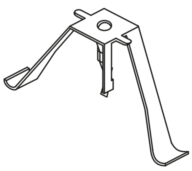
Turn Buckle



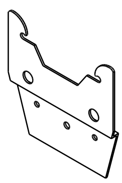
"C" Channel



A - Clip

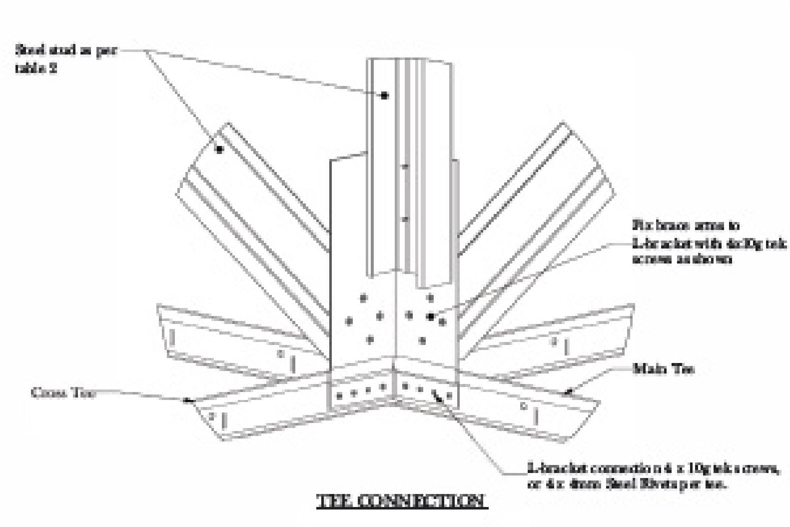


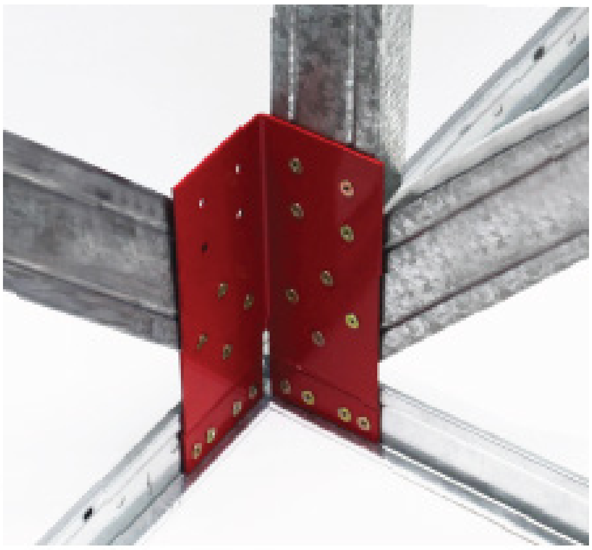
4 Prong - Clip



Robo Clip

StratoBrace





The StratoBrace is designed to lock into a two way suspended grid system in order to increase its ability to withstand lateral loads. It is a simple system that is easy to install. If perimeter fixing is insufficient for the seismic demand, a ceiling must be restrained to the structure above using another method such as StratoBrace. This product provides a tested, strong and effective method to provide lateral restraint.

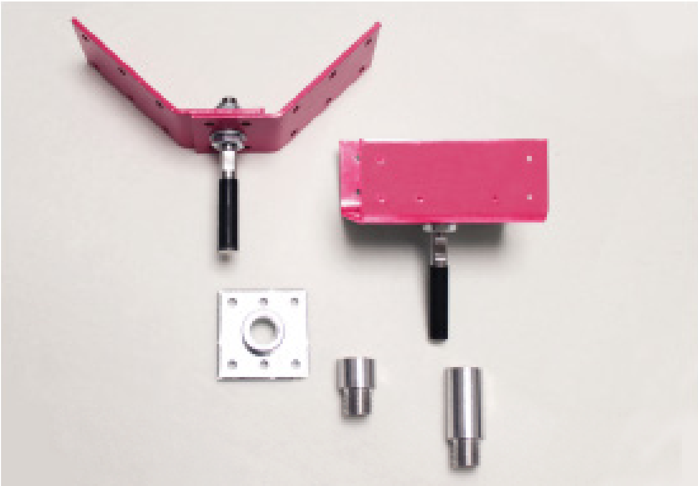
- The StratoBrace provides a proprietary bracket to attach a compression strut and two orthogonally opposing angle struts to the ceiling grid.
- Its performance has been extensively tested.
- The Stratobrace bracket uses grade 250 steel 2mm thick, its yield strength is 250MPa.
- Use the T&R Seismic Calculator to design a ceiling that complies with the requirements set out in NZS1170.5 (www.tris.co.nz/ index/home/Seismic_Calculator)

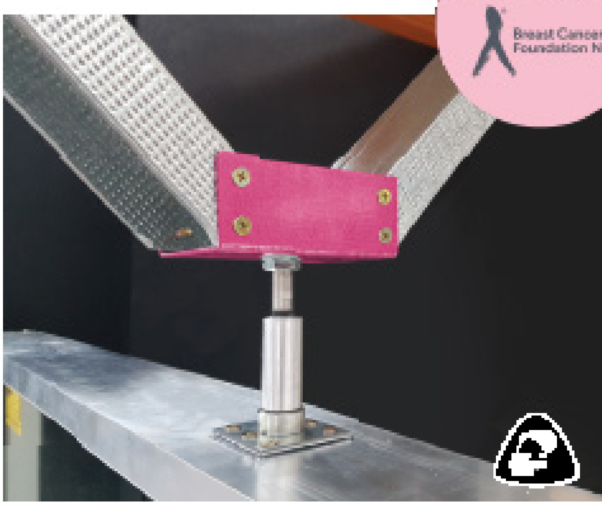
Please note: The ceiling grid must not be connected to the perimeter wall or frame (See T&Rs Z Rail or seismic wall clip). The gap between the ceiling and the surrounding wall has to be sufficiently large that the ceiling is not damaged by impacts against the wall during an earthquake.

Flexible connections should be used between ceiling-supported equipment and their ducts or pipes that are supported by the structure.

The StratoBrace (when designed and installed in full compliance with the Design Guide (T&R Seismic Suspended Ceiling Calculator) will meet the B1 structure provisions in the New Zealand Building Code.

VertiBrace





All buildings are affected by vertical movement. This movement can be caused by wind and seismic events as well as live/dead loads imposed on the floor above. In large or multi-level buildings this movement can be substantial. When not considered, vertical movement can cause irreversible damage to partition walls and may endanger occupants in the event of a natural disaster.

VertiBrace provides lateral bracing for partial height partition walls and removes the need for deflection headtrack. It prevents many of the issues seen during the Christchurch, Kaikoura and Seddon Earthquakes, helping to ensure occupant safety and limit non-structural partition damage.

The VertiBrace utilises a sliding connection that separates the partition wall from the structure above meaning that any vertical deflection doesn't damage the partition system. When installed, the VertiBrace will allow for +/- 25mm deflection, 50mm total. A taller version is available to accommodate 70mm worth of movement (+/- 35mm).

The VertiBrace cylinder is fitted with an acoustic sleeve which prevents noise as the connection slides. An additional benefit is that this greatly reduces footfall vibrations transferring down through partition walls.

VertiBrace can be fitted to timber, aluminium, and steel headtracks and can be retro-fitted to most existing partitions.

Free MarkUp Service Available

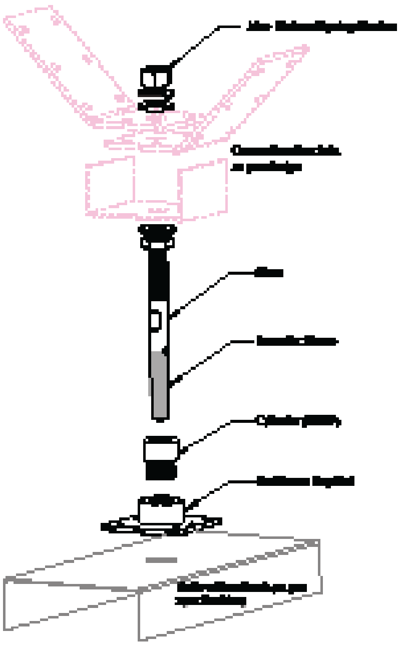
VertiBrace meets the B1 structure provisions in the New Zealand Building Code.
(when designed and installed in full compliance with the Design and Installation Guide)

The selection of the VertiBrace *Pop* or *Drop* options, are dependent on the headtrack(s) being used. For any hollow wall, use the Vertibrace *Drop* option. The stem moves through the headtrack and the cylinder is therefore shorter. Use on steel stud, aluminium and timber headtracks. Also available as VertiBrace DROP *Long Stem*. Accomodates up to +/-70mm of vertical movement. (Capacity tables don't apply to Long Stem).

When the VertiBrace needs to sit on top of the headtrack - use the VertiBrace *Pop* option. The cylinder is longer and vertical movement happens above the headtrack. Use for pocket (glazed) and solid headtracks. Also available as VertiBrace POP *Long Stem*. Accomodates up to +/- 70mm of vertical movement. (Capacity tables don't apply to Long Stem).

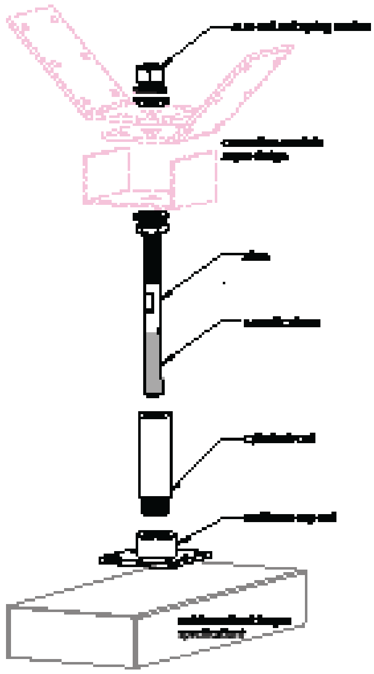
VertiBrace Drop

VertiBrace Pop



VertiBrace Drop

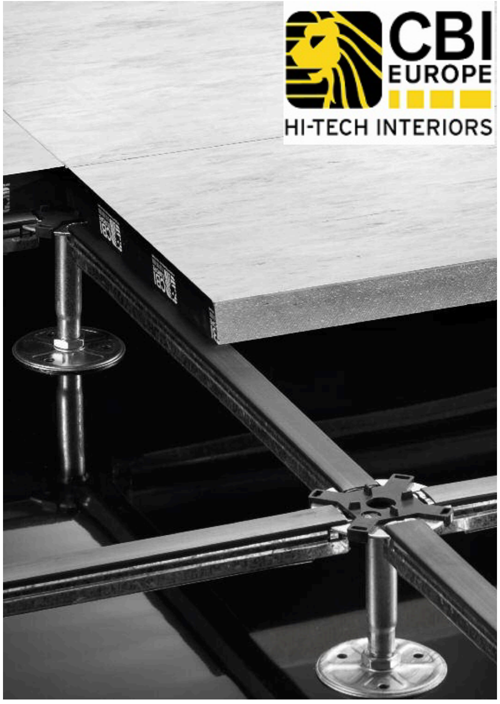
For Steel/Aluminium and Timber Headtracks



VertiBrace Pop

For Pocket (Glazed) Headtracks

Access Flooring



Seismically, access floors are a very safe alternative to running heavy equipment in the ceiling plenum. They are a great solution for projects where technical flexibility and frequent modifications of electrical, telephone and/or computer wiring is required.

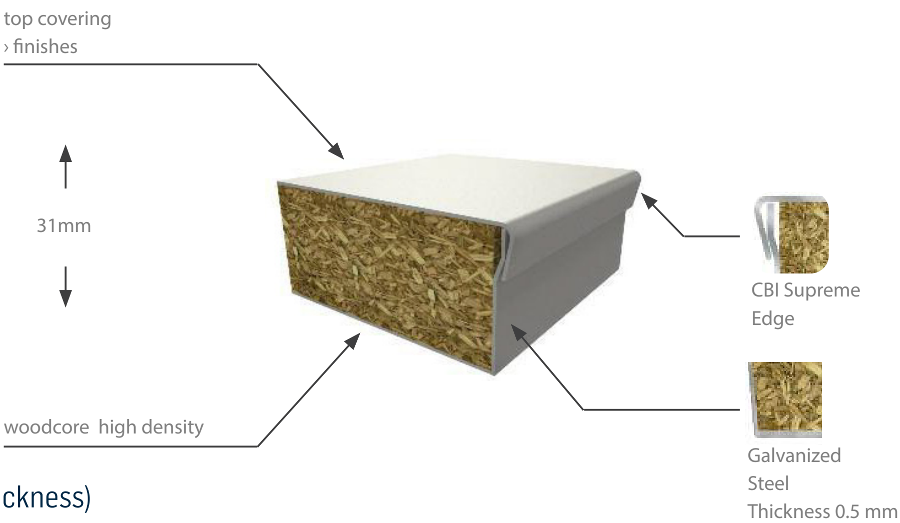
- Suitable for offices, banks, control stations and open plan office areas.
- The accessible inter-space created by the Access Floor allows for unobstructed alignment of all electrical, hydraulic ducts, computer cabling and telephone wiring.
- T&R standard stock component is a high density wood fibre core panel; with an external covering of Antistatic HPL or Steel Encapsulated panel. Other finishes are available on indent.
- Modular subtructure systems support medium weight loads.

FULLY STEEL ENCAPSULATED

› Galvanized steel with a thickness of 0.5 mm

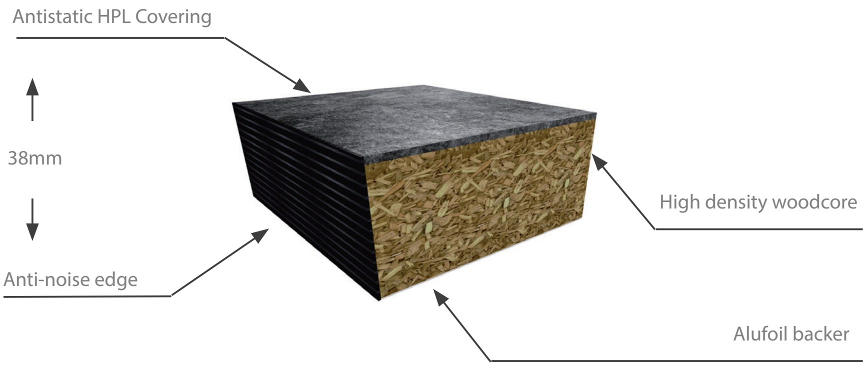
› Calcium sulphate ·

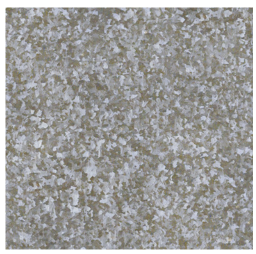
› Covering: Carpet lay-loose tiles. PVC/rubber lay-loose tiles. Moquette auto-adhesive; PVC auto-adhesive.



ANTISTATIC HPL

Alufoil Backing (0.5mm thickness)





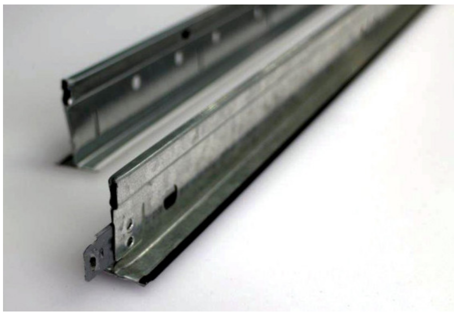
Seismic Theory

Suspended Ceiling System

The T&R Seismic System for suspended ceilings has been developed in association with JSK Consulting Engineers. It relies on the separation of the ceiling grid and perimeter walls.

The two way exposed ceiling system comprises four main concepts:

- C BI Heavy-Duty grid
- Floating and Fixed edges
- Z-Rail on floating edges
- Diaphragm Concept



Bracing Requirements

In New Zealand, seismic requirements for ceilings are based on:
- NZS 1170.5 - Earthquake Actions
- NZS 2785 - Suspended Ceilings, Design and Installation (updated in 2020)

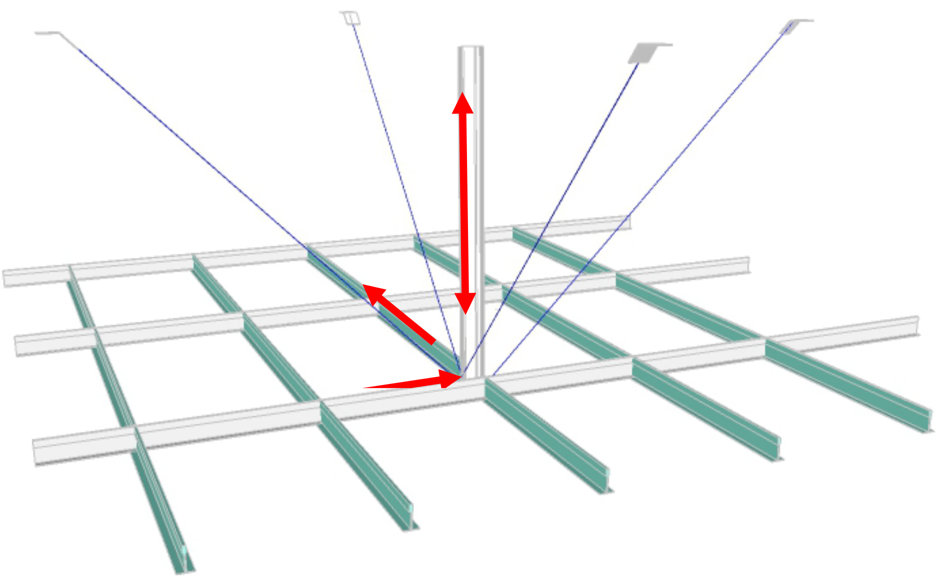
Seismic bracing requirements for a suspended ceiling are a function of many factors including the geographical location of the building and its importance level. It also takes into account the height of the ceiling above floor and ground and the mass of the grid, tiles and services.

In order to determine the type and amount of bracing needed, the following are taken into consideration:

- Ceiling mass per square meter
- Ceiling height
- Seismic Force
- Spacing of grid
- Plenum depth
- Ceiling area
- Location in New Zealand
- Part Category
- Wall capacity
- Fixing Types
- Capacity of Brace design

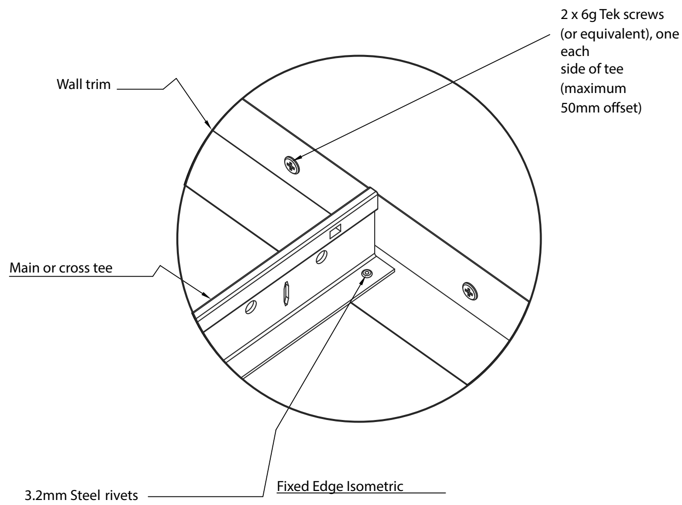
There are two bracing types;

bracing offered by edge fixing to perimeter walls and back-bracing in the ceiling plenum.

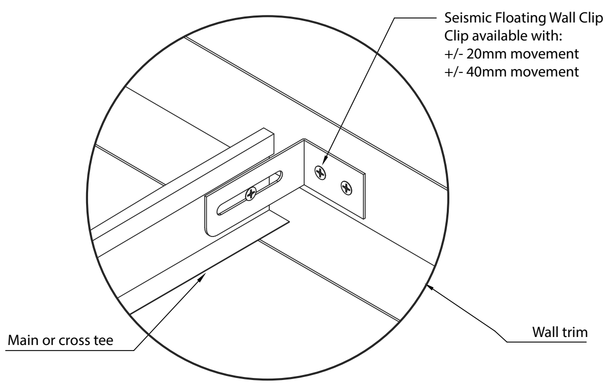


Seismic Restraint

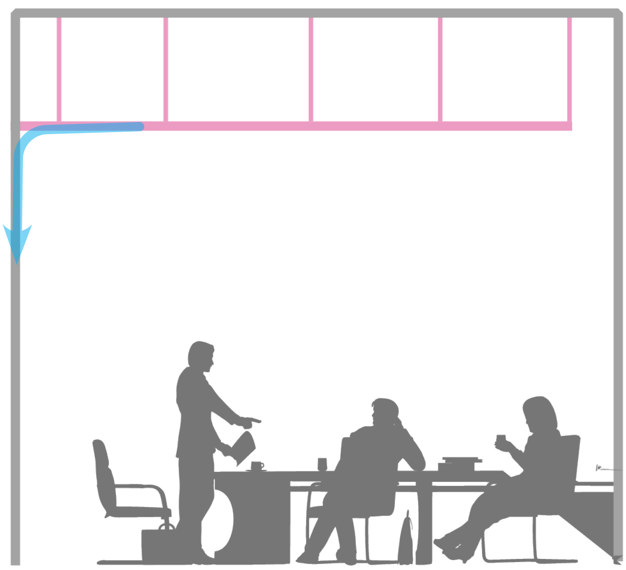
Post-Canterbury earthquake research has shown that allowance for relative motion between the ceiling and the structure must be provided. There are two ways of approaching the design of the ceiling to wall junction: fixed or floating. If the ceiling is fixed to the perimeter wall, line loads on the grids are transferred out these walls during seismic movement and this acts as seismic restraint. However, due to the nature of this layout, maximum spans are limited . When the ceiling is floating (i.e. separated from the perimeter walls), the ceiling moves with the structure above and is not affected by the wall movement. Back bracing ensures that the ceiling doesn't experience too much lateral and vertical movement. This is ideal for larger ceilings. Floating edges must also be provided around rigid objects that pass through the ceiling (e.g. columns, wall partitions, sprinklers).

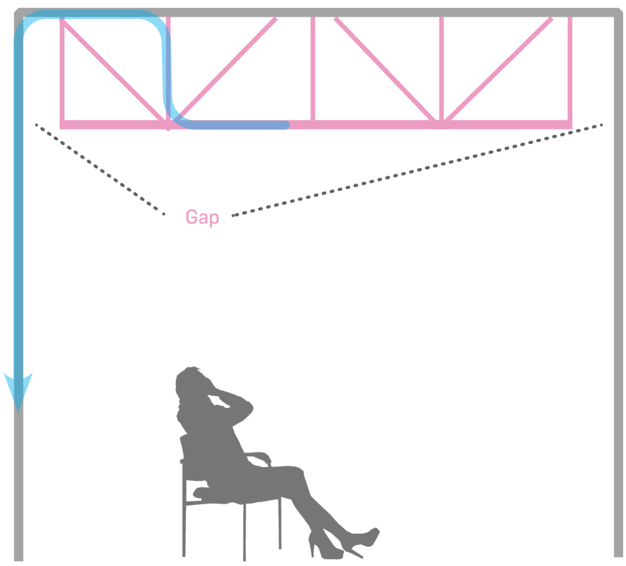


Fixed Edge Isometric



Seismic Clip Wall Edge Isometric


Fixed-edge configuration



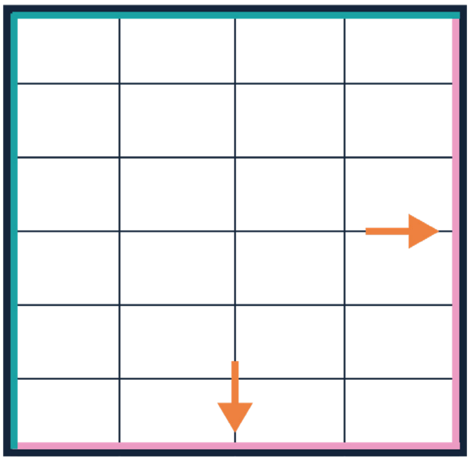
Floating-edge configuration

Edge Configurations

There are three fundamental seismic layout concepts:

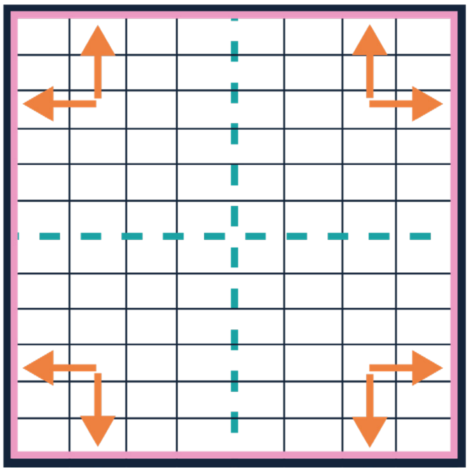
- Perimeter connecting on two adjacent walls and two walls floating
- Perimeter fixed on all four sides with 'seismic separation' to allow for movement
- Floating on all sides, fixed/braced to the structure above

Perimeter fix two walls and two walls floating



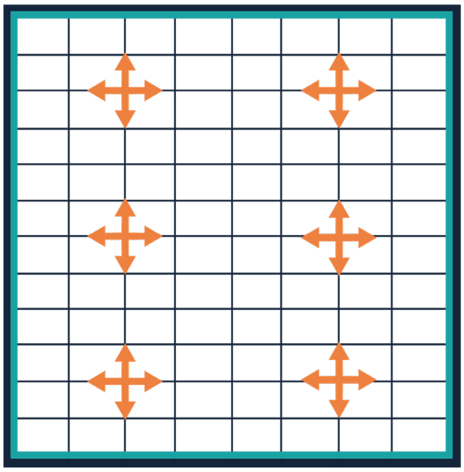
The seismic system for small and medium ceilings - where no back bracing is required - relies on two perimeter walls to add support and brace the ceiling, but allows movement on the opposite side to prevent the grid pulling apart or crushing under compression. Opposing sides are never fixed.

Perimeter fixed on all four sides with 'seismic separation' to allow for movement

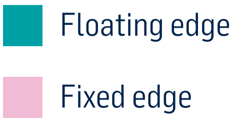


This can be used where the ceiling length and width are less than twice the maximum length for tee spans for the edge fixing method. The seismic joint effectively creates a floating edge which means that the four sections require no back bracing, whereas the complete ceiling with floating edges would. Again, opposing sides are never fixed.

Floating on all sides, fixed/braced to the structure above



On larger ceilings where back bracing is required, the seismic systems is for all sides to be floating. Because the ceiling is not attached to the perimeter walls at any point, it moves with the structure above.



Floating Edges

T&R Seismic System specifies a nominal 20mm seismic clearance for complete floating ceilings and 15mm for fixed and float ceilings between termination of tee and the wall. Site specific design may require a different gap. This should be discussed with a suitably competent chartered professional engineer.

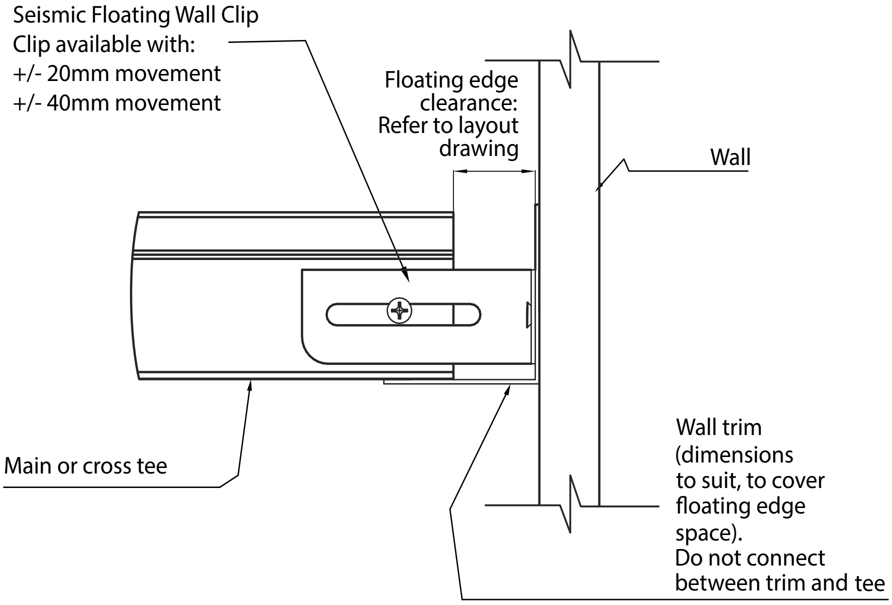
A Floating edge ensures that the line loads of the ceiling are not transferred into the wall. There are a number of ways to detail this.

The T&R Seismic System utilises a Z Rail to suspend the grid perimeter and take the dead loads to the structure above. (see drawing below). The 'Z-rail', notched at 600 centres, locks over the tees and is attached to the grid with a rivet and is suspended independently. This creates a 'frame' around the ceiling locking it together and allows the ceiling to move with the structure above. This system is ideal where designers wish to demonstrate a negative detail etc.

Another T&R system utilised a clip with a slot to allow the grid to slide. This works where the standard wall angle is maintained.

For both systems, the tees stop short of the wall to provide seismic clearance. A nominal 15/20mm is recommended but may be increased for specific design requirements and building deflection. This should be assessed on a case by case basis. The wall trim is structurally unnecessary (but provides an aesthetic cover) and this may be detailed as the designer wishes.

As no line loads are being transferred to the wall, additional structure is not necessary within it.



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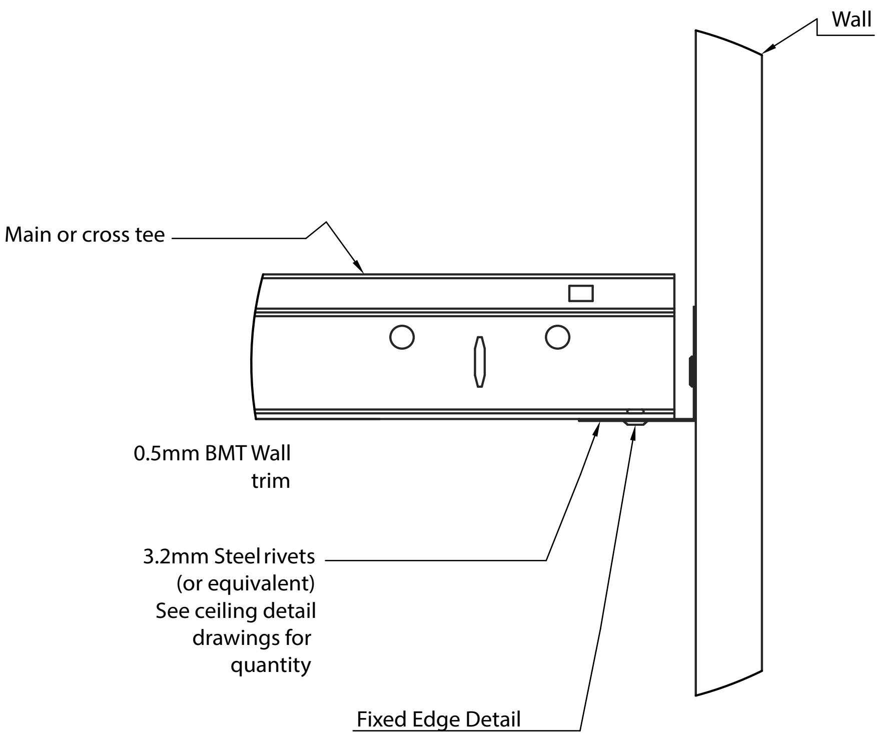
Fixed Edges

The fixed connection is providing a structural function for the ceiling. Because this system has no back-bracing, the grid stability is provided by the fixed edges.

When using fixed edges, the tee is attached to the wall trim by one or two rivets. The perimeter walls must have a continuous dwang at ceiling height to take the transfer of line loads. There must be screw fixings at 50mm either side of the termination of the tees to provide sufficient structural stability for the line load transfer.

The capacity of the wall should be checked to make sure that the line loads can be withstood.

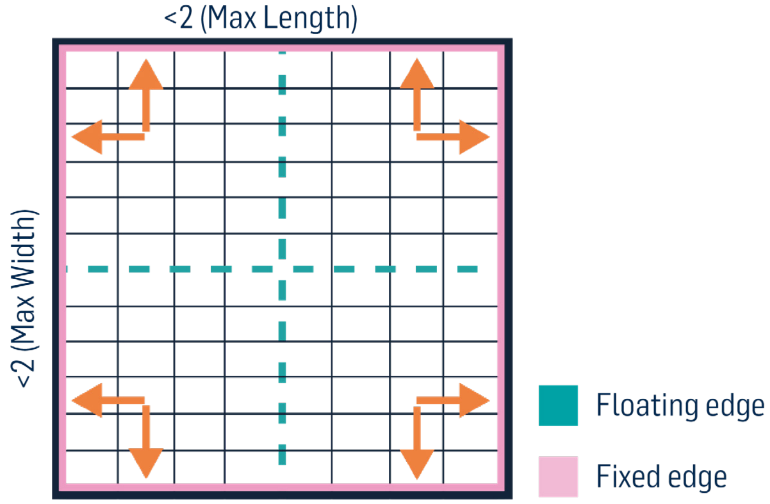


Note: Walls are to be fitted with a continuous dwang at ceiling height on walls where edge fixing is required, as per T&R seismic design guide.

Seismic Joints

There are designs where Seismic Joints are required: namely, where a seismic joint exists in the structure above the suspended ceiling.

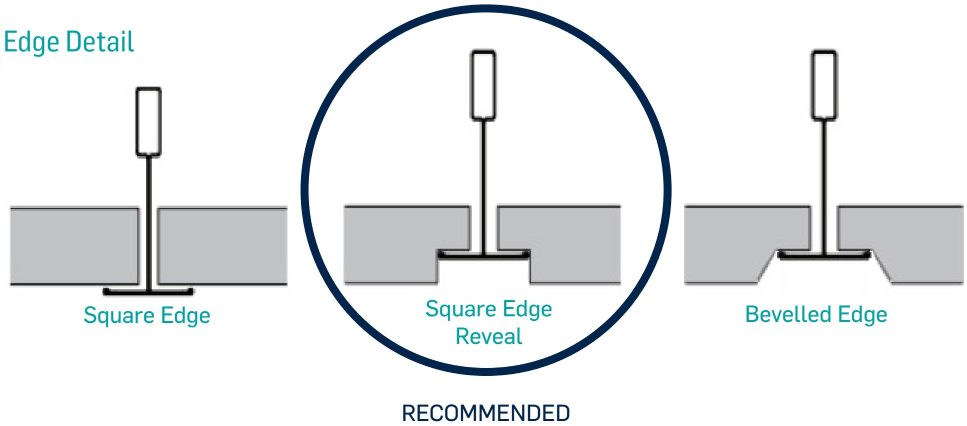
They can also be used where the ceiling length and width are **less than twice** the maximum length for Tee spans for the edge fixing method. The seismic joint effectively creates a floating edge which means that the four sections require no back bracing, whereas the complete ceiling with floating edges would.



Diaphragm Concept

Observation during seismic events has shown that the ceiling resilience/strength can be increased by using reveal tiles (as per the centre diagram below). Because the tile locks around the grid, it increases stiffness of the diaphragm. This is more effective than a standard Square Edge tile.

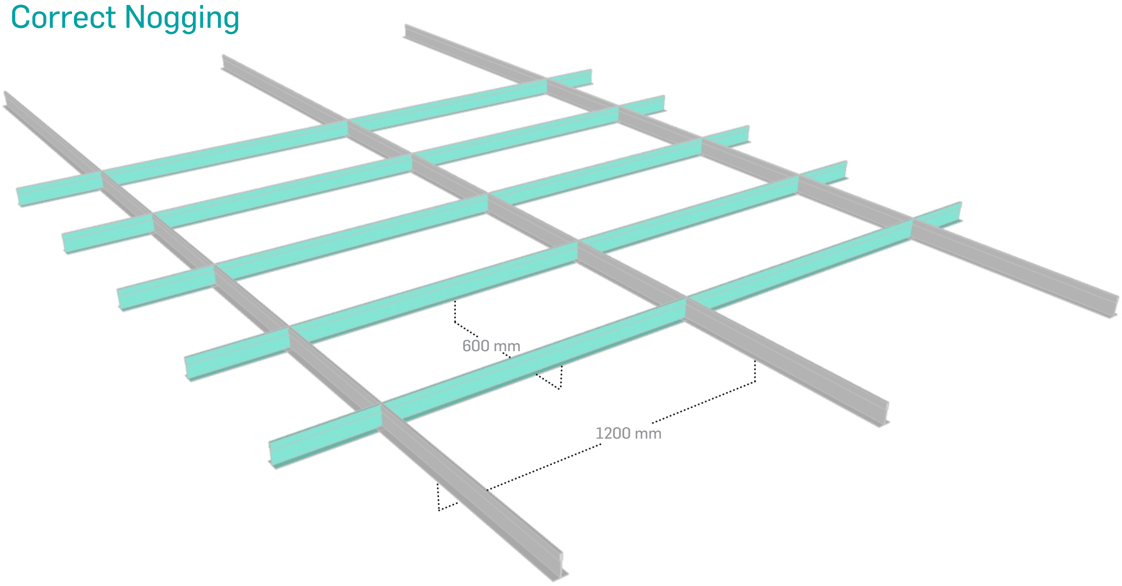
Due to the shape of the bevelled edge tiles, they are more likely to pop out of the grid during seismic activity.



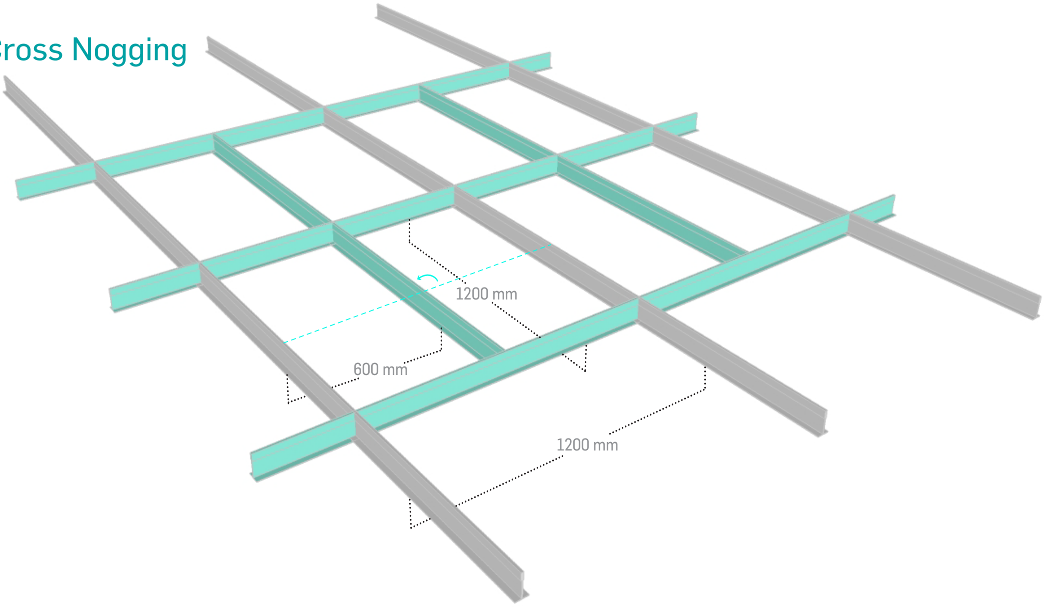
Cross Nogging

Cross Nogging is a common practise in the ceiling industry. This method rotates the orientation of the grid in order to allow the long edge of the ceiling tiles to run in the same directions as the purlins. However, because the cross tees only span between main tees at 1200 centres, and because cross tees are now supporting more than twice the mass, this practise is very detrimental to the strength of the grid. It should be avoided at all costs and will not work with the T&R Seismic System.

Correct Nogging



Cross Nogging

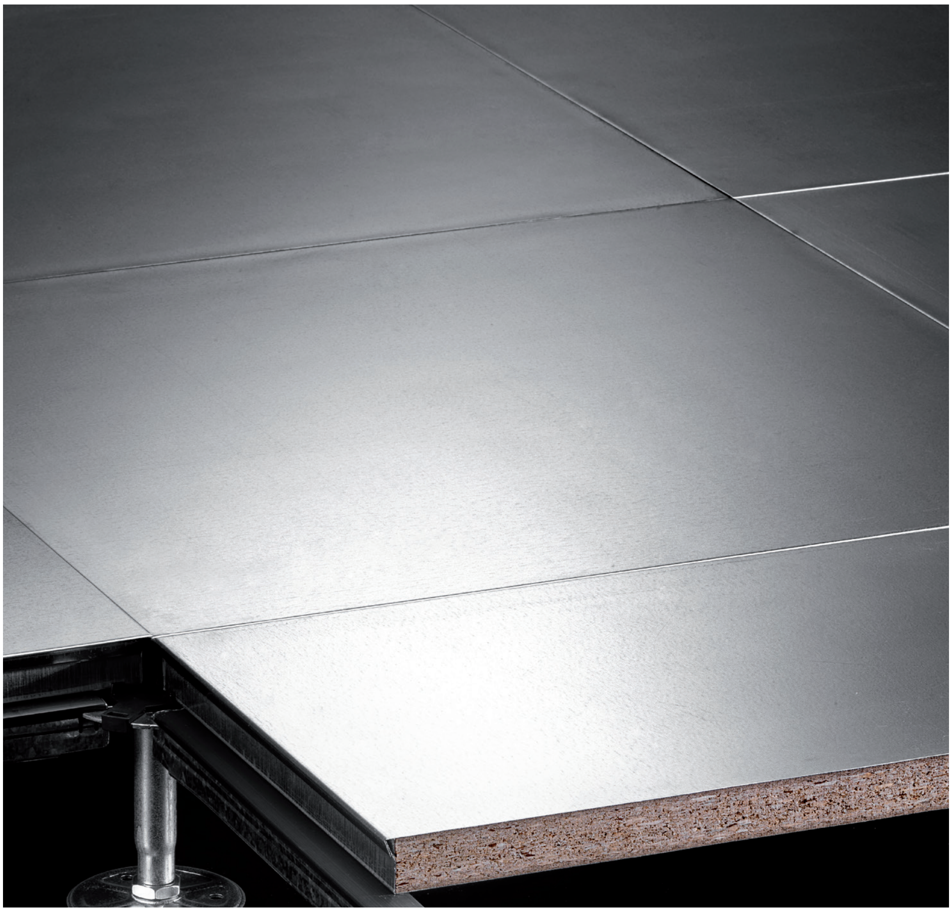


CBI Access Flooring

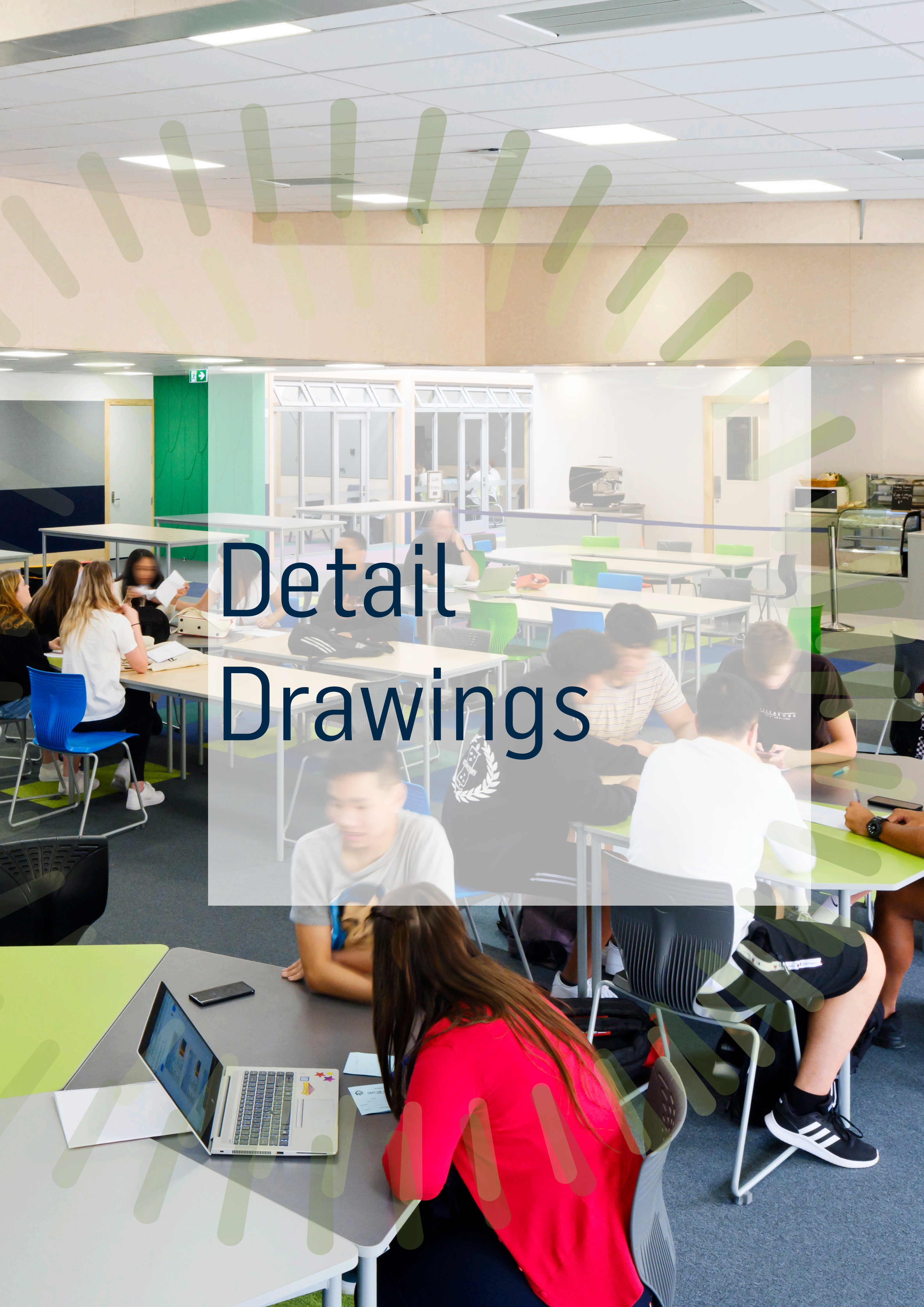
TECHNICAL SPECIFICATIONS

	FULLY STEEL ENCAPSULATED	ANTISTATIC HPL
Thickness	31 mm	38 mm
fire reaction UNI EN 13501-1	Bfl-s1	Bfl-s1
fire resistance UNI EN 13501-2	REI 30	REI 30

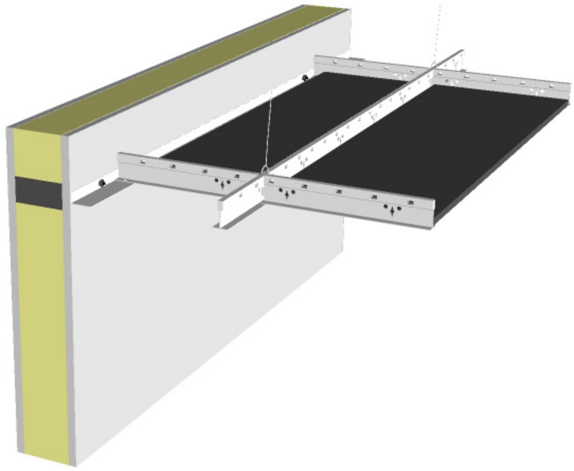
center of panel - deflection 2.5 mm	5.3 KN	4.2 KN
center of panel - ultimate load	13.4KN	12.0 KN
loading class	6	6

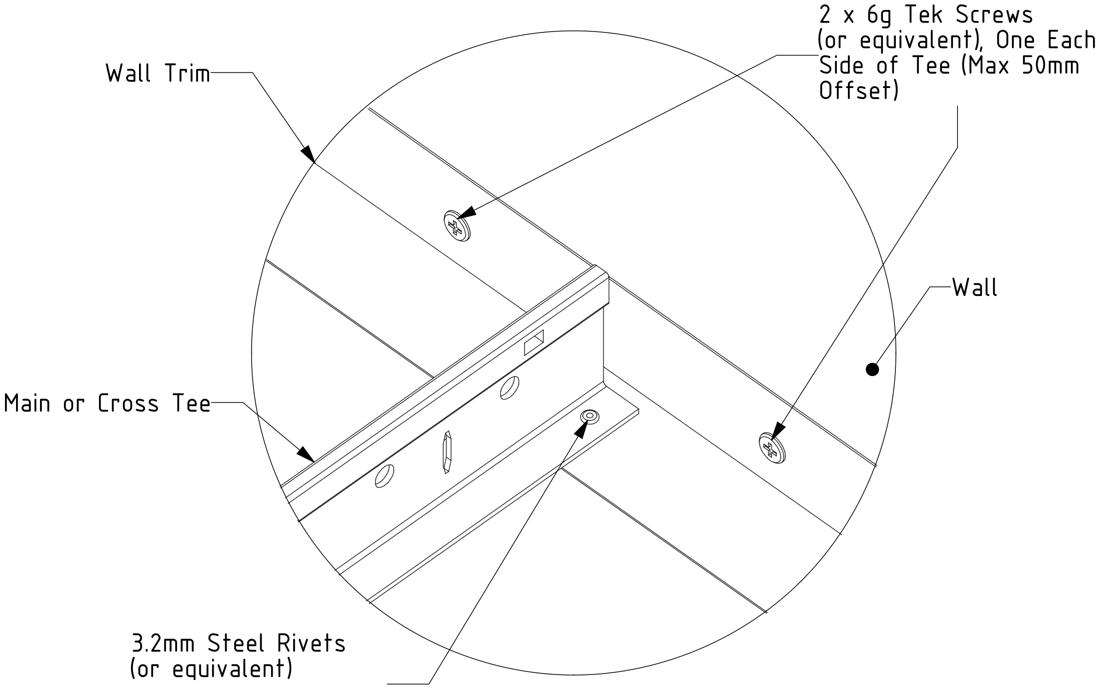


Detail Drawings

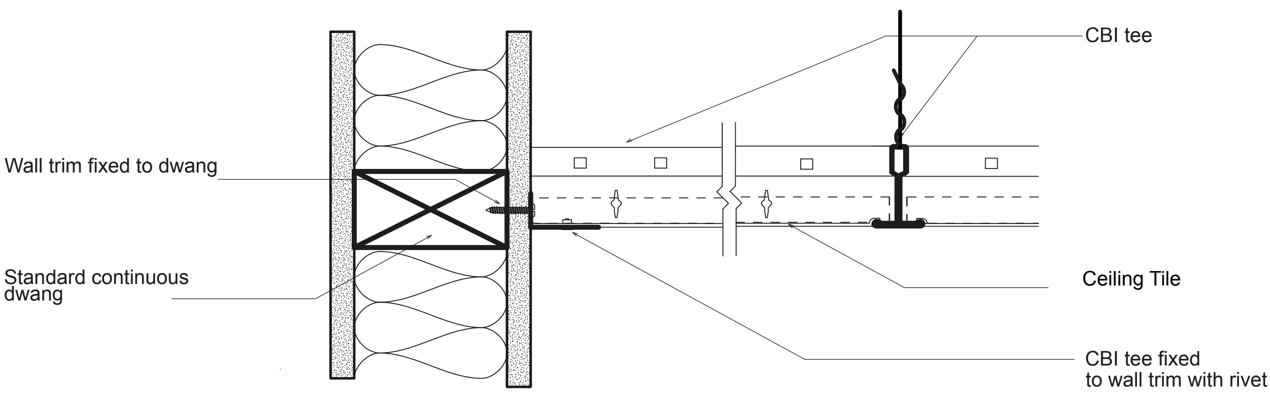


Fixed Edge





Fixed Edge Isometric

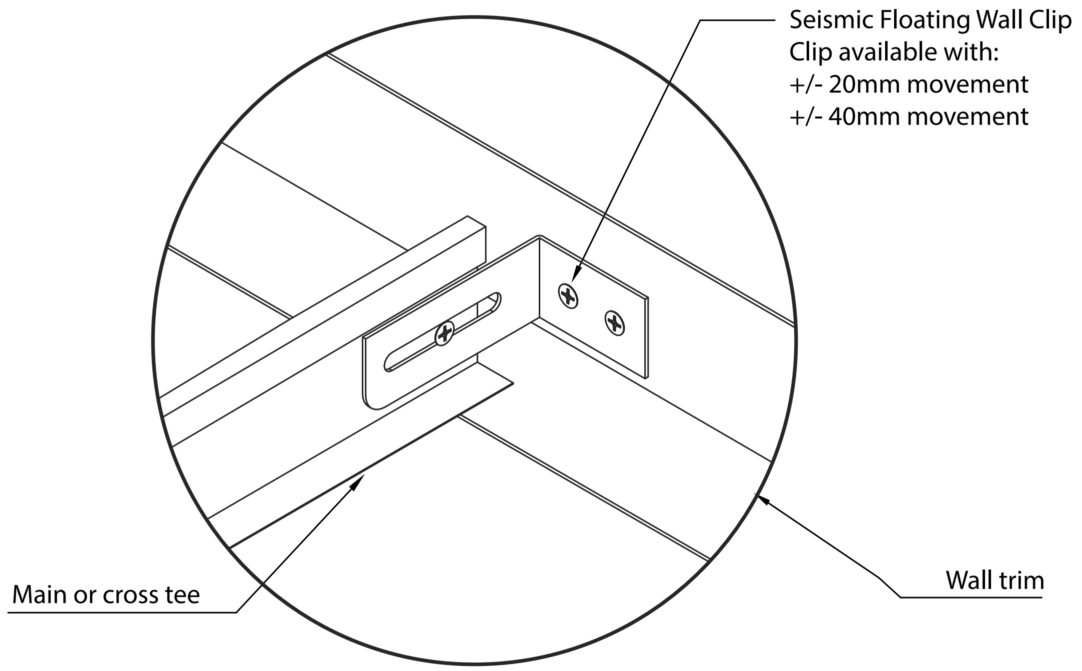


Note: walls are to be fitted with a continuous dwang at ceiling height on walls where edge fixing is required, as per T&R seismic design guide.

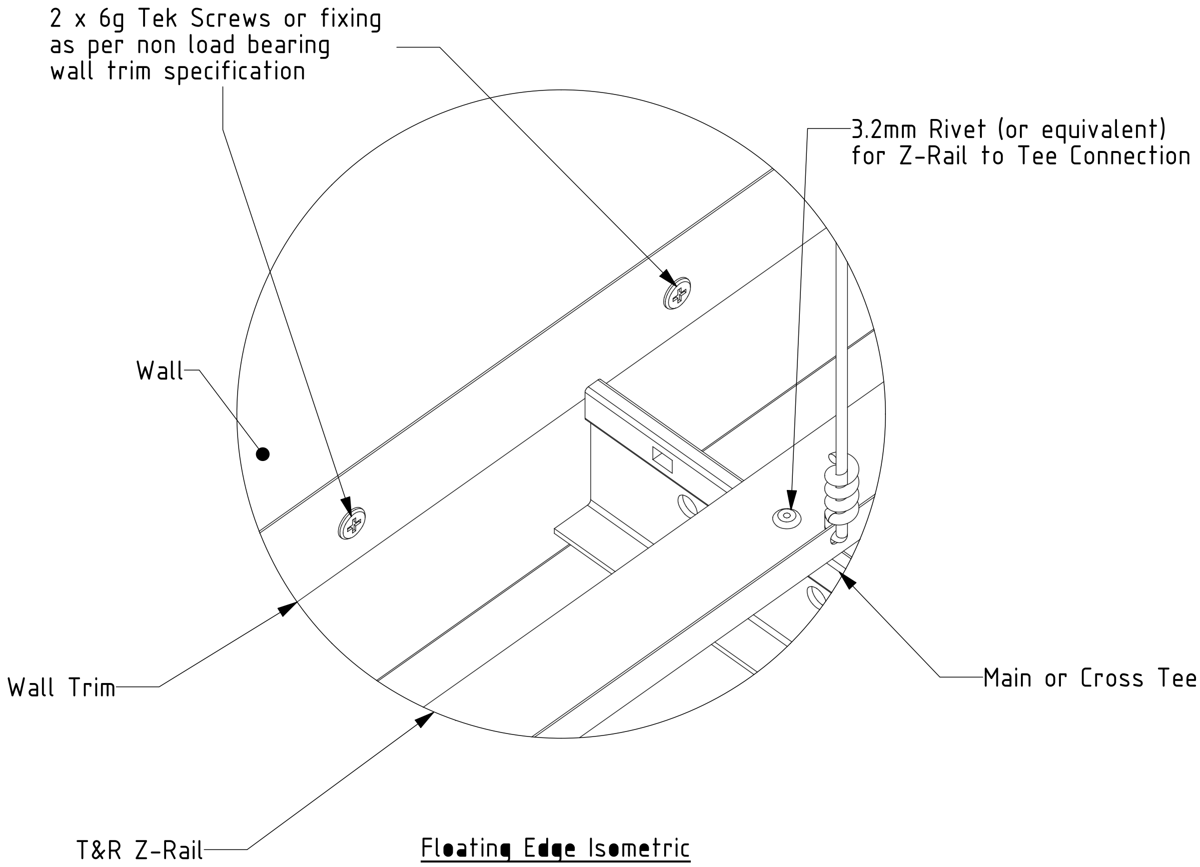
Floating Edge

T&R Seismic System specifies a nominal 20mm seismic clearance for complete floating ceilings and 15mm for fixed and float ceilings between termination of tee and the wall. Site specific design may require a different gap.

This should be discussed with a suitably competent chartered professional engineer.

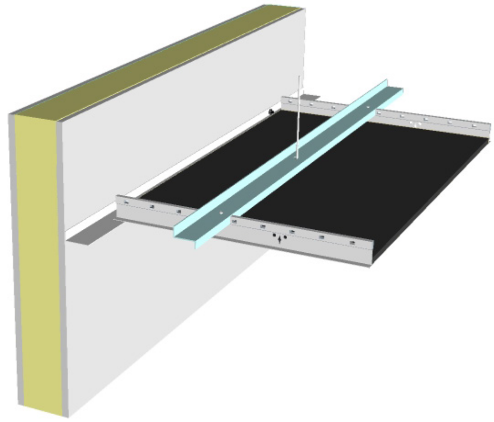


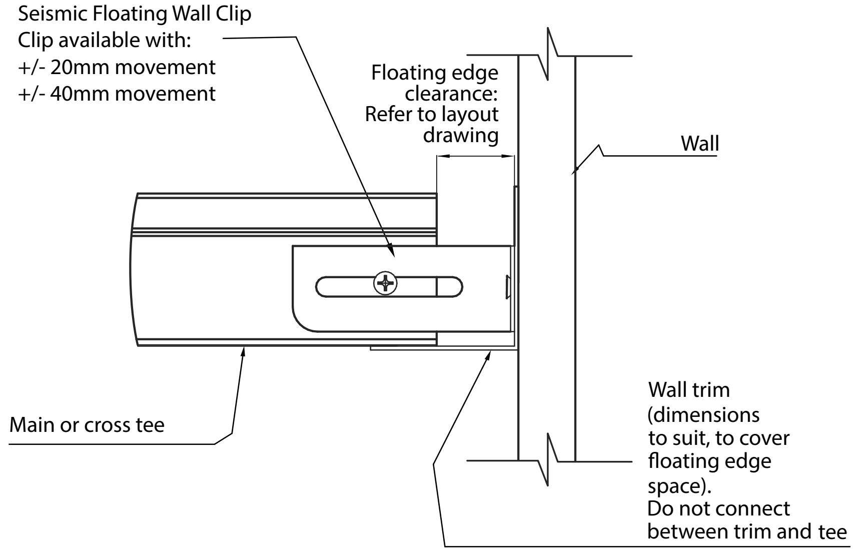
Seismic Clip Wall Edge Isometric



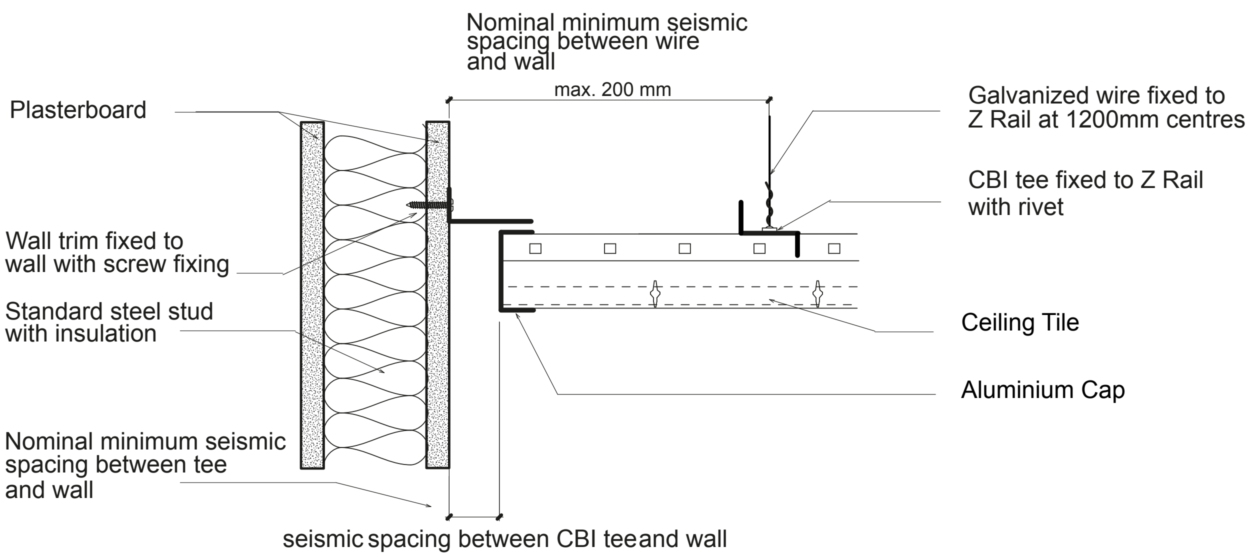
Floating Edge Isometric

Floating Edge

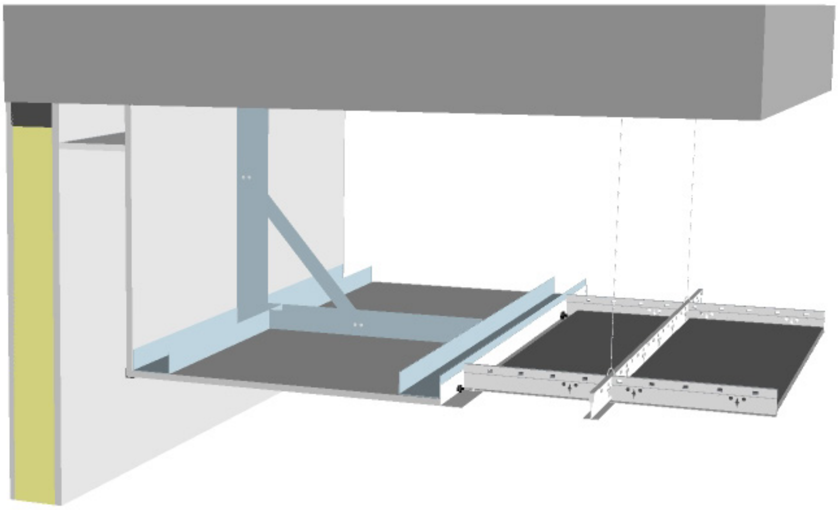




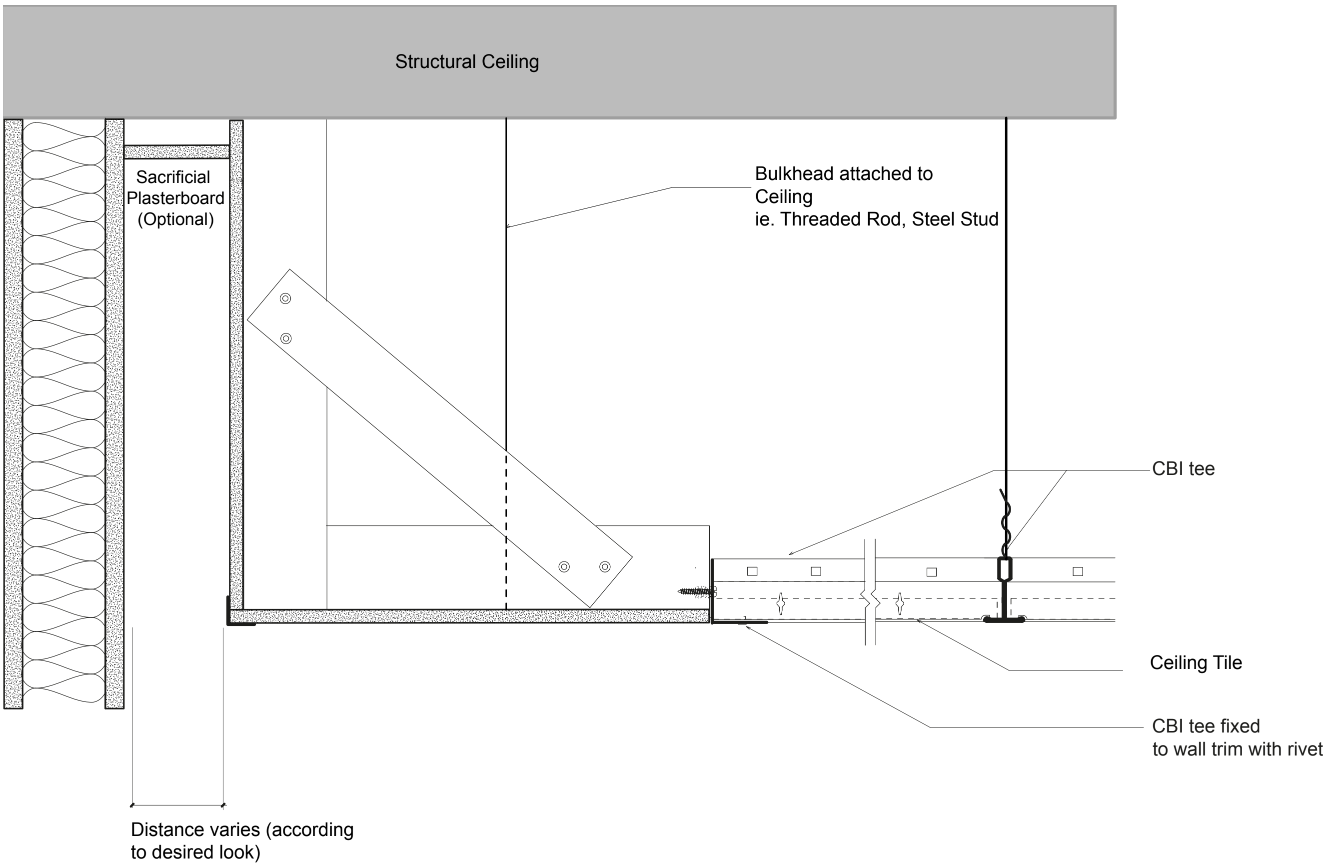
Floating Edge



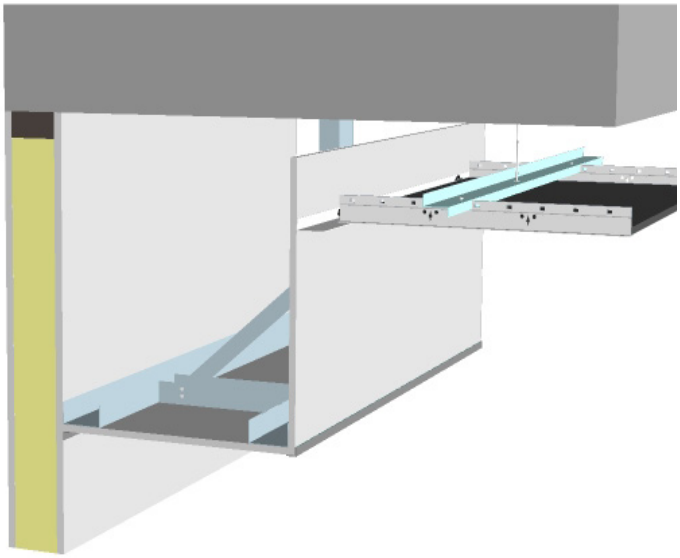
Alternative Floating Edge Section for larger seismic gaps



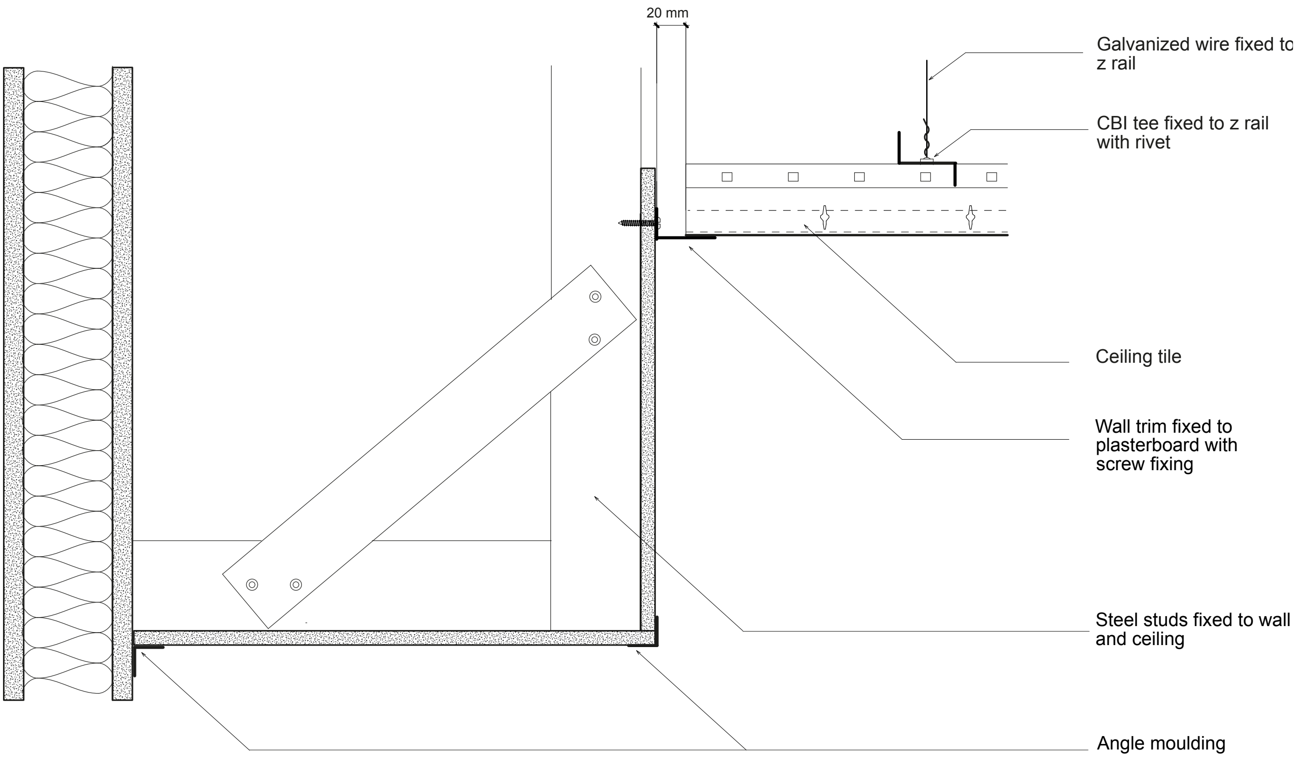
Floating Bulkhead Detail



Floating Edge



Bulk Head Floating Detail



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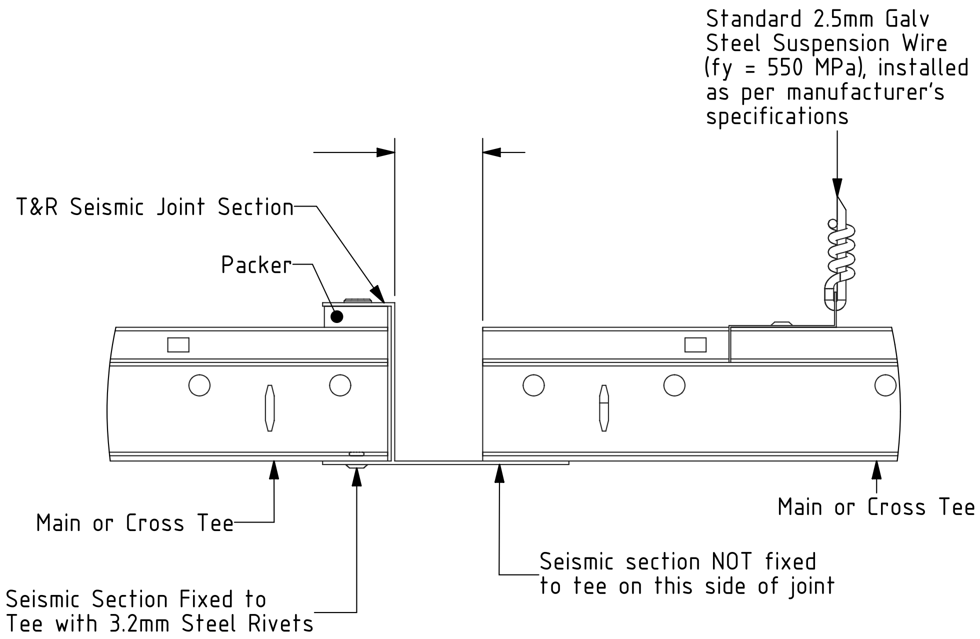
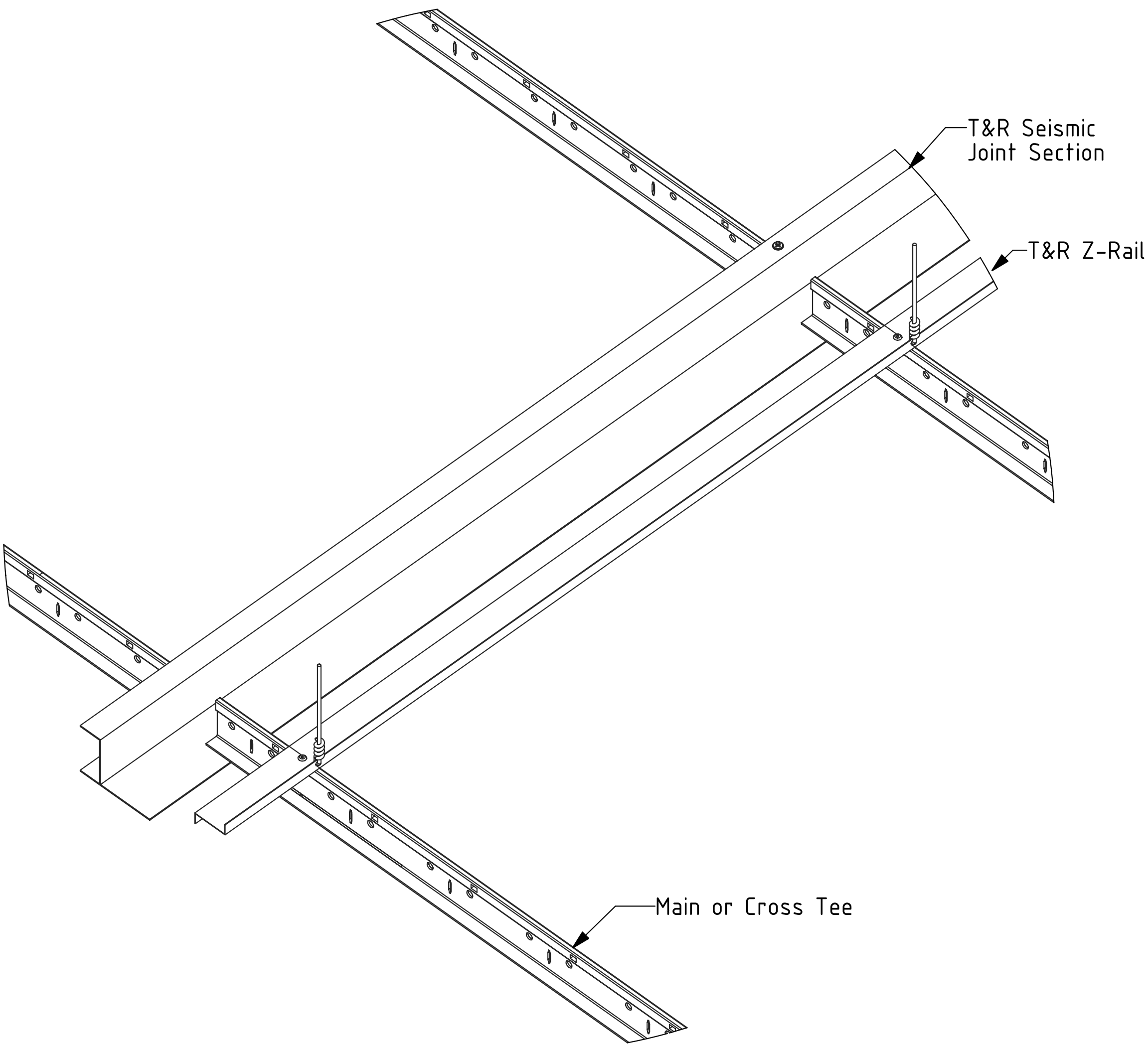
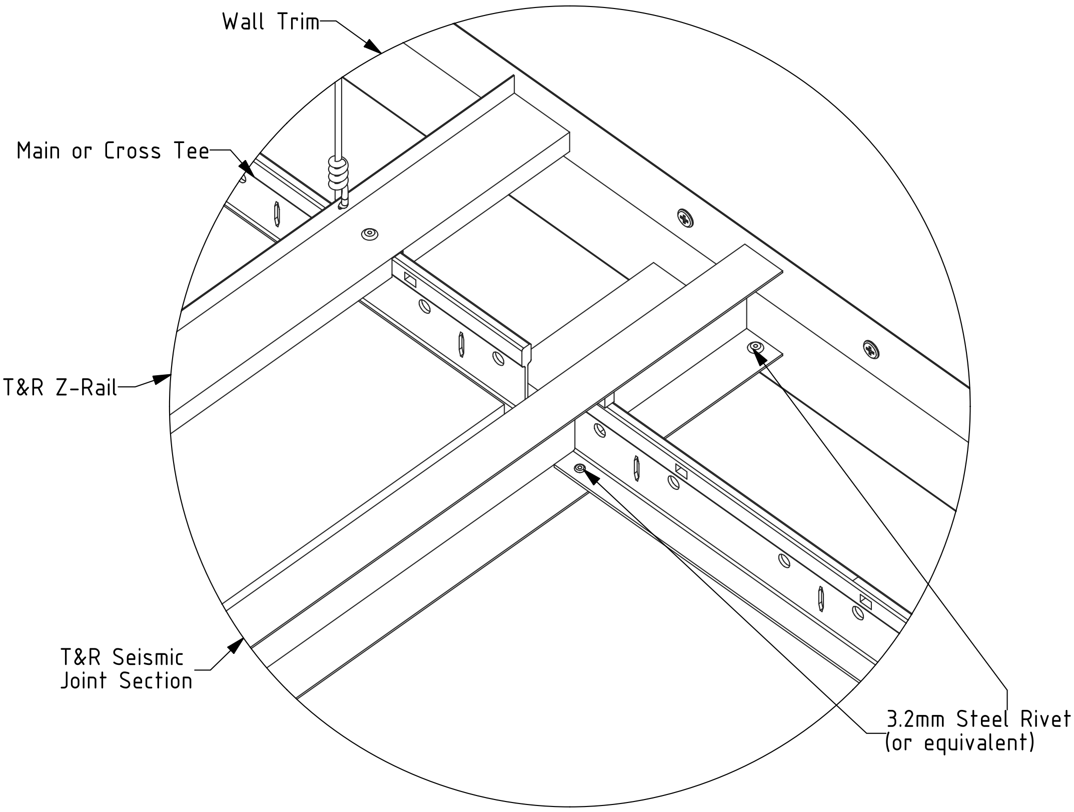
Seismic Separation Joint



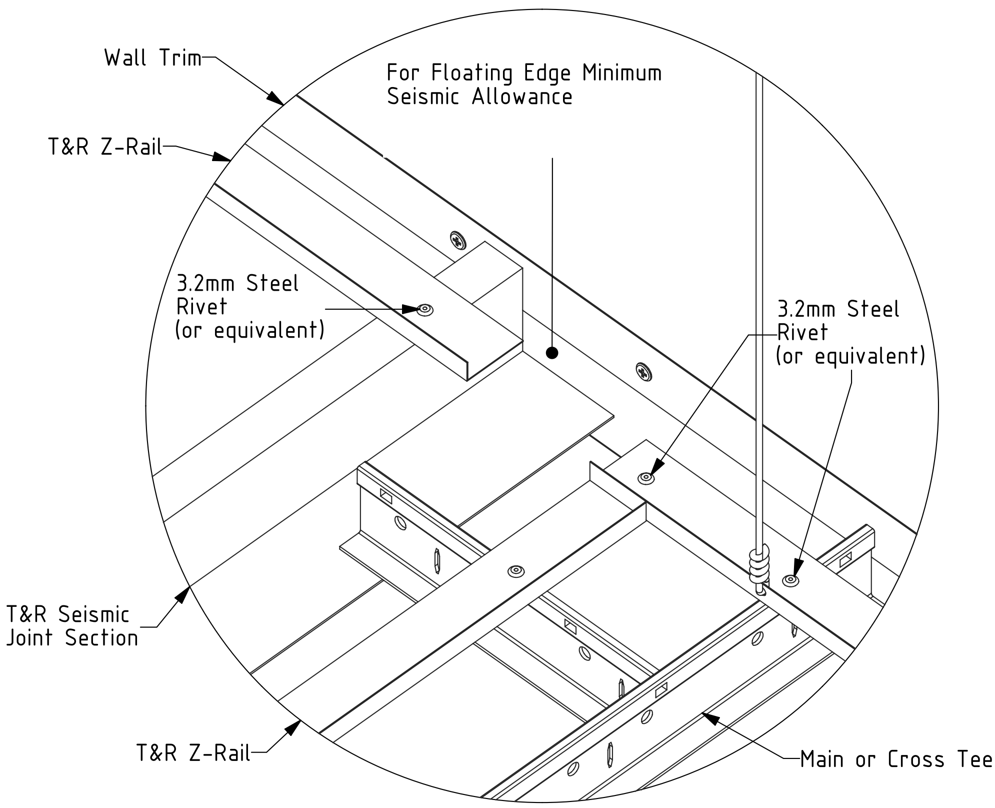
Seismic Joint Detail



Seismic Separation Joint

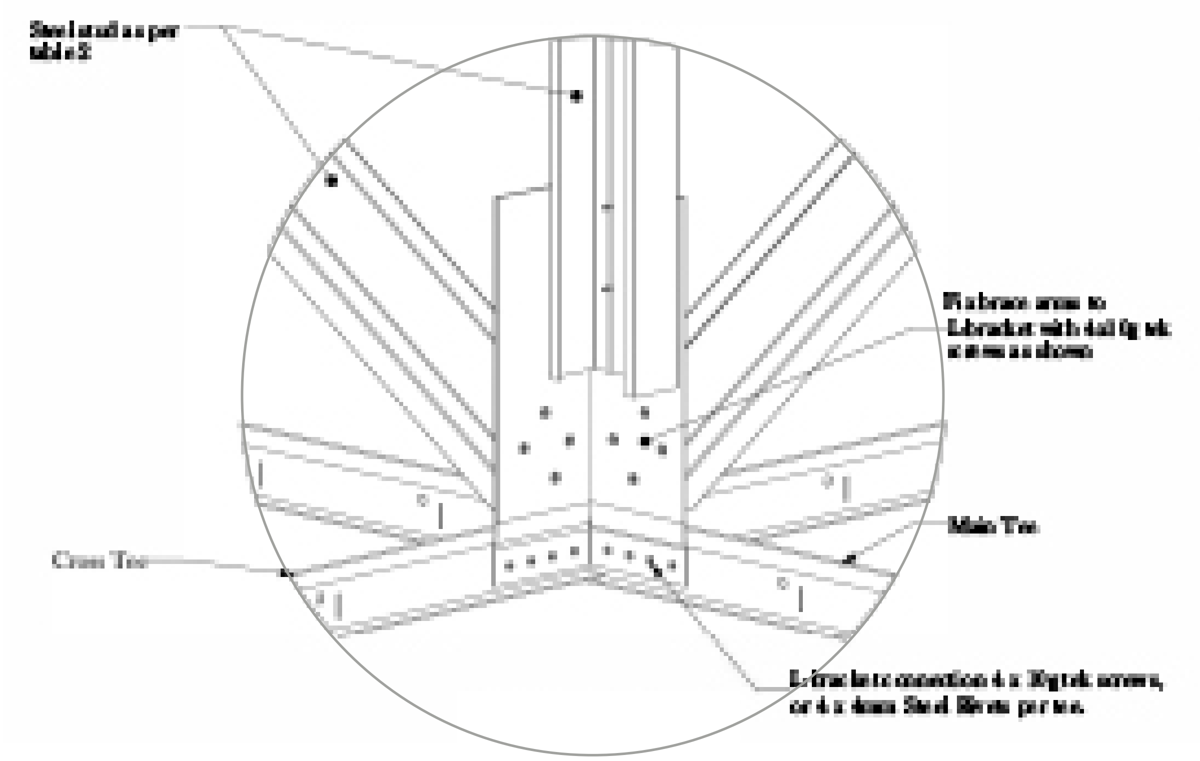


Fixed Edge Detail

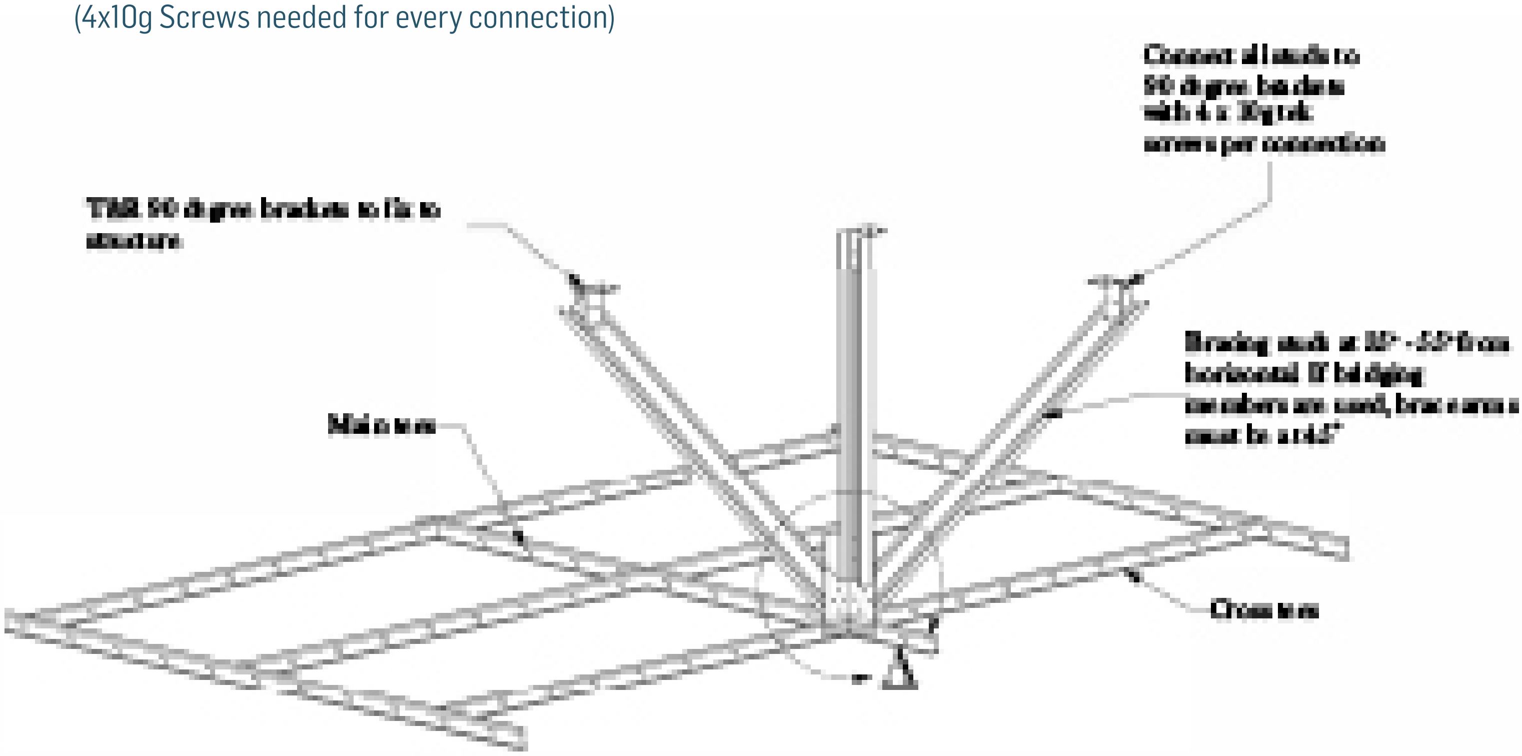


Floating Edge Detail

Back Bracing



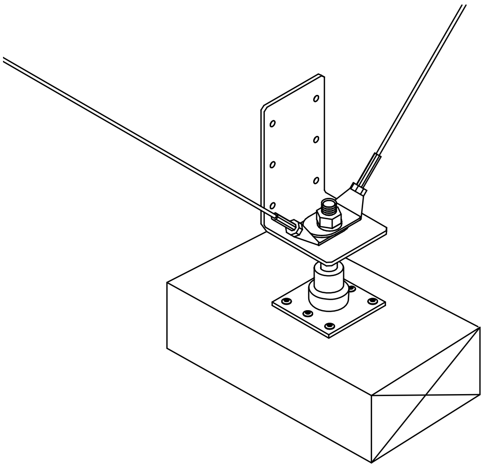
(4x10g Screws needed for every connection)

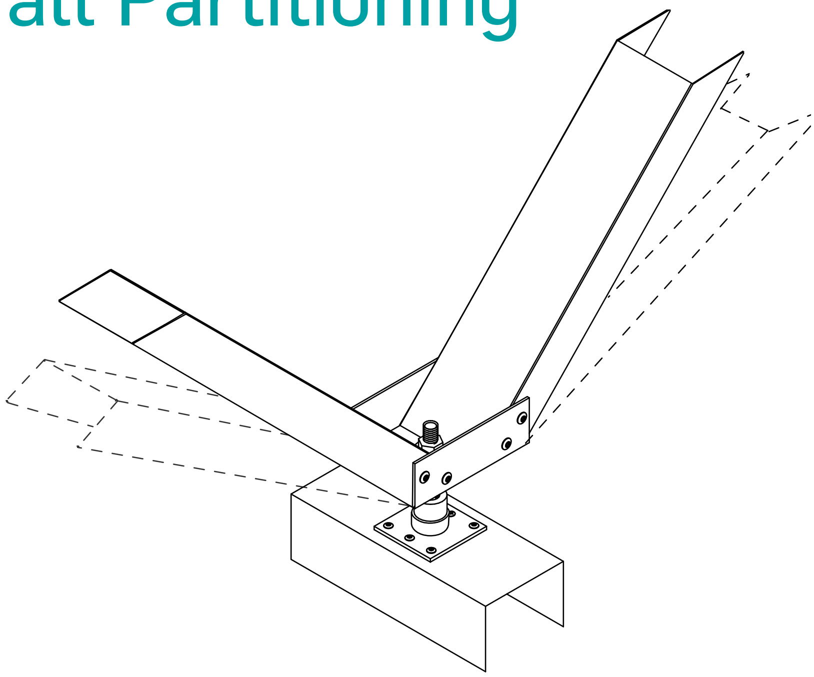


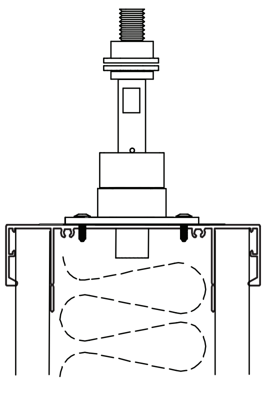
SYSTEM 3D VIEW

VERTIBRACE Wall Partitioning

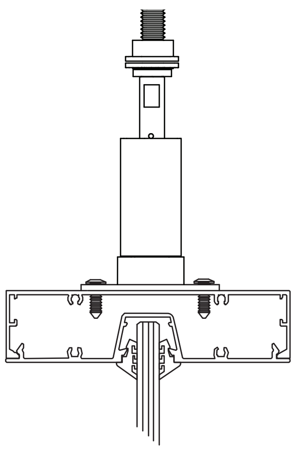
Wall Partitioning Seismic Bracing



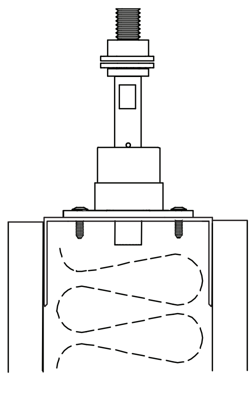




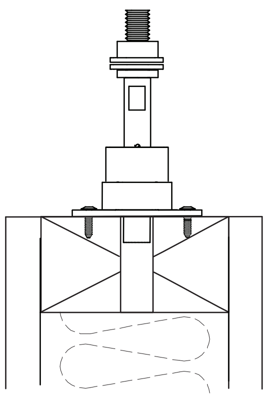
64mm Aluminium Headtrack



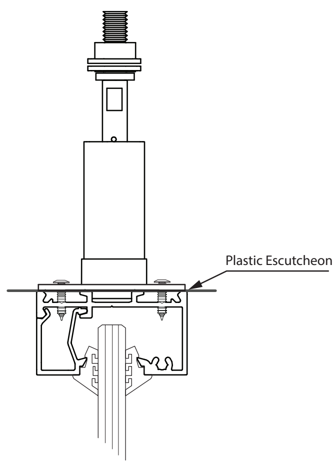
Pocket Headtrack



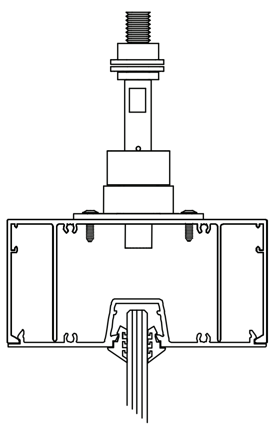
Steel Headtrack



Timber Headtrack

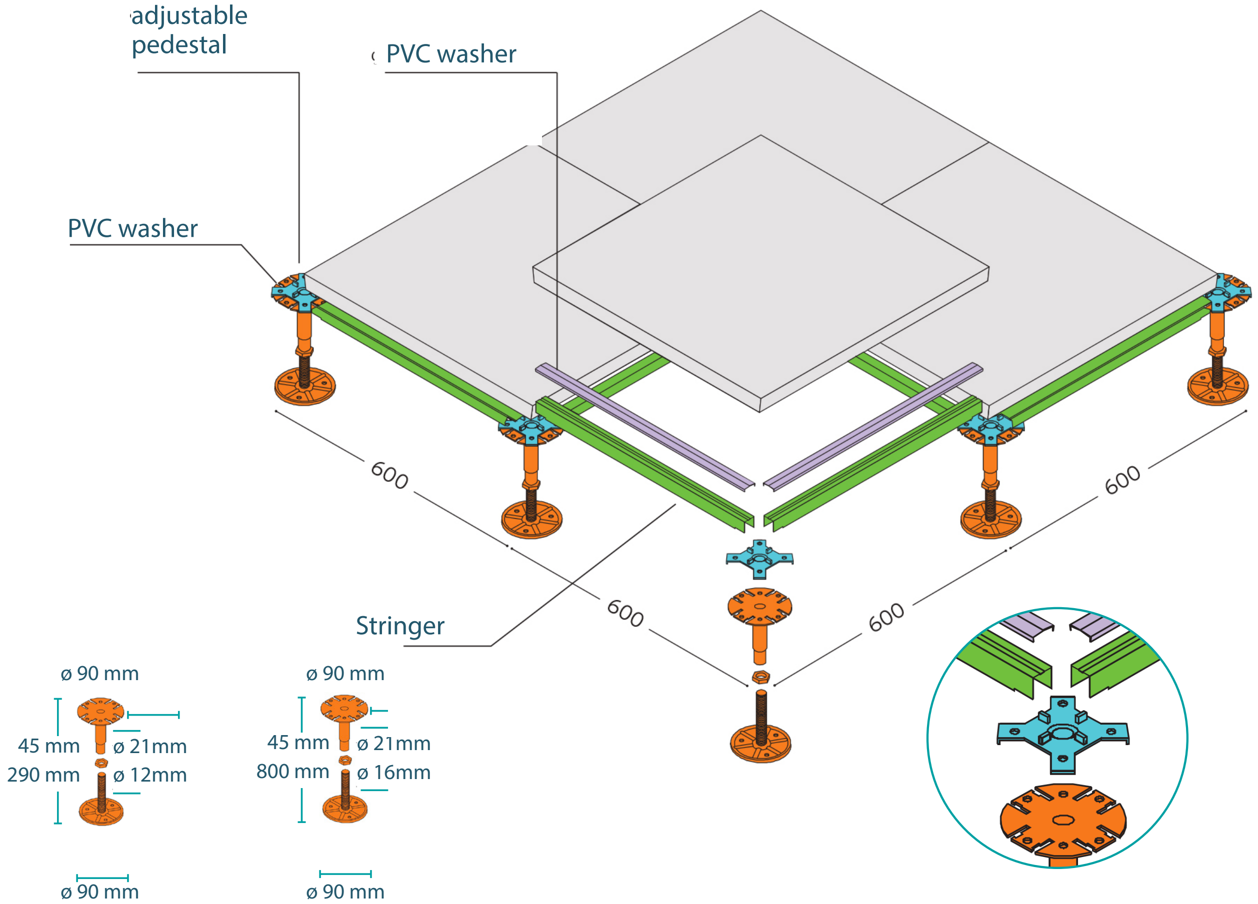


45mm Headtrack



Seismic Pocket Headtrack

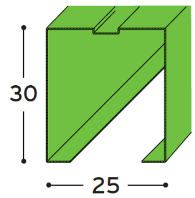
Floor System



ON REQUEST

conductive washer

STRUCTURE



WEIGHT

0.270 kg/pcs

TECHNICAL DATA

Aspects of performance value (UNI 13964 - 2005)

FIRE REACTION

(Under structure) Class A1 DM 10/03/05 DEC. 2000/147/CE

MECHANICAL RESISTANCE

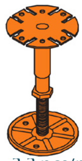
(Under structure) 548.80 N/m² Normal break load

DURABILITY

Protection against corrosion

SYSTEM COMPONENTS

Pedestal



Size

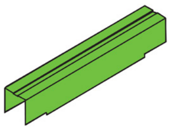
90mm 3.3 pcs/m²

PVC WASHER

Size

90mm 33 pcs/m²

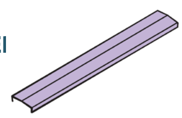
STRINGER



Size

L560mm 6 pcs/m²

PVC WASHEI



Size

L560mm 6 pcs/m²

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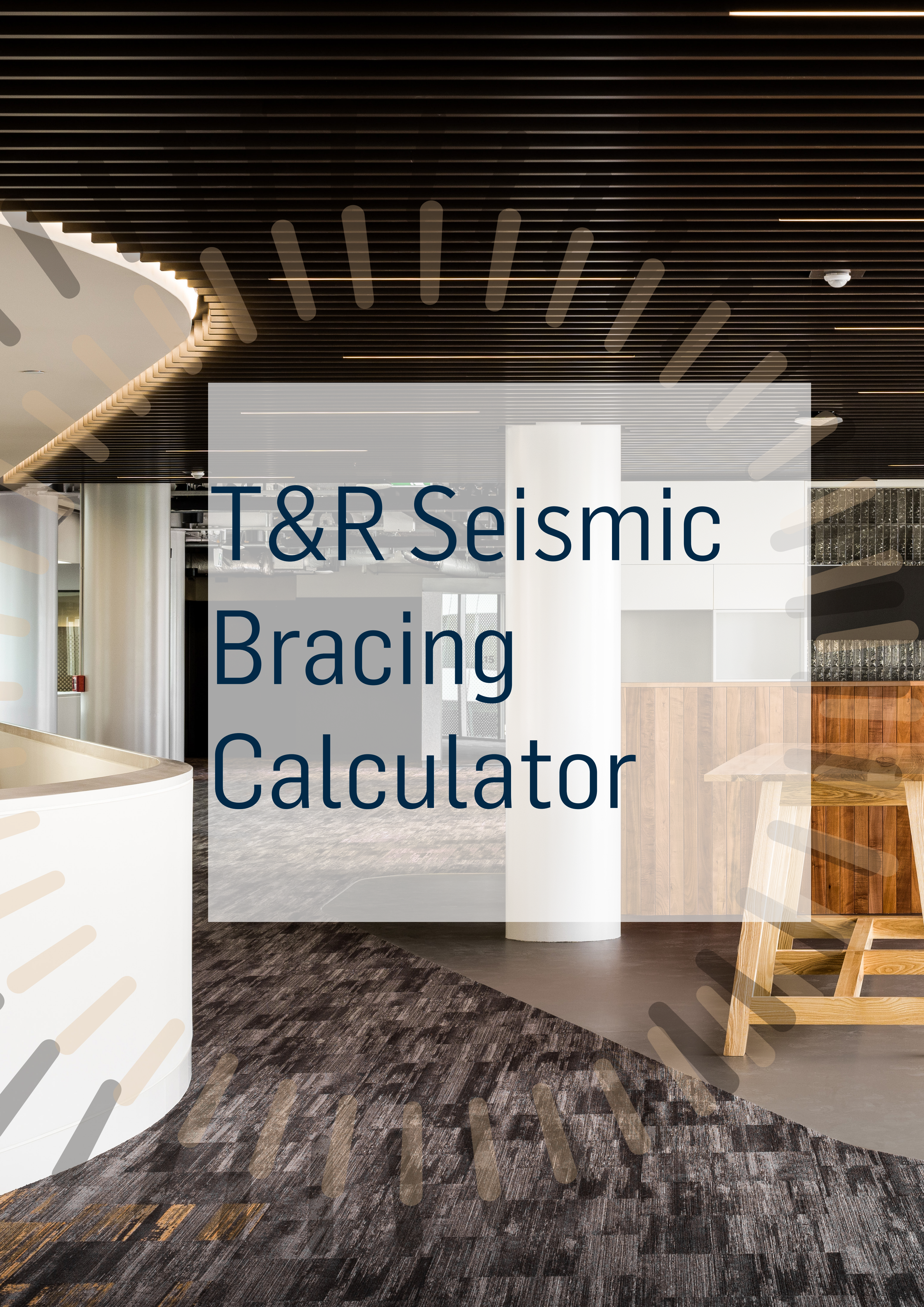

T&R Seismic Bracing Calculator

T&R Calculator

AVAILABLE ONLINE:

Visit http://www.tris.co.nz/index/home/Seismic_Calculator

Recommended Use:

The generic seismic design guide can be used to approximate the seismic bracing requirements for a suspended ceiling. The guide is intended for use by installers or designers to determine bracing requirements, and is based on a range of conservative assumptions used to determine seismic loads. Assumptions and limitations are outlined below.

To simplify the calculations required, the use of this design guide is restricted to T&R Interiors Systems' CBI Two Way Suspended Ceiling Grid and the compression-post design of seismic brace shown in this guide.

This guide should be used for indicative seismic design and costing for ceiling bracing in buildings of importance level 3 or below.

Note: Use of a generic design DOES NOT constitute a Producer Statement (PS1-Design) for the ceiling.

Usage Notes

This guide allows a designer to calculate required bracing for suspended ceilings. The calculations are based on conservative assumptions. Reduced seismic bracing designs for individual sites may be possible if a suitably qualified Chartered Professional Engineer carries out a site-specific design. This guide should not be used as a calculation template for a PS-1; specific seismic design should be carried out for these cases.

This guide has been prepared by JSK Consulting Engineers for T&R Interior Systems with the usual care and thoroughness of the consulting profession. Interpretation and application of this guide is outside the control of the engineer and therefore is the users' responsibility. This guide does not constitute a producer statement or engineer's certification, and is not for use with trafficable ceilings or ceilings which support partition walls or any other service load.

Allowance for relative motion between the ceiling and structure must be provided by floating edges. If the perimeter bracing method is used then two perpendicular edges must be fixed with the remaining two floating. If back bracing to the upper structure is used, then all edges must be floating. Floating edges must also be provided around rigid or separately braced items that pass through the ceiling. The amount of clearance should be checked by an engineer on a case-by-case basis.

Consult a suitably qualified engineer for the expected earthquake deflections of the structure.

Seismic Calculator available online

http://www.tris.co.nz/index/home/Seismic_Calculator

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Issue: July 2020