

QUAKEWORX

UNSHAKEABLE ENGINEERING®

Seismic Restraint for Suspended Ceilings

Despite their simple appearance, suspended ceilings are highly complex assemblies made of various components that are joined by many connections with inherently low capacities, making them vulnerable to earthquakes.

The objective of seismic restraint is to ascertain a successful load path for seismic forces to transfer from the ceiling to the supporting structure, while considering interactions between the ceiling and other building elements. To achieve this, continuity must be maintained between members, relative displacements must be controlled or accommodated at interfaces, and there must be a positive connection between the ceiling system and the supporting structure.

Seismic restraint for ceilings is generally achieved by either **plenum bracing** from an overhead structural soffit, or **perimeter restraint** from abutting walls or bulkheads.

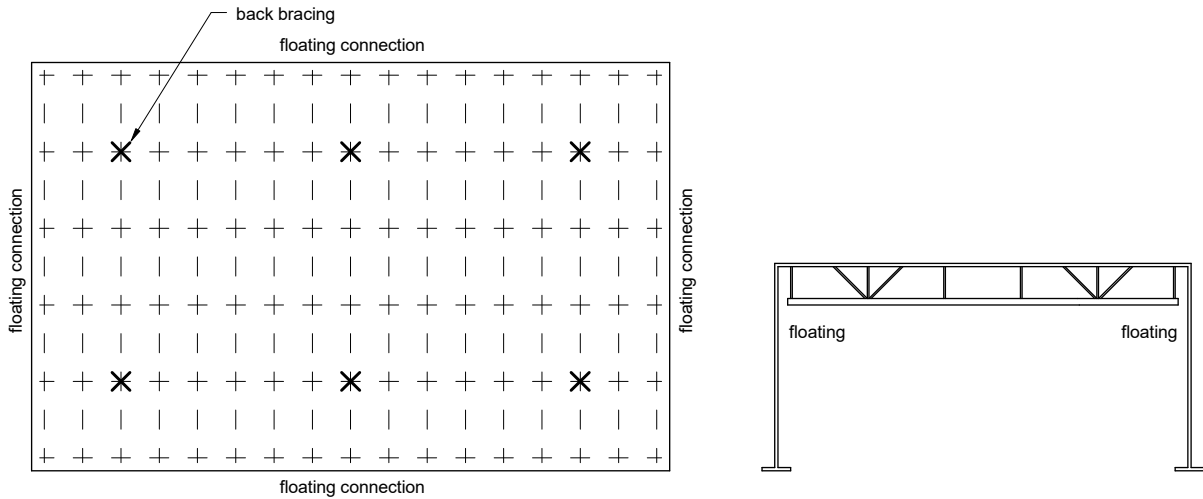


QUĀKWORX

QUĀKWORX is an engineering firm specialising in cold-formed steel structures and the seismic design and certification of nonstructural building components. **QUĀKCLIP**[®] bracing clips and **QUĀKTRAX**[®] restraint tracks for walls and ceilings are among the products developed by this firm.

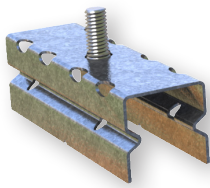
Plenum Bracing (Back Bracing)

This method is where the ceiling system is connected to a regular arrangement of plenum braces consisting of struts and ties which transfer seismic actions from the ceiling to the primary structure above. This method of restraint requires the ceiling to be installed with floating connections around the entire perimeter.

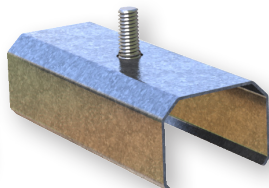


QUAKCLIP®

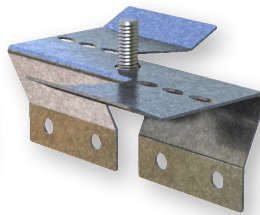
Conventional bracing methods are labor-intensive and often structurally inadequate. QUAKCLIP® is a modulated system of brackets and joiners developed for bracing ceilings, which installs quickly and easily by simply combining these fundamental components:



TCR Joiner



FC Joiner



Tee Joiner



U Bracket

Features & Benefits

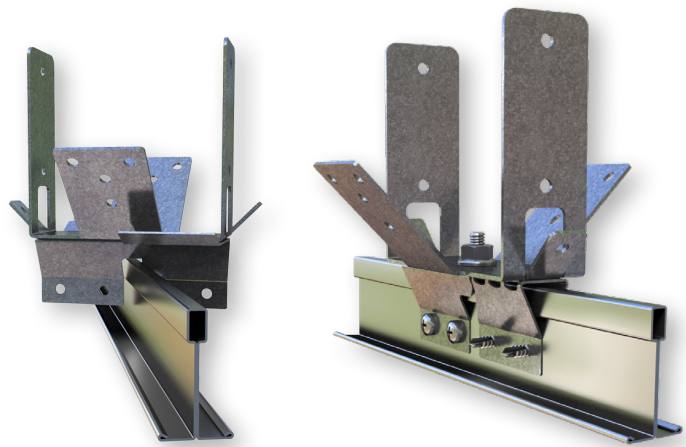
- Quick and easy installation
- Superior seismic performance
- Swivelability helps to avoid service clashes
- Stud bracing for a minimal footprint and effort
- Wire bracing for large plenum heights

QUÄKCLIP® Tee

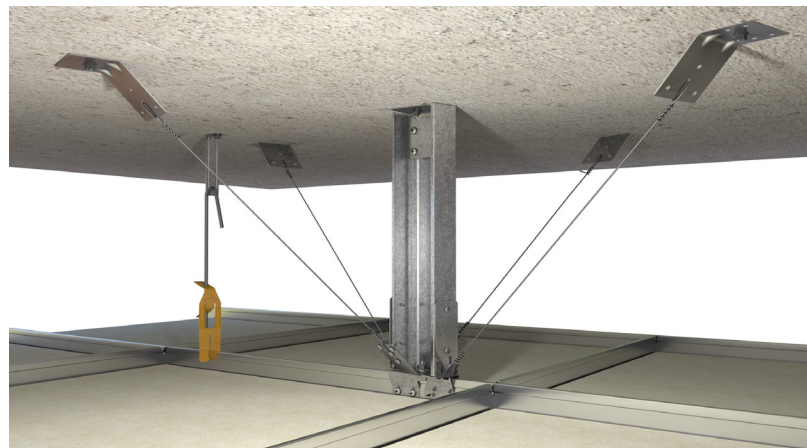


For tee-grid ceilings, the U Bracket is mated with the Tee Joiner to create QUÄKCLIP® Tee.

The Tee Joiner rotate-fits onto a ceiling main runner. The joiner 'wings' are then folded down and screw-fastened, providing a robust connection.



The bracket engages with a vertical post and splayed braces to restrain the ceiling both vertically and laterally. Either tie wire or wall studs can be used for bracing. The use of wire is particularly beneficial where there are large plenum heights and handling and installing studs can prove challenging. The use of studs, on the other hand, reduces the bracing effort and footprint as fewer connections to the structural soffit would be required and the braces would occupy less plenum space in comparison with wire, as only two angled studs would be required rather than four splayed wires. The swivelability of QUÄKCLIP® helps to avoid service clashes.



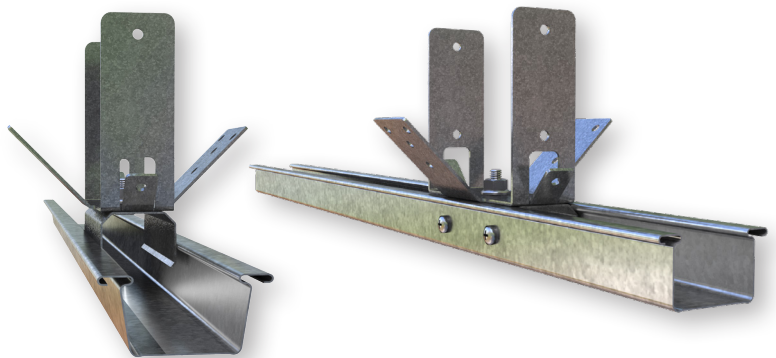
QUÄKCLIP® FC/TCR

QUÄKCLIP® FC

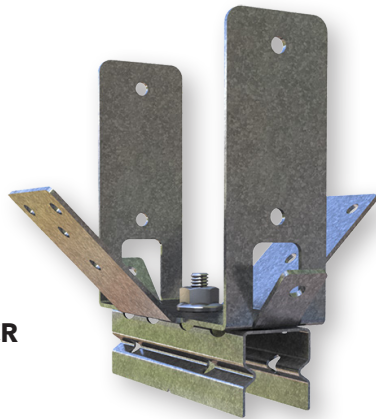


For plasterboard ceilings, the U Bracket is mated with the FC Joiner to create QUÄKCLIP® FC.

The FC Joiner simply press-fits into a furring channel and is fastened with self-tapping screws.

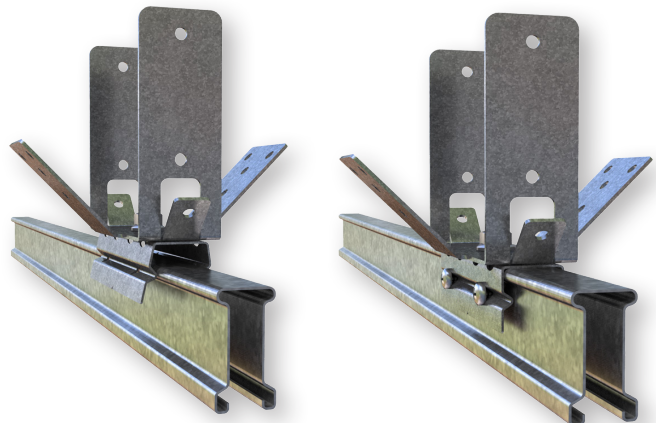


QUÄKCLIP® TCR

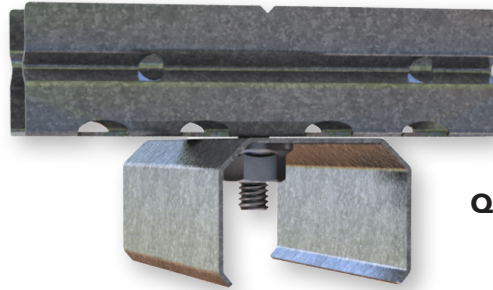


The U Bracket can instead combine with the TCR Joiner to create QUÄKCLIP® TCR.

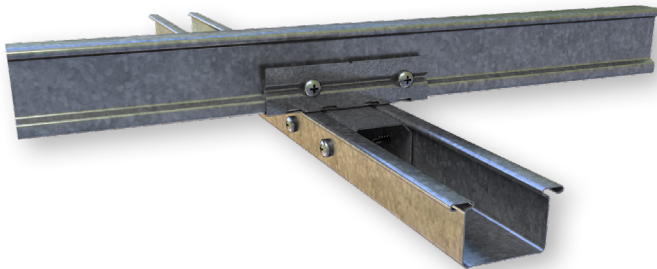
The TCR Joiner simply press-fits onto a ceiling top cross rail and is fastened with self-tapping screws.



QUAKCLIP® FC/TCR

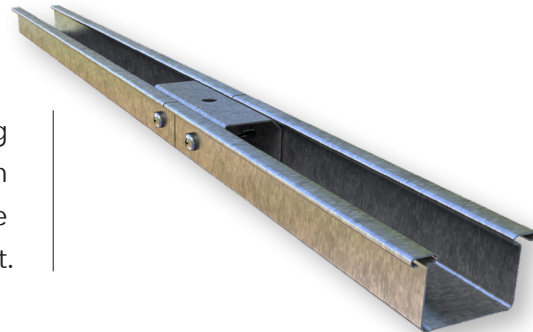


QUAKCLIP® FC/TCR Coupler

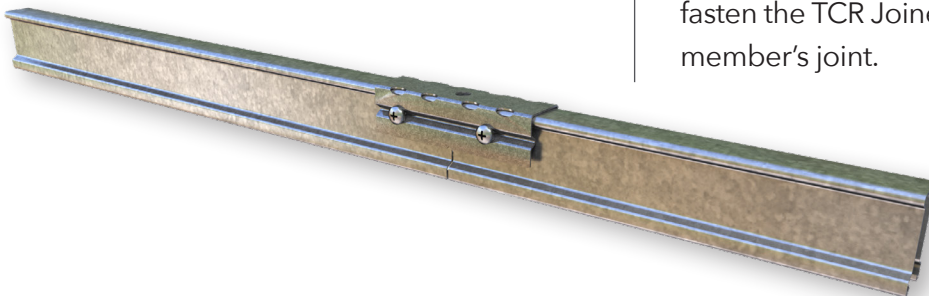


To restrain intersections, combine the FC Joiner and TCR Joiner to create QUAKCLIP® FC/TCR Coupler, and screw-fasten each to the respective grid member.

To splice furring channels, screw-fasten the FC Joiner at the member's joint.

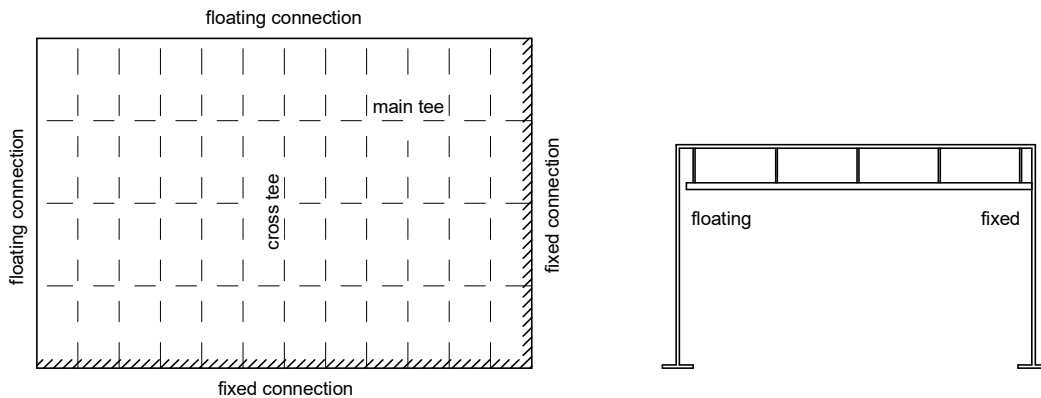


To splice top cross rails, screw-fasten the TCR Joiner at the member's joint.



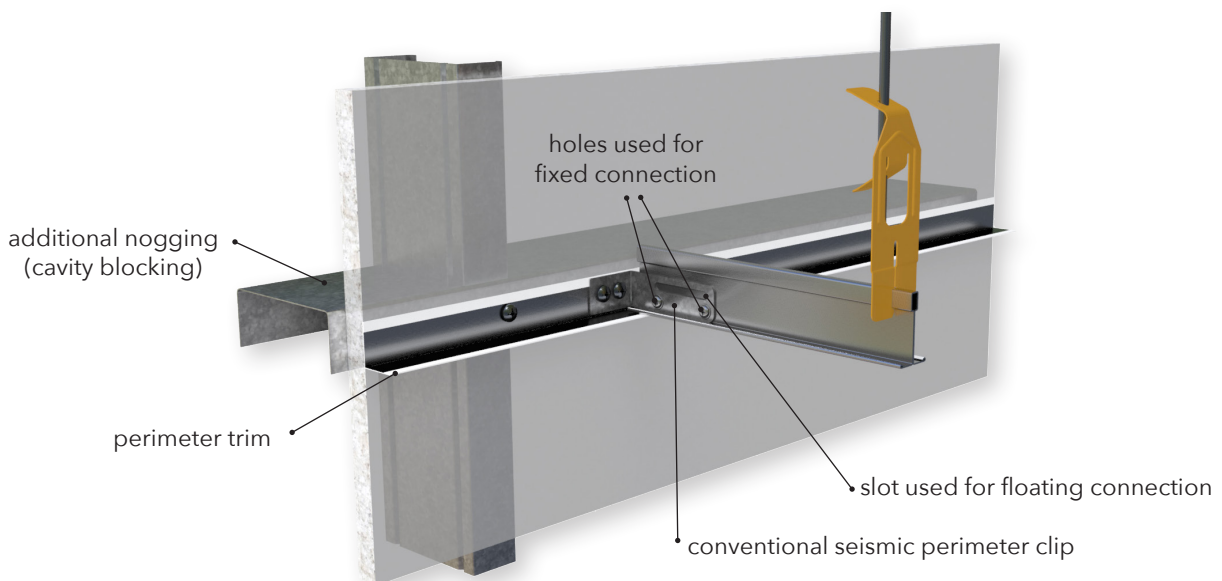
Perimeter Restraint for Exposed-Grid Ceilings

Ceilings may be seismically restrained by connecting their perimeter to an abutting structure, such as a wall or bulkhead. Perimeter restraint requires that every primary and secondary grid member have one end fixed (seismic restraint) and the other end floating (seismic isolation) at the perimeter. Normal practice is for the ceiling to be fixed on two adjacent sides, and floating on the opposing two adjacent sides.



Perimeter Seismic Restraint

Current industry practice involves the use of perimeter seismic clips that allow for either a fixed or floating connection at either end of a grid member. At the fixed end, horizontal loads within the ceiling are transferred to the perimeter wall, providing restraint. At the floating end, the ceiling is seismically isolated from the perimeter to avoid unwanted load swaps resulting from differential movement between opposing walls. Seismic clips are essential, as they prevent the spreading of grid ends and provide stability at ceiling perimeters. Also, seismic clips prevent grid ends from sliding off at the edges. These clips are connected discretely at each terminal end of each grid member. When connecting to a cavity wall (e.g. drywall), an additional row of nogging (cavity blocking) must be installed to provide fixing support for the perimeter clips, which imposes additional cost and effort.

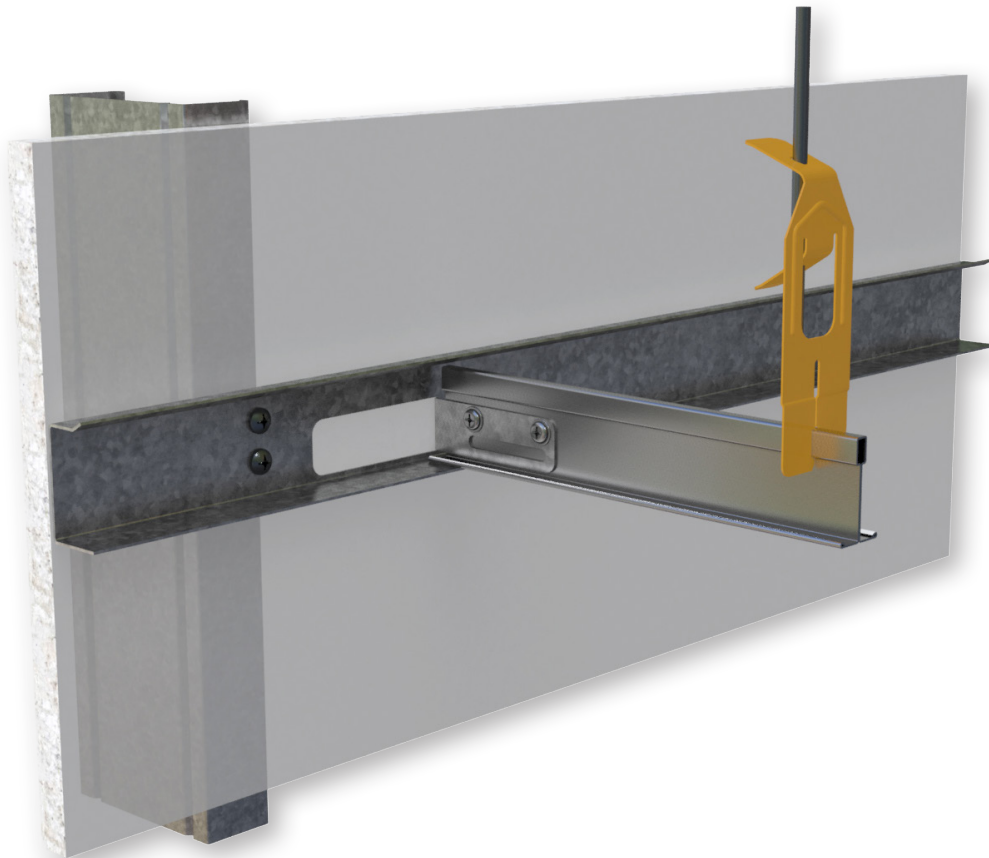
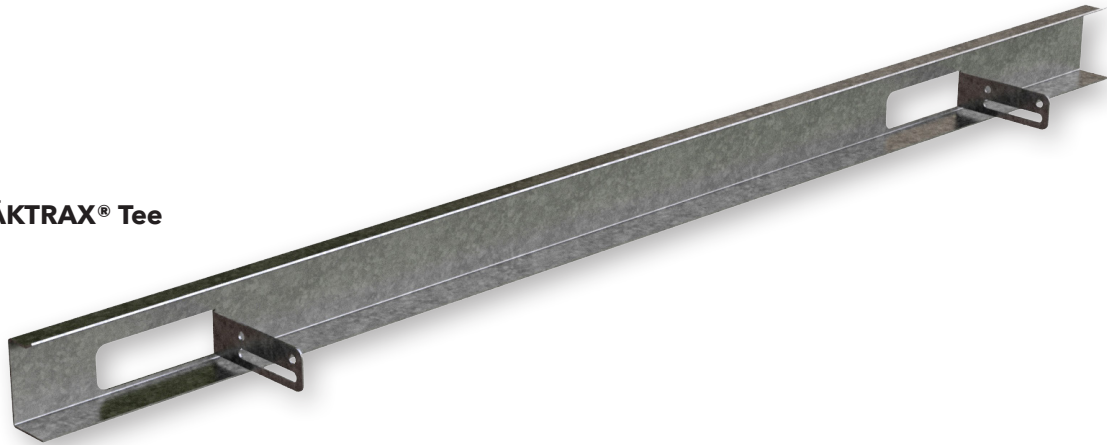


Conventional Perimeter Connection (requires cavity blocking)

QUAKTRAX® Tee

Our innovative seismic perimeter track, QUAKTRAX® Tee, integrates the perimeter trim, seismic clips, and supporting nogging into a single, continuous, face-fixed member. As such, fastening is reduced and cavity blocking is not required, saving time and money.

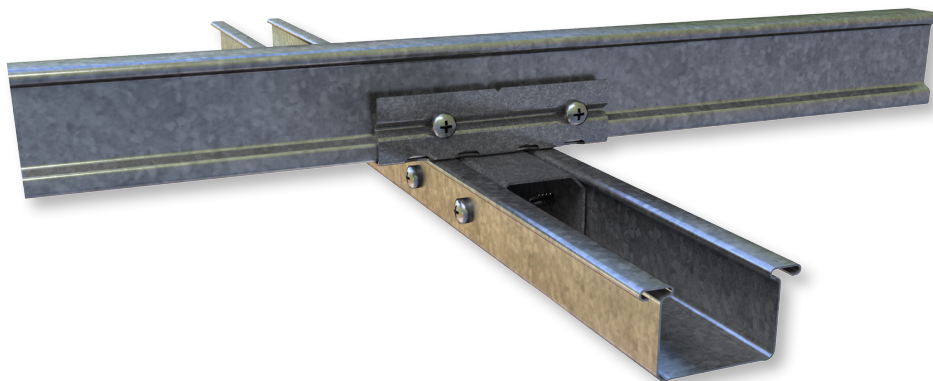
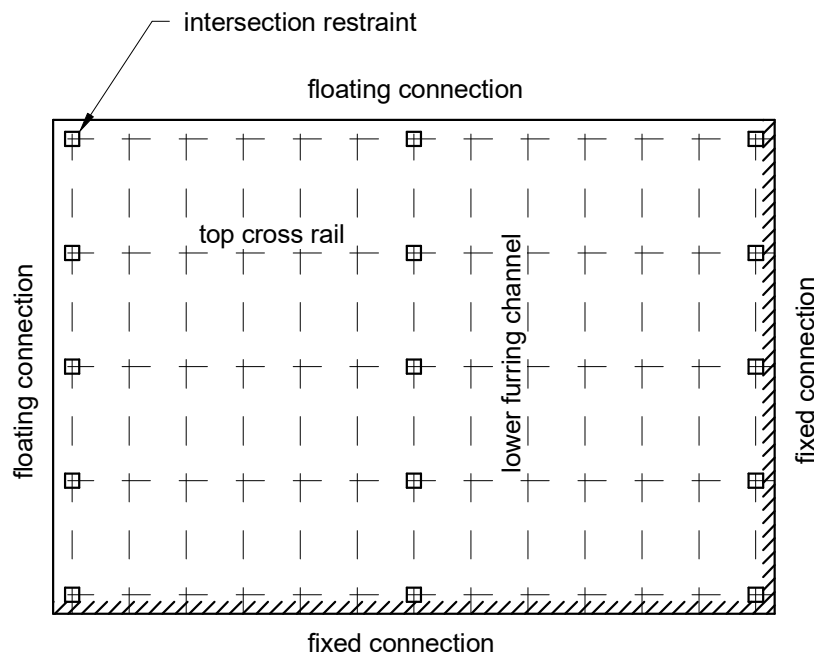
QUAKTRAX® Tee



Perimeter Connection With QUAKTRAX® Tee (cavity blocking not required)

Perimeter Restraint for Concealed-Grid Ceilings

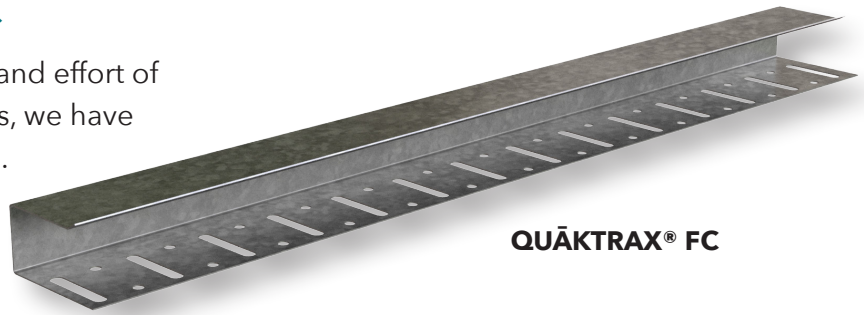
For concealed-grid ceilings having over-crossing rails, the intersection between lower furring channels and top cross rails must be restrained by additional bracketry, as locking keys are not designed for horizontal restraint. Failing to do so may result in sliding between the rails in an earthquake event, rendering perimeter restraint ineffective. Also, improper restraint of grid intersections, such as screw-fastening the top cross rail and the locking key, may cause disengagement of the furring channel from the locking key under lateral loads and a subsequent progressive collapse of the entire ceiling. This type of ceiling failure, commonly known as **blanket collapse**, may compromise life safety and result in catastrophic fatalities. Provision for such intersection restraint incurs additional cost and effort.



Perimeter Fixing With Additional Intersection Restraint Using QUAKCLIP® FC/TCR Coupler

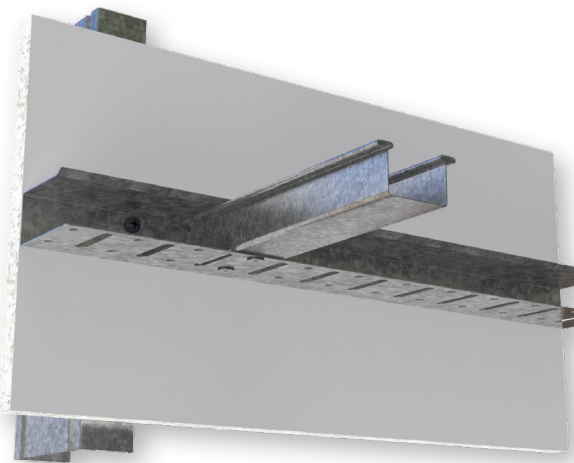
QUÄKTRAX® FC

To avoid the excessive cost and effort of restraining grid intersections, we have developed QUÄKTRAX® FC.

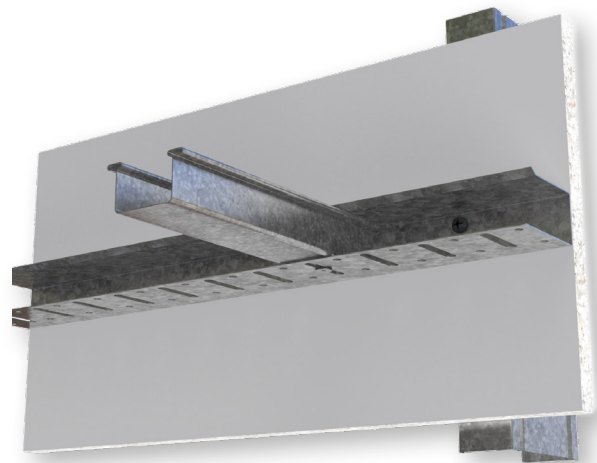


QUÄKTRAX® FC

In application, each furring channel is screw-fastened through the standard holes of the track at one end*, while at the opposite end, a screw is loosely fastened through one of the slots provided. This creates a laterally-restrained floating connection which allows the ceiling to slide in the furring channel direction but prevents movement in the top cross rail direction.

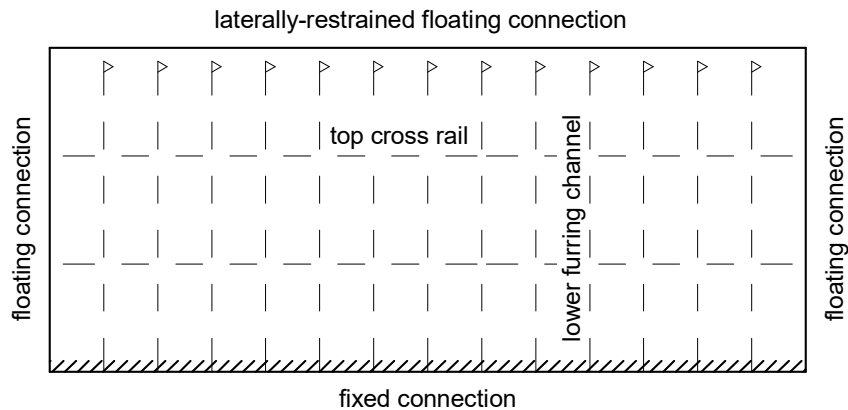


Fixed Connection



Laterally Restrained Floating Connection

As such, QUÄKTRAX® FC provides restraint in both horizontal directions of the ceiling by the furring channels alone, without relying on top cross rails and additional intersection restraint, saving time and money.



Perimeter Restraint With QUÄKTRAX® FC

*A standard perimeter track may be used for fixed connections, provided that the rules for minimum fastener spacing and edge and end distances are followed.



QUAKCALX is our premium design, construction monitoring and certification service to ensure that QUAKCLIP® and QUAKTRAX® installations are carried out in compliance with relevant standards including:

- AS/NZS 4600 Cold-Formed Steel Structures
- AS/NZS 2785 Suspended Ceilings - Design and Installation
- AS/NZS 1170.0 Structural Design Actions - Part 0: General Principles
- AS 1170.4 Structural Design Actions - Part 4: Earthquake Actions in Australia
- NZS 1170.5 Structural Design Actions - Part 5: Earthquake Actions - New Zealand

PO Box 282 | West Pennant Hills NSW 2125 | Australia

+61 484 284 347 | info@quakworx.com

quakworx.com

Disclaimer

The information in this document is illustrative only and must not be used for design purposes. QUAKWORX cannot accept any liability arising from any information or lack thereof in this publication. Consult with us for project-specific design advice.