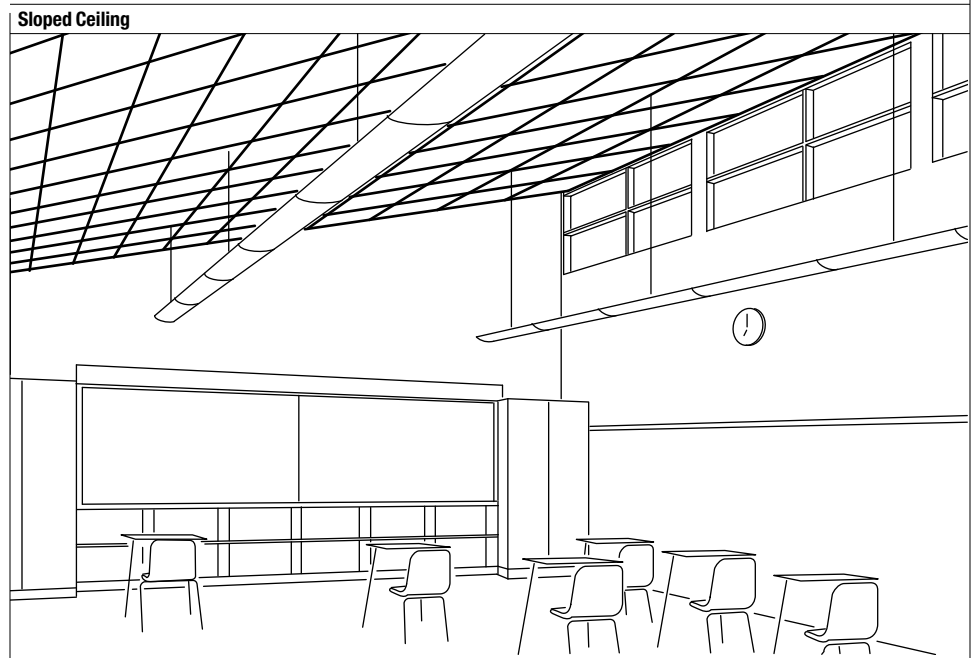

Sloped Ceilings

Designing and installing a sloped suspended ceiling can contribute to LEED® EQ Credit 8.1 Daylighting and Views. This design philosophy provides the building occupants a connection between indoor spaces and the outdoors through the introduction of daylight and views into the regularly occupied areas of the building. Generally, a sloped suspended ceiling and its supports and attachments are installed and designed in the same manner as a level suspended ceiling. However, there are exceptions and the actual construction of a sloped suspended ceiling in a seismic design category can meet code requirements in different ways.



USG® has a long history of product development and innovation for suspended ceiling systems in seismic applications and continues to commit resources to this endeavor. We have thoroughly examined lay-in sloped ceilings for seismic design categories C-F. The findings of this study and our recommendations are presented in this technical guide to assist in the interpretation of this ceiling application. There are many factors that affect the application of a sloped ceiling in a seismic design category and USG recommends that the design team, consulting engineers and code officials work together to analyze these factors and determine the appropriate construction and application of lay-in acoustical sloped ceilings. Because codes continue to evolve, check with a local official prior to designing and installing a sloped ceiling system.

Guidelines

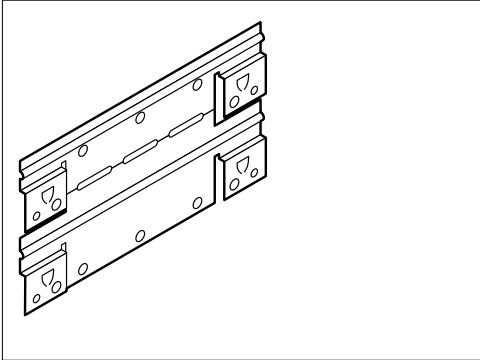
Sloped Ceilings

- Hold-down clips should be used for ceilings with slopes $\geq 15^\circ$.
- At least one hold-down should be used for each panel installed on the perimeter of the higher/top end of the slope.
- USG V15 and L15 hold-down clips are acceptable for use in sloped installations.
- The main tees shall run up/down, parallel with the slope.
- Hanger wires shall be suspended vertically.
- Struts shall remain vertical and the splay wires installed at max. 45° to the horizontal.
- Fabricated or locally sourced wall molding can be used to match the angles of the slope.
- For installations where 7/8-in. wall molding is desired and the slope is $> 15^\circ$, it is recommended that USG M7 wall molding be installed with the USG adjustable wall molding bracket.
- For installations utilizing the SB2 adjustable wall molding bracket, the brackets shall be spaced max. 24 in.
- Lower/bottom end of slope should be installed as a tight side in seismic design categories D, E and F.
- Higher/top end of slope should be installed as a floating side in seismic design categories D, E and F.
- The USG MAC2 clip may be used to secure the tee ends to the wall molding and field modified to match the slope of the tees.
- For installations with fabricated molding where the slope is $< 15^\circ$, the USG ACM7 seismic clip may be used on the lower/bottom end of slope and shall be installed with the back flanges on the inside of the wall molding with a fastener through either top fastener hole on the wing of the clip.
- For installations with fabricated molding where the slope is $< 15^\circ$, the USG ACM7 seismic clip may be used on the higher/top end of slope and shall be installed with the back flanges on the inside of the wall molding with a fastener through either lower fastener hole on the wing.
- Ceilings with slopes $> 25^\circ$ should be engineered.

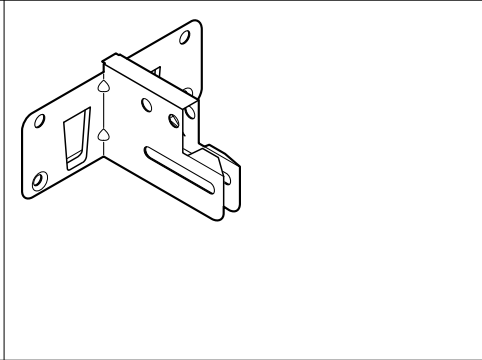
Components

Sloped Ceilings

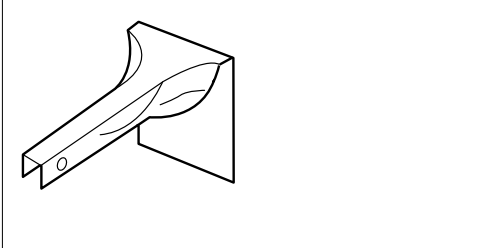
SB2 Adjustable Wall Molding Bracket



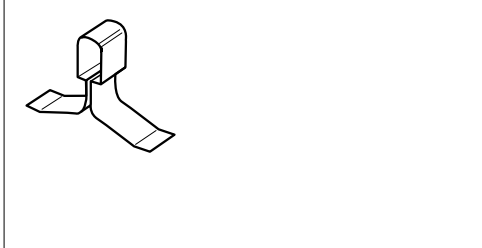
ACM7 Seismic Clip



MAC2 Clip



Panel Hold Down Clip



Requirements

Sloped Ceilings

Seismic Requirements¹

	Seismic Design Category C	Seismic Design Category D, E, F
Main-tee Classifications	Intermediate Duty	Heavy Duty
Perimeter vertical hanger wires not more than 8 in. from wall	Not required ²	Required
Grid end/wall clearance	3/8 in.	3/4 in. (two adjacent sides)
Perimeter closure (molding) width ³	7/8-in. min.	2-in. min. without seismic clip
Perimeter tee ends tied together at perimeters ⁴	Required	Required
Horizontal restraint (splay wires or rigid bracing) within 2 in. of intersection and splayed 90° apart at 45° angles for ceiling areas > 1,000 sq. ft.	Not required	Required
Compression posts (struts) 12 ft. o.c. in both directions, starting 6 ft. from walls for ceiling areas > 1,000 sq. ft.	Not required	Required
Seismic separation joint for ceiling areas > 2,500 sq. ft.	Not required	Required

¹ This is only intended as a quick reference. For a complete listing of these requirements please visit usg.com or seismicceilings.com.

Because codes continue to evolve, check with a local official prior to designing and installing a suspended ceiling system.

² When the perimeter closure angle approved for use provides min. 7/8 in [22 mm] support ledge.

³ Please see ICC-ESR-1222 for more information regarding the alternative wall moldings that may be used with the USG ACM7 seismic clip.

⁴ USG ACM7 seismic clip satisfies this requirement per ICC-ESR-1222.

Perimeter Treatment

Lay-in Suspended Ceiling Slope	Non-Seismic Installation	Seismic Design Category C	Seismic Design Category D, E, F
< 15°	USG M7 wall molding with positive attachment on all tee ends or 7/8-in. fabricated / locally sourced wall molding with positive attachment on all tee ends	USG M7 wall molding with ACM7 seismic clip or 7/8-in. fabricated / locally sourced wall molding with ACM7 seismic clip	USG M7 wall molding with ACM7 seismic clip or 7/8-in. fabricated / locally sourced wall molding with ACM7 seismic clip
15° – 25°	SB2 adjustable wall molding bracket with positive attachment on all tee ends or 7/8-in. fabricated / locally sourced wall molding with positive attachment on all tee ends	SB2 adjustable wall molding bracket installed with USG M7 wall molding and the USG ACM7 seismic clip	SB2 adjustable wall molding bracket installed with USG M7 wall molding and the USG ACM7 seismic clip
> 25°	Fabricated / locally sourced wall molding with positive attachment on all tee ends	Engineered	Engineered

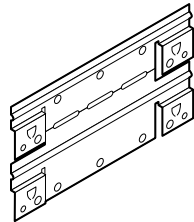
Sloped Ceiling Perimeter Treatment

SB2 Adjustable Wall Molding Bracket

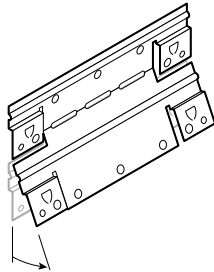
The SB2 adjustable wall molding bracket is a convenient way to secure standard wall molding at an angle to accommodate a sloped acoustical ceiling.

The brackets can be field modified to accommodate numerous slopes while utilizing standard wall molding. The SB2 adjustable wall molding bracket eliminates the need for fabricated wall molding and facilitates the use of the USG ACM7 seismic clip in sloped applications. Seismically tested and listed in PEI Evaluation Report, PER-12059.

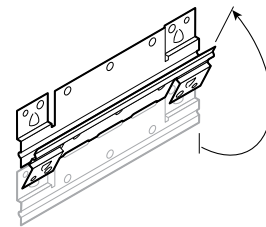
SB2 Adjustable Wall Molding Bracket



Up slope



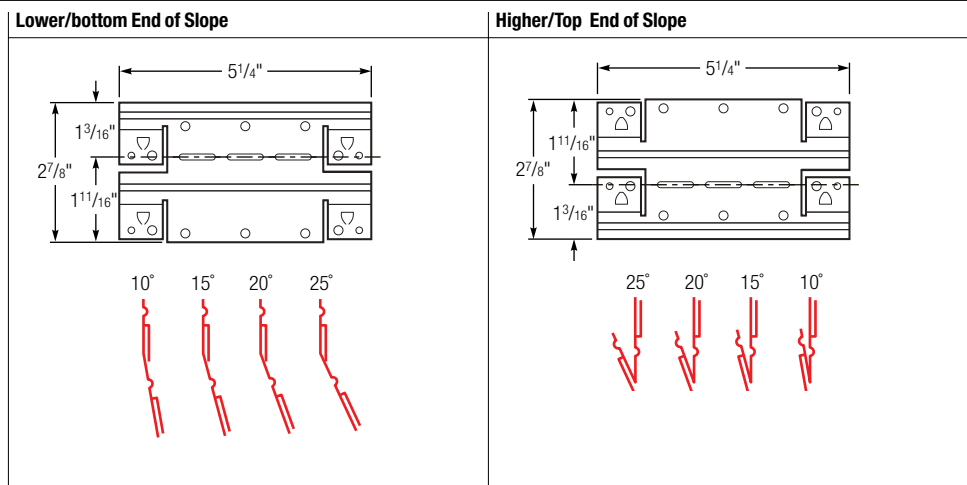
Down slope



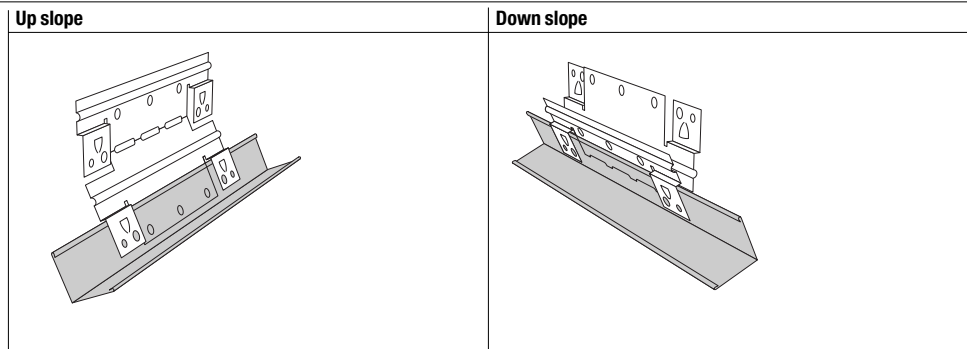
SB2 Adjustable Wall Molding Bracket

Installation

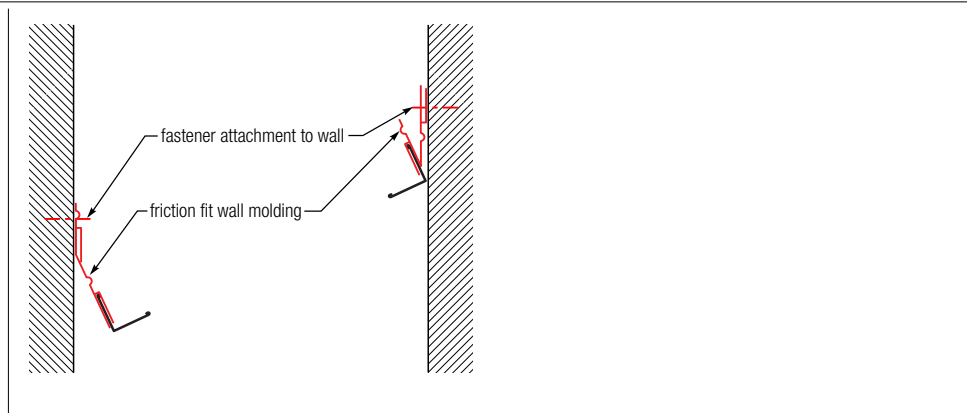
Typical Angles



Placement



Attachment to Wall



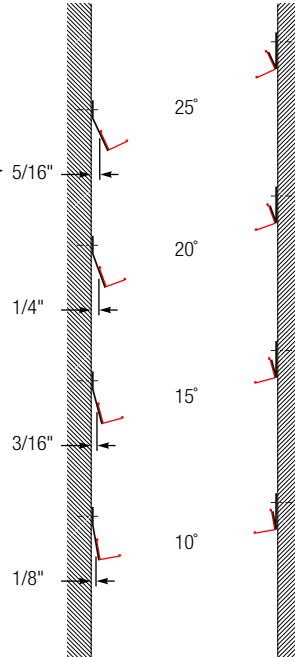
SB2 Adjustable Wall Molding Bracket

Installation

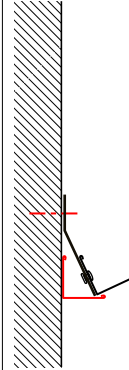
Gaps

Clearance Gaps

Visible gap located on the lower/bottom end of the slope due to the angle of the molding.



Additional Wall Molding to Finish Gap



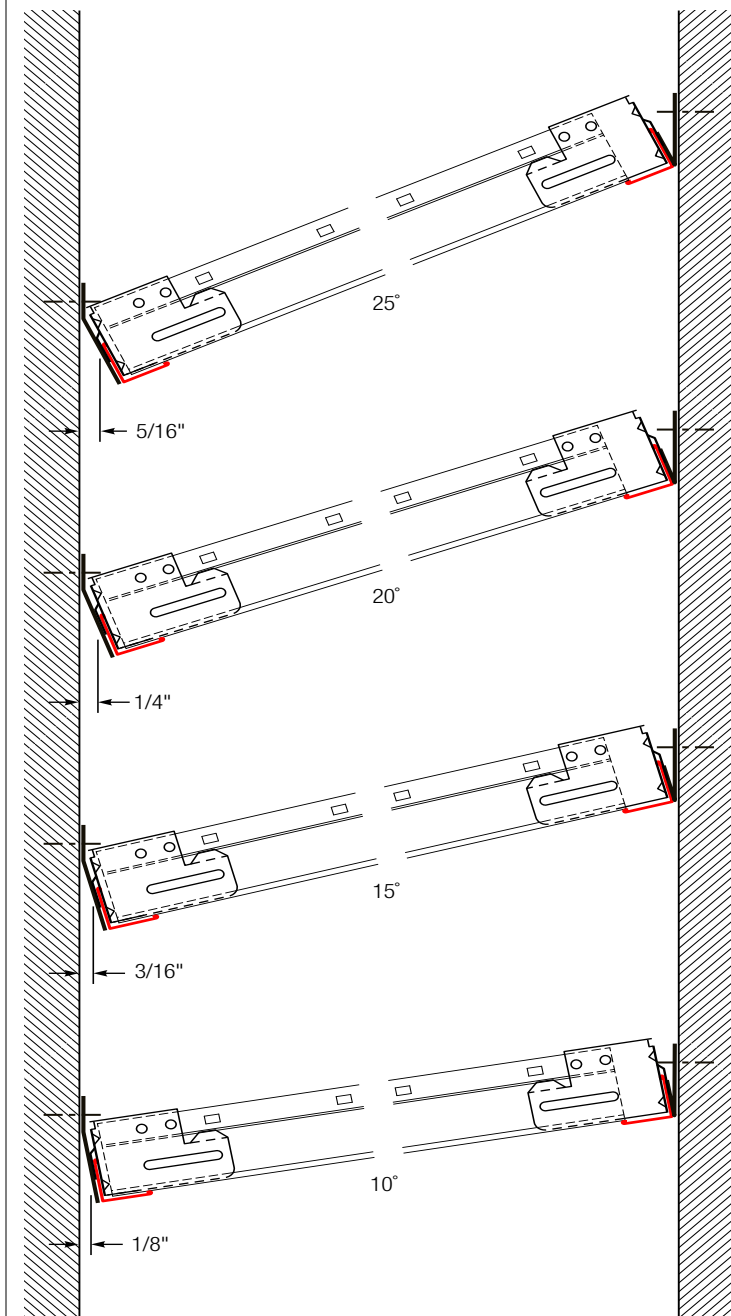
Note: Additional wall molding may be applied below the angled wall molding to conceal the gap created by the sloped ceiling.

SB2 Adjustable Wall Molding Bracket

Installation

Seismic Applications

Angles and gaps with ACM7 Clip



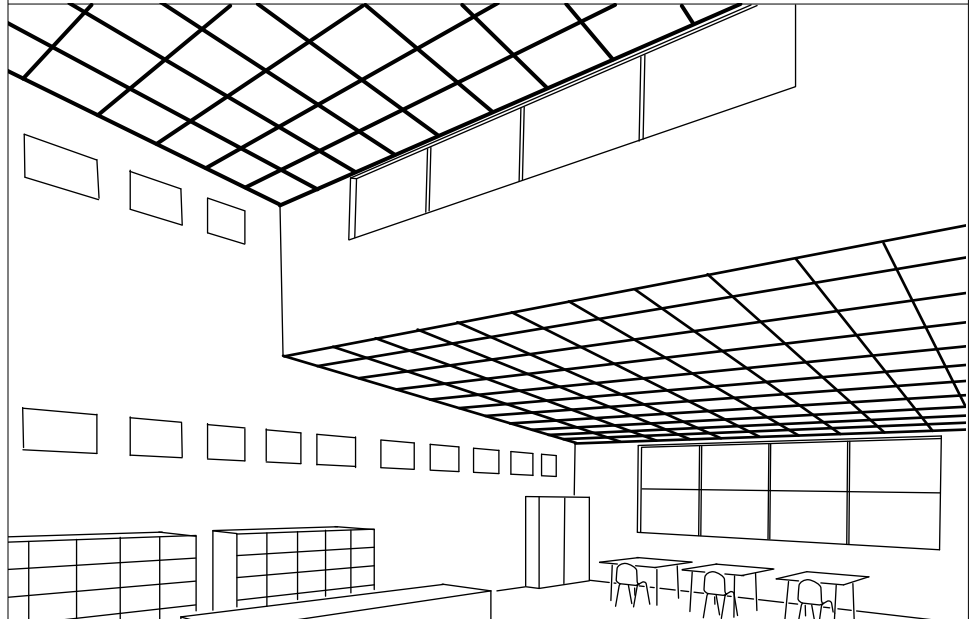
Note: 3/4" gap shown for typical seismic design categories D-F. 3/8" gap is typical for seismic design category C.

Construction

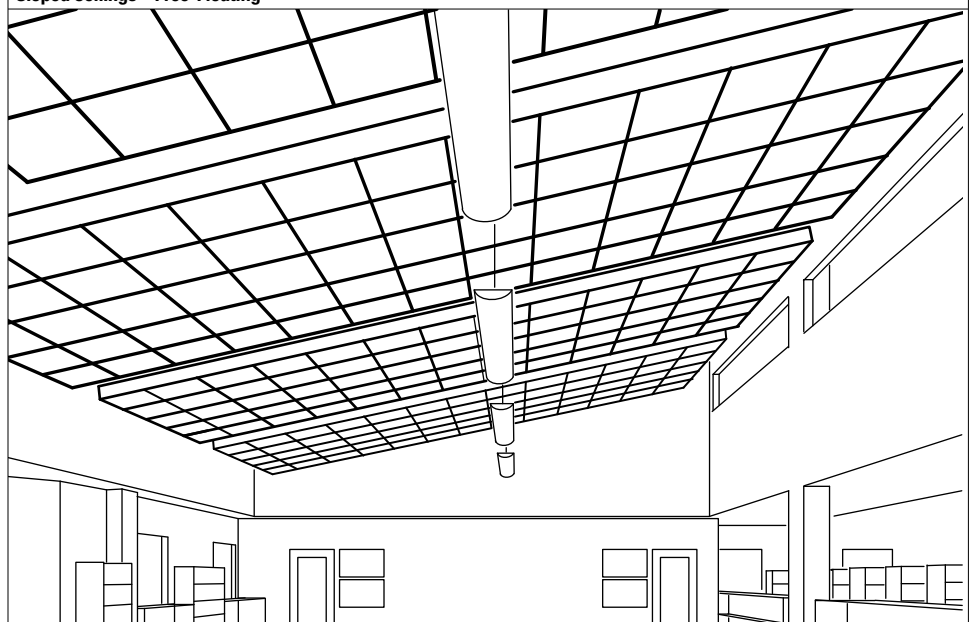
Attached Free-Floating

Generally, sloped suspended ceilings are installed attached at the perimeter or free-floating from the perimeter.

Sloped Ceilings – Attached



Sloped Ceilings – Free-Floating



Construction

Seismic Non-Seismic

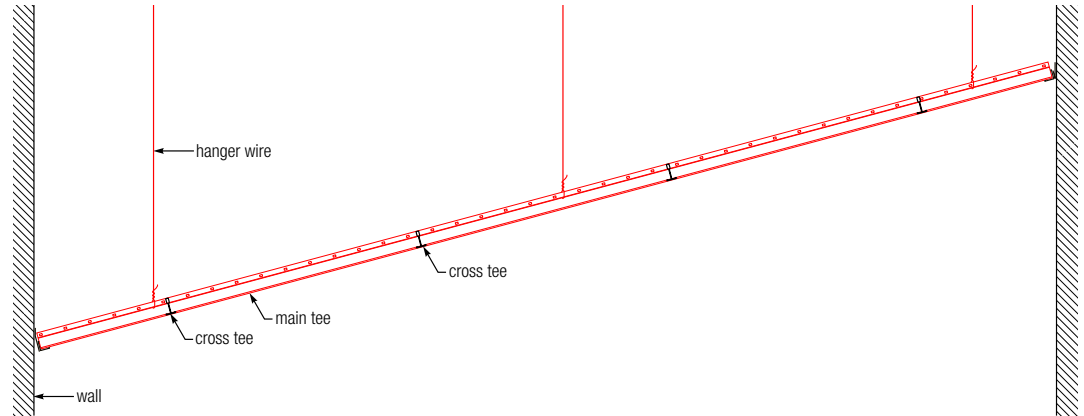
Construction	Non-Seismic Installation		Seismic Installation			
	Attached	Free-floating	Attached		Free-floating	
Category	—	—	Seismic Design Category C	Seismic Design Category D, E, F	Seismic Design Category C	Seismic Design Category D, E, F
Main-tee Classifications	Intermediate or Heavy Duty	Intermediate or Heavy Duty	Intermediate Duty	Heavy Duty	Intermediate Duty	Heavy Duty
Perimeter vertical hanger wires not more than 8 in. from wall	Not required	Not required	Not required	Required	N/A	N/A
Grid end/wall clearance	N/A	N/A	3/8 in.	3/4 in. (two adjacent sides)	N/A	N/A
Perimeter closure (molding) width	N/A	N/A	7/8-in. min.	2-in. min. without seismic clip	A perimeter trim or channel molding is typically used.	A perimeter trim or channel molding is typically used.
Perimeter tee ends tied together at perimeters*	Not required	Not required	Required	Required	Required	Required
Horizontal restraint (splay wires or rigid bracing) within 2 in. of intersection and splayed 90° apart at min. 45° angles for ceiling areas > 1,000 sq. ft.	Not required	Not required	Not required	Required	Not required	Required
Compression posts (struts) 12 ft. o.c. in both directions, starting 6 ft. from walls for ceiling areas > 1,000 sq. ft.	Not required	Not required	Not required	Required	Not required	Required
Seismic separation joint for ceiling areas > 2,500 sq. ft.	Not required	Not required	Not required	Required	Not required	Required
Hold-down clips	Not required	Not required	At least one installed for each panel located at the perimeter of the higher/top end of the slope. At least one installed for each panel in ceilings with slopes ≥ 15°.	At least one installed for each panel located at the perimeter of the higher/top end of the slope. At least one installed for each panel in ceilings with slopes ≥ 15°.	At least one installed for each panel located around the perimeter in ceilings with slopes ≥ 15°.	At least one installed for each panel located around the perimeter in ceilings with slopes ≥ 15°.

*USG ACM7 seismic clip satisfies this requirement per ICC-ESR-1222.

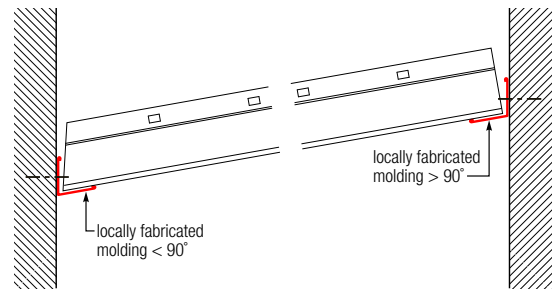
Applications

General

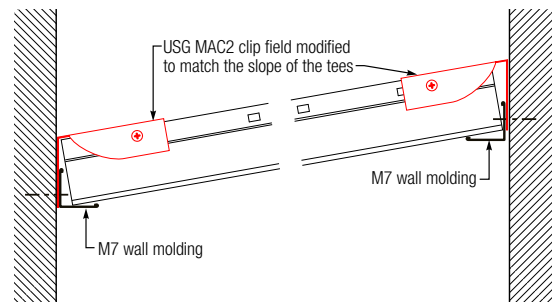
Main tees parallel with the slope and hanger wires suspended vertically.



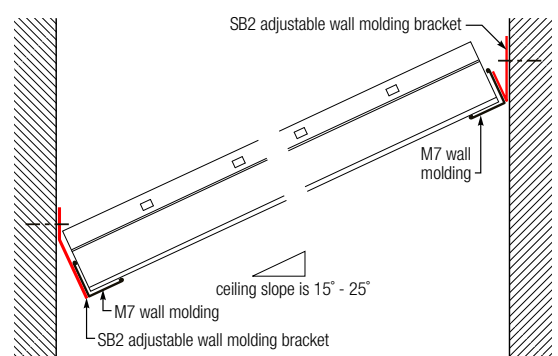
Fabricated or locally sourced molding can be used to match the angles of the slope.



The USG MAC2 clip may be used to secure the tee ends and field modified to match the slope of the tees



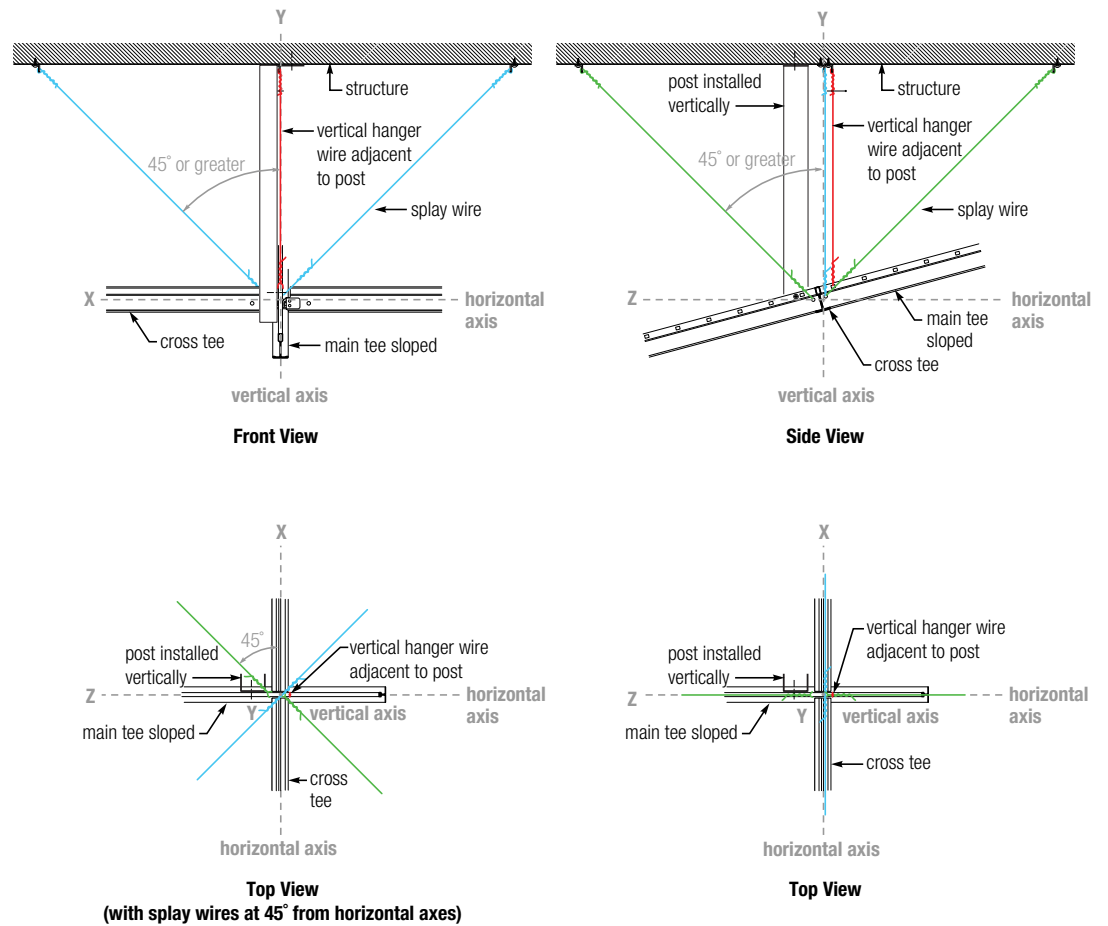
For installations where the slope is 15° - 25°, it is recommended that USG M7 molding be installed with the USG adjustable wall molding bracket.



Applications

Lateral Bracing

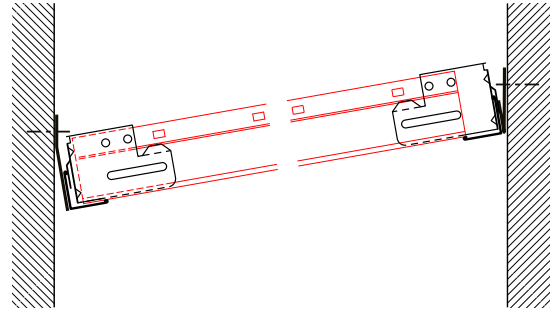
When required, struts are to remain vertical and the splay wires installed at max. 45° to the horizontal.
Please refer to SC2497 for more information about struts.



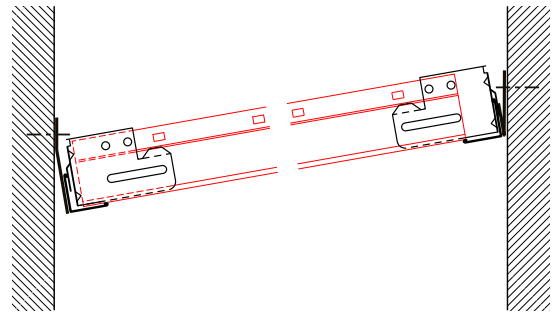
Applications

Seismic Design Categories

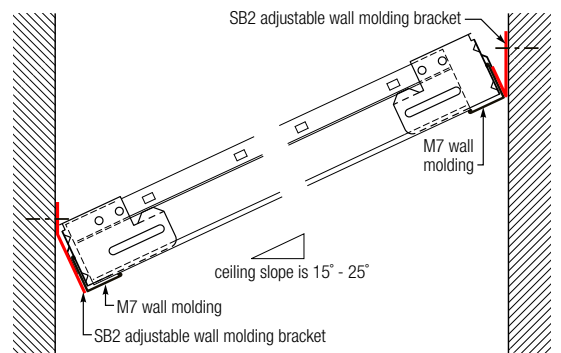
Lower/bottom end of slope should be installed as a tight side.



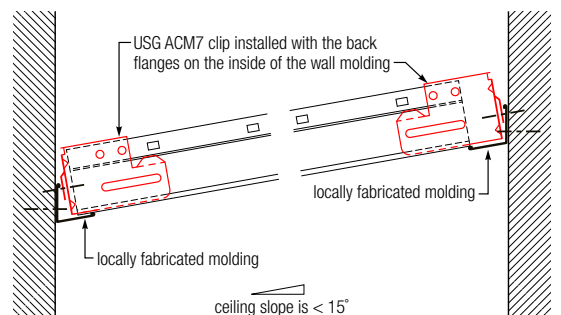
Higher/top end of slope should be installed as a floating side.



For installations where 7/8-in. wall molding is desired and the slope is 15° – 25°, it is recommended that USG M7 molding be installed with the SB2 adjustable wall molding bracket.



For installations with fabricated molding where the slope is < 15°, the USG ACM7 seismic clip may be used on the *lower/bottom end of slope* and shall be installed with the back flanges on the inside of the wall molding with a fastener through either top fastener hole on the wing of the clip. Note a slight mouse hole or opening may be visible in this application.



Notes:

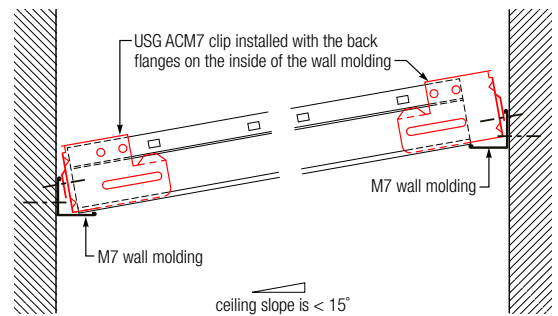
- The USG ACM7 seismic clip is not designed to function with wall molding fabricated at an angle >105° or <75°.
- 3/4" gap shown for typical seismic design categories D-F.
- 3/8" gap is typical for seismic design category C.

Applications

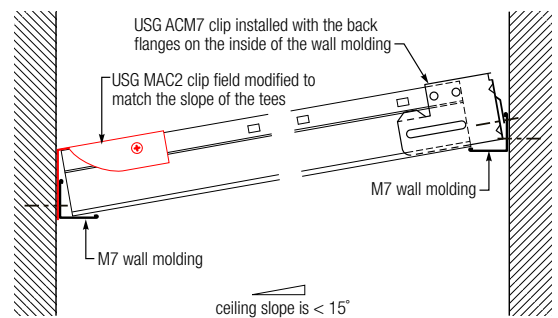
Attachments Methods

For installations with standard wall molding where the slope is $< 15^\circ$, the USG ACM7 seismic clip may be used on the *higher/top end of slope* and shall be installed with the back flanges on the inside of the wall molding with a fastener through either lower fastener hole on the wing.

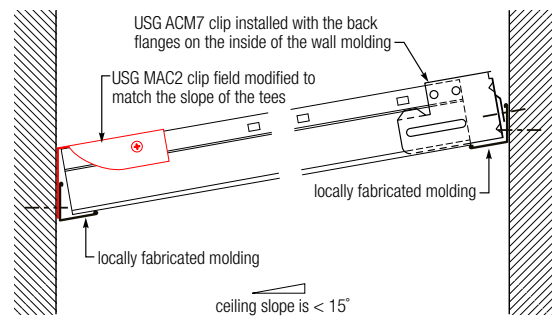
Note: The USG ACM7 seismic clip is not designed to function with wall molding fabricated at an angle $>105^\circ$ or $<75^\circ$.



For installations with standard wall molding where the slope is $< 15^\circ$, the USG MAC2 clip may be used to secure the tee ends on the lower/bottom end of slope and field modified to match the slope of the tees.



For installations with fabricated molding where the slope is $< 15^\circ$, the USG MAC2 clip may be used to secure the tee ends on the lower/bottom end of slope and field modified to match the slope of the tees.



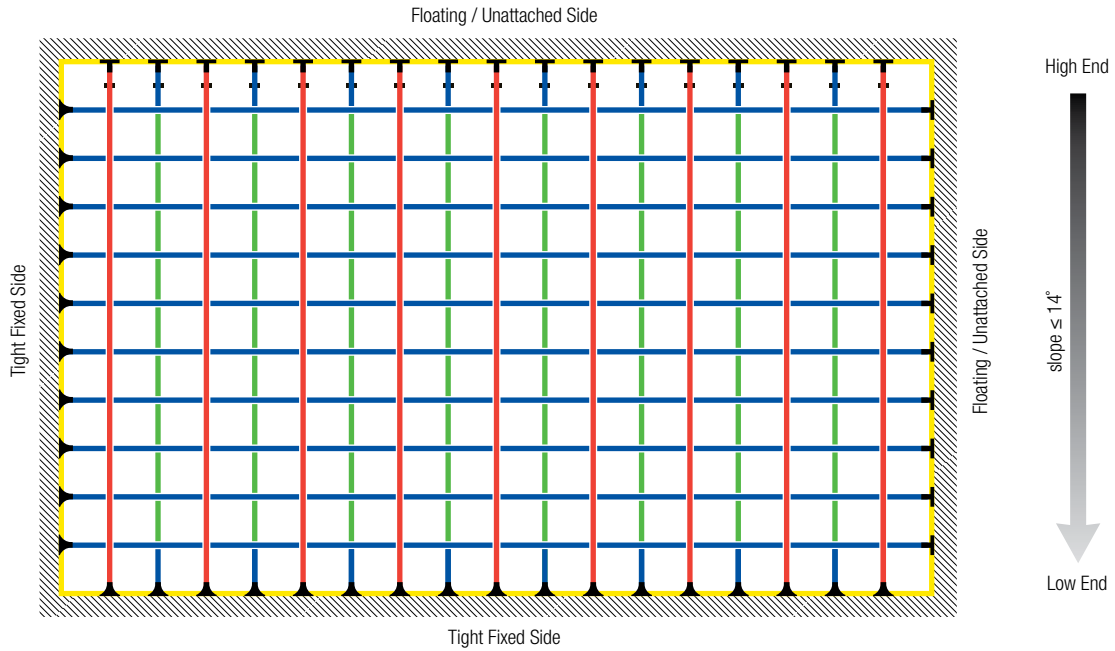
Sloped Layouts

Seismic Design Categories

- KEY**
- Main Tee
 - 4 ft. Cross Tee
 - 2 ft. Cross Tee
 - Perimeter Trim
 - USG ACM7 Seismic Clip
 - USG ACM7 Seismic Clip or USG MAC2 Clip
 - Panel Hold-Down Clip
 - Stabilizer Bar
 - Surrounding Wall

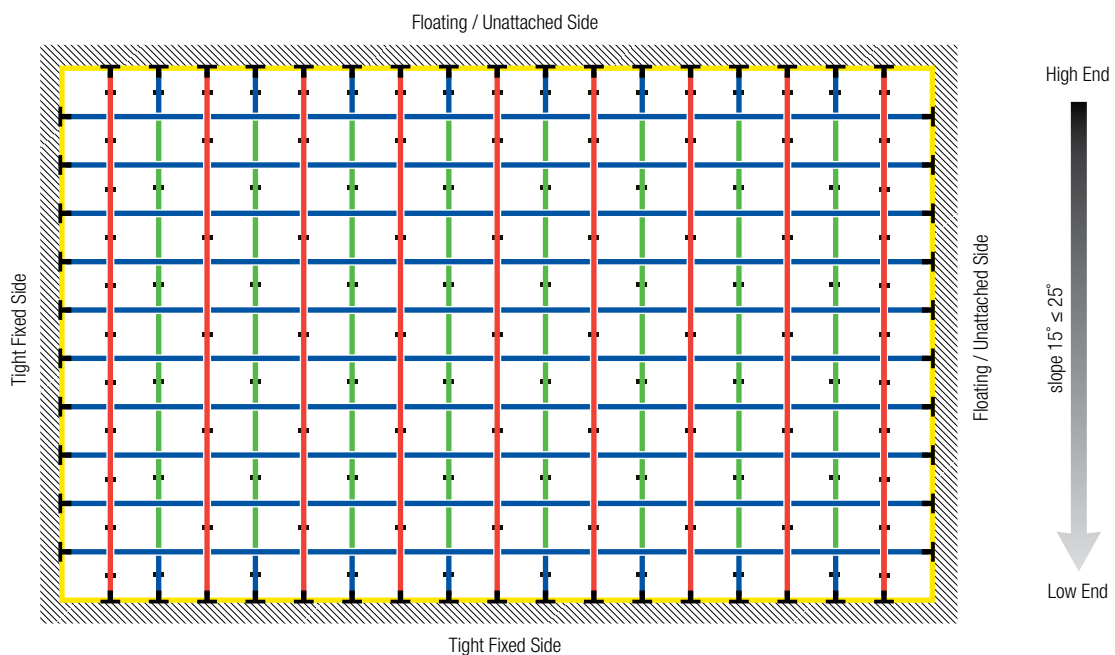
Category D, E, F

Slope: $\leq 14^\circ$



Category D, E, F

Slope: $15^\circ \leq 25^\circ$

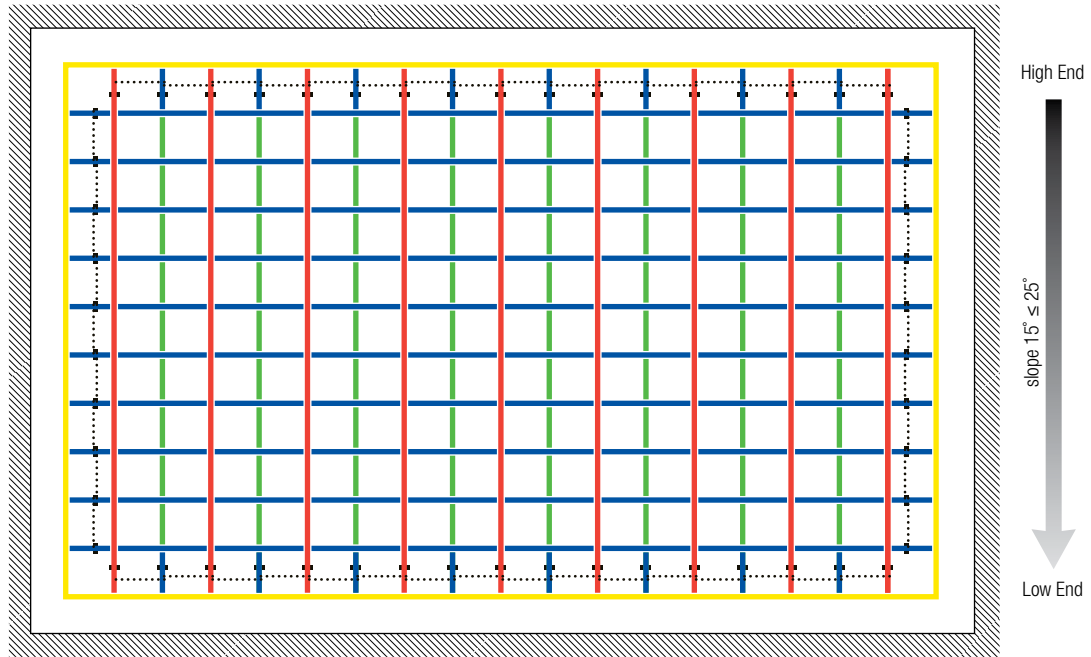


Sloped Layouts

Seismic Design Categories

- KEY**
- Main Tee
 - 4 ft. Cross Tee
 - 2 ft. Cross Tee
 - Perimeter Trim
 - USG ACM7 Seismic Clip
 - USG ACM7 Seismic Clip or USG MAC2 Clip
 - Panel Hold-Down Clip
 - Stabilizer Bar
 - Surrounding Wall

Category C, D, E, F Free Floating Slope: $15^\circ \leq 25^\circ$



Seismic Code Reference Standards

Installation Guidelines for Suspended Ceilings

International Building Code (IBC)	2003 IBC ↓	2006 IBC ↓	2009 IBC ↓	2012 IBC ↓
American Society of Civil Engineers (ASCE)	ASCE7-02 ↓	ASCE7-05 ↓	ASCE7-05 ↓	ASCE7-10 ↓
Ceilings Interior Systems Construction Association (CISCA)	CISCA Zones 0-2 CISCA Zones 3-4	CISCA Zones 0-2 CISCA Zones 3-4	CISCA Zones 0-2 CISCA Zones 3-4	ASTM E580
or ASTM International (ASTM)				

International Building Code (IBC) defines Seismic Design Categories A, B, C, D, E, and F.
www.iccsafe.org

ASCE/SEI 7 Minimum Design Loads for Buildings and Other Structures
American Society of Civil Engineers/Structural Engineer Institute (ASCE/SEI)
www.asce.org

**Guidelines for Seismic Restraint for Direct-hung Suspended Ceiling Assemblies (Zones 3-4)
Recommendations for Direct-hung Acoustical Tile and Lay-in Panel Ceilings (Zones 0-2)**
CISCA Ceilings & Interior Systems Construction Association (CISCA)
www.cisca.org

ASTM International E580/E580M Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.
ASTM International (formerly American Society for Testing and Materials)
www.astm.org

Further References

USG Seismic Ceiling Resource Center
Seismic Technical Guides
seismicceilings.com

CAUTION

Avoid bending the bracket back and forth too many times which will cause metal fatigue and weaken the bracket.

Product Information

See usg.com for the most up-to-date product information.

Installation

Must be installed in compliance with ASTM C636, ASTM E580, CISCA, and standard industry practices. ASTM C636 and the current building code limit the installation of suspended ceilings to level applications and do not address sloped ceiling conditions. Many jurisdictions accept the installation of sloped suspended ceilings, however, some jurisdictions interpret the current standards to exclude sloped ceiling installations. Check with a local official prior to designing and installing a sloped ceiling system.

Code Compliance

The information presented is correct to the best of our knowledge at the date of issuance. Because codes continue to evolve, check with a local official prior to designing and installing a ceiling system. Other restrictions and exemptions may apply. This is only intended as a quick reference.

Purpose

This seismic technical guide (STG) is intended as a resource for design professionals, to promote more uniform criteria for plan review and jobsite inspection of projects. This STG indicates an acceptable method for achieving compliance with applicable codes and regulations, although other methods proposed by design professionals may be considered and adopted.

ICC Evaluation Service, Inc., Report Compliance

Suspension systems manufactured by USG Interiors, Inc., have been reviewed and are approved by listing in ICC-ES Evaluation Report 1222. Evaluation Reports are subject to reexamination, revision and possible cancellation. Please refer to usgdesignstudio.com or usg.com for current reports.

L.A. Research Report Compliance

Down brand suspension systems manufactured by USG Interiors, Inc., have been reviewed and are approved by listing in the following L.A. Research Report number: 25764.

Progressive Engineering Inc. Evaluation Report Compliance

Seismically tested and listed in PEI Evaluation Report, PER-12059.

Notice

We shall not be liable for incidental and consequential damages, directly or indirectly sustained, nor for any loss caused by application of these goods not in accordance with current printed instructions or for other than the intended use. Our liability is expressly limited to replacement of defective goods. Any claim shall be deemed waived unless made in writing to us within thirty (30) days from date it was or reasonably should have been discovered.

Safety First!

Follow good safety/industrial hygiene practices during installation. Wear appropriate personal protective equipment. Read MSDS and literature before specification and installation.

