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Seismic Installation Manual

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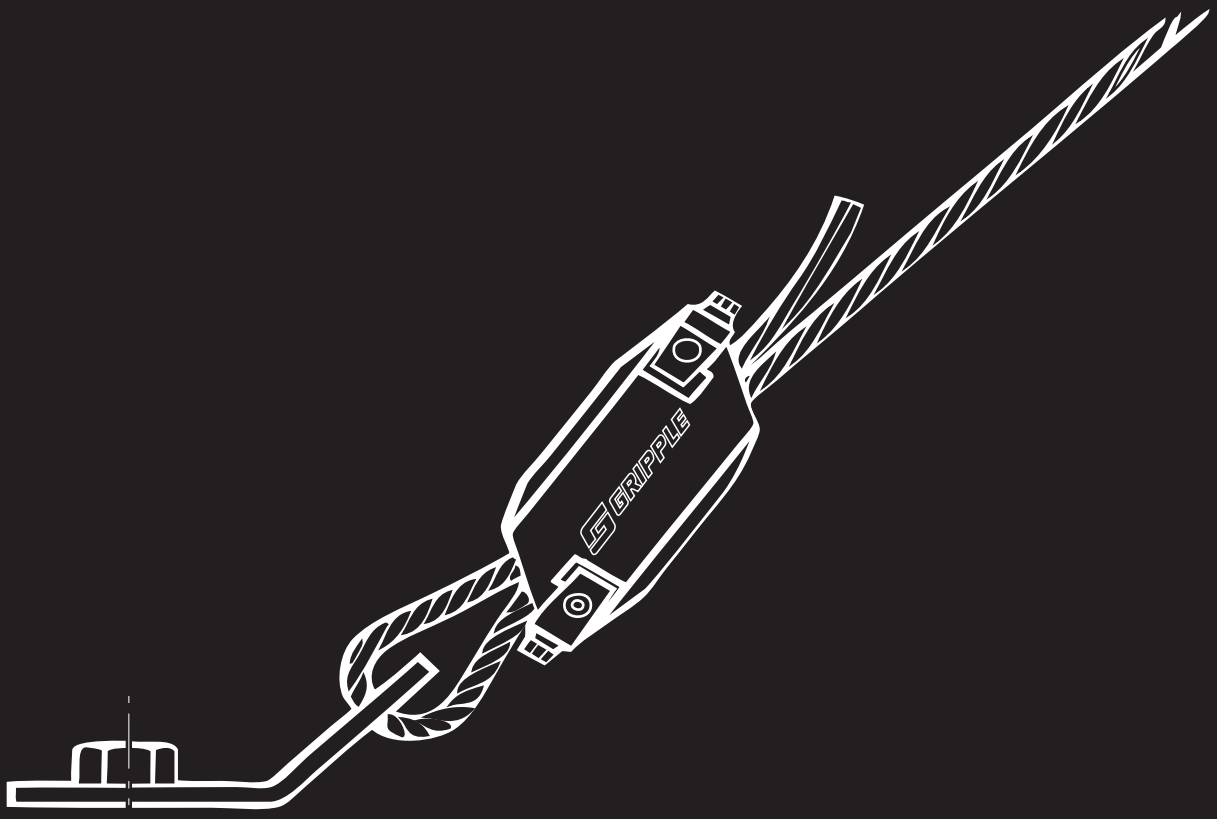
California Office of Statewide
Health Planning & Development
OPA-2123-10



This manual provides the design strength capacities and installation guidelines for the Gripple Seismic Bracing System for use in the design of an overall bracing system for suspended nonstructural components, equipment, and systems for compliance with the California Building Code 2010 Edition.

Contents / Page Number

1.1 Introduction

Gripple Seismic Bracing Systems are specifically designed and engineered to brace and secure suspended nonstructural equipment (VAV boxes, fans, unit heaters, small in-line pumps, etc.) and components (HVAC duct, conduit/cable tray, and piping) within a building or structure to minimize earthquake damage.

Gripple Seismic Bracing systems are ideal for use on nonstructural components and equipment requiring seismic design, such as in essential facilities that are required for emergency operations in the aftermath of an earthquake.

This pre-approval conforms to the 2010 California Building Code. Detailed in this manual are bracing design capacities and installation guidelines for a variety of nonstructural components, equipment, and systems. Actual bracing requirements for some sites may vary from these guidelines, and these site-specific bracing installations are not limited to the guidelines detailed here. However, any deviations from the guidelines within this manual shall be designed and justified by the Registered Design Professional and submitted for approval to the Authority Having Jurisdiction for the project.

The services of a Registered Design Professional is required to determine the seismic demand forces, required bracing, spacing, and anchorage attachment of the bracing to the structure in accordance with these guidelines and the 2010 California Building Code (CBC) design provisions and conditions for the project.

It is the responsibility of the Structural Engineer of Record for the project/site to ensure that the existing structure is capable of withstanding the full loads that may be induced by the braced equipment and Seismic attachments.

Please note that this manual does not replace code-required industry standard practices. Gripple Seismic Bracing systems, designed as per the guidelines outlined in this manual, do not guarantee adequacy of the component installation. It is the responsibility of the Registered Design Professional for the nonstructural component or system to ensure adequacy of the design, placement of the seismic bracing kits, and installation in accordance with the 2010 CBC.

Michael J. Griffin
Professional Engineer
California No. 38184

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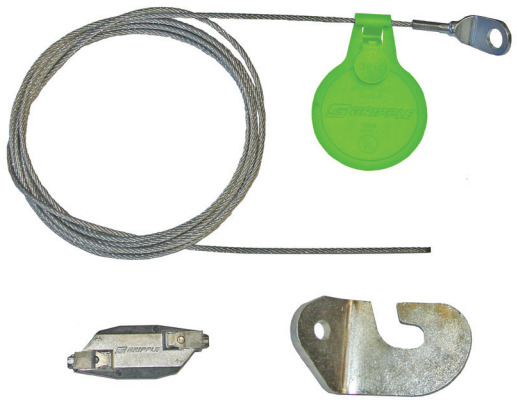
Disclaimer:

Neither Michael J. Griffin nor Gripple are the Structural or Registered Design Professional. The stability and adequacy of the structural elements, nonstructural components or seismic sway braces, hangers, brackets, bolting, anchorage and any other required attachments are the responsibility of the Registered Design Professional, or the Structural Engineer of Record for the Facility or Project. Any additional or supplementary members required to ensure the adequacy or stability of the structures the seismic sway bracing attaches to are not within the scope of this manual/document.

Gripple warrants that the Gripple Seismic Bracing Systems will achieve the applicable design strengths published if installed in accordance with the guidelines contained in this manual. Gripple disclaims any and all other express or implied warranties of fitness for any general or particular application. Anyone making use of this manual does so at their own risk, and assumes any and all liability resulting from such use.



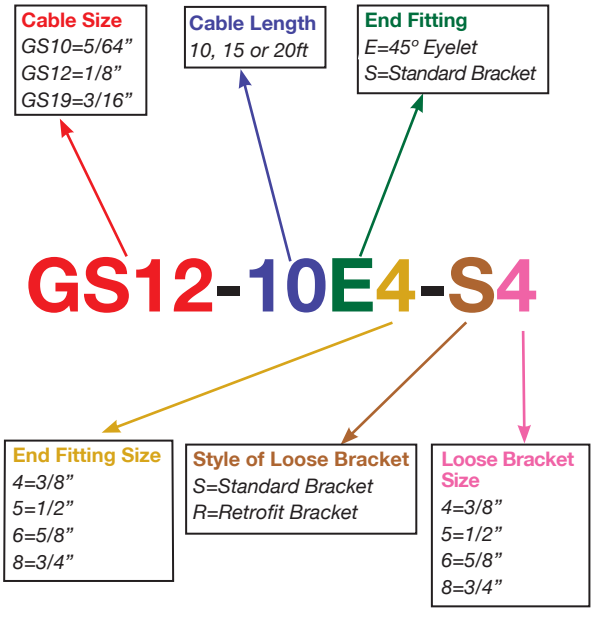
Range of Sizes

GS10

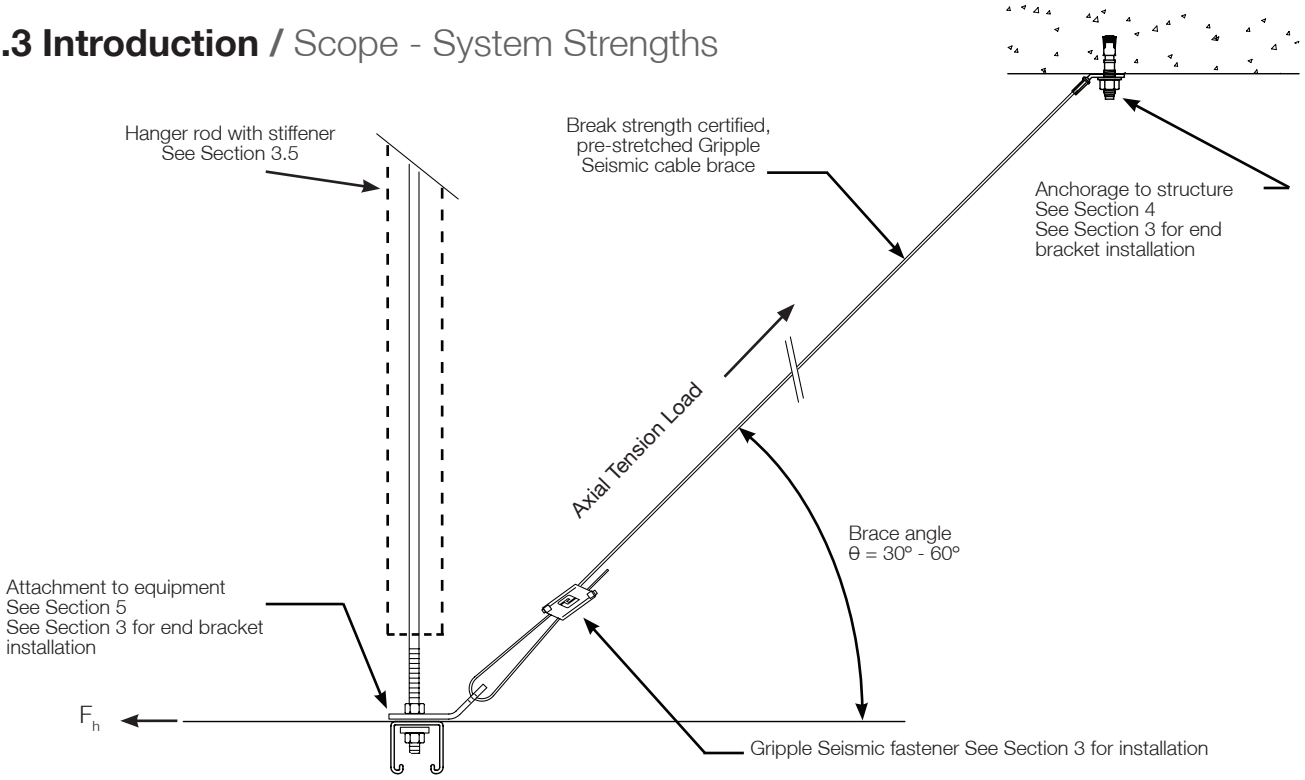
GS12

GS19

Understanding Gripple Seismic Codes



Gripple Seismic Kit Size	Length	Seismic Bracket	Rod/Structural Attachment Size	Product Code
GS10	10ft	Standard	3/8"	GS10-10E4-S4
			1/2"	GS10-10S5-S5
		Retrofit	3/8"	GS10-10E4-R4
			1/2"	GS10-10S5-R5
	15ft	Standard	3/8"	GS10-15E4-S4
			1/2"	GS10-15S5-S5
		Retrofit	3/8"	GS10-15E4-R4
			1/2"	GS10-15S5-R5
	20ft	Standard	3/8"	GS10-20E4-S4
			1/2"	GS10-20S5-S5
		Retrofit	3/8"	GS10-20E4-R4
			1/2"	GS10-20S5-R5
GS12	10ft	Standard	3/8"	GS12-10E4-S4
			1/2"	GS12-10S5-S5
		Retrofit	3/8"	GS12-10E4-R4
			1/2"	GS12-10S5-R5
	15ft	Standard	3/8"	GS12-15E4-S4
			1/2"	GS12-15S5-S5
		Retrofit	3/8"	GS12-15E4-R4
			1/2"	GS12-15S5-R5
	20ft	Standard	3/8"	GS12-20E4-S4
			1/2"	GS12-20S5-S5
		Retrofit	3/8"	GS12-20E4-R4
			1/2"	GS12-20S5-R5
GS19	10ft	Standard	3/8"	GS19-10S4-S4
			1/2"	GS19-10S5-S5
			5/8"	GS19-10S6-S6
			3/4"	GS19-10S8-S8
		Retrofit	3/8"	GS19-10S4-R4
			1/2"	GS19-10S5-R5
			5/8"	GS19-10S6-R6
			3/4"	GS19-10S8-R8
	15ft	Standard	3/8"	GS19-15S4-S4
			1/2"	GS19-15S5-S5
			5/8"	GS19-15S6-S6
			3/4"	GS19-15S8-S8
		Retrofit	3/8"	GS19-15S4-R4
			1/2"	GS19-15S5-R5
			5/8"	GS19-15S6-R6
			3/4"	GS19-15S8-R8
	20ft	Standard	3/8"	GS19-20S4-S4
			1/2"	GS19-20S5-S5
			5/8"	GS19-20S6-S6
			3/4"	GS19-20S8-S8
		Retrofit	3/8"	GS19-20S4-R4
			1/2"	GS19-20S5-R5
			5/8"	GS19-20S6-R6
			3/4"	GS19-20S8-R8



Gripple System Seismic Design Strengths - Axial Tension Load

Gripple Seismic Kit	*Cable Orientation (from horiz.)* [1]	*Seismic Bracket* [2]	*Rod, Component, or Structure Attachment Size* [3]	*Minimum Washer Requirements* [4]	*Pretension (50 kg)* [5]	*Allowable Capacity (ASD)* [6, 7] *lbs*	*Design Strength (LRFD)* [6, 7] *lbs*
GS10	*30°-60°*	*GSE4*	*3/8" dia.*	*Standard*		*225*	*350*
		GSS4	*3/8" dia.*	*Standard*			
		GSS5	*1/2" dia.*	*Standard*			
		GSR4	*3/8" dia.*	*Square*			
		GSR5	*1/2" dia.*	*Square*			
GS12	*30°-60°*	*GSE4*	*3/8" dia.*	*Standard*		*675*	*1,050*
		GSS4	*3/8" dia.*	*Standard*			
		GSS5	*1/2" dia.*	*Standard*			
		GSR4	*3/8" dia.*	*Square*			
		GSR5	*1/2" dia.*	*Square*			
GS19	*30°-60°*	*GSS4*	*3/8" dia.*	*Standard*	*X*	*1,400*	*2,100*
		GSS5	*1/2" dia.*	*Standard*	*X*		
		GSS6	*5/8" dia.*	*Standard*	*X*		
		GSS8	*3/4" dia.*	*Standard*	*X*		
		GSR4	*3/8" dia.*	*Oversized*	*X*		
		GSR5	*1/2" dia.*	*Oversized*	*X*		
		GSR6	*5/8" dia.*	*Oversized*	*X*		
		GSR8	*3/4" dia.*	*Oversized*	*X*		

1. *Orientation is the brace angle, as measured from horizontal. Permitted installation angle for the Gripple Seismic Brace System ranges from 30º to 60º.*
2. *Seismic brackets are named using the following conventions: E=eyelet, S=standard bracket, R=retrofit bracket. Attachment size for each bracket is provided in the 'Rod, Component, or Structure Attachment Size' column.*
3. *Capacity of the vertical rod/component attachment/structural attachment anchorage to be designed by the applicable nonstructural component Registered Design Professional. See Section 3.5 for selected design capacities for vertical components.*
4. *Minimum washer type approved for use with each system / bracket combination are noted in the table. Standard = standard round washer; Square = square washer measuring 1-5/8" x 1/4" thick (standard square flat plate washer for strut); Oversized = oversized rectangular or slotted washer measuring 2-1/4" x 2" x 1/4" thick (provided by Gripple, to be used with ALL GS19 retrofit brackets at brace angles between 30-60º. Washers are prioritized from lowest to highest capacity as: standard, square, then oversized. The next highest capacity may be used from the minimum shown in the Table. In no cases is a lower capacity washer allowed from the minimum shown. Note that the washer must be sized to match the corresponding anchor / rod diameter. See Section 3.4.*
5. *Pretensioning (to a minimum of 50kg - 110 lbs) is accomplished with the calibrated Gripple supplied Pretensioning Tool.*
6. *The reported seismic allowable capacities / design strengths represent the lowest capacity / strength based on established deformation and force requirements for all the system components (cable, brackets, fittings, fasteners) based on testing, excluding component and structural attachment. Refer to Section 4 for selected attachment design strengths.*
7. *System seismic allowable capacities / design strength values are to be used with the seismic demands as calculated using the applicable code provisions (CBC 2010 & ASCE/SEI 7-05).*

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The following components of the Gripple Seismic Bracing System are addressed by this OPA:

1. Gripple brackets at the pipe / nonstructural component attachment.
2. Gripple cable brace component.
3. Gripple cable fastener component.
4. Gripple bracket at the building attachment.
5. Gripple bracket attachment (anchorage) to the building structure.
6. Load path member used in conjunction with the cable brace system (compression strut at rod hanger supports).

The following defines the components or elements that are NOT addressed by this OPA, but are required to be addressed by the applicable Registered Design Professional addressing the nonstructural component seismic design / qualification:

1. Nonstructural component (pipe, conduit, bus duct, HVAC duct, fan, VAV box, unit heater, etc.) seismic qualification.
2. Nonstructural component gravity support system (rod hanger, trapeze support, assembly, etc.) design.
3. Attachment (anchorage) of the nonstructural component gravity support system to the building structure.
4. Vibration isolation components of supports of suspended nonstructural components required for operational considerations.

The Gripple seismic system design strengths or capacities are summarized in Table 1. The system allowable capacities (ASD) or design strengths (LRFD) shall equal or exceed the calculated seismic loads for the nonstructural component or system of interest using the seismic design provisions from the 2010 California Building Code and ASCE/SEI 7-05, Chapter 13 design standards.

Installation parameters identified for the Gripple Seismic Cable Bracing System include the following:

1. The Gripple Seismic Cable Bracing systems are confined to the following component combinations:

   GS10 (5/64" Cable and GS10 Fastener):
   - GSE4 Eyelet
   - GSS4 and GSS5 Standard Brackets
   - GSR4 and GSR5 Retrofit Brackets

   GS12 (1/8" Cable and GS12 Fastener):
   - GSE4 Eyelet
   - GSS4 and GSS5 Standard Brackets
   - GSR4 and GSR5 Retrofit Brackets

   GS19 (3/16" Cable and GS19 Fastener):
   - GSS4, GSS5, GSS6, and GSS8 Standard Brackets
   - GSR4, GSR5, GSR6, and GSR8 Retrofit Brackets

2. The Gripple Seismic Cable Brace system shall be installed in the range from 30^0 to 60^0 from the horizontal with 45^0 being the optimum cable angle to coincide with the 45^0 angle of the eyelet and bracket fittings.

3. The brace system shall be attached to the nonstructural component with the Gripple eyelet, GSS, or GSR bracket. Installing the cable system via looping through the trapeze support strut holes is not allowed.

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4. The brace system shall be anchored to the structural system (building attachment) with anchor bolts, selected in accordance with Section 4 to this manual or selected and designed by the Registered Design Professional addressing the nonstructural component, through the Gripple eyelet or GSS and GSR brackets, or looped around a structural member (bar joist or structural beam, etc.) and fastened with a GS fastener.

5. A 12” minimum distance between the loop attachment at a component or structural attachment and the GS fastener shall be maintained.

6. The tail of the cable shall extend a minimum of 2” beyond the GS fastener.

7. Nuts and washers are required at all bracket connections (at the structure and at the component). Standard round washers must be installed at GSE4 bracket attachments. Either standard round washers or square strut washers (1-5/8” square x 1/4” thick) may be installed with the standard brackets (GSS4, GSS5, GSS6, & GSS8). Standard square strut washers are required for the majority of retrofit bracket conditions; however, oversized square or slotted retrofit washers are required for GS19 systems utilizing retrofit brackets. Additionally, at retrofit brackets used to attach to existing components where no washer is present, an oversized square or slotted washer is required.

8. Pretensioning of the GS19 seismic cable brace systems is required. Pretensioning is accomplished using the calibrated Pretensioning Gripple Tool with the tool set to apply at least 50kg - 110 lbs. Note that all other cable systems (GS10, GS12) and orientations (30^{O}, 45^{O}, 60^{O}) may be installed hand tight or pretensioned.

9. The GS fastener (GS10, GS12, & GS19) locking screws shall be tightened once cable tension has been set.

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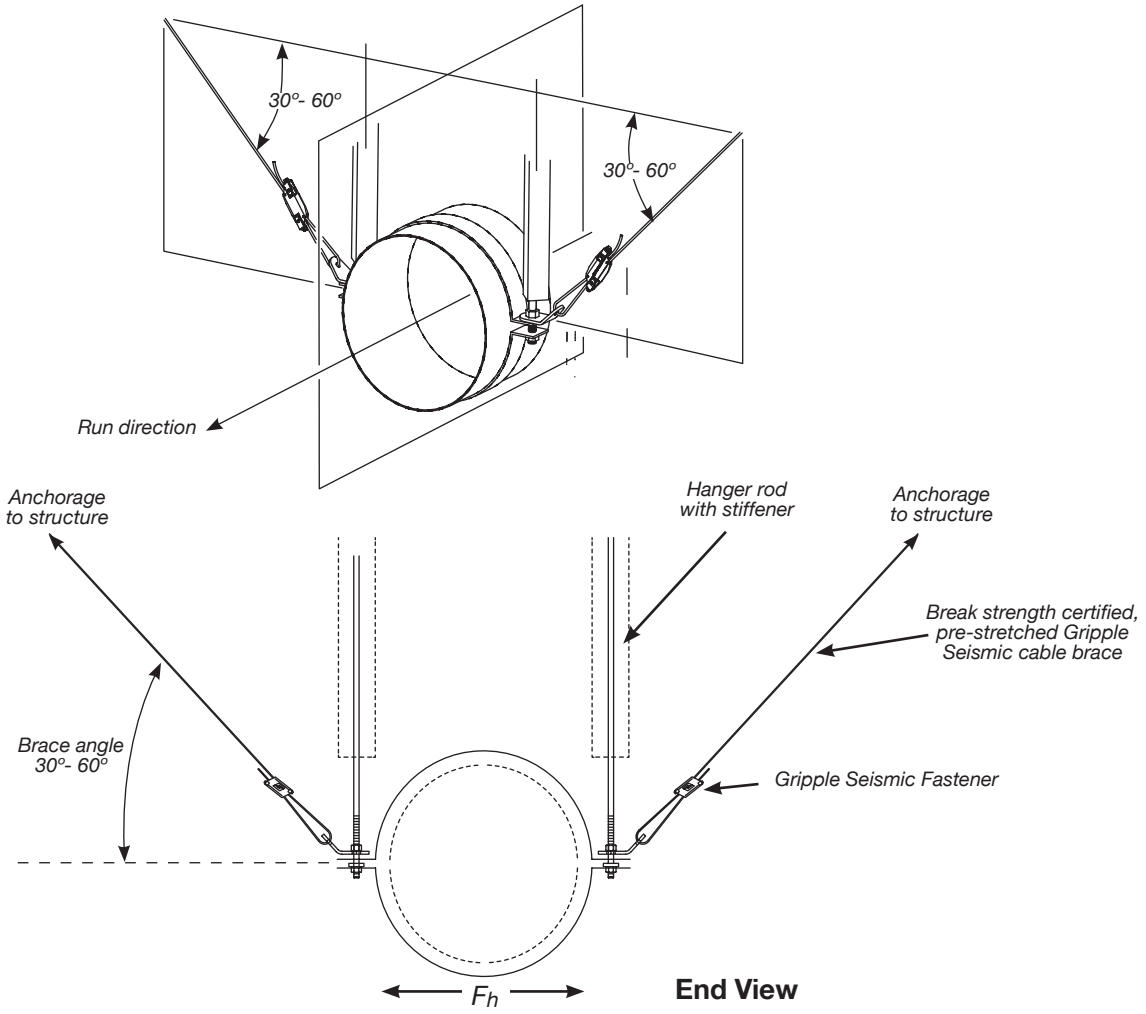

Transverse bracing acts to resist the seismic forces in a plane perpendicular to the run of braced piping, conduit, ductwork or equipment, as shown above. The seismic forces that a transverse brace resists are illustrated by F_h. A vertical force can be generated during a seismic event and as such, rod stiffeners may be required to help prevent the hanger rod from buckling under this upwards force.

Ductile Braced Components:
For piping, conduit, and equipment connections manufactured from ductile materials, the maximum allowable brace spacing for transverse bracing is typically 40ft; this brace spacing is dependent on component size, seismic force, brace components selected, and the anchorage to the structure.

Non-ductile Braced Components:
For piping, conduit, and equipment connections manufactured from non-ductile materials, the maximum allowable brace spacing for transverse bracing is typically 20ft; this brace spacing is dependent on component size, seismic force, brace components selected, and the anchorage to the structure.

Refer to Section 1.5 for brace location guidelines.

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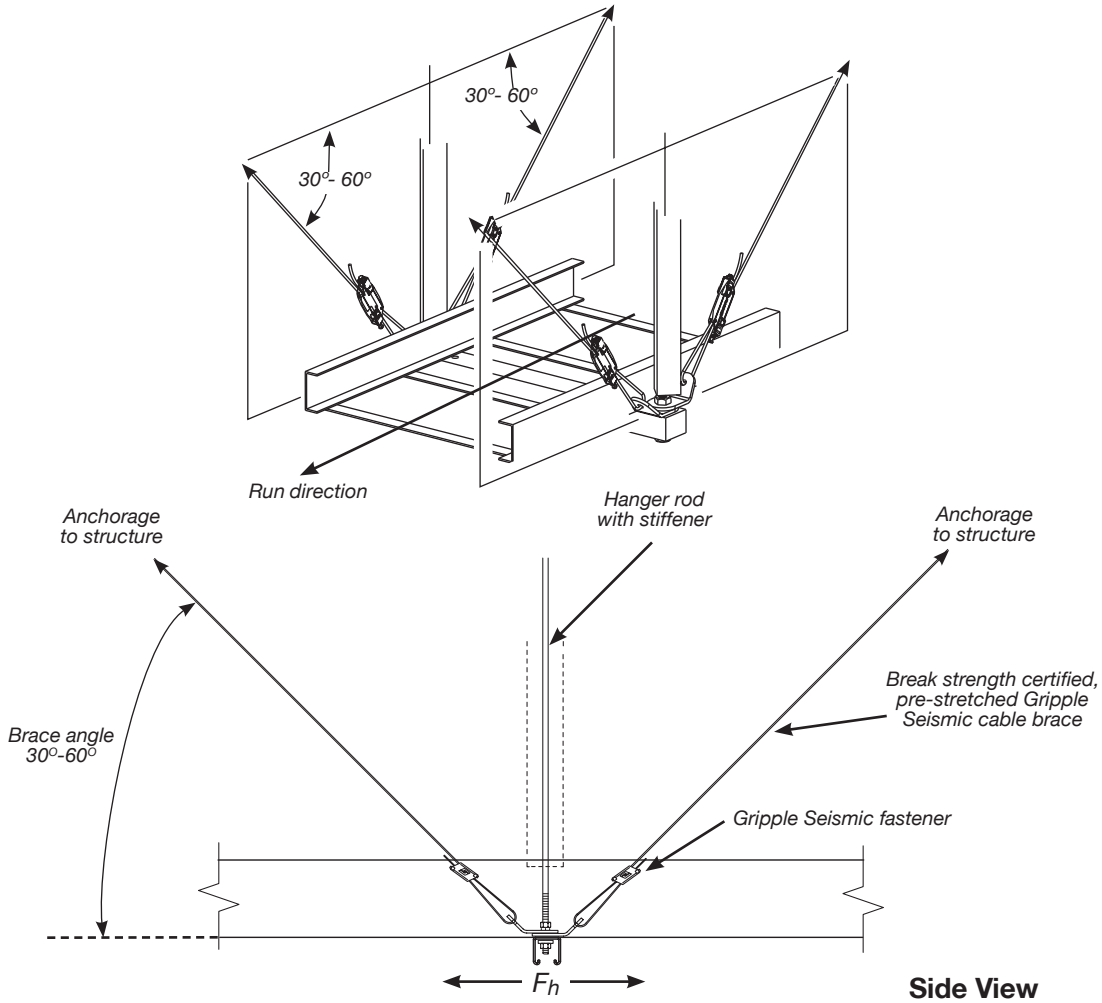

Side View

Longitudinal bracing acts to resist the seismic forces in a plane parallel to the run of braced piping, conduit, ductwork or equipment, as shown above. The seismic forces that a longitudinal brace resists are illustrated by F_h. A vertical force can be generated during a seismic event and as such, rod stiffeners may be required to help prevent the hanger rod from buckling under this upwards force.

Ductile Braced Components:
For piping, conduit, and equipment connections manufactured from ductile materials, the maximum allowable brace spacing for longitudinal bracing is typically 80ft; this brace spacing is dependent on component size, seismic force, brace components selected, and the anchorage to the structure.

Non-ductile Braced Components:
For piping, conduit, and equipment connections manufactured from non-ductile materials, the maximum allowable brace spacing for longitudinal bracing is typically 40ft; this brace spacing is dependent on component size, seismic force, brace components selected, and the anchorage to the structure.

Refer to Section 1.5 for brace location guidelines.

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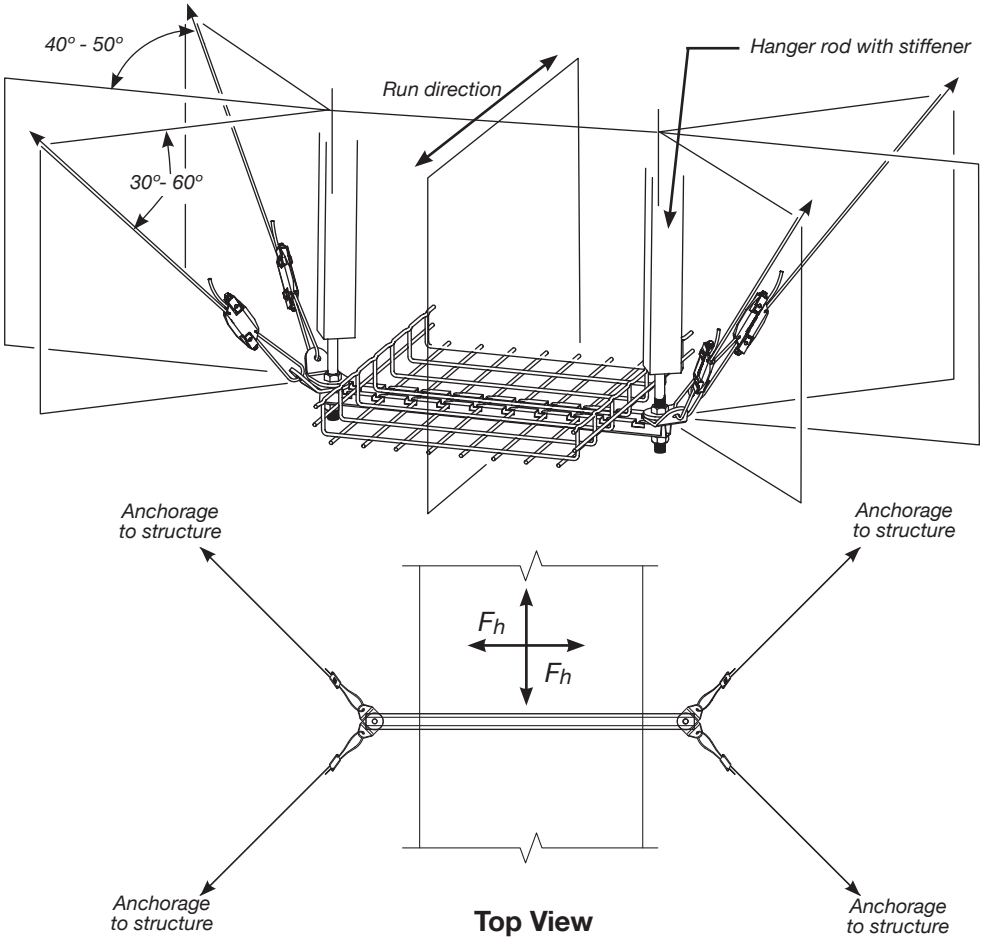

4-Way bracing acts to resist the seismic forces of the run of braced piping, conduit, ductwork or equipment, in both the transverse and longitudinal directions, as shown above. The seismic forces that a 4-Way brace resists are illustrated by F_h. A vertical force can be generated during a seismic event and as such, rod stiffeners may be required to help prevent the hanger rod from buckling under this upwards force.

Ductile Braced Components:
For piping, conduit, and equipment connections manufactured from ductile materials, the maximum allowable brace spacing for 4-Way bracing is typically limited to 80ft, so long as transverse bracing is used in addition, every 40ft; this brace spacing is dependent on component size, seismic force, brace components selected, and the anchorage to the structure.

Non-ductile Braced Components:
For piping, conduit, and equipment connections manufactured from non-ductile materials, the maximum allowable brace spacing for 4-Way bracing is typically limited to 40ft, so long as transverse bracing is used in addition, every 20ft; this brace spacing is dependent on component size, seismic force, brace components selected, and the anchorage to the structure.

Refer to Section 1.5 for brace location guidelines.

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1.5 Introduction / Brace Spacing Guidelines

Gripple Seismic Bracing must be installed on the vertical support system comprised of threaded rod (all-thread rod) hanger suspensions, or directly to a suspended individual equipment component.

Seismic bracing shall be designed in accordance with:
- the guidelines contained in this manual
- the applicable building code or local city/county code requirements for seismic design
- the engineering drawings and specifications of the specific project requirements

Component hanger spacing will typically be less than the required spacing of the seismic braces.

Typical maximum allowable brace spacing limits

The maximum allowable brace spacing for piping/conduit/ductwork constructed of ductile materials (e.g. steel, copper, aluminum) are typically:
- 40ft for transverse bracing (piping larger than 2½" dia, general conduit and ductwork)
- 80ft for longitudinal bracing (piping larger than 2½", general conduit and ductwork)
- 30ft for transverse bracing (piping smaller than 2½" dia)
- 60ft for longitudinal bracing (piping smaller than 2½" dia)

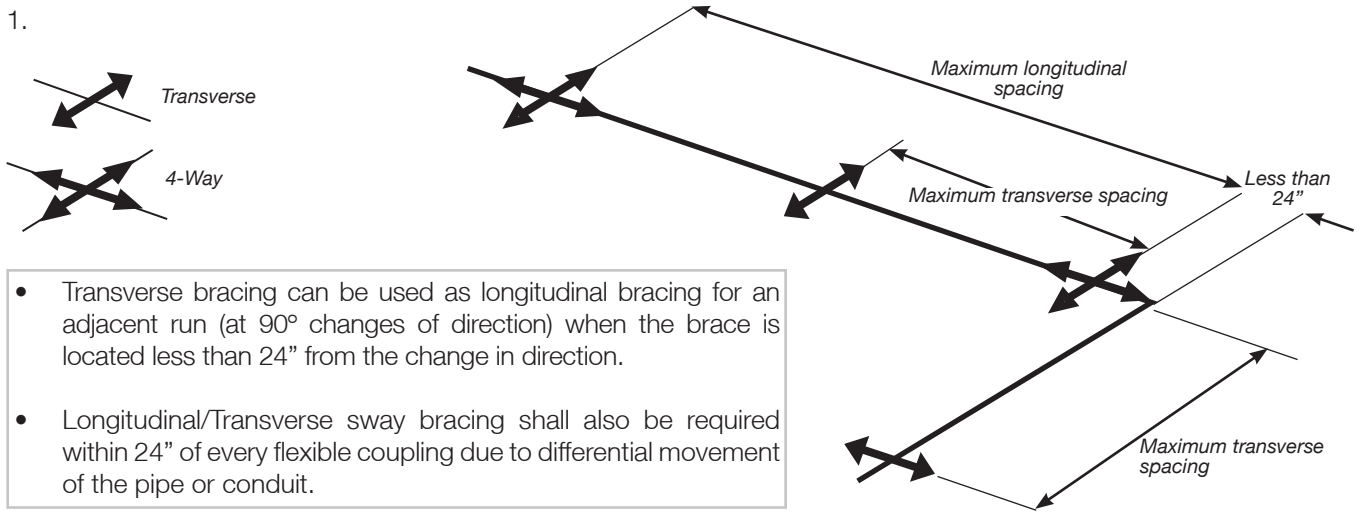
The maximum allowable brace spacing limits for piping/conduit/ductwork constructed of non-ductile materials (e.g. cast iron, plastic) are typically:
- 20ft for transverse bracing
- 40ft for longitudinal bracing

The brace spacing could be considerably less than the maximum spacing for a specific run, depending on the seismic demand loads, the size and load capacity of the cable brace system used, and the strength of the structural members/components and structural anchors which resist the resulting seismic brace forces.

Reduced spacing may also be required to prevent:
- collisions between the piping/conduit/ductwork/equipment and other non-structural components.
- rupture/shearing/slippage of flexible joints between piping/conduit/ductwork and floor/ceiling mounted equipment.

Brace size and spacing should not vary considerably along a run to ensure uniform deflection of the piping/conduit/ductwork and uniform loading of the individual braces during a seismic event.

1.



- Transverse bracing can be used as longitudinal bracing for an adjacent run (at 90° changes of direction) when the brace is located less than 24" from the change in direction.
- Longitudinal/Transverse sway bracing shall also be required within 24" of every flexible coupling due to differential movement of the pipe or conduit.

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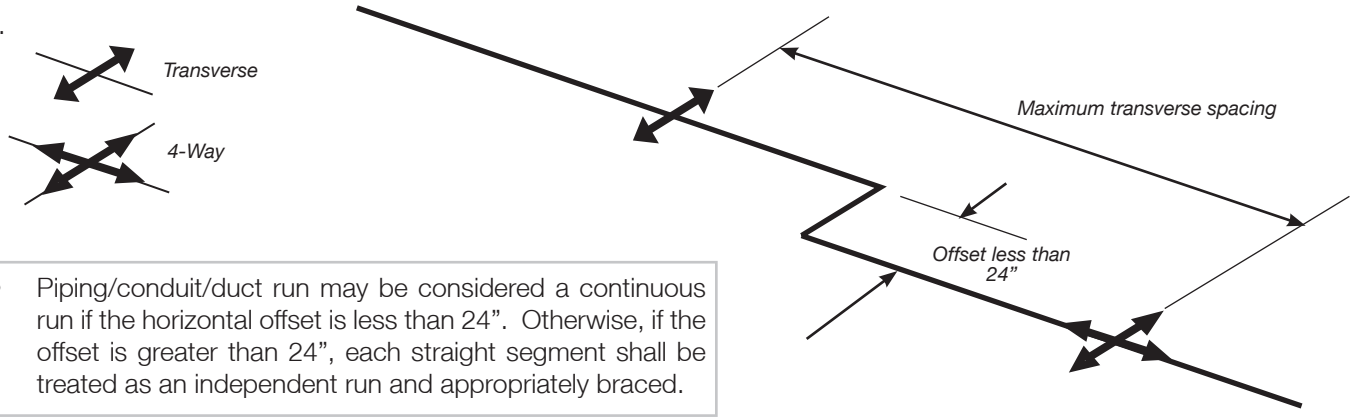
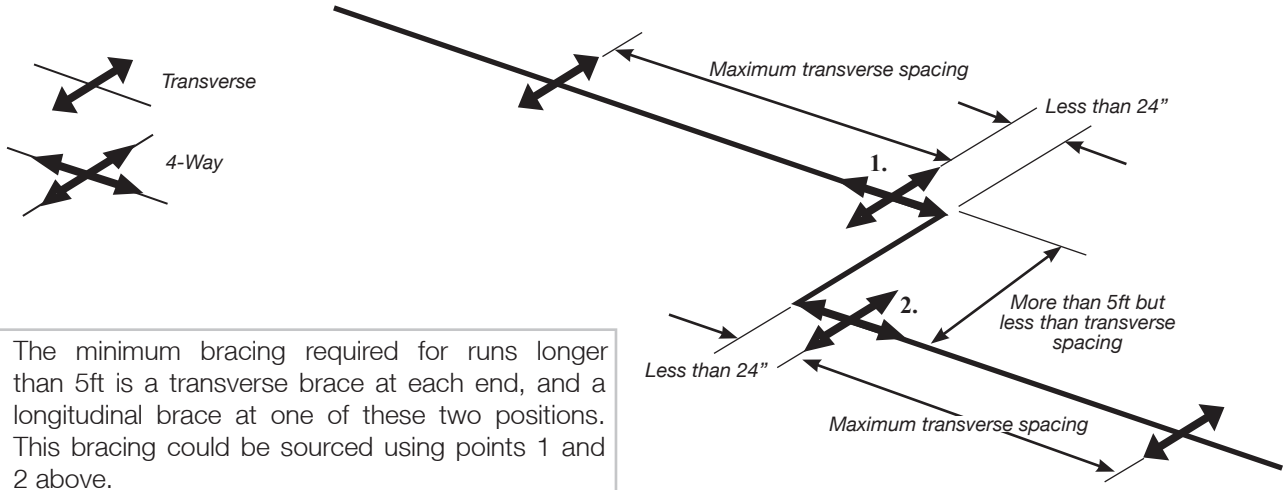
2.



- Piping/conduit/duct run may be considered a continuous run if the horizontal offset is less than 24”. Otherwise, if the offset is greater than 24”, each straight segment shall be treated as an independent run and appropriately braced.

3.



- The minimum bracing required for runs longer than 5ft is a transverse brace at each end, and a longitudinal brace at one of these two positions. This bracing could be sourced using points 1 and 2 above.

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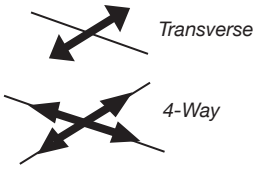
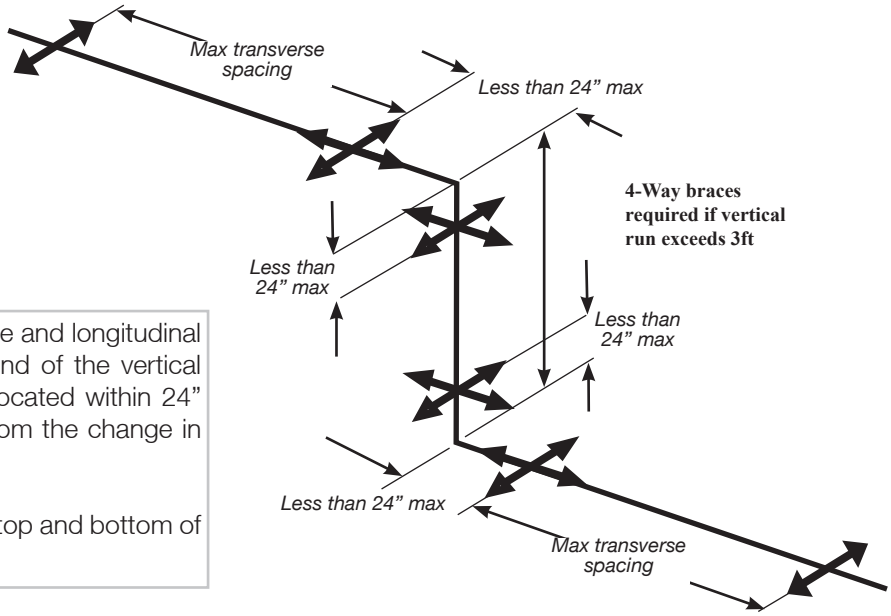
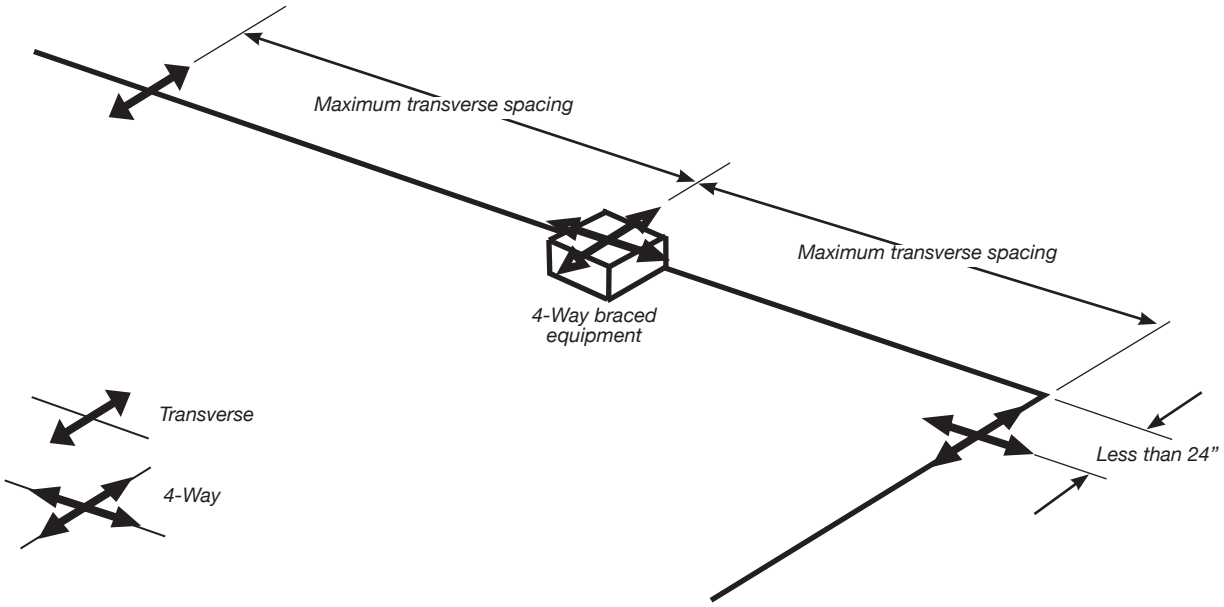
4.





- Vertical runs must have both transverse and longitudinal bracing, or a 4-Way brace at each end of the vertical run. These bracing points must be located within 24" of the end of the vertical run, away from the change in direction.
- 4-way braces shall be provided at the top and bottom of all pipe risers exceeding 3ft in length.

5.



- Each unit of equipment connected to a run of piping/conduit/ductwork should be individually and independently braced. If rigidly connected to the piping/conduit/ductwork, then the equipment bracing shall also be designed for the tributary piping/conduit/ductwork seismic forces. If the piping/conduit/ductwork is not rigidly connected, i.e. flex joints, then the equipment bracing cannot be used to brace the adjacent piping/conduit/ductwork and shall be independently braced.
- Suspended rectangular units of equipment shall be provided with a minimum of one sway brace at each corner (4 total braces). See Section 5 for details.

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General Design Process: Gripple Seismic Bracing System

The following provides the general process in designing seismic component bracing using the Gripple Seismic Bracing System.

1. Determine the routing of the distribution system (HVAC duct, cable tray, conduit, etc.) or the location of the suspended component. The Registered Design Professional shall design the appropriate vertical supports and spacing (refer to Section 3.5).

2. Calculate the seismic brace forces using the provisions of the 2010 California Building Code and ASCE 7-05. Parameters required for this calculation include the seismic weight of the component, seismic brace layout (transverse and longitudinal) and spacing, spectral acceleration (S_{DS}), component importance factor, a_P & R_P factors, elevation in the building structure, and any other applicable load combinations.

3. Select the appropriate Gripple Seismic Cable Brace System based on strength capacities required (Section 1.3). Determine required attachments for the installed condition (eyelet, standard bracket, retrofit bracket, etc.).

4. Resolve brace force into component forces (tension & shear) at anchor attachment to the structure. Apply appropriate prying factor from Section 4.3 to anchor demands.

5. Select the desired structural attachment and determine the appropriate anchor capacity from Section 4.

6. Compare anchor demands (Step 4) and anchor capacities (Step 5) to determine adequacy of selected anchor for the structural attachment.

7. Calculate forces on threaded rod and compare with capacity in Section 3.5 to determine adequacy of rod and rod stiffener requirements at brace locations.

Registered Design Professional Responsibility:

It is the responsibility of the Registered Design Professional in responsible charge to:

1. Verify that the nonstructural component or system is seismically qualified in accordance with the CBC 2010.

2. Verify that the proper Gripple Brace System is selected to meet the seismic requirements of this OPA.

3. Verify that the structure to which the Gripple Seismic Brace is anchored meets the requirements of the applicable anchorage ICC ESR.

4. Verify that anchor edge distance and spacing meets the requirements of the applicable ICC ESR.

5. Verify that the installation is in conformance with the 2010 CBC and with the details shown in this OPA. Testing of post-installed anchors shall also be performed in accordance with 2010 CBC Section 1916A.7. See Section 4.3.1 for anchor testing requirements.

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OSHPD Requirements:

General -

1. Pre-approved Gripple Seismic Bracing System and anchor systems may be used for the bracing and anchorage of pipes, conduits, ducts and suspended nonstructural equipment components. A California Licensed Engineer has designed the pre-approved systems contained in this OPA, along with supporting calculations. Therefore, the pre-approved details and calculations are not to be re-reviewed by regional staff. However, each pre-approved system requires submittals that must be reviewed and approved by OSHPD.

2. Submit plans showing how and where the pre-approved bracing and anchorage systems will be applied to each applicable system on a project specific basis. The submittal shall provide details sufficient to verify that the appropriate detail per the pre-approved details has been selected and applied for each condition and for the actual substrate that it will be connected/attached to. These plans shall be prepared by the applicable architect or engineer (Registered Design Professional - RDP) dependent upon the nonstructural system (Ref. CAC Section 7-115). The RDP shall provide a completely designed bracing and anchorage system in accordance with the pre-approved Gripple Seismic Bracing System requirements (Items 1-7 General Design Process, and Items 1-5 Registered Design Professional Responsibility noted above). The application of the pre-approved requirements and design is not the responsibility of the Inspector of Record (IOR), whose responsibility is to inspect only, not design.

3. The structural engineer of record (SEOR) for the project shall review and forward the bracing and anchorage plans for plan check with a notation indicating that the plans have been reviewed and they have been found to be in general conformance with the design of the project (Ref. CBC Section 107.3.4.2). A “shop drawing stamp” is acceptable for compliance with this requirement.

4. Regional staff, on a project specific basis, shall review bracing and anchorage details and supporting calculations that are not part of a pre-approved system. Review of bracing and anchorage details of this nature do not constitute a pre-approval that may be used on other projects without the benefit of plan review.

Pre-Approved Pipe, Duct, Conduit and Component Bracing –

1. Shop drawings of the support and bracing systems per the pre-approval shall be submitted to the discipline in responsible charge of the project for review to verify that the details are in conformance with all code requirements. The shop drawings shall be in accordance with ASCE 7-05 Section 13.6 as modified by the CBC 2010 Section 1615A.
    a. The Structural Engineer of Record (SEOR) shall verify that the supporting structure is adequate for the loads imposed on it by the supports and braces installed per the pre-approval in addition to all other loads.
    b. The SEOR shall forward the bracing and anchorage plans (including approved change orders for supplementary framing where required) to the discipline in responsible charge with a notation indicating that the plans have been reviewed and are in general conformance with the pre-approval and the design of the project (CBC Section 107.3.4.2).
    c. A “shop drawing stamp” is acceptable for compliance with this requirement.
    d. The Registered Design Professional (other than the SEOR) may provide the shop drawing stamp for small installations at the discretion of the District Structural Engineer.

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2. The SEOR shall design any supplementary framing that is needed to resist the loads, maintain stability and/or is required for installation of the pre-approved system.
    a. The supplementary framing shall be submitted to OSHPD as a change order.

3. The shop drawings (with the shop drawing stamp) shall be submitted to the District Structural Engineer to review the F_p for the pre-approved system.

4. The shop drawings (with the shop drawing stamp) shall be kept on the job site and can then be used for installation for the support and bracing.
    a. OSHPD field staff shall review the installation.

5. A copy of the selected bracing system(s) installation guide/manual shall be on the jobsite prior to starting the installation of hangers and/or braces.
    a. It is the contractor's responsibility to obtain copies of OSHPD pre-approvals and furnish the IOR with one copy each.

6. Components of two or more pre-approved bracing systems shall not be mixed. Only one pre-approved bracing system may be used for a run of pipe, duct, conduit or wsuspended component.
    a. Any substitution of a component of a pre-approved bracing system shall require OSHPD review and approval.

<u>Fire Sprinkler Piping Design & Bracing –</u>

1. The construction drawings shall have a note requiring that the spacing and details of the support and bracing of fire sprinkler piping shall comply with the NFPA 13-10 as modified by the 2010 CBC Sections 1613A/1615A and SFM Amendments.

2. Provide details and calculations for the sprinkler system sway bracing and anchorage to the structure. Where applicable, details for the support and bracing may refer to the OSHPD pre-approved Gripple Seismic Bracing and anchorage system in this OPA. All shop drawings of the sprinkler system shall be submitted to OSHPD for review and approval prior to installation.

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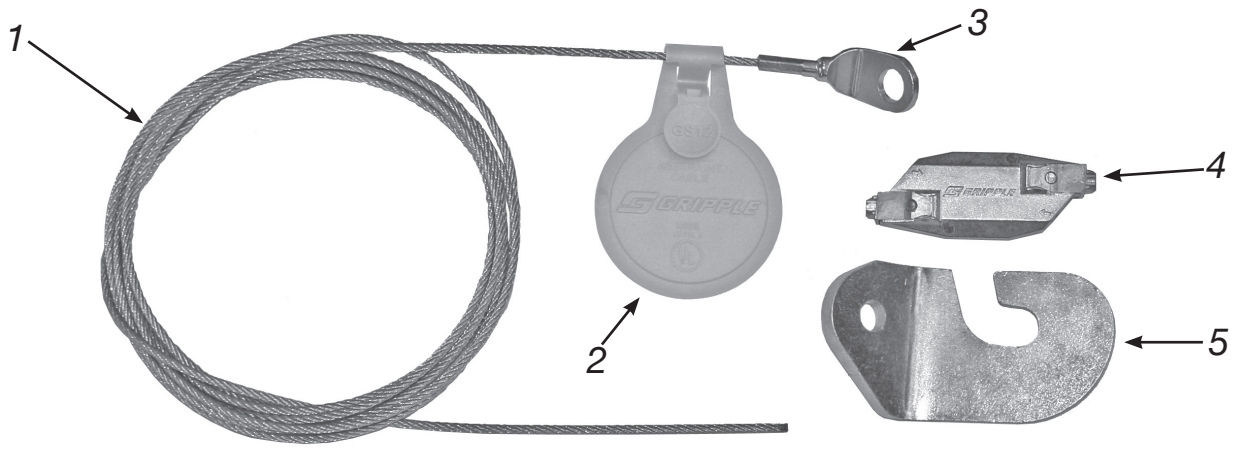
2.1 Seismic Bracing Kit and Components Overview / Kit Contents



1. Gripple Seismic Cable
Break strength certified, pre-stretched Gripple Seismic cable.
Available in lengths of 10ft, 15ft and 20ft.

2. Color Coded Tags
Pre-assembled color coded tags for easy field verification of cable diameter.
GS-10 Red; GS-12 Green; GS-19 Yellow

3. End Fitting
E-45° Eyelet
S-Standard Bracket*

** Zinc plated copper ferrules*


Eyelet


Standard Bracket

4. Gripple Seismic Fastener
GS10
GS12
GS19

Red

Green

Yellow

5. Loose bracket
Standard Bracket or Retrofit Bracket.


Standard Bracket


Retrofit Bracket

6. Gripple Tensioning Tool
Calibrated tool used to pretension GS19 cable brace installations to 110 lbs (50 kg setting on tool).

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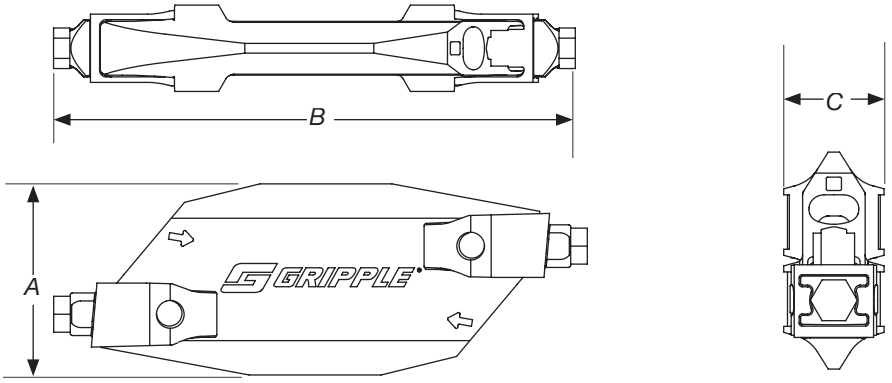
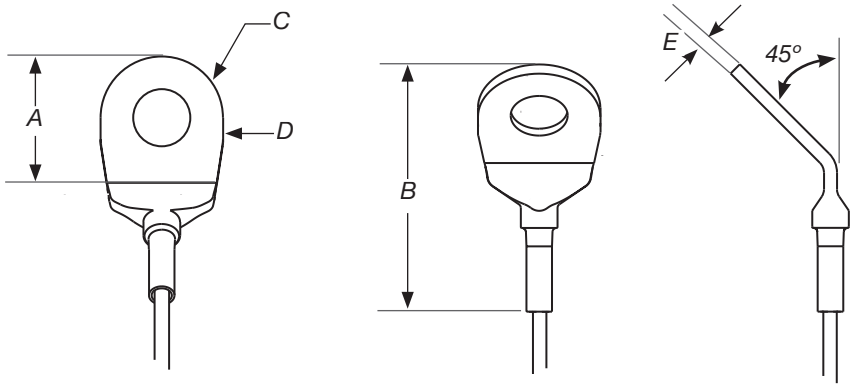
Gripple Seismic Fastener



Brace Size	Dimensions			Cable Construction
	A	B	C	
GS10 (5/64" cable)	1 9/64"	2 15/16"	33/64"	7 x 7
GS12 (1/8"cable)	1 9/64"	3 1/4"	35/64"	7 x 7
GS19 (3/16" cable)	1 11/32"	3 3/4"	9/16"	7 x 19

Gripple Eyelet



Eyelet Size	Dimensions				
	A	B	C ø	D ø	E
GSE4	1"	1 29/32"	53/64"	7/16"	1/8"

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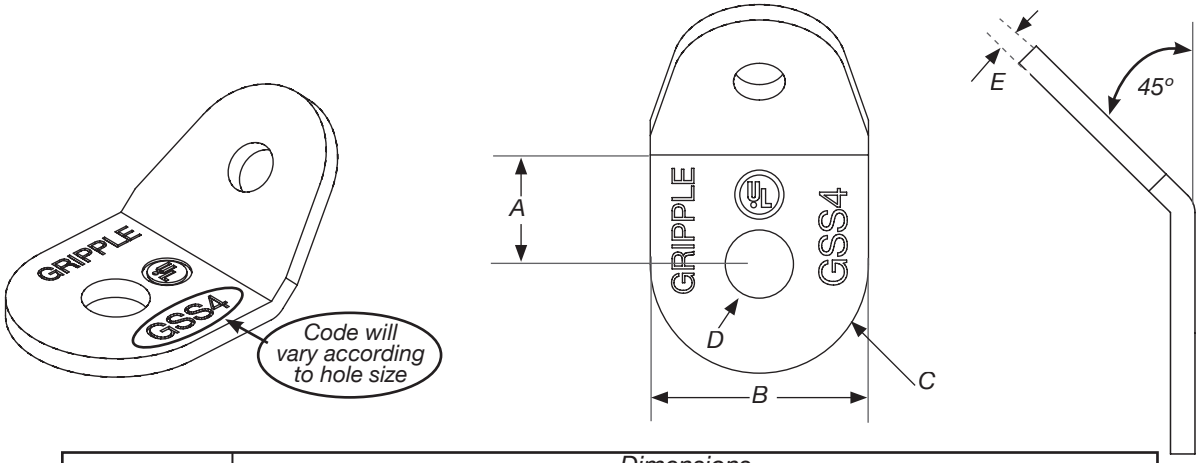
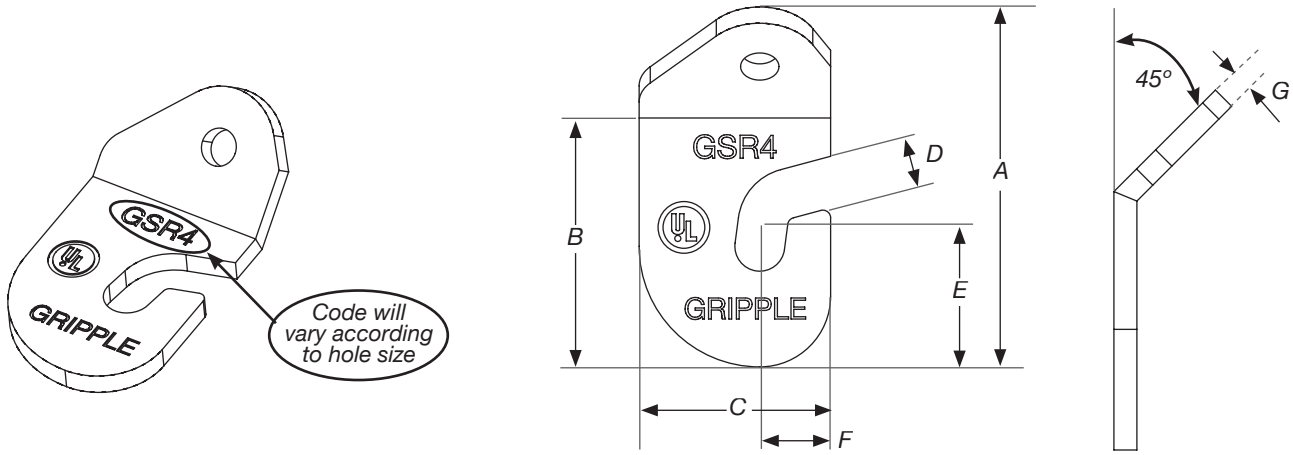
Standard Bracket



Standard Bracket Size	Dimensions				
	A	B	C ø	D ø	E
GSS4	25/32"	1 9/16"	1 9/16"	7/16"	5/32"
GSS5	13/16"	1 9/16"	1 21/32"	9/16"	5/32"
GSS6	13/16"	1 9/16"	1 21/32"	11/16"	5/32"
GSS8	1"	1 31/32"	1 31/32"	13/16"	5/32"

Retrofit Bracket



Retrofit Bracket Size	Dimensions						
	A	B	C	D	E	F	G
GSR4	3 45/64"	2 9/16"	1 31/32"	7/16"	1 1/16"	45/64"	1/4"
GSR5	3 3/4"	4 5/8"	1 31/32"	9/16"	1 5/16"	45/64"	1/4"
GSR6	3 3/4"	4 5/8"	1 31/32"	11/16"	1 5/16"	45/64"	1/4"
GSR8	4 9/64"	3 1/16"	2 1/4"	13/16"	1 13/32"	55/64"	1/4"

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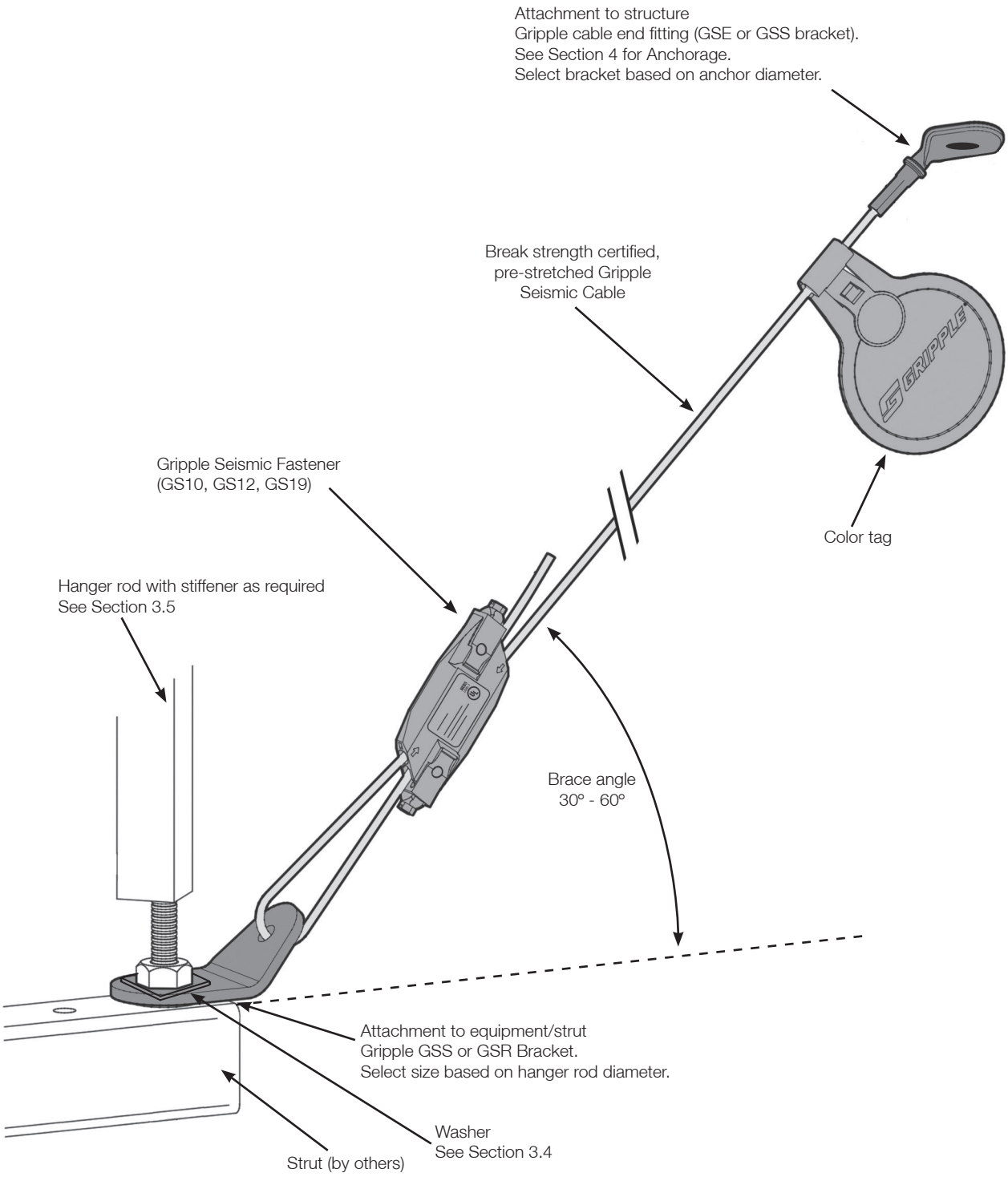
3.1 Seismic Brace Installation / Basic Brace Layout



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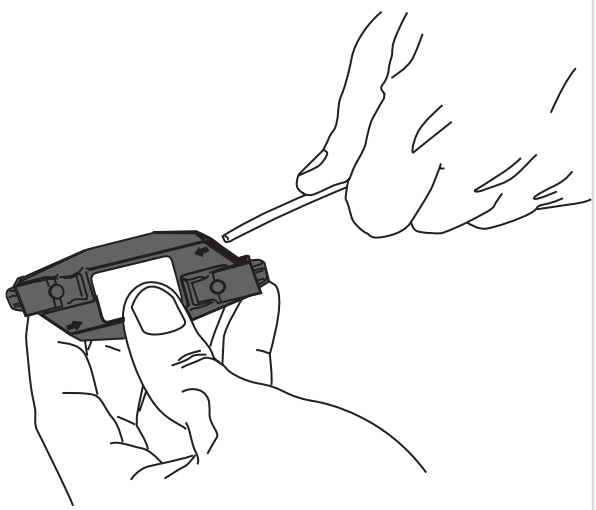
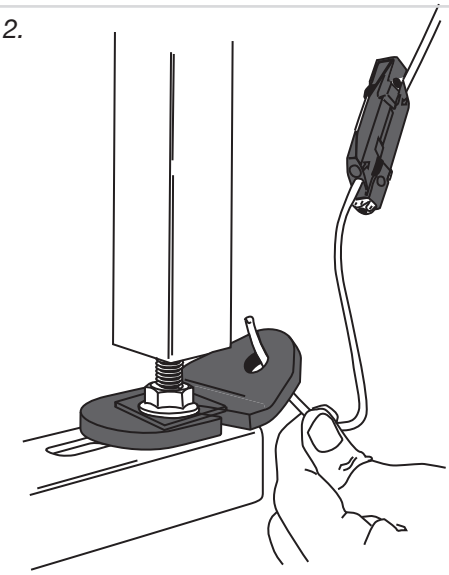
3.2 Seismic Brace Installation / Seismic Fastener Installation

1.



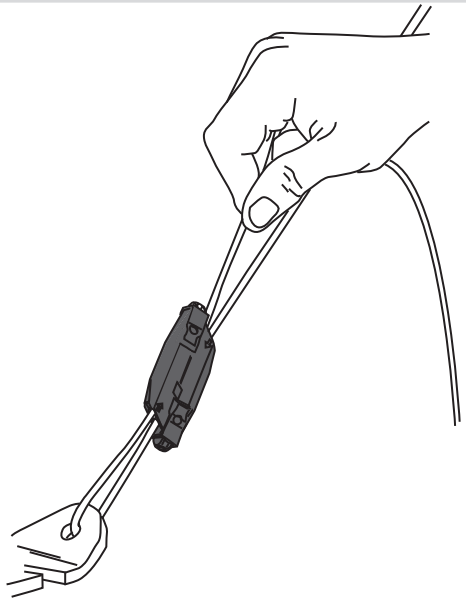
1. Thread the tail end of the cable through the first channel of the Gripple Seismic Fastener.

2.



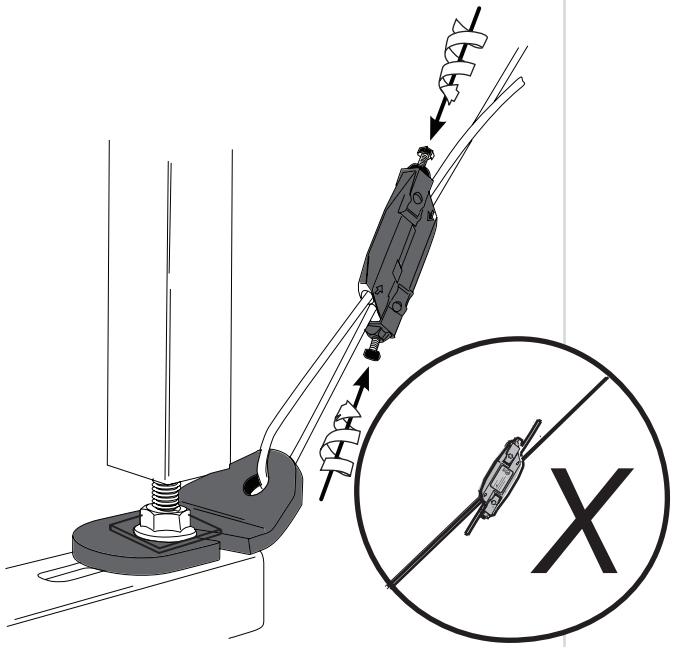
2. Thread the cable through the hole of the Gripple Seismic Bracket

3.



3. Thread the cable back through the second channel of the Gripple Fastener. A 2" tail is recommended for any future adjustments. Hand-tighten GS10 & GS12 cables to remove all slack. Pretension GS19 cables to 110 lbs (50 kg setting) using the Gripple Tensioning Tool. For spring isolated equipment, leave 1/8" visible sag in the cable.

4.



4. Hand-tighten the locking bolts until tight. Installation of the Gripple Seismic Brace is complete.

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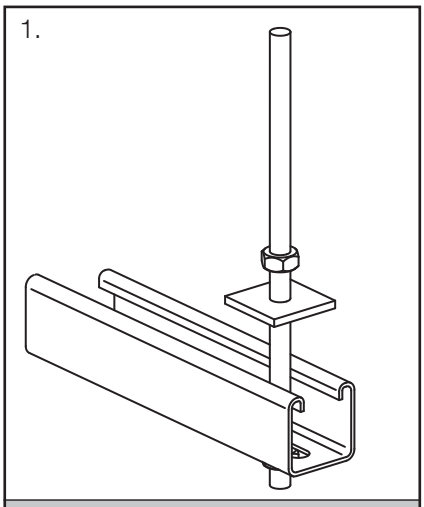
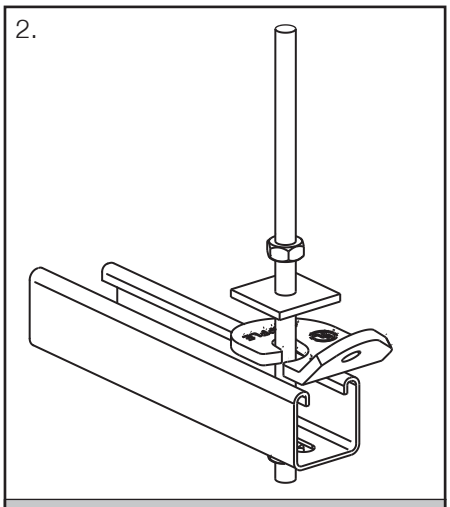
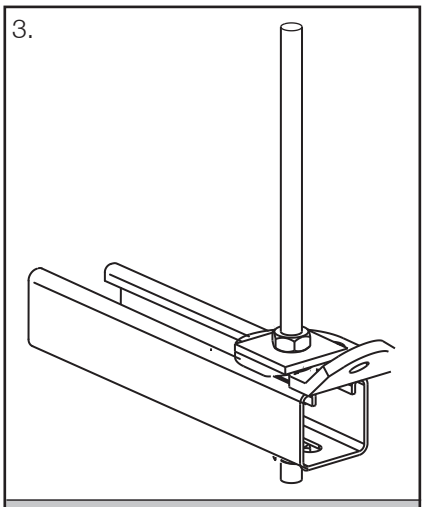
Retrofit Bracket Installation



1. Loosen nut and washer.



2. Attach Retrofit Bracket and align in direction of cable brace.



3. Tighten down nut on top of the Retrofit Bracket.

Note:

The RDP shall design the vertical support system and lateral load transfer from the Gripple bracket to the support system, including the hanger rod, attachment to the strut (nuts & bolts), and the supporting strut shown in the Figures or per an OSHPD pre-approval, for seismic applications.

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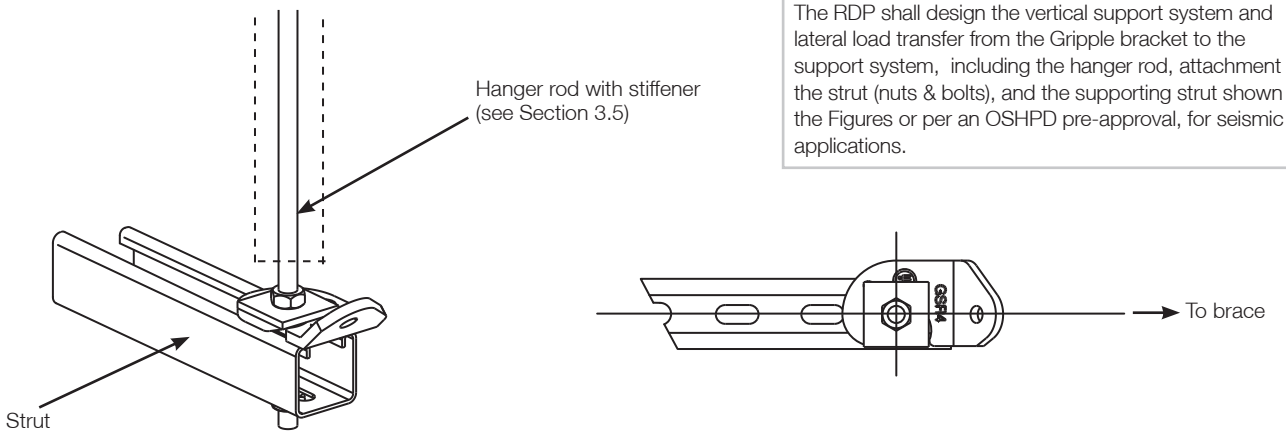
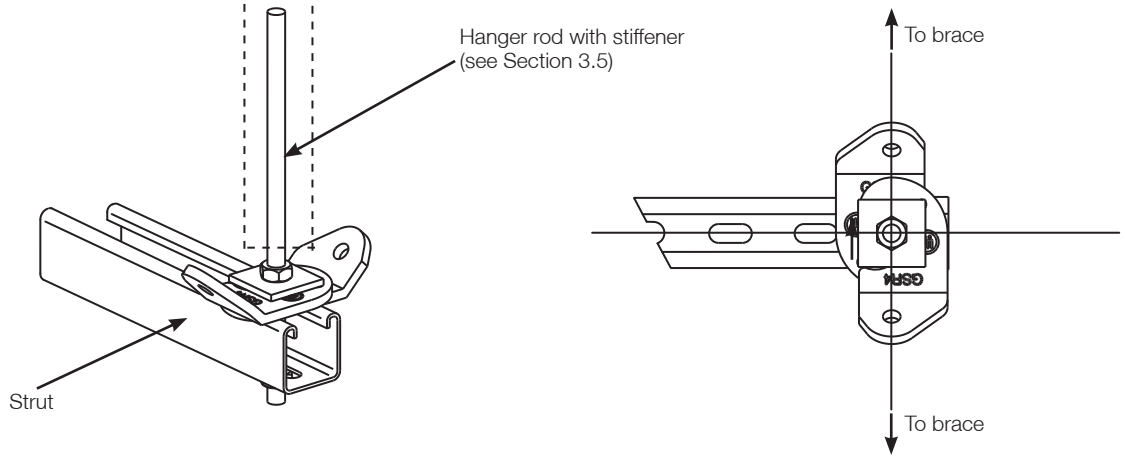
3.3.2 Seismic Bracing Installation / Bracket Stacking Installation

Typical bracket installation for Transverse bracing

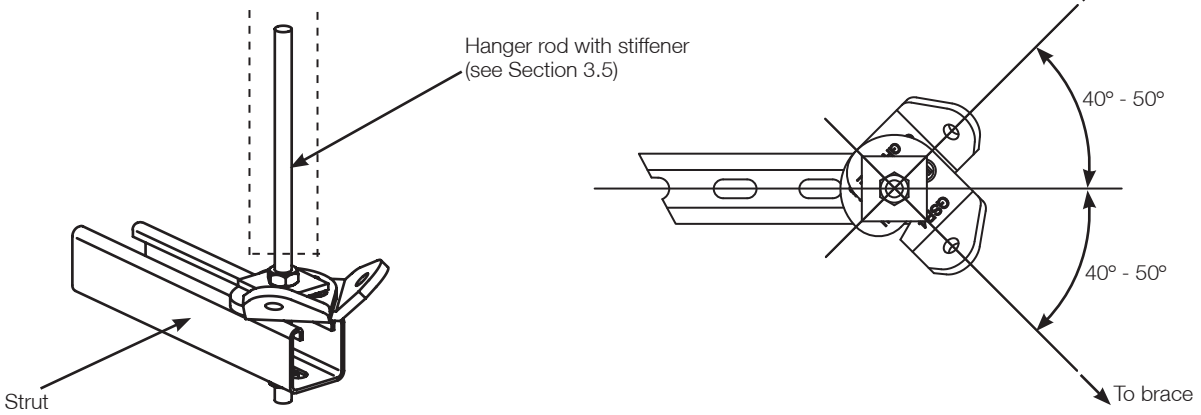


Note:
The RDP shall design the vertical support system and lateral load transfer from the Gripple bracket to the support system, including the hanger rod, attachment to the strut (nuts & bolts), and the supporting strut shown in the Figures or per an OSHPD pre-approval, for seismic applications.

Typical stacking for Longitudinal bracing



Typical stacking for '4-Way' bracing



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3.4 Seismic Brace Installation / Washers

The use of washers are required with eyelet fittings, standard brackets, and retrofit brackets. Minimum washer requirements are as follows:

Gripple Seismic Kit	Seismic Bracket	Minimum Washer Requirements *
GS10	Eyelet (GSE4)	Standard
	Standard Bracket (GSS4, GSS5)	Standard
	Retrofit Bracket (GSR4, GSR5)	Square
GS12	Eyelet (GSE4)	Standard
	Standard Bracket (GSS4, GSS5)	Standard
	Retrofit Bracket (GSR4, GSR5)	Square
GS19	Standard Bracket (GSS4, GSS5, GSS6, GSS8)	Standard
	Retrofit Bracket (GSR4, GSR5, GSR6, GSR8)	Oversized

Washer types are:

Standard = Standard round washer

Square = Square washer measuring 1-5/8" x 1/4" thick (standard square flat plate washer for strut)

Oversized = Oversized rectangular or slotted washer measuring 2-1/4" x 2" x 1/4" thick (provided by Gripple)

* Washers are prioritized from lowest to highest capacity as: standard, square, then oversized. In no case shall a lower capacity washer than the specified minimum be used.

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3.5 Seismic Bracing Installation / Support Rod Stiffeners

All-Thread Hanger Rods & Rod Stiffeners

Tensile capacities, maximum unstiffened rod length, and the maximum permitted compression force for all-thread hanger rods are provided in the table below.

The specified tensile capacities are for carbon steel rods with a minimum yield strength of 25 ksi. The maximum unstiffened rod length and maximum permitted compression force on the hanger rod are used to determine when rod stiffeners are required.

Strength Design Values for All-Thread Hanger Rods			
Rod Diameter (in.)	**Hanger Rod Tensile Strength [1, 2] (lbs.)**	**Max Unstiffened Hanger Rod Length [3] L_{max} (in.)**	**Max Compressive Force on Hanger Rod [3] P_{cr} (lbs.)**
3/8	1,095	19	370
1/2	2,025	25	710
5/8	3,240	31	1,160
3/4	4,845	37	1,750

1. *Design strengths based on AISC and A36 steel threaded rod.*
2. *Structure attachment of the all-thread rod may have a lower capacity.*
3. *Determine if stiffeners are required on the rod hanger, as follows:*
   Rod stiffeners are not required if the rod hanger is in tension.
   Rod stiffeners are not required when the rod is in compression if $L < L_{max}$ AND $P < P_{cr}$.
   Rod stiffeners are required when the rod is in compression and either $L > L_{max}$ OR $P > P_{cr}$.

At cable brace support locations, the hanger rod support(s) will be placed in compression due to the seismic forces of the cable bracing system. The tension loads on the hangers shall include the maximum tributary dead load, the vertical seismic component forces of the transverse and/or longitudinal braces, and the tributary vertical seismic load. Compression loads on the hangers shall include the vertical seismic component forces of the transverse and/or longitudinal braces, and the tributary vertical seismic load, but shall not be offset by tributary dead loads unless it can be verified that the dead loads will, in fact, be applied to the hanger in question. The compression force on the hanger rod is calculated as follows:

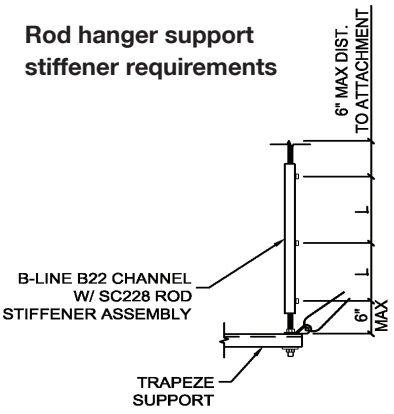
$$P_{cr} = -0.9 * DL + \text{Vertical Component of Brace Force} + \text{Vertical Seismic}$$
$$= -0.9 * DL + F_p \tan\theta + 0.2 S_{DS} DL$$

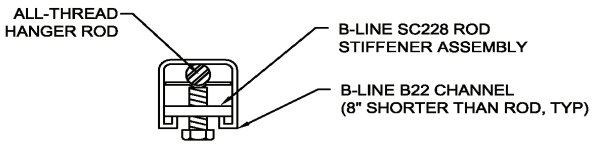
where: DL = Dead load tributary to the rod hanger support; F_p = Horizontal seismic force; θ = Brace angle measured from horizontal; S_{DS} = Design short period spectral acceleration

If P_{cr} is less than zero, the hanger rod is in tension and rod stiffeners are not required.

Where rod stiffeners are required (per Note 3 of the table above), stiffening shall be in accordance with the adjacent figure.

Rod hanger support stiffener requirements





TYP. SECTION AT SC228

ROD SIZE	CLIP SPACING (L)
3/8"Ø	13"
1/2"Ø	18"
5/8"Ø	23"
3/4"Ø	28"

NOTE:
1. B-LINE PART NUMBERS NOTED. UNISTRUT COMPONENTS MAY ALSO BE USED, AS FOLLOWS: P1000T CHANNEL W/ P2485 CRADLE CLIP, P3008 NUT, & 3/8"X1" HHCS

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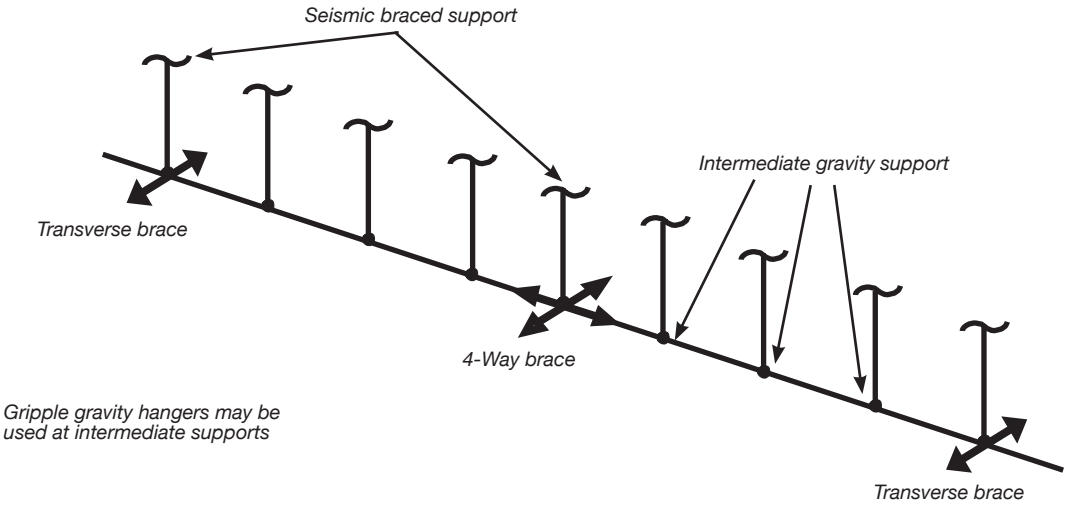
Intermediate gravity hangers between brace locations may be structural members, threaded rod, or cable systems as selected and designed by the Registered Design Professional. In no case shall seismic cable brace systems be installed at cable vertical support hangers.



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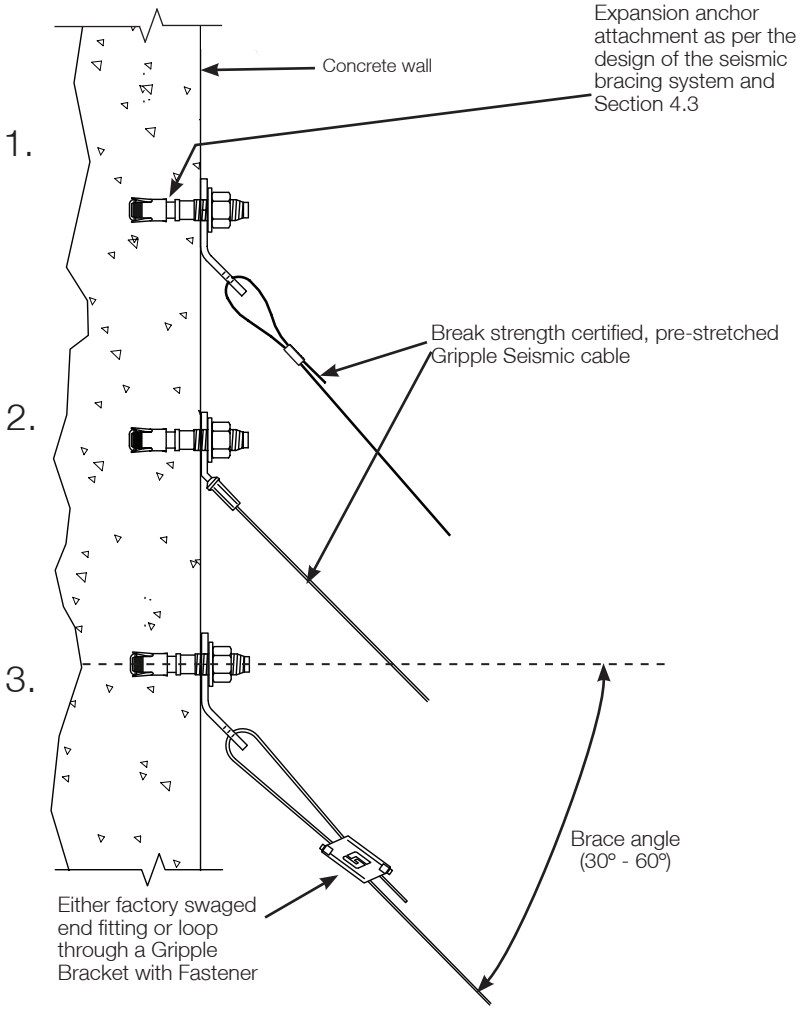
4.1.1 Brace Anchor/Attachment Installation / Concrete Wall

1. Anchor design shall be in accordance with the 2010 CBC. Typically this will include compliance with ACI318, Appendix D. See Section 4.3 for selected Anchor Types and Design Strengths.
2. Refer to applicable International Code Council evaluation service reports (ICC-ES) for each specific anchor.
3. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
4. Use caution when drilling or anchoring into a concrete wall, that the anchor embedment does not exceed the minimum required wall width as established by the anchor manufacturer.
5. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.

Color coded tag on cable for easy verification.

Warning:
Locate steel reinforcement/ rebar before drilling. Follow anchor manufacturer's installation guidelines.



1. Standard Bracket End Fitting (GS10, GS12, and GS19 systems)
2. Eyelet End Fitting (GS10 and GS12 systems)
3. Gripple Seismic Cable looped through a loose Standard Gripple Seismic Bracket, secured with a Gripple Seismic Fastener

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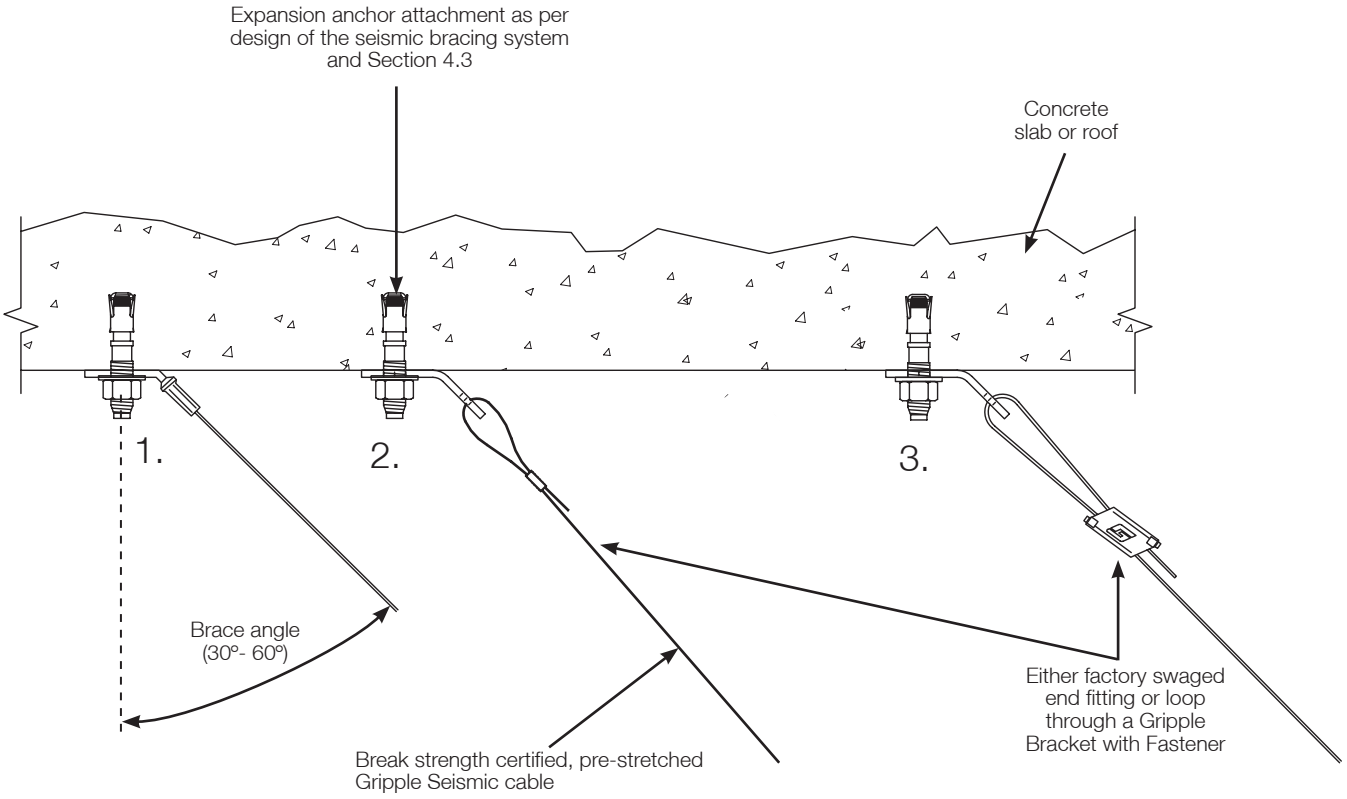
4.1.2 Brace Anchor / Attachment Installation / Concrete Ceiling / Roof

1. Anchor design shall be in accordance with the 2010 CBC. Typically this will include compliance with ACI318, Appendix D. See Section 4.3 for selected Anchor Types and Design Strengths.
2. Refer to applicable International Code Council evaluation service reports (ICC-ES) for each specific anchor.
3. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
4. Use caution when drilling or anchoring into a concrete surface, that the anchor embedment does not exceed the minimum required depth as established by the anchor manufacturer.
5. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.

Color coded tag on cable for easy verification.



1. Eyelet End Fitting (GS10 and GS12 systems)
2. Standard Bracket End Fitting (GS10, GS12, and GS19 systems)
3. Gripple Seismic Cable looped through a loose Standard Bracket, secured with a Gripple Seismic Fastener

Warning:
Locate steel reinforcement/rebar before drilling. Follow anchor manufacturer's installation guidelines.

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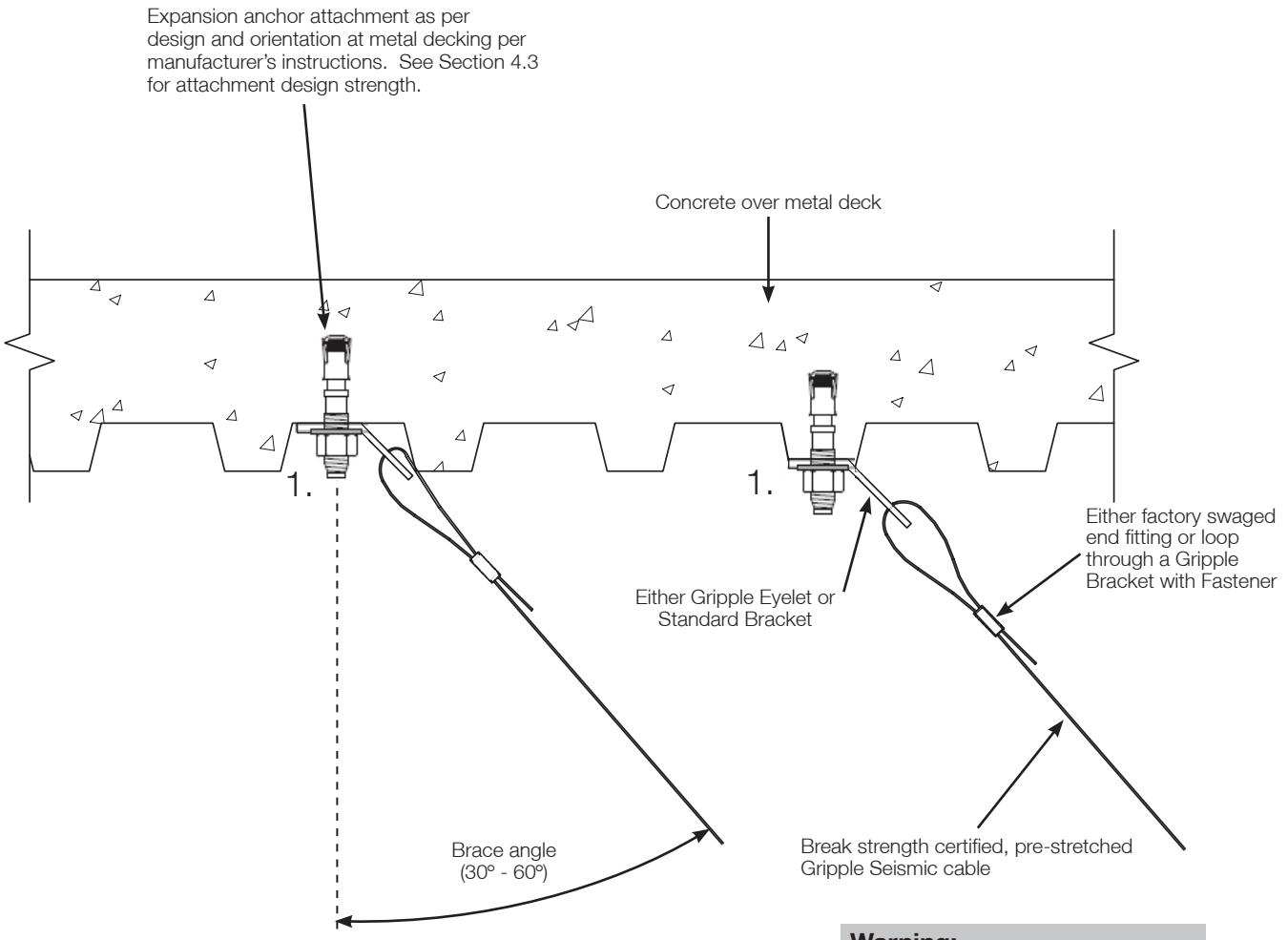
4.1.3 Brace Anchor / Attachment Installation / Concrete over Metal Decking

1. Anchor design shall be in accordance with the 2010 CBC. Typically this will include compliance with ACI318, Appendix D. See Section 4.3 for selected Anchor Types and Design Strengths.
2. Refer to applicable International Code Council evaluation service reports (ICC-ES) for each specific anchor.
3. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
4. Use caution when drilling or anchoring into a concrete surface, that the anchor embedment does not exceed the minimum required depth as established by the anchor manufacturer.
5. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.

Color coded tag on cable for easy verification.



1. Standard Bracket end fitting (GS10, GS12. and GS19 systems)

Warning:
Locate steel reinforcement/rebar before drilling. Follow anchor manufacturer's installation guidelines.

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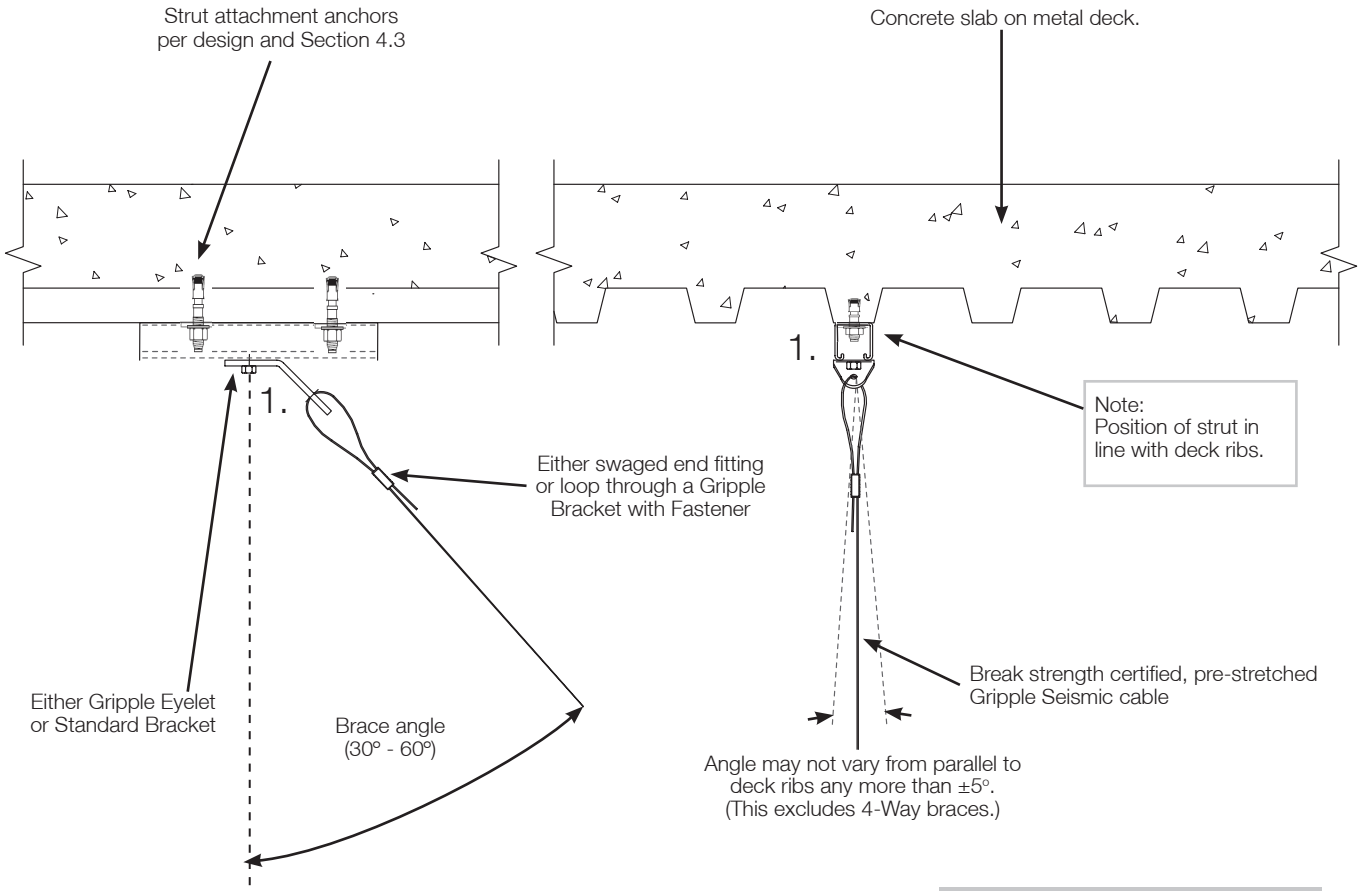
4.1.3 Brace Anchor / Attachment Installation / Concrete over Metal Decking (cont.)

1. Anchor design shall be in accordance with the 2010 CBC. Typically this will include compliance with ACI318, Appendix D. See Section 4.3 for selected Anchor Types and Design Strengths.
2. Refer to applicable International Code Council evaluation service reports (ICC-ES) for each specific anchor.
3. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
4. Use caution when drilling or anchoring into a concrete surface, that the anchor embedment does not exceed the minimum required depth as established by the anchor manufacturer.
5. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.

Color coded tag on cable for easy verification.



1. Standard Bracket End Fitting (GS10, GS12, and GS19 systems)

Note:
Gripple Bracket anchor to strut and strut shall be designed by the RDP or OSHPD pre-approval.

Warning:
Locate steel reinforcement/rebar before drilling. Follow anchor manufacturer's installation guidelines.

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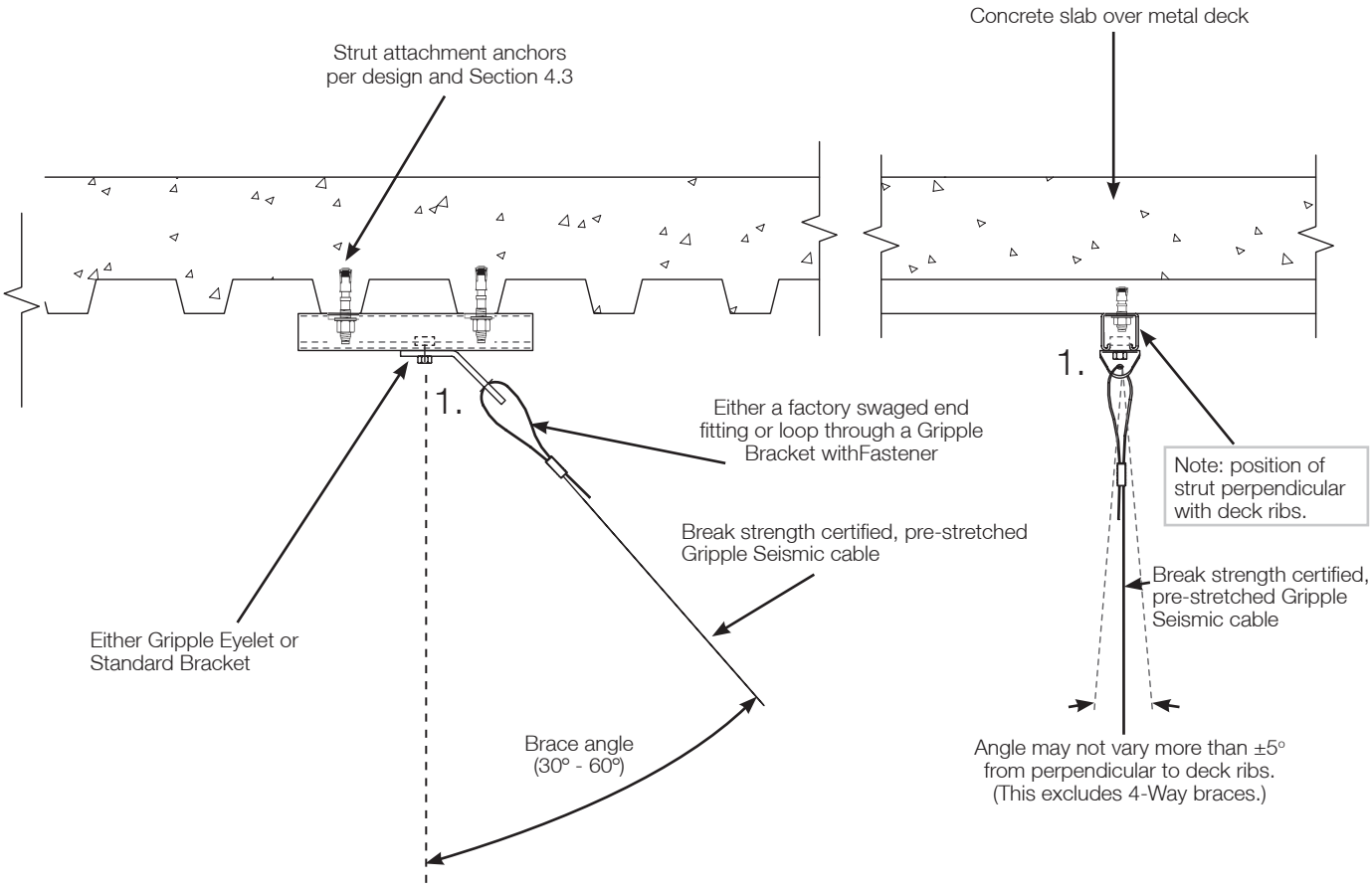
4.1.3 Brace Anchor / Attachment Installation / Concrete over Metal Decking (cont.)

1. Anchor design shall be in accordance with 2010 CBC. Typically this will include compliance with ACI318, Appendix D. See Section 4.3 for selected Anchor Types and Design Strengths.
2. Refer to applicable International Code Council evaluation service reports (ICC-ES) for each specific anchor.
3. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
4. Use caution when drilling or anchoring into a concrete surface, that the anchor embedment does not exceed the minimum required depth as established by the anchor manufacturer.
5. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.

Color coded tag on cable for easy verification.



1. Standard Bracket end fitting (GS10, GS12, and GS19 systems)

Note:
Gripple Bracket anchor to strut and strut shall be designed by the RDP or OSHPD pre-approval.

Warning:
Locate steel reinforcement/rebar before drilling. Follow anchor manufacturer's installation guidelines.

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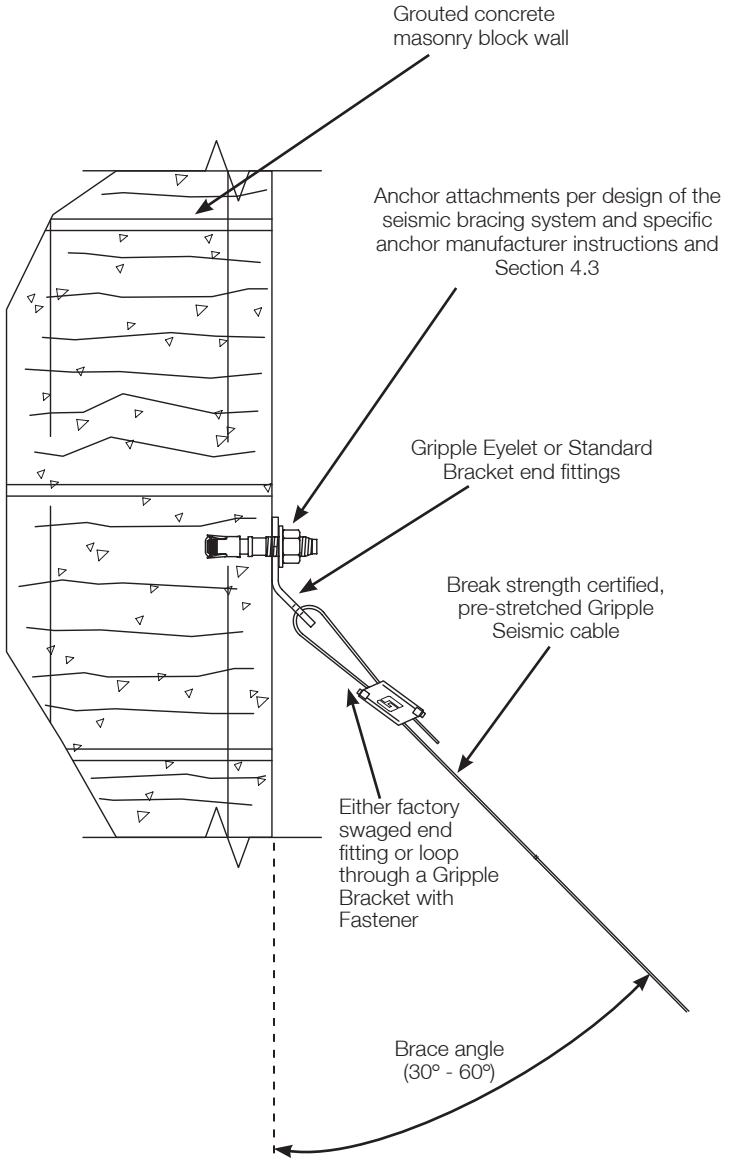
4.1.4 Brace Anchor / Attachment Installation / Concrete Block Wall

1. Anchor design shall be in accordance with the 2010 CBC. Typically this will include compliance with ACI318, Appendix D. See Section 4.3 for selected Anchor Types and Design Strengths.
2. Refer to applicable International Code Council evaluation service reports (ICC-ES) for each specific anchor.
3. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
4. Use caution when drilling or anchoring into a wall, that the anchor embedment does not exceed the minimum required wall width as established by the anchor manufacturer.
5. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.

Color coded tag on cable for easy verification.



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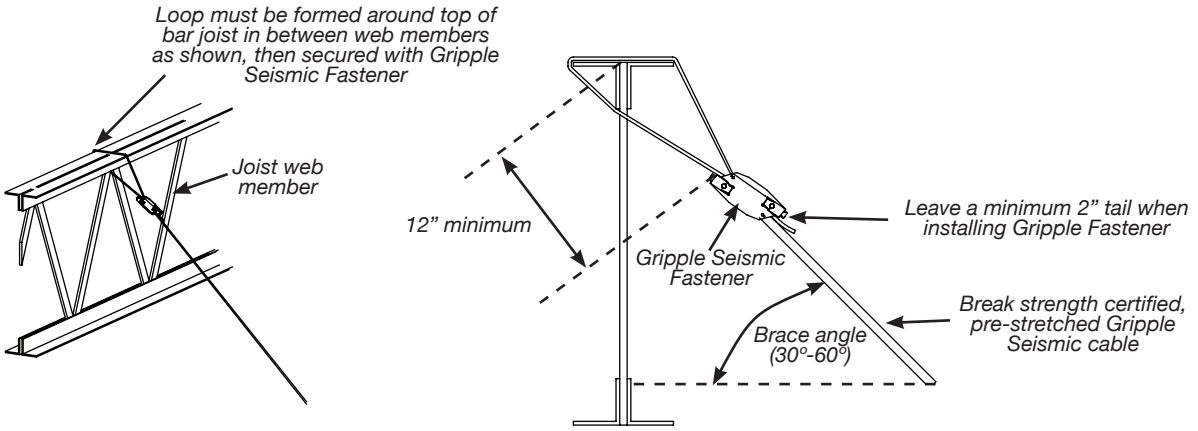
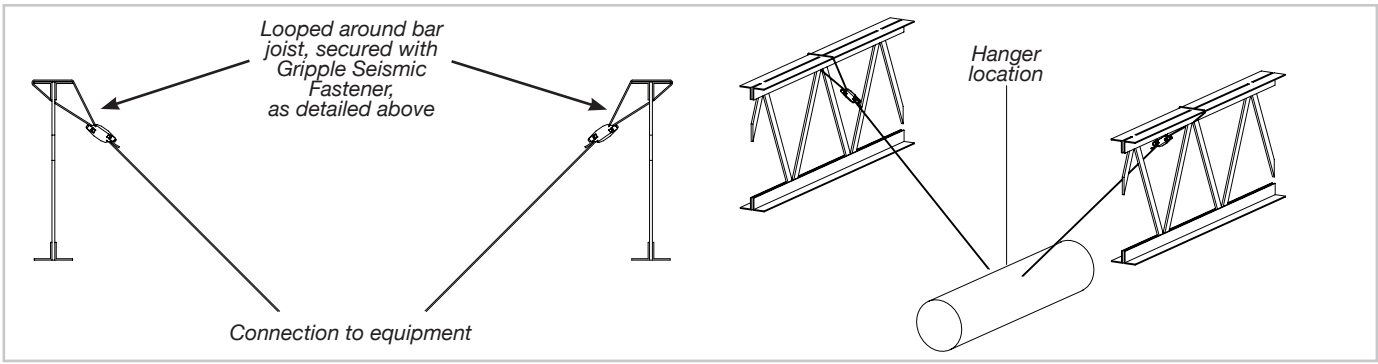
4.2.1 Brace Anchor / Attachment Installation / Bar Joist - Transverse or Longitudinal

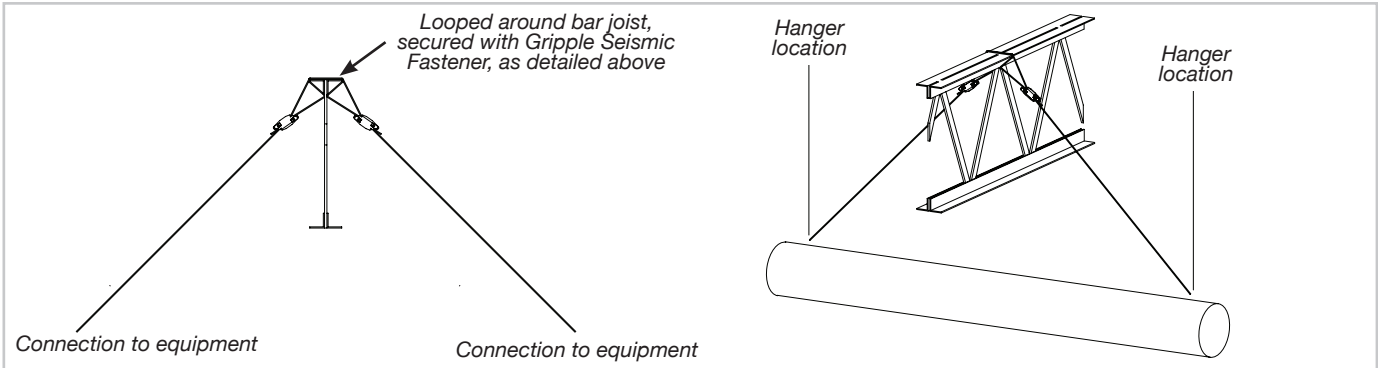
1. Details below indicate how braces may be attached to a bar joist structure.
2. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
3. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.
4. The Gripple seismic cable shall only be attached to the top chord of the bar joist member.

Color coded tag on cable for easy verification.

Note:
For the bracing arrangements detailed here, two seismic fasteners may be required (one at each end of the cable brace supplied without factory swaged on brackets).







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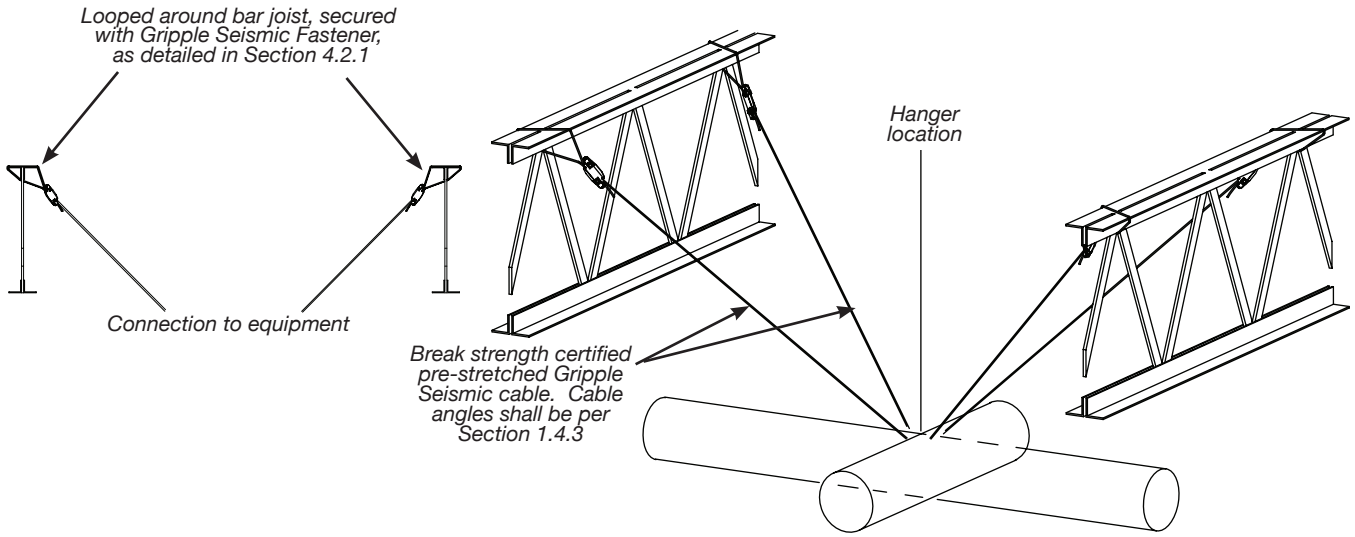
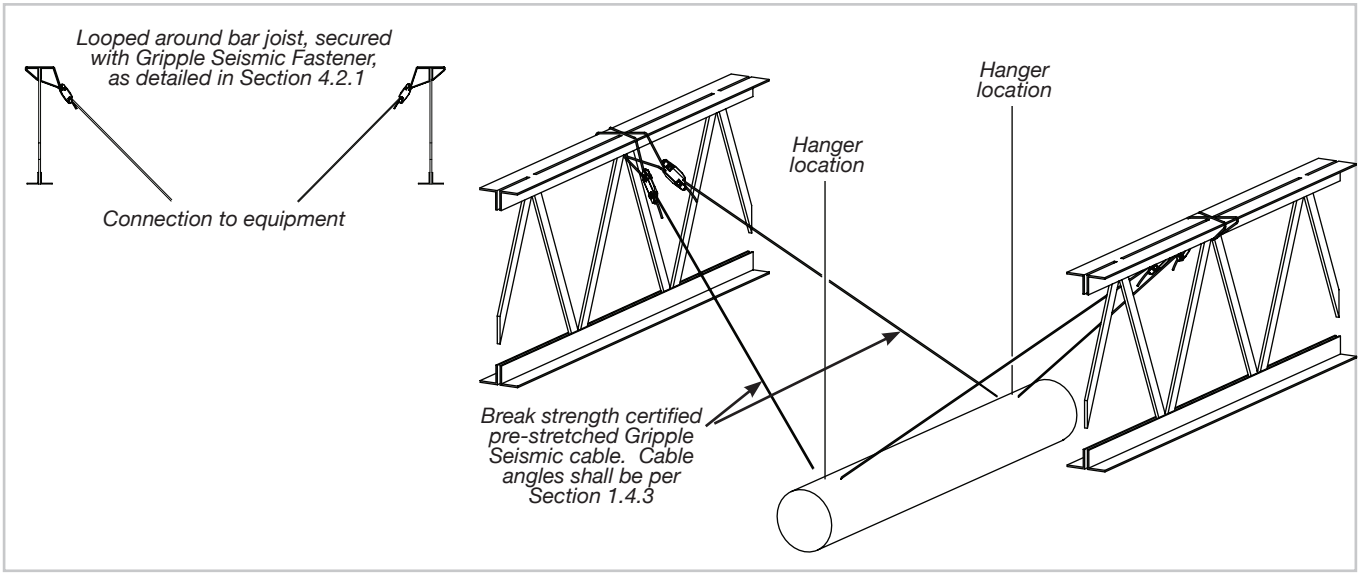
4.2.2 Brace Anchor / Attachment Installation / Bar Joist - '4-Way' Bracing

1. Details below indicate how braces may be attached to a bar joist structure for a 4-Way brace system.
2. All non-Gripple parts, rod hangers, seismic support and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
3. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.
4. The Gripple seismic cable shall only be attached to the top chord of the bar joist member.

Color coded tag on cable for easy verification.

Note:
For the bracing arrangements detailed here, two seismic fasteners may be required (one at each end of the cable brace supplied without a factory swaged on bracket).





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ANCHORAGE TO STRUCTURE (ATTACHMENT):

Design strengths (LRFD capacity values) have been calculated using national / industry approved standards for various structural attachment methods for the Gripple Seismic Bracing System. The registered design professional may use alternate structural attachment methods provided that the anchor capacities are determined in accordance with the 2010 CBC. Structural attachment methods considered herein include:

- Expansion anchors to normal weight concrete slab or normal weight concrete wall
- Expansion anchors to concrete-filled (lightweight or normal weight) metal deck
- Anchors to solid-grouted concrete masonry block wall

Gravity and seismic demands shall be combined using the load combinations specified in CBC 2010.

Assumptions used in calculating the anchor capacities are specified in each of the anchorage sections. Assumptions are typically conservative, but are representative of the most common conditions that are expected to be encountered. If the actual in-situ conditions are not bounded by the assumptions used in the capacity calculations, the Registered Design Professional shall determine anchorage values for these alternate attachment conditions based on a code rationale approach and submit to the project SEOR for approval.

Anchorage Installation/Testing Requirements

1. Anchors addressed by this OPA approval include:
    a. Hilti Kwik Bolt TZ Concrete Expansion Anchors (ICC-ES ESR-1917),
    b. Powers Power Stud+ SD2 Concrete Expansion Anchors (ICC-ES ESR-2502),
    c. Hilti Kwik Bolt 3 Masonry Expansion Anchors (ICC-ES ESR-1385)
2. Applicable anchor capacities are included in Tables 1–5. Anchors shall be installed in accordance with these & the applicable ICC-ESR Report requirements.
3. Do not drill thru existing reinforcing when installing anchors. If reinforcement is hit, stop and notify the Structural Engineer of Record (SEOR) for direction.
4. Anchor installation test requirements shall be in accordance with the 2010 CBC Section 1916A.7 as follows:
    a. Torque test 50% of the installed anchors using the Torque Wrench Method. Applicable anchor installation torque values are listed in Tables 1–5.
    b. Perform test by torque wrench method. Applicable test torque value (Tables 1-5) shall be achieved within one-half (1/2) turn of the nut.
    c. Testing shall occur at a minimum of 24 hours after anchor installation.
    d. If any anchor fails, all anchors shall be tested which are installed by the same trade and not previously tested until 20 consecutive anchors or all remaining anchors pass, then resume initial test frequency. Notify the project SEOR for corrective measures for failed anchors.
    e. Test equipment shall be calibrated by an approved testing laboratory in accordance with standard recognized procedures.

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Expansion Anchors to Normal Weight Concrete Slab or Wall

Refer to tables on the following page for anchorage to normal weight concrete slabs or normal weight concrete walls using mechanical expansion anchors. Anchor capacities for tension and shear forces are provided for the Hilti Kwik Bolt TZ and the Powers Power-Stud+ SD2 expansion anchors. The capacities have been calculated in compliance with ACI 318-08 and as modified by 2010 CBC as appropriate.

The adequacy of the anchor shall be determined by considering the interaction of tension and shear forces using the following relationship:

$$\frac{P_r * \text{Tensile Demand}}{\text{Tensile Strength}} + \frac{\text{Shear Demand}}{\text{Shear Strength}} \leq 1.2$$

(Ref. Table 6 for applicable prying factors, P_r)

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Table 1

Design Strengths for Anchorage to Normal Weight Concrete Slab Hilti Kwik Bolt TZ Expansion Anchors [1, 2]						
Anchor Diameter (in.)	Nominal Embed. (in.)	Effective Embed. (in.)	Minimum Member Thickness (in.)	Tension [3, 4] (lbs.)	Shear [3, 4] (lbs.)	Install. Torque (ft-lbs.)
3/8	2 5/16	2	4	1,210	1,380	25
1/2	2 3/8	2	4	1,280	1,380	40
1/2	3 5/8	3 1/4	6	2,625	3,570	40
5/8	3 9/16	3 1/8	5	2,505	4,940	60
5/8	4 7/16	4	6	3,630	4,940	60
3/4	4 5/16	3 3/4	6	3,295	7,100	110
3/4	5 9/16	4 3/4	8	4,695	7,630	110

1. *Design strength of anchors determined in accordance with ACI 318-08 Appendix D Provisions (cracked concrete conditions) as modified by 2010 CBC using the anchor capacities listed in ESR-1917, Hilti Kwik Bolt TZ Carbon and Stainless Steel Anchors in Concrete (May 1, 2011).*
2. *Minimum concrete compressive strength = 3,000 psi.*
3. *Expansion anchors are carbon steel.*
4. *Values assume that critical edge distance and spacing requirements have been satisfied (no reductions applied to capacities).*

Table 2

Design Strengths for Anchorage to Normal Weight Concrete Slab Powers Power-Stud+ SD2 Expansion Anchors [1, 2]						
Anchor Diameter (in.)	Nominal Embed. (in.)	Effective Embed. (in.)	Minimum Member Thickness (in.)	Tension [3, 4] (lbs.)	Shear [3, 4] (lbs.)	Install. Torque (ft-lbs.)
3/8	2 3/8	2	4	1,120	1,270	20
1/2	2 1/2	2	4 1/2	1,280	1,380	40
1/2	3 3/4	3 1/4	5 3/4	2,335	3,015	40
5/8	3 7/8	3 1/4	5 3/4	2,660	4,245	60
5/8	4 7/8	4 1/4	6 1/2	2,660	4,245	60
3/4	4 1/2	3 3/4	7	3,295	4,310	110
3/4	5 3/4	5	10	4,160	4,310	110

1. *Design strength of anchors determined in accordance with ACI 318-08 Appendix D Provisions (cracked concrete conditions), as modified by 2010 CBC using the anchor capacities listed in ESR-2502, Powers Power-Stud+ SD2 Anchors in Cracked and Uncracked Concrete (May 1, 2012).*
2. *Minimum concrete compressive strength = 3,000 psi.*
3. *Expansion anchors are carbon steel.*
4. *Values assume that critical edge distance and spacing requirements have been satisfied (no reductions applied to capacities).*

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Refer to tables below for anchorage to concrete-filled metal deck using mechanical expansion anchors. The concrete fill can be lightweight or normal weight concrete, but must have a minimum compressive strength of 3,000 psi as identified in Note 2 for the tables below. Anchor capacities for tension and shear forces are provided for the Hilti Kwik Bolt TZ and the Powers Power-Stud+ SD2 expansion anchors. The capacities have been calculated in compliance with ACI 318-08 and as modified by 2010 CBC as appropriate.

The adequacy of the anchor shall be determined by considering the interaction of tension and shear forces using the following relationship:

$$\frac{P_r * \text{Tensile Demand}}{\text{Tensile Strength}} + \frac{\text{Shear Demand}}{\text{Shear Strength}} \leq 1.2$$

(Ref. Table 6 for applicable Prying Factors, P_r)

Table 3

Design Strengths for Anchorage to Lightweight Concrete Filled Metal Deck Hilti Kwik Bolt TZ Expansion Anchors [1, 2, 3]					
Anchor Diameter (in.)	**Nominal Embed. (in.)**	**Effective Embed. (in.)**	**Tension [4, 5] (lbs.)**	**Shear [4, 5] (lbs.)**	**Install. Torque (ft-lbs.)**
3/8	2 5/16	2	710	870	25
1/2	2 3/8	2	710	1,950	40
1/2	3 5/8	3 1/4	1,275	3,210	40
5/8	3 9/16	3 1/8	975	2,805	60

1. *Design strength of anchors determined in accordance with ACI 318-08 Appendix D Provisions (cracked concrete conditions) as modified by 2010 CBC, using the anchor capacities listed in ESR-1917, Hilti Kwik Bolt TZ Carbon and Stainless Steel Anchors in Concrete (May 1, 2011) in accordance with Fig. 5A of the ESR.*
2. *Concrete-filled metal deck with 3" deck and minimum 1.5" sand lightweight (or normal weight) concrete topping for lower flute installations. Additional cover required for upper flute installations, see note 3. Minimum concrete compressive strength = 3,000 psi.*
3. *Anchors can be installed into the upper or lower flute of the metal deck provided that adequate concrete cover (5/8" clear cover, ref. Fig. 5A ESR-1917) is provided.*
4. *Expansion anchors are carbon steel.*
5. *Values assume that critical edge distance and spacing requirements have been satisfied (no reductions applied to capacities).*

Table 4

Design Strengths for Anchorage to Lightweight Concrete Filled Metal Deck Powers Power-Stud+ SD2 Expansion Anchors [1, 2, 3]					
Anchor Diameter (in.)	**Nominal Embed. (in.)**	**Effective Embed. (in.)**	**Tension [4, 5] (lbs.)**	**Shear [4] (lbs.)**	**Install. Torque (ft-lbs.)**
3/8	2 3/8	2	700	1,260	20
1/2	2 1/2	2	700	2,480	40
1/2	3 3/4	3 1/4	1,265	3,275	40
5/8	3 7/8	3 1/4	1,610	1,735	60

1. *Design strength of anchors determined in accordance with ACI 318-08 Appendix D Provisions (cracked concrete conditions) as modified by 2010 CBC, using the anchor capacities listed in ESR-2502, Powers Power-Stud+ SD2 Anchors in Cracked and Uncracked Concrete (May 1, 2012).*
2. *Concrete-filled metal deck with 3" deck and minimum 3.25" sand lightweight (or normal weight) concrete topping, minimum concrete compressive strength = 3,000 psi.*
3. *Anchors can be installed into the upper or lower flute of the metal deck provided that adequate concrete cover (3/4" clear cover, ref. Fig. 4A ESR-2502) is provided.*
4. *Expansion anchors are carbon steel.*
5. *Values assume that critical edge distance and spacing requirements have been satisfied (no reductions applied to capacities).*

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Refer to table below for anchorage to solid-grouted concrete masonry walls using the Hilti Kwik Bolt 3 Masonry Anchor. The adequacy of the anchor shall be determined by considering the interaction of tension and shear forces using the following relationship:

$$\left(\frac{P_r * \text{Tensile Demand}}{\text{Tensile Strength}}\right)^{5/3} + \left(\frac{\text{Shear Demand}}{\text{Shear Strength}}\right)^{5/3} \leq 1.0$$

(Ref. Table 6 for applicable Prying Factors, P_r)

Table 5

Allowable Strengths (ASD) for Anchorage to Solid-Grouted CMU Wall Hilti Kwik Bolt 3 Masonry Anchors [1, 2]				
Anchor Diameter (in.)	**Embed. Depth [3] (in.)**	**Tension [4, 5, 6] (lbs.)**	**Shear [4, 5, 6] (lbs.)**	**Install. Torque (ft-lbs.)**
3/8	1 5/8	257	589	15
3/8	2 1/2	626	764	15
1/2	2 1/4	502	664	25
1/2	3 1/2	724	840	25
5/8	2 3/4	651	710	65
5/8	4	994	743	65
3/4	3 1/4	829	627	120
3/4	4 3/8	1,316	657	120

1. *Allowable strength anchor capacities listed are per ESR-1385, Kwik Bolt 3 Masonry Anchors (February 1, 2012) for applications in fully grouted uncracked masonry.*
2. *Anchors must be installed in the face shell of the masonry wall (constructed as follows: minimum Type I, Grade N, lightweight, medium-weight, or normal weight concrete units conforming to ASTM C90, fully-grouted with coarse grout).*
3. *Embedment depth shall be measured from the outside face of the concrete masonry unit.*
4. *Expansion anchors are carbon steel.*
5. *Anchors shall be located a minimum of 1.375 in away from any vertical mortar joint; anchor locations are limited to one per masonry cell with a minimum spacing of 8" on center; minimum distance from end of wall is 4 in.*
6. *The use of Hilti Kwik Bolt 3 masonry anchors shall satisfy ESR-1385 Section 5.0 "Conditions of Use", and the RDP shall submit calculations to demonstrate the following:*
   a.) The masonry wall is not cracked as defined in ICC-ES AC-01 Section 2.3, and
   b.) The masonry wall will not crack under the design earthquake loads under all service load conditions; i.e. the wall remains elastic.

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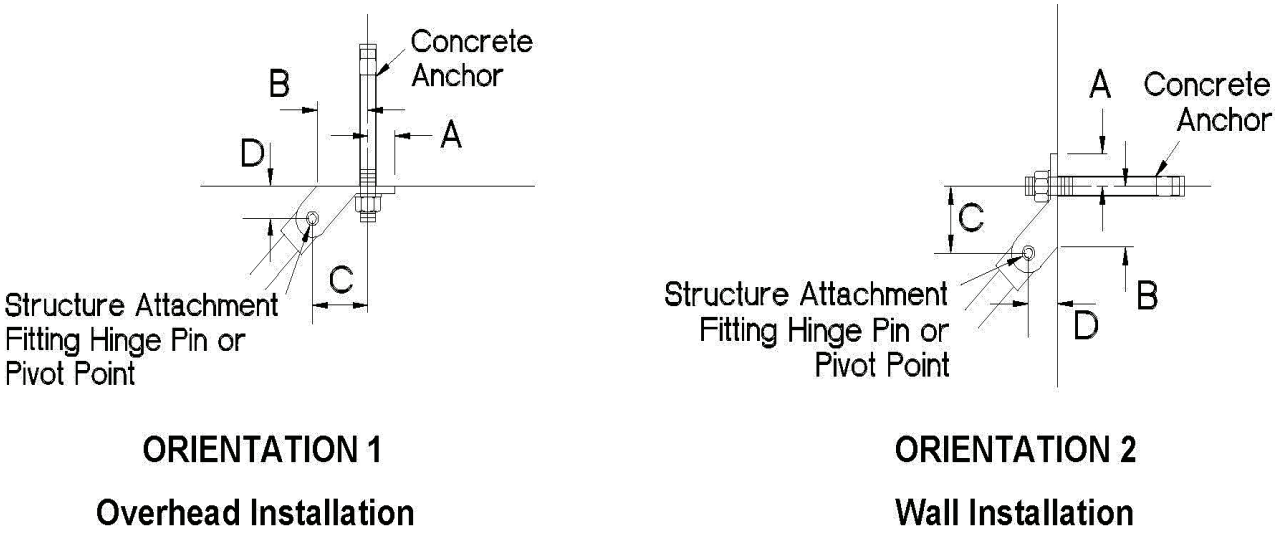
Calculations were performed to determine prying factors for anchorage design of the Gripple Seismic System. Prying forces were calculated for the eyelet and standard brackets only. Prying at the retrofit bracket was not considered, as the retrofit bracket is not utilized for anchorage to the structure.

Prying factors were calculated using the evaluation procedure detailed in Section A.9.3.5.9.1 of the 2010 edition of NFPA 13, Standard for the Installation of Sprinkler Systems. Prying factors were calculated for the two installation configurations (Orientation 1 & 2), as illustrated below in the figure below.

Installation configurations for prying factor calculations



ORIENTATION 1

Overhead Installation

ORIENTATION 2

Wall Installation

The results for the prying factor calculations are summarized in the table below. A single prying factor is provided that envelopes all of the GSS standard bracket sizes for braces oriented at 30 degrees, 45 degrees, and 60 degrees from horizontal.

Table 6

Prying Factors for Anchorage to Concrete						
Brace Angle	**Orientation 1**			**Orientation 2**		
	30°	**45°**	**60°**	**30°**	**45°**	**60°**
GSS Bracket	1.25	1.85	2.20	2.20	1.85	1.25
GSE Eyelet	1.00	1.90	3.00	3.00	1.90	1.00

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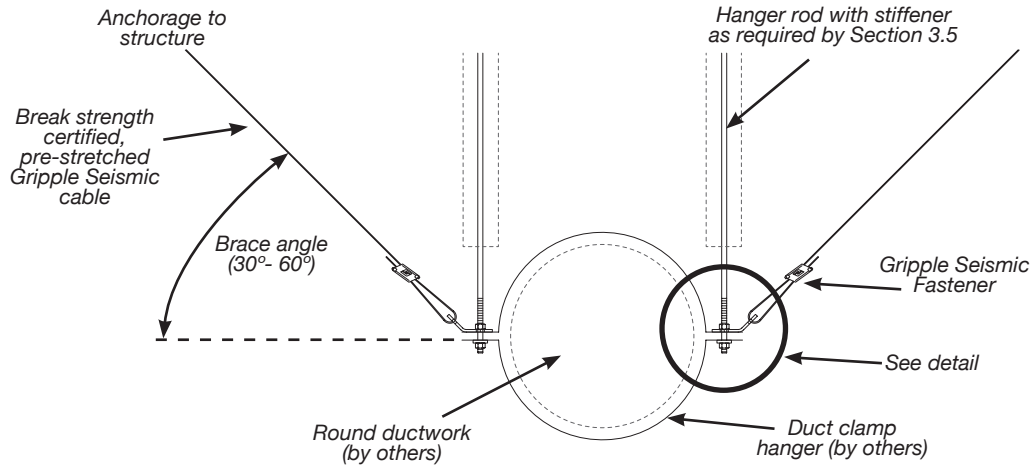
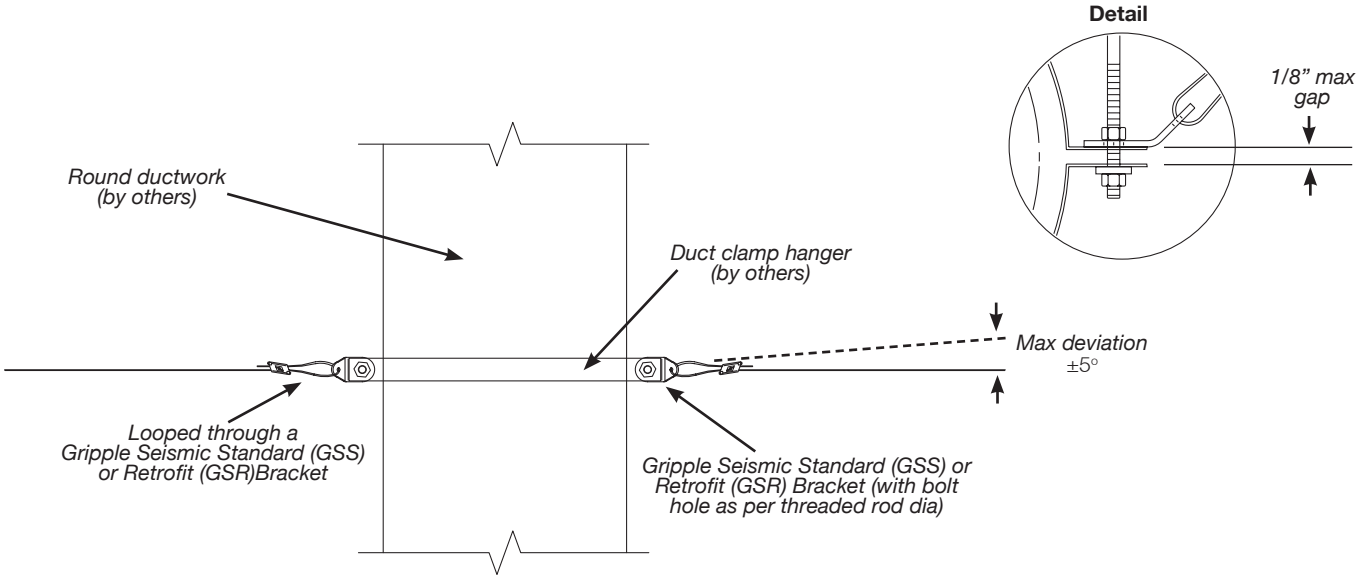
5.1.1 Round Ductwork / Transverse

1. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
2. Install cable assemblies with a 60° maximum angle from the horizontal plane.
3. Anchor cable assemblies to structure per Section 4, and as required by design.
4. Hand-tighten or pretension cables to remove slack per Section 3.2.
5. Hanger rod and rod stiffeners shall be by design and Section 3.5.
6. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.
7. Leave a 2" tail extending out of the Gripple Seismic Fastener for future adjustments.
8. Ensure locking screws are fully installed (hand-tight) into the Gripple Seismic Fastener on completion of installation.

Color coded tag on cable for easy verification.



Section View



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5.1.2 Round Ductwork / Longitudinal

1. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
2. Install cable assemblies with a 60° maximum angle from the horizontal plane.
3. Anchor cable assemblies to structure per Section 4, and as required by design.
4. Hand-tighten or pretension cables to remove slack per Section 3.2.
5. Hanger rod and rod stiffeners shall be by design and Section 3.5.
6. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.
7. Leave a 2" tail extending out of the Gripple Seismic Fastener for future adjustments.
8. Ensure locking screws are fully installed (hand-tight) into the Gripple Seismic Fastener on completion of installation.

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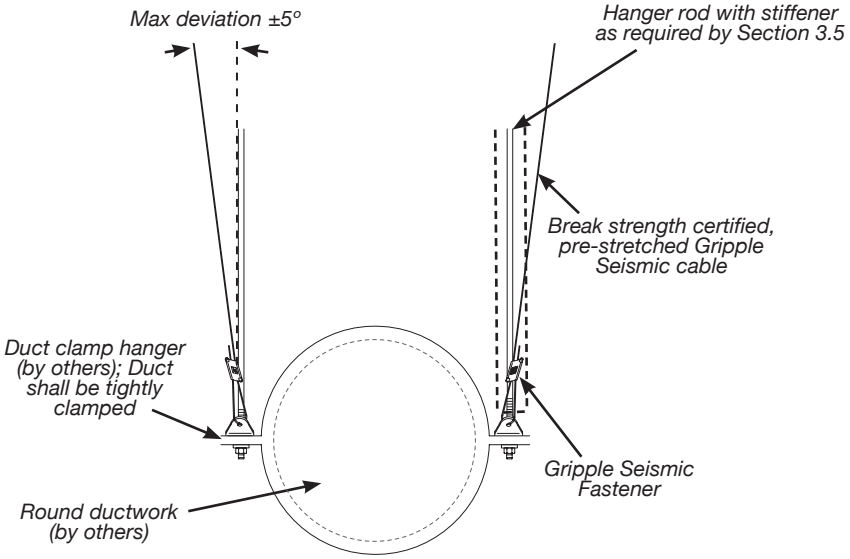
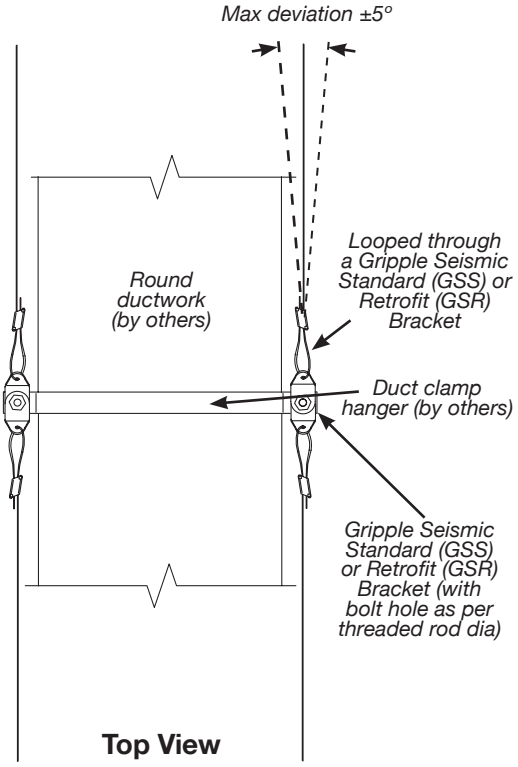
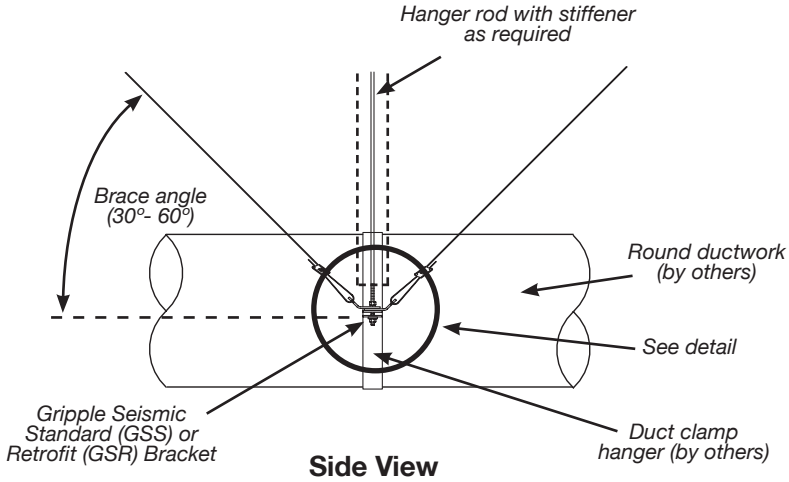


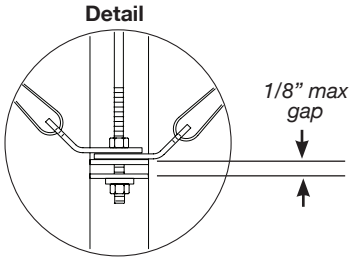
Section View



Top View



Side View



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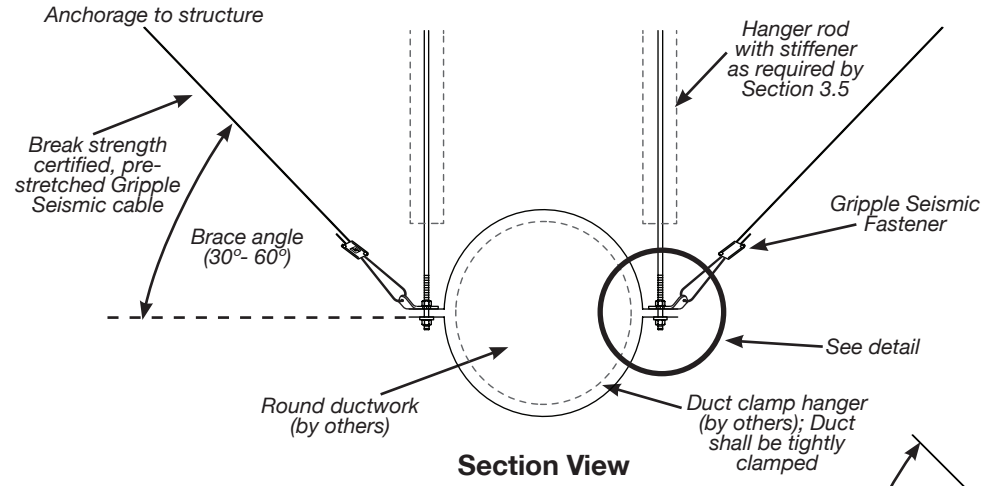
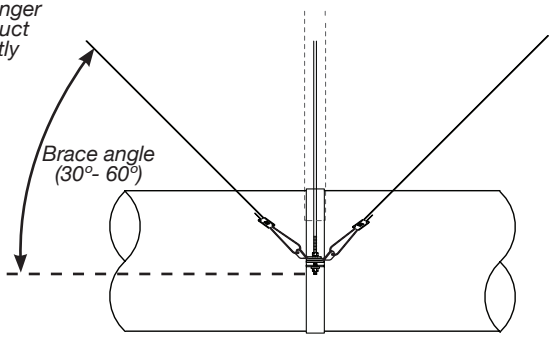
5.1.3 Round Ductwork / '4-Way'

1. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
2. Install cable assemblies with 4-Way brace angles in accordance with Section 1.4.3.
3. Anchor cable assemblies to structure per Section 4, and as required by design.
4. Hand-tighten or pretension cables to remove slack per Section 3.2.
5. Hanger rod and rod stiffeners shall be by design and Section 3.5.
6. Building structure at anchor locations must be point load capable. Verify loading wtih Structural Engineer of Record for the site/project.
7. Leave a 2" tail extending out of the Gripple Seismic Fastener for future adjustments.
8. Ensure locking screws are fully installed (hand-tight) into the Gripple Seismic Fastener on completion of installation.

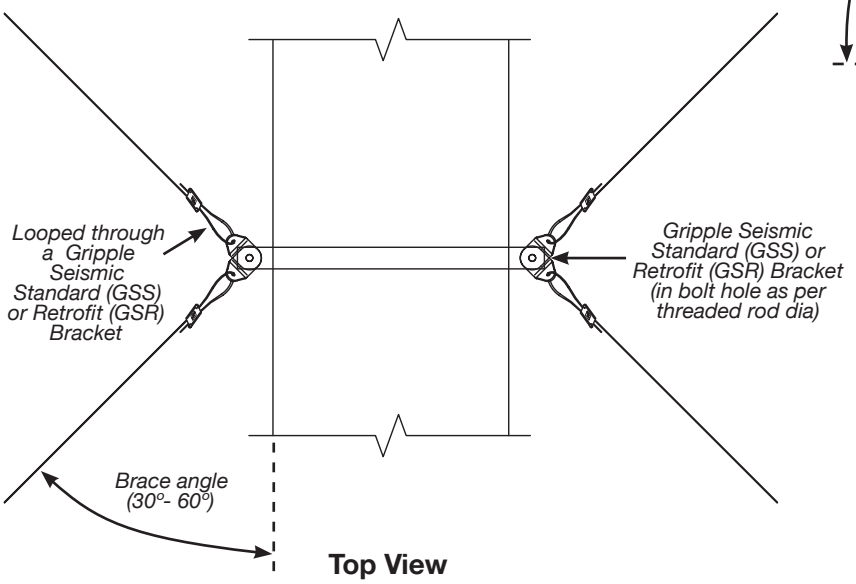
Color coded tag on cable for easy verification.



Section View

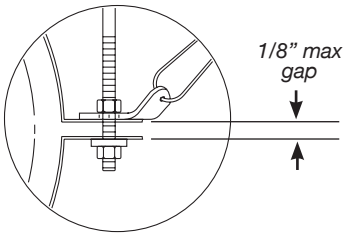


Side View



Top View

Detail



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5.2.1 Rectangular Ductwork / Transverse

1. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
2. Install cable assemblies with a 60º maximum angle from the horizontal plane.
3. Anchor cable assemblies to structure per Section 4, and as required by design.
4. Hand-tighten or pretension cables to remove slack per Section 3.2.
5. Hanger rod and rod stiffeners shall be by design and Section 3.5.
6. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.
7. Leave a 2" tail extending out of the Gripple Seismic Fastener for future adjustments.
8. Ensure locking screws are fully installed (hand-tight) into the Gripple Seismic Fastener on completion of installation.

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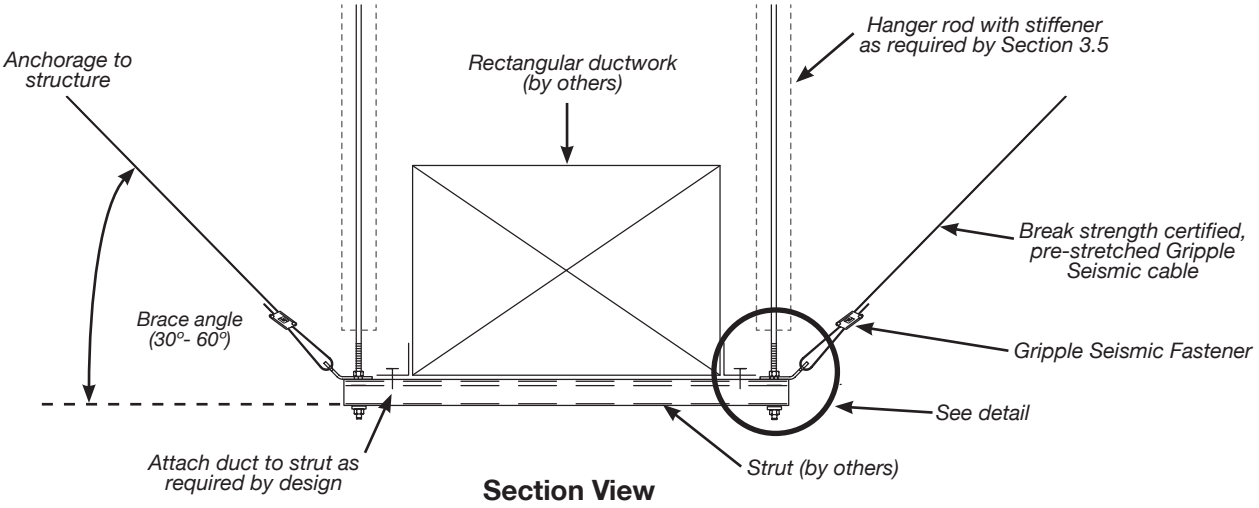
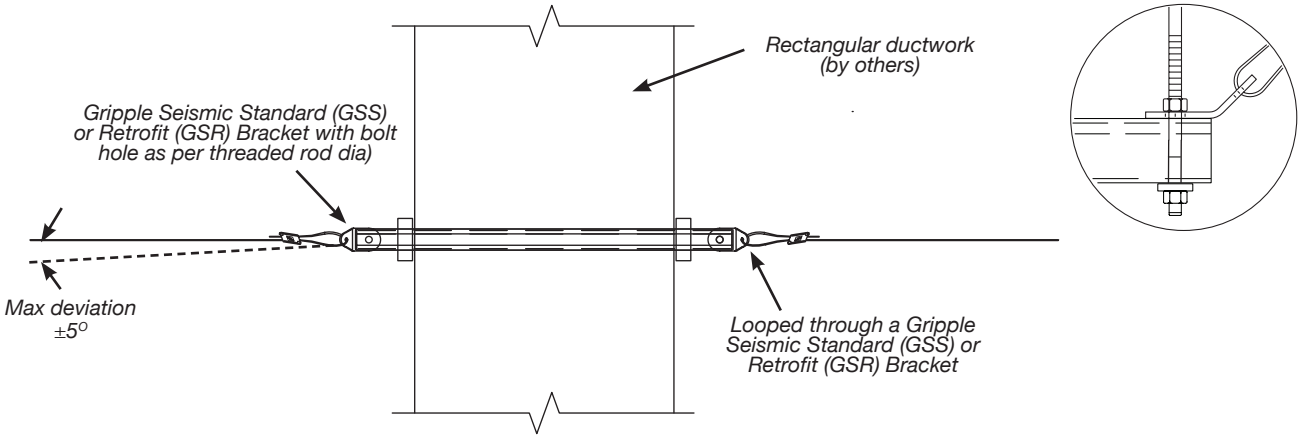


Section View



Detail

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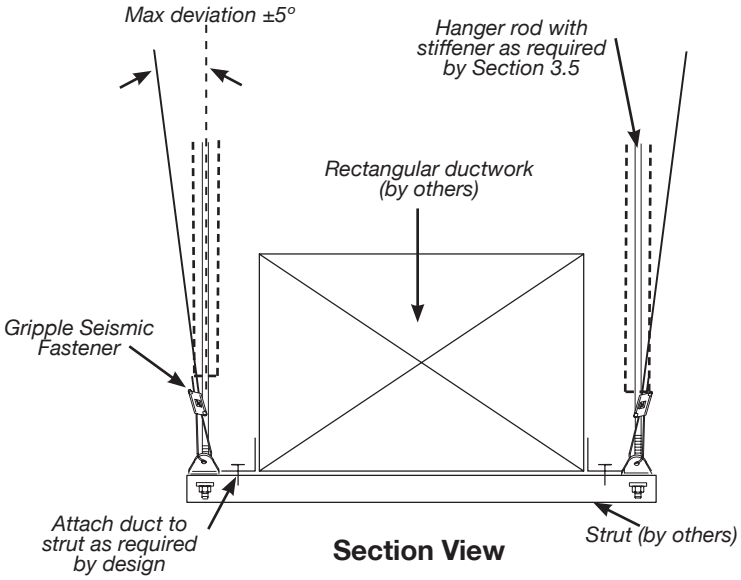
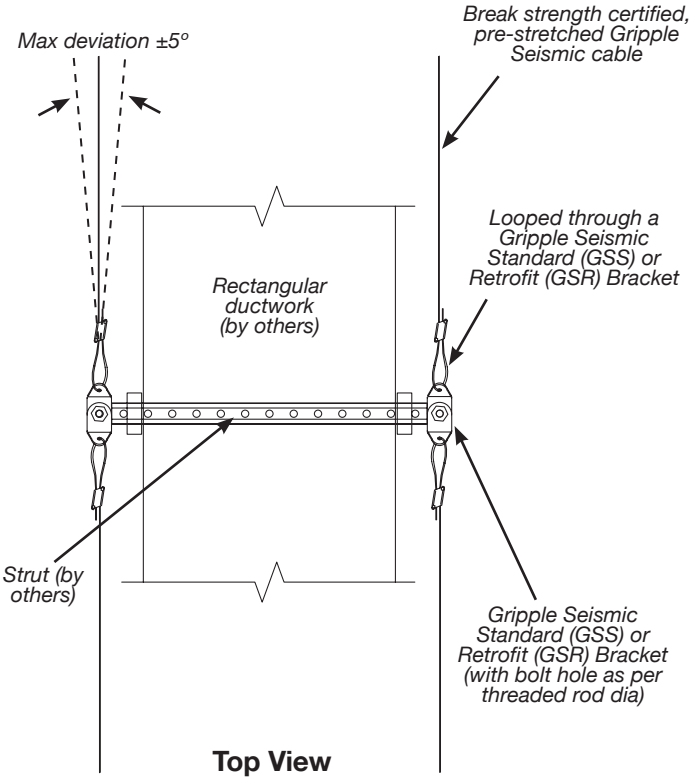
5.2.2 Rectangular Ductwork / Longitudinal

1. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
2. Install cable assemblies with a 60° maximum angle from the horizontal plane.
3. Anchor cable assemblies to structure per Section 4, and as required by design.
4. Hand-tighten or pretension cables to remove slack per Section 3.2.
5. Hanger rod and rod stiffeners shall be by design and Section 3.5.
6. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.
7. Leave a 2" tail extending out of the Gripple Seismic Fastener for future adjustments.
8. Ensure locking screws are fully installed (hand-tight) into the Gripple Seismic Fastener on completion of installation.

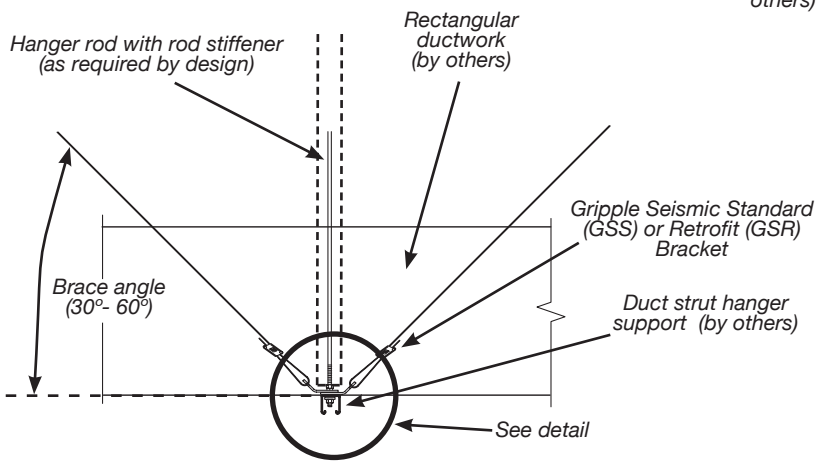
Color coded tag on cable for easy verification.



Section View

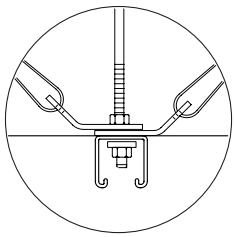


Top View



Side View

Detail



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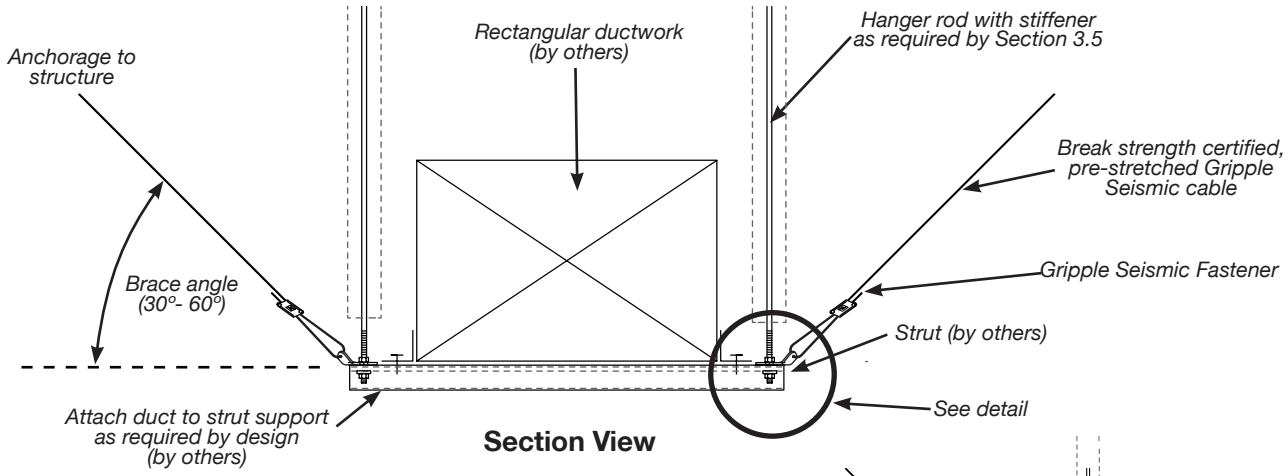
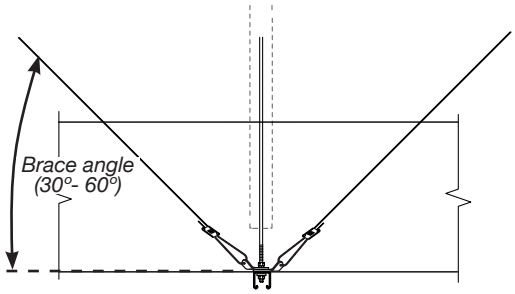
5.2.3 Rectangular Ductwork / '4-Way'

1. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
2. Install cable assemblies with 4-Way brace angles in accordance with Section 1.4.3.
3. Anchor cable assemblies to structure per Section 4, and as required by design.
4. Hand-tighten or pretension cables to remove slack per Section 3.2.
5. Hanger rod and rod stiffeners shall be by design and Section 3.5.
6. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.
7. Leave a 2" tail extending out of the Gripple Seismic Fastener for future adjustments.
8. Ensure locking screws are fully installed (hand-tight) into the Gripple Seismic Fastener on completion of installation.

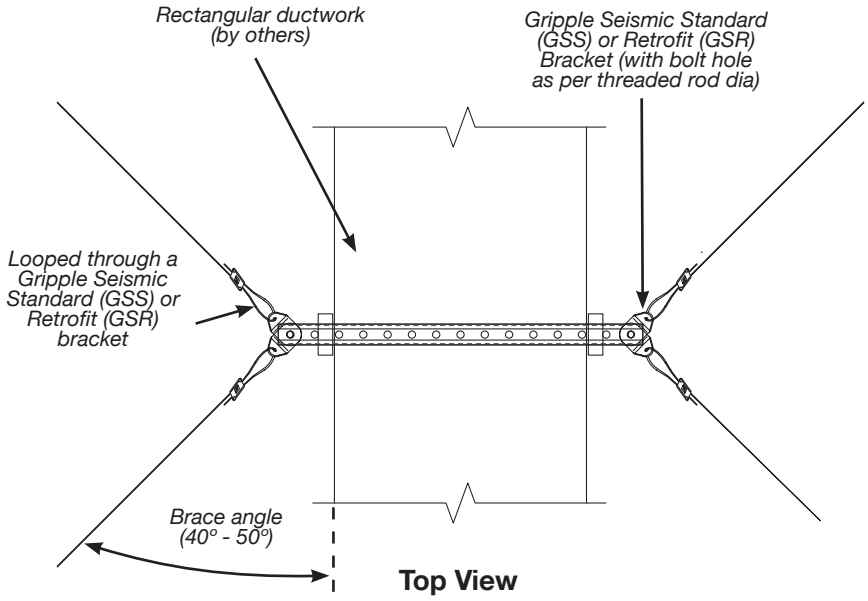
Color coded tag on cable for easy verification.



Section View

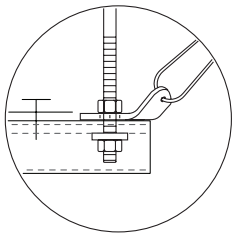


Side View



Top View

Detail



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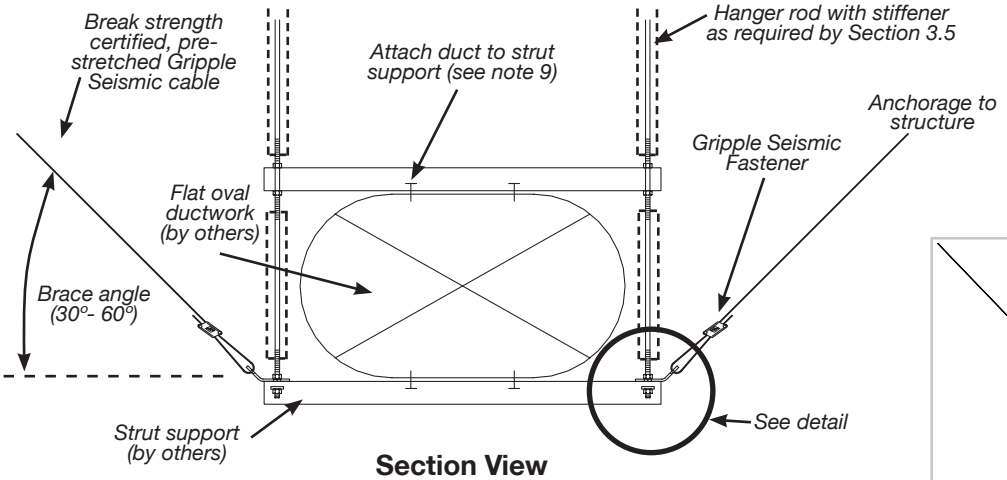
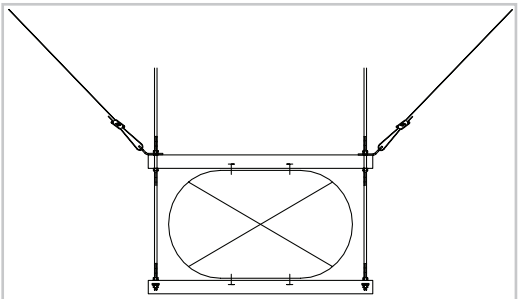
5.3.1 Flat or Oval Ductwork / Transverse

1. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
2. Install cable assemblies with a 60° maximum angle from the horizontal plane.
3. Anchor cable assemblies to structure per Section 4, and as required by design.
4. Hand-tighten or pretension cables to remove slack per Section 3.2.
5. Hanger rod and rod stiffeners shall be by design and Section 3.5.
6. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.
7. Leave a 2" tail extending out of the Gripple Seismic Fastener for future adjustments.
8. Ensure locking screws are fully installed (hand-tight) into the Gripple Seismic Fastener on completion of installation.
9. Use shortest possible screws when penetrating the ductwork to minimize airflow noise inside the duct.

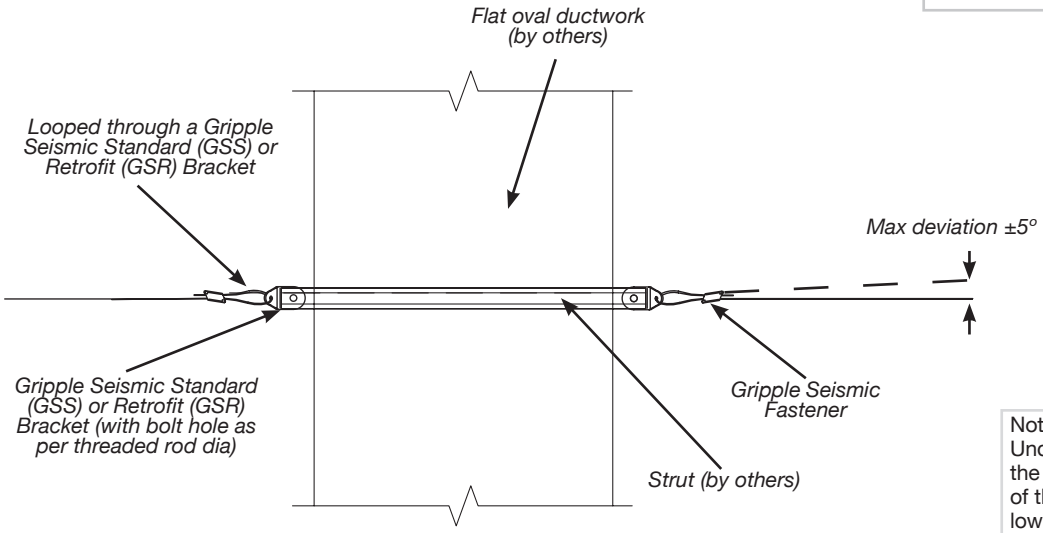
Color coded tag on cable for easy verification.



Section View

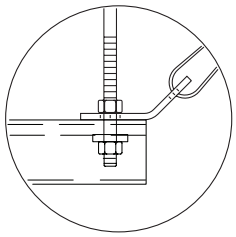


Alternative location for bracing



Top View

Detail



Note:
Under both bracing configurations the RDP shall verify the adequacy of the hanger rods at the upper and lower strut supports for axial load and bending.

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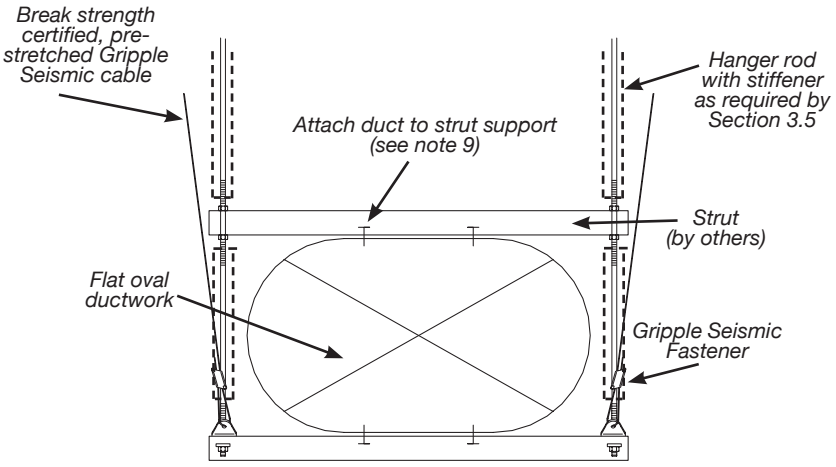
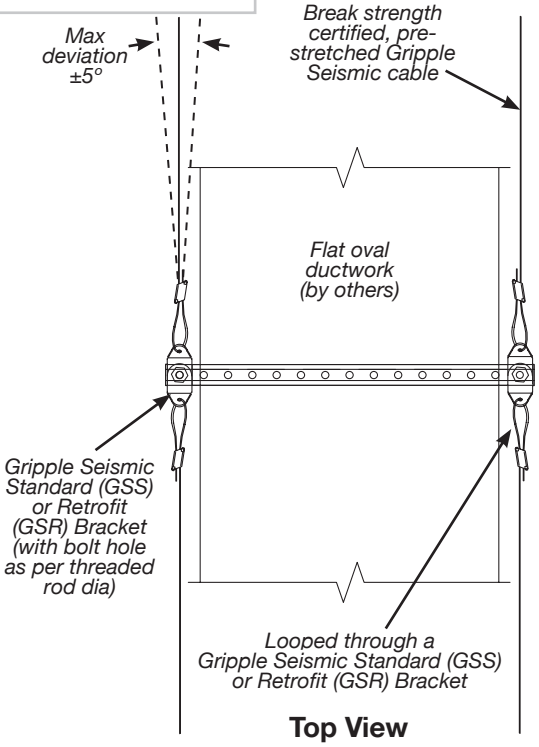
5.3.2 Flat or Oval Ductwork / Longitudinal

1. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
2. Install cable assemblies with a 60° maximum angle from the horizontal plane.
3. Anchor cable assemblies to structure per Section 4, and as required by design.
4. Hand-tighten or pretension cables to remove slack per Section 3.2.
5. Hanger rod and rod stiffeners shall be by design and Section 3.5.
6. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.
7. Leave a 2" tail extending out of the Gripple Seismic Fastener for future adjustments.
8. Ensure locking screws are fully installed (hand-tight) into the Gripple Seismic Fastener on completion of installation.
9. Use shortest possible screws when penetrating the ductwork to minimize airflow noise inside the duct.

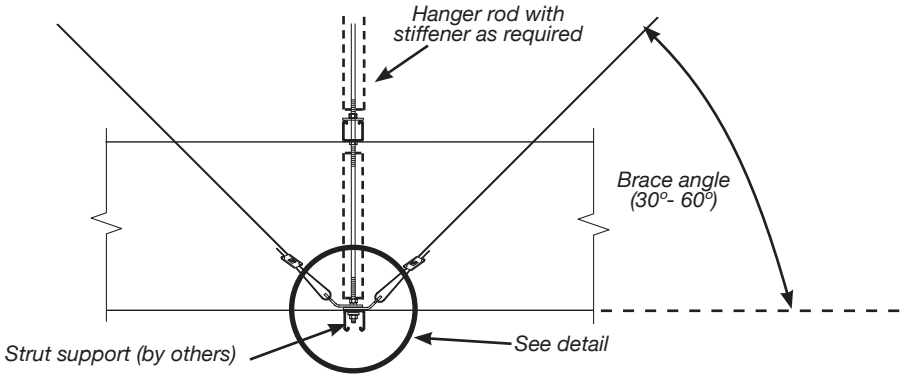
Color coded tag on cable for easy verification.



Section View

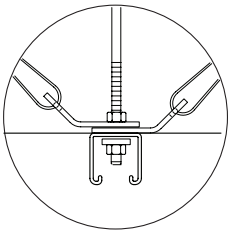


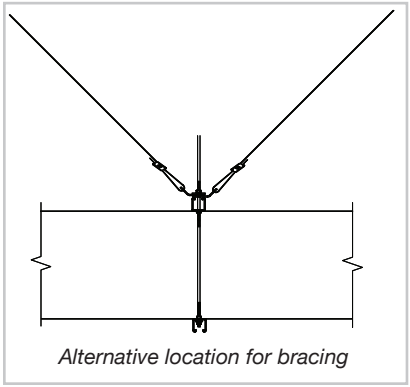
Top View



Side View

Detail





Alternative location for bracing

Note:
Under both bracing configurations the RDP shall verify the adequacy of the hanger rods at the upper and lower strut supports for axial load and bending.

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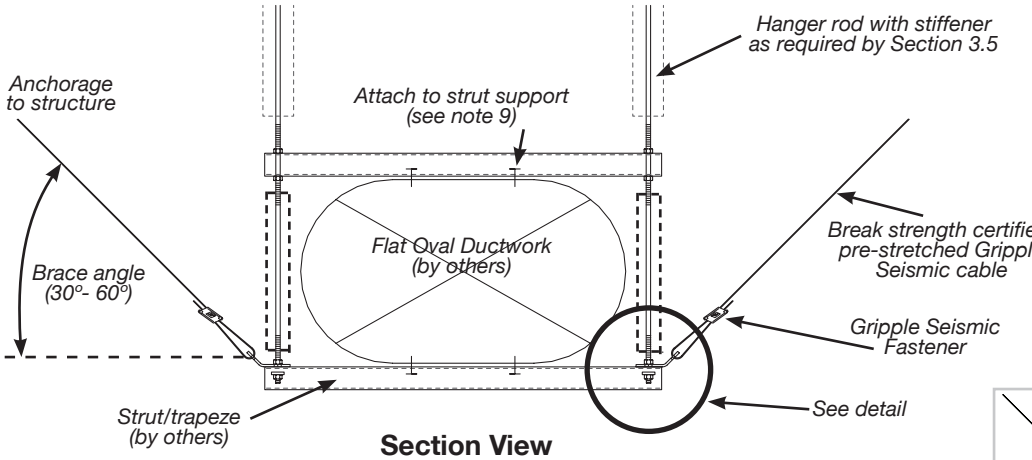
5.3.3 Flat or Oval Ductwork / '4-Way'

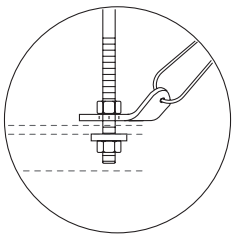
1. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
2. Install cable assemblies with 4-Way brace angles in accordance with Section 1.4.3.
3. Anchor cable assemblies to structure per Section 4, and as required by design.
4. Hand-tighten or pretension cables to remove slack per Section 3.2.
5. Hanger rod and rod stiffeners shall be by design and Section 3.5.
6. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.
7. Leave a 2" tail extending out of the Gripple Seismic Fastener for future adjustments.
8. Ensure locking screws are fully installed (hand-tight) into the Gripple Seismic Fastener on completion of installation.
9. Use shortest possible screws when penetrating the ductwork to minimize airflow noise inside the duct.

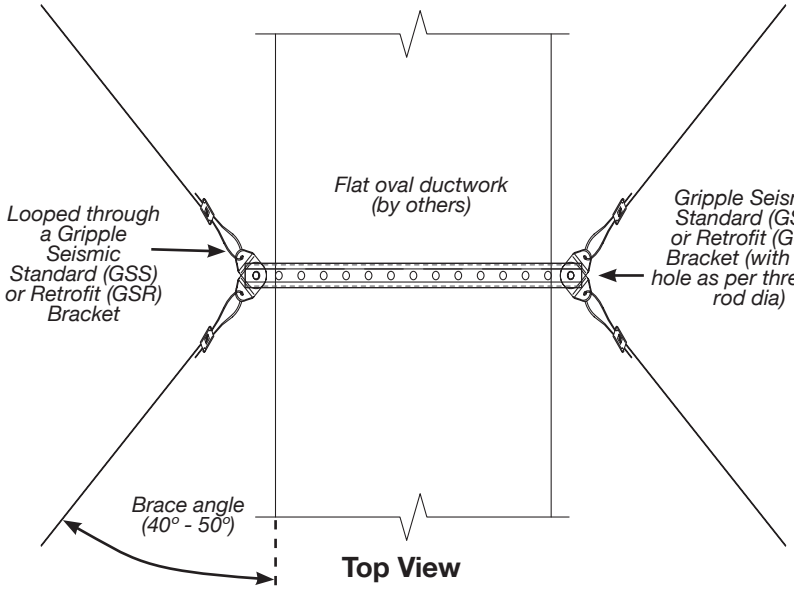
Color coded tag on cable for easy verification.



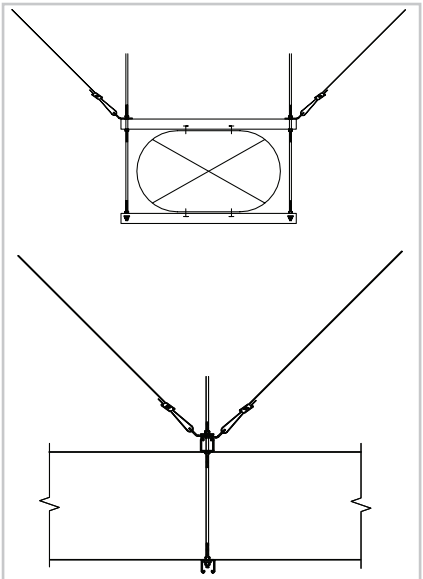
Section View

Detail





Top View



Alternative location for bracing

Note:
Under both bracing configurations the RDP shall verify the adequacy of the hanger rods at the upper and lower strut supports for axial load and bending.

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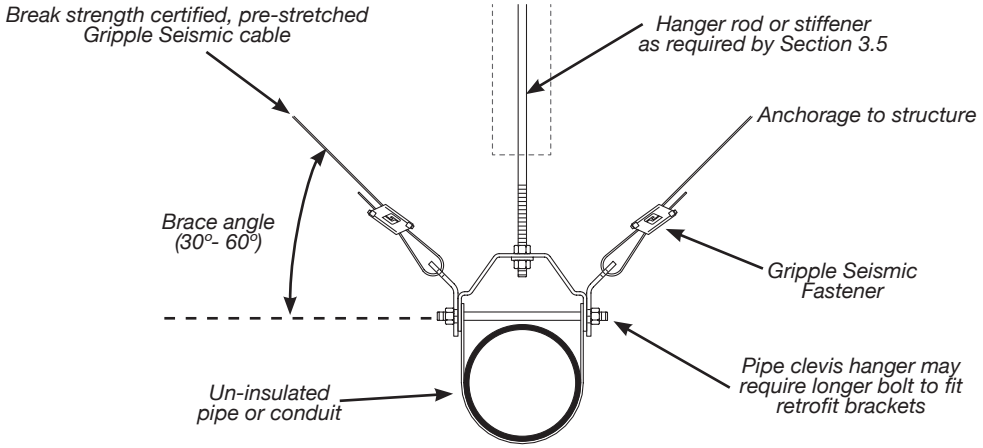
5.4.1 Un-Insulated Pipe & Conduit / Transverse

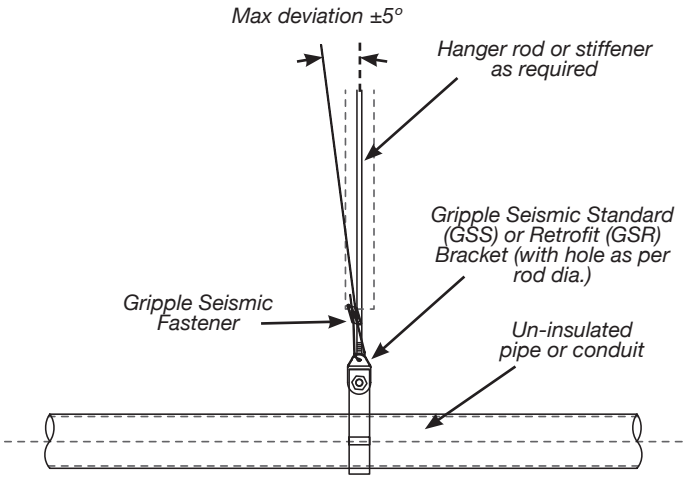
1. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
2. Install cable assemblies with a 60° maximum angle from the horizontal plane.
3. Anchor cable assemblies to structure per Section 4, and as required by design.
4. Hand-tighten or pretension cables to remove slack per Section 3.2.
5. Hanger rod and rod stiffeners shall be by design and Section 3.5.
6. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.
7. Leave a 2" tail extending out of the Gripple Seismic Fastener for future adjustments.
8. Ensure locking screws are fully installed (hand tight) into the Gripple Seismic Fastener on completion of installation.

Color coded tag on cable for easy verification.

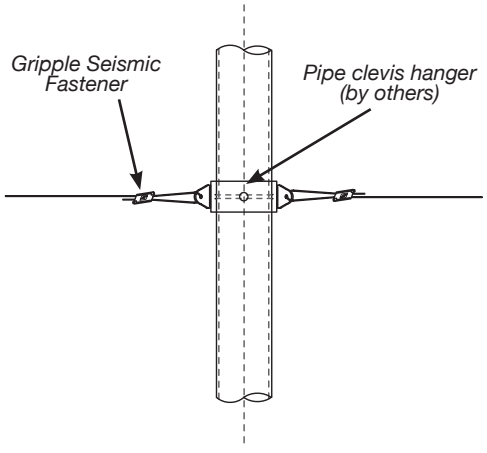
Note:
Install clevis hanger/pipe clamp and torque bolts as per manufacturer's installation guidelines.



Detail Section



Side View



Top View

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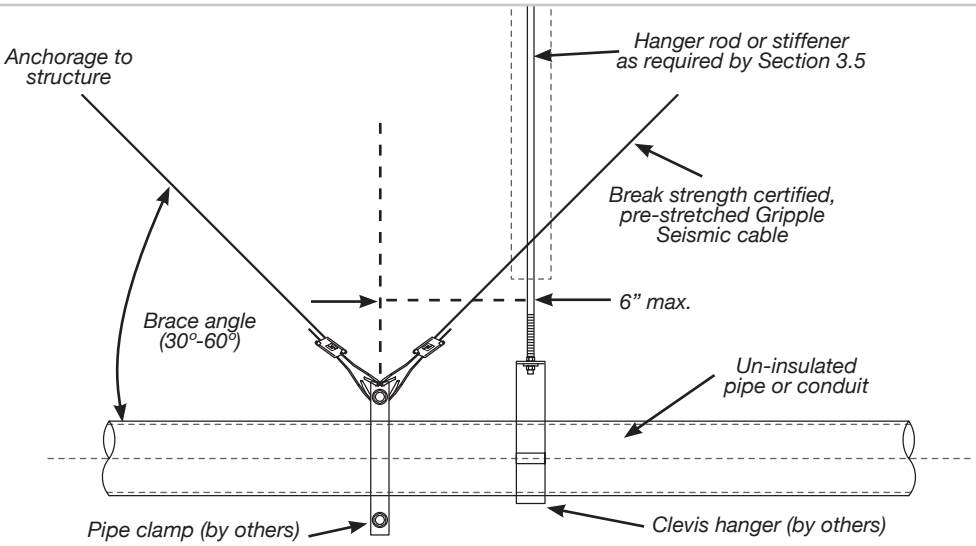
5.4.2 Un-Insulated Pipe & Conduit / Longitudinal

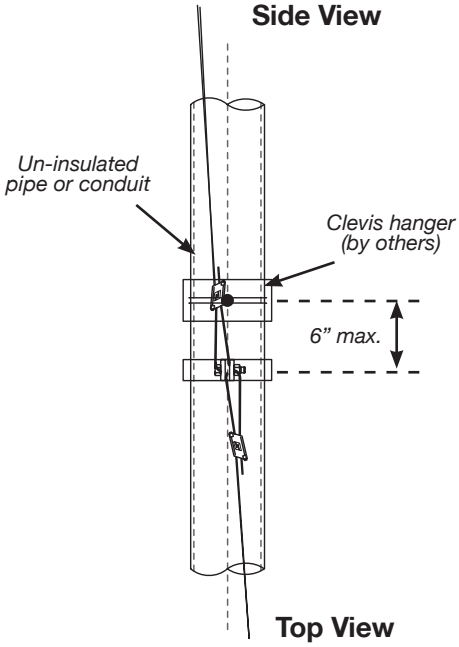
1. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
2. Install cable assemblies with a 60° maximum angle from the horizontal plane.
3. Anchor cable assemblies to structure per Section 4, and as required by design.
4. Hand-tighten or pretension cables to remove slack per Section 3.2.
5. Hanger rod and rod stiffeners shall be by design and Section 3.5.
6. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.
7. Leave a 2" tail extending out of the Gripple Seismic Fastener for future adjustments.
8. Ensure locking screws are fully installed (hand tight) into the Gripple Seismic Fastener on completion of installation.

Color coded tag on cable for easy verification.

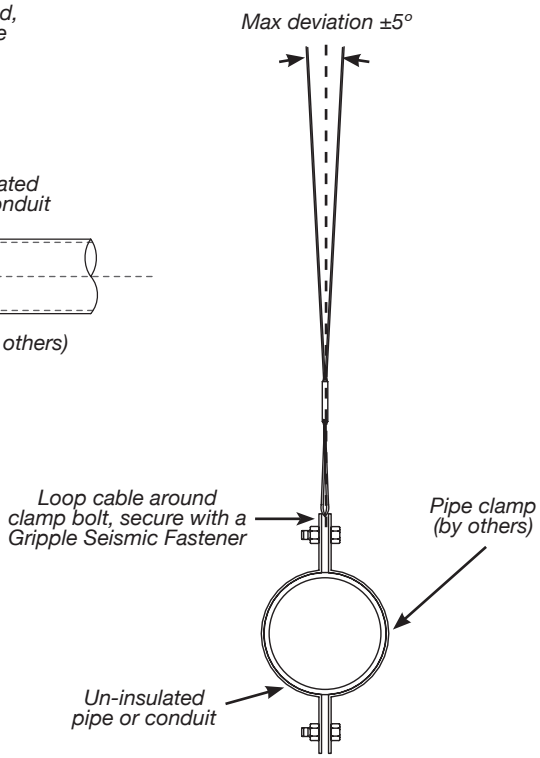
Note:
Install clevis hanger/pipe clamp and torque bolts as per manufacturer's installation guidelines.



Side View



Top View



Section View

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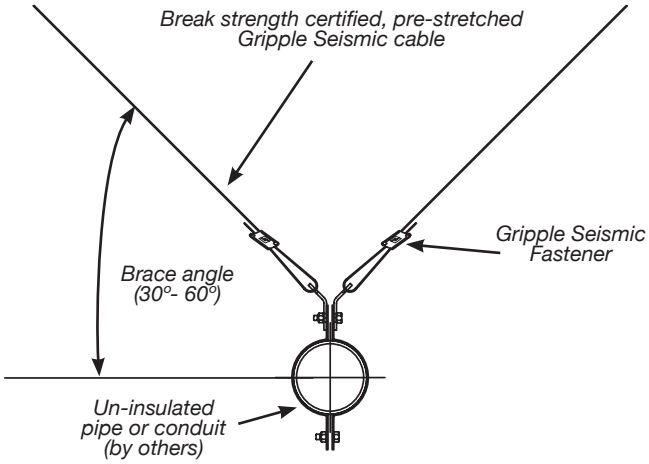
5.4.3 Un-Insulated Pipe & Conduit / '4-Way'

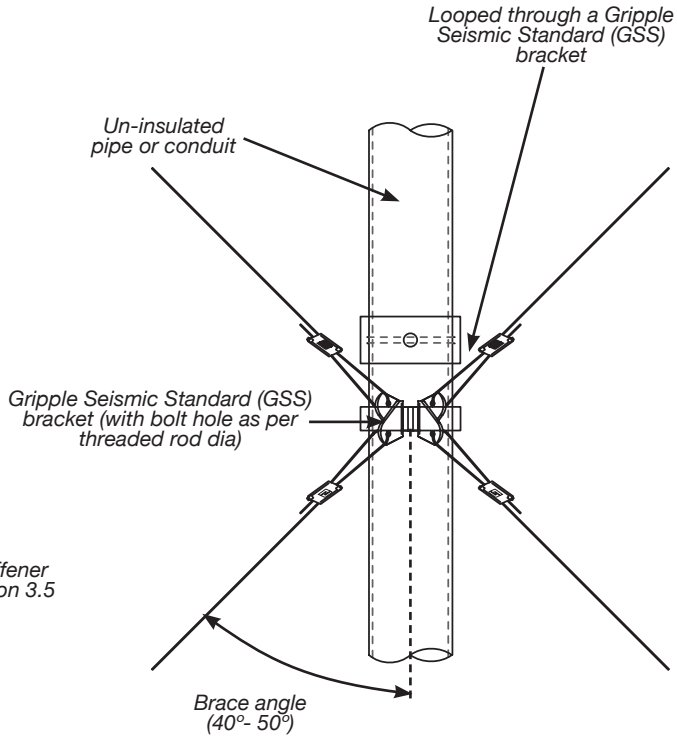
1. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
2. Install cable assemblies with 4-Way brace angles in accordance with Section 1.4.3.
3. Anchor cable assemblies to structure per Section 4, and as required by design.
4. Hand-tighten or pretension cables to remove slack per Section 3.2.
5. Hanger rod and rod stiffeners shall be by design and Section 3.5.
6. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.
7. Leave a 2" tail extending out of the Gripple Seismic Fastener for future adjustments.
8. Ensure locking screws are fully installed (hand tight) into the Gripple Seismic Fastener on completion of installation.

Color coded tag on cable for easy verification.

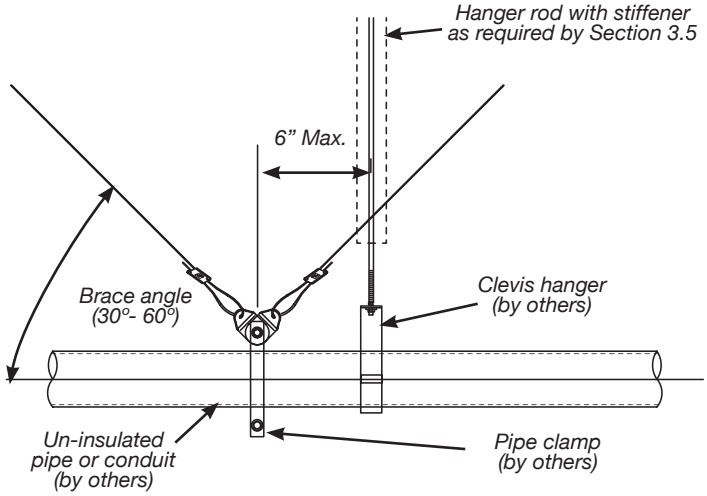
Note:
Install clevis hanger/pipe clamp and torque bolts as per manufacturers installation guidelines.



Section View



Top View



Side View

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5.5.1 Insulated Pipe & Conduit / Transverse

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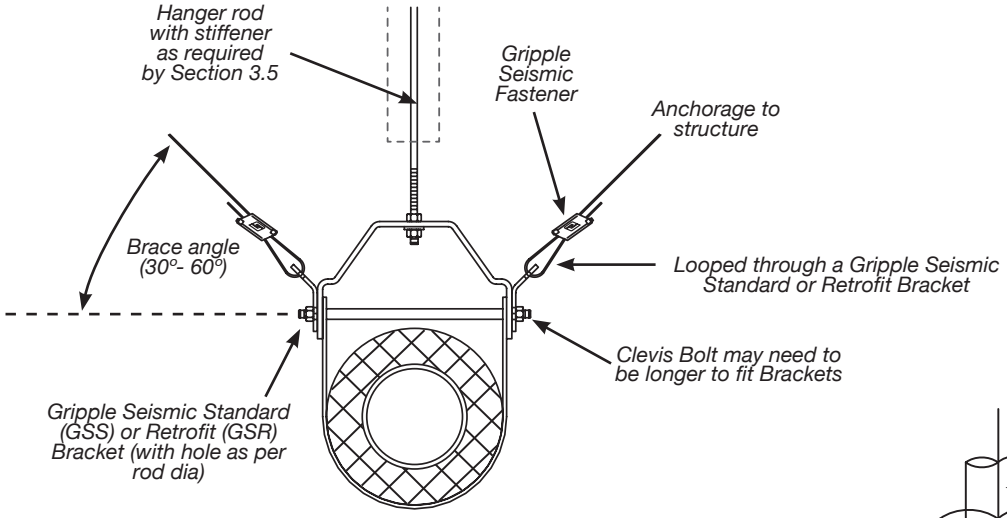
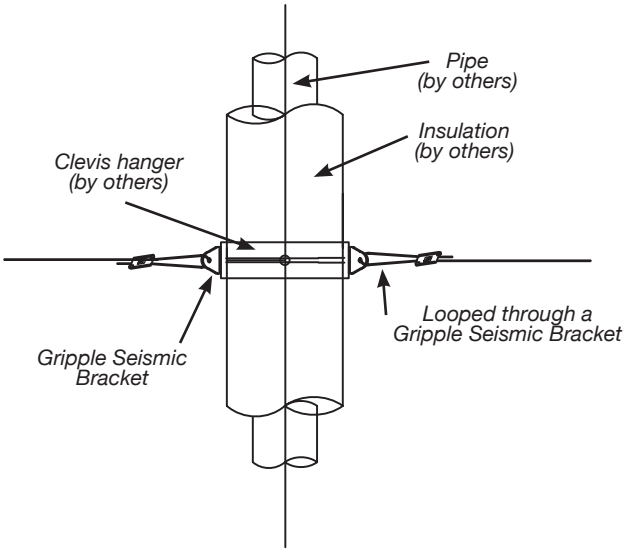
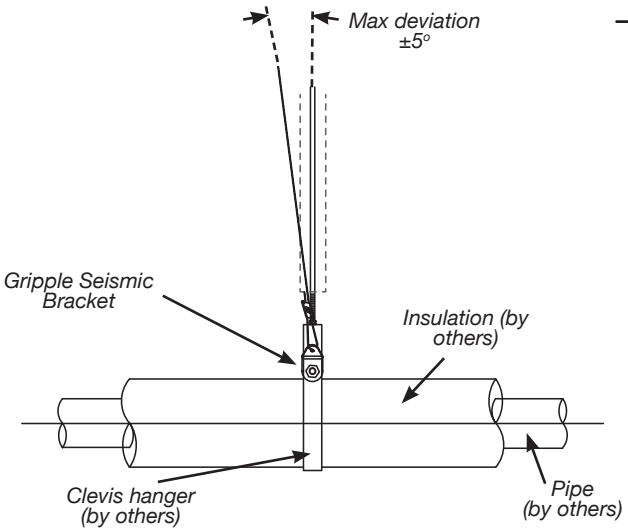
Note:
Install clevis hanger/pipe clamp and torque bolts as per manufacturers installation guidelines.



Section View



Top View



Side View

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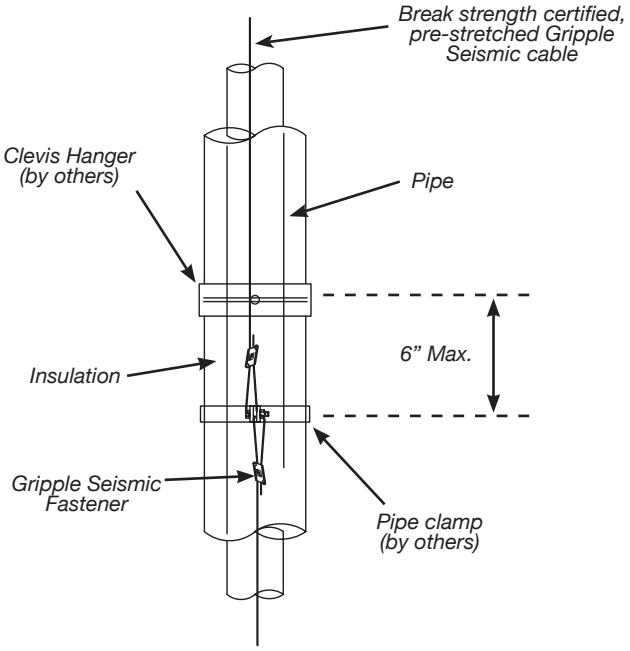
5.5.2 Insulated Pipe & Conduit / Longitudinal

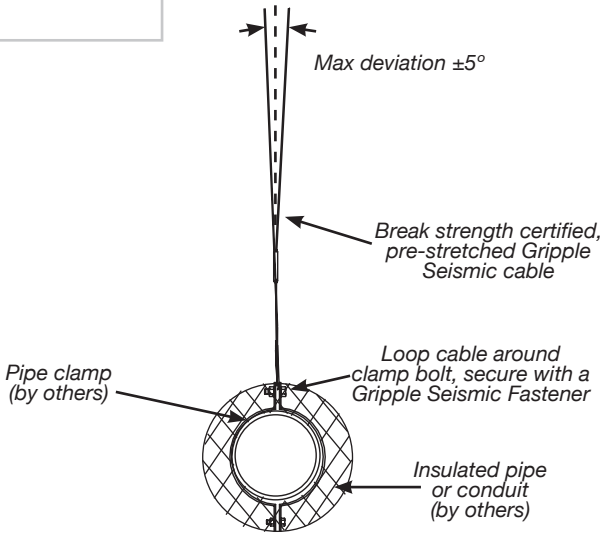
1. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
2. Install cable assemblies with a 60º maximum angle from the horizontal plane.
3. Anchor cable assemblies to structure per Section 4, and as required by design.
4. Hand-tighten or pretension cables to remove slack per Section 3.2.
5. Hanger rod and rod stiffeners shall be by design and Section 3.5.
6. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.
7. Leave a 2" tail extending out of the Gripple Seismic Fastener for future adjustments.
8. Ensure locking screws are fully installed (hand-tight) into the Gripple Seismic Fastener on completion of installation.
9. Insulate pipe clamp as required to retain thermal integrity of pipe.

Color coded tag on cable for easy verification.

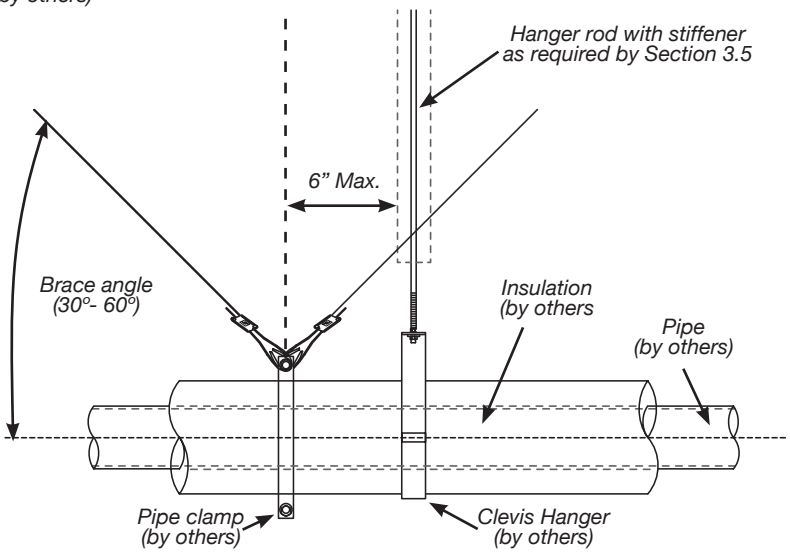
Note:
Install clevis hanger/pipe clamp and torque bolts as per manufacturers installation guidelines.



Top View



Section View



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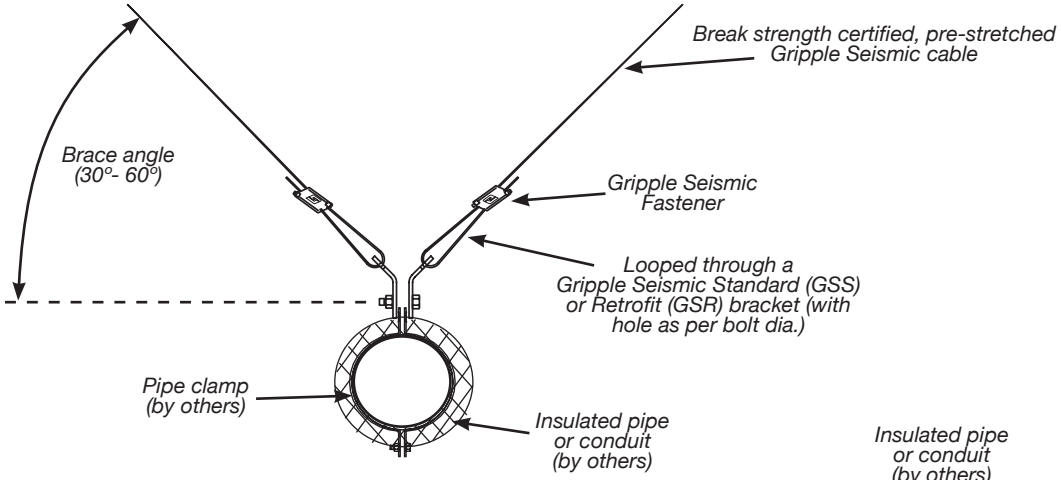
5.5.3 Insulated Pipe & Conduit / '4 Way'

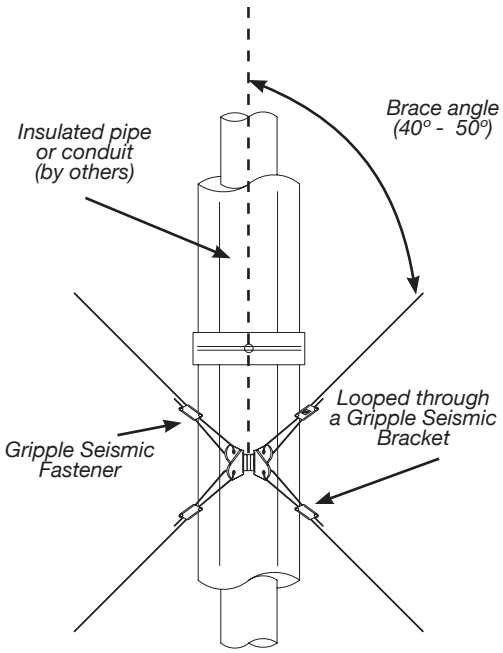
1. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
2. Install cable assemblies with 4-Way brace angles in accordance with Section 1.4.3.
3. Anchor cable assemblies to structure per Section 4, and as required by design.
4. Hand-tighten or pretension cables to remove slack per Section 3.2.
5. Hanger rod and rod stiffeners shall be by design and Section 3.5.
6. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.
7. Leave a 2" tail extending out of the Gripple Seismic Fastener for future adjustments.
8. Ensure locking screws are fully installed (hand-tight) into the Gripple Seismic Fastener on completion of installation.
9. Insulate pipe clamp as required to retain thermal integrity of pipe.

Color coded tag on cable for easy verification.

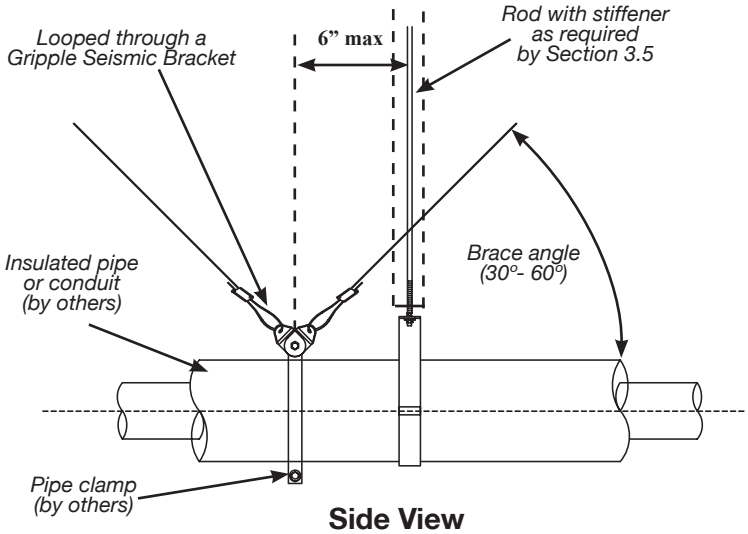
Note:
Install clevis hanger/pipe clamp and torque bolts as per manufacturers installation guidelines.



Section View



Top View



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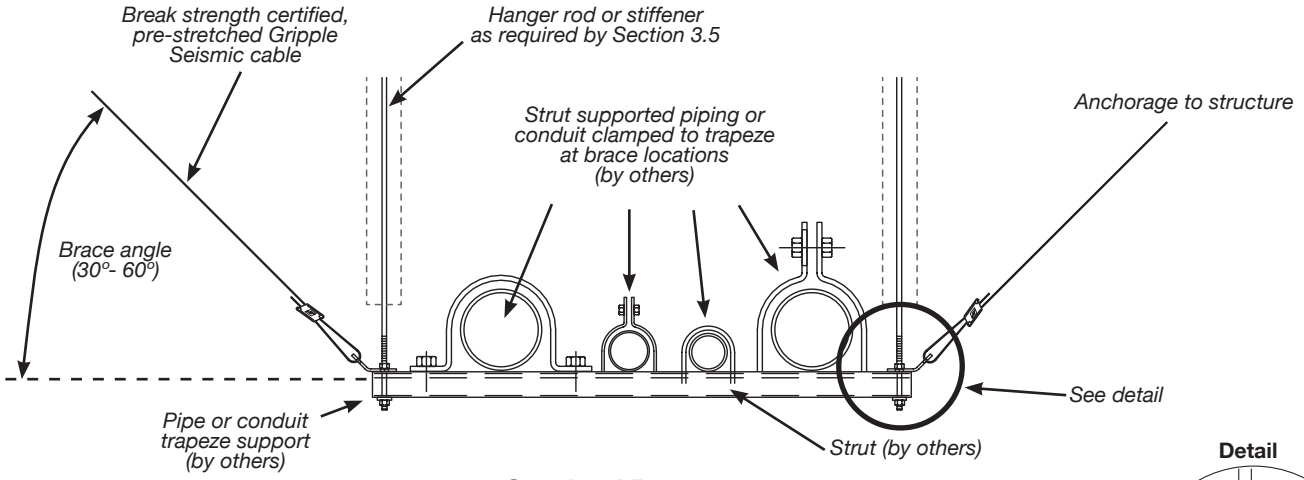
5.6.1 Trapeze/Strut Supported Piping or Conduit / Transverse

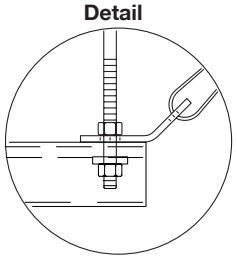
1. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
2. Install cable assemblies with a 60° maximum angle from the horizontal plane.
3. Anchor cable assemblies to structure per Section 4, and as required by design.
4. Hand-tighten or pretension cables to remove slack per Section 3.2.
5. Hanger rod and rod stiffeners shall be by design and Section 3.5.
6. Building structure at anchor locations must be point load capable. Verify loading wtih Structural Engineer of Record for the site/project.
7. Leave a 2" tail extending out of the Gripple Seismic Fastener for future adjustments.
8. Ensure locking screws are fully installed (hand-tight) into the Gripple Seismic Fastener on completion of installation.

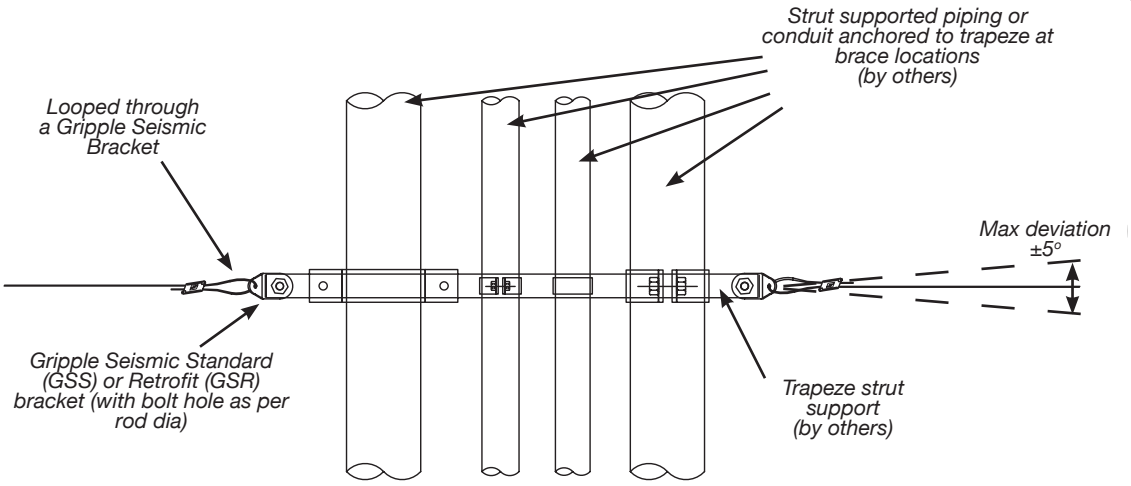
Color coded tag on cable for easy verification.

Note:
Install pipe clamp and torque bolts as per manufacturers installation guidelines.



Section View





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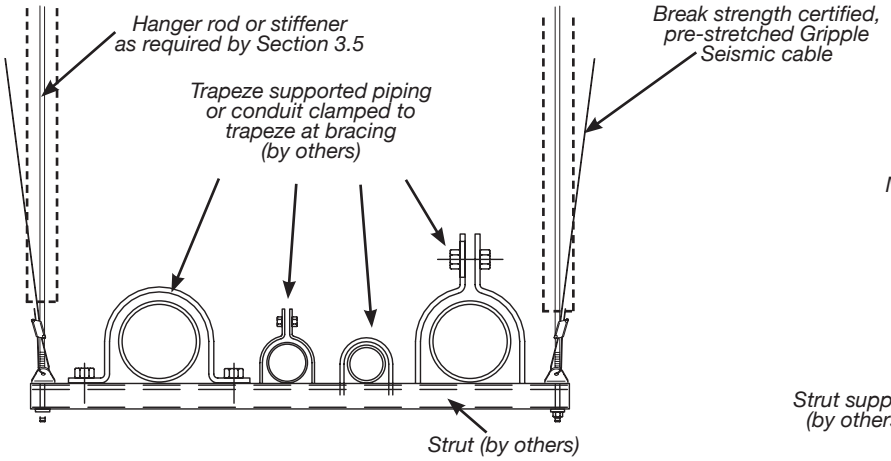
5.6.2 Trapeze/Strut Supported Piping or Conduit / Longitudinal

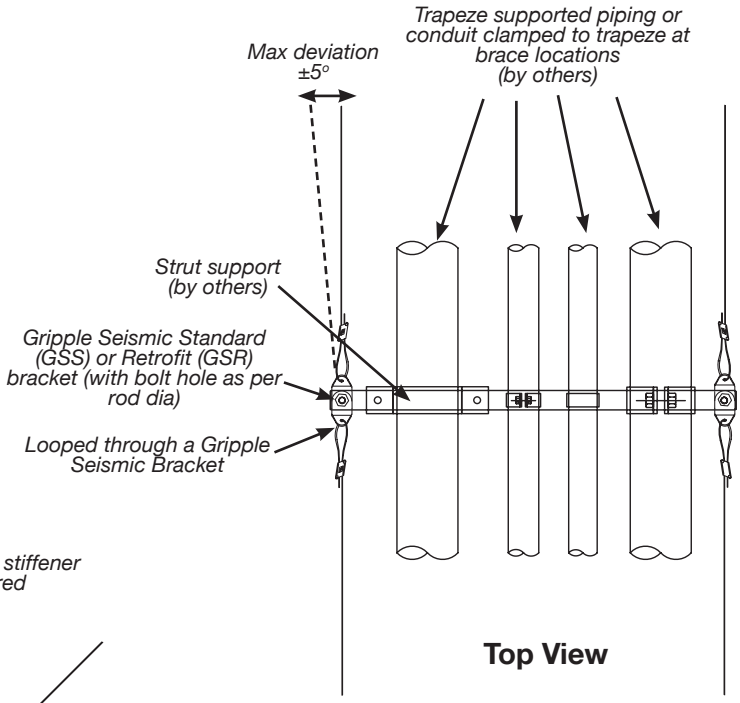
1. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
2. Install cable assemblies with a 60° maximum angle from the horizontal plane.
3. Anchor cable assemblies to structure per Section 4, and as required by design.
4. Hand-tighten or pretension cables to remove slack per Section 3.2.
5. Hanger rod and rod stiffeners shall be by design and Section 3.5.
6. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.
7. Leave a 2" tail extending out of the Gripple Seismic Fastener for future adjustments.
8. Ensure locking screws are fully installed (hand-tight) into the Gripple Seismic Fastener on completion of installation.

Color coded tag on cable for easy verification.

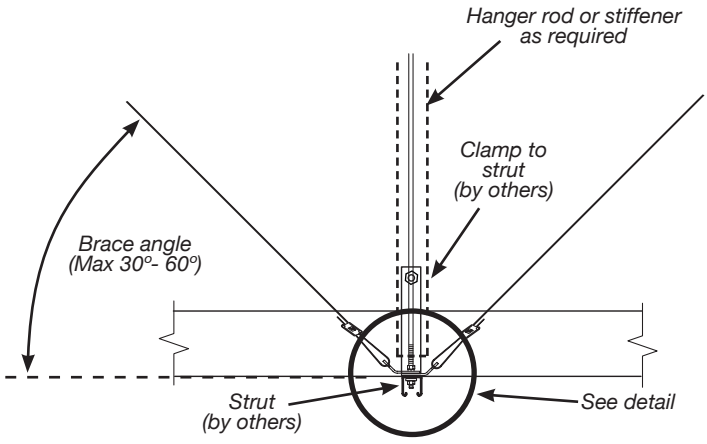
Note:
Install pipe clamp and torque bolts as per manufacturers installation guidelines.



Section View

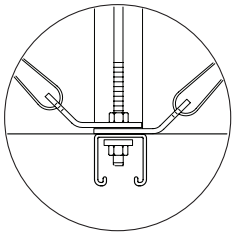


Top View



Side View

Detail



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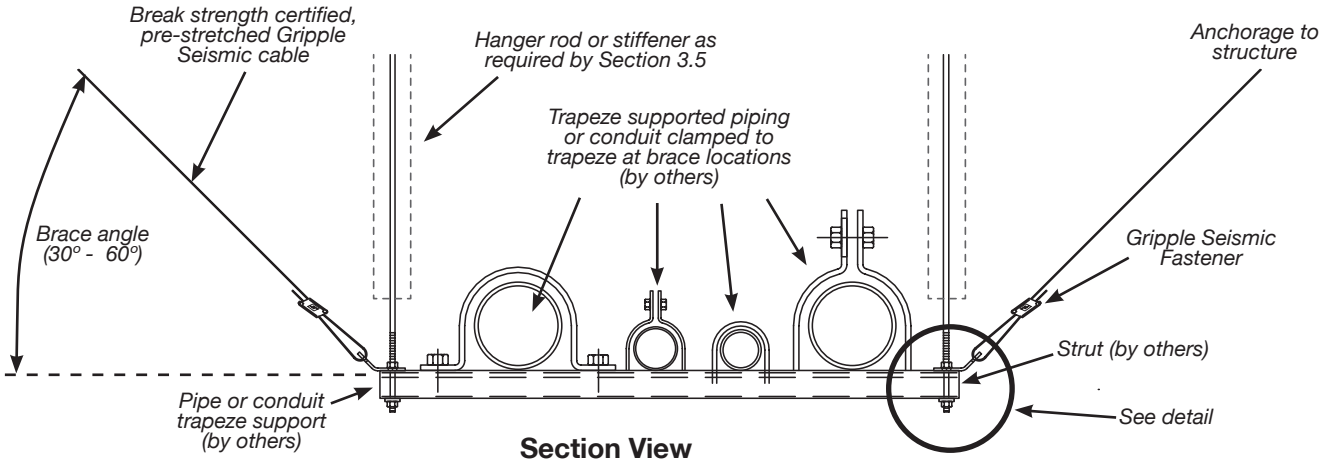
5.6.3 Trapeze/Strut Supported Piping or Conduit / '4 Way'

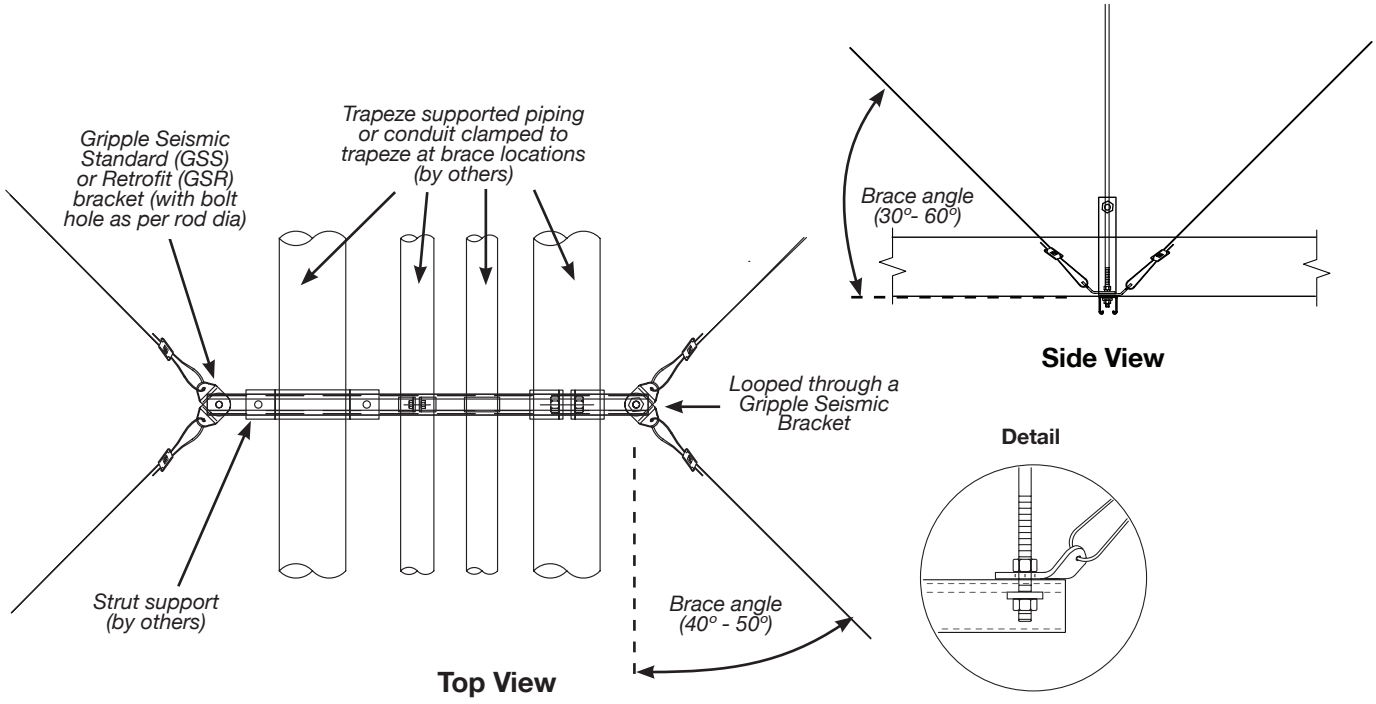
1. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
2. Install cable assemblies with 4-Way brace angles in accordance with Section 1.4.3.
3. Anchor cable assemblies to structure per Section 4, and as required by design.
4. Hand-tighten or pretension cables to remove slack per Section 3.2.
5. Hanger rod and rod stiffeners shall be by design and Section 3.5.
6. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.
7. Leave a 2" tail extending out of the Gripple Seismic Fastener for future adjustments.
8. Ensure locking screws are fully installed (hand-tight) into the Gripple Seismic Fastener on completion of installation.

Color coded tag on cable for easy verification.

Note:
Install pipe clamps and torque bolts as per manufacturers installation guidelines.



Section View



Side View

Top View

Detail

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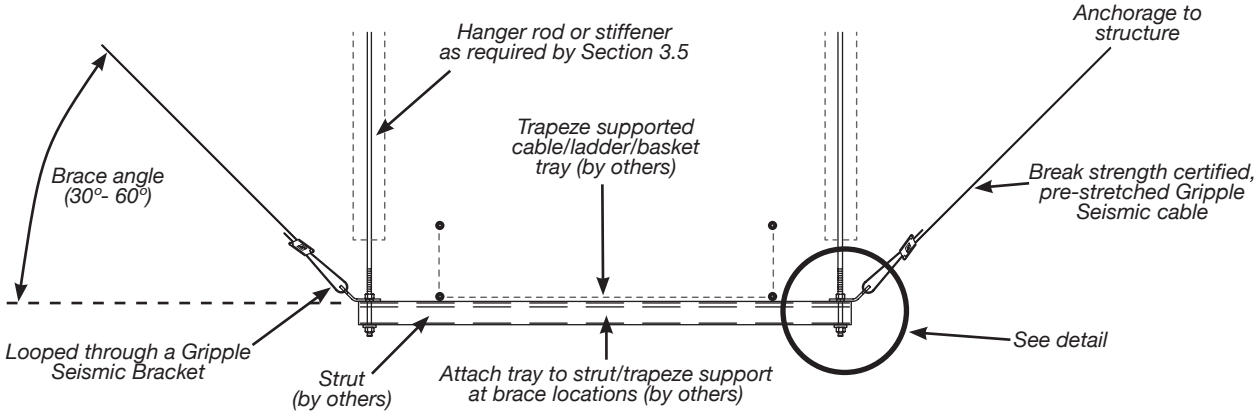
5.7.1 Electrical (Cable/Ladder/Basket Tray) / Transverse

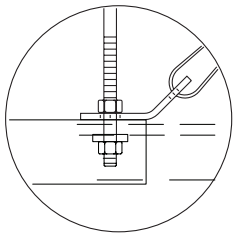
1. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
2. Install cable assemblies with a 60° maximum angle from the horizontal plane.
3. Anchor cable assemblies to structure per Section 4, and as required by design.
4. Hand-tighten or pretension cables to remove slack per Section 3.2.
5. Hanger rod and rod stiffeners shall be by design and Section 3.5.
6. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.
7. Leave a 2" tail extending out of the Gripple Seismic Fastener for future adjustments.
8 Ensure locking screws are fully installed (hand-tight) into the Gripple Seismic Fastener on completion of installation.

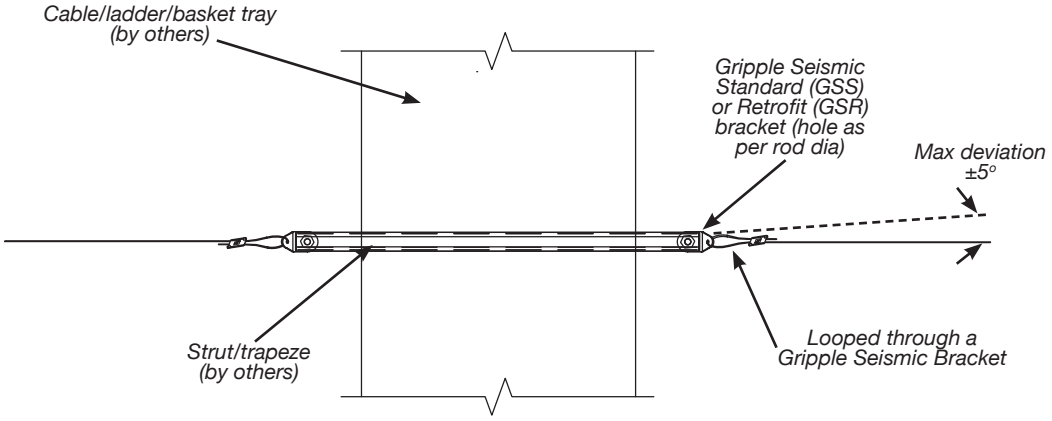
Color coded tag on cable for easy verification.



Section View

Detail





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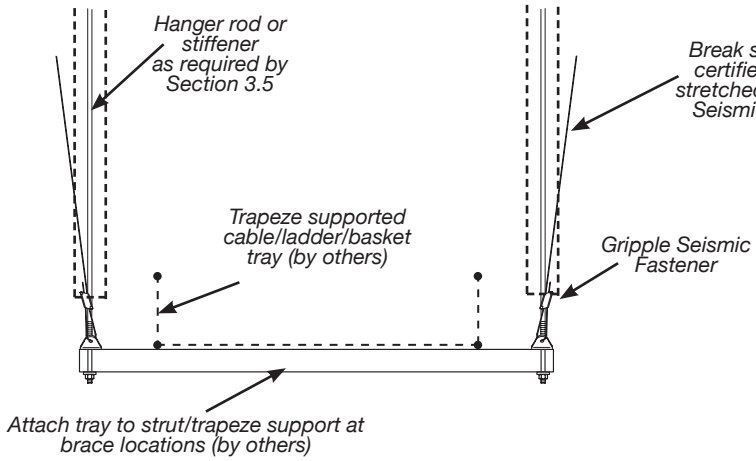
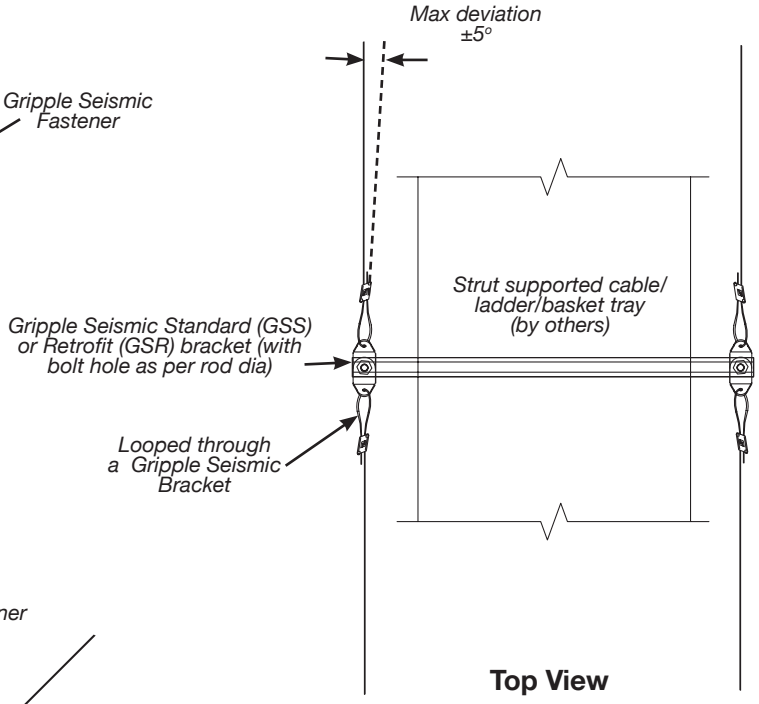
5.7.2 Electrical (Cable/Ladder/Basket Tray) / Longitudinal

1. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
2. Install cable assemblies with a 60° maximum angle from the horizontal plane.
3. Anchor cable assemblies to structure per Section 4, and as required by design.
4. Hand-tighten or pretension cables to remove slack per Section 3.2.
5. Hanger rod and rod stiffeners shall be by design and Section 3.5.
6. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.
7. Leave a 2" tail extending out of the Gripple Seismic Fastener for future adjustments.
8. Ensure locking screws are fully installed (hand-tight) into the Gripple Seismic Fastener on completion of installation.

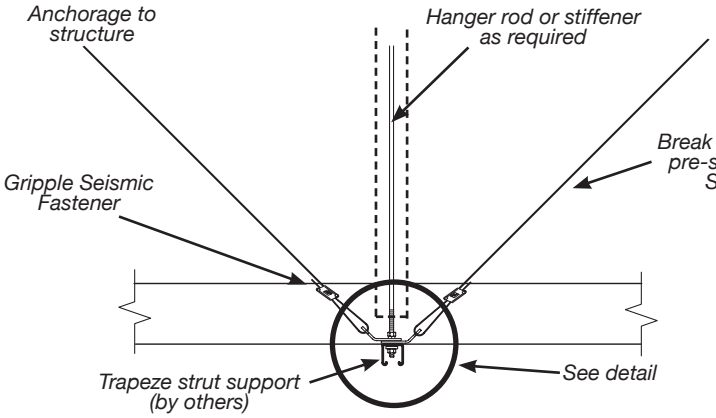
Color coded tag on cable for easy verification.



Section View

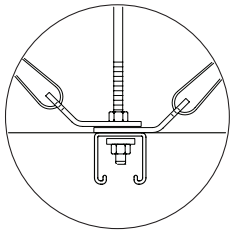


Top View



Side View

Detail



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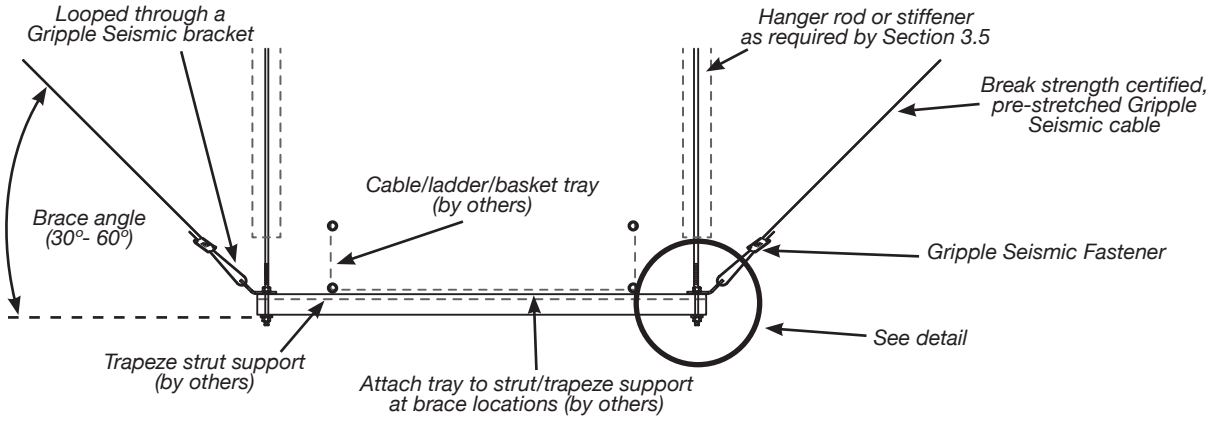
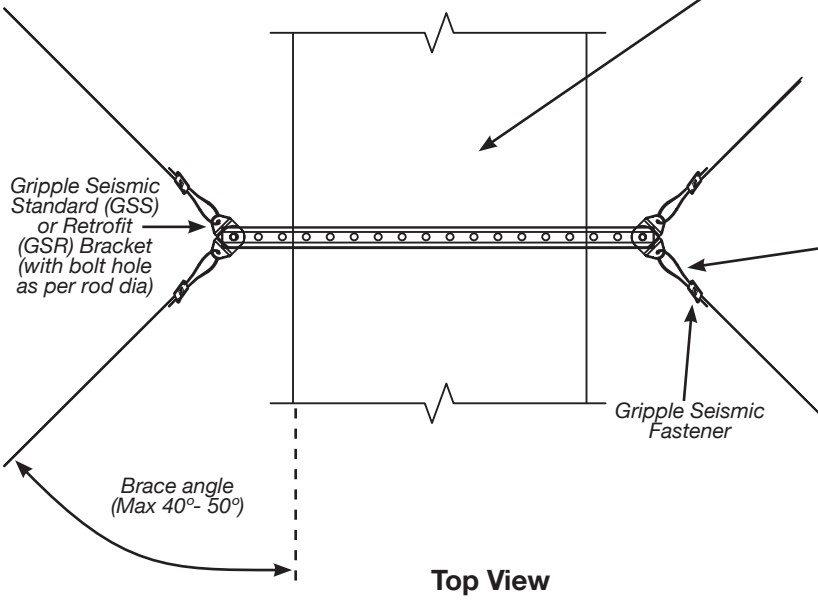
5.7.3 Electrical (Cable/Ladder/Basket Tray) / '4-Way'

1. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
2. Install cable assemblies with 4-Way brace angles in accordance with Section 1.4.3.
3. Anchor cable assemblies to structure per Section 4, and as required by design.
4. Hand-tighten or pretension cables to remove slack per Section 3.2.
5. Rod and rod stiffeners shall be by design and Section 3.5.
6. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.
7. Leave a 2" tail extending out of the Gripple Seismic Fastener for future adjustments.
8. Ensure locking screws are fully installed (hand-tight) into the Gripple Seismic Fastener on completion of installation.

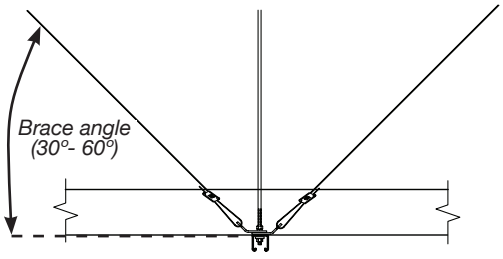
Color coded tag on cable for easy verification.



Section View

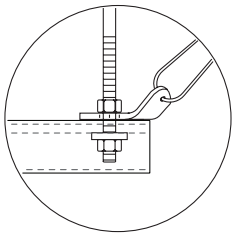


Top View



Side View

Detail



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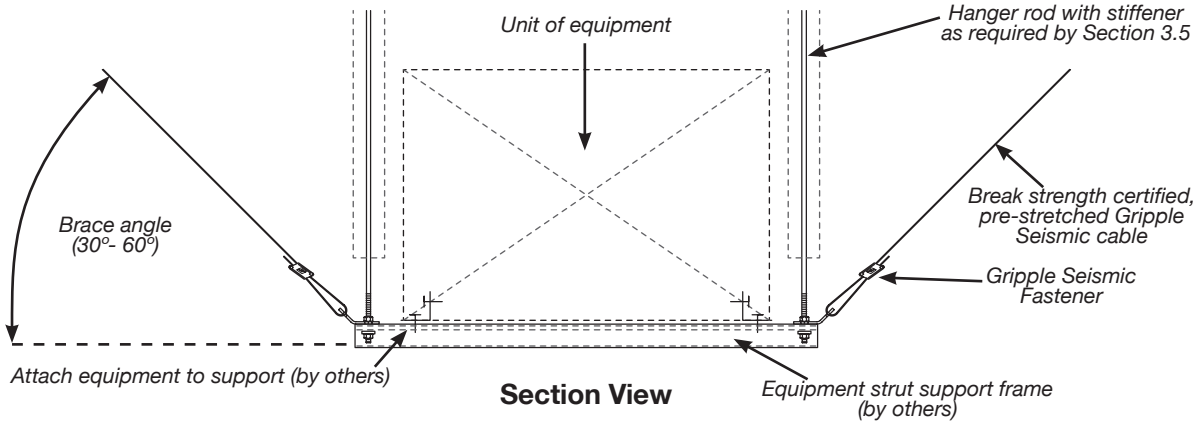
5.8.1 Rectangular Units of Equipment / '4-Way'

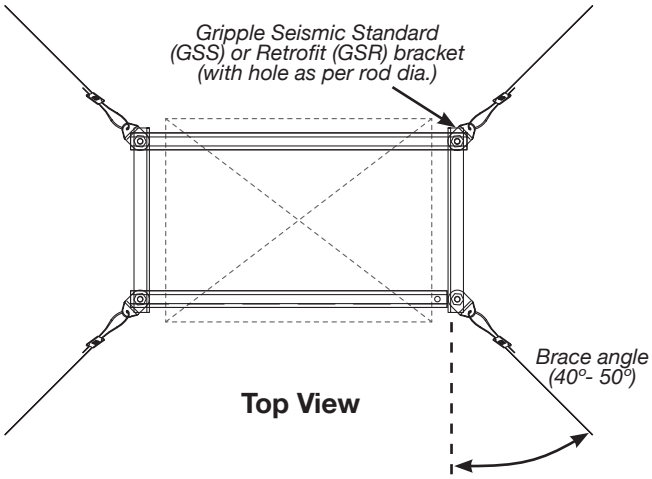
1. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
2. Install cable assemblies with 4-Way brace angles in accordance with Section 1.4.3.
3. Anchor cable assemblies to structure per Section 4, and as required by design.
4. Hand-tighten or pretension cables to remove slack per Section 3.2.
5. Hanger rod and rod stiffeners shall be by design and Section 3.5.
6. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.
7. Leave a 2" tail extending out of the Gripple Seismic Fastener for future adjustments.
8. Ensure locking screws are fully installed (hand tight) into the Gripple Seismic Fastener on completion of installation.

Color coded tag on cable for easy verification.

Note:
Use pre-installed hanger brackets/ locations in equipment, or use a supporting frame (as shown). Ensure equipment is anchored to equipment support frame as required by design.

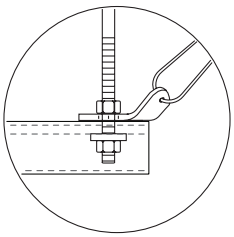


Section View

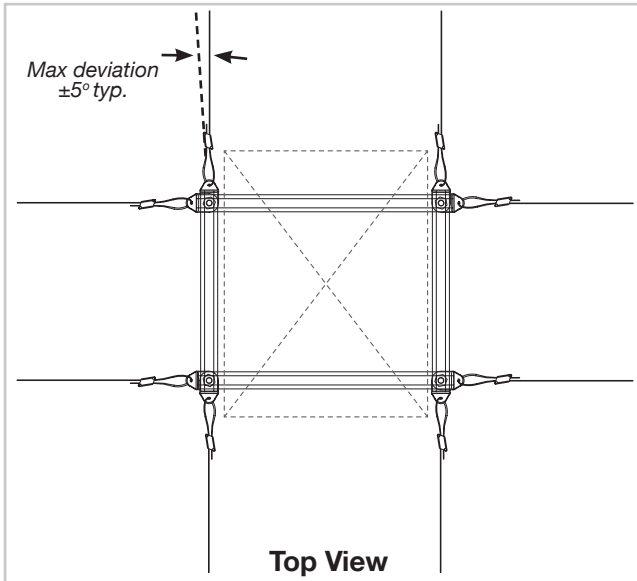


Top View

Detail



Alternate Brace Orientation:



Top View

APPROVED
Fixed Equipment Anchorage
Office of Statewide Health Planning and Development
OPA-2123-10
Pre-approval Program Manager
Anthony R. Pike
(916) 440-8470
12-Feb-2013
Reviewed By: Jeffrey Y. Kikumoto Date

REGISTERED PROFESSIONAL ENGINEER
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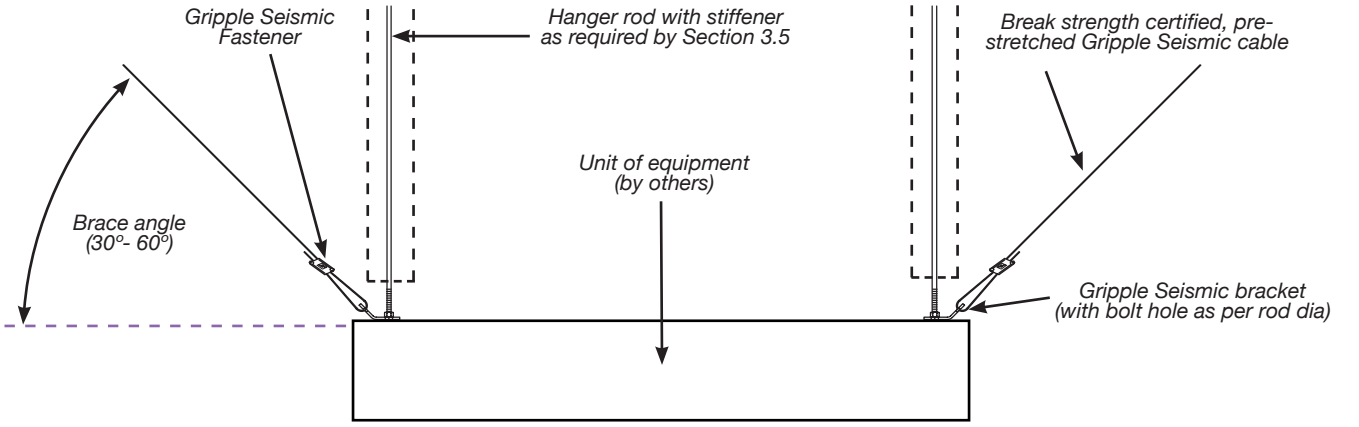
ASSOCIATE MEMBER SMACNA

5.8.2 Rectangular Units of Equipment / Linear '4-Way'

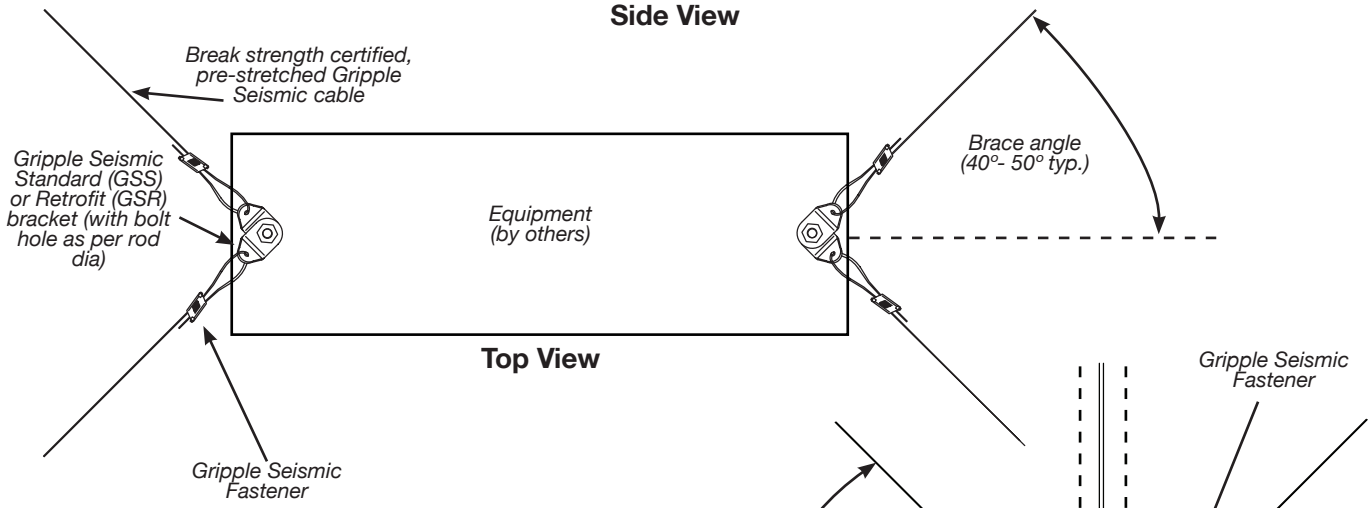
1. All non-Gripple parts, rod hangers, support products and connectors shall be approved for seismic applications where required, and shall be designed by the Registered Design Professional responsible for the design and/or OSHPD pre-approval.
2. Install cable assemblies with 4-Way brace angles in accordance with Section 1.4.3.
3. Anchor cable assemblies to structure per Section 4, and as required by design.
4. Hand-tighten or pretension cables to remove slack per Section 3.2.
5. Hanger rod and rod stiffeners shall be by design and Section 3.5.
6. Building structure at anchor locations must be point load capable. Verify loading with Structural Engineer of Record for the site/project.
7. Leave a 2" tail extending out of the Gripple Seismic Fastener for future adjustments.
8. Ensure locking screws are fully installed (hand-tight) into the Gripple Seismic Fastener on completion of installation.

Color coded tag on cable for easy verification.

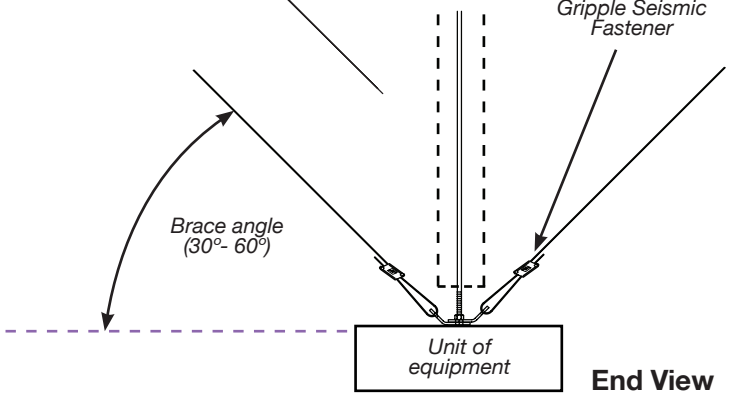
Note:
Use pre-installed hanger brackets/ locations in equipment (as shown), or use a supporting frame. Ensure equipment is anchored to equipment support frame as required by design.



Side View



Top View



End View

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Office of Statewide Health Planning and Development
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This sheet is not a part of this OPA which consists of (64) drawing sheets.
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