MASON INDUSTRIES, INC

manufacturers of noise and vibration control products
and seismic restraint systems

SEISMIC RESTRAINT GUIDELINES

October 2011 Edition

oshpd Office of Statewide Health Planning and Development

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August 26, 2008

Mr. Richard Lloyd
Mason Industries
2101 W. Crescent Ave. Suite D
Anaheim, CA 92801

Subject: Mason Seismic Restraint Guidelines for Suspended Piping, Ductwork And Electrical Systems
OPA-0349

Dear Mr Lloyd:

Mason Industries' Seismic Restraint Guidelines (OPA-0349) remains an acceptable reference for California Hospital Projects. Should you wish to confirm this information, please contact the writer by phone at: 916-440-8470 or via e-mail at: tpike@oshpd.ca.gov.

Sincerely,

Anthony R. Pike
Senior Structural Engineer

cc: File

Memorandum

State of California

oshpd

"Equitable Healthcare Accessibility for California"

To: All FDD Staff **Date:** April 22, 2008

From: John D. Gillengerten, S.E.
Deputy Director

Subject: 2007 CBC and Use of Existing Pre-Approvals

Until further notice, existing OSHPD anchorage pre-approvals (OPA) may be used on projects subject to the 2007 California Building Code (CBC) without modification. All aspects of the design and installation of the pre-approved component or system, including computation of the lateral forces, shall be in accordance with the approved OPA.

MASON INDUSTRIES

SEISMIC RESTRAINT GUIDELINES For SUSPENDED PIPING, DUCTWORK, ELECTRICAL SYSTEMS and FLOOR & ROOF MOUNTED EQUIPMENT

Tenth Edition, 2011

APPROVED

California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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Dhiru Mali
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Special Note for Engineers Specifying These Guideline:

These guidelines provide general seismic restraint requirements and details for suspended piping, ductwork and electrical systems. Prior to installation, the support and seismic restraint locations shall be verified by the engineer responsible for the design of the structure. Any deviation from the information presented shall be resolved in accordance with standard engineering practice and be approved by the enforcement agency.

These guidelines may be used for any seismic horizontal acceleration input up to 2.0g. However, component sizes are based on Allowable Stress Design (ASD). Building Codes (i.e. 1997 UBC, 2000 IBC, etc.) are changing to Strength Design based acceleration inputs. To use these guidelines for Strength Design acceleration inputs, divide the seismic horizontal acceleration by the appropriate factor stated in the applicable code to reduce it to an ASD based input. For example, if design is based on the 1997 Uniform Building Code, divide the seismic horizontal acceleration input Fp, as determined in Section 1632, by 1.4 and use the resulting acceleration in these guidelines. (e.g. If Fp = 2.1g based on 1997 UBC, use Fp = 2.1g/1.4 = 1.5g in these guidelines.)

Recommended Specification:

All suspended *piping, ductwork, conduit and cable trays** shall be provided with seismic sway braces in accordance with the Mason Industries Seismic Restraint Guidelines for Suspended Piping, Ductwork and Electrical Systems and the *applicable codes***. Seismic sway braces shall consist of galvanized steel aircraft cables or steel angles/channels. Steel aircraft cables shall be prestretched to establish a certified minimum modulus of elasticity. Cables braces shall be designed to resist seismic tension loads and steel braces shall be designed to resist both tension and compression loads with a minimum safety factor of 2. Brace end connections shall be steel assemblies that swivel to the final installation angle. Do not mix cable and steel braces to brace the same system. Steel angles or strut channels, when required, shall be clamped to the threaded hanger rods at the seismic sway brace locations utilizing a minimum of two ductile iron clamps. The bracing system shall have an Anchorage Preapproval "OPA" Number from OSHPD in the State of California verifying its capability to resist seismic forces. Cable brace assemblies shall be Type SCB, steel brace assemblies shall be Type SSB, rod clamps shall be either Type SRC or UC, pipe clevis braces shall be Type CCB and multiple anchor load distribution brackets shall be Type SLDB all as manufactured by Mason Industries, Inc.

**Modify to meet scope of engineer's responsibility.*
***Modify to include all applicable codes.*

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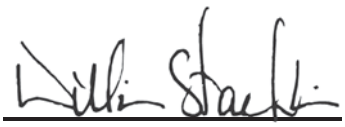

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GENERAL NOTES

1. These guidelines are designed to meet the requirements of the California Code of Regulations (CCR), Chapter 16 for essential facilities, the 1997 Uniform Building Code (Refer to Page 15), the 1996 Building Officials Code Administration, the 1997 Southern Building Code Congress International and any other horizontal acceleration input. They address seismic sway bracing for suspended pipe, duct or electrical systems and vertical risers for up to a five-story building. Riser supports must be engineered individually for six story and higher buildings.

2. For California hospitals submitted prior to November 1, 2002 and designed in accordance with the 1998 CCR, all restraints and their anchorages must be capable of restraining horizontal accelerations as follows. For nonstructural components:

   Fp = Seismic Horizontal Force = Z x 1 x Cp x Wp
   Z = Zone Factor = 0.3 for Zone 3, 0.4 for Zone 4
   I = Importance Factor = 1.5 for Essential Facilities
   Cp = Horizontal Force Factor = 0.75 for Mechanical/Electrical Systems
   Wp = Operating Weight of Pipe, Duct and/or Electrical Systems
   Therefore, Fp = 0.34g for Zone 3, 0.45g for Zone 4

   Note: The Engineer of Record shall determine the horizontal acceleration for non-California hospital projects when using these guidelines.

3. A complete description on how to use these guidelines is provided on pages 17 to 29. It includes specific examples for both using the enclosed details/ charts and layout of bracing for individual and trapeze supported systems.

Notes on Seismic Bracing:

1. These guidelines list installations, which may be exempt from bracing. However, the engineer of record shall be responsible for determining whether to allow the exceptions.

2. Each straight pipe, duct or electrical run with two or more supports requires a minimum of two transverse braces (perpendicular to the run). (Option: A longitudinal brace on the opposite side of an elbow or tee may act as a transverse brace. Refer to the layout examples detailed on pages 26 to 29.)

3. Each straight pipe, duct or electrical run requires a minimum of one longitudinal brace (parallel to the run). (Option: A transverse brace on the opposite side of an elbow or tee can sometimes act as a longitudinal brace. Refer to the layout examples detailed on pages 26 to 29.)

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GENERAL NOTES (continued)

4. Transverse and longitudinal brace shall be installed up to 45 degrees or 1(Vert.): 1(Horiz.) brace angle ratio from horizontal. Brace spacing or maximum weight per foot (meter) can be reduced to allow up to 1.5:1 or 2:1 brace angle ratios. Consult Mason Industries for braces installed at an angle higher than a 2:1 ratio.

5. Seismic bracing may consist of solid bracing designed to accept loads in tension and compression or cable bracing designed to accept tension loads only. Each brace method requires a vertical hanger at or within 4" (*102 mm*) of their attachment to the mechanical or electrical system. The vertical hanger may or may not require stiffening or additional anchorage to the structure (Refer to Notes on Supports).

6. Do not mix solid bracing with cable bracing in the same direction on any run of a mechanical or electrical system.

7. Do not brace a system to two different parts of a building, which may act differently in response to an earthquake. For example, avoid connecting a transverse brace to a wall and a longitudinal brace to a floor or roof at the same brace location.

8. Systems with significant thermal motion shall be designed on a case by case basis by a professional engineer familiar with both seismic loading and thermal expansion.

9. Seismic brace requirements for individually supported and trapeze supported systems including maximum transverse and longitudinal spacing; aircraft cable and solid brace member size; and attachment to the building structure are tabulated in Section A and D, respectively.

10. Seismic brace requirements for a trapeze supported system in Section D are based on the maximum total weight per foot (meter). In addition, the maximum total weight per foot (meter) in Section D can be used to determine seismic brace requirements for individually supported systems. Note: If the load on the trapeze is not equally distributed to each support rod, the maximum total weight per foot (meter) used to determine longitudinal brace requirements must be equal to 2 times the maximum loaded rod.

11. All components supported by a trapeze member must be clamped or bolted down to the trapeze. Pipes set in rollers or other thermal expansion supports only require clamping at seismic brace locations designed to prevent uplift but allow for thermal motion. Friction connections must have approved or tested values, such as strut nuts and bolts torqued to manufacturer's requirements.

12. Multiple or stacked trapezes that share support rods must be braced independently from one another. Each section of threaded rod between trapezes and/or the building structure is subject to vertical stiffening requirements of pages E1 or E2 (Refer to Notes on Supports).

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GENERAL NOTES (continued)

13. Vertical drops from suspended systems to equipment (or flexible connectors where applicable) may be braced using the transverse and longitudinal braces in this manual. ***Note:*** Do not exceed 1/2 of the maximum brace spacing as measured from the seismic brace to the equipment of flexible connector when bracing vertical drops. (Refer to Layout of the Seismic Braces, page 29)

14. Any system which crosses a building separation or seismic joint must be designed accommodate 2 times the joint width displacements or as specified by the engineer of record for approval by the enforcement agency.

Notes on Supports:

1. Where the seismic brace system incorporates the use of a threaded vertical hanger and designed to carry gravity loads only, additional anchorage and/or stiffening may be required as detailed. General support of pipe, duct and electrical systems to carry gravity loads shall be determined by the engineer of record and/or mechanical, plumbing or electrical code requirements. The use of "C-Clamps" designed to attach threaded rod to one side of a steel beam flange shall not be used unless they are provided with a restraining strap or hook to the opposite beam flange. Pipe clevis shall be provided with pipe insulation protection shields o protect the insulation as per MSS-SP-69. When insulation is removed to facilitate the installation of pipe clamps or other hardware, the mechanical engineer shall provide details for the re-insulation of the pipe.

2. Support rod capacity and its anchorage to the structure is an important part of a solid bracing system. Solid braces shall not be attached to existing systems or support rods designed for gravity loads unless they are checked for increased tension loads. Section K of these guidelines tabulates the seismic tension load applied to the support rod at solid brace locations.

3. Threaded vertical hanger rods where seismic sway bracing is attached may require stiffening. A vertical rod stiffener can be done two ways. One way is with a steel angle cut to the appropriate length attached to the threaded rod with a minimum of two Seismic Rod Clamps (Mason type SRC). The second way is with strut channel cut to the appropriate length and attached to the threaded rod with a minimum of two Strut Channels (Mason type UC). Maximum spacing will be as tabulated on pages B1, E1, E2, X5 and X5A. Installation of the threaded vertical hanger rod, with or without a stiffener, must conform to the details on pages G1 and G2 including maximum distance to the clamp from each end. Vibration isolation hangers (neoprene, spring, or combination of the two) must be installed within 3/8" (*10 mm*) of the structure with a vertical limit stop 1/4" (*6 mm*) from the underside of the hanger housing. Page B1 tabulates the maximum unbraced rod length (the maximum length of the rod allowed ***without*** a stiffener) and the maximum braced rod length (the maximum length of the rod allowed ***with*** a stiffener) for up to 24" (*610 mm*) diameter pipe (or the tabulated maximum weight per foot (*meter*) of an individually supported system). Pages E1 and E2 tabulate the same information for trapeze supported systems. Page E1 is based on SCB/SSB size and rod diameter, and page E2 is based on maximum total weight.

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GENERAL NOTES (continued)

4. Vibration isolation hangers at seismic sway brace locations must be installed with the top of the hanger housing flush with the structural support surface. In the case of combination spring and neoprene hangers (Mason type PC30N), a space of up to 3/8" (*10 mm*) between the top of the hanger housing and the structure due to the deflection of the neoprene element is acceptable, as detailed throughout these guidelines.

5. Trapeze supports shall consist of steel angles, back to back channels, or 12 gauge (*2.7 mm*) single or double channel strut. Determine trapeze size based on load and spacing between vertical supports on page E3. Threaded rods shall attach to the trapeze with nuts and washers on both the top and bottom.

Notes on Seismic Cable Bracing:

1. Cables shall be prestretched galvanized 7x19 strand core aircraft cable with no limit to their installed length. ***Note:*** Horizontal accelerations defined in general note 2 or by applicable code must be multiplied by 2 if non-prestretched cable is used.

2. Cables shall be installed such that the only visible slack is that due to cable sag. Cables shall not support gravity loads.

3. Cables shall be attached to both the mechanical/electrical system and the structure using the seismic cable brace components (Mason Type SCB (H,V). Refer to pages X1, X2 and X3).

4. The SCB cable bolts shall be installed per the torque requirements tabulated on pages X1, X2 and X3.

5. The SCBH component can be used for attachment directly to the threaded vertical hanger rod used for supporting system gravity loads as detailed in Sections C and F.

6. The SCBV component can be used for attachment to steel beams in lieu of bolting or welding as detailed on page H12. Note: Installation of the SCBV must be perpendicular to the steel beam.

Notes on Seismic Solid Bracing:

1. Solid bracing members shall be steel angle or 12 gauge (*2.7 mm*) channel strut. The charts in sections A and D tabulate the minimum solid brace size based on a maximum solid brace length of 9'-6" (*2.9 m*). The chart on page X4 allows for a different solid brace member size if the maximum installed length is 5'-0" (*1.5 m*) or 14'-6" (*4.4 m*).

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GENERAL NOTES (continued)

2. Solid brace members shall be attached to both the mechanical/electrical system and the structure using the seismic solid brace components (Mason Type SSB (U) or SSBS. Refer to pages X4 and X11).

3. As stated in "Notes on Supports", the support rod attachment at seismic solid brace locations must be designed to accept the seismic tension load tabulated in Section K in addition to the gravity load.

Notes on Seismic Attachment to the Building Structure:

1. Attachment to the building structure is the determining factor in the design of seismic sway bracing. Lightweight structures may limit the maximum spacing between seismic braces. The engineer of record shall determine the maximum allowable seismic loads for the building structure.

2. Attachment to four different types of structures is addressed separately. Attachment to a minimum 6" (*152 mm*) thick, 3000 psi (*20680 kPa*) stone aggregate concrete slab using expansion anchors; a minimum 3000 psi (*20680 kPa*) lightweight concrete filled metal deck using expansion anchors; a steel structure using bolts, welds or seismic clamps (Mason Type SCBV only, Refer to page X3.) or a wood structure with Lag Screws. Attachments not addressed or detailed must be engineered on an individual job basis subject to approval by the enforcement agency. ***Note:*** The engineer of record shall determine which attachment details in Section H of this manual are acceptable for steel structures.

3. Expansion anchors shall be ITW Ramset/Trubolt Wedge Anchors for 3000 psi (*20680 kPa*) stone aggregate concrete slabs and 3000 psi (*20680 kPa*) stone aggregate or lightweight concrete filled decks installed in accordance with ICBO Report ER-1372/1997, Tables 7, 8, 9 and 14. When expansion anchors are used, 50 percent of alternate bolts in a group shall be tension tested or torque tested to the test values tabulated on page X8. Testing shall be done in the presence of the project inspector and a report of the test results shall be submitted to the enforcement agency. If any anchors fail, the enforcement agency shall determine the additional testing requirements***. Note:*** This is not a standard UBC, BOCA or SBCCI requirement and may not be required for commercial buildings.

4. All welded connections shall be minimum 70xx electrode welds. ***Note:*** This is not a standard UBC, BOCA or SBCCI requirement and may not be required for commercial buildings. Charts support the use of 60xx electrode welds on Non-OSHPD/DSA projects.

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GENERAL NOTES (continued)

5. Metal decks shall be minimum 20 gauge (*0.9mm*) with a maximum 3" (*76 mm*) flute and minimum 6" (*152mm*) total thickness from bottom of flute to top of concrete fill. Concrete fill shall be minimum 3000 psi (*20680 kPa*) lightweight concrete. ***Note:*** Metal decks with minimum 3000 psi (*20680 kPa*) stone aggregate concrete fill may use the lightweight concrete deck charts.

6. Concrete attachments are based on specified anchor bolts or inserts. Substitution of alternate anchors must be approved by Mason Industries (and the enforcement agency where applicable) on a job by job basis.

7. For structures with concrete waffle slabs use the stone aggregate concrete slab charts while following the minimum edge distance requirements of the expansion anchors and/or inserts. Seismic Cable Brace, Mason Type SCB, Seismic Solid Brace, Mason Type SSB, and Seismic Solid Brace Strut Anchor Mason Type SSB components may be attached to the side of the vertical potion of the waffle as long as the brace angle ratio of the SCB or SSB relative to the surface of the concrete does not exceed 2:1.

8. When installing drilled-in anchors in existing non-prestressed reinforced concrete, use care and caution to avoid cutting or damaging reinforcing bars. When installing them in existing prestressed concrete, locate the prestressed tendons by using a non-destructive method and avoid cutting or damaging the tendons during installation.

9. Seismic Load Distribution Brackets shall be installed where (2) or (4) bolts are required for attachment to a concrete slab or deck. (Mason Type SLDB. Refer to pages X9 and X10).

10. Lag screws shall be installed into a wood structure with regard to minimum edge and end distances tabulated on Page H13. Wood must have a minimum specific gravity of 0.35, which includes Douglas Fir, Pine and Redwood. The Structural Engineer of Record shall verify wood specific gravity, connection detail and capability of structure to resist seismic loads indicated on page H13.

Notes on Suspended Piping:

1. Seismic restraints are required for the following installations:

   A. All fuel oil, gas, medical gas, compressed air, vacuum and other potentially hazardous piping systems unless specifically excepted by the engineer of record.

   B. All piping 1 1/4" (*32 mm*) nominal diameter and larger located in boiler, mechanical equipment and refrigeration mechanical rooms.

   C. All other piping 2 1/2" (*64 mm*) nominal diameter and larger.

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GENERAL NOTES (continued)

Exception:

All piping suspended by individual hanger rods 12" (*305 mm*) or less as measured from the top of the pipe to the bottom of the support where the hanger is attached. If the 12" (*305mm*) limit is exceeded by any hanger in the run, seismic bracing is required for the run. **Note: A single support location that meets the requirement of this exception does not constitute a seismic sway brace location.**

The exception also applies for trapeze supported systems if the distance as measured from the point of attachment to the trapeze to the point of attachment to the structure is less than 12" (*305 mm*). **Note: If directional changes or offsets to equipment connections do not allow for flexibility of the trapezed system (e.g. long offsets or flexible connectors) then the system must be braced regardless of pipe diameter or distance to the structure if the combined weight per foot (*meter*) of all items is greater than 10 lbs/ft (*14.9 kg/m*).**

Page 30 of these guidelines details the “12 inch Rule” for suspended piping.

In addition, to meet the 1997 Uniform Building Code CBC/2001, all of the following conditions must also be satisfied:

1. Lateral motion of piping will not cause damaging impact with surrounding systems (e.g. other pipe, duct, equipment, sprinkler heads etc.) or cause loss of system vertical support.
2. Piping must be made of ductile material with ductile connections (e.g. welded steel pipe, brazed copper pipe, etc.)
3. Vertical support connections cannot develop moments (e.g. swivel joints, eye bolts, vibration isolation hangers, etc.)

2. Steel and copper pipe with welded or brazed connections shall be braced at the spacings shown in these guidelines. Transverse brace spacing shall not exceed 50 feet (*15.2 m*) up to 0.25g, 40 feet (*12.2 m*) up to 1.0g, and 20 feet (*6.1 m*) up to 2.0g. Maximum longitudinal spacing shall not exceed 80 feet (*24.4 m*) up to 1.0g, and 40 feet (*12.2 m*) up to 2.0g. Steel and copper pipe with screwed connections brace spacing shall not exceed 1/2 the spacing listed in these guidelines. All pipe must be considered full of water when determining seismic brace requirements unless specifically engineered otherwise.

3. Cast iron pipe (no hub pipe) brace spacings shall not exceed 1/2 the spacings listed in note 2 above. In addition, braces shall be installed at each side of a change in direction of 90° or more. Cast iron pipe shall be considered full of water when determining weight.

4. Piping with grooved pipe assemblies UL listed for Standard 213 shall be braced at spacings not to exceed those listed in note 2 above. Non-UL listed grooved pipe assemblies brace spacings shall not exceed 1/2” the spacings listed in note 2 above.

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GENERAL NOTES (continued)

5. For PVC, PVDF, FRP and other specialty piping, brace spacings shall not exceed 1/2 the spacings listed in note 2 above. Braces can be selected for the actual pipe weight at these spacings.

6. Gas, fuel oil, vacuum, medical gas and compressed air piping brace spacings shall not exceed the maximum spacings listed in note 2 above. Piping constructed other than those listed in note 2 must follow the requirements of notes 3, 4 and 5.

7. Transverse restraints for insulated pipe shall be installed on clevis, J-Hanger or roller hanger supports sized to fit over insulation inserts and on trapeze supports where the insulation insert is supported by the trapeze and the clamp is sized to fit over the insulation insert.

8. Longitudinal restraints for all pipes shall be attached directly to the pipe using a pipe clamp hanger or a standard pipe clamp within 4" (*102 mm*) of a vertical support. Where required, insulation shall be installed over the pipe clamp so the pipe clamp is in direct contact with the pipe. The Engineer of Record is responsible for determining and detailing if a special clamp is required to prevent breaking the vapor barrier for chilled water systems.

9. The pipe weights tabulated in Section A are based on schedule 40 steel pipe for up to 12" (*305 mm*) diameter, schedule 30 steel pipe for 14" (*356 mm*) to 18" (*457 mm*) diameter and schedule 20 for 20" (*508 mm*) and 24" (*610 mm*) diameters. Weights also include water and insulation. Verify the maximum weight per foot (*meter*) listed in the column next to pipe size when determining seismic brace requirements tabulated in Section A. Section M of these guidelines tabulates the weight per foot (*meter*) for steel, copper, PVC and cast iron pipe.

Notes on Suspended Ductwork:

1. Seismic restraints are required for the following installations:

   A. All ductwork containing hazardous gases or exhaust unless specifically excepted by the engineer of record.

   B. All rectangular and square ducts 6 square feet (*0.56 m2*) and larger in cross sectional area and round ducts 28" (*711 mm*) and larger in diameter.

   Exception:

   All ducts suspended by hanger straps 12" (*305 mm*) or less in length as measured from top of the duct to the point of attachment to the structure. Hangers must be attached within 2" (*51 mm*) of the top of the duct with a minimum of two #10 sheet metal screws. If any hanger in the run exceeds the 12" *(305 mm*) limit, seismic bracing is required for the run. **Note: A single support location that meets the requirements of this exception does not constitute a seismic sway brace location.**

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GENERAL NOTES (continued)

The exception also applies for trapeze supported systems if the distance as measured from the point attachment to the trapeze to the point of attachment to the structure is less than 12" (*305 mm*). **Note: If directional changes or offsets to equipment connections do not allow for flexibility of the trapezed system (e.g. long offsets or flexible connectors) then the system must be braced regardless of duct size or distance to the structure if the combined weight per foot (meter) of all items is greater than 10 lbs/ft (*14.9 kg/m*).**

Page 31 of these guidelines details the “12 Inch Rule” for ductwork.

In addition, to meet the 1997 Uniform Building Code CBC/2001, all of the following conditions must be satisfied:

1. Lateral motion of ductwork will not cause damaging impact with surrounding systems (e.g. other ducts, pipes, equipment, sprinkler heads etc.) or cause loss of system vertical support.
2. Ductwork must be made of ductile material with ductile connections.
3. Vertical support connections cannot develop moments (e.g. swivel joints, eye bolts, vibration isolation hangers, etc.)

2. Ductwork conforming to SMACNA standards, including but not limited to duct construction and joint connections, shall be braced at a maximum transverse spacing of 40 feet (*12.2 m*) up to 0.25g, 30 feet (*9.1 m*) up to 1.0g, and 20 feet (*6.1 m*) up to 2.0g. Maximum longitudinal spacing shall be 80 feet (*24.4 m*) at 0.25g, 60 feet (*18.3 m*) up to 1.0g, and 40 feet (*12.2 m*) up to 2.0g.

3. Ductwork constructed of non-ductile materials or non-ductile connections, such as specialty plastic or fiberglass ductwork, shall be braced at 1/2 the spacings listed in note 2 above.

4. Rectangular and oval ductwork shall be stiffened at seismic brace locations with a trapeze support member sized to carry the gravity load of the ductwork; a minimum of (2) threaded vertical hanger rods and an upper support member over top of the duct. The trapeze and upper support members must be fastened to the ductwork with #10 sheet metal screws spaced at maximum 12" (*305mm*) centers. Refer to Pages E3 and E4 for sizing of the trapeze and upper support members.

5. Multiple ducts may be combined in a single framed and braced based on the combined duct weight.

6. Wall penetrations may be considered transverse brace locations where duct is tightly blocked unless smoke dampers are installed in the wall.

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GENERAL NOTES (continued)

7. Floor penetrations of vertical duct may be considered transverse and longitudinal brace locations where duct is tightly blocked and the distance from the floor penetration to the inside of the 90 degree turn horizontal is less than 2 duct widths. Floor penetrations may be considered transverse brace locations where duct is tightly blocked unless smoke dampers are installed in the floor.

8. Devices mounted in-line and rigidly attached to the ductwork at both ends must be braced independently from the ductwork if the unit weight is 50 lbs (*23 kg*) or greater ***or*** the unit weighs between 20 lbs (*9 kg*) and 49 lbs (*22 kg*) and is separated from the duct with a flexible connector. Flexible connections between the device and associated pipings should be provided ***or*** the unit to is attached to braced piping and flexible piping connectors are not used.

9. Section N of these guidelines tabulates duct weight per foot (*meter*) for rectangular and round ductwork of different sizes and gages.

10. If a 2 piece rod is used to support ductwork, minimum engagement of the rod shall be 1/3 of the coupling nut length. Rods shall be run up tight in the coupling nut.

Notes on Suspended Electrical Systems:

1. Seismic braces are required for the following installations:

   A. All conduit 2 1/2" (*64 mm*) trade size and larger.

   B. All cable trays with weights greater than 10 lbs/ft (*14.9 kg/m*).

   Exception:

   All conduit or cable trays suspended by individual hanger rods 12" (*305 mm*) or less as measured from the to of the conduit or cable tray to the bottom of the support where the hanger is attached. However, if any hanger in the run exceeds the 12" (*305 mm*) limit, seismic bracing is required for the run. **Note: A single support location that meets the requirements of this exception does not constitute a seismic sway brace location.**

   The exception also applies for trapeze supported systems if the distance as measured from the point of attachment to the trapeze to the point of attachment to the structure is less than 12" (*305 mm*). **Note: If directional changes or offsets to equipment connections do not allow for flexibility of the trapezed system (e.g. long offsets or flexible connectors) then the system must be braced regardless of conduit size or distance to the structure if the combined weight per foot (*meter*) of all items is greater than 10 lbs/ft (*14.9 kg/m*).**

   Page 30 of these guidelines details the “12 Inch Rule” for suspended electrical systems.

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GENERAL NOTES (continued)

In addition, to meet the 1997 Uniform Building Code CBC/2001, all of the following conditions must be satisfied:

1. Lateral motion of electrical system will not cause damaging impact with surrounding systems (e.g. other electrical systems, ducts, pipes, equipment, etc.) or cause loss of system vertical support.
2. Electrical system must be made of ductile material with ductile connections.
3. Vertical support connections cannot develop moments (e.g. swivel joints, eye bolts etc.)

2. Conduits and cable trays shall be braced at the spacings shown in these guidelines. Transverse brace spacing shall not exceed 50 feet (*15.2 m*) up to 0.25g, 40 feet (*12.2 m*) up to 1.0g, and 20 feet (*6.1 m*) up to 2.0g. Maximum longitudinal spacing shall not exceed 80 feet (*24.4 m*) up to 1.0g, and 40 feet (*12.2 m*) up to 2.0g.

3. Transverse restraints for conduit or cable trays shall be installed at general support locations. Connection of the restraint to the support shall be at the support rod connection to the hanger or cable tray.

4. Longitudinal restraints for conduits shall be attached directly to the conduit using a pipe clamp hanger or a standard pipe clamp within 4" (*102 mm*) of a vertical support. Longitudinal restraints for cable trays shall be at the support rod connection to the cable tray.

5. The charts in Section A or D may be used to determine seismic restraint components and their anchorage for conduits or cable trays. Section M of these guidelines tabulates the weight per foot (*meter*) of steel conduit with maximum conductor fill.

Notes on Vertical Risers:

1. Vertical pipe, duct or electrical systems supported at each floor up to a five story building shall be considered seismically braced if the penetration through each floor is tightly packed. Refer to Page R1 for support details.

2. Vertical risers in an open shaft must be attached to the supports with connections sized to accept the horizontal seismic loads. Support spacing shall not exceed 40 feet (*12.2 m*) up to 0.25g, 30 feet (*9.1 m*) up to 1.0g and 20 feet (*6.1 m*) up to 2.0g. Supports and connections must be engineered on a job by job basis subject to approval by the enforcement agency.

3. Vertical cast iron pipe risers attached with shield and clamp assemblies must be stiffened at the connection points of any unsupported section of pipe. Refer to Page R1 for stiffening details.

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GENERAL NOTES (continued)

1997 Uniform Building Code

As defined in the 1997 Uniform Building Code 2001 CBC, Chapter 16, Section 1632/1632A, the seismic horizontal force, Fp, may be calculated using the following formula:

$$F_p = \frac{a_p\, C_a\, I_p}{R_p}\left(1 + 3\,\frac{h_x}{h_r}\right) W_p$$

Except that: F_p shall not be less than $0.7\, C_a\, I_p\, W_p$ and need not be more than $4\, C_a\, I_p\, W_p$.

Where:

W_p = Operating Weight of Pipe, Duct and/or Electrical System

a_p = Component Amplification Factor
= 1.0 for Suspended Piping, Ductwork or Electrical Systems.

R_p = Component Response Modification Factor
= 3.0 for Suspended Piping, Ductwork or Electrical Systems.
= 1.5 for installations using concrete anchors with an embedment length-to-diameter ratio less 8. (e.g. a 1/2" (*13 mm*) diameter concrete anchor embedded less 4" (*104 mm*))

I_p = Importance Factor
1.5 for Essential Facilities such as Hospitals, Fire or Police Stations, etc., hazardous facilities and life-safety systems.
1.0 for all other Occupancies. Refer to 1997 UBC Table 16-K.

C_a = Seismic Coefficient derived from the Seismic Zone, Soil Properties and Proximity to Known Earthquake Faults summarized in 1997 UBC Tables 16-I, 16-Q and 16-S.

h_x = Element or Component Attachment Elevation with respect to grade. H_x shall not be taken less than 0.0.

h_r = Structure Roof Elevation with respect to grade.

Example:
Piping is suspended on the 1st floor of a 50 foot (*15.2 m*) high, 3-story office building. The piping is actually suspended from the 2nd floor which has an elevation of 15 feet (*4.6 m*) from grade. The building is located in Seismic Zone 3 on Soil Type SD which results in a Seismic Coefficient, $C_a = 0.36$.

$$F_p = \frac{a_p\, C_a\, I_p}{R_p}\left(1 + 3\,\frac{h_x}{h_r}\right) W_p = \frac{(1.0)(0.36)(1.0)}{3.0}\left(1 + 3\,\frac{15}{50}\right) W_p = 0.23\, W_p = 0.23g$$

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GENERAL NOTES (continued)

2000 International Building Code

As defined in the 2000 International Building Code, Chapter 16, Section 1621, the seismic horizontal force, F_p , may be calculated using the following formula:

$$F_p = \frac{0.4\ a_p\ S_{DS}\ I_p}{R_p}\left(1 + 2\ \frac{z}{h}\right) W_p$$

Except that F_p shall not be less than $0.3\ S_{DS}\ I_p\ W_p$ and need not be more than $1.6\ S_{DS}\ I_p\ W_p$
Where:

W_p = Operating Weight of Pipe, Duct and/or Electrical System

a_p = Component Amplification Factor
= 1.0 for Suspended Piping and Ductwork.
= 2.5 for Suspended Bus Ducts, Conduits and Cable Trays.

R_p = Component Response Modification Factor
= 5.0 for Suspended Bus Ducts, Conduits and Cable Trays.
= 3.5 for Suspended High Deformability Piping Systems such as welded steel pipe or brazed/soldered copper pipe.
= 2.5 for Suspended Ductwork and Limited Deformability Piping Systems such as piping with screwed fittings.
= 1.5 for installations using concrete anchors with an embedment length-to-diameter ratio less than 8. (e.g. a 1/2 (*13 mm*) diameter concrete anchor embedded less than 4" (*102 mm*)).
= 1.25 for Suspended Low Deformability Piping Systems such as cast iron pipe.

I_p = Importance Factor
= 1.5 for Essential Facilities such as Hospitals, Fire or Police Stations, etc., hazardous facilities and life-safety systems.
= 1.0 for all other Occupancies. Refer to 2000 IBC Section 1621.1.6.

S_{DS} = The Design Spectral Response Acceleration at short periods.
= 2/3 S_{MS}

S_{MS} = The Maximum Considered Earthquake Spectral Accelerations for short periods.
= F_a x S_s

S_s = The Mapped Spectral Response Acceleration at Short Periods.

F_a = The Site Coefficient as a function of Site Class (soil conditions) and Mapped Spectral Accelerations. Refer to 2000 IBC Table 1615.1.2.

z = Element or Component Attachment Elevation with respect to grade. z shall not be taken less than 0.0 or greater than h.

h = Structure Roof Elevation with respect to grade.

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GENERAL NOTES (continued)

F_p shall not be taken less than, $0.7\ C_a\ I_p\ W_p = 0.7(0.36)(1.0)\ W_p = 0.26g$
F_p shall not be greater than, $4.0\ C_a\ I_p\ W_p = 4.0(0.36)(1.0)\ W_p = 1.44g$

Therefore, $F_p = 0.26g$

For use in this manual we can convert the result from Design Strength to Allowable Stress Design by dividing the result by 1.4, **$F_p = 0.26g / 1.4 = 0.19g$**

For installations using concrete anchors installed with an embedment length-to-diameter ratio less than 8, also defined as shallow concrete anchors, the component Response Factor, $R_p = 1.5$, therefore for the same example.

$$F_p = \frac{a_p\ C_a\ I_p}{R_p}\left(1 + 3\frac{h_x}{h_r}\right)W_p = \frac{(1.0)(0.36)(1.0)}{1.5}\left(1 + 3\frac{15}{50}\right)W_p = 0.46\ W_p = 0.46g$$

Comparing this value with the minimum and maximum F_p equations previously calculated gives, $F_p = 0.46g$. Again, converting to Allowable Stress Design fo use in this manual, $F_p = 0.46g / 1.4 = 0.33g$

Consider the same example, if the piping is suspended from the roof,

$$F_p = \frac{a_p\ C_a\ I_p}{R_p}\left(1 + 3\frac{h_x}{h_r}\right)W_p = \frac{(1.0)(0.36)(1.0)}{3.0}\left(1 + 3\frac{50}{50}\right)W_p = 0.48\ W_p = 0.48g$$

Compare this value with the minimum and maximum F_p equations previously calculated gives, $F_p = 0.48 / 1.4 = 0.35g$

For shallow concrete anchor installations,

$$F_p = \frac{a_p\ C_a\ I_p}{R_p}\left(1 + 3\frac{h_x}{h_r}\right)W_p = \frac{(1.0)(0.36)(1.0)}{1.5}\left(1 + 3\frac{50}{50}\right)W_p = 0.96\ W_p = 0.96g$$

Comparing this value with the minimum and maximum F_p equations previously calculated gives, $F_p = 0.96g / 1.4 = 0.69g$

This example can be summarized as follows for use with this manual.

Office Building Level	Horizontal Acceleration Fp	Fp For Shallow Concrete Anchor Installations
1st Floor	0.19g	0.33g
2nd Floor	0.24g	0.48g
3rd Floor	0.35g	0.69g

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GENERAL NOTES (continued)

Example:

Piping with screwed fittings is suspended on the 1st floor of a 50 foot (*15.2m*) high, 3-story office building. The piping is actually suspended from the 2nd floor, which has an elevation of 15 feet (*4.6m*) from the grade. The building is located where the value of S_s is 1.00 and the site class is D.

$$S_{DS} = 2/3\ S_{MS} = 2/3\ F_a \times S_s = 2/3(1.1)(1.00) = 0.73$$

$$F_p = \frac{0.4\ a_p\ S_{DS}\ I_p}{R_p}\left(1 + 2\frac{z}{h}\right) W_p = \frac{(0.4)(1.0)(0.73)}{2.5}\left(1 + 2\frac{15}{50}\right) W_p = 0.19g$$

F_p shall not be taken less than, $0.3\ S_{DS}\ I_p\ W_p = 0.3(0.73(1.0)W_p = 0.22g$
F_p shall not be greater than, $1.6\ S_{DS}\ I_p\ W_p = 1.6(0.73(1.0)W_p = 0.17g$
Therefore, $F_p = 0.22g$

For use in this manual we can convert the result from Design Strength to Allowable Stress Design by dividing the result by 1.4, **F_p = 0.22g / 1.4 = 0.16g.**

For Installation using concrete anchors installed with an embedment length-to-diameter ratio less than 8, also defined as shallow concrete anchors, the Component Response Factor, Rp= 1.5, therefore for the same example

$$F_p = \frac{0.4\ a_p\ S_{DS}\ I_p}{R_p}\left(1 + 2\frac{z}{h}\right) W_p = \frac{(0.4)(1.0)(0.73)}{1.5}\left(1 + 2\frac{15}{50}\right) W_p = 0.31g$$

Comparing this value with the minimum and maximum F_p equations previously calculated gives, F_p = 0.31g. Again, converting to Allowable Stress Design for use in this manual, **F_p = 0.31g / 1.4 = 0.22g.**

Consider the same example, if the piping is suspended from the roof,

$$F_p = \frac{0.4\ a_p\ S_{DS}\ I_p}{R_p}\left(1 + 2\frac{z}{h}\right) W_p = \frac{(0.4)(1.0)(0.73)}{2.5}\left(1 + 2\frac{50}{50}\right) W_p = 0.35g$$

Comparing this value with the minimum and maximum F_p equations previously calculated gives, **F_p = 0.35g / 1.4 = 0.25g.**

This example can be summarized as follows for use with this manual.

Office Building Level	Horizontal Acceleration F_p	F_p For Shallow Concrete Anchor Installations
1st Floor	0.16g	0.22g
2nd Floor	0.19g	0.31g
3rd Floor	0.25g	0.42g

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DESIGN PROCEDURE
FOR INDIVIDUALLY SUPPORTED SYSTEMS

Selection charts are available for each of the following attachment methods and types of structures:

1. Expansion anchors into a 3000 psi (*20.68 MPa*), stone aggregate concrete slab.
2. Expansion anchors into a 3000 psi (*20.68 MPa*), lightweight concrete filled metal deck.
3. Bolted or welded direct to structural steel.
4. Lag screw into a wood structure.

Design Procedure:

Step 1. Select the Seismic Restraint Guideline for the actual attachment method or type of structure listed above. These charts show anchorage requirements, size of seismic cable brace (SCB) or seismic solid brace (SSB) or seismic strut brace (SSBS), cable or solid brace size and maximum brace spacing for different pipe sizes or maximum weight per foot (*meter*). (Ref. Pages A1 to A4)

Step 2. Select the Rod Stiffener Guidelines for Individually Supported Systems. This chart defines the maximum unbraced rod length, maximum braced rod length and maximum spacing between each seismic rod clamp (SRC) or strut clamp (UC). (Ref. Page B1)

Step 3. Check the minimum size of SCBH, SCB, SSBS and SSB. An increase in size may be required if a larger clevis is used on insulated pipe, etc. (Ref. Page B2)

Step 4. Select the Supported Rod Attachment Guideline, which coincides with the Seismic Restraint Guideline selected in Step 1 if using seismic solid braces. Each chart defines the seismic tension load applied to the support rod at the seismic solid brace location. (Ref. Pages K1 to K4)

The following summary may be used for easy reference.

SEISMIC RESTRAINT/SUPPORT GUIDELINES

Structure or Attachment Type	Seismic Restraint Guidelines	Rod Stiffener Guidelines	Minimum SCBH, SCB SSB and SSBS Size	Support Rod Attachment Guidelines at SSB and SSBS Locations
1	A1	B1	B2	K1
2	A2	B1	B2	K2
3	A3	B1	B2	K3
4	A4	B1	B2	K4

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DESIGN PROCEDURE
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Step 5. Select the appropriate seismic restraint details.

The following summary can be used for easy reference.

SEISMIC RESTRAINT DETAILS

	Support Type	Transverse Brace	Alternate Transverse Brace	Longitudinal Brace	Rod Stiffener
Type SCB Cable Brace System	Spring Isolated	C1	C2	C3	G1, G2
	Rigidly Supported	C4	C5	C6	G1, G2
Type SBB Solid Brace System	Rigidly Supported	C7	C8	C9	G1, G2

Step 6. Select the appropriate attachment details.

The following summary can be used for easy reference.

SEISMIC RESTRAINT DETAILS

Structure or Attachment Type	RESTRAINT DETAILS			Support Rod Attachment Details
	SCB/SSB/SSBS Direct Attachment	SCB/SSB 2 Bolt Attachment	SCB/SSB 4 Bolt Attachment	
1	H1	H2	H3	L1
2	H4	H5	H6	L2, L3
3	H7 to H12			L4 to L6
4	H13			L1 to L6

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DESIGN PROCEDURE
FOR INDIVIDUALLY SUPPORTED SYSTEMS (example)

The design procedure is used to select the appropriate guidelines and details for a particular type of structure, attachment method and support type as listed below:

Structure: 3000 psi (*20.86 MPa*) concrete filled metal deck.
Restraint Type: Seismic Cable Brace (SCB)
Restraint Attachment: Expansion Anchors
Support Attachment: Refer to project specifications for attachments designed to accept gravity loads.

A. From the design procedure on page 17, the structure/attachment type for seismic attachment is #2.

B. Follow step 1 through 6 as listed in the design procedure.

From the Seismic Restraint/Support Guidelines summary on page 17:

Step1. Select the Seismic Restraint Guideline for structure/attachment #2, sheet A2.

Step 2. Select the Rod Stiffener Guideline on sheet B1.

Step 3. Select the Minimum SCBH, SCB, SSB and SSBS size on sheet B2.

Step 4. Support Rod Attachment Guideline is not required when using seismic cable bracing.

From the Seismic Restraint Details summary on page 18

Step 5. For the spring isolated/SCB cable brace system select:
a. Sheets C1 and C2 for transverse braces.
b. Sheet C3 for longitudinal braces.
c. Sheet G1 for rod bracing details.

From the Attachment Details summary on page 18

Step 6. For seismic structure/attachment #2 select:
a. Sheet H4 for SCB direct attachment.
b. Sheet H5 for SCB (2) bolt attachment.
c. Sheet H6 for SCB (4) bolt attachment.
d. All applicable L sheets.

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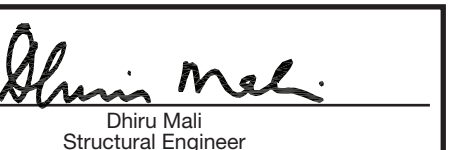

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DESIGN PROCEDURE
FOR INDIVIDUALLY SUPPORTED SYSTEMS (example continued)

There are a number of choices available to suit a variety of project requirements and field conditions. The selected guidelines and details are used to determine restraint size, anchorage and vertical rod stiffening requirements for the following pipeline with the project requirements and field conditions listed below:

Seismic Acceleration Input: 0.5 g
Pipe Size: 8" (*203 mm*) diameter steel pipe filled with water
Support Rod Diameter: 7/8" (*22 mm*)
Support Rod Length: 72" (*1829 mm*)
Restraint Type: SCBH attached to support rod at clevis, SCB attached to structure.
Maximum Brace Angle Ratio: 1:1
Restraint Spacing: Maximum Allowed

From Sheet A2 (A2m), for 8" (*203mm*) pipe and 0.5g seismic input:

a. Maximum trans. Brace spacing = 40 feet (*12.2 m*).

b. Maximum long. Brace spacing = 50 feet (*15.2 m*).

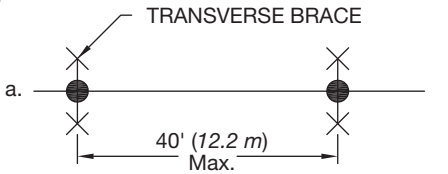
c. Use SCBH-2 attached to support rod at clevis.

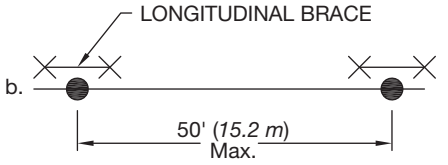
d. Use SCB-2 attached to structure

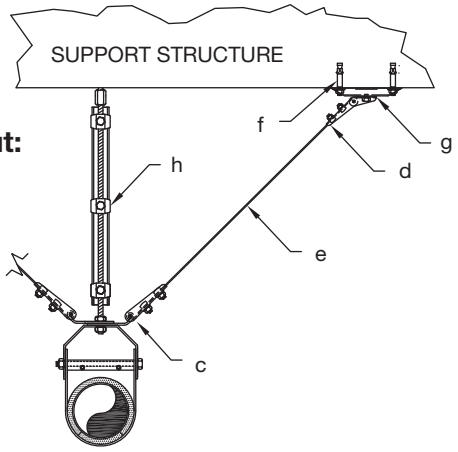
e. Cable Diameter = 3/16" (*5 mm*)

f. Use (2) 5/8" (*16 mm*) dia. With 5" (*127 mm*) embed. ITW Ramset/Red Head Trubolt Wedge exp. anchors for attachment to the structure.

g. Use an SLDB-2000 anchor bracket for the SCB attachment to the structure.







From Sheet B1 (B1m), for 8 in. (*203 mm*) pipe at 0.5g seismic input:

h. The 72" (1829 mm) long rod must be braced with a 11/2" x 11/2" x 1/4" (38 x 38 x 6 mm) angle and (3) SRC 1-1/2 rod clamps.

From Sheet B2:

i. An SCBH-2 will fit the 7/8" (*22 mm*) rod used to support the 8" (*203 mm*) pipe.

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DESIGN PROCEDURE
FOR TRAPEZE SUPPORTED SYSTEMS

Selection charts are available for each of the following attachment methods and types of structures:

1. Expansion anchors into a 3000 psi (*20.68 MPa*), stone aggregate concrete slab.
2. Expansion anchors into a 3000 psi (*20.68 MPa*), lightweight concrete filled metal deck.
3. Bolted or welded direct to structural steel.
4. Lag screws into a wood structure.

Design Procedure:

Step 1. Select the Seismic Restraint Guideline for the actual attachment method or type of structure listed above. These charts show anchorage requirements, size of SCB, SSB, or SSBS and cable or solid brace size for maximum system weight per foot (*meter*). (Ref. Pages D1 to D4)

Step 2. Select the Rod Stiffener Guidelines for Trapeze Supported Systems. Each chart defines the maximum unbraced rod length, maximum braced rod length and maximum spacing between each seismic rod clamp (SRC) or strut clamp (UC). (Ref. Pages E1 and E2)

Step 3. Select the Trapeze Support Guidelines. These charts define the maximum allowable uniform load for different trapeze support spans. (Ref. Page E3)

Step 4. Select the Upper Support Member Guideline for Rectangular/Oval Duct (Not required for round duct.) These charts define upper support member sizes for each SCH/SSB size and upper support extension (Ref. Page E4)

Step 5. Select the Support Rod Attachment Guideline which coincides with the Seismic Restraint Guideline selected in Step 1 if using seismic solid braces. Each chart defines the seismic tension load applied to the support rod at the seismic solid brace location. (Ref. Pages K1 to K4)

The following summary may be used for easy reference.

SEISMIC RESTRAINT/SUPPORT GUIDELINES

Structure or Attachment Type	Seismic Restraint Guidelines	Rod Stiffener Guidelines	Trapeze Support Guidelines	Top Brace Member Guidelines for Rect./Oval Ductwork Only	Support Rod Attachment Guidelines at SSB Locations
1	D1	E1 & E2	E3	E4	K1
2	D2	E1 & E2	E3	E4	K2
3	D3	E1 & E2	E3	E4	K3
4	D4	E1 & E2	E3	E4	K4

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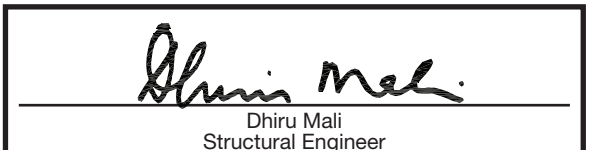

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DESIGN PROCEDURE
FOR TRAPEZE SUPPORTED SYSTEMS (continued)

Step 6. Select the appropriate seismic restraint details.

The following summary can be used for easy reference.

SEISMIC RESTRAINT DETAILS

Mechanical or Electrical System	Seismic Brace System	Support Type	All Direction Brace	Transverse Brace	Longitudinal Brace	Rod Stiffener
Piping or Conduit	Type SCB Cable Brace System	Spring Isolated	F1	F2	F3	G1, G2
		Rigidly Supported	F4	F5	F6	G1, G2
	Type SSB/SSBS Solid Brace System	Rigidly Supported	F7	F8	F9	G1, G2
Rectangular or Oval Ductwork	Type SCB Cable Brace System	Spring Isolated	F10	F11	F12	G1, G2
		Rigidly Supported	F13	F14	F15	G1, G2
	Type SSB/SSBS Solid Brace System	Rigidly Supported	F16	F17	F18	G1, G2
Round Ductwork	Type SCB Cable Brace System	Spring Isolated	F19	F20	F21	G1, G2
		Rigidly Supported	F22	F23	F24	G1, G2
	Type SSB/SSBS Solid Brace System	Rigidly Supported	F25	F26	F27	G1, G2
Electrical Cable Tray	Type SCB Cable Brace System	Rigidly Supported	F28	F29	F30	G1, G2
	Type SSB/SSBS Solid Brace System	Rigidly Supported	F31	F32	F33	G1, G2

Step 7. Select the appropriate attachment details.

The following summary can be used for easy reference.

ATTACHMENT DETAILS

Structure or Attachment Type	RESTRAINT DETAILS			Support Rod Attachment Details
	SCB/SSB/SSBS Direct Attachment	SCB/SSB 2 Bolt Attachment	SCB/SSB 4 Bolt Attachment	
1	H1	H2	H3	L1
2	H4	H5	H6	L2, L3
3	H7 to H13			L4 to L6
4	H13			L1 to L6

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DESIGN PROCEDURE
FOR TRAPEZE SUPPORTED SYSTEMS (example)

The design procedure is used to select the appropriate guidelines and details for a particular type of structure, attachment method and support type as listed below:

Mechanical/Electrical System: Rectangular Ductwork
Structure: Stone aggregate concrete slab
Restraint Type: Seismic Solid Brace (SSB or SSBS)
Restraint Attachment: Expansion Anchors
Support type: Rigid Support Rod
Support Attachment: Steel Beam Clamp

A. From the design procedure on page 21 the structure/attachment type for seismic attachment is #1

B. Follow steps 1 through 7 as listed in the design procedure.

From the Seismic Restraint/Support Guidelines summary on page 22:

Step 1. Select the Seismic Restraint Guideline for structure/attachment #1, sheet D1.

Step 2. Select the Rod Stiffener Guideline sheet E1.

Step 3. Select the Trapeze Support Guideline sheet E3.

Step 4. Select the Top Brace Member Guideline if bracing Rect./Oval Duct, sheet E4.

Step 5. Select the Support Rod Attachment Guideline at SSB/SSBS Locations for structure/attachment #1, sheet K1.

From the Seismic Restraint details summary on page 22:

Step 6. For rectangular duct, rigidly supported SSB/SSBS solid brace system select:
a. Sheet F16 for all directional braces.
b. Sheet F17 for transverse braces.
c. Sheet F18 for longitudinal braces.
d. Sheet G1 or G2 for rod bracing details.

From the Attachment Details summary on page 22:

Step 7. For structure/attachment #1, select:
a. Sheet H1 for SSB/SSBS direct attachment.
b. Sheet H2 for SSB (2) bolt attachment.
c. Sheet H3 for SSB (4) bolt attachment.
d. All applicable L sheets.

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DESIGN PROCEDURE
FOR TRAPEZE SUPPORTED SYSTEMS (example continued)

There are a number of choices available to suit a variety of project requirements and field conditions. The selected guidelines and details are used to determine restraint size, anchorage and vertical rod stiffening requirements for the following ductwork with the project requirements and field conditions as listed below:

Seismic Acceleration Input: 1.0g
Duct Size: 70" x 60" x 18 gage (*1778 x 1524 x 1.2 mm*).
Support Rod Diameter: To be determined in Section K at SSB Locations only.
Support Rod Length: 84" (*2134 mm*).
Restraint Type: SSB attached to the upper support member and the structure.
Brace Angle Ratio: 1:1
Restraint Spacing: Maximum allowed, 30 feet (*9.1m*) trans. and 60 feet (*18.3m*) long.
Trapeze Span: 72" (*1829 mm*).
Trapeze Support Spacing: 6 ft. (*1.8m*).
Top Brace Extension: 3" (*76 mm*).

Determine the Maximum Weight of the Duct:

From Sheet N6 (N6m):

a. Weight of the duct is 50 lbs/ft (*74.4 kg/m*).

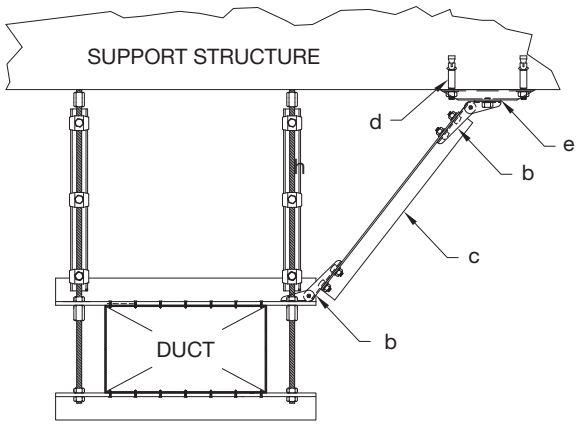
From Sheet D1 (D1m), for a maximum weight of 73 lbs/ft (*109 kg/m*) at 1.0g seismic acceleration input and 30 ft. (*9.1m*) transverse brace spacing:

b. Use SSB-3 for attachment to the top brace member and the structure.

c. Minimum brace size is 4 x 4 x 1/4" (*102 x 102 x 6 mm*) steel angle.

d. Use (4) 5/8" (*16 mm*) dia. with 5 1/8" (*130mm*) embed. ITW Ramset/Red Head Trubolt wedge expansion anchors for attachment to the structure.

e. Use an SLDB-4000 anchor bracket for the SSB attachment to the structure.



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DESIGN PROCEDURE
FOR TRAPEZE SUPPORTED SYSTEMS (example continued)

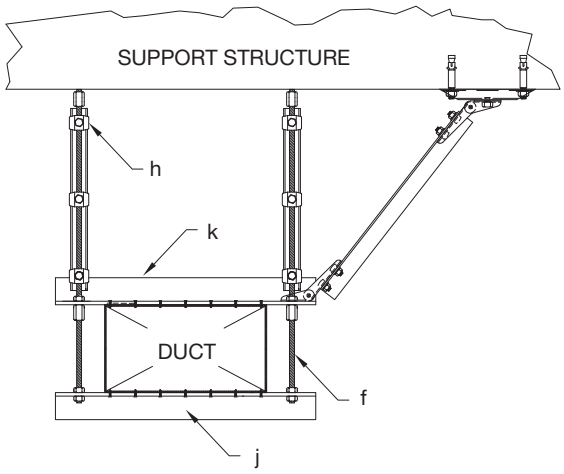
From Sheet K1 (K1m), for SSB-3:

f. Minimum support rod diameter is 3/4". (*19 mm*).

g. The attachment of the support rod to the structure must be capable of accepting the gravity load in addition to the seismic tension load of 2200 lbs. (*998 kg*).

From Sheet E1 (E1m), when using an SSB-3 and a 3/4" (*19 mm*) diameter support rod:

h. The 84" (*2134 mm*) long rod must be braced with a 1 1/2 x 1 1/2 x 1/4" (*38 x 38 x 6 mm*) steel angle and (3) SRC-1 1/2 rod clamps.



From Sheet E3 (E3m):

i. The actual load on the trapeze at 6 ft. (*1829 mm*) support spacing is : 50 lbs/ft x 6 ft. of pipe = 300 lbs. (*74 kg/m x 1.8m of pipe = 133.2 kg*)

j. For a 72" span, use a 1 5/8 x 1 5/8 x 12ga (*41 x 41 x 2.7 mm*) strut with an allowable uniform load of 560 lbs. (*254 kg*).

From Sheet E4 (E4m):

k. For a 3" (*76 mm*) top brace extension with an SSB-3, use a 1 5/8 x 1 5/8 x 12ga double strut. (*41 x 41 x 2.7 mm* double strut)

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LAYOUT OF SEISMIC BRACES

The next few pages outline a procedure for the seismic brace layout of pipes, ducts and conduits. Transverse and longitudinal braces indicated throughout are detailed in Section C for Individually Supported Systems and Section F for Trapeze Supported Systems. A transverse and longitudinal brace indicated at the same support points are defined as all directional braces for trapeze supported systems.

Step 1. Separate the layout of the system into individual straight runs. A straight run is defined as a section of pipe, duct or conduit between changes in direction. If an offset(s) occurs between changes of direction it may be neglected if the distance perpendicular to the run is less than the maximum offset length tabulated below.

STEEL PIPE OR CONDUIT

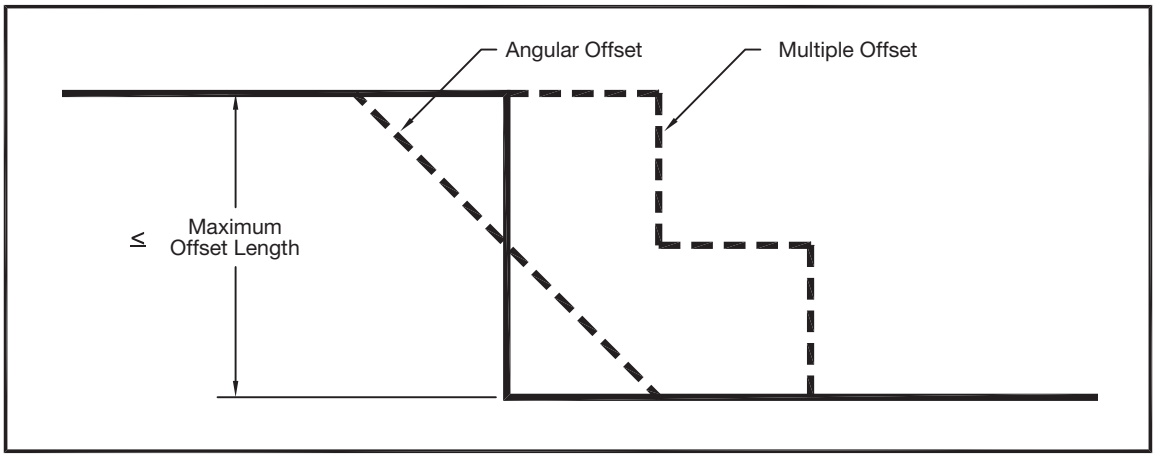
Pipe Diameter in (*mm*)	Max. Offset Length ft (m)		
	0.25g	0.5g	1.0g
1¼ to 2 (35 to 50)	4 (1.2)	2 (0.6)	1 (0.3)
2½ to 3 (65 to 75)	8 (2.4)	4 (1.2)	2 (0.6)
4 to 5 (100 to 125)	10 (3)	6 (1.8)	3 (0.9)
6 (150)	10 (3)	10 (3)	5 (1.5)
8 (200)	10 (3)	10 (3)	7 (2.1)
10 to 12 (250 to 300)	10 (3)	10 (3)	9 (2.7)
14 to 24 (350 to 600)	10 (3)	10 (3)	10 (3)

COPPER PIPE

Pipe Diameter in (*mm*)	Max. Offset Length ft (m)		
	0.25g	0.5g	1.0g
2½ to 3 (65 to 75)	2 (0.6)	1 (0.3)	0
4 to 5 (100 to 125)	4 (1.2)	2 (0.6)	1 (0.3)
6 (150)	8 (2.4)	4 (1.2)	2 (0.6)
8 (200)	10 (3)	8 (2.4)	4 (1.2)
10 (250)	10 (3)	10 (3)	5 (1.5)
12 (300)	10 (3)	10 (3)	6 (1.8)

The above Offset Charts are limited to pipe with welded, soldered, brazed or UL listed grooved joints.

Ductwork maximum offset length is 2 times the duct width. Pipe with screwed joints, cast iron pipe and PVC pipe maximum offset length is 2 feet (*0.6 m*) or as tabulated above.



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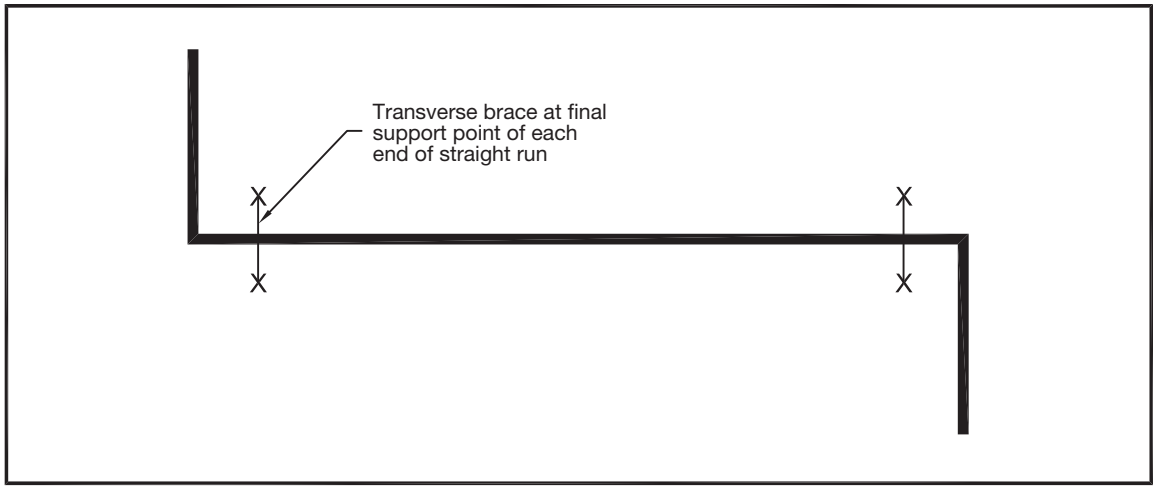
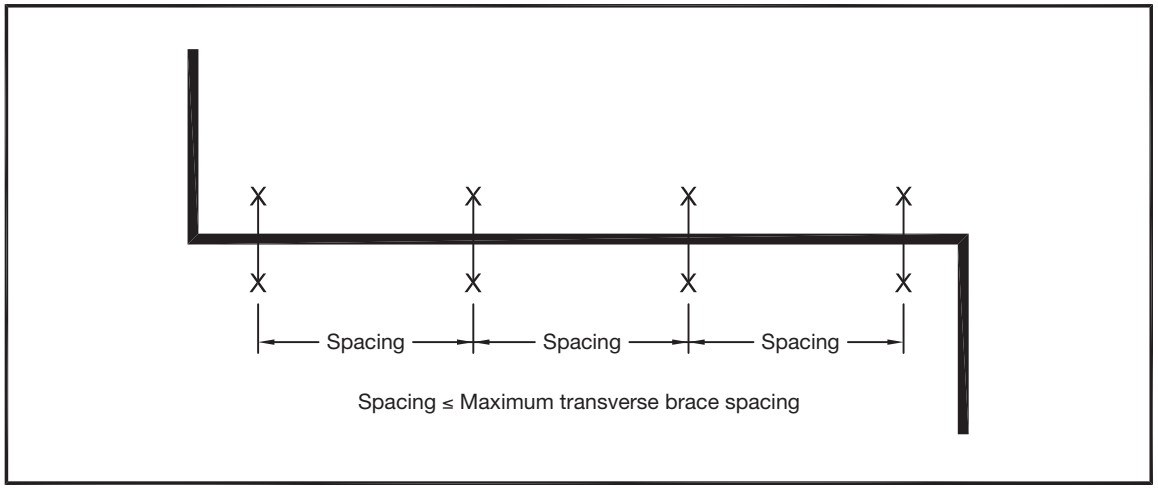
LAYOUT OF SEISMIC BRACES (continued)

Step 2. Each straight run must be braced in the transverse direct (perpendicular to the run) at each end.



Step 3. Add transverse braces, if required, to limit the spacing(s) to the maximum spacing indicated in sections A and D.



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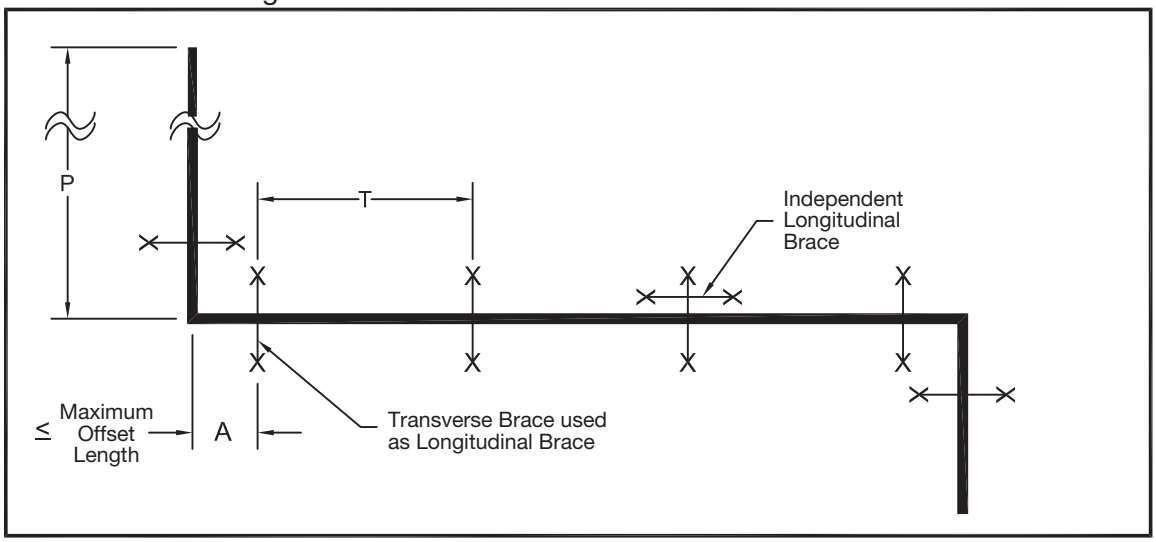
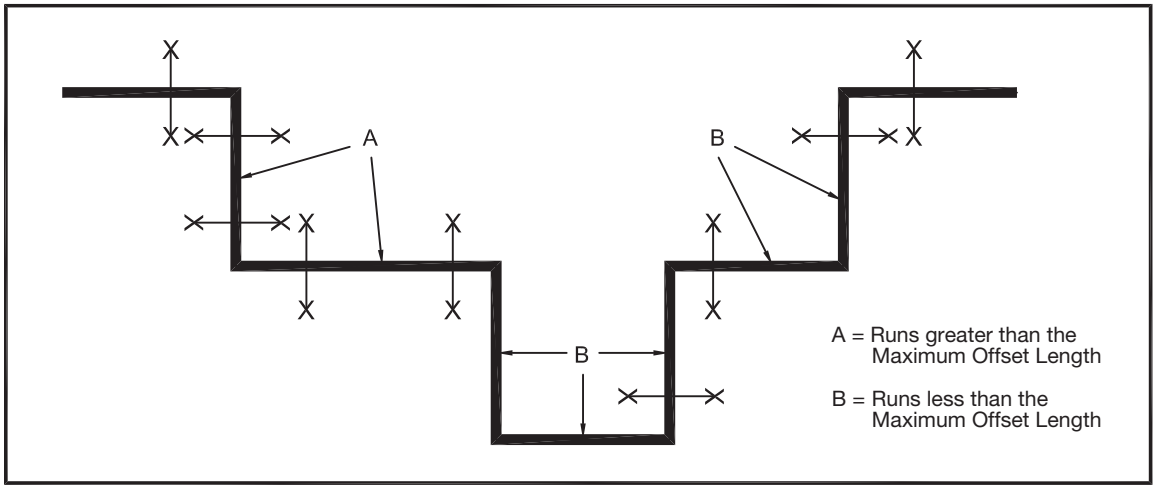
LAYOUT OF SEISMIC BRACES (continued)

Step 4. Each straight run must be braced in the longitudinal direction (parallel to the run) with at least one brace. Transverse braces within the maximum offset length discussed in Step 1 may be used in additional to or in lieu of independent longitudinal braces. The length of pipe around a 90° turn (indicated as 'P' below) longitudinally braced from a transverse brace = 0.9L-0.5T-A, where:

L = Longitudinal Brace spacing (From Section A or D)
T = The distance between Transverse Braces
A = Offset Length



Step 5. Multiple changes in direction may be treated as one complete system. Straight runs greater than the maximum offset length require 2 transverse braces. Straight runs less than the maximum offset length may require as few as one or no braces. (See layout below)



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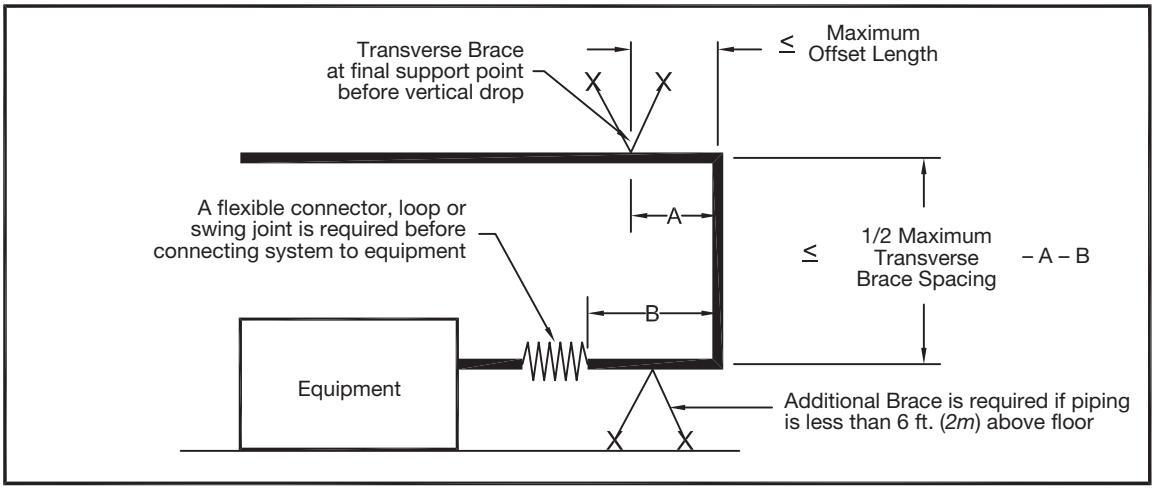
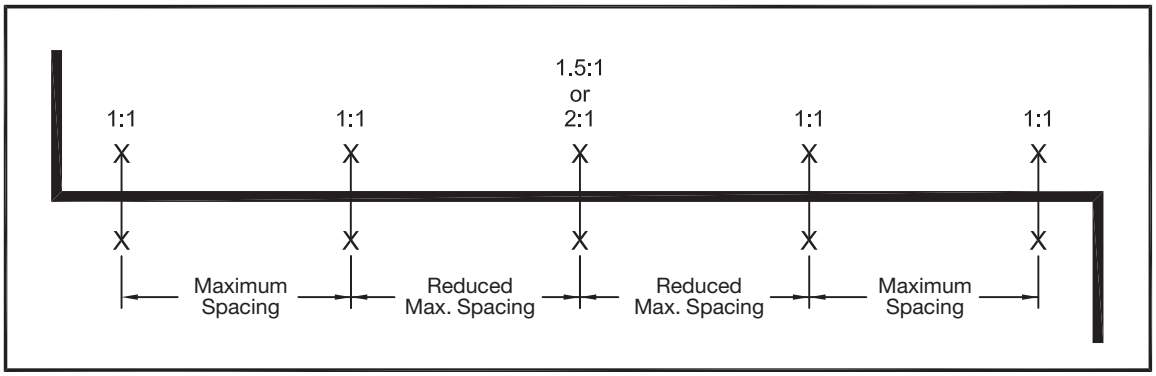
LAYOUT OF SEISMIC BRACES (continued)

Step 6. Vertical drops to equipment must be protected with a transverse brace at the final support point before the vertical drop. The distance from the transverse brace to the drop must be within the maximum offset length of the system. The length of the system braced from the transverse brace to the flexible connector is equal to 1/2 of the maximum transverse brace spacing indicated in sections A and D. If this distance is greater than 1/2 of the maximum transverse brace spacing, an additional brace is required at the end of the vertical drop by attaching to the floor.



Note: Length of system braced = 1/4 max. brace spacing for 2" to 3" (*51 to 76 mm*) dia. copper pipe. Additional brace at floor is required for 1 1/2" (*38 mm*) dia. and smaller copper pipe, and 1" (*25 mm*) dia. and smaller steel pipe, unless specific analysis is approved by the enforcement agency.

Step 7. If seismic braces installed at a 1:1 brace angle ratio from horizontal are intermixed with 1.5:1 or 2:1 brace angle ratios, and the installer opts to reduce the brace spacing as instructed on pages A1 to A4, the layout shall be as follows.



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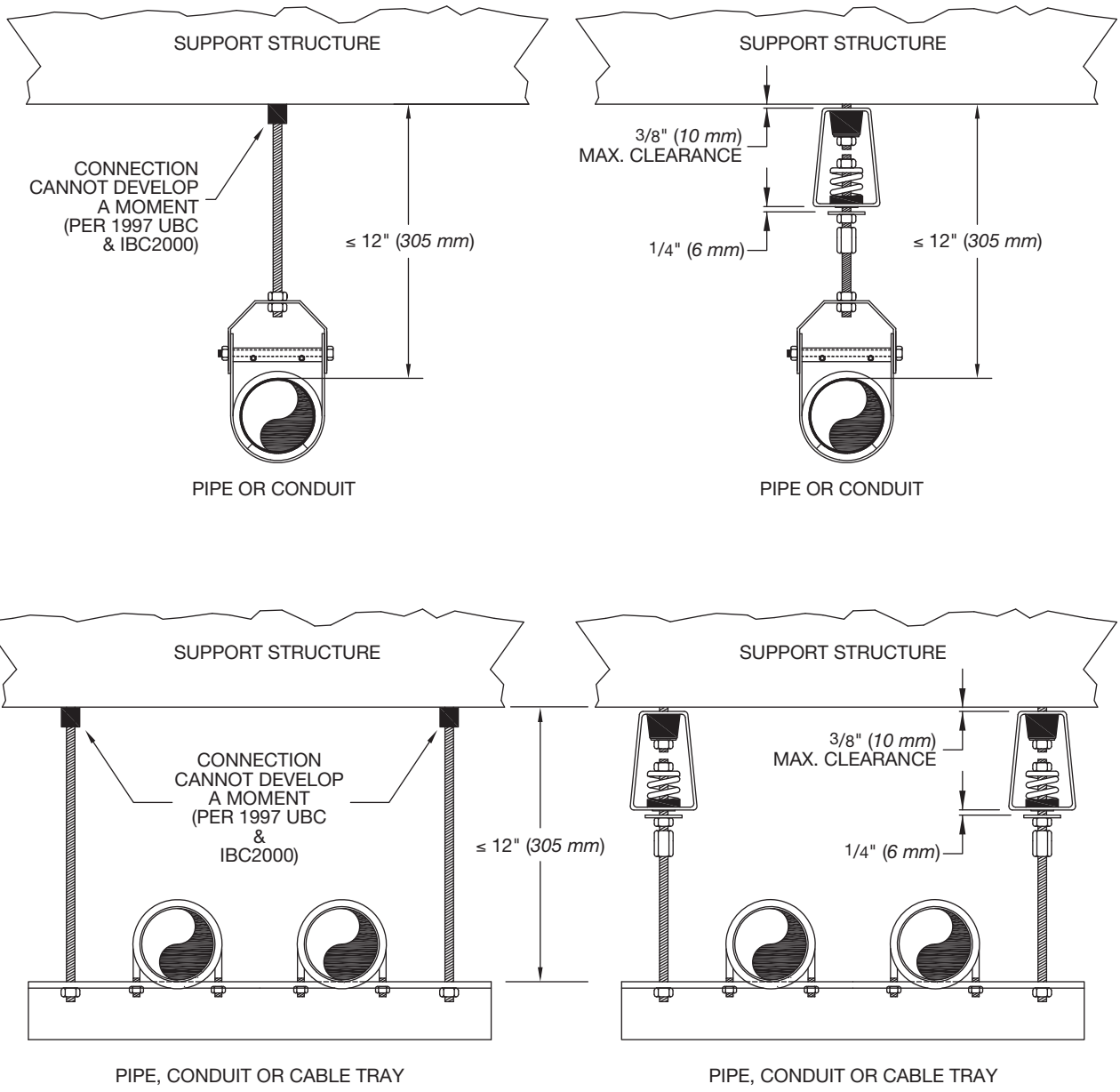
"12 INCH RULE" FOR PIPES, CONDUITS OR CABLE TRAYS



Note 1: Refer to Page 10, note 1 and page 13, note 1 for additional requirements of the "12 inch Rule".
Note 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

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California Office of Statewide Health Planning and Development
FIXED EQUIPMENT ANCHORAGE
OPA-0349 August 5, 2002

Dhiru Mali
Structural Engineer
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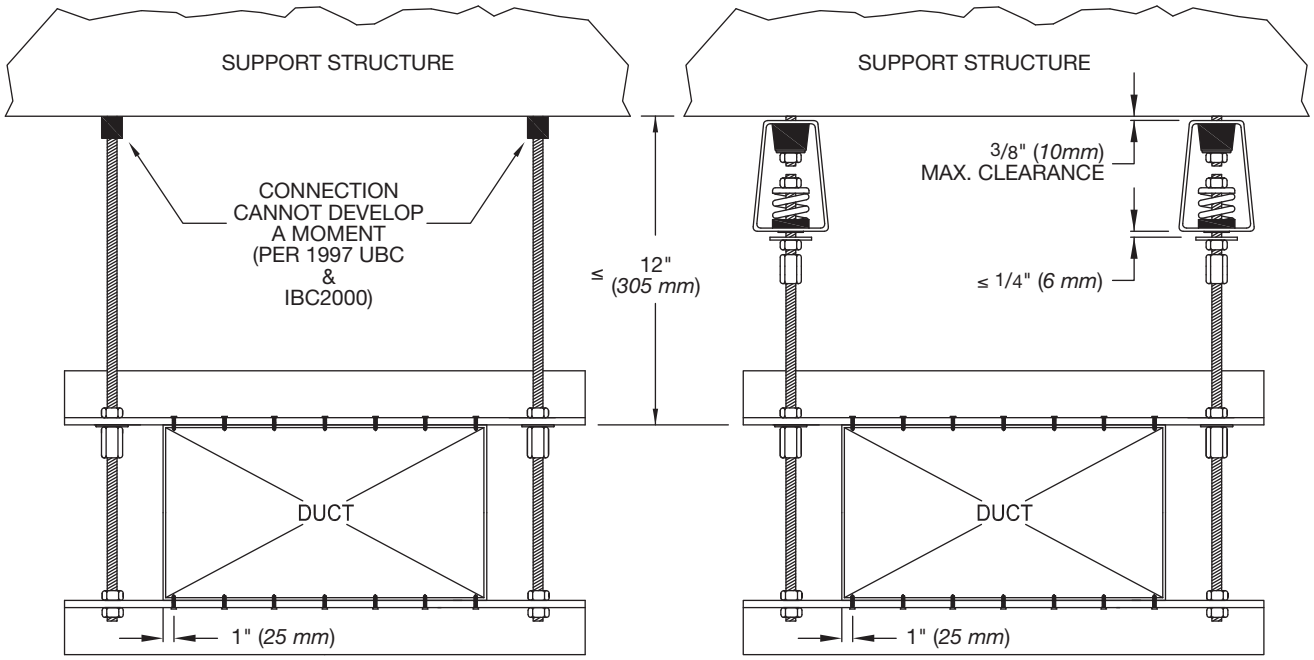
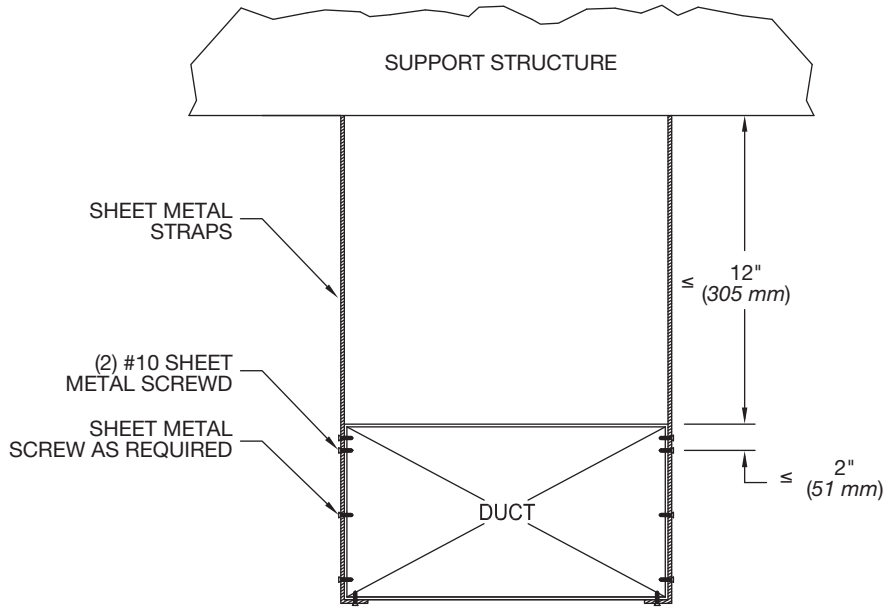
Bill Staehlin (916) 654-3362

"12 INCH RULE" FOR DUCTWORK





Note 1: Refer to Page 12, note 1 for additional requirements of the "12 inch Rule".
Note 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

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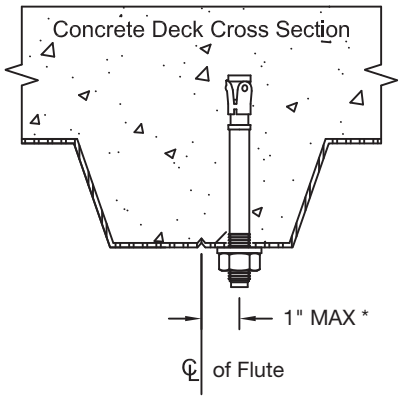
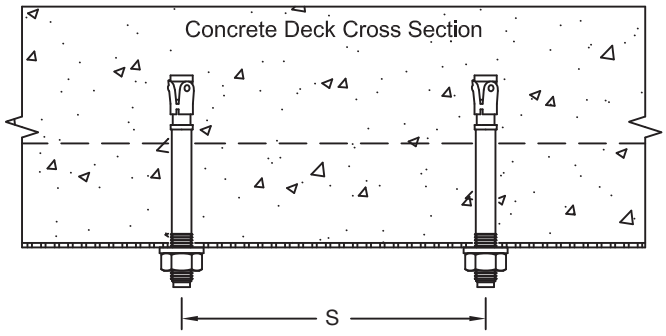
HILTI KWIK BOLT 3 ANCHORS

Allowable brace spacing in charts A2 & D2 are based on Ramset/Redhead Trubolt expansion anchors or approval equal. The following Hilti Kwik Bolt 3 anchors are approved equals.

PREAPPROVED: RAMSET/REDHEAD TRUBOLT		APPROVED EQUAL: HILTI KWIK BOLT 3	
ANCHOR TYPE	ANCHOR Ø X EMBED	ANCHOR TYPE	ANCHOR Ø X EMBED
RAMSET/REDHEAD TRUBOLT	1/2 x 3	HILTI KWIK-BOLT 3	1/2 x 31/2
RAMSET/REDHEAD TRUBOLT	5/8 x 5	HILTI KWIK-BOLT 3	5/8 x 4

Note: For use with CBC-2001, Kwik Bolt 3 embedment lengths must be increased to 8x the anchor diameter, or Rp = 1.5 must be used in calculating anchor loads.





Hilti Kwik Bolt 3 Spacing Requirements	
Anchor Diameter (in)	Minimum Allowable Spacing (S) ** (in)
1/2	77/8
5/8	9

* Reference ICBO ESR-1385, Figure 3

** Reference ICBO ESR-1385, Table 2

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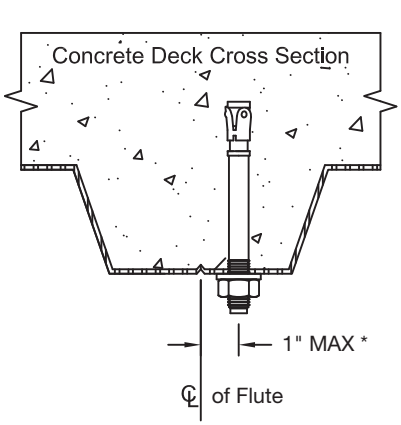
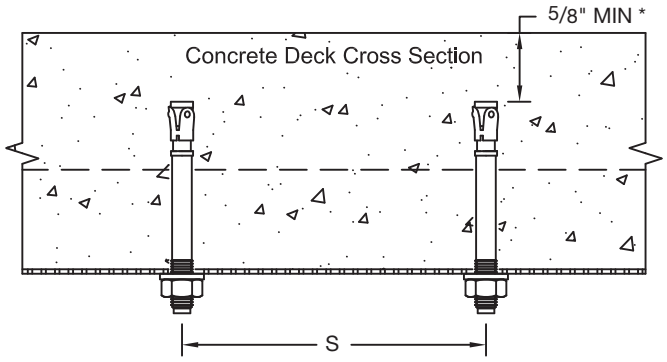
HILTI KWIK BOLT TZ ANCHORS

Allowable brace spacing in charts A2 & D2 are based on Ramset/Redhead Trubolt expansion anchors or approval equal. The following Hilti Kwik Bolt TZ anchors are approved equals.

PREAPPROVED: RAMSET/REDHEAD TRUBOLT		APPROVED EQUAL: HILTI KWIK BOLT TZ	
ANCHOR TYPE	ANCHOR Ø X EMBED	ANCHOR TYPE	ANCHOR Ø X EMBED
RAMSET/REDHEAD TRUBOLT	1/2 x 3	HILTI KWIK-BOLT TZ	1/2 x 31/4
RAMSET/REDHEAD TRUBOLT	5/8 x 5	HILTI KWIK-BOLT TZ	5/8 x 4

Note: For use with CBC-2001, Kwik Bolt 3 embedment lengths must be increased to 8x the anchor diameter, or Rp = 1.5 must be used in calculating anchor loads.





Hilti Kwik Bolt TZ Spacing Requirements	
Anchor Diameter (in)	Minimum Allowable Spacing (S) ** (in)
1/2	93/4
5/8	12

* Reference ICBO ESR-1917, Figure 5

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SSRF BRACKET SELECTION

The SSRF bracket as shown on X4A can be used as the lowest bracket attachment of a solid brace to a suspended piping or trapeze system as describe below:

INDIVIDUALLY SUPPORTED SYSTEMS

Max. Pipe Diameter (in)	(*mm*)	Max. Pipe Weight (lbs/ft)	(*kg/m*)	Rod Diameter (in)	Retrofit Bracket Size	Minimum Allowable Brace Angle	Maximum Allowable Brace Angle
5	*51*	6.2	*9.2*	3/8-16 UNC	SSRF-1	0.7:1	2:1
3	*76*	12.1	*18.0*	1/2-13 UNC	SSRF-1	0.5:1	2:1
5	*127*	26.6	*39.5*	5/8-11 UNC	SSRF-2	0.5:1	2:1
10	*254*	80.2	*119.3*	3/4-10 UNC	SSRF-2	0.5:1	2:1

The SSRF brackets indicated above can be used on pipe systems braced at the spacings shown on pages A1-A4.

Support rods must have rod bracing with a rod clamp within 1" *25mm* of each end of the rod.

TRAPEZE SUPPORTED SYSTEMS

Referenced Trapeze Weight (lbs/ft)	(*kg/m*)	Rod Diameter (in)	Retrofit Bracket Size	Minimum Allowable Brace Angle	Maximum Allowable Brace Angle
9	*13*	3/8-16 UNC	SSRF-1	0.5:1	2:1
17	*25*	1/2-13 UNC	SSRF-1	0.5:1	2:1
36	*54*	5/8-11 UNC	SSRF-2	0.5:1	2:1
36	*54*	3/4-10 UNC	SSRF-2	0.5:1	2:1

The SSRF brackets indicated above can be used on any combination of trapeze weight per food, g level and maximum brace spacing as shown in a row of the "Maximum Weight per Foot" charts on pages D1-D4 whose weight at 40 ft brace spacing and 1.0 g is equal to or less than the weight in the chart above.

The trapeze brace selections are valid for support rods carrying 70% or less of the total trapeze load.

General Notes:

Brace angles listed are Rise : Run.

Use of the SSRF bracket on pipe sizes and trapeze weights greater than those listed above must be designed and submitted for approval on a project by project basis.

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APPROVED
Fixed Equipment Anchorage
Office of Statewide Health Planning and Development
OPA-0349
on
January 31, 2008

Anthony R. Pike
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SSB BRACKET SELECTION

The SSB bracket as shown on X4B can be used as the structure attachment bracket of a solid brace to a suspended piping or trapeze system as describe below:

INDIVIDUALLY SUPPORTED SYSTEM

Max. Pipe Diameter (in)	(*mm*)	Max. Pipe Weight (lbs/ft)	(*kg/m*)	Anchor Diameter (in)		SSB Bracket Size
5	*127*	26.6	*39.5*	1/2	*13*	SSB-1
8	*203*	55.1	*82.0*	5/8	*13*	SSB-2

The SSB brackets indicated above can be used on pipe systems braced at the spacings shown on pages A1-A4.

TRAPEZE SUPPORTED SYSTEMS

Referenced Trapeze Weight (lbs/ft)	(*kg/m*)	Anchor Diameter (in)		SSB Bracket Size
5	*127*	1/2	*13*	SSB-1
8	*203*	5/8	*13*	SSB-2

The SSB brackets indicated above can be used on any combination of trapeze weight per food, g level and maximum brace spacing as shown in a row of the "Maximum Weight per Foot" charts on pages D1-D4 whose weight at 40 ft brace spacing and 1.0 g is equal to or less than the weight in the chart above and whose required anchor diameter matches that of the SSB.

General Notes:

Use of the SSB bracket on pipe sizes and trapeze weights greater than those listed above must be designed and submitted for approval on a project by project basis.

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Fixed Equipment Anchorage
Office of Statewide Health Planning and Development

OPA-0349
on
January 31, 2008

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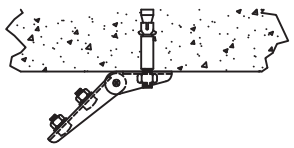
SEISMIC RESTRAINT GUIDELINES

INDIVIDUALLY SUPPORTED SYSTEMS

MINIMUM 3000 PSI STONE AGGREGATE CONCRETE SLAB EXPANSION ANCHORS



Pipe Dia. (in)	Max Weight per Foot (lbs)	Maximum Brace Spacing (ft) for Specified Seismic 'g' Loads*						Option 1		Option 2		Concrete Anchors		
		0.25g		0.5g		1.0g		SCB Size	Cable Dia. (in)	SSB/ SSBS Size	Minimum Brace Size (in)	Qty. Req'd	Dia. (in)	Embed. (in)
		Trans.	Long.	Trans.	Long.	Trans.	Long.							
1	2.8	50	80	40	80	40	80	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	21/4
11/4	3.8	50	80	40	80	40	80	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	21/4
11/2	4.5	50	80	40	80	40	80	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	21/4
2	6.2	50	80	40	80	40	68	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	41/8
21/2	9.1	50	80	40	80	40	61	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	41/8
3	12.1	50	80	40	80	40	46	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	41/8
4	18.3	50	80	40	60	30	30	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	41/8
5	26.6	50	80	40	42	21	21	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	41/8
6	34.8	50	80	40	50	25	25	SCB-2	3/16	SSBS	15/8 x 15/8 Strut	1	5/8	51/8
8	55.1	50	80	40	52	26	26	SCB-2	3/16	SSBS	15/8 x 15/8 Strut	2	5/8	51/8
10	80.2	50	72	36	36	18	18	SCB-2	3/16	SSB-3	L3 x 3 x 1/4	2	5/8	51/8
12	109.0	50	80	40	40	20	20	SCB-3	1/4	SSB-3	L4 x 4 x 1/4	4	5/8	51/8
14	122.0	50	72	36	36	18	18	SCB-3	1/4	SSB-4	L4 x 4 x 1/4	4	5/8	51/8
16	150.0	50	56	28	28	14	14	SCB-3	1/4	SSB-4	L4 x 4 x 1/4	4	5/8	51/8
18	190.0	44	44	22	22	11	11	SCB-3	1/4	SSB-4	L4 x 4 x 1/4	4	5/8	51/8
20	214.0	50	72	36	36	18	18	SCB-4	3/8	SSB-4	L4 x 4 x 1/4	4	5/8	51/8
24	289.0	50	52	26	26	13	13	SCB-4	3/8	SSB-4	L4 x 4 x 1/4	4	5/8	51/8

*Maximum braced spacing for up to 1:1 brace angle from horizontal.

For up to 1.5:1 brace angle from horizontal, divide braced rod length by 1.67; for 2:1 brace angle, divide by 2.33. Example: For 3" diameter pipe at 0.5 g input and 1.5:1 brace angle ratio, the maximum transverse spacing = 40/1.67 = 23 ft.

For maximum brace spacing at 'g' forces other than those listed, divide the 1g spacing by the desired 'g' force. Example: For a 0.74g input for 12" diameter pipe, transverse brace spacing = 20/0.74 = 27 ft. (Note: Transverse and longitudinal brace spacing shall not exceed those stated in the general notes.)

Special Note: The Structural Engineer of Record shall verify the seismic loads applied by the SCB/SSB/SSBS to the structure are acceptable. Refer to Pages H1, H2 and H3 for the maximum seismic loads.

NOTES:

Anchorage is based on attachment with an ITW Ramset/Red Head Trubolt Wedge Anchor, ICBO Report ER-1372/2000, Table 3, 4 and 5, embedded headed stud or J-bolt of equal embedment or approved equal.

Where (2) anchors are specified, the SCB, SSB or SSBS w/SLDB-2000 is required for attachment to structure. (Ref. Page H2 and X9)

Where (4) anchors are specified, the SCB or SSB w/SLDB-4000 is required for attachment to structure. (Ref. Page H3 and X10)

An increase in SCB or SSB size may be required to accommodate the cross bolt or support rod. (Ref. Page B2)

All SSB brace members tabulated are steel angle. Factory 12ga formed channel strut may be in lieu of steel angle.

All SSBS brace members tabulated are 12ga strut channel.

(Ref. page X4)

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California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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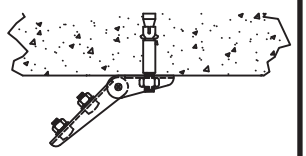
SEISMIC RESTRAINT GUIDELINES

INDIVIDUALLY SUPPORTED SYSTEMS

MINIMUM 20,680 kPa STONE AGGREGATE CONCRETE SLAB EXPANSION ANCHORS



Pipe Dia. (mm)	Max Weight per meter (kg)	Maximum Brace Spacing (*m*) for Specified Seismic 'g' Loads*						Option 1		Option 2		Concrete Anchors		
		0.25g		0.5g		1.0g		SCB Size	Cable Dia. (mm)	SSB/ SSBS Size	Minimum Brace Size (mm)	Qty. Req'd	Dia. (mm)	Embed. (mm)
		Trans.	Long.	Trans.	Long.	Trans.	Long.							
25	4.1	15.2	24.4	12.2	24.4	12.2	24.4	SCB-1	3	SSBS	41 x 41 Strut	1	13	57
32	5.6	15.2	24.4	12.2	24.4	12.2	24.4	SCB-1	3	SSBS	41 x 41 Strut	1	13	57
38	6.6	15.2	24.4	12.2	24.4	12.2	24.4	SCB-1	3	SSBS	41 x 41 Strut	1	13	57
51	9.2	15.2	24.4	12.2	24.4	12.2	20.7	SCB-1	3	SSBS	41 x 41 Strut	1	13	105
64	13.5	15.2	24.4	12.2	24.4	12.2	18.6	SCB-1	3	SSBS	41 x 41 Strut	1	13	105
76	18.0	15.2	24.4	12.2	24.4	12.2	14.0	SCB-1	3	SSBS	41 x 41 Strut	1	13	105
102	27.3	15.2	24.4	12.2	18.3	9.1	9.1	SCB-1	3	SSBS	41 x 41 Strut	1	13	105
127	39.5	15.2	24.4	12.2	12.8	6.4	6.4	SCB-1	3	SSBS	41 x 41 Strut	1	13	105
152	51.8	15.2	24.4	12.2	15.2	7.6	6.4	SCB-2	5	SSBS	41 x 41 Strut	1	16	130
203	82.0	15.2	24.4	12.2	15.8	7.9	7.9	SCB-2	5	SSBS	41 x 41 Strut	2	16	130
254	119.3	15.2	21.9	11.0	11.0	5.5	5.5	SCB-2	5	SSB-3	L76 x 76 x 6	2	16	130
305	162.2	15.2	24.4	12.2	12.0	6.1	6.1	SCB-3	6	SSB-3	L102 x 102 x 6	4	16	130
356	181.5	15.2	21.9	11.0	11.0	5.5	5.5	SCB-3	6	SSB-4	L102 x 102 x 6	4	16	130
406	222.6	15.2	17.1	8.5	8.5	4.3	4.3	SCB-3	6	SSB-4	L102 x 102 x 6	4	16	130
457	282.7	13.4	13.4	6.7	6.7	3.4	3.4	SCB-3	6	SSB-4	L102 x 102 x 6	4	16	130
508	317.7	15.2	21.9	11.0	11.0	5.5	5.5	SCB-4	10	SSB-4	L102 x 102 x 6	4	16	130
610	430.1	15.2	15.8	7.9	7.9	4.0	4.0	SCB-4	10	SSB-4	L102 x 102 x 6	4	16	130

*Maximum braced spacing for up to 1:1 brace angle from horizontal.

For up to 1.5:1 brace angle from horizontal, divide braced rod length by 1.67; for 2:1 brace angle, divide by 2.33. Example: For 76 mm diameter pipe at 0.5 g input and 1.5:1 brace angle ratio, the maximum transverse spacing = 12.2/1.67 = 7.3 m.

For maximum brace spacing at 'g' forces other than those listed, divide the 1g spacing by the desired 'g' force. Example: For a 0.74g input for 305mm diameter pipe, transverse brace spacing = 6.1/0.74 = 8.2m. (Note: Transverse and longitudinal brace spacing shall not exceed those stated in the general notes.)

Special Note: The Structural Engineer of Record shall verify the seismic loads applied by the SCB/SSB/SSBS to the structure are acceptable. Refer to Pages H1, H2 and H3 for the maximum seismic loads.

NOTES:

Anchorage is based on attachment with an ITW Ramset/Red Head Trubolt Wedge Anchor, ICBO Report ER-1372/2000, Table 3, 4 and 5, embedded headed stud or J-bolt of equal embedment or approved equal.

Where (2) anchors are specified, the SCB, SSB or SSBS w/SLDB-2000 is required for attachment to structure. (Ref. Page H2 and X9)

Where (4) anchors are specified, the SCB or SSB w/SLDB-4000 is required for attachment to structure. (Ref. Page H3 and X10)

An increase in SCB, SSB or SSBS size may be required to accommodate the cross bolt or support rod. (Ref. Page B2)

All SSB brace members tabulated are steel angle. Factory 2.7mm formed channel strut may be in lieu of steel angle.

All SSBS brace members tabulated are 12ga strut channel. (Ref. page X4)

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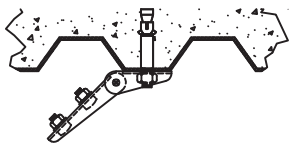
SEISMIC RESTRAINT GUIDELINES

INDIVIDUALLY SUPPORTED SYSTEMS

MINIMUM 3000 PSI LIGHTWEIGHT CONCRETE DECK EXPANSION ANCHORS



Pipe Dia. (in)	Max Weight per Foot (lbs)	Maximum Brace Spacing (ft) for Specified Seismic 'g' Loads*						Option 1		Option 2		Concrete Anchors		
		0.25g		0.5g		1.0g		SCB Size	Cable Dia. (in)	SSB/ SSBS Size	Minimum Brace Size (in)	Qty. Req'd	Dia. (in)	Embed. (in)
		Trans.	Long.	Trans.	Long.	Trans.	Long.							
1	2.8	50	80	40	80	40	80	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	3
11/4	3.8	50	80	40	80	40	80	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	3
11/2	4.5	50	80	40	80	40	80	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	3
2	6.2	50	80	40	80	40	60	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	3
21/2	9.1	50	80	40	80	40	41	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	3
3	12.1	50	80	40	62	31	31	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	3
4	18.3	50	80	40	40	20	20	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	3
5	26.6	50	56	28	28	14	14	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	3
6	34.8	50	64	32	32	16	16	SCB-2	3/16	SSBS	15/8 x 15/8 Strut	1	5/8	5
8	55.1	50	80	40	50	25	25	SCB-2	3/16	SSBS	15/8 x 15/8 Strut	2	5/8	5
10	80.2	50	68	34	34	17	17	SCB-2	3/16	SSB-3	L3 x 3 x 1/4	2	5/8	5
12	109.0	50	80	40	40	20	20	SCB-3	1/4	SSB-3	L4 x 4 x 1/4	4	5/8	5
14	122.0	50	72	36	36	18	18	SCB-3	1/4	SSB-4	L4 x 4 x 1/4	4	5/8	5
16	150.0	50	56	28	28	14	14	SCB-3	1/4	SSB-4	L4 x 4 x 1/4	4	5/8	5
18	190.0	44	44	22	22	11	11	SCB-3	1/4	SSB-4	L4 x 4 x 1/4	4	5/8	5
20	214.0	50	52	26	26	13	13	SCB-4	3/8	SSB-4	L4 x 4 x 1/4	4	5/8	5
24	289.0	36	36	18	18	9	9	SCB-4	3/8	SSB-4	L4 x 4 x 1/4	4	5/8	5

*Maximum braced spacing for up to 1:1 brace angle from horizontal.

For up to 1.5:1 brace angle from horizontal, divide braced rod length by 1.68; for 2:1 brace angle, divide by 2.38. Example: For 3" diameter pipe at 0.5 g input and 1.5:1 brace angle ratio, the maximum transverse spacing = 40/1.68 = 23 ft.

For maximum brace spacing at 'g' forces other than those listed, divide the 1g spacing by the desired 'g' force. Example: For a 0.74g Input for 12" diameter pipe, transverse brace spacing = 20/0.74 = 27 ft. (Note: Transverse and longitudinal brace spacing shall not exceed those stated in the general notes.)

Special Note: The Structural Engineer of Record shall verify the seismic loads applied by the SCB/SSB/SSBS to the structure are acceptable. Refer to Pages H4, H5 and H6 for the maximum seismic loads.

NOTES:

Anchorage is based on attachment with an ITW Ramset/Red Head Trubolt Wedge Anchor, ICBO Report ER-1372/2000, Table 4, 5 and 10, embedded headed stud or J-bolt of equal embedment or approved equal.

Where (2) anchors are specified, the SCB, SSB or SSBS w/SLDB-2000 is required for attachment to structure. (Ref. Page H5 and X9)

Where (4) anchors are specified, the SCB or SSB w/SLDB-4000 is required for attachment to structure. (Ref. Page H6 and X10)

An increase in SCB, SSB or SSBS size may be required to accommodate the cross bolt or support rod. (Ref. Page B2)

All SSB brace members tabulated are steel angle. Factory 12ga formed channel strut may be in lieu of steel angle.

All SSBS brace members tabulated are 12ga strut channel.

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FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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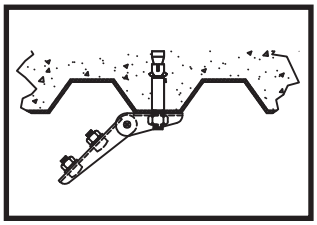
SEISMIC RESTRAINT GUIDELINES

INDIVIDUALLY SUPPORTED SYSTEMS

MINIMUM 20,680 kPa LIGHTWEIGH CONCRETE DECK EXPANSION ANCHORS



Pipe Dia. (mm)	Max Weight per meter (kg)	Maximum Brace Spacing (m) for Specified Seismic 'g' Loads*						Option 1		Option 2		Concrete Anchors		
		0.25g		0.5g		1.0g		SCB Size	Cable Dia. (mm)	SSB/ SSBS Size	Minimum Brace Size (mm)	Qty. Req'd	Dia. (mm)	Embed. (mm)
		Trans.	Long.	Trans.	Long.	Trans.	Long.							
25	4.1	15.2	24.4	12.2	24.4	12.2	24.4	SCB-1	3	SSBS	41 x 41 Strut	1	13	76
32	5.6	15.2	24.4	12.2	24.4	12.2	24.4	SCB-1	3	SSBS	41 x 41 Strut	1	13	76
38	6.6	15.2	24.4	12.2	24.4	12.2	24.4	SCB-1	3	SSBS	41 x 41 Strut	1	13	76
51	9.2	15.2	24.4	12.2	24.4	12.2	18.3	SCB-1	3	SSBS	41 x 41 Strut	1	13	76
64	13.5	15.2	24.4	12.2	24.4	12.2	12.5	SCB-1	3	SSBS	41 x 41 Strut	1	13	76
76	18.0	15.2	24.4	12.2	18.9	9.4	9.4	SCB-1	3	SSBS	41 x 41 Strut	1	13	76
102	27.3	15.2	24.4	12.2	12.2	6.1	6.1	SCB-1	3	SSBS	41 x 41 Strut	1	13	76
127	39.5	15.2	17.1	8.5	8.5	4.3	4.3	SCB-1	3	SSBS	41 x 41 Strut	1	13	76
152	51.8	15.2	19.5	9.8	9.8	4.9	4.9	SCB-2	5	SSBS	41 x 41 Strut	1	16	127
203	82.0	15.2	24.4	12.2	15.2	7.6	7.6	SCB-2	5	SSBS	41 x 41 Strut	2	16	127
254	119.3	15.2	20.7	10.4	10.4	5.2	5.2	SCB-2	5	SSB-3	L76 x 76 x 6	2	16	127
305	162.2	15.2	24.4	12.2	12.2	6.1	6.1	SCB-3	6	SSB-3	L102 x 102 x 6	4	16	127
356	181.5	15.2	21.9	11.0	11.0	5.5	5.5	SCB-3	6	SSB-4	L102 x 102 x 6	4	16	127
406	222.6	15.2	17.1	8.5	8.5	4.3	4.3	SCB-3	6	SSB-4	L102 x 102 x 6	4	16	127
457	282.7	13.4	13.4	6.7	6.7	3.4	3.4	SCB-3	6	SSB-4	L102 x 102 x 6	4	16	127
508	317.7	15.2	15.8	7.9	7.9	4.0	4.0	SCB-4	10	SSB-4	L102 x 102 x 6	4	16	127
610	430.1	11.0	11.0	5.5	5.5	2.7	2.7	SCB-4	10	SSB-4	L102 x 102 x 6	4	16	127

*Maximum braced spacing for up to 1:1 brace angle from horizontal.

For up to 1.5:1 brace angle from horizontal, divide braced spacing by 1.68; for 2:1 brace angle, divide by 2.38. Example: For 76mm diameter pipe at 0.5 g input and 1.5:1 brace angle ratio, the maximum transverse spacing = 12.2/1.68 = 7.3m.

For maximum brace spacing at 'g' forces other than those listed, divide the 1g spacing by the desired 'g' force. Example: For a 0.74g input for 305mm diameter pipe, transverse brace spacing = 6.1/0.74 = 8.2m. (Note: Transverse and longitudinal brace spacing shall not exceed those stated in the general notes.)

Special Note: The Structural Engineer of Record shall verify the seismic loads applied by the SCB/SSB/SSBS to the structure are acceptable. Refer to Pages H4, H5 and H6 for the maximum seismic loads.

NOTES:

Anchorage is based on attachment with an ITW Ramset/Red Head Trubolt Wedge Anchor, ICBO Report ER-1372/2000, Table 4, 5 and 10, embedded headed stud or J-bolt of equal embedment or approved equal.

Where (2) anchors are specified, the SCB, SSB or SSBS w/SLDB-2000 is required for attachment to structure. (Ref. Page H5 and X9)

Where (4) anchors are specified, the SCB or SSB w/SLDB-4000 is required for attachment to structure. (Ref. Page H6 and X10)

An increase in SCB or SSB size may be required to accommodate the cross bolt or support rod. (Ref. Page B2)

All SSB brace members tabulated are steel angle. Factory 2.7mm formed channel strut may be in lieu of steel angle.

All SSBS brace members tabulated are 12ga strut channel. (Ref. page X4)

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California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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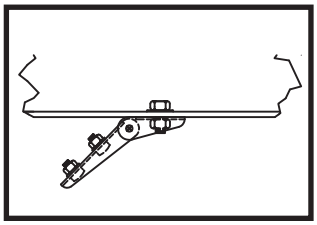
SEISMIC RESTRAINT GUIDELINES

INDIVIDUALLY SUPPORTED SYSTEMS

STRUCTURAL STEEL BEAM OR MEMBER A307 BOLT OR 70XX WELD



Pipe Dia. (in)	Max Weight per Foot (lbs)	Maximum Brace Spacing (ft) for Specified Seismic 'g' Loads*						Option 1		Option 2		Steel Bolt		Weld Size (in)
		0.25g		0.5g		1.0g		SCB Size	Cable Dia. (in)	SSB/ SSBS Size	Minimum Brace Size (in)	Qty. Req'd	Dia. (in)	
		Trans.	Long.	Trans.	Long.	Trans.	Long.							
1	2.8	50	80	40	80	40	80	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	1/8
1 1/4	3.8	50	80	40	80	40	80	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	1/8
1 1/2	4.5	50	80	40	80	40	80	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	1/8
2	6.2	50	80	40	80	40	68	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	1/8
2 1/2	9.1	50	80	40	80	40	75	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	1/8
3	12.1	50	80	40	80	40	56	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	1/8
4	18.3	50	80	40	74	37	37	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	1/8
5	26.6	50	80	40	50	25	25	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	1/8
6	34.8	50	80	40	80	40	41	SCB-2	3/16	SSBS	15/8 x 15/8 Strut	1	5/8	1/8
8	55.1	50	80	40	52	26	26	SCB-2	3/16	SSBS	15/8 x 15/8 Strut	1	5/8	1/8
10	80.2	50	72	36	36	18	18	SCB-2	3/16	SSB-3	L3 x 3 x 1/4	1	5/8	3/16
12	109.0	50	80	40	40	20	20	SCB-3	1/4	SSB-3	L4 x 4 x 1/4	1	3/4	3/16
14	122.0	50	72	36	36	18	18	SCB-3	1/4	SSB-4	L4 x 4 x 1/4	1	3/4	3/16
16	150.0	50	56	28	28	14	14	SCB-3	1/4	SSB-4	L4 x 4 x 1/4	1	3/4	3/16
18	190.0	44	44	22	22	11	11	SCB-3	1/4	SSB-4	L4 x 4 x 1/4	1	3/4	3/16
20	214.0	50	80	40	44	22	22	SCB-4	3/8	SSB-4	L4 x 4 x 1/4	1	1 1/4	3/16
24	289.0	50	64	32	32	16	16	SCB-4	3/8	SSB-4	L4 x 4 x 1/4	1	1 1/4	3/16

*Maximum braced spacing for up to 1:1 brace angle from horizontal.

For up to 1.5:1 brace angle from horizontal, divide braced spacing by 1.5; for 2:1 brace angle, divide by 2.
Example: For 3" diameter pipe at 0.5 g input and 1.5:1 brace angle ratio, the maximum transverse spacing = 40/1.5 = 26 ft.

For maximum brace spacing at 'g' forces other than those listed, divide the 1g spacing by the desired 'g' force.
Example: For a 0.74g input for 12" diameter pipe, transverse brace spacing = 20/0.74 = 27 ft. (Note: Transverse and longitudinal brace spacing shall not exceed those stated in the general notes.)

Special Note: The Structural Engineer of Record shall verify the seismic loads applied by the SCB/SSB/SSBS to the structure are acceptable. Refer to Pages H7 to H12 for the maximum seismic loads.

NOTES:

Anchorage is based on attachment with a Standard ASTM A307 Quality Bolts or E70xx electrode welds.

An increase in SCB, SSB or SSBS size may be required to accommodate the cross bolt or support rod. (Ref. Page B2)

All SSB brace members tabulated are steel angle. Factory 12ga formed channel strut may be in lieu of steel angle.

All SSBS brace members tabulated are 12ga strut channels.

(Ref. page X4)

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California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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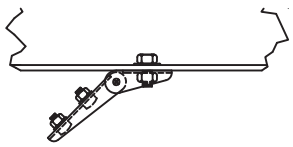
SEISMIC RESTRAINT GUIDELINES

INDIVIDUALLY SUPPORTED SYSTEMS

STRUCTURAL STEEL BEAM OR MEMBER A307 BOLT OR 70XX WELD



Pipe Dia. *(mm)*	Max Weight per meter *(kg)*	Maximum Brace Spacing (*m*) for Specified Seismic 'g' Loads*						Option 1		Option 2		Steel Bolt		Weld Size *(mm)*
		0.25g		0.5g		1.0g		SCB Size	Cable Dia. *(mm)*	SSB/ SSBS Size	Minimum Brace Size *(mm)*	Qty. Req'd	Dia. *(mm)*	
		Trans.	Long.	Trans.	Long.	Trans.	Long.							
25	4.1	15.2	24.4	12.2	24.4	12.2	24.4	SCB-1	3	SSBS	41 x 41 Strut	1	13	3
32	5.6	15.2	24.4	12.2	24.4	12.2	24.4	SCB-1	3	SSBS	41 x 41 Strut	1	13	3
38	6.6	15.2	24.4	12.2	24.4	12.2	24.4	SCB-1	3	SSBS	41 x 41 Strut	1	13	3
51	9.2	15.2	24.4	12.2	24.4	12.2	20.7	SCB-1	3	SSBS	41 x 41 Strut	1	13	3
64	13.5	15.2	24.4	12.2	24.4	12.2	22.9	SCB-1	3	SSBS	41 x 41 Strut	1	13	3
76	18.0	15.2	24.4	12.2	24.4	12.2	17.1	SCB-1	3	SSBS	41 x 41 Strut	1	13	3
102	27.3	15.2	24.4	12.2	12.6	11.3	11.3	SCB-1	3	SSBS	41 x 41 Strut	1	13	3
127	39.5	15.2	24.4	12.2	15.2	7.6	7.6	SCB-1	3	SSBS	41 x 41 Strut	1	13	3
152	51.8	15.2	24.4	12.2	24.4	12.2	12.5	SCB-2	5	SSBS	41 x 41 Strut	1	16	3
203	82.0	15.2	24.4	12.2	15.8	7.6	7.9	SCB-2	5	SSBS	41 x 41 Strut	1	16	3
254	119.3	15.2	21.9	11.0	11.0	5.5	5.5	SCB-2	5	SSB-3	L76 x 76 x 6	1	16	5
305	162.2	15.2	24.4	12.2	12.2	6.1	6.1	SCB-3	6	SSB-3	L102 x 102 x 6	1	19	5
356	181.5	15.2	21.9	11.0	11.0	5.5	5.5	SCB-3	6	SSB-4	L102 x 102 x 6	1	19	5
406	222.6	15.2	17.1	8.5	8.5	4.3	4.3	SCB-3	6	SSB-4	L102 x 102 x 6	1	19	5
457	282.7	13.4	13.4	6.7	6.7	3.4	3.4	SCB-3	6	SSB-4	L102 x 102 x 6	1	19	5
508	317.7	15.2	24.4	12.2	12.2	6.7	6.7	SCB-4	10	SSB-4	L102 x 102 x 6	1	32	5
610	430.1	15.2	19.5	9.8	9.8	4.9	4.9	SCB-4	10	SSB-4	L102 x 102 x 6	1	32	5

*Maximum braced spacing for up to 1:1 brace angle from horizontal.

For up to 1.5:1 brace angle from horizontal, divide braced spacing by 1.5; for 2:1 brace angle, divide by 2. Example: For 76mm diameter pipe at 0.5 g input and 1.5:1 brace angle ratio, the maximum transverse spacing = 12.2/1.5 = 8.1m.

For maximum brace spacing at 'g' forces other than those listed, divide the 1g spacing by the desired 'g' force. Example: For a 0.74g input for 305mm diameter pipe, transverse brace spacing = 6.1/0.74 = 8.2m. (Note: Transverse and longitudinal brace spacing shall not exceed those stated in the general notes.)

Special Note: The Structural Engineer of Record shall verify the seismic loads applied by the SCB/SSB/SSBS to the structure are acceptable. Refer to Pages H7 to H12 for the maximum seismic loads.

NOTES:

Anchorage is based on attachment with a Standard ASTM A307 Quality Bolts or E70xx electrode welds.

An increase in SCB, SSB or SSBS size may be required to accommodate the cross bolt or support rod. (Ref. Page B2)

All SSB brace members tabulated are steel angle. Factory 2.7mm formed channel strut may be in lieu of steel angle.

All SSBS brace members tabulated are 12ga strut channel.

(Ref. page X4)

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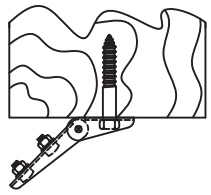
SEISMIC RESTRAINT GUIDELINES

INDIVIDUALLY SUPPORTED SYSTEMS

STRUCTURAL WOOD BEAM OR MEMBER LAG BOLT



Pipe Dia. (mm)	Max Weight per Foot (kg)	Maximum Brace Spacing (ft) for Specified Seismic 'g' Loads*						Option 1		Option 2		Lag Screws		
		0.25g		0.5g		1.0g		SCB Size	Cable Dia. (mm)	SSB Size	Minimum Brace Size (mm)	Qty. Req'd	Dia. (mm)	Embed. (mm)
		Trans.	Long.	Trans.	Long.	Trans.	Long.							
1	2.8	50	80	40	80	40	80	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	4
1 1/4	3.8	50	80	40	80	40	65	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	4
1 1/2	4.5	50	80	40	80	40	55	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	4
2	6.2	50	80	40	80	40	40	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	4
2 1/2	9.1	50	80	40	54	27	27	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	4
3	12.1	50	80	40	40	20	20	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	4
4	18.3	50	52	26	26	13	13	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	4
5	26.6	36	36	18	18	9	9	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	4
6	34.8	40	40	20	20	10	10	SCB-2	3/16	SSBS	15/8 x 15/8 Strut	1	5/8	5
8	55.1	24	24	12	12	6	6	SCB-2	3/16	SSBS	15/8 x 15/8 Strut	1	5/8	5
10	80.2	16	16	8	8	4	4	SCB-2	3/16	SSB-3	L2 x 2 x 1/4	1	5/8	5
12	109.0	12	12	6	6	3	3	SCB-2	3/16	SSB-3	L2 x 2 x 1/4	1	5/8	5

*Maximum braced spacing for up to 1:1 brace angle from horizontal.

For up to 1.5:1 brace angle from horizontal, divide braced spacing by 1.5; for 2:1 brace angle, divide by 2.

For maximum brace spacing at 'g' forces other than those listed, divide the 1g spacing by the desired 'g' force. Example: For a 0.74g input for 6" diameter pipe, transverse brace spacing = 10/0.74 = 13 ft. (Note: Transverse and longitudinal brace spacing shall not exceed those stated in the general notes.)

Special Note: The Structural Engineer of Record shall verify the seismic loads applied by the SCB/SSB/SSBS to the structure are acceptable. Refer to Pages H13 for the maximum seismic loads.

NOTES:

Anchorage is based on attachment with Lag Screws, 1997 National Design Specification Tables 9.2A & 9.3B.

An increase in SCB, SSB or SSBS size may be required to accommodate the cross bolt or support rod. (Ref. Page B2)

All SSB brace members tabulated are steel angle. Factory 12ga formed channel strut may be in lieu of steel angle.

All SSBS brace members tabulated are 12ga strut channel.

(Ref. page X4)

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California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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MASON INDUSTRIES, Inc.

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Dhiru Mali
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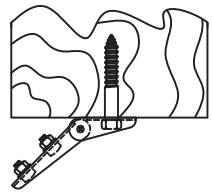
SEISMIC RESTRAINT GUIDELINES

INDIVIDUALLY SUPPORTED SYSTEMS

STRUCTURAL WOOD BEAM OR MEMBER LAG BOLT



Pipe Dia. (mm)	Max Weight per Foot (kg)	Maximum Brace Spacing (ft) for Specified Seismic 'g' Loads*						Option 1		Option 2		Lag Screws		
		0.25g		0.5g		1.0g		SCB Size	Cable Dia. (mm)	SSB Size	Minimum Brace Size (mm)	Qty. Req'd	Dia. (mm)	Embed. (mm)
		Trans.	Long.	Trans.	Long.	Trans.	Long.							
25	4.1	15.2	24.4	12.2	24.4	12.2	24.4	SCB-1	3	SSBS	41 x 41 Strut	1	13	102
32	5.6	15.2	24.4	12.2	24.4	12.2	19.8	SCB-1	3	SSBS	41 x 41 Strut	1	13	102
38	6.6	15.2	24.4	12.2	24.4	12.2	16.8	SCB-1	3	SSBS	41 x 41 Strut	1	13	102
51	9.2	15.2	24.4	12.2	24.4	12.2	12.2	SCB-1	3	SSBS	41 x 41 Strut	1	13	102
64	13.5	15.2	24.4	12.2	16.5	8.2	8.2	SCB-1	3	SSBS	41 x 41 Strut	1	13	102
76	18.0	15.2	24.4	12.2	12.2	6.1	6.1	SCB-1	3	SSBS	41 x 41 Strut	1	13	102
102	27.3	15.2	18.3	7.9	7.9	4.0	4.0	SCB-1	3	SSBS	41 x 41 Strut	1	13	102
127	39.5	11.0	11.0	5.5	5.5	2.7	2.7	SCB-1	3	SSBS	41 x 41 Strut	1	13	102
152	51.8	12.2	12.2	6.1	6.1	3.0	3.0	SCB-2	5	SSBS	41 x 41 Strut	1	16	127
203	82.0	7.3	7.3	3.7	3.7	1.8	1.8	SCB-2	5	SSBS	41 x 41 Strut	1	16	127
254	119.3	4.9	4.9	2.4	2.4	1.2	1.2	SCB-2	5	SSB-3	L51 x 51 x 6	1	16	127
305	162.2	3.7	3.7	1.8	1.8	0.9	0.9	SCB-2	5	SSB-3	L51 x 51 x 6	1	16	127

*Maximum braced spacing for up to 1:1 brace angle from horizontal.

For up to 1.5:1 brace angle from horizontal, divide braced spacing by 1.5; for 2:1 brace angle, divide by 2.

For maximum brace spacing at 'g' forces other than those listed, divide the 1g spacing by the desired 'g' force. Example: For a 0.74g input for 152mm diameter pipe, transverse brace spacing = 3.0/0.74 = 4.1m (Note: Transverse and longitudinal brace spacing shall not exceed those stated in the general notes.)

Special Note: The Structural Engineer of Record shall verify the seismic loads applied by the SCB/SSB/SSBS to the structure are acceptable. Refer to Pages H13 for the maximum seismic loads.

NOTES:

Anchorage is based on attachment with Lag Screws, 1997 National Design Specification Tables 9.2A & 9.3B.

An increase in SCB, SSB or SSBS size may be required to accommodate the cross bolt or support rod. (Ref. Page B2)

All SSB brace members tabulated are steel angle. Factory 2.7 mm formed channel strut may be in lieu of steel angle.

All SSBS brace members tabulated are 12ga strut channel.

(Ref. page X4)

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California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

Bill Staehlin (916) 654-3362

Dhiru Mali
Structural Engineer
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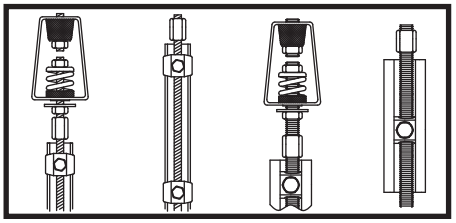
VERTICAL ROD STIFFENER GUIDELINES

INDIVIDUALLY SUPPORTED SYSTEMS

SEISMIC ROD CLAMPS
ROD DIAMETERS: 3/8 to 1 1/4 IN.



Pipe Dia. (in)	Max Weight per Foot (lbs)	Support Rod Dia. (in)	for Specified Seismic 'g' Loads* Maximum Unbraced Rod Length (in) 0.25g Trans.	0.25g Long.	0.5g Trans.	0.5g Long.	1.0g Trans.	1.0g Long.	Max Braced Rod Length (in)	SRC Size	UC Size	Max. Spacing (in)	Angle Brace Size (in)	Strut Channel Size
1	2.8	3/8	22	22	22	22	22	18	96	1	1	22	1 x 1 x 1/8	
1 1/4	3.8	3/8	22	22	22	22	22	15	96	1	1	22	1 x 1 x 1/8	
1 1/2	4.5	3/8	22	22	22	20	20	14	96	1	1	22	1 x 1 x 1/8	
2	6.2	3/8	22	22	22	17	17	13	96	1	1	22	1 x 1 x 1/8	
2 1/2	9.1	1/2	30	30	30	26	26	19	96	1	1	31	1 x 1 x 1/8	
3	12.1	1/2	30	30	30	23	23	19	96	1	1	31	1 x 1 x 1/8	15/8 x 15/8
4	18.3	5/8	38	38	38	31	31	31	96	1	2	39	1 x 1 x 1/8	x 12
5	26.6	5/8	38	35	35	31	31	31	96	1	2	39	1 x 1 x 1/8	GAUGE
2 1/2	9.1	1/2	30	30	30	26	26	19	120	1 1/2	1	31	1 1/2 x 1 1/2 x 1/4	
3	12.1	1/2	30	30	30	23	23	19	120	1 1/2	1	31	1 1/2 x 1 1/2 x 1/4	
4	18.3	5/8	38	38	38	31	31	31	120	1 1/2	2	39	1 1/2 x 1 1/2 x 1/4	
5	26.6	5/8	38	35	35	31	31	31	120	1 1/2	2	39	1 1/2 x 1 1/2 x 1/4	
6	34.8	3/4	47	46	46	32	32	32	144	1 1/2	2	48	1 1/2 x 1 1/2 x 1/4	
8	55.1	7/8	55	51	51	45	45	45	132	1 1/2		56	1 1/2 x 1 1/2 x 1/4	
10	80.2	7/8	55	44	44	44	44	44	132	1 1/2		56	1 1/2 x 1 1/2 x 1/4	
12	109.0	7/8	51	36	36	36	36	36	132	1 1/2		65	1 1/2 x 1 1/2 x 1/4	
14	122.0	1	63	47	47	47	47	47	132	1 1/2		65	1 1/2 x 1 1/2 x 1/4	
16	150.0	1	57	48	48	48	48	48	132	1 1/2		65	1 1/2 x 1 1/2 x 1/4	
18	190.0	1	51	48	48	48	48	48	132	1 1/2		65	1 1/2 x 1 1/2 x 1/4	
8	55.1	7/8	55	51	51	45	45	45	144	2		56	2 x 2 x 1/4	
10	80.2	7/8	55	44	44	44	44	44	144	2		56	2 x 2 x 1/4	
12	109.0	7/8	51	36	36	36	36	36	144	2		56	2 x 2 x 1/4	
14	122.0	1	63	47	47	47	47	47	144	2		65	2 x 2 x 1/4	
16	150.0	1	57	48	48	48	48	48	144	2		65	2 x 2 x 1/4	
18	190.0	1	51	48	48	48	48	48	144	2		65	2 x 2 x 1/4	
20	214.0	1 1/4	78	55	55	52	52	52	144	2		82	2 x 2 x 1/4	
24	289.0	1 1/4	67	53	53	53	53	53	144	2		82	2 x 2 x 1/4	

*Maximum unbraced rod length for up to 1:1 brace angle from horizontal.
For up to 1.5:1 brace angle from horizontal, divide unbraced rod length by 1.25; for 2:1 brace angle, divide by 1.5.

NOTES:
Rod stiffeners are only required at the seismic restraint locations.
Rod stiffeners are required when the length of the rod exceeds the maximum unbraced length.
A minimum of (2) rod clamps are required per support rod to attach the "Angle or Strut Channel Brace" to the support rod.

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California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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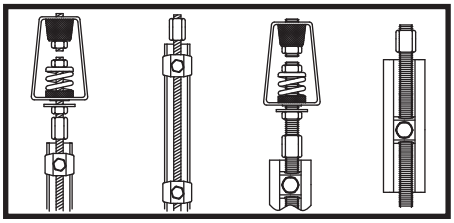
VERTICAL ROD STIFFENER GUIDELINES

INDIVIDUALLY SUPPORTED SYSTEMS

SEISMIC ROD CLAMPS
ROD DIAMETERS: 10 mm to 32 mm



Pipe Dia. *(mm)*	Max Weight per meter *(kg)*	Support Rod Dia. *(mm)*	Maximum Unbraced Rod Length (*mm*) for Specified Seismic 'g' Loads*						Max Braced Rod Length *(mm)*	SRC Size	UC Size	Max. Spacing *(mm)*	Angle Brace Size *(mm)*	Strut Channel Size *(mm)*
			0.25g		0.5g		1.0g							
			Trans.	Long.	Trans.	Long.	Trans.	Long.						
25	4.1	10	559	559	559	559	559	457	2438	1	1	559	25 x 25 x 3	
32	5.6	10	559	559	559	559	559	381	2438	1	1	559	25 x 25 x 3	
38	6.6	10	559	559	559	508	508	356	2438	1	1	559	25 x 25 x 3	
51	9.2	10	559	559	559	432	432	330	2438	1	1	559	25 x 25 x 3	
64	13.5	13	762	762	762	660	660	483	2438	1	1	787	25 x 25 x 3	
76	18.0	13	762	762	762	584	584	483	2438	1	1	787	25 x 25 x 3	41 x 41
102	27.3	16	965	965	965	787	787	787	2438	1	2	991	25 x 25 x 3	x 2.5
127	39.5	16	965	889	889	787	787	787	2438	1	2	991	25 x 25 x 3	
64	13.5	16	762	762	762	660	660	483	3048	1 1/2	1	787	38 x 38 x 6	
76	18.0	13	762	762	762	584	584	483	3048	1 1/2	1	787	38 x 38 x 6	
102	27.3	16	965	965	965	584	787	787	3048	1 1/2	2	991	38 x 38 x 6	
127	39.5	16	965	889	889	584	787	787	3048	1 1/2	2	991	38 x 38 x 6	
152	51.8	19	1194	1168	1168	813	813	813	3658	1 1/2	2	1219	38 x 38 x 6	
203	82.0	22	1397	1295	1295	1143	1143	1143	3353	1 1/2		1422	38 x 38 x 6	
254	119.3	22	1397	1118	1118	1118	1118	1118	3353	1 1/2		1422	38 x 38 x 6	
305	162.2	22	1295	914	914	914	914	914	3353	1 1/2		1422	38 x 38 x 6	
356	181.5	25	1600	1194	1194	1194	1194	1194	3353	1 1/2		1651	38 x 38 x 6	
406	222.6	25	1448	1219	1219	1219	1219	1219	3353	1 1/2		1651	38 x 38 x 6	
457	282.7	25	1295	1219	1219	1219	1219	1219	3353	1 1/2		1651	38 x 38 x 6	
203	82.0	22	1397	1295	1295	1143	1143	1143	3658	2		1422	51 x 51 x 6	
254	119.3	22	1397	1118	1118	1118	1118	1118	3658	2		1422	51 x 51 x 6	
305	162.2	22	1295	914	914	914	914	914	3658	2		1422	51 x 51 x 6	
356	181.5	25	1600	1194	1194	1194	1194	1194	3658	2		1651	51 x 51 x 6	
406	222.6	25	1448	1219	1219	1219	1219	1219	3658	2		1651	51 x 51 x 6	
457	282.7	25	1295	1219	1219	1219	1219	1219	3658	2		1651	51 x 51 x 6	
508	317.7	32	1981	1397	1397	1321	1321	1321	3658	2		2083	51 x 51 x 6	
610	430.1	32	1702	1346	1346	1346	1346	1346	3658	2		2083	51 x 51 x 6	

*Maximum unbraced rod length for up to 1:1 brace angle from horizontal.
For up to 1.5:1 brace angle from horizontal, divide unbraced rod length by 1.25; for 2:1 brace angle, divide by 1.5.

NOTES:
Rod stiffeners are only required at the seismic restraint locations.
Rod stiffeners are required when the length of the rod exceeds the maximum unbraced length.
A minimum of (2) rod clamps are required per support to attach the "Angle or Strut Channel Brace" to the support rod.

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California Office of Statewide Health Planning and Development
FIXED EQUIPMENT ANCHORAGE
OPA-0349 August 5, 2002

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MINIMUM SIZE OF SCBH, SCB, SSB AND SSBS

SCB selections are based on an SCBH attached to a standard support rod. An increase in SCBH may be required to accommodate a large support rod.

Minimum SCBH size for support rods are shown in the following table:

AT SCBH LOCATIONS:

Pipe Diameter (in) (*mm*)	Maximum Support Rod Diameter (in) (*mm*)	Minimum SCBH Size for Support Rods
1-5 *25-127*	5/8 *16*	SCBH-1
6-12 *152-305*	7/8 *22*	SCBH-1
14-18 *356-457*	11/8 *29*	SCBH-1

An SCB may be attached to the clevis cross bolt, however, an increase in SCB size may be required.

SSB and SSBS selections are based on an SSB and SSBS attached to a standard clevis cross bolt. An increase in SSB or SSBS size may be required to accommodate a large clevis cross bolt.

Minimum SCB, SSB and SSBS sizes for clevis cross bolts are shown in the following table:

AT SCB/SSB/SSBS LOCATIONS:

Pipe Diameter (in) (*mm*)	Maximum Cross Bolt (in) (*mm*)	Minimum SSB/SSB/SSBS Size for Clevis Cross Bolts
1-6 *25-152*	1/2 *13*	SCB/SSB/SSBS-12
8 *203*	5/8 *16*	SCB/SSB-2/SSBS-20, 25
10-12 *254-305*	3/4 *19*	SCB/SSB-3
14-24 *356-610*	11/4 *32*	

An SSB or SSBS may be attached to the support rod, however, an increase in SSB or SSBS size may be required.

Minimum SSB or SSBS size for support rods are shown in the following table:

AT SSB/SSBS LOCATIONS:

Pipe Diameter (in) (*mm*)	Maximum Support Rod Diameter (in) (*mm*)	Minimum SSB/SSBS Size for Support Rods
1-3 *25-76*	1/2 *13*	SSBS-12
4-5 *102-127*	5/8 *16*	SSBS-20, 25
6 *152*	3/4 *19*	SSB-3
8-24 *203-610*	11/4 *32*	SSB-4

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California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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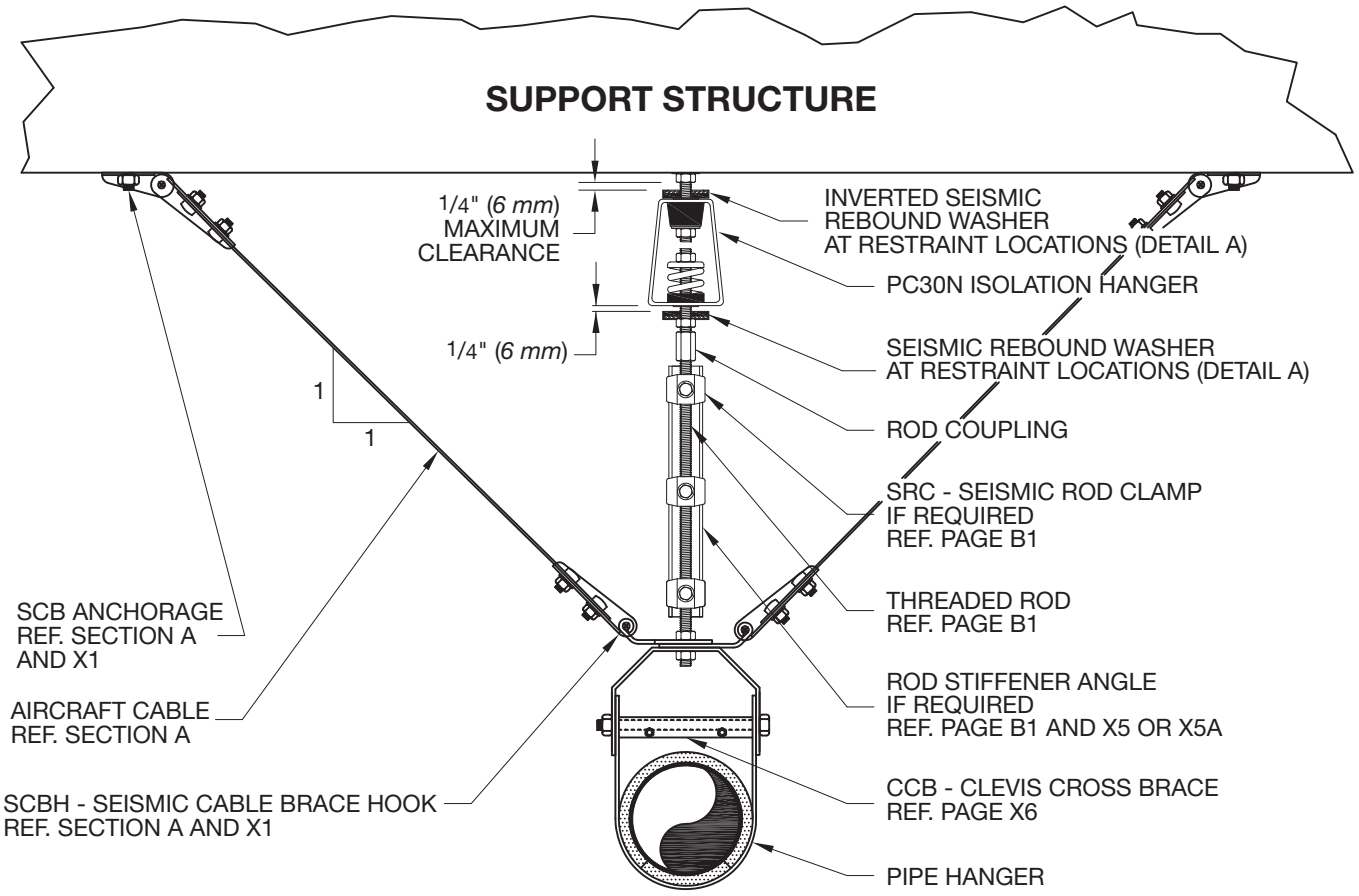
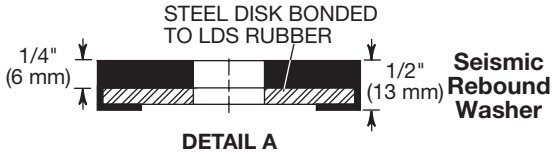
TRANSVERSE SEISMIC CABLE BRACE HOOK GUIDELINES FOR SPRING-ISOLATED CLEVIS SUPPORTED SYSTEMS





NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page B1. Brace angle ratio may be increased to 2 (vert.): 1 (horiz.). Refer to section A for limitations. Refer to page X2 for proper installation of the SCBH.

NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

NOTE 3: Install with hanger box snug to upper rebound washer, with washer tight to overhead surface. Upper hanger element deflects under load, leaving space on top.

APPROVED

Fixed Equipment Anchorage
Office of Statewide Health Planning and Development

OPA-0349
on
December 22, 2006

Anthony R. Pike
Anthony R. Pike **(916) 654-3362**

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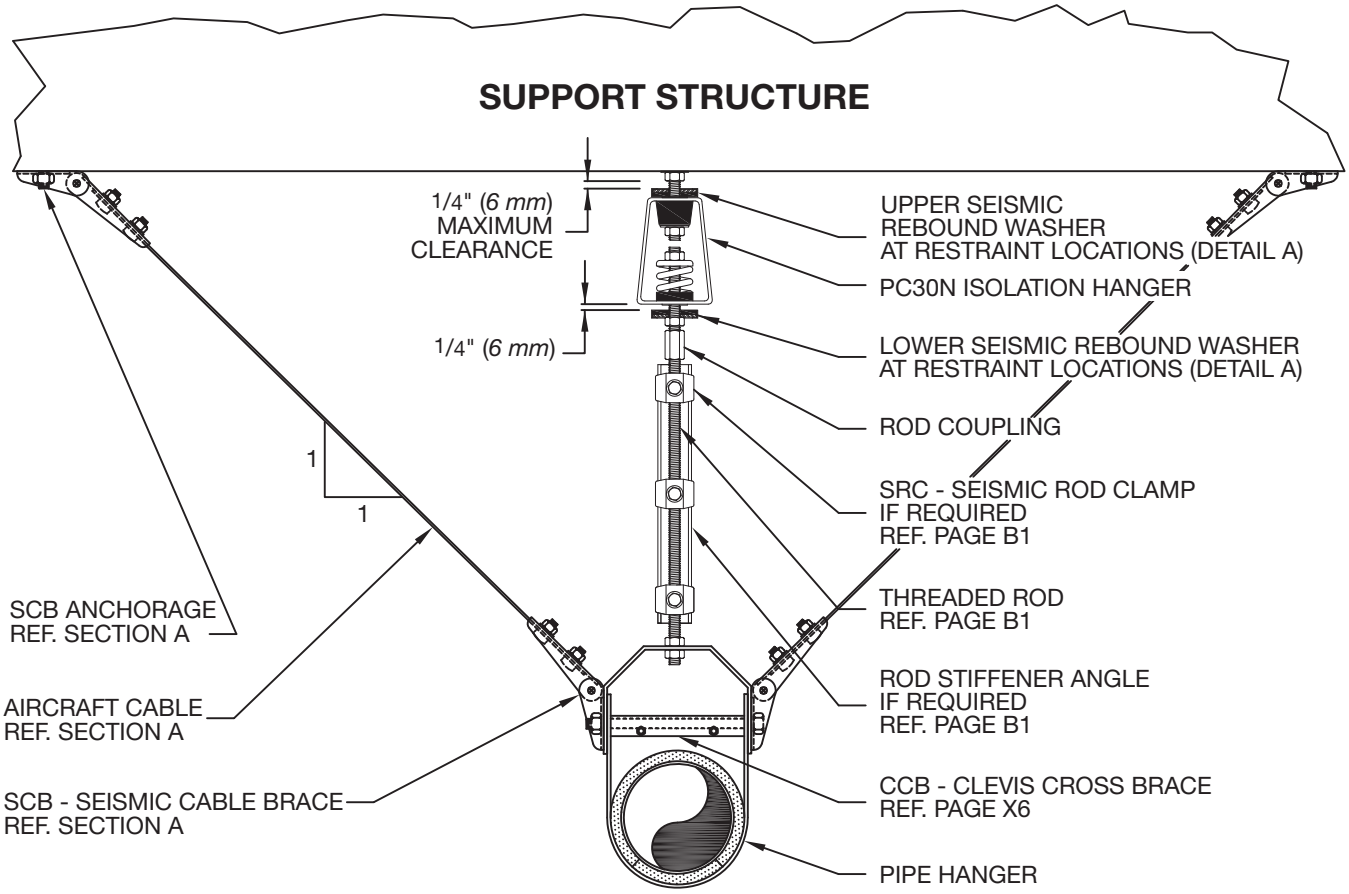
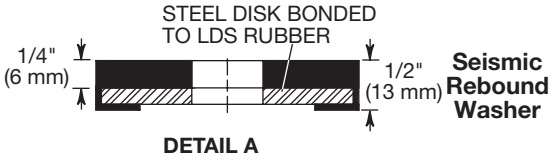
TRANSVERSE SEISMIC CABLE BRACE HOOK GUIDELINES FOR SPRING-ISOLATED CLEVIS SUPPORTED SYSTEMS





DETAIL A

NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page B1. Brace angle ratio may be increased to 2 (vert.): 1 (horiz.). Refer to section A for limitations. Refer to page X2 for proper installation of the SCBH.

NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

NOTE 3: Install with hanger box snug to upper rebound washer, with washer tight to overhead surface. Upper hanger element deflects under load, leaving space on top.

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OPA-0349 August 5, 2002

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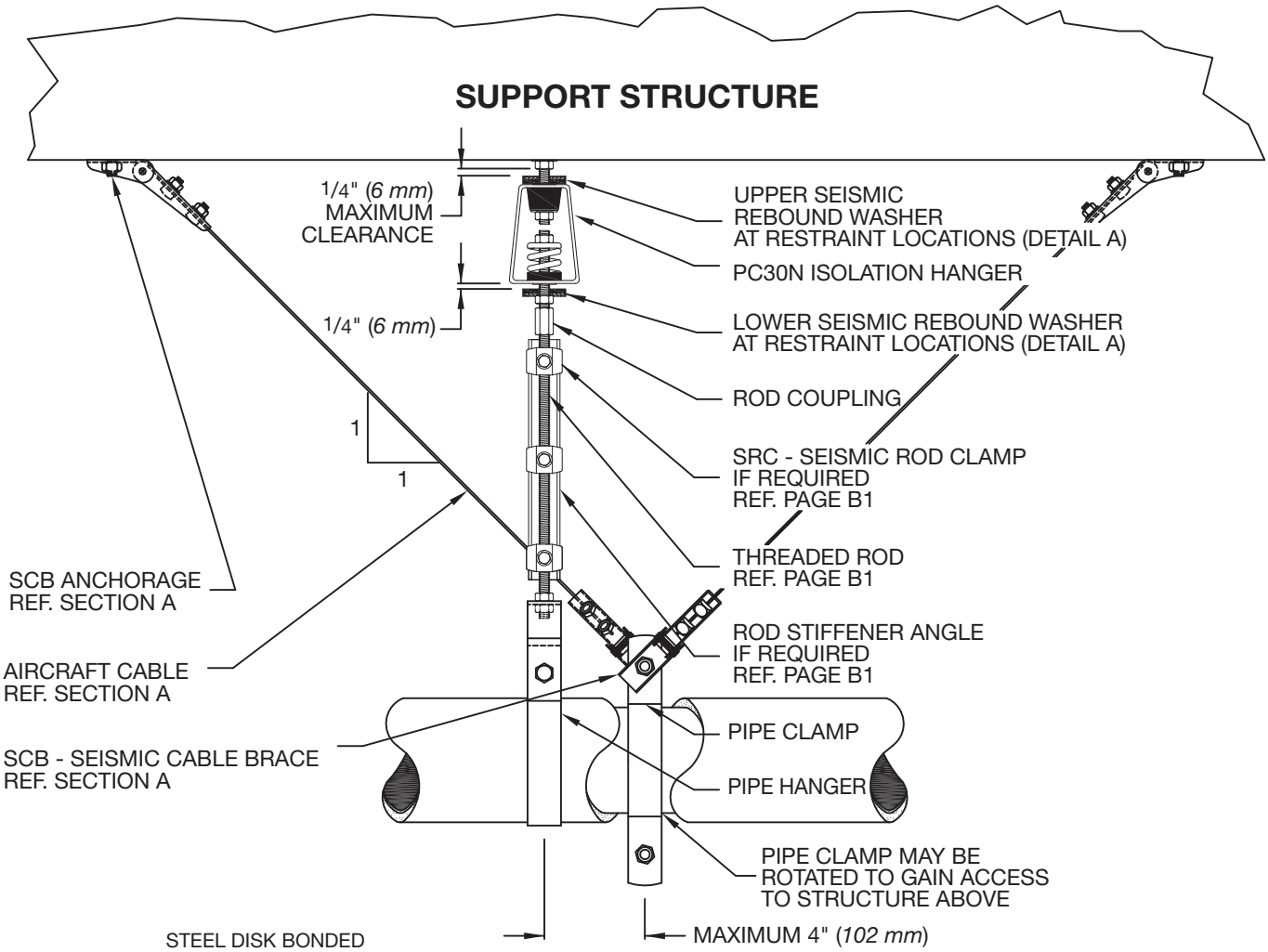
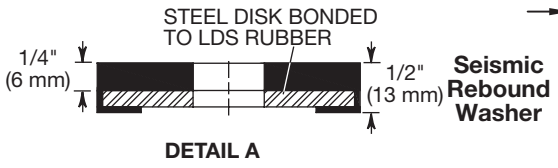
LONGITUDINAL SEISMIC CABLE BRACE GUIDELINES FOR SPRING-ISOLATED CLEVIS SUPPORTED SYSTEMS





DETAIL A

NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page B1. Brace angle ratio may be increased to 2 (vert.): 1 (horiz.). Refer to section A for limitations. Refer to page X2 for proper installation of the SCBH.

NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

NOTE 3: Install with hanger box snug to upper rebound washer, with washer tight to overhead surface. Upper hanger element deflects under load, leaving space on top.

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FIXED EQUIPMENT ANCHORAGE

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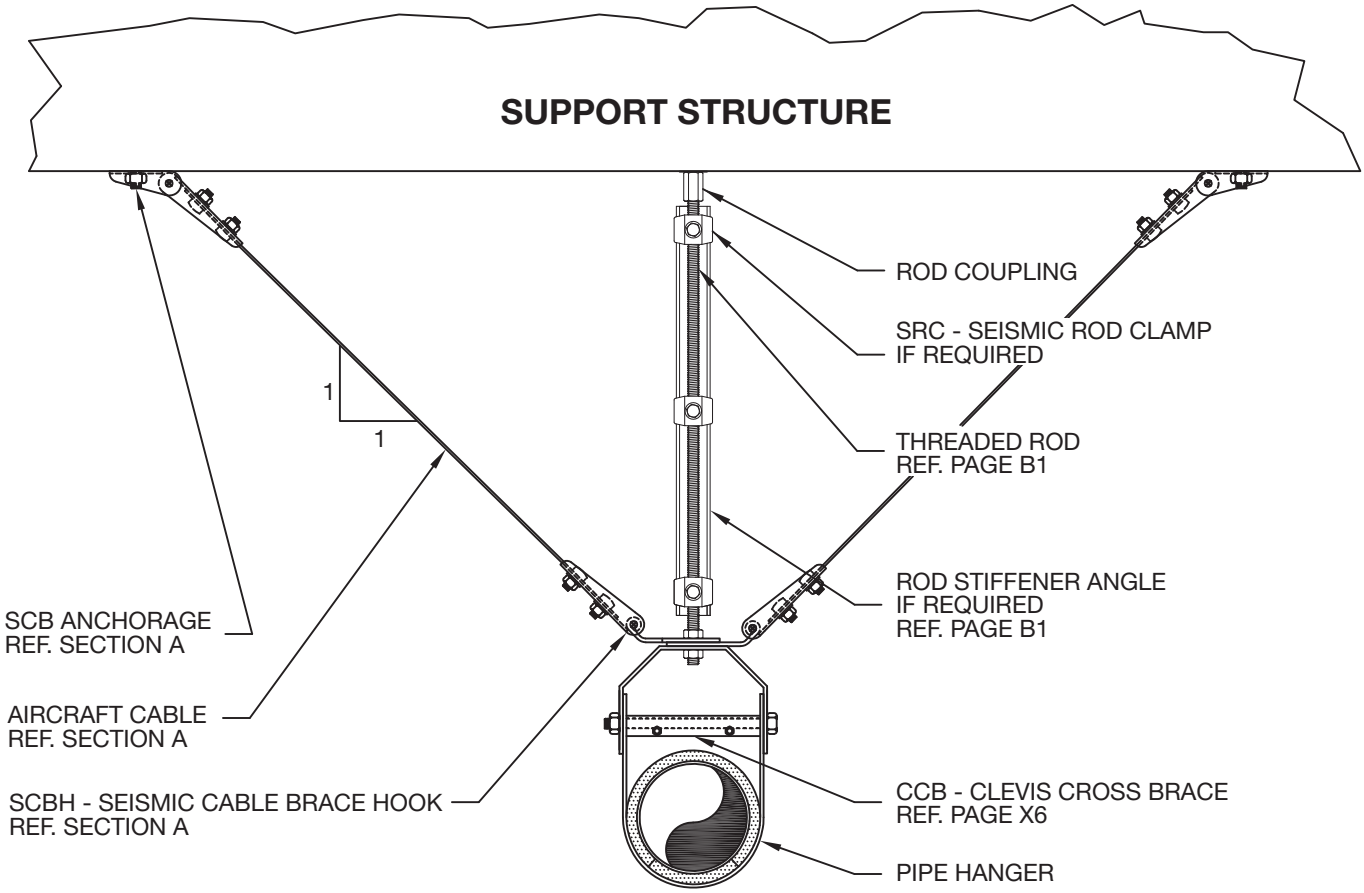
TRANSVERSE SEISMIC CABLE BRACE HOOK GUIDELINES FOR CLEVIS SUPPORTED SYSTEMS



NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page B1. Brace angle ratio may be increased to 2 (vert): 1 (horiz.). Refer to section A for limitations. Refer to page X2 for proper installation of the SCBH.

NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

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FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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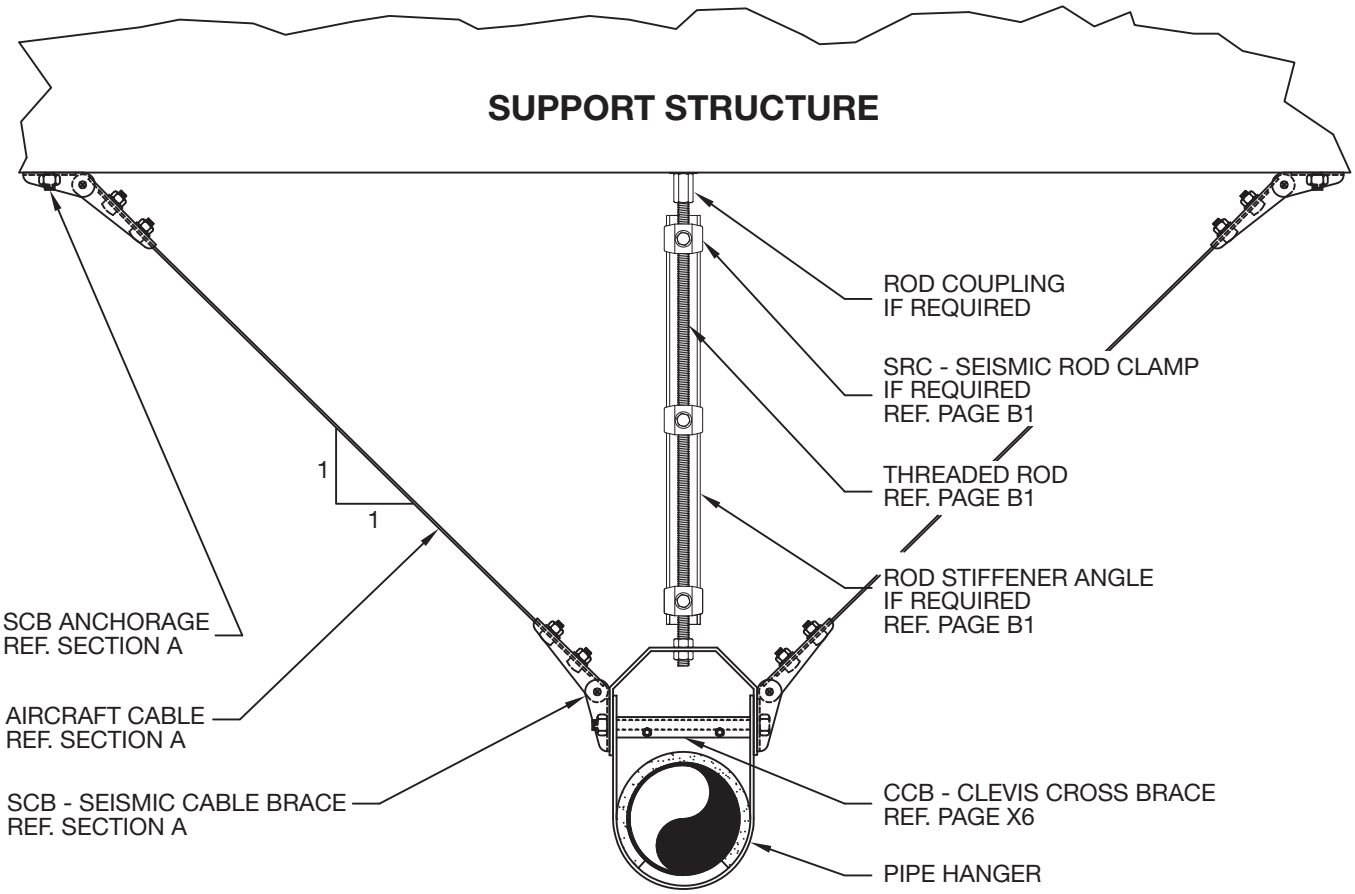
TRANSVERSE SEISMIC CABLE BRACE GUIDELINES FOR CLEVIS SUPPORTED SYSTEMS



NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page B1. Brace angle ratio may be increased to 2 (vert): 1 (horiz.). Refer to section A for limitations.

NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

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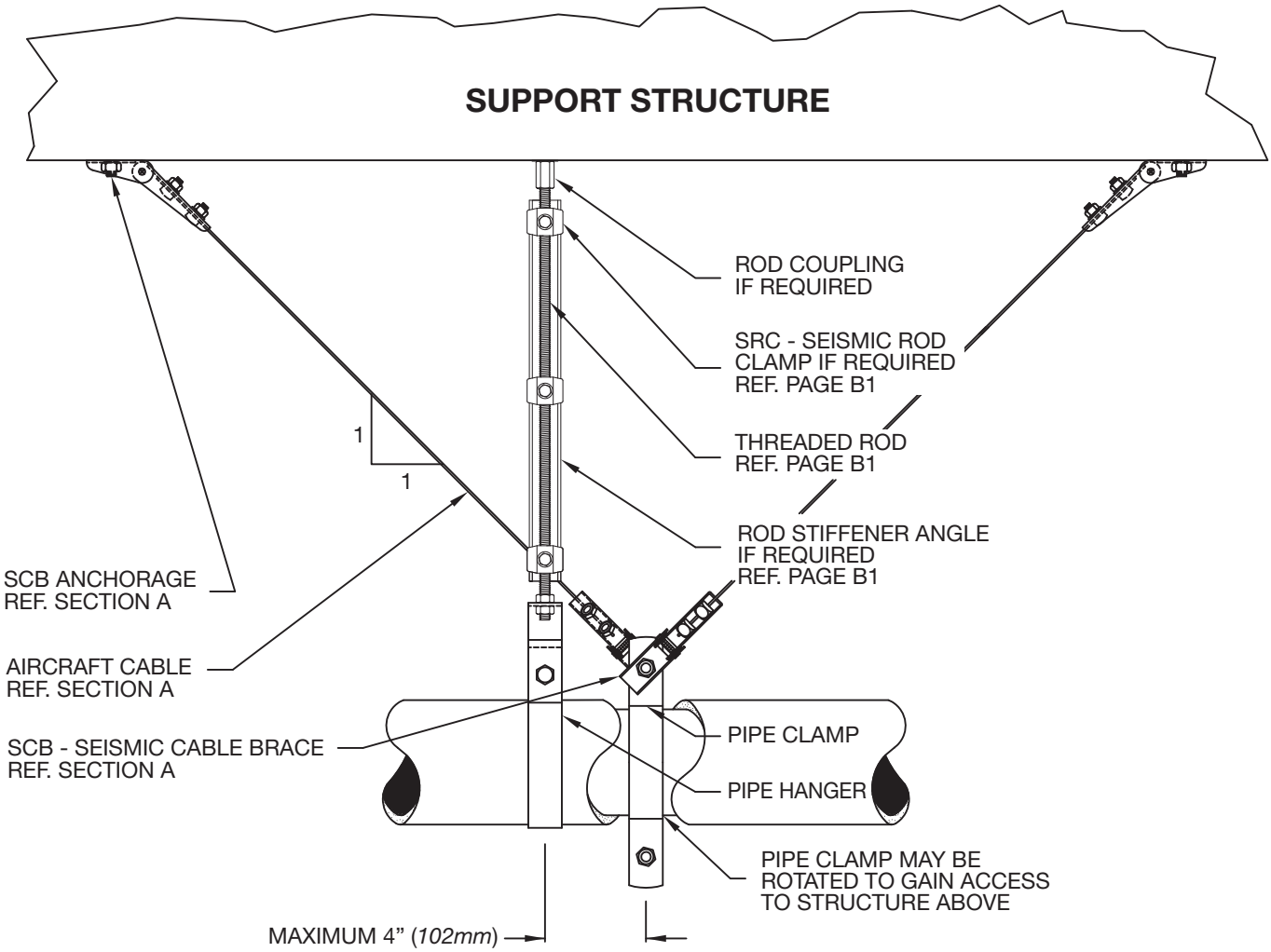
LONGITUDINAL SEISMIC CABLE BRACE GUIDELINES FOR CLEVIS SUPPORTED SYSTEMS



NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page B1. Brace angle ratio may be increased to 2 (vert): 1 (horiz.). Refer to section A for limitations.

NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

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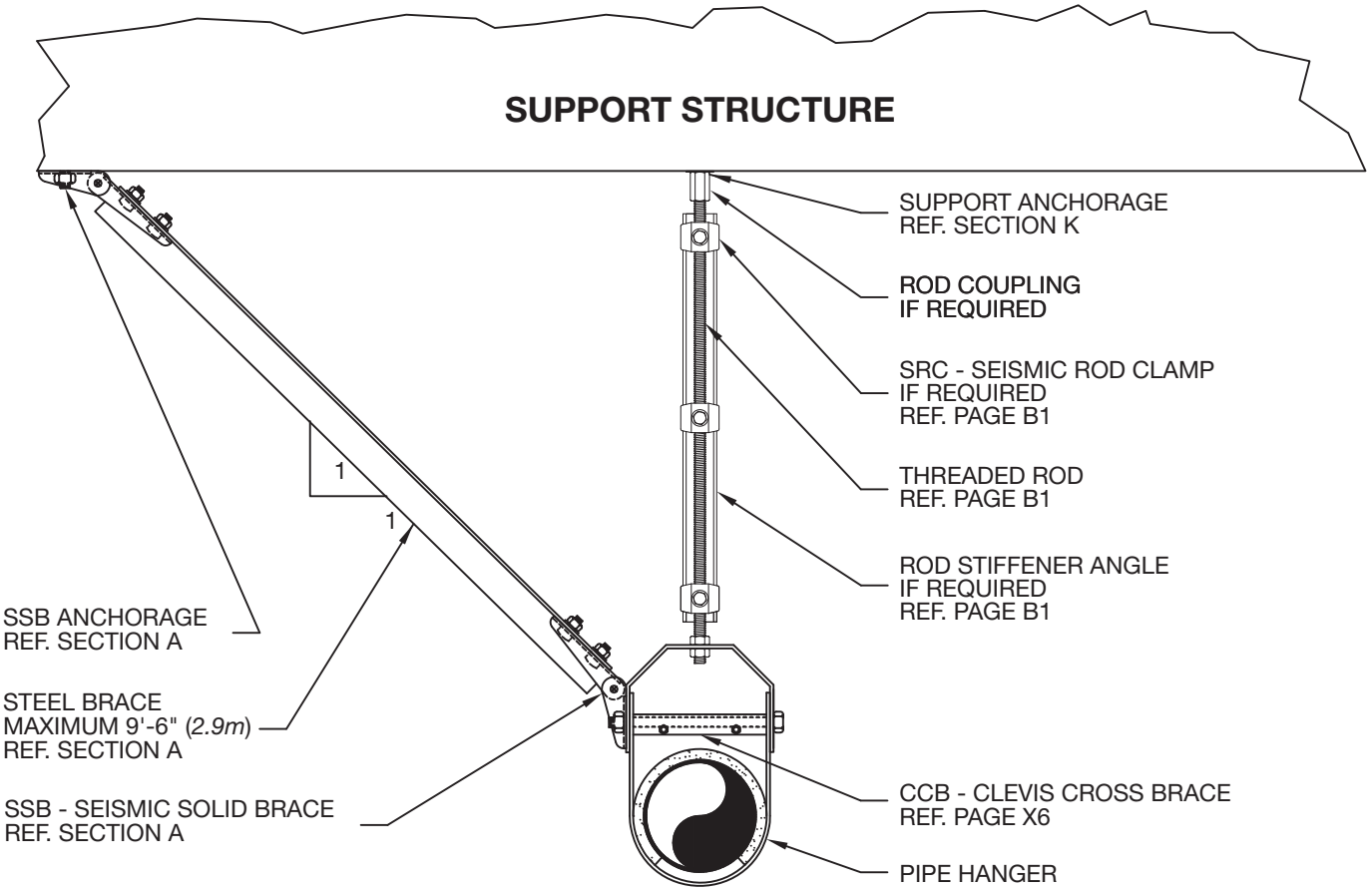
TRANSVERSE SEISMIC SOLID BRACE GUIDELINES FOR CLEVIS SUPPORTED SYSTEMS



NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page B1. Brace angle ratio may be increased to 2 (vert): 1 (horiz.). Refer to section A for limitations.

NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

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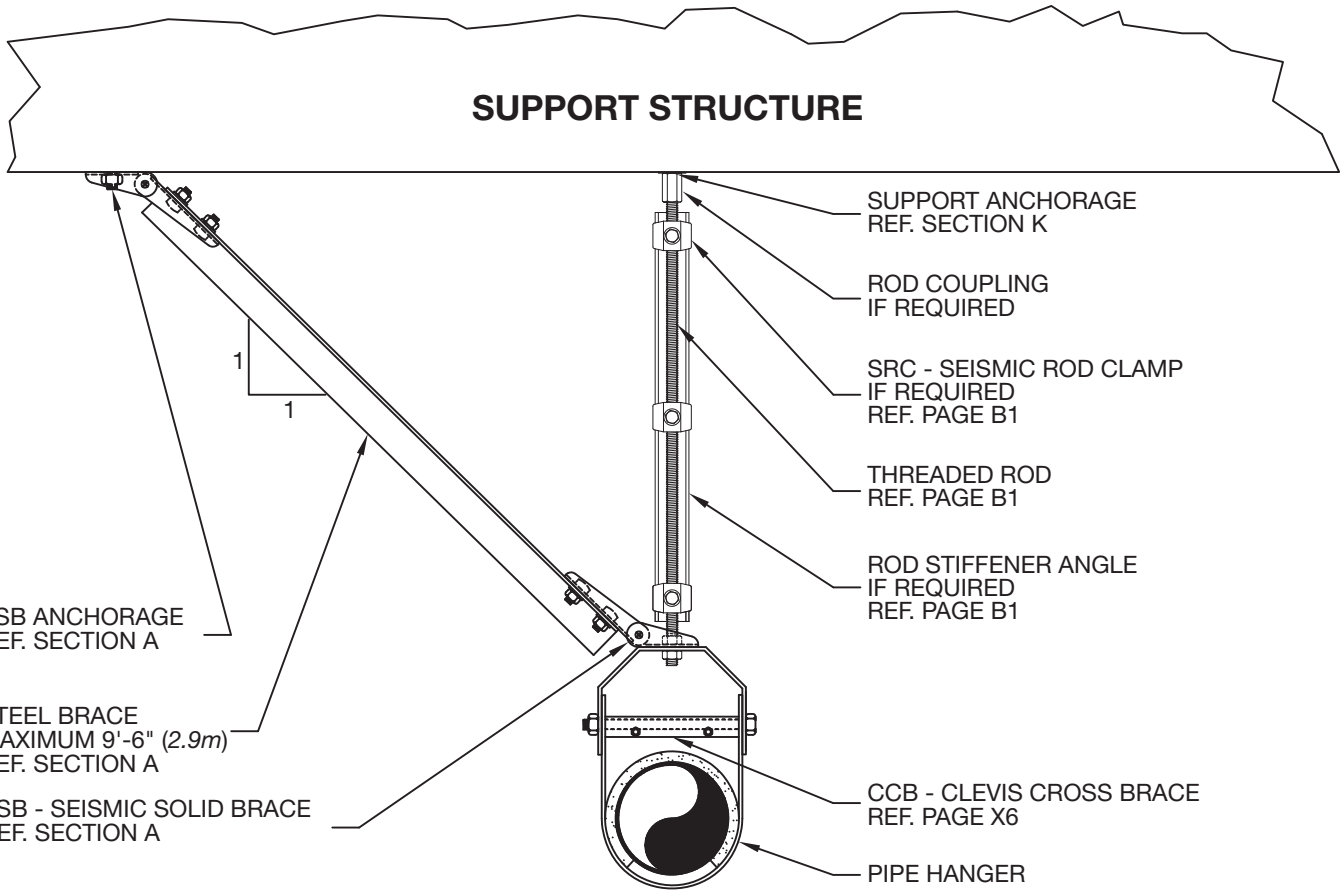
TRANSVERSE SEISMIC SOLID BRACE GUIDELINES FOR CLEVIS SUPPORTED SYSTEMS



NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page B1. Brace angle ratio may be increased to 2 (vert): 1 (horiz.). Refer to section A for limitations.

NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

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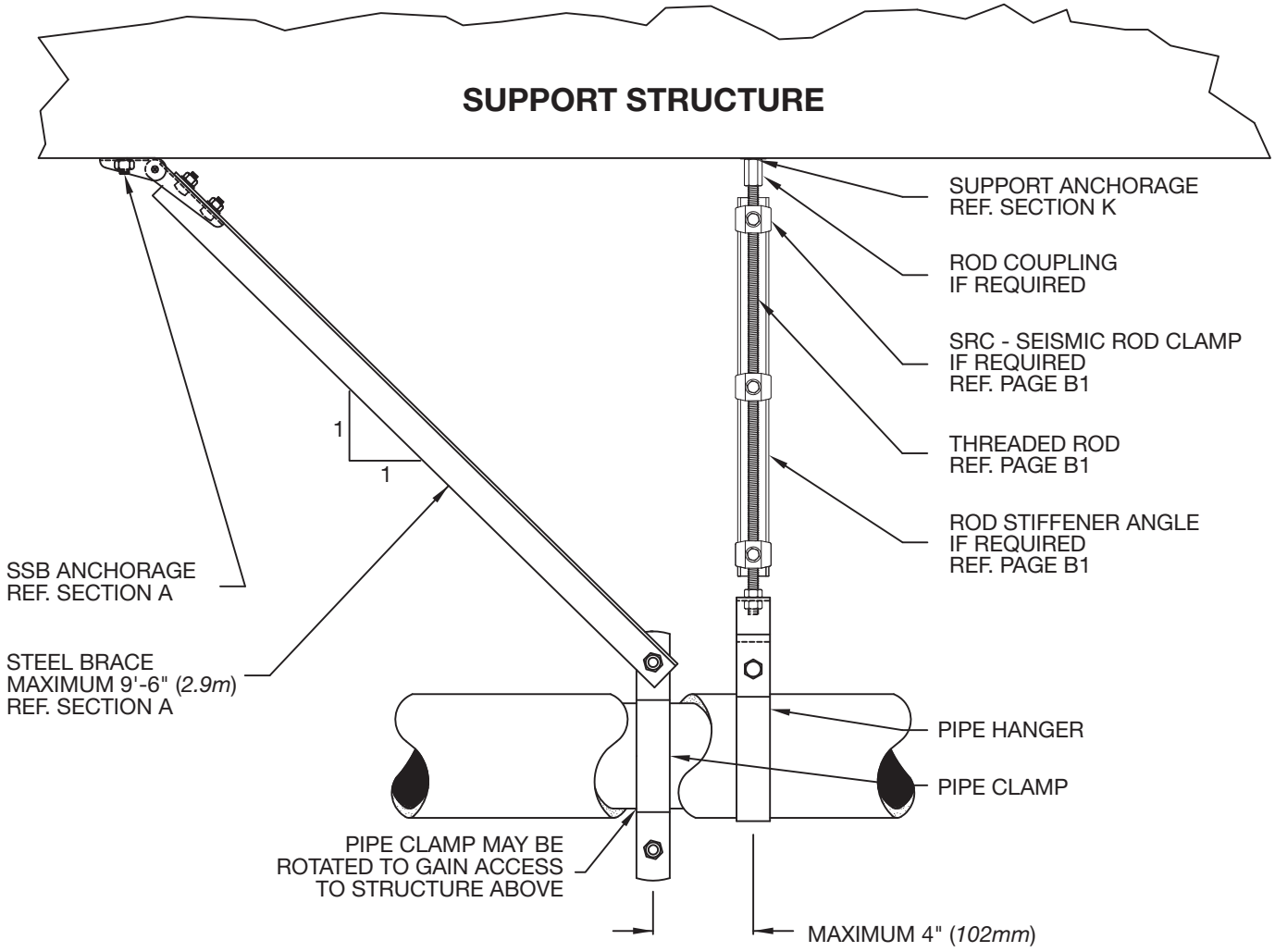
LONGITUDINAL SEISMIC SOLID BRACE GUIDELINES FOR CLEVIS SUPPORTED SYSTEMS



NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page B1. Brace angle ratio may be increased to 2 (vert): 1 (horiz.). Refer to section A for limitations.

NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

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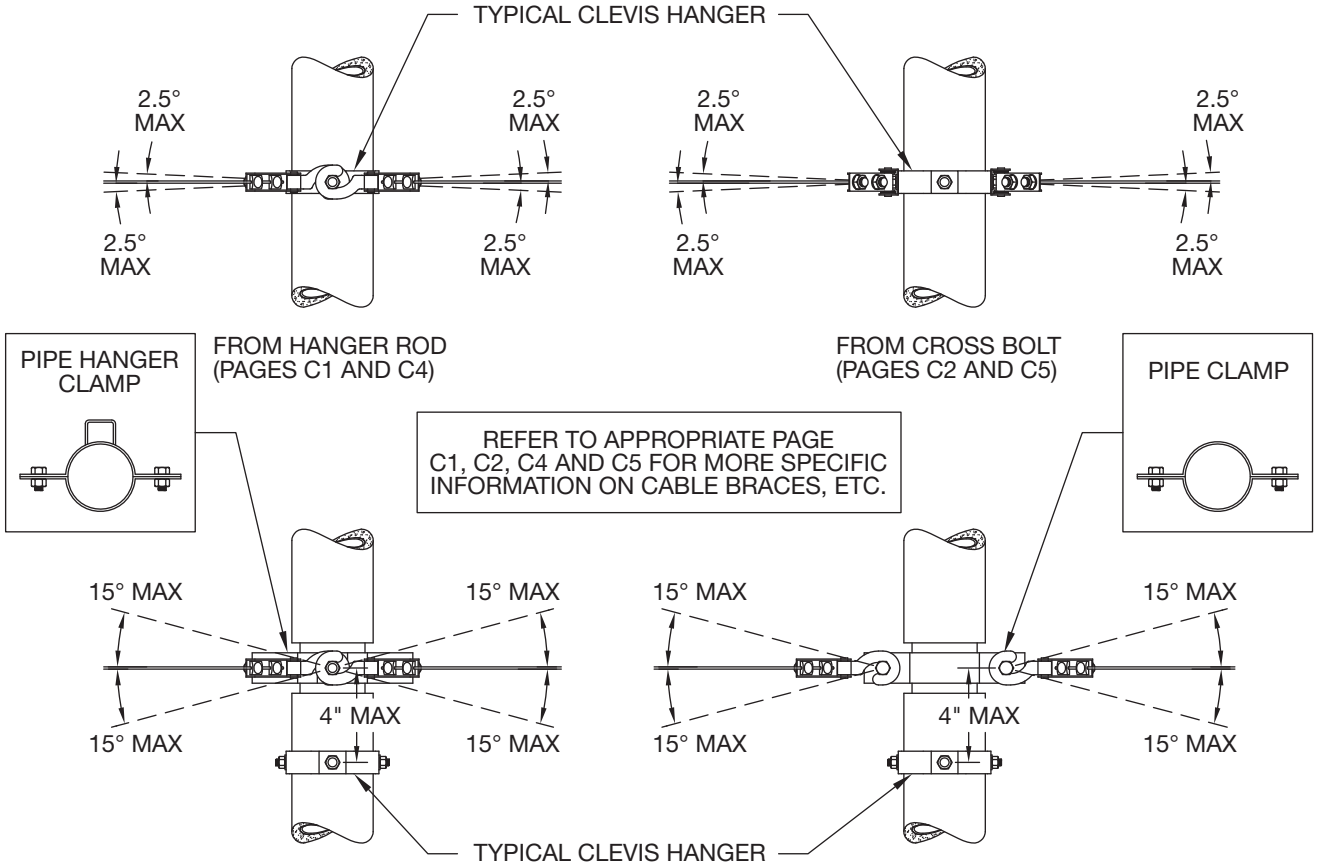
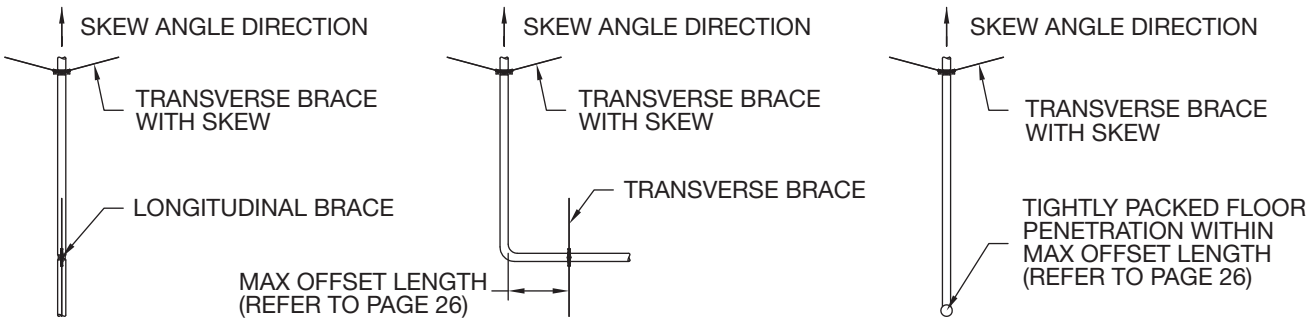
TRANSVERSE SEISMIC CABLE BRACE GUIDELINES
ALLOWABLE BRACE ANGLE VARIATIONS IN PLAN
FOR DETAIL PAGES C1, C2, C4 AND C5



The Angle variation may increase beyond 2.5° up to 15° provided both braces are attached to a pipe clamp, skewed in the same direction and a longitudinal brace occurs opposite the skewed angle direction as shown below.



NOTE: Any or all brace locations are permitted to use the angle variation to meet field conditions.

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Fixed Equipment Anchorage
Office of Statewide Health Planning and Development
OPA-0349
on
August 5, 2002
Anthony R. Pike **(916) 654-3362**

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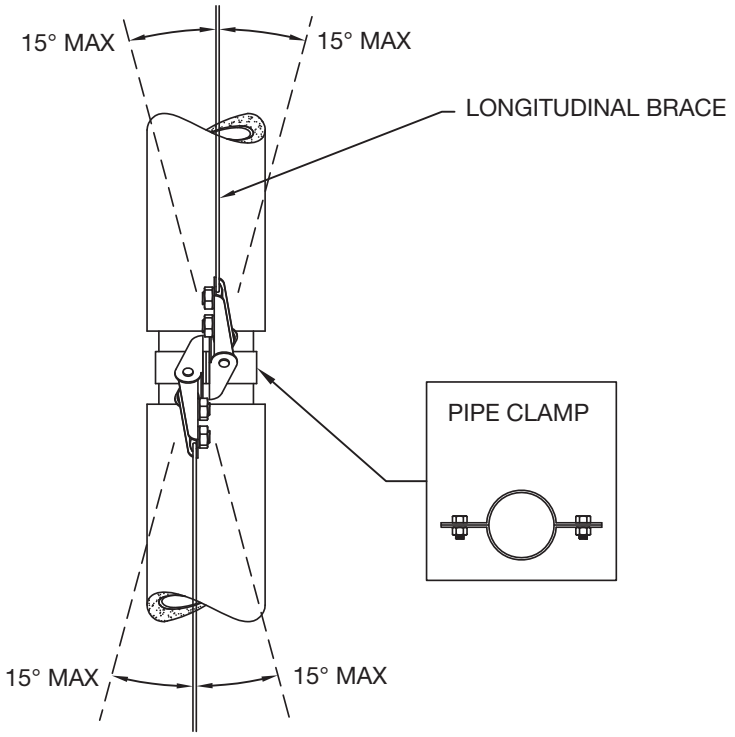
LONGITUDINAL SEISMIC CABLE BRACE GUIDELINES
ALLOWABLE BRACE ANGLE VARIATIONS IN PLAN
FOR DETAIL PAGES C3 AND C6



REFER TO APPROPRIATE PAGE
C3 AND C6 FOR MORE SPECIFIC
INFORMATION ON CABLE BRACES, ETC.

NOTE: Any or all brace locations are permitted to use the angle variation to meet field conditions.

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Office of Statewide Health Planning and Development

OPA-0349
on
August 5, 2002

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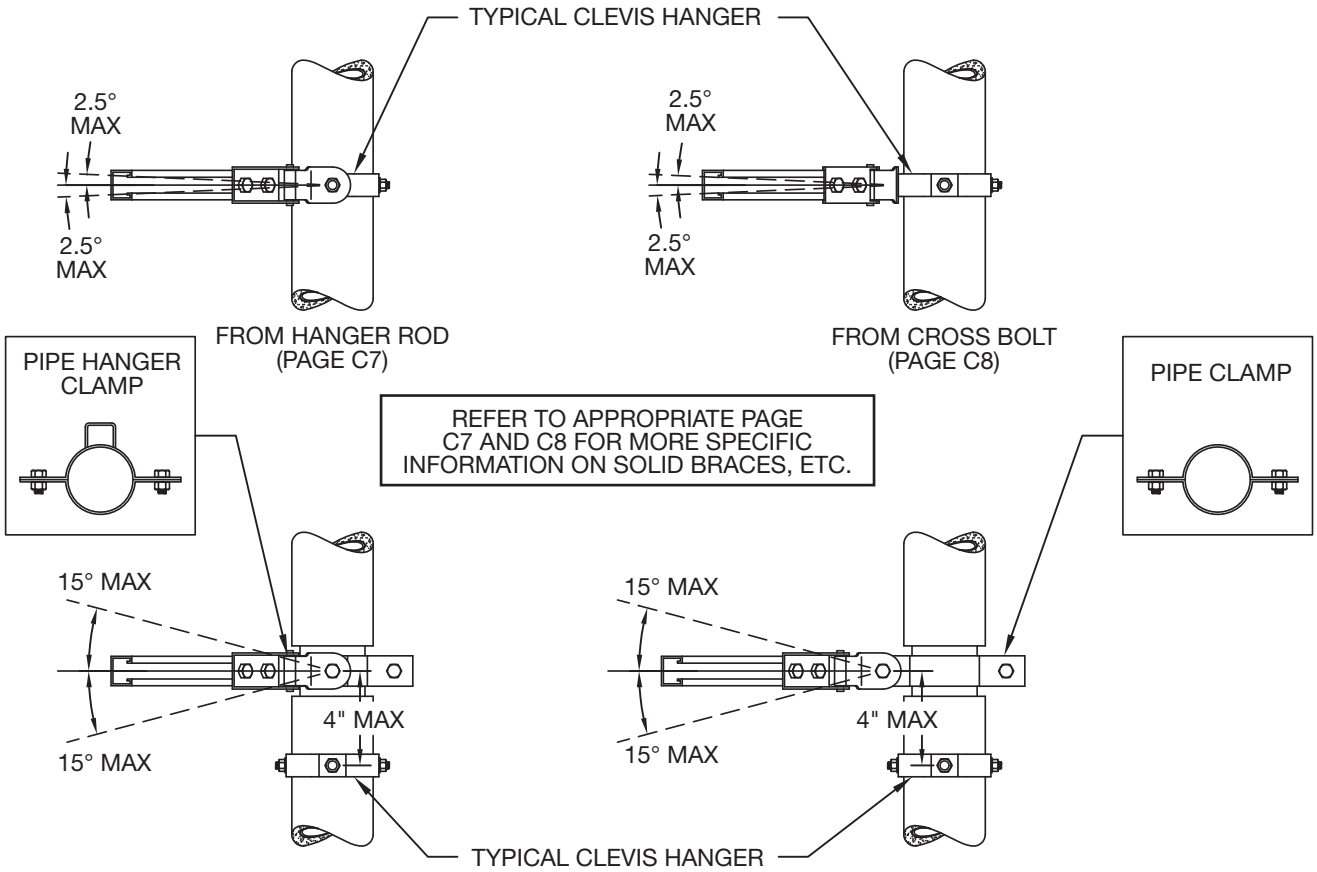
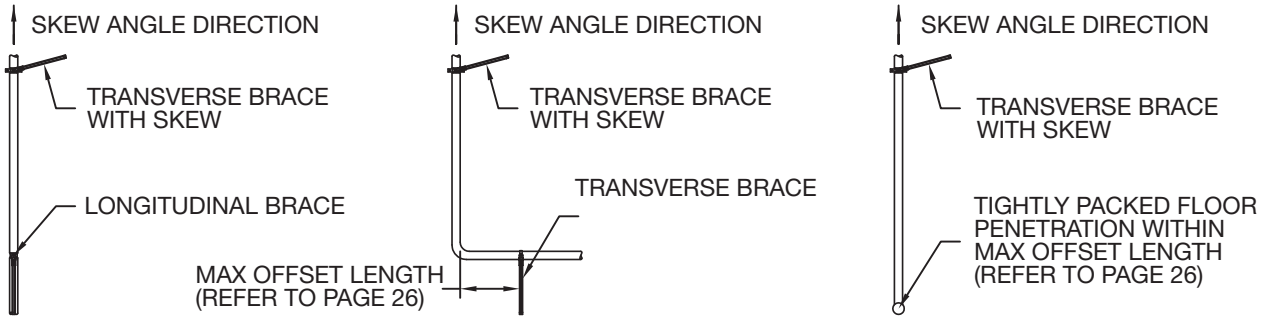
TRANSVERSE SEISMIC SOLID BRACE GUIDELINES
ALLOWABLE BRACE ANGLE VARIATIONS IN PLAN
FOR DETAIL PAGES C7 AND C8



The Angle variation may increase beyond 2.5° up to 15° provided the brace is attached to a pipe clamp and a longitudinal brace occurs opposite the skewed angle direction as shown below.



NOTE: Any or all brace locations are permitted to use the angle variation to meet field conditions.

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Fixed Equipment Anchorage
Office of Statewide Health Planning and Development
OPA-0349
on
January 31, 2008
Anthony R. Pike **(916) 654-3362**

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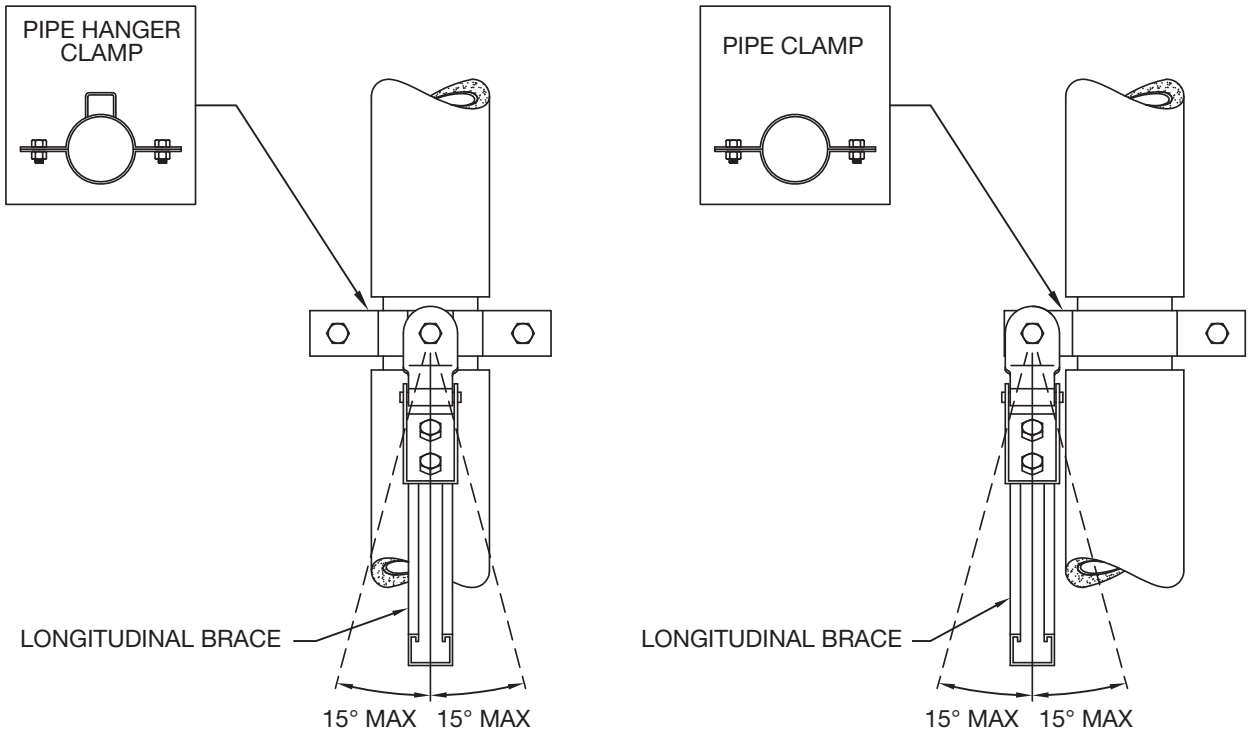
LONGITUDINAL SEISMIC SOLID BRACE GUIDELINES
ALLOWABLE BRACE ANGLE VARIATIONS IN PLAN
FOR DETAIL PAGE C9



REFER TO APPROPRIATE PAGE C9
FOR MORE SPECIFIC INFORMATION ON
CABLE BRACES, ETC.

NOTE: Any or all brace locations are permitted to use the angle variation to meet field conditions.

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Fixed Equipment Anchorage
Office of Statewide Health Planning and Development

OPA-0349
on
January 31, 2008

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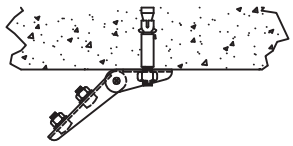
SEISMIC RESTRAINT GUIDELINES

INDIV./TRAPEZE SUPPORTED SYSTEMS

MINIMUM 3000 PSI STONE AGGREGATE CONCRETE SLAB EXPANSION ANCHORS



Maximum Weight per Foot (lbs.) for Specified 'g' Loads * at Maximum Transverse Brace Spacings (ft.) **									Option 1		Option 2		Concrete Anchors		
0.25g			0.5g			1.0g			SCB Size	Cable Dia. (in)	SSB/ SSBS Size	Minimum Brace Size (in)	Qty Req'd	Dia. (in)	Embed. (in)
20 ft.	30 ft.	40 ft.	20 ft.	30 ft.	40 ft.	20 ft.	30 ft.	40 ft.							
72	48	36	36	24	18	18	12	9	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	21/4
112	75	56	56	37	28	28	19	14	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	41/8
176	117	88	88	59	44	44	29	22	SCB-2	3/16	SSBS	15/8 x 15/8 Strut	1	5/8	51/8
248	165	124	124	83	62	62	41	31	SCB-3	1/4	SSB-3	L3 x 3 x 1/4	1	3/4	65/8
288	192	144	144	96	72	72	48	36	SCB-2	3/16	SSB-2	L3 x 3 x 1/4	2	5/8	51/8
440	293	220	220	147	110	110	73	55	SCB-3	1/4	SSB-3	L4 x 4 x 1/4	4	5/8	51/8
800	533	400	400	267	200	200	133	100	SCB-4	3/8	SSB-4	L4 x 4 x 1/4	4	5/8	51/8

* Maximum weight per foot for up to 1:1 brace angle from horizontal.
For up to 1.5:1 brace angle from horizontal, divide weight per foot by 1.75; for 2:1 brace angle, divide by 2.44.
Example: Reduce the maximum weight of 36 kg/m at 0.5 input for a 1.5:1 brace angle ratio as follows, 24/1.75 = 13 lbs/ft.

For maximum weight per foot at 'g' forces other than those listed, divide the 1.0g weight per foot by the desired 'g' force.
Example: Consider a 0.74g input, for a maximum weight of 12 lbs/ft from the 1.0g chart above, the adjusted weight per foot = 12/0.74 = 16 lbs/ft.

** For trapeze supported systems requiring SCB/SSBS to SCB/SSB-3 and SSB-4, the maximum longitudinal brace spacing = 2 times the maximum transverse spacing, not to exceed 80 feet. For trapeze supported systems requiring an SCB-4, install SCB-4s transversely and SCBH-3s longitudinally every 40 feet. For individually supported systems, the maximum longitudinal brace spacing = the maximum transverse brace spacing.

Special Note: The Structural Engineer of Record shall verify the seismic loads applied by the SCB/SSB/SSBS to the structure are acceptable. Refer to Pages H1, H2 and H3 for the maximum seismic loads.

NOTES:

Anchorage is based on attachment with an ITW Ramset/Red Head Trubolt Wedge Anchor, ICBO Report ER-1372/2000, Table 3, 4 and 5, Embed.ded headed stud or J-bolt of equal Embed.ment or approved equal.

Where (2) anchors are specified, the SCB, SSB or SSBS w/SLDB-2000 is required for attachment to structure. (Ref. Page H2 and X9)

Where (4) anchors are specified, the SCB or SSB w/SLDB-4000 is required for attachment to structure. (Ref. Page H3 and X10)

All SSB brace members tabulated are steel angle. Factory 12ga formed channel strut may be used in lieu of steel angle.

All SSBS brace members tabulated are 12ga strut channel.

(Ref. page X4)

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California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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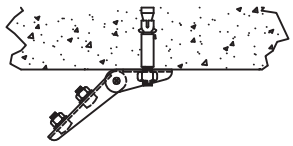
SEISMIC RESTRAINT GUIDELINES

INDIV./TRAPEZE SUPPORTED SYSTEMS

MINIMUM 20,680 kPa STONE AGGREGATE CONCRETE SLAB EXPANSION ANCHORS



Maximum Weight per Meter (*kg*) for Specified 'g' Loads * at Maximum Transverse Brace Spacings (*m*) **									Option 1		Option 2		Concrete Anchors		
0.25g			0.5g			1.0g			SCB Size	Cable Dia. (*mm*)	SSB/ SSBS Size	Minimum Brace Size (*mm*)	Qty Req'd	Dia. (*mm*)	Embed. (*mm*)
6m	9.1m	12.2m	6m	9.1m	12.2m	9.1m	9.1m	12.2m							
107	71	54	54	36	27	27	18	13	SCB-1	3	SSBS	41 x 41 Strut	1	13	57
167	111	83	83	56	42	42	28	21	SCB-1	3	SSBS	41 x 41 Strut	1	13	105
262	175	131	131	87	65	65	44	33	SCB-2	5	SSBS	41 x 41 Strut	1	16	130
369	246	185	185	123	92	92	62	46	SCB-3	6	SSB-3	L76 x 76 x 6	1	19	168
429	286	214	214	143	107	107	71	54	SCB-2	5	SSB-2	L76 x 76 x 6	2	16	130
655	437	327	327	218	164	164	109	82	SCB-3	6	SSB-3	L102 x 102 x 6	4	16	130
1191	794	595	595	397	298	298	198	149	SCB-4	10	SSB-4	L102 x 102 x 6	4	16	130

* Maximum weight per meter for up to 1:1 brace angle from horizontal.
For up to 1.5:1 brace angle from horizontal, divide weight per meter by 1.75; for 2:1 brace angle, divide by 2.44.
Example: Reduce the maximum weight of 36 kg/m at 0.5 input for a 1.5:1 brace angle ratio as follows, 36/1.75 = 20 kg/m.

For maximum weight per meter at 'g' forces other than those listed, divide the 1.0g weight per meter by the desired 'g' force.
Example: Consider a 0.74g input, for a maximum weight of 18 kg/m from the 1.0g chart above, the adjusted weight per meter = 18/0.74 = 24 kg/m.

** For trapeze supported systems requiring SCB/SSBS to SCB/SSB-3 and SSB-4, the maximum longitudinal brace spacing = 2 times the maximum transverse spacing, not to exceed 24.4 m. For trapeze supported systems requiring an SCB-4, install SCB-4s transversely and SCBH-3s longitudinally every 12.2 m. For individually supported systems, the maximum longitudinal brace spacing = the maximum transverse brace spacing.

Special Note: The Structural Engineer of Record shall verify the seismic loads applied by the SCB/SSBS to the structure are acceptable. Refer to Pages H1, H2 and H3 for the maximum seismic loads.

NOTES:

Anchorage is based on attachment with an ITW Ramset/Red Head Trubolt Wedge Anchor, ICBO Report ER-1372/2000, Table 3, 4 and 5, Embed.ded headed stud or J-bolt of equal Embed.ment or approved equal.

Where (2) anchors are specified, the SCB, SSB or SSBS w/SLDB-2000 is required for attachment to structure. (Ref. Page H2 and X9)

Where (4) anchors are specified, the SCB or SSB w/SLDB-4000 is required for attachment to structure. (Ref. Page H3 and X10)

All SSB brace members tabulated are steel angle. Factory 2.7 mm formed channel strut may be used in lieu of steel angle.

All SSBS brace members tabulated are 12ga strut channels.

(Ref. page X4)

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FIXED EQUIPMENT ANCHORAGE
OPA-0349 August 5, 2002

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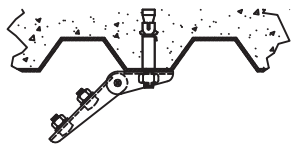
SEISMIC RESTRAINT GUIDELINES

INDIV./TRAPEZE SUPPORTED SYSTEMS

MINIMUM 3000 PSI LIGHTWEIGHT CONCRETE DECK EXPANSION ANCHORS



Maximum Weight per Foot (lbs.) for Specified 'g' Loads * at Maximum Transverse Brace Spacings (ft.) **									Option 1		Option 2		Concrete Anchors		
0.25g			0.5g			1.0g			SCB Size	Cable Dia. (in)	SSB/ SSBS Size	Minimum Brace Size (in)	Qty Req'd	Dia. (in)	Embed. (in)
20 ft.	30 ft.	40 ft.	20 ft.	30 ft.	40 ft.	20 ft.	30 ft.	40 ft.							
72	48	36	36	24	18	18	12	9	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	3
112	75	56	56	37	28	28	19	14	SCB-2	3/16	SSBS	15/8 x 15/8 Strut	1	5/8	5
96	64	48	48	32	24	24	16	12	SCB-3	1/4	SSB-3	L2 x 2 x 1/4	1	3/4	31/4
136	91	68	68	45	34	34	23	17	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	2	1/2	3
280	187	140	140	93	70	70	47	35	SCB-2	3/16	SSBS	15/8 x 15/8 Strut	2	5/8	5
440	293	220	220	147	110	110	73	55	SCB-3	1/4	SSB-3	L4 x 4 x 1/4	4	5/8	5
568	379	284	284	189	142	142	95	71	SCB-4	3/8	SSB-4	L4 x 4 x 1/4	4	5/8	5

* Maximum weight per foot for up to 1:1 brace angle from horizontal.
For up to 1.5:1 brace angle from horizontal, divide weight per foot by 1.8; for 2:1 brace angle, divide by 2.4.
Example: Reduce the maximum weight of 24 lbs/ft at 0.5g input for a 1.5:1 brace angle ratio as follows, 24/1.8 = 13 lbs/ft.

For maximum weight per foot at 'g' forces other than those listed, divide the 1.0g weight per foot by the desired 'g' force.
Example: Consider a 0.74g input, for a maximum weight of 12 lbs/ft from the 1.0g chart above, the adjusted weight per foot = 12/0.74 = 16 lbs/ft.

** For trapeze supported systems requiring SCB/SSBS to SCB/SSB-3 and SSB-4, the maximum longitudinal brace spacing = 2 times the maximum transverse spacing, not to exceed 80 feet. For trapeze supported systems requiring an SCB-4, install SCB-4s transversely and SCBH-3s longitudinally every 40 feet. For individually supported systems, the maximum longitudinal brace spacing = the maximum transverse brace spacing.

Special Note: The Structural Engineer of Record shall verify the seismic loads applied by the SCB/SSBS to the structure are acceptable. Refer to Pages H4, H5 and H6 for the maximum seismic loads.

NOTES:

Anchorage is based on attachment with an ITW Ramset/Red Head Trubolt Wedge Anchor, ICBO Report ER-1372/2000, Table 4, 5 and 10, Embed.ded headed stud or J-bolt of equal Embed.ment or approved equal.

Where (2) anchors are specified, the SCB, SSB or SSBS w/SLDB-2000 is required for attachment to structure. (Ref. Page H5 and X9)

Where (4) anchors are specified, the SCB or SSB w/SLDB-4000 is required for attachment to structure. (Ref. Page H6 and X10)

All SSB brace members tabulated are steel angle. Factory 12ga formed channel strut may be used in lieu of steel angle.

All SSB brace members tabulated are 12ga strut channels.

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California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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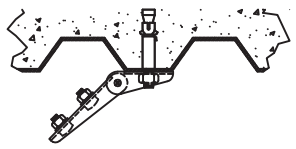
SEISMIC RESTRAINT GUIDELINES

INDIV./TRAPEZE SUPPORTED SYSTEMS

MINIMUM 20,680 kPa LIGHTWEIGHT CONCRETE DECK EXPANSION ANCHORS



Maximum Weight per Meter (*kg*) for Specified 'g' Loads * at Maximum Transverse Brace Spacings (*m*) **									Option 1		Option 2		Concrete Anchors		
0.25g			0.5g			1.0g			SCB Size	Cable Dia. (*mm*)	SSB Size	Minimum Brace Size (*mm*)	Qty Req'd	Dia. (*mm*)	Embed. (*mm*)
6.1m	9.1m	12.2m	6.1m	9.1m	12.2m	6.1m	9.1m	12.2m							
107	71	54	54	36	27	27	18	13	SCB-1	3	SSBS	41 x 41 Strut	1	13	76
167	111	83	83	56	42	42	28	21	SCB-2	5	SSBS	41 x 41 Strut	1	16	127
143	95	71	71	48	36	36	24	18	SCB-3	6	SSB-3	L51 x 51 x 6	1	19	83
202	135	101	101	67	51	51	34	25	SCB-1	3	SSBS	41 x 41 Strut	2	13	76
417	278	208	208	139	104	104	69	52	SCB-2	5	SSBS	41 x 41 Strut	2	16	127
655	437	327	327	218	164	164	109	82	SCB-3	6	SSB-3	L102 x 102 x 6	4	16	127
845	564	423	423	282	211	211	141	106	SCB-4	10	SSB-4	L102 x 102 x 6	4	16	127

* Maximum weight per meter for up to 1:1 brace angle from horizontal.
For up to 1.5:1 brace angle from horizontal, divide weight per meter by 1.8; for 2:1 brace angle, divide by 2.4.
Example: Reduce the maximum weight of 36 kg/m at 0.5 input for a 1.5:1 brace angle ratio as follows, 36/1.8 = 20 kg/m

For maximum weight per meter at 'g' forces other than those listed, divide the 1.0g weight per meter by the desired 'g' force.
Example: Consider a 0.74g input, for a maximum weight of 21 kg/m from the 1.0g chart above, the adjusted weight per meter = 21/0.74 = 28 kg/m.

** For trapeze supported systems requiring SCB/SSB/SSBS to SCB/SSB-3 and SSB-4, the maximum longitudinal brace spacing = 2 times the maximum transverse spacing, not to exceed 24.4 m. For trapeze supported systems requiring an SCB-4, install SCB-4s transversely and SCBH-3s longitudinally every 12.2 m. For individually supported systems, the maximum longitudinal brace spacing = the maximum transverse brace spacing.

Special Note: The Structural Engineer of Record shall verify the seismic loads applied by the SCB/SSB/SSBS to the structure are acceptable. Refer to Pages H4, H5 and H6 for the maximum seismic loads.

NOTES:

Anchorage is based on attachment with an ITW Ramset/Red Head Trubolt Wedge Anchor, ICBO Report ER-1372/2000, Table 4, 5 and 10, Embed.ded headed stud or J-bolt of equal Embed.ment or approved equal.

Where (2) anchors are specified, the SCB, SSB or SSBS w/SLDB-2000 is required for attachment to structure. (Ref. Page H5 and X9)

Where (4) anchors are specified, the SCB or SSB w/SLDB-4000 is required for attachment to structure. (Ref. Page H6 and X10)

All SSB brace members tabulated are steel angle. Factory 2.7 mm formed channel strut may be used in lieu of steel angle.

All SSBS brace members tabulated are 12ga strut channels.

(Ref. page X4)

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California Office of Statewide Health Planning and Development
FIXED EQUIPMENT ANCHORAGE
OPA-0349 August 5, 2002

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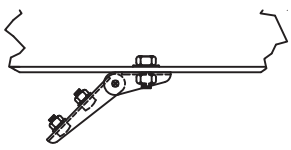
SEISMIC RESTRAINT GUIDELINES

INDIV./TRAPEZE SUPPORTED SYSTEMS

STRUCTURAL STEEL BEAM OR MEMBER A307 BOLT OR 70XX WELD



Maximum Weight per Foot (lbs.) for Specified 'g' Loads * at Maximum Transverse Brace Spacings (ft.) **									Option 1		Option 2		Steel Bolt		Weld Size (*mm*)
0.25g			0.5g			1.0g			SCB Size	Cable Dia. (in)	SSB/ SSBS Size	Minimum Brace Size (in)	Qty Req'd	Dia. (*mm*)	
20 ft.	30 ft.	40 ft.	20 ft.	30 ft.	40 ft.	20 ft.	30 ft.	40 ft.							
136	91	68	68	45	34	34	23	17	SCB-1	1/8	SSBS	1 5/8 x 1 5/8 Strut	1	1/2	1/8
288	192	144	144	96	72	72	48	36	SCB-2	3/16	SSBS	1 5/8 x 1 5/8 Strut	1	5/8	1/8
440	293	220	220	147	110	110	73	55	SCB-3	1/4	SSB-3	L4 x 4 x 1/4	1	3/4	3/16
888	592	444	444	296	222	222	148	111	SCB-4	3/8	SSB-4	L4 x 4 x 1/4	1	1 1/4	3/16

* Maximum weight per foot for up to 1:1 brace angle from horizontal.
For up to 1.5:1 brace angle from horizontal, divide weight per foot by 1.5; for 2:1 brace angle, divide by 2.
Example: Reduce the maximum weight of 45 lbs/ft at 0.5g input for a 1.5:1 brace angle ratio as follows, 45/1.5 = 30 lbs/ft.

For maximum weight per foot at 'g' forces other than those listed, divide the 1.0g weight per foot by the desired 'g' force.
Example: Consider a 0.74g input, for a maximum weight of 17 lbs/ft from the 1.0g chart above, the adjusted weight per foot = 17/0.74 = 22 lbs/ft.

** For trapeze supported systems requiring SCB/SSBS to SCB/SSB-3 and SSB-4, the maximum longitudinal brace spacing = 2 times the maximum transverse spacing, not to exceed 80 feet. For trapeze supported systems requiring an SCB-4, install SCB-4s transversely and SCBH-3s longitudinally every 40 feet. For individually supported systems, the maximum longitudinal brace spacing = the maximum transverse brace spacing.

Special Note: The Structural Engineer of Record shall verify the seismic loads applied by the SCB/SSB/SSBS to the structure are acceptable. Refer to Pages H7 to H12 for the maximum seismic loads.

NOTES:
Anchorage is based on attachment with a Standard ASTM A307 Quality Bolts or E70xx Electrode Welds.
All SSB brace members tabulated are steel angle. Factory 12ga formed channel strut may be used in lieu of steel angle.
All SSBS brace members tabulated are 12ga strut channels.

(Ref. page X4)

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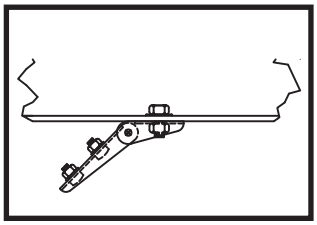
SEISMIC RESTRAINT GUIDELINES

INDIV./TRAPEZE SUPPORTED SYSTEMS

STRUCTURAL STEEL BEAM OR MEMBER A307 BOLT OR 70XX WELD



Maximum Weight per Meter (*kg*) for Specified 'g' Loads * at Maximum Transverse Brace Spacings (*m*) **									Option 1		Option 2		Steel Bolt		Weld Size (*mm*)
0.25g			0.5g			1.0g			SCB Size	Cable Dia. (*mm*)	SSB/ SSBS Size	Minimum Brace Size (*mm*)	Qty Req'd	Dia. (*mm*)	
6.1m	9.1m	12.2m	6.1m	9.1m	12.2m	6.1m	9.1m	12.2m							
202	135	101	101	67	51	51	34	25	SCB-1	3	SSBS	41 x 41 Strut	1	13	3
429	286	214	214	143	107	107	71	54	SCB-2	5	SSBS	41 x 41 Strut	1	16	3
655	437	327	327	218	164	164	109	82	SCB-3	6	SSB-3	L102 x 102 x 6	1	19	5
1321	881	661	661	440	330	330	220	165	SCB-4	10	SSB-4	L102 x 102 x 6	1	32	5

* Maximum weight per meter for up to 1:1 brace angle from horizontal.
For up to 1.5:1 brace angle from horizontal, divide weight per meter by 1.5; for 2:1 brace angle, divide by 2.
Example: Reduce the maximum weight of 67 kg/m at 0.5g input for a 1.5:1 brace angle ratio as follows, 67/1.5 = 44 kg/m.

For maximum weight per meter at 'g' forces other than those listed, divide the 1.0g weight per meter by the desired 'g' force.
Example: Consider a 0.74g input, for a maximum weight of 54 kg/m from the 1.0g chart above, the adjusted weight per meter = 54/0.74 = 72 kg/m.

** For trapeze supported systems requiring SCB/SSBS to SCB/SSB-3 and SSB-4, the maximum longitudinal brace spacing = 2 times the maximum transverse spacing, not to exceed 24.4 m. For trapeze supported systems requiring an SCB-4, install SCB-4s transversely and SCBH-3s longitudinally every 12.2 m. For individually supported systems, the maximum longitudinal brace spacing = the maximum transverse brace spacing.

Special Note: The Structural Engineer of Record shall verify the seismic loads applied by the SCB/SSB/SSBS to the structure are acceptable. Refer to Pages H7 to H12 for the maximum seismic loads.

NOTES:
Anchorage is based on attachment with a Standard ASTM A307 Quality Bolts or E70xx Electrode Welds.
All SSB brace members tabulated are steel angle. Factory 2.7 mm formed channel strut may be used in lieu of steel angle.
All SSB brace members tabulated are 12ga strut channel.

(Ref. page X4)

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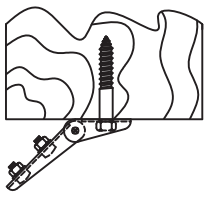
SEISMIC RESTRAINT GUIDELINES

INDIV./TRAPEZE SUPPORTED SYSTEMS

STRUCTURAL WOOD BEAM OR MEMBER LAG BOLT



Maximum Weight per Foot (lbs.) for Specified 'g' Loads * at Maximum Transverse Brace Spacings (ft.) **									Option 1		Option 2		Lag Screw		
0.25g			0.5g			1.0g			SCB Size	Cable Dia. (in)	SSB/ SSBS Size	Minimum Brace Size (in)	Qty Req'd	Dia. (in)	Embed. (in)
20 ft.	30 ft.	40 ft.	20 ft.	30 ft.	40 ft.	20 ft.	30 ft.	40 ft.							
48	32	24	24	16	12	12	8	6	SCB-1	1/8	SSBS	15/8 x 15/8 Strut	1	1/2	4
72	48	36	36	24	18	18	12	9	SCB-2	3/16	SSBS	15/8 x 15/8 Strut	1	5/8	5
96	64	48	48	32	24	24	16	12	SCB-3	1/4	SSB-3	L4 x 4 x 1/4	1	3/4	6

* Maximum weight per foot for up to 1:1 brace angle from horizontal.
For up to 1.5:1 brace angle from horizontal, divide weight per foot by 1.5; for 2:1 brace angle, divide by 2.
Example: Reduce the maximum weight of 16 lbs/ft at 0.5g input for a 1.5:1 brace angle ratio as follows, 16/1.5 = 10 lbs/ft.

For maximum weight per foot at 'g' forces other than those listed, divide the 1.0g weight per foot by the desired 'g' force.
Example: Consider a 0.74g input, for a maximum weight of 12 lbs/ft from the 1.0g chart above, the adjusted weight per foot = 12/0.74 = 16 lbs/ft.

** For trapeze supported systems, the maximum longitudinal brace spacing is 2 times the transverse brace spacing not to exceed 80 feet. For individually supported systems, the maximum longitudinal brace spacing = the maximum transverse brace spacing.

Special Note: The Structural Engineer of Record shall verify the seismic loads applied by the SCB/SSB/SSBS to the structure are acceptable. Refer to Page H13 for the maximum seismic loads.

NOTES:
Anchorage is based on attachment with Lag Screws, 1991 National Design Specification Tables 9.2A & 9.3B.
All SSB brace members tabulated are steel angle. Factory 12ga formed channel strut may be used in lieu of steel angle.
All SSBS brace members tabulated are 12ga strut channel.

(Ref. page X4)

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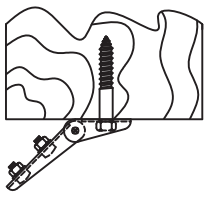
SEISMIC RESTRAINT GUIDELINES

INDIV./TRAPEZE SUPPORTED SYSTEMS

STRUCTURAL WOOD BEAM OR MEMBER LAG BOLT



Maximum Weight per Meter (kg) for Specified 'g' Loads * at Maximum Transverse Brace Spacings (m) **									Option 1		Option 2		Lag Screw		
0.25g			0.5g			1.0g			SCB Size	Cable Dia. (mm)	SSB/ SSBS Size	Minimum Brace Size (mm)	Qty Req'd	Dia. (mm)	Embed. (mm)
6.1m	9.1m	12.2m	6.1m	9.1m	12.2m	6.1m	9.1m	12.2m							
71	48	36	36	24	18	18	12	9	SCB-1	3	SSBS	41 x 41 Strut	1	13	102
107	71	54	54	36	27	27	18	13	SCB-2	5	SSBS	41 x 41 Strut	1	16	127
143	95	71	71	48	36	36	24	18	SCB-3	6	SSB-3	L102 x 102 x 6	1	19	152

* Maximum weight per meter for up to 1:1 brace angle from horizontal.
For up to 1.5:1 brace angle from horizontal, divide weight per meter by 1.5; for 2:1 brace angle, divide by 2
Example: Reduce the maximum weight of 24 kg/m at 0.5g input for a 1.5:1 brace angle ratio as follows, 24/1.5 = 16 kg/m.

For maximum weight per meter at 'g' forces other than those listed, divide the 1.0g weight per meter by the desired 'g' force.
Example: Consider a 0.74g input, for a maximum weight of 18 kg/m from the 1.0g chart above, the adjusted weight per meter = 18/0.74 = 24 kg/m.

** For trapeze supported systems, the maximum longitudinal brace spacing is 2 times the transverse spacing not to exceed 24.4 m. For individually supported systems, the maximum longitudinal brace spacing = the maximum transverse brace spacing.

Special Note: **The Structural Engineer of Record shall verify the seismic loads applied by the SCB/SSB/SSBS to the structure are acceptable. Refer to Page H13 for the maximum seismic loads.**

NOTES:
Anchorage is based on attachment with Lag Screws, 1991 National Design Specification Tables 9.2A & 9.3B.
All SSB brace members tabulated are steel angle. Factory 2.7 mm formed channel strut may be used in lieu of steel angle.
All SSBS brace members tabulated are 12ga strut channel.

(Ref. page X4)

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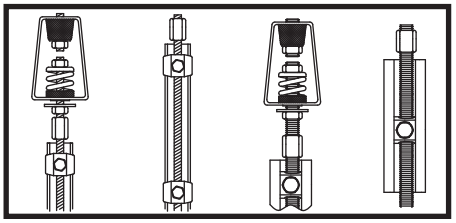
VERTICAL ROD STIFFENER GUIDELINES

INDIV./TRAPEZE SUPPORTED SYSTEMS

SEISMIC ROD CLAMPS
ROD DIAMETERS: 1/2 to 1 1/4"



SCB or SSB Size	Support Rod Dia. (in)	Maximum Unbraced Rod Length (in)	Maximum Braced Rod Length (in)	SRC Size	UC Size	Max. Spacing (in)	Angle Brace Size (in)	Strut Channel Size
0	3/8	13	96	1	1	22	1 x 1 x 1/8	
1	1/2	19	96	1	1	31	1 x 1 x 1/8	
	1/2	19	120	1 1/2	1	31	1 1/2 x 1 1/2 x 1/4	15/8 x 15/8 x 12 GAUGE
	5/8	31	96	1	2	39	1 x 1 x 1/8	
	5/8	31	120	1 1/2	2	39	1 1/2 x 1 1/2 x 1/4	
2	5/8	21	96	1	2	39	1 x 1 x 1/8	
	3/4	32	144	1 1/2	2	48	1 1/2 x 1 1/2 x 1/4	
	7/8	44	132	1 1/2		56	1 1/2 x 1 1/2 x 1/4	
	7/8	44	144	2		56	2 x 2 x 1/4	
3	3/4	26	144	1 1/2	2	48	1 1/2 x 1 1/2 x 1/4	15/8 x 15/8 x 12 GAUGE
	7/8	36	132	1 1/2		56	1 1/2 x 1 1/2 x 1/4	
	7/8	36	144	2		56	2 x 2 x 1/4	
	1	47	144	2		65	2 x 2 x 1/4	
	1 1/8	59	144	2		73	2 x 2 x 1/4	
4	1	33	144	2		65	2 x 2 x 1/4	
	1 1/8	42	144	2		73	2 x 2 x 1/4	
	1 1/4	54	144	2		82	2 x 2 x 1/4	

NOTES:
Rod stiffeners are only required at the seismic restraint locations.
Rod stiffeners are required when the length of the rod exceeds the maximum unbraced length.
A minimum of (2) rod clamps are required per support rod to attach the "Angle or Strut Channel Brace" to the support rod.

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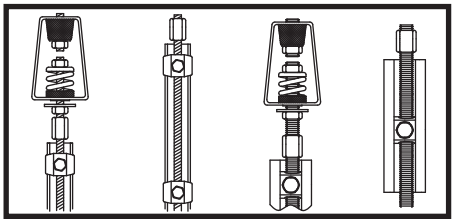
VERTICAL ROD STIFFENER GUIDELINES

INDIV./TRAPEZE SUPPORTED SYSTEMS

SEISMIC ROD CLAMPS
ROD DIAMETERS: 13 to 32 mm



SCB or SSB Size	Support Rod Dia. (*mm*)	Maximum Unbraced Rod Length (*mm*)	Maximum Braced Rod Length (*mm*)	SRC Size	UC Size	Max. Spacing (*mm*)	Angle Brace Size (*mm*)	Strut Channel Size (*mm*)
0	10	330	2438	1	1	558	25 x 25 x 3	41 x 41 x 2.5
1	13	483	2438	1	1	787	25 x 25 x 3	41 x 41 x 2.5
	13	483	3048	11/2	1	787	38 x 38 x 6	41 x 41 x 2.5
	16	787	2438	1	2	991	25 x 25 x 3	41 x 41 x 2.5
	16	787	3048	11/2	2	991	38 x 38 x 6	41 x 41 x 2.5
2	16	533	2438	1	2	991	25 x 25 x 3	41 x 41 x 2.5
	19	813	3658	11/2	2	1219	38 x 38 x 6	41 x 41 x 2.5
	22	1118	3353	11/2		1422	38 x 38 x 6	
	22	1118	3658	2		1422	51 x 51 x 6	
3	19	660	3658	11/2	2	1219	38 x 38 x 6	41 x 41 x 2.5
	22	914	3353	11/2		1422	38 x 38 x 6	
	22	914	3658	2		1422	51 x 51 x 6	
	25	1194	3658	2		1651	51 x 51 x 6	
	29	1499	3658	2		1854	51 x 51 x 6	
4	25	838	3658	2		1651	51 x 51 x 6	
	29	1067	3658	2		1854	51 x 51 x 6	
	32	1372	3658	2		2083	51 x 51 x 6	

NOTES:
Rod stiffeners are only required at the seismic restraint locations.
Rod stiffeners are required when the length of the rod exceeds the maximum unbraced length.
A minimum of (2) rod clamps are required per support rod to attach the “Angle or Strut Channel Brace” to the support rod.

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APPROVED
California Office of Statewide Health Planning and Development
FIXED EQUIPMENT ANCHORAGE
OPA-0349 August 5, 2002

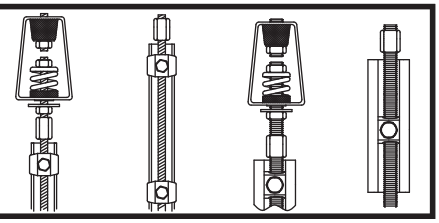
Bill Staehlin (916) 654-3362

Dhiru Mali
Structural Engineer
California SE No. 2811

VERTICAL ROD STIFFENER GUIDELINES

INDIV./TRAPEZE SUPPORTED SYSTEMS

SEISMIC ROD CLAMPS
ROD DIAMETERS: 3/8 to 11/4”



Support Rod Dia. (in)	Maximum Weight per Foot(lbs.) for Specified ‘g’ Loads * 0.25g	0.5g	1.0g	Maximum Unbraced Rod Length** (in)	Maximum Braced Rod Length (in)	SRC Size	UC Size	Max. Spacing (in)	Angle Brace Size (in)	Strut Channel Size
3/8	20	10	5	19	96	1	1	22	1 x 1 x 1/8	
3/8	40	20	10	13	96	1	1	22	1 x 1 x 1/8	
1/2	40	20	10	25	96	1	1	31	1 x 1 x 1/8	
1/2	124	62	31	14	96	1	1	31	1 x 1 x 1/8	
5/8	60	30	15	33	96	1	2	39	1 x 1 x 1/8	
5/8	144	72	36	21	96	1	2	39	1 x 1 x 1/8	15/8 x 15/8 x 12 GAUGE
1/2	80	40	20	18	120	11/2	1	31	11/2 x 11/2 x 1/4	
1/2	120	60	30	14	120	11/2	1	31	11/2 x 11/2 x 1/4	
5/8	80	40	20	29	120	11/2	2	39	11/2 x 11/2 x 1/4	
5/8	132	66	33	22	120	11/2	2	39	11/2 x 11/2 x 1/4	
3/4	100	50	25	38	144	11/2	2	48	11/2 x 11/2 x 1/4	
3/4	248	124	62	24	144	11/2	2	48	11/2 x 11/2 x 1/4	
7/8	160	80	40	42	132	11/2		56	11/2 x 11/2 x 1/4	
7/8	460	230	115	25	132	11/2		56	11/2 x 11/2 x 1/4	
1	200	100	50	50	132	11/2		65	11/2 x 11/2 x 1/4	
1	500	250	125	31	132	11/2		65	11/2 x 11/2 x 1/4	
7/8	160	80	40	42	144	2		56	2 x 2 x 1/4	
7/8	440	220	110	25	144	2		56	2 x 2 x 1/4	
1	200	100	50	50	144	2		65	2 x 2 x 1/4	
1	500	250	125	31	144	2		65	2 x 2 x 1/4	
11/8	240	120	60	57	144	2		73	2 x 2 x 1/4	
11/8	500	250	125	39	144	2		73	2 x 2 x 1/4	
11/4	300	150	75	65	144	2		82	2 x 2 x 1/4	
11/4	500	250	125	51	144	2		82	2 x 2 x 1/4	

* Based on 40 foot brace spacing. For 20 and 30 foot brace spacing, multiply the weight per foot by 2 and 1.33, respectively. For maximum weight per foot at ‘g’ forces other than those listed, divide the 1.0g weight per foot by the desired ‘g’ force. Example: Consider a 0.74g input, for a maximum weight of 10 lbs/ft from the 1.0g chart above, the adjusted weight per foot = 10/0.74 = 13 lbs/ft.

** For maximum unbraced rod length at a maximum weight per foot other than those listed, interpolate between maximum unbraced rod lengths of equal diameter.
Example: Consider maximum weights per foot of 75 and 125 with respective maximum unbraced rod lengths of 65 and 51. For 100 lbs/ft., the maximum unbraced rod length = 58".

NOTES:
Rod stiffeners are only required at the seismic restraint locations.
Rod stiffeners are required when the length of the rod exceeds the maximum unbraced length.
A minimum of (2) rod clamps are required per support rod to attach the “Angle or Strut Channel Brace” to the support rod.

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California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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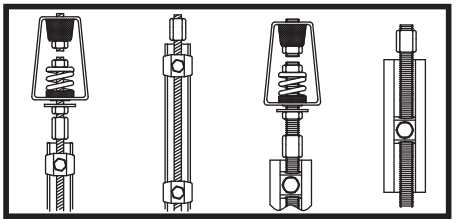
VERTICAL ROD STIFFENER GUIDELINES

INDIVIDUALLY SUPPORTED SYSTEMS

SEISMIC ROD CLAMPS
ROD DIAMETERS: 10 to 32 mm



Support Rod Dia. (*mm*)	Maximum Weight per Meter (*kg*) for Specified 'g' Loads *			Maximum Unbraced Rod Length** (*mm*)	Maximum Braced Rod Length (*mm*)	SRC Size	UC Size	Max. Spacing (*mm*)	Angle Brace Size (*mm*)	Strut Channel Size (*mm*)
	0.25g	0.5g	1.0g							
10	29	14	7	483	2438	1	1	559	25 x 25 x 3	41 x 41 x 2.5
10	59	29	14	330	2438	1	1	559	25 x 25 x 3	
13	59	29	14	635	2438	1	1	787	25 x 25 x 3	
13	184	92	46	356	2439	1	1	787	25 x 25 x 3	
16	89	44	22	838	2438	1	2	991	25 x 25 x 3	
16	214	107	53	533	2438	1	2	991	25 x 25 x 3	
13	119	59	29	457	3048	1 1/2	1	787	38 x 38 x 6	
13	178	89	44	356	3048	1 1/2	1	787	38 x 38 x 6	
16	119	59	29	737	3048	1 1/2	2	991	38 x 38 x 6	
16	196	98	49	559	3048	1 1/2	2	991	38 x 38 x 6	
19	148	74	37	965	3658	1 1/2	2	1219	38 x 38 x 6	
19	369	184	92	610	3658	1 1/2	2	1219	38 x 38 x 6	
22	238	119	59	1067	3353	1 1/2		1422	38 x 38 x 6	
22	684	342	171	635	3353	1 1/2		1422	38 x 38 x 6	
25	297	148	74	1270	3353	1 1/2		1651	38 x 38 x 6	
25	744	372	186	787	3353	1 1/2		1651	38 x 38 x 6	
22	238	119	59	1067	3658	2		1422	51 x 51 x 6	
22	654	327	163	635	3658	2		1422	51 x 51 x 6	
25	297	148	74	1270	3658	2		1651	51 x 51 x 6	
25	744	372	186	787	3658	2		1651	51 x 51 x 6	
29	357	178	89	1448	3658	2		1854	51 x 51 x 6	
29	744	372	186	991	3658	2		1854	51 x 51 x 6	
32	446	223	111	1651	3658	2		2083	51 x 51 x 6	
32	744	372	186	1295	3658	2		2083	51 x 51 x 6	

* Based on 12.2 meter brace spacing. For 6.1 and 9.1 meter brace spacing, multiply the weight per meter by 2 and 1.33, respectively. For maximum weight per meter at 'g' forces other than those listed, divide the 1.0g weight per meter by the desired 'g' force. Example: Consider a 0.74g input, for a maximum weight of 14 kg/m from the 1.0g chart above, the adjusted weight per meter = 14/0.74 = 18 kg/m.

** For maximum unbraced rod length at a maximum weight per meter other than those listed, interpolate between maximum unbraced rod lengths of equal diameter.
Example: Consider maximum weights per meter of 111 and 186 with respective maximum unbraced rod lengths of 1651 and 1295. For 148.5 kg/m, the maximum unbraced rod length = 1473 mm.

NOTES:
Rod stiffeners are only required at the seismic restraint locations.
Rod stiffeners are required when the length of the rod exceeds the maximum unbraced length.
A minimum of (2) rod clamps are required per support rod to attach the "Angle or Strut Channel Brace" to the support rod.

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FIXED EQUIPMENT ANCHORAGE
OPA-0349 August 5, 2002

Bill Staehlin (916) 654-3362

Dhiru Mali
Structural Engineer
California SE No. 2811

TRAPEZE SUPPORT GUIDELINES

Trapeze Span (in)	Trapeze Steel	Maximum Uniform Load (lbs)	Vertical Deflection at Load (in)
12	A	3380	0.01
	Double A	9530	0.01
	B	10415	0.01
	C	1700	0.01
	D	3250	0.01
24	A	1690	0.06
	Double A	4765	0.03
	B	5205	0.03
	D	1600	0.03
	E	3800	0.02
36	A	1120	0.13
	Double A	3175	0.07
	B	3470	0.07
	Double B	10620	0.04
	E	2550	0.04
48	A	845	0.23
	Double A	2380	0.13
	B	2600	0.12
	Double B	7965	0.06
	E	1900	0.08
60	A	675	0.35
	Double A	1905	0.20
	B	2080	0.19
	Double B	6370	0.10
	F	2800	0.09

Trapeze Span (in)	Trapeze Steel	Maximum Uniform Load (lbs)	Vertical Deflection at Load (in)
72	A	560	0.50
	Double A	1585	0.29
	B	1735	0.27
	Double B	5310	0.14
	F	2300	0.13
84	A	480	0.69
	Double A	1360	0.39
	B	1485	0.36
	Double B	4550	0.20
	G	2700	0.22
96	A	420	0.90
	Double A	1190	0.51
	B	1300	0.47
	Double B	3980	0.26
	H	5000	0.26
108	A	375	1.14
	Double A	1055	0.64
	B	1155	0.60
	Double B	3540	0.32
	J	7500	0.28
120	A	335	1.40
	Double A	950	0.80
	B	1040	0.74
	Double B	3185	0.40
	K	10000	0.30

NOTES:
1. When loads are concentrated near midspan, allowable loads shall be multiplied by 0.5 and deflections by 0.8.
2. Calculations based on section properties tabulated below.

TRAPEZE STEEL DESCRIPTION

Trapeze Steel	Steel Description	Weight (lbs/ft)	Area (in^2)	Ixx (in^4)	Sxx (in^3)	rx (in)	Iyy (in^4)	Syy (in^3)	ry (in)
A	15/8 x 15/8 Strut	1.90	0.555	0.186	0.203	0.579	0.239	0.294	0.655
Double A	15/8 x 15/8 Strut	3.80	1.110	0.930	0.572	0.915	0.478	0.588	0.656
B	15/8 x 31/4 Strut	3.05	0.896	1.094	0.625	1.105	0.436	0.537	0.697
Double B	15/8 x 31/4 Strut	6.10	1.792	6.215	1.912	1.862	0.872	1.074	0.697
C	2 x 2 x 1/8 Angle	1.65	0.484	0.190	0.131	0.626	0.190	0.131	0.626
D	2 x 2 x 1/4 Angle	3.19	0.938	0.348	0.247	0.609	0.348	0.247	0.609
E	3 x 3 x 1/4 Angle	4.90	1.440	1.240	0.577	0.930	1.240	0.577	0.930
F	4 x 4 x 1/4 Angle	6.60	1.940	3.040	1.050	1.250	3.040	1.050	1.250
G	Double C3 x 4.1	8.20	2.420	3.320	2.200	1.170	0.394	0.404	
H	Double C4 x 5.4	10.80	3.180	7.700	3.860	1.560	0.638	0.566	
J	Double C5 x 6.7	13.40	3.940	14.980	6.000	1.950	0.958	0.756	
K	Double C6 x 8.2	16.40	4.800	26.200	8.760	2.340	1.389	0.984	

NOTES:
1. Strut elements have 12 gage thickness.
2. Structural steel angles and channels are A36 steel.
3. "Double A" or "Double B" refers to a factory supplied back to back strut "A"or "B"
4. Trapeze styles "G" to "K" are back to back steel channels welded together top and bottom with plates at the support rods.

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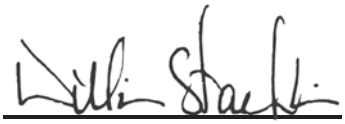
FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002



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TRAPEZE SUPPORT GUIDELINES

Trapeze Span (*mm*)	Trapeze Steel	Maximum Uniform Load (*lbs*)	Vertical Deflection at Load (*mm*)
305	A	1533.1	0.25
	Double A	4322.7	0.25
	B	4724.2	0.25
	C	771.1	0.25
	D	1474.2	0.25
610	A	766.6	1.52
	Double A	2161.4	0.76
	B	2360.9	0.76
	D	725.7	0.76
	E	1723.6	0.51
914	A	508.0	3.30
	Double A	1440.2	1.78
	B	1574.0	1.78
	Double B	4817.1	1.02
	E	1156.7	1.02
1219	A	383.3	5.84
	Double A	1079.5	3.30
	B	1179.3	3.05
	Double B	3612.9	1.52
	E	861.8	2.03
1524	A	306.2	8.89
	Double A	864.1	5.08
	B	943.5	4.83
	Double B	2889.4	2.54
	F	1270.1	2.29
1829	A	254.0	12.70
	Double A	718.9	7.37
	B	787.0	6.86
	Double B	2408.6	3.56
	F	1043.3	3.30
2134	A	217.7	17.53
	Double A	616.9	9.91
	B	673.6	9.14
	Double B	2063.8	5.08
	G	1224.7	5.59
2438	A	190.5	22.86
	Double A	539.8	12.95
	B	589.7	11.94
	Double B	1805.3	6.60
	H	2268.0	6.60
2743	A	170.1	28.96
	Double A	478.5	16.26
	B	523.9	15.24
	Double B	1605.7	8.13
	J	3401.9	7.11
3048	A	152.0	35.56
	Double A	430.9	20.32
	B	471.7	18.80
	Double B	1444.7	10.16
	K	4535.9	7.62

NOTES:
1. When loads are concentrated near midspan, allowable loads shall be multiplied by 0.5 and deflections by 0.8.
2. Calculations based on section properties tabulated below.

TRAPEZE STEEL DESCRIPTION

Trapeze Steel	Steel Description (*mm*)	Weight (*kg/m*)	Area (cm^2)	Ixx (cm^4)	Sxx (cm^3)	rx (*cm*)	Iyy (cm^4)	Syy (cm^3)	ry (*cm*)
A	41 x 41 x 2.7 Strut	2.8	3.6	7.7	3.3	1.5	9.9	4.8	1.7
Double A	41 x 41 x 2.7 Strut	5.7	7.2	38.7	9.4	2.3	19.9	9.6	1.7
B	41 x 83 x 2.7 Strut	4.5	5.8	45.5	10.2	2.8	18.1	8.8	1.8
Double B	41 x 83 x 2.7 Strut	9.1	11.6	258.7	31.3	4.7	36.3	17.6	1.8
C	51 x 51 x 3 Angle	2.5	3.1	7.9	2.1	1.6	7.9	2.1	1.6
D	51 x 51 x 6 Angle	4.7	6.1	14.5	4.0	1.5	14.5	4.0	1.5
E	51 x 51 x 6 Angle	7.3	9.3	51.6	9.5	2.4	51.6	9.5	2.4
F	102 x 102 x 6 Angle	9.8	12.5	–	17.2	3.2	126.5	17.2	3.2
G	Double C76 x 6.1	12.2	15.6	138.2	36.1	3.0	16.4	6.6	
H	Double C102 x 8.0	16.1	20.5	320.5	63.3	4.0	26.6	9.3	
J	Double C127 x 10.0	19.9	25.4	623.5	98.3	5.0	39.9	12.4	
K	Double C152 x 12.2	24.4	31.0	1090.5	143.6	5.9	57.7	16.1	

NOTES:
1. Strut elements have 2.7 mm thickness
2. Structural steel angles and channels are A36 steel.
3. "Double A" or "Double B" refers to a factory supplied back to back strut "A"or "B"
4. Trapeze styles "G" to "K" are back to back steel channels welded together top and bottom with plates at the support rods.

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LONGITUDINAL AND ALL-DIRECTIONAL SEISMIC BRACE TRAPEZE SUPPORT GUIDELINES FOR Fp = 0.25G

Maximum Allowable Trapeze Member Length (inches) at Longitudinal Seismic Brace Locations													
Trapeze Member		Single Strut 15/8 x 15/8 x 12 Gage			Double Strut 15/8 x 15/8 x 12 Gage			4 x 4 x 1/4 Angle			4 x 4 x 1/4 Tube Steel		
Longitudinal Brace Spacing (ft)		40	60	80	40	60	80	40	60	80	40	60	80
Pipe / Duct Trapeze Weight (plf)	10	120	120	112	120	120	120	120	120	120	120	120	120
	20	72	63	56	120	120	120	120	120	120	120	120	120
	30	48	42	37	120	102	88	120	120	120	120	120	120
	40	36	31	28	91	77	66	120	120	120	120	120	120
	50	29	25	22	73	61	53	120	114	98	120	120	120
	60	24	21	18	61	51	44	113	95	82	120	120	120
	70	20	18	16	52	44	38	97	81	70	120	120	120
	80	18	15	14	45	38	33	84	71	61	120	120	120
	90	16	14	12	40	34	29	75	63	54	120	120	120
	100	14	12		36	30	26	67	57	49	120	120	120
	125				29	24	21	54	45	39	120	120	120
	150				24	20	17	45	38	32	120	120	120
	175				20	17	15	38	32	28	120	120	120
	200				18	15	13	33	28	24	120	120	106
	250				14	12		27	22	19	117	98	85

Horizontal G Level = 0.25 Wp

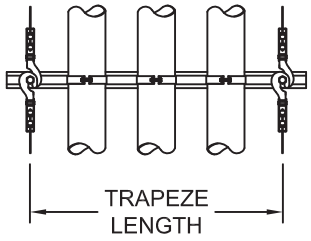
Vertical G Level = 0.25 Wp

Maximum trapeze support spacing = 10 ft

Trapeze member size with allowable length tabulated above is calculated by limiting:

1) Trapeze length to 120"
2) Gravity deflection to L/120

Trapeze Member	Properties				
	Sx	Sy	Ixx	Fbx	Fby
Single Strut: 15/8 x 15/8 x 12 Gage	0.172	0.247	0.157	25000	33250
Double Strut: 15/8 x 15/8 x 12 Gage	0.486	0.493	0.791	25000	33250
4 x 4 x 1/4 Angle	1.050	1.050	3.040	21600	28728
4 x 4 x 1/4 Tube Steel	4.110	4.110	8.220	23760	31601



PLAN VIEW OF TYPICAL TRAPEZE

NOTE: Strut properties are from the Power-Strut catalog, reduced 15% for pierced channels.

OSHPD

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PENDING

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LONGITUDINAL AND ALL-DIRECTIONAL SEISMIC BRACE TRAPEZE SUPPORT GUIDELINES FOR Fp = 0.25G

Maximum Allowable Trapeze Member Length (cm) at Longitudinal Seismic Brace Locations													
Trapeze Member		Single Strut 41 x 41 x 2.7 mm			Double Strut 41 x 41 x 2.7 mm			Angle 102 x 102 x 6 mm			Tube Steel 102 x 102 x 6 mm		
Longitudinal Brace Spacing (m)		12.2	18.3	24.4	12.2	18.3	24.4	12.2	18.3	24.4	12.2	18.3	24.4
Pipe / Duct Trapeze Weight (kg/m)	14.9	305	305	284	305	305	305	305	305	305	305	305	305
	29.8	184	160	142	305	305	305	305	305	305	305	305	305
	44.6	122	107	94	305	261	225	305	305	305	305	305	305
	59.5	92	80	71	232	196	169	305	305	305	305	305	305
	74.4	73	64	56	186	156	135	305	290	251	305	305	305
	89.3	61	53	47	155	130	112	287	242	209	305	305	305
	104.2	52	45	40	132	112	96	246	207	179	305	305	305
	119.1	46	40	35	116	98	84	215	181	156	305	305	305
	133.9	40	35	31	103	87	75	191	161	139	305	305	305
	148.8	36	32		93	78	67	172	145	125	305	305	305
	186.0				74	62	54	138	116	100	305	305	305
	223.2				62	52	45	115	96	83	305	305	305
	260.4				53	44	38	98	83	71	305	305	305
	297.6				46	39	33	86	72	62	305	305	270
	372.0				37	31		69	58	50	297	250	216

Horizontal G Level = 0.25 Wp

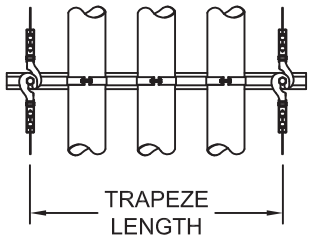
Vertical G Level = 0.25 Wp

Maximum trapeze support spacing = 3.05 m

Trapeze member size with allowable length tabulated above is calculated by limiting:

1) Trapeze length to 305 cm
2) Gravity deflection to L/120

Trapeze Member	Properties				
	Sx	Sy	Ixx	Fbx	Fby
Single Strut: 41 x 41 x 2.7 mm	2.814	4.039	6.545	1758	2338
Double Strut: 41 x 41 x 2.7 mm	7.967	8.079	32.90	1758	2338
Angle: 102 x 102 x 6 mm	17.21	17.21	126.5	1519	2020
Tube Steel: 102 x 102 x 6 mm	67.35	67.35	342.1	1670	2222



PLAN VIEW OF TYPICAL TRAPEZE

NOTE: Strut properties are from the Power-Strut catalog, reduced 15% for pierced channels.

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LONGITUDINAL AND ALL-DIRECTIONAL SEISMIC BRACE TRAPEZE SUPPORT GUIDELINES FOR Fp = 0.50G

Maximum Allowable Trapeze Member Length (inches) at Longitudinal Seismic Brace Locations													
Trapeze Member		Single Strut 15/8 x 15/8 x 12 Gage			Double Strut 15/8 x 15/8 x 12 Gage			4 x 4 x 1/4 Angle			4 x 4 x 1/4 Tube Steel		
Longitudinal Brace Spacing (ft)		40	60	80	40	60	80	40	60	80	40	60	80
Pipe / Duct Trapeze Weight (plf)	10	101	83	71	120	120	120	120	120	120	120	120	120
	20	50	41	35	120	97	81	120	120	120	120	120	120
	30	33	27	23	81	65	54	120	120	100	120	120	120
	40	25	20	17	61	48	40	113	90	75	120	120	120
	50	20	16	14	48	39	32	90	72	60	120	120	120
	60	16	13		40	32	27	75	60	50	120	120	120
	70	14			34	27	23	64	51	43	120	120	120
	80	12			30	24	20	56	45	37	120	120	120
	90				27	21	18	50	40	33	120	120	120
	100				24	19	16	45	36	30	120	120	120
	125				19	15	13	36	28	24	120	120	103
	150				16	13		30	24	20	120	104	86
	175				13			25	20	17	111	89	74
	200				12			22	18	15	97	78	64
	250							18	14	12	78	62	51

Horizontal G Level = 0.50 Wp

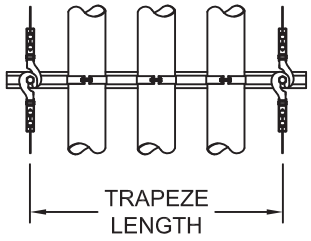
Vertical G Level = 0.50 Wp

Maximum trapeze support spacing = 10 ft

Trapeze member size with allowable length tabulated above is calculated by limiting:

1) Trapeze length to 120"
2) Gravity deflection to L/120

Trapeze Member	Properties				
	Sx	Sy	Ixx	Fbx	Fby
Single Strut: 15/8 x 15/8 x 12 Gage	0.172	0.247	0.157	25000	33250
Double Strut: 15/8 x 15/8 x 12 Gage	0.486	0.493	0.791	25000	33250
4 x 4 x 1/4 Angle	1.050	1.050	3.040	21600	28728
4 x 4 x 1/4 Tube Steel	4.110	4.110	8.220	23760	31601



PLAN VIEW OF TYPICAL TRAPEZE

NOTE: Strut properties are from the Power-Strut catalog, reduced 15% for pierced channels.

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FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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LONGITUDINAL AND ALL-DIRECTIONAL SEISMIC BRACE TRAPEZE SUPPORT GUIDELINES FOR Fp = 0.50G

Maximum Allowable Trapeze Member Length (cm) at Longitudinal Seismic Brace Locations													
Trapeze Member		Single Strut 41 x 41 x 2.7 mm			Double Strut 41 x 41 x 2.7 mm			Angle 102 x 102 x 6 mm			Tube Steel 102 x 102 x 6 mm		
Longitudinal Brace Spacing (m)		12.2	18.3	24.4	12.2	18.3	24.4	12.2	18.3	24.4	12.2	18.3	24.4
Pipe / Duct Trapeze Weight (kg/m)	14.9	256	213	181	305	305	305	305	305	305	305	305	305
	29.8	128	106	90	305	248	207	305	305	305	305	305	305
	44.6	85	71	60	206	165	138	305	305	255	305	305	305
	59.5	64	53	45	155	124	103	287	230	191	305	305	305
	74.4	51	42	36	124	99	82	230	184	153	305	305	305
	89.3	42	35		103	82	69	191	153	127	305	305	305
	104.2	36			88	71	59	164	131	109	305	305	305
	119.1	32			77	62	51	143	115	95	305	305	305
	133.9				68	55	46	127	102	85	305	305	305
	148.8				62	49	41	115	92	76	305	305	305
	186.0				49	39	33	92	73	61	305	305	264
	223.2				41	33		76	61	51	305	264	220
	260.4				35			65	52	43	283	226	188
	297.6				31			57	46	38	247	198	165
	372.0							46	36		198	158	132

Horizontal G Level = 0.50 Wp

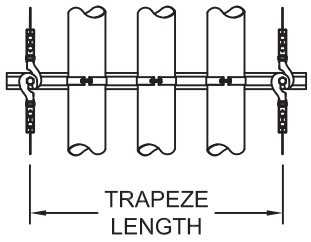
Vertical G Level = 0.50 Wp

Maximum trapeze support spacing = 3.05 m

Trapeze member size with allowable length tabulated above is calculated by limiting:

1) Trapeze length to 305 cm
2) Gravity deflection to L/120

Trapeze Member	Properties				
	Sx	Sy	Ixx	Fbx	Fby
Single Strut: 41 x 41 x 2.7 mm	2.814	4.039	6.545	1758	2338
Double Strut: 41 x 41 x 2.7 mm	7.967	8.079	32.90	1758	2338
Angle: 102 x 102 x 6 mm	17.21	17.21	126.5	1519	2020
Tube Steel: 102 x 102 x 6 mm	67.35	67.35	342.1	1670	2222



PLAN VIEW OF TYPICAL TRAPEZE

NOTE: Strut properties are from the Power-Strut catalog, reduced 15% for pierced channels.

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LONGITUDINAL AND ALL-DIRECTIONAL SEISMIC BRACE TRAPEZE SUPPORT GUIDELINES FOR Fp = 0.75G

Maximum Allowable Trapeze Member Length (inches) at Longitudinal Seismic Brace Locations													
Trapeze Member		Single Strut 15/8 x 15/8 x 12 Gage			Double Strut 15/8 x 15/8 x 12 Gage			4 x 4 x 1/4 Angle			4 x 4 x 1/4 Tube Steel		
Longitudinal Brace Spacing (ft)		40	60	80	40	60	80	40	60	80	40	60	80
Pipe / Duct Trapeze Weight (plf)	10	77	62	52	120	120	117	120	120	120	120	120	120
	20	38	31	26	91	71	58	120	120	108	120	120	120
	30	25	20	17	61	47	39	113	88	72	120	120	120
	40	19	15	13	45	35	29	84	66	54	120	120	120
	50	15	12		36	28	23	67	53	43	120	120	120
	60	12			30	23	19	56	44	36	120	120	120
	70				26	20	16	48	37	31	120	120	120
	80				22	17	14	42	33	27	120	120	116
	90				20	15	13	37	29	24	120	120	103
	100				18	14		33	26	21	120	114	93
	125				14			27	21	17	117	91	74
	150				12			22	17	14	97	76	62
	175							19	15	12	83	65	53
	200							16	13		73	57	46
	250							13			58	45	37

Horizontal G Level = 0.75 Wp

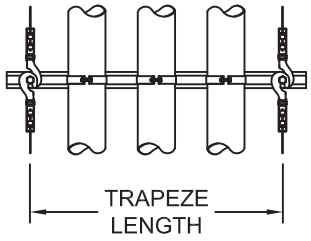
Vertical G Level = 0.75 Wp

Maximum trapeze support spacing = 10 ft

Trapeze member size with allowable length tabulated above is calculated by limiting:

1) Trapeze length to 120"
2) Gravity deflection to L/120

Trapeze Member	Properties				
	Sx	Sy	Ixx	Fbx	Fby
Single Strut: 15/8 x 15/8 x 12 Gage	0.172	0.247	0.157	25000	33250
Double Strut: 15/8 x 15/8 x 12 Gage	0.486	0.493	0.791	25000	33250
4 x 4 x 1/4 Angle	1.050	1.050	3.040	21600	28728
4 x 4 x 1/4 Tube Steel	4.110	4.110	8.220	23760	31601



PLAN VIEW OF TYPICAL TRAPEZE

NOTE: Strut properties are from the Power-Strut catalog, reduced 15% for pierced channels.

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LONGITUDINAL AND ALL-DIRECTIONAL SEISMIC BRACE TRAPEZE SUPPORT GUIDELINES FOR Fp = 0.75G

Maximum Allowable Trapeze Member Length (cm) at Longitudinal Seismic Brace Locations													
Trapeze Member		Single Strut 41 x 41 x 2.7 mm			Double Strut 41 x 41 x 2.7 mm			Angle 102 x 102 x 6 mm			Tube Steel 102 x 102 x 6 mm		
Longitudinal Brace Spacing (m)		12.2	18.3	24.4	12.2	18.3	24.4	12.2	18.3	24.4	12.2	18.3	24.4
Pipe / Duct Trapeze Weight (kg/m)	14.9	196	159	133	305	305	298	305	305	305	305	305	305
	29.8	98	79	66	233	182	149	305	305	276	305	305	305
	44.6	65	53	44	155	121	99	287	224	184	305	305	305
	59.5	49	39	33	116	91	74	215	168	138	305	305	305
	74.4	39	31		93	72	59	172	134	110	305	305	305
	89.3	32			77	60	49	143	112	92	305	305	305
	104.2				66	52	42	123	96	78	305	305	305
	119.1				58	45	37	107	84	69	305	305	297
	133.9				51	40	33	95	74	61	305	305	264
	148.8				46	36		86	67	55	305	289	237
	186.0				37			69	53	44	297	231	190
	223.2				31			57	44	36	247	193	158
	260.4							49	38	31	212	165	135
	297.6							43	33		185	144	118
	372.0							34			148	115	95

Horizontal G Level = 0.75 Wp

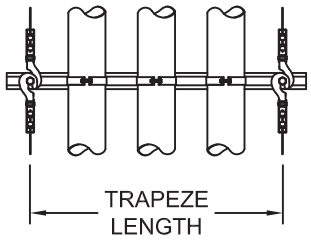
Vertical G Level = 0.75 Wp

Maximum trapeze support spacing = 3.05 m

Trapeze member size with allowable length tabulated above is calculated by limiting:

1) Trapeze length to 305 cm
2) Gravity deflection to L/120

Trapeze Member	Properties				
	Sx	Sy	Ixx	Fbx	Fby
Single Strut: 41 x 41 x 2.7 mm	2.814	4.039	6.545	1758	2338
Double Strut: 41 x 41 x 2.7 mm	7.967	8.079	32.90	1758	2338
Angle: 102 x 102 x 6 mm	17.21	17.21	126.5	1519	2020
Tube Steel: 102 x 102 x 6 mm	67.35	67.35	342.1	1670	2222



PLAN VIEW OF TYPICAL TRAPEZE

NOTE: Strut properties are from the Power-Strut catalog, reduced 15% for pierced channels.

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LONGITUDINAL AND ALL-DIRECTIONAL SEISMIC BRACE TRAPEZE SUPPORT GUIDELINES FOR Fp = 1.00G

Maximum Allowable Trapeze Member Length (inches) at Longitudinal Seismic Brace Locations													
Trapeze Member		Single Strut 15/8 x 15/8 x 12 Gage			Double Strut 15/8 x 15/8 x 12 Gage			4 x 4 x 1/4 Angle			4 x 4 x 1/4 Tube Steel		
Longitudinal Brace Spacing (ft)		40	60	80	40	60	80	40	60	80	40	60	80
Pipe / Duct Trapeze Weight (plf)	10	62	50	41	120	113	91	120	120	120	120	120	120
	20	31	25	20	73	56	45	120	104	84	120	120	120
	30	20	16	13	48	37	30	90	69	56	120	120	120
	40	15	12		36	28	22	67	52	42	120	120	120
	50	12			29	22	18	54	41	33	120	120	120
	60				24	18	15	45	34	28	120	120	120
	70				20	16	13	38	29	24	120	120	104
	80				18	14		33	26	21	120	112	91
	90				16	12		30	23	18	120	99	81
	100				14			27	20	16	117	89	73
	125							21	16	13	93	71	58
	150							18	13		78	59	48
	175							15			66	51	41
	200							13			58	44	36
	250										46	35	29

Horizontal G Level = 1.00 Wp

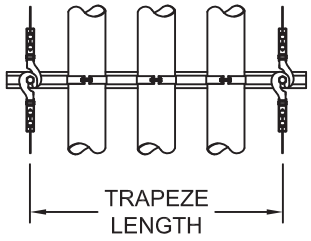
Vertical G Level = 1.00 Wp

Maximum trapeze support spacing = 10 ft

Trapeze member size with allowable length tabulated above is calculated by limiting:

1) Trapeze length to 120"
2) Gravity deflection to L/120

Trapeze Member	Properties				
	Sx	Sy	Ixx	Fbx	Fby
Single Strut: 15/8 x 15/8 x 12 Gage	0.172	0.247	0.157	25000	33250
Double Strut: 15/8 x 15/8 x 12 Gage	0.486	0.493	0.791	25000	33250
4 x 4 x 1/4 Angle	1.050	1.050	3.040	21600	28728
4 x 4 x 1/4 Tube Steel	4.110	4.110	8.220	23760	31601



PLAN VIEW OF TYPICAL TRAPEZE

NOTE: Strut properties are from the Power-Strut catalog, reduced 15% for pierced channels.

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LONGITUDINAL AND ALL-DIRECTIONAL SEISMIC BRACE TRAPEZE SUPPORT GUIDELINES FOR Fp = 1.00G

Maximum Allowable Trapeze Member Length (cm) at Longitudinal Seismic Brace Locations													
Trapeze Member		Single Strut 41 x 41 x 2.7 mm			Double Strut 41 x 41 x 2.7 mm			Angle 102 x 102 x 6 mm			Tube Steel 102 x 102 x 6 mm		
Longitudinal Brace Spacing (m)		12.2	18.3	24.4	12.2	18.3	24.4	12.2	18.3	24.4	12.2	18.3	24.4
Pipe / Duct Trapeze Weight (kg/m)	14.9	159	127	105	305	287	233	305	305	305	305	305	305
	29.8	79	63	52	186	143	116	305	265	215	305	305	305
	44.6	53	42	35	124	95	77	230	176	143	305	305	305
	59.5	39	31		93	71	58	172	132	107	305	305	305
	74.4	31			74	57	46	138	106	86	305	305	305
	89.3				62	47	38	115	88	71	305	305	305
	104.2				53	41	33	98	75	61	305	305	265
	119.1				46	35		86	66	53	305	285	232
	133.9				41	31		76	58	47	305	253	206
	148.8				37			69	53	43	297	228	185
	186.0							55	42	34	237	182	148
	223.2							46	35		198	152	123
	260.4							39			169	130	106
	297.6							34			148	114	92
	372.0										118	91	74

Horizontal G Level = 1.00 Wp

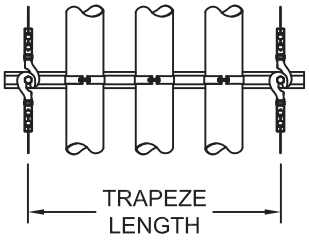
Vertical G Level = 1.00 Wp

Maximum trapeze support spacing = 3.05 m

Trapeze member size with allowable length tabulated above is calculated by limiting:

1) Trapeze length to 305 cm
2) Gravity deflection to L/120

Trapeze Member	Properties				
	Sx	Sy	Ixx	Fbx	Fby
Single Strut: 41 x 41 x 2.7 mm	2.814	4.039	6.545	1758	2338
Double Strut: 41 x 41 x 2.7 mm	7.967	8.079	32.90	1758	2338
Angle: 102 x 102 x 6 mm	17.21	17.21	126.5	1519	2020
Tube Steel: 102 x 102 x 6 mm	67.35	67.35	342.1	1670	2222



PLAN VIEW OF TYPICAL TRAPEZE

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UPPER SUPPORT MEMBER GUIDELINES FOR RECTANGULAR/OVAL DUCT

Upper support member selection at all directional and longitudinal brace locations is based on top brace extension E as shown on page H14.
Upper support member extension at transverse brace locations is not restricted.

The following table defines upper support member sizes for maximum extension E of 6" or 12".

	E = 6" Maximum	
	Member Size (in)	
Size	Steel Angle	12 GA Strut
SCBH/SSBS	2 1/2 x 2 1/2 x 12ga	1 5/8 x 1 5/8
SCBH/SSBS	3 x 3 x 12ga	1 5/8 x 1 5/8
SCBH/SSB-3	4 x 4 x 12ga	Double 1 5/8 x 1 5/8

	E = 12" Maximum	
	Member Size (in)	
Size	Steel Angle	12 GA Strut
SCBH/SSBS	2 1/2 x 2 1/2 x 3/16	1 5/8 x 1 5/8
SCBH/SSBS	3 x 3 x 3/16	Double 1 5/8 x 1 5/8
SCBH/SSB-3	4 x 4 x 1/4	

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California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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UPPER SUPPORT MEMBER GUIDELINES FOR RECTANGULAR/OVAL DUCT

Upper support member selection at all directional and longitudinal brace locations is based on top brace extension E as shown on page H14.
Upper support member extension at transverse brace locations is not restricted.

The following table defines upper support member sizes for maximum extension E of 152 or 305 *mm*.

	E = 152 *mm* Maximum	
	Member Size (*mm*)	
Size	Steel Angle	Strut
SCBH/SSBS	64 x 64 x 2.7	41 x 41 x 2.7
SCBH/SSBS	76 x 76 x 2.7	41 x 41 x 2.7
SCBH/SSB-3	102 x 102 x 2.7	Double 41 x 41 x 2.7

	E = 305 *mm* Maximum	
	Member Size (*mm*)	
Size	Steel Angle	Strut
SCBH/SSBS	64 x 64 x 5	41 x 41 x 2.7
SCBH/SSBS	76 x 76 x 5	Double 41 x 41 x 2.7
SCBH/SSB-3	102 x 102 x 6	

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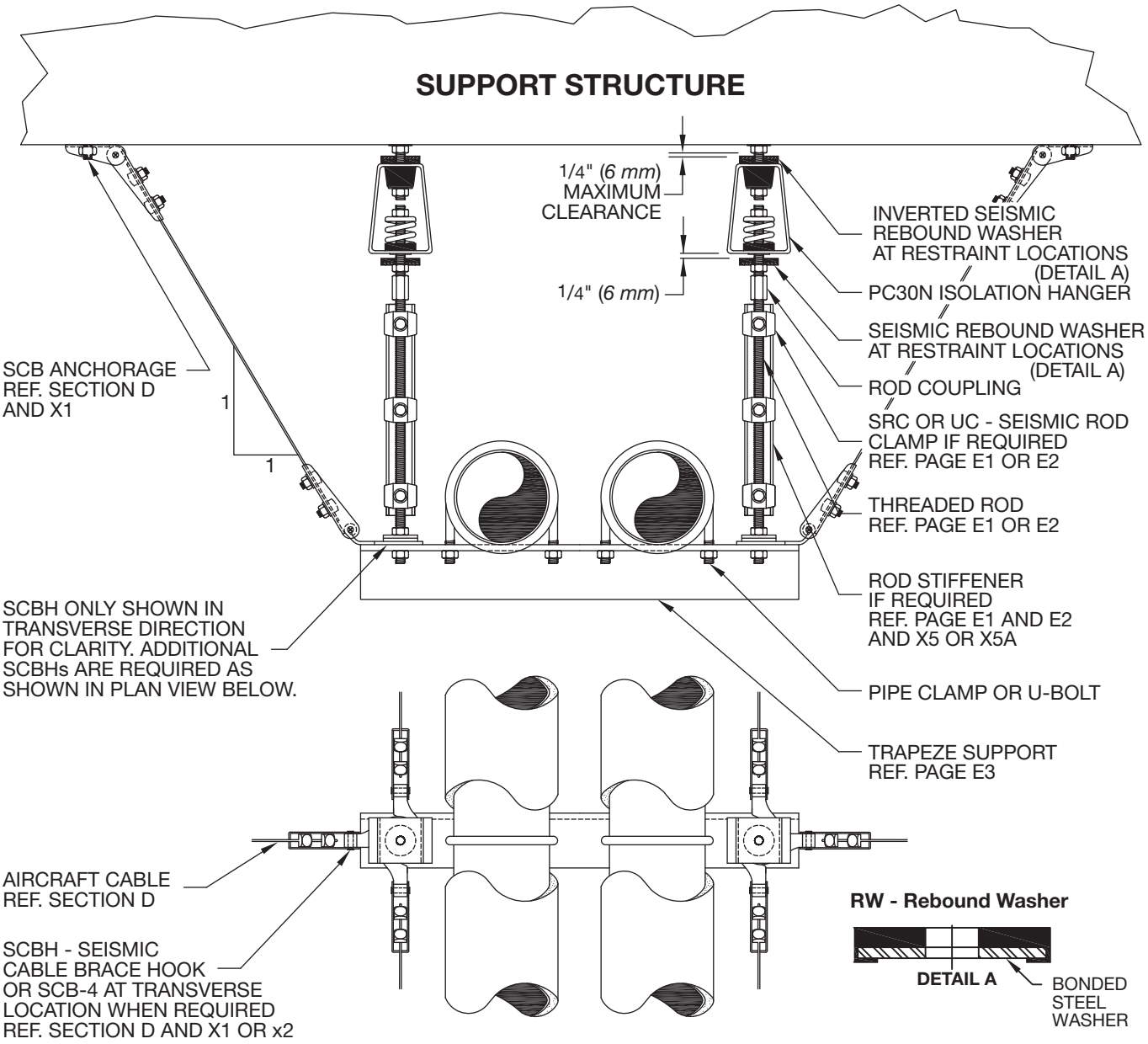
California Office of Statewide Health Planning and Development
FIXED EQUIPMENT ANCHORAGE
OPA-0349 August 5, 2002

Bill Staehlin (916) 654-3362

Dhiru Mali
Structural Engineer
California SE No. 2811

ALL-DIRECTIONAL SEISMIC CABLE BRACE HOOK GUIDELINES FOR SPRING-ISOLATED TRAPEZE SUPPORTED PIPE/CONDUIT



NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page B1. Brace angle ratio may be increased to 2 (vert.): 1 (horiz.). Refer to section A for limitations. Refer to page X2 for proper installation of the SCBHs.
NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.
NOTE 3: Install with hanger box snug to upper rebound washer, with washer tight to overhead surface. Upper hanger element deflects under load, leaving space on top.

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FIXED EQUIPMENT ANCHORAGE

OPA-0349 December 22, 2006

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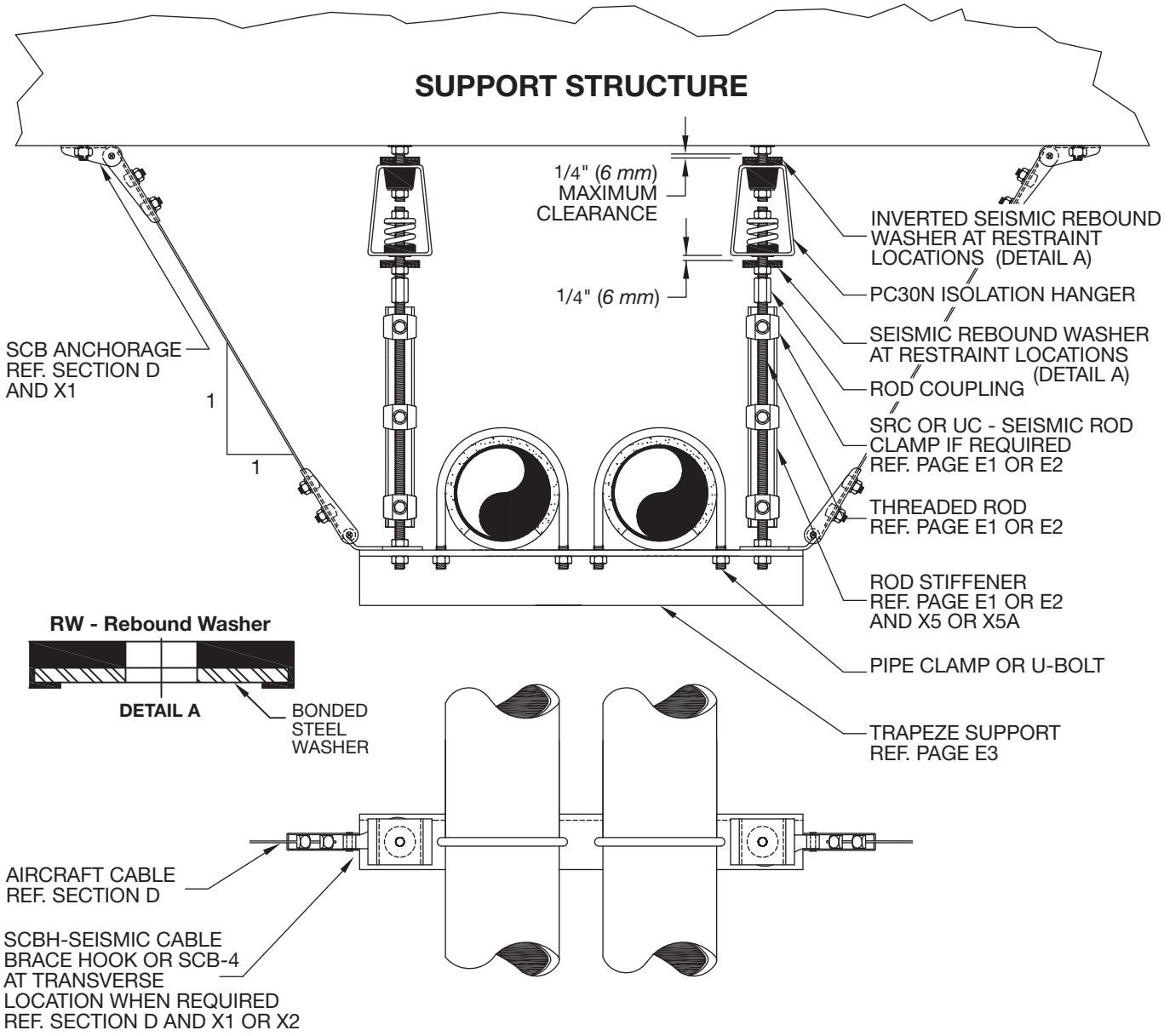

NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page B1. Brace angle ratio may be increased to 2 (vert.): 1 (horiz.). Refer to section A for limitations. Refer to page X2 for proper installation of the SCBHs.

NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

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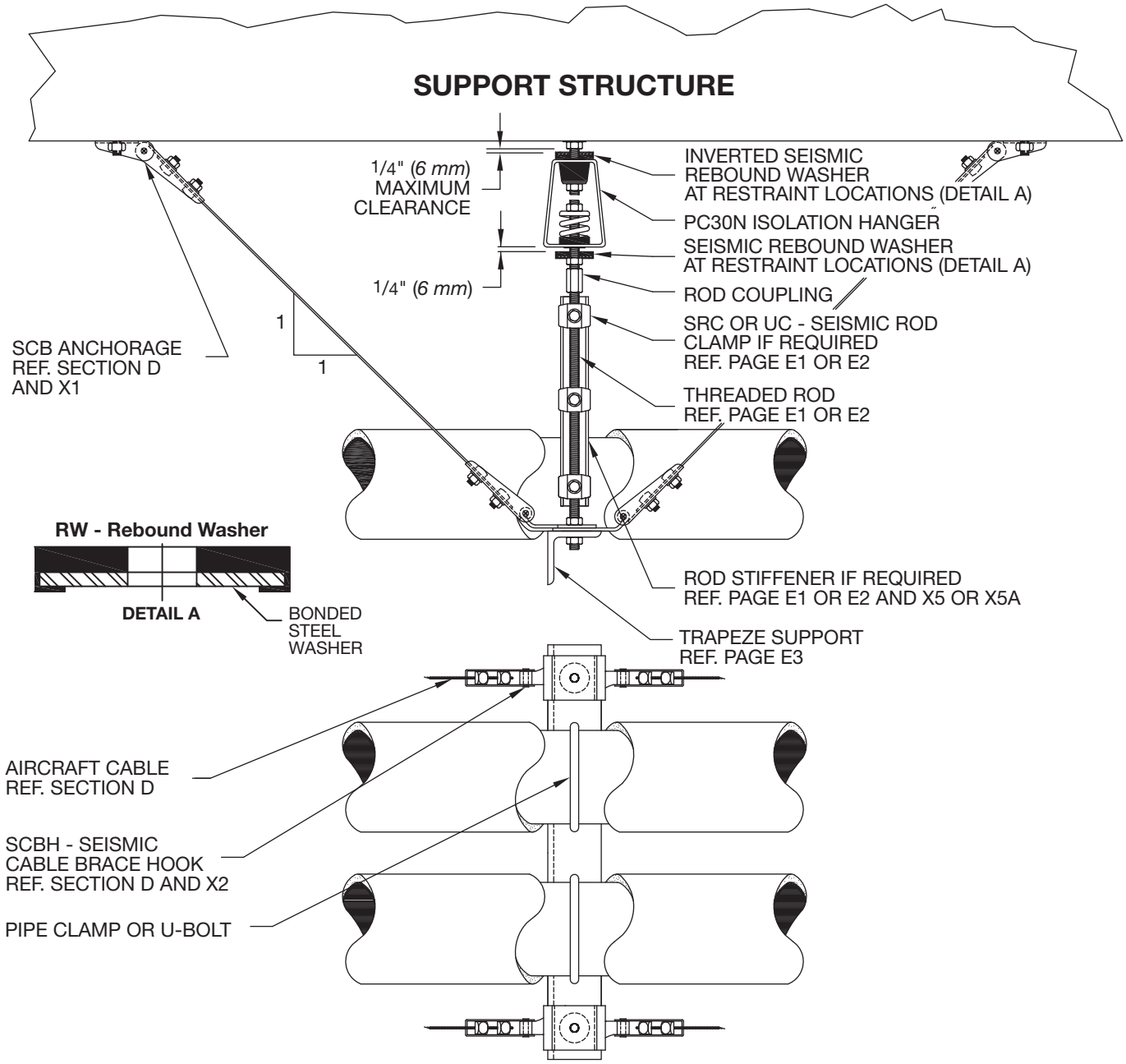
LONGITUDINAL SEISMIC CABLE BRACE HOOK GUIDELINES FOR SPRING-ISOLATED TRAPEZE SUPPORTED PIPE/CONDUIT



NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page B1. Brace angle ratio may be increased to 2 (vert.): 1 (horiz.). Refer to section A for limitations. Refer to page X2 for proper installation of the SCBHs.
NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.
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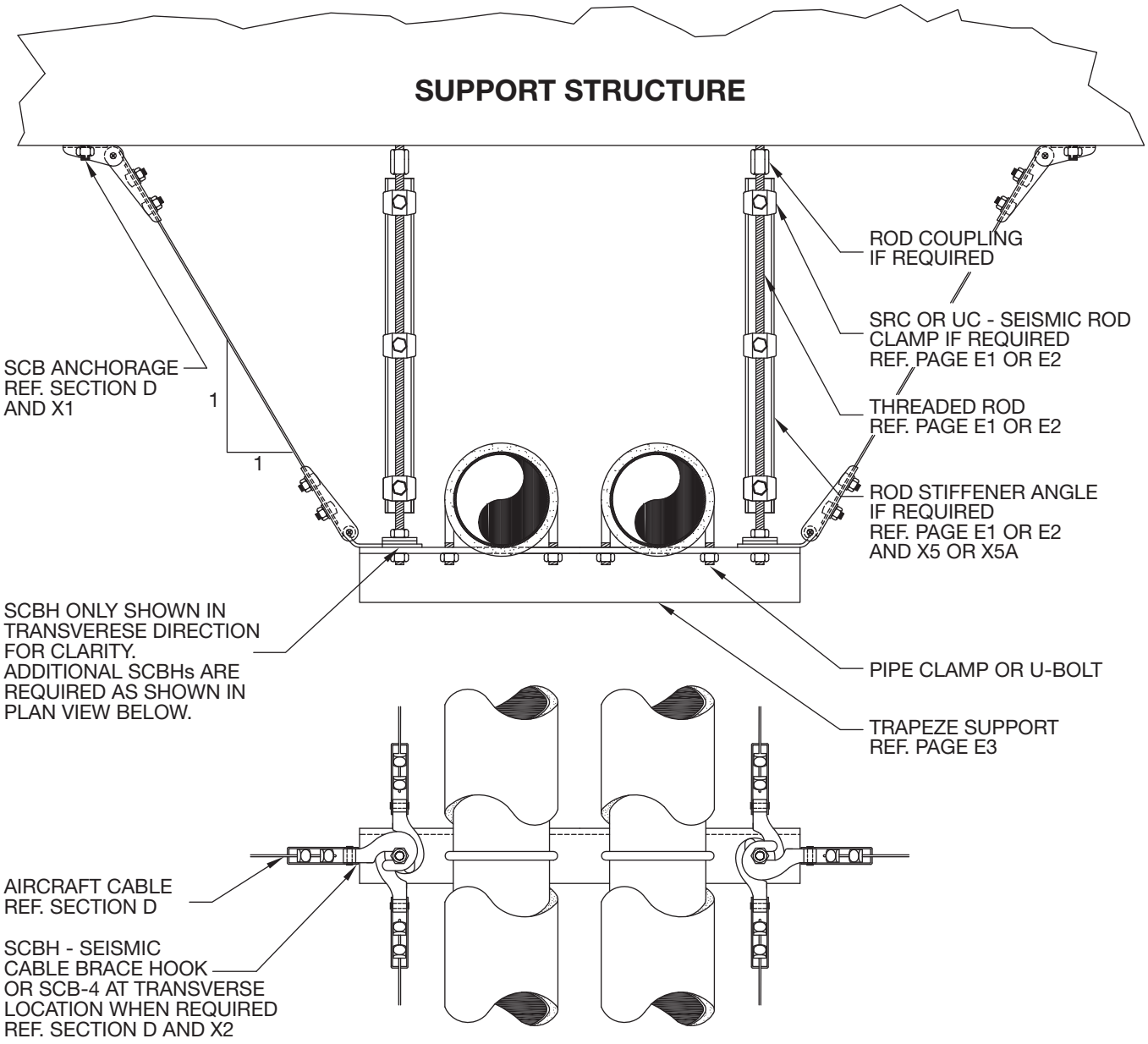

NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page E1 or E2. Brace angle ratio may be increased to 2 (vert): 1 (horiz.). Refer to section D for limitations. Refer to page X2 for proper installation of the SCBHs.

NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

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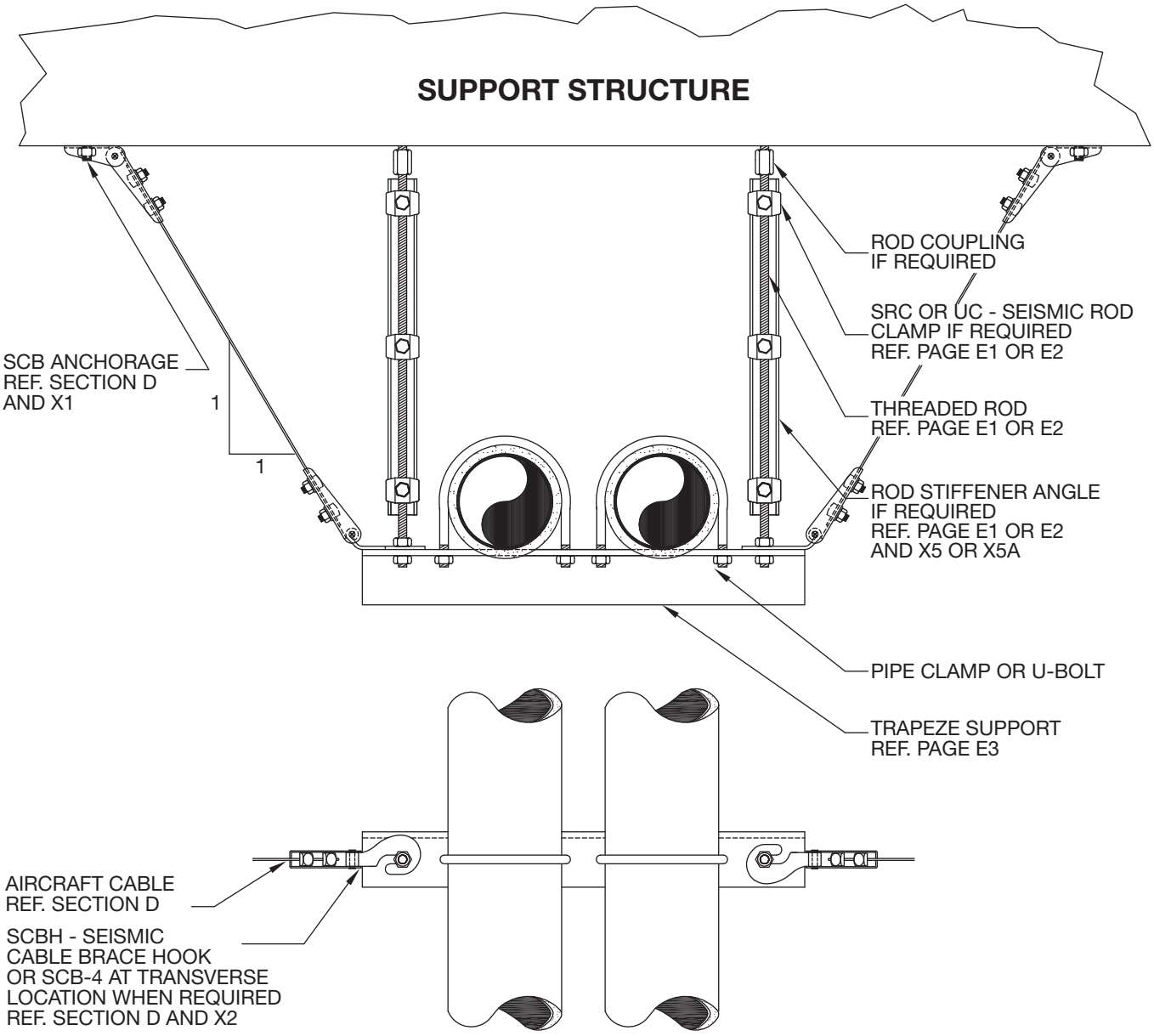

NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page E1 or E2. Brace angle ratio may be increased to 2 (vert): 1 (horiz.). Refer to section D for limitations. Refer to page X2 for proper installation of SCBHs.

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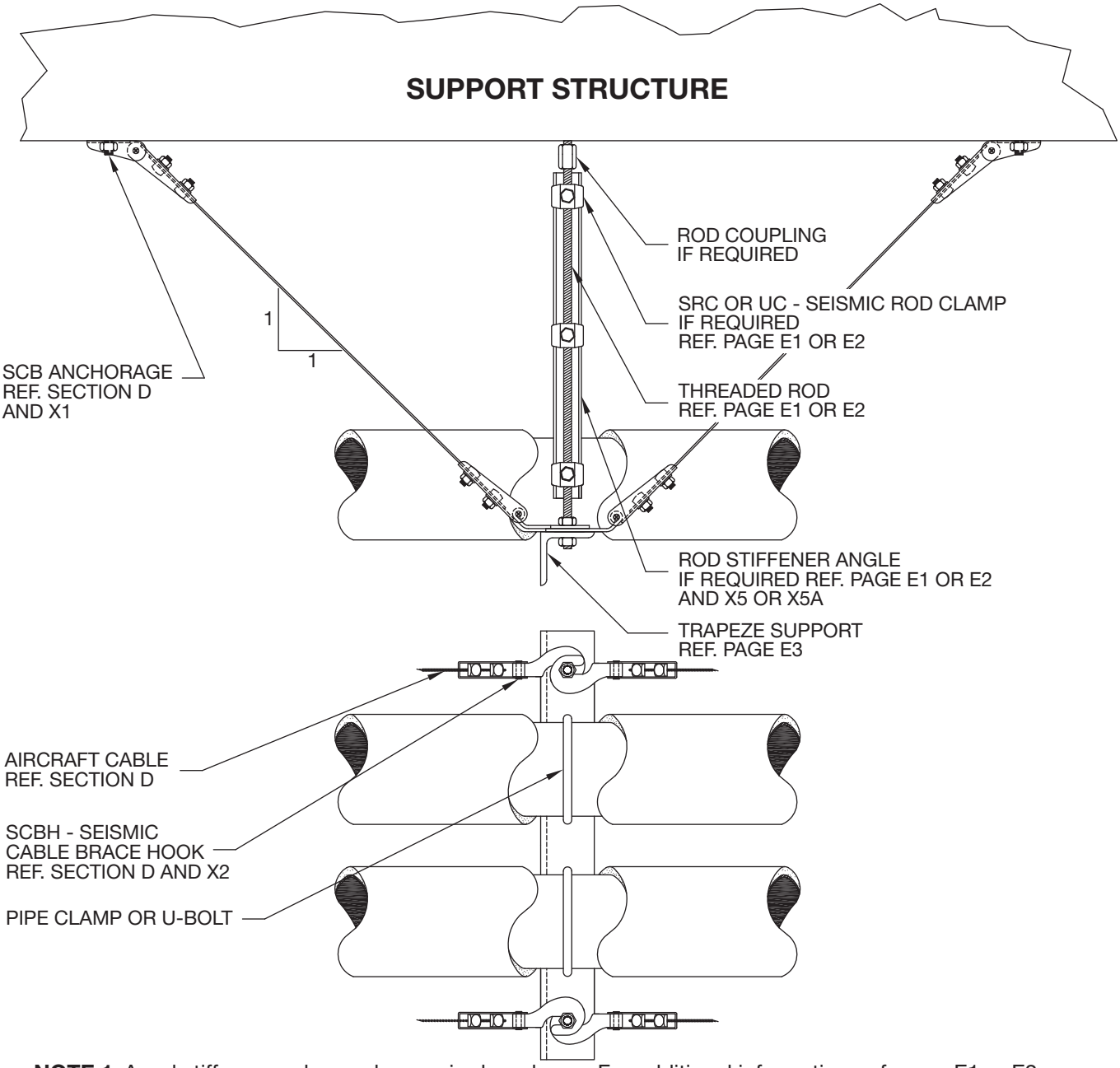
LONGITUDINAL SEISMIC CABLE BRACE HOOK GUIDELINES FOR TRAPEZE SUPPORTED PIPE/CONDUIT



NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page E1 or E2. Brace angle ratio may be increased to 2 (vert): 1 (horiz.). Refer to section D for limitations. Refer to page X2 for proper installation of SCBHs.

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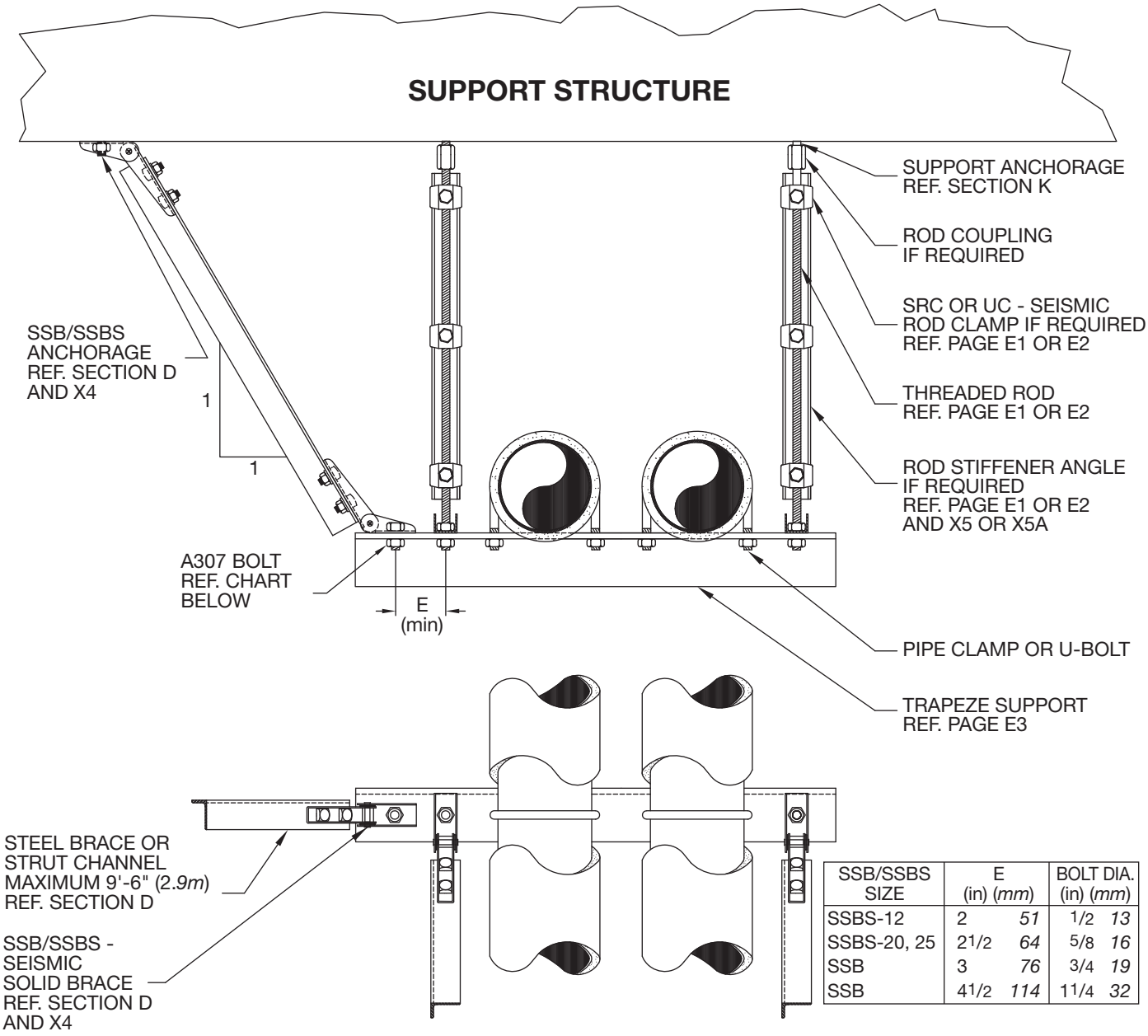
ALL-DIRECTIONAL SEISMIC SOLID BRACE GUIDELINES FOR TRAPEZE SUPPORTED PIPE/CONDUIT



SSB/SSBS SIZE	E (in) (*mm*)	BOLT DIA. (in) (*mm*)
SSBS-12	2 *51*	1/2 *13*
SSBS-20, 25	2 1/2 *64*	5/8 *16*
SSB	3 *76*	3/4 *19*
SSB	4 1/2 *114*	1 1/4 *32*

NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page E1 or E2. Brace angle ratio may be increased to 2 (vert): 1 (horiz.). Refer to section A for limitations.

NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

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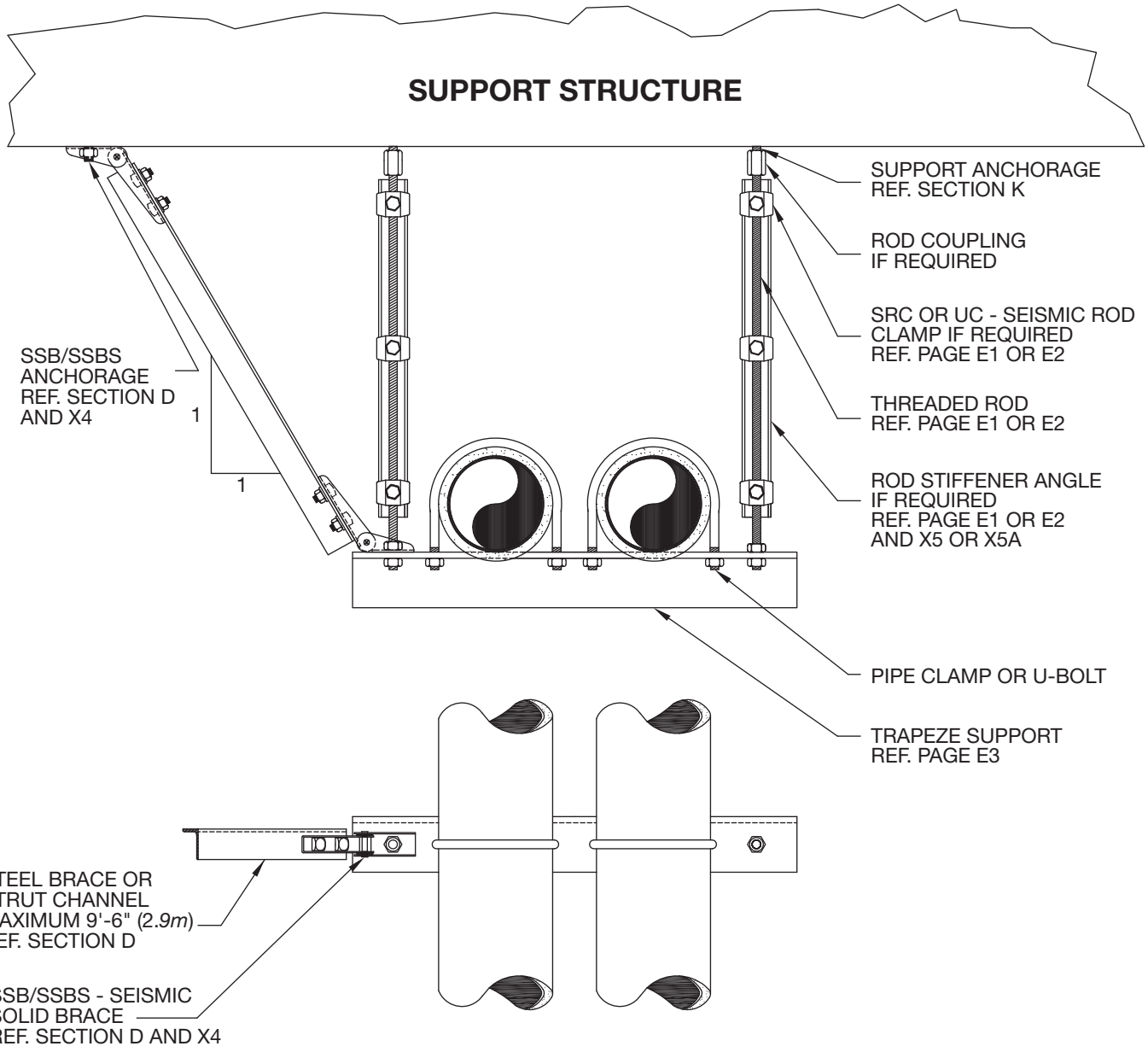

NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page E1 or E2. Brace angle ratio may be increased to 2 (vert): 1 (horiz.). Refer to section D for limitations.

NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

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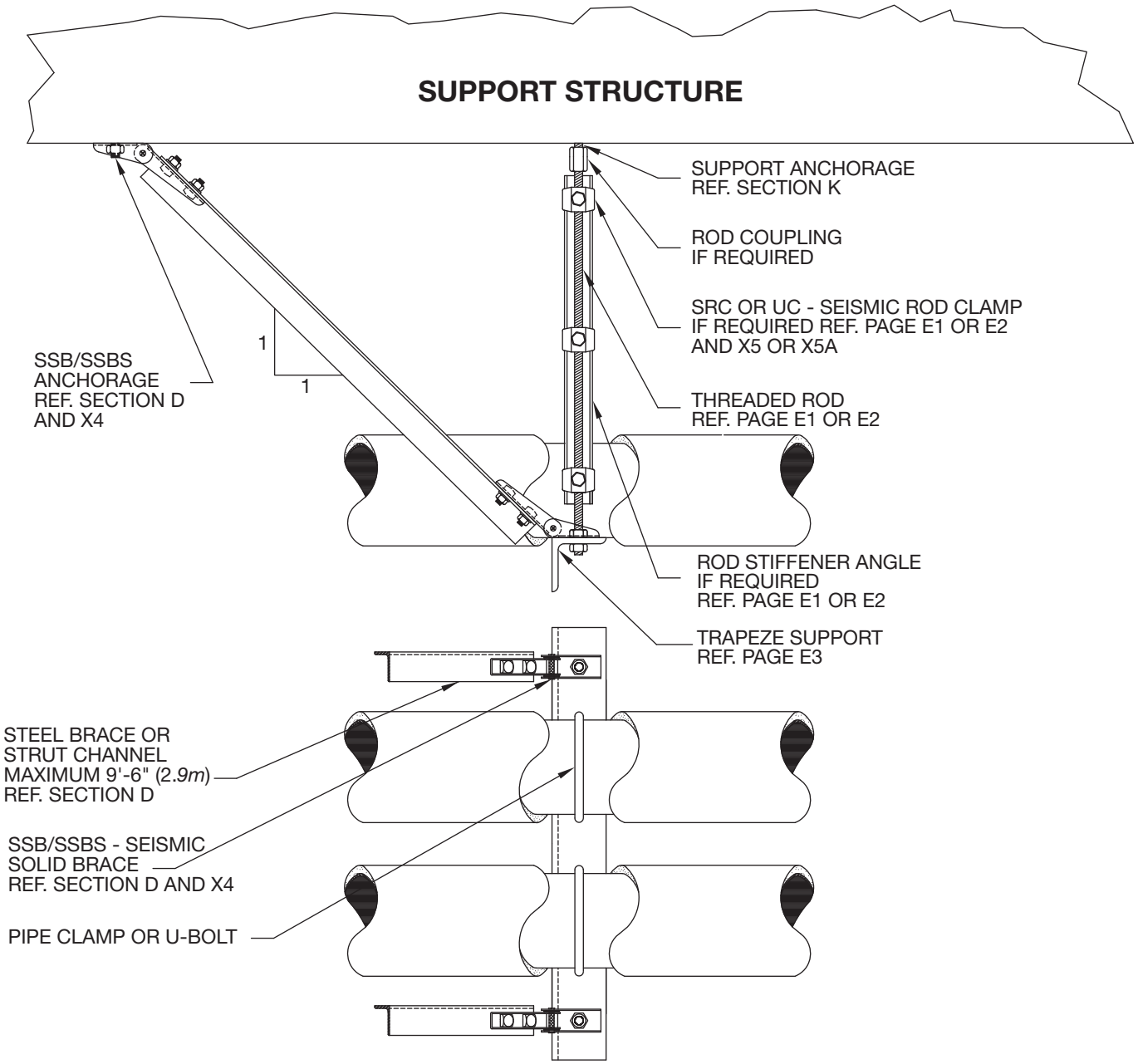
LONGITUDINAL SEISMIC SOLID BRACE GUIDELINES FOR TRAPEZE SUPPORTED PIPE/CONDUIT



NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page E1 or E2. Brace angle ratio may be increased to 2 (vert): 1 (horiz.). Refer to section D for limitations.

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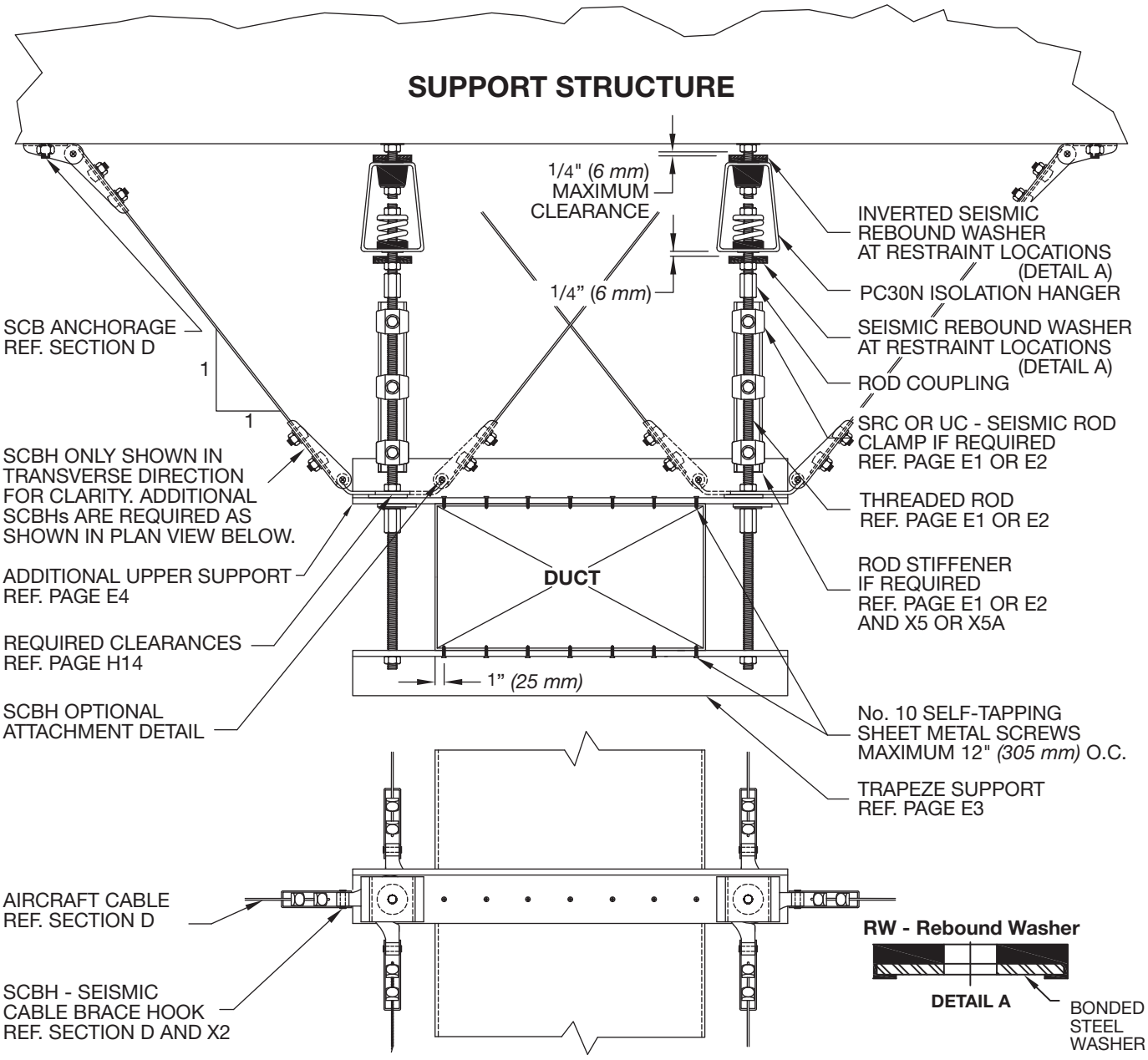
ALL-DIRECTIONAL SEISMIC CABLE BRACE HOOK GUIDELINES FOR SPRING-ISOLATED RECTANGULAR/OVAL DUCT



NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page B1. Brace angle ratio may be increased to 2 (vert.): 1 (horiz.). Refer to section A for limitations. Refer to page X2 for proper installation of the SCBHs.
NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.
NOTE 3: Install with hanger box snug to upper rebound washer, with washer tight to overhead surface. Upper hanger element deflects under load, leaving space on top.

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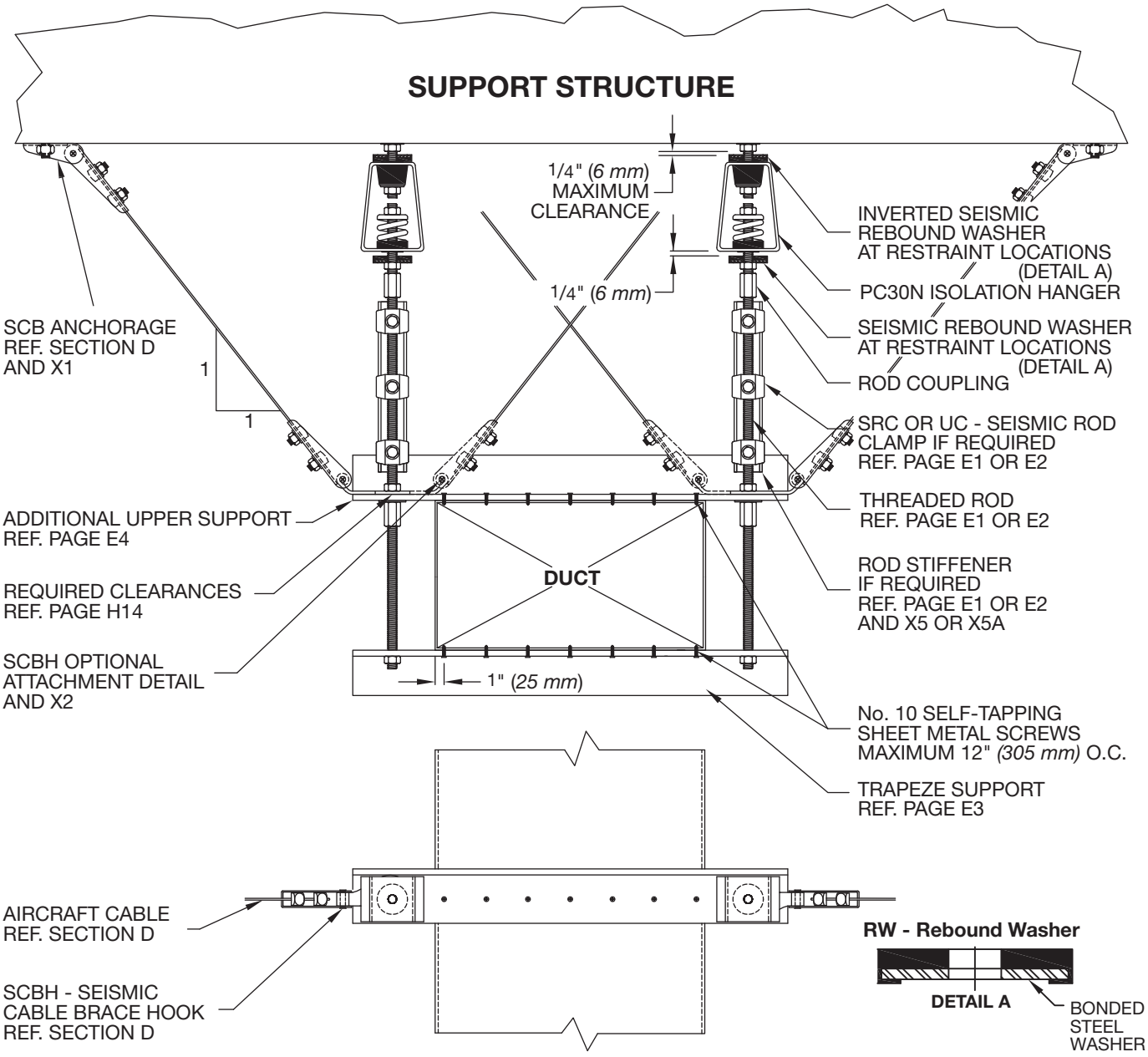
Fixed Equipment Anchorage
Office of Statewide Health Planning and Development
OPA-0349
on
December 22, 2009
Anthony R. Pike **(916) 654-3362**

Dhiru Mali
Structural Engineer
California SE No. 2811

TRANSVERSE SEISMIC CABLE BRACE HOOK GUIDELINES FOR SPRING-ISOLATED RECTANGULAR/OVAL DUCT



NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page B1. Brace angle ratio may be increased to 2 (vert.): 1 (horiz.). Refer to section A for limitations. Refer to page X2 for proper installation of the SCBHs.
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Fixed Equipment Anchorage
Office of Statewide Health Planning and Development

OPA-0349
on
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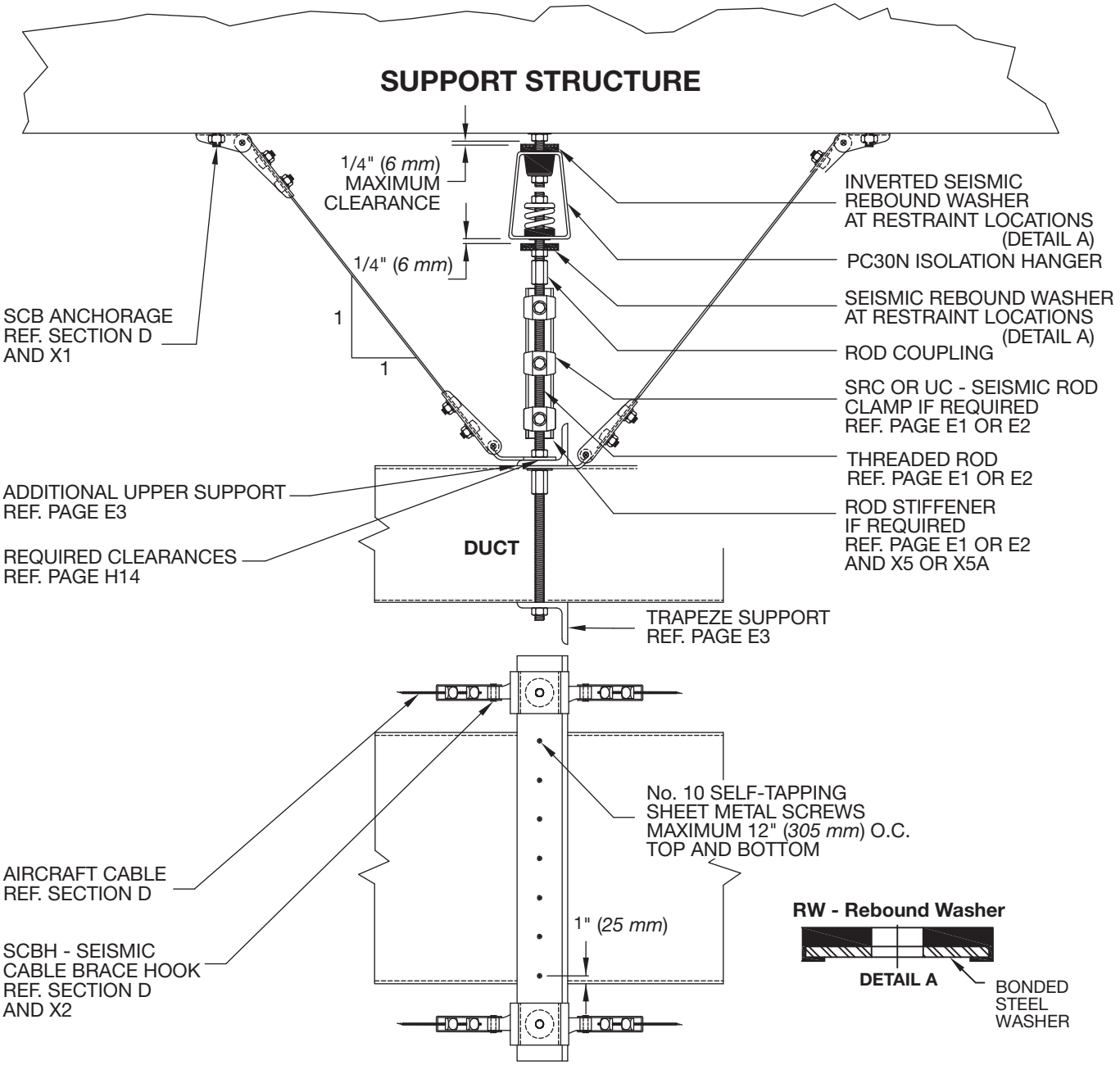
LONGITUDINAL SEISMIC CABLE BRACE HOOK GUIDELINES FOR SPRING-ISOLATED RECTANGULAR/OVAL DUCT



NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page B1. Brace angle ratio may be increased to 2 (vert.): 1 (horiz.). Refer to section A for limitations. Refer to page X2 for proper installation of the SCBHs.
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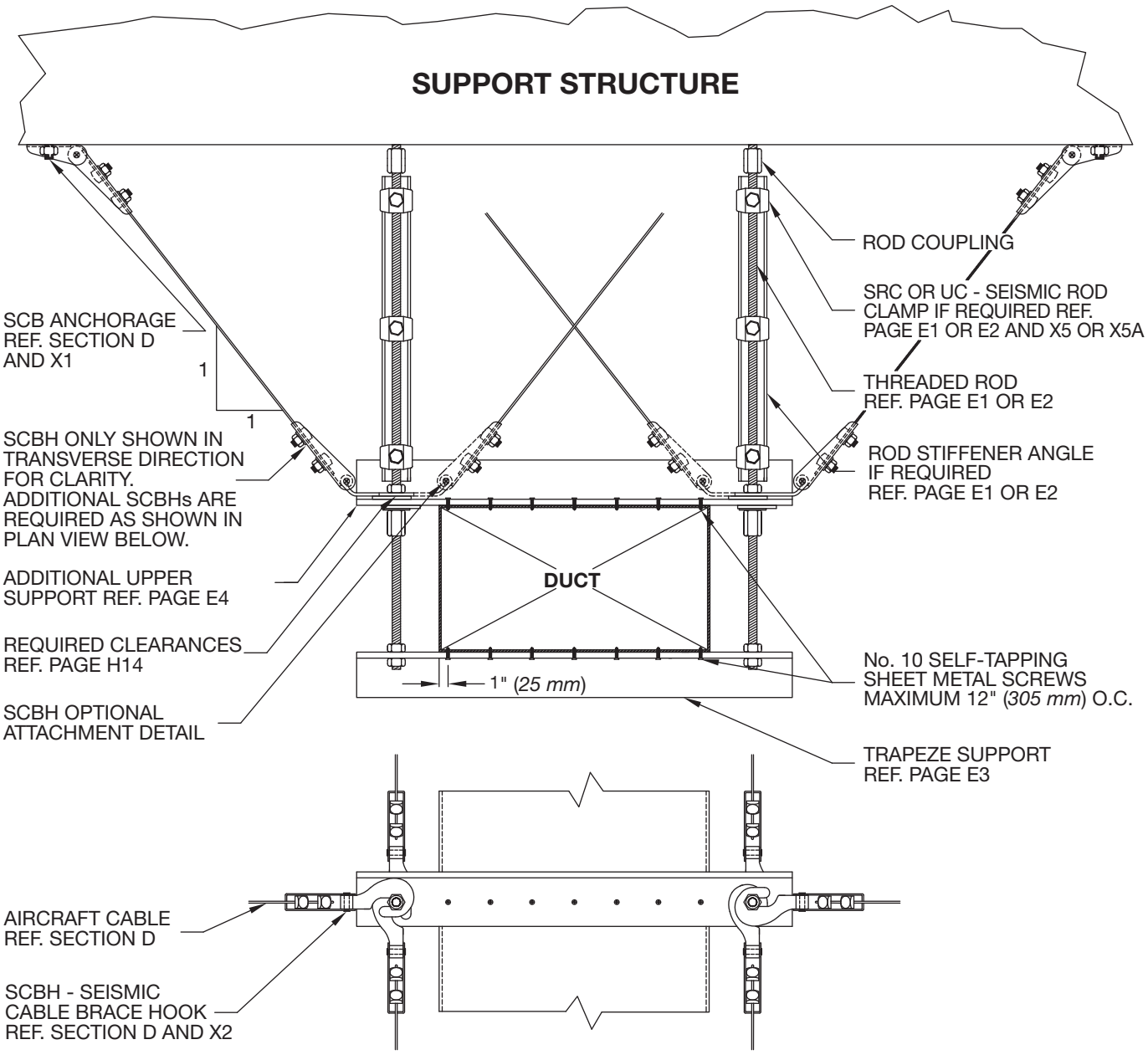
ALL-DIRECTIONAL SEISMIC CABLE BRACE HOOK GUIDELINES FOR RECTANGULAR/OVAL DUCT



NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page E1 or E2. Brace angle ratio may be increased to 2 (vert.): 1 (horiz.). Refer to section D for limitations. Refer to page X2 for proper installation of the SCBHs.

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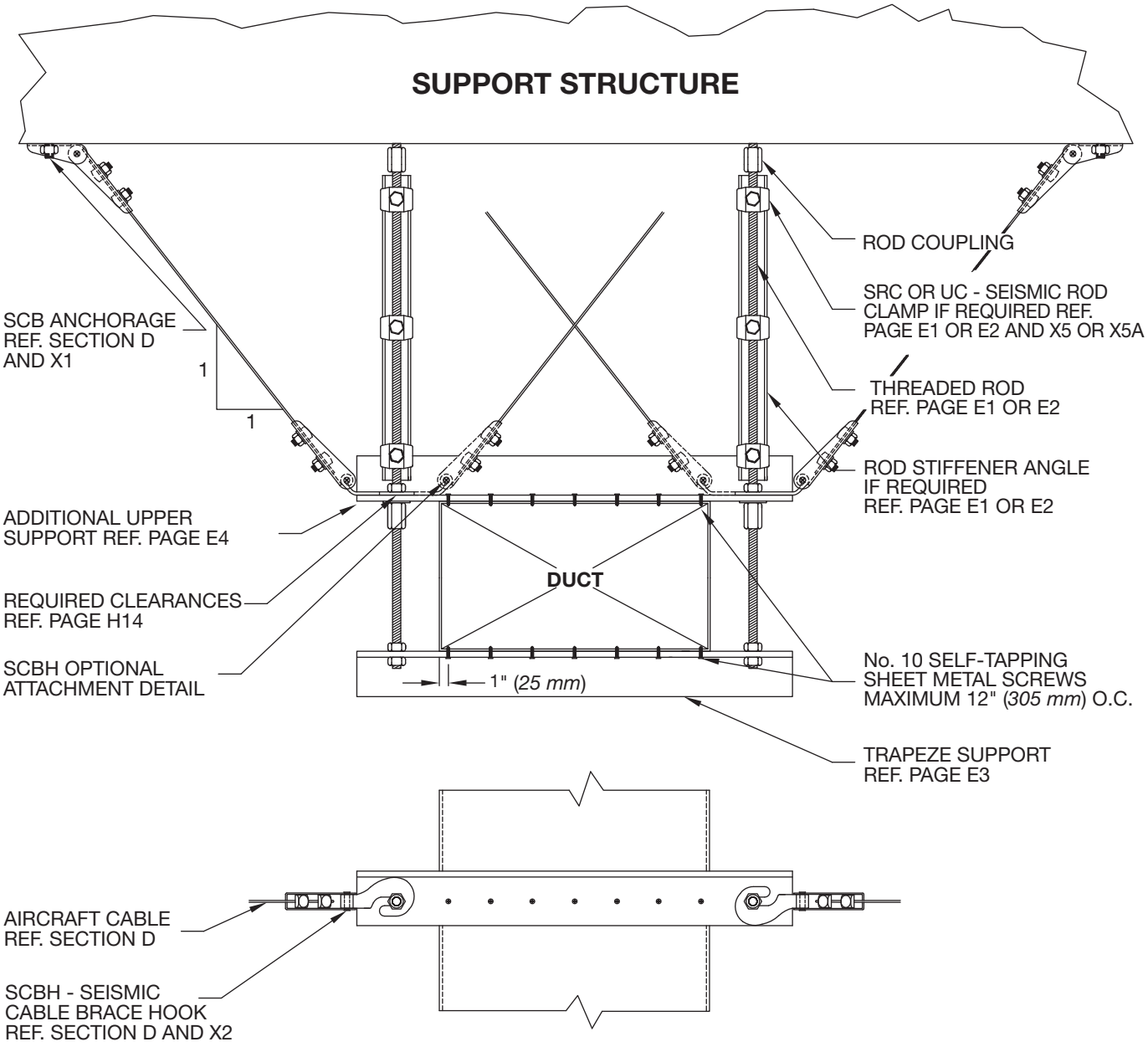

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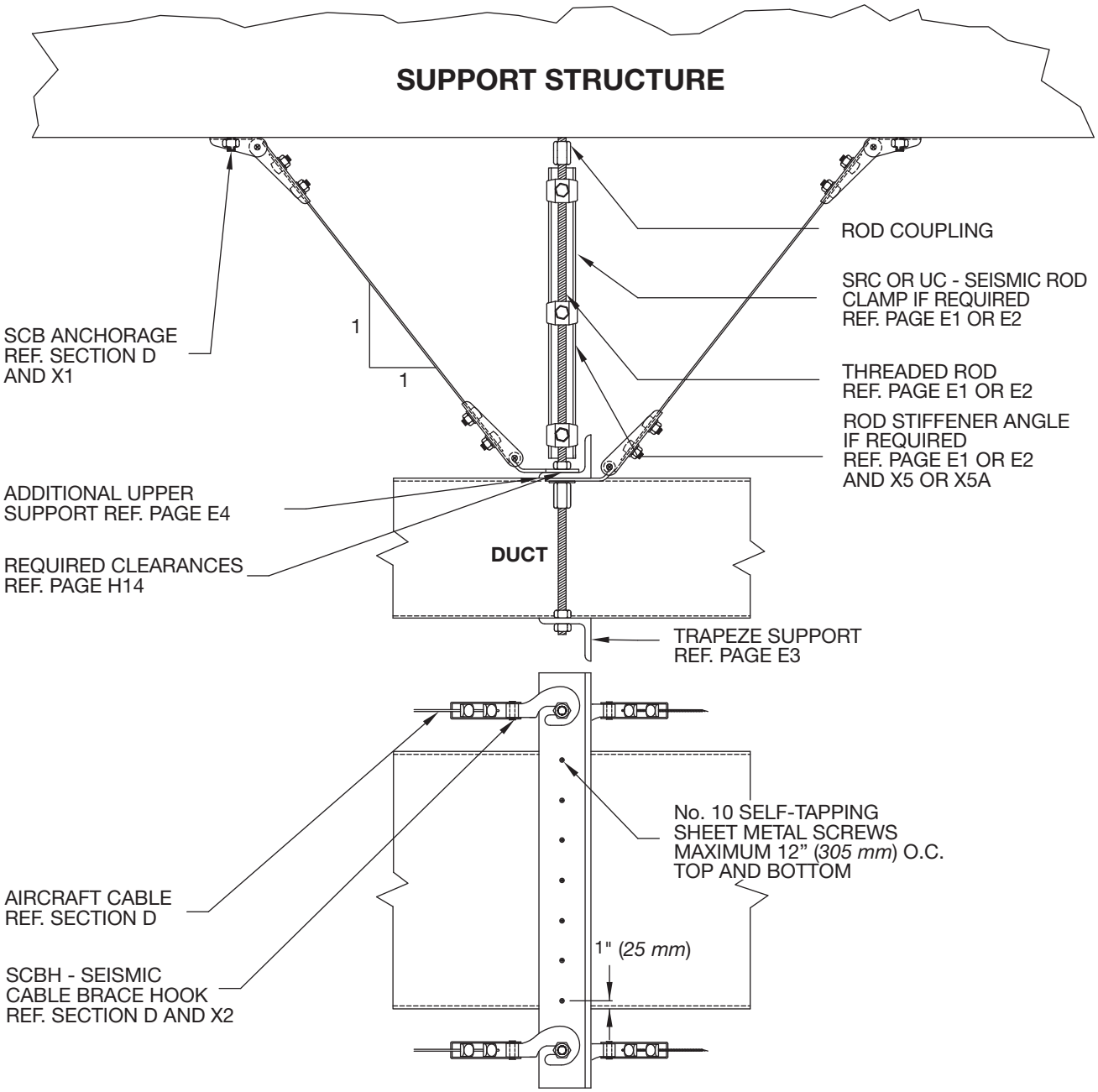
LOGITUDINAL SEISMIC CABLE BRACE HOOK GUIDELINES FOR RECTANGULAR/OVAL DUCT



NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page E1 or E2. Brace angle ratio may be increased to 2 (vert.): 1 (horiz.). Refer to section D for limitations. Refer to page X2 for proper installation of the SCBHS.

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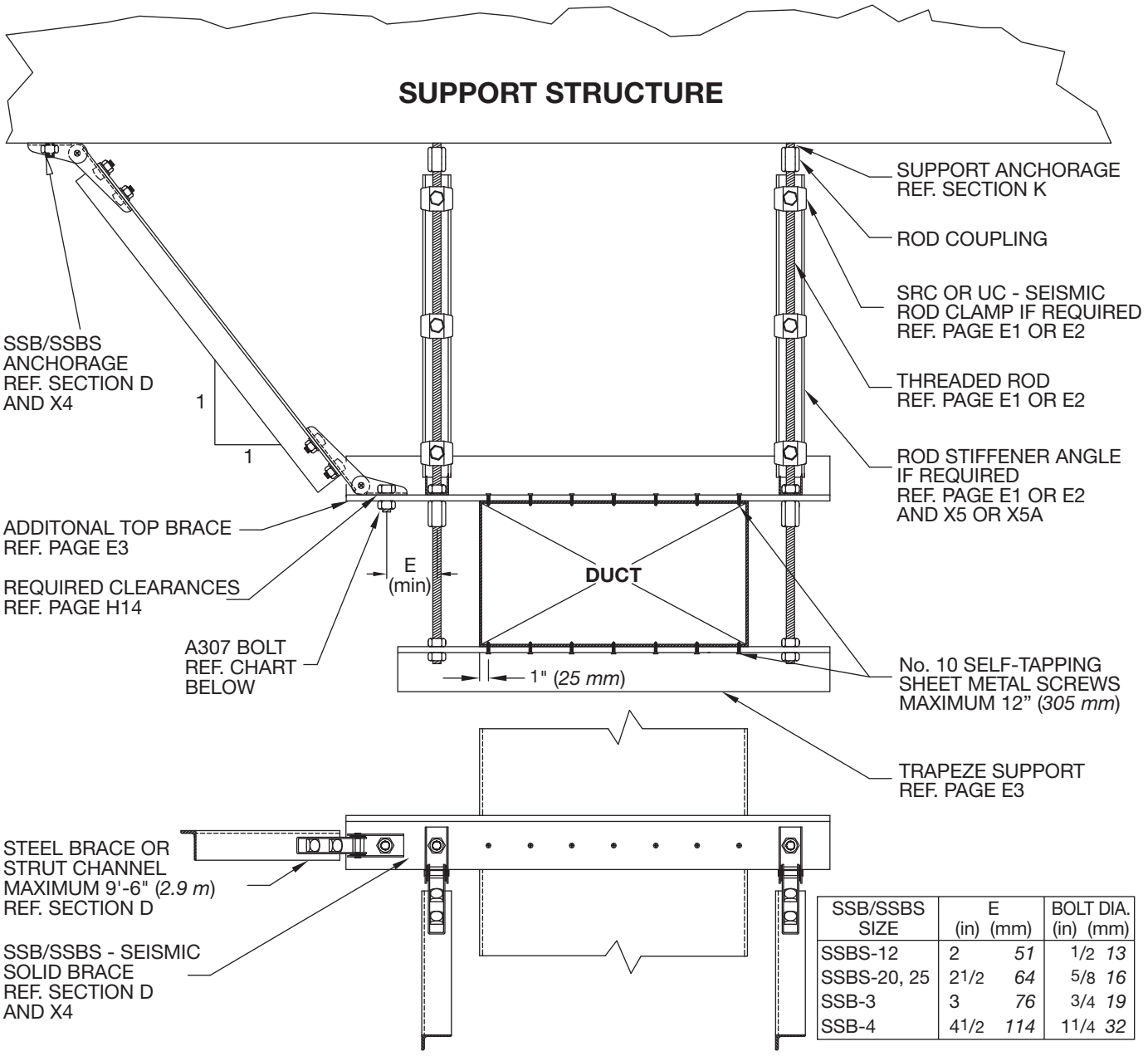

SSB/SSBS SIZE	E (in)	E (mm)	BOLT DIA. (in)	BOLT DIA. (mm)
SSBS-12	2	*51*	1/2	*13*
SSBS-20, 25	2 1/2	*64*	5/8	*16*
SSB-3	3	*76*	3/4	*19*
SSB-4	4 1/2	*114*	1 1/4	*32*

NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page E1 or E2. Brace angle ratio may be increased to 2 (vert): 1 (horiz.). Refer to section D for limitations.

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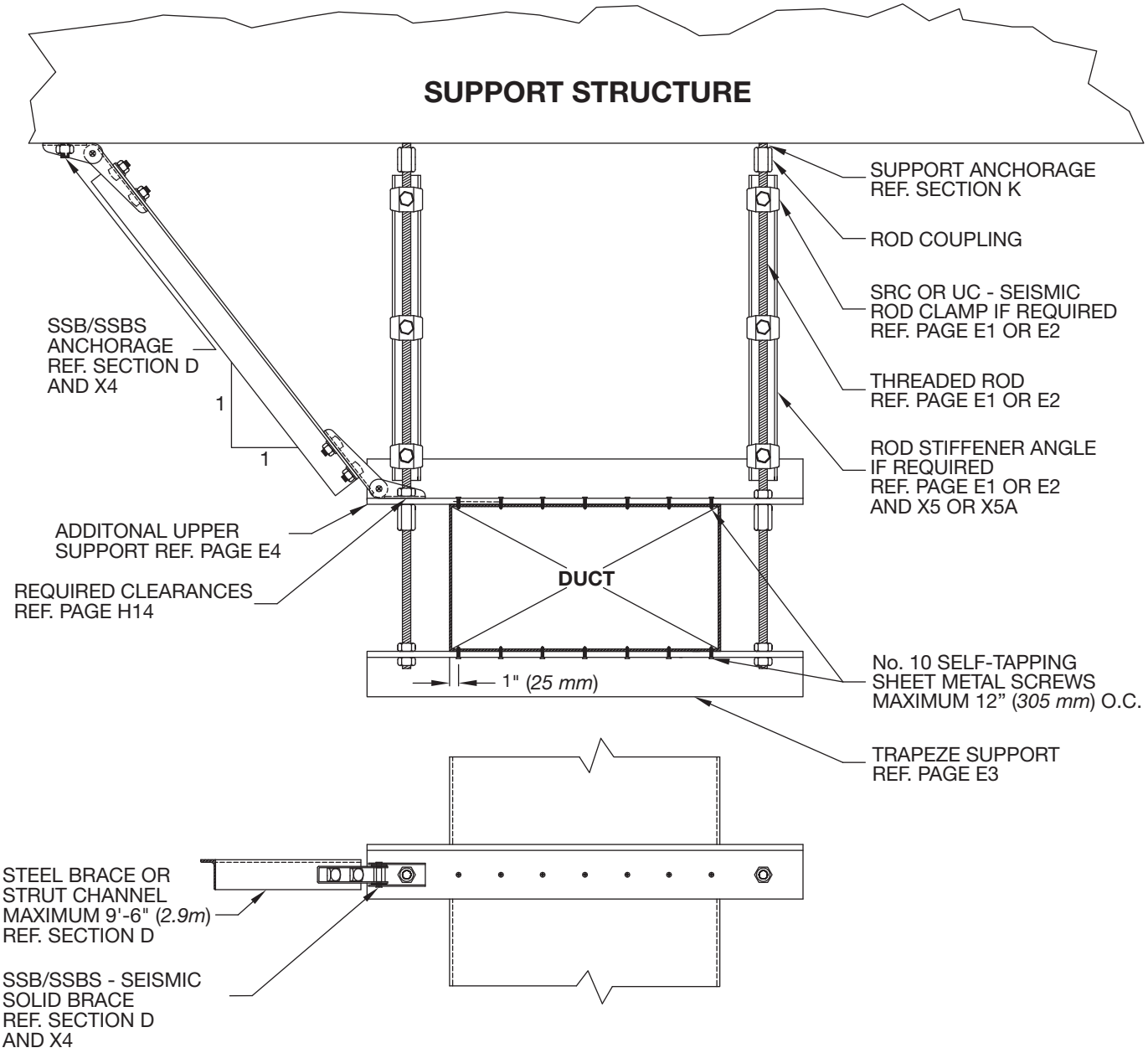
TRANSVERSE SEISMIC SOLID BRACE GUIDELINES FOR RECTANGULAR/OVAL DUCT



NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page E1 or E2. Brace angle ratio may be increased to 2 (vert): 1 (horiz.). Refer to section D for limitations.

NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

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FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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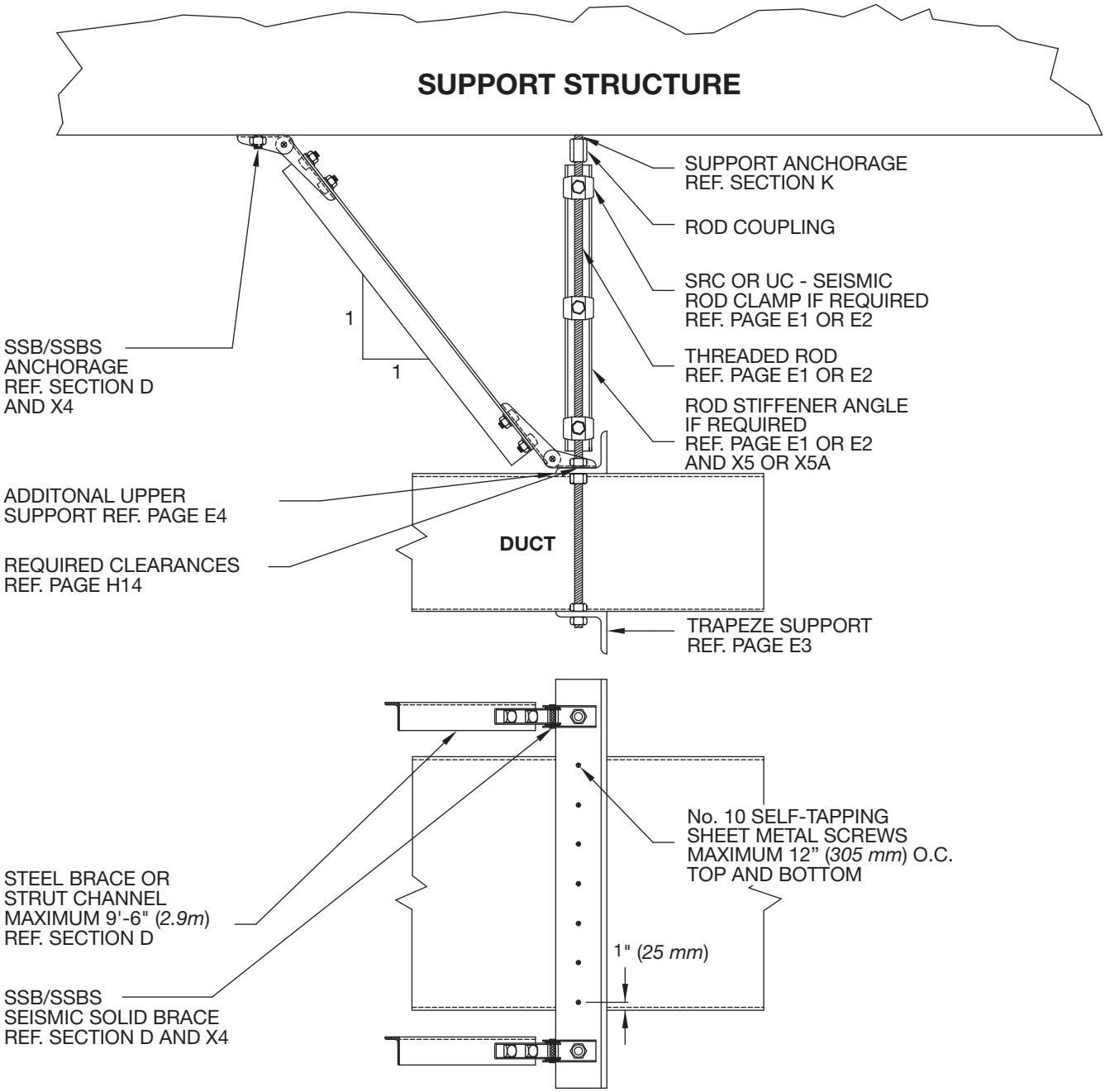
Dhiru Mali
Structural Engineer
California SE No. 2811

LONGITUDINAL SEISMIC SOLID BRACE GUIDELINES FOR RECTANGULAR/OVAL DUCT



NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page E1 or E2. Brace angle ratio may be increased to 2 (vert): 1 (horiz.). Refer to section D for limitations.

NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

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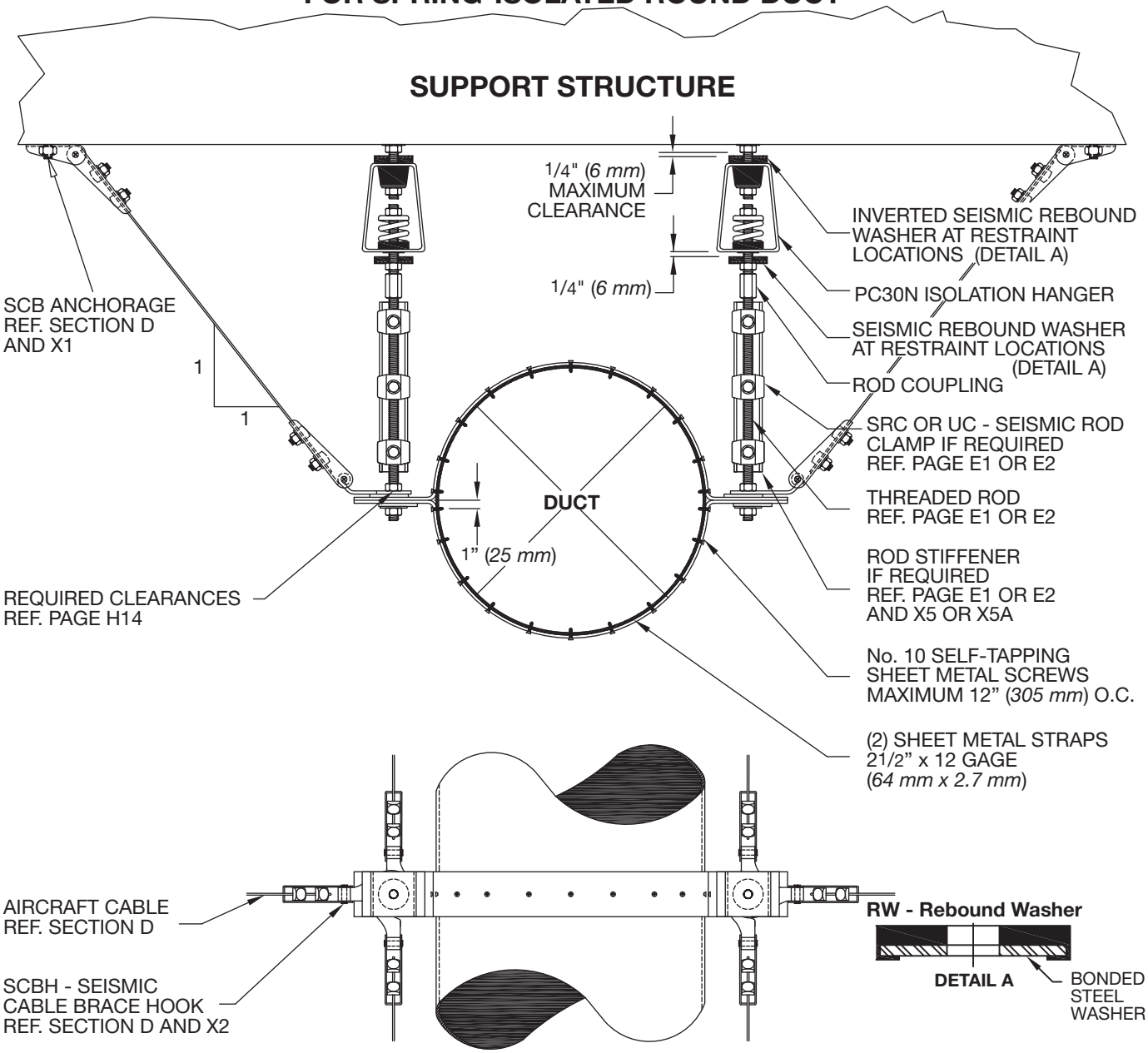
ALL-DIRECTIONAL SEISMIC CABLE BRACE HOOK GUIDELINES FOR SPRING-ISOLATED ROUND DUCT



NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page B1. Brace angle ratio may be increased to 2 (vert.): 1 (horiz.). Refer to section A for limitations. Refer to page X2 for proper installation of the SCBHs.

NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

NOTE 3: Install with hanger box snug to upper rebound washer, with washer tight to overhead surface. Upper hanger element deflects under load, leaving space on top.

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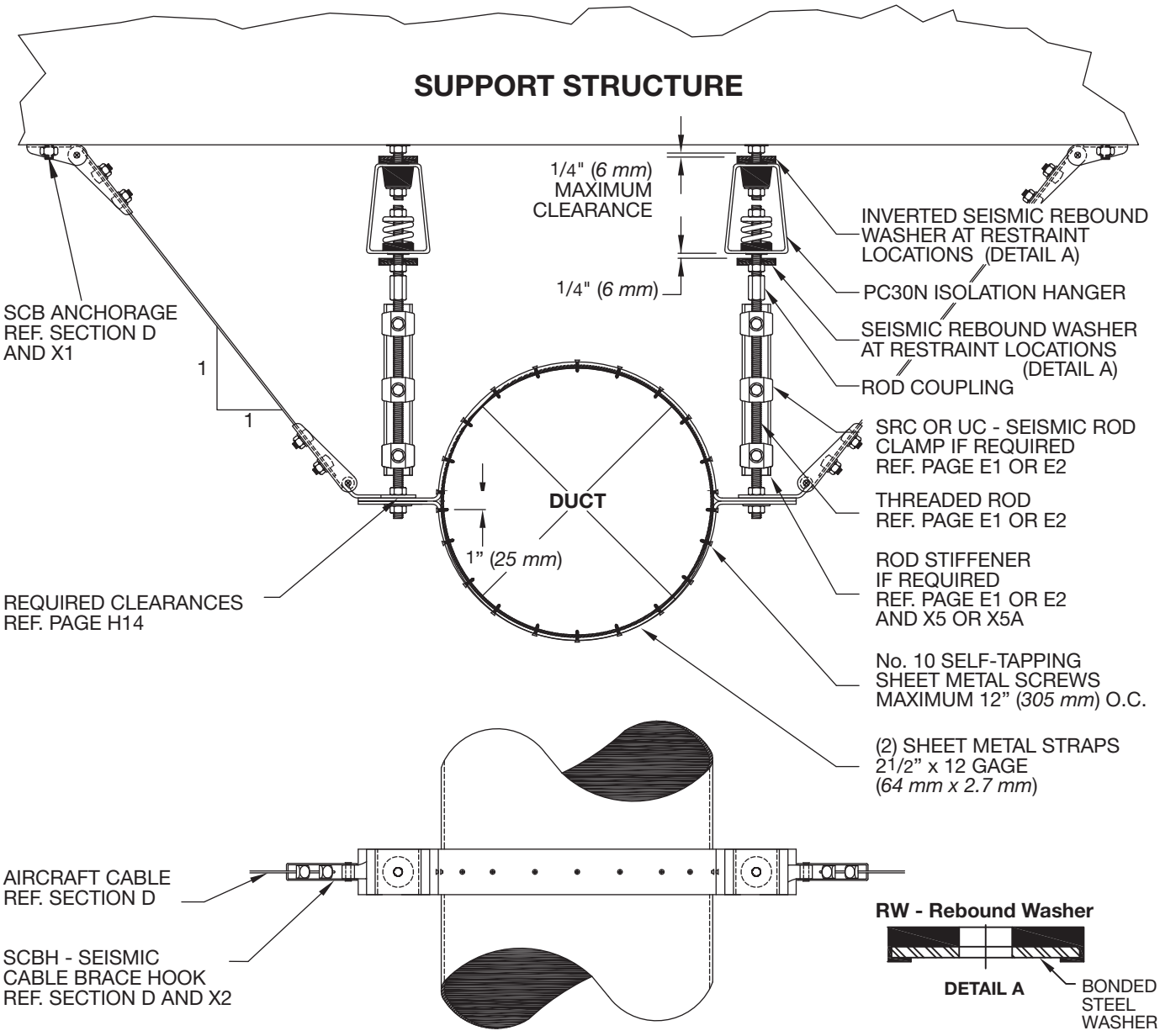
TRANSVERSE SEISMIC CABLE BRACE HOOK GUIDELINES FOR SPRING-ISOLATED ROUND DUCT



NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page B1. Brace angle ratio may be increased to 2 (vert.): 1 (horiz.). Refer to section A for limitations. Refer to page X2 for proper installation of the SCBHs.

NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

NOTE 3: Install with hanger box snug to upper rebound washer, with washer tight to overhead surface. Upper hanger element deflects under load, leaving space on top.

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OPA-0349 December 22, 2006

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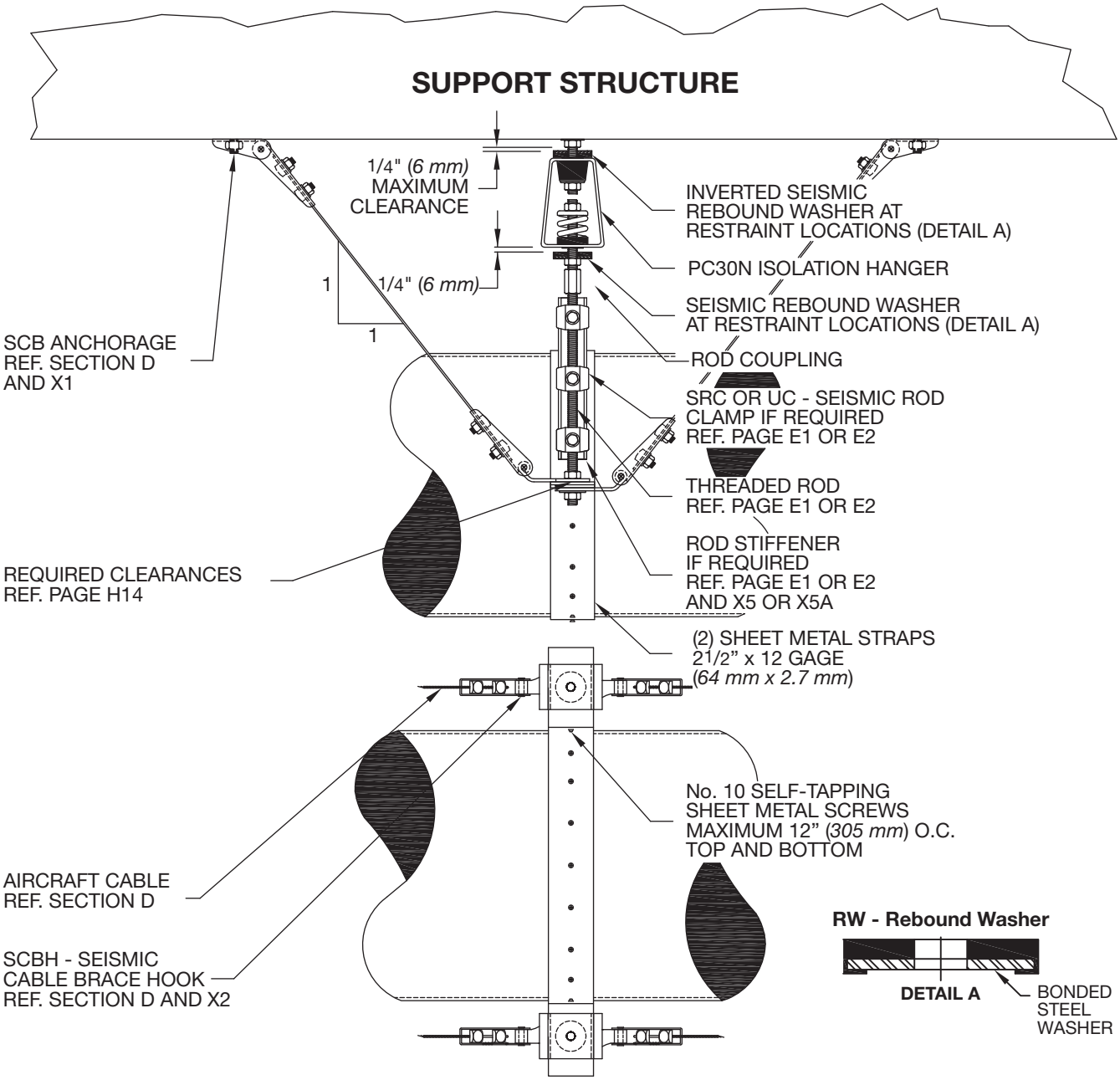
LONGITUDINAL SEISMIC CABLE BRACE HOOK GUIDELINES FOR SPRING-ISOLATED ROUND DUCT



NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page B1. Brace angle ratio may be increased to 2 (vert.): 1 (horiz.). Refer to section A for limitations. Refer to page X2 for proper installation of the SCBHs.

NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

NOTE 3: Install with hanger box snug to upper rebound washer, with washer tight to overhead surface. Upper hanger element deflects under load, leaving space on top.

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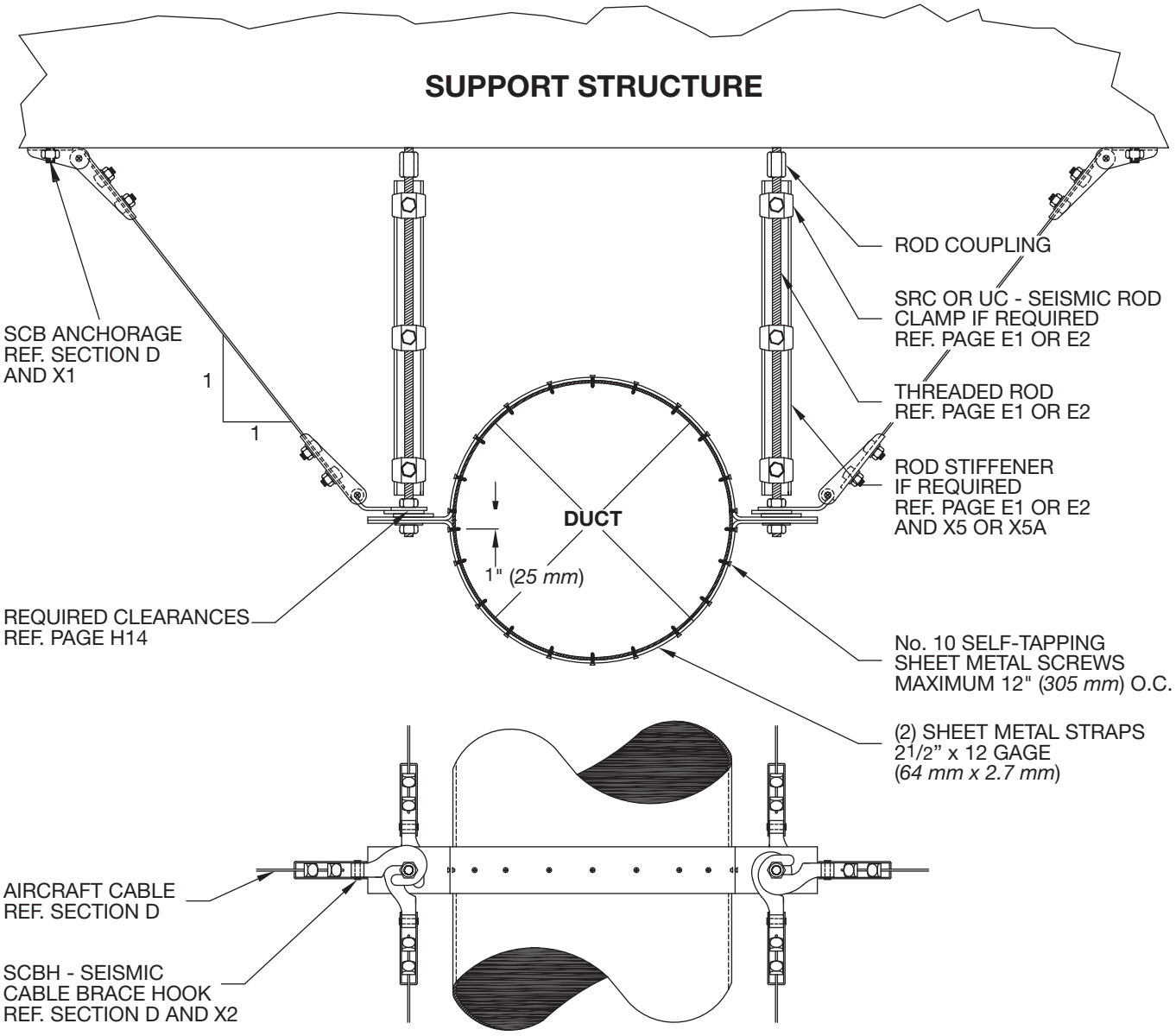
ALL-DIRECTIONAL SEISMIC CABLE BRACE HOOK GUIDELINES FOR ROUND DUCT



NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page E1 or E2. Brace angle ratio may be increased to 2 (vert.): 1 (horiz.). Refer to section D for limitations. Refer to page X2 for proper installation of SCBHS.

NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

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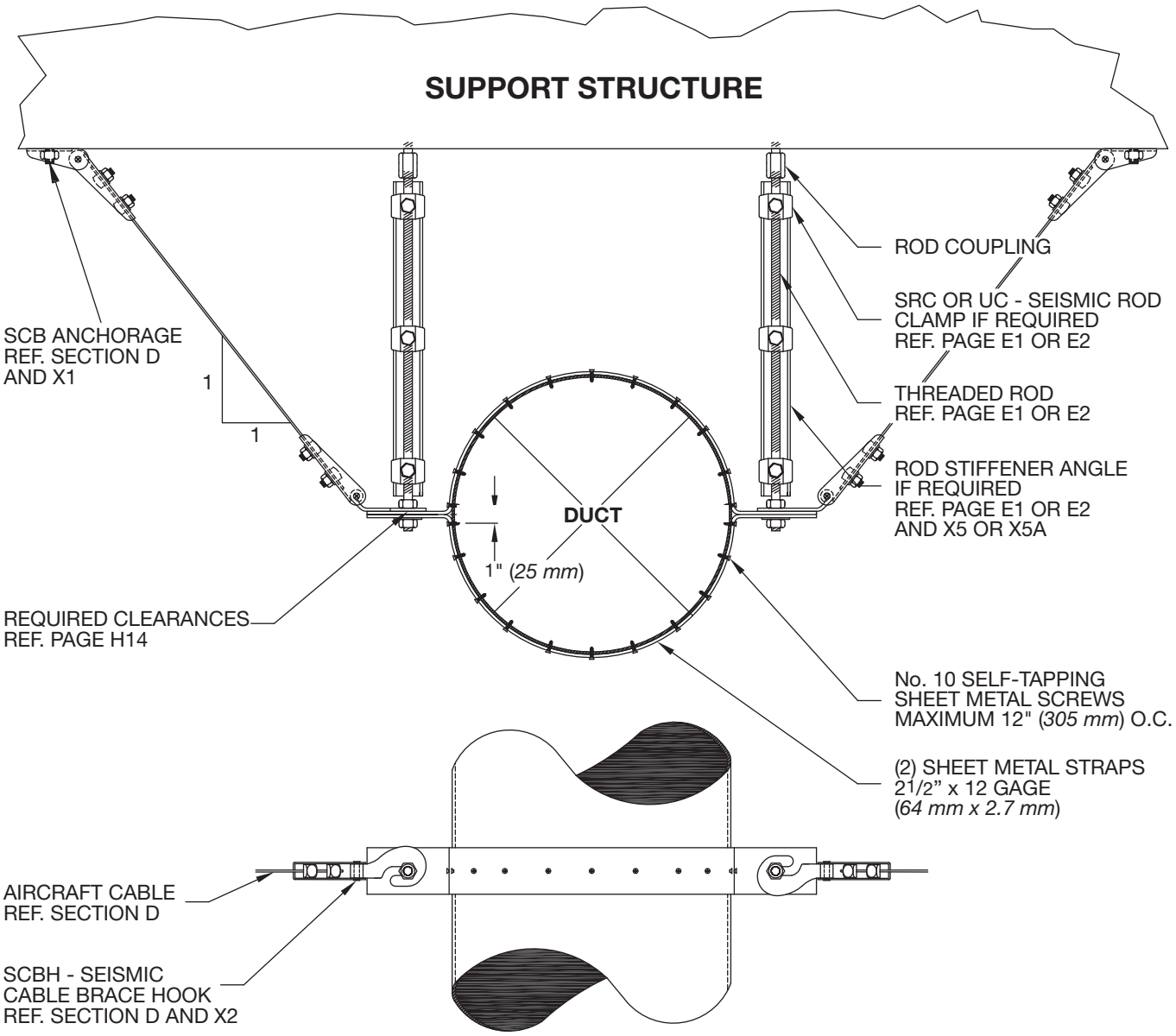
TRANSVERSE SEISMIC CABLE BRACE HOOK GUIDELINES FOR ROUND DUCT



NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page E1 or E2. Brace angle ratio may be increased to 2 (vert.): 1 (horiz.). Refer to section D for limitations. Refer to page X2 for proper installation of SCBHS.

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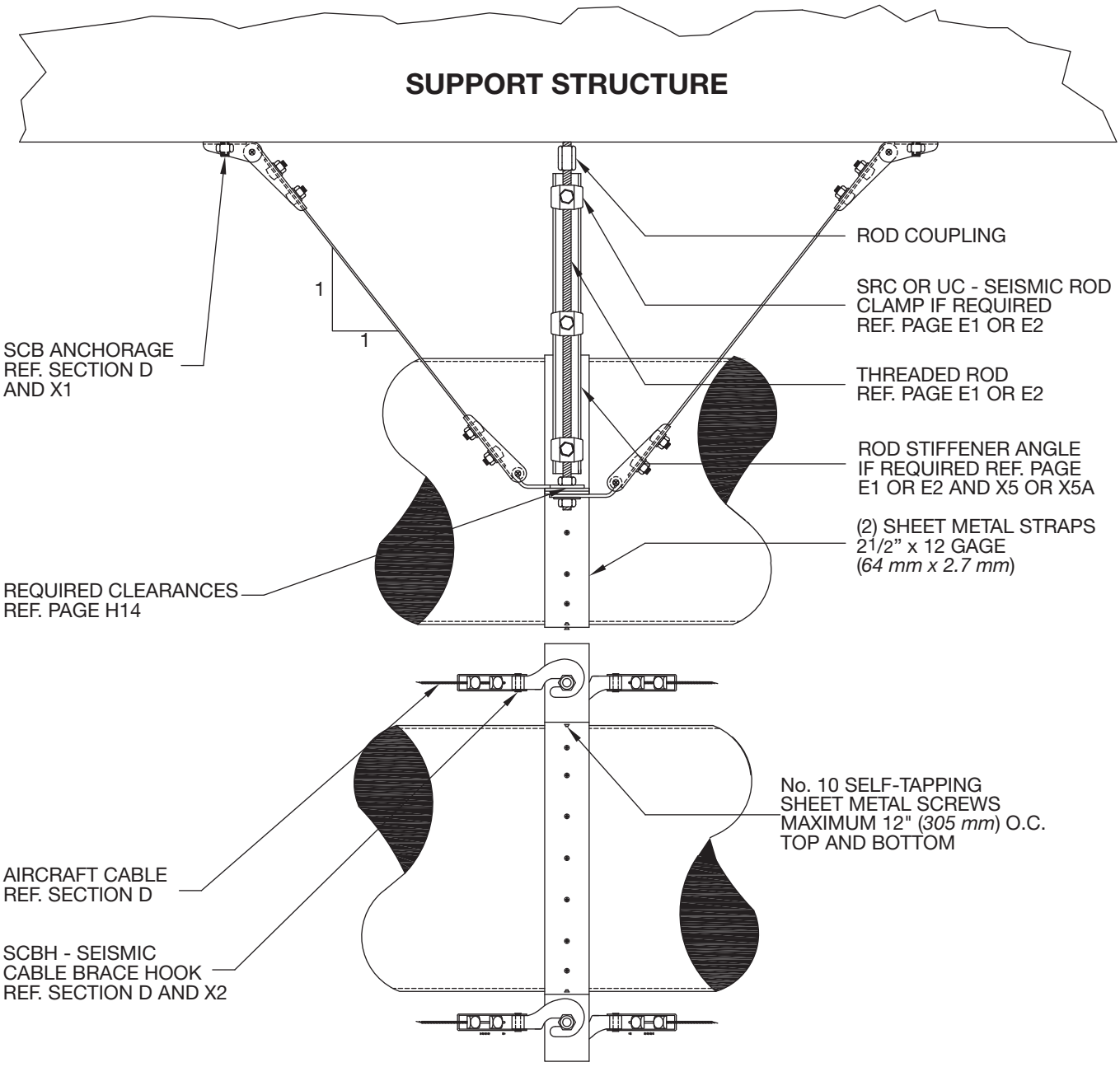
LONGITUDINAL SEISMIC CABLE BRACE HOOK GUIDELINES FOR ROUND DUCT



NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page E1 or E2. Brace angle ratio may be increased to 2 (vert.): 1 (horiz.). Refer to section D for limitations. Refer to page X2 for proper installation of SCBHs.

NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

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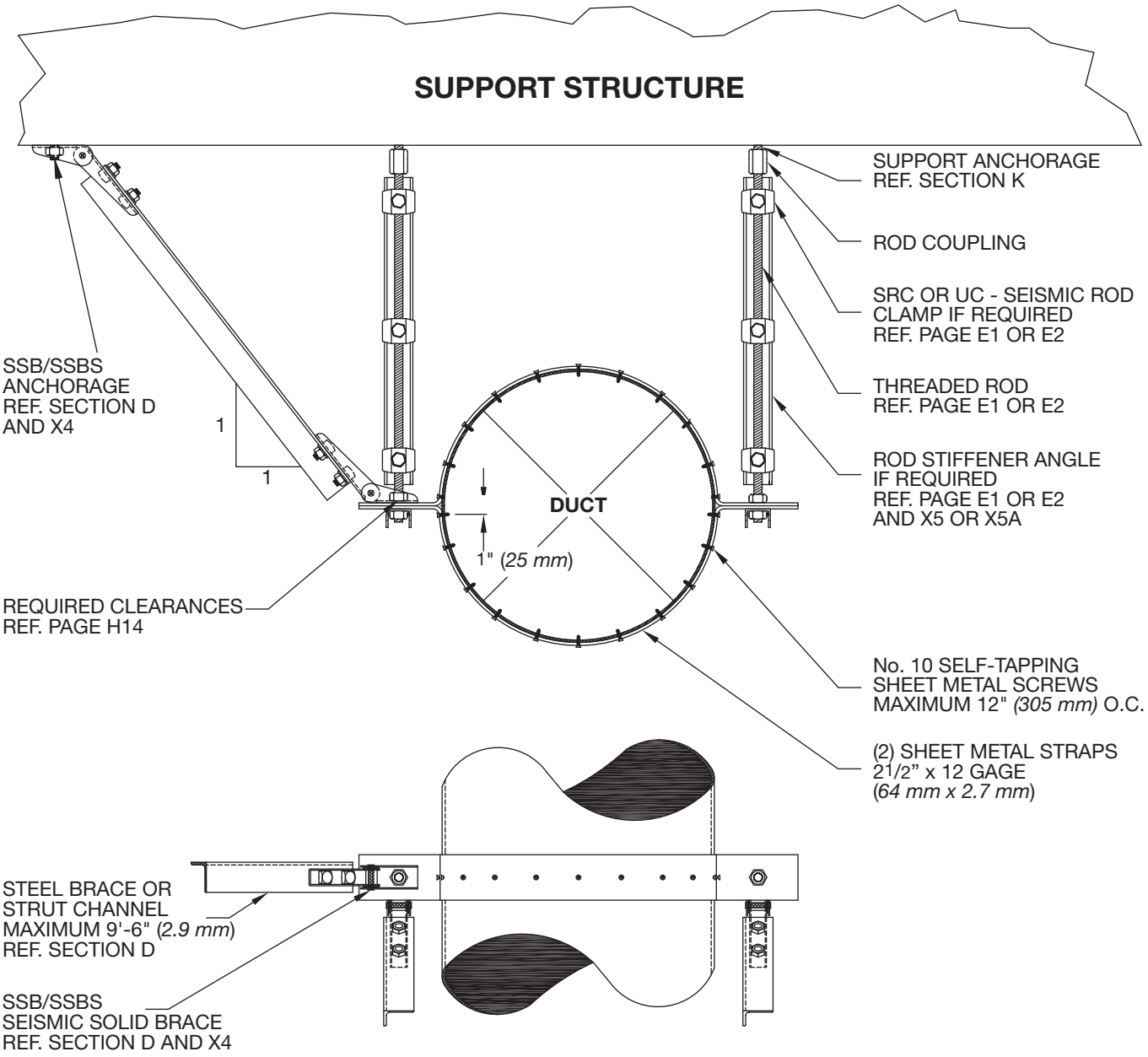
ALL-DIRECTIONAL SEISMIC SOLID BRACE GUIDELINES FOR ROUND DUCT



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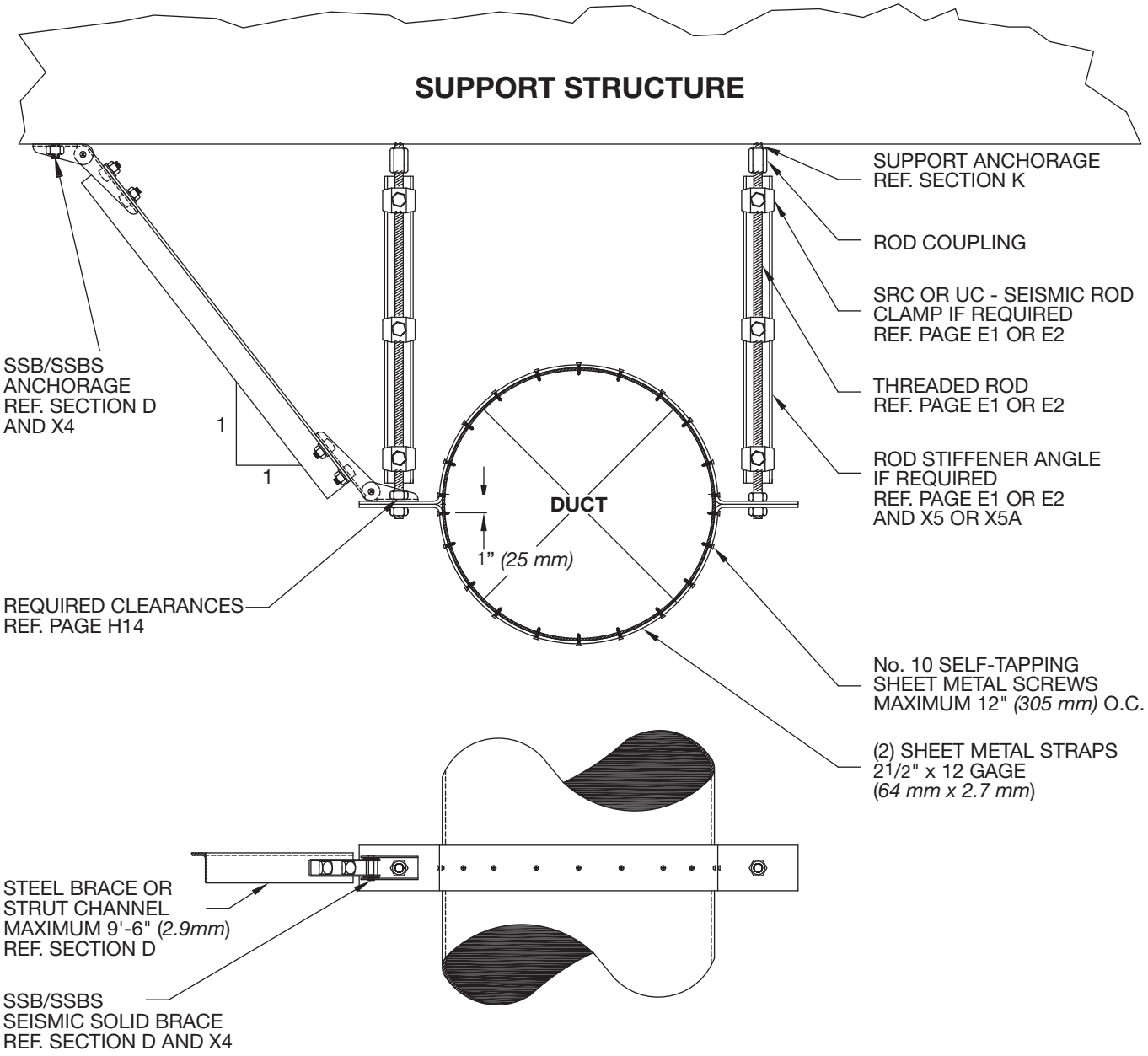
TRANSVERSE SEISMIC SOLID BRACE GUIDELINES FOR ROUND DUCT



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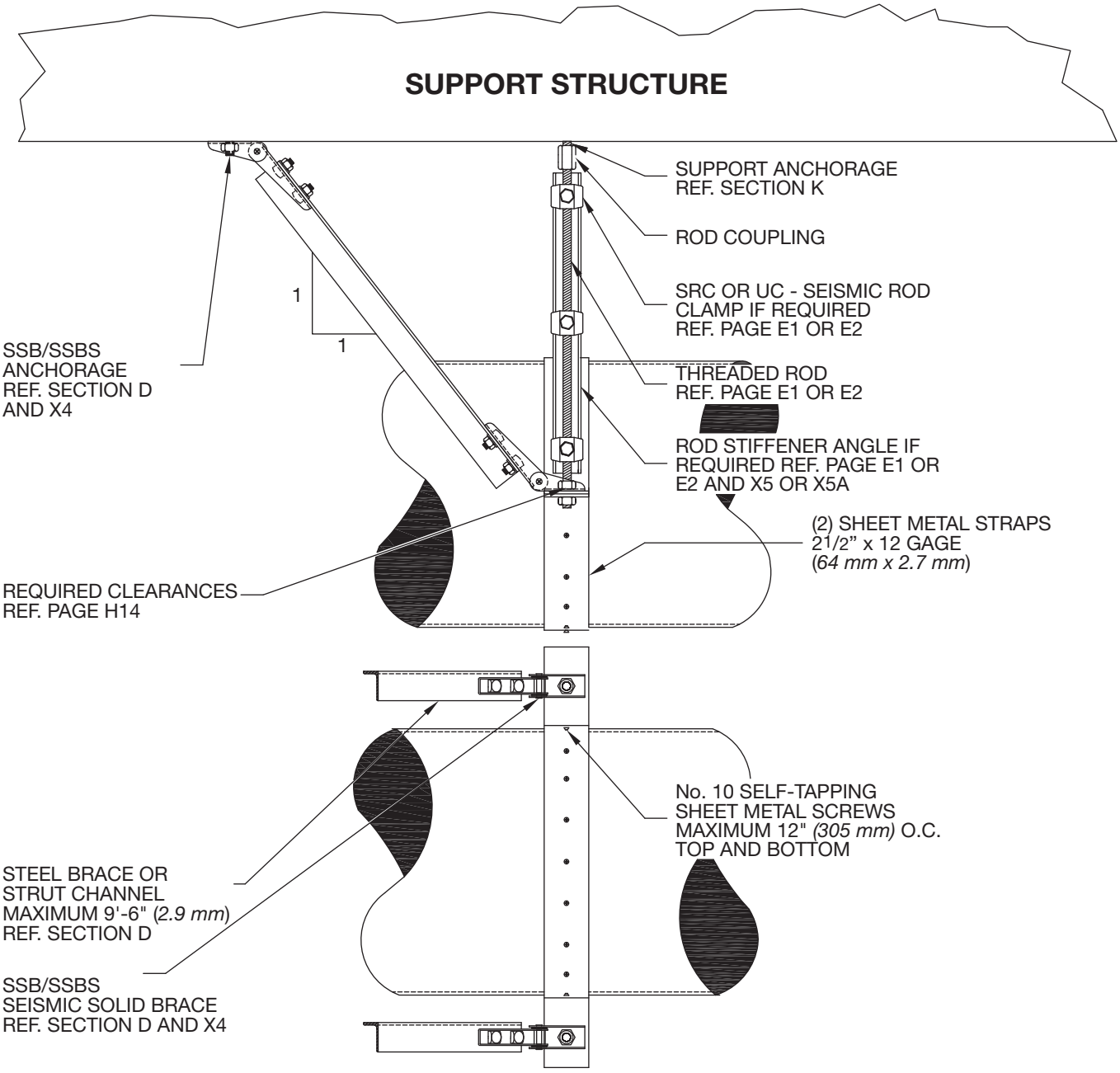
LONGITUDINAL SEISMIC SOLID BRACE GUIDELINES FOR ROUND DUCT



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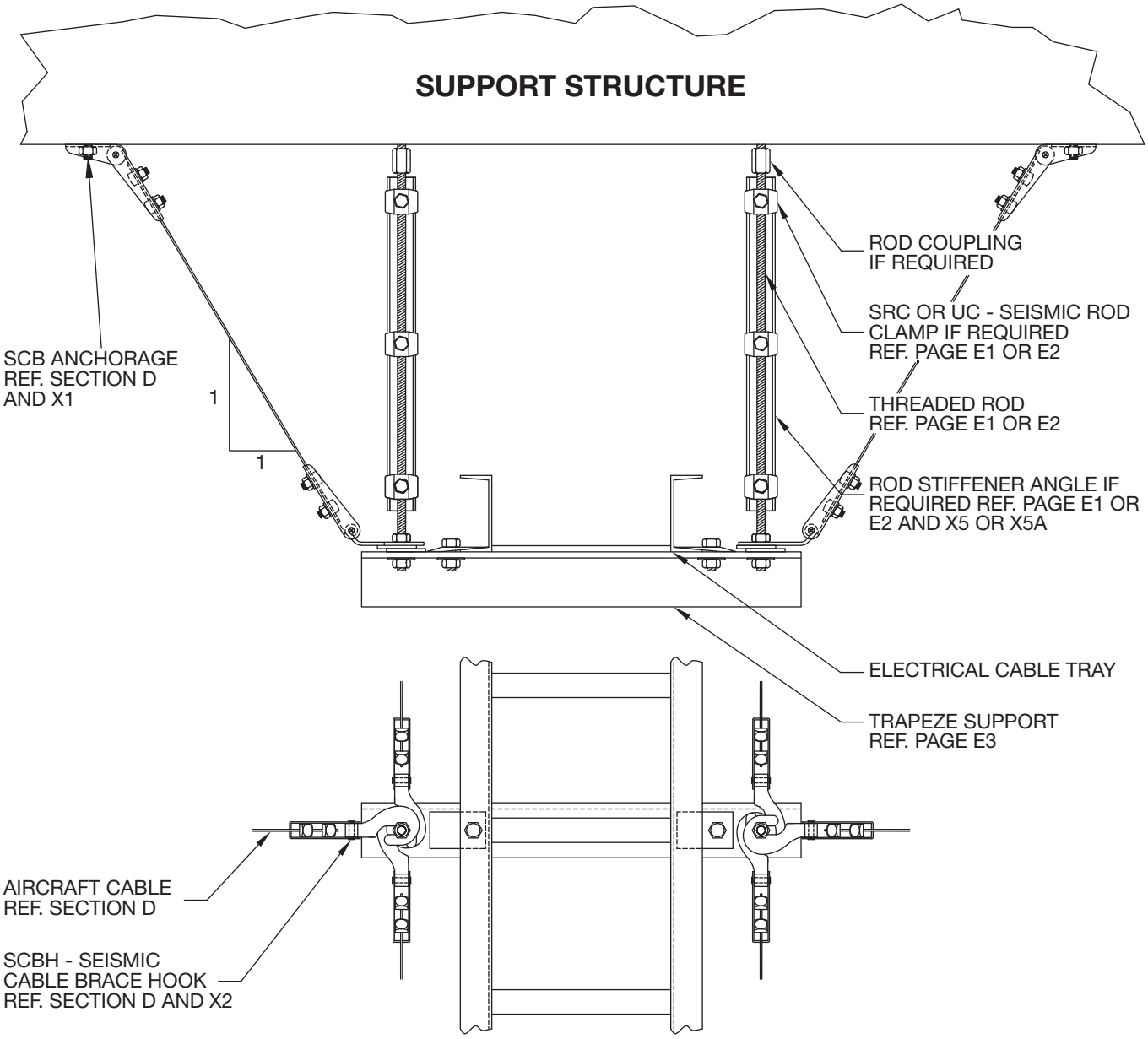
ALL-DIRECTIONAL SEISMIC CABLE BRACE HOOK GUIDELINES FOR TRAPEZE SUPPORTED ELECTRICAL CABLE TRAYS



NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page E1 or E2. Brace angle ratio may be increased to 2 (vert.): 1 (horiz.). Refer to section D for limitations. Refer to page X2 for proper installation of SCBHs.

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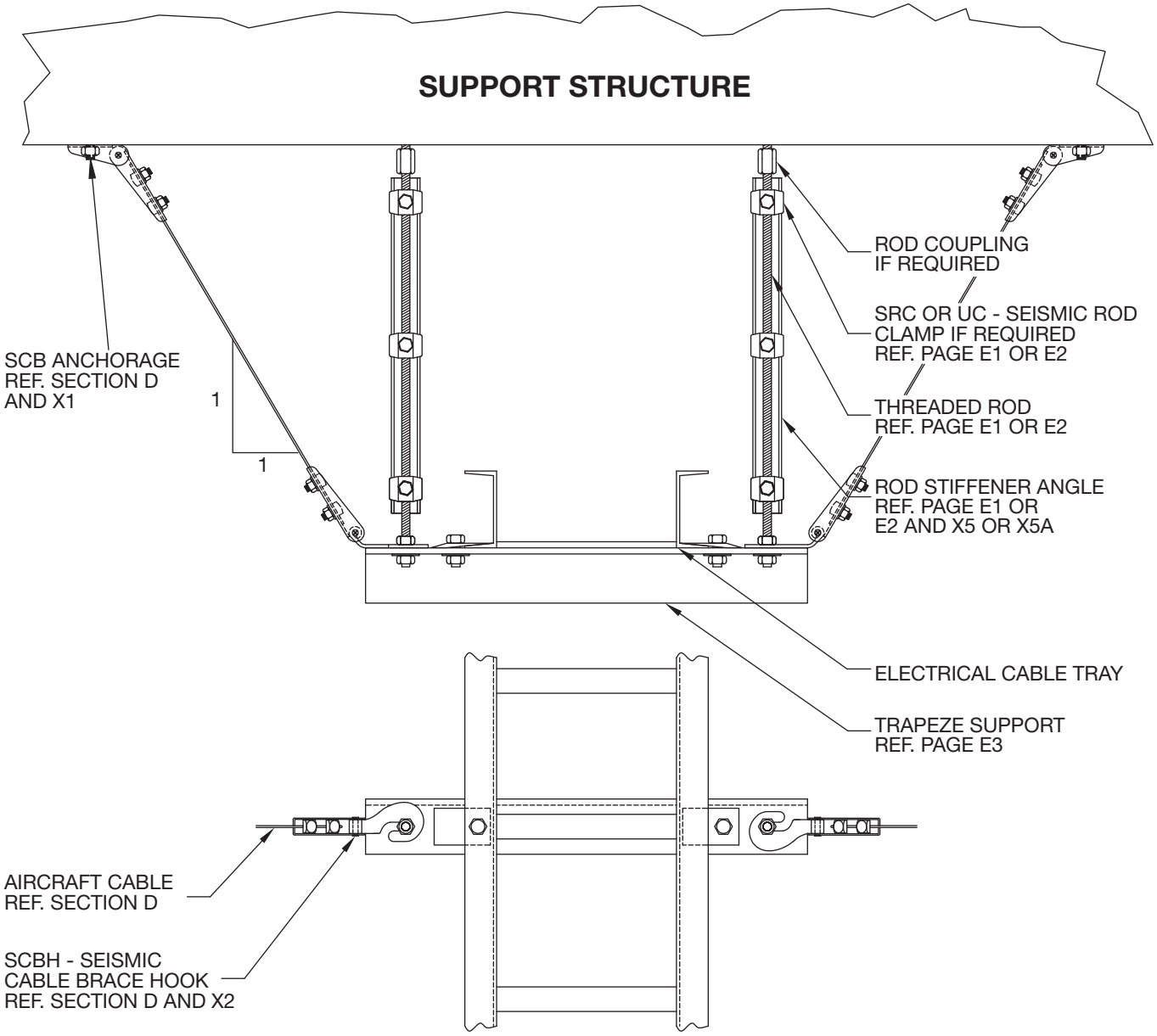
TRANSVERSE SEISMIC CABLE BRACE HOOK GUIDELINES FOR TRAPEZE SUPPORTED ELECTRICAL CABLE TRAYS



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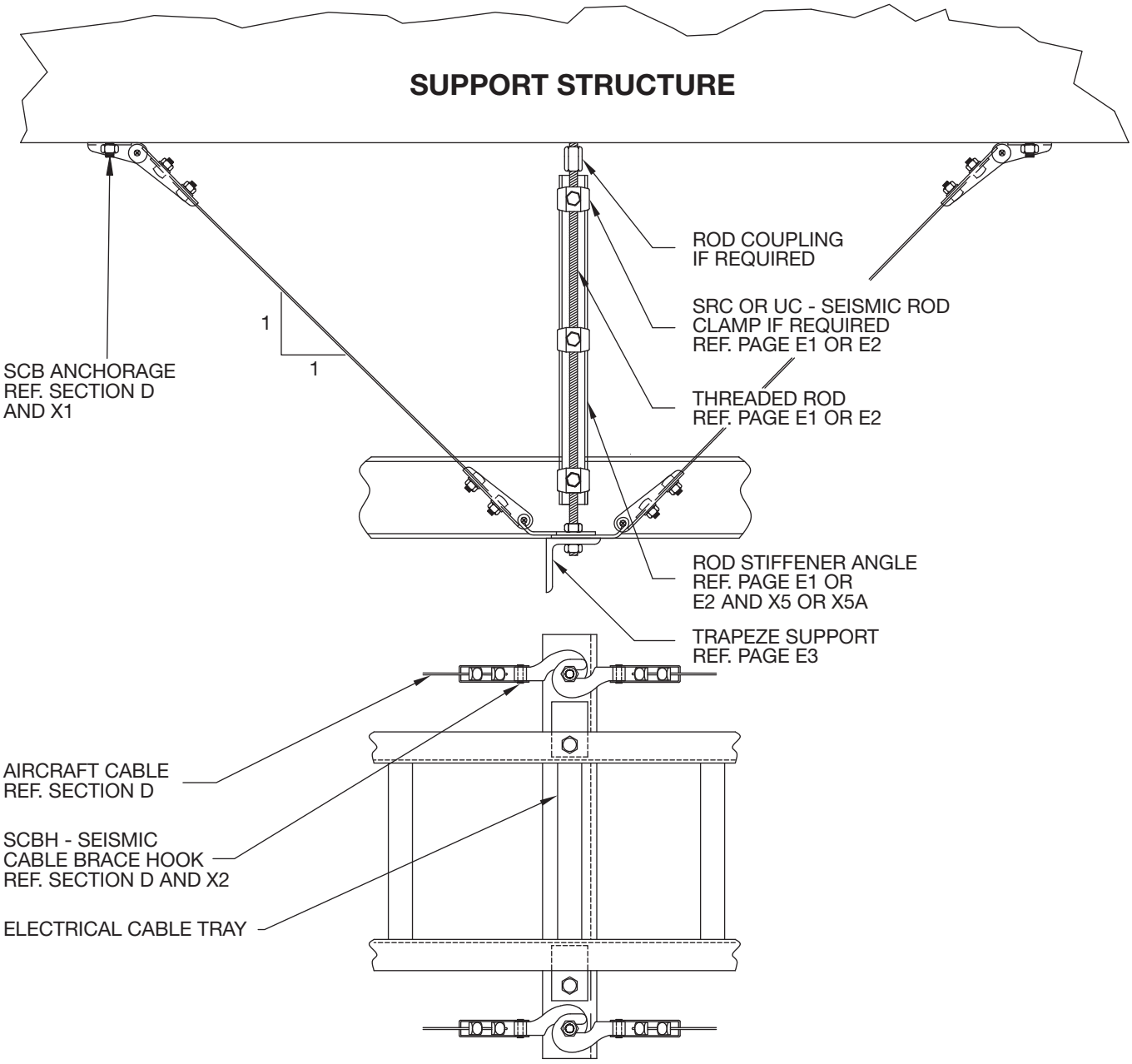
LONGITUDINAL SEISMIC CABLE BRACE HOOK GUIDELINES FOR TRAPEZE SUPPORTED ELECTRICAL CABLE TRAYS



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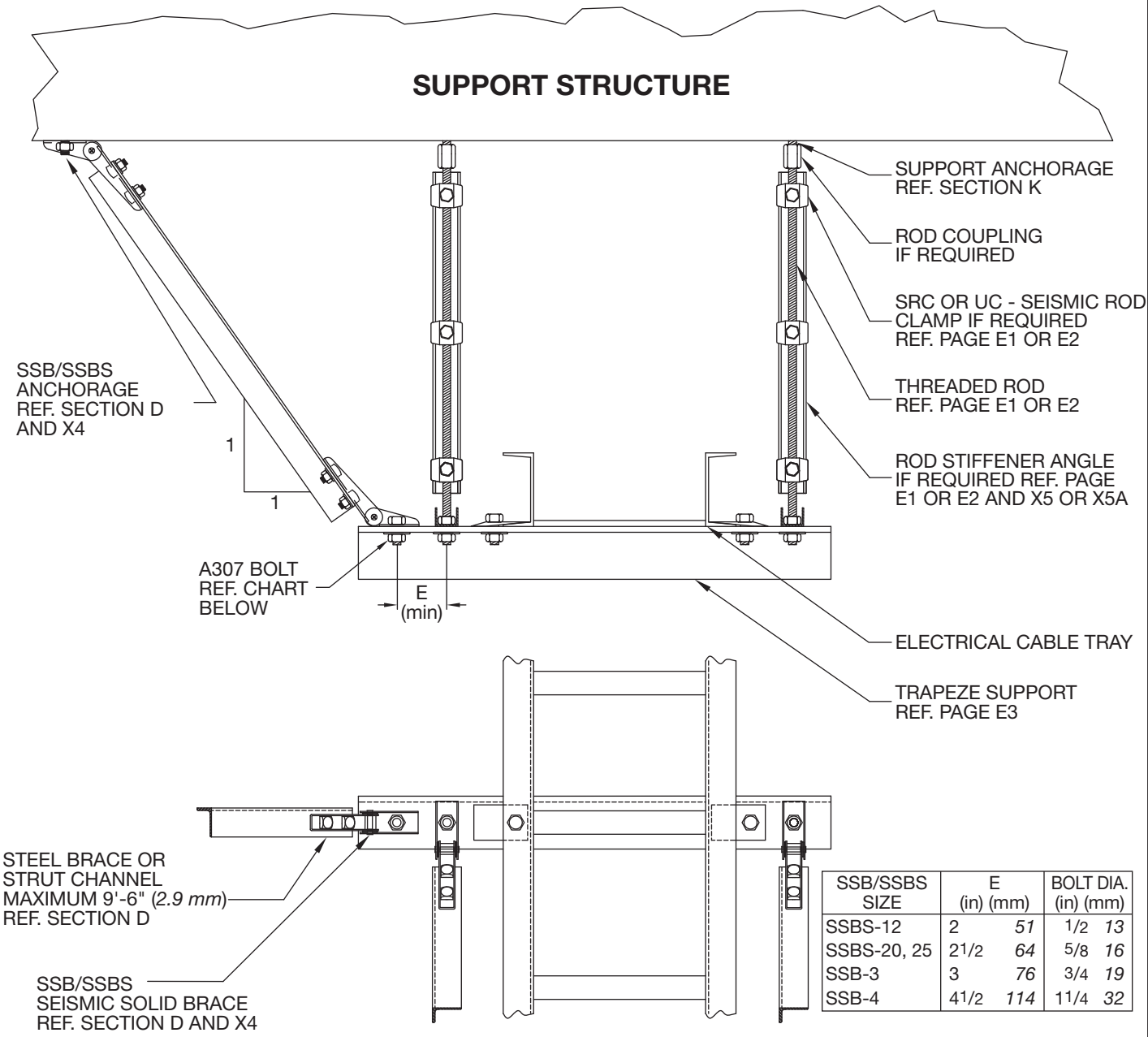
ALL-DIRECTIONAL SEISMIC SOLID BRACE GUIDELINES FOR TRAPEZE SUPPORTED ELECTRICAL CABLE TRAYS



SSB/SSBS SIZE	E (in)	E (mm)	BOLT DIA. (in)	BOLT DIA. (mm)
SSBS-12	2	*51*	1/2	*13*
SSBS-20, 25	2 1/2	*64*	5/8	*16*
SSB-3	3	*76*	3/4	*19*
SSB-4	4 1/2	*114*	1 1/4	*32*

NOTE 1: A rod stiffener angle may be required as shown. For additional information, ref. page E1 or E2. Brace angle ratio may be increased to 2 (vert.): 1 (horiz.). Refer to section D for limitations.

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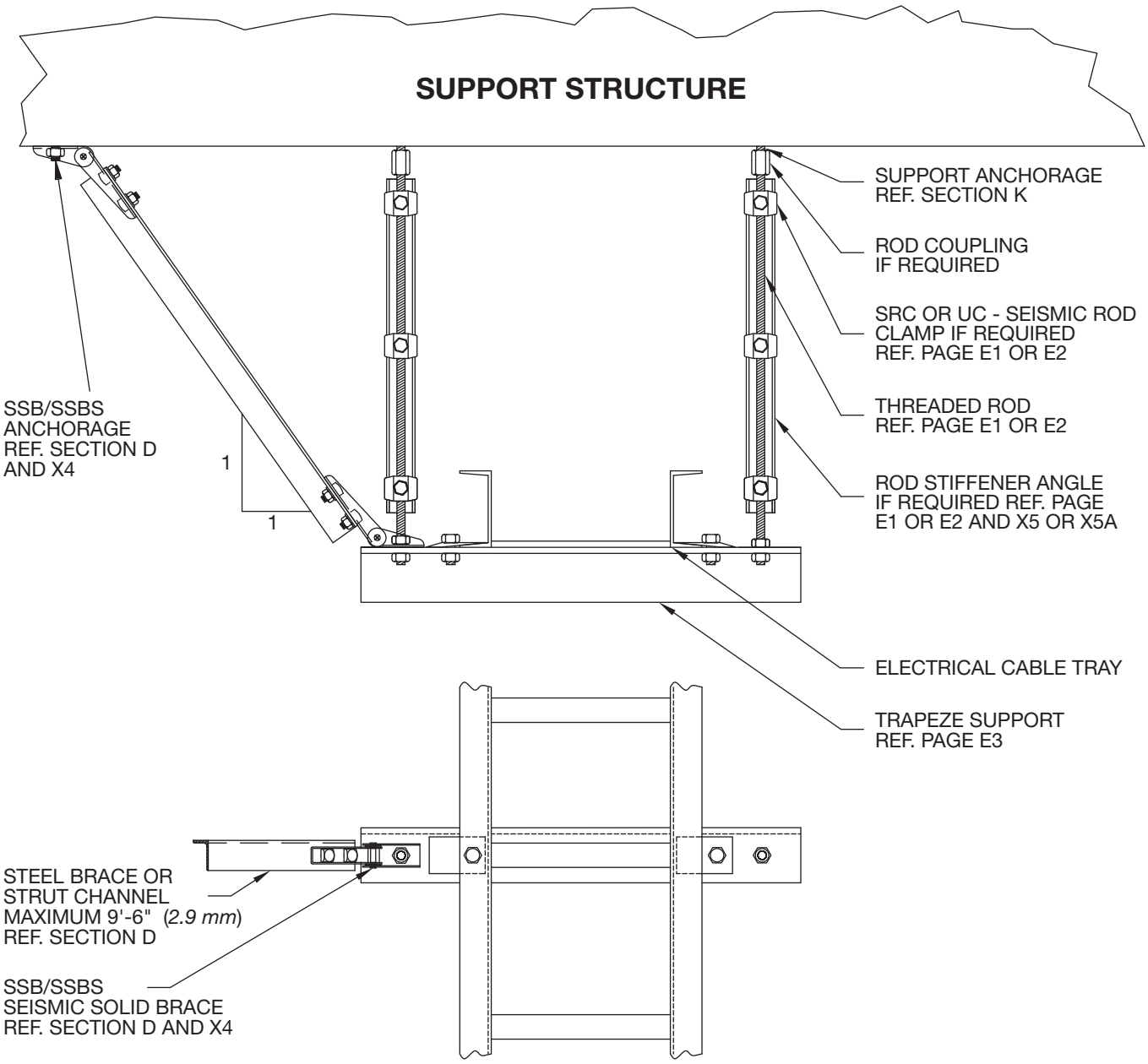

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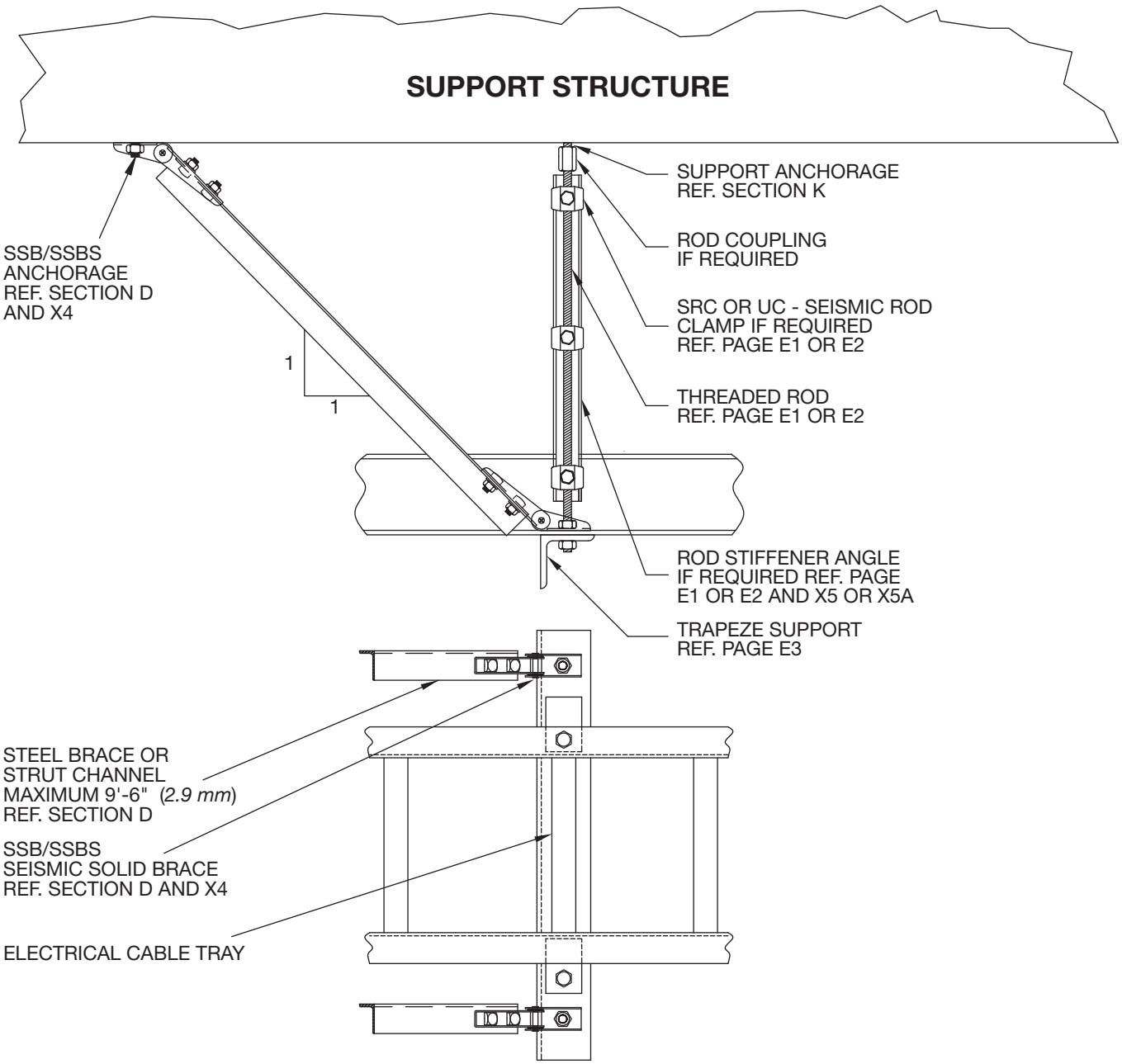

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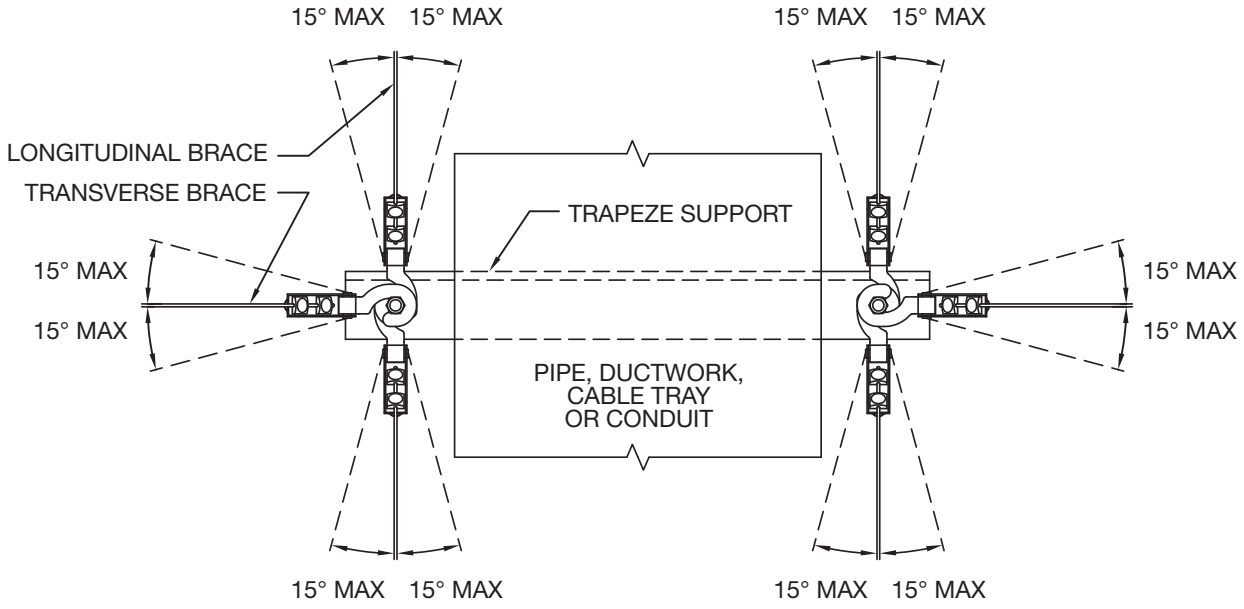
ALL-DIRECTIONAL SEISMIC CABLE BRACE GUIDELINES
ALLOWABLE BRACE ANGLE VARIATIONS IN PLAN
FOR DETAIL PAGES F1, F4, F10, F13, F19, F22 AND F28



REFER TO APPROPRIATE PAGE
F1, F4, F10, F13, F19, F22 AND F28
FOR MORE SPECIFIC INFORMATION
ON CABLE BRACES, TRAPEZE SUPPORTS, ETC.

NOTE: Any or all brace locations are permitted to use the angle variation to meet field conditions.

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Fixed Equipment Anchorage
Office of Statewide Health Planning and Development

OPA-0349
on
March 19, 2009

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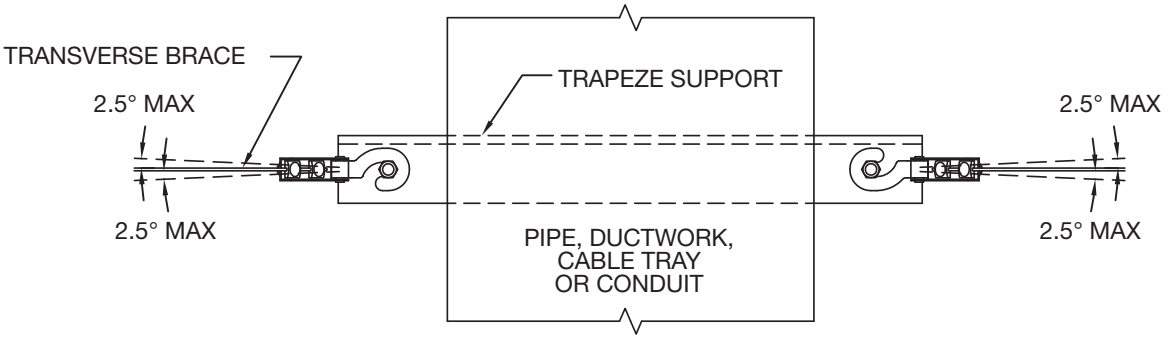
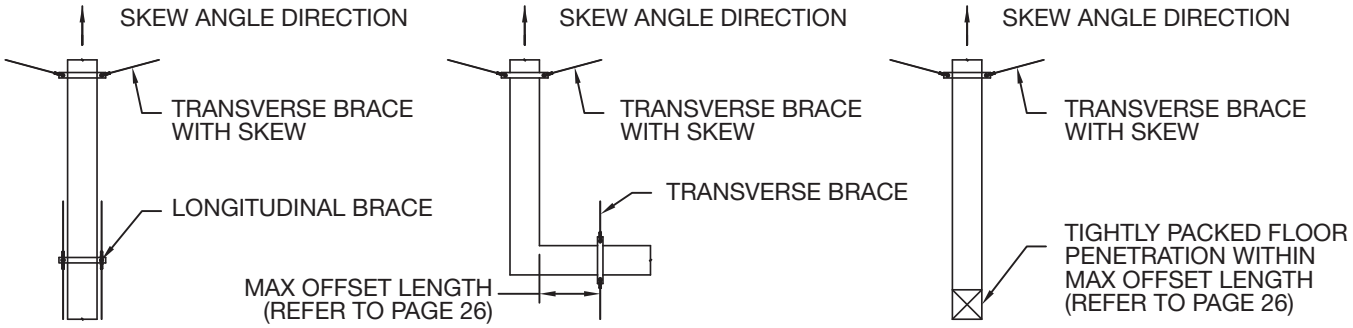
TRANSVERSE SEISMIC CABLE BRACE GUIDELINES
ALLOWABLE BRACE ANGLE VARIATIONS IN PLAN
FOR DETAIL PAGES F2, F5, F11, F14, F20, F23 AND F29



REFER TO APPROPRIATE PAGE
F2, F5, F11, F14, F20, F23 AND F29
FOR MORE SPECIFIC INFORMATION
ON CABLE BRACES, TRAPEZE SUPPORTS, ETC.

The angle variation may increase beyond 2.5° up to 15° provided both braces are skewed in the same direction and a longitudinal brace occurs opposite the skewed angle direction as shown below.

Additionally, for trapeze piping there must be at least (2) pipes on the trapeze that vary by no more than 1 pipe diameter.



NOTE: Any or all brace locations are permitted to use the angle variation to meet field conditions.

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Office of Statewide Health Planning and Development

OPA-0349
on
April 6, 2008

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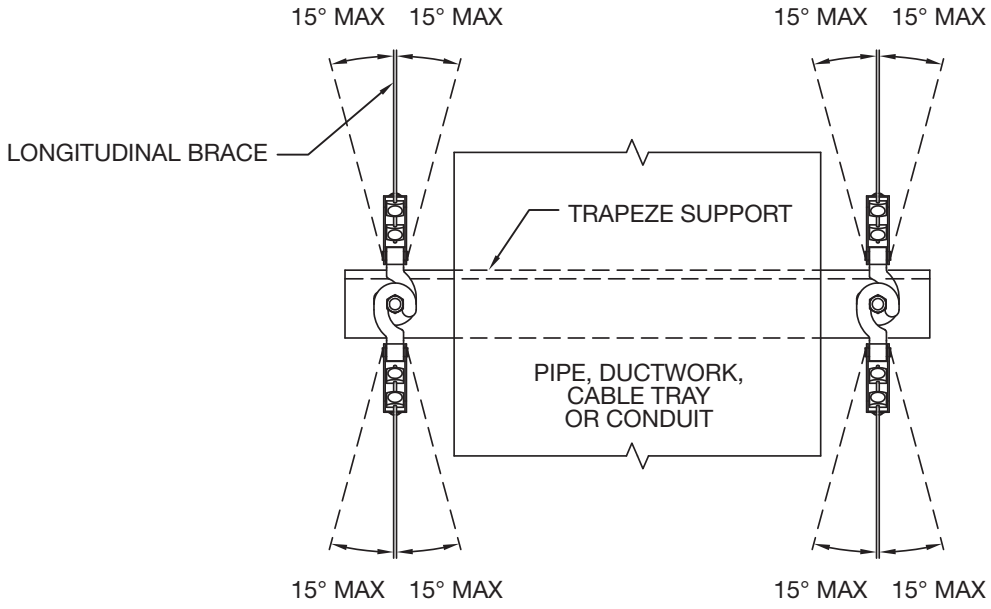
LONGITUDINAL SEISMIC CABLE BRACE GUIDELINES
ALLOWABLE BRACE ANGLE VARIATIONS IN PLAN
FOR DETAIL PAGES F3, F6, F12, F15, F21, F24 AND F30



REFER TO APPROPRIATE PAGE
F3, F6, F12, F15, F21, F24 AND F30
FOR MORE SPECIFIC INFORMATION
ON CABLE BRACES, TRAPEZE SUPPORTS, ETC.

NOTE: Any or all brace locations are permitted to use the angle variation to meet field conditions.

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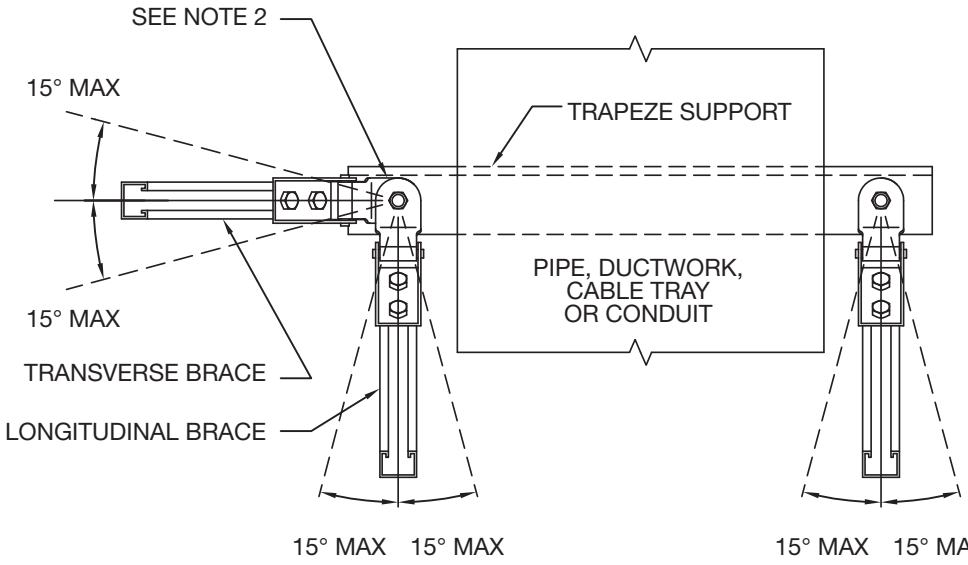
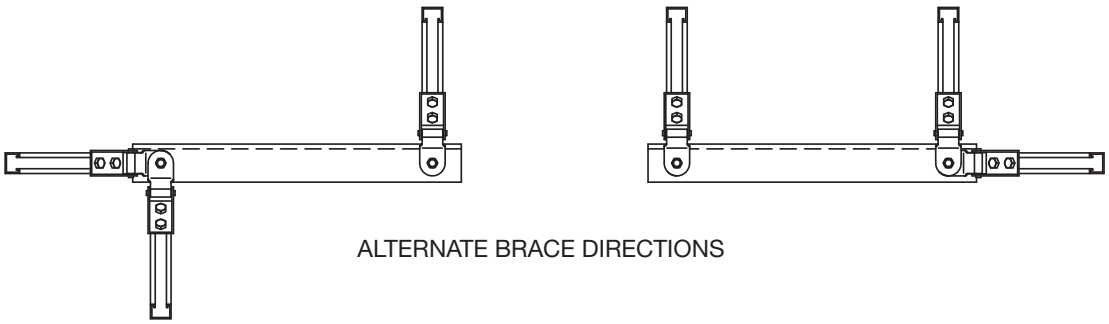
ALL-DIRECTIONAL SEISMIC SOLID BRACE GUIDELINES
ALLOWABLE BRACE ANGLE VARIATIONS IN PLAN
FOR DETAIL PAGES F7, F16, F25 AND F31





ALTERNATE BRACE DIRECTIONS

REFER TO APPROPRIATE PAGE
F7, F16, F25 AND F31
FOR MORE SPECIFIC INFORMATION
ON CABLE BRACES, TRAPEZE SUPPORTS, ETC.

NOTE 1: Any or all brace locations are permitted to use the angle variation to meet field conditions.

NOTE 2: Mason type SSBS components may be stacked at the hanger rod location as detailed. Mason type SSB components cannot be stacked and must be installed as shown on pages F7, F16, F25 and F31.

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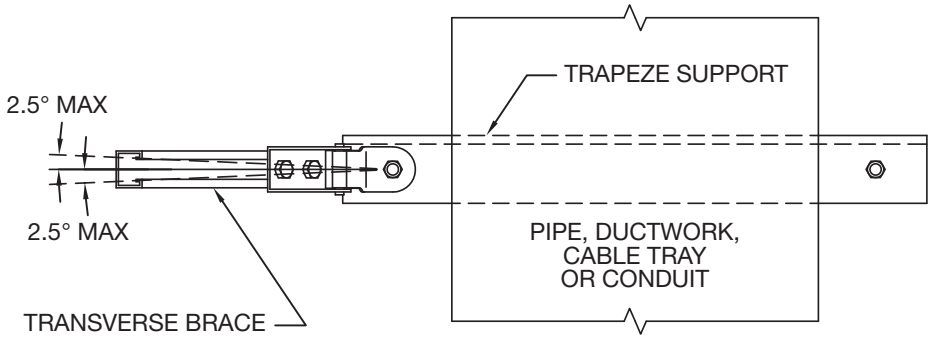
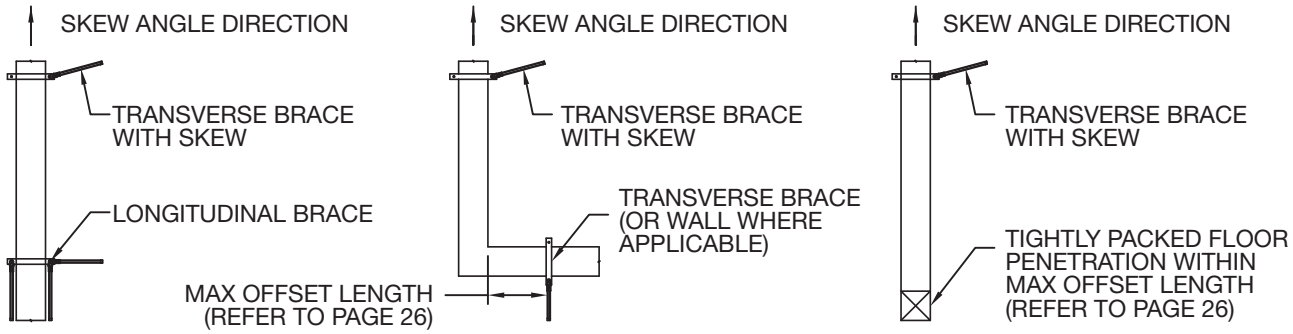
TRANSVERSE SEISMIC SOLID BRACE GUIDELINES
ALLOWABLE BRACE ANGLE VARIATIONS IN PLAN
FOR DETAIL PAGES F8, F17, F26 AND F32



REFER TO APPROPRIATE PAGE
F8, F17, F26 AND F32
FOR MORE SPECIFIC INFORMATION
ON CABLE BRACES, TRAPEZE SUPPORTS, ETC.

The angle variation may increase beyond 2.5° up to 15° provided a longitudinal brace occurs opposite the skewed angle direction as shown below.

Additionally, for trapeze piping there must be at least (2) pipes on the trapeze that vary by no more than 1 pipe diameter.



NOTE: Any or all brace locations are permitted to use the angle variation to meet field conditions.

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OPA-0349
on
December 22, 2006

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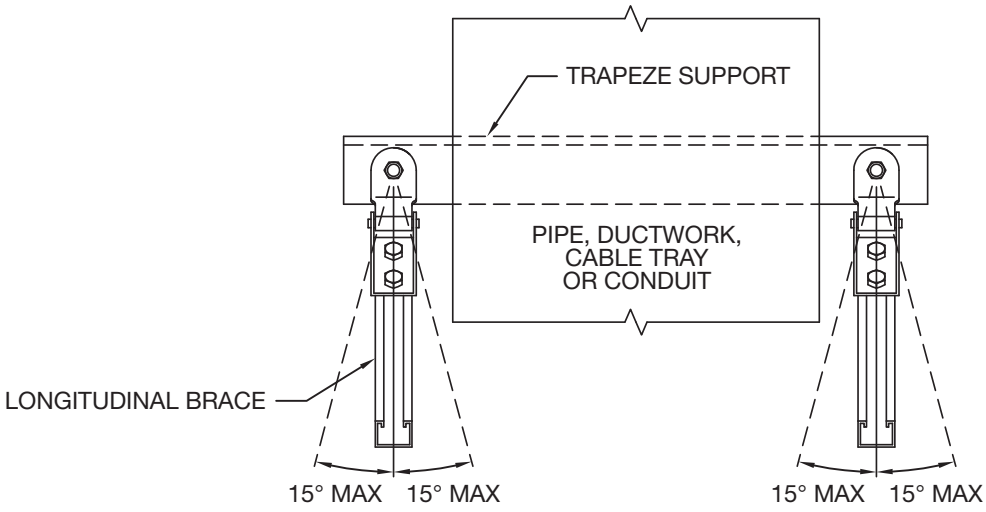
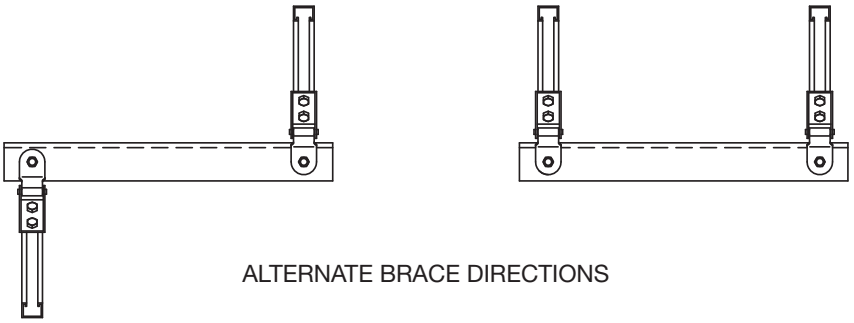
ALL-DIRECTIONAL SEISMIC SOLID BRACE GUIDELINES
ALLOWABLE BRACE ANGLE VARIATIONS IN PLAN
FOR DETAIL PAGES F9, F18, F27 AND F33





ALTERNATE BRACE DIRECTIONS

REFER TO APPROPRIATE PAGE
F9, F18, F27 AND F33
FOR MORE SPECIFIC INFORMATION
ON CABLE BRACES, TRAPEZE SUPPORTS, ETC.

NOTE: Any or all brace locations are permitted to use the angle variation to meet field conditions.

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Fixed Equipment Anchorage
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OPA-0349
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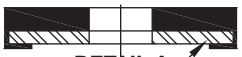
ROD STIFFENER GUIDELINES FOR THE SRC - SEISMIC ROD CLAMP

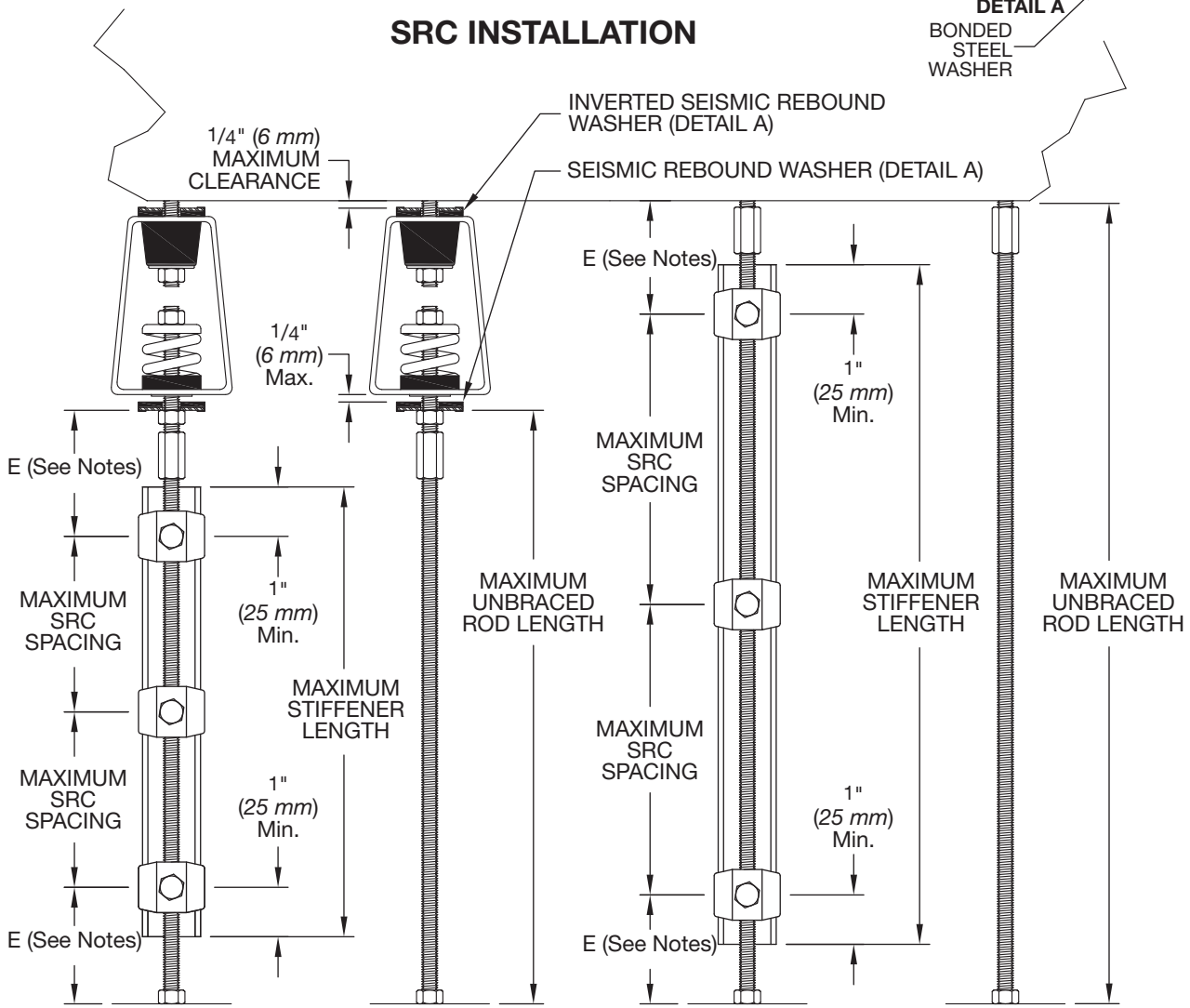
RW - Rebound Washer



DETAIL A

BONDED STEEL WASHER

SRC INSTALLATION



NOTE 1: E = 3" (*76 mm*) maximum for 1/4" *6 mm*) to 1/2" (*13 mm*) rods, and E = 6" (*152 mm*) maximum for 5/8" (*16 mm*) to 11/4" (*32 mm*) diameter rods. A minimum of (2) SRC Seismic Rod Clamps per stiffener angle are required. Ref. Pages B1, E1 or E2 for Maximum Unbraced Rod Length, Maximum SRC Spacing and Maximum Stiffener Length.

NOTE 2: Install hanger boxes snug to upper rebound washer, with washer tight to overhead surface. Upper hanger element deflects under load, leaving clearance on top.

NOTE 3: For Seismic Rebound Washer requirements, Ref. Section L and Page X11.

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OPA-0349 December 22, 2006

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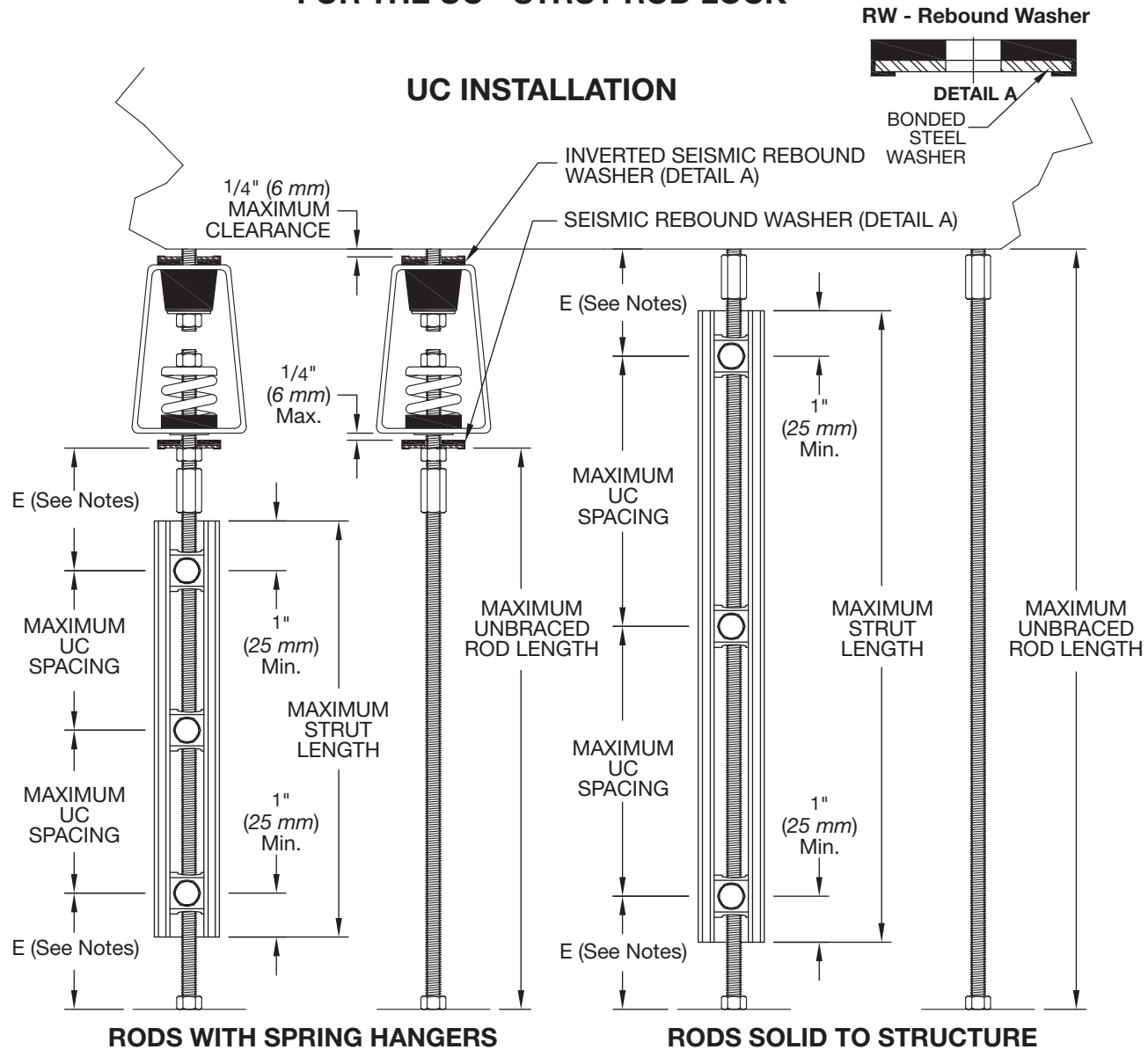
ROD STIFFENER GUIDELINES
FOR THE UC - STRUT ROD LOCK



NOTE 1: E = 3" (*76 mm*) maximum for 1/4" *6 mm*) to 1/2" (*13 mm*) rods, and E = 6" (*152 mm*) maximum for 5/8" (*16 mm*) to 1 1/4" (*32 mm*) diameter rods. A minimum of (2) UC Seismic Rod Clamps per stiffener angle are required. Ref. Pages B1, E1 or E2 for Maximum Unbraced Rod Length, Maximum UC Spacing and Maximum Stiffener Length.

NOTE 2: Install hanger boxes snug to upper rebound washer, with washer tight to overhead surface. Upper hanger element deflects under load, leaving clearance on top.

NOTE 3: For Seismic Rebound Washer requirements, Ref. Section L and Page X11.

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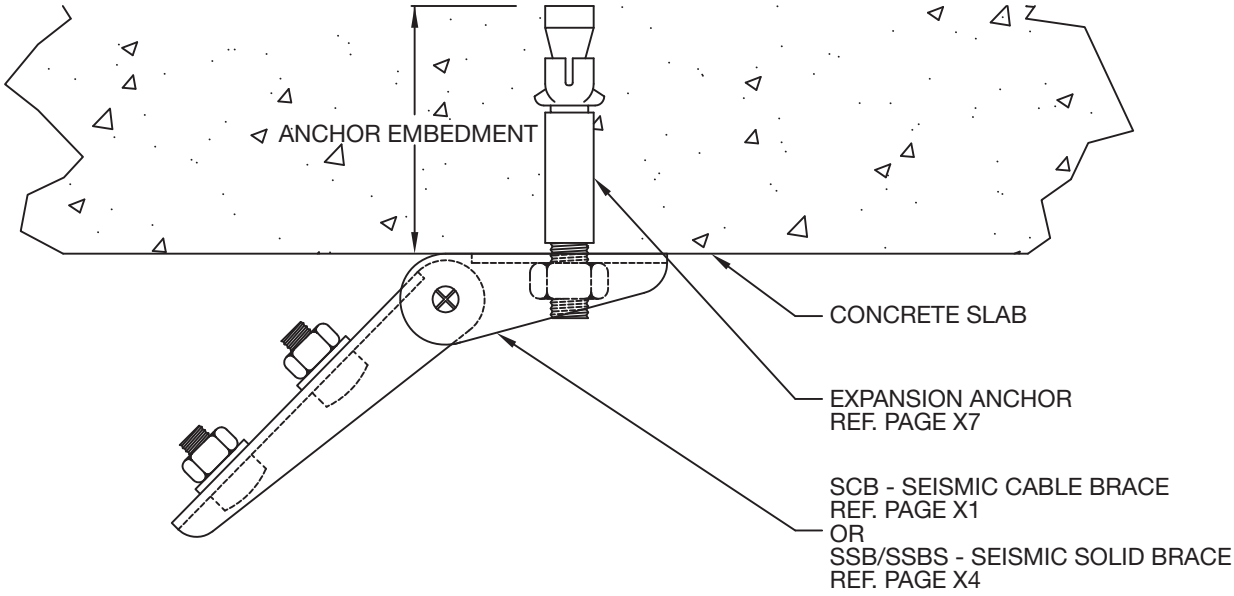
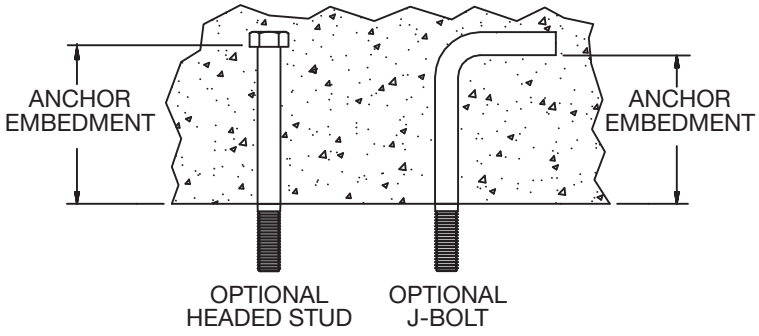
SCB, SSB OR SSBS ATTACHMENT TO A CONCRETE SLAB WITH (1) EXPANSION ANCHOR



MAXIMUM EXPANSION ANCHOR LOADS TO STRUCTURE UP TO 2:1 BRACE ANGLE

SCB SIZE	SSB/SSBS SIZE	TENSION (lbs)	TENSION (*kN*)	SHEAR (lbs)	SHEAR (*kN*)
1	SSBS-12	810	*3.6*	560	*2.5*
2	SSBS-20, 25	1185	*5.3*	880	*3.9*
3	SSB-3	1730	*7.7*	1240	*5.5*



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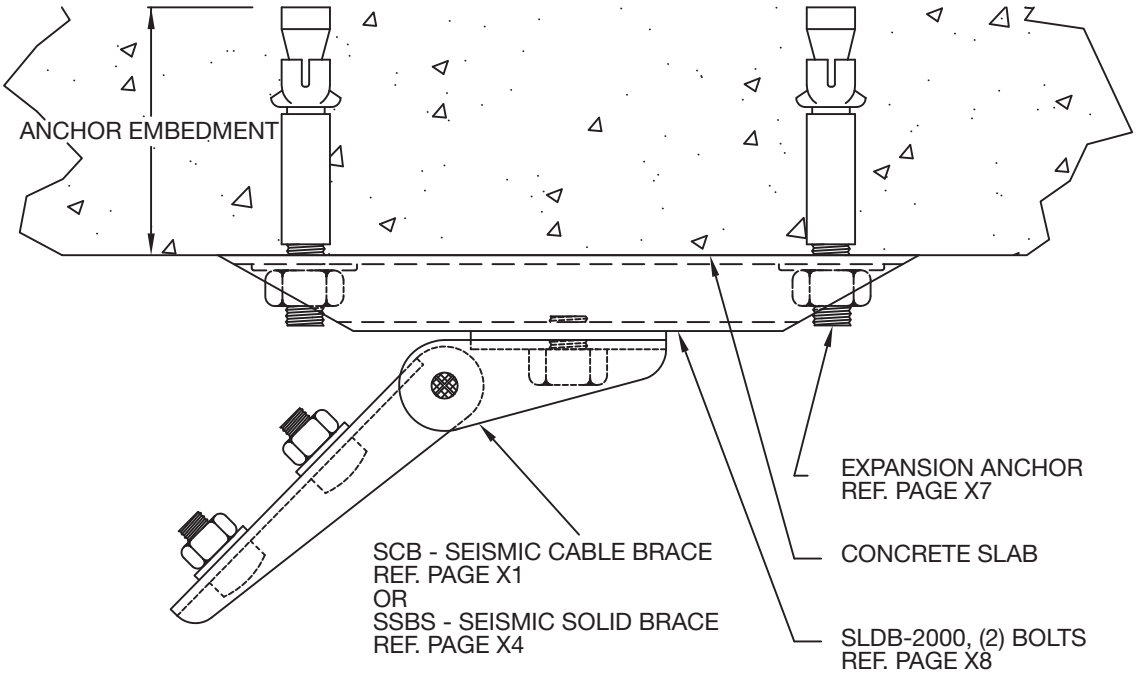
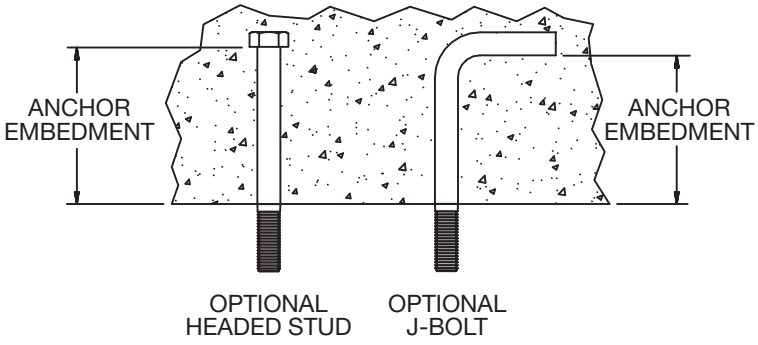
SCB OR SSBS ATTACHMENT
TO A CONCRETE SLAB WITH (2) EXPANSION ANCHORS



MAXIMUM SLDB-2000 LOADS
TO STRUCTURE UP TO 2:1 BRACE ANGLE

SCB SIZE	SSBS SIZE	TENSION (lbs) (*kN*)	SHEAR (lbs) (*kN*)
2	20, 25	1680 *7.5*	1440 *6.4*



NOTE: SCB AND SSBS Seismic Braces must be aligned with long axis of the SLDB-2000 as shown above.

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OPA-0349 August 5, 2002

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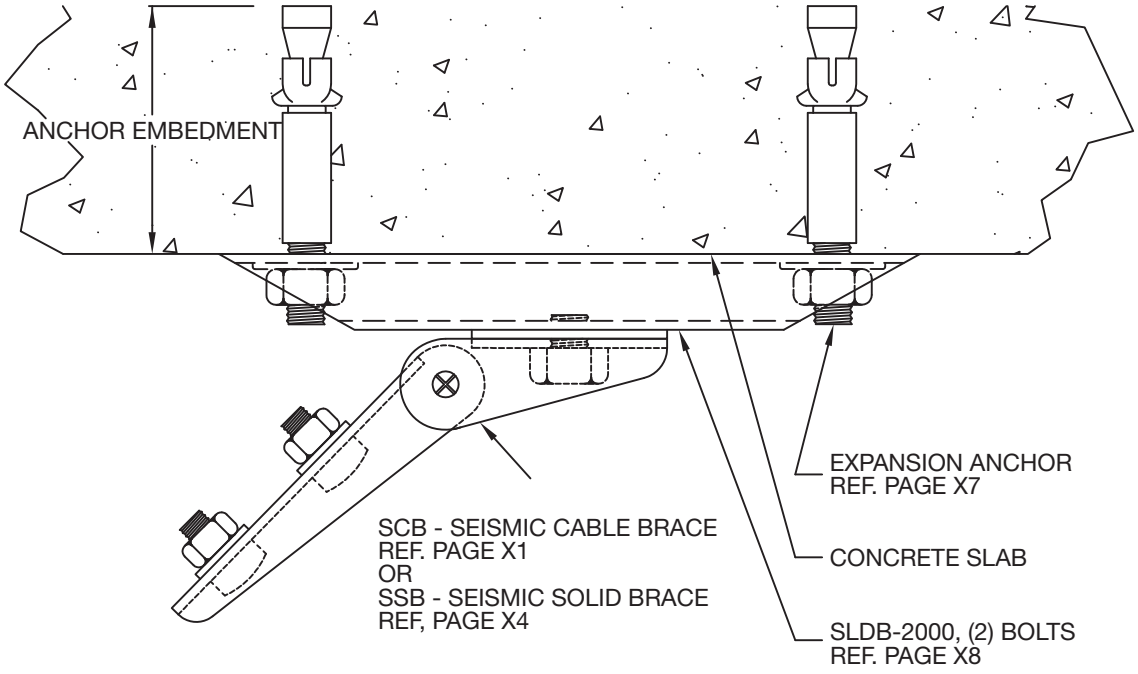
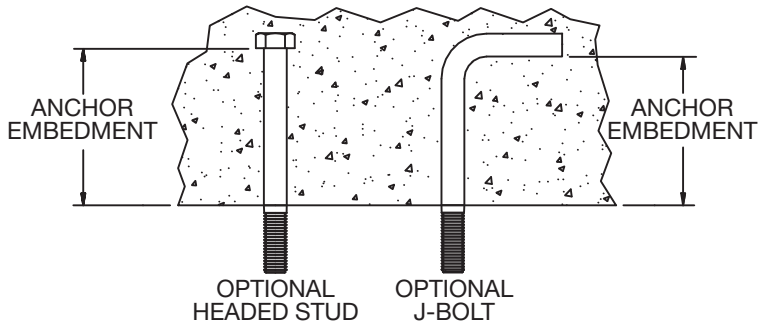
SCB OR SSB ATTACHMENT
TO A CONCRETE SLAB WITH (4) EXPANSION ANCHORS



MAXIMUM SLDB-4000 LOADS
TO STRUCTURE UP TO 2:1 BRACE ANGLE

SCB/SSB SIZE	TENSION (lbs)	(*kN*)	SHEAR (lbs)	(*kN*)
3	2805	*12.5*	2200	*9.8*
4	4000	*17.8*	4000	*17.8*



NOTE: SCB AND SSB Seismic Braces may be rotated in plan view to suit field conditions.

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FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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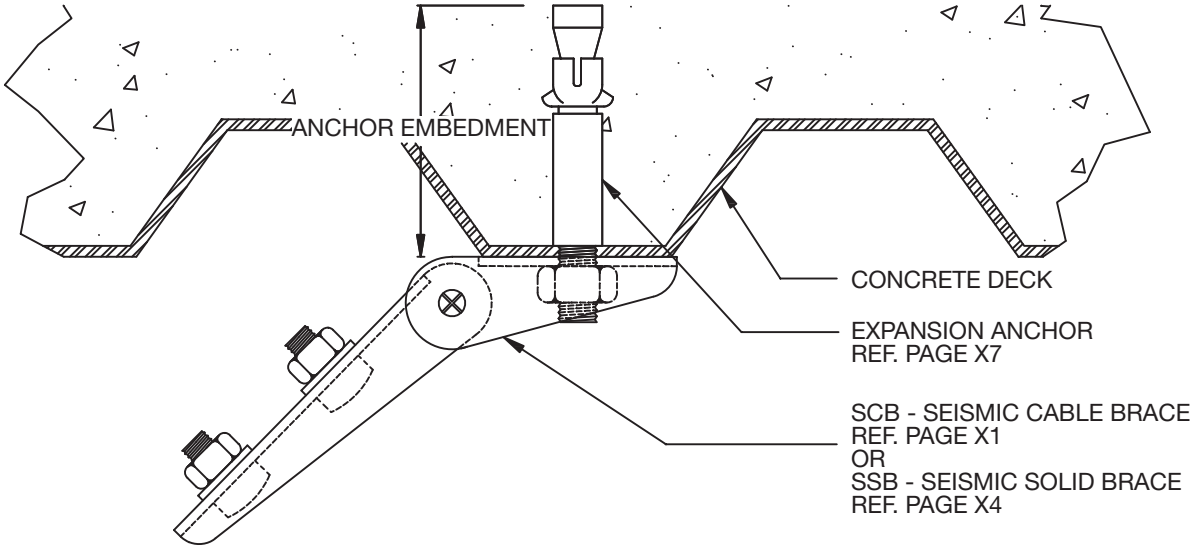
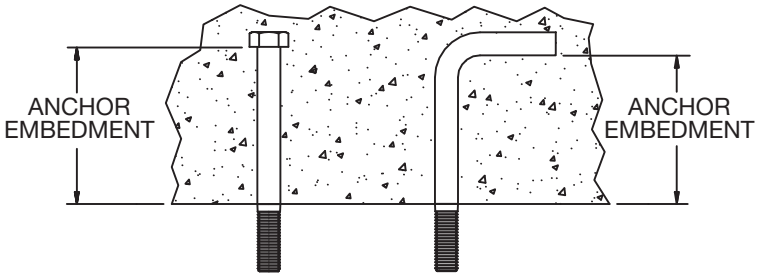
SCB, SSB OR SSBS ATTACHMENT TO A CONCRETE DECK WITH (1) EXPANSION ANCHORS



MAXIMUM EXPANSION ANCHOR LOADS TO STRUCTURE UP TO 2:1 BRACE ANGLE

SCB SIZE	SSB/SSBS SIZE	TENSION (lbs)	TENSION (*kN*)	SHEAR (lbs)	SHEAR (*kN*)
1	SSBS-12	540	*2.4*	360	*1.6*
2	SSBS-20,25	790	*3.5*	560	*2.5*
3	SSB	665	*3.0*	480	*2.2*



NOTE: SCB, SSB AND SSBS Seismic Braces may be rotated in plan view to suit field conditions.

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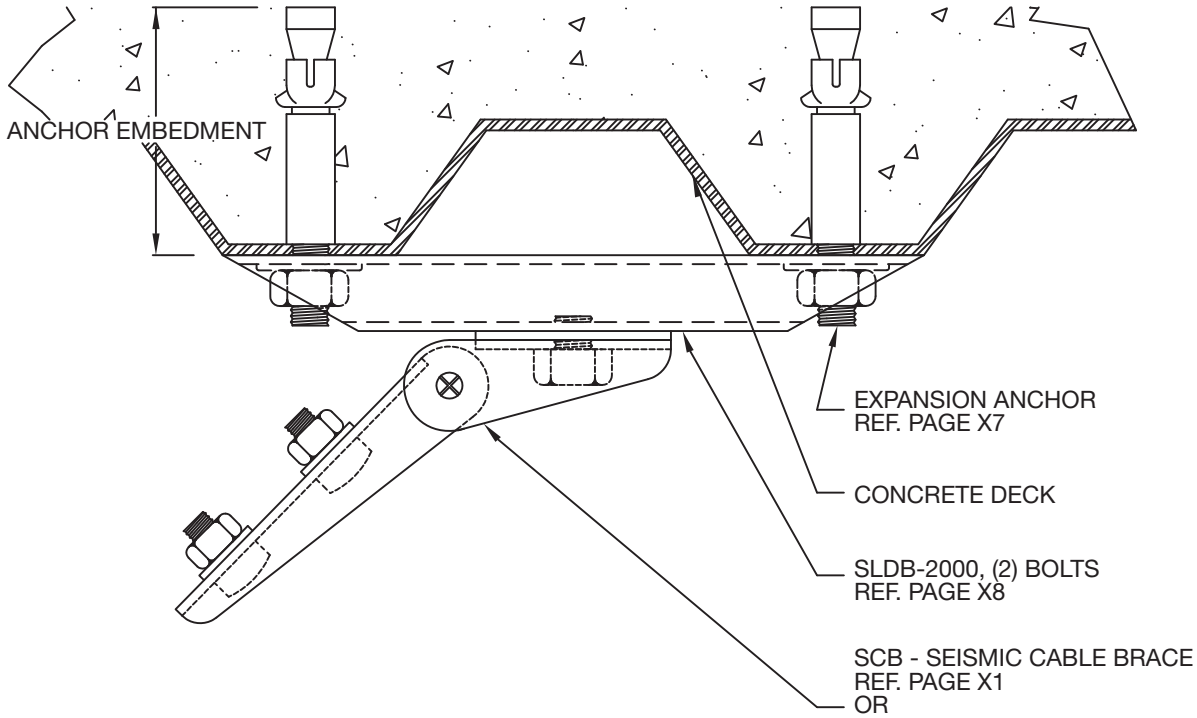
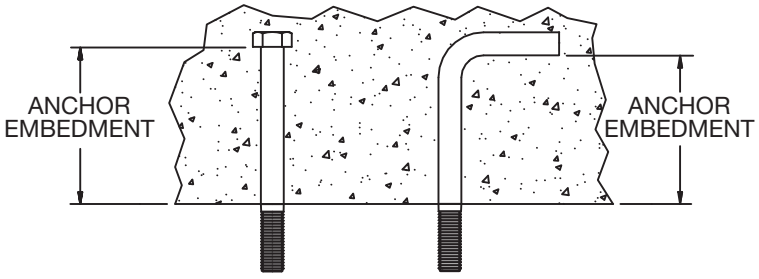
SCB OR SSB ATTACHMENT
TO A CONCRETE DECK WITH (2) EXPANSION ANCHORS



MAXIMUM SLDB-2000 LOADS
TO STRUCTURE UP TO 2:1 BRACE ANGLE

SCB/SSB SIZE	TENSION (lbs)	TENSION (*kN*)	SHEAR (lbs)	SHEAR (*kN*)
1	800	*3.6*	680	*3.0*
2	1520	*6.8*	1400	*6.3*



NOTE: SCB AND SSB Seismic Braces must be aligned with long axis of the SLDB-2000 as shown above.

A P P R O V E D

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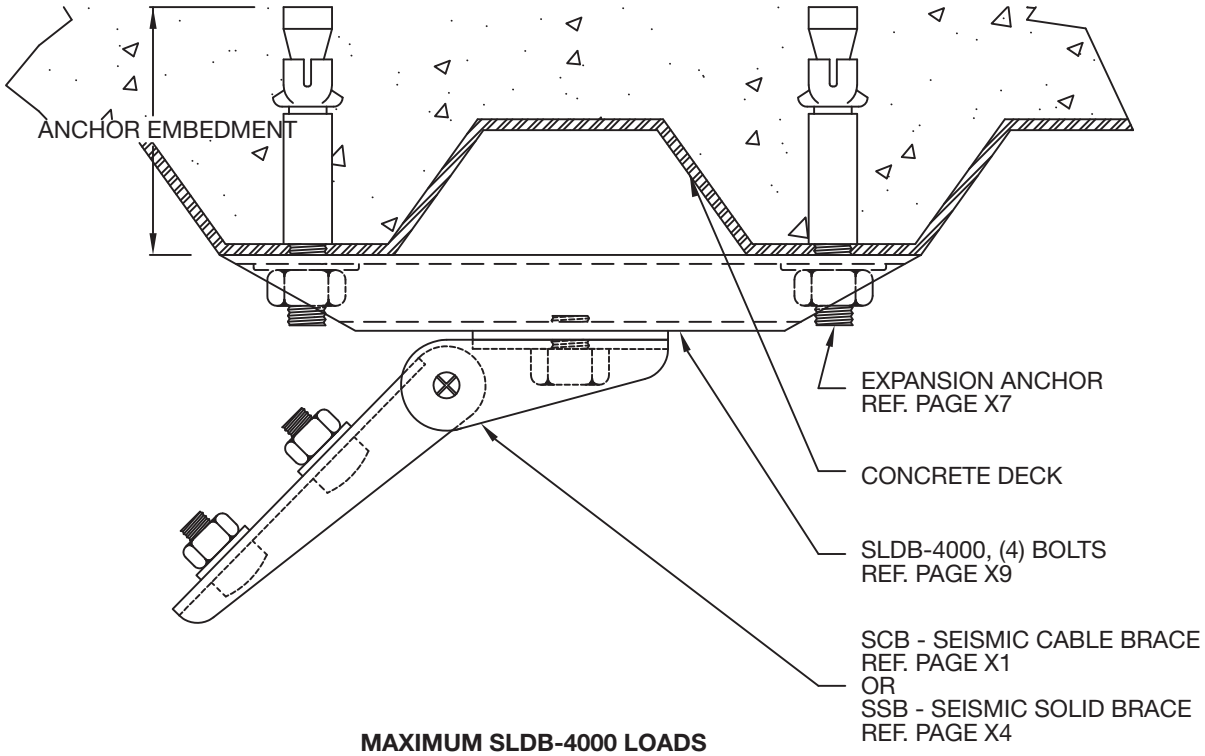
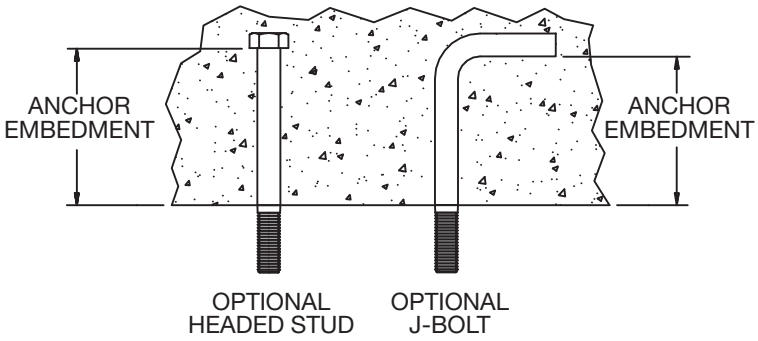
SCB OR SSB ATTACHMENT
TO A CONCRETE DECK WITH (4) EXPANSION ANCHORS



MAXIMUM SLDB-4000 LOADS
TO STRUCTURE UP TO 2:1 BRACE ANGLE

SCB/SSB SIZE	TENSION (lbs)	(*kN*)	SHEAR (lbs)	(*kN*)
3	2800	*12.5*	2200	*9.8*
4	3120	*13.9*	2840	*12.7*



NOTE: SCB AND SSB Seismic Braces may be rotated in plan view to suit field conditions.

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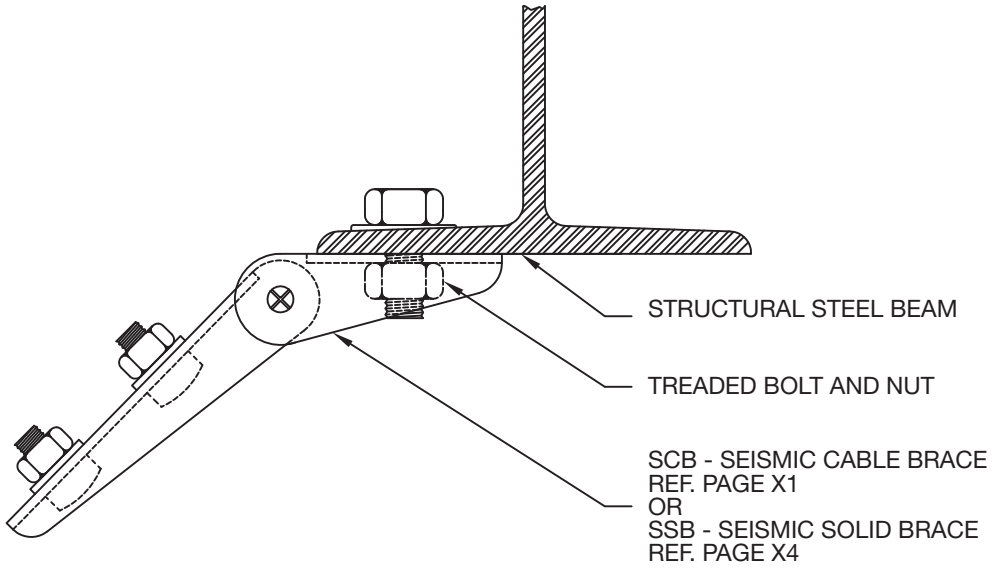
California Office of Statewide Health Planning and Development
FIXED EQUIPMENT ANCHORAGE
OPA-0349 August 5, 2002

Bill Staehlin (916) 654-3362

Dhiru Mali
Structural Engineer
California SE No. 2811

SCB OR SSB BOLTED ATTACHMENT TO A STRUCTURAL STEEL BEAM



MAXIMUM ANCHOR BOLT LOADS TO STRUCTURE UP TO 1:1 BRACE ANGLE

SCB/SSB SIZE	TENSION* (lbs)	(*kN*)	SHEAR (lbs)	(*kN*)
1	935	*4.2*	680	*3.0*
2	1835	*8.2*	1440	*6.4*
3	2910	*13.0*	2200	*9.8*
4	6830	*30.4*	4625	*20.6*

*For up to 1.5:1 or 2:1 brace angle, Multiply by 1.4 or 1.6 respectively.

NOTE 1: The structural engineer of record must check the structural steel for the seismic loads from the seismic restraint system.

NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

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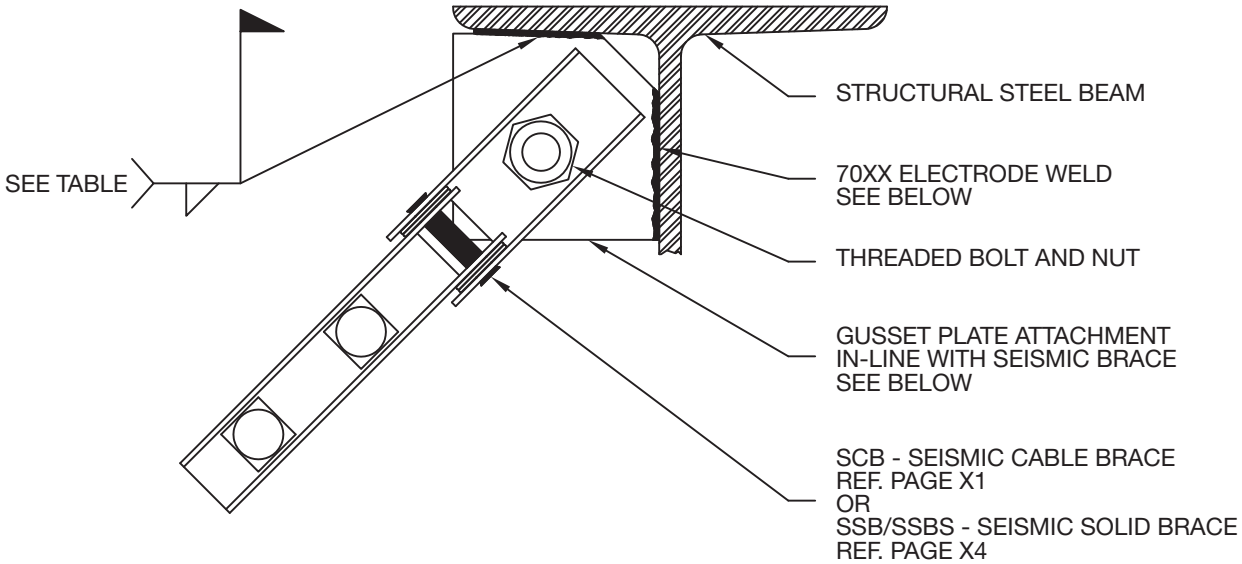
SCB OR SSB/SSBS BOLTED ATTACHMENT TO A GUSSET PLATE OF A STRUCTURAL STEEL BEAM



MAXIMUM SCB/SSB LOADS TO STRUCTURE UP TO 1:1 BRACE ANGLE

SCB SIZE	SSB/SSBS SIZE	TENSION* lbs (kN)		SHEAR lbs (kN)	
1	SSBS-12	690	*3.1*	690	*3.1*
2	SSBS-20, 25	1450	*6.5*	1450	*6.5*
3	SSB-3	2230	*10.0*	2230	*10.0*
4	SSB-4	4865	*21.7*	4865	*21.7*

*For up to 1.5:1 or 2:1 brace angle, multiply by 1.2 or 1.3 respectively.

SCB SIZE	SSB/SSBS SIZE	PLATE SIZE (in) (mm)	HOLE DIA. (in) (mm)		FILLET WELD SIZE (in) (mm)	
1	SSBS-12	3 x 3 x 1/4 (76 x 76 x 6)	9/16	*14*	3/16	*5*
2	SSBS-20, 25	4 x 4 x 1/4 (76 x 76 x 6)	11/16	*17*	3/16	*5*
3	SSBS-3	5 x 5 x 3/8 (127 x 127 x 10)	13/16	*21*	1/4	*6*
4	SSBS-4	6 x 6 x 3/8 (152 x 152 x 10)	15/16	*33*	1/4	*6*

NOTE 1: The structural engineer of record must check the structural steel for the seismic loads from the seismic restraint system.

NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

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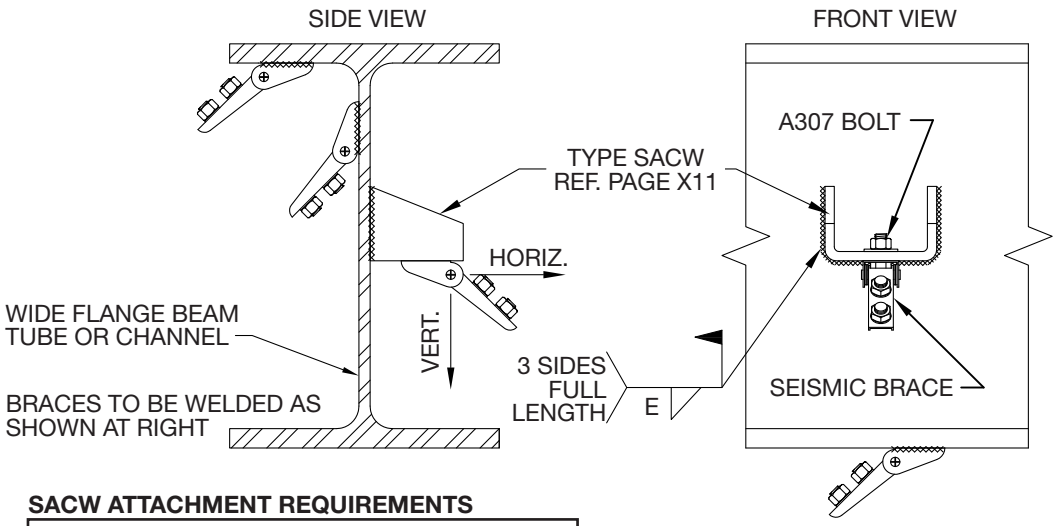
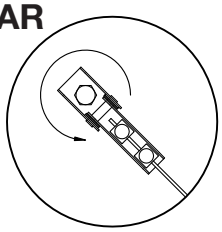
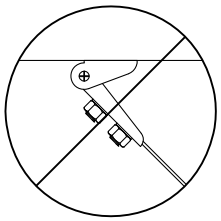
SCB OR SSB WELDED ATTACHMENT PERPENDICULAR TO A STRUCTURAL STEEL MEMBER





BRACE CAN BE ROTATED TO ANY ANGLE AS SHOWN

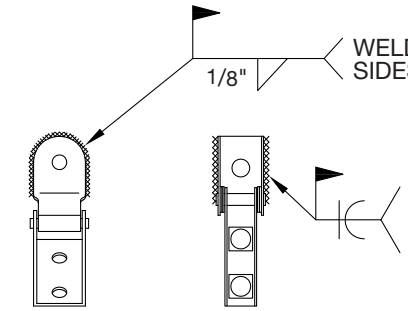


DO NOT BEND BRACE PAST 90°

SACW ATTACHMENT REQUIREMENTS

SIZE	SEISMIC BRACE SIZE	A307 BOLT DIA.	WELD SIZE (E)
SACW-0	SCB-0	3/8"	1/8"
SACW-1	SCB-1 SSB-1 SSBS-12	1/2"	1/8"
SACW-2	SCB-2 SSB-2 SSBS-12	5/8"	3/16"
SACW-3	SCB-3 SSB-3	3/4"	3/16"
SACW-4	SCB-4 SSB-4	1 1/4"	1/4"

FOR BOLT TORQUE REQUIREMENTS REF. PAGE H15.



SSBS-12 OR SSBS-20

SCB/SSB WELDED FULL LENGTH ON (2) SIDES

Mason Seismic Brace Size	E70XX Weld Size
SCB-0	0.047"
SCB/SSB-1	0.056"
SCB/SSB-2	0.084"
SCB/SSB-3	0.103"
SCB/SSB-4	0.117"

Maximum Seismic Brace Loads To Structure At Various Brace Angles (lbs)

Brace Angle (Rise:Run)	SCB-0		SCB-1/SSB-1 SSBS-12		SCB-2/SSB-2 SSBS-20 (Up to 1.5:1)		SCB-3/SSB-3		SCB-4 /SSB-4	
	Vertical	Hortizontal	Vertical	Hortizontal	Vertical	Hortizontal	Vertical	Hortizontal	Vertical	Hortizontal
2:1	447	224	872	436	1834	917	2817	1409	6149	3075
1.5:1	416	277	811	541	1706	1137	2621	1747	5720	3814
1:1	354	354	689	689	1450	1450	2227	2227	4861	4861
1:1.5	277	416	541	811	1137	1706	1747	2621	3814	5720
1:2	224	447	436	872	917	1834	1409	2817	3075	6149

NOTE: The structural engineer of record must check the structural steel for the attachment location and seismic loads from the seismic restraint system.

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Fixed Equipment Anchorage
Office of Statewide Health Planning and Development

OPA-0349
on
July 22, 2009

Jerry Yee **(916) 654-3362**

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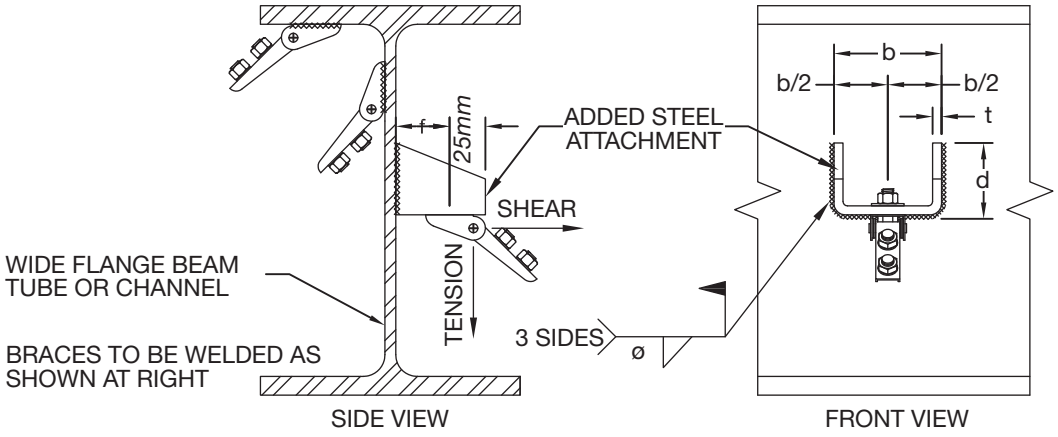
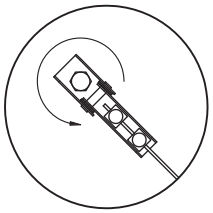
SCB OR SSB WELDED ATTACHMENT PERPENDICULAR TO A STRUCTURAL STEEL MEMBER

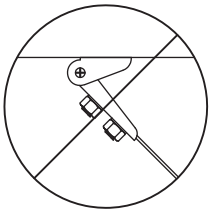


SIDE VIEW

FRONT VIEW

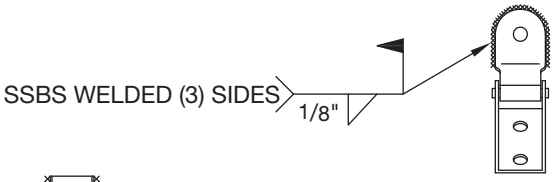


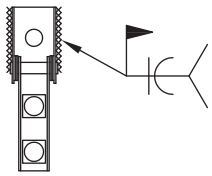
BRACE CAN BE ROTATED TO ANY ANGLE AS SHOWN



DO NOT BEND BRACE PAST 90°

ADDED STEEL ATTACHMENT DIMENSIONS (mm)						
BRACE SIZE	WIDTH (b)	HEIGHT (d)	THICK-NESS (t)	BOLT HOLE (f)	BOLT HOLE DIA.	WELD DIA. (Ø)
SCB-0	51	38	6	32	11	3
SCB-1 SSB-1 SSBS-12	76	51	6	38	14	3
SCB-2 SSB-2 SSBS-20	102	64	10	51	17	5
SCB-3 SSB-3	127	83	10	64	21	5
SCB-4 SSB-4	152	114	10	89	33	6





SCB/SSB WELDED (2) SIDES

Mason Seismic Brace Size	E70XX Weld Diameter
SCB-0	2
SCB/SSB-1	3
SCB/SSB-2	3
SCB/SSB-3	5
SCB/SSB-4	5

Maximum Seismic Brace Loads To Structure At Various Brace Angles (kN)										
Brace Angle (Rise:Run)	SCB-0		SCB-1/SSB-1 SSBS-12		SCB-2/SSB-2 SSBS-20 (Up to 1.5:1)		SCB-3/SSB-3		SCB-4 /SSB-4	
	Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear
2:1	2.0	1.0	3.9	1.9	8.2	4.1	12.5	6.3	27.4	13.7
1.5:1	1.9	1.2	3.6	2.4	7.6	5.1	11.7	7.8	23.4	15.2
1:1	1.6	1.6	3.1	3.1	6.4	6.4	9.9	9.9	21.6	21.6
1:1.5	1.2	1.9	2.4	3.6	5.1	7.6	7.8	11.7	15.2	23.4
1:2	1.0	2.0	1.9	3.9	4.1	8.2	6.3	12.5	13.7	27.4

NOTE: The structural engineer of record must check the structural steel for the attachment location and seismic loads from the seismic restraint system.

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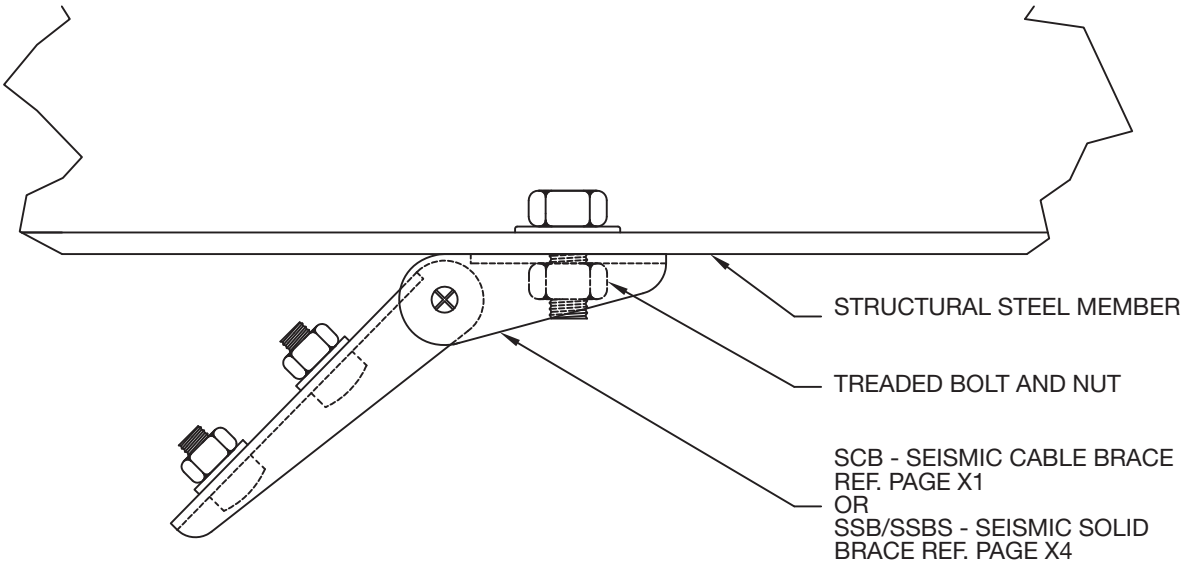
SCB OR SSB BOLTED ATTACHMENT TO A STRUCTURAL STEEL MEMBER



MAXIMUM ANCHOR BOLT LOADS TO STRUCTURE UP TO 1:1 BRACE ANGLE

SCB SIZE	SCB/SSB SIZE	TENSION* (lbs)	(*kN*)	SHEAR (lbs)	(*kN*)
1	SSBS-12	935	*4.2*	680	*3.0*
2	SSBS-20, 25	1835	*8.2*	1440	*6.4*
3	SSB-3	2910	*13.0*	2200	*9.8*
4	SSB-4	6830	*30.4*	4625	*20.6*

*For up to 1.5:1 or 2:1 brace angle, Multiply by 1.4 or 1.6 respectively.

NOTE 1: The structural engineer of record must check the structural steel for the seismic loads from the seismic restraint system.

NOTE 2: For tightening requirements of bolts, nuts and strut nuts reference H15.

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California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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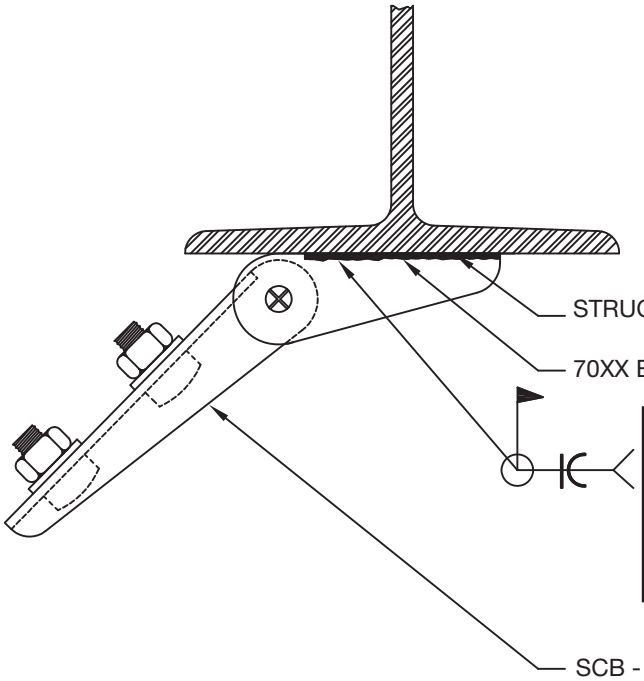
SCB OR SSB/SSBS WELDED ATTACHMENT TO A STRUCTURAL STEEL BEAM



SCB SIZE	SCB/SSBS SIZE	WELD SIZE
1	SSBS-12	1/8" *3mm*
2	SSBS-20, 25	1/8" *3mm*
3	SSB-3	3/16" *5mm*
4	SSB-4	3/16" *5mm*

MAXIMUM SCB/SSB LOADS TO STRUCTURE UP TO 1:1 BRACE ANGLE

SCB SIZE	SCB/SSBS SIZE	TENSION* (lbs)	TENSION* (*kN*)	SHEAR (lbs)	SHEAR (*kN*)
1	SSBS-12	690	*3.1*	690	*3.1*
2	SSBS-20, 25	1450	*6.5*	1450	*6.5*
3	SSB-3	2230	*10.0*	2230	*10.0*
4	SSB-4	4865	*21.7*	4865	*21.7*

* For up to 1.5:1 or 2:1 brace angle, Multiply by 1.2 or 1.3 respectively.

NOTE: The structural engineer of record must check the structural steel for the seismic loads from the seismic restraint system.

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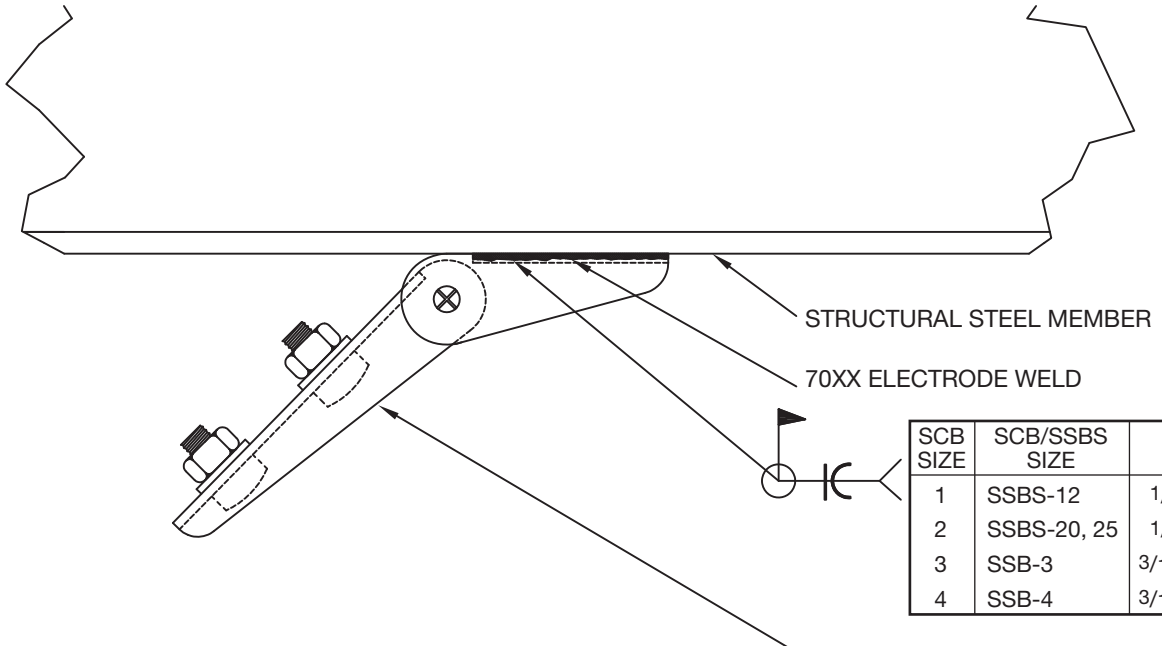
SCB OR SSB WELDED ATTACHMENT TO A STRUCTURAL STEEL MEMBER



SCB SIZE	SCB/SSBS SIZE	WELD SIZE
1	SSBS-12	1/8" *3mm*
2	SSBS-20, 25	1/8" *3mm*
3	SSB-3	3/16" *5mm*
4	SSB-4	3/16" *5mm*

MAXIMUM SCB/SSB LOADS TO STRUCTURE UP TO 1:1 BRACE ANGLE

SCB SIZE	SCB/SSBS SIZE	TENSION* (lbs)	TENSION* (*kN*)	SHEAR (lbs)	SHEAR (*kN*)
1	SSBS-12	690	*3.1*	690	*3.1*
2	SSBS-20, 25	1450	*6.5*	1450	*6.5*
3	SSB-3	2230	*10.0*	2230	*10.0*
4	SSB-4	4865	*21.7*	4865	*21.7*

* For up to 1.5:1 or 2:1 brace angle, Multiply by 1.2 or 1.3 respectively.

NOTE: The structural engineer of record must check the structural steel for the seismic loads from the seismic restraint system.

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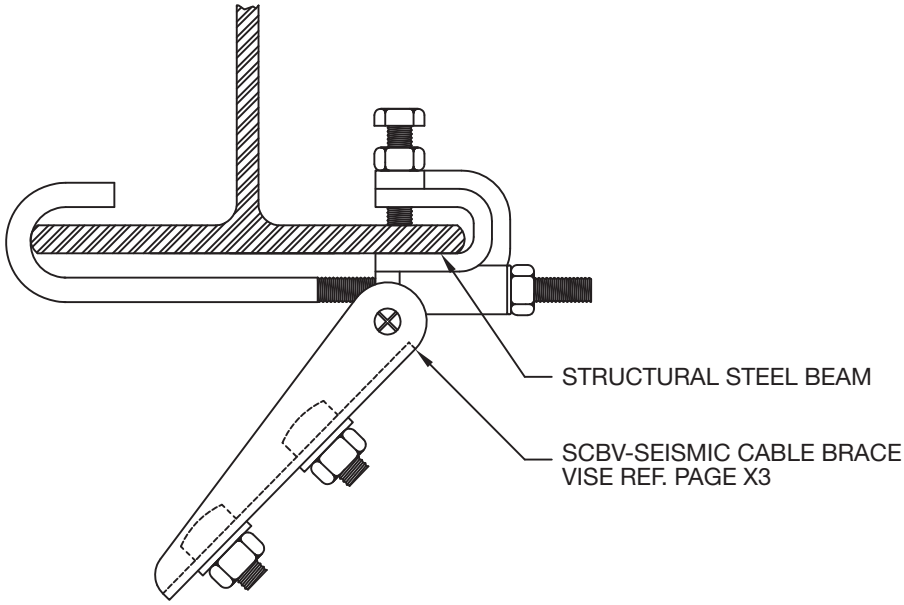
SCBV - SEISMIC CABLE BRACE VISE ATTACHMENT TO A STRUCTURAL STEEL BEAM



MAXIMUM SCB/SSB LOADS TO STRUCTURE UP TO 1:1 BRACE ANGLE

SCBV SIZE	TENSION* (lbs)	(*kN*)	SHEAR (lbs)	(*kN*)
1	690	*3.1*	690	*3.1*
2	1450	*6.5*	1450	*6.5*
3	2230	*10.0*	2230	*10.0*

* For up to 1.5:1 or 2:1 brace angle, Multiply by 1.2 or 1.3 respectively.

NOTE: The structural engineer of record must check the structural steel for the seismic loads from the seismic restraint system.

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OPA-0349 August 5, 2002

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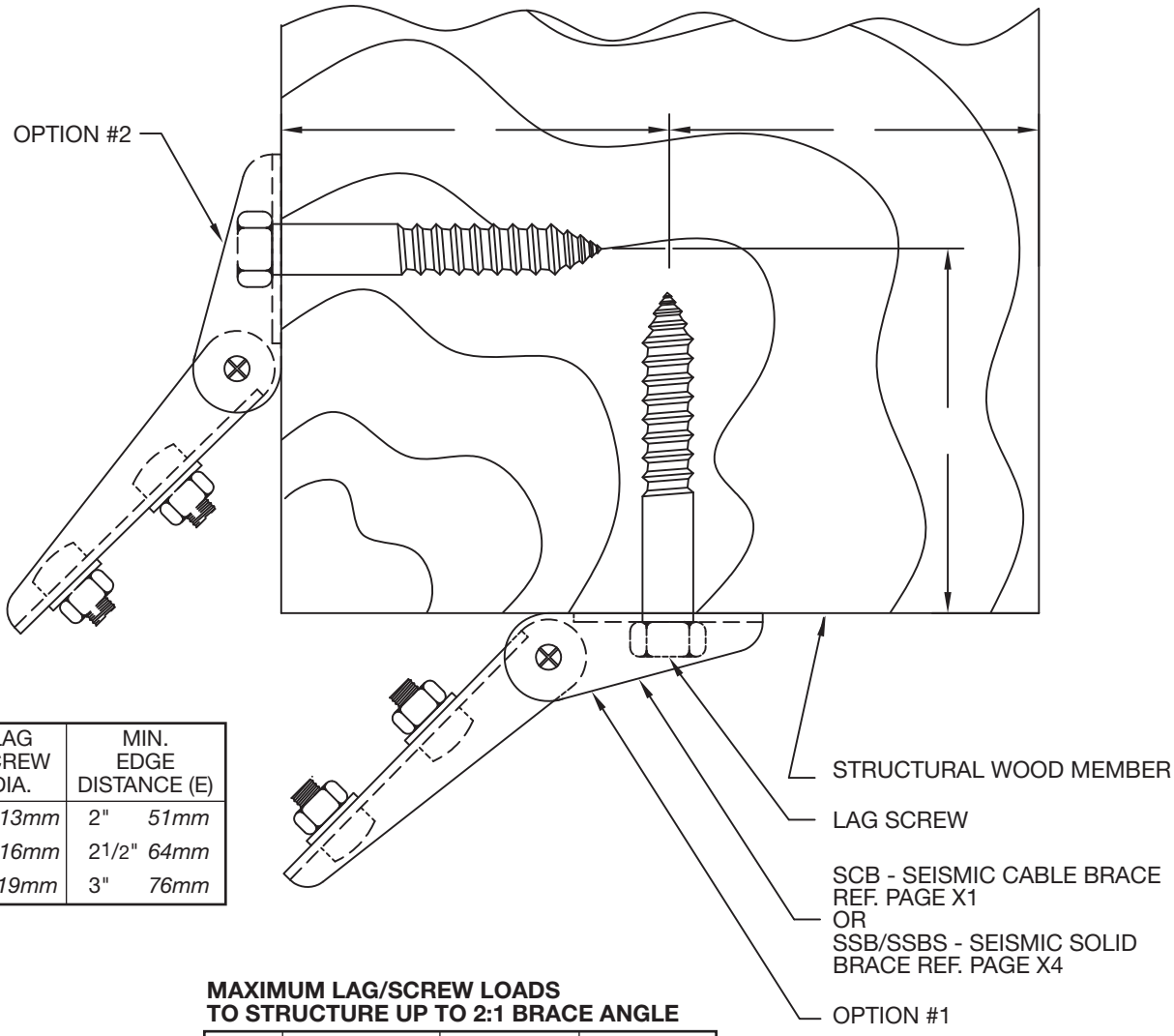
SCB OR SSB/SSBS LAG SCREW ATTACHMENT TO A STRUCTURAL WOOD MEMBER



LAG SCREW DIA.	MIN. EDGE DISTANCE (E)
1/2" *13mm*	2" *51mm*
5/8" *16mm*	2 1/2" *64mm*
3/4" *19mm*	3" *76mm*

MAXIMUM LAG/SCREW LOADS TO STRUCTURE UP TO 2:1 BRACE ANGLE

SCB SIZE	SCB/SSBS SIZE	TENSION (lbs)	TENSION (*kN*)	SHEAR (lbs)	SHEAR (*kN*)
1	SSBS-12	570	*2.5*	360	*1.6*
2	SSBS-20, 25	920	*4.1*	560	*2.5*
3	SSB-3	1330	*5.9*	760	*3.4*

NOTE: The structural engineer of record must check the structural wood member for the seismic loads from the seismic restraint system.

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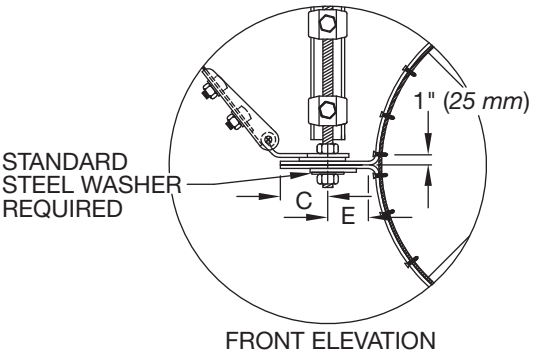
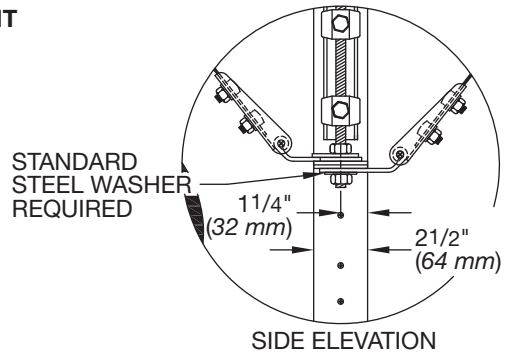
REQUIRED CLEARANCE DETAILS
FOR SCBH/SSB/SSBS ATTACHMENT TO DUCT

ROUND DUCT ATTACHMENT

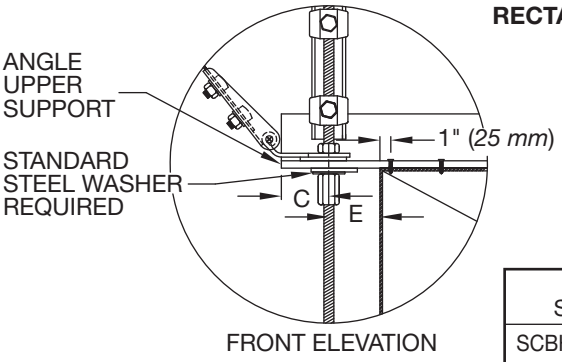


FRONT ELEVATION

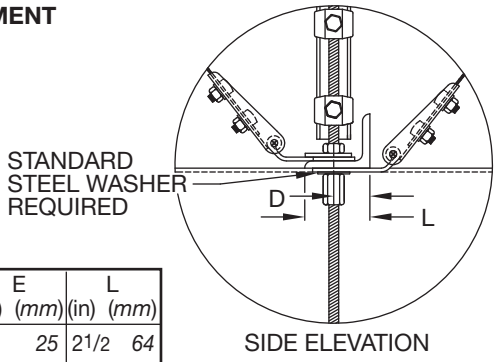


SIDE ELEVATION

RECTANGULAR DUCT ATTACHMENT

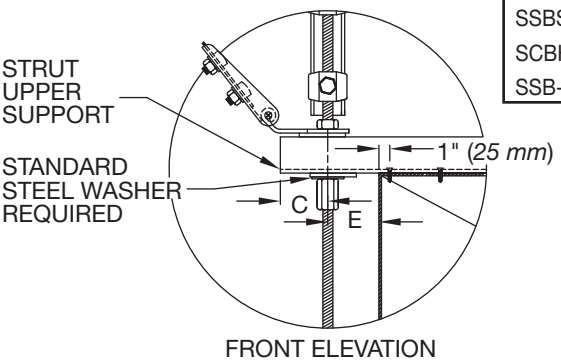


FRONT ELEVATION

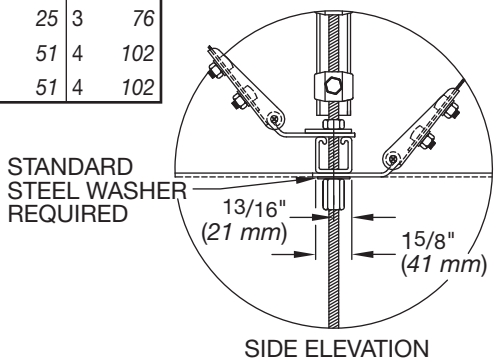


SIDE ELEVATION

SIZE	C (in)	C (mm)	D (in)	D (mm)	E (in)	E (mm)	L (in)	L (mm)
SCBH-1	1	25	1 1/2	38	1	25	2 1/2	64
SSBS-12	1	25	1 1/2	38	1	25	2 1/2	64
SCBH-2	1 3/4	44	2 1/4	57	1 3/4	44	3	76
SSBS-20,25	1 1/2	38	2 1/4	57	1	25	3	76
SCBH-3	2	51	2 5/8	67	2	51	4	102
SSB-3	2	51	2 5/8	67	2	51	4	102



FRONT ELEVATION



SIDE ELEVATION

NOTE: Ref. Page E4 for upper support sizes and maximum upper support extensions. The (E) dimension listed above is the minimum extension required for SCBH/SSB clearance.

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OPA-0349 August 5, 2002

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TIGHTENING REQUIREMENTS

TURN OF NUT METHOD

For turn-of-nut tightening, hand-adjust the bolt snug tight where there is firm contact between the bolt and connected metal components.

LENGTH OF BOLT	ADDITIONAL TIGHTENING
Up to and including 4 diameters	1/3 Turn
Over 4 diameters and not more than 8 diameter	1/2 Turn
Over 8 diameter and not more than 12 diameter	2/3 Turn

TORQUE FOR A307 BOLTS AND A36 THREADED ROD

DIAMETER SIZE	TORQUE ft-lbs	(*N-m*)
3/8	20	*27*
1/2	49	*66*
5/8	97	*131*
3/4	173	*235*

TORQUE FOR STRUT NUTS

DIAMETER SIZE	TORQUE ft-lbs	(*N-m*)
3/8	19	*25*
1/2	50	*70*
5/8	100	*135*
3/4	125	*170*

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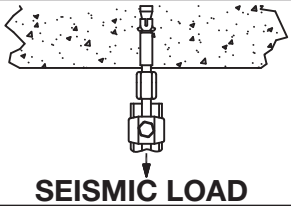
VERTICAL SUPPORT GUIDLINES

SSB LOCATIONS

SEISMIC LOAD ON SUPPORT RODS FOR USE WITH PAGES A1 AND D1



SEISMIC LOAD

AT INDIVIDUAL SUPPORTS:

Pipe Diameter (in)	Support Rod Diameter (in)	Seismic Tension Load* (lbs.)
1–2	3/8	425
2 1/2–3	1/2	560
4–5	5/8	560
6	3/4	870
8–10	7/8	1445
12	7/8	2180
14–18	1	2200
20–24	1 1/4	3760

AT TRAPEZE SUPPORTS:

Size	Support Rod Diameter (in)	Seismic Tension Load* (lbs.)
SSBS-12	1/2	560
SSBS-20,25	5/8	1440
SSB-3	3/4	2200
SSB-4	1	4000

* The attachment point of the support rod to the structure must be designed to accept the addition of the seismic tension load tabulated above and the gravity load of the item supported. THIS IS ONLY REQUIRED FOR SUPPORT RODS WHERE THE SEISMIC SOLID BRACE IS ATTACHED.

Example: For a 10" diameter pipe supported by a minimum 7/8" diameter rod, assume the gravity load is 800 lbs. The total tension load on the support rod
= 1445 lbs. (see table above) + 800 lbs. = 2245 lbs.

Select a concrete expansion anchor (Ref. Page X7), concrete insert anchor, or any other approved attachment which can accept this total tension load.

To reduce the total tension load on the support rod to meet the allowable tension load of the attachment, reduce the seismic brace spacing or the support spacing or both.

Example: Assume the total tension load on the support is 2245 lbs. from the example above. If the allowable tension load of the attachment is 1400 lbs., reduce the brace spacing by 50% and the support spacing by 20%. The revised total tension load on the support rod
= 1445 lbs. x 50% + 800 lbs. x 80% = 1362.5 lbs. < 1400 lbs.

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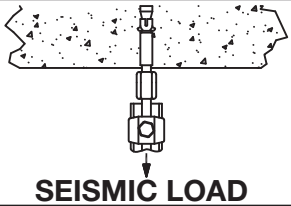
VERTICAL SUPPORT GUIDLINES

SSB/SSBS LOCATIONS

SEISMIC LOAD ON SUPPORT RODS FOR USE WITH PAGES A1 AND D1



SEISMIC LOAD

AT INDIVIDUAL SUPPORTS:

Pipe Diameter (mm)	Support Rod Diameter (mm)	Seismic Tension Load* (kN)
25–51	10	1.9
64–76	13	2.5
102–127	16	2.5
152	19	3.9
203–254	22	6.5
305	22	9.7
356–457	25	9.8
508–610	32	16.8

AT TRAPEZE SUPPORTS:

Size	Support Rod Diameter (mm)	Seismic Tension Load* (kN)
SSBS-12	13	2.5
SSBS-20,25	16	6.5
SSB-3	19	9.8
SSB-4	25	17.8

* The attachment point of the support rod to the structure must be designed to accept the addition of the seismic tension load tabulated above and the gravity load of the item supported. THIS IS ONLY REQUIRED FOR SUPPORT RODS WHERE THE SEISMIC SOLID BRACE IS ATTACHED.

Example: For a *254 mm* diameter pipe supported by a minimum *22 mm* diameter rod, assume the gravity load is 3.6 kN. The total tension load on the support rod

= 6.5 kN (see table above) + 3.6 kN = 10.1 kN

Select a concrete expansion anchor (Ref. Page X7), concrete insert anchor, or any other approved attachment which can accept this total tension load.

To reduce the total tension load on the support rod to meet the allowable tension load of the attachment, reduce the seismic brace spacing or the support spacing or both.

Example: Assume the total tension load on the support is 10.1 kN. from the example above. If the allowable tension load of the attachment is 6.3 kN, reduce the brace spacing by 50% and the support spacing by 20%. The revised total tension load on the support rod

= 6.5 kN x 50% + 3.6 kN x 80% = 6.1 kN < 6.3 kN

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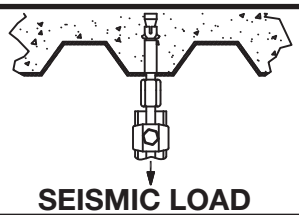
VERTICAL SUPPORT GUIDLINES

SSB/SSBS LOCATIONS

SEISMIC LOAD ON SUPPORT RODS FOR USE WITH PAGES A2 AND D2



SEISMIC LOAD

AT INDIVIDUAL SUPPORTS:

Pipe Diameter (in)	Support Rod Diameter (in)	Seismic Tension Load* (lbs.)
1–2	3/8	375
2 1/2–3	1/2	375
4–5	5/8	375
6	3/4	560
8–10	7/8	1380
12	7/8	2180
14–18	1	2200
20–24	1 1/4	2785

AT TRAPEZE SUPPORTS:

Size	Support Rod Diameter (in)	Seismic Tension Load* (lbs.)
SSBS-12	1/2	680
SSBS-20,25	5/8	1440
SSB-3	3/4	2200
SSB-4	1	3800

* The attachment point of the support rod to the structure must be designed to accept the addition of the seismic tension load tabulated above and the gravity load of the item supported. THIS IS ONLY REQUIRED FOR SUPPORT RODS WHERE THE SEISMIC SOLID BRACE IS ATTACHED.

Example: For a 10" Diameter pipe supported by a minimum 7/8" diameter rod, assume the gravity load is 800 lbs. The total tension load on the support rod
= 1380 lbs. (see table above) + 800 lbs. = 2180 lbs.

Select a concrete expansion anchor (Ref. Page X7), concrete insert anchor, or any other approved attachment which can accept this total tension load.

To reduce the total tension load on the support rod to meet the allowable tension load of the attachment, reduce the seismic brace spacing or the support spacing or both.

Example: Assume the total tension load on the support is 2180 lbs. from the example above. If the allowable tension load of the attachment is 1400 lbs., reduce the brace spacing by 50% and the support spacing by 20%. The revised total tension load on the support rod
= 1380 lbs. x 50% + 800 lbs. x 80% = 1330 lbs. < 1400 lbs.

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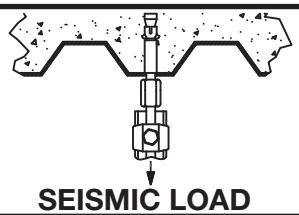
VERTICAL SUPPORT GUIDLINES

SSB LOCATIONS

SEISMIC LOAD ON SUPPORT RODS FOR USE WITH PAGES A2 AND D2



SEISMIC LOAD

AT INDIVIDUAL SUPPORTS:

Pipe Diameter (mm)	Support Rod Diameter (mm)	Seismic Tension Load* (kN)
25–51	10	1.7
64–76	13	1.7
102–127	16	1.7
152	19	2.5
203–254	22	6.2
305	22	9.7
356–457	25	9.8
508–610	32	12.4

AT TRAPEZE SUPPORTS:

SSB Size	Support Rod Diameter (mm)	Seismic Tension Load* (kN)
1	13	3.0
2	16	6.3
3	19	9.8
4	25	16.9

* The attachment point of the support rod to the structure must be designed to accept the addition of the seismic tension load tabulated above and the gravity load of the item supported. THIS IS ONLY REQUIRED FOR SUPPORT RODS WHERE THE SEISMIC SOLID BRACE IS ATTACHED.

Example: For a *254mm* diameter pipe supported by a minimum *22mm* diameter rod, assume the gravity load is 3.6 kN. The total tension load on the support rod

= 6.2 kN (see table above) + 3.6 kN = 9.8 kN

Select a concrete expansion anchor (Ref. Page X7), concrete insert anchor, or any other approved attachment which can accept this total tension load.

To reduce the total tension load on the support rod to meet the allowable tension load of the attachment, reduce the seismic brace spacing or the support spacing or both.

Example: Assume the total tension load on the support is 9.8 kN. from the example above. If the allowable tension load of the attachment is 6.3 kN, reduce the brace spacing by 50% and the support spacing by 20%. The revised total tension load on the support rod

= 6.2 kN x 50% + 3.6 kN x 80% = 6.0 kN < 6.3 kN

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VERTICAL SUPPORT GUIDLINES

SSB/SSBS LOCATIONS

SEISMIC LOAD ON SUPPORT RODS FOR USE WITH PAGES A3 AND D3

SEISMIC LOAD

AT INDIVIDUAL SUPPORTS:

Pipe Diameter (in)	Support Rod Diameter (in)	Seismic Tension Load* (lbs.)
1–2	3/8	425
2 1/2–3	1/2	685
4–5	5/8	685
6	3/4	1430
8–10	7/8	1445
12	7/8	2180
14–18	1	2200
20–24	1 1/4	4710

AT TRAPEZE SUPPORTS:

Size	Support Rod Diameter (in)	Seismic Tension Load* (lbs.)
SSBS-12	1/2	680
SSBS-20,25	5/8	1440
SSB-3	3/4	2200
SSB-4	1	4840

* The attachment point of the support rod to the structure must be designed to accept the addition of the seismic tension load tabulated above and the gravity load of the item supported. THIS IS ONLY REQUIRED FOR SUPPORT RODS WHERE THE SEISMIC SOLID BRACE IS ATTACHED.

Example: For a 10" Diameter pipe supported by a minimum 7/8" diameter rod, assume the gravity load is 800 lbs. The total tension load on the support rod
= 1445 lbs. (see table above) + 800 lbs. = 2245 lbs.

Select a concrete expansion anchor (Ref. Page X7), concrete insert anchor, or any other approved attachment which can accept this total tension load.

To reduce the total tension load on the support rod to meet the allowable tension load of the attachment, reduce the seismic brace spacing or the support spacing or both.

Example: Assume the total tension load on the support is 2245 lbs. from the example above. If the allowable tension load of the attachment is 1400 lbs., reduce the brace spacing by 50% and the support spacing by 20%. The revised total tension load on the support rod
= 1445 lbs. x 50% + 800 lbs. x 80% = 1362.5 lbs. < 1400 lbs.

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VERTICAL SUPPORT GUIDLINES

SSB/SSBS LOCATIONS

SEISMIC LOAD ON SUPPORT RODS FOR USE WITH PAGES A3 AND D3

SEISMIC LOAD

AT INDIVIDUAL SUPPORTS:

Pipe Diameter (mm)	Support Rod Diameter (mm)	Seismic Tension Load* (kN)
25–51	10	1.9
64–76	13	3.1
102–127	16	3.1
152	19	6.4
203–254	22	6.5
305	22	9.7
356–457	25	9.8
508–610	32	21.0

AT TRAPEZE SUPPORTS:

Size	Support Rod Diameter (mm)	Seismic Tension Load* (kN)
SSBS-12	13	3.0
SSBS-20, 25	16	6.5
SSB-3	19	9.8
SSB-4	25	21.6

* The attachment point of the support rod to the structure must be designed to accept the addition of the seismic tension load tabulated above and the gravity load of the item supported. THIS IS ONLY REQUIRED FOR SUPPORT RODS WHERE THE SEISMIC SOLID BRACE IS ATTACHED.

Example: For a *254mm* diameter pipe supported by a minimum *22mm* diameter rod, assume the gravity load is 3.6 kN. The total tension load on the support rod

= 6.5 kN (see table above) + 3.6 kN = 10.1 kN

Select a concrete expansion anchor (Ref. Page X7), concrete insert anchor, or any other approved attachment which can accept this total tension load.

To reduce the total tension load on the support rod to meet the allowable tension load of the attachment, reduce the seismic brace spacing or the support spacing or both.

Example: Assume the total tension load on the support is 1018 kg. from the example above. If the allowable tension load of the attachment is 6.3 kN, reduce the brace spacing by 50% and the support spacing by 20%. The revised total tension load on the support rod

= 6.5 kN x 50% + 3.6 kN x 80% = 6.2 kN < 6.3 kN

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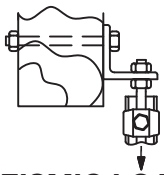
VERTICAL SUPPORT GUIDLINES

SSB/SSBS LOCATIONS

SEISMIC LOAD SUPPORT RODS FOR USE WITH PAGES A4 AND D4



SEISMIC LOAD

AT INDIVIDUAL SUPPORTS:

Pipe Diameter (in)	Support Rod Diameter (in)	Seismic Tension Load* (lbs.)
1–2	3/8	250
2 1/2–3	1/2	250
4–5	5/8	250
6	3/4	350
8–12	7/8	350

AT TRAPEZE SUPPORTS:

Size	Support Rod Diameter (in)	Seismic Tension Load* (lbs.)
SSBS-12	1/2	240
SSBS-20,25	5/8	360
SSB-3	3/4	480

* The attachment point of the support rod to the structure must be designed to accept the addition of the seismic tension load tabulated above and the gravity load of the item supported. THIS IS ONLY REQUIRED FOR SUPPORT RODS WHERE THE SEISMIC SOLID BRACE IS ATTACHED.

Example: For a 10" Diameter pipe supported by a minimum 7/8" diameter rod, assume the gravity load is 800 lbs. The total tension load on the support rod
= 350 lbs. (see table above) + 800 lbs. = 1150 lbs.

Select a concrete expansion anchor (Ref. Page X7), concrete insert anchor, or any other approved attachment which can accept this total tension load.

To reduce the total tension load on the support rod to meet the allowable tension load of the attachment, reduce the seismic brace spacing or the support spacing or both.

Example: Assume the total tension load on the support is 1150 lbs. from the example above. If the allowable tension load of the attachment is 900 lbs., reduce the brace spacing by 50% and the support spacing by 20%. The revised total tension load on the support rod
= 350 lbs. x 50% + 800 lbs. x 80% = 815 lbs. < 900 lbs.

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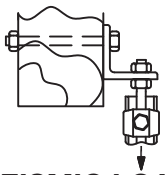
VERTICAL SUPPORT GUIDLINES

SSB/SSBS LOCATIONS

SEISMIC LOAD SUPPORT RODS FOR USE WITH PAGES A4 AND D4



SEISMIC LOAD

AT INDIVIDUAL SUPPORTS:

Pipe Diameter (mm)	Support Rod Diameter (mm)	Seismic Tension Load* (kN)
25–51	10	1.2
64–76	13	1.2
102–127	16	1.2
152	19	1.6
203–305	22	1.6

AT TRAPEZE SUPPORTS:

Size	Support Rod Diameter (mm)	Seismic Tension Load* (kg)
SSBS-12	13	1.1
SSBS-20, 25	16	1.6
SSB-3	19	2.2

* The attachment point of the support rod to the structure must be designed to accept the addition of the seismic tension load tabulated above and the gravity load of the item supported. THIS IS ONLY REQUIRED FOR SUPPORT RODS WHERE THE SEISMIC SOLID BRACE IS ATTACHED.

Example: For a *254mm* diameter pipe supported by a minimum *22mm* diameter rod, assume the gravity load is 3.6 kN. The total tension load on the support rod

= 1.6 kN (see table above) + 3.6 kN = 5.2 kN

Select a concrete expansion anchor (Ref. Page X7), concrete insert anchor, or any other approved attachment which can accept this total tension load.

To reduce the total tension load on the support rod to meet the allowable tension load of the attachment, reduce the seismic brace spacing or the support spacing or both.

Example: Assume the total tension load on the support is 5.2 kN. from the example above. If the allowable tension load of the attachment is 4.0 kN, reduce the brace spacing by 50% and the support spacing by 20%. The revised total tension load on the support rod

= 1.6 kN x 50% + 3.6 kN x 80% = 3.7 kN < 4.0 kN

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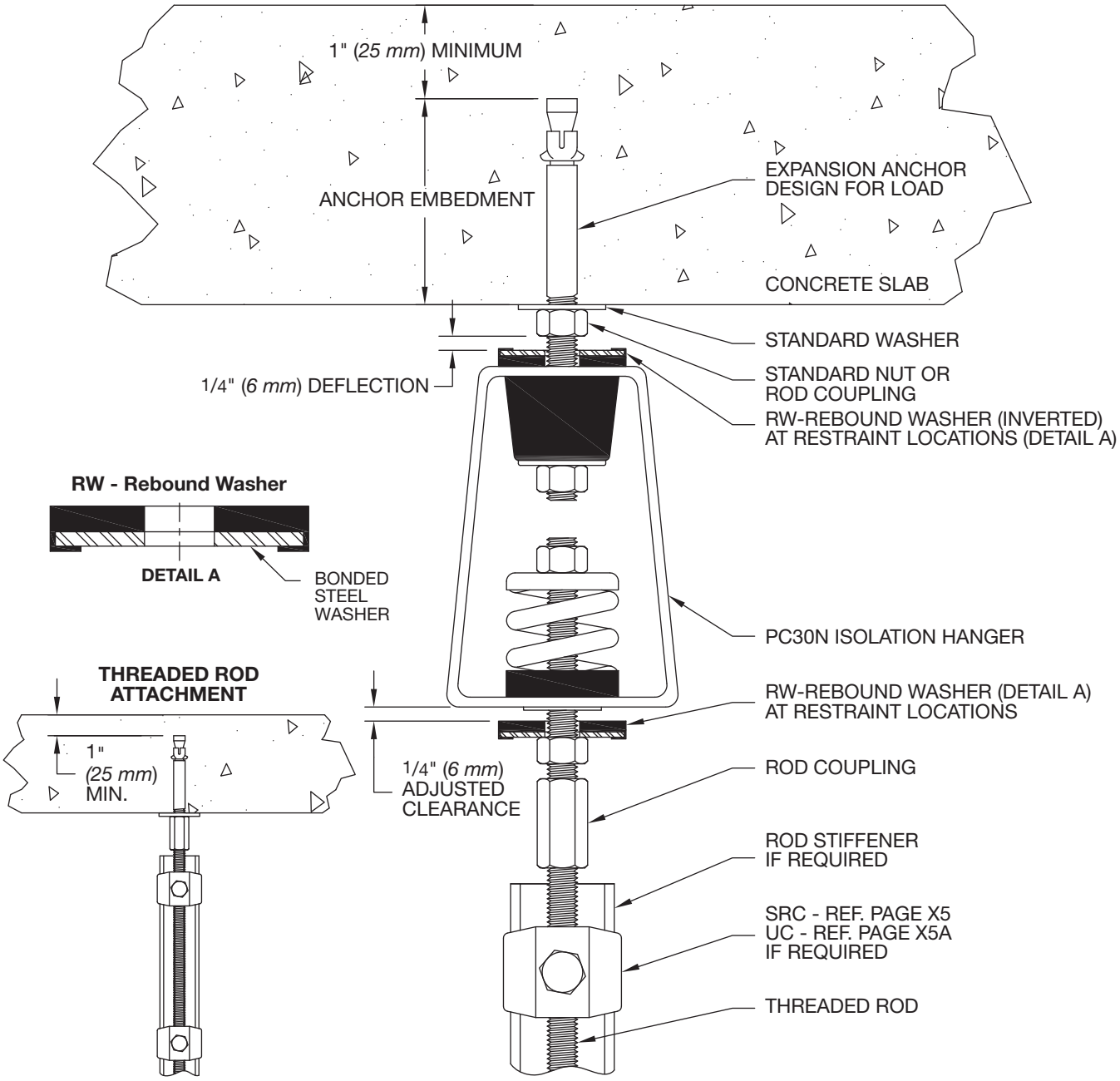
PC30N ISOLATION HANGER ATTACHMENT TO A CONCRETE SLAB WITH (1) EXPANSION ANCHOR



NOTE 1: For tightening requirements of bolts, nuts and strut nuts reference H15.

NOTE 2: Install with hanger box snug to upper rebound washer, with washer tight to overhead surface. Upper hanger element deflects under load, leaving space on top.

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Fixed Equipment Anchorage
Office of Statewide Health Planning and Development

OPA-0349
on
April 6, 2009

Anthony R. Pike

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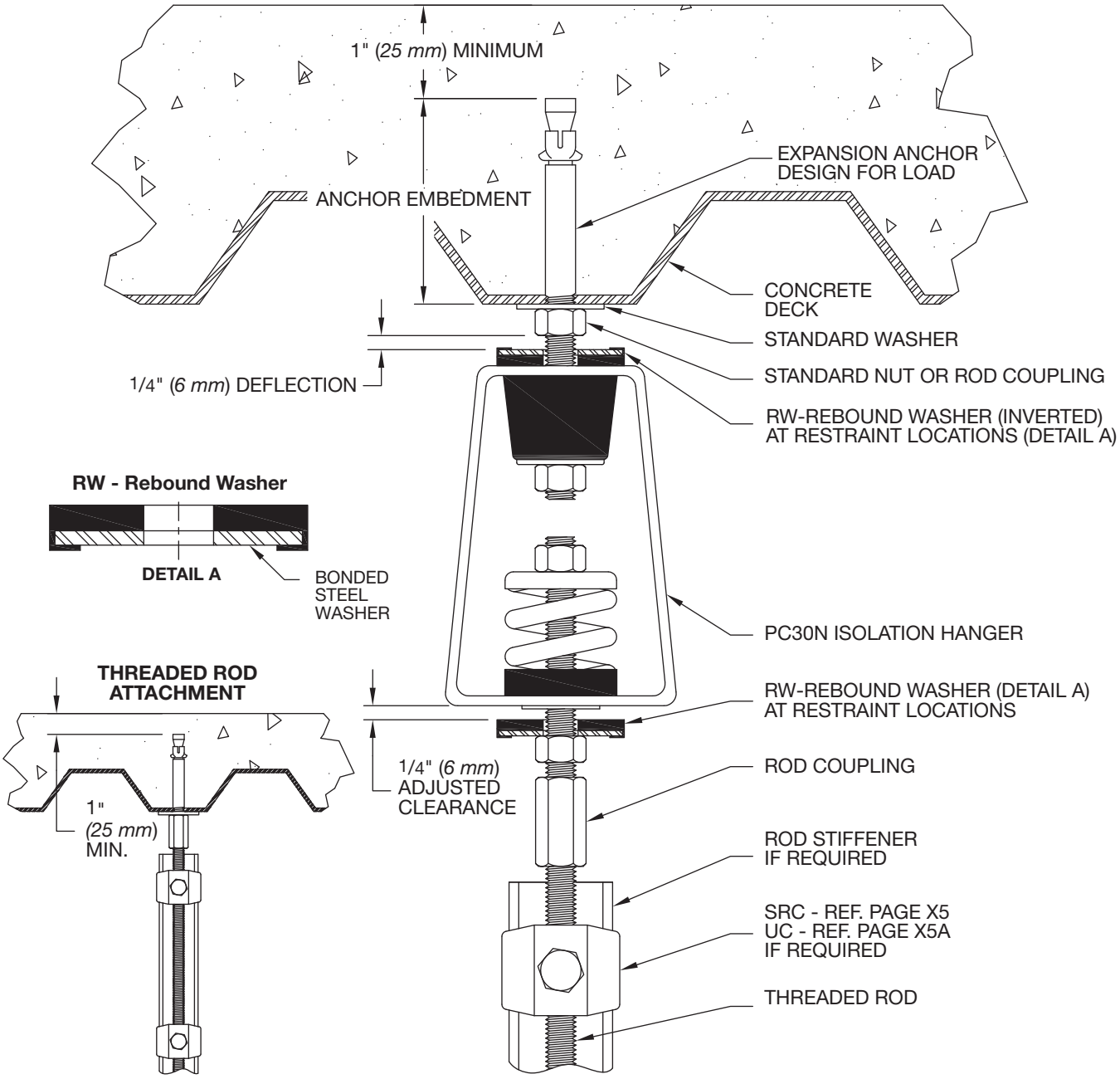
PC30N ISOLATION HANGER ATTACHMENT TO A CONCRETE DECK WITH (1) EXPANSION ANCHOR



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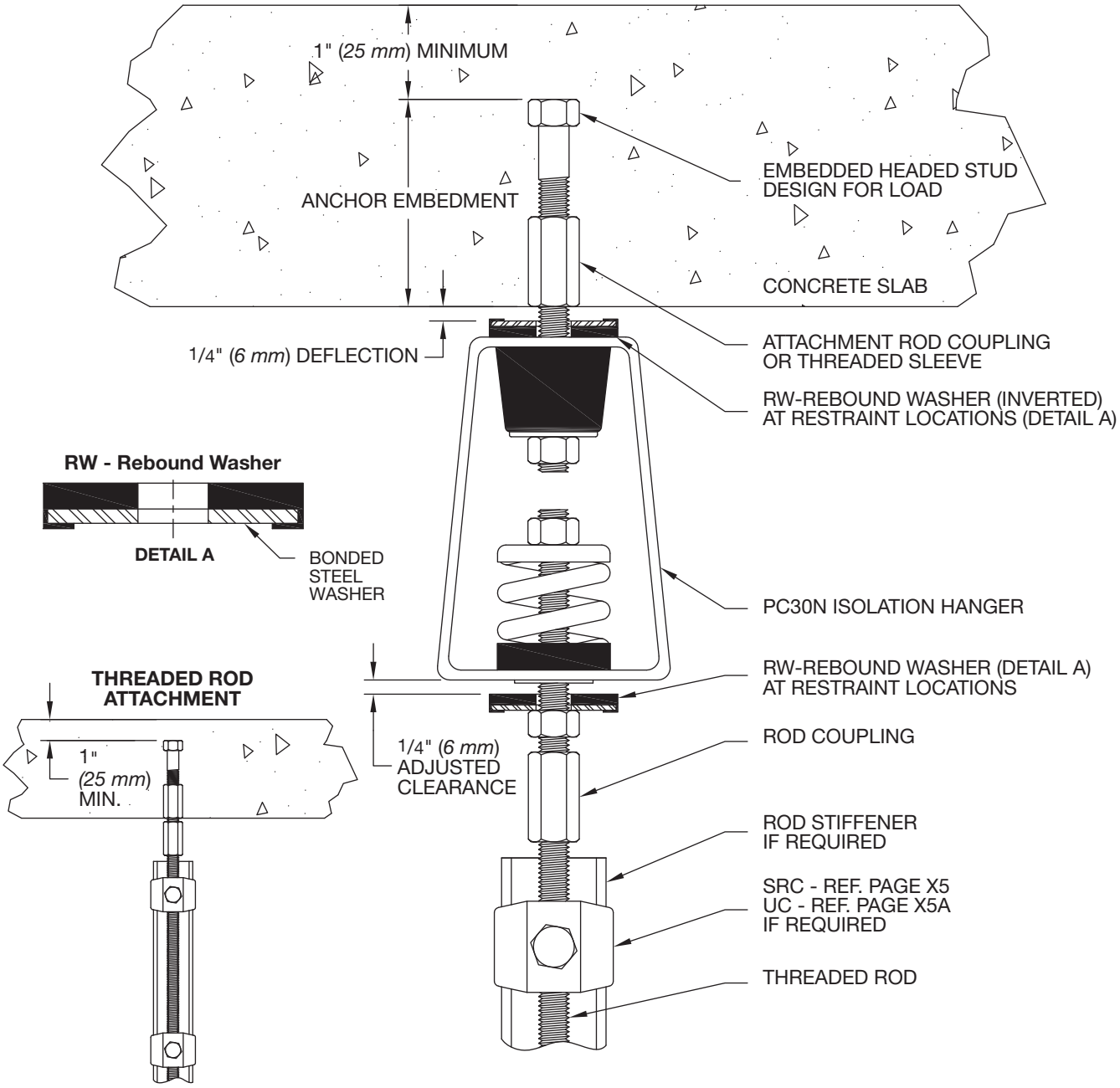
PC30N ISOLATION HANGER ATTACHMENT TO A CONCRETE SLAB WITH (1) EMBEDDED HEADED STUD



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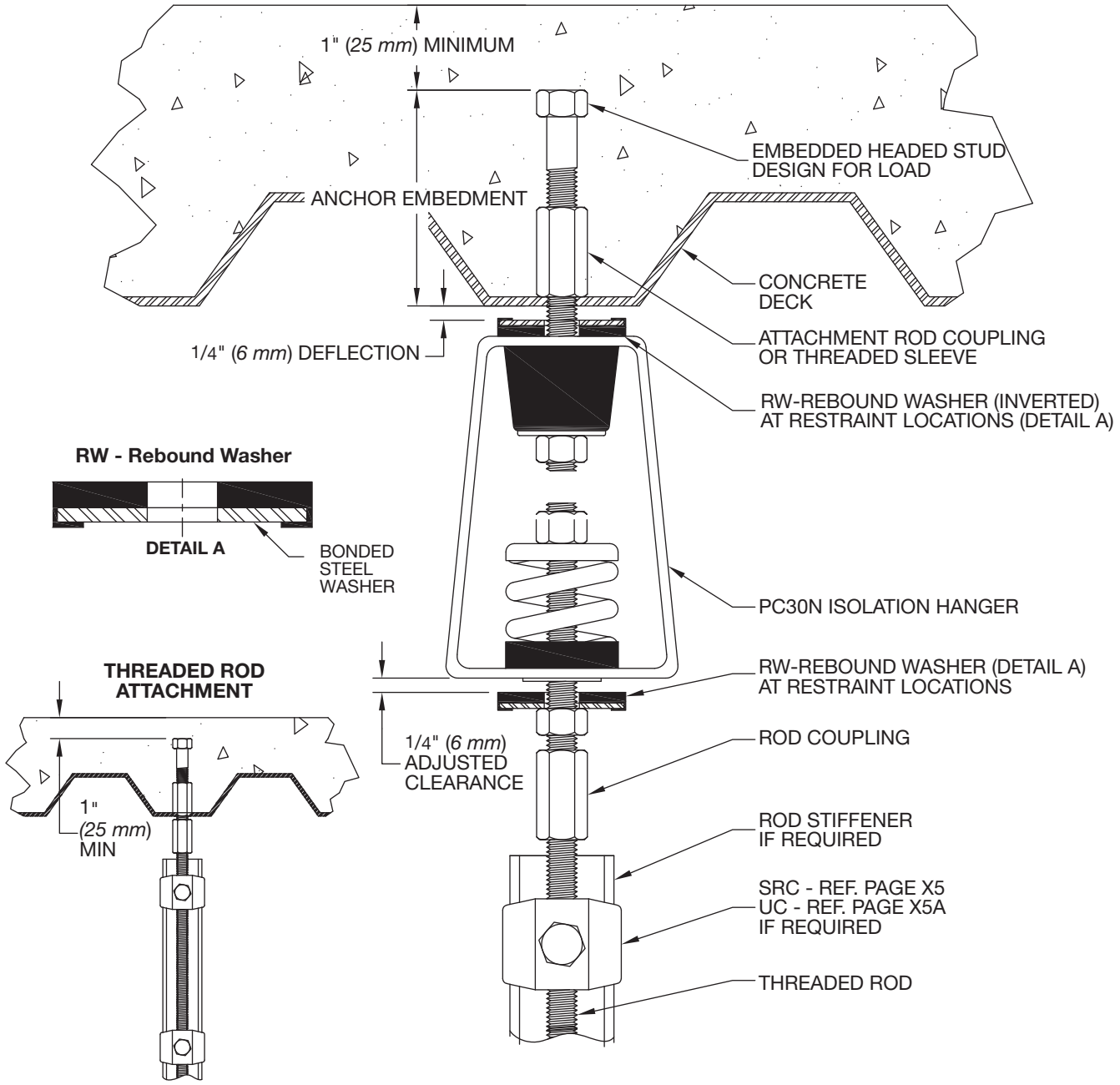

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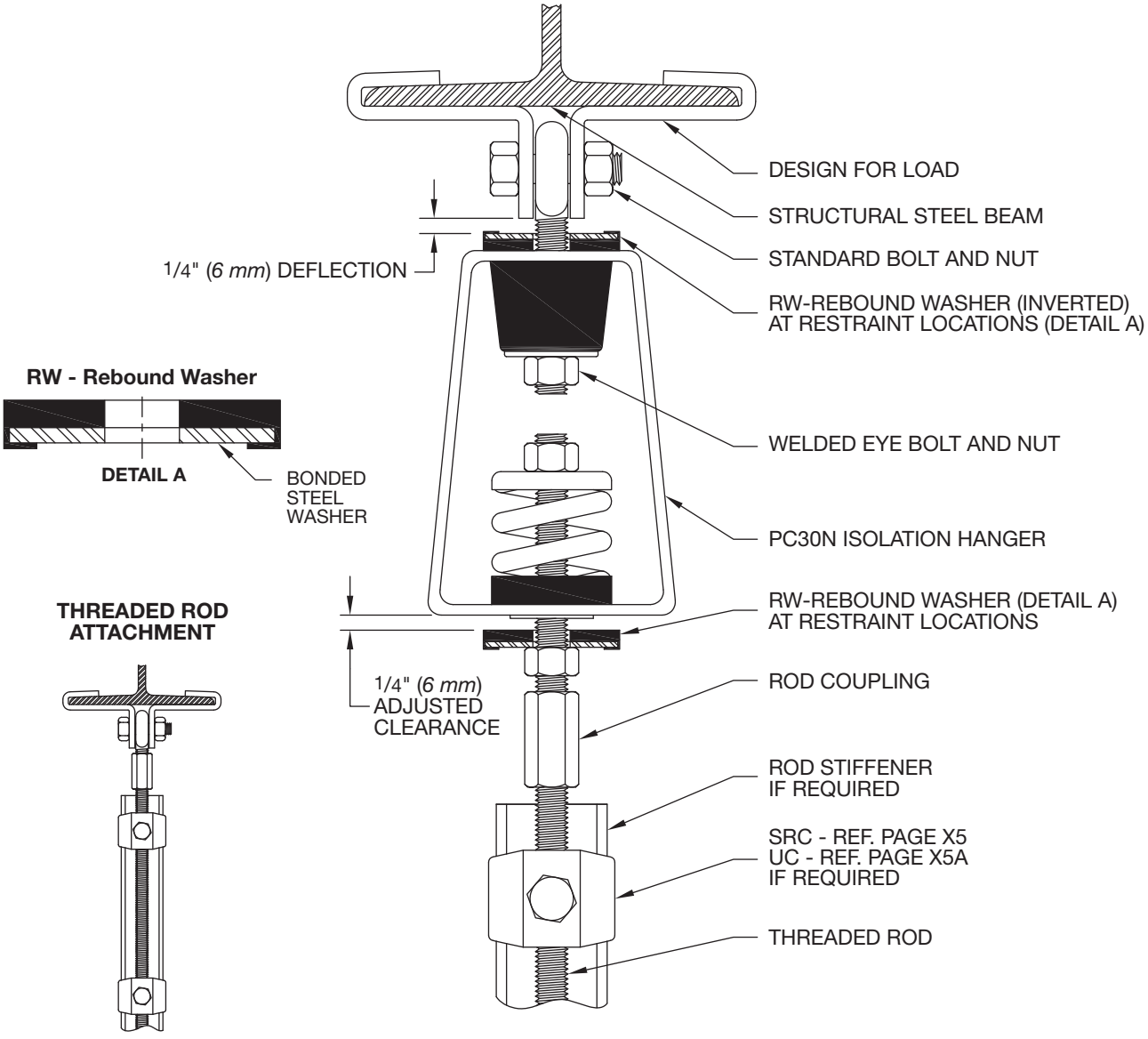
PC30N ISOLATION HANGER ATTACHMENT TO A STRUCTURAL STEEL BEAM WITH A BEAM CLAMP



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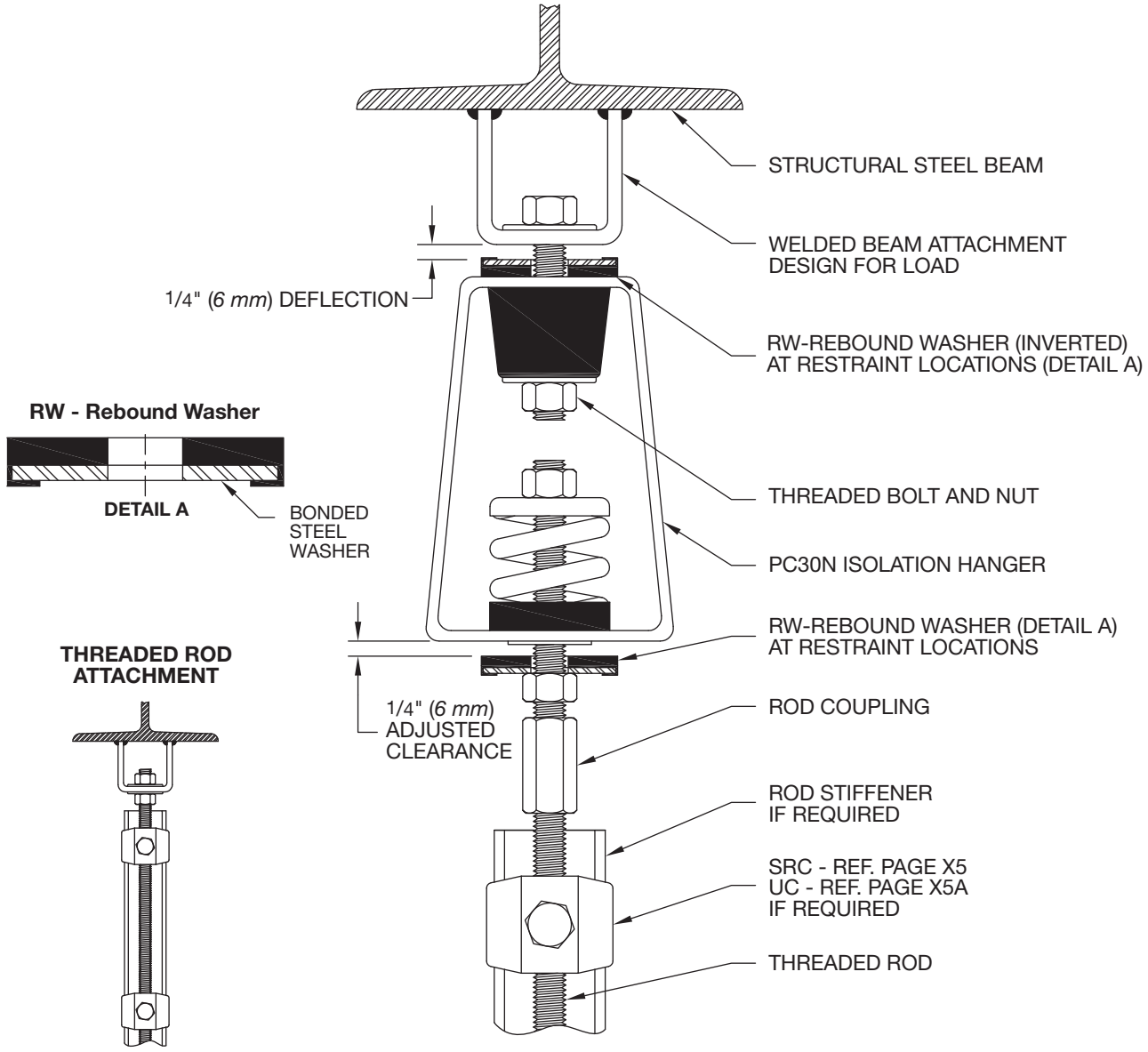
PC30N ISOLATION HANGER ATTACHMENT
TO A MODIFIED STRUCTURAL STEEL BEAM WITH (1) ANCHOR



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Page
L5

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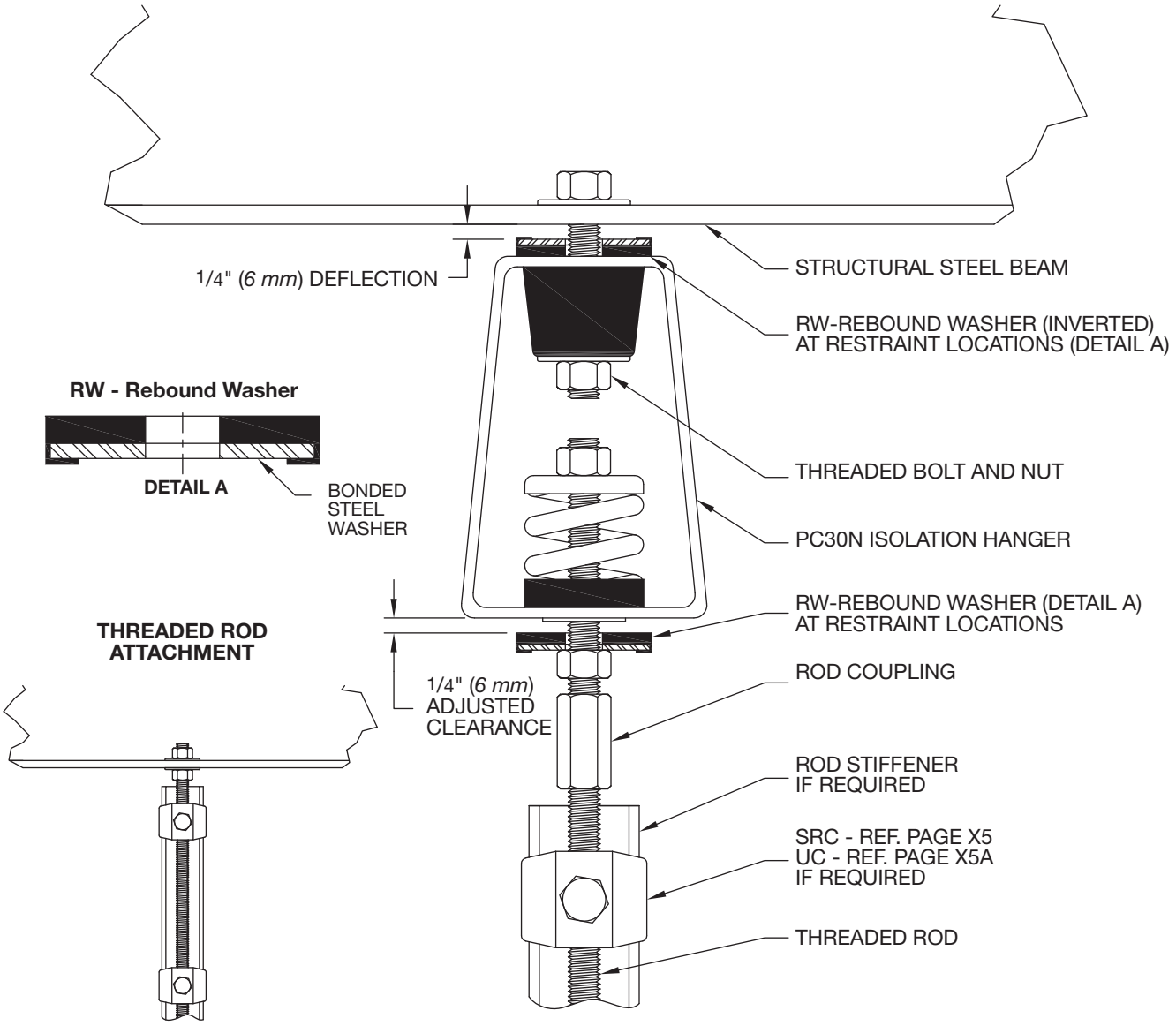
TO A MODIFIED STRUCTURAL STEEL BEAM WITH (1) ANCHOR



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PIPE WEIGHTS

STEEL PIPE

Pipe Diameter (in)	Pipe Schedule	Insulation Thickness (in)	Weight per Foot (lbs)			
			Pipe	Water	Insulation	Total
1	40	1	1.7	0.4	0.7	2.8
1 1/4	40	1	2.3	0.7	0.8	3.8
1 1/2	40	1	2.7	0.9	0.9	4.5
2	40	1	3.7	1.5	1.0	6.2
2 1/2	40	1	5.8	2.1	1.2	9.1
3	40	1	7.6	3.2	1.3	12.1
4	40	1	11.0	5.5	1.8	18.3
5	40	1 1/2	15.0	8.7	2.9	26.6
6	40	1 1/2	19.0	12.5	3.3	34.8
8	40	1 1/2	29.0	22.0	4.1	55.1
10	40	1 1/2	41.0	34.0	5.2	80.2
12	40	1 1/2	54.0	49.0	6.0	109.0
14	30	1 1/2	55.0	60.0	7.0	122.0
16	30	1 1/2	63.0	79.0	7.5	150.0
18	30	1 1/2	82.0	100.0	8.0	190.0
20	20	1 1/2	79.0	126.0	8.5	214.0
24	20	1 1/2	95.0	184.0	10.0	289.0

COPPER PIPE

Pipe Diameter (in)	Copper Type	Insulation Thickness (in)	Weight per Foot (lbs)			
			Pipe	Water	Insulation	Total
1	L	1	0.7	0.4	0.7	1.8
1 1/4	L	1	0.9	0.6	0.8	2.3
1 1/2	L	1	1.1	0.8	0.9	2.8
2	L	1	1.8	1.4	1.0	4.2
2 1/2	L	1	2.5	2.1	1.2	5.8
3	L	1	3.3	3.0	1.3	7.6
3 1/2	L	1	4.3	4.0	1.5	9.8
4	L	1	5.4	5.2	1.8	12.4
5	L	1 1/2	7.6	8.1	2.9	18.6
6	L	1 1/2	10.2	11.6	3.3	25.1
8	L	1 1/2	19.3	20.3	4.1	43.7
10	L	1 1/2	30.1	31.6	5.2	66.9
12	L	1 1/2	40.4	45.4	6.0	91.8

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California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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PIPE WEIGHTS

STEEL PIPE

Pipe Diameter (mm)	Pipe Schedule	Insulation Thickness (mm)	Weight per Meter (kg)			
			Pipe	Water	Insulation	Total
25	40	25	2.5	0.6	1.0	4.1
32	40	25	3.4	1.0	1.2	5.6
38	40	25	4.0	1.3	1.3	6.6
51	40	25	5.5	2.2	1.5	9.2
64	40	25	8.6	3.1	1.8	13.5
76	40	25	11.3	4.8	1.9	18.0
102	40	25	16.4	8.2	2.7	27.3
127	40	38	22.3	12.9	4.3	39.5
152	40	38	28.3	18.6	4.9	51.8
203	40	38	43.2	32.7	6.1	82.0
254	40	38	61.0	50.6	7.7	119.3
305	40	38	80.4	72.9	8.9	162.2
356	30	38	81.8	89.3	10.4	181.5
406	30	38	93.8	117.6	11.2	222.6
457	30	38	122.0	148.8	11.9	282.7
508	20	38	117.6	187.5	12.6	317.7
610	20	38	141.4	273.8	14.9	430.1

COPPER PIPE

Pipe Diameter (mm)	Copper Type	Insulation Thickness (mm)	Weight per Meter (kg)			
			Pipe	Water	Insulation	Total
25	L	25	1.0	0.6	1.0	2.6
32	L	25	1.3	0.9	1.2	3.4
38	L	25	1.6	1.2	1.3	4.1
51	L	25	2.7	2.1	1.5	6.3
64	L	25	3.7	3.1	1.8	8.6
76	L	25	4.9	4.5	1.9	11.3
89	L	25	6.4	6.0	2.2	14.6
102	L	25	8.0	7.7	2.7	18.4
127	L	38	11.3	12.1	4.3	27.7
152	L	38	15.2	17.3	4.9	37.4
203	L	38	28.7	30.2	6.1	65.0
254	L	38	44.8	47.0	7.7	99.5
305	L	38	60.1	67.3	8.9	136.3

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Dhiru Mali
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PIPE WEIGHTS (continued)

SCHEDULE 40 PVC PIPE

Pipe Diameter (in)	Wall Thickness (in)	Weight per Foot (lbs)		
		Pipe	Water	Total
1/2	0.109	0.15	0.13	0.28
3/4	0.113	0.20	0.23	0.43
1	0.133	0.30	0.37	0.67
1 1/4	0.140	0.40	0.65	1.05
1 1/2	0.145	0.48	0.88	1.36
2	0.154	0.64	1.45	2.10
2 1/2	0.203	1.02	2.07	3.09
3	0.216	1.33	3.20	4.53
3 1/2	0.226	1.60	4.28	5.88
4	0.237	1.90	5.51	7.41
5	0.258	2.77	8.66	11.43
6	0.280	3.34	12.15	15.49
8	0.322	5.28	21.60	26.88
10	0.366	7.51	34.10	41.61
12	0.406	10.02	48.50	58.52

SCHEDULE 80 PVC PIPE

Pipe Diameter (in)	Wall Thickness (in)	Weight per Foot (lbs)		
		Pipe	Water	Total
1/2	0.147	0.15	0.10	0.25
3/4	0.154	0.26	0.19	0.45
1	0.179	0.38	0.31	0.69
1 1/4	0.191	0.53	0.56	1.08
1 1/2	0.200	0.64	0.77	1.40
2	0.218	0.88	1.28	2.16
2 1/2	0.276	1.35	1.83	3.18
3	0.300	1.80	2.86	4.66
3 1/2	0.318	2.20	3.85	6.05
4	0.337	2.64	4.98	7.62
5	0.375	4.13	7.87	12.00
6	0.432	5.03	11.29	16.32
8	0.500	8.02	19.80	27.82
10	0.593	11.89	31.10	42.99
12	0.687	16.37	44.00	60.37

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PIPE WEIGHTS (continued)

SCHEDULE 40 PVC PIPE

Pipe Diameter (mm)	Wall Thickness (mm)	Weight per Meter (kg)		
		Pipe	Water	Total
13	2.8	0.22	0.19	0.41
19	2.9	0.30	0.34	0.64
25	3.4	0.45	0.55	1.00
32	3.6	0.60	0.97	1.57
38	3.7	0.71	1.31	2.02
51	3.9	0.95	2.16	3.11
64	5.2	1.52	3.08	4.60
76	5.5	1.98	4.76	6.74
89	5.7	2.38	6.37	8.75
102	6.0	2.83	8.20	11.03
127	6.6	4.12	12.89	17.01
152	7.1	4.97	18.08	23.05
203	8.2	7.86	32.14	40.00
254	9.3	11.18	50.75	61.93
305	10.3	14.91	72.18	87.06

SCHEDULE 80 PVC PIPE

Pipe Diameter (mm)	Wall Thickness (mm)	Weight per Meter (kg)		
		Pipe	Water	Total
13	3.7	0.22	0.15	0.37
19	3.9	0.39	0.28	0.57
25	4.6	0.57	0.46	1.03
32	4.9	0.79	0.83	1.62
38	5.1	0.95	1.15	2.10
51	5.5	1.31	1.90	3.21
64	7.0	2.01	2.72	4.73
76	7.6	2.68	4.26	6.94
89	8.1	3.27	5.73	9.00
102	8.6	3.93	7.41	11.34
127	9.5	6.15	11.71	17.86
152	11.0	7.49	16.80	24.29
203	12.7	11.94	29.47	41.41
254	15.1	17.69	46.28	63.97
305	17.5	24.36	65.48	89.84

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PIPE WEIGHTS (continued)

CAST IRON PIPE

Pipe Diameter (in)	Class	Weight per Foot (lbs)		
		Pipe	Water	Total
3	150	12.2	3.7	15.9
4	150	16.4	5.7	22.1
6	150	25.7	12.8	38.5
8	150	36.7	23.1	59.8
10	150	48.7	35.5	84.2
12	150	62.9	51.0	113.9
14	150	78.8	69.3	148.1
16	150	95.0	90.3	185.3
18	150	114.7	114.0	228.7
20	150	135.9	141.5	277.4
24	150	190.4	201.0	391.4

STEEL CONDUIT

Conduit Diameter (in)	Wall Thickness (in)	Conduit Wt./Ft. (lbs)	Max. Wt./Ft. of Conduit and Conductor (lbs)	
			Lead Covered	Not Lead Covered
1/2	0.112	0.852	1.172	1.042
3/4	0.124	1.134	1.754	1.398
1	0.124	1.684	2.614	2.347
1 1/4	0.155	2.281	4.311	3.581
1 1/2	0.167	2.731	5.891	4.546
2	0.172	3.678	8.528	7.208
2 1/2	0.219	5.819	11.509	10.219
3	0.219	7.616	16.506	14.506
3 1/2	0.219	9.202	19.052	17.491
4	0.219	10.889	24.749	21.479
5	0.367	14.810	35.870	30.830
6	0.367	19.185	50.685	43.425

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PIPE WEIGHTS (continued)

CAST IRON PIPE

Pipe Diameter (mm)	Class	Weight per Meter (kg)		
		Pipe	Water	Total
76	150	18.2	5.5	23.7
102	150	24.4	8.5	32.9
152	150	38.2	19.0	57.2
203	150	54.6	34.4	89.0
254	150	72.5	52.8	125.3
305	150	93.6	75.9	169.5
356	150	117.3	103.1	220.4
406	150	141.4	134.4	275.8
457	150	170.7	169.7	370.4
508	150	202.2	210.6	412.8
610	150	283.3	299.1	582.4

STEEL CONDUIT

Conduit Diameter (mm)	Wall Thickness (mm)	Conduit Wt./m (kg)	Max. Wt./m of Conduit and Conductor (kg)	
			Lead Covered	Not Lead Covered
13	2.8	1.27	1.74	1.55
19	3.1	1.69	2.61	2.08
25	3.1	2.51	3.89	3.49
32	3.9	3.39	6.42	5.33
38	4.2	4.06	8.77	6.77
51	4.4	5.47	12.69	10.73
64	5.6	8.66	17.13	15.21
76	5.6	11.33	24.56	21.59
89	5.6	13.69	28.35	26.03
102	5.6	16.20	36.83	31.96
127	9.3	22.04	53.38	45.88
152	9.3	28.55	75.42	64.62

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OPA-0349 August 5, 2002

Bill Staehlin (916) 654-3362

Dhiru Mali
Structural Engineer
California SE No. 2811

DUCT WEIGHTS

GALVANIZED RECTANGULAR DUCT
24 Gage - Sizes 3" x 3" to 28" x 28"
(lbs / foot)

Size in)	3	4	5	6	7	8	9	10	12	14	16	18	20	22	24	26	28
3	1.28	1.49	1.70	1.96	2.13	2.34	2.55	2.77	3.19	3.62	4.04	4.47	4.80	5.42	5.85	6.20	6.84
4		1.70	1.96	2.13	2.34	2.55	2.77	2.98	3.40	3.82	4.26	4.69	5.10	5.64	6.07	6.50	7.07
5			2.13	2.34	2.55	2.77	2.98	3.19	3.62	4.04	4.47	4.80	5.42	5.85	6.29	6.72	7.25
6				2.55	2.77	2.98	3.19	3.40	3.82	4.26	4.69	5.10	5.64	6.01	6.50	6.94	7.40
7					2.98	3.19	3.40	3.62	4.04	4.47	4.80	5.42	5.85	6.29	6.72	7.15	7.55
8						3.40	3.62	3.82	4.26	4.69	5.10	5.64	6.07	6.50	6.94	7.37	7.80
9							3.82	4.04	4.47	4.89	5.42	5.85	6.29	6.72	7.15	7.59	8.09
10								4.26	4.69	5.10	5.64	6.07	6.50	6.94	7.37	7.80	8.24
12									5.10	5.64	6.07	6.50	6.94	7.37	7.80	8.24	8.67
14										6.07	6.50	6.94	7.37	7.80	8.24	8.67	9.10
16											6.94	7.37	7.80	8.24	8.67	9.10	9.54
18												7.80	8.64	8.67	9.10	9.54	9.97
20													8.67	9.10	9.54	9.97	10.42
22														9.54	9.97	10.42	10.85
24															10.42	10.85	11.29
26																11.29	11.72
28																	12.13

NOTES: Weights include allowance for laps and seams.
Refer to page N10 for different gage weight conversions.

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DUCT WEIGHTS

GALVANIZED RECTANGULAR DUCT
0.61 mm Thick - Sizes 76 mm x 76 mm to 711 mm x 711 mm
(kg/m)

Size m(m)	76	102	127	152	178	203	229	254	305	356	406	457	508	559	610	660	711
76	1.90	2.22	2.53	2.92	3.17	3.48	3.79	4.12	4.75	5.39	6.01	6.65	7.14	8.07	8.71	9.23	10.2
102		2.53	2.92	3.17	3.48	3.79	4.12	4.43	5.06	5.68	6.34	6.98	7.59	8.39	9.03	9.67	10.5
127			3.17	3.48	3.79	4.12	4.43	4.75	5.39	6.01	6.65	7.14	8.07	8.71	9.36	10.0	10.8
152				3.79	4.12	4.43	4.75	5.06	5.68	6.34	6.98	7.59	8.39	8.94	9.67	10.3	11.0
178					4.43	4.75	5.06	5.39	6.01	6.65	7.14	8.07	8.71	9.36	10.0	10.6	11.2
203						5.06	5.39	5.68	6.34	6.98	7.59	8.39	9.03	9.67	10.3	11.0	11.6
229							5.82	6.01	6.65	7.28	8.07	8.71	9.36	10.0	10.6	11.3	12.0
254								6.34	6.98	7.59	8.39	9.03	9.67	10.3	11.0	11.6	12.3
305									7.59	8.39	9.03	9.67	10.3	11.0	11.6	12.3	12.9
356										9.03	9.67	10.3	11.0	11.6	12.3	12.9	13.5
406											10.3	11.0	11.6	12.3	12.9	13.5	14.2
457												11.6	12.9	12.9	13.5	14.2	14.8
508													12.9	13.5	14.2	14.8	15.5
559														14.2	14.8	15.5	16.2
610															15.5	16.2	16.8
660																16.8	17.4
711																	18.1

NOTES: Weights include allowance for laps and seams.
Refer to page N10m for different duct thickness weight conversions.

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California SE No. 2811

GALVANIZED RECTANGULAR DUCT
22 Gage - Sizes 30" x 3" to 40" x 40"
(lbs / foot)

Size (in)	30	32	34	36	38	40
3	8.6	8.8	9.1	9.3	9.9	10.5
4	8.8	9.1	9.3	9.6	10.5	11.0
5	9.1	9.3	9.6	9.8	10.8	11.3
6	9.3	9.6	9.8	10.1	11.1	11.6
7	9.6	9.8	10.1	10.3	11.3	11.8
8	10.1	10.6	11.1	11.6	11.8	12.1
9	10.3	10.8	11.3	11.8	12.1	12.3
10	10.6	11.1	11.6	12.1	12.3	12.6
12	11.1	11.6	12.1	12.3	12.6	13.1
14	11.6	12.1	12.6	13.1	13.4	13.6
16	12.1	12.6	13.1	13.6	13.9	14.1
18	12.6	13.1	13.6	14.1	14.4	14.6
20	13.1	13.6	14.1	14.6	14.8	15.0
22	13.6	14.1	14.6	15.1	15.4	15.6
24	14.1	14.6	15.1	15.6	15.8	16.1
26	14.6	15.1	15.6	16.1	16.4	16.6
28	15.1	15.6	16.1	16.6	16.9	17.1
30	15.6	16.1	16.6	17.1	17.4	17.7
32		16.6	17.1	17.6	17.9	18.1
34			17.6	18.1	18.3	18.5
36				18.6	18.9	19.1
38					19.1	19.5
40						20.9

NOTES: Weights include allowance for laps and seams.
Refer to page N10 for different gage weight conversions.

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GALVANIZED RECTANGULAR DUCT
0.76 mm Thick - Sizes 762 mm x 76 mm to 1016 mm x 1016 mm
(kg/m)

Size (mm)	762	813	864	914	965	1016
76	12.8	13.1	13.5	13.8	14.7	15.6
102	13.1	13.5	13.8	14.3	15.6	16.4
127	13.5	13.8	14.3	14.6	16.1	16.8
152	13.8	14.3	14.6	15.0	16.5	17.3
178	14.3	14.6	15.0	15.3	16.8	17.6
203	15.0	15.8	16.5	17.3	17.6	18.0
229	15.3	16.1	16.8	17.6	18.0	18.3
254	15.8	16.5	17.3	18.0	18.3	18.8
305	16.5	17.3	18.0	18.3	18.8	19.5
356	17.3	18.0	18.8	19.5	19.9	20.2
406	18.0	18.8	19.5	20.2	20.7	21.0
457	18.8	19.5	20.2	21.0	21.4	21.7
508	19.5	20.2	21.0	21.7	22.0	22.3
559	20.2	21.0	21.7	22.5	22.9	23.2
610	21.0	21.7	22.5	23.2	23.5	24.0
660	21.7	22.5	23.2	24.0	24.4	24.7
711	22.5	23.2	24.0	24.7	25.1	25.4
762	23.2	24.0	24.7	25.4	25.9	26.3
813		24.7	25.4	26.2	26.6	26.9
864			26.2	26.9	27.2	27.5
914				27.7	28.1	28.4
965					28.4	29.0
1016						31.1

NOTES: Weights include allowance for laps and seams.
Refer to page N10m for different thickness weight conversions.

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DUCT WEIGHTS (continued)

GALVANIZED RECTANGULAR DUCT
20 Gage - Sizes 142" x 3" to 58" x 58"
(lbs / foot)

Size (in)	42	44	46	48	50	52	54	56	58
3	13.3	13.9	14.5						
4	13.6	14.2	14.8						
5	13.9	14.5	15.1						
6	14.2	14.8	15.4	16.0	16.6	17.2	17.7	18.4	18.9
7	14.5	15.1	15.7						
8	14.8	15.4	16.0	16.6	17.2	17.7	18.4	18.9	19.6
9	15.4	15.7	16.3						
10	15.7	16.0	16.6	17.2	17.7	18.4	18.9	19.6	20.1
12	16.0	16.6	17.2	17.7	18.4	18.9	19.6	20.1	20.7
14	16.6	17.2	17.7	18.4	18.9	19.6	20.1	20.7	21.3
16	17.2	17.7	18.4	18.9	19.6	20.1	20.7	21.3	21.9
18	17.7	18.4	18.9	19.6	20.1	20.7	21.3	21.9	22.5
20	18.4	18.9	19.5	20.1	20.7	21.3	21.9	22.5	23.1
22	18.9	19.5	20.1	20.7	21.3	21.9	22.5	23.1	23.7
24	19.5	20.1	20.7	21.3	21.9	22.5	23.1	23.7	24.3
26	20.1	20.7	21.3	21.9	22.5	23.1	23.7	24.3	24.9
28	20.7	21.3	21.8	22.5	23.1	23.7	24.3	24.9	25.3
30	21.3	21.8	22.5	23.1	23.7	24.3	24.9	25.3	26.1
32	21.5	22.5	23.0	23.7	24.3	24.9	25.3	26.1	26.7
34	22.5	23.0	23.6	24.3	24.9	25.3	26.1	26.7	27.3
36	23.0	23.6	24.8	24.9	25.3	26.1	26.7	27.3	27.8
38	23.6	24.8	25.4	25.3	26.1	26.7	27.3	27.8	28.4
40	24.8	25.4	26.0	26.1	26.7	27.3	27.8	28.4	29.0
42	25.4	26.0	26.5	26.7	27.3	27.8	28.4	29.0	29.6
44		26.5	27.1	27.3	27.8	28.4	29.0	29.6	30.2
46			27.7	27.8	28.4	29.0	29.6	30.2	30.8
48				28.4	29.0	29.6	30.2	30.8	31.4
50					29.6	30.2	30.8	31.4	32.0
52						30.8	31.4	32.0	32.6
54							32.0	32.6	33.2
56								33.2	33.6
58									34.4

NOTES: Weights include allowance for laps and seams.
Refer to page N10 for different gage weight conversions.

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DUCT WEIGHTS (continued)

GALVANIZED RECTANGULAR DUCT
0.91 mm Thick - Sizes 1067 mm x 76 mm to 1473 mm x 1473 mm
(kg/m)

Size (mm)	1067	1118	1168	1219	1270	1321	1372	1422	1473
76	19.8	20.7	21.6						
102	20.2	21.1	22.0						
127	20.7	21.6	22.5						
152	21.1	22.0	22.9	23.8	24.7	25.6	26.3	27.4	28.1
178	21.6	22.5	23.4						
203	22.0	22.9	23.8	24.7	25.6	26.3	27.4	28.1	29.2
229	22.9	23.4	24.3						
254	23.4	23.8	24.7	25.6	26.3	27.4	28.1	29.2	29.9
305	23.8	24.7	25.6	26.3	27.4	28.1	29.2	29.9	30.8
356	24.7	25.6	26.3	27.4	28.1	29.2	29.9	30.8	31.7
406	25.6	26.3	27.4	28.1	29.2	29.9	30.8	31.7	32.6
457	26.3	27.4	28.1	29.2	29.9	30.8	31.7	32.6	33.5
508	27.4	28.1	29.2	29.9	30.8	31.7	32.6	33.5	34.4
559	28.1	29.2	29.9	30.8	31.7	32.6	33.5	34.4	35.3
610	29.2	29.9	30.8	31.7	32.6	33.5	34.4	35.3	36.2
660	29.9	30.8	31.7	32.6	33.5	34.4	35.3	36.2	37.1
711	30.8	31.7	32.6	33.5	34.4	35.3	36.2	37.1	37.7
762	31.7	32.6	33.5	34.4	35.3	36.2	37.1	37.7	38.8
813	32.6	33.5	34.4	35.3	36.2	37.1	37.7	38.8	39.7
864	33.5	34.4	35.3	36.2	37.1	37.7	38.8	39.7	40.6
914	34.4	35.3	36.2	37.1	37.7	38.8	39.7	40.6	41.4
965	35.5	36.2	37.1	37.7	38.8	39.7	40.6	41.4	42.3
1016	36.2	37.1	37.7	38.8	39.7	40.6	41.4	42.3	43.2
1067	37.1	37.7	38.8	39.7	40.6	41.4	42.3	43.2	44.0
1118		38.8	39.7	40.6	41.4	42.3	43.2	44.0	44.9
1168			40.6	41.4	42.3	43.2	44.0	44.9	45.8
1219				42.3	43.2	44.0	44.9	45.8	46.7
1270					44.0	44.9	45.8	46.7	47.6
1321						45.8	46.7	47.6	48.5
1372							47.6	48.5	49.4
1422								49.4	50.0
1473									51.2

NOTES: Weights include allowance for laps and seams.
Refer to page N10m for different thickness weight conversions.

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DUCT WEIGHTS (continued)

GALVANIZED RECTANGULAR DUCT
18 Gage - Sizes 60" x 6" to 78" x 58"
(lbs / foot)

Size (in)	60	62	64	66	68	70	72	74	76	78
6	25.4	26.2	27.0	27.7	28.5	29.3	30.0	30.8	31.6	32.5
8	26.2	27.0	27.7	28.5	29.3	30.0	30.8	31.6	32.5	33.1
10	27.0	27.7	28.5	29.3	30.0	30.8	31.6	32.5	33.1	33.9
12	27.7	28.5	29.3	30.0	30.8	31.6	32.5	33.1	33.9	34.6
14	28.5	29.3	30.0	30.8	31.6	32.5	33.1	33.9	34.6	35.4
16	29.3	30.0	30.8	31.6	32.5	33.1	33.9	34.6	35.4	36.2
18	30.0	30.8	31.6	32.5	33.1	33.9	34.6	35.4	36.2	37.0
20	30.8	31.6	32.5	33.1	33.9	34.6	35.4	36.2	37.0	37.7
22	31.6	32.5	33.1	33.9	34.6	35.4	36.2	37.0	37.7	38.5
24	32.5	33.1	33.9	34.6	35.4	36.2	37.0	37.7	38.5	39.3
26	33.1	33.9	34.6	35.4	36.2	37.0	37.7	38.5	39.3	40.0
28	33.9	34.6	35.4	36.2	37.0	37.7	38.5	39.3	40.0	40.8
30	34.6	35.4	36.2	37.0	37.7	38.5	39.3	40.0	40.8	41.6
32	35.4	36.2	37.0	37.7	38.5	39.3	40.0	40.8	41.6	42.4
34	36.2	37.0	37.7	38.5	39.3	40.0	40.8	41.6	42.4	43.1
36	37.0	37.7	38.5	39.3	40.0	40.8	41.6	42.4	43.1	43.9
38	37.7	38.5	39.3	40.0	40.8	41.6	42.4	43.1	43.9	44.6
40	38.5	39.3	40.0	40.8	41.6	42.4	43.1	43.9	44.6	45.4
42	39.3	40.0	40.8	41.6	42.4	43.1	43.9	44.6	45.4	46.2
44	40.0	40.8	41.6	42.4	43.1	43.9	44.6	45.4	46.2	47.0
46	40.8	41.6	42.4	43.1	43.9	44.6	45.4	46.2	47.0	47.7
48	41.6	42.4	43.1	43.9	44.6	45.4	46.2	47.0	47.7	48.5
50	42.4	43.1	43.9	44.6	45.4	46.2	47.0	47.7	48.5	49.3
52	43.1	43.9	44.6	45.4	46.2	47.0	47.7	48.5	49.3	50.0
54	43.9	44.6	45.4	46.2	47.0	47.7	48.5	49.3	50.0	50.8
56	44.6	45.4	46.2	47.0	47.7	48.5	49.3	50.0	50.8	51.6
58	45.4	46.2	47.0	47.7	48.5	49.3	50.0	50.8	51.6	52.4

NOTES: Weights include allowance for laps and seams.
Refer to page N10 for different gage weight conversions.

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Dhiru Mali
Structural Engineer
California SE No. 2811

GALVANIZED RECTANGULAR DUCT
1.21mm Thick - Sizes 1524 mm x 152 mm to 1981 mm x 1473 mm
(kg / m)

Size (mm)	1524	1575	1626	1676	1727	1778	1829	1880	1930	1981
152	37.8	39.0	40.2	41.2	42.4	43.6	44.6	45.8	47.0	48.4
203	39.0	40.2	41.2	42.4	43.6	44.6	45.8	47.0	48.4	49.3
254	40.2	41.2	42.4	43.6	44.6	45.8	47.0	48.4	49.3	50.4
305	41.2	42.4	43.6	44.8	45.8	47.0	48.4	49.3	50.4	51.5
356	42.4	43.6	44.8	45.8	47.0	48.4	49.3	50.4	51.5	52.7
406	43.6	44.8	45.8	47.0	48.4	49.3	50.4	51.5	52.7	53.9
457	44.8	45.8	47.0	48.4	49.3	50.4	51.5	52.7	53.9	55.1
508	45.8	47.0	48.4	49.3	50.4	51.5	52.7	53.9	55.1	56.1
559	47.0	48.4	49.3	50.4	51.5	52.7	53.9	55.1	56.1	57.3
610	48.4	49.3	50.4	51.5	52.7	53.9	55.1	56.1	57.3	58.5
660	49.3	50.4	51.5	52.7	53.9	55.1	56.1	57.3	58.5	59.5
711	50.4	51.5	52.7	53.9	55.1	56.1	57.3	58.5	59.5	60.7
762	51.5	52.7	53.9	55.1	56.1	57.3	58.5	59.5	60.7	61.9
813	52.7	53.9	55.1	56.1	57.3	58.5	59.5	60.7	61.9	63.1
864	53.9	55.1	56.1	57.3	58.5	59.5	60.7	61.9	63.1	64.1
914	55.1	56.1	57.3	58.5	59.5	60.7	61.9	63.1	64.1	65.3
965	56.1	57.3	58.5	59.5	60.7	61.9	63.1	64.1	65.3	66.4
1016	57.3	58.5	59.5	60.7	61.9	63.1	64.1	65.3	66.4	67.6
1067	58.5	59.5	60.7	61.9	63.1	64.1	65.3	66.4	67.6	68.8
1118	59.5	60.7	61.9	63.1	64.1	65.3	66.4	67.6	68.8	69.6
1168	60.7	61.9	63.1	64.1	65.3	66.4	67.6	68.8	69.9	71.0
1219	61.9	63.1	64.1	65.3	66.4	67.6	68.8	69.9	71.0	72.2
1270	63.1	64.1	65.3	66.4	67.6	68.8	69.9	71.0	72.2	73.4
1321	64.1	65.3	66.4	67.6	68.8	69.9	71.0	72.2	73.4	74.4
1372	65.3	66.4	67.6	68.8	69.9	71.0	72.2	73.4	74.4	75.6
1422	66.4	67.6	68.8	69.9	71.0	72.2	73.4	74.4	75.6	76.8
1473	67.6	68.8	69.9	71.0	72.2	73.4	74.4	75.6	76.8	78.0

NOTES: Weights include allowance for laps and seams.
Refer to page N10m for different thickness weight conversions.

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OPA-0349 August 5, 2002

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DUCT WEIGHTS (continued)

GALVANIZED RECTANGULAR DUCT
18 Gage - Sizes 80" x 6" to 98" x 58"
(lbs / foot)

Size (in)	80	82	84	86	88	90	92	94	96	98
6	33.1	33.9	34.6	35.4	36.2	37.0	37.7	38.5	39.3	40.0
8	33.9	34.6	35.4	36.2	37.0	37.7	38.5	39.3	40.0	40.8
10	34.6	35.4	36.2	37.0	37.7	38.5	39.3	40.0	40.8	41.6
12	35.4	36.2	37.0	37.7	38.5	39.3	40.0	40.8	41.6	42.4
14	36.2	37.0	37.7	38.5	39.3	40.0	40.8	41.6	42.2	43.1
16	37.0	37.7	38.5	39.3	40.0	40.8	41.6	42.4	43.1	43.9
18	37.7	38.5	39.3	40.0	40.8	41.6	42.4	43.1	43.9	44.6
20	38.5	39.3	40.0	40.8	41.6	42.4	43.1	43.9	44.6	45.4
22	39.3	40.0	40.8	41.6	42.4	43.1	43.9	44.6	45.4	46.2
24	40.0	40.8	41.6	42.4	43.1	43.9	44.6	45.4	46.2	47.0
26	40.8	41.6	42.4	43.1	43.9	44.6	45.4	46.2	47.0	47.7
28	41.6	42.4	43.1	43.9	44.6	45.4	46.2	47.0	47.7	48.5
30	42.4	43.1	43.9	44.6	45.4	46.2	47.0	47.7	48.5	49.3
32	43.1	43.9	44.6	45.4	46.2	47.0	47.7	48.5	49.3	50.0
34	43.9	44.6	45.4	46.2	47.0	47.7	48.5	49.3	50.0	50.8
36	44.6	45.4	46.2	47.0	47.7	48.5	49.3	50.0	50.8	51.6
38	45.4	46.2	47.0	47.7	48.5	49.3	50.0	50.8	51.6	52.4
40	46.2	47.0	47.7	48.5	49.3	50.0	50.8	51.6	52.4	53.1
42	47.0	47.7	48.5	49.3	50.0	50.8	51.6	52.4	53.1	53.9
44	47.7	48.5	49.3	50.0	50.8	51.6	52.4	53.1	53.9	54.5
46	48.5	49.3	50.0	50.8	51.6	52.4	53.1	53.9	54.5	55.5
48	49.3	50.0	50.8	51.6	52.4	53.1	53.9	54.5	55.5	56.3
50	50.0	50.8	51.6	52.4	53.1	53.9	54.5	55.5	56.3	57.0
52	50.8	51.6	52.4	53.1	53.9	54.5	55.5	56.3	57.0	57.7
54	51.6	52.4	53.1	53.9	54.5	55.5	56.3	57.0	57.7	58.5
56	52.4	53.1	53.9	54.5	55.5	56.3	57.0	57.7	58.5	59.4
58	53.1	53.9	54.5	55.5	56.3	57.0	57.7	58.5	59.4	60.0

NOTES: Weights include allowance for laps and seams.
Refer to page N10 for different thickness weight conversions.

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GALVANIZED RECTANGULAR DUCT
1.21 mm Thick - Sizes 2032 mm x 152 mm to 2489 mm x 1473 mm
(kg / m)

Size (mm)	2032	2083	2134	2184	2235	2286	2337	2388	2184	2489
152	49.3	50.4	51.5	52.7	53.9	55.1	56.1	57.3	58.5	59.5
203	50.4	51.5	52.7	53.9	55.1	56.1	57.3	58.5	59.5	60.7
254	51.5	52.7	53.9	55.1	56.1	57.3	58.5	59.5	60.7	61.9
305	52.7	53.9	55.1	56.1	57.3	58.5	59.5	60.7	61.9	63.1
356	53.9	55.1	56.1	57.3	58.5	59.5	60.7	61.9	63.1	64.1
406	55.1	56.1	57.3	58.5	59.5	60.7	61.9	63.1	64.1	65.3
457	56.1	57.3	58.5	59.5	60.7	61.9	63.1	64.1	65.3	66.4
508	57.3	58.5	59.5	60.7	61.9	63.1	64.1	65.3	66.4	67.6
559	58.5	59.5	60.7	61.9	63.1	64.1	65.3	66.4	67.6	68.8
610	59.5	60.7	61.9	63.1	64.1	65.3	66.4	67.6	68.8	69.9
660	60.7	61.9	63.1	64.1	65.3	66.4	67.6	68.8	69.9	71.0
711	61.9	63.1	64.1	65.3	66.4	67.6	68.8	69.9	71.0	72.2
762	63.1	64.1	65.3	66.4	67.6	68.8	69.9	71.0	72.2	73.4
813	64.1	65.3	66.4	67.6	68.8	69.9	71.0	72.2	73.4	74.4
864	65.3	66.4	67.6	68.8	69.9	71.0	72.2	73.4	74.4	75.6
914	66.4	67.6	68.8	69.9	71.0	72.2	73.4	74.4	75.6	76.8
965	67.6	68.8	69.9	71.0	72.2	73.4	74.4	75.6	76.8	78.0
1016	68.8	69.9	71.0	72.2	73.4	74.4	75.6	76.8	78.0	79.0
1067	69.9	71.0	72.2	73.4	74.4	75.6	76.8	78.0	79.0	80.2
1118	71.0	72.2	73.4	74.4	75.6	76.8	78.0	79.0	80.2	81.1
1168	72.2	73.4	74.4	75.6	76.8	78.0	79.0	80.2	81.1	82.6
1219	73.4	74.4	75.6	76.8	78.0	79.0	80.2	81.1	82.6	83.8
1270	74.4	75.6	76.8	78.0	79.0	80.2	81.1	82.6	83.8	84.8
1321	75.6	76.8	78.0	79.0	80.2	81.1	82.6	83.8	84.8	85.9
1372	76.8	78.0	79.0	80.2	81.1	82.6	83.8	84.8	85.9	87.1
1422	78.0	79.0	80.2	81.1	82.6	83.8	84.8	85.9	87.1	88.4
1473	79.0	80.2	81.1	82.6	83.8	84.8	85.9	87.1	88.4	89.3

NOTES: Weights include allowance for laps and seams.
Refer to page N10m for different thickness weight conversions.

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GALVANIZED RECTANGULAR DUCT
18 Gage - Sizes 60" x 60" to 78" x 78"
(lbs / foot)

Size (in)	60	62	64	66	68	70	72	74	76	78
60	46.2	47.0	47.7	48.5	49.3	50.0	50.8	51.6	52.4	53.1
62		47.7	48.5	49.3	50.0	50.8	51.6	52.4	53.1	53.9
64			49.3	50.0	50.8	51.6	52.4	53.1	53.9	54.6
66				50.8	51.6	52.4	53.1	53.9	54.6	55.5
68					52.4	53.1	53.9	54.6	55.5	56.3
70						53.9	54.6	55.5	56.3	57.0
72							55.5	56.3	57.0	57.7
74								57.0	57.7	58.5
76									58.5	59.4
78										60.0

NOTES: Weights include allowance for laps and seams.
Refer to page N10 for different gage weight conversions.

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DUCT WEIGHTS (continued)

GALVANIZED RECTANGULAR DUCT
1.21mm Thick - Sizes 1524mm x 1524mm to 1981mm x 1981mm
(kg / m)

Size (mm)	1524	1575	1626	1676	1727	1778	1829	1880	1930	1981
1524	68.8	69.9	71.0	72.3	73.4	74.4	75.6	76.8	78.0	79.0
1575		71.0	72.3	73.4	74.4	75.6	76.8	78.0	79.0	80.2
1626			73.4	74.4	75.6	76.8	78.0	79.0	80.2	81.3
1676				75.6	76.8	78.0	79.0	80.2	81.3	82.6
1727					78.0	79.0	80.2	81.3	82.6	83.8
1778						80.2	81.3	82.6	83.8	84.8
1829							82.6	83.8	84.8	85.9
1880								84.8	85.9	87.1
1930									87.1	88.4
1981										89.3

NOTES: Weights include allowance for laps and seams.
Refer to page N10m for different thickness weight conversions.

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GALVANIZED RECTANGULAR DUCT
18 Gage - Sizes 80" x 60" to 98" x 98"
(lbs / foot)

Size (in)	80	82	84	86	88	90	92	94	96	98
60	53.9	54.6	55.5	56.3	57.0	57.7	58.5	59.4	60.0	60.8
62	54.6	55.5	56.3	57.0	57.7	58.5	59.4	60.0	60.8	61.6
64	55.5	56.3	57.0	57.7	58.5	59.4	60.0	60.8	61.6	62.4
66	56.3	57.0	57.7	58.5	59.4	60.0	60.8	61.6	62.4	63.1
68	57.0	57.7	58.5	59.4	60.0	60.8	61.6	62.4	63.1	63.9
70	57.7	58.5	59.4	60.0	60.8	61.6	62.4	63.1	63.9	64.6
72	58.5	59.4	60.0	60.8	61.6	62.4	63.1	63.9	64.6	65.5
74	59.4	60.0	60.8	61.6	62.4	63.1	63.9	64.6	65.5	66.3
76	60.0	60.8	61.6	62.4	63.1	63.9	64.6	65.5	66.3	67.0
78	60.8	61.6	62.4	63.1	63.9	64.6	65.5	66.3	67.0	67.7
80	61.6	62.4	63.1	63.9	64.6	65.5	66.3	67.0	67.7	68.5
82		63.1	63.9	64.6	65.5	66.3	67.0	67.7	68.5	69.3
84			64.6	65.5	66.3	67.0	67.7	68.5	69.3	70.0
86				66.3	67.0	67.7	68.5	69.3	70.0	70.7
88					67.7	68.5	69.3	70.0	70.7	71.5
90						69.3	70.0	70.7	71.5	72.4
92							70.7	71.5	72.4	73.1
94								72.4	73.1	73.9
96									73.9	74.6
98										75.5

NOTES: Weights include allowance for laps and seams.
Refer to page N10 for different gage weight conversions.

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DUCT WEIGHTS (continued)

GALVANIZED RECTANGULAR DUCT
1.21 mm Thick - Sizes 2032 mm x 1524 mm to 2489 mm x 2489 mm
(kg / m)

Size (mm)	2032	2083	2134	2184	2235	2286	2337	2388	2438	2489
1524	80.2	81.3	82.6	83.8	84.8	85.9	87.1	88.4	89.3	90.5
1575	81.3	82.6	83.8	84.8	85.9	87.1	88.4	89.3	90.5	91.7
1626	82.6	83.8	84.8	85.9	87.1	88.4	89.3	90.5	91.7	92.9
1676	83.8	84.8	85.9	87.1	88.4	89.3	90.5	91.7	92.9	93.9
1727	84.8	85.9	87.1	88.4	89.3	90.5	91.7	92.9	93.9	95.1
1778	85.9	87.1	88.4	89.3	90.5	91.7	92.9	93.9	95.1	96.1
1829	87.1	88.4	89.3	90.5	91.7	92.9	93.9	95.1	96.1	97.5
1880	88.4	89.3	90.5	91.7	92.9	93.9	95.1	96.1	97.5	98.7
1930	89.3	90.5	91.7	92.9	93.9	95.1	96.1	97.5	98.7	99.7
1981	90.5	91.7	92.9	93.9	95.1	96.1	97.5	98.7	99.7	100.7
2032	91.7	92.9	93.9	95.1	96.1	97.5	98.7	99.7	100.7	101.9
2083		93.9	95.1	96.1	97.5	98.7	99.7	100.7	101.9	103.1
2134			96.1	97.5	98.7	99.7	100.7	101.9	103.1	104.2
2184				98.7	99.7	100.7	101.9	103.1	104.2	105.2
2235					100.7	101.9	103.1	104.2	105.2	106.4
2286						103.1	104.2	105.2	106.4	107.7
2337							105.2	106.4	107.7	108.8
2388								107.7	108.8	110.0
2438									110.0	111.0
2489										112.4

NOTES: Weights include allowance for laps and seams.
Refer to page N10m for different thickness weight conversions.

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DUCT WEIGHTS (continued)

GALVANIZED ROUND DUCT
30 to 24 Gage - Sizes 3" to 84"
(lbs. / foot)

Dia. (in)	30 Gage Seam Gage Spiral	30 Gage Seam Gage Long.	28 Gage Seam Gage Spiral	28 Gage Seam Gage Long.	26 Gage Seam Gage Spiral	26 Gage Seam Gage Long.	24 Gage Seam Gage Spiral	24 Gage Seam Gage Long.
3	0.6	0.60	0.7	0.71	0.9	0.82	1.0	1.05
4	0.8	0.77	0.9	0.92	1.2	1.06	1.3	1.60
5	0.9	0.94	1.1	1.12	1.4	1.30	1.6	1.66
6	1.1	1.11	1.4	1.32	1.7	4.54	2.0	1.96
7	1.3	1.28	1.6	1.53	1.9	1.77	2.4	2.26
8	1.5	1.46	1.9	1.73	2.1	2.01	2.6	2.57
9	1.6	1.63	2.0	1.94	2.3	2.25	3.0	2.87
10	1.9	1.80	2.2	2.14	2.5	2.48	3.3	3.17
11	2.0	1.97	2.4	2.35	2.8	2.72	3.6	3.48
12	2.2	2.14	2.6	2.55	3.0	2.96	3.8	3.78
14		2.49	3.0	2.96	3.5	3.43	4.4	4.38
16		2.83	3.4	3.37	4.0	3.91	5.1	4.99
18		3.18	3.8	3.78	4.4	4.38	5.7	5.59
20			4.2	4.19	5.0	4.86	6.4	6.20
22			4.7	4.60	5.4	5.33	7.0	6.80
24			5.2	5.01	6.0	5.80	7.8	7.41
26					6.6	6.28	8.5	8.02
28					7.0	6.75	8.9	8.62
30					7.1	7.23	9.3	9.23
32						7.70	10.1	9.83
34						8.18		10.44
36						8.65	11.5	11.05
40						9.60	12.8	12.26
44						10.55	14.4	13.47
48						11.50	15.4	14.68
50							16.0	15.28
54								16.50
56								17.10
60								18.31
72								21.95
84								25.58

NOTES: Weights include allowance for laps and seams.
Refer to page N10 for different gage weight conversions.

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FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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DUCT WEIGHTS (continued)

GALVANIZED ROUND DUCT
0.30 to 0.61 mm Thick - Sizes 76 mm to 2134 mm Diameter
(kg / m)

Dia. (in)	0.30mm Seam Gage Spiral	0.30mm Seam Gage Long.	0.38mm Seam Gage Spiral	0.38mm Seam Gage Long.	0.45mm Seam Gage Spiral	0.45mm Seam Gage Long.	0.61mm Seam Gage Spiral	0.61mm Seam Gage Long.
76	0.9	0.89	1.0	1.06	1.3	1.22	1.5	1.56
102	1.2	1.15	1.3	1.37	1.8	1.58	1.9	2.38
127	1.3	1.40	1.6	1.67	2.1	1.93	2.4	2.47
152	1.6	1.65	2.1	1.96	2.5	6.76	3.0	2.92
178	1.9	1.90	2.4	2.28	2.8	2.63	3.6	3.36
203	2.2	2.17	2.8	2.57	3.1	2.99	3.9	3.82
229	2.4	2.43	3.0	2.89	3.4	3.35	4.5	4.27
254	2.8	2.68	3.3	3.18	3.7	3.69	4.9	4.72
279	3.0	2.93	3.9	3.50	4.2	4.05	5.4	5.18
305	3.3	3.18	3.9	3.79	4.5	4.40	5.7	5.63
356		3.71	4.5	4.40	5.2	5.10	6.5	6.52
406		4.21	5.1	5.01	6.0	5.82	7.6	7.43
457		4.73	5.7	5.63	6.5	6.52	8.5	8.32
508			6.3	6.24	7.4	7.23	9.5	9.23
559			7.0	6.85	8.0	7.93	10.4	10.1
610			7.7	7.46	8.9	8.63	11.6	11.0
660					9.8	9.34	12.6	11.9
711					10.4	10.0	13.2	12.8
762					10.6	10.8	13.8	13.7
813						11.5	15.0	14.6
864						12.2		15.5
914						12.9	17.1	16.4
1016						14.3	19.0	18.2
1118						15.7	21.4	20.0
1219						17.1	22.9	21.8
1270							23.8	22.7
1372								24.6
1422								25.4
1524								27.2
1829								32.7
2134								38.1

NOTES: Weights include allowance for laps and seams.
Refer to page N10m for different gage weight conversions.

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DUCT WEIGHTS (continued)

GALVANIZED ROUND DUCT
22 to 16 Gage - Sizes 3" to 84" Diameter
(lbs. / foot)

Dia. (in)	22 Gage Seam Gage Spiral	22 Gage Seam Gage Long.	20 Gage Seam Gage Spiral	20 Gage Seam Gage Long.	18 Gage Seam Gage Spiral	18 Gage Seam Gage Long.	16 Gage Seam Gage Spiral	16 Gage Seam Gage Long.
3	1.2	1.28	1.3	1.51	2.0	1.97		2.42
4	1.5	1.65	1.8	1.94	2.6	2.53		3.12
5	2.0	2.02	2.3	2.38	3.2	3.10		3.81
6	2.4	2.39	2.6	2.81	3.7	3.66	5.0	4.51
7	2.8	2.75	3.3	3.24	4.3	4.23	5.8	5.20
8	3.2	3.12	3.7	3.68	4.8	4.79	6.7	5.90
9	3.5	3.49	4.0	4.11	5.3	5.36	7.5	6.60
10	4.0	3.86	4.7	4.54	6.0	5.92	8.3	7.29
11	4.4	4.23	5.1	4.98	6.7	6.49	9.1	7.98
12	4.7	4.60	5.2	5.41	7.2	7.05	10.0	8.68
14	5.4	5.33	6.4	6.28	8.3	8.19	11.7	10.8
16	6.2	6.07	7.3	7.15	9.4	9.32	13.4	11.47
18	6.9	6.80	8.1	8.01	10.5	10.45	15.0	12.86
20	7.8	7.54	9.0	8.88	11.7	11.58	16.7	14.25
22	8.4	8.28	9.9	9.75	12.9	12.71	18.4	15.84
24	9.5	9.01	11.0	10.83	14.4	13.84	20.0	17.04
26	10.3	9.75	12.2	11.48	15.8	14.97	21.7	18.43
28	11.0	10.49	12.9	12.35	16.5	16.10	23.4	19.82
30	11.8	11.22	13.6	13.22	17.2	17.23	25.0	21.21
32	12.6	11.96	14.6	14.09	18.9	18.36	26.7	22.60
34		12.70		14.95		19.49		24.00
36	14.2	13.43	16.6	15.82	21.5	20.62	30.0	25.38
40	15.5	14.91	18.5	17.56	23.8	22.88	33.4	28.17
44	17.4	16.38	20.5	19.29	26.7	25.15	36.7	30.96
48	18.7	17.85	22.2	21.03	29.2	27.41	40.1	33.74
50	19.5	18.59	23.3	21.89	30.0	28.54	41.7	35.13
54		20.06		23.63		30.80	45.1	37.91
56		20.79		24.50		31.93	46.7	39.31
60		22.27		26.23		34.19	50.1	42.09
72		26.69		31.44		40.98		50.44
84		31.11		36.64		47.76		58.79

NOTES: Weights include allowance for laps and seams.
Refer to page N10 for different gage weight conversions.

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FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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DUCT WEIGHTS (continued)

GALVANIZED ROUND DUCT
0.76 to 1.52 mm Thick - Sizes 76 mm to 2134 mm Diameter
(kg / m)

Dia. (mm)	0.76mm Seam Gage Spiral	0.76mm Seam Gage Long.	0.91mm Seam Gage Spiral	0.91mm Seam Gage Long.	1.21mm Seam Gage Spiral	1.21mm Seam Gage Long.	1.52mm Seam Gage Spiral	1.52mm Seam Gage Long.
76	1.8	1.90	1.9	2.25	3.0	2.93		3.60
102	2.2	2.46	2.7	2.89	3.9	3.77		4.64
127	3.0	3.01	3.4	3.54	4.8	4.61		5.67
152	3.6	3.56	3.9	4.18	5.5	5.45	7.4	6.71
178	4.2	4.09	4.9	4.82	6.4	6.29	8.6	7.74
203	4.8	4.64	5.5	5.48	7.1	7.13	10.0	8.78
229	5.2	5.19	6.0	6.12	7.9	7.98	11.2	9.82
254	6.0	5.74	7.0	6.76	8.9	8.81	12.4	10.85
279	6.5	6.29	7.6	7.41	10.0	9.66	13.5	11.88
305	7.0	6.85	7.7	8.05	10.7	10.49	15.0	12.92
356	8.0	7.93	9.5	9.35	12.4	12.19	17.4	15.00
406	9.2	9.03	10.9	10.64	14.0	13.87	19.9	17.07
457	10.3	10.12	12.1	11.92	15.6	15.55	22.3	19.14
508	11.6	11.22	13.4	13.21	17.4	17.23	24.9	21.21
559	12.5	12.32	14.7	14.51	19.2	18.91	27.4	23.57
610	14.1	13.41	16.4	16.12	21.4	20.60	30.0	25.36
660	15.3	14.51	18.2	17.08	23.5	22.28	32.3	27.43
711	16.4	15.61	19.2	18.38	24.6	23.96	34.8	29.50
762	17.6	16.70	20.2	19.67	25.6	25.64	37.2	31.56
813	18.8	17.80	21.7	20.97	28.1	27.32	39.7	33.63
864		18.90		22.25		29.00		35.72
914	21.1	19.99	24.7	23.54	32.0	30.69	44.6	37.77
1016	23.1	22.19	27.5	26.13	35.4	34.05	49.7	41.92
1118	25.9	24.38	30.5	28.71	39.7	37.43	54.6	46.07
1219	27.8	26.56	33.0	31.30	43.5	40.79	59.7	50.21
1270	29.0	27.66	34.7	32.58	44.6	42.47	62.1	52.28
1372		29.85		35.17		45.84	67.1	56.42
1422		30.94		36.46		47.52	69.5	58.50
1524		33.14		39.03		50.88	74.6	62.64
1829		39.72		46.79		60.98		75.06
2134		46.30		54.53		71.07		87.49

NOTES: Weights include allowance for laps and seams.
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OPA-0349 August 5, 2002

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DUCT WEIGHTS (continued)

GALVANIZED SHEET METAL CONVERSION CHARTS

Table A - Converting Lighter Gages to Heavier Gages

Gage	26	24	22	20	18	16
28	1.16	1.48	1.85	2.12	2.76	3.40
26		1.27	1.55	1.83	2.38	2.93
24			1.22	1.43	1.87	2.30
22				1.18	1.53	1.89
20					1.30	1.60
18						1.23

Table B - Converting Heavier Gages to Lighter Gages

Gage	26	24	22	20	18	16
28	0.86	0.67	0.55	0.47	0.36	0.29
26		0.78	0.65	0.55	0.42	0.34
24			0.82	0.70	0.53	0.43
22				0.85	0.65	0.53
20					0.77	0.63
18						0.81

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DUCT WEIGHTS (continued)

GALVANIZED SHEET METAL CONVERSION CHARTS

Table A - Converting to Thicker Sheet Metal Duct

Thick (mm)	0.45	0.61	0.76	0.91	1.21	1.52
0.38	1.16	1.48	1.85	2.12	2.76	3.40
0.45		1.27	1.55	1.83	2.38	2.93
0.61			1.22	1.43	1.87	2.30
0.76				1.18	1.53	1.89
0.91					1.30	1.60
1.21						1.23

Table B - Converting to Thinner Sheet Metal Duct

Thick (mm)	0.45	0.61	0.76	0.91	1.21	1.52
0.38	0.86	0.67	0.55	0.47	0.36	0.29
0.45		0.78	0.65	0.55	0.42	0.34
0.61			0.82	0.70	0.53	0.43
0.76				0.85	0.65	0.53
0.91					0.77	0.63
1.21						0.81

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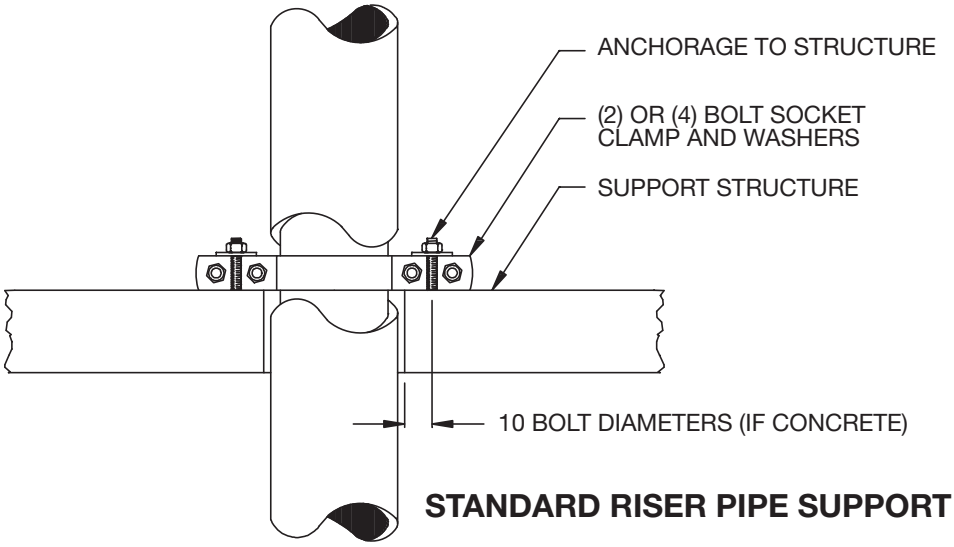
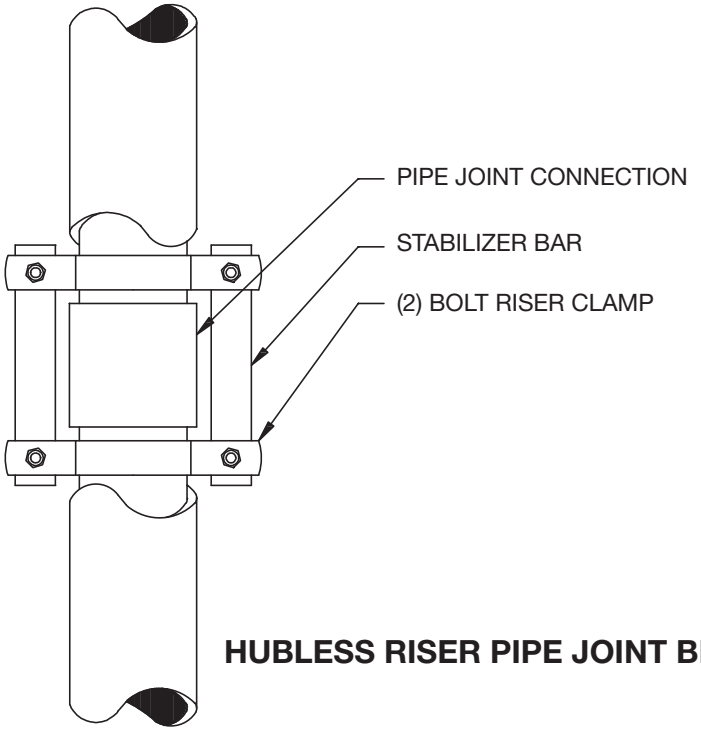
RISER PIPING



STANDARD RISER PIPE SUPPORT



HUBLESS RISER PIPE JOINT BRACE

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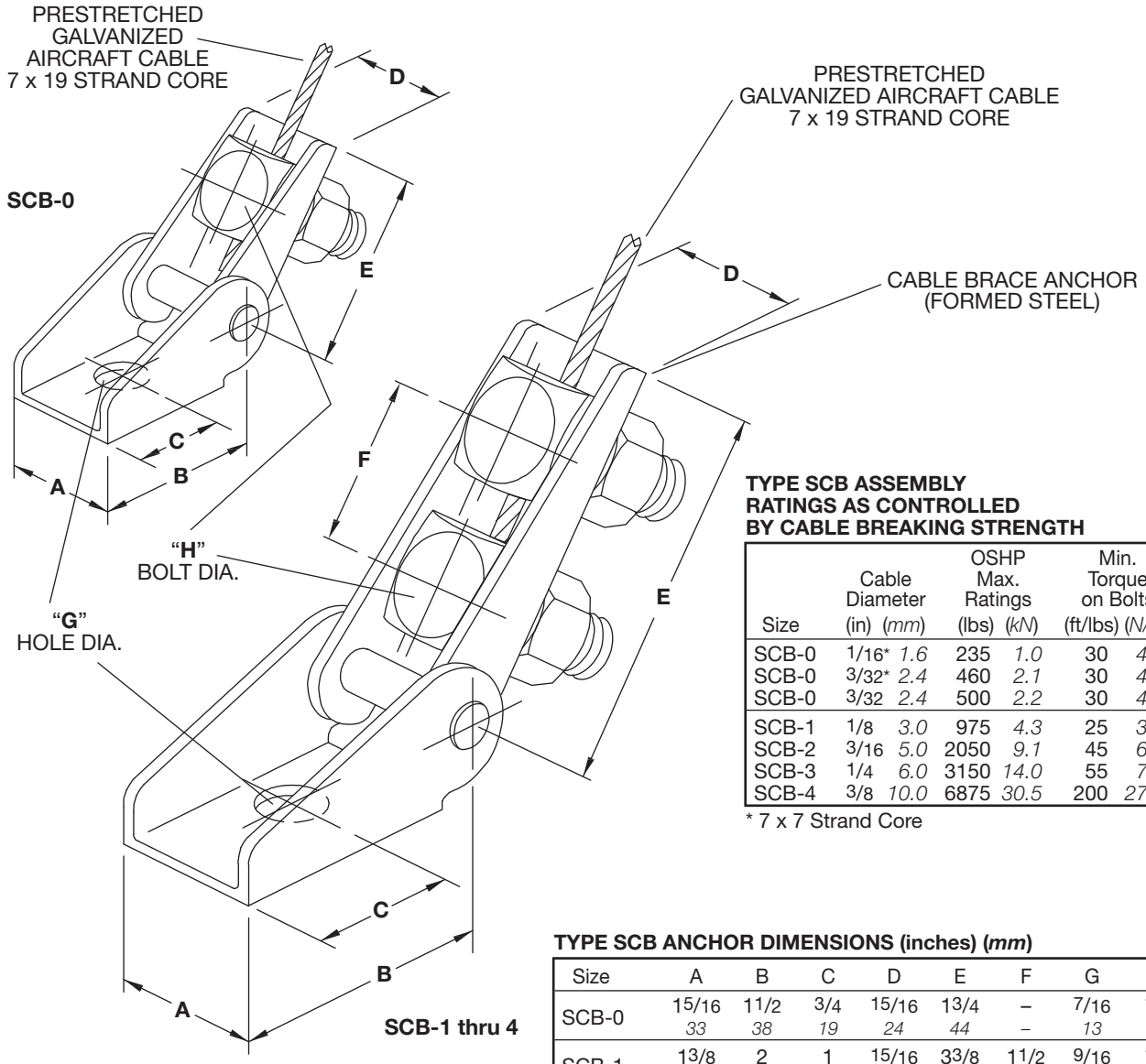
SCB - SEISMIC CABLE BRACE



TYPE SCB ASSEMBLY RATINGS AS CONTROLLED BY CABLE BREAKING STRENGTH

Size	Cable Diameter (in)	(*mm*)	OSHP Max. Ratings (lbs)	(*kN*)	Min. Torque on Bolts (ft/lbs)	(*N/m*)
SCB-0	1/16*	*1.6*	235	*1.0*	30	*41*
SCB-0	3/32*	*2.4*	460	*2.1*	30	*41*
SCB-0	3/32	*2.4*	500	*2.2*	30	*41*
SCB-1	1/8	*3.0*	975	*4.3*	25	*34*
SCB-2	3/16	*5.0*	2050	*9.1*	45	*61*
SCB-3	1/4	*6.0*	3150	*14.0*	55	*75*
SCB-4	3/8	*10.0*	6875	*30.5*	200	*271*

* 7 x 7 Strand Core

TYPE SCB ANCHOR DIMENSIONS (inches) (*mm*)

Size	A	B	C	D	E	F	G	H
SCB-0	15/16 *33*	1 1/2 *38*	3/4 *19*	15/16 *24*	1 3/4 *44*	– *–*	7/16 *13*	1/2 *13*
SCB-1	1 3/8 *35*	2 *51*	1 *25*	15/16 *24*	3 3/8 *86*	1 1/2 *38*	9/16 *14*	1/2 *13*
SCB-2	1 5/8 *41*	2 3/4 *70*	1 3/8 *35*	1 3/16 *30*	4 3/8 *111*	1 3/4 *45*	11/16 *17*	5/8 *16*
SCB-3	2 *51*	3 1/2 *89*	1 3/4 *45*	1 7/16 *37*	4 3/4 *121*	2 *51*	1 3/16 *21*	3/4 *19*
SCB-4	3 1/8 *79*	5 *127*	2 1/2 *64*	1 15/16 *49*	5 3/4 *146*	2 1/4 *57*	15/16 *33*	1 *25*

NOTE: Bracket Material is A36 Steel

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Fixed Equipment Anchorage
Office of Statewide Health Planning and Development

OPA-0349
on
December 22, 2006

Anthony R. Pike
Anthony R. Pike **(916) 654-3362**

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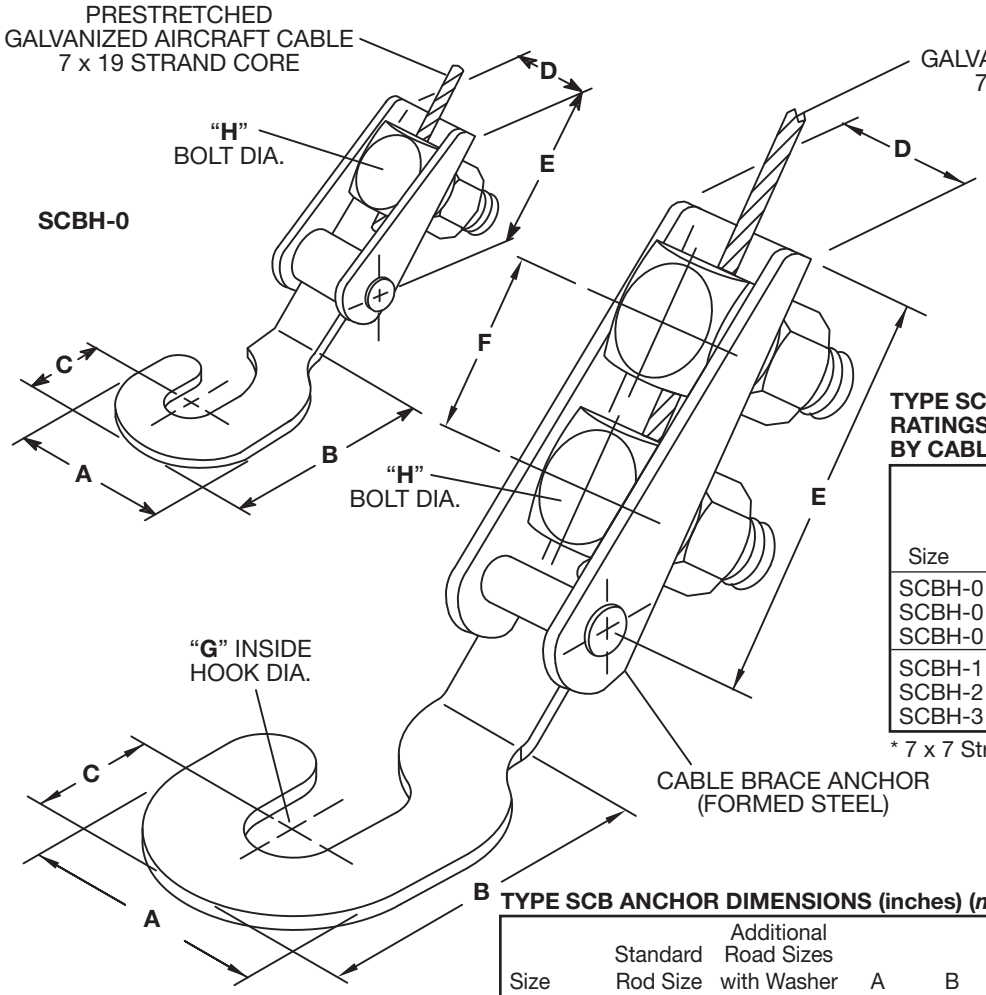
Page
X1

SCBH - SEISMIC CABLE BRACE WITH HOOK ATTACHMENT



SCBH-1 thru 3

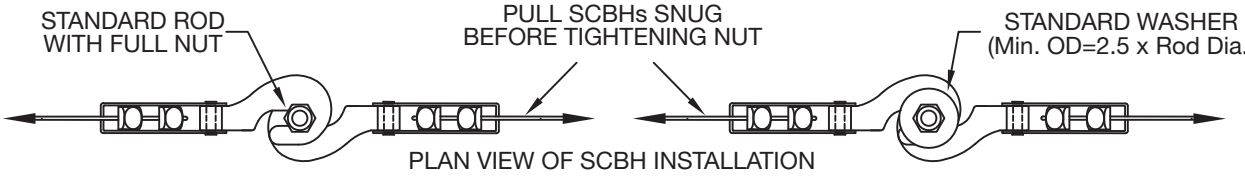
TYPE SCBH ASSEMBLY RATINGS AS CONTROLLED BY CABLE BREAKING STRENGTH

Size	Cable Diameter (in)	(*mm*)	OSHPD Max. Ratings (lbs)	(*kN*)	Min. Torque on Bolts (ft/lbs)	(*N/m*)
SCBH-0	1/16*	*1.6*	235	*1.0*	30	*41*
SCBH-0	3/32*	*2.4*	460	*2.1*	30	*41*
SCBH-0	3/32	*2.4*	500	*2.2*	30	*41*
SCBH-1	1/8	*3.0*	975	*4.3*	25	*34*
SCBH-2	3/16	*5.0*	2050	*9.1*	45	*61*
SCBH-3	1/4	*6.0*	3150	*14.0*	55	*75*

* 7 x 7 Strand Core

TYPE SCB ANCHOR DIMENSIONS (inches) (*mm*)

Size	Standard Rod Size	Additional Road Sizes with Washer	A	B	C	D	E	F	G	H
SCBH-0	3/8	1/4	13/8	21/16	11/16	15/16	13/4	–	3/8	1/2
	10	*6*	*35*	*52*	*18*	*24*	*45*	*–*	*10*	*13*
SCBH-1	5/8	3/8 – 1/2	17/8	23/8	1	1	33/8	11/2	5/8	1/2
	16	*10 - 13*	*48*	*60*	*25*	*25*	*86*	*38*	*16*	*13*
SCBH-2	7/8	1/2 – 3/4	27/8	33/4	13/8	13/16	43/8	13/4	7/8	5/8
	22	*13 - 19*	*73*	*95*	*35*	*30*	*111*	*45*	*22*	*16*
SCBH-3	11/8	5/8 – 1	31/2	43/4	13/4	17/16	43/4	2	11/8	3/4
	29	*16 - 25*	*89*	*121*	*44*	*37*	*121*	*51*	*29*	*19*



PLAN VIEW OF SCBH INSTALLATION

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Office of Statewide Health Planning and Development

OPA-0349
on
December 22, 2006

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Page **X2**

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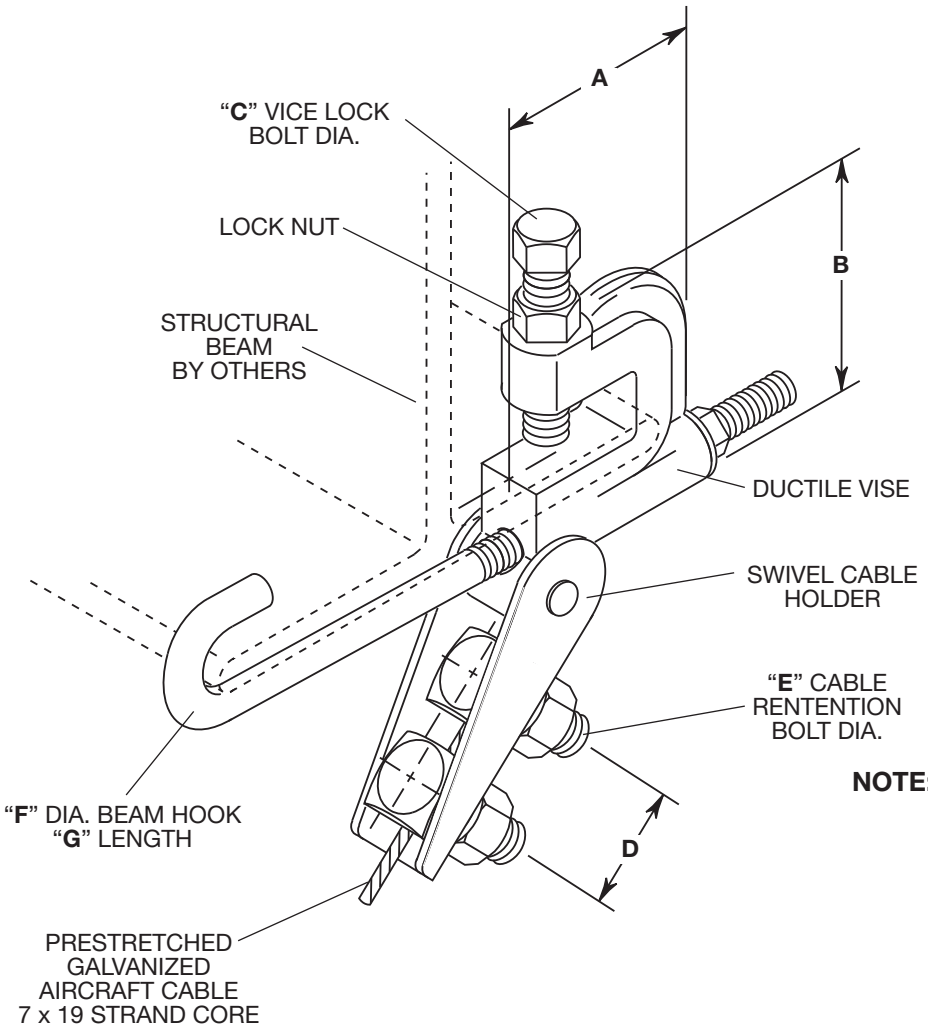
SCBV - SEISMIC CABLE BRACE WITH BEAM CLAMP ATTACHMENT



TYPE SCBV ASSEMBLY RATINGS AS CONTROLLED BY CABLE BREAKING STRENGTH

Size	Cable Diameter (in)	(*mm*)	OSHPD Max. Ratings (lbs)	(*kN*)	Min. Torque on Bolts (ft/lbs)	(*N/m*)
SCBV-1	1/8	*3.0*	975	*4.3*	25	*34*
SCBV-2	3/16	*5.0*	2050	*9.1*	45	*61*
SCBV-3	1/4	*6.0*	3150	*14.0*	55	*75*

NOTE: Not to be used as a vertical hanger for equipment, ductwork or piping. To be used as a seismic restraint only.
The structural engineer of record must check the structural steel for the seismic loads from the seismic restraint system.

TYPE SCBV ANCHOR DIMENSIONS (inches) (*mm*)

Size	Width	VICE JAW Clearance	Depth	A	B	C	D	E	F	G	Beam Flange Width Range
SCBV-1	17/8 *48*	23/8 *60*	7/16 *11*	17/8 *48*	23/8 *60*	7/16 *11*	11/2 *38*	1/2 *13*	3/8 *10*	10 *254*	31/2 - 81/2 *89 - 216*
SCBV-2	27/8 *73*	3 *76*	1/2 *13*	27/8 *73*	3 *76*	1/2 *13*	13/4 *44*	5/8 *16*	3/8 *10*	12 *305*	31/2 - 10 *89 - 254*
SCBV-3	33/8 *86*	33/4 *95*	5/8 *16*	33/8 *86*	33/4 *95*	5/8 *16*	2 *51*	3/4 *19*	1/2 *13*	12 *305*	4 - 91/2 *102 - 241*

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FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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Page **X3**

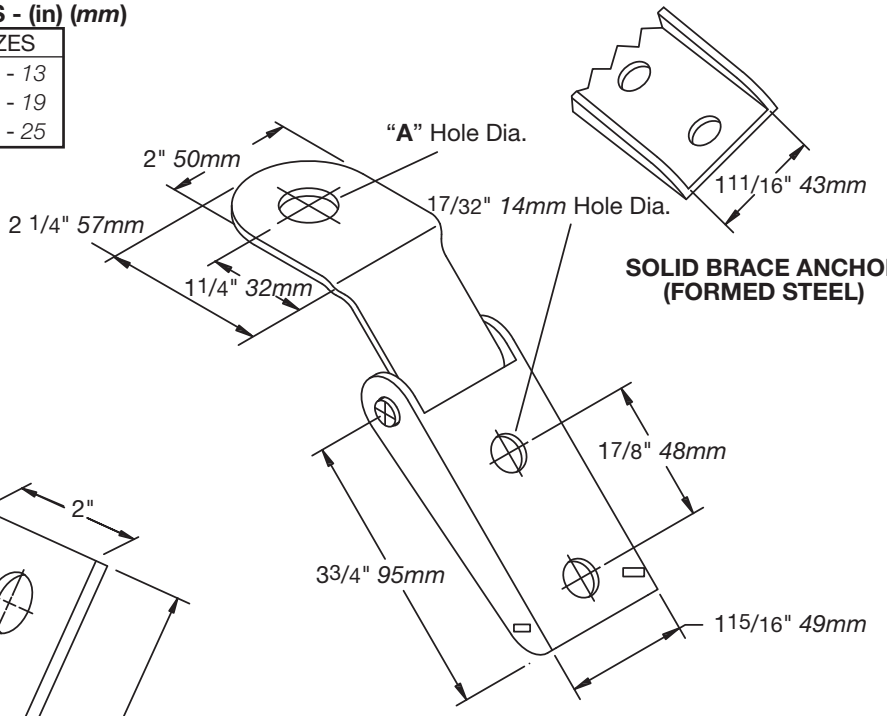
SSB(U) & SSBS - SEISMIC SOLID BRACE

TYPE SSBS ANCHORS DIMENSIONS - (in) (*mm*)

SIZE	A		FOR ROD SIZES	
SSBS-12	17/32	*13*	3/8 - 1/2	*9 - 13*
SSBS-20	25/32	*20*	5/8 - 3/4	*16 - 19*
SSBS-25	11/32	*26*	7/8 - 1	*22 - 25*

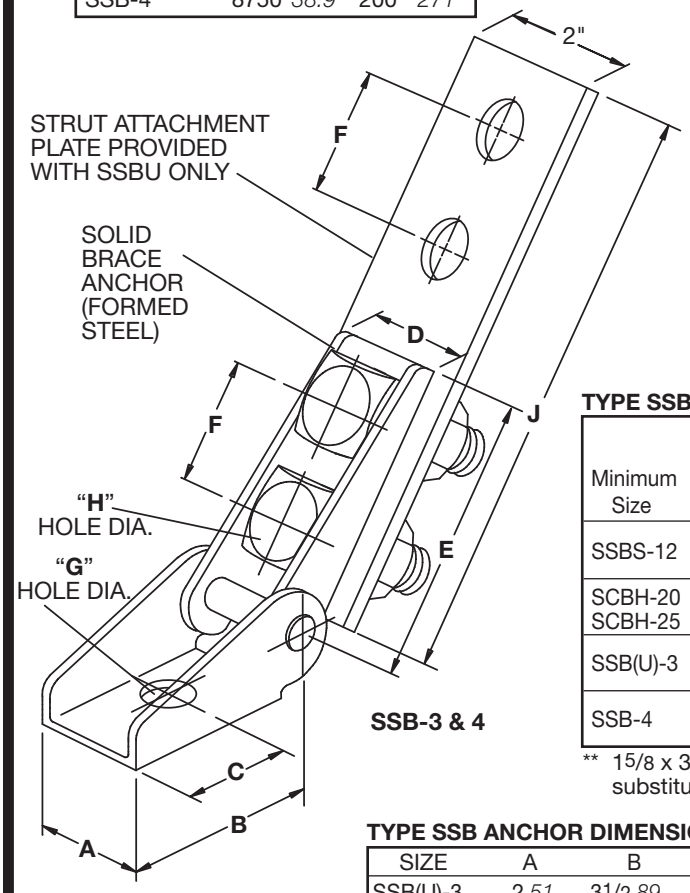
TYPE SSB(U) & SSBS ANCHOR RATINGS

Size	OSHPD Max. Ratings (lbs)	(*kN*)	Min. Torque on Bolts (ft/lbs)	(*N/m*)
SSBS-12	1250	*5.6*	50	*68*
SSBS-20, 25	3000	*13.4*	50	*68*
SSBS(U)-3	5000	*22.2*	55	*68*
SSB-4	8750	*38.9*	200	*271*



SOLID BRACE ANCHOR (FORMED STEEL)

SSBS-12, 20 & 25



SSB-3 & 4

TYPE SSB & SSBS ANCHOR RATINGS WITH STEEL BRACE MEMBERS

Minimum Size	OSHPD Max. Ratings (lbs)	(*kN*)	Minimum Steel Brace Member - (in) (*mm*) at Maximum Brace Length 5' - 0" *1.5m*	9' - 6" *2.9m*	14' - 6" *4.4m*
SSBS-12	1250	*5.6*	15/8 x 15/8 Strut 41 x 41 Strut	15/8 x 15/8 Strut 41 x 41 Strut	15/8 x 31/4 Strut 41 x 83 Strut
SCBH-20 SCBH-25	3000	*13.4*	15/8 x 15/8 Strut 41 x 41 Strut	15/8 x 31/4 Strut 41 x 83 Strut	N/A
SSB(U)-3	5000	*22.3*	2 x 2 x 1/4 Angle** 51 x 51 x 6 Angle**	3 x 3 x 1/4 Angle** 76 x 76 x 6 Angle**	4 x 4 x 1/4 Angle 102 x 102 x 6 Angle
SSB-4	8125	*36.1*	3 x 3 x 1/4 Angle 76 x 76 x 6 Angle	5 x 5 x 1/4 Angle 102 x 102 x 6 Angle	5 x 5 x 3/8 Angle 127 x 127 x 10 Angle

** 15/8 x 33/4 x 12ga *41 mm x 83 mm x 2.7 mm* formed strut may be substituted using the Type SSBU component.

TYPE SSB ANCHOR DIMENSIONS (inches) (*mm*)

SIZE	A	B	C	D	E	F	G	H	J
SSB(U)-3	2 *51*	31/2 *89*	13/4 *44*	17/16 *37*	43/4 *121*	2 *51*	13/16 *21*	3/4 *19*	9 *229*
SSB-4	31/8 *79*	5 *127*	21/2 *64*	115/16 *49*	53/4 *146*	21/4 *57*	15/16 *33*	1 *25*	———

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FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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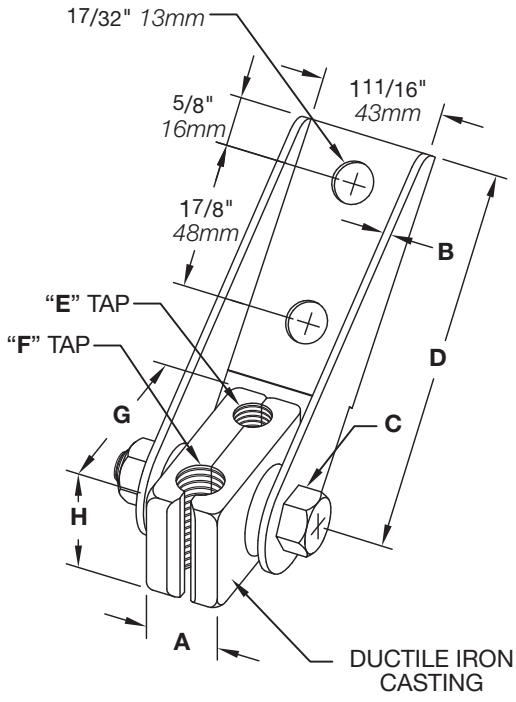
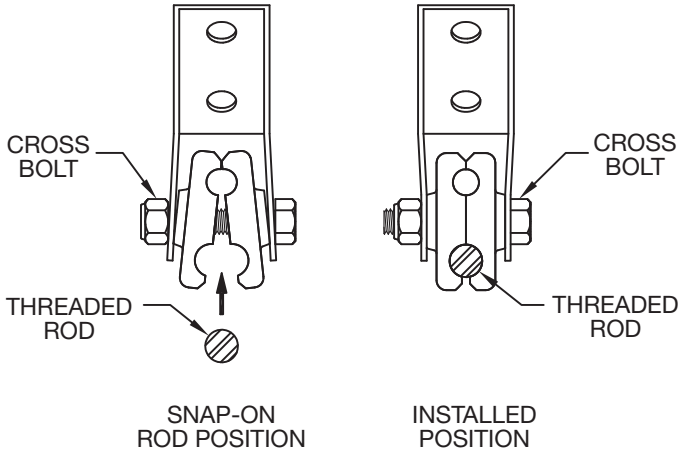
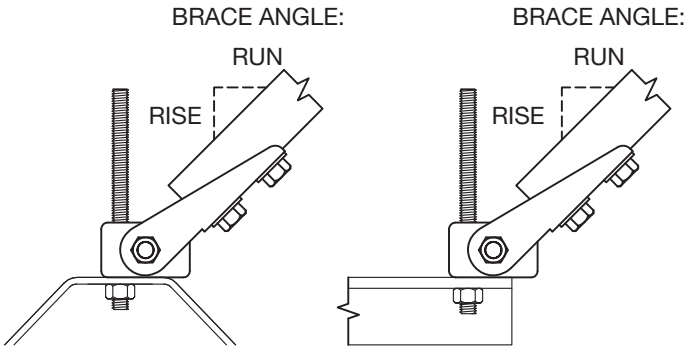
SSRF - SEISMIC SOLID RETROFIT BRACE





INSTALLATION PROCEDURE



INSTALL SSRF TIGHT TO CLEVIS OR TRAPEZE MEMBER

TORQUE NUT ON THREADED ROD AND STRUT NUTS PER H15

TYPE SSRF ASSEMBLY RATING

Size	Rod Size (in)	Allowable Load at 45° (lbs)	(*kg*)	Cross Bolt Torque (ft/lbs)	(*N/m*)
SSRF-1	3/8	820	*372*	20	*27*
	1/2	1460	*662*		
SSRF-2	5/8	2080	*943*	49	*66*
	3/4	2500	*1137*		

TYPE SSRF ANCHOR DIMENSIONS (inches) (*mm*)

SIZE	A	B	C	D	E	F	G	H
SSRF-1	3/4 *19*	1/8 *3*	3/8-16 UNC x 21/2	45/8 *117*	3/8-16 UNC	1/2-13 UNC	2 *51*	11/4 *32*
SSRF-2	11/8 *28*	1/8 *3*	1/2-13 UNC x 21/2	5 *127*	5/8-11 UNC	3/4-10 UNC	25/8 *67*	15/8 *41*

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Fixed Equipment Anchorage
Office of Statewide Health Planning and Development

OPA-0349
on
January 16, 2009

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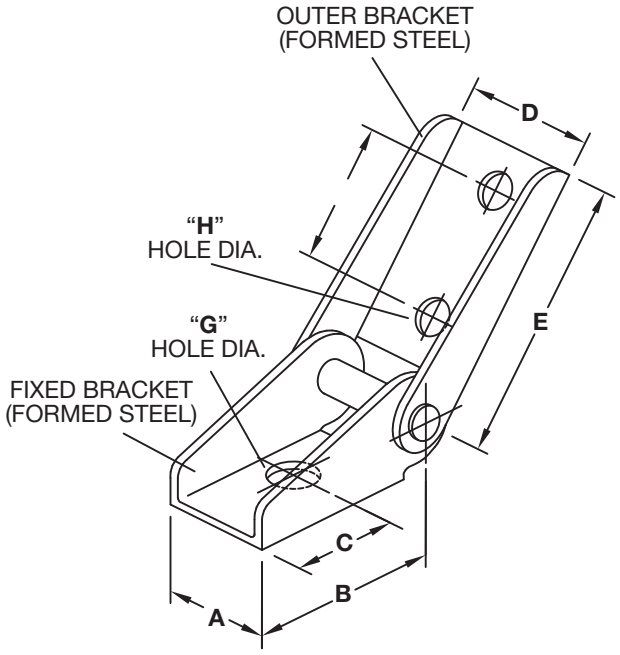
SSB-1 & SSB-2 - SEISMIC SOLID BRACE

TYPE SSB ANCHOR RATINGS

Size	OSHPD Maximum Ratings (lbs)	(*kN*)	Brace Attachment Bolt Size (in)	(*mm*)	Minimum Torque on Bolts (ft/lbs)	(*N/m*)
SSB-1	1500	*6.7*	1/2	*13*	50	*68*
SSB-2	3000	*13.4*	1/2	*13*	50	*68*



SSB-1, 2

TYPE SSB MATERIALS

Size	Fixed Bracket Thickness (in)	(*Gauge*)	Outer Bracket Thickness (in)	(*Gauge*)	Brace Pin Diameter (in)	(*mm*)
SSB-1	0.092	*13*	0.120	*11*	3/8	*10*
SSB-2	0.135	*10*	0.120	*11*	3/8	*10*

TYPE SSB ANCHOR DIMENSIONS (inches) (*mm*)

SIZE	A		B		C		D		E		F		G		H	
SSB-1	13/8	*35*	2	*51*	1	*25*	115/16	*49*	33/4	*95*	17/8	*48*	9/16	*14*	17/32	*14*
SSB-2	15/8	*41*	23/4	*70*	13/8	*35*	115/16	*49*	33/4	*95*	17/8	*48*	11/16	*17*	17/32	*14*

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OPA-0349
on
January 16, 2009

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Page
X4B

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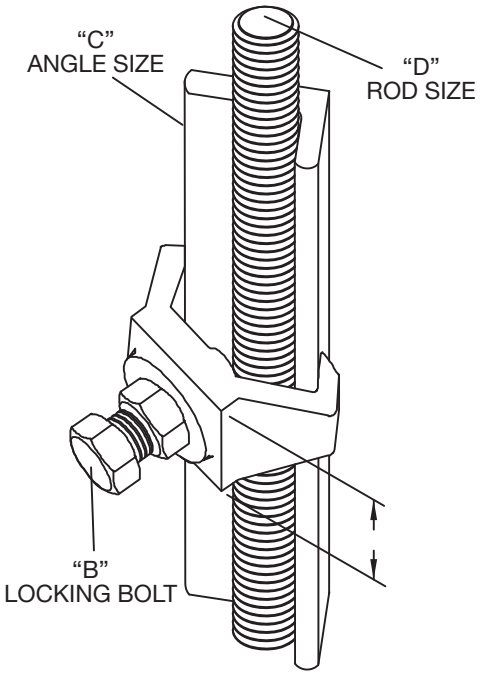
SRC - SEISMIC ROD CLAMP



TYPE SRC WITH STEEL ANGLE ASSEMBLY RATINGS

Rod Size (in)	Rod Size (*mm*)	Maximum Compr. Force (lbs)	Maximum Compr. Force (*kN*)	Steel Angle Stiffener Minimum Size (in)	Steel Angle Stiffener Minimum Size (*mm*)	Steel Angle Stiffener Maximum Length (in)	Steel Angle Stiffener Maximum Length (*mm*)	Maximum SRC Spacing (in)	Maximum SRC Spacing (*mm*)
1/4	*6*	75	*0.3*	1 x 1 x 1/8	*25 x 25 x 3*	96	*2438*	14	*35*
3/8	*10*	425	*1.9*	1 x 1 x 1/8	*25 x 25 x 3*	96	*2438*	22	*559*
1/2	*13*	1275	*5.6*	1 x 1 x 1/8	*25 x 25 x 3*	96	*2438*	31	*787*
		1200	*5.3*	1 1/2 x 1 1/2 x 1/4	*38 x 38 x 6*	120	*3048*	31	*787*
5/8	*16*	1475	*6.5*	1 x 1 x 1/8	*25 x 25 x 3*	96	*2438*	39	*991*
		1325	*5.9*	1 1/2 x 1 1/2 x 1/4	*38 x 38 x 6*	120	*3048*	39	*991*
3/4	*19*	2500	*11.1*	1 1/2 x 1 1/2 x 1/4	*38 x 38 x 6*	144	*3658*	48	*1212*
7/8	*22*	4600	*20.4*	1 1/2 x 1 1/2 x 1/4	*38 x 38 x 6*	132	*3353*	56	*1422*
		4400	*19.5*	2 x 2 x 1/4	*51 x 51 x 6*	144	*3658*	56	*1422*
1	*25*	5800	*25.8*	1 1/2 x 1 1/2 x 1/4	*38 x 38 x 6*	132	*3353*	65	*1651*
		6900	*30.7*	2 x 2 x 1/4	*51 x 51 x 6*	144	*3658*	65	*1651*
1 1/8	*29*	9600	*42.7*	2 x 2 x 1/4	*51 x 51 x 6*	144	*3658*	73	*1854*
1 1/4	*32*	12000	*53.4*	2 x 2 x 1/4	*51 x 51 x 6*	144	*3658*	82	*2083*

Note: Refer to page G1 for SRC installation details.

TYPE SRC ANCHOR DIMENSIONS (inches) (*mm*)

SIZE	A	A (*mm*)	B	B (*mm*)	C	C (*mm*)	D Acceptable Rod Size	D Acceptable Rod Size (*mm*)
SRC-1	1 3/8	*35*	1/2 x 1 3/4 Long	*13 x 44 Long*	1 x 1 x 1/8	*25 x 25 x 3*	1/4 - 5/8	*6 - 16*
SRC-1 1/2	1 9/16	*40*	5/8 x 2 Long	*16 x 51 Long*	1 1/2 x 1 1/2 x 1/4	*38 x 38 x 6*	1/2 - 1	*13 - 25*
SRC-2	1 3/4	*44*	5/8 x 3 Long	*16 x 76 Long*	2 x 2 x 1/4	*51 x 51 x 6*	7/8 - 1 1/4	*22 - 32*

NOTE: For tightening requirements of bolts, nuts and strut nuts reference H15.

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FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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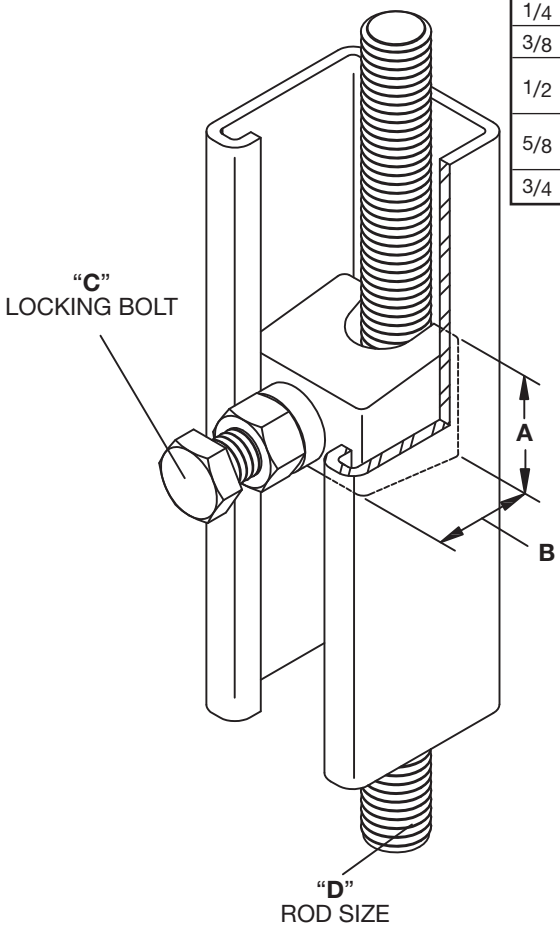
UC - SEISMIC ROD CLAMPS
FOR STRUT CHANNELS



TYPE UC WITH STEEL STRUT ASSEMBLY RATINGS

Rod Size (in)	Rod Size (*mm*)	Maximum Compr. Force (lbs)	Maximum Compr. Force (*kN*)	Steel Angle Stiffener Minimum Size (in)	Steel Angle Stiffener Minimum Size (*mm*)	Steel Angle Stiffener Maximum Length (in)	Steel Angle Stiffener Maximum Length (*mm*)	Maximum SRC Spacing (in)	Maximum SRC Spacing (*mm*)
1/4	*6*	75	*0.3*	15/8 x 15/8 x 12 Gage	*41 x 41 x 2.5*	96	*2438*	14	*356*
3/8	*10*	425	*1.9*	15/8 x 15/8 x 12 Gage	*41 x 41 x 2.5*	96	*2438*	22	*559*
1/2	*13*	1275	*5.6*	15/8 x 15/8 x 12 Gage	*41 x 41 x 2.5*	96	*2438*	31	*787*
		1200	*5.3*	15/8 x 15/8 x 12 Gage	*41 x 41 x 2.5*	120	*3048*	31	*787*
5/8	*16*	1475	*6.5*	15/8 x 15/8 x 12 Gage	*41 x 41 x 2.5*	96	*2438*	39	*991*
		1325	*5.9*	15/8 x 15/8 x 12 Gage	*41 x 41 x 2.5*	120	*3048*	39	*991*
3/4	*19*	2500	*11.1*	15/8 x 15/8 x 12 Gage	*41 x 41 x 2.5*	144	*3658*	48	*1212*

TYPE UC DIMENSIONS (inches) (*mm*)

SIZE	A	B	C	D Acceptable Rod Size
UC-1	1 *25*	11/8 *28*	3/8 -16 UNC	3/8 - 1/2 *10 - 13*
UC-2	11/4 *32*	11/8 *28*	1/2 -13 UNC	5/8 - 3/4 *16 - 19*

NOTE: For tightening requirements of bolts, nuts and strut nuts reference H15.

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OPA-0349 August 5, 2002

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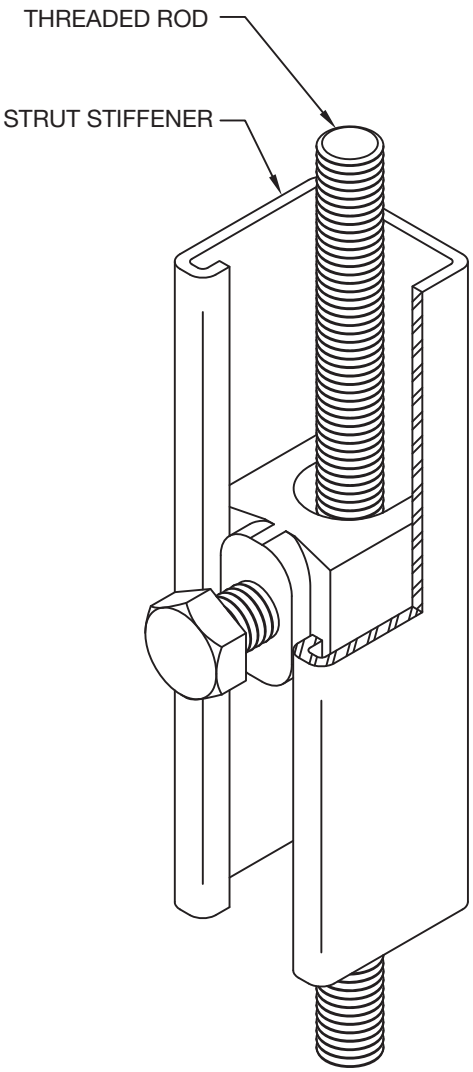
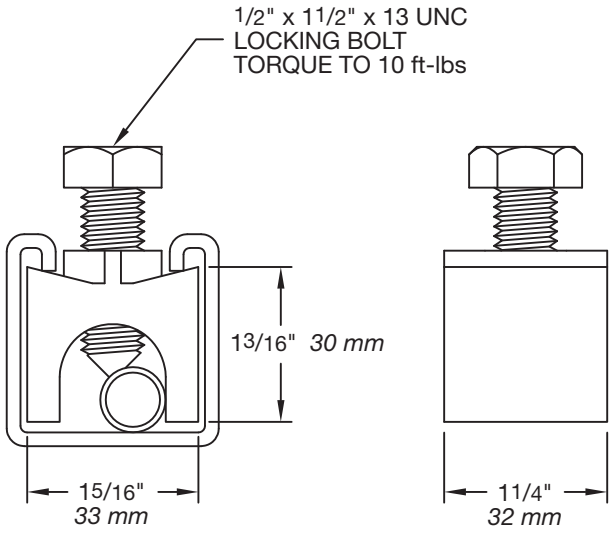
UCC - SEISMIC ROD CLAMPS
FOR STRUT CHANNELS



TYPE UCC WITH STEEL STRUT ASSEMBLY RATINGS

Rod Size (in)	Rod Size (*mm*)	Maximum Compr. Force (lbs)	Maximum Compr. Force (*kN*)	Steel Angle Stiffener Minimum Size (in)	Steel Angle Stiffener Minimum Size (*mm*)	Maximum Length (in)	Maximum Length (*mm*)	Maximum SRC Spacing (in)	Maximum SRC Spacing (*mm*)
3/8	*10*	425	*1.9*	15/8 x 15/8 x 12 Gage	*41 x 41 x 2.5*	96	*2438*	22	*559*
1/2	*13*	1275	*5.6*	15/8 x 15/8 x 12 Gage	*41 x 41 x 2.5*	96	*2438*	31	*787*
		1200	*5.3*	15/8 x 15/8 x 12 Gage	*41 x 41 x 2.5*	120	*3048*	31	*787*
5/8	*16*	1475	*6.5*	15/8 x 15/8 x 12 Gage	*41 x 41 x 2.5*	96	*2438*	39	*991*
		1325	*5.9*	15/8 x 15/8 x 12 Gage	*41 x 41 x 2.5*	120	*3048*	39	*991*
3/4	*19*	2500	*11.1*	15/8 x 15/8 x 12 Gage	*41 x 41 x 2.5*	144	*3658*	48	*1212*



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Fixed Equipment Anchorage
Office of Statewide Health Planning and Development

OPA-0349
on
January 16, 2009

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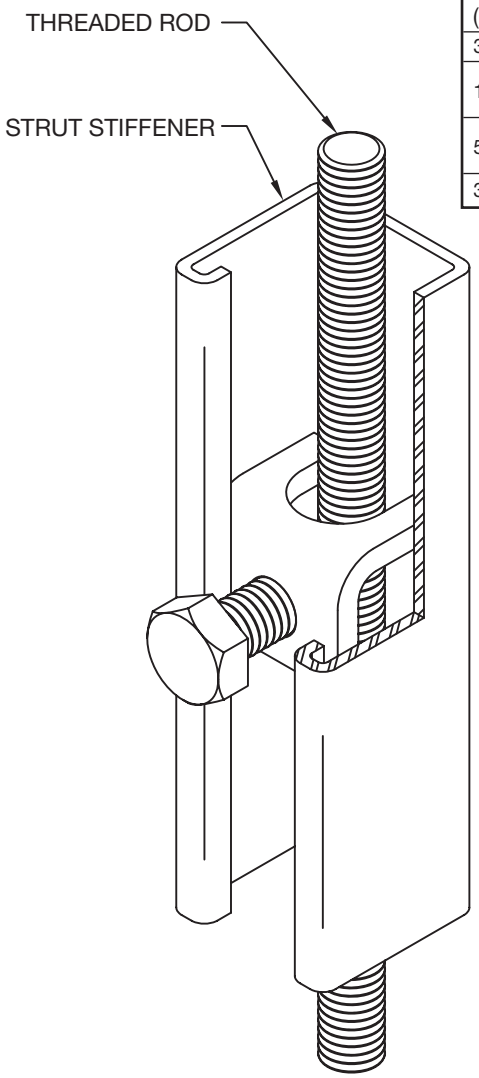
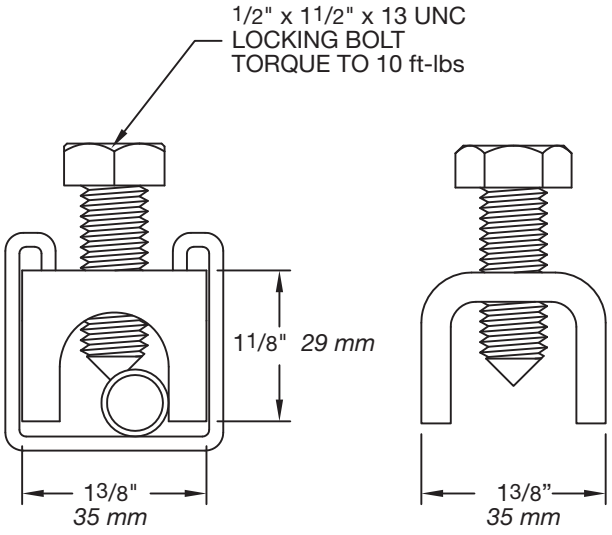
SUSC - STEEL UNIVERSAL STRUT CLAMPS

TYPE SUSC WITH STEEL STRUT ASSEMBLY RATINGS

Rod Size (in)	Rod Size (*mm*)	Maximum Compr. Force (lbs)	Maximum Compr. Force (*kN*)	Steel Angle Stiffener Minimum Size (in)	Steel Angle Stiffener Minimum Size (*mm*)	Maximum Length (in)	Maximum Length (*mm*)	Maximum SRC Spacing (in)	Maximum SRC Spacing (*mm*)
3/8	*10*	425	*1.9*	1 5/8 x 1 5/8 x 12 Gage	*41 x 41 x 2.5*	96	*2438*	22	*559*
1/2	*13*	1275	*5.6*	1 5/8 x 1 5/8 x 12 Gage	*41 x 41 x 2.5*	96	*2438*	31	*787*
		1200	*5.3*	1 5/8 x 1 5/8 x 12 Gage	*41 x 41 x 2.5*	120	*3048*	31	*787*
5/8	*16*	1475	*6.5*	1 5/8 x 1 5/8 x 12 Gage	*41 x 41 x 2.5*	96	*2438*	39	*991*
		1325	*5.9*	1 5/8 x 1 5/8 x 12 Gage	*41 x 41 x 2.5*	120	*3048*	39	*991*
3/4	*19*	2500	*11.1*	1 5/8 x 1 5/8 x 12 Gage	*41 x 41 x 2.5*	144	*3658*	48	*1212*





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OSHPD

APPROVAL

PENDING

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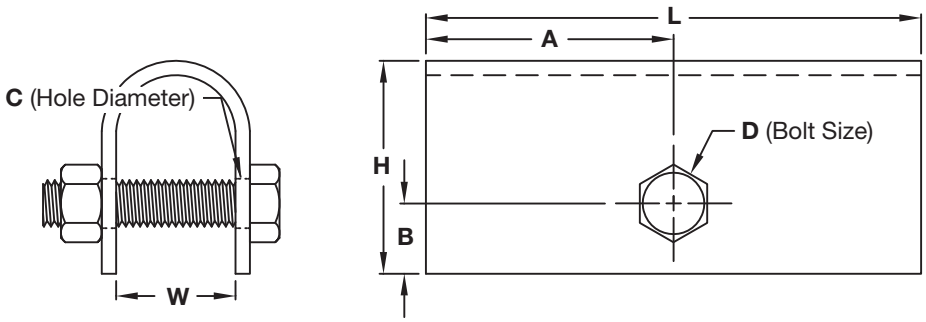
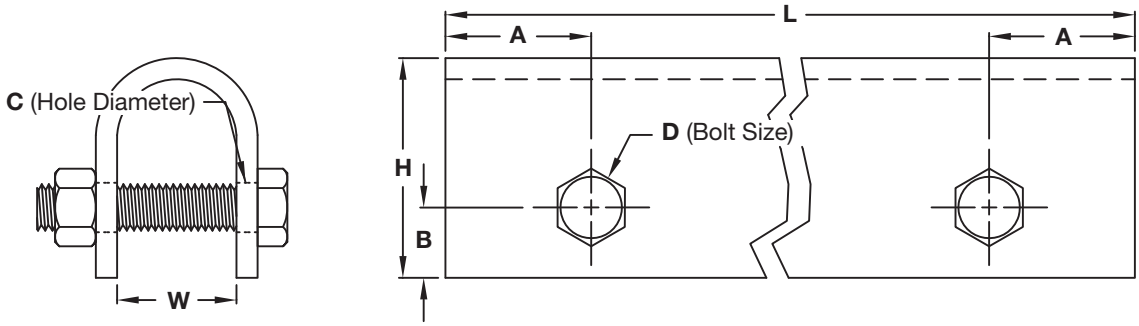
CCB - CLEVIS CROSSBOLT BRACE

(1) BOLT CLEVIS CROSSBOLT BRACE - Clevis Sizes 1 1/2" - 2 1/2" *38 mm - 64 mm*



(2) BOLT CLEVIS CROSSBOLT BRACE - Clevis Sizes 3" - 30" *76mm - 762mm*



CCB DIMENSIONS (inches) (*mm*)

SIZE	L	W	H	A	B	C	D
CCB-1 1/2 *38*	17/8 *48*	1/4 *6*	1 *25*	15/16 *24*	1/2 *13*	7/16 *11*	3/8-16 UNC x 1 1/4 *10-16 UNC x 32*
CCB-2 *51*	2 3/8 *60*	1/4 *6*	1 *25*	1 3/16 *30*	1/2 *13*	7/16 *11*	3/8-16 UNC x 1 1/4 *10-16 UNC x 32*
CCB-2 1/2 *64*	2 7/8 *73*	3/8 *10*	1 1/8 *29*	1 7/16 *37*	1/2 *13*	7/16 *11*	3/8-16 UNC x 1 1/4 *10-16 UNC x 32*
CCB-3 *76*	3 1/2 *89*	3/8 *10*	1 1/8 *29*	3/4 *19*	1/2 *13*	7/16 *11*	3/8-16 UNC x 1 1/4 *10-16 UNC x 32*
CCB-4 *102*	4 1/2 *114*	3/8 *10*	1 1/8 *29*	1 *25*	1/2 *13*	7/16 *11*	3/8-16 UNC x 1 1/4 *10-16 UNC x 32*
CCB-5 *127*	5 9/16 *141*	1/2 *13*	1 5/16 *33*	1 *25*	1/2 *13*	7/16 *11*	3/8-16 UNC x 1 3/4 *10-16 UNC x 44*
CCB-6 *152*	6 5/8 *168*	1/2 *13*	1 5/16 *33*	1 1/2 *25*	1/2 *13*	7/16 *11*	3/8-16 UNC x 1 3/4 *10-16 UNC x 44*
CCB-8 *203*	8 5/8 *219*	5/8 *16*	1 7/16 *37*	2 *51*	1/2 *13*	7/16 *11*	3/8-16 UNC x 1 3/4 *10-16 UNC x 44*
CCB-10 *254*	10 3/4 *273*	3/4 *19*	1 9/16 *40*	2 1/2 *64*	1/2 *13*	7/16 *11*	3/8-16 UNC x 1 3/4 *10-16 UNC x 44*
CCB-12 *305*	12 3/4 *324*	3/4 *19*	1 9/16 *40*	3 1/2 *76*	1/2 *13*	7/16 *11*	3/8-16 UNC x 1 3/4 *10-16 UNC x 44*
CCB-14 *356*	14 *356*	7/8 *22*	1 11/16 *43*	3 1/2 *89*	1/2 *13*	7/16 *11*	3/8-16 UNC x 1 3/4 *10-16 UNC x 44*
CCB-16 *406*	16 *406*	1 *25*	1 7/8 *48*	4 *102*	1/2 *13*	7/16 *11*	3/8-16 UNC x 2 *10-16 UNC x 51*
CCB-18 *457*	18 *457*	1 1/8 *29*	2 *51*	4 1/2 *114*	1/2 *13*	7/16 *11*	3/8-16 UNC x 2 *10-16 UNC x 51*
CCB-20 *508*	20 *508*	1 1/4 *32*	2 1/2 *64*	5 *127*	3/4 *19*	9/16 *14*	1/2-13 UNC x 2 1/2 *13-13 UNC x 64*
CCB-24 *610*	24 *610*	1 1/4 *32*	2 1/2 *64*	6 *152*	3/4 *19*	9/16 *14*	1/2-13 UNC x 2 1/2 *13-13 UNC x 64*
CCB-30 *762*	30 *762*	1 1/4 *32*	2 1/2 *64*	7 1/2 *191*	3/4 *19*	9/16 *14*	1/2-13 UNC x 2 1/2 *13-13 UNC x 64*

NOTE: For tightening requirements of bolts, nuts and strut nuts reference H15.

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California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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EXPANSION ANCHORS

Table 1 - ITW Ramset/Red Head Trubolt Wedge Anchor Ratings into 3000 psi (*20,680 kPa*) Stone Aggregate Concrete, ICBO Report ER-1372, Tables 7, 8 and 9.

Anchor Size (in)	(*mm*)	Installation Torque (ft/lbs)	(*N/m*)	Minimum Anchor Embedment (in)	(*mm*)	Minimum Edge Distance (in)	(*mm*)	Minimum Anchor Spacing (in)	(*mm*)	Standard Tension (lbs)	(*kN*)	Standard Shear (lbs)	(*kN*)	Shear with IR-26-6 Reduction (lbs)	(*kN*)
3/8	*10*	25	*34*	1 1/2	*38*	2 5/8	*67*	5 1/4	*133*	245	*1.1*	615	*2.7*	492	*2.2*
3/8	*10*	25	*34*	3	*76*	3 3/4	*95*	6	*152*	585	*2.6*	1015	*4.5*	812	*3.6*
1/2	*13*	55	*75*	2 1/4	*57*	4	*102*	7 7/8	*200*	610	*2.7*	1190	*5.3*	952	*4.2*
1/2	*13*	55	*75*	4 1/8	*105*	5 1/4	*133*	6 1/4	*159*	890	*3.9*	1810	*8.0*	1448	*6.4*
5/8	*16*	90	*122*	2 3/4	*70*	4 7/8	*124*	9 5/8	*244*	860	*3.8*	1780	*7.9*	1424	*6.3*
5/8	*16*	90	*122*	5 1/8	*130*	6 1/2	*165*	7 3/4	*197*	1340	*6.0*	2685	*11.9*	2148	*9.5*
3/4	*19*	175	*237*	3 1/4	*83*	5 3/4	*146*	11 3/8	*289*	1120	*5.0*	2935	*13.0*	2348	*10.4*
3/4	*19*	175	*237*	6 5/8	*168*	8 3/8	*213*	10	*254*	1790	*8.0*	5500	*24.5*	4400	*19.4*

Table 2 - ITW Ramset/Red Head Trubolt Wedge Anchor Ratings into Lower Flute of Minimum 20 gage (*0.9mm*) Steel Deck with 3000 psi (*20,680 kPa*) Lightweight Concrete Fill, ICBO Report ER-1372, Tables 7, 8 and 14.

Anchor Size (in)	(*mm*)	Installation Torque (ft/lbs)	(*N/m*)	Minimum Anchor Embedment (in)	(*mm*)	Minimum Edge Distance (in)	(*mm*)	Minimum Anchor Spacing (in)	(*mm*)	Standard Tension (lbs)	(*kN*)	Standard Shear (lbs)	(*kN*)	Shear with IR-26-6 Reduction (lbs)	(*kN*)
3/8	*10*	25	*34*	1 1/2	*38*	2 5/8	*67*	5 1/4	*133*	237	*1.1*	790	*3.5*	632	*2.8*
3/8	*10*	25	*34*	3	*76*	3 3/4	*95*	6	*152*	355	*1.6*	1000	*4.4*	800	*3.5*
1/2	*13*	55	*75*	2 1/4	*57*	4	*102*	7 7/8	*200*	425	*1.9*	1345	*6.0*	1076	*4.8*
1/2	*13*	55	*75*	3	*76*	5 1/4	*133*	6 1/4	*159*	560	*2.5*	1655	*7.3*	1324	*5.9*
5/8	*16*	90	*122*	3	*76*	4 7/8	*124*	9 5/8	*245*	590	*2.6*	1375	*6.1*	1100	*4.9*
5/8	*16*	90	*122*	5	*127*	6 1/2	*165*	7 3/4	*197*	822	*3.6*	2285	*10.2*	1828	*8.1*
3/4	*19*	175	*237*	3 1/4	*83*	5 3/4	*146*	11 3/8	*289*	730	*3.2*	2220	*9.8*	1776	*7.9*
3/4	*19*	175	*237*	5 5/8	*133*	8 3/8	*213*	10	*254*	880	*3.9*	n/a		n/a	

NOTES:

Anchors must be installed in compliance with manufacturer's recommendations and the respective ICBO Report including tabulated edge distances and spacings listed above.

For combined tension and shear loads on anchors, use the following equation:

Where:

$$\left(\frac{P_S}{P_T}\right)^{\frac{5}{3}} + \left(\frac{V_S}{V_T}\right)^{\frac{5}{3}} \leq 1$$

Ps, Vs = Applied Loads

Pt, Vt = Allowable Loads

Ratings may not be increased to accommodate periodic loads such as wind or seismic loads.

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California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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EXPANSION ANCHOR TEST VALUES

Anchor Size (in)	(*mm*)	Option 1 Concrete Slab Test Values (lbs)	(*kN*)	Option 2 Concrete Deck Test Values (lbs)	(*kN*)	Torque Test Values (ft/lbs)	(*N/m*)
3/8	*10*	1170	*5.2*	710	*3.2*	25	*34*
1/2	*13*	1780	*7.9*	1120	*5.0*	50	*68*
5/8	*16*	2680	*11.9*	1644	*7.3*	80	*108*
3/4	*19*	3580	*15.9*	1760	*7.8*	150	*203*

NOTES:

1. Anchor diameter refers to the thread size.
2. Apply proof test loads to anchors without removing the nut if possible. If not, remove nut and install a threaded coupler to the same tightness of the original nut using a torque wrench and apply load.
3. Reaction loads from test fixtures may be applied close to the anchor being tested, provided the anchor is not restrained from withdrawing by the fixture(s).
4. Test equipment is to be calibrated by an approved testing laboratory in accordance with standard recognized procedures.
5. Torque testing can occur on an individual basis when test procedures are submitted and approved by the enforcement agency. Tabulated values may be forthcoming once the enforcement agency has more data to evaluate the feasibility of standard torque values.
6. The following criteria apply for the acceptance of installed anchors:

   HYDRAULIC RAM METHOD: The anchor should have no observable movement at the applicable test load. A practical way to determine observable movement is that the washer under the nut becomes loose.

   TORQUE WRENCH METHOD: The applicable test torque must be reached within 1/4 turn of the nut for 3/8" (*10 mm*) diameter anchors and 1/2 turn of the nut for all others.
7. Testing should occur 24 hours minimum after installation of the subject anchors.

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FIXED EQUIPMENT ANCHORAGE

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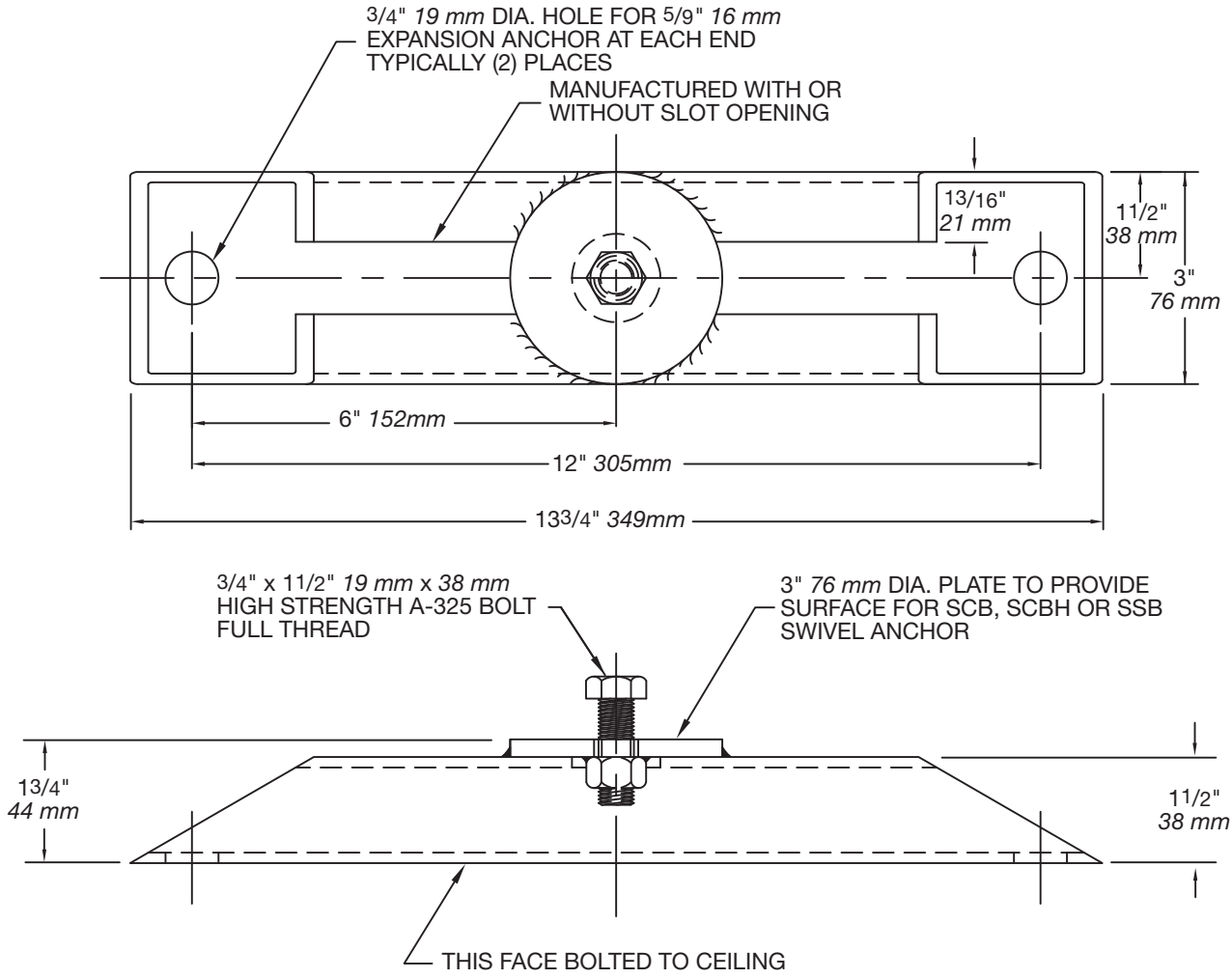
SLDB - SEISMIC LOAD DISTRIBUTION BRACKET



SLDB-2000

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California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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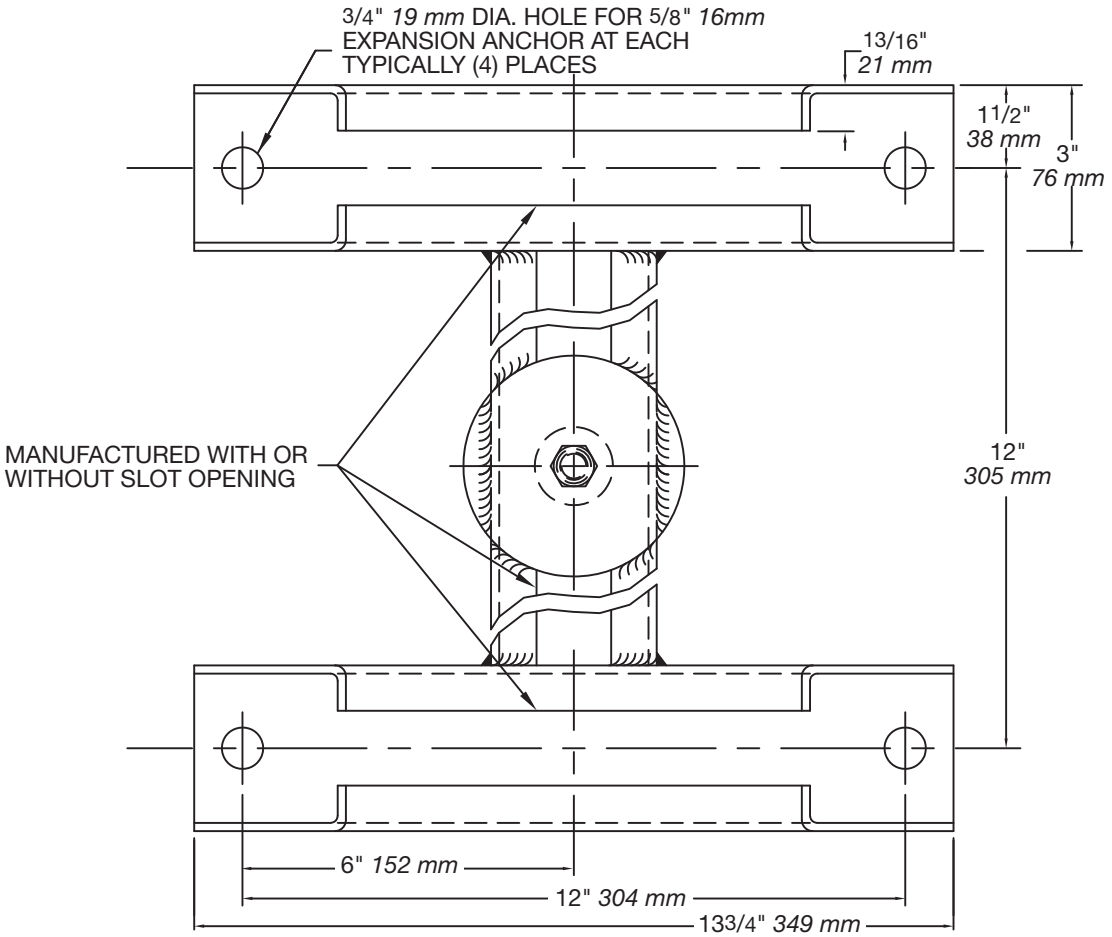

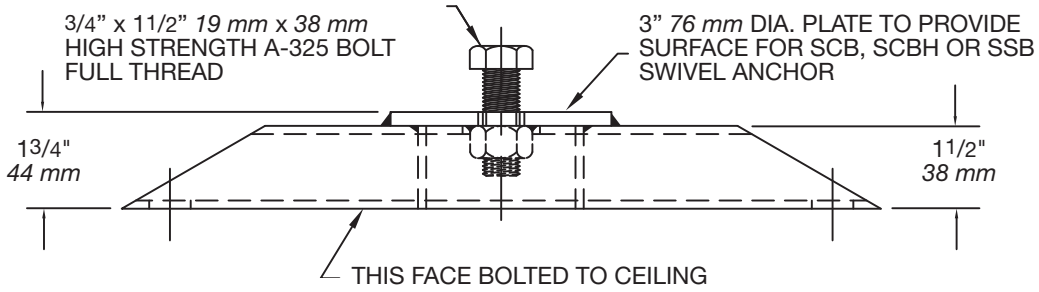

SLDB-4000

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FIXED EQUIPMENT ANCHORAGE

OPA-0349 August 5, 2002

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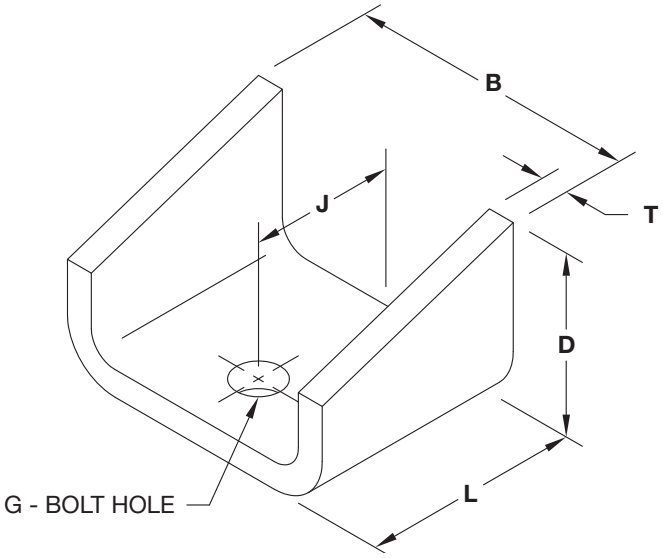
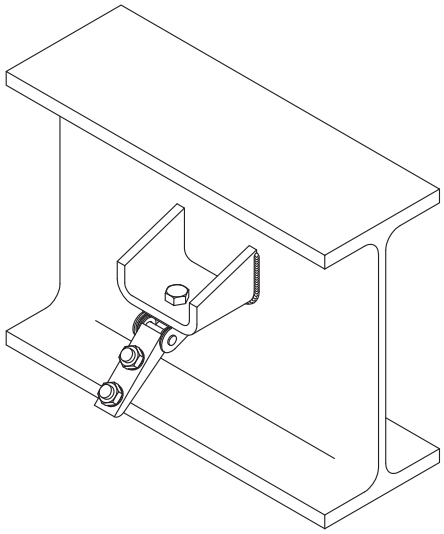
SACW - SEISMIC ATTACHMENT CLIP FOR WELDING





SACW SHOWN WELDED TO STRUCTURAL BEAM WITH BOLTED SCB

TYPE SACW DIMENSIONS (inches) (*mm*)

Size	Width (B) (in) (*mm*)	Height (D) (in) (*mm*)	Thickness (T) (in) (*mm*)	Length (L) (in) (*mm*)	Bolt Hole Location (J) (in) (*mm*)	Bolt Hole Diameter (G) (in) (*mm*)	Compatible Seismic Braces
SACW-0	2 *51*	1 1/2 *38*	1/4 *6*	2 1/4 *57*	1 1/4 *32*	7/16 *11*	SCB-0
SACW-1	3 *76*	2 *51*	1/4 *6*	2 1/2 *64*	1 1/2 *38*	9/16 *14*	SCB-1 SSB-1 SSBS-12
SACW-2	4 *102*	2 1/2 *64*	3/8 *10*	3 *76*	2 *51*	11/16 *17*	SCB-2 SSB-2 SSBS-20
SACW-3	5 *127*	3 1/4 *83*	3/8 *10*	3 1/2 *89*	2 1/2 *64*	13/16 *21*	SCB-3 SSB-3
SACW-3	6 *152*	5 *127*	3/8 *10*	5 *127*	3 1/2 *89*	15/16 *33*	SCB-4 SSB-4

NOTE: Refer to page HBA for SACW attachment information and maximum loads.

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APPROVED
Fixed Equipment Anchorage
Office of Statewide Health Planning and Development
OPA-0349
on
July 22, 2009
Jerry Yee (916) 654-3362

Dhiru Mali
Structural Engineer
California SE No. 2811

SEISMIC RESTRAINT GUIDELINES for FLOOR and ROOF MOUNTED EQUIPMENT

TABLE OF CONTENTS

Other codes such as the BOCA, SBCCI and UBC are still in use in some areas and would have different values.

SEISMIC ANALYSIS

A seismic restraint system must be designed to accommodate the forces as called for in chapter 16 of the code. The analysis should include all dead and seismic loads, including the capacity of the connections to the equipment and the structure. A detailed design of the anchorage, such as the bolt diameter, length, embedment, or weld size and length is required. Analysis should also include calculations for relative displacement to avoid equipment impacting other equipment or structural elements of the building. This can be calculated by knowing the floor to ceiling height. The relative displacement can be calculated as 0.01 x the floor to ceiling height . This displacement must not cause impact or disconnection of components of the equipment, piping, ductwork or electrical connections. These relative movements should be handled as follows:

Piping systems should use proper flex connections to take up this movement in all horizontal directions. Ductwork should use proper flex connections to take up this movement in all horizontal directions. Electrical connections must have loops or other means of flexibility to take up this movement in all horizontal directions.

There are significant changes between the older model codes (BOCA, SBCCI and UBC) and the IBC codes. One of the main changes is the requirement in the IBC that essential systems in essential facilities as defined in Occupancy Category IV (refer to page FM4) must be operational after the designated earthquake. A certificate of compliance is required by code to attest to the system s seismic capabilities. This is the first time system fragility levels are being considered for commercial projects.

CERTIFICATES OF COMPLIANCE

Useful Excerpts from Sections 16 and 17 of IBC 2006/ASCE 7-05
Read entire sections of IBC 2006/ASCE 7-05 for complete understanding

DEFINITIONS OF TERMS

ASCE-7-05 Section 11.2 DESIGNATED SEISMIC SYSTEM. Those architectural, electrical, and mechanical systems and their components that require design in accordance with Chapter 13 and for which the component importance factor, I_P, is greater than one.

COMPONENT. A part of element of an architectural, electrical, mechanical, or structural system.

> **Component, equipment.** A mechanical or electrical component or element that is part of a mechanical or electrical system within or without a building.
>
> **Component, flexible.** Component, including its attachments, having a fundamental period greater than 0.06 second.
>
> **Component, rigid.** Component, including its attachments, having a fundamental period less than or equal to 0.06 second.

SPECIAL INSPECTION IBC 2006 1707.8 Mechanical and electrical components. Special inspection for mechanical and electrical equipment shall be as follows:

1. Periodic special inspection is required during the anchorage of electrical equipment for emergency or standby power systems in structures assigned to Seismic Design Category C, D, E or F;

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2. Periodic special inspection is required during the installation of anchorage of other electrical equipment in structures assigned to Seismic Design Category E or F;
3. Periodic special inspection is required during installation of piping systems intended to carry flammable, combustible or highly toxic contents and their associated mechanical units in structures assigned to Seismic Design Category C, D, E or F;
4. Periodic special inspection is required during the installation of HVAC ductwork that will contain hazardous materials in structures assigned to Seismic Design Category C, D, E or F; and
5. Periodic special inspection is required during the installation of vibration isolation systems in structures assigned to Seismic Design Category C, D, E or F where the construction documents require a nominal clearance of 0.25 inches (6.4 mm) or less between the equipment support frame and restraint.

1707.9 Designated seismic system verifications. The special inspector shall examine designated seismic systems requiring seismic qualification in accordance with Section 1708.5 and verify that the label, anchorage or mounting conforms to the certificate of compliance.

1707.10 Seismic isolation system. Periodic special inspection is required during the fabrication and installation of isolator units and energy dissipation devices that are part of the seismic isolation system.

CERTIFICATES OF COMPLIANCE

IBC-2006 1708.5 Mechanical and electrical equipment. Each manufacturer of **designated seismic system components** shall test or analyze the **component** and its mounting system or anchorage and shall submit a **certificate of compliance** for review and acceptance by the registered design professional in responsible charge of the design of the **designated seismic system** and for approval by the building official. The evidence of compliance shall be by actual test on a shake table, by three-dimensional shock tests, by an analytical method using dynamic characteristics and forces, by the use of experience data (i.e., historical data demonstrating acceptable seismic performance), or by more rigorous analysis providing for equivalent safety. The **special inspector** shall examine the **designated seismic system** and shall determine whether the anchorages and label conform with the evidence of compliance.

ASCE 13.2.2 Special Certification Requirements for Designated Seismic Systems. Certifications shall be provided for designated seismic systems assigned to Seismic Design Categories C through F as follows:

a. Active mechanical and electrical equipment that must remain operable following the design earthquake shall be certified by the supplier as operable based on approved shake table testing in accordance with Section 13.2.5 or experience data in accordance with Section 13.2.6. Evidence demonstrating compliance of this requirement shall be submitted to the authority having jurisdiction after review and approval by the registered design professional.

b. Components with hazardous contents shall be certified by the supplier as maintaining containment following the design earthquake by (1) analysis, (2) approved shake table testing in accordance with Section 13.2.5, or (3) experience data in accordance with Section 13.2.6. Evidence demonstrating compliance of this requirement shall be submitted to the authority having jurisdiction after review and approval by the registered design professional.

ASCE 13.2.6 Experience Data Alternative for Seismic Capacity Determination. As an alternative to the analytical requirements of sections 13.2 through 13.6, use of experience data shall be deemed as an acceptable method to determine the seismic capacity of components and their supports and attachments. Seismic qualification by experience data based upon nationally recognized procedures acceptable to the authority having jurisdiction shall be deemed to satisfy the design and evaluation requirements provided that the substantiated seismic capacities equal or exceed the seismic demands determined in accordance with Sections 13.3.1 and 13.3.2.

Occupancy Categories IBC 2006–1604.5

I. Buildings and other structures that represent a low hazard to human life in the event of failure, including but not limited to:
- Agricultural facilities.
- Certain temporary facilities.
- Minor storage facilities.

II. Buildings and other structures except those listed in Categories I, III and IV.

III. Buildings and other structures that represent a substantial hazard to human life in the event of failure, including but not limited to:
- Covered structures whose primary occupancy is public assembly with an occupant load greater than 300.
- Buildings and other structures with elementary school, secondary school or day-care facilities with with an occupant load greater than 250.
- Buildings and other structures with an occupant load greater than 500 for colleges or adult education facilities.
- Health care facilities with occupant load of 50 or more resident patients, but not having surgery or emergency treatment facilities.
- Jails and detention facilities.
- Any other occupancy with an occupant load greater than 5,000.
- Power-generating stations, water treatment for potable water, waste water treatment facilities and other public utility facilities not included in Category IV.
- Buildings and other structures not included in Category IV containing sufficient quantities of toxic or explosive substances to be dangerous to the public if released.

IV. Buildings and other structures designated as essential facilities including, but not limited to:
- Hospitals and other health care facilities having surgery or emergency treatment facilities.
- Fire, rescue and police stations and emergency vehicle garages.
- Designated earthquake, hurricane or other emergency shelters.
- Designated emergency preparedness, communication, and operation centers and other facilities required for emergency response.
- Power-generating stations and other public utility facilities required as emergency back-up facilities for Category IV structures.
- Structures containing highly toxic materials.
- Aviation control towers, air traffic control centers and emergency aircraft hangars.
- Buildings and other structures having critical national defense functions.
- Water treatment facilities required to maintain water pressure for fire suppression.

TABLE 1613.5.6– SELECTION OF SEISMIC DESIGN CATEGORY (A, B, C, D)

	SEISMIC DESIGN CATEGORY		
Value of S_{ds}	Occupancy Categories I or II	Occupancy Category III	Occupancy Category IV
0 to 0.167g	A	A	A
0.168g to 0.330g	B	B	C
0.331g to 0.500g	C	C	D
Over 0.500g	D	D	D

S_{ds} Design spectral response acceleration $S_{ds} = 2/3 (S_s \times F_a)$ where F_a is the soil site coefficient

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ANCHORAGE OF EQUIPMENT

Proper cast in anchors are always preferable, but it is usually impractical to locate them during construction, therefore post installed anchors must be used. These drill in anchors can be either expansion (wedge) or adhesive (chemical). Wedge anchors are load assisted, and therefore provide excellent resistance to vibration and shock loadings. Their slip potential is actually a positive feature in seismic applications, giving early warning of potential failure whereas other anchors fail catastrophically. Adhesive anchors offer high load capacity, closer edge and spacer distances. Most adhesive anchors cannot be used in overhead applications.

Mason offers three types of anchors:

1. The Mason SAST Seismic Anchor Self Tapping [FM57] is a self tapping concrete screw to fasten equipment. This design is for use with restrained mounts and snubbers where periodic removal and inspection may be required as the SAST s do not require lifting of mounts or snubbers over a stud. See page FM57 for information.

2. The Mason SAS Seismic Anchor Stud [FM56] is a male wedge anchor. We offer this form for direct anchorage suspension applications such as with our SCB, Seismic Cable Brace system, for use on piping and suspended equipment. See page FM56 for information.

3. The Mason SRA Seismic Rod Anchor [FM58] is a threaded rod locked in place with an epoxy adhesive. This design is used for anchoring floor mounted equipment, restrained equipment and snubbers where higher loads are present and cannot be handled by the SAST anchors. The SRA comes in standard and high strength grade carbon steel and two grades of stainless steel. See information on page FM58.

Another type of attachment to concrete is with embedded bolts. These are standard A-307 or higher quality bolts set into concrete as it is poured. One major problem with this system is the exact bolting arrangement needs to be known in advance for proper placement. Table 2 has allowable values for embedded bolts from chapter 19 of the 1997 UBC.

TABLE 2
Allowable Loads (lbs & Kn) on Embedded Bolts
(Stone aggregate concrete and minimum A307 bolts)

Bolt Dia. (in)	Minimum Embedment (in)	Minimum Edge Distance (in)	Minimum Spacing (in)	Minimum Concrete Strength (psi)					
				F'c = 2000		F'c = 3000		F'c = 4000	
				Tension	Shear	Tension	Shear	Tension	Shear
1/4	2-1/2	1-1/2	3	200	500	200	500	200	500
3/8	3	2-1/4	4-1/2	500	1100	500	1100	500	1100
1/2	4	3	6	950	1250	950	1250	950	1250
	4	5	6	1400	1550	1500	1650	1500	1750
5/8	4-1/2	3-3/4	7-1/2	1500	2750	1500	2750	1500	2750
	4-1/2	6-1/4	7-1/2	2050	2900	2200	3000	2400	3050
3/4	5	4-1/2	9	2250	2940	2250	3560	2250	3560
	5	7-1/2	9	2700	4250	2950	4300	3200	4400
7/8	6	5-1/4	10-1/2	2550	3350	2550	4050	2550	4050
1	7	6	12	2850	3750	3250	4500	3650	5300
1-1/8	8	6-3/4	13-1/2	3400	4750	3400	4750	3400	4750
1-1/4	9	7-1/2	15	4000	5800	4000	5800	4000	5800

Metric version of Table 2 continues on page FM6

Bolt Dia. (mm)	Minimum Embedment (mm)	Minimum Edge Distance (mm)	Minimum Spacing (mm)	Minimum Concrete Strength (mPa)					
				F'c = 13.8		F'c = 20.7		F'c = 27.6	
				Tension	Shear	Tension	Shear	Tension	Shear
6	64	38	76	0.8	2.2	0.8	2.2	0.8	2.2
10	76	57	114	2.2	4.8	2.2	4.8	2.2	4.8
13	102 102	76 127	152 152	4.2 6.2	5.5 6.8	4.2 6.6	5.5 7.3	4.2 6.6	5.5 7.7
16	114 114	95 159	191 191	6.6 9.1	12.2 12.9	6.6 9.7	12.2 13.3	6.6 10.6	12.2 13.5
19	127 127	114 191	229 229	10.0 12.0	13.0 18.9	10.0 13.1	15.8 19.1	10.0 14.2	15.8 19.5
22	152	133	268	11.3	14.9	11.3	18.0	11.3	18.0
25	178	152	305	12.6	16.6	14.4	20.0	16.2	23.5
29	203	171	343	15.1	21.1	15.1	21.1	15.1	21.1
32	229	191	381	17.8	25.8	17.8	25.8	17.8	25.8

Equipment may also be attached to steel. The calculations for determining the loads at the base of the restraint are the same, but you compare allowable stresses rather than allowable pullout loadings on the bolts. The Manual of Steel Construction, 9th edition as published by the American Institute of Steel Construction, Inc. gives you allowable stresses and formulas for determining the actual stress. Table 3 is the tensile stress and root areas for steel bolts. The following equations should be used to calculate the stresses.

Tensile Stress, $f_t = \frac{T_{bolt}}{A_{tsa}}$ and Shear Stress, $f_v = \frac{V_{bolt}}{A_{ra}}$

where, A_{tsa} and A_{ra} are the Tensile and Root areas of the bolt.

Allowable Shear Stress, F_v = 10,000 psi *(68.9 MPa)* x 1.33* = 13,333 psi *(92 MPa)*

Allowable Tensile Stress, F_t: the basic equation is,

F_t = 26,000 psi *(179.3 MPa)* - $1.8f_v \leq$ 20,000 psi *(137.8 MPa)*

If F_t is less that 20,000 psi *(137.8 MPa)*, the allowable stress is:

$F_t = (26{,}000 - 1.8\ f_v) \times 1.33$*

If F_t is over 20,000 psi *(137.8 MPa)*, then F_t = 20,000 psi *(137.8 MPa)* x 1.33* = 26,666 psi *(183.9 MPa)*

*A 33% increase in stress is allowable in seismic applications.

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TABLE 3

Tensile Stress Area and Root Area for Steel Bolts

Bolt Diameter		Tensile Stress Area		Root Area	
(in)	*(mm)*	(in^2)	*(mm^2)*	(in^2)	*(mm^2)*
3/8	*10*	0.078	*50.3*	0.068	*43.8*
1/2	*13*	0.142	*91.6*	0.126	*81.2*
5/8	*16*	0.226	*145.8*	0.202	*130.3*
3/4	*19*	0.334	*215.5*	0.302	*194.8*
7/8	*22*	0.462	*298.0*	0.419	*270.3*
1	*25*	0.606	*390.9*	0.554	*357.4*
1-1/8	*29*	0.763	*492.2*	0.693	*447.0*
1-1/4	*32*	0.969	*625.1*	0.890	*574.1*

Equipment can be mounted to wood structures using lag screws. The capacities of the lag screws are based on the diameter (D), depth of penetration and the specific gravity of the wood. There are also dimensional limitations to the edges, ends and spacing between screws (see FM8). The minimum penetration is 4D, with full capacity at 8D. Table 4 has the allowable loads at both 4D and 8D. These are valid as long as the dimensional requirements of Table 5 are met. The values in Table 4 are for a specific gravity of wood of approximately 0.35, which is one of the lightest specific gravity woods. Woods with higher specific gravities will have a higher factor of safety.

TABLE 4

Lag Screw Allowable Values

Diameter		Allowable Withdrawal Load (Tension)				Allowable Lateral Load (Shear)			
		4D		8D		4D		8D	
(in)	*(mm)*	(lbs)	*(kN)*	(lbs)	*(kN)*	(lbs)	*(kN)*	(lbs)	*(kN)*
3/8	*10*	267	*1.15*	535	*2.3*	130	*.55*	260	*1.1*
1/2	*13*	442	*1.95*	885	*3.9*	195	*.85*	390	*1.7*
5/8	*16*	655	*2.9*	1310	*5.8*	270	*1.2*	540	*2.4*
3/4	*19*	900	*4.0*	1800	*8.0*	360	*1.6*	720	*3.2*
7/8	*22*	1177	*5.2*	2355	*10.4*	455	*2.0*	910	*4.0*
1	*25*	1490	*6.6*	2980	*13.2*	575	*2.55*	1150	*5.1*

Table 5

Lag Screw Location Limitations

Diameter		Minimum Edge Distances		Minimum End Distances		Minimum Spacing between Screws	
		7D		4D		5D	
(in)	*(mm)*	(in)	*(mm)*	(in)	*(mm)*	(in)	*(mm)*
3/8	*10*	2-5/8	*67*	1-1/2	*38*	1-7/8	*48*
1/2	*13*	3-1/2	*89*	2	*50*	2-1/2	*65*
5/8	*16*	4-3/8	*111*	2-1/2	*65*	3-1/8	*79*
3/4	*19*	5-1/4	*133*	3	*75*	3-3/4	*95*
7/8	*22*	6-1/8	*155*	3-1/2	*89*	4-3/8	*111*
1	*25*	7	*178*	4	*100*	5	*125*

After finding the actual shear V_b and tension T_b on the lag screw, the values need to be combined. The combined load P_α is from the equation,

$$P_\alpha = \sqrt{T_b^2 + V_b^2} \qquad \alpha = \tan^{-1}\left(\frac{T_b}{V_b}\right)$$

The combined allowable load $P_{\alpha\,\text{allowable}}$ can be found using the following equation.

$$P_{\alpha\,\text{allowable}} = \frac{WZ}{W\cos^2\alpha + Z\sin^2\alpha}$$

Comparing the two values, if $P_{\alpha\,\text{allowable}} > P_\alpha$, then the connection is adequate.

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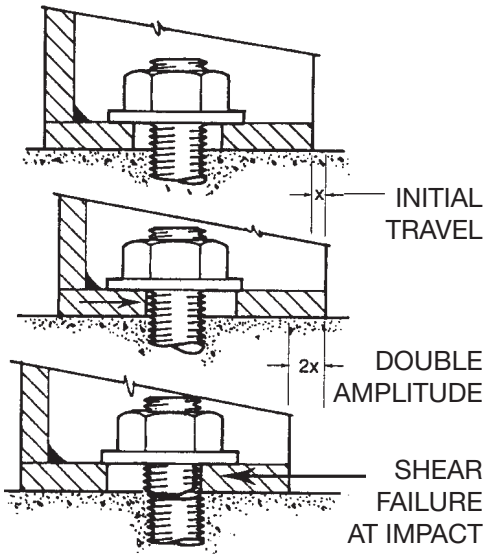
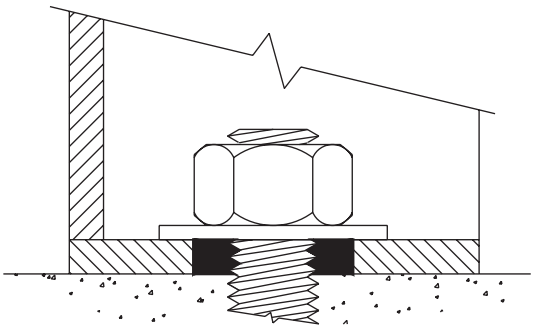
When there is excessive clearance between anchor bolts and equipment holes, the equipment has a tendency to shear off the anchor bolts during earthquakes or bomb blasts at accelerations as low as 0.2 G. The reason as explained in the figure is a velocity buildup because of sliding. What was initially analyzed as a static system becomes dynamic.

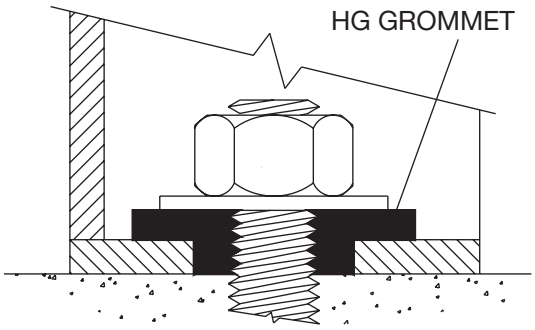
Type HG [FM55] neoprene hole grommets and Type HCF hole clearance filler provide quick solutions as they fill this clearance created by practical tolerances, off center bolts or the extreme situation where holes are enlarged on the jobsite by drilling or burning. HG grommets surround the bolt shaft and help deaccelerate the system.



IMPACT SHEAR FAILURE



HCF REMEDY
(Hole Clearance Filler)



HG REMEDY [FM49]
(Neoprene Hole Grommet)

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HOUSEKEEPING PADS

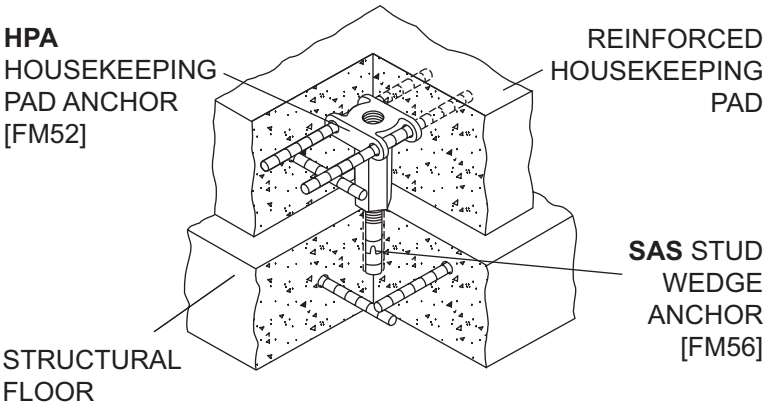
A major cause of equipment restraint failure is the breaking up of housekeeping pads. Virtually all housekeeping pads are poured independently after completion of the structure. In many cases there is no mechanical attachment to the structural floor and the pad itself may not be reinforced.

The floor diaphragm vibrates vertically and under resonant conditions generates more than 1G. This tosses the pad and the machine attached to it. As the pad crashes back it breaks up and the equipment loses all anchorage.

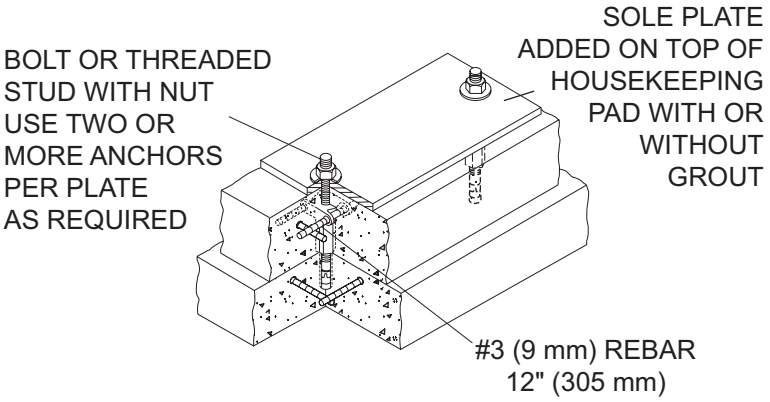
Since housekeeping pad sizes and locations are not established until after a machine room floor is poured, there is no way to cast in rebar pad stirrups. There is an undefined engineering area as to who should design and what type of cast in restraints should be used. In designing the HPA anchor system we have assumed the responsibility as part of our system certification. See Tables 6 & 7 on page FM11 HPA Anchorage Guidelines.

The HPA anchor [FM52] is manufactured in three sizes and has three anchoring capacities. The inverted hexagonal pyramid locks into the cured housekeeping pad and has provision for passing 2 #3 rebars through the holes on top for positioning the pad reinforcement system.

HOUSEKEEPING PAD ANCHOR ONLY



COMBINED HOUSEKEEPING PAD AND SOLE PLATE ANCHOR



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The number of anchors that are needed depend on the HPA size and the vertical rating of the SAS stud anchor as listed.

TABLE 6

F_P Up To 0.5G (see example FM14)

Housekeeping Pad Area FT^2 *(M^2)*	Reinforcing 12" *(300mm)* on Center Each Way	Perimeter HPA Size 24" *(600mm)* on Center	Interior HPA Size 36" *(900mm)* on Center	Maximum Weight of Pad and Equipment lbs *(kg)*
Up to 40 *(3.7)*	# 3 *(T8)*	HPA-1/2	HPA-1/2	8000 *(3,600)*
41 *(3.8)* to 100 *(9.3)*	# 4 *(T12)*	HPA-5/8	HPA-5/8	15,000 *(6,800)*
101 *(9.4)* to 250 (23)	# 4 *(T12)*	HPA-5/8	HPA-5/8	25,000 (11,400)
251 *(23)* to 400 (37)	# 5 *(T16)*	HPA-3/4	HPA-3/4	50,000 (22,800)

TABLE 7

F_P = 0.5G To 1.0G (see example FM14)

Housekeeping Pad Area FT^2 *(M^2)*	Reinforcing 12" *(300mm)* on Center Each Way	Perimeter HPA Size and Centers	Interior HPA Size 36" *(900mm)* on Center	Maximum Weight of Pad and Equipment lbs *(kg)*
Up to 40 *(3.7)*	# 3 *(T8)*	HPA-5/8 24"*(600mm)* on Center	HPA-5/8	8000 *(3,600)*
41 *(3.8)* to 100 *(9.3)*	# 4 *(T12)*	HPA-5/8 24"*(600mm)* on Center	HPA-5/8	15,000 *(6,800)*
101 *(9.4)* to 250 (23)	# 4 *(T12)*	HPA-3/4 18"*(450mm)* on Center	HPA-3/4	25,000 *(11,400)*
251 *(23)* to 400 *(37)*	# 5 *(T16)*	HPA-3/4 18"*(450mm)* on Center	HPA-3/4	50,000 *(22,800)*

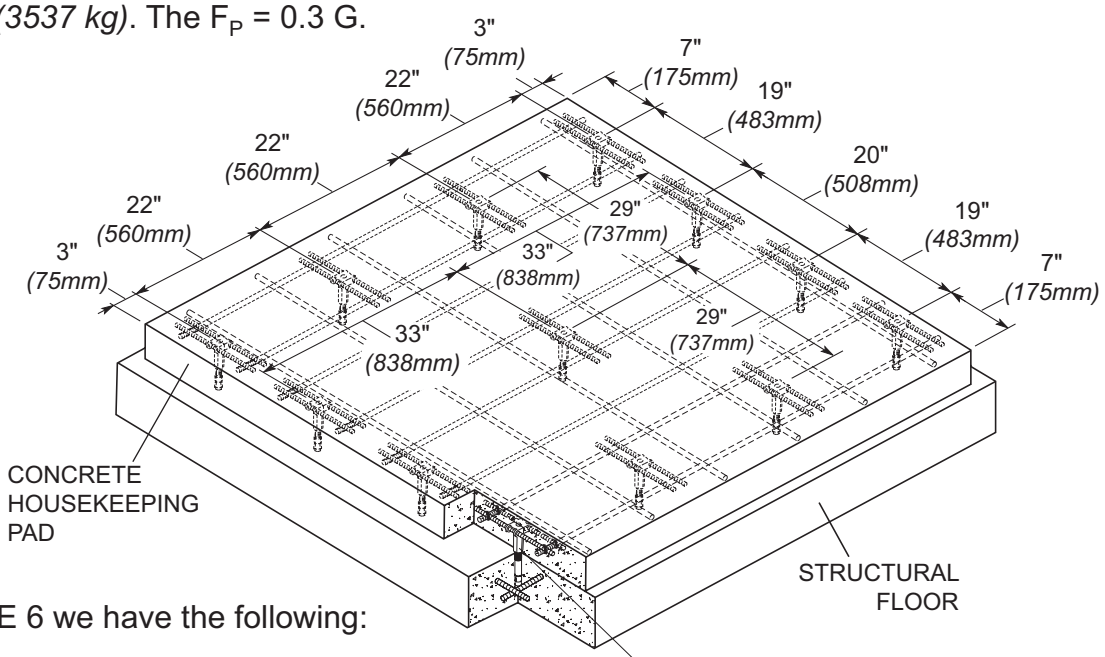
Notes for TABLES 6 & 7

1. These tables apply to systems where the center of gravity of the combined weight of the pad, equipment and isolation system is less than the width of the pad.

2. Reinforcing is to be placed at the centerline of the pad.

Example No.1– Housekeeping Pad

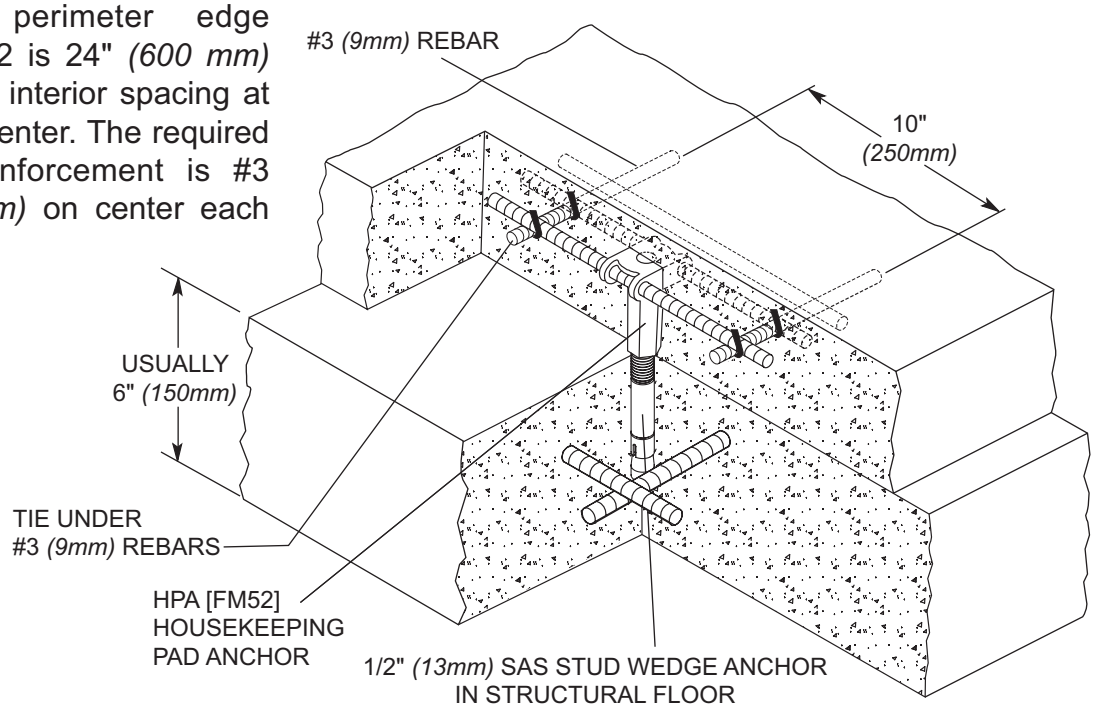
The housekeeping pad for a pump on a concrete inertia base is 6' x 6' x 4" (1830 x 1830 x100 mm). The combined weight of the pump, motor, housekeeping pad and concrete inertia *base is 7800 lbs (3537 kg)*. The F_P = 0.3 G.



Using TABLE 6 we have the following:

The area of the pad is 36 ft^2 (3.4 m^2). so use the "Up to 40 (3.7m)" row.

The maximum perimeter edge spacing of HPA-1/2 is 24" *(600 mm)* on center, and the interior spacing at 36" *(900 mm)* on center. The required minimum pad reinforcement is #3 rebar 12" *(300 mm)* on center each way (O.C.E.W.).



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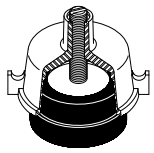
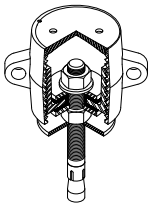
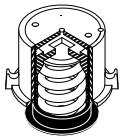
Many mechanical rooms are located over or adjacent to sensitive occupied space so a concrete floating floor is used to decrease the airborne noise. Our Low Dynamic Stiffness Bridge Bearing Rubber or steel spring supported concrete floating floors can improve the STC rating by 25 points and the INR by 44. Equipment mounted on these floating floors must be seismically attached. Because the floating floor is raised above the structural floor and supported by resilient mounts, the floating floor must be seismically mated with the structural slab. This is accomplished by using our style SFFS OSHPD approved floating floor snubbers. The SFFS has OSHPD approval OPA-321. SFFS snubbers are located close to the housekeeping pads to prevent the equipment overturning moment from breaking or buckling the floating floor.



FSN
Floating Floor Mount

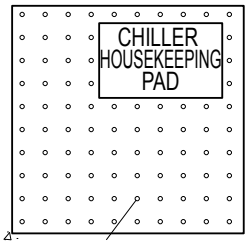


SFFS
Seismic Floating Floor Snubber
See page FM51

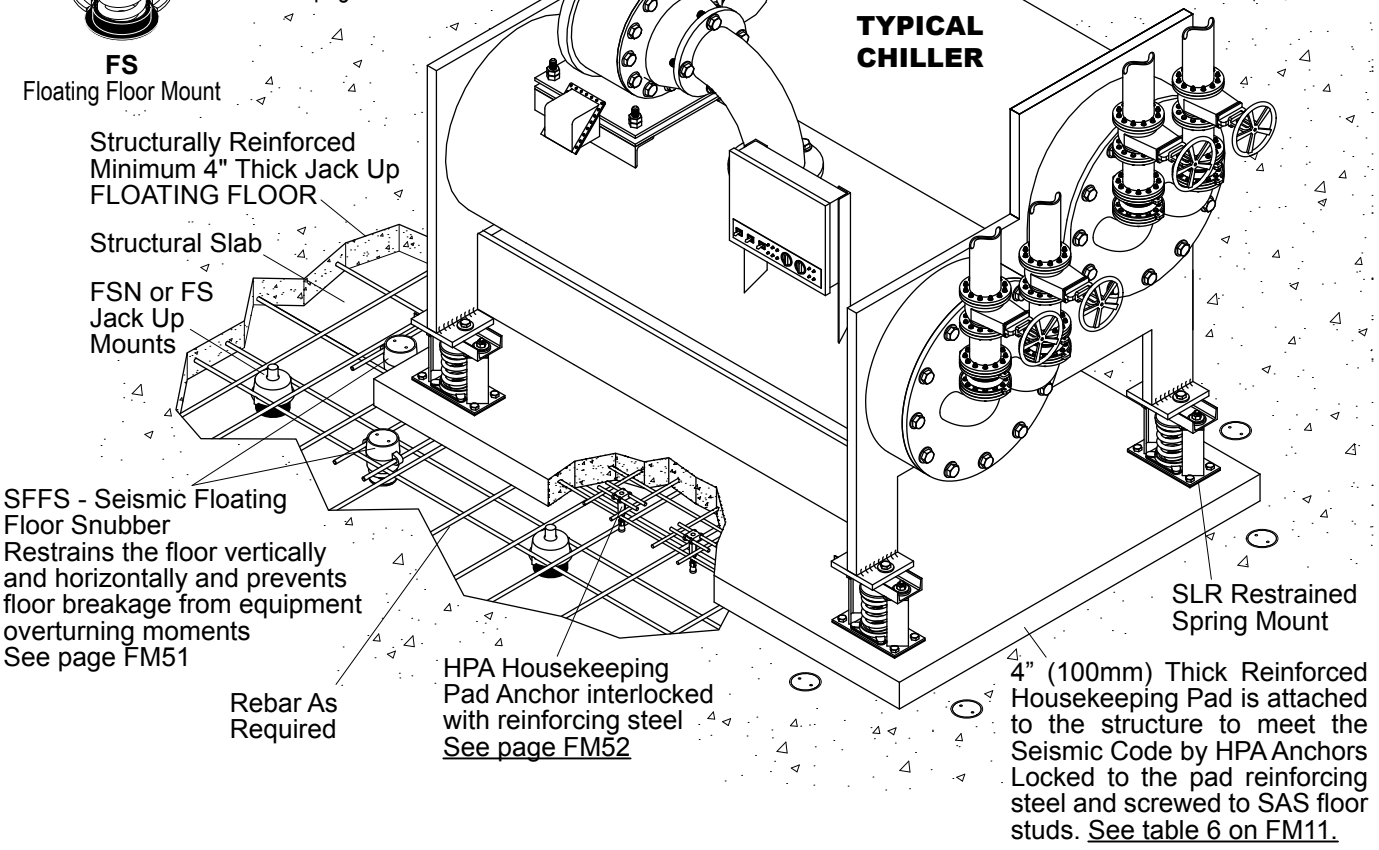


FS
Floating Floor Mount

Typical FLOATING FLOOR Layout



FSN or FS Jack Up Mounts



APPROVED

California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0321 August 4, 1995

John Maniscalco

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Structural Engineer
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Example No. 2– Floating Floor with SFFS Snubber Bolt Selection

A piece of equipment is mounted on a 15 ft x 7 ft (460 cm x 215 cm) housekeeping pad on a large floating floor. The combined weight of equipment, concrete and housekeeping pad is 24,050 lbs (10910 kg) and the combined H_{cg} = 36" (91 cm). Lateral forces are restrained by a perimeter curb and vertical forces are restrained by four (8) SFFS - Seismic Floating Floor Snubbers. The specified S_{DS} =0.33 and F_P = 0.50 G.

FLOATING FLOOR DETAIL
Equipment Weight = 8000 lbs (3629 kg)
Floor Weight,
18 ft x 12 ft (550 cm x 365 cm) = 10800 lbs (4910 kg)
Housekeeping Pad Weight,
15 ft x 9 ft (457 cm x 274 cm) = 5250 lbs (2381 kg)
b_1 = 132 in (335 cm)
b_2 = 96 in (244 cm)
H_{cg} = 36 in (91cm) combined
N = 8

Using the equations from FM14:

$F_P = W \times G = 24050 \times 0.5 = 12025$ lbs

$F_{PV} = 0.2\, S_{DS}\, W = 0.2 \times 0.33 \times 24050$

$F_{PV} = 1587$ lbs (7.06 kN)

$$I_{XX} = \frac{N(N+2)b_1^2}{12(N-2)} = \frac{8(8+2)\,132^2}{12(8-2)} = 19360$$

$$I_{YY} = \frac{Nb_2^2}{4} = \frac{8\,(96)^2}{4} = 18432$$

$$\Theta = \text{TAN}^{-1}\left(\frac{I_{YY}\, b_1}{I_{XX}\, b_2}\right) = \text{TAN}^{-1}\left(\frac{8712 \times 132}{18432 \times 96}\right)$$

$\Theta = 33°$

With one bolt in each SFFS, the tension on each anchor due to overturning is:

$$T_b = F_{PV} / 8 + \left((F_P \cos \Theta\, H_{cg}) / I_{YY}\right)\ (b_2/2) + \left((F_P \sin \Theta\, H_{cg}) / I_{XX}\right)(b_1/2)$$

$$T_b = 1587/8 + \left((12025 \cos 33° \times 36) / 18432\right)(96/2) + \left((12025 \sin 33° \times 36) / 19360\right)(132/2)$$

$T_b = 198 + 945 + 803 = 1946$ lbs (8.66 kN)

The SFFS uses 3/4" diameter anchors for attachment to the structural slab below. The allowable Tension for a 3/4" Mason SASE anchor is 2740 lbs. Substituting into the interaction check equation from ACI 318, D.7.3 and ASCE 7-05 13.4.2.

$1.3\, T_b / T_{ALLOWABLE} \leq 1.0$

$1.3 \times 1946 / 2740 = 0.92 < 1.0$

Therfore $3/4$" (19mm) SASE anchors [FM51] with $5\,3/4$" (143mm) embedment are adequate.

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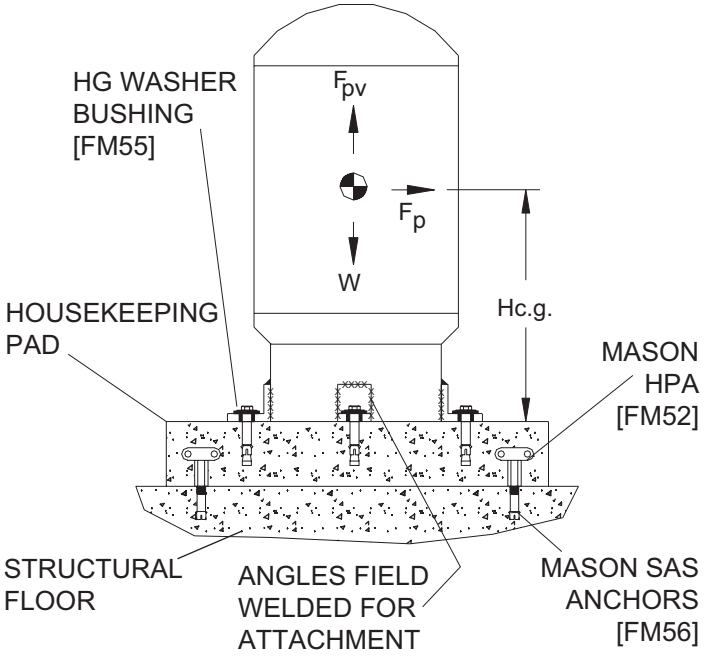
RIGIDLY MOUNTED NON-ISOLATED EQUIPMENT

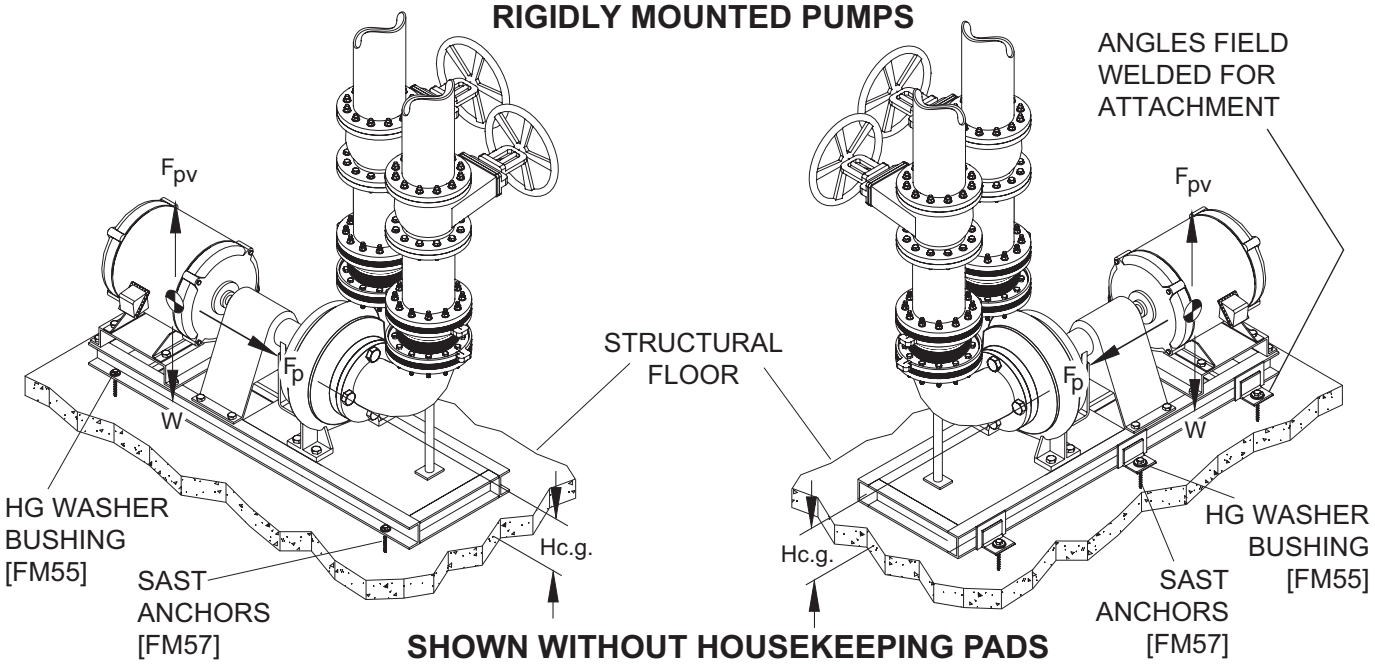
Rigidly mounted or non-isolated equipment must be bolted in position. Bolts should be selected in accordance with the anchor bolt section. For most equipment, stud type wedge anchors can be installed with equipment in place, because the drilling hole of stud anchors matches the stud's diameter. Where this is not possible due to lack of clearance, female wedge anchor bolts should be used, as the equipment can be slid into place and not lifted over the bolts. Most equipment is supplied with holes for bolting. Equipment that does not have holes may be drilled or have angles bolted or welded to them when drilling is not practical. In areas within high seismic zones, the bolt hole locations and sizes may not be adequate. In these cases, additional holes must be drilled or other attachments provided.



RIGIDLY MOUNTED TANK

Anchors subject to vibrating loads should be installed with our HG Neoprene bushing that surrounds the bolt shaft and head and protects the anchor from vibration.

RIGIDLY MOUNTED PUMPS



SHOWN WITHOUT HOUSEKEEPING PADS

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The equations for rigidly mounted equipment are:

$F_P = W \times G$

$F_{PV} = 1/3\ F_P$ (If required by local code)

$T = (-W + F_{PV})/N_B + F_P \times Hc.g. [\cos \emptyset /(N_2 \times a) + \sin \emptyset/(N_1 \times b)]$

$V = F_P /N_B$

$\emptyset = TAN^{-1} [(N_2 \times a)/ (N_1 \times b)]$

Where,
W = weight of system
F_P = seismic horizontal force
F_{PV} = seismic vertical force (if required by local code)
T = tensile force on one bolt
V = shear force on one bolt
N_B = number of bolts
N_1 = number of bolts in tension along the length
N_2 = number of bolts in tension along the width
$\emptyset$= critical angle where maximum tension occurs
H c.g.= Height of combined center of gravity
a= Bolt hole dimension along the length
b= Bolt hole dimension along the width

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Example No. 3– Pump Anchorage

A 50 HP *(37.5 KW)* end suction pump is mounted to a housekeeping pad. The combined weight of the pump and motor is 1500 lbs. *(680 kg)*. The dimensions of the pump assembly are as shown. The anchorage bolt-holes in the pump frame are 7/8" *(22 mm)*. The system is mounted in an area that has a F_P = 0.5 G.

Substituting numbers for letters in the equations on the previous page, where:
a = 42" *(1067mm)* b = 28" *(711mm)*

$F_P = W \times G$

F_P = 1500 lbs. x 0.5 = 750 lbs. *(3.34 kN)*

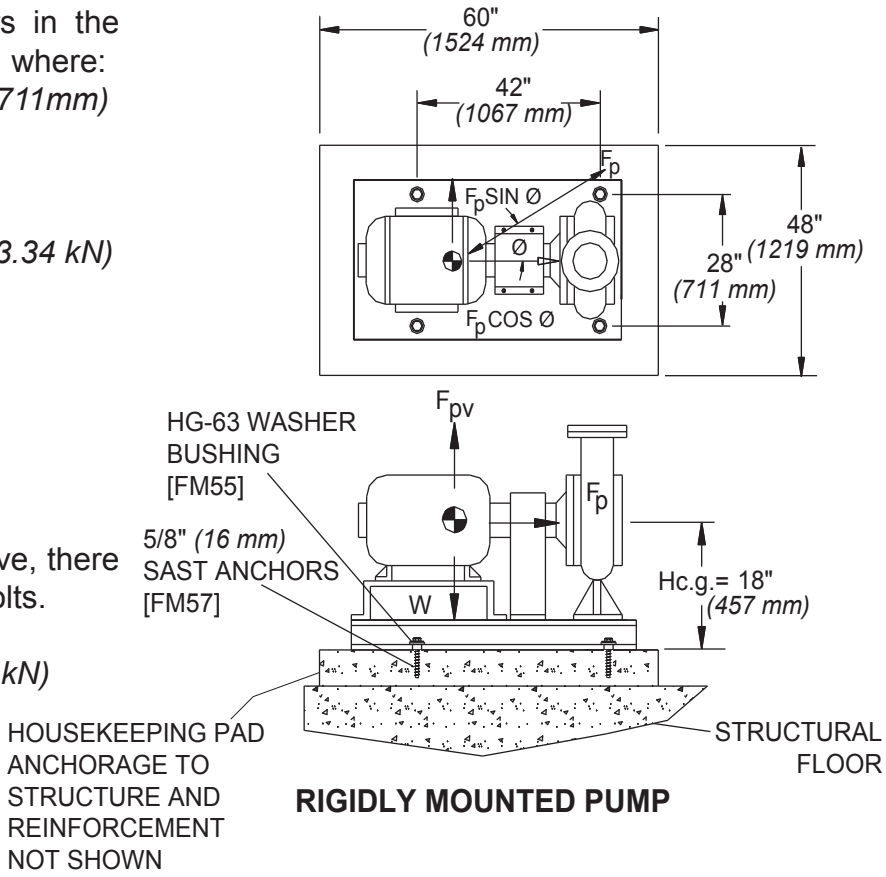
F_{PV} = 750/3 = 250 lbs. *(1.11 kN)*

$\emptyset = 56^o$

T = -22.5 lbs. *(- 0.1 kN)*

Since the tensile force is negative, there is no overturning force on the bolts.

V = 750 lbs. / 4 = 188 lbs. *(0.83 kN)*



RIGIDLY MOUNTED PUMP

Since there are 7/8" *(22 mm)* holes in the system frame, we can use 5/8" *(16 mm)* Mason SAST anchors [FM57] with HG-63 neoprene bushings [FM55]. Entering the values in the unity equation for tension and shear in shown in ICC-ES-ESR-2713,

$(T_{actual} / T_{allowable}) + (V_{actual} / V_{allowable}) \leq 1.2$

Inserting values into the equation, we get:

$(0 / 1810) + (188 / 3870) = 0.05 \leq 1.2$

Therefore 5/8" dia. SAST anchors [FM57] with 4-3/8" *(111 mm)* embedment are adequate.

Example No. 4– Chiller Anchorage Bolt Section

A chiller that weighs 20,000 lbs. *(9091 kg)* is anchored to the structural floor and has dimensions as shown. The chiller is located in an area where its F_P = 0.75. The sole plate attached to the bottom foot has two 7/8" *(22 mm)* diameter holes spaced 12" *(300 mm)* apart. The concrete slab has 3000 psi concrete.

$F_P = W \times G$
F_P = 20,000 lbs. x 0.75 G = 15,000 lbs. *(66.7 kN)*

$F_{PV} = 1/3\ F_P$
F_{PV} = 15,000 lbs./3 = 5,000 lbs. *(22.2 kN)*

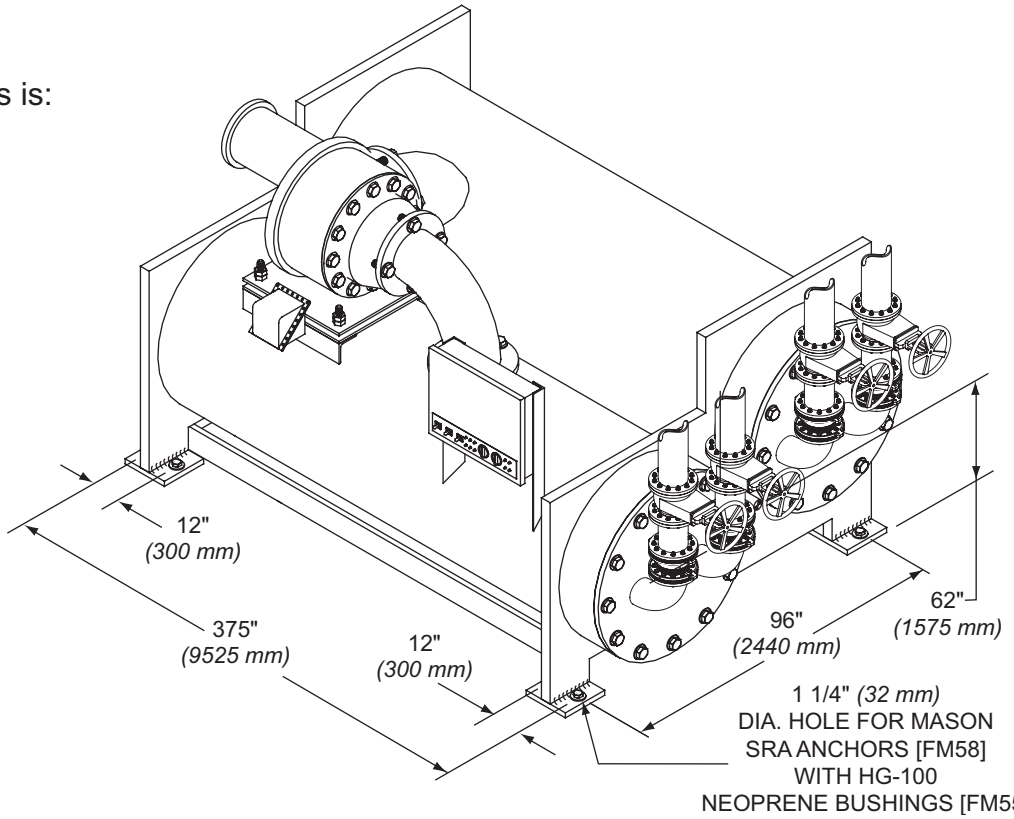
$\emptyset = TAN^{-1} (N_2 \times a / N_1 \times b)$
$\emptyset = TAN^{-1} (4 \times 375 / 4 \times 96)$
$\emptyset = 75^o$

The tension on each of the four bolts
along one side of the chiller is:

$T = (-W + F_{PV}) / N_b + F_P \times H$ c.g. $[\cos \emptyset / (N_2 \times a) + \sin \emptyset / (N_1 \times b)]$
$T = (-15{,}000 + 5{,}000) / 8 + 15{,}000 \times 63\ [\cos 75 / (4 \times 375) + \sin 75 / (4 \times 96)]$
T = 1,275 lbs. *(5.67 kN)*

The shear on the 8 bolts is:

$V = F_P / N_b$
V = 15,000/8
V = 1,875 lbs *(8.34 kN)*



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Since there are 7/8" *(22 mm)* holes in the chiller soleplate, we can use 3/4" *(19 mm)* diameter Mason SRA anchors [FM58] with HG-75 neoprene bushings [FM55]. The allowable tension will be 2269 lbs. *(10.1 kN)* and shear will be 3927 lbs. *(17.5 kN)*. Substituting into the unity equation for tension and shear as shown in ICC-ES-ESR-2713, we calculate:

(1275 / 2269) + (1875 / 3927) = 1.04 < 1.2

Since the unity equation is less than 1.2, the 3/4" *(19 mm)* Mason SAST anchors [FM57] with 5-1/2" *(140 mm)* embedment are adequate.

DIRECT MOUNTED EQUIPMENT SUPPORTED BY ISOLATORS WITH BUILT IN RESTRAINTS

Equipment is described as directly mounted when the isolators are attached without the need for an intermediate steel or concrete base. The easiest method is to use an isolator with built in restraints. See the following figures for details of direct mounted attachments.

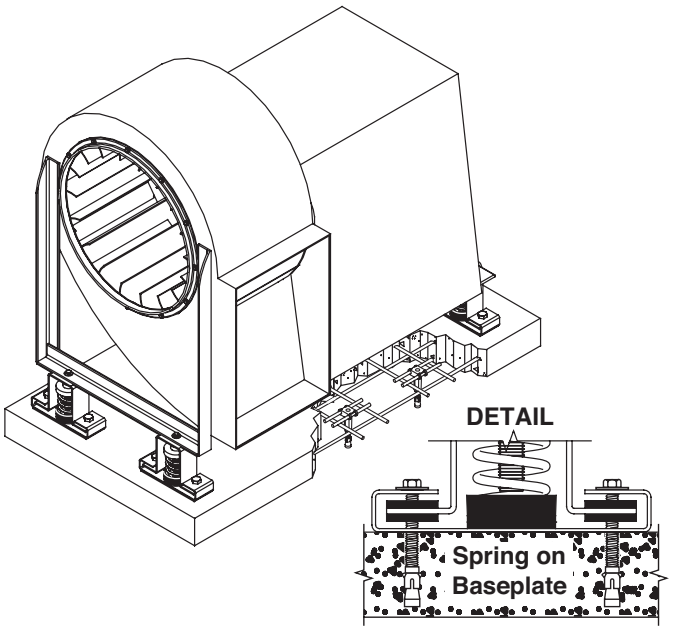
There are two types of isolators with built in restraints. The first has a continuous base plate or housing that transfers the load to the floor. These include the SLR, SLRS, SLRSO, RBA, RCA and BR series mountings. Calculations include the weight of the equipment to help resist overturning. The equations are the same as rigidly mounted equipment pages FM15 through FM19.

The second style transfers the weight of the equipment through a spring or rubber element directly to the structure rather than through the housing, typically Type SSLFH (see illustrations below). Since the weight of the system is not on the base plate or housing, the fasteners do not have this help to resist overturning.

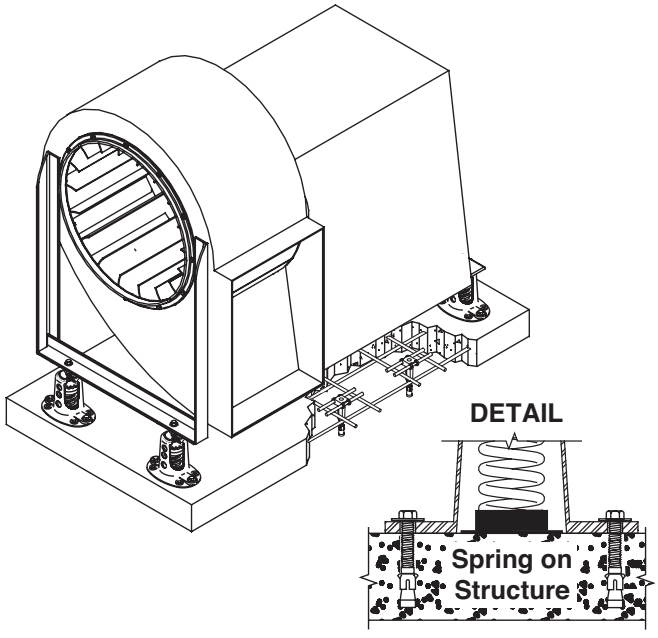
The following equations are used to determine the maximum tension T, compression C, and shear V on the welds or system fasteners when the weight of the system is not on the base plate or mounting housing.

$$T = -\frac{F_{PV}}{N_M} - \frac{F_P \cos\varnothing(\frac{b_2}{2})Hc.g.}{I_{YY}} - \frac{F_P \sin\varnothing(\frac{b_1}{2})Hc.g.}{I_{XX}} \qquad C = \frac{F_{PV}}{N_M} + \frac{F_P \cos\varnothing(\frac{b_2}{2})Hc.g.}{I_{YY}} + \frac{F_P \sin\varnothing(\frac{b_1}{2})Hc.g.}{I_{XX}} \qquad V = \frac{F_P}{N_M}$$

CENTRIFUGAL FAN
DIRECTLY MOUNTED ON SLR MOUNTS
(Springs rest on mounting baseplate)



CENTRIFUGAL FAN
DIRECTLY MOUNTED ON SSLFH MOUNTS
(Springs rest directly on structure)



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Where,
F_p = Seismic Horizontal Force
F_{pv} = Seismic Vertical Force
b_1 = Maximum Length between Mounts
b_2 = Maximum Width between Mounts
Hc.g.= Height from Mount Contact Point to Equipment Center of Gravity
N_M = Number of Mounts

$$I_{xx} = \frac{N_m(N_s+2)b_1^2}{12(N_s-2)}$$

$$I_{YY} = \frac{N_m(b_2)^2}{4}$$

$$\emptyset = TAN^{-}1(\frac{I_{YY}b_1}{I_{XX}b_2})$$

Example No. 5– Bolt Selection for BLOWER Mounted on SLR-A Mounts

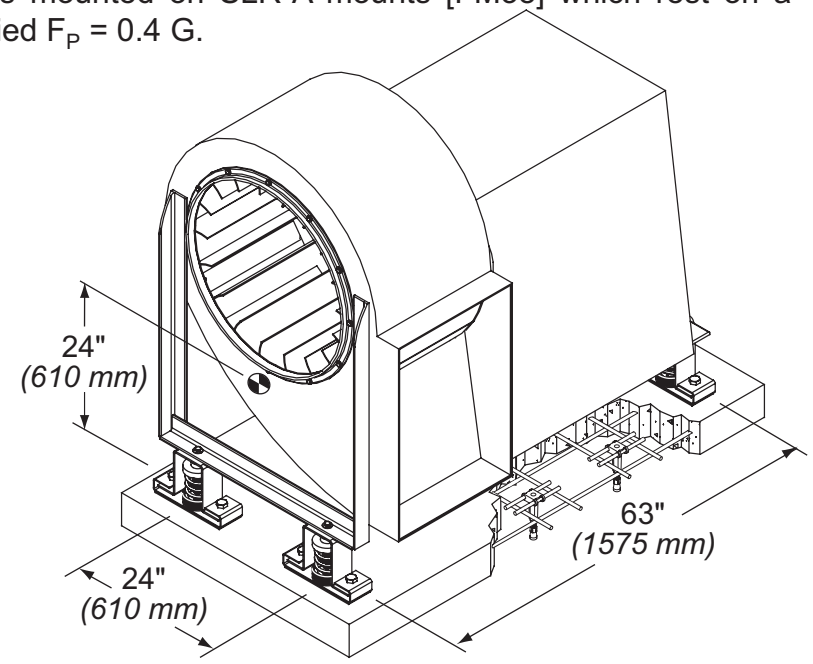
A Fan weighs 1,175 lbs. *(534 kg)*. It is mounted on SLR-A mounts [FM38] which rest on a concrete housekeeping pad. The specified F_P = 0.4 G.

Using the equations from FM14:

F_P = W x G
F_P = 1,175 lbs. x 0.4 G
F_P = 470 lbs. *(2.1 kN)*

F_{PV} = 1/3 F_P
F_{PV} = 470 lbs. / 3
F_{PV} = 157 lbs. *(0.7 kN)*

$\emptyset = TAN^{-1}$ (N_2 x a / N_1 x b)
$\emptyset = TAN^{-1}$ (2 x 63 / 2 x 24)
$\emptyset = 69^o$



The tension on each SLR-A mount due to overturning is:

T = (-W + F_{PV}) / N_b + F_P x H c.g. [cos $\emptyset$ / (N_2 x a) + sin $\emptyset$ / (N_1 x b)]
T = (-1,175 + 157) / 4 + 470 x 24 [cos69 / (2 x 63) + sin69 / (2 X 24)]
T = -3 lbs. *(0.013 kN)*
Since T is negative, T will be taken as zero for calculations. Because the tension force is negative their is no overturning of the system.

The shear on each SLR-A mount is:

V = F_P / No. of Mounts
V = 470 lbs. / 4
V = 118 lbs. *(0.53 kN)*

The tension on one bolt of each SLR-A mount is:

T_b = [(V x Ht. of Mount) / (N_b x d)] + T / N_b
T_b = [118 lbs. x 5) / (2 x 1-1/4)] + 0 / 2
T_b = 236 lbs. *(1.05 kN)*

The shear on one bolt of each SLR-A mount is:

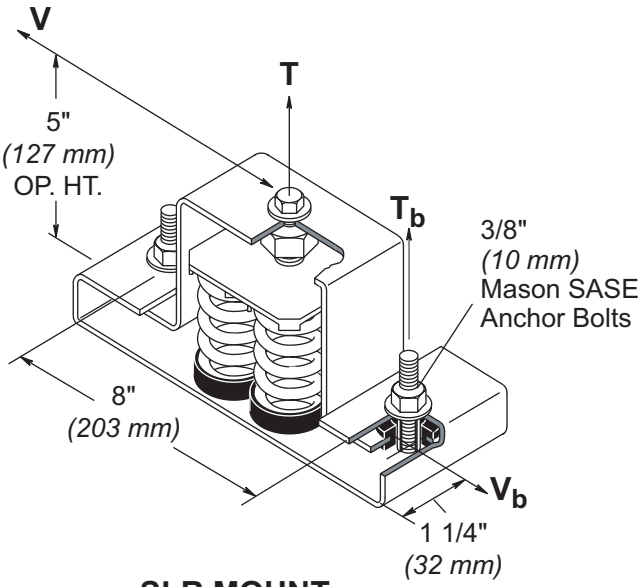
V_b = V / N_b
V_b = 118 lbs. / 2
V_b = 59 lbs. *(0.26 kN)*

The SLR-A mount [FM38] is anchored to the housekeeping pad with two 3/8" Mason SASE Anchors [FM56]. The allowable loads for the Mason SASE Anchors are reduced due to the spacing of the SLR-A mounts. The allowable tensile load is therefore 1037 lbs. *(4.61 kN)*, and the allowable shear load is 819 lbs. *(3.64 kN).*

Entering the values into the unity equation for tension and shear as shown in ICC-ES-ESR-2713, we get:

$$\left(\frac{236}{1037}\right) + \left(\frac{59}{819}\right) = 0.30 \leq 1.2$$

Since the unity equation is less than 1.2, the 3/8" SASE Anchors [FM56] with 2-7/8" *(73mm)* embedment are adequate.



SLR MOUNT DETAIL

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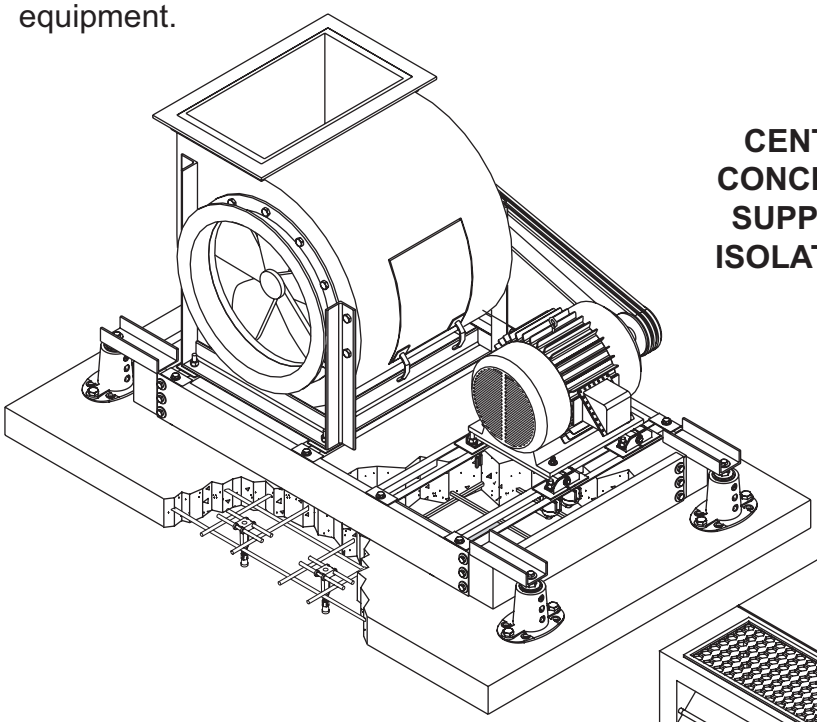
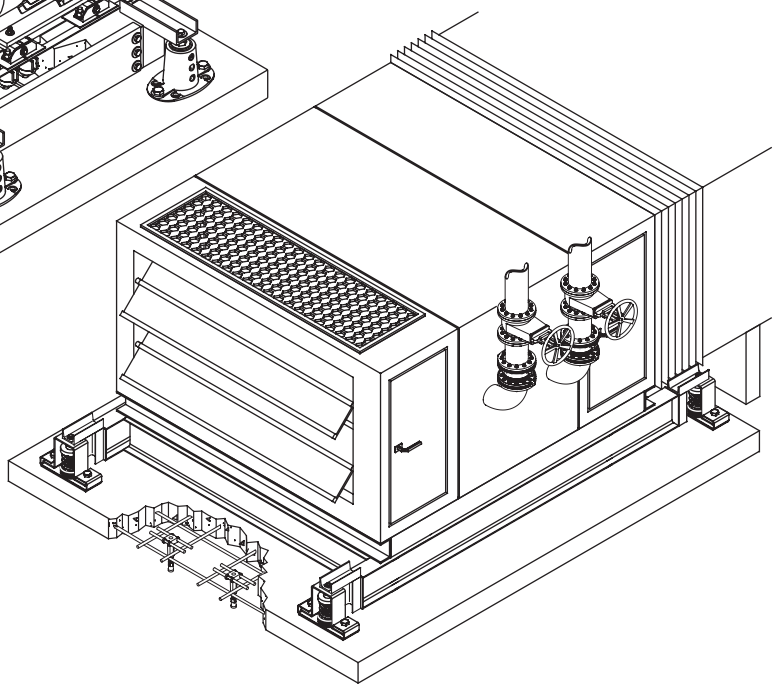
There are two ways that base mounted equipment can be restrained. First is to use an isolator with built in restraints (see illustrations below), and the second is to use separate snubbers and isolators (see illustrations on FM26).

BASE MOUNTED EQUIPMENT SUPPORTED BY ISOLATORS WITH BUILT IN RESTRAINTS

Some equipment requires a supplementary steel frame or concrete base for rigidity. Concrete bases may be used to increase mass, provide rigidity or act as a partial sound barrier directly below the equipment. Concrete inertia bases can have frames of channel, wide flange beams (KSL) or formed sections (BMK). Steel frames can be made from angle, channel (MSL) or wide flange beams (WFSL). These bases must be capable of withstanding the twisting and torsional loads applied during an earthquake as well as the operational forces generated by the equipment.



CENTRIFUGAL FAN ON CONCRETE INERTIA BASE SUPPORTED BY SPRING ISOLATORS WITH BUILT IN RESTRAINTS



AIR HANDLER ON SUPPLEMENTARY STEEL BASE SUPPORTED BY SPRING ISOLATORS WITH BUILT IN RESTRAINTS

Example No. 6– SSLFH Mount Bolt Selections for Pump Mounted on Concrete Base

A horizontally split case pump has a combined weight of the pump, motor, and concrete inertia base of 7565 lbs *(3438 kg)*. The pump is mounted on a 10" *(250 mm)* deep BMK base with SSLFH mounts [FM47]. The specified F_P for this area is F_P = 0.3 G.

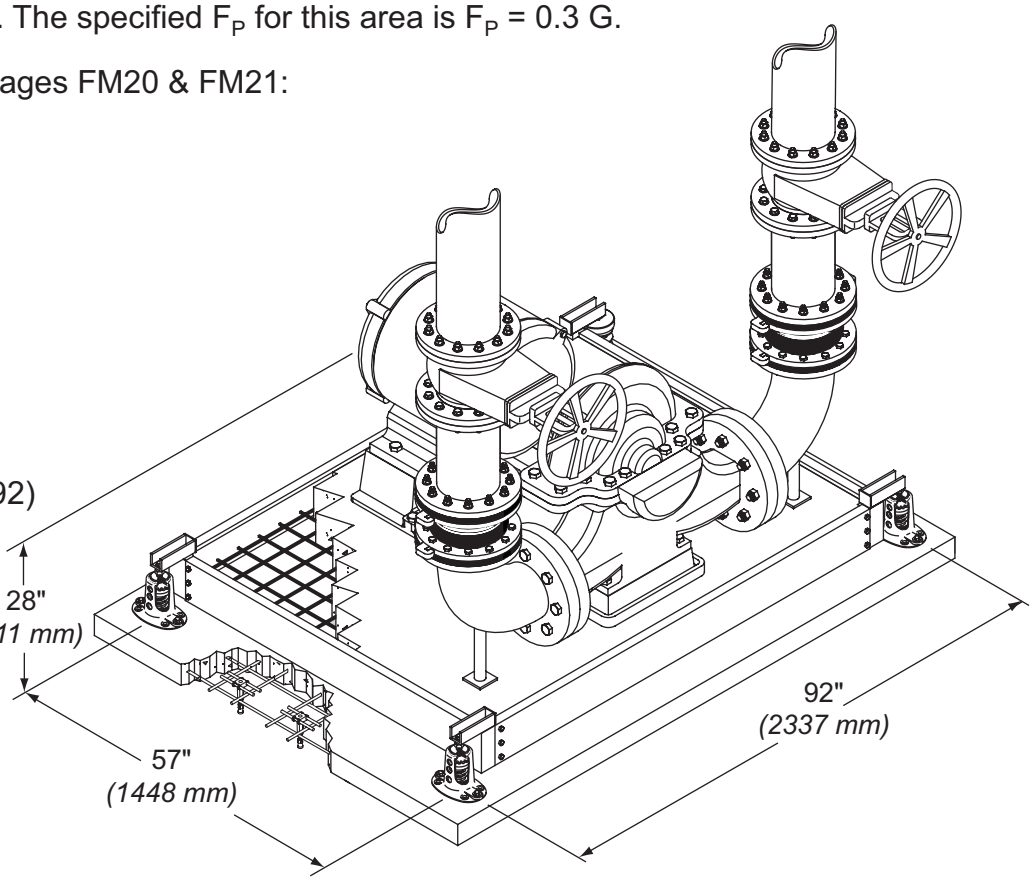
Using equations from pages FM20 & FM21:

$F_P = W \times G$
F_P = 7,565 lbs. x 0.3 G
F_P = 2,270 lbs. *(10 kN)*

$F_{PV} = 1/3\ F_P$
F_{PV} = 2,270 lbs. / 3
F_{PV} = 757 lbs. *(3.4 kN)*

$\emptyset = TAN^{-1} (I_{YY}b_1/I_{XX}b_2)$
$\emptyset = TAN^{-1}$ (2 x 57 / 2 x 92)
$\emptyset = 32^o$

where
b_1 = 92" *(2337 mm)*
b_2 = 57" *(1448 mm)*



The tension on each mount due to overturning is:

$T = - [F_{PV} / N_M] - [F_P \cos \emptyset\ (b_2/2)Hc.g./I_{YY}] - [F_P \sin \emptyset\ (b_1/2)Hc.g./I_{XX}]$
$T = - [757 / 4] - [2270 \cos 32\ (57/2)28/[4(57)^2 / 4]] - [2270 \sin 32\ (92/2)28/[4(4+2)(92)^2 /12(4-2)]]$
T = -189 - 473 - 183 = -845 lbs. (*3.75 kN)*

The shear on each mount is:

V = F_P / No. of Mounts
V = 2,270 lbs. / 4
V = 568 lbs. *(2.52 kN)*

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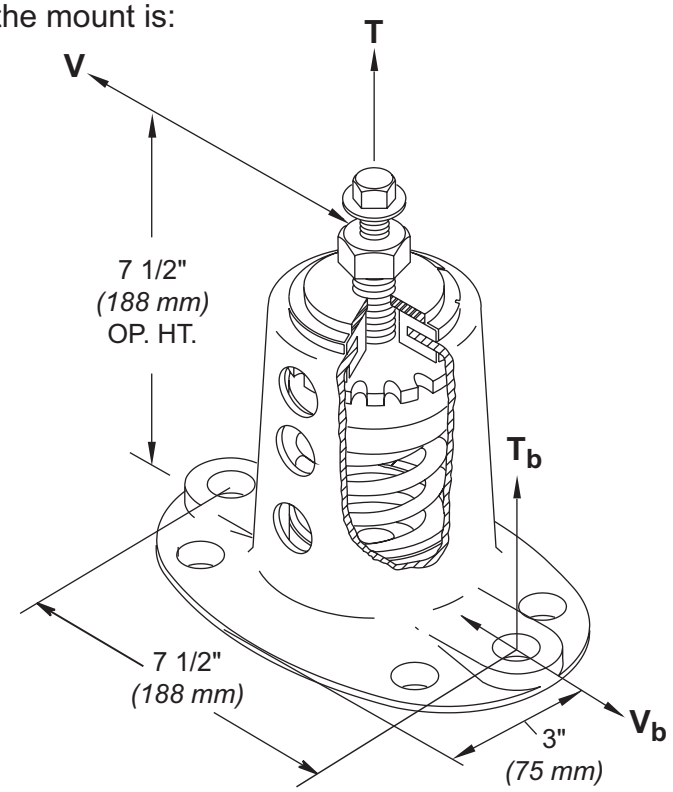
The Mount overturning tension on each bolt of the mount is:

T_b = [(V x Ht. of Mount) / (N_b x d)] + T / N_b
T_b = [568 lbs. x 7 1/2) / (2 x 3)] + 845 / 2
T_b = 1133 lbs. *(5.04 kN)*

The shear on each bolt of the mount is:

V_b = V / N_b
V_b = 568 lbs. / 2
V_b = 284 lbs. *(1.26 kN)*



MOUNT DETAIL

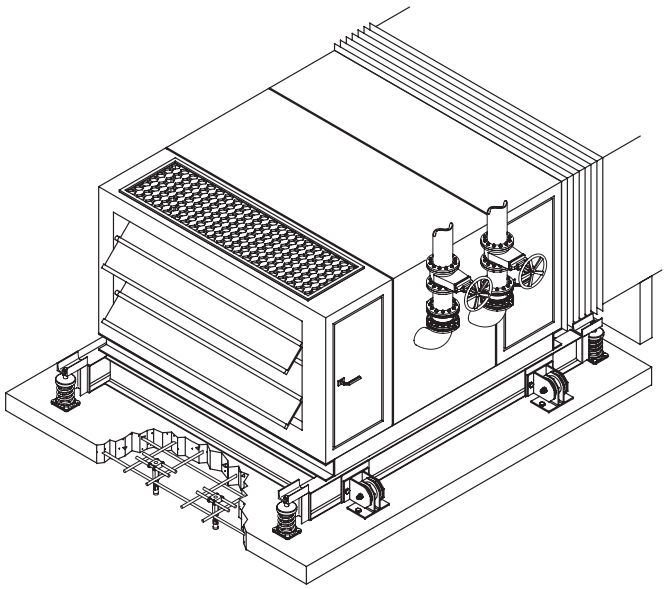
The SSLFH-B [FM46] housing has 3/4" *(19 mm)* holes for 5/8" *(16 mm)* SAST anchors [FM57]. The allowable values have been derated due to the spacing of the bolt holes in the SSLFH. Entering the above values along with the reduced allowable values from ICC-ES-ESR-2713 yields the following.

(1133 /1723) + (284 /1974) = 0.80 $\leq$ 1.2

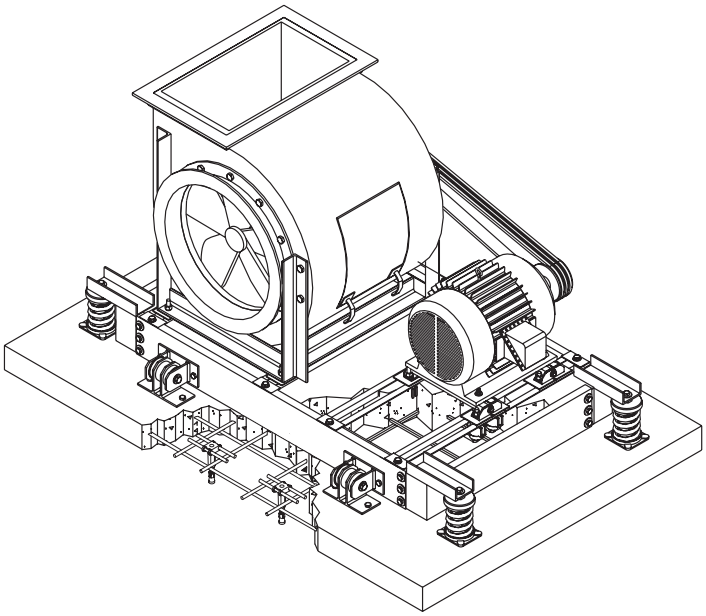
Since the unity equation is less than 1.2, the 5/8" *(16 mm)* SAST anchors [FM57] with 4-1/2" *(114 mm)* embedment are adequate.

BASE MOUNTED EQUIPMENT USING ISOLATORS WITH SEPARATE SEISMIC SNUBBERS

The most reliable and equipment sparing vibration isolation and seismic restraint system is base mounted incorporating free standing vibration isolators and separate seismic snubbers. Unanchored, free standing vibration isolators ensure effective isolation while separate all-directional seismic snubbers provide complete seismic protection and limit shock to the equipment. The supporting base is the key component of a successful system. Two independent rails rather than a continuous base would roll during an earthquake and result in failure. The base can be either a steel frame or a concrete inertia base. Both systems should be provided with height saving brackets for the vibration isolators and proper connection points for the seismic snubbers.



AIR HANDLER ON SUPPLEMENTARY STEEL BASE WITH SLF SPRING MOUNTS AND Z-1011 SEISMIC SNUBBERS [FM44]



CENTRIFUGAL FAN ON KSL BASE WITH SLF SPRING MOUNTS AND Z-1011 SEISMIC SNUBBERS [FM44]

There are 2 different all-directional seismic snubber designs.

The Z-1225 [FM50] is designed to keep the unit in place while cushioning the impact load with replaceable 1/4" *(6 mm)* thick bridge bearing neoprene bushings. Equipment shock is not calculated.

The Z-1011 [FM49] is not only designed to keep the unit in place but the replaceable 3/4" *(19 mm)* thick bridge bearing neoprene bushings dramatically reduce the impact load to a maximum of 4g. The 4g acceleration is within the fragility tolerances of most equipment. This helps ensure continued functionality of the system as well as prevent motion. This is specifically critical to emergency generators, transformers, and other essential or life safety systems.

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The following equations are used to determine the maximum tension T, maximum compression C, and the maximum shear V on any one seismic snubber. Individual calculations for the determination of the tension and shear on the anchor bolts, are listed by the type of snubber.

$$T = -\frac{F_{PV}}{N_s} - \frac{F_P \cos\emptyset\left(\frac{b_2}{2}\right) Hc.g.}{I_{YY}} - \frac{F_P \sin\emptyset\left(\frac{b_1}{2}\right) Hc.g.}{I_{XX}}$$

$$C = \frac{F_{PV}}{N_s} + \frac{F_P \cos\emptyset\left(\frac{b_2}{2}\right) Hc.g.}{I_{YY}} + \frac{F_P \sin\emptyset\left(\frac{b_1}{2}\right) Hc.g.}{I_{XX}}$$

$$V = \frac{F_P}{N_s}$$

Where,

F_p = Seismic Horizontal Force
F_{pv} = Seismic Vertical Force
b_1 = Maximum Length between Seismic Snubbers
b_2 = Maximum Width between Seismic Snubbers
Hc.g.= Height from Snubber Contact Point to Equipment Center of Gravity
N_S = Number of Seismic Snubbers

Once the maximum tension, compression and shear are calculated and checked against the maximum certified horizontal and vertical loads of the seismic snubber, the anchorage of the snubber is designed using the following equations.

$$I_{xx} = \frac{N_s(N_s+2)b_1^2}{12(N_s-2)}$$

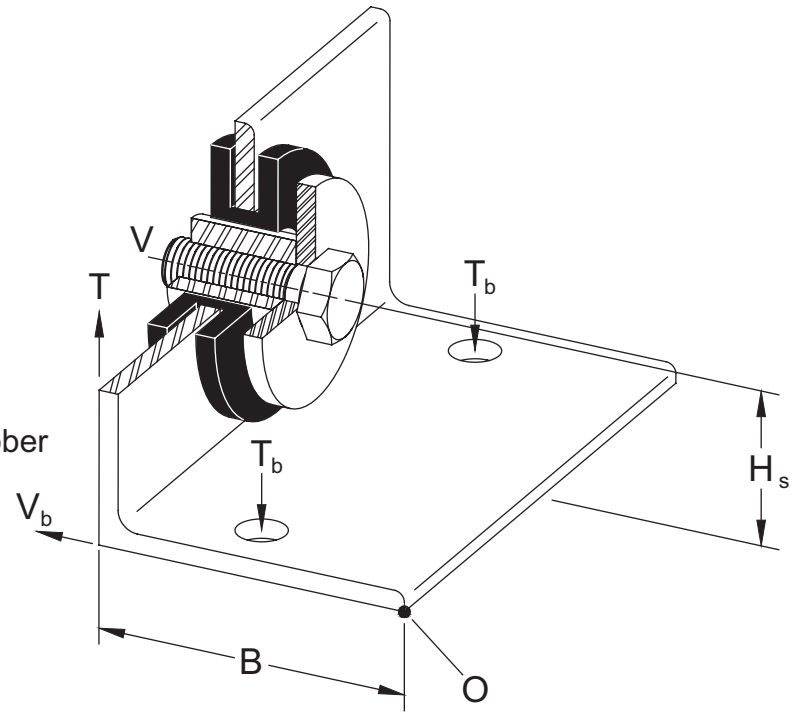
$$I_{YY} = \frac{N_s(b_2)^2}{4}$$

$$\theta = TAN^{-1}\left(\frac{I_{YY}\, b_1}{I_{XX}\, b_2}\right)$$

For Z-1225-250 to 2000 Seismic Snubbers [FM50]: Summing Moments about 'O':

$$T_b = \frac{V(H_s)}{N_b(\frac{B}{2})} + \frac{2(T)}{N_b}$$

$$V_b = \frac{V}{N_b}$$



Where,
From Overturning Calculations:
T = Maximum Tension on a Snubber
C = Maximum Compression on a Snubber
V = Maximum Shear on a Snubber
H_S = Height to Snubber Contact Point
B = Snubber Base Width
N_S = number of Snubbers
N_b = Number of Anchor Bolts = 2
T_b= Tension per Anchor Bolt
V_b= Shear per Anchor Bolt

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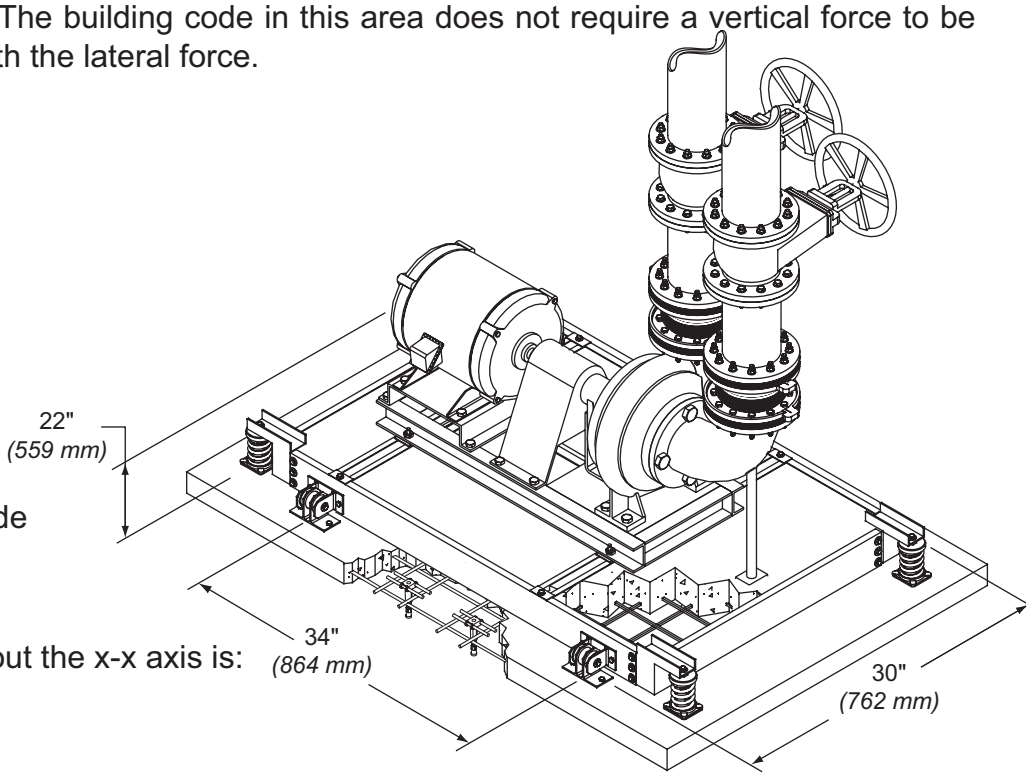
Example No. 7 – Concrete Inertia Base with Z-1011 Snubbers Bolt Selection

A 10 HP *(7.5 KW)* pump is mounted on a concrete inertia base with SLF springs and Z-1011-500 snubbers. The combined weight of the pump, motor and inertia base is 1200 lbs *(544 kg)*. The F_P = 0.4G. The building code in this area does not require a vertical force to be simultaneously applied with the lateral force.

b_1 = 34" *(864 mm)*
b_2 = 30" *(762 mm)*
N_b = 2
N_S = 4
Hc.g. = 22" *(559 mm)*

F_P = W x G
F_P = 1,200 lbs. x 0.4 G
F_P = 480 lbs. *(2.14 kN)*

F_{PV} = 0 as the building code does not require it.



The moment of inertia about the x-x axis is:

$$I_{XX} = \frac{N_s\,(N_s + 2)\,(b_1)^2}{12\,(N_s - 2)}$$

$$I_{XX} = \frac{4\,(4 + 2)\,(34)^2}{12\,(4 - 2)}$$

$$I_{XX} = 1{,}156\ in^4$$

The moment of inertia about the y-y axis is:

$$I_{yy} = \frac{N_s\,(b_2)^2}{4}$$

$$I_{yy} = \frac{4\,(30)^2}{4}$$

$$I_{yy} = 900\ in^4$$

$$\emptyset = TAN^{-1}\left(\frac{I_{yy}\,(b_1)}{I_{xx}\,(b_2)}\right)$$

$$\emptyset = TAN^{-1}\left(\frac{900\,(34)}{1{,}156\,(30)}\right)$$

$$\emptyset = 42^{o}$$

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The compression, tension and shear on the snubbers are to be calculated as follows:

$$C = \frac{F_{pv}}{N_s} + \frac{F_p \cos 0\ (b_2 / 2)\ Hc.g.}{I_{yy}} + \frac{F_p \sin 0\ (b_1 / 2)\ Hc.g}{I_{xx}}$$

$$C = 0 + \frac{480 \cos 41\ (30 / 2)\ 22}{900} + \frac{480 \sin 41\ (34 / 2)\ 22}{1{,}156}$$

$C = 235$ lbs *(0.11 kN)*

$$T = -\frac{F_{pv}}{N_s} - \frac{F_p \cos 0\ (b_2 / 2)\ Hc.g.}{I_{yy}} - \frac{F_p \sin 0\ (b_1 / 2)\ Hc.g}{I_{xx}}$$

$$T = 0 - \frac{480 \cos 41\ (30 / 2)\ 22}{900} - \frac{480 \sin 41\ (34 / 2)\ 22}{1{,}156}$$

$T = -235$ lbs *(0.11 kN)*

$V = F_P$ / No. of Snubbers
$V = 480$ lbs. / 4
$V = 120$ lbs. *(0.53 kN)*

From [FM32] the calculations for tension and shear on the anchor bolts of a Z-1011-500 are where

$H_s = 3$
$B = 3$

$$T_b = \frac{V(H_s)}{\frac{N_b\,(B)}{2}} + \frac{T}{N_b} \qquad T_b = \frac{120(3)}{\frac{2\,(3)}{2}} + \frac{235}{2} \qquad T_b = 238 \text{ lbs } \textit{(1.06 kN)}$$

$V_b = V / N_b$
$V_b = 120$ lbs. / 2
$V_b = 60$ lbs. *(0.27 kN)*

The Z-1011-500 Snubber [FM49] has 1/2" *(13mm)* holes for 3/8" *(10mm)* SAST Anchors [FM57] spaced 6-1/4" *(159mm)* apart. The SAST Anchors [FM57] are derated based on this spacing and the allowable tension load is 1009 lbs *(4.5 kN)* and the shear is 873 lbs *(3.88 kN)*.

Entering these values into the unity equation in ICC-ES-ESR-2713.

$$(238 / 1009) + (60 / 873) = 0.30 < 1.2$$

Since the unity equation is less than 1.2, the 3/8" *(10mm)* SAST [FM57] with 3-1/4" *(83mm)* embedment are adequate.

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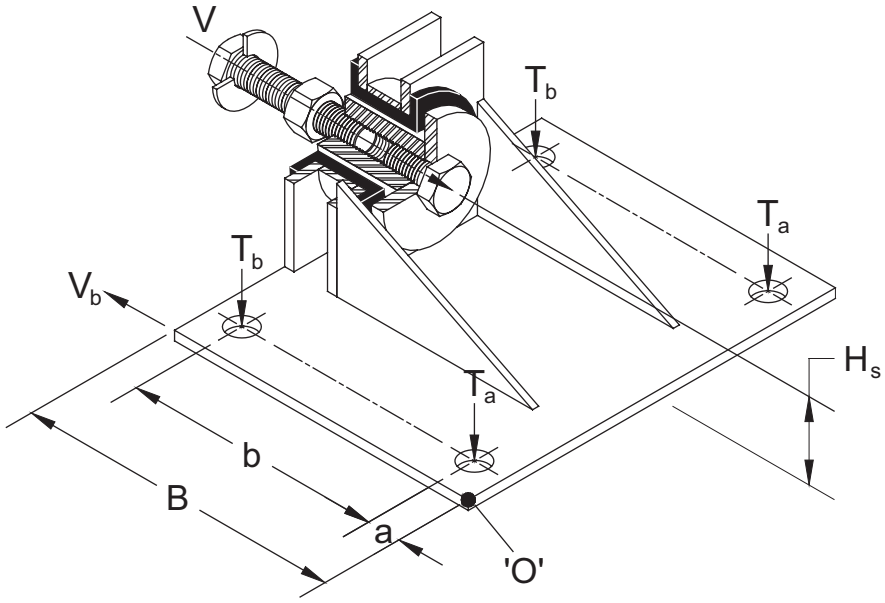
For Z-1225-3000 to 5000 Seismic Snubbers [FM50]:

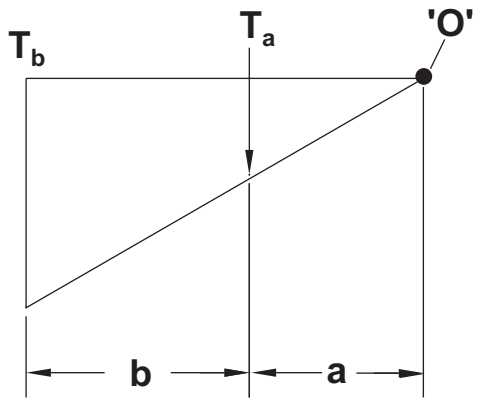
Summing Moments about 'O':

$$T_b = \frac{V(H_s)+T(B)}{(\frac{N_b}{2})(a+b+\frac{a^2}{(a+b)})}$$

$$V_b = \frac{V}{N_b}$$



Where,
From Overturning Calculations:
T= Maximum Tension on Snubber
V = Maximum Shear on Snubber
H_s = Height to Snubber Contact Point
B = Snubber Base Width
a = Edge Distance to Anchor Bolts
b = Spacing Between Anchor Bolts along Width
N_b= Number of Anchor Bolts = 4
T_b= Maximum Tension per Anchor Bolt
V_b= Shear per Anchor Bolt



$$T_a = \frac{T_b \times a}{(a + b)}$$

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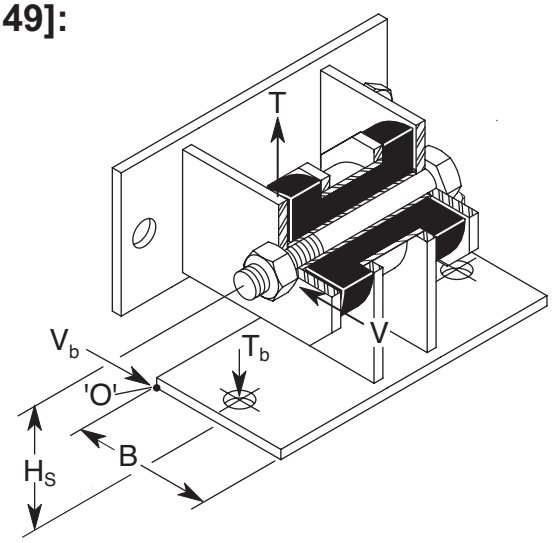
For Z-1011-500 to 1250 Seismic Snubbers [FM49]:

Summing Moments about 'O':

$$T_b = \frac{V(H_s)}{\frac{N_b(B)}{2}} + \frac{T}{N_b}$$

$$V_b = \frac{V}{N_b}$$



Where,

From Overturning Calculations:

T= Maximum Tension on Snubber

V= Maximum Shear on Snubber

H = Height to Snubber Contact Point

B = Snubber Base Width

N_b= Number of Anchor Bolts = 2

T_b= Tension per Anchor Bolt

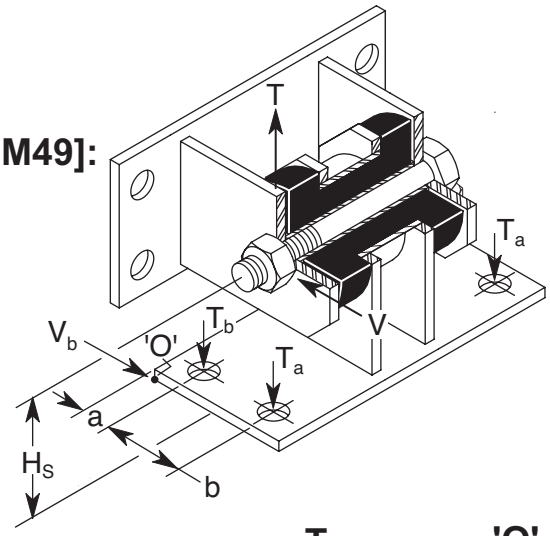
V_b = Shear per Anchor Bolt

For Z-1011-5000 to 25000 Seismic Snubbers [FM49]:

Summing Moments about 'O':

$$T_b = \frac{V(H_s)}{(\frac{N_b}{2})(a+b+(\frac{a^2}{a+b}))} + \frac{T}{N_b}$$

$$V_b = \frac{V}{N_b}$$



Where,

From Overturning Calculations:

T= Maximum Tension on Snubber

V = Maximum Shear on Snubber

H = Height to Snubber Contact Point

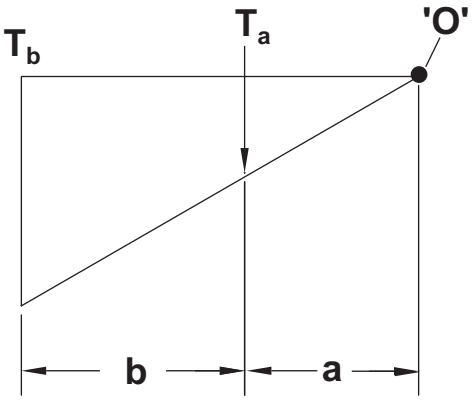
a = Edge Distance to Anchor Bolts

b = Spacing Between Anchor Bolts along Width

N_b= Number of Anchor Bolts = 4

T_b= Maximum Tension per Anchor Bolt

V_b= Shear per Anchor Bolt



$$T_a = \frac{T_b \times a}{(a + b)}$$

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DYNAMIC ANALYSIS OF FLOOR MOUNTED EQUIPMENT

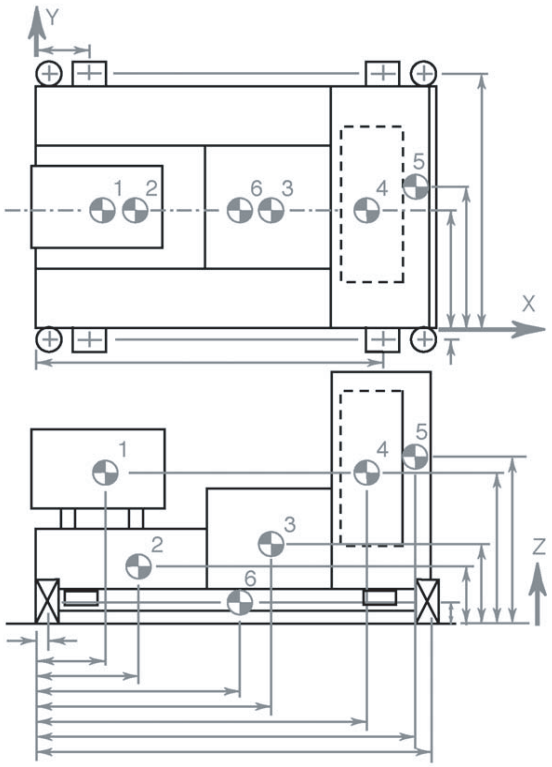
Static calculation methods are used to verify the equipment anchorage is adequate to resist the lateral forces determined by the appropriate design code. These static determinations do not consider the effects of support resonance, restraint resonance or restraint design. Airgaps of over 1/4" *(6 mm)*, and no or inadequate cushioning can amplify statically calculated forces by factors as high as 20.

Proper restraint, with maximum airgaps of 1/4" *(6 mm)*, and thick, resilient cushioning keep amplification to a minimum and protect equipment from high accelerations that could cause severe damage.

The Z-1011 [FM49] snubber system was designed to minimize amplification and protect equipment components and connections. The design and certification of the snubber system can be used in one of two ways. First, as the basis of design for static code compliant calculations, as shown in previous sections of this manual. The small airgaps and 3/4" *(20 mm)* cushioning will limit forces to the equipment and anchor bolts although it is not calculated.

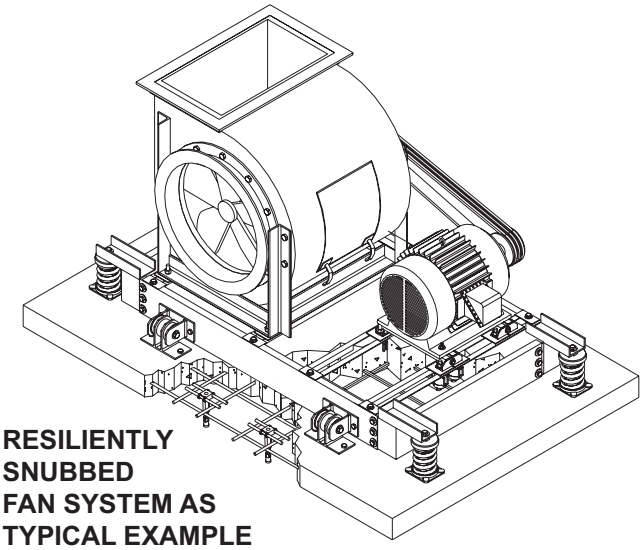
Second, as a more advanced method, in a dynamic analysis to determine snubber forces, equipment displacements, and maximum acceleration of the equipment components in as many as 26 locations. These analyses are run with site and structure-specific response spectra to accurately model the system's reponse to the earthquake.

FM34 is a summary of this program.



1 - CG MOTOR
2 - CG MOTOR PEDESTAL
3 - CG BEARING PEDESTAL
4 - CG FAN WHEEL
5 - CG FAN HOUSING
6 - CG BASE

MATHEMATICAL MODEL OF SNUBBED FAN SYSTEM



RESILIENTLY SNUBBED FAN SYSTEM AS TYPICAL EXAMPLE

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TECHNICAL DESCRIPTION of Z-1011
COMPUTER DYNAMIC ANALYSIS PROGRAM

Modeling Assumptions

Equipment is modeled as a single, three-dimensional rigid body composed of several rigidly attached lumped masses. Each support is modeled as a combination of linear springs and air gaps as shown in Sketch A. With these assumptions, the system is conservative and has six natural modes and frequencies.

Method of Analysis

An approximate solution is obtained employing a response spectrum technique. The final solution is obtained as a combination of modal responses in the form of a “most probable” value (rms of six modes) and an “upperbound” value (sum of absolute values of six modes).

The solution technique is motivated by the following three properties of linear systems:

1. Rayleigh’s principle, which for conservative systems states that in any mode, maximum kinetic energy equals maximum potential energy.
2. The earthquake response spectrum which yields the maximum kinetic energy as a function of natural frequency.

These principles are applied to the nonlinear snubber-isolator system by the assumption that:

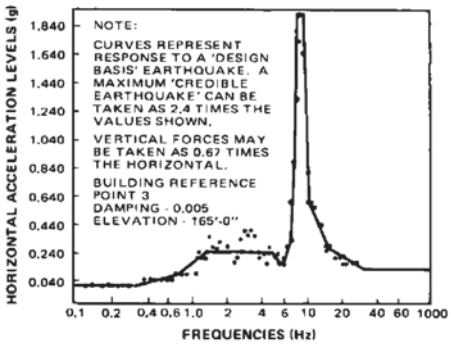
3. At each support, the nonlinear snubber-isolator spring combi-nation may be replaced by a single equivalent linear spring which is dependent on the displacement amplitudes, as depicted in Sketch B.

Thus, (1) and (2) yield displacement amplitude as a function of natural frequencies, and (3) yields natural frequencies as a function of displacement amplitude.

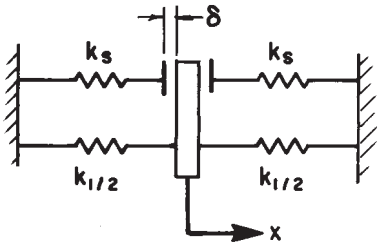
This transcendental relationship is solved by an iterative procedure as follows: from the non-snubbed natural frequencies, the modal kinetic energies are determined using the response spectrum. By equating kinetic and potential energies, the non-linear displacement amplitudes are obtained numerically. From these displacements, a new estimate of effective natural frequency is obtained using the equivalent linear support stiffnesses. The procedure is continued until the natural frequencies converge.

Our interactive computer program utilizing the above solution technique runs on a PDP-10 time-sharing system. The program provides estimates of maximum response, displacement and acceleration at any location of the system. In particular, the program provides direct read-out of maximum displacement and force load at each equipment component as well as any remote connection. The program can simultaneously accept three different sets of response data (one for each mode) if required.

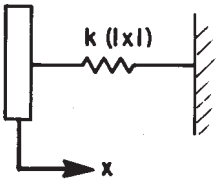
ACCELERATION RESPONSE SPECTRUM



COMPUTER MODELING DIAGRAMS



SKETCH A



SKETCH B

δ .. SNUBBER AIR GAP
k_S .. SNUBBER STIFFNESS
k_I .. ISOLATOR STIFFNESS
X .. SUPPORT DISPLACEMENT
k(|x|).. EQUIVALENT LINEAR STIFFNESS

TYPICAL IN x, y AND z DIRECTIONS

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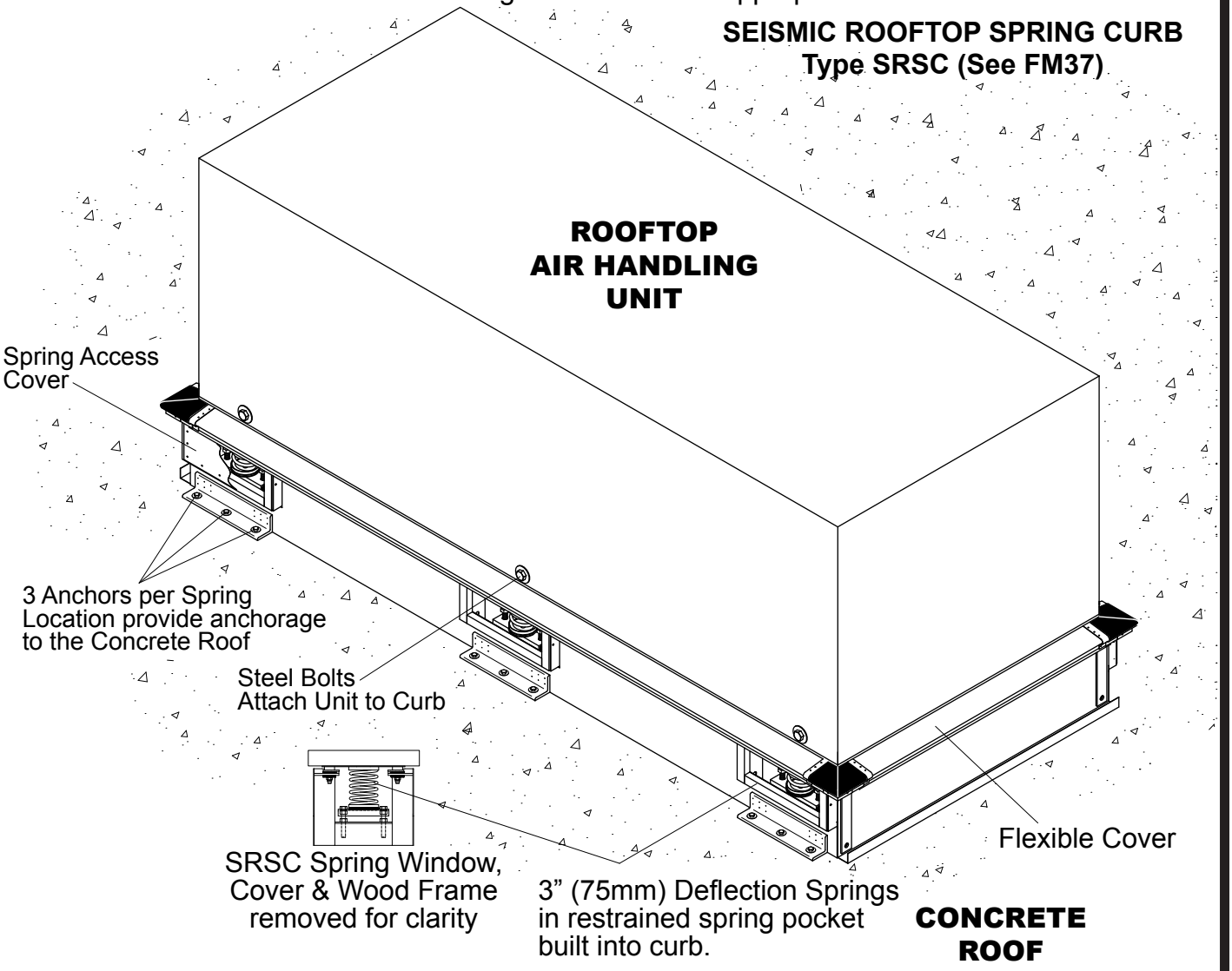
Hospitals and other buildings use roof top Air Handlers that would vibrate the structure and transmit Airborne Noise. Since the supporting roof curb is part of the air stream, the requirement is an air tight Vibration Isolation Curb with additional downward sound reduction reinforcement. The rooftop location in seismic zones means, resistance to the highest seismic loads along with rooftop wind forces. Three inch (75mm) deflection steel springs on rubber pads within captive housings both reduce the vibration by some 95% and help the optional acoustical package lower the noise level in the occupied space. below about 26 dBA. Our SRSC Curbs meet these conditions structurally with approval OPA-0207. Three inch (75mm) deflection springs built into structural curb pockets with restraints reduce the vibration to less than acceptable limits and tests show reductions of 26 dBA when the acoustical package is added. Both the rooftop equipment attachment to the base and the base anchors to the roof building structure follow appropriate codes.

SEISMIC ROOFTOP SPRING CURB
Type SRSC (See FM37)



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California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0207 January 6, 2003

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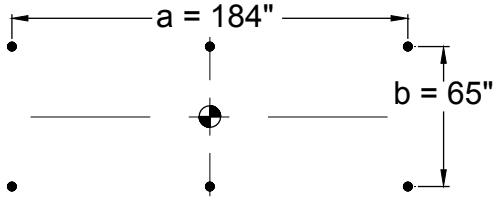
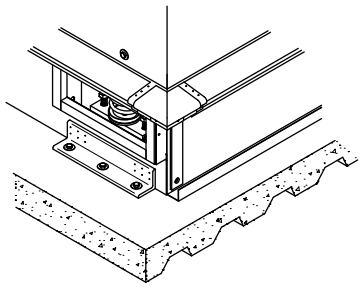
Dhiru Mali
Structural Engineer
California SE No. 281 1

Example No. 8– SRSC Curb attached to 3 1/2" Q-Deck with Normal Weight Concrete

S_{DS} = 0.62, F_P = 1.0 G, W_P = 5000 lbs
$F_{PV} = 0.2\ S_{DS}\ W_P = 0.2 \times 0.62 \times 5000 = 620$ lbs (2.76 kN)
N_F = # of fasteners/windows of unit to curb = 6
n1 = # of fasteners affected due to overturning in width = 3
n2 = # of fasteners affected due to overturning in length = 2
a- distance between outermost fasteners along length = 184"
b- distance between outermost fasteners along width = 65"
H_{cg} = center of gravity in vertical direction = 45"



$$\Theta = TAN^{-1}\left(\frac{n2 \times a}{n1 \times a}\right) = TAN^{-1}\left(\frac{2 \times 184}{3 \times 65}\right) = 62°$$



$$T = (-W_P + F_{PV} / N_F + (F_P \times H_{cg} \times \left(\frac{\cos\Theta}{n2 \times a}\right) + \left(\frac{\sin\Theta}{n1 \times b}\right)$$

$$= (-5000 + 620 / 6 + (5000 \times 45 \times \left(\frac{\cos 62}{2 \times 184}\right) + \left(\frac{\sin 62}{3 \times 65}\right)$$

T = 576 lbs (2.56 kN)
$V = F_P / N_F = 5000 / 6 = 833$ lbs (3.71 kN)

Assuming unit does <u>not</u> fully overhang RSC top rail, and using 1/2" A307 bolts:

$f_t = T / TSA = 576$ lbs / 0.142 in^2 = 4056 psi

$f_v = V / RA = 833$ lbs / 0.126 in^2 = 6611 psi

$F_{v\ allow}$ = 10000 psi > $F_V F$

$F_{t\ allow} = 26000 - 1.8 \times f_v \leq 20000$ psi

$F_{t\ allow}$ = 14100 lbs > F_t

H_C = Height of curb = 20 in.

$$t = \frac{F_P\ (H_{cg} + H_c) + (-W + F_{PV}) \times b/2}{(N_P/2) \times b \times 3\ anchors} = \frac{5000\ (45 + 20) + (-5000 + 620) \times 65/2}{(6/2) \times 65 \times 3\ anchors} = 312\ lbs\ (1.39\ kN)$$

$$v = \frac{F_P}{(N_f) \times 3\ anchors} = \frac{5000}{(6) \times 3} = 278\ lbs\ (1.24\ kN)$$

Using a $^1/_2$"-SAS anchor with $2^3/_4$" embedment:

$$\frac{t}{T_{ALL\ (ASD)}} + \frac{v}{V_{ALL\ (ASD)}} \leq 1.2$$

$$\frac{312}{980} + \frac{278}{1055} \leq 1.2$$

$0.58 \leq 1.2$

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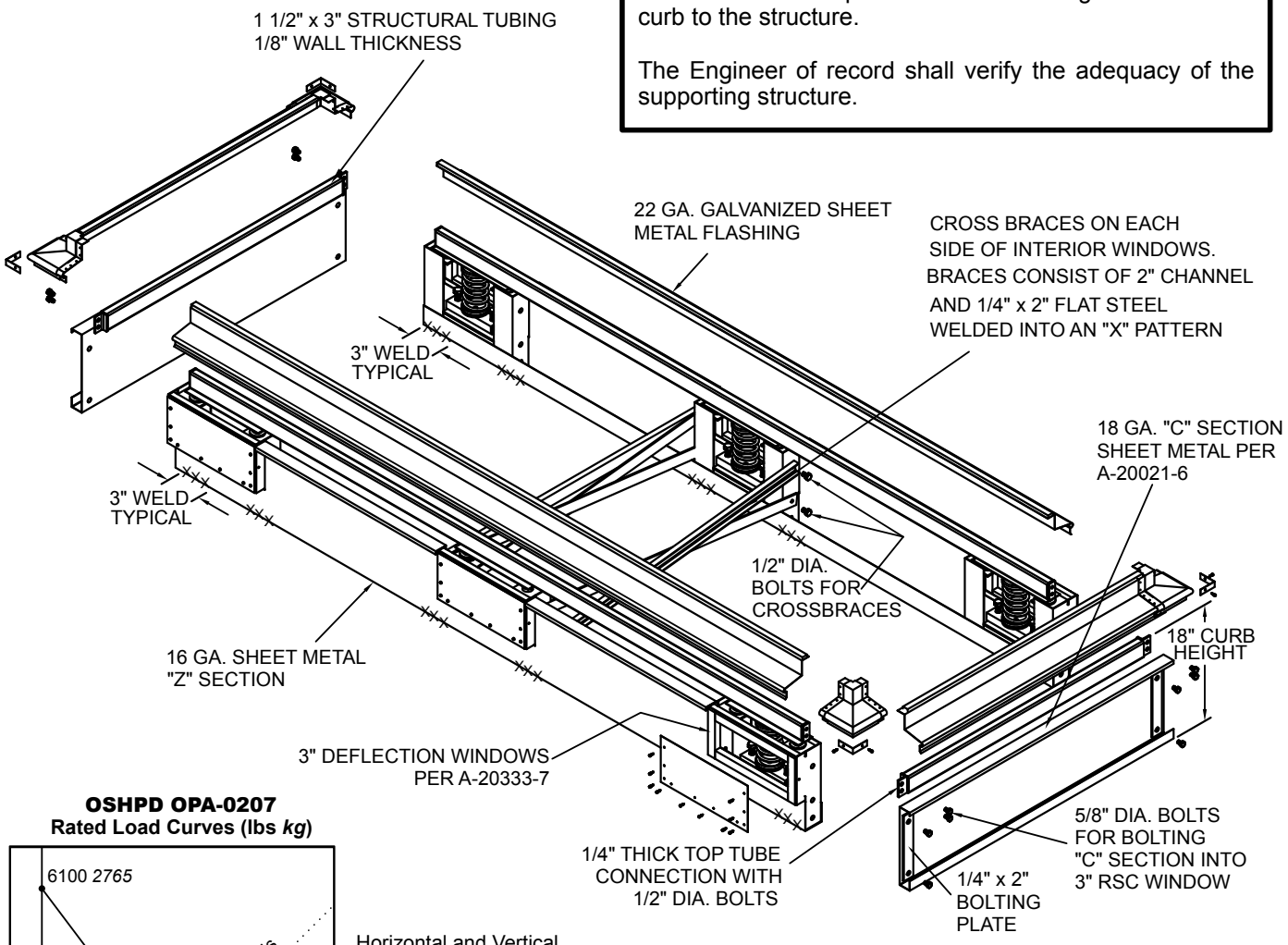
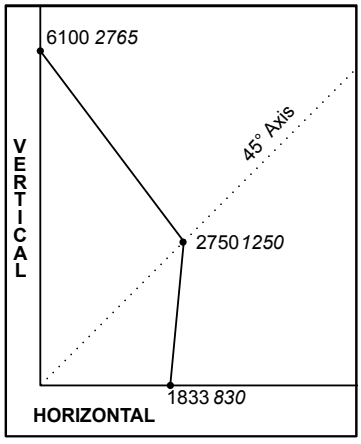
SRSC 3"(*75mm*) Defl. Seismic Roof Curb

The Pre-Approval is for the capacity of the curb only and calculations are required for the anchorage details of the curb to the structure.

The Engineer of record shall verify the adequacy of the supporting structure.



OSHPD OPA-0207
Rated Load Curves (lbs *kg*)



Horizontal and Vertical plotted Ratings are California OSHPD approved values having the OSHPD Anchorage Preapproval Number OPA-0207. Testing and calculations were performed to meet OSHPD criteria. Ratings are for a single window.

To use approved OSHPD rated load curves:
1) Calculate Vertical and Horizontal Forces on mounting including translations and overturning.
2) Plot Horizontal Load vs Vertical Load. The point must fall within the area below the OSHPD curve.

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California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0207 January 6, 2003

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Richard Pastorino
Civil Engineer
California CE No. 30112

SLR 1"(*25mm*) Defl. A Springs

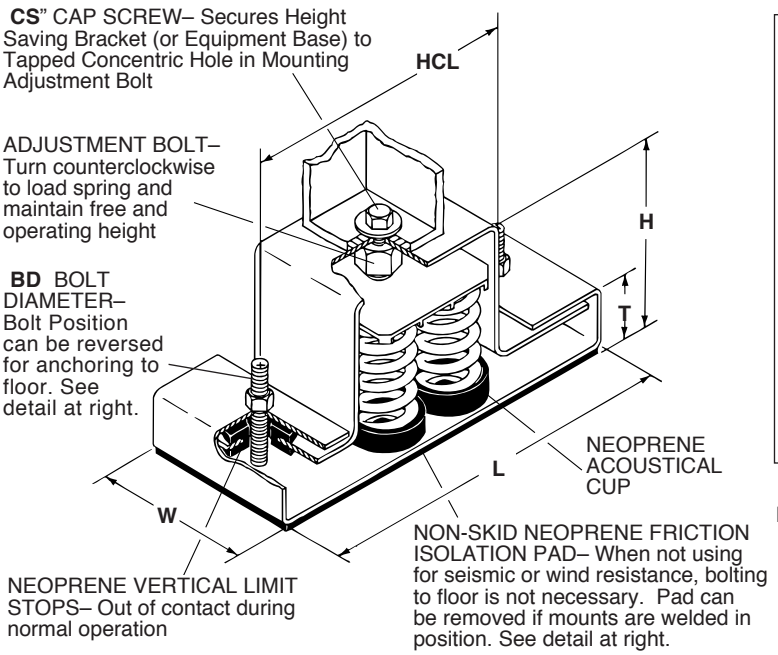


Illustration shows a 4 spring SLR-4A. SLR-A has 1 spring and SLR-2A has 2 springs.

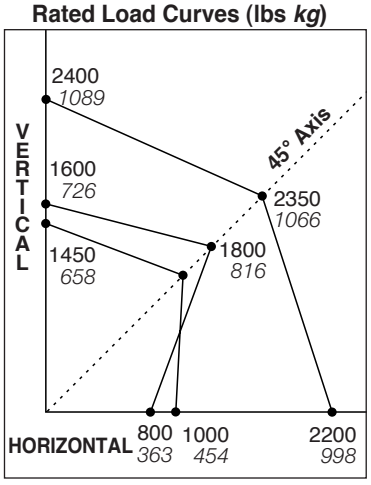
Mounts are galvanized.

All springs have additional travel to solid equal to 50% of the rated deflection.

Solid Spring Height = Free Height minus 1.5 times Rated Deflection.

OSHPD OPA-0195

Rated Load Curves (lbs *kg*)



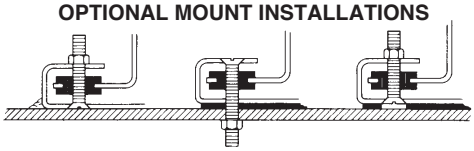
For kN divide kg by 102

Horizontal and Vertical plotted Ratings are California OSHPD approved values having the OSHPD Anchorage Preapproval Number OPA-0195. Testing and calculations were performed to meet OSHPD criteria.

To use approved OSHPD rated load curves: 1) Calculate Vertical and Horizontal Forces on mounting including translations and overturning moments.
2) Plot Horizontal Load vs Vertical Load. The point must fall within the area below the OSHPD curve.

NOTE: Maximum G rating applies to mounting only without base plate

OPTIONAL MOUNT INSTALLATIONS



WELDED IN POSITION | BOLTED IN POSITION | HELD IN PLACE BY FRICTION PAD

TYPE SLR RATINGS

Type & Size	Rated Capacity (lbs) *(kg)*	Rated Defl (in) *(mm)*	Spring Constant (lbs/in)*(kg/mm)*	Spring Color	Max. Horiz Static G Rating
SLR-A-45	45 *20*	1.60 *41*	28 *0.5*	Blue	17.8
SLR-A-75	75 *34*	1.50 *38*	50 *0.9*	Orange	10.7
SLR-A-125	125 *57*	1.33 *34*	94 *1.7*	Brown	6.4
SLR-A-200	200 *91*	1.15 *29*	174 *3.1*	Black	4.0
SLR-A-310	310 *141*	1.00 *25*	310 *5.6*	Yellow	2.6
SLR-A-400	400 *181*	1.00 *25*	400 *7.2*	Green	2.0
SLR-A-510	510 *231*	1.00 *25*	510 *9.2*	Red	1.6
SLR-A-625	625 *283*	1.00 *25*	625 *11.3*	White	1.3
SLR-2A-620	620 *281*	1.00 *25*	620 *11.2*	Yellow	1.6
SLR-2A-800	800 *363*	1.00 *25*	800 *14.5*	Green	1.3
SLR-2A-1020	1020 *463*	1.00 *25*	1020 *18.5*	Red	1.0
SLR-2A-1250	1250 *567*	1.00 *25*	1250 *22.7*	White	0.8
SLR-4A-1240	1240 *563*	1.00 *25*	1240 *22.5*	Yellow	1.8
SLR-4A-1600	1600 *726*	1.00 *25*	1600 *29.0*	Green	1.4
SLR-4A-2040	2040 *925*	1.00 *25*	2040 *37.0*	Red	1.1
SLR-4A-2500	2500 *1134*	1.00 *25*	2500 *45.4*	White	0.9

Horizontal G Ratings are for quick reference only– Use OSHPD Rated Load Curves.

Housing load ratings expressed in max. G s are based on tests with bolted connections to steel top and bottom. SLR housings require uniform support under entire base plate.

TYPE SLR DIMENSIONS (inches *mm*)

Size	H	L	T	W	BD	CS	HCL
SLR-A	5 1/8 *130*	8 3/4 *222*	1 5/8 *41*	2 1/2 *64*	3/8 *10*	3/8 -16UNC x 1 *3/8"-16UNC x 25*	6 *152*
SLR-2A	5 1/8 *130*	11 5/8 *295*	1 3/4 *41*	2 1/2 *64*	3/8 *10*	3/8 -16UNC x 1 *3/8"-16UNC x 25*	8 3/4 *222*
SLR-4A	5 1/8 *130*	11 1/8 *283*	1 3/4 *41*	4 1/2 *114*	1/2 *13*	1/2 -13UNC x11 1/4 *1/2"-13UNC x 32*	8 *203*

SPRING DATA

Size	Spring OD (in) (mm)	Free Ht. (in)	(mm)	Ratio Kx/Ky	Ratio OD/OH
A	1 3/4 *44*	3-3 3/8	*76-86*	0.50-0.90	0.74-1.25

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APPROVED

California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0195 January 6, 2003

Bill Staehlin (916) 654-3362

Gummadi Dharma Reddy
Civil Engineer
California No. 29627

SLREBP (Extended Base Plate)
1"(*25mm*) Defl. A Springs

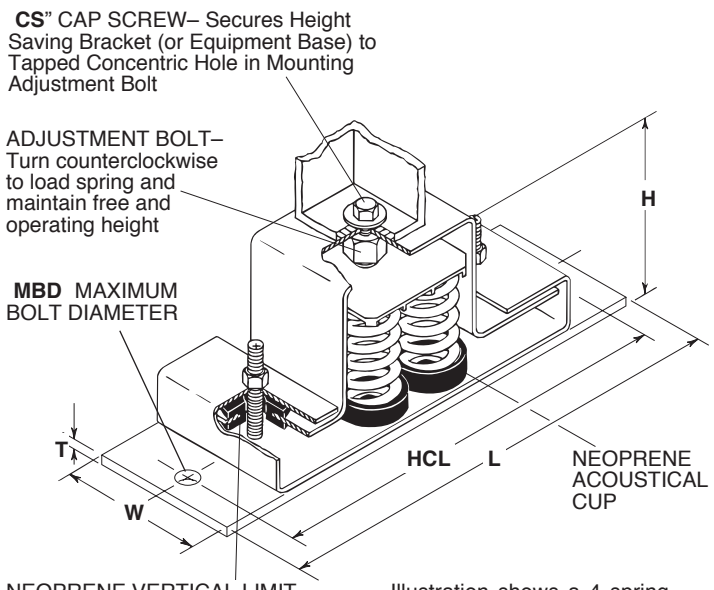
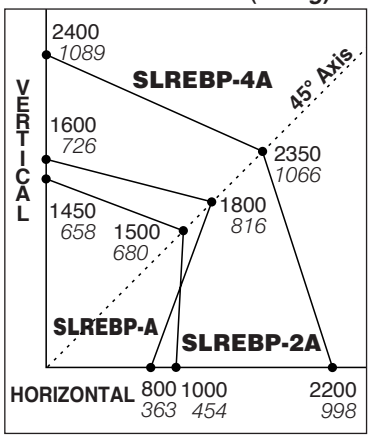


Illustration shows a 4 spring SLREBP-4A. SLREBP-A has 1 spring and SLREBP-2A has 2 springs. Mounts are galvanized.

All springs have additional travel to solid equal to 50% of the rated deflection.

Solid Spring Height = Free Height minus 1.5 times Rated Deflection.

OSHPD OPA-0195
Rated Load Curves (lbs *kg*)



For kN divide kg by 102

Horizontal and Vertical plotted Ratings are California OSHPD approved values having the OSHPD Anchorage Preapproval Number OPA-0195. Testing and calculations were performed to meet OSHPD criteria.

To use approved OSHPD rated load curves: 1) Calculate Vertical and Horizontal Forces on mounting including translations and overturning moments. 2) Plot Horizontal Load vs Vertical Load. The point must fall within the area below the OSHPD curve.

Housing load ratings expressed in max. G s are based on tests with bolted connections to steel top and bottom. SLREBP housings require uniform support under entire base plate.

*NOTE: Maximum G rating applies to mounting only without extended base plate. Typical base plate shown. Extended base plates are submitted for approval on a job by job basis.

TYPE SLREBP RATINGS

Type & Size	Rated Capacity (lbs) *(kg)*	Rated Defl (in) *(mm)*	Spring Constant (lbs/in)*(kg/mm)*	Spring Color	Max. Horiz Static G Rating
SLREBP-A-45	45 *20*	1.60 *41*	28 *0.5*	Blue	17.8
SLREBP-A-75	75 *34*	1.50 *38*	50 *0.9*	Orange	10.7
SLREBP-A-125	125 *57*	1.33 *34*	94 *1.7*	Brown	6.4
SLREBP-A-200	200 *91*	1.15 *29*	174 *3.1*	Black	4.0
SLREBP-A-310	310 *141*	1.00 *25*	310 *5.6*	Yellow	2.6
SLREBP-A-400	400 *181*	1.00 *25*	400 *7.2*	Green	2.0
SLREBP-A-510	510 *231*	1.00 *25*	510 *9.2*	Red	1.6
SLREBP-A-625	625 *283*	1.00 *25*	625 *11.3*	White	1.3
SLREBP-2A-620	620 *281*	1.00 *25*	620 *11.2*	Yellow	1.6
SLREBP-2A-800	800 *363*	1.00 *25*	800 *14.5*	Green	1.3
SLREBP-2A-1020	1020 *463*	1.00 *25*	1020 *18.5*	Red	1.0
SLREBP-2A-1250	1250 *567*	1.00 *25*	1250 *22.7*	White	0.8
SLREBP-4A-1240	1240 *563*	1.00 *25*	1240 *22.5*	Yellow	1.8
SLREBP-4A-1600	1600 *726*	1.00 *25*	1600 *29.0*	Green	1.4
SLREBP-4A-2040	2040 *925*	1.00 *25*	2040 *37.0*	Red	1.1
SLREBP-4A-2500	2500 *1134*	1.00 *25*	2500 *45.4*	White	0.9

SPRING DATA

Size	Spring OD (in) *(mm)*	Free Ht. (in)	Free Ht. *(mm)*	Ratio Kx/Ky	Ratio OD/OH
A	1 3/4 *44*	3-3 3/8	*76-86*	0.50-0.90	0.74-1.25

TYPE SLREBP DIMENSIONS (inches *mm*)

Size	H	L	T	W	CS	MBD	HCL
SLREBP-A	5 1/4 *133*	12 1/4 *311*	1/4 *6*	2 1/2 *64*	3/8 -16UNC x1 *3/8"-16UNC x 25*	1/2 *13*	10 3/4 *273*
SLREBP-2A	5 1/4 *133*	15 5/8 *397*	1/4 *6*	3 *76*	3/8 -16UNC x1 *3/8"-16UNC x 25*	5/8 *16*	13 7/8 *352*
SLREBP-4A	5 1/4 *133*	15 5/8 *397*	1/4 *6*	4 1/2 *114*	1/2 -13UNC x1 1/4 *1/2"-13UNC x 32*	3/4 *19*	13 5/8 *346*

Horizontal G Ratings are for quick reference only
Use OSHPD Rated Load Curves.

APPROVED

California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0195 January 6, 2003

Bill Staehlin (916) 654-3362

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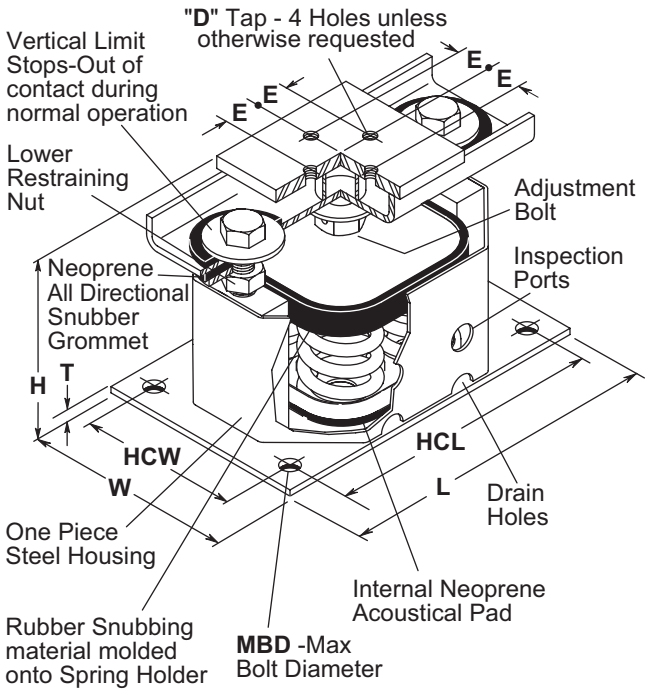
Gummadi Dharma Reddy
Civil Engineer
California No. 29627

SLRS 1"(*25mm*) Defl. B, 1 - 4 Springs



TYPE SLRS DIMENSIONS (inches and *mm*)

Size	H	T	D	E	L	HCL	W	HCW	MBD
B	8 5/8 *219*	1/4 *6*	1/2 *13*	1 1/8 *29*	8 1/2 *216*	7 *178*	4 1/4 *108*	2 3/4 *70*	5/8 *16*
1	8 5/8 *219*	1/4 *6*	5/8 *16*	1 3/8 *35*	9 1/2 *241*	7 1/2 *191*	5 1/4 *133*	3 1/2 *89*	5/8 *16*
2	8 5/8 *219*	1/4 *6*	5/8 *16*	1 3/8 *35*	14 *356*	12 1/4 *311*	5 1/4 *133*	3 1/2 *89*	5/8 *16*
4	8 5/8 *219*	1/4 *6*	7/8 *22*	1 3/8 *35*	13 *330*	11 *279*	8 3/8 *213*	6 1/4 *159*	3/4 *19*

TYPE SLRS RATINGS

SLRS Size	Rated Capacity (lbs) *(kg)*	Rated Defl (in) *(mm)*	Spring Constant (lbs/in)*(kg/mm)*	Max. G Rating	Spring Color
B-65	65 *29*	2.10 *53*	31 *0.55*	24.6	Brown
B-85	85 *39*	2.10 *53*	40 *0.74*	18.9	Wht/Blk
B-115	115 *52*	2.00 *51*	57 *1.02*	13.9	Silver
B-150	150 *68*	2.00 *51*	75 *1.33*	10.6	Orange
B-280	280 *127*	1.60 *41*	174 *3.10*	5.7	Green
B-450	450 *204*	1.31 *33*	344 *6.18*	3.5	Red
B-750	750 *340*	1.12 *28*	670 *12.14*	2.1	White
B-1000	1000 *454*	1.00 *25*	1000 *18.16*	1.6	Blue
1-1000	1000 *454*	1.00 *25*	1000 *18.16*	6.0	Black
1-1350	1350 *612*	1.00 *25*	1350 *24.48*	4.4	Yellow
1-1750	1750 *794*	1.00 *25*	1750 *31.76*	3.4	Black*
1-2100	2100 *953*	1.00 *25*	2100 *38.12*	2.8	Yellow
1-2385	2385 *1082*	1.00 *25*	2385 *43.28*	2.5	Yellow**
1-2650	2650 *1202*	1.00 *25*	2650 *48.08*	2.3	Red*
1-2935	2935 *1331*	1.00 *25*	2935 *53.24*	2.0	Red**
2-3500	3500 *1588*	1.00 *25*	3500 *63.52*	1.5	Black*
2-4200	4200 *1905*	1.00 *25*	4200 *76.20*	1.2	Yellow*
2-4770	4770 *2164*	1.00 *25*	4770 *86.56*	1.1	Yellow**
4-5400	5400 *2449*	1.00 *25*	5400 *97.96*	2.0	Yellow
4-7000	7000 *3175*	1.00 *25*	7000 *127.00*	1.6	Black*
4-8400	8400 *3810*	1.00 *25*	8400 *152.40*	1.3	Yellow*
4-9540	9540 *4327*	1.00 *25*	9540 *173.08*	1.2	Yellow**
4-10600	10600 *4808*	1.00 *25*	10600 *192.32*	1.1	Red*
4-11740	11740 *5325*	1.00 *25*	11740 *213.00*	0.9	Red**

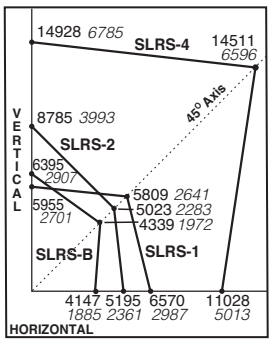
*with Red inner spring **with Green inner spring

Illustration above shows a SLRS-4 with four C springs. Not shown are SLRS-B, which has one B spring, SLRS-1 with one C spring, SLRS-2 with two C springs.

Housing load ratings expressed in G s are based on tests with bolted connections to steel top and bottom. SLRS housings require uniform support under entire base plate.

SLRS mounts include seismic and wind restraints with code compliant all-directional neoprene bushings and 1/4 maximum air gap.

OSHPD OPA-194
Rated Load Curves (lbs *kg*)



Horizontal, Vertical and 45 plotted Ratings are California OSHPD approved values having the OSHPD Anchorage Preapproval Number OPA-0194. Testing and calculations were performed to meet OSHPD criteria.

To use approved OSHPD rated load curves:

1) Calculate Vertical and Horizontal Forces on mountings including translations and overturning moments.
2) Plot Horizontal and Vertical Loads. The intersection must fall within the area below the OSHPD curve.

SPRING CHARACTERISTICS (inches and *mm*)

Spring Size	OD	Free Height	Ratio Kx/Ky	Ratio OD/OH
B	2 3/8 *60*	4 *102*	0.70-0.90	0.80-1.25
C	2 7/8 *73*	4 1/8 *105*	0.90-1.10	0.92

All springs have an additional travel to solid equal to 50% of the rated deflection.

Solid Spring Height = Free Height minus 1.5 times the Rated Deflection.

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APPROVED
California Office of Statewide Health Planning and Development
FIXED EQUIPMENT ANCHORAGE
OPA-0194 January 6, 2003
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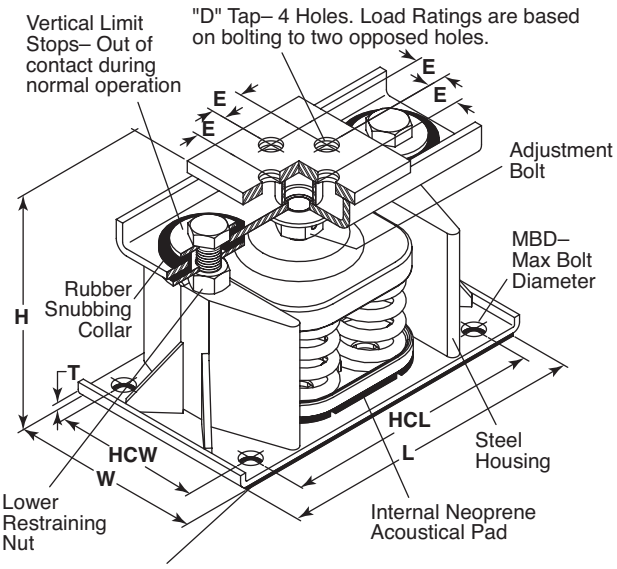
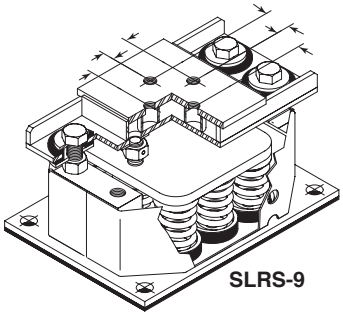
Gummadi Dharma Reddy
Civil Engineer
California No. 29627

SLRSO 1"(*25mm*) Defl. B, 1 - 9 Springs



Non-Skid Pad is used in Non-Seismic zones only. Remove pad prior to bolting. Reduce published height by 1/8" if pad is removed.

Illustration above shows a SLRSO-4 housing with four C springs.



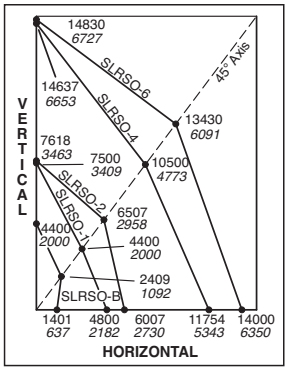
SLRS-9

SLRS-9 has nine C springs and has closed sides. Not shown are SLRSO-B with one B spring and SLRSO-1, SLRSO-2 & SLRSO-6 with one, two and six C springs respectively.

All springs have an additional travel to solid equal to 50% of the rated deflection.

Designs using these mounts to resist wind loads must be in accordance with ASCE 7-05.

OSHPD OPA-194
Rated Load Curves (lbs *kg*)



All mounts except SLRS-9 are awaiting OSHPD-194 approval. SLRS-9 has not been submitted.

Horizontal, Vertical and 45 plotted Ratings are California OSHPD submitted values having the OSHPD Anchorage Preapproval Number OPA-0194. Testing and calculations were performed to meet OSHPD criteria.

To use OSHPD submitted rated load curves:

1) Calculate Vertical and Horizontal Forces on mountings including translations and overturning moments.
2) Plot Horizontal and Vertical Loads. The intersection must fall within the area below the OSHPD curve.

TYPE SLRSO and SLRS DIMENSIONS (inches and *mm*)

Size	H	T	D	E	L	HCL	W	HCW	MBD
SLRSO-B	8 3/4 *222*	3/8 *10*	1/2 *13*	1 1/8 *29*	8 1/2 *216*	7 *178*	4 1/4 *108*	2 3/4 *70*	5/8 *16*
SLRSO-1	8 3/4 *222*	3/8 *10*	5/8 *16*	1 3/8 *35*	9 1/2 *241*	7 1/2 *191*	5 1/4 *133*	3 1/2 *89*	5/8 *16*
SLRSO-2	8 3/4 *222*	3/8 *10*	5/8 *16*	1 3/8 *35*	14 *356*	12 1/4 *311*	5 1/4 *133*	3 1/2 *89*	5/8 *16*
SLRSO-4	8 3/4 *222*	3/8 *10*	7/8 *22*	1 3/8 *35*	13 3/4 *350*	11 *279*	8 *203*	6 1/4 *159*	3/4 *19*
SLRSO-6	9 3/4 *248*	3/8 *10*	1 *25*	1 5/8 *41*	19 *483*	15 7/8 *403*	9 *229*	6 *152*	1 *25*
SLRS-9	9 3/4 *248*	5/8 *16*	1 *25*	2 *51*	18 *457*	15 3/4 *400*	13 *330*	10 3/4 *273*	1 *25*

TYPE SLRSO and SLRS RATINGS 1" *25mm* Deflection Series

SLRSO Size	Rated Capacity (lbs)	*(kg)*	Rated Defl (in) *(mm)*	Spring Constant (lbs/in)	*(kg/mm)*	Max. Horiz. Housing G Rating	Spring Color
B-65	65	*29*	2.10 *53*	31	*0.55*	21.6	Brown
B-85	85	*39*	2.10 *53*	40	*0.74*	16.5	Wht/Blk
B-115	115	*52*	2.00 *51*	57	*1.02*	12.2	Silver
B-150	150	*68*	2.00 *51*	75	*1.33*	9.3	Orange
B-280	280	*127*	1.60 *41*	174	*3.10*	5.0	Green
B-450	450	*204*	1.31 *33*	344	*6.18*	3.1	Red
B-750	750	*340*	1.12 *28*	670	*12.1*	1.9	White
B-1000	1000	*454*	1.00 *25*	1000	*18.2*	1.4	Blue
1-1000	1000	*454*	1.00 *25*	1000	*18.2*	4.8	Black
1-1350	1350	*612*	1.00 *25*	1350	*24.5*	3.6	Yellow
1-1750	1750	*794*	1.00 *25*	1750	*31.8*	2.7	Black*
1-2100	2100	*953*	1.00 *25*	2100	*38.1*	2.3	Yellow
1-2385	2385	*1082*	1.00 *25*	2385	*43.3*	2.0	Yellow**
1-2650	2650	*1202*	1.00 *25*	2650	*48.1*	1.8	Red*
1-2935	2935	*1331*	1.00 *25*	2935	*53.2*	1.6	Red**
2-3500	3500	*1588*	1.00 *25*	3500	*63.5*	1.7	Black*
2-4200	4200	*1905*	1.00 *25*	4200	*76.2*	1.4	Yellow*
2-4770	4770	*2164*	1.00 *25*	4770	*86.6*	1.3	Yellow**
4-5400	5400	*2449*	1.00 *25*	5400	*98.0*	2.2	Yellow
4-7000	7000	*3175*	1.00 *25*	7000	*127.0*	1.7	Black*
4-8400	8400	*3810*	1.00 *25*	8400	*152.4*	1.4	Yellow*
4-9540	9540	*4327*	1.00 *25*	9540	*173.1*	1.2	Yellow**
4-10600	10600	*4808*	1.00 *25*	10600	*192.3*	1.1	Red*
4-11740	11740	*5325*	1.00 *25*	11740	*213.0*	1.0	Red**
6-12600	12600	*5715*	1.00 *25*	12600	*228.6*	1.1	Yellow*
6-14310	14310	*6491*	1.00 *25*	14310	*259.6*	1.0	Yellow**
6-15900	15900	*7212*	1.00 *25*	15900	*288.5*	0.9	Red*
6-17610	17610	*7988*	1.00 *25*	17610	*319.5*	0.8	Red**
SLRS Size							
9-18900	18900	*8573*	1.00 *25*	18900	*342.9*		Yellow*
9-21465	21465	*9736*	1.00 *25*	21465	*389.4*		Yellow**
9-23850	23850	*10818*	1.00 *25*	23850	*432.7*		Red*

*with Red inner spring **with Green inner spring SLRS-9 under test

Housing load ratings expressed in G s are based on tests with bolted connections to steel top and bottom. SLRSO & SLRS housings require uniform support under entire base plate.

SPRING CHARACTERISTICS (inches and *mm*)

Spring Size	OD	Free Height	Ratio Kx/Ky	Ratio OD/OH
B	2 3/8 *60*	4 0/0 *102*	0.70-0.80	0.80
C	2 7/8 *73*	4 1/8 *105*	0.90-1.10	0.92

All springs have an additional travel to solid equal to 50% of the rated deflection.

Solid Spring Height = Free Height minus 1.5 times the Rated Deflection.

APPROVAL PENDING

California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0194

Submitted for Approval December, 2007

MASON INDUSTRIES, Inc.
Manufacturers of Vibration Control Products
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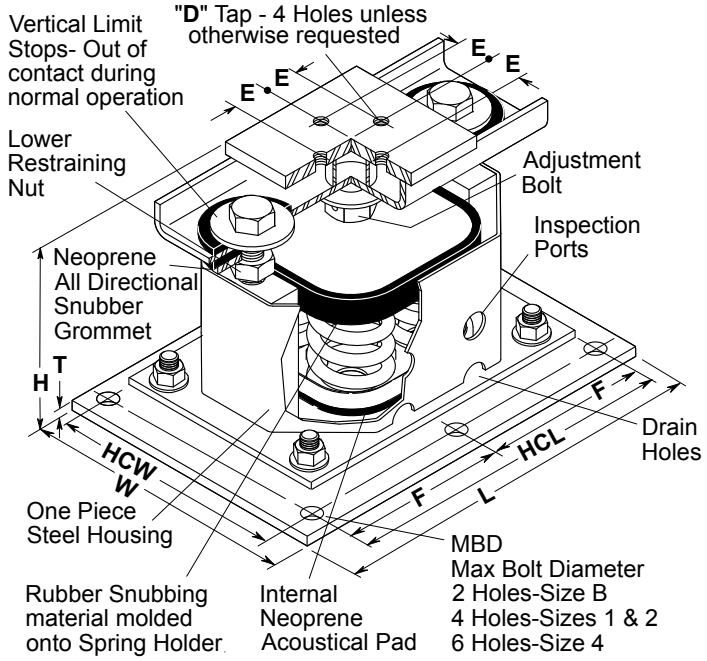
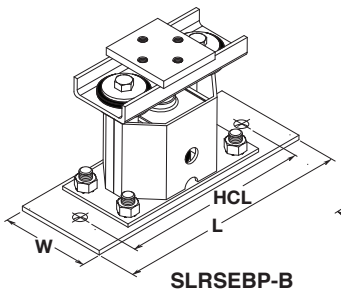
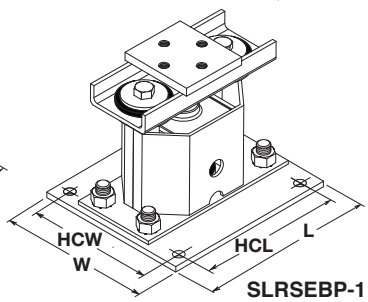
Patrick J. Lama
Civil Engineer
California No. 25878

SLRSEBP(Extended Base Plate)
1"(*25mm*) Defl. B, 1 - 4 Springs



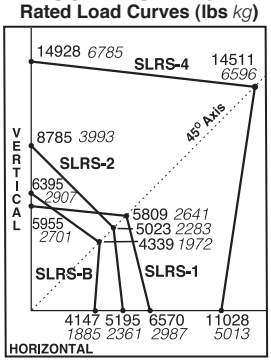


SLRSEBP-B



SLRSEBP-1

OSHPD OPA-194
Rated Load Curves (lbs *kg*)



Horizontal, Vertical and 45 plotted Ratings are California OSHPD approved values having the OSHPD Anchorage Preapproval Number OPA-0194. Testing and calculations were performed to meet OSHPD criteria.

To use approved OSHPD rated load curves:

1) Calculate Vertical and Horizontal Forces on mountings including translations and overturning moments.
2) Plot Horizontal and Vertical Loads. The intersection must fall within the area below the OSHPD curve.

TYPE SLRSEBP DIMENSIONS (inches and *mm*)

Size	H	T	D	E	L	HCL	F	W	HCW	MBD
B	9 *229*	3/8 *10*	1/2 *13*	1 1/8 *29*	13 *330*	10 1/2 *267*	- -	5 *127*	- -	5/8 *16*
1	9 *229*	3/8 *10*	5/8 *16*	1 3/8 *35*	10 *254*	8 *203*	- -	10 *254*	8 *203*	5/8 *16*
2	9 *229*	3/8 *10*	5/8 *16*	1 3/8 *35*	14 1/2 *368*	11 *295*	- -	12 *305*	9 *229*	3/4 *19*
4	9 *229*	3/8 *10*	7/8 *22*	1 3/8 *35*	19 *483*	16 *406*	8 *203*	14 *356*	11 *279*	3/4 *19*

Illustration at right shows a SLRSEBP-4 with four C springs. SLRSEBP-B has one B spring, SLRSEBP-1 has one C spring, and SLRSEBP-2 (not shown) has two C springs.

Housing load ratings expressed in G s are based on tests with bolted connections to steel top and bottom. SLRSEBP housings require uniform support under entire base plate.

Approval applies to mount only. Baseplate not approved. Baseplate shown is satisfactory for most installations. Anchorage and baseplate calculations are provided for all installations. Baseplate modified when required.

SLRS mounts include seismic and wind restraints with code compliant all-directional neoprene bushings and 1/4 maximum air gap.

TYPE SLRSEBP RATINGS

Size	Rated Capacity (lbs) *(kg)*	Rated Defl (in) *(mm)*	Spring Constant (lbs/in)*(kg/mm)*	Max. G Rating	Spring Color
B-65	65 *29*	2.10 *53*	31 *0.55*	24.6	Brown
B-85	85 *39*	2.10 *53*	40 *0.74*	18.9	Wht/Blk
B-115	115 *52*	2.00 *51*	57 *1.02*	13.9	Silver
B-150	150 *68*	2.00 *51*	75 *1.33*	10.6	Orange
B-280	280 *127*	1.60 *41*	174 *3.10*	5.7	Green
B-450	450 *204*	1.31 *33*	344 *6.18*	3.5	Red
B-750	750 *340*	1.12 *28*	670 *12.14*	2.1	White
B-1000	1000 *454*	1.00 *25*	1000 *18.16*	1.6	Blue
1-1000	1000 *454*	1.00 *25*	1000 *18.16*	6.0	Black
1-1350	1350 *612*	1.00 *25*	1350 *24.48*	4.4	Yellow
1-1750	1750 *794*	1.00 *25*	1750 *31.76*	3.4	Black*
1-2100	2100 *953*	1.00 *25*	2100 *38.12*	2.8	Yellow
1-2385	2385 *1082*	1.00 *25*	2385 *43.28*	2.5	Yellow**
1-2650	2650 *1202*	1.00 *25*	2650 *48.08*	2.3	Red*
1-2935	2935 *1331*	1.00 *25*	2935 *53.24*	2.0	Red**
2-3500	3500 *1588*	1.00 *25*	3500 *63.52*	1.5	Black*
2-4200	4200 *1905*	1.00 *25*	4200 *76.20*	1.2	Yellow*
2-4770	4770 *2164*	1.00 *25*	4770 *86.56*	1.1	Yellow**
4-5400	5400 *2449*	1.00 *25*	5400 *97.96*	2.0	Yellow
4-7000	7000 *3175*	1.00 *25*	7000 *127.00*	1.6	Black*
4-8400	8400 *3810*	1.00 *25*	8400 *152.40*	1.3	Yellow*
4-9540	9540 *4327*	1.00 *25*	9540 *173.08*	1.2	Yellow**
4-10600	10600 *4808*	1.00 *25*	10600 *192.32*	1.1	Red*
4-11740	11740 *5325*	1.00 *25*	11740 *213.00*	0.9	Red**

*with Red inner spring **with Green inner spring

SPRING CHARACTERISTICS (inches and *mm*)

Spring Size	OD	Free Height	Ratio Kx/Ky	Ratio OD/OH
B	2 3/8 *60*	4 *102*	0.70-0.90	0.80-1.25
C	2 7/8 *73*	4 1/8 *105*	0.90-1.10	0.92

All springs have an additional travel to solid equal to 50% of the rated deflection.

Solid Spring Height = Free Height minus 1.5 times the Rated Deflection.

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APPROVED
California Office of Statewide Health Planning and Development
FIXED EQUIPMENT ANCHORAGE
OPA-0194 January 6, 2003
Bill Staehlin (916) 654-3362

Gummadi Dharma Reddy
Civil Engineer
California No. 29627

SLRSOEBP(Extended Base Plate)
1"(*25mm*) Defl. B, 1 - 9 Springs

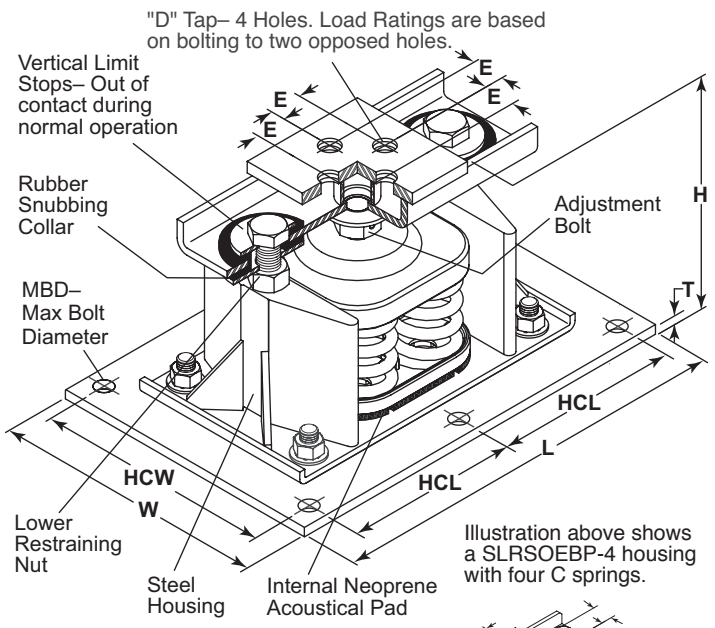
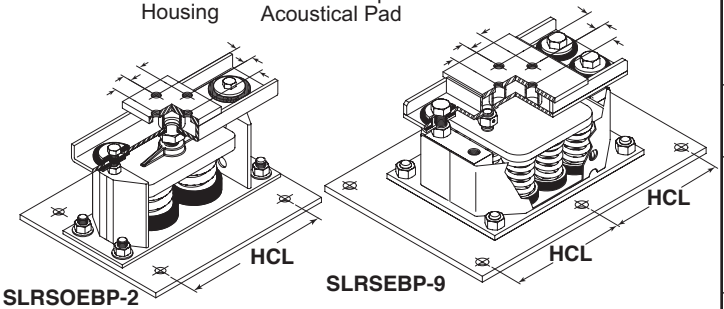


Illustration above shows a SLRSOEBP-4 housing with four C springs.



SLRSOEBP-2 **SLRSEBP-9**

SLRSOEBP-2 has two C springs and SLRSEBP-9 has nine C springs and has closed sides. Not shown are SLRSOEBP-B with one B spring, SLRSOEBP-1 with one C spring and SLRSOEBP-6 with six C springs.

TYPE SLRSOEBP and SLRSEBP DIMENSIONS (inches and *mm*)

Type & Size	H	T	D	E	L	HCL	W	HCW	MBD
SLRSOEBP-B	9 *229*	3/8 *10*	1/2 *13*	11/8 *29*	13 *330*	101/2 *267*	5 *127*	– –	5/8 *16*
SLRSOEBP-1	9 *229*	3/8 *10*	5/8 *16*	13/8 *35*	10 *254*	8 *203*	10 *254*	8 *203*	5/8 *16*
SLRSOEBP-2	9 *229*	3/8 *10*	5/8 *16*	13/8 *35*	141/2 *368*	11 *280*	12 *305*	9 *229*	3/4 *19*
SLRSOEBP-4	9 *229*	3/8 *10*	7/8 *22*	13/8 *35*	19 *482*	8 *203*	14 *356*	11 *280*	3/4 *19*
SLRSOEBP-6	101/4 *260*	1/2 *13*	1 *25*	15/8 *41*	27 *686*	12 *305*	15 *381*	12 *305*	1 *25*
SLRSEBP-9	101/4 *260*	5/8 *16*	1 *25*	2 *51*	27 *686*	12 *305*	19 *483*	16 *406*	1 *25*

TYPE SLRSOEBP & SLRSEBP RATINGS 1" *25mm* **Deflection Series**

SLRSOEBP Size	Rated Capacity (lbs)	*(kg)*	Rated Defl (in)	*(mm)*	Spring Constant (lbs/in)	*(kg/mm)*	Max. Horiz. G Rating Bolted to Concrete	Spring Color
B-65	65	*29*	2.10	*53*	31	*0.55*	21.6	Brown
B-85	85	*39*	2.10	*53*	40	*0.74*	16.5	Wht/Blk
B-115	115	*52*	2.00	*51*	57	*1.02*	12.2	Silver
B-150	150	*68*	2.00	*51*	75	*1.33*	9.3	Orange
B-280	280	*127*	1.60	*41*	174	*3.10*	5.0	Green
B-450	450	*204*	1.31	*33*	344	*6.18*	3.1	Red
B-750	750	*340*	1.12	*28*	670	*12.1*	1.9	White
B-1000	1000	*454*	1.00	*25*	1000	*18.2*	1.4	Blue
1-1000	1000	*454*	1.00	*25*	1000	*18.2*	4.4	Black
1-1350	1350	*612*	1.00	*25*	1350	*24.5*	3.3	Yellow
1-1750	1750	*794*	1.00	*25*	1750	*31.8*	2.5	Black*
1-2100	2100	*953*	1.00	*25*	2100	*38.1*	2.1	Yellow
1-2385	2385	*1082*	1.00	*25*	2385	*43.3*	1.9	Yellow**
1-2650	2650	*1202*	1.00	*25*	2650	*48.1*	1.7	Red*
1-2935	2935	*1331*	1.00	*25*	2935	*53.2*	1.5	Red**
2-3500	3500	*1588*	1.00	*25*	3500	*63.5*	1.7	Black*
2-4200	4200	*1905*	1.00	*25*	4200	*76.2*	1.4	Yellow*
2-4770	4770	*2164*	1.00	*25*	4770	*86.6*	1.3	Yellow**
4-5400	5400	*2449*	1.00	*25*	5400	*98.0*	1.7	Yellow
4-7000	7000	*3175*	1.00	*25*	7000	*127.0*	1.3	Black*
4-8400	8400	*3810*	1.00	*25*	8400	*152.4*	1.1	Yellow*
4-9540	9540	*4327*	1.00	*25*	9540	*173.1*	1.0	Yellow**
4-10600	10600	*4808*	1.00	*25*	10600	*192.3*	0.9	Red*
4-11740	11740	*5325*	1.00	*25*	11740	*213.0*	0.8	Red**
6-12600	12600	*5715*	1.00	*25*	12600	*228.6*	0.8	Yellow*
6-14310	14310	*6491*	1.00	*25*	14310	*259.6*	0.7	Yellow**
6-15900	15900	*7212*	1.00	*25*	15900	*288.5*	0.65	Red*
6-17610	17610	*7988*	1.00	*25*	17610	*319.5*	0.6	Red**
SLRSEBP Size								
9-18900	18900	*8573*	1.00	*25*	18900	*342.9*		Yellow*
9-21465	21465	*9736*	1.00	*25*	21465	*389.4*		Yellow**
9-23850	23850	*10818*	1.00	*25*	23850	*432.7*		Red*

*with Red inner spring **with Green inner spring SLRSEBP-9 under test

Horizontal load ratings expressed in G s are based on calculations with bolted connections to steel on top and concrete inserts on bottom. SLRSOEBP housings require uniform support under entire base plate.

All springs have an additional travel to solid equal to 50% of the rated deflection.

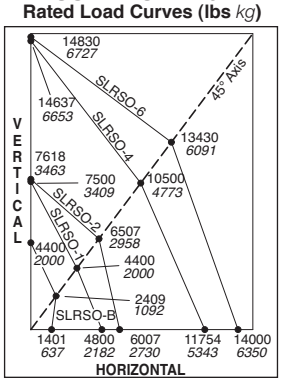
Solid Spring Height = Free Height minus 1.5 times the Rated Deflection.

SPRING CHARACTERISTICS (inches and *mm*)

Spring Size	OD	Free Height	Ratio Kx/Ky	Ratio OD/OH
B	23/8 *60*	4 *102*	0.70-0.80	0.80
C	27/8 *73*	41/8 *105*	0.90-1.10	0.92

Designs using these mounts to resist wind loads must be in accordance with ASCE 7-05.

OSHPD OPA-194
Rated Load Curves (lbs *kg*)



All mounts except SLRSEBP-9 are awaiting OSHPD-194 approval. SLRSEBP-9 has not been submitted.

Horizontal, Vertical and 45 plotted Ratings are California OSHPD submitted values having the OSHPD Anchorage Preapproval Number OPA-0194. Testing and calculations were performed to meet OSHPD criteria.

To use OSHPD submitted rated load curves:

1) Calculate Vertical and Horizontal Forces on mountings including translations and overturning moments.
2) Plot Horizontal and Vertical Loads. The intersection must fall within the area below the OSHPD curve.

APPROVAL PENDING

California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0194

Submitted for Approval December, 2007

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Patrick J. Lama
Civil Engineer
California No. 25878

SLRS 2"(*50mm*) Defl. B, B2 & C2 Springs

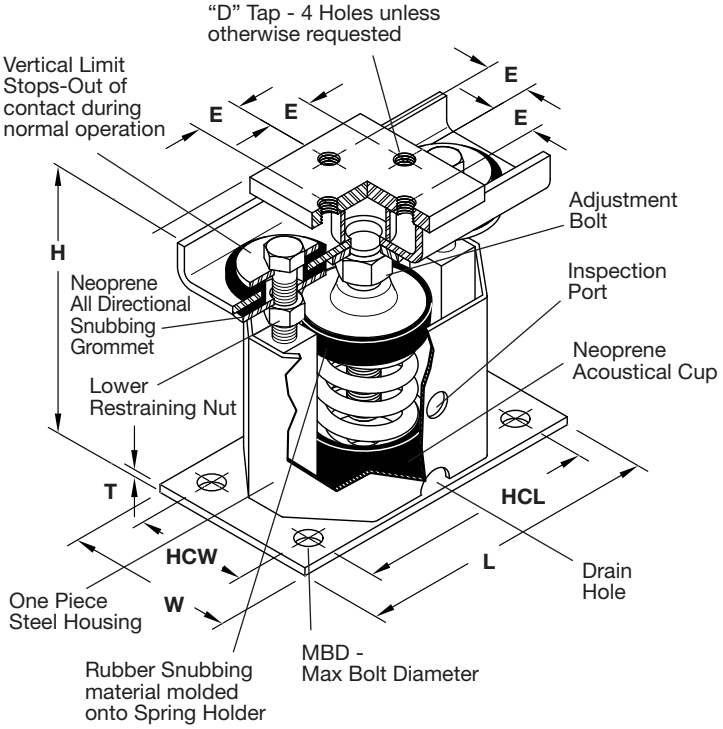
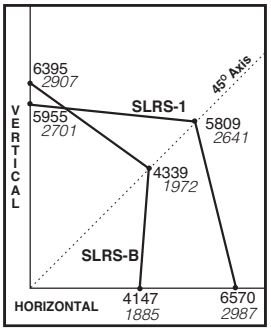


Illustration above shows a SLRS-B housing with one B or B2 spring. SLRS-1 housing has one C2 spring.

Housing load ratings expressed in G s are based on tests with bolted connections to steel top and bottom. SLRS housings require uniform support under entire base plate.

SLRS mounts include seismic and wind restraints with code compliant all-directional neoprene bushings and 1/4 maximum air gap.

OSHPD OPA-194
Rated Load Curves (lbs *kg*)



Horizontal, Vertical and 45 plotted Ratings are California OSHPD approved values having the OSHPD Anchorage Preapproval Number OPA-0194. Testing and calculations were performed to meet OSHPD criteria.

To use approved OSHPD rated load curves:

1) Calculate Vertical and Horizontal Forces on mountings including translations and overturning moments.
2) Plot Horizontal and Vertical Loads. The intersection must fall within the area below the OSHPD curve.

TYPE SLRS DIMENSIONS (inches and *mm*)

Size	H	T	D	E	L	HCL	W	HCW	MBD
B	8 5/8	1/4	1/2	1 1/8	81/2	7	4 1/4	2 3/4	5/8
B2	*219*	*6*	*13*	*29*	*216*	*178*	*108*	*70*	*16*
C2	8 5/8	1/4	5/8	1 3/8	91/2	71/2	51/4	31/2	5/8
	219	*6*	*16*	*35*	*241*	*191*	*133*	*89*	*16*

TYPE SLRS RATINGS *with Red inner spring

SLRS Size	Rated Capacity (lbs) *(kg)*	Rated Defl (in) *(mm)*	Spring Constant (lbs/in)*(kg/mm)*	Max. G Rating	Spring Color
B-20	20 *9*	2.40 *61*	8 *0.15*	80.0	Tan
B-26	26 *12*	2.18 *55*	12 *0.22*	61.5	Wht/Blue
B-35	35 *16*	2.20 *56*	16 *0.29*	45.7	Purple
B-50	50 *23*	2.20 *56*	24 *0.41*	32.0	Wht/Red
B-65	65 *29*	2.10 *53*	31 *0.55*	24.6	Brown
B-85	85 *39*	2.10 *53*	40 *0.74*	18.8	Wht/Blk
B-115	115 *52*	2.00 *51*	57 *1.02*	13.9	Silver
B-150	150 *68*	2.00 *51*	75 *1.33*	10.7	Orange
B2-210	210 *95*	2.12 *54*	99 *1.76*	7.6	Silver
B2-290	290 *132*	2.00 *51*	144 *2.59*	5.5	Blue
B2-450	450 *204*	2.00 *51*	224 *4.00*	3.6	Tan
B2-680	680 *308*	2.00 *51*	340 *6.04*	2.4	Gray
C2-125	125 *57*	2.50 *64*	50 *0.89*	48.0	Purple
C2-170	170 *77*	2.40 *61*	70 *1.26*	35.0	Brown
C2-210	210 *95*	2.30 *58*	90 *1.64*	28.3	Red
C2-260	260 *118*	2.20 *56*	120 *2.11*	23.0	White
C2-330	330 *150*	2.00 *51*	165 *2.94*	18.0	Black
C2-460	460 *209*	2.00 *51*	230 *4.10*	13.0	Blue
C2-610	610 *277*	2.00 *51*	305 *5.43*	9.8	Green
C2-880	880 *399*	2.00 *51*	440 *7.82*	6.8	Gray
C2-1210	1210 *549*	2.00 *51*	605 *10.76*	4.9	Silver
C2-1540	1540 *699*	2.00 *51*	770 *13.71*	3.9	Gray*
C2-1870	1870 *848*	2.00 *51*	935 *16.63*	3.2	Silver*

Published ratings allow minimum 25% additional travel to solid. For a full 50% specified minimum use the following ratings:

Size	Derated Capacity (lbs)(kg)	Defl. (in)(mm)	Size	Derated Capacity (lbs) (kg)	Defl. (in)(mm)
B2-450	410 *186*	1.83 *46*	C2-1210	1010 *458*	1.67 *42*
B2-680	565 *256*	1.67 *42*	C2-1540	1285 *583*	1.67 *42*
C2-880	800 *363*	1.82 *46*	C2-1870	1560 *708*	1.67 *42*

SPRING CHARACTERISTICS (inches and *mm*)

Spring Size	OD	Free Height	Ratio Kx/Ky	Ratio OD/OH
B	2 3/8 *60*	4 *102*	0.55-0.65	0.95-1.00
B2	2 3/8 *60*	4 1/2 *114*	0.80-0.90	1.19-1.48
C2	2 7/8 *73*	5 *127*	0.63-0.85	0.96-1.15

All springs without have an additional travel to solid equal to 50% of the rated deflection.

Solid Spring Height = Free Height minus 1.5 times the Rated Deflection except as noted.

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APPROVED
California Office of Statewide Health Planning and Development
FIXED EQUIPMENT ANCHORAGE
OPA-0194 January 6, 2003
Bill Staehlin (916) 654-3362

Gummadi Dharma Reddy
Civil Engineer
California No. 29627

SLRSO 2"(*50mm*) Defl. B, B2 & C2 Springs

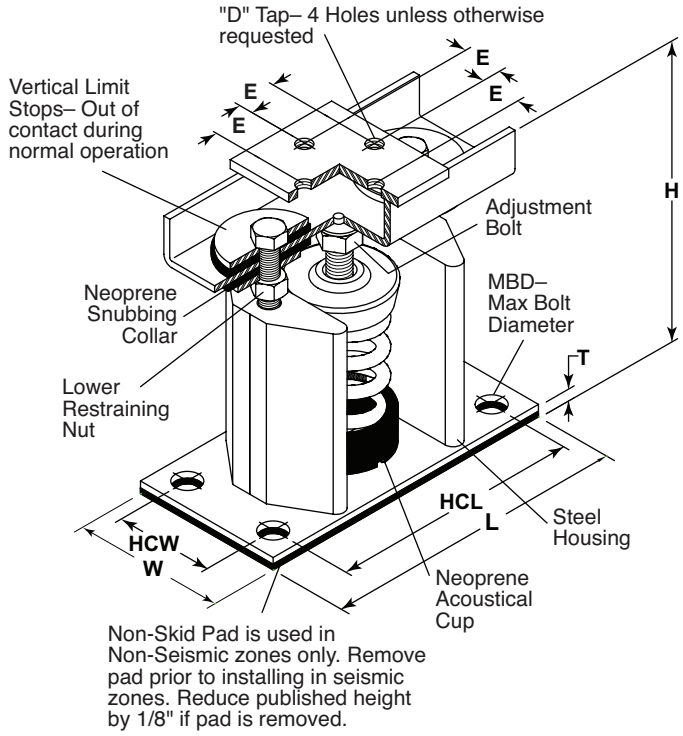


Illustration above shows a SLRSO-B housing with one B or B2 spring. SLRSO-1 housing contains one C2 spring.

TYPE SLRSO and SLRS DIMENSIONS (inches and *mm*)

Type & Size	H	T	D	E	L	HCL	W	HCW	MBD
SLRSO-B	8 3/4 *222*	3/8 *10*	1/2 *13*	1 1/8 *29*	8 1/2 *216*	7 *178*	4 1/4 *108*	2 3/4 *70*	5/8 *16*
SLRSO-B2	8 3/4 *222*	3/8 *10*	5/8 *16*	1 3/8 *35*	9 1/2 *241*	7 1/2 *191*	5 1/4 *133*	3 1/2 *89*	5/8 *16*
SLRSO-C2	8 3/4 *222*	3/8 *10*	5/8 *16*	1 3/8 *35*	14 *356*	12 1/4 *311*	5 1/4 *133*	3 1/2 *89*	5/8 *16*

TYPE SLRSO and SLRS RATINGS 2" *50mm* Deflection Series

SLRSO Size	Rated Capacity (lbs) *(kg)*	Rated Defl **(in)** *(mm)*	Spring Constant (lbs/in) *(kg/mm)*	Max. Horiz. Housing G Rating	Spring Color
B-20	20 *9*	2.40 *61*	8 *0.15*	70.0	Tan
B-26	26 *12*	2.18 *55*	12 *0.22*	53.9	Wht/Blue
B-35	35 *16*	2.20 *56*	16 *0.29*	40.0	Purple
B-50	50 *23*	2.20 *56*	24 *0.41*	28.0	Wht/Red
B-65	65 *29*	2.10 *53*	31 *0.55*	21.6	Brown
B-85	85 *39*	2.10 *53*	40 *0.74*	16.5	Wht/Blk
B-115	115 *52*	2.00 *51*	57 *1.02*	12.2	Silver
B-150	150 *68*	2.00 *51*	75 *1.33*	9.3	Orange
B2-210	210 *95*	2.12 *54*	99 *1.76*	6.8	Silver
B2-290	290 *132*	2.00 *51*	144 *2.59*	4.9	Blue
B2-450	450 *204*	2.00 *51*	224 *4.00*	3.2	Tan
B2-680	680 *308*	2.00 *51*	340 *6.04*	2.1	Gray
C2-125	125 *57*	2.50 *64*	50 *0.89*	38.4	Purple
C2-170	170 *77*	2.40 *61*	70 *1.26*	28.2	Brown
C2-210	210 *95*	2.30 *58*	90 *1.64*	22.8	Red
C2-260	260 *118*	2.20 *56*	120 *2.11*	18.5	White
C2-330	330 *150*	2.00 *51*	165 *2.94*	14.5	Black
C2-460	460 *209*	2.00 *51*	230 *4.10*	10.4	Blue
C2-610	610 *277*	2.00 *51*	305 *5.43*	7.9	Green
C2-880	880 *399*	2.00 *51*	440 *7.82*	5.5	Gray
C2-1210	1210 *549*	2.00 *51*	605 *10.8*	4.0	Silver
C2-1540	1540 *699*	2.00 *51*	770 *13.7*	3.1	Gray*
C2-1870	1870 *848*	2.00 *51*	935 *16.6*	2.6	Silver*

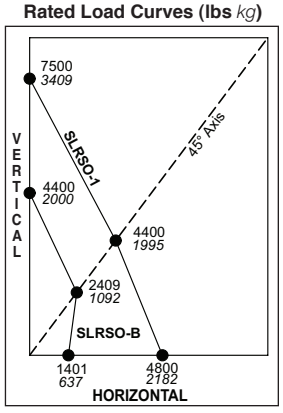
*with Red inner spring

Housing load ratings expressed in G s are based on tests with bolted connections to steel top and bottom. SLRSO housings require uniform support under entire base plate.

Published ratings allow minimum 25% additional travel to solid. For a full 50% specified minimum use the following ratings:

Size	Derated Capacity (lbs)(kg)	Defl. (in)(mm)	Size	Derated Capacity (lbs) (kg)	Defl. (in)(mm)
B2-450	410 *186*	1.83 *46*	C2-1210	1010 *458*	1.67 *42*
B2-680	565 *256*	1.67 *42*	C2-1540	1285 *583*	1.67 *42*
C2-880	800 *363*	1.82 *46*	C2-1870	1560 *708*	1.67 *42*

OSHPD OPA-194
Rated Load Curves (lbs *kg*)



All mounts are awaiting OSHPD-194 approval.

Horizontal, Vertical and 45 plotted Ratings are California OSHPD submitted values having the OSHPD Anchorage Preapproval Number OPA-0194. Testing and calculations were performed to meet OSHPD criteria.

To use OSHPD submitted rated load curves:

1) Calculate Vertical and Horizontal Forces on mountings including translations and overturning moments.
2) Plot Horizontal and Vertical Loads. The intersection must fall within the area below the OSHPD curve.

SPRING CHARACTERISTICS (inches and *mm*)

Spring Size	OD	Free Height	Ratio Kx/Ky	Ratio OD/OH
B	2 3/8 *60*	4 *102*	0.55-0.65	0.95-1.00
B2	2 3/8 *60*	4 1/2 *114*	0.80-0.90	1.19-1.48
C2	2 7/8 *73*	5 *127*	0.63-0.85	0.96-1.15

All springs without have an additional travel to solid equal to 50% of the rated deflection.

Solid Spring Height = Free Height minus 1.5 times the Rated Deflection.

APPROVAL PENDING

California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0194

Submitted for Approval December, 2007

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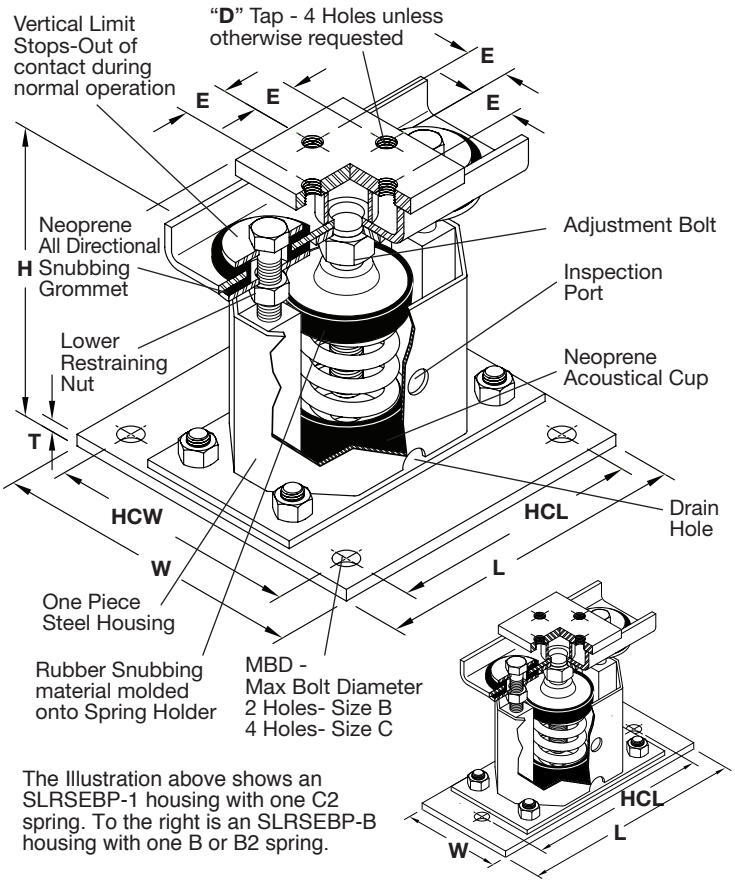
Patrick J. Lama
Civil Engineer
California No. 25878

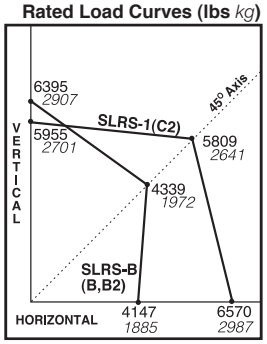
SLRSEBP(Extended Base Plate)
2"(*50mm*) Defl. B, B2 & C2 Springs



The Illustration above shows an SLRSEBP-1 housing with one C2 spring. To the right is an SLRSEBP-B housing with one B or B2 spring.

Approval applies to mount only. Baseplate not approved. Baseplate shown is satisfactory for most installations. Anchorage and baseplate calculations are provided for all installations. Baseplate modified when required.

OSHPD OPA-194
Rated Load Curves (lbs *kg*)



Horizontal, Vertical and 45 plotted Ratings are California OSHPD approved values having the OSHPD Anchorage Preapproval Number OPA-0194. Testing and calculations were performed to meet OSHPD criteria.

To use approved OSHPD rated load curves:

1) Calculate Vertical and Horizontal Forces on mountings including translations and overturning moments.
2) Plot Horizontal and Vertical Loads. The intersection must fall within the area below the OSHPD curve.

TYPE SLRSEBP DIMENSIONS (inches and *mm*)

Size	H	T	D	E	L	HCL	W	HCW	MBD
B & B2	9 *229*	3/8 *10*	1/2 *13*	1 1/8 *29*	13 *330*	10 1/2 *267*	5 *127*	- -	5/8 *16*
C2	9 *229*	3/8 *10*	5/8 *16*	1 3/8 *35*	10 *254*	8 *203*	10 *254*	8 *203*	5/8 *16*

Housing load ratings expressed in G s are based on tests with bolted connections to steel top and bottom. SLRSEBP housings require uniform support under entire base plate. Tests were run with one bolt in top plate.

SLRS mounts include seismic and wind restraints with code compliant all-directional neoprene bushings and 1/4 maximum air gap.

TYPE SLRSEBP RATINGS *with Red inner spring

Size	Rated Capacity (lbs) *(kg)*	Rated Defl (in) *(mm)*	Spring Constant (lbs/in)*(kg/mm)*	Max. G Rating	Spring Color
B-20	20 *9*	2.40 *61*	8 *0.15*	80.0	Tan
B-26	26 *12*	2.18 *55*	12 *0.22*	61.5	Wht/Blue
B-35	35 *16*	2.20 *56*	16 *0.29*	45.7	Purple
B-50	50 *23*	2.20 *56*	24 *0.41*	32.0	Wht/Red
B-65	65 *29*	2.10 *53*	31 *0.55*	24.6	Brown
B-85	85 *39*	2.10 *53*	40 *0.74*	18.8	Wht/Blk
B-115	115 *52*	2.00 *51*	57 *1.02*	13.9	Silver
B-150	150 *68*	2.00 *51*	75 *1.33*	10.7	Orange
B2-210	210 *95*	2.12 *54*	99 *1.76*	7.6	Silver
B2-290	290 *132*	2.00 *51*	144 *2.59*	5.5	Blue
B2-450	450 *204*	2.00 *51*	224 *4.00*	3.6	Tan
B2-680	680 *308*	2.00 *51*	340 *6.04*	2.4	Gray
C2-125	125 *57*	2.50 *64*	50 *0.89*	48.0	Purple
C2-170	170 *77*	2.40 *61*	70 *1.26*	35.0	Brown
C2-210	210 *95*	2.30 *58*	90 *1.64*	28.3	Red
C2-260	260 *118*	2.20 *56*	120 *2.11*	23.0	White
C2-330	330 *150*	2.00 *51*	165 *2.94*	18.0	Black
C2-460	460 *209*	2.00 *51*	230 *4.10*	13.0	Blue
C2-610	610 *277*	2.00 *51*	305 *5.43*	9.8	Green
C2-880	880 *399*	2.00 *51*	440 *7.82*	6.8	Gray
C2-1210	1210 *549*	2.00 *51*	605 *10.76*	4.9	Silver
C2-1540	1540 *699*	2.00 *51*	770 *13.71*	3.9	Gray*
C2-1870	1870 *848*	2.00 *51*	935 *16.63*	3.2	Silver*

Published ratings allow minimum 25% additional travel to solid. For a full 50% specified minimum use the following ratings:

Size	Derated Capacity (lbs)(*kg*)	Defl. (in)(*mm*)	Size	Derated Capacity (lbs) (*kg*)	Defl. (in)(*mm*)
B2-450	410 *186*	1.83 *46*	C2-1210	1010 *458*	1.67 *42*
B2-680	565 *256*	1.67 *42*	C2-1540	1285 *583*	1.67 *42*
C2-880	800 *363*	1.82 *46*	C2-1870	1560 *708*	1.67 *42*

SPRING CHARACTERISTICS (inches and *mm*)

Spring Size	OD	Free Height	Ratio Kx/Ky	Ratio OD/OH
B	2 3/8 *60*	4 *102*	0.55-0.65	0.95-1.00
B2	2 3/8 *60*	4 1/2 *114*	0.80-0.90	1.19-1.48
C2	2 7/8 *73*	5 *127*	0.63-0.85	0.96-1.15

All springs without have an additional travel to solid equal to 50% of the rated deflection.

Solid Spring Height = Free Height minus 1.5 times the Rated Deflection except as noted.

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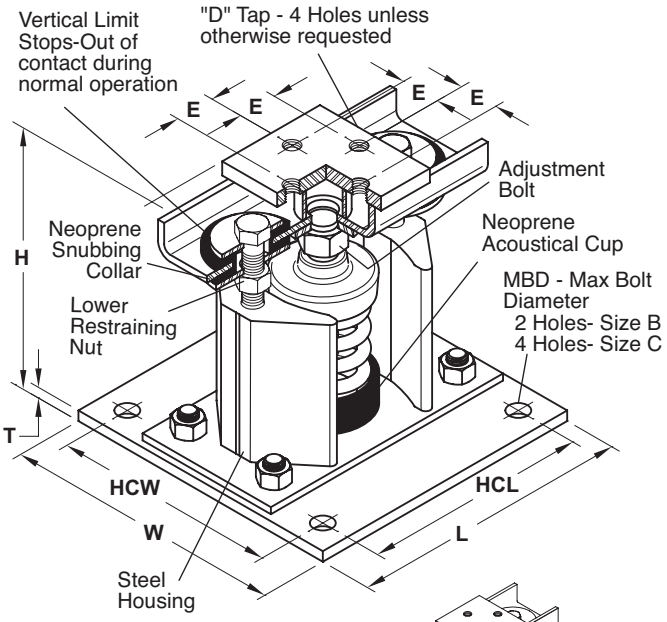
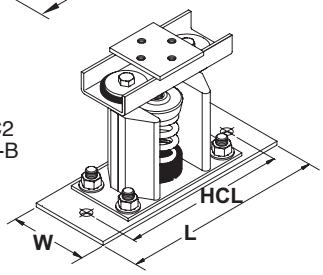
APPROVED
California Office of Statewide Health Planning and Development
FIXED EQUIPMENT ANCHORAGE
OPA-0194 January 6, 2003
Bill Staehlin (916) 654-3362

Gummadi Dharma Reddy
Civil Engineer
California No. 29627

SLRSOEBP(Extended Base Plate) 2"(*50mm*) Defl. B, B2 & C2 Springs





The Illustration above shows an SLRSOEBP-1 housing with one C2 spring. Below it is an SLRSOEBP-B housing with one B or B2 spring.

TYPE SLRSOEBP and SLRSEBP DIMENSIONS (inches and *mm*)

Type & Size	H	T	D	E	L	HCL	W	HCW	MBD
SLRSOEBP-B & B2	9 *229*	3/8 *10*	1/2 *13*	1 1/8 *29*	13 *330*	10 1/2 *267*	5 *127*	–	5/8 *16*
SLRSOEBP-C2	9 *229*	3/8 *10*	5/8 *16*	1 3/8 *35*	10 *254*	8 *203*	10 *254*	8 *203*	5/8 *16*

TYPE SLRSOEBP and SLRSEBP RATINGS 2" *50mm* Deflection Series

SLRSOEBP Size	Rated Capacity (lbs) *(kg)*	Rated Defl (in) *(mm)*	Spring Constant (lbs/in) *(kg/mm)*	Max. Horiz. G Rating Bolted to Concrete	Spring Color
B-20	20 *9*	2.40 *61*	8 *0.15*	70.0	Tan
B-26	26 *12*	2.18 *55*	12 *0.22*	53.9	Wht/Blue
B-35	35 *16*	2.20 *56*	16 *0.29*	40.0	Purple
B-50	50 *23*	2.20 *56*	24 *0.41*	28.0	Wht/Red
B-65	65 *29*	2.10 *53*	31 *0.55*	21.6	Brown
B-85	85 *39*	2.10 *53*	40 *0.74*	16.5	Wht/Blk
B-115	115 *52*	2.00 *51*	57 *1.02*	12.2	Silver
B-150	150 *68*	2.00 *51*	75 *1.33*	6.8	Orange
B2-210	210 *95*	2.12 *54*	99 *1.76*	9.3	Silver
B2-290	290 *132*	2.00 *51*	144 *2.59*	4.9	Blue
B2-450	450 *204*	2.00 *51*	224 *4.00*	3.2	Tan
B2-680	680 *308*	2.00 *51*	340 *6.04*	2.1	Gray
C2-125	125 *57*	2.50 *64*	50 *0.89*	35.5	Purple
C2-170	170 *77*	2.40 *61*	70 *1.26*	26.1	Brown
C2-210	210 *95*	2.30 *58*	90 *1.64*	21.1	Red
C2-260	260 *118*	2.20 *56*	120 *2.11*	17.1	White
C2-330	330 *150*	2.00 *51*	165 *2.94*	13.5	Black
C2-460	460 *209*	2.00 *51*	230 *4.10*	9.6	Blue
C2-610	610 *277*	2.00 *51*	305 *5.43*	7.3	Green
C2-880	880 *399*	2.00 *51*	440 *7.82*	5.0	Gray
C2-1210	1210 *549*	2.00 *51*	605 *10.8*	3.7	Silver
C2-1540	1540 *699*	2.00 *51*	770 *13.7*	2.9	Gray*
C2-1870	1870 *848*	2.00 *51*	935 *16.6*	2.4	Silver*

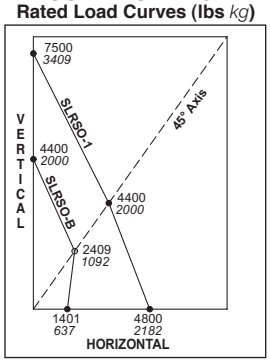
*with Red inner spring

Horizontal load ratings expressed in G s are based on calculations with bolted connections to steel on top and concrete inserts on bottom. SLRSOEBP housings require uniform support under entire base plate.

Published ratings allow minimum 25% additional travel to solid. For a full 50% specified minimum use the following ratings:

Size	Derated Capacity (lbs) *(kg)*	Defl. (in) *(mm)*	Size	Derated Capacity (lbs) *(kg)*	Defl. (in) *(mm)*
B2-450	410 *186*	1.83 *46*	C2-1210	1010 *458*	1.67 *42*
B2-680	565 *256*	1.67 *42*	C2-1540	1285 *583*	1.67 *42*
C2-880	800 *363*	1.82 *46*	C2-1870	1560 *708*	1.67 *42*

OSHPD OPA-194
Rated Load Curves (lbs *kg*)



All mounts are awaiting OSHPD-194 approval.

Horizontal, Vertical and 45 plotted Ratings are California OSHPD submitted values having the OSHPD Anchorage Preapproval Number OPA-0194. Testing and calculations were performed to meet OSHPD criteria.

To use OSHPD submitted rated load curves:

1) Calculate Vertical and Horizontal Forces on mountings including translations and overturning moments.
2) Plot Horizontal and Vertical Loads. The intersection must fall within the area below the OSHPD curve.

SPRING CHARACTERISTICS (inches and *mm*)

Spring Size	OD	Free Height	Ratio Kx/Ky	Ratio OD/OH
B	2 3/8 *60*	4 *102*	0.55-0.65	0.95-1.00
B2	2 3/8 *60*	4 1/2 *114*	0.80-0.90	1.19-1.48
C2	2 7/8 *73*	5 *127*	0.63-0.85	0.96-1.15

All springs without have an additional travel to solid equal to 50% of the rated deflection.

Solid Spring Height = Free Height minus 1.5 times the Rated Deflection.

Designs using these mounts to resist wind loads must be in accordance with ASCE 7-05.

APPROVAL PENDING

California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0194

Submitted for Approval December, 2007

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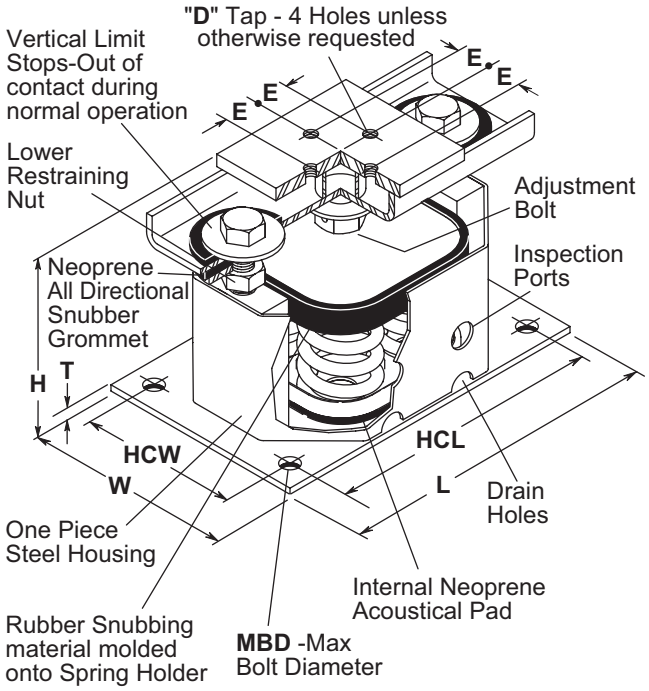
Patrick J. Lama
Civil Engineer
California No. 25878

SLRS 2"(*50mm*) Defl. 2-C2, 4-C2 Springs



TYPE SLRS DIMENSIONS (inches and *mm*)

Size	H	T	D	E	L	HCL	W	HCW	MBD
2-C2	8 5/8 *219*	1/4 *6*	5/8 *16*	1 3/8 *35*	14 *356*	12 1/4 *311*	5 1/4 *133*	3 1/2 *89*	5/8 *16*
4-C2	8 5/8 *219*	1/4 *6*	7/8 *22*	1 3/8 *35*	13 *330*	11 *279*	8 3/8 *213*	6 1/4 *159*	3/4 *19*

TYPE SLRS RATINGS

SLRS Size	Rated Capacity (lbs) *(kg)*	Rated Defl (in) *(mm)*	Spring Constant (lbs/in)*(kg/mm)*	Max. G Rating	Spring Color
2-C2-340	340 *154*	2.40 *61*	140 *2.52*	15.3	Brown
2-C2-420	420 *191*	2.30 *58*	180 *3.29*	12.4	Red
2-C2-520	520 *236*	2.20 *56*	240 *4.21*	10.0	White
2-C2-660	660 *299*	2.00 *51*	330 *5.86*	7.9	Black
2-C2-920	920 *417*	2.00 *51*	460 *8.18*	5.7	Blue
2-C2-1220	1220 *553*	2.00 *51*	610 *10.84*	4.3	Green
2-C2-1760	1760 *798*	2.00 *51*	880 *15.65*	3.0	Gray
2-C2-2420	2420 *1098*	2.00 *51*	1210 *21.53*	2.2	Silver
2-C2-3080	3080 *1397*	2.00 *51*	1540 *27.39*	1.7	Gray*
2-C2-3740	3740 *1696*	2.00 *51*	1870 *33.24*	1.4	Silver*
4-C2-4840	4840 *2195*	2.00 *51*	2420 *43.04*	2.3	Silver
4-C2-6160	6160 *2794*	2.00 *51*	3080 *54.78*	1.8	Gray*
4-C2-7480	7480 *3393*	2.00 *51*	3740 *66.53*	1.5	Silver*

*with Red inner spring

Illustration above shows a SLRS-4-C2 housing with four C2 springs. Not shown are SLRS-2-C2 with two C2 springs.

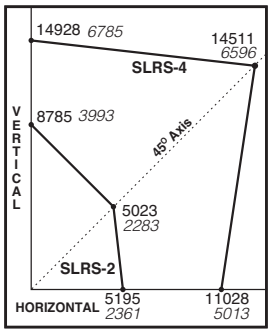
Housing load ratings expressed in G s are based on tests with bolted connections to steel top and bottom. SLRS housings require uniform support under entire base plate. Test were run with one bolt in top plate.

SLRS mounts include seismic and wind restraints with code compliant all-directional neoprene bushings and 1/4 maximum air gap.

Published ratings allow minimum 25% additional travel to solid. For a full 50% specified minimum use the following ratings:

Size	Derated Capacity (lbs)	(*kg*)	Defl. (in)	(*mm*)
2-C2-1760	1600	*726*	1.67	*42*
2-C2-2420	2020	*916*	1.67	*42*
2-C2-3080	2570	*1166*	1.67	*42*
2-C2-3740	3120	*1415*	1.67	*42*
4-C2-4840	4040	*1833*	1.67	*42*
4-C2-6160	5145	*2334*	1.67	*42*
4-C2-7480	6245	*2833*	1.67	*42*

OSHPD OPA-194
Rated Load Curves (lbs *kg*)



Horizontal, Vertical and 45 plotted Ratings are California OSHPD approved values having the OSHPD Anchorage Preapproval Number OPA-0194. Testing and calculations were performed to meet OSHPD criteria.

To use approved OSHPD rated load curves:

1) Calculate Vertical and Horizontal Forces on mountings including translations and overturning moments.
2) Plot Horizontal and Vertical Loads. The intersection must fall within the area below the OSHPD curve.

SPRING CHARACTERISTICS (inches and *mm*)

Spring Size	OD	Free Height	Ratio Kx/Ky	Ratio OD/OH
C2	2 7/8 *73*	5 *127*	0.63-0.85	0.96-1.15

All springs without have an additional travel to solid equal to 50% of the rated deflection.

Solid Spring Height = Free Height minus 1.5 times the Rated Deflection except as noted.

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APPROVED
California Office of Statewide Health Planning and Development
FIXED EQUIPMENT ANCHORAGE
OPA-0194 January 6, 2003

Bill Staehlin (916) 654-3362

Page
FM44

Gummadi Dharma Reddy
Civil Engineer
California No. 29627

SLRSO 2"(*50mm*) Defl. 2-C2, 4-C2, 6-C2 & 9-C2 Springs

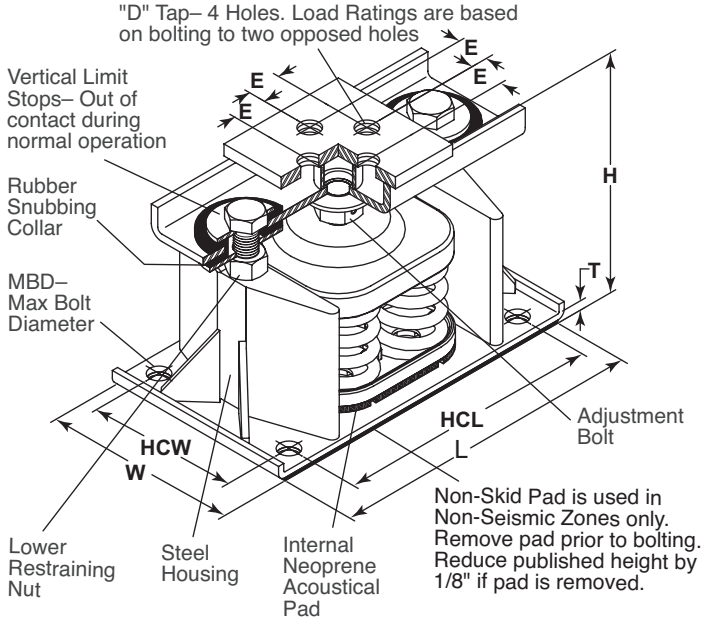
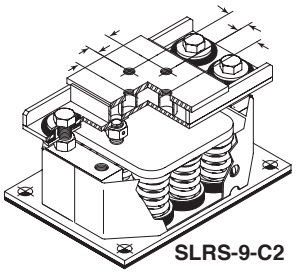


Illustration above shows a SLRSO-4-C2 housing with four C springs. SLRS-9-C2 has nine C2 springs and has closed sides. Not shown are SLRSO-2-C2 with two C2 springs and SLRSO-6-C2 with six C2 springs.

Designs using these mounts to resist wind loads must be in accordance with ASCE 7-05.



SLRS-9-C2

TYPE SLRSO and SLRS DIMENSIONS (inches and *mm*)

Type & Size	H	T	D	E	L	HCL	W	HCW	MBD
SLRSO-2-C2	8 3/4 *222*	3/8 *10*	5/8 *16*	1 3/8 *35*	14 *356*	12 1/4 *311*	5 1/4 *133*	3 1/2 *89*	5/8 *16*
SLRSO-4-C2	8 3/4 *222*	3/8 *10*	7/8 *22*	1 3/8 *35*	13 3/4 *350*	11 *279*	8 *203*	6 1/4 *159*	3/4 *19*
SLRSO-6-C2	9 3/4 *248*	3/8 *10*	1 *25*	1 5/8 *41*	19 *483*	15 7/8 *403*	9 *229*	6 *152*	1 *25*
SLRS-9-C2	9 3/4 *248*	5/8 *16*	1 *25*	2 *51*	18 *457*	15 3/4 *400*	13 *330*	10 3/4 *273*	1 *25*

TYPE SLRSO and SLRS RATINGS 2" *50mm* Deflection Series

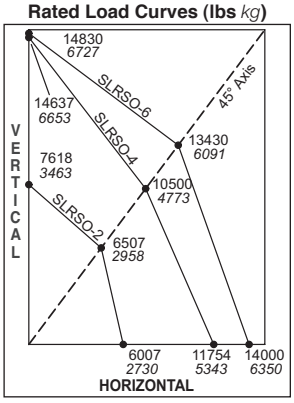
SLRSO Size	Rated Capacity (lbs) *(kg)*	Rated Defl (in) *(mm)*	Spring Constant (lbs/in) *(kg/mm)*	Max. Horiz. Housing G Rating	Spring Color
2-C2-340	340 *154*	2.40 *61*	140 *2.52*	17.7	Brown
2-C2-420	420 *191*	2.30 *58*	180 *3.29*	14.3	Red
2-C2-520	520 *236*	2.20 *56*	240 *4.21*	11.6	White
2-C2-660	660 *299*	2.00 *51*	330 *5.86*	9.1	Black
2-C2-920	920 *417*	2.00 *51*	460 *8.18*	6.5	Blue
2-C2-1220	1220 *553*	2.00 *51*	610 *10.8*	4.9	Green
2-C2-1760	1760 *798*	2.00 *51*	880 *15.7*	3.4	Gray
2-C2-2420	2420 *1098*	2.00 *51*	1210 *21.5*	2.5	Silver
2-C2-3080	3080 *1397*	2.00 *51*	1540 *27.4*	1.9	Gray*
2-C2-3740	3740 *1696*	2.00 *51*	1870 *33.2*	1.6	Silver*
4-C2-4840	4840 *2195*	2.00 *51*	2420 *43.0*	2.4	Silver
4-C2-6160	6160 *2794*	2.00 *51*	3080 *54.8*	1.9	Gray*
4-C2 7480	7480 *3393*	2.00 *51*	3740 *66.5*	1.6	Silver*
6-C2-7260	7260 *3293*	2.00 *51*	3630 *64.6*	1.9	Silver
6-C2-9240	9240 *4191*	2.00 *51*	4620 *82.2*	1.5	Gray*
6-C2-11220	11220 *5089*	2.00 *51*	5610 *99.8*	1.3	Silver*
SLRS Size					
9-C2-13860	13860 *6287*	2.00 *51*	6930 *123.2*		Gray*
9-C2-16830	16830 *7634*	2.00 *51*	8415 *149.7*		Silver*

*with Red inner spring

SLRS-9 under test

Housing load ratings expressed in G s are based on tests with bolted connections to steel top and bottom. SLRSO & SLRS housings require uniform support under entire base plate.

OSHPD OPA-194
Rated Load Curves (lbs *kg*)



All mounts except SLRS-9-C2 are awaiting OSHPD-194 approval. SLRS-9-C2 has not been submitted.

Horizontal, Vertical and 45 plotted Ratings are California OSHPD submitted values having the OSHPD Anchorage Preapproval Number OPA-0194. Testing and calculations were performed to meet OSHPD criteria.

To use OSHPD submitted rated load curves:

1) Calculate Vertical and Horizontal Forces on mountings including translations and overturning moments.
2) Plot Horizontal and Vertical Loads. The intersection must fall within the area below the OSHPD curve.

Published ratings allow minimum 25% additional travel to solid. For a full 50% specified minimum use the following ratings:

SLRSO Size	50% Travel to Solid Capacity (lbs) *(kg)*	Defl. (in) *(mm)*	SLRSO Size	50% Travel to Solid Capacity (lbs) *(kg)*	Defl. (in) *(mm)*
2-C2-1760	1600 *726*	1.67 *42*	4-C2-7480	6245 *2833*	1.67 *42*
2-C2-2420	2020 *916*	1.67 *42*	6-C2-7260	6060 *2749*	1.67 *42*
2-C2-3080	2570 *1166*	1.67 *42*	6-C2-9240	7715 *3500*	1.67 *42*
2-C2-3740	3120 *1415*	1.67 *42*	6-C2-11220	9370 *4250*	1.67 *42*
4-C2-4840	4040 *1833*	1.67 *42*	9-C2-13860	11570 *5248*	1.67 *42*
4-C2-6160	5145 *2334*	1.67 *42*	9-C2-16830	14050 *6373*	1.67 *42*

SPRING CHARACTERISTICS (inches and *mm*)

Spring Size	OD	Free Height	Ratio Kx/Ky	Ratio OD/OH
C2	2 7/8 *73*	5 *127*	0.63-0.85	0.96-1.15

All springs without have an additional travel to solid equal to 50% of the rated deflection.

Solid Spring Height = Free Height minus 1.5 times the Rated Deflection.

APPROVAL PENDING

California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0194

Submitted for Approval December, 2007

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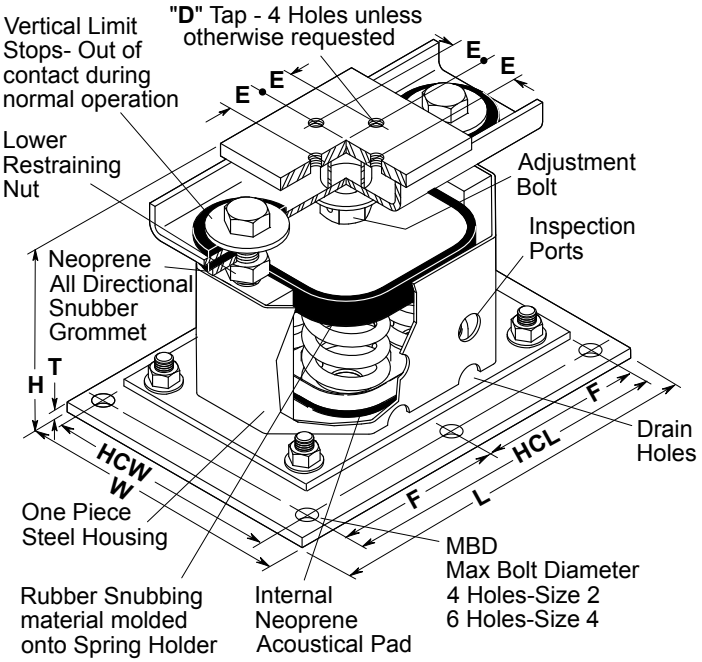
Patrick J. Lama
Civil Engineer
California No. 25878

SLRSEBP(Extended Base Plate)
2"(*50mm*) Defl. 2-C2 & 4-C2 Springs



TYPE SLRSEBP DIMENSIONS (inches and *mm*)

Size	H	T	D	E	L	HCL	F	W	HCW	MBD
2-C2	9 *229*	3/8 *10*	5/8 *16*	13/8 *35*	141/2 *368*	11 *295*	- -	12 *305*	9 *229*	3/4 *19*
4-C2	9 *229*	3/8 *10*	7/8 *22*	13/8 *35*	19 *483*	16 *406*	8 *203*	14 *356*	11 *279*	3/4 *19*

Illustration at left shows a SLRSEBP-4 with 4 C2 springs. Not shown is SLRSEBP-2 with two C2 springs.

Housing load ratings expressed in G s are based on tests with bolted connections to steel top and bottom. SLRSEBP housings require uniform support under entire base plate. Tests were run with one bolt in top plate.

SLRS mounts include seismic and wind restraints with code compliant all-directional neoprene bushings and 1/4 maximum air gap.

TYPE SLRSEBP RATINGS

Size	Rated Capacity (lbs) *(kg)*	Rated Defl (in) *(mm)*	Spring Constant (lbs/in)*(kg/mm)*	Max. G Rating	Spring Color
2-C2-340	340 *154*	2.40 *61*	140 *2.52*	15.3	Brown
2-C2-420	420 *191*	2.30 *58*	180 *3.29*	12.4	Red
2-C2-520	520 *236*	2.20 *56*	240 *4.21*	10.0	White
2-C2-660	660 *299*	2.00 *51*	330 *5.86*	7.9	Black
2-C2-920	920 *417*	2.00 *51*	460 *8.18*	5.7	Blue
2-C2-1220	1220 *553*	2.00 *51*	610 *10.84*	4.3	Green
2-C2-1760	1760 *798*	2.00 *51*	880 *15.65*	3.0	Gray
2-C2-2420	2420 *1098*	2.00 *51*	1210 *21.53*	2.2	Silver
2-C2-3080	3080 *1397*	2.00 *51*	1540 *27.39*	1.7	Gray*
2-C2-3740	3740 *1696*	2.00 *51*	1870 *33.24*	1.4	Silver*
4-C2-4840	4840 *2195*	2.00 *51*	2420 *43.04*	2.3	Silver
4-C2-6160	6160 *2794*	2.00 *51*	3080 *54.78*	1.8	Gray*
4-C2 7480	7480 *3393*	2.00 *51*	3740 *66.53*	1.5	Silver*

*with Red inner spring

Approval applies to mount only. Baseplate not approved. Baseplate shown is satisfactory for most installations. Anchorage and baseplate calculations are provided for all installations. Baseplate modified when required.

Published ratings allow minimum 25% additional travel to solid. For a full 50% specified minimum use the following ratings:

Size	Derated Capacity (lbs) (*kg*)	Defl. (in)(*mm*)	Size	Derated Capacity (lbs) (*kg*)	Defl. (in) (*mm*)
2-C2-1760	1600 *726*	1.67 *42*	4-C2-4840	4040 *1833*	1.67 *42*
2-C2-2420	2020 *916*	1.67 *42*	4-C2-6160	5145 *2334*	1.67 *42*
2-C2-3080	2570 *1166*	1.67 *42*	4-C2-7480	6245 *2833*	1.67 *42*
2-C2-3740	3120 *1415*	1.67 *42*			

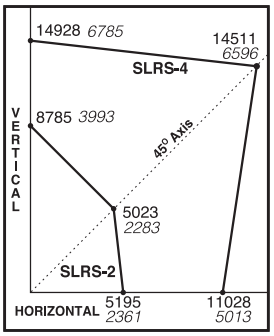
SPRING CHARACTERISTICS (inches and *mm*)

Spring Size	OD	Free Height	Ratio Kx/Ky	Ratio OD/OH
C2	27/8 *73*	5 *127*	0.63-0.85	0.96-1.15

All springs without have an additional travel to solid equal to 50% of the rated deflection.

Solid Spring Height = Free Height minus 1.5 times the Rated Deflection except as noted.

OSHPD OPA-194
Rated Load Curves (lbs *kg*)



Horizontal, Vertical and 45 plotted Ratings are California OSHPD approved values having the OSHPD Anchorage Preapproval Number OPA-0194. Testing and calculations were performed to meet OSHPD criteria.

To use approved OSHPD rated load curves:

1) Calculate Vertical and Horizontal Forces on mountings including translations and overturning moments.
2) Plot Horizontal and Vertical Loads. The intersection must fall within the area below the OSHPD curve.

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APPROVED
California Office of Statewide Health Planning and Development
FIXED EQUIPMENT ANCHORAGE
OPA-0194 January 6, 2003

Bill Staehlin (916) 654-3362

Gummadi Dharma Reddy
Civil Engineer
California No. 29627

SLRSOEBP (Extended Base Plate) 2"(*50mm*) Defl. 2-C2, 4-C2, 6-C2 & 9-C2 Springs

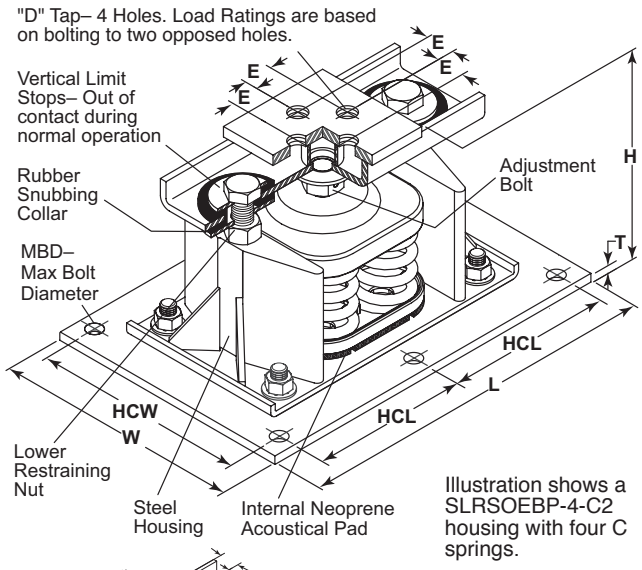
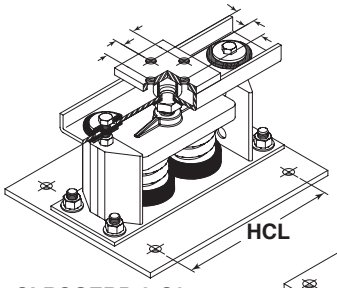
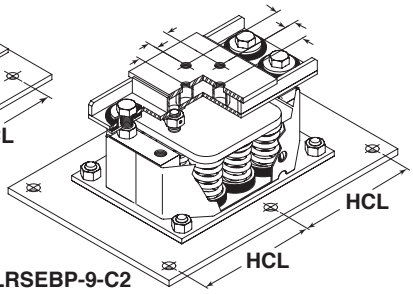


Illustration shows a SLRSOEBP-4-C2 housing with four C springs.



SLRSOEBP-2-C2



SLRSEBP-9-C2

SLRSOEBP-2-C2 has two C2 springs and SLRSEBP-9-C2 has nine C2 springs and has closed sides. Not shown is SLRSOEBP-6-C2 with six C2 springs.

TYPE SLRSOEBP and SLRSEBP DIMENSIONS (inches and *mm*)

Type & Size	H	T	D	E	L	HCL	W	HCW	MBD
SLRSOEBP-2-C2	9 *229*	3/8 *10*	5/8 *16*	1 3/8 *35*	141/2 *368*	11 *280*	11 *280*	9 *229*	3/4 *19*
SLRSOEBP-4-C2	9 *229*	3/8 *10*	7/8 *22*	1 3/8 *35*	19 *482*	8 *203*	14 *356*	11 *280*	3/4 *19*
SLRSOEBP-6-C2	101/4 *260*	1/2 *13*	1 *25*	1 5/8 *41*	27 *686*	12 *305*	15 *381*	12 *305*	1 *25*
SLRSEBP-9-C2	101/4 *260*	5/8 *16*	1 *25*	2 *51*	27 *686*	12 *305*	19 *483*	16 *406*	1 *25*

TYPE SLRSOEBP and SLRSEBP RATINGS 2" *50mm* Deflection Series

SLRSOEBP Size	Rated Capacity (lbs)	*(kg)*	Rated Defl (in)	*(mm)*	Spring Constant (lbs/in)	*(kg/mm)*	Max. Horiz. G Rating Bolted to Concrete	Spring Color
2-C2-340	340	*154*	2.40	*61*	140	*2.52*	17.7	Brown
2-C2-420	420	*191*	2.30	*58*	180	*3.29*	14.3	Red
2-C2-520	520	*236*	2.20	*56*	240	*4.21*	11.6	White
2-C2-660	660	*299*	2.00	*51*	330	*5.86*	9.1	Black
2-C2-920	920	*417*	2.00	*51*	460	*8.18*	6.5	Blue
2-C2-1220	1220	*553*	2.00	*51*	610	*10.8*	4.9	Green
2-C2-1760	1760	*798*	2.00	*51*	880	*15.7*	3.4	Gray
2-C2-2420	2420	*1098*	2.00	*51*	1210	*21.5*	2.5	Silver
2-C2-3080	3080	*1397*	2.00	*51*	1540	*27.4*	1.9	Gray*
2-C2-3740	3740	*1696*	2.00	*51*	1870	*33.2*	1.6	Silver*
4-C2-4840	4840	*2195*	2.00	*51*	2420	*43.0*	1.9	Silver
4-C2-6160	6160	*2794*	2.00	*51*	3080	*54.8*	1.5	Gray*
4-C2 7480	7480	*3393*	2.00	*51*	3740	*66.5*	1.2	Silver*
6-C2-7260	7260	*3293*	2.00	*51*	3630	*64.6*	1.4	Silver
6-C2-9240	9240	*4191*	2.00	*51*	4620	*82.2*	1.1	Gray*
6-C2-11220	11220	*5089*	2.00	*51*	5610	*99.8*	0.9	Silver*
SLRSEBP Size								
9-C2-13860	13860	*6287*	2.00	*51*	6930	*123.2*		Gray*
9-C2-16830	16830	*7634*	2.00	*51*	8415	*149.7*		Silver*

*with Red inner spring

SLRSEBP-9 under test

Horizontal load ratings expressed in G s are based on calculations with bolted connections to steel on top and concrete inserts on bottom. SLRSOEBP housings require uniform support under entire base plate.

Published ratings allow minimum 25% additional travel to solid. For a full 50% specified minimum use the following ratings:

SLRSO Size	50% Travel to Solid Capacity (lbs) (*kg*)	Defl. (in) (*mm*)	SLRSO Size	50% Travel to Solid Capacity (lbs) (*kg*)	Defl. (in) (*mm*)
2-C2-1760	1600 *726*	1.67 *42*	4-C2-7480	6245 *2833*	1.67 *42*
2-C2-2420	2020 *916*	1.67 *42*	6-C2-7260	6060 *2749*	1.67 *42*
2-C2-3080	2570 *1166*	1.67 *42*	6-C2-9240	7715 *3500*	1.67 *42*
2-C2-3740	3120 *1415*	1.67 *42*	6-C2-11220	9370 *4250*	1.67 *42*
4-C2-4840	4040 *1833*	1.67 *42*	9-C2-13860	11570 *5248*	1.67 *42*
4-C2-6160	5145 *2334*	1.67 *42*	9-C2-16830	14050 *6373*	1.67 *42*

SPRING CHARACTERISTICS (inches and *mm*)

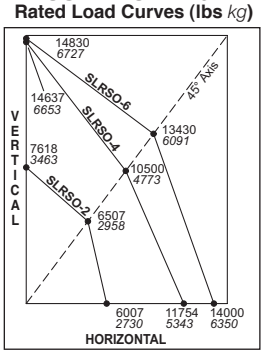
Spring Size	OD	Free Height	Ratio Kx/Ky	Ratio OD/OH
C2	27/8 *73*	5 *127*	0.63-0.85	0.96-1.15

All springs without have an additional travel to solid equal to 50% of the rated deflection.

Solid Spring Height = Free Height minus 1.5 times the Rated Deflection.

Designs using these mounts to resist wind loads must be in accordance with ASCE 7-05.

OSHPD OPA-194
Rated Load Curves (lbs *kg*)



All mounts except SLRSEBP-9-C2 are awaiting OSHPD-194 approval. SLRSEBP-9-C2 has not been submitted.

Horizontal, Vertical and 45 plotted Ratings are California OSHPD submitted values having the OSHPD Anchorage Preapproval Number OPA-0194. Testing and calculations were performed to meet OSHPD criteria.

To use OSHPD submitted rated load curves:

1) Calculate Vertical and Horizontal Forces on mountings including translations and overturning moments.
2) Plot Horizontal and Vertical Loads. The intersection must fall within the area below the OSHPD curve.

APPROVAL PENDING

California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0194

Submitted for Approval December, 2007

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Patrick J. Lama
Civil Engineer
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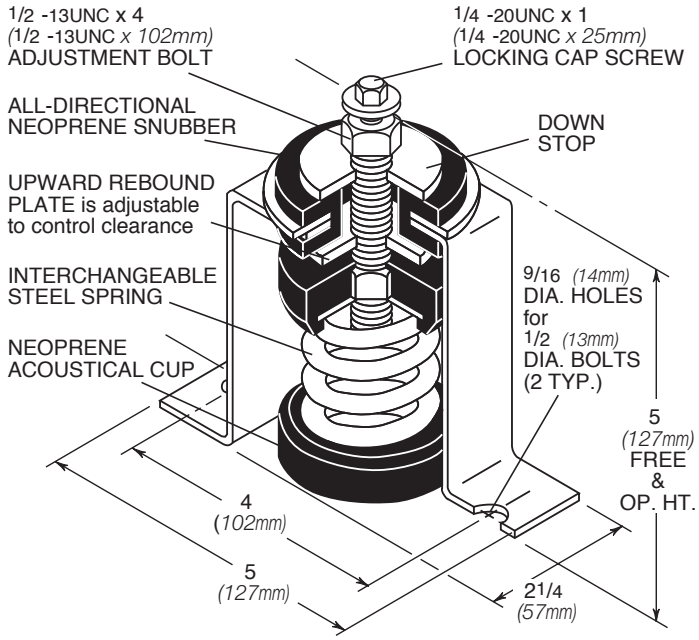
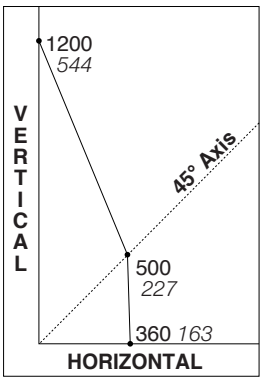
Page

FM45A

SSLFH-X 1" (*25mm*) Defl.



OSHPD OPA-0199 Rated Load Curves (lbs *kg*)



For kN divide kg by 102

Horizontal and Vertical plotted Ratings are California OSHPD approved values having the OSHPD Anchorage Preapproval Number OPA-0199. Testing and calculations were performed to meet OSHPD criteria.

To use approved OSHPD rated load curves:

1) Calculate Vertical and Horizontal Forces on mountings including translations and overturning moments. 2) Plot Horizontal Load vs Vertical Load. The point must fall within the area below the OSHPD curve.

Mounts are galvanized.

SPRING DATA

Size	Spring OD (in) (mm)	Free Ht. (in) (mm)	Ratio Kx/Ky	Ratio OD/OH
23-130	1 1/2 *38*	2 3/8 *60*	0.70-0.90	0.88-1.25
125-220	1 1/2 *38*	2 5/8 *67*	0.75	0.92-1.00

Designs using these mounts to resist wind loads must be in accordance with ASCE 7-95.

TYPE SSLFH RATINGS

Size	Rated Capacity (lbs) (kg)	Rated Defl (in) (mm)	Spring Constant (lbs/in) (kg/mm)	Spring Color/ Stripe	Max. G Rating
SSLFH-X-23	23 *10*	1.30 *33*	18 *0.33*	Brown	15.7
SSLFH-X-33	33 *15*	1.10 *28*	30 *0.55*	Red	10.9
SSLFH-X-54	54 *24*	1.20 *30*	45 *0.82*	White	6.7
SSLFH-X-76	76 *34*	1.02 *26*	73 *1.32*	Black	4.7
SSLFH-X-113	113 *51*	1.00 *25*	113 *2.06*	Yellow	3.2
SSLFH-X-130	130 *59*	1.00 *25*	130 *2.37*	Purple	2.8
SSLFH-X-175	175 *79*	1.00 *25*	175 *3.19*	Silver	2.1
SSLFH-X-210	210 *95*	1.00 *25*	210 *3.82*	Blue	1.7

Horizontal G Ratings are for quick reference only– Use OSHPD Rated Load Curves.

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APPROVED

California Office of Statewide Health Planning and Development

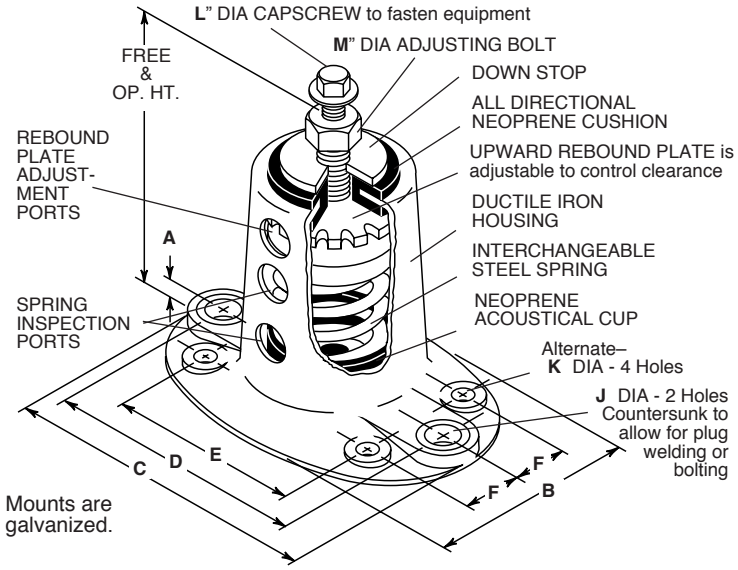
FIXED EQUIPMENT ANCHORAGE

OPA-0199 January 6, 2003

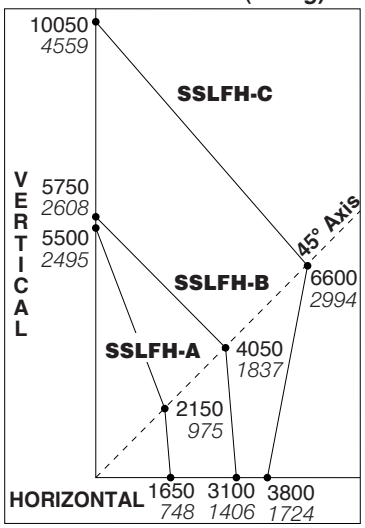
Bill Staehlin (916) 654-3362

Patrick J. Lama
Civil Engineer
California No. 25878

SSLFH 1" (*25mm*) Defl.



OSHPD OPA-0198
Rated Load Curves (lbs *kg*)



Horizontal, Vertical and 45 plotted Ratings are California OSHPD approved values having the OSHPD Anchorage Preapproval Number OPA-0198. Testing and calculations were performed to meet OSHPD criteria.

To use approved OSHPD rated load curves:

1) Calculate Vertical and Horizontal Forces on mountings including translations and overturning moments. 2) Plot Horizontal Load vs Vertical Load. The point must fall within the area below the OSHPD curve.

For kN divide kg by 102

Designs using these mounts to resist wind loads must be in accordance with ASCE 7-95.

TYPE SSLFH RATINGS

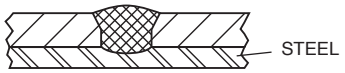
Size	Rated Capacity (lbs)	(kg)	Rated Defl (in)	(mm)	Spring Constant (lbs/in)	(kg/mm)	Spring Color/ Stripe	Max. G Rating
SSLFH-A-45	45	*20*	1.60	*41*	28	*0.5*	Blue	37.8
SSLFH-A-75	75	*34*	1.50	*38*	50	*0.9*	Orange	22.7
SSLFH-A-125	125	*57*	1.33	*34*	94	*1.7*	Brown	13.6
SSLFH-A-200	200	*91*	1.15	*29*	174	*3.1*	Black	8.5
SSLFH-A-310	310	*141*	1.00	*25*	310	*5.6*	Yellow	5.5
SSLFH-A-400	400	*181*	1.00	*25*	400	*7.2*	Green	4.3
SSLFH-A-510	510	*231*	1.00	*25*	510	*9.2*	Red	3.3
SSLFH-A-625	625	*283*	1.00	*25*	625	*11.3*	White	2.7
SSLFH-B-65	65	*29*	2.10	*53*	31	*0.6*	Brown	47.7
SSLFH-B-85	85	*39*	2.10	*53*	40	*0.7*	White	36.5
SSLFH-B-115	115	*52*	2.00	*51*	57	*1.0*	Silver	27.0
SSLFH-B-150	150	*68*	2.00	*51*	75	*1.3*	Orange	20.7
SSLFH-B-280	280	*127*	1.60	*41*	174	*3.1*	Green	11.1
SSLFH-B-450	450	*204*	1.31	*33*	344	*6.2*	Red	6.9
SSLFH-B-750	750	*340*	1.12	*28*	670	*12.1*	White	4.1
SSLFH-B-1000	1000	*454*	1.00	*25*	1000	*18.2*	Blue	3.1
SSLFH-B-1250	1250	*567*	1.00	*25*	1250	*22.7*	Gray	2.5
SSLFH-B-1650	1650	*748*	1.00	*25*	1650	*30.0*	Black	1.9
SSLFH-C-1000	1000	*454*	1.00	*25*	1000	*18.2*	Black	3.8
SSLFH-C-1350	1350	*612*	1.00	*25*	1350	*24.5*	Yellow	2.8
SSLFH-C-1750	1750	*794*	1.00	*25*	1750	*31.8*	Black*	2.2
SSLFH-C-2100	2100	*953*	1.00	*25*	2100	*38.1*	Yellow*	1.8
SSLFH-C-2385	2385	*1082*	1.00	*25*	2385	*43.3*	Yellow**	1.6
SSLFH-C-2650	2650	*1202*	1.00	*25*	2650	*48.1*	Red*	1.4
SSLFH-C-2935	2935	*1331*	1.00	*25*	2935	*53.2*	Red**	1.3

with Black stripe *with Red inner spring **with Green inner spring

Horizontal G Ratings are for quick reference only - Use OSHPD Rated Load Curves.

PLUG WELDED RATINGS

Size	Horizontal (lbs)	(kg)	Vertical (lbs)	(kg)
SSLFH-A	1650	*748*	5500	*2495*
SSLFH-B	3100	*1406*	4345	*1971*
SSLFH-C	3800	*1724*	5630	*2554*



TYPICAL PLUG WELD

Plug Welded Testing and Calculations were performed to meet OSHPD criteria.

TYPE SSLFH DIMENSIONS (inches *mm*)

Size	A	B	C	D	E	F	J	K	L	M	Free & Op Ht
SSLFH-A	1/4 *6*	4 *102*	61/4 *159*	43/4 *121*	4 *102*	11/8 *29*	3/4 *19*	1/2 *13*	3/8-16UNC	3/4 *19*	6 *152*
SSLFH-B	1/2 *13*	6 *152*	91/4 *235*	71/2 *191*	51/2 *140*	15/8 *41*	3/4 *19*	5/8 *16*	1/2-13UNC	7/8 *22*	71/2 *191*
SSLFH-C	1/2 *13*	7 *178*	11 *279*	9 *229*	6 *152*	2 *51*	7/8 *22*	3/4 *19*	5/8-11UNC	1 *25*	8 *203*

SPRING DATA

Size	Spring OD (in)	*(mm)*	Free Ht. (in)	*(mm)*	Ratio Kx/Ky	Ratio OD/OH
A-45-400	13/4	*44*	3	*76*	0.70-0.90	0.88-1.25
A-510-625	13/4	*44*	31/8-33/8	*79-86*	0.50-0.60	0.74-0.82
B	23/8	*60*	4	*102*	0.65-0.90	0.76-1.25
C	27/8	*73*	41/8	*105*	0.90-1.00	0.92

APPROVED

California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0198 January 6, 2003

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Civil Engineer
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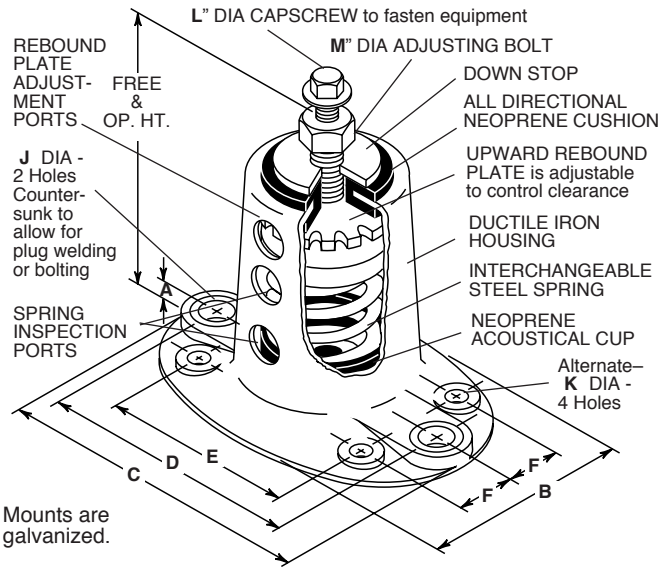
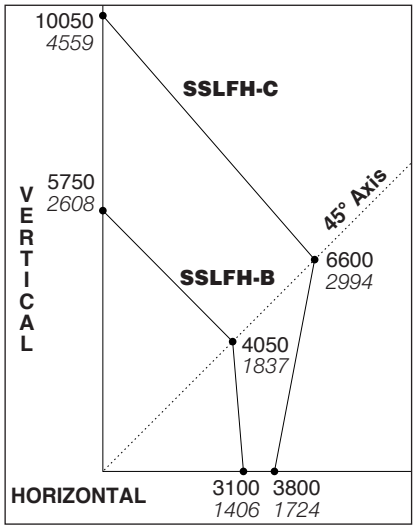
SSLFH 2" (*51mm*) Defl.



Mounts are galvanized.

Designs using these mounts to resist wind loads must be in accordance with ASCE 7-95.

OSHPD OPA-0198
Rated Load Curves (lbs *kg*)



Horizontal, Vertical and 45 plotted Ratings are California OSHPD approved values having the OSHPD Anchorage Preapproval Number OPA-0198. Testing and calculations were performed to meet OSHPD criteria.

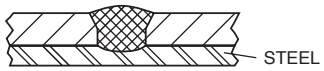
To use approved OSHPD rated load curves:

1) Calculate Vertical and Horizontal Forces on mountings including translations and overturning moments.
2) Plot Horizontal Load vs Vertical Load. The point must fall within the area below the OSHPD curve.

For kN divide kg by 102

PLUG WELDED RATINGS

Size	Horizontal (lbs) *(kg)*	Vertical (lbs) *(kg)*
SSLFH-B & B2	3100 *1406*	4345 *1971*
SSLFH-C	3800 *1724*	5630 *2554*



TYPICAL PLUG WELD

Plug Welded Testing and Calculations were performed to meet OSHPD criteria.

TYPE SSLFH RATINGS

Size	Rated Capacity (lbs) *(kg)*	Rated Defl (in) *(mm)*	Spring Constant (lbs/in) *(kg/mm)*	Spring Color/ Stripe	Max. G Rating
SSLFH-B-20	20 *9*	2.40 *61*	8 *0.1*	Tan	155.0
SSLFH-B-26	26 *12*	2.18 *55*	12 *0.2*	White/Blue	119.2
SSLFH-B-35	35 *16*	2.20 *56*	16 *0.3*	Purple	88.6
SSLFH-B-50	50 *23*	2.20 *56*	24 *0.4*	White/Red	62.0
SSLFH-B-65	65 *30*	2.10 *53*	31 *0.6*	Brown	47.7
SSLFH-B-85	85 *39*	2.10 *53*	40 *0.7*	White/Black	36.5
SSLFH-B-115	115 *52*	2.00 *51*	57 *1.0*	Silver	27.0
SSLFH-B-150	150 *68*	2.00 *51*	75 *1.3*	Orange	20.7
SSLFH-B2-210	210 *95*	2.12 *54*	99 *1.8*	Silver	14.8
SSLFH-B2-290	290 *131*	2.00 *51*	144 *2.6*	Blue	10.7
SSLFH-B2-450	450 *204*	2.00 *51*	224 *4.0*	Tan	6.9
SSLFH-B2-680	680 *308*	2.00 *51*	340 *6.0*	Gray	4.6
SSLFH-C2-125	125 *57*	2.50 *64*	50 *0.9*	Purple	30.4
SSLFH-C2-170	170 *77*	2.40 *61*	70 *1.3*	Brown	22.4
SSLFH-C2-210	210 *95*	2.30 *58*	90 *1.6*	Red	18.1
SSLFH-C2-260	260 *118*	2.20 *56*	120 *2.1*	White	14.6
SSLFH-C2-330	330 *150*	2.00 *51*	165 *2.9*	Black	11.5
SSLFH-C2-460	460 *209*	2.00 *51*	230 *4.1*	Blue	8.3
SSLFH-C2-610	610 *277*	2.00 *51*	305 *5.4*	Green	6.2
SSLFH-C2-880	880 *399*	2.00 *51*	440 *7.8*	Gray	4.3
SSLFH-C2-1210	1210 *549*	2.00 *51*	605 *10.8*	Silver	3.1
SSLFH-C2-1540	1540 *699*	2.00 *51*	770 *13.7*	Gray*	2.5
SSLFH-C2-1870	1870 *848*	2.00 *51*	935 *16.6*	Silver*	2.0

Horizontal G Ratings are for quick reference only– Use OSHPD Rated Load Curves.

*with RED inner spring

TYPE SSLFH DIMENSIONS (inches *mm*)

Size	A	B	C	D	E	F	J	K	L	M	Free & Op Ht
SSLFH-B&B2	1/2 *13*	6 *152*	91/4 *235*	71/2 *191*	51/2 *140*	15/8 *41*	3/4 *19*	5/8 *16*	1/2-13UNC	7/8 *22*	71/2 *191*
SSLFH-C2	1/2 *13*	7 *178*	11 *279*	9 *229*	6 *152*	2 *51*	7/8 *22*	3/4 *19*	5/8-11UNC	1 *25*	8 *203*

SPRING DATA

Size	Spring OD (in) *(mm)*	Free Ht. (in) *(mm)*	Ratio Kx/Ky	Ratio OD/OH
B & B2	23/8 *60*	4 *102*	0.65-0.90	0.76-1.25
C	27/8 *73*	41/8 *105*	0.90-1.00	0.92

Published ratings allow minimum 25% additional travel to solid. For a full 50% specified minimum use the following ratings:

Size	Derated Capacity (lbs) *(kg)*	Defl (in) *(mm)*	Size	Derated Capacity (lbs) *(kg)*	Defl (in) *(mm)*
B2-450	410 *186*	1.83 *46.5*	C2-1210	1010 *458*	1.67 *42.4*
B2-680	565 *256*	1.66 *42.2*	C2-1540	1285 *583*	1.67 *42.4*
C2-880	800 *363*	1.82 *46.2*	C2-1870	1560 *708*	1.67 *42.4*

All springs without have additional travel to solid equal to 50% of the rated deflection.

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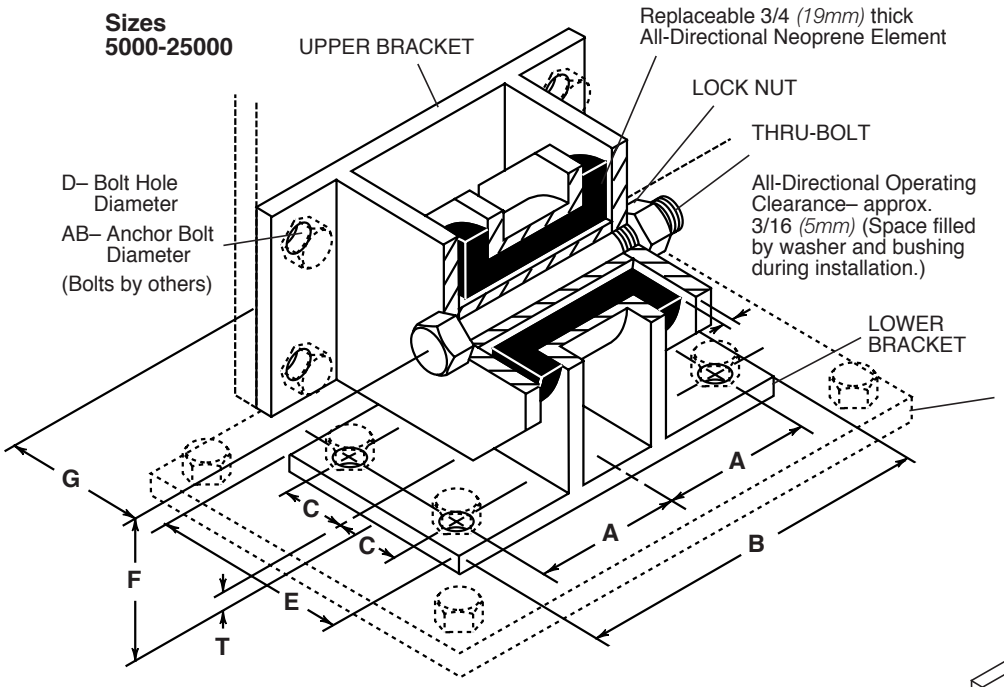
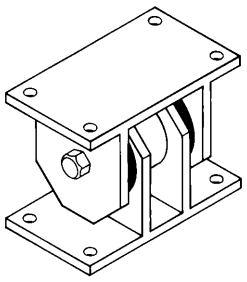
APPROVED
California Office of Statewide Health Planning and Development
FIXED EQUIPMENT ANCHORAGE
OPA-0198 January 6, 2003
Bill Staehlin (916) 654-3362

Patrick J. Lama
Civil Engineer
California No. 25878

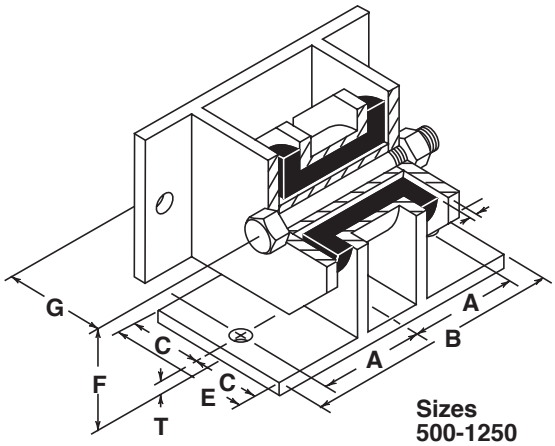
Z-1011 Seismic Snubbers





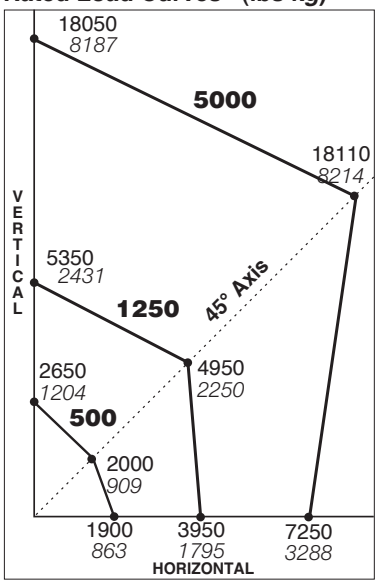
ALTERNATE
180 POSITION

When Steel Sole Plates are used, level and anchor Sole Plates properly to concrete. Snubber Baseplate may be bolted or welded to Sole Plate.



Sizes
500-1250

OSHPD OPA-0197
Rated Load Curves– (lbs *kg*)



For kN divide kg by 102

Horizontal, Vertical and 45 plotted Ratings are California OSHPD approved values having the OSHPD Anchorage Preapproval Number OPA-0197. Testing and calculations were performed to meet OSHPD criteria. Z-1011 snubbers sizes 500, 1250 & 5000 were submitted to OSHPD in November 2003 and are awaiting approval.

TYPE Z-1011 1G ALL DIRECTIONAL LOAD RATINGS AND DIMENSIONS

	Type & Size	1G All Directional Load Ratings	A	AB	B	C	D	E	F	G	T
U.S.A. or British (lbs & inches)	Z-1011-500	500 lbs	3 1/8	3/8	7 1/2	1 1/2	1/2	3	3	2 1/2	1/4
	Z-1011-1250	1250 lbs	3 3/8	1/2	8 1/4	3	5/8	6	4 3/8	4 3/8	3/8
	Z-1011-5000	5000 lbs	5	5/8	12 1/2	2 1/2	3/4	7	5	5	1/2
	Z-1011-13000	13000 lbs	6	1	14 1/2	2 3/4	1 1/8	8	5 3/4	5 3/4	3/4
	Z-1011-25000	25000 lbs	6 3/8	1 1/4	16	4 1/8	1 3/8	11	8	8	1
Metric (kgs & mm)	*Z-1011-500*	*227 kg*	*79*	*10*	*191*	*38*	*13*	*76*	*76*	*64*	*6*
	Z-1011-1250	*568 kg*	*86*	*13*	*210*	*76*	*16*	*152*	*111*	*111*	*10*
	Z-1011-5000	*2273 kg*	*127*	*16*	*318*	*64*	*19*	*178*	*127*	*127*	*13*
	Z-1011-13000	*5909 kg*	*152*	*25*	*368*	*70*	*29*	*203*	*146*	*146*	*19*
	Z-1011-25000	*11364 kg*	*162*	*32*	*406*	*105*	*35*	*279*	*203*	*203*	*25*

APPROVAL PENDING

California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0197

Submitted for Approval November, 2003

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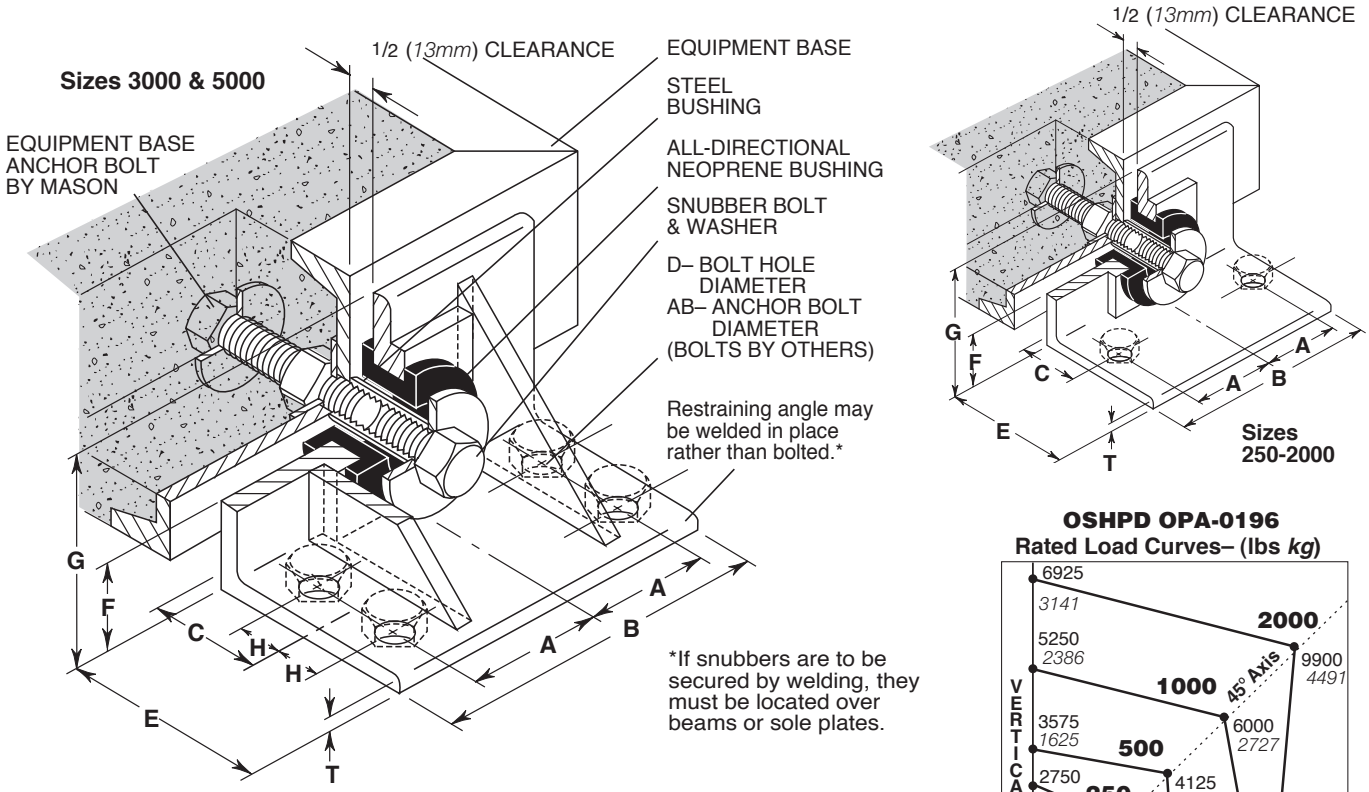
California No. 25878

Z-1225 Seismic Snubbers



Horizontal, Vertical and 45 plotted Ratings are California OSHPD approved values having the OSHPD Anchorage Preapproval Number OPA-0196. Testing and calculations were performed to meet OSHPD criteria.Z-1225-2000 was submitted to OSHPD in November 2003 and is awaiting approval.

To use approved OSHPD rated load curves: 1) Calculate Vertical and Horizontal Forces on mounting including translations and overturning moments. 2) Plot Horizontal Load vs Vertical Load. The point must fall within the area below the OSHPD curve.

OSHPD OPA-0196
Rated Load Curves– (lbs *kg*)

For kN divide kg by 102

TYPE Z-1225 1G ALL DIRECTIONAL LOAD RATINGS AND DIMENSIONS

	Type & Size	1G All Directional Load Ratings	A	AB	B	C	D	E	F	G	H	T	Equipment Base Anchor Bolt Size & Length
U.S.A. or British (lbs & inches)	Z-1225-250	250 lbs	2	1/2	5	1 3/4	5/8	3	2 1/8	3 1/2		1/4	1/2 -13 UNC-4
	Z-1225-500	500 lbs	2 3/4	1/2	7	1 3/4	5/8	4	2 3/8	4		1/4	5/8 -11 UNC-6
	Z-1225-1000	1000 lbs	3	5/8	8	2 1/2	3/4	5	2 1/2	5		3/8	3/4 -10 UNC-6
	Z-1225-2000	2000 lbs	5	3/4	12	3	7/8	6	3	6		1/2	3/4 -10 UNC-6
	Z-1225-3000	3000 lbs	4 3/4	3/4	12	5	7/8	10	3 1/4	6 3/8	3 3/4	3/8	7/8 -9 UNC-6
	Z-1225-5000	5000 lbs	6	1	15	6	1 1/8	12	3 1/2	6 3/8	4 3/4	3/8	1 -8 UNC-6
***Metric* (*kgs & mm*)**	*Z-1225-250*	*113 kg*	*51*	*13*	*127*	*44*	*16*	*76*	*54*	*89*	—	*6*	1/2 -13 UNC-*102*
	Z-1225-500	*227 kg*	*70*	*13*	*178*	*44*	*16*	*102*	*60*	*102*	—	*6*	5/8 -11 UNC-*152*
	Z-1225-1000	*455 kg*	*76*	*16*	*203*	*64*	*19*	*127*	*64*	*127*	—	*10*	3/4 -10 UNC-*152*
	Z-1225-2000	*909 kg*	*127*	*19*	*305*	*76*	*22*	*152*	*76*	*152*	—	*13*	3/4 -10 UNC-*152*
	Z-1225-3000	*1364 kg*	*121*	*19*	*305*	*127*	*22*	*254*	*83*	*162*	*95*	*10*	7/8 -9 UNC-*152*
	Z-1225-5000	*2273 kg*	*152*	*25*	*381*	*152*	*29*	*305*	*89*	*162*	*121*	*10*	1 -8 UNC-*152*

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APPROVED
California Office of Statewide Health Planning and Development
FIXED EQUIPMENT ANCHORAGE
OPA-0196 January 6, 2003

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Patrick J. Lama
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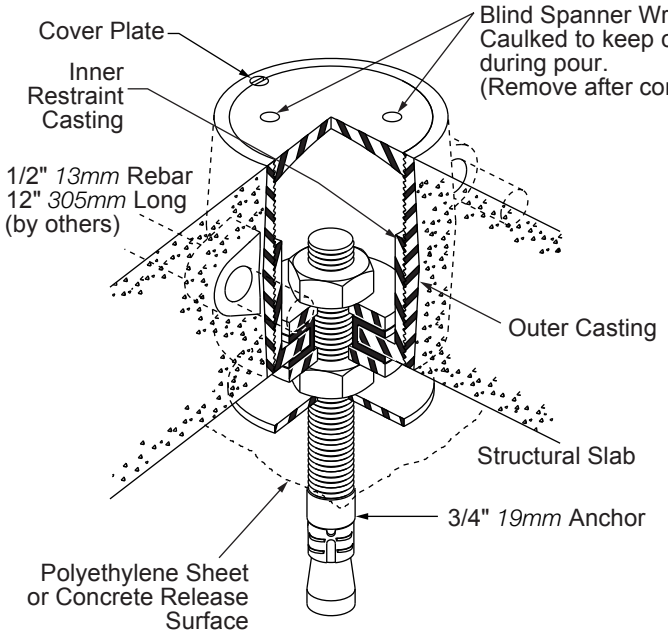
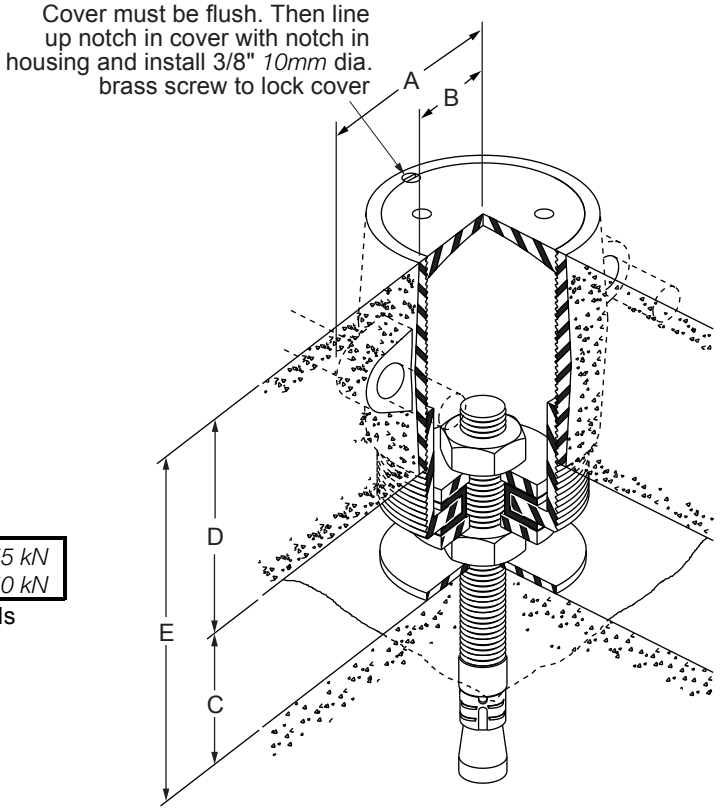
SFFS Seismic Floating Floor Snubber

POSITION 1 (FLOOR IN POURED POSITION)



POSITION 2 (FLOOR IN RAISED POSITION)



TYPE SFFS RATINGS

Allowable Vertical Loading of Housing	= 5520 lbs. *24.55 kN*
Allowable Horizontal Loading of Housing	= 7750 lbs. *34.50 kN*

NOTE : Capacity of Snubber is dictated by allowable loads on the Anchor Bolt.

TYPE SFFS DIMENSIONS

Housing Dimensions A	Housing Dimensions B	Air Gap C	Floor Thickness D	Overall Height E
3 1/8" *79 mm*	1 15/16" *49 mm*	Most Common 1" or 2" *25 or 50 mm* Occasionally 3" or 4" *75 or 100 mm*	Minimum 3" - *75 mm* Most Common 4" - *100 mm* Occasionally 6" thru 12" *150 - 300 mm*	Air Gap plus Floor Thickness

Illustrated housing is for 4" *100mm* thick floating floors. Other configurations are availiable for 3" *75mm*, 5" *125mm* and 6" *150mm* thick floating floors as required.

APPROVED

California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0207 January 6, 2003

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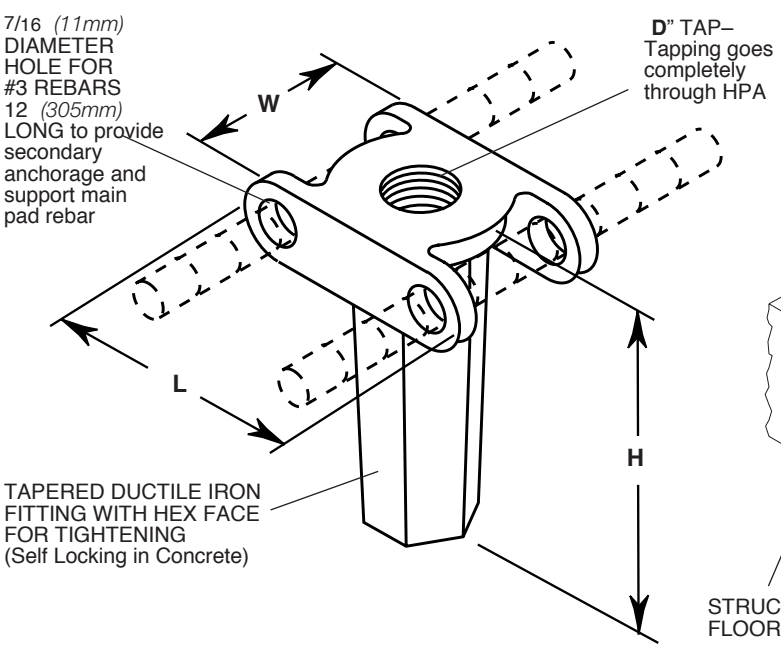
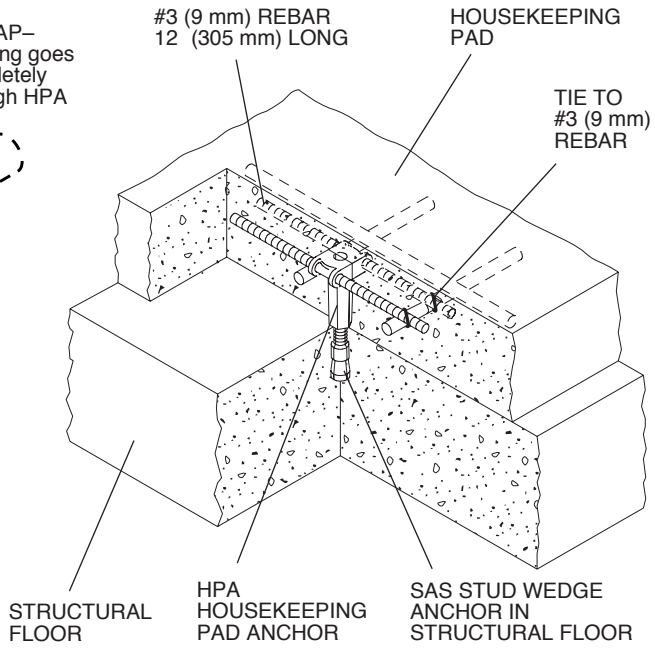
Richard Rustorino
Civil Engineer
California CE No. 30112

HPA SEISMIC HOUSEKEEPING PAD ANCHOR





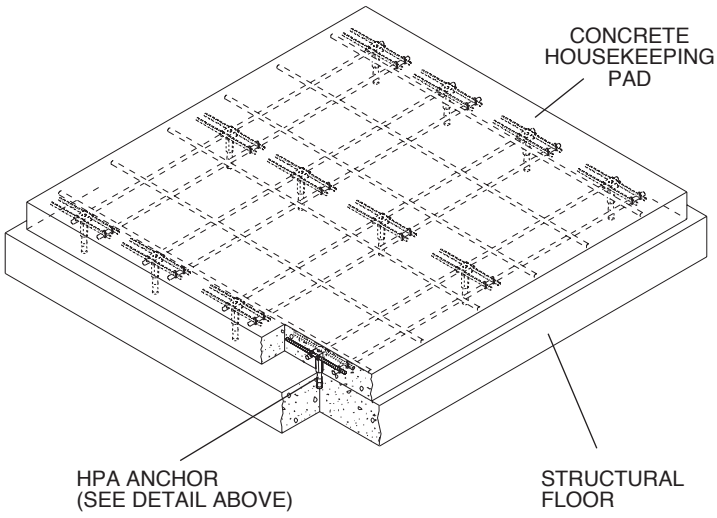
TYPE HPA DIMENSIONS (inches)

Size	L	W	H	D	SAS Stud Anchor Capacity in 3000 psi Concrete Tension (lbs)	Shear (lbs)
HPA-1/2	2 1/8	1 1/4	3	1/2 UNC	820	1540
HPA-5/8	2 3/8	1 1/2	3	5/8 UNC	1210	2260
HPA-3/4	2 3/4	1 3/4	3	3/4 UNC	1545	3675

TYPE HPA DIMENSIONS (mm)

Size	*L*	*W*	*H*	*D*	*SAS Stud Anchor Capacity in 20 Mpa Concrete Tension (kg)*	*Shear (kg)*
HPA-1/2	*54*	*32*	*75*	*1/2"UNC*	*372*	*699*
HPA-5/8	*60*	*38*	*75*	*5/8"UNC*	*549*	*1025*
HPA-3/4	*70*	*44*	*75*	*3/4"UNC*	*701*	*1667*

For kN divide kg by 102



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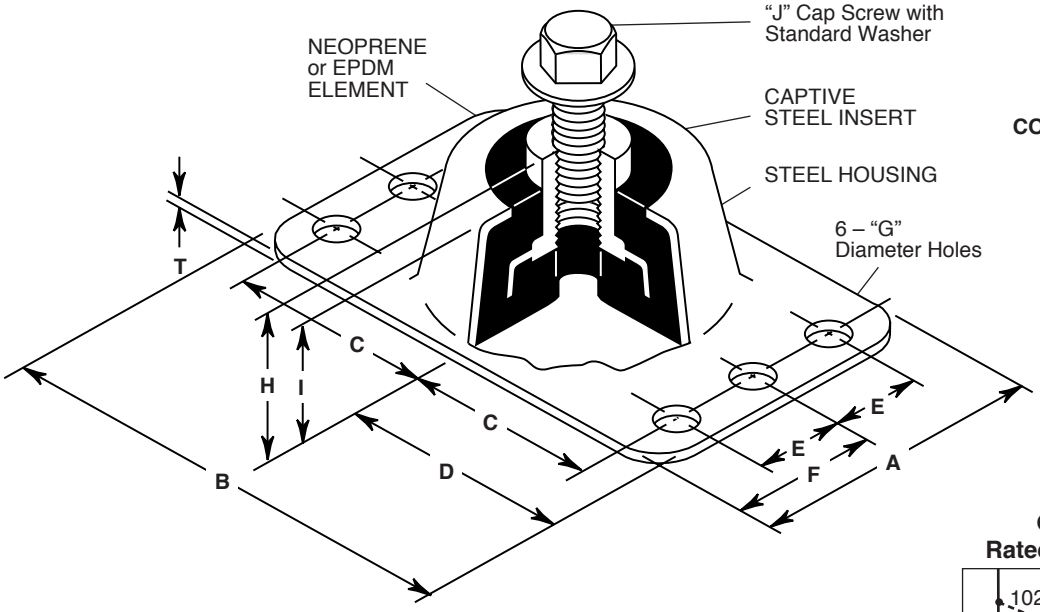
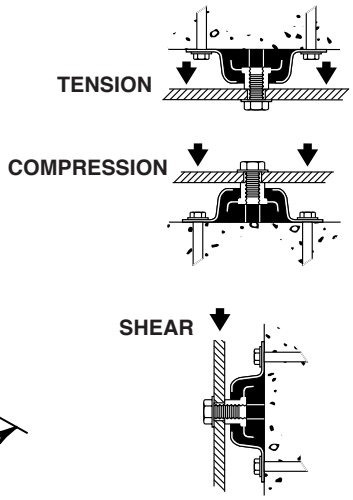
Email Addresses– Info@Mason-Ind.com • Info@MasonAnaheim.com

RBA, RCA & RDA

NEOPRENE SEISMIC MOUNTINGS





TYPE RBA, RCA and RDA DIMENSIONS (inches *millimeters*)

Type	A	B	C	D	E	F	G	H	I	J	T
RBA	3 76	4 3/4 121	1 15/16 49	2 3/8 60	1 25	1 1/2 38	7/16 11	1 7/8 48	1 1/2 38	1/2-13UNC x 1 1/4	3/32 2
RCA	3 3/4 95	6 1/4 159	2 1/2 64	3 1/8 79	1 1/4 32	1 7/8 48	9/16 14	1 7/8 48	1 1/2 38	5/8 -11UNC x 1 1/4	3/32 2
RDA	5 127	8 203	3 1/4 83	4 102	1 3/4 44	2 1/2 64	3/4 19	2 3/8 60	1 7/8 48	7/8 -9UNC x 1 1/4	3/16 5

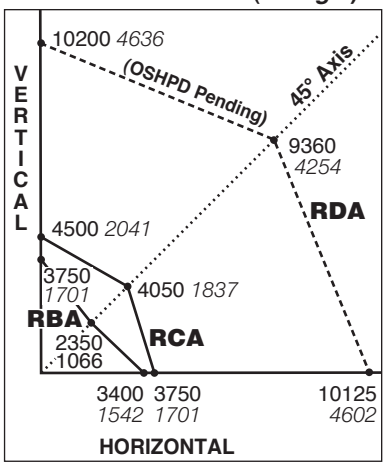
TYPE RBA, RCA and RDA RATINGS

Type	Size (Color Mark)	Duro-meter	COMPRESSION Rated Capacity (lbs *kgs*)	COMPRESSION Rated Defl (in *mm*)	TENSION Rated Capacity (lbs *kgs*)	TENSION Rated Defl (in *mm*)	SHEAR Rated Capacity (lbs *kgs*)	SHEAR Rated Defl (in *mm*)	Maximum Horizontal Static G Rating
RBA-	Black Green White	30 45 60	250 *113* 525 *238* 1000 *454*	0.15 *4*	200 *91* 420 *191* 800 *363*	0.12 *3*	200 *90* 420 *191* 800 *363*	0.09 *2*	13.6 6.5 3.4
RCA-	Green Red White	40 50 60	1400 *635* 2100 *953* 3500 *1588*	0.15 *4*	1000 *454* 1500 *680* 2500 *1134*	0.12 *3*	400 *181* 600 *272* 1000 *454*	0.09 *2*	2.7 1.8 1.1
RDA-	Green Red White	40 50 60	2800 *1270* 4200 *1910* 7100 *3230*	0.18 *5*	2000 *910* 2900 *1320* 4200 *1910*	0.15 *4*	900 *410* 1300 *590* 1800 *820*	0.12 *3*	3.3 2.2 1.3

All Rated Capacities are based on proper neoprene loadings without metal to metal contact. Seismic Max. G Ratings are based on metal failure under static seismic loadings as defined in the building codes.

Horizontal G Ratings are for quick reference only– Use OSHPD Rated Load Curves.

OSHPD OPA-0200
Rated Load Curves (lbs *kgs*)



Horizontal, Vertical and 45 plotted Ratings are California OSHPD approved values having the OSHPD Anchorage Preapproval Number OPA-0200. Testing and calculations were performed to meet OSHPD criteria.

To use approved OSHPD rated load curves: 1) Calculate Vertical and Horizontal Forces on mounting including translations and overturning moments. 2) Plot Horizontal Load vs Vertical Load. The point must fall within the area below the OSHPD curve.

For kN divide kg by 102

APPROVED

California Office of Statewide Health Planning and Development

FIXED EQUIPMENT ANCHORAGE

OPA-0200 January 6, 2003

Bill Staehlin (916) 654-3362

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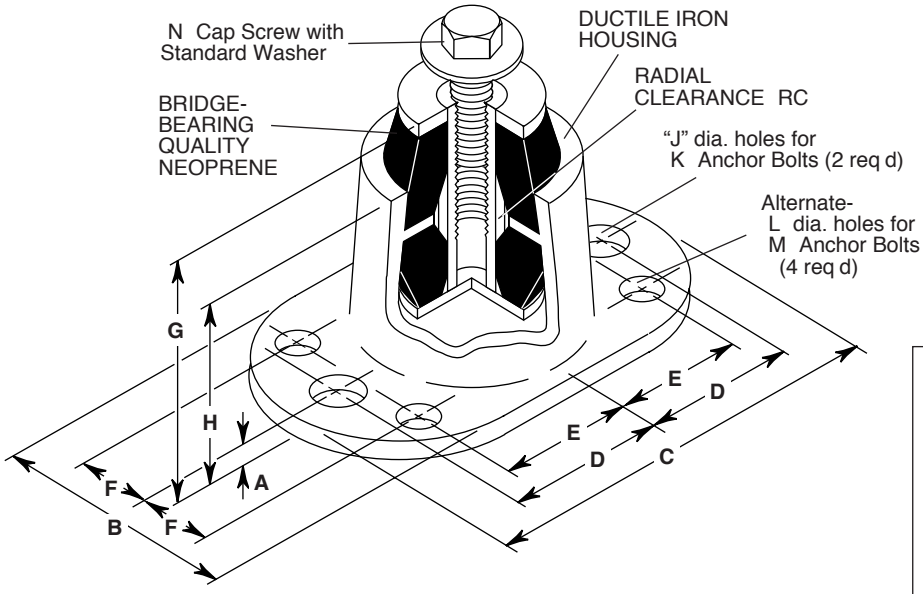
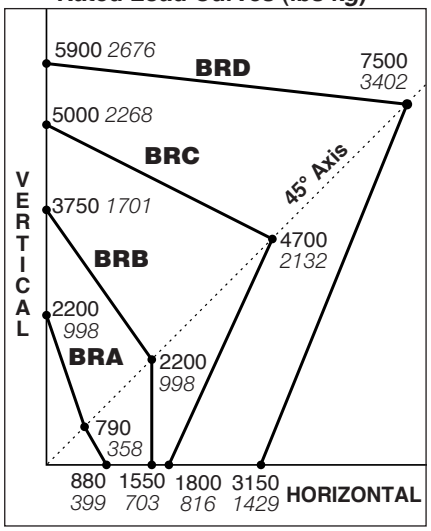
Patrick J. Lama
Civil Engineer
California No. 25878

BR NEOPRENE SEISMIC MOUNTINGS



NOTE:
All Hardware Plated

OSHPD OPA-0201
Rated Load Curves (lbs *kg*)



For kN divide kg by 102

TYPE BR DIMENSIONS (inches *mm*)

Type	A	B	C	D	E	F	G	H	J	K	L	M	N	RC
BRA	3/16 *5*	2 1/2 *64*	4 1/4 *108*	1 5/8 *41*	1 3/8 *34*	3/4 *19*	3 *76*	1 *25*	1/2 *13*	3/8 *10*	3/8 *10*	1/4 *6*	5/16 x 1 *5/16 x 25*	3/16 *5*
BRB	3/16 *5*	3 1/4 *83*	5 3/4 *146*	2 1/4 *57*	1 7/8 *48*	7/8 *22*	3 *76*	2 *51*	5/8 *16*	1/2 *13*	1/2 *13*	3/8 *10*	7/16 x 1 *7/16 x 25*	1/4 *6*
BRC	1/4 *6*	5 1/4 *133*	9 *229*	3 5/8 *92*	3 *76*	1 1/2 *38*	6 1/2 *165*	4 1/2 *114*	7/8 *22*	3/4 *22*	3/4 *22*	5/8 *16*	5/8 x 11/2 *5/8 x 38*	5/8 *16*
BRD	1/4 *6*	6 *152*	10 1/2 *267*	4 3/8 *111*	3 5/8 *92*	1 5/8 *41*	6 1/2 *165*	4 1/2 *114*	7/8 *22*	3/4 *22*	3/4 *22*	5/8 *16*	5/8 x 11/2 *5/8 x 38*	5/8 *16*

TYPE BR RATINGS

Type & Size (Color Mark)	Duro-meter	COMPRESSION Rated Capacity (lbs)(*kg*)	COMPRESSION Rated Defl (in)(*mm*)	TENSION Rated Capacity (lbs)(*kg*)	TENSION Rated Defl (in)(*mm*)	SHEAR Rated Capacity (lbs)(*kg*)	SHEAR Rated Defl (in)(*mm*)	Maximum Horizontal Static G Rating
BR-A-Green	40	85 *39*		85 *39*		20 *9*		10.4
BR-A-Red	50	125 *57*	0.2	125 *57*	0.18	30 *14*	0.13	7.0
BR-A-White	60	205 *93*	*5*	205 *95*	*5*	50 *23*	*3*	4.3
BR-A-Yellow	70	290 *132*		290 *132*		70 *32*		3.0
BR-B-Red	50	450 *204*	0.2	500 *227*	0.18	100 *45*	0.15	3.4
BR-B-White	60	740 *336*	*5*	750 *340*	*5*	170 *77*	*4*	2.1
BR-B-Yellow	70	1040 *472*		1050 *476*		240 *109*		1.5
BR-C-Red	50	650 *295*	0.3	750 *340*	0.25	380 *172*	0.50	2.8
BR-C-White	60	1100 *499*	*8*	1150 *522*	*6*	500 *227*	*13*	1.6
BR-C-Yellow	70	1540 *699*		1610 *730*		700 *318*		1.2
BR-D-White	60	2390 *1084*	0.3	2450 *1111*	0.25	750 *340*	0.50	1.3
BR-D-Yellow	70	3150 *1429*	*8*	3430 *1556*	*6*	1050 *476*	*13*	1.0

Horizontal, Vertical and 45 plotted Ratings are California OSHPD approved values having the OSHPD Anchorage Preapproval Number OPA-0201. Testing and calculations were performed to meet OSHPD criteria.

To use approved OSHPD rated load curves: 1) Calculate Vertical and Horizontal Forces on mounting including translations and overturning moments. 2) Plot Horizontal Load vs Vertical Load. The point must fall within the area below the OSHPD curve.

All Rated Capacities are based on proper neoprene loadings without metal to metal contact. Seismic Max. G Ratings are based on metal failure under static seismic loadings as defined in the building codes.

Horizontal G Ratings are for quick reference only– Use OSHPD Rated Load Curves.

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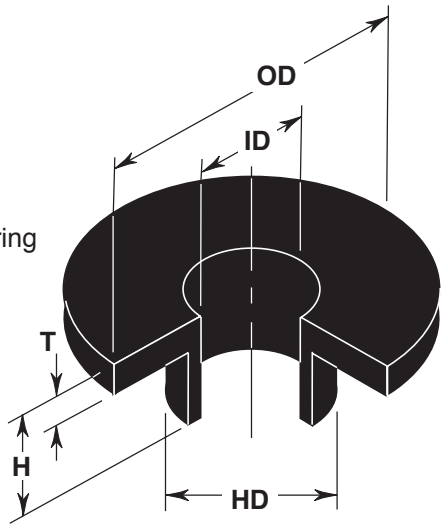
APPROVED
California Office of Statewide Health Planning and Development
FIXED EQUIPMENT ANCHORAGE
OPA-0201 January 6, 2003

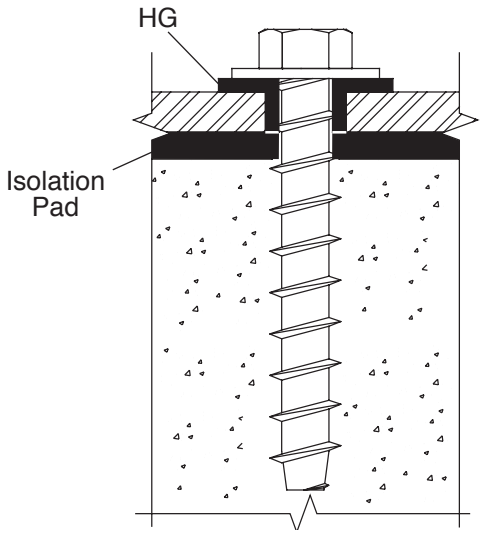
Bill Staehlin (916) 654-3362

Richard E. Pustorino
Civil Engineer
California No. 30112

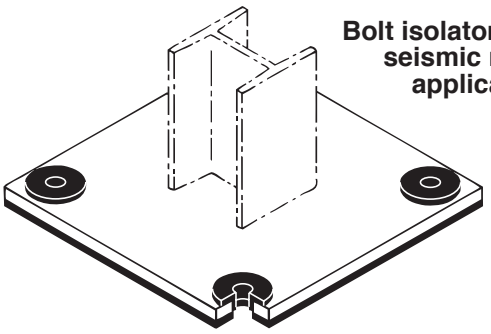
HG WASHER-BUSHINGS

Material:
Bridge-Bearing Neoprene



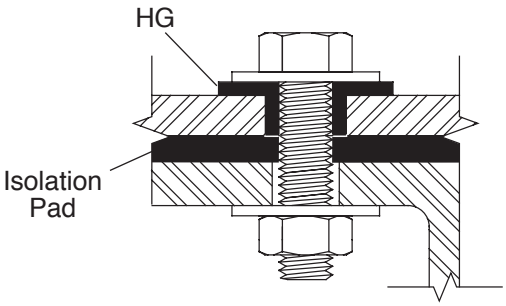


Steel to Concrete Detail



Bolt isolator and seismic relief application

HG Washer Bushings may be used without isolation pads to limit bolt shear from impact.



Steel to Steel Detail

BRIDGE-BEARING NEOPRENE SPECIFICATIONS

ORIGINAL PHYSICAL PROPERTIES			TESTED FOR AGING				COMPRES-SION SET
			(c)			(d)	(e)
(a) Duro-meter	(b) Tensile Strength (min)	(b) Elongat. at Break (min)	OVEN AGING(70h/212 F) Hard-ness (max)	Tensile Strength (max)	Elongat. at Break (max)	OZONE 1 ppm in air by Vol.20% Strain 100F	22hrs 150F Method B
40±5	2000 psi	450%	+15%	±15%	-40%	No Cracks	30%(max)
50±5	2500 psi	400%	+15%	±15%	-40%	No Cracks	25%(max)
60±5	2500 psi	350%	+15%	±15%	-40%	No Cracks	25%(max)

(a)ASTM D-676 (b)ASTM D-412 (c)ASTM D-573 (d)ASTM D-1149 (e)ASTM D-395

TYPE HG DIMENSIONS

Size	Bolt Dia.* (in) *(mm)*	Allowable Shear Load in a Steel to Steel Connection (lbs) (kN)	Allowable Tension Load in a Steel to Steel Connection (lbs) (kN)	ID (in) *(mm)*	HD (in) *(mm)*	OD (in) *(mm)*	T (in) *(mm)*	H (in) *(mm)*
HG-25	1/4 *6*	490 *2.2*	980 *4.4*	1/4 *6*	1/2 *13*	1 *25*	1/8 *3*	3/8 *10*
HG-38	3/8 *10*	1100 *4.9*	2200 *9.8*	3/8 *10*	5/8 *16*	1 1/4 *32*	1/8 *3*	1/2 *13*
HG-50	1/2 *13*	1960 *8.7*	3920 *17.4*	1/2 *13*	3/4 *19*	1 5/8 *41*	1/8 *3*	1/2 *13*
HG-63	5/8 *16*	3070 *13.6*	6140 *27.2*	5/8 *16*	7/8 *22*	2 *51*	3/16 *5*	5/8 *16*
HG-75	3/4 *19*	4420 *19.7*	8840 *39.4*	3/4 *19*	1 *25*	2 1/4 *57*	3/16 *5*	5/8 *16*
HG-100	1 *25*	7850 *34.9*	15700 *69.8*	1 *25*	1 1/4 *32*	2 3/4 *70*	1/4 *6*	7/8 *22*
HG-125	1 1/4 *32*	12270 *54.6*	24540 *109.2*	1 1/4 *32*	1 1/2 *38*	3 1/4 *83*	1/4 *6*	7/8 *22*
HG-150	1 1/2 *38*	17670 *78.6*	35340 *157.2*	1 1/2 *38*	1 3/4 *45*	3 3/4 *95*	1/4 *6*	1 *25*

* Retention strength based on diameter of anchor bolt and anchoring method.

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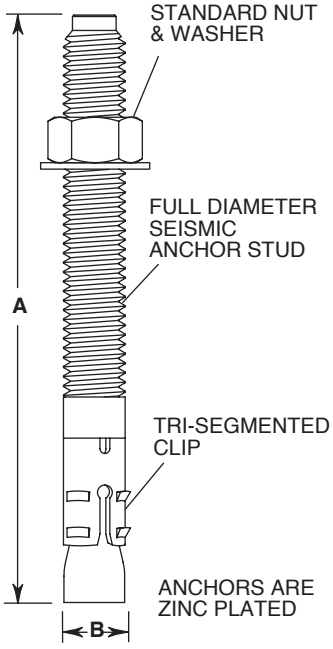
SAS & SASE SEISMIC ANCHOR STUDS

SAS and SASE



TYPE SAS STANDARD LENGTH ANCHOR STUD RATINGS BASED ON ALLOWABLE STRESS DESIGN (ASD) installed into 2500 psi (17.2 Mpa) Normal Weight or Sand– Lightweight Concrete*

Type and Size	Embedment Depth (in) (mm)	Normal Weight Concrete Tension† (lbs) (kg)	Normal Weight Concrete Shear (lbs) (kg)	Lightweight Concrete Tension† (lbs) (kg)	Lightweight Concrete Shear (lbs) (kg)
SAS-3/8	2 51	445 200	650 295	360 165	390 175
SAS-1/2	2 3/4 70	980 445	1055 480	590 270	635 290
SAS-5/8	3 3/8 86	1325 600	2845 1290	795 360	1710 775
SAS-3/4	4 1/8 105	1520 690	3870 1755	915 415	2325 1055
SAS-1	5 1/4 133	2220 1005	5960 2705	1335 605	3575 1620

TYPE SASE EXTENDED LENGTH ANCHOR STUD RATINGS BASED ON ALLOWABLE STRESS DESIGN (ASD) installed into 2500 psi (17.2 Mpa) Normal Weight or Sand– Lightweight Concrete*

Type and Size	Embedment Depth (in) (mm)	Normal Weight Concrete Tension† (lbs) (kg)	Normal Weight Concrete Shear (lbs) (kg)	Lightweight Concrete Tension† (lbs) (kg)	Lightweight Concrete Shear (lbs) (kg)
SASE-3/8	2 7/8 73	950 430	820 390	690 315	820 370
SASE-1/2	3 7/8 98	1275 580	2960 1340	1080 490	2325 1055
SASE-5/8	5 1/8 130	2355 1070	4520 2050	1660 755	3580 1625
SASE-3/4	5 3/4 146	2740 1245	6980 3165	1645 745	4190 1900

TYPE SAS & SASE ANCHOR STUD RATINGS BASED ON ALLOWABLE STRESS DESIGN (ASD) installed in the Soffit of 3000 psi (20.7 Mpa) Normal Weight or Sand-Lightweight Concrete-filled Profile Steel Deck Assemblies*.
Anchors must be installed in either the lower or upper flutes of the profile deck.

Type and Size	Embedment Depth (in) (mm)	Tension (lbs) (kg)	Shear (lbs) (lbs)
SAS-3/8	2 51	430 195	725 330
SASE-3/8	3 3/8 86	760 345	1590 720
SAS-1/2	2 3/4 70	695 315	970 440
SASE-1/2	4 1/2 114	930 420	2085 945
SAS-5/8	3 3/8 86	890 405	1200 545
SASE-5/8	5 5/8 143	1700 770	3185 1445

For combined allowable stress design tension and shear forces on anchors, use the following equation:

$$\frac{T_{Applied}}{T_{Allowable\ (ASD)}} + \frac{V_{Applied}}{V_{Allowable\ (ASD)}} \leq 1.2$$

TYPE SAS & SASE ANCHOR STUD DIMENSIONS

Type and Size	A (in) (mm)	B (in) (mm)	Maximum Tightening Torque (Ft-lbs) (N-m)
SAS-3/8	3 1/2 89	3/8 10	30 41
SAS-1/2	4 1/4 108	1/2 13	50 68
SAS-5/8	5 127	5/8 16	85 116
SAS-3/4	6 1/4 159	3/4 19	180 244
SAS-1	7 178	1 25	230 312
SASE-3/8	5 127	3/8 10	30 41
SASE-1/2	5 1/2 140	1/2 13	50 68
SASE-5/8	7 178	5/8 16	85 116
SASE-3/4	8 1/2 216	3/4 19	180 245

Anchors have the following Code Reports:
- ICC-ES-ESR-1771 and City of Los Angeles RR25705 for cracked & uncracked concrete
- Florida Statewide Product Approval FL11506.6

* These values are applicable when the anchors are installed with periodic special inspection as set forth in Section 1701.5.2 and Section 1704.13 of the IBC.

The Tension values may be increased for greater compressive strength, up to 8500 psi (58.6 MPa), by multiplying the value by $(F_c/2500)^{0.5}$, where F_c is the specified strength of concrete in psi.
For example: SAS-1/2 in 4000 psi normal weight concrete

$$T = \left(\frac{4000}{2500}\right)^{0.5} \times 980 \text{ lbs} = 1240 \text{ lbs}$$

NOTES:
1. All values are for single anchors with no edge distance or spacing reduction.
2. Anchorage must be designed in accordance with ACI 318-05 Appendix D.
3. Allowable loads are for the attachment of non-structural components.
4. Allowable loads are based on 100% seismic loading in seismic design categories C-F.

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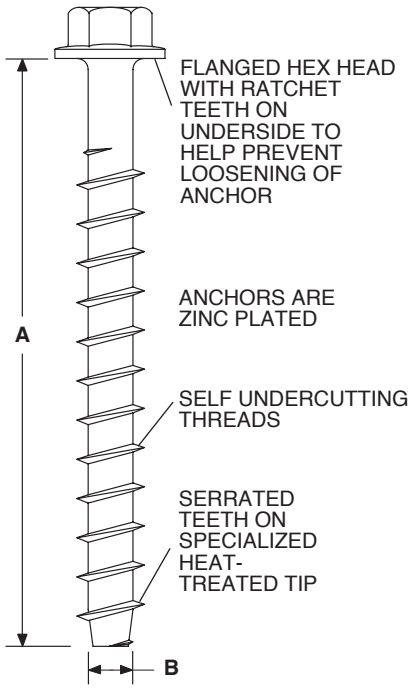
Tension and Shear Values as verified by ICC Report ICC-ES-ESR-1771.

ICC EVALUATION SERVICE

ICC Report ICC-ES-ESR-1771

Patrick J. Lama
Civil Engineer
California No. 25878

SAST SEISMIC ANCHOR SELF-TAPPING



TYPE SAST ANCHOR BOLT RATINGS BASED ON ALLOWABLE STRESS DESIGN (ASD)

Type and Size	Embedment Depth (in)	*(mm)*	Installed into 2500psi (17.2Mpa) Normal Weight Concrete Tension† (lbs)	*(kg)*	Shear (lbs)	*(kg)*	Installed into 2500psi (17.2Mpa) Lightweight Concrete Tension† (lbs)	*(kg)*	Shear (lbs)	*(kg)*	Maximum Tightening Torque (Ft-lbs)	*(N-m)*
SAST-3/8	3 1/4	*83*	920	*410*	1160	*525*	555	*250*	695	*315*	50	*68*
SAST-1/2	4	*102*	1500	*680*	2010	*910*	900	*405*	1205	*545*	65	*88*
SAST-5/8	4 1/2	*114*	1810	*820*	3870	*1755*	1085	*490*	2325	*1055*	140	*190*
SAST-3/4	5 1/2	*140*	2070	*940*	3925	*1780*	1245	*565*	2355	*1065*	150	*205*

For combined allowable stress design tension and shear forces on anchors, use the following equation:

$$\frac{T_{Applied}}{T_{Allowable\ (ASD)}} + \frac{V_{Applied}}{V_{Allowable\ (ASD)}} \leq 1.2$$

* These values are applicable when the anchors are installed with periodic special inspection as set forth in Section 1701.5.2 and Section 1704.13 of the IBC.

The Tension values may be increased for greater compressive strength, up to 8500 psi (58.6 MPa), by multiplying the value by $(F'_c/2500)^{0.5}$, where F'_c is the specified strength of concrete in psi.
For example: SAST-1/2 in 4000 psi normal weight concrete

$$T = \left(\frac{4000}{2500}\right)^{0.5} \times 1500 \text{ lbs} = 1895 \text{ lbs}$$

TYPE SAST ANCHOR BOLT DIMENSIONS

Type and Size	A (in)	*(mm)*	B (in)	*(mm)*
SAST-3/8	4	*102*	3/8	*10*
SAST-1/2	5	*127*	1/2	*13*
SAST-5/8	6	*152*	5/8	*16*
SAST-3/4	7	*178*	3/4	*19*

Anchors have the following Code Reports:
- ICC-ES-ESR-2713 and City of Los Angeles Report RR25741 for cracked & uncracked concrete
- ICC-ES-ESR-1056 and City of Los Angeles Report RR25560 for CMU (Concrete Masonry Units)
- Florida Statewide Approval FL11506.7
- Factory Mutual 3017082

NOTES:
1. All values are for single anchors with no edge distance or spacing reduction.
2. Anchorage must be designed in accordance with ACI 318-05 Appendix D.
3. Allowable loads are for the attachment of non-structural components.
4. Allowable loads are based on 100% seismic loading in seismic design categories C-F.

Tension and Shear Values as verified by ICC Report ICC-ES-ESR-2713.

ICC EVALUATION SERVICE

ICC Report ICC-ES-ESR-2713

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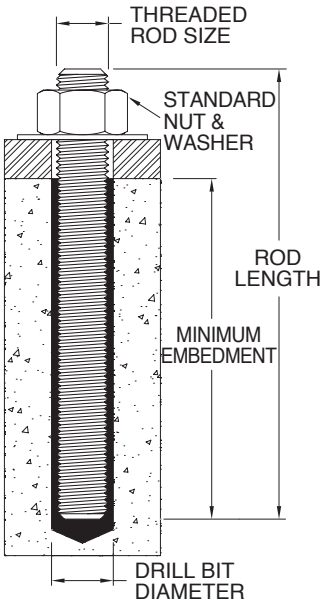
SRA



TYPE SRA ANCHOR DATA

Type and Size	Threaded Rod Size	Rod Length (in)	Rod Length **(mm)**	Embedment Depth (in)	Embedment Depth **(mm)**	Drill Bit Dia (in)	Minimum Concrete Thickness (in)	Minimum Concrete Thickness **(mm)**	Maximum Tightening Torque After curing (Ft-lbs)	Maximum Tightening Torque After curing **(N-m)**	Number of Anchors that can be installed per 22oz of adhesive
SRA-1/2	1/2-13 UNC	7	**178**	5	**127**	5/8	7 1/2	**190**	20	**27**	30
SRA-5/8	5/8-11 UNC	8	**203**	6	**152**	3/4	9 1/4	**235**	30	**41**	20
SRA-3/4	3/4-10 UNC	9	**229**	7	**178**	7/8	10 3/4	**273**	45	**61**	14
SRA-1	1-8 UNC	11	**280**	9	**229**	1 1/8	14	**355**	80	**108**	7

CURE SCHEDULE

Concrete Temperature F	Concrete Temperature **°C**	Cure Time (Hrs.)
50	**10**	72
70	**21**	24
90	**32**	24
110	**43**	24

For water saturated concrete, these times should be doubled.

For combined allowable stress design tension and shear forces on anchors, use the following equation:

$$\frac{T_{Applied}}{T_{Allowable\ (ASD)}} + \frac{V_{Applied}}{V_{Allowable\ (ASD)}} \leq 1.2$$

NOTES:
1. All values are for single anchors with no edge distance or spacing reduction.
2. Anchorage must be designed in accordance with ACI 318-05 Appendix D.
3. Allowable loads are for the attachment of non-structural components.
4. Allowable loads are based on 100% seismic loading in seismic design categories C-F.

Anchors have the following Code Reports:
- ICC-ES-ESR-2508 and City of Los Angeles Report RR25744 for cracked & uncracked concrete
- NSF/ANSI Standard 61 (216in2 / 1000 gal)

TYPE SRA ANCHOR RATINGS BASED ON ALLOWABLE STRESS DESIGN (ASD)
installed into 2500 psi (17.2 Mpa) Normal Weight Concrete*

Type and Size	A307 Grade C Threaded Rod		A193 Grade B7 Threaded Rod		A193 Grade B6 Stainless Steel (Type 410) Threaded Rod		A193 Grade B8 Stainless Steel (Type 18-8, 304) Threaded Rod	
	Tension (in) **(mm)**	Shear (lbs) **(kg)**	Tension (lbs) **(kg)**	Shear (lbs) **(kg)**	Tension (lbs) **(kg)**	Shear (lbs) **(kg)**	Tension (lbs) **(kg)**	Shear (lbs) **(kg)**
SRA-1/2	2360 **1070**	1595 **720**	2360 **1070**	3440 **1560**	2360 **1070**	3410 **1545**	2360 **1070**	2325 **1055**
SRA-5/8	2440 **1105**	2540 **1150**	2440 **1105**	5475 **2480**	2440 **1105**	5425 **2460**	2440 **1105**	3700 **1680**
SRA-3/4	4780 **2165**	3755 **1700**	4780 **2165**	8095 **3670**	4780 **2165**	8015 **3635**	4780 **2165**	5465 **2480**
SRA-1	7830 **3552**	6815 **3090**	7830 **3552**	14685 **6660**	7830 **3552**	14545 **6600**	7830 **3552**	9920 **4500**

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Tension and Shear Values as verified by ICC Report ICC-ES-ESR-2508.

ICC EVALUATION SERVICE

ICC Report ICC-ES-ESR-2508

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