APPLICATION FOR OSHPD PREAPPROVAL OF MANUFACTURER'S CERTIFICATION (OPM)

OFFICE USE ONLY
APPLICATION #: OPM-0052-13

OSHPD Preapproval of Manufacturer's Certification (OPM)

Type: ☐ New ☒ Renewal ☒ Update to CBC 2013 OPM Number: OPM-0052-13 (04/09/2014)

Manufacturer Information

Manufacturer: B-Line / TOLCO

Manufacturer's Technical Representative: Alex Schickling

Mailing Address: 509 West Monroe Street, Highland, IL 62249

Telephone: 800 851-7415 Email: AlexanderWSchickling@eaton.com

Product Information

Product Name: TOLCO Seismic Bracing / B-Line Strut & Fittings / B-Line Pipe Hangers

Product Type: Seismic Bracing and Support Systems

Product Model Number: Various

General Description: Supports and Attachments of Non-structural Fire Protection Systems

Applicant Information

Applicant Company Name: Eaton's B-Line Business

Contact Person: Greg Shaughnessy

Mailing Address: 509 West Monroe Street, Highland, IL 62249

Telephone: 800 851-7415 Email: GregoryJShaughnessy@eaton.com

I hereby agree to reimburse the Office of Statewide Health Planning and Development review fees in accordance with the California Administrative Code, 2013.

Signature of Applicant: Date: April 21, 2014

Title: Product Line Manager – Seismic Bracing Company Name: Eaton's B-Line Business

Registered Design Professional Preparing Engineering Recommendations

Company Name: H.S.A. Consulting Engineers

Name: Zubair Sheikh S.E. California License Number: S4039

Mailing Address: 3857 Birch Street #416 Newport Beach, CA 92660

Telephone: 714 662-2612 Email: Zubair@hsace.com

OSHPD Special Seismic Certification Preapproval (OSP)

☐ Special Seismic Certification is preapproved under OSP-
(Separate application for OSP is required)

☒ Special Seismic Certification is not preapproved

Certification Method(s)

☐ Testing in accordance with: ☐ ICC-ES AC156 ☒ FM 1950-10

☒ Other* (Please Specify): FM 1950-10 plus additional pre-approved test criteria to cover products not covered by FM-1950-10, such as cable sway brace attachments

*Use of criteria other than those adopted by the California Building Standards Code, 2013 (CBSC 2013) for component supports and attachments are not permitted. For distribution system, interior partition wall, and suspended ceiling seismic bracings, test criteria other than those adopted in the CBSC 2013 may be used when approved by OSHPD prior to testing.

☐ Analysis

☐ Experience Data

☒ Combination of Testing, Analysis, and/or Experience Data (Please Specify): Use of pre-approved test criteria

List of Attachments Supporting the Manufacturer's Certification

☒ Test Report ☒ Drawings ☒ Calculations ☒ Manufacturer's Catalog

☐ Other(s) (Please Specify):

OFFICE USE ONLY – OSHPD APPROVAL VALID FOR CBC 2013 ONLY

Signature: Date: May 6, 2014

Print Name: William Staehlin

Title: Senior Structural Engineer

Condition of Approval (if applicable):

Seismic Restraint Systems Guidelines

CALIFORNIA BUILDING CODE 2013 (CBC2013)

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B-Line by EATON

EATON'S B-LINE BUSINESS
509 West Monroe Street | Highland, IL. 62249
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Structural Engineer: Zubair Sheikh
California SE No. S4039

Date: October 24, 2013

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Appendix A - For Reference Only

SECTION 1

GENERAL INFORMATION

0.0 PREFACE

This OSHPD Pre-approval of Manufacturer's Certification (OPM) is based on the CBC 2013.
The demand (Design Forces) for use with this OPM shall be based on the CBC 2013.

I. SCOPE AND LIMITATIONS:

This pre-approval is for the seismic bracing of interior fire sprinkler piping. It does not address other loads such as, but not limited to, those generated by thermal growth, pressure, fluid dynamics, pipe rupture or movements of equipment that braced components are attached to. It does not address components that cross seismic separations of buildings or components attached to portions of the structure or equipment that will experience relative seismic drifts other than pipe risers.

II. The ranges of components sizes and material included in the pre-approval are as follows:

a) Fire Sprinklers Pipe:
   i. Steel Pipe Sizes:
      Schedule (LW): 1", 1 1/4", 1 1/2", 2", 2 1/2", 3", 3 1/2", 4", 5", 6", 8"
      Schedule 10: 1", 1 1/4", 1 1/2", 2", 2 1/2", 3", 3 1/2", 4", 5", 6", 8"
      0.188 (0.188" <= Pipe Wall Thickness): 8"
      Schedule 40: 1", 1 1/4", 1 1/2", 2", 2 1/2", 3", 3 1/2", 4", 5", 6", 8", 10", 12"

b) Brace Pipe:
   i. Steel (ASTM A53 Type E Grade B) Schedule 40: 1", 1 1/4", 1 1/2", 2" NPS

III. The substrates included in this pre-approval are as follows:

   a. Concrete
   b. Metal Decking
   c. Steel
   d. Wood

IV. This Pre-approval is for the design of supports and attachments of fire seismic sway bracing only.

V. Construction Tolerances:

   a. Construction tolerances shall be as noted on the drawing details and appendices.
   b. Construction tolerance for angles of all braces shall be limited to ±5°, out of plan as shown on page 4-6.
   a. The recommended brace angle is 45° for the diagonal brace, or 1 (vert.) to 1 (horiz.) brace ratio. However, the brace can be installed between 30°-90° from vertical. See page 4-6.

1.0 INTRODUCTION

I. This manual is prepared as a guideline for seismic bracing design for fire sprinkler system piping. Following is an outline of the manual:

Section 1 - General Information. Presents general notes and requirements for seismic bracing fire protection systems. It also includes a general step by step procedure for seismic bracing design using this manual.

Section 2 - Single Hanger Rigid Brace Details. Includes seismic bracing details for individually hung piping using rigid brace members.

Section 3 - Structural Attachments. Shows structural attachment details and allowable strengths for attaching seismic bracing to supporting structure. It includes structural attachments to concrete slabs, steel deck with sand lightweight concrete, attachments to steel beams and bar joists, and attachments to wood beams.

Section 4 - Seismic Brace Components. Includes details and allowable strengths for seismic bracing components used in the seismic bracing design. Components include brace attachment fittings.

Appendix A - Pipe. Includes a metric conversion chart and weight charts for pipe. Utility weights are for reference only and are not within scope of work of the OPM approval.

II. This pre-approval may be used for the design of seismic sway bracing of fire sprinkler systems. A California Licensed Structural Engineer (CLSE) has designed this pre-approval, along with supporting calculations. Therefore, the pre-approved details and calculations are not to be re-reviewed by regional staff. However, each fire sprinkler system requires submittals that must be reviewed and approved by OSHPD.

III. Seismic bracing design and layout drawings shall be either prepared by a Registered Structural Engineer licensed in California with experience in the design of seismic bracing for fire protection systems, or prepared by a qualified engineer with experience in the design of seismic bracing for fire protection systems and reviewed, stamped and signed by a Registered Structural Engineer licensed in California with experience in the design of seismic bracing fire protection systems. This is the definition of "user" below and as allowed for Licensed Specialty Contractors by CAC 2013, Title 24, Part 1, 7-115(c).

IV. Not Used

V. Modifications and/or changes to the designs shown in this guideline shall be performed or reviewed by a qualified Registered Structural Engineer and approved by OSHPD.

VI. When more than one criteria is presented, the more stringent criteria shall be used. The data presented in this manual is subject to change without notice. Refer to the appropriate codes and standards for additional information and requirements.

VII. Not Used

VIII. It is the responsibility of the user of this manual to be familiar with all requirements for seismic bracing and shall be proficient in determining and applying utility loads for their application.

IX. The user of this manual shall determine the spacing and layout for the required bracing. The user shall determine the maximum horizontal, vertical and axial force component of the earthquake demand loads. The user's calculations must take into consideration the increases in loads caused by construction tolerances.

X. As with all pre-approved details, systems, etc., construction documents are still required showing how and where this pre-approved support, attachment and bracing system will be applied on a project specific basis. This process is needed to verify that the appropriate detail has been selected and applied for each condition and for the actual substrate that it will be connected/attached to.

XI. The Structural Engineer of Record (SEOR) must review and forward the support, attachment and bracing plans for plan check with a notation indicating that the plans have been reviewed and they have been found to be in general conformance with the design of the project. A "shop drawing stamp" is usually acceptable for compliance with this requirement. The regional staff, on a project specific basis, must review support, attachment and bracing details and supporting calculations that are not part of this pre-approval. Review of support, attachment and bracing details of this nature does not constitute a pre-approval that may be used on other projects without the benefit of plan review. The structural engineer of record shall verify the adequacy of the supporting structure and its components for the loads applied to the supporting structure and its components by the seismic bracing systems, and compliance with the applicable codes and standards.

XII. **Layout Drawings:**

a. Layout drawings of the support and bracing systems per this pre-approval shall be submitted to the discipline in responsible charge of the project for review to verify that the details are in conformance with all code requirements. The layout drawings shall be in accordance with ASCE 7-10 (including supplements nos. 1 & 2) as modified by the CBC 2013 Section 1616A.

i. The Structural Engineer of Record (SEOR) shall verify that the supporting structure is adequate for the loads imposed on it by the supports and braces installed per the pre-approval in addition to all other loads.

ii. The SEOR will forward the supports, attachments and bracing plans (including approved change orders for supplementary framing where required) to the discipline in responsible charge with a notation indicating that the plans have been reviewed and are in general conformance with this pre-approval, the design of the project (CBC 2013, Section 7-153), and NFPA 13, 2013 Edition.

iii. A "shop drawing stamp" may be used to indicate compliance with this requirement.

iv. The Registered Design Professional (other than the SEOR) may provide the shop drawing stamp for small installations at the discretion of the District Structural Engineer.

b. The SEOR shall design any supplementary framing that is needed to resist the loads, maintain stability and/or is required for installation of this pre-approval. The supplementary framing shall be submitted to OSHPD as an Amended Construction Document (ACD).

c. The layout drawings (with the shop drawing stamp) shall be submitted to OSHPD to review:

i. Structure supporting the distribution system has adequate capacity.
ii. Seismic Design Forces (F_P) are in accordance with the CBC 2013.
iii. Verify that the submittal is within the scope of the OSHPD Pre-approval of Manufacturer's Certification (OPM):
   a. Size of distribution system components.
   b. Spacing of bracing and flex joints.
   c. Substrate for attachments.

d. The layout drawings (with the shop drawing stamp) shall be kept on the jobsite and can then be used for installation for the support and bracing. OSHPD field staff will review the installation.

e. A copy of this pre-approval shall be on the jobsite prior to starting installation of hangers and/or braces. It is the contractor's and IOR's responsibility to obtain copies of OSHPD Pre-approvals from the OSHPD Pre-approval Program's website.

XIII. Components of two or more pre-approved bracing systems shall not be mixed. Only this pre-approved bracing system may be used for a run of pipe. Any substitution of a component of this pre-approval shall require OSHPD review and approval.

2.0 BUILDING CODES, STANDARDS, & GUIDELINES

I. The Tolco Seismic Restraint Guidelines are designed to meet or exceed the requirements of the following:

2013 California Building Code (CBC 2013)
ANSI / AWC NDS-2012
NFPA 13 Standard for the Installation of Sprinkler Systems 2013 Edition
American Concrete Institute (ACI 318-11)
American Society of Civil Engineers (ASCE 7-10) Including Supplements Nos. 1 & 2.

These guidelines are intended to describe seismic restraints for the fire protection industry's most commonly used single hung pipe for up to 12-inch pipe.

Determine bracing design based on NFPA 13, 2013 zone of influence, Annex E.

$$a_P = 2.5;\ R_P = 4.5;\ S_{DS} = 2.5;\ \Omega_0 = 2.5;\ I_P = 1.5;\ z/h = 1;$$

3.0 SEISMIC BRACING GENERAL REQUIREMENTS - FIRE PROTECTION PIPING

I. Lateral (transverse) Seismic Bracing is required for the following fire protection piping.

a) For Seismic Design Category C, D, E, or F, and Ip is equal to 1.5.
   i. All mains.
   ii. All cross mains.
   iii. All branch lines 2 1/2" and larger
   iv. The last length of pipe at the end of a feed or cross main shall be provided with a lateral brace.

II. Transverse bracing shall be provided at 40 ft. maximum spacing for welded steel pipe.

a) Lateral (transverse) seismic bracing is to protect piping against movement perpendicular to the run of pipe.
b) Lateral (transverse) seismic bracing shall be spaced at a maximum of 40' for piping (2 1/2" diameter and larger) constructed of ductile materials (e.g. Steel); 30' maximum span (piping smaller than 2 1/2" diameter).
c) A lateral (transverse) seismic brace placed on the pipe run section at the opposite side of an elbow within 24" may act as a longitudinal brace. For an example, see page 1-9.
d) The minimum required bracing for runs longer than 5' is a transverse brace at each end, and a longitudinal brace at one of those two positions. For an example, see page 1-9.
e) Rigid grooved couplings listed for UL Standard 213 shall be permitted in horizontal runs of pipe. Flexible grooved couplings listed for UL Standard 213 shall be permitted in vertical risers (to accommodate drift) and at other locations (e.g. seismic separations, equipment nozzles, etc.) to accommodate small movement and/or rotation. Non-UL listed grooved couplings shall not be used unless approved on a project specific basis.

Exceptions

All piping suspended by individual hanger rods 6 inches or less in length from the top of the pipe to the bottom of the support structure where hanger is connected. All of the hangers of a run must comply with the 6 inch rule or bracing is required.

III. Longitudinal bracing shall be at 80 ft. maximum spacing for welded steel pipe.

a) Longitudinal seismic bracing is to protect piping against movement parallel to the run of pipe.
b) Longitudinal seismic bracing shall be spaced a maximum of 80' for piping (2 1/2" diameter and larger) constructed of ductile materials (e.g. Steel); 60' maximum span (piping smaller than 2 1/2" diameter) for an example, see page 1-9.
c) Each pipe run shall have at least one longitudinal brace, additional longitudinal braces are required when the maximum longitudinal spacing is exceeded. For an example, see page 1-9.

IV. When determining horizontal load requirements, follow NFPA 13 Zone of Influence requirements.

V. A piping system shall not be braced to different parts of the building that may respond differently during seismic activity.

The following Tolco products were engineered with torque indicators to ensure proper installation:

Fig. 980 Universal Swivel Sway Brace Attachments have a break-off bolt head

Fig. 1000 Sway Brace Attachments have material that flattens out or comes together to ensure proper engagement

Fig. 1001 Sway Brace Attachments have bolt heads that bottom out

Fig. 800, Fig. 825 & Fig. 828 Adjustable Sway Brace Attachments to Steel and Joist have break-off head bolts

Fig. 4L and 4LA Braced Pipe Attachments have break-off bolts heads

VI. Refer to the appropriate codes and standards for additional information and requirements.

VII. See Appendix pages 5-7 thru 5-10 for lateral sway bracing tables.

VIII. Vertical Offsets / Risers:

a) Tops of vertical offsets/risers exceeding 3' in length shall be provided with a four-way brace. Bracing shall be located within 24" of the end of the vertical run. Refer to partial isometric A on page 1.16.

b) Distance between four-way braces for risers shall not exceed 25'.

4.0 SEISMIC BRACING LAYOUT - GENERAL REQUIREMENTS

I. The TOLCO Seismic Restraint Guidelines provides for the protection of suspended pipe systems against excessive movement due to seismic forces.

II. The seismic restraint assemblies in this guideline are designed to simultaneously resist vertical loads due to the weight of the component and its contents and both horizontal and vertical seismic loads.

III. Horizontal loads are braced with two types of seismic restraints;

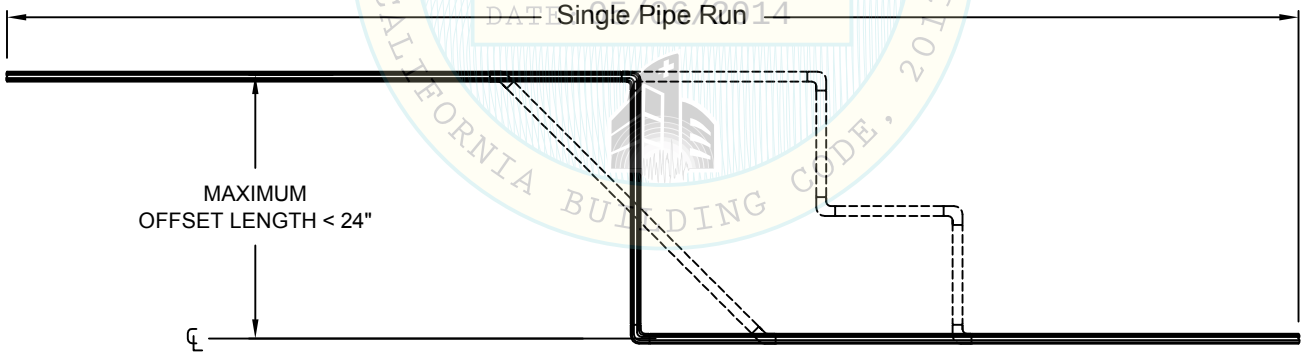
a) Transverse Brace to protect pipe against movement perpendicular to its run.

b) Longitudinal Brace to protect pipe against movement parallel to its run.

IV. A run of pipe is defined as a continuous straight length, or one with allowable offsets, that are less than 24". If the offset is 24" or greater, each straight segment shall be treated as an independent run and shall be braced. Refer to partial plan on page 1-10.

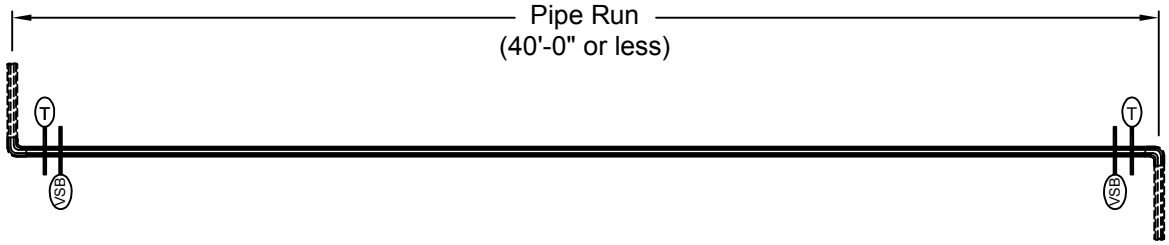
LEGEND

T	Transverse Location
L	Longitudinal Location
TL	Transverse Location also acting as Longitudinal
VSB	A Vertical Seismic Brace (VSB) shall be placed within 6" of all Single Transverse & Longitudinal braces. See XVI.

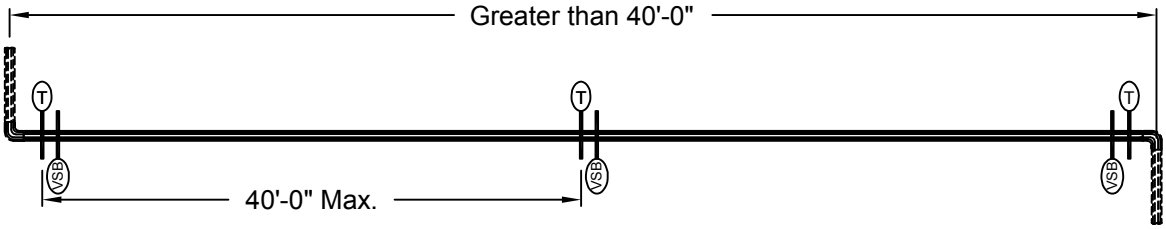


NOTE: When a run of pipe that requires bracing transitions down to a size that does not, the point of transition is considered the end of the run and will require a transverse brace. For an offset less than 24", this is still considered a single run of pipe.

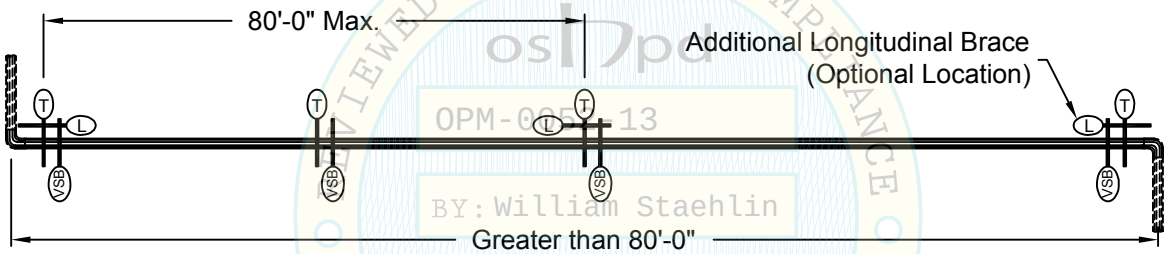
V. Each run of pipe requires a minimum of two transverse braces, one at each end of the run.



VI. If the distance between the two transverse braces exceeds the maximum allowable spacing, add transverse braces as needed.

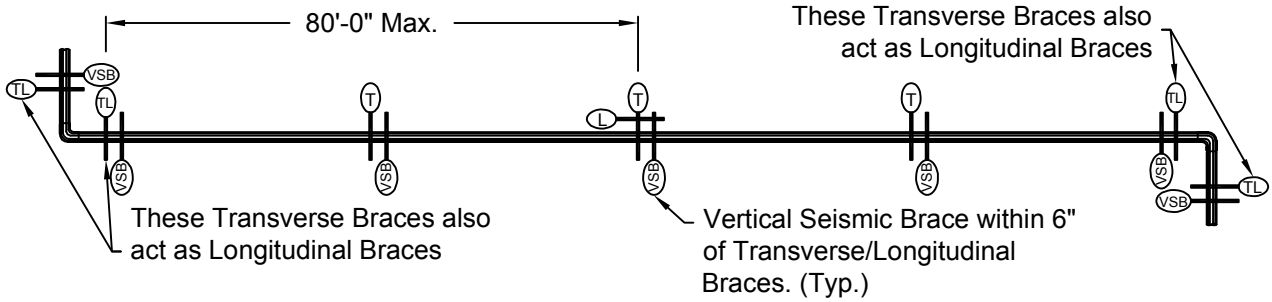


VII. Each pipe run must have at least one longitudinal brace. If the maximum allowable longitudinal spacing is exceeded then add longitudinal braces to meet the spacing requirement.

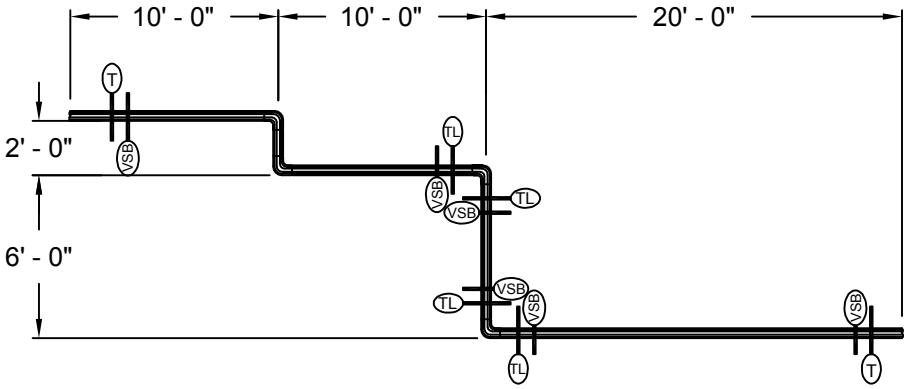


VIII. Each run of pipe requires a minimum of one longitudinal brace. However, a transverse brace placed on the run section at the opposite side of an elbow or tee within 24" may act as a longitudinal brace, and is labeled a "DUAL USE" brace. See layout example below.

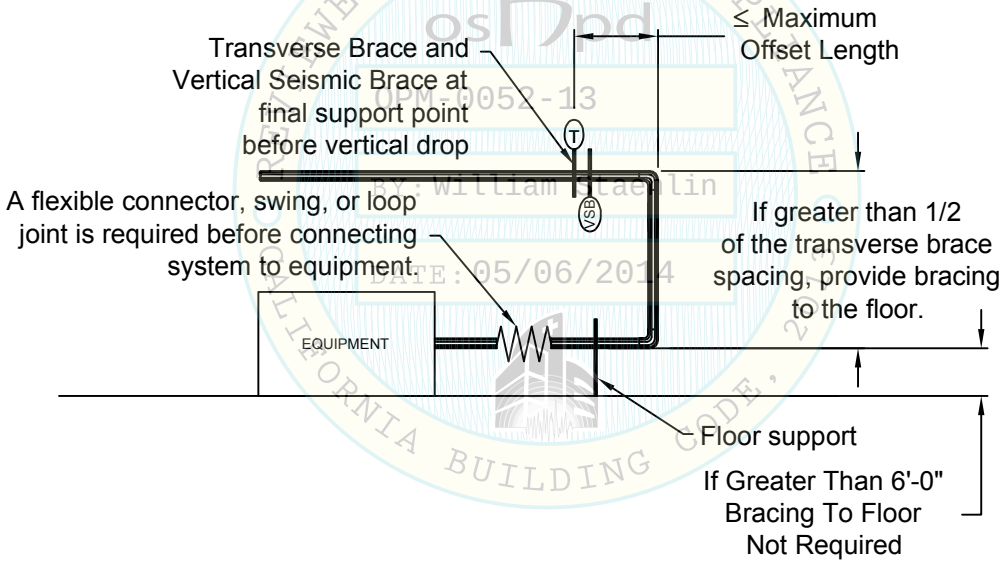
a) Longitudinal and Longitudinal "DUAL USE" braces on single supported pipe shall be attached directly to the pipe.
b) Bracing installed to smaller piping shall not be used to brace larger piping.



IX. In some cases several short runs may occur in close proximity. By following the preceding guidelines each run should have longitudinal and transverse bracing. Transverse bracing may be used as longitudinal bracing and vice versa on runs adjacent to each other as long as the total length of pipe tributary to the brace does not exceed the maximum allowable spacing. In cases where it does, additional braces are required.



X. At vertical pipe drop to equipment, where pipe is connected to the equipment using a flexible connection, provide transverse bracing before the vertical drop. The total length from the transverse brace to the vertical drop should not be more than the allowable offset previously determined. Provide transverse bracing at the floor after the vertical drop if the total length of the pipe from the transverse brace before the vertical drop to the flexible connection is greater than ½ of the maximum transverse brace spacing.



XI. When pipe crosses a building seismic separation or seismic joint it must be capable of accommodating the joint displacements as specified by the engineer of record.

XII. A rigid pipe shall not be braced to dissimilar parts of a building structure or two dissimilar building systems that may move different from one another during an earthquake. Bracing should be attached to the part of the building structure that is supporting the pipe.

XIII. Transverse and longitudinal braces shall be installed as shown in this guideline up to 90° from horizontal. However, the recommended brace ratio is 45° from horizontal, or 1 (vert.) to 1 (horiz.) brace ratio. Spacing for additional brace angles may be achieved by the following:

XIV. All transverse, longitudinal, and vertical braces utilizing steel pipe with Tolco Fig. 900 series fittings may have an alignment tolerance of 5° from center without adversely affecting the given loads.

XV. The seismic brace assemblies in this guideline consist of three important components; Anchorage and connections to building structure, brace member such as pipe, and seismic brace attachments. For details and load information of structural attachments see Section 3, for details of brace assemblies see applicable "Brace Details" section(s).

XVI. Single Rigid Brace locations are required to be at or within 6 inches of a vertical seismic brace (VSB) assembly to protect against vertical movement. An exception to this would be the use of two opposing rigid braces at the same location. In this case no additional vertical seismic brace assembly is necessary.

XVII. Steel bolt connections to steel structure or components shall not have a diameter less than 1/16" less than the mounting hole. Steel bolt connections to concrete structure shall not have a diameter less that 1/8" less than the mounting hole.

XVIII. Bracing shall be omitted on runs less than 10ft. in total length.

5.0 GENERAL DESIGN PROCEDURE

The following presents a general procedure for design of seismic bracing. The following assumes that a piping design layout has been provided, and that gravity hanger supports have been designed by others. The following also assumes that seismic bracing has been determined to be required. Refer to the appropriate codes and standards for additional information and requirements.

I. Seismic Force Coefficient

Determine the total design lateral seismic force coefficient based on the applicable code, project drawings, and specifications. This coefficient is commonly referred to as the "G-factor"; i.e. Fp = .5G. In case of a conflict, use the more stringent criteria. The total design horizontal seismic force coefficient, when multiplied by the weight of the piping, represents the total design lateral seismic force.

According to CBC 2013 the total design lateral seismic force, Fp, or per NFPA, C_P and the total vertical seismic force, Fv, shall be determined from the following formulas. The final Fp, Fv shall be divided by 1.4 to convert the strength based seismic force to the allowable stress based seismic force. This is necessary because the loads and brace spacing in this manual are based on the allowable stress design.

Horizontal Seismic Force

$$Fp = \frac{\frac{0.4\ ap\ Sds}{\frac{Rp}{Ip}}\ (1+2\frac{z}{h})\ Wp}$$

Except that:

Fp shall not be less than 0.3 Sds Ip Wp and
Need not be more than 1.6 Sds Ip Wp

Seismic Coefficient Table NFPA-13

S_s	C_P
0.33 or less	0.31
0.50	0.40
0.75	0.43
0.95	0.50
1.00	0.52
1.25	0.60

S_s	C_P
1.50	0.71
2.00	0.95
2.40	1.14
3.00	1.43
3.50	1.63
3.73	1.74

Linear Interpolation of NFPA-13 2013 Table (9.3.5.9.3)

$$C_P = C_{p\text{ - low}} + \frac{C_{P\text{ - high}} - C_{p\text{ - low}}}{S_{S\text{ - high}} - S_{S\text{ - low}}}\ (S_S - S_{S\text{ - low}})$$

$C_P = 0.467\ S_S$
(See NFPA 13-13, 9.3.5.9.3 and E3)

Vertical Seismic Force
Fv = 0.2 Sds Wp

Sds - Design spectral acceleration for short periods

ap - Component amplification factor (Per NFPA 13, for steel pipe ap = 2.5)

Ip - Component importance factor (Per NFPA 13, Ip = 1.5)

Wp - Component operating weight (Per NFPA 13, 9.3.5.9.2, Wp shall be taken as 1.15 times the weight of the water filled piping)

Rp - Component response modification factor (Per NFPA 13, for steel pipe. Rp = 4.5)

z - Height of structure at point of attachment with respect to the base (For worst case scenario, use z/h = 1)

h - Average roof height of structure with respect to the base (For worst case scenario, use z/h = 1)

Sds = $\frac{2}{3}$ Fa • Ss (Per NFPA 13, May assume Fa = 2.5)

Refer to CBC 2013 codes for additional information & requirements.

II. Seismic Bracing Detail

Select a seismic bracing detail. For example, if a rigid transverse brace is required for installation, go to page 2-1 through 2-6 in Section 2 "Single Hanger Rigid Brace Details" for all applicable transverse brace details.

III. Structural Attachment Detail

Select a structural attachment detail. For example, if a wedge anchor into normal weight concrete slab is required for installation at a seismic brace location, go to page 3-1 thru 3-3 in Section 3 "Structural Attachment" for all applicable seismic brace attachment details corresponding to various wedge anchor types.

IV. Brace Spacing

Determine the maximum transverse and longitudinal brace spacing from the section "Structural Attachments". This brace spacing is based on the allowable loads for the specific structural attachment detail previously selected.

The brace spacing shall not exceed the maximum allowable brace spacing requirements listed in section 1 general notes.

Also see Appendix pages 5-7 thru 5-9 for lateral sway bracing tables for ZOI weights of various brace spacing and sprinkler pipe specifications.

V. Brace Member

Select a brace member and determine its total length. A brace member may be steel pipe. Maximum allowable horizontal seismic loads and maximum allowable lengths for the different brace members are listed on page 4-6. The maximum applied horizontal seismic load shall be equal to or less than the maximum allowable horizontal seismic loads.

VI. Bracing Layout

Layout the seismic bracing as explained in the previous section "Seismic Bracing Layout Procedure".

6.0 GENERAL INSTALLATION NOTES:

I. Single Hanger Rigid Brace Installation Guideline

a) The design of all gravity hangers is not in the scope of this pre-approval. SEOR to verify the vertical seismic brace within 6" of the diagonal brace member are designed for gravity load plus vertical seismic loads. The design of the gravity hangers not within 6" of seismic braces to be approved on a project specific basis by OSHPD.

b) All vertical seismic braces must be plumbed to the support structure.

c) The recommended brace angle is 45° for the diagonal brace, or 1 (Vert.) to 1 (Horiz.) brace ratio. However, the brace can be installed between 30°-90° degrees from vertical.

d) All transverse, longitudinal , and vertical braces utilizing steel pipe with Tolco Fig. 900 series fitting has an alignment tolerance of 5° from center without adversely affecting the given capacities. See page 4-6 for more information.

7.0 COMPONENT PART NUMBER REFERENCE:

Tolco Fig. 4L	
Part Number	Description
Y088024*	FG 4L 2 1/2" IN LINE SWAY BRACE ATT
Y088030*	FG 4L 3" IN LINE SWAY BRACE ATT
Y088040*	FG 4L 4" IN LINE SWAY BRACE ATT
Y088050*	FG 4L 5" IN LINE SWAY BRACE ATT
Y088060*	FG 4L 6" IN LINE SWAY BRACE ATT
Y088080*	FG 4L 8" IN LINE SWAY BRACE ATT

Tolco Fig. 4LA	
Part Number	Description
Y093010*	FG 4LA 1" LONG LAT SWAY BRC ATT
Y093012*	FG 4LA 1 1/4" LONG LAT SWAY BRC ATT
Y093014*	FG 4LA 1 1/2" LONG LAT SWAY BRC ATT
Y093020*	FG 4LA 2" LONG LAT SWAY BRC ATT
Y093024*	FG 4LA 2 1/2" LONG LAT SWAY BRC ATT
Y093030*	FG 4LA 3" LONG LAT SWAY BRC ATT
Y093040*	FG 4LA 4" LONG LAT SWAY BRC ATT
Y093060*	FG 4LA 6" LONG LAT SWAY BRC ATT
Y093080*	FG 4LA 8" LONG LAT SWAY BRC ATT
Y093100*	FG 4LA 10" LONG LAT SWAY BRC ATT
Y093120*	FG 4LA 12" LONG LAT SWAY BRC ATT

Tolco Fig. 800	
Part Number	Description
Y338001*	FG 800 TYPE1X4-6 ATMT
Y338002*	FG 800 TYPE1X6-8 ATMT
Y338003*	FG 800 TYPE1X8-10 ATMT
Y338004*	FG 800 TYPE1X10-12 ATMT
Y338005*	FG 800 TYPE1X12-14 ATMT
Y338006*	FG 800 TYPE1X14-16 ATMT
Y338007*	FG 800 TYPE1X16-18 ATMT
Y338201*	FG 800 TYPE2X4-6 ATMT
Y338202*	FG 800 TYPE2X6-8 ATMT
Y338203*	FG 800 TYPE2X8-10 ATMT
Y338204*	FG 800 TYPE2X10-12 ATMT
Y338205*	FG 800 TYPE2X12-14 ATMT
Y338206*	FG 800 TYPE2X14-16 ATMT
Y338207*	FG 800 TYPE2X16-18 ATMT

Tolco Fig. 825	
Part Number	Description
Y340000*	FG 825 BJ EQBATMT

Tolco Fig. 828	
Part Number	Description
Y340800*	FG 828 UNIV STRUCT SWAY BRC ATTACH

Tolco Fig. 906	
Part Number	Description
Y334010012 *	FIG. 906 1 & 1 1/4 MFA PLN W 9/16 HOLE

Tolco Fig. 980	
Part Number	Description
Y3410003*	FG 980 3/8" HL UNIVBRCATT
Y341000*	FG 980 1/2" HL UNIVBRCATT
Y3410005*	FG 980 5/8" HL UNIVBRCATT
Y3410006*	FG 980 3/4" HL UNIVBRCATT

Tolco Fig. 1000	
Part Number	Description
Y380010010*	1X1 FASTC
Y380010012*	1 1/4X1 FASTC PLN
Y380010014*	1 1/2X1 FASTC PLN
Y380010020*	2X1 "FAST CLAMP" SWAY BRACE ATTMNT
Y380010024*	2 1/2X1 "FAST CLAMP" SWAY BRACE ATTACHMENT
Y380010030*	3X1 "FAST CLAMP" SWAY BRACE ATTACHMENT
Y380010034*	3 1/2X1 FASTC
Y380010040*	4X1 "FAST CLAMP" SWAY BRACE ATTACHMENT
Y380012010*	1X1 1/4" "FAST CLAMP" SWAY BRACE ATTACHMENT
Y380012012*	1 1/4X1 1/4FASTC
Y380012014*	1 1/2X1 1/4FASTC
Y380012020*	2X1 1/4 FASTC
Y380012024*	2 1/2X1 1/4""FAST CLAMP" SWAY BRACE ATTMNT
Y380012030*	3X1 1/4" "FAST CLAMP" SWAY BRACE ATTACHMENT
Y380012034*	3 1/2X1 1/4FASTC PLN
Y380012040*	4X1 1/4" "FAST CLAMP" SWAY BRACE ATTACHMENT

Tolco Fig. 1001	
Part Number	Description
Y379010010*	1 X 1 SWAY BRACE ATTACHMENT
Y379010012*	1 1/ 4 X 1 SWAY BRACE ATTACHMENT
Y379010014*	1 1/2 X 1 SWAY BRACE ATTACHMENT
Y379010020*	2 X 1 SWAY BRACE ATTACHMENT
Y379010024*	2 1/2X 1 SWAY BRACE ATTACHMENT
Y379010030*	3X 1 SWAY BRACE ATTACHMENT
Y379010040*	4X 1 SWAY BRACE ATTACHMENT
Y379010060*	6X 1 SWAY BRACE ATTACHMENT
Y379010080*	8X 1 SWAY BRACE ATTACHMENT
Y379012010*	1 X 1 1/4 SWAY BRACE ATTACHMENT
Y379012012*	1 1/4 X 1 1/4 SWAY BRACE ATTACHMENT
Y379012014*	1 1/2 X 1 1/4 SWAY BRACE ATTACHMENT
Y379012020*	2 X 1 1/4 SWAY BRACE ATTACHMENT
Y379012024*	2 1/2X 1 1/4 SWAY BRACE ATTACHMENT
Y379012030*	3X 1 1/4" SWAY BRACE ATTACHMENT
Y379012040*	4X 1 1/4" SWAY BRACE ATTACHMENT
Y379012060*	6X 1 1/4" SWAY BRACE ATTACHMENT
Y379012080*	8X 1 1/4" SWAY BRACE ATTACHMENT

*ADD THE FOLLOWING SUFFIEXES TO CHANGE THE FINISH OF THE COMPONENT.

NO SUFFIX INDICATES PLAIN FINISH.

a.) E - Electro- Galvanized

b.) HDG - Hot Dipped Galvanized

c.) 304 - Stainless Steel [Grade 304]

d.) 316 - Stainless Steel [Grade 316]

FOR EXAMPLE, THE PART NUMBER FOR A TOLCO FIG. 4L WITH AN ELECTRO-GALVANIZED FINISH IS Y088060E

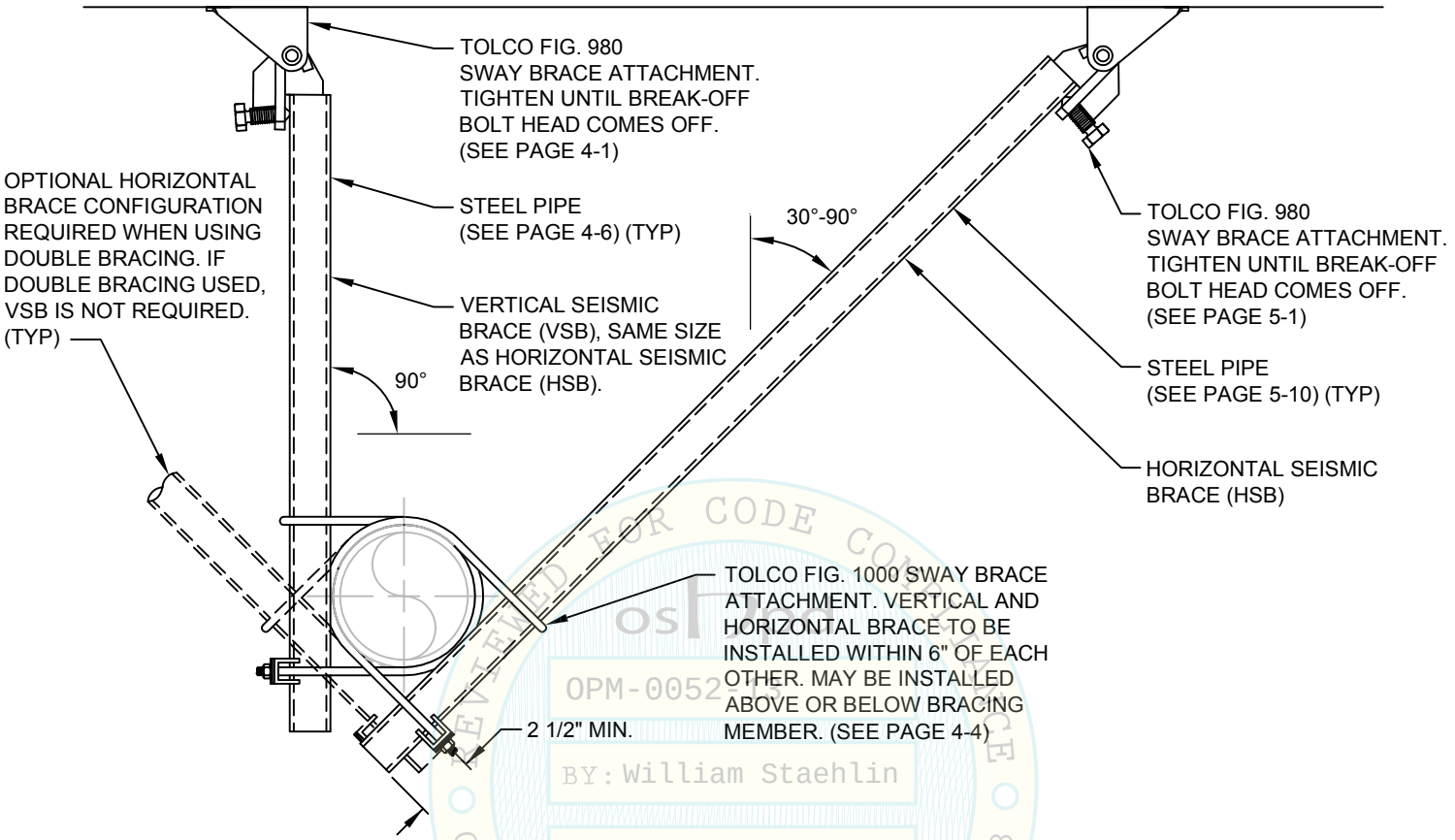
SECTION 2

SINGLE HANGER RIGID BRACE DETAILS

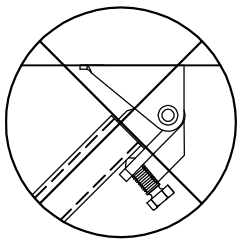
TRANSVERSE RIGID BRACE FOR SINGLE HUNG PIPE WITH FIG. 1000 FAST CLAMP

DETAIL
1G-A

SEE SECTION 3 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



1" - 4" PIPE MAX



DO NOT BEND
BRACE PAST 90°

NOTES:

1.) DESIGN OF HANGER SUPPORTING GRAVITY LOADS ONLY NOT IN SCOPE OF THIS PRE-APPROVAL. DESIGN OF HANGER TO BE APPROVED ON PROJECT SPECIFIC BASIS BY OSHPD.
2.) SEE SECTION 3 AND SECTION 4 FOR ALLOWABLE LOADS FOR VARIOUS BRACE ANGLE CONFIGURATIONS.
3.) VSB AND HORIZONTAL SEISMIC BRACE MAY USE DIFFERENT APPROVED COMPONENTS.

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Structural Engineer: Zubair Sheikh
California SE No. S4039

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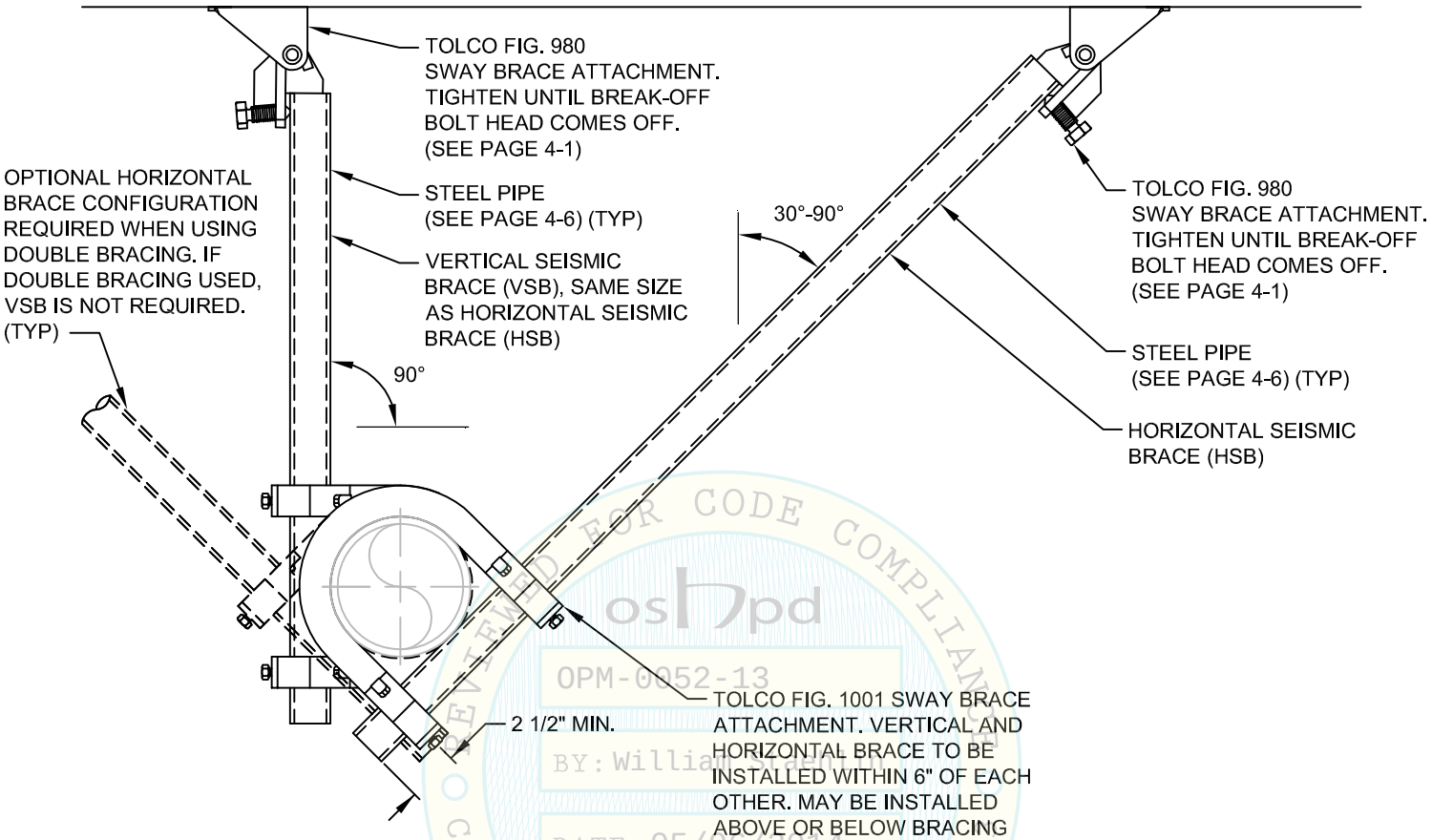
Date: **February 14, 2014**

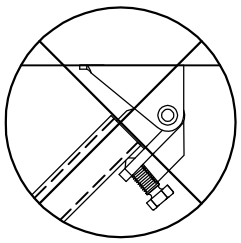
TRANSVERSE RIGID BRACE FOR SINGLE HUNG PIPE WITH FIG. 1001 FAST CLAMP

DETAIL
1G-B

SEE SECTION 3 FOR STRUCTURAL ATTACHMENTS FOR HANGER AND BRACE



1" - 8" PIPE MAX



DO NOT BEND BRACE PAST 90°

NOTES:

1.) DESIGN OF HANGER SUPPORTING GRAVITY LOADS ONLY NOT IN SCOPE OF THIS PRE-APPROVAL. DESIGN OF HANGER TO BE APPROVED ON PROJECT SPECIFIC BASIS BY OSHPD.
2.) SEE SECTION 3 AND SECTION 4 FOR ALLOWABLE LOADS FOR VARIOUS BRACE ANGLE CONFIGURATIONS.
3.) VSB AND HORIZONTAL SEISMIC BRACE MAY USE DIFFERENT APPROVED COMPONENTS.

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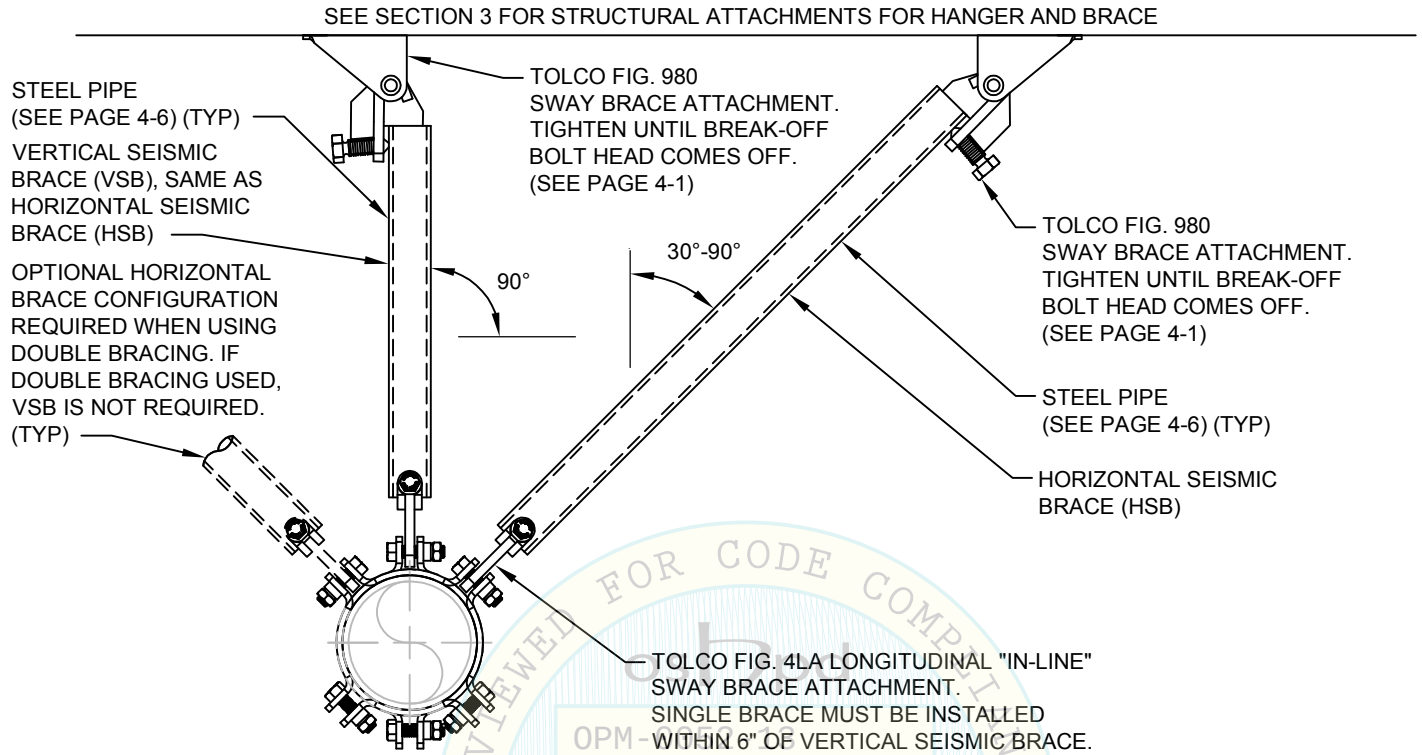
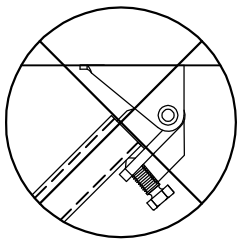
Date: **February 14, 2014**

TRANSVERSE RIGID BRACE FOR SINGLE HUNG PIPE WITH FIG. 4LA1 FAST CLAMP

DETAIL
1LA



1" - 12" PIPE MAX



DO NOT BEND
BRACE PAST 90°

NOTES:

1.) DESIGN OF HANGER SUPPORTING GRAVITY LOADS ONLY NOT IN SCOPE OF THIS PRE-APPROVAL. DESIGN OF HANGER TO BE APPROVED ON PROJECT SPECIFIC BASIS BY OSHPD.
2.) SEE SECTION 3 AND SECTION 4 FOR ALLOWABLE LOADS FOR VARIOUS BRACE ANGLE CONFIGURATIONS.
3.) VSB AND HORIZONTAL SEISMIC BRACE MAY USE DIFFERENT APPROVED COMPONENTS.

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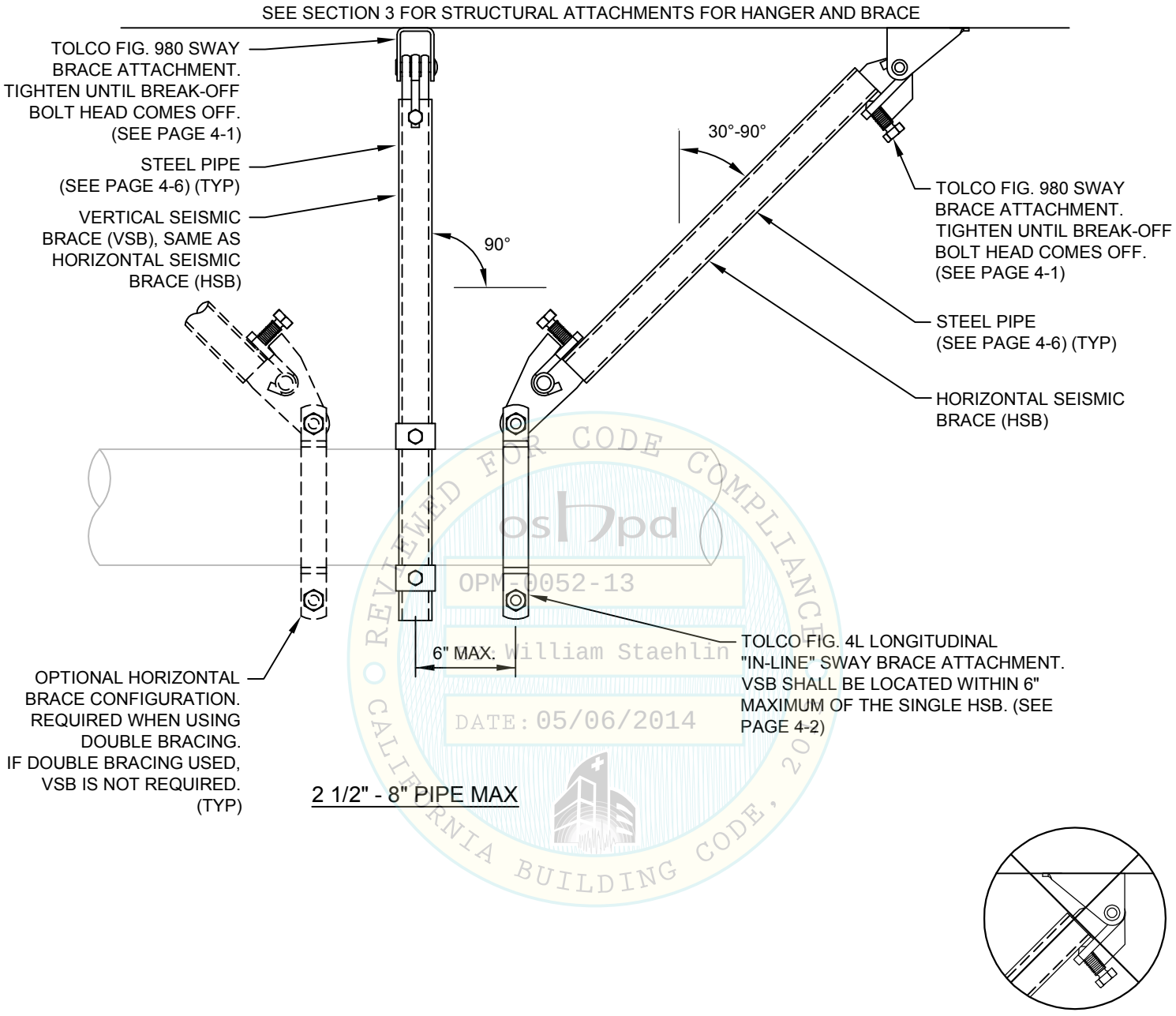
LONGITUDINAL RIGID BRACE FOR SINGLE HUNG PIPE WITH LONGITUDINAL "IN-LINE" PIPE CLAMP

DETAIL
2L



DO NOT BEND BRACE PAST 90°

NOTES:

1.) DESIGN OF HANGER SUPPORTING GRAVITY LOADS ONLY NOT IN SCOPE OF THIS PRE-APPROVAL. DESIGN OF HANGER TO BE APPROVED ON PROJECT SPECIFIC BASIS BY OSHPD.
2.) SEE SECTION 3 AND SECTION 4 FOR ALLOWABLE LOADS FOR VARIOUS BRACE ANGLE CONFIGURATIONS.
3.) VSB AND HORIZONTAL SEISMIC BRACE MAY USE DIFFERENT APPROVED COMPONENTS.

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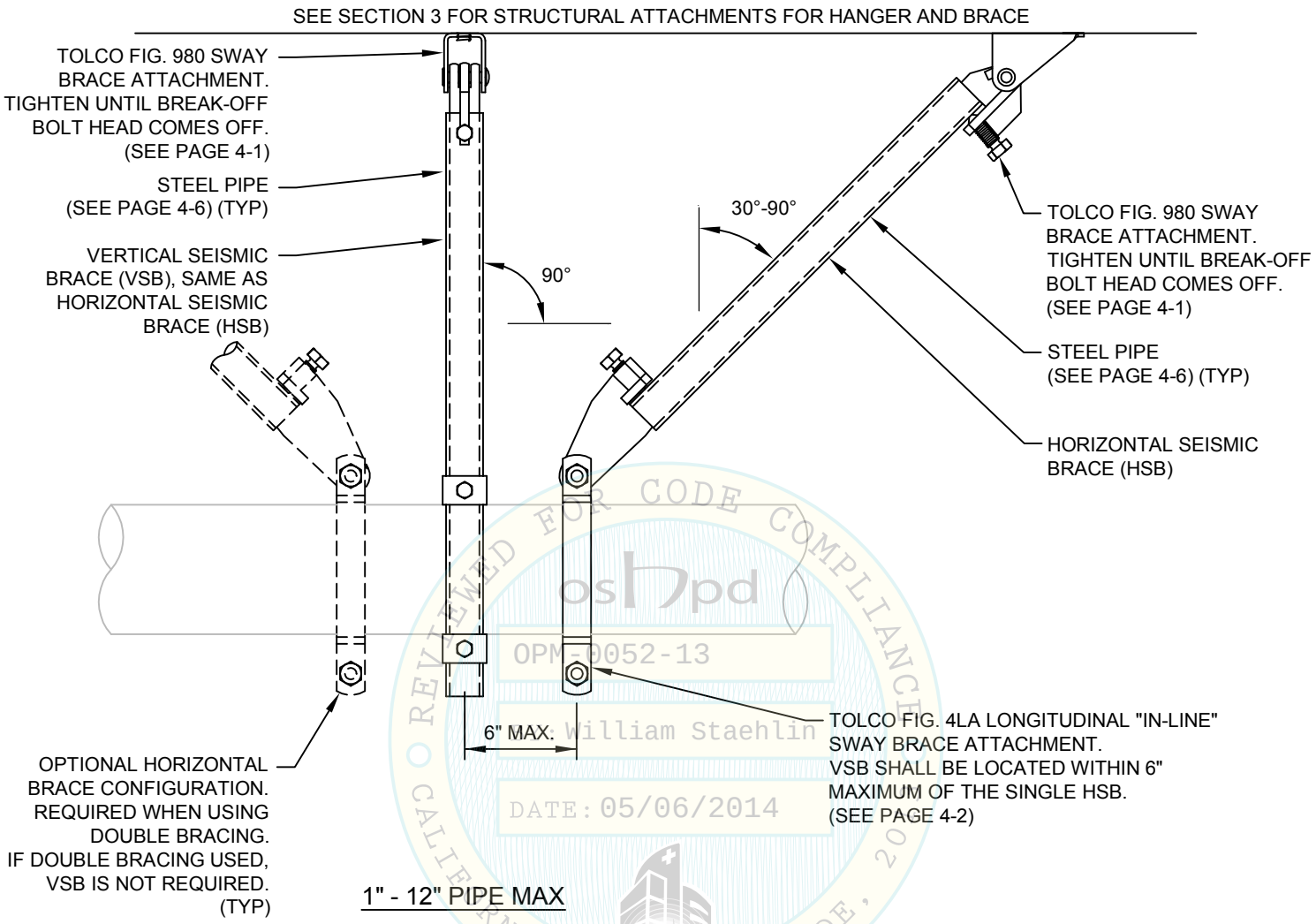
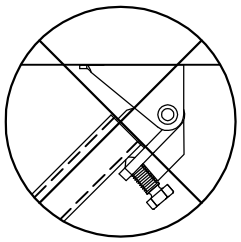
LONGITUDINAL RIGID BRACE FOR SINGLE HUNG PIPE WITH LONGITUDINAL "IN-LINE" PIPE CLAMP

DETAIL
2LA





DO NOT BEND BRACE PAST 90°

NOTES:

1.) DESIGN OF HANGER SUPPORTING GRAVITY LOADS ONLY NOT IN SCOPE OF THIS PRE-APPROVAL. DESIGN OF HANGER TO BE APPROVED ON PROJECT SPECIFIC BASIS BY OSHPD.
2.) SEE SECTION 3 AND SECTION 4 FOR ALLOWABLE LOADS FOR VARIOUS BRACE ANGLE CONFIGURATIONS.
3.) VSB AND HORIZONTAL SEISMIC BRACE MAY USE DIFFERENT APPROVED COMPONENTS.

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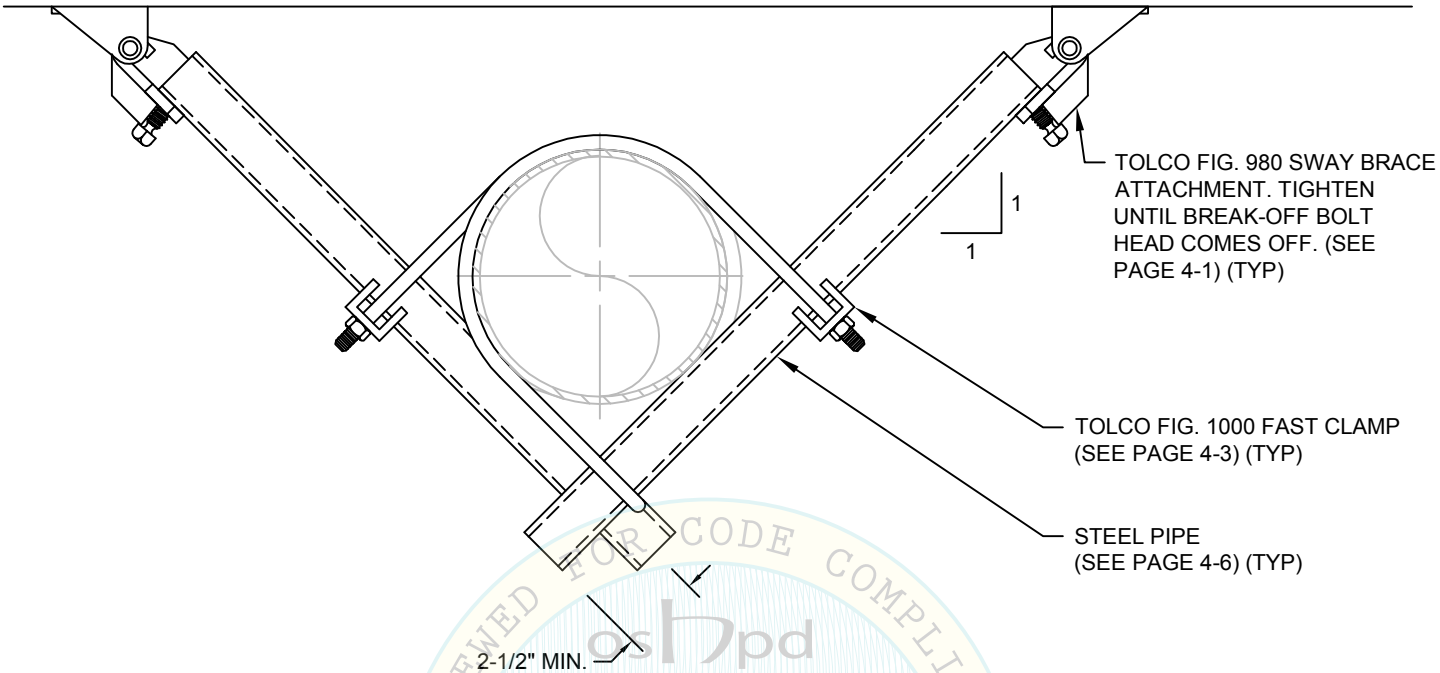
DOUBLE FAST CLAMP RISER BRACE

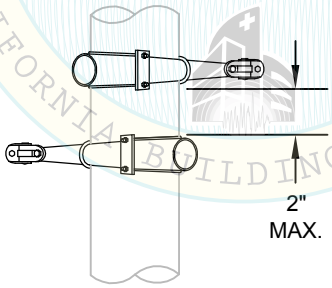
DETAIL
R1-A

SEE SECTION 3 FOR STRUCTURAL ATTACHMENTS FOR BRACE

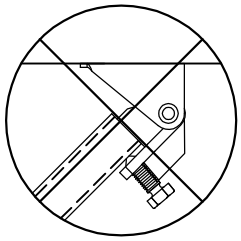


1" - 4" PIPE MAX

PLAN VIEW



ELEVATION



DO NOT BEND BRACE PAST 90°

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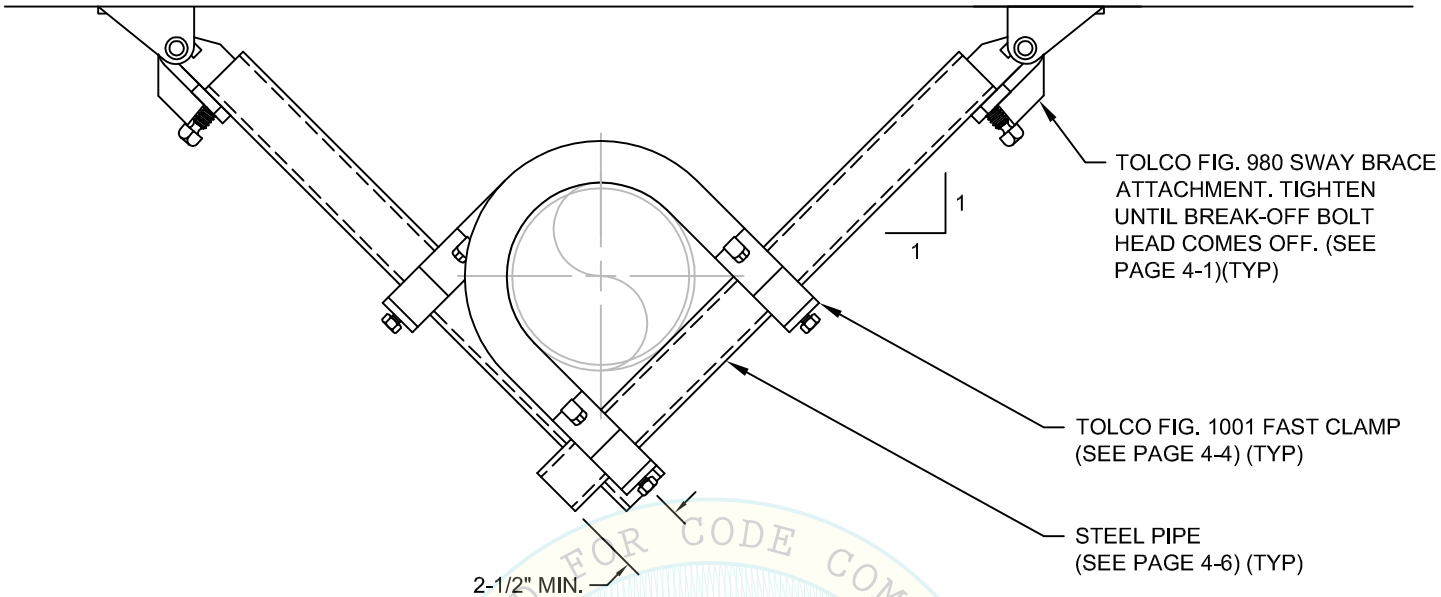
Date: February 14, 2014

DOUBLE FAST CLAMP RISER BRACE

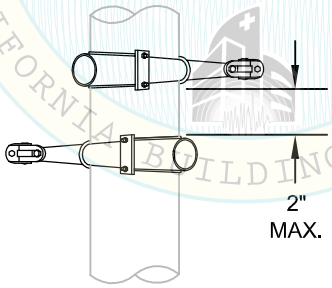
DETAIL
R1-B

SEE SECTION 3 FOR STRUCTURAL ATTACHMENTS FOR BRACE

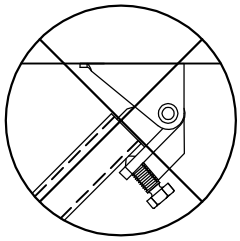


1" - 8" PIPE MAX

PLAN VIEW



ELEVATION



DO NOT BEND BRACE PAST 90°

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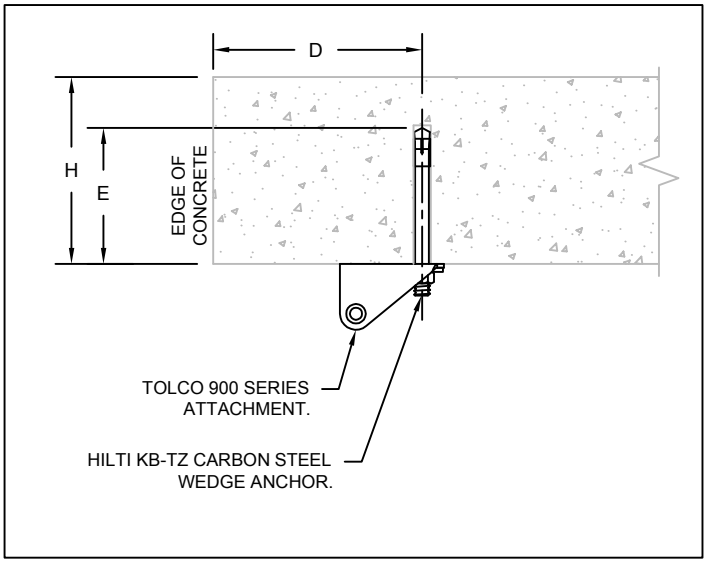
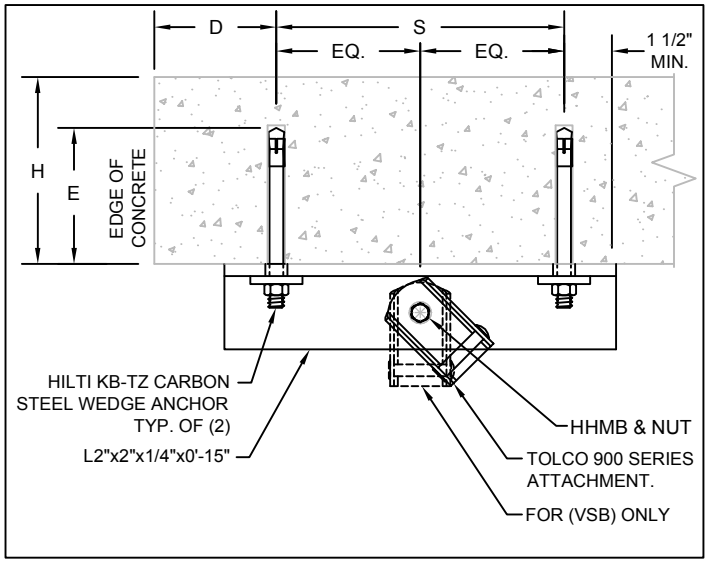
SECTION 3

STRUCTURAL ATTACHMENT

HILTI KB-TZ WEDGE ANCHORS IN 4,000 PSI NORMAL WEIGHT CONCRETE





ANCHOR DIA.	'E' MIN. EFFECTIVE ANCHOR EMBED. DEPTH	'D' MIN. EDGE DISTANCE	'S' MIN. SPACING BETWEEN ANCHORS (MAX 12")	'H' MIN. BASE MATERIAL THICKNESS	ANCHOR CAPACITY				
					MAX. HORIZONTAL LOAD W/ BRACE ANGLE FROM VERTICAL @				MAX. VERTICAL LOAD W/ BRACE ANGLE FROM VERTICAL @
					30-44	45-59	60-74	75-90	0
3/8"	2"	12"	6"	4"	288	288	288	288	288
1/2"	2"	12"	6"	4"	328	328	328	328	328
1/2"	3 1/4"	12"	9 3/4"	6"	450	653	883	1235	880
5/8"	3 1/8"	12"	9 1/2"	5"	656	656	656	656	656
5/8"	4"	12"	12"	6"	902	902	902	902	902
3/4"	3 3/4"	12"	11 1/4"	6"	594	884	1235	1235	1105

MAX. HORIZONTAL LOAD INCLUDES OVER STRENGTH FACTOR Ω_0 =2.5 PER ASCE 7-10, TABLE 13.6-1 TO SATISFY ACI-318-11.

NOTES:

1.) ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MIN. COMPRESSIVE STRENGTH OF 4,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-1917 (HILTI KB-TZ EXPANSION ANCHOR) FOR ANCHORS IN CRACKED CONCRETE. ALLOWABLE LOADS HAVE BEEN MULTIPLIED BY 0.75 FOR ALLOWABLE LOADS GOVERNED BY CONCRETE FAILURE MODES PER ACI 318-11, APPENDIX D, D.3.3.4.4 AND INTERACTION BASED ON D.7.3.

2.) 50 PERCENT OF THE EXPANSION TYPE ANCHORS (ALTERNATE ANCHORS IN ANY GROUP ARRANGEMENT) SHALL BE PROOF TESTED TO TWICE THE ALLOWABLE CAPACITY IN TENSION. IF ANY ANCHOR FAILS, TEST ALL PREVIOUS UNTESTED ANCHORS OF THE SAME TYPE AND INSTALLED BY THE SAME TRADE UNTIL 20 CONSECUTIVE ANCHORS PASS, THEN RESUME WITH 50% TESTING OF ANCHOR. SEE PAGE 3-17.

3.) FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-1917 (2013)

5.) WHEN INSTALLING ANCHORS IN REINFORCED CONCRETE, AVOID DAMAGING REINFORCING STEEL.

6.) WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE. LOCATE PRESTRESSING STEEL AND AVOID DAMAGING PRESTRESSING STEEL.

7.) STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS.

8.) SPECIAL INSPECTION SHALL BE PROVIDED PER CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT AND TIGHTENING TORQUE.

9.)TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE EQUAL TO THE ANCHOR DIAMETER. SEE PAGE 3-17.

10.) HOLE SIZE IN ANGLE SHALL BE NO LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI. SEE PAGE 4-5.

11.) TEST AND TEST LOADS FOR POST-INSTALLED ANCHORS IN CONCRETE MUST COMPLY WITH CBC 1913A.7 AND MANUFACTURERS ICC REPORT. TEST ACCEPTANCE CRITERIA MUST COMPLY WITH CBC 1913A.7.4

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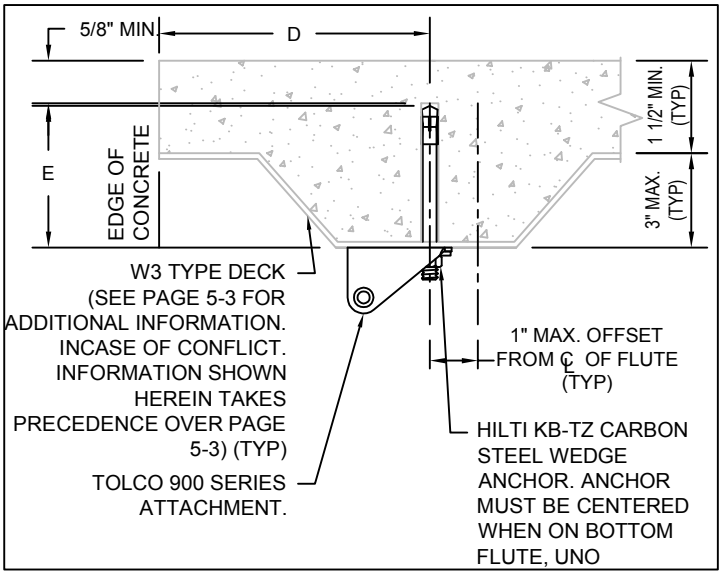
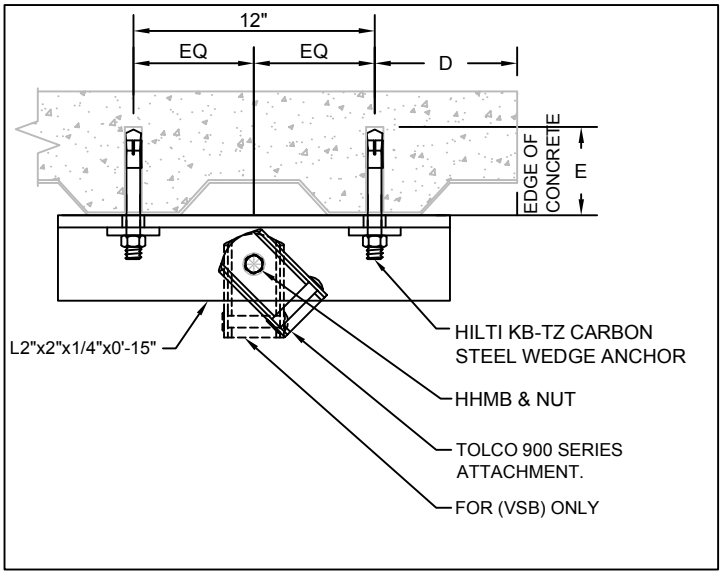
HILTI KB-TZ WEDGE ANCHOR IN 3,000 PSI
SAND LIGHTWEIGHT CONCRETE OVER METAL DECK - 20 GA (MIN.)





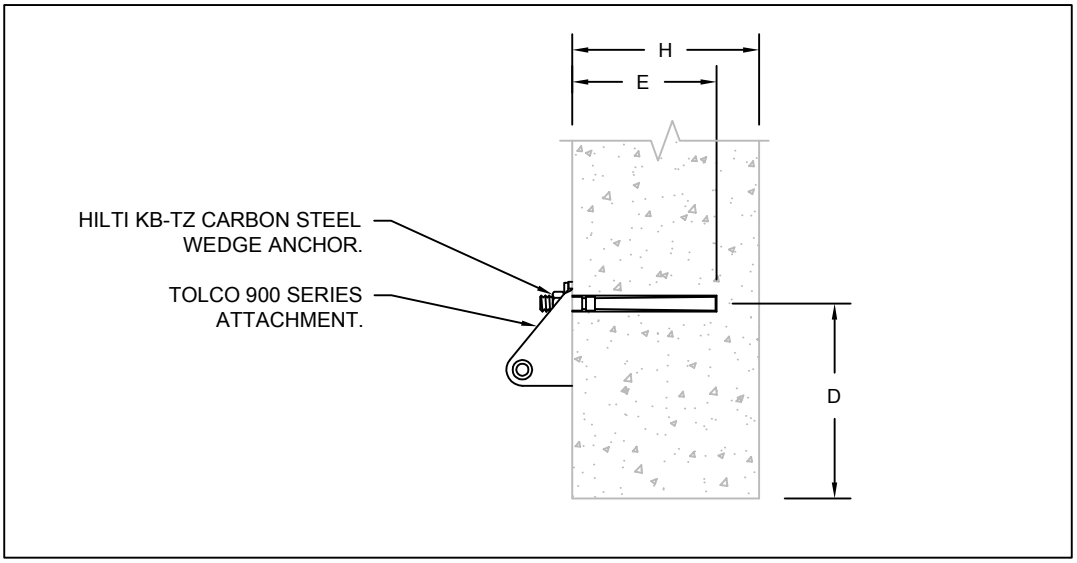
ANCHOR DIA.	'E' MIN. EFFECTIVE ANCHOR EMBED. DEPTH	'D' MIN. EDGE DISTANCE	MIN. SPACING BETWEEN ANCHORS ON SAME FLUTE	ANCHOR CAPACITY				
				MAX. HORIZONTAL LOAD W/ BRACE ANGLE FROM VERTICAL @				MAX. VERTICAL LOAD W/ BRACE ANGLE FROM VERTICAL @
				30-44	45-59	60-74	75-90	0
3/8"	2"	12"	6 3/4"	143	143	143	143	143
1/2"	2"	12"	6 3/4"	186	186	186	186	186
1/2"	3 1/4"	12"	9 3/4"	211	327	476	706	370
5/8"	3 1/8"	12"	9 3/8"	258	258	258	258	258
5/8"	4"	12"	12"	344	508	698	1012	654

MAX. HORIZONTAL LOAD INCLUDES OVER STRENGTH FACTOR Ω_0 =2.5 PER ASCE 7-10, TABLE 13.6-1 TO SATISFY ACI-318-11.

NOTES:

1.) ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN SAND LIGHTWEIGHT CONCRETE HAVING A MIN. COMPRESSIVE STRENGTH OF 3,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-1917 (HILTI KB-TZ EXPANSION ANCHOR) FOR ANCHORS IN CRACKED CONCRETE. ALLOWABLE LOADS HAVE BEEN MULTIPLIED BY 0.75 FOR ALLOWABLE LOADS GOVERNED BY CONCRETE FAILURE MODES PER ACI 318-11, APPENDIX D, D.3.3.4.4 AND INTERACTION BASED ON D.7.3.
2.) 50 PERCENT OF THE EXPANSION TYPE ANCHORS (ALTERNATE ANCHORS IN ANY GROUP ARRANGEMENT) SHALL BE PROOF TESTED TO TWICE THE ALLOWABLE CAPACITY IN TENSION. IF ANY ANCHOR FAILS, TEST ALL PREVIOUS UNTESTED ANCHORS OF THE SAME TYPE AND INSTALLED BY THE SAME TRADE UNTIL 20 CONSECUTIVE ANCHORS PASS, THEN RESUME WITH 50% TESTING OF ANCHOR. SEE PAGE 3-17.
3.) FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-1917 (2013)
4.) MINIMUM CONCRETE THICKNESS SHALL COMPLY WITH ICC ESR-1917 (2012) REFER TO METAL DECK DIMENSIONS SHOWN ABOVE.
5.) WHEN INSTALLING ANCHORS IN REINFORCED CONCRETE, AVOID DAMAGING REINFORCING STEEL.
6.) WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE. LOCATE PRESTRESSING STEEL AND AVOID DAMAGING PRESTRESSING STEEL.
7.) STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS.
8.) SPECIAL INSPECTION SHALL BE PROVIDED PER CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT AND TIGHTENING TORQUE.
9.) TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE EQUAL TO THE ANCHOR DIAMETER. SEE PAGE 3-17.
10.) HOLE SIZE IN ANGLE SHALL BE NO LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.
11.) HOLE DIAMETER THROUGH METAL DECK MAY NOT EXCEED ANCHOR HOLE DIAMETER BY MORE THAN 1/8" PER ICC-ESR.
12.) TEST AND TEST LOADS FOR POST-INSTALLED ANCHORS IN CONCRETE MUST COMPLY WITH CBC 1913A.7 AND MANUFACTURERS ICC REPORT. TEST ACCEPTANCE CRITERIA MUST COMPLY WITH CBC 1913A.7.4

HILTI KB-TZ WEDGE ANCHORS IN 4,000 PSI NORMAL WEIGHT CONCRETE WALL / BEAM



ANCHOR DIA.	'E' MIN. EFFECTIVE ANCHOR EMBED. DEPTH	'D' MIN. EDGE DISTANCE	'H' MIN. BASE MATERIAL THICKNESS	ANCHOR CAPACITY
				MAX. HORIZONTAL LOAD W/ BRACE @ 45-90° FROM VERTICAL (LB)
3/8"	2"	12"	4"	288
1/2"	2"	12"	4"	328
1/2"	3 1/4"	12"	6"	653
5/8"	3 1/8"	12"	5"	656
5/8"	4"	12"	6"	902
3/4"	3 3/4"	12"	6"	884

NOTES:

1.) ALLOWABLE LOADS ARE FOR ANCHORS INSTALLED IN STONE AGGREGATE CONCRETE HAVING A MIN. COMPRESSIVE STRENGTH OF 4,000 PSI AT THE TIME OF INSTALLATION AND DETERMINED PER ICC ESR-1917 (HILTI KB-TZ EXPANSION ANCHOR) FOR ANCHORS IN CRACKED CONCRETE. ALLOWABLE LOADS HAVE BEEN MULTIPLIED BY 0.75 FOR ALLOWABLE LOADS GOVERNED BY CONCRETE FAILURE MODES PER ACI 318-11, APPENDIX D, D.3.3.4.4 AND INTERACTION BASED ON D.7.3.

2.) 50 PERCENT OF THE EXPANSION TYPE ANCHORS (ALTERNATE ANCHORS IN ANY GROUP ARRANGEMENT) SHALL BE PROOF TESTED TO TWICE THE ALLOWABLE CAPACITY IN TENSION. IF ANY ANCHOR FAILS, TEST ALL PREVIOUS UNTESTED ANCHORS OF THE SAME TYPE AND INSTALLED BY THE SAME TRADE UNTIL 20 CONSECUTIVE ANCHORS PASS, THEN RESUME WITH 50% TESTING OF ANCHOR. SEE PAGE 3-17.

3.) FOLLOW ALL WEDGE ANCHOR INSTALLATION REQUIREMENTS PER ICC ESR-1917 (2013)

4.) WHEN INSTALLING ANCHORS IN REINFORCED CONCRETE, AVOID DAMAGING REINFORCING STEEL.

5.) WHEN INSTALLING ANCHORS IN PRESTRESSED CONCRETE. LOCATE PRESTRESSING STEEL AND AVOID DAMAGING PRESTRESSING STEEL.

6.) STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS.

7.) SPECIAL INSPECTION SHALL BE PROVIDED PER CBC. THE SPECIAL INSPECTOR MUST BE ON THE JOBSITE CONTINUOUSLY DURING ANCHOR INSTALLATION TO VERIFY ANCHOR TYPE, ANCHOR DIMENSIONS, HOLE DIMENSIONS, ANCHOR SPACING, EDGE DISTANCES, SLAB THICKNESS, ANCHOR EMBEDMENT AND TIGHTENING TORQUE.

8.) TOLCO 900 SERIES ATTACHMENT DIAMETER SHALL BE EQUAL TO THE ANCHOR DIAMETER.

9.) TEST AND TEST LOADS FOR POST-INSTALLED ANCHORS IN CONCRETE MUST COMPLY WITH CBC 1913A.7 AND MANUFACTURERS ICC REPORT. TEST ACCEPTANCE CRITERIA MUST COMPLY WITH CBC 1913A.7.4. SEE PAGE 3-17

10.) DESIGN LOAD INFORMATION LISTED IN TABLE BECOMES INVALID WHEN THE BRACE ANGLE IS GREATER THAN 45° FROM THE HORIZONTAL. SUCH USE IS NOT INCLUDED IN THE SCOPE OF THIS PRE-APPROVAL AND IS TO BE SUBMITTED FOR REVIEW AND APPROVAL ON A PROJECT SPECIFIC BASIS BY OSHPD.

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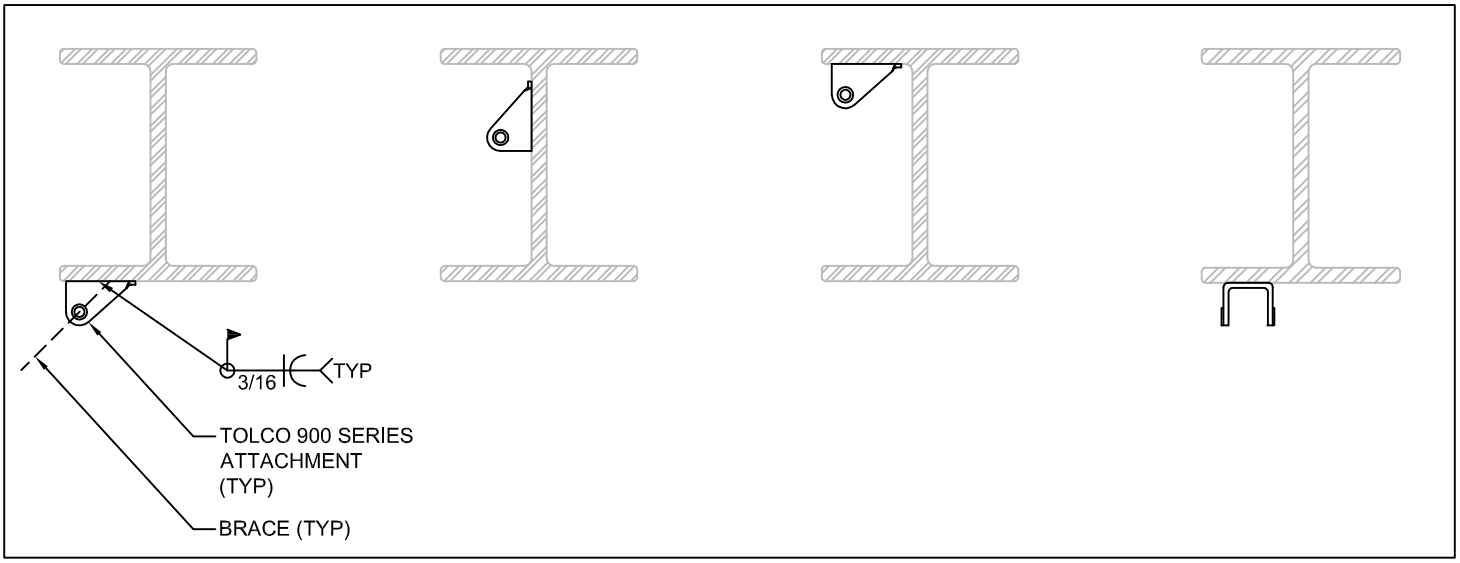
WELD TO STEEL



MIN. WELD	MAX. HORIZONTAL SEISMIC LOAD W/ BRACE @ 45° FROM VERTICAL (Lbs.)
3/16"	1970*

* LOAD GOVERNED BY TOLCO 900 SERIES ATTACHMENT

MIN. WELD	MAX. VERTICAL SEISMIC LOAD W/ BRACE @ 0° FROM VERTICAL (Lbs.)
3/16"	1970*

* LOAD GOVERNED BY TOLCO 900 SERIES ATTACHMENT

NOTES:

1.) ALL STRUCTURAL STEEL SHALL BE MINIMUM A36.
2.) STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS.
3.) WELDING SHALL BE DONE BY ELECTRIC SHIELDED ARC PROCESS USING E-70XX ELECTRODES.
4.) ALL WELDING SHALL BE PERFORMED BY A CERTIFIED WELDER.
5.) ALL WELDS SHALL BE IN CONFORMANCE WITH 2013 CALIFORNIA BUILDING CODE. (CBC)
6.) CONTINUOUS INSPECTION IS REQUIRED FOR ALL WELDING.
7.) NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)

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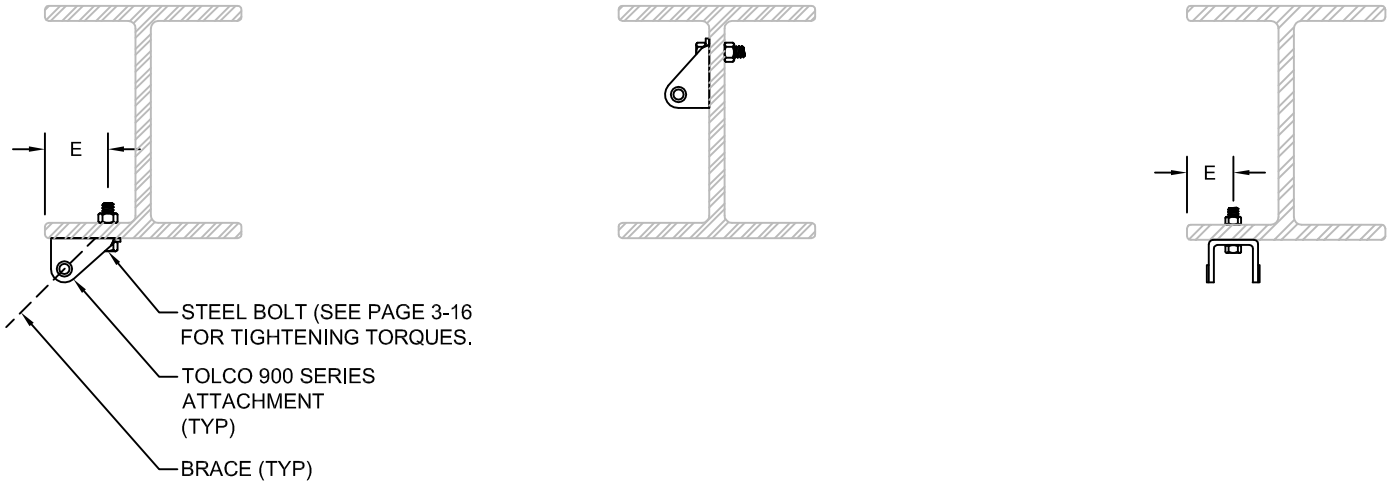
BOLT TO STEEL



BOLT DIA.	MAX. HORIZONTAL SEISMIC LOAD W/ BRACE @ 45° FROM VERTICAL (Lbs.)	'E' MIN. EDGE DISTANCE
3/8"	500	1"
1/2"	800	1"
5/8"	1200	1 1/2"
3/4"	1970*	1 1/2"

*LOAD GOVERNED BY TOLCO 900 SERIES ATTACHMENT

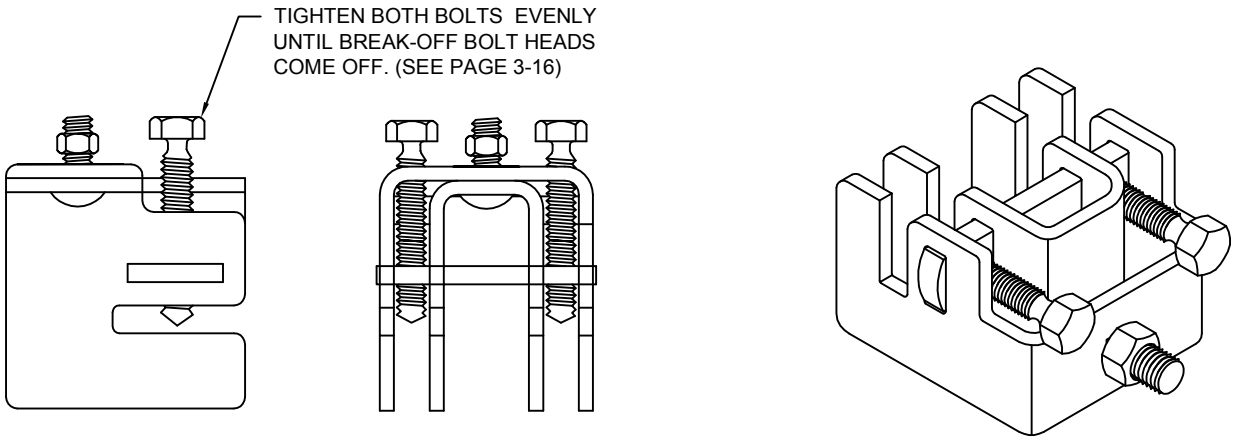
NOTES:

1.) ALL STRUCTURAL STEEL SHALL BE MINIMUM A36.
2.) FASTENERS SHALL BE A307 BOLTS OR BETTER.
3.) STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF STRUCTURE TO RESIST ALL BRACE LOADS.
4.) NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)

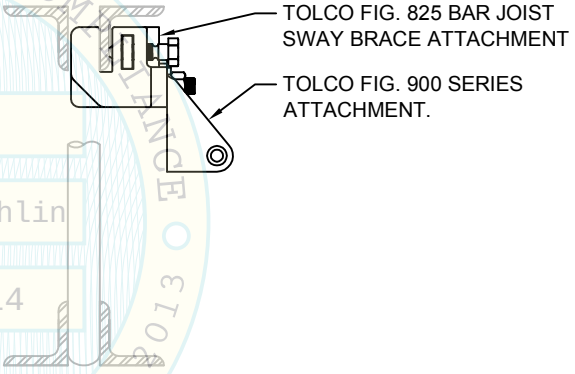
BOLT DIA.	MAX. VERTICAL SEISMIC LOAD W/ BRACE @ 0° FROM VERTICAL (Lbs.)	'E' MIN. EDGE DISTANCE
3/8"	500	1"
1/2"	800	1"
5/8"	1200	1 1/2"
3/4"	1970*	1 1/2"

*LOAD GOVERNED BY TOLCO 900 SERIES ATTACHMENT

TOLCO FIG. 825 STEEL MEMBER ATTACHMENT



SEISMIC BRACE ASSEMBLY CONFIGURATION



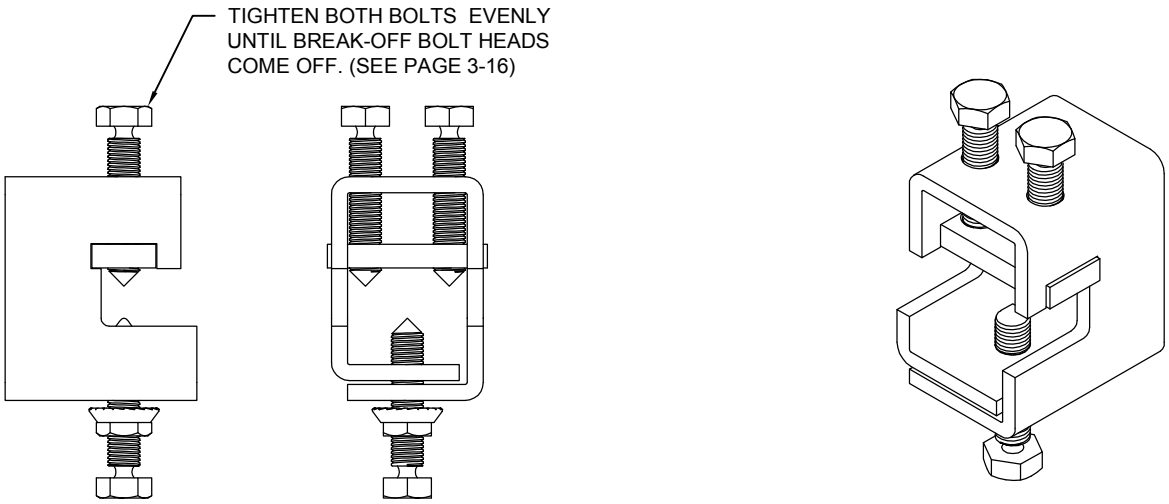
ORIENTATION	ALLOWABLE HORIZONTAL CAPACITY (lbf) PER INSTALLATION ANGLE FROM VERTICAL, lb (N)				REMARKS
	30°-44°	45°-59°	60°-74°	75°-90°	
PERPENDICULAR TO BEAM	990 (4405)	1360 (6050)	1670 (7430)	1860 (8275)	a, b
PARALLEL TO BEAM	460 (2045)	630 (2800)	770 (3425)	860 (3825)	a, b

a.) FM APPROVED WHEN USED WITH 1", 1-1/4", 1-1/2", OR 2" SCH. 40 STEEL PIPE AS THE BRACE MEMBER.
b.) JOIST OR BEAM THICKNESS: MAXIMUM 3/8" THICK.

NOTES:

1.) STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS.
2.) APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS PLUS VERTICAL SEISMIC LOADS.
3.) NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
4.) PRODUCT COMES WITH 1/2" STUD TO CONNECT SWIVEL SWAY BRACE ATTACHMENT. FOR FIG. 980, MUST USE PART NUMBER Y341000*.

TOLCO FIG. 828 STEEL BEAM ATTACHMENT



ORIENTATION	ALLOWABLE HORIZONTAL CAPACITY (lbf) PER INSTALLATION ANGLE FROM VERTICAL, lb (N)				REMARKS
	30°-44°	45°-59°	60°-74°	75°-90°	
PERPENDICULAR TO BEAM	1570	2220	1210	700	a, b
	(6980)	(9870)	(5380)	(3110)	
PARALLEL TO BEAM	690	970	1210	1330	a, b
	(3060)	(4310)	(5380)	(5910)	

a.) FM APPROVED WHEN USED WITH 1", 1-1/4", 1-1/2", OR 2" SCH. 40 STEEL PIPE AS THE BRACE MEMBER.
b.) JOIST OR BEAM THICKNESS: MAXIMUM 3/8" TO 7/8".

NOTES:

1.) STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF STEEL MEMBER TO RESIST ALL BRACE LOADS.
2.) NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES. (SEE AISC 341AND/OR STRUCTURAL DRAWINGS.)
3.) PRODUCT COMES WITH 1/2" STUD TO CONNECT SWIVEL SWAY BRACE ATTACHMENT. FOR FIG. 980, MUST USE PART NUMBER Y341000*.

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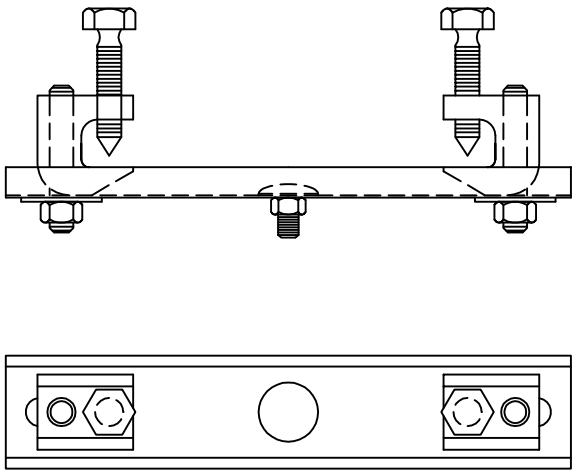
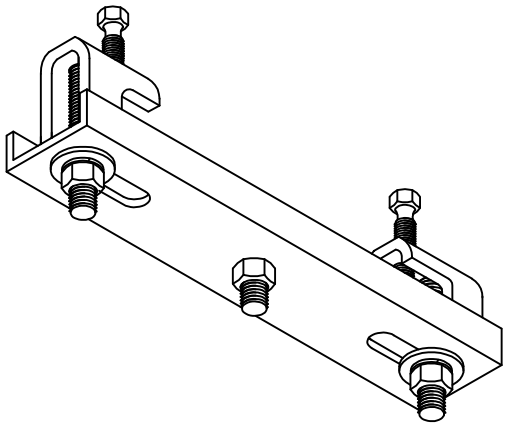
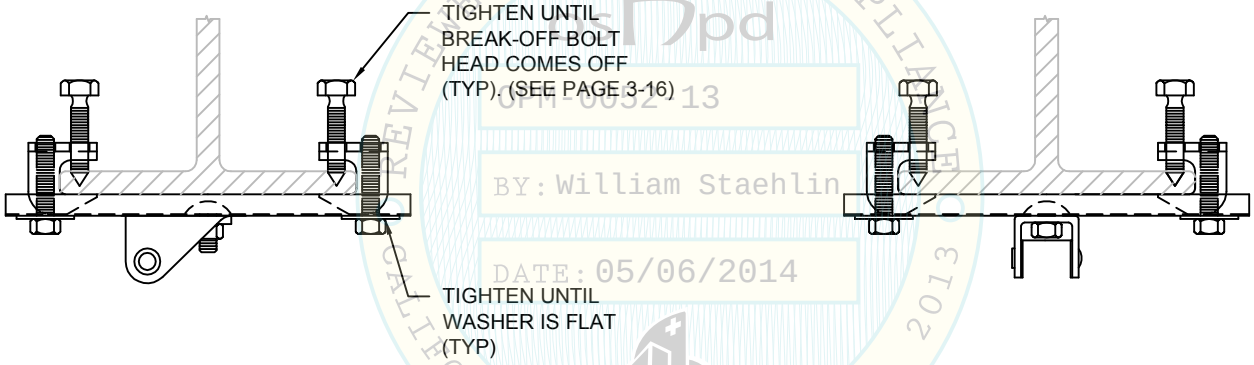
TOLCO FIG. 800 ATTACHMENT TO STEEL BEAM





SHOWN WITH 900 SERIES ATTACHMENT ACROSS BEAM

SHOWN WITH 900 SERIES ATTACHMENT ALONG BEAM



ORIENTATION	ALLOWABLE HORIZONTAL CAPACITY (lbf) PER INSTALLATION ANGLE FROM VERTICAL, lb (N)				REMARKS
	30°-44°	45°-59°	60°-74°	75°-90°	
PERPENDICULAR TO BEAM	1430 (6360)	1970 (8765)	1980 (8805)	NOT RATED	a, b
PARALLEL TO BEAM	930 (4135)	1310 (5825)	1610 (7160)	1800 (8005)	a, b

a.) FM APPROVED WHEN USED WITH 1", 1-1/4", 1-1/2", OR 2" SCH. 40 STEEL PIPE AS THE BRACE MEMBER.
b.) 4"-18" WIDE MAX.; 3/4" THICK FLANGE MAX.

NOTES:

1.) STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF STEEL MEMBER TO RESIST ALL BRACE LOADS.
2.) NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
3.) PRODUCT COMES WITH 1/2" STUD TO CONNECT SWIVEL SWAY BRACE ATTACHMENT. FOR FIG. 980, MUST USE PART NUMBER Y341000*.

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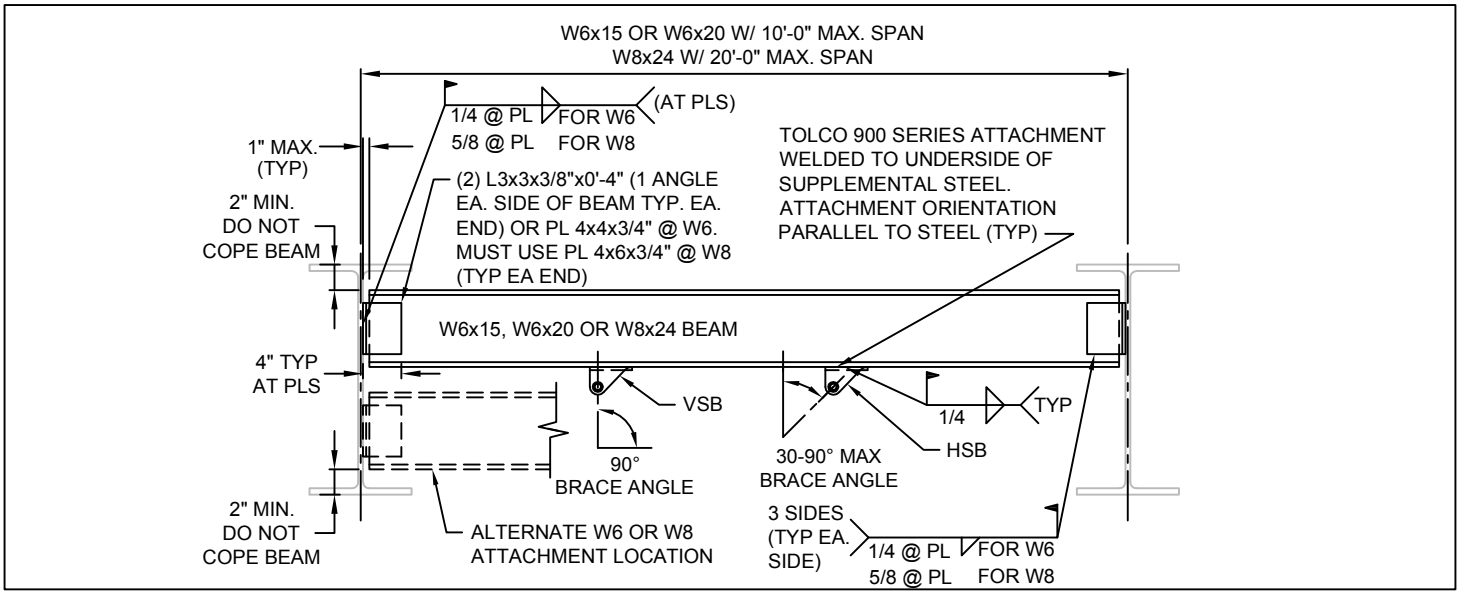
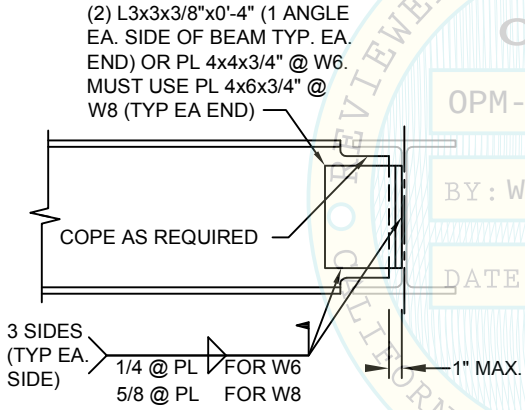
WIDE FLANGE BEAM SUPPLEMENTAL STEEL
HORIZONTAL/ VERTICAL SEISMIC SUPPORT DETAIL



OPTIONAL ATTACHMENT



NOTES:

1.) STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF STRUCTURE TO RESIST ALL BRACE LOADS.
2.) W6x15 OR W6x20 W/ SPAN = 10'-0" MAX., MAXIMUM TOTAL HORIZONTAL AND VERTICAL ALLOWABLE LOAD - 1,590 LBS.
3.) W8x24 W/ SPAN = 20'-0" MAX., MAXIMUM TOTAL HORIZONTAL AND VERTICAL ALLOWABLE LOAD - 1,590 LBS.
4.) NO ATTACHMENT SHALL BE MADE IN THE PROTECTED ZONES. (SEE AISC 341 AND/OR STRUCTURAL DRAWINGS.)
5.) WELDING SHALL BE DONE BY ELECTRIC SHIELDED ARC PROCESS USING E-70XX ELECTRODES.
6.) ALL WELDING SHALL BE PERFORMED BY A CERTIFIED WELDER.
7.) ALL WELDS SHALL BE IN CONFORMANCE WITH 2013 CALIFORNIA BUILDING CODE. (CBC)
8.) CONTINUOUS INSPECTION IS REQUIRED FOR ALL WELDING.

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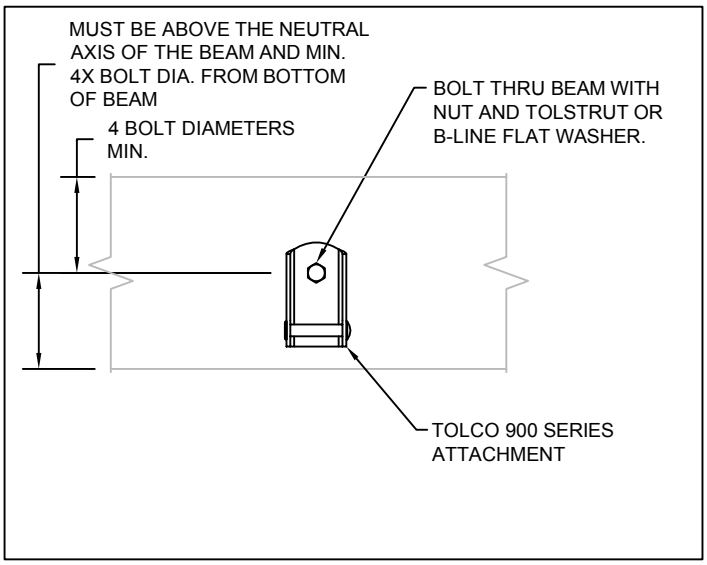
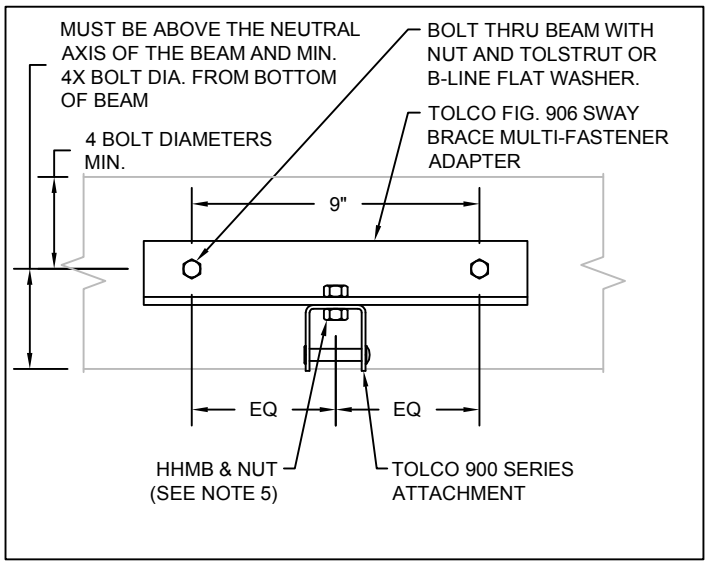
THRU-BOLT STRUCTURAL ATTACHMENTS PERPENDICULAR TO WOOD BEAM





BOLT DIAMETER	MAX. HORIZONTAL SEISMIC LOAD W/ BRACE @ 45° FROM VERTICAL (Lbs.)	
	1 BOLT	2 BOLT
1/2"	300	600
5/8"	360	720
3/4"	400	800

BOLT DIAMETER	MAX. VERTICAL SEISMIC LOAD W/ BRACE @ 0° FROM VERTICAL (Lbs.)	
	1 BOLT	2 BOLT
1/2"	300	600
5/8"	360	720
3/4"	400	800

NOTES:

1.) BOLT HOLES SHALL BE BORED 1/16" LARGER THAN THE NOMINAL BOLT DIAMETER.
2.) LOADS FOR THRU-BOLT ATTACHMENTS ARE DERIVED FROM CBC 2013 AND NDS 2012 FOR DOUGLAS FIR-LARCH [S.G. = 0.50], CALIFORNIA REDWOOD (CLOSE GRAIN) [S.G. = 0.44] AND SOUTHERN PINE [S.G. = 0.55].
3.) MINIMUM BEAM SIZE = 4x
4.) STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS, INCLUDING BUT NOT LIMITED TO ANY BLOCKING REQUIREMENTS.
5.) FASTENERS SHALL BE A307 BOLTS OR BETTER.
6.) DESIGN LOAD INFORMATION LISTED IN TABLE BECOMES INVALID WHEN THE BRACE ANGLE IS GREATER THAN 45° FROM THE VERTICAL. SUCH USE IS NOT INCLUDED IN THE SCOPE OF THIS PRE-APPROVAL AND IS TO BE SUBMITTED FOR REVIEW AND APPROVAL ON A PROJECT SPECIFIC BASIS BY OSHPD, EXCEPT WHEN BRACE IS 0° FROM VERTICAL.

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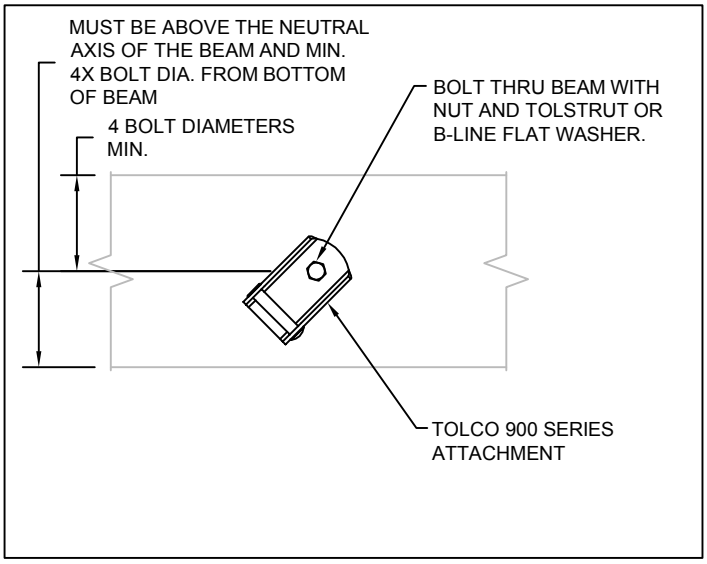
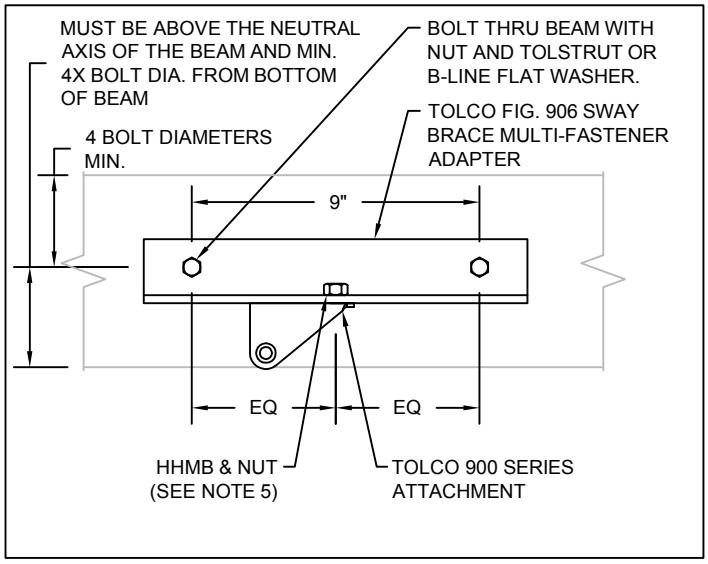
THRU-BOLT STRUCTURAL ATTACHMENTS
PARALLEL TO WOOD BEAM





BOLT DIAMETER	MAX. HORIZONTAL SEISMIC LOAD W/ BRACE @ 45° FROM VERTICAL (Lbs.)	
	1 BOLT	2 BOLT
1/2"	260	440
5/8"	320	540
3/4"	380	600

BOLT DIAMETER	MAX. VERTICAL SEISMIC LOAD W/ BRACE @ 0° FROM VERTICAL (Lbs.)	
	1 BOLT	2 BOLT
1/2"	260	440
5/8"	320	540
3/4"	380	600

NOTES:

1.) BOLT HOLES SHALL BE BORED 1/16" LARGER THAN THE NOMINAL BOLT DIAMETER.
2.) LOADS FOR THRU-BOLT ATTACHMENTS ARE DERIVED FROM CBC 2013 AND NDS 2012 FOR DOUGLAS FIR - LARCH [Sg = 0.50], LARCH, CALIFORNIA REDWOOD (CLOSE GRAIN) [S.G. = 0.44] AND SOUTHERN PINE [Sg = 0.55].
3.) MINIMUM BEAM SIZE = 4x
4.) STRUCTURAL ENGINEER OF RECORD SHALL VERIFY ADEQUACY OF THE STRUCTURE FOR THE TABULATED ALLOWABLE LOADS, INCLUDING BUT NOT LIMITED TO ANY BLOCKING REQUIREMENTS.
5.) FASTENERS SHALL BE A307 BOLTS OR BETTER.
6.) DESIGN LOAD INFORMATION LISTED IN TABLE BECOMES INVALID WHEN THE BRACE ANGLE IS GREATER THAN 45° FROM THE VERTICAL. SUCH USE IS NOT INCLUDED IN THE SCOPE OF THIS PRE-APPROVAL AND IS TO BE SUBMITTED FOR REVIEW AND APPROVAL ON A PROJECT SPECIFIC BASIS BY OSHPD, EXCEPT WHEN BRACE IS AT 0° FROM VERTICAL.

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BOLT AND NUT TIGHTENING REQUIREMENTS

TORQUE FOR NUTS USED W/ GRADE A307 AND GRADE A36 THREADED ROD

SIZE	TORQUE (FT-LBS)
1/4"	6
5/16"	11
3/8"	20
1/2"	49
5/8"	97
3/4"	173

APPROXIMATE TORQUES FOR BREAK-OFF BOLTS

SIZE	TORQUE (FT-LBS)
FIG. 4L	36-40
FIG. 4LA - SMALL	15-17
FIG. 4LA - LARGE	36-40
FIG. 800	36-40
FIG. 825	31-35
FIG. 828	31-35
FIG. 828	36-40

TEST LOADS AND ACCEPTANCE CRITERIA FOR EXPANSION ANCHORS

ANCHOR SIZE	EMBED h_{ef} (INCH)	ANCHOR SIZE		TENSION TEST TORQUE (FT-LB)
		4000 PSI NWC (CAP x 1.25)	3000 PSI SAND LWC ON METAL DECK (CAP x 1.25)	
HILTI KB-TZ 3/8"	2	1854	1186	25
HILTI KB-TZ 1/2"	2	1854	1186	40
HILTI KB-TZ 1/2"	3 1/4"	3789	2128	40
HILTI KB-TZ 5/8"	3 1/8"	3620	1625	60
HILTI KB-TZ 5/8"	4"	5241	3774	60
HILTI KB-TZ 3/4"	3 3/4"	4758	—-	110

INSTALLATION: INSTALL THE CONCRETE ANCHORS IN ACCORDANCE WITH THE REQUIREMENTS GIVEN IN THE ICC EVALUATION REPORT FOR THE SPECIFIC ANCHOR.

JOB TESTING: FOR VERIFYING SATISFACTORY INSTALLATION WORKMANSHIP, PERFORM JOB SITE TESTING IN ACCORDANCE WITH THE TENSION LOAD TABLE PROVIDED IN THIS DOCUMENT. TEST 50% OF THE INSTALLED ANCHORS. THE TEST LOAD MAY BE APPLIED BY ANY METHOD INCLUDING MANUFACTURER'S TORQUE CRITERIA TESTING THAT WILL EFFECTIVELY MEASURE THE TENSION IN THE ANCHOR SUCH AS DIRECT PULL WITH A HYDRAULIC JACK OR CALIBRATED SPRING LOADING DEVICES. ALL TESTS SHALL BE CONDUCTED BY A TESTING LABORATORY CONTRACTED BY THE FACILITY IN THE PRESENCE OF THE SPECIAL INSPECTOR AND THE INSPECTOR OF RECORD. SPECIAL INSPECTOR SHALL FILE A REPORT OF THE TEST RESULTS WITH OSHPD PER CBC 2013, SECTION 1913A.7.3. IF ANY ANCHORS FAILS TESTING, TEST ALL ANCHORS OF THE SAME TYPE INSTALLED BY THE SAME TRADE AND NOT PREVIOUSLY TESTED UNTIL TWENTY (20) CONSECUTIVE ANCHORS PASS, THEN RESUME THE INITIAL TEST FREQUENCY. THEN TEST SHALL BE PERFORMED 24 HOURS OR MORE AFTER INSTALLATION. TESTING MAY BE DONE PRIOR TO SEISMIC BRACE INSTALLATION. ALSO REFER TO THE 2013 CBC SECTION 1913A.7, "TESTS FOR POST-INSTALLED ANCHORS IN CONCRETE" FOR DETERMINATION OF TENSION TEST LOAD.

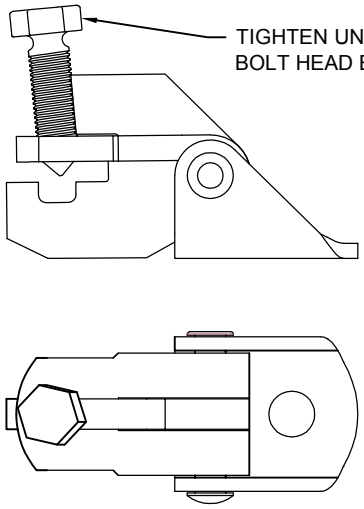
FAILURE/ACCEPTANCE CRITERIA: THE FOLLOWING CRITERIA APPLY FOR THE ACCEPTANCE OF INSTALLED ANCHORS:

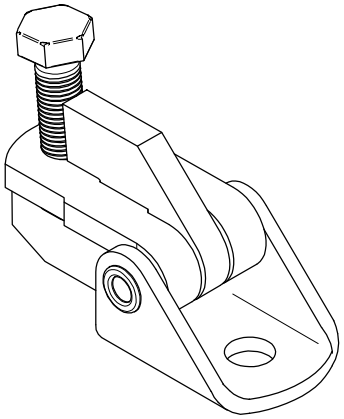
- HYDRAULIC RAM METHOD: APPLY AND HOLD TEST LOAD FOR A MINIMUM OF 15 SECONDS. THE ANCHOR SHOULD HAVE NO OBSERVABLE MOVEMENT AT THE APPLICABLE TEST LOAD WHERE WASHERS ARE USED. FOR WEDGE TYPE ANCHORS, SUCH AS POWER-STUD+, A PRACTICAL WAY TO DETERMINE OBSERVABLE MOVEMENT IS THAT THE WASHER UNDER THE NUT BECOMES LOOSE.
- TORQUE WRENCH METHOD: THE APPLICABLE TEST TORQUE MUST BE REACHED WITHIN THE FOLLOWING LIMITS: WEDGE TYPE: ONE-HALF ($\frac{1}{2}$) TURN OF THE NUT.

SECTION 4

SEISMIC BRACE COMPONENTS

TOLCO FIG. 980 UNIVERSAL SWIVEL SWAY BRACE ATTACHMENT





ALLOWABLE HORIZONTAL CAPACITY (lbf) per INSTALLATION ANGLE FROM VERTICAL, lb (N)				
30°-44°	45°-59°	60°-74°	75°-90°	REMARKS
1320 (5870)	1970 (8760)	2310 (10270)	2550 (11340)	a

a. FM APPROVED WHEN USED WITH 1, 1-1/4, 1-1/2, OR 2 INCH SCHEDULE 40 STEEL PIPE AS THE BRACE MEMBER.

NOTES:

1.) BRACE MUST BE SCH. 40 STEEL PIPE.
2.) DESIGN OF HANGER SUPPORTING GRAVITY LOADS ONLY NOT IN SCOPE OF THIS PRE-APPROVAL. DESIGN OF HANGER TO BE APPROVED ON PROJECT SPECIFIC BASIS BY OSHPD.

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TOLCO FIG. 4L OR 4LA "IN-LINE" PIPE CLAMP SWAY BRACE

FIG. 4L - LONGITUDINAL ORIENTATION

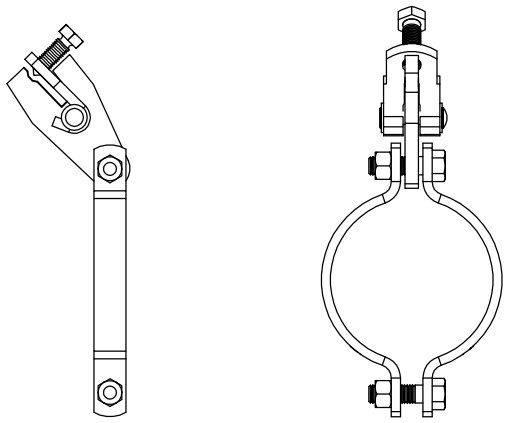


FIG. 4LA - LONGITUDINAL ORIENTATION

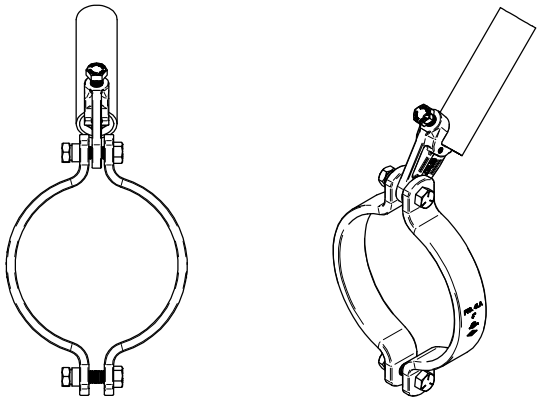
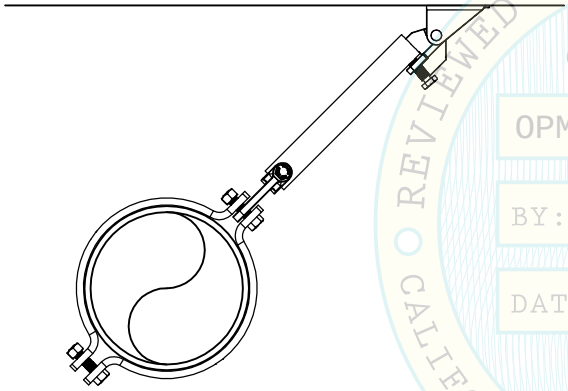


FIG. 4LA - LATERAL ORIENTATION



NOTES:

1.) TIGHTEN BOLTS TO FOLLOWING TORQUE VALUES:

1/4"	6 FT-LBS
5/16"	11 FT-LBS
3/8"	20 FT-LBS
1/2"	49 FT-LBS
5/8"	97 FT-LBS
3/4"	173 FT-LBS
1"	250 FT-LBS

2.) REFERENCE PAGE 4-2a FOR ALLOWABLE LONGITUDINAL AND LATERAL LOADS, AND PIPE DIAMETERS PERMITTED.

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TOLCO FIG. 4L OR 4LA "IN-LINE" PIPE CLAMP SWAY BRACE (LOADS)

MODEL	PART DESCRIPTION	ORIENTATION	RUN PIPE NOMINAL SIZE, IN.	PIPE RUN REFERENCE	ALLOWABLE HORIZONTAL CAPACITY (lbf) PER INSTALLATION ANGLE, lb (N)				REMARKS
					30°-44°	45°-59°	60°-74°	75°-90°	
4L	LONGITUDINAL IN-LINE ATTACHMENT	LONGITUDINAL	2 1/2	SCHD 10, SCHD 40	1030 (4581)	1180 (5248)	1420 (6315)	1590 (7072)	b
4L	LONGITUDINAL IN-LINE ATTACHMENT	LONGITUDINAL	3, 4	SCHD 10, SCHD 40	530 (2357)	730 (3247)	890 (3958)	990 (4403)	b
4L	LONGITUDINAL IN-LINE ATTACHMENT	LONGITUDINAL	5, 6, 8	0.188, SCHD 40	490 (2179)	680 (3024)	830 (3692)	930 (4136)	b, c

REMARKS:

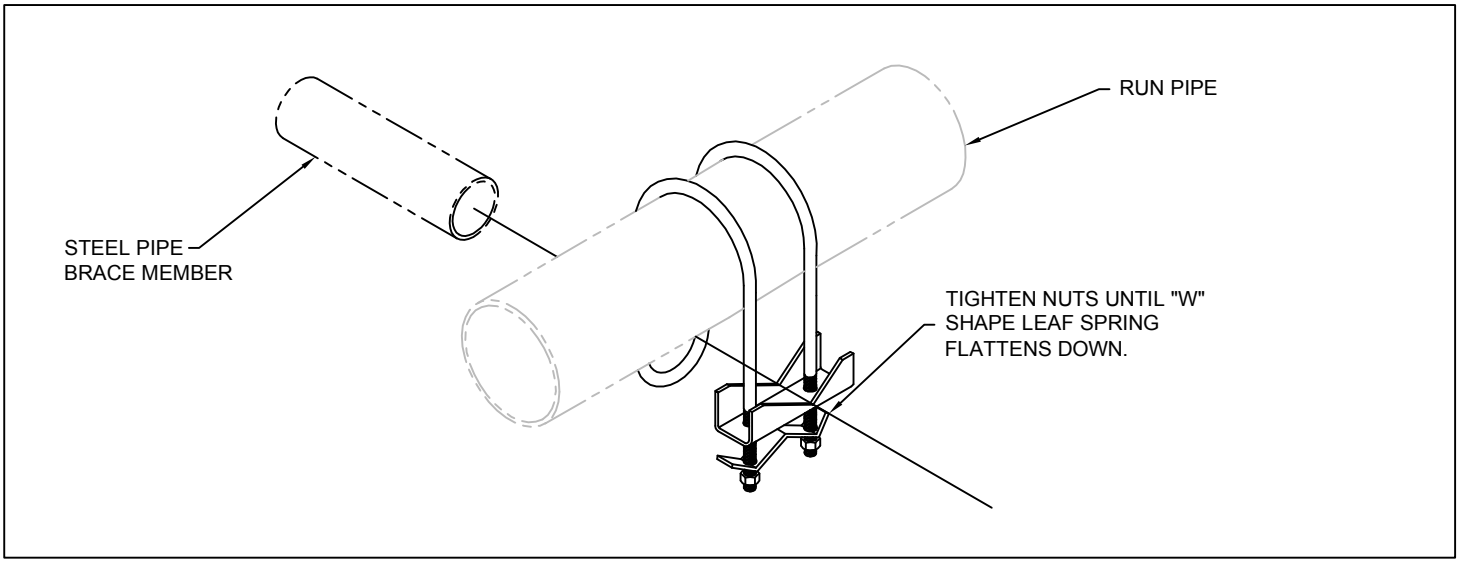
a.) NOT USED
b.) LOAD RATING FOR SCH. 10 ABOVE MAY BE APPLIED TO SCH. 40 STEEL PIPES.
c.) LOAD RATING FOR 0.188 ABOVE REFERS TO 0.188 INCH WALL THICKNESS PIPE AND CAN BE APPLIED TO ANY THICKER WALL.

Model	Run Pipe Nominal Size, in.	Run Pipe Reference	Longitudinal Allowable Horizontal Capacity (lbf) per Installation Angle, lb (N)				Lateral Allowable Horizontal Capacity (lbf) per Installation Angle, lb (N)				Remarks
			30°-44°	45°-59°	60°-74°	75°-90°	30°-44°	45°-59°	60°-74°	75°-90°	
4LA	1	LW, 10, 40	680 (3020)	970 (4310)	1190 (5290)	1320 (5870)	680 (3020)	970 (4310)	1190 (5290)	1320 (5870)	a, b, c
4LA	1 ¼	LW, 10,40	680 (3020)	970 (4310)	1190 (5290)	1320 (5870)	680 (3020)	970 (4310)	1190 (5290)	1320 (5870)	a, b, c
4LA	1 ½	LW, 10, 40	680 (3020)	970 (4310)	1190 (5290)	1320 (5870)	680 (3020)	970 (4310)	1190 (5290)	1320 (5870)	a, b, c
4LA	2	LW, 10, 40	680 (3020)	860 (3820)	1030 (4580)	1150 (5110)	680 (3020)	970 (4310)	1190 (5290)	1320 (5870)	a, b, c
4LA	2 ½	LW, 10, 40	680 (3020)	970 (4310)	1190 (5290)	1320 (5870)	680 (3020)	970 (4310)	1190 (5290)	1320 (5870)	a, b, c
4LA	3	LW, 10, 40	680 (3020)	970 (4310)	1190 (5290)	1320 (5870)	680 (3020)	970 (4310)	1190 (5290)	1320 (5870)	a, b, c
4LA	3 ½	LW, 10, 40	680 (3020)	970 (4310)	1190 (5290)	1320 (5870)	680 (3020)	970 (4310)	1190 (5290)	1320 (5870)	a, b, c
4LA	4	LW, 10, 40	680 (3020)	970 (4310)	1190 (5290)	1320 (5870)	680 (3020)	970 (4310)	1190 (5290)	1320 (5870)	a, b, c
4LA	6	LW, 10, 40	1620 (7200)	2260 (10050)	2010 (8940)	2220 (9870)	1620 (7200)	2300 (10230)	2820 (12540)	3140 (13960)	a, b, c
4LA	8	.188, 40	1620 (7200)	1660 (7380)	1570 (6980)	1740 (7730)	1620 (7200)	2300 (10230)	2820 (12540)	3140 (13960)	a, b, d
4LA	10	40	1620 (7200)	1660 (7380)	1570 (6980)	1740 (7730)	1620 (7200)	2300 (10230)	2820 (12540)	3140 (13960)	a
4LA	12	40	1620 (7200)	1660 (7380)	1570 (6980)	1740 (7730)	1620 (7200)	2300 (10230)	2820 (12540)	3140 (13960)	a

REMARKS:

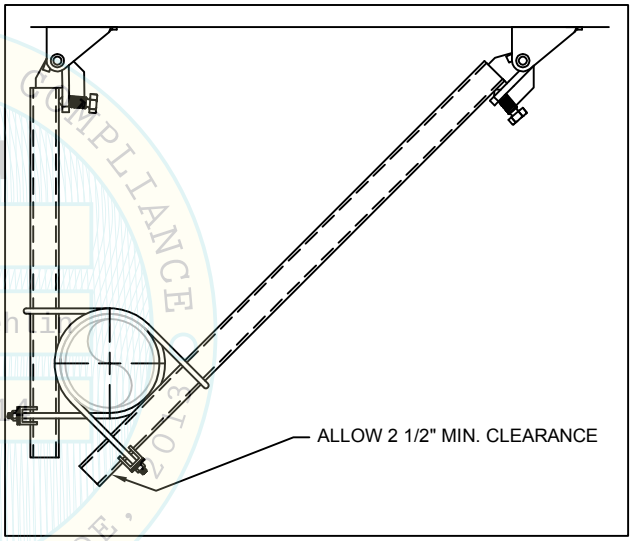
a.) FM APPROVED WHEN USED WITH 1", 1 1/4", 1 1/2" OR 2" SCH. 40 STEEL PIPE AS THE BRACE MEMBER.
b.) LOAD RATING FOR LW ABOVE REFERS TO FM APPROVED LIGHTWALL PIPE, COMMONLY REFERRED TO AS "SCHEDULE 7".
c.) LOAD RATING FOR SCHEDULE 10 ABOVE MAY BE APPLIED TO FM APPROVED THINWALL PIPE AND SCHEDULE 40 STEEL PIPES.
d.) LOAD RATING FOR 0.188 ABOVE REFERS TO 0.188 INCH WALL THICKNESS PIPE AND CAN BE APPLIED TO ANY THICKER WALL.

TOLCO FIG. 1000 FAST CLAMP



RUN PIPE REF.	RUN PIPE SIZE (in)	ORIENTATION	ALLOWABLE HORIZONTAL CAPACITY (lbf) PER INSTALLATION ANGLE FROM VERTICAL, lb (N)				REMARKS
			30°-44°	45°-59°	60°-74°	75°-90°	
LW, 10, 40.	1, 1-1/4 1-1/2, 2, 2-1/2	LATERAL	200	280	340	380	a, b
			(880)	(1240)	(1510)	(1690)	
LW, 10, 40.	3, 4	LATERAL	230	320	400	450	a, b
			(1020)	(1420)	(1770)	(2000)	

a.) FM APPROVED WHEN USED WITH 1, 1-1/4, 1-1/2, OR 2 INCH SCHEDULE 40 STEEL PIPE AS THE BRACE MEMBER.
b.) LOAD RATING FOR SCHEDULE 10 ABOVE MAY BE APPLIED TO FM APPROVED THINWALL PIPE AND SCHEDULE 40 STEEL PIPES.



NOTES:

1.) FIG. 1000 MAY BE POSITIONED ABOVE OR BELOW BRACE MEMBER.

2.) FIG. 1000 MAY BE INSTALLED SUCH THAT NUTS ARE ON THE OPPOSITE SIDE THAN AS SHOWN.

3.) DESIGN OF HANGER SUPPORTING GRAVITY LOADS ONLY NOT IN SCOPE OF THIS PRE-APPROVAL. DESIGN OF HANGER TO BE APPROVED ON PROJECT SPECIFIC BASIS BY OSHPD.

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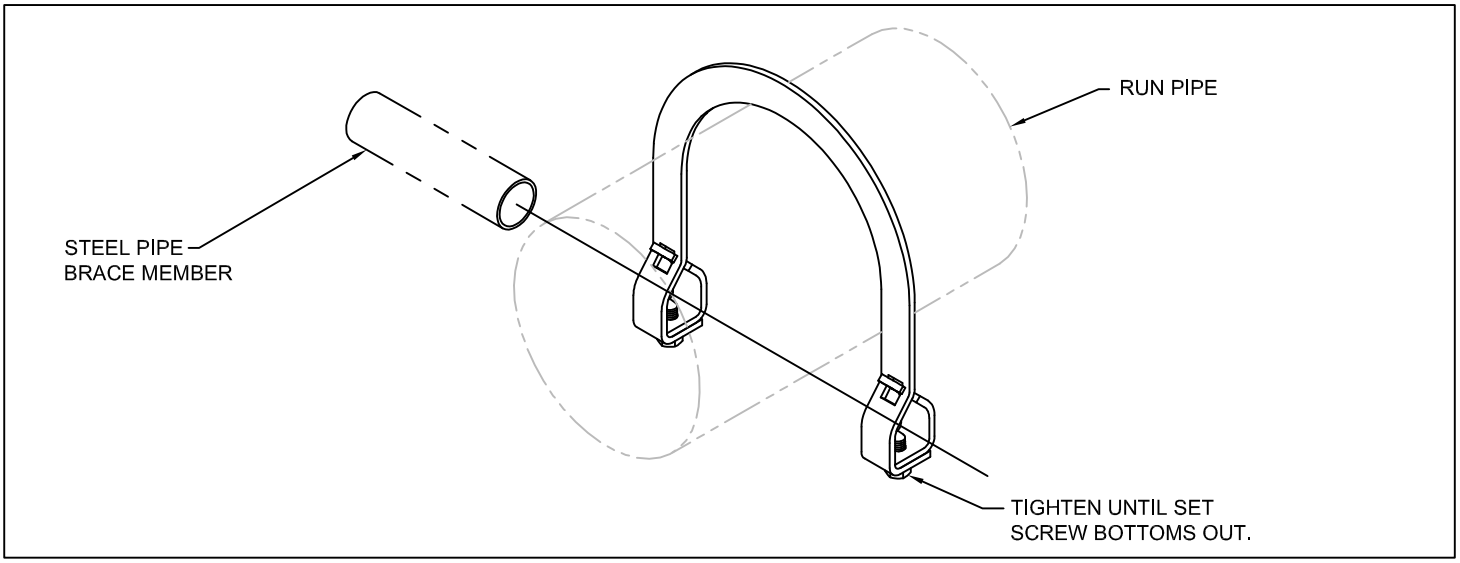
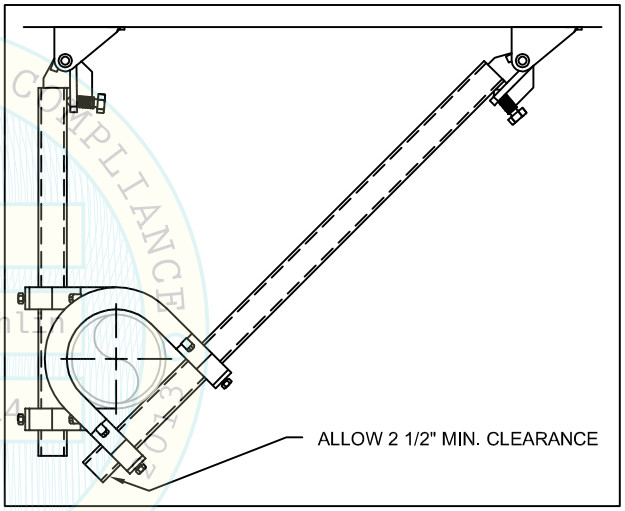
TOLCO FIG. 1001 SWAY BRACE ATTACHMENT



RUN PIPE REF.	RUN PIPE SIZE (in)	ORIENTATION	ALLOWABLE HORIZONTAL CAPACITY (lbf) PER INSTALLATION ANGLE FROM VERTICAL, lb (N)				REMARKS
			30°-44°	45°-59°	60°-74°	75°-90°	
LW, 10, 40.	1	LATERAL	1800	2550	3120	3490	a, b
			(8000)	(11340)	(13870)	(15520)	
LW, 10, 40.	1 1/4, 1 1/2, 2	LATERAL	1230	1740	2140	2380	a, b
			(5470)	(7730)	(9510)	(10580)	
LW, 10, 40.	2 1/2	LATERAL	800	1130	1380	1540	a, b
			(3550)	(5020)	(6130)	(6850)	
LW, 10, 40.	3, 4	LATERAL	850	1200	1470	1640	a, b
			(3780)	(5330)	(6530)	(7290)	
LW, 10, 40.	5, 6, 8	LATERAL	510	730	890	990	a, b
			(2260)	(3240)	(3950)	(4400)	

a.) FM APPROVED WHEN USED WITH 1, 1-1/4, 1-1/2, OR 2 INCH SCHEDULE 40 STEEL PIPE AS THE BRACE MEMBER.
b.) LOAD RATING FOR SCHEDULE 10 ABOVE MAY BE APPLIED TO GB/T 3091, GB/T 3092, EN 10255M AND H, JIS G3454, FM APPROVED THINWALL PIPE AND SCHEDULE 40 STEEL PIPES.

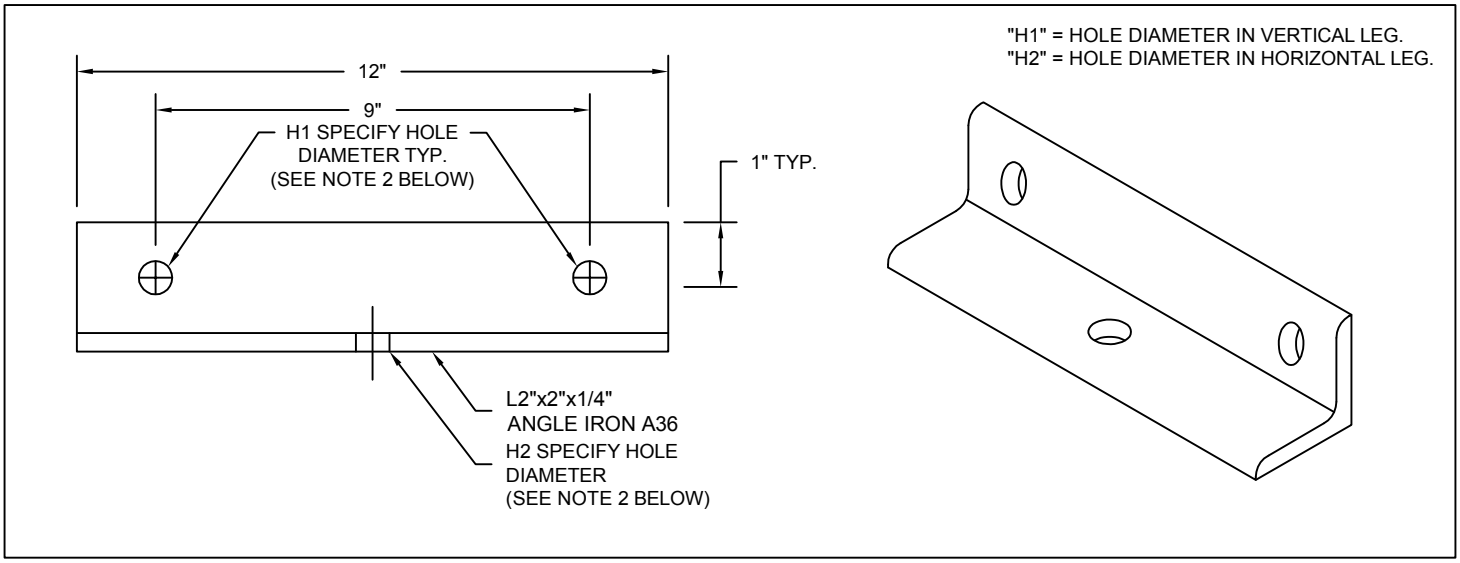


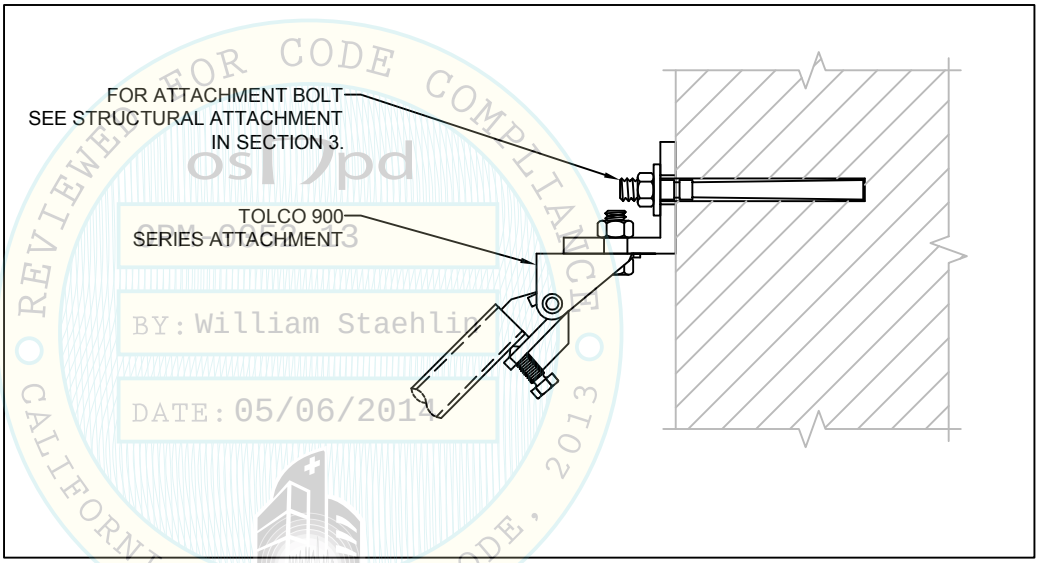
NOTES:

1.) FIG. 1001 MAY BE POSITIONED ABOVE OR BELOW BRACE MEMBER.

2.) DESIGN OF HANGER SUPPORTING GRAVITY LOADS ONLY NOT IN SCOPE OF THIS PRE-APPROVAL. DESIGN OF HANGER TO BE APPROVED ON PROJECT SPECIFIC BASIS BY OSHPD.

TOLCO FIG. 906 SWAY BRACE MULTI-FASTENER ADAPTER





NOTES:

1.) FOR DESIGN LOADS SEE STRUCTURAL ATTACHMENT IN SECTION 3.
2.) HOLE DIAMETER TO BE NO LARGER THAN BOLT DIAMETER PLUS 1/16" PER AISI.
3.) APPLIED LOADS INCLUDE VERTICAL GRAVITY LOADS, VERTICAL SEISMIC LOAD AND HORIZONTAL SEISMIC LOADS.

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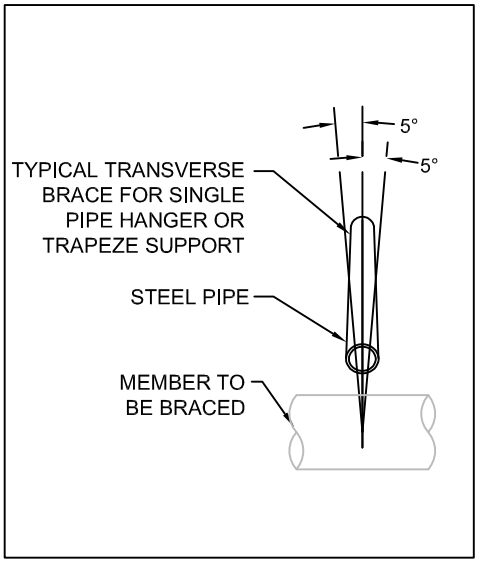
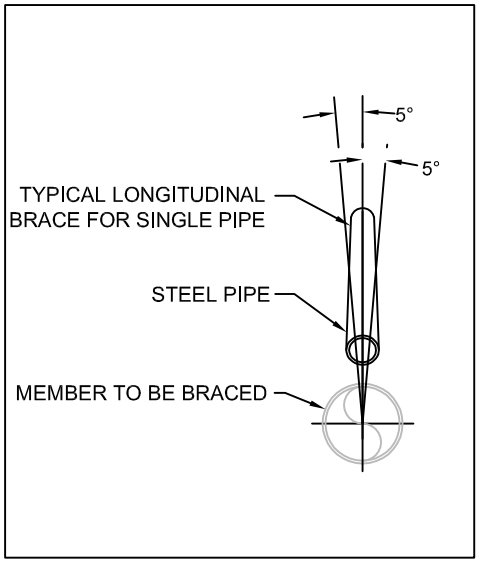
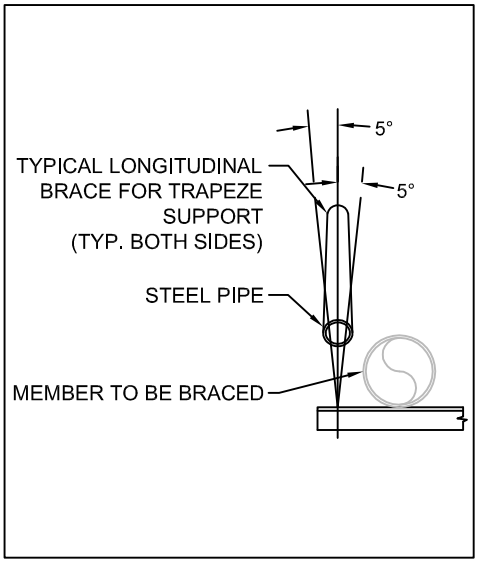
MAXIMUM ALLOWABLE LENGTHS AND CONCENTRIC LOADS FOR BRACE MEMBERS







PIPE DIAMETER	MAXIMUM LENGTH	SCH.	BRACE CAPACITY				
			ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE @ MAX. INSTALLATION ANGLE FROM VERTICAL (Lbs.)				MAX. VERTICAL SEISMIC LOAD W/ BRACE ANGLE FROM VERTICAL @
			30-44	45-59	60-74	75-90	0°
SEISMIC BRACING (KL / r = 200)							
1"	7'-0"	40	560	792	970	1082	1121
1 1/4"	9'-0"	40	755	1067	1307	1458	1510
1 1/2"	10'-4"	40	920	1301	1594	1778	1841
2"	13'-1"	40	1227	1735	2126	2371	2455
SEISMIC BRACING (KL / r = 300)							
1"	10'-6"	40	306	432	530	591	612
1 1/4"	13'-6"	40	410	580	711	793	821
1 1/2"	15'-7"	40	493	697	853	952	986
2"	19'-9"	40	650	919	1125	1255	1300

NOTES:

1.) ALL LONGITUDINAL AND TRANSVERSE BRACING UTILIZING PIPE AS THE BRACING MEMBER HAS A TOLERANCE OF 5° FROM CENTER IN EITHER DIRECTION WITHOUT AFFECTING THE ALLOWABLE LOADS.
2.) TABULATED LOADS ARE SUBJECT TO LIMITS GOVERNED BY THE CAPACITY OF THE PRIMARY STRUCTURE, INCLUDING, BUT NOT LIMITED TO CONCRETE FILL OVER METAL DECK CAPACITY. PER THE CONTRACT DOCUMENTS.
3.) STEEL (ASTM A53 TYPE E GRADE B) SCHEDULE 40: 1", 1 1/4", 1 1/2", 2" NPS. SEE ALSO PAGE 1-1.

BRANCH LINE RESTRAINT
ROD RESTRAINT TABLES

ROD RESTRAINT (KL / r = 200)

ROD DIAMETER	MAXIMUM LENGTH (in)	"r" RADIUS OF GYRATION (in)	ROD RESTRAINT CAPACITY				
			ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE @ MAX. INSTALLATIONS ANGLE FROM VERTICAL (lb.)				MAX. VERTICAL SEISMIC LOAD W/ BRACE ANGLE FROM VERTICAL @
			30-44	45-59	60-74	75-90	0
3/8"	15"	0.07675	132	187	229	255	265
1/2"	20"	0.10425	262	371	454	507	525

ROD RESTRAINT (KL / r = 300)

ROD DIAMETER	MAXIMUM LENGTH (in)	"r" RADIUS OF GYRATION (in)	ROD RESTRAINT CAPACITY				
			ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE @ MAX. INSTALLATIONS ANGLE FROM VERTICAL (lb.)				MAX. VERTICAL SEISMIC LOAD W/ BRACE ANGLE FROM VERTICAL @
			30-44	45-59	60-74	75-90	0
3/8"	23"	0.07675	57	81	99	111	115
1/2"	30"	0.10425	112	159	194	217	225

ROD RESTRAINT (KL / r = 400)

ROD DIAMETER	MAXIMUM LENGTH (in)	"r" RADIUS OF GYRATION (in)	ROD RESTRAINT CAPACITY				
			ALLOWABLE HORIZONTAL SEISMIC LOAD W/ BRACE @ MAX. INSTALLATIONS ANGLE FROM VERTICAL (lb.)				MAX. VERTICAL SEISMIC LOAD W/ BRACE ANGLE FROM VERTICAL @
			30-44	45-59	60-74	75-90	0
3/8"	30"	0.07675	34	48	58	65	68
1/2"	40"	0.10425	67	95	116	130	135

NOTES:

1.) THE INTENT OF THIS PAGE IS TO SHOW COMPLIANCE WITH NFPA SECTION 9.3.6.1 (5).

2.) PER NFPA 13 SECTION 9.3.6.1: RESTRAINT IS CONSIDERED A LESSER DEGREE OF RESISTING LOADS THAN BRACING.

3.) RESTRAINT MAY BE PROVIDED USING HANGERS NOT LESS THAN 45 DEGREES FROM VERTICAL INSTALLED WITHIN 6 INCHES OF THE VERTICAL HANGER ARRANGED FOR RESTRAINT AGAINST UPWARD MOVEMENT, PROVIDED IT IS UTILIZED SUCH THAT KL/r DOES NOT EXCEED 400, WHERE THE ROD SHALL EXTEND TO THE PIPE OR HAVE A SURGE CLIP INSTALLED.

4.) SEE NFPA 13 SECTION 9.3.6 FOR ADDITIONAL OPTIONS.

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APPENDIX A
FOR REFERENCE ONLY

METRIC CONVERSION CHART

Convert From	To	Multiply By	Convert From	To	Multiply By
Angle			**Mass**		
degree	radian(rad)	1.745329 x 10-2	pound (avoirdupois)	kilogram (kg)	4.535924 x 10-1
radian(rad)	degree	5.729578 x 10+1	kilogram (kg)	pound (avoirdupois)	2.204622
Area			**Mass Per Unit Length**		
foot ^{2}	square meter (m^2)	9.290304 x 10-2	lb/ft	kilogram/meter (kg/m)	1.488164
inch ^{2}	square meter (m^2)	6.451600 x 10-4	lb/in	kilogram/meter (kg/m)	1.785797 x 10+1
circular mil	square meter (m^2)	5.067075 x 10-10	kg/m	lb/ft	6.719689 x 10-1
sq. centimeter (cm^2)	square inch (in^2)	1.550003 x 10-1	kg/m	lb/in	5.599741 x 10-2
sq. meter (m^2)	foot ^{2}	1.076391 x 10+1			
sq. meter (m^2)	inch^2	1.550003 x 10+3	**Mass Per Unit Volume**		
sq. meter (m^2)	circular mil	1.973525 x 10+9	lb/ft ^{3}	kilogram/meter (kg/m^3)	1.601846 x 10+1
			lb/in ^{3}	kilogram/meter (kg/m^3)	2.767990 x 10+4
Temperature			kg/m ^{3}	lb/ft ^{3}	6.242797 x 10-2
degree Fahrenheit	degree Celsius	t°C = (t°F-32) /1.8	kg/m ^{3}	lb/in ^{3}	3.612730 x 10-5
degree Celsius	degree Fahrenheit	t°F = 1.8t°C + 32	lbs/ft ^{3}	lbs/in ^{3}	1.728000 x 10+3
Force			**Mass Per Area Unit**		
pounds-force (lbs)	newtons (N)	4.448222	lb/ft ^{2}	kilogram/sq.meter(kg/m^2)	1.601846 x 10+1
			kg/m ^{2}	kilogram/sq.meter(kg/m^2)	2.767990 x 10+4
Length					
foot (ft)	meter (m)	3.047000 x 10-1	**Mass Per Unit Volume**		
inch (in)	meter (m)	2.540000 x 10-2	lbf/in^2 (psi)	pascal (Pa)	6.894757 x 10+3
mil	meter (m)	2.540000 x 10-5	kip/in^2 (ksi)	pascal (Pa)	6.894757 x 10+6
inch (in)	micrometer (µm)	2.540000 x 10+4	lbf/in^2 (psi)	megapascals (MPa)	6.894757 x 10-3
meter (m)	foot (ft)	3.280840	pascal (Pa)	pound force/sq. inch(psi)	1.450377 x 10-4
meter (m)	inch (in)	3.937008 x 10+1	pascal (Pa)	kip per sq. inch (ksi)	1.450377 x 10-7
meter (m)	mil	3.937008 x 10+4			
micrometer (µm)	inch (in)	3.937008 x 10-5	**Bending Moment or Torque**		
Volume			lbf•ft	newton meter (N•m)	1.355818
foot ^{3}	cubic meter (m^3)	2.831685 x 10-2	lbf•in	newton meter (N•m)	1.129848 x 10-1
inch ^{3}	cubic meter (m^3)	1.638706 x 10-5	N•m	lbf•ft	7.375621 x 10-1
cubic centimeter (cm^3)	cubic inch (in^3)	6.102374 x 10-2	N•m	lbf•in	8.850748
cubic meter (m^3)	foot ^{3}	3.531466 x 10+1			
cubic meter (m^3)	inch^3	6.102376 x 10+4			
gallon (U.S. liquid)	cubic meter (m^3)	3.785412 x 10-3			

PIPE WEIGHTS

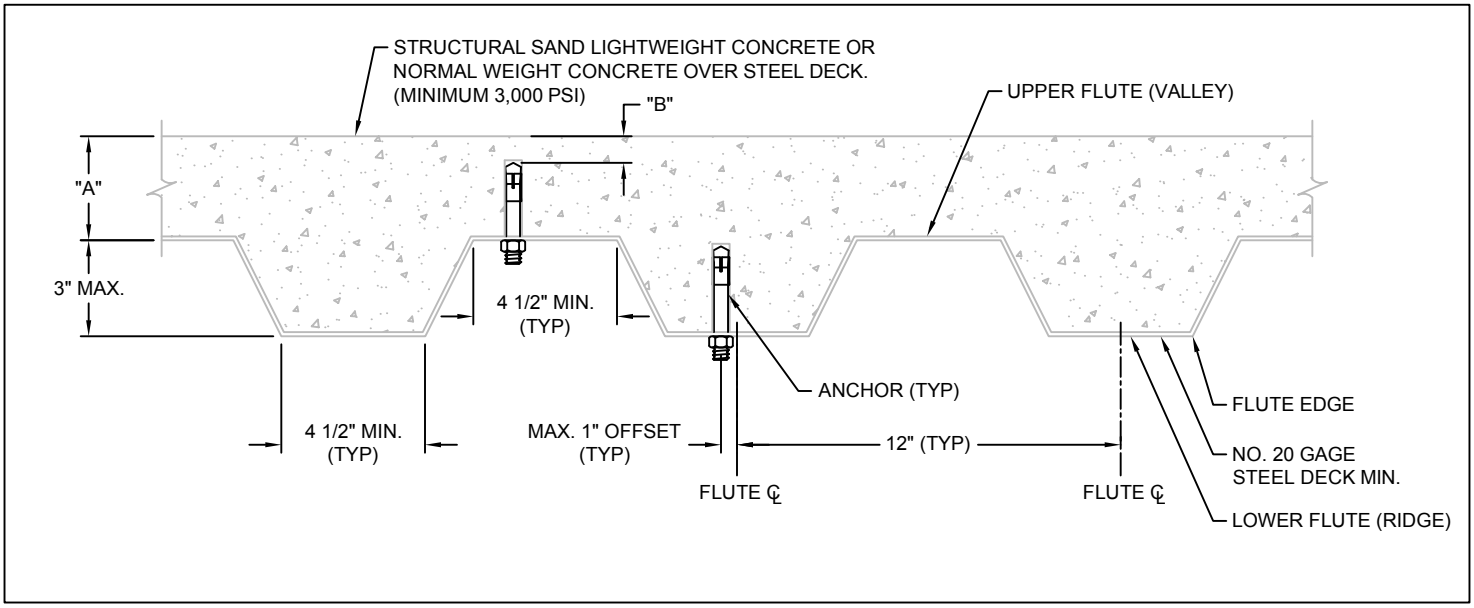
STEEL PIPE			
Pipe Dia.	Pipe Sch.	Weight Per Foot (lbs.)	
		Water Filled	Total*
1"	40	2.05	2.36
1-1/4"	40	2.93	3.37
1-1/2"	40	3.61	4.15
2"	40	5.13	5.90
2-1/2"	40	7.89	9.07
3"	40	10.82	12.44
3-1/2"	40	13.48	15.50
4"	40	16.40	18.86
5"	40	23.47	26.99
6"	40	31.69	36.44
8"	**	40.15	46.17
8"	40	50.23	57.76
10"	40	74.65	85.85
12"	40	98.58	113.37

*FOR PIPE SIZES 1"-6" WATER FILLED WEIGHT BASED ON NFPA-13-13, TABLE A.9.3.5.9, WEIGHT TABLES PLUS 15% FITTINGS ALLOWANCE.
** = 0.188" WALL PIPE

STEEL PIPE			
Pipe Dia.	Pipe Sch.	Weight Per Foot (lbs.)	
		Water Filled	Total*
1"	10	1.81	2.08
1-1/4"	10	2.52	2.90
1-1/2"	10	3.04	3.50
2"	10	4.22	4.85
2-1/2"	10	5.89	6.77
3"	10	7.94	9.13
3-1/2"	10	9.78	11.25
4"	10	11.78	13.55
5"	10	17.30	19.90
6"	10	23.03	26.49
8"	10	40.08	46.09

*WATER FILLED WEIGHT BASED ON NFPA-13-13, TABLE A.9.3.5.9, WEIGHT TABLES PLUS 15% FITTINGS ALLOWANCE.

W3 TYPE DECKS INFORMATION



WEDGE ANCHOR TYPE	MIN. CONCRETE FILL COVER "A"	ICC-ES ESR #	ANCHOR DIA.	COVER "B"
HILTI KB-TZ	3 1/4"	1917	3/8", 1/2", 5/8"	5/8"

1.0 SUMMARY OF TYPICAL DESIGN EXAMPLE

A. GENERAL

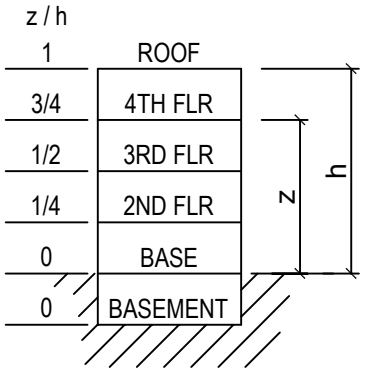
1. The Registered Design Professional (RDP) reviews Section 1 - overview of this OPM.

B. DEMAND

1. The RDP determines the lateral acceleration and vertical acceleration "G" (Cp in NFPA 13) for the seismic forces Fp and Fpv using information provided in the project documents. In the example below, the maximim horizontal and vertical forces on the seismic braces are calculated for use anywhere within the state of California. Please note that these maximum values may be reduced for the site specific project location as well as for the location within the height of a building in order to obtain lower demand values if so required to meet brace spacing criteria.

ASCE 7-10 AS AMENDED BY CBC 2013

SECTION	13.3	FORCES FOR LRFD, UNO	
SECTION	13.3.1	$F_p = \frac{0.4 a_p S_{DS} W_p}{R_p/I_p}(1+2z/h) = W_p$	
TABLE	13.6.1	$a_p = 2.5$	(NOT ASME® B31)
		$R_p = 4.5$	(NOT ASME B31)
		$\Omega_o = 2.50$	(FOR ANCHORAGE TO CONC)
		$S_{DS} = 2.5$	(MAX STATE OF CALIFORNIA VALUE)
SECTION	13.1.3	$I_p = 1.5$	(EMERGENCY SYSTEM)
		$z = h$	$z/h \leq 1.0$
		$\Omega_o F_p = 6.25$	W_p (FOR LRFD ANCHORAGE TO CONCRETE)



SAMPLE BLDG ELEV.

SECTION 13.3.1 MAX $F_p = 1.6 S_{DS} I_p W_p = 6.0 W_p$

SECTION 13.3.1 MIN $F_p = 0.3 S_{DS} I_p W_p = 1.125 W_p$

$1.125 W_p \leq 2.5 W_p \leq 6.0 W_p$

SECTION 13.3.1 $F_{pv} = \pm 0.20 S_{DS} W_p = \pm 0.50 W_p$:

FOR ASD $F_p = (2.5 W_p)(0.7) = 1.75 W_p$ AND $F_{pv} = (\pm 0.50 W_p)(0.7) = \pm 0.35 W_p$

2. The RDP uses the NFPA 13 guidelines to prepare the fire sprinkler layout drawings.
3. The RDP determines the brace locations and shows them on the layout drawings.
4. The RDP determines the branch line weight plus tributary main line weight (W) for each seismic brace using the NFPA 13 zone of influence (ZOI) method. For this example assume that W = 500 LBS for a 4" diameter schedule 10 main line service pipe.
5. The RDP compares the calculated 500 LBS weight to the allowable weight (W) shown in permissible total weight tables for service pipes. The 500 LB for this example was taken from the "water filled" column on page 5-2, and must be factored as shown in step 7 on page 5-5. From page 5.8, the maximum permissible weight of 589 lbs. will allow a lateral transverse brace spacing of 25 feet for the 4" diameter main line service pipe.

B. DEMAND (CONTINUED)

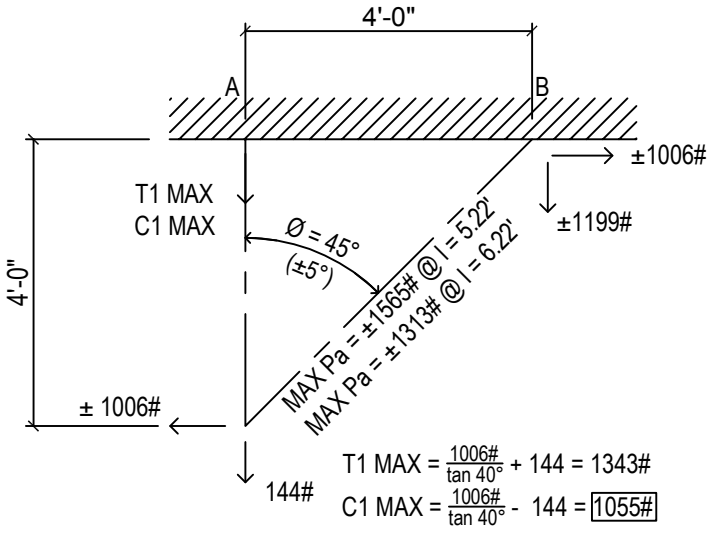
6. The RDP makes adjustments to the lateral transverse brace spacing and recalculates (W) if so required.
7. The RDP determines the operating weight (Wp = 1.15W) by applying the 1.15 factor as per NFPA 13 SECTION 9.3.5.9.2. in this example Wp = 1.15 (500 LBS) = 575 LBS. If TOTAL weight values from tables on page 5-2 are used, skip this step, since 1.15 factor is already included in table values. The 500 LBS for this example does not included the 1.15 factor and so is applied here.
8. The RDP calculates the lateral force Fp and Vertical force Fpv on the seismic brace using the Wp provided by the Specialty Contractor. Note that in the example, it is conservatively assumed that the vertical gravity load is based on the maximum allowable vertical hanger spacing for the main service pipe line per NFPA 13. for this example, at ASD level of design

Wp = 575 LBS

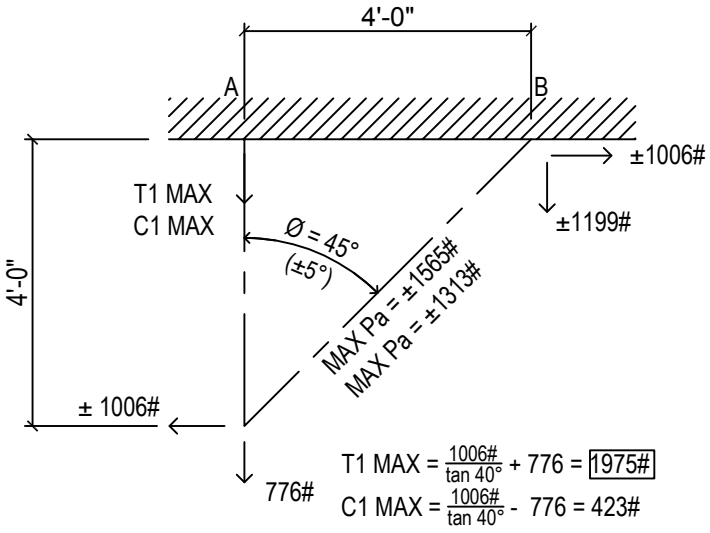
Fp = ±1.75 (575 LBS) = ±1,006 LBS

Fpv = ±0.35 (575 LBS) = ±201 LBS

LOAD COMBINATION 1 (0.6Wp-Fpv) = 345-201 = 144#



LOAD COMBINATION 2 (Wp+Fpv) = 575+201 = 776#



9. The RDP verifies that there is a vertical seismic brace within six inches of each transverse and longitudinal brace.
10. The RDP chooses appropriate seismic brace support elements per pages 2-2 and 4-4 of the OPM. For this example the Tolco Fig. 1001 Fast Clamp connection is chosen for both the transverse and vertical seismic brace. Refer to pages 2-2 and 4-4.
11. The RDP chooses appropriate seismic attachment elements to structure as per section 3 of the OPM.

C. CAPACITY

1. The RDP determines the governing capacity of the assembled supports and attachment.
   a. Determine capacity of support element for service pipe per tested values on page 4-4. Per page 4-4 the Tolco Fig. 1001 Fast Clamp capacity for a 4" diameter, schedule 10 service pipe is 850 lbs for any brace angle between 30 to 90 degrees. The capacity is 1640 lbs at 90 degrees if used as a vertical brace. This is higher than the demand and the Fig. 1001 can be used as part of the brace assembly for this approval.
   b. Determine capacity of brace pipe support as per calculated allowable values in table provided on page 4-6. For this example, it is assumed that the brace pipe is no longer than 7 feet. A 1 1/4" diameter brace pipe has a horizontal capacity of 755 lbs and can be used as part of the transverse and vertical brace assemblies in this example.
   c. Determine capacity of the typical Tolco Fig. 980 support between brace pipe and seismic attachment element. Per page 4-1 the Fig. 980 has a capacity of 1320 lbs for any brace angle between 30 to 90 degrees and can be used as part of the brace assembly in this example.
   d. Determine capacity of seismic attachment elements to supporting structure as per Section 3 of the OPM, anchorage to concrete. For this example choose Hilti 5/8" w/ 3-1/4" embed concrete anchor as shown on page 3-1. The maximum allowable horizontal load capacity of the attachment for a brace angle of 40 degree is 902 lbs. This is much less than the calculated demand of 1006 lbs.
   e. Please note that for anchorage to concrete, use combined forces check as ACI 318-11 as well as the over strength factor Ω_0 per ASCE 7-10 supplement #1 for concrete that is included in the Section 3 tables.
2. The RDP determines whether the demand on the brace is less than the capacity of the assembly. In this example, the brace pipe capacity of 755 lbs is found to be much less than the calculated demand of 1006 lbs thus, the brace spacing (i.e. (W) based on ZOI) will need to be reduced.
3. The RDP determines using a capacity versus demand ratio the approximate revised allowable brace spacing.
   a. For this example (755 lb/1006 lb) 25 ft = 18 ft. The revised spacing and new ZOI loads can then be determined for the assembly chosen.
   b. Alternatively, by instead first choosing a larger brace pipe with a larger capacity, the assembly's capacity can be increased. In that case the Fig. 1001 Fast Clamp at 850 lb would govern. Performing the capacity versus demand ratio would then determine a new larger allowable brace spacing of (850 lb/1006 lb) 25 ft = 21 ft. The revised spacing and new ZOI loads can then be determined for the assembly chosen.

MAXIMUM LOAD IN ZONE OF INFLUENCE (ZOI) OF A LATERAL SWAY BRACE

Schedule LW Steel Pipe

Pipe Size (1)	Outside Diameter				Weight		Hanger	Applied	Max M	Max Load from ZOI in lb., Fpw					Max Weight from ZOI in lb., W W = Fpw/1.15 Cp				
	OD (1)	t_{nom} (1)	S (2)	M_{Max}	w/ water Wp	Fv+Wp	Spacing (3) S_{hanger}	Moment M_{hanger}	Horiz. $M_{horizontal}$	Transverse Brace Spacing in ft.					Transverse Brace Spacing in ft.				
in	in	in	in^3	ft-lb	lb/ft	lb/ft	ft	ft-lb	ft-lb	20	25	30	35	40	20	25	30	35	40
1	1.315	0.065	0.071	116	1.36	1.84	12	33	111	64	50	42			32	25	21		
1-1/4	1.66	0.065	0.117	190	1.93	2.60	12	47	185	106	83	69			52	41	34		
1-1/2	1.9	0.065	0.156	253	2.37	3.20	12	58	246	141	111	92			70	55	46		
2	2.375	0.065	0.248	403	3.35	4.53	12	81	395	226	177	148			112	88	73		
2-1/2	2.875	0.083	0.462	751	5.03	6.78	12	122	741	423	333	278			210	165	138		
3	3.5	0.083	0.695	1129	6.88	9.28	12	167	1117	638	502	418	359	314	317	249	208	178	156
3-1/2	4	0.083	0.915	1487	8.55	11.54	12	208	1473	842	662	552	473	414	418	329	274	235	206
4	4.5	0.083	1.166	1895	10.39	14.03	12	253	1878	1073	844	703	603	527	533	419	349	300	262
5	5.5625	0.109	2.332	3789	16.21	21.88	12	394	3769	2154	1694	1412	1210	1059	1070	842	701	601	526
6	6.625	0.109	3.337	5423	21.72	29.32	12	528	5397	3084	2426	2021	1733	1516	1532	1205	1004	861	753
8	8.625	0.109	5.717	9290	34.18	46.14	12	831	9253	5287	4159	3466	2970	2599	2627	2066	1722	1476	1292

Density of medium: 62.4 lb/cu ft Water
Density of pipe: 500 lb/cu ft Steel
Fp= 1.75 Wp
Fv= 0.35 Wp
Steel strength Fy: 30000 psi

1 Steel pipe dimensions per NFPA 13 Table A.6.3.2
2 S = (PI * OD^4 - (OD - 2 * 0.93 * t_{nom})^4) / 32 * OD
3 Maximum distance between hangers per NFPA 13, Table 9.2.2.1

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Page No: 5-7
Date: February 14, 2014

MAXIMUM LOAD IN ZONE OF INFLUENCE (ZOI) OF A LATERAL SWAY BRACE

Schedule 10 Steel Pipe

Pipe Size (1)	Outside Diameter OD (1)	t_{nom} (1)	S (2)	M_{Max}	Weight w/ water Wp	Fv+Wp	Hanger Spacing (3) S_{hanger}	Applied Moment M_{hanger}	Max M Horiz. $M_{horizontal}$	Max Load from ZOI in lb., Fpw Transverse Brace Spacing in ft.					Max Weight from ZOI in lb., W W = Fpw/1.15 Cp Transverse Brace Spacing in ft.				
in	in	in	in^3	ft-lb	lb/ft	lb/ft	ft	ft-lb	ft-lb	20	25	30	35	40	20	25	30	35	40
1	1.315	0.109	0.109	177	1.84	2.49	12	45	171	98	77	64			49	38	32		
1-1/4	1.66	0.109	0.182	296	2.55	3.44	12	62	290	166	130	109			82	65	54		
1-1/2	1.9	0.109	0.245	397	3.09	4.17	15	117	380	217	171	142			108	85	71		
2	2.375	0.109	0.395	642	4.28	5.77	15	162	621	355	279	232			176	139	115		
2-1/2	2.875	0.12	0.644	1047	5.97	8.06	15	227	1022	584	459	383			290	228	190		
3	3.5	0.12	0.975	1585	8.04	10.86	15	305	1555	889	699	582	499	437	442	347	289	248	217
3-1/2	4	0.12	1.289	2095	9.89	13.35	15	376	2061	1178	926	772	662	579	585	460	384	329	288
4	4.5	0.12	1.647	2677	11.91	16.08	15	452	2638	1508	1186	988	847	741	749	589	491	421	368
5	5.5625	0.134	2.831	4600	17.48	23.59	15	664	4552	2601	2046	1705	1461	1279	1293	1017	847	726	635
6	6.625	0.134	4.059	6597	23.24	31.38	15	882	6537	3736	2938	2448	2099	1836	1856	1460	1217	1043	912
8	8.625	0.188	9.611	15617	40.46	54.62	15	1536	15542	8881	6985	5821	4989	4366	4413	3471	2892	2479	2169

Density of medium: 62.4 lb/cu ft Water
Density of pipe: 500 lb/cu ft Steel
Fp= 1.75 Wp
Fv= 0.35 Wp
Steel strength Fy: 30000 psi

1 Steel pipe dimensions per NFPA 13 Table A.6.3.2
2 S = (PI * OD^4 - (OD - 2 * 0.93 * t_{nom})^4) / 32 * OD
3 Maximum distance between hangers per NFPA 13, Table 9.2.2.1

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MAXIMUM LOAD IN ZONE OF INFLUENCE (ZOI) OF A LATERAL SWAY BRACE

Schedule 40 Steel Pipe

Pipe Size (1)	Outside Diameter OD (1)	t_{nom} (1)	S (2)	M_{Max}	Weight w/ water Wp	Fv+Wp	Hanger Spacing (3) S_{hanger}	Applied Moment M_{hanger}	Max M Horiz. $M_{horizontal}$	Max Load from ZOI in lb., Fpw Transverse Brace Spacing in ft.					Max Weight from ZOI in lb., W W = Fpw/1.15 Cp Transverse Brace Spacing in ft.				
in	in	in	in^3	ft-lb	lb/ft	lb/ft	ft	ft-lb	ft-lb	20	25	30	35	40	20	25	30	35	40
1	1.315	0.133	0.126	205	2.09	2.82	12	51	199	114	89	74			56	44	37		
1-1/4	1.66	0.14	0.222	361	2.97	4.01	12	72	354	202	159	132			100	79	66		
1-1/2	1.9	0.145	0.308	501	3.66	4.94	15	139	481	275	216	180			137	108	90		
2	2.375	0.154	0.529	859	5.19	7.00	15	197	836	478	376	313			237	187	156		
2-1/2	2.875	0.203	1.005	1632	7.99	10.79	15	303	1604	917	721	601			455	358	299		
3	3.5	0.216	1.625	2640	10.94	14.77	15	415	2607	1490	1172	976	837	732	740	582	485	416	364
3-1/2	4	0.226	2.253	3662	13.59	18.34	15	516	3625	2071	1629	1358	1164	1018	1029	810	675	578	506
4	4.5	0.237	3.023	4913	16.54	22.33	15	628	4872	2784	2190	1825	1564	1369	1383	1088	907	777	680
5	5.5625	0.258	5.119	8318	23.60	31.85	15	896	8270	4725	3717	3097	2655	2323	2348	1847	1539	1319	1154
6	6.625	0.28	7.972	12955	31.90	43.06	15	1211	12898	7370	5797	4831	4141	3623	3662	2880	2400	2057	1800
8	8.625	0.322	15.757	25605	50.84	68.64	15	1930	25532	14590	11475	9563	8196	7172	7250	5702	4752	4073	3564
10	10.75	0.365	28.012	45519	75.52	101.95	15	2867	45429	25959	20417	17014	14584	12761	12899	10145	8454	7247	6341
12	12.75	0.375	41.005	66633	99.63	134.50	15	3783	66525	38014	29899	24916	21356	18687	18889	14857	12381	10612	9285

Density of medium: 62.4 lb/cu ft Water
Density of pipe: 500 lb/cu ft Steel
Fp= 1.75 Wp
Fv= 0.35 Wp
Steel strength Fy: 30000 psi

1 Steel pipe dimensions per NFPA 13 Table A.6.3.2
2 S = (PI * OD^4 - (OD - 2 * 0.93 * t_{nom})^4) / 32 * OD
3 Maximum distance between hangers per NFPA 13, Table 9.2.2.1

CBC 2013 SEISMIC FORCE CALCULATION

PIPING SEISMIC FORCE FACTOR (HIGH DEFORMABILITY)

Seismic force per the California Building Code CBC 2013, Title 24 Part 2, and California Maximum

$a_p := 2.5$ Component Amplification Factor

$R_p := 4.5$ Component Response Modification Factor

$S_{DS} := 2.5$ Design Spectral Response Acceleration at Short Periods Maximum in California

$I_p := 1.5$ Importance Factor

$1.6 \cdot S_{DS} \cdot I_p = 6$ Horizontal Seismic Shear Coefficient, Upper Limit

$\frac{0.4a_p \cdot S_{DS}}{\frac{R_p}{I_p}} \cdot \left(1 + 2 \cdot \frac{1}{1}\right) = 2.5$ Horizontal Seismic Shear Coefficient, Controls

$0.3 \cdot S_{DS} \cdot I_p = 1.125$ Horizontal Seismic Shear Coefficient, Lower Limit

$\frac{0.4a_p \cdot S_{DS}}{\frac{R_p}{I_p}} \cdot \left(1 + 2 \cdot \frac{1}{1}\right) \cdot (0.7) = 1.75$ Seismic Shear Coefficient, Service Level

$Fp := \frac{0.4a_p \cdot S_{DS}}{\frac{R_p}{I_p}} \cdot \left(1 + 2 \cdot \frac{1}{1}\right)(0.7) \cdot Wp$ Seismic Lateral Force, Service Level

$0.2 \cdot S_{DS} \cdot (0.7) = 0.35$ Seismic Vertical Coefficient, Service Level

$Fv := 0.2 \cdot S_{DS} \cdot (0.7) Wp$ Seismic Vertical Force, Service Level

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