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

OSHPD Preapproval of Manufacturer's Certification (OPM)

Type: ☑ New  ☐ Renewal  ☑ Update to Pre-CBC 2013 OPA Number: OPA-2804-10

Manufacturer Information

Manufacturer: Anvil International, LLC
Manufacturer’s Technical Representative: Gregory Ohnemus
Mailing Address: 160 Frenchtown Road, North Kingstown, RI 02852
Telephone: (401) 558-2584  Email: gohnemus@anvilintl.com

Product Information

Product Name: Seismic Sway Bracing for Fire Protection Systems
Product Type: Seismic Sway Bracing
Product Model Number: Figures 770, 771, 772, 775, 776, and 778
General Description: Pipe clamp & brace pipe supports, & attachment of supports to wood, steel & conc. structure

Applicant Information

Applicant Company Name: Anvil International
Contact Person: Gregory Ohnemus
Mailing Address: 160 Frenchtown Road, North Kingston, RI 02852
Telephone: (401) 558-2584  Email: gohnemus@anvilintl.com

I hereby agree to reimburse the Office of Statewide Health Planning and Development review fees in accordance with the California Administrative Code, 2016.

Signature of Applicant: [Signature]
Date: 05/26/2016
Title: Product Engineer
Company Name: Anvil International, LLC. (anvilintl.com)
Registered Design Professional Preparing Engineering Recommendations

Company Name: CYS Structural Engineers, Inc.  
Name: Dieter T. Siebald  California License Number: S4346  
Mailing Address: 2495 Natomas Park Drive, Suite # 650, Sacramento, CA 95833  
Telephone: (916) 920-2020  Email: dieters@cyseng.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):  

*Use of criteria other than those adopted by the California Building Standards Code, 2016 (CBSC 2016) 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 2016 may be used when approved by OSHPD prior to testing.

- Analysis  
- Experience Data  
- Combination of Testing, Analysis, and/or Experience Data (Please Specify): Testing per FM 1950-10 and Analysis per pertinent chapters of 2013 CBC.

List of Attachments Supporting the Manufacturer's Certification

- Test Report  
- Drawings  
- Calculations  
- Other(s) (Please Specify): (3) FM Approval Reports, (3) FM Certificates of Compliance, OPA-2804-10,  

FM Approval Standard 1950 March 2010,

OFFICE USE ONLY – OSHPD APPROVAL VALID FOR CBC 2016 & ALL PRE-2016 CODE BASED PROJECTS

Signature: ___________________________ Date: 09/26/2016
Print Name: Jeffrey Kikumoto  
Title: SSE  
Condition of Approval (if applicable):  

“Access to Safe, Quality Healthcare Environments that Meet California’s Diverse and Dynamic Needs”

STATE OF CALIFORNIA – HEALTH AND HUMAN SERVICES AGENCY
OSH-FD-700 (REV 12/16/15)
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   1.2. BRACE SPACING GUIDELINES PER NFPA 13 - 2013
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8. TYPICAL SWAY BRACE DESIGN PROCEDURE
1. GENERAL INFORMATION:

1.1. PRE-APPROVAL GUIDE SCOPE & ABBREVIATIONS


1.1.2. THE PURPOSE OF THIS PRE-APPROVAL MANUAL IS FOR THE DESIGN OF SUPPORTS & ATTACHMENTS OF THE SEISMIC SWAY BRCG OF INTERIOR PIPING FOR FIRE SPRINKLER SYSTEMS SUBJECT TO SEISMIC LOADS.

1.1.3. INTERMEDIATE HANGERS & RESTRAINTS FOR OTHER LOADS (I.E. THERMAL LOADS, WATER HAMMER, PRESSURE, OR WATER JET LOADS) ARE BY OTHERS & ARE NOT ADDRESSED IN THIS OPM. FURTHERMORE, DOES NOT ADDRESS COMPONENTS THAT CROSS SEISMIC SEPARATIONS, NOR DOES IT ADDRESS COMPONENTS OTHER THAN PIPE RISERS ATTACHED TO PORTIONS OF THE STRUCTURE OR EQUIPMENT THAT WILL EXPERIENCE RELATIVE SEISMIC DISPLACEMENT.

1.1.4. THIS PRE-APPROVAL IS INTENDED FOR PIPING SYSTEMS W/ THE PIPE COMPONENT SIZES LISTED IN TABLE 1.1.1 & TABLE 1.1.2.

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TABLE 1.1.1 — FIRE SPRINKLER SERVICE PIPE

¹ WALL THK IS 0.188”. SEE SECTION 1.7.5.

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TABLE 1.1.2 — BRACE PIPE

1.1.5. THE SEISMIC SWAY BRCG SYSTEM SHALL BE ATTACHED TO CONC, STL, OR WOOD SUBSTRATES SUITABLE FOR SUPPORT OF THE REQ LOAD. FOR ATTACHMENT TO THE UNDERSIDE OF CONC FLRS OR A ROOF W/ OR WITHOUT MTL DECK, TO THE FACE OF CONC WALLS, OR TO THE UNDERSIDE OF CONC BMS, SEE SECTION 2. FOR ATTACHMENT TO WOOD BMS, SEE SECTION 3. FOR ATTACHMENT TO WF STL BMS & BAR JOISTS, SEE SECTIONS 4.2 & 4.3.

1.1.6. THIS OPM IS INTENDED FOR THE DESIGN OF SUPPORTS & ATTACHMENTS OF SEISMIC SWAY BRCG FOR FIRE PROTECTION SYSTEMS LOCATED IN THE INTERIOR OF A BUILDING.
1.1. PRE-APPROVAL GUIDE SCOPE & ABBREVIATIONS (CONTINUED)

1.1.7. ABBREVIATIONS:

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### 1.1. PRE-APPROVAL GUIDE SCOPE & ABBREVIATIONS (CONTINUED)

#### 1.1.7. ABBREVIATIONS:

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<td>ULTIMATE STRENGTH DESIGN</td>
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**Sheet Title:** GENERAL INFORMATION

**PRE-APPROVAL GUIDE SCOPE & ABBREVIATIONS**

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**TEL** (916) 920-2020

**www.cyseng.com**

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**Job No:** 14090

**Date:** 09-22-2016

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1.2. **BRACE SPACING GUIDELINES PER NFPA 13 – 2013**

1.2.1. A RUN OF PIPE IS CONSIDERED A CONT STRAIGHT LENGTH IF THE MAX OFFSET IS LESS THAN 24”. IF THE OFFSET IS 24” OR GREATER, EA CONT STRAIGHT LENGTH SHALL BE TREATED AS AN INDEPENDENT RUN & BRACED APPROPRIATELY. SEE FIGURE 1.2.1.

1.2.2. TRANS SEISMIC BRCG

1.2.2.1. TRANS BRCG MAY ALSO BE REFERRED TO AS LATERAL BRCG.

1.2.2.2. TRANS BRCG LIMITS SEISMIC MOVEMENT PERP TO THE SERVICE PIPE RUN IN THE HORIZ DIRECTION.

1.2.2.3. TRANS BRCG SHALL BE PROVIDED ON ALL FEED & CROSS MAINS REGARDLESS OF SERVICE PIPE SIZE & ALL OTHER PIPING (E.G. BRANCH LINES, ETC.) W/ A SERVICE PIPE DIA OF 2½” & LARGER. THE LAST LENGTH OF PIPE AT THE END OF A FEED OR CROSS MAIN SHALL BE PROVIDED W/ A TRANS BRACE.

1.2.2.4. TRANS BRCG MAX SPAC FOR PIPING CONSTRUCTED OF DUCTILE MATERIALS (E.G. STL) SHALL BE 40 FT (2½” DIA PIPING & LARGER); 30 FT MAX SPAN (PIPE SMALLER THAN 2½” DIA), SEE FIGURE 1.2.2. NOTE THAT THE FLEXURAL CAPACITY OF THE SERVICE PIPE OR THE BRACE ASSEMBLY OR THE MAX CALCULATED LOAD IN THE NFPA ZONE OF INFLUENCE MAY REDUCE THE SPAC OF THE TRANS BRCG. REFER TO SECTION 8, STEP 4.

1.2.2.5. A TRANS BRACE PLACED WITHIN 24” OF A 90 DEG CHANGE OF DIRECTION OF THE SERVICE PIPE (E.G. ELBOW, TEE, CROSS, ETC.) MAY ACT AS A LONG BRACE; SEE FIGURE 1.2.2.

1.2.2.6. THE MIN BRACE REQUIREMENTS FOR SERVICE PIPE RUNS EXCEEDING 5 FT IS A TRANS BRACE AT EA END OF THE RUN & A LONG BRACE AT ONE OF THOSE TWO POSITIONS; SEE FIGURE 1.2.3.

1.2.2.7. BRCG INSTALLED ON SMALLER PIPING SHALL NOT BE USED TO BRACE LARGER DIA PIPING.

1.2.2.8. EXCEPTIONS: ALL PIPING SUSPENDED BY INDIVIDUAL HANGER BOLDS 6” OR LESS IN LENGTH FROM THE TOP OF THE PIPE TO THE BOTT OF THE SUPPORT STRUCTURE WHERE HANGER IS CONNECTED. ALL OF THE HANGERS OF A RUN MUST COMPLY W/ THE 6-INCH RULE OR BRCG IS REQ.
1.2. **BRACE SPACING GUIDELINES PER NFPA 13 – 2013**

1.2.3. LONG SEISMIC BRGC

1.2.3.1. LONG BRGC LIMITS SEISMIC MOVEMENT PARALLEL TO THE SERVICE PIPE RUN.

1.2.3.2. LONG BRGC MAX SPCG FOR PIPING CONSTRUCTED OF DUCTILE MATERIALS (E.G. STL) SHALL BE 80 FT (2½" DIA PIPING & LARGER); 60 FT MAX SPAN (PIPING SMALLER THAN 2½" DIA); SEE FIGURE 1.2.2.

1.2.3.3. EA PIPE RUN MUST HAVE AT LEAST ONE LONG BRACE. ADDNL LONG BRACES ARE REQ WHEN THE MAX LONG SPCG IS EXCEEDED; SEE FIGURES 1.2.1, 1.2.2, & 1.2.3.

1.2.4. VERT SEISMIC BRGC

1.2.4.1. VERT BRGC LIMITS SEISMIC MOVEMENT PERP TO THE SERVICE PIPE IN THE VERT DIRECTION.

1.2.4.2. VERT BRGC SHALL BE PLACED NO MORE THAN 6” FROM EA TRANS & LONG SEISMIC BRACE. SEE FIGURES 1.2.1 THRU 1.2.4.

1.2.4.3. WHEN A TRANS & LONG SEISMIC BRACE OCCUR AT THE SAME LOCATION, A VERT SEISMIC BRACE SHALL BE PLACED BETWEEN THE TRANS & LONG SEISMIC BRACES.

1.2.5. VERT OFFSETS/RISERS

1.2.5.1. A FOUR-WAY BRACE SHALL BE PROVIDED WITHIN 24” OF THE TOP OF A VERT OFFSET OR RISER EXCEEDING 3 FT. SEE FIGURE 1.2.4.

1.2.5.2. FOUR-WAY BRGC MAX SPCG FOR PIPE CONSTRUCTED OF DUCTILE MATERIALS (E.G. STL) SHALL BE 25 FT. SEE FIGURE 1.2.4.

1.2.6. WHEN CALCULATING HORIZ & VERT SEISMIC LOAD REQUIREMENTS, USE TABLE 1.2.1 TO CALCULATE THE WT OF WATER-FILLED PIPE.

1.2.7. FOR SWAY BRACE PIPE AXIAL CAPACITY & ALLOWABLE PIPE LENGTH, USE TABLE 1.2.2 & TABLE 1.2.3

1.2.8. SERVICE PIPES THAT CROSS A BLDG SEPARATION OR SEISMIC JOINT MUST BE DESIGNED TO ACCOMMODATE THE SEISMIC RELATIVE DISPLACEMENT AS PER ASCE 7-10, SECTION 13.3.2 OR AS SPECIFIED BY THE SEOR ON THE OSHPD APPROVED CONSTRUCTION DOCUMENTS.
1.2. BRACE SPACING GUIDELINES PER NFPA 13 - 2013 (CONTINUED)

A PIPE HANGER IS NOT A VERT SEISMIC BRACE. PIPE HANGERS ARE NOT PART OF THIS OPM & ARE NOT SHOWN IN THIS OPM

LEGEND:

TRANS (LATERAL) & LONG SEISMIC BRACES

TRANS (LATERAL) SEISMIC BRACE

FIGURE 1.2.1 - BRCG FOR PIPING W/ A 24" MAX OFFSET

LEGEND:

TRANS (LATERAL) & LONG SEISMIC BRACES

TRANS (LATERAL) SEISMIC BRACE

FIGURE 1.2.2 - BRCG FOR PIPING W/ MAX LONG & TRANS SPCG
1.2. BRACE SPACING GUIDELINES PER NFPA 13 – 2013 (CONTINUED)

A PIPE HANGER IS NOT A VERT SEISMIC BRACE. PIPE HANGERS ARE NOT PART OF THIS OPM & ARE NOT SHOWN IN THIS OPM

LEGEND:
- TRANS (LATERAL) & LONG SEISMIC BRACES
- TRANS (LATERAL) SEISMIC BRACE

FIGURE 1.2.3 – MIN REQ BRCG FOR PIPING W/ A 5’-0” MIN OFFSET

1 AT LEAST ONE LONG BRACE REQ; BRACE SHALL BE PLACED AT EITHER POSITION 1 OR POSITION 2 UP TO 12’-0” LONG SERVICE PIPE RUN; BOTH LOCATION (1&2) PLUS OWN INDIVIDUAL LATERAL BRCG IF GREATER THAN 12’-0”
1.2. **BRACE SPACING GUIDELINES PER NFPA 13 – 2013 (CONTINUED)**

A PIPE HANGER IS **NOT** A VERT SEISMIC BRACE. PIPE HANGERS ARE NOT PART OF THIS OPM & ARE NOT SHOWN IN THIS OPM.

FOUR-WAY SEISMIC BRACES, SEE SECTION 7.
FOUR-WAY SEISMIC BRACG SHALL NOT BE REQ WHERE RISERS PENETRATE INTERMEDIATE FLRS IN MULTI-STORY BLDGS WHERE THE CLEARANCE DOES NOT EXCEED THE LIMITS OF NFPA 13 SECTION 9.3.4.

**LEGEND:**

- **TRANS (LATERAL) & LONG SEISMIC BRACES**
- **TRANS (LATERAL) SEISMIC BRACE**  A VERT SEISMIC BRACE – MUST BE WITHIN 6” OF EA TRANS & EA LONG BRACE
- **MAX TRANS SPCC**

**FIGURE 1.2.4 — BRCC FOR PIPING W/ A VERT RISER**
### Table 1.2.1 - Weight of Water-Filled Service Pipe

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<th>WT of Sched 40 Water-Filled Pipe 1 (LBS/FT)</th>
<th>WT of Sched 10 Water-Filled Pipe 1 (LBS/FT)</th>
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<td>23.03</td>
<td>21.92</td>
</tr>
<tr>
<td>8</td>
<td>47.70</td>
<td>40.08</td>
<td>N/A</td>
</tr>
</tbody>
</table>

1. Piping WTS per NFPA 13, Table A.9.3.5.9 for determining vert. & horiz loads.
2. Sched 30.
3. Wall Thk is 0.188”. See Section 1.7.5.
4. Piping WTS per Table 8.5.3.

### Table 1.2.2 - Brace Pipe Dims & Properties

<table>
<thead>
<tr>
<th>Brace Pipe (NPS) 1</th>
<th>Pipe Sched</th>
<th>Nominal Outside Dia (IN)</th>
<th>Nominal Wall Thk (IN)</th>
<th>Design Wall Thk (IN)</th>
<th>Cross Sectional Area (A) (IN²)</th>
<th>D/t</th>
<th>Radius of Gyration (r) (IN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40</td>
<td>1.315</td>
<td>0.133</td>
<td>0.124</td>
<td>0.463</td>
<td>10.6</td>
<td>0.423</td>
</tr>
<tr>
<td>1/4</td>
<td>40</td>
<td>1.660</td>
<td>0.140</td>
<td>0.130</td>
<td>0.626</td>
<td>12.8</td>
<td>0.543</td>
</tr>
</tbody>
</table>

### Table 1.2.3 - Brace Pipe Member Length & Axial Capacity - Combined Flexure & Axial Load

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3'-6&quot;</td>
<td>100</td>
<td>0.524</td>
<td>3015</td>
<td>3377</td>
</tr>
<tr>
<td>1</td>
<td>7'-0&quot;</td>
<td>200</td>
<td>0.524</td>
<td>1406</td>
<td>1448</td>
</tr>
<tr>
<td>1</td>
<td>10'-6&quot;</td>
<td>300</td>
<td>0.524</td>
<td>706</td>
<td>716</td>
</tr>
<tr>
<td>1/4</td>
<td>4'-6&quot;</td>
<td>100</td>
<td>0.690</td>
<td>4009</td>
<td>4491</td>
</tr>
<tr>
<td>1/4</td>
<td>9'-0&quot;</td>
<td>200</td>
<td>0.690</td>
<td>1875</td>
<td>1933</td>
</tr>
<tr>
<td>1/4</td>
<td>13'-6&quot;</td>
<td>300</td>
<td>0.690</td>
<td>943</td>
<td>958</td>
</tr>
</tbody>
</table>

1. Axial capacity calculated w/ dims from Table 1.2.2. & per AISC Steel Construction Manual, 14th Edition, Part 2. Loads controlled by critical column load. K=1; modulus of elasticity taken as 29,000,000 psi; ASTM A53 Gr A, Fy=30 ksi; e=0.2/D - nom ASTM A53 Gr B, Fy=35 ksi. Axial capacity shown is ASD. Multiply value by 1.5 to convert to load in LRFD.
1.3. RESPONSIBILITIES OF THE CALIFORNIA REGISTERED DESIGN PROFESSIONAL (CRDP)

1.3.1. ANVIL INTERNATIONAL’S DESIGN GUIDELINES FOR SEISMIC BRCG OF INTERIOR FIRE SPRINKLER SYSTEMS ARE IN COMPLIANCE W/ THE FOLLOWING:
   1.3.1.1. 2013 CBC, TITLE 24, PART 2, VOLUME 2
   1.3.1.2. ASCE 7–10 INCLUDING SUPPLEMENTS #1 & #2
   1.3.1.3. NFPA 13, 2013 EDITION
   1.3.1.4. ANSI/AWC NDS–2012
   1.3.1.5. ACI 318–11

1.3.2. IT IS THE RESPONSIBILITY OF THE CRDP DESIGNING THE BRCG SYSTEM, TO VERIFY THAT THE SYSTEM DESIGN IS IN CONFORMANCE W/ THE 2013 CBC INCLUDING SECTION 1616A. MODIFICATIONS TO ASCE 7 SECTION 13 & THE APPLICATIONS & DETAILS SHOWN WITHIN THIS PRE-APPROVAL.

1.3.3. THE CRDP MUST SHOW THE OSHPD APPROVED PRE-APPROVAL NUMBER (OPM–0351–13) & THE SUPPORT & BRCG OF ALL INTERIOR SERVICE PIPES ON THE LAYOUT DRAWINGS & PREPARE THEM FOR SUBMITAL TO THE DISCIPLINE IN RESPONSIBLE CHARGE OF THE PROJECT FOR REVIEW & APPROVAL. THE CRDP MUST STAMP & SIGN THE LAYOUT DRAWINGS.

1.3.4. THE CRDP MUST REVIEW SECTION 1.1 TO VERIFY THAT THE SIZES & TYPES OF COMPONENTS & THE SUBSTRATES ON HIS/HER PROJECT ARE INCLUDED IN THIS PRE-APPROVAL PRIOR TO LISTING THE OPM ON THE LAYOUT DRAWINGS AS AN OPTION FOR THE BRCG OF THE DISTRIBUTION SYSTEM. IF THE PROJECT INCLUDES ANY COMPONENTS OR CONNECTIONS TO SUBSTRATES THAT ARE NOT INCLUDED IN THIS PRE-APPROVAL, THEN THEY MUST BE ENGINEERED & DETAILED ON THE LAYOUT DRAWINGS THAT ARE BEING SUBMITTED.

1.3.5. THE CRDP MUST REVIEW SECTION 1.2 TO BE FAMILIAR W/ ALL REQUIREMENTS FOR SEISMIC SWAY BRCG.

1.3.6. PER SECTION 1.2.4. THE CRDP SHALL ARRANGE & DESIGN THE TRANS, LONG & VERT SEISMIC BRACES SO THAT THERE IS A VERT SEISMIC BRACE NO MORE THAN 6" FROM EA TRANS & EA LONG BRACE MEMBER. PLEASE NOTE THAT A GRAVITY SERVICE PIPE HANGER IS NOT A VERT SEISMIC BRACE.
1.3. RESPONSIBILITIES OF THE CALIFORNIA REGISTERED DESIGN PROFESSIONAL (CRDP)

1.3.7. THE CRDP SHALL CHECK THE VERT SEISMIC BRACE ASSEMBLY FOR BOTH TENSION & COMPRESSION LOADS & DETERMINE WHETHER THE VERT SEISMIC BRACE ASSEMBLY OF THE BRCG SYSTEM IS ADEQUATE. THE TENSION LOADS ON THE VERT SEISMIC BRACE ASSEMBLY MUST INCLUDE THE MAX TRIBUTARY DEAD LOAD, THE VERT COMPONENTS OF THE TRANS &/OR LONG BRACES, & THE TRIBUTARY VERT SEISMIC LOAD. COMPRESSION LOADS ON THE VERT SEISMIC BRACE ASSEMBLY MUST INCLUDE THE VERT COMPONENTS OF THE TRANS &/OR LONG BRACES, & THE TRIBUTARY VERT SEISMIC LOAD, BUT MUST NOT BE OFFSET BY TRIBUTARY DEAD LOADS UNLESS IT CAN BE VERIFIED THAT THE DEAD LOADS WILL, IN FACT, BE APPLIED TO THE VERT SEISMIC BRACE ASSEMBLY IN QUESTION.

1.3.8. THE CRDP SHALL ARRANGE THE ANCHORS TO ENSURE THAT THEY CAN BE INSTALLED IN ACCORDANCE W/ THIS PRE-APPROVAL & THAT THERE ARE NO SLAB EDGES, OPENINGS, OR OTHER ANCHORS NEAR THE ANCHORS TO REDUCE THEIR CAPACITIES. THE CAPACITIES INDICATED IN THIS PRE-APPROVAL ARE BASED ON A MIN DISTANCE TO EDGE OF CONC, AS SHOWN IN TABLE 2.1.1 & APPLICABLE LRFD LOAD COMBINATIONS PER ASCE 7 SECTION 12.4 IN THE ANALYSIS. THE ANCHOR CAPACITIES ARE FOR USE IN THE INTERACTION EQUATION PER ACI 318-11 SECTION D.7.
1.4. USING ANVIL INTERNATIONAL’S PRE-APPROVAL GUIDE

IT IS THE RESPONSIBILITY OF THE USER OF THIS MANUAL TO BE FAMILIAR WITH ALL REQUIREMENTS FOR SEISMIC SWAY BRCG INTENDED FOR USE WITH FIRE SPRINKLER PIPING SYSTEMS & SHALL BE PROFICIENT IN DETERMINING & APPLYING PIPE LOADS FOR THEIR APPLICATION.

PER NFPA 13, THE USER SHALL DETERMINE THE SPCG & LAYOUT FOR THE REQ BRCG. THE USER SHALL DETERMINE THE MAX HORIZ, VERT, & AXIAL FORCE COMPONENT OF THE EARTHQUAKE DEMAND LOADS ACCORDING TO NFPA 13 – SECTION 9.3. USER’S CALCULATION MUST TAKE INTO CONSIDERATION THE INCREASES IN LOADS CAUSED BY CONSTRUCTION TOLERANCES. CONSTRUCTION TOLERANCES FOR ANGLES OF ALL SEISMIC BRACES FROM VERT OR HORIZ SHALL BE LIMITED TO ±5.0 DEGREES. CONSTRUCTION TOLERANCES FOR VERT SEISMIC BRACES FROM VERT SHALL BE LIMITED TO ±5.0 DEGREES.

BASED ON THE USER’S DETERMINED MAX HORIZ, VERT, & AXIAL FORCES, THE USER MUST SELECT THE APPROPRIATE SEISMIC BRACE CLAMP(S) FROM SECTION 5. THE SEISMIC BRACE CLAMP’S DESIGN LOAD CAPACITY, FOR THE GIVEN PIPE SIZE, MUST BE GREATER THAN THE MAX USER CALCULATED FORCES.

AFTER SELECTING A SEISMIC BRACE CLAMP FROM SECTION 5, THE USER IS TO SELECT THE APPROPRIATE BRACE PIPE AS PER TABLES 1.2.2 & 1.2.3, & THE APPROPRIATE ATTACHMENT TO SUPPORTING STRUCTURE FROM SECTIONS 2, 3, OR 4. THE ATTACHMENT’S DESIGN LOAD CAPACITY, FOR THE GIVEN PIPE SIZE, MUST BE GREATER THAN THE MAX USER CALCULATED FORCES.

SEE SECTION 8 FOR AN EXAMPLE OF A TYP SWAY BRACE DESIGN PROCEDURE.

1.4.1. THIS PRE-APPROVAL MAY BE USED FOR THE DESIGN OF SEISMIC SWAY BRCG OF INTERIOR FIRE SPRINKLER SYSTEMS. A CSLF HAS DESIGNED THIS PRE-APPROVAL, ALONG W/SUPPORTING CALCULATIONS. THEREFORE, THE PRE-APPROVED DETAILS & CALCULATIONS ARE NOT TO BE RE-REVIEWED BY OSHPD REGIONAL STAFF. HOWEVER, EA FIRE SPRINKLER SYSTEM REQUIRES SUBmittALS THAT MUST BE REVIEWED & APPROVED BY OSHPD.

1.4.2. AS W/ ALL PRE-APPROVED DETAILS, SYSTEMS, ETC., PLANS ARE STILL REQ SHOWING HOW & WHERE THIS PRE-APPROVED ANCHORAGE & BRCG SYSTEM WILL BE APPLIED TO THE FIRE SPRINKLER SYSTEM ON A PROJECT SPECIFIC BASIS. THIS PROCESS IS NEEDED TO VERIFY THAT THE APPROPRIATE DETAIL HAS BEEN SELECTED & APPLIED FOR EA CONDITION & FOR THE ACTUAL SUBSTRATE THAT IT WILL BE CONNECTED/ATTACHED TO. FOR THE FIRE SPRINKLER SYSTEM, THESE LAYOUT PLANS MUST BE PREPARED BY A CRDP. SEE CALIFORNIA ADMINISTRATIVE CODE (CAC) 2013, TITLE 24, PART 1, SECTION 7–115.
1.4. USING ANVIL INTERNATIONAL’S PRE-APPROVAL GUIDE (CONTINUED)

1.4.3. THE PRE-APPROVED DETAILS CONTAINED WITHIN THIS PRE-APPROVAL HAVE RELATED TABLES & CHARTS WHICH MUST BE USED TO SELECT THE APPROPRIATE DETAIL FOR EA LOCATION THAT AN ANCHOR OR BRACE IS TO BE INSTALLED. THE APPLICATION OF THESE CRITERIA SHOULD NEVER BECOME THE RESPONSIBILITY OF THE “INSPECTOR OF RECORD” (IOR), WHOSE RESPONSIBILITY IS TO INSPECT ONLY, NOT DESIGN.

1.4.4. THE OSHPD REGIONAL STAFF, ON A PROJECT SPECIFIC BASIS, MUST REVIEW SUPPORTS, ATTACHMENTS & BRCG DETAILS & SUPPORTING CALCULATIONS THAT ARE NOT PART OF THIS PRE-APPROVAL. REVIEW OF SUPPORTS, ATTACHMENTS & BRCG DETAILS OF THIS NATURE DO NOT CONSTITUTE A PRE-APPROVAL THAT MAY BE USED ON OTHER PROJECTS WITHOUT THE BENEFIT OF PLAN REVIEW.

1.4.5. LAYOUT DRAWINGS:

1.4.5.1. LAYOUT DRAWINGS OF THE SUPPORT ATTACHMENTS, & BRCG 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 W/ ALL CODE REQUIREMENTS. THE LAYOUT DRAWINGS SHALL BE IN ACCORDANCE W/ ASCE 7-10 SECTION 13.6 (INCLUDING SUPPLEMENTS 1 & 2) AS MODIFIED BY CBC 2013 SECTION 1616A.

1.4.5.1.1. THE SEOR SHALL VERIFY THAT THE SUPPORTING STRUCTURE IS ADEQUATE FOR THE LOADS IMPOSED ON IT BY THE SUPPORTS & BRACES INSTALLED PER THE PRE-APPROVAL IN ADDITION TO ALL OTHER DESIGN LOADS.

1.4.5.1.2. THE SEOR MUST REVIEW & FORWARD THE SUPPORTS, ATTACHMENTS & BRCG PLANS (INCLUDING APPROVED CHANGE ORDERS FOR THE SUPPLEMENTARY FRAMING WHERE REQ) FOR PLAN CHECK W/ A NOTATION INDICATING THAT THE PLANS HAVE BEEN REVIEWED & ARE IN GENERAL CONFORMANCE W/ THIS PRE-APPROVAL, THE DESIGN OF THE PROJECT (CAC 2013, SECTION 7-153), & NFPA 13, 2013 EDITION.

1.4.5.1.3. A “SHOP DRAWING STAMP” MAY BE USED TO INDICATE COMPLIANCE W/ THE REQUIREMENT IN 1.4.5.1.2.

1.4.5.1.4. THE CALIFORNIA REGISTERED DESIGN PROFESSIONAL (CRDP OTHER THAN THE SEOR) MAY PROVIDE THE SHOP DRAWING STAMP FOR SMALL INSTALLATIONS AT THE DISCRETION OF THE OSHPD DISTRICT STRUCTURAL ENGINEER.
1.4. USING ANVIL INTERNATIONAL’S PRE-APPROVAL GUIDE (CONTINUED)

1.4.5.2. THE SEOR SHALL DESIGN ANY SUPPLEMENTARY FRAMING THAT IS NEEDED TO RESIST THE LOADS, MAINTAIN STABILITY &/OR IS REQ FOR INSTALLATION OF THIS PRE-APPROVAL. THE SUPPLEMENTARY FRAMING SHALL BE SUBMITTED TO OSHPD AS AN AMENDED CONSTRUCTION DOCUMENT (ACD).

1.4.5.3. THE LAYOUT DRAWINGS (W/ THE SHOP DRAWING STAMP) SHALL BE SUBMITTED TO OSHPD FOR REVIEW OF THE FOLLOWING:
   a. STRUCTURE SUPPORTING THE DISTRIBUTION SYSTEM HAS ADEQUATE CAPACITY.
   b. SEISMIC DESIGN FORCES (Fp) & (Fpv) ARE IN ACCORDANCE W/ CBC 2013 & Wp SHALL COMPLY W/ NFPA 13 PROVISIONS.
   c. VERIFY THAT THE SUBMITTAL IS WITHIN THE SCOPE OF OPM.
      • SIZE & DISTRIBUTION SYSTEM COMPONENTS
      • SPCG & BRCG OF FLEX JOINTS CLEARLY IDENTIFIED WHERE THEY OCCUR, &
      • SUBSTRATE FOR ATTACHMENT

1.0.5.1. THE LAYOUT DRAWINGS (W/ THE SHOP DRAWING STAMP) SHALL BE KEPT ON THE JOBSITE & MAY BE USED AS REFERENCE FOR INSTALLATION FOR THE SUPPORTS & BRCG CONTAINED WITHIN THIS PRE-APPROVAL. OSHPD FIELD STAFF WILL REVIEW THE INSTALLATION.

1.0.5.2. A COPY OF THIS PRE-APPROVAL SHALL BE ON THE JOBSITE PRIOR TO STARTING THE INSTALLATION OF HANGERS &/OR BRACES. THE IOR & THE CONTRACTOR SHALL EA OBTAIN A COPY OF THIS PRE-APPROVAL FROM THE OSHPD PRE-APPROVAL PROGRAMS WEBSITE.

1.0.5.3. COMPONENTS OF TWO OR MORE PRE-APPROVED BRCG SYSTEMS SHALL NOT BE MIXED. ONLY THIS PRE-APPROVAL MAY BE USED FOR THE FIRE SPRINKLER SYSTEM. ANY SUBSTITUTION OF COMPONENT OF THIS PRE-APPROVAL SHALL REQUIRE OSHPD REVIEW & APPROVAL.
1.5. **SEISMIC DESIGN CRITERIA**

The seismic demand calculation in this report uses the method from NFPA 13 Annex E.3 "Computing the Seismic Demand on Piping Systems". The seismic forces are determined to conform to the method in ASCE 7-10. This section shows the design criteria, how the LRFD seismic force is calculated using the methods in ASCE 7-10, & how the calculated LRFD force is converted to the ASD force used in NFPA 13.

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>DESCRIPTION</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>$q_p$</td>
<td>Component amplification factor, taken as 2.5 for piping systems</td>
<td>2.5</td>
</tr>
<tr>
<td>$I_p$</td>
<td>Component importance factor, taken as 1.5 for fire sprinkler systems (emergency systems - piping not in conformance w/ ASME B31)</td>
<td>1.5</td>
</tr>
<tr>
<td>$R_p$</td>
<td>Component response modification factor, taken as follows:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• High-deformability piping w/ joints made by welding or brazing</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>• High or limited-deformability piping w/ joints made by threading, bonding, compression couplings, or grooved couplings.</td>
<td>4.5</td>
</tr>
<tr>
<td>$S_{ds}$</td>
<td>Short period spectral acceleration is taken as not greater than 2.5 for the state of California. CRDP shall determine site specific $S_{ds}$</td>
<td>2.5</td>
</tr>
<tr>
<td>$\Omega_0$</td>
<td>Overstrength factor for anchorage to conc.</td>
<td>2.5</td>
</tr>
<tr>
<td>$z$</td>
<td>HT of the component attachment w/ respect to the base</td>
<td>USER DEFINED</td>
</tr>
<tr>
<td>$h$</td>
<td>Average roof HT of the structure w/ respect to the base</td>
<td>USER DEFINED</td>
</tr>
<tr>
<td>$W_p$</td>
<td>Component operating wt.</td>
<td>USER DEFINED</td>
</tr>
<tr>
<td>$F_p$</td>
<td>LRFD horiz seismic design force</td>
<td>OUTPUT</td>
</tr>
<tr>
<td>$F_{pw}$</td>
<td>NFPA-13 ASD horiz seismic design force ($F_{pw} = 0.7F_p$)</td>
<td>OUTPUT</td>
</tr>
</tbody>
</table>

1. Per NFPA 13 section 9.3.5.9.2, the wt of system being braced ($W_p$) shall be taken as 1.15 times the wt of the water-filled piping. The factor is intended to approximate the addnl wt of all the valves, fittings, & other devices attached to the system.

**Sheet Title:** General Information  
**SEISMIC DESIGN CRITERIA**

**CYS STRUCTURAL ENGINEERS, INC.**  
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SACRAMENTO, CA 95833  
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www.cyseng.com

**Job No:** 14090  
**Date:** 09-22-2016  
**Page:** 16 of 60  
**09/26/2016**  
**OPM-0351-13: Reviewed for Code Compliance by Jeffrey Kikumoto**
1.5. **SEISMIC DESIGN CRITERIA (CONTINUED)**

1.5.1. HORIZ SEISMIC DESIGN FORCE \( F_p \) PER ASCE 7–10, SECTION 13.3.1

\[ F_p = 0.4 \, q_p \, S_{DS} \, I_p \, W_p \, (1+2Z_f'/R_p) \]

**Fp SHALL NOT BE TAKEN AS LESS THAN:**

\[ F_p \, (\text{min}) = 0.3 \, S_{DS} \, I_p \, W_p \]

**AND Fp IS NOT REQ TO BE TAKEN AS GREATER THAN:**

\[ F_p \, (\text{max}) = 1.6 \, S_{DS} \, I_p \, W_p \]

**NOTE:** VERT SEISMIC LOAD EFFECT IS APPLIED AS A DEAD LOAD FACTOR ADJUSTMENT & IS ACCOUNTED FOR IN THE ASD & LRFD LOAD COMBINATIONS BLW.

1.5.2. DETERMINE FORCES

ASSUMING THE USE OF GROOVED COUPLINGS, \( R_p = 4.5 \) AND \( q_p = 2.5 \)

ASSUMING MAX HT OF COMPONENT, \( z/h < 1 \)

ASSUMING MAX \( S_{DS} \) FOR THE STATE OF CALIFORNIA, \( S_{DS} = 2.50 \)

\[ F_p = 0.4(2.5)(2.50)(1.5)W_p(3)/4.5 \quad F_p = 2.50W_p \text{ GOVERNS DESIGN} \]

\[ F_p(\text{min}) = 0.3(2.50)(1.5)W_p \quad F_p(\text{min}) = 1.125W_p \]

\[ F_p(\text{max}) = 1.6(2.50)(1.5)W_p \quad F_p(\text{max}) = 6.00W_p \]

1.5.3. ASD LOAD COMBINATIONS FOR SUPPORTS & ATTACHMENTS EXCEPT CONC ANCHORS

1.5.3.1. \( (1.0 + 0.14 \, S_{DS}) \, W_p \pm 0.7 \, F_p \)

1.5.3.2. \( (0.6 - 0.14 \, S_{DS}) \, W_p \pm 0.7 \, F_p \)

1.5.4. LRFD LOAD COMBINATIONS FOR CONC ANCHORS

1.5.4.1. \( (1.2 + 0.2 \, S_{DS}) \, W_p \pm \sigma_0 \, F_p \)

1.5.4.2. \( (0.9 - 0.2 \, S_{DS}) \, W_p \pm \sigma_0 \, F_p \)

1.5.5. CONVERTING FROM LRFD TO ASD

TO CONVERT TO THE NFPA 13 ASD HORIZ SEISMIC DESIGN FORCE \( (F_{pw}) \), THE ASCE 7 LRFD HORIZ SEISMIC DESIGN FORCE \( (F_p) \) IS MULTIPLIED BY A LOAD FACTOR OF 0.7. ASSUMING THE USE OF VARIABLES FROM SECTION 1.5.2 ABV, IT FOLLOWS:

\[ F_{pw} = 0.7F_p = (0.7)(2.50W_p) \quad F_{pw} = 1.75W_p \]
1.6. **ALLOWABLE CAPACITIES OF SEISMIC BRACE COMPONENTS**


FM CERTIFICATES OF COMPLIANCE HAVE BEEN FILED W/ OSHPD. SEE TABLE 1.6.1

<table>
<thead>
<tr>
<th>APPROVAL IDENTIFICATION NUMBERS</th>
<th>APPROVAL GRANTED</th>
<th>ANVIL FIGURE NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3039348</td>
<td>MAY 17, 2011</td>
<td>770, 772, 776</td>
</tr>
<tr>
<td>3041475</td>
<td>MAY 16, 2011</td>
<td>771, 775</td>
</tr>
<tr>
<td>3047205</td>
<td>JANUARY 2, 2013</td>
<td>778</td>
</tr>
</tbody>
</table>

**TABLE 1.6.1 - FM CERTIFICATES OF COMPLIANCE**

ALLOWABLE CAPACITY OF BRACE SUB-ASSEMBLIES HAVE BEEN DETERMINED BY RESOLVING THE LOAD RATING (I.E. THE LOAD RESULTING IN FAILURE OR EXCEEDING OF DEFORMATION LIMITS) TO THE HORIZ DIRECTION & DIVIDING BY 1.5 TO ALLOW VALUES TO BE USED DIRECTLY FOR ASD. FOR LRFD CAPACITIES, THE VALUES WILL NEED TO BE MULTIPLIED BY 1.5.

1.7. **CERTIFICATES OF COMPLIANCE**

1.7.1. ALLOWABLE HORIZ CAPACITY FOR THINNER WALLED SERVICE PIPES MAY BE USED FOR THICKER WALLED PIPES. HOWEVER, ALLOWABLE HORIZ CAPACITY FOR THICKER WALLED SERVICE PIPES SHALL NOT BE USED FOR THINNER WALLED PIPES.

1.7.2. LOAD RATING FOR LW PIPE REFERS TO FM APPROVED LW PIPE, COMMONLY REFERRED TO AS SCHED 7. THESE RATING MAY ALSO BE APPLIED TO EN10220 & GB/T 8163 PIPE.

1.7.3. LOAD RATING FOR SCHED 10 MAY BE APPLIED TO GB/T 3091, GB/T 3092, EN 10255 M & H, JIS G3452, FM APPROVED THIN WALL & SCHED 40 PIPE.

1.7.4. COMPONENTS 770, 771, 775, & 776 FM APPROVED WHEN USED W/ 1" OR 1¼" SCHED 40, GB/T 3091, EN 10255 H, & JIS G3454 BRACE PIPE.

1.7.5. FM APPROVALS DO NOT APPROVE SEISMIC BRCG PRODUCTS FOR USE W/ 8" NPS SERVICE PIPE W/ A WALL THK LESS THAN 0.188". ASME B36.10M–2004 DEFINES SCHED 10 MIN WALL THK FOR 8" NPS SERVICE PIPES AS 0.134". THEREFORE, CERTIFICATES OF COMPLIANCE SPECIFY THE PIPE AS "0.188" RATHER THAN "SCHED 10". IT IS TYP IN THE UNITED STATES THAT 8" NPS PIPE THAT IS MARKETED AS "SCHED 10" HAS A WALL THK OF 0.188", WHICH IS GREATER THAN THE MIN WALL THK SPECIFIED BY ASME B36.10M–2004.
2. ANCHORAGE TO CONCRETE STRUCTURE:

2.1. EXPANSION ANCHORS

2.1.1. EXPANSION ANCHORS INSTALLED IN NWC, OR TO THE UNDERSIDE (SOFFIT) OF CONC FILLED (NWC OR SLWC) PROFILE MTL DECK ASSEMBLIES, SHALL BE EITHER:

HILTI KWIK BOLT TZ CARBON STEEL (KB-TZ) EXPANSION ANCHORS
PER ICC ESR-1917, REISSUED MAY 2015

ITW REDHEAD CARBON STEEL TRUBOLT+ WEDGE ANCHORS
PER ICC ESR-2427, REISSUED NOVEMBER 2015

POWERS POWER-STUD+ SD1 CARBON STEEL EXPANSION ANCHORS
PER ICC ESR-2818, REISSUED DECEMBER 2015.

INSTALLATION SHALL COMPLY W/ CBC SECTION 1616A.1.19. OTHER TYPES & BRANDS OF EXPANSION ANCHORS MAY BE USED PROVIDED THEIR CAPABILITIES & STRENGTHS ARE EQ OR BETTER THAN THE ABV SPECIFIED ANCHORS, & ALL HAVE CURRENT ICC REPORTS W/ CRACKED CONC COMPLIANCE IN ACCORDANCE W/ AC193 ACCEPTANCE CRITERIA FOR MECHANICAL ANCHORS IN CONC ELEMENTS. AN OSHPD CHANGE ORDER IS REQ FOR ANY SUBSTITUTION OF A SPECIFIED MECHANICAL ANCHOR.

!!!Figure 2.1.1 - Anchor Installation Info!!!
2.1. **Expansion Anchors (continued)**

<table>
<thead>
<tr>
<th>Installation Info</th>
<th>Symbol</th>
<th>1/4&quot; Nominal Anchor Dia (Inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective Min Embedment</td>
<td>hef</td>
<td>2</td>
</tr>
<tr>
<td>Nominal Embedment</td>
<td>h nom</td>
<td>2 1/2</td>
</tr>
<tr>
<td>Min Hole Depth</td>
<td>ho</td>
<td>2 1/4</td>
</tr>
<tr>
<td>Min Conc Thk</td>
<td>t min</td>
<td>4</td>
</tr>
<tr>
<td>Min Edge Distance</td>
<td>E min</td>
<td>6</td>
</tr>
</tbody>
</table>

**Table 2.1.1.A** — Hilti Kwik Bolt TZ Installation Info

Per IBC-ES Report ESR-1917 Table 1 & Table 3

1 Edge Distance Used in Design to Obtain Allowable Shear & Tension Values.

<table>
<thead>
<tr>
<th>Installation Info</th>
<th>Symbol</th>
<th>1/4&quot; Nominal Anchor Dia (Inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective Min Embedment</td>
<td>hef</td>
<td>2</td>
</tr>
<tr>
<td>Nominal Embedment</td>
<td>h nom</td>
<td>2 1/2</td>
</tr>
<tr>
<td>Min Hole Depth</td>
<td>ho</td>
<td>2 1/4</td>
</tr>
<tr>
<td>Min Conc Thk</td>
<td>t min</td>
<td>4</td>
</tr>
<tr>
<td>Min Edge Distance</td>
<td>E min</td>
<td>6</td>
</tr>
</tbody>
</table>

**Table 2.1.1.B** — ITW Redhead Trubolt+ Installation Info

Per IBC-ES Report ESR-2427 Table 2

1 Edge Distance Used in Design to Obtain Allowable Shear & Tension Values.

<table>
<thead>
<tr>
<th>Installation Info</th>
<th>Symbol</th>
<th>1/4&quot; Nominal Anchor Dia (Inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective Min Embedment</td>
<td>hef</td>
<td>2</td>
</tr>
<tr>
<td>Nominal Embedment</td>
<td>h nom</td>
<td>2 1/2</td>
</tr>
<tr>
<td>Min Hole Depth</td>
<td>ho</td>
<td>2 1/4</td>
</tr>
<tr>
<td>Min Conc Thk</td>
<td>t min</td>
<td>4</td>
</tr>
<tr>
<td>Min Edge Distance</td>
<td>E min</td>
<td>6</td>
</tr>
</tbody>
</table>

**Table 2.1.1.C** — Powers Power-Stud+ SD1 Installation Info

Per IBC-ES Report ESR-2818 Table 1

1 Edge Distance Used in Design to Obtain Allowable Shear & Tension Values.
2.1. EXPANSION ANCHORS (CONTINUED)

2.1.2. EXPANSION ANCHOR TESTING

2.1.2.1. ALL TESTS SHALL BE CONDUCTED BY A TESTING LABORATORY CONTRACTED BY
THE FACILITY IN THE PRESENCE OF THE SPECIAL INSPECTOR & THE IOR.
A REPORT OF THE TEST RESULTS SHALL BE SUBMITTED TO THE ENFORCEMENT
AGENCY.

2.1.2.2. TESTING MAY BE DONE PRIOR TO SEISMIC BRACE INSTALLATION.

2.1.2.3. REFER TO THE 2013 CBC, SECTION 1913A.7 "TESTS FOR POST-INSTALLED
ANCHORS IN CONCRETE" FOR DETERMINATION OF TEST LOAD & ACCEPTANCE
CRITERIA. TEST LOADS ARE GIVEN IN TABLES 2.1.2.A & 2.1.2.B & ACCEPTANCE
CRITERIA IS GIVEN IN SECTION 2.1.2.7 BLW.

2.1.2.4. EXPANSION ANCHORS SHALL HAVE 50 PERCENT OF THE INSTALLED ANCHORS
PROOF TESTED. IF ANY ANCHOR FAILS TESTING, TEST 20 CONSECUTIVE ANCHORS,
ALL INSTALLED BY THE SAME TRADE, UNTIL 20 CONSECUTIVE ANCHORS PASS.
ONLY AFTER 20 CONSECUTIVE ANCHORS PASS SHALL THE 50 PERCENT TESTING
RESUME.

2.1.2.5. TESTING SHALL OCCUR A MIN. OF 24 HOURS AFTER ANCHOR INSTALLATION.

2.1.2.6. TEST EQUIPMENT SHALL BE CALIBRATED BY AN APPROVED TESTING & CALIBRATION
FACILITY.

2.1.2.7. THERE ARE TWO ACCEPTABLE TEST METHODS, HYDRAULIC RAM & TORQUE WRENCH
METHOD.
- HYDRAULIC RAM METHOD:
  DIRECT PULL W/ A HYDRAULIC JACK OR CALIBRATED SPRING LOADING DEVICE.
  APPLY & HOLD TEST LOAD FOR A MIN. OF 15 SECONDS. THE ANCHOR SHALL
  HAVE NO OBSERVABLE MOVEMENT AT THE APPLICABLE TEST LOAD WHERE
  WASHERS ARE USED. A PRACTICAL WAY TO DETERMINE OBSERVABLE
  MOVEMENT IS THAT THE WASHER UNDER THE NUT BECOMES LOOSE.
- TORQUE WRENCH METHOD:
  MFR’S TORQUE CRITERIA TESTING MUST BE REACHED WITHIN ½ TURN OF THE
  NUT.
2.1. **Expansion Anchors (Continued)**

<table>
<thead>
<tr>
<th>Conc Strength f'c (Psi)</th>
<th>Effective Min Embedment (hfe) - 2&quot;</th>
<th>Effective Min Embedment (hfe) - 3 1/2&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tension Test Load (LBS)&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Torque (FT-LBS)</td>
</tr>
<tr>
<td>Hilti ITW Powers</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>3000</td>
<td>1597</td>
<td>2453</td>
</tr>
<tr>
<td>4000</td>
<td>3281</td>
<td>1672</td>
</tr>
</tbody>
</table>

**Table 2.1.2.A** – Testing Criteria for 1/2" Dia Anchors in Soffit of MTL Deck W/ NWC or SLWC, See Figure 2.1.2 Blw

<sup>1</sup> Apply Proof Tension Test Load to Anchor WithoutRemoving the Nut If Possible.

<table>
<thead>
<tr>
<th>Conc Strength f'c (Psi)</th>
<th>Effective Min Embedment (hfe) - 2&quot;</th>
<th>Effective Min Embedment (hfe) - 3 1/2&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tension Test Load (LBS)&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Torque (FT-LBS)</td>
</tr>
<tr>
<td>Hilti ITW Powers</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>3000</td>
<td>1597</td>
<td>2453</td>
</tr>
<tr>
<td>4000</td>
<td>3281</td>
<td>1672</td>
</tr>
</tbody>
</table>

**Table 2.1.2.B** – Testing Criteria for 1/2" Dia Anchors in NWC

<sup>1</sup> Apply Proof Tension Test Load to Anchor WithoutRemoving the Nut If Possible.

---

**Figure 2.1.2** – Anchor in Soffit of MTL Deck

---

**Sheet Title:** Anchorage to Concrete Structure Expansion Anchors

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**Job No:** 14090
**Date:** 09-22-2016
**Page:** 22 of 60
2.2. SUPPORTS & ATTACHMENTS

2.2.1. ELEVATED SLAB & VERT FACE OF WALLS & BMS.

2.2.1.1. BRACE ANGLE (θ) PER NFPA FIGURE 9.3.5.12.1.

2.2.1.2. SEE TABLE 2.2.1 FOR ADDNL ANCHOR INSTALLATION INFO.

2.2.1.3. SEE SECTION 4.1 FOR ADDNL INFO ON ANVIL FIGURE 771 INSTALLATION.

2.2.1.4. INTERACTION OF TENSILE & SHEAR FORCES SHALL BE VERIFIED BY THE CRDP PER THE ICC REPORTS & ACI 318-11 APPENDIX D. SEOR SHALL VERIFY THE SUITABILITY OF THE STRUCTURE FOR DETERMINED LOADS.

2.2.1.5. STRENGTH DESIGN CAPACITIES IN SHEAR & TENSION ARE PROVIDED FOR ANCHORS INSTALLED IN CONC OF MIN COMPRESSIVE STRENGTH AS LISTED IN TABLE 2.2.1 AT THE TIME OF INSTALLATION. THE CAPACITIES WERE DETERMINED FOR ANCHORS IN CRACKED CONC PER THE ICC REPORTS OF THE MFR’S LISTED IN SECTION 2.1.1 & ARE PRESENTED ONLY AS AN AID TO THE CRDP. THE CRDP MAY COMPUTE CONC ANCHOR CAPACITIES PER ICC REPORTS & ACI 318-11 APPENDIX D FOR ANY CONDITION NOT COVERED.

2.2.1.6. WHEN INSTALLING ANCHORS, AVOID DAMAGING REINIF OR PRE-STRESSING STL.

ELEVATED SLAB

FIGURE 2.2.1a – ANCHORING DETAILS FOR 3000 PSI & 4000 PSI NWC
2.2. **SUPPORTS & ATTACHMENTS (CONTINUED)**

**Figure 2.2.1b** - ANCHORING DETAILS FOR 3000 PSI & 4000 PSI NWC

<table>
<thead>
<tr>
<th>CONC STRENGTH ( f'c ) (PSI)</th>
<th>ANCHOR DIA (INCH)</th>
<th>EFFECTIVE EMBED (INCH)</th>
<th>MIN CONC EDGE DISTANCE (INCH)</th>
<th>MIN SPCG THK (INCH)</th>
<th>MIN CONC THK (INCH)</th>
<th>TENSION CAPACITY ( \sigma_n ) (LBS)</th>
<th>SHEAR CAPACITY ( \sigma_v ) (LBS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3000</td>
<td>( \frac{3}{4} )</td>
<td>2</td>
<td>6</td>
<td>18</td>
<td>4</td>
<td>1280</td>
<td>1840</td>
</tr>
<tr>
<td>3000</td>
<td>( \frac{3}{4} )</td>
<td>3</td>
<td>6</td>
<td>18</td>
<td>6</td>
<td>2620 (^1)</td>
<td>2480</td>
</tr>
<tr>
<td>4000</td>
<td>( \frac{3}{4} )</td>
<td>2</td>
<td>6</td>
<td>18</td>
<td>4</td>
<td>1480</td>
<td>2120</td>
</tr>
<tr>
<td>4000</td>
<td>( \frac{3}{4} )</td>
<td>3</td>
<td>6</td>
<td>18</td>
<td>6</td>
<td>3030 (^2)</td>
<td>2860 (^3)</td>
</tr>
</tbody>
</table>

**Table 2.2.1** - ANCHORING TO 3000 PSI & 4000 PSI NWC (USE W/ LRFD)

1. TENSION CAPACITY FOR POWERS IS 1330 LBS.
2. TENSION CAPACITY FOR POWERS IS 1540 LBS.
3. SHEAR CAPACITY FOR POWERS IS 2570 LBS.
2.2. SUPPORTS & ATTACHMENTS (CONTINUED)

2.2.2. CONC FILL OVER MTL DECK

2.2.2.1. BRACE ANGLE (θ) PER NFPA FIGURE 9.3.5.12.1.

2.2.2.2. SEE TABLE 2.2.2 FOR ADDNL ANCHOR INSTALLATION INFO.

2.2.2.3. SEE SECTION 4.1 FOR ADDNL INFO ON ANVIL FIGURE 771 INSTALLATION.

2.2.2.4. INTERACTION OF TENSILE & SHEAR FORCES SHALL BE VERIFIED BY THE CRDP PER THE ICC REPORTS & ACI 318-11 APPENDIX D. SEOR SHALL VERIFY THE SUITABILITY OF THE STRUCTURE FOR DETERMINED LOADS.

2.2.2.5. STRENGTH DESIGN CAPACITIES IN SHEAR & TENSION ARE PROVIDED FOR ANCHORS INSTALLED IN CONC OF MIN COMPRESSIVE STRENGTH AS LISTED IN TABLE 2.2.2 AT THE TIME OF INSTALLATION. FOR ADDNL COMMENTS REGARDING CAPACITIES PROVIDED, SEE SECTION 2.2.1.5.

2.2.1.6. WHEN INSTALLING ANCHORS, AVOID DAMAGING REINF OR PRE-STRESSING STL.

![Diagram of anchoring details for 3000 PSI NWC or SLWC deck]

**Figure 2.2.2 - Anchoring Details for 3000 PSI NWC or SLWC Deck**

<table>
<thead>
<tr>
<th>ANCHOR DIA (INCH)</th>
<th>EFFECTIVE EMBED (INCH)</th>
<th>MIN EDGE DISTANCE (INCH)</th>
<th>MIN SPCC S min</th>
<th>TENSION CAPACITY @Nn (LBS)</th>
<th>SHEAR CAPACITY @Vn (LBS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>½</td>
<td>2</td>
<td>6</td>
<td>6²/₃</td>
<td>710</td>
<td>1430</td>
</tr>
<tr>
<td>1</td>
<td>3½</td>
<td>6</td>
<td>9²/₃</td>
<td>1270</td>
<td>2450</td>
</tr>
</tbody>
</table>

**Table 2.2.2 - Anchoring to 3000 PSI NWC or SLWC Deck (USE w/ LRFD)**

VALUES ENVELOPE ALL THREE MFR’S EXPANSION ANCHORS

1 PARALLEL TO FLUTES
3. **ANCHORAGES TO WOOD STRUCTURE:**

3.1. **SUPPORTS & ATTACHMENTS**

3.1.1. **MIN WOOD MEMBER THK = 1.5”**

3.1.2. **ANVIL FIGURE 771 SWAY BRACE SWIVEL ATTACHMENT SHALL BE MOUNTED TO THE MOUNTING BOLT. SEE SECTION 4.1 FOR ANVIL FIGURE 771 INSTALLATION INSTRUCTIONS. BRACE ANGLE (θ) PER NFPA 13, FIGURE 9.3.5.12.1.**

![Diagram of Anvil Figure 771 Sway Brace Swivel Attachment]

- **3.5” Min END DISTANCE**
- **END OF MEMBER**
- **2” Min**
- **NEUTRAL AXIS**
- **1” OR 1¾” SCHED 40 BRACE PIPE**
- **WOOD MEMBER**
- **BRACE PIPE**
- **BRACE ANGLE (θ)**
- **NOTE:** BOLTS MUST BE INSTALLED ABV NEUTRAL AXIS OF BM.

![Diagram of Anvil Figure 771 Sway Brace Swivel Attachment continued]

- **PARALLEL TO WOOD STRUCTURE**
- **NEUTRAL AXIS**
- **2” Min**
- **1” OR 1¾” SCHED 40 BRACE PIPE**
- **WOOD MEMBER**
- **ANVIL FIGURE 771**
- **BRACE ANGLE (θ)**
- **NOTE:** THRU-BOLT SHALL BE TIGHTENED AT TIME OF INSTALLATION & RE-TIGHTENED BEFORE COMPLETION OF JOB.

![Diagram of Anvil Figure 771 Sway Brace Swivel Attachment continued]

- **PERP TO WOOD STRUCTURE**
- **½” THRU-BOLT W/ STD NUT & ⅜”x1⅜” STL PLATE WASHER W/ ⅛” Ø HOLE, TYP**
- **ANVIL FIGURE 771**
- **1” OR 1¾” SCHED 40 BRACE PIPE**
- **WOOD MEMBER**
- **BRACE ANGLE (θ)**

**FIGURE 3.1.1 – ANCHORING TO WOOD FOR PERP & PARALLEL LOADS**

---

**SHEET TITLE: ANCHORAGES TO WOOD STRUCTURE**

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**Job No:** 14090

**Date:** 09-22-2016

**Page:** 26 of 60
3.2. MAX ALLOWABLE LOADS

3.2.1 FOR THE MAX ALLOWABLE HORIZ & VERT LOADS FOR TRANS, LONG, & VERT SEISMIC BRACES USING THE ½” DIA MOUNTING BOLT, SEE TABLE 3.2.1.

<table>
<thead>
<tr>
<th>BOLT DIA (INCH)</th>
<th>SEISMIC APPLICATIONS</th>
<th>BRACE ANGLE $^3$ (°) (DEG)</th>
<th>MAX LOAD $^1, 2, 5$ (LBS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>½</td>
<td>LONG &amp; TRANS</td>
<td>30 – 44</td>
<td>501</td>
</tr>
<tr>
<td></td>
<td></td>
<td>45 – 59</td>
<td>562</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60 – 90</td>
<td>643</td>
</tr>
<tr>
<td></td>
<td>VERT $^4$</td>
<td>0</td>
<td>436</td>
</tr>
</tbody>
</table>

**TABLE 3.2.1** – ANCHORING TO WOOD MAX ALLOWABLE LOADS FOR BRACES PARALLEL TO WOOD STRUCTURE

$^1$ VALUES PER NDS 2012.

$^2$ VALUES BASED ON MIN SPECIFIC GRAVITY, $G=0.50$ FOR DOUGLAS FIR–LARCH WOOD SPECIES.

$^3$ BRACE PIPE INSTALLATION ANGLES ARE DETERMINED FROM VERT.

$^4$ MAX ALLOWABLE VERT SEISMIC LOAD IS AN AXIAL LOAD.

$^5$ MAX ALLOWABLE LOADS DO NOT INCLUDE PRYING ACTION. SEOR TO CALCULATE ALLOWABLE LOADS FOR BRACES PARALLEL TO WOOD STRUCTURE INCLUDING PRYING ACTION.

3.2.2 SEOR TO CALCULATE ALLOWABLE LOADS FOR BRACES PERPENDICULAR TO WOOD STRUCTURE INCLUDING PRYING ACTION.

3.3 FASTENER SPECIFICATION

MOUNTING BOLT ½” ASTM A307, GR A (60,000 KSI MIN TENSILE STRENGTH)

WASHER ½” ASTM F844

NUT ½” ASTM A563, GR A
4. **ANCHORAGES TO STEEL STRUCTURE**

4.1. **FIGURE 771 – SWAY BRACE SWIVEL ATTACHMENT**

4.1.1. **PRODUCT OVERVIEW**

4.1.1.1. ANVIL’S FIGURE 771 IS A SEISMIC SWIVEL CONNECTOR DESIGNED TO CONNECT BRACE PIPE TO A STRUC MEMBER OR SEISMIC SUPPORT. STRUC MEMBERS & SEISMIC SUPPORTS INCLUDE CONC, WOOD, ANVIL’S FIGURE 772, & ANVIL’S FIGURE 778. SEE SECTION 2.2, SECTION 3.1, SECTION 4.2, & SECTION 4.3 RESPECTIVELY FOR THE RELATED STRUC MEMBER & SEISMIC ATTACHMENT INSTALLATION INSTRUCTIONS.

4.1.1.2. ANVIL’S FIGURE 771 MAY BE INSTALLED IN LONG, TRANS, & VERT SEISMIC BRACE ORIENTATIONS.

4.1.1.3. REFER TO SECTION 6.2 FOR THE MATERIAL SPECS FOR THE FIGURE 771.

![Diagram of Brace Pipe Swivel Attachment]

**BRACE PIPE SOCKET**  
**BRACE PIPE FITTING**  
**½" HEX NUT**  
**M12 SHEAR BOLT**  
**½" HEX HEAD BOLT**  
**MOUNTING HOLE FOR ½" HEX HEAD CAP SCREW, EXPANSION ANCHOR, CARRIAGE BOLT, OR THRU-BOLT**

**FIGURE 4.1.1 – FIGURE 771**

4.1.2. **INSTALLATION INSTRUCTIONS**

4.1.2.1. INSERT BRACE PIPE INTO BRACE SOCKET UNTIL BRACE PIPE BOTTOMS OUT.

4.1.2.2. TORQUE SHEAR BOLT UNTIL BOLT HEAD SHEARS OFF. SEE FIGURE 4.1.3.

4.1.2.3. INSERT ½" HEX HEAD CAP SCREW, EXPANSION ANCHOR, CARRIAGE BOLT, OR THRU-BOLT THRU THE MOUNTING HOLE. SEE FIGURE 4.1.1 FOR MOUNTING HOLE LOCATION.

4.1.2.4. FOR TIGHTENING OR TORQUEING OF THE HEX HEAD CAP SCREW, EXPANSION ANCHOR, CARRIAGE BOLT, OR THRU-BOLT, SEE SECTIONS 2.1.2, 3.1, 4.2.2, OR 4.3.2 RESPECTIVELY.
4.1. **FIGURE 771 — SWAY BRACE SWIVEL ATTACHMENT (CONTINUED)**

4.1.2.5 ENSURE BRACE PIPE IS SET TO THE DESIRED BRACE INSTALLATION ANGLE FROM VERT. SEE EXAMPLES IN FIGURE 4.1.2 & FIGURE 4.1.4 FOR INSTALLATION BRACE ANGLE (θ) PER NFPA 13, SECTION 9.

NOTE: THIS MAY ALSO BE A PARALLEL MEMBER

ANGLE A, B, C, OR V

ANGLE G, H, I, OR W

(Rotation is around bolt. Angle for component & brace pipe is not changing)

ANGLE D, E, F, OR W

(Opposite or mirror image of angle A, B, C or V)

**FIGURE 770 — FIGURE 771, FIGURE 775, & FIGURE 776**

**PERP TO STRUC MEMBER**

**PARALLEL TO STRUC MEMBER**

**FIGURE 4.1.2 — FIGURE 770, FIGURE 775, & FIGURE 776**

NOTE:

Installation brace angle is always measured from vert.

THUS ANGELS "A" THROUGH "I" AND "V" & "W" ARE THE SAME AS THE BRACE ANGLE (θ) USED IN THIS OPM.
4.1. **FIGURE 771 – SWAY BRACE SWIVEL ATTACHMENT (CONTINUED)**

![Diagram of a sway brace swivel attachment]

**NOTES:**
1. PRYING ACTION MUST BE CONSIDERED. SEE FIGURE 2.2.1.a FOR DIMS.
2. FOR BRACE ANGLE, SEE FIGURE 4.1.2.

**TABLE 4.1.1 – FIGURE 771 – MAX ALLOWABLE HORIZ & VERT SEISMIC LOADS (ASD)**

<table>
<thead>
<tr>
<th>BRACE PIPE (NPS)</th>
<th>SEISMIC APPLICATIONS</th>
<th>INSTALLATION ORIENTATIONS</th>
<th>BRACE ANGLE (°)</th>
<th>MAX LOAD (LBS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 &amp; 1/4</td>
<td>LONG &amp; TRANS</td>
<td>A, D, G</td>
<td>30 – 44</td>
<td>1800</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B, E, H</td>
<td>45 – 59</td>
<td>2540 4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C, F, I</td>
<td>60 – 90</td>
<td>3110 4</td>
</tr>
<tr>
<td>VSB 3</td>
<td></td>
<td>V, W</td>
<td>0</td>
<td>1800</td>
</tr>
</tbody>
</table>

1. LOADS DETERMINED FROM FM APPROVAL. SEE SECTION 1.6 FOR ASD/LRFD DESIGN FACTORS.
2. BRACE PIPE INSTALLATION ANGLES ARE DETERMINED FROM VERT, SEE FIGURE 4.1.2.
3. MAX ALLOWABLE VSB LOAD IS AN AXIAL LOAD.
4. 1800 FOR INSTALLATION ORIENTATIONS H & I.

**TABLE 4.1.4 – FIGURE 771 CONNECTED TO FIGURE 778 BM CLAMP**

4.1.2.6. FIGURE 778 MAY BE REPLACE W/ FIGURE 772 WHERE WF BM & LOADS ALLOW.

**4.1.3. MAX ALLOWABLE LOADS**

4.1.3.1. FOR THE MAX ALLOWABLE HORIZ & VERT LOADS FOR TRANS, LONG, & VERT SEISMIC BRACES USING THE FIGURE 771 – SWAY BRACE SWIVEL SUPPORT, SEE TABLE 4.1.1.
4.2. **FIGURE 772 – ADJUSTABLE STEEL BEAM ATTACHMENT**

4.2.1. PRODUCT OVERVIEW

4.2.1.1. ANVIL’S FIGURE 772 IS A SEISMIC SUPPORT DESIGNED TO RIGIDLY ATTACH TO A WF BEAM & TO ANVIL’S FIGURE 771 (NOT SHOWN HERE IN FIGURE 4.2.1 FOR CLARITY).

4.2.1.2. ANVIL’S FIGURE 772 MAY BE INSTALLED IN LONG, TRANS, & VERT SEISMIC BRACE ORIENTATIONS.

4.2.1.3. REFER TO SECTION 6.3 FOR THE MATERIAL SPECS FOR THE FIGURE 772.

---

**FIGURE 4.2.1 – FIGURE 772 MOUNTING DETAILS**

- **(E) WF BM PER TABLE 4.2.1**
- **M12 SHEAR BOLT, TYP OF 2**
- **2x1½ CHANNEL**
- **FLAT WASHER, TYP OF 2**
- **FOR CARRIAGE BOLT ASSEMBLY, SEE FIGURE 4.2.3**
- **L**

---

**FIGURE 4.2.2 – SECTION VIEW OF FIGURE 772**

- **½" HEX HEAD C-CLAMP BOLT, TYP OF 2**
- **FLAT WASHER, TYP OF 2**
- **FOR CARRIAGE BOLT ASSEMBLY, SEE FIGURE 4.2.3**
- **L**

---

**SHEET TITLE: ANCHORAGES TO STEEL STRUCTURE**

**FIGURE 772 - ADJUSTABLE STEEL BEAM ATTACHMENT**
4.2. **FIGURE 772 – ADJUSTABLE STEEL BEAM ATTACHMENT (CONTINUED)**

![Diagram of channel web with bolts and nuts](image)

**FIGURE 4.2.3 – DETAIL OF CARRIAGE BOLT ASSEMBLY**

4.2.2. **INSTALLATION INSTRUCTIONS**

4.2.2.1. See Table 4.2.1 & Table 4.2.2 to determine recommended Figure 772 size based on (E) WF BM Dims. Min flange THK is 3/8".

4.2.2.2. C-clamp bolts shall be adjusted along the 1/2" dia slot in the channel web until the C-clamps fully engage the vert edges of the (E) WF BM bott flange.

4.2.2.3. Torque EA M12 shear bolt until head shears off to properly anchor the BM C-clamp to the WF BM.

4.2.2.4. Torque EA BM C-clamp bolt to 55 ft-lbs to secure channel to the (E) WF BM.

4.2.2.5. Assemble carriage bolt & corresponding flat washer & insert thru the mounting hole in the channel. See Figure 4.2.3 for sectioned view.

4.2.2.6. Figure 771 sway brace swivel attachment shall be mounted to Figure 772 carriage bolt. See Section 4.1 for Figure 771 swivel connector installation instructions. Installation brace angle (θ) from vert for Figure 771 is per NFPA 13, Section 9.
### 4.2. FIGURE 772 - ADJUSTABLE STEEL BEAM ATTACHMENT (CONTINUED)

<table>
<thead>
<tr>
<th>TYPE</th>
<th>( \frac{3}{8}'' - \frac{3}{4}'' ) FLANGE THK</th>
<th>( \frac{3}{4}'' - \frac{1}{2}'' ) FLANGE THK</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHANNEL LENGTH (L) (IN)</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>BM WIDTH RANGE (IN)</td>
<td>4 - 7</td>
<td>7 - 10</td>
</tr>
<tr>
<td>BM SIZE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W4x13</td>
<td>W8x35</td>
<td>W10x49</td>
</tr>
<tr>
<td>W5x16</td>
<td>W8x40</td>
<td>W10x54</td>
</tr>
<tr>
<td>W6x16</td>
<td>W8x48</td>
<td>W10x60</td>
</tr>
<tr>
<td>W6x20</td>
<td>W10x39</td>
<td>W10x68</td>
</tr>
<tr>
<td>W8x21</td>
<td>W10x45</td>
<td>W12x58</td>
</tr>
<tr>
<td>W8x24</td>
<td>W10x49</td>
<td>W12x65</td>
</tr>
<tr>
<td>W10x22</td>
<td>W12x40</td>
<td>W14x61</td>
</tr>
<tr>
<td>W10x30</td>
<td>W12x45</td>
<td>W14x68</td>
</tr>
<tr>
<td>W12x26</td>
<td>W12x50</td>
<td>W16x67</td>
</tr>
<tr>
<td>W12x35</td>
<td>W12x53</td>
<td>W16x77</td>
</tr>
<tr>
<td>W14x30</td>
<td>W12x58</td>
<td>W18x76</td>
</tr>
<tr>
<td>W14x38</td>
<td>W14x43</td>
<td>W18x86</td>
</tr>
<tr>
<td>W16x26</td>
<td>W14x48</td>
<td>W24x84</td>
</tr>
<tr>
<td>W16x40</td>
<td>W14x53</td>
<td>W27x84</td>
</tr>
<tr>
<td>W18x40</td>
<td>W14x61</td>
<td>W27x102</td>
</tr>
<tr>
<td>W18x46</td>
<td>W14x68</td>
<td>-</td>
</tr>
<tr>
<td>W21x50</td>
<td>W16x45</td>
<td>-</td>
</tr>
<tr>
<td>W21x57</td>
<td>W16x50</td>
<td>-</td>
</tr>
<tr>
<td>W27x84</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

| TABLE 4.2.1 - FIGURE 772 SIZE CHART |
### 4.2. **FIGURE 772 – ADJUSTABLE STEEL BEAM ATTACHMENT (CONTINUED)**

#### 4.2.3. MAX ALLOWABLE LOADS

**4.2.3.1. FOR THE MAX ALLOWABLE HORIZ & VERT LOADS FOR TRANS, LONG, & VERT SEISMIC BRACES USING THE FIGURE 771 & FIGURE 772 SUPPORTS PERP & PARALLEL TO WF BM FLANGES, SEE TABLE 4.2.2.**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SEISMIC APPLICATIONS</th>
<th>BRACE ANGLE 2 (φ) (DEG)</th>
<th>FLANGE THK (IN)</th>
<th>FLANGE WIDTH (IN)</th>
<th>FIGURE 772 LENGTH (L) (IN)</th>
<th>MAX LOAD PERP TO BM (x)(LBS)</th>
<th>MAX LOAD PARALLEL TO BM (z)(LBS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>LONG &amp; TRANS</td>
<td>30 - 44</td>
<td>3/8 - 3/4</td>
<td>4 - 7</td>
<td>540</td>
<td>470</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>45 - 59</td>
<td>3/8 - 3/4</td>
<td>4 - 7</td>
<td>710</td>
<td>480</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>60 - 90</td>
<td>3/8 - 3/4</td>
<td>4 - 7</td>
<td>880</td>
<td>580</td>
<td></td>
</tr>
<tr>
<td>VSB</td>
<td></td>
<td>0</td>
<td>3/8 - 3/4</td>
<td>4 - 7</td>
<td>4 - 7</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7 - 10</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9 - 12</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12 - 15</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>LONG &amp; TRANS</td>
<td>30 - 44</td>
<td>3/4 - 1/4</td>
<td>7 - 10</td>
<td>470</td>
<td>330</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>45 - 59</td>
<td>3/4 - 1/4</td>
<td>7 - 10</td>
<td>740</td>
<td>640</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>60 - 90</td>
<td>3/4 - 1/4</td>
<td>7 - 10</td>
<td>910</td>
<td>790</td>
<td></td>
</tr>
<tr>
<td>VSB</td>
<td></td>
<td>0</td>
<td>3/4 - 1/4</td>
<td>7 - 10</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9 - 12</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12 - 15</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TABLE 4.2.2 – FIGURE 772 – MAX ALLOWABLE HORIZ & VERT SEISMIC LOADS (ASD)**

1. LOADS DETERMINED FROM FM APPROVAL. SEE SECTION 1.6 FOR ASD/LRFD DESIGN FACTORS.
2. BRACE PIPE INSTALLATION ANGLES ARE DETERMINED FROM VERT.
3. FOR WF BM SIZE CORRESPONDING TO TYPE A OR B, SEE TABLE 4.2.1.
4. MAX ALLOWABLE VSB LOAD IS AN AXIAL LOAD.
4.3. **FIGURE 778 – BAR JOIST BEAM ATTACHMENT**

4.3.1. **PRODUCT OVERVIEW**

4.3.1.1. ANVIL’S FIGURE 778 IS A SEISMIC SUPPORT DESIGNED TO RIGIDLY ATTACH TO A WF BM OR BAR JOIST & TO ANVIL’S FIGURE 771.

4.3.1.2. ANVIL’S FIGURE 778 MAY BE INSTALLED IN LONG, TRANS, & VERT SEISMIC BRACE ORIENTATIONS.

4.3.1.3. REFER TO SECTION 6.6 FOR THE MATERIAL SPECS FOR THE FIGURE 778.

![Diagram of Bar Joist Beam Attachment]

**FIGURE 4.3.1**  **FIGURE 778**

4.3.2. **INSTALLATION INSTRUCTIONS**

4.3.2.1. PLACE THE BAR ATTACHMENT ON THE (E) WF BM OR BAR JOIST. THE FLANGE OF THE WF BM OR THE TOP CHORD OF THE BAR JOIST MUST FULLY ENGAGE W/ THE THROAT OF THE FIGURE 778 BAR JOIST ATTACHMENT. SEE FIGURES 4.3.2 OR 4.3.4.

4.3.2.2. TORQUE SHEAR BOLTS EQUALLY & ALTERNATELY UNTIL BOTH BOLT HEADS SHEAR OFF. SEE FIGURES 4.3.3 OR 4.3.5; (2) TYP PER CLAMP.

4.3.2.3. FIGURE 771 SWAY BRACE SWIVEL SHALL BE MOUNTED TO FIGURE 778 W/ A HEX HEAD CAP SCREW. SEE SECTION 4.1 FOR FIGURE 771 INSTALLATION INSTRUCTIONS. INSTALLATION BRACE ANGLE (θ) PER NFPA 13, SECTION 9.

4.3.2.4. SEE TABLE 4.3.1 FOR COMPATIBLE BM & BAR JOIST FLANGE THICKNESSES. FLANGE THK IS ⅛" MIN, ⅜" MAX.

4.3.2.5. AT BAR JOIST, ATTACHMENT TO STL MEMBER SHALL BE WITHIN 6" ON CHORD PANEL POINT.
4.3. FIGURE 778 - BAR JOIST BEAM ATTACHMENT (CONTINUED)

BAR ATTACHMENT

FIGURE 771 SWAY BRACE SWIVEL

1" OR 1½" SCHED 40 BRACE PIPE

M12 SHEAR BOLT

½" HEX HEAD CAP SCREW

NOTE: PRYING ACTION MUST BE CONSIDERED. SEE FIGURE 2.2.1.a FOR DIMS.

FIGURE 4.3.2 - FIGURE 778 & FIGURE 771 HORIZ ORIENTATION, SIDE VIEW

BAR ATTACHMENT

M12 SHEAR BOLT

1" OR 1½" SCHED 40 BRACE PIPE

FIGURE 771 SWAY BRACE SWIVEL

M12 SHEAR BOLT

FIGURE 4.3.3 - FIGURE 778 & FIGURE 771 HORIZ ORIENTATION, FRONT VIEW

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4.3. **FIGURE 778 - BAR JOIST BEAM ATTACHMENT (CONTINUED)**

![Diagram of bar joist beam attachment]

**NOTE:**
PRYING ACTION MUST BE CONSIDERED.
SEE FIGURE 2.2.1.a FOR DIMS.

**FIGURE 4.3.4 - FIGURE 778 & FIGURE 771 VERT ORIENTATION, SIDE VIEW**

**FIGURE 4.3.5 - FIGURE 778 & FIGURE 771 VERT ORIENTATION, FRONT VIEW**
4.3. **FIGURE 778 – BAR JOIST BEAM ATTACHMENT (CONTINUED)**

4.3.3. MAX ALLOWABLE LOADS

4.3.3.1. FOR THE MAX ALLOWABLE HORIZ & VERT LOADS FOR LONG, TRANS, & VERT SEISMIC BRACES USING THE FIGURE 771 & 778 SUPPORTS PERP & PARALLEL TO BAR JOIST OR WF BM FLANGES, SEE TABLE 4.3.1.

<table>
<thead>
<tr>
<th>STL STRUCTURE</th>
<th>SEISMIC APPLICATION</th>
<th>BRACE ANGLE (θ) (DEG)</th>
<th>FLANGE THK (IN)</th>
<th>MAX LOAD 1 (x) (LBS)</th>
<th>MAX LOAD 1 (z) (LBS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAR JOIST</td>
<td>LONG &amp; TRANS</td>
<td>30 – 44</td>
<td>⅜ – ¾</td>
<td>1570</td>
<td>1280</td>
</tr>
<tr>
<td></td>
<td></td>
<td>45 – 59</td>
<td></td>
<td>1490</td>
<td>1840</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60 – 90</td>
<td></td>
<td>1040</td>
<td>2210</td>
</tr>
<tr>
<td></td>
<td>VSB 3</td>
<td>0</td>
<td></td>
<td></td>
<td>1280</td>
</tr>
<tr>
<td>WF BM</td>
<td>LONG &amp; TRANS</td>
<td>30 – 44</td>
<td>⅞ – ¾</td>
<td>1030</td>
<td>870</td>
</tr>
<tr>
<td></td>
<td></td>
<td>45 – 59</td>
<td></td>
<td>2260</td>
<td>1440</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60 – 90</td>
<td></td>
<td>2490</td>
<td>1230</td>
</tr>
<tr>
<td></td>
<td>VSB 3</td>
<td>0</td>
<td></td>
<td></td>
<td>870</td>
</tr>
</tbody>
</table>

**TABLE 4.3.1 – ANVIL FIGURE 778 MAX ALLOWABLE HORIZ & VERT SEISMIC LOADS (ASD)**

1. LOADS DETERMINED FROM FM APPROVAL; SEE SECTION 1.6 FOR ASD/LRFD DESIGN FACTORS.
2. BRACE PIPE INSTALLATION ANGLES ARE DETERMINED FROM VERT.
3. MAX ALLOWABLE VSB LOAD IS AN AXIAL LOAD.

**BY:** Jeffrey Y. Kikumoto

**DATE:** 09/26/2016

---

**SHEET TITLE:** ANCHORAGE TO STEEL STRUCTURE

**FIGURE 778 - BAR JOIST BEAM ATTACHMENT**

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5. SEISMIC PIPE CLAMPS

5.1. FIGURE 770 – Q BRACE CLAMP

5.1.1. PRODUCT OVERVIEW

5.1.1.1. ANVIL’S FIGURE 770 – Q BRACE CLAMP IS DESIGNED TO RIGIDLY CONNECT THE BRACE PIPE TO THE SERVICE PIPE.

5.1.1.2. ANVIL’S FIGURE 770 MAY BE INSTALLED IN TRANS & VERT SEISMIC BRACE ORIENTATIONS.

5.1.1.3. REFER TO SECTION 6.1 FOR THE MATERIAL SPECS FOR THE FIGURE 770.

5.1.2. INSTALLATION INSTRUCTIONS

5.1.2.1. PLACE THE $\frac{3}{8}$" THRD ROD HOOP OVER THE SERVICE PIPE & SLIDE THE BRACE PIPE THRU THE OPEN ENDS OF THE $\frac{3}{8}$" THRD ROD HOOP. THE BRACE PIPE END MUST EXTEND AT LEAST 2" PAST THE CLAMP BAR. SEE FIGURE 5.1.2.

5.1.2.2. ENSURE BRACE PIPE IS SET TO THE DESIRED INSTALLATION BRACE ANGLE. SEE FIGURE 5.1.2. INSTALLATION BRACE ANGLE ($\theta$) FROM VERT IS PER NFPA 13, SECTION 9.

5.1.2.3. TORQUE HEX NUTS EQUALLY & ALTERNATELY TO THE TORQUE LISTED IN TABLE 5.1.1. ENSURE INDICATOR QUIP IS COMPLETELY FLATTENED & THE BRACE PIPE IS TIGHT AGAINST THE SERVICE PIPE.

\[ \frac{3}{8}" \text{ THRD ROD HOOP} \]

\[ \text{SERVICE PIPE} \]

\[ 1" \text{ OR } \frac{1}{2}" \text{ SCHED 40 BRACE PIPE} \]

\[ \text{CLAMP BAR} \]

\[ \text{SPRING CLAMP} \]

\[ \text{HEX NUT} \]

**FIGURE 5.1.1 – Q BRACE CLAMP SIDE VIEW**
5.1. **FIGURE 770 - Q BRACE CLAMP (CONTINUED)**

**NOTES:**
1. VERT SEISMIC BRACE ORIENTATION SIM.
2. A VERT SEISMIC BRACE MUST BE INSTALLED WITHIN 6" OF EA TRANS SEISMIC BRACE.
3. A PIPE HANGER IS NOT A VERT SEISMIC BRACE. PIPE HANGERS ARE NOT PART OF THIS OPM.

**TABLE 5.1.1 - FIGURE 770 - Q BRACE CLAMP REQ INSTALLATION TORQUE**

<table>
<thead>
<tr>
<th>FIGURE 770 - Q BRACE CLAMP SIZE</th>
<th>INSTALLATION TORQUE (FT/LBS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot; - 3&quot;</td>
<td>14</td>
</tr>
<tr>
<td>4&quot; - 5&quot;</td>
<td>17</td>
</tr>
<tr>
<td>6&quot;</td>
<td>20</td>
</tr>
</tbody>
</table>

**FIGURE 5.1.2 - TRANS & VERT SEISMIC BRACE ORIENTATION**

DATE: 09/26/2016

**FIGURE 770 - Q BRACE CLAMP SIZE**

- BRACE ANGLE
- THRD ROD HOOP
- CLAMP BAR
- SERVICE PIPE
- AXIAL LOAD
- SPRING CLAMP
- HEX NUT, TYP OF 2
### FIGURE 770 - Q BRACE CLAMP (CONTINUED)

#### 5.1.3. MAX ALLOWABLE HORIZ & VERT SEISMIC LOADS

<table>
<thead>
<tr>
<th>SERVICE PIPE (NPS)</th>
<th>BRACE PIPE (NPS)</th>
<th>SEISMIC APPLICATIONS</th>
<th>BRACE ANGLE (θ) (Deg)</th>
<th>MAX LOAD 1 SCHED 10 &amp; UP (LBS)</th>
<th>MAX LOAD 2 LW (LBS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1, 1¼</td>
<td>TRANS</td>
<td>30 – 44</td>
<td>1110</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>45 – 59</td>
<td>1570</td>
<td>360</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>60 – 90</td>
<td>1930</td>
<td>440</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VSB 4</td>
<td>0</td>
<td>1110</td>
<td>250</td>
</tr>
<tr>
<td>1¼, 1½, 2, 2½, 3</td>
<td>1, 1¼</td>
<td>TRANS</td>
<td>30 – 44</td>
<td>570</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>45 – 59</td>
<td>810</td>
<td>360</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>60 – 90</td>
<td>1000</td>
<td>440</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VSB 4</td>
<td>0</td>
<td>570</td>
<td>250</td>
</tr>
<tr>
<td>4, 5</td>
<td>1, ½</td>
<td>TRANS</td>
<td>30 – 44</td>
<td>760</td>
<td>410</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>45 – 59</td>
<td>1070</td>
<td>590</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>60 – 90</td>
<td>1320</td>
<td>720</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VSB 4</td>
<td>0</td>
<td>760</td>
<td>410</td>
</tr>
<tr>
<td>6</td>
<td>1, ¼</td>
<td>TRANS</td>
<td>30 – 44</td>
<td>770</td>
<td>450</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>45 – 59</td>
<td>1090</td>
<td>630</td>
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<td></td>
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<td>60 – 90</td>
<td>1340</td>
<td>780</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VSB 4</td>
<td>0</td>
<td>770</td>
<td>450</td>
</tr>
</tbody>
</table>

**TABLE 5.1.2** - FIGURE 770 MAX ALLOWABLE HORIZ & VERT SEISMIC LOADS (ASD)

1 LOADS DETERMINED FROM FM APPROVAL; SEE SECTION 1.6 FOR ASD/LRFD DESIGN FACTORS.

2 SEE SECTION 1.7 FOR APPROVED LW PIPE.

3 BRACE PIPE INSTALLATION ANGLES ARE DETERMINED FROM VERT.

4 MAX ALLOWABLE VSB LOAD IS AN AXIAL LOAD.
5.2. **FIGURE 775 — LATERAL/LONGITUDINAL BRACE CLAMP**

5.2.1. **PRODUCT OVERVIEW**

5.2.1.1. **ANVIL’S FIGURE 775 — LATERAL/LONG BRACE CLAMP IS DESIGNED TO RIGIDLY CONNECT THE BRACE PIPE TO THE SERVICE PIPE.**

5.2.1.2. **ANVIL’S FIGURE 775 — MAY BE INSTALLED IN TRANS, LONG, & VERT SEISMIC BRACE ORIENTATIONS.**

5.2.1.3. **REFER TO SECTION 6.4 FOR THE MATERIAL SPECS FOR THE FIGURE 775.**

5.2.2. **INSTALLATION INSTRUCTIONS**

5.2.2.1. **POSITION PIPE CLAMP AT DESIRED LOCATION ON THE SERVICE PIPE & HAND TIGHTEN THE HEX BOLTS. ENSURE THE SPACER & THE BRACE PIPE CONNECTOR ARE POSITIONED ON THE BOLT BETWEEN THE PIPE CLAMP EARS.**

5.2.2.2. **INSERT BRACE PIPE INTO THE SOCKET OF THE BRACE PIPE CONNECTOR UNTIL BRACE PIPE BOTTOMS OUT, SEE FIGURE 5.2.2.**

5.2.2.3. **TIGHTEN SHEAR BOLT, AT THE BRACE PIPE CONNECTOR, UNTIL THE BOLT HEAD BREAKS OFF.**

5.2.2.4. **ENSURE BRACE PIPE IS SET TO THE DESIRED INSTALLATION BRACE ANGLE. SEE FIGURES 5.2.1 & 5.2.3. INSTALLATION BRACE ANGLE (θ) FROM VERT IS PER NFPA 13, SECTION 9.**

5.2.2.5. **TIGHTEN HEX BOLTS & HEX NUTS EQUALLY & ALTERNATELY UNTIL MTL–TO–MTL CONTACT IS ACHIEVED W/ THE TORQUE VALUES LISTED IN TABLE 5.2.1.**

---

**SHEET TITLE: SEISMIC PIPE CLAMPS**

**FIGURE 775 - LATERAL / LONGITUDINAL BRACE CLAMP**

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5.2. **FIGURE 775 — LATERAL/LONGITUDINAL BRACE CLAMP (CONTINUED)**

**NOTES:**
1. VERT SEISMIC BRACE ORIENTATION SIM.
2. A VERT SEISMIC BRACE MUST BE INSTALLED WITHIN 6” OF EA TRANS SEISMIC BRACE.
3. A PIPE HANGER IS NOT A VERT SEISMIC BRACE. PIPE HANGERS ARE NOT PART OF THIS OPM.

1” OR 1¼” SCHD 40 BRACE PIPE

VERT SEISMIC BRACE BEYOND, SEE NOTES

PIPE CLAMP, TYP OF 2

HEX BOLT.
½” FOR PIPE 2½–5;
¾” FOR PIPE 6–8.
TYP OF 2

SPACER LOCATION

FLAT WASHER, TYP OF 2

HEX NUT.

SERVICE PIPE

½” FOR PIPE 2½–5;
¾” FOR PIPE 6–8, TYP

**FIGURE 5.2.1 — TRANS & VERT SEISMIC BRACE ORIENTATION**

BRACE PIPE

SHEAR BOLT

BRACE PIPE CONNECTOR

**FIGURE 5.2.2 — SHEAR BOLT–BRACE PIPE INTERACTION DETAIL**
5.2. **FIGURE 775 — LATERAL/LONGITUDINAL BRACE CLAMP (CONTINUED)**

![Diagram of a brace clamp system](image)

**NOTES:**
A PIPE HANGER IS NOT A VERT SEISMIC BRACE. PIPE HANGERS ARE NOT PART OF THIS OPM.

**TABLE 5.2.1 — FIGURE 775 BRACE CLAMP REQ INSTALLATION TORQUE**

<table>
<thead>
<tr>
<th>BRACE CLAMP SIZE (IN)</th>
<th>INSTALLATION TORQUE (FT/LBS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2½ - 3</td>
<td>80</td>
</tr>
<tr>
<td>4 - 5</td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>120</td>
</tr>
<tr>
<td>8</td>
<td>140</td>
</tr>
</tbody>
</table>

**TABLE 5.2.3 — LONG & VERT SEISMIC BRACE ORIENTATION**
### 5.2. **FIGURE 775 – LATERAL/LONGITUDINAL BRACE CLAMP (CONTINUED)**

#### 5.2.3. MAX ALLOWABLE HORIZ & VERT SEISMIC LOADS

<table>
<thead>
<tr>
<th>SERVICE PIPE (NPS)</th>
<th>BRACE PIPE (NPS)</th>
<th>SEISMIC APPLICATIONS</th>
<th>BRACE ANGLE (°) DEG</th>
<th>MAX LOAD 1 &amp; UP (LBS)</th>
<th>MAX LOAD 1, 2 LW (LBS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2½</td>
<td>1, 1¼</td>
<td>LONG &amp; TRANS</td>
<td>30 – 44</td>
<td>1370</td>
<td>1570</td>
</tr>
<tr>
<td></td>
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<tr>
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<td>LONG &amp; TRANS</td>
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<td>30 – 44</td>
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<tr>
<td>6</td>
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<td>LONG &amp; TRANS</td>
<td>30 – 44</td>
<td>1520</td>
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<td>45 – 59</td>
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<td>60 – 90</td>
<td>2570</td>
<td>910</td>
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<td>VSB 4</td>
<td>0</td>
<td>1520</td>
<td>1570</td>
</tr>
<tr>
<td>8</td>
<td>1, 1¼</td>
<td>LONG &amp; TRANS</td>
<td>30 – 44</td>
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<td></td>
<td>VSB 4</td>
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<td>–</td>
</tr>
</tbody>
</table>

**TABLE 5.2.2 – FIGURE 775 MAX ALLOWABLE HORIZ & VERT SEISMIC LOADS (ASD)**

1. LOADS DETERMINED FROM FM APPROVAL; SEE SECTION 1.6 FOR ASD/LRFD DESIGN FACTORS.
2. SEE SECTION 1.7 FOR APPROVED LW PIPE.
3. BRACE PIPE INSTALLATION ANGLES ARE DETERMINED FROM VERT.
4. MAX ALLOWABLE VSB LOAD IS AN AXIAL LOAD.

---

**SHEET TITLE:** SEISMIC PIPE CLAMPS

**FIGURE 775 - LATERAL / LONGITUDINAL BRACE CLAMP**

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**09/26/2016**

OPM-0351-13: Reviewed for Code Compliance by Jeffrey Kikumoto
5.3. **FIGURE 776 – BRACE CLAMP**

5.3.1. **PRODUCT OVERVIEW**

5.3.1.1. Anvil’s Figure 776 – Brace Clamp is designed to rigidly connect the brace pipe to the service pipe.

5.3.1.2. Anvil’s Figure 776 may be installed in trans & vert seismic brace orientations.

5.3.1.3. Refer to section 6.5 for the material specs for the figure 776.

5.3.2. **INSTALLATION INSTRUCTIONS**

5.3.2.1. Position pipe clamp hoop section at the desired location on the service pipe by sliding the hoop over the service pipe.

5.3.2.2. Slide brace pipe thru the stirrups & ensure brace pipe is set to the desired installation brace angle. See figure 5.3.1. Installation brace angle from vert is per (g) NFPA 13, Section 9.

5.3.2.3. Brace pipe must extend 2” min past the end of the retainer clip.

5.3.2.4. Tighten hex head set screw until head bottoms out on stirrup surface.

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BY: Jeffrey Y. Kikumoto

DATE: 09/26/2016
5.3. **FIGURE 776 – BRACE CLAMP (CONTINUED)**

**NOTES:**

1. VERT SEISMIC BRACE ORIENTATION SIM.
2. A VERT SEISMIC BRACE MUST BE INSTALLED WITHIN 6" OF EA TRANS SEISMIC BRACE.
3. A PIPE HANGER IS NOT A VERT SEISMIC BRACE. PIPE HANGERS ARE NOT PART OF THIS OPM.

---

**Figure 5.3.1 – Trans & Vert Seismic Brace Orientation**

1" OR 1¼" SCHED 40 BRACE PIPE

½" HEX HEAD SET SCREW.

FOR PROPER INSTALLATION, TIGHTEN UNTIL HEAD BOTTOMS OUT ON STIRRUP SURFACE.

---

**Sheet Title:** Seismic Pipe Clamps

**Figure 776 - Brace Clamp**

CYS Structural Engineers, Inc.
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Sacramento, CA 95833

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### 5.3. **FIGURE 776 – BRACE CLAMP (CONTINUED)**

#### 5.3.3. MAX ALLOWABLE HORIZ & VERT SEISMIC LOADS

<table>
<thead>
<tr>
<th>SERVICE PIPE (NPS)</th>
<th>BRACE PIPE (NPS)</th>
<th>SEISMIC APPLICATIONS</th>
<th>BRACE ANGLE (^\circ) (DEG)</th>
<th>MAX LOAD (^1) SCHED 10 &amp; UP (LBS)</th>
<th>MAX LOAD (^1,,2) LW (LBS)</th>
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<tbody>
<tr>
<td>2½</td>
<td>1, 1¼</td>
<td>TRANS</td>
<td>(30 - 44)</td>
<td>620</td>
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<td>VSB (^4)</td>
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<td>600</td>
</tr>
<tr>
<td>3</td>
<td>1, 1¼</td>
<td>TRANS</td>
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<td>620</td>
<td>520</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(45 - 59)</td>
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<td>670</td>
<td>520</td>
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<td>(0)</td>
<td>540</td>
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</tr>
</tbody>
</table>

**TABLE 5.3.1 – FIGURE 776 MAX ALLOWABLE HORIZ & VERT SEISMIC LOADS (ASD)**

1. LOADS DETERMINED FROM FM APPROVAL; SEE SECTION 1.6 FOR ASD/LRFD DESIGN FACTORS.
2. SEE SECTION 1.7 FOR APPROVED LIGHTWALL (LW) PIPE.
3. BRACE PIPE INSTALLATION ANGLES ARE DETERMINED FROM VERT.
4. MAX ALLOWABLE VSB LOAD IS AN AXIAL LOAD.
6. MATERIAL SPECIFICATIONS

6.1. FIGURE 770 — Q BRACE CLAMP

CLAMP BAR
ASTM A1011, CS, TYPE A, B, OR C

SPRING CLAMP
AISI/SAE 1050 (OR EQUAL)

THREADED ROD, 3⁄8”–16 UNC–2A
AISI 1006–1015 OR ASTM A36

HEX NUT, 3⁄8”–16 UNC–2B
ASTM A563, GR A

6.2. FIGURE 771 — SWAY BRACE SWIVEL ATTACHMENT

CONNECTOR FITTING
DUCTILE IRON, ASTM A536, GR 65–45–12

BRACE PIPE FITTING
DUCTILE IRON, ASTM A536, GR 65–45–12

HEX HEAD CAP SCREW,
1⁄2”–13 UNC–2A×2¼”
CARBON STEEL, ASTM A307, GR A

HEX HEAD BOLT, 1⁄2”–13 UNC–2A×2”
SAE J429, GR 5

HEX NUT, 1⁄2”–13 UNC–2B
CARBON STEEL, ASTM A563, GR A

SHEAR BOLT, M12 X 1.75
STEEL, GR 8.8, ISO R898

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BY: Jeffrey Y. Kikumoto
DATE: 09/26/2016

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TEL  (916) 920-2020
www.cyseng.com

Job No: 14090
Date: 09-22-2016
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### 6.3 Figure 772 — Adjustable Steel Beam Attachment

<table>
<thead>
<tr>
<th>Component</th>
<th>Material Specifications</th>
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<tr>
<td>Beam C-Clamp</td>
<td>ASTM A1011, DS, TYPE B</td>
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<tr>
<td>Attachment Channel</td>
<td>ASTM A36 CHANNEL 2 X 1 X 3/8</td>
</tr>
<tr>
<td>Hex Head C-Clamp Bolt, 1/2&quot;-13 UNC-2A X 3&quot; FOR</td>
<td>Carbon Steel, ASTM A307, GR A</td>
</tr>
<tr>
<td>3/4&quot; Max Flange Thickness</td>
<td>Carbon Steel, ASTM A307, GR A</td>
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<tr>
<td>Flat Washer</td>
<td>Carbon Steel, ASTM F844, TYPE A</td>
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<tr>
<td>Spring Lock Washer, 1/2&quot;</td>
<td>Carbon Steel, Rockwell Hardness C45–51</td>
</tr>
<tr>
<td>Shear Bolt, M12 X 1.75</td>
<td>Steel, GR 8.8, ISO R98</td>
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<tr>
<td>Push-Nut Bolt Retainer</td>
<td>Low Carbon Steel</td>
</tr>
<tr>
<td>Carriage Bolt, 1/2&quot;-13 UNC-2A X1 1/2&quot; SAE J429 GR 5</td>
<td>Low Carbon Steel, Hardened, ASTM F436</td>
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<tr>
<td>Heavy Hex Head Mounting Nut, 1/2&quot;-13 UNC-2B</td>
<td>Carbon Steel, ASTM A563, GR A</td>
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<tr>
<td>Washer, 3/8&quot;</td>
<td>Carbon Steel, ASTM A563, GR A</td>
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**Date:** 09/26/2016
6.4. **FIGURE 775 — LATERAL/LONGITUDINAL BRACE CLAMP**

<table>
<thead>
<tr>
<th>BRACE PIPE CONNECTOR</th>
<th>DUCTILE IRON, ASTM A536 GR 65-45-12</th>
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<tbody>
<tr>
<td>PIPE CLAMP, PIPE SIZE 2½” – 5”</td>
<td>ASTM A1011, CS TYPE, TYPE A, B, OR C (OR ASTM A36)</td>
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<tr>
<td>PIPE CLAMP, PIPE SIZE 6” – 8”</td>
<td>A515 GR 65 – 70 (OR ASTM A36)</td>
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<tr>
<td>HEX BOLT, M12 X 1.75</td>
<td>STEEL, GR 8.8, ISO R898</td>
</tr>
</tbody>
</table>

**PIPE SIZE 2½” – 5 ASSEMBLY**
- HEX HEAD BOLT, ½”-13 UNC-2A X 2” SAE J429 GR 5
- FLAT WASHER, ½” CARBON STEEL, ASTM F844, TYPE A
- HEX NUT, ½”-13 UNC-2B CARBON STEEL, ASTM A563, GR A
- SPACER CARBON STEEL, ASTM A53, GR B OR A106 GR B

**PIPE SIZE 6 – 8 ASSEMBLY**
- HEX HEAD BOLT, ¾”-10 UNC-2A X 3” SAE J429 GR 5
- FLAT WASHER, ¾” CARBON STEEL, ASTM F844, TYPE A
- HEX NUT, ¾”-10UNC-2B CARBON STEEL, ASTM A563 GR A
- SPACER CARBON STEEL, ASTM A53, GR B OR A106 GR B

6.5. **FIGURE 776 — BRACE CLAMP**

<table>
<thead>
<tr>
<th>PIPE CLAMP RETAINER CLIP</th>
<th>ASTM A1011, CS, TYPE A, B, OR C</th>
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<tbody>
<tr>
<td>PIPE CLAMP HOOP SECTION</td>
<td>ASTM A1011, DS, TYPE B</td>
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<td>HEX HEAD SET SCREW, ½”-13UNC-2A X 1”</td>
<td>STEEL, SAE J429 GR 5</td>
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6.6. **FIGURE 778 — BAR JOIST BEAM ATTACHMENT**

<table>
<thead>
<tr>
<th>BAR ATTACHMENT</th>
<th>DUCTILE IRON, ASTM A536, GR 65-45-12</th>
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<tr>
<td>SHEAR BOLT, M12 X 1.75</td>
<td>STEEL, GR 8.8, ISO R898</td>
</tr>
<tr>
<td>HEX HEAD CAP SCREW, ½”-13 UNC-2A X 1½”</td>
<td>CARBON STEEL, ASTM A307, GR A</td>
</tr>
</tbody>
</table>

**SHEET TITLE: MATERIAL SPECIFICATIONS**

**LATERAL / LONGITUDINAL BRACE CLAMP; BRACE CLAMP; BAR JOIST BEAM ATTACHMENT**

CYS STRUCTURAL ENGINEERS, INC.

<table>
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<th>Job No: 14090</th>
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<tr>
<td>Date: 09-22-2016</td>
</tr>
<tr>
<td>Page: 51 of 60</td>
</tr>
</tbody>
</table>
7. RISER FOUR-WAY SEISMIC BRACES

7.1. **FIGURE 770 – Q BRACE CLAMP**

7.1.1 EA PRINCIPAL LOAD DIRECTION (#1 OR #2) AS SHOWN IN FIGURE 7.1.1 SHALL BE EVALUATED BY THE CRDP FOR \( \pm f_p \) OR \( \pm f_{pw} \).

7.1.2 PER NFPA® 13, ONE PAIR OF BRACES IS REQ FOR FOUR-WAY SEISMIC BRCG OF VERT RISERS.

7.1.3 FOR MAX ALLOWABLE LATERAL SEISMIC LOAD OF FIGURE 770, SEE TRANS SEISMIC LOAD IN TABLE 5.1.2.

---

**FIGURE 770 – Q BRACE CLAMP FOR PROPER INSTALLATION, SEE SECTION 5.1, TYP**

1"" TO 8"" VERT RISER PIPE

FOR PROPER INSTALLATION, SEE SECTION 5.1

2ND BRACE PIPE IS REQ & SHALL BE 6"" MAX & TO \& ABV OR BLW

1"" OR 1\(\frac{1}{4}"\) SCHED 40 BRACE PIPE, TYP

**FIGURE 771 SWAY BRACE SWIVEL ATTACHMENT, TYP**

FOR ATTACHMENT TO (E) SUPPORTING STRUCTURE OR FIGURE 772 OR FIGURE 778, SEE SECTIONS 2, 3, & 4, TYP

**PLAN VIEW**

**FIGURE 7.1.1 – RISER FOUR-WAY SEISMIC BRACE USING FIGURE 770 – Q BRACE CLAMP**

---

**SHEET TITLE: RISER FOUR-WAY SEISMIC BRACES**

**FIGURE 770 – Q BRACE CLAMP**

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7. **RISER FOUR-WAY SEISMIC BRACES**

7.2. **FIGURE 775 – LATERAL BRACE CLAMP**

7.2.1 EA PRINCIPAL LOAD DIRECTION (#1 OR #2) AS SHOWN IN FIGURE 7.2.1 SHALL BE EVALUATED BY THE CRDP FOR $\pm F_p$ OR $\pm F_{pw}$. 

7.2.2 PER NFPA® 13, ONE PAIR OF BRACES IS REQ FOR FOUR-WAY SEISMIC BRCG OF VERT RISERS. 

7.2.3 FOR MAX ALLOWABLE LATERAL SEISMIC LOAD OF FIGURE 775, SEE TRANS SEISMIC LOAD IN TABLE 5.2.2.

---

**Figure 7.2.1 – Riser Four-Way Seismic Brace Using Figure 775– Lateral Brace Clamp**

- **1\"** TO **8\"** VERT RISER PIPE
- **1\"** OR **1\"\"** SCHED 40 BRACE PIPE, TYP
- **30-44 DEG**
- **FOR ATTACHMENT TO (E) SUPPORTING STRUCTURE OR FIGURE 772 OR FIGURE 778, SEE SECTIONS 2, 3, & 4, TYP**

---

**Figure 775 – Lateral Brace Clamp for Proper Installation, See Section 5.2, TYP**

- **1\"** TO **8\"** VERT RISER PIPE
- **FOR PROPER INSTALLATION, SEE SECTION 5.2**
- **LOAD DIRECTION #1**
- **2ND BRACE PIPE IS REQ & SHALL BE 6\" MAX & TO & ABV OR BLW**
- **LOAD DIRECTION #2**
- **FIGURE 771 SWAY BRACE SWIVEL ATTACHMENT, TYP**
- **X/W = 4 - 9\"**
- **30-44 DEG**

---

**Sheet Title:** Riser Four-Way Seismic Braces

**Figure 775 - Lateral Brace Clamp**

---

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7. **RISER FOUR-WAY SEISMIC BRACES**

7.3. **FIGURE 776 – BRACE CLAMP**
(123,163),(887,821)

7.3.1 EA PRINCIPAL LOAD DIRECTION (#1 OR #2) AS SHOWN IN FIGURE 7.3.1 SHALL BE EVALUATED BY THE CRDP FOR ±F_p OR ±F_pw.

7.3.2 PER NFPA® 13, ONE PAIR OF BRACES IS REQ FOR FOUR-WAY SEISMIC BRCG OF VERT RISERS.

7.3.3 FOR MAX ALLOWABLE LATERAL SEISMIC LOAD OF FIGURE 776, SEE TRANS SEISMIC LOAD IN TABLE 5.3.1.

**FIGURE 776 – BRACE CLAMP FOR PROPER INSTALLATION, SEE SECTION 5.3, TYP**

1" ø TO 8" ø VERT RISER PIPE

FOR PROPER INSTALLATION, SEE SECTION 5.3

1" ø OR 1¼" ø SCHED 40 BRC Pipe, TYP

LOAD DIRECTION #1

2ND BRACE PIPE IS REQ & SHALL BE 6" MAX C TO C ABV OR BLW

FOR ATTACHMENT TO (E) SUPPORTING STRUCTURE OR FIGURE 772 OR FIGURE 778, SEE SECTIONS 2, 3, & 4, TYP

**FIGURE 7.3.1 – RISER FOUR-WAY SEISMIC BRACE USING FIGURE 776– BRACE CLAMP**
8. **TYPICAL SWAY BRACE DESIGN PROCEDURE**

8.1 **STEP 1**

THE CRDP REVIEWS SECTION 1 OF THIS OPM.

**NOTE:** THIS EXAMPLE ASSUMES THE CRDP IS FAMILIAR W/ NFPA-13 SECTION 9.3.5.

8.2 **STEP 2 – DETERMINE SEISMIC DESIGN CRITERIA FOR THE PROJECT SITE**

**GIVEN FOR THIS EXAMPLE**

PER SECTION 1.5 OF THIS OPM
\[ a_p = 2.5 \quad R_p = 4.5 \quad \text{(FOR PIPING W/ GROOVED COUPLINGS)} \]
\[ I_p = 1.5 \quad Q_0 = 2.5 \quad \text{(FOR CONC ANCHORS ONLY)} \]

PIPING IS LOCATED AT ROOF LEVEL WHERE \( z/h \leq 1.0 \)

PROJECT SITE \( S_{DS} = 2.00 \)

APPLIED LOAD IS 4'-0" BLW POINT OF ATTACHMENT TO SUPPORTING STRUCTURE

**DETERMINE SEISMIC DESIGN FORCE**

\[ F_p = 0.4 \quad a_p \quad S_{DS} \quad I_p \quad (1+2Q_0/R_p) \quad W_p = 2.00W_p \quad \text{(GOVERNS DESIGN)} \]
\[ F_p \quad \text{(min)} = 0.3 \quad S_{DS} \quad I_p \quad W_p = 0.90W_p \]
\[ F_p \quad \text{(max)} = 1.6 \quad S_{DS} \quad I_p \quad W_p = 4.80W_p \]

**ASD LOAD COMBINATIONS FOR ALL SUPPORTS & ATTACHMENTS EXCEPT CONC ANCHORS**

\[ (1.0 + 0.14 \quad S_{DS}) \quad D \quad \pm 0.7 \quad F_p = 1.28D \pm 0.7F \]
\[ (0.6 - 0.14 \quad S_{DS}) \quad D \quad \pm 0.7 \quad F_p = 0.32D \pm 0.7F_p \]

**LRFD LOAD COMBINATIONS FOR CONC ANCHORS**

\[ (1.2 + 0.2 \quad S_{DS}) \quad D \quad \pm 0.7 \quad F_p = 1.6D \pm 2.5F_p \]
\[ (0.9 - 0.2 \quad S_{DS}) \quad D \quad \pm 0.7 \quad F_p = 0.5D \pm 2.5F_p \]

8.3 **STEP 3 – DETERMINE SEISMIC DEMANDS**

**GIVEN FOR THIS EXAMPLE**

- MAIN SERVICE PIPE 4" SCHED 40 W/ GRAVITY HANGER SPACING = 15 ft
- THREE BRANCH LINES 1½" SCHED 10, EA BRANCH LINE IS 20 ft LONG
- LATERAL SWAY BRACE SPCG (SERVICE PIPE SPAN) = 30 ft
- PER NFPA-13 SECTION E.2.2, ASSUME BRANCH LINES AT THIRD-POINTS OF PIPE SPAN & NEAR EA SUPPORT
- BRACES INSTALLED AT A BRACE ANGLE (θ) = 50°
- PER SECTION 1.4 OF THIS OPM, BRACE ANGLE CONSTRUCTION TOLERANCES OF ±5° MUST BE CONSIDERED DURING DESIGN.
- WTS OF WATER-FILLED PIPES PER TABLE 1.2.1 OF THIS OPM

---

**Sheet Title:** TYPICAL SWAY BRACE DESIGN PROCEDURE

CYS STRUCTURAL ENGINEERS, INC.
2495 NATOMAS PARK DRIVE, SUITE 650
SACRAMENTO, CA 95833

Job No: 14090
Date: 09-22-2016
Page: 55 of 60

09/26/2016

OPM-0351-13: Reviewed for Code Compliance by Jeffrey Kikumoto

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8.3 **STEP 3 – DETERMINE SEISMIC DEMANDS (CONTINUED)**

**DETERMINE GRAVITY LOAD TRIBUTARY TO VERT BRACE**

\[ W = WT \text{ OF MAIN LINE (4" SCHED 40)} = 16.40 \text{ plf} \times 15 \text{ ft} = 246 \text{ lbs} \]

**DETERMINE LOAD IN THE (ZOI) OF A TRANS SWAY BRACE**

\[ \text{WT OF MAIN LINE (4" SCHED 40)} = 16.40 \text{ plf} \times 30 \text{ ft} = 492 \text{ lbs} \]
\[ \text{WT OF BRANCH LINES (1/2" SCHED 10)} = 3 \times 3.04 \text{ plf} \times 20 \text{ ft} = 182 \text{ lbs} \]
\[ W_p = 1.15 (492 + 182) = 776 \text{ lbs} \]

**CALCULATE HORIZ SEISMIC FORCE ON TRANS SWAY BRACE**

\[ F_p = 2.00W_p = 2.00 (776) = 1552 \text{ lbs} \]
\[ F_{pw} = 0.7F_p = 1086 \text{ lbs (ASD LEVEL FORCE)} \]

**CALCULATE SUPPORT FORCES & ATTACHMENT REACTIONS**

**ASD LOAD COMBINATIONS:**

\[ 1.28W \pm 0.7F_p \]
\[ 0.32W \mp 0.7F_p \]

\[ P_{o,T \text{ MAX}} = (1086/\sin 45^\circ) = \pm 1536 \text{ lbs} \]
\[ \text{at } L = (4.0/\cos 45^\circ) = 5.66' \]
\[ P_{o,T \text{ MIN}} = (1086/\sin 55^\circ) = \pm 1326 \text{ lbs} \]
\[ \text{at } L = (4.0/\cos 55^\circ) = 6.97' \]

\[ P_{o,V \text{ TENSION}} = 1.28(-246) - (1086/\tan 45^\circ) = -1401 \text{ lbs} \]
\[ P_{o,V \text{ COMPRESSION}} = 0.32(-246) + (1086/\tan 45^\circ) = +1008 \text{ lbs} \]

\[ R_{H,B} = 0.7F_p = 1086 \text{ lbs SHEAR} \]
\[ R_{V,B} = (R_{H,B}/\tan 45^\circ) = 1086 \text{ lbs MAX TENSION} \]
\[ R_{V,A} = 1401 \text{ lbs MAX TENSION} \]

**CALCULATE REACTIONS FOR CONC ANCHORS**

**LRFD LOAD COMBINATIONS:**

\[ 1.6D + 2.5F_p \]
\[ 0.5D - 2.5F_p \]

\[ R_{H,B} = 2.5F_p = 2.5 (1552) = 3880 \text{ lbs SHEAR} \]
\[ R_{V,B} = (R_{H,B}/\tan 45^\circ) = 3880 \text{ lbs MAX TENSION} \]
\[ R_{V,A} = 1.6(-246) - (3880/\tan 45^\circ) = 4274 \text{ lbs MAX TENSION} \]

**NOTE:** WHERE BOTH A LONG & A TRANS SEISMIC BRACE ARE LOCATED WITHIN 6" OF THE SAME VERT SEISMIC BRACE, THE AXIAL FORCE DUE TO EA SWAY BRACE SHALL BE CONSIDERED. THIS EXAMPLE HAS NO LONG SEISMIC BRACE AT THIS VERT SEISMIC BRACE.
8.4 **STEP 4—VERIFY CAPACITIES**

VERIFY SERVICE PIPE FLEXURAL CAPACITY FOR CALCULATED (Z01) LOAD (SECTION 8.5 OF THIS OPM) PER TABLE 8.5.2, THE MAX ALLOWABLE (Z01) LOAD \( F_{pw} \) FOR A 4" SCH40 MAIN SERVICE PIPE SPANNING 30 ft IS 1828 lbs WHICH IS LARGER THAN THE CALCULATED DEMAND OF 1086 lbs.

THEREFORE, THE 4" SCH40 MAIN SERVICE PIPE IS ADEQUATE FOR THE SEISMIC LOAD.

**NOTE:** IF THE DEMAND EXCEEDED THE ALLOWABLE, THE 30 ft LATERAL SWAY BRACE SPCG WOULD HAVE TO BE REDUCED.

**TRANS SEISMIC BRACE (LATERAL SWAY BRACE)**

SELECT APPROPRIATE SEISMIC BRACE CLAMP (SECTION 5 OF THIS OPM)

PER TABLE 5.2.2, THE MAX ALLOWABLE HORIZ LOAD FOR A FIGURE 775 BRACE CLAMP ON A 4" MAIN SERVICE PIPE FOR TRANS SWAY BRACE INSTALLED AT ANGLE OF 45°–55° IS 1810 lbs WHICH IS LARGER THAN THE CALCULATED DEMAND OF 1086 lbs.

THEREFORE, USE FIGURE 775 BRACE CLAMP.

SELECT TRANS BRACE PIPE SIZE (SECTION 1.2 OF THIS OPM)

PER TABLE 1.2.3, FOR A TRANS SWAY BRACE DEMAND OF 1536 lbs AND 6.97 ft MAX LENGTH, SELECT A 1¼" SCH40 ASTM A53 OR A BRACE PIPE W/ AN AXIAL CAPACITY OF 1875 lbs UP TO A MAX LENGTH OF 9′–0″.

VERIFY SWAY BRACE SWIVEL ATTACHMENT (SECTION 4.1 OF THIS OPM)

PER TABLE 4.1.1, THE MAX ALLOWABLE HORIZ LOAD FOR A FIGURE 771 SWAY BRACE SWIVEL CONNECTOR AT A TRANS SWAY BRACE INSTALLED AT ANGLE OF 45°–55° IS 2540 lbs WHICH IS LARGER THAN THE CALCULATED DEMAND OF 1086 lbs.

CHECK 2 OPTIONS FOR ATTACHMENT TO STRUCTURE

**OPTION 1:** SELECT APPROPRIATE ATTACHMENT TO STL BM (SECTION 4.2 & 4.3 OF THIS OPM)

PER TABLE 4.2.1, FOR A STL BEAM SIZE OF W18x60, USE FIGURE 772 SIZE TYPE A.

PER TABLE 4.2.2, THE MAX ALLOWABLE HORIZ LOAD FOR A FIGURE 772 TYPE A ADJUSTABLE STL BEAM ATTACHMENT INSTALLED AT ANGLE OF 45°–55° PERP TO A STL BM IS 710 lbs WHICH IS SMALLER THAN THE CALCULATED DEMAND OF 1086 lbs.

THEREFORE, FIGURE 772 ATTACHMENT IS NO GOOD, TRY FIGURE 778 ATTACHMENT. PER TABLE 4.3.1, THE MAX ALLOWABLE HORIZ LOAD FOR A FIGURE 778 WF BM FLANGE ATTACHMENT INSTALLED AT ANGLE OF 45°–55° PERP TO A STL BEAM IS 2260 lbs WHICH IS LARGER THAN THE CALCULATED DEMAND OF 1086 lbs.

THEREFORE, USE FIGURE 778 WF BM FLANGE ATTACHMENT.

**SHEET TITLE: TYPICAL SWAY BRACE DESIGN PROCEDURE**
8.4 STEP 4 – VERIFY CAPACITIES (CONTINUED)

OPTION 2: CHECK ATTACHMENT TO SOFFIT OF CONC FILLED MTL DECK (SECTION 2.2.2 OF THIS OPM)
THE CRDP SHALL CHECK THE CONC ANCHORS FOR THE EFFECTS OF COMBINED TENSION &
SHEAR FORCES (INCLUDING PRYING ACTION) IN ACCORDANCE W/ ACI 318–11 SECTION D.7.
DESIGN STRENGTH CAPACITY VALUES IN TENSION & SHEAR ARE PROVIDED IN TABLE 2.2.2
FOR 1/2" ANCHORS IN A COMMON INSTALLATION TO UNDERSIDE OF CONC FILLED MTL DECK.
THE CRDP SHALL DESIGN ANCHORS FOR ANY OTHER INSTALLATIONS IN ACCORDANCE W/
ACI 318–11 APPENDIX D & ICC REPORTS. USE OF MFR’S SOFTWARE TO AID DESIGN IS
RECOMMENDED.

\[
R_{V_B} = R_{V_B} = 3880 \text{ lbs PER PREVIOUS CALC} \\
V_u = R_{V_B} = 3880 \text{ lbs} \\
M_c = R_{V_B}(1.65") - R_{H_B}(0.81") = 3259 \text{ ft-lb} \\
N_u = R_{V_B} + M_c/(0.9*0.84) = 8191 \text{ lbs}
\]

\[N_u/\#N_u + V_u/\#V_u \leq 1.2\]

8191/1270 + 3880/2450 >>> 1.2
THEREFORE, ANCHOR IS NO GOOD & DESIGN MUST BE REVISED.

VERT SEISMIC BRACE
SELECT APPROPRIATE SEISMIC BRACE CLAMP (SECTION 5 OF THIS OPM)
PER TABLE 5.2.2, THE MAX ALLOWABLE HORIZ LOAD FOR A FIGURE 775 BRACE CLAMP ON A
4" MAIN SERVICE PIPE FOR VERT BRACE INSTALLED AT ANGLE OF 0° IS 1280 lbs WHICH IS
LARGER THAN THE CALCULATED DEMAND OF 1086 lbs.
THEREFORE, USE FIGURE 775 BRACE CLAMP.

SELECT VERT BRACE PIPE SIZE (SECTION 1.2 OF THIS OPM)
PER TABLE 1.2.3, FOR A VERT BRACE DEMAND OF 1086 lbs AND 4.0 ft MAX LENGTH,
SELECT A 1" SCH40 ASTM A53 GR A BRACE PIPE WITH AN AXIAL CAPACITY OF 1406 lbs
UP TO A MAX LENGTH OF 7’-0”.

VERIFY SWAY BRACE SWIVEL ATTACHMENT (SECTION 4.1 OF THIS OPM)
PER TABLE 4.1.1, THE MAX ALLOWABLE LOAD FOR A FIGURE 771 SWAY BRACE SWIVEL
CONNECTOR AT A VERT BRACE INSTALLED AT ANGLE OF 0° IS 1800 lbs
WHICH IS LARGER THAN THE VERT BRACE DEMAND OF 1086 lbs.

SELECT APPROPRIATE ATTACHMENT TO STL BM (SECTION 4.2 OF THIS OPM)
PER TABLE 4.2.1, FOR A STL BM SIZE OF W18x60, USE FIGURE
772 SIZE TYPE A, PER TABLE 4.2.2, THE MAX ALLOWABLE LOAD
FOR A FIGURE 772 TYPE A ADJUSTABLE STL BM ATTACHMENT
INSTALLED AT ANGLE OF 0° PERP TO A STL BM IS 470 lbs
WHICH IS LESS THAN THE VERT BRACE DEMAND OF 1086 lbs.
THEREFORE, FIGURE 772 ATTACHMENT IS NO GOOD & DESIGN
MUST BE REVISED.
8.5 **MAX PERMISSIBLE LOAD IN THE ZONE OF INFLUENCE OF A SWAY BRACE**

The max permissible load in the zone of influence (ZOI) of a sway brace shall not exceed the values given in Table 8.5.1, Table 8.5.2, or Table 8.5.3 in this OPM in lieu of Table 9.3.5.5.2(a), Table 9.3.5.5.2(b), or Table 9.3.5.5.2(c) as shown in 2013 NFPA-13. The tables are based on common configurations of mains & branch lines per NFPA-13 section E.2.2. Where the configuration of the mains & branch lines vary significantly from the assumed layout, the pipe stresses should be checked by engineering analysis. Please note: the three tables differ from the NFPA-13 published values because they consider vert plus lateral load demand & use $t_{design} = 0.96 t_{nom}$ as per Table footnotes.

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<th>SERVICE PIPE</th>
<th>OD</th>
<th>$l_{nom}$</th>
<th>$S$</th>
<th>WATER-FILLED PIPE WT (PLF)</th>
<th>GRAVITY HANGER SPCC* (FT)</th>
<th>LATERAL SWAY BRACE SPCC (FT)</th>
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**TABLE 8.5.1 - MAX LOAD (F_{lw}) IN ZOI (LBS), (F_y = 30 KSI MIN) SCHEDULE 10 STEEL PIPE**

**FOOTNOTES FOR TABLE 8.5.1, TABLE 8.5.2 & TABLE 8.5.3.**

1) STL PIPE DIMS (NOMINAL WALL THK ($l_{nom}$ & OD) PER NFPA TABLE A.6.3.2, EXCEPT LW-SCHEDULE $l_{nom}$ PER ANVIL.

2) SECTION MODULUS, $S = \frac{\pi (OD)^4 - (OD - 2t_{design})^4}{32 (OD)}$ WHERE $t_{design} = 0.96 t_{nom}$ PER AISC 360.

3) MAX DISTANCE BETWEEN GRAVITY HANGERS PER NFPA TABLE 9.2.2.1(a).

4) THE TABLES FOR MAX LOAD ($F_{lw}$) IN ZOI ARE BASED ON SPECIFIC CONFIGURATIONS OF MAINS & BRANCH LINES. SEE NFPA SECTION E.2.2.

5) ASSUMES BRANCH LINES AT CENTER-POINTS OF PIPE SPAN & NEAR EA SUPPORT.

6) ASSUMES BRANCH LINES AT THIRD-POINTS OF PIPE SPAN & NEAR EA SUPPORT.

7) ASSUMES BRANCH LINES AT QUARTER-POINTS OF PIPE SPAN & NEAR EA SUPPORT.
### 8.5 Max Permissible Load in the Zone of Influence of a Sway Brace (Continued)

<table>
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<th>SERVICE PIPE NPS</th>
<th>OD (IN)</th>
<th>( t_{com} ) (IN)</th>
<th>( f ) (IN)</th>
<th>WATER-FILLED PIPE WT (PLF)</th>
<th>GRAVITY HANGER SPCG (FT)</th>
<th>LATERAL SWAY BRACE SPCG2 (FT)</th>
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</table>

**TABLE 8.5.2** - Max Load \((F_{mol})\) in ZOI (LBS). \((f_y = 30\) KSI MIN) SCHEDULE 40 STEEL PIPE

### Footnotes for Table 8.5.2 & Table 8.5.3

**FOOTNOTES FOR TABLE 8.5.2 & TABLE 8.5.3**

SEE PREVIOUS PAGE FOR FOOTNOTES