



OFFICE OF STATEWIDE HEALTH PLANNING AND DEVELOPMENT
FACILITIES DEVELOPMENT DIVISION

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

OFFICE USE ONLY

APPLICATION #: OPM-0542

OSHPD Preapproval of Manufacturer's Certification (OPM)

Type: [X] New [] Renewal/Update

Manufacturer Information

Manufacturer: ERICO International Corporation

Manufacturer's Technical Representative: Ward Judson

Mailing Address: 34600 Solon Road, Solon, OH 44139

Telephone: (440) 528-3788 Email: ward.judson@nVent.com

Product Information

Product Name: nVent CADDY Seismic Bracing for MEP Systems

Product Type: Various Components & Supports for Seismic Bracing

Product Model Number: CSBQIKCL, CSBQG, CSBBRP, CSBMA, CSBBRS1, CSBBRS2, CSBBRS3, CSBU1, CSBU2, CSBUS1, CSBUS2, CSBUS1PA, CSBUS2PA, CSBS1, CSBS1A, CSBS2, CSBS3, CSBS4, CSBS5, CSB, CSBT

General Description: The product consists of support members for seismic bracing of MEP systems that include service pipe, conduit, cable tray, and round & rectangular gage ducts.

Applicant Information

Applicant Company Name: ERICO International Corporation, a division of nVent

Contact Person: Ward Judson

Mailing Address: 3400 Solon Road,, Solon, OH 44139

Telephone: (440) 528-3788 Email: Ward.judson@nvent.com

Title: Engineering Manager

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STATE OF CALIFORNIA - HEALTH AND HUMAN SERVICES AGENCY





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Registered Design Professional Preparing Engineering Recommendations

Company Name: CYS STRUCTURAL ENGINEERS, INC.
Name: Dieter 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 OSP Number: _____

Certification Method

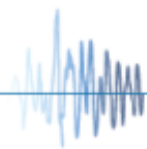
Testing in accordance with: ICC-ES AC156 FM 1950-16
 Other(s) (Please Specify): _____

*Use of criteria other than those adopted by the California Building Standards Code, 2019 (CBSC 2019) 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 2019 may be used when approved by OSHPD prior to testing.

- Analysis
- Experience Data
- Combination of Testing, Analysis, and/or Experience Data (Please Specify): _____

OSHPD Approval

Date: 09/07/2021
Name: Jeffrey Kikumoto Title: Senior Structural Engineer
Condition of Approval (if applicable): _____



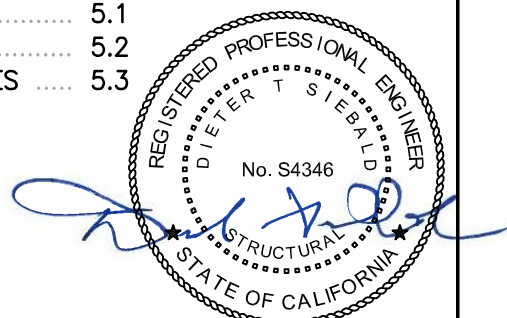
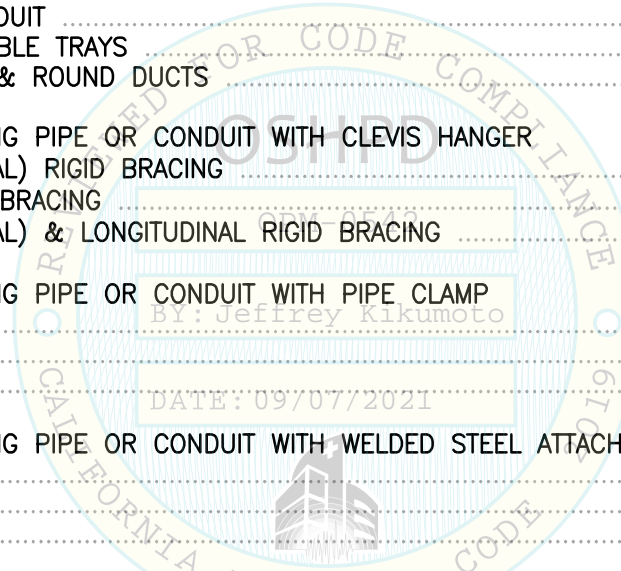
SEISMIC BRACING FOR
MEP SYSTEMS



TABLE OF CONTENTS
OPM-0542

PAGE

| | |
|---|-------|
| SECTION 1 – OVERVIEW & GENERAL NOTES | |
| CONDITIONS OF USE | 1.1 |
| SCOPE | 1.2 |
| CONSTRUCTION TOLERANCES | 1.3 |
| HOW TO USE THIS PRE-APPROVAL & RESPONSIBILITIES OF THE CLSE | 1.4 |
| | |
| MECHANICAL & CAST-IN-PLACE ANCHOR REQUIREMENTS | 1.10 |
| | |
| ABBREVIATIONS | 1.20 |
| TRADEMARK FOOTNOTES | 1.21 |
| | |
| SUPPORT & ATTACHMENT MATERIAL STANDARDS | 1.30 |
| | |
| DESIGN PARAMETERS & BRACING GUIDELINES | |
| PIPING & CONDUIT | 1.100 |
| ELECTRICAL CABLE TRAYS | 1.200 |
| RECTANGULAR & ROUND DUCTS | 1.300 |
| | |
| SECTION 2 – SINGLE HUNG PIPE OR CONDUIT WITH CLEVIS HANGER | |
| TRANSVERSE (LATERAL) RIGID BRACING | 2.1 |
| LONGITUDINAL RIGID BRACING | 2.2 |
| TRANSVERSE (LATERAL) & LONGITUDINAL RIGID BRACING | 2.3 |
| | |
| SECTION 3 – SINGLE HUNG PIPE OR CONDUIT WITH PIPE CLAMP | |
| NOT USED | 3.1 |
| NOT USED | 3.3 |
| NOT USED | 3.5 |
| | |
| SECTION 4 – SINGLE HUNG PIPE OR CONDUIT WITH WELDED STEEL ATTACHMENT | |
| NOT USED | 4.1 |
| NOT USED | 4.2 |
| NOT USED | 4.3 |
| | |
| SECTION 5 – SINGLE PIPE OR CONDUIT WITH LATERAL CONCENTRIC BRACES | |
| CSB WITH BRACE PIPE FOR 1"Ø TO 12"Ø SERVICE PIPES | 5.1 |
| CSBT TELESCOPING ASSEMBLY FOR 1"Ø TO 4"Ø SERVICE PIPES | 5.2 |
| CSBT WITH TELESCOPING ASSEMBLY FOR 1"Ø TO 4"Ø SERVICE PIPES | 5.3 |



SHEET TITLE: TABLE OF CONTENTS



CYS STRUCTURAL ENGINEERS, INC.

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|---------|------------|
| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 0.1 of . |

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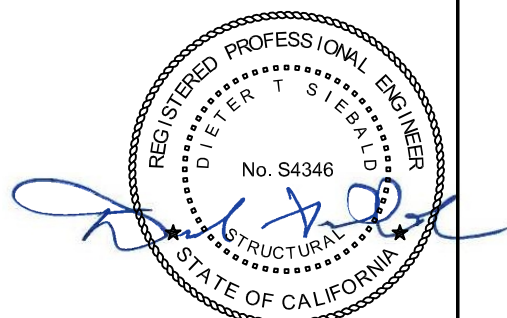
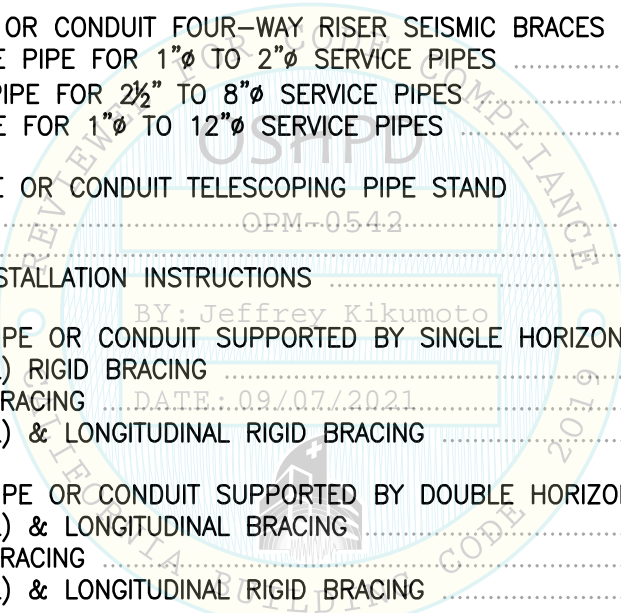
SEISMIC BRACING FOR
MEP SYSTEMS



TABLE OF CONTENTS

PAGE

| | |
|--|------|
| SECTION 6 – SINGLE PIPE OR CONDUIT WITH LATERAL ECCENTRIC BRACES & RESTRAINT RODS | |
| CSBQIKCL WITH BRACE PIPE FOR 1"Ø TO 2"Ø SERVICE PIPES | 6.1 |
| CSBQG WITH BRACE PIPE FOR 2½" TO 8"Ø SERVICE PIPES | 6.2 |
| CSBBRP WITH RESTRAINT ROD FOR 1"Ø TO 2"Ø SERVICE PIPES | 6.3 |
| SECTION 7 – SINGLE PIPE OR CONDUIT WITH LONGITUDINAL BRACES | |
| CSB WITH BRACE PIPE FOR 1"Ø TO 12"Ø SERVICE PIPES | 7.1 |
| SECTION 8 – SINGLE PIPE OR CONDUIT WITH VERTICAL BRACES & RESTRAINT RODS | |
| CSBQIKCL WITH BRACE PIPE FOR 1"Ø TO 2"Ø SERVICE PIPES | 8.1 |
| CSBQG WITH BRACE PIPE FOR 2½" TO 8"Ø SERVICE PIPES | 8.2 |
| CSBBRP WITH RESTRAINT ROD FOR 1"Ø TO 2"Ø SERVICE PIPES | 8.3 |
| CSB WITH BRACE PIPE FOR 1"Ø TO 12"Ø SERVICE PIPES | 8.4 |
| CSBT WITH TELESCOPING ASSEMBLY FOR 1"Ø TO 4"Ø SERVICE PIPES | 8.5 |
| SECTION 9 – SINGLE PIPE OR CONDUIT FOUR-WAY RISER SEISMIC BRACES | |
| CSBQIKCL WITH BRACE PIPE FOR 1"Ø TO 2"Ø SERVICE PIPES | 9.1 |
| CSBQG WITH BRACE PIPE FOR 2½" TO 8"Ø SERVICE PIPES | 9.2 |
| CSB WITH BRACE PIPE FOR 1"Ø TO 12"Ø SERVICE PIPES | 9.3 |
| SECTION 10 – SINGLE PIPE OR CONDUIT TELESCOPING PIPE STAND | |
| CTS04 | 10.1 |
| NOT USED | 10.2 |
| CTS04 POST BASE INSTALLATION INSTRUCTIONS | 10.3 |
| SECTION 11 – MULTIPLE PIPE OR CONDUIT SUPPORTED BY SINGLE HORIZONTAL TRAPEZE STRUT | |
| TRANSVERSE (LATERAL) RIGID BRACING | 11.1 |
| LONGITUDINAL RIGID BRACING | 11.2 |
| TRANSVERSE (LATERAL) & LONGITUDINAL RIGID BRACING | 11.3 |
| SECTION 12 – MULTIPLE PIPE OR CONDUIT SUPPORTED BY DOUBLE HORIZONTAL TRAPEZE STRUT | |
| TRANSVERSE (LATERAL) & LONGITUDINAL BRACING | 12.1 |
| LONGITUDINAL RIGID BRACING | 12.2 |
| TRANSVERSE (LATERAL) & LONGITUDINAL RIGID BRACING | 12.3 |



SHEET TITLE: TABLE OF CONTENTS (CONTINUED)



CYS STRUCTURAL ENGINEERS, INC.

2495 NATOMAS PARK DRIVE, SUITE 650
SACRAMENTO, CA 95833

TEL (916) 920-2020
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| | |
|---------|------------|
| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 0.2 of . |

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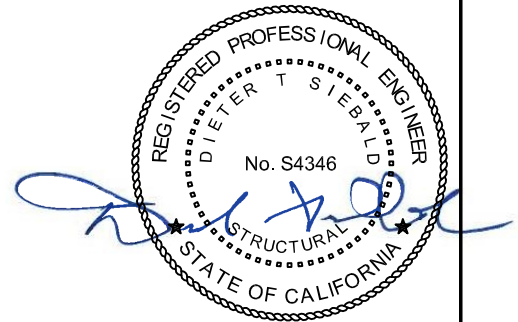
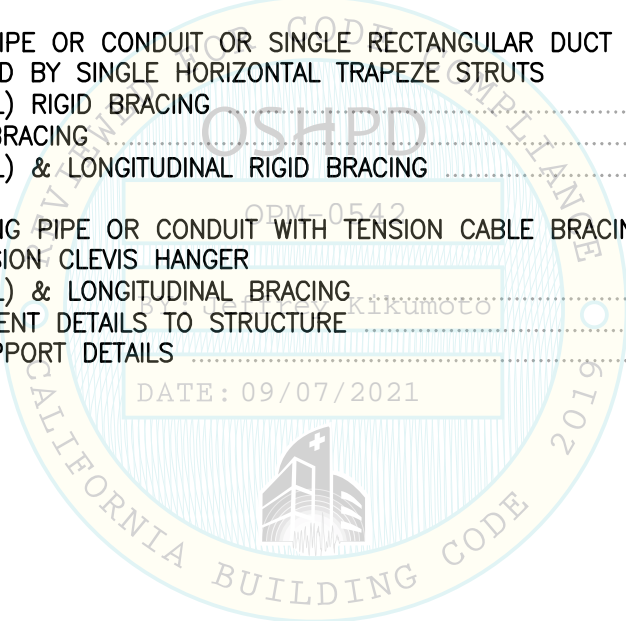
SEISMIC BRACING FOR
MEP SYSTEMS



TABLE OF CONTENTS

PAGE

| | |
|--|------|
| SECTION 13 – SINGLE CABLE TRAY SUPPORTED BY SINGLE HORIZONTAL TRAPEZE STRUT | |
| TRANSVERSE (LATERAL) RIGID BRACING | 13.1 |
| LONGITUDINAL RIGID BRACING | 13.2 |
| TRANSVERSE (LATERAL) & LONGITUDINAL RIGID BRACING | 13.3 |
| TRANSVERSE (LATERAL) & LONGITUDINAL RIGID BRACING AT CONCRETE WALL & FLOOR ... | 13.4 |
| SECTION 14 – SINGLE RECTANGULAR DUCT SUPPORTED BY TWO SINGLE HORIZONTAL TRAPEZE STRUTS | |
| TRANSVERSE (LATERAL) RIGID BRACING | 14.1 |
| LONGITUDINAL RIGID BRACING | 14.2 |
| TRANSVERSE (LATERAL) & LONGITUDINAL RIGID BRACING | 14.3 |
| SECTION 15 – SINGLE ROUND DUCT SUPPORTED BY SHEET METAL STRAPS | |
| TRANSVERSE (LATERAL) RIGID BRACING | 15.1 |
| LONGITUDINAL RIGID BRACING | 15.2 |
| TRANSVERSE (LATERAL) & LONGITUDINAL RIGID BRACING | 15.3 |
| SECTION 16 – MULTIPLE PIPE OR CONDUIT OR SINGLE RECTANGULAR DUCT OR SINGLE CABLE TRAY SUPPORTED BY SINGLE HORIZONTAL TRAPEZE STRUTS | |
| TRANSVERSE (LATERAL) RIGID BRACING | 16.1 |
| LONGITUDINAL RIGID BRACING | 16.2 |
| TRANSVERSE (LATERAL) & LONGITUDINAL RIGID BRACING | 16.3 |
| SECTION 17 – SINGLE HUNG PIPE OR CONDUIT WITH TENSION CABLE BRACING & COMPRESSION CLEVIS HANGER | |
| TRANSVERSE (LATERAL) & LONGITUDINAL BRACING | 17.1 |
| SUPPORT & ATTACHMENT DETAILS TO STRUCTURE | 17.2 |
| SEISMIC BRACING SUPPORT DETAILS | 17.3 |



SHEET TITLE: TABLE OF CONTENTS (CONTINUED)



CYS STRUCTURAL ENGINEERS, INC.

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| Date: | 09/08/2021 |
| Page: | 0.3 of . |

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SEISMIC BRACING FOR
MEP SYSTEMS



TABLE OF CONTENTS

PAGE

| | | |
|---|--|--------|
| SECTION 100 – SUPPORTS & ATTACHMENT DETAILS TO UNDERSIDE OF METAL DECK WITH CONCRETE FILL | | |
| CSBMA | POST INSTALLED ANCHORS W/ BRACE PIPE PARALLEL | 100.1 |
| CSBMA | POST INSTALLED ANCHORS W/ BRACE PIPE PERPENDICULAR | 100.2 |
| CSBMA | POST INSTALLED ANCHORS W/ BRACE STRUT PARALLEL | 100.3 |
| CSBMA | POST INSTALLED ANCHORS W/ BRACE STRUT PERPENDICULAR | 100.4 |
| CSBMA | CAST IN PLACE ANCHORS W/ BRACE PIPE PARALLEL | 100.5 |
| CSBMA | CAST IN PLACE ANCHORS W/ BRACE PIPE PERPENDICULAR | 100.6 |
| CSBMA | CAST IN PLACE ANCHORS W/ BRACE STRUT PARALLEL | 100.7 |
| CSBMA | CAST IN PLACE ANCHORS W/ BRACE STRUT PERPENDICULAR | 100.8 |
| CSBU | POST INSTALLED ANCHOR W/ BRACE PIPE | 100.9 |
| CSBUS | POST INSTALLED ANCHOR W/ BRACE STRUT | 100.10 |
| CSBU | CAST IN PLACE ANCHOR W/ BRACE PIPE | 100.11 |
| CSBUS | CAST IN PLACE ANCHOR W/ BRACE STRUT | 100.12 |
| STRUT | POST INSTALLED ANCHORS W/ BRACE PIPE PARALLEL & VERTICAL ROD | 100.13 |
| STRUT | POST INSTALLED ANCHORS W/ BRACE STRUT PARALLEL & VERTICAL ROD | 100.14 |
| STRUT | CAST IN PLACE ANCHORS W/ BRACE PIPE PARALLEL & VERTICAL ROD | 100.15 |
| STRUT | CAST IN PLACE ANCHORS W/ BRACE STRUT PARALLEL & VERTICAL ROD | 100.16 |
| CSBBRS3 | POST-INSTALLED ANCHOR OR CIP INSERT W/ RESTRAINT ROD | 100.17 |
| SECTION 101 – SUPPORTS & ATTACHMENT DETAILS TO UNDERSIDE OF CONCRETE FLOOR OR ROOF | | |
| CSBMA | POST INSTALLED ANCHORS W/ BRACE PIPE PARALLEL | 101.1 |
| CSBMA | POST INSTALLED ANCHORS W/ BRACE PIPE PERPENDICULAR | 101.2 |
| CSBMA | POST INSTALLED ANCHORS W/ BRACE STRUT PARALLEL | 101.3 |
| CSBMA | POST INSTALLED ANCHORS W/ BRACE STRUT PERPENDICULAR | 101.4 |
| CSBMA | CAST IN PLACE ANCHORS W/ BRACE PIPE PARALLEL | 101.5 |
| CSBMA | CAST IN PLACE ANCHORS W/ BRACE PIPE PERPENDICULAR | 101.6 |
| CSBMA | CAST IN PLACE ANCHORS W/ BRACE STRUT PARALLEL | 101.7 |
| CSBMA | CAST IN PLACE ANCHORS W/ BRACE STRUT PERPENDICULAR | 101.8 |
| CSBU | POST INSTALLED ANCHOR W/ BRACE PIPE | 101.9 |
| CSBU | POST INSTALLED ANCHOR W/ BRACE STRUT | 101.10 |
| CSBU | CAST IN PLACE ANCHOR W/ BRACE PIPE | 101.11 |
| CSBU | CAST IN PLACE ANCHOR W/ BRACE STRUT | 101.12 |
| STRUT | POST INSTALLED ANCHORS W/ BRACE PIPE PARALLEL & VERTICAL ROD | 101.13 |
| STRUT | POST INSTALLED ANCHORS W/ BRACE STRUT PARALLEL & VERTICAL ROD | 101.14 |
| STRUT | CAST IN PLACE ANCHORS W/ BRACE PIPE PARALLEL & VERTICAL ROD | 101.15 |
| STRUT | CAST IN PLACE ANCHORS W/ BRACE STRUT PARALLEL & VERTICAL ROD | 101.16 |
| CSBBRS3 | POST-INSTALLED ANCHOR W/ RESTRAINT ROD | 101.17 |



SHEET TITLE: TABLE OF CONTENTS (CONTINUED)

| | | |
|--|--------------------------------------|---|
| <p>CYS STRUCTURAL ENGINEERS, INC. 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833</p> | TEL (916) 920-2020 www.cyseng.com | Job No: 19039 Date: 09/08/2021 Page: 0.4 of . |
|--|--------------------------------------|---|

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SEISMIC BRACING FOR
MEP SYSTEMS



TABLE OF CONTENTS

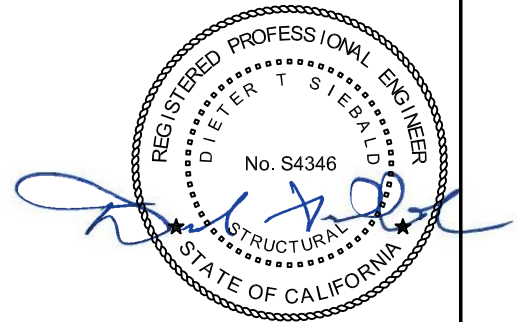
PAGE

SECTION 102 – SUPPORTS & ATTACHMENT DETAILS TO CONCRETE WALL

| | | |
|-------|---|-------|
| CSBU | POST INSTALLED ANCHORS W/ BRACE PIPE | 102.1 |
| CSBU | POST INSTALLED ANCHORS W/ BRACE STRUT | 102.2 |
| CSBMA | POST INSTALLED ANCHORS W/ BRACE PIPE | 102.3 |
| CSBMA | POST INSTALLED ANCHORS W/ BRACE STRUT | 102.4 |
| STRUT | POST-INSTALLED ANCHORS W/ BRACE PIPE | 102.5 |
| STRUT | POST-INSTALLED ANCHORS W/ BRACE STRUT | 102.6 |

SECTION 103 – SUPPORTS & ATTACHMENT DETAILS TO WIDE FLANGE STEEL BEAMS

| | | |
|-----------------------|---|--------|
| CSBS1, CSBS1A & CSBS2 | BOTTOM FLANGE W/ BRACE PIPE PARALLEL | 103.1 |
| CSBS1, CSBS1A & CSBS2 | BOTTOM FLANGE W/ BRACE PIPE PERPENDICULAR | 103.2 |
| CSBS1 & CSBS2 | BOTTOM FLANGE W/ BRACE STRUT PARALLEL | 103.3 |
| CSBS1 & CSBS2 | BOTTOM FLANGE W/ BRACE STRUT PERPENDICULAR | 103.4 |
| CSBS1, CSBS1A & CSBS2 | TOP FLANGE W/ BRACE PIPE PARALLEL | 103.5 |
| CSBS1, CSBS1A & CSBS2 | TOP FLANGE W/ BRACE PIPE PERPENDICULAR | 103.6 |
| CSBS1 & CSBS2 | TOP FLANGE W/ BRACE STRUT PARALLEL | 103.7 |
| CSBS1 & CSBS2 | TOP FLANGE W/ BRACE STRUT PERPENDICULAR | 103.8 |
| CSBS3, CSBS4 & CSBS5 | BOTTOM FLANGE W/ BRACE PIPE PARALLEL | 103.9 |
| CSBS3, CSBS4 & CSBS5 | BOTTOM FLANGE W/ BRACE PIPE PERPENDICULAR | 103.10 |
| CSBU | BOTTOM FLANGE W/ BRACE PIPE PARALLEL | 103.11 |
| CSBU | BOTTOM FLANGE W/ BRACE PIPE PERPENDICULAR | 103.12 |
| CSBU | BOTTOM FLANGE W/ BRACE STRUT PARALLEL | 103.13 |
| CSBU | BOTTOM FLANGE W/ BRACE STRUT PERPENDICULAR | 103.14 |
| CSBU | TOP FLANGE W/ BRACE PIPE PERPENDICULAR | 103.15 |
| CSBU | TOP FLANGE W/ BRACE STRUT PERPENDICULAR | 103.16 |
| CSBU | SIDE WEB W/ BRACE PIPE PERPENDICULAR | 103.17 |
| CSBU | SIDE WEB W/ BRACE STRUT PERPENDICULAR | 103.18 |
| CSBBS1 | TOP OR BOTTOM FLANGE W/ RESTRAINT ROD | 103.19 |
| CSBBS3 | W/ MODEL 300 BEAM CLAMP TO TOP OR BOTTOM FLANGE W/ RESTRAINT ROD | 103.20 |
| L-BRACKETS | ..... | 103.21 |
| CSBS1 & CSBS2 | BOTTOM FLANGE W/ CSBT BRACE PERPENDICULAR | 103.22 |



SHEET TITLE: TABLE OF CONTENTS (CONTINUED)



CYS STRUCTURAL ENGINEERS, INC.

2495 NATOMAS PARK DRIVE, SUITE 650
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TEL (916) 920-2020
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| | |
|---------|------------|
| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 0.5 of . |

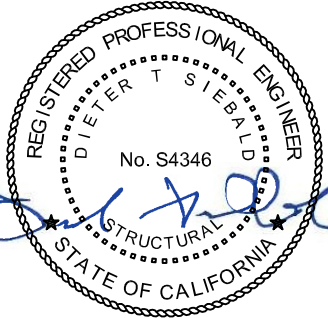
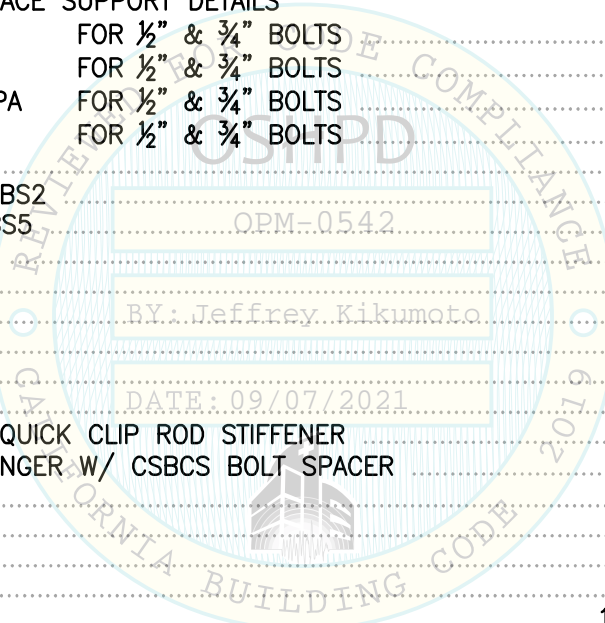
SEISMIC BRACING FOR
MEP SYSTEMS



TABLE OF CONTENTS

PAGE

| | | |
|--|--|--------|
| SECTION 104 – SUPPORTS & ATTACHMENT DETAILS TO TOP CHORD OF STEEL BAR JOISTS | | |
| CSBS1 | TO VERTICAL LEG W/ BRACE PIPE PARALLEL | 104.1 |
| CSBS1 | TO VERTICAL LEG W/ BRACE PIPE PERPENDICULAR | 104.2 |
| CSBS1 | TO VERTICAL LEG W/ BRACE STRUT PARALLEL | 104.3 |
| CSBS1 | TO VERTICAL LEG W/ BRACE STRUT PERPENDICULAR | 104.4 |
| CSBS1 | TO HORIZONTAL LEG W/ BRACE PIPE PARALLEL | 104.5 |
| CSBS1 | TO HORIZONTAL LEG W/ BRACE PIPE PERPENDICULAR | 104.6 |
| CSBS1 | TO HORIZONTAL LEG W/ BRACE STRUT PARALLEL | 104.7 |
| CSBS1 | TO HORIZONTAL LEG W/ BRACE STRUT PERPENDICULAR | 104.8 |
| CSBBS1 | TO HORIZONTAL LEG W/ RESTRAINT ROD PERPENDICULAR OR PARALLEL | 104.9 |
| SECTION 105 – SUPPORTS & ATTACHMENT DETAILS TO STEEL C OR Z PURLINS | | |
| CSBBS1 | TO HORIZONTAL LEG W/ RESTRAINT ROD PERPENDICULAR OR PARALLEL | 105.1 |
| SECTION 106 – SEISMIC BRACE SUPPORT DETAILS | | |
| CSBU1 & CSBU2 | FOR 1/2" & 3/4" BOLTS | 106.1 |
| CSBUS1 & CSBUS2 | FOR 1/2" & 3/4" BOLTS | 106.2 |
| CSBUS1PA & CSBUS2PA | FOR 1/2" & 3/4" BOLTS | 106.3 |
| CSBMA | FOR 1/2" & 3/4" BOLTS | 106.4 |
| STRUT CHANNEL | ..... | 106.5 |
| CSBS1, CSBS1A & CSBS2 | ..... | 106.6 |
| CSBS3, CSBS4 & CSBS5 | ..... | 106.7 |
| CSBBS1 & CSBBS3 | ..... | 106.8 |
| NOT USED | ..... | 106.9 |
| 325 L-BRACKET | ..... | 106.10 |
| 328 L-BRACKET | ..... | 106.11 |
| 329 L-BRACKET | ..... | 106.12 |
| NOT USED | ..... | 106.13 |
| CSBRS NVENT CADDY QUICK CLIP ROD STIFFENER | ..... | 106.14 |
| CADDY 401 CLEVIS HANGER W/ CSBCS BOLT SPACER | ..... | 106.15 |
| CSB | ..... | 106.16 |
| CSBR1 | ..... | 106.17 |
| CSBR2 | ..... | 106.18 |
| NOT USED | ..... | 106.19 |
| CSBQIKCL | ..... | 106.20 |
| CSBQG | ..... | 106.21 |
| CSBBRP | ..... | 106.22 |
| CCC | ..... | 106.23 |
| SCH | ..... | 106.24 |
| USC | ..... | 106.25 |
| BC200000EG | ..... | 106.27 |
| EZ RISER CLAMP | ..... | 106.28 |
| ERICO STRUT NUT | ..... | 106.29 |



SHEET TITLE: TABLE OF CONTENTS (CONTINUED)



CYS STRUCTURAL ENGINEERS, INC.

2495 NATOMAS PARK DRIVE, SUITE 650
SACRAMENTO, CA 95833

TEL (916) 920-2020
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| | |
|---------|------------|
| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 0.6 of . |

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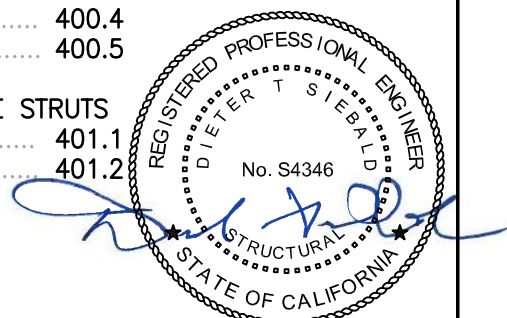
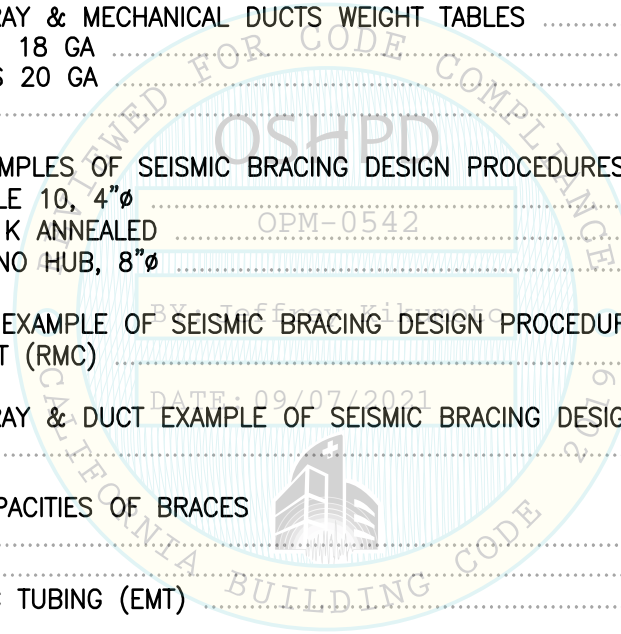
**SEISMIC BRACING FOR
MEP SYSTEMS**



TABLE OF CONTENTS

PAGE

| | |
|---|--------|
| SECTION 200 – PIPE TRANSVERSE BRACE SPACING TABLES | |
| STEEL PIPE SCHEDULE LW (LIGHT-WALL SCHEDULE 7) | 200.1 |
| STEEL PIPE SCHEDULE 10 | 200.2 |
| STEEL PIPE SCHEDULE 40 | 200.3 |
| COPPER PIPE TYPE K DRAWN W/ SOLDERED JOINTS | 200.4 |
| COPPER PIPE TYPE K ANNEALED | 200.5 |
| COPPER PIPE TYPE L DRAWN W/ SOLDERED JOINTS | 200.6 |
| COPPER PIPE TYPE L ANNEALED | 200.7 |
| CAST IRON PIPE – NO HUB | 200.8 |
| SECTION 201 – ELECTRICAL CONDUIT TRANSVERSE BRACE SPACING TABLES | |
| RIGID METAL CONDUIT (RMC) | 201.1 |
| INTERMEDIATE METAL CONDUIT (IMC) | 201.2 |
| ELECTRICAL METALLIC TUBING (EMT) | 201.3 |
| SECTION 202 – CABLE TRAY & MECHANICAL DUCTS WEIGHT TABLES | |
| RECTANGULAR DUCTS 18 GA | 202.1 |
| RECTANGULAR DUCTS 20 GA | 202.2 |
| ROUND DUCTS | 202.3 |
| SECTION 300 – PIPE EXAMPLES OF SEISMIC BRACING DESIGN PROCEDURES | |
| STEEL PIPE SCHEDULE 10, 4"Ø | 300.1 |
| COPPER PIPE, TYPE K ANNEALED | 300.10 |
| CAST IRON PIPE – NO HUB, 8"Ø | 300.20 |
| SECTION 301 – CONDUIT EXAMPLE OF SEISMIC BRACING DESIGN PROCEDURES | |
| RIGID METAL CONDUIT (RMC) | 301.1 |
| SECTION 302 – CABLE TRAY & DUCT EXAMPLE OF SEISMIC BRACING DESIGN PROCEDURES | |
| RECTANGULAR DUCT | 302.1 |
| SECTION 400 – AXIAL CAPACITIES OF BRACES | |
| PIPES | 400.1 |
| STRUTS | 400.2 |
| ELECTRICAL METALLIC TUBING (EMT) | 400.3 |
| RESTRAINT RODS | 400.4 |
| TENSION CABLES | 400.5 |
| SECTION 401 – AXIAL & FLEXURAL CAPACITIES OF HORIZONTAL TRAPEZE STRUTS | |
| 12 GA SINGLE STRUT | 401.1 |
| 12 GA DOUBLE STRUT | 401.2 |



SHEET TITLE: TABLE OF CONTENTS (CONTINUED)



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| | |
|---------|------------|
| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 0.7 of . |

C:\Users\camachom\appdata\local\temp\AcPublish_39788\S1_Erico MEP.dwg Time: Sep 08, 2021 - 10:25am Login: camachom DimScale: 8 LScale: 4

SEISMIC BRACING FOR
MEP SYSTEMS



TABLE OF CONTENTS

PAGE

| | |
|--|-------|
| SECTION 500 – CAPACITY TABLES OF BRACE SUPPORTS AT SYSTEM COMPONENTS | |
| CSBQIKCL | 500.1 |
| CSB | 500.2 |
| CSB, CSBBRP, CSBQG & CSBT | 500.3 |
| CSBCS, CSBR1, CSBR2, CSBTR, SCH-B & BC200000BG | 500.4 |
| USC & CCC | 500.5 |
| TABLE FOOTNOTES | 500.6 |
| SECTION 600 – CAPACITY TABLE OF BRACE SUPPORTS AT SUPPORTING STRUCTURE | |
| CSBBRS, CSBU, CSBS, CSBUS & CSBMA | 600.1 |
| TABLE FOOTNOTES | 600.2 |

APPENDICES:

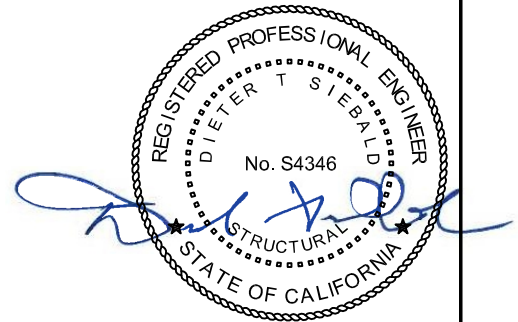
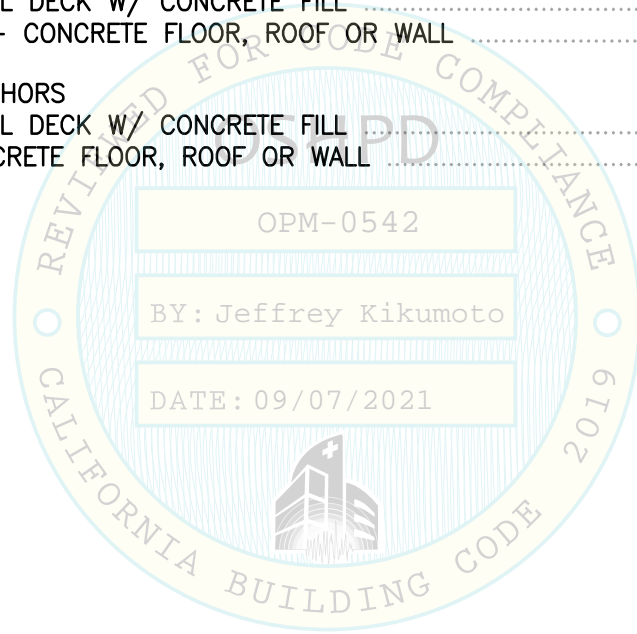
APPENDIX 'A': CAPACITY TABLES OF ANCHORS

MECHANICAL ANCHORS

| | |
|--|----|
| CASE 1 – METAL DECK W/ CONCRETE FILL | A1 |
| CASES 2 & 3 – CONCRETE FLOOR, ROOF OR WALL | A3 |

CAST-IN-PLACE ANCHORS

| | |
|---|----|
| CASE 4 – METAL DECK W/ CONCRETE FILL | A5 |
| CASE 5 – CONCRETE FLOOR, ROOF OR WALL | A6 |



SHEET TITLE: TABLE OF CONTENTS (CONTINUED)



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| | |
|---------|------------|
| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 0.8 of . |

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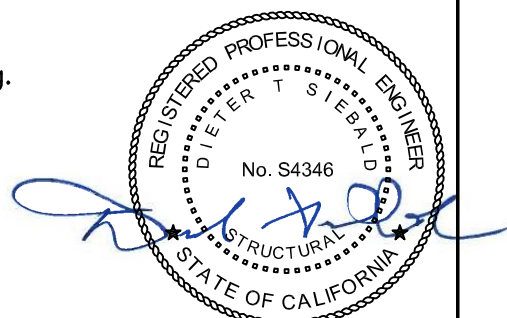
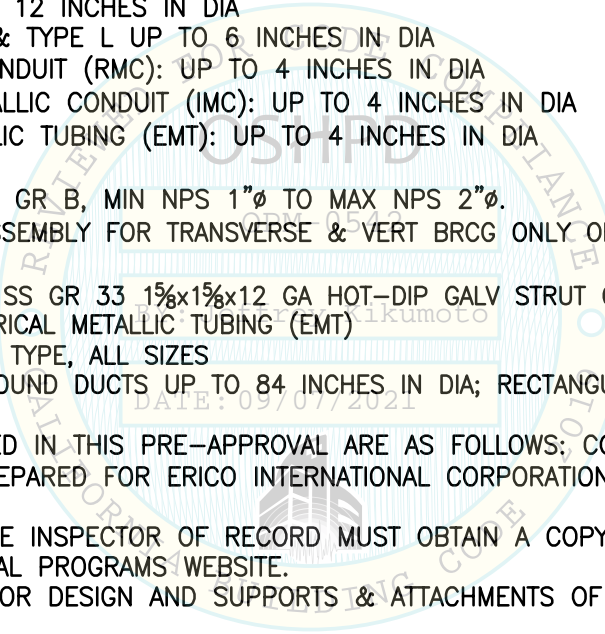
SEISMIC BRACING FOR MEP SYSTEMS



CONDITIONS OF USE:

1. THIS OSHPD PRE-APPROVAL OF MANUFACTURER'S CERTIFICATION (OPM) IS BASED ON THE CBC 2019. THE DEMAND (DESIGN FORCES) FOR USE W/ THIS OPM MUST BE BASED ON THE CBC 2019.
2. THIS PRE-APPROVAL IS FOR THE SEISMIC BRCG OF INTERIOR PIPES, CONDUITS, CABLE TRAYS AND DUCTS. IT DOES NOT ADDRESS OTHER LOADS SUCH AS, BUT NOT LIMITED TO, THOSE GENERATED BY THERMAL EXPANSION, PRESSURE, FLUID DYNAMICS, PIPE RUPTURE OR MOVEMENTS OF EQUIPMENT TO WHICH BRACE COMPONENTS ARE ATTACHED. IT DOES NOT ADDRESS COMPONENTS THAT CROSS SEISMIC SEPARATIONS OF BLDGS. NOR DOES IT ADDRESS COMPONENTS (OTHER THAN PIPE RISERS) ATTACHED TO PORTIONS OF THE STRUCTURE OR EQUIPMENT THAT WILL EXPERIENCE RELATIVE SEISMIC DISPLACEMENT. THE RANGE OF COMPONENT SIZES AND MATERIAL INCLUDED IN THE PRE-APPROVAL ARE AS FOLLOWS:
 - A. SERVICE PIPE/CONDUIT DIAMETERS:
 - STEEL: SCHEDULE 10 UP TO 12 INCHES IN DIA
(INCLUDES 0.188, REFER TO SECTION 500, FOOTNOTES g & h)
 - STEEL: SCHEDULE 40 UP TO 12 INCHES IN DIA
 - STEEL: SCHEDULE LW (i.e., SCHEDULE 7, REFER TO SECTION 500 TABLE, FOOTNOTE c) UP TO 6 INCHES IN DIA
 - CAST IRON: UP TO 12 INCHES IN DIA
 - COPPER: TYPE K & TYPE L UP TO 6 INCHES IN DIA
 - RIGID METALLIC CONDUIT (RMC): UP TO 4 INCHES IN DIA
 - INTERMEDIATE METALLIC CONDUIT (IMC): UP TO 4 INCHES IN DIA
 - ELECTRICAL METALLIC TUBING (EMT): UP TO 4 INCHES IN DIA
 - B. BRACE PIPES:
 - STEEL: ASTM® A53 GR B, MIN NPS 1"Ø TO MAX NPS 2"Ø.
 - C. TELESCOPIC BRACE ASSEMBLY FOR TRANSVERSE & VERT BRCG ONLY OF 1"Ø TO 4"Ø SERVICE PIPES.
 - D. BRACE STRUTS:
 - STEEL: ASTM A653 SS GR 33 1½x1½x12 GA HOT-DIP GALV STRUT CHANNEL.
 - E. BRACE TUBING: ELECTRICAL METALLIC TUBING (EMT)
 - F. CABLE TRAYS: LADDER TYPE, ALL SIZES
 - G. GALVANIZED DUCTS: ROUND DUCTS UP TO 84 INCHES IN DIA; RECTANGULAR DUCTS UP TO 120 INCHES IN WIDTH.

THE SUBSTRATES INCLUDED IN THIS PRE-APPROVAL ARE AS FOLLOWS: CONC, CONC/MTL DECK, & STL.
3. THESE DRAWINGS ARE PREPARED FOR ERICO INTERNATIONAL CORPORATION, A DIVISION OF NVENT, SOLON, OHIO 44139.
4. THE CONTRACTOR AND THE INSPECTOR OF RECORD MUST OBTAIN A COPY OF THIS PRE-APPROVAL FROM THE OSHPD PRE-APPROVAL PROGRAMS WEBSITE.
5. THIS PRE-APPROVAL IS FOR DESIGN AND SUPPORTS & ATTACHMENTS OF MEP SYSTEM SEISMIC SWAY BRACING ONLY.
6. THIS PRE-APPROVAL IS LIMITED TO INDOOR USE.
7. THE MAX ALLOWABLE S_{DS} FOR THIS PRE-APPROVAL IS LIMITED TO 2.5g.



SHEET TITLE: OVERVIEW & GENERAL NOTES
CONDITIONS OF USE

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| | | | Page: | 1.1 of . |

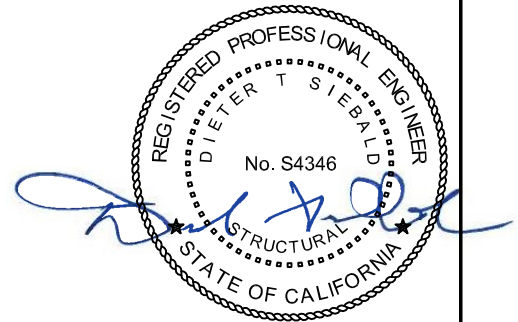
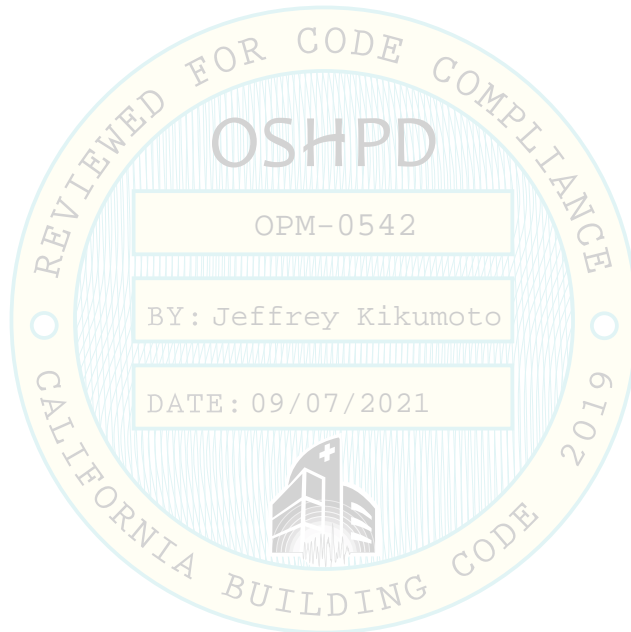
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SEISMIC BRACING FOR MEP SYSTEMS



SCOPE:

1. THIS PRE-APPROVAL MAY BE USED FOR SEISMIC BRACING OF 1"Ø TO 12"Ø SERVICE (RUN) PIPES OR CONDUITS, OR CABLE TRAYS, OR RECTANGULAR & ROUND DUCTS.
2. IN ADDITION, THIS PRE-APPROVAL MAY BE USED FOR SEISMIC BRACE ATTACHMENTS TO THE UNDERSIDE OF CONC FLRS OR ROOF W/ OR WITHOUT MTL DECK, TO THE FACE OF CONC WALLS, TO WF STL BMS, TO OPEN WEB STL JOISTS, OR TO STL PURLINS (RESTRAINTS ONLY).



**SHEET TITLE: OVERVIEW & GENERAL NOTES
SCOPE**

| | | | |
|--|---------------------------------------|---------|------------|
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| | 2495 NATOMAS PARK DRIVE, SUITE 650 | Date: | 09/08/2021 |
| | SACRAMENTO, CA 95833 | Page: | 1.2 of . |
| | TEL (916) 920-2020 www.cyseng.com | | |

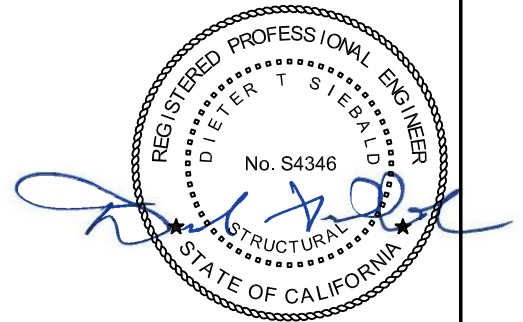
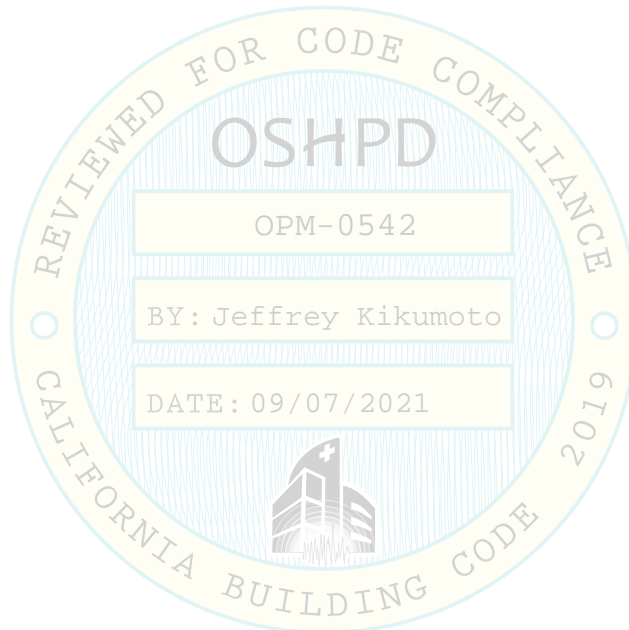
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SEISMIC BRACING FOR
MEP SYSTEMS



CONSTRUCTION TOLERANCES:

1. CONSTRUCTION TOLERANCES MUST BE AS NOTED ON THE DRAWING ATTACHMENT DTLs AND SECTION 500.
2. CONSTRUCTION TOLERANCE FOR ANGLES OF ALL BRACES FROM HORIZ MUST BE LIMITED TO ± 5 DEGREES.
3. CONSTRUCTION TOLERANCE FOR VERT SEISMIC BRACES FROM VERT MUST BE LIMITED TO ± 5 DEGREES.



SHEET TITLE: OVERVIEW & GENERAL NOTES
CONSTRUCTION TOLERANCES



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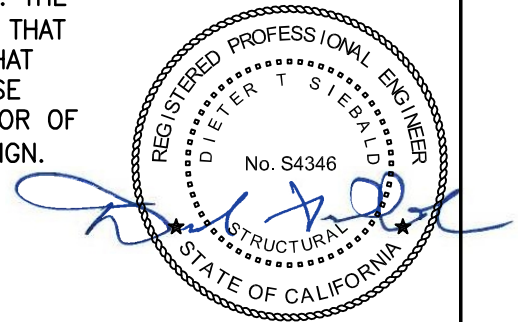
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|---------|------------|
| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 1.3 of . |

SEISMIC BRACING FOR MEP SYSTEMS



HOW TO USE THIS PRE-APPROVAL:

1. THIS PRE-APPROVAL MAY BE USED FOR THE DESIGN OF SEISMIC SWAY BRCG OF MEP SYSTEMS. A CALIFORNIA LICENSED STRUCTURAL ENGINEER (CLSE) HAS DESIGNED THIS PRE-APPROVAL, ALONG W/ SUPPORTING CALCULATIONS. THEREFORE, THE PRE-APPROVED DTLs AND CALCULATIONS ARE NOT TO BE RE-REVIEWED BY REGIONAL STAFF. HOWEVER, EA MEP SYSTEM REQUIRES SUBMITTALS THAT MUST BE REVIEWED AND APPROVED BY OSHPD.
2. AS W/ ALL PRE-APPROVED DTLs, SYSTEMS, ETC., PLANS (i.e. LAYOUT DRAWINGS) ARE STILL REQ SHOWING HOW AND WHERE THIS PRE-APPROVED SUPPORTS, ATTACHMENTS AND BRCG SYSTEM WILL BE APPLIED TO THE MEP SYSTEM ON A PROJECT SPECIFIC BASIS. THIS PROCESS IS NEEDED TO VERIFY THAT THE APPROPRIATE DTL HAS BEEN SELECTED AND APPLIED FOR EA CONDITION AND FOR THE ACTUAL SUBSTRATE THAT IT WILL BE CONNECTED/ATTACHED TO. FOR THE MEP SYSTEM, THESE PLANS MUST BE PREPARED, STAMPED & SIGNED BY A CALIFORNIA REGISTERED DESIGN PROFESSIONAL (CRDP). SEE 2019 CAC SECTION 7-115.
 - A. THE CRDP REVIEWING THE BRACE SYSTEM IS RESPONSIBLE FOR THE ADEQUACY OF THE DESIGN AND APPLICATION OF THIS OPM.
 - B. THE CRDP MUST ARRANGE AND DESIGN THE TRANSVERSE, LONGITUDINAL AND VERT SEISMIC BRACES SO THAT THERE IS A VERT SEISMIC BRACE NO MORE THAN 6" FROM EA TRANSVERSE AND EA LONGITUDINAL BRACE MEMBER. FOR VERT SEISMIC BRACES SEE SECTION 8. PLEASE NOTE THAT A TYP VERT SERVICE PIPE ROD HANGER IS NOT A VERT SEISMIC BRACE.
 - C. THE CRDP MUST CHECK THE VERT SEISMIC BRACE ASSEMBLY FOR BOTH TENSION AND COMPRESSION LOADS AND DETERMINE WHETHER THE VERT SEISMIC BRACE ASSEMBLY OF THE BRCG SYSTEM REQUIRES COMPRESSION STIFFENERS OR OTHER STRENGTHENING. THE TENSION LOADS ON THE VERT SEISMIC BRACE ASSEMBLY MUST INCLUDE THE MAX TRIBUTARY DEAD LOAD, THE VERT COMPONENTS OF THE TRANSVERSE AND/OR LONGITUDINAL BRACES, AND THE TRIBUTARY VERT SEISMIC LOAD. COMPRESSION LOADS ON THE VERT SEISMIC BRACE ASSEMBLY MUST INCLUDE THE VERT COMPONENTS OF THE TRANSVERSE AND/OR LONGITUDINAL BRACES, AND 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.
 - D. THE CRDP MUST ARRANGE THE ANCHORS TO ENSURE THAT THEY CAN BE INSTALLED IN ACCORDANCE W/ THE PRE-APPROVAL AND THAT THERE ARE NO SLAB EDGES, OPENINGS, OR OTHER ANCHORS NEAR ENOUGH TO THE ANCHORS TO REDUCE THEIR ALLOWABLE CAPACITIES. THE ALLOWABLE CAPACITIES INDICATED IN APPENDIX A OF THIS OPM ARE BASED ON A MIN DISTANCE TO EDGE OF CONC, AS SHOWN IN THE ALLOWABLE LOAD TABLE IN APPENDIX A AND APPLICABLE LOAD COMBINATIONS PER ASCE 7 SECTION 12.4 IN THE ANALYSIS. THE ALLOWABLE ANCHOR CAPACITIES ARE FOR USE IN THE INTERACTION EQUATION PER ACI 318-14 SECTION 17.6.
3. THIS PRE-APPROVAL RELIES ON A PRESCRIPTIVE COOKBOOK APPROACH. THE PRE-APPROVED DTLs HAVE TABLES AND CHARTS ASSOCIATED W/ THEM THAT MUST BE USED TO SELECT THE APPROPRIATE DTL 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 RECORDS (IOR), WHOSE RESPONSIBILITY IS TO INSPECT ONLY, NOT DESIGN.



SHEET TITLE: OVERVIEW
HOW TO USE THIS PRE-APPROVAL

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|--|--|--------------------------------------|----------|
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| | | Page: | 1.4 of . |

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SEISMIC BRACING FOR
MEP SYSTEMS




HOW TO USE THIS PRE-APPROVAL (CONTINUED):

4. THE STRUCTURAL ENGINEER OF RECORD (SEOR) MUST REVIEW AND FORWARD THE SUPPORTS, ATTACHMENTS AND BRCG PLANS FOR PLAN CHECK W/ A NOTATION INDICATING THAT THE PLANS HAVE BEEN REVIEWED AND THEY HAVE BEEN FOUND TO BE IN GENERAL CONFORMANCE W/ THE DESIGN OF THE PROJECT; SEE CAC SECTION 7-126. A "SHOP DRAWING STAMP" IS USUALLY ACCEPTABLE FOR COMPLIANCE W/ THIS REQUIREMENT.
5. THE REGIONAL STAFF, ON A PROJECT SPECIFIC BASIS, MUST REVIEW SUPPORTS, ATTACHMENTS AND BRCG DTLS AND SUPPORTING CALCULATIONS THAT ARE NOT PART OF THIS PRE-APPROVAL. REVIEW OF SUPPORTS, ATTACHMENTS AND BRCG DTLS OF THIS NATURE DO NOT CONSTITUTE A PRE-APPROVAL THAT MAY BE USED ON OTHER PROJECTS WITHOUT THE BENEFIT OF PLAN REVIEW AND APPROVAL.
6. LAYOUT DRAWINGS:
 - A. LAYOUT DRAWINGS OF THE SUPPORT AND BRCG SYSTEMS PER THIS PRE-APPROVAL MUST BE SUBMITTED TO THE DISCIPLINE IN RESPONSIBLE CHARGE OF THE PROJECT FOR REVIEW TO VERIFY THAT THE DTLS ARE IN CONFORMANCE W/ ALL CODE REQUIREMENTS. THE LAYOUT DRAWINGS MUST BE IN ACCORDANCE W/ ASCE® 7-16 SECTION 13.6 (INCLUDING SUPPLEMENT #1 & CH 13 ERRATA) AS MODIFIED BY THE CBC 2019 SECTION 1617A.
 - a) THE STRUCTURAL ENGINEER OF RECORD (SEOR) MUST VERIFY THAT THE SUPPORTING STRUCTURE IS ADEQUATE FOR THE LOADS IMPOSED ON IT BY THE SUPPORTS AND BRACES INSTALLED PER THE PRE-APPROVAL IN ADDITION TO ALL OTHER LOADS.
 - b) THE SEOR WILL FORWARD THE SUPPORTS, ATTACHMENTS AND BRCG PLANS (INCLUDING APPROVED CHANGE ORDERS FOR SUPPLEMENTARY FRAMING WHERE REQ) TO THE DISCIPLINE IN RESPONSIBLE CHARGE W/ A NOTATION INDICATING THAT THE PLANS HAVE BEEN REVIEWED AND ARE IN GENERAL CONFORMANCE W/ THIS PRE-APPROVAL, THE DESIGN OF THE PROJECT (CAC 2019, SECTION 7-153).
 - c) A "SHOP DRAWING STAMP" MAY BE USED TO INDICATE COMPLIANCE W/ THIS REQUIREMENT.
 - d) THE CALIFORNIA REGISTERED DESIGN PROFESSIONAL (CRDP OTHER THAN SEOR) MAY PROVIDE THE SHOP DRAWING STAMP FOR SMALL INSTALLATIONS AT THE DISCRETION OF THE OSHPD DISTRICT STRUCTURAL ENGINEER.
 - B. THE SEOR MUST DESIGN ANY SUPPLEMENTARY FRAMING THAT IS NEEDED TO RESIST THE LOADS, MAINTAIN STABILITY AND/OR IS REQ FOR INSTALLATION OF THIS PRE-APPROVAL. THE SUPPLEMENTARY FRAMING MUST BE SUBMITTED TO OSHPD AS AN "AMENDED CONSTRUCTION DOCUMENT" (ACD).
 - C. THE LAYOUT DRAWINGS (W/ THE SHOP DRAWING STAMP) MUST BE SUBMITTED TO OSHPD FOR REVIEW OF THE FOLLOWING:
 - a) STRUCTURE SUPPORTING THE DISTRIBUTION SYSTEM HAS ADEQUATE CAPACITY.
 - b) SEISMIC DESIGN FORCES (F_p) ARE IN ACCORDANCE W/ CBC 2019.
 - c) VERIFY THAT THE SUBMITTAL IS WITHIN THE SCOPE OF OSHPD PRE-APPROVAL OF MANUFACTURER'S CERTIFICATION (OPM):
 - SIZE AND DISTRIBUTION SYSTEM COMPONENTS
 - SPACING OF BRCG AND FLEX JOINTS, AND
 - SUBSTRATE FOR ATTACHMENTS
 FOR EXAMPLE PROBLEMS SHOWING CALCULATIONS OF ELEMENTS AND SELECTION OF ELEMENTS TO SATISFY THE DEMANDS FROM THE OPM, SEE SECTION 300.



SHEET TITLE: OVERVIEW & GENERAL NOTES
HOW TO USE THIS PRE-APPROVAL (CONTINUED)

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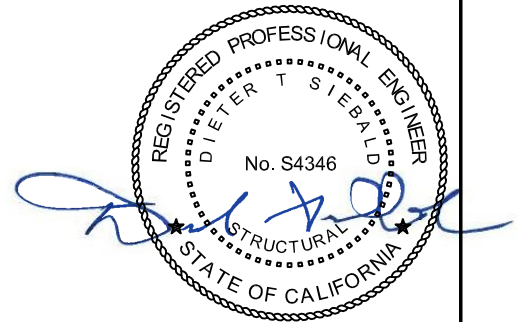
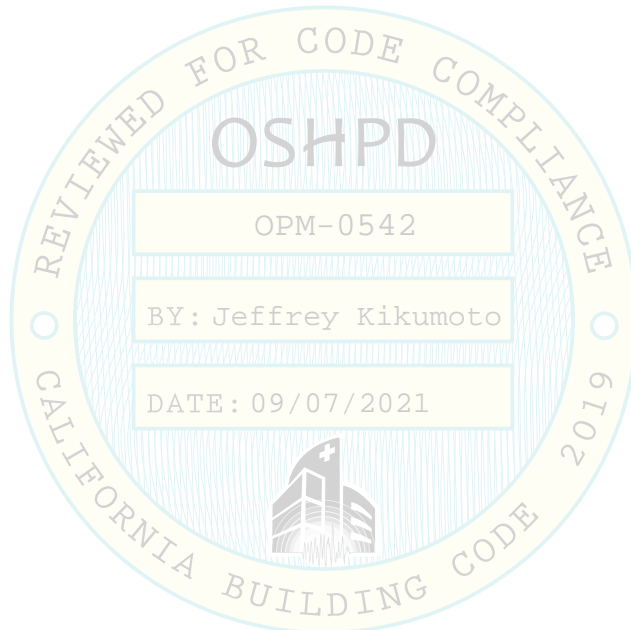
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SEISMIC BRACING FOR
MEP SYSTEMS



HOW TO USE THIS PRE-APPROVAL (CONTINUED):

- 6. LAYOUT DRAWINGS (CONTINUED):
 - D. THE LAYOUT DRAWINGS (W/ THE SHOP DRAWING STAMP) MUST BE KEPT ON THE JOB SITE AND CAN THEN BE USED FOR INSTALLATION OF THE SUPPORT AND BRCG. OSHPD FIELD STAFF WILL REVIEW THE INSTALLATION.
 - E. A COPY OF THIS PRE-APPROVAL MUST BE ON THE JOB SITE PRIOR TO STARTING THE 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 PROGRAMS WEBSITE.
 - F. COMPONENTS OF TWO OR MORE PRE-APPROVED BRCG SYSTEMS MUST NOT BE MIXED. ONLY THIS PRE-APPROVAL MAY BE USED FOR THE MEP SYSTEM. ANY SUBSTITUTION OF COMPONENT OF THIS PRE-APPROVAL MUST REQUIRE OSHPD REVIEW AND APPROVAL.
- 7. IT IS THE RESPONSIBILITY OF THE CRDP DESIGNING THE BRACE SYSTEM, TO VERIFY THAT THE SYSTEM DESIGN IS IN CONFORMANCE W/ THE 2019 CBC SECTION 1617A AND W/ THE DTLS SHOWN IN THIS PRE-APPROVAL.



NOTE:
PAGES 1.7 TO 1.9 NOT USED

SHEET TITLE: OVERVIEW & GENERAL NOTES
HOW TO USE THIS PRE-APPROVAL (CONTINUED)

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|  CYS STRUCTURAL ENGINEERS, INC. 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833 | Job No: 19039 |
| | Date: 09/08/2021 |
| | Page: 1.6 of . |

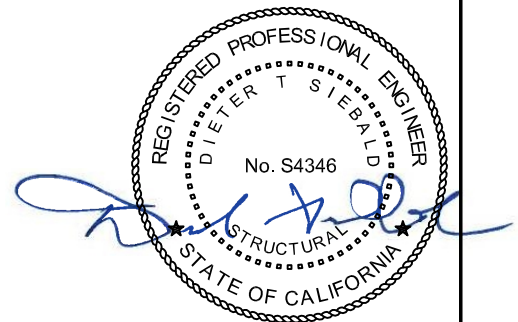
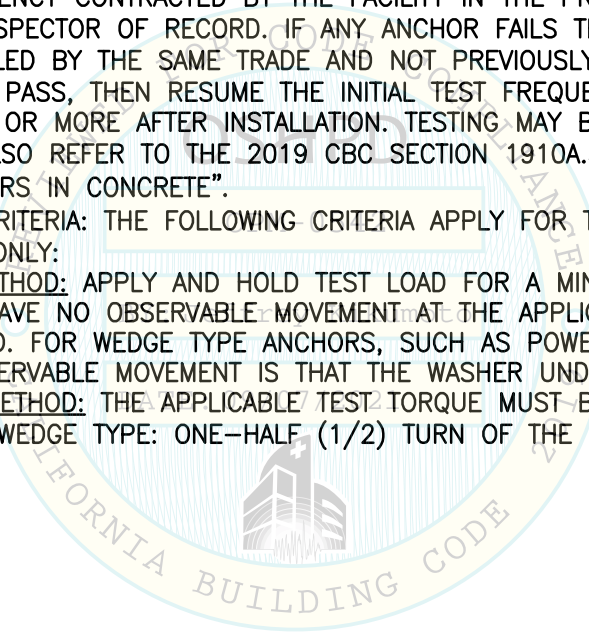
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SEISMIC BRACING FOR
MEP SYSTEMS



MECHANICAL & CAST-IN-PLACE ANCHOR REQUIREMENTS:

1. MECHANICAL & CAST-IN-PLACE ANCHORS:
 - A. ANCHORS INSTALLED IN NWC OR SLWC MUST BE PER ANCHOR TABLES PROVIDED IN THIS MECHANICAL & CAST-IN-PLACE ANCHOR REQUIREMENTS SECTION. INSTALLATION MUST COMPLY W/ SECTION 1617A.1.19 OF THE 2019 CBC. ANCHORS MUST HAVE 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 ANCHOR.
 - B. INSTALLATION: INSTALL THE CONC ANCHORS PER THE PARAMETERS SET FORTH WITHIN THIS OPM & EVALUATION REPORT FOR THE SPECIFIC ANCHOR.
2. MECHANICAL ANCHORS ONLY:
 - A. JOB TESTING FOR MECHANICAL ANCHORS ONLY: FOR VERIFYING SATISFACTORY INSTALLATIONS WORKMANSHIP, PERFORM JOB SITE TESTING IN ACCORDANCE W/ INSTALLATION PARAMETERS TABLE PROVIDED ON THE FOLLOWING PAGES. TEST 50% OF THE INSTALLED ANCHORS. THE TEST LOAD MAY BE APPLIED BY ANY METHOD INCLUDING MFR'S TORQUE CRITERIA TESTING THAT WILL EFFECTIVELY MEASURE THE TENSION IN THE ANCHOR SUCH AS DIRECT PULL W/ A HYDRAULIC JACK OR CALIBRATED SPRING LOADING DEVICES. ALL TESTS MUST BE CONDUCTED BY AN APPROVED TESTING/INSPECTION AGENCY CONTRACTED BY THE FACILITY IN THE PRESENCE OF THE SPECIAL INSPECTOR AND THE INSPECTOR OF RECORD. IF ANY ANCHOR 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. THE TEST MUST BE PERFORMED 24 HOURS OR MORE AFTER INSTALLATION. TESTING MAY BE DONE PRIOR TO SEISMIC BRACE INSTALLATION. ALSO REFER TO THE 2019 CBC SECTION 1910A.5, "TESTS FOR POST-INSTALLED ANCHORS IN CONCRETE".
 - B. FAILURE/ACCEPTANCE CRITERIA: THE FOLLOWING CRITERIA APPLY FOR THE ACCEPTANCE OF MECHANICAL ANCHORS ONLY:
 - HYDRAULIC RAM METHOD: APPLY AND HOLD TEST LOAD FOR A MIN 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 (1/2) TURN OF THE NUT.



SHEET TITLE: OVERVIEW & GENERAL NOTES
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| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 1.10 of . |

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**SEISMIC BRACING FOR
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MECHANICAL & CAST-IN-PLACE ANCHOR REQUIREMENTS (CONTINUED):

2. MECHANICAL ANCHORS ONLY:

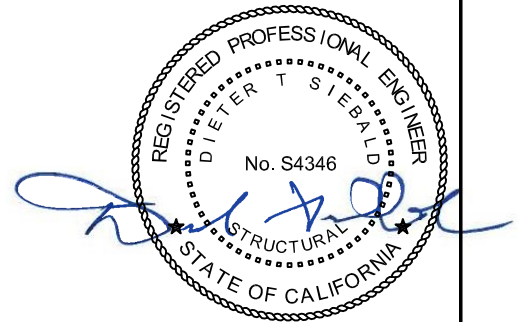
C. INSTALLATION PARAMETERS FOR MECHANICAL ANCHORS:

| MFR | TYPE | ESR REPORT | ANCHOR | NOMINAL | EFFECTIVE | MIN MEMBER | TORQUE |
|-----------------|--------------------------|------------|----------------|------------------|-----------------|-----------------------|-------------------|
| | | | DIAMETER (IN) | EMBED (IN) | EMBED (IN) | THK ¹ (IN) | (FT-LBS) |
| | | | d _a | h _{nom} | h _{ef} | h _{min} | T _{inst} |
| DEWALT / POWERS | Power-Stud+ SD1 | ESR-2818 | 0.5 | 2.5 | 2 | 4 | 40 |
| | | | 0.5 | 3.75 | 3.25 | 6 | 40 |
| | | | 0.75 | 4 | 3.125 | 6 | 110 |
| | | | 0.75 | 5.625 | 4.75 | 10 | 110 |
| | Power-Stud+ SD2 | ESR-2502 | 0.5 | 2.5 | 2 | 4.5 | 40 |
| | | | 0.5 | 3.75 | 3.25 | 5.75 | 40 |
| | | | 0.75 | 4.5 | 3.75 | 7 | 110 |
| | Power-Stud+ SD4 (SS304) | ESR-2502 | 0.5 | 2.5 | 2 | 4 | 40 |
| | | | 0.75 | 4.5 | 3.75 | 6 | 110 |
| | Power-Stud+ SD6 (SS316) | ESR-2502 | 0.5 | 2.5 | 2 | 4 | 40 |
| | | | 0.75 | 4.5 | 3.75 | 6 | 110 |
| | Snake+ | ESR-2272 | 0.375 | 1.63 | 1.1 | 4 | 8 |
| | | | 0.5 | 2.19 | 1.54 | 4 | 36 |
| | Mini-Undercut+ (5/8" OD) | ESR-3912 | 0.375 | 0.75 | 0.75 | 2.5 | 5 |
| Hangermate+ | ESR-3889 | 0.25 | 1.625 | 1.2 | 3.25 | 19 | |
| | | 0.25 | 2.5 | 1.94 | 4 | 25 | |
| HILTI | HDI-P TZ | ESR-4236 | 0.375 | 0.75 | 0.75 | 2.5 | 5 |
| | | | 0.5 | 2.5 | 2 | 4 | 50 |
| | Kwik Bolt TZ2 | ESR-4266 | 0.5 | 3.75 | 3.25 | 6 | 50 |
| | | | 0.75 | 4 | 3.25 | 5.5 | 110 |
| | | | 0.75 | 4.5 | 3.75 | 6 | 110 |
| 0.75 | 5.5 | 4.75 | 8 | 110 | | | |

FOR HILTI KWIK BOLT TZ2 SS TORQUE VALUES ARE AS FOLLOWS:

| ANCHOR DIAMETER (IN) | TORQUE (FT-LBS) |
|-------------------------|--------------------|
| d _a | T _{inst} |
| 0.5 | 40 |
| 0.75 | 125 |

NOTE:
TABLE CONTINUED ON NEXT PAGE



**SHEET TITLE: OVERVIEW & GENERAL NOTES
MECHANICAL & CAST-IN-PLACE REQUIREMENTS (CONTINUED)**

| | | |
|---|--------------------------------------|--|
|  CYS STRUCTURAL ENGINEERS, INC. 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833 | TEL (916) 920-2020 www.cyseng.com | Job No: 19039 Date: 09/08/2021 Page: 1.11 of . |
|---|--------------------------------------|--|

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SEISMIC BRACING FOR MEP SYSTEMS



MECHANICAL & CAST-IN-PLACE ANCHOR REQUIREMENTS (CONTINUED):

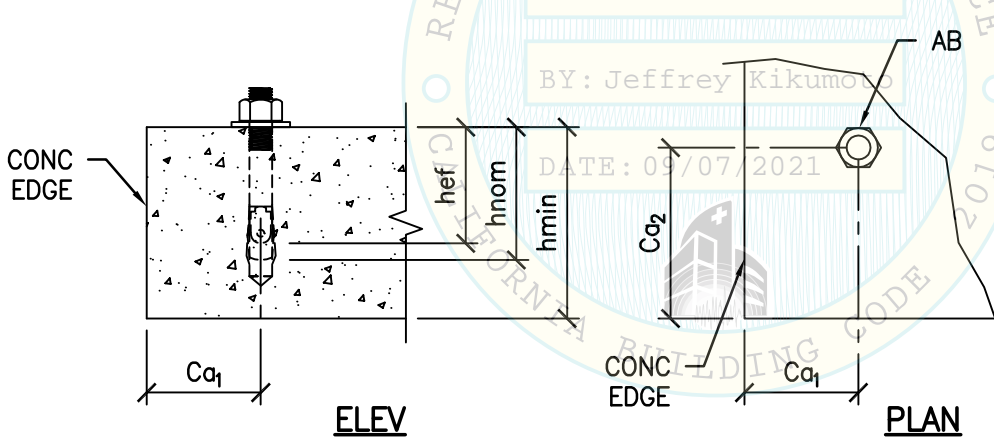
2. MECHANICAL ANCHORS ONLY:

C. INSTALLATION PARAMETERS FOR MECHANICAL ANCHORS:

| MFR | TYPE | ESR REPORT | ANCHOR DIAMETER (IN) d_a | NOMINAL EMBED (IN) h_{nom} | EFFECTIVE EMBED (IN) h_{ef} | MIN MEMBER THK ¹ (IN) h_{min} | TORQUE (FT-LBS) T_{inst} |
|---------|--------------------------|------------|-------------------------------|---------------------------------|----------------------------------|---|-------------------------------|
| SIMPSON | Strong-Tie Strong-Bolt 2 | ESR-3037 | 0.5 | 2.75 | 2.25 | 4 | 60 |
| | | | 0.5 | 3.875 | 3.375 | 5.5 | 60 |
| | | | 0.75 | 4.125 | 3.375 | 6.75 | 150 |
| | | | 0.75 | 5.75 | 5 | 8.75 | 150 |
| | Strong-Tie Titen HD | ESR-2713 | 0.5 | 3.25 | 2.35 | 5 | 65 |
| | | | 0.5 | 4 | 2.99 | 6.25 | 65 |
| | | | 0.75 | 4 | 2.94 | 6 | 150 |
| | | | 0.75 | 5.5 | 4.22 | 8.75 | 150 |
| | | | 0.75 | 6.25 | 4.86 | 10 | 150 |

FOOTNOTES:

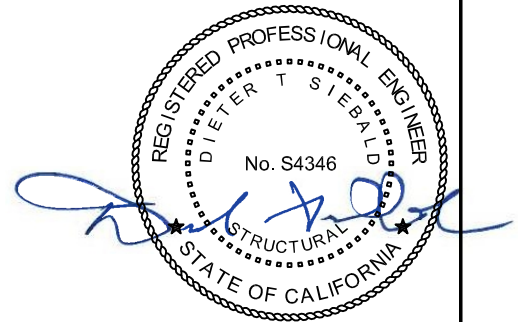
- FOR CASE 1 (STL DECK SOFFIT), REFER TO DTLs IN SECTION 100 FOR MTL DECK & CONC FILL DIMS.
- FOR MIN EDGE DISTANCE, REFER TO DTL BLW.
- FOR LRFD CAPACITY, SEE APPENDIX "A".
- FOR "KB-TZ2" & "HANGERMATE+", DECK STRENGTH MUST BE $F_y = 50,000$ PSI, MIN.



| ANCHOR DIA | C_{a1} (MIN) | C_{a2} (MIN) |
|------------|----------------|----------------|
| 1/4" | 4" | 6" |
| 3/8" | 6" | 9" |
| 1/2" | 8" | 12" |
| 3/4" | 10" | 15" |

MIN EDGE DISTANCE FOR ANCHORS

- C_{a1} IS THE MIN CONC EDGE DISTANCE.
- C_{a2} IS THE MIN CONC EDGE DISTANCE IN THE PERP DIRECTION.



SHEET TITLE: OVERVIEW & GENERAL NOTES

MECHANICAL & CAST-IN-PLACE REQUIREMENTS (CONTINUED)



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| Page: | 1.12 of . |

SEISMIC BRACING FOR
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MECHANICAL & CAST-IN-PLACE ANCHOR REQUIREMENTS (CONTINUED):

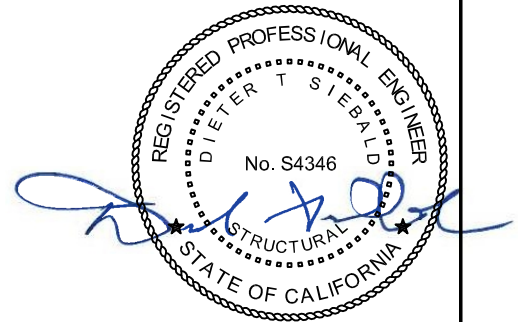
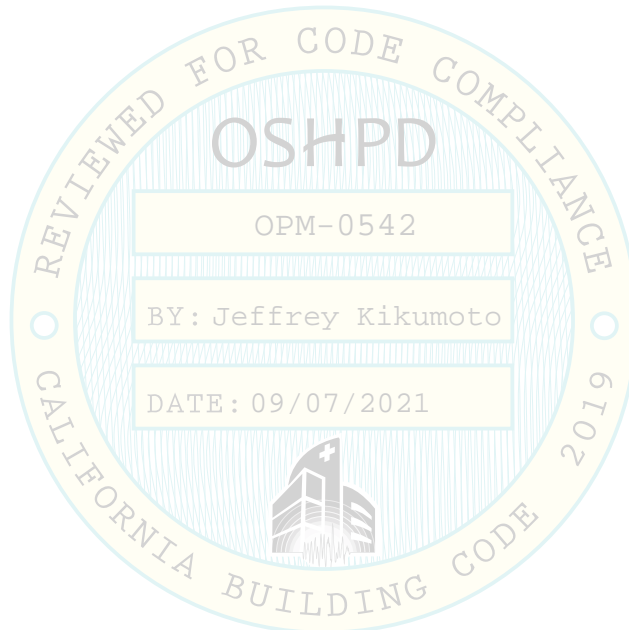
2. MECHANICAL ANCHORS ONLY:

D. THREE (3) CONDITIONS OF POST-INSTALLED ANCHORAGE TO CONC ARE SPECIFIED & PRESENTED IN THIS PRE-APPROVAL:

CASE 1: THE SEISMIC BRACE IS ATTACHED TO THE UNDERSIDE OF A SUSPENDED FLR OR ROOF OF A BLDG. IT IS ASSUMED THE FLRS & ROOF ARE BUILT OF MIN 3/4" NWC OR SLWC TOPPING ($f'_c = 3000$ PSI MIN) OVER 20 GAGE MIN MTL DECK ($F_y = 33,000$ PSI, MIN UNO PER FOOTNOTE 4 IN INSTALLATION PARAMETERS FOR MECHANICAL ANCHORS TABLE ON PG 1.12. INSTALLATION IN THE SOFFIT OF MTL DECK MUST COMPLY W/ MIN REQUIREMENTS NOTED IN SECTION 100 OF THIS OPM.

CASE 2: THE SEISMIC BRACE IS ATTACHED TO THE UNDERSIDE OF A SUSPENDED FLR OR ROOF OF A BLDG. IT IS ASSUMED THE FLRS & ROOF ARE BUILT OF NORMAL WT REINFORCED CONC. ($f'_c = 3000$ PSI, MIN). THK PER TABLE ABV.

CASE 3: THE SEISMIC BRACE IS ATTACHED TO A CONC WALL IN A BLDG. IT IS ASSUMED THE WALLS ARE BUILT OF NORMAL WT REINFORCED CONC ($f'_c = 3000$ PSI, MIN). THK PER TABLE ON PREVIOUS PAGES.



SHEET TITLE: OVERVIEW & GENERAL NOTES
MECHANICAL & CAST-IN-PLACE REQUIREMENTS (CONTINUED)



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SEISMIC BRACING FOR MEP SYSTEMS



MECHANICAL & CAST-IN-PLACE ANCHOR REQUIREMENTS (CONTINUED):

3. CAST-IN-PLACE ANCHORS ONLY:

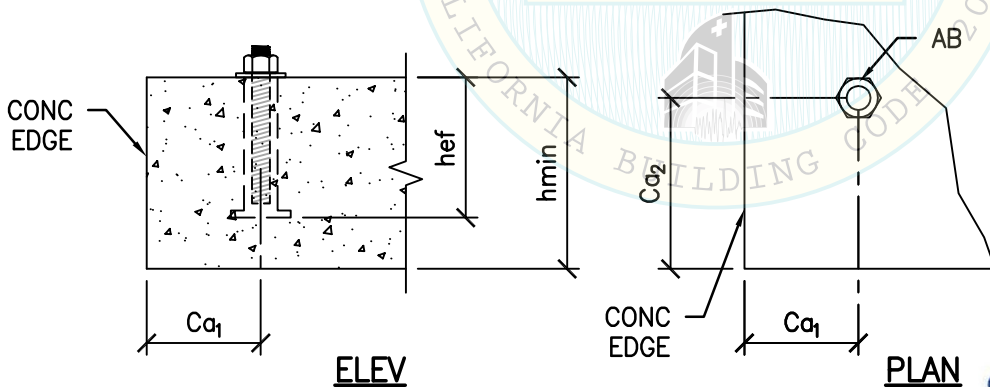
A. INSTALLATION PARAMETERS FOR CAST-IN-PLACE ANCHORS:

| | TYPE | ESR REPORT | ANCHOR | EFFECTIVE | BEARING | MIN MEMBER |
|-----------------|-------------------------|------------|---------------|------------|-------------------------|-----------------------|
| | | | DIAMETER (IN) | EMBED (IN) | AREA (IN ²) | THK ¹ (IN) |
| | | | d_a | h_{ef} | A_{brg} | h_{min} |
| DEWALT / POWERS | Wood-Knocker II+ Insert | ESR-3657 | 0.7 | 1.75 | 1.2 | 3.5 |
| | | | 1 | 1.75 | 1.4 | 3.5 |
| | Bang-It Deck Insert | ESR-3657 | 0.7 | 1.75 | 1.2 | SEE NOTE 1 |
| | | | 1 | 1.75 | 1.4 | |
| | DDI+ Deck Insert | ESR-3958 | 0.375 | 1.5 | 0.17 | |
| | | | 0.5 | 1.75 | 0.28 | |
| | | 0.625 | 2 | 0.45 | | |

FOOTNOTES:

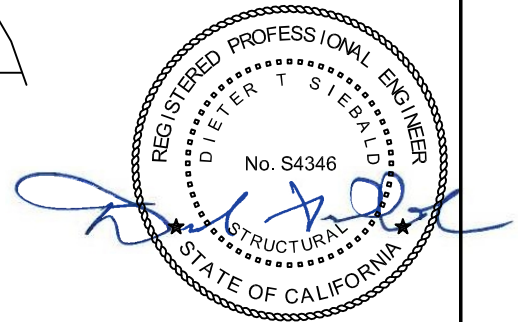
- FOR CASE 1 (STL DECK SOFFIT), REFER TO DTLs IN SECTION 100 FOR MTL DECK & CONC FILL DIMS.
- FOR MIN EDGE DISTANCE, REFER TO DTL BLW.
- FOR LRFD CAPACITY, SEE APPENDIX "A".
- FOR "WOOD-KNOCKER II+" & "BANG-IT" DECK INSERTS PER ESR-3657, THE FOLLOWING LIMITATIONS MUST APPLY:
 - ONLY 1/2", 5/8" & 3/4" SINGLE THRD INSERTS ARE QUALIFIED PER THIS OPM. MULTI-THRD INSERTS ARE NOT ALLOWED.
 - THRD ROD MUST CONFORM TO ASTM A36, ASTM F1554 GRADE A36, ASTM F1554 GR 105 OR ASTM A193 GR B7
- FOR DDI+ INSERT DECK STRENGTH MUST BE $F_y = 50$ KSI, MIN

| ANCHOR DIA | C_{a1} (MIN) | C_{a2} (MIN) |
|------------|----------------|----------------|
| 1/4" | 4" | 6" |
| 3/8" | 6" | 9" |
| 1/2" | 8" | 12" |
| 3/4" | 10" | 15" |



MIN EDGE DISTANCE FOR ANCHORS

- C_{a1} IS THE MIN CONC EDGE DISTANCE.
- C_{a2} IS THE MIN CONC EDGE DISTANCE IN THE PERP DIRECTION.



SHEET TITLE: OVERVIEW & GENERAL NOTES

MECHANICAL & CAST-IN-PLACE REQUIREMENTS (CONTINUED)

| | | | | |
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| | CYS STRUCTURAL ENGINEERS, INC. | | Job No: | 19039 |
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MEP SYSTEMS

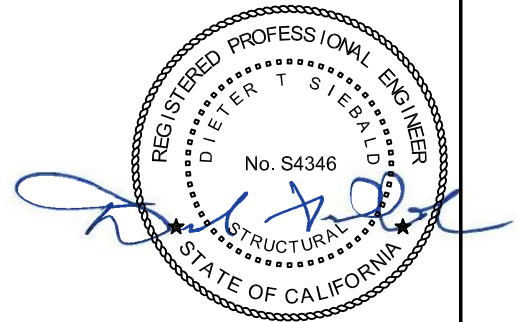
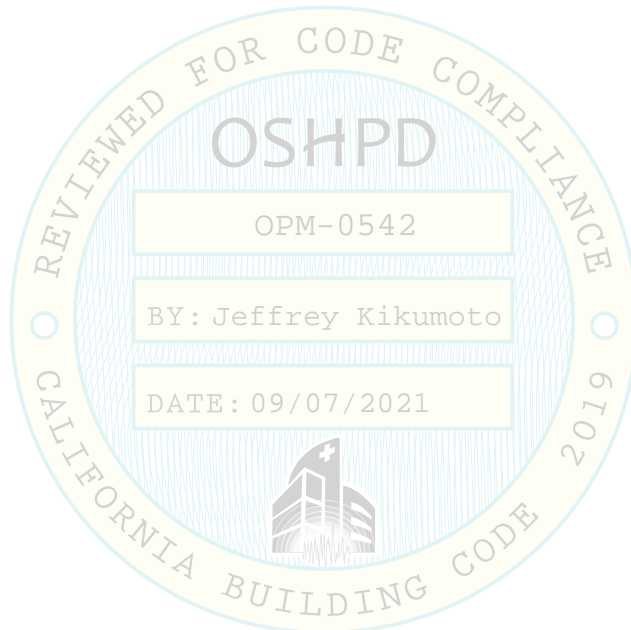


MECHANICAL & CAST-IN-PLACE ANCHOR REQUIREMENTS (CONTINUED):

3B. TWO (2) CONDITIONS OF CAST-IN-PLACE (CIP) ANCHORAGE TO CONC IS SPECIFIED & PRESENTED IN THIS APPROVAL.

CASE 4: THE SEISMIC BRACE IS ATTACHED TO THE UNDERSIDE OF A SUSPENDED FLR OR ROOF OF A BLDG. IT IS ASSUMED THE FLRS & ROOF ARE BUILT OF MIN 3/4" NWC OR SLWC TOPPING (f'c= 3000 PSI MIN) OVER 20 GAGE MIN MTL DECK (Fy = 33,000 PSI, MIN UNO PER CAST-IN-PLACE ANCHOR TABLE FOOTNOTE 5 ON PG 1.14. INSTALLATION IN THE SOFFIT OF MTL DECK MUST COMPLY W/ MIN REQUIREMENTS NOTED IN SECTION 100 OF THIS OPM.

CASE 5: THE SEISMIC BRACE IS ATTACHED TO THE UNDERSIDE OF A SUSPENDED FLR OR ROOF OF A BLDG. IT IS ASSUMED THE FLRS & ROOF ARE BUILT OF MIN 4 1/2" NORMAL WT REINFORCED CONC (f'c = 3000 PSI MIN).



NOTE:
PAGES 1.16 TO 1.19 NOT USED

SHEET TITLE: OVERVIEW & GENERAL NOTES
MECHANICAL & CAST-IN-PLACE REQUIREMENTS (CONTINUED)

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| | Page: 1.15 of . |

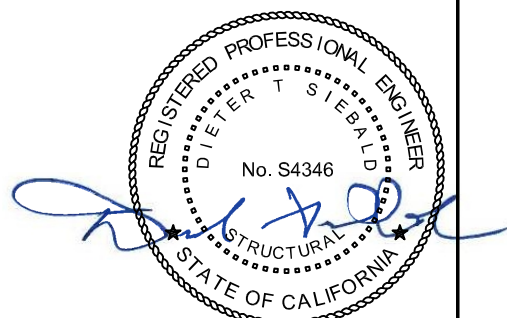
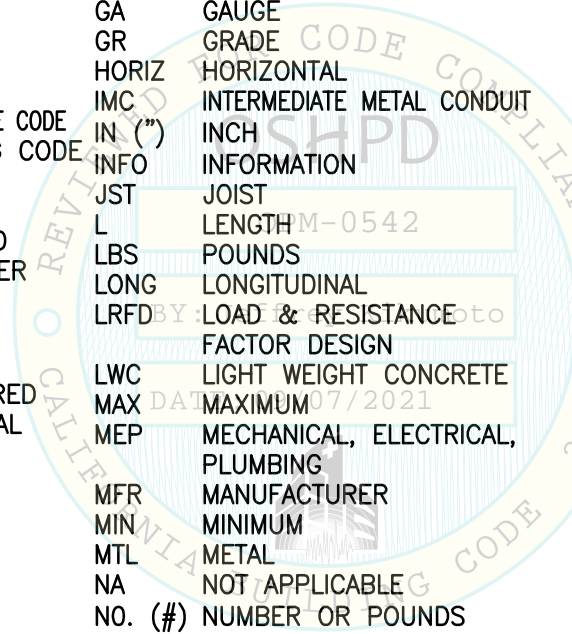
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SEISMIC BRACING FOR MEP SYSTEMS



ABBREVIATIONS

| | | | | | |
|---------|---|---------|---|--------|--|
| ⊙ | AT | f'c | SPECIFIED COMPRESSIVE STRENGTH OF CONCRETE | R | RADIUS OF GYRATION |
| AB | ANCHOR BOLT | | | REINF | REINFORCING/REINFORCEMENT |
| ABV | ABOVE | FLG | FLANGE | REQ | REQUIRED |
| ACI® | AMERICAN CONCRETE INSTITUTE | FLR | FLOOR | RMC | RIGID METAL CONDUIT |
| AISC® | AMERICAN INSTITUTE OF STEEL CONSTRUCTION | FM® | FM APPROVALS (AKA FACTORY MUTUAL) | SCHED | SCHEDULE |
| ALT | ALTERNATE | Fp | HORIZONTAL SEISMIC FORCE PER ASCE/SEI 7-16 SEISMIC FORCE REQUIREMENTS | SDS | SELF-DRILLING SCREW |
| ASCE® | AMERICAN SOCIETY OF CIVIL ENGINEERS | Fvnet | VERTICAL FORCE RESULTANT FROM Fpw | SEOR | STRUCTURAL ENGINEER OF RECORD |
| ASME® | AMERICAN SOCIETY OF MECHANICAL ENGINEERS | Fpv | VERTICAL SEISMIC FORCE PER ASCE 7-16 SEISMIC FORCE REQUIREMENTS | SIM | SIMILAR |
| ASD | ALLOWABLE STRENGTH DESIGN | Fy | SPECIFIED MINIMUM YIELD STRESS OF STEEL, KSI | SLWC | SAND LIGHTWEIGHT CONCRETE |
| ASTM® | AMERICAN SOCIETY FOR TESTING & MATERIALS | GA | GAUGE | SMACNA | SHEET METAL AND AIR CONDITIONING CONTRACTOR'S NATIONAL ASSOCIATION |
| BM | BEAM | GR | GRADE | SMS | SHEET METAL SCREWS |
| BLDG | BUILDING | HORIZ | HORIZONTAL | STL | STEEL |
| BLW | BELOW | IMC | INTERMEDIATE METAL CONDUIT | STRUC | STRUCTURAL |
| BOTT | BOTTOM | IN. (") | INCH | T | ANCHORAGE TENSION REACTION DUE TO SEISMIC FORCE |
| BRCG | BRACING | INFO | INFORMATION | T/C | TENSION OR COMPRESSION |
| BTW | BETWEEN | JST | JOIST | THK | THICK/THICKNESS |
| CAC | CALIFORNIA ADMINISTRATIVE CODE | L | LENGTH | THRD | THREAD/THREADED |
| CBC | CALIFORNIA BUILDING CODE | LBS | POUNDS | TRAN | TRANSVERSE |
| CG | CENTER OF GRAVITY | LONG | LONGITUDINAL | TYP | TYPICAL |
| CIP | CAST-IN-PLACE | LRFD | LOAD & RESISTANCE FACTOR DESIGN | UNO | UNLESS NOTED OTHERWISE |
| CLSE | CALIFORNIA LICENSED STRUCTURAL ENGINEER | LWC | LIGHT WEIGHT CONCRETE | V | ANCHORAGE SHEAR REACTION DUE TO SEISMIC FORCE |
| ⊕ | CENTERLINE | MAX | MAXIMUM | UL® | UNDERWRITERS' LABORATORIES |
| CONC | CONCRETE | MEP | MECHANICAL, ELECTRICAL, PLUMBING | USD | ULTIMATE STRENGTH DESIGN |
| CONN | CONNECTION | MFR | MANUFACTURER | VERT | VERTICAL |
| CRDP | CALIFORNIA REGISTERED DESIGN PROFESSIONAL | MIN | MINIMUM | W/ | WITH |
| | | MTL | METAL | WF | WIDE FLANGE |
| DIM | DIMENSION | NA | NOT APPLICABLE | Wp | WEIGHT OF INSULATED WATER-FILLED PIPE |
| DTL | DETAIL | NO. (#) | NUMBER OR POUNDS | WT | WEIGHT |
| DIA (ϕ) | DIAMETER | NWC | NORMAL WEIGHT CONCRETE | | |
| (E) | EXISTING CONDITION | OPM | OSHPD PRE-APPROVAL OF MANUFACTURER'S CERTIFICATION | | |
| EA | EACH | OSHPD | OFFICE OF STATEWIDE HEALTH PLANNING & DEVELOPMENT | | |
| EE | EACH END | PERP | PERPENDICULAR | | |
| ELEV | ELEVATION | PG | PAGE | | |
| EMT | ELECTRICAL METALLIC TUBING | PSI | POUNDS PER SQUARE INCH | | |
| EQUIP | EQUIPMENT | | | | |



SHEET TITLE: OVERVIEW & GENERAL NOTES
ABBREVIATIONS

| | | | | |
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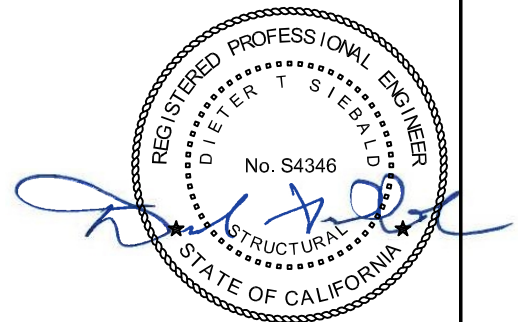
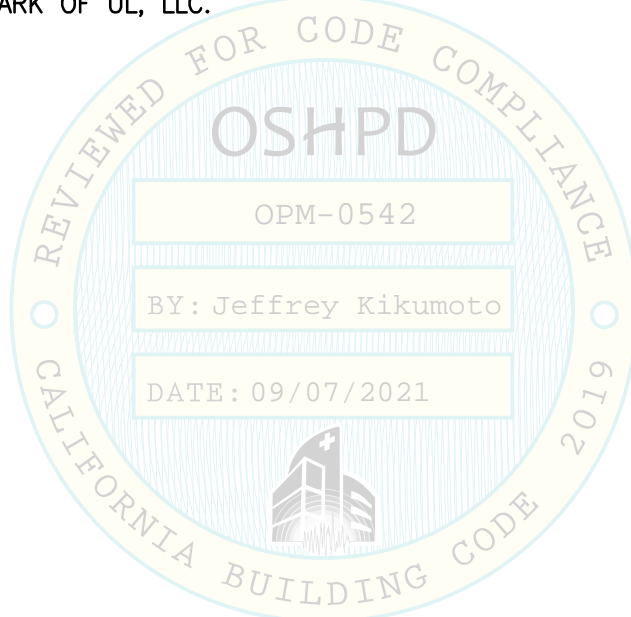
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TRADEMARK FOOTNOTES:

FOOTNOTES:

ACI IS A REGISTERED TRADEMARK OF THE AMERICAN CONCRETE INSTITUTE
 AISC IS A REGISTERED TRADEMARK OF THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION
 ASCE IS A REGISTERED TRADEMARK OF AMERICAN SOCIETY OF CIVIL ENGINEERS
 ASME IS A REGISTERED TRADEMARK OF AMERICAN SOCIETY OF MECHANICAL ENGINEERS
 ASTM IS A REGISTERED TRADEMARK OF AMERICAN SOCIETY FOR TESTING AND MATERIALS
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 TRADEMARKS OF ERICO INTERNATIONAL CORPORATION
 ELCO IS A REGISTERED TRADEMARK OF INFASTECH INTELLECTUAL PROPERTIES Pte, LTD.
 FM IS A REGISTERED CERTIFICATION MARK OF FM APPROVALS LLC, LTD
 POWER-STUD+, SNAKE+, MINI-UNDERCUT+, WOOD-KNOCKER, WOOD-KNOCKER II+ &
 HANGERMATE+ ARE REGISTERED TRADEMARKS OF DEWALT/POWERS FASTENERS, INC.
 KWIK BOLT TZ & HDI-P TZ ARE REGISTERED TRADEMARKS OF HILTI, INC.
 STRONG-BOLT 2 & TITEN HD ARE REGISTERED TRADEMAKRS OF SIMPSON STRONG-TIE
 COMPANY, INC.
 TRUBOLT & TRUBOLT+ ARE REGISTERED TRADEMARKS OF ITW RED HEAD
 UL IS A REGISTERED TRADEMARK OF UL, LLC.



NOTE:
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TRADEMARK FOOTNOTES



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| Page: | 1.21 of . |

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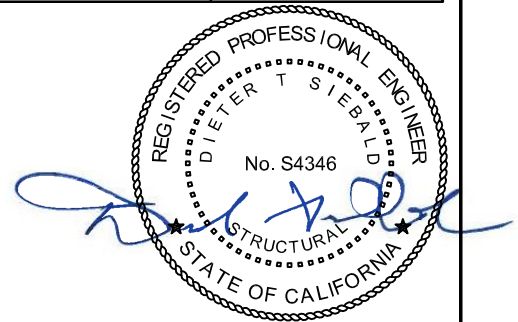
SEISMIC BRACING FOR
MEP SYSTEMS



SUPPORT AND ATTACHMENT MATERIAL STANDARDS:

| SUPPORT | STANDARD | SUPPLEMENTARY SUPPORT & ATTACHMENT | STANDARD |
|--|---|--|----------------------------|
| CSB | ASTM A1011 GR 36 | BRACE & PIPE CLAMPS | |
| | | SCREW | HRS GR 1045 |
| | | NUT | HRS GR 1045 |
| | | CARRIAGE BOLT | ASTM A307 |
| CSBBRP | ASTM A449 & A563, (PLATING) B633 & A123 | CLAMP BRACKET | ASTM A36 |
| | | CASTING | ASTM A536 |
| | | HEX BOLT | ASTM A449 |
| CSBBRS | ASTM A536, (PLATING) B633 & A123 | | |
| BRACE PIPE, 1", 1¼", 1½", 2" | ASTM A53 GR B | | |
| THREADED ROD, ⅜", ½", ⅝", ¾" | ASTM A36 | | |
| | | EXPANSION ANCHORS | REFER TO GENERAL NOTE 2 |
| CSBMA | ASTM® A36, (PLATING) B633 & A123 | | |
| CSBQG | ASTM A449 & A563, (PLATING) B633 & A123 | CLAMP BRACKET | ASTM A36 |
| | | CLAMPING BAR | ASTM A36 |
| | | FLANGE NUT | A563 GR B |
| | | HEX BOLT | ASTM A449 |
| CSBQIKCL | ASTM® A536, (PLATING) B633 & A123 | CLAMP BRACKET | ASTM A36 |
| | | U-BOLT | ASTM A36 |
| | | FLANGE NUT | GB699 |
| | | SHEAR NUT | Y15P6 |
| CSBS1, CSBS1A, CSBS2, CSBS3, CSBS4, CSBS5 | ASTM A1018 HSLA-F GR 50 | CLAMP MAIN BODY | |
| | | CONE POINT SCREW | HRS GR 1045 |
| | | CARRIAGE BOLT | ASTM A307 |
| | | SERRATED FLANGE NUT | GR 5 |
| | | SHEAR OFF NUT | GR 5 |

FOR CONTINUATION, SEE FOLLOWING PAGE



SHEET TITLE: OVERVIEW & GENERAL NOTES
COMPONENT MATERIAL STANDARDS



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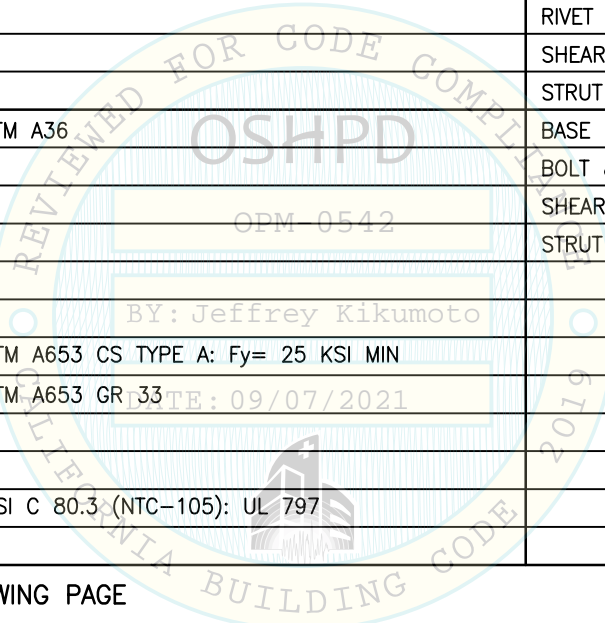
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Page: 1.30 of .

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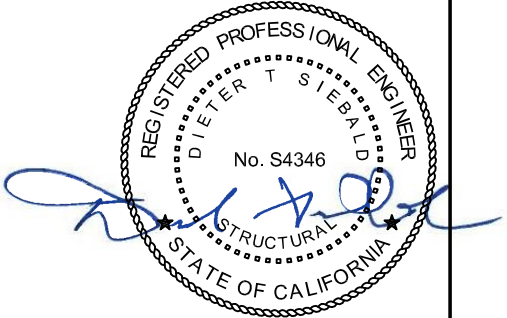


SUPPORT AND ATTACHMENT MATERIAL STANDARDS (CONTINUED):

| SUPPORT | STANDARD | SUPPLEMENTARY SUPPORT & ATTACHMENT | STANDARD |
|---------------------------|-------------------------------------|--|---------------|
| CSBT | ASTM A36 | TELESCOPING PIPES SCH 10 | Fy= 28 KSI |
| | | RIVETS | GR C1006 |
| | | V-BOLT | ASTM A307 |
| | | 5/16" ϕ SELF-TAPPING SCREW | ELCO ECC720 |
| | | STAMPING & CSBTB1 | ASTM A36 |
| | | NUTS ON THRD ROD | Fy= 55 KSI |
| CSBU1 & CSBU2 BODY & BASE | ASTM A1011 GR 36 | RIVET | CHS GR 1006 |
| | | CONE POINT SCREW | HRS GR 1045 |
| CSBUS1 & CSBUS2 | ASTM A1011 GR 36 | BASE | ASTM A109 |
| | | RIVET | CHS GR 1006 |
| | | SHEAR BOLT | Y15 |
| | | STRUT NUT | SAE 1015-1020 |
| CSBUS1PA & CSBUS2PA | ASTM A36 | BASE | ASTM A36 |
| | | BOLT & NUT | ANSI 1218 |
| | | SHEAR BOLT | Y15 |
| | | STRUT NUT | SAE 1015-1020 |
| | | | |
| | | | |
| ERICO TYPE A STRUT | ASTM A653 CS TYPE A: Fy= 25 KSI MIN | | |
| UNISTRUT P1001 | ASTM A653 GR 33 | | |
| UNISTRUT WOLF WASHER | | | |
| UNISTRUT P1010 SPRING NUT | | | |
| BRACE EMT | ANSI C 80.3 (NTC-105): UL 797 | | |



FOR CONTINUATION, SEE FOLLOWING PAGE



SHEET TITLE: OVERVIEW & GENERAL NOTES
COMPONENT MATERIAL STANDARDS

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| <p>CYS STRUCTURAL ENGINEERS, INC. 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833</p> | <p>TEL (916) 920-2020 www.cyseng.com</p> | Job No: 19039 |
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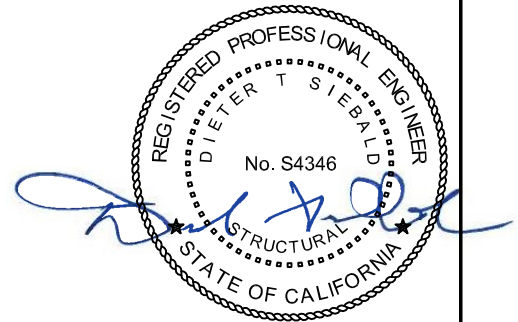
SEISMIC BRACING FOR
MEP SYSTEMS



SUPPORT AND ATTACHMENT MATERIAL STANDARDS (CONTINUED):

| SUPPORT | STANDARD | SUPPLEMENTARY SUPPORT & ATTACHMENT | STANDARD |
|---|--|--|---------------------------------|
| 320W | ASTM A109 NO.3 Fu= 55 KSI MIN | | |
| 325 | ASTM A1011CS TYPE B, Fy= 30 KSI MIN | | |
| 328 | ASTM A1011 GR 1010 | | |
| 329 | ASTM A570; (PLATING) ASTM B633 | | |
| CSBRS1 | ASTM A1008 CS TYPE B Fy= 20 KSI MIN | | |
| | | HEX SCREW | GRADE 5 |
| | | HEX NUT | GRADE 5 |
| CSBRS2, CSBRS3, CSBRS4, CSBRS5, CSBRS6 | AISI 316 SS | | |
| 401 | ASTM A1011 Fy= 30 KSI MIN; (PLATING) ASTM B633 | TOP & BOTT | |
| | | CROSS-BOLT | ASTM A307 GRADE A |
| | | HEX NUT | ASTM A563 GRADE B |
| CSBR1 | ASTM A1011 GR 36; (PLATING) B633 | STAMPED BODY | |
| | | CONE POINT SCREW | HRS GR 1045 Fy= 51.5 KSI MIN |
| | | CARRIAGE BOLTS | GRADE 5 |
| | | SHEAR OFF NUT | HRS GR 1045 Fy= 56.6 KSI MIN |
| CSBR2 | ASTM A1011 GR 36; (PLATING) B633 | STAMPED BODY | |
| | | SEAR BOLTS | HRS GR 1045 |
| | | CARRIAGE BOLTS | GRADE 5 |
| | | SHEAR OFF NUT | HRS GR 1045 Fy= 56.6 KSI MIN |
| | | STRUT NUT | SAE 1015-1020 |
| 429 | ASTM A1011 Fy= 30 KSI MIN; (PLATING) ASTM B633 | CLAMP HALVES | |
| | | HEX NUT | GB699 |
| | | MULTI-HEAD SCREW | TENSILE STRENGTH= 700 N/mm2 |
| | | O-RING | NATURAL RUBBER |
| | | SPACER | POLYETHYLENE |

FOR CONTINUATION, SEE FOLLOWING PAGE



SHEET TITLE: OVERVIEW & GENERAL NOTES
COMPONENT MATERIAL STANDARDS

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| | | Page: 1.32 of . |

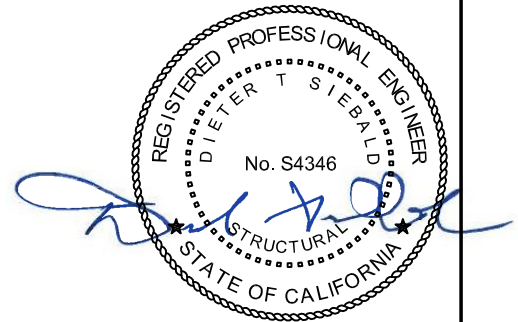
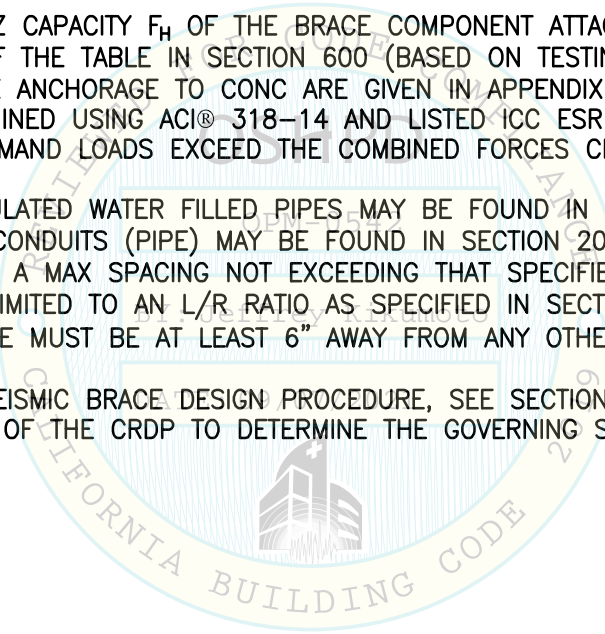
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SEISMIC BRACING FOR MEP SYSTEMS



DESIGN PARAMETERS & BRACING GUIDELINES – PIPING & CONDUIT:

1. DESIGN AND INSTALLATION OF THE SEISMIC BRCG FOR PIPING & CONDUIT SYSTEMS MUST CONFORM TO ASCE/SEI 7-16 SECTION 13.
2. DTLs OF THE SUPPORT AND BRCG OF PIPING & CONDUIT SYSTEMS MUST COMPLY W/ THE 2019 CBC SECTION 1613A EARTHQUAKE LOADS & SECTION 1617A MODIFICATIONS TO ASCE 7.
3. THE CRDP MUST PROVIDE DTLs AND CALCULATIONS FOR THE SEISMIC BRCG AND THEIR SUPPORTS & ATTACHMENTS TO THE STRUCTURE. WHERE APPLICABLE, DTLs FOR THE SUPPORT AND BRCG MAY BE REFERRED TO THIS OSHPD PRE-APPROVAL. ALL LAYOUT DRAWINGS OF THE PIPING OR CONDUIT SYSTEM MUST BE SUBMITTED TO OSHPD FOR REVIEW AND APPROVAL PRIOR TO INSTALLATION.
4. THE CRDP MUST DETERMINE THE CONFIGURATION OF THE PIPING OR CONDUIT SYSTEM AND THE DEMAND LOADS ON ALL PIPING OR CONDUIT COMPONENTS, BRCG, AND SUPPORTS & ATTACHMENTS. THE CRDP MUST DETERMINE THE GOVERNING CAPACITY & WEAKEST LINK IN THE LOAD PATH FOR EACH DESIRED BRCG COMBINATION BASED ON THE CAPACITY OF THE INDIVIDUAL ELEMENTS BLW:
 - A. THE ALLOWABLE HORIZ CAPACITY F_H OF THE BRACE COMPONENT ATTACHED TO THE SERVICE PIPE OR CONDUIT AS GIVEN IN SECTION 500 (BASED ON TESTING).
 - B. THE ALLOWABLE AXIAL CAPACITY OF THE LATERAL BRACE OR BRANCH LINE RESTRAINT ROD AS GIVEN IN SECTION 400.
 - C. THE ALLOWABLE HORIZ CAPACITY F_H OF THE BRACE COMPONENT ATTACHED TO THE STRUCTURE ARE GIVEN AT THE END OF THE TABLE IN SECTION 600 (BASED ON TESTING).
 - D. THE CAPACITY OF THE ANCHORAGE TO CONC ARE GIVEN IN APPENDIX A. THE TENSION AND SHEAR VALUES WERE DETERMINED USING ACI® 318-14 AND LISTED ICC ESR REPORTS. THE CRDP MUST DETERMINE IF THE DEMAND LOADS EXCEED THE COMBINED FORCES CHECK PER ACI 318-14, SECTION 17.
5. THE DEAD LOADS OF INSULATED WATER FILLED PIPES MAY BE FOUND IN SECTION 200 & THE DEAD LOADS OF CABLE FILLED CONDUITS (PIPE) MAY BE FOUND IN SECTION 201.
6. SEISMIC BRCG MUST HAVE A MAX SPACING NOT EXCEEDING THAT SPECIFIED IN SECTIONS 200 & 201.
7. SEISMIC BRCG MUST BE LIMITED TO AN L/R RATIO AS SPECIFIED IN SECTION 400.
8. SEISMIC BRACE ANCHORAGE MUST BE AT LEAST 6" AWAY FROM ANY OTHER ANCHORAGE OR CONC EDGES UNO IN SECTION 1.
9. FOR EXAMPLES OF THE SEISMIC BRACE DESIGN PROCEDURE, SEE SECTIONS 300 & 301.
10. IT IS THE RESPONSIBILITY OF THE CRDP TO DETERMINE THE GOVERNING SEISMIC LOADS.



SHEET TITLE: OVERVIEW & GENERAL NOTES
DESIGN PARAMETERS & BRACING GUIDELINES - PIPING & CONDUIT

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| | SACRAMENTO, CA 95833 | Page: | 1.100 of . |
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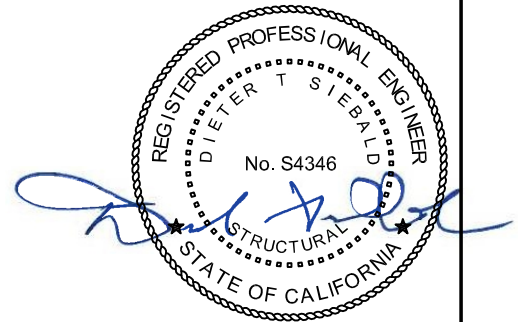
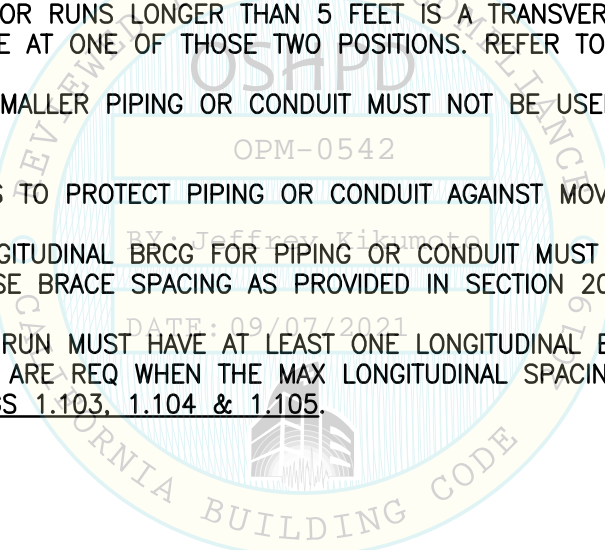
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SEISMIC BRACING FOR
MEP SYSTEMS



DESIGN PARAMETERS & BRACING GUIDELINES – PIPING & CONDUIT (CONTINUED):

11. A RUN OF PIPE OR CONDUIT IS CONSIDERED A CONTINUOUS RUN IF THE MAX OFFSET IS LESS THAN 24". IF THE OFFSET IS 24" OR GREATER, EA STRAIGHT SEGMENT MUST BE TREATED AS AN INDEPENDENT RUN AND BRACED. REFER TO PARTIAL PLAN ON PG 1.103 PLEASE NOTE THAT RIGID GROOVED COUPLING LISTED FOR UL® STANDARD 213 MUST BE PERMITTED IN HORIZ RUN OF SERVICE PIPE. FLEXIBLE GROOVED COUPLING LISTED FOR UL STANDARD 213 MUST BE PERMITTED IN VERT RISERS (TO ACCOMMODATE DRIFT) AND OTHER LOCATION (e.g. SEISMIC SEPARATION, EQUIPMENT NOZZLE, ETC.) TO ACCOMMODATE SMALL MOVEMENT AND/OR ROTATION. NON-UL LISTED GROOVED COUPLINGS MUST NOT BE USED UNLESS APPROVED ON PROJECT SPECIFIC BASIS.
12. TRANSVERSE BRGC:
 - A. TRANSVERSE BRGC IS TO PROTECT PIPING OR CONDUIT AGAINST MOVEMENT PERP TO THE RUN OF PIPE OR CONDUIT.
 - B. TRANSVERSE BRGC MUST BE PROVIDED ON ALL PIPING OR CONDUIT W/ A DIA OF 2½" AND LARGER.
 - C. MAX SPACING OF TRANSVERSE BRGC FOR PIPING OR CONDUIT MUST BE AS PROVIDED IN SECTION 200 OR 201. REFER TO PARTIAL PLAN ON PG 1.104.
 - D. A TRANSVERSE BRACE PLACED ON THE PIPE OR CONDUIT RUN SECTION AT THE OPPOSITE SIDE OF AN ELBOW WITHIN 24" MAY ACT AS A LONGITUDINAL BRACE. THE TRANSVERSE BRACE ACTING AS A LONGITUDINAL BRACE MUST NOT HAVE THE TRIBUTARY LOAD GOING TO IT EXCEED THAT GOING TO A TYP TRANSVERSE BRACE. REFER TO PARTIAL PLAN ON PG 1.104.
 - E. THE MIN REQ BRGC FOR RUNS LONGER THAN 5 FEET IS A TRANSVERSE BRACE AT EA END, AND A LONGITUDINAL BRACE AT ONE OF THOSE TWO POSITIONS. REFER TO PARTIAL PLAN ON PG 1.105.
 - F. BRGC INSTALLED TO SMALLER PIPING OR CONDUIT MUST NOT BE USED TO BRACE LARGER PIPING OR CONDUIT.
13. LONGITUDINAL BRGC:
 - A. LONGITUDINAL BRGC IS TO PROTECT PIPING OR CONDUIT AGAINST MOVEMENT PARALLEL TO THE RUN OF PIPE OR CONDUIT.
 - B. MAX SPACING OF LONGITUDINAL BRGC FOR PIPING OR CONDUIT MUST NOT EXCEED 3 TIMES THE ALLOWABLE TRANSVERSE BRACE SPACING AS PROVIDED IN SECTION 200 OR 201. REFER TO PARTIAL PLAN ON PG 1.104.
 - C. EA PIPE OR CONDUIT RUN MUST HAVE AT LEAST ONE LONGITUDINAL BRACE. ADDITIONAL LONGITUDINAL BRACES ARE REQ WHEN THE MAX LONGITUDINAL SPACING IS EXCEEDED. REFER TO PARTIAL PLANS ON PGS 1.103, 1.104 & 1.105.



SHEET TITLE: OVERVIEW & GENERAL NOTES
DESIGN PARAMETERS & BRACING GUIDELINES - PIPING & CONDUIT

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SEISMIC BRACING FOR
MEP SYSTEMS

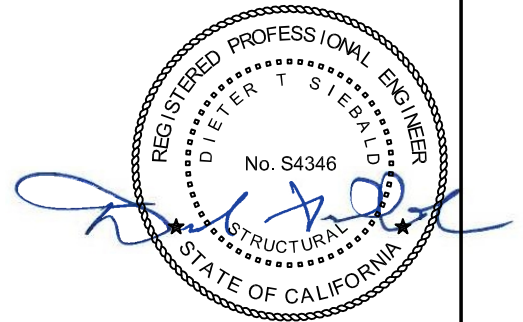
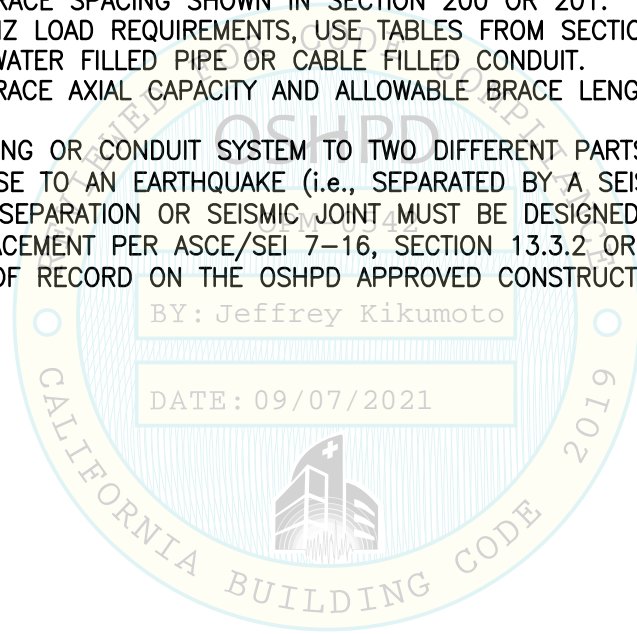


DESIGN PARAMETERS & BRACING GUIDELINES – PIPING & CONDUIT (CONTINUED):

14. VERT OFFSETS/RISERS:
 - A. TOPS OF VERT OFFSETS/RISERS EXCEEDING 3 FEET IN LENGTH MUST BE PROVIDED W/ A FOUR-WAY BRACE. BRG MUST BE LOCATED WITHIN 24" OF THE END OF THE VERT RUN. REFER TO PARTIAL ISOMETRIC A ON PG 1.106.
 - B. PER 2019 CPC TABLE 313.3, DISTANCE BTW FOUR-WAY BRACES FOR RISERS MUST NOT EXCEED 25 FEET FOR STL PIPE, 10 FEET FOR COPPER PIPE, & 15 FEET FOR CAST IRON PIPE.
 - C. THE VERT PIPING OR CONDUIT SYSTEM MUST BE SEISMICALLY BRACED AS IT PASSES THRU A FLR OR ROOF PENETRATION. THE SEISMIC BRACE SUPPORT MUST CONSIST OF A STRUT OR STL MEMBER ATTACHED TO THE CONC FLR OR STRU FLR FRMG MEMBERS. SUPPORTS & ATTACHMENTS FOR EACH RISER MUST BE DESIGNED FOR ALL GRAVITY, SEISMIC, & THERMAL LOADS. RELATIVE DISPLACEMENT BETWEEN FLOORS MUST BE CONSIDERED IN THE DESIGN & THE DESIGN IS SUBJECT TO APPROVAL BY OSHPD. AS AN ALTERNATE, VERT PIPING OR CONDUIT SYSTEMS SUPPORTED AT EA FLR MUST BE CONSIDERED SEISMICALLY BRACED IF THE PENETRATION THROUGH EA FLR IS TIGHTLY PACKED W/ APPROVED FIRESTOPS, SATISFYING NFPA 13-16 SECTION 9.3.5.8.5 & THE FLR TO FLR SPACING DOES NOT EXCEED THE MAX BRACE SPACING SHOWN IN SECTION 200 OR 201.
15. WHEN CALCULATING HORIZ LOAD REQUIREMENTS, USE TABLES FROM SECTION 200 OR 201 TO CALCULATE THE WT OF INSULATED WATER FILLED PIPE OR CABLE FILLED CONDUIT.
16. FOR LATERAL SEISMIC BRACE AXIAL CAPACITY AND ALLOWABLE BRACE LENGTH, SEE TABLES IN SECTION 400.
17. **DO NOT** BRACE THE PIPING OR CONDUIT SYSTEM TO TWO DIFFERENT PARTS OF A BLDG WHICH MAY ACT DIFFERENTLY IN RESPONSE TO AN EARTHQUAKE (i.e., SEPARATED BY A SEISMIC JOINT). ANY SYSTEM THAT CROSSES A BLDG SEPARATION OR SEISMIC JOINT MUST BE DESIGNED TO ACCOMMODATE THE SEISMIC RELATIVE DISPLACEMENT PER ASCE/SEI 7-16, SECTION 13.3.2 OR AS SPECIFIED BY THE STRUCTURAL ENGINEER OF RECORD ON THE OSHPD APPROVED CONSTRUCTION DOCUMENTS.

BY: Jeffrey Kikumoto

DATE: 09/07/2021



SHEET TITLE: OVERVIEW & GENERAL NOTES
DESIGN PARAMETERS & BRACING GUIDELINES - PIPING & CONDUIT

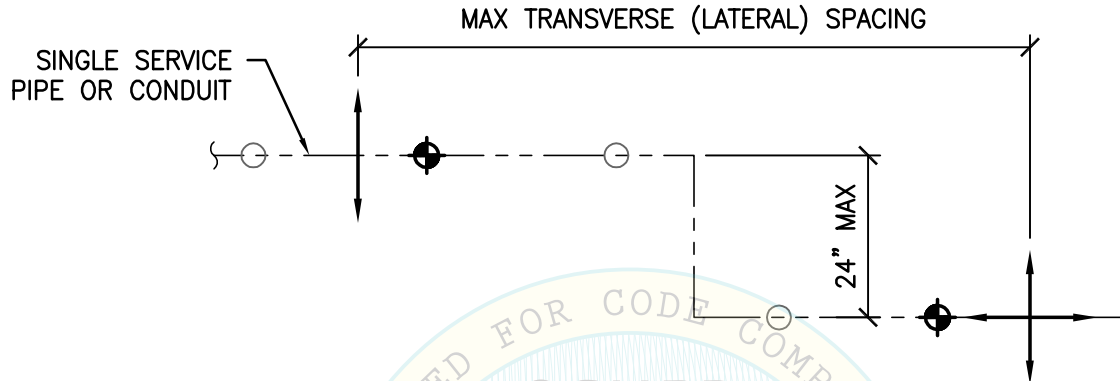
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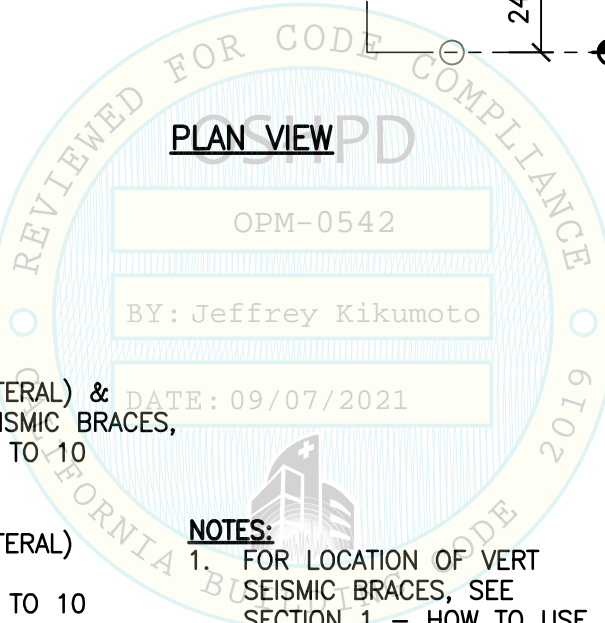
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MEP SYSTEMS



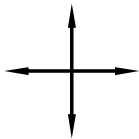
DESIGN PARAMETERS & BRACING GUIDELINES – PIPING & CONDUIT (CONTINUED):



PLAN VIEW



LEGEND:



TRANSVERSE (LATERAL) & LONGITUDINAL SEISMIC BRACES, SEE SECTIONS 2 TO 10



TRANSVERSE (LATERAL) SEISMIC BRACE, SEE SECTIONS 2 TO 10



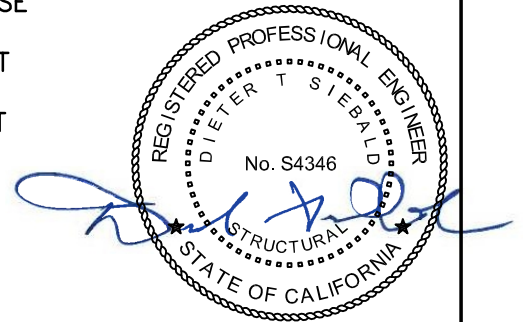
VERT SEISMIC BRACE – MUST BE WITHIN 6" OF ALL TRANSVERSE AND LONGITUDINAL BRACES



VERT PIPE OR CONDUIT HANGER (NOT PART OF OPM) SHOWN FOR REFERENCE ONLY

NOTES:

1. FOR LOCATION OF VERT SEISMIC BRACES, SEE SECTION 1 – HOW TO USE THIS PRE-APPROVAL.
2. A VERT PIPE OR CONDUIT HANGER IS NOT A VERT SEISMIC BRACE & IS NOT PART OF THIS OPM.



SHEET TITLE: OVERVIEW & GENERAL NOTES

DESIGN PARAMETERS & BRACING GUIDELINES - PIPING & CONDUIT



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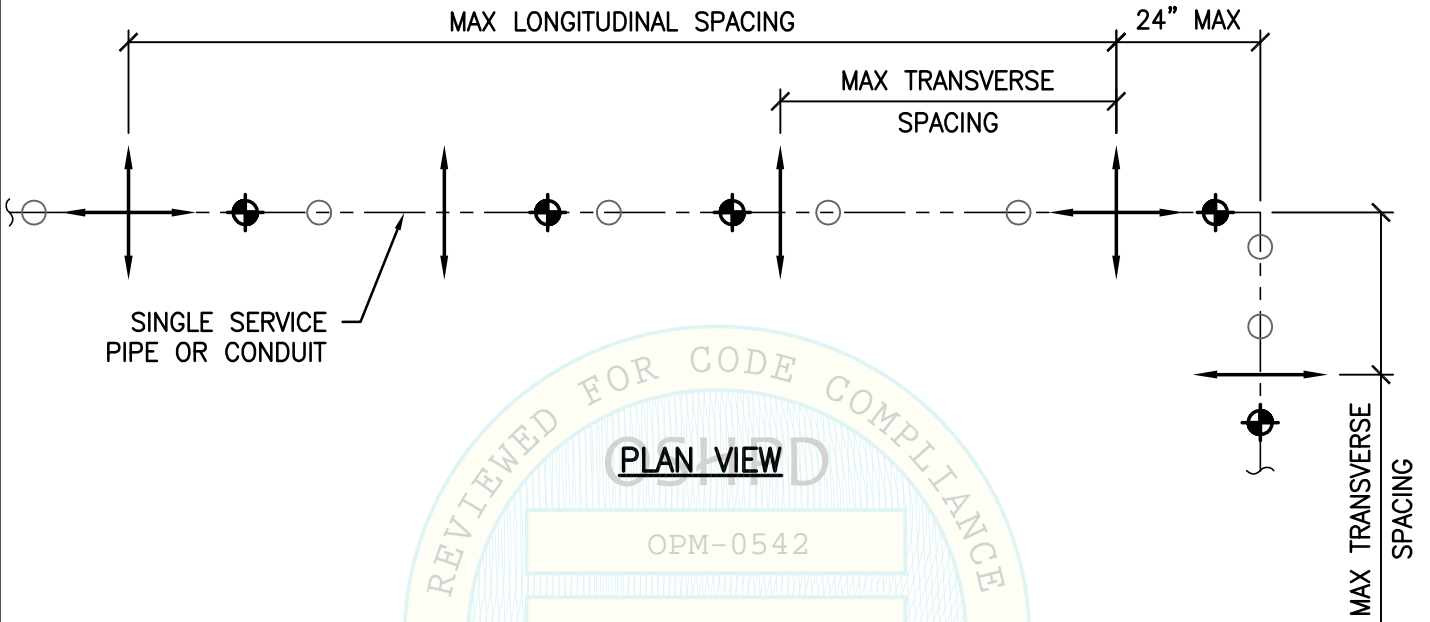
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| Page: | 1.103 of . |

SEISMIC BRACING FOR
MEP SYSTEMS



DESIGN PARAMETERS & BRACING GUIDELINES – PIPING & CONDUIT (CONTINUED):



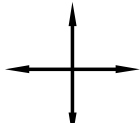
PLAN VIEW

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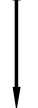
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LEGEND:



TRANSVERSE (LATERAL) & LONGITUDINAL SEISMIC BRACES, SEE SECTIONS 2 TO 10



TRANSVERSE (LATERAL) SEISMIC BRACE, SEE SECTIONS 2 TO 10



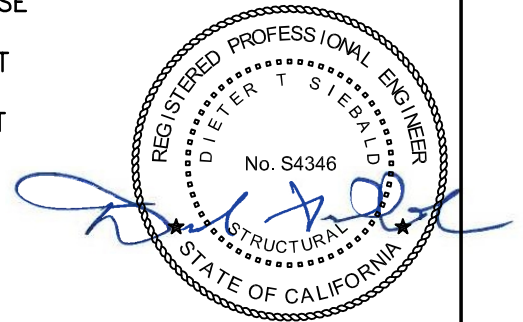
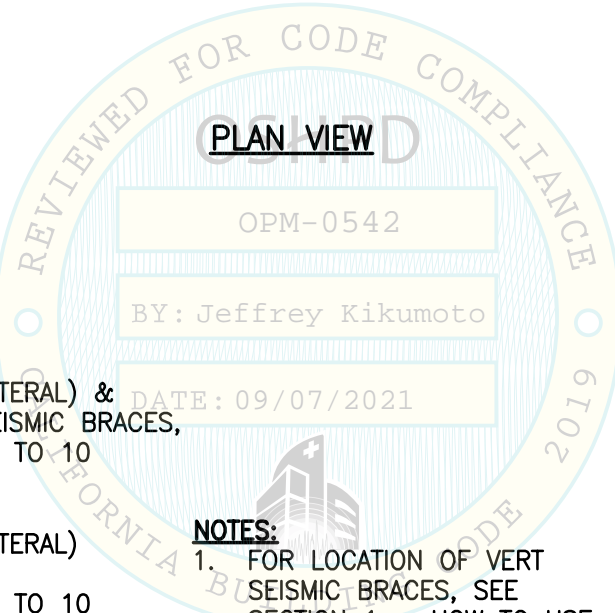
VERT SEISMIC BRACE – MUST BE WITHIN 6" OF ALL TRANSVERSE AND LONGITUDINAL BRACES



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NOTES:

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2. A VERT PIPE OR CONDUIT HANGER IS NOT A VERT SEISMIC BRACE & IS NOT PART OF THIS OPM.



SHEET TITLE: OVERVIEW & GENERAL NOTES

DESIGN PARAMETERS & BRACING GUIDELINES - PIPING & CONDUIT



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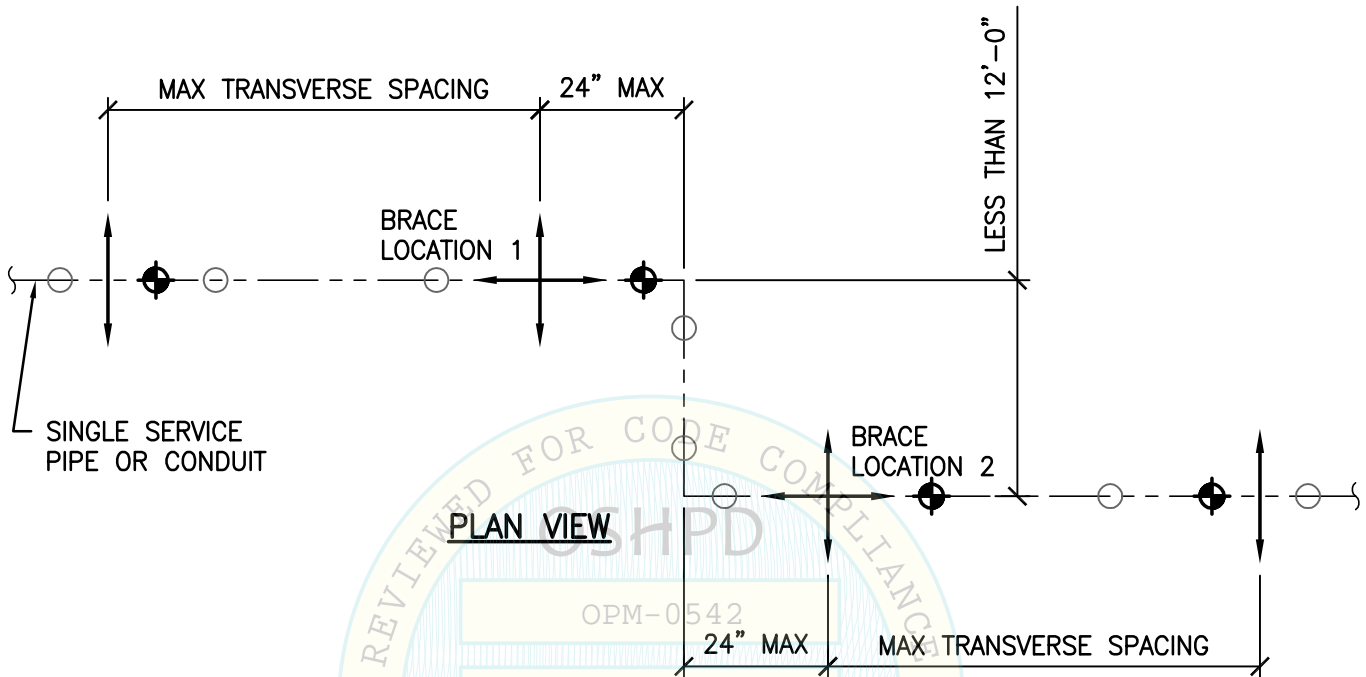
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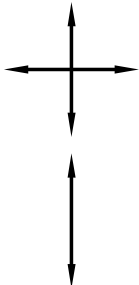
SEISMIC BRACING FOR
MEP SYSTEMS



DESIGN PARAMETERS & BRACING GUIDELINES – PIPING & CONDUIT (CONTINUED):



LEGEND:



TRANSVERSE (LATERAL) & LONGITUDINAL SEISMIC BRACES, SEE SECTIONS 2 TO 10

TRANSVERSE (LATERAL) SEISMIC BRACE, SEE SECTIONS 2 TO 10



VERT SEISMIC BRACE – MUST BE WITHIN 6" OF ALL TRANSVERSE AND LONGITUDINAL BRACES



VERT PIPE OR CONDUIT HANGER (NOT PART OF OPM) SHOWN FOR REFERENCE ONLY

NOTES:

1. FOR LOCATION OF VERT SEISMIC BRACES, SEE SECTION 1 – HOW TO USE THIS PRE-APPROVAL.
2. AT LEAST ONE LONGITUDINAL BRACE IS REQ AT EA OF THE TWO CONTINUOUS RUNS SHOWN. A LONGITUDINAL BRACE MUST BE LOCATED AT BOTH BRACE LOCATION 1 & BRACE LOCATION 2. THE MAX ALLOWABLE LONGITUDINAL BRACE SPACING MUST NOT BE EXCEEDED.
3. A VERT PIPE OR CONDUIT HANGER IS NOT A VERT SEISMIC BRACE & IS NOT PART OF THIS OPM.
4. NOTE THAT THE LONGITUDINAL BRACES LOCATED AT BRACE LOCATIONS 1&2 WILL ALSO ACT AS TRANSVERSE BRACES FOR THE SERVICE PIPE OR CONDUIT RUN LOCATED BTW THE TWO CONTINUOUS RUNS. ANY ADDITIONAL LOAD TO THE LONGITUDINAL BRACES MUST BE CONSIDERED IN THE BRACE EVALUATION.



SHEET TITLE: OVERVIEW & GENERAL NOTES

DESIGN PARAMETERS & BRACING GUIDELINES - PIPING & CONDUIT



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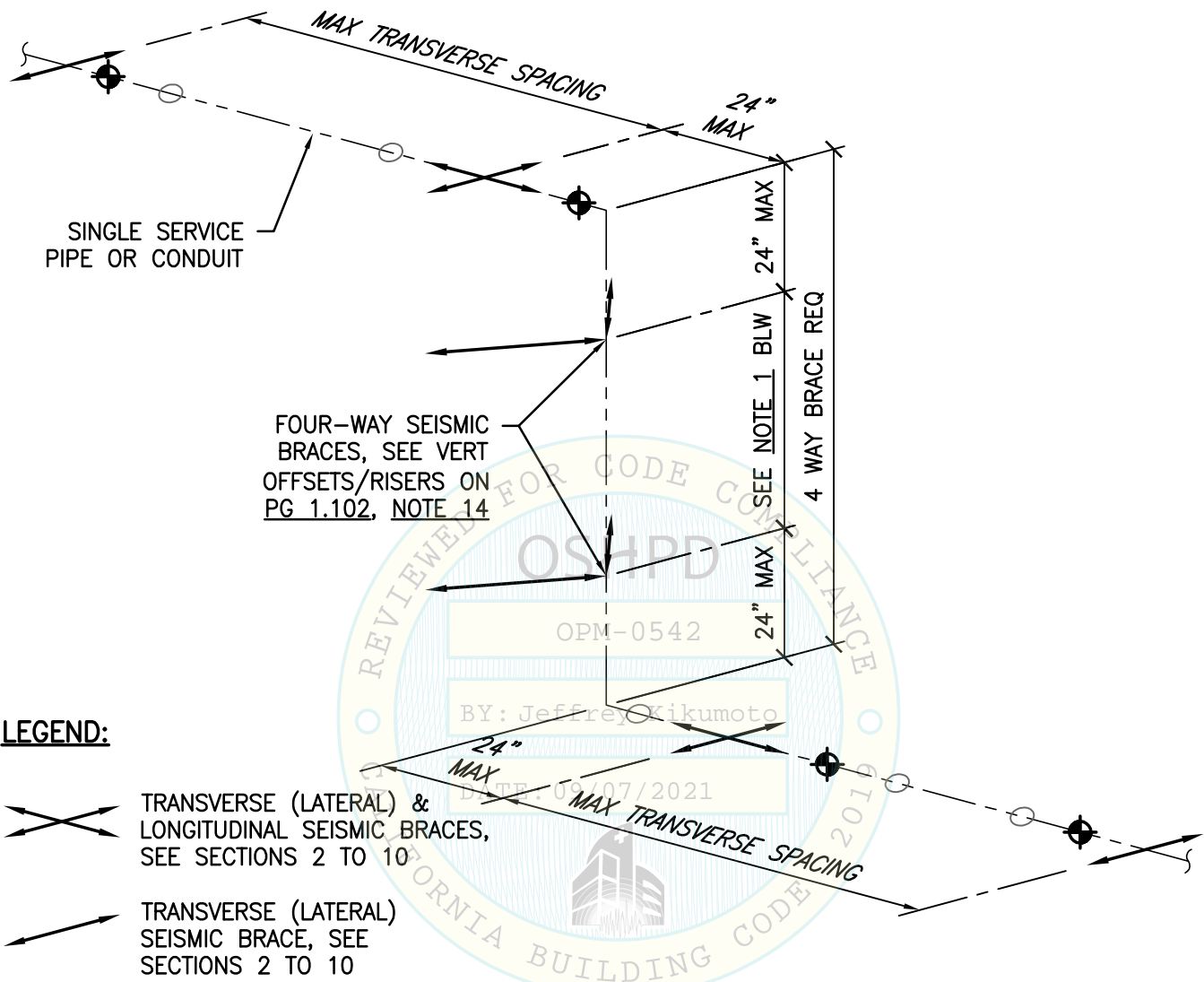
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| Date: | 09/08/2021 |
| Page: | 1.105 of . |

SEISMIC BRACING FOR
MEP SYSTEMS



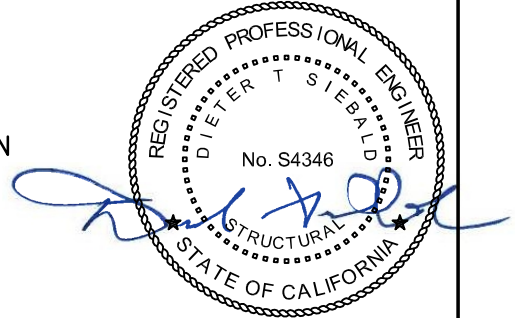
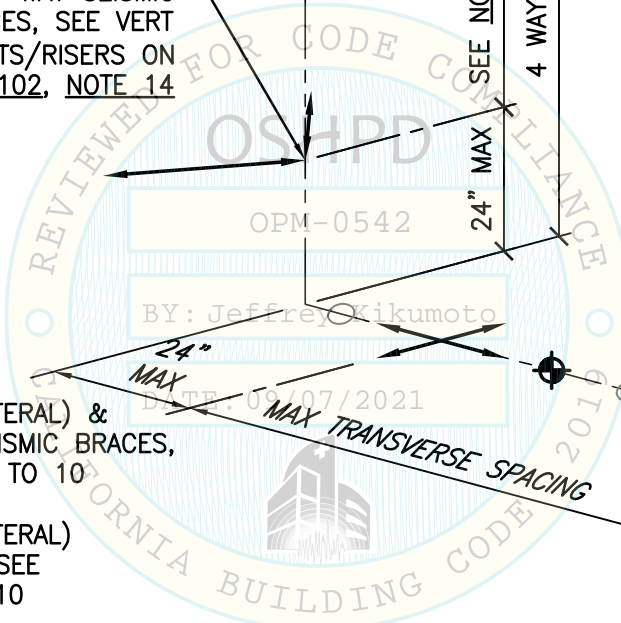
DESIGN PARAMETERS & BRACING GUIDELINES – PIPING & CONDUIT (CONTINUED):



LEGEND:

- TRANSVERSE (LATERAL) & LONGITUDINAL SEISMIC BRACES, SEE SECTIONS 2 TO 10
- TRANSVERSE (LATERAL) SEISMIC BRACE, SEE SECTIONS 2 TO 10
- FOUR-WAY RISER SEISMIC BRACES, SEE SECTION 9
- VERT SEISMIC BRACE – MUST BE WITHIN 6" OF ALL TRANSVERSE AND LONGITUDINAL BRACES
- VERT PIPE OR CONDUIT HANGER (NOT PART OF OPM) SHOWN FOR REFERENCE ONLY

NOTE:
FOR VERT RISERS AT FLOOR PENETRATIONS SEE NOTE 14 ON PG 1.102.



SHEET TITLE: OVERVIEW & GENERAL NOTES
DESIGN PARAMETERS & BRACING GUIDELINES - PIPING & CONDUIT

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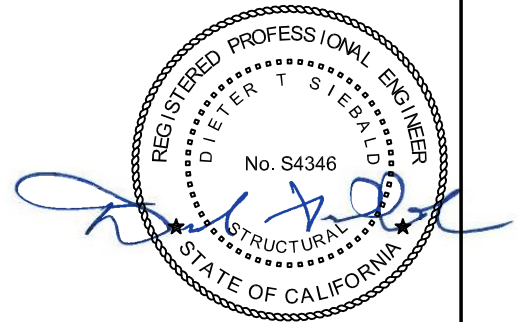
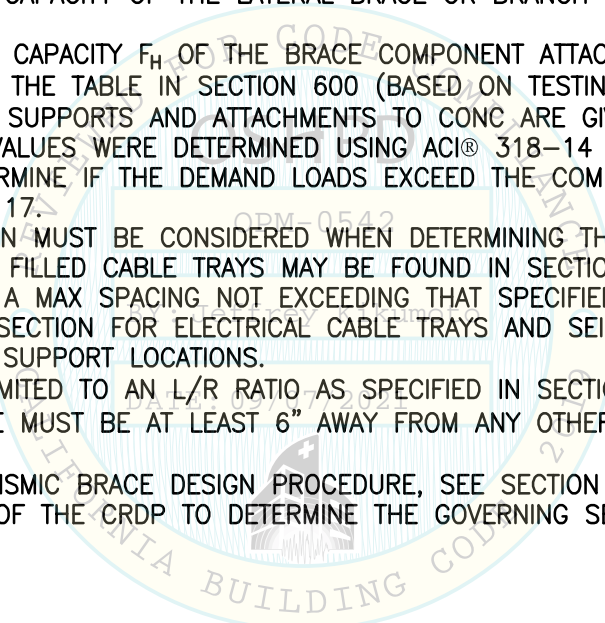
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SEISMIC BRACING FOR MEP SYSTEMS



DESIGN PARAMETERS & BRACING GUIDELINES – ELECTRICAL CABLE TRAYS:

1. DESIGN AND INSTALLATION OF THE SEISMIC BRCG FOR ELECTRICAL CABLE TRAY SYSTEMS MUST CONFORM TO ASCE/SEI 7-16 SECTION 13.
2. THE DTLS OF THE SUPPORT AND BRCG OF ELECTRICAL CABLE TRAY SYSTEMS MUST COMPLY W/ THE 2019 CBC SECTION 1613A EARTHQUAKE LOADS AND SECTION 1617A MODIFICATIONS TO ASCE 7.
3. THE CRDP MUST PROVIDE DTLS AND CALCULATIONS FOR THE SEISMIC BRCG AND THEIR SUPPORTS AND ATTACHMENTS TO THE STRUCTURE. WHERE APPLICABLE, DTLS FOR THE SUPPORT AND BRCG MAY BE REFERRED TO THIS OSHPD PRE-APPROVAL. ALL LAYOUT DRAWINGS OF THE ELECTRICAL CABLE TRAY SYSTEM MUST BE SUBMITTED TO OSHPD FOR REVIEW AND CABLE TRAY BRACE SPACING MUST BE APPROVED BY OSHPD PRIOR TO INSTALLATION.
4. THE CRDP MUST DETERMINE THE CONFIGURATION OF THE ELECTRICAL CABLE TRAY SYSTEM AND THE DEMAND LOADS ON ALL ELECTRICAL CABLE TRAY COMPONENTS, BRCG, SUPPORTS AND ATTACHMENTS. THE CRDP MUST DETERMINE THE GOVERNING CAPACITY FOR EACH DESIRED BRCG COMBINATION BASED ON THE CAPACITY OF THE INDIVIDUAL ELEMENTS BLW:
 - A. THE ALLOWABLE HORIZ CAPACITY F_H OF THE BRACE COMPONENT ATTACHED TO THE ELECTRICAL CABLE TRAY AS GIVEN IN SECTION 500 (BASED ON TESTING).
 - B. THE ALLOWABLE AXIAL CAPACITY OF THE LATERAL BRACE OR BRANCH LINE RESTRAINT ROD AS GIVEN IN SECTION 400.
 - C. THE ALLOWABLE HORIZ CAPACITY F_H OF THE BRACE COMPONENT ATTACHED TO THE STRUCTURE ARE GIVEN AT THE END OF THE TABLE IN SECTION 600 (BASED ON TESTING).
 - D. THE CAPACITY OF THE SUPPORTS AND ATTACHMENTS TO CONC ARE GIVEN IN APPENDIX A. THE TENSION AND SHEAR VALUES WERE DETERMINED USING ACI® 318-14 AND LISTED ICC ESR REPORTS. THE CRDP MUST DETERMINE IF THE DEMAND LOADS EXCEED THE COMBINED FORCES CHECK PER ACI 318-14, SECTION 17.
 - E. ECCENTRIC DISTRIBUTION MUST BE CONSIDERED WHEN DETERMINING THE VALUE USED IN DESIGN.
5. THE DEAD LOADS OF WIRE FILLED CABLE TRAYS MAY BE FOUND IN SECTION 202.
6. SEISMIC BRCG MUST HAVE A MAX SPACING NOT EXCEEDING THAT SPECIFIED IN THIS DESIGN PARAMETERS AND BRACING GUIDELINES SECTION FOR ELECTRICAL CABLE TRAYS AND SEISMIC BRCG RESTRAINTS MUST BE ATTACHED AT GENERAL SUPPORT LOCATIONS.
7. SEISMIC BRCG MUST BE LIMITED TO AN L/R RATIO AS SPECIFIED IN SECTION 400.
8. SEISMIC BRACE ANCHORAGE MUST BE AT LEAST 6" AWAY FROM ANY OTHER ANCHORAGE OR CONC EDGES UNO IN SECTION 1.
9. FOR EXAMPLES OF THE SEISMIC BRACE DESIGN PROCEDURE, SEE SECTION 302.
10. IT IS THE RESPONSIBILITY OF THE CRDP TO DETERMINE THE GOVERNING SEISMIC LOADS.



SHEET TITLE: OVERVIEW & GENERAL NOTES

DESIGN PARAMETERS & BRACING GUIDELINES - ELECTRICAL CABLE TRAYS



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| Page: | 1.200 of . |

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SEISMIC BRACING FOR
MEP SYSTEMS



DESIGN PARAMETERS & BRACING GUIDELINES – ELECTRICAL CABLE TRAYS (CONTINUED):

11. A RUN OF ELECTRICAL CABLE TRAY IS CONSIDERED A CONTINUOUS RUN IF THE MAX OFFSET IS LESS THAN THE MAX DISTANCE ALLOWED BY THE MFR. IF THE OFFSET IS GREATER THAN THE MAX DISTANCE ALLOWED BY THE MFR, EA STRAIGHT SEGMENT MUST BE TREATED AS AN INDEPENDENT RUN AND BRACED. REFER TO PARTIAL PLAN ON PG 1.203. CABLE TRAY MUST BE SPLICED AS PER MFR.
12. TRANSVERSE BRCCG:
 - A. TRANSVERSE BRCCG IS TO PROTECT ELECTRICAL CABLE TRAY AGAINST MOVEMENT PERP TO THE RUN OF ELECTRICAL CABLE TRAY. TRANSVERSE BRCCG IS GOING TO BE LOCATED AT THE THREADED ROD SUPPORT WHICH NEEDS TO BE ADEQUATE FOR COMBINED GRAVITY & VERT SEISMIC LOADS.
 - B. A TRANSVERSE BRACE PLACED ON THE ELECTRICAL CABLE TRAY RUN SECTION AT THE OPPOSITE SIDE OF AN ELBOW WITHIN THE MAX DISTANCE ALLOWED BY THE MFR MAY ACT AS A LONGITUDINAL BRACE. REFER TO PARTIAL PLAN ON PG 1.204.
 - C. THE MIN REQ BRCCG FOR RUNS LONGER THAN 5 FEET IS A TRANSVERSE BRACE AT EA END, AND A LONGITUDINAL BRACE AT ONE OF THOSE TWO POSITIONS. REFER TO PARTIAL PLAN ON PG 1.205.
 - D. MULTIPLE COMPONENTS SUPPORTED BY TWO SINGLE HORIZ TRAPEZE STRUTS AS SHOWN ON PGS 16.1 THROUGH 16.3 MUST USE THE LEAST TRANSVERSE & LONGITUDINAL BRACE SPACING OF ALL THE COMPONENTS ATTACHED TO THE HORIZ TRAPEZE STRUTS.
 - E. MAX ALLOWABLE SPACING OF TRANSVERSE BRCCG FOR CABLE TRAY MUST NOT EXCEED THE MFR SPECIFICATIONS. REFER TO PARTIAL PLAN OF PG 1.204.
13. LONGITUDINAL BRCCG:
 - A. LONGITUDINAL BRCCG IS TO PROTECT ELECTRICAL CABLE TRAY AGAINST MOVEMENT PARALLEL TO THE RUN OF ELECTRICAL CABLE TRAY. LONGITUDINAL BRCCG IS GOING TO BE LOCATED AT THE THREADED ROD SUPPORT WHICH NEEDS TO BE ADEQUATE FOR COMBINED GRAVITY & VERT SEISMIC LOADS.
 - B. EA ELECTRICAL CABLE TRAY RUN MUST HAVE AT LEAST ONE LONGITUDINAL BRACE. ADDITIONAL LONGITUDINAL BRACES ARE REQ WHEN THE MAX LONGITUDINAL SPACING IS EXCEEDED. REFER TO PARTIAL PLANS ON PGS 1.203, 1.204 & 1.205.
 - C. MAX ALLOWABLE SPACING OF LONGITUDINAL BRCCG FOR CABLE TRAY MUST NOT EXCEED THE MFR SPECIFICATIONS.
14. VERT OFFSETS/RISERS:
 - A. TOPS OF VERT OFFSETS/RISERS EXCEEDING 3 FEET IN LENGTH MUST BE PROVIDED W/ A FOUR-WAY BRACE. BRCCG MUST BE LOCATED WITHIN 24" OF THE END OF THE VERT RUN. REFER TO PARTIAL ISOMETRIC A ON PG 1.206. FOUR-WAY BRACING MUST BE DESIGNED BY THE DESIGN PROFESSIONAL. TRAPEZE TYPE SUPPORTS MAY BE USED. HOWEVER, CLIP ANGLES W/ SCREWS MUST BE USED TO ATTACH VERT CABLE TRAY TO THE HORIZ STRUT(S).
 - B. DISTANCE BTW FOUR-WAY BRACES FOR RISERS MUST NOT EXCEED 10 FT & THOSE SPECIFIED BY THE MFR.
 - C. VERT RISERS SUPPORTED AT A FLOOR MUST BE CONSIDERED SEISMICALLY BRACED AT THE FLR IF THE PENETRATION THROUGH THE FLR IS TIGHTLY PACKED WITH FIRE PROTECTION MATERIAL. FOR PENETRATIONS THROUGH FLR OPGS THAT ARE NOT TIGHTLY PACKED, SUPPORTS & ATTACHMENTS FOR EA RISER SHOWN IN DETAILS ON PG 13.4, MUST BE DESIGNED FOR ALL GRAVITY, SEISMIC, & THERMAL LOADS. RELATIVE DISPLACEMENT BTW FLRS MUST BE CONSIDERED IN THE DESIGN & THE DESIGN IS SUBJECT TO APPROVAL BY OSHPD.

DATE: 08/07/2021



SHEET TITLE: OVERVIEW & GENERAL NOTES

DESIGN PARAMETERS & BRACING GUIDELINES - ELECTRICAL CABLE TRAYS

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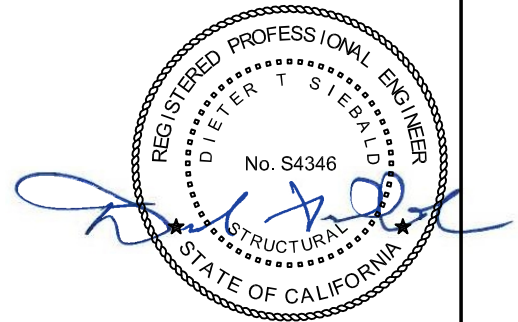
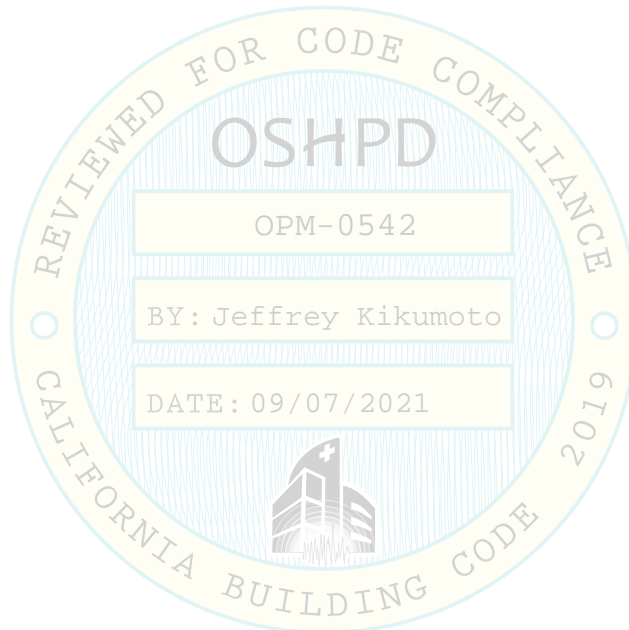
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SEISMIC BRACING FOR
MEP SYSTEMS



DESIGN PARAMETERS & BRACING GUIDELINES – ELECTRICAL CABLE TRAYS (CONTINUED):

15. WHEN CALCULATING HORIZ LOAD REQUIREMENTS, USE TABLES FROM SECTION 202 TO CALCULATE THE WT OF WIRE FILLED ELECTRICAL CABLE TRAY.
16. FOR LATERAL SEISMIC BRACE AXIAL CAPACITY AND ALLOWABLE BRACE LENGTH, SEE TABLES IN SECTION 400.
17. DO NOT BRACE THE ELECTRICAL CABLE TRAY SYSTEM TO TWO DIFFERENT PARTS OF A BLDG WHICH MAY ACT DIFFERENTLY IN RESPONSE TO AN EARTHQUAKE (i.e., SEPARATED BY A SEISMIC JOINT). ANY SYSTEM THAT CROSSES A BLDG SEPARATION OR SEISMIC JOINT MUST BE DESIGNED TO ACCOMMODATE THE SEISMIC RELATIVE DISPLACEMENT PER ASCE/SEI 7-16, SECTION 13.3.2 OR AS SPECIFIED BY THE STRUCTURAL ENGINEER OF RECORD ON THE OSHPD APPROVED CONSTRUCTION DOCUMENTS.
18. CABLE TRAYS MUST BE POSITIVELY FASTENED TO THE SUPPORT AS DETAILED IN SECTION 13.



SHEET TITLE: OVERVIEW & GENERAL NOTES

DESIGN PARAMETERS & BRACING GUIDELINES - ELECTRICAL CABLE TRAYS



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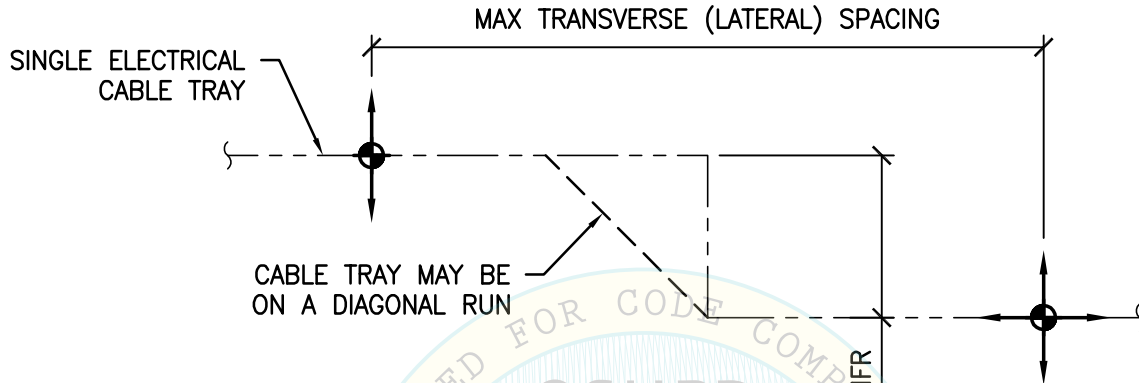
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SEISMIC BRACING FOR
MEP SYSTEMS



DESIGN PARAMETERS & BRACING GUIDELINES – ELECTRICAL CABLE TRAYS (CONTINUED):



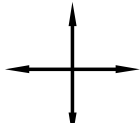
PLAN VIEW

OPM-0542

BY: Jeffrey Kikumoto

DATE: 09/07/2021

LEGEND:



TRANSVERSE (LATERAL) &
LONGITUDINAL SEISMIC BRACES,
SEE SECTIONS 13 & 16



TRANSVERSE (LATERAL)
SEISMIC BRACE,
SEE SECTIONS 13 & 16



ELECTRICAL CABLE TRAY
TRAPEZE SUPPORT W/
SEISMIC BRACES

NOTE:

1. CABLE TRAY TRANSVERSE &
LONGITUDINAL BRACE SPCG
MUST NOT EXCEED THOSE
SPECIFIED BY THE MFR.



SHEET TITLE: OVERVIEW & GENERAL NOTES

DESIGN PARAMETERS & BRACING GUIDELINES - ELECTRICAL CABLE TRAYS



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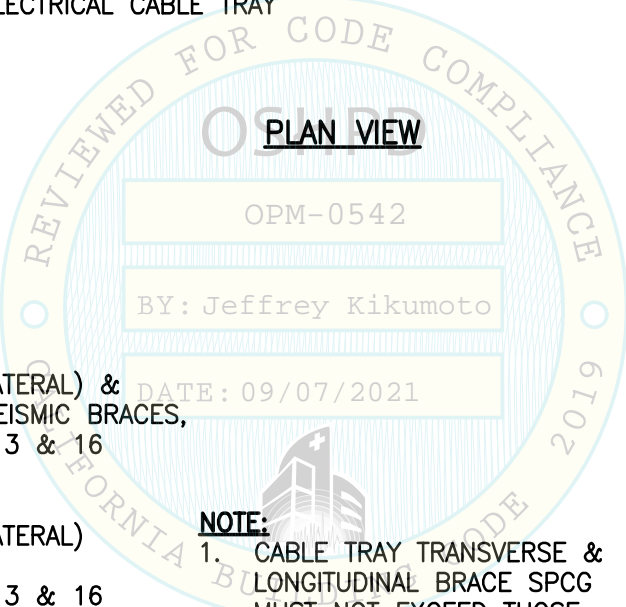
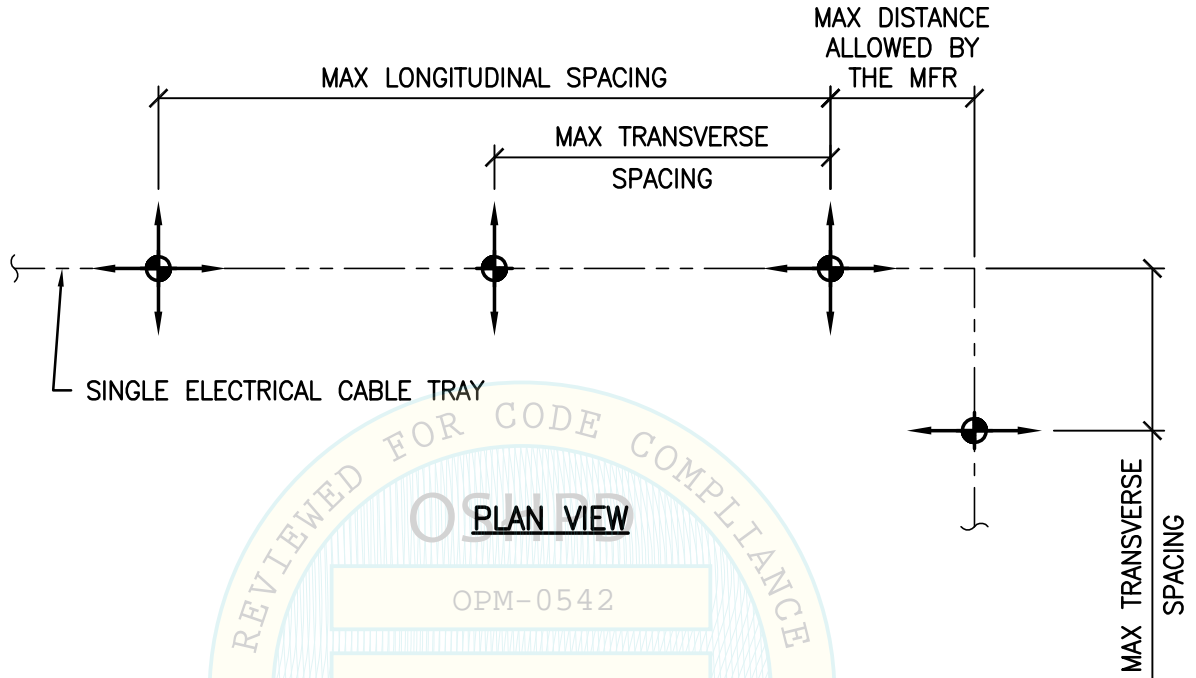
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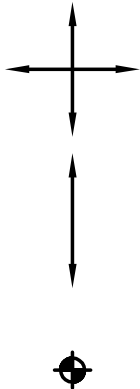
SEISMIC BRACING FOR
MEP SYSTEMS



DESIGN PARAMETERS & BRACING GUIDELINES – ELECTRICAL CABLE TRAYS (CONTINUED):



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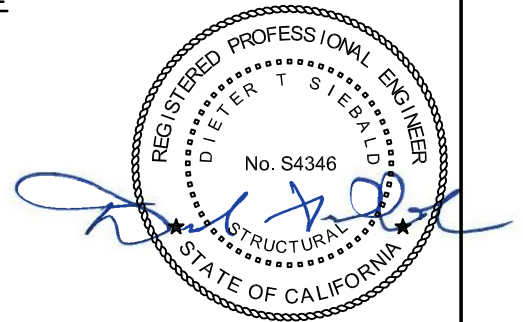
TRANSVERSE (LATERAL) & LONGITUDINAL SEISMIC BRACES, SEE SECTIONS 13 & 16

TRANSVERSE (LATERAL) SEISMIC BRACE, SEE SECTIONS 13 & 16

ELECTRICAL CABLE TRAY TRAPEZE SUPPORT W/ SEISMIC BRACES

NOTE:

1. CABLE TRAY TRANSVERSE & LONGITUDINAL BRACE SPCG MUST NOT EXCEED THOSE SPECIFIED BY THE MFR.



SHEET TITLE: OVERVIEW & GENERAL NOTES

DESIGN PARAMETERS & BRACING GUIDELINES - ELECTRICAL CABLE TRAYS



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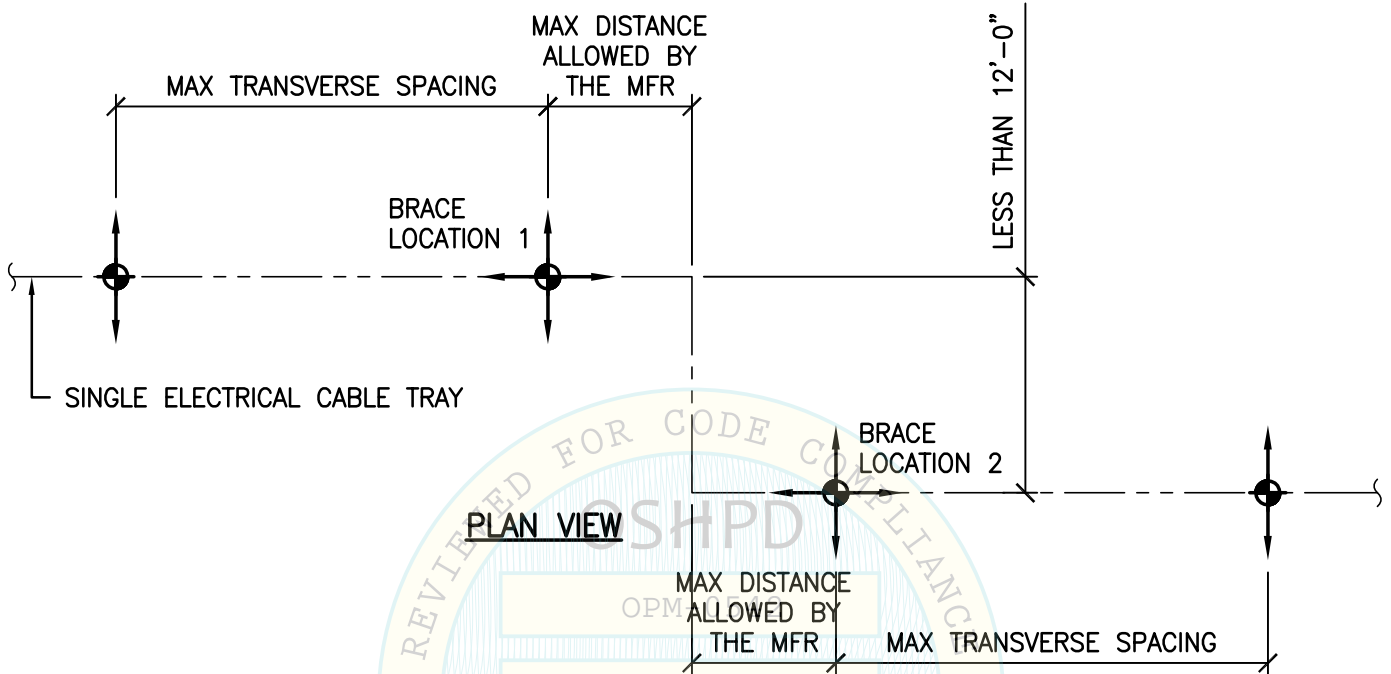
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SEISMIC BRACING FOR
MEP SYSTEMS

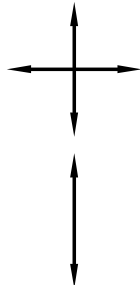


DESIGN PARAMETERS & BRACING GUIDELINES – ELECTRICAL CABLE TRAYS (CONTINUED):



PLAN VIEW

LEGEND:



TRANSVERSE (LATERAL) &
LONGITUDINAL SEISMIC BRACES,
SEE SECTIONS 13 & 16

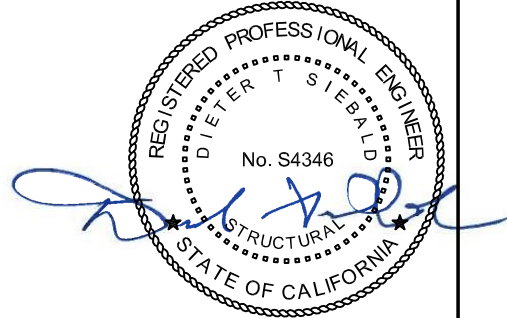
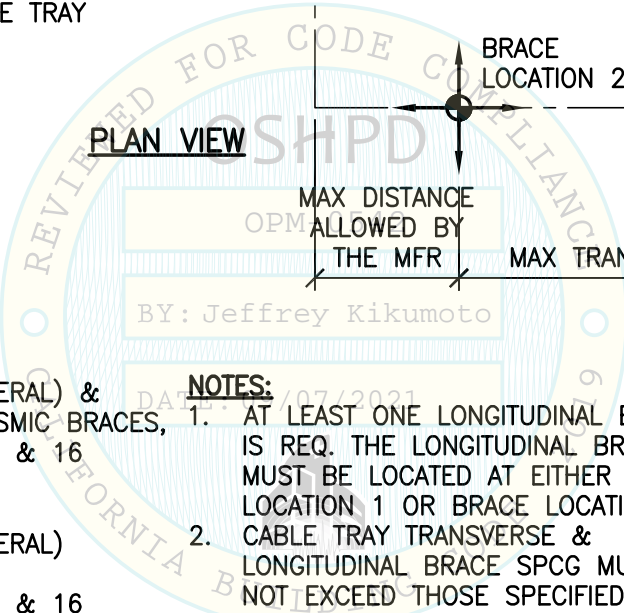
TRANSVERSE (LATERAL)
SEISMIC BRACE,
SEE SECTIONS 13 & 16



ELECTRICAL CABLE TRAY
TRAPEZE SUPPORT W/
SEISMIC BRACES

NOTES:

1. AT LEAST ONE LONGITUDINAL BRACE IS REQ. THE LONGITUDINAL BRACE MUST BE LOCATED AT EITHER BRACE LOCATION 1 OR BRACE LOCATION 2.
2. CABLE TRAY TRANSVERSE & LONGITUDINAL BRACE SPCG MUST NOT EXCEED THOSE SPECIFIED BY THE MFR.



SHEET TITLE: OVERVIEW & GENERAL NOTES

DESIGN PARAMETERS & BRACING GUIDELINES - ELECTRICAL CABLE TRAYS



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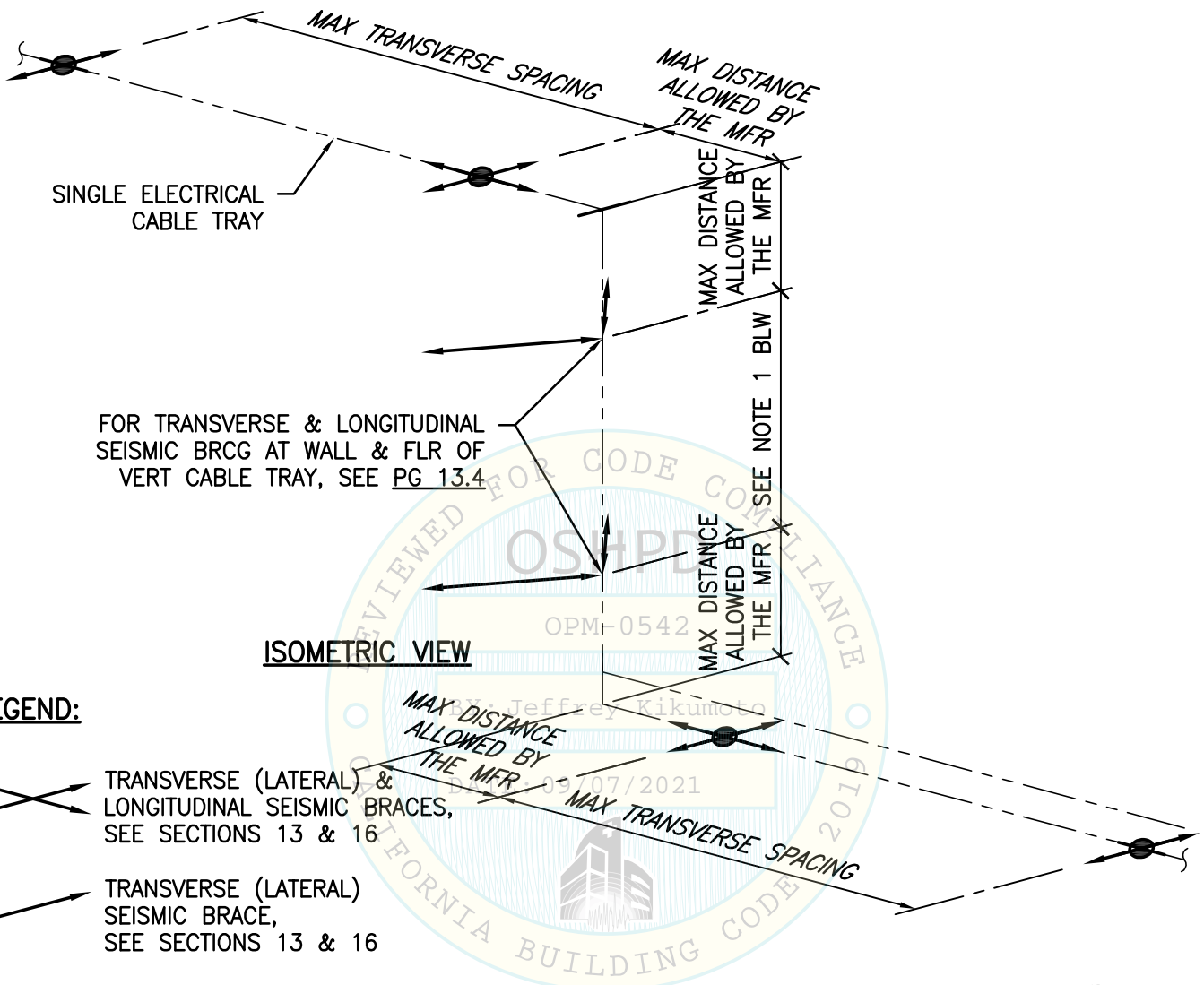
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SEISMIC BRACING FOR
MEP SYSTEMS



DESIGN PARAMETERS & BRACING GUIDELINES – ELECTRICAL CABLE TRAYS (CONTINUED):

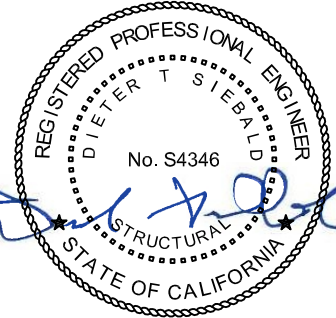


LEGEND:

- TRANSVERSE (LATERAL) & LONGITUDINAL SEISMIC BRACES, SEE SECTIONS 13 & 16
- TRANSVERSE (LATERAL) SEISMIC BRACE, SEE SECTIONS 13 & 16
- ELECTRICAL CABLE TRAY TRAPEZE SUPPORT W/ SEISMIC BRACES

NOTES:

1. SPCG OF VERT RISERS MUST NOT EXCEED 10 FT & THOSE SPECIFIED BY THE MFR.
2. FOR VERT RISERS AT FLOOR PENETRATIONS SEE NOTE 14 ON PG 1.201.



SHEET TITLE: OVERVIEW & GENERAL NOTES

DESIGN PARAMETERS & BRACING GUIDELINES - ELECTRICAL CABLE TRAYS

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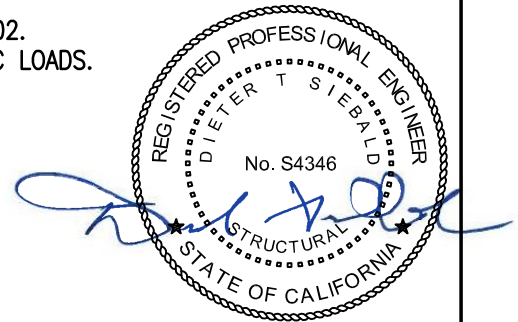
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SEISMIC BRACING FOR
MEP SYSTEMS



DESIGN PARAMETERS & BRACING GUIDELINES – RECTANGULAR & ROUND DUCTS:

1. DESIGN AND INSTALLATION OF THE SEISMIC BRCG FOR DUCTWORK SYSTEMS MUST CONFORM TO ASCE/SEI 7-16 SECTION 13 & 2019 CBC SECTION 1617.A.1.25.
2. THE SPACING AND DTLs OF THE SUPPORT AND BRCG OF DUCTWORK SYSTEMS MUST COMPLY W/ ASCE/SEI 7-16 SECTION 13.6 PER 2019 CBC SECTIONS 1601.1.4 & 1617A.1.18 APPLICABLE ONLY TO OSHPD 1,2,4,5 & 1R DESIGNATED PROJECTS, DISTRIBUTED HVAC DUCTWORK AND FACTORY BUILT VENT DUCT WEIGHING 5 PLF OR LESS ARE EXEMPT FROM DESIGN FOR THE SEISMIC FORCES OF ASCE 7-16 §13.3., AND REMAINING DUCT SYSTEMS. DESIGN FOR THE SEISMIC FORCES AND RELATIVE DISPLACEMENTS SHALL NOT BE REQ FOR HVAC DUCTWORK & FACTORY BUILT VENT DUCT WHERE FLEXIBLE CONNECTIONS OR OTHER ASSEMBLIES ARE PROVIDED TO ACCOMMODATE THE RELATIVE DISPLACEMENT BTW THE DUCT SYSTEM & ASSOCIATED COMPONENTS, THE DUCT SYSTEM IS POSITIVELY ATTACHED TO THE STRUCTURE, AND WHERE ONE OF THE FOLLOWING APPLY:
 - A. TRAPEZE ASSEMBLIES W/ $\frac{3}{8}$ " OR $\frac{1}{2}$ " ϕ ROD HANGERS NOT EXCEEDING 12" IN LENGTH FROM THE DUCT SUPPORT POINT TO THE CONNECTION AT THE SUPPORTING STRUCTURE ARE USED TO SUPPORT DUCT, AND THE TOTAL WT SUPPORTED BY ANY SINGLE TRAPEZE IS LESS THAN 10 PLF AND 100 LBS OR LESS; OR
 - B. THE DUCT IS SUPPORTED BY INDIVIDUAL ROD HANGERS $\frac{3}{8}$ " OR $\frac{1}{2}$ " ϕ , AND EA HANGER IN THE DUCT RUN IS 12" OR LESS IN LENGTH FROM THE DUCT SUPPORT POINT TO THE CONNECTION AT THE SUPPORTING STRUCTURE, AND THE TOTAL WT SUPPORTED BY ANY SINGLE ROD IS 50 LBS OR LESS.
3. THE CRDP MUST PROVIDE DTLs AND CALCULATIONS FOR THE SEISMIC BRCG AND THEIR SUPPORTS AND ATTACHMENTS TO THE STRUCTURE. WHERE APPLICABLE, DTLs FOR THE SUPPORT AND BRCG MAY BE REFERRED TO THIS OSHPD PRE-APPROVAL. ALL LAYOUT DRAWINGS OF THE DUCTWORK SYSTEM MUST BE SUBMITTED TO OSHPD FOR REVIEW AND APPROVAL PRIOR TO INSTALLATION.
4. THE CRDP MUST DETERMINE THE CONFIGURATION OF THE DUCTWORK SYSTEM AND THE DEMAND LOADS ON ALL DUCTWORK COMPONENTS, BRCG, AND SUPPORTS AND ATTACHMENTS. THE CRDP MUST DETERMINE THE GOVERNING CAPACITY FOR EACH DESIRED BRCG COMBINATION BASED ON THE CAPACITY OF THE INDIVIDUAL ELEMENTS BLW:
 - A. THE ALLOWABLE HORIZ CAPACITY F_H OF THE BRACE COMPONENT ATTACHED TO THE DUCTWORK AS GIVEN IN SECTION 500 (BASED ON TESTING).
 - B. THE ALLOWABLE AXIAL CAPACITY OF THE LATERAL BRACE AS GIVEN IN SECTION 400.
 - C. THE ALLOWABLE HORIZ CAPACITY F_H OF THE BRACE COMPONENT ATTACHED TO THE STRUCTURE ARE GIVEN AT THE END OF THE TABLE IN SECTION 600 (BASED ON TESTING).
 - D. THE CAPACITY OF THE ANCHORAGE TO CONC ARE GIVEN IN APPENDIX A. THE TENSION AND SHEAR VALUES WERE DETERMINED USING ACI® 318-14 AND LISTED ICC ESR REPORTS. THE CRDP MUST DETERMINE IF THE DEMAND LOADS EXCEED THE COMBINED FORCES CHECK PER ACI 318-14, SECTION 17.
4. THE DEAD LOADS OF DUCTWORK MAY BE FOUND IN SECTION 202.
5. SEISMIC BRCG MUST HAVE A MAX SPACING NOT EXCEEDING THAT SPECIFIED IN THIS SECTION.
6. SEISMIC BRCG MUST BE LIMITED TO AN L/R RATIO AS SPECIFIED IN SECTION 400.
7. SEISMIC BRACE ANCHORAGE MUST BE AT LEAST 6" AWAY FROM ANY OTHER ANCHORAGE OR CONC EDGES UNO IN SECTION 1.
8. FOR AN EXAMPLE OF THE SEISMIC BRACE DESIGN PROCEDURE, SEE SECTION 302.
9. IT IS THE RESPONSIBILITY OF THE CRDP TO DETERMINE THE GOVERNING SEISMIC LOADS.



SHEET TITLE: OVERVIEW & GENERAL NOTES
DESIGN PARAMETERS & BRACING GUIDELINES - RECTANGULAR & ROUND DUCTS

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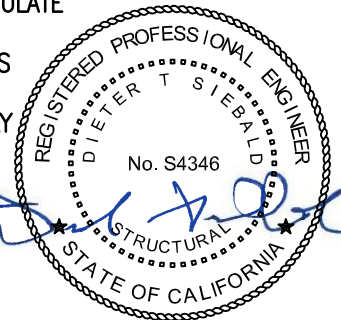
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SEISMIC BRACING FOR
MEP SYSTEMS



**DESIGN PARAMETERS & BRACING GUIDELINES – RECTANGULAR & ROUND DUCTS
(CONTINUED):**

11. A RUN OF DUCTWORK IS CONSIDERED A CONTINUOUS RUN IF THE MAX OFFSET IS LESS THAN 24". IF THE OFFSET IS 24" OR GREATER, EA STRAIGHT SEGMENT MUST BE TREATED AS AN INDEPENDENT RUN AND BRACED. REFER TO PARTIAL PLAN ON PG 1.303.
12. TRANSVERSE BRG:
 - A. TRANSVERSE BRG IS TO PROTECT DUCTWORK AGAINST MOVEMENT PERP TO THE RUN OF DUCTWORK.
 - B. TRANSVERSE BRG MUST BE PROVIDED ON ALL FEED AND CROSS DUCTS REGARDLESS OF SIZE. THE LAST LENGTH OF DUCTWORK AT THE END OF A FEED OR CROSS DUCT MUST BE PROVIDED W/ A TRANSVERSE BRACE.
 - C. TRANSVERSE BRG MAX SPACING FOR DUCTWORK CONFORMING TO SMACNA STANDARDS MUST BE 30 FT. REFER TO PARTIAL PLAN ON PG 1.304.
 - D. A TRANSVERSE BRACE PLACED ON THE DUCTWORK RUN SECTION AT THE OPPOSITE SIDE OF AN ELBOW WITHIN 24" MAY ACT AS A LONGITUDINAL BRACE. REFER TO PARTIAL PLAN ON PG 1.304.
 - E. THE MIN REQ BRG FOR RUNS LONGER THAN 5 FEET IS A TRANSVERSE BRACE AT EA END, AND A LONGITUDINAL BRACE AT ONE OF THOSE TWO POSITIONS. REFER TO PARTIAL PLAN ON PG 1.302.
 - F. BRG INSTALLED TO SMALLER DUCTWORK MUST NOT BE USED TO BRACE LARGER DUCTWORK.
13. LONGITUDINAL BRG:
 - A. LONGITUDINAL BRG IS TO PROTECT DUCTWORK AGAINST MOVEMENT PARALLEL TO THE RUN OF DUCTWORK.
 - B. LONGITUDINAL BRG MAX SPACING FOR DUCTWORK CONFORMING TO SMACNA STANDARDS MUST BE 60 FT. REFER TO PARTIAL PLAN ON PG 1.304.
 - C. EA DUCTWORK RUN MUST HAVE AT LEAST ONE LONGITUDINAL BRACE. ADDITIONAL LONGITUDINAL BRACES ARE REQ WHEN THE MAX LONGITUDINAL SPACING IS EXCEEDED. REFER TO PARTIAL PLANS ON PGS 1.303, 1.304 & 1.305.
14. VERT OFFSETS/RISERS:
 - A. TOPS OF VERT OFFSETS/RISERS EXCEEDING 3 FEET IN LENGTH MUST BE PROVIDED W/ A FOUR-WAY BRACE. BRG MUST BE LOCATED WITHIN 24" OF THE END OF THE VERT RUN. REFER TO PARTIAL ISOMETRIC A ON PG 1.305. FOUR-WAY BRG MUST BE DESIGNED BY THE DESIGN PROFESSIONAL. TRAPEZE TYPE SUPPORTS MAY BE USED. HOWEVER, CLIP ANGLES W/ SCREWS MUST BE USED TO ATTACH VERT DUCTS TO THE HORIZ STRUT(S).
 - B. DISTANCE BTW FOUR-WAY BRACES FOR RISERS MUST NOT EXCEED 25 FEET.
 - C. VERT DUCTWORK SYSTEMS SUPPORTED AT EA FLR SHALL BE CONSIDERED SEISMICALLY BRACED IF THE PENETRATION THROUGH EA FLR IS TIGHTLY PACKED AND THE FLR-TO-FLR SPACING IS NOT IN EXCESS OF 30 FEET.
 - D. VERT DUCT RISERS IN AN OPEN SHAFT MUST BE ATTACHED TO STL SUPPORT WITH BOTH STL SUPPORTS AND CONNECTIONS SIZED TO ACCEPT THE COMBINED GRAVITY AND SEISMIC LOADS. THERMAL LOADS SHALL BE CONSIDERED, WHERE APPLICABLE. LATERAL SEISMIC RESTRAINT SPACING SHALL NOT EXCEED 30 FEET. SUPPORTS AND CONNECTIONS MUST BE ENGINEERED ON A JOB BY JOB BASIS SUBJECT TO APPROVAL BY THE ENFORCEMENT AGENCY. SEISMIC RELATIVE DISPLACEMENT BTW FLRS SHALL BE CONSIDERED IN THE DESIGN.
15. WHEN CALCULATING HORIZ LOAD REQUIREMENTS, USE TABLE FROM SECTION 202 TO CALCULATE THE WT OF DUCTWORK.
16. FOR LATERAL SEISMIC BRACE AXIAL CAPACITY AND ALLOWABLE BRACE LENGTH, SEE TABLES IN SECTION 400.
17. **DO NOT** BRACE THE DUCTWORK SYSTEM TO TWO DIFFERENT PARTS OF A BLDG WHICH MAY ACT DIFFERENTLY IN RESPONSE TO AN EARTHQUAKE (i.e., SEPARATED BY A SEISMIC JOINT). ANY SYSTEM THAT CROSSES A BLDG SEPARATION OR SEISMIC JOINT MUST BE DESIGNED TO ACCOMMODATE THE SEISMIC RELATIVE DISPLACEMENT PER ASCE/SEI 7-16, SECTION 13.3.2 OR AS SPECIFIED BY THE STRUCTURAL ENGINEER OF RECORD ON THE OSHPD APPROVED CONSTRUCTION DOCUMENTS.



SHEET TITLE: OVERVIEW & GENERAL NOTES
DESIGN PARAMETERS & BRACING GUIDELINES - RECTANGULAR & ROUND DUCTS

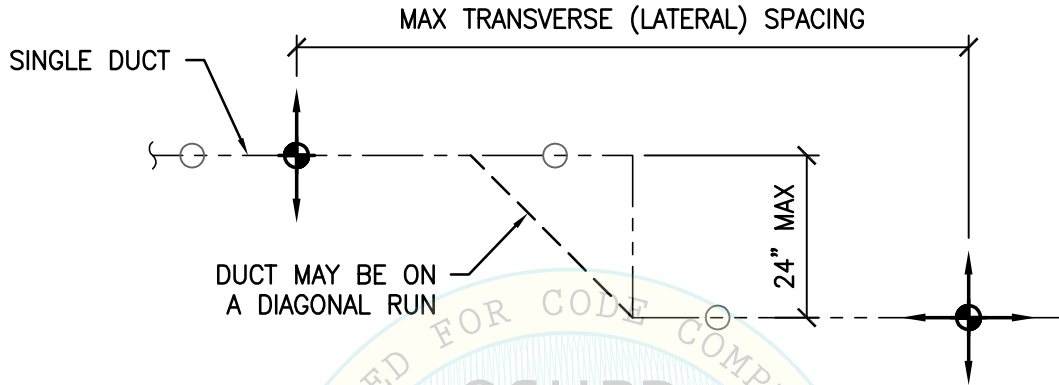
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| <p>CYS STRUCTURAL ENGINEERS, INC. 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833</p> | TEL (916) 920-2020 www.cyseng.com | Job No: 19039 Date: 09/08/2021 Page: 1.301 of . |
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SEISMIC BRACING FOR
MEP SYSTEMS



**DESIGN PARAMETERS & BRACING GUIDELINES – RECTANGULAR & ROUND DUCTS
(CONTINUED):**

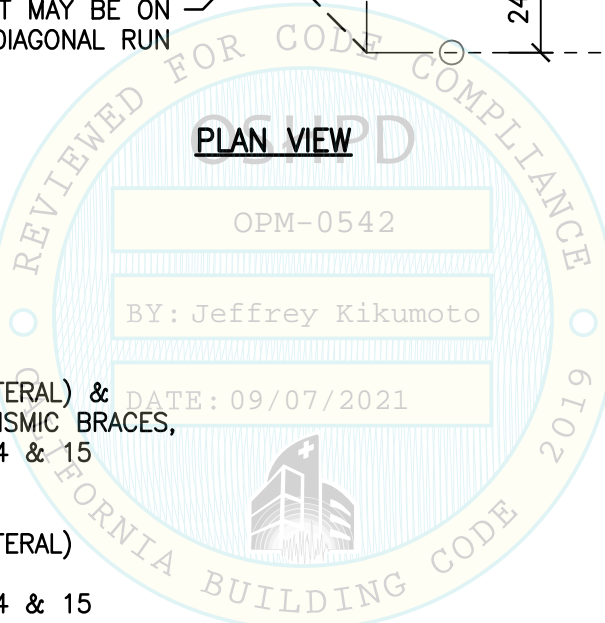


PLAN VIEW

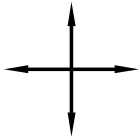
OPM-0542

BY: Jeffrey Kikumoto

DATE: 09/07/2021



LEGEND:



TRANSVERSE (LATERAL) &
LONGITUDINAL SEISMIC BRACES,
SEE SECTIONS 14 & 15



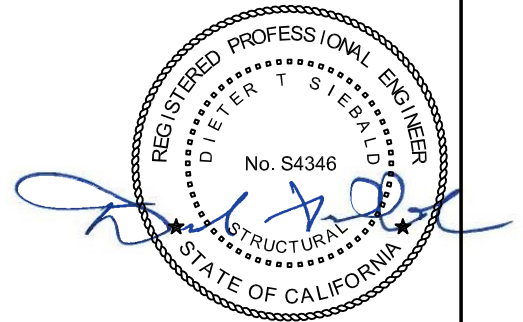
TRANSVERSE (LATERAL)
SEISMIC BRACE,
SEE SECTIONS 14 & 15



RECTANGULAR OR ROUND
DUCT TRAPEZE SUPPORT
W/ SEISMIC BRACE



RECTANGULAR OR ROUND DUCT TRAPEZE
SUPPORT W/O SEISMIC BRACES
(NOT PART OF OPM) SHOWN FOR
REFERENCE ONLY



SHEET TITLE: OVERVIEW & GENERAL NOTES

DESIGN PARAMETERS & BRACING GUIDELINES - RECTANGULAR & ROUND DUCTS



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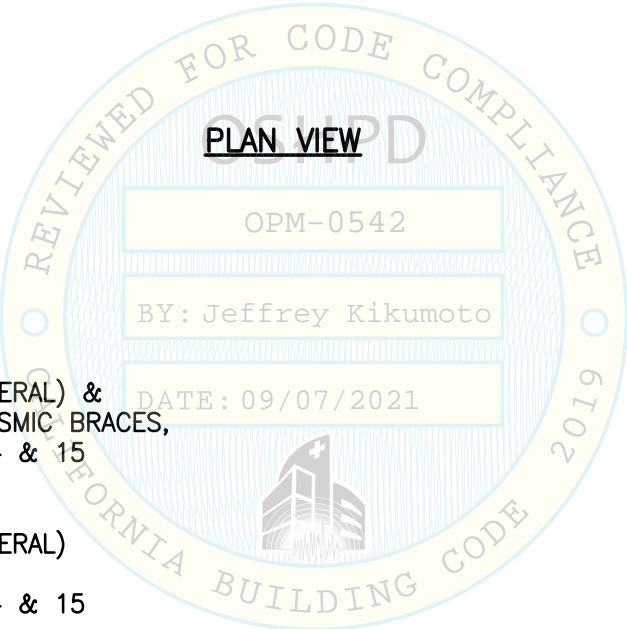
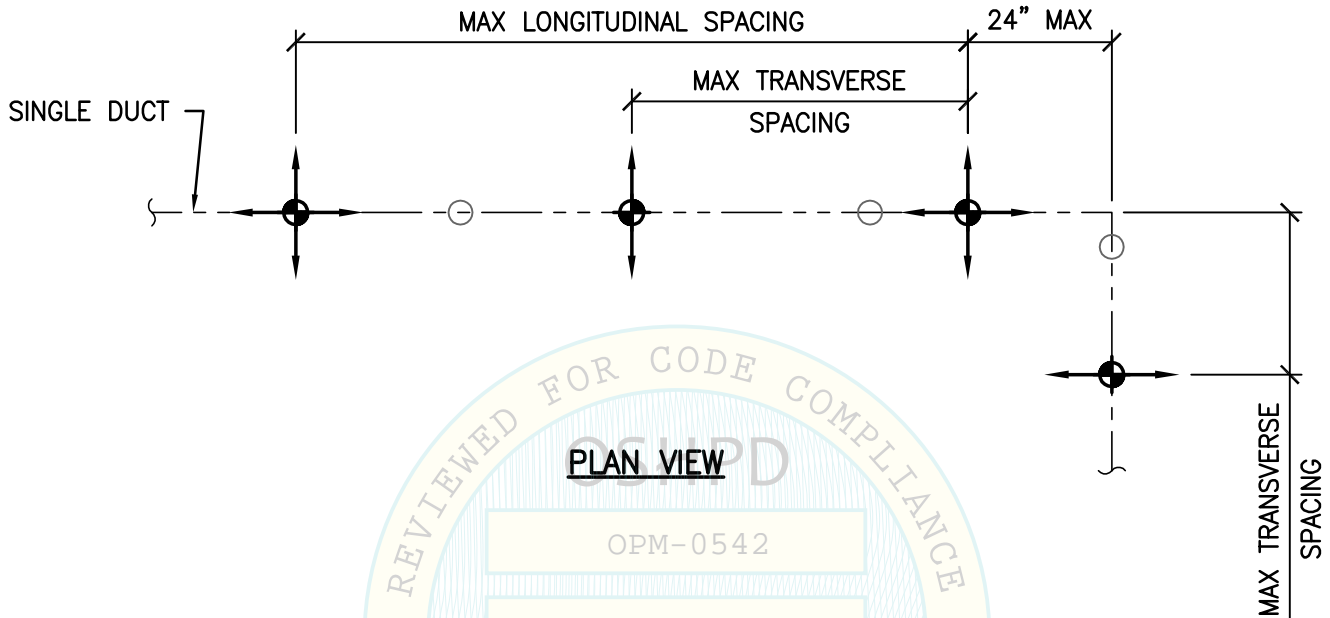
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Page: 1.302 of .

SEISMIC BRACING FOR
MEP SYSTEMS

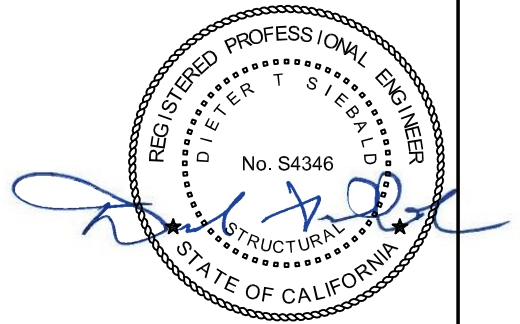


**DESIGN PARAMETERS & BRACING GUIDELINES – RECTANGULAR & ROUND DUCTS
(CONTINUED):**



LEGEND:

- TRANSVERSE (LATERAL) & LONGITUDINAL SEISMIC BRACES, SEE SECTIONS 14 & 15
- TRANSVERSE (LATERAL) SEISMIC BRACE, SEE SECTIONS 14 & 15
- RECTANGULAR OR ROUND DUCT TRAPEZE SUPPORT W/ SEISMIC BRACE
- RECTANGULAR OR ROUND DUCT TRAPEZE SUPPORT W/O SEISMIC BRACES (NOT PART OF OPM) SHOWN FOR REFERENCE ONLY



SHEET TITLE: OVERVIEW & GENERAL NOTES
DESIGN PARAMETERS & BRACING GUIDELINES - RECTANGULAR & ROUND DUCTS



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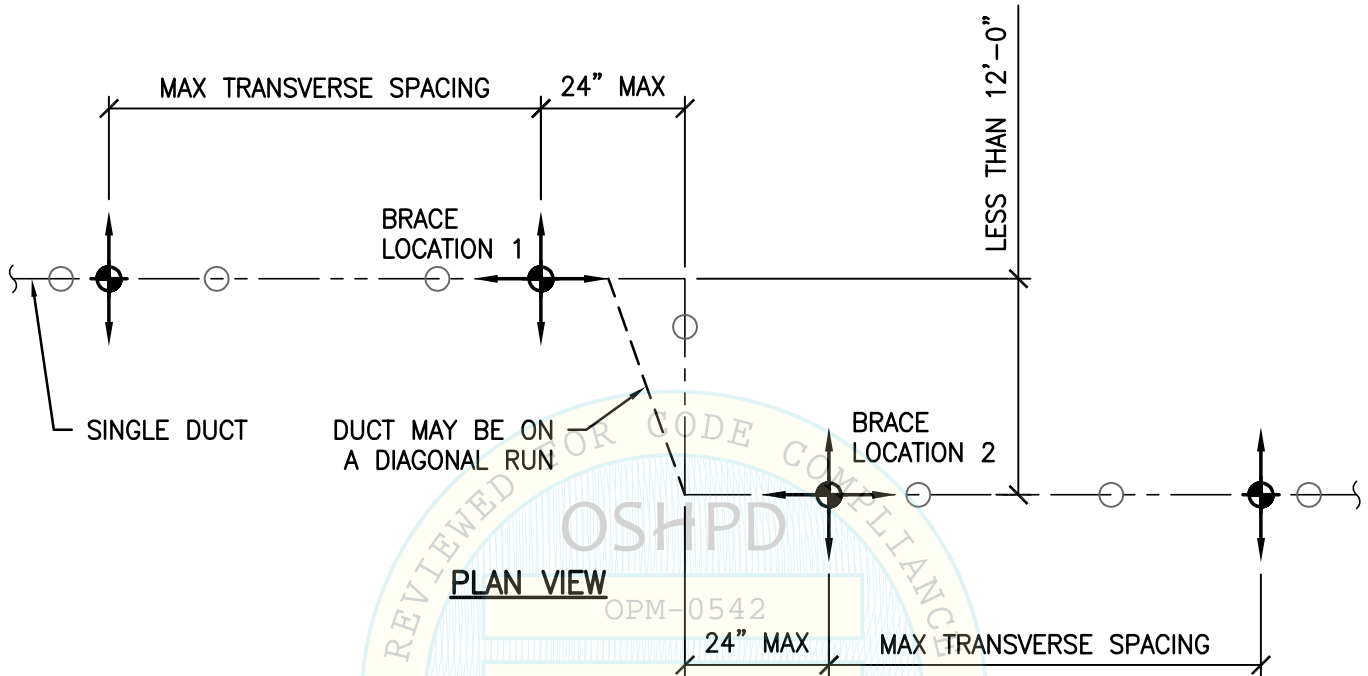
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SEISMIC BRACING FOR
MEP SYSTEMS

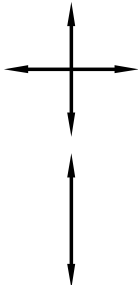


**DESIGN PARAMETERS & BRACING GUIDELINES – RECTANGULAR & ROUND DUCTS
(CONTINUED):**



PLAN VIEW

LEGEND:



TRANSVERSE (LATERAL) &
LONGITUDINAL SEISMIC BRACES,
SEE SECTIONS 14 & 15

TRANSVERSE (LATERAL)
SEISMIC BRACE,
SEE SECTIONS 14 & 15



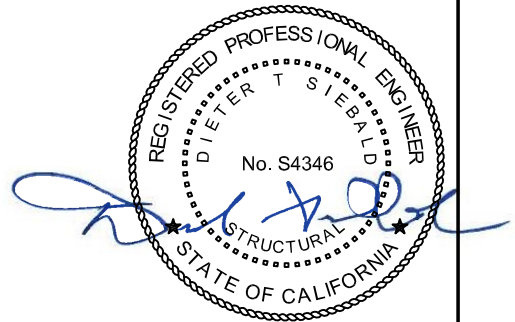
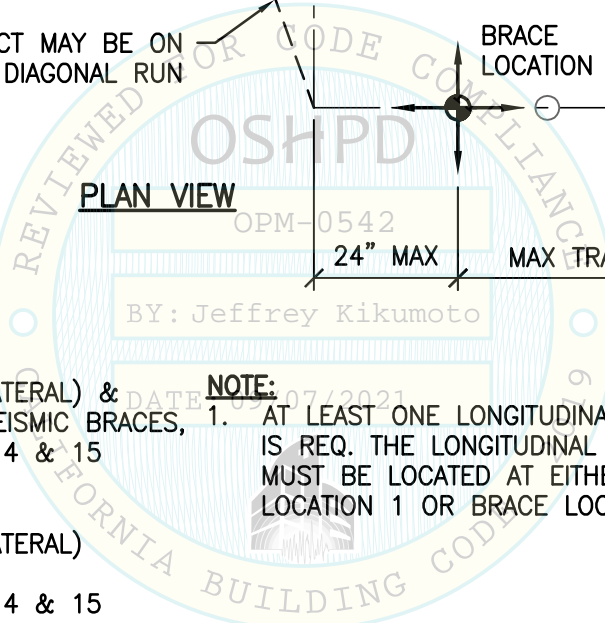
RECTANGULAR OR ROUND
DUCT TRAPEZE SUPPORT
W/ SEISMIC BRACE



RECTANGULAR OR ROUND DUCT TRAPEZE
SUPPORT W/O SEISMIC BRACES
(NOT PART OF OPM) SHOWN FOR
REFERENCE ONLY

NOTE:

1. AT LEAST ONE LONGITUDINAL BRACE
IS REQ. THE LONGITUDINAL BRACE
MUST BE LOCATED AT EITHER BRACE
LOCATION 1 OR BRACE LOCATION 2.



SHEET TITLE: OVERVIEW & GENERAL NOTES

DESIGN PARAMETERS & BRACING GUIDELINES - RECTANGULAR & ROUND DUCTS



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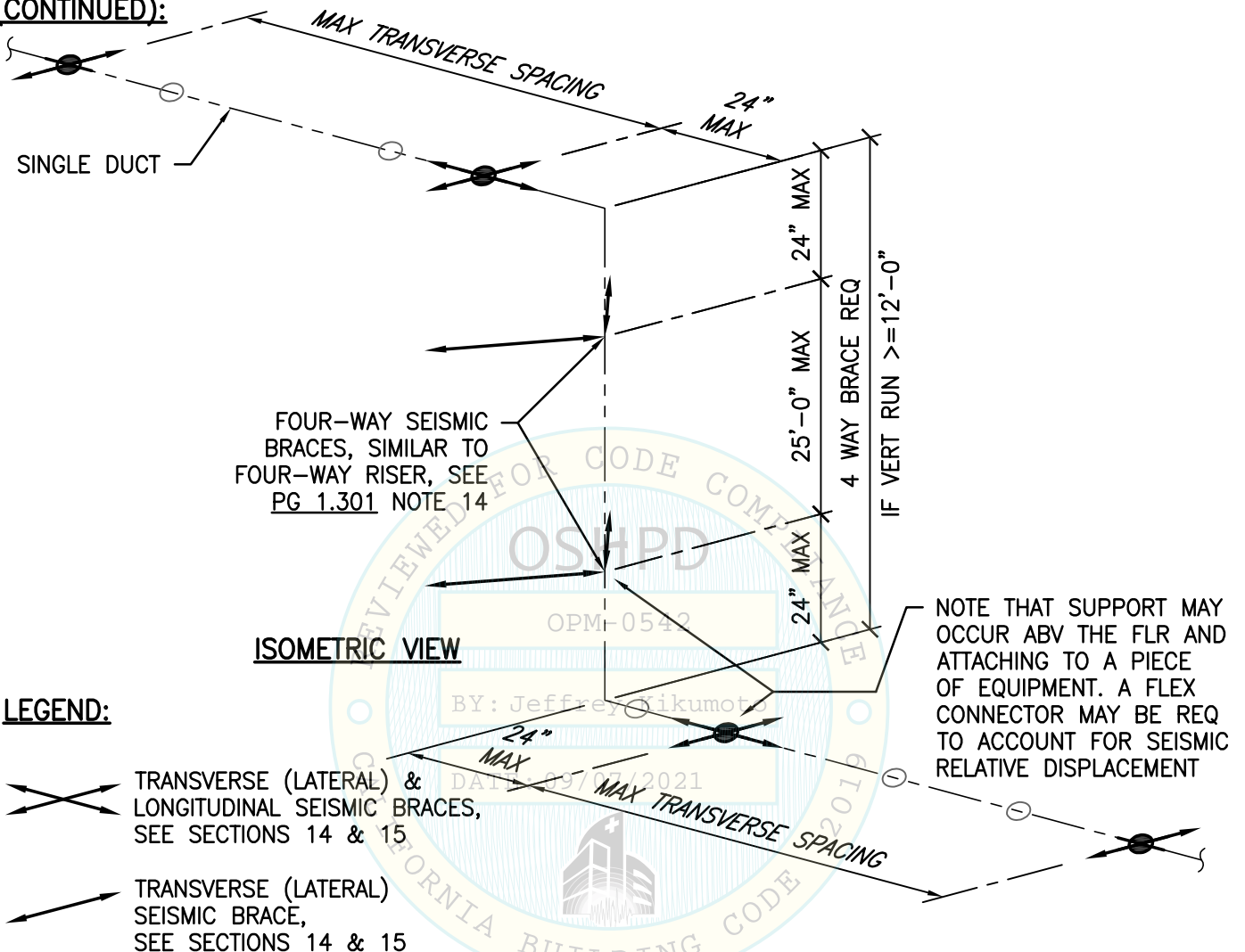
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SEISMIC BRACING FOR MEP SYSTEMS



DESIGN PARAMETERS & BRACING GUIDELINES – RECTANGULAR & ROUND DUCTS (CONTINUED):

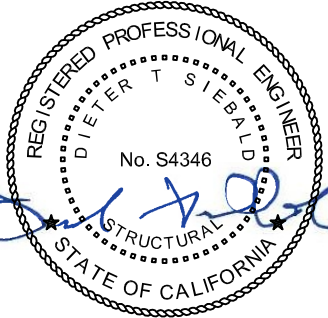


NOTE THAT SUPPORT MAY OCCUR ABOVE THE FLR AND ATTACHING TO A PIECE OF EQUIPMENT. A FLEX CONNECTOR MAY BE REQUIRED TO ACCOUNT FOR SEISMIC RELATIVE DISPLACEMENT

LEGEND:

- TRANSVERSE (LATERAL) & LONGITUDINAL SEISMIC BRACES, SEE SECTIONS 14 & 15
- TRANSVERSE (LATERAL) SEISMIC BRACE, SEE SECTIONS 14 & 15
- FOUR-WAY RISER SEISMIC BRACES, SEE SECTIONS 14 & 15
- RECTANGULAR OR ROUND DUCT TRAPEZE SUPPORT W/ SEISMIC BRACE
- RECTANGULAR OR ROUND DUCT TRAPEZE SUPPORT W/O SEISMIC BRACES (NOT PART OF OPM) SHOWN FOR REFERENCE ONLY

NOTE:
FOUR-WAY BRCG MUST NOT BE REQ WHERE RISERS PENETRATE INTERMEDIATE FLRS IN MULTI-STORY BLDGS WHERE THE CLEARANCE BTW FLRS DOES NOT EXCEED 12'-0", PROVIDED THE PENETRATION THROUGH THE FLR IS CONSIDERED SEISMICALLY BRACED PER NOTE 14 ON PG 1.301.

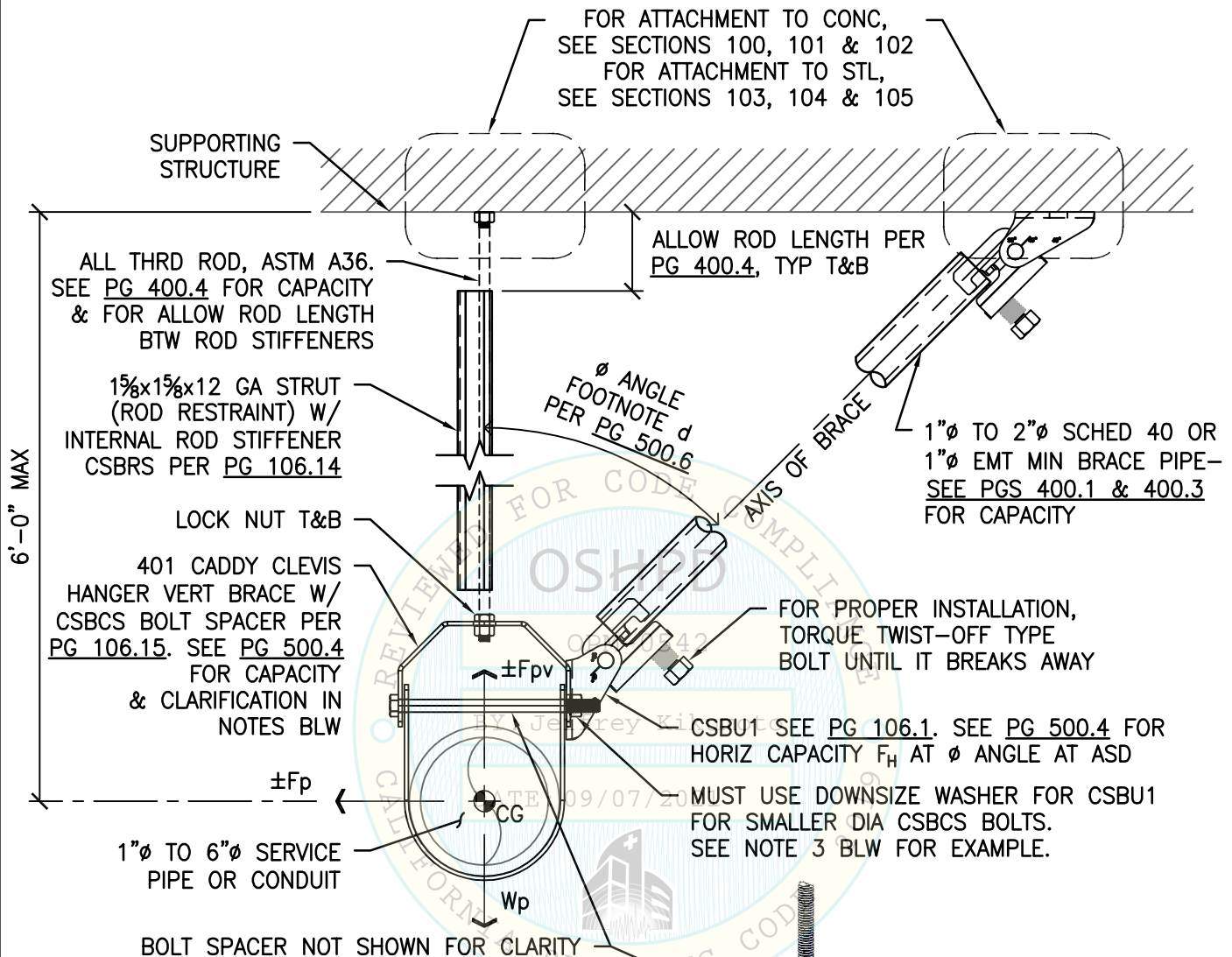


SHEET TITLE: OVERVIEW & GENERAL NOTES
DESIGN PARAMETERS & BRACING GUIDELINES - RECTANGULAR & ROUND DUCTS

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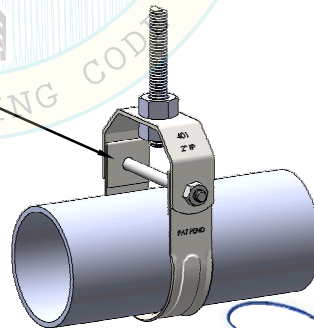
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SEISMIC BRACING FOR MEP SYSTEMS



NOTES:

1. FOR 3" & 3 1/2" PIPE & FOR 30 DEG-44 DEG USE CAPACITY FOR 4" PIPE.
2. FOR DIAMETERS NOT NOTED, USE CAPACITY FOR SMALLER DIA PIPE UNLESS CAPACITY FOR LARGER IS LESS.
3. FOR 1/4" DIA CSBRS CLEVIS BOLT USE 2- 9/32"x1 1/4" STANDARD LOW CARBON STL FLAT FENDER WASHERS & TORQUE TO 10 FT-LBS. FOR 3/8" DIA BOLT USE 1- STANDARD 3/8" WASHER & TORQUE TO 25 FT-LBS. FOR 1/2" DIA BOLT NO WASHER IS REQ & TORQUE TO 50 FT-LBS.
4. IF CLEVIS HANGER IS USED AS A VERT BRACE HANGER WITHOUT A TRAN BRACE, IT IS CAPABLE TO RESIST DEAD & SEISMIC VERT LOADS ($W_p \pm F_{pv}$) OF 600 LBS AT ASD.
5. THE MAX TRAN BRACE SPACING &/OR MAX HANGER SPACING CALLED ON PG 200.3 MAY HAVE TO BE REDUCED BASED ON THE 600 LBS LIMIT.

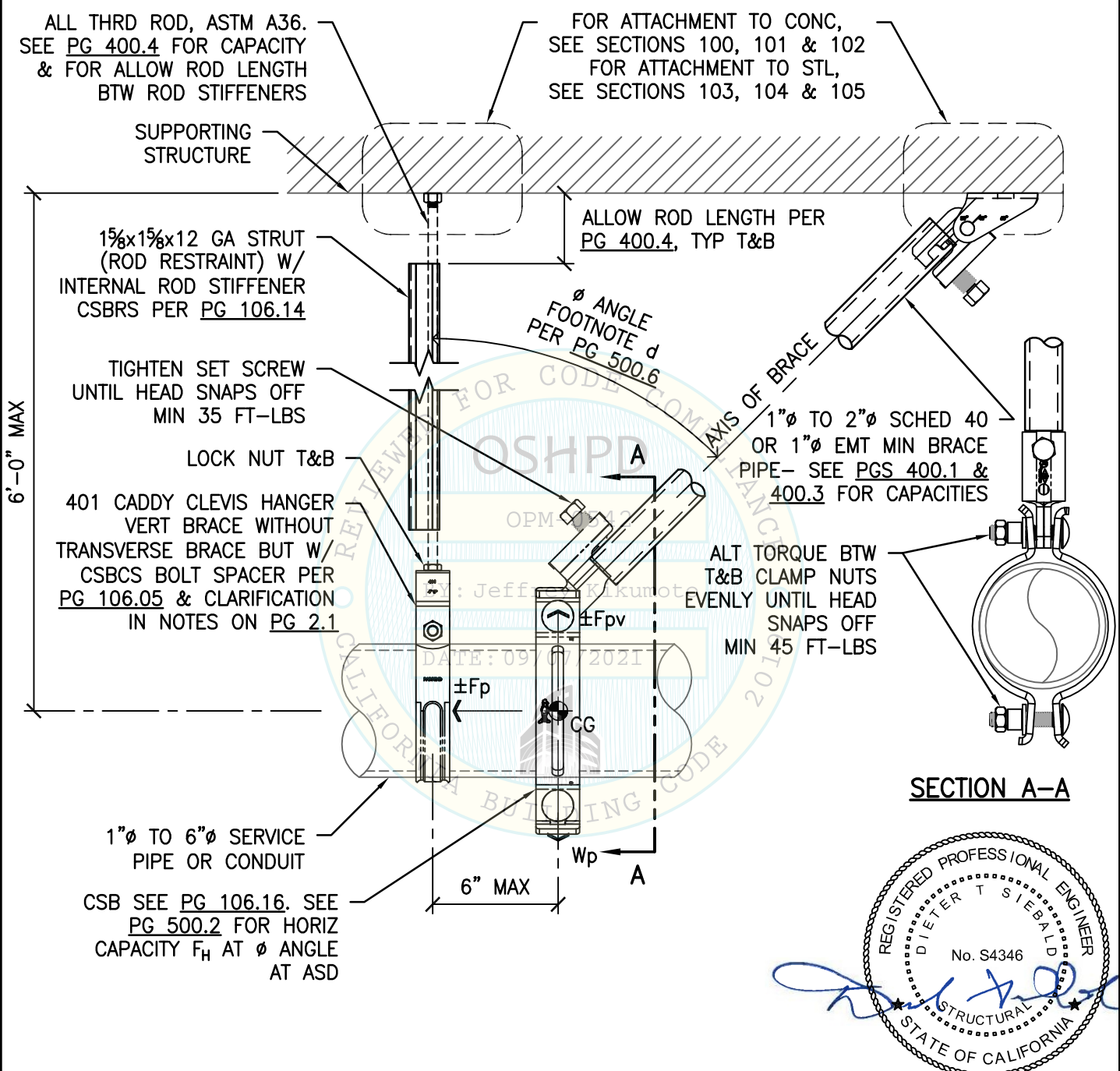


**SHEET TITLE: SINGLE HUNG PIPE OR CONDUIT W/ CLEVIS HANGER
TRANSVERSE (LATERAL) RIGID BRACING**

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SEISMIC BRACING FOR MEP SYSTEMS



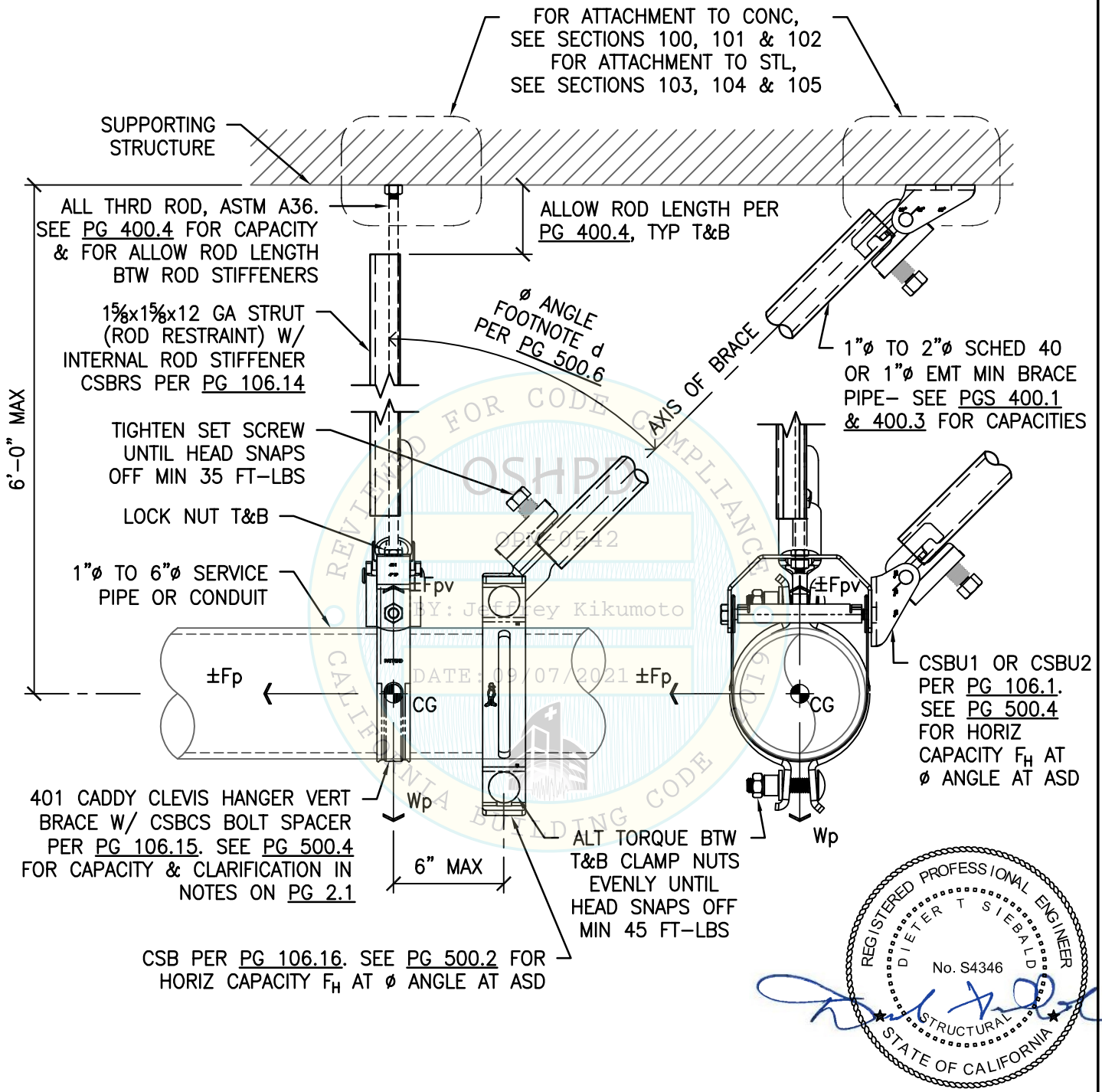
SHEET TITLE: SINGLE HUNG PIPE OR CONDUIT W/ CLEVIS HANGER
LONGITUDINAL RIGID BRACING

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SEISMIC BRACING FOR MEP SYSTEMS



SHEET TITLE: SINGLE HUNG PIPE OR CONDUIT W/ CLEVIS HANGER
TRANSVERSE (LATERAL) & LONGITUDINAL RIGID BRACING

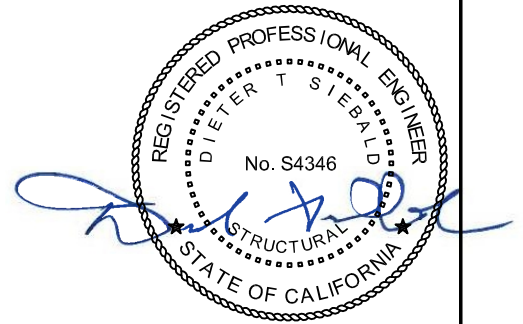
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SEISMIC BRACING FOR
MEP SYSTEMS



NOT USED



SHEET TITLE: SINGLE HUNG PIPE OR CONDUIT W/ PIPE CLAMP
TRANSVERSE (LATERAL) RIGID BRACING



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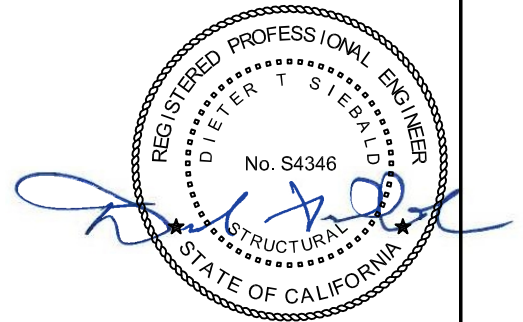
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SEISMIC BRACING FOR
MEP SYSTEMS



NOT USED



SHEET TITLE: SINGLE HUNG PIPE OR CONDUIT W/ PIPE CLAMP
TRANSVERSE (LATERAL) RIGID BRACING AT TOP OF PIPE CLAMP



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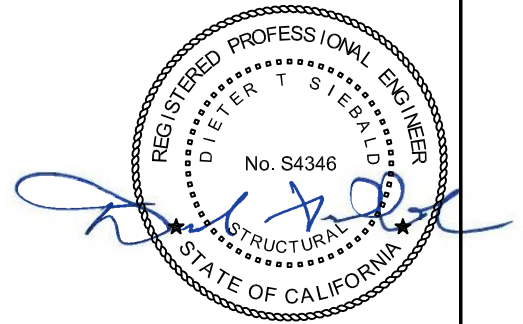
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SEISMIC BRACING FOR
MEP SYSTEMS



NOT USED



SHEET TITLE: SINGLE HUNG PIPE OR CONDUIT W/ PIPE CLAMP
LONGITUDINAL RIGID BRACING



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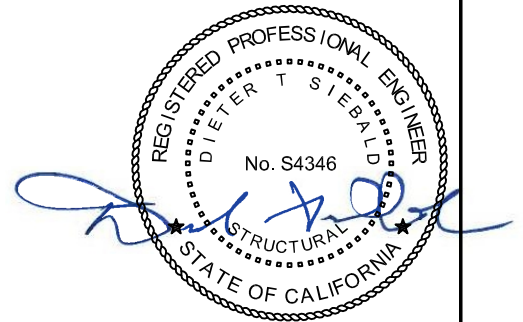
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SEISMIC BRACING FOR
MEP SYSTEMS



NOT USED



SHEET TITLE: SINGLE HUNG PIPE OR CONDUIT W/ PIPE CLAMP
LONGITUDINAL RIGID BRACING AT TOP OF PIPE CLAMP



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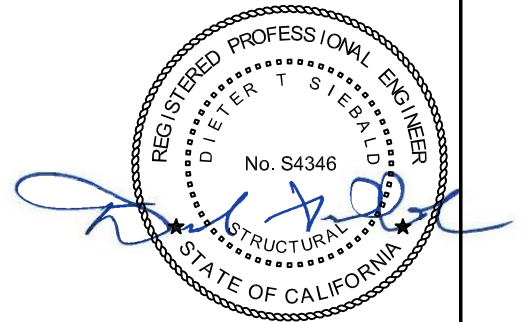
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SEISMIC BRACING FOR
MEP SYSTEMS



NOT USED



SHEET TITLE: SINGLE HUNG PIPE OR CONDUIT W/ PIPE CLAMP
TRANSVERSE (LATERAL) & LONGITUDINAL RIGID BRACING



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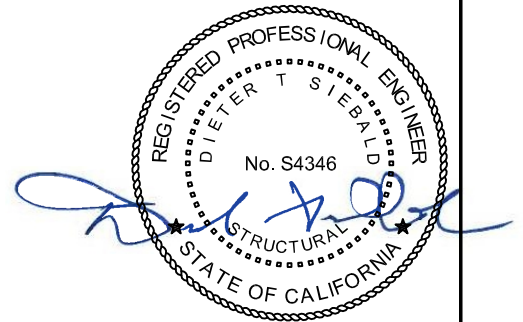
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SEISMIC BRACING FOR
MEP SYSTEMS



NOT USED



SHEET TITLE: SINGLE HUNG PIPE OR CONDUIT W/ PIPE CLAMP
TRANSVERSE & LONGITUDINAL RIGID BRACING AT TOP OF PIPE CLAMP



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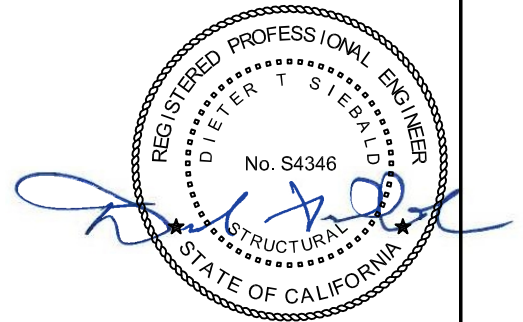
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SEISMIC BRACING FOR
MEP SYSTEMS



NOT USED



SHEET TITLE: SINGLE HUNG PIPE OR CONDUIT W/ WELDED STEEL ATTACHMENT
TRANSVERSE (LATERAL) RIGID BRACING



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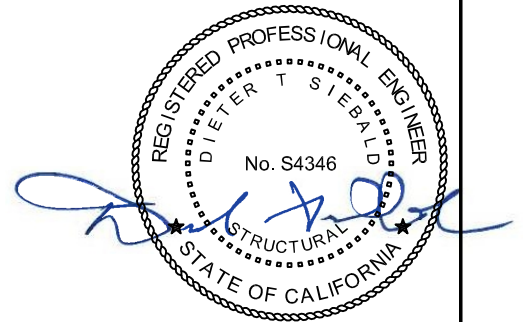
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SEISMIC BRACING FOR
MEP SYSTEMS



NOT USED



SHEET TITLE: SINGLE HUNG PIPE OR CONDUIT W/ WELDED STEEL ATTACHMENT
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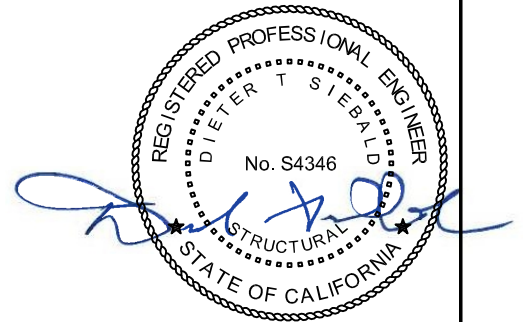
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SEISMIC BRACING FOR
MEP SYSTEMS



NOT USED



SHEET TITLE: SINGLE HUNG PIPE OR CONDUIT W/ WELDED STEEL ATTACHMENT
TRANSVERSE (LATERAL) & LONGITUDINAL RIGID BRACING



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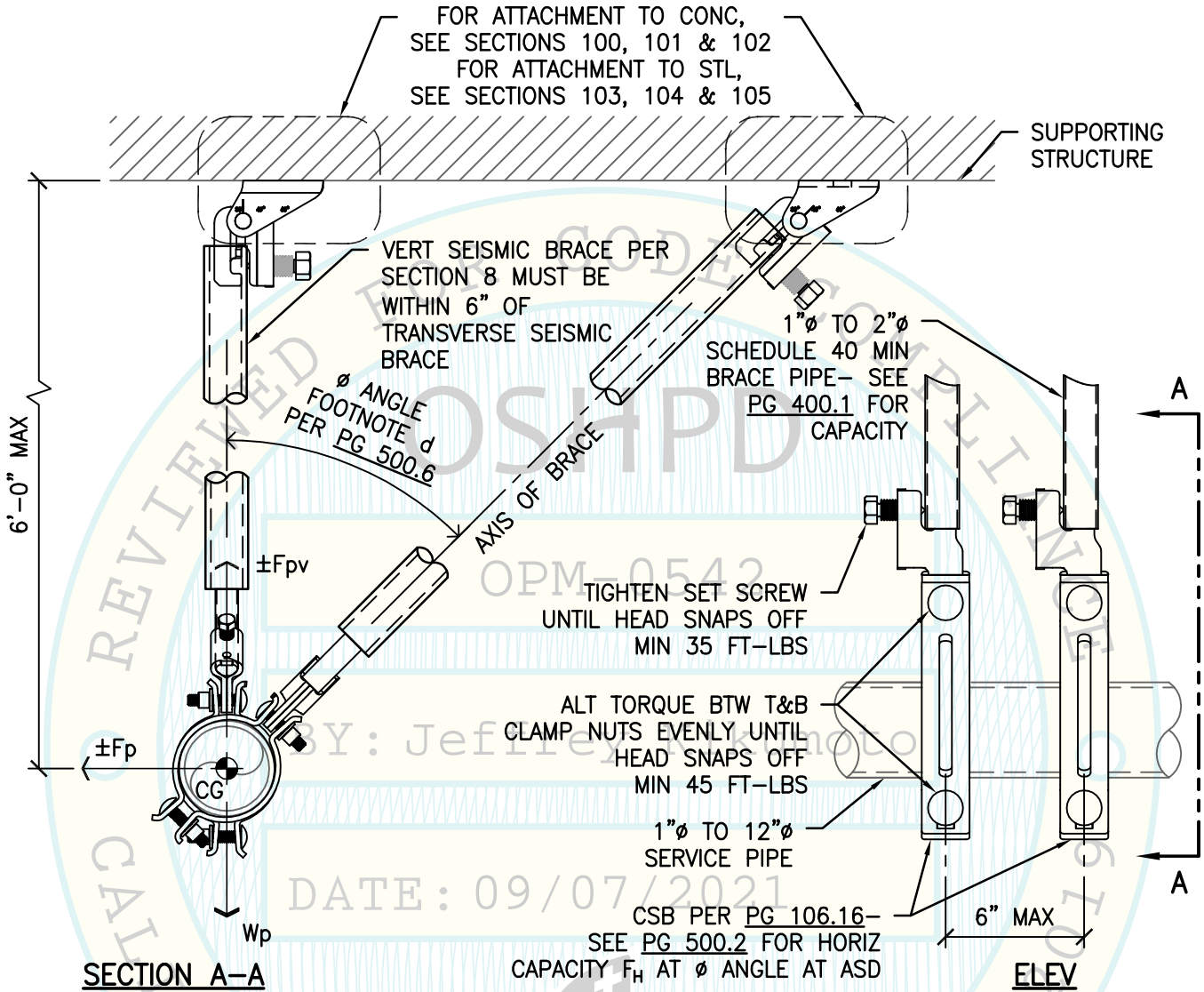
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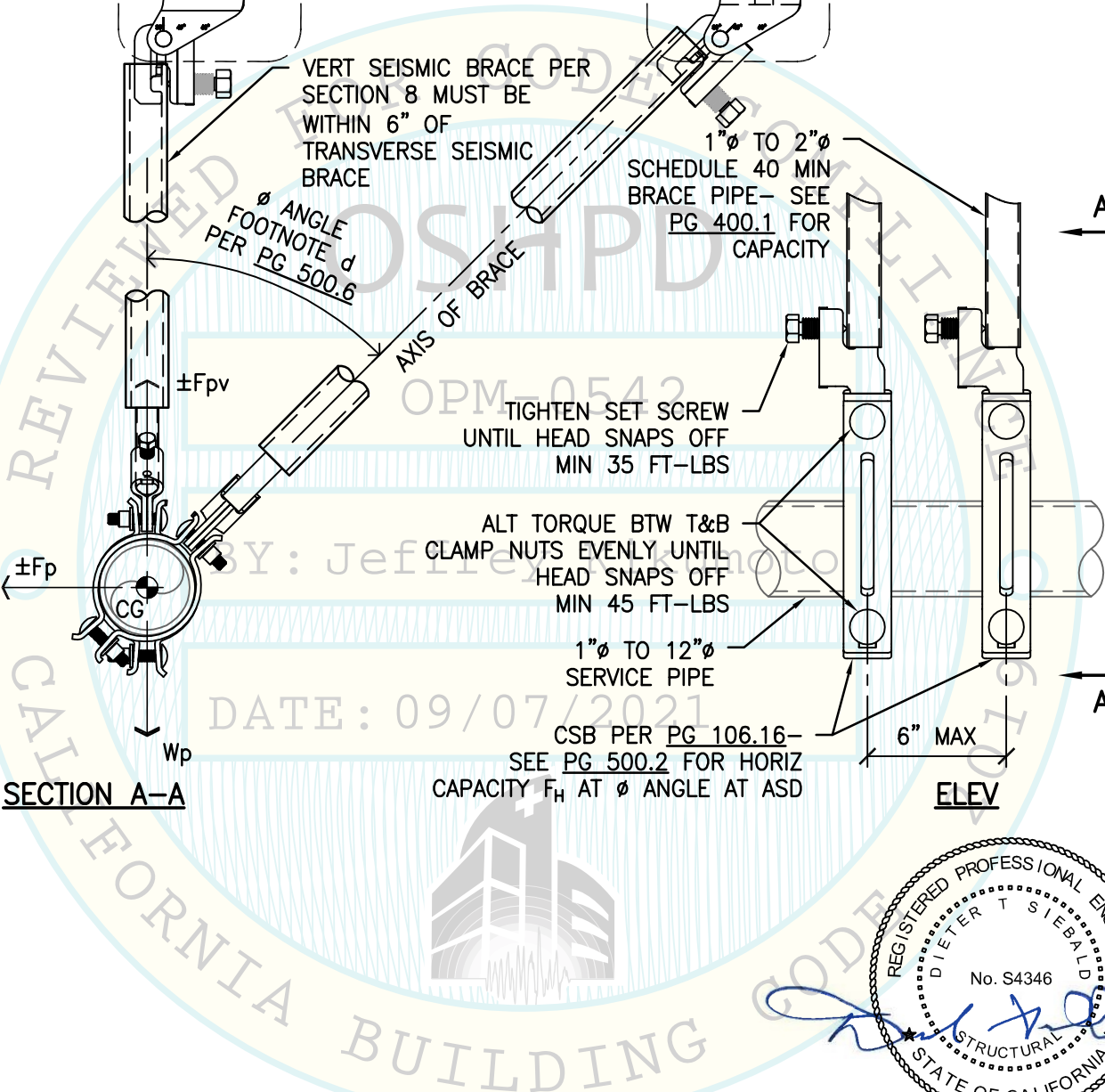
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SEISMIC BRACING FOR MEP SYSTEMS



SECTION A-A

ELEV

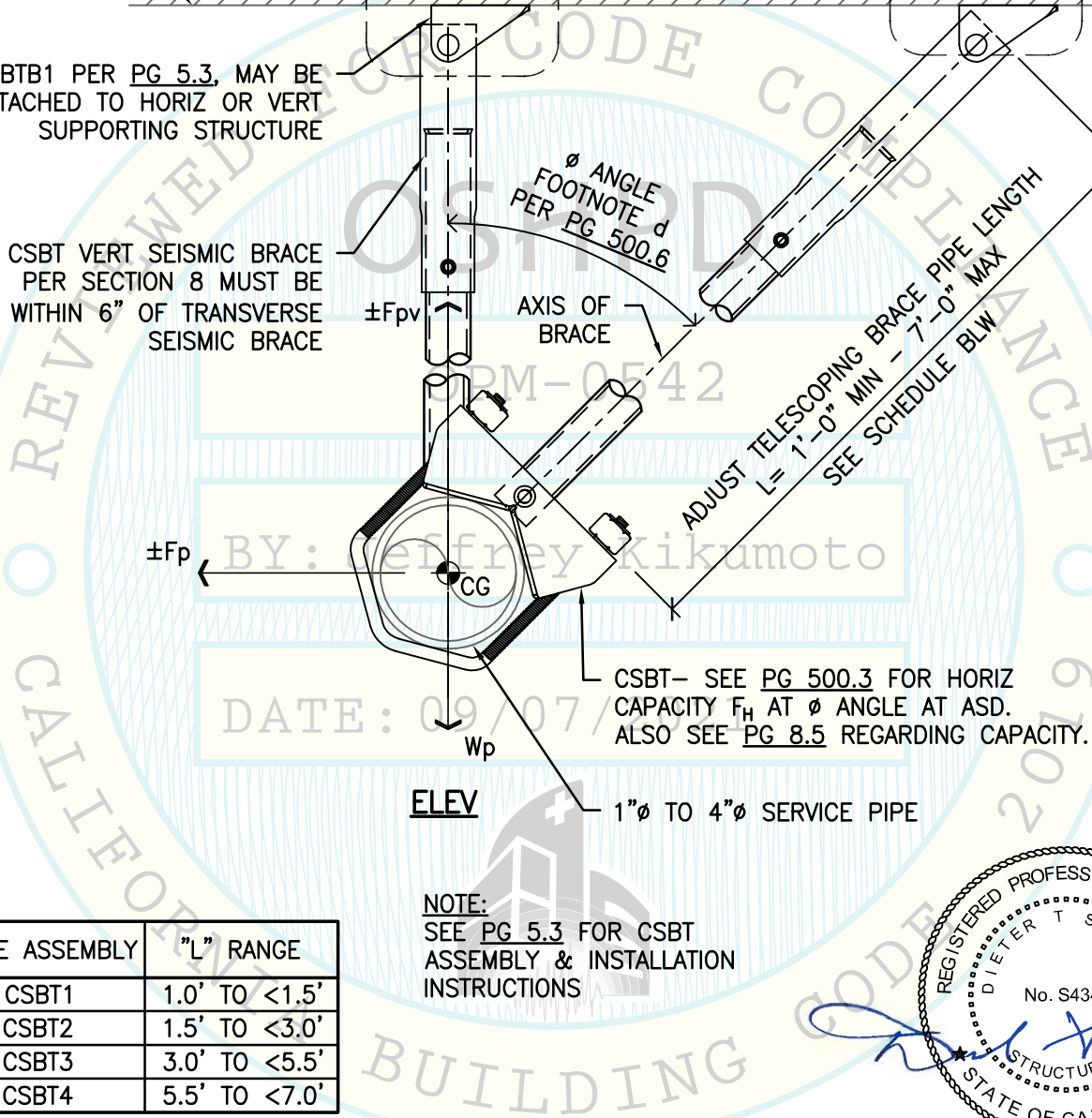
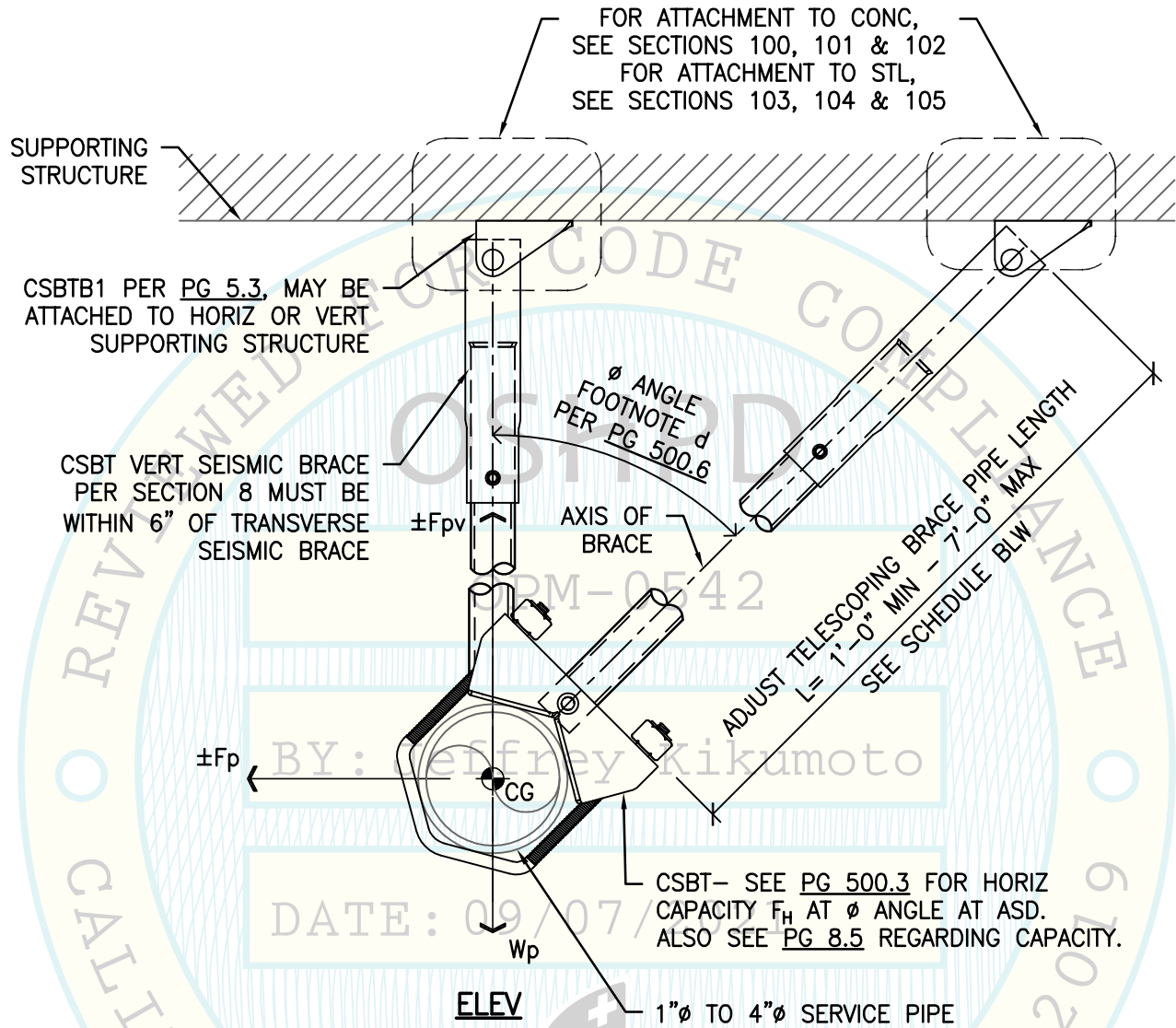


**SHEET TITLE: SINGLE PIPE OR CONDUIT WITH LATERAL CONCENTRIC BRACES
CSB WITH BRACE PIPE FOR 1"Ø TO 12"Ø SERVICE PIPES**

| | | |
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SEISMIC BRACING FOR MEP SYSTEMS



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| BRACE ASSEMBLY | "L" RANGE |
|----------------|---------------|
| CSBT1 | 1.0' TO <1.5' |
| CSBT2 | 1.5' TO <3.0' |
| CSBT3 | 3.0' TO <5.5' |
| CSBT4 | 5.5' TO <7.0' |

NOTE:
SEE PG 5.3 FOR CSBT ASSEMBLY & INSTALLATION INSTRUCTIONS



**SHEET TITLE: SINGLE PIPE OR CONDUIT WITH LATERAL CONCENTRIC BRACES
CSBT TELESCOPING ASSEMBLY FOR 1"Ø TO 4"Ø SERVICE PIPES**



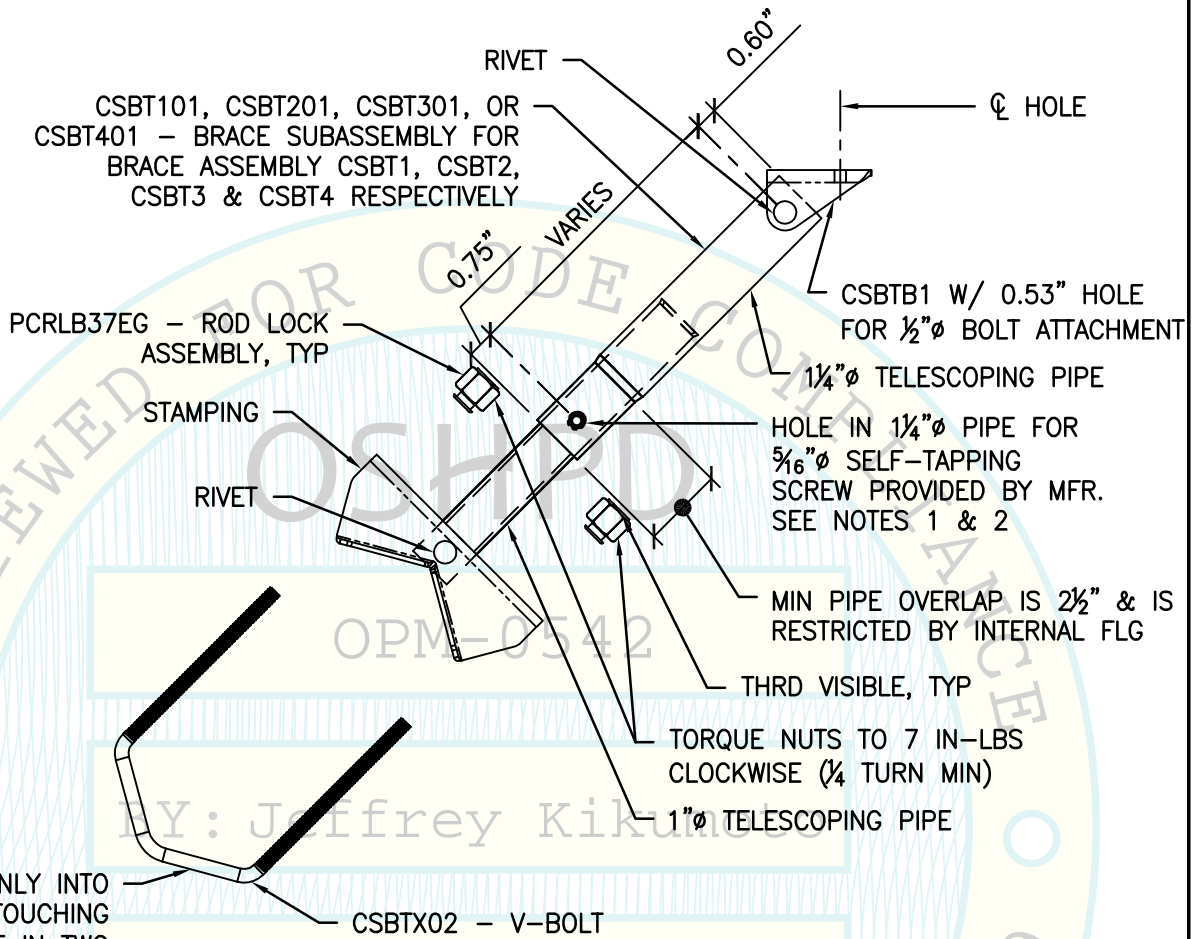
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| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 5.2 of . |

SEISMIC BRACING FOR MEP SYSTEMS



PUSH CLAMP EVENLY INTO NUTS UNTIL TOUCHING (SERVICE) PIPE IN TWO PLACES

NOTES:

1. INSTALL W/ A STD SCREW GUN W/ A SIZE OF 5/16" (8mm) HEX HEAD TOOL AT RECOMMENDED 1010 RPM INSTALLATION SPEED. HEX HEAD SHOULD BE SEATED (NO THREAD VISIBLE)
2. STD SCREW GUN NEEDS CLUTCH SET OR A DEPTH SENSITIVE NOSEPIECE FOR CORRECT SEATING OF FASTENER. NOT FOLLOWING INSTRUCTION COULD RESULT IN SHEARING HEAD OFF OF FASTENER
3. SEE SECTION 500 FOR CAPACITY OF SHOWN ASSEMBLY WHEN ATTACHED TO SUPPORTING STRUCTURE ABV. FOR ATTACHMENT TO VERT SURFACES SUCH AS WALLS OR BMS, USE 475 LBS.
4. THE CSBT TELESCOPING ASSEMBLY IS A COMPLETE MANUFACTURED BRACE ASSEMBLY & IS REFERENCED AS SUCH IN THIS OPM.

DATE: 09/07/2021



**SHEET TITLE: SINGLE PIPE OR CONDUIT WITH LATERAL CONCENTRIC BRACES
CSBT WITH TELESCOPING ASSEMBLY FOR 1"Ø TO 4"Ø SERVICE PIPES**



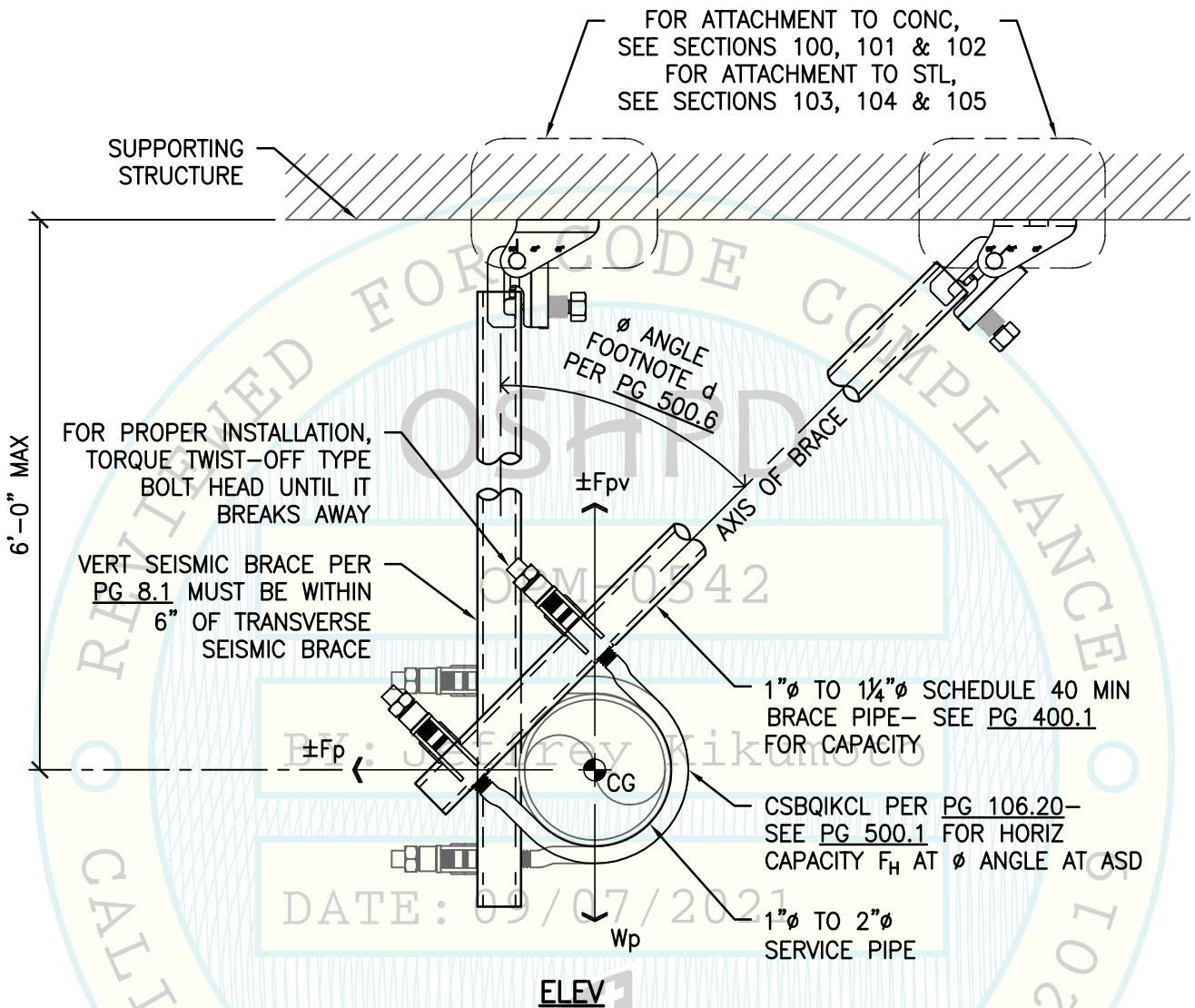
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| Date: | 09/08/2021 |
| Page: | 5.3 of . |

SEISMIC BRACING FOR
MEP SYSTEMS



FOR ATTACHMENT TO CONC,
SEE SECTIONS 100, 101 & 102
FOR ATTACHMENT TO STL,
SEE SECTIONS 103, 104 & 105

SUPPORTING
STRUCTURE

6'-0" MAX

FOR PROPER INSTALLATION,
TORQUE TWIST-OFF TYPE
BOLT HEAD UNTIL IT
BREAKS AWAY

VERT SEISMIC BRACE PER
PG 8.1 MUST BE WITHIN
6" OF TRANSVERSE
SEISMIC BRACE

±Fp

±Fpv

CG

Wp

ELEV

DATE: 09/07/2021

1"Ø TO 1¼"Ø SCHEDULE 40 MIN
BRACE PIPE- SEE PG 400.1
FOR CAPACITY

CSBQIKCL PER PG 106.20-
SEE PG 500.1 FOR HORIZ
CAPACITY F_H AT Ø ANGLE AT ASD

1"Ø TO 2"Ø
SERVICE PIPE

Ø ANGLE
FOOTNOTE d
PER PG 500.6

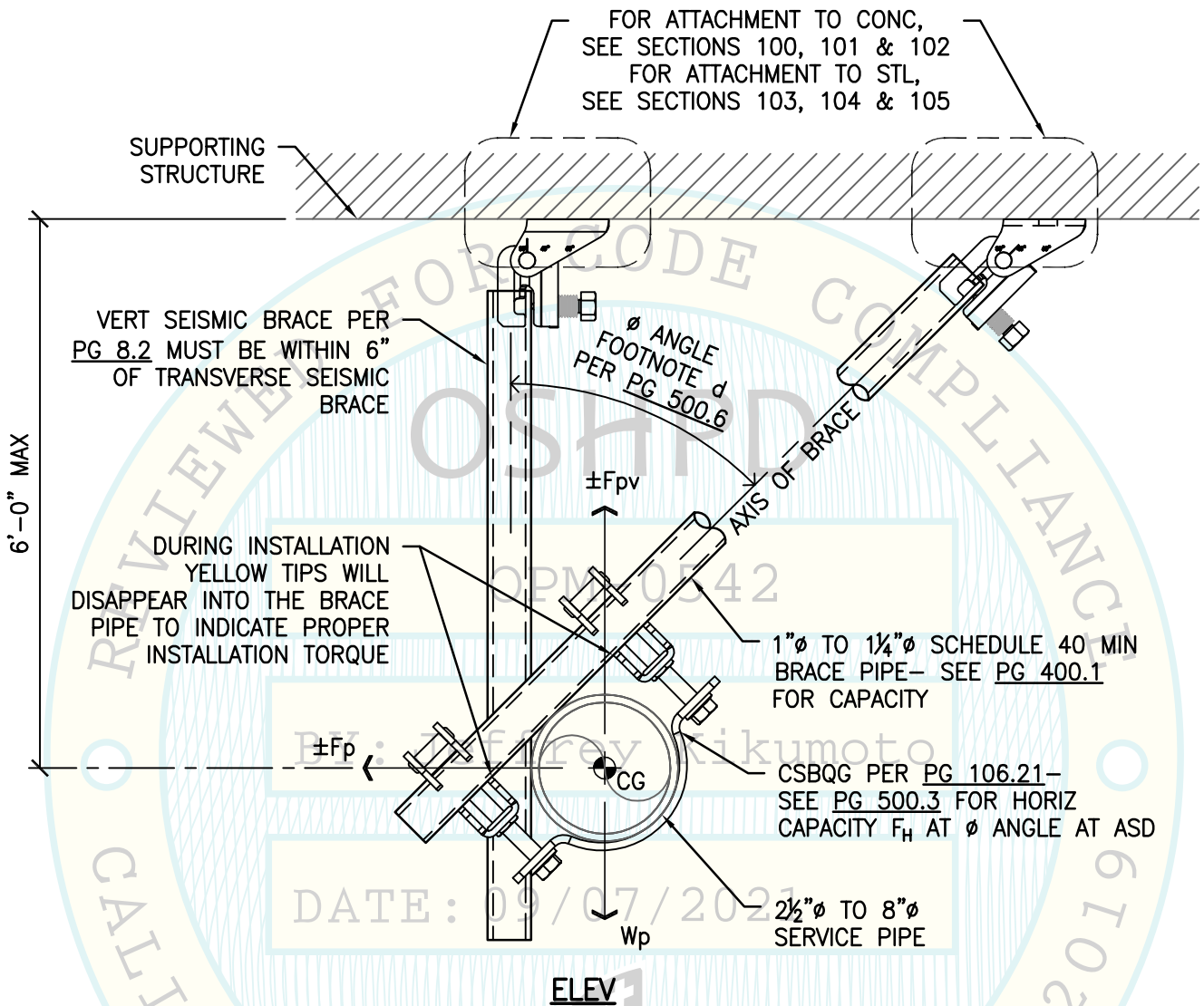
AXIS OF BRACE



SHEET TITLE: SINGLE PIPE OR CONDUIT W/ LATERAL ECCENTRIC BRACES & RESTRAINT RODS
CSBQIKCL WITH BRACE PIPE FOR 1"Ø TO 2"Ø SERVICE PIPES

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SEISMIC BRACING FOR MEP SYSTEMS



DATE: 09/07/2021

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SHEET TITLE: SINGLE PIPE OR CONDUIT W/ LATERAL ECCENTRIC BRACES & RESTRAINT RODS
CSBQG WITH BRACE PIPE FOR 2.5"Ø TO 8"Ø SERVICE PIPES



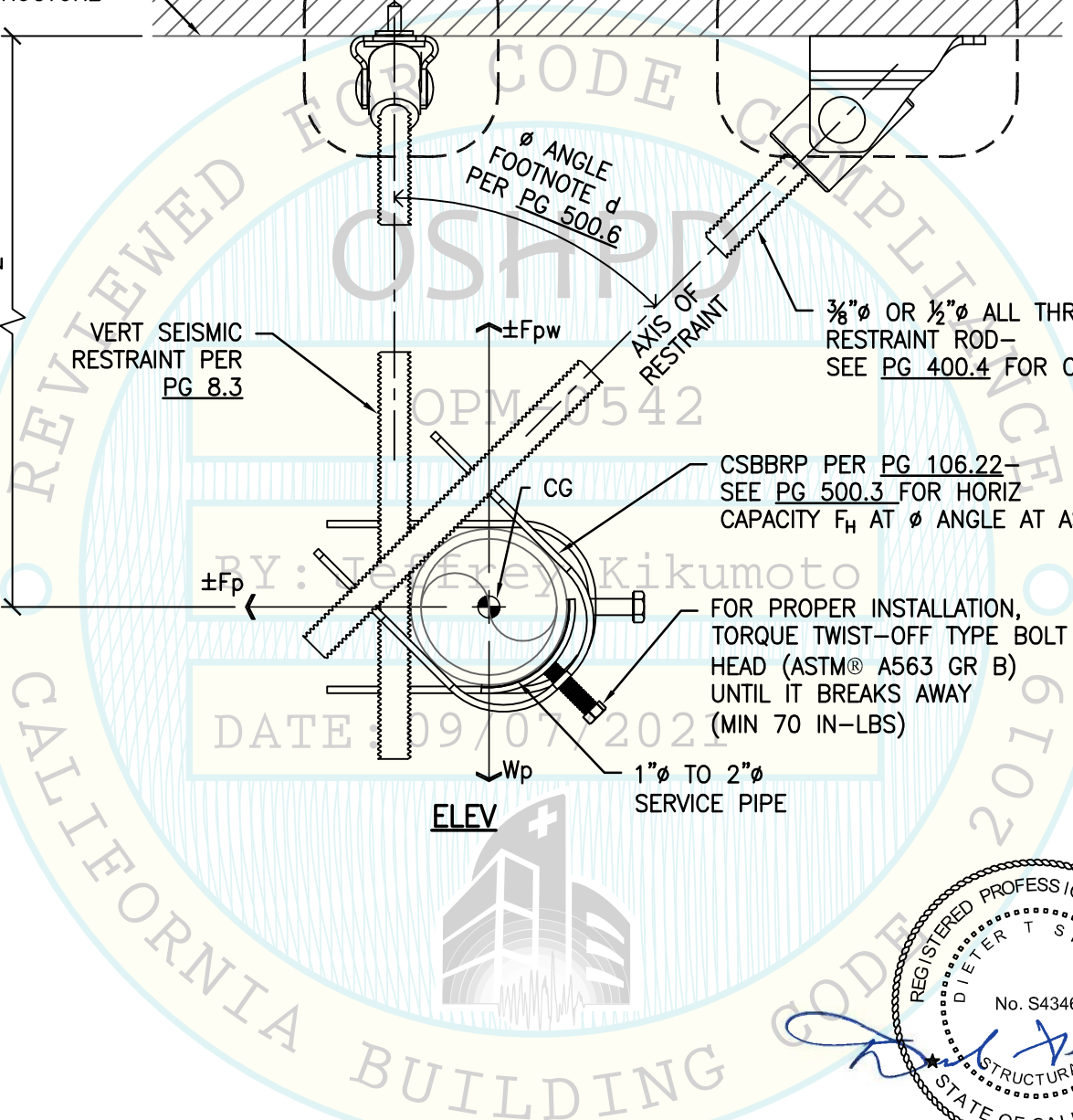
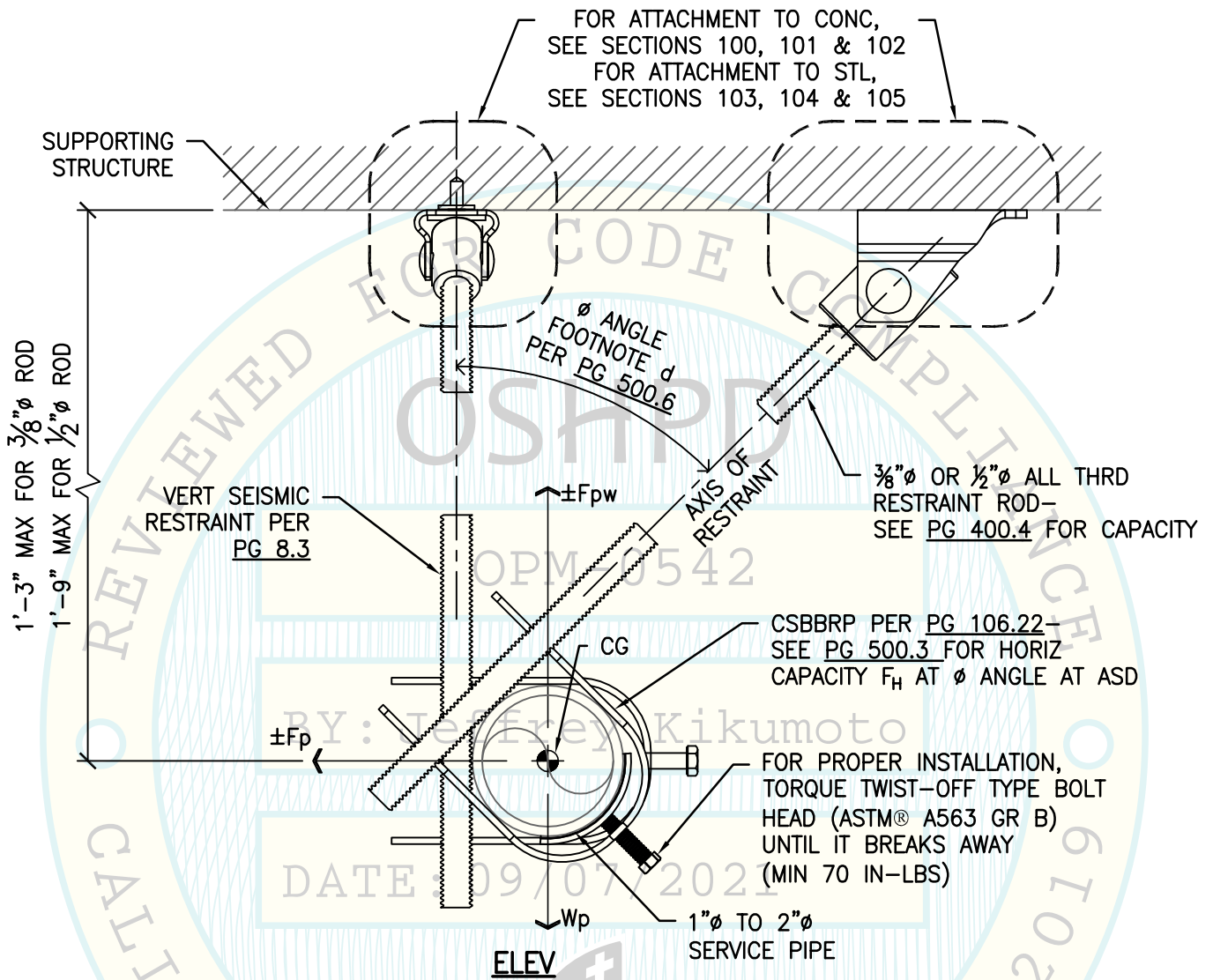
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SEISMIC BRACING FOR MEP SYSTEMS

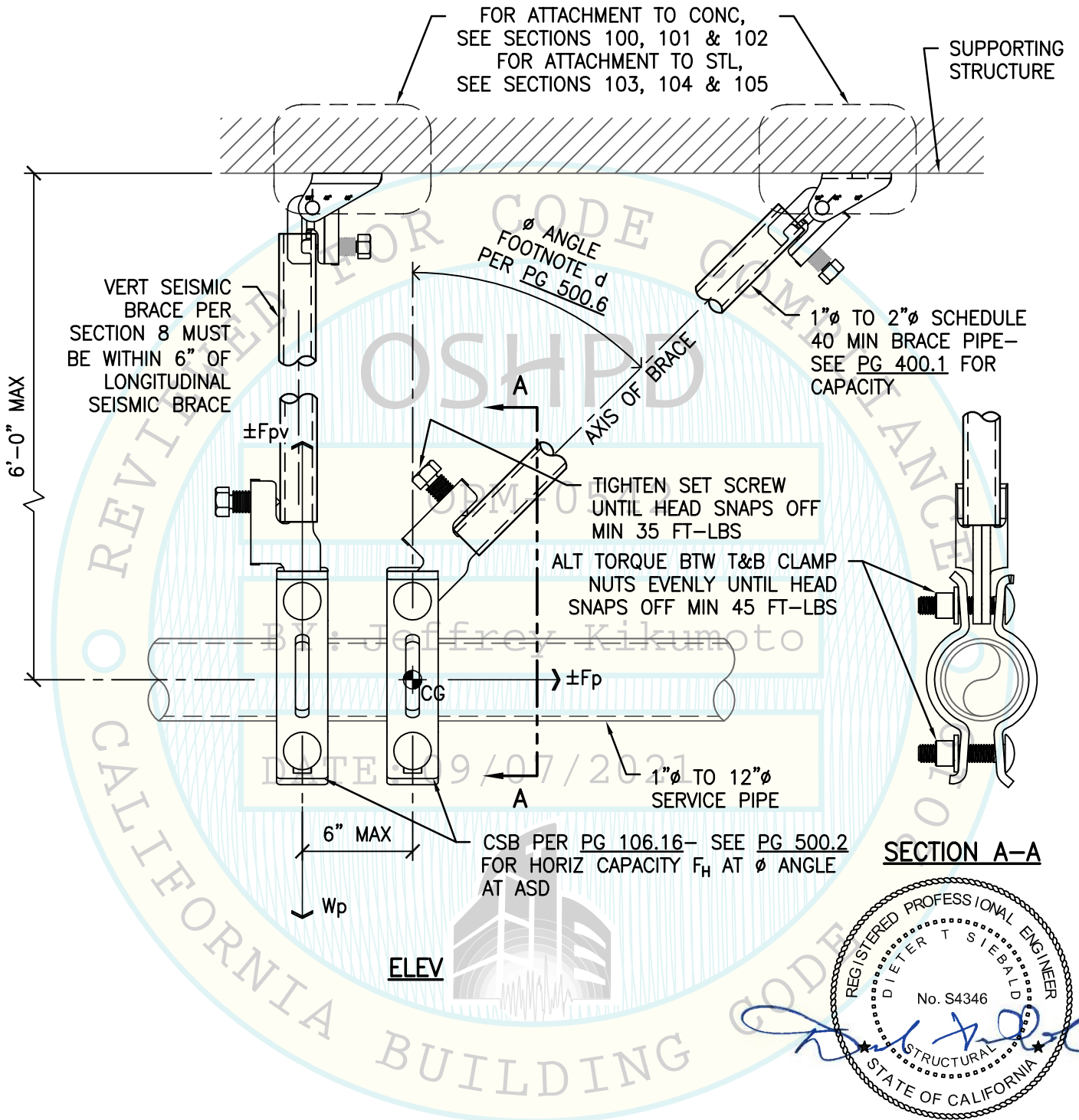


SHEET TITLE: SINGLE PIPE OR CONDUIT W/ LATERAL ECCENTRIC BRACES & RESTRAINT RODS
CSBBRP WITH RESTRAINT ROD FOR 1"Ø TO 2"Ø SERVICE PIPES

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SEISMIC BRACING FOR
MEP SYSTEMS

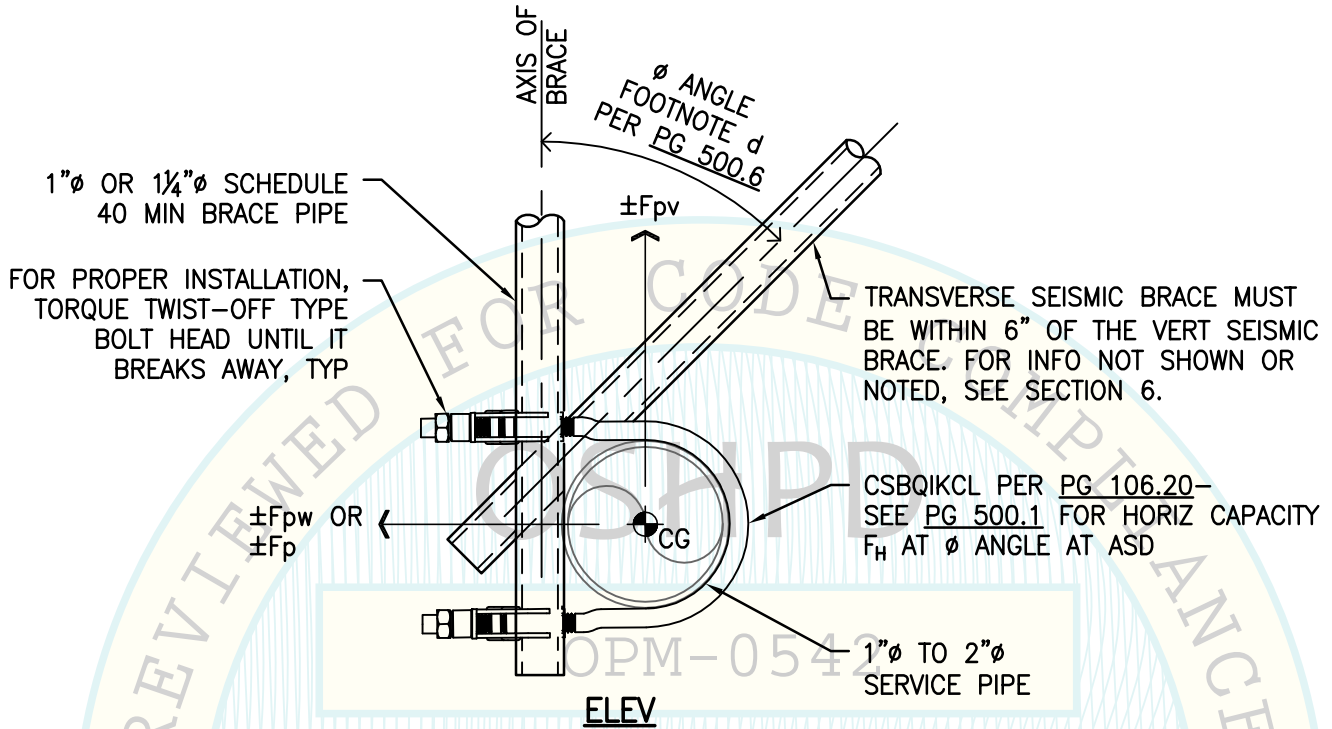


SHEET TITLE: SINGLE PIPE OR RIGID METAL CONDUIT WITH LONGITUDINAL BRACES
CSB WITH BRACE PIPE FOR 1" ϕ TO 12" ϕ SERVICE PIPES

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SEISMIC BRACING FOR
MEP SYSTEMS



BY: Jeffrey Kikumoto

DATE: 09/07/2021

NOTES:

1. FOR ATTACHMENT TO CONC, SEE SECTIONS 100, 101 & 102. FOR ATTACHMENT TO STL, SEE SECTIONS 103, 104 & 105.
2. FOR CONSTRUCTION TOLERANCE, SEE SECTION 1.
3. USE $\phi=90^\circ$ OF TRANSVERSE MODE (SEE SECTION 500) FOR AXIAL CAPACITY OF BRACE PIPE.
4. FOR BRACE PIPE AXIAL CAPACITY, SEE SECTION 400.
5. THIS VERT SEISMIC BRACE SHALL NOT BE USED AS A TYP SERVICE PIPE HANGER FOR LONG TERM GRAVITY LOADS.



SHEET TITLE: SINGLE PIPE OR CONDUIT WITH VERTICAL BRACES & RESTRAINT RODS
CSBQIKCL WITH BRACE PIPE FOR 1"Ø TO 2"Ø SERVICE PIPES



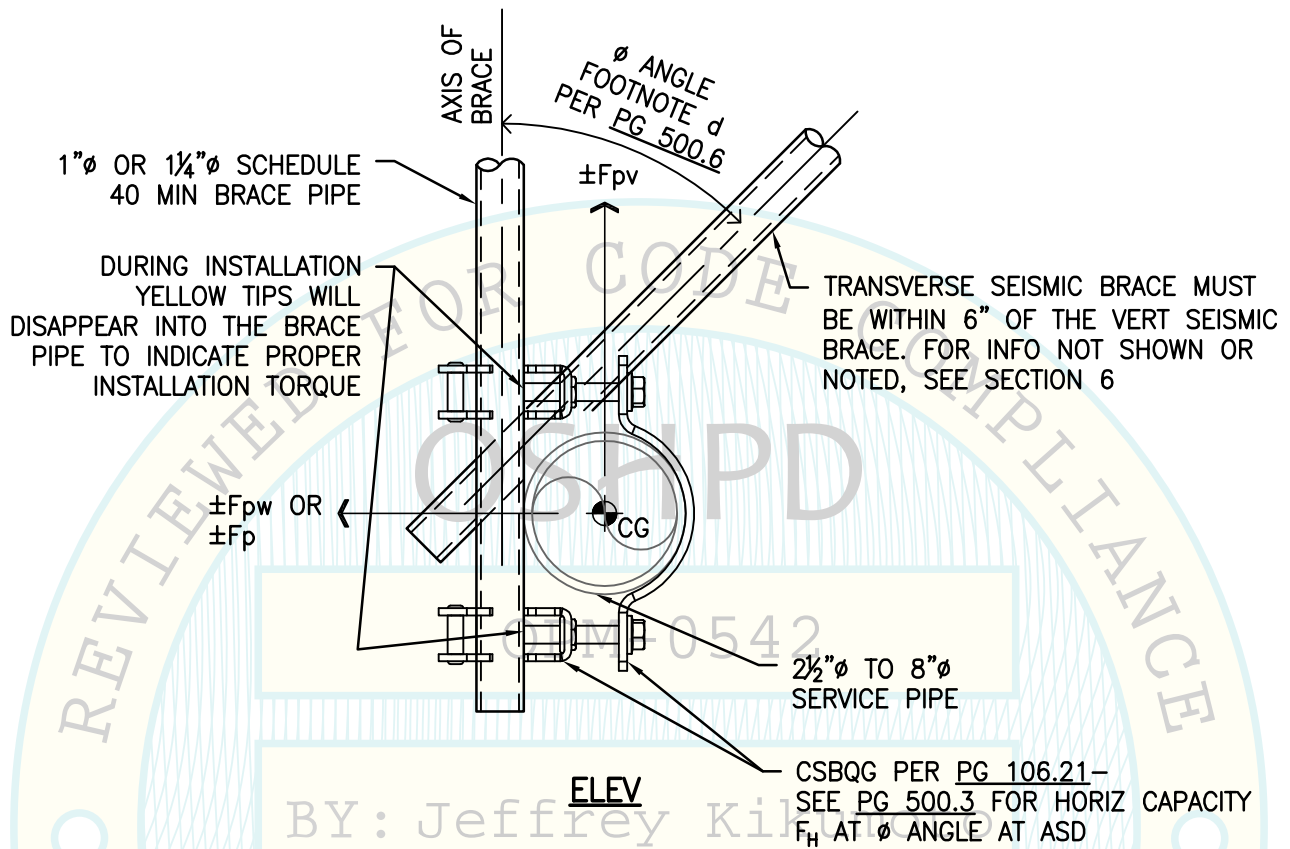
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SEISMIC BRACING FOR
MEP SYSTEMS



BY: Jeffrey Kikumoto

DATE: 09/07/2021

NOTES:

1. FOR ATTACHMENT TO CONC, SEE SECTIONS 100, 101 & 102. FOR ATTACHMENT TO STL, SEE SECTIONS 103, 104 & 105.
2. FOR CONSTRUCTION TOLERANCE, SEE SECTION 1.
3. USE $\phi=90^\circ$ OF TRANSVERSE MODE (SEE SECTION 500) FOR AXIAL CAPACITY OF BRACE PIPE.
4. FOR BRACE PIPE AXIAL CAPACITY, SEE SECTION 400.
5. THIS VERT SEISMIC BRACE SHALL NOT BE USED AS A TYP SERVICE PIPE HANGER FOR LONG TERM GRAVITY LOADS.



SHEET TITLE: SINGLE PIPE OR CONDUIT WITH VERTICAL BRACES & RESTRAINT RODS
CSBQG WITH BRACE PIPE FOR 2.5" ϕ TO 8" ϕ SERVICE PIPES



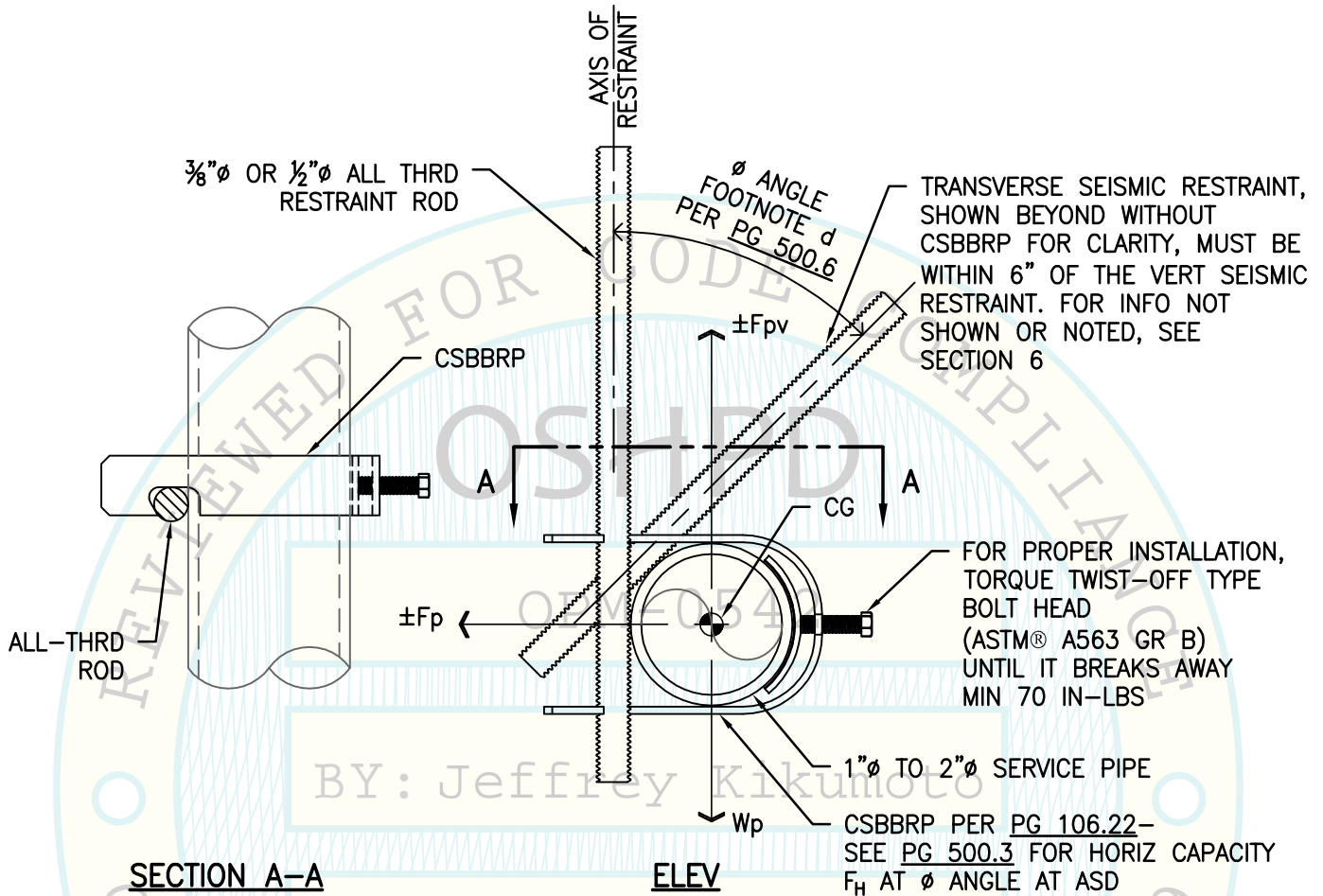
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| Page: | 8.2 of . |

SEISMIC BRACING FOR
MEP SYSTEMS



BY: Jeffrey Kikumoto

DATE: 09/07/2021

NOTES:

1. FOR ATTACHMENT TO CONC, SEE SECTIONS 100, 101 & 102. FOR ATTACHMENT TO STL, SEE SECTIONS 103, 104 & 105.
2. THE CSBBRP W/ RESTRAINT ROD IS A BRANCH LINE RESTRAINT DEVICE (NOT A BRACE).
3. FOR CONSTRUCTION TOLERANCE, SEE SECTION 1.
4. USE $\phi=90^\circ$ OF TRANSVERSE MODE (SEE SECTION 500) FOR AXIAL CAPACITY OF COMPONENT.
5. FOR RESTRAINT ROD AXIAL CAPACITY, SEE SECTION 400.
6. THIS VERT SEISMIC RESTRAINT MAY ALSO BE USED AS A TYP SERVICE PIPE HANGER FOR LONG TERM GRAVITY LOADS, HOWEVER NOT IN COMBINATION AS A SEISMIC RESTRAINT AND GRAVITY HANGER.



SHEET TITLE: SINGLE PIPE OR CONDUIT WITH VERTICAL BRACES & RESTRAINT RODS
CSBBRP WITH RESTRAINT ROD FOR 1"Ø TO 2"Ø SERVICE PIPES



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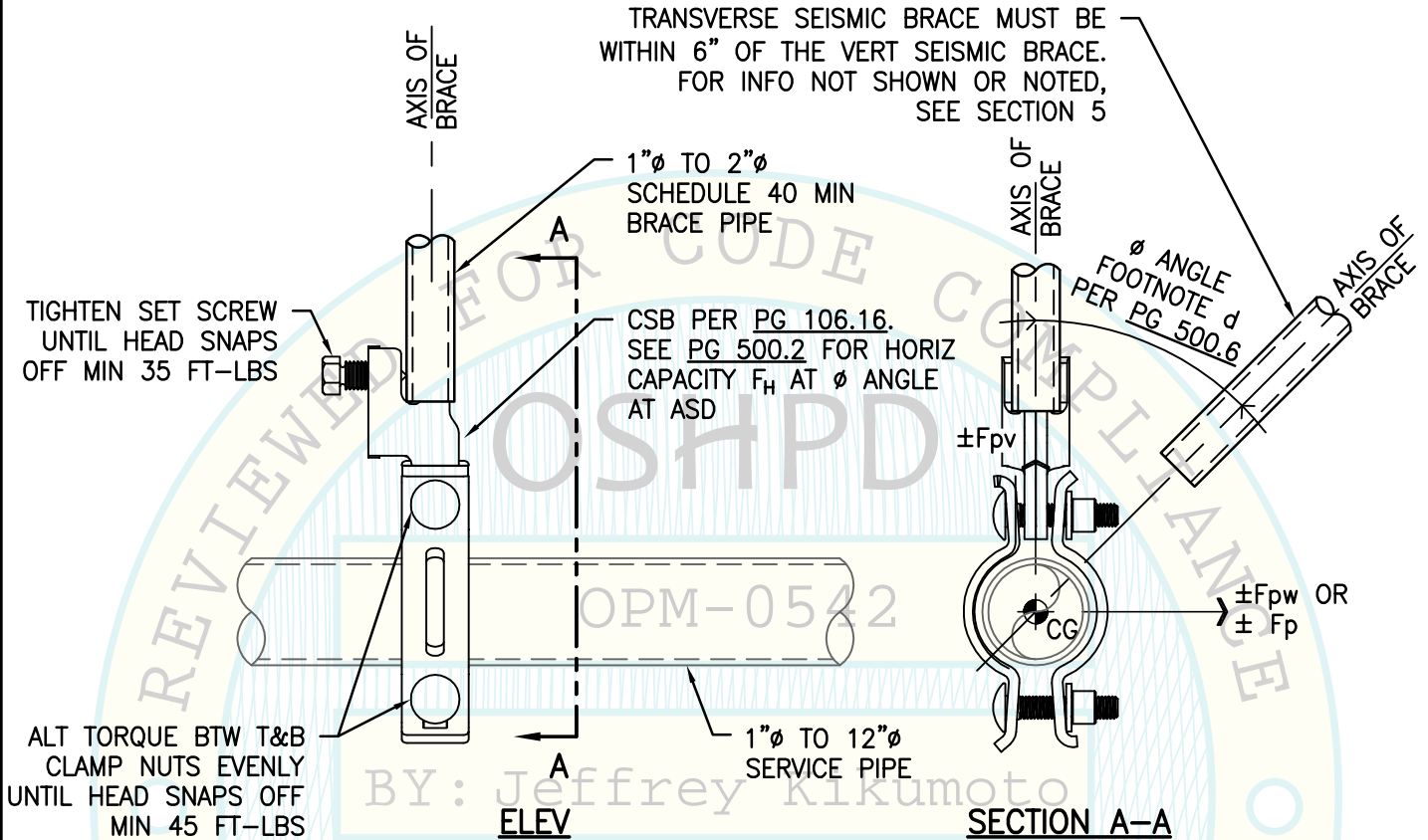
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| Date: | 09/08/2021 |
| Page: | 8.3 of . |

SEISMIC BRACING FOR
MEP SYSTEMS



TRANSVERSE SEISMIC BRACE MUST BE WITHIN 6" OF THE VERT SEISMIC BRACE. FOR INFO NOT SHOWN OR NOTED, SEE SECTION 5



OPM-0542

BY: Jeffrey Kikumoto

DATE: 09/07/2021

NOTES:

1. FOR ATTACHMENT TO CONC, SEE SECTIONS 100, 101 & 102. FOR ATTACHMENT TO STL, SEE SECTIONS 103, 104 & 105.
2. FOR CONSTRUCTION TOLERANCE, SEE SECTION 1.
3. USE $\phi=90^\circ$ OF TRANSVERSE MODE (SEE SECTION 500) FOR AXIAL CAPACITY OF BRACE PIPE.
4. FOR BRACE PIPE AXIAL CAPACITY, SEE SECTION 400.
5. THIS VERT SEISMIC BRACE MAY ALSO BE USED AS A TYP SERVICE PIPE HANGER FOR LONG TERM GRAVITY LOADS.

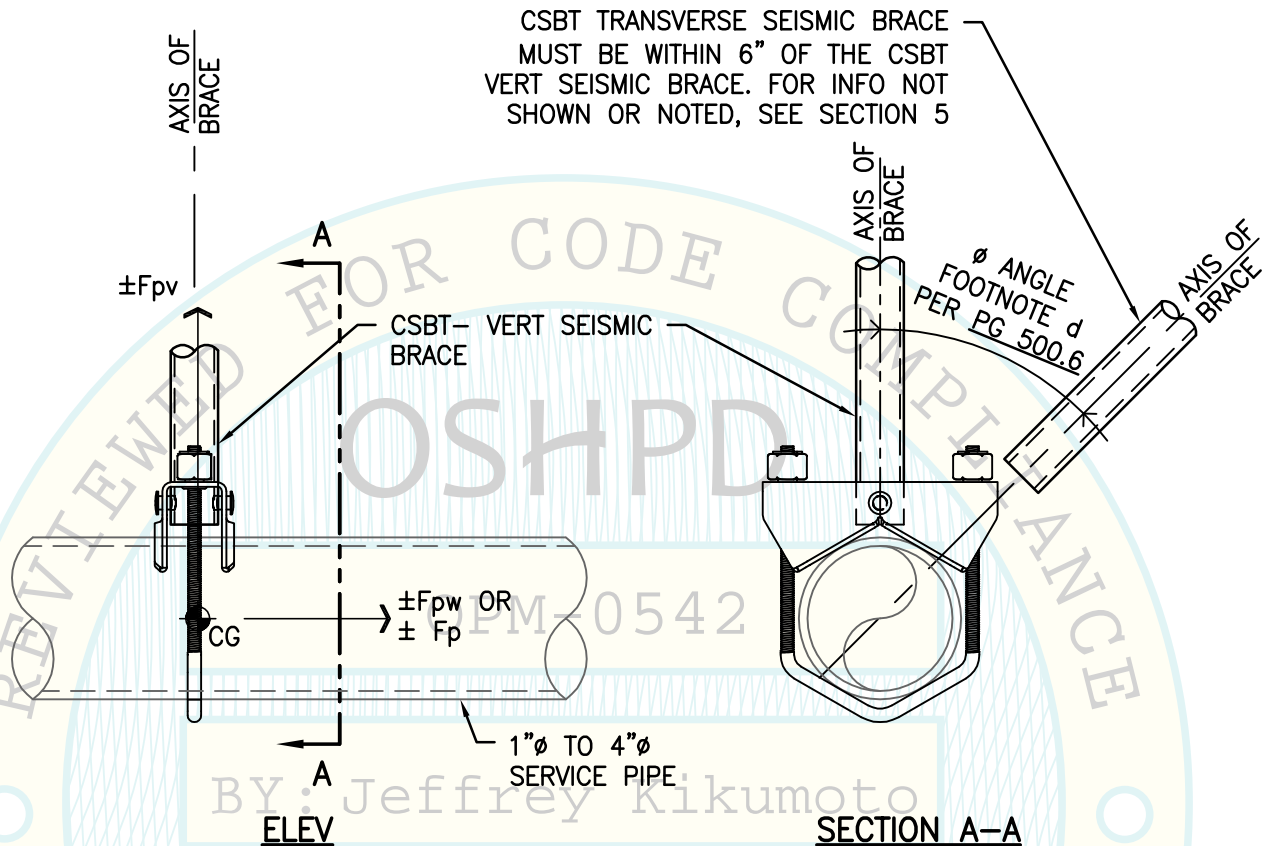


SHEET TITLE: SINGLE PIPE OR CONDUIT WITH VERTICAL BRACES & RESTRAINT RODS
CSB WITH BRACE PIPE FOR 1"Ø TO 12"Ø SERVICE PIPES

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SEISMIC BRACING FOR MEP SYSTEMS



CSBT TRANSVERSE SEISMIC BRACE MUST BE WITHIN 6" OF THE CSBT VERT SEISMIC BRACE. FOR INFO NOT SHOWN OR NOTED, SEE SECTION 5

Ø ANGLE FOOTNOTE d PER PG 500.6

NOTES:

1. FOR ATTACHMENT TO CONC, SEE SECTIONS 100, 101 & 102. FOR ATTACHMENT TO STL, SEE SECTIONS 103, 104 & 105.
2. FOR CONSTRUCTION TOLERANCE, SEE SECTION 1.
3. THE CSBT WAS TESTED AS AN ASSEMBLY W/ THE BRACE PIPE, THE SERVICE PIPE ATTACHED COMPONENT & THE BLDG ATTACHED COMPONENT INCLUDED IN ONE TEST FOR THE FOUR LISTED BRACE PIPE ANGLES AS SHOWN ON PG 500.3. THERE IS NO NEED TO CHECK EA OF THE THREE BRACE ASSEMBLY COMPONENTS. THE PROVIDED VALUES ARE FOR THE ASSEMBLY.
4. THE CSBT TESCOPING BRACE PIPE ASSEMBLY COMPONENTS & INSTALLATION INSTRUCTIONS ARE SHOWN ON PG 5.3.
5. THIS VERT SEISMIC BRACE MAY ALSO BE USED AS A TYP SERVICE PIPE HANGER FOR LONG TERM GRAVITY LOADS.

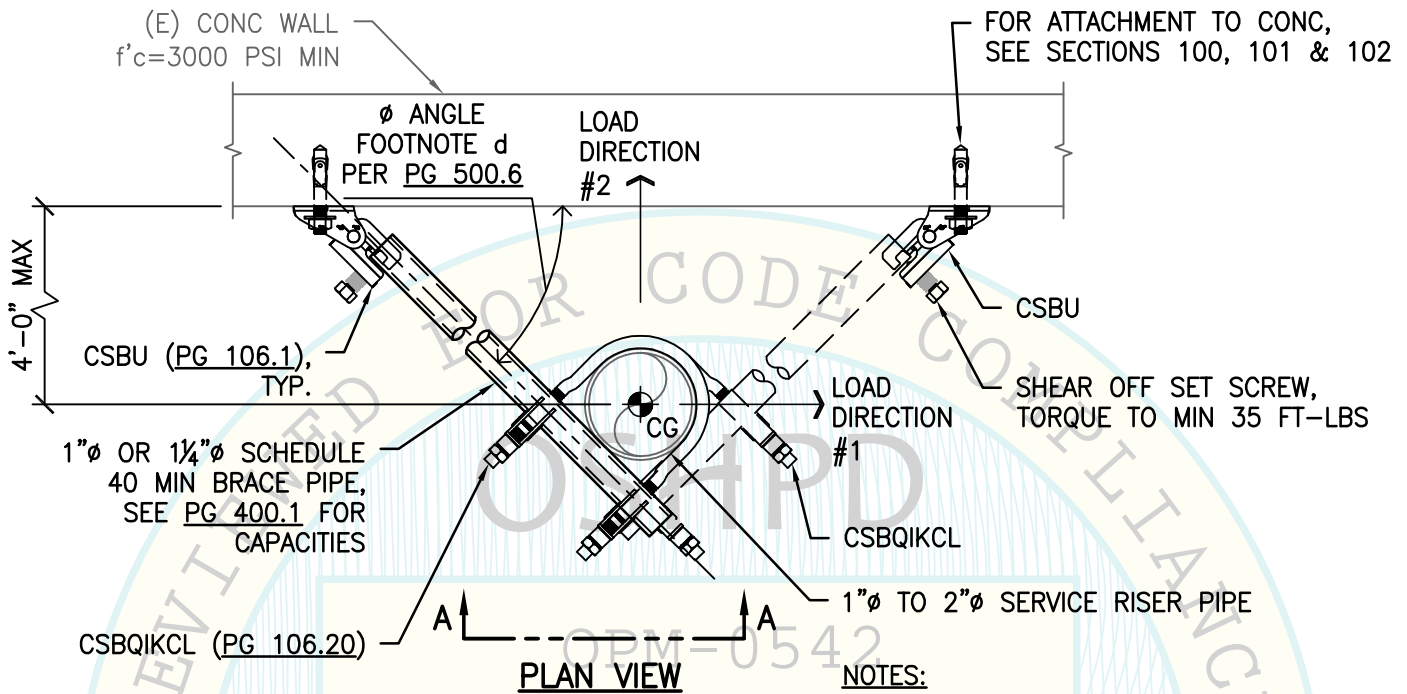


**SHEET TITLE: SINGLE PIPE OR CONDUIT WITH VERTICAL BRACES & RESTRAINT RODS
CSBT WITH TELESCOPING ASSEMBLY FOR 1"Ø TO 4"Ø SERVICE PIPES**

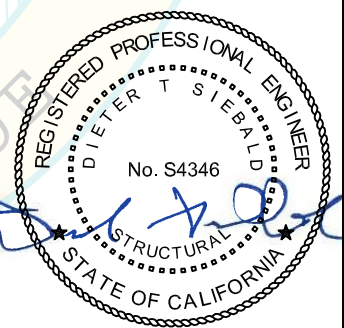
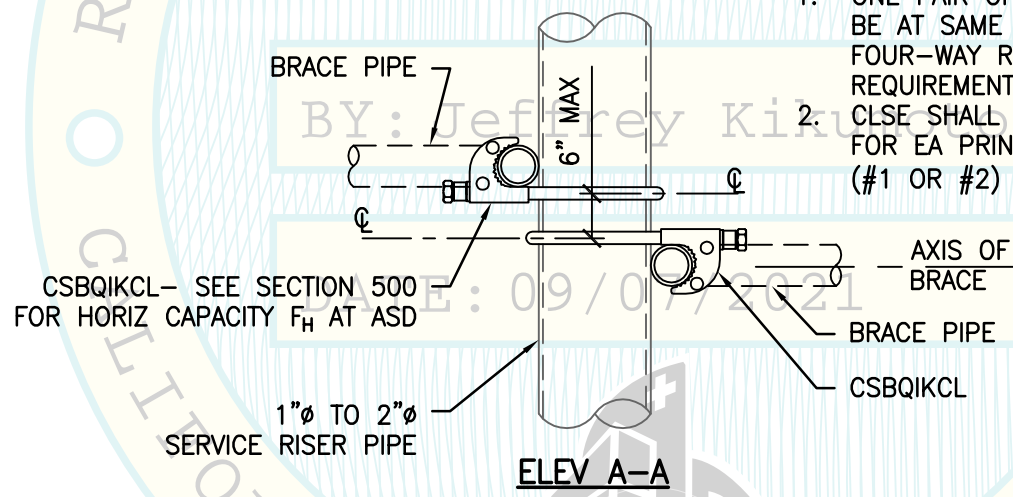
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SEISMIC BRACING FOR MEP SYSTEMS



- NOTES:**
- ONE PAIR OF BRACE PIPES NEED TO BE AT SAME OPP ANGLE TO SATISFY FOUR-WAY RISER BRGC REQUIREMENTS.
 - CLSE SHALL EVALUATE $\pm F_p$ OR $\pm F_{pw}$ FOR EA PRINCIPAL LOAD DIRECTION (#1 OR #2) AS SHOWN.

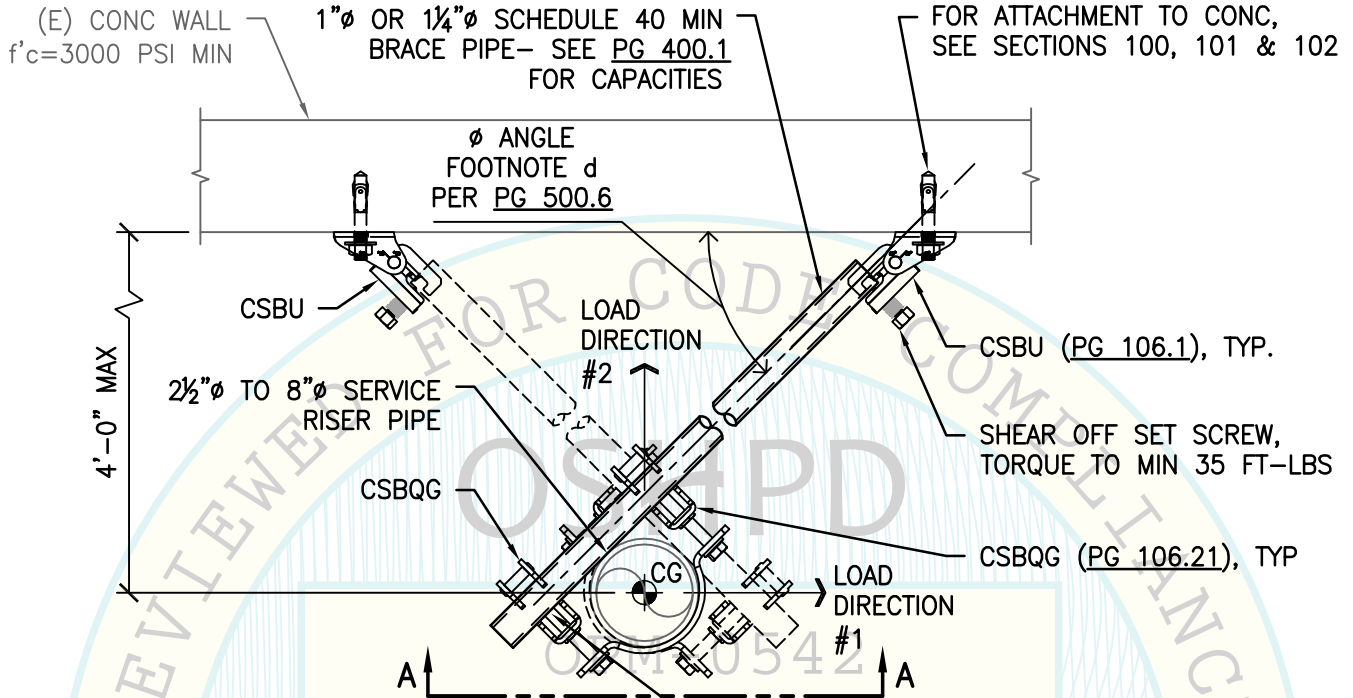


**SHEET TITLE: SINGLE PIPE OR CONDUIT FOUR-WAY RISER SEISMIC BRACES
CSBQIKCL WITH BRACE PIPES FOR 1"Ø TO 2"Ø SERVICE PIPES**

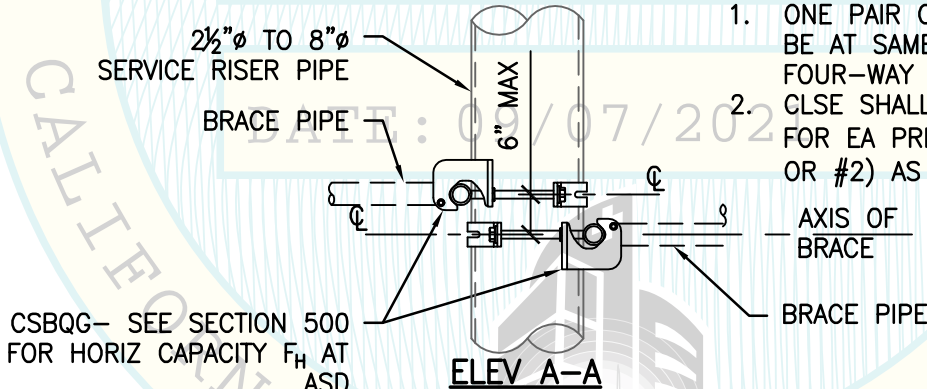
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SEISMIC BRACING FOR MEP SYSTEMS



PLAN VIEW



NOTES:

1. ONE PAIR OF BRACE PIPES NEED TO BE AT SAME OPP ANGLE TO SATISFY FOUR-WAY RISER BRCG REQUIREMENTS.
2. CLSE SHALL EVALUATE $\pm F_p$ OR $\pm F_{pw}$ FOR EA PRINCIPAL LOAD DIRECTION (#1 OR #2) AS SHOWN.



**SHEET TITLE: SINGLE PIPE OR RIGID METAL CONDUIT FOUR-WAY RISER SEISMIC BRACES
CSBQG WITH BRACE PIPES FOR 2.5"Ø TO 8"Ø SERVICE PIPES**



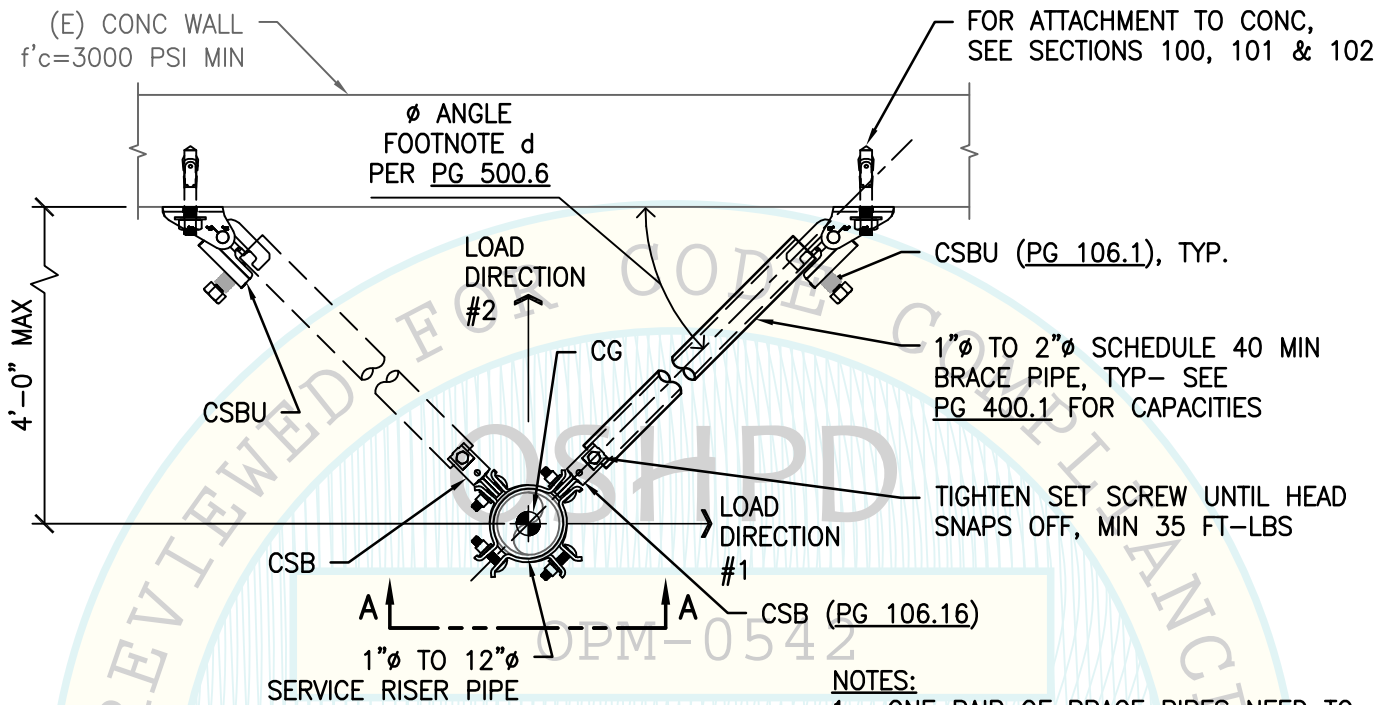
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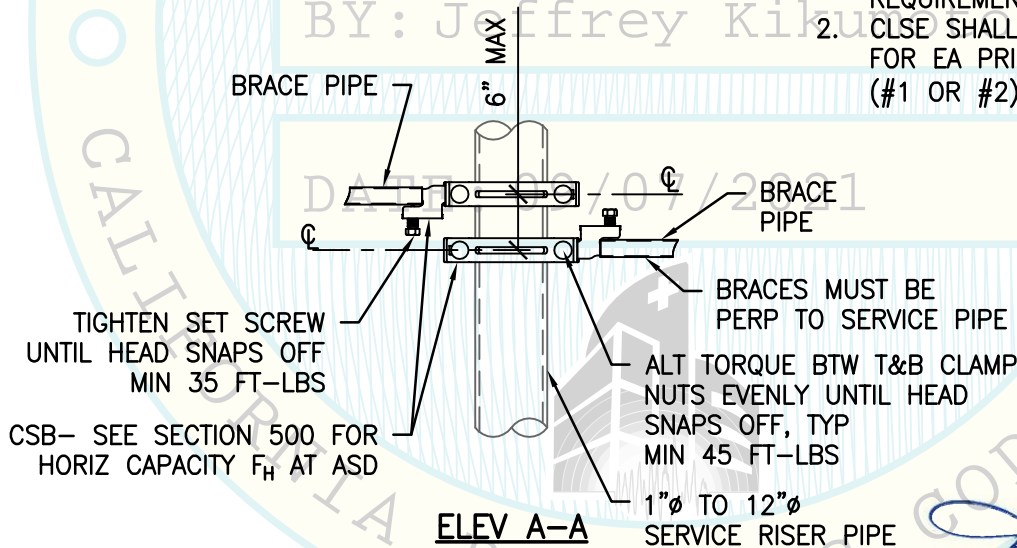
SEISMIC BRACING FOR MEP SYSTEMS



PLAN VIEW

NOTES:

1. ONE PAIR OF BRACE PIPES NEED TO BE AT SAME OPP ANGLE TO SATISFY FOUR-WAY RISER BRCC REQUIREMENTS.
2. CLSE SHALL EVALUATE $\pm F_p$ OR $\pm F_w$ FOR EA PRINCIPAL LOAD DIRECTION (#1 OR #2) AS SHOWN.



ELEV A-A

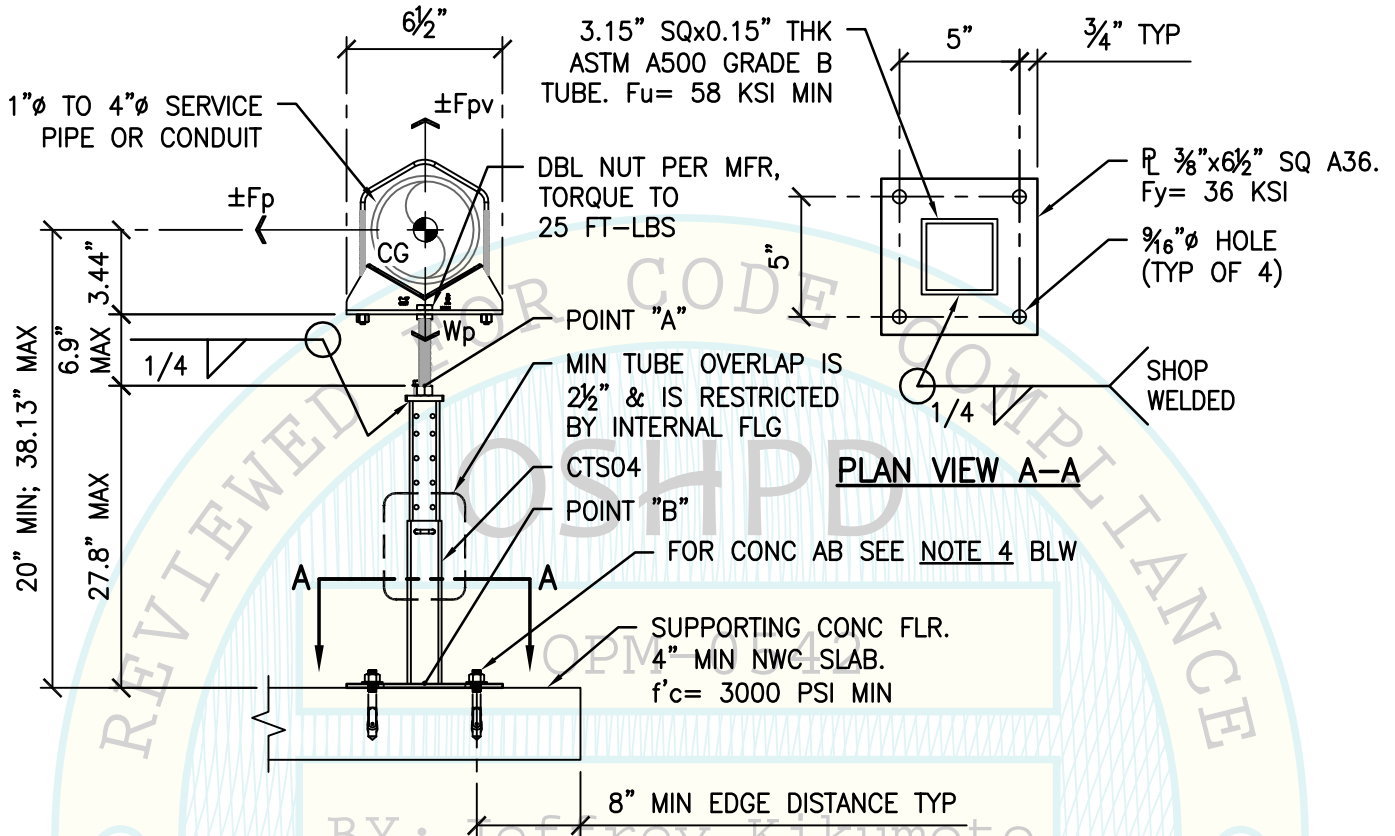


**SHEET TITLE: SINGLE PIPE OR CONDUIT FOUR-WAY RISER SEISMIC BRACES
CSB WITH BRACE PIPES FOR 1"Ø TO 12"Ø SERVICE PIPES**

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SEISMIC BRACING FOR MEP SYSTEMS



NOTES:

1. THE CTS04 TELESCOPING PIPE STAND IS A COMPLETE MANUFACTURED BRACE PIPE ASSEMBLY. FOR INSTALLATION INSTRUCTIONS, SEE PG 10.3.
2. THE CTS04 BRACE PIPE ASSEMBLY MAY BE USED W/ AN INVERTED CSB LONGITUDINAL BRACE. REFER TO SECTION 7.
3. MAX ALLOWABLE MOMENT FOR THRD ROD AT ASD IS 3000 IN-LBS (POINT "A"). MAX ALLOWABLE MOMENT FOR BASE R_L , ANCHORS & TUBE STL AT ASD IS 5200 IN-LBS (POINT "B"). CONCURRENT MAX AXIAL COMPRESSION LOAD AT ASD IS 2000 LBS. $F_{p,max}$ = 136 LBS AT ASD.
4. THE ALLOWABLE LOADS QUALIFY 1/2" ϕ x 2" MIN EMBED CONC AB FOR DEEPER SUPPORTING FLRS, A LARGER ANCHOR EMBEDMENT MAY BE USED. SEE SECTION 1 FOR CONC AB INSTALLATION REQUIREMENTS.
5. BASE R_L MAY BE WELDED TO SUPPORTING STRUC STL BUT MUST BE DESIGNED ON A PROJECT SPECIFIC BASIS & MUST REQ SPECIFIC OSHPD APPROVAL
6. SEE SECTION 200 FOR PIPE WEIGHTS.



SHEET TITLE: SINGLE PIPE OR CONDUIT INTERIOR TELESCOPING PIPE STAND
CTS04



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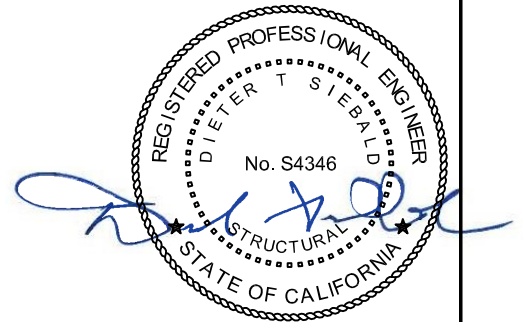
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| Page: | 10.1 of . |

SEISMIC BRACING FOR
MEP SYSTEMS



NOT USED



SHEET TITLE: SINGLE PIPE, EMT OR CONDUIT INTERIOR TELESCOPING PIPE STAND
CTS10



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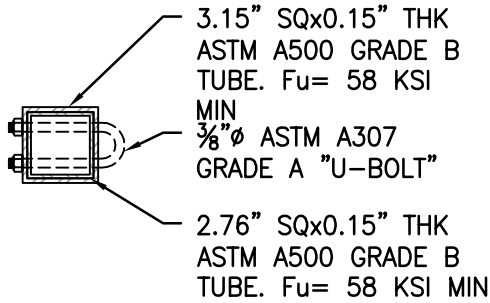
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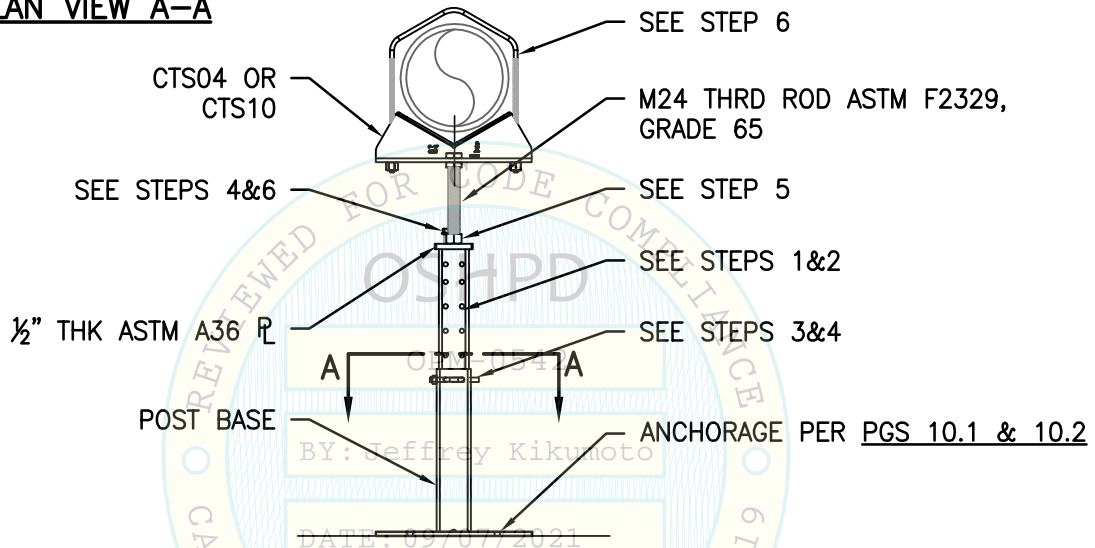
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SEISMIC BRACING FOR MEP SYSTEMS



PLAN VIEW A-A



TELESCOPING PIPE STAND INSTALLATION INSTRUCTIONS:

- STEP 1: INSERT POST ASSEMBLY.
- STEP 2: ADJUST HT OF POST ASSEMBLY.
- STEP 3: INSERT U-BOLT (BY MFR) & TORQUE NUTS TO 35 FT-LBS.
- STEP 4: REMOVE SET SCREW
- STEP 5: ROTATE NUT ON LEVELING ROD.
AT FINAL POSITION, TORQUE TO 25 FT-LBS.
- STEP 6: REPLACE SET SCREW & HAND TIGHTEN. SET SCREW SO THAT IT
STOPS NUT ROTATION. PRESS V-BOLT AGAINST PIPE &
TORQUE TO 7 FT-LBS.



**SHEET TITLE: SINGLE PIPE OR CONDUIT TELESCOPING PIPE STAND
CTS04 & CTS10 POST BASE INSTALLATION INSTRUCTIONS**



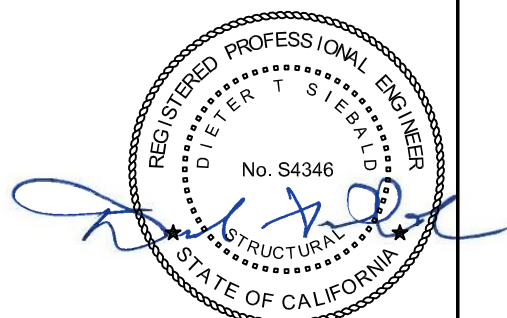
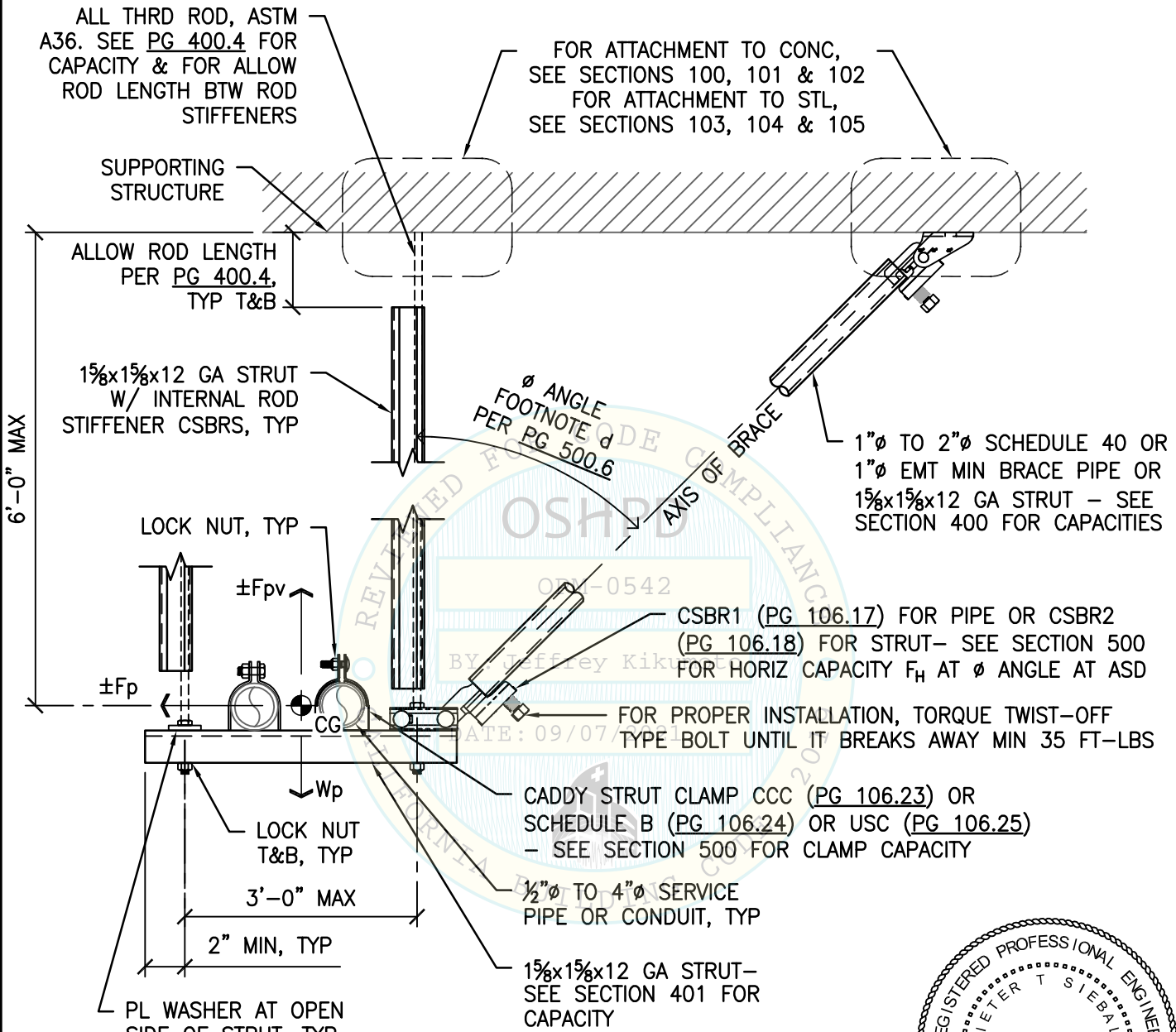
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| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 10.3 of . |

SEISMIC BRACING FOR MEP SYSTEMS

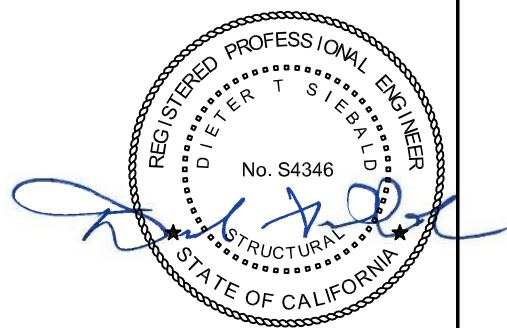
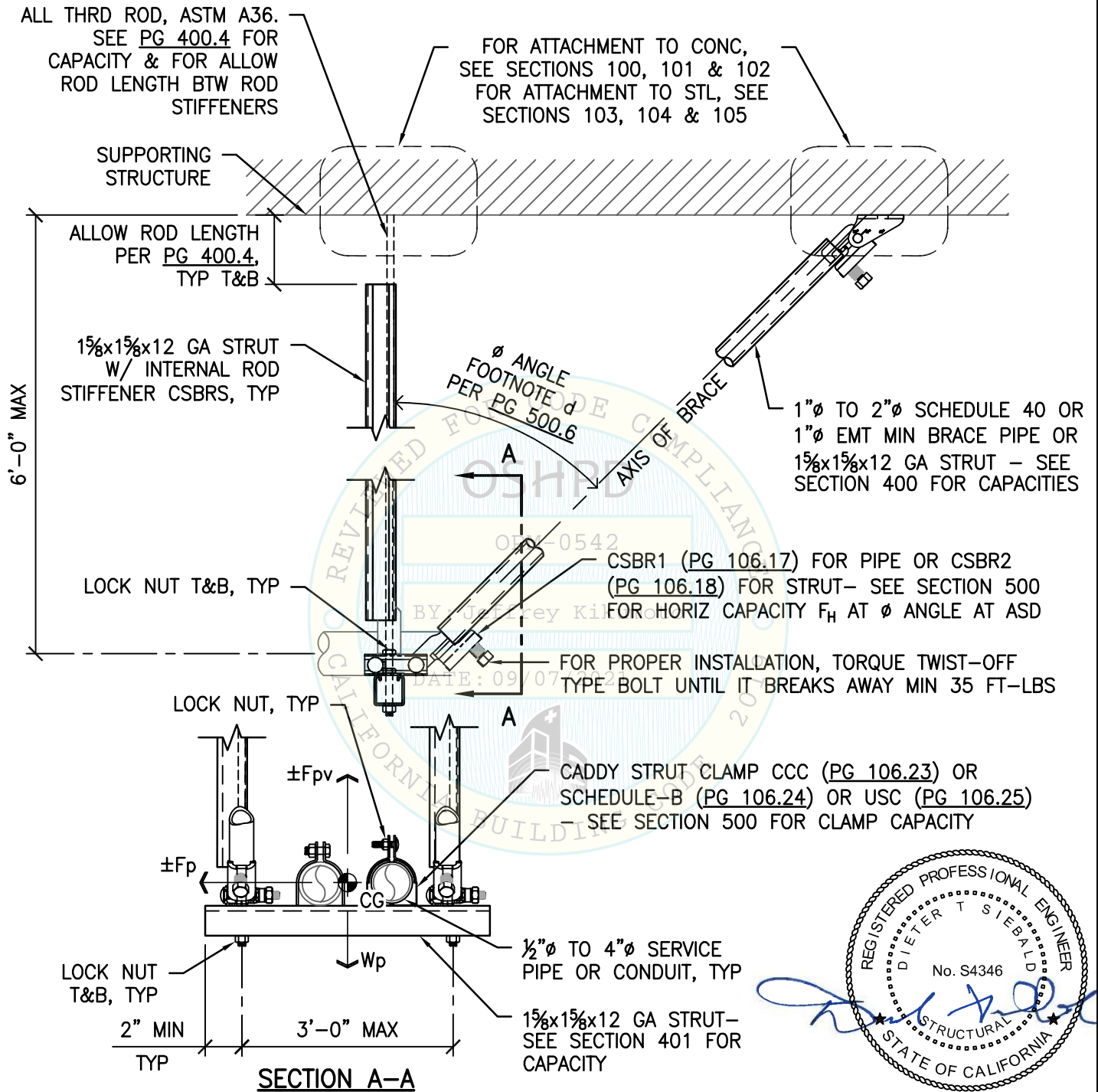


SHEET TITLE: MULTIPLE PIPE OR CONDUIT SUPPORTED BY SINGLE HORIZONTAL TRAPEZE STRUT TRANSVERSE (LATERAL) RIGID BRACING

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| <p>CYS STRUCTURAL ENGINEERS, INC. 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833</p> | Job No: 19039 |
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| | Page: 11.1 of 1 |

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SEISMIC BRACING FOR MEP SYSTEMS

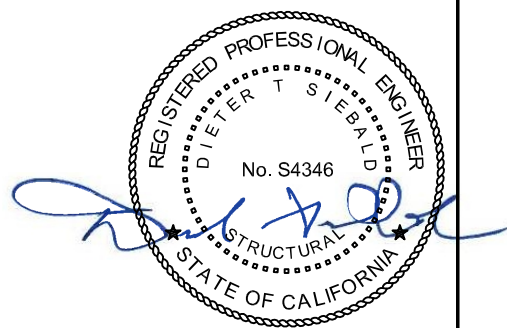
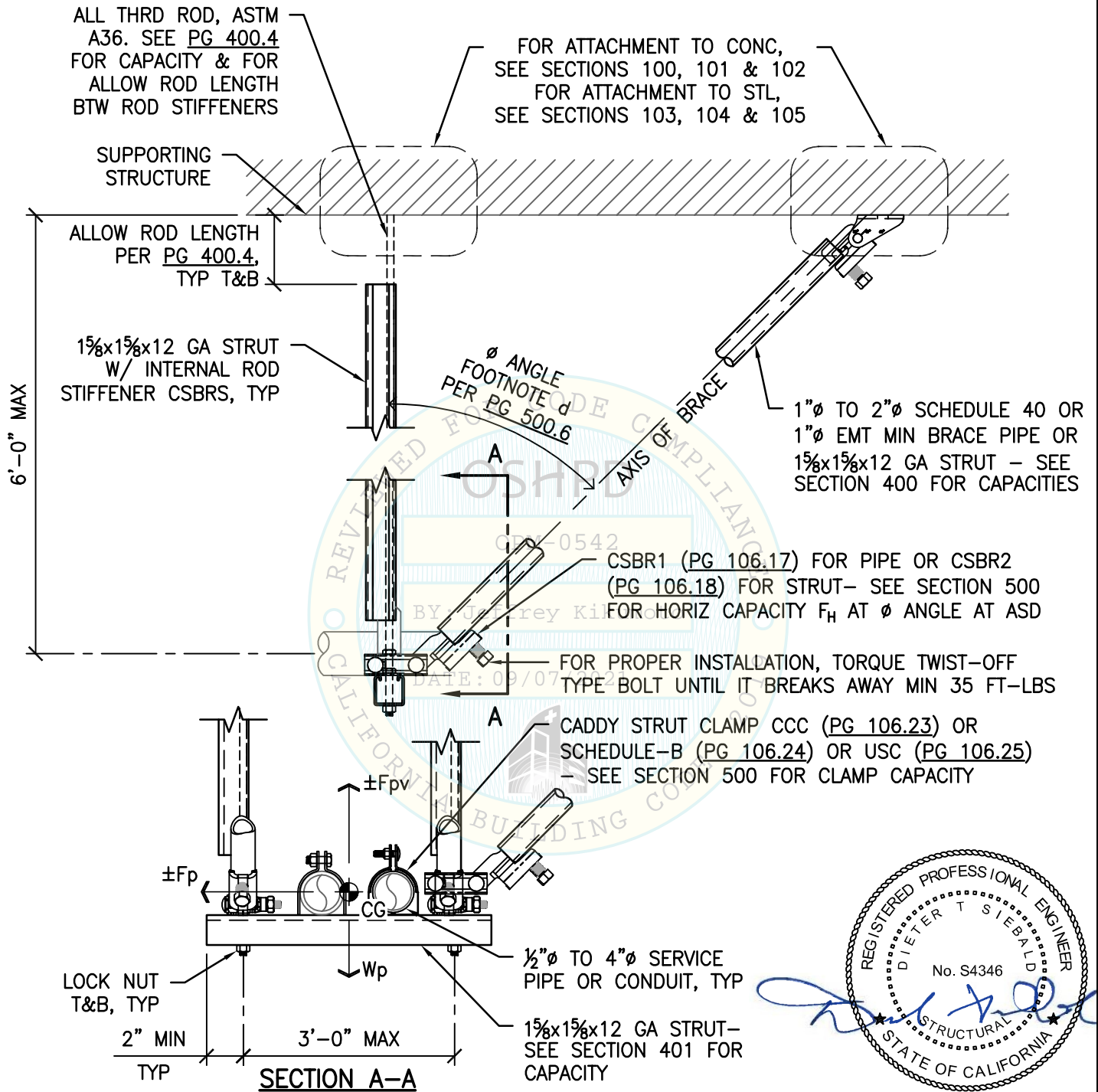


SHEET TITLE: MULTIPLE PIPE OR CONDUIT SUPPORTED BY SINGLE HORIZONTAL TRAPEZE STRUT
LONGITUDINAL RIGID BRACING

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|--|---------------------------------------|--------------------|
| | CYS STRUCTURAL ENGINEERS, INC. | Job No: 19039 |
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| | SACRAMENTO, CA 95833 | www.cyseng.com |
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SEISMIC BRACING FOR MEP SYSTEMS

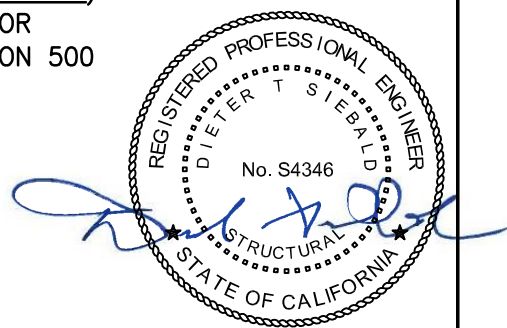
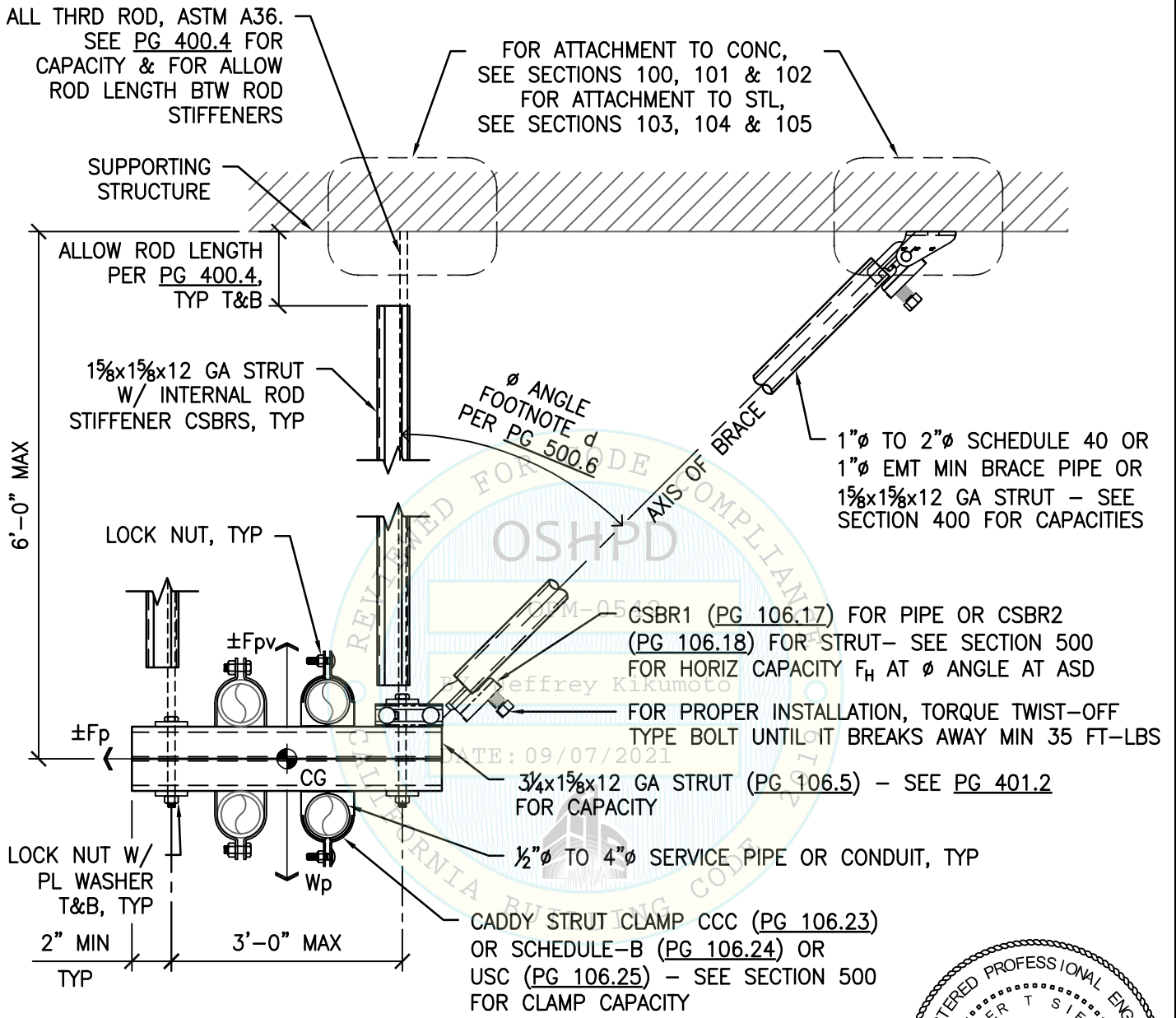


SHEET TITLE: MULTIPLE PIPE OR CONDUIT SUPPORTED BY SINGLE HORIZONTAL TRAPEZE STRUT TRANSVERSE (LATERAL) & LONGITUDINAL RIGID BRACING

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SEISMIC BRACING FOR MEP SYSTEMS

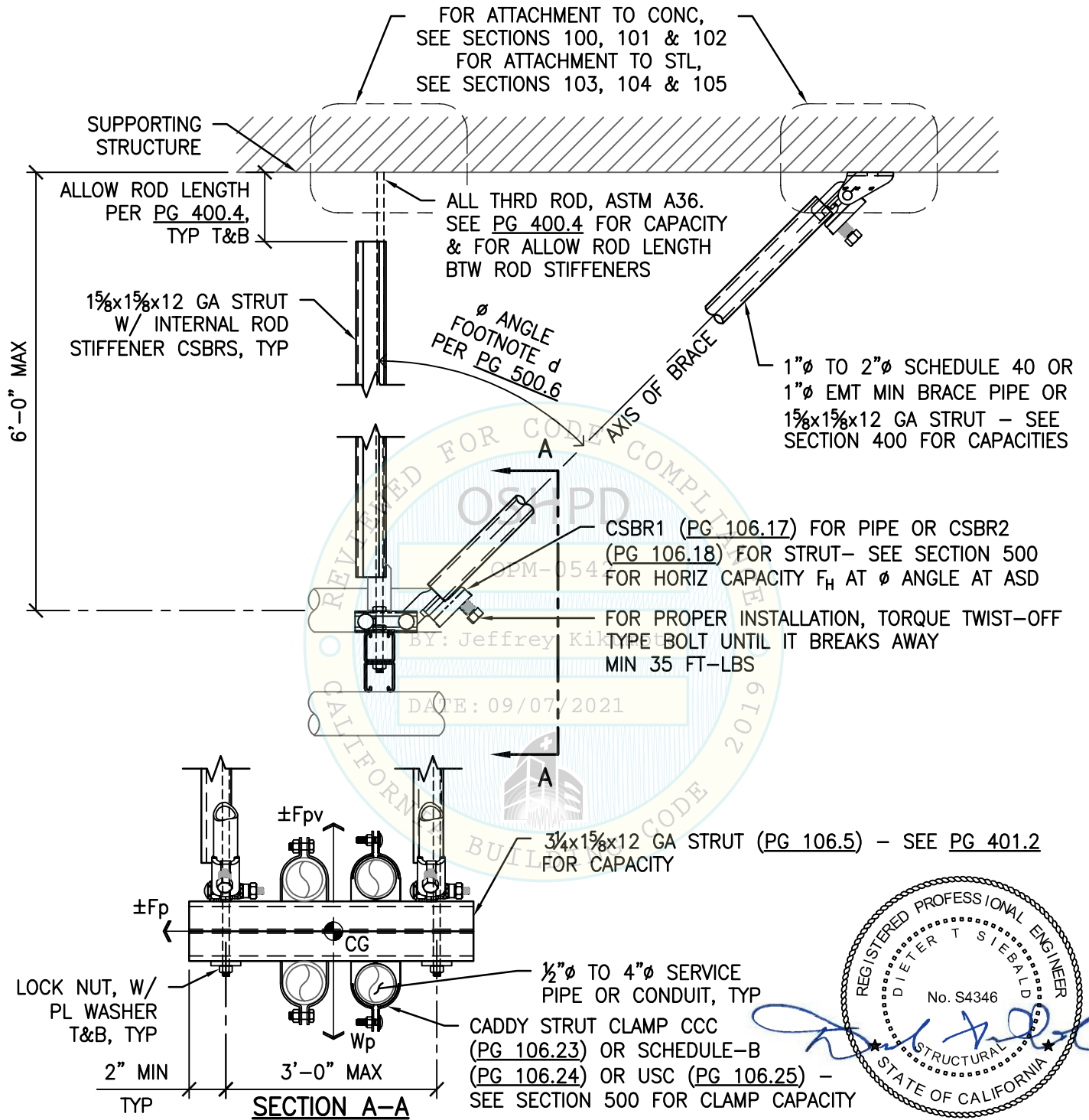


SHEET TITLE: MULTIPLE PIPE OR CONDUIT SUPPORTED BY DOUBLE HORIZONTAL TRAPEZE STRUT
TRANSVERSE (LATERAL) RIGID BRACING

| | | |
|--|--------------------|------------------|
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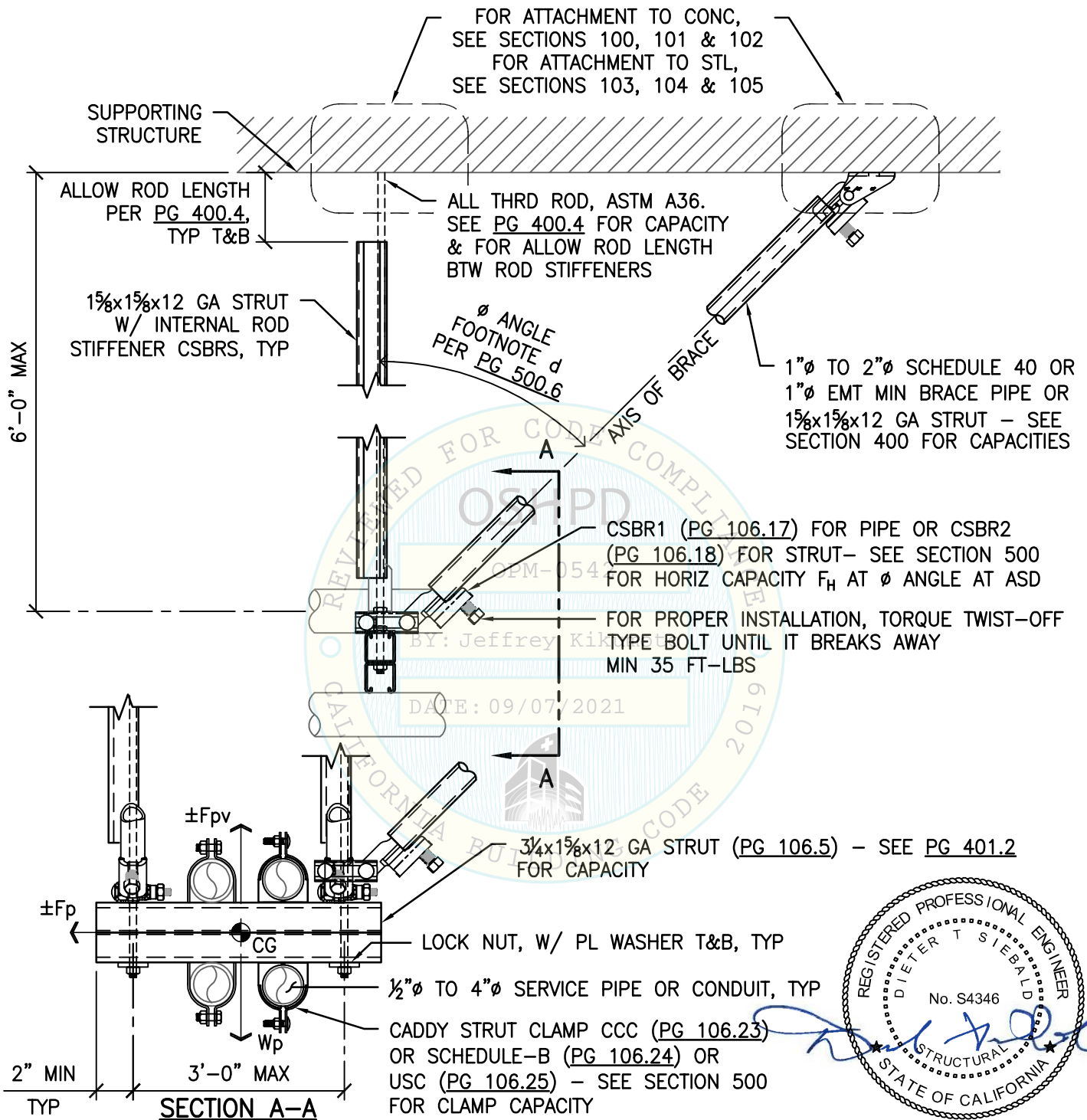
SEISMIC BRACING FOR MEP SYSTEMS



SHEET TITLE: MULTIPLE PIPE OR CONDUIT SUPPORTED BY DOUBLE HORIZONTAL TRAPEZE STRUT
LONGITUDINAL RIGID BRACING

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| | Page: 12.2 of |

SEISMIC BRACING FOR MEP SYSTEMS



SHEET TITLE: MULTIPLE PIPE OR CONDUIT SUPPORTED BY DOUBLE HORIZONTAL TRAPEZE STRUT
TRANSVERSE (LATERAL) & LONGITUDINAL RIGID BRACING

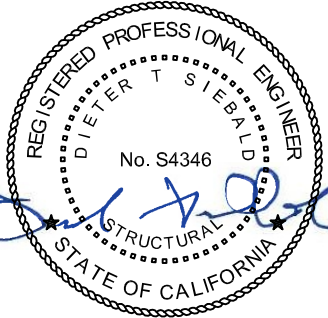


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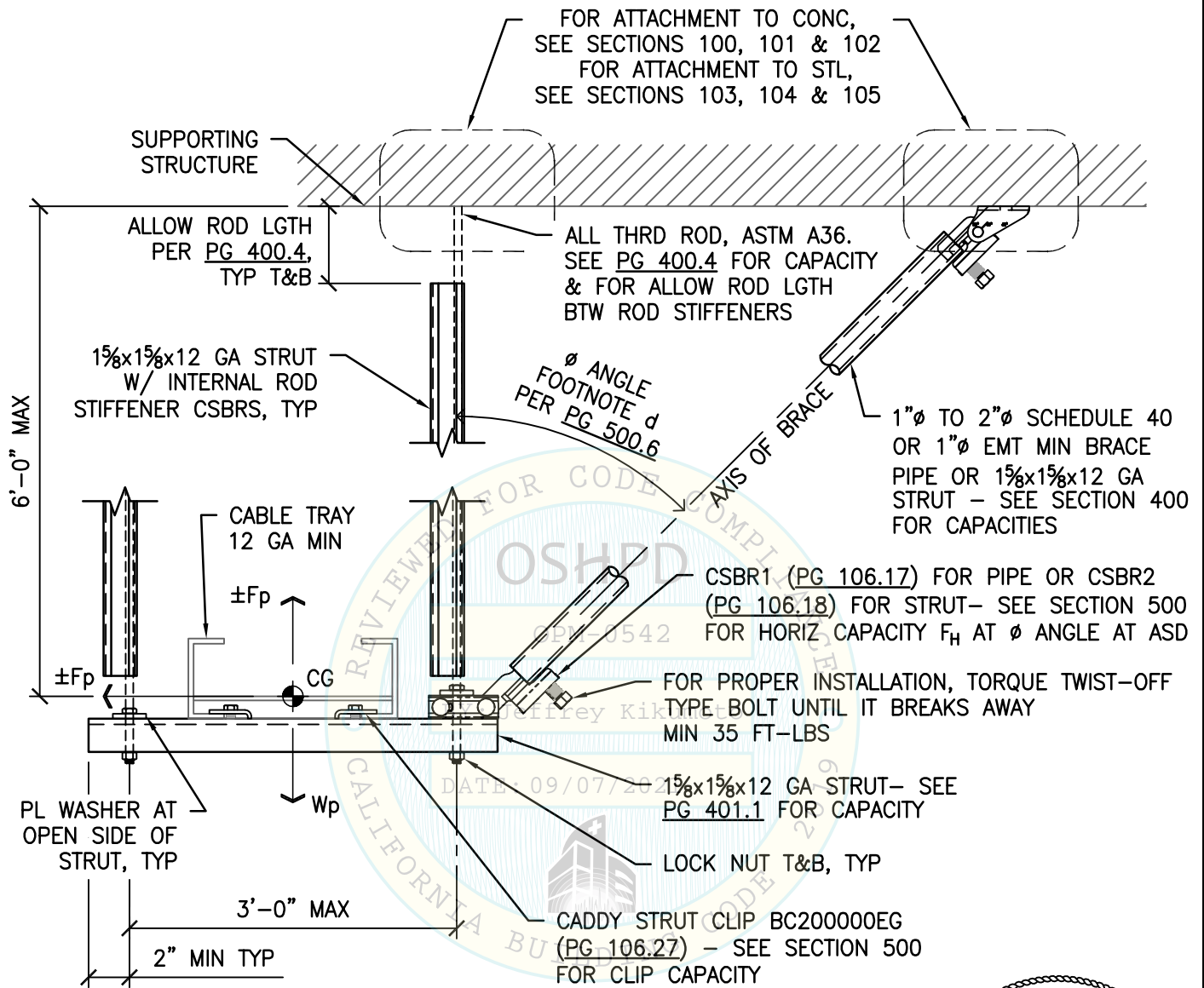
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| Page: | 12.3 of |

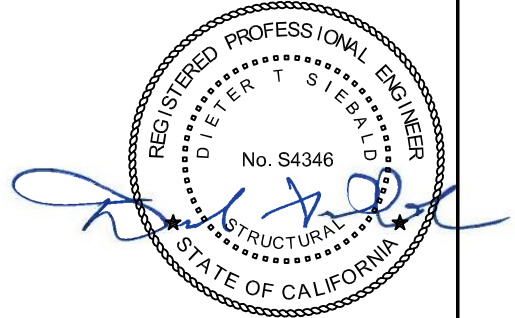


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SEISMIC BRACING FOR MEP SYSTEMS



NOTE:
FOR CABLE TRAY REFER TO DESIGN PARAMETERS & BRCG GUIDELINES ON PGS 1.200 THRU 1.206.

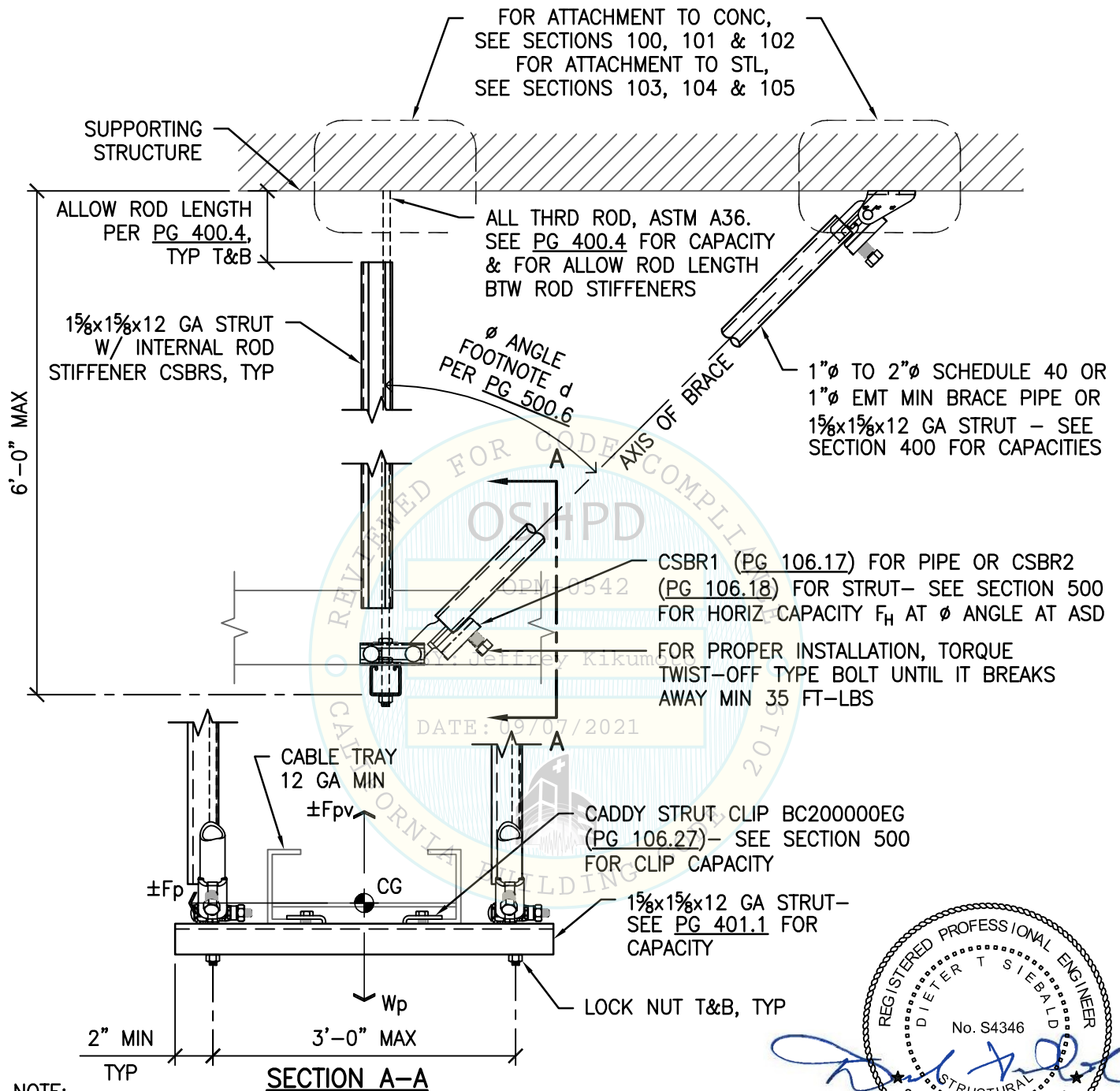


SHEET TITLE: SINGLE CABLE TRAY SUPPORTED BY SINGLE HORIZONTAL TRAPEZE STRUT TRANSVERSE (LATERAL) RIGID BRACING

| | | |
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| | Page: | 13.1 of |

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SEISMIC BRACING FOR MEP SYSTEMS



NOTE:
FOR CABLE TRAY REFER TO DESIGN PARAMETERS & BRCG GUIDELINES
ON PGS 1.200 THRU 1.206.

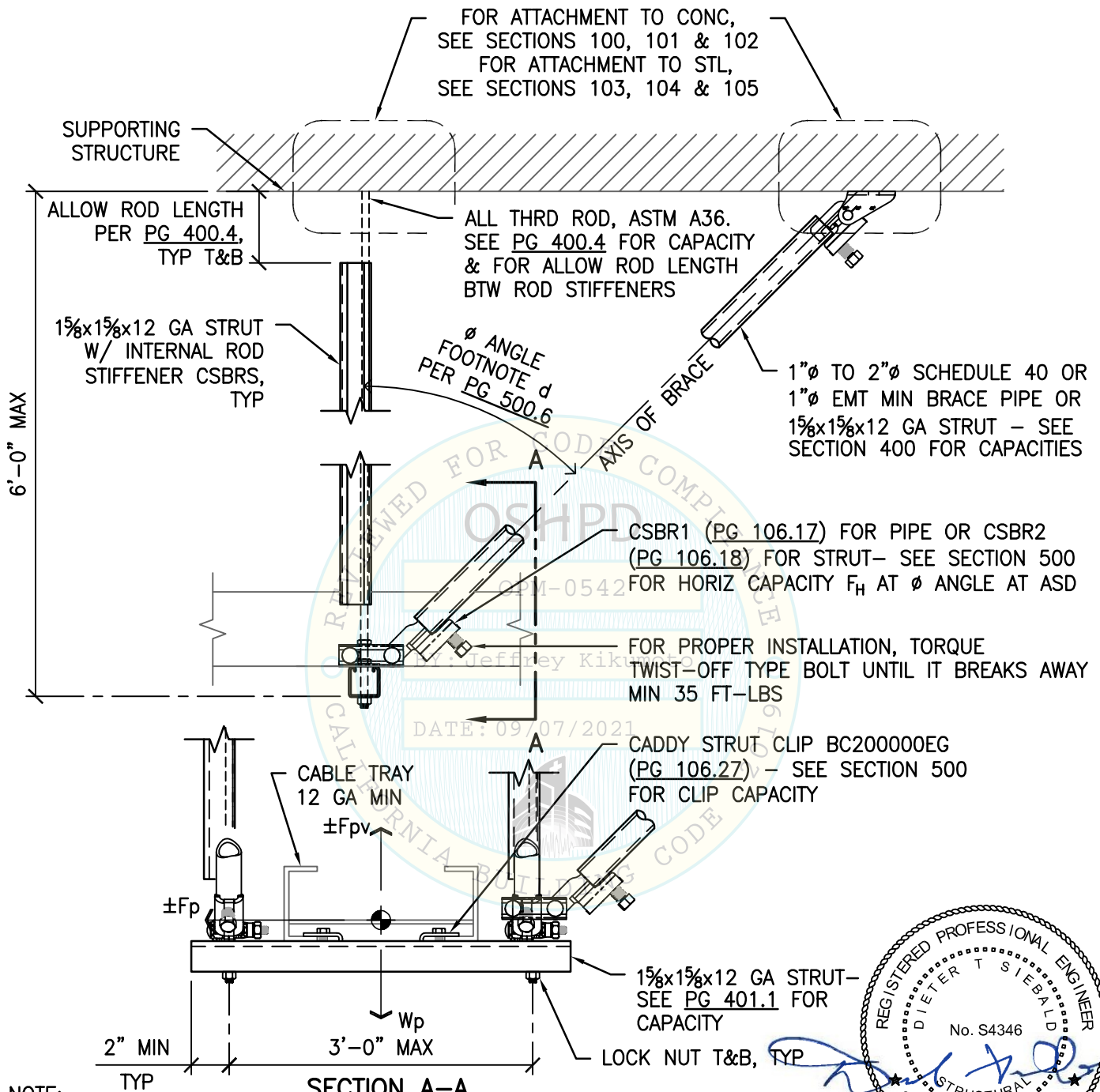


SHEET TITLE: SINGLE CABLE TRAY SUPPORTED BY SINGLE HORIZONTAL TRAPEZE STRUT
LONGITUDINAL RIGID BRACING

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| | Page: 13.2 of |

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SEISMIC BRACING FOR MEP SYSTEMS



NOTE:
FOR CABLE TRAY REFER TO DESIGN PARAMETERS & BRCG GUIDELINES
ON PGS 1.200 THRU 1.206.



SHEET TITLE: SINGLE CABLE TRAY SUPPORTED BY SINGLE HORIZONTAL TRAPEZE STRUT
TRANSVERSE (LATERAL) & LONGITUDINAL RIGID BRACING



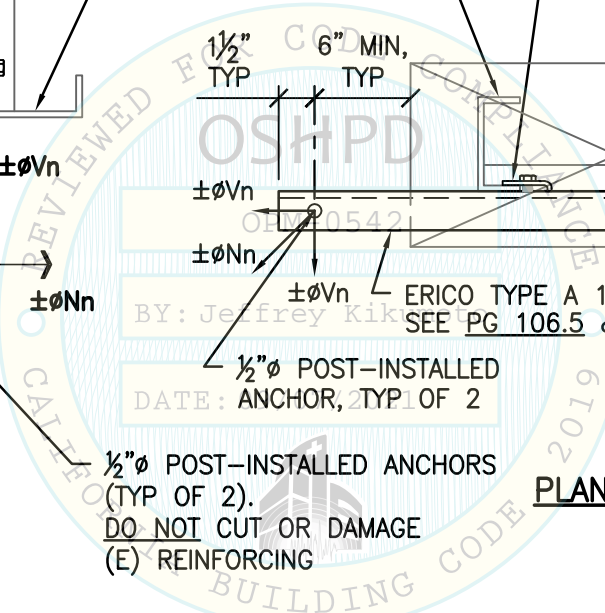
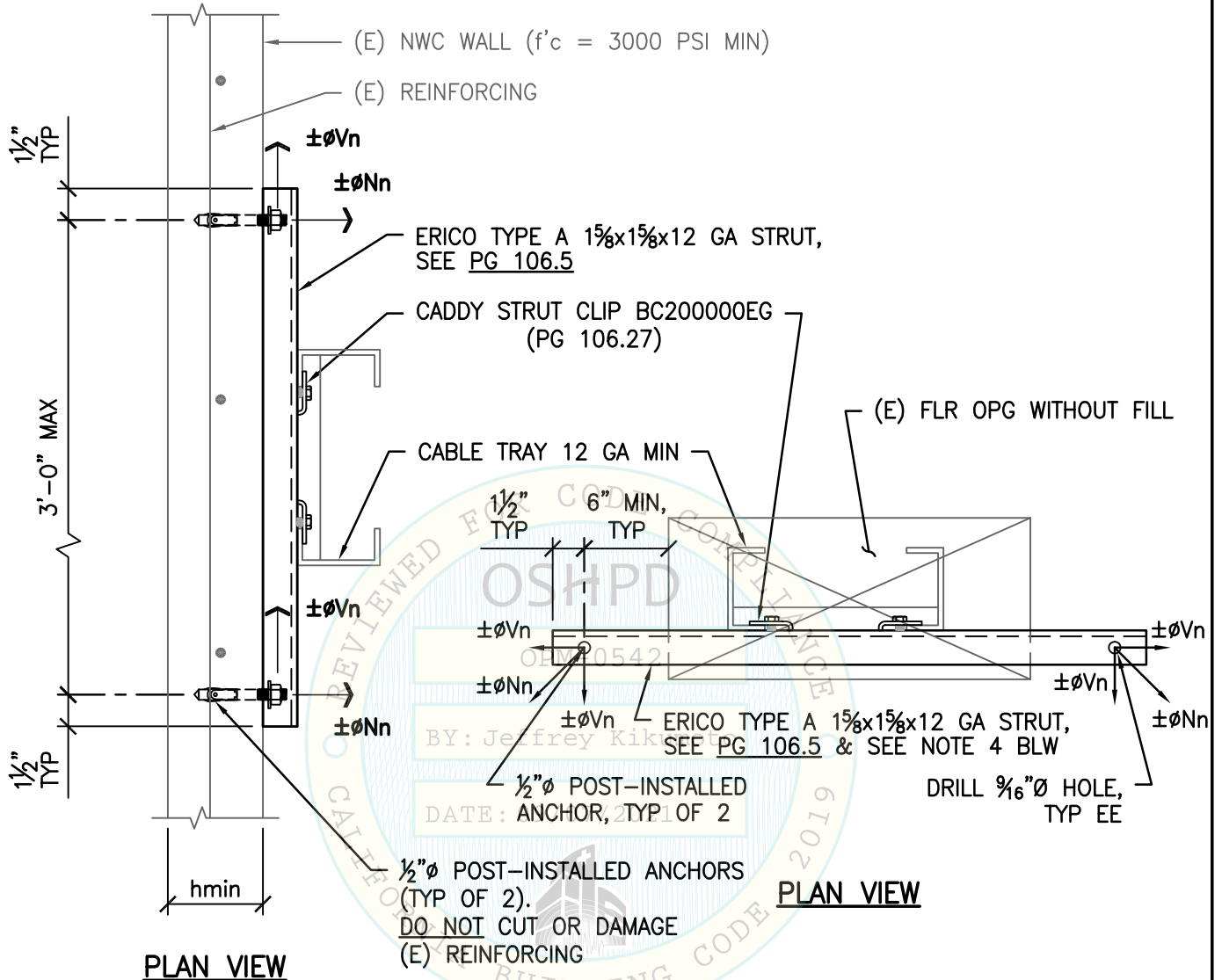
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| Date: | 09/08/2021 |
| Page: | 13.3 of |

SEISMIC BRACING FOR MEP SYSTEMS



NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. SEOR MUST VERIFY CAPACITY OF THE STRUT WHEN THE STRUT IS LONGER THAN 3'-3".

**SHEET TITLE: SINGLE CABLE TRAY SUPPORTED BY SINGLE HORIZONTAL TRAPEZE STRUT
TRANSVERSE (LATERAL) & LONGITUDINAL RIGID BRACING AT CONCRETE WALL & FLOOR**



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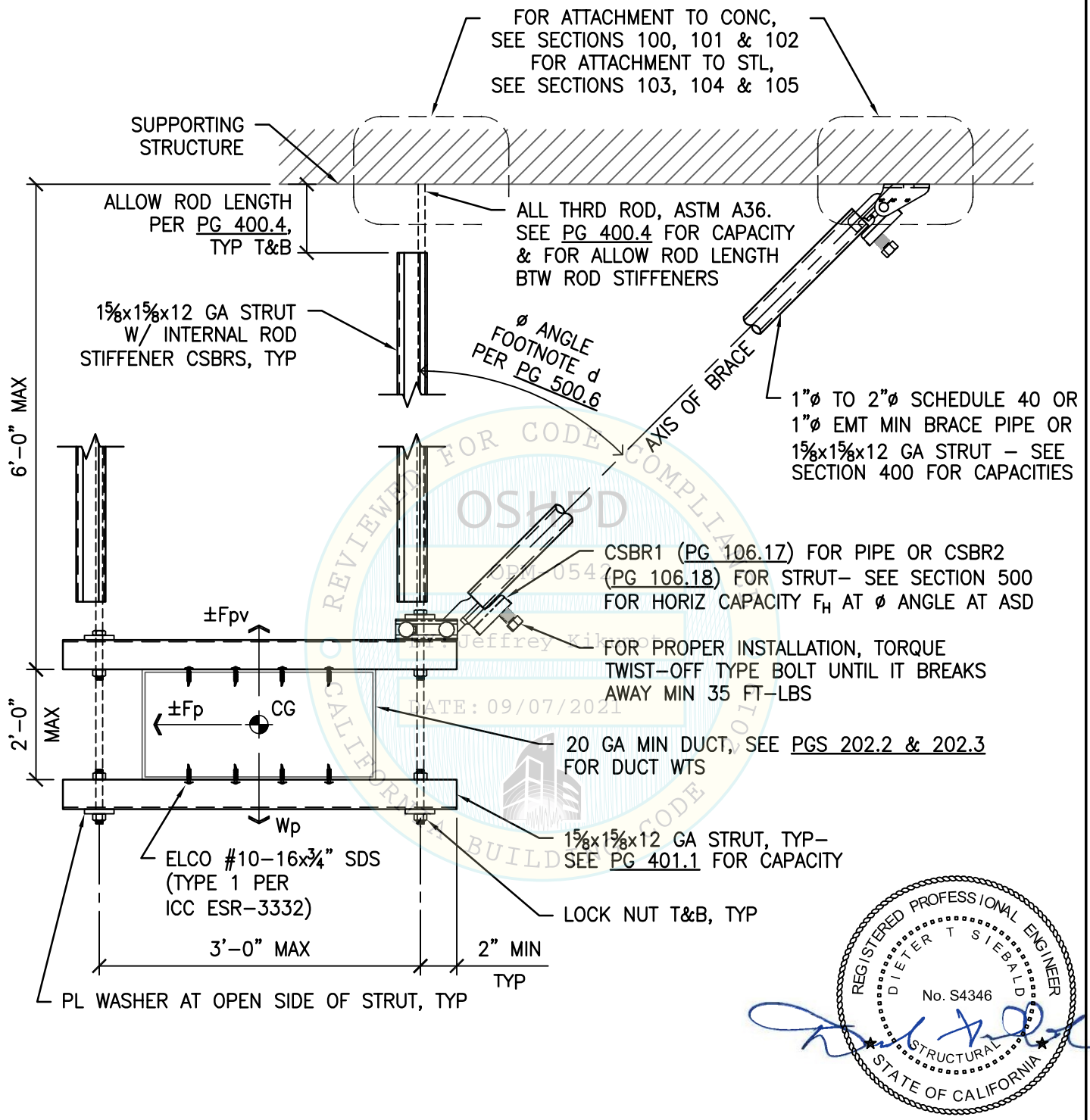
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| Page: | 13.4 of . |

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SEISMIC BRACING FOR MEP SYSTEMS



SHEET TITLE: SINGLE RECTANGULAR DUCT SUPPORTED BY TWO SINGLE HORIZONTAL TRAPEZE STRUTS
TRANSVERSE (LATERAL) RIGID BRACING



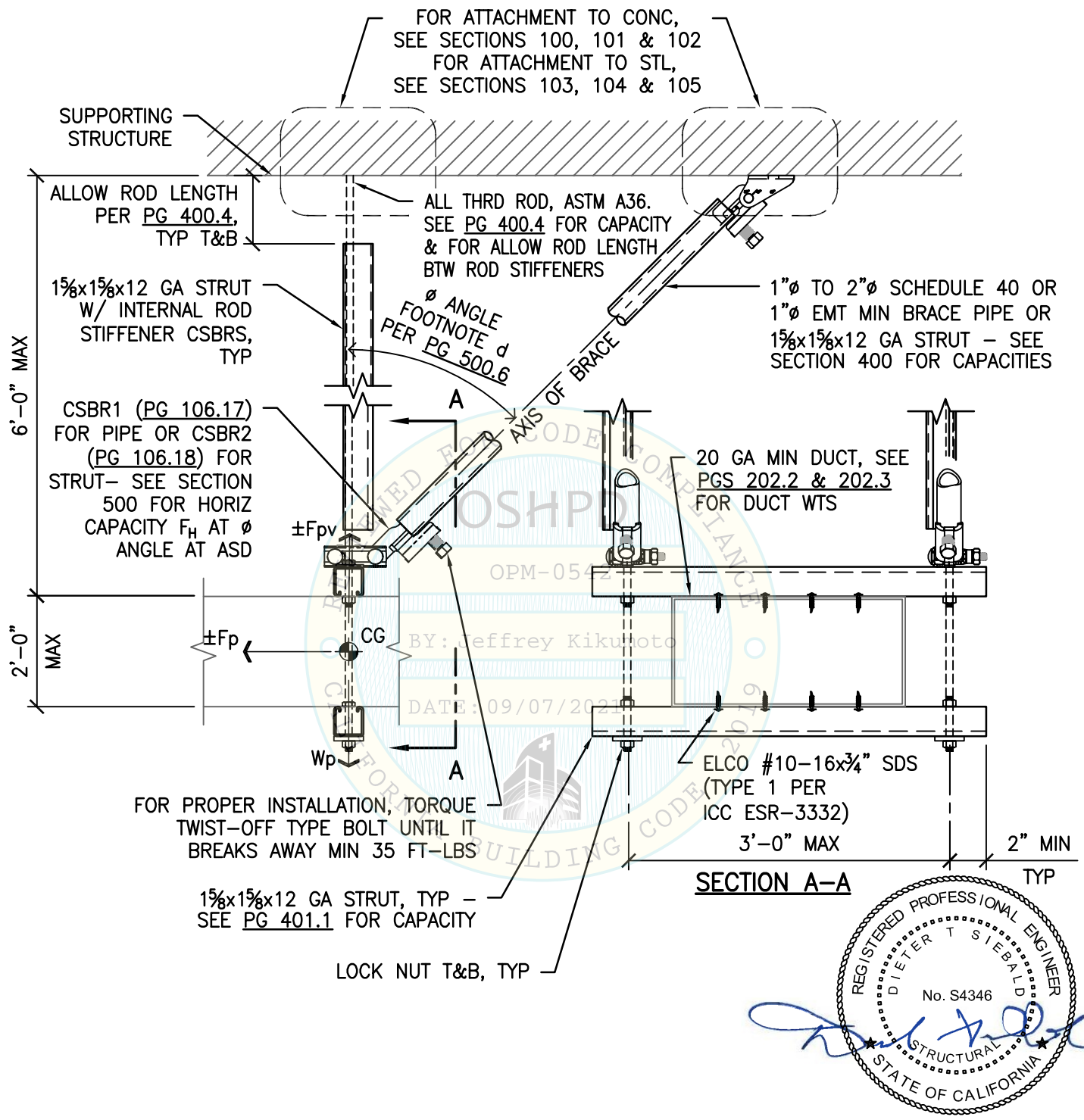
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| Page: | 14.1 of |

SEISMIC BRACING FOR MEP SYSTEMS



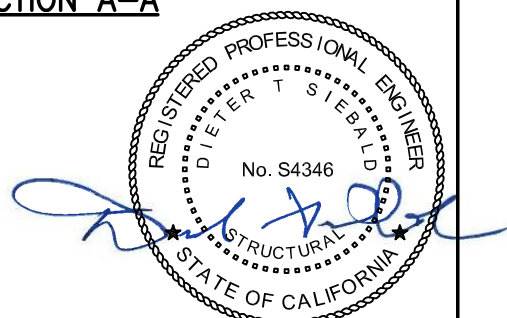
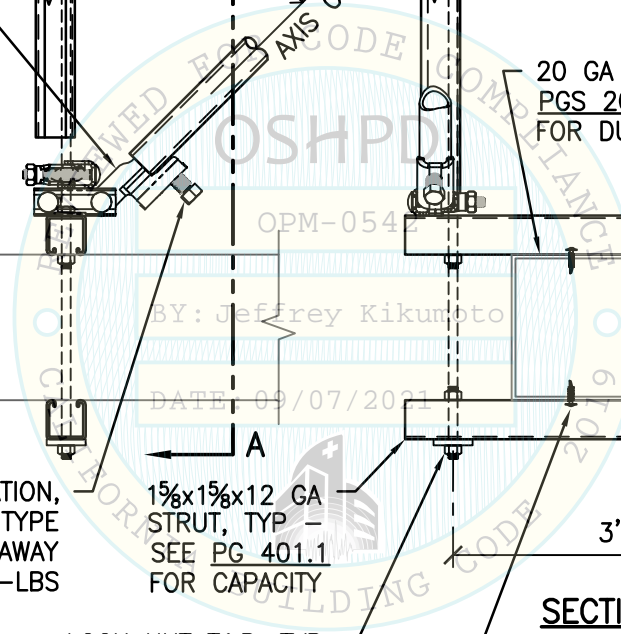
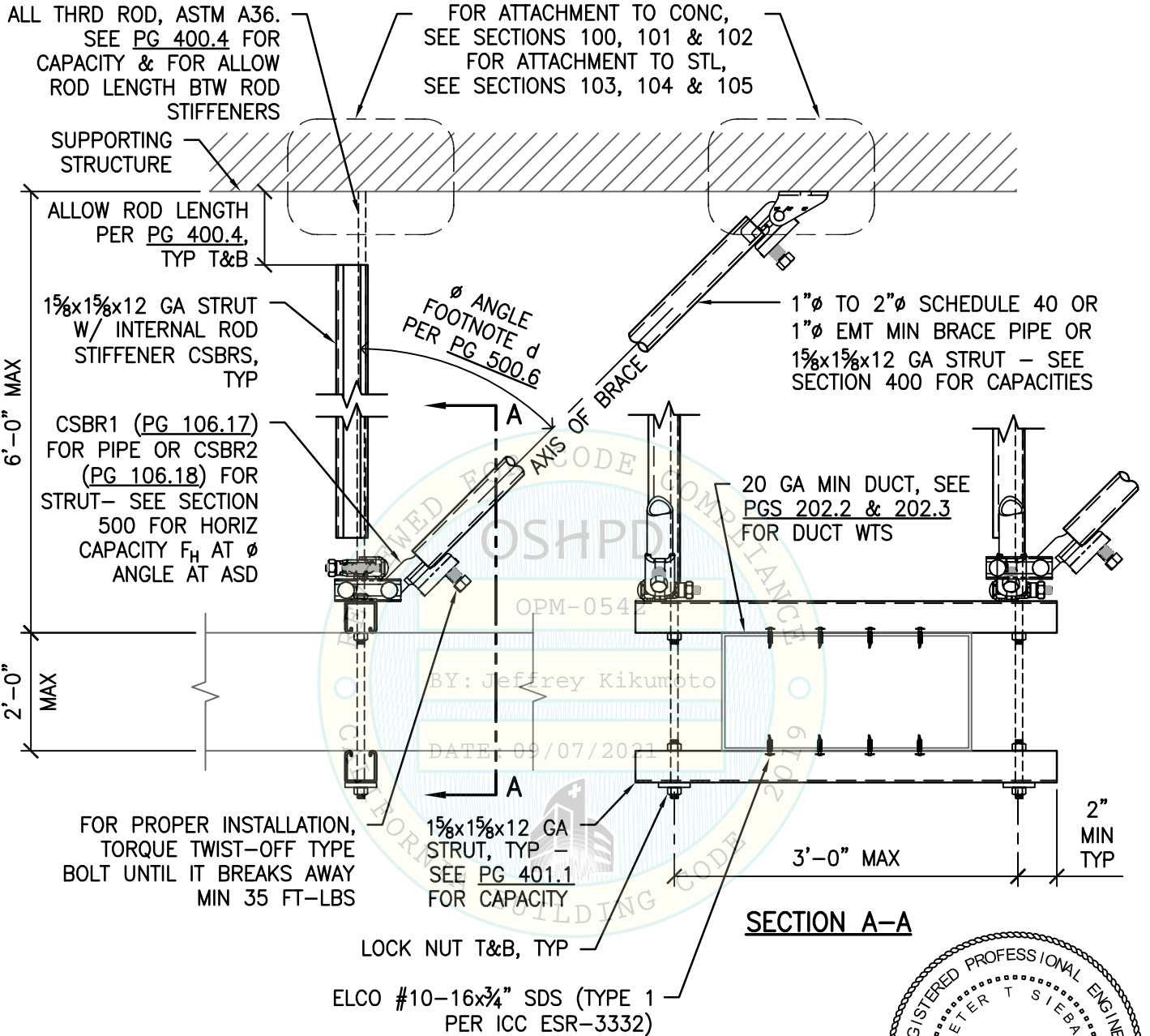
SHEET TITLE: SINGLE RECTANGULAR DUCT SUPPORTED BY TWO SINGLE HORIZONTAL TRAPEZE STRUTS
LONGITUDINAL RIGID BRACING

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| <p>CYS STRUCTURAL ENGINEERS, INC. 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833</p> | Job No: 19039 |
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SEISMIC BRACING FOR MEP SYSTEMS

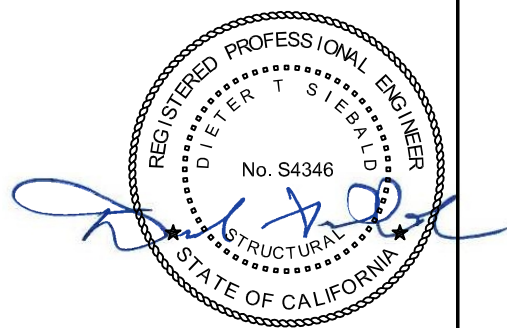
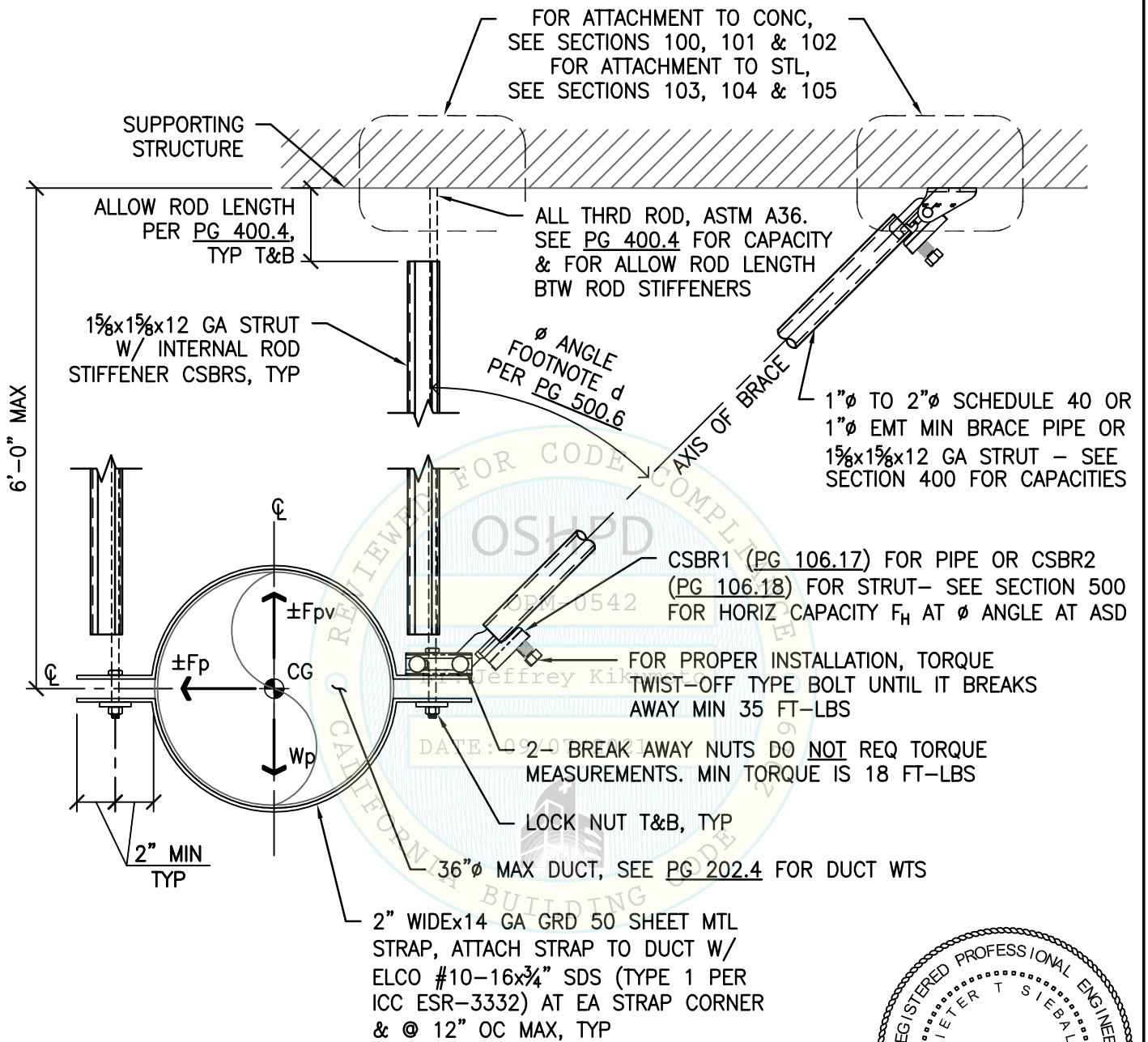


SHEET TITLE: SINGLE RECTANGULAR DUCT SUPPORTED BY TWO SINGLE HORIZONTAL TRAPEZE STRUTS
TRANSVERSE (LATERAL) & LONGITUDINAL RIGID BRACING

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SEISMIC BRACING FOR MEP SYSTEMS

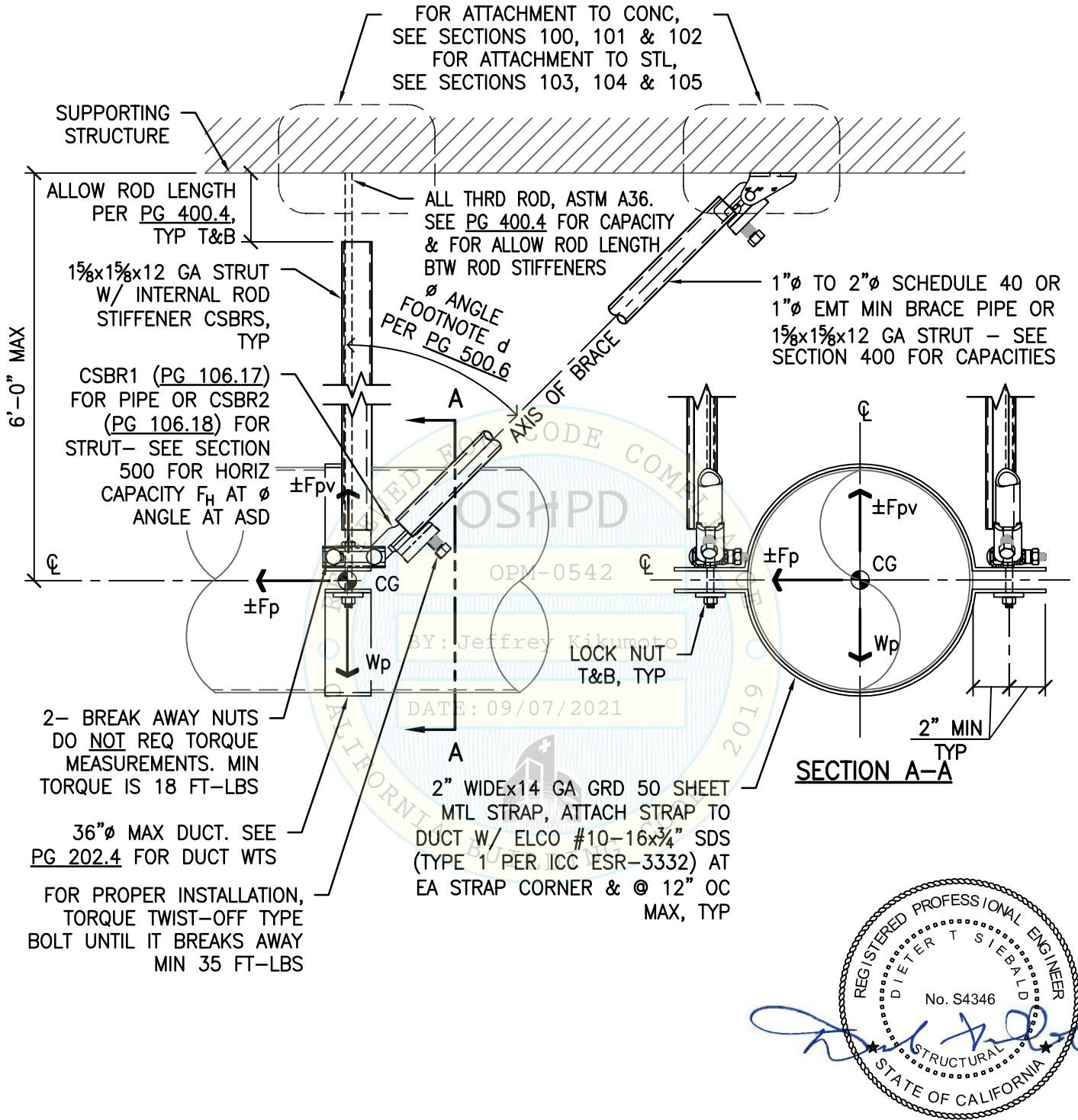


SHEET TITLE: SINGLE ROUND DUCT SUPPORTED BY SHEET METAL STRAPS
TRANSVERSE (LATERAL) RIGID BRACING

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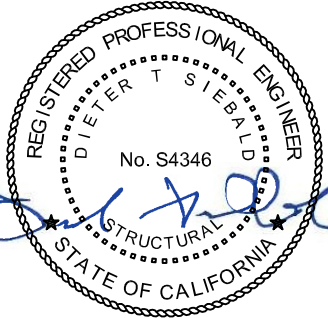
SEISMIC BRACING FOR MEP SYSTEMS



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**SHEET TITLE: SINGLE ROUND DUCT SUPPORTED BY SHEET METAL STRAPS
LONGITUDINAL RIGID BRACING**

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| | Page: 15.2 of |



SEISMIC BRACING FOR MEP SYSTEMS



FOR ATTACHMENT TO CONC,
SEE SECTIONS 100, 101 & 102
FOR ATTACHMENT TO STL,
SEE SECTIONS 103, 104 & 105

SUPPORTING
STRUCTURE

ALLOW ROD LENGTH
PER PG 400.4,
TYP T&B

1 5/8 x 1 5/8 x 12 GA STRUT
W/ INTERNAL ROD
STIFFENER CSBRS, TYP

ALL THRD ROD, ASTM A36.
SEE PG 400.4 FOR CAPACITY
& FOR ALLOW ROD LENGTH
BTW ROD STIFFENERS

Ø ANGLE
FOOTNOTE d
PER PG 500.6

1" Ø TO 2" Ø SCHEDULE 40 OR
1" Ø EMT MIN BRACE PIPE OR
1 5/8 x 1 5/8 x 12 GA STRUT - SEE
SECTION 400 FOR CAPACITIES

6'-0" MAX

LONG BRACE
(TYP OF 2).
SEE PG 15.2

CSBR1 (PG 106.17) FOR PIPE OR CSBR2
(PG 106.18) FOR STRUT- SEE SECTION 500
FOR HORIZ CAPACITY F_H AT Ø ANGLE AT ASD

FOR PROPER INSTALLATION, TORQUE TWIST-OFF
TYPE BOLT UNTIL IT BREAKS AWAY, TYP
MIN 35 FT-LBS

2- BREAK AWAY NUTS DO NOT REQ TORQUE
MEASUREMENTS. MIN TORQUE IS 18 FT-LBS

LOCK NUT T&B, TYP

36" Ø MAX DUCT, SEE PG 202.4
FOR DUCT WTS

2" WIDE x 14 GA GRD 50 SHEET
MTL STRAP, ATTACH STRAP TO
DUCT W/ ELCO #10-16 x 3/4" SDS
(TYPE 1 PER ICC ESR-3332) AT
EA STRAP CORNER & @ 12" OC
MAX, TYP



SHEET TITLE: SINGLE ROUND DUCT SUPPORTED BY SHEET METAL STRAPS
TRANSVERSE (LATERAL) & LONGITUDINAL RIGID BRACING



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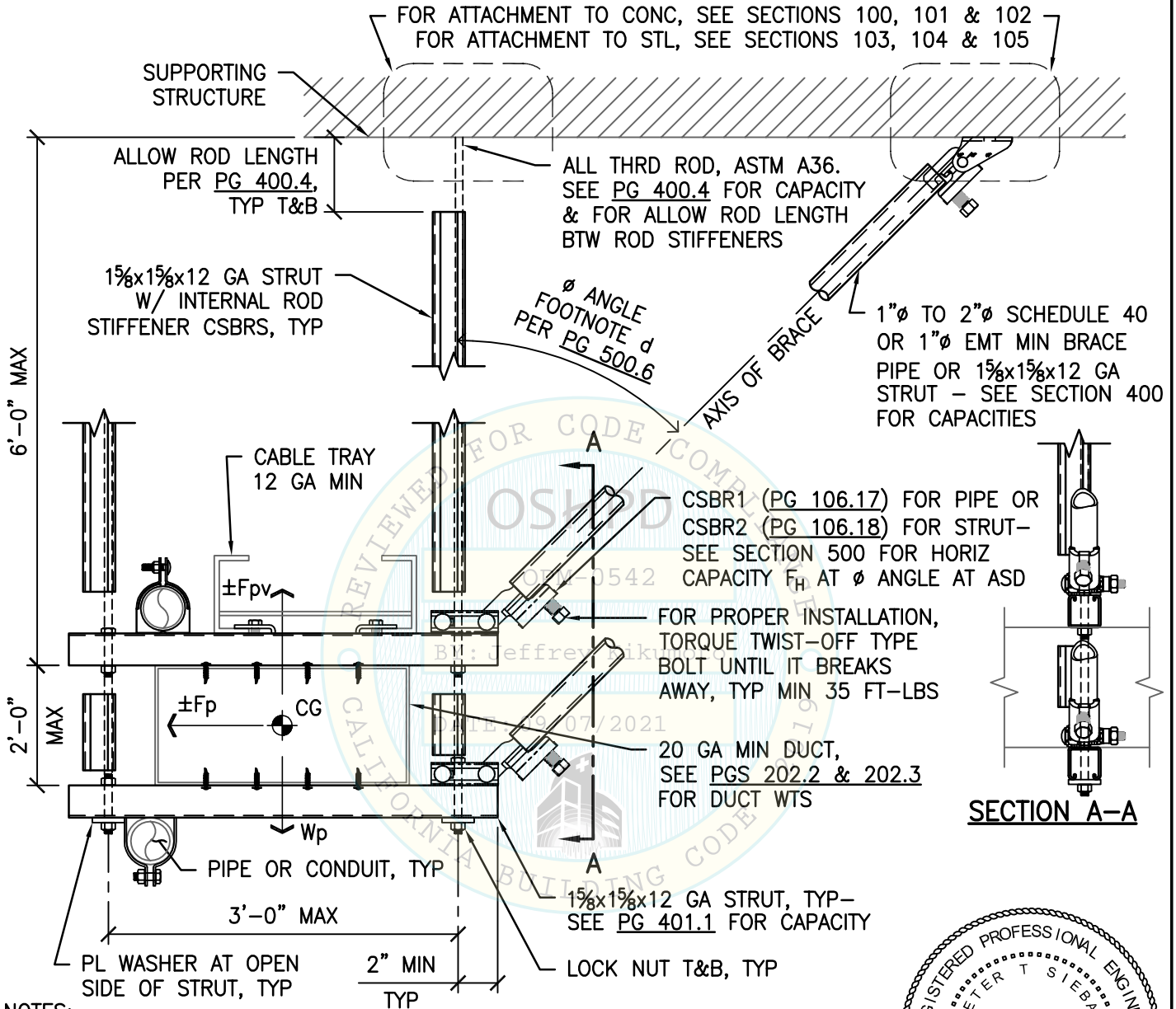
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SEISMIC BRACING FOR MEP SYSTEMS



TRANSVERSE (LATERAL) RIGID BRACING



NOTES:

1. FOR COMPONENT ATTACHMENTS TO STRUT, SEE PGS 11.1, 13.1 & 14.1.
2. DESIGN PROFESSIONAL MUST CALCULATE DESIGN VALUES FOR EACH TRAPEZE SUPPORT. SPACING BETWEEN BRACED TRAPEZE SUPPORTS MUST NOT EXCEED THE SMALLEST ALLOWABLE SPACING FOR ANY ONE SYSTEM COMPONENT ATTACHED TO THE SUPPORT.
3. DESIGN PROFESSIONAL MUST CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_p VALUE USED IN DESIGN.



SHEET TITLE: MULTIPLE PIPE OR CONDUIT OR SINGLE RECTANGULAR DUCT OR SINGLE CABLE TRAY SUPPORTED BY TWO SINGLE HORIZONTAL TRAPEZE STRUTS



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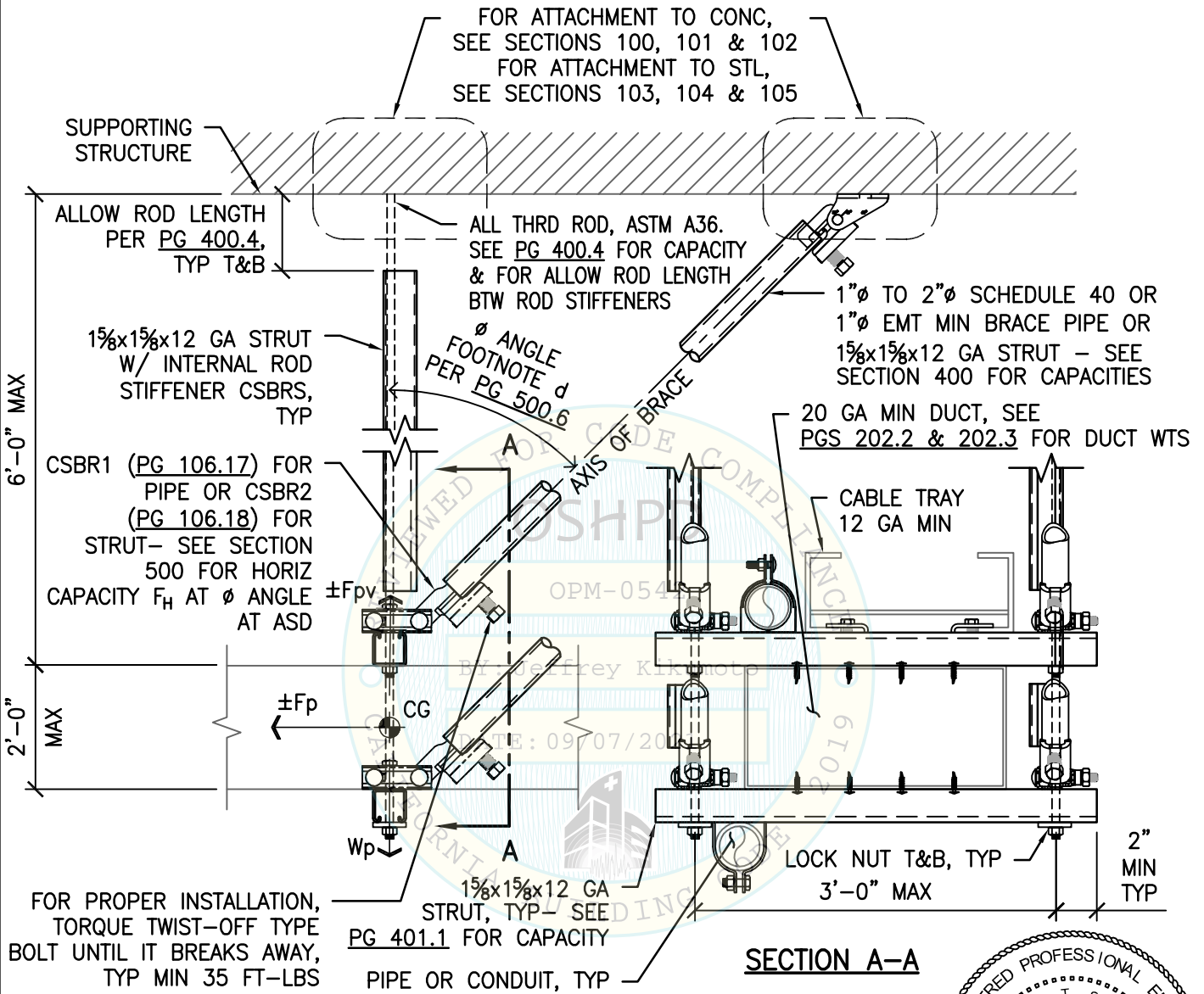
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SEISMIC BRACING FOR MEP SYSTEMS

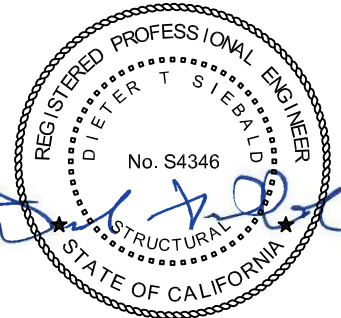


LONGITUDINAL RIGID BRACING



NOTES:

1. FOR COMPONENT ATTACHMENTS TO STRUT, SEE PGS 11.1, 13.1 & 14.1.
2. DESIGN PROFESSIONAL MUST CALCULATE DESIGN VALUES FOR EACH TRAPEZE SUPPORT. SPACING BETWEEN BRACED TRAPEZE SUPPORTS MUST NOT EXCEED THE SMALLEST ALLOWABLE SPACING FOR ANY ONE SYSTEM COMPONENT ATTACHED TO THE SUPPORT.
3. DESIGN PROFESSIONAL MUST CONSIDER ECCENTRIC LOAD DISTRIBUTION WHEN DETERMINING THE F_p VALUE USED IN DESIGN.



SHEET TITLE: MULTIPLE PIPE OR CONDUIT OR SINGLE RECTANGULAR DUCT OR SINGLE CABLE TRAY SUPPORTED BY TWO SINGLE HORIZONTAL TRAPEZE STRUTS

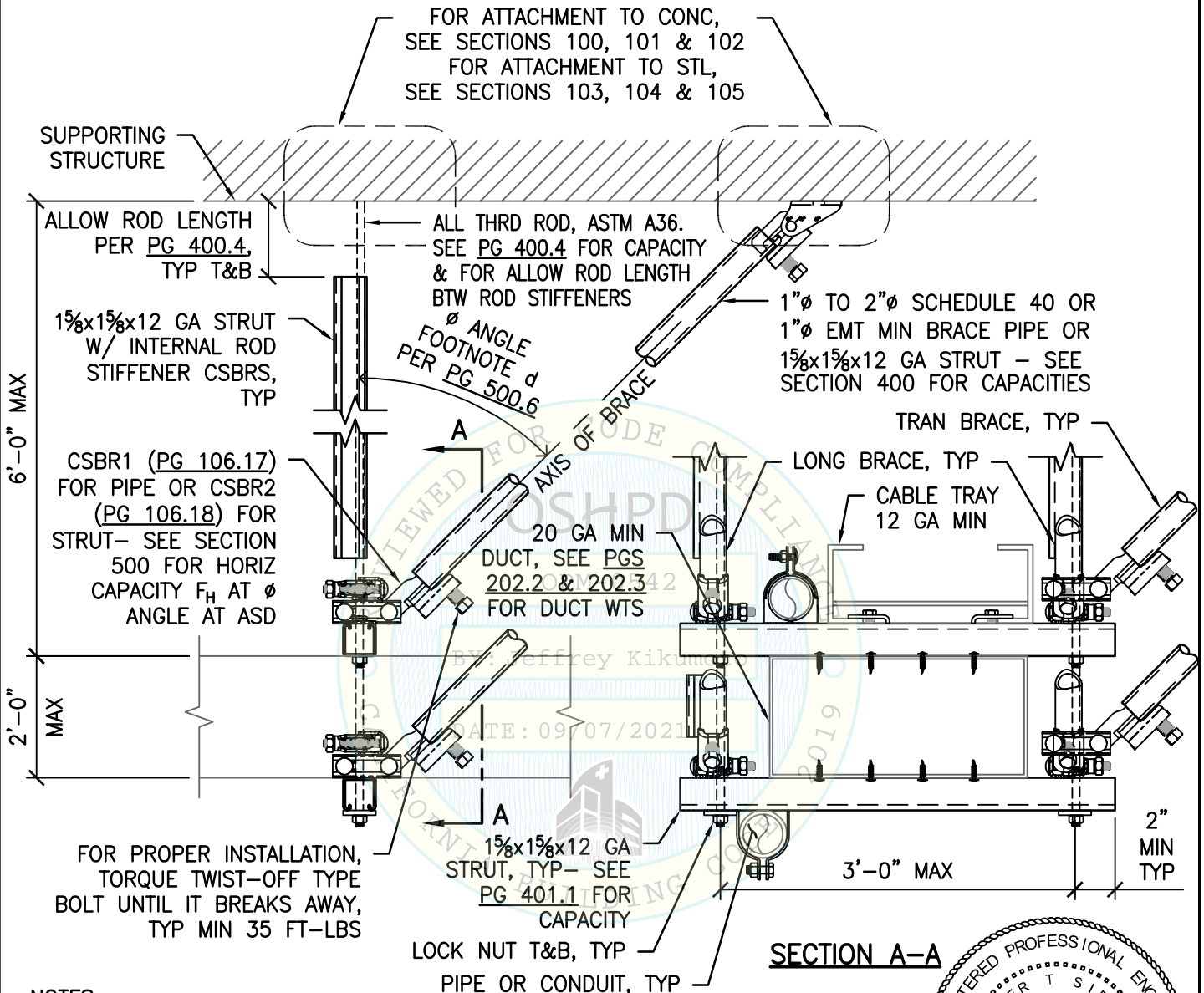
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SEISMIC BRACING FOR MEP SYSTEMS

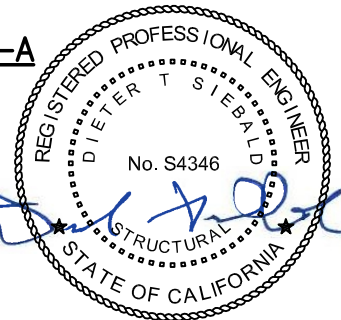


TRANSVERSE (LATERAL) & LONGITUDINAL RIGID BRACING



NOTES:

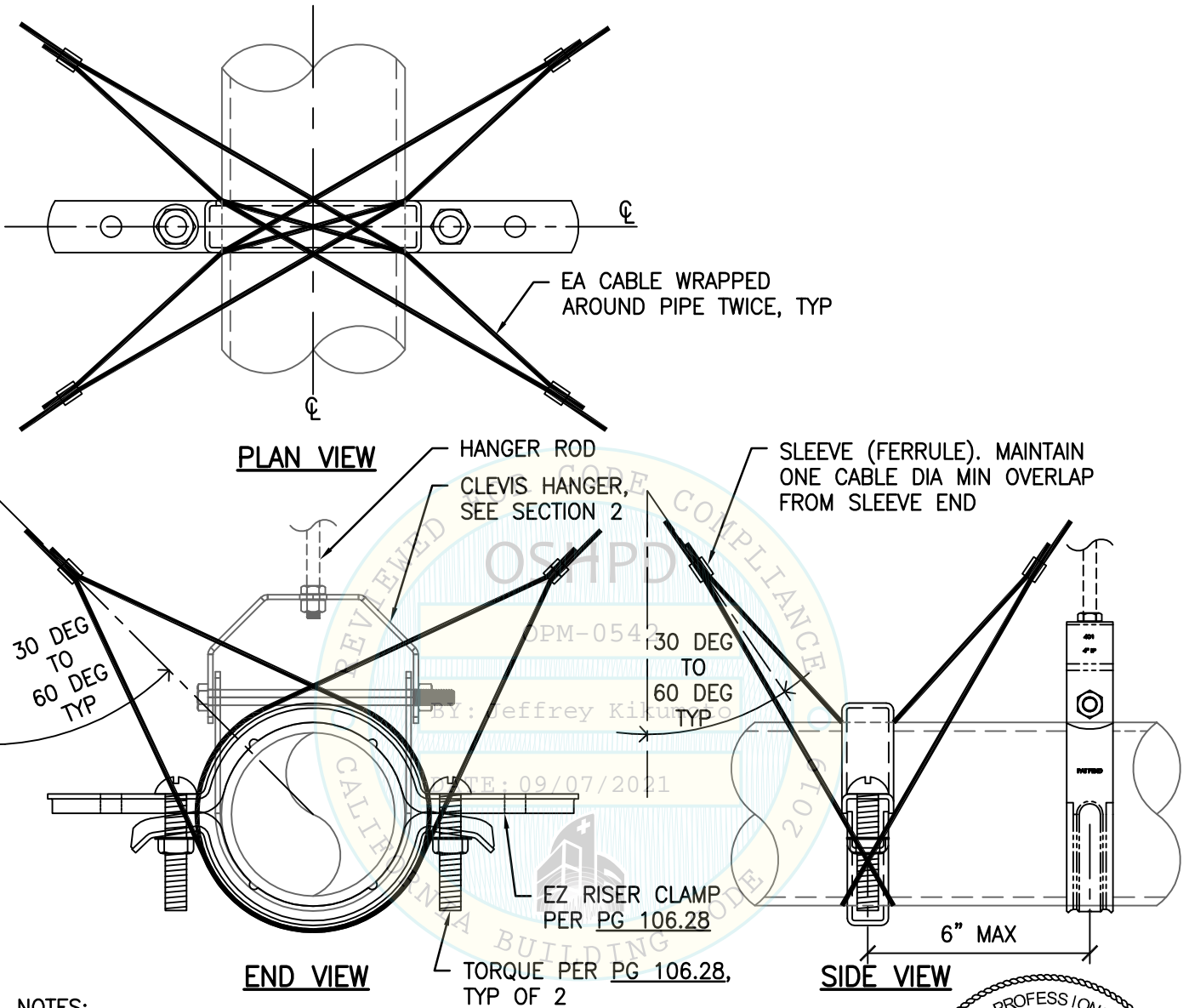
1. FOR COMPONENT ATTACHMENTS TO STRUT, SEE PGS 11.1, 13.1 & 14.1.
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SHEET TITLE: MULTIPLE PIPE OR CONDUIT OR SINGLE RECTANGULAR DUCT OR SINGLE CABLE TRAY SUPPORTED BY SINGLE HORIZONTAL TRAPEZE STRUTS

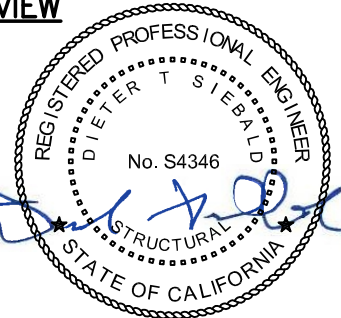
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| | | | Page: | 16.3 of |

SEISMIC BRACING FOR MEP SYSTEMS



NOTES:

1. FOR CABLE & SLEEVE CAPACITY, SEE PG 400.5
2. THE SLEEVE HAS TO BE SWAGED BY USING A SWAGING TOOL SUPPLIED BY CADDY. REFER TO PG 400.5 INSTRUCTIONS FOR NUMBER OF SWAGES NEEDED PER CABLE SIZE.
3. FOR ATTACHMENT TO STRUCTURE, SEE PG 17.2.
4. MAX DIA OF SERVICE PIPE NOT TO EXCEED 6".
5. CABLE CONNS SHOWN ON PGS 17.1 TO 17.3 ARE NOT TO BE USED FOR GRAVITY CONNS OF EQUIP, DUCTWORK OR PIPING; TO BE USED FOR SEISMIC RESTRAINT ONLY.



SHEET TITLE: SINGLE HUNG PIPE OR CONDUIT W/ TENSION CABLE BRACING & COMPRESSION CLEVIS HANGER TRANSVERSE (LATERAL) & LONGITUDINAL BRACING

| | | |
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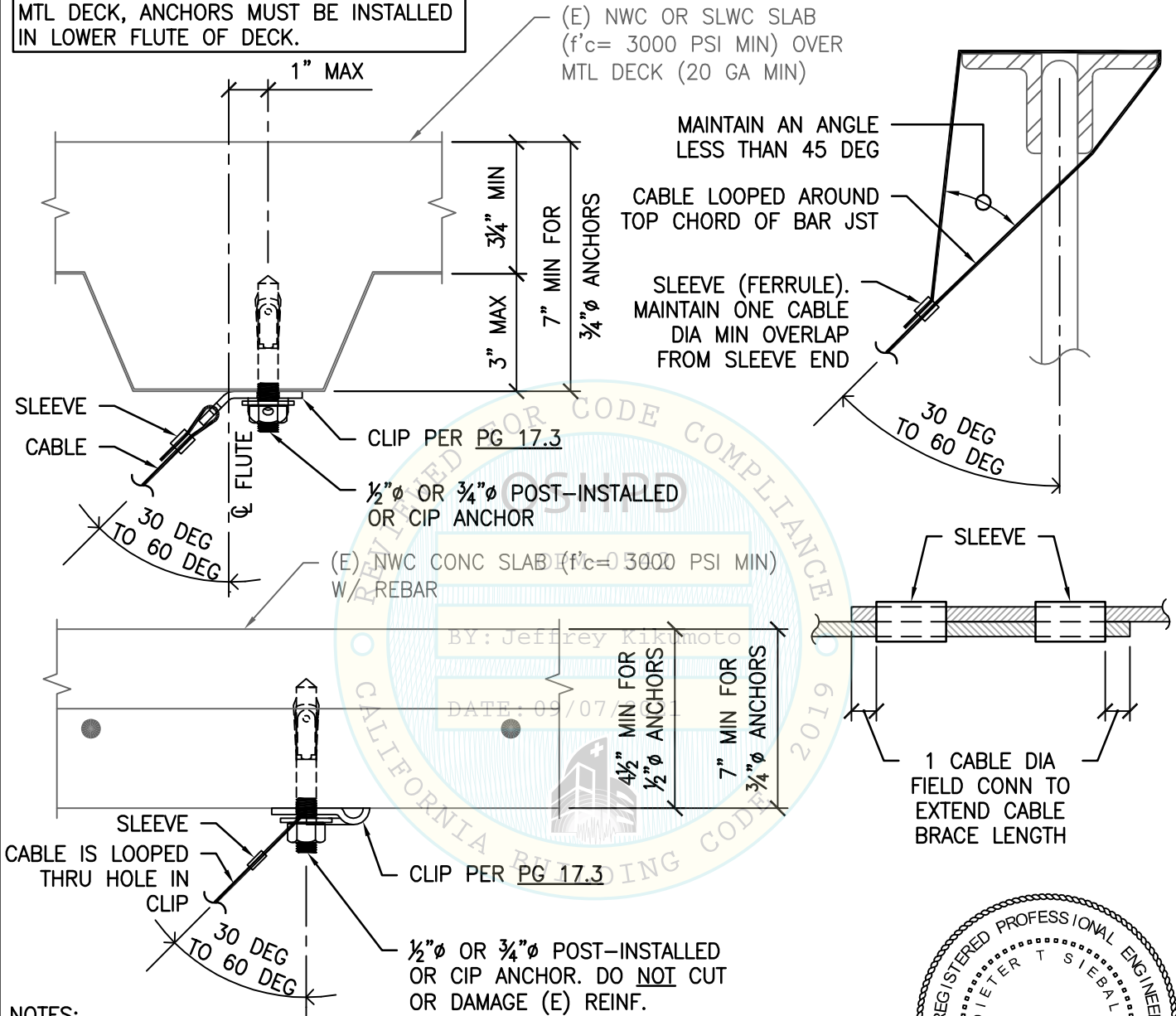
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SEISMIC BRACING FOR MEP SYSTEMS



NOTE:

WHEN ATTACHING TO CONC FILL OVER
MTL DECK, ANCHORS MUST BE INSTALLED
IN LOWER FLUTE OF DECK.



NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.



**SHEET TITLE: SINGLE HUNG PIPE OR CONDUIT W/ TENSION CABLE BRACING & COMPRESSION CLEVIS HANGER
SUPPORT & ATTACHMENT DETAILS TO STRUCTURE**

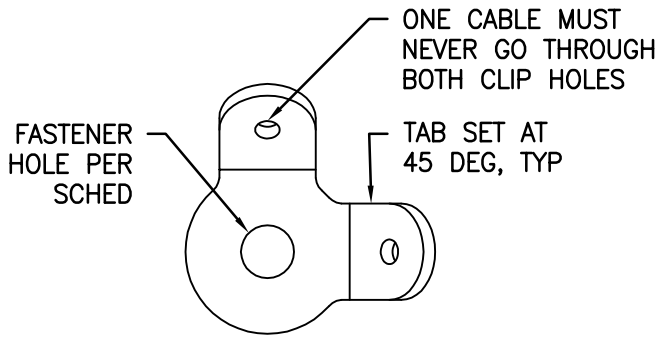
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SEISMIC BRACING FOR MEP SYSTEMS



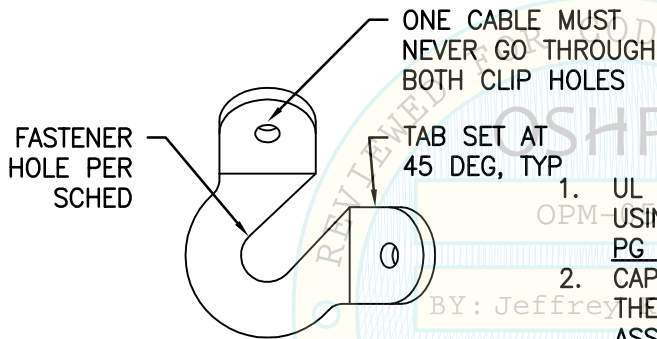
UNIVERSAL RESTRAINT CLIP



| PART NO. | CABLE SIZE | HOLE DIA | UL LOAD RATING ¹ |
|----------|---------------|----------|-----------------------------|
| CSBURC38 | 3/32" - 3/16" | 3/8" | 1900 LBS |
| CSBURC12 | | 1/2" | |
| CSBURC58 | | 5/8" | |

1. UL LOAD RATING OF THE CLIP IS BASED ON TESTING USING MAX CABLE SIZE. CABLE CAPACITY IS ON PG 400.5.
2. CAPACITY OF CLIP ALWAYS EXCEEDS THE CAPACITY OF THE CABLE. HOWEVER, FOR THE CABLE & CLIP ASSEMBLY ALWAYS USE THE LOWER VALUE OF THE CLIP OR CABLE.
3. CABLE BRGC CAN BE INSTALLED AT ANY BRACE ANGLE.

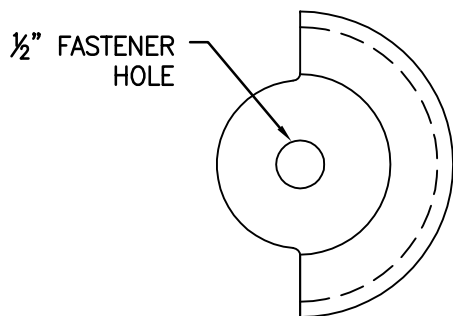
UNIVERSAL RESTRAINT CLIP RETROFIT



| PART NO. | CABLE SIZE | HOLE DIA | UL LOAD RATING ¹ |
|-----------|---------------|----------|-----------------------------|
| CSBURCR38 | 3/32" - 3/16" | 3/8" | 1900 LBS |
| CSBURCR12 | | 1/2" | |
| CSBURCR58 | | 5/8" | |

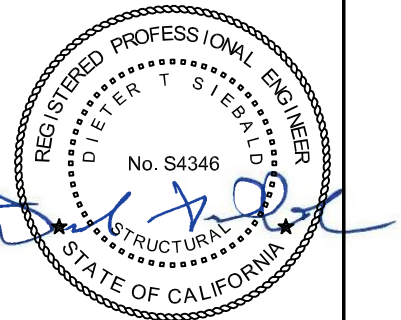
1. UL LOAD RATING OF THE CLIP IS BASED ON TESTING USING MAX CABLE SIZE. CABLE CAPACITY IS ON PG 400.5.
2. CAPACITY OF CLIP ALWAYS EXCEEDS THE CAPACITY OF THE CABLE. HOWEVER, FOR THE CABLE & CLIP ASSEMBLY ALWAYS USE THE LOWER VALUE OF THE CLIP OR CABLE.
3. CABLE BRGC CAN BE INSTALLED AT ANY BRACE ANGLE.

NO PRY CLIP



| PART NO. | CABLE SIZE | HOLE DIA | UL LOAD RATING ¹ |
|----------|---------------|----------|-----------------------------|
| CSBNPC12 | 3/32" - 3/16" | 1/2" | 1900 LBS |

1. UL LOAD RATING OF THE CLIP IS BASED ON TESTING USING MAX CABLE SIZE. CABLE CAPACITY IS ON PG 400.5.
2. CAPACITY OF CLIP ALWAYS EXCEEDS THE CAPACITY OF THE CABLE. HOWEVER, FOR THE CABLE & CLIP ASSEMBLY ALWAYS USE THE LOWER VALUE OF THE CLIP OR CABLE.
3. CABLE BRGC CAN BE INSTALLED AT ANY BRACE ANGLE.



SHEET TITLE: SINGLE HUNG PIPE OR CONDUIT W/ TENSION CABLE BRACING & COMPRESSION CLEVIS HANGER
SEISMIC BRACE SUPPORT DETAILS



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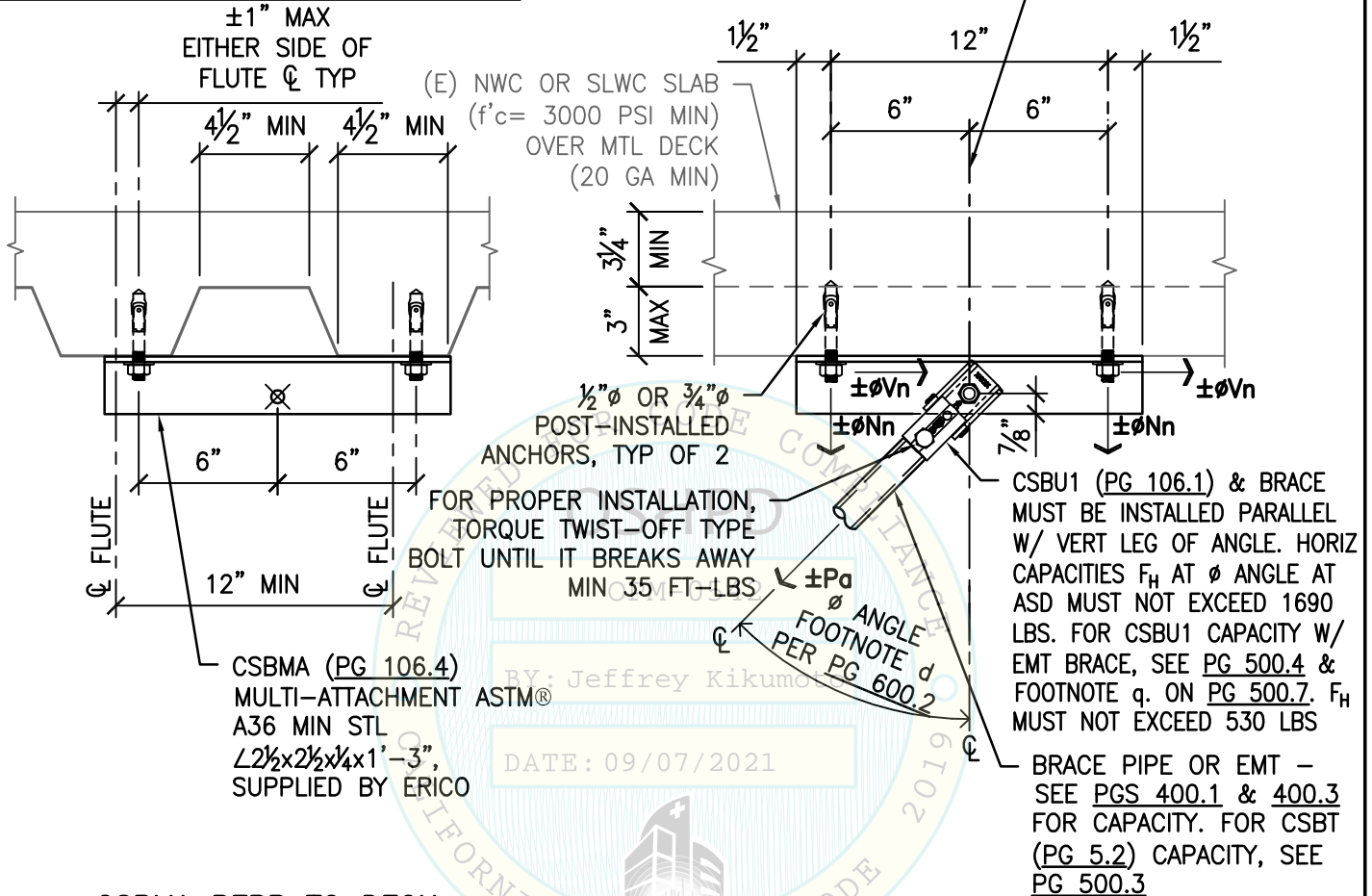
Job No: 19039
Date: 09/08/2021
Page: 17.3 of .

SEISMIC BRACING FOR MEP SYSTEMS



NOTE:
WHEN ATTACHING TO CONC FILL OVER
MTL DECK, ANCHORS MUST BE INSTALLED
IN LOWER FLUTE OF DECK.

$\frac{1}{2}$ " ϕ ASTM[®] A307 MIN BOLT W/
STANDARD NUT AND LOCK WASHER,
SUPPLIED BY CONTRACTOR

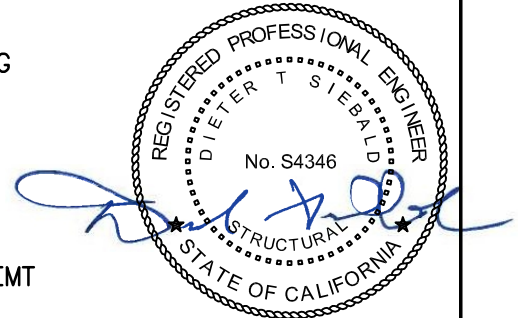


CSBMA PERP TO DECK

CSBMA PARALLEL TO DECK

NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. SEE PG 106.4 FOR ALLOWABLE CAPACITY OF THE CSBMA ANGLE.
5. WHEN USING EMT BRACE, MUST HAVE ATTACHMENT QUALIFIED TO USE EMT AT BOTH ENDS OF EMT BRACE



SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF METAL DECK W/ CONCRETE FILL
CSBMA POST INSTALLED ANCHORS W/ BRACE PIPE PARALLEL



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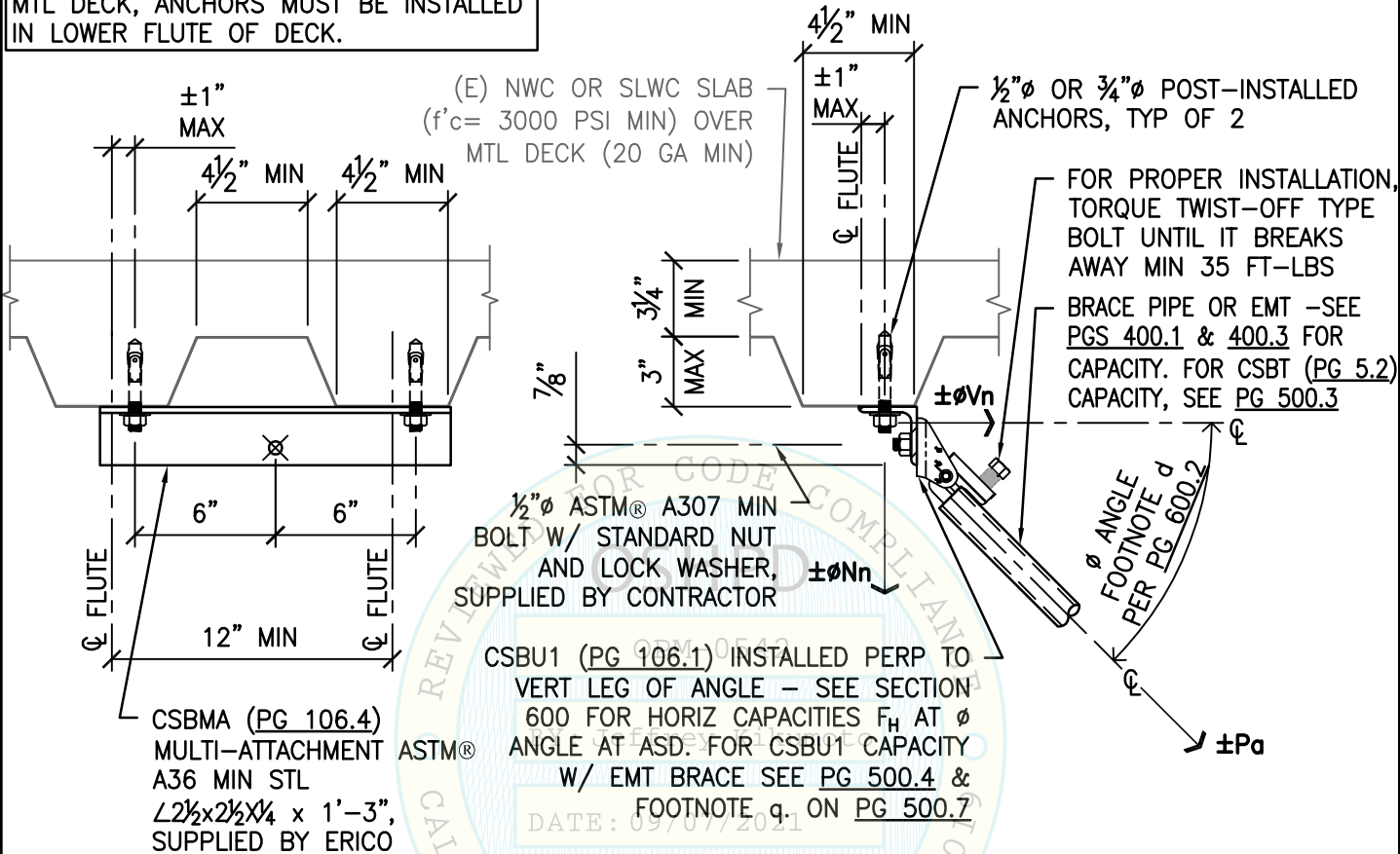
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| Page: | 100.1 of |

SEISMIC BRACING FOR MEP SYSTEMS



NOTE:
WHEN ATTACHING TO CONC FILL OVER
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IN LOWER FLUTE OF DECK.

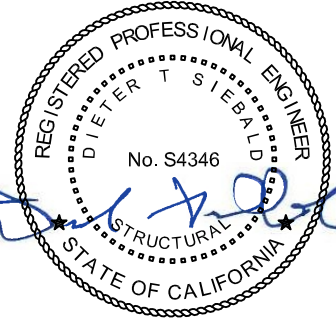


CSBMA PERP TO DECK

CSBMA PARALLEL TO DECK

NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
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5. WHEN USING EMT BRACE, MUST HAVE ATTACHMENT QUALIFIED TO USE EMT AT BOTH ENDS OF EMT BRACE.



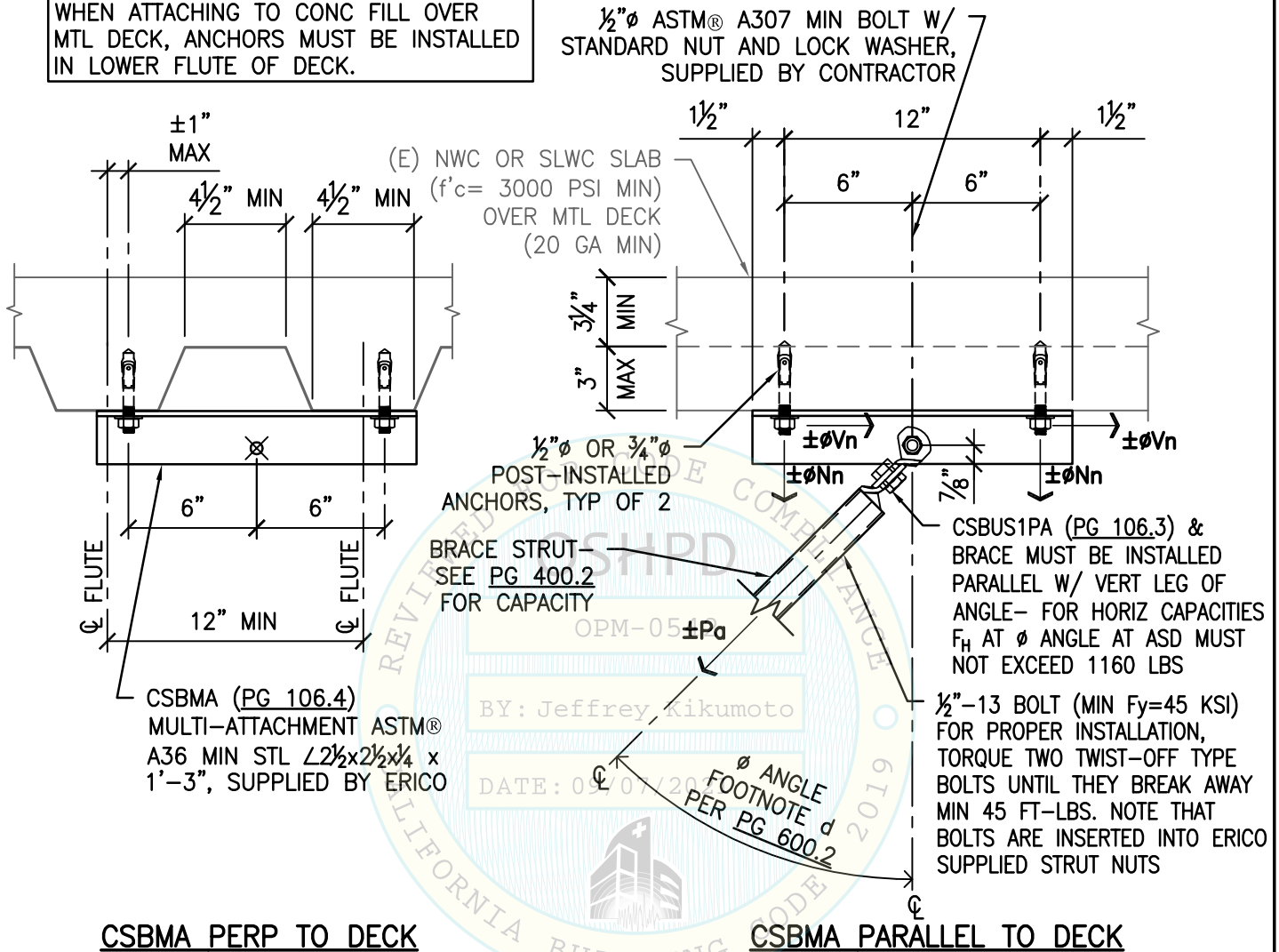
SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF METAL DECK W/ CONCRETE FILL
CSBMA POST INSTALLED ANCHORS W/ BRACE PIPE PERPENDICULAR

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SEISMIC BRACING FOR MEP SYSTEMS

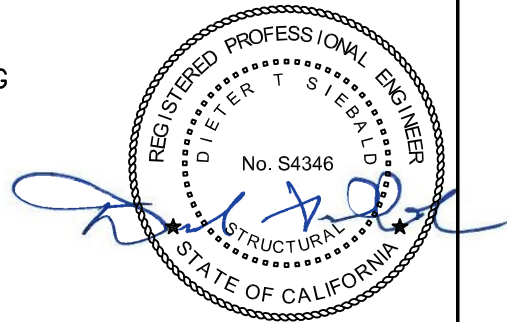


NOTE:
WHEN ATTACHING TO CONC FILL OVER
MTL DECK, ANCHORS MUST BE INSTALLED
IN LOWER FLUTE OF DECK.



NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. SEE PG 106.4 FOR ALLOWABLE CAPACITY OF THE CSBMA ANGLE.



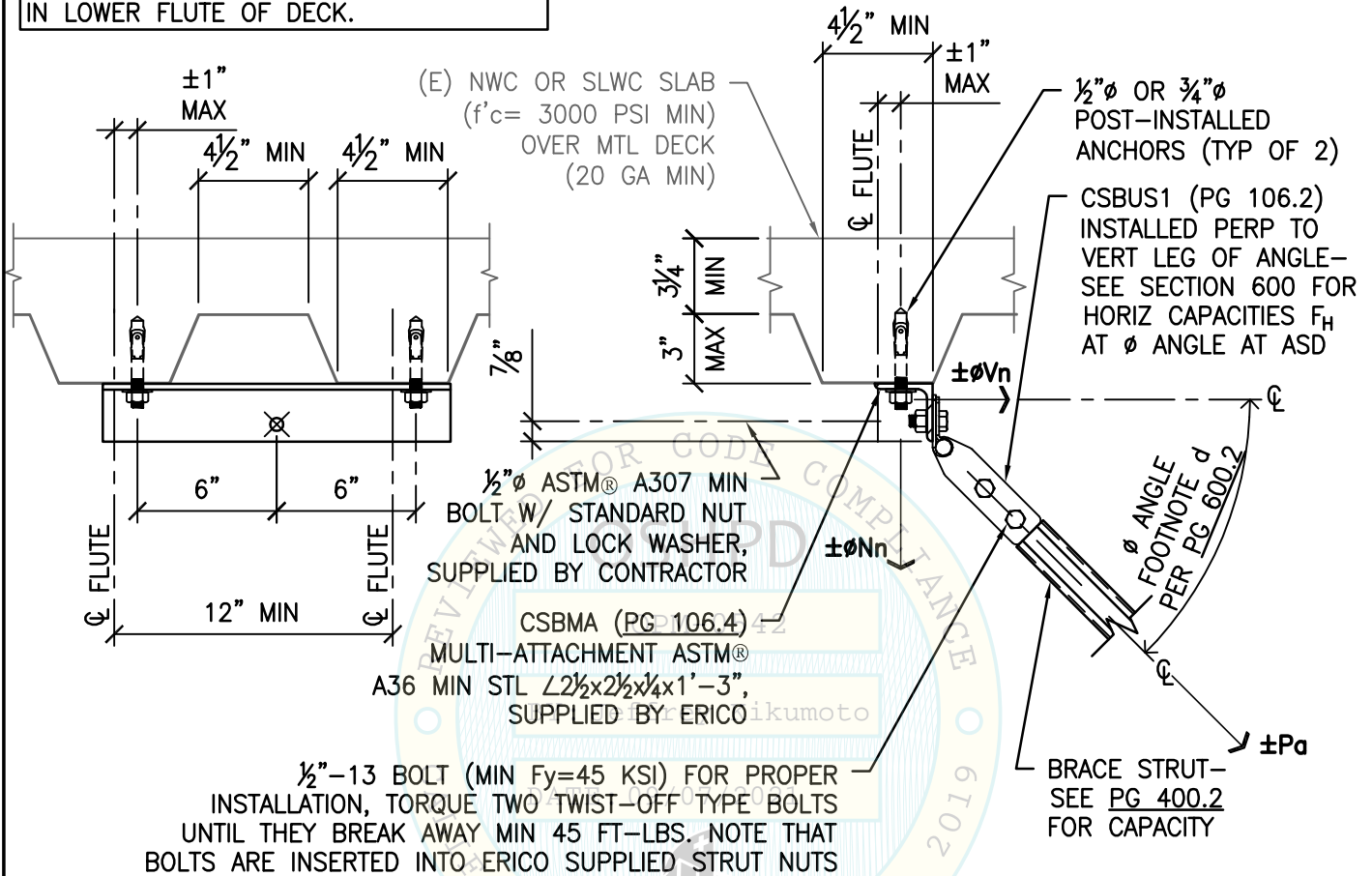
SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF METAL DECK W/ CONCRETE FILL
CSBMA POST INSTALLED ANCHORS W/ BRACE STRUT PARALLEL

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SEISMIC BRACING FOR MEP SYSTEMS



NOTE:
WHEN ATTACHING TO CONC FILL OVER
MTL DECK, ANCHORS MUST BE INSTALLED
IN LOWER FLUTE OF DECK.

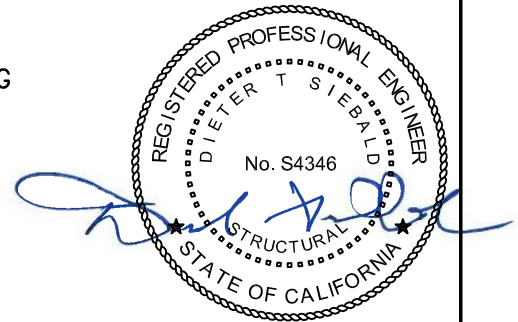


CSBMA PERP TO DECK

CSBMA PARALLEL TO DECK

NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. SEE PG 106.4 FOR ALLOWABLE CAPACITY OF THE CSBMA ANGLE.



**SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF METAL DECK W/ CONCRETE FILL
CSBMA POST INSTALLED ANCHORS W/ BRACE STRUT PERPENDICULAR**



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| Page: | 100.4 of |

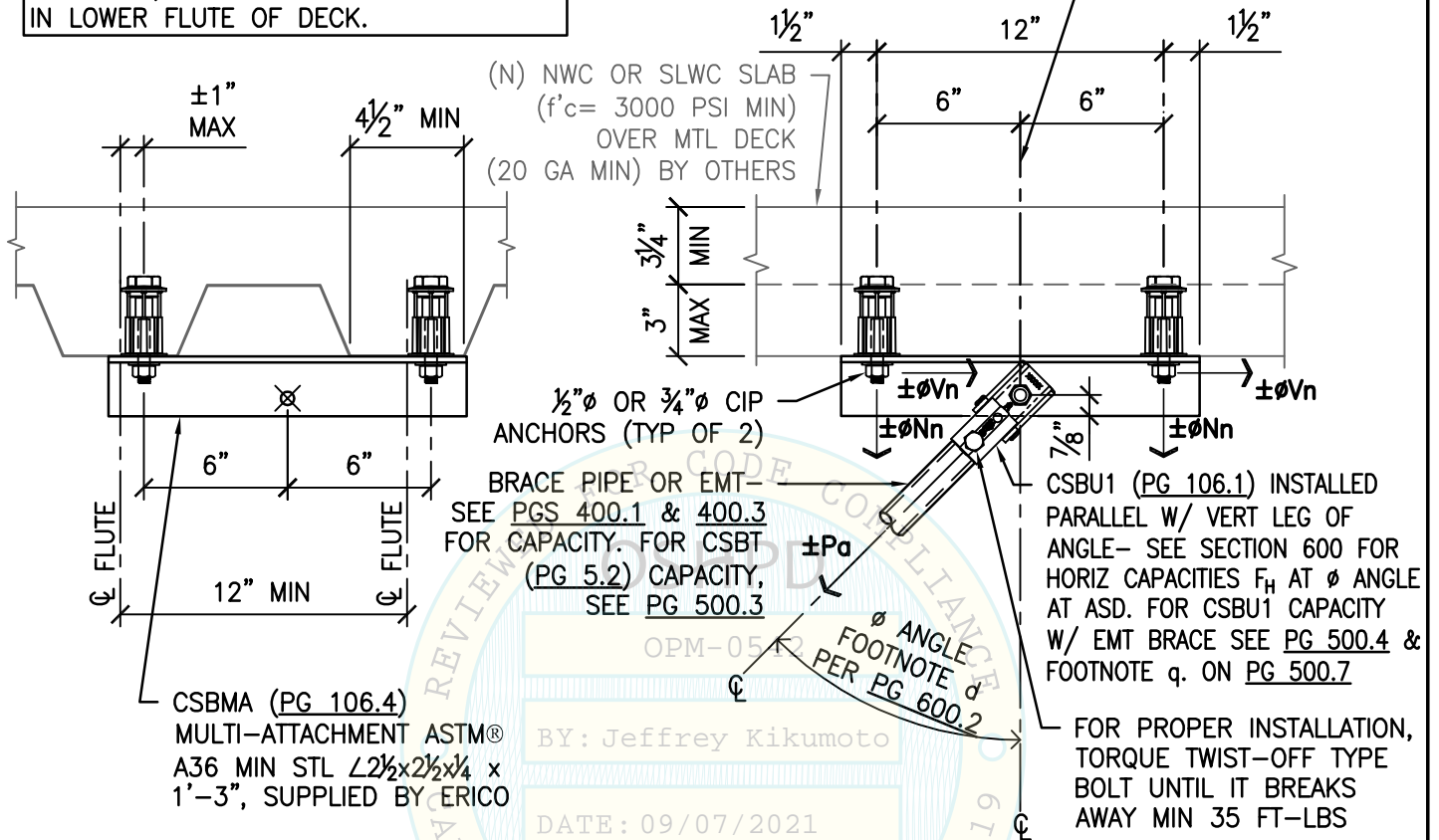
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SEISMIC BRACING FOR MEP SYSTEMS



NOTE:
WHEN ATTACHING TO CONC FILL OVER
MTL DECK, ANCHORS MUST BE INSTALLED
IN LOWER FLUTE OF DECK.

$\frac{1}{2}$ " ϕ ASTM® A307 MIN BOLT W/
STANDARD NUT AND LOCK WASHER,
SUPPLIED BY CONTRACTOR

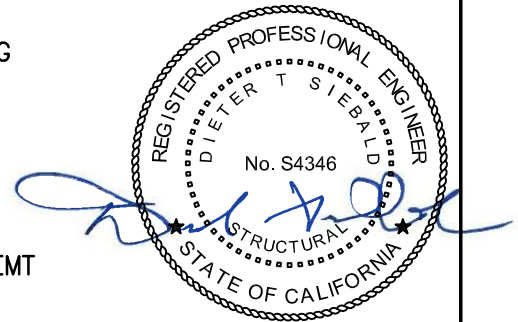


CSBMA PERP TO DECK

CSBMA PARALLEL TO DECK

NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. SEE PG 106.4 FOR ALLOWABLE CAPACITY OF THE CSBMA ANGLE.
5. WHEN USING EMT BRACE, MUST HAVE ATTACHMENT QUALIFIED TO USE EMT AT BOTH ENDS OF EMT BRACE.



SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF METAL DECK W/ CONCRETE FILL
CSBMA CAST IN PLACE ANCHORS W/ BRACE PIPE PARALLEL



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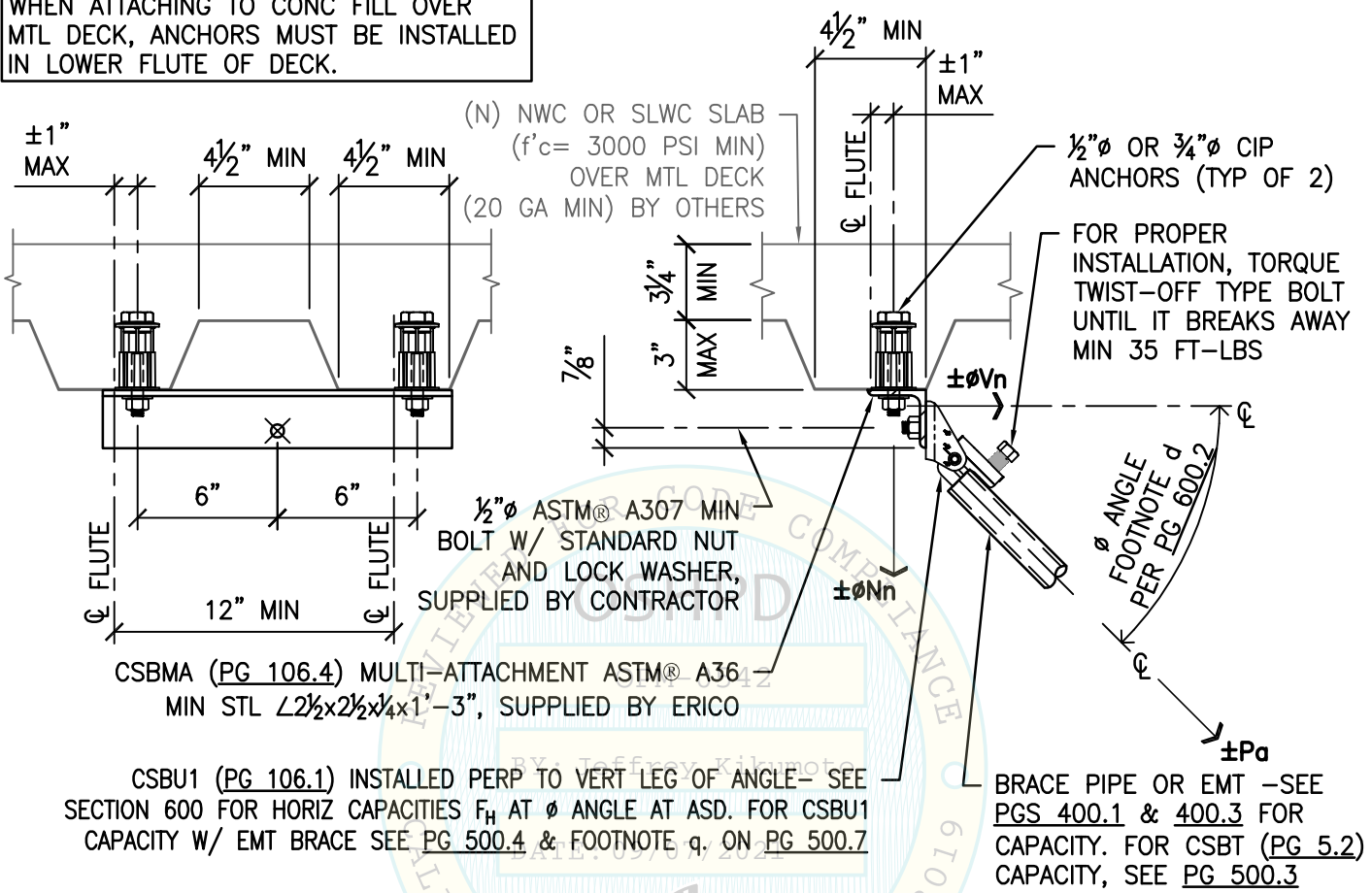
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| Page: | 100.5 of |

SEISMIC BRACING FOR MEP SYSTEMS



NOTE:
WHEN ATTACHING TO CONC FILL OVER
MTL DECK, ANCHORS MUST BE INSTALLED
IN LOWER FLUTE OF DECK.



CSBMA PERP TO DECK

CSBMA PARALLEL TO DECK

NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. SEE PG 106.4 FOR ALLOWABLE CAPACITY OF THE CSBMA ANGLE.
5. WHEN USING EMT BRACE, MUST HAVE ATTACHMENT QUALIFIED TO USE EMT AT BOTH ENDS OF EMT BRACE.



**SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF METAL DECK W/ CONCRETE FILL
CSBMA CAST IN PLACE ANCHORS W/ BRACE PIPE PERPENDICULAR**

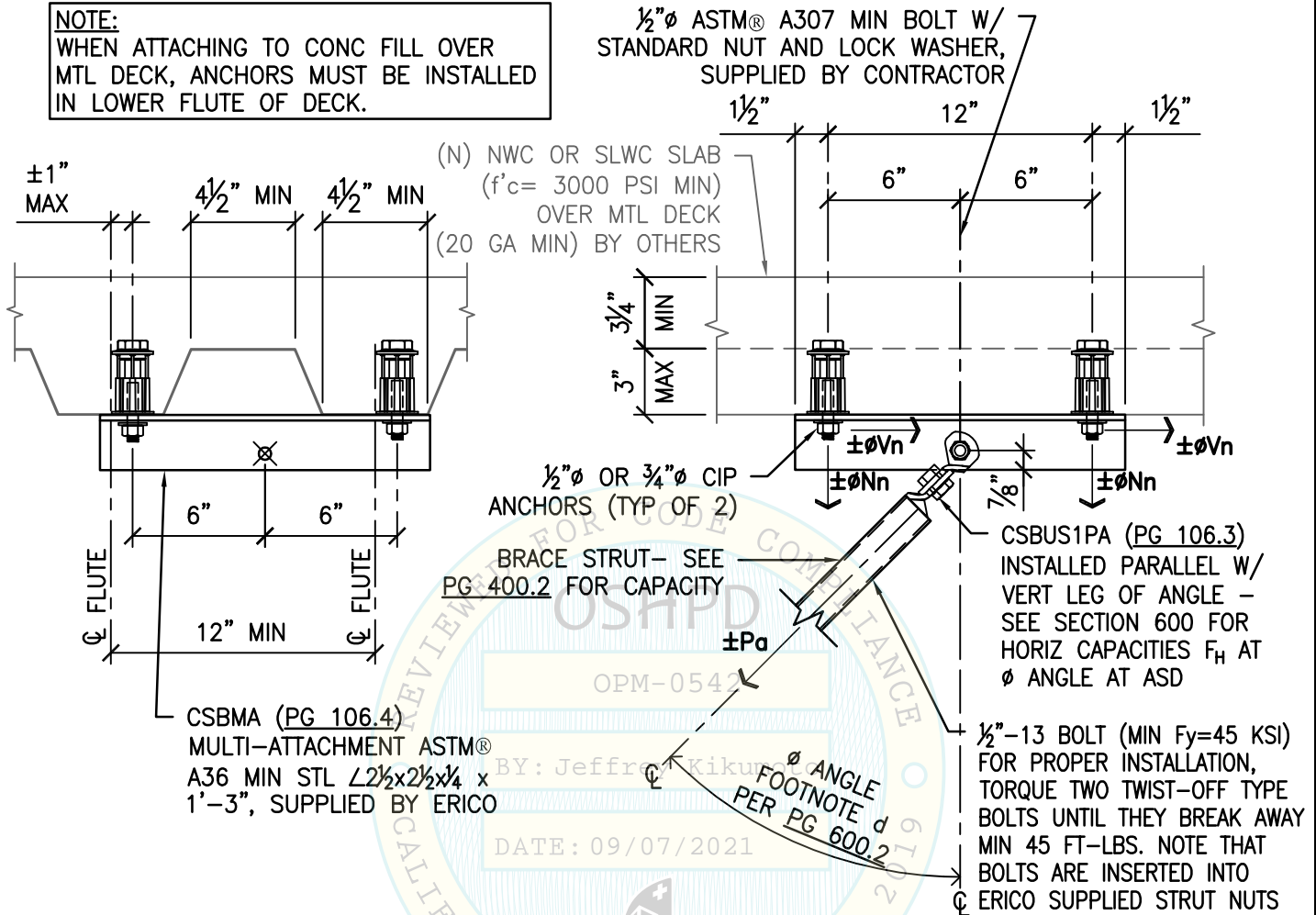
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SEISMIC BRACING FOR MEP SYSTEMS



NOTE:
WHEN ATTACHING TO CONC FILL OVER
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IN LOWER FLUTE OF DECK.

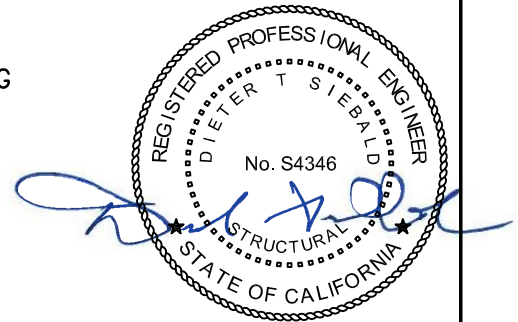


CSBMA PERP TO DECK

CSBMA PARALLEL TO DECK

NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. SEE PG 106.4 FOR ALLOWABLE CAPACITY OF THE CSBMA ANGLE.



**SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF METAL DECK W/ CONCRETE FILL
CSBMA CAST IN PLACE ANCHORS W/ BRACE STRUT PARALLEL**



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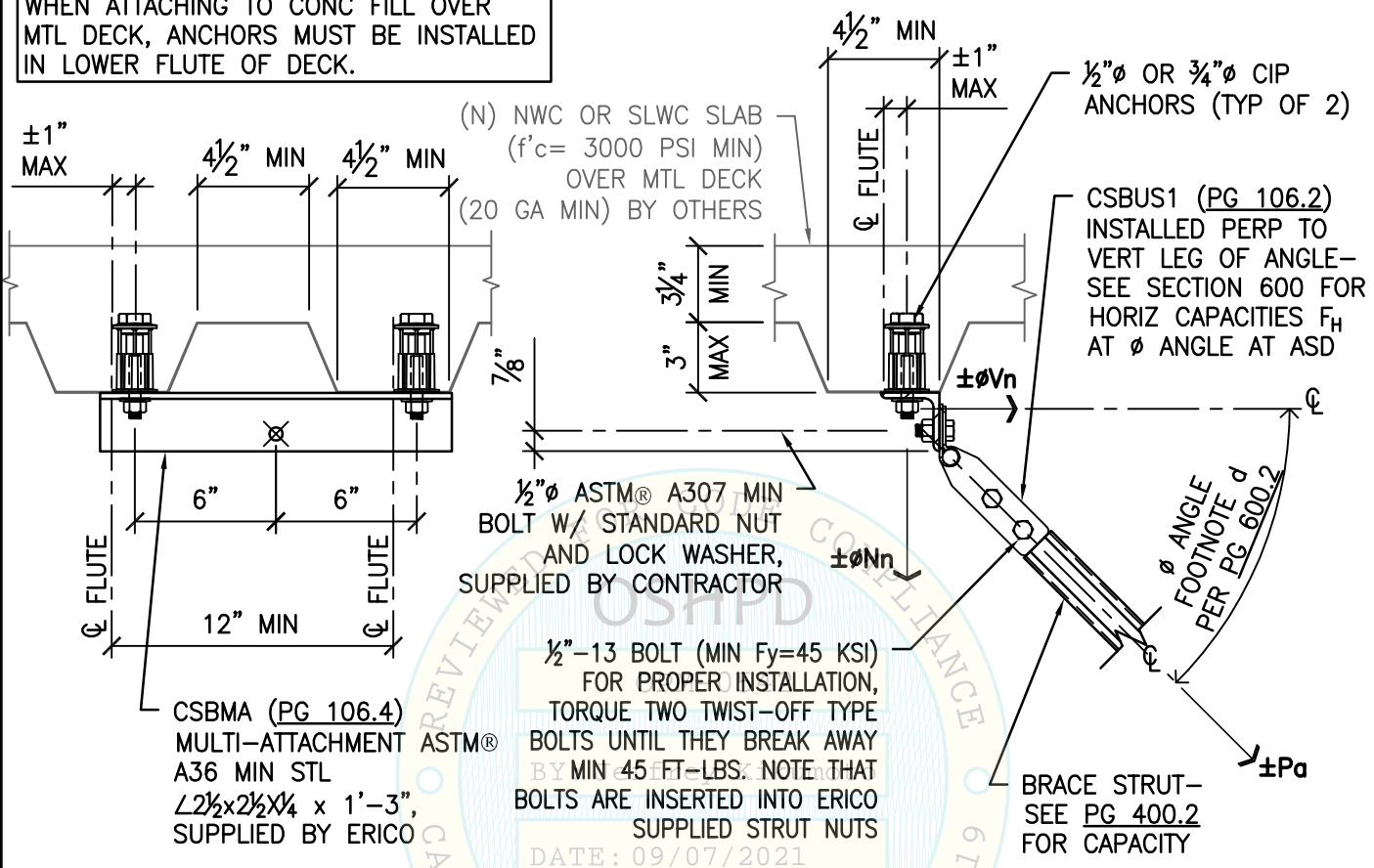
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SEISMIC BRACING FOR MEP SYSTEMS



NOTE:
WHEN ATTACHING TO CONC FILL OVER
MTL DECK, ANCHORS MUST BE INSTALLED
IN LOWER FLUTE OF DECK.



CSBMA PERP TO DECK

CSBMA PARALLEL TO DECK

NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. SEE PG 106.4 FOR ALLOWABLE CAPACITY OF THE CSBMA ANGLE.



SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF METAL DECK W/ CONCRETE FILL
CSBMA CAST IN PLACE ANCHORS W/ BRACE STRUT PERPENDICULAR

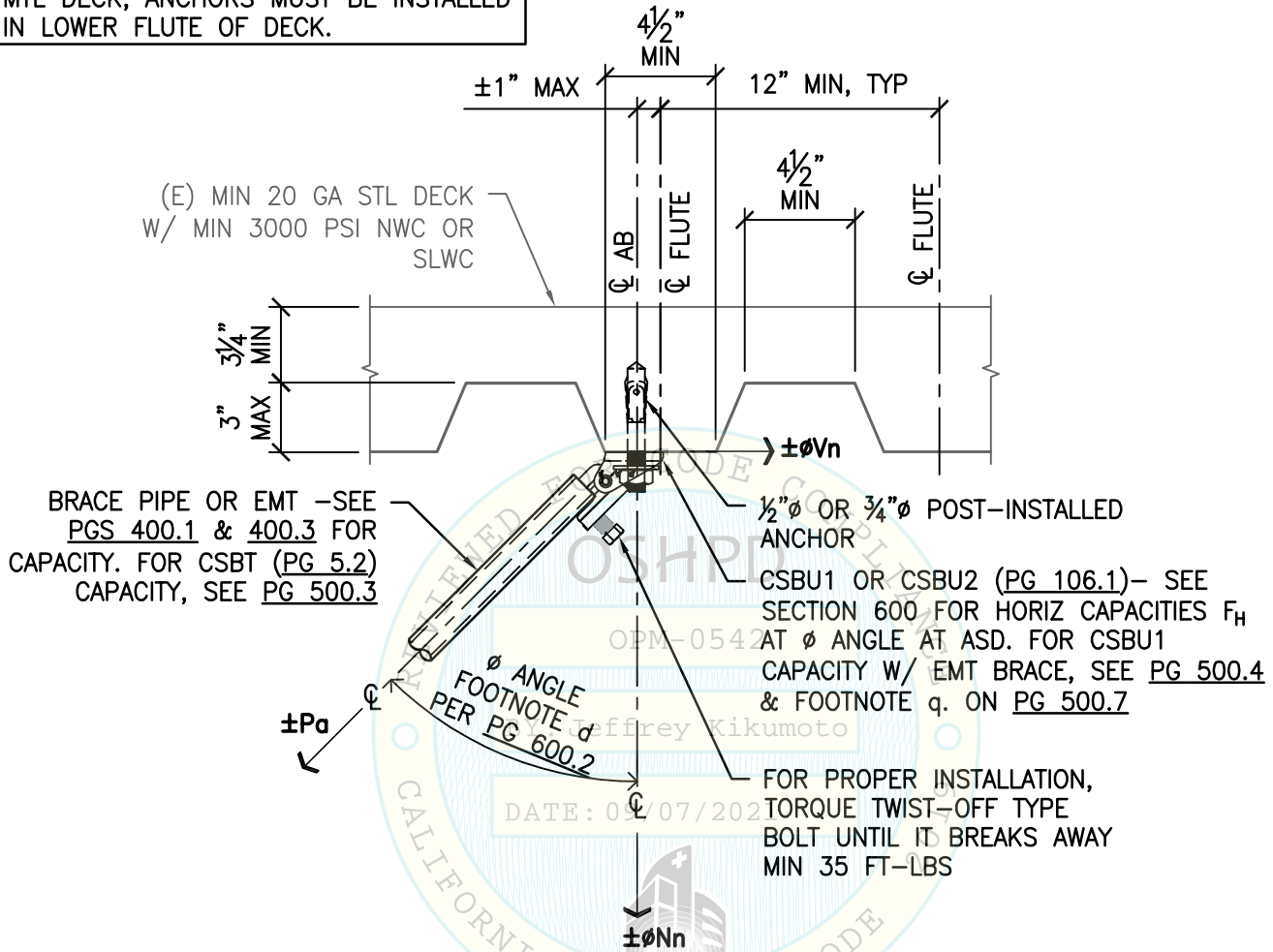
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SEISMIC BRACING FOR MEP SYSTEMS

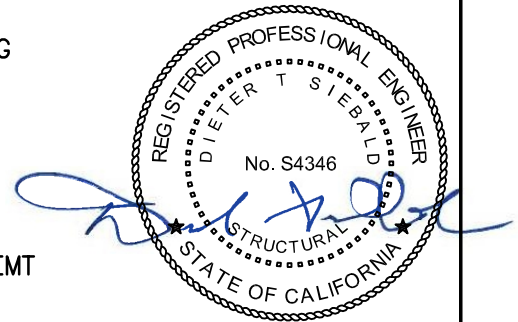


NOTE:
WHEN ATTACHING TO CONC FILL OVER
MTL DECK, ANCHORS MUST BE INSTALLED
IN LOWER FLUTE OF DECK.



NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. EMT MUST NOT BE USED W/ CSBU2.
5. WHEN USING EMT BRACE, MUST HAVE ATTACHMENT QUALIFIED TO USE EMT AT BOTH ENDS OF EMT BRACE.



SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF METAL DECK W/ CONCRETE FILL
CSBU POST INSTALLED ANCHOR W/ BRACE PIPE



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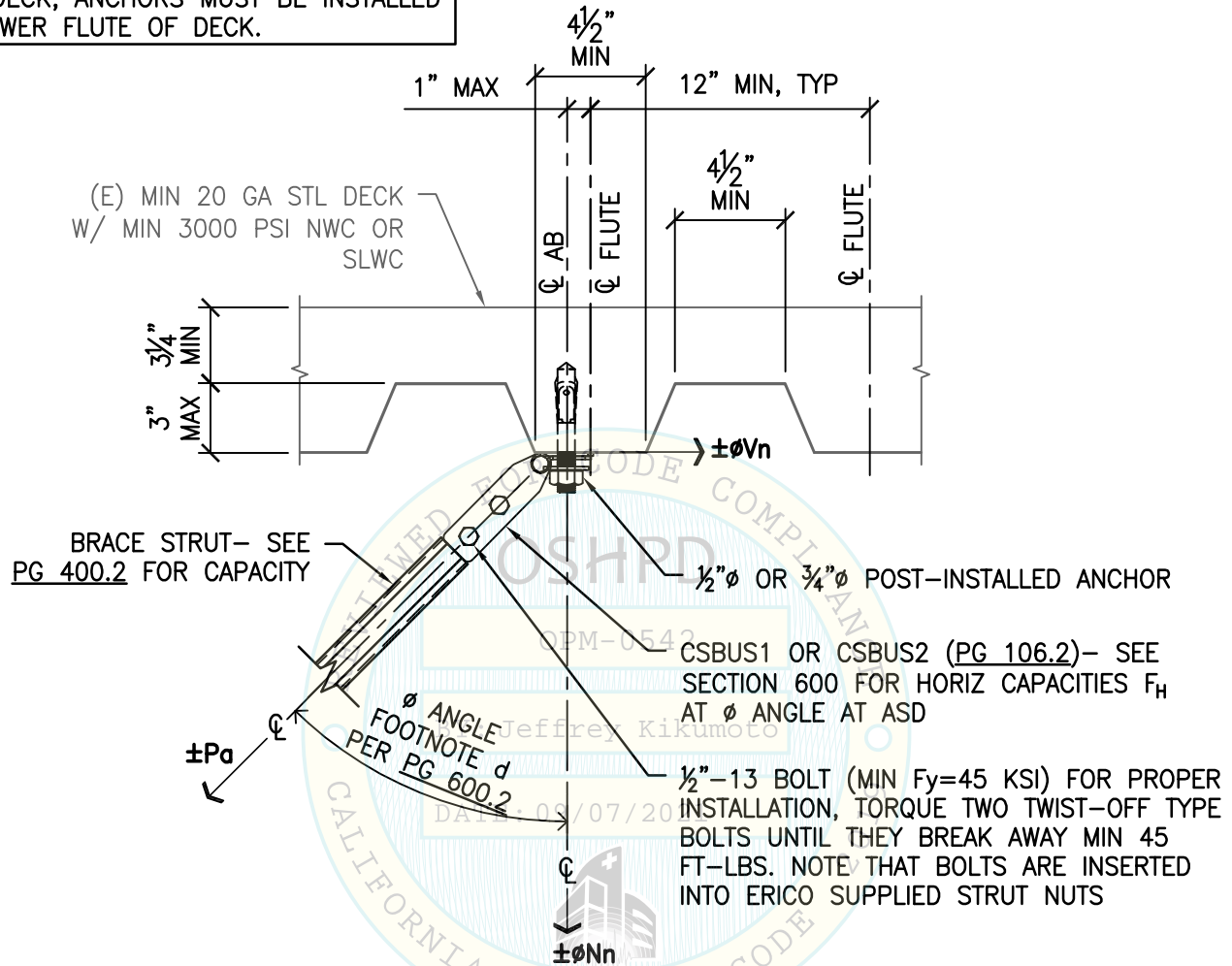
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| Page: | 100.9 of . |

SEISMIC BRACING FOR MEP SYSTEMS



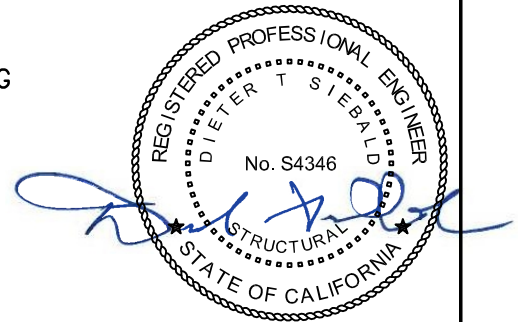
NOTE:

WHEN ATTACHING TO CONC FILL OVER
MTL DECK, ANCHORS MUST BE INSTALLED
IN LOWER FLUTE OF DECK.



NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.



SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF METAL DECK W/ CONCRETE FILL
CSBUS POST INSTALLED ANCHOR W/ BRACE STRUT



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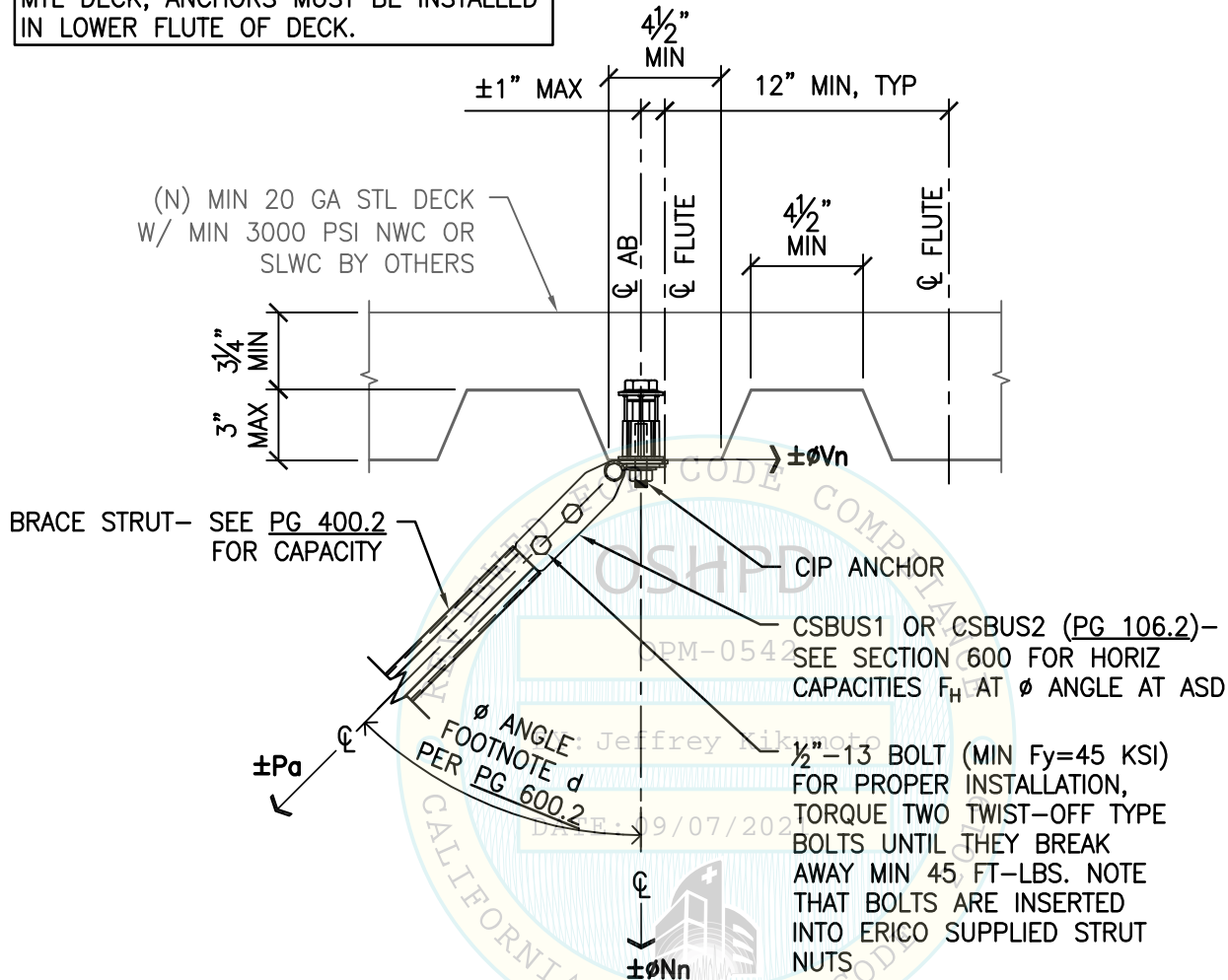
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| Page: | 100.10 of . |

SEISMIC BRACING FOR MEP SYSTEMS



NOTE:
WHEN ATTACHING TO CONC FILL OVER
MTL DECK, ANCHORS MUST BE INSTALLED
IN LOWER FLUTE OF DECK.



NOTES:

1. SPECIALTY INSERTS INSTALLED IN NWC MUST BE HEADED CAST-IN SPECIALTY INSERTS IN CRACKED CONC AS NOTED PER APPENDIX 'A', CASE 4 ON PG A5.
2. INSTALLATION MUST BE IN ACCORDANCE W/ THE REQUIREMENTS OF THE ICC-ES EVALUATION REPORT FOR THE SPECIFIED ANCHOR.
3. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
4. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
5. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.



**SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF METAL DECK W/ CONCRETE FILL
CSBUS CAST IN PLACE ANCHOR W/ BRACE STRUT**



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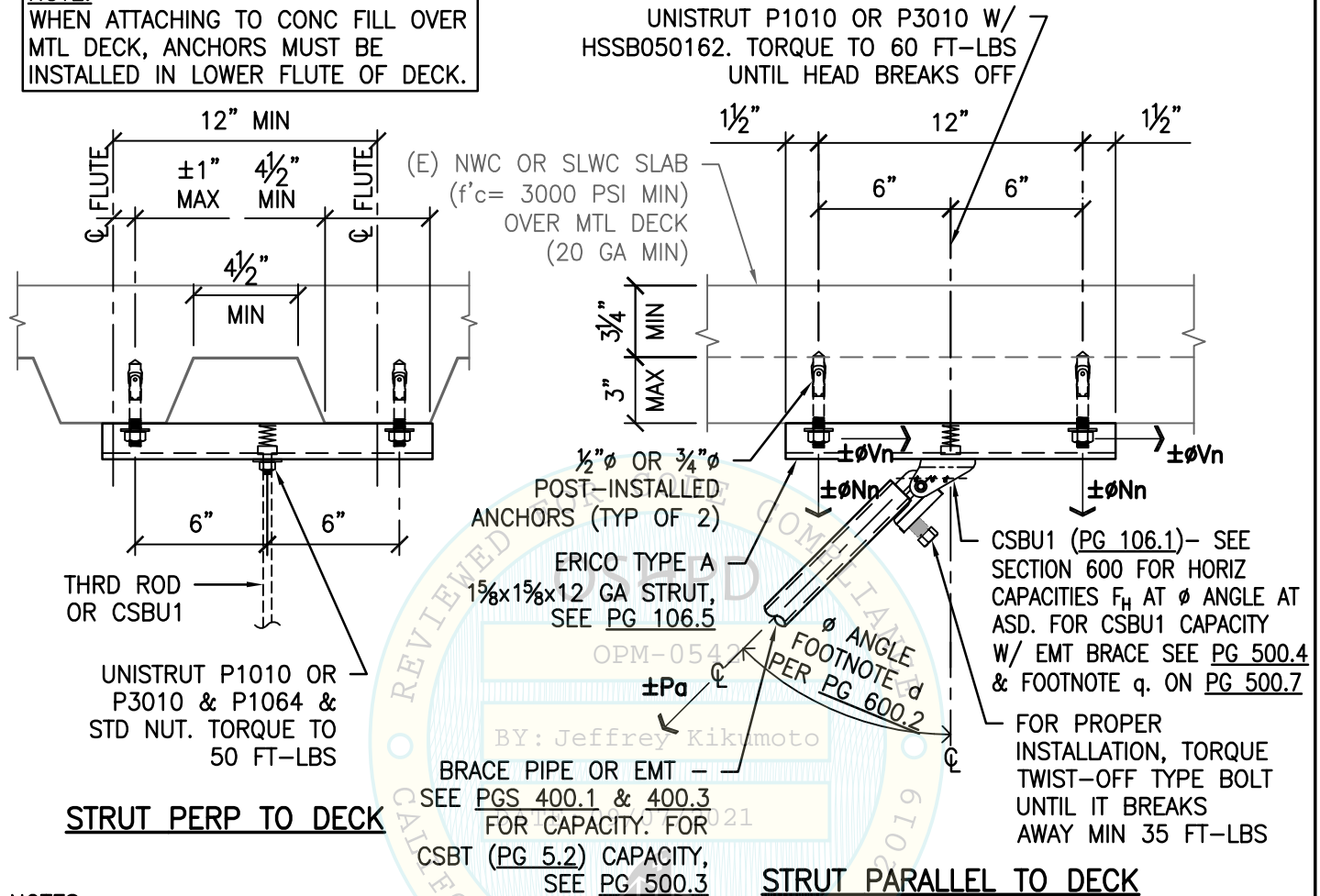
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| Page: | 100.12 of |

SEISMIC BRACING FOR MEP SYSTEMS

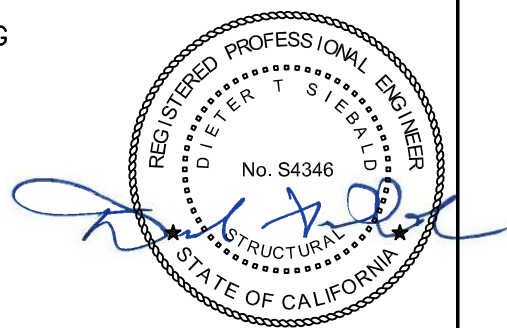


NOTE:
WHEN ATTACHING TO CONC FILL OVER
MTL DECK, ANCHORS MUST BE
INSTALLED IN LOWER FLUTE OF DECK.



NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR STRUT. PLEASE NOTE THAT CAPACITY PROVIDED IS FOR THE WORST-CASE ANCHOR CONDITION & HIGHER VALUES MAY BE OBTAINED VIA THE SEOR.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. THE ALLOWABLE ASD SLIP LOAD & TENSION LOAD FOR THE UNISTRUT P1010 OR P3010 IS 1370 LBS & 2810 LBS RESPECTIVELY. THE ALLOWABLE LOAD PERP TO THE STRUT IS 1035 LBS.



**SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF METAL DECK W/ CONCRETE FILL
STRUT POST INSTALLED ANCHORS W/ BRACE PIPE PARALLEL & VERTICAL ROD**

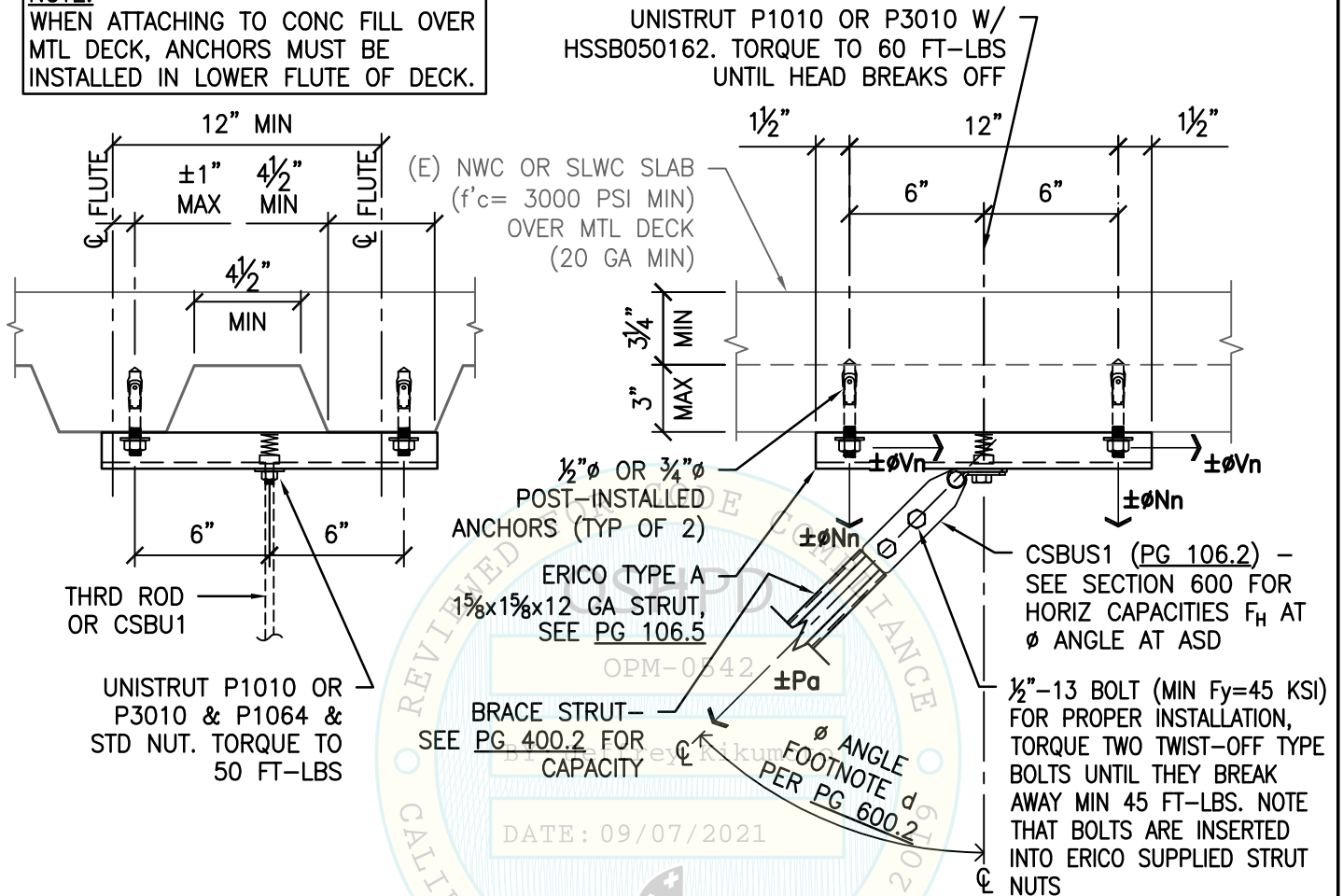
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| | 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833 | Date: 09/08/2021 |
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SEISMIC BRACING FOR MEP SYSTEMS



NOTE:
WHEN ATTACHING TO CONC FILL OVER MTL DECK, ANCHORS MUST BE INSTALLED IN LOWER FLUTE OF DECK.



STRUT PERP TO DECK

STRUT PARALLEL TO DECK

NOTES:

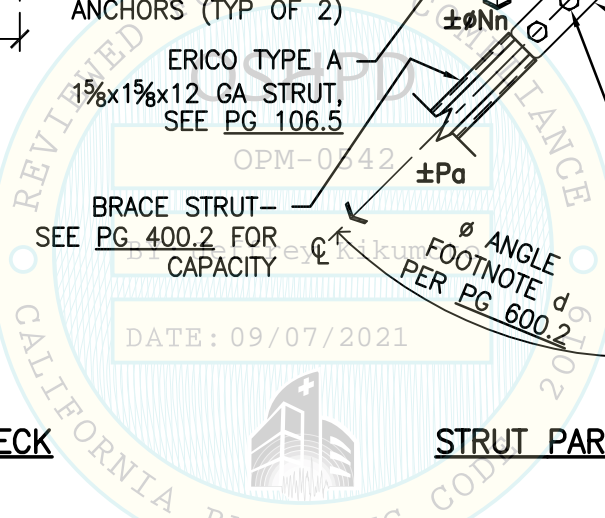
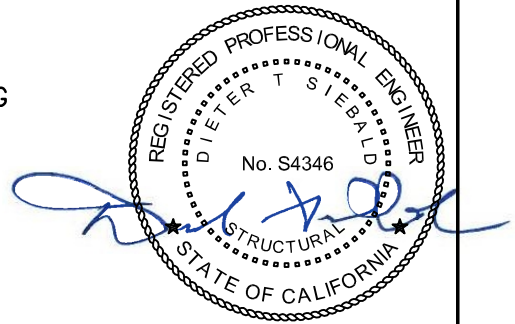
1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR STRUT. PLEASE NOTE THAT CAPACITY PROVIDED IS FOR THE WORST-CASE ANCHOR CONDITION & HIGHER VALUES MAY BE OBTAINED VIA THE SEOR.
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SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF METAL DECK W/ CONCRETE FILL
STRUT POST INSTALLED ANCHORS W/ BRACE STRUT PARALLEL & VERTICAL ROD

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| Page: | 100.14 of |



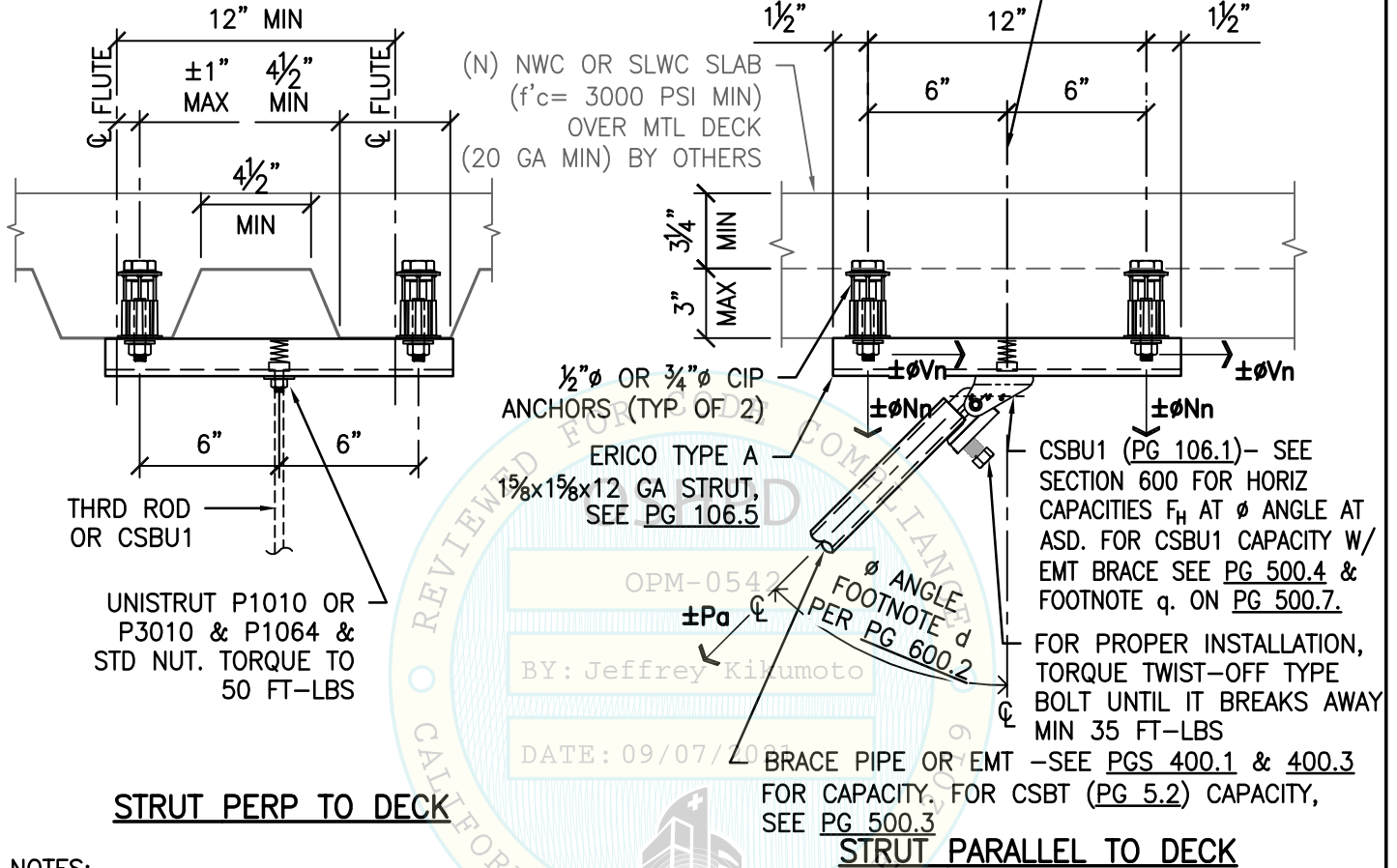
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SEISMIC BRACING FOR MEP SYSTEMS



NOTE:
WHEN ATTACHING TO CONC FILL OVER
MTL DECK, ANCHORS MUST BE
INSTALLED IN LOWER FLUTE OF DECK.

UNISTRUT P1010 OR P3010 W/
HSSB050162. TORQUE TO 60 FT-LBS
UNTIL HEAD BREAKS OFF



STRUT PERP TO DECK

STRUT PARALLEL TO DECK

NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR STRUT. PLEASE NOTE THAT CAPACITY PROVIDED IS FOR THE WORST-CASE ANCHOR CONDITION & HIGHER VALUES MAY BE OBTAINED VIA THE SEOR.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. THE ALLOWABLE ASD SLIP LOAD & TENSION LOAD FOR THE UNISTRUT P1010 OR P3010 IS 1370 LBS & 2810 LBS RESPECTIVELY. THE ALLOWABLE LOAD PERP TO THE STRUT IS 1035 LBS.



**SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF METAL DECK W/ CONCRETE FILL
STRUT CAST IN PLACE ANCHORS W/ BRACE PIPE PARALLEL & VERTICAL ROD**

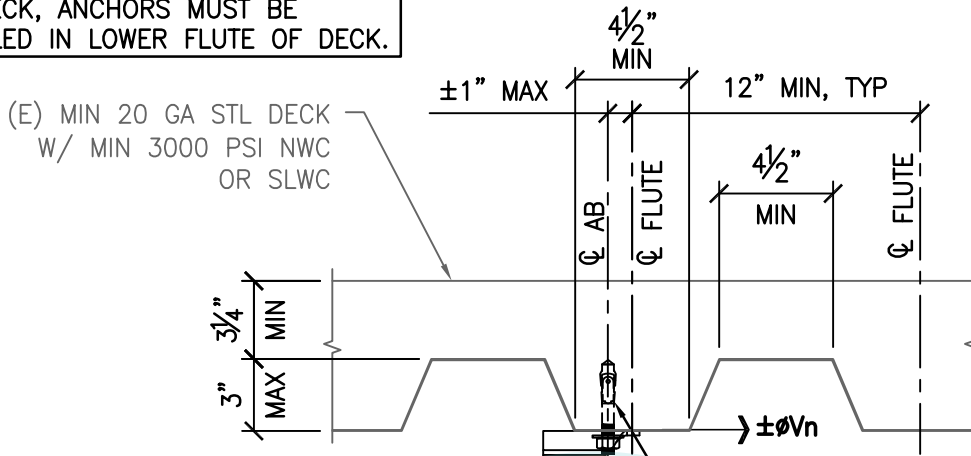
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| | | | Page: 100.15 of | |

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SEISMIC BRACING FOR MEP SYSTEMS



NOTE:
WHEN ATTACHING TO CONC FILL OVER
MTL DECK, ANCHORS MUST BE
INSTALLED IN LOWER FLUTE OF DECK.



$\frac{3}{8}$ " ϕ OR $\frac{1}{2}$ " ϕ ALL THRD RESTRAINT
ROD THRD DEPTH IS 0.3" FOR EA
ROD SIZE—SEE PG 400.4 FOR
CAPACITY

$\frac{3}{8}$ " ϕ POST-INSTALLED SCREW ANCHOR
OR CONC INSERT. PER FOOTNOTE h.
ON PG 600.3, ATTACHMENT BOLT
MUST FIT INTO CONC INSERT

ϕ ANGLE
FOOTNOTE d
PER PG 600.2

CSBBRS3 (PG 106.8)—SEE SECTION
600 FOR HORIZ CAPACITIES F_H AT ϕ
ANGLE AT ASD THRD DEPTH IS 0.3" FOR
EA ROD SIZE

NOTES:

1. SEE APPENDIX 'A' CASE 1, PG A1 FOR CONC ANCHORAGE CAPACITY FOR POST-INSTALLED DEWALT/POWERS SNAKE+ SCREW ANCHOR. SEE APPENDIX 'A' CASE 4, PG A5 FOR CONC ANCHORAGE CAPACITY OF CIP DEWALT/POWERS DDI+ DECK INSERT ANCHOR.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A' FOR THE ANCHORS IN NOTE 1.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. THRD ROD MAY CONTROL THE CAPACITY OF THE RESTRAINT ASSEMBLY.



**SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF METAL DECK W/ CONCRETE FILL
CSBBRS3 POST INSTALLED ANCHOR OR CIP INSERT W/ RESTRAINT ROD**



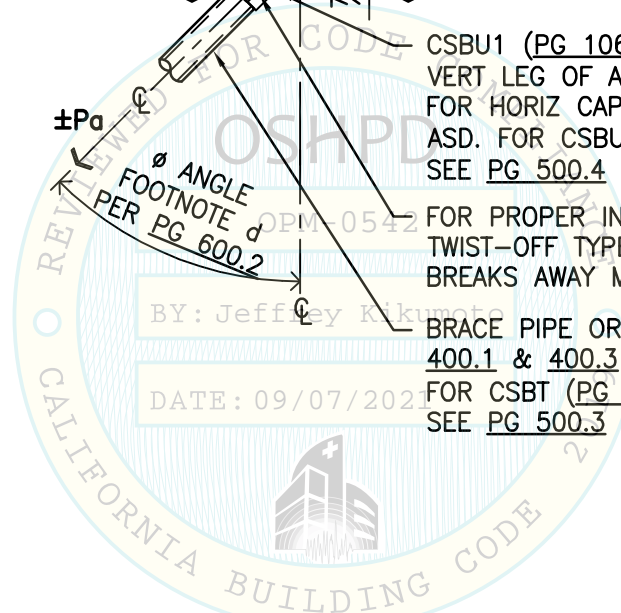
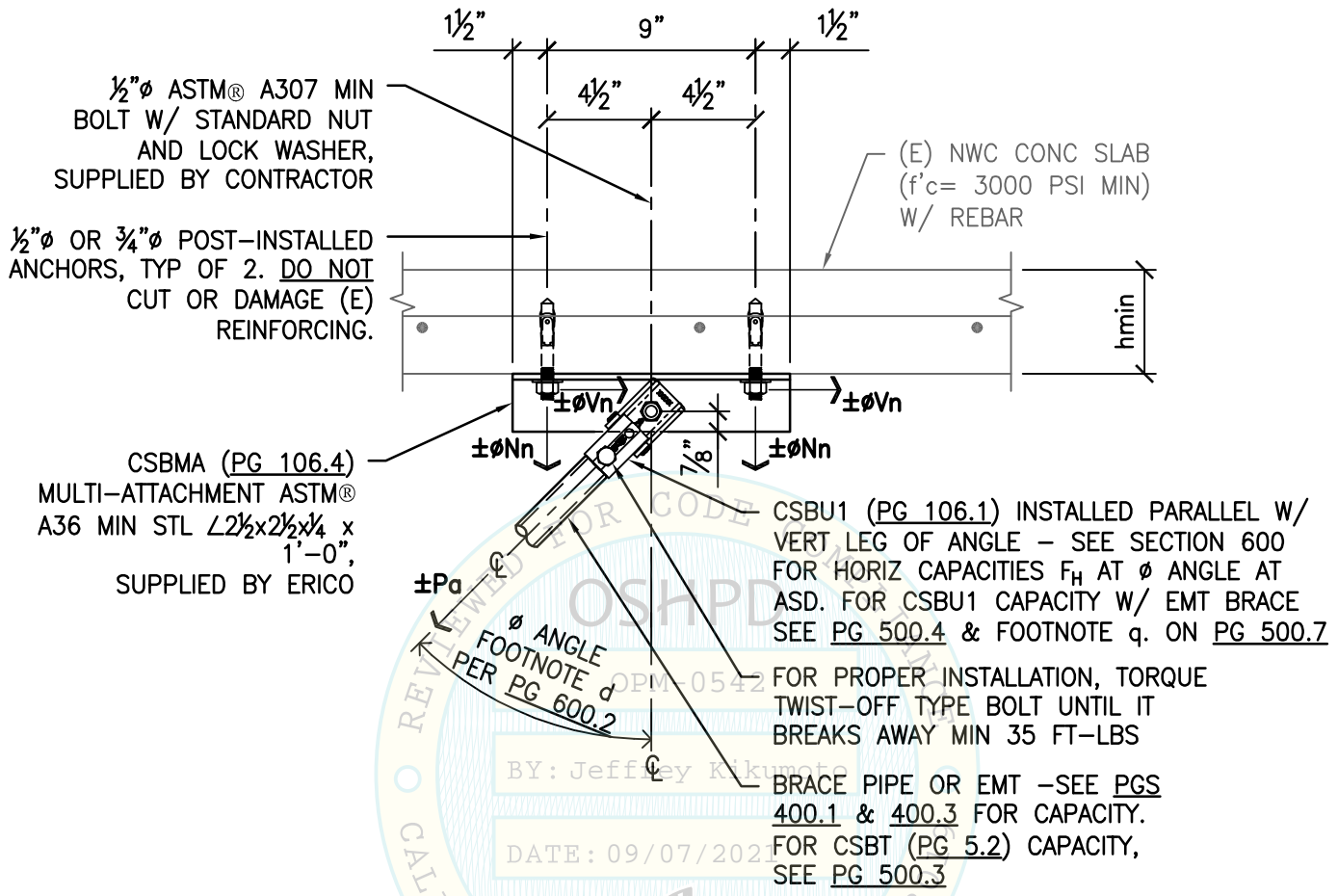
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| Page: | 100.17 of . |

SEISMIC BRACING FOR MEP SYSTEMS



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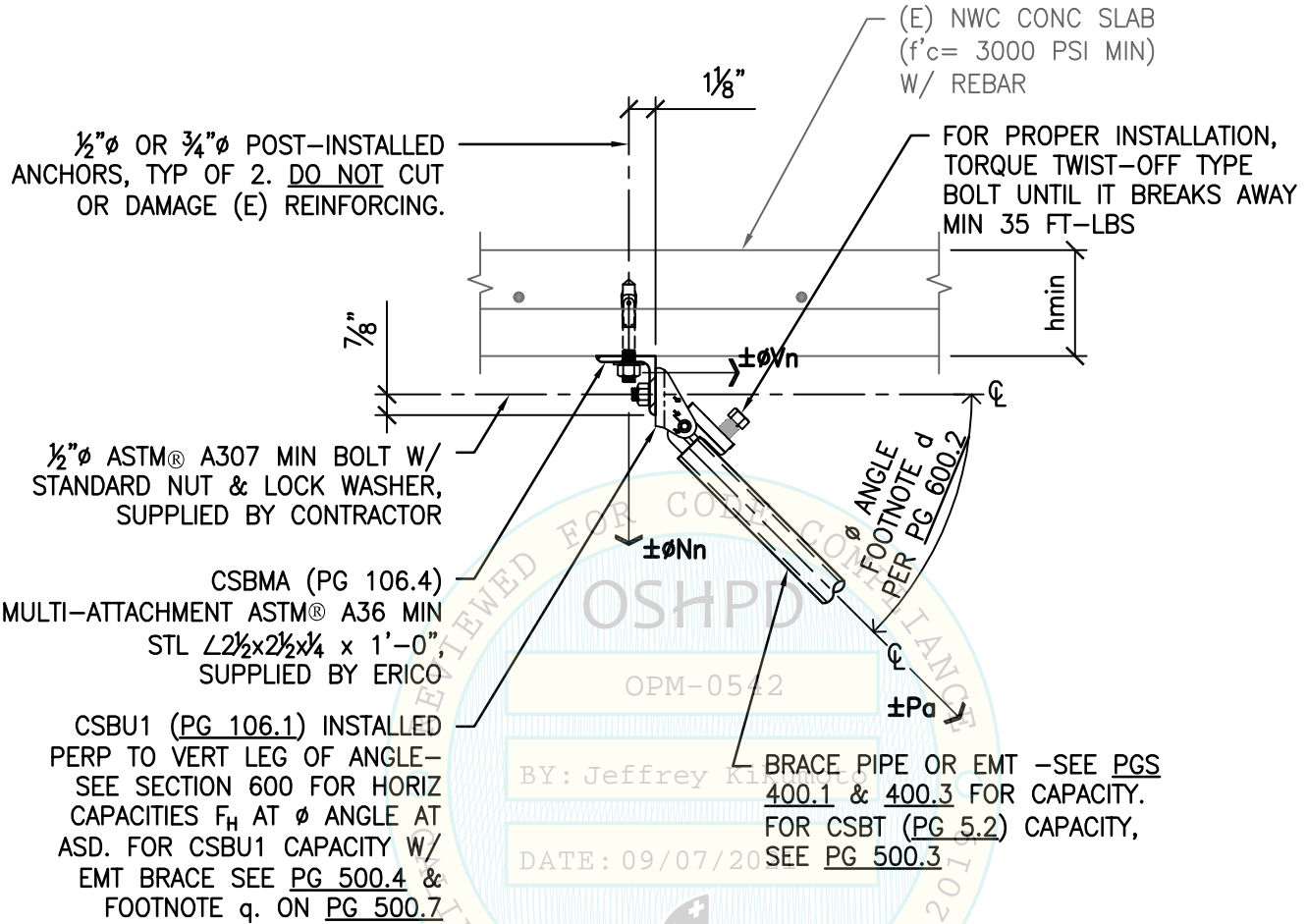
1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR CSBMA. PLEASE NOTE THAT CAPACITY PROVIDED IS FOR THE WORST-CASE ANCHOR CONDITION & HIGHER VALUES MAY BE OBTAINED VIA THE SEOR.
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3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. SEE PG 106.4 FOR ALLOWABLE CAPACITY OF THE CSBMA ANGLE.

**SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF CONCRETE FLOOR OR ROOF
CSBMA POST INSTALLED ANCHORS W/ BRACE PIPE PARALLEL**

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SEISMIC BRACING FOR MEP SYSTEMS

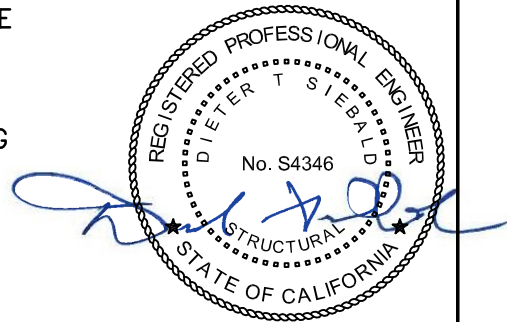


NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR CSBMA. PLEASE NOTE THAT CAPACITY PROVIDED IS FOR THE WORST-CASE ANCHOR CONDITION & HIGHER VALUES MAY BE OBTAINED VIA THE SEOR.
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4. SEE PG 106.4 FOR ALLOWABLE CAPACITY OF THE CSBMA ANGLE.

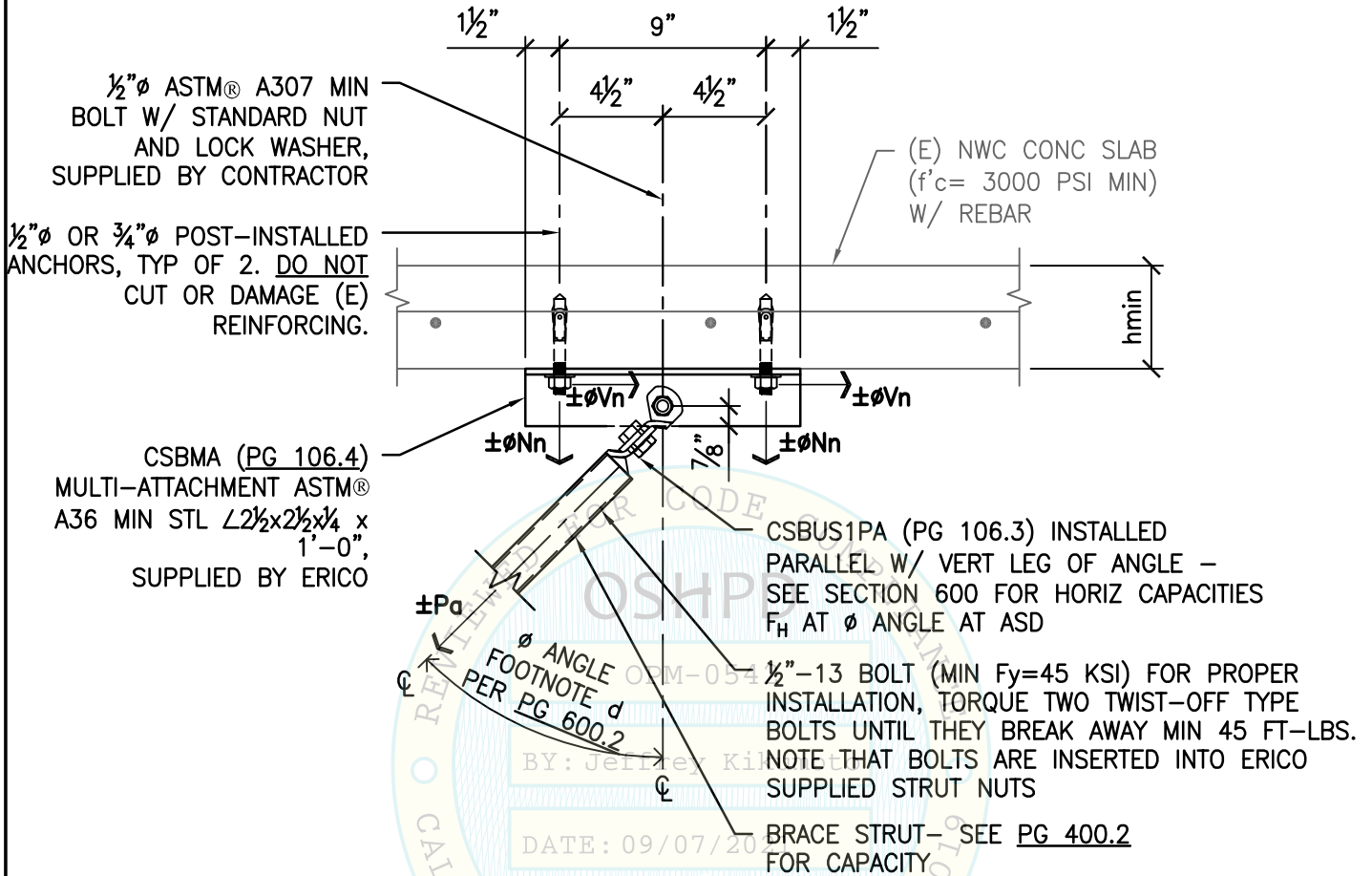
SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF CONCRETE FLOOR OR ROOF
CSBMA POST INSTALLED ANCHORS W/ BRACE PIPE PERPENDICULAR

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SEISMIC BRACING FOR MEP SYSTEMS



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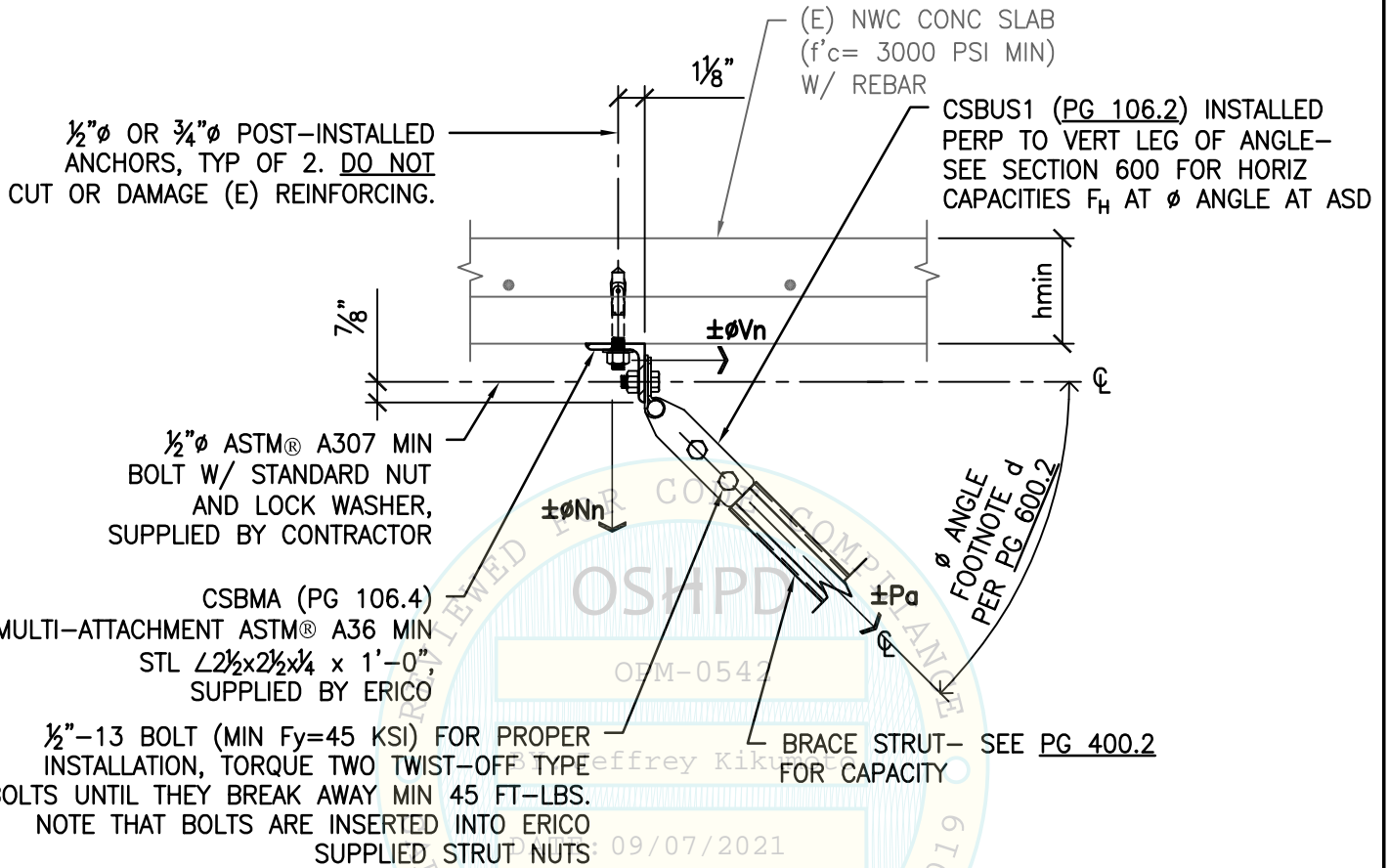
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3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. SEE PG 106.4 FOR ALLOWABLE CAPACITY OF THE CSBMA ANGLE.

**SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF CONCRETE FLOOR OR ROOF
CSBMA POST INSTALLED ANCHORS W/ BRACE STRUT PARALLEL**

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SEISMIC BRACING FOR MEP SYSTEMS

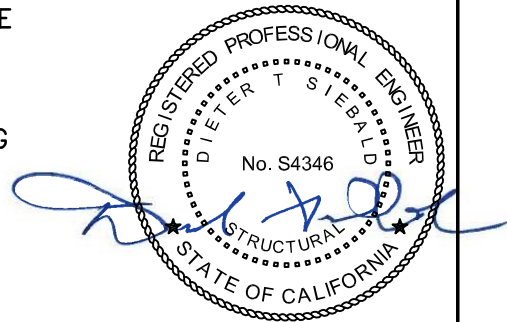


NOTES:

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3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. SEE PG 106.4 FOR ALLOWABLE CAPACITY OF THE CSBMA ANGLE.

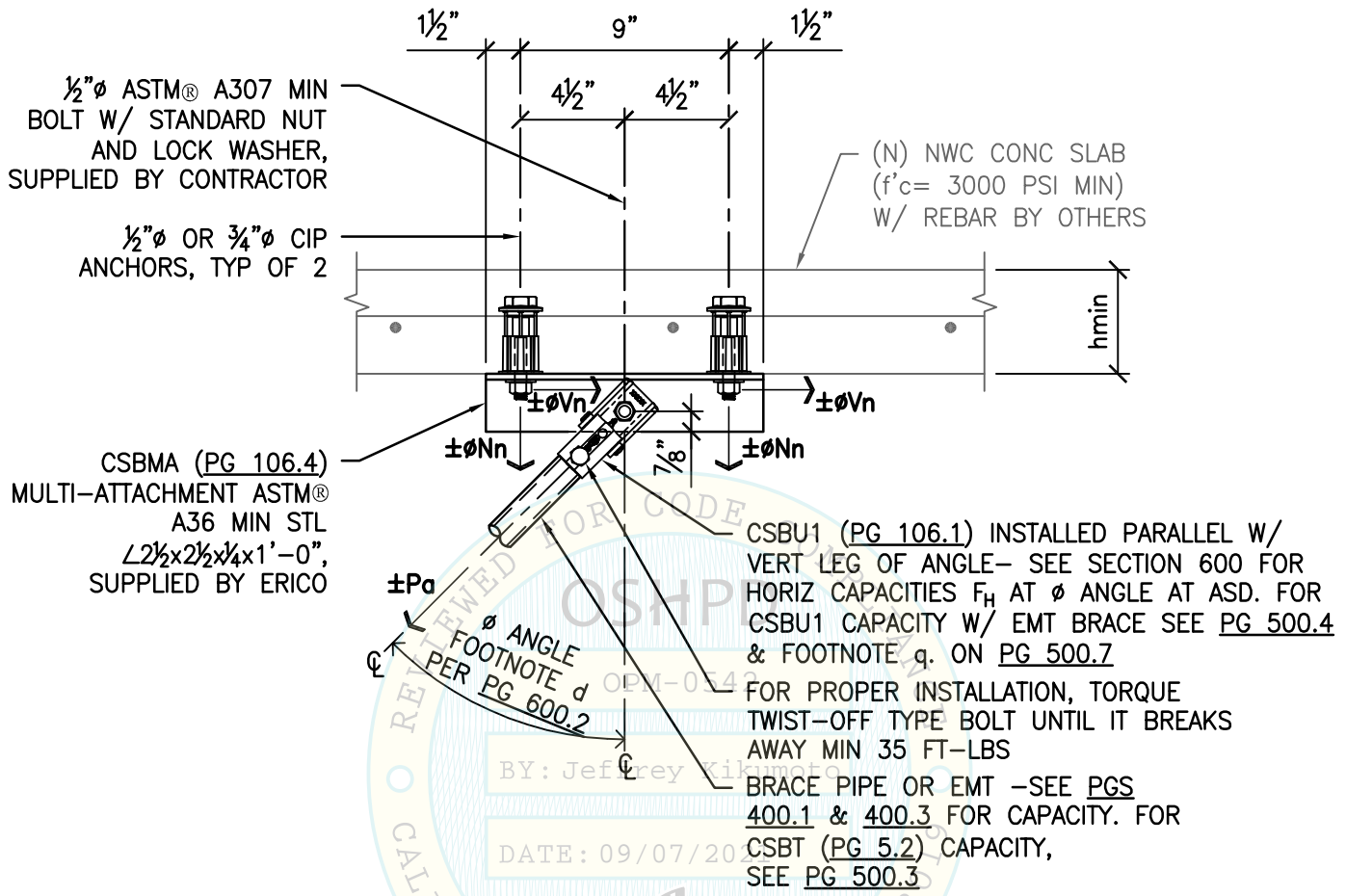
**SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF CONCRETE FLOOR OR ROOF
CSBMA POST INSTALLED ANCHORS W/ BRACE STRUT PERPENDICULAR**

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| | | | Page: 101.4 of . |



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SEISMIC BRACING FOR MEP SYSTEMS



1/2"Ø ASTM® A307 MIN BOLT W/ STANDARD NUT AND LOCK WASHER, SUPPLIED BY CONTRACTOR

1/2"Ø OR 3/4"Ø CIP ANCHORS, TYP OF 2

(N) NWC CONC SLAB (f'c= 3000 PSI MIN) W/ REBAR BY OTHERS

CSBMA (PG 106.4) MULTI-ATTACHMENT ASTM® A36 MIN STL L2 1/2 x 2 1/2 x 1/4 x 1'-0", SUPPLIED BY ERICO

CSBU1 (PG 106.1) INSTALLED PARALLEL W/ VERT LEG OF ANGLE- SEE SECTION 600 FOR HORIZ CAPACITIES FH AT Ø ANGLE AT ASD. FOR CSBU1 CAPACITY W/ EMT BRACE SEE PG 500.4 & FOOTNOTE q. ON PG 500.7

FOR PROPER INSTALLATION, TORQUE TWIST-OFF TYPE BOLT UNTIL IT BREAKS AWAY MIN 35 FT-LBS BRACE PIPE OR EMT -SEE PGS 400.1 & 400.3 FOR CAPACITY. FOR CSBT (PG 5.2) CAPACITY, SEE PG 500.3

NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR CSBMA. PLEASE NOTE THAT CAPACITY PROVIDED IS FOR THE WORST-CASE ANCHOR CONDITION & HIGHER VALUES MAY BE OBTAINED VIA THE SEOR.
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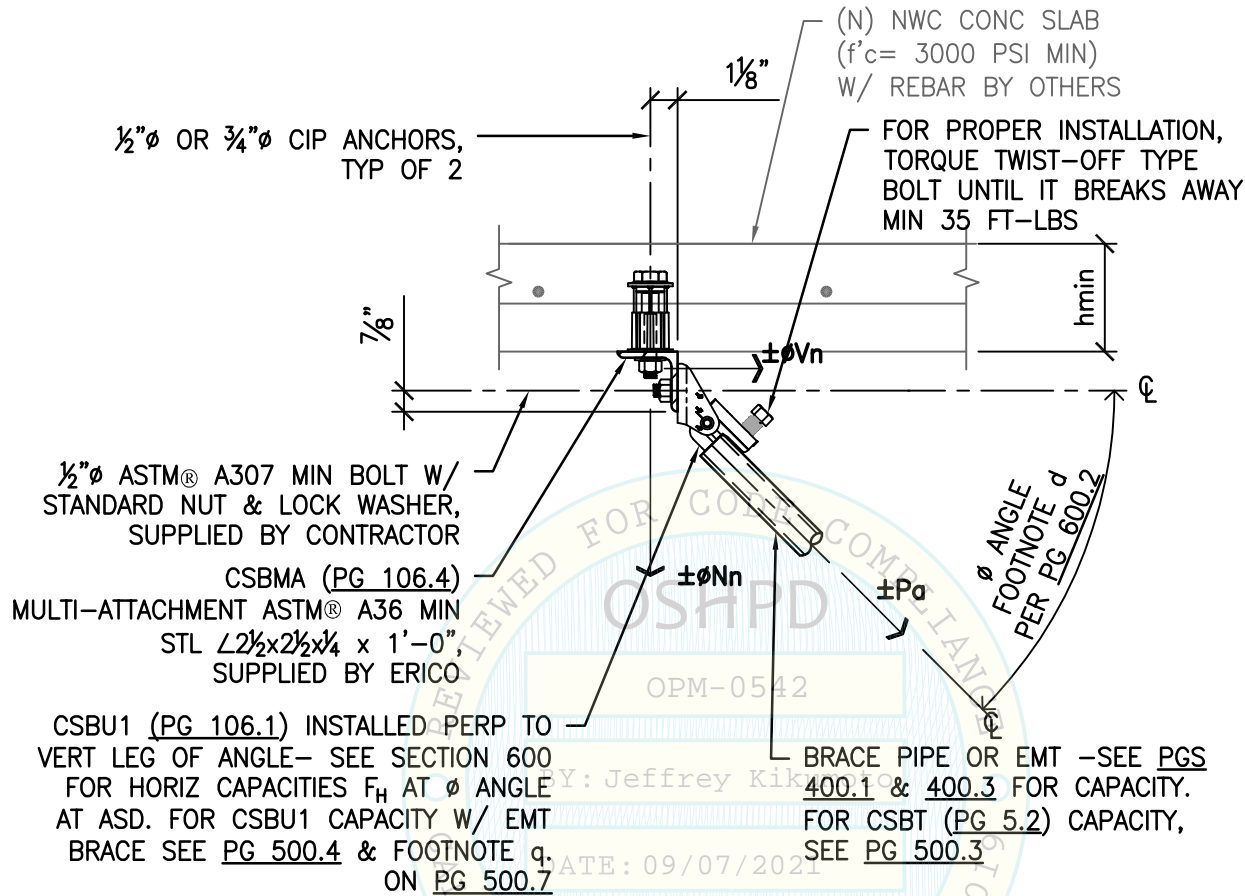


**SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF CONCRETE FLOOR OR ROOF
CSBMA CAST IN PLACE ANCHORS W/ BRACE PIPE PARALLEL**

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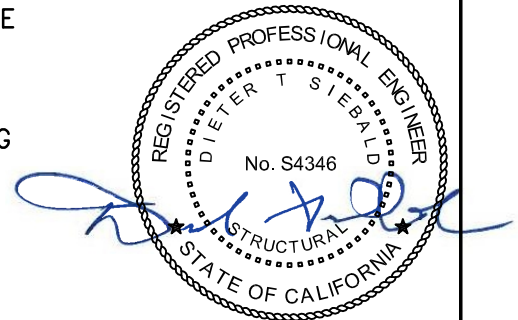
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SEISMIC BRACING FOR MEP SYSTEMS



NOTES:

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3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. SEE PG 106.4 FOR ALLOWABLE CAPACITY OF THE CSBMA ANGLE.

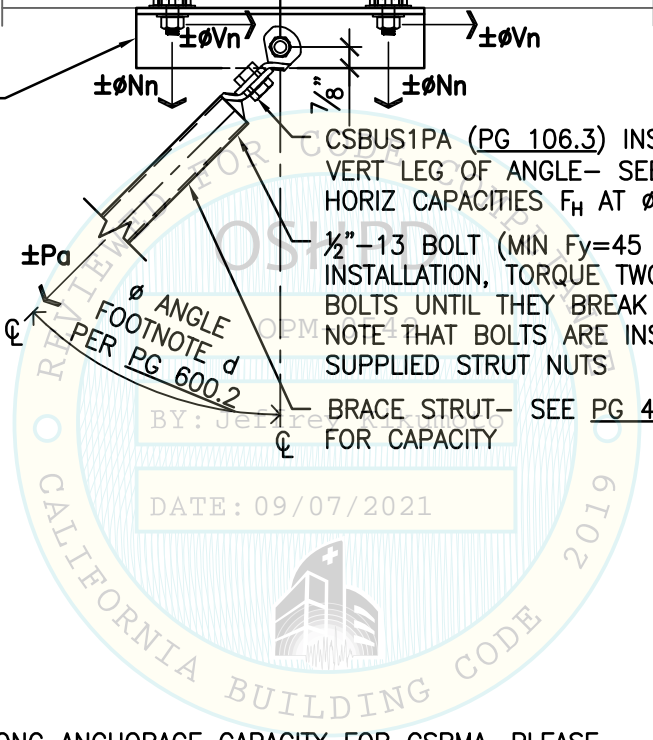
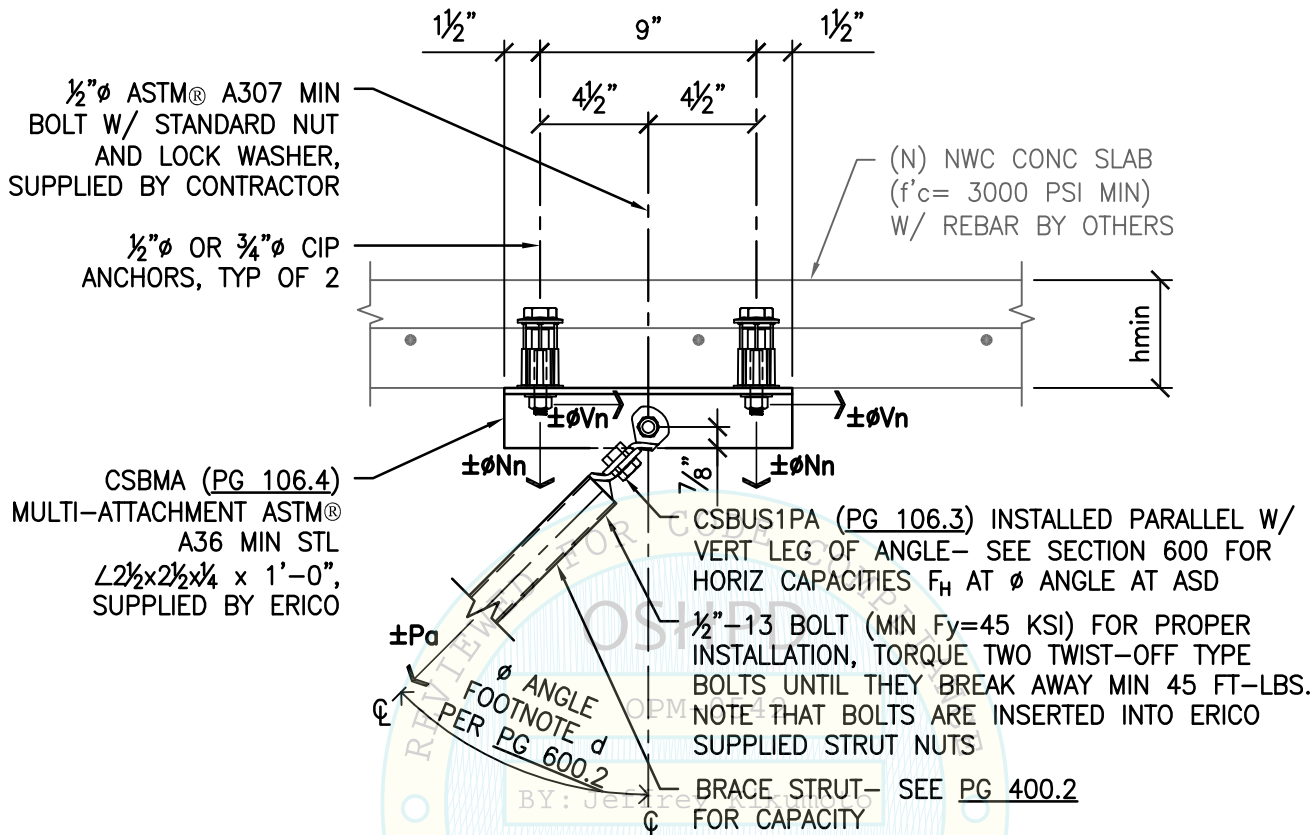


**SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF CONCRETE FLOOR OR ROOF
CSBMA CAST IN PLACE ANCHORS W/ BRACE PIPE PERPENDICULAR**

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SEISMIC BRACING FOR MEP SYSTEMS



DATE: 09/07/2021

NOTES:

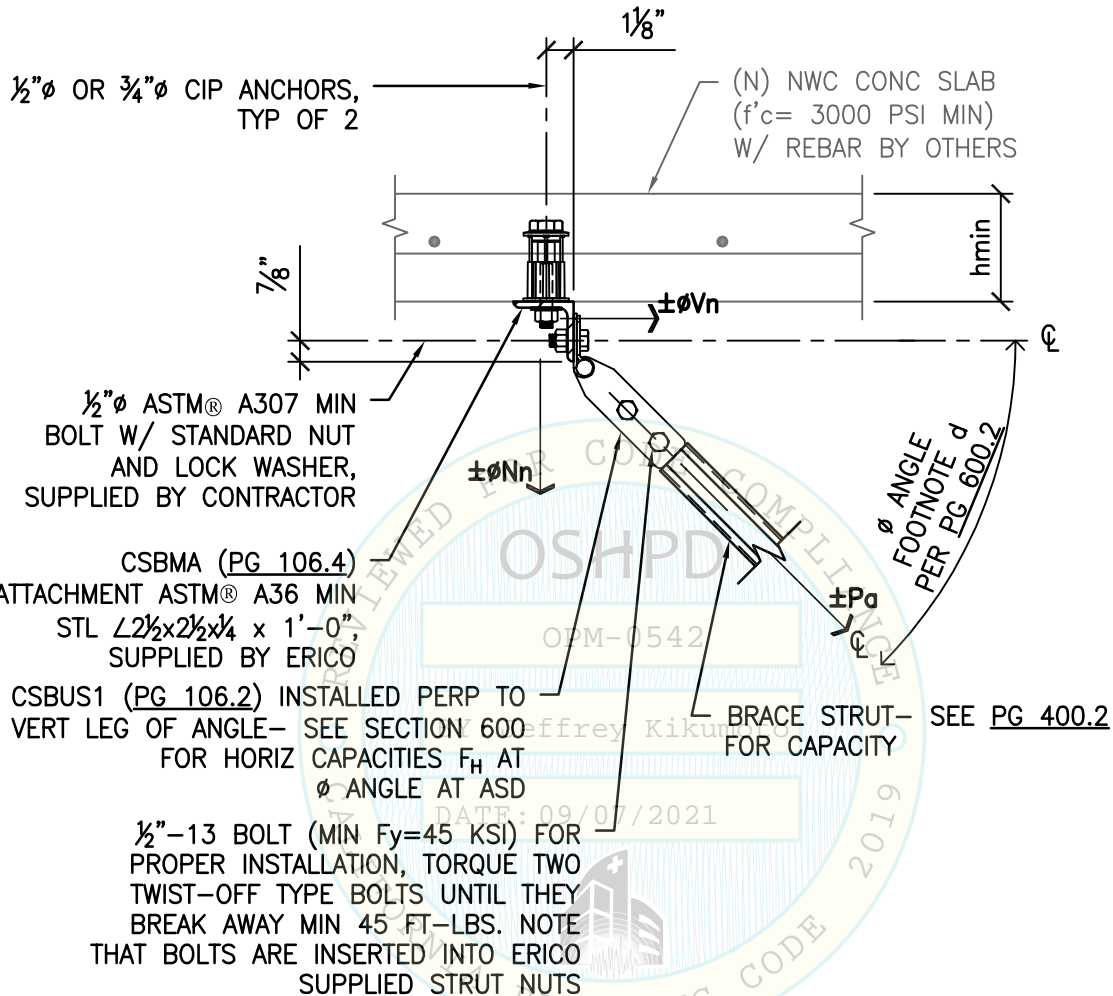
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3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. SEE PG 106.4 FOR ALLOWABLE CAPACITY OF THE CSBMA ANGLE.

**SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF CONCRETE FLOOR OR ROOF
CSBMA CAST IN PLACE ANCHORS W/ BRACE STRUT PARALLEL**

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SEISMIC BRACING FOR MEP SYSTEMS

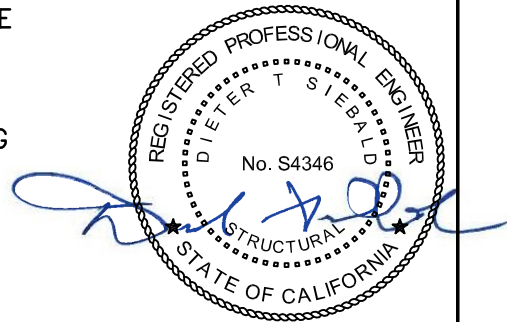


NOTES:

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3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. SEE PG 106.4 FOR ALLOWABLE CAPACITY OF THE CSBMA ANGLE.

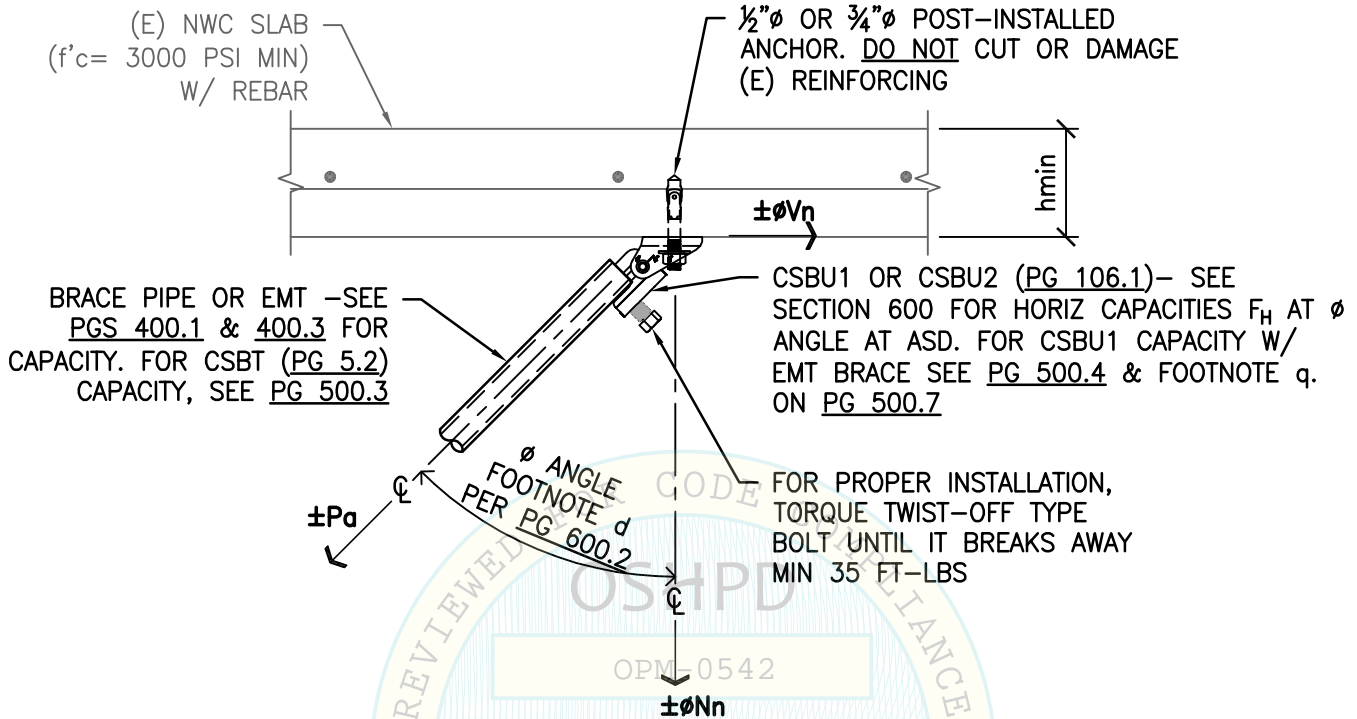
**SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF CONCRETE FLOOR OR ROOF
CSBMA CAST IN PLACE ANCHORS W/ BRACE STRUT PERPENDICULAR**

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| | | | Page: | 101.8 of . |



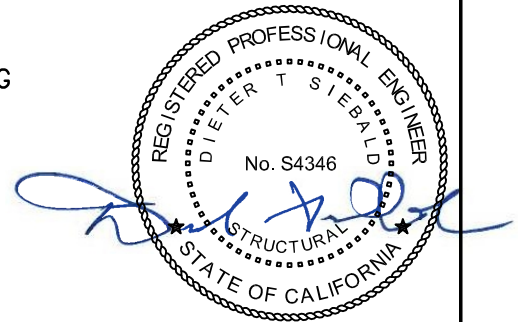
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SEISMIC BRACING FOR MEP SYSTEMS



NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. EMT MUST NOT BE USED W/ CSBU2.

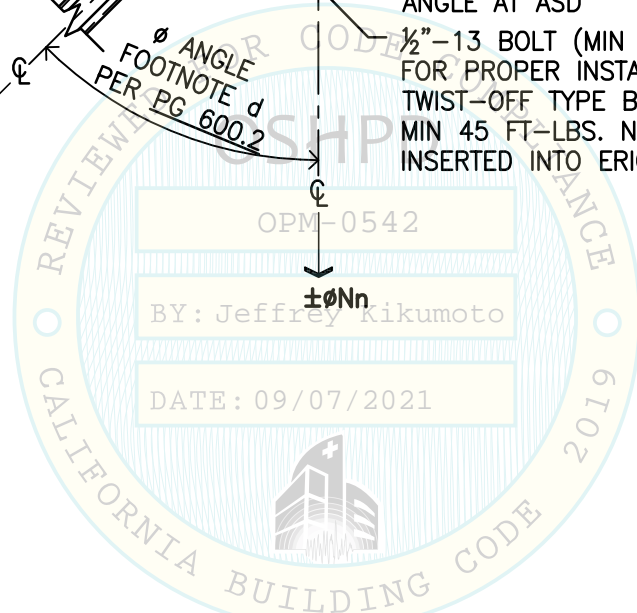
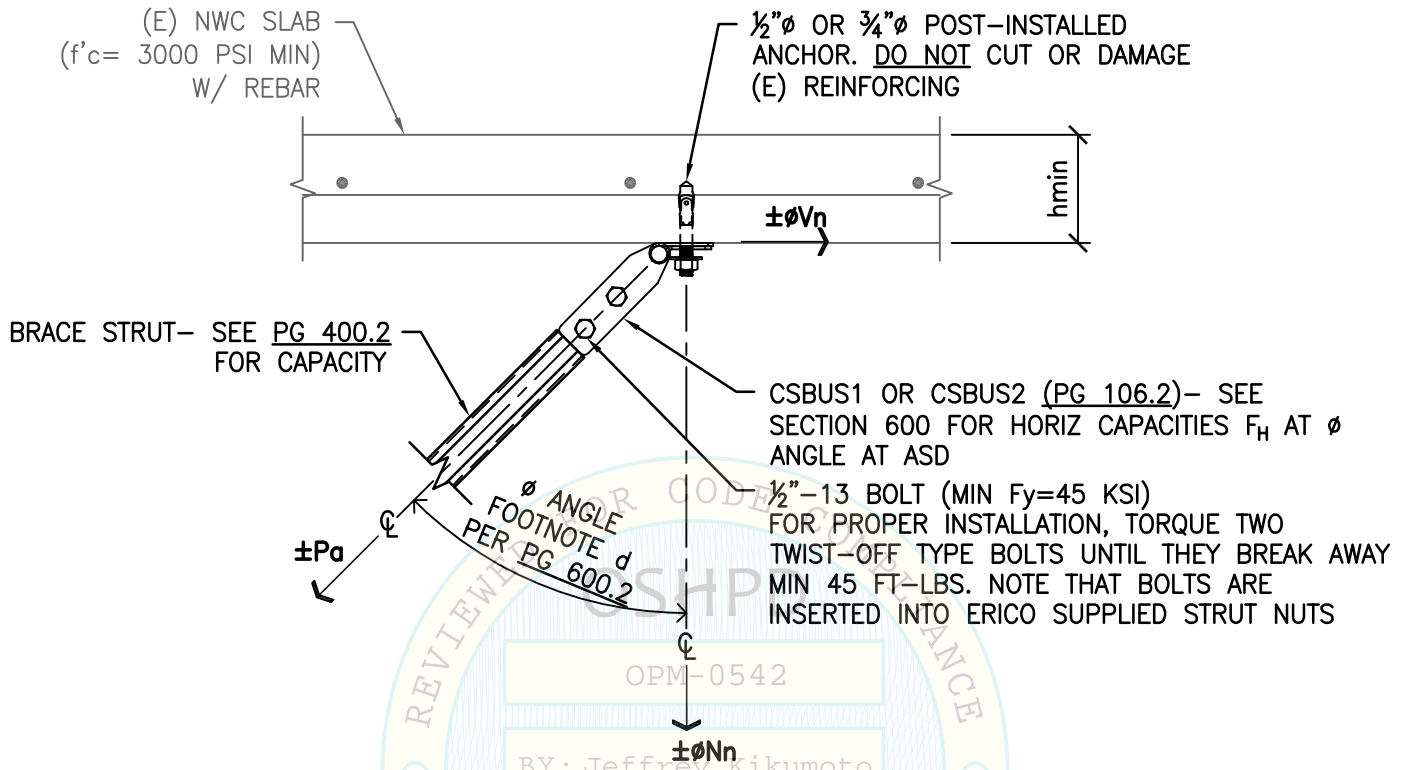


**SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF CONCRETE FLOOR OR ROOF
CSBU POST INSTALLED ANCHOR W/ BRACE PIPE**

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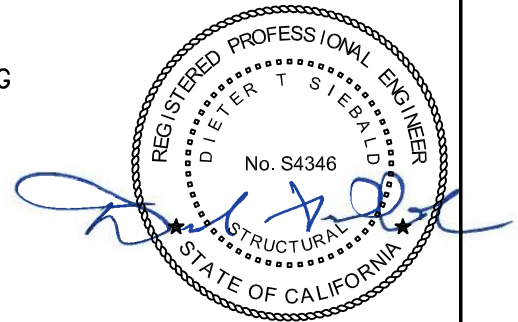
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SEISMIC BRACING FOR MEP SYSTEMS



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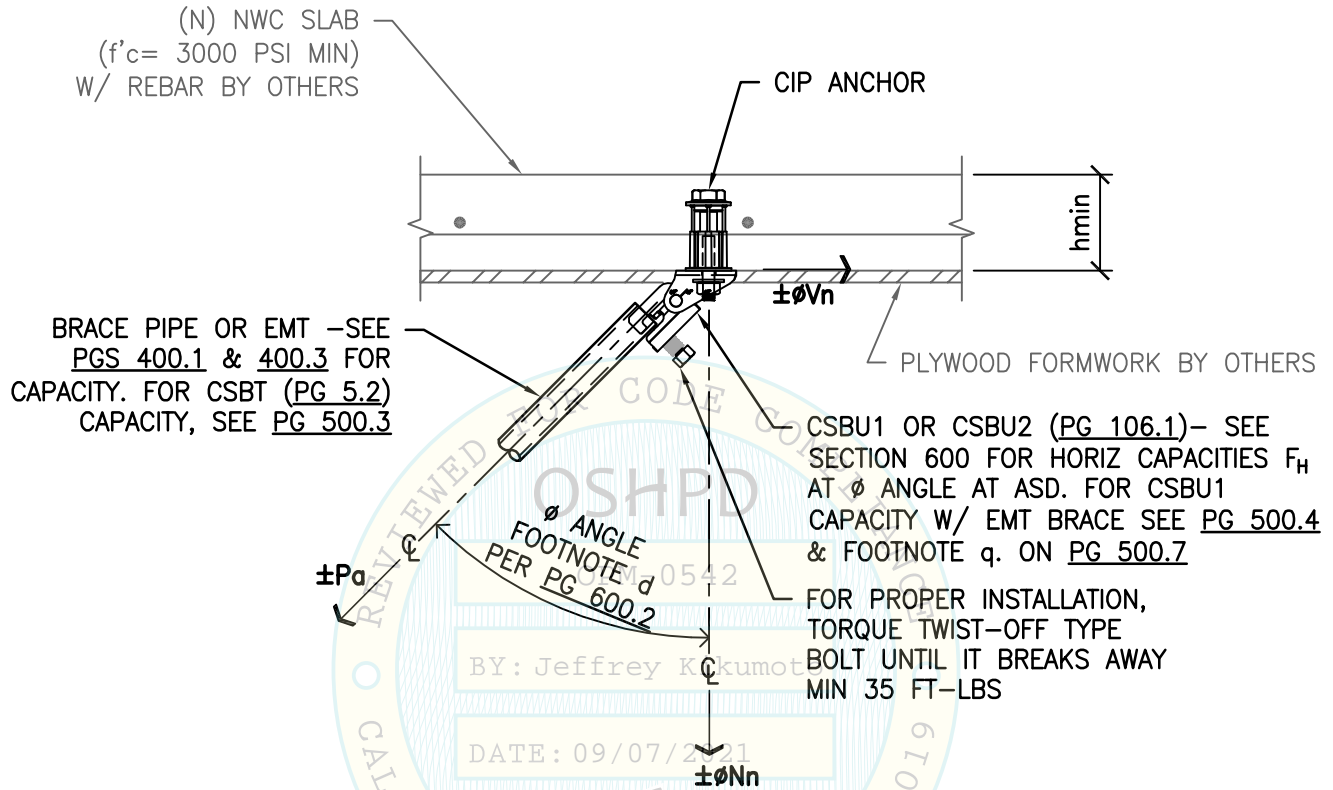
1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.



**SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF CONCRETE FLOOR OR ROOF
CSBU POST INSTALLED ANCHOR W/ BRACE STRUT**

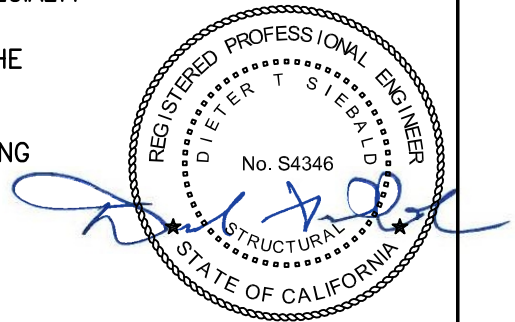
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|--|---------------------------------------|--------------------|-------|-------------|
| | CYS STRUCTURAL ENGINEERS, INC. | Job No: | 19039 | |
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SEISMIC BRACING FOR MEP SYSTEMS



NOTES:

1. SPECIALTY INSERTS INSTALLED IN NWC MUST BE HEADED CAST-IN SPECIALTY INSERTS IN CRACKED CONC AS NOTED IN APPENDIX 'A'.
2. INSTALLATION MUST BE IN ACCORDANCE W/ THE REQUIREMENTS OF THE ICC-ES EVALUATION REPORT FOR THE SPECIFIED ANCHOR.
3. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
4. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
5. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
6. EMT MUST NOT BE USED W/ CSBU2.



**SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF CONCRETE FLOOR OR ROOF
CSBU CAST IN PLACE ANCHOR W/ BRACE PIPE**



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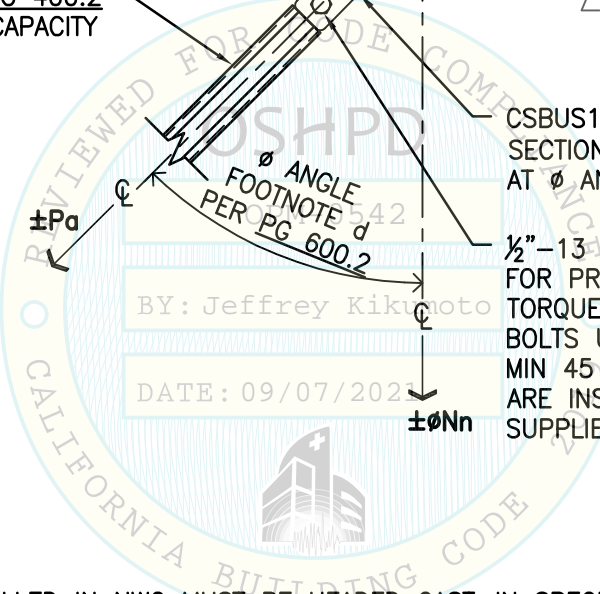
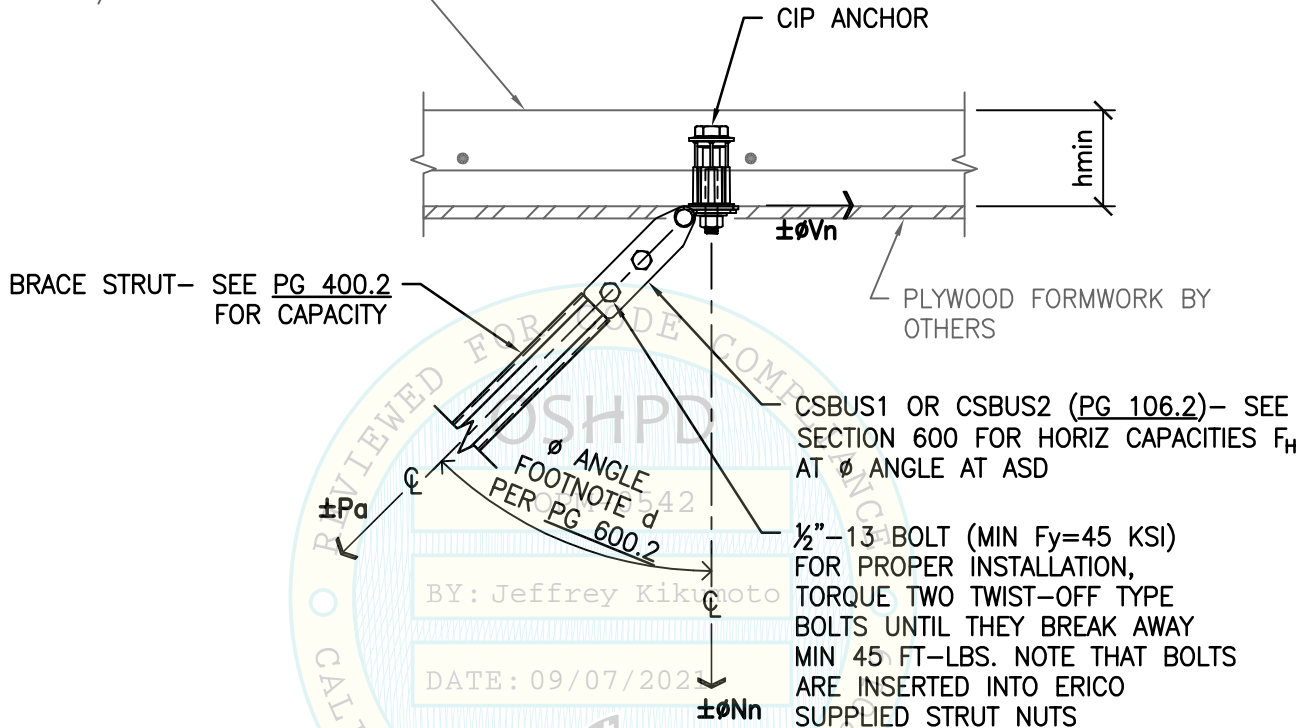
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| Date: | 09/08/2021 |
| Page: | 101.11 of . |

SEISMIC BRACING FOR MEP SYSTEMS



(N) NWC SLAB ($f'_c = 3000$ PSI MIN)
W/ REBAR BY OTHERS



NOTES:

1. SPECIALTY INSERTS INSTALLED IN NWC MUST BE HEADED CAST-IN SPECIALTY INSERTS IN CRACKED CONC AS NOTED IN APPENDIX 'A'.
2. INSTALLATION MUST BE IN ACCORDANCE W/ THE REQUIREMENTS OF THE ICC-ES EVALUATION REPORT FOR THE SPECIFIED ANCHOR.
3. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
4. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
5. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.

**SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF CONCRETE FLOOR OR ROOF
CSBU CAST IN PLACE ANCHOR W/ BRACE STRUT**



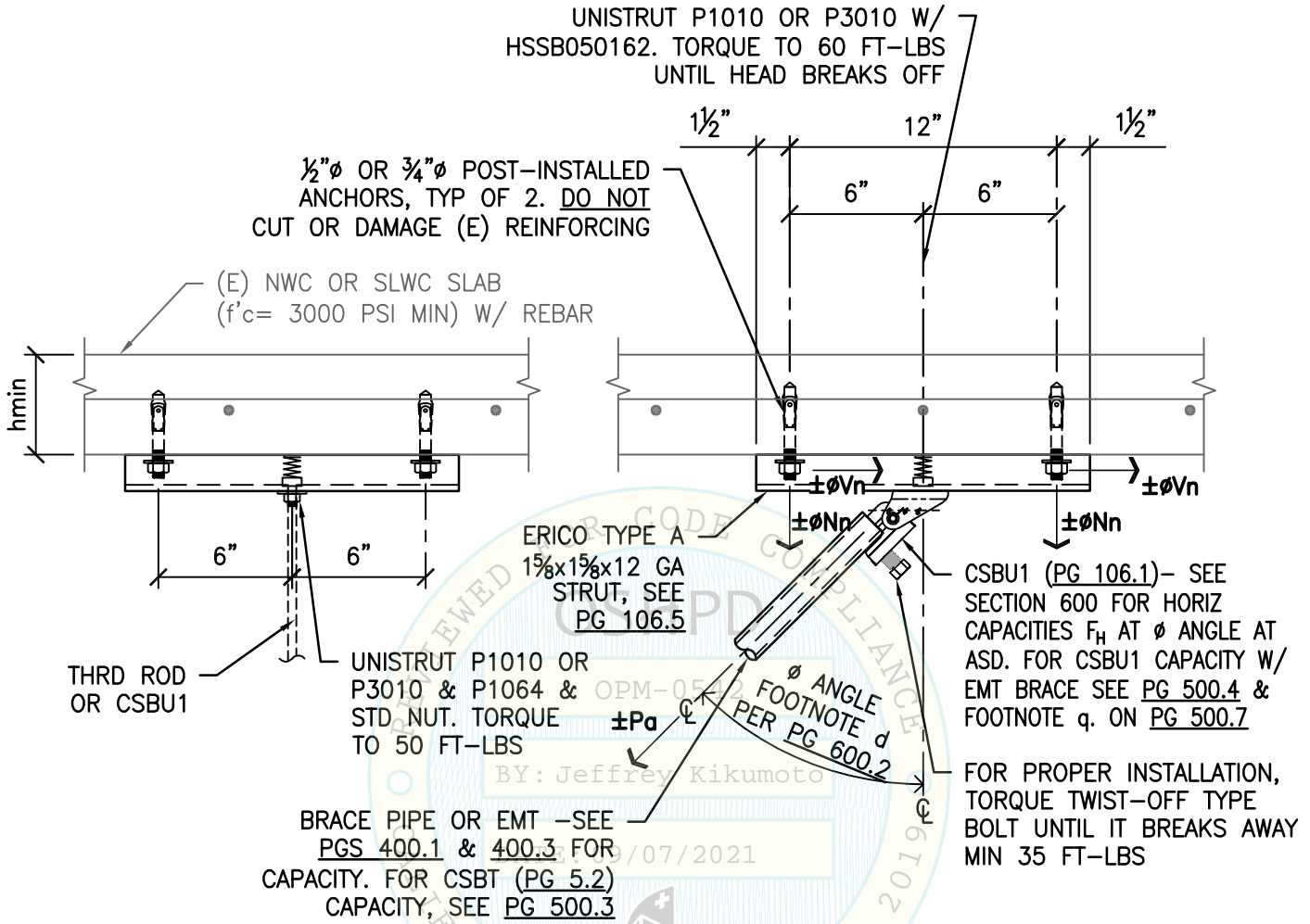
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| Date: | 09/08/2021 |
| Page: | 101.12 of . |

SEISMIC BRACING FOR MEP SYSTEMS



NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. THE ALLOWABLE ASD SLIP LOAD & TENSION LOAD FOR THE UNISTRUT P1010 OR P3010 IS 1370 LBS & 2810 LBS RESPECTIVELY. THE ALLOWABLE LOAD PERP TO THE STRUT IS 1035 LBS.

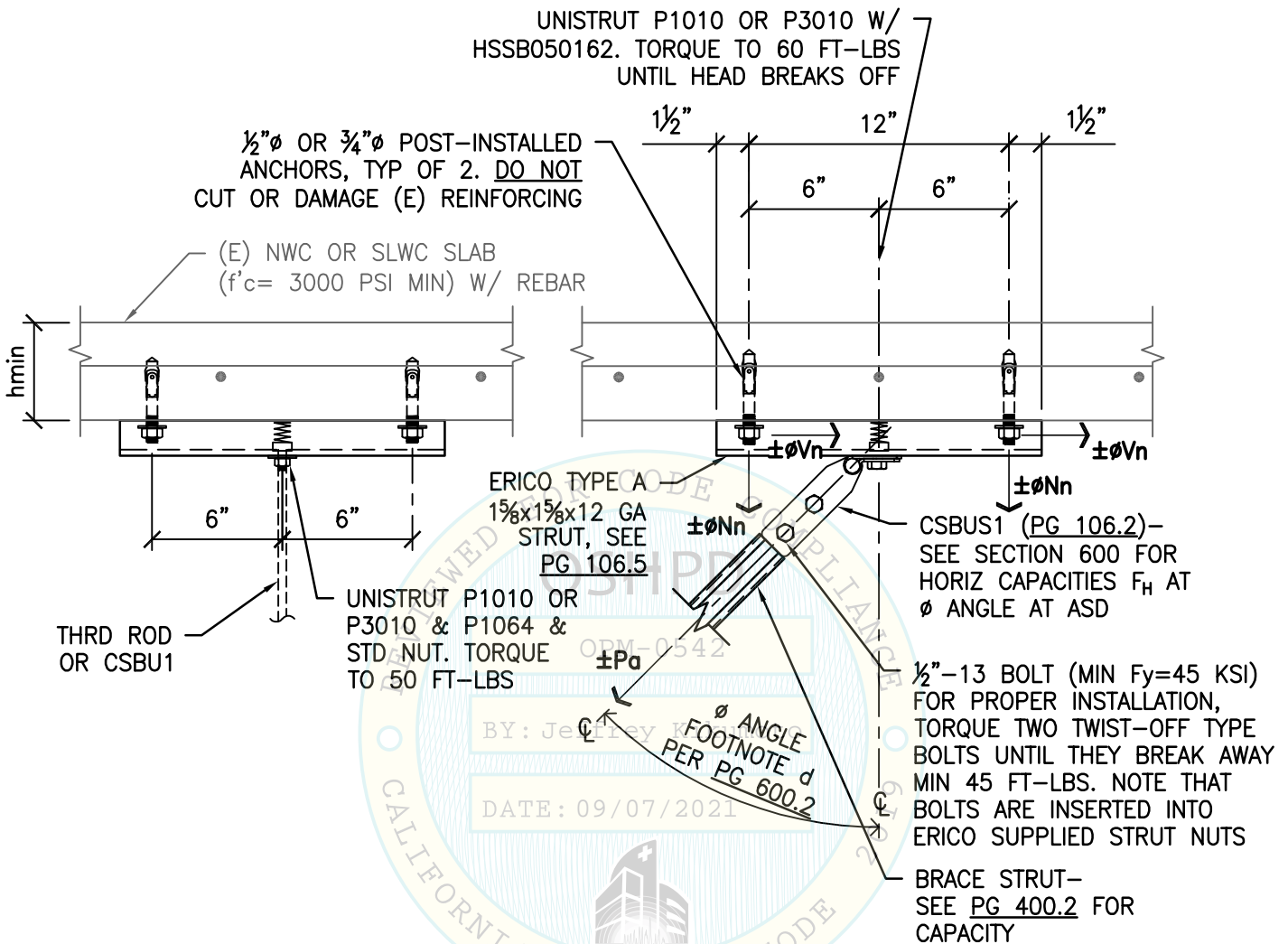


**SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF CONCRETE FLOOR OR ROOF
STRUT POST INSTALLED ANCHORS W/ BRACE PIPE PARALLEL & VERTICAL ROD**

| | | | |
|--|--|--------------------------------------|------------------|
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| | 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833 | TEL (916) 920-2020 www.cyseng.com | Date: 09/08/2021 |

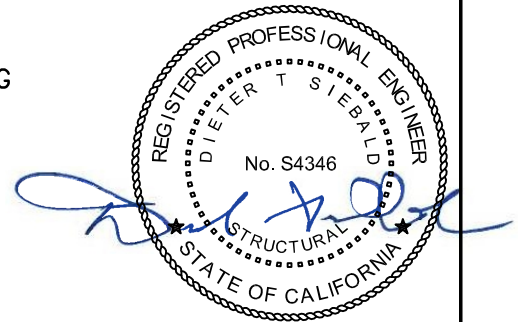
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SEISMIC BRACING FOR MEP SYSTEMS



NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. THE ALLOWABLE ASD SLIP LOAD & TENSION LOAD FOR THE UNISTRUT P1010 OR P3010 IS 1370 LBS & 2810 LBS RESPECTIVELY. THE ALLOWABLE LOAD PERP TO THE STRUT IS 1035 LBS.



**SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF CONCRETE FLOOR OR ROOF
STRUT POST INSTALLED ANCHORS W/ BRACE STRUT PARALLEL**



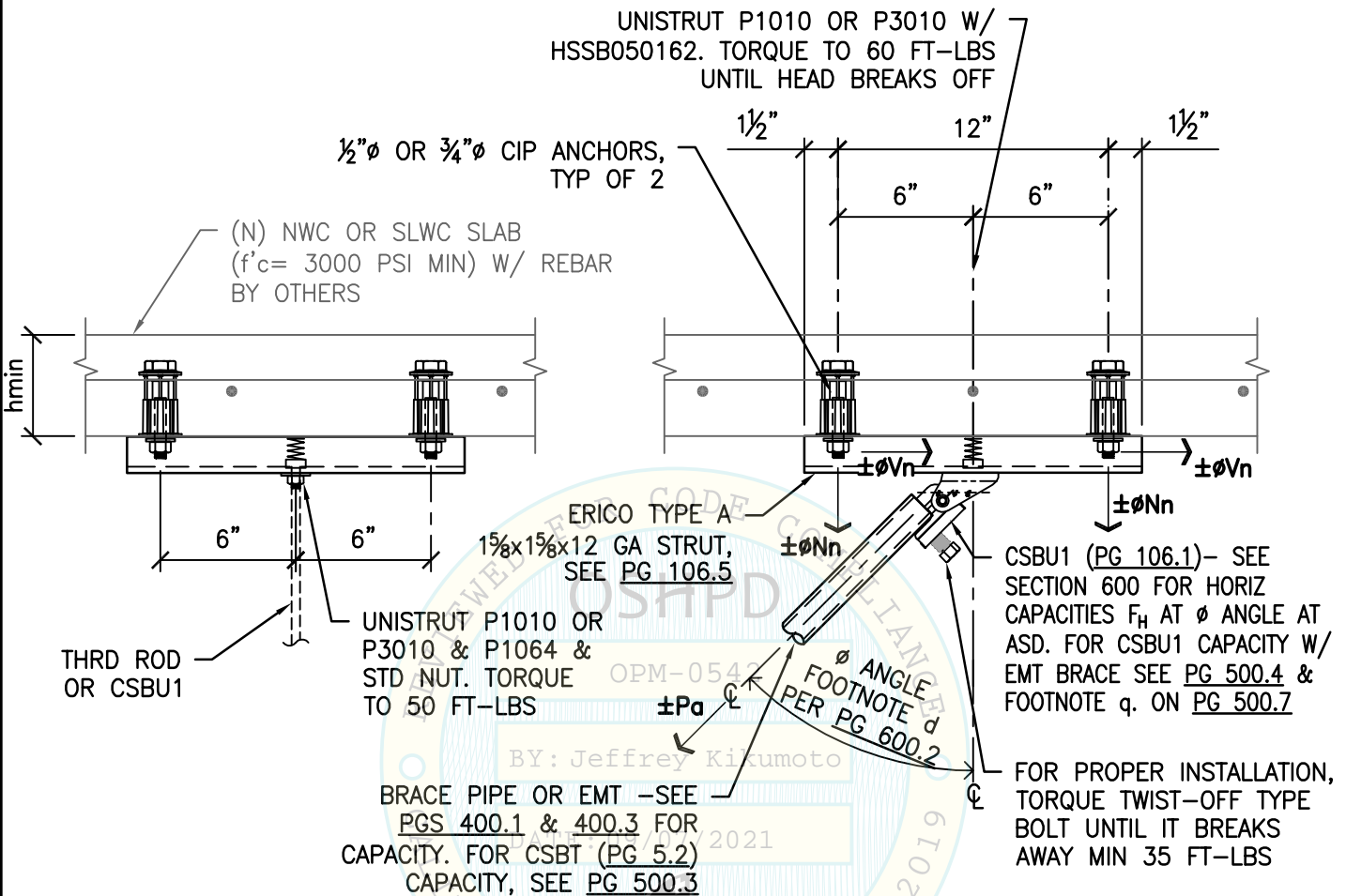
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| Date: | 09/08/2021 |
| Page: | 101.14 of . |

SEISMIC BRACING FOR MEP SYSTEMS



NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. THE ALLOWABLE ASD SLIP LOAD & TENSION LOAD FOR THE UNISTRUT P1010 OR P3010 IS 1370 LBS & 2810 LBS RESPECTIVELY. THE ALLOWABLE LOAD PERP TO THE STRUT IS 1035 LBS.

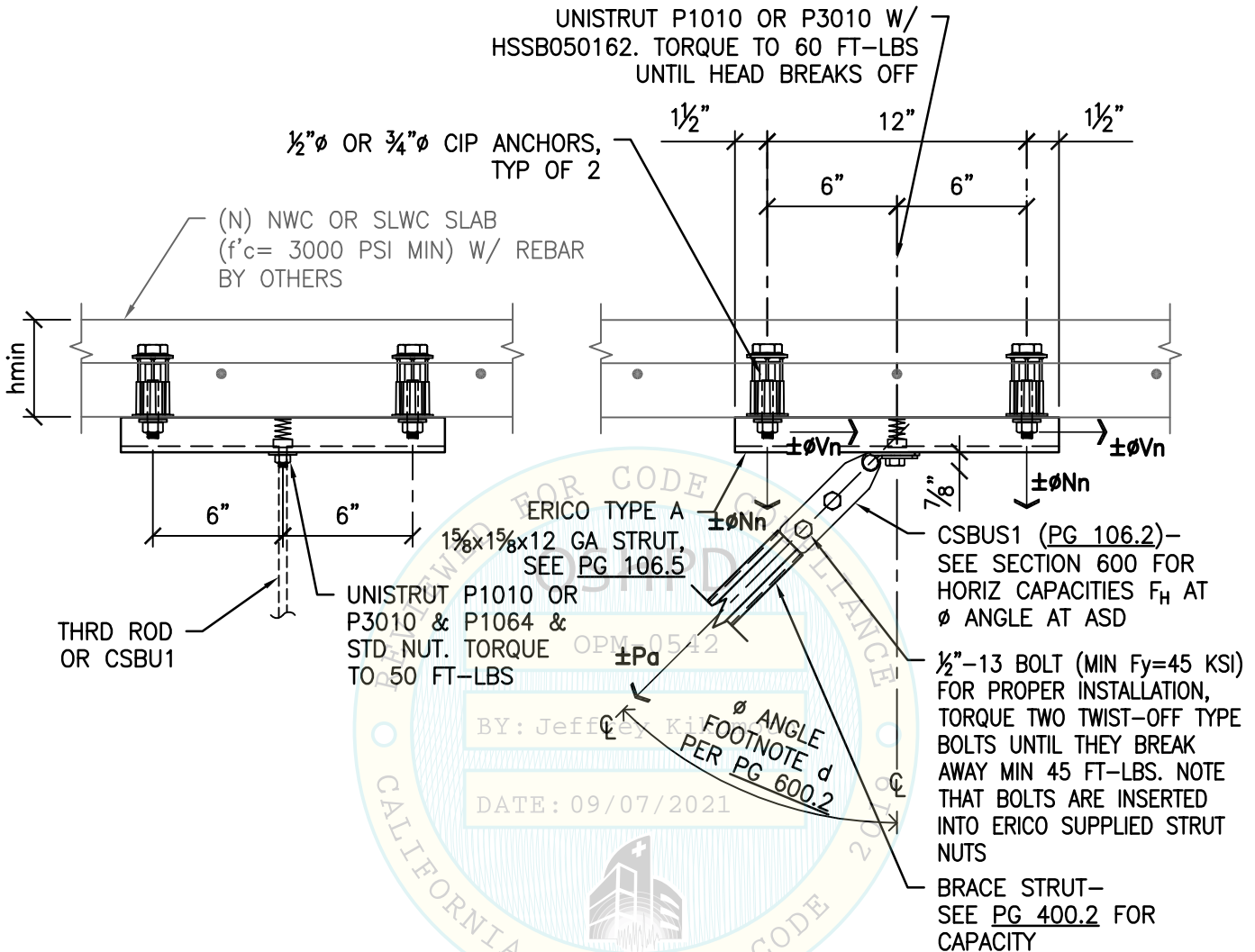


**SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF CONCRETE FLOOR OR ROOF
STRUT CAST IN PLACE ANCHORS W/ BRACE PIPE PARALLEL & VERTICAL ROD**

| | | | |
|--|--|--------------------------------------|------------------|
| | CYS STRUCTURAL ENGINEERS, INC. | Job No: 19039 | |
| | 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833 | TEL (916) 920-2020 www.cyseng.com | Date: 09/08/2021 | Page: 101.15 of . |

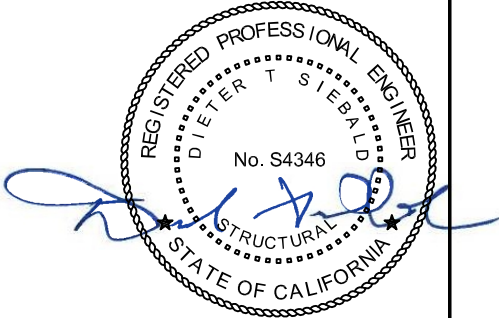
c:\Users\camachom\appdata\local\temp\AcPublish_39788\S1_Erico MEP.dwg Time: Sep 08, 2021 - 10:32am Login: camachom DimScale: 8 L1Scale: 4

SEISMIC BRACING FOR MEP SYSTEMS



NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. THE ALLOWABLE ASD SLIP LOAD & TENSION LOAD FOR THE UNISTRUT P1010 OR P3010 IS 1370 LBS & 2810 LBS RESPECTIVELY. THE ALLOWABLE LOAD PERP TO THE STRUT IS 1035 LBS.

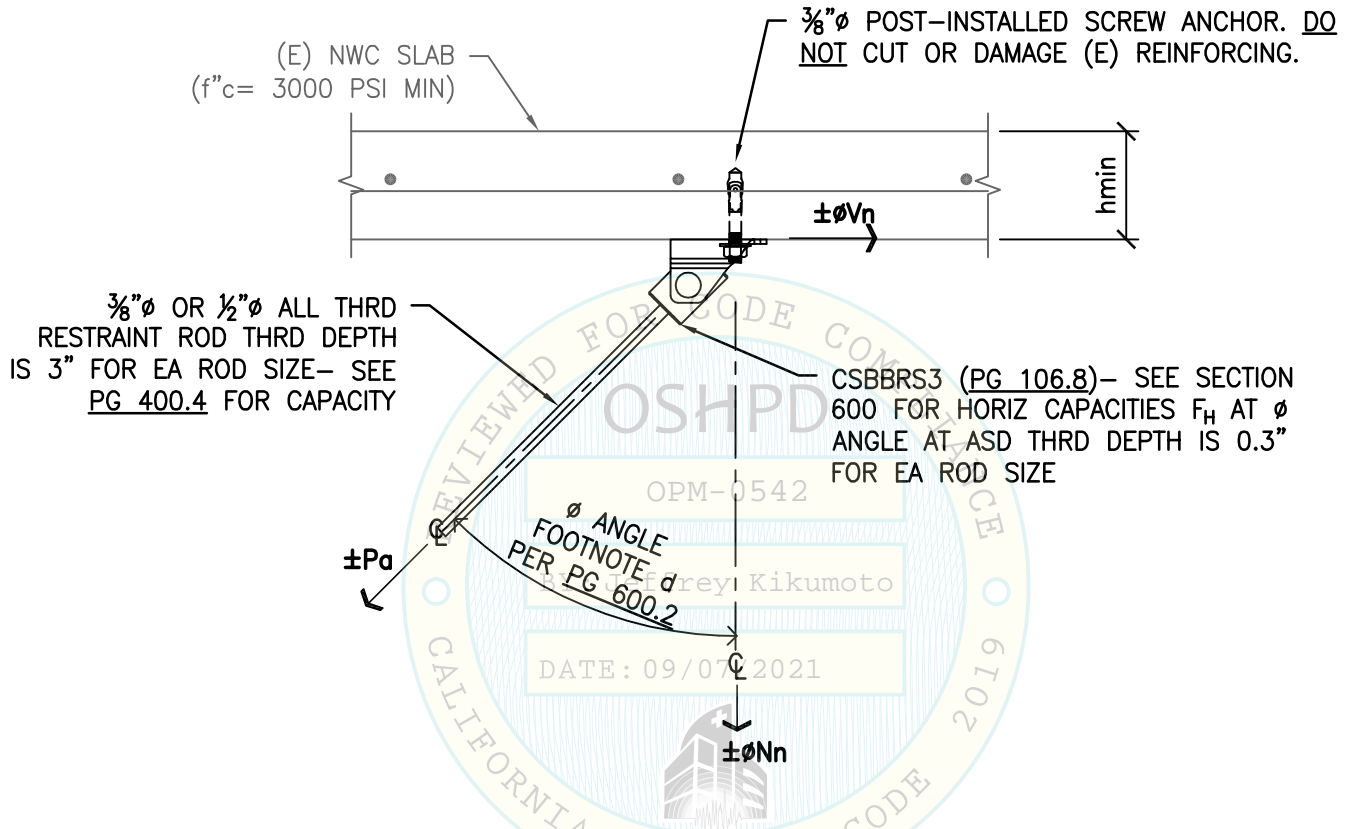


**SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF CONCRETE FLOOR OR ROOF
STRUT CAST IN PLACE ANCHORS W/ BRACE STRUT PARALLEL & VERTICAL ROD**

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|--|--|--------------------------------------|-------|-------------|
| | CYS STRUCTURAL ENGINEERS, INC. | Job No: | 19039 | |
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| | | | Page: | 101.16 of . |

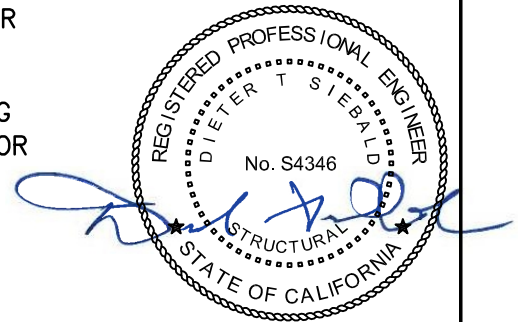
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SEISMIC BRACING FOR MEP SYSTEMS



NOTES:

1. SEE APPENDIX 'A' CASE 2, PG A3 FOR CONC ANCHORAGE CAPACITY FOR POST-INSTALLED DEWALT/POWERS SNAKE+ SCREW ANCHOR.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A' FOR THE ANCHOR IN NOTE 1.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. THRD ROD MAY CONTROL THE CAPACITY OF THE RESTRAINT ASSEMBLY.



**SHEET TITLE: SUPPORTS & ATTACHMENT DETAIL TO UNDERSIDE OF CONCRETE FLOOR OR ROOF
CSBBRS3 POST INSTALLED ANCHOR W/ RESTRAINT ROD**

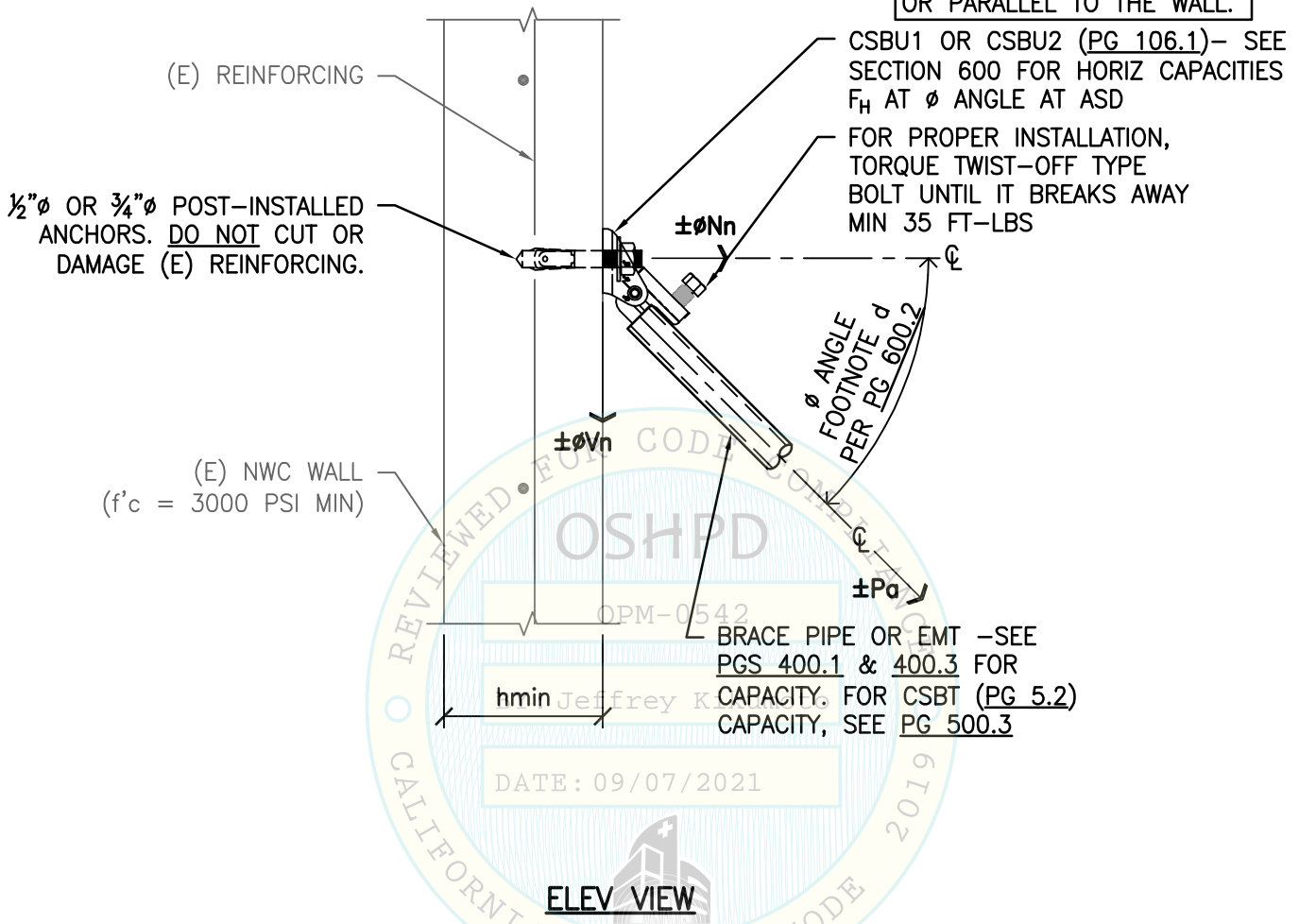
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| | CYS STRUCTURAL ENGINEERS, INC. | Job No: | 19039 | |
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SEISMIC BRACING FOR MEP SYSTEMS

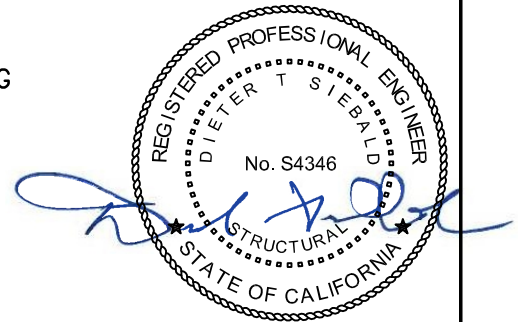


NOTE:
SERVICE PIPE MAY BE PERP
OR PARALLEL TO THE WALL.



NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. EMT MUST NOT BE USED W/ CSBU2.



**SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO CONCRETE WALL
CSBU POST INSTALLED ANCHORS W/ BRACE PIPE**

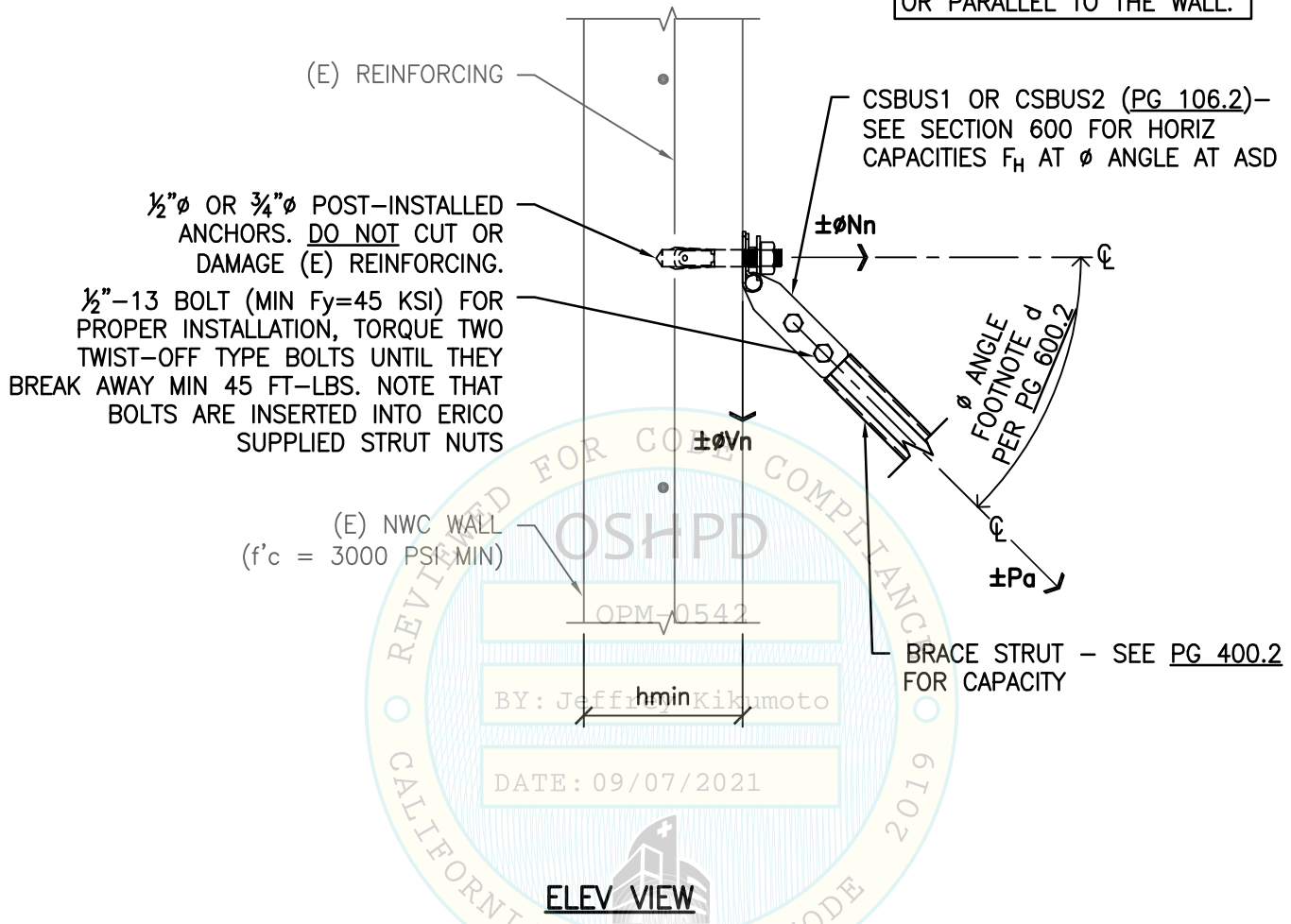
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| | CYS STRUCTURAL ENGINEERS, INC. | Job No: | 19039 |
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SEISMIC BRACING FOR MEP SYSTEMS

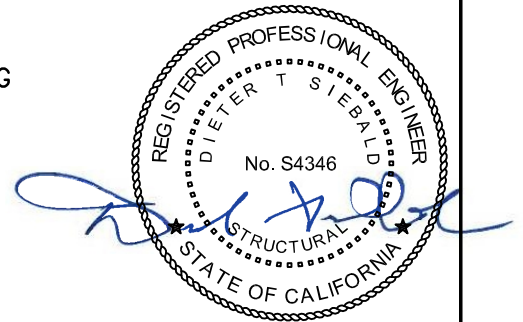


NOTE:
SERVICE PIPE MAY BE PERP
OR PARALLEL TO THE WALL.



NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.



**SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO CONCRETE WALL
CSBU POST INSTALLED ANCHORS W/ BRACE STRUT**

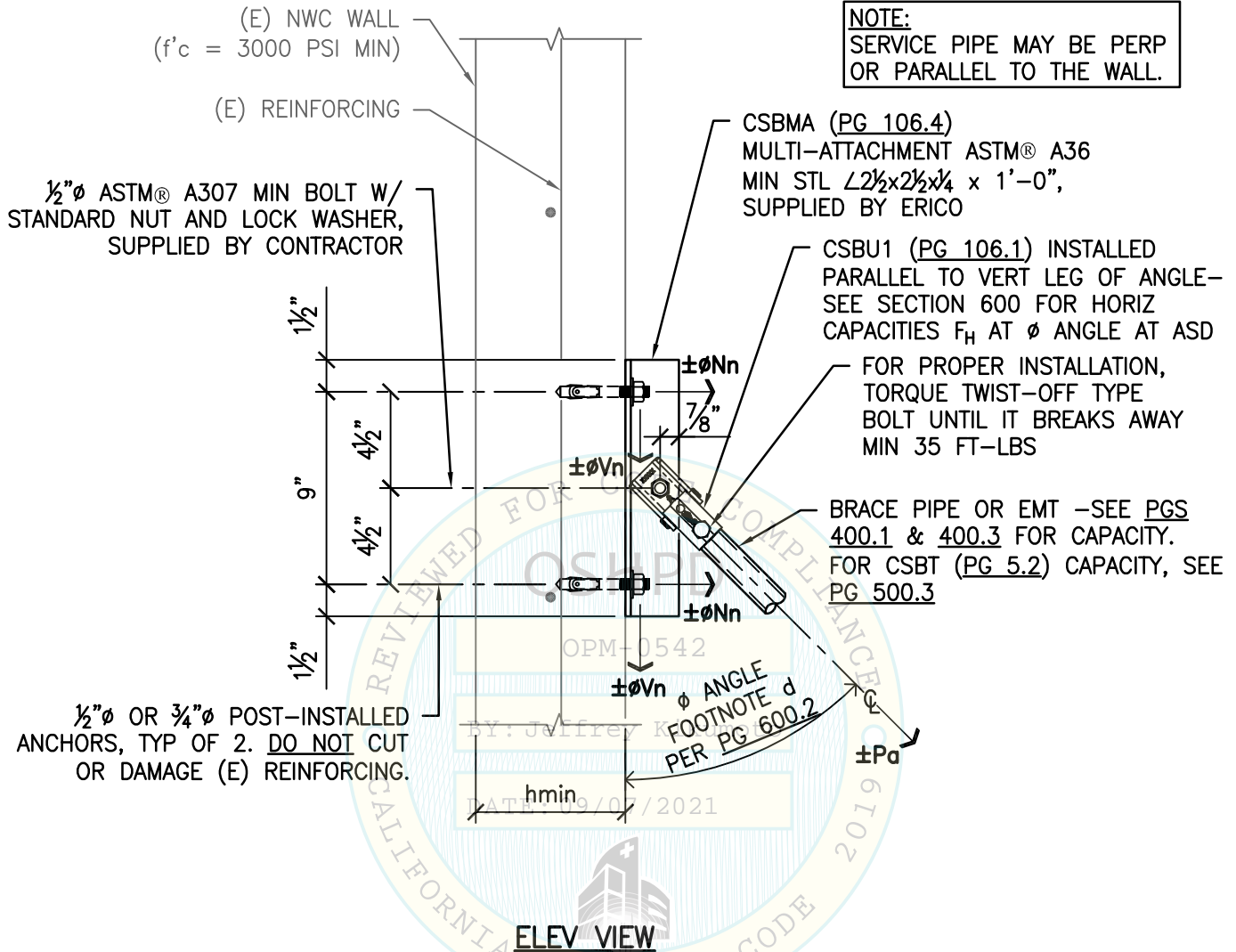
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SEISMIC BRACING FOR MEP SYSTEMS

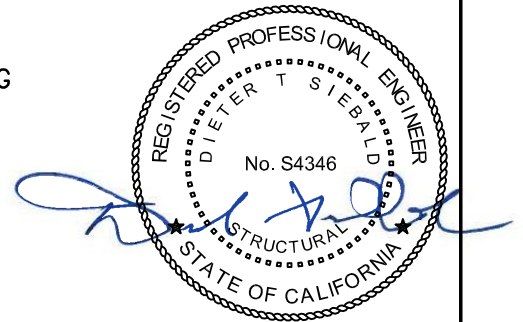


NOTE:
SERVICE PIPE MAY BE PERP
OR PARALLEL TO THE WALL.



NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. SEE PG 106.4 FOR ALLOWABLE CAPACITY OF THE CSBMA ANGLE.



**SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO CONCRETE WALL
CSBMA POST INSTALLED ANCHORS W/ BRACE PIPE**

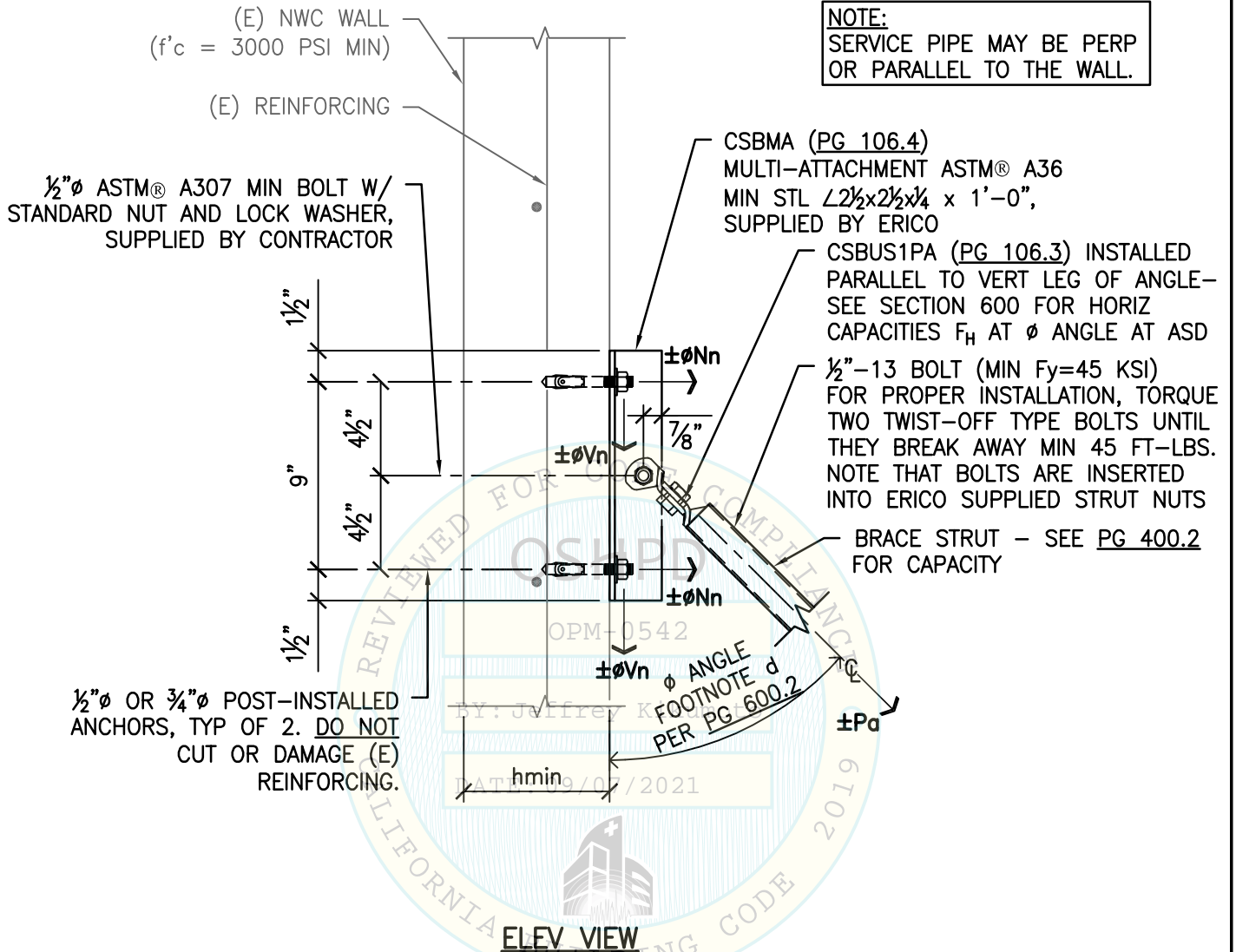
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SEISMIC BRACING FOR MEP SYSTEMS

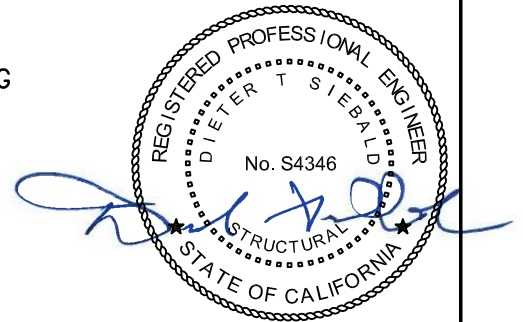


NOTE:
SERVICE PIPE MAY BE PERP
OR PARALLEL TO THE WALL.



NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. SEE PG 106.4 FOR ALLOWABLE CAPACITY OF THE CSBMA ANGLE.



**SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO CONCRETE WALL
CSBMA POST INSTALLED ANCHORS W/ BRACE STRUT**

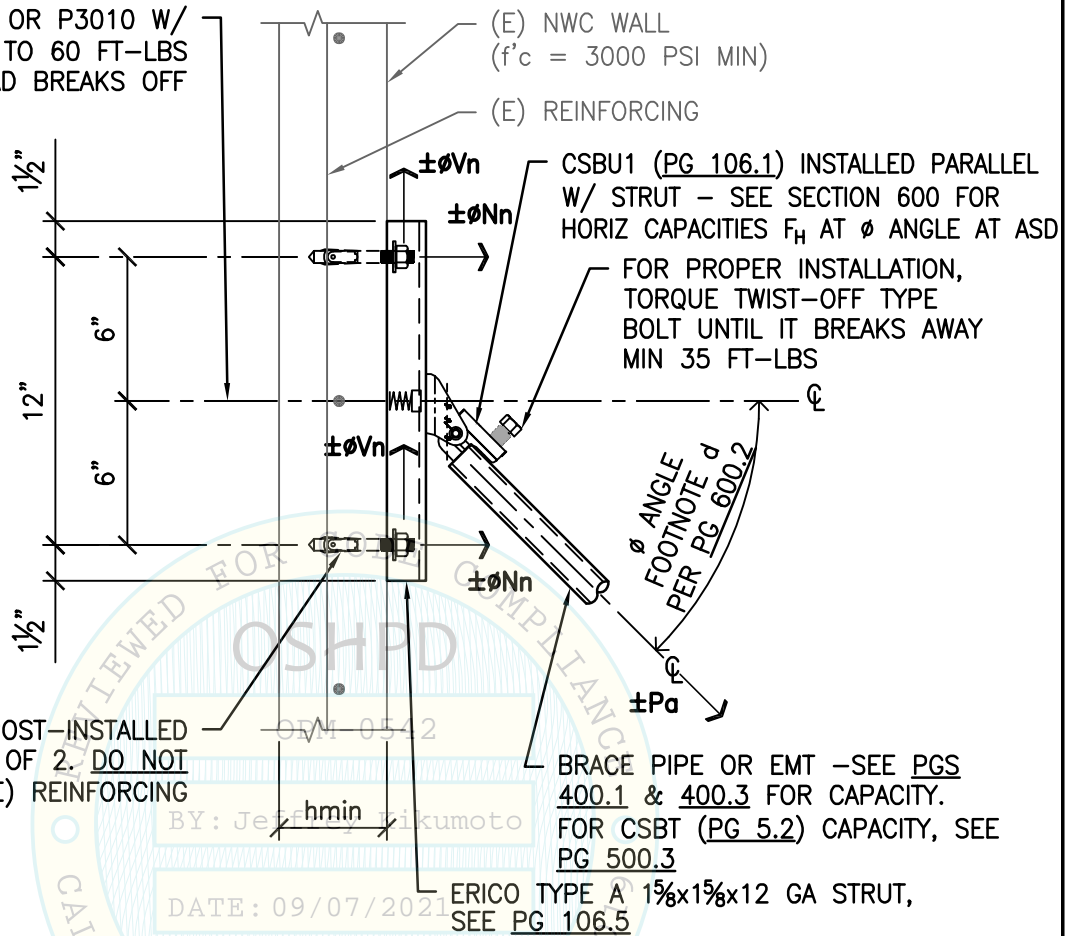
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| | CYS STRUCTURAL ENGINEERS, INC. | Job No: | 19039 | |
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SEISMIC BRACING FOR MEP SYSTEMS



UNISTRUT P1010 OR P3010 W/
HSSB050162. TORQUE TO 60 FT-LBS
UNTIL HEAD BREAKS OFF

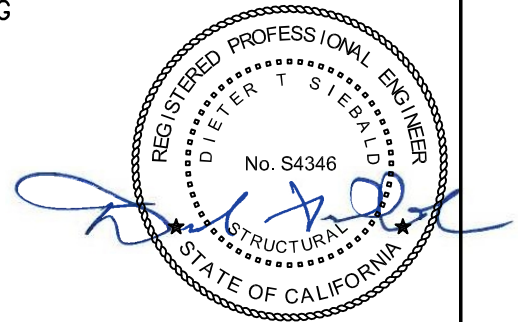


1/2"Ø OR 3/4"Ø POST-INSTALLED
ANCHORS, TYP OF 2. **DO NOT**
CUT OR DAMAGE (E) REINFORCING

BRACE PIPE OR EMT -SEE PGS
400.1 & 400.3 FOR CAPACITY.
FOR CSBT (PG 5.2) CAPACITY, SEE
PG 500.3

NOTES:

1. SEE APPENDIX 'A' FOR CONC ANCHORAGE CAPACITY FOR ANCHORS.
2. SEOR MUST VERIFY LRFD DEMAND FORCES INCLUDE Ω_o WHEN CHECKING CONC ANCHORAGE CAPACITY PROVIDED IN APPENDIX 'A'.
3. SEE GENERAL NOTES & HOW TO USE THIS PRE-APPROVAL.
4. THE ALLOWABLE ASD SLIP LOAD & TENSION LOAD FOR THE UNISTRUT P1010 OR P3010 IS 1370 LBS & 2810 LBS RESPECTIVELY.



**SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO CONCRETE WALL
STRUT POST INSTALLED ANCHORS W/ BRACE PIPE**



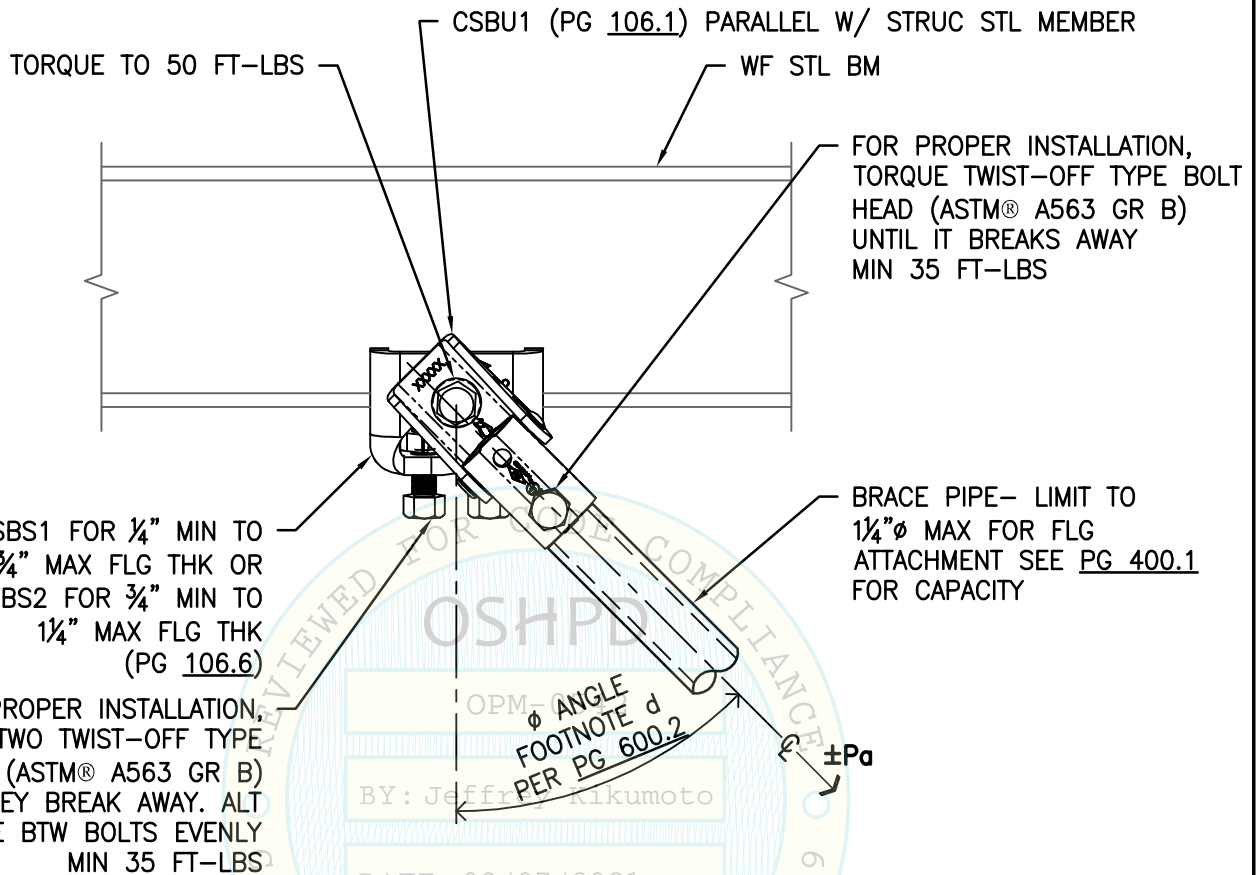
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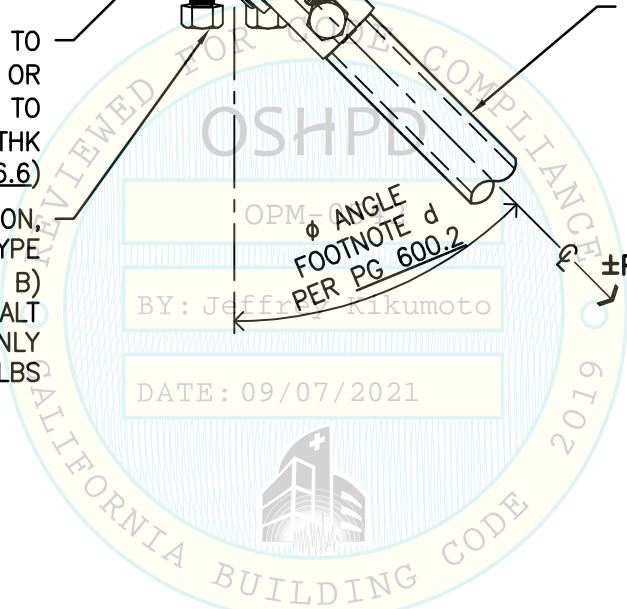
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| Page: | 102.5 of |

SEISMIC BRACING FOR MEP SYSTEMS



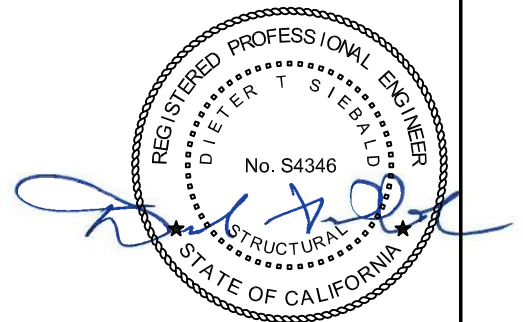
FOR PROPER INSTALLATION, TORQUE TWO TWIST-OFF TYPE BOLT HEADS (ASTM® A563 GR B) UNTIL THEY BREAK AWAY. ALT TORQUE BTW BOLTS EVENLY MIN 35 FT-LBS

BRACE PIPE- LIMIT TO 1 1/4" Ø MAX FOR FLG ATTACHMENT SEE PG 400.1 FOR CAPACITY



NOTES:

1. SEE SECTIONS 500 & 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBS1, CSBS1A, CSBS2 OR CSBU1 AT ASD W/ BRACE PIPE PARALLEL TO STRUC STL MEMBER (FOOTNOTE i. ON PG 600.3).
2. CSBS1A IS A PRE-ASSEMBLY OF CSBS1 & CSBU1.
3. PRE-ASSEMBLY CSBS1A CAN BE USED WHENEVER THE CSBS1 & CSBU1 ARE CALLED OUT.
4. THE CSBS1 OR CSBS2 DO NOT ROTATE. IT IS THE BRACE MEMBER THAT ROTATES.



SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO WIDE FLANGE STEEL BEAMS
CSBS1, CSBS1A & CSBS2 BOTTOM FLANGE W/ BRACE PIPE PARALLEL



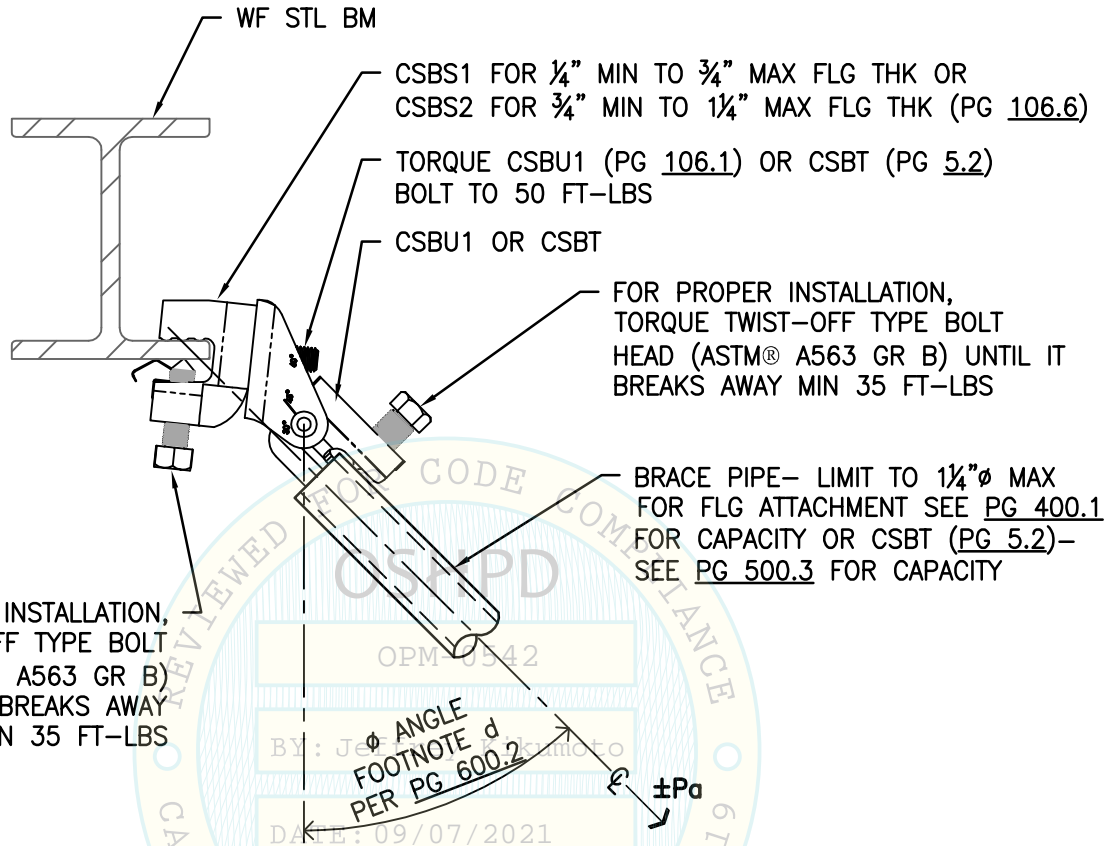
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| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 103.1 of . |

SEISMIC BRACING FOR MEP SYSTEMS



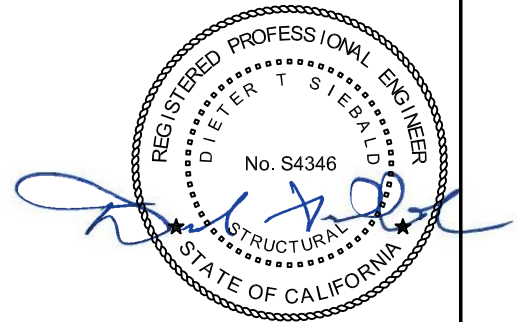
FOR PROPER INSTALLATION,
TORQUE TWIST-OFF TYPE BOLT
HEAD (ASTM® A563 GR B)
UNTIL IT BREAKS AWAY
MIN 35 FT-LBS

FOR PROPER INSTALLATION,
TORQUE TWIST-OFF TYPE BOLT
HEAD (ASTM® A563 GR B) UNTIL IT
BREAKS AWAY MIN 35 FT-LBS

BRACE PIPE- LIMIT TO 1 1/4" Ø MAX
FOR FLG ATTACHMENT SEE PG 400.1
FOR CAPACITY OR CSBT (PG 5.2)-
SEE PG 500.3 FOR CAPACITY

NOTES:

1. SEE SECTIONS 500 & 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBS1, CSBS1A, CSBS2, CSBU1 OR CSBT AT ASD W/ BRACE PIPE PERP TO STRUC STL MEMBER (FOOTNOTE j. ON PG 600.3).
2. CSBS1A IS A PRE-ASSEMBLY OF CSBS1 & CSBU1.
3. PRE-ASSEMBLY CSBS1A CAN BE USED WHENEVER THE CSBS1 & CSBU1 ARE CALLED OUT.
4. THE CSBS1 OR CSBS2 DO NOT ROTATE. IT IS THE BRACE MEMBER THAT ROTATES.



**SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO WIDE FLANGE STEEL BEAMS
CSBS1, CSBS1A & CSBS2 BOTTOM FLANGE W/ BRACE PIPE PERPENDICULAR**



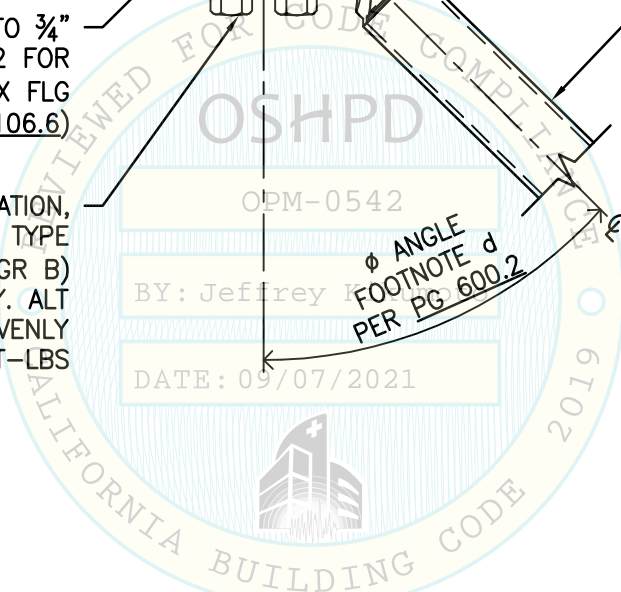
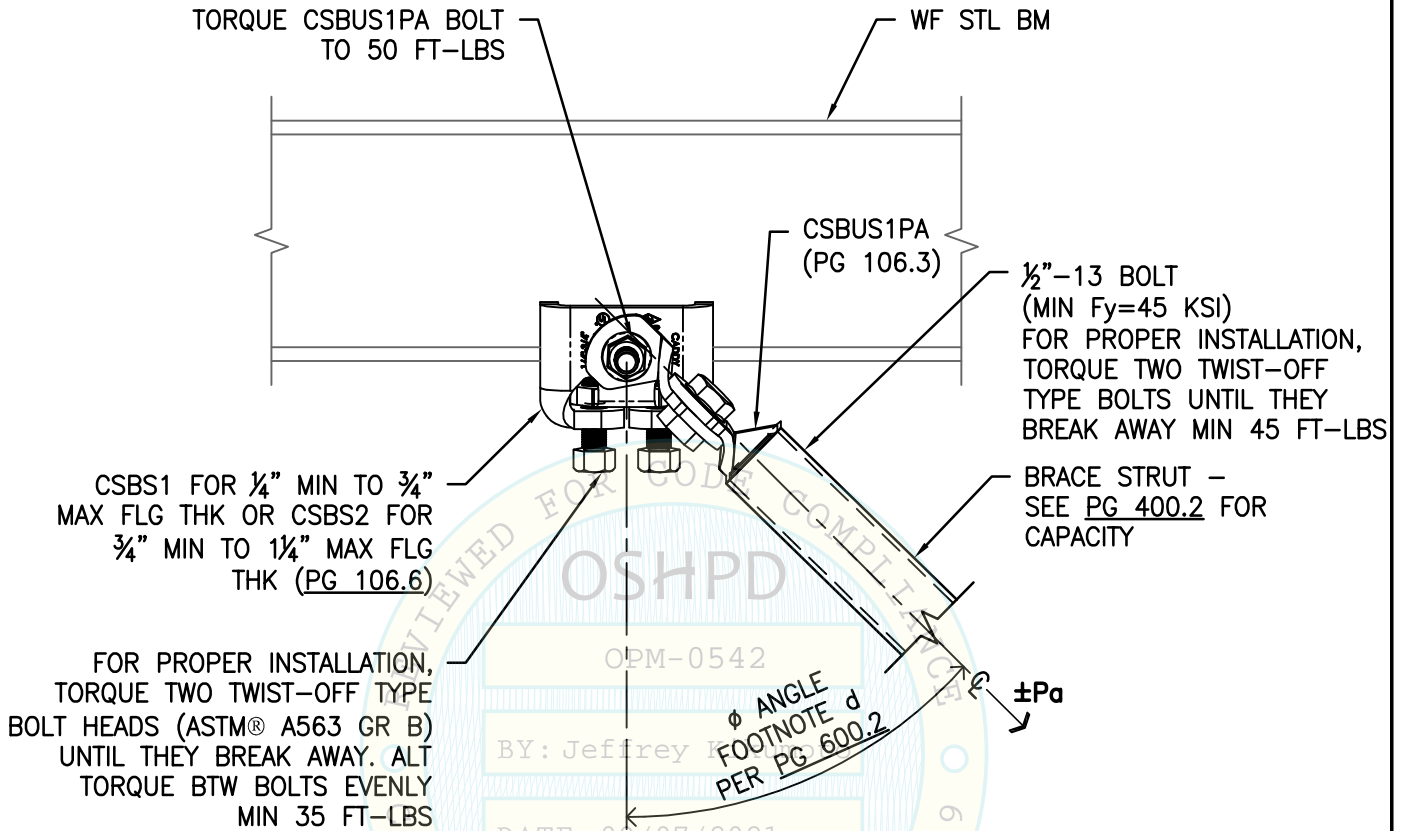
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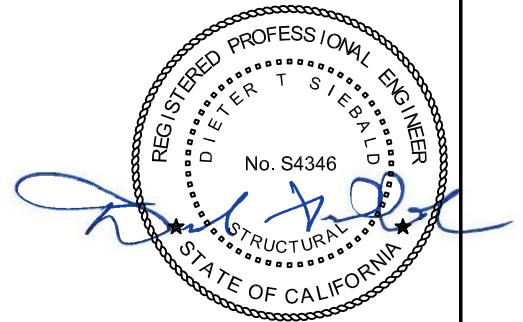
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| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 103.2 of . |

SEISMIC BRACING FOR MEP SYSTEMS



NOTES:

1. SEE SECTION 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBS1, CSBS2 OR CSBUS1PA AT ASD W/ BRACE PIPE PARALLEL TO STRUC STL MEMBER (FOOTNOTE i. ON PG 600.3).
2. THE CSBS1 OR CSBS2 DO NOT ROTATE. IT IS THE BRACE MEMBER THAT ROTATES.

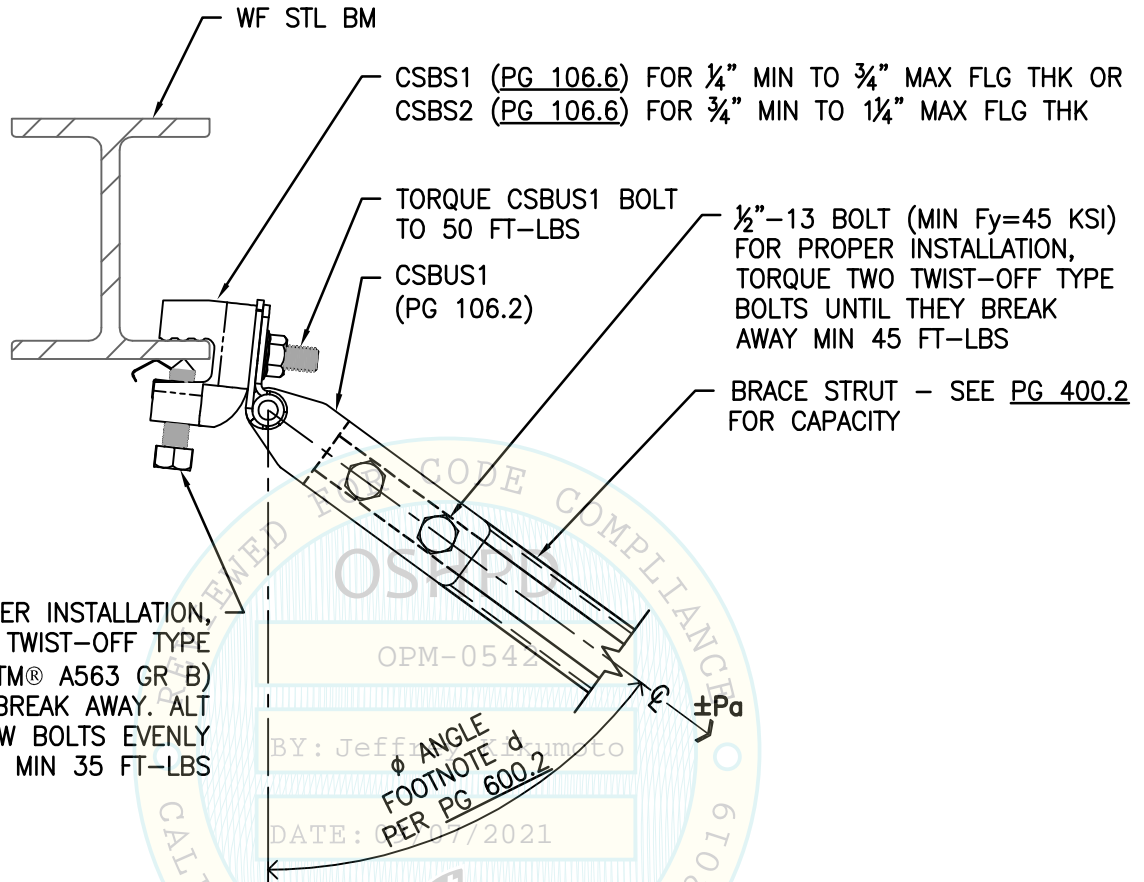


**SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO WIDE FLANGE STEEL BEAMS
CSBS1 & CSBS2 BOTTOM FLANGE W/ BRACE STRUT PARALLEL**

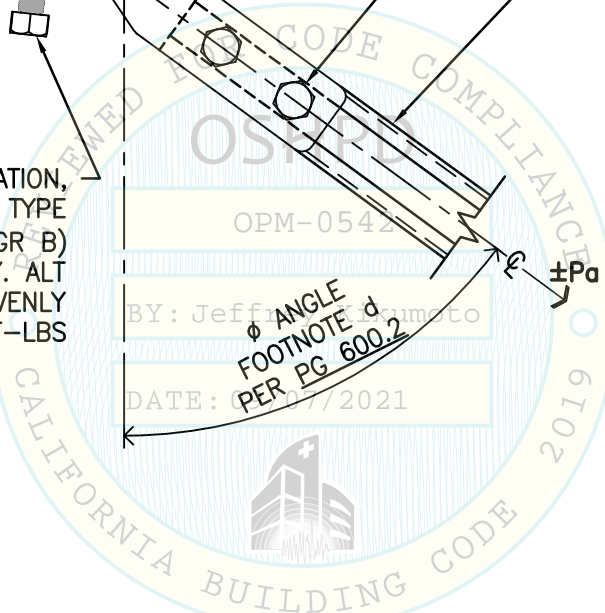
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| | | Page: | 103.3 of . |

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SEISMIC BRACING FOR
MEP SYSTEMS



FOR PROPER INSTALLATION,
TORQUE TWO TWIST-OFF TYPE
BOLT HEADS (ASTM® A563 GR B)
UNTIL THEY BREAK AWAY. ALT
TORQUE BTW BOLTS EVENLY
MIN 35 FT-LBS



NOTES:

1. SEE SECTION 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBS1, CSBS2 OR CSBUS1 AT ASD W/ BRACE PIPE PERP TO STRUC STL MEMBER (FOOTNOTE j. ON PG 600.3).
2. THE CSBS1 OR CSBS2 DO NOT ROTATE. IT IS THE BRACE MEMBER THAT ROTATES.

SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO WIDE FLANGE STEEL BEAMS
CSBS1 & CSBS2 BOTTOM FLANGE W/ BRACE STRUT PERPENDICULAR



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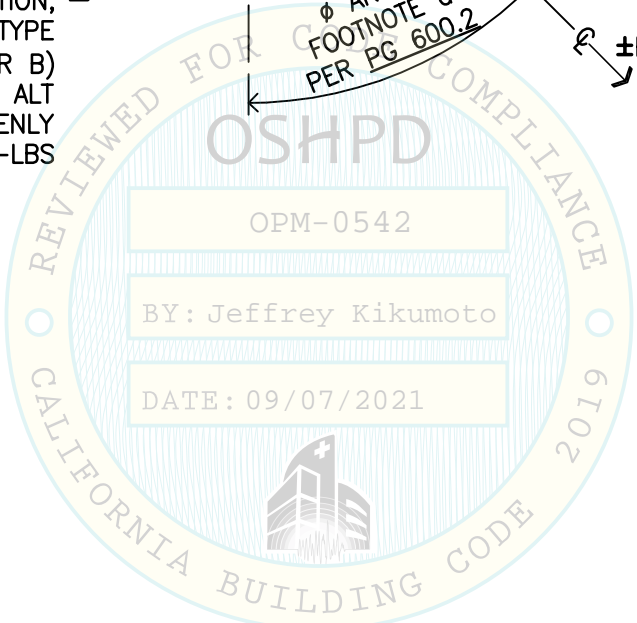
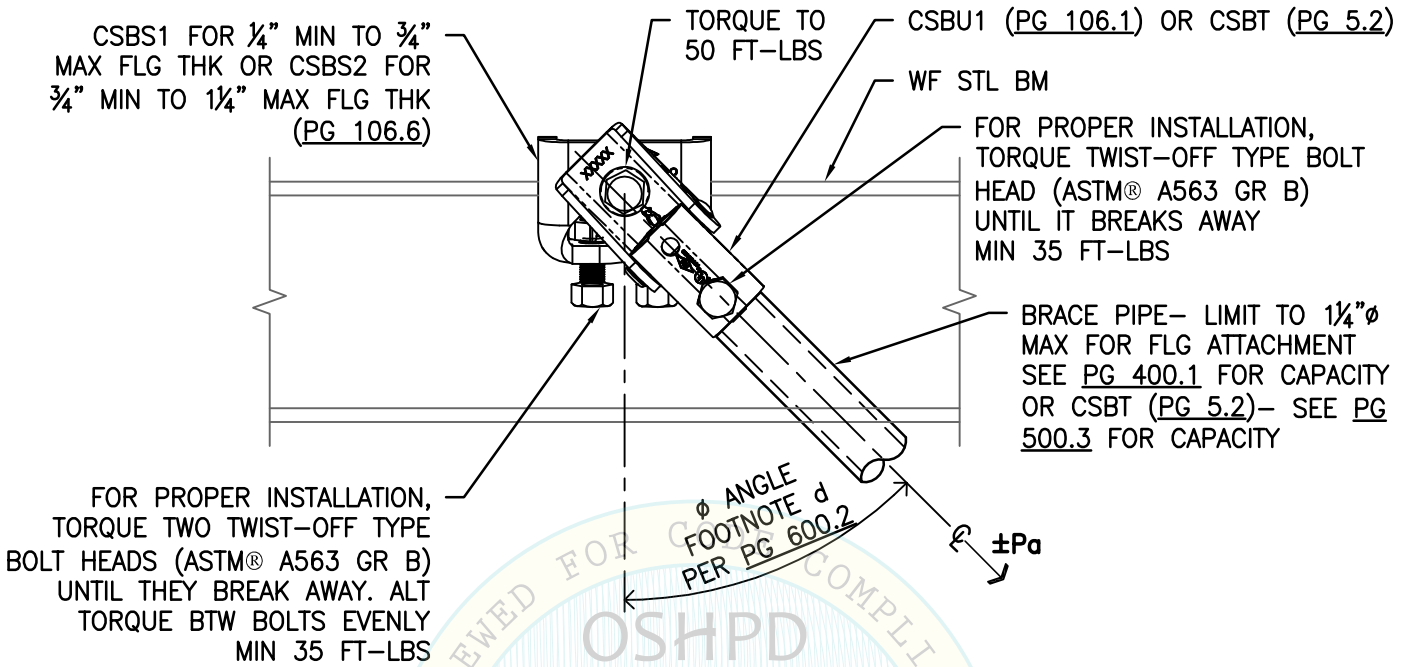
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| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 103.4 of . |

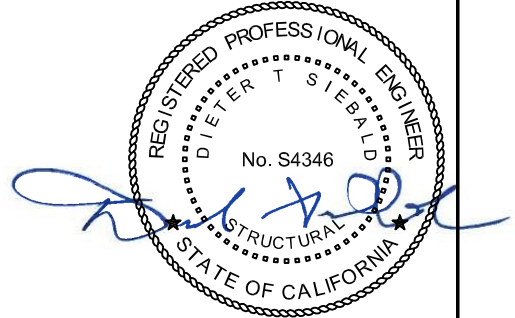
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SEISMIC BRACING FOR
MEP SYSTEMS



NOTES:

1. SEE SECTIONS 500 & 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBS1, CSBS1A, CSBS2, CSBU1 OR CSBT AT ASD.
2. CSBS1A IS A PRE-ASSEMBLY OF CSBS1 & CSBU1.
3. PRE-ASSEMBLY CSBS1A CAN BE USED WHENEVER THE CSBS1 & CSBU1 ARE CALLED OUT.
4. THE CSBS1 OR CSBS2 DO NOT ROTATE. IT IS THE BRACE MEMBER THAT ROTATES.



SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO WIDE FLANGE STEEL BEAMS
CSBS1, CSBS1A & CSBS2 TOP FLANGE W/ BRACE PIPE PARALLEL



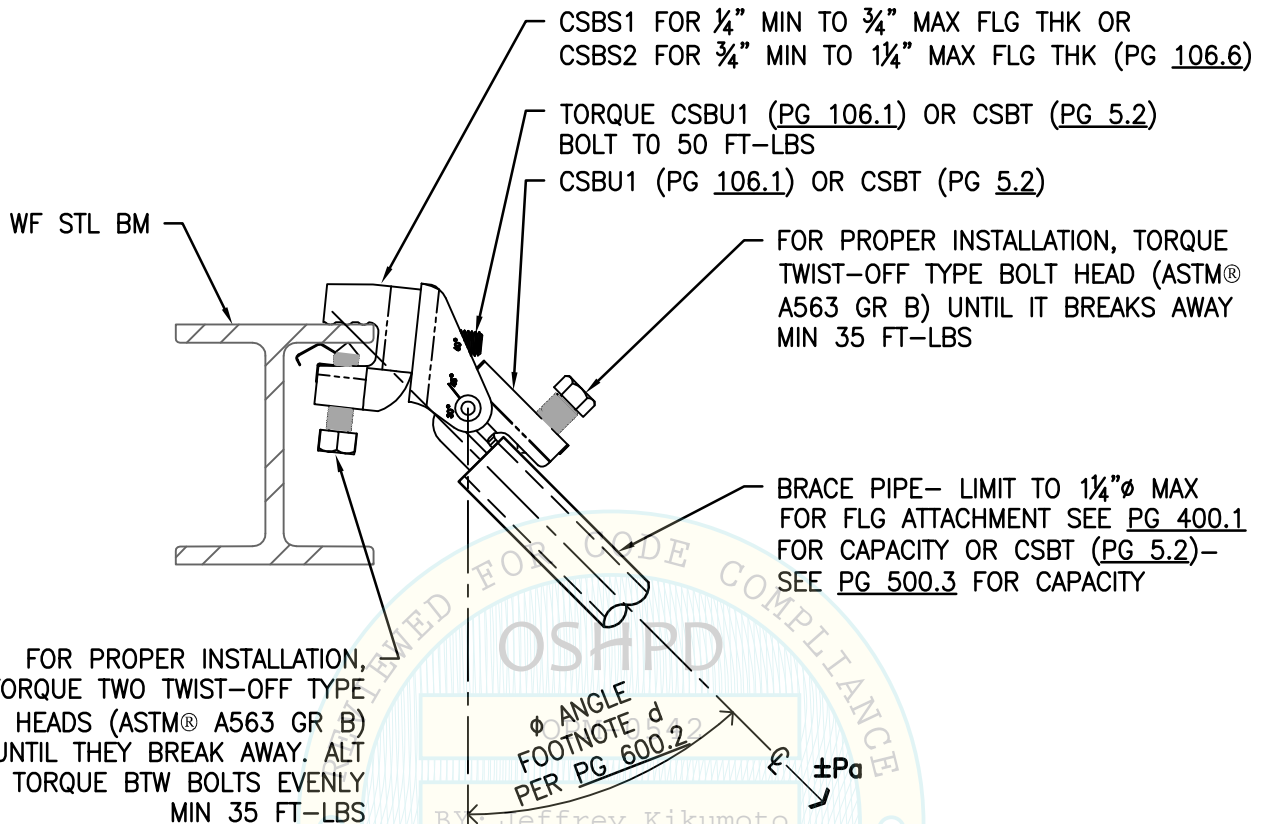
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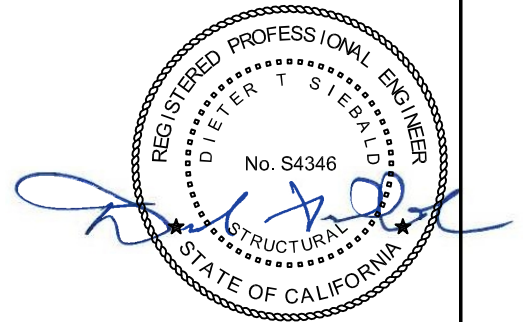
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| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 103.5 of . |

SEISMIC BRACING FOR MEP SYSTEMS



NOTES:

1. SEE SECTIONS 500 & 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBS1, CSBS1A, CSBS2, CSBU1 OR CSBT AT ASD.
2. CSBS1A (PG 106.6) IS A PRE-ASSEMBLY OF CSBS1 & CSBU1.
3. PRE-ASSEMBLY CSBS1A CAN BE USED WHENEVER THE CSBS1 & CSBU1 ARE CALLED OUT.



**SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO WIDE FLANGE STEEL BEAMS
CSBS1, CSBS1A & CSBS2 TOP FLANGE W/ BRACE PIPE PERPENDICULAR**



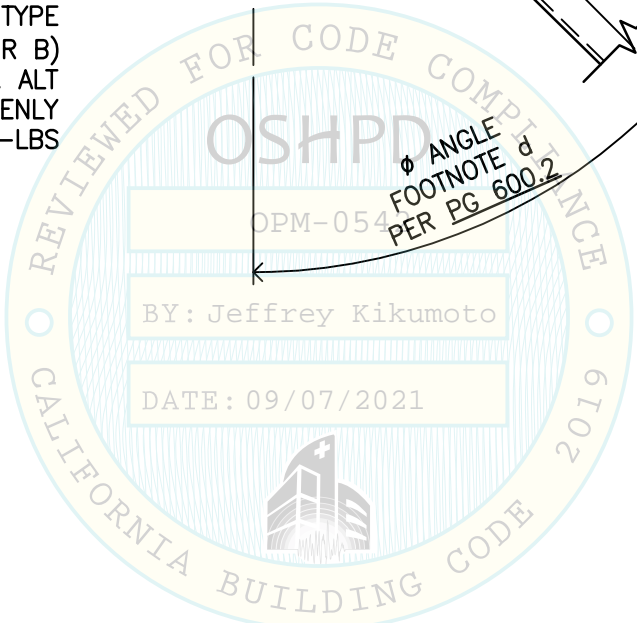
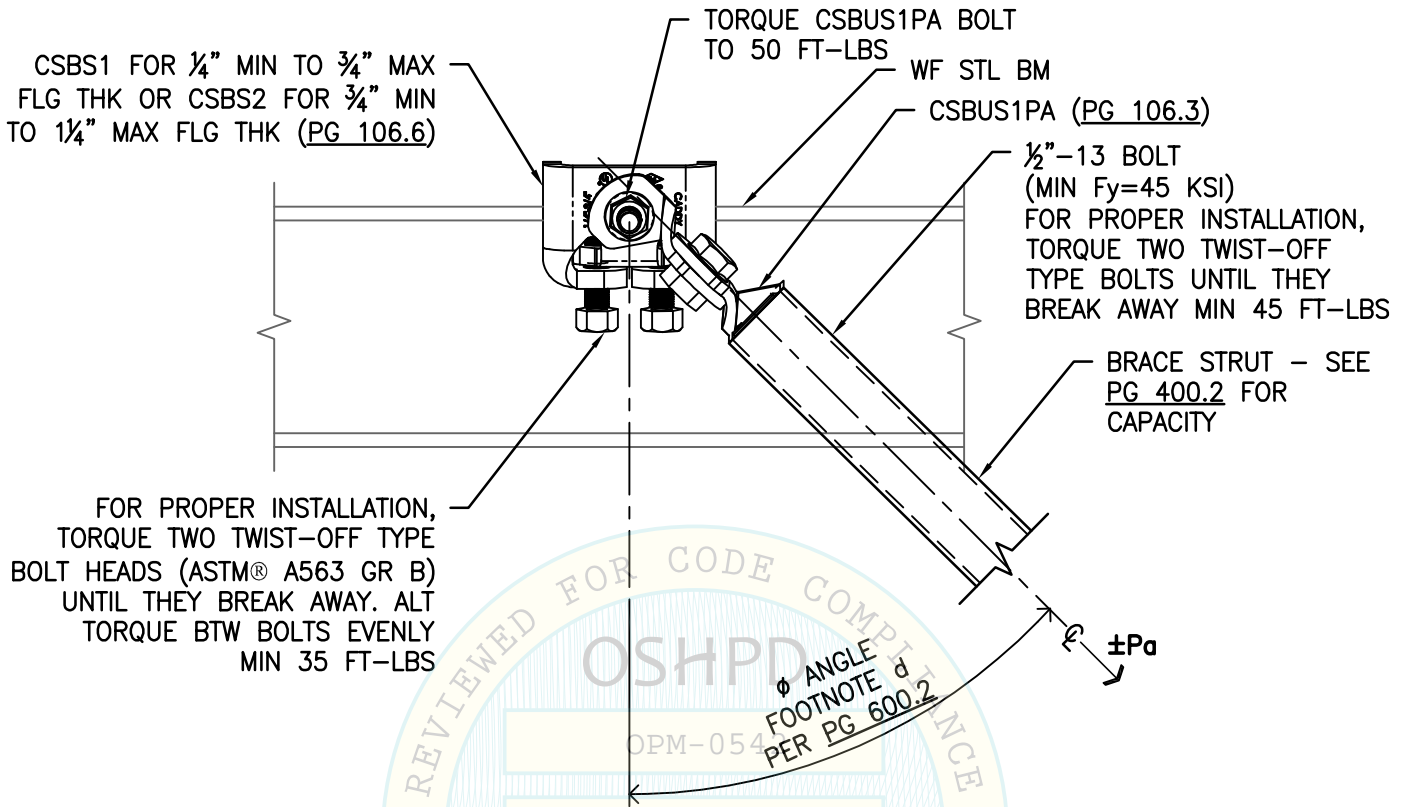
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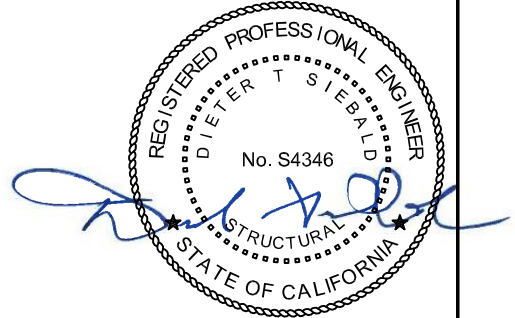
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|---------|------------|
| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 103.6 of . |

SEISMIC BRACING FOR MEP SYSTEMS



NOTE:
SEE SECTION 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBS1,
CSBS2 OR CSBUS1PA AT ASD.

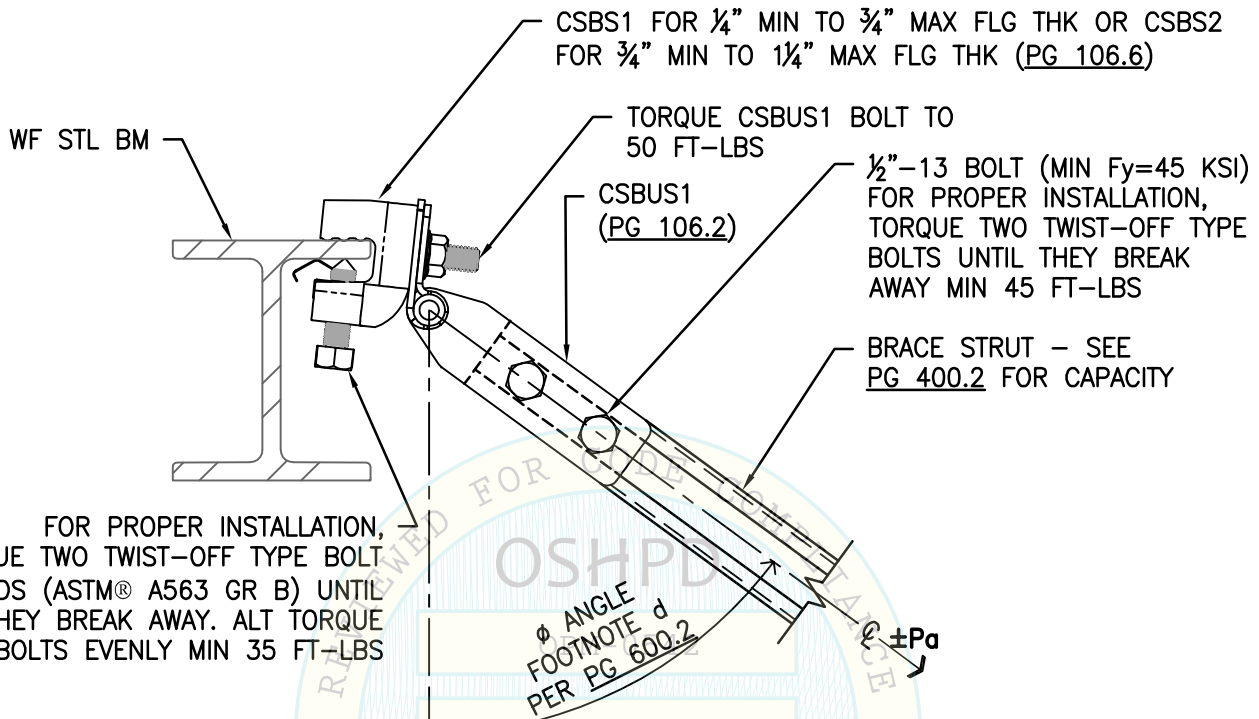


SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO WIDE FLANGE STEEL BEAMS
CSBS1 & CSBS2 TOP FLANGE W/ BRACE STRUT PARALLEL

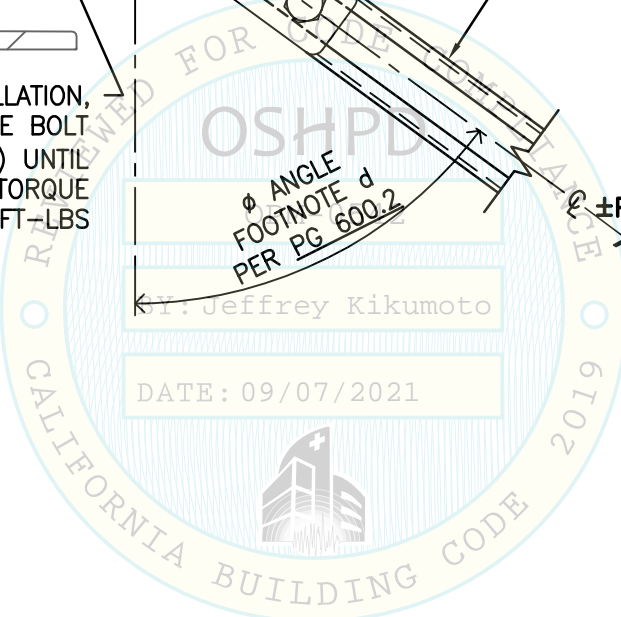
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| <p>CYS STRUCTURAL ENGINEERS, INC. 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833</p> | TEL (916) 920-2020 www.cyseng.com | Job No: 19039 Date: 09/08/2021 Page: 103.7 of . |
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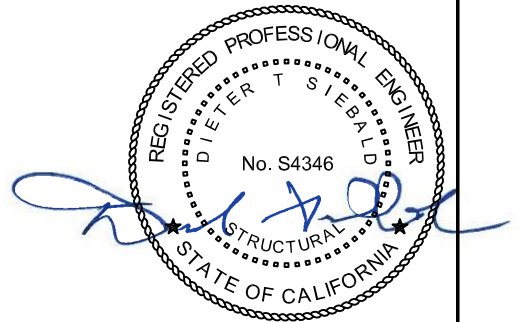
SEISMIC BRACING FOR
MEP SYSTEMS



FOR PROPER INSTALLATION,
TORQUE TWO TWIST-OFF TYPE
HEADS (ASTM® A563 GR B)
UNTIL THEY BREAK AWAY. ALT
TORQUE BTW BOLTS EVENLY
MIN 35 FT-LBS



NOTE:
SEE SECTION 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBS1,
CSBS2 OR CSBUS1 AT ASD.



SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO WIDE FLANGE STEEL BEAMS
CSBS1 & CSBS2 TOP FLANGE W/ BRACE STRUT PERPENDICULAR

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|--|--------------------------------------|---|
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SEISMIC BRACING FOR MEP SYSTEMS



| PART NO. | FLG THK | FLG WIDTH | THRD ROD |
|----------|----------------|---------------|----------|
| CSBS3 | 1/4" TO 3/4" | 4" TO 8 1/2" | 12" |
| CSBS4 | 1/4" TO 3/4" | 4" TO 14 1/2" | 17" |
| CSBS5 | 3/4" TO 1 1/4" | 4" TO 18" | 21 1/2" |

FOR PROPER INSTALLATION,
TORQUE TWO TWIST-OFF TYPE BOLT
HEADS (ASTM® A563 GR B) UNTIL
THEY BREAK AWAY. ALT TORQUE BTW
BOLTS EVENLY MIN 35 FT-LBS

1/2-13 UNC-2Ax1.75" CARRIAGE BOLT
& 1/2-13 UNC-2B SERRATED FLG
NUT SUPPLIED BY ERICO®
(ASTM A449, 25-34 HRC HARDNESS).
TORQUE TO 50 FT-LBS

FOR PROPER INSTALLATION,
TORQUE TWIST-OFF TYPE
BOLT HEAD UNTIL IT BREAKS
AWAY MIN 35 FT-LBS

BRACE PIPE SEE PG 400.1 FOR
CAPACITY OR CSBT (PG 5.2)
SEE PG 500.3 FOR CAPACITY

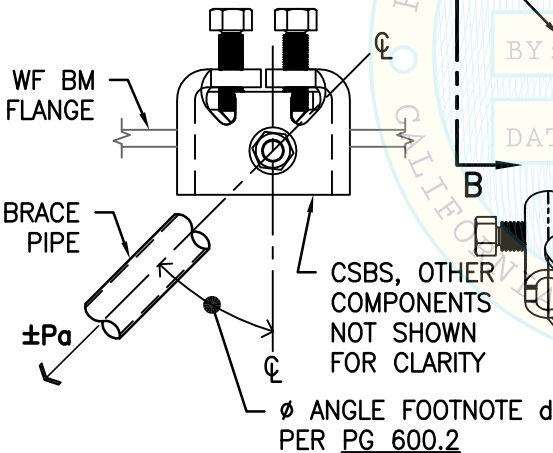
(E) WF BM. SEE SEOR
RESPONSIBILITIES IN SECTION 1

1/4" THK FLG SHOE

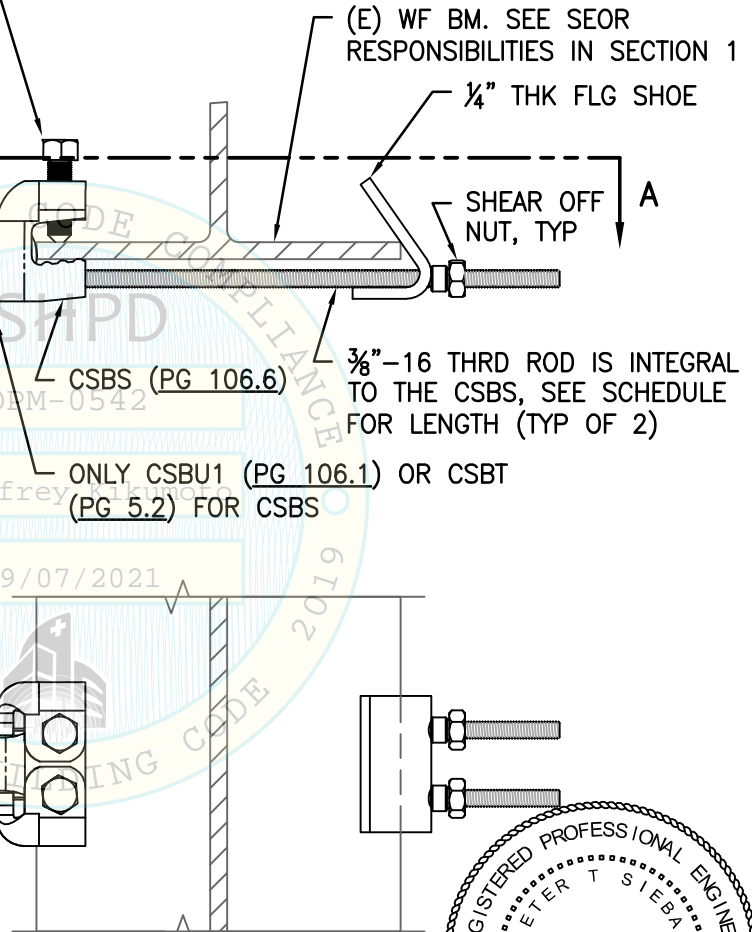
SHEAR OFF
NUT, TYP

3/8"-16 THRD ROD IS INTEGRAL
TO THE CSBS, SEE SCHEDULE
FOR LENGTH (TYP OF 2)

ONLY CSBU1 (PG 106.1) OR CSBT
(PG 5.2) FOR CSBS



SECTION VIEW B-B



PLAN VIEW A-A

NOTE:
SEE SECTIONS 500 & 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE
OF CSBS3, CSBS4, CSBS5, CSBU1 OR CSBT AT ASD.

**SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO WIDE FLANGE STEEL BEAMS
CSBS3, CSBS4 & CSBS5 BOTTOM FLANGE W/ BRACE PIPE PARALLEL**



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| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 103.9 of |

SEISMIC BRACING FOR MEP SYSTEMS



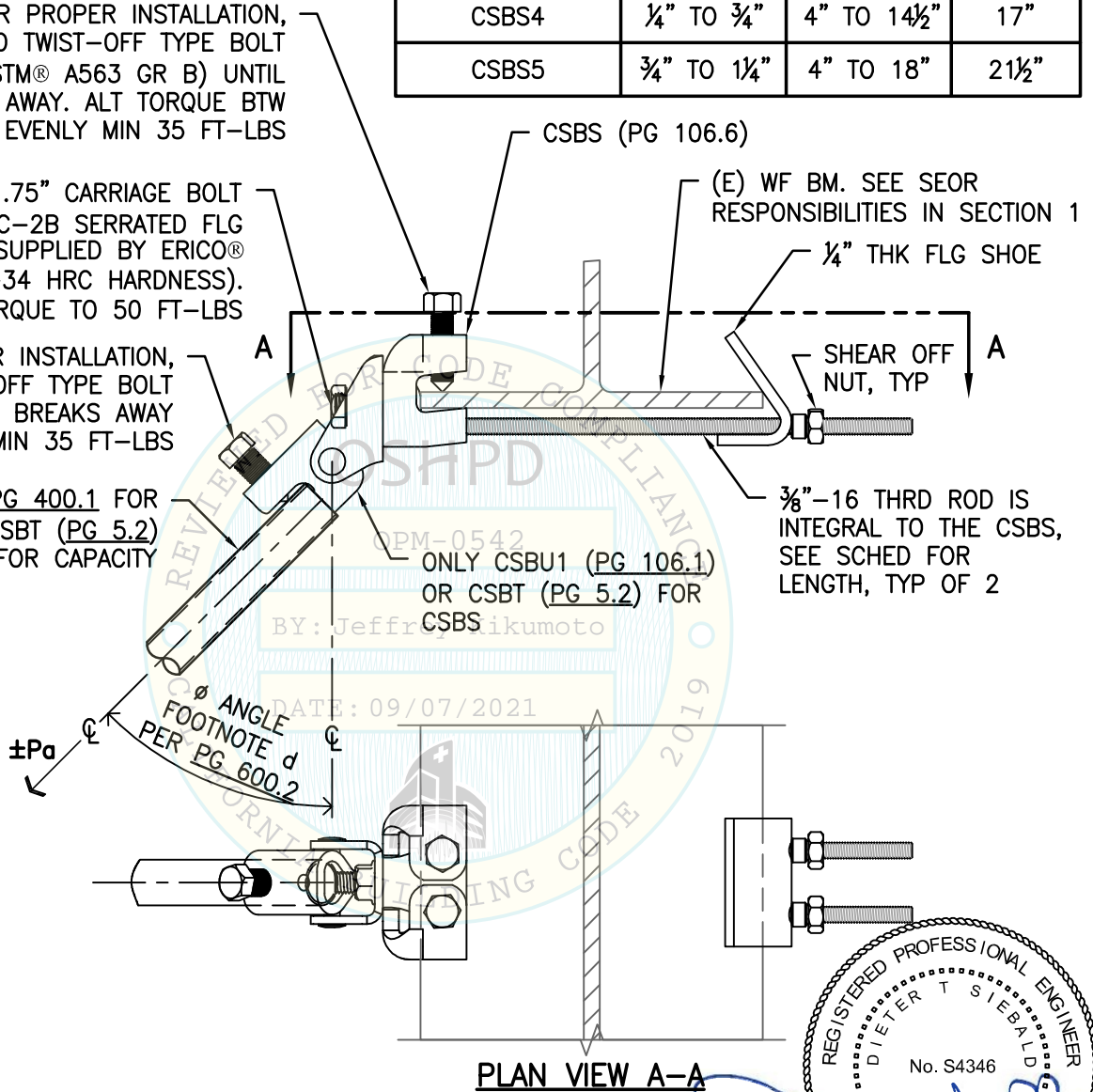
| PART NO. | FLG THK | FLG WIDTH | THRD ROD |
|----------|----------------|---------------|----------|
| CSBS3 | 1/4" TO 3/4" | 4" TO 8 1/2" | 12" |
| CSBS4 | 1/4" TO 3/4" | 4" TO 14 1/2" | 17" |
| CSBS5 | 3/4" TO 1 1/4" | 4" TO 18" | 21 1/2" |

FOR PROPER INSTALLATION,
TORQUE TWO TWIST-OFF TYPE BOLT
HEADS (ASTM® A563 GR B) UNTIL
THEY BREAK AWAY. ALT TORQUE BTW
BOLTS EVENLY MIN 35 FT-LBS

1/2-13 UNC-2A x 1.75" CARRIAGE BOLT
& 1/2-13 UNC-2B SERRATED FLG
NUT SUPPLIED BY ERICO®
(ASTM A449, 25-34 HRC HARDNESS).
TORQUE TO 50 FT-LBS

FOR PROPER INSTALLATION,
TORQUE TWIST-OFF TYPE BOLT
HEAD UNTIL IT BREAKS AWAY
MIN 35 FT-LBS

BRACE PIPE SEE PG 400.1 FOR
CAPACITY OR CSBT (PG 5.2)
SEE PG 500.3 FOR CAPACITY

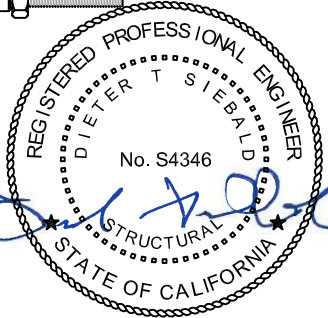


±Pa
∅ ANGLE
FOOTNOTE d
PER PG 600.2

ONLY CSBU1 (PG 106.1)
OR CSBT (PG 5.2) FOR
CSBS

3/8"-16 THRD ROD IS
INTEGRAL TO THE CSBS,
SEE SCHED FOR
LENGTH, TYP OF 2

PLAN VIEW A-A



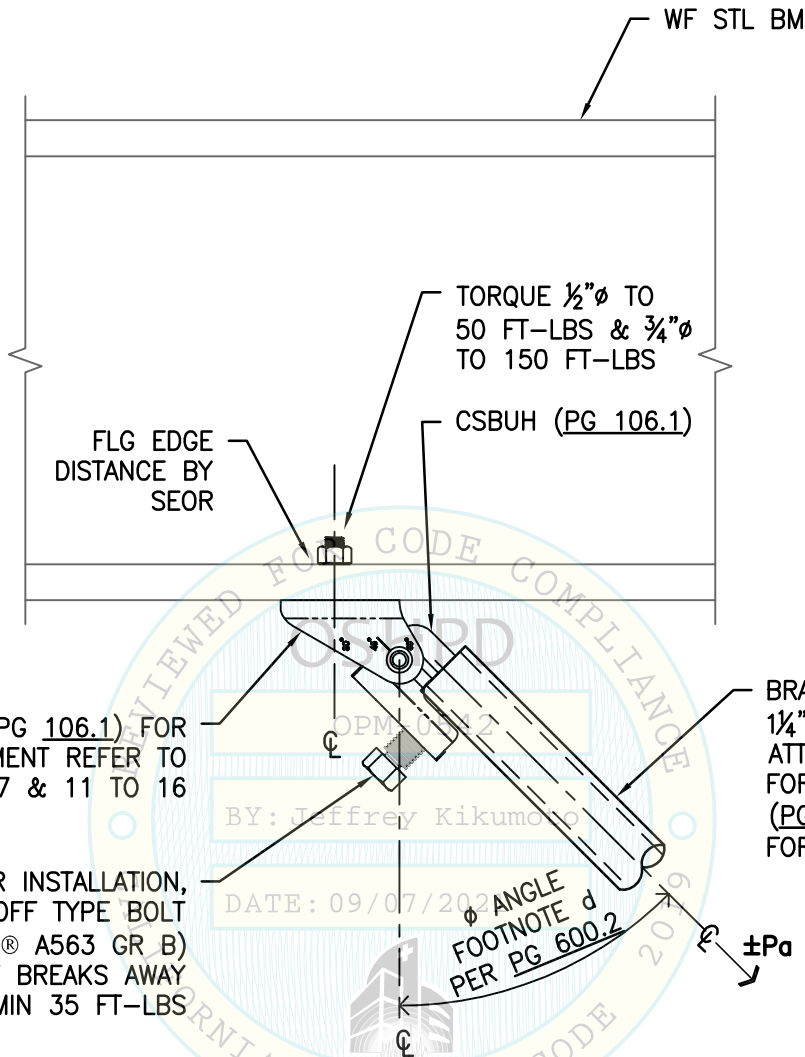
NOTE:
SEE SECTIONS 500 & 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE
OF CSBS3, CSBS4, CSBS5, CSBU1 OR CSBT AT ASD.

**SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO WIDE FLANGE STEEL BEAMS
CSBS3, CSBS4 & CSBS5 BOTTOM FLANGE W/ BRACE PIPE PERPENDICULAR**

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SEISMIC BRACING FOR MEP SYSTEMS



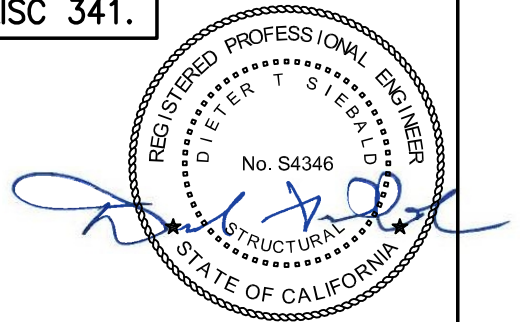
CSBU1 OR CSBU2 (PG 106.1) FOR BRACE ATTACHMENT REFER TO SECTIONS 2 TO 7 & 11 TO 16

FOR PROPER INSTALLATION, TORQUE TWIST-OFF TYPE BOLT HEAD (ASTM® A563 GR B) UNTIL IT BREAKS AWAY MIN 35 FT-LBS

BRACE PIPE - LIMIT TO 1 1/4"φ MAX FOR FLG ATTACHMENT SEE PG 400.1 FOR CAPACITY OR CSBT (PG 5.2) - SEE PG 500.3 FOR CAPACITY

WARNING: ATTACHMENTS ARE NOT ALLOWED IN PROTECTED ZONES AS DEFINED IN AISC 341.

NOTE:
SEE SECTIONS 500 & 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBU1, CSBU2 OR CSBT AT ASD.



SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO WIDE FLANGE STEEL BEAMS
CSBU BOTTOM FLANGE W/ BRACE PIPE PARALLEL



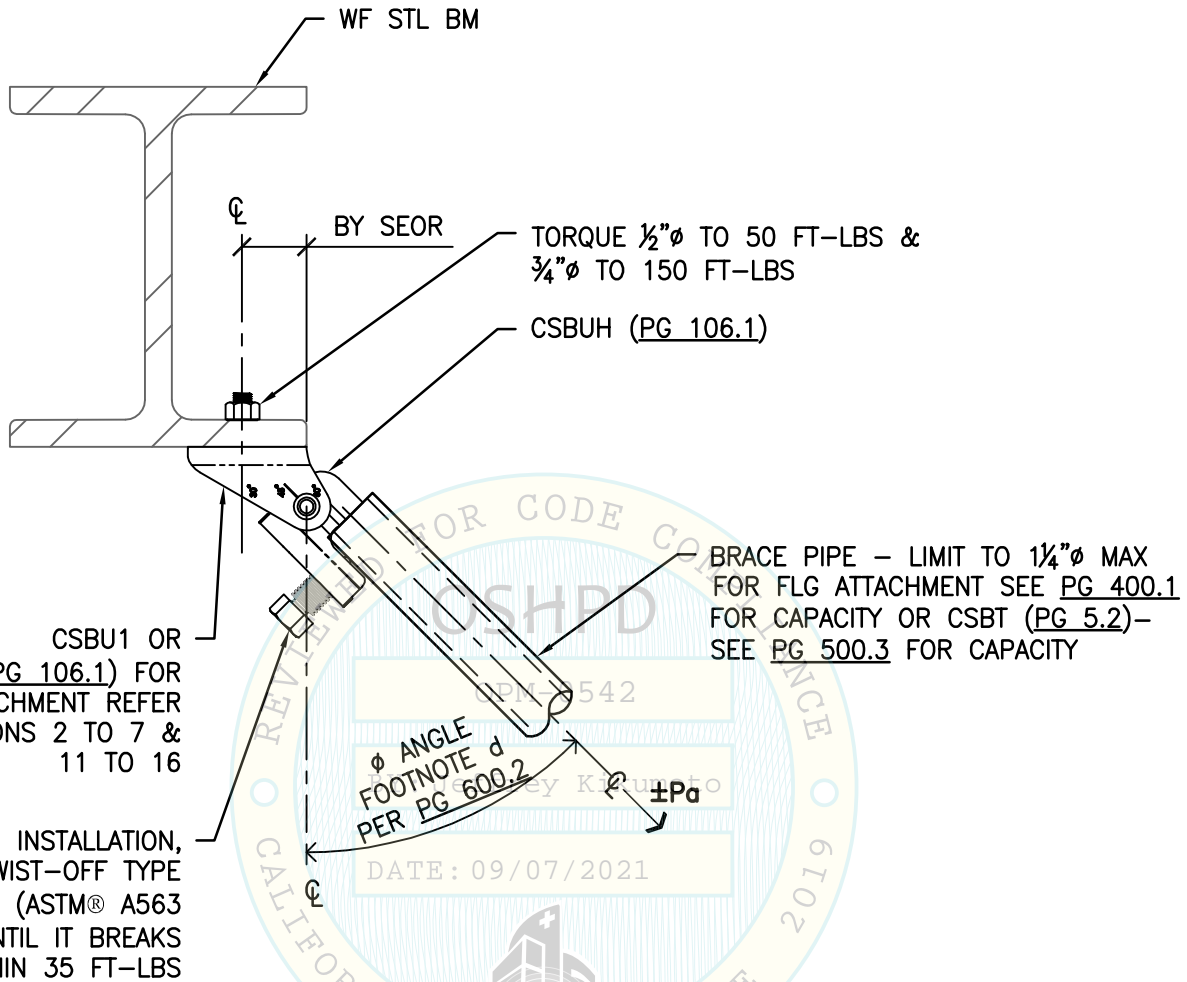
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| Date: | 09/08/2021 |
| Page: | 103.11 of . |

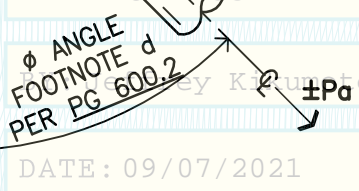
SEISMIC BRACING FOR
MEP SYSTEMS



CSBU1 OR CSBU2 (PG 106.1) FOR BRACE ATTACHMENT REFER TO SECTIONS 2 TO 7 & 11 TO 16

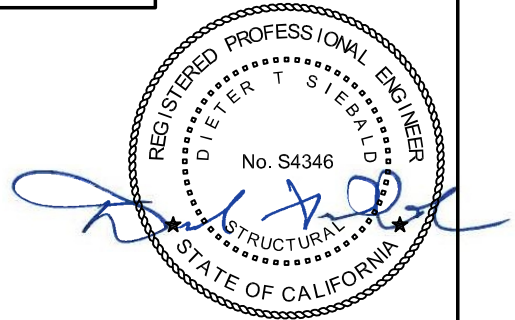
FOR PROPER INSTALLATION, TORQUE TWIST-OFF TYPE BOLT HEAD (ASTM® A563 GR B) UNTIL IT BREAKS AWAY MIN 35 FT-LBS

BRACE PIPE – LIMIT TO 1/4"Ø MAX FOR FLG ATTACHMENT SEE PG 400.1 FOR CAPACITY OR CSBT (PG 5.2) – SEE PG 500.3 FOR CAPACITY



WARNING: ATTACHMENTS ARE NOT ALLOWED IN PROTECTED ZONES AS DEFINED IN AISC 341.

NOTE:
SEE SECTIONS 500 & 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBU1, CSBU2 OR CSBT AT ASD.



SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO WIDE FLANGE STEEL BEAMS
CSBU BOTTOM FLANGE W/ BRACE PIPE PERPENDICULAR



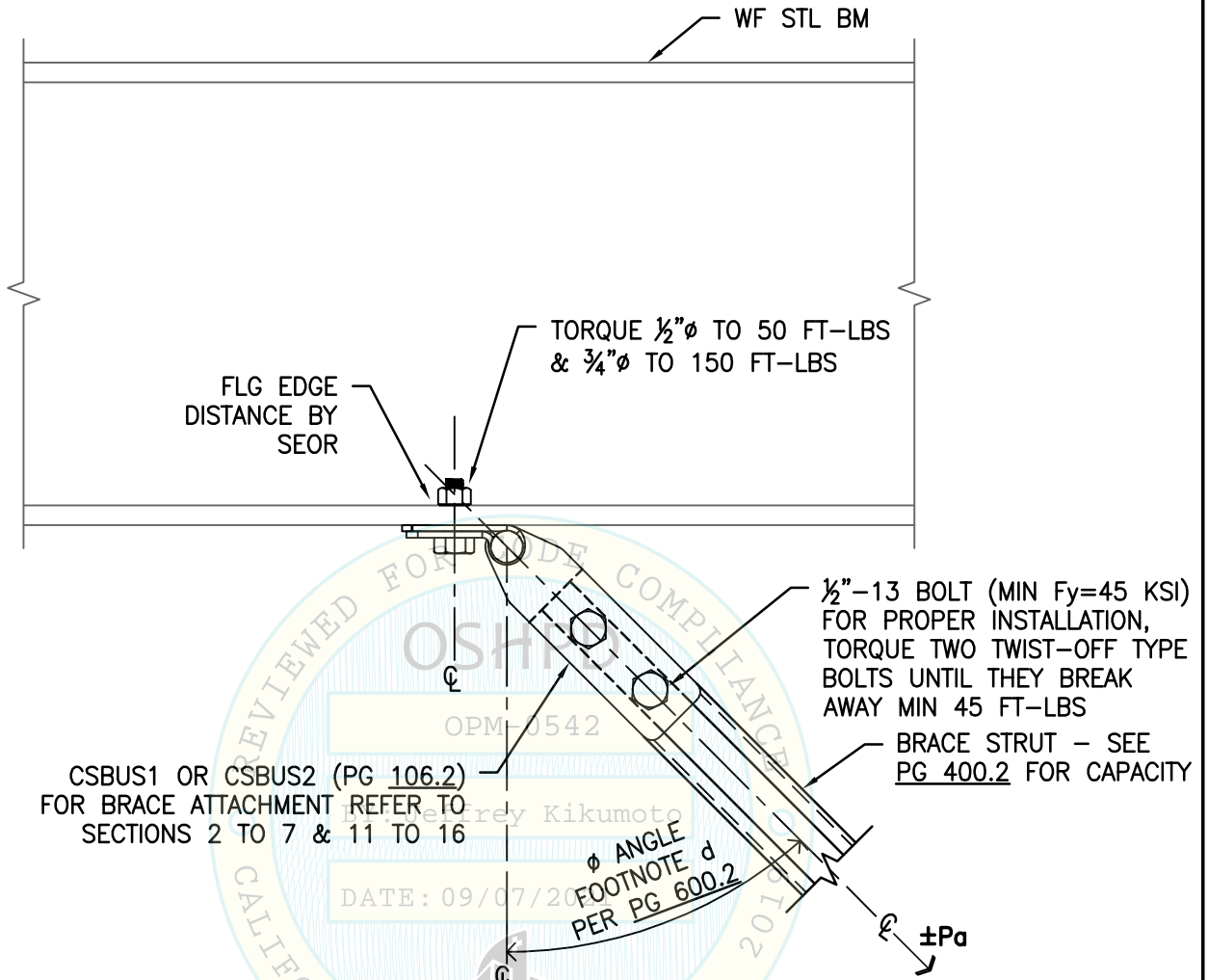
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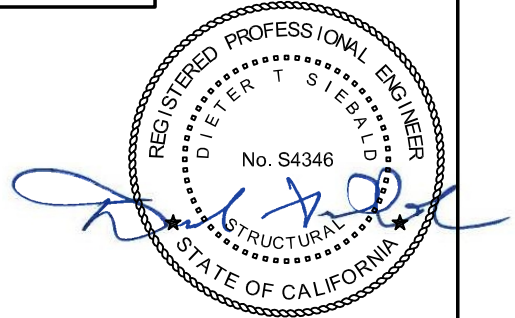
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| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 103.12 of . |

SEISMIC BRACING FOR MEP SYSTEMS



WARNING: ATTACHMENTS ARE NOT ALLOWED IN PROTECTED ZONES AS DEFINED IN AISC 341.

NOTE:
SEE SECTION 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBUS1 OR CSBUS2 AT ASD.

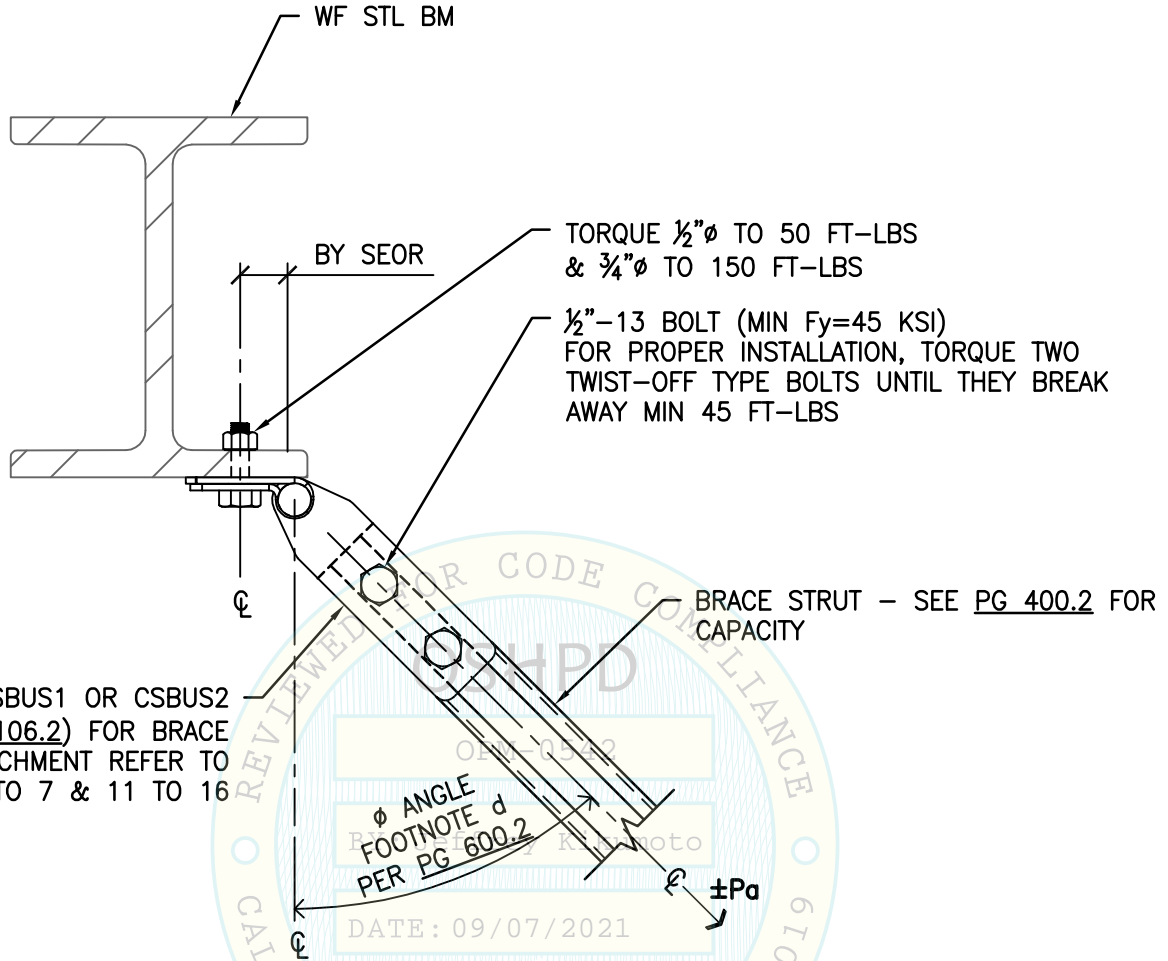


SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO WIDE FLANGE STEEL BEAMS
CSBU BOTTOM FLANGE W/ BRACE STRUT PARALLEL

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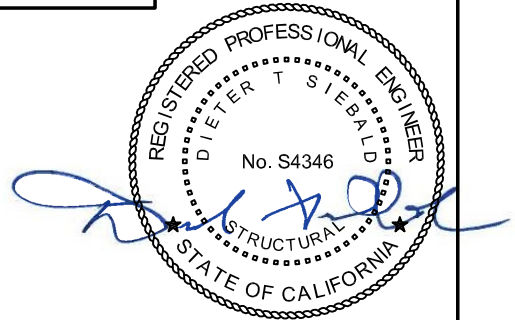
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SEISMIC BRACING FOR
MEP SYSTEMS



WARNING: ATTACHMENTS ARE NOT ALLOWED IN PROTECTED ZONES AS DEFINED IN AISC 341.

NOTE:
SEE SECTION 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBUS1 OR CSBUS2 AT ASD.

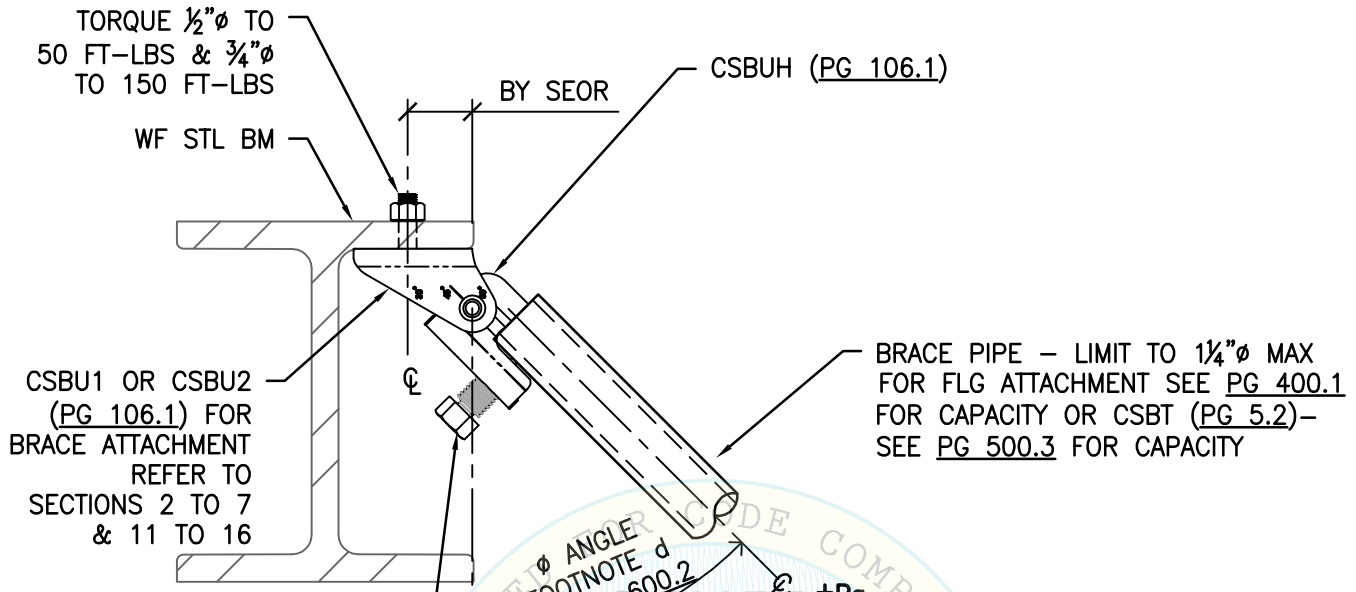


SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO WIDE FLANGE STEEL BEAMS
CSBU BOTTOM FLANGE W/ BRACE STRUT PERPENDICULAR

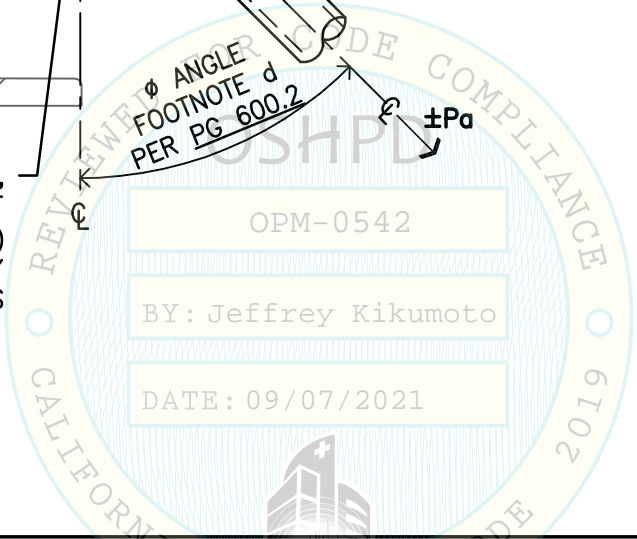
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| <p>CYS STRUCTURAL ENGINEERS, INC. 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833</p> | TEL (916) 920-2020 www.cyseng.com | Job No: 19039 Date: 09/08/2021 Page: 103.14 of . |
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SEISMIC BRACING FOR MEP SYSTEMS

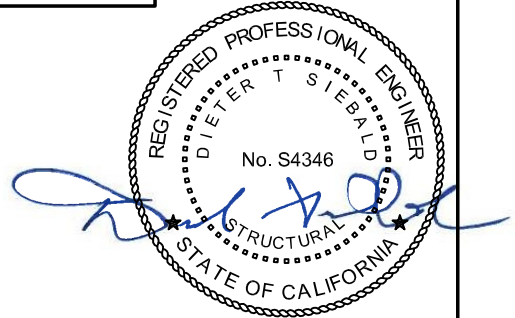


FOR PROPER INSTALLATION,
TORQUE TWIST-OFF TYPE BOLT
HEAD (ASTM® A563 GR B)
UNTIL IT BREAKS AWAY
MIN 35 FT-LBS



**WARNING: ATTACHMENTS ARE NOT ALLOWED IN
PROTECTED ZONES AS DEFINED IN AISC 341.**

NOTE:
SEE SECTIONS 500 & 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE
OF CSBU1, CSBU2 OR CSBT AT ASD.

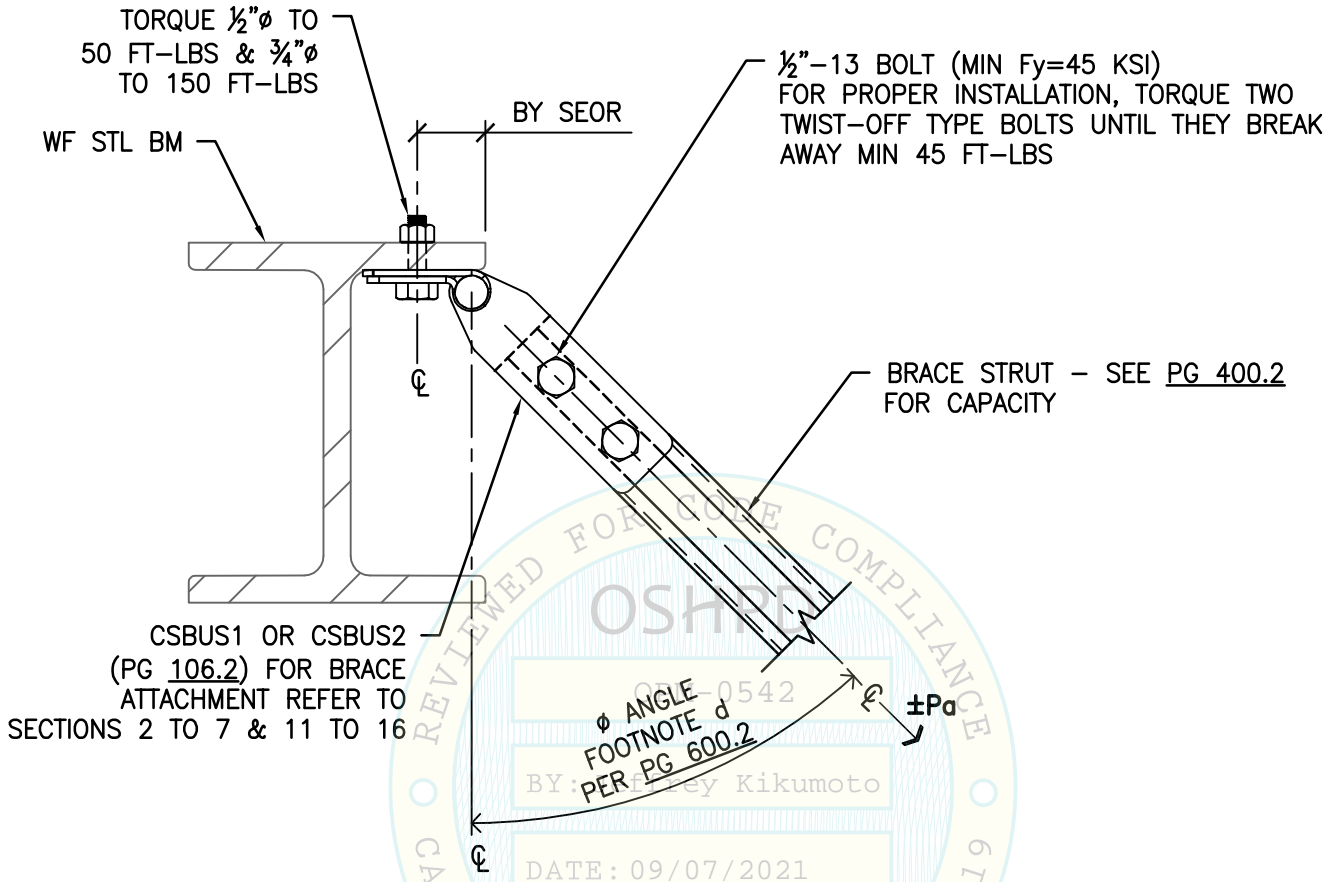


**SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO WIDE FLANGE STEEL BEAMS
CSBU TOP FLANGE W/ BRACE PIPE PERPENDICULAR**

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|--|--|--------------------------------------|-------|-------------|
| | CYS STRUCTURAL ENGINEERS, INC. | Job No: | 19039 | |
| | 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833 | TEL (916) 920-2020 www.cyseng.com | Date: | 09/08/2021 |
| | | | Page: | 103.15 of . |

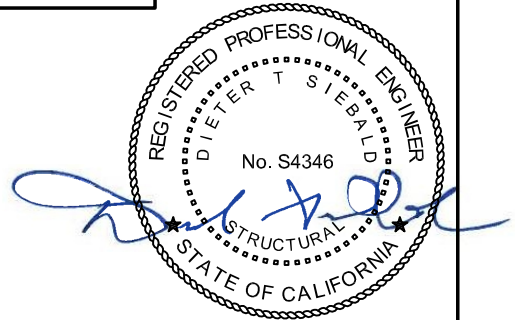
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SEISMIC BRACING FOR MEP SYSTEMS



WARNING: ATTACHMENTS ARE NOT ALLOWED IN PROTECTED ZONES AS DEFINED IN AISC 341.

NOTE:
SEE SECTION 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBUS1 OR CSBUS2 AT ASD.

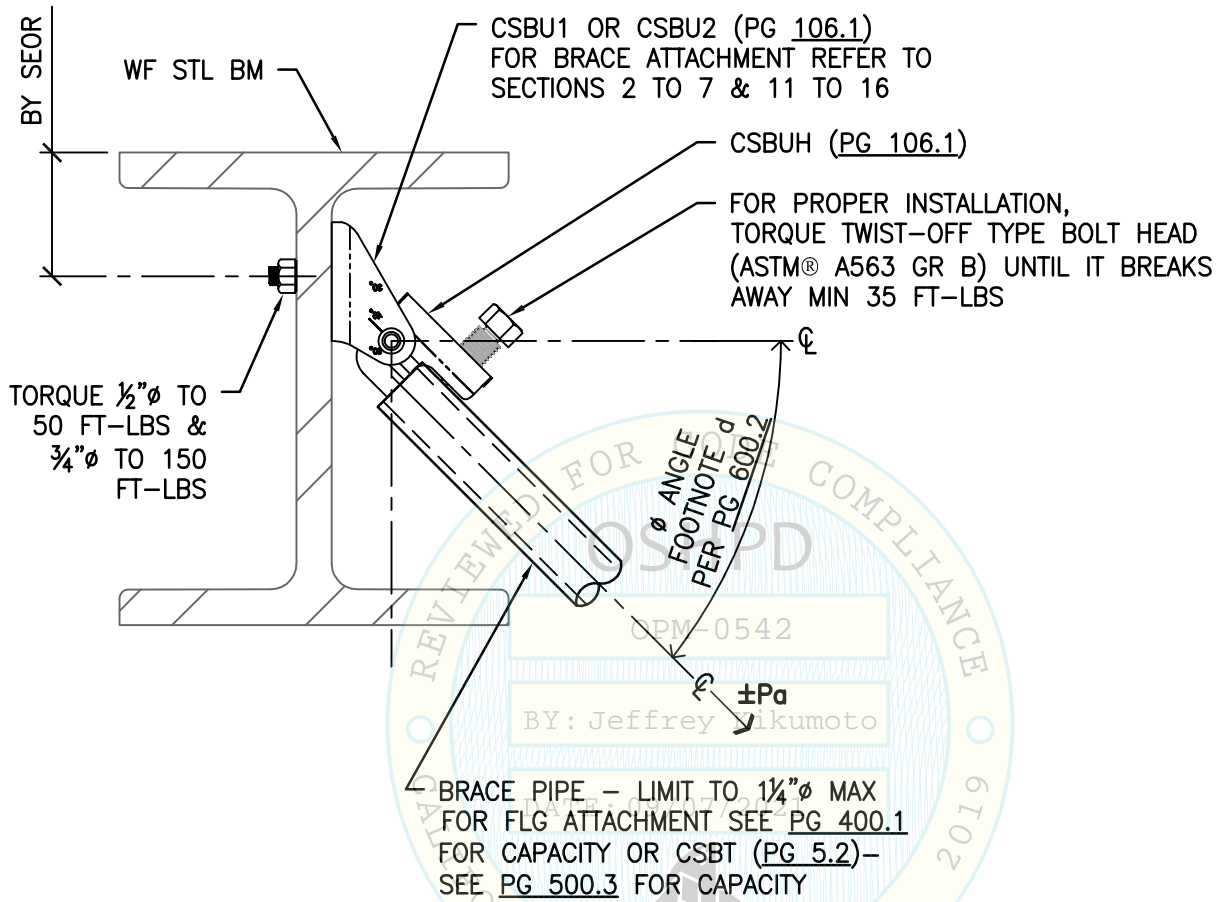


**SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO WIDE FLANGE STEEL BEAMS
CSBU TOP FLANGE W/ BRACE STRUT PERPENDICULAR**

| | | | | |
|--|--|--------------------------------------|-------|-------------|
| | CYS STRUCTURAL ENGINEERS, INC. | Job No: | 19039 | |
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| | | | Page: | 103.16 of . |

c:\Users\camachom\appdata\local\temp\AcPublish_39788\S1_Erico MEP.dwg Time: Sep08, 2021 - 11:17am Login: camachom DimScale: 8 LScale: 4

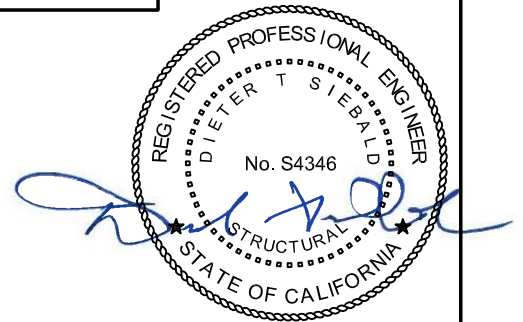
SEISMIC BRACING FOR MEP SYSTEMS



**WARNING: ATTACHMENTS ARE NOT ALLOWED IN
PROTECTED ZONES AS DEFINED IN AISC 341.**

NOTE:

SEE SECTIONS 500 & 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE
OF CSBU1, CSBU2 OR CSBT AT ASD.



**SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO WIDE FLANGE STEEL BEAMS
CSBU TOP FLANGE W/ BRACE PIPE PERPENDICULAR**



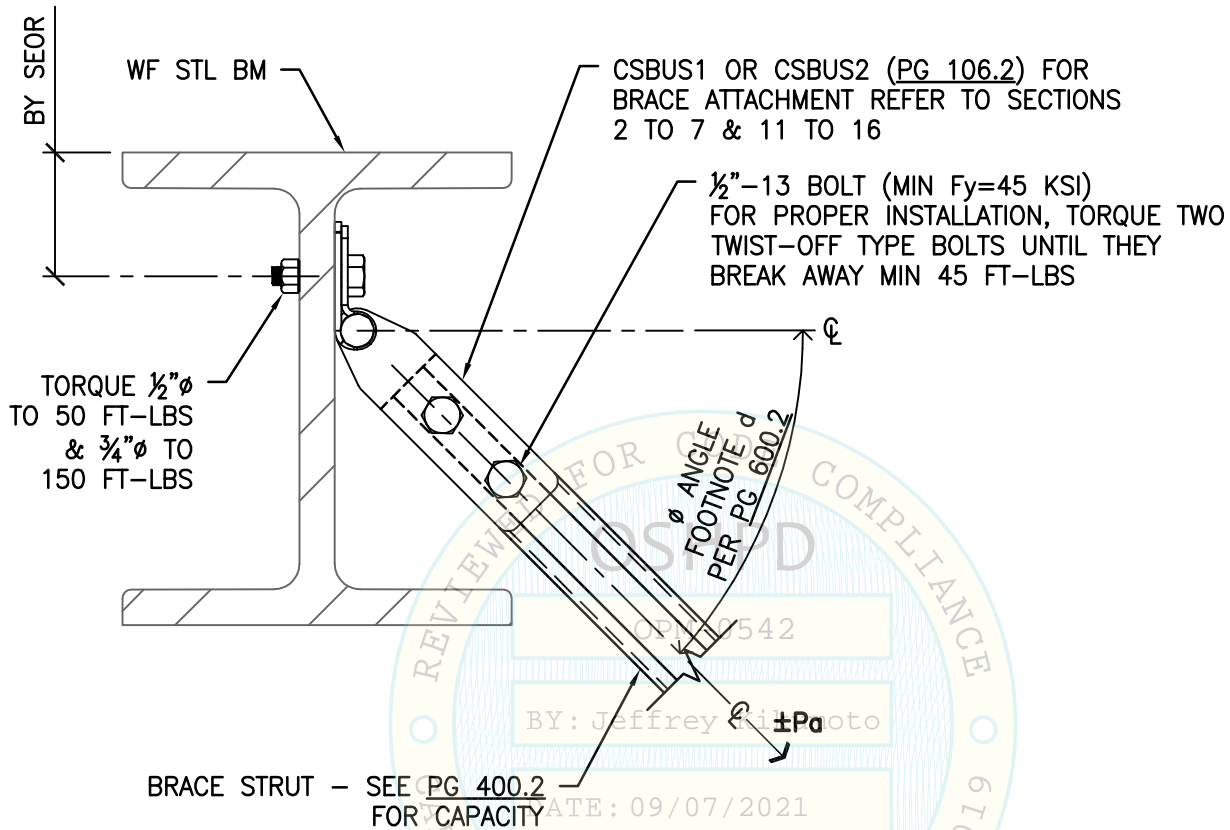
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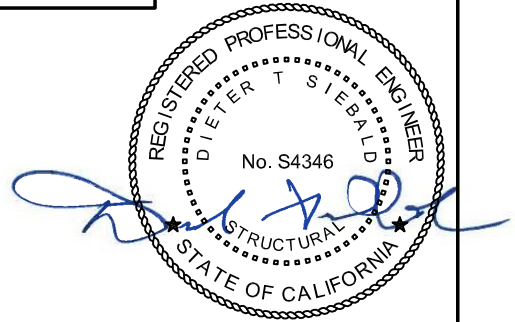
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| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 103.17 of . |

SEISMIC BRACING FOR MEP SYSTEMS



WARNING: ATTACHMENTS ARE NOT ALLOWED IN PROTECTED ZONES AS DEFINED IN AISC 341.

NOTE:
SEE SECTION 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBUS1 OR CSBUS2 AT ASD.



**SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO WIDE FLANGE STEEL BEAMS
CSBU TOP FLANGE W/ BRACE STRUT PERPENDICULAR**

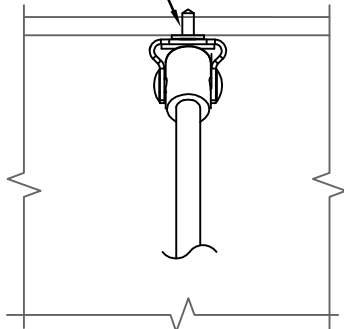
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| | 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833 | Date: 09/08/2021 |
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SEISMIC BRACING FOR MEP SYSTEMS



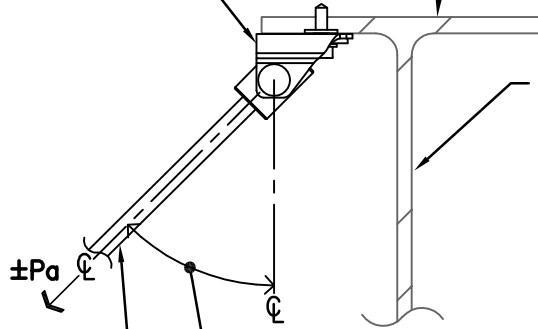
CSBBRS1 TO TOP
OR BOTT FLG
(PG 106.8)



RESTRAINT ROD - SEE
PG 400.4 FOR CAPACITY

RESTRAINT PERP TO BM

CSBBRS1
(PG 106.8)
TO TOP FLG



∅ ANGLE FOOTNOTE d
PER PG 600.2

RESTRAINT PERP TO BM

12 GA MIN TO 5/16" MAX FLG THK
(IF bf > 5/16", USE CSBBRS3 W/
MODEL 300 BM CLAMP

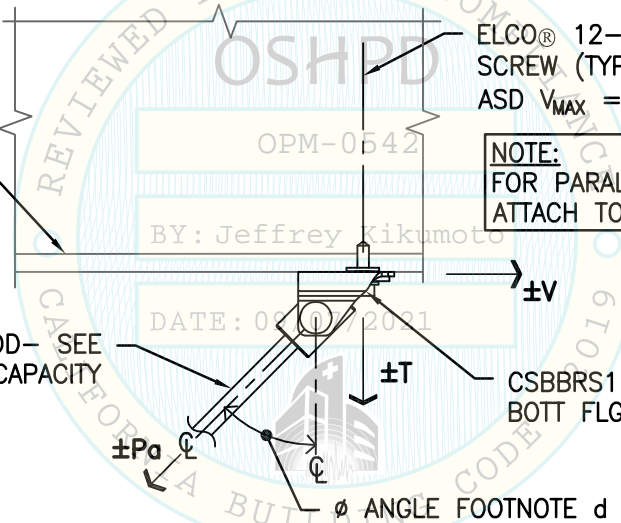
(E) STRUC STL MEMBER
(IE WF BM, CHANNEL,
ANGLE, ETC.)
SEE SEOR RESPONSIBILITES
IN SECTION 1

NOTE:
ATTACHMENT MAY ALSO
BE TO THE WEB OF
THE WF BM.

12 GA MIN TO 5/16" MAX
FLG THK (IF bf > 5/16",
USE CSBBRS3 W/ MODEL
300 BM CLAMP)

RESTRAINT ROD - SEE
PG 400.4 FOR CAPACITY

RESTRAINT PARALLEL TO BM



ELCO® 12-24x1/4" SELF-DRILLING
SCREW (TYPE 7: ICC ESR-3294) AT
ASD $V_{MAX} = 370\#$ & $T_{MAX} = 257\#$

NOTE:
FOR PARALLEL TO BM CONDITION
ATTACH TO BOTT FLG ONLY.

CSBBRS1 (PG 106.8) TO
BOTT FLG

∅ ANGLE FOOTNOTE d
PER PG 600.2

**WARNING: ATTACHMENTS ARE NOT ALLOWED IN
PROTECTED ZONES AS DEFINED IN AISC 341.**

NOTES:

- SEE SECTION 600 FOR HORIZ CAPACITY F_H AT ∅ ANGLE OF CSBBRS1 AT ASD.
- THE RESTRAINT ROD MAY GOVERN THE CAPACITY OF THE RESTRAINT ASSEMBLY.



SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO WIDE FLANGE STEEL BEAMS
CSBBRS1 TOP OR BOTTOM FLANGE BEAMS W/ RESTRAINT ROD



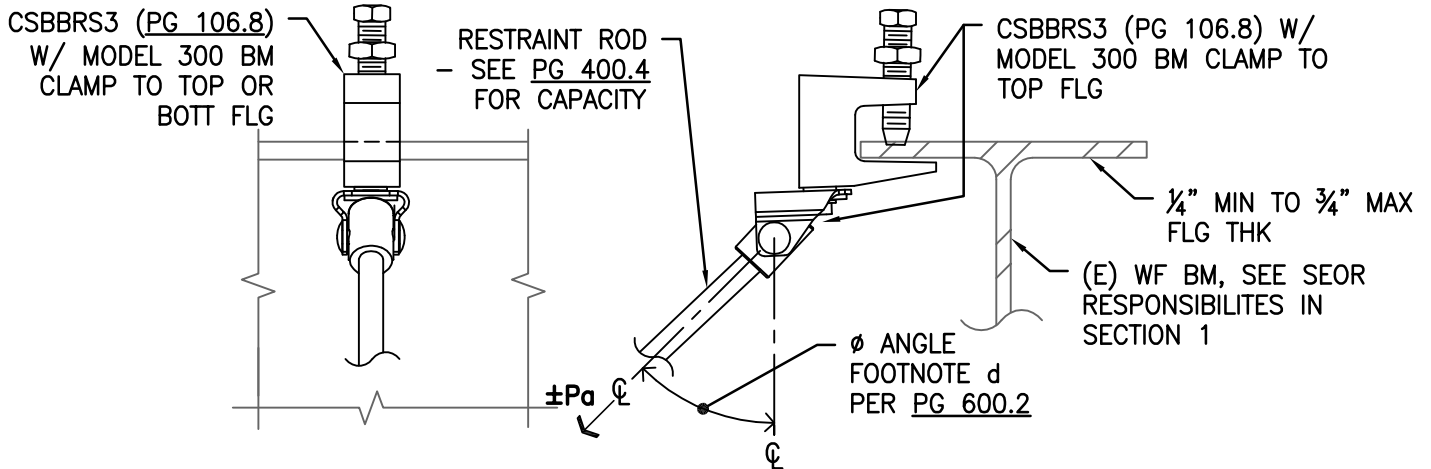
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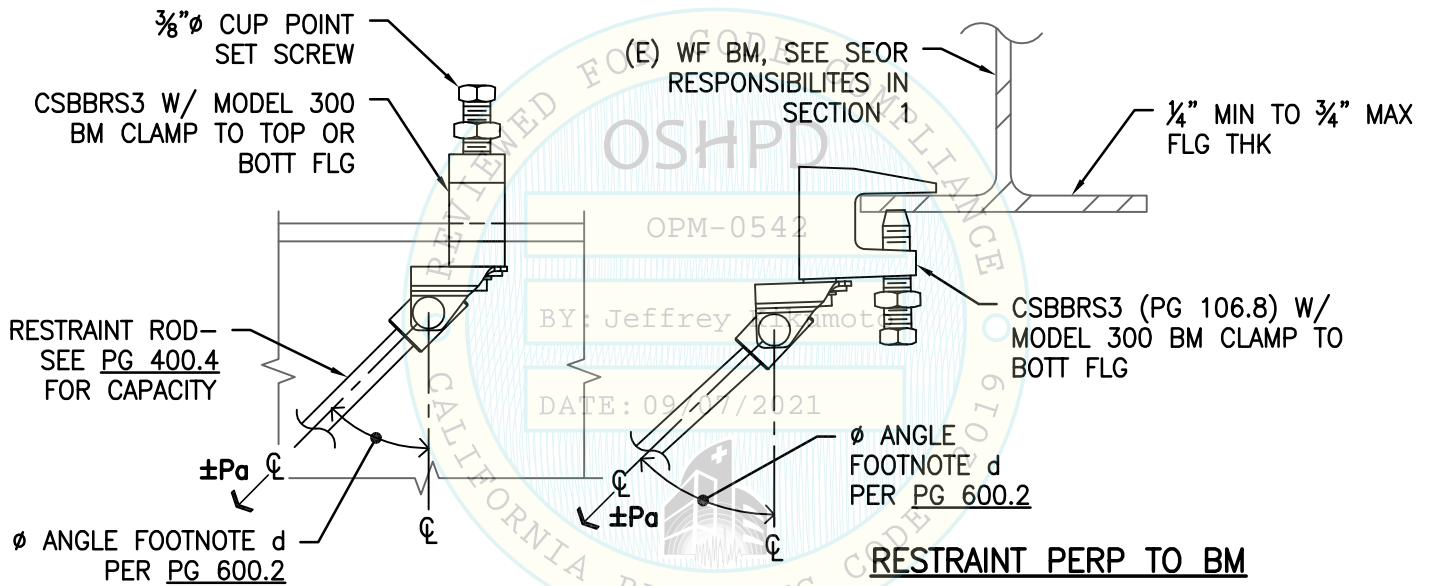
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| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 103.19 of . |

SEISMIC BRACING FOR MEP SYSTEMS



RESTRAINT PERP TO BM

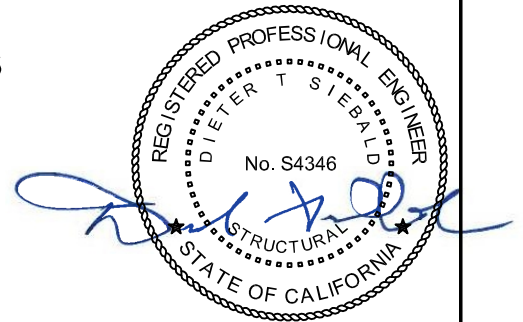
RESTRAINT PERP TO BM



RESTRAINT PARALLEL TO BEAM

NOTES:

1. SEE SECTION 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBBRS3 W/ MODEL 300 BM CLAMP AT ASD.
2. SET SCREW CAN BE EITHER UP OR DOWN ON TOP OR BOTT FLG.
3. THE RESTRAINT ROD MAY GOVERN THE CAPACITY OF THE RESTRAINT ASSEMBLY.
4. TORQUE SET SCREW TO 60 IN-LBS, TYP.



SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO WIDE FLANGE STEEL BEAMS
CSBBRS3 W/ MODEL 300 BEAM CLAMP TO TOP OR BOTTOM FLANGE W/ RESTRAINT ROD



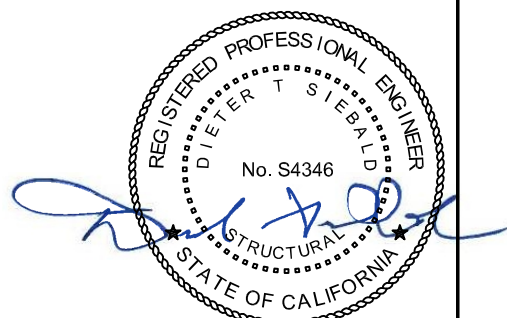
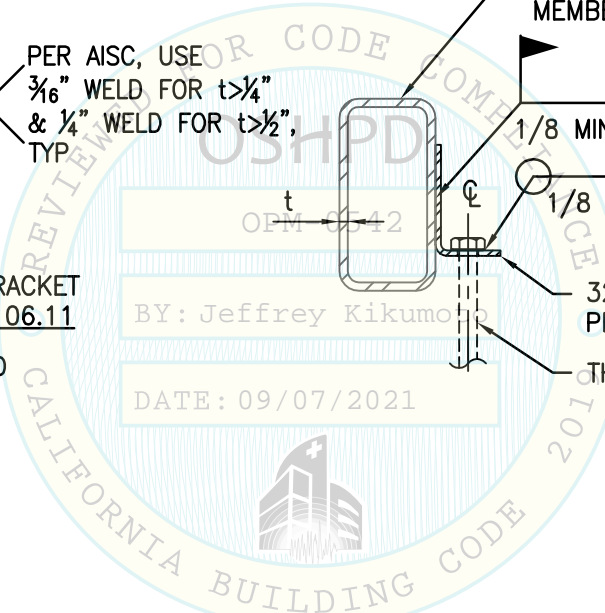
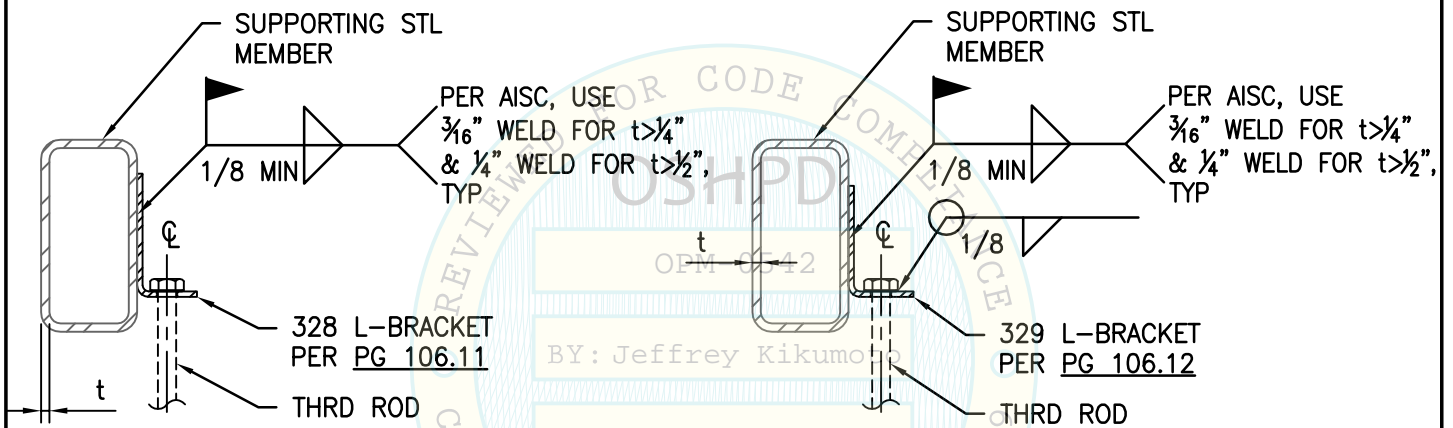
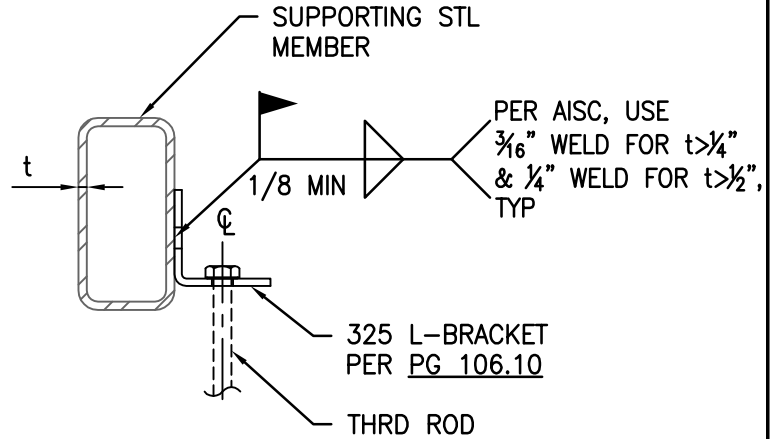
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| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 103.20 of |

SEISMIC BRACING FOR MEP SYSTEMS



NOTES:

1. SEE PGS 106.9 TO 106.13 FOR VERT LOAD CAPACITY.
2. SEOR TO CHECK CAPACITY OF SUPPORTING STRUC MEMBER.
3. THE THRD ROD MAY GOVERN THE CAPACITY, SEE PG 400.4.

**SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO WIDE FLANGE STEEL BEAMS
U-BRACKETS & L-BRACKETS**



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| Date: | 09/08/2021 |
| Page: | 103.21 of . |

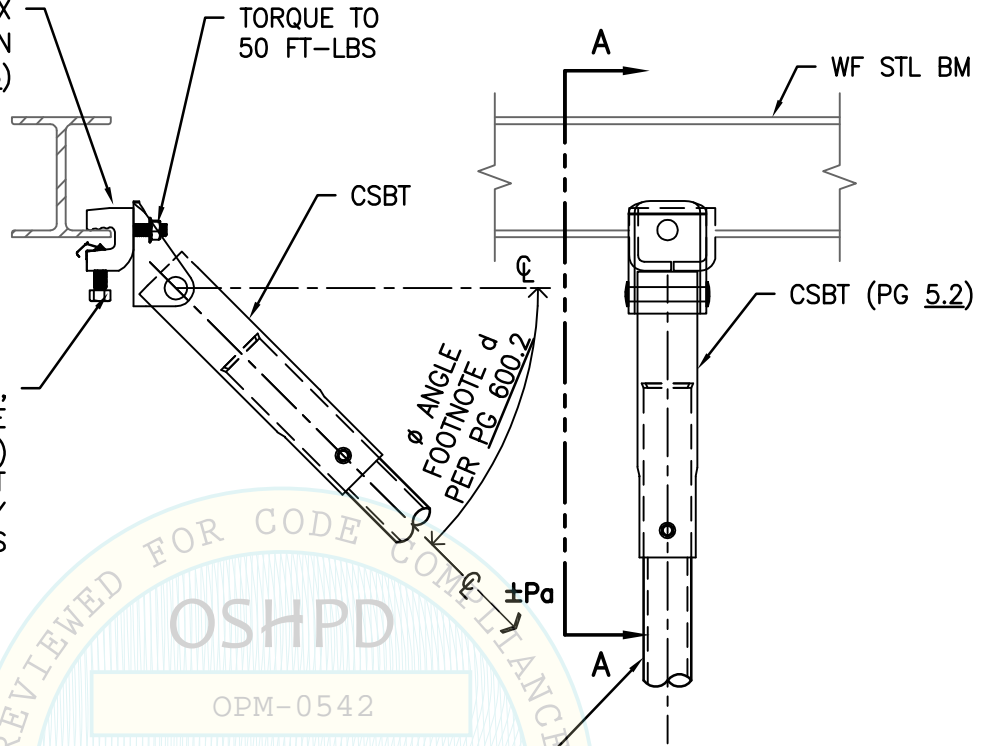
SEISMIC BRACING FOR MEP SYSTEMS



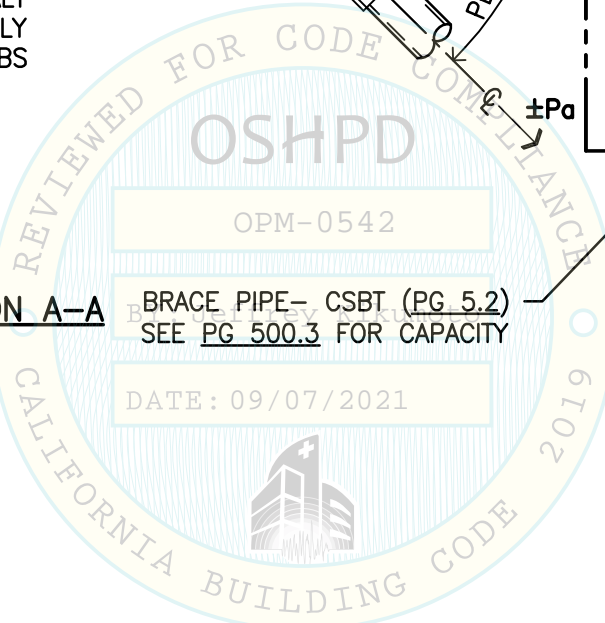
CSBS1 FOR 1/4" MIN TO 3/4" MAX
FLG THK OR CSBS2 FOR 3/4" MIN
TO 1 1/4" MAX FLG THK (PG 106.6)

TORQUE TO
50 FT-LBS

FOR PROPER INSTALLATION,
TORQUE TWO TWIST-OFF TYPE
BOLT HEADS (ASTM® A563 GR B)
UNTIL THEY BREAK AWAY. ALT
TORQUE BTW BOLTS EVENLY
MIN 35 FT-LBS

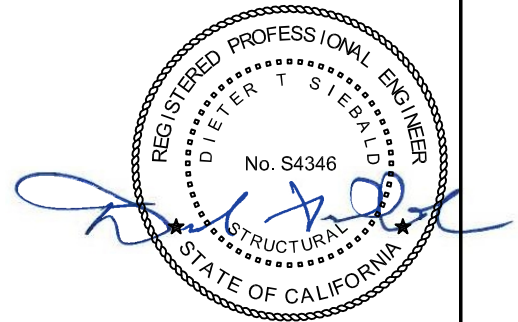


SECTION A-A BRACE PIPE - CSBT (PG 5.2)
SEE PG 500.3 FOR CAPACITY



NOTE:

1. SEE SECTIONS 500 & 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBS1, CSBS2 OR CSBT AT ASD W/ CSBT BRACE PARALLEL TO STRUC STL MEMBER (FOOTNOTE i. ON PG 600.3).

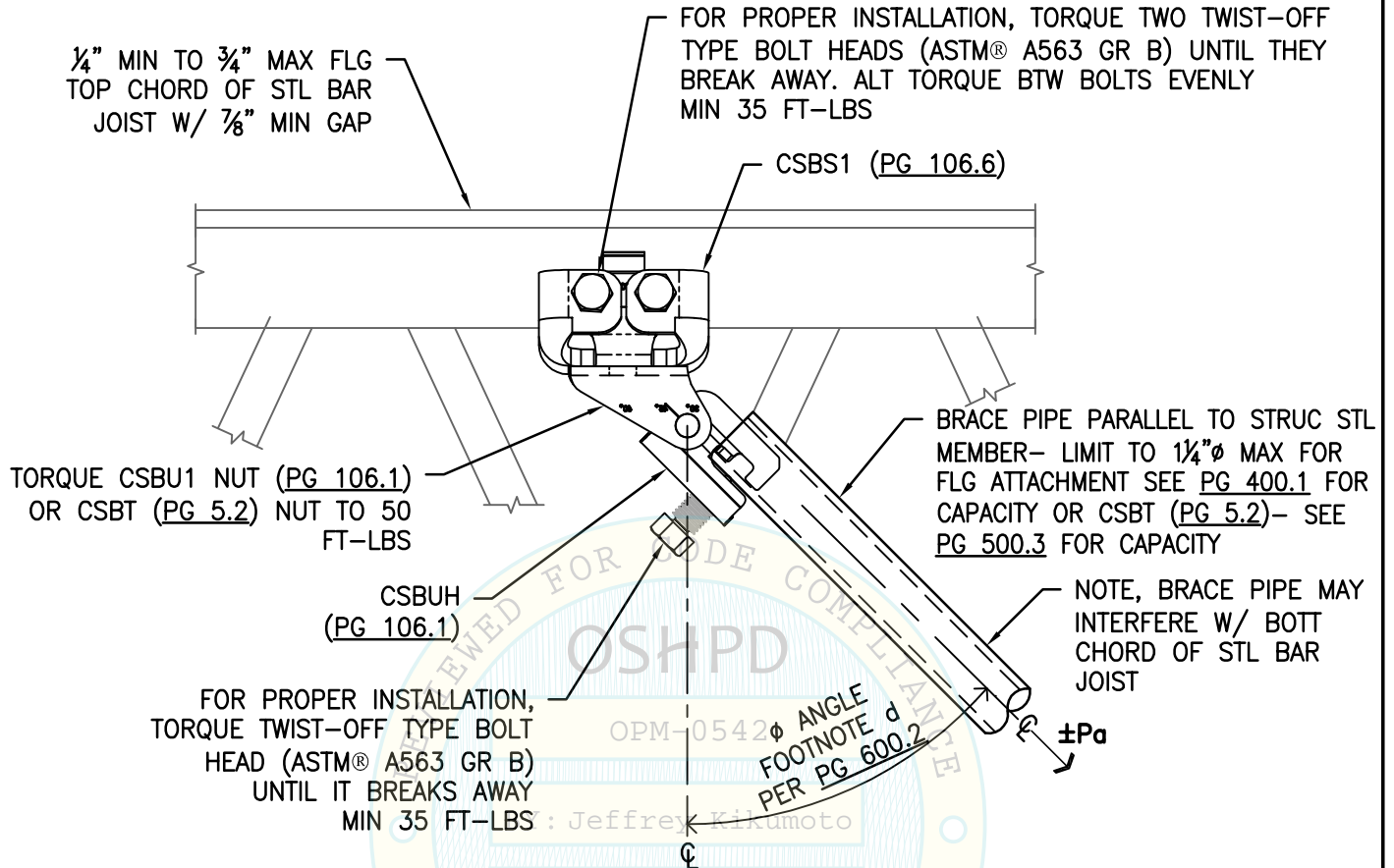


**SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO WIDE FLANGE STEEL BEAMS
CSBS1 & CSBS2 BOTTOM FLANGE W/ CSBT BRACE PERPENDICULAR**

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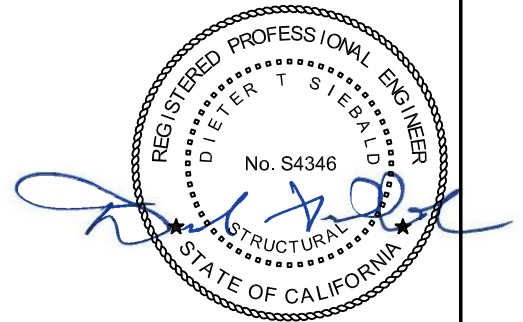
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SEISMIC BRACING FOR MEP SYSTEMS



NOTES:

1. SEE SECTIONS 500 & 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBS1A OR CSBT AT ASD W/ BRACE PIPE PARALLEL TO STRUC STL MEMBER (FOOTNOTE i. ON PG 600.3).
2. CSBS1A IS A PRE-ASSEMBLY OF CSBS1 & CSBU1.
3. PRE-ASSEMBLY CSBS1A CAN BE USED WHENEVER THE CSBS1 & CSBU1 ARE CALLED OUT.



SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO TOP CHORD OF STEEL BAR JOISTS
CSBS1 TO VERTICAL LEG W/ BRACE PIPE PARALLEL



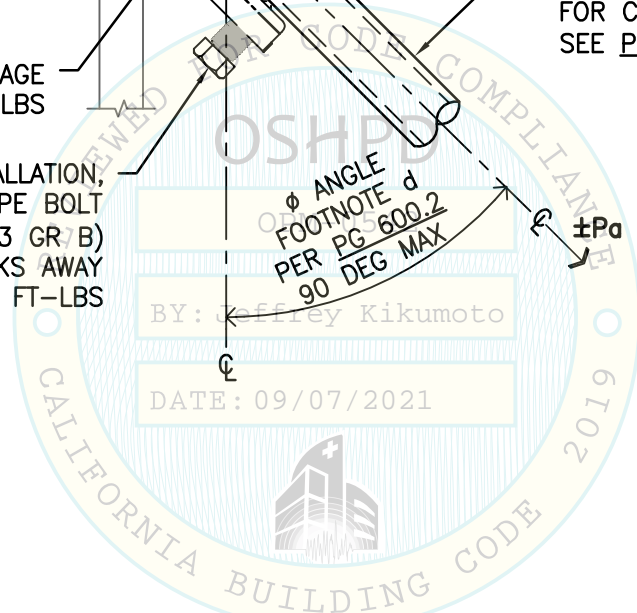
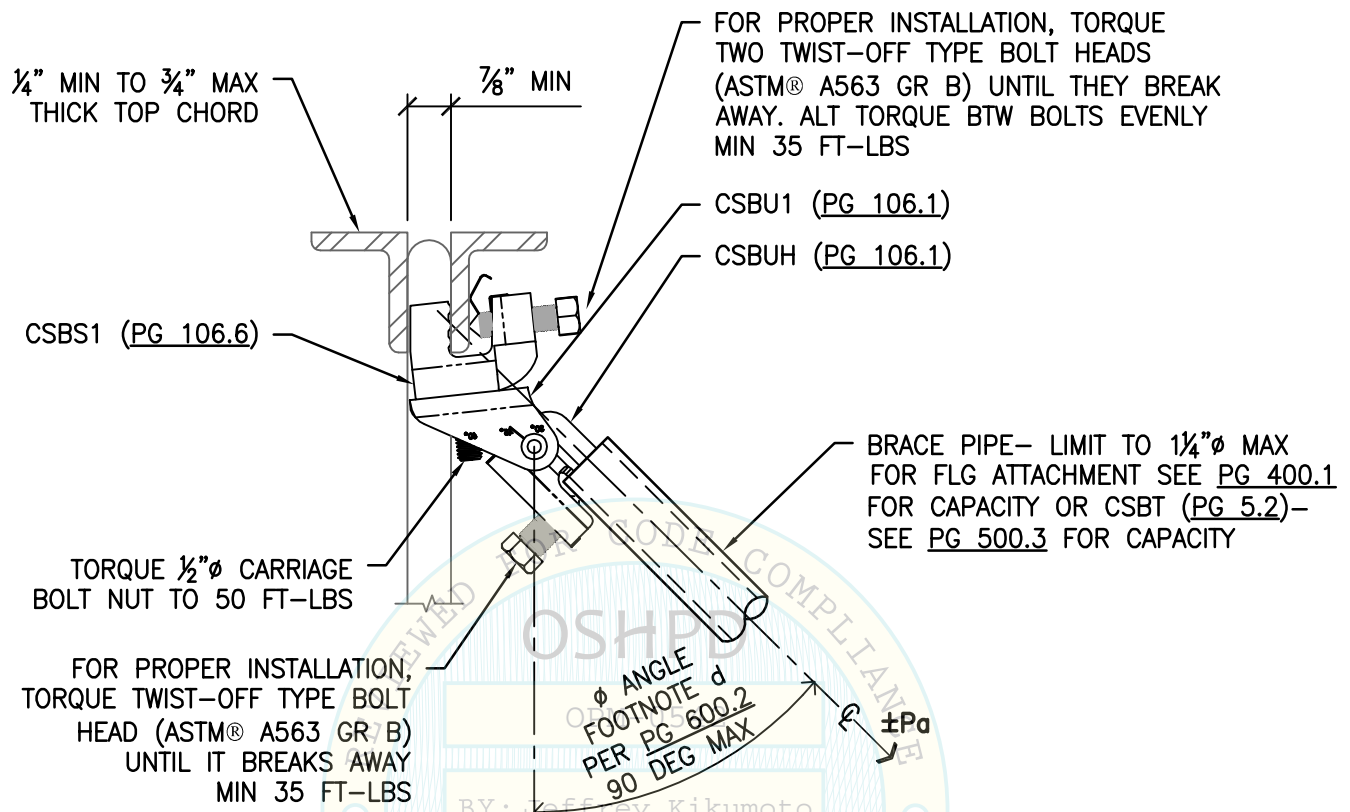
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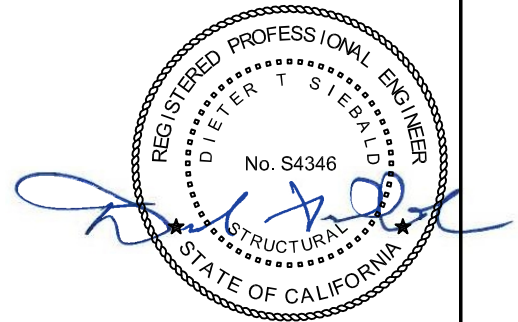
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| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 104.1 of . |

SEISMIC BRACING FOR MEP SYSTEMS



NOTES:

1. SEE SECTIONS 500 & 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBS1A OR CSBT AT ASD W/ BRACE PIPE PERP TO STRUC STL MEMBER (FOOTNOTE j. ON PG 600.3).
2. CSBS1A IS A PRE-ASSEMBLY OF CSBS1 & CSBU1.
3. PRE-ASSEMBLY CSBS1A CAN BE USED WHENEVER THE CSBS1 & CSBU1 ARE CALLED OUT.
4. NOTE THAT BOTT FLG MAY RESTRICT MOVEMENT OF BRACE TO STRAIGHT VERT.



**SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO TOP CHORD OF STEEL BAR JOISTS
CSBS1 TO VERTICAL LEG W/ BRACE PIPE PERPENDICULAR**



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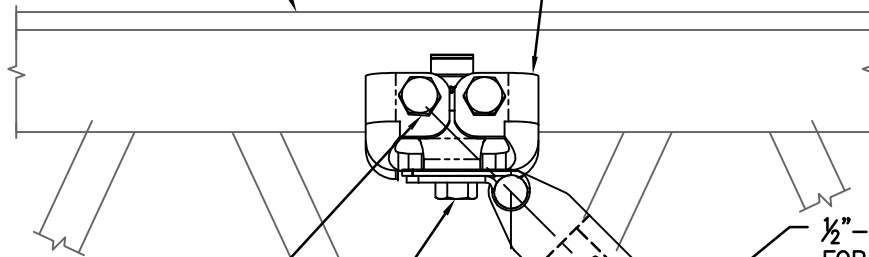
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| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 104.2 of . |

SEISMIC BRACING FOR MEP SYSTEMS



1/4" MIN TO 3/4" MAX FLG
TOP CHORD OF STL BAR
JOIST W/ 7/8" MIN GAP

CSBS1 (PG 106.6)



FOR PROPER INSTALLATION,
TORQUE TWO TWIST-OFF TYPE
BOLT HEADS (ASTM® A563 GR B)
UNTIL THEY BREAK AWAY. ALT
TORQUE BTW BOLTS EVENLY
MIN 35 FT-LBS

TORQUE CSBUS1 BOLT
NUT TO 50 FT-LBS

CSBUS1
(PG 106.2)

Ø ANGLE
FOOTNOTE i
PER PG 600.2

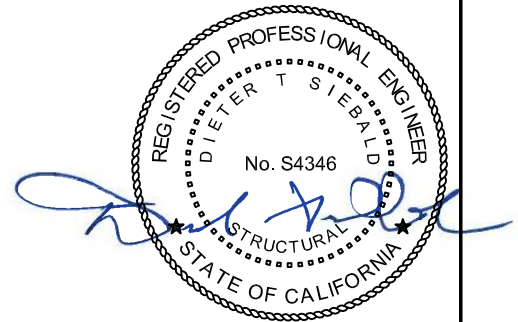
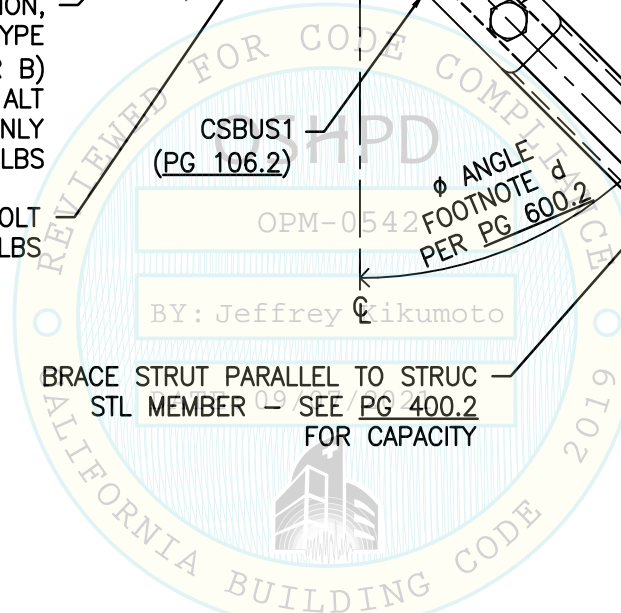
1/2"-13 BOLT (MIN Fy=45 KSI)
FOR PROPER INSTALLATION,
TORQUE TWO TWIST-OFF
TYPE BOLTS UNTIL THEY
BREAK AWAY MIN 45 FT-LBS.
NOTE THAT BOLTS ARE
INSERTED INTO ERICO
SUPPLIED STRUT NUTS

BRACE STRUT PARALLEL TO STRUC
STL MEMBER SEE PG 400.2
FOR CAPACITY

NOTE, BRACE MAY
INTERFERE W/ BOTT CHORD
OF STL BAR JOIST

NOTE:

SEE SECTION 600 FOR HORIZ CAPACITY F_H AT Ø ANGLE OF CSBS1
OR CSBUS1 AT ASD W/ BRACE STRUT PARALLEL TO STRUC STL
MEMBER (FOOTNOTE i. ON PG 600.3)



SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO TOP CHORD OF STEEL BAR JOISTS
CSBS1 TO VERTICAL LEG W/ BRACE STRUT PARALLEL



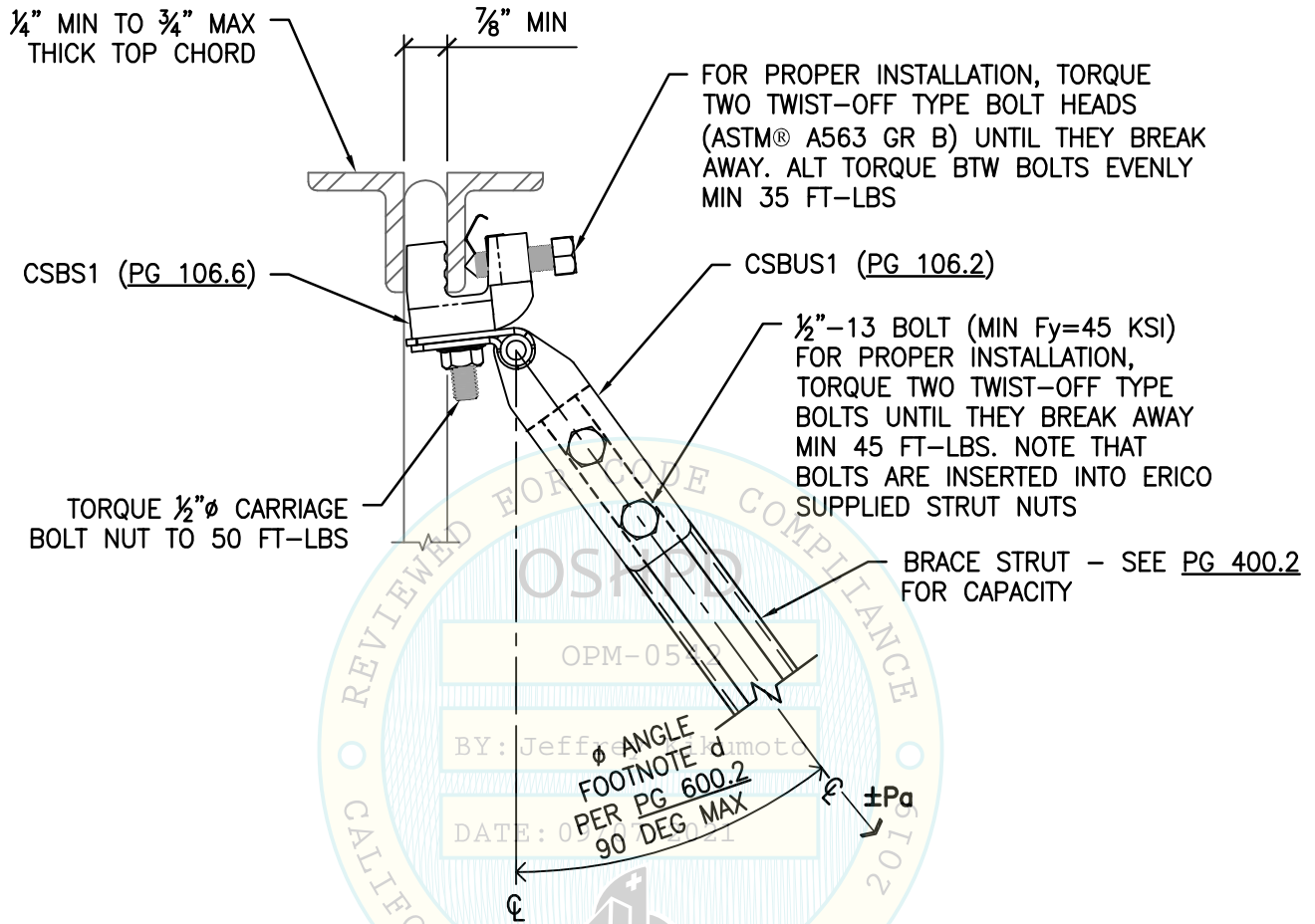
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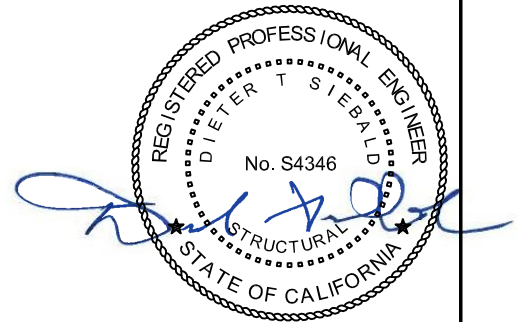
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| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 104.3 of . |

SEISMIC BRACING FOR MEP SYSTEMS



NOTES:

1. SEE SECTION 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBUS1 AT ASD W/ BRACE STRUT PERP TO STRUC STL MEMBER (FOOT NOTE j. ON PG 600.3).
2. NOTE THAT BOTT FLG MAY RESTRICT MOVEMENT TO STRAIGHT VERT.



**SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO TOP CHORD OF STEEL BAR JOISTS
CSBS1 TO VERTICAL LEG W/ BRACE STRUT PERPENDICULAR**



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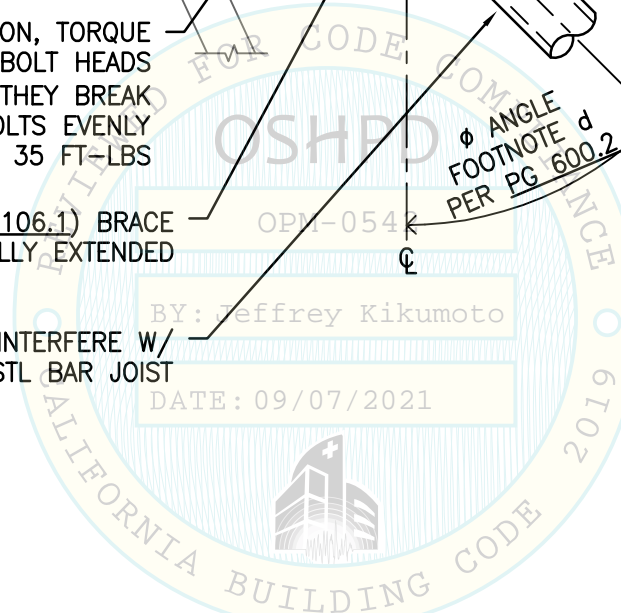
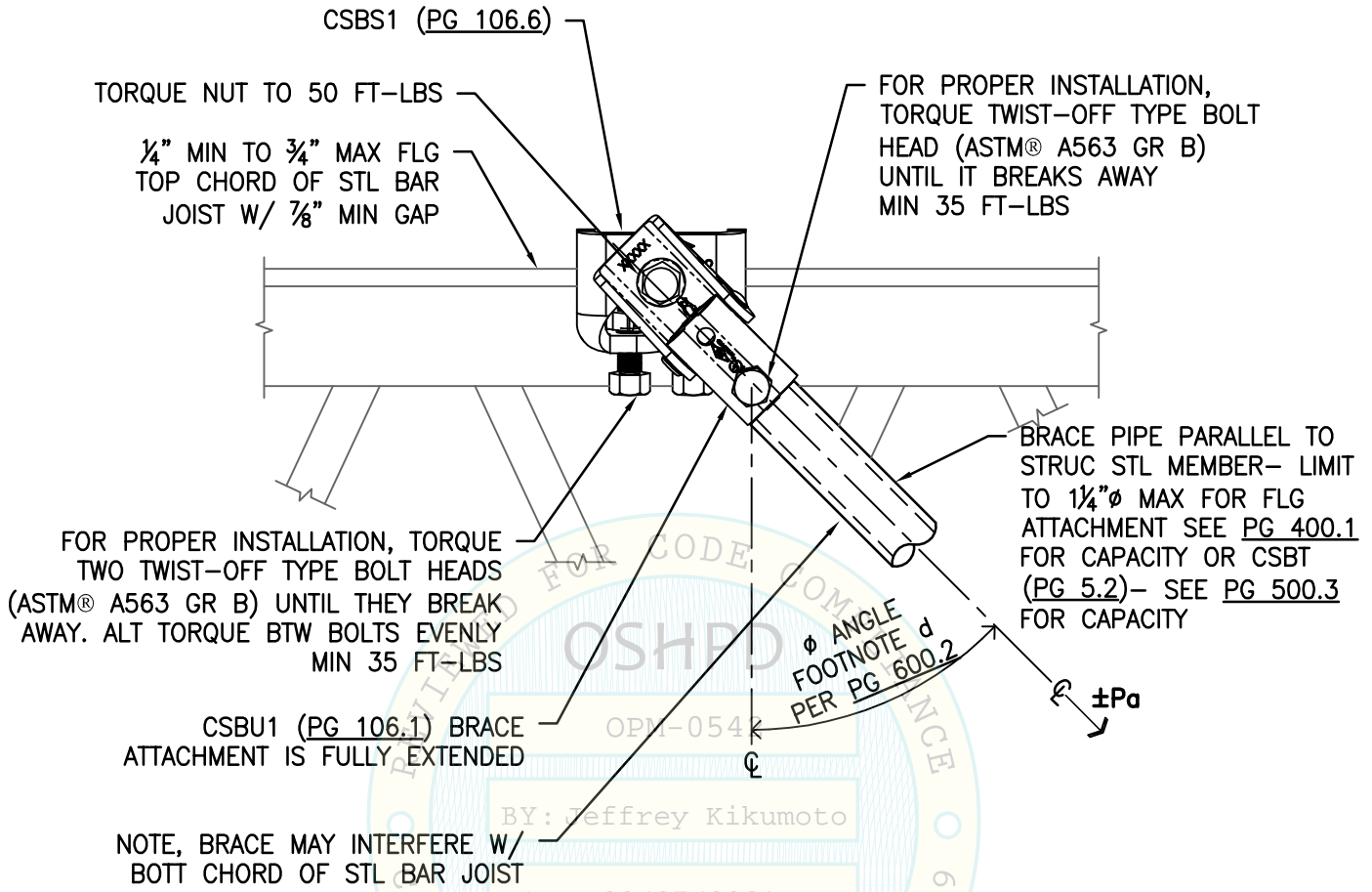
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| Date: | 09/08/2021 |
| Page: | 104.4 of . |

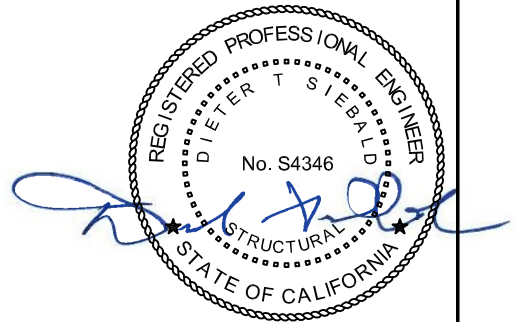
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SEISMIC BRACING FOR MEP SYSTEMS



NOTES:

1. SEE SECTIONS 500 & 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBS1A OR CSBT AT ASD W/ BRACE PIPE PARALLEL TO STRUC STL MEMBER (FOOTNOTE i. ON PG 600.3).
2. CSBS1A IS A PRE-ASSEMBLY OF CSBS1 & CSBU1.
3. PRE-ASSEMBLY CSBS1A CAN BE USED WHENEVER THE CSBS1 & CSBU1 ARE CALLED OUT.

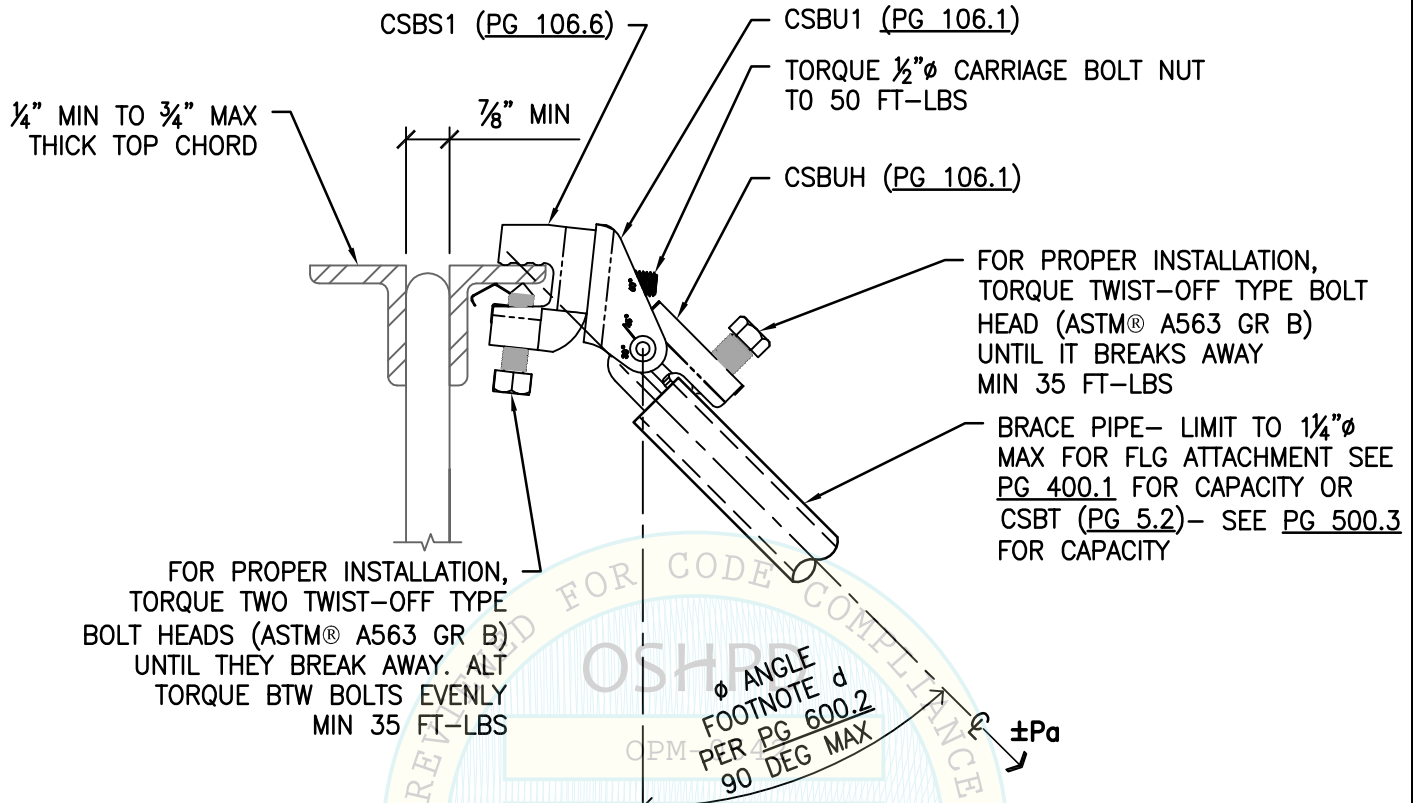


**SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO TOP CHORD OF STEEL BAR JOISTS
CSBS1 TO HORIZONTAL LEG W/ BRACE PIPE PARALLEL**

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| | | | Page: 104.5 of . |

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SEISMIC BRACING FOR MEP SYSTEMS

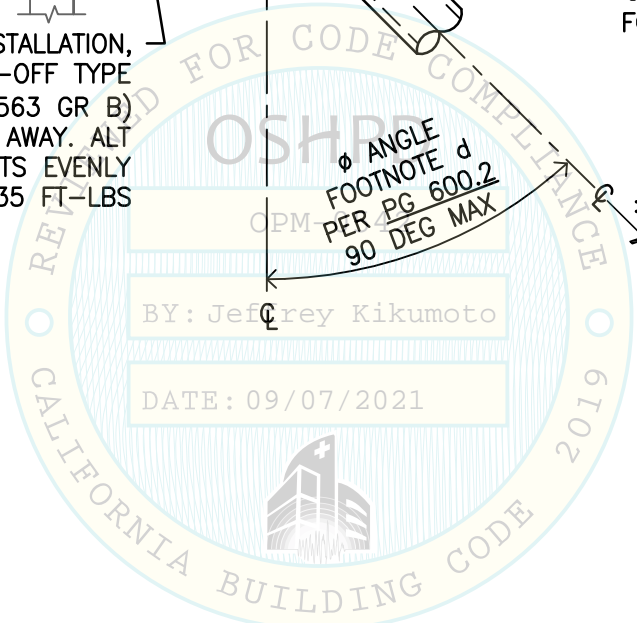


FOR PROPER INSTALLATION, TORQUE TWO TWIST-OFF TYPE BOLT HEADS (ASTM® A563 GR B) UNTIL THEY BREAK AWAY. ALT TORQUE BTW BOLTS EVENLY MIN 35 FT-LBS

FOR PROPER INSTALLATION, TORQUE TWIST-OFF TYPE BOLT HEAD (ASTM® A563 GR B) UNTIL IT BREAKS AWAY MIN 35 FT-LBS

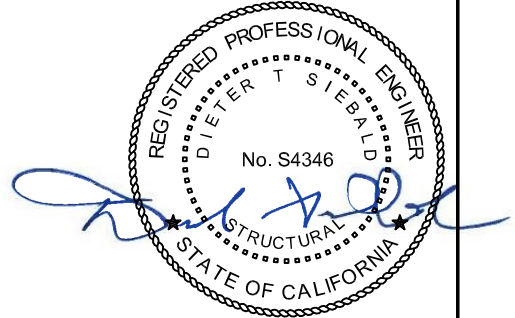
BRACE PIPE- LIMIT TO 1 1/4" Ø MAX FOR FLG ATTACHMENT SEE PG 400.1 FOR CAPACITY OR CSBT (PG 5.2)- SEE PG 500.3 FOR CAPACITY

Ø ANGLE FOOTNOTE d PER PG 600.2 90 DEG MAX



NOTES:

1. SEE SECTIONS 500 & 600 FOR HORIZ CAPACITY F_H AT Ø ANGLE OF CSBS1A OR CSBT AT ASD W/ BRACE PIPE PERP TO STRUC STL MEMBER (FOOTNOTE j. ON PG 600.3).
2. CSBS1A IS A PRE-ASSEMBLY OF CSBS1 & CSBU1.
3. PRE-ASSEMBLY CSBS1A CAN BE USED WHENEVER THE CSBS1 & CSBU1 ARE CALLED OUT.
4. NOTE THAT BOTT FLG MAY RESTRICT MOVEMENT OF BRACE TO STRAIGHT VERT.

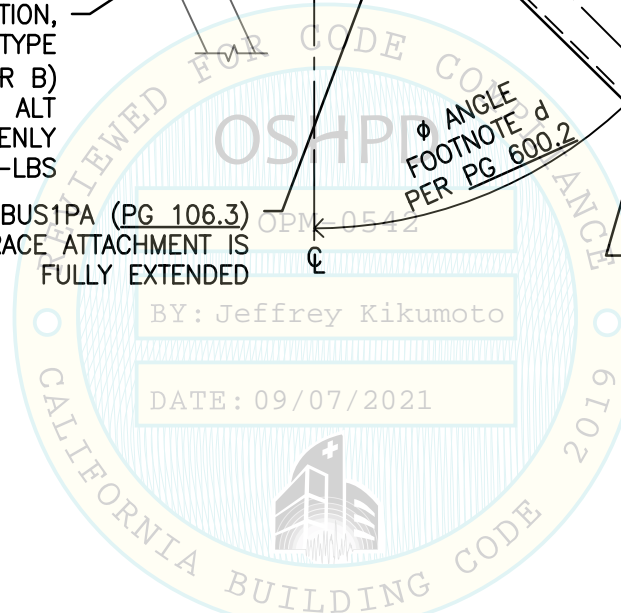
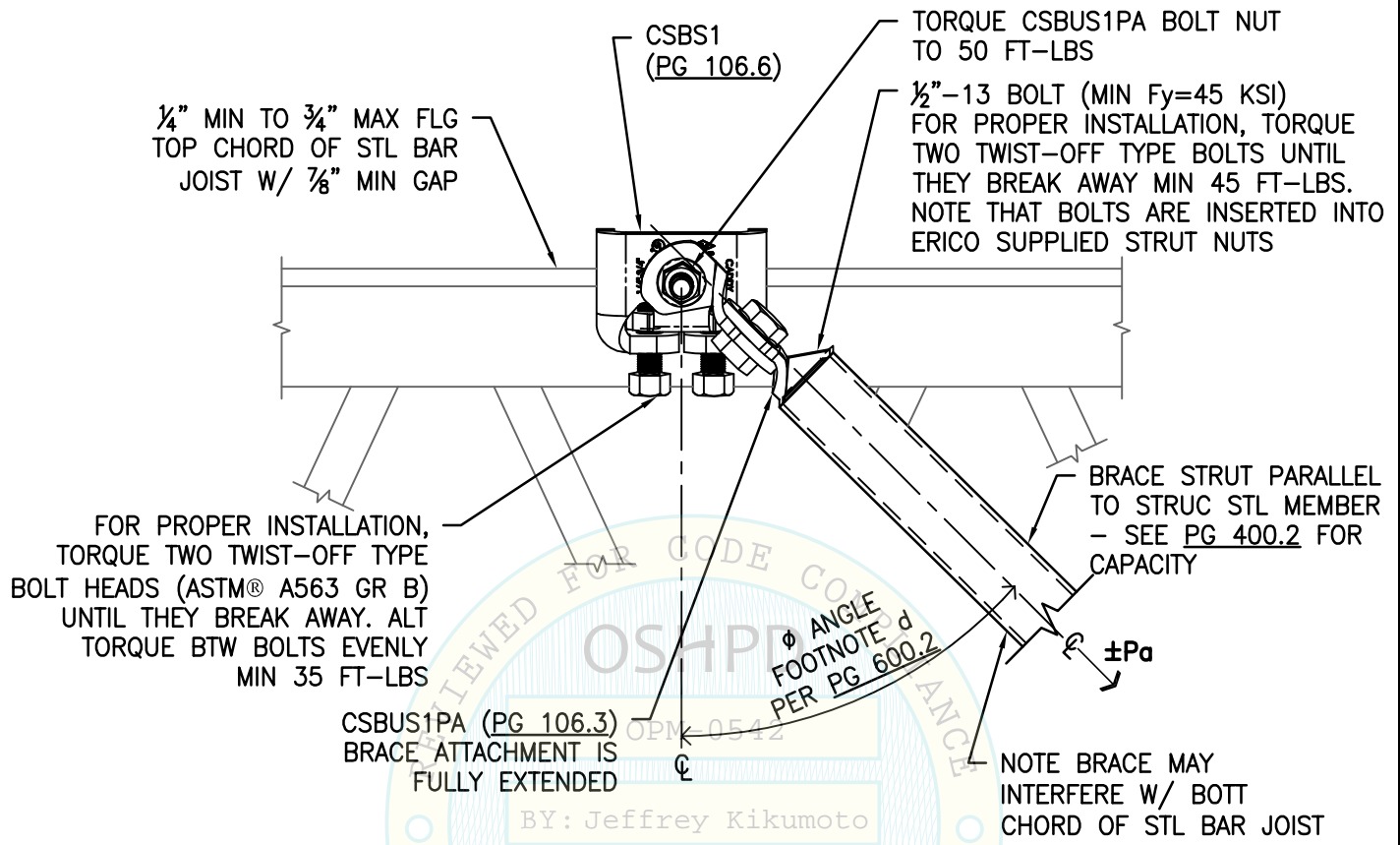


**SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO TOP CHORD OF STEEL BAR JOISTS
CSBS1 TO HORIZONTAL LEG W/ BRACE PIPE PERPENDICULAR**

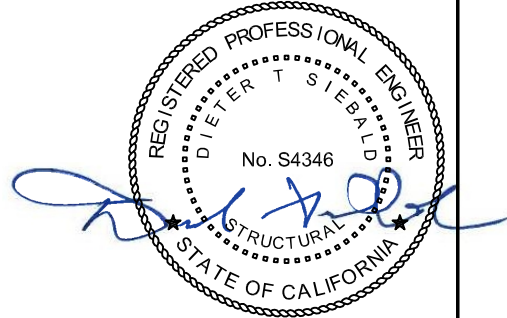
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| | | | Page: | 104.6 of . |

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SEISMIC BRACING FOR
MEP SYSTEMS



NOTE:
SEE SECTION 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBUS1PA AT ASD W/ BRACE STRUT PARALLEL TO STRUC STL MEMBER (FOOTNOTE i. ON PG 600.3).

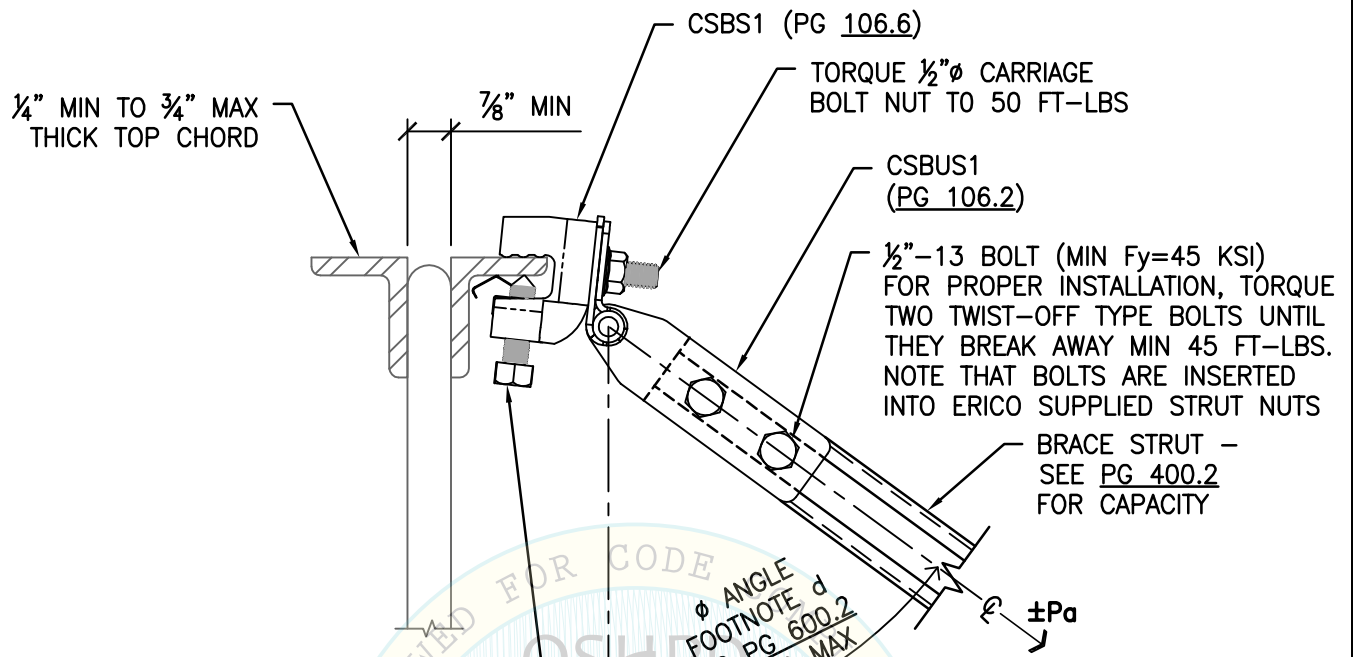


SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO TOP CHORD OF STEEL BAR JOISTS
CSBUS1 TO HORIZONTAL LEG W/ BRACE STRUT PARALLEL

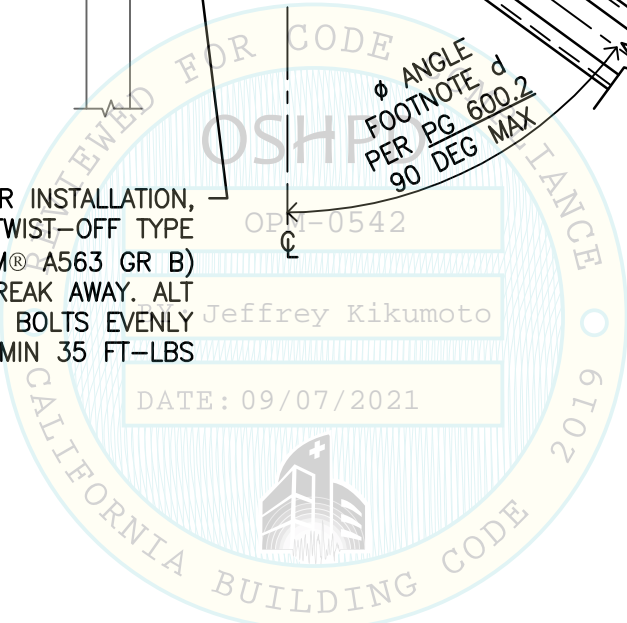
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| <p>CYS STRUCTURAL ENGINEERS, INC. 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833</p> | TEL (916) 920-2020 www.cyseng.com | Job No: 19039 Date: 09/08/2021 Page: 104.7 of |
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SEISMIC BRACING FOR MEP SYSTEMS

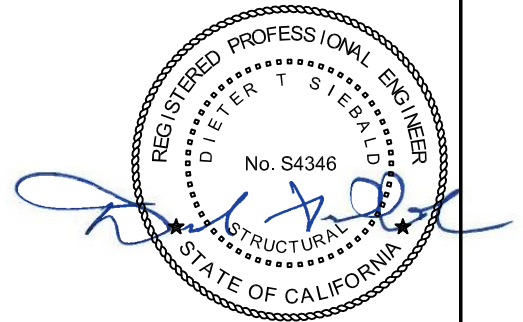


FOR PROPER INSTALLATION,
TORQUE TWO TWIST-OFF TYPE
BOLT HEADS (ASTM® A563 GR B)
UNTIL THEY BREAK AWAY. ALT
TORQUE BTW BOLTS EVENLY
MIN 35 FT-LBS



NOTES:

1. SEE SECTION 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBS1 AT ASD W/ BRACE STRUT PERP TO STRUC STL MEMBER (FOOTNOTE j. ON PG 600.3).
2. NOTE THAT BOTT FLG MAY RESTRICT MOVEMENT OF BRACE TO STRAIGHT VERT.



SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO TOP CHORD OF STEEL BAR JOISTS
CSBS1 TO HORIZONTAL LEG W/ BRACE STRUT PERPENDICULAR



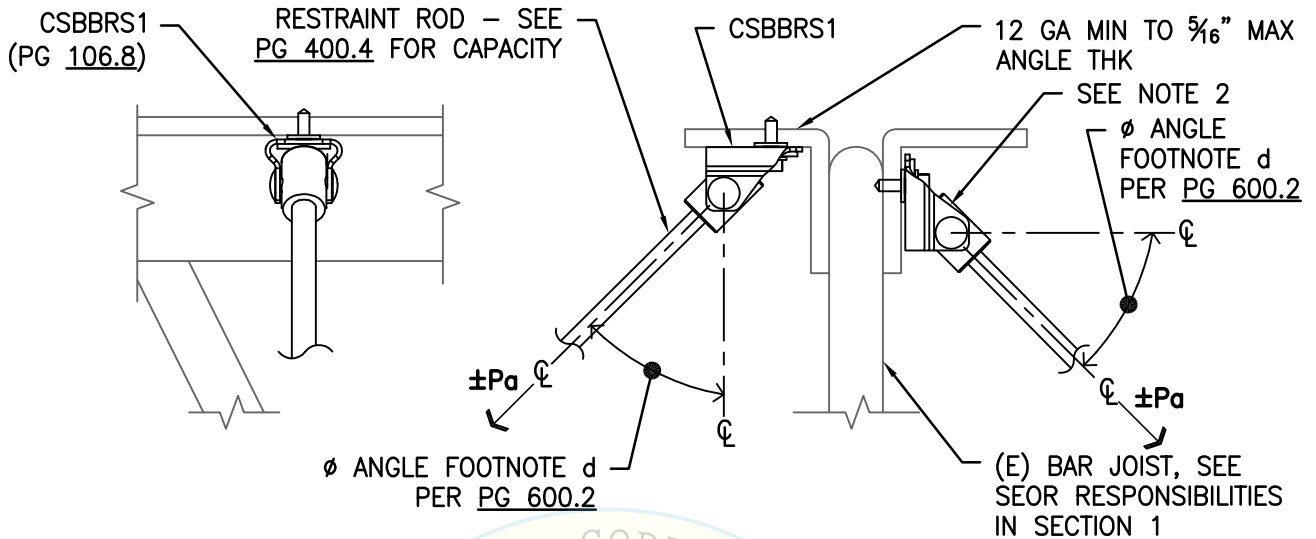
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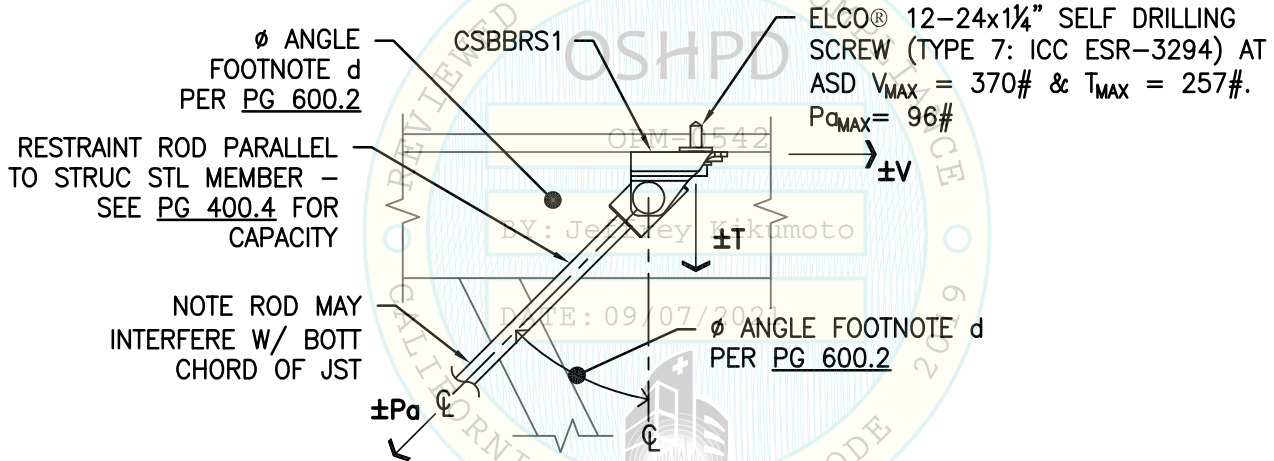
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| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 104.8 of . |

SEISMIC BRACING FOR MEP SYSTEMS



RESTRAINT PERP TO JOIST

RESTRAINT PERP TO JOIST

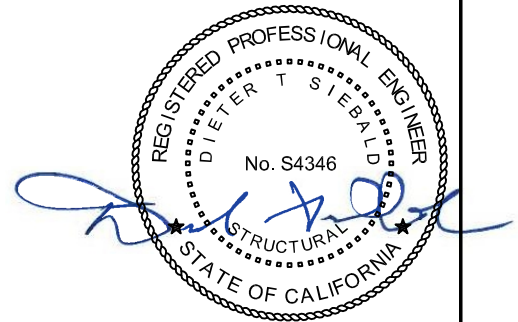


RESTRAINT PARALLEL TO JOIST

TOP FLG ATTACHMENT

NOTES:

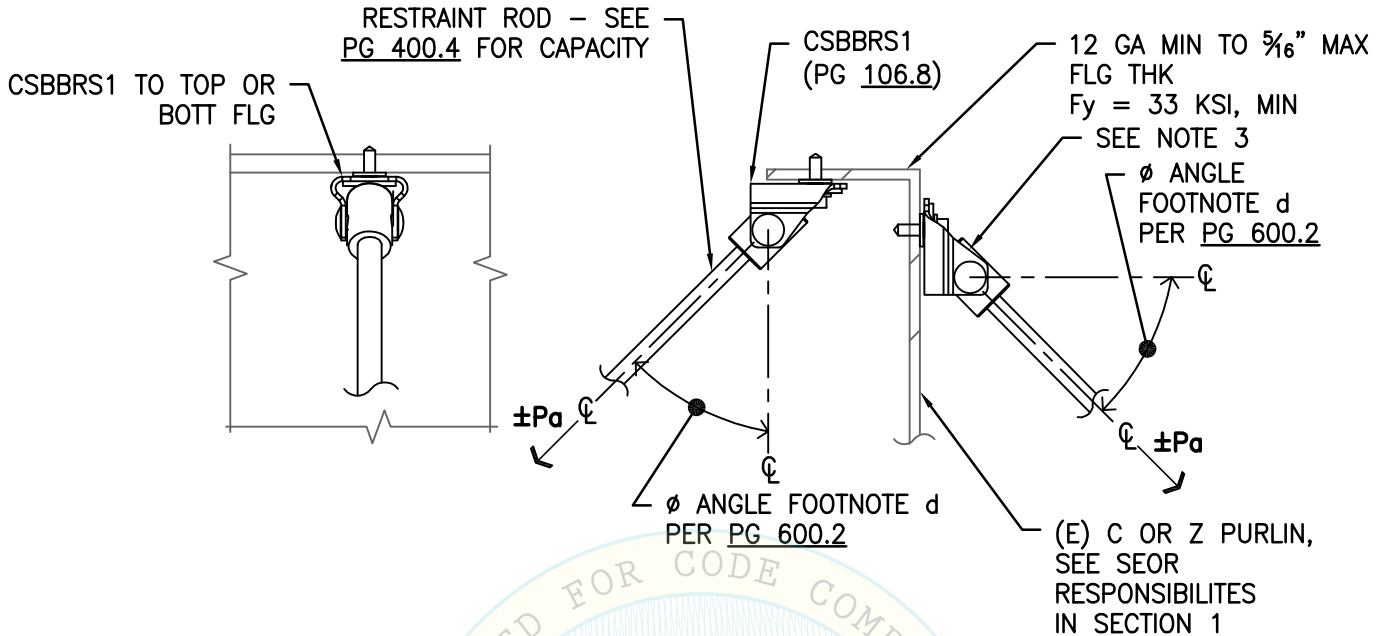
1. SEE SECTION 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBBRS1 AT ASD.
2. THE CSBBRS1 MAY ALSO ATTACH TO THE VERT LEG OF THE JOIST TOP CHORD. DO NOT SCREW INTO JOIST WEB MEMBERS.
3. THE RESTRAINT ROD MAY GOVERN THE CAPACITY OF THE RESTRAINT ASSEMBLY.



SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO TOP CHORD OF STEEL BAR JOISTS
CSBBRS1 TO HORIZONTAL LEG W/ RESTRAINT ROD PERPENDICULAR OR PARALLEL

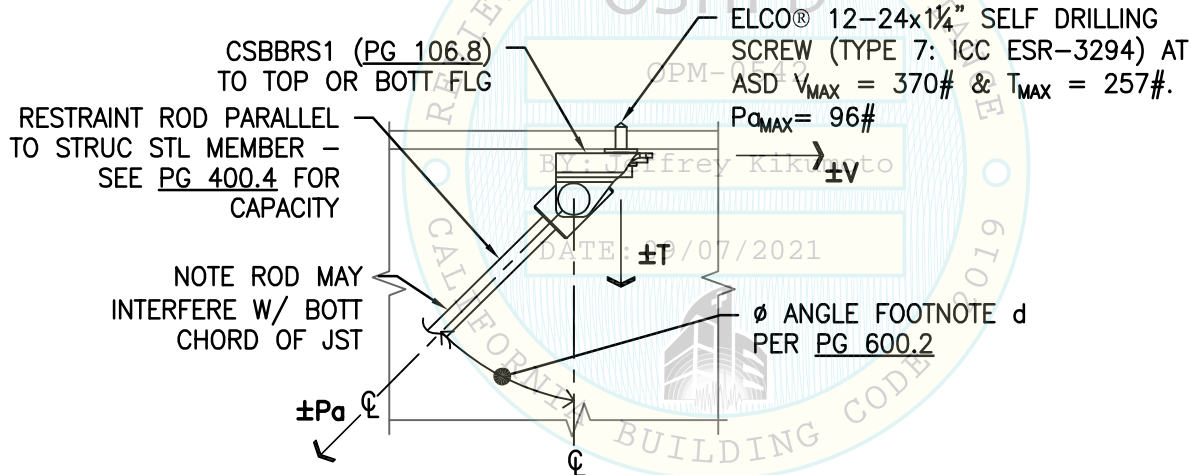
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SEISMIC BRACING FOR MEP SYSTEMS



RESTRAINT PERP TO PURLIN

RESTRAINT PERP TO PURLIN



RESTRAINT PARALLEL TO PURLIN

NOTES:

1. SEE SECTION 600 FOR HORIZ CAPACITY F_H OF AT ϕ ANGLE CSBBRS1 AT ASD.
2. THE RESTRAINT ROD MAY GOVERN THE CAPACITY OF THE RESTRAINT ASSEMBLY.
3. ATTACHMENT MAY ALSO BE TO THE WEB OF THE PURLIN, WHICH IS SUGGESTED SO AS TO MINIMIZE TORSION.



SHEET TITLE: SUPPORTS & ATTACHMENT DETAILS TO C OR Z PURLINS
CSBBRS1 TO HORIZONTAL FLANGE W/ RESTRAINT ROD PERPENDICULAR OR PARALLEL



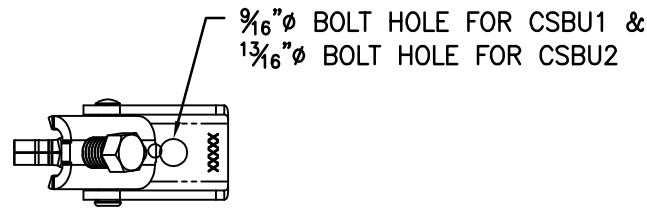
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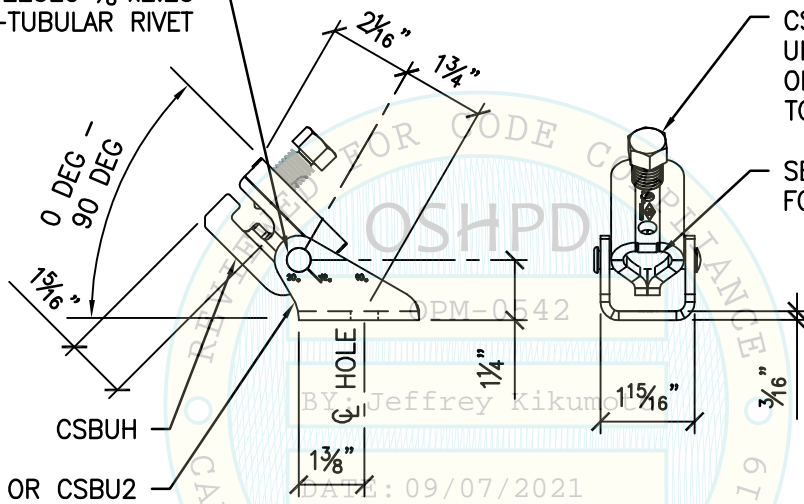
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|---------|------------|
| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 105.1 of |

SEISMIC BRACING FOR
MEP SYSTEMS



BOTT VIEW

CSBRIVET225EG 3/8"x2.25
LONG SEMI-TUBULAR RIVET



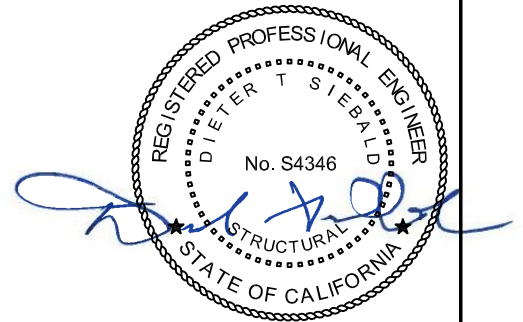
CSB0621500EG 5/8-11
UNC CONE POINT SHEAR
OFF SET SCREW, TORQUE
TO MIN 35 FT-LBS

SEE SECTIONS 2 TO 17
FOR PIPE DIA.

SIDE VIEWS

NOTES:

1. SEE SECTION 600 FOR HORIZ CAPACITY F_H AT θ ANGLE OF CSBU1 & CSBU2 AT ASD.
2. FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.



SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS

CSBU1 & CSBU2 FOR 1/2" & 3/4" BOLTS

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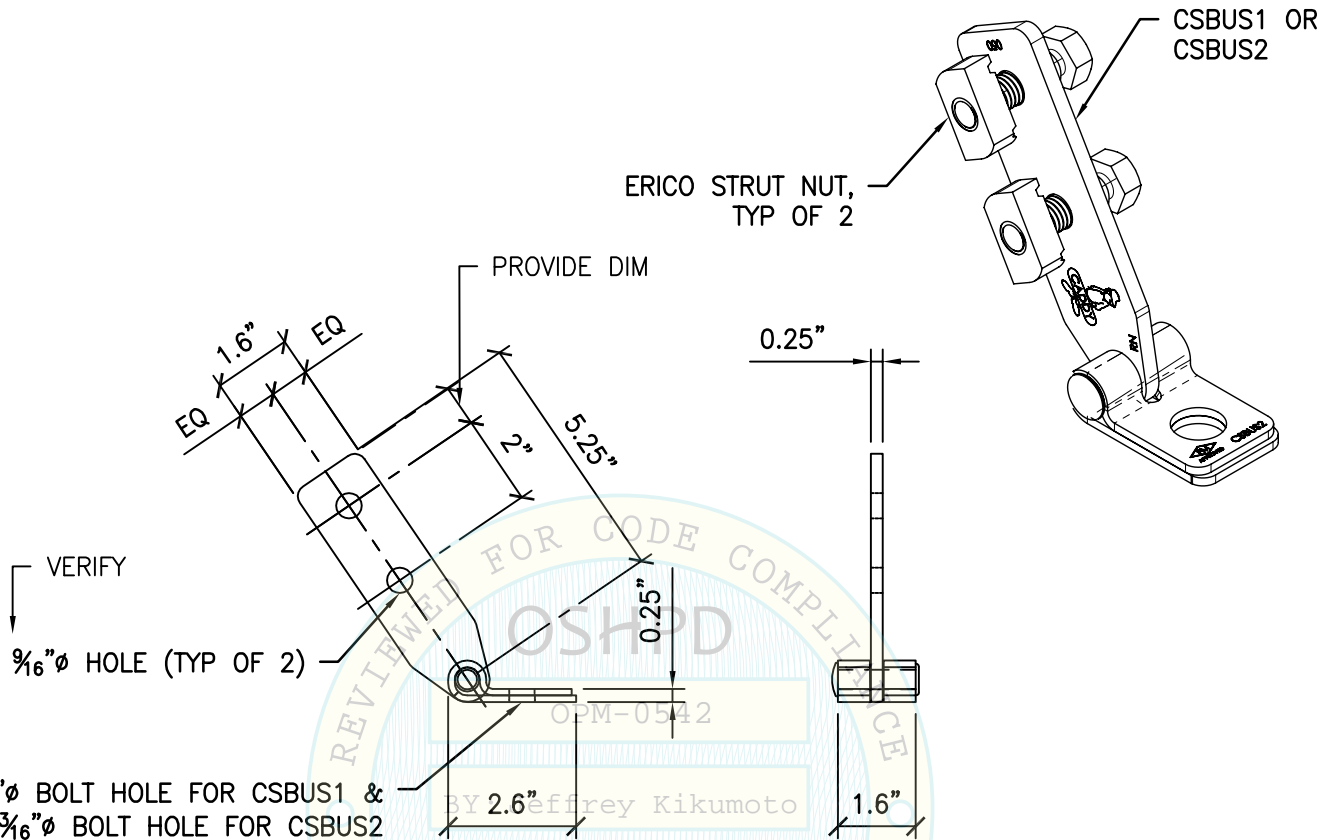


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| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 106.1 of . |

SEISMIC BRACING FOR MEP SYSTEMS



NOTES:

1. SEE SECTION 600 FOR HORIZ CAPACITY F_H AT θ ANGLE OF CSBUS1 & CSBUS2 AT ASD.
2. FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.
3. STRUT NUTS & SHEAR OFF BOLTS ARE SUPPLIED & PRE-ASSEMBLED BY ERICO & ARE INTEGRAL TO THE CSBUS1 & CSBUS2 PRODUCTS.
4. FOR ERICO STRUT NUT, SEE PG 106.29.



**SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
CSBUS1 & CSBUS2 FOR 1/2" & 3/4" BOLTS**



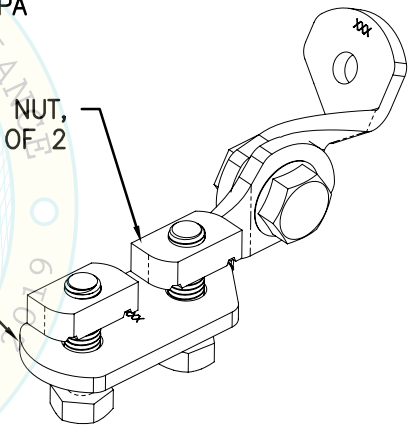
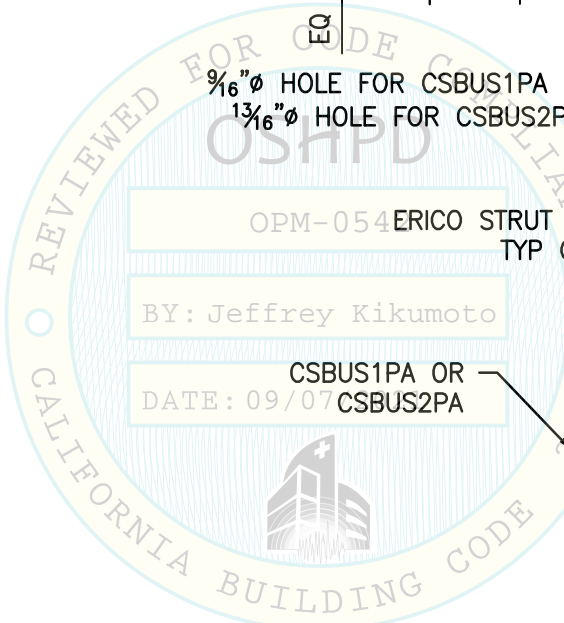
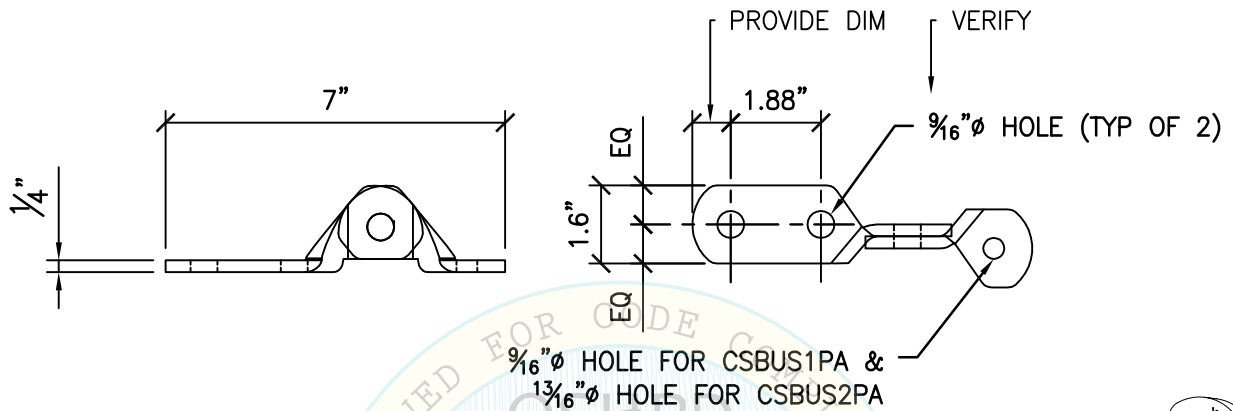
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| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 106.2 of . |

SEISMIC BRACING FOR MEP SYSTEMS



NOTES:

1. SEE SECTION 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBUS1PA & CSBUS2PA AT ASD.
2. FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.
3. STRUT NUTS & SHEAR OFF BOLTS ARE SUPPLIED & PRE-ASSEMBLED BY ERICO & ARE INTEGRAL TO THE CSBUS1 & CSBUS2 PRODUCTS.
4. FOR ERICO STRUT NUT, SEE PG 106.29.



SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
CSBUS1PA & CSBUS2PA FOR 1/2" & 3/4" BOLTS

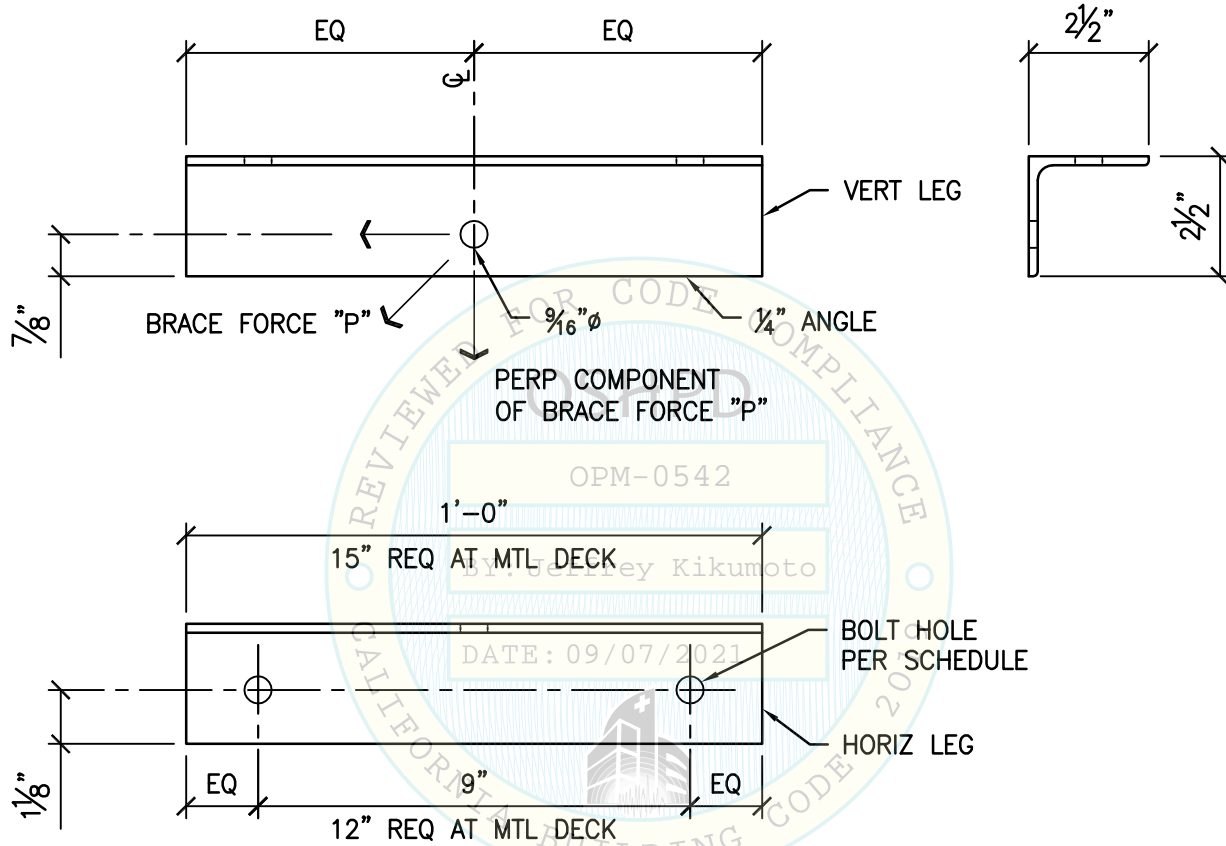
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SEISMIC BRACING FOR MEP SYSTEMS

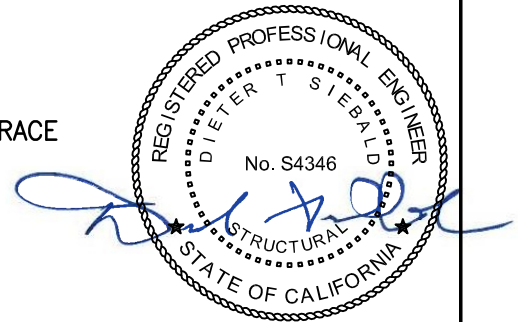


| | BOLT HOLE DIA |
|---------------|------------------|
| CSBMA050050EG | 9/16" |
| CSBMA050075EG | 13/16" |



NOTES:

1. THE ALLOWABLE PERP LOAD TO THE CSBMA IS 2400 LBS. THE BRACE FORCE "P" SHALL BE LIMITED SUCH THAT THE PERP COMPONENT OF BRACE FORCE "P" DOES NOT EXCEED 2400 LBS AT ASD
2. FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.
3. USE 3/4" ϕ ANCHOR AT CSBMA050075EG



SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS

CSBMA FOR 1/2" & 3/4" BOLTS

CYS STRUCTURAL ENGINEERS, INC.

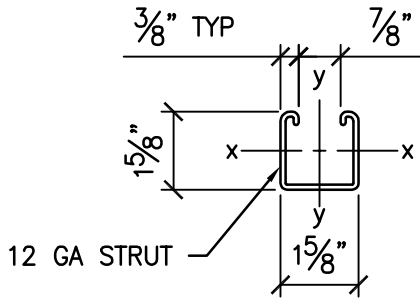


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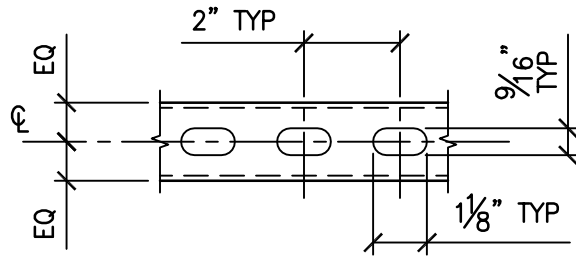
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| Page: | 106.4 of . |

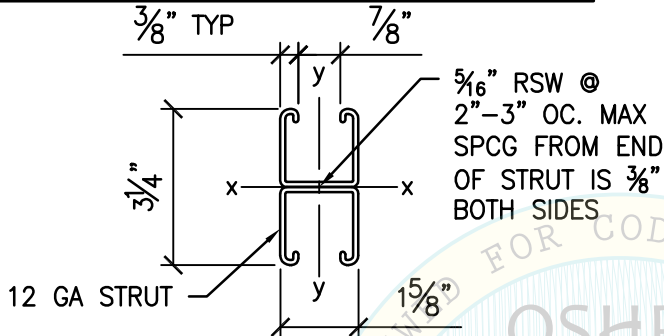
SEISMIC BRACING FOR MEP SYSTEMS



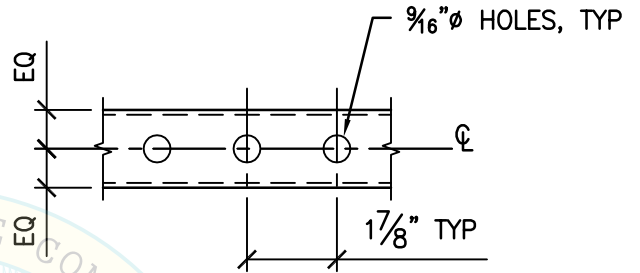
"TYPE A" SINGLE STRUT CROSS SECTION



STRUT BOTT VIEW W/ SLOTTED HOLES



UNISTRUT CROSS SECTION



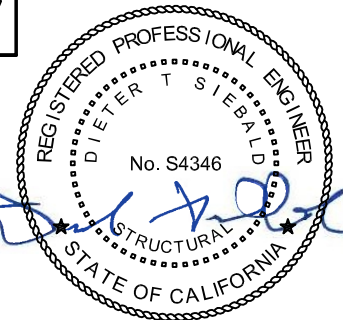
**STRUT BOTT VIEW W/ STD
SIZE PUNCHED HOLES**

MIN STRUT SECTION PROPERTIES

| STRUT MEMBER | WEIGHT (LBS/FT) | AREA (IN ²) | I_{xx} (IN ⁴) | S_{xx} (IN ³) | r_x (IN) | I_{yy} (IN ⁴) | S_{yy} (IN ³) | r_y (IN) |
|---|-----------------|-------------------------|-----------------------------|-----------------------------|------------|-----------------------------|-----------------------------|------------|
| 1 5/8 x 1 5/8 x 12 GA SINGLE STRUT, SOLID | 1.879 | 0.533 | 0.182 | 0.199 | 0.574 | 0.234 | 0.289 | 0.651 |
| 1 5/8 x 1 5/8 x 12 GA SINGLE STRUT, HALF-SLOT | 1.779 | 0.494 | 0.156 | 0.171 | 0.562 | 0.232 | 0.286 | 0.686 |
| UNISTRUT P1001 1 5/8 x 3/4 x 12 GA STRUT, SOLID | 3.780 | 1.110 | 0.928 | 0.571 | 0.915 | 0.471 | 0.580 | 0.651 |
| UNISTRUT P1001T 1 5/8 x 3/4 x 12 GA STRUT, SLOTTED | 3.680 | 0.992 | 0.927 | 0.571 | 0.968 | 0.468 | 0.576 | 0.687 |

NOTES:

- SEE SECTIONS 400 & 401 FOR STRUT LGTH & AXIAL CAPACITY OR AXIAL W/ FLEXURAL CAPACITY.
- FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.31 & ONWARDS.
- RATED LOADS AT BOLTED CONNS SHOWN IN THIS OPM ARE NOT VALID AT HALF-SLOTTED HOLES IN THE STRUT CHANNEL. ALL BOLT HOLES MUST BE STD SIZE (BOLT SIZE + 1/16")



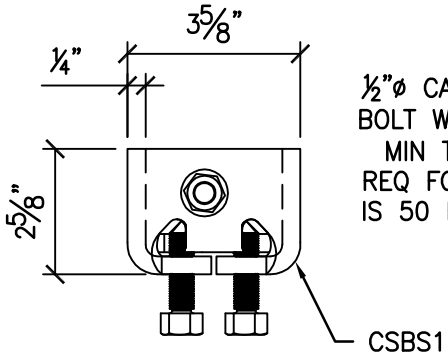
**SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
STRUT CHANNEL**

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| | SACRAMENTO, CA 95833 | Page: 106.5 of . |

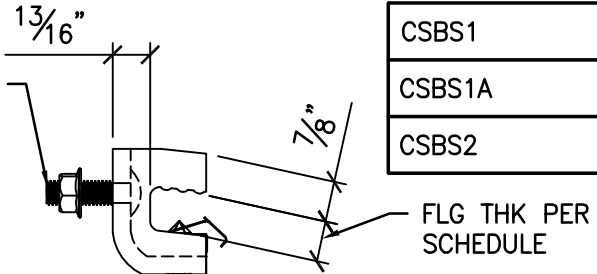
SEISMIC BRACING FOR MEP SYSTEMS



CSBS1



1/2" ϕ CARRIAGE BOLT W/ NUT. MIN TORQUE REQ FOR NUT IS 50 FT-LBS

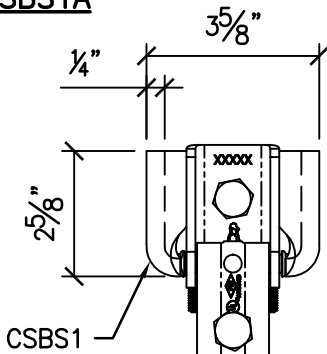


| | FLG THK |
|--------|---------------|
| CSBS1 | 1/4" - 3/4" |
| CSBS1A | 1/4" - 3/4" |
| CSBS2 | 3/4" - 1 1/4" |

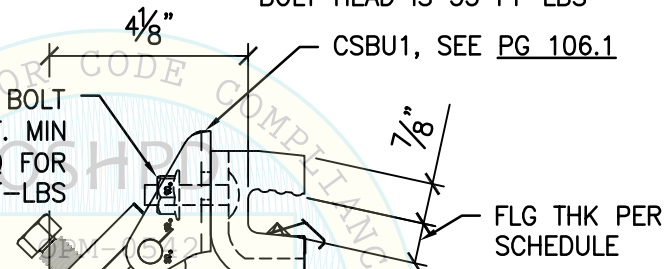
2- 1/2" ϕ RODS W/ TWIST-OFF TYPE BOLT HEADS. MIN TORQUE REQ FOR BOLT HEAD IS 35 FT-LBS

FLG THK PER SCHEDULE

CSBS1A



1/2" ϕ CARRIAGE BOLT W/ NUT. MIN TORQUE REQ FOR NUT IS 50 FT-LBS



CSBU1, SEE PG 106.1

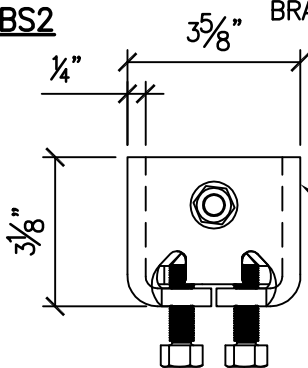
FLG THK PER SCHEDULE

2- 1/2" ϕ RODS W/ TWIST-OFF TYPE BOLT HEADS. MIN TORQUE REQ FOR BOLT HEAD IS 35 FT-LBS

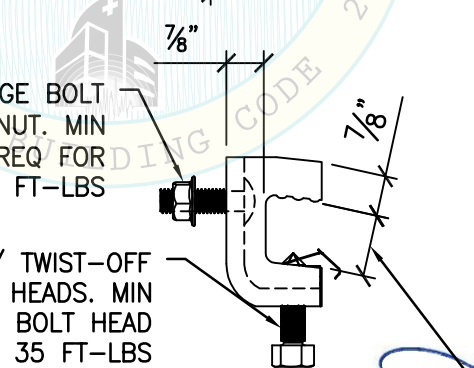
SEE SECTIONS 2 TO 17 FOR BRACE PIPE DIA.

CSBUH, SEE PG 106.1

CSBS2



1/2" ϕ CARRIAGE BOLT W/ NUT. MIN TORQUE REQ FOR NUT IS 50 FT-LBS



2- 1/2" ϕ RODS W/ TWIST-OFF TYPE BOLT HEADS. MIN TORQUE REQ FOR BOLT HEAD IS 35 FT-LBS

FLG THK PER SCHEDULE

NOTES:

- SEE SECTION 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBS1, CSBS1A & CSBS2 AT ASD.
- FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.



SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
CSBS1, CSBS1A & CSBS2



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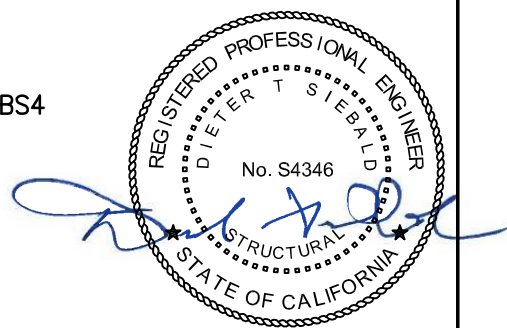
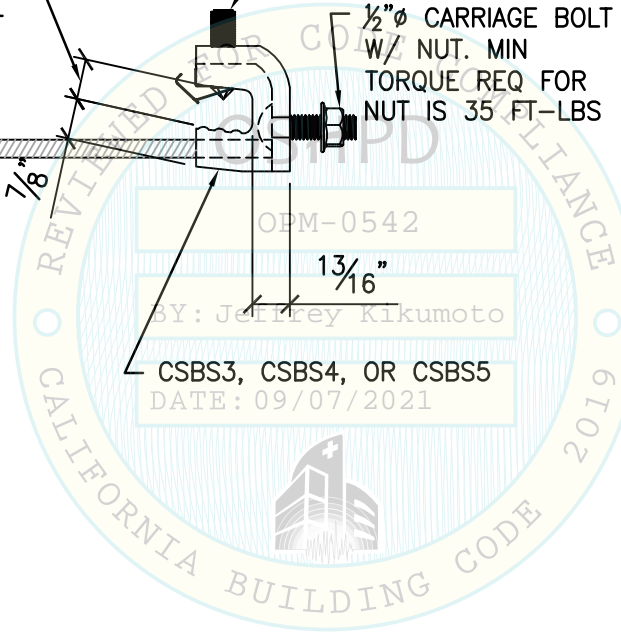
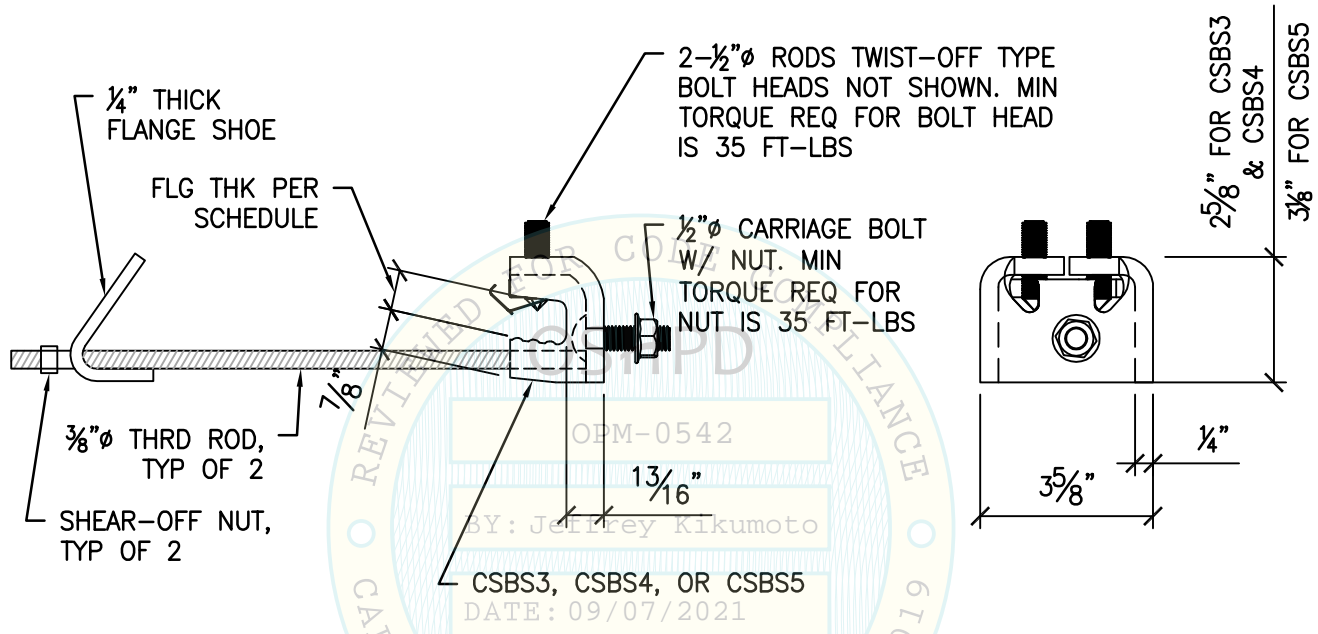
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| Date: | 09/08/2021 |
| Page: | 106.6 of |

SEISMIC BRACING FOR MEP SYSTEMS



| | FLG WIDTH | FLG THK |
|-------|-----------|----------|
| CSBS3 | 4" - 8½" | ¼" - ¾" |
| CSBS4 | 4" - 14½" | ¼" - ¾" |
| CSBS5 | 4" - 18" | ¾" - 1¼" |



NOTES:

- SEE SECTION 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBS3, CSBS4 & CSBS5 AT ASD.
- FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.

SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
CSBS3, CSBS4 & CSBS5



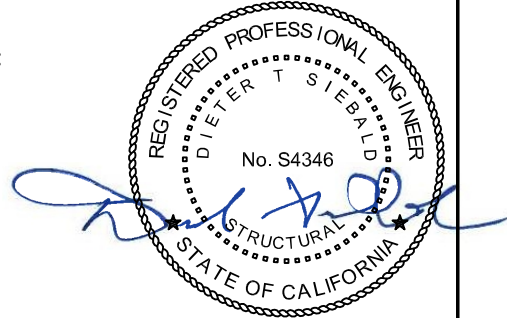
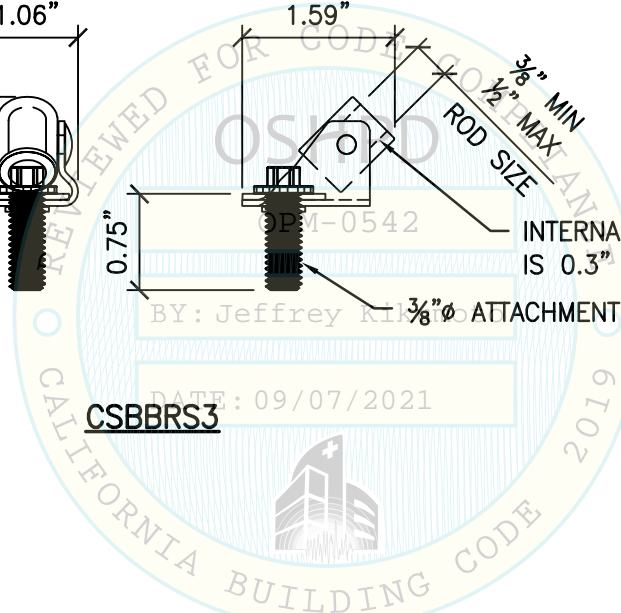
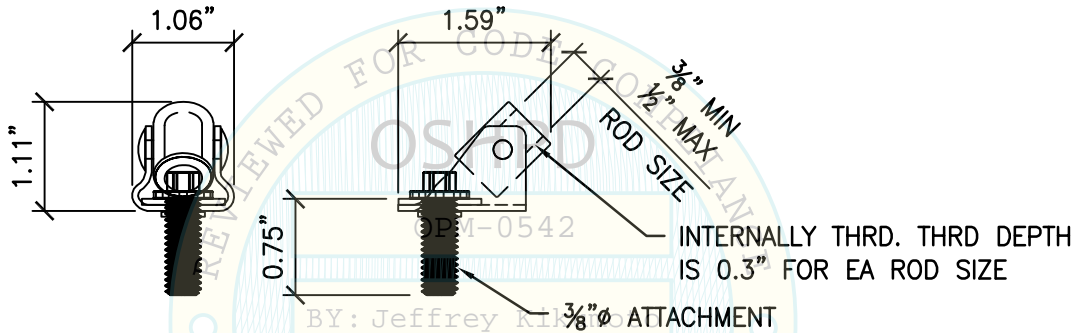
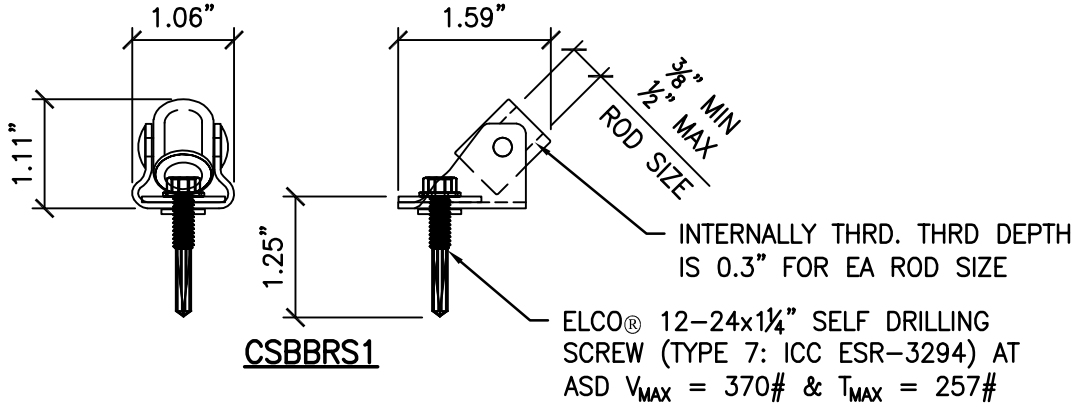
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| Page: | 106.7 of . |

SEISMIC BRACING FOR MEP SYSTEMS



NOTES:

1. SEE SECTION 600 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBBRS1 & CSBBRS3 AT ASD.
2. FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.

SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
CSBBRS1 & CSBBRS3



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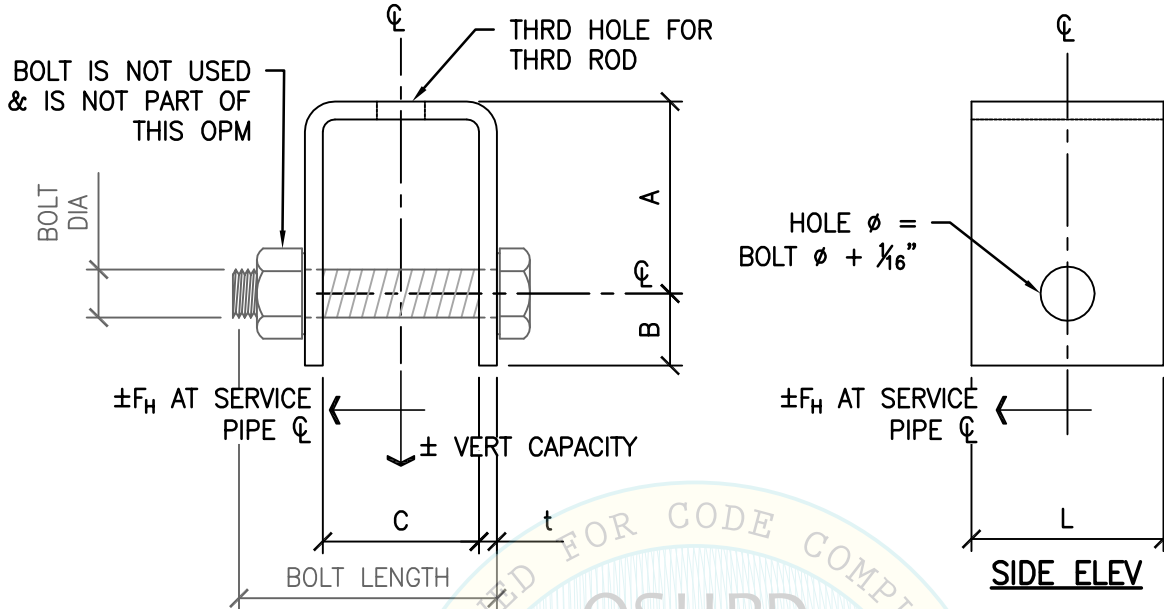
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| Page: | 106.8 of . |

SEISMIC BRACING FOR
MEP SYSTEMS



320W WELDED BEAM OR SERVICE PIPE ATTACHMENT



| PART # | THRD ROD DIA | A | B | C | BOLT DIA | BOLT LENGTH | t | L | HORIZ CAPACITY FH (LBS) | VERT CAPACITY (LBS) |
|------------|--------------|----|--------|---------|----------|-------------|------|--------|-------------------------|---------------------|
| 320W0037PL | 3/8" | 2" | 7/8" | 1 1/16" | - | - | 1/4" | 2" | 156 | 7764 |
| 320W0050PL | 1/2" | 2" | 7/8" | 1 5/8" | - | - | 1/4" | 2" | 156 | 7764 |
| 320W0062PL | 5/8" | 2" | 1" | 1 5/8" | - | - | 1/4" | 2" | 153 | 7767 |
| 320W0075PL | 3/4" | 2" | 1 1/8" | 1 7/8" | - | - | 3/8" | 2 1/2" | 425 | 9475 |

NOTES:

- 320W. WHEN WELDED TO SERVICE PIPES OR SUPPORTING STL MEMBER IS ONLY USED W/ 3/8" & 1/2" THRD RODS. SEE PGS 4.1 TO 4.3 & 103.21.
- FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.
- F_H CAPACITY IS BASED ON THE CONDITION WHERE THE BRACKET IS WELDED TO THE SERVICE PIPE (SEE PG 4.1). F_H IS NOT APPLICABLE WHEN THE BRACKET IS WELDED TO SUPPORTING STL MEMBERS. CAPACITY IS AT ASD.
- VERT CAPACITY IS BASED ON THE CONDITION WHERE THE BRACKET SUPPORTS VERT SEISMIC BRACES. CAPACITY IS AT ASD & IS THE TOTAL VERT LOAD THAT THE BRACKET CAN RESIST, INCLUDING BOTH W_p & F_{PV}.



SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
320W U-BRACKET

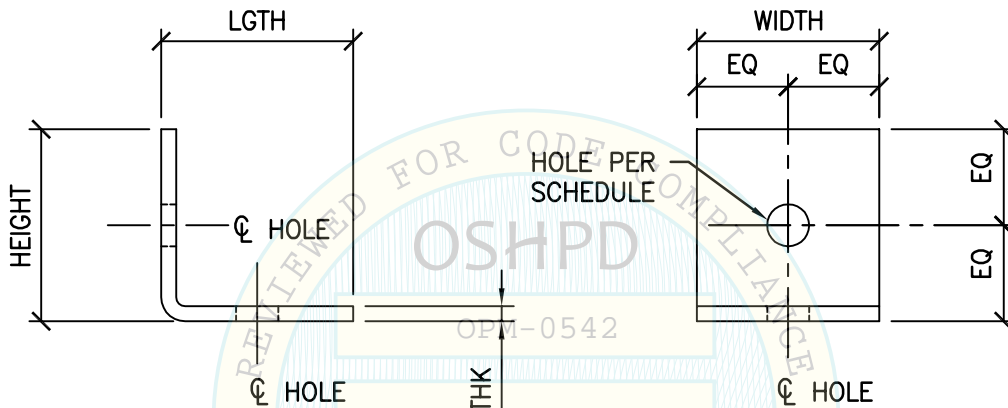
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| | Date: | 09/08/2021 |
| | Page: | 106.9 of |

SEISMIC BRACING FOR
MEP SYSTEMS



325 STEEL SIDE BEAM ATTACHMENT

| | HOLE SIZE | HEIGHT | LGTH | WIDTH | THK | BRACKET CAPACITY (LBS) |
|-----------|-----------|--------|--------|-------|-------|------------------------|
| 3250037EG | 7/16" | 2" | 2" | 1.9" | 5/32" | 210 |
| 3250050EG | 9/16" | 2" | 2" | 1.9" | 5/32" | 210 |
| 3250062EG | 1 1/16" | 2 1/2" | 2 1/2" | 2.5" | 1/4" | 560 |
| 3250075EG | 1 3/16" | 3" | 3" | 3" | 3/8" | 1260 |



NOTES:

1. SEE SCHEDULE ABV FOR VERT CAPACITY AT SUPPORTING STRUCTURE FOR 325 L-BRACKET.
2. FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.
3. CAPACITY IS AT ASD & IS THE TOTAL LOAD THAT THE BRACKET CAN RESIST, INCLUDING BOTH W_p & F_{pv}



SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
325 L-BRACKET



CYS STRUCTURAL ENGINEERS, INC.

2495 NATOMAS PARK DRIVE, SUITE 650
SACRAMENTO, CA 95833

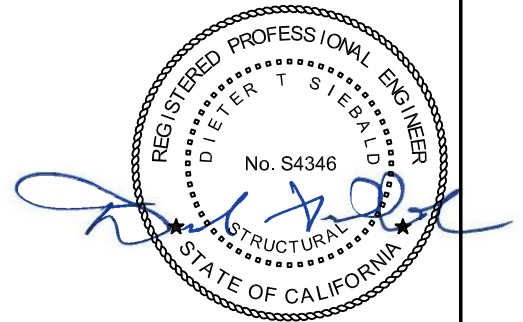
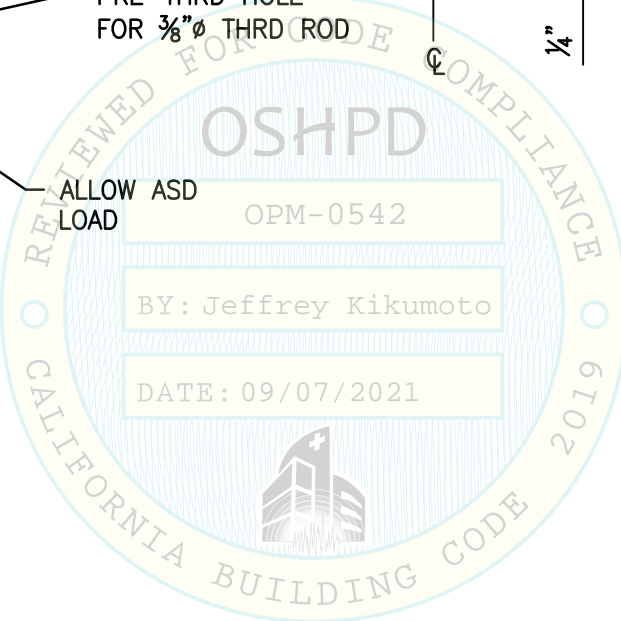
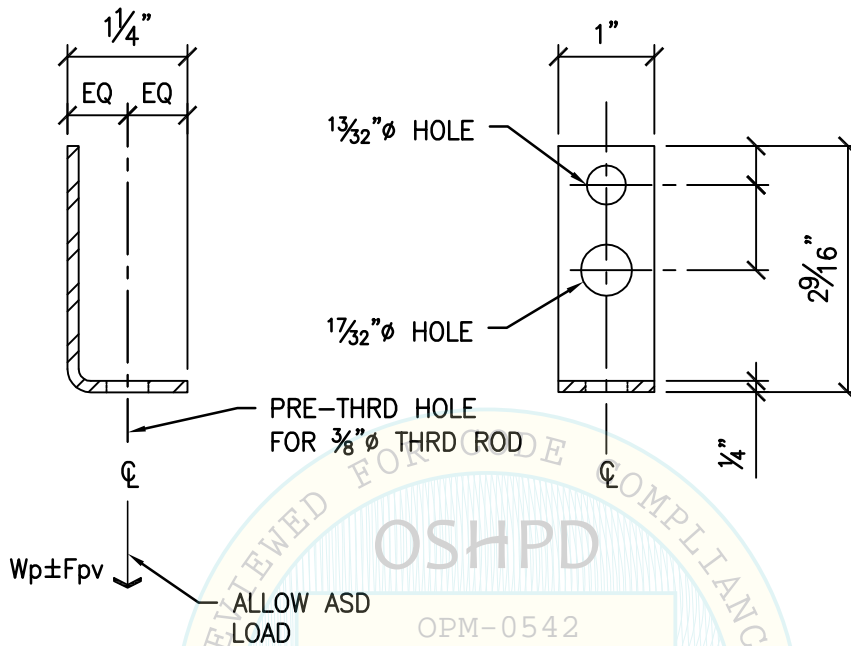
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Job No: 19039
Date: 09/08/2021
Page: 106.10 of .

SEISMIC BRACING FOR
MEP SYSTEMS



328 THREADED STEEL SIDE BEAM ATTACHMENT



NOTES:

1. SEE PG 400.4 FOR THRD ROD CAPACITY OF 328 L-BRACKET AT ASD.
2. FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.
3. L-BRACKET CAPACITY INCLUDES BOTH W_p & F_{pv} & IS 146# AT ASD.

SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
328 L-BRACKET



CYS STRUCTURAL ENGINEERS, INC.

2495 NATOMAS PARK DRIVE, SUITE 650
SACRAMENTO, CA 95833

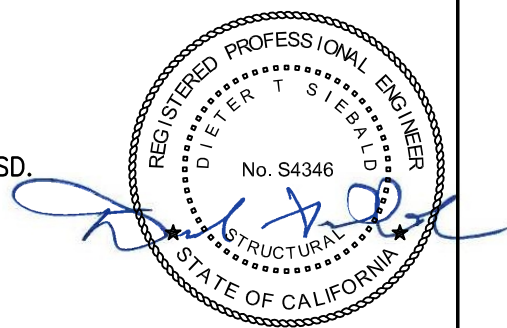
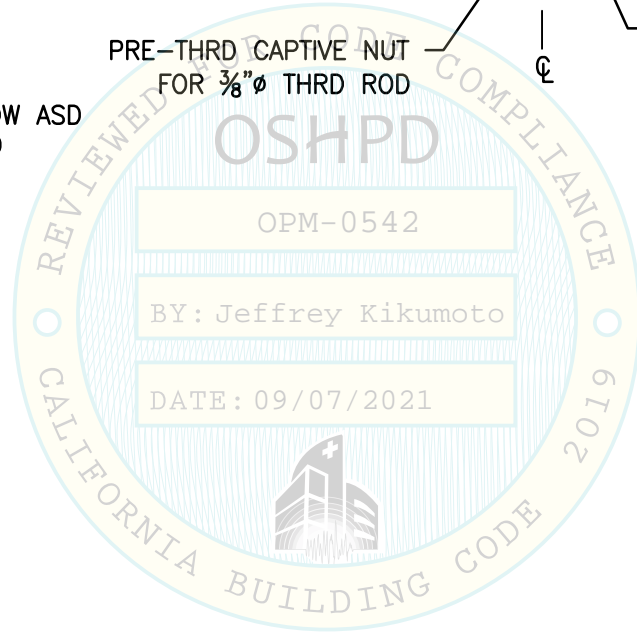
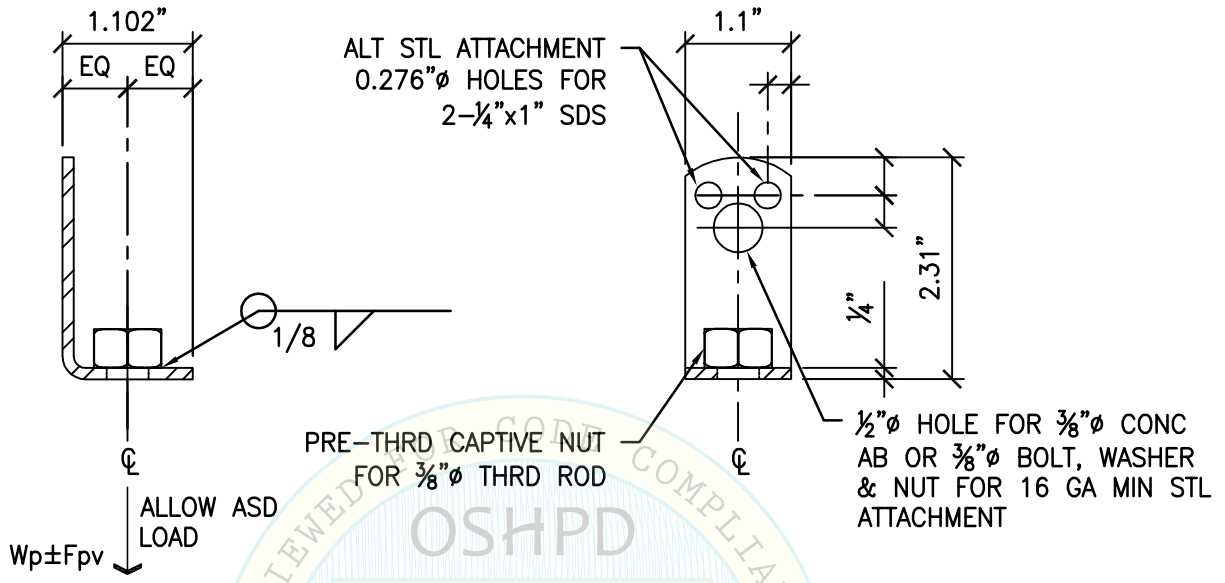
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| Date: | 09/08/2021 |
| Page: | 106.11 of . |

SEISMIC BRACING FOR
MEP SYSTEMS



329 SIDE BEAM ATTACHMENT



NOTES:

1. SEE PG 400.4 FOR THRD ROD CAPACITY 329 L-BRACKET AT ASD.
2. FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.
3. 329 L-BRACKET CAPACITY INCLUDES BOTH W_p & F_{pv} & IS 220# AT ASD.

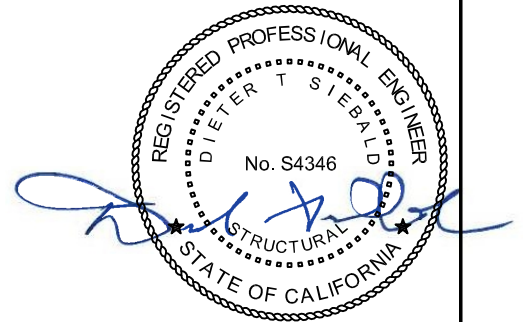
SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
329 L-BRACKET

| | |
|--|-------------------|
|  <p>CYS STRUCTURAL ENGINEERS, INC. 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833</p> | Job No: 19039 |
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| | Page: 106.12 of . |

SEISMIC BRACING FOR
MEP SYSTEMS



NOT USED



SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS



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Page: 106.13 of .

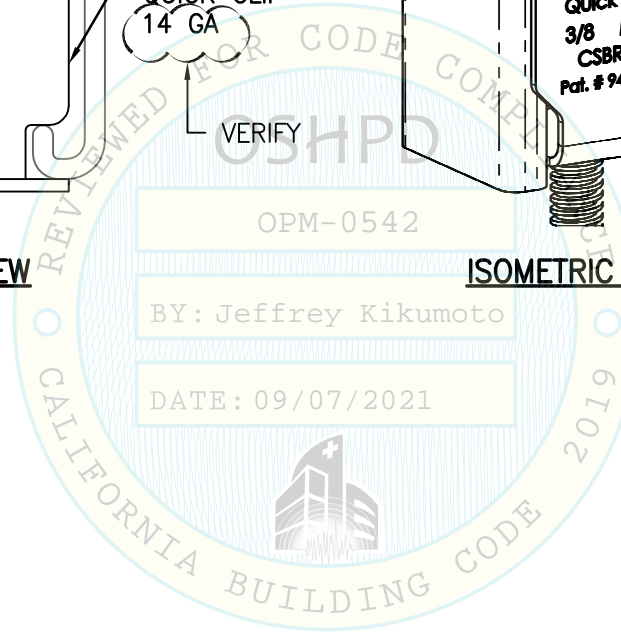
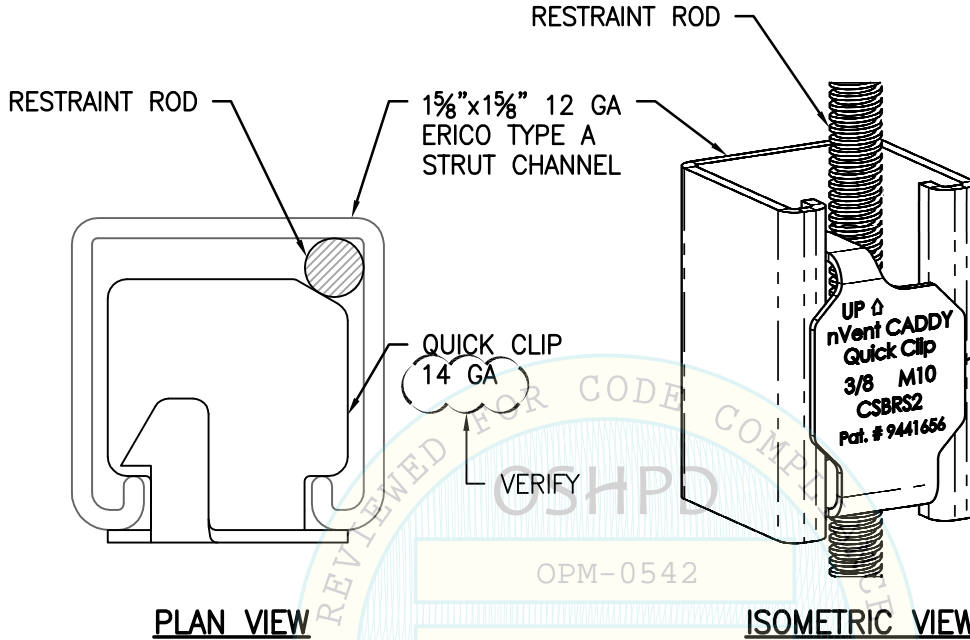
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SEISMIC BRACING FOR
MEP SYSTEMS



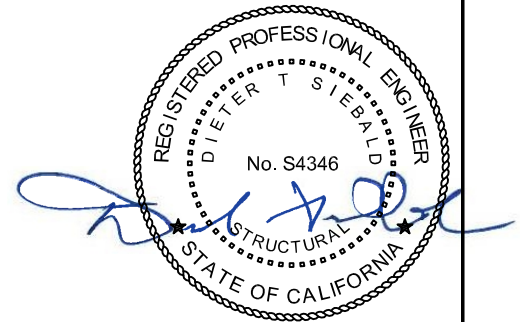
NVENT CADDY QUICK CLIP ROD STIFFENER CSBRS (X)

| | ROD DIA ϕ |
|--------|----------------|
| CSBRS2 | 3/8" |
| CSBRS3 | 1/2" |
| CSBRS4 | 5/8" |
| CSBRS5 | 3/4" |



NOTES:

1. SEE PG 400.4 FOR ROD CAPACITY W/ OR WITHOUT STIFFENERS.
2. FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.



SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
CSBRS NVENT CADDY QUICK CLIP ROD STIFFENER



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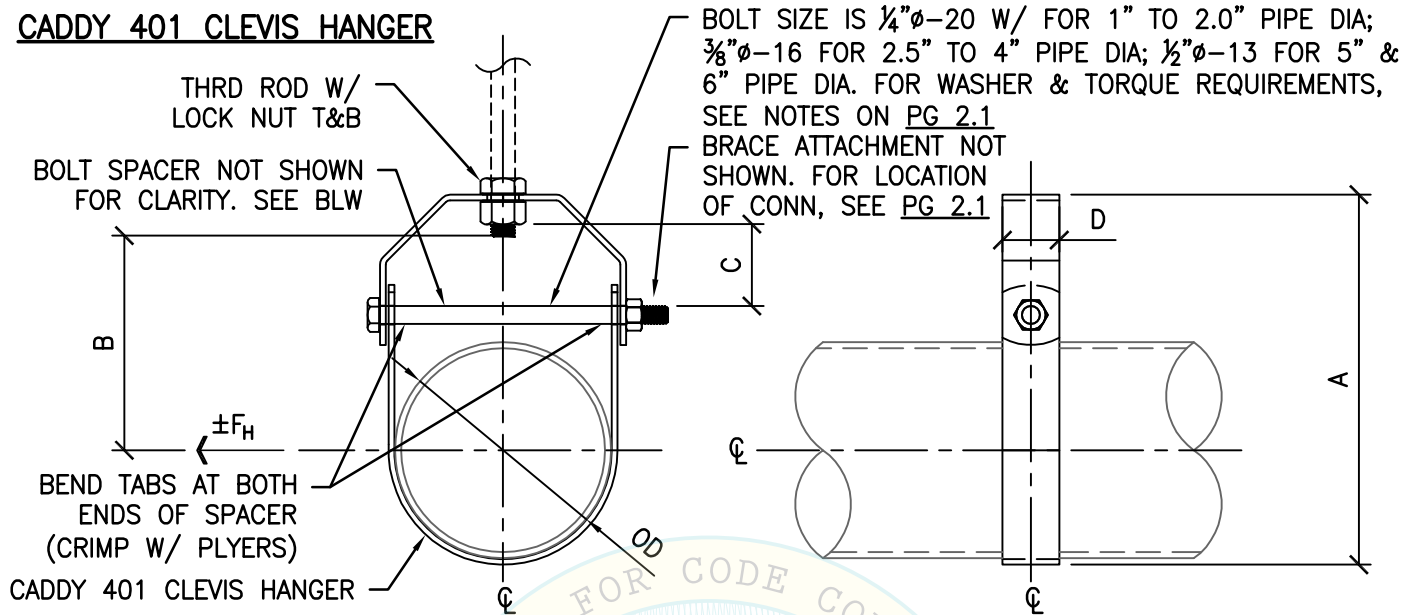
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| Date: | 09/08/2021 |
| Page: | 106.14 of . |

SEISMIC BRACING FOR MEP SYSTEMS



CADDY 401 CLEVIS HANGER



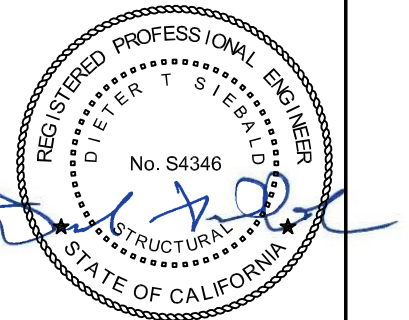
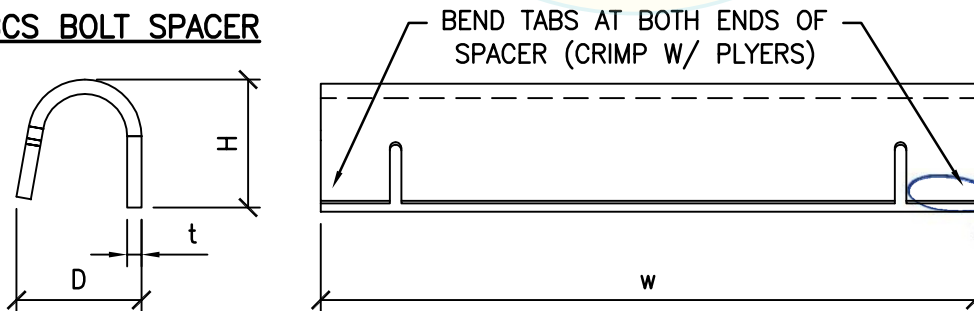
| PART # | PIPE DIA (IN) | OD (IN) | ROD SIZE (IN) | A (IN) | B (IN) | C (IN) | D (IN) |
|-----------|---------------|---------|---------------|----------|--------|--------|--------|
| 4010100EG | 1 | 1.315 | 3/8 | 2 13/16 | 1 3/8 | 3/8 | 0.748 |
| 4010125EG | 1 1/4 | 1.660 | 3/8 | 3 3/8 | 1 9/16 | 3/8 | 0.948 |
| 4010150EG | 1 1/2 | 1.900 | 3/8 | 3 1 1/16 | 2 1/4 | 1 1/16 | 0.948 |
| 4010200EG | 2 | 2.375 | 3/8 | 4 5/16 | 2 1/2 | 7/8 | 0.948 |
| 4010250EG | 2 1/2 | 2.875 | 1/2 | 5 5/16 | 3 1/4 | 1 | 1.181 |
| 4010300EG | 3 | 3.5 | 1/2 | 6 1/16 | 3 1/2 | 1 1/8 | 1.181 |
| 4010350EG | 3 1/2 | 4 | 1/2 | 6 1 3/16 | 4 | 1 5/16 | 1.181 |
| 4010400EG | 4 | 4.5 | 5/8 | 7 7/16 | 4 3/8 | 1 3/8 | 1.181 |
| 4010500EG | 5 | 5.563 | 5/8 | 9 1/16 | 5 5/8 | 1 5/8 | 1.181 |
| 4010600EG | 6 | 6.625 | 3/4 | 10 9/16 | 6 | 1 7/8 | 1.496 |

| BOLT SPACER PART # | PIPE DIA (IN) | W (IN) | H (IN) | t (IN) | D (IN) |
|--------------------|---------------|--------|--------|--------|--------|
| CSBCS0100 | 1 | 1.21 | 0.51 | 0.075 | 0.51 |
| CSBCS0125 | 1 1/4 | 1.55 | 0.51 | 0.075 | 0.51 |
| CSBCS0150 | 1 1/2 | 1.71 | 0.51 | 0.075 | 0.51 |
| CSBCS0200 | 2 | 2.28 | 0.51 | 0.075 | 0.51 |
| CSBCS0250 | 2 1/2 | 2.78 | 0.67 | 0.075 | 0.65 |
| CSBCS0300 | 3 | 3.41 | 0.67 | 0.075 | 0.65 |
| CSBCS0350 | 3 1/2 | 3.91 | 0.67 | 0.075 | 0.65 |
| CSBCS0400 | 4 | 4.41 | 0.67 | 0.075 | 0.65 |
| CSBCS0500 | 5 | 5.50 | 0.98 | 0.075 | 0.90 |
| CSBCS0600 | 6 | 6.56 | 0.98 | 0.075 | 0.90 |

NOTES:

- SEE SECTION 500 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CADDY 401 CLEVIS HANGER W/ CSBCS BOLT SPACER & CSBU1 BRACE ASSEMBLY.
- FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.

CSBCS BOLT SPACER



SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
CADDY 401 CLEVIS HANGER W/ CSBCS BOLT SPACER



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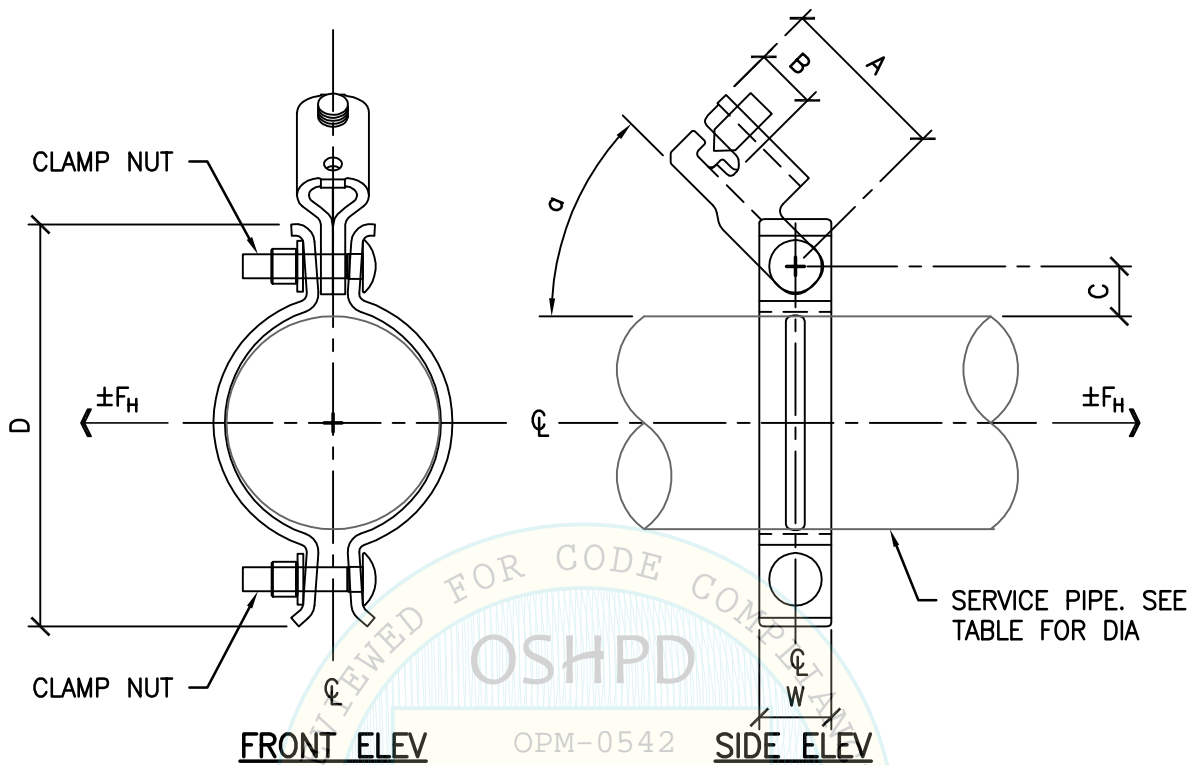
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| Date: | 09/08/2021 |
| Page: | 106.15 of |

SEISMIC BRACING FOR MEP SYSTEMS



CSB



| PART # | PIPE DIA (IN) | α | W (IN) | A (IN) | B (IN) | C (IN) | D (IN) |
|---------|---------------|----|--------|--------|--------|--------|--------|
| CSB0100 | 1 | 45 | 1½ | 3⅞ | 1⅝ | 5⁄8 | 5 |
| CSB0125 | 1¼ | 45 | 1½ | 3⅞ | 1⅝ | 1⅛ | 5½ |
| CSB0150 | 1½ | 45 | 1½ | 3⅞ | 1⅝ | ¾ | 5⅜ |
| CSB0200 | 2 | 45 | 1½ | 3⅞ | 1⅝ | 1⅜ | 6 |
| CSB0250 | 2½ | 45 | 1½ | 3⅞ | 1⅝ | 1⅝ | 6¾ |
| CSB0300 | 3 | 45 | 1½ | 3⅞ | 1⅝ | 1 | 7⅜ |
| CSB0400 | 4 | 45 | 1½ | 3⅞ | 1⅝ | 1⅛ | 8½ |
| CSB0500 | 5 | 45 | 1½ | 3⅞ | 1⅝ | 1 | 10⅛ |
| CSB0600 | 6 | 45 | 1½ | 3⅞ | 1⅝ | 1⅛ | 10⅞ |
| CSB0800 | 8 | 45 | 1½ | 3⅞ | 1⅝ | 1¼ | 13 |
| CSB1000 | 10 | 45 | 1½ | 3⅞ | 1⅝ | 1⅜ | 15 |
| CSB1200 | 12 | 45 | 1½ | 3⅞ | 1⅝ | 1⅜ | 16⅞ |

NOTES:

- SEE SECTION 500 FOR HORIZ CAPACITY F_H AT α ANGLE AT ASD OF CSB.
- FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.
- LONGITUDINAL PIPE BRACE SHOWN. WHEN SERVING AS A TRANSVERSE BRACE, BRACE PIPE IS AT 90 DEG ANGLE TO RUN PIPE.



SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
CSB



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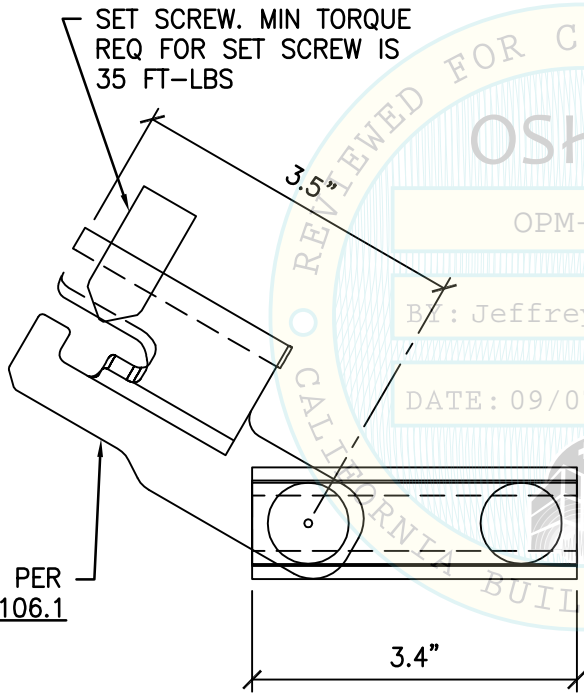
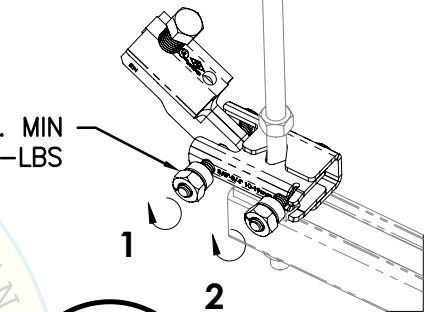
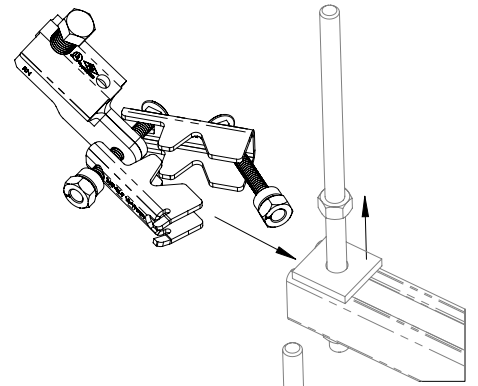
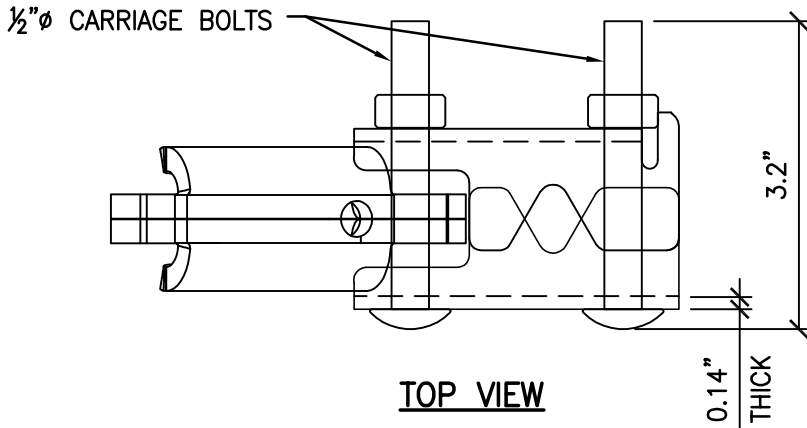
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| Page: | 106.16 of |

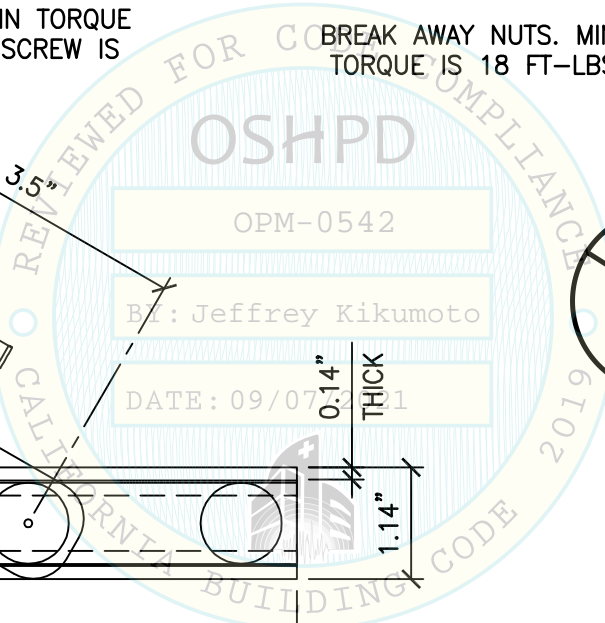
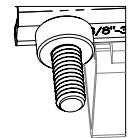
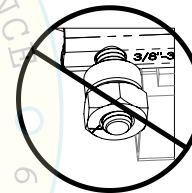
SEISMIC BRACING FOR
MEP SYSTEMS



CSBR1 RETROFIT TRAPEZE ATTACHMENT



BREAK AWAY NUTS. MIN TORQUE IS 18 FT-LBS



NOTES:

- SEE SECTION 500.4 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF CSBR1.
- FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.

SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
CSBR1



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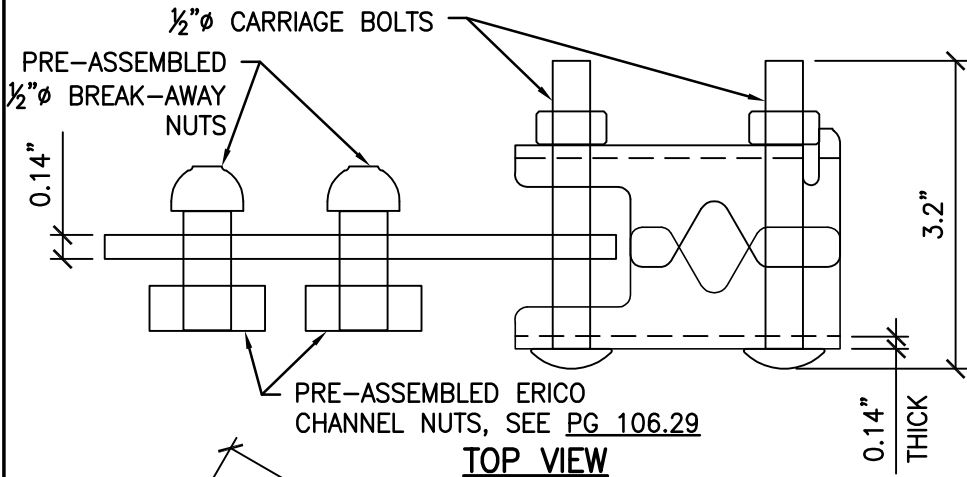
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| Page: | 106.17 of |

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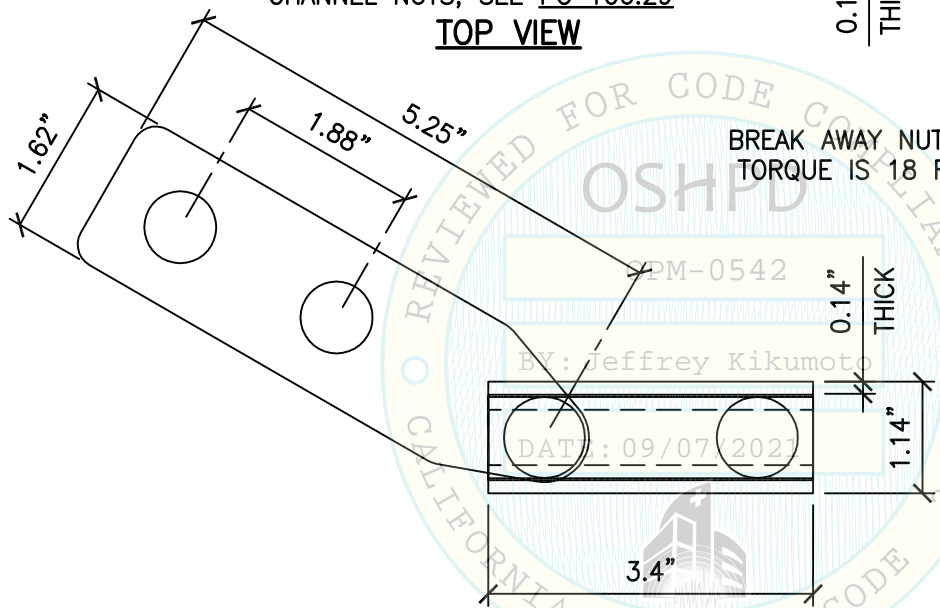
SEISMIC BRACING FOR
MEP SYSTEMS



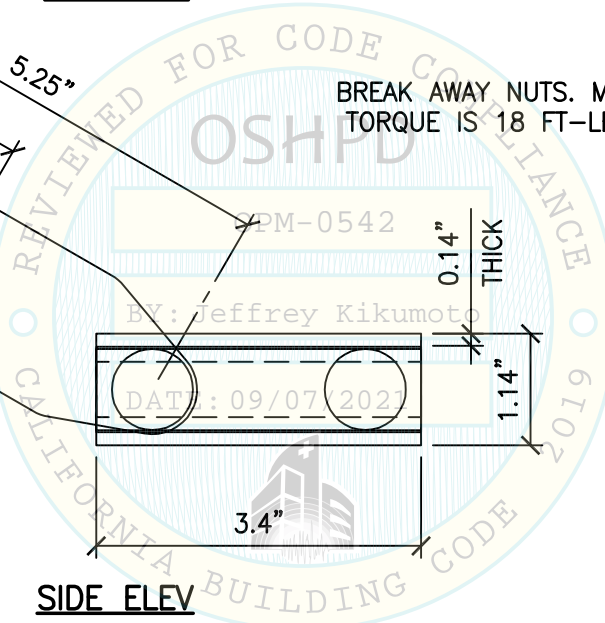
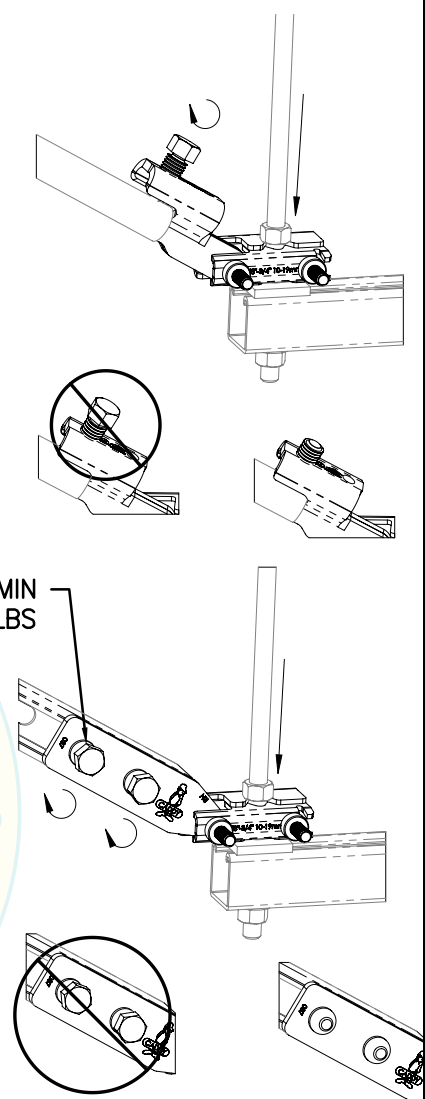
CSBR2 RETROFIT TRAPEZE ATTACHMENT



TOP VIEW



SIDE ELEV



NOTES:

1. SEE SECTION 500.4 FOR HORIZ CAPACITY F_H AT θ ANGLE OF CSBR2.
2. FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.
3. STRUT NUTS & SHEAR OFF BOLTS ARE SUPPLIED & PRE-ASSEMBLED BY ERICO & ARE INTEGRAL TO THE CSBR2 PRODUCT.
4. FOR ERICO STRUT NUT, SEE PG 106.29.

SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
CSBR2

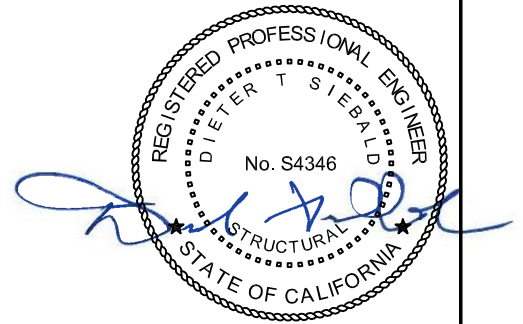
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| | Page: 106.18 of |

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SEISMIC BRACING FOR
MEP SYSTEMS



NOT USED



SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
CADDY 429 PIPE CLAMP



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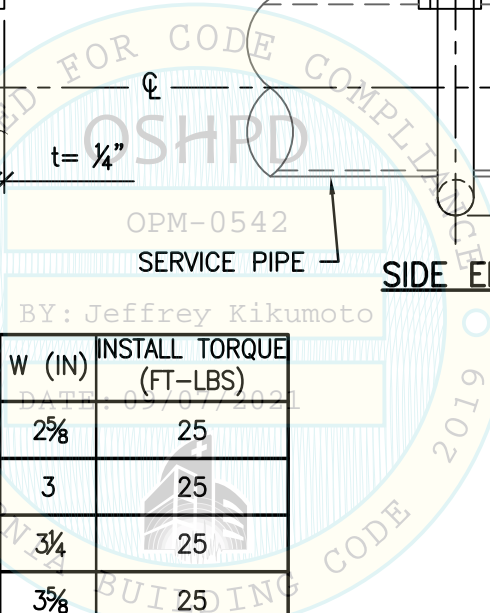
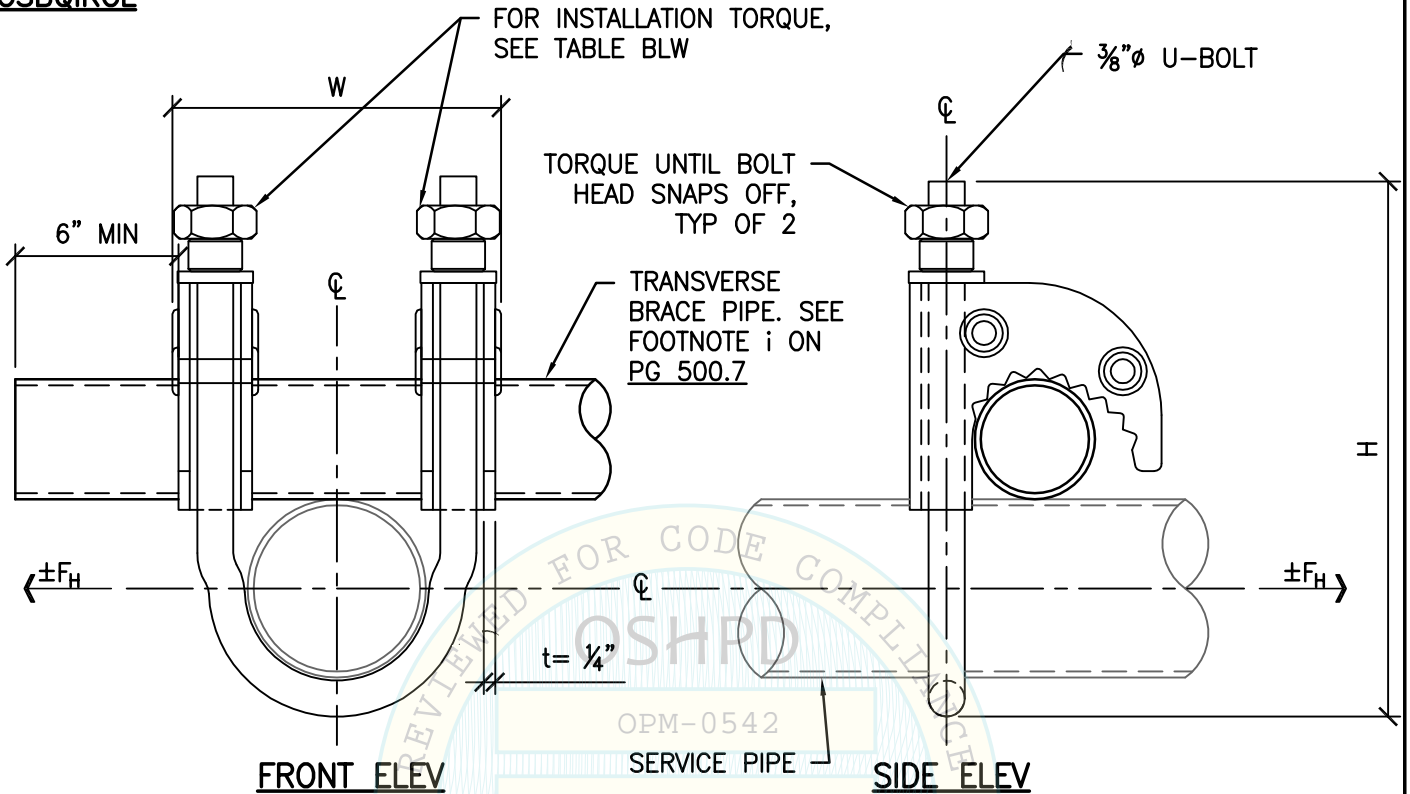
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SEISMIC BRACING FOR MEP SYSTEMS



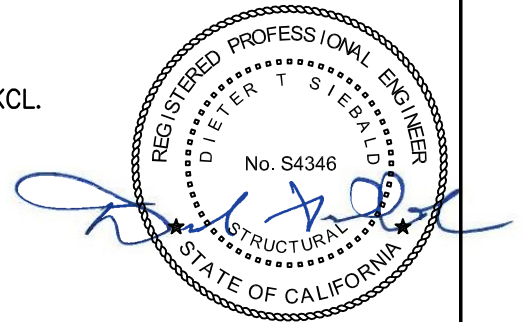
CSBQIKCL



| PART # | SERVICE PIPE SIZE (IN) | H (IN) | W (IN) | INSTALL TORQUE (FT-LBS) |
|---------------|-------------------------------|-------------------------------|-------------------------------|-------------------------|
| CSBQIKCL100EG | 1 | 5 ⁵ / ₈ | 2 ⁵ / ₈ | 25 |
| CSBQIKCL125EG | 1 ¹ / ₄ | 5 ³ / ₈ | 3 | 25 |
| CSBQIKCL150EG | 1 ¹ / ₂ | 5 ⁵ / ₈ | 3 ¹ / ₄ | 25 |
| CSBQIKCL200EG | 2 | 6 ³ / ₈ | 3 ³ / ₈ | 25 |

NOTES:

1. SEE PG 500.1 FOR HORIZ CAPACITY F_H AT ϕ ANGLE AT ASD OF CSBQIKCL.
2. FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.
3. CSBQIKCL CAN ALSO BE USED AS FOUR-WAY RISER. SEE PG 9.1



SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
CSBQIKCL



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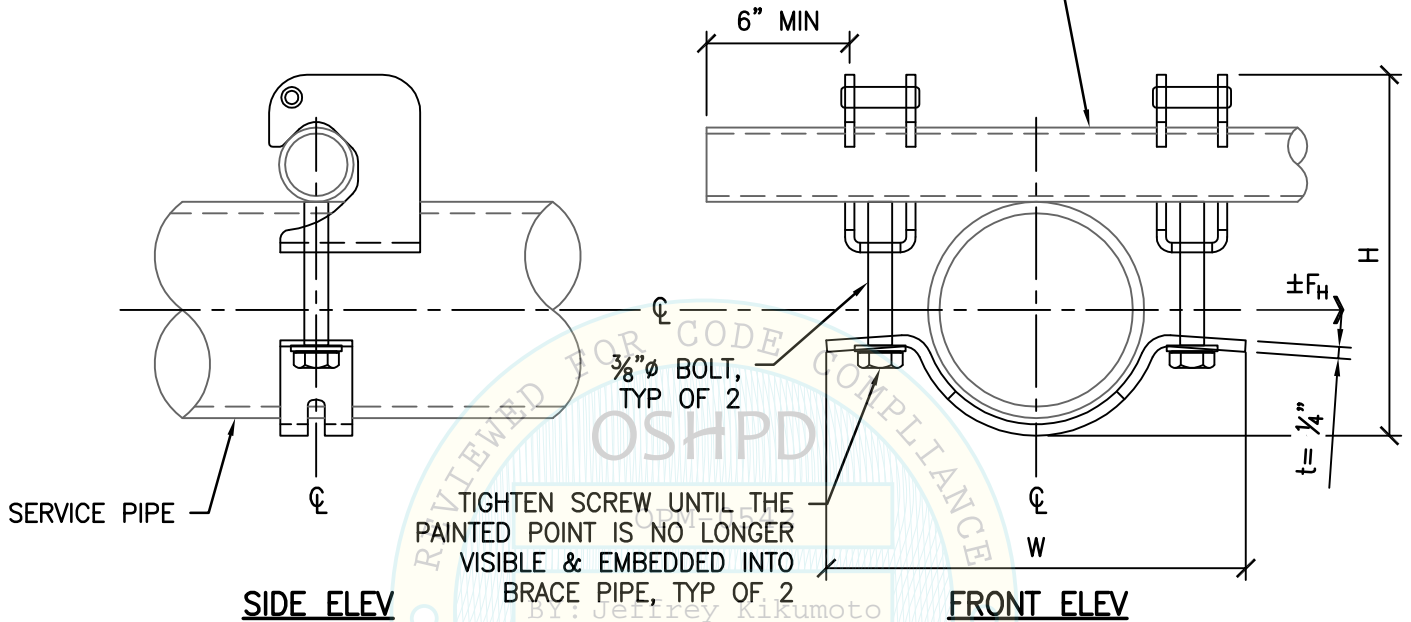
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| Page: | 106.20 of |

SEISMIC BRACING FOR MEP SYSTEMS



CSBQG

TRANSVERSE BRACE PIPE, SHOWN
HERE 90 DEG FROM VERT. SEE
FOOTNOTE i ON PG 500.7

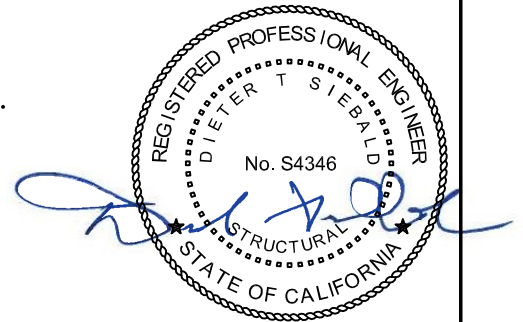


TIGHTEN SCREW UNTIL THE
PAINTED POINT IS NO LONGER
VISIBLE & EMBEDDED INTO
BRACE PIPE, TYP OF 2

| PART # | SERVICE PIPE SIZE (IN) | H (IN) | W (IN) |
|------------|------------------------|--------|--------|
| CSBQG250EG | 2½ | 5⅞ | 6¾ |
| CSBQG300EG | 3 | 6½ | 7½ |
| CSBQG400EG | 4 | 7½ | 8¾ |
| CSBQG600EG | 6 | 9⅝ | 11¾ |
| CSBQG800EG | 8 | 11⅜ | 13⅞ |

NOTES:

- SEE PG 500.3 FOR HORIZ CAPACITY F_H AT ϕ ANGLE AT ASD OF CSBQG.
- FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.
- CSBQG CAN ALSO BE USED AS FOUR-WAY RISER. SEE PG 9.2



SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
CSBQG

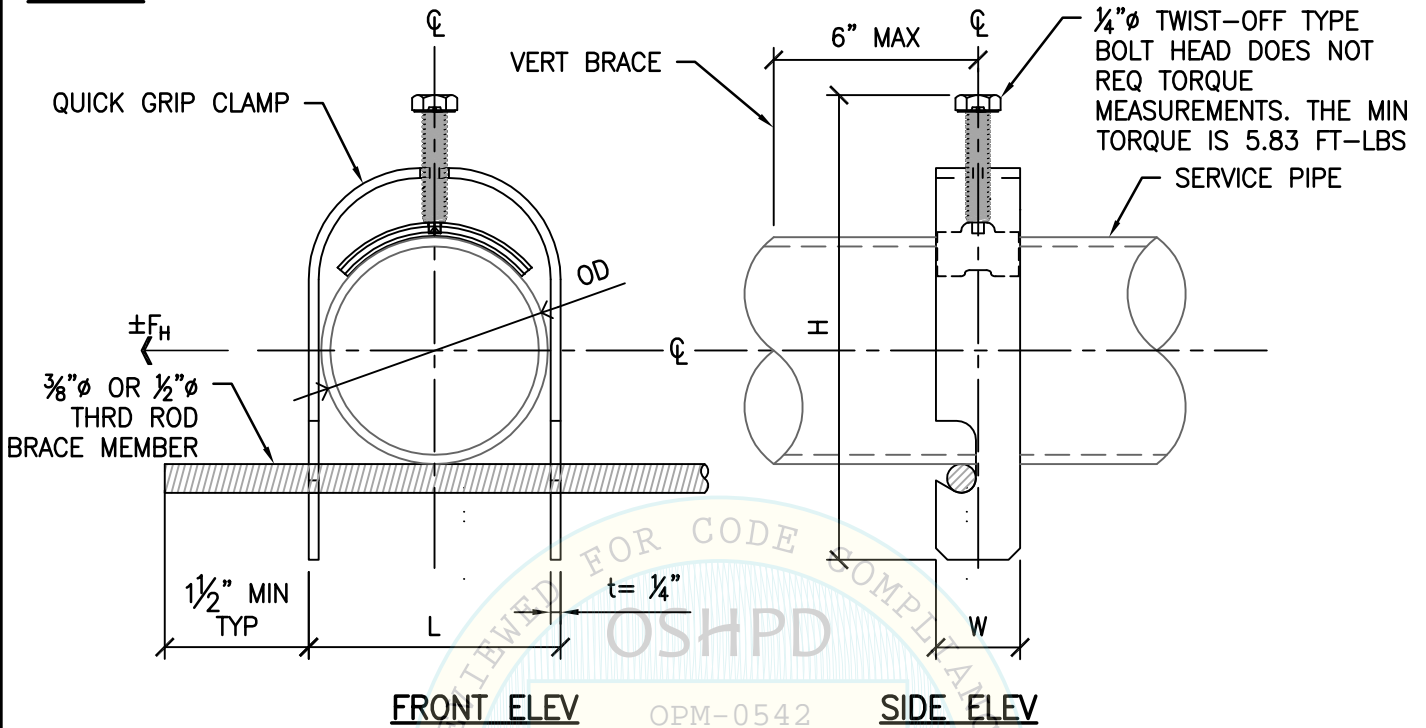
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SEISMIC BRACING FOR MEP SYSTEMS



CSBBRP



FRONT ELEV

SIDE ELEV

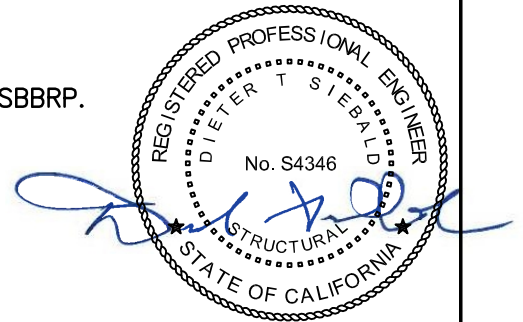
OPM-0542

BY: Jeffrey Kikumoto

| PART # | SERVICE PIPE SIZE (IN) | OD (IN) | H (IN) | L (IN) | W (IN) |
|-------------|------------------------|---------|--------|--------|--------|
| CSBBRP100EG | 1 | 1.32 | 6.67 | 1.63 | 0.88 |
| CSBBRP125EG | 1¼ | 1.66 | 7.56 | 1.97 | 0.88 |
| CSBBRP150EG | 1½ | 1.90 | 8.20 | 2.21 | 0.88 |
| CSBBRP200EG | 2 | 2.38 | 9.45 | 2.69 | 0.88 |

NOTES:

- SEE PG 500.3 FOR HORIZ CAPACITY F_H AT ϕ ANGLE OF AT ASD FOR CSBBRP.
- FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.



SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
CSBBRP



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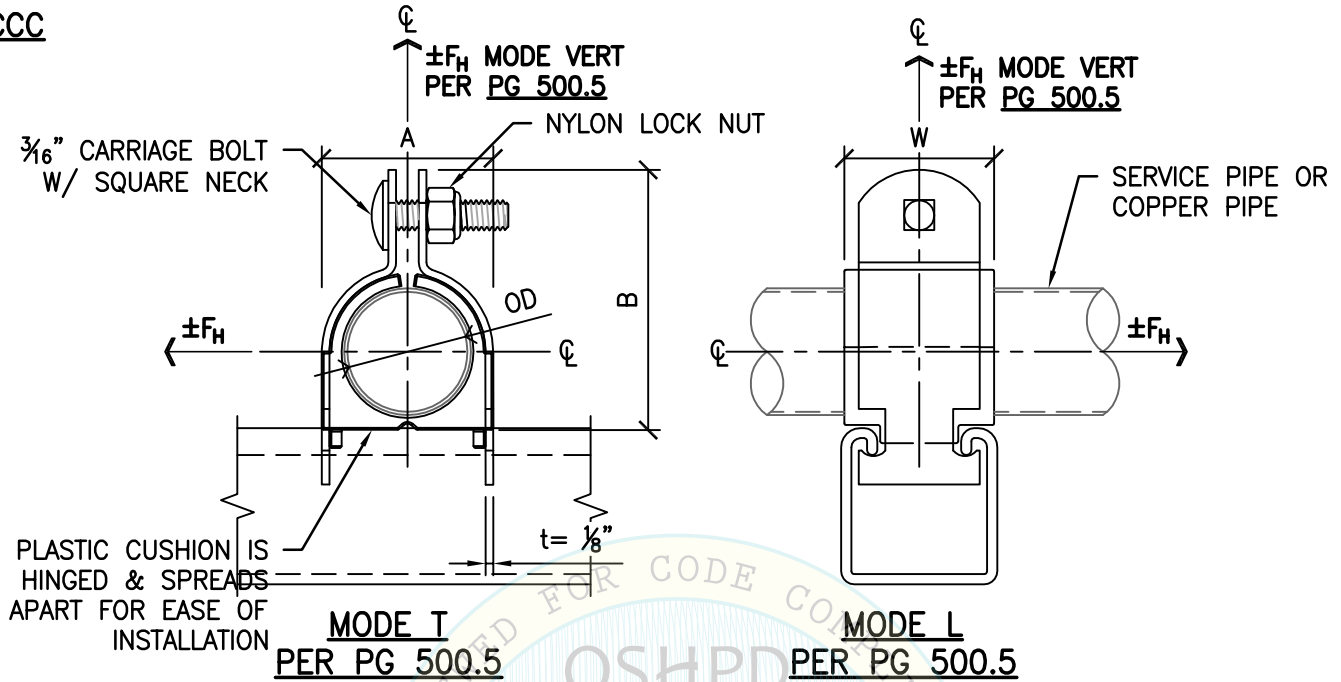
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| Date: | 09/08/2021 |
| Page: | 106.22 of . |

SEISMIC BRACING FOR MEP SYSTEMS



CCC



MODE T
PER PG 500.5

MODE L
PER PG 500.5

| PART # | OD (IN) | COPPER TUBE SIZE (IN) | PIPE SIZE (IN) | W (IN) | A (IN) | B (IN) |
|---------|---------|-----------------------|----------------|--------|--------|--------|
| CCC0062 | 5/8 | 1/2 | 3/8 | 1.562 | 0.995 | 1.64 |
| CCC0075 | 3/4 | 5/8 | - | 1.562 | 1.120 | 1.77 |
| CCC0087 | 7/8 | 3/4 | 1/2 | 1.562 | 1.245 | 1.89 |
| CCC0100 | 1 | - | 3/4 | 1.562 | 1.370 | 2.02 |
| CCC0112 | 1 1/8 | 1 | - | 1.562 | 1.535 | 2.46 |
| CCC0125 | 1 1/4 | - | 1 | 1.562 | 1.660 | 2.58 |
| CCC0137 | 1 3/8 | 1 1/4 | - | 1.562 | 1.785 | 2.71 |
| CCC0150 | 1 1/2 | - | 1 1/4 | 1.562 | 1.910 | 2.84 |
| CCC0162 | 1 5/8 | 1 1/2 | 1 1/4 | 1.562 | 2.035 | 2.96 |
| CCC0187 | 1 7/8 | - | 1 1/2 | 1.562 | 2.325 | 3.21 |
| CCC0212 | 2 1/8 | 2 | - | 1.562 | 2.700 | 3.58 |
| CCC0237 | 2 3/8 | - | 2 | 1.562 | 2.950 | 3.84 |
| CCC0262 | 2 5/8 | 2 1/2 | - | 1.562 | 3.200 | 4.08 |
| CCC0312 | 3 1/8 | 3 | - | 1.562 | 3.700 | 4.58 |
| CCC0412 | 4 1/8 | 4 | - | 1.562 | 4.825 | 5.95 |
| CCC0450 | 4 1/2 | - | 4 | 1.562 | 5.200 | 6.32 |

NOTES:

- SEE PG 500.5 FOR MODE T & MODE L HORIZ CAPACITY F_H & FOR MODE VERT CAPACITY F_H AT ϕ ANGLE OF 0° AT ASD OF CCC.
- FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.
- FOR 5/8" & 3/4" COPPER TUBE SIZE & 3/8" & 1/2" PIPE SIZE, USE 1/2" PIPE SIZE CAPACITY SHOWN ON PG 500.5. FOR 1 1/4" & 1 1/2" COPPER TUBE SIZE, USE 1" CAPACITY SHOWN ON PG 500.5. FOR 3" & 2 1/2" COPPER TUBE SIZE, USE 2" CAPACITY SHOWN FOR L MODE & 4" CAPACITIES FOR VERT & T MODES ON PG 500.5.



SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
CCC



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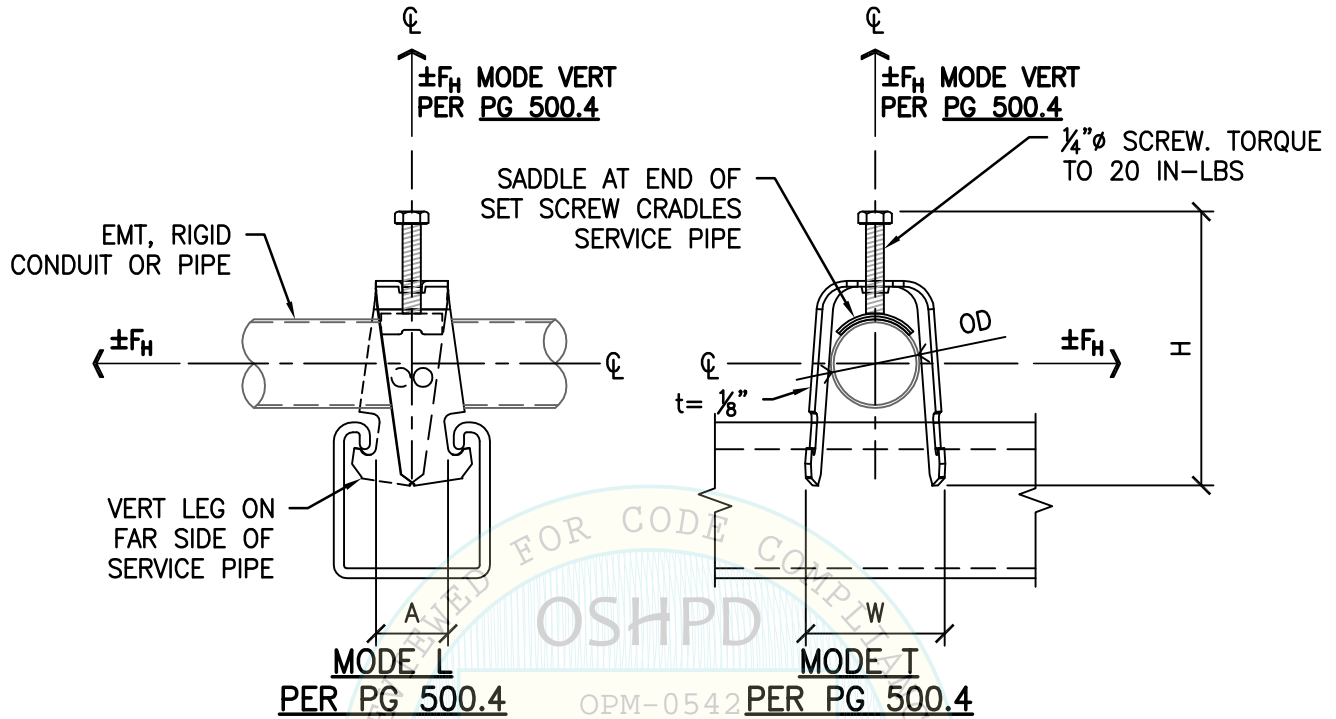
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| Job No: | 19039 |
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| Page: | 106.23 of |

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SEISMIC BRACING FOR MEP SYSTEMS



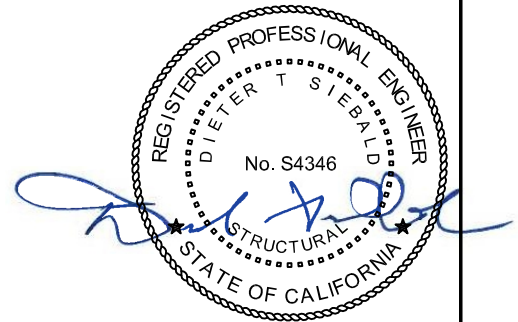
SCH-B



| PART # | OD (IN) | EMT (IN) | RIGID CONDUIT OR PIPE SIZE (IN) | W (IN) | H (IN) | A (IN) |
|--------|---------|----------|---------------------------------|--------|--------|--------|
| SCH12B | 0.92 | - | 1/2 | 1.30 | 2.60 | 3 1/32 |
| SCH16B | 1.16 | 1 | 3/4 | 1.50 | 2.70 | 3 1/32 |
| SCH20B | 1.51 | 1 1/4 | 1 | 1.90 | 3.00 | 3 1/32 |
| SCH24B | 1.74 | 1 1/2 | 1 1/4 | 2.20 | 3.20 | 3 1/32 |
| SCH32B | 2.20 | 2 | 1 1/2 | 2.20 | 3.20 | 3 1/32 |
| SCH40B | 2.38 | - | 2 | 3.00 | 4.00 | 3 1/32 |
| SCH48B | 2.88 | 2 1/2 | 2 1/2 | 3.00 | 4.00 | 3 1/32 |
| SCH56B | 3.50 | 3 | 3 | 3.00 | 4.00 | 3 1/32 |
| SCH64B | 4.00 | 3 1/2 | 3 1/2 | 3.00 | 4.00 | 3 1/32 |
| SCH72B | 4.50 | 4 | 4 | 3.00 | 4.00 | 3 1/32 |

NOTES:

- SEE PG 500.4 FOR MODE T & MODE L HORIZ CAPACITY F_H & FOR MODE VERT CAPACITY F_H AT ϕ ANGLE OF 0° AT ASD OF SCH-B.
- FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.



SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
SCH-B



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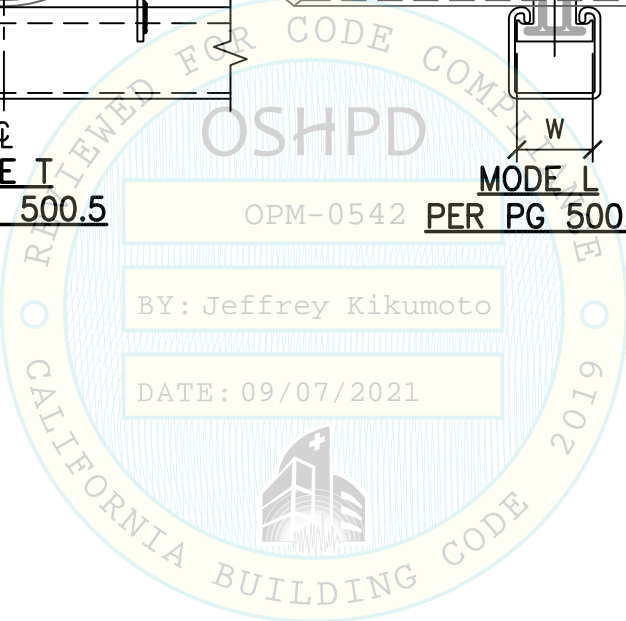
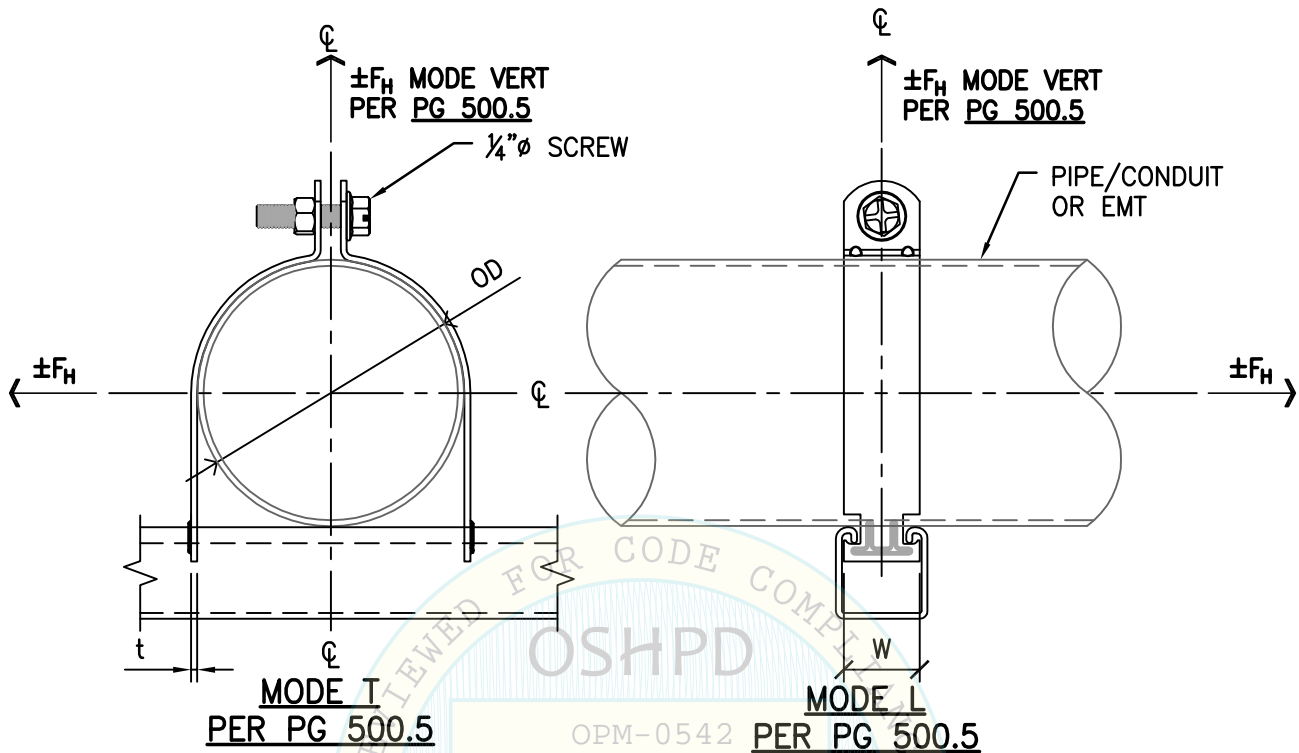
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| Page: | 106.24 of |

SEISMIC BRACING FOR
MEP SYSTEMS

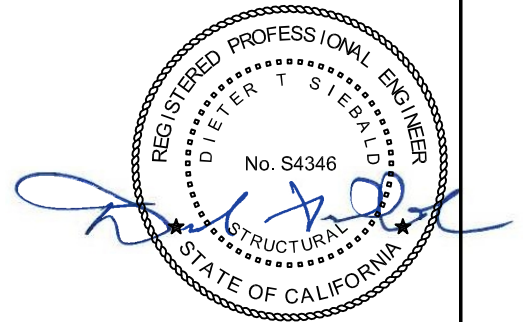


USC



NOTES:

1. SEE PG 500.5 FOR MODE T & MODE L HORIZ CAPACITY F_H & FOR MODE VERT CAPACITY F_H AT ϕ ANGLE OF 0° AT ASD OF USC.
2. FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.
3. FOR PART NUMBERS & SERVICE PIPE DIA, ETC., SEE PG 106.26.



SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
USC



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| Page: | 106.25 of . |

SEISMIC BRACING FOR MEP SYSTEMS

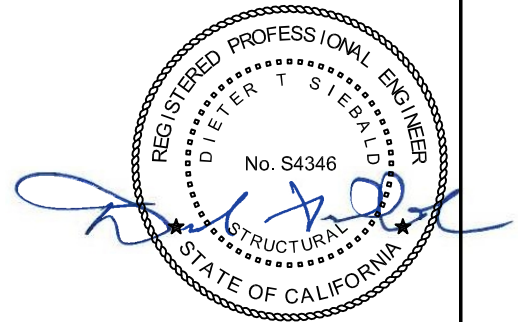
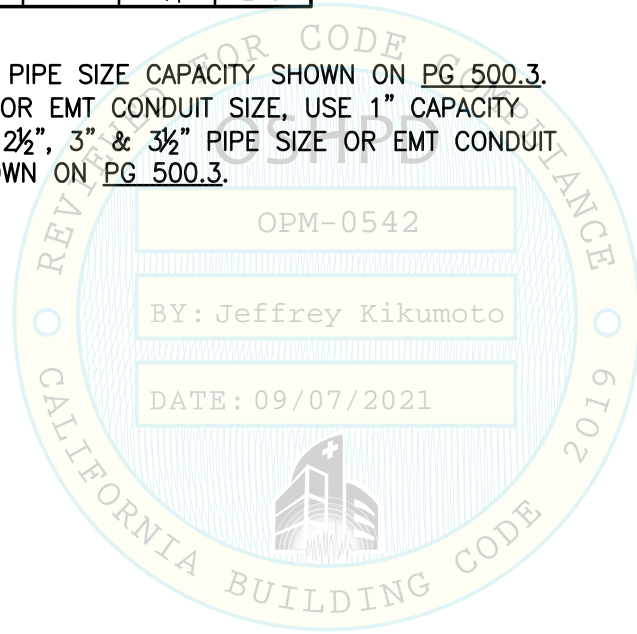


USC (CONTINUED)

| PART # | OD (IN) | PIPE SIZE (IN) | EMT CONDUIT SIZE (IN) | W (IN) | t (IN) |
|----------|-----------|----------------|-----------------------|--------|--------|
| USC021EG | 0.81-0.84 | 1/2 | - | 1 1/4 | 16 GA |
| USC026EG | 1.00-1.06 | 3/4 | - | 1 1/4 | 16 GA |
| USC031EG | 1.16-1.26 | - | 1 | 1 1/4 | 16 GA |
| USC033EG | 1.29-1.32 | 1 | - | 1 1/4 | 16 GA |
| USC040EG | 1.51-1.60 | - | 1 1/4 | 1 1/4 | 14 GA |
| USC042EG | 1.63-1.67 | 1 1/4 | - | 1 1/4 | 14 GA |
| USC046EG | 1.69-1.77 | - | 1 1/2 | 1 1/4 | 14 GA |
| USC048EG | 1.87-1.97 | 1 1/2 | - | 1 1/4 | 14 GA |
| USC058EG | 2.20-2.25 | - | 2 | 1 1/4 | 12 GA |
| USC060EG | 2.34-2.45 | 2 | - | 1 1/4 | 12 GA |
| USC073EG | 2.75-2.88 | 2 1/2 | 2 1/2 | 1 1/4 | 12 GA |
| USC086EG | 3.31-3.50 | 3 | 3 | 1 1/4 | 12 GA |
| USC101EG | 3.87-4.04 | 3 1/2 | 3 1/2 | 1 1/4 | 12 GA |
| USC113EG | 4.37-4.54 | 4 | 4 | 1 1/4 | 12 GA |

NOTE:

FOR 3/4" PIPE SIZE, USE 1/2" PIPE SIZE CAPACITY SHOWN ON PG 500.3.
 FOR 1 1/4" & 1 1/2" PIPE SIZE OR EMT CONDUIT SIZE, USE 1" CAPACITY SHOWN ON PG 500.3. FOR 2 1/2", 3" & 3 1/2" PIPE SIZE OR EMT CONDUIT SIZE, USE 2" CAPACITY SHOWN ON PG 500.3.



SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
USC (CONTINUED)

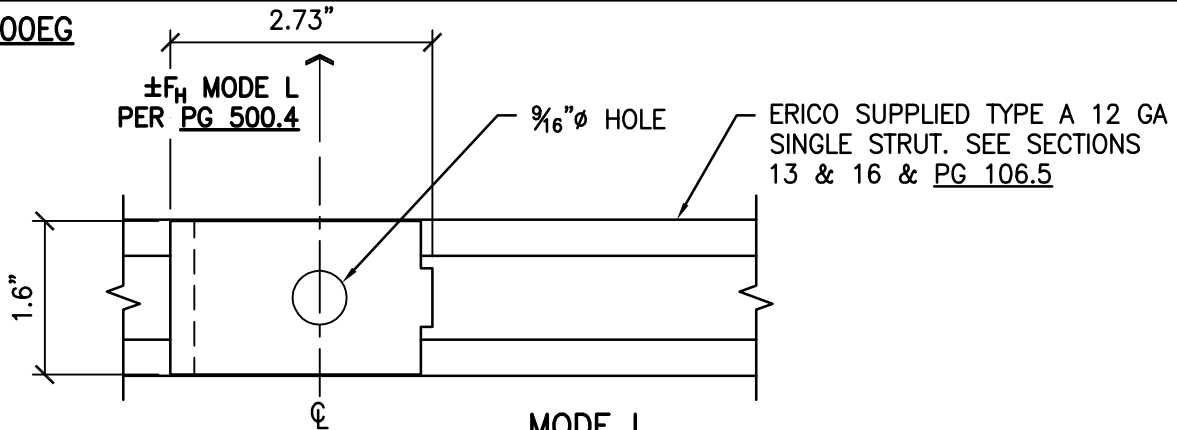
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SEISMIC BRACING FOR
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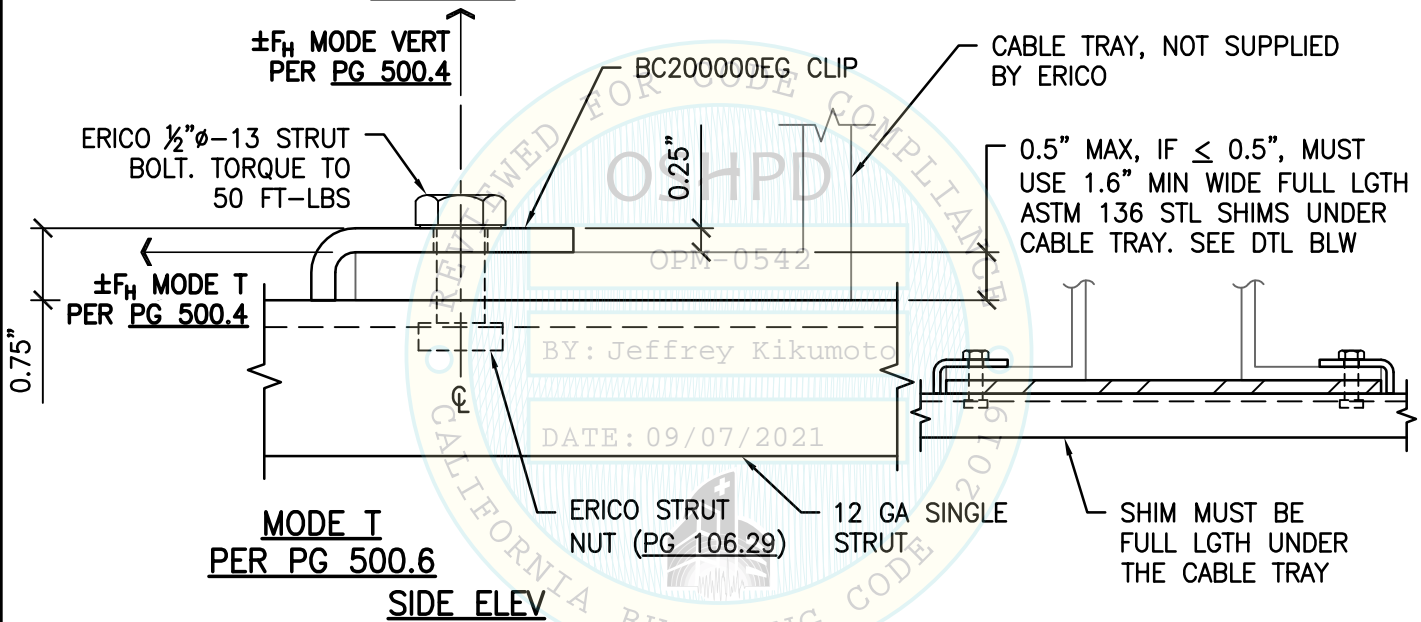


BC200000EG



TOP VIEW

**MODE L
PER PG 500.6**



SIDE ELEV

**MODE T
PER PG 500.6**

NOTES:

1. SEE PG 500.4 FOR MODE T & MODE L HORIZ CAPACITY F_H & FOR MODE VERT CAPACITY F_v AT θ ANGLE OF BRACE MEMBER AT ASD FOR BC200000EG.
2. FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.
3. INSTALLATION OF BC200000EG CLIP MUST ALWAYS BE IN PAIRS AT OPPOSITE SIDES OF THE CABLE TRAY.
4. FOR ERICO STRUT NUT SEE PG 106.29.
5. ERICO STRUT NUT WAS FM TESTED AS PART OF A BRACED ASSEMBLY.



SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
BC200000EG

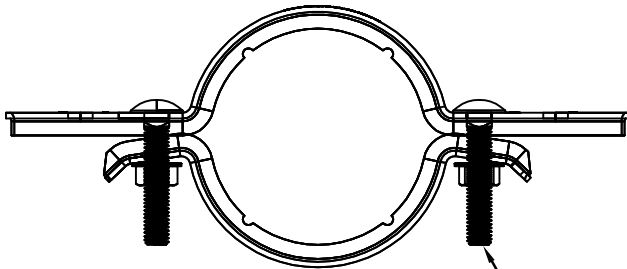
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| | Page: 106.27 of |

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SEISMIC BRACING FOR MEP SYSTEMS



EZ RISER CLAMP



FOR BOLT SIZE & BOLT TORQUE, SEE SCHEDULE & NOTES BLW



| PART # | PIPE SIZE | OD (IN) | HOLE SIZE (IN) | BOLT DIA (IN) | A (IN) | B (IN) | C (IN) | STATIC LOAD (LBS) |
|---------|-----------|---------|----------------|---------------|--------|--------|--------|-------------------|
| EZR0050 | ½" | 0.84 | 0.39 | ¾-16 | 8½ | 5⅝ | ⅞ | 255 |
| EZR0075 | ¾" | 1.05 | 0.39 | ¾-16 | 9 | 5⅝ | ⅞ | 255 |
| EZR0100 | 1" | 1.315 | 0.39 | ¾-16 | 9 | 5⅝ | ⅞ | 255 |
| EZR0125 | 1¼" | 1.66 | 0.39 | ¾-16 | 9½ | 6 | ⅞ | 255 |
| EZR0150 | 1½" | 1.9 | 0.39 | ¾-16 | 9⅞ | 6¼ | ⅞ | 255 |
| EZR0200 | 2" | 2.375 | 0.39 | ¾-16 | 10¼ | 1 | 1 | 255 |
| EZR0250 | 2½" | 2.875 | 0.39 | ¾-16 | 11 | 7½ | 1 | 390 |
| EZR0300 | 3" | 3.5 | 0.39 | ¾-16 | 11¾ | 8⅝ | 1 | 530 |
| EZR0350 | 3½" | 4 | 0.52 | ½-13 | 12⅝ | 9⅝ | 1¼ | 670 |
| EZR0400 | 4" | 4.5 | 0.52 | ½-13 | 13 | 10 | 1¼ | 810 |
| EZR0500 | 5" | 5.563 | 0.52 | ½-13 | 14½ | 11¾ | 1½ | 1160 |
| EZR0600 | 6" | 6.625 | 0.52 | ½-13 | 16 | 12¾ | 1½ | 1570 |

NOTES:

- FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.
- CLAMP IS FITTED FOR STL PIPE & MUST BE INSTALLED BLW A COUPLING OR SHEAR LUG, W/ BOLTS TORQUED TO RECOMMENDED VALUES.
- USE OF A SOCKET OR DRIVER IS RECOMMENDED FOR INSTALLATION.
- EZ RISER CLAMP IS ONLY INTENDED FOR USE W/ SECTION 17 NON-RIGID CABLE SUPPORTS & HOLDS THE CABLES IN PLACE.
- INSTALL PER MFR'S INSTRUCTIONS & TORQUE ¾" - 16 BOLTS TO 19 FT-LBS & ½"-13 BOLTS TO 50 FT-LBS.



SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
EZ-RISER CLAMP



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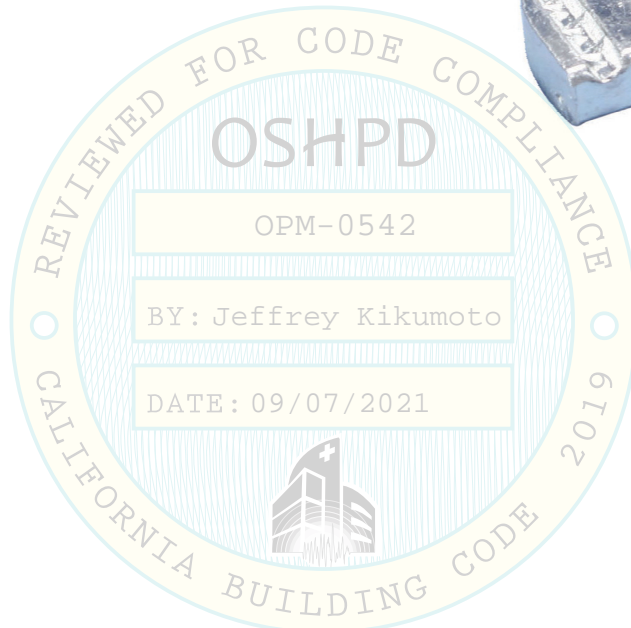
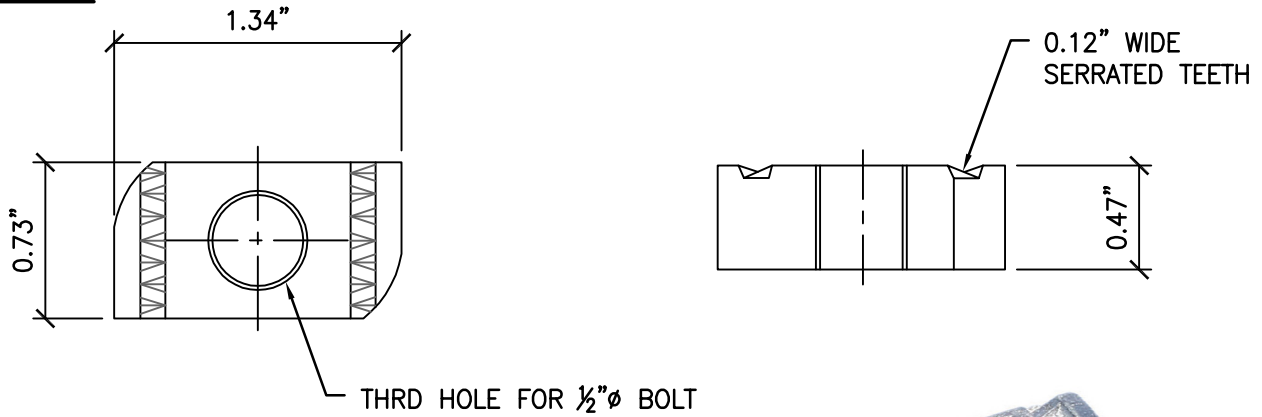
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| Page: | 106.28 of . |

SEISMIC BRACING FOR
MEP SYSTEMS

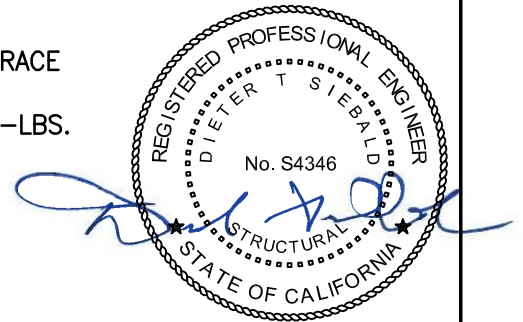


STRUT NUT



NOTES:

1. FOR MATERIAL STANDARDS, SEE SECTION 1, PG 1.30 & ONWARDS.
2. ERICO STRUT NUT IS ONLY USED IN THIS OPM FOR PRE-ASSEMBLED BRACE COMPONENTS THAT HAVE BEEN FM TESTED AS AN ASSEMBLY.
3. INSTALL PER MFR'S INSTRUCTIONS & TORQUE 1/2"Ø-13 BOLTS TO 50 FT-LBS.



SHEET TITLE: SEISMIC BRACE SUPPORT DETAILS
ERICO STRUT NUT



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| Page: | 106.29 of . |

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SEISMIC BRACING FOR MEP SYSTEMS



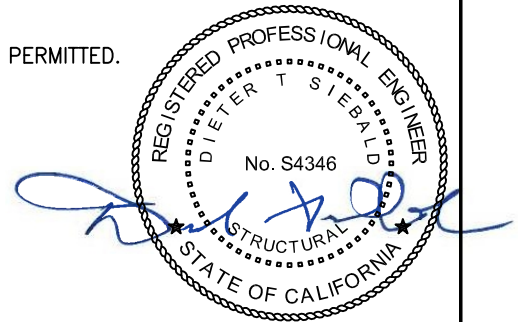
PIPE TRANSVERSE BRACE SPACING TABLES MAX LOAD TO EACH TRANSVERSE BRACE AT ASD LEVEL OF DESIGN

Schedule LW Steel Pipe (Light-Wall Schedule 7)

| F _y = 30 ksi | | | F _y Reduction ⁽⁷⁾ = 0.9 | | | Insulated Water- Filled Pipe Wt | L _v = Hanger Spacing ⁽³⁾ | Max Transverse Spacing per Seismic Design Force "F _p " (ft) ⁽⁵⁾⁽⁶⁾ | | | |
|-----------------------------|-------------------|---------------------------------|---|------------------|------------------|--|--|---|------|-----|------|
| Pipe Size ⁽¹⁾ | OD ⁽¹⁾ | t _{nom} ⁽¹⁾ | S ⁽²⁾ | r ⁽⁴⁾ | M _{cap} | | | 0.5 | 0.75 | 1 | 1.25 |
| | | | | | | | | Corresp. Vert. Seismic Effect, "Ev" | | | |
| (in) | (in) | (in) | (in ³) | (in) | (ft-lb) | (plf) | (ft) | 0.1 | 0.15 | 0.2 | 0.25 |
| 1 1/4 | 1.660 | 0.062 | 0.11 | 0.16 | 253 | 2.7 | 6 | 26 | 23 | 20 | 18 |
| 1 1/2 | 1.900 | 0.080 | 0.19 | 0.19 | 422 | 3.5 | 8 | 30 | 25 | 22 | 19 |
| 2 | 2.375 | 0.080 | 0.30 | 0.21 | 675 | 4.6 | 9 | 33 | 28 | 24 | 21 |
| 2 1/2 | 2.875 | 0.083 | 0.46 | 0.24 | 1040 | 6.2 | 10 | 36 | 30 | 26 | 23 |
| 3 | 3.500 | 0.092 | 0.76 | 0.28 | 1721 | 8.4 | 11 | 40 | 33 | 28 | 25 |
| 4 | 4.500 | 0.092 | 1.29 | 0.32 | 2891 | 12.5 | 12 | 43 | 35 | 30 | 27 |
| 6 | 6.625 | 0.115 | 3.51 | 0.43 | 7902 | 25.2 | 12 | 51 | 42 | 36 | 32 |

Hanger spacing is based on the minimum of the strength of the pipe, deflection of L/60 and deflection of 6in

1. STL PIPE DIM AS PROVIDED BY ERICO.
2. $S = [\pi (OD)^4 - (OD - 2t_{design})^4] / 32 (OD)$ WHERE $t_{design} = 0.93 t_{nom}$ (PER AISC 360).
3. MAX DISTANCE BTW HANGERS IS BASED ON SCHEDULE 10 HANGER SPACING IN TABLE 4 OF "ANSI/MSS SP-58-2018: PIPE HANGERS AND SUPPORTS - MATERIALS, DESIGN, MANUFACTURE, SELECTION, APPLICATION AND INSTALLATION" (MSS SP-58-2009). THE CAPACITY OF THE SCHEDULE 7 PIPE IS COMPARED TO THE CAPACITY OF THE SCHEDULE 10 PIPES. THE SCHEDULE 7 HANGER SPACING CORRESPONDS TO THE SCHEDULE 10 PIPE THAT HAS A LOWER CAPACITY THAN THE SCHEDULE 7 PIPE. MAX DISTANCE IS NOT TO EXCEED 12FT PER 2019 CA PLUMBING CODE, TABLE 313.3.
4. $r = \sqrt{[(OD)^2 + (OD - 2t_{design})^2] / 4}$ WHERE $t_{design} = 0.93 t_{nom}$ (PER AISC 360).
5. PIPES MODELED AS PIN-PIN. THE FLEXURAL DEMAND EQUATION USED IS: $M = wL^2/8$. MAX TRANSVERSE SPACING INCLUDES EFFECTS OF BI-AXIAL BENDING FROM BOTH VERT & HORIZ LOADS. PER OSHPD, THE ALLOWABLE DEFLECTION IS LIMITED TO THE LESSER OF L/60 OR 6".
6. FOR SEISMIC DESIGN FORCE, "F_p" BTW TABULATED VALUES, LINEAR INTERPOLATION IS PERMITTED.
7. REFER TO ASCE 7-16, SECTION 13.6.7



**SHEET TITLE: PIPE TRANSVERSE BRACE SPACING TABLES
STEEL PIPE SCHEDULE LW (LIGHT-WALL SCHEDULE)**

| | | |
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SEISMIC BRACING FOR
MEP SYSTEMS



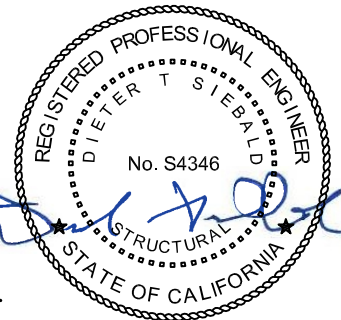
PIPE TRANSVERSE BRACE SPACING TABLES
MAX LOAD TO EACH TRANSVERSE BRACE AT ASD LEVEL OF DESIGN

Schedule 10 Steel Pipe

ASTM A53, TYPE E, GRADE A

| Fy = 30 ksi | | Fy Reduction ⁽⁷⁾ = 0.9 | | | | Insulated Water- Filled Pipe Wt | L _v = Hanger Spacing ⁽³⁾ | Max Transverse Spacing per Seismic Design Force "F _p " (ft) ^{(5),(6)} | | | |
|---------------------|-------------------|-----------------------------------|--------------------|------------------|------------------|--|--|--|-------------------------------------|------|------|
| Pipe ⁽¹⁾ | OD ⁽¹⁾ | t _{nom} ⁽¹⁾ | S ⁽²⁾ | r ⁽⁴⁾ | M _{cap} | | | 0.5 | 0.75 | 1 | 1.25 |
| (in) | (in) | (in) | (in ³) | (in) | (ft-lb) | | | (plf) | Corresp. Vert. Seismic Effect, "Ev" | | |
| | | | | | | | 0.1 | 0.15 | 0.2 | 0.25 | |
| 1 | 1.315 | 0.109 | 0.11 | 0.18 | 171 | 2.5 | 7 | 24 | 21 | 19 | 18 |
| 1 1/4 | 1.660 | 0.109 | 0.18 | 0.21 | 287 | 3.3 | 7 | 29 | 25 | 23 | 20 |
| 1 1/2 | 1.900 | 0.109 | 0.24 | 0.22 | 384 | 3.9 | 9 | 31 | 27 | 23 | 21 |
| 2 | 2.375 | 0.109 | 0.39 | 0.25 | 621 | 5.2 | 10 | 34 | 30 | 26 | 23 |
| 2 1/2 | 2.875 | 0.120 | 0.64 | 0.29 | 1013 | 7.1 | 11 | 38 | 33 | 28 | 25 |
| 3 | 3.500 | 0.120 | 0.98 | 0.32 | 1533 | 9.2 | 12 | 41 | 36 | 31 | 27 |
| 4 | 4.500 | 0.120 | 1.65 | 0.36 | 2589 | 13.6 | 12 | 46 | 38 | 33 | 30 |
| 5 | 5.563 | 0.134 | 2.83 | 0.43 | 4451 | 20.2 | 12 | 50 | 42 | 36 | 32 |
| 6 | 6.625 | 0.134 | 4.06 | 0.47 | 6381 | 26.3 | 12 | 53 | 44 | 38 | 34 |
| 8 | 8.625 | 0.188* | 9.61 | 0.63 | 15107 | 41.1 | 12 | 63 | 56 | 48 | 43 |
| 10 | 10.75 | 0.188* | 15.1 | 0.70 | 23753 | 57.9 | 12 | 67 | 59 | 51 | 45 |
| 12 | 12.75 | 0.330 | 36.4 | 1.01 | 57285 | 93.6 | 12 | 78 | 71 | 63 | 56 |

- STL PIPE DIM AS PROVIDED BY ERICO.
- $S = [\pi (OD)^4 - (OD - 2t_{design})^4] / 32 (OD)$ WHERE $t_{design} = 0.93 t_{nom}$ (PER AISC 360).
- MAX DISTANCE BTW HANGERS PER TABLE 4 OF "ANSI/MSS SP-58-2018: PIPE HANGERS AND SUPPORTS - MATERIALS, DESIGN, MANUFACTURE, SELECTION, APPLICATION AND INSTALLATION" (MSS SP-58-2009). MAX DISTANCE IS NOT TO EXCEED 12FT PER 2019 CA PLUMBING CODE, TABLE 313.3.
- $r = \sqrt{[(OD)^2 + (OD - 2t_{design})^2] / 4}$ WHERE $t_{design} = 0.93 t_{nom}$ (PER AISC 360).
- PIPES MODELED AS PIN-PIN. THE FLEXURAL DEMAND EQUATION USED IS: $M = wL^2/8$. MAX TRANSVERSE SPACING INCLUDES EFFECTS OF BI-AXIAL BENDING FROM BOTH VERT & HORIZ LOADS PER OSHPD, THE ALLOWABLE DEFLECTION IS LIMITED TO THE LESSER OF L/60 OR 6".
- FOR SEISMIC DESIGN FORCE, "F_p" BTW TABULATED VALUES, LINEAR INTERPOLATION IS PERMITTED.
- REFER TO ASCE 7-16, SECTION 13.6.7



SHEET TITLE: PIPE TRANSVERSE BRACE SPACING TABLES
STEEL PIPE SCHEDULE 10



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Page: 200.2 of .

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**SEISMIC BRACING FOR
MEP SYSTEMS**



PIPE TRANSVERSE BRACE SPACING TABLES
MAX LOAD TO EACH TRANSVERSE BRACE AT ASD LEVEL OF DESIGN

Schedule 40 Steel Pipe

ASTM A53, TYPE E, GRADE A

| Fy = 30 ksi | | Fy Reduction ⁽⁷⁾ = 0.9 | | Insulated Water- Filled Pipe Wt | L _v = Hanger Spacing ⁽³⁾ | Max Transverse Spacing per Seismic Design Force "F _p " (ft) ^{(5),(6)} | | | | | |
|---------------------|-------------------|-----------------------------------|--------------------|--|--|--|------------------|-------------------------------------|------|-----|------|
| Pipe ⁽¹⁾ | OD ⁽¹⁾ | t _{nom} ⁽¹⁾ | S ⁽²⁾ | | | r ⁽⁴⁾ | M _{cap} | 0.5 | 0.75 | 1 | 1.25 |
| | | | | | | | | Corresp. Vert. Seismic Effect, "Ev" | | | |
| (in) | (in) | (in) | (in ³) | (in) | (ft-lb) | (plf) | (ft) | 0.1 | 0.15 | 0.2 | 0.25 |
| 1 | 1.315 | 0.133 | 0.13 | 0.20 | 331 | 2.8 | 7 | 24 | 21 | 19 | 18 |
| 1 1/4 | 1.660 | 0.140 | 0.22 | 0.23 | 583 | 3.8 | 7 | 29 | 25 | 23 | 21 |
| 1 1/2 | 1.900 | 0.145 | 0.31 | 0.25 | 809 | 4.5 | 9 | 32 | 28 | 25 | 22 |
| 2 | 2.375 | 0.154 | 0.53 | 0.29 | 1388 | 6.2 | 10 | 35 | 32 | 28 | 25 |
| 2 1/2 | 2.875 | 0.203 | 1.00 | 0.37 | 2637 | 9.1 | 11 | 40 | 36 | 32 | 28 |
| 3 | 3.500 | 0.216 | 1.62 | 0.42 | 4265 | 12.1 | 12 | 44 | 40 | 35 | 31 |
| 4 | 4.500 | 0.237 | 3.02 | 0.50 | 7936 | 18.3 | 12 | 49 | 44 | 40 | 35 |
| 5 | 5.563 | 0.258 | 5.12 | 0.58 | 13439 | 26.6 | 12 | 54 | 49 | 43 | 38 |
| 6 | 6.625 | 0.280 | 7.97 | 0.67 | 20927 | 34.8 | 12 | 59 | 53 | 47 | 42 |
| 8 | 8.625 | 0.322 | 15.8 | 0.82 | 41362 | 55.1 | 12 | 67 | 60 | 53 | 48 |
| 10 | 10.75 | 0.365 | 28.0 | 0.97 | 73531 | 74.7 | 12 | 74 | 67 | 62 | 55 |
| 12 | 12.75 | 0.406 | 44.1 | 1.12 | 115741 | 102.1 | 12 | 80 | 73 | 66 | 59 |

- STL PIPE DIM AS PROVIDED BY ERICO.
- $S = [\pi (OD)^4 - (OD - 2t_{design})^4] / 32 (OD)$ WHERE $t_{design} = 0.93 t_{nom}$ (PER AISC 360).
- MAX DISTANCE BTW HANGERS PER TABLE 4 OF "ANSI/MSS SP-58-2018: PIPE HANGERS AND SUPPORTS - MATERIALS, DESIGN, MANUFACTURE, SELECTION, APPLICATION AND INSTALLATION" (MSS SP-58-2009). MAX DISTANCE IS NOT TO EXCEED 12FT PER 2019 CA PLUMBING CODE, TABLE 313.3.
- $r = \text{sqrt} [(OD)^2 + (OD - 2t_{design})^2] / 4$ WHERE $t_{design} = 0.93 t_{nom}$ (PER AISC 360).
- PIPES MODELED AS PIN-PIN. THE FLEXURAL DEMAND EQUATION USED IS: $M = wL^2/8$. MAX TRANSVERSE SPACING INCLUDES EFFECTS OF BI-AXIAL BENDING FROM BOTH VERT & HORIZ LOADS. PER OSHPD. THE ALLOWABLE DEFLECTION IS LIMITED TO THE LESSER OF L/60 OR 6".
- FOR SEISMIC DESIGN FORCE, "F_p" BTW TABULATED VALUES, LINEAR INTERPOLATION IS PERMITTED.
- REFER TO ASCE 7-16, SECTION 13.6.7



SHEET TITLE: PIPE TRANSVERSE BRACE SPACING TABLES
STEEL PIPE SCHEDULE 40



CYS STRUCTURAL ENGINEERS, INC.

2495 NATOMAS PARK DRIVE, SUITE 650
SACRAMENTO, CA 95833

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Job No: 19039
Date: 09/08/2021
Page: 200.3 of .

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**SEISMIC BRACING FOR
MEP SYSTEMS**



**PIPE TRANSVERSE BRACE SPACING TABLES
MAX LOAD TO EACH TRANSVERSE BRACE AT ASD LEVEL OF DESIGN**

Drawn Copper Tube: Type K Soldered. Fy = 30ksi

| Fy = 30 ksi | | Fy Reduction ⁽⁶⁾ = 0.9 | | | | Insulated Water-Filled Pipe Wt (plf) | L _v = Hanger Spacing ⁽³⁾ (ft) | Max Transverse Spacing per Seismic Design Force "F _p " (ft) ⁽⁵⁾ | | | |
|----------------------------------|---------------------------|---|--|--------------------------|-----------------------------|---|--|---|------|------|------|
| Pipe Size ⁽¹⁾ (in) | OD ⁽¹⁾ (in) | t _{nom} ⁽¹⁾ (in) | S ⁽²⁾ (in ³) | r ⁽⁴⁾ (in) | M _{cap} (ft-lb) | | | 0.5 | 0.75 | 1 | 1.25 |
| | | | | | | | | Corresp. Vert. Seismic Effect, "Ev" | | | |
| | | | | | | | 0.1 | 0.15 | 0.2 | 0.25 | |
| 3/4 | 0.875 | 0.065 | 0.03 | 0.11 | 40 | 1.4 | 5 | 14 | 12 | 11 | 10 |
| 1 | 1.125 | 0.065 | 0.05 | 0.13 | 69 | 1.9 | 6 | 17 | 14 | 13 | 12 |
| 1 1/4 | 1.375 | 0.065 | 0.08 | 0.15 | 106 | 2.4 | 6 | 19 | 16 | 15 | 14 |
| 1 1/2 | 1.625 | 0.072 | 0.12 | 0.17 | 165 | 3.0 | 6 | 22 | 19 | 17 | 16 |
| 2 | 2.125 | 0.083 | 0.25 | 0.21 | 331 | 4.4 | 8 | 26 | 23 | 21 | 19 |
| 2 1/2 | 2.625 | 0.095 | 0.43 | 0.25 | 582 | 6.1 | 9 | 30 | 27 | 24 | 22 |
| 3 | 3.125 | 0.109 | 0.71 | 0.29 | 950 | 8.2 | 10 | 33 | 30 | 27 | 25 |
| 3 1/2 | 3.625 | 0.120 | 1.05 | 0.32 | 1414 | 10.5 | 10 | 36 | 32 | 30 | 27 |
| 4 | 4.125 | 0.134 | 1.52 | 0.37 | 2049 | 13.4 | 10 | 38 | 35 | 32 | 29 |
| 5 | 5.125 | 0.160 | 2.81 | 0.45 | 3789 | 20.4 | 10 | 42 | 38 | 36 | 32 |
| 6 | 6.125 | 0.192 | 4.82 | 0.53 | 6492 | 28.4 | 10 | 47 | 42 | 39 | 36 |
| 8 | 8.125 | 0.271 | 11.90 | 0.73 | 16034 | 49.6 | 10 | 55 | 50 | 46 | 44 |
| 10 | 10.125 | 0.338 | 23.05 | 0.91 | 31053 | 75.9 | 10 | 62 | 56 | 52 | 49 |
| 12 | 12.125 | 0.405 | 39.60 | 1.09 | 53357 | 107.4 | 10 | 68 | 61 | 57 | 54 |

1. COPPER PIPE DIM PER COPPER DEVELOPMENT ASSOCIATION, INC.
2. $S = [\pi (OD)^4 - (OD - 2t_{design})^4] / 32 (OD)$ WHERE $t_{design} = 0.93 t_{nom}$ (PER AISC 360).
3. MAX DISTANCE BTW HANGERS PER TABLE 4 OF "ANSI/MSS SP-58-2018: PIPE HANGERS AND SUPPORTS - MATERIALS, DESIGN, MANUFACTURE, SELECTION, APPLICATION AND INSTALLATION" (MSS SP-58-2009). MAX DISTANCE IS NOT TO EXCEED 6'-0" FOR 1 1/2" DIA PIPE & SMALLER AND MAX DISTANCE IS NOT TO EXCEED 10'-0" FOR 2" DIA PIPE OR LARGER PER CA PLUMBING CODE, TABLE 313.3.
4. $r = \sqrt{[(OD)^2 + (OD - 2 * t_{design})^2]} / 4$ WHERE $t_{design} = 0.93 t_{nom}$ (PER AISC 360).
5. PIPES MODELED AS PIN-PIN. THE FLEXURAL DEMAND EQUATION USED IS: $M = wL^2/8$. MAX TRANSVERSE SPACING INCLUDES EFFECTS OF BI-AXIAL BENDING FROM BOTH VERT & HORIZ LOADS. PER OSHPD, THE ALLOWABLE DEFLECTION IS LIMITED TO THE LESSER OF L/60 OR 6".
6. REFER TO ASCE 7-16, SECTION 13.6.7



**SHEET TITLE: PIPE TRANSVERSE BRACE SPACING TABLES
COPPER PIPE TYPE K DRAWN W/ SOLDERED JOINTS**



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| Page: | 200.4 of . |

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**SEISMIC BRACING FOR
MEP SYSTEMS**

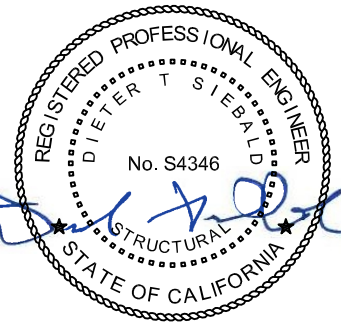


**PIPE TRANSVERSE BRACE SPACING TABLES
MAX LOAD TO EACH TRANSVERSE BRACE AT ASD LEVEL OF DESIGN**

Copper Tube: Type K Annealed. Fy = 9ksi

| Fy = 9 ksi | | Fy Reduction ⁽⁶⁾ = 0.9 | | | | Insulated Water- Filled Pipe Wt | Lv = Hanger Spacing ⁽³⁾ | Max Transverse Spacing per Seismic Design Force "Fp" (ft) ⁽⁵⁾ | | | |
|---------------------|-------------------|-----------------------------------|--------------------|------------------|------------------|--|--|---|-------------------------------------|-----|------|
| Pipe ⁽¹⁾ | OD ⁽¹⁾ | t _{nom} ⁽¹⁾ | S ⁽²⁾ | r ⁽⁴⁾ | M _{cap} | | | 0.5 | 0.75 | 1 | 1.25 |
| (in) | (in) | (in) | (in ³) | (in) | (ft-lb) | | | (plf) | Corresp. Vert. Seismic Effect, "Ev" | | |
| | | | | | | | | 0.1 | 0.15 | 0.2 | 0.25 |
| 3/4 | 0.875 | 0.065 | 0.03 | 0.11 | 12 | 1.4 | 5 | 8 | 7 | 6 | 5 |
| 1 | 1.125 | 0.065 | 0.05 | 0.13 | 21 | 1.9 | 6 | 9 | 7 | 6 | 5 |
| 1 1/4 | 1.375 | 0.065 | 0.08 | 0.15 | 32 | 2.4 | 6 | 11 | 9 | 8 | 7 |
| 1 1/2 | 1.625 | 0.072 | 0.12 | 0.17 | 50 | 3.0 | 6 | 13 | 10 | 9 | 8 |
| 2 | 2.125 | 0.083 | 0.25 | 0.21 | 99 | 4.4 | 8 | 14 | 12 | 10 | 9 |
| 2 1/2 | 2.625 | 0.095 | 0.43 | 0.25 | 175 | 6.1 | 9 | 16 | 13 | 11 | 10 |
| 3 1/2 | 3.625 | 0.120 | 1.05 | 0.32 | 424 | 10.5 | 10 | 20 | 16 | 14 | 12 |
| 4 | 4.125 | 0.134 | 1.52 | 0.37 | 615 | 13.4 | 10 | 22 | 18 | 15 | 13 |
| 5 | 5.125 | 0.160 | 2.81 | 0.45 | 1137 | 20.4 | 10 | 25 | 20 | 18 | 16 |
| 6 | 6.125 | 0.192 | 4.82 | 0.53 | 1948 | 28.4 | 10 | 29 | 24 | 20 | 18 |
| 8 | 8.125 | 0.271 | 11.90 | 0.73 | 4810 | 49.6 | 10 | 36 | 29 | 25 | 22 |
| 10 | 10.125 | 0.338 | 23.05 | 0.91 | 9316 | 75.9 | 10 | 41 | 34 | 29 | 26 |
| 12 | 12.125 | 0.405 | 39.60 | 1.09 | 16007 | 107.4 | 10 | 46 | 37 | 32 | 29 |

1. COPPER PIPE DIM PER COPPER DEVELOPMENT ASSOCIATION, INC.
2. $S = [\pi (OD)^4 - (OD - 2t_{design})^4] / 32 (OD)$ WHERE $t_{design} = 0.93 t_{nom}$ (PER AISC 360).
3. MAX DISTANCE BTW HANGERS PER TABLE 4 OF "ANSI/MSS SP-58-2018: PIPE HANGERS AND SUPPORTS - MATERIALS, DESIGN, MANUFACTURE, SELECTION, APPLICATION AND INSTALLATION" (MSS SP-58-2009). MAX DISTANCE IS NOT TO EXCEED 6'-0" FOR 1 1/2" DIA PIPE & SMALLER AND MAX DISTANCE IS NOT TO EXCEED 10'-0" FOR 2" DIA PIPE OR LARGER PER CA PLUMBING CODE, TABLE 313.3.
4. $r = \text{sqrt} [(OD)^2 + (OD - 2 * t_{design})^2] / 4$ WHERE $t_{design} = 0.93 t_{nom}$ (PER AISC 360).
5. PIPES MODELED AS PIN-PIN. THE FLEXURAL DEMAND EQUATION USED IS: $M = wL^2/8$. MAX TRANSVERSE SPACING INCLUDES EFFECTS OF BI-AXIAL BENDING FROM BOTH VERT & HORIZ LOADS. PER OSHPD, THE ALLOWABLE DEFLECTION IS LIMITED TO THE LESSER OF L/60 OR 6".
6. REFER TO ASCE 7-16, SECTION 13.6.7



**SHEET TITLE: PIPE TRANSVERSE BRACE SPACING TABLES
COPPER PIPE TYPE K ANNEALED**

| | | |
|--|--|--|
| <p>CYS STRUCTURAL ENGINEERS, INC. 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833</p> | <p>TEL (916) 920-2020 www.cyseng.com</p> | <p>Job No: 19039 Date: 09/08/2021 Page: 200.5 of .</p> |
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SEISMIC BRACING FOR
MEP SYSTEMS

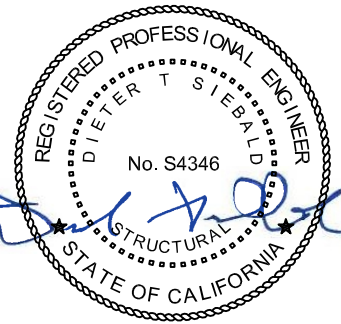


PIPE TRANSVERSE BRACE SPACING TABLES
MAX LOAD TO EACH TRANSVERSE BRACE AT ASD LEVEL OF DESIGN

Drawn Copper Tube: Type L Soldered. Fy = 30ksi

| Fy = 30 ksi | | | Fy Reduction ⁽⁶⁾ = 0.9 | | | Insulated Water- Filled Pipe Wt | Lv = Hanger Spacing ⁽³⁾ | Max Transverse Spacing per Seismic Design Force "Fp" (ft) ⁽⁵⁾ | | | |
|---------------------|-------------------|---------------------------------|-----------------------------------|------------------|------------------|--|--|---|-------------------------------------|------|------|
| Pipe ⁽¹⁾ | OD ⁽¹⁾ | t _{nom} ⁽¹⁾ | S ⁽²⁾ | r ⁽⁴⁾ | M _{cap} | | | 0.5 | 0.75 | 1 | 1.25 |
| (in) | (in) | (in) | (in ³) | (in) | (ft-lb) | | | (plf) | Corresp. Vert. Seismic Effect, "Ev" | | |
| | | | | | | | 0.1 | 0.15 | 0.2 | 0.25 | |
| 3/4 | 0.875 | 0.045 | 0.02 | 0.10 | 9 | 1.3 | 5 | 13 | 11 | 10 | 9 |
| 1 | 1.125 | 0.050 | 0.04 | 0.12 | 16 | 1.7 | 6 | 16 | 14 | 12 | 11 |
| 1 1/4 | 1.375 | 0.055 | 0.07 | 0.13 | 27 | 2.2 | 6 | 18 | 16 | 14 | 13 |
| 1 1/2 | 1.625 | 0.060 | 0.10 | 0.15 | 42 | 2.8 | 6 | 21 | 18 | 16 | 15 |
| 2 | 2.125 | 0.070 | 0.21 | 0.19 | 85 | 4.1 | 8 | 26 | 22 | 20 | 19 |
| 2 1/2 | 2.625 | 0.080 | 0.37 | 0.23 | 149 | 5.7 | 9 | 30 | 26 | 23 | 21 |
| 3 1/2 | 3.625 | 0.100 | 0.89 | 0.30 | 359 | 9.8 | 10 | 35 | 32 | 29 | 26 |
| 4 | 4.125 | 0.110 | 1.27 | 0.33 | 513 | 12.4 | 10 | 37 | 34 | 31 | 28 |
| 5 | 5.125 | 0.125 | 2.24 | 0.40 | 905 | 18.6 | 10 | 41 | 37 | 34 | 30 |
| 6 | 6.125 | 0.140 | 3.60 | 0.46 | 1454 | 25.1 | 10 | 45 | 41 | 37 | 33 |
| 8 | 8.125 | 0.200 | 9.00 | 0.63 | 3638 | 43.7 | 10 | 53 | 48 | 44 | 40 |
| 10 | 10.125 | 0.250 | 17.47 | 0.79 | 7061 | 66.8 | 10 | 59 | 54 | 50 | 46 |
| 12 | 12.125 | 0.280 | 28.18 | 0.91 | 11392 | 91.9 | 10 | 65 | 58 | 54 | 50 |

1. COPPER PIPE DIM PER COPPER DEVELOPMENT ASSOCIATION, INC.
2. $S = [\pi (OD)^4 - (OD - 2t_{design})^4] / 32 (OD)$ WHERE $t_{design} = 0.93 t_{nom}$ (PER AISC 360).
3. MAX DISTANCE BTW HANGERS PER TABLE 4 OF "ANSI/MSS SP-58-2018: PIPE HANGERS AND SUPPORTS - MATERIALS, DESIGN, MANUFACTURE, SELECTION, APPLICATION AND INSTALLATION" (MSS SP-58-2009). MAX DISTANCE IS NOT TO EXCEED 6'-0" FOR 1 1/2" DIA PIPE & SMALLER AND MAX DISTANCE IS NOT TO EXCEED 10'-0" FOR 2" DIA PIPE OR LARGER PER CA PLUMBING CODE, TABLE 313.3.
4. $r = \sqrt{[(OD)^2 + (OD - 2 * t_{design})^2]} / 4$ WHERE $t_{design} = 0.93 t_{nom}$ (PER AISC 360).
5. PIPES MODELED AS PIN-PIN. THE FLEXURAL DEMAND EQUATION USED IS: $M = wL^2/8$. MAX TRANSVERSE SPACING INCLUDES EFFECTS OF BI-AXIAL BENDING FROM BOTH VERT & HORIZ LOADS. PER OSHPD, THE ALLOWABLE DEFLECTION IS LIMITED TO THE LESSER OF L/60 OR 6".
6. REFER TO ASCE 7-16, SECTION 13.6.7



SHEET TITLE: PIPE TRANSVERSE BRACE SPACING TABLES
COPPER PIPE TYPE L DRAWN W/ SOLDERED JOINTS



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| Page: | 200.6 of . |

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SEISMIC BRACING FOR MEP SYSTEMS



PIPE TRANSVERSE BRACE SPACING TABLES MAX LOAD TO EACH TRANSVERSE BRACE AT ASD LEVEL OF DESIGN

Copper Tube: Type L Annealed. Fy = 9ksi

| Fy = 9 ksi | | Fy Reduction ⁽⁶⁾ = 0.9 | | | | Insulated Water- Filled Pipe Wt (plf) | Lv = Hanger Spacing ⁽³⁾ (ft) | Max Transverse Spacing per Seismic Design Force "Fp" (ft) ⁽⁵⁾ | | | |
|-----------------------------|---------------------------|---|--|--------------------------|-----------------------------|---|--|---|------|----|------|
| Pipe ⁽¹⁾ (in) | OD ⁽¹⁾ (in) | t _{nom} ⁽¹⁾ (in) | S ⁽²⁾ (in ³) | r ⁽⁴⁾ (in) | M _{cap} (ft-lb) | | | 0.5 | 0.75 | 1 | 1.25 |
| | | | | | | | | Corresp. Vert. Seismic Effect, "Ev" | | | |
| | | | | | | 0.1 | 0.15 | 0.2 | 0.25 | | |
| 3/4 | 0.875 | 0.045 | 0.02 | 0.10 | 9 | 1.3 | 5 | 7 | 5 | 5 | 4 |
| 1 | 1.125 | 0.050 | 0.04 | 0.12 | 16 | 1.7 | 6 | 8 | 6 | 5 | 5 |
| 1 1/4 | 1.375 | 0.055 | 0.07 | 0.13 | 27 | 2.2 | 6 | 10 | 8 | 7 | 6 |
| 1 1/2 | 1.625 | 0.060 | 0.10 | 0.15 | 42 | 2.8 | 6 | 12 | 10 | 8 | 7 |
| 2 | 2.125 | 0.070 | 0.21 | 0.19 | 85 | 4.1 | 8 | 13 | 11 | 9 | 8 |
| 2 1/2 | 2.625 | 0.080 | 0.37 | 0.23 | 149 | 5.7 | 9 | 15 | 12 | 10 | 9 |
| 3 | 3.125 | 0.090 | 0.59 | 0.26 | 239 | 7.6 | 10 | 16 | 13 | 11 | 10 |
| 3 1/2 | 3.625 | 0.100 | 0.89 | 0.30 | 359 | 9.8 | 10 | 19 | 15 | 13 | 11 |
| 4 | 4.125 | 0.110 | 1.27 | 0.33 | 513 | 12.4 | 10 | 21 | 16 | 14 | 12 |
| 5 | 5.125 | 0.125 | 2.24 | 0.40 | 905 | 18.6 | 10 | 23 | 19 | 16 | 14 |
| 6 | 6.125 | 0.140 | 3.60 | 0.46 | 1454 | 25.1 | 10 | 26 | 21 | 18 | 16 |
| 8 | 8.125 | 0.200 | 9.00 | 0.63 | 3638 | 43.7 | 10 | 33 | 27 | 23 | 20 |
| 10 | 10.125 | 0.250 | 17.47 | 0.79 | 7061 | 66.8 | 10 | 38 | 31 | 26 | 24 |
| 12 | 12.125 | 0.280 | 28.18 | 0.91 | 11392 | 91.9 | 10 | 41 | 34 | 29 | 26 |

1. COPPER PIPE DIM PER COPPER DEVELOPMENT ASSOCIATION, INC.
2. $S = [\pi (OD)^4 - (OD - 2 * t_{design})^4] / 32 (OD)$ WHERE $t_{design} = 0.93 t_{nom}$ (PER AISC 360).
3. MAX DISTANCE BTW HANGERS PER TABLE 4 OF "ANSI/MSS SP-58-2018: PIPE HANGERS AND SUPPORTS - MATERIALS, DESIGN, MANUFACTURE, SELECTION, APPLICATION AND INSTALLATION" (MSS SP-58-2009). MAX DISTANCE IS NOT TO EXCEED 6'-0" FOR 1 1/2" DIA PIPE & SMALLER AND MAX DISTANCE IS NOT TO EXCEED 10'-0" FOR 2" DIA PIPE OR LARGER PER CA PLUMBING CODE, TABLE 313.3.
4. $r = \text{sqrt} [(OD)^2 + (OD - 2 * t_{design})^2] / 4$ WHERE $t_{design} = 0.93 t_{nom}$ (PER AISC 360).
5. PIPES MODELED AS PIN-PIN. THE FLEXURAL DEMAND EQUATION USED IS: $M = wL^2/8$. MAX TRANSVERSE SPACING INCLUDES EFFECTS OF BI-AXIAL BENDING FROM BOTH VERT & HORIZ LOADS. PER OSHPD, THE ALLOWABLE DEFLECTION IS LIMITED TO THE LESSER OF L/60 OR 6".
6. REFER TO ASCE 7-16, SECTION 13.6.7



SHEET TITLE: PIPE TRANSVERSE BRACE SPACING TABLES COPPER PIPE TYPE L ANNEALED



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| Page: | 200.7 of . |

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SEISMIC BRACING FOR
MEP SYSTEMS



PIPE TRANSVERSE BRACE SPACING TABLES
MAX LOAD TO EACH TRANSVERSE BRACE AT ASD LEVEL OF DESIGN

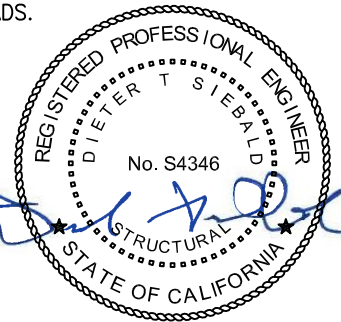
Cast Iron Pipe. Fy = 17.85ksi

ASTM A808

| Fy = 17.85 ksi | | Fy Reduction ⁽⁶⁾ = 0.1 | | | | Water-Filled Pipe Wt (plf) | Lv = Hanger Spacing ⁽²⁾ (ft) | Max Transverse Spacing per Seismic Design Force "Fp" (ft) ⁽⁴⁾ | | | |
|----------------|---------|-----------------------------------|-------------------------------------|-----------------------|--------------------------|----------------------------|---|--|------|----|------|
| Pipe Size (in) | OD (in) | t _{nom} (in) | S ⁽¹⁾ (in ³) | r ⁽³⁾ (in) | M _{cap} (ft-lb) | | | 0.5 | 0.75 | 1 | 1.25 |
| | | | | | | | | Corresp. Vert. Seismic Effect, "Ev" | | | |
| | | | | | | 0.1 | 0.15 | 0.2 | 0.25 | | |
| 1 1/2 | 1.900 | 0.160 | 0.33 | 0.26 | 30 | 3.3 | 8 | NP | NP | NP | NP |
| 2 | 2.350 | 0.160 | 0.53 | 0.30 | 47 | 5.0 | 8 | 3 | 1 | NP | NP |
| 3 | 3.350 | 0.160 | 1.15 | 0.36 | 102 | 8.3 | 8 | 7 | 5 | 4 | 3 |
| 4 | 4.380 | 0.190 | 2.36 | 0.45 | 210 | 12.8 | 8 | 10 | 8 | 7 | 6 |
| 5 | 5.300 | 0.190 | 3.53 | 0.49 | 314 | 17.6 | 8 | 12 | 9 | 8 | 7 |
| 6 | 6.300 | 0.190 | 5.06 | 0.54 | 451 | 22.9 | 8 | 13 | 10 | 8 | 7 |
| 8 | 8.380 | 0.230 | 10.92 | 0.68 | 973 | 39.3 | 8 | 15 | 12 | 11 | 9 |
| 10 | 10.560 | 0.280 | 21.17 | 0.85 | 1886 | 59.8 | 8 | 19 | 15 | 13 | 11 |
| 12 | 12.500 | 0.280 | 30.01 | 0.92 | 2673 | 81.0 | 8 | 19 | 15 | 13 | 12 |

- CAST IRON PIPE DIM PER ASTM A888.
- $S = [\pi (OD)^4 - (OD - 2 * t_{design})^4] / 32 (OD)$ WHERE $t_{design} = 0.93 t_{nom}$ (PER AISC 360).
- MAX DISTANCE BTW HANGERS PER TABLE 4 OF, "ANSI/MSS SP-58-2018: PIPE HANGERS AND SUPPORTS - MATERIALS, DESIGN, MANUFACTURE, SELECTION, APPLICATION AND INSTALLATION" (MSS SP-58-2009). MAX DISTANCE IS NOT TO EXCEED 6'-0" FOR 1 1/2" DIA PIPE & SMALLER AND MAX DISTANCE IS NOT TO EXCEED 10'-0" FOR 2" DIA PIPE OR LARGER PER CA PLUMBING CODE, TABLE 313.3.
- $r = \text{sqrt} [(OD)^2 + (OD - 2 * t_{design})^2] / 4$ WHERE $t_{design} = 0.93 t_{nom}$ (PER AISC 360).
- PIPES MODELED AS PIN-PIN. THE FLEXURAL DEMAND EQUATION USED IS: $M = wL^2/8$. MAX TRANSVERSE SPACING INCLUDES EFFECTS OF BI-AXIAL BENDING FROM BOTH VERT & HORIZ LOADS. PER OSHPD, THE ALLOWABLE DEFLECTION IS LIMITED TO THE LESSER OF L/60 OR 6".
- REFER TO ASCE 7-16, SECTION 13.6.7

BY: Jeffrey Kikumoto



SHEET TITLE: PIPE TRANSVERSE BRACE SPACING TABLES
CAST IRON PIPE - NO HUB



CYS STRUCTURAL ENGINEERS, INC.

2495 NATOMAS PARK DRIVE, SUITE 650
SACRAMENTO, CA 95833

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

Job No: 19039
Date: 09/08/2021
Page: 200.8 of .

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SEISMIC BRACING FOR
MEP SYSTEMS

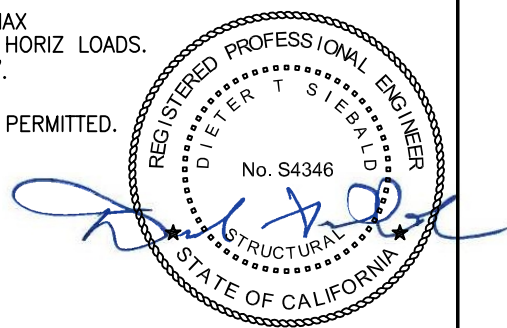


ELECTRICAL CONDUIT TRANSVERSE BRACE SPACING TABLES
MAX LOAD TO EACH TRANSVERSE BRACE AT ASD LEVEL OF DESIGN

Rigid Metal Conduit (RMC)

| Fy = 30 ksi | | Fy Reduction ⁽⁷⁾ = 0.7 | | | | Cable-Filled Pipe Wt (plf) | Lv = Hanger Spacing ⁽³⁾ (ft) | Max Transverse Spacing per Seismic Design Force "Fp" (ft) ⁽⁵⁾ | | | |
|-------------------------------|------------------------|--------------------------------------|-------------------------------------|-----------------------|--------------------------|----------------------------|---|--|------|----|------|
| Pipe Size ⁽¹⁾ (in) | OD ⁽¹⁾ (in) | t _{nom} ⁽¹⁾ (in) | S ⁽²⁾ (in ³) | r ⁽⁴⁾ (in) | M _{cap} (ft-lb) | | | 0.5 | 0.75 | 1 | 1.25 |
| | | | | | | | | Corresp. Vert. Seismic Effect, "Ev" | | | |
| | | | | | | 0.1 | 0.15 | 0.2 | 0.25 | | |
| 1/2 | 0.840 | 0.109 | 0.04 | 0.26 | 41 | 1.2 | 7 | 19 | 17 | 14 | 13 |
| 3/4 | 1.050 | 0.113 | 0.07 | 0.33 | 70 | 1.8 | 7 | 21 | 18 | 15 | 14 |
| 1 | 1.315 | 0.133 | 0.13 | 0.42 | 132 | 2.6 | 7 | 25 | 21 | 18 | 16 |
| 1 1/4 | 1.660 | 0.140 | 0.22 | 0.54 | 233 | 3.4 | 7 | 30 | 25 | 22 | 19 |
| 1 1/2 | 1.900 | 0.145 | 0.31 | 0.62 | 323 | 4.4 | 9 | 31 | 25 | 22 | 19 |
| 2 | 2.375 | 0.154 | 0.53 | 0.79 | 554 | 6.5 | 10 | 33 | 27 | 23 | 21 |
| 2 1/2 | 2.875 | 0.203 | 1.00 | 0.95 | 1053 | 9.9 | 11 | 37 | 30 | 26 | 23 |
| 3 | 3.500 | 0.216 | 1.62 | 1.16 | 1702 | 13.7 | 12 | 40 | 33 | 28 | 25 |
| 3 1/2 | 4.000 | 0.226 | 2.25 | 1.34 | 2361 | 17.4 | 13 | 42 | 34 | 29 | 26 |
| 4 | 4.500 | 0.237 | 3.02 | 1.51 | 3168 | 21.6 | 14 | 43 | 35 | 30 | 27 |

- CONDUIT DIM PER WESTERN TUBE.
- $S = [\pi (OD)^4 - (OD - 2t_{design})^4] / 32 (OD)$ WHERE $t_{design} = 0.93 t_{nom}$ (PER AISC 360).
- MAX DISTANCE BTW HANGERS IS BASED ON STD WT STL PIPE HANGER SPACING IN TABLE 4 OF "ANSI/MSS SP-58-2018: PIPE HANGERS AND SUPPORTS - MATERIALS, DESIGN, MANUFACTURE, SELECTION, APPLICATION AND INSTALLATION" (MSS SP-58-2009).
- $r = \text{sqrt} [(OD)^2 + (OD - 2t_{design})^2] / 4$ WHERE $t_{design} = 0.93 t_{nom}$ (PER AISC 360).
- PIPES MODELED AS PIN-PIN. THE FLEXURAL DEMAND EQUATION USED IS: $M = wL^2/8$. MAX TRANSVERSE SPACING INCLUDES EFFECTS OF BI-AXIAL BENDING FROM BOTH VERT & HORIZ LOADS. PER OSHPD, THE ALLOWABLE DEFLECTION IS LIMITED TO THE LESSER OF L/60 OR 6".
- FOR SEISMIC DESIGN FORCE, "Fp" BTW TABULATED VALUES, LINEAR INTERPOLATION IS PERMITTED.
- REFER TO ASCE 7-16, SECTION 13.6.5.



SHEET TITLE: ELECTRICAL CONDUIT TRANSVERSE BRACE SPACING TABLES
RIGID METAL CONDUIT (RMC)

| | | |
|--|--------------------------------------|---|
| <p>CYS STRUCTURAL ENGINEERS, INC. 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833</p> | TEL (916) 920-2020 www.cyseng.com | Job No: 19039 Date: 09/08/2021 Page: 201.1 of |
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SEISMIC BRACING FOR
MEP SYSTEMS

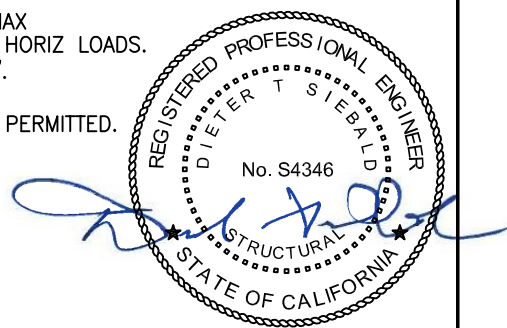


ELECTRICAL CONDUIT TRANSVERSE BRACE SPACING TABLES
MAX LOAD TO EACH TRANSVERSE BRACE AT ASD LEVEL OF DESIGN

Intermediate Metal Conduit (IMC)

| Fy = 30 ksi | | Fy Reduction ⁽⁷⁾ = 0.7 | | | | Cable-Filled Pipe Wt (plf) | Lv = Hanger Spacing ⁽³⁾ (ft) | Max Transverse Spacing per Seismic Design Force "Fp" (ft) ⁽⁵⁾ | | | |
|---------------------|-------------------|-----------------------------------|--------------------|------------------|------------------|----------------------------------|--|---|------|------|------|
| Pipe ⁽¹⁾ | OD ⁽¹⁾ | t _{nom} ⁽¹⁾ | S ⁽²⁾ | r ⁽⁴⁾ | M _{cap} | | | 0.5 | 0.75 | 1 | 1.25 |
| (in) | (in) | (in) | (in ³) | (in) | (ft-lb) | | | Corresp. Vert. Seismic Effect, "Ev" | | | |
| | | | | | | | 0.1 | 0.15 | 0.2 | 0.25 | |
| 1/2 | 0.815 | 0.070 | 0.03 | 0.26 | 28 | 1.0 | 7 | 18 | 15 | 12 | 11 |
| 3/4 | 1.029 | 0.075 | 0.05 | 0.34 | 50 | 1.6 | 7 | 20 | 16 | 13 | 12 |
| 1 | 1.290 | 0.085 | 0.09 | 0.43 | 90 | 2.2 | 7 | 23 | 19 | 16 | 14 |
| 1 1/4 | 1.638 | 0.085 | 0.14 | 0.55 | 151 | 2.8 | 7 | 27 | 22 | 19 | 17 |
| 1 1/2 | 1.883 | 0.090 | 0.20 | 0.63 | 214 | 3.7 | 9 | 27 | 22 | 19 | 17 |
| 2 | 2.360 | 0.095 | 0.35 | 0.80 | 362 | 5.6 | 10 | 28 | 23 | 19 | 17 |
| 2 1/2 | 2.857 | 0.140 | 0.73 | 0.96 | 762 | 8.7 | 11 | 33 | 27 | 23 | 20 |
| 3 | 3.476 | 0.140 | 1.10 | 1.18 | 1156 | 11.9 | 12 | 35 | 28 | 24 | 21 |
| 3 1/2 | 3.971 | 0.140 | 1.46 | 1.36 | 1531 | 14.9 | 13 | 35 | 28 | 24 | 22 |
| 4 | 4.466 | 0.140* | 1.87 | 1.53 | 1958 | 18.5 | 14 | 35 | 28 | 24 | 21 |

1. CONDUIT DIM PER WESTERN TUBE.
2. $S = [\pi (OD)^4 - (OD - 2t_{design})^4] / 32 (OD)$ WHERE $t_{design} = 0.93 t_{nom}$ (PER AISC 360).
3. MAX DISTANCE BTW HANGERS IS BASED ON STD WT STL PIPE HANGER SPACING IN TABLE 4 OF "ANSI/MSS SP-58-2018: PIPE HANGERS AND SUPPORTS - MATERIALS, DESIGN, MANUFACTURE, SELECTION, APPLICATION AND INSTALLATION" (MSS SP-58-2009).
4. $r = \text{sqrt} [(OD)^2 + (OD - 2t_{design})^2] / 4$ WHERE $t_{design} = 0.93 t_{nom}$ (PER AISC 360).
5. PIPES MODELED AS PIN-PIN. THE FLEXURAL DEMAND EQUATION USED IS: $M = wL^2/8$. MAX TRANSVERSE SPACING INCLUDES EFFECTS OF BI-AXIAL BENDING FROM BOTH VERT & HORIZ LOADS. PER OSHPD, THE ALLOWABLE DEFLECTION IS LIMITED TO THE LESSER OF L/60 OR 6".
6. FOR SEISMIC DESIGN FORCE, "Fp" BTW TABULATED VALUES, LINEAR INTERPOLATION IS PERMITTED.
7. REFER TO ASCE 7-16, SECTION 13.6.5.



SHEET TITLE: ELECTRICAL CONDUIT TRANSVERSE BRACE SPACING TABLES
INTERMEDIATE METAL CONDUIT (IMC)



CYS STRUCTURAL ENGINEERS, INC.

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Page: 201.2 of .

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SEISMIC BRACING FOR
MEP SYSTEMS

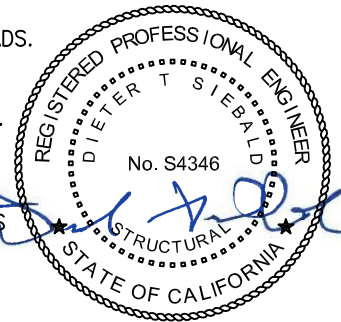


ELECTRICAL CONDUIT TRANSVERSE BRACE SPACING TABLES
MAX LOAD TO EACH TRANSVERSE BRACE AT ASD LEVEL OF DESIGN

Electrical Metal Tubing (EMT)

| Fy = 30 ksi | | Fy Reduction ⁽⁷⁾ = 0.7 | | | | Cable-Filled Pipe Wt | Lv = Hanger Spacing ⁽³⁾ | Max Transverse Spacing per Seismic Design Force "Fp" (ft) ⁽⁵⁾ | | | |
|---------------------|-------------------|-----------------------------------|--------------------|------------------|------------------|-------------------------|--|---|------|-----|------|
| Pipe ⁽¹⁾ | OD ⁽¹⁾ | t _{nom} ⁽¹⁾ | S ⁽²⁾ | r ⁽⁴⁾ | M _{cap} | | | 0.5 | 0.75 | 1 | 1.25 |
| (in) | (in) | (in) | (in ³) | (in) | (ft-lb) | | | Corresp. Vert. Seismic Effect, "Ev" | | | |
| | | | | | | (plf) | (ft) | 0.1 | 0.15 | 0.2 | 0.25 |
| 1/2 | 0.706 | 0.042 | 0.01 | 0.24 | 14 | 0.7 | 7 | 14 | 11 | 10 | 8 |
| 3/4 | 0.992 | 0.049 | 0.03 | 0.33 | 32 | 1.2 | 7 | 18 | 14 | 12 | 11 |
| 1 | 1.163 | 0.057 | 0.05 | 0.39 | 51 | 1.7 | 7 | 19 | 15 | 13 | 12 |
| 1 1/4 | 1.520 | 0.070 | 0.10 | 0.51 | 109 | 2.2 | 7 | 26 | 21 | 18 | 16 |
| 1 1/2 | 1.740 | 0.065 | 0.13 | 0.59 | 136 | 2.9 | 9 | 23 | 19 | 16 | 14 |
| 2 | 2.197 | 0.065 | 0.21 | 0.75 | 221 | 4.5 | 10 | 23 | 19 | 16 | 14 |
| 2 1/2 | 2.875 | 0.072 | 0.41 | 0.99 | 425 | 6.5 | 11 | 28 | 22 | 19 | 17 |
| 3 | 3.500 | 0.072 | 0.61 | 1.21 | 637 | 9.1 | 12 | 28 | 22 | 19 | 17 |
| 3 1/2 | 3.834 | 0.083 | 0.84 | 1.33 | 879 | 12.1 | 13 | 28 | 22 | 19 | 17 |
| 4 | 4.500 | 0.083 | 1.2 | 1.56 | 1222 | 15.4 | 14 | 28 | 23 | 19 | 17 |

1. CONDUIT DIM PER WESTERN TUBE.
2. $S = [\pi (OD)^4 - (OD - 2t_{design})^4] / 32 (OD)$ WHERE $t_{design} = 0.93 t_{nom}$ (PER AISC 360).
3. MAX DISTANCE BTW HANGERS IS BASED ON STD WT STL PIPE HANGER SPACING IN TABLE 4 OF "ANSI/MSS SP-58-2018: PIPE HANGERS AND SUPPORTS - MATERIALS, DESIGN, MANUFACTURE, SELECTION, APPLICATION AND INSTALLATION" (MSS SP-58-2009).
4. $r = \text{sqrt} [(OD)^2 + (OD - 2t_{design})^2] / 4$ WHERE $t_{design} = 0.93 t_{nom}$ (PER AISC 360).
5. PIPES MODELED AS PIN-PIN. THE FLEXURAL DEMAND EQUATION USED IS: $M = wL^2/8$. MAX TRANSVERSE SPACING INCLUDES EFFECTS OF BI-AXIAL BENDING FROM BOTH VERT & HORIZ LOADS. PER OSHPD, THE ALLOWABLE DEFLECTION IS LIMITED TO THE LESSER OF L/60 OR 6".
6. FOR SEISMIC DESIGN FORCE, "Fp" BTW TABULATED VALUES, LINEAR INTERPOLATION IS PERMITTED.
7. REFER TO ASCE 7-16, SECTION 13.6.5.
8. COUPLINGS FOR UP TO 2 1/2" EMT TO MEET PROJECT SPECS. HOWEVER, COMPRESSION COUPLINGS OR COUPLINGS W/ MIN 2- SCREWS AT EA END; E.G. CONDUIT CAN BE PUSHED INTO COUPLING APPROX 2" & SET W/ MIN 2- SCREWS, SHALL BE USED FOR 3", 3 1/2" & 4" EMT



SHEET TITLE: ELECTRICAL CONDUIT TRANSVERSE BRACE SPACING TABLES
ELECTRICAL METALLIC TUBING (EMT)



CYS STRUCTURAL ENGINEERS, INC.

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Page: 201.3 of .

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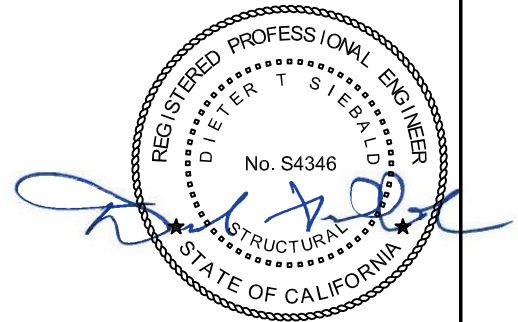
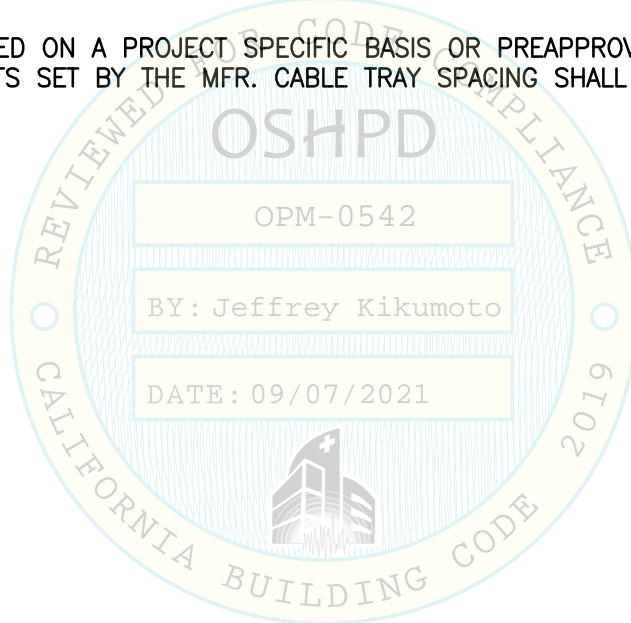
SEISMIC BRACING FOR
MEP SYSTEMS



CABLE TRAY WEIGHT TABLES
MAX WEIGHT AT ASD LEVEL OF DESIGN

| Weight of Data Cable Filled Cable Trays | | | | | | | |
|---|---------------|-------------|--------------|--------------|--------------|--------------|--------------|
| Depth of Tray | Width of Tray | | | | | | |
| | 6" (PLF) | 9" (PLF) | 12" (PLF) | 18" (PLF) | 24" (PLF) | 30" (PLF) | 36" (PLF) |
| 2" | 5.0 | 7.0 | 9.0 | 14.0 | 17.0 | 21.0 | 27.0 |
| 3" | 7.0 | 10.0 | 14.0 | 21.0 | 26.0 | 32.0 | 41.0 |
| 4" | 9.0 | 13.0 | 18.0 | 27.0 | 35.0 | 43.0 | 54.0 |
| 5" | 12.0 | 17.0 | 23.0 | 34.0 | 43.0 | 53.0 | 68.0 |
| 6" | 14.0 | 20.0 | 27.0 | 41.0 | 52.0 | 64.0 | 81.0 |

NOTE:
CABLE TRAY MUST BE APPROVED ON A PROJECT SPECIFIC BASIS OR PREAPPROVED BY OSHPD.
DO NOT EXCEED SPACING LIMITS SET BY THE MFR. CABLE TRAY SPACING SHALL BE APPROVED OR PREAPPROVED BY OSHPD.



SHEET TITLE: CABLE TRAY & MECHANICAL DUCTS WEIGHT TABLES
CABLE TRAYS



CYS STRUCTURAL ENGINEERS, INC.

2495 NATOMAS PARK DRIVE, SUITE 650
SACRAMENTO, CA 95833

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| Date: | 09/08/2021 |
| Page: | 202.1 of . |

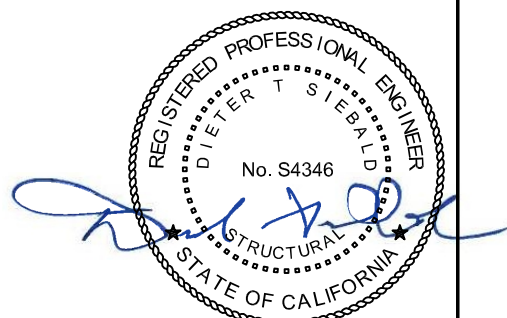
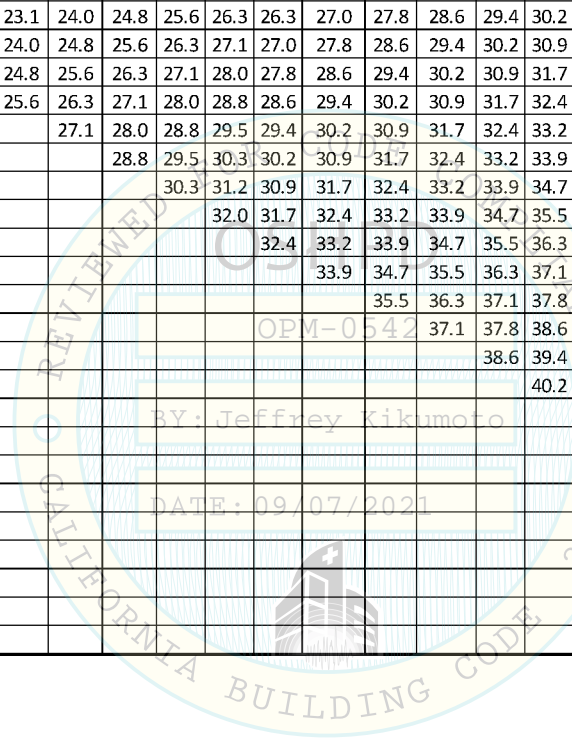
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SEISMIC BRACING FOR MEP SYSTEMS



RECTANGULAR DUCTS WEIGHT TABLES MAX WEIGHT AT ASD LEVEL OF DESIGN

| | | Width (in) | | | | | | | | | | | | | | | | | | | | | | |
|------------|----|------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Wt (plf) | | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 |
| Depth (in) | 6 | 12.9 | 13.8 | 14.4 | 15.1 | 15.9 | 16.8 | 17.6 | 18.4 | 18.6 | 19.4 | 20.0 | 20.8 | 21.6 | 22.4 | 23.1 | 23.9 | 24.7 | 25.4 | 26.2 | 27.0 | 27.7 | 28.5 | 29.3 |
| | 8 | 13.8 | 14.6 | 15.1 | 15.9 | 16.8 | 17.6 | 18.4 | 19.1 | 19.4 | 20.0 | 20.8 | 21.6 | 22.4 | 23.1 | 23.9 | 24.7 | 25.5 | 26.2 | 27.0 | 27.7 | 28.5 | 29.3 | 30.0 |
| | 10 | 14.6 | 15.3 | 15.9 | 16.8 | 17.6 | 18.4 | 19.1 | 20.0 | 20.0 | 20.8 | 21.6 | 22.4 | 23.1 | 23.9 | 24.7 | 25.5 | 26.3 | 27.0 | 27.7 | 28.5 | 29.3 | 30.0 | 30.8 |
| | 12 | 15.3 | 16.3 | 16.8 | 17.6 | 18.4 | 19.1 | 20.0 | 20.8 | 20.8 | 21.6 | 22.4 | 23.1 | 23.9 | 24.7 | 25.5 | 26.3 | 27.0 | 27.8 | 28.5 | 29.3 | 30.0 | 30.8 | 31.6 |
| | 14 | 16.3 | 17.0 | 17.6 | 18.4 | 19.1 | 20.0 | 20.8 | 21.6 | 21.6 | 22.4 | 23.1 | 23.9 | 24.7 | 25.5 | 26.3 | 27.0 | 27.8 | 28.5 | 29.3 | 30.0 | 30.9 | 31.6 | 32.3 |
| | 16 | 17.0 | 17.8 | 18.4 | 19.1 | 20.0 | 20.8 | 21.6 | 22.3 | 22.4 | 23.1 | 23.9 | 24.7 | 25.5 | 26.3 | 27.0 | 27.8 | 28.6 | 29.3 | 30.0 | 30.8 | 31.6 | 32.3 | 33.1 |
| | 18 | 17.8 | 18.7 | 19.1 | 20.0 | 20.8 | 21.6 | 22.3 | 23.1 | 23.1 | 23.9 | 24.7 | 25.5 | 26.3 | 27.0 | 27.8 | 28.6 | 29.4 | 30.0 | 30.8 | 31.6 | 32.3 | 33.1 | 33.9 |
| | 20 | 18.7 | 19.4 | 20.0 | 20.8 | 21.6 | 22.3 | 23.1 | 24.0 | 23.9 | 24.7 | 25.5 | 26.3 | 27.0 | 27.8 | 28.6 | 29.4 | 30.2 | 30.8 | 31.6 | 32.3 | 33.1 | 33.9 | 34.7 |
| | 22 | 19.4 | 20.4 | 20.8 | 21.6 | 22.3 | 23.1 | 24.0 | 24.8 | 24.7 | 25.5 | 26.3 | 27.0 | 27.8 | 28.6 | 29.4 | 30.2 | 30.9 | 31.6 | 32.3 | 33.1 | 33.9 | 34.7 | 35.4 |
| | 24 | 20.4 | 21.1 | 21.6 | 22.3 | 23.1 | 24.0 | 24.8 | 25.6 | 25.5 | 26.3 | 27.0 | 27.8 | 28.6 | 29.4 | 30.2 | 30.9 | 31.7 | 32.3 | 33.1 | 33.9 | 34.7 | 35.4 | 36.2 |
| | 26 | 21.1 | 21.9 | 22.3 | 23.1 | 24.0 | 24.8 | 25.6 | 26.3 | 26.3 | 27.0 | 27.8 | 28.6 | 29.4 | 30.2 | 30.9 | 31.7 | 32.4 | 33.1 | 33.9 | 34.7 | 35.4 | 36.2 | 37.0 |
| | 28 | | 22.8 | 23.1 | 24.0 | 24.8 | 25.6 | 26.3 | 27.1 | 27.0 | 27.8 | 28.6 | 29.4 | 30.2 | 30.9 | 31.7 | 32.4 | 33.2 | 33.9 | 34.7 | 35.4 | 36.2 | 37.0 | 37.7 |
| | 30 | | | 24.0 | 24.8 | 25.6 | 26.3 | 27.1 | 28.0 | 27.8 | 28.6 | 29.4 | 30.2 | 30.9 | 31.7 | 32.4 | 33.2 | 33.9 | 34.7 | 35.4 | 36.2 | 37.0 | 37.7 | 38.5 |
| | 32 | | | | 25.6 | 26.3 | 27.1 | 28.0 | 28.8 | 28.6 | 29.4 | 30.2 | 30.9 | 31.7 | 32.4 | 33.2 | 33.9 | 34.7 | 35.5 | 36.2 | 37.0 | 37.7 | 38.5 | 39.3 |
| | 34 | | | | | 27.1 | 28.0 | 28.8 | 29.5 | 29.4 | 30.2 | 30.9 | 31.7 | 32.4 | 33.2 | 33.9 | 34.7 | 35.5 | 36.3 | 37.0 | 37.7 | 38.5 | 39.3 | 40.0 |
| | 36 | | | | | | 28.8 | 29.5 | 30.3 | 30.2 | 30.9 | 31.7 | 32.4 | 33.2 | 33.9 | 34.7 | 35.5 | 36.3 | 37.0 | 37.7 | 38.5 | 39.3 | 40.0 | 40.8 |
| | 38 | | | | | | | 30.3 | 31.2 | 30.9 | 31.7 | 32.4 | 33.2 | 33.9 | 34.7 | 35.5 | 36.3 | 37.1 | 37.7 | 38.5 | 39.3 | 40.0 | 40.8 | 41.6 |
| | 40 | | | | | | | | 32.0 | 31.7 | 32.4 | 33.2 | 33.9 | 34.7 | 35.5 | 36.3 | 37.1 | 37.8 | 38.5 | 39.3 | 40.0 | 40.8 | 41.6 | 42.4 |
| | 42 | | | | | | | | | 32.4 | 33.2 | 33.9 | 34.7 | 35.5 | 36.3 | 37.1 | 37.8 | 38.6 | 39.3 | 40.0 | 40.8 | 41.6 | 42.4 | 43.1 |
| | 44 | | | | | | | | | | 33.9 | 34.7 | 35.5 | 36.3 | 37.1 | 37.8 | 38.6 | 39.4 | 40.0 | 40.8 | 41.6 | 42.4 | 43.1 | 43.9 |
| 46 | | | | | | | | | | | 35.5 | 36.3 | 37.1 | 37.8 | 38.6 | 39.4 | 40.2 | 40.8 | 41.6 | 42.4 | 43.1 | 43.9 | 44.7 | |
| 48 | | | | | | | | | | | | 37.1 | 37.8 | 38.6 | 39.4 | 40.2 | 41.0 | 41.6 | 42.4 | 43.1 | 43.9 | 44.7 | 45.4 | |
| 50 | | | | | | | | | | | | | 38.6 | 39.4 | 40.2 | 41.0 | 41.7 | 42.4 | 43.1 | 43.9 | 44.7 | 45.4 | 46.2 | |
| 52 | | | | | | | | | | | | | | 40.2 | 41.0 | 41.7 | 42.5 | 43.1 | 43.9 | 44.7 | 45.4 | 46.2 | 47.0 | |
| 54 | | | | | | | | | | | | | | | 41.7 | 42.5 | 43.3 | 43.9 | 44.7 | 45.4 | 46.2 | 47.0 | 47.7 | |
| 56 | | | | | | | | | | | | | | | | 43.3 | 44.1 | 44.7 | 45.4 | 46.2 | 47.0 | 47.7 | 48.5 | |
| 58 | | | | | | | | | | | | | | | | | 44.9 | 45.4 | 46.2 | 47.0 | 47.7 | 48.5 | 49.3 | |
| 60 | | | | | | | | | | | | | | | | | | 46.2 | 47.0 | 47.7 | 48.5 | 49.3 | 50.1 | |
| 62 | | | | | | | | | | | | | | | | | | | 47.7 | 48.5 | 49.3 | 50.1 | 50.8 | |
| 64 | | | | | | | | | | | | | | | | | | | | 49.3 | 50.1 | 50.8 | 51.6 | |
| 66 | | | | | | | | | | | | | | | | | | | | | 50.8 | 51.6 | 52.4 | |
| 68 | | | | | | | | | | | | | | | | | | | | | | 52.4 | 53.1 | |
| 70 | | | | | | | | | | | | | | | | | | | | | | | 53.9 | |



SHEET TITLE: CABLE TRAY & MECHANICAL DUCTS WEIGHT TABLES
RECTANGULAR DUCTS 18 GA

| | | |
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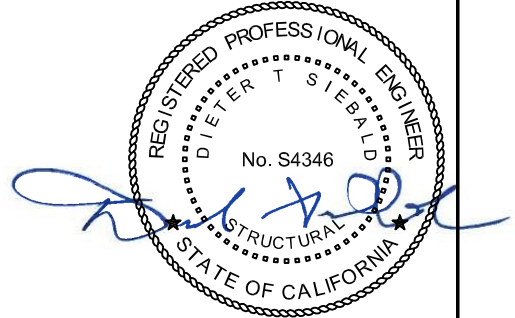
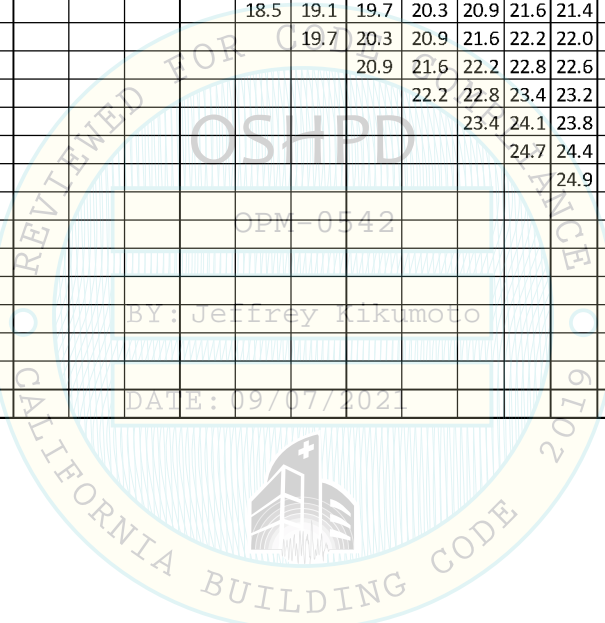
SEISMIC BRACING FOR
MEP SYSTEMS



RECTANGULAR DUCTS WEIGHT TABLES
MAX WEIGHT AT ASD LEVEL OF DESIGN

Rectangular Duct Weights - 20 Gage

| | | Width (in) | | | | | | | | | | | | | | | | | | | | | | | |
|------------|----|------------|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|----|
| | | Wt (plf) | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 |
| Depth (in) | 10 | 7.4 | 8.0 | 8.7 | 9.3 | 9.9 | 10.6 | 11.2 | 11.7 | 12.3 | 13.0 | 13.6 | 14.2 | 14.8 | 15.5 | 15.4 | 16.0 | 16.6 | 17.2 | 17.8 | 18.4 | 19.0 | 19.6 | 20.2 | |
| | 12 | 8.0 | 8.7 | 9.3 | 9.9 | 10.6 | 11.2 | 11.7 | 12.4 | 13.0 | 13.6 | 14.2 | 14.8 | 15.5 | 16.0 | 16.0 | 16.6 | 17.2 | 17.8 | 18.4 | 19.0 | 19.6 | 20.2 | 20.8 | |
| | 14 | 8.7 | 9.3 | 9.9 | 10.6 | 11.2 | 11.7 | 12.4 | 13.0 | 13.6 | 14.2 | 14.8 | 15.5 | 16.0 | 16.6 | 16.6 | 17.2 | 17.8 | 18.4 | 19.0 | 19.6 | 20.2 | 20.8 | 21.4 | |
| | 16 | | 9.9 | 10.6 | 11.2 | 11.7 | 12.4 | 13.0 | 13.6 | 14.2 | 14.8 | 15.5 | 16.0 | 16.6 | 17.2 | 17.2 | 17.8 | 18.4 | 19.0 | 19.6 | 20.2 | 20.8 | 21.4 | 22.0 | |
| | 18 | | | 11.2 | 11.7 | 12.4 | 13.0 | 13.6 | 14.3 | 14.8 | 15.5 | 16.0 | 16.6 | 17.2 | 17.8 | 17.8 | 18.4 | 19.0 | 19.6 | 20.2 | 20.8 | 21.4 | 22.0 | 22.6 | |
| | 20 | | | | 12.4 | 13.0 | 13.6 | 14.3 | 14.9 | 15.5 | 16.0 | 16.6 | 17.2 | 17.8 | 18.5 | 18.4 | 19.0 | 19.6 | 20.2 | 20.8 | 21.4 | 22.0 | 22.6 | 23.2 | |
| | 22 | | | | | 13.6 | 14.3 | 14.9 | 15.6 | 16.0 | 16.6 | 17.2 | 17.8 | 18.5 | 19.1 | 19.0 | 19.6 | 20.2 | 20.8 | 21.4 | 22.0 | 22.6 | 23.2 | 23.8 | |
| | 24 | | | | | | 14.9 | 15.6 | 16.2 | 16.6 | 17.2 | 17.8 | 18.5 | 19.1 | 19.7 | 19.6 | 20.2 | 20.8 | 21.4 | 22.0 | 22.6 | 23.2 | 23.8 | 24.4 | |
| | 26 | | | | | | | 16.2 | 16.7 | 17.2 | 17.8 | 18.5 | 19.1 | 19.7 | 20.3 | 20.2 | 20.8 | 21.4 | 22.0 | 22.6 | 23.2 | 23.8 | 24.4 | 24.9 | |
| | 28 | | | | | | | | 17.4 | 17.8 | 18.5 | 19.1 | 19.7 | 20.3 | 20.9 | 20.8 | 21.4 | 22.0 | 22.6 | 23.2 | 23.8 | 24.4 | 24.9 | 25.5 | |
| | 30 | | | | | | | | | 18.5 | 19.1 | 19.7 | 20.3 | 20.9 | 21.6 | 21.4 | 22.0 | 22.6 | 23.2 | 23.8 | 24.4 | 24.9 | 25.5 | 26.1 | |
| | 32 | | | | | | | | | | 19.7 | 20.3 | 20.9 | 21.6 | 22.2 | 22.0 | 22.6 | 23.2 | 23.8 | 24.4 | 24.9 | 25.5 | 26.1 | 26.7 | |
| | 34 | | | | | | | | | | | 20.9 | 21.6 | 22.2 | 22.8 | 22.6 | 23.2 | 23.8 | 24.4 | 24.9 | 25.5 | 26.1 | 26.7 | 27.3 | |
| | 36 | | | | | | | | | | | | 22.2 | 22.8 | 23.4 | 23.2 | 23.8 | 24.4 | 24.9 | 25.5 | 26.1 | 26.7 | 27.3 | 27.9 | |
| | 38 | | | | | | | | | | | | | 23.4 | 24.1 | 23.8 | 24.4 | 24.9 | 25.5 | 26.1 | 26.7 | 27.3 | 27.9 | 28.5 | |
| | 40 | | | | | | | | | | | | | | 24.7 | 24.4 | 24.9 | 25.5 | 26.1 | 26.7 | 27.3 | 27.9 | 28.5 | 29.1 | |
| | 42 | | | | | | | | | | | | | | | 24.9 | 25.5 | 26.1 | 26.7 | 27.3 | 27.9 | 28.5 | 29.1 | 29.7 | |
| | 44 | | | | | | | | | | | | | | | | 26.1 | 26.7 | 27.3 | 27.9 | 28.5 | 29.1 | 29.7 | 30.3 | |
| | 46 | | | | | | | | | | | | | | | | | 27.3 | 27.9 | 28.5 | 29.1 | 29.7 | 30.3 | 30.9 | |
| | 48 | | | | | | | | | | | | | | | | | | 28.5 | 29.1 | 29.7 | 30.3 | 30.9 | 31.5 | |
| 50 | | | | | | | | | | | | | | | | | | | 29.7 | 30.3 | 30.9 | 31.5 | 32.1 | | |
| 52 | | | | | | | | | | | | | | | | | | | | 30.9 | 31.5 | 32.1 | 32.7 | | |
| 54 | | | | | | | | | | | | | | | | | | | | | 32.1 | 32.7 | 33.3 | | |
| 56 | | | | | | | | | | | | | | | | | | | | | | 33.3 | 33.9 | | |
| 58 | | | | | | | | | | | | | | | | | | | | | | | 34.5 | | |



SHEET TITLE: CABLE TRAY & MECHANICAL DUCTS WEIGHT TABLES
RECTANGULAR DUCTS 20 GA

| | | |
|--|--------------------------------------|---|
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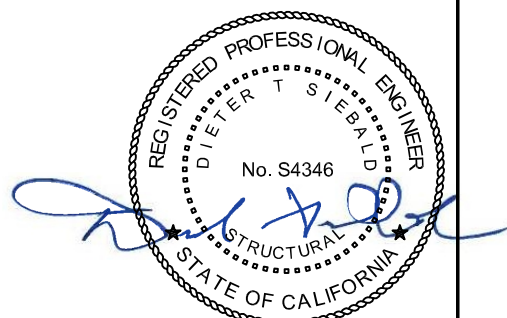
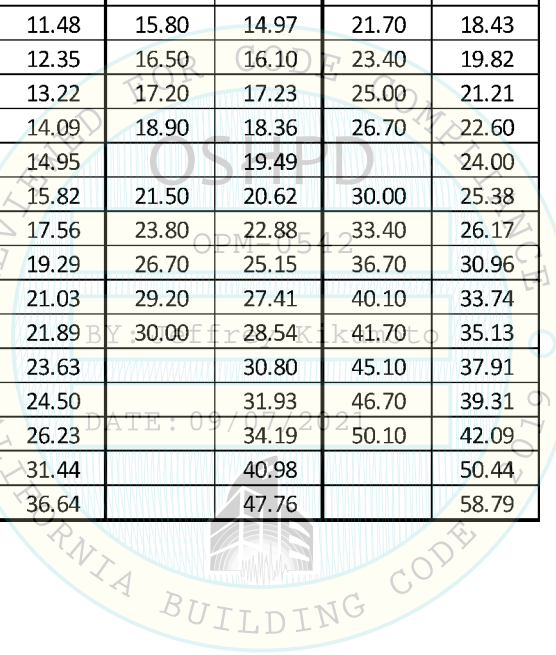
SEISMIC BRACING FOR
MEP SYSTEMS



ROUND DUCTS WEIGHT TABLES
MAX WEIGHT AT ASD LEVEL OF DESIGN

Round Duct Weights

| DIA. (IN) | 22 GAGE | | 20 GAGE | | 18 GAGE | | 16 GAGE | |
|-----------|--------------|-------------|--------------|-------------|--------------|-------------|--------------|-------------|
| | SEAM GAGE | | SEAM GAGE | | SEAM GAGE | | SEAM GAGE | |
| | SPIRAL (plf) | LONG. (plf) | SPIRAL (plf) | LONG. (plf) | SPIRAL (plf) | LONG. (plf) | SPIRAL (plf) | LONG. (plf) |
| 14 | 5.40 | 5.33 | 6.40 | 6.28 | 8.30 | 8.19 | 11.70 | 10.08 |
| 16 | 6.20 | 6.07 | 7.30 | 7.15 | 9.40 | 9.32 | 13.40 | 11.47 |
| 18 | 6.90 | 6.80 | 8.10 | 8.01 | 10.50 | 10.45 | 15.00 | 12.86 |
| 20 | 7.80 | 7.54 | 9.00 | 8.88 | 11.70 | 11.58 | 16.70 | 14.25 |
| 22 | 8.40 | 8.28 | 9.90 | 9.75 | 12.90 | 12.71 | 18.40 | 15.84 |
| 24 | 9.50 | 9.01 | 11.00 | 10.83 | 14.40 | 13.84 | 20.00 | 17.04 |
| 26 | 10.30 | 9.75 | 12.20 | 11.48 | 15.80 | 14.97 | 21.70 | 18.43 |
| 28 | 11.00 | 10.49 | 12.90 | 12.35 | 16.50 | 16.10 | 23.40 | 19.82 |
| 30 | 11.80 | 11.22 | 13.60 | 13.22 | 17.20 | 17.23 | 25.00 | 21.21 |
| 32 | 12.60 | 11.96 | 14.60 | 14.09 | 18.90 | 18.36 | 26.70 | 22.60 |
| 34 | | 12.70 | | 14.95 | | 19.49 | | 24.00 |
| 36 | 14.20 | 13.43 | 16.66 | 15.82 | 21.50 | 20.62 | 30.00 | 25.38 |
| 40 | 15.50 | 14.91 | 18.50 | 17.56 | 23.80 | 22.88 | 33.40 | 26.17 |
| 44 | 17.40 | 16.38 | 20.50 | 19.29 | 26.70 | 25.15 | 36.70 | 30.96 |
| 48 | 18.70 | 17.85 | 22.20 | 21.03 | 29.20 | 27.41 | 40.10 | 33.74 |
| 50 | 19.50 | 18.59 | 23.30 | 21.89 | 30.00 | 28.54 | 41.70 | 35.13 |
| 46 | | 20.06 | | 23.63 | | 30.80 | 45.10 | 37.91 |
| 54 | | 20.79 | | 24.50 | | 31.93 | 46.70 | 39.31 |
| 60 | | 22.27 | | 26.23 | | 34.19 | 50.10 | 42.09 |
| 72 | | 26.69 | | 31.44 | | 40.98 | | 50.44 |
| 84 | | 31.11 | | 36.64 | | 47.76 | | 58.79 |



SHEET TITLE: CABLE TRAY & MECHANICAL DUCTS WEIGHT TABLES
ROUND DUCTS



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| Date: | 09/08/2021 |
| Page: | 202.4 of . |

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SEISMIC BRACING FOR MEP SYSTEMS



SEISMIC BRACING DESIGN PROCEDURE FOR 4" DIA SCHEDULE 10 STEEL PIPE:

A. GENERAL

1. THE CALIFORNIA REGISTERED DESIGN PROFESSIONAL (CRDP) REVIEWS SECTION 1 – OVERVIEW & GENERAL NOTES OF THIS OPM.

B. DEMAND

1. THE CRDP DETERMINES THE LATERAL ACCELERATION & VERT ACCELERATION "G" FOR THE SEISMIC FORCES F_p & F_{pv} USING INFORMATION PROVIDED IN THE PROJECT DOCUMENTS.

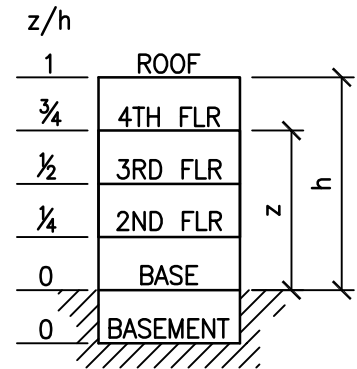
a. TRANSVERSE, LONGITUDINAL & VERTICAL SEISMIC BRACE DEMANDS ARE PRESENTED IN SECTION B OF THIS DESIGN PROCEDURE. FOR BRACE CAPACITIES & D/C RATIOS SEE SECTION C.

b. IN THE EXAMPLE BLW, THE MAX HORIZ & VERT FORCES ON THE BRACES ARE CALCULATED FOR AN ASSUMED SPECIFIC LOCATION THAT HAS AN S_{DS} VALUE OF 1.75 & A z/h RATIO OF ≤ 1.0 .

ASCE /SEI 7-16 AS AMENDED BY CBC 2019

SECTION 13.1.3 $I_p = 1.5$ (SEE CBC 1617A.1.17)
SECTION 13.3.1 SEISMIC DESIGN FORCES AT LRFD, UNO
 $F_p = 0.4 a_p S_{DS} W_p (1+2 z/h) = 1.75 W_p$

TABLE 13.6-1 R_p/I_p
 $a_p = 2.5$ (NOT ASME® B31)
 $R_p = 4.5$ (NOT ASME B31)
 $\Omega_o = 2.0$ (FOR ANCHORAGE TO CONC, SEE CBC 1617A.1.23)
 $S_{DS} = 1.75$ (ASSUMED VALUE USED FOR THIS EXAMPLE)
 $z = h$ $z/h \leq 1.0$ (ASSUMED)



SAMPLE BLDG ELEV

FORCES AT LRFD

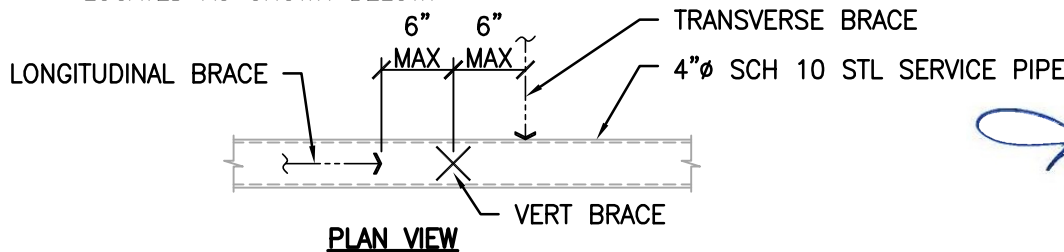
F_p (MAX) = $1.6 S_{DS} I_p W_p = 4.2 W_p$
 F_p (MIN) = $0.3 S_{DS} I_p W_p = 0.7875 W_p$
 $F_p = 1.75 W_p$
 $\Omega_o F_p = 3.5 W_p$ (FOR LRFD ANCHORAGE TO CONC)
 $F_{pv} = 0.20 S_{DS} W_p = 0.35 W_p$

FORCES AT ASD

$F_p = 0.7 F_p = 0.7 (1.75 W_p) = 1.225 W_p$
 $F_{pv} = 0.7 F_{pv} = 0.7 (0.35 W_p) = 0.245 W_p$

2. THE CRDP USES THE SECTION 1 DESIGN PARAMETERS & BRACING GUIDELINES TO PREPARE THE MEP LAYOUT DRAWINGS.

3. THE CRDP DETERMINES THE BRACE LOCATIONS & SHOWS THEM ON THE LAYOUT DRAWINGS AND VERIFIES THAT THERE IS A VERTICAL BRACE WITHIN SIX INCHES OF EA TRANSVERSE & LONGITUDINAL BRACE. ASSUME BRACES ARE LOCATED AS SHOWN BELOW.



SHEET TITLE: PIPE EXAMPLES OF SEISMIC BRACING DESIGN PROCEDURES
STEEL PIPE SCHEDULE 10, 4" DIA



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| Date: | 09/08/2021 |
| Page: | 300.1 of . |

SEISMIC BRACING FOR MEP SYSTEMS



PIPE BRACE SPACING:

SUMMARY OF TYP DESIGN EXAMPLE (CONTINUED)

B. DEMAND (CONTINUED):

4. THE CRDP COMPARES THE BRACE LOCATIONS TO THE ALLOWABLE TRANSVERSE BRACE SPACING SHOWN IN PERMISSIBLE BRACE SPACING TABLES IN SECTION 200 FOR STL SERVICE PIPES. THE SCHEDULE 10 TABLE IS ON PG 200.2. LATERAL TRANSVERSE BRACE SPACING OF 32 FEET FOR THE 4" DIA SCHEDULE 10 INSULATED & WATER FILLED MAIN LINE SERVICE PIPE IS ALLOWED WHEN THE HORIZ FORCE, "Fp", IS LESS THAN 1.25 Wp AT ASD LEVEL OF DESIGN. THE CRDP MAY INTERPOLATE VALUES.
5. THE CRDP MAKES ADJUSTMENTS TO THE LATERAL TRANSVERSE BRACE SPACING ON THE LAYOUT DRAWINGS IF SO REQ.
6. THE CRDP DETERMINES THE OPERATING WT. IN THIS EXAMPLE Wp = 435 LBS. (13.6 PLF x 32 FT)
- 7a. THE CRDP CALCULATES THE LATERAL FORCE Fp & VERT FORCE Fpv ON THE SEISMIC BRACE USING THE Wp. NOTE THAT IN THE EXAMPLE, IT IS CONSERVATIVELY ASSUMED THAT THE VERT GRAVITY LOAD IS BASED ON THE MAX ALLOWABLE VERT HANGER SPACING OF 12 FT FOR THE MAIN STL SERVICE PIPE LINE PROVIDED IN THE TABLE ON PG 200.2. THIS EXAMPLE IS AT ASD LEVEL OF DESIGN, EXCEPT FOR CONC ATTACHMENT, WHICH IS AT LRFD W/ Ωo.

Wp = 435 LBS

LRFD:

Fp = ±1.225 (435 LBS) = ±533 LBS

Ωo Fp Wp = ±2x1.75 (435 LBS) = ±1523 LBS

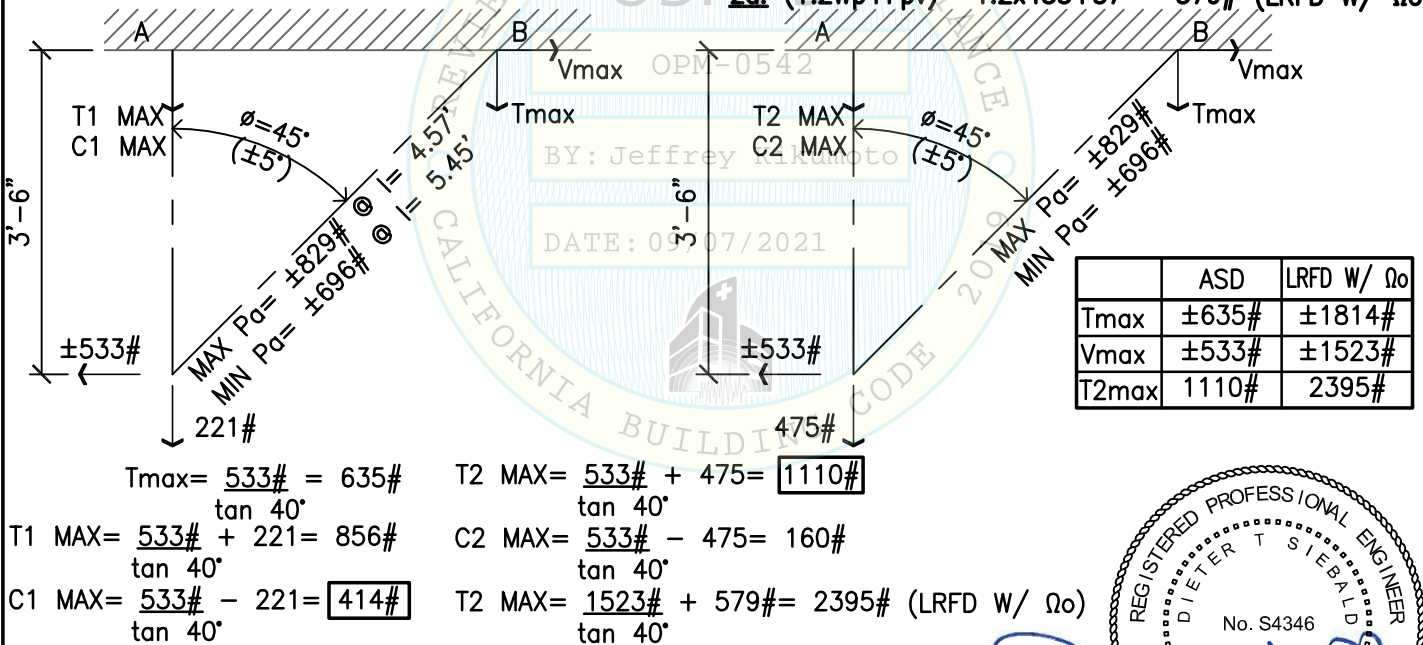
Fpv = ±0.245 (13.6 PLF x 12 FT) = ±40 LBS

Fpv = ±0.35 (13.6 PLF x 12 FT) = ±57 LBS

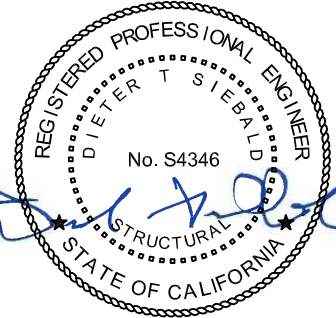
7b. TRANSVERSE BRACING

LOAD COMBINATION 1. (0.6Wp-Fpv)= 261-40= 221# **LOAD COMBINATION 2. (Wp+Fpv)= 435+40= 475#**

2a. (1.2Wp+Fpv)= 1.2x435+57 = 579# (LRFD W/ Ωo)



| | ASD | LRFD W/ Ωo |
|-------|-------|------------|
| Tmax | ±635# | ±1814# |
| Vmax | ±533# | ±1523# |
| T2max | 1110# | 2395# |



SHEET TITLE: PIPE EXAMPLES OF SEISMIC BRACING DESIGN PROCEDURES
STEEL PIPE SCHEDULE 10, 4" DIA



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Page: 300.2 of .

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SEISMIC BRACING FOR MEP SYSTEMS



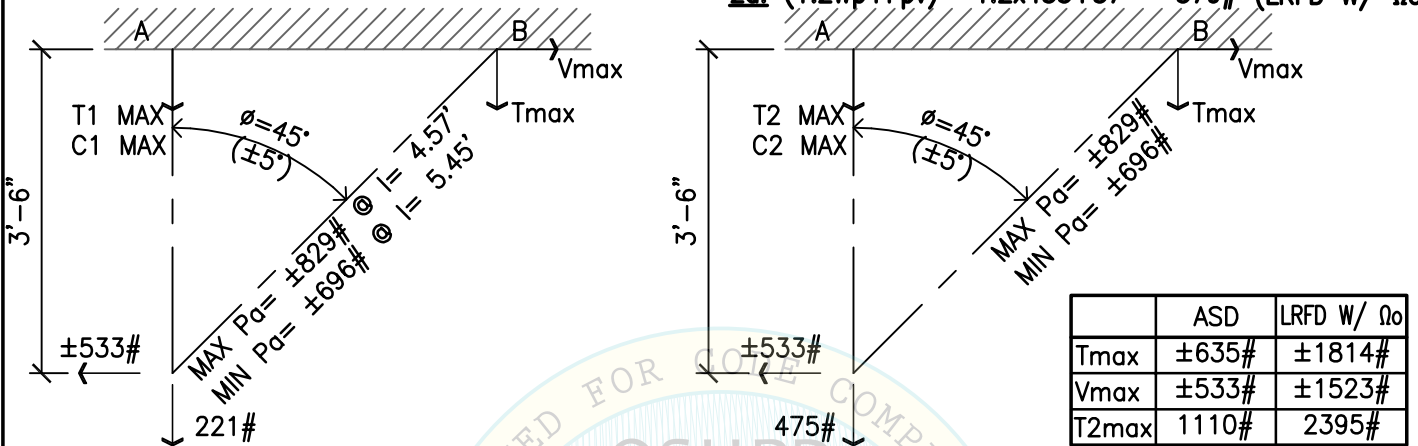
PIPE BRACE SPACING:

SUMMARY OF TYP DESIGN EXAMPLE (CONTINUED)

B. DEMAND (CONTINUED):

7c. LONGITUDINAL BRACING (ASSUME SAME SPACING AS TRANSVERSE BRACING)

LOAD COMBINATION 1. $(0.6Wp - Fpv) = 261 - 40 = 221\#$ **LOAD COMBINATION 2.** $(Wp + Fpv) = 435 + 40 = 475\#$
2a. $(1.2Wp + Fpv) = 1.2 \times 435 + 57 = 579\#$ (LRFD W/ Ω_0)



| | ASD | LRFD W/ Ω_0 |
|-------|-------|--------------------|
| Tmax | ±635# | ±1814# |
| Vmax | ±533# | ±1523# |
| T2max | 1110# | 2395# |

$$T_{max} = \frac{533\#}{\tan 40^\circ} = 635\#$$

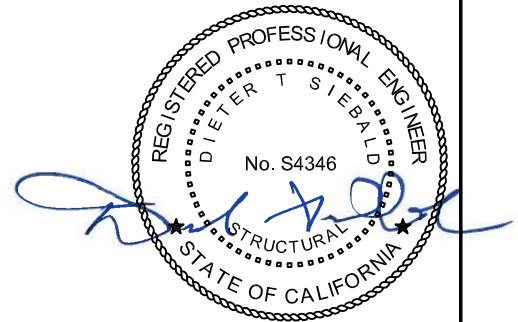
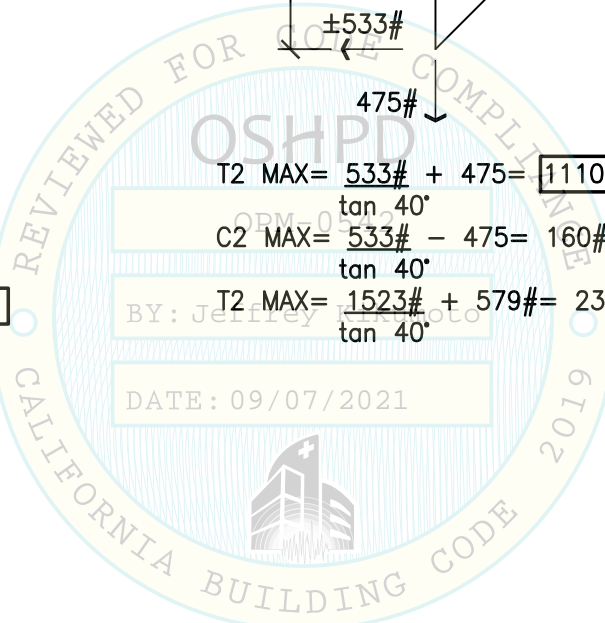
$$T1 \text{ MAX} = \frac{533\#}{\tan 40^\circ} + 221 = 856\#$$

$$C1 \text{ MAX} = \frac{533\#}{\tan 40^\circ} - 221 = 414\#$$

$$T2 \text{ MAX} = \frac{533\#}{\tan 40^\circ} + 475 = 1110\#$$

$$C2 \text{ MAX} = \frac{533\#}{\tan 40^\circ} - 475 = 160\#$$

$$T2 \text{ MAX} = \frac{1523\#}{\tan 40^\circ} + 579\# = 2395\# \text{ (LRFD W/ } \Omega_0)$$



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 STEEL PIPE SCHEDULE 10, 4" DIA



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Job No: 19039
 Date: 09/08/2021
 Page: 300.3 of .

SEISMIC BRACING FOR MEP SYSTEMS



PIPE BRACE SPACING:

SUMMARY OF TYP DESIGN EXAMPLE (CONTINUED)

B. DEMAND (CONTINUED):

7d. VERTICAL BRACING

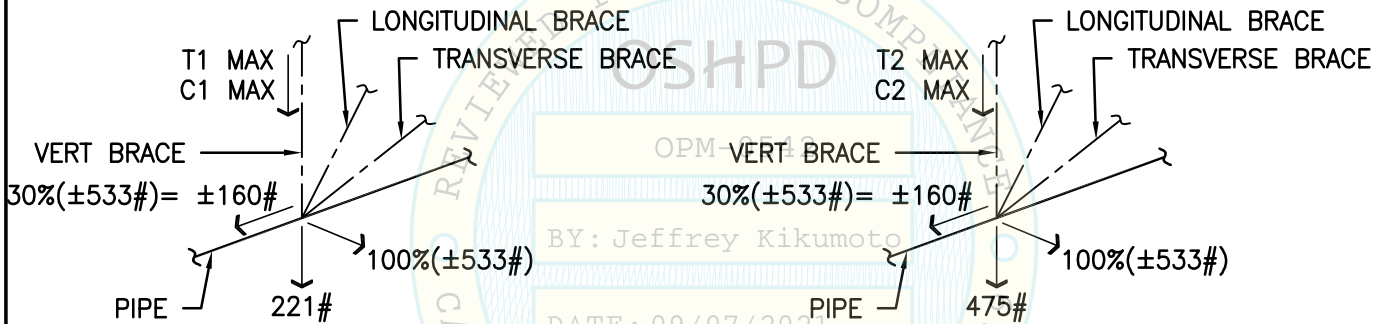
THE COMBINED REACTIONS DUE TO THE SEISMIC FORCES IN THE TRANSVERSE & LONGITUDINAL DIRECTIONS IS SUMMARIZED IN THE TABLE BELOW. THE GOVERNING REACTION SHOWN IS THE MAXIMUM OF THE TWO SCENARIOS WHERE THE SEISMIC LOAD IS:

1. 100% IN THE TRANSVERSE DIRECTION AND 30% IN THE LONGITUDINAL DIRECTION OR
2. 30% IN THE TRANSVERSE DIRECTION AND 100% IN THE LONGITUDINAL DIRECTION

NOTES:

1. SEISMIC LOADING IS THE SAME FOR LONGITUDINAL & TRANSVERSE BRACING SO BOTH SCENERIOS RESULT IN THE SAME REACTIONS. FOR SIMPLICITY'S SAKE, ONLY SCENERIO 1 IS SHOWN BELOW.
2. FOR LENGTH & ANGLE INFO NOT SHOWN, REFER TO SECTIONS 7b & 7c.

LOAD COMBINATION 1. $(0.6W_p - F_{pv}) = 261 - 40 = 221\#$ **LOAD COMBINATION 2.** $(W_p + F_{pv}) = 435 + 40 = 475\#$
2a. $(1.2W_p + F_{pv}) = 1.2 \times 435 + 57 = 579\#$ (LRFD W/ Ω_o)



$$T1 \text{ MAX} = \frac{533\#}{\tan 40^\circ} + \frac{0.3(533\#)}{\tan 40^\circ} + 221\# = 1047\#$$

$$C1 \text{ MAX} = \frac{533\#}{\tan 40^\circ} + \frac{0.3(533\#)}{\tan 40^\circ} - 221\# = \boxed{605\#}$$

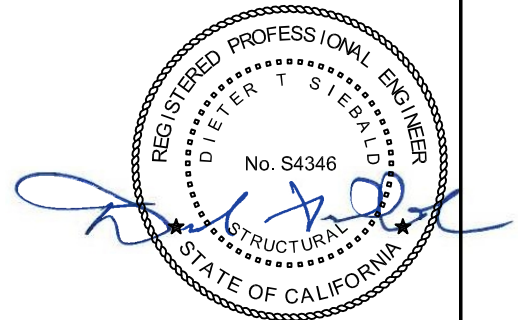
$$C1 \text{ MAX} = \frac{1523\#}{\tan 40^\circ} + \frac{0.3(1523\#)}{\tan 40^\circ} - 579\# = 1781\# \text{ (LRFD W/ } \Omega_o)$$

$$T2 \text{ MAX} = \frac{533\#}{\tan 40^\circ} + \frac{0.3(533\#)}{\tan 40^\circ} + 475\# = \boxed{1301\#}$$

$$C2 \text{ MAX} = \frac{533\#}{\tan 40^\circ} + \frac{0.3(533\#)}{\tan 40^\circ} - 475\# = 351\#$$

$$T2 \text{ MAX} = \frac{1523\#}{\tan 40^\circ} + \frac{0.3(1523\#)}{\tan 40^\circ} + 579\# = 2939\# \text{ (LRFD W/ } \Omega_o)$$

| | ASD | LRFD W/ Ω_o |
|-------|--------|--------------------|
| C1max | ±605# | ±1781# |
| T2max | ±1301# | ±2939# |



SHEET TITLE: PIPE EXAMPLES OF SEISMIC BRACING DESIGN PROCEDURES

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| Page: | 300.4 of . |

SEISMIC BRACING FOR
MEP SYSTEMS



PIPE BRACE SPACING:

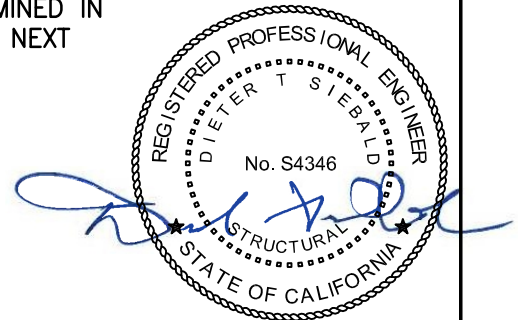
SUMMARY OF TYP DESIGN EXAMPLE (CONTINUED)

C. CAPACITY

1. THE CRDP CHOOSES APPROPRIATE SEISMIC BRACE SUPPORT ELEMENTS PER SECTIONS 2 THRU 17 OF THIS OPM. FOR THIS EXAMPLE THE ERICO CSBQG SERVICE PIPE CONNECTION IS CHOSEN FOR BOTH THE TRANSVERSE & VERT SEISMIC BRACE SHOWN ON PGS 6.2 & 8.2 RESPECTIVELY. THE CSB SERVICE PIPE CONNECTION IS CHOSEN FOR THE LONGITUDINAL SEISMIC BRACE SHOWN ON PG 7.1.
2. THE CRDP CHOOSES APPROPRIATE SEISMIC ATTACHMENT ELEMENTS TO STRUCTURE AS PER SECTIONS 100 THRU 102 OF THIS OPM. (SEE NOTES c & d BELOW).
3. THE CRDP DETERMINES THE GOVERNING CAPACITY OF THE ASSEMBLED SUPPORTS & ATTACHMENT.
 - a1. TRANSVERSE & VERT BRACE – DETERMINE CAPACITY OF SUPPORT ELEMENT FOR SERVICE PIPE PER TESTED VALUES IN SECTION 500. PER PG 500.3, THE CSBQG CAPACITY FOR A 4" DIA, SCHEDULE 10 SERVICE PIPE IS 890 LBS FOR ANY BRACE ANGLE BTW 30 TO 90 DEGREES. THE CAPACITY IS 1730 LBS AT 90 DEGREES IF USED AS A VERT BRACE. THIS IS HIGHER THAN THE DEMAND & THE CSBQG CAN BE USED AS PART OF THE BRACE ASSEMBLY IN THIS EXAMPLE.
 - a2. LONGITUDINAL BRACE – DETERMINE CAPACITY OF SUPPORT ELEMENT FOR SERVICE PIPE PER TESTED VALUES IN SECTION 500. PER PG 500.2, THE CSB CAPACITY FOR A 4" DIA, SCHEDULE 10 SERVICE PIPE IS 1300 LBS FOR ANY BRACE ANGLE BTW 30 TO 90 DEGREES. THIS IS HIGHER THAN THE DEMAND & THE CSB CAN BE USED AS PART OF THE BRACE ASSEMBLY IN THIS EXAMPLE.
 - b. DETERMINE CAPACITY OF BRACE SUPPORT AS PER CALCULATED ALLOWABLE VALUES IN TABLES PROVIDED IN SECTION 400. FOR THIS EXAMPLE, IT IS ASSUMED THE BRACE PIPE IS NO LONGER THAN 6 FEET. PER PG 400.1, A 1 INCH DIA SCH 40 BRACE PIPE HAS AN AXIAL CAPACITY OF 1850 LBS & CAN BE USED AS PART OF THE TRANSVERSE, LONGITUDINAL & VERT BRACE ASSEMBLIES IN THIS EXAMPLE.
 - c. DETERMINE CAPACITY OF ASSUMED CSBU2 SUPPORT BTW BRACE PIPE & SEISMIC ATTACHMENT ELEMENT (SEE PG 101.9). PER PG 600.1 IN SECTION 600, THE CSBU2 HAS A CAPACITY OF 1110 LBS FOR ANY BRACE ANGLE BTW 30 TO 90 DEGREES.
 - d. DETERMINE CAPACITY OF SEISMIC ATTACHMENT TO SUPPORTING STRUCTURE. PER APPENDIX A, LRFD CAPACITIES FOR VARIOUS CONC ANCHORS HAVE BEEN PROVIDED. FOR THIS EXAMPLE, ASSUME A 6" THK CONC SLAB & $f'_c = 3000$ PSI. CHOOSE 0.75"x3.75" EMBED HILTI KB-TZ2. PER PG A3, TENSION CAPACITY IS 3296# & SHEAR CAPACITY IS 6414# PER ANCHOR BOLT.
4. THE CRDP DETERMINES WHETHER THE DEMAND IN SECTION B, STEPS 1 THROUGH 7 IS LESS THAN THE CAPACITY OF THE ASSEMBLY DETERMINED IN SECTION C, STEPS 1a THROUGH 1d. FOR SUMMARY, SEE TABLE ON NEXT PG WHICH SHOWS ALL D/C RATIOS TO BE ACCEPTABLE.

NOTE:

- THE CONC ANCHOR CAPACITIES WERE CALCULATED ACCORDING TO ACI® 318-14. AS PER SUPPLEMENT #1 OF ASCE/SEI® 7-16, THE OVERSTRENGTH FACTOR Ω_o APPLIES TO CONC ANCHORAGE.



SHEET TITLE: PIPE EXAMPLES OF SEISMIC BRACING DESIGN PROCEDURES
STEEL PIPE SCHEDULE 10, 4" DIA



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| Page: | 300.5 of . |

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SEISMIC BRACING FOR
MEP SYSTEMS



PIPE BRACE SPACING:

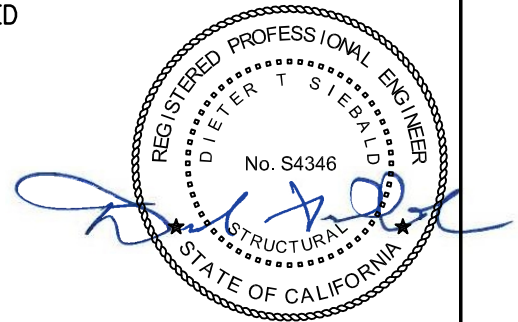
SUMMARY OF TYP DESIGN EXAMPLE (CONTINUED)

C. CAPACITY (CONTINUED):

5. IF THE D/C RATIOS ARE UNACCEPTABLE, SUCH AS THE BELOW D/C RATIO OF 1.17, THE CRDP DETERMINES VIA DIRECT DEMAND VS CAPACITY RATIO THE APPROXIMATE REVISED ALLOWABLE BRACE SPACING. FOR THIS EXAMPLE, (32 FEET)/(1.17) = 27.3 FEET > 10 FT MIN.

| | STEP | COMPONENT | CAPACITY | DEMAND | DEMAND/CAPACITY RATIO | FORCE LEVEL |
|--------------------|--------------|------------------------|----------|--------|-----------------------|--------------------------|
| TRANSVERSE BRACE | a | CSBQG | 890 | 533 | 0.60 | ASD |
| | b | 1" DIA BRACE PIPE | 1850 | 829 | 0.45 | |
| | c | CSBU2 | 1110 | 533 | 0.48 | |
| | d* | ANCHOR-TENSION | 2625 | 1814 | 0.69 | LRFD, W/ OVERSTRENGTH |
| | ANCHOR-SHEAR | 3572 | 1523 | 0.43 | | |
| | | ANCHOR-COMBINED FORCES | - | - | 0.78 | |
| LONGITUDINAL BRACE | a | CSB | 1300 | 533 | 0.41 | ASD |
| | b | 1" DIA BRACE PIPE | 1850 | 829 | 0.45 | |
| | c | CSBU2 | 1110 | 533 | 0.48 | |
| | d* | ANCHOR-TENSION | 2625 | 1814 | 0.69 | LRFD, W/ OVERSTRENGTH |
| | ANCHOR-SHEAR | 3572 | 1523 | 0.43 | | |
| | | ANCHOR-COMBINED FORCES | - | - | 0.78 | |
| VERTICAL BRACE | a | CSBQG | 1730 | 1301 | 0.75 | ASD |
| | b | 1" DIA BRACE PIPE | 1850 | 1301 | 0.70 | |
| | c | CSBU2 | 1110 | 1301 | 1.17 | |
| | d* | ANCHOR-TENSION | 3296 | 2939 | 0.89 | LRFD, W/ OVERSTRENGTH |

* FOR THIS EXAMPLE, IT WAS ASSUMED THAT THERE IS NO PRYING ACTION ON THE ATTACHMENT. IT IS THE RESPONSIBILITY OF THE CDRP TO CHECK FOR PRYING. SEE SECTION B ON PREVIOUS PG FOR DEMAND FORCES. COMBINED ANCHOR RATIO= (TENSION RATIO)^{5/3} + (SHEAR RATIO)^{5/3}.



SHEET TITLE: PIPE EXAMPLES OF SEISMIC BRACING DESIGN PROCEDURES
STEEL PIPE SCHEDULE 10, 4" DIA



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| Page: | 300.6 of . |

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SEISMIC BRACING FOR MEP SYSTEMS



SEISMIC BRACING DESIGN PROCEDURE FOR 4" DIA COPPER PIPE, TYPE K ANNEALED:

A. GENERAL

1. THE CALIFORNIA REGISTERED DESIGN PROFESSIONAL (CRDP) REVIEWS SECTION 1 – OVERVIEW & GENERAL NOTES OF THIS OPM.

B. DEMAND

1. THE CRDP DETERMINES THE LATERAL ACCELERATION & VERT ACCELERATION "G" FOR THE SEISMIC FORCES F_p & F_{pv} USING INFORMATION PROVIDED IN THE PROJECT DOCUMENTS.

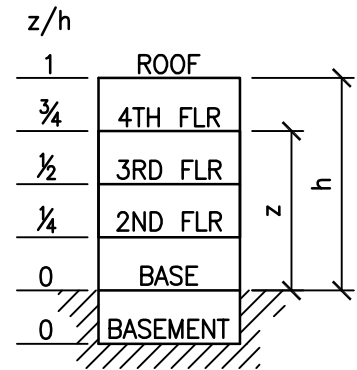
a. IN THE EXAMPLE BLW, THE MAX HORIZ & VERT FORCES ON THE BRACES ARE CALCULATED FOR AN ASSUMED SITE SPECIFIC LOCATION THAT HAS AN S_{DS} VALUE OF 1.75 & A z/h RATIO OF < 1.0.

b. NOTE THAT ONLY TRANSVERSE BRACE DEMAND IS PRESENTED IN THIS DESIGN PROCEDURE. LONGITUDINAL BRACE DEMAND WILL BE SIM & RESULTING VERT SEISMIC FORCES SHALL BE COMBINED ON COMMON VERT BRACE MEMBER.

ASCE /SEI 7-16 AS AMENDED BY CBC 2019

SECTION 13.1.3 $I_p = 1.5$ (SEE CBC 1617A.1.17)
 SECTION 13.3.1 SEISMIC DESIGN FORCES AT LRFD, UNO
 $F_p = 0.4ap S_{DS} W_p (1+2 z/h) = 1.75 W_p$

TABLE 13.6-1 R_p/I_p
 $a_p = 2.5$ (NOT ASME® B31)
 $R_p = 4.5$ (NOT ASME B31)
 $\Omega_o = 2.0$ (FOR ANCHORAGE TO CONC, SEE CBC 1617A.1.23)
 $S_{DS} = 1.75$ (ASSUMED VALUE USED FOR THIS EXAMPLE)
 $z = h$ $z/h \leq 1.0$ (ASSUMED)



SAMPLE BLDG ELEV

FORCES AT LRFD

F_p (MAX) = $1.6 S_{DS} I_p W_p = 4.2 W_p$
 F_p (MIN) = $0.3 S_{DS} I_p W_p = 0.7875 W_p$
 $F_p = 1.75 W_p$
 $\Omega_o F_p = 3.5 W_p$ (FOR LRFD ANCHORAGE TO CONC)

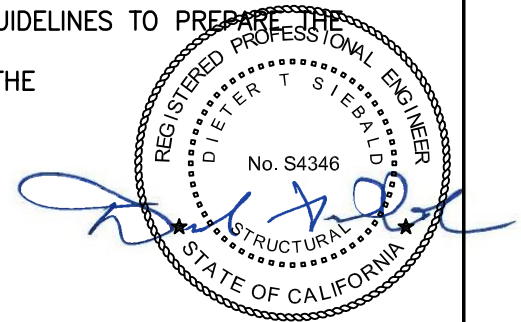
$F_{pv} = 0.20 S_{DS} W_p = 0.35 W_p$

FORCES AT ASD

$F_p = 0.7 F_p = 0.7 (1.75 W_p) = 1.225 W_p$
 $F_{pv} = 0.7 F_{pv} = 0.7 (0.35 W_p) = 0.245 W_p$

2. THE CRDP USES THE SECTION 1 DESIGN PARAMETERS & BRACING GUIDELINES TO PREPARE THE MEP LAYOUT DRAWINGS.

3. THE CRDP DETERMINES THE BRACE LOCATIONS & SHOWS THEM ON THE LAYOUT DRAWINGS.



SHEET TITLE: PIPE EXAMPLES OF SEISMIC BRACING DESIGN PROCEDURES
 COPPER PIPE TYPE K ANNEALED, 4" DIA



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| Page: | 300.10 of . |

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SEISMIC BRACING FOR MEP SYSTEMS



PIPE TRANSVERSE BRACE SPACING:

SUMMARY OF TYP DESIGN EXAMPLE (CONTINUED)

C. CAPACITY

1. THE CRDP DETERMINES THE GOVERNING CAPACITY OF THE ASSEMBLED SUPPORTS & ATTACHMENT.
 - a. DETERMINE CAPACITY OF SUPPORT ELEMENT FOR SERVICE PIPE PER TESTED VALUES IN SECTION 500. PER PG 500.3, THE CSBQG CAPACITY FOR A 4" DIA, TYPE K ANNEALED PIPE IS 1190 LBS FOR ANY BRACE ANGLE BTW 30 TO 90 DEGREES. THE CAPACITY IS 2300 LBS AT 90 DEGREES IF USED AS A VERT BRACE. THIS IS HIGHER THAN THE DEMAND & THE CSBQG CAN BE USED AS PART OF THE BRACE ASSEMBLY IN THIS EXAMPLE.
 - b. DETERMINE CAPACITY OF BRACE SUPPORT AS PER CALCULATED ALLOWABLE VALUES IN TABLES PROVIDED IN SECTION 400. FOR THIS EXAMPLE, IT IS ASSUMED THE BRACE PIPE IS NO LONGER THAN 6 FEET. PER PG 400.1, A 1 INCH DIA SCH 40 BRACE PIPE HAS AN AXIAL CAPACITY OF 1850 LBS & CAN BE USED AS PART OF THE TRANSVERSE & VERT BRACE ASSEMBLIES IN THIS EXAMPLE.
 - c. DETERMINE CAPACITY OF ASSUMED CSBU1 SUPPORT BTW BRACE PIPE & SEISMIC ATTACHMENT ELEMENT. PER PG 600.1 IN SECTION 600, THE CSBU1 HAS A CAPACITY OF 1270 LBS FOR ANY BRACE ANGLE BTW 30 TO 90 DEGREES.
 - d. DETERMINE CAPACITY OF SEISMIC ATTACHMENT TO SUPPORTING STRUCTURE. PER APPENDIX A, LRFD CAPACITIES FOR VARIOUS CONC ANCHORS HAVE BEEN PROVIDED. FOR THIS EXAMPLE, ASSUME A 5¾" THK CONC SLAB & $f'_c = 3000$ PSI. CHOOSE 0.5"x3.25" EMBED POWERS POWER-STUD SD2. PER PG A3, TENSION CAPACITY IS 2336# & SHEAR CAPACITY IS 3130#.

NOTE:

- THE CONC ANCHOR CAPACITIES WERE CALCULATED ACCORDING TO ACI® 318-14. AS PER SUPPLEMENT #1 OF ASCE/SEI® 7-16, THE OVERSTRENGTH FACTOR Ω_o APPLIES TO CONC ANCHORAGE.

2. THE CRDP DETERMINES WHETHER THE DEMAND IN SECTION B, STEPS 1 THROUGH 7 IS LESS THAN THE CAPACITY OF THE ASSEMBLY DETERMINED IN SECTION C, STEPS 1a THROUGH 1d. FOR SUMMARY, SEE TABLE BLW WHICH SHOWS ALL D/C RATIOS TO BE ACCEPTABLE.
3. IF THE D/C RATIOS ARE UNACCEPTABLE, SUCH AS AN ASSUMED D/C RATIO OF 1.08, THE CRDP DETERMINES VIA DIRECT DEMAND VS CAPACITY RATIO THE APPROXIMATE REVISED ALLOWABLE BRACE SPACING. FOR THIS EXAMPLE, (29 FEET)/(1.08) = 26.8 FEET > 10 FEET MIN.

| STEP | COMPONENT | CAPACITY | DEMAND | DEMAND/CAPACITY RATIO | FORCE LEVEL |
|------|------------------------|----------|--------|-----------------------|--------------------------|
| a | CSBQG | 1190 | 444 | 0.37 | ASD |
| b | 1" DIA BRACE PIPE | 1850 | 691 | 0.37 | |
| c | CSBU1 | 1270 | 444 | 0.35 | |
| d* | ANCHOR-TENSION | 2336 | 1510 | 0.64 | LRFD, W/ OVERSTRENGTH |
| | ANCHOR-SHEAR | 3130 | 1267 | 0.40 | |
| | ANCHOR-COMBINED FORCES | - | - | 0.69 | |

* FOR THIS EXAMPLE, IT WAS ASSUMED THAT THERE IS NO PRYING ACTION ON THE ATTACHMENT. IT IS THE RESPONSIBILITY OF THE RDP TO CHECK FOR PRYING. SEE SECTION B ON PREVIOUS PG FOR DEMAND FORCES. COMBINED ANCHOR RATIO= (TENSION RATIO)^{5/3} + (SHEAR RATIO)^{5/3}.



SHEET TITLE: PIPE EXAMPLES OF SEISMIC BRACING DESIGN PROCEDURES
COPPER PIPE TYPE K ANNEALED, 4" DIA



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| Page: | 300.12 of . |

SEISMIC BRACING FOR
MEP SYSTEMS



SEISMIC BRACING DESIGN PROCEDURE FOR 8" DIA CAST IRON PIPE:

A. GENERAL

1. THE CALIFORNIA REGISTERED DESIGN PROFESSIONAL (CRDP) REVIEWS SECTION 1 – OVERVIEW & GENERAL NOTES OF THIS OPM.

B. DEMAND

1. THE CRDP DETERMINES THE LATERAL ACCELERATION & VERT ACCELERATION "G" FOR THE SEISMIC FORCES F_p & F_{pv} USING INFORMATION PROVIDED IN THE PROJECT DOCUMENTS.

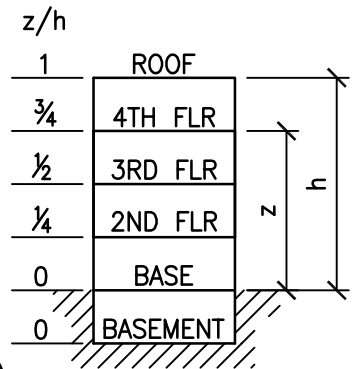
a. IN THE EXAMPLE BLW, THE MAX HORIZ & VERT FORCES ON THE BRACES ARE CALCULATED FOR AN ASSUMED SITE SPECIFIC LOCATION THAT HAS AN S_{DS} VALUE OF 1.15 & A z/h RATIO OF < 1.0.

b. NOTE THAT ONLY TRANSVERSE BRACE DEMAND IS PRESENTED IN THIS DESIGN PROCEDURE. LONGITUDINAL BRACE DEMAND WILL BE SIM & RESULTING VERT SEISMIC FORCES SHALL BE COMBINED ON COMMON VERT BRACE MEMBER.

ASCE /SEI 7-16 AS AMENDED BY CBC 2019

SECTION 13.1.3 $I_p = 1.5$ (SEE CBC 1617A.1.17)
SECTION 13.3.1 SEISMIC DESIGN FORCES AT LRFD, UNO
 $F_p = 0.4 a_p S_{DS} W_p (1+2 z/h) = 0.83 W_p$

TABLE 13.6-1 R_p/I_p
 $a_p = 1.0$ (PLUMBING)
 $R_p = 2.5$ (PLUMBING)
 $\Omega_o = 2.0$ (FOR ANCHORAGE TO CONC, SEE CBC 1617A.1.23)
 $S_{DS} = 1.15$ (ASSUMED VALUE USED FOR THIS EXAMPLE)
 $z = h$ $z/h \leq 1.0$ (ASSUMED)



SAMPLE BLDG ELEV

FORCES AT LRFD

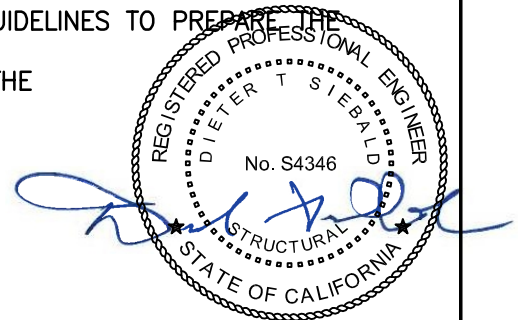
F_p (MAX) = $1.6 S_{DS} I_p W_p = 2.76 W_p$
 F_p (MIN) = $0.3 S_{DS} I_p W_p = 0.52 W_p$
 $F_p = 0.83 W_p$
 $\Omega_o F_p = 1.66 W_p$ (FOR LRFD ANCHORAGE TO CONC)

$F_{pv} = 0.20 S_{DS} W_p = 0.23 W_p$

FORCES AT ASD

$F_p = 0.7 F_p = 0.7 (0.83 W_p) = 0.58 W_p$
 $F_{pv} = 0.7 F_{pv} = 0.7 (0.23 W_p) = 0.161 W_p$

2. THE CRDP USES THE SECTION 1 DESIGN PARAMETERS & BRACING GUIDELINES TO PREPARE THE MEP LAYOUT DRAWINGS.
3. THE CRDP DETERMINES THE BRACE LOCATIONS & SHOWS THEM ON THE LAYOUT DRAWINGS.



SHEET TITLE: PIPE EXAMPLES OF SEISMIC BRACING DESIGN PROCEDURES
CAST IRON PIPE - NO HUB, 8" DIA

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| | Page: | 300.20 of . |

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SEISMIC BRACING FOR MEP SYSTEMS



PIPE TRANSVERSE BRACE SPACING:

SUMMARY OF TYP DESIGN EXAMPLE (CONTINUED)

C. CAPACITY

1. THE CRDP DETERMINES THE GOVERNING CAPACITY OF THE ASSEMBLED SUPPORTS & ATTACHMENT.
 - a. DETERMINE CAPACITY OF SUPPORT ELEMENT FOR CAST IRON PIPE PER TESTED VALUES IN SECTION 500. PER PG 500.3, THE CSBQG (PG 106.21) CAPACITY FOR AN 8" DIA, CAST IRON PIPE IS 590 LBS FOR ANY BRACE ANGLE BTW 30 TO 90 DEGREES. THE CAPACITY IS 1140 LBS AT 90 DEGREES IF USED AS A VERT BRACE. THIS IS HIGHER THAN THE DEMAND & THE CSBQG CAN BE USED AS PART OF THE BRACE ASSEMBLY IN THIS EXAMPLE.
 - b. DETERMINE CAPACITY OF BRACE SUPPORT AS PER CALCULATED ALLOWABLE VALUES IN TABLES PROVIDED IN SECTION 400. FOR THIS EXAMPLE, IT IS ASSUMED THE BRACE PIPE IS NO LONGER THAN 6 FEET. PER PG 400.1, A 1 INCH DIA SCH 40 BRACE PIPE HAS AN AXIAL CAPACITY OF 1850 LBS & CAN BE USED AS PART OF THE TRANSVERSE & VERT BRACE ASSEMBLIES IN THIS EXAMPLE.
 - c. DETERMINE CAPACITY OF ASSUMED CSBU1 SUPPORT BTW BRACE PIPE & SEISMIC ATTACHMENT ELEMENT. PER PG 600.1 IN SECTION 600, THE CSBU1 HAS A CAPACITY OF 1270 LBS FOR ANY BRACE ANGLE BTW 30 TO 90 DEGREES.
 - d. DETERMINE CAPACITY OF SEISMIC ATTACHMENT TO SUPPORTING STRUCTURE. PER APPENDIX A, LRFD CAPACITIES FOR VARIOUS CONC ANCHORS HAVE BEEN PROVIDED. FOR THIS EXAMPLE, ASSUME A 5¾" THK CONC SLAB & $f'_c = 3000$ PSI. CHOOSE 0.5"x3.25" EMBED POWERS POWER-STUD SD2. PER PG A3, TENSION CAPACITY IS 2336# & SHEAR CAPACITY IS 3130#.

NOTE:

- THE CONC ANCHOR CAPACITIES WERE CALCULATED ACCORDING TO ACI® 318-14. AS PER SUPPLEMENT #1 OF ASCE/SEI® 7-16, THE OVERSTRENGTH FACTOR Ω_o APPLIES TO CONC ANCHORAGE.

2. THE CRDP DETERMINES WHETHER THE DEMAND IN SECTION B, STEPS 1 THROUGH 7 IS LESS THAN THE CAPACITY OF THE ASSEMBLY DETERMINED IN SECTION C, STEPS 1a THROUGH 1d. FOR SUMMARY, SEE TABLE BLW WHICH SHOWS ALL D/C RATIOS TO BE ACCEPTABLE.
3. IF THE D/C RATIOS ARE UNACCEPTABLE, SUCH AS AN ASSUMED D/C RATIO OF 1.1 FOR THE CSBQG, THE CRDP DETERMINES VIA DIRECT DEMAND VS CAPACITY RATIO THE APPROXIMATE REVISED ALLOWABLE BRACE SPACING. FOR THIS EXAMPLE, (8 FEET)/(1.1) = 7.38 FEET. THE CRDP PROCEEDS TO CHECK WHETHER THE D/C RATIO FOR THE CSBQG WILL MEET THE REVISED ALLOWABLE BRACE SPACING.

| STEP | COMPONENT | CAPACITY | DEMAND | DEMAND/CAPACITY RATIO | FORCE LEVEL |
|------|------------------------|----------|--------|-----------------------|--------------------------|
| a | CSBQG | 590 | 183 | 0.31 | ASD |
| b | 1" DIA BRACE PIPE | 1850 | 584 | 0.32 | |
| c | CSBU1 | 1270 | 183 | 0.14 | |
| d* | ANCHOR-TENSION | 2336 | 622 | 0.27 | LRFD, W/ OVERSTRENGTH |
| | ANCHOR-SHEAR | 3130 | 522 | 0.17 | |
| | ANCHOR-COMBINED FORCES | - | - | 0.17 | |

* FOR THIS EXAMPLE, IT WAS ASSUMED THAT THERE IS NO PRYING ACTION ON THE ATTACHMENT. IT IS THE RESPONSIBILITY OF THE RDP TO CHECK FOR PRYING. SEE SECTION B ON PREVIOUS PG FOR DEMAND FORCES. COMBINED ANCHOR RATIO = $(\text{TENSION RATIO})^{5/3} + (\text{SHEAR RATIO})^{5/3}$.



SHEET TITLE: PIPE EXAMPLES OF SEISMIC BRACING DESIGN PROCEDURES
CAST IRON PIPE - NO HUB, 8" DIA



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| Page: | 300.22 of . |

SEISMIC BRACING FOR MEP SYSTEMS



SEISMIC BRACING DESIGN PROCEDURE FOR 4" DIA RIGID METAL CONDUIT (RMC):

A. GENERAL

1. THE CALIFORNIA REGISTERED DESIGN PROFESSIONAL (CRDP) REVIEWS SECTION 1 – OVERVIEW & GENERAL NOTES OF THIS OPM.

B. DEMAND

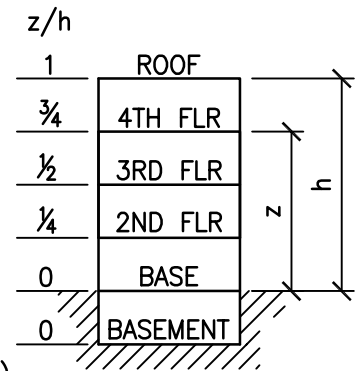
1. THE CRDP DETERMINES THE LATERAL ACCELERATION & VERT ACCELERATION "G" FOR THE SEISMIC FORCES F_p & F_{pv} USING INFORMATION PROVIDED IN THE PROJECT DOCUMENTS.

- a. IN THE EXAMPLE BLW, THE MAX HORIZ & VERT FORCES ON THE BRACES ARE CALCULATED FOR AN ASSUMED SPECIFIC LOCATION THAT HAS AN S_{DS} VALUE OF 1.75 & A z/h RATIO OF ≤ 1.0 .
- b. NOTE THAT ONLY TRANSVERSE BRACE DEMAND IS PRESENTED IN THIS DESIGN PROCEDURE. LONGITUDINAL BRACE DEMAND WILL BE SIM & RESULTING VERT SEISMIC FORCES SHALL BE COMBINED ON COMMON VERT BRACE MEMBER.

ASCE /SEI 7-16 AS AMENDED BY CBC 2019

SECTION 13.1.3 $I_p = 1.5$ (SEE CBC 1617A.1.17)
 SECTION 13.3.1 SEISMIC DESIGN FORCES AT LRFD, UNO
 $F_p = 0.4 a_p S_{DS} W_p (1+2 z/h) = 1.31 W_p$

TABLE 13.6-1 R_p/I_p
 $a_p = 2.5$ (ELECTRICAL CONDUIT)
 $R_p = 6.0$ (ELECTRICAL CONDUIT)
 $\Omega_o = 2.0$ (FOR ANCHORAGE TO CONC, SEE CBC 1617A.1.23)
 $S_{DS} = 1.75$ (ASSUMED VALUE USED FOR THIS EXAMPLE)
 $z = h$ $z/h \leq 1.0$ (ASSUMED)



SAMPLE BLDG ELEV

FORCES AT LRFD

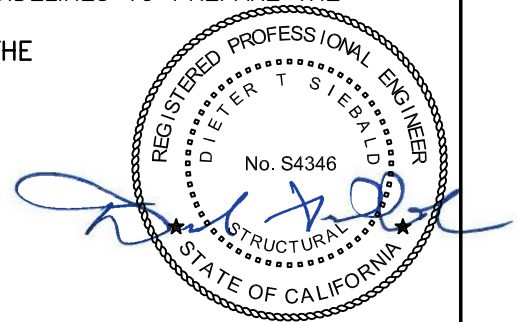
F_p (MAX) = $1.6 S_{DS} I_p W_p = 4.2 W_p$
 F_p (MIN) = $0.3 S_{DS} I_p W_p = 0.7875 W_p$
 $F_p = 1.31 W_p$
 $\Omega_o F_p = 2.62 W_p$ (FOR LRFD ANCHORAGE TO CONC)

$F_{pv} = 0.20 S_{DS} W_p = 0.35 W_p$

FORCES AT ASD

$F_p = 0.7 F_p = 0.7 (1.31 W_p) = 0.917 W_p$
 $F_{pv} = 0.7 F_{pv} = 0.7 (0.35 W_p) = 0.245 W_p$

2. THE CRDP USES THE SECTION 1 DESIGN PARAMETERS & BRACING GUIDELINES TO PREPARE THE MEP LAYOUT DRAWINGS.
3. THE CRDP DETERMINES THE BRACE LOCATIONS & SHOWS THEM ON THE LAYOUT DRAWINGS.



SHEET TITLE: CONDUIT EXAMPLE OF SEISMIC BRACING DESIGN PROCEDURES
RIGID METAL CONDUIT (RMC)



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| Date: | 09/08/2021 |
| Page: | 301.1 of . |

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SEISMIC BRACING FOR MEP SYSTEMS



TRANSVERSE BRACE SPACING:

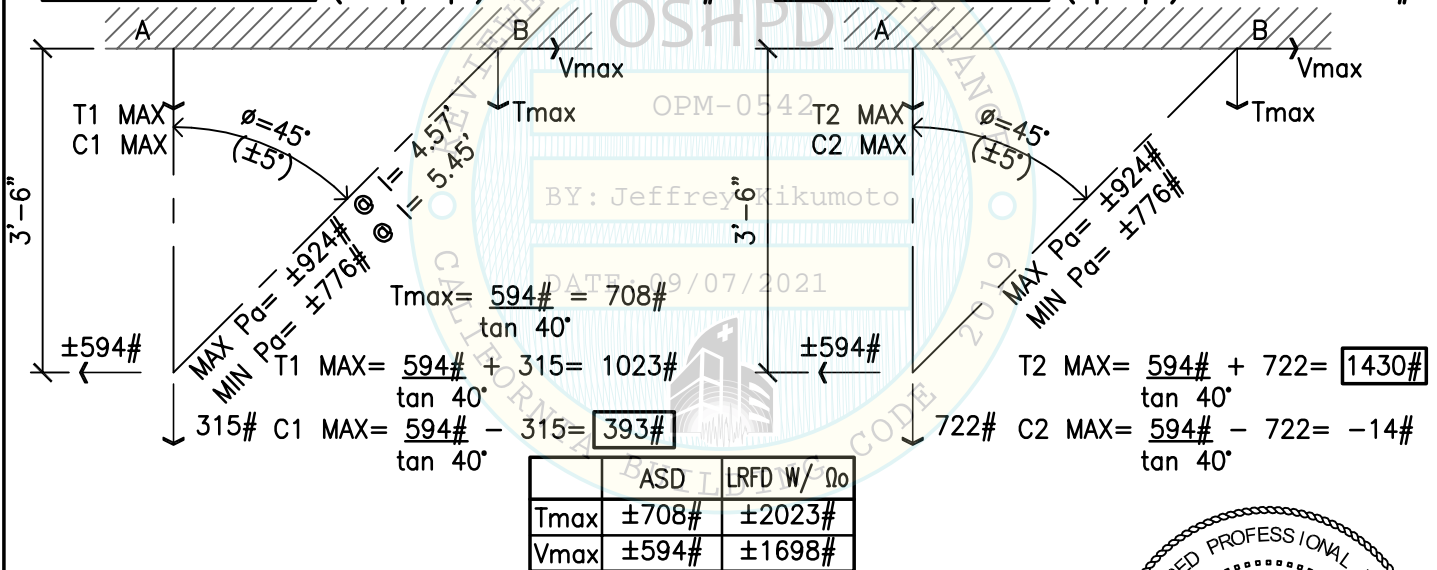
SUMMARY OF TYP DESIGN EXAMPLE (CONTINUED)

B. DEMAND (CONTINUED):

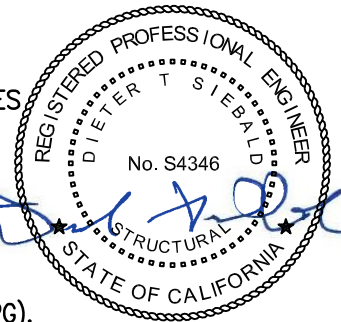
4. THE CRDP COMPARES THE BRACE LOCATIONS TO THE ALLOWABLE TRANSVERSE BRACE SPACING SHOWN IN PERMISSIBLE BRACE SPACING TABLES IN SECTION 201 FOR ELECTRICAL CONDUIT. THE RIGID METAL CONDUIT TABLE IS ON PG 201.1. LATERAL TRANSVERSE BRACE SPACING OF 30 FEET FOR THE 4" DIA RIGID METAL CONDUIT IS ALLOWED WHEN THE HORIZ FORCE, "Fp", IS LESS THAN 1.00 Wp AT ASD LEVEL OF DESIGN. THE CRDP MAY INTERPOLATE VALUES.
5. THE CRDP MAKES ADJUSTMENTS TO THE LATERAL TRANSVERSE BRACE SPACING ON THE LAYOUT DRAWINGS IF SO REQ.
6. THE CRDP DETERMINES THE OPERATING WT. IN THIS EXAMPLE $W_p = 648$ LBS. (21.6 PLF x 30 FT)
7. THE CRDP CALCULATES THE LATERAL FORCE F_p & VERT FORCE F_{pv} ON THE SEISMIC BRACE USING THE W_p PROVIDED BY THE RDP. NOTE THAT IN THE EXAMPLE, IT IS CONSERVATIVELY ASSUMED THAT THE VERT GRAVITY LOAD IS BASED ON THE MAX ALLOWABLE VERT HANGER SPACING OF 14 FT FOR THE CONDUIT LINE PROVIDED IN THE TABLE ON PG 201.1. THIS EXAMPLE IS AT ASD LEVEL OF DESIGN, EXCEPT FOR CONC ATTACHMENT WHICH IS AT LRFD W/ Ω_o .

$$\begin{aligned}
 W_p &= 648 \text{ LBS} & \text{LRFD:} \\
 F_p &= \pm 0.917 (648 \text{ LBS}) = \pm 594 \text{ LBS} & \Omega_o F_p W_p = \pm 2.0 \times 1.31 (648 \text{ LBS}) = \pm 1698 \text{ LBS} \\
 F_{pv} &= \pm 0.245 (21.6 \text{ PLF} \times 14 \text{ FT}) = \pm 74 \text{ LBS}
 \end{aligned}$$

LOAD COMBINATION 1. $(0.6W_p - F_{pv}) = 389 - 74 = 315\#$ LOAD COMBINATION 2. $(W_p + F_{pv}) = 648 + 74 = 722\#$



8. THE CRDP VERIFIES THAT THERE IS A VERT SEISMIC BRACE WITHIN SIX INCHES OF EA TRANSVERSE & LONGITUDINAL BRACE.
9. THE CRDP CHOOSES APPROPRIATE SEISMIC BRACE SUPPORT ELEMENTS PER SECTIONS 2 THRU 17 OF THIS OPM. FOR THIS EXAMPLE THE ERICO CSBQG SERVICE PIPE CONNECTION IS CHOSEN FOR BOTH THE TRANSVERSE & VERT SEISMIC BRACE SHOWN ON PGS 6.2 & 8.2 RESPECTIVELY.
10. THE CRDP CHOOSES APPROPRIATE SEISMIC ATTACHMENT ELEMENTS TO STRUCTURE AS PER SECTIONS 100 THRU 105 OF THIS OPM. (SEE SECTION C, NOTES c & d, NEXT PG).



**SHEET TITLE: CONDUIT EXAMPLE OF SEISMIC BRACING DESIGN PROCEDURES
RIGID METAL CONDUIT (RMC)**

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SEISMIC BRACING FOR
MEP SYSTEMS



TRANSVERSE BRACE SPACING:

SUMMARY OF TYP DESIGN EXAMPLE (CONTINUED)

C. CAPACITY

1. THE CRDP DETERMINES THE GOVERNING CAPACITY OF THE ASSEMBLED SUPPORTS & ATTACHMENT.
 - a. DETERMINE CAPACITY OF SUPPORT ELEMENT FOR SERVICE PIPE PER TESTED VALUES IN SECTION 500. PER PG 500.3, THE CSBQG CAPACITY FOR A 4" DIA PIPE/RMC IS 1190 LBS FOR ANY BRACE ANGLE BTW 30 TO 90 DEGREES. THE CAPACITY IS 2300 LBS AT 90 DEGREES IF USED AS A VERT BRACE. THIS IS HIGHER THAN THE DEMAND & THE CSBQG CAN BE USED AS PART OF THE BRACE ASSEMBLY IN THIS EXAMPLE.
 - b. DETERMINE CAPACITY OF BRACE SUPPORT AS PER CALCULATED ALLOWABLE VALUES IN TABLES PROVIDED IN SECTION 400. FOR THIS EXAMPLE, IT IS ASSUMED THE BRACE PIPE IS NO LONGER THAN 6 FEET. PER PG 400.1, A 1 INCH DIA SCH 40 BRACE PIPE HAS AN AXIAL CAPACITY OF 1850 LBS & CAN BE USED AS PART OF THE TRANSVERSE & VERT BRACE ASSEMBLIES IN THIS EXAMPLE.
 - c. DETERMINE CAPACITY OF ASSUMED CSBU1 SUPPORT BTW BRACE PIPE & SEISMIC ATTACHMENT ELEMENT. PER PG 600.1 IN SECTION 600, THE CSBU1 HAS A CAPACITY OF 1690 LBS FOR ANY BRACE ANGLE BTW 30 TO 90 DEGREES.
 - d. DETERMINE CAPACITY OF VERT BRACE ATTACHMENT TO STRUCTURE. USE CSBU1 PER PG 101.9. THE CAPACITY IS 1690 LBS WHICH IS HIGHER THAN THE DEMAND. THE CSBU1 CAN BE USED AS PART OF THE BRACE ASSEMBLY IN THIS EXAMPLE.
 - e. DETERMINE CAPACITY OF SEISMIC ATTACHMENT TO SUPPORTING STRUCTURE. PER APPENDIX A, LRFD CAPACITIES FOR VARIOUS CONC ANCHORS HAVE BEEN PROVIDED. FOR THIS EXAMPLE, ASSUME A 5¾" THICK CONC SLAB & f'c= 3000 PSI. CHOOSE 0.50"x3.25" EMBED POWERS POWER-STUD SD2. PER PG A3, TENSION CAPACITY IS 2336# & SHEAR CAPACITY IS 3130#.

NOTE:

- THE CONC ANCHOR CAPACITIES WERE CALCULATED ACCORDING TO ACI® 318-14. AS PER SUPPLEMENT #1 OF ASCE/SEI® 7-16, THE OVERSTRENGTH FACTOR Ω_o APPLIES TO CONC ANCHORAGE.

2. THE CRDP DETERMINES WHETHER THE DEMAND IN SECTION B, STEPS 1 THROUGH 7 IS LESS THAN THE CAPACITY OF THE ASSEMBLY DETERMINED IN SECTION C, STEPS 1a THROUGH 1d. FOR SUMMARY, SEE TABLE BLW WHICH SHOWS ALL D/C RATIOS TO BE ACCEPTABLE.
3. IF THE D/C RATIOS ARE UNACCEPTABLE, SUCH AS AN ASSUMED D/C RATIO OF 1.15, THE CRDP DETERMINES VIA DIRECT DEMAND VS CAPACITY RATIO THE APPROXIMATE REVISED ALLOWABLE BRACE SPACING. FOR THIS EXAMPLE, (30 FEET)/(1.15) = 26.1 FEET > 10 FEET MIN.

| STEP | COMPONENT | CAPACITY | DEMAND | DEMAND/CAPACITY RATIO | FORCE LEVEL |
|------|------------------------|----------|--------|-----------------------|--------------------------|
| a | CSBQG | 1190 | 594 | 0.50 | ASD |
| b | 1" DIA BRACE PIPE | 1850 | 924 | 0.50 | |
| c | CSBU1 | 1690 | 594 | 0.35 | |
| d* | ANCHOR-TENSION | 2336 | 2023 | 0.87 | LRFD, W/ OVERSTRENGTH |
| | ANCHOR-SHEAR | 3130 | 1698 | 0.54 | |
| | ANCHOR-COMBINED FORCES | - | - | 1.15 | |

* FOR THIS EXAMPLE, IT WAS ASSUMED THAT THERE IS NO PRYING ACTION ON THE ATTACHMENT. IT IS THE RESPONSIBILITY OF THE RDP TO CHECK FOR PRYING. SEE SECTION B ON PREVIOUS PG FOR DEMAND FORCES. COMBINED ANCHOR RATIO= (TENSION RATIO)^{5/3} + (SHEAR RATIO)^{5/3}.



SHEET TITLE: CONDUIT EXAMPLE OF SEISMIC BRACING DESIGN PROCEDURES
RIGID METAL CONDUIT (RMC)

| | | |
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SEISMIC BRACING FOR
MEP SYSTEMS



SEISMIC BRACING DESIGN PROCEDURE FOR CABLE TRAYS & DUCTS:

SINGLE HORIZONTAL TRAPEZE STRUT W/ VERTICAL & TRANSVERSE SEISMIC BRACES

A. GENERAL

1. THE CALIFORNIA REGISTERED DESIGN PROFESSIONAL (CRDP) REVIEWS SECTION 1 – OVERVIEW & GENERAL NOTES OF THIS OPM.
2. DESIGN EXAMPLE IS FOR A CABLE TRAY SUPPORTED BY A TRAPEZE. THE PROCEDURE FOR DUCTS SUPPORTED BY TRAPEZES IS SIMILAR. FOR ATTACHMENT OF A DUCT OR CABLE TRAY TO THE TRAPEZE, SEE SECTION 13 OR 16. FOR CLIP CAPACITY, SEE SECTION 500.

B. DEMAND

1. THE CRDP DETERMINES THE LATERAL ACCELERATION & VERT ACCELERATION "G" FOR THE SEISMIC FORCES F_p & F_{pv} USING INFORMATION PROVIDED IN THE PROJECT DOCUMENTS.
 - a. TRANSVERSE, LONGITUDINAL & VERTICAL SEISMIC BRACE DEMANDS ARE PRESENTED IN SECTION B OF THIS DESIGN PROCEDURE. FOR BRACE CAPACITIES & D/C RATIOS SEE SECTION C.
 - b. IN THE EXAMPLE BLW, THE MAX HORIZ & VERT FORCES ON THE BRACES ARE CALCULATED FOR AN ASSUMED SPECIFIC LOCATION THAT HAS AN S_{DS} VALUE OF 1.75 & A z/h RATIO OF ≤ 1.0 .

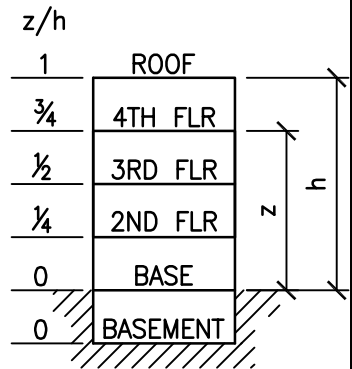
ASCE /SEI 7-16 AS AMENDED BY CBC 2019

SECTION 13.1.3 $l_p = 1.5$ (SEE CBC 1617A.1.17)
 SECTION 13.3.1 SEISMIC DESIGN FORCES AT LRFD, UNO
 $F_p = 0.4 a_p S_{DS} W_p (1+2 z/h) = 1.31 W_p$

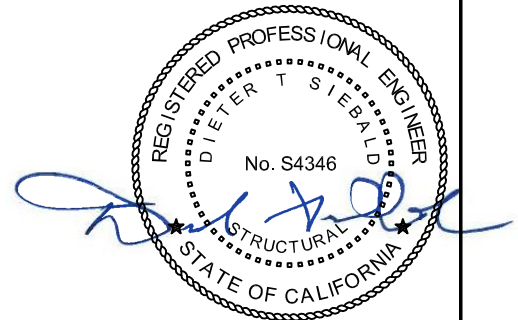
TABLE 13.6-1
 R_p/l_p
 $a_p = 2.5$ (CABLE TRAYS)
 $R_p = 6.0$ (CABLE TRAYS)
 $\Omega_o = 2.0$ (FOR ANCHORAGE TO CONC, BY SEE CBC 1617A.1.23)
 $S_{DS} = 1.75$ (ASSUMED VALUE USED FOR THIS EXAMPLE)
 $z = h$ $z/h \leq 1.0$ (ASSUMED)

FORCES AT LRFD
 F_p (MAX) = $1.6 S_{DS} l_p W_p = 4.2 W_p$
 F_p (MIN) = $0.3 S_{DS} l_p W_p = 0.7875 W_p$
 $F_p = 1.31 W_p$
 $\Omega_o F_p = 2.62 W_p$ (FOR LRFD ANCHORAGE TO CONC)
 $F_{pv} = 0.20 S_{DS} W_p = 0.35 W_p$

FORCES AT ASD
 $F_p = 0.7 F_p = 0.7 (1.31 W_p) = 0.917 W_p$
 $F_{pv} = 0.7 F_{pv} = 0.7 (0.35 W_p) = 0.245 W_p$



SAMPLE BLDG ELEV



SHEET TITLE: CABLE TRAY & DUCT EXAMPLE OF SEISMIC BRACING DESIGN PROCEDURES
CABLE TRAY



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Page: 302.1 of .

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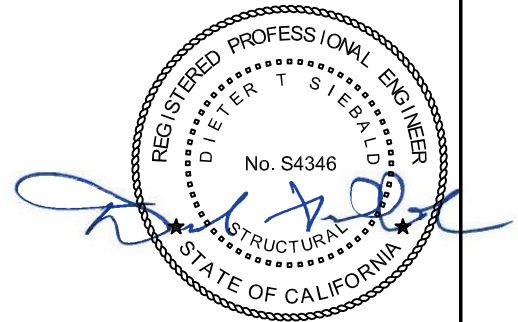
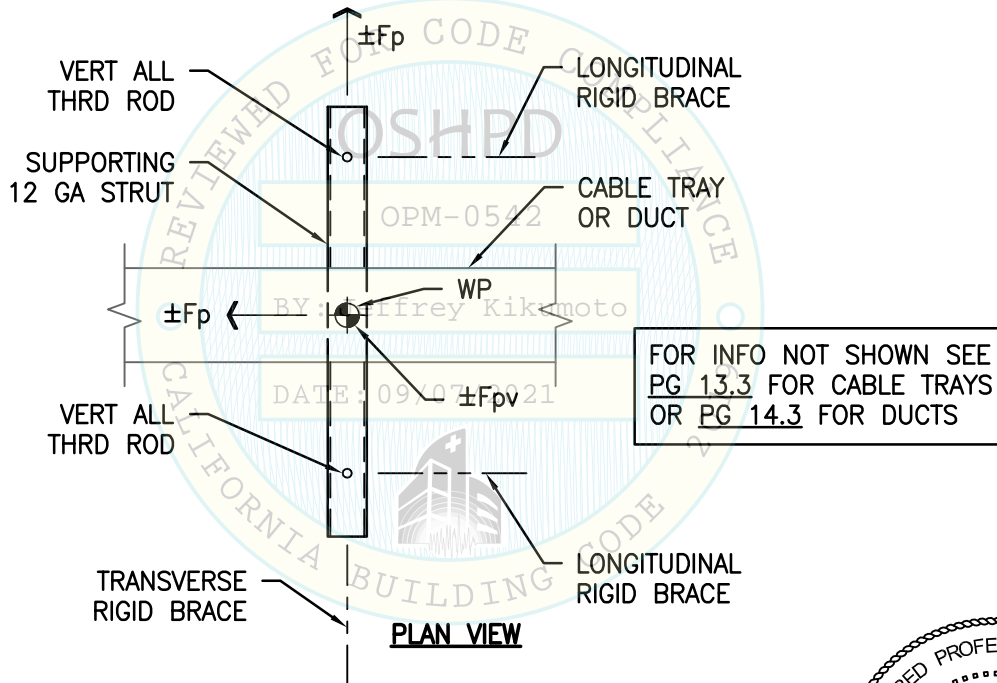
SEISMIC BRACING FOR MEP SYSTEMS



SEISMIC BRACING DESIGN PROCEDURE FOR CABLE TRAYS & DUCTS:

B. DEMAND (CONTINUED):

2. THE CRDP USES THE SECTION 1 DESIGN PARAMETERS & BRACING GUIDELINES TO PREPARE THE MEP LAYOUT DRAWINGS.
3. THE CRDP DETERMINES THE BRACED TRAPEZE LOCATIONS & SHOWS THEM ON THE LAYOUT DRAWINGS.
4. THE CRDP DETERMINES THE TRIBUTARY MAIN LINE WT (W_p) FOR EA SEISMIC BRACED TRAPEZE. FOR THIS EXAMPLE, SEE PLAN VIEW BELOW. ASSUME THAT $W_p = 360$ LBS (18 PLF x 20 FT) FOR A 4" DEEP x 12" WIDE CABLE TRAY AS SHOWN ON PG 202.1.
5. THE CRDP COMPARES THE CALCULATED 360 LBS WT TO THE ALLOWABLE WT TABLES FOR TRAPEZES IN SECTION 401. FOR THIS EXAMPLE, WHICH USES A HORIZ FORCE (F_p), EQ TO OR LESS THAN $0.917 W_p$ AT ASD LEVEL OF DESIGN, THE USE OF A 24" LONG P1000 IS PERMITTED FOR THE TRAPEZE SINCE PER PG 401.1 FOR A 24" LONG SINGLE STRUT & $F_p < 1.225 W_p$ THE 360 LBS DEMAND IS LESS THAN THE 375 LBS ALLOWABLE CAPACITY. THE CALCULATED WEIGHT IS BASED ON THE CABLE TRAY WT (IN PLF) PER PG 202.1 x AN ASSUMED TRANSVERSE & LONGITUDINAL BRACE SPACING OF 20 FT. IT IS ASSUMED THAT THE CABLE TRAY IS CTRD ON THE SUPPORTING STRUT. FOR DUCTS (NOT USED IN THIS EXAMPLE), SEE PGS 202.2 & 202.3 FOR WT.



SHEET TITLE: CABLE TRAY & DUCT EXAMPLE OF SEISMIC BRACING DESIGN PROCEDURES
CABLE TRAY



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| Date: | 09/08/2021 |
| Page: | 302.2 of . |

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SEISMIC BRACING FOR MEP SYSTEMS



BRACE SPACING:

SEISMIC BRACING PROCEDURE (CONTINUED)

B. DEMAND (CONTINUED):

6. THE CRDP MAKES ADJUSTMENTS TO THE LATERAL TRANSVERSE BRACE & TRAPEZE SPACING ON THE LAYOUT DRAWINGS & RECALCULATES WT IF SO REQ.
7. THE CRDP DETERMINES THE OPERATING WT IN THIS EXAMPLE $W_p = 360$ LBS & IS ASSUMED EQUALLY DISTRIBUTED TO VERT SUPPORT RODS. IF ECCENTRIC LOAD DISTRIBUTION OCCURS, APPLY 2/3 & 1/3 DISTRIBUTION TO RODS.
- 8a. THE CRDP CALCULATES THE LATERAL FORCE F_p & VERT FORCE F_{pv} ON THE SEISMIC BRACE & TRAPEZE USING THE W_p PROVIDED BY THE RDP. NOTE THAT IN THE EXAMPLE, IT IS CONSERVATIVELY ASSUMED THAT THE VERT GRAVITY LOAD $W_p = 360$ LBS EVEN THOUGH THE MAX ALLOWABLE VERT HANGER SPACING IS ONLY 10 FT. THIS EXAMPLE IS AT ASD LEVEL OF DESIGN, EXCEPT FOR CONC ATTACHMENT WHICH IS AT LRFD W/Ω_o .

$$W_p = 360 \text{ LBS}$$

$$F_p = \pm 0.917 (360 \text{ LBS}) = \pm 330 \text{ LBS}$$

$$F_{pv} = \pm 0.245 (360 \text{ LBS}) = \pm 88 \text{ LBS}$$

LRFD:

$$\Omega_o F_p = \pm 2 \times 1.31 (360 \text{ LBS}) = \pm 943 \text{ LBS}$$

$$F_{pv} = \pm 0.35 (360 \text{ LBS}) = \pm 126 \text{ LBS}$$

NOTE: CONSERVATIVELY USED $W_p = 360\#$ FOR EASE OF CALC.

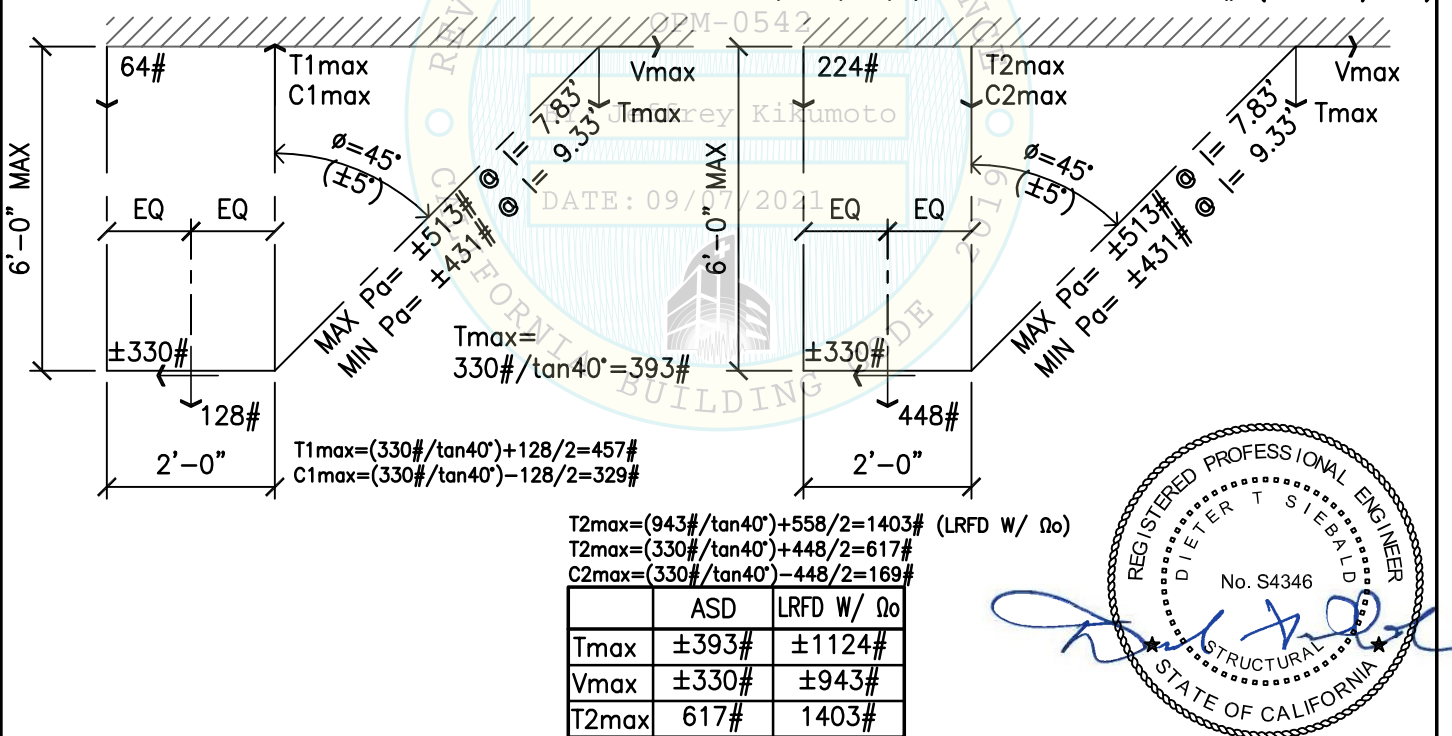
ACTUAL IS 18plf x 10 FT = 180#

8b. TRANSVERSE BRACING

LOAD COMBINATION 1. $(0.6W_p - F_{pv}) = 216 - 88 = 128\#$

LOAD COMBINATION 2. $(W_p + F_{pv}) = 360 + 88 = 448\#$

2a. $(1.2W_p + F_{pv}) = 1.2 \times 360 + 126 = 558\#$ (LRFD W/Ω_o)



SHEET TITLE: CABLE TRAY & DUCT EXAMPLE OF SEISMIC BRACING DESIGN PROCEDURES
CABLE TRAY

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SEISMIC BRACING FOR MEP SYSTEMS



BRACE SPACING:

SEISMIC BRACING PROCEDURE (CONTINUED)

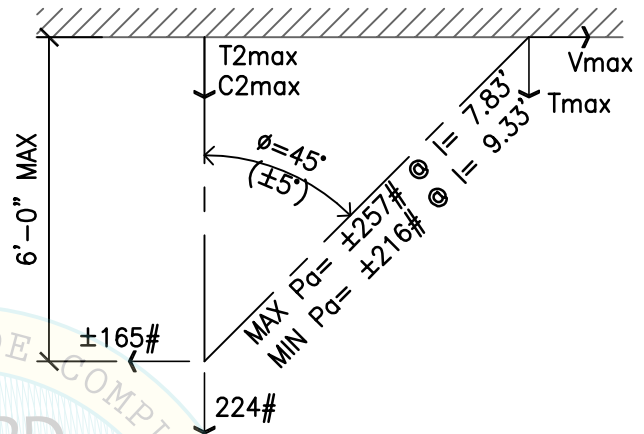
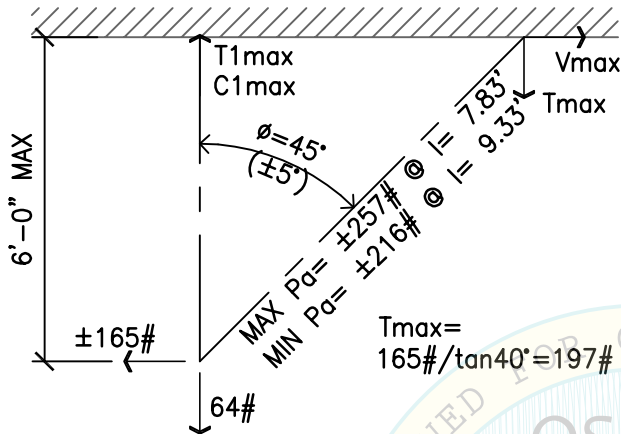
B. DEMAND (CONTINUED):

8c. LONGITUDINAL BRACING (ASSUME SAME SPACING AS TRANSVERSE BRACING)

LOAD COMBINATION 1. $(0.6W_p - F_{pv}) = 108 - 44 = 64\#$

LOAD COMBINATION 2. $(W_p + F_{pv}) = 180 + 44 = 224\#$

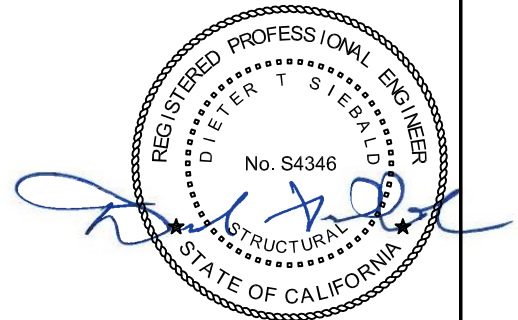
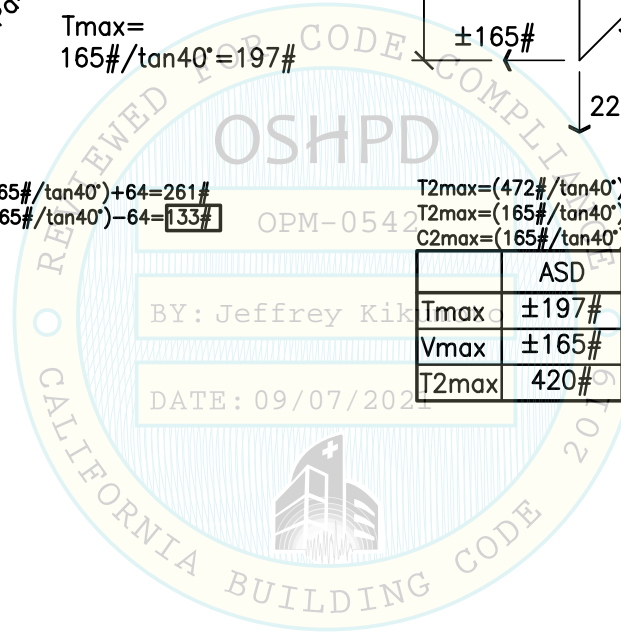
2a. $(1.2W_p + F_{pv}) = 1.2 \times 180 + 63 = 279\#$ (LRFD W/ Ω_0)



$T1_{max} = (165\# / \tan 40^\circ) + 64 = 261\#$
 $C1_{max} = (165\# / \tan 40^\circ) - 64 = 133\#$

$T2_{max} = (472\# / \tan 40^\circ) + 279 = 842\#$ (LRFD W/ Ω_0)
 $T2_{max} = (165\# / \tan 40^\circ) + 224 = 420\#$
 $C2_{max} = (165\# / \tan 40^\circ) - 224 < 0$ (NO COMPRESSION)

| | ASD | LRFD W/ Ω_0 |
|-------|-------|--------------------|
| Tmax | ±197# | ±562# |
| Vmax | ±165# | ±472# |
| T2max | 420# | 842# |



SHEET TITLE: CABLE TRAY & DUCT EXAMPLE OF SEISMIC BRACING DESIGN PROCEDURES
CABLE TRAY

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SEISMIC BRACING FOR MEP SYSTEMS



BRACE SPACING:

SEISMIC BRACING PROCEDURE (CONTINUED)

B. DEMAND (CONTINUED):

7d. VERTICAL BRACING

THE COMBINED REACTIONS DUE TO THE SEISMIC FORCES IN THE TRANSVERSE & LONGITUDINAL DIRECTIONS IS SUMMARIZED IN THE TABLE BELOW. THE GOVERNING REACTION SHOWN IS THE MAXIMUM OF THE TWO SCENARIOS WHERE THE SEISMIC LOAD IS:

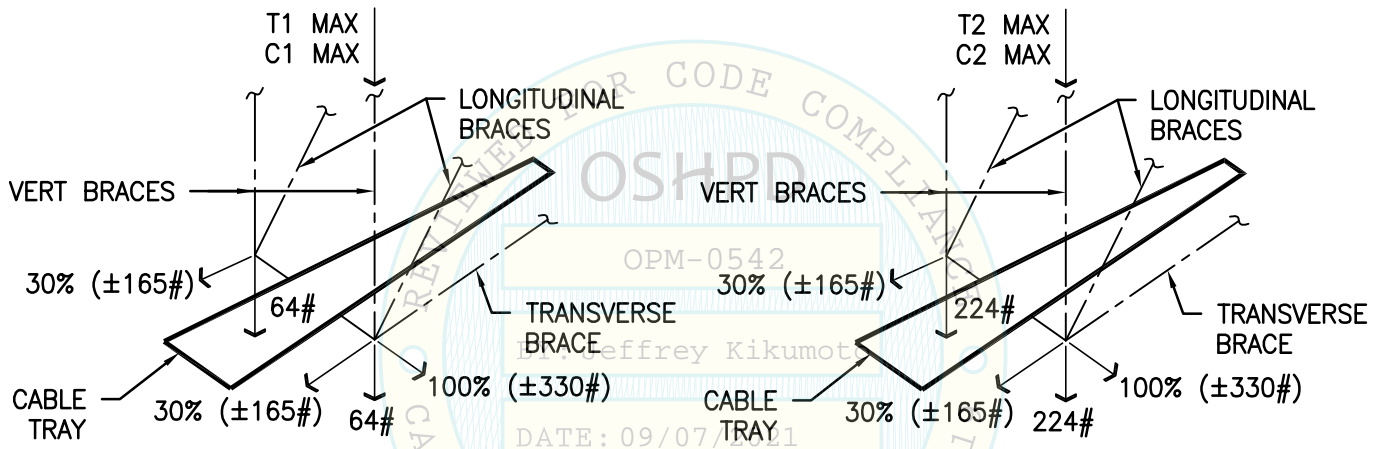
1. 100% IN THE TRANSVERSE DIRECTION AND 30% IN THE LONGITUDINAL DIRECTION OR
2. 30% IN THE TRANSVERSE DIRECTION AND 100% IN THE LONGITUDINAL DIRECTION

NOTE:

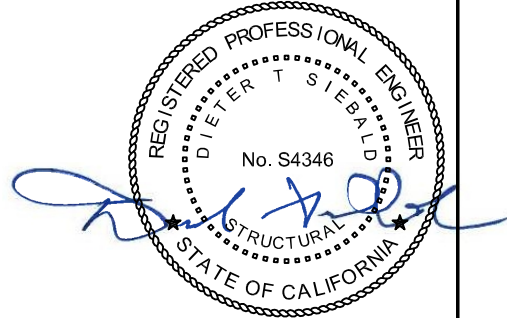
1. FOR LENGTH & ANGLE INFO NOT SHOWN, REFER TO SECTIONS 7b & 7c.

LOAD COMBINATION 1. $(0.6W_p - F_{pv}) = 216 - 88 = 128\#$ **LOAD COMBINATION 2.** $(W_p + F_{pv}) = 360 + 88 = 448\#$
2a. $(1.2W_p + F_{pv}) = 1.2 \times 360 + 126 = 558\#$ (LRFD W/ Ω_o)

SCENARIO 1



| | |
|---|--|
| $T1 \text{ MAX} = \frac{330\#}{\tan 40^\circ} + \frac{0.3(165\#)}{\tan 40^\circ} + 64\# = 516\#$ $C1 \text{ MAX} = \frac{330\#}{\tan 40^\circ} + \frac{0.3(165\#)}{\tan 40^\circ} - 64\# = \boxed{388\#}$ | $T2 \text{ MAX} = \frac{330\#}{\tan 40^\circ} + \frac{0.3(165\#)}{\tan 40^\circ} + 224\# = \boxed{676\#}$ $C2 \text{ MAX} = \frac{330\#}{\tan 40^\circ} + \frac{0.3(165\#)}{\tan 40^\circ} - 224\# = 228\#$ $T2 \text{ MAX} = \frac{943\#}{\tan 40^\circ} + \frac{0.3(943/2)}{\tan 40^\circ} + 279\# = 1571\# \text{ (LRFD W/ } \Omega_o)$ |
|---|--|



SHEET TITLE: CABLE TRAY & DUCT EXAMPLE OF SEISMIC BRACING DESIGN PROCEDURES
CABLE TRAY

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SEISMIC BRACING FOR MEP SYSTEMS

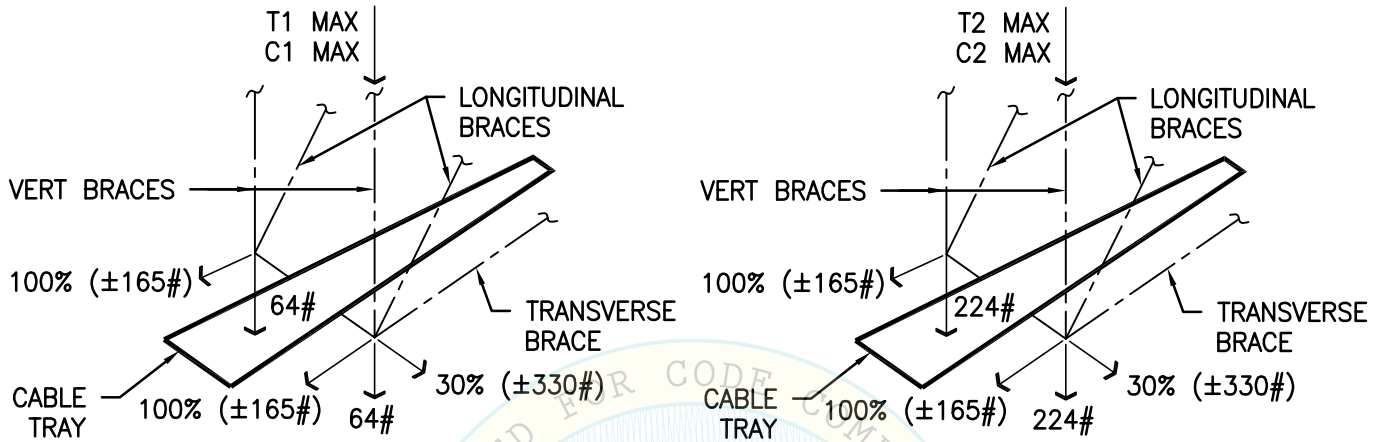


BRACE SPACING:

SEISMIC BRACING PROCEDURE (CONTINUED)

B. DEMAND (CONTINUED):

SCENARIO 2



$$T1 \text{ MAX} = \frac{165\#}{\tan 40^\circ} + \frac{0.3(330\#)}{\tan 40^\circ} + 64\# = 379\#$$

$$C1 \text{ MAX} = \frac{165\#}{\tan 40^\circ} + \frac{0.3(330\#)}{\tan 40^\circ} - 64\# = 251\#$$

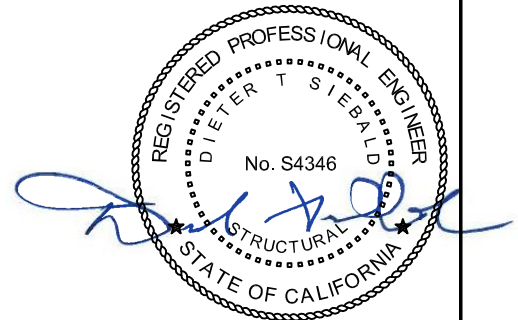
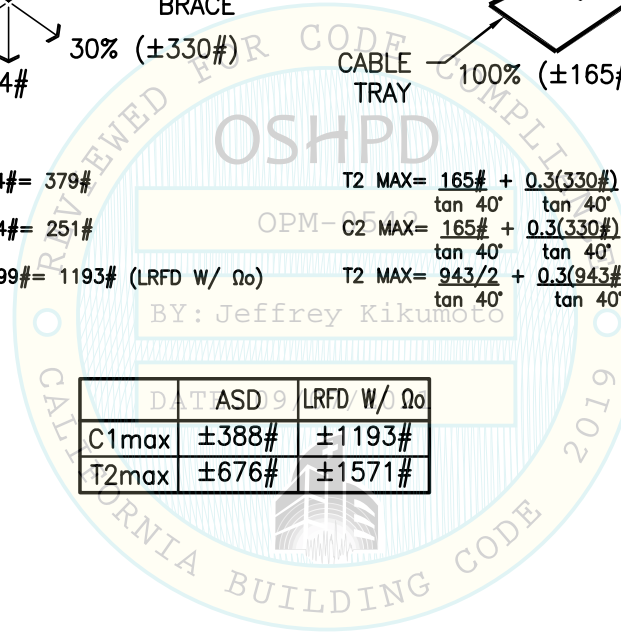
$$C1 \text{ MAX} = \frac{943/2}{\tan 40^\circ} + \frac{0.3(943\#)}{\tan 40^\circ} - 99\# = 1193\# \text{ (LRFD W/ } \Omega_0)$$

$$T2 \text{ MAX} = \frac{165\#}{\tan 40^\circ} + \frac{0.3(330\#)}{\tan 40^\circ} + 224\# = 539\#$$

$$C2 \text{ MAX} = \frac{165\#}{\tan 40^\circ} + \frac{0.3(330\#)}{\tan 40^\circ} - 224\# = 91\#$$

$$T2 \text{ MAX} = \frac{943/2}{\tan 40^\circ} + \frac{0.3(943\#)}{\tan 40^\circ} + 279\# = 1178\# \text{ (LRFD W/ } \Omega_0)$$

| | ASD 9 | LRFD W/ Ω_0 |
|-------|-------|--------------------|
| C1max | ±388# | ±1193# |
| T2max | ±676# | ±1571# |



**SHEET TITLE: CABLE TRAY & DUCT EXAMPLE OF SEISMIC BRACING DESIGN PROCEDURES
CABLE TRAY**

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|--|---------------------------------------|------------------|
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| | 2495 NATOMAS PARK DRIVE, SUITE 650 | Date: 09/08/2021 |
| | SACRAMENTO, CA 95833 | Page: 302.6 of . |

L:\Jobs\19039 ERICO - MEP OPM\ACAD\STRU\S2_Erico MEP.dwg Time: Sep 08, 2021 - 10:36am Login: camachom DimScale: 8 LTScale: 4

SEISMIC BRACING FOR
MEP SYSTEMS



BRACE SPACING:

SEISMIC BRACING PROCEDURE (CONTINUED)

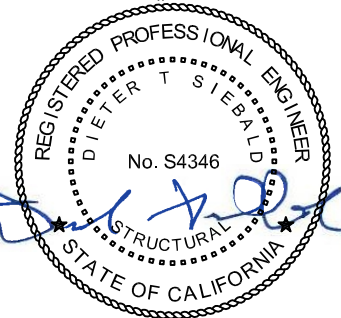
C. CAPACITY

1. THE CRDP CHOOSES APPROPRIATE SEISMIC BRACE SUPPORT ELEMENTS PER SECTIONS 2 THRU 17 OF THIS OPM. FOR THIS EXAMPLE THE ERICO CSBR1 CONNECTION & SCH 40 BRACE PIPE IS CHOSEN FOR THE TRANSVERSE & LONGITUDINAL SEISMIC BRACES SHOWN ON PG 13.3 & CADDY STRUT CLIP BC200000EG FOR THE CABLE TRAY TO STRUT CONNECTION. THE VERT BRACES WILL CONSIST OF THE ALL-THRD ROD W/ 12 GA STRUT W/ INTERNAL ROD STIFFENER CSBRS.
2. THE CRDP CHOOSES APPROPRIATE SEISMIC ATTACHMENT ELEMENTS TO STRUCTURE AS PER SECTIONS 100 THRU 105 OF THIS OPM. (SEE NOTES f & g BELOW).
3. THE CRDP DETERMINES THE GOVERNING CAPACITY OF THE ASSEMBLED SUPPORTS & ATTACHMENT.
 - a. DETERMINE CAPACITY OF HORIZ TRAPEZE STRUT PER VALUES IN SECTION 401. PER PG 401.1, THE CAPACITY FOR A 24" LONG NON-SLOTTED UNISTRUT P1000 IS 375# FOR COMBINED VERT, TRANSVERSE & LONGITUDINAL LOADING (AT $F_p = 1.225 W_p$)
 - b. DETERMINE CAPACITY OF BC200000EG PER VALUES IN SECTION 500. PER PG 500.4, THE CAPACITY FOR TRANSVERSE LOADING IS 396#. THE CAPACITY FOR LONGITUDINAL LOADING IS 2400#.
 - c. DETERMINE CAPACITY OF CSBR1 PER VALUES IN SECTION 500. PER PG 500.4, THE CAPACITY WHEN USED WITH A SCH 40 BRACE PIPE IS 755# FOR ANY BRACE ANGLE BTW 30 DEG TO 90 DEG.
 - d. AS AN ALTERNATE, DETERMINE CAPACITY OF CSBR2 PER VALUES IN SECTION 500 PER PG 500.4, THE CAPACITY WHEN USED WITH A BRACE STRUT IS 1051# FOR ANY BRACE ANGLE BTW 30 DEG TO 90 DEG.
 - e. DETERMINE CAPACITY OF AXIAL BRACE AS PER CALCULATED ALLOWABLE VALUES IN TABLES PROVIDED IN SECTION 400. FOR THIS EXAMPLE, IT IS ASSUMED THE TRANSVERSE & LONGITUDINAL BRACE PIPES ARE NO LONGER THAN 6 FEET. PER PG 400.1, A 1 INCH DIA SCH 40 BRACE PIPE HAS AN AXIAL CAPACITY OF 1850 LBS & CAN BE USED AS PART OF THE TRANSVERSE & LONGITUDINAL BRACE ASSEMBLIES IN THIS EXAMPLE. FOR THIS EXAMPLE, IT IS ALSO ASSUMED THE VERTICAL BRACE ROD LENGTH NOT WITHIN THE $1\frac{5}{8} \times 1\frac{5}{8} \times 12GA$ STRUT IS NO LONGER THAN 9 INCHES. PER PG 400.4, A $\frac{3}{8}$ " DIA RESTRAINT ROD HAS AN AXIAL CAPACITY OF 777#.
 - f. DETERMINE CAPACITY OF CSBU1 SUPPORT BTW BRACE PIPE & SEISMIC ATTACHMENT ELEMENT. PER PG 600.1 IN SECTION 600, THE CSBU1 HAS A CAPACITY OF 1270 LBS, BASED ON SCHEDULE 40 PIPE USED FOR BRACE, FOR ANY BRACE ANGLE BTW 30 TO 90 DEGREES.
 - g. DETERMINE CAPACITY OF UNISTRUT STRUT NUT SUPPORT BTW THREAD ROD & SEISMIC ATTACHMENT ELEMENT. PER PG 101.13, NOTE 4 IN SECTION 101, THE UNISTRUT STRUT NUT HAS A SLIP LOAD CAPACITY OF 1370 LBS & TENSION LOAD CAPACITY OF 2810 LBS.
 - h. DETERMINE CAPACITY OF SEISMIC ATTACHMENT TO SUPPORTING STRUCTURE. PER APPENDIX A, LRFD CAPACITIES FOR VARIOUS CONC ANCHORS HAVE BEEN PROVIDED. FOR THIS EXAMPLE, CHOOSE 0.5×3.25 " EMBED POWERS POWER-STUD SD2. PER PG A3, TENSION CAPACITY IS 2336# & SHEAR CAPACITY IS 3130#.

NOTE:

- THE CONC ANCHOR CAPACITIES WERE CALCULATED ACCORDING TO ACI® 318-14. AS PER SUPPLEMENT #1 OF ASCE/SEI® 7-16, THE OVERSTRENGTH FACTOR Ω_o APPLIES TO CONC ANCHORAGE.

4. THE CRDP DETERMINES WHETHER THE DEMAND IN SECTION B, STEPS 1 THROUGH 7 IS LESS THAN THE CAPACITY OF THE ASSEMBLY DETERMINED IN SECTION C, STEPS 1a THROUGH 1d FOR SUMMARY. FOR SUMMARY, SEE TABLE ON PG 302.8 WHICH SHOWS ALL D/C RATIOS TO BE ACCEPTABLE.



SHEET TITLE: CABLE TRAY & DUCT EXAMPLE OF SEISMIC BRACING DESIGN PROCEDURES
CABLE TRAY

| | | |
|--|--------------------------------------|---|
| <p>CYS STRUCTURAL ENGINEERS, INC. 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833</p> | TEL (916) 920-2020 www.cyseng.com | Job No: 19039 Date: 09/08/2021 Page: 302.7 of |
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SEISMIC BRACING FOR
MEP SYSTEMS



BRACE SPACING:

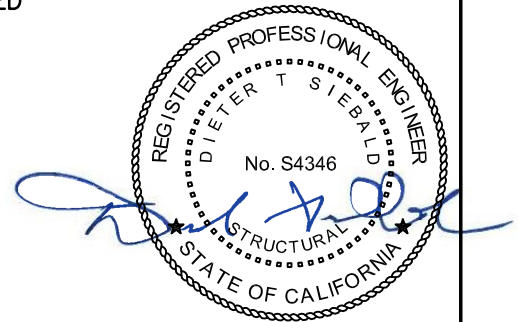
SEISMIC BRACING PROCEDURE (CONTINUED)

C. CAPACITY

5. IF THE D/C RATIOS ARE UNACCEPTABLE, SUCH AS THE BLW D/C RATIO OF 1.19, THE CRDP DETERMINES VIA DIRECT DEMAND VS CAPACITY RATIO THE APPROXIMATE REVISED ALLOWABLE BRACE SPACING. FOR THIS EXAMPLE, (20 FEET)/(1.19) = 16.8 FEET

| | STEP | COMPONENT | CAPACITY | DEMAND | DEMAND/CAPACITY RATIO | FORCE LEVEL |
|---------------------|------|--------------------------|--------------|--------|-----------------------|--------------------------|
| TRANSVERSE BRACE | a | UNISTRUT P1000 TRAPEZE | 375 | 448 | 1.19 | ASD |
| | b | BC200000EG | 396 | 330 | 0.83 | |
| | c | CSBR1 | 755 | 330 | 0.44 | |
| | e | 1" DIA SCH 40 BRACE PIPE | 1850 | 513 | 0.28 | |
| | f | CSBU1 | 1270 | 330 | 0.26 | |
| | h* | ANCHOR-TENSION | 2336 | 1124 | 0.48 | |
| | | ANCHOR-SHEAR | 3130 | 943 | 0.30 | LRFD, W/ OVERSTRENGTH |
| | | ANCHOR-COMBINED FORCES | - | - | 0.43 | |
| LONGITUDINAL BRACES | c | CSBR1 | 755 | 165 | 0.22 | ASD |
| | e | 1" DIA SCH 40 BRACE PIPE | 1850 | 257 | 0.14 | |
| | f | CSBU1 | 1270 | 165 | 0.13 | |
| | h* | ANCHOR-TENSION | 2336 | 562 | 0.24 | LRFD, W/ OVERSTRENGTH |
| | | | ANCHOR-SHEAR | 3130 | 472 |  | 0.15 |
| | | ANCHOR-COMBINED FORCES | - | - | 0.14 | |
| VERTICAL BRACES | e | VERT ALL THRD ROD | 777 | 676 | 0.87 | ASD |
| | g | UNISTRUT STRUT NUT | 1370 | 330 | 0.24 | |
| | h* | ANCHOR-TENSION | 2336 | 786 | 0.34 | LRFD, W/ OVERSTRENGTH |
| | | | | | | |

* FOR THIS EXAMPLE, IT WAS ASSUMED THAT THERE IS NO PRYING ACTION ON THE ATTACHMENT. IT IS THE RESPONSIBILITY OF THE CDRP TO CHECK FOR PRYING. SEE SECTION B ON PREVIOUS PG FOR DEMAND FORCES. COMBINED ANCHOR RATIO= (TENSION RATIO)^{5/3} + (SHEAR RATIO)^{5/3}.



SHEET TITLE: CABLE TRAY & DUCT EXAMPLE OF SEISMIC BRACING DESIGN PROCEDURES
CABLE TRAY



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| | |
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| Job No: | 19039 |
| Date: | 09/08/2021 |
| Page: | 302.8 of . |

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SEISMIC BRACING FOR
MEP SYSTEMS

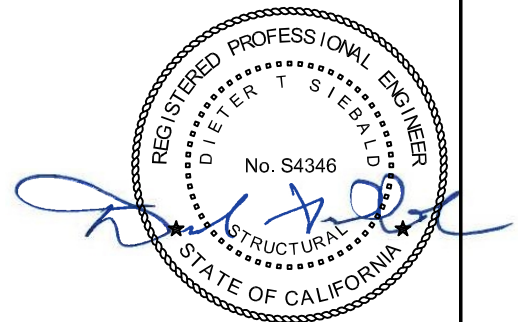
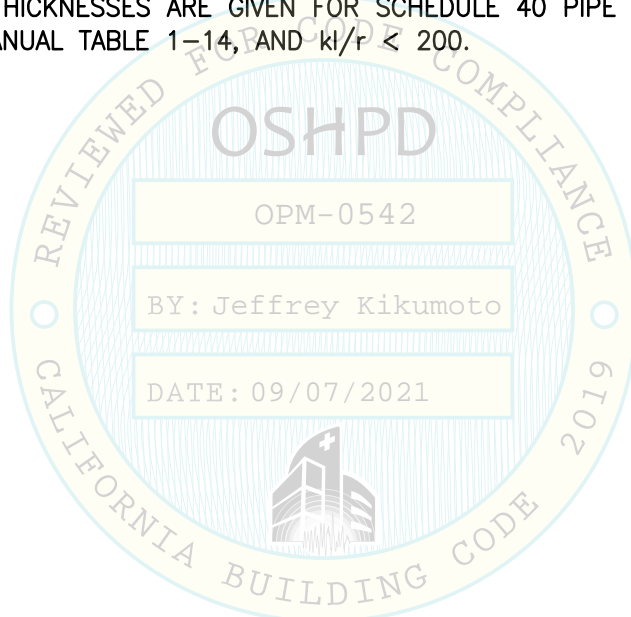


**AXIAL CAPACITIES OF BRACES
PIPES**

| LATERAL SWAY BRACE PIPE AXIAL CAPACITY (POUNDS) | | | | | | | | | | |
|---|-------------|------------------|-----------------|----------------------------|------|--------|-------------|------|------|------|
| NOMINAL DIA | OUTSIDE DIA | NOMINAL WALL THK | DESIGN WALL THK | AREA Ag (in ²) | D/t | r (in) | PIPE LENGTH | | | |
| | | | | | | | 4' | 6' | 8' | 10' |
| 1.00" | 1.32" | 0.133" | 0.124" | 0.46 | 10.6 | 0.423 | 3082 | 1850 | N/A | N/A |
| 1.25" | 1.66" | 0.140" | 0.130" | 0.62 | 12.8 | 0.543 | 4764 | 3523 | 2332 | N/A |
| 1.50" | 1.90" | 0.145" | 0.135" | 0.75 | 14.1 | 0.626 | 5983 | 4843 | 3447 | 2452 |
| 2.00" | 2.38" | 0.154" | 0.143" | 1.00 | 16.6 | 0.791 | 8409 | 7452 | 6149 | 4667 |

NOTES:

1. BRACE PIPE AXIAL CAPACITY SHOWN IS AT ASD LEVEL DESIGN. FOR LRFD-LEVEL DESIGN, PER ANSI/AISC 360-16 SECTION E1, MULTIPLY BY 1.5.
2. LOAD APPLIED AT EDGE OF PIPE TO ACCOUNT FOR ECCENTRICITY OF BRACE ATTACHMENT.
3. BRACE DIAMETERS AND THICKNESSES ARE GIVEN FOR SCHEDULE 40 PIPE AS PER ANSI/AISC® STEEL CONSTRUCTION MANUAL TABLE 1-14, AND $kl/r \leq 200$.



SHEET TITLE: AXIAL CAPACITIES OF BRACES
PIPES



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Job No: 19039
Date: 09/08/2021
Page: 400.1 of .

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SEISMIC BRACING FOR
MEP SYSTEMS



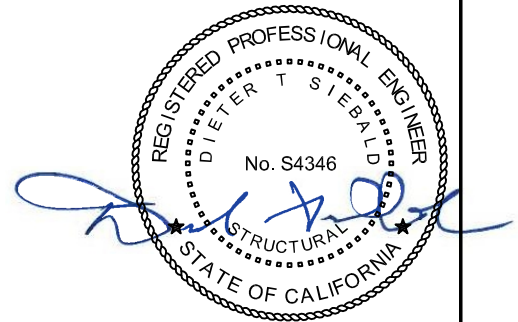
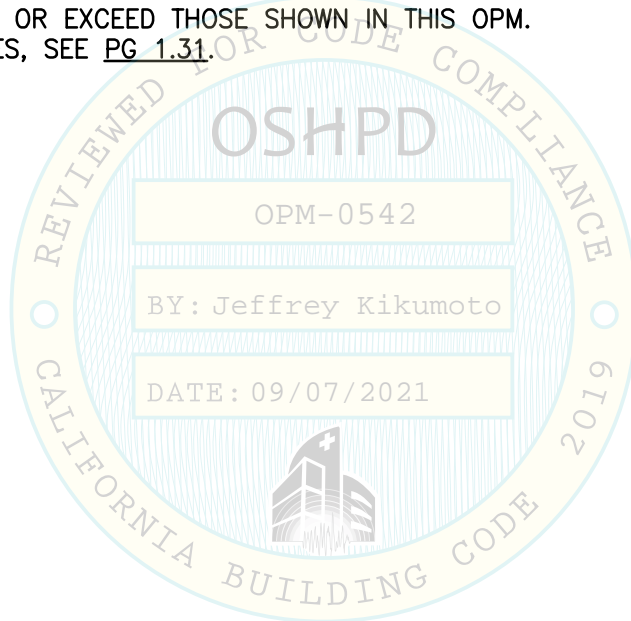
AXIAL CAPACITIES OF BRACES

STRUTS

| ERICO TYPE A SINGLE STRUT AXIAL CAPACITY (POUNDS) | | | | | | | | |
|---|-----------------------------------|--|---------------------|--------------|------|------|------|-------------|
| I _{xx} (in ⁴) | S _{xx} (m ³) | AREA A _g (in ²) | r _x (in) | STRUT LENGTH | | | | FORCE LEVEL |
| | | | | 4' | 6' | 8' | 10' | |
| 0.182 | 0.199 | 0.533 | 0.574 | 2600 | 2000 | 1500 | 1200 | ASD |
| | | | | 3900 | 3000 | 2250 | 1800 | LRFD |

NOTES:

- BRACE STRUT AXIAL CAPACITIES ARE GIVEN FOR ERICO TYPE A SOLID SINGLE STRUT (1⁵/₈"x1⁵/₈"x12 GA) AND $kl/r < 200$. SEE SECTION "SEISMIC BRACE SUPPORT DETAILS", PG 106.5 FOR ADDNL PROPERTIES.
- DESIGN PARAMETERS ARE FOR X AXIS ONLY.
- LOAD APPLIED AT SLOT FACE TO ACCOUNT FOR ECCENTRICITY OF BRACE ATTACHMENT.
- REDUCE CAPACITIES BY 15% FOR PUNCHED OT SLOTTED TRACK CAPACITIES. SEOR SHALL VERIFY STRUT PROPERTIES MEET OR EXCEED THOSE SHOWN IN THIS OPM.
- FOR MATERIAL PROPERTIES, SEE PG 1.31.



SHEET TITLE: AXIAL CAPACITIES OF BRACES
STRUTS

| | | |
|--|--------------------------------------|---|
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SEISMIC BRACING FOR
MEP SYSTEMS

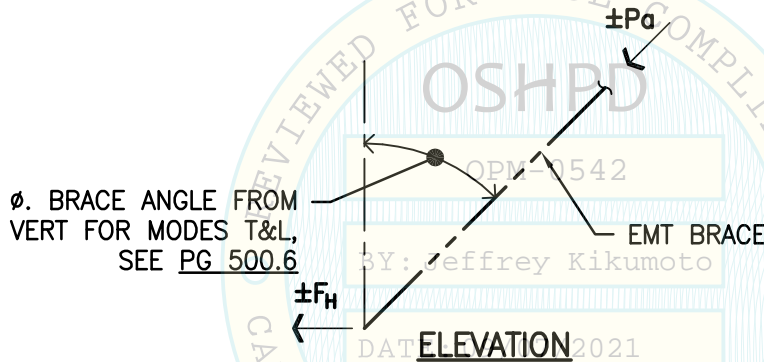


**AXIAL CAPACITIES OF BRACES
ELECTRICAL METALLIC TUBING (EMT)**

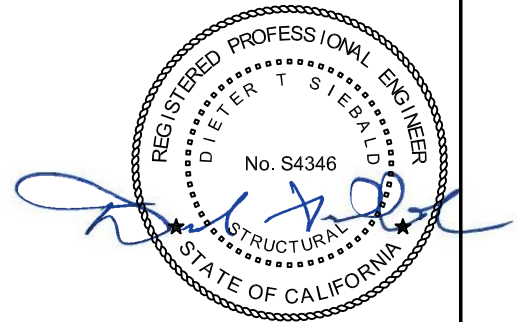
| LATERAL SWAY BRACE EMT AXIAL CAPACITY P _a (POUNDS) | | | | | | | | | | | | | | |
|---|-------------|------------------|-----------------|----------------------------|------|--------|-------------|------|------|------|-----|-----|-----|-----|
| NOMINAL DIA | OUTSIDE DIA | NOMINAL WALL THK | DESIGN WALL THK | AREA Ag (in ²) | D/t | r (in) | PIPE LENGTH | | | | | | | |
| | | | | | | | 1' | 2' | 3' | 4' | 5' | 6' | 8' | 10' |
| 1.00" | 1.16" | 0.057" | 0.057" | 0.20 | 20.4 | 0.392 | 2246 | 2058 | 1746 | 1332 | 966 | 724 | N/A | N/A |

NOTES:

- BRACE EMT AXIAL CAPACITY SHOWN IS AS P_a AT ASD LEVEL DESIGN WHERE $kl/r < 200$.
- BRACE DIAMETERS AND THICKNESSES ARE GIVEN FOR EMT AS PER UL 797 & ANSI C80.3.
- MATERIAL SHALL BE HOT-DIPPED GALV W/ YIELD STRESS F_y = 45 KSI MIN.
- LOAD APPLIED AT EDGE OF EMT TO ACCOUNT FOR ECCENTRICITY OF BRACE ATTACHMENT.



| UNBRACED LGTH (FT) | ALLOWABLE $\pm F_H$ (LBS) | | | |
|--------------------|---------------------------|-------|-------|-------|
| | ϕ (DEGREES) | | | |
| | 30-44 | 45-59 | 60-74 | 75-90 |
| 1 | 1123 | 1588 | 1945 | 2170 |
| 2 | 1029 | 1455 | 1783 | 1988 |
| 3 | 873 | 1235 | 1512 | 1687 |
| 4 | 666 | 942 | 1154 | 1287 |
| 5 | 483 | 683 | 837 | 934 |
| 6 | 362 | 512 | 627 | 699 |
| 8 | N/A | N/A | N/A | N/A |
| 10 | N/A | N/A | N/A | N/A |



SHEET TITLE: AXIAL CAPACITIES OF BRACES
ELECTRICAL METALLIC TUBING (EMT)

| | |
|--|------------------|
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| | Date: 09/08/2021 |
| | Page: 400.3 of |

L:\Jobs19\19039 ERICO - MEP OPM\ACAD\STRU\S2_Erico MEP.dwg Time:Sep08,2021-10:37am Login:camachom DimScale:8 LScale:4

SEISMIC BRACING FOR MEP SYSTEMS

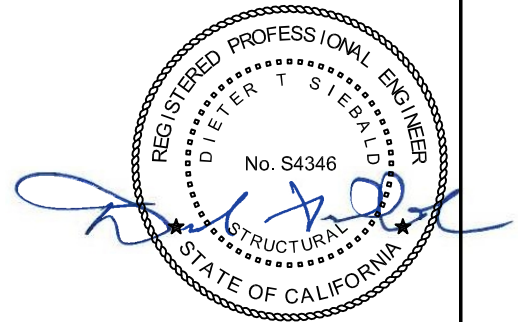
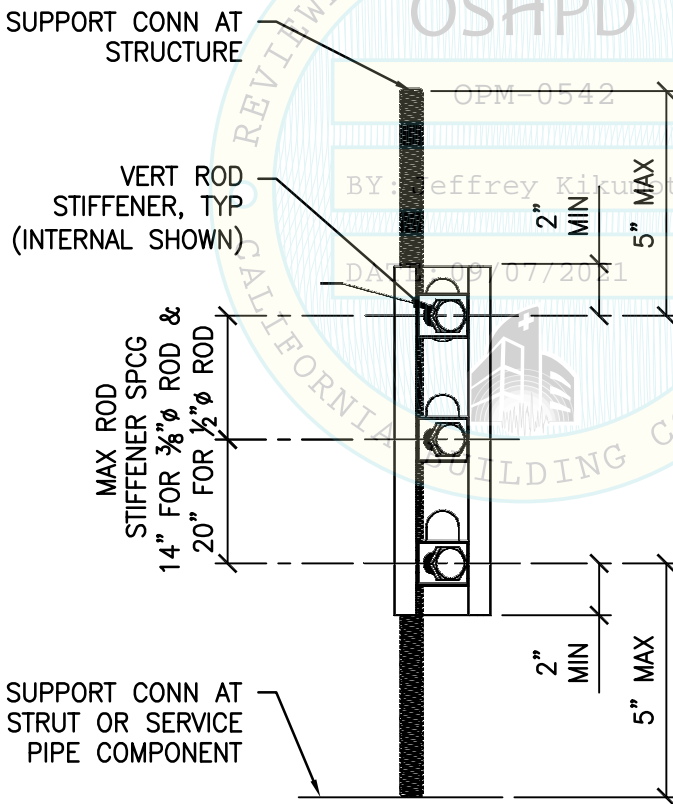


AXIAL CAPACITIES OF BRACES RESTRAINT RODS

| RESTRAINT ROD AXIAL COMPRESSION CAPACITY (POUNDS) | | | | | | |
|---|------------|-------|-------|-------|--------|-------|
| NOMINAL DIA | ROD LENGTH | | | | | |
| | 1'-9" | 1'-5" | 1'-3" | 1'-1" | 0'-11" | 0'-9" |
| 3/8" | - | - | 293# | 390# | 544# | 777# |
| 1/2" | 505# | 770# | 989# | 1295# | 1635# | 1985# |
| 5/8" | 1286# | 1952# | 2370# | 2810# | 3251# | 3671# |
| 3/4" | 2829# | 3861# | 4401# | 4935# | 5444# | 5908# |

NOTES:

1. RESTRAINT ROD AXIAL CAPACITY SHOWN IS AT ASD LEVEL DESIGN. FOR LRFD-LEVEL DESIGN, PER ANSI/AISC 360-16 SECTION E1, MULTIPLY CAPACITY BY 1.5.
2. ROD DIAMETERS ARE BASED ON ALL THREAD ROD, CAPACITY IS BASED ON ASTM® A36 AND $kl/r \leq 200$. INTERPOLATION IS ACCEPTABLE.
3. FOR RODS W/ ROD STIFFENERS, "ROD LENGTH" REFERS TO MAX DISTANCE BTW ROD STIFFENERS AS PER PG 106.14.
4. ROD STIFFENERS MUST BE INSTALLED PER ERICO/nVENT INSTRUCTIONS.



SHEET TITLE: AXIAL CAPACITIES OF BRACES
RESTRAINT RODS

| | | |
|--------------------------------------|---------------------------------------|-------------------------|
| | CYS STRUCTURAL ENGINEERS, INC. | Job No: 19039 |
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SEISMIC BRACING FOR
MEP SYSTEMS

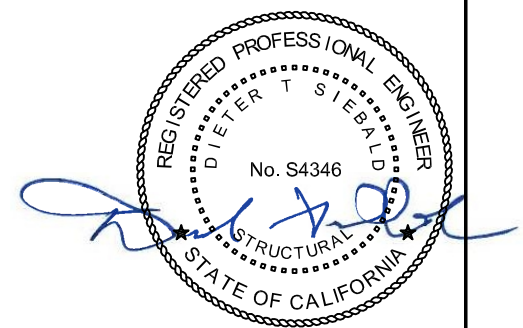
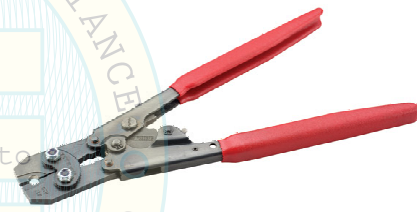
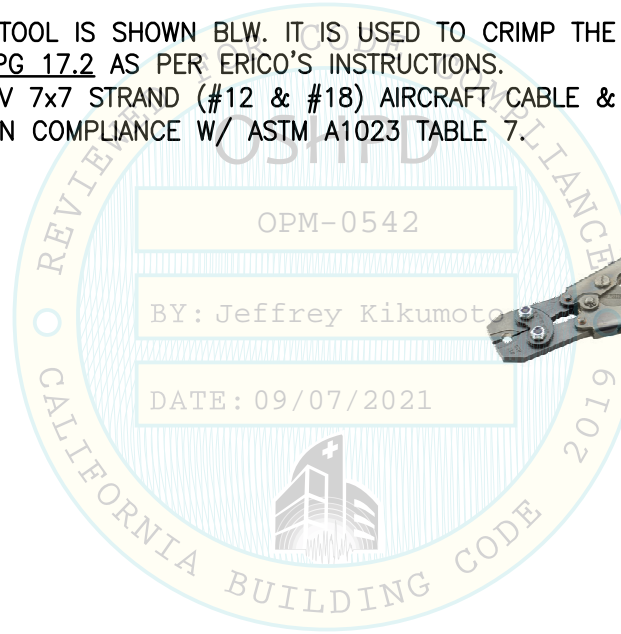


**AXIAL CAPACITIES OF BRACES
TENSION CABLES**

| AIRCRAFT CABLE SIZE ⁴ | ERICO SLEEVE PART# ¹ | CABLE MIN BREAKING FORCE | SAFETY FACTOR | ALLOW LOAD AT ASD | REQ # OF SWAGES PER SLEEVE ² |
|----------------------------------|---------------------------------|--------------------------|---------------|-------------------|---|
| 3/32" (#12) | CSB12SLVB | 920 LBS | 2.20 | 410 | 2 (1) |
| 1/8" (#18) | CSB18SLVB | 1700 LBS | 2.20 | 770 | 2 (1) |
| 3/16" (#36) | CSB36SLVB | 4200 LBS | 2.20 | 1900 | 3 (2) |

NOTES:

- NOTE THAT THE CAPACITY OF THE SLEEVED LOOPS IS THE SAME AS THE MIN BREAK STRENGTH OF THE CABLE.
- NUMBER OF SWAGES PER SLEEVE WHEN THE ERICO HAND SWAGE TOOL IS USED. NUMBER IN PARENTHESIS IS THE NUMBER OF SWAGES PER SLEEVE WHEN THE ERICO BATTERY SWAGE TOOL IS USED.
- ERICO HAND SWAGE TOOL IS SHOWN BLW. IT IS USED TO CRIMP THE ERICO PROVIDED OVAL SLEEVE SHOWN ON PG 17.2 AS PER ERICO'S INSTRUCTIONS.
- PRE-STRETCHED GALV 7x7 STRAND (#12 & #18) AIRCRAFT CABLE & GALV 7x19 STRAND (#36) AIRCRAFT CABLE IS IN COMPLIANCE W/ ASTM A1023 TABLE 7.



SHEET TITLE: AXIAL CAPACITIES OF BRACES
TENSION CABLES

| | |
|---|------------------|
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| | Date: 09/08/2021 |
| | Page: 400.5 of . |

L:\Jobs19\19039 ERICO - MEP OPM\ACAD\STRU\S2_Erico MEP.dwg Time: Sep08, 2021 - 10:37am Login: camachom DimScale: 8 LTScale: 4

SEISMIC BRACING FOR
MEP SYSTEMS



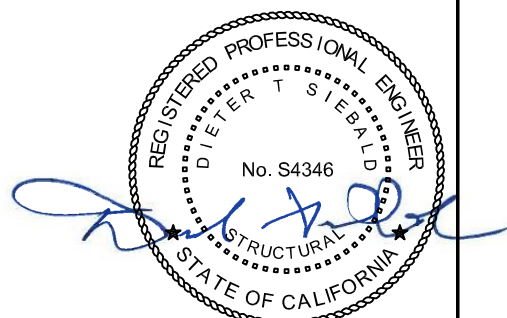
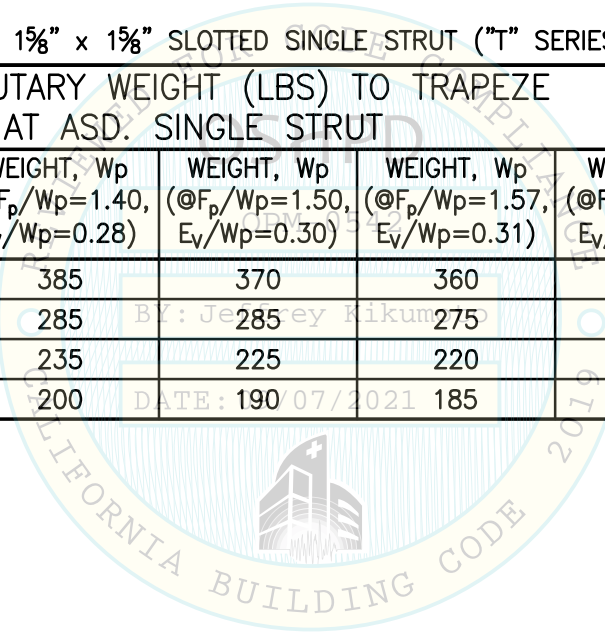
AXIAL & FLEXURAL CAPACITIES OF HORIZONTAL TRAPEZE STRUTS
MAX LOAD TO EACH TRAPEZE AT ASD LEVEL OF DESIGN

LOAD SUMMARY @ ASD: 12GA 1 5/8" x 1 5/8" NON-SLOTTED SINGLE STRUT ("P" SERIES)

| MAX TRIBUTARY WEIGHT (LBS) TO TRAPEZE AT ASD. SINGLE STRUT | | | | | |
|---|--|--|--|--|--|
| STRUT LENGTH (IN) | WEIGHT, Wp (@Fp/Wp=1.225, Ev/Wp=0.245) | WEIGHT, Wp (@Fp/Wp=1.40, Ev/Wp=0.28) | WEIGHT, Wp (@Fp/Wp=1.50, Ev/Wp=0.30) | WEIGHT, Wp (@Fp/Wp=1.57, Ev/Wp=0.31) | WEIGHT, Wp (@Fp/Wp=1.75, Ev/Wp=0.35) |
| 18 | 500 | 460 | 440 | 429 | 408 |
| 24 | 375 | 350 | 340 | 330 | 310 |
| 30 | 300 | 280 | 270 | 265 | 252 |
| 36 | 250 | 235 | 225 | 220 | 210 |

LOAD SUMMARY @ ASD: 12GA 1 5/8" x 1 5/8" SLOTTED SINGLE STRUT ("T" SERIES)

| MAX TRIBUTARY WEIGHT (LBS) TO TRAPEZE AT ASD. SINGLE STRUT | | | | | |
|---|--|--|--|--|--|
| STRUT LENGTH (IN) | WEIGHT, Wp (@Fp/Wp=1.225, Ev/Wp=0.245) | WEIGHT, Wp (@Fp/Wp=1.40, Ev/Wp=0.28) | WEIGHT, Wp (@Fp/Wp=1.50, Ev/Wp=0.30) | WEIGHT, Wp (@Fp/Wp=1.57, Ev/Wp=0.31) | WEIGHT, Wp (@Fp/Wp=1.75, Ev/Wp=0.35) |
| 18 | 415 | 385 | 370 | 360 | 335 |
| 24 | 320 | 285 | 285 | 275 | 255 |
| 30 | 255 | 235 | 225 | 220 | 205 |
| 36 | 215 | 200 | 185 | 185 | 175 |



SHEET TITLE: AXIAL & FLEXURAL CAPACITIES OF HORIZONTAL TRAPEZE STRUTS
12 GA SINGLE STRUT

| | |
|--|------------------|
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| | Date: 09/08/2021 |
| | Page: 401.1 of . |

L:\Jobs\19039 ERICO - MEP OPM\ACAD\STRU\S2_Erico MEP.dwg Time:Sep08,2021-10:37am Login:camachom DimScale:8 LScale:4

SEISMIC BRACING FOR
MEP SYSTEMS



AXIAL & FLEXURAL CAPACITIES OF HORIZONTAL TRAPEZE STRUTS
MAX LOAD TO EACH TRAPEZE AT ASD LEVEL OF DESIGN

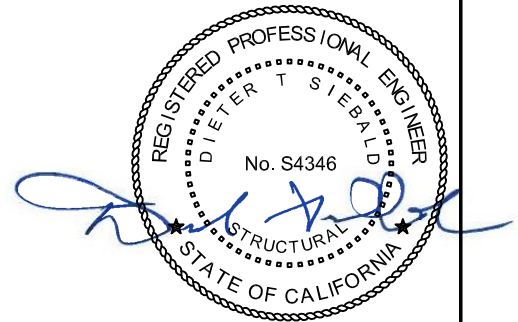
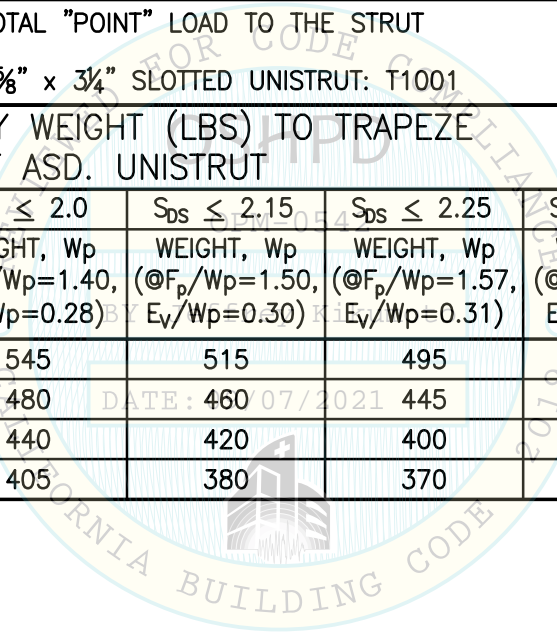
LOAD SUMMARY @ ASD: 12GA 1 5/8" x 3/4" UNISTRUT: P1001

| MAX TRIBUTARY WEIGHT (LBS) TO TRAPEZE AT ASD. UNISTRUT | | | | | |
|---|---|---|---|---|---|
| STRUT LENGTH (IN) | $S_{DS} \leq 1.75$ | $S_{DS} \leq 2.0$ | $S_{DS} \leq 2.15$ | $S_{DS} \leq 2.25$ | $S_{DS} \leq 2.50$ |
| | WEIGHT, Wp (@ $F_p/W_p=1.225$, $E_v/W_p=0.245$) | WEIGHT, Wp (@ $F_p/W_p=1.40$, $E_v/W_p=0.28$) | WEIGHT, Wp (@ $F_p/W_p=1.50$, $E_v/W_p=0.30$) | WEIGHT, Wp (@ $F_p/W_p=1.57$, $E_v/W_p=0.31$) | WEIGHT, Wp (@ $F_p/W_p=1.75$, $E_v/W_p=0.35$) |
| 18 | 700 | 640 | 610 | 590 | 535 |
| 24 | 640 | 580 | 550 | 530 | 485 |
| 30 | 580 | 520 | 495 | 480 | 440 |
| 36 | 520 | 480 | 450 | 440 | 410 |

NOTE: WEIGHTS ARE THE MAX TOTAL "POINT" LOAD TO THE STRUT

LOAD SUMMARY @ ASD: 12GA 1 5/8" x 3/4" SLOTTED UNISTRUT: T1001

| MAX TRIBUTARY WEIGHT (LBS) TO TRAPEZE AT ASD. UNISTRUT | | | | | |
|---|---|---|---|---|---|
| STRUT LENGTH (IN) | $S_{DS} \leq 1.75$ | $S_{DS} \leq 2.0$ | $S_{DS} \leq 2.15$ | $S_{DS} \leq 2.25$ | $S_{DS} \leq 2.50$ |
| | WEIGHT, Wp (@ $F_p/W_p=1.225$, $E_v/W_p=0.245$) | WEIGHT, Wp (@ $F_p/W_p=1.40$, $E_v/W_p=0.28$) | WEIGHT, Wp (@ $F_p/W_p=1.50$, $E_v/W_p=0.30$) | WEIGHT, Wp (@ $F_p/W_p=1.57$, $E_v/W_p=0.31$) | WEIGHT, Wp (@ $F_p/W_p=1.75$, $E_v/W_p=0.35$) |
| 18 | 610 | 545 | 515 | 495 | 450 |
| 24 | 540 | 480 | 460 | 445 | 410 |
| 30 | 485 | 440 | 420 | 400 | 375 |
| 36 | 440 | 405 | 380 | 370 | 345 |



SHEET TITLE: AXIAL & FLEXURAL CAPACITIES OF HORIZONTAL TRAPEZE STRUTS
12 GA DOUBLE STRUT

| | | |
|--|---------|------------|
| <p>CYS STRUCTURAL ENGINEERS, INC. 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833</p> | Job No: | 19039 |
| | Date: | 09/08/2021 |
| | Page: | 401.2 of |

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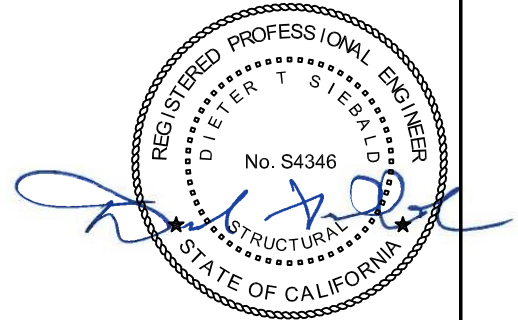
SEISMIC BRACING FOR MEP SYSTEMS



CAPACITY TABLE OF BRACE SUPPORTS AT SYSTEM COMPONENTS

ALSO SEE NOTES AT END OF TABLE (NOTES 'a' THRU 'd' ARE TYP)

| MODE | COMPONENT DESCRIPTION | RUN PIPE NOMINAL DIA (INCHES) | RUN PIPE REFERENCE | HORIZ CAPACITY F _H (POUNDS) PER INSTALLATION ANGLE ϕ | | | | NOTES |
|------|-----------------------|-------------------------------|--------------------|--|-----------|-----------|-----------|---------|
| | | | | 30° - 44° | 45° - 59° | 60° - 74° | 75° - 90° | |
| L | CSB | 1 | LW,10,40 | 970 | 930 | 950 | 1050 | c,h,j,k |
| L | CSB | 1¼ | LW,10,40 | 970 | 930 | 950 | 1050 | c,h,j,k |
| L | CSB | 1½ | LW,10,40 | 900 | 1390 | 1630 | 1690 | c,h,j,k |
| L | CSB | 2 | LW,10,40 | 900 | 1360 | 1630 | 1690 | c,h,j,k |
| L | CSB | 2½ | LW,10,40 | 990 | 1360 | 1640 | 1870 | c,h,j,k |
| L | CSB | 3 | LW,10,40 | 980 | 1340 | 1640 | 1870 | c,h,j,k |
| L | CSB | 4 | LW,10,40 | 980 | 1340 | 1640 | 1970 | c,h,j,k |
| L | CSB | 5 | LW,10,40 | 980 | 1340 | 1640 | 1970 | c,h,j,k |
| L | CSB | 6 | LW,10,40 | 1060 | 1460 | 1760 | 2010 | c,h,j,k |
| L | CSB | 8,10 | 0.188,40 | 910 | 1250 | 1760 | 1980 | g,h,j |
| L | CSB | 12 | 0.188,40 | 1030 | 1300 | 1570 | 1870 | g,h,j |
| T | CSB | 1 | LW,10,40 | 1120 | 1580 | 1940 | 2170 | c,h,j,k |
| T | CSB | 1¼ | LW,10,40 | 1040 | 1470 | 1800 | 2020 | c,h,j,k |
| T | CSB | 1½ | LW,10,40 | 1040 | 1470 | 1800 | 2020 | c,h,j,k |
| T | CSB | 2 | LW,10,40 | 1040 | 1470 | 1800 | 2020 | c,h,j,k |
| T | CSB | 2½ | LW,10,40 | 1080 | 1520 | 1870 | 2090 | c,h,j,k |
| T | CSB | 3 | LW,10,40 | 1040 | 1480 | 1810 | 2030 | c,h,j,k |
| T | CSB | 4 | LW,10,40 | 1040 | 1480 | 1810 | 2030 | c,h,j,k |
| T | CSB | 5 | LW,10,40 | 1040 | 1480 | 1810 | 2030 | c,h,j,k |
| T | CSB | 6 | LW,10,40 | 1090 | 1540 | 1890 | 2120 | c,h,j,k |
| T | CSB | 8,10 | 0.188,40 | 990 | 1410 | 1730 | 1930 | g,h,j |
| T | CSB | 12 | 0.188,40 | 1260 | 1780 | 2180 | 2440 | g,h,j |
| R | CSB | 1 | LW,10,40 | 2170 | 2170 | 2170 | 2170 | c,h,j,k |
| R | CSB | 1¼ | LW,10,40 | 2020 | 2020 | 2020 | 2020 | c,h,j,k |
| R | CSB | 1½ | LW,10,40 | 2020 | 2020 | 2020 | 2020 | c,h,j,k |
| R | CSB | 2 | LW,10,40 | 2020 | 2020 | 2020 | 2020 | c,h,j,k |



SHEET TITLE: CAPACITY TABLE OF BRACE SUPPORTS AT SYSTEM COMPONENTS
CSB

| | |
|---|------------------|
| CYS STRUCTURAL ENGINEERS, INC. 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833 | Job No: 19039 |
| | Date: 09/08/2021 |
| | Page: 500.2 of |

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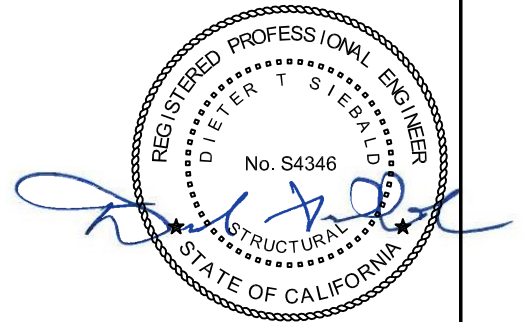
SEISMIC BRACING FOR MEP SYSTEMS



CAPACITY TABLE OF BRACE SUPPORTS AT SYSTEM COMPONENTS

ALSO SEE NOTES AT END OF TABLE (NOTES 'a' THRU 'd' ARE TYP)

| MODE | COMPONENT DESCRIPTION | RUN PIPE NOMINAL DIA (INCHES) | RUN PIPE REFERENCE | HORIZ CAPACITY F _H (POUNDS) PER INSTALLATION ANGLE ϕ | | | | NOTES |
|------|-----------------------|-------------------------------|--------------------|--|-----------|-----------|-----------|-------------------|
| | | | | 30° - 44° | 45° - 59° | 60° - 74° | 75° - 90° | |
| R | CSB | 2½ | LW,10,40 | 2090 | 2090 | 2090 | 2090 | c,h,j,k |
| R | CSB | 3 | LW,10,40 | 2030 | 2030 | 2030 | 2030 | c,h,j,k |
| R | CSB | 4 | LW,10,40 | 2030 | 2030 | 2030 | 2030 | c,h,j,k |
| R | CSB | 5 | LW,10,40 | 2030 | 2030 | 2030 | 2030 | c,h,j,k |
| R | CSB | 6 | LW,10,40 | 2120 | 2120 | 2120 | 2120 | c,h,j,k |
| R | CSB | 8, 10 | 0.188,40 | 1930 | 1930 | 1930 | 1930 | g,h,j |
| R | CSB | 12 | 0.188,40 | 2440 | 2440 | 2440 | 2440 | g,h,j |
| T | CSBBRP | 1 AND 1¼ | LW,10,40 | 90 | 120 | 150 | 170 | c,e,j,k |
| T | CSBBRP | 1 AND 1¼ | LW,10,40 | 100 | 140 | 180 | 200 | c,f,j,k |
| T | CSBBRP | 1½ AND 2 | LW,10,40 | 100 | 140 | 180 | 200 | c,e,j,k |
| T | CSBBRP | 1½ AND 2 | LW,10,40 | 80 | 110 | 140 | 150 | c,f,j,k |
| T | CSBQG | 2½ | LW,10,40 | 670 | 1060 | 1390 | 1610 | c,i,j,k,s |
| T | CSBQG | 3 | LW,10,40 | 890 | 1260 | 1550 | 1730 | c,i,j,k |
| T | CSBQG | 4 | LW,10,40 | 890 | 1260 | 1550 | 1730 | c,i,j,k |
| T | CSBQG | 5,6 | LW,10,40 | 650 | 920 | 1130 | 1260 | c,i,j,k |
| | | | | | | | | |
| T | CSBQG | 8 | 0.188,40 | 590 | 830 | 1020 | 1140 | g,i,j |
| R | CSBQG | 2½ | LW,10,40 | 1610 | 1610 | 1610 | 1610 | c,i,j,k,s |
| R | CSBQG | 3 | LW,10,40 | 1730 | 1730 | 1730 | 1730 | c,i,j,k |
| R | CSBQG | 4 | LW,10,40 | 1730 | 1730 | 1730 | 1730 | c,i,j,k |
| R | CSBQG | 5,6 | LW,10,40 | 1260 | 1260 | 1260 | 1260 | c,i,j,k |
| | | | | | | | | |
| R | CSBQG | 8 | 0.188,40 | 1140 | 1140 | 1140 | 1140 | g,i,j |
| T | CSBT | 1 - 4 | LW,10,40 | 475 | 790 | 790 | 890 | aa,ab,j,k, m,x |
| | | | | | | | | |
| | | | | | | | | |



SHEET TITLE: CAPACITY TABLE OF BRACE SUPPORTS AT SYSTEM COMPONENTS
CSB, CSBBRP, CSBQG & CSBT

| | |
|---|------------------|
| CYS STRUCTURAL ENGINEERS, INC. 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833 | Job No: 19039 |
| | Date: 09/08/2021 |
| | Page: 500.3 of . |

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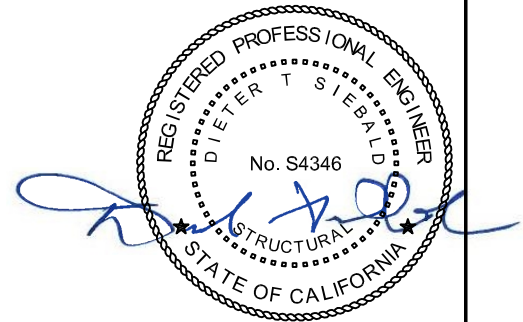
SEISMIC BRACING FOR MEP SYSTEMS



CAPACITY TABLE OF BRACE SUPPORTS AT SYSTEM COMPONENTS

ALSO SEE NOTES AT END OF TABLE (NOTES 'a' THRU 'd' ARE TYP, UNO)

| MODE | COMPONENT DESCRIPTION | RUN PIPE NOMINAL DIA (INCHES) | RUN PIPE REFERENCE | HORIZ CAPACITY F _H (POUNDS) PER INSTALLATION ANGLE ϕ | | | | | | NOTES |
|----------|-----------------------|-------------------------------|--------------------|--|-----------|-----------|-----------|-----------|------|--------------|
| | | | | 0° | 30° - 44° | 45° - 59° | 60° - 74° | 75° - 90° | 90° | |
| T | CSBCS | 1 | EMT,LW,10,40 | - | 115 | 240 | 173 | 191 | - | j,k,q,t,x,aa |
| T | CSBCS | 2 | EMT,LW,10,40 | - | 191 | 318 | 179 | 198 | - | j,k,q,t,x,aa |
| T | CSBCS | 2½ | EMT,LW,10,40 | - | 293 | 363 | 290 | 321 | - | j,k,q,t,x,aa |
| T | CSBCS | 4, 5, 6 | EMT,LW,10,40 | - | 186 | 412 | 439 | 485 | - | j,k,q,t,x,aa |
| T | CSBR1 | - | NA | - | 623 | 876 | 1055 | 1176 | - | o,v |
| T | CSBR1 | - | NA | - | 755 | 1109 | 1681 | 1875 | - | h,v |
| T | CSBR2 | - | NA | - | 1051 | 1480 | 1781 | 1987 | - | v,w |
| VERTICAL | SCH-B | ½ | EMT,LW,10,40 | 418 | - | - | - | - | - | k,x,y,aa |
| T | SCH-B | ½ | EMT,LW,10,40 | - | - | - | - | - | 54 | k,x,y,aa |
| L | SCH-B | ½ | EMT,LW,10,40 | - | - | - | - | - | 46 | k,x,y,aa |
| VERTICAL | SCH-B | 1 | EMT,LW,10,40 | 432 | - | - | - | - | - | k,x,y,aa |
| T | SCH-B | 1 | EMT,LW,10,40 | - | - | - | - | - | 76 | k,x,y,aa |
| L | SCH-B | 1 | EMT,LW,10,40 | - | - | - | - | - | 84 | k,x,y,aa |
| VERTICAL | SCH-B | 2 | EMT,LW,10,40 | 1013 | - | - | - | - | - | k,x,y,aa |
| T | SCH-B | 2 | EMT,LW,10,40 | - | - | - | - | - | 100 | k,x,y,aa |
| L | SCH-B | 2 | EMT,LW,10,40 | - | - | - | - | - | 118 | k,x,y,aa |
| VERTICAL | SCH-B | 4 | EMT,LW,10,40 | - | - | - | - | - | - | k,x,y,aa |
| T | SCH-B | 4 | EMT,LW,10,40 | - | - | - | - | - | 68 | k,x,y,aa |
| L | SCH-B | 4 | EMT,LW,10,40 | - | - | - | - | - | 58 | k,x,y,aa |
| VERTICAL | BC200000EG | NA | CABLE TRAY | 2400 | - | - | - | - | - | u |
| T | BC200000EG | NA | CABLE TRAY | - | - | - | - | - | 396 | u |
| L | BC200000EG | NA | CABLE TRAY | - | - | - | - | - | 2400 | u |



SHEET TITLE: CAPACITY TABLE OF BRACE SUPPORTS AT SYSTEM COMPONENTS
CSBU1, CSBCS, CSBR1, CSBR2, CSBTR, SCH & BC200000BG

| | | |
|---|--------------------|------------------|
| CYS STRUCTURAL ENGINEERS, INC. 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833 | TEL (916) 920-2020 | Job No: 19039 |
| | www.cyseng.com | Date: 09/08/2021 |
| | | Page: 500.4 of |

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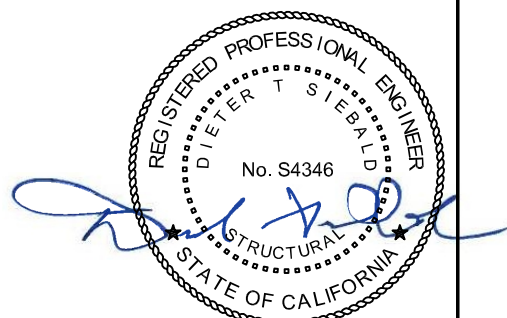
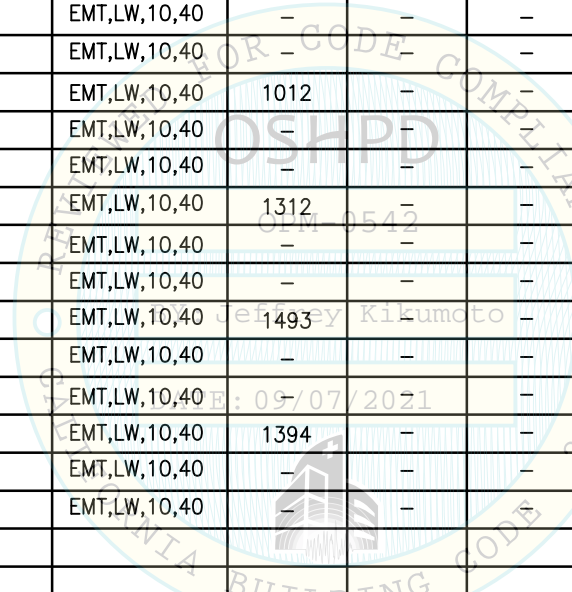
SEISMIC BRACING FOR MEP SYSTEMS



CAPACITY TABLE OF BRACE SUPPORTS AT SYSTEM COMPONENTS

ALSO SEE NOTES AT END OF TABLE (NOTES 'a' THRU 'd' ARE TYP)

| MODE | COMPONENT DESCRIPTION | RUN PIPE NOMINAL DIA (INCHES) | RUN PIPE REFERENCE | HORIZ CAPACITY F _H (POUNDS) PER INSTALLATION ANGLE ϕ | | | | | | NOTES |
|----------|-----------------------|-------------------------------|--------------------|--|-----------|-----------|-----------|-----------|-----|----------|
| | | | | 0° | 30° - 44° | 45° - 59° | 60° - 74° | 75° - 90° | 90° | |
| VERTICAL | USC | 1/2 | EMT,LW,10,40 | 790 | - | - | - | - | - | k,x,y,aa |
| T | USC | 1/2 | EMT,LW,10,40 | - | - | - | - | - | 118 | k,x,y,aa |
| L | USC | 1/2 | EMT,LW,10,40 | - | - | - | - | - | 91 | k,x,y,aa |
| VERTICAL | USC | 1 | EMT,LW,10,40 | 754 | - | - | - | - | - | k,x,y,aa |
| T | USC | 1 | EMT,LW,10,40 | - | - | - | - | - | 198 | k,x,y,aa |
| L | USC | 1 | EMT,LW,10,40 | - | - | - | - | - | 82 | k,x,y,aa |
| VERTICAL | USC | 2 | EMT,LW,10,40 | 1652 | - | - | - | - | - | k,x,y,aa |
| T | USC | 2 | EMT,LW,10,40 | - | - | - | - | - | 559 | k,x,y,aa |
| L | USC | 2 | EMT,LW,10,40 | - | - | - | - | - | 130 | k,x,y,aa |
| VERTICAL | USC | 4 | EMT,LW,10,40 | 1297 | - | - | - | - | - | k,x,y,aa |
| T | USC | 4 | EMT,LW,10,40 | - | - | - | - | - | 749 | k,x,y,aa |
| L | USC | 4 | EMT,LW,10,40 | - | - | - | - | - | 310 | k,x,y,aa |
| VERTICAL | CCC | 1/2 | EMT,LW,10,40 | 1012 | - | - | - | - | - | k,x,z,aa |
| T | CCC | 1/2 | EMT,LW,10,40 | - | - | - | - | - | 61 | k,x,z,aa |
| L | CCC | 1/2 | EMT,LW,10,40 | - | - | - | - | - | 117 | k,x,z,aa |
| VERTICAL | CCC | 1 | EMT,LW,10,40 | 1312 | - | - | - | - | - | k,x,z,aa |
| T | CCC | 1 | EMT,LW,10,40 | - | - | - | - | - | 115 | k,x,z,aa |
| L | CCC | 1 | EMT,LW,10,40 | - | - | - | - | - | 89 | k,x,z,aa |
| VERTICAL | CCC | 2 | EMT,LW,10,40 | 1493 | - | - | - | - | - | k,x,z,aa |
| T | CCC | 2 | EMT,LW,10,40 | - | - | - | - | - | 123 | k,x,z,aa |
| L | CCC | 2 | EMT,LW,10,40 | - | - | - | - | - | 130 | k,x,z,aa |
| VERTICAL | CCC | 4 | EMT,LW,10,40 | 1394 | - | - | - | - | - | k,x,z,aa |
| T | CCC | 4 | EMT,LW,10,40 | - | - | - | - | - | 74 | k,x,z,aa |
| L | CCC | 4 | EMT,LW,10,40 | - | - | - | - | - | 181 | k,x,z,aa |



SHEET TITLE: CAPACITY TABLE OF BRACE SUPPORTS AT SYSTEM COMPONENTS
USC & CCC

| | | |
|--|--|------------------|
| | CYS STRUCTURAL ENGINEERS, INC. | Job No: 19039 |
| | 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833 | Date: 09/08/2021 |
| | TEL (916) 920-2020 www.cyseng.com | Page: 500.5 of . |

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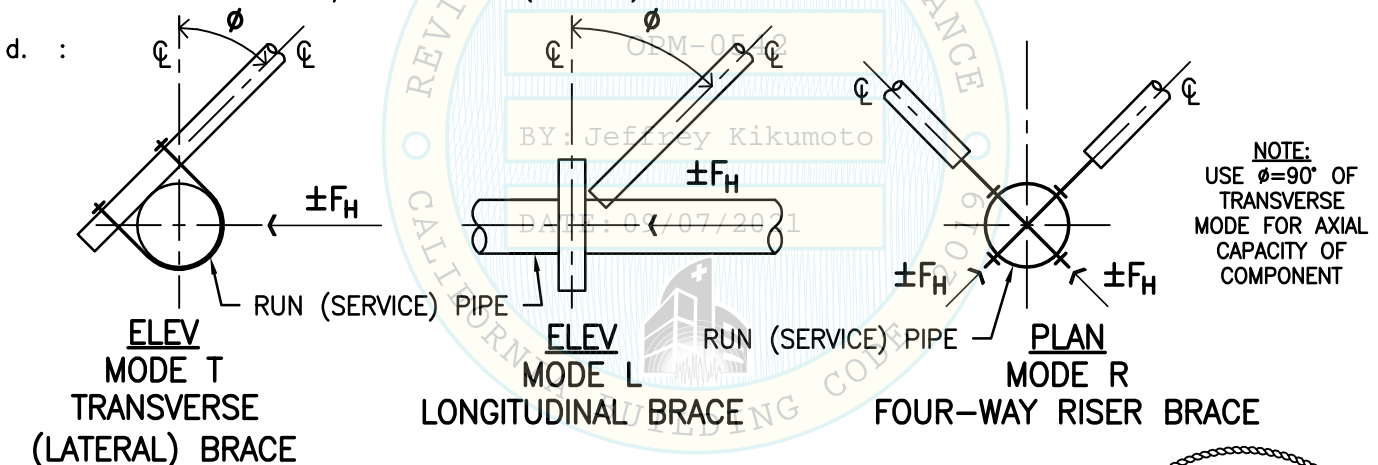
SEISMIC BRACING FOR
MEP SYSTEMS



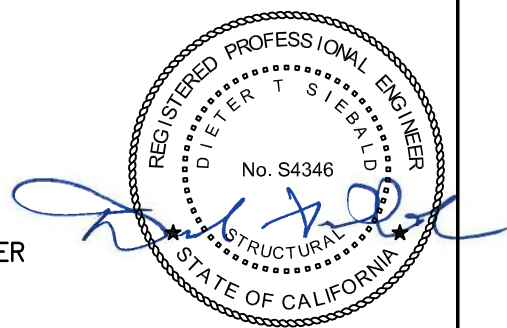
CAPACITY TABLE OF BRACE SUPPORTS AT SYSTEM COMPONENTS

TABLE FOOTNOTES:

- a. ALLOWABLE HORIZ CAPACITIES AT ALLOWABLE STRESS DESIGN OF BRACE COMPONENTS, F_H IN THE TABLE, ARE BASED ON TESTING PER ANSI/FM® APPROVAL STANDARD FOR SEISMIC SWAY BRACES FOR PIPE, TUBING AND CONDUIT, CLASS NUMBER 1950-2016 APPROVED FEBRUARY 1, 2016. THE FM SPECIFICATION TESTED REPORT PROJECT NUMBERS PR449669 REISSUE 1 SIGNED 01/16/2020 & PR449672 REISSUE 3, APPENDIX "A", REISSUED MARCH 10, 2021; PR3056157 APPENDIX "A" DATED MAY 10, 2016; PR3060189 APPENDIX "B" DATED JUNE 2, 2017; PR454958 APPENDIX "A" REISSUED APRIL 6, 2021. ALLOWABLE HORIZ CAPACITY, F_H IN THE TABLE, OF BRACE SUB-ASSEMBLIES HAVE BEEN DETERMINED BY RESOLVING THE LOAD RATING (i.e. THE LOAD RESULTING IN FAILURE OR EXCEEDANCE OF DEFORMATION LIMITS) TO THE HORIZ DIRECTION AND DIVIDING BY A SAFETY FACTOR OF 2.0 TO ALLOW THE VALUES TO BE USED DIRECTLY FOR ALLOWABLE STRESS DESIGN (ASD). FOR LOAD AND RESISTANCE FACTOR DESIGN (LRFD) CAPACITIES, THE ABV VALUES WILL NEED TO BE MULTIPLIED BY 1.5.
- b. ALLOWABLE HORIZ CAPACITY, F_H AT ASD, FOR THINNER WALLED RUN (SERVICE) PIPES MAY BE USED FOR THICKER WALLED PIPES BUT NOT VICE VERSA (i.e. SCHEDULE LW CAPACITIES F_H AT ASD MAY BE USED FOR SCHEDULE 10).
- c. LOAD RATINGS FOR LW ABV REFERS TO FM APPROVED LIGHTWALL PIPE, COMMONLY REFERRED TO AS "SCHEDULE 7". THESE RATINGS MAY ALSO BE APPLIED TO AS 1074 LIGHTWALL, EN 10220, EN 10255 L, AND GB/T 8163 RUN (SERVICE) PIPE, UNLESS OTHERWISE SPECIFIED.



- e. LOAD RATINGS BASED ON THE USE OF A $\frac{3}{8}$ " ϕ -16 UNC (M10x1.5) THRD ROD AS THE BRACE MEMBER.
- f. LOAD RATINGS BASED ON THE USE OF A $\frac{1}{2}$ " ϕ -13 UNC (M12x1.75) THRD ROD AS THE BRACE MEMBER.
- g. LOAD RATINGS FOR "0.188 WALL" ABV MAY BE APPLIED TO ANY THICKER WALLED PIPE UNLESS OTHERWISE SPECIFIED.



SHEET TITLE: CAPACITY TABLE OF BRACE SUPPORTS AT SYSTEM COMPONENTS
TABLE FOOTNOTES

| | |
|--|------------------|
| <p>CYS STRUCTURAL ENGINEERS, INC. 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833</p> | Job No: 19039 |
| | Date: 09/08/2021 |
| | Page: 500.6 of |

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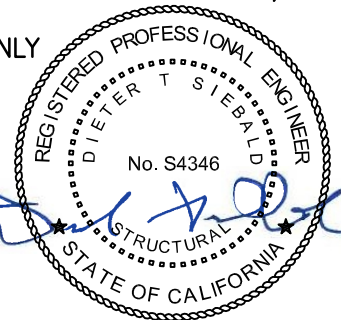
SEISMIC BRACING FOR
MEP SYSTEMS



CAPACITY TABLE OF BRACE SUPPORTS AT SYSTEM COMPONENTS

TABLE FOOTNOTES (CONTINUED):

- h. FM® APPROVED WHEN USED W/ 1", 1¼", 1½" OR 2" (DN25, DN32, DN40, DN50) NPS SCHEDULE 40, GB/T 3091, EN 10255 (HEAVY), AS 1074 (HEAVY) OR JIS G3454 **BRACE PIPE**.
- i. FM APPROVED WHEN USED W/ 1" AND 1¼" (DN25 AND DN32) NPS SCHEDULE 40, AS 1074 (HEAVY), GB/T 3091, EN 10255 (HEAVY), OR JIS G3454 **BRACE PIPE**.
- j. LOAD RATINGS FOR SCHEDULE 40 IN TABLE ABV MAY ALSO BE APPLIED TO AS 1074 (HEAVY), GB/T 3091, EN 10255 (HEAVY), AND JIS G3454 PIPE.
- k. LOAD RATINGS FOR SCHEDULE 10 IN TABLE ABV MAY ALSO BE APPLIED TO GB/T 3091, EN 10255 (MEDIUM OR HEAVY), JIS G3452, FM APPROVED THINWALL, AND SCHEDULE 40 PIPES UNLESS OTHERWISE INDICATED.
- l. FM APPROVALS DO NOT APPROVE SEISMIC BRCG PRODUCTS FOR USE W/ 8"Ø AND 10"Ø SERVICE PIPES (NPS PIPE) W/ A WALL THK LESS THAN 0.188". ASME® B36.10M-2004 DEFINES SCHEDULE 10 MIN WALL THK FOR 8"Ø AND 10"Ø SERVICE PIPES (NPS PIPE) AS 0.134" AND 0.159", RESPECTIVELY. THEREFORE, CERTIFICATES OF COMPLIANCE SPECIFY THE PIPE AS "0.188" RATHER THAN "SCHEDULE 10". IT IS TYP IN THE UNITED STATES THAT 8"Ø AND 10"Ø NPS PIPE THAT IS MARKETED AS "SCHEDULE 10" HAS A WALL THK OF 0.188", WHICH IS GREATER THAN THE MIN WALL THK SPECIFIED BY ASME B36.10M-2004.
- m. TESTING FOR THE CSBT IS FOR THE WHOLE TELESCOPING BRACE ASSEMBLY FOR ALL LENGTHS & INCLUDING THE ATTACHMENT COMPONENTS TO THE SUPPORTING STRUCTURE AS SHOWN IN SECTION 8.
- n. LOAD RATING FOR SCH. 40 **BRACE PIPE** NOTED IN FOOTNOTES h & i ABV MAY BE APPLIED TO SCH. 80 **BRACE PIPE** HAVING THE SAME DIA.
- o. LOAD RATING FOR EMT IN TABLE ABV REFERS TO 1" DIA MIN ELECTRICAL METALLIC TUBE CONDUIT OR 1" DIA MIN RIGID METALLIC CONDUIT-STEEL AS **BRACE MEMBER**.
- p. LOAD RATING FOR NO HUB CAST IRON PIPE.
- q. CSBCS RATING APPLIES WHEN CSBCS IS USED W/ nVENT CADDY MODEL 401 CLEVIS HANGER & CSBU1 ATTACHED TO THE CROSS BOLT ON THE SIDE OF THE 401 CLEVIS HANGER
- r. WHEN THE CSBT IS ATTACHED TO A VERT FACE OF A WALL OR BM, THE CAPACITY IS LIMITED TO 475 LBS.
- s. INCLUDES CSBQG0250MEG TO ACCOMMODATE DN65 PIPE SIZE.
- t. LOAD RATING FOR EMT RUN PIPE ABV REFERS TO ELECTRIC METALLIC TUBE CONDUIT, 1" DIA MIN.
- u. LOAD RATING WHEN USED AS A PAIR.
- v. LOAD RATING APPLIES TO ¾" OR ½" ROD AS VERT MEMBER BEING BRACED.
- w. LOAD RATING APPLIES WHEN 12 GA STRUT IS USED AS BRACE MEMBER.
- x. LOAD RATING FOR SCH 40 MAY BE APPLIED TO SCH 80.
- y. LOAD RATING APPLIES WHEN THE PRODUCT IS USED W/ ELECTRIC METALLIC TUBING OR RIGID METAL CONDUIT-STEEL AS DEFINED IN ANSI C80.1.
- z. LOAD RATING APPLIES WHEN THE PRODUCT IS USED W/ COPPER TUBING, ELECTRIC METALLIC TUBING, RIGID METALLIC CONDUIT-STEEL AS DEFINED IN ANSI C80.1.
- aa. LOAD RATINGS FOR LW ABV REFERS TO FM APPROVED LIGHTWALL PIPE, COMMONLY REFERRED TO AS "SCHEDULE 7". THESE RATINGS MAY ALSO BE APPLIED TO EN 10220 & GB/T 8163 RUN (SERVICE) PIPE.
- ab. IF THE CSBTB1 ATTACHMENT TO THE BRACE IS ROTATED 90° FROM WHAT IS SHOWN ON PG 5.2. THE ALLOWABLE VALUE MUST NOT EXCEED 475 POUNDS.



SHEET TITLE: CAPACITY TABLE OF BRACE SUPPORTS AT SYSTEM COMPONENTS
TABLE FOOTNOTES

| | | |
|--|--------------------------------------|---|
| <p>CYS STRUCTURAL ENGINEERS, INC. 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833</p> | TEL (916) 920-2020 www.cyseng.com | Job No: 19039 Date: 09/08/2021 Page: 500.7 of |
|--|--------------------------------------|---|

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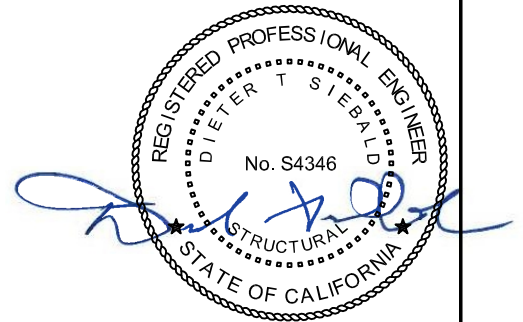
SEISMIC BRACING FOR MEP SYSTEMS



CAPACITY TABLE OF BRACE SUPPORTS AT SUPPORTING STRUCTURE

ALSO SEE NOTES AT END OF TABLE (NOTES 'a' THRU 'd' ARE TYP UNO)

| MODE | COMPONENT DESCRIPTION | JOIST OR BM THICKNESS INCHES | JOIST OR BM WIDTH INCHES | ORIENTATION | HORIZ CAPACITY F _H (POUNDS) PER INSTALLATION ANGLE ϕ | | | | NOTES |
|------|-----------------------|------------------------------|--------------------------|--------------|--|-----------|-----------|-----------|-------|
| | | | | | 30° - 44° | 45° - 59° | 60° - 74° | 75° - 90° | |
| NA | CSBBS1 | 12 GA (0.1094") - 0.50 | NA | NA | 160 | 230 | 150 | 150 | e |
| NA | CSBBS1 | 12 GA (0.1094") - 0.50 | NA | NA | 160 | 220 | 150 | 170 | f |
| NA | CSBBS3 | NA | NA | NA | 240 | 230 | 140 | 150 | h |
| NA | CSBBS3 | 16 GA MIN | NA | NA | 240 | 230 | 140 | 150 | i |
| NA | CSBBS3 | 0.25 - 0.75 | NA | LATERAL | 120 | 170 | 150 | 170 | e,f,g |
| NA | CSBBS3 | 0.25 - 0.75 | NA | LONGITUDINAL | 80 | 120 | 160 | 190 | e,f,g |
| NA | CSBU1 | NA | NA | NA | 530 | 910 | 1110 | 1220 | m |
| NA | CSBU1 | NA | NA | NA | 1270 | 1660 | 1990 | 2320 | j |
| NA | CSBU2 | NA | NA | NA | 1110 | 1710 | 2140 | 2320 | j |
| NA | CSBS1 | 0.25 - 0.75 | NA | LATERAL | 640 | 1330 | 210 | 2130 | j |
| NA | CSBS1 | 0.25 - 0.75 | NA | LONGITUDINAL | 520 | 1070 | 1510 | 1800 | j |
| NA | CSBS1A | 0.25 - 0.75 | NA | LATERAL | 640 | 1330 | 210 | 2130 | j |
| NA | CSBS1A | 0.25 - 0.75 | NA | LONGITUDINAL | 520 | 1070 | 1510 | 1800 | j |
| NA | CSBS2 | 0.75 - 1.25 | NA | LATERAL | 790 | 1610 | 1930 | 2150 | j |
| NA | CSBS2 | 0.75 - 1.25 | NA | LONGITUDINAL | 650 | 1320 | 1640 | 2010 | j |
| NA | CSBS3 | 0.25 - 0.75 | 4 - 8.5 | LATERAL | 790 | 1610 | 1930 | 2150 | j |
| NA | CSBS3 | 0.25 - 0.75 | 4 - 8.5 | LONGITUDINAL | 650 | 1320 | 1640 | 2010 | j |
| NA | CSBS4 | 0.25 - 0.75 | 4 - 14.5 | LATERAL | 820 | 1660 | 2120 | 2210 | j |
| NA | CSBS4 | 0.25 - 0.75 | 4 - 14.5 | LONGITUDINAL | 450 | 970 | 1460 | 2250 | j |
| NA | CSBS5 | 0.75 - 1.25 | 4 - 18 | LATERAL | 820 | 1660 | 2120 | 2210 | j |
| NA | CSBS5 | 0.75 - 1.25 | 4 - 18 | LONGITUDINAL | 450 | 970 | 1460 | 2250 | j |
| NA | CSBUS1 | NA | NA | NA | 1230 | 2130 | 2560 | 2860 | k |
| NA | CSBUS2 | NA | NA | NA | 1230 | 2130 | 2560 | 2860 | k |
| NA | CSBUS1PA | NA | NA | NA | 760 | 1160 | 1400 | 1920 | k |
| NA | CSBUS2PA | NA | NA | NA | 760 | 1160 | 1400 | 1920 | k |
| NA | CSBMA | NA | NA | NA | 1385 | 2400 | 4156 | 4700 | n |



SHEET TITLE: CAPACITY TABLE OF BRACE SUPPORTS AT SUPPORTING STRUCTURE
CSBBS, CSBU, CSBS, CSBUS & CSBMA

| | | |
|--|--|--------------------------------------|
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| | | Page: 600.1 of . |

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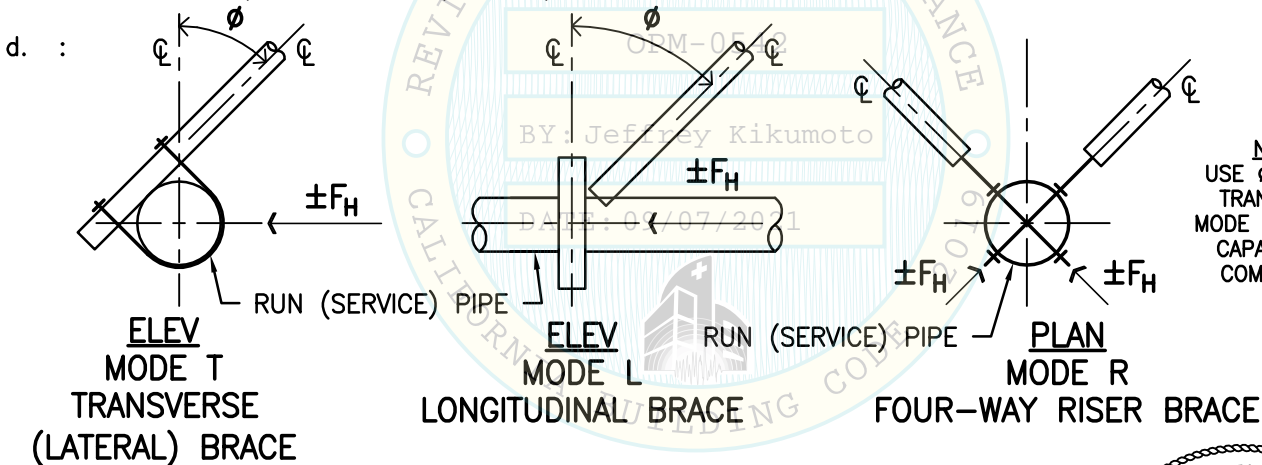
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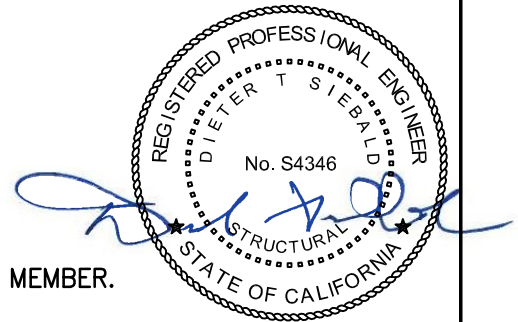
CAPACITY TABLE OF BRACE SUPPORTS AT SUPPORTING STRUCTURE

TABLE FOOTNOTES:

- a. ALLOWABLE HORIZ CAPACITIES AT ALLOWABLE STRESS DESIGN OF BRACE COMPONENTS, F_H IN THE TABLE, ARE BASED ON TESTING PER ANSI/FM® APPROVAL STANDARD FOR SEISMIC SWAY BRACES FOR PIPE, TUBING AND CONDUIT, CLASS NUMBER 1950-2016 APPROVED FEBRUARY 1, 2016, FM SPECIFICATION TESTED REPORT PROJECT NUMBER PR454958 REISSUE 1 SIGNED AND DATED 03/17/2020 & REISSUED 04/06/2021, FM APPROVAL REPORT PROJECT NO. 003060189 APPENDIX B SPECIFICATION TESTED PRODUCTS SIGNED AND DATED 06/02/2017, & FM SPECIFICATION TESTED REPORT PROJECT NO. 449672 REISSUE 3 SIGNED & DATED 03/04/2019 & REISSUED 03/10/2021. ALLOWABLE HORIZ CAPACITY, F_H IN THE TABLE, OF BRACE SUB-ASSEMBLIES HAVE BEEN DETERMINED BY RESOLVING THE LOAD RATING (i.e. THE LOAD RESULTING IN FAILURE OR EXCEEDANCE OF DEFORMATION LIMITS) TO THE HORIZ DIRECTION AND DIVIDING BY A SAFETY FACTOR OF 2.0 TO ALLOW THE VALUES TO BE USED DIRECTLY FOR ALLOWABLE STRESS DESIGN (ASD). FOR LOAD AND RESISTANCE FACTOR DESIGN (LRFD) CAPACITIES, THE ABV VALUES WILL NEED TO BE MULTIPLIED BY 1.5.
- b. ALLOWABLE HORIZ CAPACITY, F_H AT ASD, FOR THINNER WALLED RUN (SERVICE) PIPES MAY BE USED FOR THICKER WALLED PIPES BUT NOT VICE VERSA (i.e. SCHEDULE LW CAPACITIES F_H AT ASD MAY BE USED FOR SCHEDULE 10).
- c. LOAD RATINGS FOR LW ABV REFERS TO FM APPROVED LIGHTWALL PIPE, COMMONLY REFERRED TO AS "SCHEDULE 7". THESE RATINGS MAY ALSO BE APPLIED TO AS 1074 LIGHTWALL, EN 10255 L, EN 10220 AND GB/T 8163 RUN (SERVICE) PIPE, UNLESS OTHERWISE SPECIFIED.



- e. LOAD RATINGS BASED ON THE USE OF A $\frac{3}{8}$ " ϕ -16 UNC (M10x1.5) THRD ROD AS THE **BRACE MEMBER**.
- f. LOAD RATINGS BASED ON THE USE OF A $\frac{1}{2}$ " ϕ -13 UNC (M12x1.75) THRD ROD AS THE **BRACE MEMBER**.
- g. LOAD RATINGS BASED ON THE USE OF A MODEL 300 BM CLAMP ($\frac{3}{8}$ " ϕ -16 UNC/M10x1.5 BOLT) AS MEANS FOR ATTACHMENT TO STRUC MEMBER.



SHEET TITLE: CAPACITY TABLE OF BRACE SUPPORTS AT SUPPORTING STRUCTURE
TABLE FOOTNOTES

| | | |
|--|--------------------------------------|---|
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|--|--------------------------------------|---|

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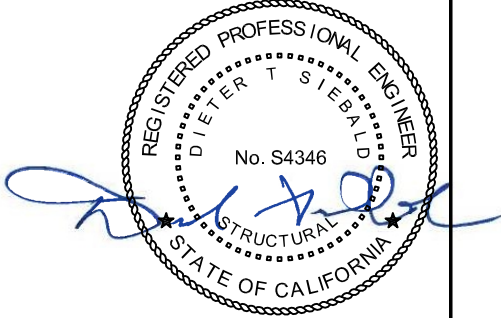
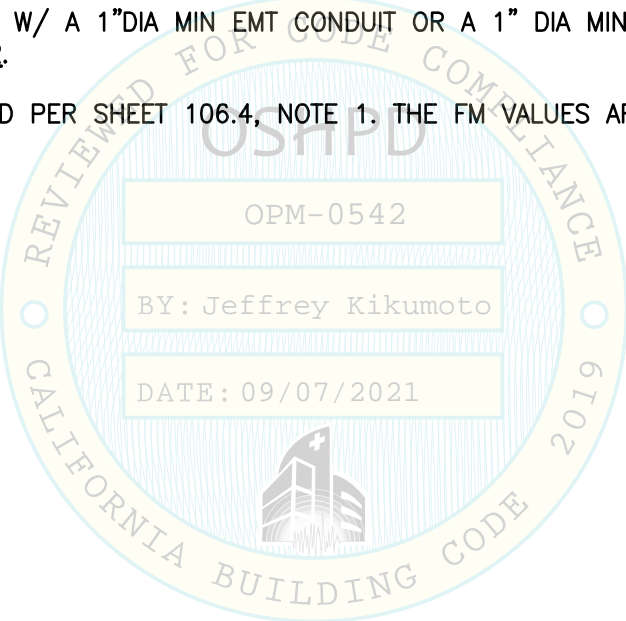
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MEP SYSTEMS



CAPACITY TABLE OF BRACE SUPPORTS AT SUPPORTING STRUCTURE

TABLE FOOTNOTES (CONTINUED):

- h. LOAD RATINGS BASED ON THE USE OF A $\frac{3}{8}$ " ϕ -16 UNC (M10x1.5) THRD FASTENER AS THE ATTACHMENT FASTENER TO A CONC INSERT.
- i. FM APPROVED WHEN USED W/ 1" AND $1\frac{1}{4}$ " (DN25 AND DN32) NPS SCHEDULE 40 AS 1074 HEAVY, GB/T 3091, EN 10255 (HEAVY), OR JIS G3454 **BRACE PIPE**.
- j. FM APPROVED WHEN USED W/ 1", $1\frac{1}{4}$ ", $1\frac{1}{2}$ " OR 2" (DN25, DN32, DN40, DN50) NPS SCHEDULE 40, GB/T 3091, EN 10255 (HEAVY), AS 1074 HEAVY OR JIS G3454 **BRACE PIPE**.
- k. FM APPROVED W/ 12 GA OR THICKER ERICO "TYPE A" STRUT AS **BRACE MEMBER**. FOR "TYPE A" STRUT SEE PGS 1.31 & 106.5.
- l. LOAD RATINGS BASED ON THE USE OF $\frac{3}{8}$ "-16 UNC (M10x1.5) THRD FASTENER AS THE ATTACHMENT FASTENER TO THE STRUCTURAL MEMBER.
- m. LOAD RATING WHEN USED W/ A 1"DIA MIN EMT CONDUIT OR A 1" DIA MIN RMC AS DETAILED IN ANSI C80.1 AS **BRACE MEMBER**.
- n. CSBMA LOADS ARE LIMITED PER SHEET 106.4, NOTE 1. THE FM VALUES ARE SUPERSEDED BY VALUES PROVIDED ON PG 106.4.



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SHEET TITLE: CAPACITY TABLE OF BRACE SUPPORTS AT SUPPORTING STRUCTURE
TABLE FOOTNOTES



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| Page: | 600.3 of . |

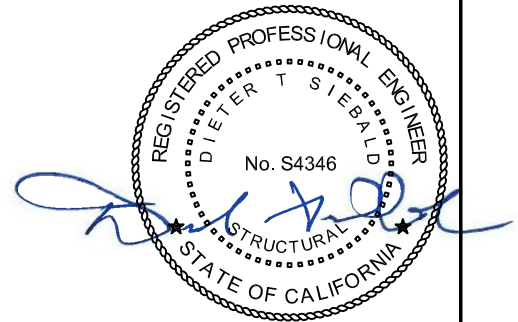
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MEP SYSTEMS



APPENDIX 'A'

| MECHANICAL ANCHOR CAPACITY (CASE 1: METAL DECK WITH CONCRETE FILL) | | | | | | |
|--|-----------------|------------|-------------------------------|----------------------------------|---|---|
| MFR | TYPE | ESR REPORT | ANCHOR DIAMETER (IN) d_a | EFFECTIVE EMBED (IN) h_{ef} | LRFD TENSION CAPACITY (LBS) ϕT_n | LRFD SHEAR CAPACITY (LBS) ϕV_n |
| DEWALT / POWERS | Power-Stud+ SD1 | ESR-2818 | 0.5 | 2 | 1165 | 1489 |
| | | | 0.5 | 3.25 | 1165 | 1489 |
| | | | 0.75 | 3.125 | 1377 | 2971 |
| | | | 0.75 | 4.75 | 1377 | 2971 |
| | Power-Stud+ SD2 | ESR-2502 | 0.5 | 2 | 714 | 2480 |
| | | | 0.5 | 3.25 | 1268 | 3276 |
| | | | 0.75 | 3.75 | 1692 | 1833 |
| | Snake+ | ESR-2272 | 0.375 | 1.1 | 524 | 462 |
| | | | 0.5 | 1.54 | 634 | 1197 |
| | Hangermate+ | ESR-3889 | 0.25 | 1.2 | 141 | 624 |
| 0.25 | | | 1.94 | 141 | 624 | |
| HILTI | Kwik Bolt TZ2 | ESR-4266 | 0.5 | 2 | 1041 | 1469 |
| | | | 0.5 | 3.25 | 1628 | 2753 |
| | | | 0.75 | 3.25 | 1621 | 2655 |
| | | | 0.75 | 3.75 | 1818 | 5112 |

NOTE:
TABLE CONTINUED ON NEXT PAGE



SHEET TITLE: APPENDIX 'A'
CAPACITY TABLES OF ANCHORS



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| Page: | A1 of . |

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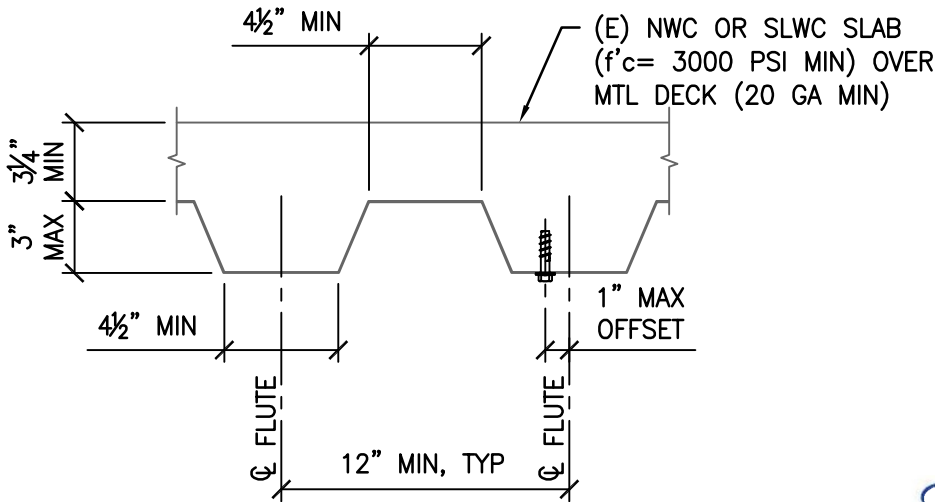
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MEP SYSTEMS



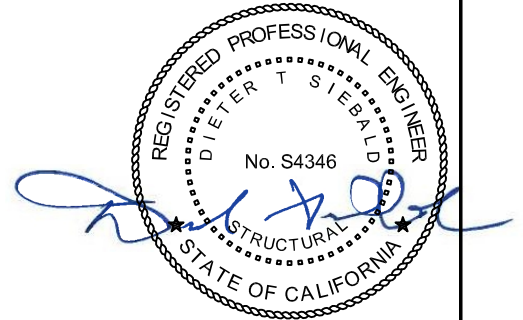
APPENDIX 'A'

MECHANICAL ANCHOR CAPACITY (CASE 1: METAL DECK WITH CONCRETE FILL)

| MFR | TYPE | ESR REPORT | ANCHOR DIAMETER (IN) d_a | EFFECTIVE EMBED (IN) h_{ef} | LRFD TENSION CAPACITY (LBS) ϕT_n | LRFD SHEAR CAPACITY (LBS) ϕV_n |
|---------------------|-----------------------------|------------|-------------------------------|----------------------------------|---|---|
| SIMPSON | Strong-Tie Strong-Bolt 2 | ESR-3037 | 0.5 | 2.25 | 995 | 1248 |
| | | | 0.5 | 4 | 1777 | 2678 |
| | | | 0.75 | 3.375 | 1372 | 2399 |
| | Strong-Tie Strong-Bolt 2 SS | ESR-3037 | 0.5 | 2.25 | 970 | 1560 |
| | | | 0.5 | 4 | 1243 | 2129 |
| | | | 0.75 | 3.375 | 1477 | 3588 |
| Strong-Tie Titen HD | ESR-2713 | 0.5 | 1.29 | 441 | 939 | |
| | | 0.5 | 2.56 | 995 | 1708 | |



DECK REQUIREMENTS



SHEET TITLE: APPENDIX 'A'
CAPACITY TABLES OF ANCHORS



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Job No: 19039
Date: 09/08/2021
Page: A2 of .

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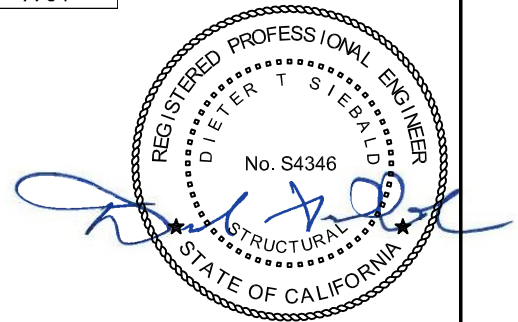
SEISMIC BRACING FOR MEP SYSTEMS



APPENDIX 'A'

| MECHANICAL ANCHOR CAPACITY (CASE 2, 3: CONCRETE FLOOR, ROOF, OR WALL) | | | | | | |
|---|-------------------------|------------|---------------|------------|----------------|----------------|
| MFR | TYPE | ESR REPORT | ANCHOR | EFFECTIVE | LRFD TENSION | LRFD SHEAR |
| | | | DIAMETER (IN) | EMBED (IN) | CAPACITY (LBS) | CAPACITY (LBS) |
| | | | d_a | h_{ef} | ϕT_n | ϕV_n |
| DEWALT / POWERS | Power-Stud+ SD1 | ESR-2818 | 0.5 | 2 | 1284 | 1844 |
| | | | 0.5 | 3.25 | 1338 | 2574 |
| | | | 0.75 | 3.125 | 2508 | 5577 |
| | | | 0.75 | 4.75 | 4699 | 6263 |
| | Power-Stud+ SD2 | ESR-2502 | 0.5 | 2 | 1284 | 1844 |
| | | | 0.5 | 3.25 | 2336 | 3130 |
| | | | 0.75 | 3.75 | 3296 | 5239 |
| | | | 0.75 | 5 | 4163 | 5239 |
| | Power-Stud+ SD4 (SS304) | ESR-2502 | 0.5 | 2 | 1284 | 1797 |
| | | | 0.75 | 3.75 | 3296 | 5034 |
| | Power-Stud+ SD6 (SS316) | ESR-2502 | 0.5 | 2 | 1284 | 1797 |
| | | | 0.75 | 3.75 | 3296 | 5034 |
| | Snake+ | ESR-2272 | 0.375 | 1.1 | 524 | 501 |
| | | | 0.5 | 1.54 | 867 | 1246 |
| Mini-Undercut+ (5/8" OD) | ESR-3912 | 0.375 | 0.75 | 135 | 272 | |
| Hangermate+ | ESR-3889 | 0.25 | 1.2 | 192 | 360 | |
| | | 0.25 | 1.94 | 625 | 834 | |
| HDI-P TZ | ESR-4236 | 0.375 | 0.75 | 153 | 272 | |
| HILTI | Kwik Bolt TZ2 | ESR-4266 | 0.5 | 2 | 1284 | 1844 |
| | | | 0.5 | 3.25 | 2660 | 4415 |
| | | | 0.75 | 3.25 | 2216 | 6365 |
| | | | 0.75 | 3.75 | 3296 | 6414 |
| | | | 0.75 | 4.75 | 4646 | 7764 |
| | Kwik Bolt TZ2 SS | ESR-4266 | 0.5 | 2 | 1086 | 1560 |
| | | | 0.5 | 3.25 | 2660 | 4415 |
| | | | 0.75 | 3.75 | 3296 | 6414 |
| | | | 0.75 | 4.75 | 4697 | 7764 |

NOTE:
TABLE CONTINUED ON NEXT PAGE



SHEET TITLE: APPENDIX 'A'
CAPACITY TABLES OF ANCHORS

| | | | | |
|--|---------------------------------------|--|---------|------------|
| | CYS STRUCTURAL ENGINEERS, INC. | | Job No: | 19039 |
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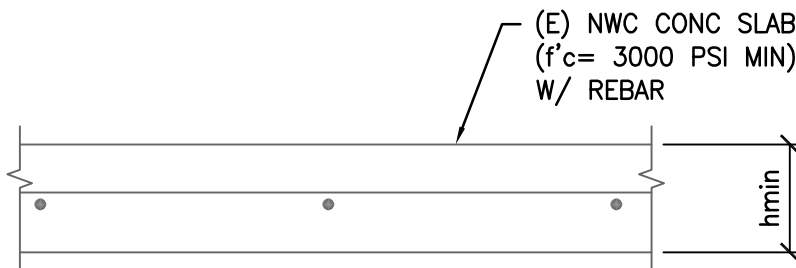


APPENDIX 'A'

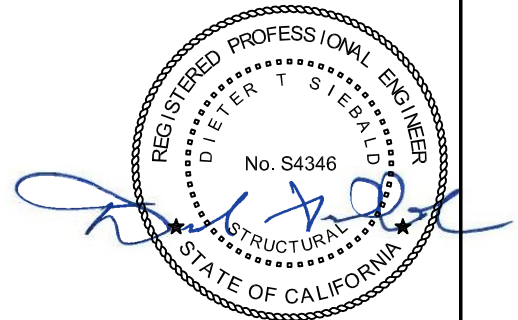
| MECHANICAL ANCHOR CAPACITY (CASE 2, 3: CONCRETE FLOOR, ROOF, OR WALL) | | | | | | |
|---|-----------------------------|------------|-------------------------------|----------------------------------|---|---|
| MFR | TYPE | ESR REPORT | ANCHOR DIAMETER (IN) d_a | EFFECTIVE EMBED (IN) h_{ef} | LRFD TENSION CAPACITY (LBS) ϕT_n | LRFD SHEAR CAPACITY (LBS) ϕV_n |
| SIMPSON | Strong-Tie Strong-Bolt 2 | ESR-3037 | 0.5 | 2.25 | 1532 | 2200 |
| | | | 0.5 | 3.375 | 2662 | 4232 |
| | | | 0.75 | 3.375 | 2814 | 5329 |
| | | | 0.75 | 5 | 4539 | 6563 |
| | Strong-Tie Strong-Bolt 2 SS | ESR-3037 | 0.5 | 2.25 | 1367 | 2200 |
| | | | 0.5 | 3.375 | 2299 | 3965 |
| | | | 0.75 | 3.375 | 2814 | 5329 |
| | | | 0.75 | 5 | 4395 | 6563 |
| | Strong-Tie Titen HD | ESR-2713 | 0.5 | 2.35 | 1635 | 2348 |
| | | | 0.5 | 2.99 | 2347 | 2874 |
| | | | 0.75 | 2.94 | 2051 | 5610 |
| | | | 0.75 | 4.22 | 3242 | 5610 |
| | | | 0.75 | 4.86 | 3842 | 5610 |

NOTES:

1. ANCHOR CAPACITY VALUES SHOWN ARE AT LRFD LEVEL DESIGN & FOR SINGLE ANCHOR WITHOUT EFFECTS DUE TO ADJ ANCHORS. FOR ANCHOR GROUPS, SEOR MUST PROVIDE ADDNL CONC BREAKOUT CHECKS AS REQ. VERIFY THAT SUPPORTING STRUCTURE IS ADEQUATE TO SUPPORT THE WEIGHT & FORCES SHOWN IN ADDITION TO ALL OTHER LOADS.
2. SEE SECTION 1 – OVERVIEW & GENERAL NOTES FOR SETTING INFO. SEE SECTION 101 & SECTION 102 FOR SLAB PROPERTIES.
3. SEE PG 1.13 FOR CASES 2 & 3 DESCRIPTION.



SLAB REQUIREMENTS



SHEET TITLE: APPENDIX 'A'
CAPACITY TABLES OF ANCHORS



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| Page: | A4 of . |

SEISMIC BRACING FOR
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APPENDIX 'A'

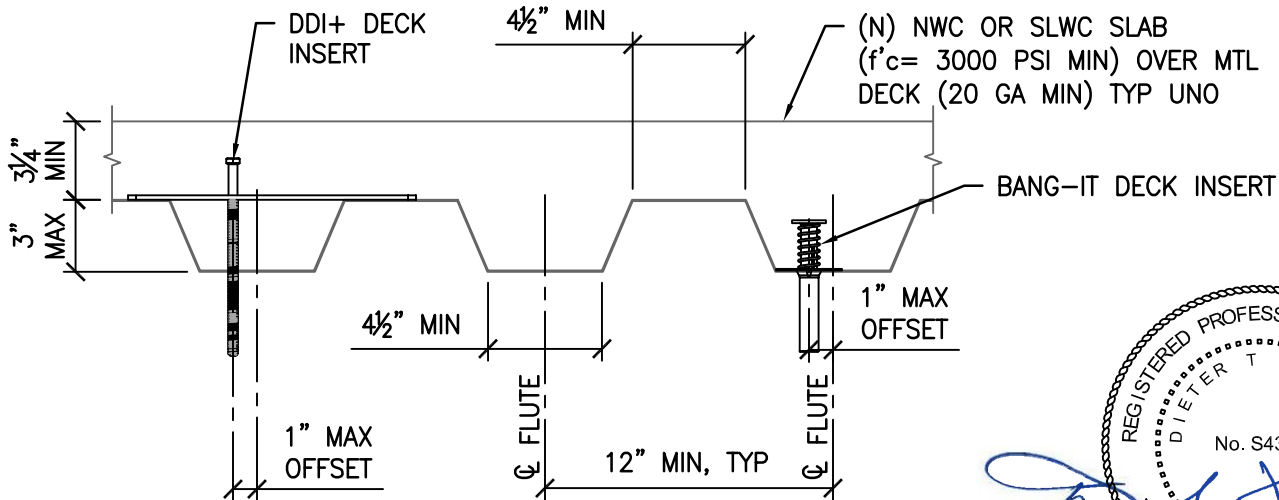
CAST-IN PLACE ANCHOR CAPACITY (CASE 4: METAL DECK WITH CONCRETE FILL)

| MFR | TYPE | ESR REPORT | ANCHOR DIAMETER (IN) d_a | EFFECTIVE EMBED (IN) h_{ef} | LRFD TENSION CAPACITY (LBS) ϕT_n | LRFD SHEAR CAPACITY (LBS) ϕV_n |
|-------------------|---------------------|------------|-------------------------------|----------------------------------|---|---|
| DEWALT/ POWERS | Bang-It Deck Insert | ESR-3657 | 0.7(*) | 1.75 | 970 | 1368 |
| | | | 1(*) | 1.75 | 970 | 1617 |
| | DDI+ Deck Insert | ESR-3958 | 0.375 | 1.5 | 808 | 1209 |
| | | | 0.5 | 1.75 | 970 | 2046 |
| | | | 0.625 | 2 | 1141 | 3441 |

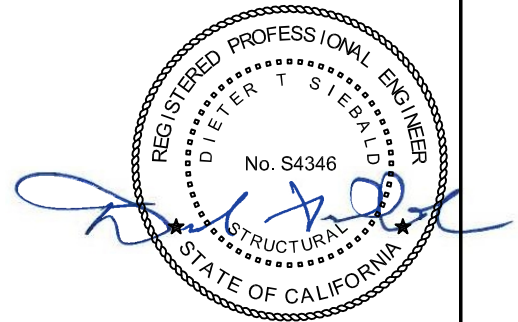
(*) OUTSIDE DIA OF THE STL INSERT BODY

NOTES:

1. ANCHOR CAPACITY VALUES SHOWN ARE AT LRFD LEVEL DESIGN & FOR SINGLE ANCHOR WITHOUT EFFECTS DUE TO ADJ ANCHORS. FOR ANCHOR GROUPS, SEOR MUST PROVIDE ADDNL CONC BREAKOUT CHECKS AS REQ. VERIFY THAT SUPPORTING STRUCTURE IS ADEQUATE TO SUPPORT THE WEIGHT & FORCES SHOWN IN ADDITION TO ALL OTHER LOADS.
2. SEE SECTION 1 - OVERVIEW & GENERAL NOTES FOR SETTING INFO. SEE SECTION 100 FOR DECK DIMS & CONC FILL PROPERTIES.
3. SEE PG 1.15 FOR CASE 4 DESCRIPTION.
4. SEE PG 1.13 FOR ANCHORAGE CASES 1 THROUGH 3 & PG 1.15 FOR ANCHORAGE CASES 4 & 5.
5. SEE PG 1.14 FOR THRD ROD SIZES THAT CAN BE USED FOR "BANG-IT" DECK INSERTS.
6. "DDI+" DECK INSERTS MUST BE INSTALLED SO THAT THRD PORTION IS LOCATED IN BOTT FLUTE AS SHOWN BLW. SEE PG 1.14 FOR DECK REQ FOR DDI DECK INSERT.



DECK REQUIREMENTS



SHEET TITLE: APPENDIX 'A'
CAPACITY TABLES OF ANCHORS



CYS STRUCTURAL ENGINEERS, INC.

2495 NATOMAS PARK DRIVE, SUITE 650
SACRAMENTO, CA 95833

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

Job No: 19039
Date: 09/08/2021
Page: A5 of .

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SEISMIC BRACING FOR
MEP SYSTEMS

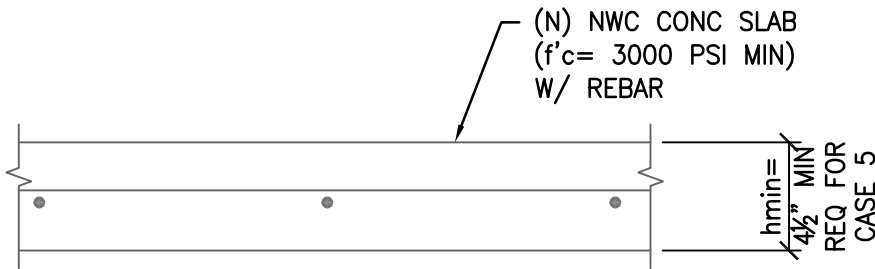


APPENDIX 'A'

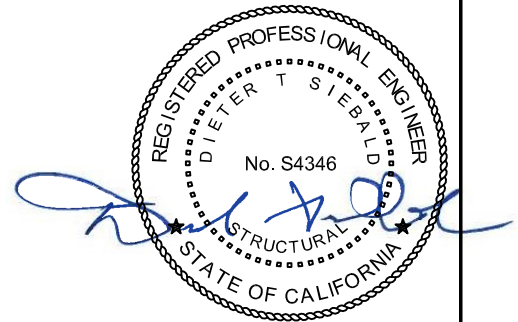
| CAST-IN PLACE ANCHOR CAPACITY (CASE 5: CONCRETE FLOOR, ROOF, OR WALL) | | | | | | |
|---|-------------------------|------------|-------------------------------|----------------------------------|---|---|
| MFR | TYPE | ESR REPORT | ANCHOR DIAMETER (IN) d_a | EFFECTIVE EMBED (IN) h_{ef} | LRFD TENSION CAPACITY (LBS) ϕT_n | LRFD SHEAR CAPACITY (LBS) ϕV_n |
| DEWALT / POWERS | Wood-Knocker II+ Insert | ESR-3657 | 0.7 | 1.75 | 1484 | 2131 |
| | | | 1 | 1.75 | 1484 | 2131 |

NOTES:

1. ANCHOR CAPACITY VALUES SHOWN ARE AT LRFD LEVEL DESIGN & FOR SINGLE ANCHOR WITHOUT EFFECTS DUE TO ADJ ANCHORS. FOR ANCHOR GROUPS, SEOR MUST PROVIDE ADDNL CONC BREAKOUT CHECKS AS REQ. VERIFY THAT SUPPORTING STRUCTURE IS ADEQUATE TO SUPPORT THE WEIGHT & FORCES SHOWN IN ADDITION TO ALL OTHER LOADS.
2. SEE SECTION 1 – OVERVIEW & GENERAL NOTES FOR SETTING INFO. SEE SECTION 101 & SECTION 102 FOR SLAB PROPERTIES.
3. SEE PG 1.15 FOR CASE 5 DESCRIPTION.
4. SEE PG 1.13 FOR ANCHORAGE CASES 1 THROUGH 3 & PG 1.15 FOR ANCHORAGE CASES 4 & 5.
5. SEE PG 1.14 THRD ROD SIZES THAT CAN BE USED FOR WOOD-KNOCKER II+ INSERTS.



SLAB REQUIREMENTS



SHEET TITLE: APPENDIX 'A'
CAPACITY TABLES OF ANCHORS

| | | |
|--|--------------------------------------|--|
| <p>CYS STRUCTURAL ENGINEERS, INC. 2495 NATOMAS PARK DRIVE, SUITE 650 SACRAMENTO, CA 95833</p> | TEL (916) 920-2020 www.cyseng.com | Job No: 19039 Date: 09/08/2021 Page: A6 of . |
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