STRUCTURAL CALCULATIONS

FOR

SUSPENDED BUS SYSTEM SEISMIC SUPPORTS

SEISMIC SUPPORT GUIDELINES

PROJECT:

REVISION 0
Original Calculations Dated 05/30/17

CALCULATIONS PREPARED BY:

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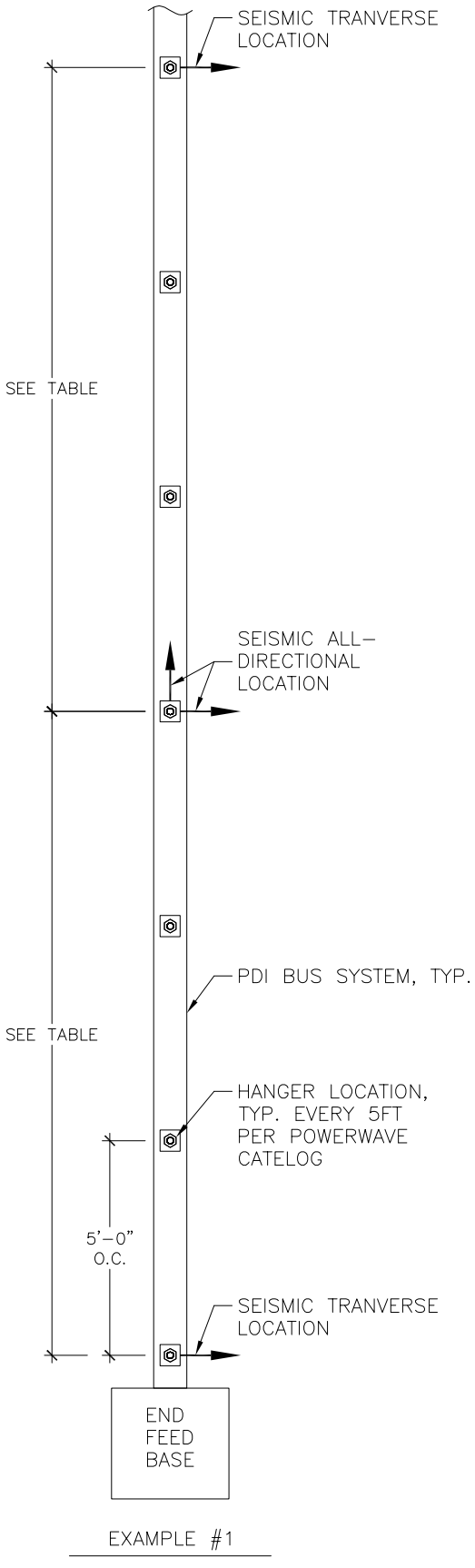
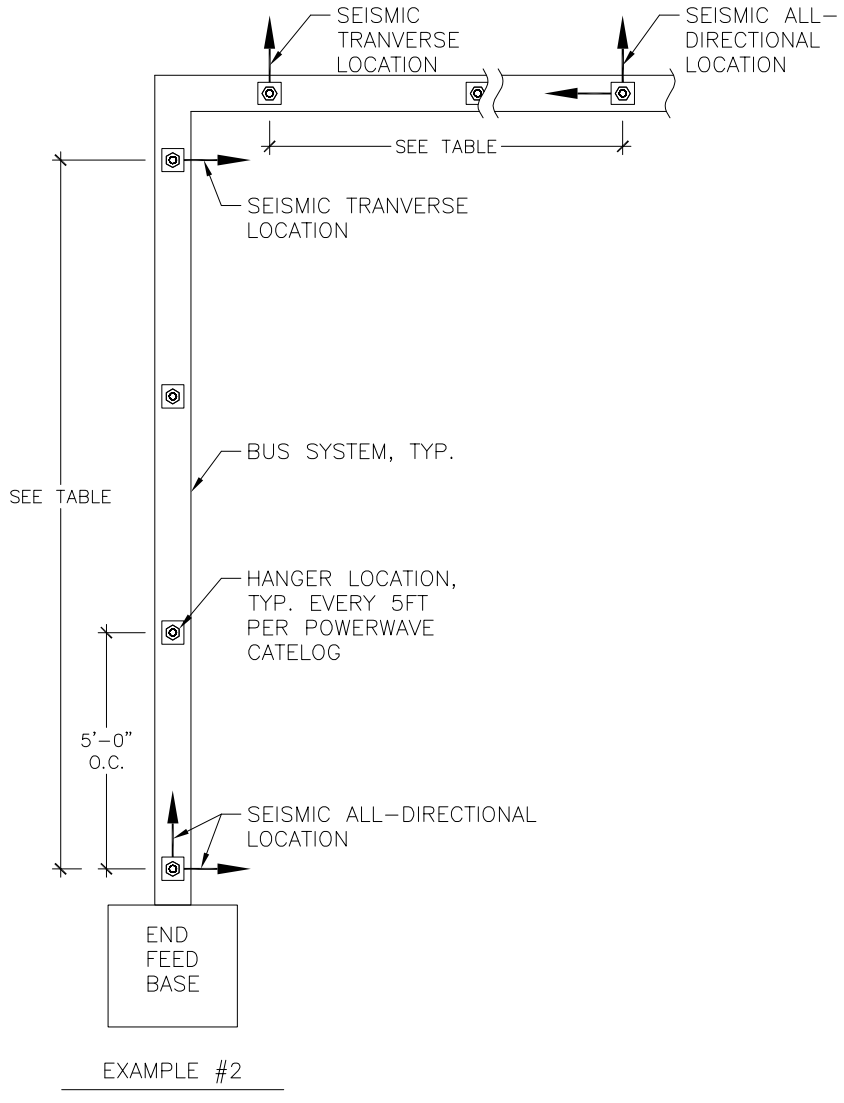
DETERMINE 'G' FORCE PER PROJECT'S SPECIFIC:

S_{DS} = SPECTRAL ACCELERATION
(TYPICALLY AVAILABLE ON PROJECT STRUCTURE SHEET)

$F_P = 0.5 * S_{DS}$
(DEMAND 'G' FORCE)



EXAMPLE #1

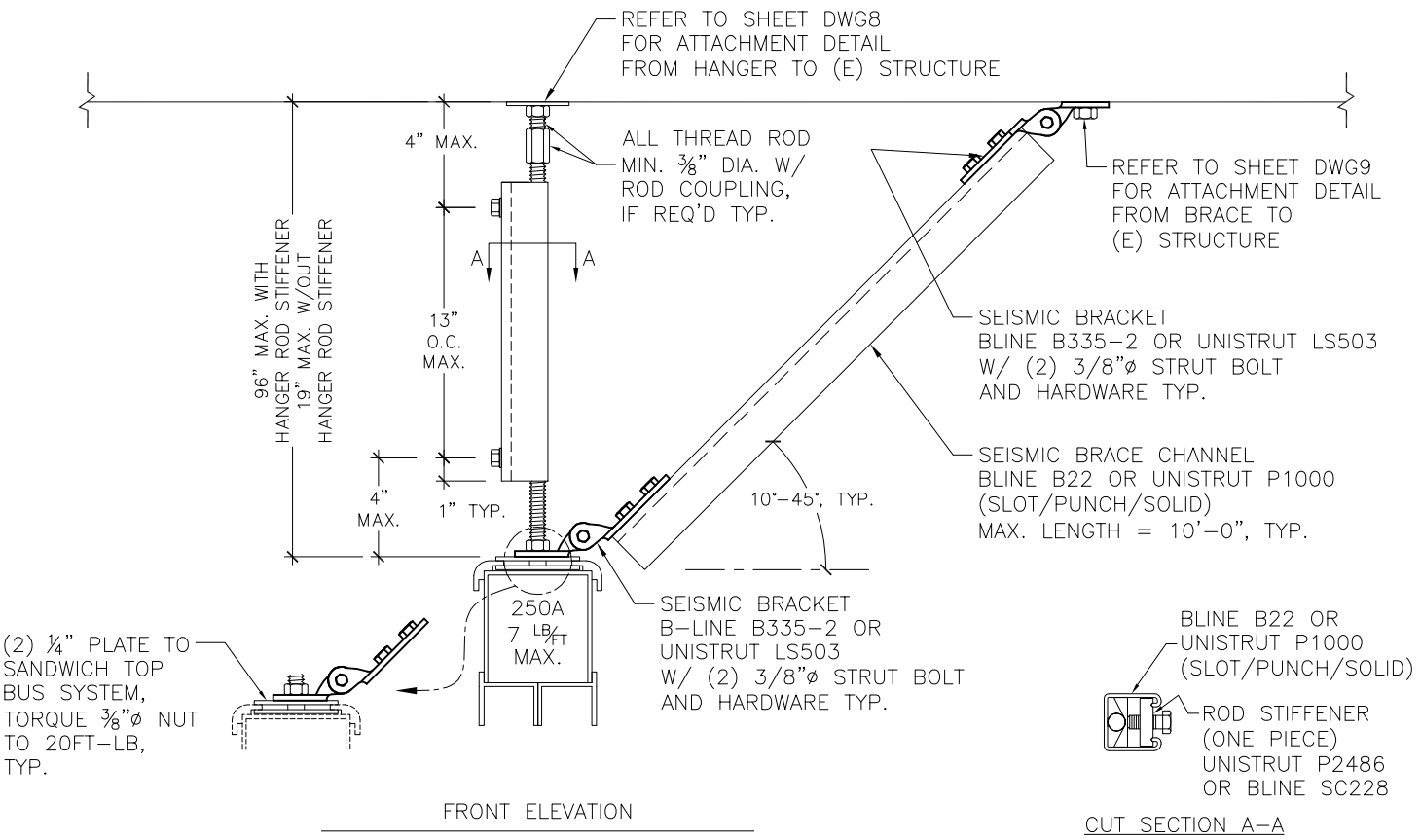


EXAMPLE #2

NOTE: CONSTRUCTION SHALL NOT BEGIN UNTIL ALL SUBMITTALS ARE APPROVED.

A. PALMA engineering p.o. box 1075 pleasanton, ca 94566	PROJECT: SEISMIC SUSPENDED PDI BUS SYSTEM SUPPORTS	TAG: SUPPORT GUIDELINES	SHEET: DWG1

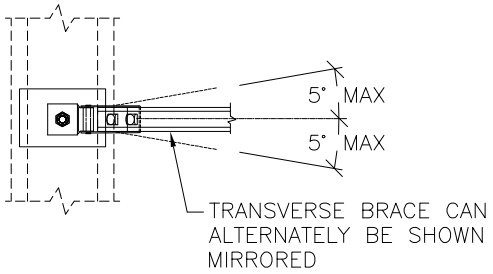
TRANSVERSE SEISMIC RESTRAINT SUSPENDED BUSRAIL



FRONT ELEVATION

CUT SECTION A-A

SEISMIC 'G'	SUPPORT SPACING
0.50G	40 FT. MAX.
0.75G	25 FT. MAX.
1.00G	20 FT. MAX.



PLAN VIEW

NOTE: CONSTRUCTION SHALL NOT BEGIN UNTIL ALL SUBMITTALS ARE APPROVED.

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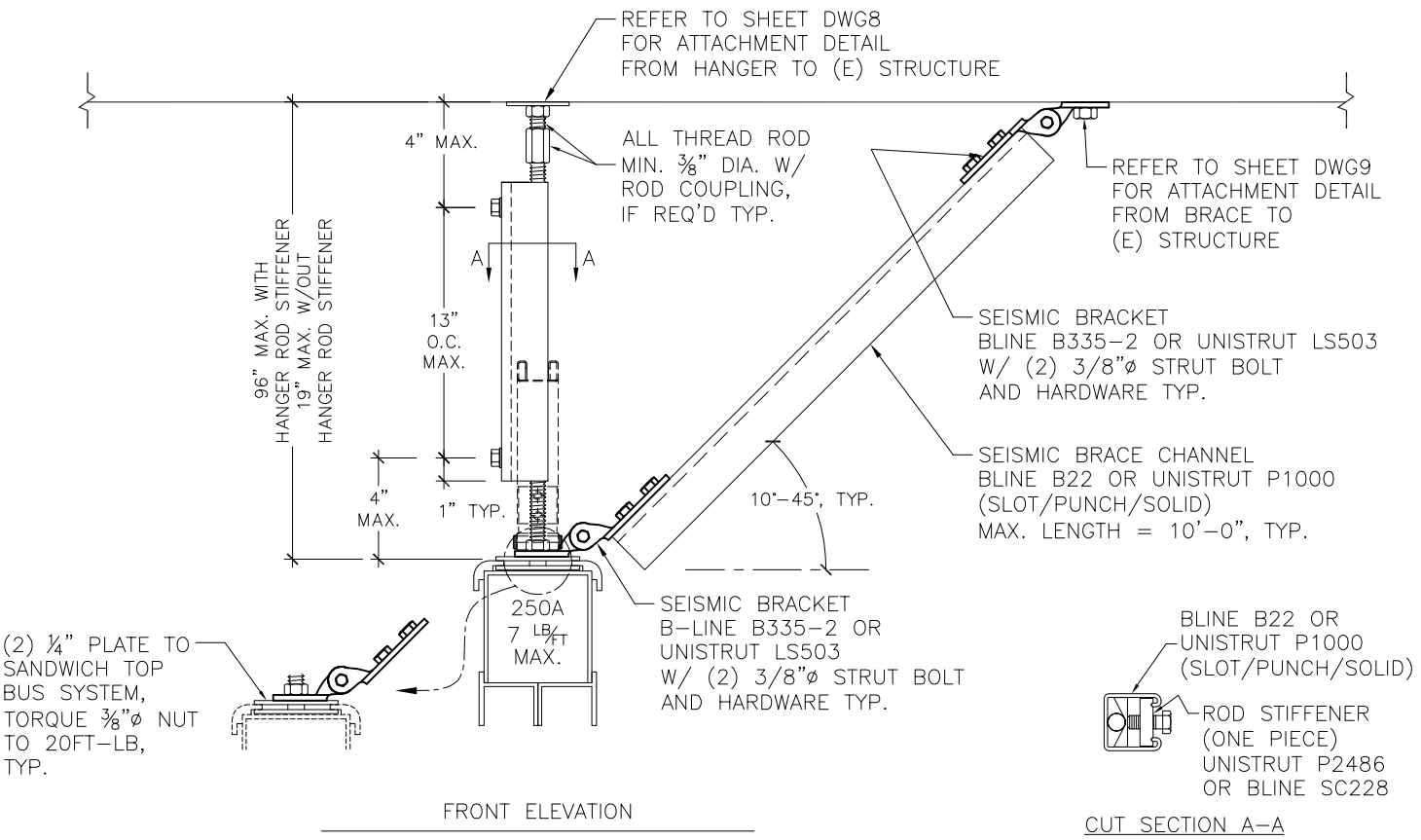
PROJECT: SEISMIC SUSPENDED BUS SYSTEM SUPPORTS

TAG: HPW2-250-VH38-SM [250A - 7 LB/FT]

SHEET: DWG2

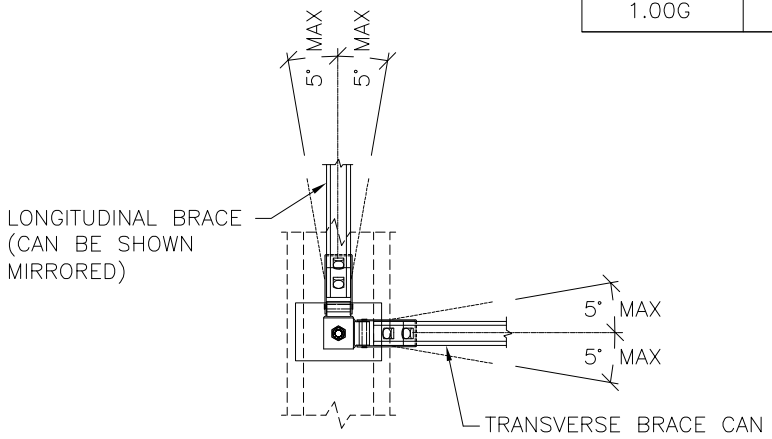
ALL–DIRECTIONAL SEISMIC RESTRAINT SUSPENDED BUSRAIL



FRONT ELEVATION

CUT SECTION A–A

SEISMIC 'G'	SUPPORT SPACING
0.50G	80 FT. MAX.
0.75G	50 FT. MAX.
1.00G	40 FT. MAX.



PLAN VIEW

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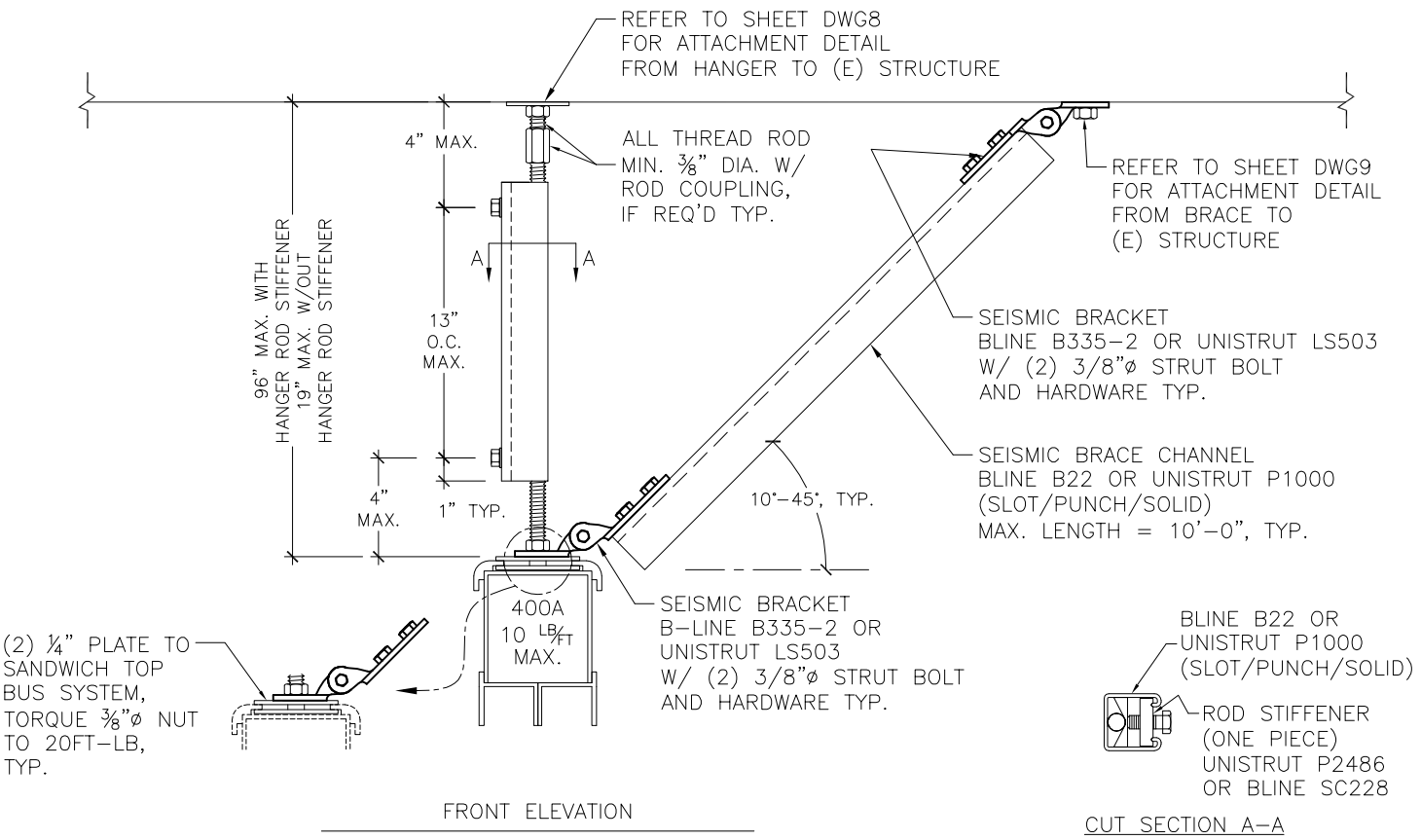
PROJECT: SEISMIC SUSPENDED BUS SYSTEM SUPPORTS

TAG: HPW2-250-VH38-SM [250A - 7 LB/FT]

SHEET: DWG3

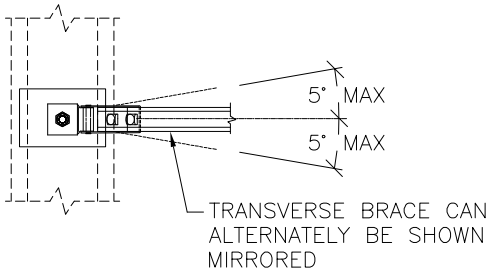
TRANSVERSE SEISMIC RESTRAINT SUSPENDED BUSRAIL



FRONT ELEVATION

CUT SECTION A-A

SEISMIC 'G'	SUPPORT SPACING
0.50G	40 FT. MAX.
0.75G	25 FT. MAX.
1.00G	20 FT. MAX.



PLAN VIEW

NOTE: CONSTRUCTION SHALL NOT BEGIN UNTIL ALL SUBMITTALS ARE APPROVED.

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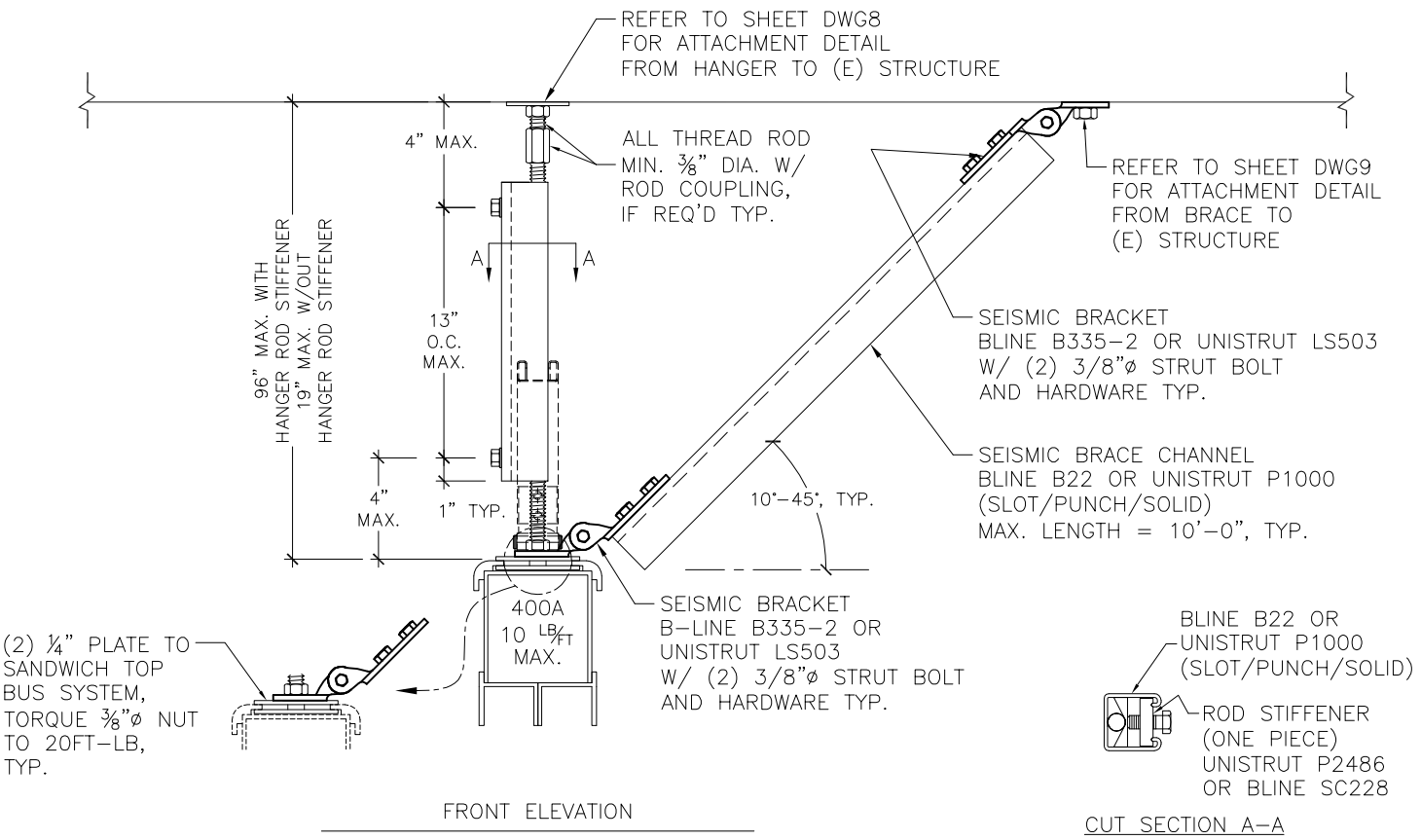
PROJECT: SEISMIC SUSPENDED BUS SYSTEM SUPPORTS

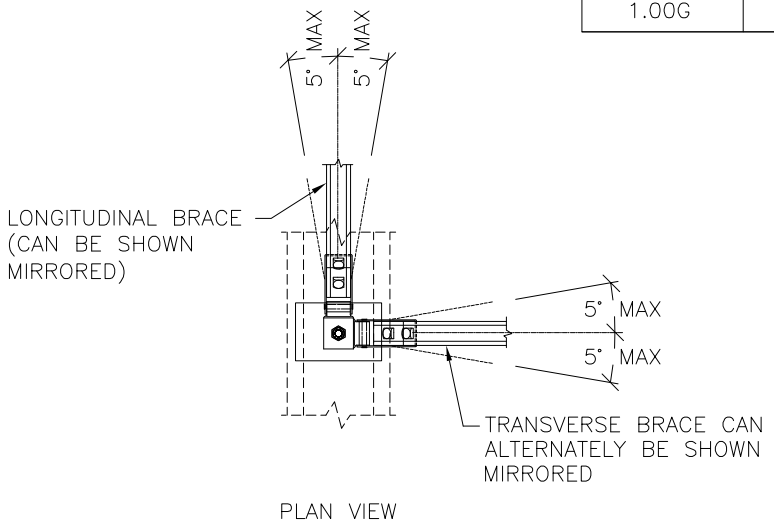
TAG: HPW2-400-VH38-SM [250A - 10 LB/FT]

SHEET: DWG4

ALL–DIRECTIONAL SEISMIC RESTRAINT SUSPENDED BUSRAIL



SEISMIC 'G'	SUPPORT SPACING
0.50G	80 FT. MAX.
0.75G	50 FT. MAX.
1.00G	40 FT. MAX.



PLAN VIEW

NOTE: CONSTRUCTION SHALL NOT BEGIN UNTIL ALL SUBMITTALS ARE APPROVED.

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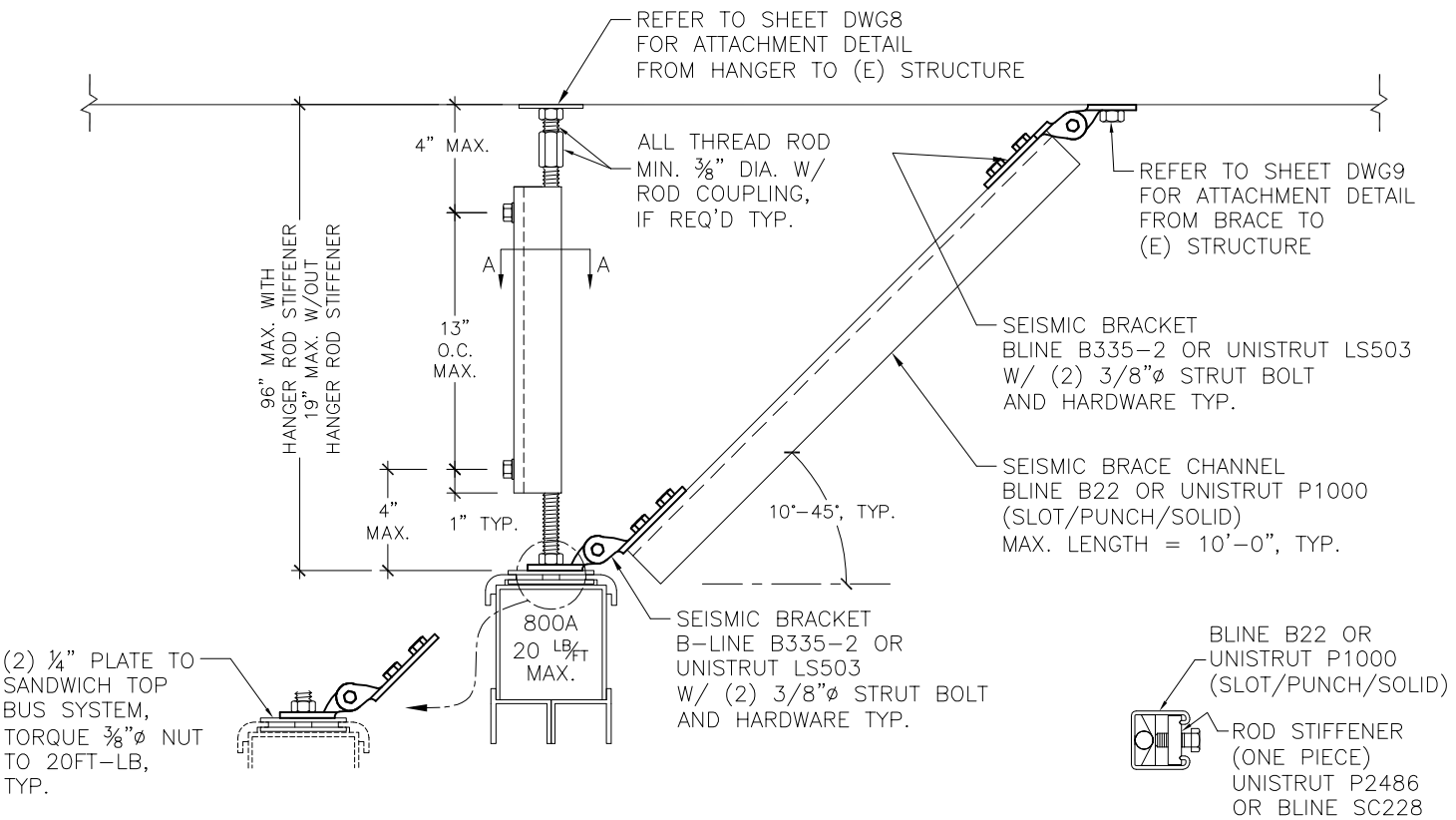
PROJECT: SEISMIC SUSPENDED BUS SYSTEM SUPPORTS

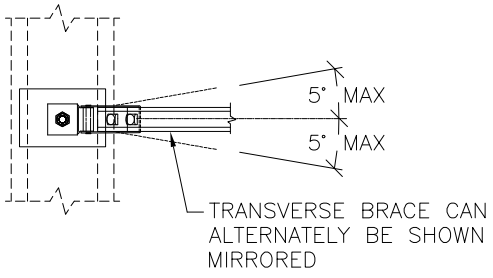
TAG: HPW2-400-VH38-SM [250A - 10 LB/FT]

SHEET: DWG5

TRANSVERSE SEISMIC RESTRAINT SUSPENDED BUSRAIL



SEISMIC 'G'	SUPPORT SPACING
0.50G	20 FT. MAX.
0.75G	15 FT. MAX.
1.00G	15 FT. MAX.



PLAN VIEW

NOTE: CONSTRUCTION SHALL NOT BEGIN UNTIL ALL SUBMITTALS ARE APPROVED.

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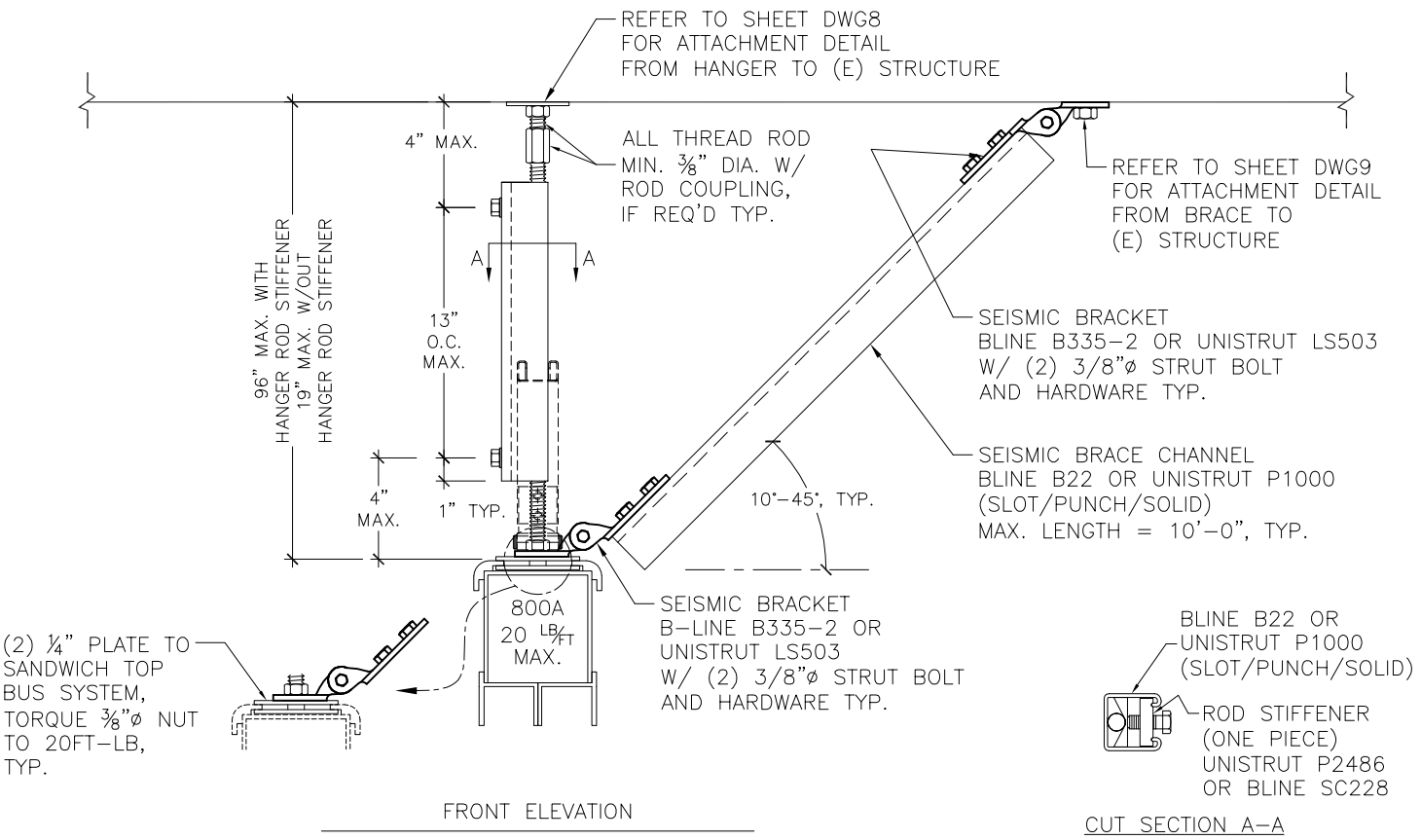
PROJECT: SEISMIC SUSPENDED BUS SYSTEM SUPPORTS

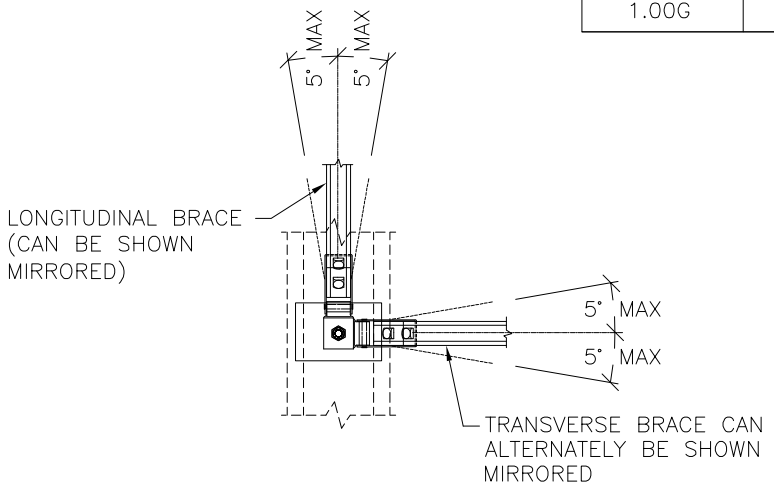
TAG: HPW2-800-VH38-SM [800A - 20 LB/FT]

SHEET: DWG6

ALL–DIRECTIONAL SEISMIC RESTRAINT SUSPENDED BUSRAIL



SEISMIC 'G'	SUPPORT SPACING
0.50G	40 FT. MAX.
0.75G	30 FT. MAX.
1.00G	30 FT. MAX.



PLAN VIEW

NOTE: CONSTRUCTION SHALL NOT BEGIN UNTIL ALL SUBMITTALS ARE APPROVED.

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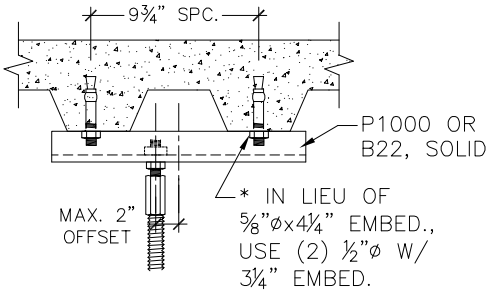
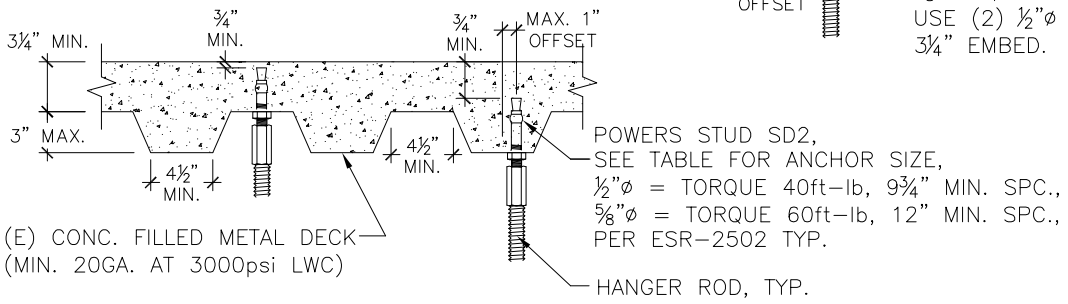
PROJECT:	TAG:	SHEET:
SEISMIC SUSPENDED BUS SYSTEM SUPPORTS	HPW2-800-VH38-SM [800A - 20 LB/FT]	DWG7

UPPER STRUCTURE ATTACHMENT FOR SEISMIC HANGER

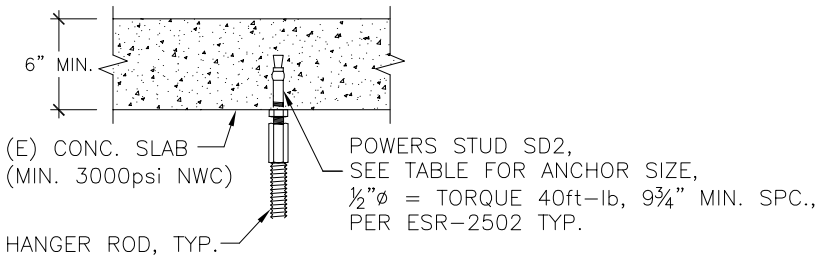
SEISMIC 'G'	250AMP SYSTEM	400AMP SYSTEM	800AMP SYSTEM
0.50G	½"ø x 3¼" EMBED.	½"ø x 3¼" EMBED.	½"ø x 3¼" EMBED.
0.75G	½"ø x 3¼" EMBED.	½"ø x 3¼" EMBED.	½"ø x 3¼" EMBED.
1.00G	½"ø x 3¼" EMBED.	½"ø x 3¼" EMBED.	⅝"ø x 4¼" EMBED. *





HANGER ATTACHMENT TO (E) CONC. DECK

SEISMIC 'G'	250AMP SYSTEM	400AMP SYSTEM	800AMP SYSTEM
0.50G	½"ø x 3¼" EMBED.	½"ø x 3¼" EMBED.	½"ø x 3¼" EMBED.
0.75G	½"ø x 3¼" EMBED.	½"ø x 3¼" EMBED.	½"ø x 3¼" EMBED.
1.00G	½"ø x 3¼" EMBED.	½"ø x 3¼" EMBED.	½"ø x 3¼" EMBED.



HANGER ATTACHMENT TO (E) CONC. SLAB

NOTE: CONSTRUCTION SHALL NOT BEGIN UNTIL ALL SUBMITTALS ARE APPROVED.
STRUCTURAL ENGINEERING OF RECORD TO VERIFY ADEQUACY OF THE STRUCTURE FOR THE APPLIED LOAD.

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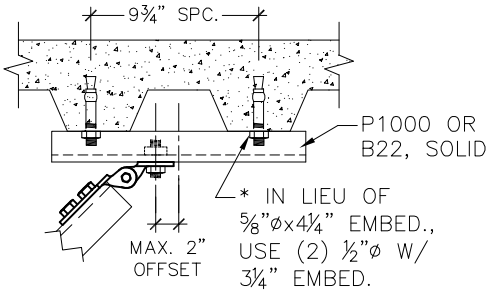
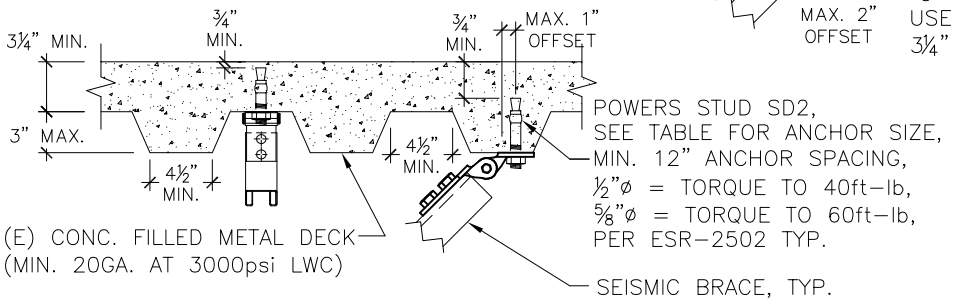
PROJECT:	TAG:	SHEET:
SEISMIC SUSPENDED BUS SYSTEM SUPPORTS	HANGER ANCHOR DETAILS	DWG8

UPPER STRUCTURE ATTACHMENT FOR SEISMIC BRACE

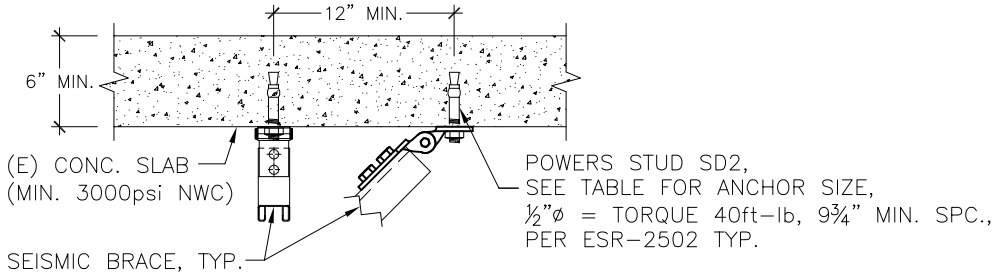
SEISMIC 'G'	250AMP SYSTEM	400AMP SYSTEM	800AMP SYSTEM
0.50G	½"ø x 3¼" EMBED.	½"ø x 3¼" EMBED.	½"ø x 3¼" EMBED.
0.75G	½"ø x 3¼" EMBED.	½"ø x 3¼" EMBED.	⅝"ø x 4¼" EMBED. *
1.00G	½"ø x 3¼" EMBED.	½"ø x 3¼" EMBED.	⅝"ø x 4¼" EMBED. *





BRACE ATTACHMENT TO (E) CONC. DECK

SEISMIC 'G'	250AMP SYSTEM	400AMP SYSTEM	800AMP SYSTEM
0.50G	½"ø x 3¼" EMBED.	½"ø x 3¼" EMBED.	½"ø x 3¼" EMBED.
0.75G	½"ø x 3¼" EMBED.	½"ø x 3¼" EMBED.	½"ø x 3¼" EMBED.
1.00G	½"ø x 3¼" EMBED.	½"ø x 3¼" EMBED.	½"ø x 3¼" EMBED.



HANGER ATTACHMENT TO (E) CONC. SLAB

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STRUCTURAL ENGINEERING OF RECORD TO VERIFY ADEQUACY OF THE STRUCTURE FOR THE APPLIED LOAD.

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PROJECT:	TAG:	SHEET:
SEISMIC SUSPENDED BUS SYSTEM SUPPORTS	BRACE ANCHOR DETAILS	DWG9

STRUCTURAL CALCULATIONS

DESIGN CRITERIA:

Govening Code: 2012 International Building Code/2013 California Building Code (CBC) & ASCE7-10

DESCRIPTION:

Substantiate suspended electrical bus system seismic load and dead weight. Members will be chosen to design at worst case load combination according to ASCE7 Chapter 2.

LOADING CRITERIA:

VERTICAL LOAD:

$L_s := 5 \cdot ft$	Maximum tributary length of support for dead load
$W_{250} := 7 \cdot \frac{lb}{ft}$	Max. weight for 250Amp bus system
$W_{400} := 10 \cdot \frac{lb}{ft}$	Max. weight for 400Amp bus system
$W_{800} := 20 \cdot \frac{lb}{ft}$	Max. weight for 800Amp bus system

SEISMIC LOAD:

Seismic demand per each different project can be determined through this equation:

$$F_p := \frac{0.4 \cdot a_p \cdot S_{DS}}{\frac{R_p}{I_p}} \cdot \left(1 + 2 \cdot \frac{z}{h}\right)$$ and can be simplify to this, $\boxed{F_p := 0.50 \cdot S_{DS}}$

where,	$z := 1$	Height in structure of point of attachment of component w/ respect to the base
	$h := 1$	Average roof height of structure w/ respect to base
	$I_p := 1.0$	Component importance factor
	$a_p := 2.5$	Component amplification factor (ASCE7, table 13.6-1)
	$R_p := 6.0$	Component response modification factor (ASCE7, table 13.6-1)
	S_{DS}	Spectral acceleration, short period. (Per project's structure sheet or USGS Seismic Design Maps)

Let's assume seismic demand cateogorize into these three zone:

$F_{p1} := 0.50$	Seismic demand at 0.50G
$F_{p2} := 0.75$	Seismic demand at 0.75G
$F_{p3} := 1.00$	Seismic demand at 1.00G

SEISMIC DESIGN AT 0.50G:

converting Horizontal Seismic Force, F_{ph}, in allowable yields

$F_{ph} := 0.7 \cdot F_{p1} = 0.35$ ASCE7 Sect. 13.1.7, for ASD

additional Vertical Seismic Force, F_{pv}, yields:

$F_{pv} := 0.20$

CHECK SEISMIC BRACE MEMBER:

REACTIONS:

$\theta := 45 \cdot deg$ Allowable brace ratio angle (1:1 = 45.0°, 1.5:1 = 56.3°, 2:1 = 63.4°)

$N_{brT} := 1$ Number of brace(s) in transverse direction

$N_{brL} := 1$ Number of brace(s) in longitudinal direction

For 250Amp & 400Amp bus system:

$L_{t1} := 40 \cdot ft$ Maximum tributary length of support for transverse seismic

$L_{l1} := 80 \cdot ft$ Maximum tributary length of support for longitudinal seismic

For 800Amp bus system:

$L_{t2} := 20 \cdot ft$ Maximum tributary length of support for transverse seismic

$L_{l2} := 40 \cdot ft$ Maximum tributary length of support for longitudinal seismic

Maximum brace compression in transverse direction

$F_{brT1} := \frac{(F_{ph} \cdot W_{400}) \cdot L_{t1}}{N_{brT} \cdot \cos(\theta)} = 198\,lb$ $F_{brT2} := \frac{(F_{ph} \cdot W_{800}) \cdot L_{t2}}{N_{brT} \cdot \cos(\theta)} = 198\,lb$

Maximum brace compression in longitudinal direction

$F_{brL1} := \frac{(F_{ph} \cdot W_{400}) \cdot L_{l1}}{N_{brL} \cdot \cos(\theta)} = 396\,lb$ $F_{brL2} := \frac{(F_{ph} \cdot W_{800}) \cdot L_{l2}}{N_{brL} \cdot \cos(\theta)} = 396\,lb$

COMPRESSION CHECK FOR SINGLE STRUT:

Unistrut P1000 Member designation

$L_{u2} := 120 \cdot in$ Unbraced length of member

$P_{allow} := 1380 \cdot lb$ Max. allowable load at slot face

$F_{brL2} = 396\,lb \leq P_{allow} = 1380\,lb$ **Okay!**

CHECK STRUT NUT CONNECTION:

3/8" Dia. Strut Nut Member designation

$V_{allow} := 800 \cdot lb$ Allowable resistance to slip

$N_{snut} := 1$ Number of strut nut(s)

$F_{brT2} = 198\,lb \leq V_{allow} \cdot N_{snut} = 800\,lb$ **Okay!**

CHECK HANGER ROD MEMBER:

MEMBER PHYSICAL PROPERTIES:

$\mathbf{d} := 0.375 \cdot \mathbf{in}$ Min. all-threaded rod member size

$\mathbf{N_{hr}} := 1$ Number of hanger supporting busduct

CHECK FOR TENSION:

$\mathbf{T_{hrAllow}} := 730 \cdot \mathbf{lb}$ Allowable load per MSS SP-58

$$\mathbf{T_{rod}} := \frac{\mathbf{W_{800}} \cdot \mathbf{L_s} + \mathbf{W_{800}} \cdot \mathbf{L_s} \cdot \mathbf{F_{pv}}}{\mathbf{N_{hr}}} + \mathbf{F_{brL2}} \cdot \sin(\theta) = 400\,\mathbf{lb} \quad \leq \quad \mathbf{T_{hrAllow}} = 730\,\mathbf{lb} \quad \textbf{Okay!}$$

CHECK FOR COMPRESSION FROM UPLIFT:

$$\mathbf{P_{rod}} := \frac{\mathbf{W_{800}} \cdot \mathbf{L_s} + \mathbf{W_{800}} \cdot \mathbf{L_s} \cdot \mathbf{F_{pv}}}{\mathbf{N_{hr}}} - \mathbf{F_{brL2}} \cdot \sin(\theta) = -160\,\mathbf{lb}$$

Using AISC requirements for maximum allowable length and maximum allowable stress:

$\frac{\mathbf{K} \cdot \mathbf{L_{hr}}}{\mathbf{r_{hr}}} \leq 200$ where, $\mathbf{K} := 1.0$ $\mathbf{d} = 0.375 \cdot \mathbf{in}$ $\mathbf{r_{hr}} := \frac{\mathbf{d}}{4}$

therefore, $\mathbf{L_{hr}} := \frac{200 \cdot \mathbf{r_{hr}}}{\mathbf{K}} = 18.75 \cdot \mathbf{in}$ (Maximum length allowed for hanger rod subjected to compression without stiffener)

Let stiffen hanger rod with 1-5/8"x12GA single channel with rod's clamp at $\mathbf{L_{u3}} := 13 \cdot \mathbf{in}$

Thus, $\frac{\mathbf{K} \cdot \mathbf{L_{u3}}}{\mathbf{r_{hr}}} = 139$ where, $\mathbf{F_y} := 36000 \frac{\mathbf{lb}}{\mathbf{in}^2}$ $\mathbf{E} := 29000000 \cdot \frac{\mathbf{lb}}{\mathbf{in}^2}$ $\mathbf{A} := 0.555 \cdot \mathbf{in}^2$

$$\mathbf{F_e} := \frac{\pi^2 \cdot \mathbf{E}}{\left(\frac{\mathbf{K} \cdot \mathbf{L_{u3}}}{\mathbf{r_{hr}}}\right)^2} = 14885 \cdot \frac{\mathbf{lb}}{\mathbf{in}^2}$$

$$\frac{\mathbf{K} \cdot \mathbf{L_{u3}}}{\mathbf{r_{hr}}} = 139 \quad > \quad 4.71 \cdot \sqrt{\frac{\mathbf{E}}{\mathbf{F_y}}} = 134 \quad \text{(AISC Sect. 16.1, Chapt. E-3)}$$

$$\mathbf{F_{cr}} := 0.877 \cdot \mathbf{F_e} = 13054 \cdot \frac{\mathbf{lb}}{\mathbf{in}^2}$$

$\mathbf{P_n} := \mathbf{F_{cr}} \cdot \mathbf{A} = 7245\,\mathbf{lb}$

CHECK FOR FAILURE:

$\Omega := 1.67$ Safety factor

$$\left|\mathbf{P_{rod}}\right| = 160\,\mathbf{lb} \quad \leq \quad \frac{\mathbf{P_n}}{\Omega} = 4338\,\mathbf{lb} \qquad \textbf{Okay!}$$

CHECK SEISMIC ANCHOR ATTACHMENT TO CONCRETE STRUCTURE:

Per ASCE 13.4.2, Anchor's design force must carry 2.5 times the force in the component.

$\Delta_{conc} := 2.5$ Anchor design factor to concrete

$\Delta_{lrfd} := 0.7$ ASD to LRFD

ANCHOR REACTION(S) AT *SEISMIC BRACE* TO STRUCTURAL LOCATION:

$T_a := \left(F_{brL2} \cdot \sin(\theta)\right) \cdot \left(\frac{\Delta_{conc}}{\Delta_{lrfd}}\right) = 1000\,lb$ Seismic brace anchor tension

$V_a := \left(F_{brL2} \cdot \cos(\theta)\right) \cdot \left(\frac{\Delta_{conc}}{\Delta_{lrfd}}\right) = 1000\,lb$ Seismic brace anchor shear

Consider Powers Stud SD2 expansion anchor at 1/2" dia. with 3-1/4" min. effective embedment.

ANCHOR REACTION(S) AT *SEISMIC HANGER* TO STRUCTURAL LOCATION:

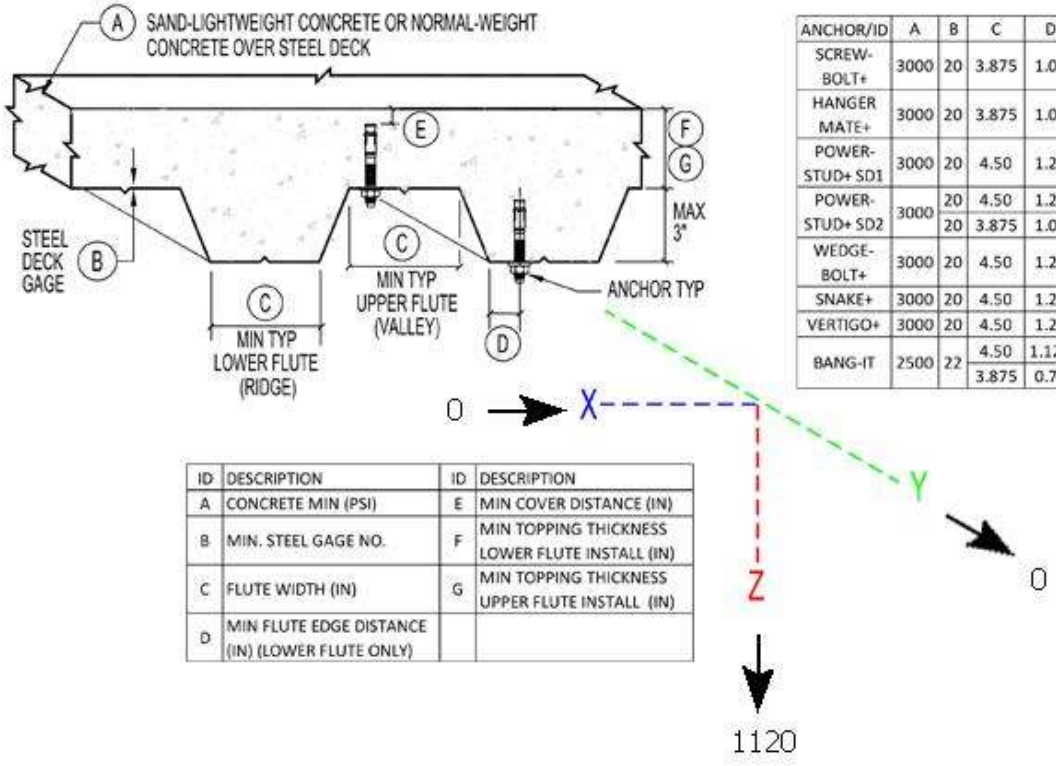
$$P_o := \frac{W_{800} \cdot L_s + W_{800} \cdot L_s \cdot F_{pv}}{N_{hr}}$$

$T_{a2} := P_o + T_a = 1120\,lb$ Seismic hanger anchor tension

Consider Powers Stud SD2 expansion anchor at 1/2" dia. with 3-1/4" min. effective embedment.

** Refer to attached Powers Design Assist for anchor specification and concrete break-out calculations.

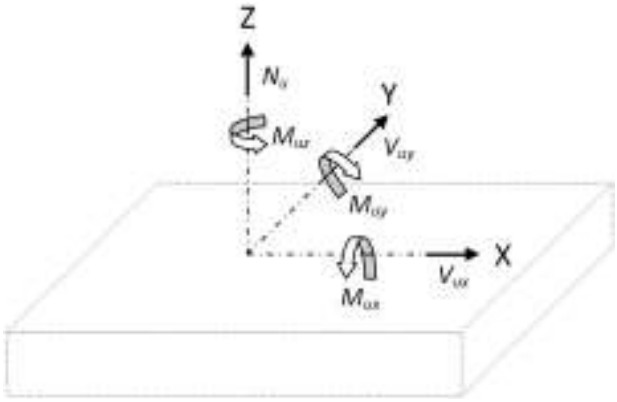
GEOMETRY:



ANCHOR/ID	A	B	C	D	E	F	G
SCREW-BOLT+	3000	20	3.875	1.00	0.75	2.50	2.50
HANGER MATE+	3000	20	3.875	1.00	0.75	2.50	2.50
POWER-STUD+ SD1	3000	20	4.50	1.25	0.75	3.25	3.25
POWER-STUD+ SD2	3000	20	4.50	1.25	0.75	3.25	3.25
		20	3.875	1.00	1.00	3.75	3.75
WEDGE-BOLT+	3000	20	4.50	1.25	0.75	3.25	3.25
SNAKE+	3000	20	4.50	1.25	1.00	3.00	3.00
VERTIGO+	3000	20	4.50	1.25	0.75	3.25	3.25
BANG-IT	2500	22	4.50	1.125	1.00	1.50	3.00
			3.875	0.75		1.50	3.00

ID	DESCRIPTION	ID	DESCRIPTION
A	CONCRETE MIN (PSI)	E	MIN COVER DISTANCE (IN)
B	MIN. STEEL GAGE NO.	F	MIN TOPPING THICKNESS LOWER FLUTE INSTALL (IN)
C	FLUTE WIDTH (IN)	G	MIN TOPPING THICKNESS UPPER FLUTE INSTALL (IN)
D	MIN FLUTE EDGE DISTANCE (IN) (LOWER FLUTE ONLY)		

LOAD ACTIONS: [lb], [ft-lb]



Design loads / actions		
N_u	1120	lb
V_{ux}	0	lb
V_{uy}	0	lb
M_{ux}	-	
M_{uy}	-	
M_{uz}	-	

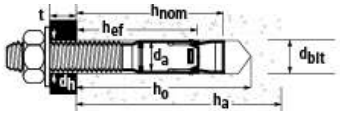
Eccentric profile

e_x = 0.00 inch; e_y = 0.00 inch

Load reversal X-direction	100	%
Load reversal Y-direction	100	%

SUMMARY:

Selected anchor: Power-Stud+ SD2
1/2" Ø; hnom 3-3/4" (95mm), Grade 2
Effective embedment: h_{ef} = 3.250 inch
Approval: ICC-ES ESR-2502



Basic principles of design:

Design method:	ACI 318-11 (Appendix D)							
Concrete:	Sand-lightweight concrete			cracked concrete		f'_c = 3000	psi	
Load combinations:	from Section 9.2							
	Factored loads							
	Ω_0 = User enters load							
Anchor parameters:	c_{min} = -	inch	s_{min} = -		inch	h_{min} = -		inch
	c_{ac} = 10.00	inch	s_{cr} = 9.75		inch	Anchor ductility:		yes
Reinforcement:	Tension:	Condition B		Shear:		Condition A		
Stand-off:	not existent							
Seismic loads:	yes							
	Tension load	yes (D.3.3.4.3(d))						
	Shear load	yes (D.3.3.5.3(c))						

Resulting anchor forces / load distribution:

Anchor No.	Tension load	Shear load
#1	1120 lb	0 lb
Maximum	1120 lb	0 lb

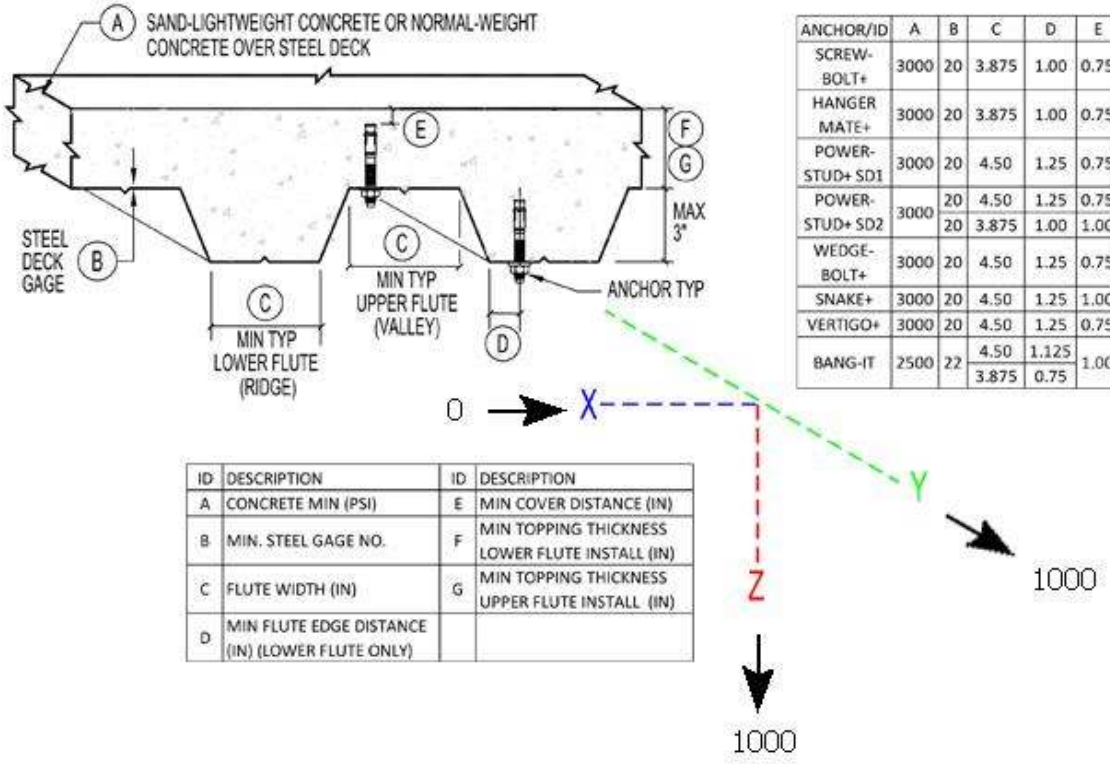
Max. concrete compression strain: 0.00 ‰
Max. concrete compression stress: 0 psi
Resulting tension force: 0 lb
Resulting compression force: 0 lb

Calculations:	Design proof:	Demand		Capacity		Status	
	Tension load	1120	lb	1268	lb	0.88 ≤ 1.0	OK
	Shear load	-	-	-	-	-	
	Interaction	-	-	-	-	-	

Anchor plate: Material: f_{yk} = 36000 psi
Length x width: 8.00 inch x 8.00 inch
Actual plate thickness: 0.394 inch
Calculated plate thickness: - inch not calculated

Profile: none selected

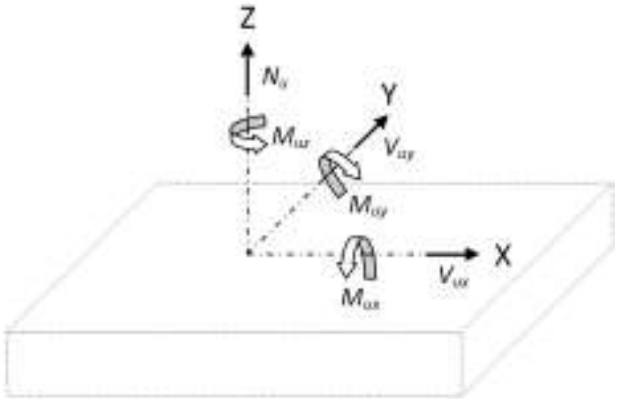
GEOMETRY:



ANCHOR/ID	A	B	C	D	E	F	G
SCREW-BOLT+	3000	20	3.875	1.00	0.75	2.50	2.50
HANGER MATE+	3000	20	3.875	1.00	0.75	2.50	2.50
POWER-STUD+ SD1	3000	20	4.50	1.25	0.75	3.25	3.25
POWER-STUD+ SD2	3000	20	4.50	1.25	0.75	3.25	3.25
		20	3.875	1.00	1.00	3.75	3.75
WEDGE-BOLT+	3000	20	4.50	1.25	0.75	3.25	3.25
SNAKE+	3000	20	4.50	1.25	1.00	3.00	3.00
VERTIGO+	3000	20	4.50	1.25	0.75	3.25	3.25
BANG-IT	2500	22	4.50	1.125	1.00	1.50	3.00
			3.875	0.75		1.50	3.00

ID	DESCRIPTION	ID	DESCRIPTION
A	CONCRETE MIN (PSI)	E	MIN COVER DISTANCE (IN)
B	MIN. STEEL GAGE NO.	F	MIN TOPPING THICKNESS LOWER FLUTE INSTALL (IN)
C	FLUTE WIDTH (IN)	G	MIN TOPPING THICKNESS UPPER FLUTE INSTALL (IN)
D	MIN FLUTE EDGE DISTANCE (IN) (LOWER FLUTE ONLY)		

LOAD ACTIONS: [lb], [ft-lb]

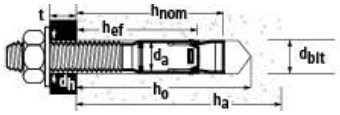


Design loads / actions		
N_u	1000	lb
V_{ux}	0	lb
V_{uy}	1000	lb
M_{ux}	-	
M_{uy}	-	
M_{uz}	-	

Eccentric profile		
e_x = 0.00 inch; e_y = 0.00 inch		
Load reversal X-direction	100	%
Load reversal Y-direction	100	%

SUMMARY:

Selected anchor: Power-Stud+ SD2
1/2" Ø; hnom 3-3/4" (95mm), Grade 2
Effective embedment: h_{ef} = 3.250 inch
Approval: ICC-ES ESR-2502



Basic principles of design:

Design method:	ACI 318-11 (Appendix D)							
Concrete:	Sand-lightweight concrete			cracked concrete		f'_c = 3000	psi	
Load combinations:	from Section 9.2							
	Factored loads							
	Ω_0 = User enters load							
Anchor parameters:	c_{min} = -	inch	s_{min} = -	inch	h_{min} = -	inch		
	c_{ac} = 10.00	inch	s_{cr} = 9.75	inch	Anchor ductility:	yes		
Reinforcement:	Tension:	Condition B	Shear:	Condition A				
Stand-off:	not existent							
Seismic loads:	yes							
	Tension load	yes (D.3.3.4.3(d))						
	Shear load	yes (D.3.3.5.3(c))						

Resulting anchor forces / load distribution:

Anchor No.	Tension load	Shear load
#1	1000 lb	1000 lb
Maximum	1000 lb	1000 lb

Max. concrete compression strain:	0.00	‰
Max. concrete compression stress:	0	psi
Resulting tension force:	0	lb
Resulting compression force:	0	lb

Calculations:	Design proof:	Demand		Capacity		Status	
	Tension load	1000	lb	1268	lb	0.79 ≤ 1.0	OK
	Shear load	1000	lb	3276	lb	0.31 ≤ 1.0	
	Interaction	-	-	-	-	0.91 ≤ 1.0	

Anchor plate:

Material:	f_{yk} = 36000 psi			
Length x width:	8.00	inch	x 8.00	inch
Actual plate thickness:	0.394	inch		
Calculated plate thickness:	-	inch	not calculated	

Profile: none selected

SEISMIC DESIGN AT 0.75G:

converting Horizontal Seismic Force, F_{ph}, in allowable yields

$F_{ph} := 0.7 \cdot F_{p2} = 0.53$ ASCE7 Sect. 13.1.7, for ASD

additional Vertical Seismic Force, F_{pv}, yields:

$F_{pv} := 0.20$

CHECK SEISMIC BRACE MEMBER:

REACTIONS:

$\theta := 45 \cdot deg$ Allowable brace ratio angle (1:1 = 45.0°, 1.5:1 = 56.3°, 2:1 = 63.4°)

$N_{brT} := 1$ Number of brace(s) in transverse direction

$N_{brL} := 1$ Number of brace(s) in longitudinal direction

For 250Amp & 400Amp bus system:

$L_{t1} := 25 \cdot ft$ Maximum tributary length of support for transverse seismic

$L_{l1} := 50 \cdot ft$ Maximum tributary length of support for longitudinal seismic

For 800Amp bus system:

$L_{t2} := 15 \cdot ft$ Maximum tributary length of support for transverse seismic

$L_{l2} := 30 \cdot ft$ Maximum tributary length of support for longitudinal seismic

Maximum brace compression in transverse direction

$$F_{brT1} := \frac{(F_{ph} \cdot W_{400}) \cdot L_{t1}}{N_{brT} \cdot \cos(\theta)} = 186\,lb \qquad F_{brT2} := \frac{(F_{ph} \cdot W_{800}) \cdot L_{t2}}{N_{brT} \cdot \cos(\theta)} = 223\,lb$$

Maximum brace compression in longitudinal direction

$$F_{brL1} := \frac{(F_{ph} \cdot W_{400}) \cdot L_{l1}}{N_{brL} \cdot \cos(\theta)} = 371\,lb \qquad F_{brL2} := \frac{(F_{ph} \cdot W_{800}) \cdot L_{l2}}{N_{brL} \cdot \cos(\theta)} = 445\,lb$$

COMPRESSION CHECK FOR SINGLE STRUT:

Unistrut P1000 Member designation

$L_{u2} := 120 \cdot in$ Unbraced length of member

$P_{allow} := 1380 \cdot lb$ Max. allowable load at slot face

$F_{brL2} = 445\,lb \leq P_{allow} = 1380\,lb$ **Okay!**

CHECK STRUT NUT CONNECTION:

3/8" Dia. Strut Nut Member designation

$V_{allow} := 800 \cdot lb$ Allowable resistance to slip

$N_{snut} := 1$ Number of strut nut(s)

$F_{brT2} = 223\,lb \leq V_{allow} \cdot N_{snut} = 800\,lb$ **Okay!**

CHECK HANGER ROD MEMBER:

MEMBER PHYSICAL PROPERTIES:

$\mathbf{d} := 0.375 \cdot \mathbf{in}$ Min. all-threaded rod member size

$\mathbf{N_{hr}} := 1$ Number of hanger supporting busduct

CHECK FOR TENSION:

$\mathbf{T_{hrAllow}} := 730 \cdot \mathbf{lb}$ Allowable load per MSS SP-58

$$\mathbf{T_{rod}} := \frac{\mathbf{W_{800}} \cdot \mathbf{L_s} + \mathbf{W_{800}} \cdot \mathbf{L_s} \cdot \mathbf{F_{pv}}}{\mathbf{N_{hr}}} + \mathbf{F_{brL2}} \cdot \sin(\boldsymbol{\theta}) = 435\,\mathbf{lb} \quad \leq \quad \mathbf{T_{hrAllow}} = 730\,\mathbf{lb} \quad \textbf{Okay!}$$

CHECK FOR COMPRESSION FROM UPLIFT:

$$\mathbf{P_{rod}} := \frac{\mathbf{W_{800}} \cdot \mathbf{L_s} + \mathbf{W_{800}} \cdot \mathbf{L_s} \cdot \mathbf{F_{pv}}}{\mathbf{N_{hr}}} - \mathbf{F_{brL2}} \cdot \sin(\boldsymbol{\theta}) = -195\,\mathbf{lb}$$

Using AISC requirements for maximum allowable length and maximum allowable stress:

$\frac{\mathbf{K} \cdot \mathbf{L_{hr}}}{\mathbf{r_{hr}}} \leq 200$ where, $\mathbf{K} := 1.0$ $\mathbf{d} = 0.375 \cdot \mathbf{in}$ $\mathbf{r_{hr}} := \frac{\mathbf{d}}{4}$

therefore, $\mathbf{L_{hr}} := \frac{200 \cdot \mathbf{r_{hr}}}{\mathbf{K}} = 18.75 \cdot \mathbf{in}$ (Maximum length allowed for hanger rod subjected to compression without stiffener)

Let stiffen hanger rod with 1-5/8"x12GA single channel with rod's clamp at $\mathbf{L_{u3}} := 13 \cdot \mathbf{in}$

Thus, $\frac{\mathbf{K} \cdot \mathbf{L_{u3}}}{\mathbf{r_{hr}}} = 139$ where, $\mathbf{F_y} := 36000 \frac{\mathbf{lb}}{\mathbf{in}^2}$ $\mathbf{E} := 29000000 \cdot \frac{\mathbf{lb}}{\mathbf{in}^2}$ $\mathbf{A} := 0.555 \cdot \mathbf{in}^2$

$$\mathbf{F_e} := \frac{\pi^2 \cdot \mathbf{E}}{\left(\frac{\mathbf{K} \cdot \mathbf{L_{u3}}}{\mathbf{r_{hr}}}\right)^2} = 14885 \cdot \frac{\mathbf{lb}}{\mathbf{in}^2}$$

$$\frac{\mathbf{K} \cdot \mathbf{L_{u3}}}{\mathbf{r_{hr}}} = 139 \quad > \quad 4.71 \cdot \sqrt{\frac{\mathbf{E}}{\mathbf{F_y}}} = 134 \quad \text{(AISC Sect. 16.1, Chapt. E-3)}$$

$$\mathbf{F_{cr}} := 0.877 \cdot \mathbf{F_e} = 13054 \cdot \frac{\mathbf{lb}}{\mathbf{in}^2}$$

$$\mathbf{P_n} := \mathbf{F_{cr}} \cdot \mathbf{A} = 7245\,\mathbf{lb}$$

CHECK FOR FAILURE:

$\boldsymbol{\Omega} := 1.67$ Safety factor

$$\left|\mathbf{P_{rod}}\right| = 195\,\mathbf{lb} \quad \leq \quad \frac{\mathbf{P_n}}{\boldsymbol{\Omega}} = 4338\,\mathbf{lb} \quad \textbf{Okay!}$$

CHECK SEISMIC ANCHOR ATTACHMENT TO CONCRETE STRUCTURE:

Per ASCE 13.4.2, Anchor's design force must carry 2.5 times the force in the component.

$\Delta_{conc} := 2.5$ Anchor design factor to concrete

$\Delta_{lrfd} := 0.7$ ASD to LRFD

ANCHOR REACTION(S) AT *SEISMIC BRACE* TO STRUCTURAL LOCATION:

$T_a := \left(F_{brL2} \cdot \sin(\theta)\right) \cdot \left(\frac{\Delta_{conc}}{\Delta_{lrfd}}\right) = 1125\,lb$ Seismic brace anchor tension

$V_a := \left(F_{brL2} \cdot \cos(\theta)\right) \cdot \left(\frac{\Delta_{conc}}{\Delta_{lrfd}}\right) = 1125\,lb$ Seismic brace anchor shear

Consider Powers Stud SD2 expansion anchor at 5/8" dia. with 4-1/4" min. effective embedment.

ANCHOR REACTION(S) AT *SEISMIC HANGER* TO STRUCTURAL LOCATION:

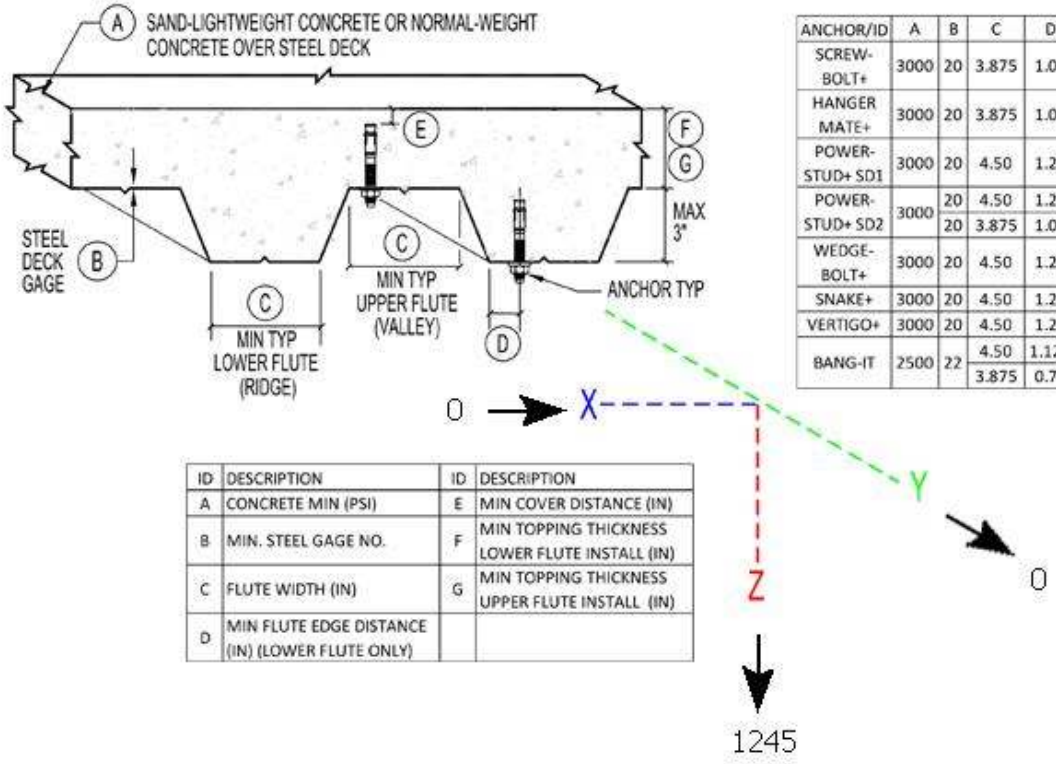
$$P_o := \frac{W_{800} \cdot L_s + W_{800} \cdot L_s \cdot F_{pv}}{N_{hr}}$$

$T_{a2} := P_o + T_a = 1245\,lb$ Seismic hanger anchor tension

Consider Powers Stud SD2 expansion anchor at 1/2" dia. with 3-1/4" min. effective embedment.

** Refer to attached Powers Design Assist for anchor specification and concrete break-out calculations.

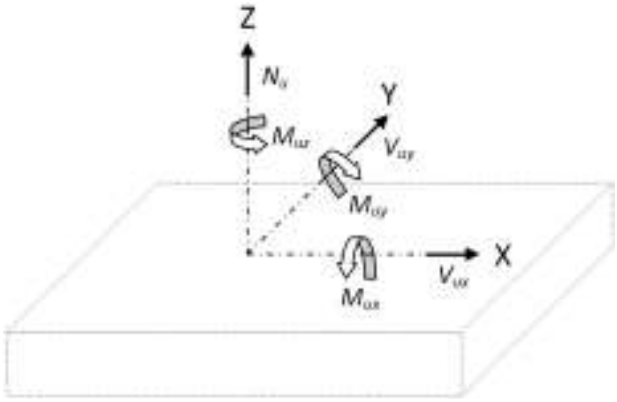
GEOMETRY:



ANCHOR/ID	A	B	C	D	E	F	G
SCREW-BOLT+	3000	20	3.875	1.00	0.75	2.50	2.50
HANGER MATE+	3000	20	3.875	1.00	0.75	2.50	2.50
POWER-STUD+ SD1	3000	20	4.50	1.25	0.75	3.25	3.25
POWER-STUD+ SD2	3000	20	4.50	1.25	0.75	3.25	3.25
		20	3.875	1.00	1.00	3.75	3.75
WEDGE-BOLT+	3000	20	4.50	1.25	0.75	3.25	3.25
SNAKE+	3000	20	4.50	1.25	1.00	3.00	3.00
VERTIGO+	3000	20	4.50	1.25	0.75	3.25	3.25
BANG-IT	2500	22	4.50	1.125	1.00	1.50	3.00
			3.875	0.75		1.50	3.00

ID	DESCRIPTION	ID	DESCRIPTION
A	CONCRETE MIN (PSI)	E	MIN COVER DISTANCE (IN)
B	MIN. STEEL GAGE NO.	F	MIN TOPPING THICKNESS LOWER FLUTE INSTALL (IN)
C	FLUTE WIDTH (IN)	G	MIN TOPPING THICKNESS UPPER FLUTE INSTALL (IN)
D	MIN FLUTE EDGE DISTANCE (IN) (LOWER FLUTE ONLY)		

LOAD ACTIONS: [lb], [ft-lb]



Design loads / actions		
N_u	1245	lb
V_{ux}	0	lb
V_{uy}	0	lb
M_{ux}	-	
M_{uy}	-	
M_{uz}	-	

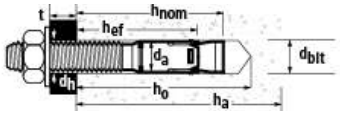
Eccentric profile

e_x = 0.00 inch; e_y = 0.00 inch

Load reversal X-direction	100	%
Load reversal Y-direction	100	%

SUMMARY:

Selected anchor: Power-Stud+ SD2
1/2" Ø; hnom 3-3/4" (95mm), Grade 2
Effective embedment: h_{ef} = 3.250 inch
Approval: ICC-ES ESR-2502



Basic principles of design:

Design method:	ACI 318-11 (Appendix D)							
Concrete:	Sand-lightweight concrete		cracked concrete			f'_c = 3000	psi	
Load combinations:	from Section 9.2							
	Factored loads							
	Ω_0 = User enters load							
Anchor parameters:	c_{min} = -	inch	s_{min} = -	inch	h_{min} = -	inch		
	c_{ac} = 10.00	inch	s_{cr} = 9.75	inch	Anchor ductility:	yes		
Reinforcement:	Tension:	Condition B	Shear:	Condition A				
Stand-off:	not existent							
Seismic loads:	yes							
	Tension load	yes (D.3.3.4.3(d))						
	Shear load	yes (D.3.3.5.3(c))						

Resulting anchor forces / load distribution:

Anchor No.	Tension load	Shear load
#1	1245 lb	0 lb
Maximum	1245 lb	0 lb

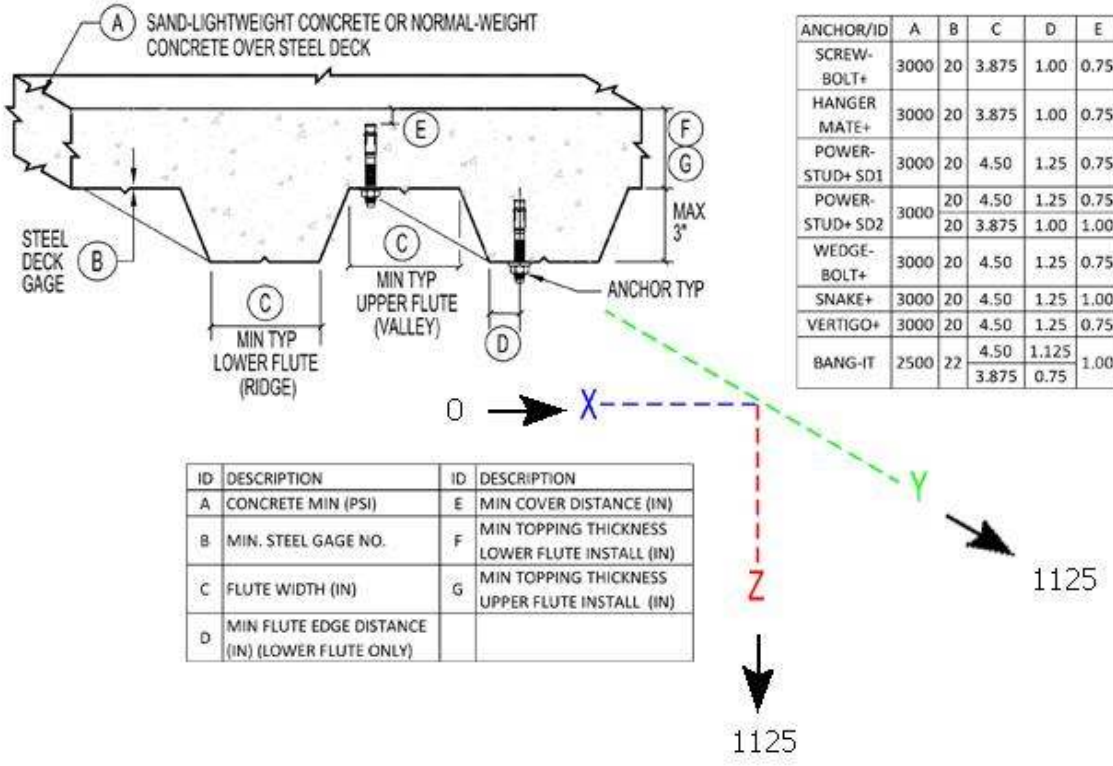
Max. concrete compression strain: 0.00 ‰
Max. concrete compression stress: 0 psi
Resulting tension force: 0 lb
Resulting compression force: 0 lb

Calculations:	Design proof:	Demand		Capacity		Status	
	Tension load	1245	lb	1268	lb	0.98 ≤ 1.0	OK
	Shear load	-	-	-	-	-	
	Interaction	-	-	-	-	-	

Anchor plate: Material: f_{yk} = 36000 psi
Length x width: 8.00 inch x 8.00 inch
Actual plate thickness: 0.394 inch
Calculated plate thickness: - inch not calculated

Profile: none selected

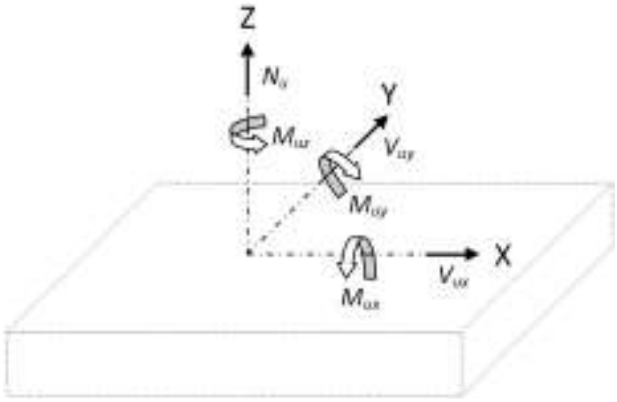
GEOMETRY:



ANCHOR/ID	A	B	C	D	E	F	G
SCREW-BOLT+	3000	20	3.875	1.00	0.75	2.50	2.50
HANGER MATE+	3000	20	3.875	1.00	0.75	2.50	2.50
POWER-STUD+ SD1	3000	20	4.50	1.25	0.75	3.25	3.25
POWER-STUD+ SD2	3000	20	4.50	1.25	0.75	3.25	3.25
		20	3.875	1.00	1.00	3.75	3.75
WEDGE-BOLT+	3000	20	4.50	1.25	0.75	3.25	3.25
SNAKE+	3000	20	4.50	1.25	1.00	3.00	3.00
VERTIGO+	3000	20	4.50	1.25	0.75	3.25	3.25
BANG-IT	2500	22	4.50	1.125	1.00	1.50	3.00
			3.875	0.75		1.50	3.00

ID	DESCRIPTION	ID	DESCRIPTION
A	CONCRETE MIN (PSI)	E	MIN COVER DISTANCE (IN)
B	MIN. STEEL GAGE NO.	F	MIN TOPPING THICKNESS LOWER FLUTE INSTALL (IN)
C	FLUTE WIDTH (IN)	G	MIN TOPPING THICKNESS UPPER FLUTE INSTALL (IN)
D	MIN FLUTE EDGE DISTANCE (IN) (LOWER FLUTE ONLY)		

LOAD ACTIONS: [lb], [ft-lb]



Design loads / actions		
N_u	1125	lb
V_{ux}	0	lb
V_{uy}	1125	lb
M_{ux}	-	
M_{uy}	-	
M_{uz}	-	

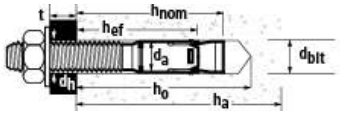
Eccentric profile

e_x = 0.00 inch; e_y = 0.00 inch

Load reversal X-direction	100	%
Load reversal Y-direction	100	%

SUMMARY:

Selected anchor: Power-Stud+ SD2
5/8" Ø; hnom 4-7/8" (124mm), Grade 2
Effective embedment: h_{ef} = 4.250 inch
Approval: ICC-ES ESR-2502



Basic principles of design:

Design method:	ACI 318-11 (Appendix D)							
Concrete:	Sand-lightweight concrete			cracked concrete		f'_c = 3000	psi	
Load combinations:	from Section 9.2							
	Factored loads							
	Ω_0 = User enters load							
Anchor parameters:	c_{min} = -	inch	s_{min} = -	inch	h_{min} = -	inch		
	c_{ac} = 10.00	inch	s_{cr} = 12.75	inch	Anchor ductility:	yes		
Reinforcement:	Tension:	Condition B	Shear:	Condition A				
Stand-off:	not existent							
Seismic loads:	yes							
	Tension load	yes (D.3.3.4.3(d))						
	Shear load	yes (D.3.3.5.3(c))						

Resulting anchor forces / load distribution:

Anchor No.	Tension load	Shear load
#1	1125 lb	1125 lb
Maximum	1125 lb	1125 lb

Max. concrete compression strain: 0.00 ‰
Max. concrete compression stress: 0 psi
Resulting tension force: 0 lb
Resulting compression force: 0 lb

Calculations:	Design proof:	Demand		Capacity		Status	
	Tension load	1125	lb	2542	lb	0.44 ≤ 1.0	OK
	Shear load	1125	lb	2889	lb	0.39 ≤ 1.0	
	Interaction	-	-	-	-	0.69 ≤ 1.0	

Anchor plate: Material: f_{yk} = 36000 psi
Length x width: 8.00 inch x 8.00 inch
Actual plate thickness: 0.394 inch
Calculated plate thickness: - inch not calculated

Profile: none selected

SEISMIC DESIGN AT 1.00G:

converting Horizontal Seismic Force, F_{ph}, in allowable yields

$F_{ph} := 0.7 \cdot F_{p3} = 0.70$ ASCE7 Sect. 13.1.7, for ASD

additional Vertical Seismic Force, F_{pv}, yields:

$F_{pv} := 0.20$

CHECK SEISMIC BRACE MEMBER:

REACTIONS:

$\theta := 45 \cdot deg$ Allowable brace ratio angle (1:1 = 45.0°, 1.5:1 = 56.3°, 2:1 = 63.4°)

$N_{brT} := 1$ Number of brace(s) in transverse direction

$N_{brL} := 1$ Number of brace(s) in longitudinal direction

For 250Amp & 400Amp bus system:

$L_{t1} := 20 \cdot ft$ Maximum tributary length of support for transverse seismic

$L_{l1} := 40 \cdot ft$ Maximum tributary length of support for longitudinal seismic

For 800Amp bus system:

$L_{t2} := 15 \cdot ft$ Maximum tributary length of support for transverse seismic

$L_{l2} := 30 \cdot ft$ Maximum tributary length of support for longitudinal seismic

Maximum brace compression in transverse direction

$$F_{brT1} := \frac{(F_{ph} \cdot W_{400}) \cdot L_{t1}}{N_{brT} \cdot \cos(\theta)} = 198\,lb \qquad F_{brT2} := \frac{(F_{ph} \cdot W_{800}) \cdot L_{t2}}{N_{brT} \cdot \cos(\theta)} = 297\,lb$$

Maximum brace compression in longitudinal direction

$$F_{brL1} := \frac{(F_{ph} \cdot W_{400}) \cdot L_{l1}}{N_{brL} \cdot \cos(\theta)} = 396\,lb \qquad F_{brL2} := \frac{(F_{ph} \cdot W_{800}) \cdot L_{l2}}{N_{brL} \cdot \cos(\theta)} = 594\,lb$$

COMPRESSION CHECK FOR SINGLE STRUT:

Unistrut P1000 Member designation

$L_{u2} := 120 \cdot in$ Unbraced length of member

$P_{allow} := 1380 \cdot lb$ Max. allowable load at slot face

$F_{brL2} = 594\,lb \leq P_{allow} = 1380\,lb$ **Okay!**

CHECK STRUT NUT CONNECTION:

3/8" Dia. Strut Nut Member designation

$V_{allow} := 800 \cdot lb$ Allowable resistance to slip

$N_{snut} := 1$ Number of strut nut(s)

$F_{brT2} = 297\,lb \leq V_{allow} \cdot N_{snut} = 800\,lb$ **Okay!**

CHECK HANGER ROD MEMBER:

MEMBER PHYSICAL PROPERTIES:

$\mathbf{d} := 0.375 \cdot \mathbf{in}$ Min. all-threaded rod member size

$\mathbf{N_{hr}} := 1$ Number of hanger supporting busduct

CHECK FOR TENSION:

$\mathbf{T_{hrAllow}} := 730 \cdot \mathbf{lb}$ Allowable load per MSS SP-58

$$\mathbf{T_{rod}} := \frac{\mathbf{W_{800}} \cdot \mathbf{L_s} + \mathbf{W_{800}} \cdot \mathbf{L_s} \cdot \mathbf{F_{pv}}}{\mathbf{N_{hr}}} + \mathbf{F_{brL2}} \cdot \sin(\boldsymbol{\theta}) = 540\,\mathbf{lb} \quad \leq \quad \mathbf{T_{hrAllow}} = 730\,\mathbf{lb} \quad \textbf{Okay!}$$

CHECK FOR COMPRESSION FROM UPLIFT:

$$\mathbf{P_{rod}} := \frac{\mathbf{W_{800}} \cdot \mathbf{L_s} + \mathbf{W_{800}} \cdot \mathbf{L_s} \cdot \mathbf{F_{pv}}}{\mathbf{N_{hr}}} - \mathbf{F_{brL2}} \cdot \sin(\boldsymbol{\theta}) = -300\,\mathbf{lb}$$

Using AISC requirements for maximum allowable length and maximum allowable stress:

$\frac{\mathbf{K} \cdot \mathbf{L_{hr}}}{\mathbf{r_{hr}}} \leq 200$ where, $\mathbf{K} := 1.0$ $\mathbf{d} = 0.375 \cdot \mathbf{in}$ $\mathbf{r_{hr}} := \frac{\mathbf{d}}{4}$

therefore, $\mathbf{L_{hr}} := \frac{200 \cdot \mathbf{r_{hr}}}{\mathbf{K}} = 18.75 \cdot \mathbf{in}$ (Maximum length allowed for hanger rod subjected to compression without stiffener)

Let stiffen hanger rod with 1-5/8"x12GA single channel with rod's clamp at $\mathbf{L_{u3}} := 13 \cdot \mathbf{in}$

Thus, $\frac{\mathbf{K} \cdot \mathbf{L_{u3}}}{\mathbf{r_{hr}}} = 139$ where, $\mathbf{F_y} := 36000 \frac{\mathbf{lb}}{\mathbf{in}^2}$ $\mathbf{E} := 29000000 \cdot \frac{\mathbf{lb}}{\mathbf{in}^2}$ $\mathbf{A} := 0.555 \cdot \mathbf{in}^2$

$$\mathbf{F_e} := \frac{\pi^2 \cdot \mathbf{E}}{\left(\frac{\mathbf{K} \cdot \mathbf{L_{u3}}}{\mathbf{r_{hr}}}\right)^2} = 14885 \cdot \frac{\mathbf{lb}}{\mathbf{in}^2}$$

$$\frac{\mathbf{K} \cdot \mathbf{L_{u3}}}{\mathbf{r_{hr}}} = 139 \quad > \quad 4.71 \cdot \sqrt{\frac{\mathbf{E}}{\mathbf{F_y}}} = 134 \quad \text{(AISC Sect. 16.1, Chapt. E-3)}$$

$$\mathbf{F_{cr}} := 0.877 \cdot \mathbf{F_e} = 13054 \cdot \frac{\mathbf{lb}}{\mathbf{in}^2}$$

$$\mathbf{P_n} := \mathbf{F_{cr}} \cdot \mathbf{A} = 7245\,\mathbf{lb}$$

CHECK FOR FAILURE:

$\boldsymbol{\Omega} := 1.67$ Safety factor

$$\left|\mathbf{P_{rod}}\right| = 300\,\mathbf{lb} \quad \leq \quad \frac{\mathbf{P_n}}{\boldsymbol{\Omega}} = 4338\,\mathbf{lb} \quad \textbf{Okay!}$$

CHECK SEISMIC ANCHOR ATTACHMENT TO CONCRETE STRUCTURE:

Per ASCE 13.4.2, Anchor's design force must carry 2.5 times the force in the component.

$\Delta_{conc} := 2.5$ Anchor design factor to concrete

$\Delta_{lrfd} := 0.7$ ASD to LRFD

ANCHOR REACTION(S) AT *SEISMIC BRACE* TO STRUCTURAL LOCATION:

$T_a := \left(F_{brL2} \cdot \sin(\theta)\right) \cdot \left(\frac{\Delta_{conc}}{\Delta_{lrfd}}\right) = 1500\,lb$ Seismic brace anchor tension

$V_a := \left(F_{brL2} \cdot \cos(\theta)\right) \cdot \left(\frac{\Delta_{conc}}{\Delta_{lrfd}}\right) = 1500\,lb$ Seismic brace anchor shear

Consider Powers Stud SD2 expansion anchor at 5/8" dia. with 4-1/4" min. effective embedment.

ANCHOR REACTION(S) AT *SEISMIC HANGER* TO STRUCTURAL LOCATION:

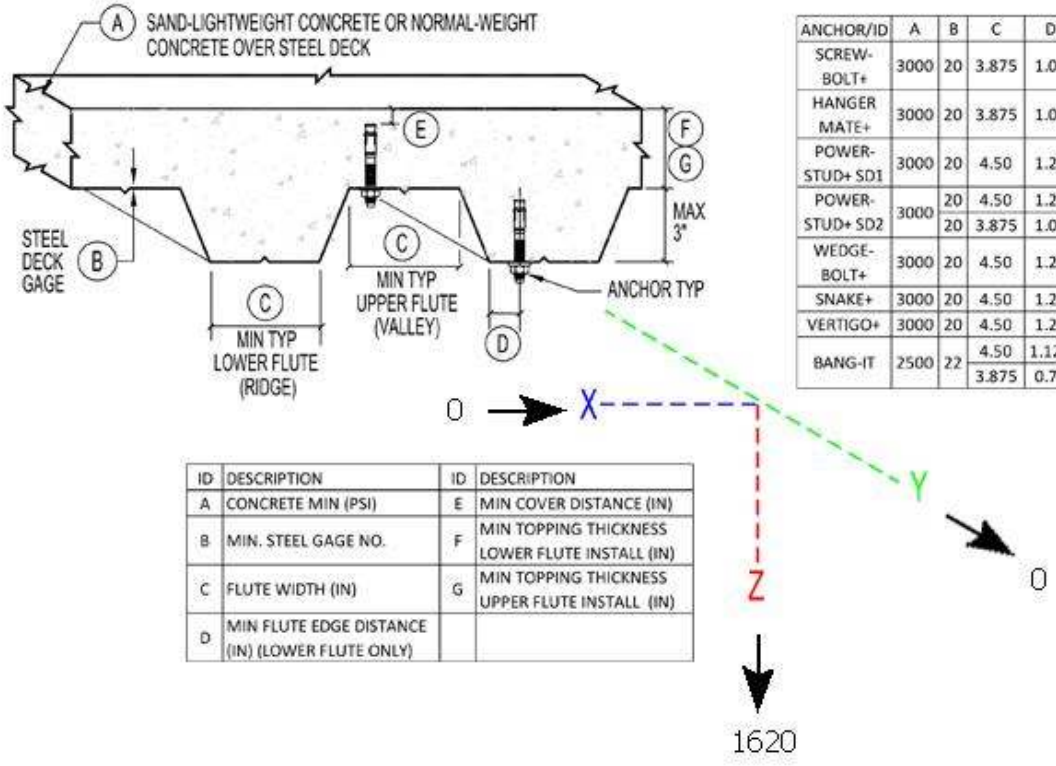
$$P_o := \frac{W_{800} \cdot L_s + W_{800} \cdot L_s \cdot F_{pv}}{N_{hr}}$$

$T_{a2} := P_o + T_a = 1620\,lb$ Seismic hanger anchor tension

Consider Powers Stud SD2 expansion anchor at 5/8" dia. with 4-1/4" min. effective embedment.

** Refer to attached Powers Design Assist for anchor specification and concrete break-out calculations.

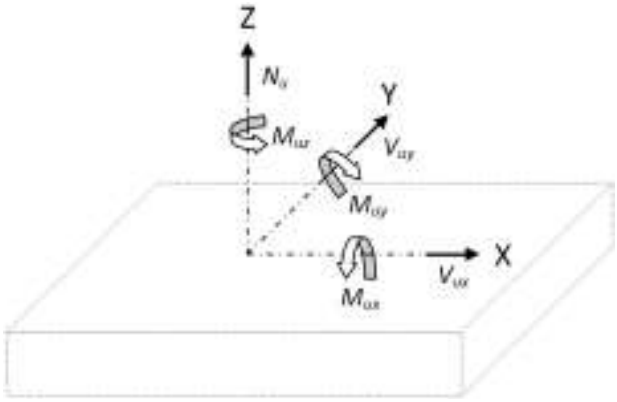
GEOMETRY:



ANCHOR/ID	A	B	C	D	E	F	G
SCREW-BOLT+	3000	20	3.875	1.00	0.75	2.50	2.50
HANGER MATE+	3000	20	3.875	1.00	0.75	2.50	2.50
POWER-STUD+ SD1	3000	20	4.50	1.25	0.75	3.25	3.25
POWER-STUD+ SD2	3000	20	4.50	1.25	0.75	3.25	3.25
		20	3.875	1.00	1.00	3.75	3.75
WEDGE-BOLT+	3000	20	4.50	1.25	0.75	3.25	3.25
SNAKE+	3000	20	4.50	1.25	1.00	3.00	3.00
VERTIGO+	3000	20	4.50	1.25	0.75	3.25	3.25
BANG-IT	2500	22	4.50	1.125	1.00	1.50	3.00
			3.875	0.75		1.50	3.00

ID	DESCRIPTION	ID	DESCRIPTION
A	CONCRETE MIN (PSI)	E	MIN COVER DISTANCE (IN)
B	MIN. STEEL GAGE NO.	F	MIN TOPPING THICKNESS LOWER FLUTE INSTALL (IN)
C	FLUTE WIDTH (IN)	G	MIN TOPPING THICKNESS UPPER FLUTE INSTALL (IN)
D	MIN FLUTE EDGE DISTANCE (IN) (LOWER FLUTE ONLY)		

LOAD ACTIONS: [lb], [ft-lb]



Design loads / actions		
N_u	1620	lb
V_{ux}	0	lb
V_{uy}	0	lb
M_{ux}	-	
M_{uy}	-	
M_{uz}	-	

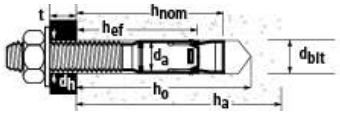
Eccentric profile

e_x = 0.00 inch; e_y = 0.00 inch

Load reversal X-direction	100	%
Load reversal Y-direction	100	%

SUMMARY:

Selected anchor: Power-Stud+ SD2
5/8" Ø; hnom 4-7/8" (124mm), Grade 2
Effective embedment: h_{ef} = 4.250 inch
Approval: ICC-ES ESR-2502



Basic principles of design:

Design method:	ACI 318-11 (Appendix D)							
Concrete:	Sand-lightweight concrete		cracked concrete			f'_c = 3000	psi	
Load combinations:	from Section 9.2							
	Factored loads							
	Ω_0 = User enters load							
Anchor parameters:	c_{min} = -	inch	s_{min} = -	inch	h_{min} = -	inch		
	c_{ac} = 10.00	inch	s_{cr} = 12.75	inch	Anchor ductility:	yes		
Reinforcement:	Tension:	Condition B	Shear:	Condition A				
Stand-off:	not existent							
Seismic loads:	yes							
	Tension load	yes (D.3.3.4.3(d))						
	Shear load	yes (D.3.3.5.3(c))						

Resulting anchor forces / load distribution:

Anchor No.	Tension load	Shear load
#1	1620 lb	0 lb
Maximum	1620 lb	0 lb

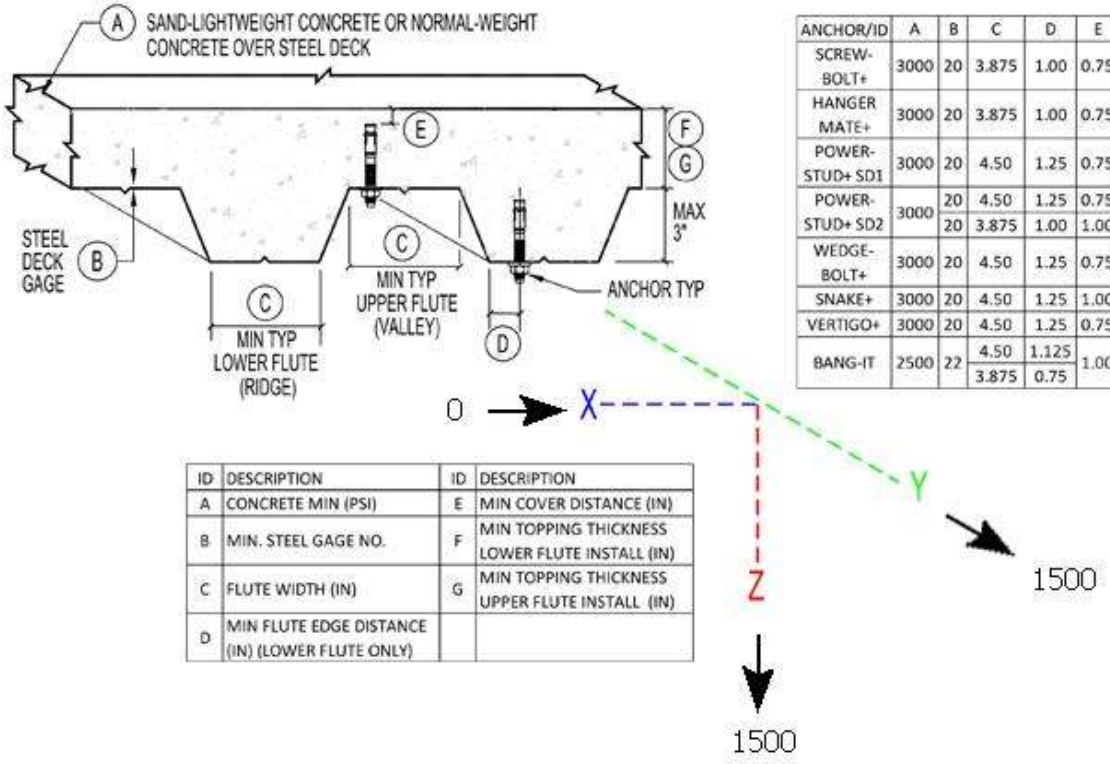
Max. concrete compression strain: 0.00 ‰
Max. concrete compression stress: 0 psi
Resulting tension force: 0 lb
Resulting compression force: 0 lb

Calculations:	Design proof:	Demand		Capacity		Status	
	Tension load	1620	lb	2542	lb	0.64 ≤ 1.0	OK
	Shear load	-	-	-	-	-	
	Interaction	-	-	-	-	-	

Anchor plate: Material: f_{yk} = 36000 psi
Length x width: 8.00 inch x 8.00 inch
Actual plate thickness: 0.394 inch
Calculated plate thickness: - inch not calculated

Profile: none selected

GEOMETRY:



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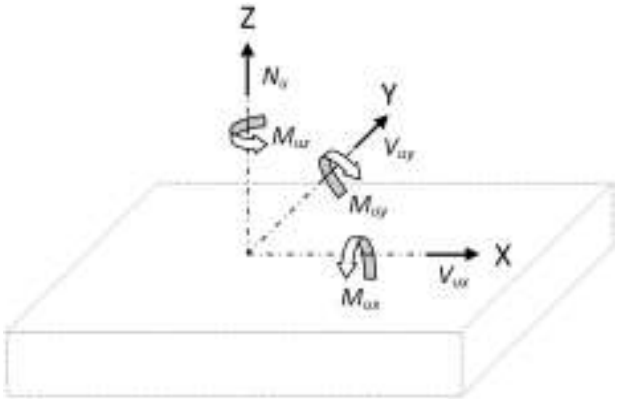

Design loads / actions		
N_u	1500	lb
V_{ux}	0	lb
V_{uy}	1500	lb
M_{ux}	-	
M_{uy}	-	
M_{uz}	-	

Eccentric profile

e_x = 0.00 inch; e_y = 0.00 inch

Load reversal X-direction	100	%
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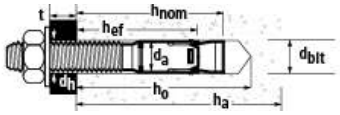

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	c_{ac} = 10.00	inch	s_{cr} = 12.75	inch	Anchor ductility:	yes		
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Stand-off:	not existent							
Seismic loads:	yes							
	Tension load	yes (D.3.3.4.3(d))						
	Shear load	yes (D.3.3.5.3(c))						

Resulting anchor forces / load distribution:

Anchor No.	Tension load	Shear load
#1	1500 lb	1500 lb
Maximum	1500 lb	1500 lb

Max. concrete compression strain: 0.00 ‰
Max. concrete compression stress: 0 psi
Resulting tension force: 0 lb
Resulting compression force: 0 lb

Calculations:	Design proof:	Demand		Capacity		Status	
	Tension load	1500	lb	2542	lb	0.59 ≤ 1.0	OK
	Shear load	1500	lb	2889	lb	0.52 ≤ 1.0	
	Interaction	-	-	-	-	0.92 ≤ 1.0	

Anchor plate: Material: f_{yk} = 36000 psi
Length x width: 8.00 inch x 8.00 inch
Actual plate thickness: 0.394 inch
Calculated plate thickness: - inch not calculated

Profile: none selected