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PRCTI20240784

City of Puyallup Building REVIEWED FOR COMPLIANCE
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City of Puyallup
Development & Permitting Services
ISSUED PERMIT

Building	Planning
Engineering	Public Works
Fire	Traffic

CENTERIS VOLTAGE PARK
1023 39th Avenue South East
Puyallup, WA 98374

Scale Matrix Battery Room
Structural Calculations
w/ △1 Permit Revisions

PAUL J. BRIENEN
STATE OF WASHINGTON
32114
STRUCTURAL ENGINEER
PROFESSIONAL ENGINEER

Project Number 24201.4
June 14, 2024

Calculations required to be provided by the Permittee on site for all Inspections

Phone: (206) 397-0000 1316 Central Avenue South, Suite 200, Kent, WA 98032 www.bse-ps.com

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INFILL STUD WALLS DESIGN CRITERIA

Phone: (206) 397-0000 1316 Central Avenue South, Suite 200, Kent, WA 98032 www.bse-ps.com

Design Codes

1 Design Codes: International Building Code, 2021
ASCE 7-16
AISI Standards
AISI S100-16(2020) w/ S2-20
AISI S202-20
AISI S220-20
AISI S240-20
AISI S400-20

Vertical Loads on Ceiling Framing

Dead Load = 20 psf total
(includes weight of (4) layers of Gyp for 2-hour fire rating,
CFS joist weight, plywood wearing surface, and 5psf for MEP)
Live Load = 40 psf
(Access similar to Catwalks or Maintenance spaces)

CEILING CONSTRUCTION: 2-HOUR RATING

	2.5 psf	PLYWOOD (3/4" ATTACHED w/ #10 SCREWS @ 12" o.c.)
2plf/2ft =	1.0 psf	8" STUDS, 43-mil min 24" o.c. w/ SCREWS @ 12" o.c.
	2.5 psf	5/8" Gyp (1st layer)
	2.5 psf	5/8" Gyp (2nd layer)
	2.5 psf	5/8" Gyp (3rd layer)
1/2plf/2ft =	1/4 psf	HAT-SHAPED FURRING PERP. TO JOISTS
	2.5 psf	5/8" Gyp (4th layer)
	5 psf	MEP
≈	3/4 psf	GIRDERS
	19.5 psf	

use 20psf DEAD LOAD

CEILING HEIGHT, Z = 12ft
STRUCTURE HEIGHT h =

ROOF LIVE LOAD = 40psf

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Seismic Parameters

Site Class = D (Assumed)

S_{DS} = 1.006

Values per ASCE Hazards Report (See following pages)

Seismic Coefficients from Table 13.5-1 (ASCE 7-16)

Table 13.5-1 Coefficients for Architectural Components

Architectural Component	a_p[a]	R_p	Ω_0[b]
Interior nonstructural walls and partitions[c]			
Plain (unreinforced) masonry walls	1	1½	1½
All other walls and partitions	1	2½	2
Cantilever elements (unbraced or braced to structural frame below its center of mass)			
Parapets and cantilever interior nonstructural walls	2½	2½	2
Chimneys where laterally braced or supported by the structural frame	2½	2½	2
Cantilever elements (braced to structural frame above its center of mass)			
Parapets	1	2½	2
Chimneys	1	2½	2
Exterior nonstructural walls[c]	1[b]	2½	2
Exterior nonstructural wall elements and connections[b]			
Wall element	1	2½	NA
Body of wall panel connections	1	2½	NA
Fasteners of the connecting system	1¼	1	1
Veneer			
Limited deformability elements and attachments	1	2½	2
Low-deformability elements and attachments	1	1½	2
Penthouses (except where framed by an extension of the building frame)	2½	3½	2
Ceilings			
All	1	2½	2
Cabinets			

[a]A lower value for a_p shall not be used unless justified by detailed dynamic analysis. The value for a_p shall not be less than 1. The value of $a_p = 1$ is for rigid components and rigidly attached components. The value of $a_p = 2½$ is for flexible components and flexibly attached components.
[b]Overstrength where required for nonductile anchorage to concrete and masonry. See Section 12.4.3 for seismic load effects including overstrength.
[c]Where flexible diaphragms provide lateral support for concrete or masonry walls and partitions, the design forces for anchorage to the diaphragm shall be as specified in Section 12.11.2.

Wall Design Criteria

Ceiling height ≤ 12'-0"
Internal Pressure = 5 psf (ASD)
Maximum Deflection = L/240 (Flexible Finishes)

Bearing Walls have Flexural and Axial Bracing
at 72" oc (mid-ht) max

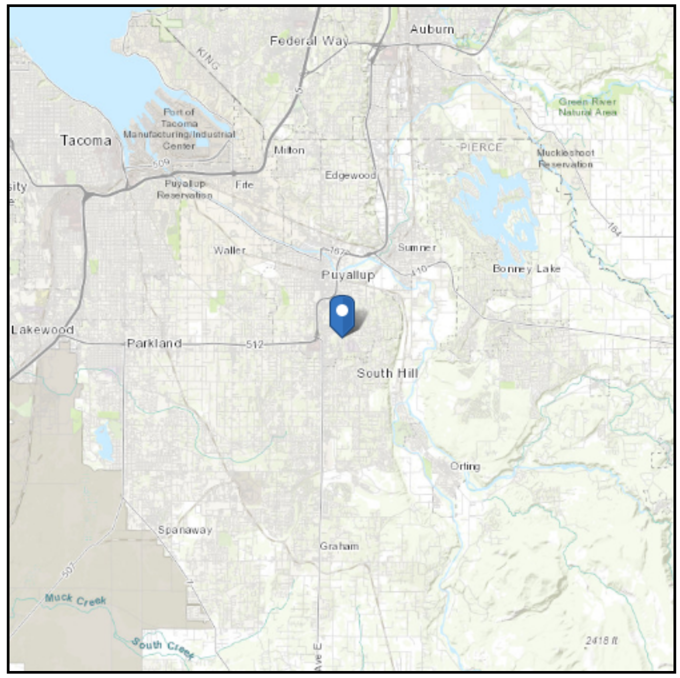
Joist and Girder Design Criteria

See earlier page of Design Criteria for Loading
Maximum Live Load Deflection = L/360
Maximum Total Deflection = L/240

ASCE Hazards Report

Address:
1023 39th Ave SE
Puyallup, Washington
98374

Standard:	ASCE/SEI 7-16	**Latitude:**	47.160853
Risk Category:	II	**Longitude:**	-122.279318
Soil Class:	D - Default (see Section 11.4.3)	**Elevation:**	482.88472036372787 ft (NAVD 88)



Wind

Results:

Wind Speed	98 Vmph
10-year MRI	67 Vmph
25-year MRI	73 Vmph
50-year MRI	78 Vmph
100-year MRI	83 Vmph

Data Source:	ASCE/SEI 7-16, Fig. 26.5-1B and Figs. CC.2-1–CC.2-4, and Section 26.5.2
Date Accessed:	Mon Feb 05 2024

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-16 Standard. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (annual exceedance probability = 0.00143, MRI = 700 years).

Site is not in a hurricane-prone region as defined in ASCE/SEI 7-16 Section 26.2.

Seismic

Site Soil Class: D - Default (see Section 11.4.3)

Results:

S_S :	1.257	S_{D1} :	N/A
S_1 :	0.434	T_L :	6
F_a :	1.2	PGA :	0.5
F_v :	N/A	PGA_M :	0.6
S_{MS} :	1.509	F_{PGA} :	1.2
S_{M1} :	N/A	I_e :	1
S_{DS} :	1.006	C_v :	1.351

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

Data Accessed: Mon Feb 05 2024

Date Source: USGS Seismic Design Maps

Seismic Forces

Wall Type Infill Walls

Wall Seismic Weight, W

	PSF
• Metal Stud Framing	1.5
• (4) Layers 5/8" Gypsum Wall Board (Multiply weight by actual layers of GWB.)	10
• Acoustic Insulation	2
•	

Total = 14 PSF

Wall & Fastener Seismic Force

a_p = 1 R_p = 2.5
S_{DS} = 1.006 I_p = 1 z/h = 1

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

F_d = 0.483W (LRFD)
$E_{ASD} = 0.7F_d$ = 0.338W (ASD)

ASD Force = 4.6 PSF

Fastener - Anchorage to Concrete

a_p = 1 R_p = 2.5 Ω_o = 2.5
S_{DS} = 1.006 I_p = 1 z/h = 1

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

F_d = 1.207W (LRFD)
$E_{ASD} = 0.7F_d/1.2^*$= 0.845W (ASD)

ASD Force = 11.4 PSF

ANCHOR AND CONNECTOR DESIGN INFORMATION

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Track Connection Distances - Based on Connector Capacities

PRESSURE MAX HEIGHT

For 5.0 psf (GWB finishes)

Max Considered Height

13.50	Track Demand =	(Ht)/2*5psf =		33.8 plf			
	Connection to Concrete**	MIN SHOTPIN CAPACITY	v =	120lbs/anchor	spacing ≤	18.7 in	@ (11.4psf)
	Connection to Steel	MIN SCREW CAPACITY	v =	230lbs/anchor	spacing ≤	30.0 in	

** Where seismic forces control anchorage, Fastener spacing calculated includes Overstrength Reduction

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Project: CENTERIS Date: 2/7/24

CHECK TRACK FOR MAX FASTENER SPACING

S_{MAX} must meet $M_{A\,400T125-33} = 3.97$ k·in

$V_{A\,400T125-33} = 940^{\#}$

Uniform Load (DEMAND) = 5psf * (12'-0")/2
= 30plf

for 36" o.c. SPACING, $M_{DEMAND} \leq \frac{wL^2}{8} = \frac{(30plf)(36")^2}{8} = 4.86$ k·in ✗

THIS IS TOO Large!

if SPACING IS 30" o.c. → $M_{DEMAND} = 3.375$ k·in ✓

Check Shear = $V_{DEMAND} = 30plf * \frac{30" o.c.}{2} * \frac{1ft}{12"} = 37.5^{\#}$ ✓ $\leq 940^{\#}$ OK

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TABLE 2—ALLOWABLE LOADS FOR FASTENERS DRIVEN INTO STEEL[1,2,3,4]

FASTENER	SHANK DIAMETER (INCH)	ALLOWABLE LOADS (lbf)											
Steel Thickness (inch):		1/8		3/16		1/4		3/8		1/2		3/4	
Load Direction:		**Tension**	**Shear**	**Tension**	**Shear**	**Tension**	**Shear**	**Tension**	**Shear**	**Tension**	**Shear**	**Tension**	**Shear**
X-S13 THP	0.145	140[10]	300	300[10]	450	300[10]	450	300[10]	450	--	--	--	--
X-S16P8TH	0.145	--	--	225[10]	420	225[10]	430	225[10]	430	225[10]	430	--	--
X-EGN14 X-S 14 B3 X-S 14 G3	0.118	140	230	220	245	225	290	280[6]	330[6]	280[6]	330[6]	280[6]	330[6]
X-EGN14[5] X-S 14 B3[5] X-S 14 G3[5]	0.118	--	--	220	295	260	355	280[6]	385[6]	280[6]	385[6]	280[6]	385[6]
X-GHP## X-P ## G3 X-P ## B3	0.118	125[10]	230	170[10]	245	200[10]	230	250[10]	255	--	--	--	--
X-P 17 G2[7] X-P 20 G2[7]	0.118	--	--	140[10]	220	180[8]	200[8]	225[6]	220[6]	--	--	--	--
X-P 14 G2[7]	0.118	--	--	--	--	215[8]	290[8]	150[9]	195[9]	130[9]	150[9]	130[9]	150[9]

For **SI:** 1 inch = 25.4 mm, 1 ksi = 6.89 MPa, 1 lbf = 4.4 N.

X-GHP/X-P B3 EMBED CAPACITY TO STEEL

[1]Unless otherwise noted, fasteners must be driven to where the full length of the point of the fastener penetrates through the steel base material.
[2]Unless otherwise noted, steel base material must have minimum yield and tensile strengths (F_y and F_u) equal to 36 ksi and 58 ksi, respectively.
[3]Unless otherwise noted, allowable loads are applicable to static loads and seismic loads in accordance with Section 4.1.
[4]Fastener spacing must be a minimum of 1.0 inch and edge distance must be a minimum of 0.50 inch.
[5]Steel base material must have minimum yield and tensile strengths (F_y and F_u) equal to 50 ksi and 65 ksi, respectively.
[6]Fastener point penetration through the steel is not necessary, provided a minimum embedment of 0.320 inch is achieved.
[7]Tabulated loads for this fastener apply to static load conditions only. For seismic loading, allowable loads must be limited in accordance with Section 4.1.5, Item 3.
[8]Full fastener point penetration through the steel is not necessary, provided a minimum point penetration of 0.08 inch is achieved.
[9]Fastener point penetration through the steel is not necessary, provided a minimum embedment of 0.25 inch is achieved.
[10]For steel-to-steel connections designed in accordance with Section 4.1.4, the tabulated allowable load may be increased by a factor of 1.25, and the design strength may be taken as the tabulated allowable load multiplied by a factor of 2.0.

TABLE 3—ALLOWABLE LOADS FOR FASTENERS DRIVEN INTO NORMALWEIGHT CONCRETE[1,2,3]

FASTENER	SHANK DIAMETER (inch)	MINIMUM EMBEDMENT DEPTH (inches)	ALLOWABLE LOADS (lbf)					
Concrete Compressive Strength:			2,000 psi		4,000 psi		6,000 psi	
Load Direction:			Tension	Shear	Tension	Shear	Tension	Shear
X-C ## (Black Collated Strip or Guidance Washer)	0.138	3/4	45	75	65	105	95	195
		1	85	150	160	200	105	270
		1 1/4	130	210	270	290	165	325
		1 1/2	175	260	270	360	--	--
X-C ## (White Collated Strip or Guidance Washer)	0.138	3/4	45	75	60	105	--	--
		1	85	150	90	200	--	--
		1 1/4	130	210	130	290	--	--
X-C22 P8TH (Black Collated Strip or Guidance Washer)	0.138	3/4	55	130	90	170	100	200
X-C22 P8TH (White Collated Strip or Guidance Washer)	0.138	3/4	55	130	90	170	--	--
X-GN (except for X-GN 39)	0.118	3/4	95	120	95	120	--	--
		1	115	220	115	220	--	--
X-GN39 X-C 39 G2 X-C 39 G3	0.101	5/8	50	80	50	80	--	--
		1	60	100	60	100	--	--
X-GHP## X-P 17 G2, X-P 20 G2 X-P ## G3 X-P ## B3	0.118	5/8	--	--	50	120	50	90
		3/4	80	120	--	--	--	--
X-C ## G2 (except for X-C 39 G2) X-C 36 B3	0.108	3/4	110	190	110	190	110	190
X-C ## G3 (except for X-C 39 G3) X-C ## B3 (except for X-C 36 B3)	0.118	3/4	110	190	110	190	110	190

For **SI:** 1 inch = 25.4 mm, 1 psi = 6.89 kPa, 1 lbf = 4.4 N.

[1]Fasteners must not be driven until the concrete has reached the designated minimum compressive strength, or the minimum compressive strength specified in the applicable code, whichever is greater.

[2]Concrete thickness must be a minimum of 3 times the embedment depth of the fastener. Fastener spacing must be a minimum of 4 inches and edge distance must be a minimum of 3 inches.

[3]The fasteners listed in the table above may be used for static load conditions and for the seismic load conditions described in Section 4.1.5, as applicable. The tabulated allowable loads apply to static load conditions. For seismic load conditions, the allowable loads must be limited in accordance with Section 4.1.5, Items 2 and 4, as applicable.

3(5/8") = 1 7/8" < 2 1/2" OK

X-GHP/X-P B3 EMBED CAPACITY TO CONCRETE

TABLE 1—FASTENER DESCRIPTION AND APPLICATIONS

FASTENER[1]	FASTENER DESCRIPTION	SHANK TYPE	SHANK DIAMETER [inch (mm)]	HEAD DIAMETER [inch (mm)]	MAXIMUM POINT LENGTH [inch (mm)]	MINIMUM EFFECTIVE SHANK LENGTH [inch (mm)]	FASTENER COATING	APPLICABLE BASE MATERIAL	APPLICABLE LOAD TABLES
X-U ##	Universal Powder Actuated Fastener	Knurled, straight	0.157 (4.0)	0.323 (8.2)	0.433 (11.0)	See Footnote 2	ASTM B633, SC1, Type III	Steel	2, 7
								Concrete	3, 4
								Conc.-filled deck	5
								CMU	6
X-U 15	Powder Actuated Fastener	Knurled, stepped	0.145 (3.7)	0.323 (8.2)	0.413 (10.5)	0.61 (15.5)	ASTM B633, SC1, Type III	Steel	2
X-P ##	Powder Actuated Fastener	Smooth straight	0.157 (4.0)	0.323 (8.2)	0.524 (13.3)	See Footnote 3	ASTM B633, SC1, Type III	Concrete	3
								Conc.-filled deck	5
								CMU	6

For **SI:** 1 inch = 25.4 mm.

[1]## denotes numbers used in fastener designation to represent nominal fastener length in mm, e.g. X-U 27 has a nominal shank length of 27 mm.
[2]For fastener length of 16 mm, the minimum effective shank length is 14.8 mm (0.58 inch). For longer fasteners, the minimum effective shank length can be calculated in terms of the designated length as (##-0.5) in mm and (##-0.5)/25.4 in inches.
[3]The minimum effective shank length can be calculated in terms of the designated length as (##-1) in mm and (##-1)/25.4 in inches.

TABLE 2—ALLOWABLE LOADS FOR FASTENERS DRIVEN INTO STEEL[1,2,6]

FASTENER DESCRIPTION	FASTENER	SHANK DIAMETER (inch)	ALLOWABLE LOADS (lbf)									
Steel Thickness (inch):			3/16		1/4		3/8		1/2		≥ 3/4	
Load Direction:			Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear
Universal Knurled Shank	X-U	0.157	500[7]	720	775[7]	720	935	720	900	720	350[4]	375[4]
											275[3]	350[3]
Universal Knurled Shank	X-U 15	0.145	155	400	230	395	420	450	365[5]	500[5]	365[5]	400[5]

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.4 N; 1 ksi = 6.9 MPa.

[1]Allowable load capacities are based on base steel with a minimum yield strength (F_y) of 36 ksi and a minimum tensile strength (F_u) of 58 ksi.
[2]The fasteners must be driven to where the point of the fastener penetrates through the steel base material, unless otherwise noted.
[3]Based upon a minimum point penetration of 3/8 inch.
[4]Based upon a minimum point penetration of 1/2 inch.
[5]Based upon a minimum point penetration of 15/32 inch.
[6]Allowable loads are applicable to static and seismic loads in accordance with Section 4.1.
[7]For steel-to-steel connections designed in accordance with Section 4.1.6 for static loads only, the tabulated allowable load may be increased by a factor of 1.25, and the design strength maybe taken as the tabulated allowable load multiplied by a factor of 2.0.

X-U EMBED CAPACITY TO STEEL

TABLE 3—ALLOWABLE LOADS FOR FASTENERS DRIVEN INTO NORMAL-WEIGHT CONCRETE[1,2,4]

FASTENER DESCRIPTION	FASTENER	SHANK DIAMETER (inch)	MINIMUM EMBEDMENT DEPTH (inches)	ALLOWABLE LOADS (lbf)							
Concrete Compressive Strength:				2500 psi		4000 psi		6000 psi		8000 psi	
Load Direction:				Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear
Universal Knurled Shank	X-U	0.157	$^{3}/_{4}$	100	125	100	125	105	205	–	–
			1	165	190	170	225	110[3]	280[3]	–	–
			$1^{1}/_{4}$	240	310	280	310	180	425	–	–
			$1^{1}/_{2}$	275	420	325	420	–	–	–	–
Smooth Shank	X-P	0.157	$^{3}/_{4}$[5]	100	155	100	175	105	205	135	205
			1[5]	165	220	180	225	150	300	150	215
			$1^{1}/_{4}$[5]	240	310	280	310	180	425	–	–
			$1^{1}/_{2}$[5]	310	420	–	–	–	–	–	–

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.4 N, 1 psi = 6895 Pa.

[1]Unless otherwise noted, values apply to normal weight cast-in-place concrete. Fasteners must not be driven until the concrete has reached the designated minimum compressive strength.
[2]Unless otherwise noted, concrete thickness must be a minimum of 3 times the embedment depth of the fastener.
[3]This allowable load value for the X-U fastener also applies to normal weight hollow core concrete slabs with f'_c of 6600 psi and minimum dimensions shown in Figure 7, when installed in accordance with Section 4.2.4.
[4]The fasteners listed in the table above may be used for static load conditions and for the seismic load conditions described in Section 4.1.6, as applicable. The tabulated allowable loads apply to static load conditions. For seismic load conditions, the allowable loads must be limited in accordance with Section 4.1.6, Items 2 and 3, as applicable.
[5]Applies to fastening of cold-formed steel up to 54 mil thick using the X-P 22, X-P 27, X-P 34 and X-P 40 fasteners, respectively, for the $^{3}/_{4}$, 1, $1^{1}/_{4}$ and $1^{1}/_{2}$ inch embedment depths.

3(3/4") =2 1/4" < 2 1/2" OK

X-U/X-P EMBED CAPACITY
TO CONCRETE

TABLE 4—ALLOWABLE LOADS FOR FASTENERS DRIVEN INTO NORMAL-WEIGHT CONCRETE USING DX-KWIK[1,2,3,4]

FASTENER DESCRIPTION	FASTENER	SHANK DIAMETER (inch)	MINIMUM EMBEDMENT (inches)	ALLOWABLE LOADS (lbf)			
Concrete Compressive Strength:				4,000 psi		6,000 psi	
Load Direction:				Tension	Shear	Tension	Shear
Universal Knurled Shank	X-U 47 P8 w/ DX-KWIK	0.157	$1^{1}/_{2}$	395	405	360	570

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.4 N, 1 psi = 6895 Pa.

[1]X-U Fastener is installed using the DX-KWIK drilled pilot hole installation procedure described in Section 4.2.5.
[2]Pilot holes must not be drilled until the concrete has reached the designated minimum compressive strength.
[3]Concrete thickness must be a minimum of 3 times the embedment depth of the fastener.
[4]The fasteners listed in the table above may be used for static load conditions and for the seismic load conditions described in Section 4.1.6, as applicable. The tabulated allowable loads apply to static load conditions. For seismic load conditions, the allowable loads must be limited in accordance with Section 4.1.6, Items 2 and 3, as applicable.

Screw Capacities

Table Notes

1. Capacities based on AISI S100 Section E4.
2. When connecting materials of different steel thicknesses or tensile strengths, use the lowest values. Tabulated values assume two sheets of equal thickness are connected.
3. Capacities are based on Allowable Strength Design (ASD) and include safety factor of 3.0.
4. Where multiple fasteners are used, screws are assumed to have a center-to-center spacing of at least 3 times the nominal diameter (d).
5. Screws are assumed to have a center-of-screw to edge-of-steel dimension of at least 1.5 times the nominal diameter (d) of the screw.
6. Pull-out capacity is based on the lesser of pull-out capacity in sheet closest to screw tip or tension strength of screw.
7. Pull-over capacity is based on the lesser of pull-over capacity for sheet closest to screw header or tension strength of screw.
8. Values are for pure shear or tension loads. See AISI Section E4.5 for combined shear and pull-over.
9. Screw Shear (Pss), tension (Pts), diameter, and head diameter are from CFSEI Tech Note (F701-12).
10. Screw shear strength is the average value, and tension strength is the lowest value listed in CFSEI Tech Note (F701-12).
11. Higher values for screw strength (Pss, Pts), may be obtained by specifying screws from a specific manufacturer.

Allowable Screw Connection Capacity (lbs)

Thickness (Mils)	Design Thickness	Fy Yield (ksi)	Fu Tensile (ksi)	#6 Screw (Pss = 643 lbs, Pts = 419 lbs) 0.138" dia, 0.272" Head			#8 Screw (Pss= 1278 lbs, Pts = 586 lbs) 0.164" dia, 0.272" Head			#10 Screw (Pss= 1644 lbs, Pts = 1158 lbs) 0.190" dia, 0.340" Head			#12 Screw (Pss= 2330 lbs, Pts = 2325 lbs) 0.216" dia, 0.340" Head			¼" Screw (Pss= 3048 lbs, Pts = 3201 lbs) 0.250" dia, 0.409" Head		
				Shear	Pull-Out	Pull-Over	Shear	Pull-Out	Pull-Over	Shear	Pull-Out	Pull-Over	Shear	Pull-Out	Pull-Over	Shear	Pull-Out	Pull-Over
18	0.0188	33	33	44	24	84	48	29	84	52	33	105	55	38	105	60	44	127
27	0.0283	33	33	82	37	127	89	43	127	96	50	159	102	57	159	110	66	191
30	0.0312	33	33	95	40	140	103	48	140	111	55	175	118	63	175	127	73	211
33	0.0346	33	45	151	61	140	164	72	195	177	84	265	188	95	265	203	110	318
43	0.0451	33	45	214	79	140	244	94	195	263	109	345	280	124	345	302	144	415
~~54~~	~~0.0566~~	~~33~~	~~45~~	~~214~~	~~100~~	~~140~~	~~344~~	~~118~~	~~195~~	~~370~~	~~137~~	~~386~~	~~394~~	~~156~~	~~433~~	~~424~~	~~180~~	~~521~~
~~68~~	~~0.0713~~	~~33~~	~~45~~	~~214~~	~~125~~	~~140~~	~~426~~	~~149~~	~~195~~	~~523~~	~~173~~	~~386~~	~~557~~	~~196~~	~~545~~	~~600~~	~~227~~	~~656~~
~~97~~	~~0.1017~~	~~33~~	~~45~~	~~214~~	~~140~~	~~140~~	~~426~~	~~195~~	~~195~~	~~548~~	~~246~~	~~386~~	~~777~~	~~280~~	~~775~~	~~1,016~~	~~324~~	~~936~~
~~118~~	~~0.1242~~	~~33~~	~~45~~	~~214~~	~~140~~	~~140~~	~~426~~	~~195~~	~~195~~	~~548~~	~~301~~	~~386~~	~~777~~	~~342~~	~~775~~	~~1,016~~	~~396~~	~~1,067~~
54	0.0566	50	65	214	140	140	426	171	195	534	198	386	569	225	625	613	261	752
68	0.0713	50	65	214	140	140	426	195	195	548	249	386	777	284	775	866	328	948
97	0.1017	50	65	214	140	140	426	195	195	548	356	386	777	405	775	1,016	468	1,067
118	0.1242	50	65	214	140	140	426	195	195	548	386	386	777	494	775	1,016	572	1,067

SCREW ALLOWABLE LOADS & UL ASSEMBLIES

SCREW ALLOWABLE LOADS (LBS.)

MODEL NO.	DESIGN THICKNESS (in)	MIN. THICKNESS (in)	FY YIELD (ksi)	FU TENSILE (ksi)	#6 SCREW (0.138" dia; 0.25" head)		#8 SCREW (0.164" Dia; 0.3125" Head)		#10 SCREW (0.190" Dia; 0.340" Head)		#12 SCREW (0.216" Dia; 0.340" Head)	
					SHEAR	TENSION	SHEAR	TENSION	SHEAR	TENSION	SHEAR	TENSION
VIPER-X-18	0.0188	0.0179	57	65	142[1]	48	150[1]	57	164[1]	66	109	75
VIPER-X-22	0.0235	0.0223	57	65	174[1]	60	184[1]	71	236[1]	82	152	93

Notes:

1 Shear values are tested per AISI S100-12 and S905 procedure.

2. Capacities are based on section E4 of the AISI S100-12 Specification.

3. Capacities are based on Allowable Strength Design (ASD).

4. Screw pull-out capacities are based on listed head diameter.

5. Two sheets of equal thickness and tensile strength are assumed in tabulated values.

6. When materials of different steel thickness and tensile strength are connected, use the lowest value for shear capacity (tilting and bearing), for pull-out capacity use sheet closest to screw tip and for pull-over capacity use sheet closest to screw head.

7. Where multiple fasteners are used, screws are assumed to have a center-to-center spacing of at least 3 times the nominal diameter.

8. Screws are assumed to have a center-of-screw to edge-of-steel dimension of at least 1.5 times the nominal diameter of the screw.

9. When screws are subjected to combination of shear and tension forces, interaction equation of AISI S100-12 Specification section E4.5 shall be used.

UL ASSEMBLIES – VIPER-X FIRE TESTING DATA (ASTM E119)

UL DESIGN NO.	VIPER-X (DESIGN THICKNESS)	WALL RATING
U411	18 MIL	2 HR
U412	18 MIL	2 HR
U419	18 MIL	1, 2, 3 or 4 HR
U435	18 MIL	3 or 4 HR
U465	18 MIL	1 HR Chase
V417	18 MIL	1 HR
V435	18 MIL	1 HR
V448	18 MIL	1 HR
V469	18 MIL	1 or 2 HR Chase
V486	18 MIL	1, 2, or 2-1/2 HR
V489	18 MIL	1, 2, 3 or 4 HR
V496	18 MIL	1 or 2 HR Chase
V498	18 MIL	1, 2, 3 or 4 HR
W411	18 MIL	1/2 or 1 HR
W424	18 MIL	1/2 or 1 HR
W433	18 MIL	1/2 HR
W440	18 MIL	1, 2, 3 or 4 HR

SHEET METAL SCREW (SMS) ALLOWABLE STRENGTHS (CONTINUED)

TABLE 3 - NON-PRYING CONDITION

SHEET METAL SCREW ALLOWABLE STRENGTHS FOR STEEL TO STEEL CONNECTIONS WITH TWO LAYERS OF 5/8" GYP BOARD BETWEEN STEEL SURFACES.

F_y (KSI)	MIL (STEEL GA)	FASTENER SIZE									
		NO. 14 0.250 IN		NO. 12 0.216 IN		NO. 10 0.190 IN		NO. 8 0.164 IN		NO. 6 0.138 IN	
		SHEAR (LB)	TENSION (LB)	SHEAR (LB)	TENSION (LB)	SHEAR (LB)	TENSION (LB)	SHEAR (LB)	TENSION (LB)	SHEAR (LB)	TENSION (LB)
50	97 (12)	166	275	130	205						
	68 (14)	166	275	130	205	100	159				
	54 (16)	166	261	130	205	100	159	80	118		
33	43 (18)	166	144	130	124	100	109	80	94	50	79
	33 (20)					70	84	50	72	40	61

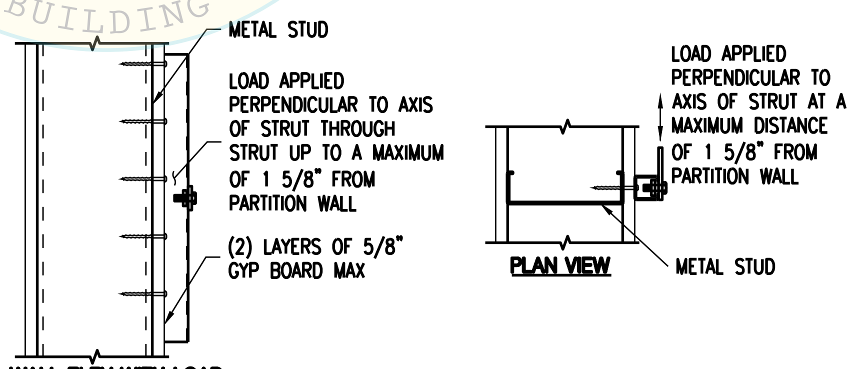
NOTES:
1. SEE GENERAL NOTES ON ST1.06 FOR MORE INFORMATION.
2. ALLOWABLE STRENGTH VALUES DO NOT ACCOUNT FOR EFFECTS FROM PRYING. RDP IN RESPONSIBLE CHARGE TO PROVIDE ADEQUATE BLOCKING/RESTRAINT TO PREVENT PRYING ACTION. WHERE PRYING OCCURS, THE VALUES AND CONSTRAINTS OF TABLE 4 SHALL BE USED.

TABLE 4 - PRYING CONDITION (SEE DETAILS BELOW - STRUT CAN BE HORIZONTAL OR VERTICAL)

SHEET METAL SCREW ALLOWABLE STRENGTHS FOR STEEL TO STEEL CONNECTIONS WITH ONE OR TWO LAYERS OF 5/8" GYP BOARD BETWEEN STEEL SURFACES AND MAXIMUM PRYING MOMENT ARM OF 1 5/8".

F_y (KSI)	MIL (STEEL GA)	FASTENER SIZE									
		NO. 14 0.250 IN		NO. 12 0.216 IN		NO. 10 0.190 IN		NO. 8 0.164 IN		NO. 6 0.138 IN	
		SHEAR (LB)	TENSION (LB)	SHEAR (LB)	TENSION (LB)	SHEAR (LB)	TENSION (LB)	SHEAR (LB)	TENSION (LB)	SHEAR (LB)	TENSION (LB)
50	97 (12)	40	275	30	205						
	68 (14)	40	275	30	205	25	159				
	54 (16)	40	261	30	205	25	159	20	118		
33	43 (18)	40	144	30	124	25	109	20	94	10	79
	33 (20)					15	84	15	72	10	61

NOTES:
1. SEE GENERAL NOTES ON ST1.06 FOR MORE INFORMATION.
2. THE ALLOWABLE STRENGTH VALUES LISTED IN TABLE 4 ARE BASED UPON A LIMITED TEST ASSEMBLY WHERE THE ORIGIN AND DIRECTION OF THE LOAD RESULTS IN PRYING UPON THE FASTENER. THE MAGNITUDE OF THIS PRYING EFFECT SHALL BE LIMITED TO A MOMENT ARM OF 1 5/8" FROM THE FASTENER.



WALL ELEV WITH LOAD APPLIED THROUGH STRUT

SECTION TITLE:
STANDARD PARTITION WALL DETAILS

SHEET TITLE:
SHEET METAL SCREW ALLOWABLE STRENGTHS (CONTINUED)

OPD NO.: ST1.08

DIVIDE BY 5 SAFETY FACTOR FOR ALLOWABLE LOADS

c) The metal-critical joint may fail in one of two ways. Failure occurs when the resistance of the screw head to embedment is greater than the resistance of the metal to lateral and/or withdrawal load, and the screw tears away from the metal framing. Failure also occurs when thin metal in a metal-to-plywood joint crushes or tears away from the screw.

Tables 1 and 2 present ultimate lateral loads for wood- and sheet-metal-screw connections in plywood-and-metal joints. Loaded end distance in these tests was one inch. Plywood face grain was parallel to the load since this direction yields the lowest lateral loads when the joint is plywood-critical. All wood-screw specimens were tested with a 3/16-in.-thick steel side plate, and values should be modified if thinner steel is used.

TABLE 1

SCREWS: METAL-TO-PLYWOOD CONNECTIONS[(a)]

Depth of Threaded Penetration (in.)	Ultimate Lateral Load (lbf)[(b)]					
	Wood Screws			Sheet Metal Screws		
	#8	#10	#12	#8	#10	#12
1/2	415	(500)	590	465	(565)	670
5/8	–	–	–	500	(600)	705
3/4	–	–	–	590	(655)	715

(a) Plywood was C-D grade with exterior glue (all plies Group 1), face grain parallel to load. Side plate was 3/16"-thick steel.

(b) Values in parentheses are estimates based on other tests.

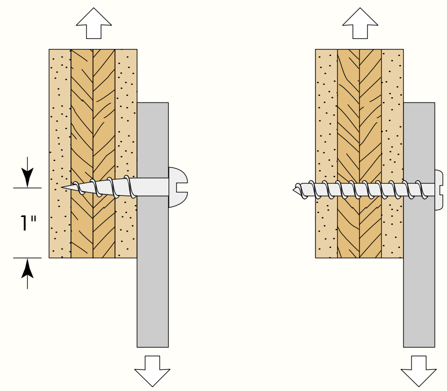


TABLE 2

SHEET METAL SCREWS: PLYWOOD-TO-METAL CONNECTIONS[(a)]

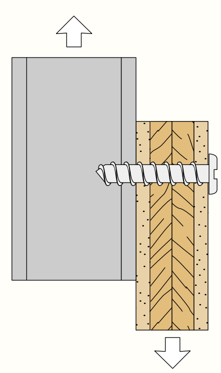
Framing	Plywood Thickness (in.)	Ultimate Lateral Load (lbf)[(b)]				
		Screw Size				1/4"-20 Self Tapping Screw
		#8	#10	#12	#14	
0.080-in. Aluminum	1/4	330	360	390	410	590
	1/2	630	850*	860	920	970
	3/4	910*	930*	1250	1330	1440
0.078-in. Galvanized Steel (14 gage)	1/4	360	380	400	410	650
	1/2	700*	890*	900	920	970
	3/4	700*	950*	1300*	1390*	1500

(a) Plywood was A-C EXT (all plies Group 1), face grain parallel to load.

(b) Loads denoted by an asterisk(*) were limited by screw-to-framing strength; others were limited by plywood strength.

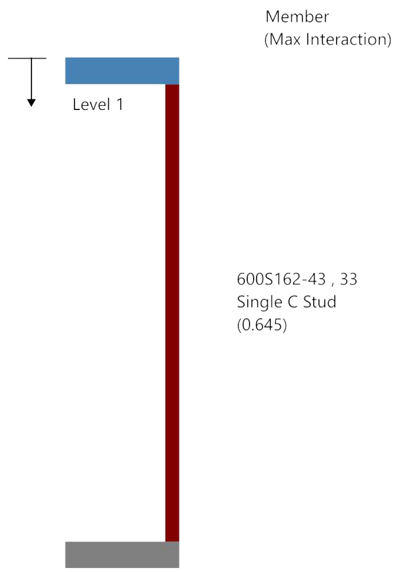
IF ALLOWABLE IS A FOS = 5, THEN

#8	#10	#12	
140	190	260	LBS



BEARING CFS WALL DESIGNS

BEARING WALL
6" STUDS



Load Inputs

Top Level is a Roof?	False
Axial Loads Redistributed?	True
Live Load Reduction Applied?	False
Roof Snow Load	0 psf
Roof Wind Uplift	0 psf
Wind Load Defl Modifier	1.0

Stacked Wall Summary Report

Model Inputs

Level	Wall Height (ft)	Stud Spacing (in)	Supported Member Tributary Length (ft)	Gravity Load Ecc. (in)	Flexural Bracing (in)	Axial KyLy (in)	Axial KtLt (in)	K-Phi Flexure (lb-in/in)	Dist. K-Phi Axial (lb-in/in)	Lm (in)
1	12	24	8	Stud Depth/2	72	72	72	0	0	None

Level	Wall D (psf)	Roof or Floor D (psf)	Floor or Roof L or Lr (psf)	L Reduction Factor	MWFRS Windward W (psf)	MWFRS Leeward W (psf)	C&C Windward W (psf)	C&C Leeward W (psf)	Seismic Coefficient Eh/D	Seismic Coefficient Ev/D
1	14	20	40	1	5	5	5	5	0.3	0.14

Load Combinations

LC Number	D	L	Max Roof (Lr or S)	S	MWFRS Windward (W)	MWFRS Leeward (W)	C&C Windward (W)	C&C Leeward (W)	Roof Uplift (W)	Seismic (Eh or Ev)
1	1	1	0	0	0	0	0	0	0	0

1

Load Combinations

LC Number	D	L	Max Roof (Lr or S)	S	MWFRS Windward (W)	MWFRS Leeward (W)	C&C Windward (W)	C&C Leeward (W)	Roof Uplift (W)	Seismic (Eh or Ev)
2	1	0	1	0	0	0	0	0	0	0
3	1	0.75	0.75	0	0.75	0	0	0	0	0
4	1	0.75	0.75	0	0	0.75	0	0	0	0
5	1	0	0	0	0	0	1	0	0	0
6	1	0	0	0	0	0	0	1	0	0
7	1	0	0	0	0	0	0	0	0	1
8	1	0.75	0	0.75	0	0	0	0	0	0.75
9	0.6	0	0	0	0	0	0	0	1	0
10	0.6	0	0	0	0	0	0	0	1	0

Member Selection

Level	Section	Fy (ksi)	Configuration	Ma-Fy (ft-lb)	Ma-Dist (ft-lb)	Ma-Brc (ft-lb)	Axial Pa (lb)	Axial Pa-Dist (lb)
1	600S162-43	33	Single	1271	1088	983	2471.9	4787

Level	Bending and Axial Interactions: Control LC	M(LC) (ft-lb)	P(LC) (lb)	Max Intr	Shear and Web Crippling: Rmax (lb)	Control LC	Va (lb)	Rmax/Va	Pa (lb)	Stiffener Req'd
1	1	240	960	**0.645**	67	6	1416	0.047	259	No

Deflection

Deflection Multiplier for C&C Wind Load : 1.0

Level	D(Unif) (in)	L/	Control LC	D(Total) (in)	L/	Control LC
1	0.068	L/2109	6	0.098	L/1470	4

BSE
***B**rienen **S**tructural **E**ngineers, P.S.*

BEARING CFS WALL OPENING DESIGNS

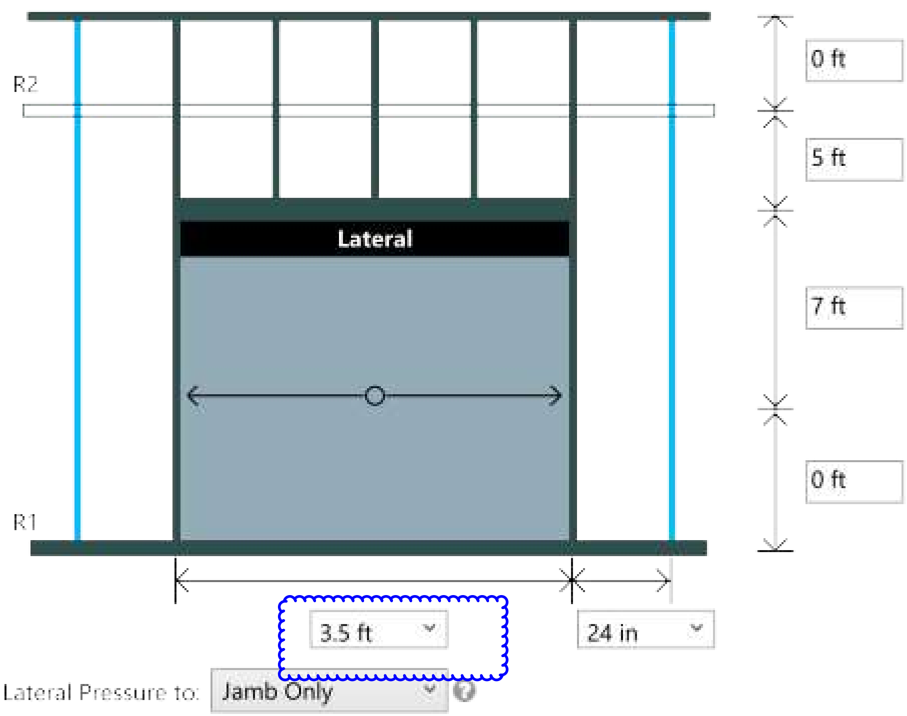
Phone: (206) 397-0000 1316 Central Avenue South, Suite 200, Kent, WA 98032 www.bse-ps.com

TYP SINGLE DOOR OPN'G
BEARING WALL
6" STUDS

Project Name: Centeris
Model: 6" BRG WALL HDR @ TYP DRWY
Code: AISI S100-16w/S2-20

1

Date: 06/14/2024
Simpson Strong-Tie® CFS Designer™ 5.2.4.0



Design Loads

Wall Lateral Pressure :	**5 psf**
Parapet Lateral Pressure :	
RO Lateral Pressure :	**Jamb Only**
Lateral element force multiplier	
Strength :	**1.0**
Deflection :	**1**
Header:	**Box (lateral combined)**
Gravity Load at Header:	**14 psf**
Additional Pt. Load ea. Stud :	**560 lbs**

Brace Settings

Component(s)	Members(s)	Flexural Bracing	Axial KyLy	Axial KtLt	Distortional K-Phi(lb-in/in)	Distortional Lm	Interconnection Spacing
Jamb Studs	600S162-43(33), Single	60 in	60 in	60 in	0	None	N/A
Vertical Header	400S125-33(33), Boxed	Full	N/A	N/A	0	None	N/A
Lateral Header	600T125-33(33), Single	Full	N/A	N/A	0	None	N/A

Analysis Results

Component(s)	Members(s)	Axial Load (lb)	Max KL/r	Max. Moment (ft-lb)	Max. Shear (lb)	Bottom Reaction (lb)	Top or End Reaction (lb)
Jamb Studs	600S162-43(33), Single	612.5	104	247.5	82.5	82.5	60.6
Vertical Header	400S125-33(33), Boxed	N/A	N/A	535.9	612.5	N/A	612.5
Lateral Header	600T125-33(33), Single	N/A	N/A	19.1	21.9	N/A	21.9

Design Results

Component(s)	Members(s)	Deflection Span	Deflection Parapet	A + M Interaction	V + M Interaction	Web Stiffners	Design OK
Jamb Studs	600S162-43(33), Single	L/1582	L/0	0.439	0.19	No	Yes
Vertical Header	400S125-33(33), Boxed	L/1099	NA	0.80	0.80	R1, R2	Yes
Lateral Header	600T125-33(33), Single	L/36920	NA	0.04	0.04	No	Yes

Simpson Strong-Tie® Connectors @ Jambs

Support	Rx(lb)	Ry(lb)	Simpson Strong-Tie® Connector	Connector Interaction	Anchor Interaction
R2	60.63	0.00	By Others & Anchorage Designed by Engineer	NA	NA
R1	82.50	878.50	600T125-33 (33) & (1) .157", 3/4" embed SST PDPA/PDPAT to 4000 nw concrete	40.24 %	61.11 %

* Reference catalog for connector and anchor requirement notes as well as screw placements requirement.

TOP CONN IS BRACED BY JOISTS

Simpson Strong-Tie® Wall Stud Bridging Connectors @ Jambs

Span/Parapet	Bracing Length(in.)	Design Number of Braces	Pn(lb.)	LSUBH (Min)[1]	LSUBH (Max)[1]	SUBH (Min)[1]	SUBH (Max)[1]	MSUBH (Min)[1]	MSUBH (Max)[1]
Span	60	3	5402.7	OK (0.28)	OK (0.17)	OK (0.23)	OK (0.14)	No Soln	No Soln

Notes:

1) Values in parentheses are stress ratios.
2) Bridging connectors are not designed for back-back, box, or built-up sections.
3) Reference www.strongtie.com for latest load data, important information, and general notes.
4) CFS Designer will not select bridging connectors unless all flexural and axial bracing settings are the same.
5) If the bracing length is larger than the span length, bridging connectors are not designed.

BSE

Brienen ***S***tructural ***E***ngineers, P.S.

CFS JOIST FRAMING DESIGN

Phone: (206) 397-0000 1316 Central Avenue South, Suite 200, Kent, WA 98032 www.bse-ps.com

BSE

***B**rienen **S**tructural **E**ngineers, P.S.*

JOISTS: DEAD = 20PSF TOT
LIVE = 40PSF

IF WE USE 8" STUDS → 800S200-68 @ 24" o.c.
800S162-54 @ 16" o.c.

If WE USE 10" STUDS → 1000 S 200-54 @ 24" o.c.
1000 S 137-54 @ 16" o.c.

RXN = @ 24" SPACING = 960#
@ 16" SPACING = 640#

JOIST BRACING REQUIREMENTS, CONTINUED

B2.6 Bracing Design

Bracing members shall be designed either on the basis of discretely braced design or on the basis of continuously braced design, in accordance with the following:

(a) Discretely Braced Design. For discretely braced design, *bracing* members shall be designed in accordance with Section C2.2 of AISI S100 [CSA S136].

(b) Continuously Braced Design. For continuously braced design, *bracing* members shall be designed in accordance with Section C2.2 of AISI S100 [CSA S136], unless the following requirements, as applicable, are met:

✓ (1) Members are spaced no greater than 24 inches (610 mm) on center.

✓ (2) The sheathing or deck shall consist of a minimum of 3/8 inch (9.5 mm) wood *structural sheathing* that complies with DOC PS 1, DOC PS 2, CSA O437 or CSA O325, or *steel deck* with a minimum profile depth of 9/16 in. (14.3 mm) and a minimum thickness of 0.0269 in. (0.683 mm). The sheathing or deck shall be attached with minimum No. 8 screws at a maximum 12 inches (305 mm) on center.

(3) *Floor joists* and *ceiling joists* with simple or continuous spans that exceed 8 feet (2.44 m) shall have the tension *flanges* laterally braced. Each intermediate brace shall be spaced at 8 feet (2.44 m) maximum and shall be designed to resist a required lateral force, P_L, determined in accordance with the following:

For uniform *loads*:

$$P_L = 1.5(m/d)\,F \qquad (Eq.\ B2.6\text{-}1)$$

where

m = Distance from shear center to mid-plane of *web*

d = Depth of *C-shape* section

F = wa

w = Uniform *design load* [*factored load*]

a = Distance between center line of braces

FOR OUR 10" DEEP JOISTS

PL = 1.5*(1.14"/10")*(1.2*20psf + 1.6*40psf)*(2ft oc) * (8ft)

PL = 240 lbs

YIELD STRENGTH OF 33MIL x 1 1/2" STRAP

φTn = (0.9)*(1.5")*(0.035")*(33ksi) = 1560 lbs

JOIST BRACING REQUIREMENTS

B1.2 Design Basis

The proportioning, designing and detailing of *cold-formed steel light-frame lateral force-resisting systems*, *trusses*, *structural members*, *connections* and *connectors* shall be in accordance with AISI S100 [CSA S136], and the reference documents except as modified or supplemented by the requirements of this Standard.

B1.2.1 Floor Joists, Ceiling Joists and Roof Rafters

B1.2.1.1 *Floor joists*, *ceiling joists* and *roof rafters* shall be designed either on the basis of discretely braced design or on the basis of continuously braced design, in accordance with the following:

(a) Discretely Braced Design. Floor and roof assemblies using discretely braced design shall be designed neglecting the structural *bracing* and composite-action contribution of attached sheathing or deck. The discretely braced design requirements of the Standard shall be applied to assemblies where the

APPLICABLE SECTION FOR DETAIL 14/MS1.2

sheathing or deck is not attached directly to *structural members*.

(b) Continuously Braced Design. Unless noted otherwise in Section B2 or B4, the continuously braced design requirements of this Standard shall be limited to assemblies where *structural sheathing* or *steel deck* is attached directly to *floor joists*, *ceiling joists* and *roof rafters* that comply with all of the following conditions:

(1) Maximum *web* depth = 14 inches (356 mm)
(2) Maximum *design thickness* = 0.1242 inches (3.155 mm)
(3) Minimum design *yield strength*, F_y = 33 ksi (230 MPa)
(4) Maximum design *yield strength*, F_y = 50 ksi (345 MPa)

APPLICABLE SECTION FOR BRACING USING PW WEAR SURFACE TOP AND GYP BOT

TYP CFS CEILING JOISTS
10" STUDS, 24" OC.

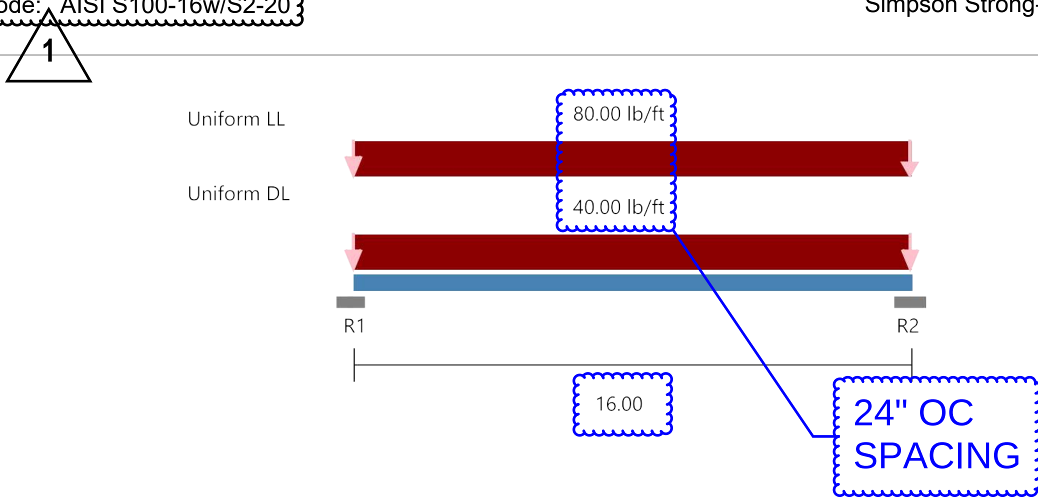
Project Name: Centeris

Model: 16ft Floor Joist @ 10" @ 24" OC - 40 psf LL

Date: 06/14/2024

Code: AISI S100-16w/S2-20

Simpson Strong-Tie® CFS Designer™ 5.2.4.0



Section :	1000S200-54 (50 ksi) @ 24 in" o.c. Single C Stud (punched)		
Maxo =	4254.2 ft-lb	**Va =** 1660.8 lb	**I =** 10.769 in^4

Deflection Limits: Total Load - 240 | Live Load - 360

Load Comb:
1. DL + LL All spans
2. DL + LL Even spans
3. DL + LL Odd spans
4. LL All spans
5. LL Even spans
6. LL Odd spans

CLIP CONNECTION STIFFENS JOIST

Joist Flexural and Deflection

	Mmax (ft-lb)	K-phi (lb-in/in)	Lm (in)	Ma-dist (ft-lb)	Mmax/ Ma min	Load Comb.	TL Defl	Load Comb.	LL Defl	Load Comb.
Span	3840	0.0	192.0	3770.5	1.018	1	L/345	1	L/517	4

Joist Bending and Web Crippling

Support	Load (lb)	Load Comb.	Bearing (in)	Pa (lb)	Pn (lb)	Max Intr.	Load Comb.	Stiffeners Required
R1	960.0	1	1.00	553.2	968.1	0.90	1	YES
R2	960.0	1	1.00	553.2	968.1	0.90	1	YES

Joist Bending and Shear

Support	Vmax (lb)	Load Comb.	Va Factor	V/Va	M/Ma	Intr. Unstiffened	Load Comb.	Intr. Stiffened	Load Comb.
R1	960.0	1	1.000	0.58	0.00	0.58	1	N/A	N/A
R2	960.0	1	1.000	0.58	0.00	0.58	1	N/A	N/A

Joist Reaction and Connections

Support	Rx(lb)	Ry(lb)	Simpson Strong-Tie Connector	Connector Interaction	Anchor Interaction
R1	0.0	960.0	S/DHUTF (3)#10 Joist & (6)#10 top,(8)#14 x 2" face to 14ga top plate	56.47 %	56.47 %
R2	0.0	960.0	S/DHUTF (3)#10 Joist & (6)#10 top,(8)#14 x 2" face to 14ga top plate	56.47 %	56.47 %

* Reference catalog for connector and anchor requirement notes as well as screw placement requirements

S/DHUTF Drywall Hangers

The S/DHUTF top-mount hanger is designed to carry joist loads to a CFS stud wall through two layers of ⅝" gypsum board (drywall). This hanger installs after the drywall is in place and comes in sizes that accommodate most typical joists used in multi-family and commercial construction.

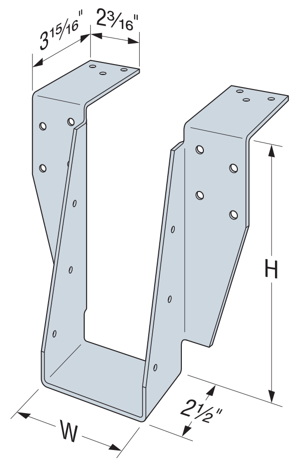
Material: 97 mil (12 ga.)

Finish: Galvanized (G90)

Installation:

- Use all specified fasteners; see General Notes
- Hanger to be framed in-line with vertical wall stud
- Drywall is installed first
- Wall top track must be restrained to counteract load eccentricity from hanger

Codes: See p. 13 for Code Reference Key Chart



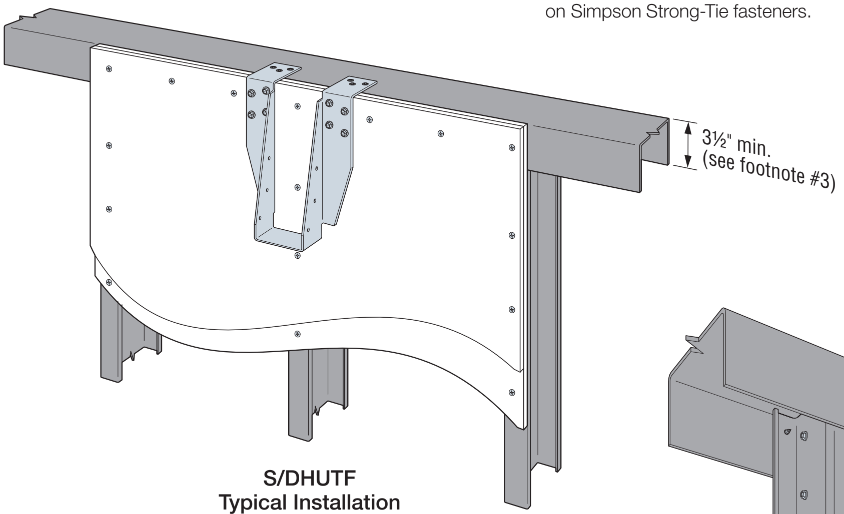
S/DHUTF
US Patent: 9,394,680

Model No.	Dimensions (in.)	
	W	H
S/DHU1.68/8TF	1 ¹¹⁄₁₆	8
S/DHU1.68/10TF		10
S/DHU1.68/12TF		12
S/DHU2.1/8TF	2⅛	8
S/DHU2.1/10TF		10
S/DHU2.1/12TF		12
S/DHU2.56/8TF	2⁹⁄₁₆	8
S/DHU2.56/10TF		10
S/DHU2.56/12TF		12

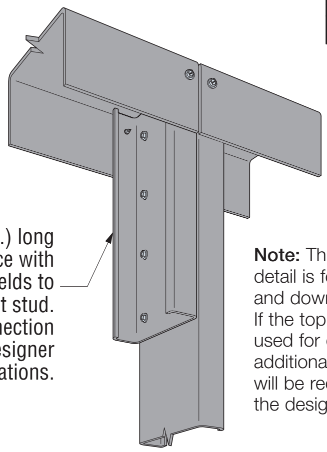
S/DHUTF Allowable Loads (lb.)

Model	Fasteners[6]			Allowable Load (lb.)		Code Ref.
	Top	Face	Joist	Uplift	Down	
S/DHUTF	(6) #10	(8) #14 x 2"	(3) #10	1,230	1,700	—

1. Designer shall ensure that the joist member adequately transfers load to the hanger.
2. Tabulated loads assume (2x) ⅝" Type X drywall attached per IBC.
3. Wall studs designed per designer specifications. At a minimum, the assembly must consist of 600T350-68, Gr. 50 ksi top track and 600S162-43, Gr. 33 ksi wall studs spaced at a maximum of 24" o.c.
4. Tabulated loads are based on testing with full bearing of 3¹⁵⁄₁₆" hanger top flange. The minimum joist gauge is 54 mil (16 ga.).
5. S/DHUTF hanger can be installed ¾" max. from the center of the vertical stud per the in-line framing specifications of the AISI General Provisions without load adjustment.
6. See the current *Fastening Systems* catalog at **strongtie.com** for more information on Simpson Strong-Tie fasteners.

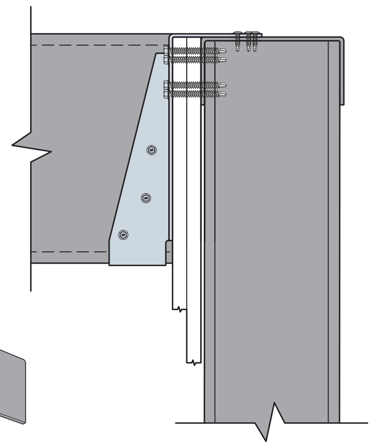


S/DHUTF
Typical Installation



Note: This splice detail is for uplift and download only. If the top track is used for drag, additional detailing will be required by the designer.

Typical Top Track Splice

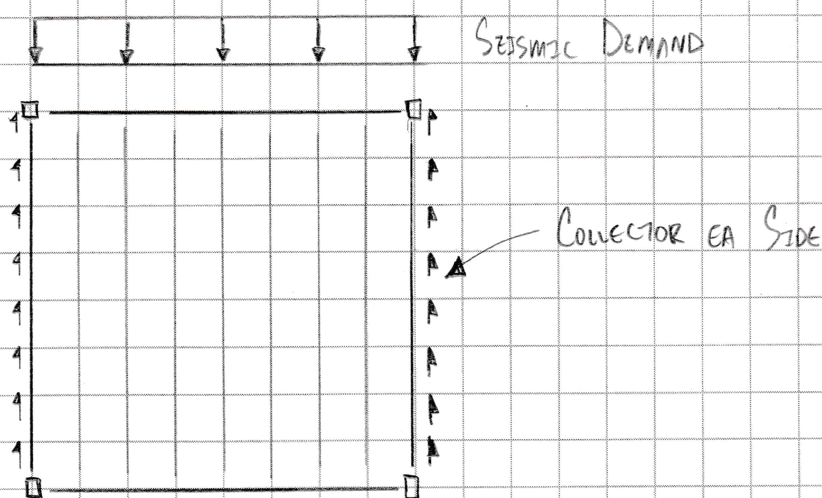


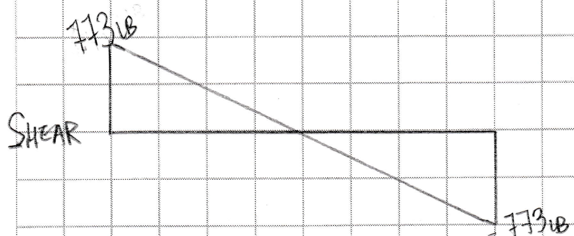
Typical Installation Over (2) Layers of ⅝" Drywall

Joist Framing Connectors

LATERAL DESIGN

PLYWOOD-ON-MTL JOIST DIAPHRAGMS





COLLECTOR LOAD = 773 LBS (LRFD)
= 541 LBS (ASD)

SHEAR TRANSFER FROM DIAPHRAGM TO COLLECTOR = (15) #10 SCREWS THRU PLYWOOD INTO COLLECTOR

$V_{A,SCREW}$ = 190 LBS
OF SCREWS REQ'D = 541 LBS / 190 LB/SCREW = 2.8 SCREWS OK!

ALLOWABLE DIAPHRAGM SHEAR PER AISI S400-20 §F2.4

$\phi V_n = \phi v_n L$
$= (0.6)(555\ lb/ft)(16\ ft) = 5328\ LBS \gg 773\ LBS$ OK!

COLLECTOR ATTACHMENT TO COLUMNS EA SIDE, $T_{REQ'D} = \frac{1}{2}(541\ LBS) = 271\ LBS$ (ASD)

SIMPSON RCA-C225/97 w/ (4) #10 SMS TO TRACK & (2) Ø1/4" x 1 7/8" TITEN HD ANCHORS

T_a = 280 LBS TO CRACKED CONCRETE > $T_{REQ'D}$ = 271 LBS OK!

WALL CONSTRUCTION: (4) LAYERS GYP - (4)(2.5psf) = 10psf
MTL STUDS - 1.5psf
ACOUSTIC INS - 2psf
13.5psf
USE 14psf

BATTERY ROOM

TOTAL CEILING SEISMIC WEIGHT = (20psf)(256 ft²) = 5.1K
TOP HALF OF WALLS = (½)(12ft)(14psf)(64ft) = 5.4K
TOTAL WALL LENGTH

TOTAL SEISMIC MASS = 10.5K

FIND F_p PER ASCE 7-16, EQN 13.3-1

$$F_p = \frac{0.4(a_p) S_{DS} W_p}{R_p/I_p}\left(1 + 2\frac{z}{h}\right) = \frac{0.4(1.0)(1.006)(10.5^k)}{(2.5/1.0)}\left(1 + 2\left(\frac{12ft}{47ft}\right)\right)$$

$F_p = 0.243\, W_p < F_{p\,MIN} = 0.302\, W_p$ ∴ $F_p = 3.2$ KIPS TOTAL

FIND SEISMIC LOAD TO EACH COLUMN

\# OF COLUMNS = 4

SEISMIC LOAD PER COLUMN $= \frac{3.2\text{ KIPS}}{4} = 0.8$ KIPS/COLUMN

BSE

***B**rienen **S**tructural **E**ngineers, P.S.*

Diaphragm Shear Provisions from AISI 400-20, Section F2.4

F2.4 Shear Strength

F2.4.1 Nominal Strength

The *nominal strength* of *diaphragms* sheathed with *wood structural panels* is permitted to be determined in accordance with Eq. F2.4.1-1 subject to the requirements in Section F2.4.1.1.

$$V_n = v_n L \qquad (Eq.\ F2.4.1\text{-}1)$$

where

L = *Diaphragm* resistance length, in ft (m)

v_n = *Nominal shear strength* per unit length as specified in Table F2.4-1, lb/ft (kN/m)

F2.4.1.1 Requirements for Tabulated Systems

The following requirements shall apply to *diaphragms* sheathed with *wood structural panels*:

(a) The aspect ratio (length:width) of the *diaphragm* does not exceed 4:1 for blocked *diaphragms* and 3:1 for unblocked *diaphragms*.

(b) *Joists* and *tracks* are ASTM A1003 Structural Grade 33 (Grade 230) Type H steel for members with a *designation thickness* of 33 and 43 mils, and ASTM A1003 Structural Grade 50 (Grade 340) Type H steel for members with a *designation thickness* equal to or greater than 54 mils.

(c) The minimum *designation thickness* of *structural members* is 33 mils.

(d) *Joists* are C-shape members with a minimum *flange* width of 1-5/8 in. (41.3 mm), minimum *web* depth of 3-1/2 in. (89 mm) and minimum *edge stiffener* of 3/8 in. (9.5 mm).

(e) *Track* has a minimum *flange* width of 1-1/4 in. (31.8 mm) and a minimum *web* depth of 3-1/2 in. (89 mm).

(f) Screws for *structural members* are a minimum No. 8 and are in accordance with ASTM C1513.

(g) *Wood structural panel* sheathing is manufactured using exterior glue and complies with DOC PS-1 and DOC PS-2.

(h) Screws used to attach *wood structural panels* are minimum No. 8 where *structural members* have a *designation thickness* of 54 mils or less and No. 10 where *structural members* have a *designation thickness* greater than 54 mils and comply with ASTM C1513.

(i) Screws in the field of the panel are attached to intermediate supports at a maximum 12-in. (305 mm) spacing along the *structural members*.

(j) Panels less than 12-in. (305-mm) wide are not used.

(k) Maximum *joist* spacing is 24 in. (610 mm) on center.

(l) Where *diaphragms* are designed as blocked, all panel edges are attached to *structural members* or *panel blocking*.

(m) Where used as *blocking*, flat *strap* is a minimum thickness of 33 mils with a minimum width of 1-1/2 in. (38.1 mm) and is installed below the sheathing.

(n) Where *diaphragms* are designed as blocked, the screws are installed through the sheathing to the *blocking*.

(o) Fasteners along the edges in shear panels are placed from panel edges not less than

F2.4.2 Available Strength

The *available strength* ($\phi_v V_n$ or V_n/Ω_v) shall be determined from the *nominal strength* using the applicable *safety factors* and *resistance factors* given in this section in accordance with the applicable design method – *ASD* or *LRFD* as follows:

Ω_v = 2.50 (*ASD*)

ϕ_v = 0.60 (*LRFD*)

F2.4.3 Design Deflection

The deflection of a *diaphragm* with *wood structural panel* sheathing shown in Table F2.4-1 shall be determined by principles of mechanics considering the deformation of the sheathing and its attachment, *chords* and *collectors*.

Table F2.4-1
Nominal Shear Strength (v_n) per Unit Length for Diaphragms Sheathed With Wood Structural Panel Sheathing [1, 2]
***United States and Mexico* (lb/ft)**

Sheathing	Thickness (in.)	Blocked				Unblocked	
		Screw spacing at diaphragm boundary edges and at all continuous panel edges (in.)				Screws spaced maximum of 6 in. on all supported edges	
		6	4	2.5	2	Load perpendicular to unblocked edges and continuous panel joints	All other configurations
		Screw spacing at all other panel edges (in.)					
		6	6	4	3		
Structural I	3/8	768	1022	1660	2045	685	510
	7/16	768	1127	1800	2255	755	565
	15/32	925	1232	1970	2465	825	615
C-D, C-C and other graded wood structural panels	3/8	690	920	1470	1840	615	460
	7/16	760	1015	1620	2030	680	505
	15/32	832	1110	1770	2215	740	555

1. For SI: 1" = 25.4 mm, 1 ft = 0.305 m, 1 lb = 4.45 N
2. For *diaphragms* sheathed with *wood structural panels*, tabulated R_n values are applicable for short-term *load* duration (seismic *loads*).

Phone: (206) 397-0000 1316 Central Avenue South, Suite 200, Kent, WA 98032 www.bse-ps.com

RCA-C Rigid Connector Angle for Concrete

Our lineup of rigid connector angles (RCA) has a new addition with the RCA-C. The RCA-C is an ideal solution for attaching stud framing to concrete supports. This connector provides the most anchor options for attaching to concrete in comparison to other similar connectors on the market. The connector's design includes holes for a ½"-diameter anchor, or two ¼"-diameter concrete screws, accompanied by a wide array of fastening options — thus saving the installer the time and cost of drilling connector holes at the jobsite. In addition, the RCA connectors have been rigorously tested and load rated, giving you the confidence of quality and performance for your job.

Features:

- 2" x 2" legs provide plenty of room to make attachments to structure and stud framing.
- Multiple screw pattern options to stud framing for different load ratings.
- Can be used as either a heavy-duty shear and tension connector or light-duty moment connection.
- Prepunched holes for screws to stud framing and attachment to concrete. Prepunched holes on anchor leg provide options for (1) ½"-diameter anchor, (2) ¼"-diameter anchors, or (2) ¼"-diameter concrete screws.
- Attachment to concrete or masonry can be achieved with ½"-diameter Titen HD®, ½"-diameter Strong-Bolt® 2, ¼"-diameter Titen HD, or ¼"-diameter Titen Turbo™.

Material: RCA-C — 97 mil (12 ga.), 50 ksi

Finish: Galvanized (G90)

Installation:

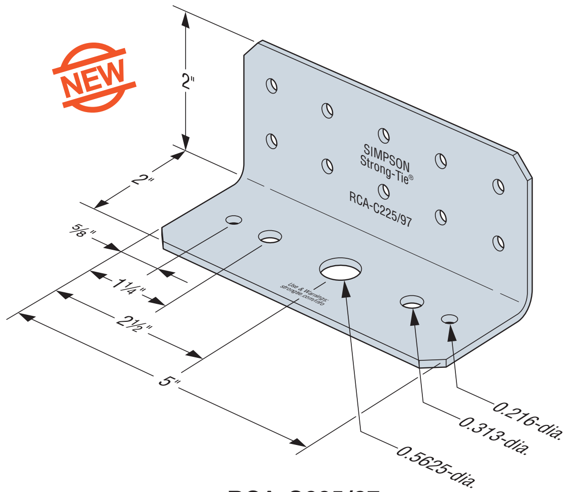
- Use all specified anchors/fasteners.

Codes: Tested per ICC-ES AC261 and calculations per AISI RP18-4, AISI S100 or generally accepted industry standards. Visit **strongtie.com** for the latest load values and testing information.

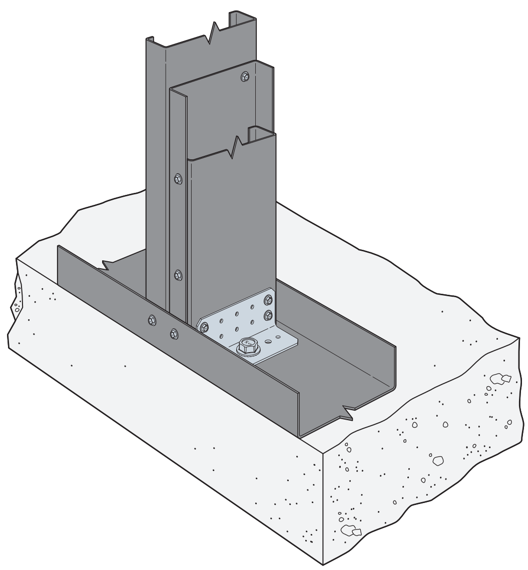
Ordering Information: RCA-C225/97-R55
(55 connectors per bucket)

Simpson Strong-Tie® Anchors for RCA-C Attachment to Concrete or Masonry

Anchor Type	Anchor Diameter
Titen HD Heavy-Duty Screw Anchor	½" or ¼"
Strong-Bolt 2 Wedge Anchor	½"
Titen Turbo Concrete and Masonry Screw Anchor	¼"



RCA-C225/97



RCA-C Installation at Post

SIMPSON Strong-Tie

RCA-C Rigid Connector Angle for Concrete

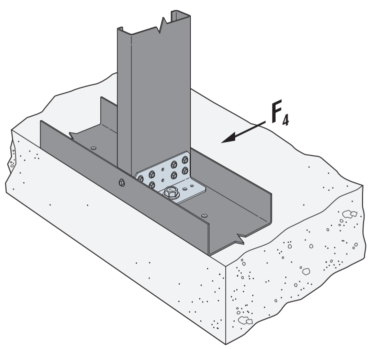


Figure A
F_4 Loading
(one anchor shown)

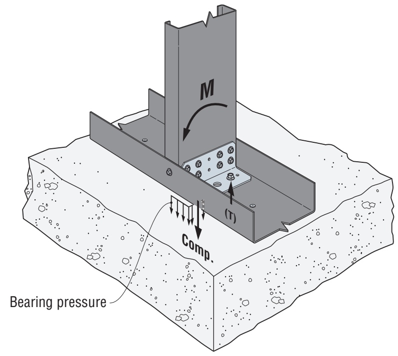


Figure B
Anchor Tension, T, Created from Moment
(two anchors shown)

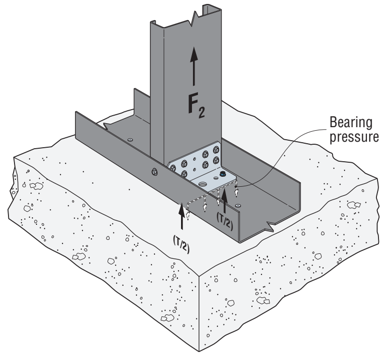


Figure C
Anchor Tension, T, Created from F_2
(two anchors shown)

Table 1: RCA-C Allowable Connector Loads (lb.)

Model No.	Anchor Type	Fastener Pattern	No. of #10 Fasteners to Stud	Framing Member Thickness mil (ga.)	Connector Rotational Stiffness β (in.-kip/rad.)	Allowable Load: Moment M (in.-lb.)	Allowable Load: Tension F_2 (lb.)	Allowable Load: Shear F_4 (lb.)	Anchor Tension, T: At Allowable Moment, M (lb.) f'c = 4,000 psi	Anchor Tension, T: At Allowable Tension Load, F_2 (lb.) f'c = 4,000 psi
RCA-C225/97	(1) ½"-diameter Titen HD® or (1) ½"-diameter Strong-Bolt® 2	4A	4	33 (20)	130	845	660	425	345	705
				43 (18)	160	1,500	1,020	550	615	1,105
				54 (16)	165	1,900	1,050	1,050	785	1,140
		8A	8	33 (20)	155	1,830	1,050	845	755	1,140
				43 (18)	160	3,215	1,050	1,105	1,355	1,140
				54 (16)	175	4,075	1,050	2,100	1,745	1,140
		10A	10	33 (20)	155	3,430	1,050	845	1,455	1,140
				43 (18)	160	4,905	1,050	1,105	2,140	1,140
				54 (16)	175	7,640	1,050	2,100	3,540	1,140
	(2) ¼"-diameter Titen HD	4B	4	33 (20)	155	1,100	660	480	295	705
				43 (18)	200	1,770	1,020	625	480	1,105
				54 (16)	220	2,005	1,050	1,185	545	1,140
		8B	8	33 (20)	170	2,375	1,050	960	645	1,140
				43 (18)	220	3,795	1,050	1,250	1,040	1,140
				54 (16)	240	4,300	1,050	2,375	1,180	1,140
		10B	10	33 (20)	170	4,450	1,050	960	1,225	1,140
				43 (18)	220	5,790	1,050	1,250	1,610	1,140
				54 (16)	240	8,060	1,050	2,375	2,285	1,140
	(2) ¼"-diameter Titen Turbo™	4C	4	33 (20)	190	1,100	660	480	250	705
				43 (18)	250	1,770	1,020	625	405	1,105
				54 (16)	310	2,005	1,050	1,185	460	1,140
		8C	8	33 (20)	200	2,375	1,050	960	545	1,140
				43 (18)	260	3,795	1,050	1,250	880	1,140
				54 (16)	320	4,300	1,050	2,375	995	1,140
		10C	10	33 (20)	200	4,450	1,050	960	1,035	1,140
				43 (18)	260	5,790	1,050	1,250	1,355	1,140
				54 (16)	320	8,060	1,050	2,375	1,910	1,140

1. For additional important information, see General Information and Notes on p. 26.
2. The designer is responsible for anchorage design. Reference Table 2 on p. 114 for anchorage solutions.
3. See illustrations for fastener pattern placement.
4. Tabulated values are based on framing members with track and stud of the same thickness and (1) #10 screw into each stud flange unless otherwise noted.
5. Tabulated moment values correspond to maximum connector strength without consideration of serviceability. The designer must check out-of-plane deflections using tabulated rotational stiffness.
6. Tabulated connector rotational stiffness may be used for any wall heights. The designer must consider member deflection due to bending in the stud member.
7. Per IBC 2021, 2018, 2015, 2012 Table 1604.3 footnote f, wind load is permitted to be taken as 0.42 times "component and cladding loads" for deflection checks. For IBC 2009 and earlier, the factor is 0.7 instead of 0.42. Tabulated values have not been adjusted.
8. Allowable loads are based on cold-formed steel members with a minimum F_y of 33 ksi and F_u of 45 ksi for 43 mil (18 ga.) and thinner and a minimum F_y of 50 ksi and F_u of 65 ksi for 54 mil (16 ga.) and thicker.
9. Connectors subjected to tension, shear and moment loads: $F_2/F_{2all} + F_4/F_{4all} + M/M_{all} \leq 1.0$. F_4 interaction with Moment not required to be checked for walls 2'-0" or taller. Where: F_2, F_4 and M are the applied ASD tension, shear and moment, respectively. F_{2all}, F_{4all}, M_{all} are the allowable tension, shear and moment from Table 1, respectively.
10. Anchor tension, T, is the force in the anchor, or both anchors for two-anchor solutions, at maximum allowable, M, or maximum allowable tension, F_2. See Table 2 on p. 114 for pre-engineered anchorage solutions that incorporate anchor T into the solution.
11. Anchor tension is calculated using AISC Steel Design Guide 1. The Anchor Bolt Design illustration (Figure B) shows the anchor tension, T, based on an applied moment, M. An illustration for the anchor tension, T, based on a vertical tension load, F_2, shown in Figure C.
12. Anchor tension, T, may be interpolated. Examples:
    - M_{req} = 3,312 in.-lb. (given), fastener pattern 10C, 54 mil studs. Anchor tension, T, at allowable moment = (3,312/8,060) x 1,910 = 785 lb.
    - T_{req} = 525 lb. (given), fastener pattern 4A, 33 mil studs. Anchor tension, T, at allowable tension load, F_2 = (525/660) x 755 = 601 lb.
13. Tabulated anchor tension, T, is based on f'_c = 4,000 psi. For f'_c = 3,000 psi, use an increase factor of 1.05.

RCA-C Rigid Connector Angle for Concrete

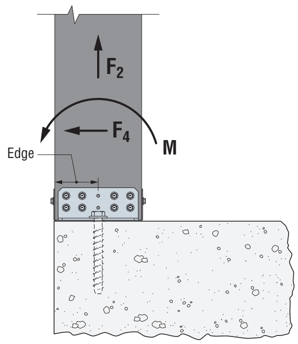


Figure A
One Anchor

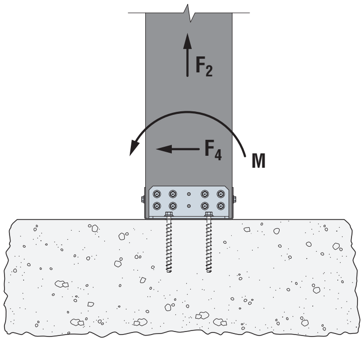


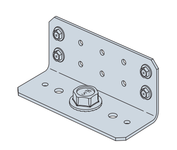
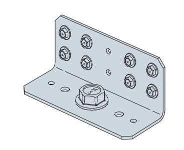
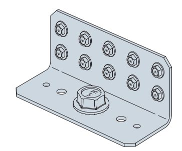
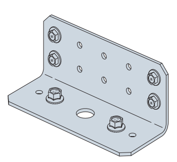
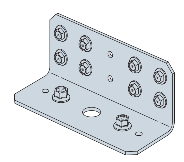
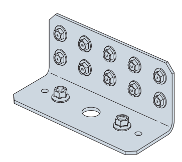
Figure B
Two Anchors

Table 2: RCA-C Allowable Anchorage Loads (lb.)

Model No.	Type of Concrete	Anchor Type	Nominal Embedment Depth, h_{nom} (in.)	Min. Concrete Thickness, $h_{min.}$ (in.)	Min. Anchor Edge Distance (in.)	Uncracked 4,000 psi Concrete			Cracked 4,000 psi Concrete					
						Wind and Seismic in SDC A and B			Wind and Seismic in SDC A and B			Seismic in SDC C and D		
						Allowable			Allowable			Allowable		
						Moment M (in.-lb.)	Tension F_2 (lb.)	Shear F_4 (lb.)	Moment M (in.-lb.)	Tension F_2 (lb.)	Shear F_4 (lb.)	Moment M (in.-lb.)	Tension F_2 (lb.)	Shear F_4 (lb.)
RCA-C225/97	SLWC	(1) ½"-diameter Titen HD®	3¼	5	3	3,015	1,165	885	2,190	845	635	785	305	295
					12	3,425	1,320	1,560	2,465	950	1,105	885	340	515
		(1) ½"-diameter Strong-Bolt® 2	2¾	6	4	2,185	845	975	2,315	895	965	830	320	450
					12	2,890	1,115	1,465	2,315	895	1,035	830	320	485
		(2) ¼"-diameter Titen HD	1⅝	3¼	1½	1,265	565	445	1,205	540	315	425	190	150
					6	2,410	1,025	1,070	1,375	595	680	485	210	315
		(2) ¼"-diameter Titen Turbo™	1¾	3¼	1¾	1,360	590	495	—	—	—	—	—	—
					3	1,955	835	520	—	—	—	—	—	—
	NWC	(1) ½"-diameter Titen HD	3¼	5	3	4,330	1,670	1,305	3,165	1,225	930	1,150	445	435
					12	4,895	1,890	2,295	3,555	1,375	1,625	1,295	500	760
		(1) ½"-diameter Strong-Bolt 2	2¾	6	4	3,160	1,220	1,435	3,345	1,290	1,420	1,215	470	665
					12	4,150	1,605	2,150	3,345	1,290	1,525	1,215	470	710
		(2) ¼"-diameter Titen HD	1⅝	3¼	1½	1,855	825	655	1,765	785	465	625	280	220
					6	3,515	1,475	1,455	2,010	860	995	710	310	465
		(2) ¼"-diameter Titen Turbo	1¾	3¼	1¾	1,990	855	520	—	—	—	—	—	—
					3	2,860	1,205	520	—	—	—	—	—	—

1. Anchor allowable loads have been determined using ACI 314-14 Chapter 17 anchorage calculations with the minimum concrete compressive strength, f'_c, and slab thickness listed. Sand-Lightweight Concrete is abbreviated as SLWC, Normal Weight Concrete is abbreviated as NWC.
2. Load values are for anchor based on ACI 318-14, condition B, load factors from ACI 318 Section 5.3, no supplemental edge reinforcement, $\Psi_{c,V} = 1.0$ for cracked concrete and periodic special inspection. Reference ICC-ES or IAPMO-UES evaluation reports for further information.
3. Allowable Stress Design (ASD) values were determined by multiplying calculated strength design values by a conversion factor, Alpha (α), of 0.7 for seismic loads and 0.6 for wind loads. ASD values for other load combinations may be determined using alternate conversion factors.
4. End distances are assumed as N/A perpendicular to load.
5. Tabulated allowable ASD loads for Wind and Seismic in SDC A and B are based on using wind conversion factors and may be increased by 1.17 for seismic SDC A and B only.
6. Allowable loads have been divided by an Omega (Ω) seismic factor of 2.5 for brittle failure as required by ACI 318-14 Chapter 17.
7. Tabulated capacities are based on maximum allowable anchorage loads only. The capacity of the connection system shall be the minimum of the tabulated value and the RCA-C allowable load value listed on Table 1 on p. 113.
8. Tabulated loads in Table 2 are based on $f'_c = 4{,}000$ psi. For $f'_c = 3{,}000$ psi, use an adjustment factor of 0.86.
9. For anchor subjected to tension, shear and moment loads:
   When $(F_4/F_{4all}) \le 0.2$ — $F_2/F_{2all} + M/M_{all} \le 1.0$
   When $(F_2/F_{2all} + M/M_{all}) \le 0.2$ — $F_4/F_{4all} \le 1.0$
   When $(F_4/F_{4all}) > 0.2$ and $(F_2/F_{2all} + M/M_{all}) > 0.2$ — $(F_2/F_{2all} + M/M_{all}) + (F_4/F_{4all}) \le 1.2$
   Where: F_2, F_4 and M are the applied ASD tension, shear and moment, respectively.
   F_{2all}, F_{4all}, M_{all} are the allowable tension, shear and moment from Table 2, respectively.

RCA-C Fastener Patterns

(1) ½"-Diameter Titen HD/Strong-Bolt 2		
Pattern 4A	Pattern 8A	Pattern 10A
		
(2) ¼"-Diameter Titen HD		
Pattern 4B	Pattern 8B	Pattern 10B
		
(2) ¼"-Diameter Titen Turbo		
Pattern 4C	Pattern 8C	Pattern 10C