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Initial Approval
October, 2013

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July, 2020

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Libertyville, IL 60048

Approved Manufacturing Locations
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Product
USG Structural Panel Concrete Subfloor
(a.k.a. 3/4" STRUCTO-CRETE® Structural Concrete Panels)

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General Details

The approved manufacturing plant has an approved Q.C. Manual to manufacture **USG** Structural Panel Concrete Subfloor and is audited quarterly by *Progressive Engineering Inc.* **USG** Structural Panel Concrete Subfloor is also known as 3/4" STRUCTO-CRETE® Structural Concrete Panels, and the contents of this **PER** are applicable to both product names.

Product Description

USG Structural Panel Concrete Subfloor is a noncombustible concrete sheathing panel used in conjunction with cold-formed steel joists, trusses, or hot-rolled steel framing to form a load bearing structural floor or wall system. **USG** Structural Panel Concrete Subfloor is a nominal 3/4" [19mm] thick x 4' [1220mm] wide x 8' [2440mm] long. The floor panels have a Tongue and Groove edge along the 8' [2440mm] sides and the wall panels are square edged. The panels have a maximum weight of 5.3psf [25.9 kg/m²] from the manufacturing plant. The panels are a composite material consisting of alkali-resistant fiberglass and a cementitious binder.

USG Structural Panel Concrete Subfloor are noncombustible per ASTM E136 (CAN CSA S114) and have a mold resistance value of no less than 10 per ASTM D3273 and a rating of 1 or less per ASTM G21. This products have also been shown to be termite resistant when tested in accordance with AWWA Standard E1-13 exposure C, and comply with the VOC emission requirements of the California Department of Public Health CDPH/EHLB/Standard Method Version 1.1 (Emission testing method for CA Specification 01350).

Product Application

USG Structural Panel Concrete Subfloor is used as a single floor or as the subfloor (Concrete Subfloor) in conjunction with an underlayment to form a structural floor system to resist gravity loading, floor diaphragm loading and concentrated loading as typically found in Residential and Commercial Type I or Type II Construction. Product may also be used in wall applications in accordance with Table 8 and Table 9.

Framing

Cold-formed steel framing shall comply with AISI and have minimum yield strength of 50 ksi [345 MPa], minimum 18 ga. [40mil] or 0.0403" [1.0236mm] thickness, and minimum G60 galvanized coating. Member flanges must have a minimum width of 1-5/8" [41.27mm]. As an alternative, SPF lumber, 1/8" [3mm] or 1/4" [6mm] steel framing may also be used in conjunction with the fasteners and edge distance listed in Table 2. Typical frame spacing ranges from 12" o.c. [305mm] to 24" o.c. [610mm] for floors. See Table 4 and Table 5 for floor diaphragm shear design values.

Compliance

International Residential Code		International Building Code		City of Los Angeles Building Code (LABC)		California Building Code	
2012 -	Section R301.1.3 Section R301.7	2012 -	Section 703.5.1 Section 703.5.2	2017	Chapters 16 & 17 (As applicable)	2019	Section 703.5.1 Section 703.5.2
2015 -	Section R301.1.3 Section R301.7 Section R302.6		Section 1607.1 (Table) Section 1607.4				Table 1607.1 Section 1607.3 & 1607.4
2018 -	Section R301.1.3 Section R301.7	2015	Section 703.5.1 Section 703.5.2 Section 1607.1 (Table) Section 1607.3 & 1607.4	City of Los Angeles Residential Code (LARC)		California Residential Code	
		2018	Section 703.5.1 Section 703.5.2 Section 1607.1 (Table) Section 1607.3 & 1607.4	2017	Section R301.1.3	2019	Section R301.1.3
			Section R301.7				

- Meets or exceeds the requirements of ICC-ES AC 318 Structural Cementitious Floor Sheathing Panels, Effective July 1, 2009.
- Meets or exceeds the requirements of ICC-ES AC 319 Horizontal Diaphragms Consisting of Structural Cementitious Floor Sheathing Panels Attached to Cold-formed Steel Framing—Approved June 2005, Editorially Revised January 2012.
- Meets the requirements of Table R301.7 Allowable Deflection of Structural Members for Joist Spacing of 24" [610mm] o.c. per the 2012, 2015 & 2018 IRC.

Compliance Continued

- Meets or exceeds the requirements for noncombustible core in accordance with Section 703.5.1 of the 2012, 2015 & 2018 IBC.
- Meets or exceeds the requirements for materials having a structural base of noncombustible material when tested in accordance with ASTM E 136 as defined in 2012, 2015 & 2018 IBC Section 703.5.2 and CAN CSA S114.
- Meets the requirements of Section R301.1.3 Engineered Design for otherwise conventional construction for buildings per the 2012, 2015 & 2018 IRC.
- Meets the requirements of Section R301.1.3 Engineered Design for otherwise conventional construction for buildings per the 2019 California Residential Code.
- For Canadian applications suitability needs to be reviewed by Architect or Engineer of record prior to use.
- Meets or exceeds the requirements of the 2012, 2015 & 2018 IBC Table 1607.1, 2012 Ontario Building Code Table 4.1.5.9 and the 2019 California Building Code; Minimum Uniformly Distributed Live Loads and Minimum Concentrated Live Loads, when installed per manufacturer's instructions.
- Surface Burning Characteristics - Flame Spread Index of 0 / Smoke Development Index of 0 or less when tested in accordance with ASTM E 84.
- Meets & exceeds requirements for concentrated load per ICC AC318 when tested in accordance with ASTM E661 using a 1" [25mm] and 3" [76mm] loading diameter for Wet & Dry conditions.
- Meets and exceeds the requirements of the 2012, 2015 & 2018 IBC and the 2019 California Building Code Section 1607.3 Uniform live loads and Section 1607.4, Concentrated Live Load of 2,000 Lbs.
- Meets or exceeds the 2017 City of Los Angeles Building Code (LABC) - The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 & 17, as applicable.
- Meets or exceeds the requirements of the 2017 Los Angeles Residential Code (LARC) - Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.

General Product Installation

1. **USG** Structural Panel Concrete Subfloor is to be installed and maintained during construction following this report and the **USG** installation instructions. Installation instructions must be made easily available to the product installer.
2. When cutting **USG** Structural Panel Concrete Subfloor, safety glasses and a NIOSH approved N-95 dust mask should be worn at all times due to dust produced by the cutting of this product.
3. Fasteners shall be flush or slightly below the surface and care must be taken to not strip out in the framing. No fastener shall be installed within 2" [51mm] of the corner of a panel and shall not be closer than the minimum distance from panel edges indicated in Table 2 of this **PER**.
4. The tongue and groove joints shall be oriented perpendicular to the framing.
5. The 3/4" [19mm] **USG** Structural Panel Concrete Subfloor is mechanically fastened to the cold-formed steel joists, hot-rolled steel, or wood floor framing with the applicable fasteners indicated in Table 2 of this report.
6. Install panels in a running board pattern bridging a minimum of 2 framing spans. The minimum panel width, measured parallel to the framing, shall be no less than 24" [610mm].
7. Fasteners are applied as shown on the following Screw pattern A, B, C & D diagrams and notes.
8. Up to a 6" [152mm] x 6" [152mm] cutout through the panels is allowed without blocking. Up to a 44" [1118mm] x 44" [1118mm] cutout is allowed with sufficient blocking around the perimeter of the opening. Larger openings shall be designed by the Engineer of record and are beyond the scope of this report.
9. **USG** Structural Panel Concrete Subfloor must be protected from construction abrasive wear and impact after panel installation until the floor has its final finish applied. Refer to the **USG** Installation Instructions.
10. **USG** Structural Panel Concrete Subfloor must have blocked edges for panels that are less than 24" wide. The Katz blocking should be fastened through the panel and with the blocking into the joist with a recommended fastener.

Product Storage

USG Structural Panel Concrete Subfloor shall be stored in a dry location. Placement of the palletized product must be on level firm ground or a floor capable of carrying the approximate 3,400 lb. [1545kg] pallet weight. Pallets shall not be stacked more than three high and must be stacked with direct alignment on the pallet below it. If a dry location is unavailable, cover pallets with a waterproof tarp or covering. Sub-freezing temperature may cause the panels to freeze together. Should this happen, move the panels to a warmer location to thaw out. Do not use tools or chemicals to loosen the panels as this will cause damage to the panels and will void the performance ratings described in this **PER**.

Product Labeling

Each bundle shipped of **USG** Structural Panel Concrete Subfloor that are covered by this **PER**, must have a label attached with at least the following information:

1. **USG** Name and Location / Plant Number
2. Date of manufacture
3. This **PER** Number & **Pei ES** Logo

Acceptable Evaluation Marks



Table 1: Physical and Mechanical Properties
USG Structural Panel Concrete Subfloor

	Test Standard	Requirements	Tested Values
Concentrated Load, Wet or Dry	ASTM E661	550 lb [2.45 kN] Static 0.108" [2.7 mm] max. deflection @ 200lb [0.89 kN]	804 lb [3.58 kN] Static 0.066" [1.7 mm] max. deflection @ 200lb [0.89 kN]
Fastener Lateral Resistance ¹	ASTM D1761	Dry >210 lb [0.93 kN] Wet >160 lb [0.71 kN]	Dry: 776 lb [3.45 kN] Wet: 800 lb [3.56 kN]
Density - Oven Dried ²	ASTM C1185	minimum 75 lb/ft ³ [1200 kg/m ³]	78.6 lb/ft ³ [1258 kg/m ³]
Weight, 3/4" [19mm] Thickness as Delivered	ASTM D1037		5.3 lb/ft ² [25.9 kg/m ²]
pH Value	ASTM D1293		10.5
Linear Variation with Change in Moisture 25% to 90% Relative Humidity	ASTM C1185	<0.10%	0.06%
Thickness Swell	ASTM D1037	≤ 3.0%	0.04%
Freeze/Thaw resistance	ASTM C1185	Minimum of 75% retention of Physical Properties	100% Retention
Mold Resistance	ASTM D3273	10	10
	ASTM G21	≤ 1	≤ 1
Water Absorption ³	ASTM C1185	<15.0%	9%
Noncombustibility	ASTM E136	Must Pass	Passed
Surface burning Characteristics	ASTM E84	0 Flame Spread / Smoke Developed Index 5	0 Flame Spread / Smoke Developed Index 0
Long Term Durability	ASTM C1185	min. 75% retention of physical properties	100%
Water Durability	ASTM C1185	min. 70% retention of physical properties	83%
Water Vapor Transmission (Method B)	ASTM E96		Permeance 1.4 Perm

Notes:

1. Fastener Lateral Resistance measured with applicable fasteners in Table 2.
2. Density Measured at Equilibrium Conditioning per Section 5.2.3.1-Tested 28 days after manufacturing
3. Absorption Measured from Equilibrium Conditioning followed by immersion in Water for 48 hours

Table 2: Acceptable Diaphragm Fasteners¹
USG Structural Panel Concrete Subfloor

Minimum Framing	Minimum Edge Distance	Manufacturer	Part No.	Type
16ga [1.438mm] Cold-Formed Steel	1/2" [13mm]	Grabber Construction Products, Inc.	CGH8158LG	#8 x 1-5/8" winged self-drilling screw
		Grabber Construction Products, Inc.	CGHM8200LG	#8 x 2" self-drilling screw
		Simpson Strong-Tie Company, Inc.	CBSDQ158S	#8 x 1-5/8" winged self-drilling screw
18ga [1.0236mm] Cold-Formed Steel	1" [25mm]	Grabber Construction Products, Inc.	CGH8158LG	#8 x 1-5/8" winged self-drilling screw
1/8" Hot Rolled Steel min. 50 ksi	1" [25mm]	Aerosmith	5324HPG	.145" dia. x 1-1/4" lg. power actuated fastener
		Hilti	X-U 32MX	.157" dia. x 1-1/4" lg. power actuated fastener
		Grabber Construction Products, Inc.	CC12250LRG	#12 x 2-1/2" winged self-drilling screw
		DeWalt	50458-PWR	.157" dia. x 1-1/4" lg. power actuated fastener
1/4" A36 Hot Rolled Steel	3/4" [19mm]	Grabber Construction Products, Inc.	CC12250LRG	#12 x 2-1/2" winged self-drilling screw
		Muro North America	RSM645	M6 x 45mm winged self-drilling screw
		Simpson Strong-Tie Company, Inc.	TBG1260S	#12 x 2-3/8", Flat Head, Strong-Drive® TB WOOD-TO-STEEL screw
SPF Lumber (Min. S.G. = 0.42)	5/8" [16mm]	Grabber Construction Products, Inc.	C8200L2M	#8 x 2", Flat Head, Type 17, Nibs, GrabberGard,
		Simpson Strong-Tie Company, Inc.	WSNTLG2S	#8 x 2", Flat Head, Twin threads, Nibs
	1/2" [13mm]	Senco ²	GL24AABF	8d Ring Shank Nails

Notes:

1. Fastener pull-through capacity of 581-lbs [2584N] may be applied to all listed fasteners. Capacity is based on **ultimate tested value** for all tabulated fasteners. The engineer or designer of record shall apply an appropriate safety factor (ASD) or resistance factor (LRFD).
2. Senco 8d ring shank nails are manufactured with a length of 2-3/8" [60mm], a head diameter of 0.266" [6.8mm], and a shank diameter of 0.113" [2.9mm]. Equivalent 8d ring shank nails meeting these dimensional requirements may be utilized when approved by the engineer or designer of record.
3. Screw lengths shown are minimums

Floor Usage

Table 3: Uniform Live Load Performance Rating²

USG Structural Panel Concrete Subfloor

Span Rating	Conditions	Live Load Rating ¹ (PSF)
12" [305mm]	Dry or Wet	512 [24.5 kPa]
16" [406mm]	Dry or Wet	283 [13.5 kPa]
24" [610mm]	Dry or Wet	120 [5.7 kPa]

Notes:

1. Live load ratings have been determined from testing based upon a minimum 120 psf [5.7 Kpa] service live load for the 24" [610mm] span rating and a maximum panel live load deflection = L/360. A factor of safety of 3.0 applied.
2. A minimum of two framing spans required per panel piece.
3. Tabulated live load ratings are valid for a service level dead load of 10 psf [0.5 Kpa] or less.

Table 4: Safety Factors and Resistance Factors for Diaphragms

USG Structural Panel Concrete Subfloor

Framing Type	Fastener Type	Earthquake			Wind		
		Ω (ASD)	ϕ (LRFD)	ϕ (LSD) ⁴	Ω (ASD)	ϕ (LRFD)	ϕ (LSD) ⁴
Steel ¹	Screws	2.50	0.65	0.60	2.35	0.70	0.65
Wood ^{2,3}	Screws or Nails	3.30	0.50	--	2.35	0.70	--

Notes:

1. **Tabulated values have been evaluated for horizontal diaphragm use only.**
2. Safety factors and resistance factors for USG Structural Panel Concrete Subfloor diaphragms installed over cold-formed and hot-rolled steel framing are based upon Table D5 of AISI S100-2007.
3. Safety factors and resistance factors for USG Structural Panel Concrete Subfloor diaphragms installed over wood studs are based on the worst case of the standard factors from the American Wood Council Special Design Provisions for Wind and Seismic (AWC SDPWS-2008) and those tabulated for steel framing.
4. Earthquake factors for installations over wood construction are based upon the wind factors modified by a factor of 1.4 to match the general seismic strength reduction observed in Tables 4.2A, 4.2B, 4.2C, and 4.2D of AWC SDPWS-2008.
5. Limit States Design (LSD) shall be used in combination with the load combinations found in the National Building Code of Canada (NBCC).

Table 5: Simple Beam Diaphragm Testing
USG Structural Panel Concrete Subfloor

Fastener Spacing			Joist Spacing	Screw Pattern ^{2,3}	Panel Blocking	S _u - Ultimate Shear Strength (plf)	X	Aspect Ratio
Diaphragm Perimeter	Panel Perimeter	Field						
4" [102mm]	4" [102mm]	12" [305mm]	16" [407mm]	B	None	1,462 [21.3 kn/m]	0.443	3:1
6" [152mm]	6" [152mm]					1,395 [20.4 kn/m]	0.421	
4" [102mm]	4" [102mm]	12" [305mm]	24" [610mm]	B	None	1,341 [19.6 kn/m]	0.476	3:1
6" [152mm]	6" [152mm]					1,053 [15.4 kn/m]	0.397	
6" [152mm]	6" [152mm]	12" [305mm]	24" [610mm]	C	4" [102mm] wide x 16ga. [1.438mm] Strap	1,468 [21.4 kn/m]	0.180	4:1
2" [51mm]	6" [152mm]	12" [305mm]	24" [610mm]	D	4" [102mm] wide x 16ga. [1.438mm] Strap	1,999 [29.1 kn/m]	0.218	4:1
2" [51mm]	4" [102mm]					2,541 [37.0 kn/m]	0.313	

Notes:

1. Refer to Table 4 of this **PER** for applicable diaphragm safety (Ω) and load resistance (φ) factors corresponding to ASD, LRFD, and/or LSD design methods.
2. **Screw Pattern B** - Panel fasteners must be inset 2" [51mm] from the corners. Fastener edge distance at all panel edges must comply with distances in Table 2, as well as exception to the tongue and groove joints where the framing joists are perpendicular to the joint. The fasteners should be kept flush or slightly below the surface of the panel. At the T&G panel joists where the framing joists are perpendicular to the joint, one (1) panel fastener is required. One fastener should be 1" [25mm] and the other 2" [51mm] from the panel edge.
3. **Screw Pattern C** - Panels shall be fastened as described in Screw Pattern B with the addition of fasteners at 6" [152mm] o.c. along the metal Strap Blocking on both sides of seam .
4. **Screw Pattern D** - Panels shall be fastened as described in Screw Pattern C with the addition of fasteners at 2" [51mm] o.c. around the entire Diaphragm Perimeter.

Deflection Equation for Simple Beam Diaphragm

$$\Delta = \frac{5Vl^3}{8EAb} + \frac{Vl}{4Gt} + Xle_n$$

- Where: V = Unit shear in the direction under consideration, plf
 ℓ = Diaphragm length, ft.
 b = Diaphragm width, ft.
 E = Elastic modulus of steel rim chords, 29,500,000psi
 A = Net area of steel rim chord cross section, in²
 G = Shear modulus of **USG** Structural Panel Concrete Subfloor for shear, 285,714 psi
 t = Effective thickness of **USG** Structural Panel Concrete Subfloor for shear, 0.73 in.
 e_n = Screw joint slippage at load per screw on perimeter of interior panel
 e_n @ 0.20S_u = 0.011
 e_n @ 0.33S_u = 0.019
 e_n @ 0.60S_u = 0.032
 e_n @ S_u = 0.084
 X = Slip Co-efficient. See Table 5 above.

Table 6: Cantilever Floor Diaphragm Testing
USG Structural Panel Concrete Subfloor

Fastener Spacing		Joist Spacing	Screw Pattern ^{3,4}	Panel Blocking	S _u - Ultimate Shear Strength (plf)*	X
Perimeter	Field					
6" [152mm]	12" [305mm]	24" [610mm]	B	None	487 [7.1 kN/m]	0.518
8" [203mm]	12" [305mm]	24" [610mm]	B	None	475 [6.9 kN/m]	0.511
4" [102mm]	12" [305mm]	24" [610mm]	A	None	713 [10.4 kN/m]	0.732
6" [152mm]	12" [305mm]				525 [7.7 kN/m]	0.625
8" [203mm]	12" [305mm]				465 [6.8 kN/m]	0.754
4" [102mm]	12" [305mm]	16" [406mm]	A	None	975 [14.2 kN/m]	0.833
6" [152mm]	12" [305mm]				915 [13.4 kN/m]	0.765
8" [203mm]	12" [305mm]				860 [12.6 kN/m]	0.702
4" [102mm]	12" [305mm]	12" [305mm]	A	None	1121 [16.4 kN/m]	0.759
6" [152mm]	12" [305mm]				940 [13.7 kN/m]	0.541
8" [203mm]	12" [305mm]				772 [11.3 kN/m]	0.484
6" [152mm]	12" [305mm]	24" [610mm]	C	4" [102mm] wide x 16ga. [1.438mm] Strap	1148 [19.8 kN/m]	0.354

Notes:

1. Refer to Table 4 of this PER for applicable diaphragm safety (Ω) and load resistance (φ) factors corresponding to ASD, LRFD, and/or LSD design methods.
2. 2 to 1 maximum Aspect Ratio
3. **Screw Pattern A & B** - Panel fasteners must be inset 2" [51mm] from the corners. Fastener edge distance at all panel edges must comply with Table 2 distances with exception to the tongue and groove joints where the framing joists are perpendicular to the joint. The fasteners should be kept flush or slightly below the surface of the panel. At the T&G panel joists where the framing joists are perpendicular to the joint, two (2) panel fasteners are required for Pattern A and one (1) fastener for Pattern B. One fastener should be 1" [25mm] and the other 2" [51mm] from the panel edge.
4. **Screw Pattern C** - Panels shall be fastened as described in Screw Pattern B with the addition of fasteners at 6" [152mm] o.c. along the metal Strap Blocking on both sides of seam .

Deflection Equation for Cantilever Diaphragm

$$\Delta = \frac{5V(2l)^3}{8EA b} + \frac{V(2l)}{4Gt} + X(2l)e_n$$

Where: V = Unit shear in the direction under consideration, plf

ℓ = Diaphragm length, ft.

b = Diaphragm width, ft.

E = Elastic modulus of steel rim chords, 29,500,000psi

A = Net area of steel rim chord cross section, in²

G = Shear modulus of USG Structural Panel Concrete Subfloor for shear, 285,714 psi

t = Effective thickness of USG Structural Panel Concrete Subfloor for shear, 0.73 in.

e_n = Screw joint slippage at load per screw on perimeter of interior panel

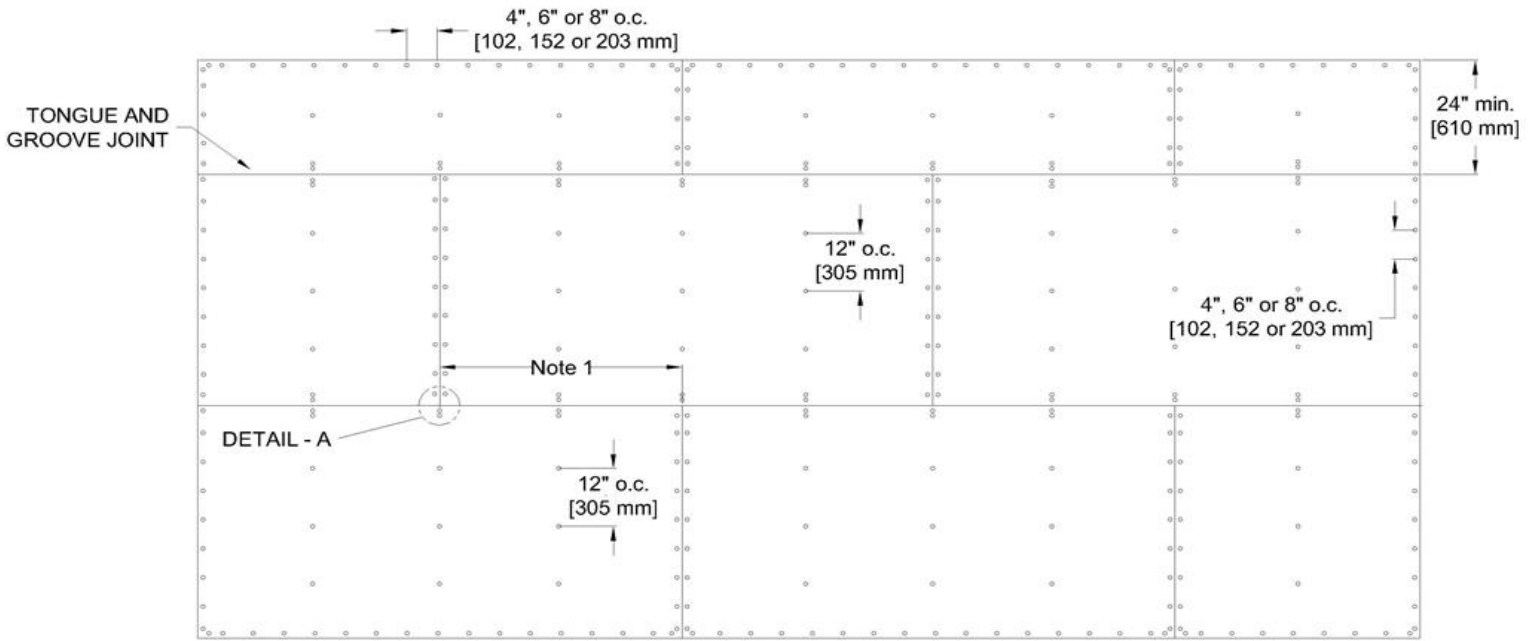
$$e_n @ 0.20S_u = 0.011$$

$$e_n @ 0.33S_u = 0.019$$

$$e_n @ 0.60S_u = 0.032$$

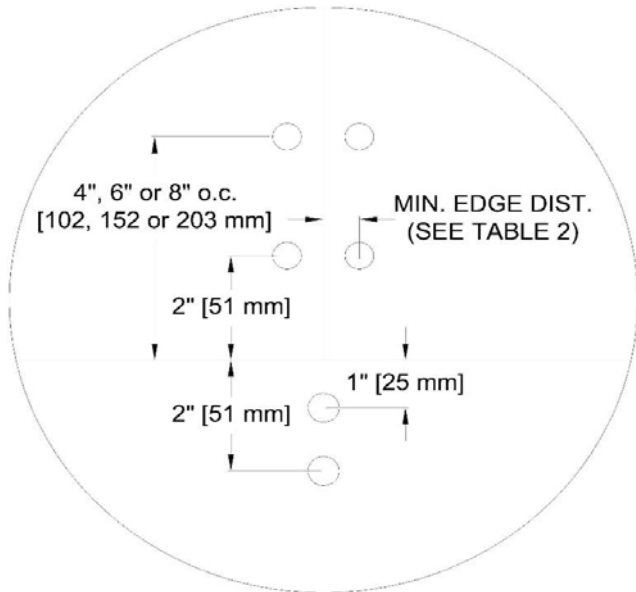
$$e_n @ S_u = 0.084$$

X = Slip Co-efficient. See Table 6 above.

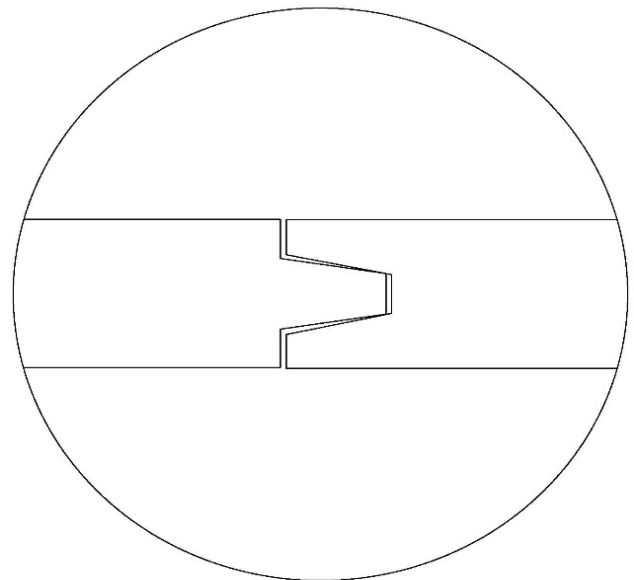


1. Two Span offset of Seams w/o Blocking, One Span w/ Blocking.

Screw Pattern A

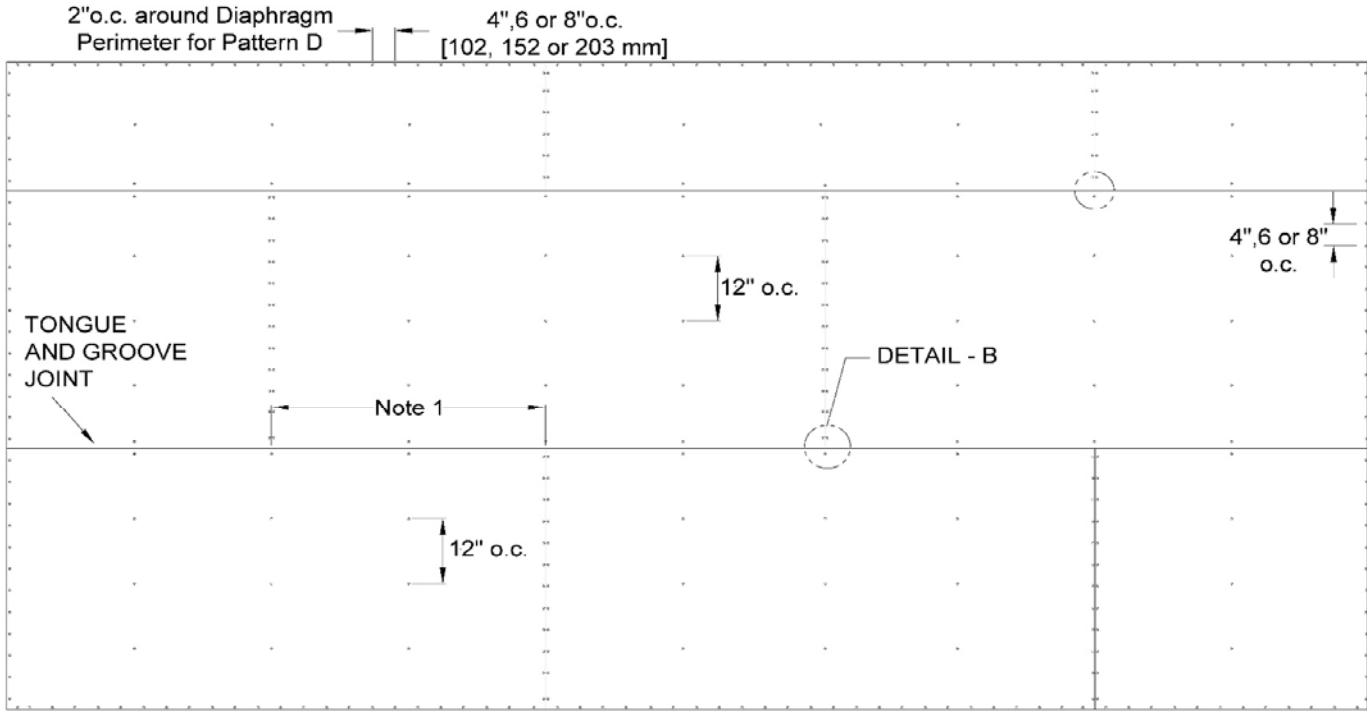


DETAIL - A



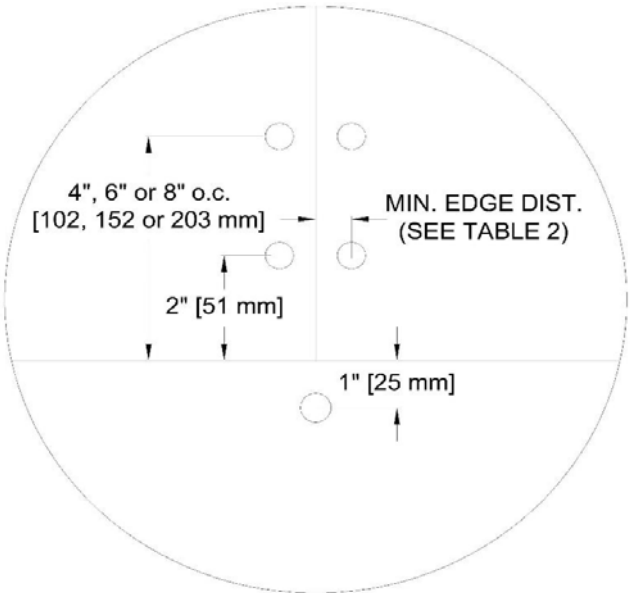
Tongue & Groove

Figure 1 - Screw Pattern "A" Details

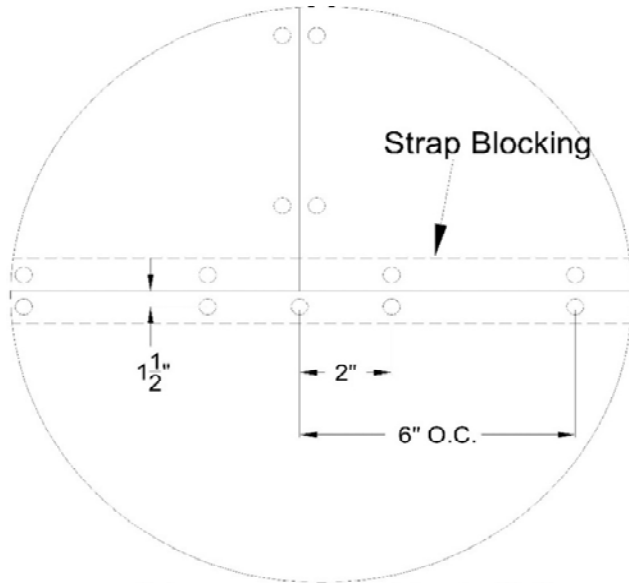


1. Two Span Minimum offset of Seams w/o Blocking, One Span offset w/ Blocking.

Screw Pattern B & D



DETAIL - B



Strap Block Detail for Screw Pattern C & D

Figure 2 - Screw Pattern B, C & D Details

Table 7: Floor Anchorage Options - USG Structural Panel Concrete Subfloor^{1,2,3}
 Nominal Withdrawal Capacities per Anchor

Anchor Type	ASTM D 1037 Value (1 Layer)	Subfloor Layers	Distance Between Bolts, d							
			2"	4"	6"	8"	51mm	102mm	152mm	203mm
3/8" SnapToggle ^{®4}	1481 lb [6588 N]	1	927 lb	1072 lb	1154 lb	1166 lb	4124 N	4768 N	5133 N	5187 N
		2	1719 lb*	1719 lb*	1719 lb*	1719 lb*	7646 N*	7646 N*	7646 N*	7646 N*
1/2" SnapToggle ^{®5}	1616 lb [7188 N]	1	948 lb	1085 lb	1166 lb	1176 lb	4217 N	4826 N	5187 N	5231 N
		2	1843 lb	2088 lb	2273 lb	2400 lb	8198 N	9287 N	10111 N	10676 N
1/4"x3" Peel Rivet ⁶	758 lb [3372 N]	1	636 lb	668 lb	668 lb	668 lb	2829 N	2971 N	2971 N	2971 N

For ASD designs use minimum $\Omega = 4.0$; For LRFD designs use maximum $\phi = 0.40$

Notes:

1. TOGGLER Anchor System and peel rivet capacity is based on random anchors purchased from a distributor and have not been evaluated for installations other than that described in Table 7 and Figure 3. This **PER** verifies the **USG** Structural Panel Concrete Subfloor capacity only, and actual toggler anchor capacity without panel failure shall be verified by the engineer or designer of record through the SnapToggle anchor or peel rivet manufacturer.
 2. TOGGLER Anchor System shall be installed with a maximum torque setting of 200 in-lb [23 N-m].
 3. Anchors have been evaluated for use general component connections to the **USG** Structural Panel Concrete Subfloor (i.e. auditorium seating, lightweight equipment, etc.). Final application must be reviewed and approved by the engineer or designer of record.
 4. TOGGLER Anchor System 3/8" SnapToggle[®] (Item No. BC) w/ a Grade 8 Hex Head Bolt. Ultimate withdrawal occurred at a maximum tested shear per pair of 232 lb [1032 N] for one-layer and 430 lb [1913 N] for two layers.
 5. TOGGLER Anchor System 1/2" SnapToggle[®] (Item No. BD) w/ a Grade 5 Hex Head Bolt. Ultimate withdrawal occurred at a maximum tested shear per pair of 294 lb [1308 N] for one-layer and 600 lb [2669 N] for two layers.
 6. Peel Rivets manufactured by SFS Intec (Part No. TPR-L-6, 3x76). Ultimate withdrawal occurred at a maximum tested shear per pair of 167 lb [743 N] for a single layer of **USG** Structural Panel Concrete Subfloor.
- * Denotes Toggler Failure by Strip out.

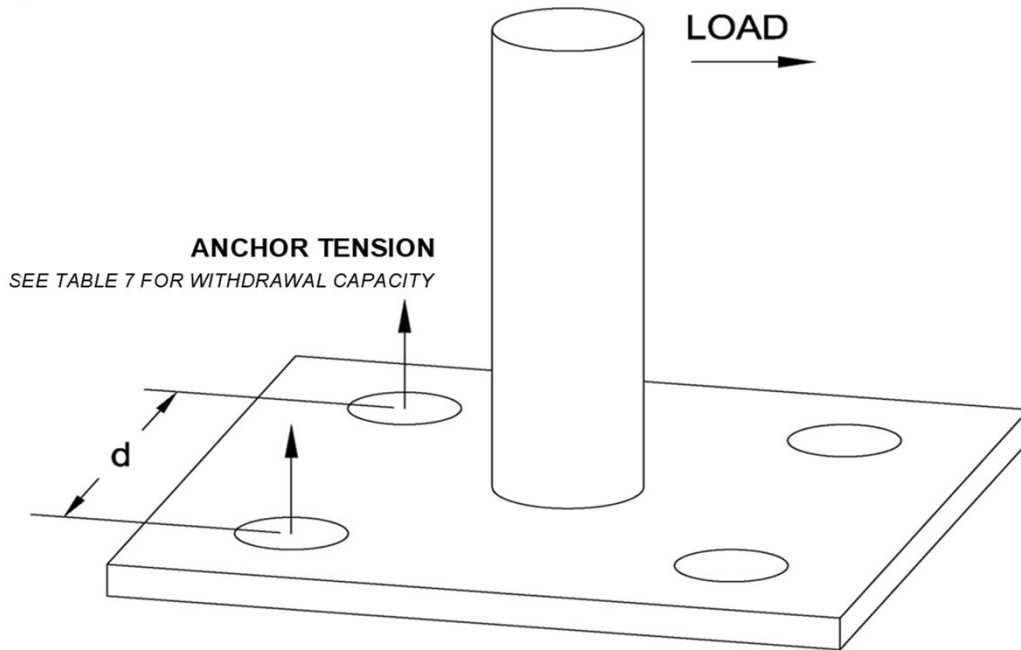


Figure 3 - Typical Toggler Bolt Application

Wall Usage

Table 8

Tested Static Wall Shear Values using 16ga. [54mil] or 0.0538" [1.438mm] X 3-5/8" [92mm] flange Steel Studs **16"** [406mm] o.c.

Sides Sheathed	Strap at Seam	Sheathing Orientation	Fastener Spacing		Ultimate Load in plf	G' Lbs./in	Ultimate Load kN/m	G' N/mm
			Perimeter	Field				
Single	no	Vertical	8" [203mm]	12" [305mm]	914	6185	13.3	1083
Single	no	Vertical	6" [152mm]	12" [305mm]	1320	7416	19.2	1299
Single	no	Vertical	4" [102mm]	12" [305mm]	1726	8647	25.1	1514
Single	yes	Horizontal	8" [203mm]	12" [305mm]	984	5535	14.3	969
Single	yes	Horizontal	6" [152mm]	12" [305mm]	1402	7269	20.4	1273
Single	yes	Horizontal	4" [102mm]	12" [305mm]	1821	9003	26.5	1577
Double	yes	Horizontal	8" [203mm]	12" [305mm]	1901	13287	27.7	2327
Double	yes	Horizontal	6" [152mm]	12" [305mm]	2625	22677	38.2	3971
Double	yes	Horizontal	4" [102mm]	12" [305mm]	3349	32067	48.8	5616

Note:

1. The Ultimate Load does not include a safety factor and walls have not been evaluated for cyclic design loads.

Table 9

Tested Static Wall Shear Values using 16ga. [54mil] or 0.0538" [1.438mm] X 3-5/8" [92mm] flange Steel Studs **24"** [610mm] o.c.

Sides Sheathed	Strap at Seam	Sheathing Orientation	Fastener Spacing		Ultimate Load in plf	G' Lbs./in	Ultimate Load kN/m	G' N/mm
			Perimeter	Field				
Single	no	Vertical	8" [203mm]	12" [305mm]	819	5882	11.9	1030
Single	no	Vertical	6" [152mm]	12" [305mm]	1201	7736	17.5	1355
Single	no	Vertical	4" [102mm]	12" [305mm]	1584	9590	23.1	1679
Single	yes	Horizontal	8" [203mm]	12" [305mm]	906	5117	13.2	896
Single	yes	Horizontal	6" [152mm]	12" [305mm]	1292	7384	18.8	1293
Single	yes	Horizontal	4" [102mm]	12" [305mm]	1679	9590	24.5	1679
Double	yes	Horizontal	8" [203mm]	12" [305mm]	1730	11684	25.2	2046
Double	yes	Horizontal	6" [152mm]	12" [305mm]	2432	19945	35.4	3493
Double	yes	Horizontal	4" [102mm]	12" [305mm]	3135	28207	45.7	4940

Note:

1. The Ultimate Load does not include a safety factor and walls have not been evaluated for cyclic design loads.