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Initial Approval
November, 2014

Re-Approved
July, 2017

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Report Owner

United States Gypsum Company

700 North Highway 45
Libertyville, IL 60048

Product

USG Structural Panel Concrete Roof Deck

(a.k.a. 3/4" **USG** Securock® Concrete Roof Deck Panel)

Approved Manufacturing Locations

USG Structural Technologies, LLC

309 Hallberg Street
Delavan, WI 53115

For Evaluation Report Questions

USG Contact: Manny Hurtado, Building Codes Manager

Phone: 847-970-5179

Email: mhurtado@usg.com

General Details

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

Product Description

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

USG Structural Panel Concrete Roof Deck 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. These panel products have also been shown to be termite resistant when tested in accordance with AWPA 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 Roof Deck is used as a roof deck sheathing to form a structural roof system to resist gravity loading, roof deck loading and concentrated loading as typically found in Residential and Commercial Type I or Type II Construction.

Roof Framing

Roof framing must be Cold-formed 50 ksi steel framing complying with AISI and a minimum thickness of 16 ga. [54mil] or 0.0538" [1.366mm] with a minimum G60 galvanized coating. Joist flanges supporting the **USG** Structural Panel Concrete Roof Deck must have a minimum width of 1-5/8" [41.27mm]. Roof frame spacing shall be no greater than 48" o.c.[1219.2mm]. As an alternative, SPF lumber or 1/4" A36 steel framing may also be used in conjunction with the fasteners and edge distance listed in Table 2.

Compliance

2012/2015 International Residential Code	2012/2015 International Building Code
Section R301.1.3	Section 703.5.1
	Section 703.5.2
	Section 1607.4

- Meets or exceeds the requirements of ICC-ES AC 318 Structural Cementitious Floor & Roof 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 48" o.c. [1219mm] using L/240 per the 2012 & 2015 IRC.
- Meets or exceeds the requirements for noncombustible core in accordance with Section 703.5.1 of the 2012 & 2015 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 IBC Section 703.5.2. and CAN CSA S114.
- Meets or exceeds the nail withdrawal requirements of Table 6 of APA PS-2 for use as a roof sheathing.

Compliance Continued

- For Canadian applications suitability needs to be reviewed by Architect or Engineer of record prior to use.
- Meets the requirements of Section R301.1.3 Engineered Design for otherwise conventional construction for buildings per the 2012 & 2015 IBC.
- Surface Burning Characteristics - Flame Spread Index of 0 / Smoke Development Index of 0 when tested in accordance with ASTM E84.
- 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.

General Product Installation

1. **USG** Structural Panel Concrete Roof Deck 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. **USG** Structural Panel Concrete Roof Deck must be allowed to acclimate to job site conditions for a minimum of 48 hours.
3. When cutting **USG** Structural Panel Concrete Roof Deck, 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.
4. 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" [50.8mm] 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**.

Product Installation for Roof Applications

1. The tongue and groove joints shall be oriented perpendicular to the framing.
2. The 3/4" [19mm] **USG** Structural Panel Concrete Roof Deck is fastened to the cold-formed steel, hot rolled steel, or wood framing with the applicable fasteners indicated in Table 2.
3. Install panels in a running bond pattern bridging a minimum of 2 framing spans. The minimum panel width, measured parallel to the framing, shall be no less than 48" [1219mm].
4. Fasteners are applied as shown in the Screw Pattern A, B, C, D, or E diagrams, on pages seven (7) and eight (8) of this report.
5. Up to a 6" [152.4mm] x 6" cutout through the panels is allowed without blocking. Up to a 44" [1117.6mm] x 44" 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.
6. **USG** Structural Panel Concrete Roof Deck must be protected from construction abrasive wear and impact after panel installation until the final roof covering is applied. Refer to the **USG** Installation Instructions.

Product Storage

USG Structural Panel Concrete Roof Deck shall be stored in a dry location. Placement of the palletted product must be on level firm ground or a floor capable of carrying the approximate 3,400 lbs.[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 Roof Deck that is 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 Roof Deck

Description	Test Standard	Values
Concentrated Load	ASTM E661	550 lbs [2.45 Mpa] Static 0.108" [2.7 mm] max. deflection @ 200lbs [0.89 kN]
Individual Fastener Lateral Resistance ¹	ASTM D1761	Dry >210 lbs [0.93 kN] Wet >160 lbs [0.71 kN]
Density - Oven Dried ²	ASTM C1185	75 lb/ft ³ [1200 kg/m ³]
Weight, 3/4" [19mm] Thickness Delivered	ASTM D1037	5.3 lbs/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%
Thickness Swell	ASTM D1037	max. 3.0%
Freeze/Thaw resistance	ASTM C1185	Passed 50 cycles
Mold Resistance	ASTM D3273	10
	ASTM G21	0
Water Absorption ³	ASTM C1185	<15.0%
Noncombustibility	ASTM E136	Passed
Surface burning Characteristics	ASTM E84	0 Flame Spread / Smoke Developed Index 0
Long Term Durability	ASTM C1185	min. 75% retention of physical properties
Water Durability	ASTM C1185	min. 70% retention of physical properties
Water Vapor Transmission (Method B)	ASTM E96	Permeance < 2 Perm

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 48hours

Table 2: Acceptable Diaphragm Fasteners¹
USG Structural Panel Concrete Roof Deck

Framing Type	Minimum Edge Distance	Manufacturer	Part No.	Type
16ga Cold-Formed Steel	1/2" [13mm]	Grabber Construction Products, Inc.	CGH8158LG	#8 x 1-5/8" winged self-drilling screw
		Simpson Strong-Tie Company, Inc.	CBSDQ158S	#8 x 1-5/8" winged self-drilling 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
1/4" A36 Hot Rolled Steel	3/4" [19mm]	Simpson Strong-Tie Company, Inc.	TBG1260S	#12 x 2-3/8", Flat Head, Strong-Drive® TB WOOD-TO-STEEL Screw

Note:

1. Fastener pull-through capacity of 581-lbs [2584N] may be applied to all listed fasteners. Capacity is based upon the minimum average **ultimate tested capacity** for all tabulated fasteners. The engineer or designer of record shall apply an appropriate safety factor (ASD) or resistance factor (LRFD or LSD) in accordance with this **PER** or applicable code/standard.
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.

Table 3: Uniform Load Performance
USG Structural Panel Concrete Roof Deck

Span Rating ²	Conditions	Nominal Load ^{1,3} (PSF)	Nominal Uplift Capacity ⁵ (PSF)			
			8/12	8/8	6/6	4/4
12" [304.8mm]	Dry or Wet	1320 [63.2 kPa]	513 [24.6 kPa]	770 [36.9 kPa]	1026 [49.1 kPa]	1320 [63.2 kPa]
16" [406.4mm]	Dry or Wet	744 [35.6 kPa]	385 [18.4 kPa]	577 [27.6 kPa]	744 [35.6 kPa]	744 [35.6 kPa]
20" [508.0mm]	Dry or Wet	516 [24.7 kPa]	308 [9.2 kPa]	462 [13.8 kPa]	516 [18.4 kPa]	516 [27.6 kPa]
24" [609.6mm]	Dry or Wet	330 [15.8 kPa]	257 [12.3 kPa]	330 [15.8 kPa]	330 [15.8 kPa]	330 [15.8 kPa]
32" [812.8mm]	Dry or Wet	240 [11.5 kPa]	192 [9.2 kPa]	240 [11.5 kPa]	240 [11.5 kPa]	240 [11.5 kPa]
48" [1219.2mm]	Dry or Wet	150 [7.2 kPa]	128 [6.1 kPa]	150 [7.2 kPa]	150 [7.2 kPa]	150 [7.2 kPa]

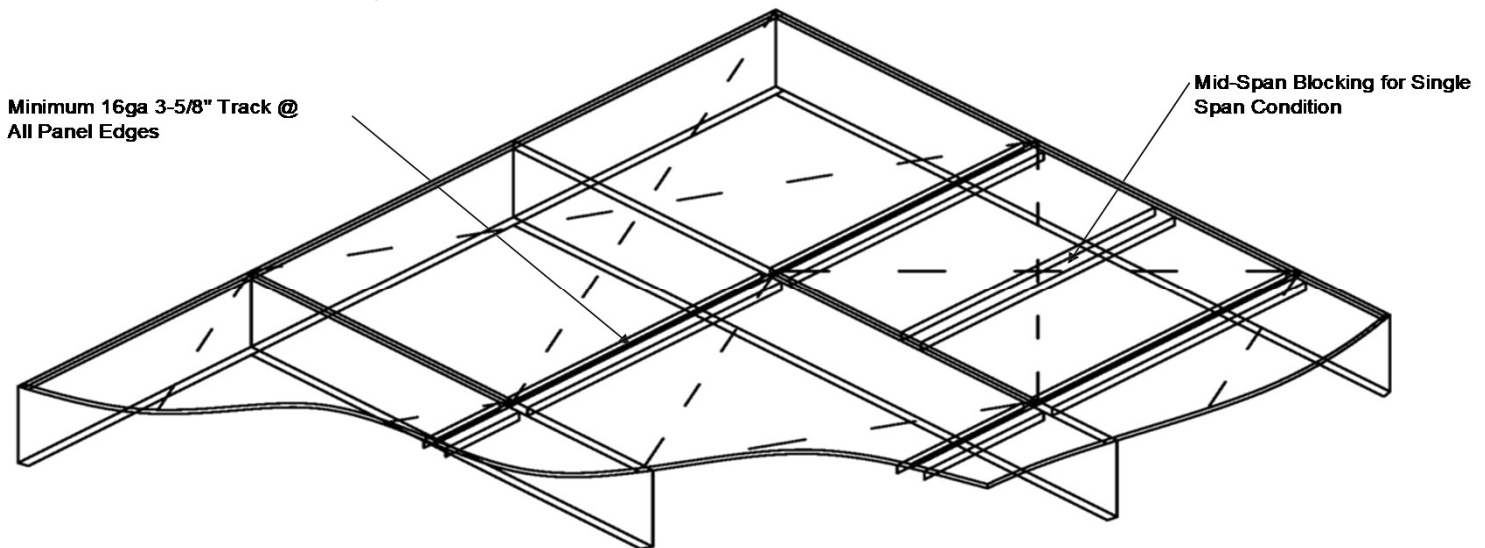
1. For ASD designs use minimum $\Omega = 3.0$; For LRFD designs use maximum $\phi = 0.50$; For LSD designs use maximum $\phi = 0.40$

2. Two framing spans minimum per panel piece for span ratings of 12" [304.8mm] through 24" [812.8mm].

3. The Nominal Load values are by engineering analysis based on flexural test results.

4. Blocking at all joints perpendicular to framing to be minimum 16 ga [54mil] or 0.0538" [1.366mm] thick 3-5/8" track. For sheathing installation where a single span condition exists, additional track blocking is required perpendicular to the framing located mid way between the edges of the panel. See Detail 1.

5. Nominal uplift capacity based upon the worst case of panel flexure, pull-over of a #8 wafer head screw with a head diameter of 0.306" [7.77mm], and #8 screw withdrawal from minimum 16ga with a minimum yield strength of 50 ksi. Screw nominal withdrawal capacity taken as 513 pounds based on AISI S100 Section E4.



Detail 1 - Blocking Detail for 48" o.c. Span Rating (Isometric View)

Table 4 - Safety Factors and Resistance Factors for Diaphragms
USG Structural Panel Concrete Roof Deck

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. Safety factors and resistance factors for USG Structural Panel Concrete Roof Deck diaphragms installed over cold-formed and hot-rolled steel framing are based upon Table D5 of AISI S100-2007.

2. Safety factors and resistance factors for USG Structural Panel Concrete Roof Deck 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.

3. 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.

4. 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 Roof Deck

Fastener Spacing		Joist		Screw Pattern ¹	Panel Blocking	S _y Shear Strength (plf)*	X	Aspect Ratio
Perimeter	Field	Gauge	Spacing					
4" [101.6mm]	12" [304.8mm]	16 [1.438mm]	16" [406.4mm]	B	None	1462 [21.3 kN/m]	0.443	3:1
6" [152.4mm]						1395 [20.4 kN.m]		
4" [101.6mm]	12" [304.8mm]	16 [1.438mm]	24" [609.6mm]	B	None	1341 [19.6 kNm]	0.476	3:1
6" [152.4mm]						1053 [15.4 kNm]		
6" [152.4mm]	12" [304.8mm]	16 [1.438mm]	24" [609.6mm]	C	4" [101.6mm]wide x 16ga.[1.438mm] Strap	1468 [21.4 kNm]	0.180	4:1
4" [101.6mm]	12" [304.8mm]	16 [1.438mm]	32" or 48" [812.8mm or 1219.2mm]	D	4" [101.6mm]wide x 16ga.[1.438mm] C-Track	2036 [29.7 kNm]	0.216	2.1:1
8" [203.2mm]	12" [304.8mm]	16 [1.438mm]	32" or 48" [812.8mm or 1219.2mm]	E	4" [101.6mm]wide x 16ga.[1.438mm] C-Track	1318 [19.2 kNm]	0.193	2.1:1

Refer to Table 4 of this PER for applicable diaphragm safety (Ω) and load resistance factors (ϕ) corresponding to ASD, LRFD, and/or LSD design methods.

Screw Pattern 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 joints, where the framing joists are perpendicular to the joint, one (1) panel fastener is required. One fastener should be 1" [25mm] from the panel edge.

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 .

Screw Pattern D - Panels shall be fastened as described in Screw Pattern B with the addition of fasteners at 4" [152mm] o.c. along the metal C-Track Blocking on both sides of seam. *When framing is spaced at 32" o.c., 4" [101.6mm] by 16ga. [1.438mm] strap blocking may be used in place of the C-Track blocking.*

Screw Pattern E - Panels shall be fastened as described in Screw Pattern B with the addition of fasteners at 8" [152mm] o.c. along the metal C-Track Blocking on both sides of seam. *When framing is spaced at 32" o.c., 4" [101.6mm] by 16ga. [1.438mm] strap blocking may be used in place of the C-Track blocking.*

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 Roof Deck for shear, 285,714 psi

t = Effective thickness of USG Structural Panel Concrete Roof Deck 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 3 above.

Table 6: Cantilever Diaphragm Testing
USG Structural Panel Concrete Roof Deck

Fastener Spacing		Joist Spacing	Screw Pattern	Panel Blocking	Su Shear Strength (plf)*	X
Perimeter	Field					
6" [152.4mm]	12" [304.8mm]	24" [609.6mm]	B	None	487 [7.1 kN/m]	0.518
8" [203.2mm]	12" [304.8mm]	24" [609.6mm]	B	None	475 [6.9 kN/m]	0.511
4" [101.6mm]	12" [304.8mm]	24" [609.6mm]	A	None	713 [10.4 kN/m]	0.732
6" [152.4mm]	12" [304.8mm]				525 [7.7 kN/m]	0.625
8" [203.2mm]	12" [304.8mm]				465 [6.8 kN/m]	0.754
4" [101.6mm]	12" [304.8mm]				975 [14.2 kN/m]	0.833
6" [152.4mm]	12" [304.8mm]	16" [406.4mm]	A	None	915 [13.4 kN/m]	0.765
8" [203.2mm]	12" [304.8mm]				860 [12.6 kN/m]	0.702
4" [101.6mm]	12" [304.8mm]				1121 [16.4 kN/m]	0.759
6" [152.4mm]	12" [304.8mm]	12" [304.8mm]	A	None	940 [13.7 kN/m]	0.541
8" [203.2mm]	12" [304.8mm]				772 [11.3 kN/m]	0.484
6" [152.4mm]	12" [304.8mm]				24" [609.6mm]	C
4" [101.6mm]	12" [304.8mm]	32" or 48" [812.8mm or 1219.2mm]	D	4" [101.6mm] wide x 16ga. [1.438mm] C-Track	1641 [23.9 kN/m]	0.426
8" [203.2mm]	12" [304.8mm]	32" or 48" [812.8mm or 1219.2mm]	E	4" [101.6mm] wide x 16ga. [1.438mm] C-Track	1098 [16.0 kN/m]	0.391

Refer to Table 4 of this PER for applicable diaphragm safety (Ω) and load resistance factors (ϕ) corresponding to ASD, LRFD, and/or LSD design methods.

2 to 1 maximum Aspect Ratio

Screw Pattern A & B - Panel fasteners must be inset 2" [50.8mm] 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" [25.4mm] and the other 2" [50.8mm] from the panel edge.

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 .

Screw Pattern D - Panels shall be fastened as described in Screw Pattern B with the addition of fasteners at 4" [102mm] o.c. along the C-Track Blocking on both sides of seam. *When framing is spaced at 32" o.c., 4" [101.6mm] by 16ga. [1.438mm] strap blocking may be used in place of the C-Track blocking.*

Screw Pattern E - Panels shall be fastened as described in Screw Pattern B with the addition of fasteners at 8" [203mm] o.c. along the C-Track Blocking on both sides of seam. *When framing is spaced at 32" o.c., 4" [101.6mm] by 16ga. [1.438mm] strap blocking may be used in place of the C-Track blocking.*

Deflection Equation for Cantilever Diaphragm

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

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 Roof Deck for shear, 285,714 psi

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

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

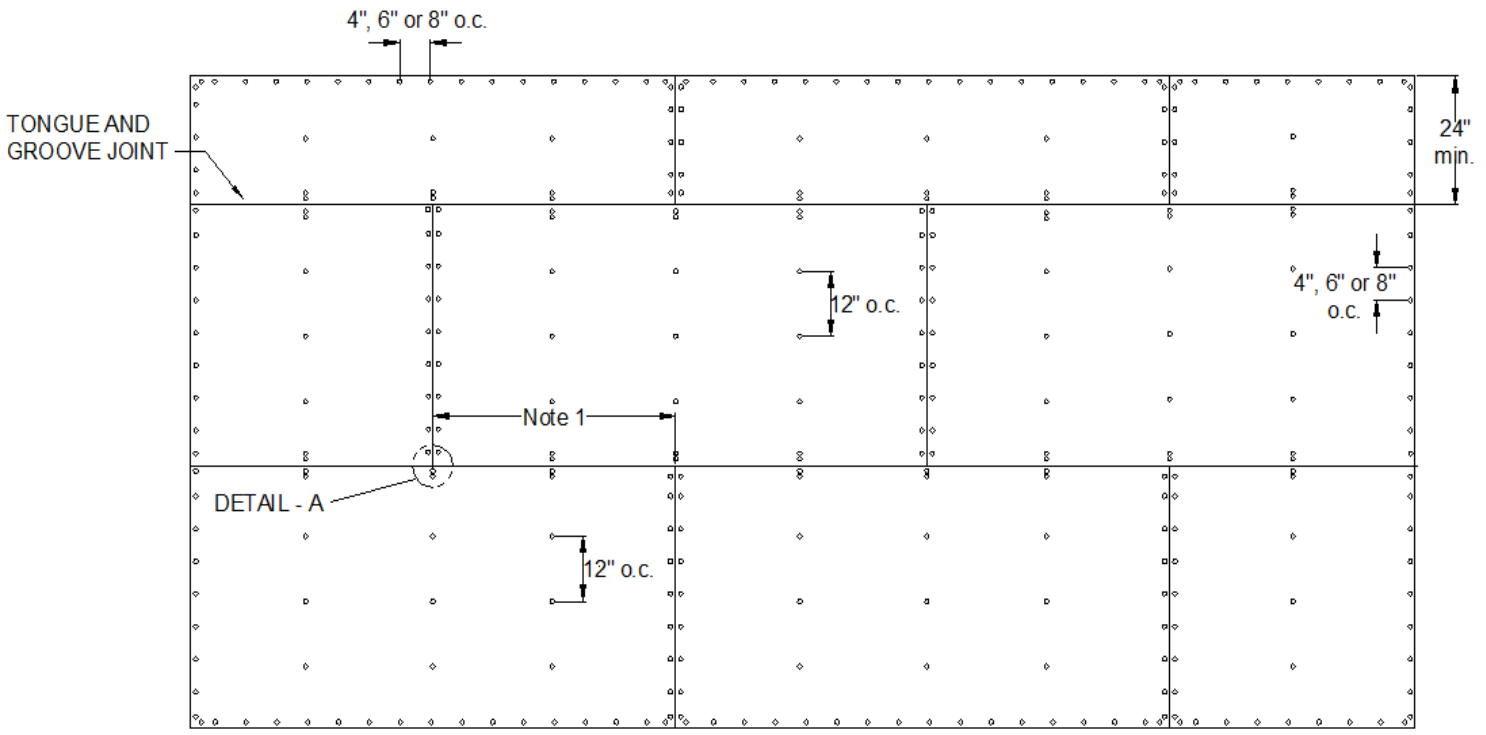
$$e_n @ 0.20S_u = 0.011$$

$$e_n @ 0.33S_u = 0.019$$

$$e_n @ 0.60S_u = 0.032$$

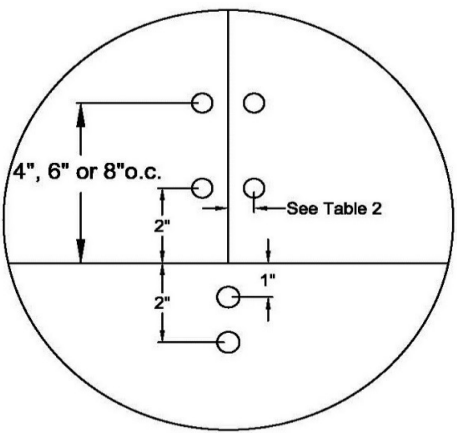
$$e_n @ S_u = 0.084$$

X = Slip Co-efficient. See Table 4 above.

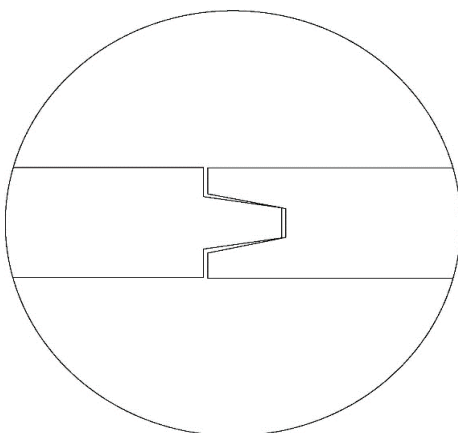


1. Two Span offset of Seams w/o Blocking, One Span w/ Blocking.

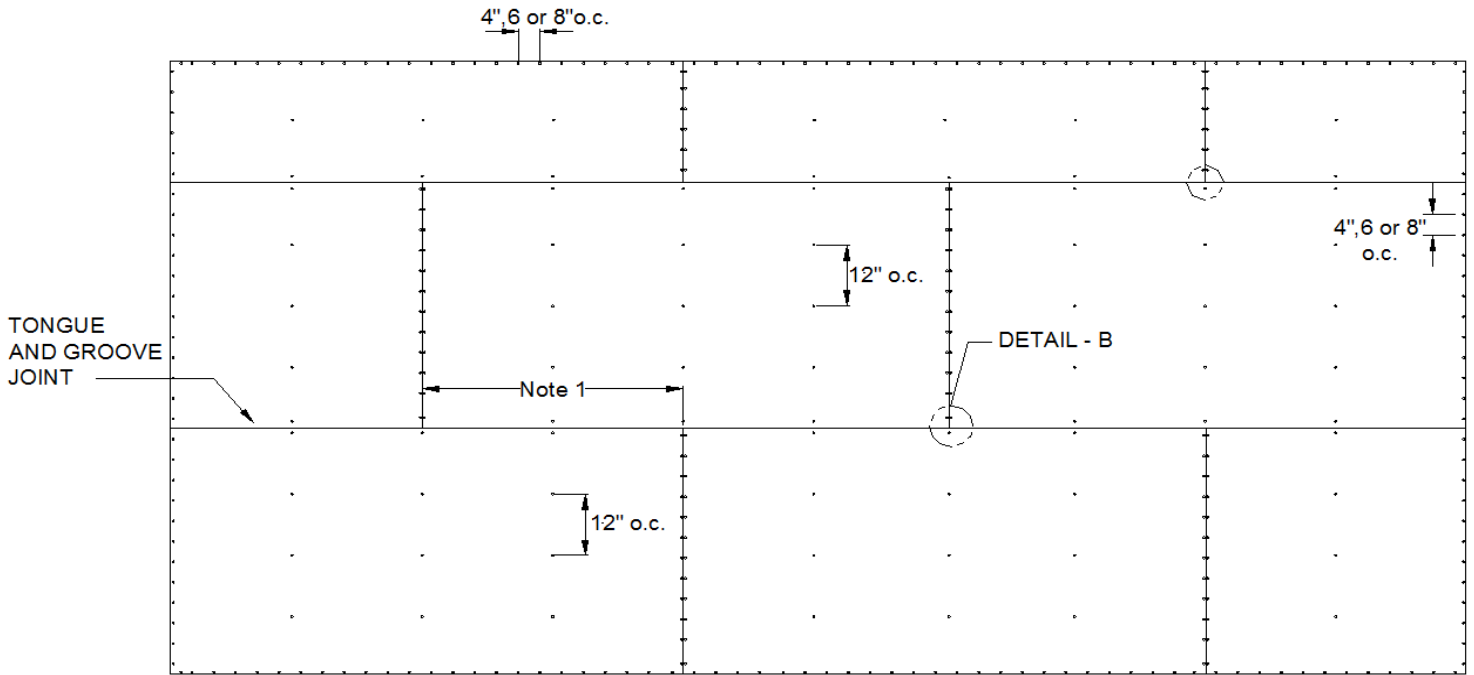
Screw Pattern A



DETAIL - A

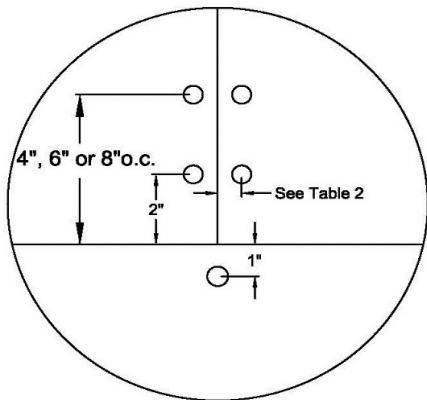


Tongue & Groove

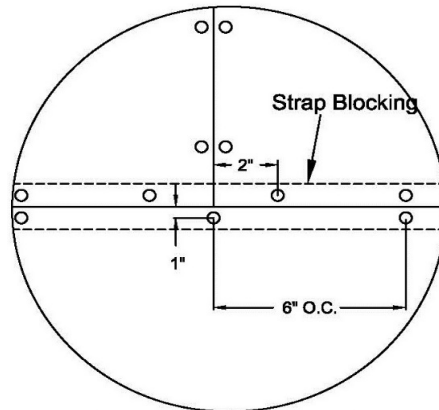


1. Two Span Minimum offset of Seams w/o Blocking, One Span offset w/ Blocking.

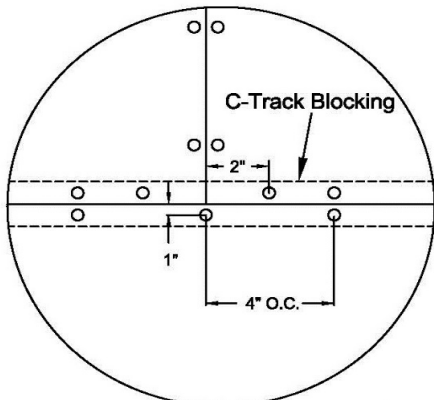
Screw Pattern B



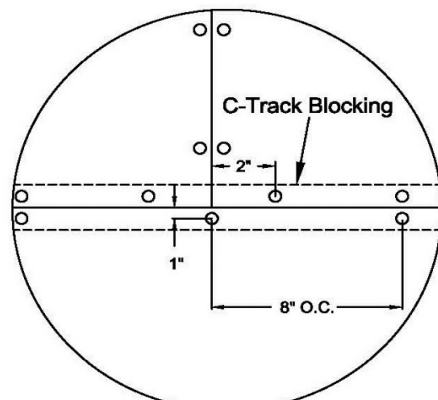
DETAIL - B



Strap Block Detail for Screw Pattern C



C-Track Block Detail for Screw Pattern D



C-Track Block Detail for Screw Pattern E