NUCOR CORPORATION - VULCRAFT/VERCO GROUP

VULCRAFT GROUP
7205 Gault Avenue North
Fort Payne, Alabama 35967
(256) 845-2460
www.vulcraft.com

VERCO DECKING, INC.
a NUCOR Company
4340 North 42nd Avenue
Phoenix, Arizona 85019
(602) 272-1347
www.vercodeck.com

STEEL DECK PANELS

CSI Division: 05 00 00 – METALS
CSI Sections: 05 31 00 – STEEL DECK
05 31 13 – STEEL FLOOR DECKING
05 31 23 – STEEL ROOF DECKING

1.0 RECOGNITION

Steel deck panels recognized in this report have been evaluated for use as a component of horizontal or sloped floor and roof systems supporting out of plane loads, in-plane diaphragm shears, and in-plane axial loads. Physical characteristics and structural performance properties comply with the intent of the provisions of the following codes and regulations:

- 2021, 2018, 2015 and 2012 International Building Code® (IBC)
- 2021, 2018, 2015 and 2012 International Residential Code® (IRC)
- 2022 California Building Code (CBC) – attached supplement
- 2023 City of Los Angeles Building Code (LABC) – attached supplement
- 2023 City of Los Angeles Residential Code (LARC) – attached supplement

2.0 LIMITATIONS

Use of the steel deck panels recognized in this report is subject to the following limitations:

2.1 Sound Transmission Performance: Acoustic performance is beyond the scope of this report.

2.2 Fire-Resistance Ratings: Fire-resistance performance is beyond the scope of this report.

2.3 The steel deck panels shall be installed in accordance with the applicable code, the manufacturer's published installation instructions, and this report. Where there is a conflict, the most restrictive requirements shall govern.

2.4 Calculations and details demonstrating that the loads applied to the steel deck panels comply with this report shall be submitted to the building official for approval. Calculations and drawings shall be prepared, signed, and sealed by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

2.5 The steel panels recognized in this report are produced by Vulcraft in Fort Payne, Alabama.

2.6 The Sammys X-Press anchors recognized in this report are produced in Elk Grove Village, Illinois.

2.7 The PinTail™ anchors recognized in this report are produced in Cerritos, California and Cumming, Georgia.

3.0 PRODUCT USE

3.1 General:

Steel deck panels may be designed to resist out-of-plane loads, in-plane diaphragm shear loads, and axial loads.

3.2 Design:

3.2.1 Out-of-Plane Strength and Deflection: Out-of-plane strength of steel deck panels shall be determined using engineering mechanics and deck panel properties presented in this report. Steel deck panels shall not be used under conditions subject to loads that are predominately cyclic in nature unless a registered design professional submits substantiating calculations to the building official in accordance with AISI S100-16 (2020) w/S2-20 and AISI S100-16 Chapter M under the 2021 and 2018 IBC and IRC, respectively (AISI S100-07/S2-10 and AISI S100-12 Chapter G under the 2012 and 2015 IBC and IRC, respectively).

Deflections resulting from out-of-plane loads shall comply with Section 1604.3 of the IBC.

3.2.2 Composite Steel Deck-Slabs: Composite steel deck-slab out-of-plane load strength (superimposed loads) shall be determined in accordance with ANSI/SDI C using properties and composite coefficients in this report. Use of concrete-filled composite steel deck slabs to support loads that are predominantly vibratory is beyond the scope of this report.

3.2.3 Composite Beams with Formed Steel Deck: Composite beams with formed steel deck included in this report shall be designed in accordance with AISC 360-22 Section I3.2c where the nominal rib height shall not be greater than 3-1/2 in. The strength of steel headed stud anchors used with deck profiles listed in this report shall be determined in accordance with AISC 360-22 Section I8.

3.2.4 Composite Joists with Formed Steel Deck: Composite joists with formed steel deck included in this report shall be designed in accordance with SJI 200-2015 where the nominal rib height shall not be greater than 3-1/2 in. The strength of steel headed stud anchors used with deck profiles listed in this report shall be determined in accordance with SJI 200-2015 Section 4.5.4 where the value R_p is determined in accordance with AISC 360-22 Section I8.

3.2.5 Reactions: The strength of steel deck panels to resist reaction loads at supports and locations of concentrated loads shall be determined based on either the web crippling strength or web shear strength. Web crippling strength shall be determined in accordance with AISI S100-16 (2020) w/S2-20 and AISI S100-16 Section G5 under the 2021 and 2018 IBC and IRC, respectively (AISI S100-07/S2-10 and AISI S100-12 Section C3.4.1 under the 2012 and 2015 IBC and IRC, respectively) and the properties in this report. Deck panel web shear strength of deck panel webs shall be determined in accordance with AISI S100-16 (2020) w/S2-20 and AISI S100-16 Section G2.1 under the 2021 and 2018 IBC and IRC, respectively (AISI S100-07/S2-10 and AISI S100-12 Appendix 1 Section 1.2.2.2.1 under the 2012 and 2015 IBC and IRC, respectively) and the properties in this report. The strength of web-perforated deck panels shall be determined in accordance with the equations in this report.

3.2.6 In-Plane (Diaphragm) Shear Strength and Stiffness: The in-plane shear strength of steel roof deck, non-composite steel deck, or composite steel deck-slabs shall be determined in accordance with AISI S310-16 including the modifications and properties in this report. For steel deck-slabs it is permitted to determine diaphragm shear strength and shear stiffness with the provisions of this report in lieu of AISI S310-16. The steel deck-slab provisions in this report were developed based on full scale reverse cyclic testing.

When steel deck panels are used as the stressed skin shear carrying element of a horizontal or sloped diaphragm as defined in Section 202 of the IBC, the diaphragm length and width shall be limited by one of the following: engineering mechanics, applied loads, shear capacity of the diaphragm, diaphragm shear deflection limited by the requirements of ASCE/SEI 7 in Sections 12.8.6 entitled, "Story Drift Determination", or Section 12.12 entitled, "Drift and Deformation". Shear deflection shall be based on the shear stiffness for the steel deck diaphragm and equations of mechanics.

The use of steel deck diaphragms for vertical diaphragms (shear walls) is beyond the scope of this report.

3.2.7 Axial Strength: The axial strength or combined axial and bending strength of steel deck panels shall be determined in accordance with AISI S100 using the properties in this report.

3.2.8 Wall Bracing: The design for anchorage of structural walls and transfer of anchorage forces into the diaphragm shall be in accordance with Section 12.11.2 of ASCE/SEI 7, subject to the following limitations:

1. Transfer of anchorage forces into diaphragm shall be in the direction parallel to the flutes (ribs) of the steel deck.

2. When acting as the continuous ties or struts between diaphragm chords, anchorage forces shall be distributed into the diaphragm in the direction parallel to the flutes (ribs) of the steel deck.

3. Combined axial load and bending shall be considered in accordance with Section H1 of AISI S100-16 (2020) w/S2-20 and AISI S100-16 under the 2021 and 2018 IBC and IRC, respectively (Section C5.1 of AISI S100-07/S2-10 and AISI S100-12 under the 2012 and 2015 IBC and IRC, respectively) to determine the strength of steel deck (without concrete fill) used to resist wall anchorage forces or to resist continuous tie forces parallel to the flutes (ribs).

4. Power-actuated fasteners, self-drilling screws, or welded connections described in this report are permitted to provide positive means of attachment to satisfy the connection requirements in ASCE/SEI 7 Section 12.11.2.2.1.

3.2.9 Partial Panels, Openings, Holes or Penetrations through Steel Deck: The registered design professional may submit design calculations and details to the building official for approval based on the principles of engineering mechanics for partial panels, openings, holes or penetrations. For lateral force resisting systems, the calculations shall consider the effects of partial panels, openings, holes, or penetrations on the overall strength and stiffness of the diaphragm.

3.2.10 Supporting Member Materials: Supporting members shall comply with the requirements of AISI S310-16.

3.2.11 Bekaert Dramix® Steel Fiber: Bekaert Dramix steel fibers shall comply with ER-465 and the provisions of this report.

3.2.11.1 Minimum Temperature and Shrinkage Reinforcement: For steel deck-slabs, minimum temperature and shrinkage reinforcement dosage utilizing Bekaert Dramix steel fiber shall be determined in accordance with the provisions of this report in lieu of ANSI/SDI C-2017 or ANSI/SDI NC-2017 when used.

3.2.12 Connections:

3.2.12.1 Self-Drilling Screws: Self-drilling screws may be used to attach steel deck panels to supporting members and to attach the sidelaps of steel deck panels to each other in accordance with AISI S100 and AISI S310 unless described in this report. The screws shall be manufactured in accordance with SAE J78 and shall be compliant with ASTM C1513.

3.2.12.2 Proprietary Fasteners: Proprietary screws and power actuated fasteners (PAF's) may be used to attach steel deck panels to supporting members in accordance with this report. The fasteners shall be designed to attach steel deck panels to supporting members and shall be described in a current evaluation report issued by an approved and accredited evaluation service agency.

3.2.12.3 Welds: Welds may be used to attach steel deck panels to supporting members and to attach the sidelaps of steel deck panels to each other in accordance with AISI S100 and AISI S310-16. The minimum tensile strength of the weld filler shall be designated as a minimum of 60 ksi (413.7 MPa) and comply with the appropriate AWS standard.

3.3 Installation:

Steel deck panel erection sequence and installation method is the responsibility of the contractor(s) performing installation of the steel deck panels. Installation shall be in accordance with this report, ANSI/SDI RD, ANSI/SDI NC and ANSI/SDI C and all welds shall comply with AWS D1.3. Where conflicts occur, the more restrictive shall govern. Additional installation information is available in the Steel Deck Institute (SDI MOC) Manual of Construction with Steel Deck and manufacturer's recommendations. Mechanical fasteners shall be installed in accordance with the manufacturer's current evaluation report issued by an approved and accredited evaluation service agency. Quality control during installation shall comply with ANSI/SDI QA/QC.

3.4 Inspections:

3.4.1 General: Special inspection is required in accordance with IBC Chapter 17. Quality control and quality assurance for deck installation shall comply with ANSI/SDI QA/QC, where the special inspector duties are as set forth for the quality assurance inspector (QAI). Structural observations shall be provided where required in 2021, 2018 and 2015 IBC Section 1704.6, or 2012 IBC Section 1704.5.

3.4.2 Jobsite Welding: Periodic special inspection for welding shall be in accordance with IBC Section 1705.2.2. Prior to proceeding, the welder shall demonstrate the ability to produce the prescribed weld to the special inspector's satisfaction. The inspector's duties include verification of materials, weld preparation, welding procedures, and welding processes.

3.4.3 Concrete: Continuous and periodic special inspection for concrete and concrete reinforcement shall be in accordance with Section 1705.3 of the IBC. The inspector's duties include sampling and testing, and verification of concrete mixes, reinforcement types and placement, and concrete placement.

3.4.4 Seismic-Force-Resisting Systems and Wind-Force-Resisting Systems: Where the steel deck is used in a seismic-force-resisting system in structures assigned to Seismic Design Category C, D, E or F, periodic special inspections for weld, screw and power-actuated fastener connections are required in accordance with 2021 IBC Section 1705.13.3, 2018 and 2015 IBC Section 1705.12.3 or 2012 IBC Section 1705.11.3.

Where the steel deck is used in a wind-force-resisting system in structures located in areas described in 2021 IBC Section 1705.12, 2018 and 2015 IBC Section 1705.11 or 2012 IBC Section 1705.10), periodic special inspections for weld, screw and power-actuated fastener connections are required in accordance with 2021 IBC Section 1705.12.3, 2018 and 2015 IBC Section 1705.11.3 or 2012 IBC Section 1705.10.3, respectively.

4.0 PRODUCT DESCRIPTION

4.1 Steel Deck Panels: The steel deck panels described in this report are cold-formed from steel sheets into panels with fluted sections. Panel characteristics including profile designation, sidelap type, applicable sidelap fasteners and perforations for fluted profiles are described in the tables and figures that accompany this report.

The galvanized deck panels are formed from either ASTM A653 or A1063 steel, with a minimum G30 galvanized coating designation.

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4.2 Concrete: Concrete shall be either lightweight concrete or normal weight concrete and comply with Chapter 19 of the IBC. Calcium chloride or admixtures containing chloride ions shall be limited in accordance with ACI 318-19 19.3.4.1 and 26.4.2.2(g), ACI 318-14 26.4.1.4.1(c), or ACI 318-11 3.6.4. The minimum compressive strength shall be as indicated in the tables and figures of this report.

5.0 IDENTIFICATION

Each bundle of deck panels is identified with a visible label. The label includes the manufacturer's name (Vulcraft), production location (Ft. Payne, Alabama), deck type, steel gage and evaluation report number (ER-0423).

Each box of PinTail™ anchors is identified with a visible label. The label includes the manufacturer's name (Vulcraft, Verco Decking, Inc.), part number, quantity, installation instructions and evaluation report number (ER-0423).

Either one of the IAPMO UES Marks of Conformity may also be used as noted below.

IAPMO ES or UES

IAPMO UES ER-0423

6.0 SUBSTANTIATING DATA

Data in accordance with the IAPMO Uniform Evaluation Service Evaluation Criteria EC007-2021, Evaluation Criteria for Steel Composite, Non-composite, and Roof Deck Construction. Test reports are from laboratories in compliance with ISO/IEC 17025.

7.0 STATEMENT OF RECOGNITION

This evaluation report describes the results of research completed by IAPMO Uniform Evaluation Service on Vulcraft/Verco Group Steel Floor Decking and Steel Roof Decking. Products are manufactured at locations noted in Section 2.5 and 2.6 of this report under a quality control program with periodic inspection under the supervision of IAPMO UES.

For additional information about this evaluation report please visit www.uniform-es.org or email at info@uniform-es.org

CALIFORNIA SUPPLEMENT

REPORT HOLDER
NUCOR CORPORATION - VULCRAFT/VERCO GROUP

VULCRAFT GROUP
7205 Gault Avenue North
Fort Payne, Alabama 35967
(256) 845-2460
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VERCO DECKING, INC.
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STEEL DECK PANELS

CSI Sections: **05 05 23 METAL FASTENINGS**
05 31 00 STEEL DECKING
05 31 13 STEEL FLOOR DECKING
05 31 23 STEEL ROOF DECKING

1.0 RECOGNITION

Vulcraft Group and Verco Decking Inc. Steel Deck Panels described in IAPMO UES ER-0423 and this supplement have been evaluated for use as components of floor and roof systems. The structural properties of the steel deck panels were evaluated for compliance with the following codes and regulations:

- 2022 California Building Code (CBC)

2.0 LIMITATIONS

Use of the Vulcraft and Verco Steel Deck Panels recognized in this report is subject to the following limitations:

2.1 Diaphragm deflections shall not exceed the permitted relative deflection of walls between the diaphragm level and the floor below. The flexibility limitations shown in Table 1604A.4 of the California Building Code may be used as a guide in lieu of a rational analysis of the anticipated deflections.

2.2 As applicable, in accordance with CBC Section 2210A.1.1.2, the minimum base steel thickness of the steel deck shall be 0.0359 inches (0.9 mm), except for single-story open structures, where the steel deck is not used as a diaphragm and there are no suspended hangers or bracing for nonstructural components attached to the deck.

2.3 Special Inspections are required in accordance with CBC Sections 1705.2 and 1705A.2, Steel Construction; and CBC Sections 1705.3 and 1705A.3, Concrete Construction.

2.4 Structural Observation is required in accordance with CBC Sections 1704.6 and 1704A.6.

2.5 Concrete tests and materials shall comply with CBC Sections 1909.2, 1903A, and 1910A, as applicable.

2.6 This supplement expires concurrently with ER-0423.

For additional information about this evaluation report, please visit www.uniform-es.org or email at info@uniform-es.org

CITY OF LOS ANGELES SUPPLEMENT

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Fort Payne, Alabama 35967
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1.0 RECOGNITION

Vulcraft Group and Verco Decking Inc. Steel Deck Panels described in IAPMO UES ER-0423 and this supplement have been evaluated for use as components of floor and roof systems. The structural properties of the steel deck panels were evaluated for compliance with the following codes and regulations:

- 2023 City of Los Angeles Building Code (LABC)
- 2023 City of Los Angeles Residential Code (LARC)

2.0 LIMITATIONS

Use of the Vulcraft and Verco Steel Deck Panels recognized in ER-0423 and this supplement is subject to the following limitations:

2.1 Design, installation, and inspection shall be in accordance with Chapters 16 and 17 of the LABC, as applicable, due to local amendments to these chapters.

2.2 Computations and details demonstrating that the loads applied to the decks comply with this report shall be submitted to the Department of Building and Safety for approval. In accordance with LABC Section 106.3.3.2, computations and drawings shall be prepared, stamped, and signed by a California registered design professional for the type of service performed except as otherwise permitted by the Department of Building and Safety.

2.3 For each job where the deck units are specified, the following information shall be indicated on the plans submitted to the Department of Building and Safety for approval.: (a) Cross-section details of the deck panels; (b) fastener details, including deck welding or other fasteners at supports, at diaphragm boundaries parallel to flutes, at shear transfer elements, and at side seams if such fasteners are required; (c) minimum length of deck panels; and (d) design shears.

2.4 Deck welding shall be performed by Los Angeles City certified cold-formed steel welders. Prior to proceeding with the welding, the welders shall demonstrate to the Deputy Inspectors their ability to produce the prescribed weld satisfactorily. A sample of the deck material shall be welded to steel simulating the framing. The sample specimen shall then be twisted, and if the deck material tears or if the weld in torsion indicates the proper fusion area, the weld shall be considered satisfactory.

2.5 Admixtures containing calcium chloride or other corrosive materials shall not be used in the concrete mix for the slab.

2.6 Prior to placement of the concrete for the slab, the steel deck panels shall be cleaned and oil, grease and other materials which may adversely affect the bonding of the concrete to the deck shall be removed.

2.7 In structures with long term live loads (i.e., warehouses, computer rooms, file rooms, etc.), the allowable loads in the tables of ER-0423 shall be reduced to account for creep in the concrete.

2.8 This supplement expires concurrently with ER-0423.

For additional information about this evaluation report, please visit www.uniform-es.org or email at info@uniform-es.org

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PERFORATED PROFILES

Perforated Web Reduction Factor

The perforated web reduction factor, q_s is calculated as follows:

$$q_s = 1 - (1 - k)\left(\frac{W_p}{h_w}\right) \qquad \text{[Eq. W-1]}$$

$$p_o = 0.9069\left(\frac{{d_p}^2}{{c_p}^2}\right) \qquad \text{[Eq. W-2]}$$

$$k = 1 - 2.175p_o \ \text{ for } \ p_o < 0.20$$
$$k = 0.9 + {p_o}^2 - 1.875p_o \text{ for } \ 0.20 \le p_o \le 0.58 \qquad \text{[Eq. W-3]}$$

Where:

q_s = Perforated web reduction factor

k = Ratio of stiffness

W_p = Width of perforated band in web, in.

h_w = Flat dimension of web measured in plane of web, in.

p_o = Percentage of open area

d_p = Diameter of perforation hole, in.

c_p = Perforation hole center-to-center spacing, in.

Shear Strength of Profiles with Perforated Webs

The vertical shear strength for profiles with perforated webs shall be calculated as follows:

$$V_{np} = q_s n_w V_n \sin\theta \qquad \text{[Eq. W-4]}$$

Where:

V_{np} = Vertical shear strength of profile with perforated web

n_w = Number of webs per foot

V_n = The nominal shear strength of solid web calculated in accordance with AISI S100-16 (2020) w/S2-20 and AISI S100-16 Sec. G2.1 or Sec C3.2.1 of AISI S100-07/S2-10 and AISI S100-12, kips

θ = Angle between plane of web and plane of bearing surface, deg

Web-Crippling Strength of Profiles with Perforated Webs

The web-crippling strength of a perforated web shall be calculated in accordance with AISI S100-16 (2020) w/S2-20 and AISI S100-16 Sec. G5 or Sec C3.4 of AISI S100-07/S2-10 and AISI S100-12 with the following modified equation:

$$P_n = Ct^2F_y \cdot \sin\theta \cdot \left(1 - C_R\sqrt{\frac{R}{t}}\right)\left(1 + C_N\sqrt{\frac{N}{t}}\right)\left(1 - C_h\sqrt{\frac{h_w}{q_s t}}\right)$$

[AISI S100-16 (2020) w/S2-20 and AISI S100-16 Eq. G5-1 or Eq. C3.4.1-1 of AISI S100-07/S2-10 and AISI S100-12] *(Modified)*

All variables are as defined in AISI S100-16 (2020) w/S2-20 and AISI S100-16 Section G5 or Sec C3.4 of AISI S100-07/S2-10 and AISI S100-12

CONNECTIONS THROUGH PERFORATED MATERIAL[1]						
Fastener Property	**Fastener**	**Adjustment Factor, ρ**	**Individial Connections**		**Diaphragms**	
			Ω (ASD)	**ϕ (LRFD)**	**Ω (ASD)**	**ϕ (LRFD)**
Nominal Shear Strength	Screw	1.00	3.00	0.50	Per AISI S310-16 Table B1.1	
	PAF[2]	$2.76t + 0.58 \le 1.00$	2.75	0.60		
	Weld[3]	$0.99d + 0.05 \le 1.00$	2.80	0.55		
Nominal Pullover Strength	Screw, PAF	0.85	3.00	0.50		
Nominal Tension Strength	Weld[2,4]	$0.19tF_u + 0.11 \le 1.00$	3.00	0.50		
Flexibility	Screw	1.71	-			
	PAF	1.15				
	Weld	1.00				

[1] For connections through perforated material, multiply calculated fastener property by appropriate adjustment factor.

[2] t = Base steel thickness of panel (in.)

[3] d = Visible diameter of arc spot weld (in.)

[4] F_u = Tensile strength of sheet steel (ksi)

COMPOSITE STEEL DECK-SLAB COEFFICIENT, K

The flexural strength for composite steel floor deck slabs utilizing steel deck panels be designed in accordance with ANSI/SDI C-2017 Section A2.2 where:

$$K = 2.03 - 1.31\left(\frac{h_c}{h - y_b}\right) \ge K_{min} \qquad \text{[Eq. K-1]}$$

Where:

h_c = Thickness of concrete cover (in.)
h = Total thickness of deck slab (in.)
y_b = Distance from extreme bottom fiber to neutral axis of gross section (in.)
K_{min} = Minimum composite steel-deck slab coefficient per section property tables

SUPPORT CONNECTION TENSION FLEXIBILITY

The flexibility of support connection in tension shall be determined in accordance with Eq. T-1:

$$S_t = 1/(1706 \cdot t^2 \cdot d_w + 2.51) \qquad \text{[Eq. T-1]}$$

Where:

S_t = Structural support connection tension flexibility (in/k)
d_w = Diameter of support connection or fastener (in.)
t = Base steel thickness of panel (in.)

SUPPORT CONNECTION SHEAR RUPTURE STRENGTH

The support connection shear rupture strength for the steel deck shall be determined in accordance with Eq. R-1:

$$P_{nv} = 2 \cdot F_u \cdot t \cdot (e - d/2) \qquad \Omega = 2.75 \text{ (ASD)} \qquad \phi = 0.60 \text{ (LRFD)} \qquad \phi = 0.60 \text{ (LSD)} \qquad \text{[Eq. R-1]}$$

Where:

P_{nv} = Nominal support connection shear rupture strength
F_u = Tensile strength of sheet steel (ksi)
t = Base steel thickness of panel (in.)
e = Distance between center of connection and edge of sheet (parallel to force) (in.)
d = Visible weld diameter or fastener shank diameter (in.)

DIAPHRAGM SHEAR STRENGTH AND STIFFNESS

Diaphragm shear strength and stiffness shall be calculated per AISI S310-16 with the following modifications:

D1 Diaphragm Shear Strength per Unit Length Controlled by Connection Strength, S_{nf}

The nominal shear strength [resistance] per unit length of a diaphragm controlled by connection strength, S_{nf}, shall be the smallest of S_{ni}, S_{nc}, S_{ne}, and S_{np}.

$$S_{np} = \text{minimum}\left(n_d P_{nf}\frac{1}{w_t}\right) \qquad \text{[Eq. D1-4]}$$

Where

S_{np} = Nominal shear strength [resistance] per unit length of diaphragm controlled by connections along the edge perpendicular to the panel span and located at exterior support

n_d = Number of support connections at any given bottom flute along a panel end perpendicular to the panel span and located at exterior support

w_t = Greatest tributary width to any given bottom flute with support connections along the edge perpendicular to the panel span and located at exterior support

All other variables are as defined in AISI S310-16 Section D1

D2.1 Fluted Panel

The nominal diaphragm shear strength [resistance] per unit length, S_{nb}, for either acoustic or non-acoustic fluted panels shall be the smallest of S_{no}, and S_{nl}.

$$S_{no} = \alpha\frac{7890}{{L_v}^2}\left(\frac{{I_{xg}}^3 t^3 d}{s}\right)^{0.25} \qquad \text{[Eq. D2.1-1]}$$

$$S_{nl} = P_n\frac{d-e}{D_d}\left(\frac{12}{d}\right) \qquad \text{[Eq. D2.1-2]}$$

Where

α = 1.00 for panels fastened to support at every bottom flute at exterior supports
0.75 for panels not fastened to support at every bottom flute at exterior supports

S_{no} = Nominal diaphragm shear strength [resistance] per unit length controlled by panel out-of-plane buckling, kip/ft

S_{nl} = Nominal diaphragm shear strength [resistance] per unit length controlled by exterior support local web buckling, kip/ft

d = Panel corrugation pitch, in.

e = One-half the bottom flat width of panel measured between points of intercept, in.

D_d = Depth of panel, in.

$$P_n = 4.36t^2F_y \cdot \sin\theta \cdot \left(1 - 0.04\sqrt{\frac{R}{t}}\right)\left(1 + 0.25\sqrt{\frac{N_e}{t}}\right)\left(1 - 0.025\sqrt{\frac{h_w}{t}}\right) \qquad \text{[Eq. D2.1-3]}$$

Where

t = Base steel thickness of panel, in.
F_y = Design yield stress, ksi
θ = Angle between plane of web and plane of bearing surface, deg.
R = Inside bend radius, in.
N_e = Bearing Length at end of panel support, in.
h_w = Flat dimension of web measured in plane of web, in.

D5.1.1 Stiffness of Fluted Panels

For spacing of fasteners connecting panels along longitudinal edges parallel to the deck flutes greater that the interior side-lap seam fastener spacing:

$$d_e \le \frac{S_s}{S_f} d_s \qquad \text{[Eq. G]}$$

Where:

d_e = Spacing of parallel edge fasteners
d_s = Spacing of sidelap fasteners
S_s = Sidelap connection flexibility (in/kip)
S_f = Structural support connection flexibility (in/k)

DIAPHRAGM SHEAR STRENGTH AND STIFFNESS OF STRUCTURAL CONCRETE FILLED STEEL DECK-SLABS

For structural concrete deck-slabs with a concrete thickness above the top of the deck no less that 2 in. or greater than 6 in., the nominal shear strength per unit length of diaphragms with structural concrete fill is calculated in accordance with Eq. C-1 and the diaphragm stiffness is calculated in accordance with Eq. C-4.

$S_n = S_c + S_f$ Ω = 2.00 (ASD) ϕ = 0.80 (LRFD) ϕ = 0.70 (LSD) [Eq. C-1]

$$S_c = k_c \cdot \lambda \cdot b \cdot \left[\left(D_c + \frac{D_d}{2}\right) + t \cdot \left(\frac{E}{E_c}\right) \cdot \left(\frac{d}{s}\right)\right] \cdot \sqrt{f'_c} \quad \text{[Eq. C-2]}$$

For $D \geq 35$ pcy, $S_f = 0.37 \cdot f_{150} \cdot \left(D_c + \frac{D_d}{2}\right)$ [Eq. C-3]

For $D < 35$ pcy, $S_f = 0.00$

$$G' = 4.8 \cdot \left[\left(D_c + \frac{D_d}{2}\right) + t \cdot \left(\frac{E}{E_c}\right) \cdot \left(\frac{d}{s}\right)\right] \cdot \sqrt{f'_c} \quad \text{[Eq. C-4]}$$

For structural concrete deck-slabs utilizing dovetail deck profiles and Bekaert Dramix 4D 65/60 BG Steel Fibers installed in accordance with IAPMO UES ER-465, steel fiber reinforced concrete properties are determined in accordance with Eq. BD-1

For normal weight concrete, 15 pcy ≤ D ≤ 66 pcy. For light weight concrete, 20 pcy ≤ D ≤ 66 pcy

$$f_{r1}, f_{r4}, f_{150}, R^D_{T,150} = C_1 \cdot \left(\frac{D}{\sqrt{f'_c}}\right)^2 + C_2 \cdot \left(\frac{D}{\sqrt{f'_c}}\right) \quad \text{[Eq. BD-1]}$$

	f_{r1}	f_{r4}	f_{150}	$R^D_{T,150}$
C_1	-81	-127	-127	-30
C_2	537	507	507	105

Bekaert Dramix 4D 65/60 BG required minimum dosage for temperature and shrinkage shall satisfy the requirements of equation BD-2 with a dosage for normal weight concrete, 15 pcy ≤ D ≤ 66 pcy and for light weight concrete, 20 pcy ≤ D ≤ 66 pcy.

$$39.96 \cdot \lambda \cdot \sqrt{f'_c} \cdot D_c \cdot R^D_{T,150}/100 \geq \max(540 \cdot D_c, 1680\ \text{lbf}) \quad \text{[Eq. BD-2]}$$

Where:

S_n = Nominal shear strength of diaphragm system with concrete fill
S_c = Shear strength of steel deck and structural concrete calculated in accordance with Eq. C-2, k/ft
S_f = Bekaert Dramix steel fiber contribution to shear strength calculated in accordance with Eq. C-3
G' = Shear stiffness of concrete deck-slab diaphragm, k/in
k_c = Factor for structural concrete strength
= 3.2/1000
λ = 1.00 for normal weight concrete
= 0.75 for lightweight concrete
b = Unit width of diaphragm with structural concrete fill
= 12 in.
D_c = Depth of concrete above steel deck flutes, in.
D_d = Depth of steel deck, in.
D = Fiber dosage, pcy
t = Base steel thickness of panel, in.
E = Modulus of elasticity of steel
E_c = Modulus of elasticity of concrete in accordance with ACI 318
d = Panel corrugation pitch, in.
s = Developed flute width of single corrugation, in.
f'_c = Structural concrete compressive strength, psi ≥ 2500 psi
f_{r1} = Stress corresponding $CMOD_1$, psi, as defined in IAPMO UES ER-465
f_{r4} = Stress corresponding to $CMOD_4$, psi, as defined in IAPMO UES ER-465
f_{150} = Stress at L/150, psi
$R^D_{T,150}$ = Equivalent flexural stress ratio as defined by IAPMO UES ER-465

All other variables as defined in IAPMO UES ER-465

STRUCTURAL CONCRETE FILLED STEEL DECK-SLAB SHEAR TRANSFER TO CHORDS AND COLLECTORS

Shear transfer of structural concrete fill deck-slab to chords and collectors shall be in accordance with AISI S310-16 Section D4.4 including D4.4.1 with safety and resistance factors for connections of the composite deck slab to supports as follows:

1. Steel headed stud anchors with nominal shear strength determined in accordance with AISC 360 with the following factors:
   Ω = 3.00 (ASD) ϕ = 0.55 (LRFD) ϕ = 0.50 (LSD)
2. Available strength [factored resistance] for welds shall be determined in accordance with AISI S100-16.
3. Available strength [factored resistance] for screws shall be determined in accordance with AISI S100-16.
4. Available strength [factored resistance] for proprietary fasteners shall be determined in accordance with this report, Ω and ϕ are listed on Page 13 of this report.

PROPRIETARY FASTENERS

Hilti

The nominal shear strength [resistance] for the Hilti X-ENP-19 L15 PAF shall be determined in accordance with Eq. H-1:

$P_{nf} = 56 \cdot t \cdot (1 - t) \leq P_{nvp}$ [Eq. H-1]

The nominal shear strength [resistance] for the Hilti X-HSN24 PAF shall be determined in accordance with Eq. H-2:

$P_{nf} = 52 \cdot t \cdot (1 - t) \leq P_{nvp}$ [Eq. H-2]

The flexibility of the Hilti X-ENP-19 L15 shall be determined in accordance with Eq. H-3a:

$$S_f = \frac{0.75}{1000\sqrt{t}}$$ [Eq. H-3a]

The flexibility of the Hilti X-HSN24 PAF shall be determined in accordance with Eq. H-3b:

$$S_f = \frac{1.25}{1000\sqrt{t}}$$ [Eq. H-3b]

The nominal tension strength [resistance] for the Hilti X-HSN 24 controlled by pull-out shall be determined in accordance with Eq. H-4:

$P_{not} = 8 \cdot t_{support} + 0.088 \leq 1.875$ Ω = 2.50 (ASD) ϕ = 0.65 (LRFD) ϕ = 0.55 (LSD) [Eq. H-4]

The nominal tension strength [resistance] for the X-ENP-19 L15 controlled by pull-out shall be determined in accordance with Eq. H-5:

$P_{not} = 2.625$ Ω = 2.50 (ASD) ϕ = 0.65 (LRFD) ϕ = 0.55 (LSD) [Eq. H-5]

Simpson Strong-Tie

The nominal shear strength [resistance] for the Simpson XL Screw shall be determined in accordance with Eq. S-1:

$P_{nf} = 78 \cdot t \cdot (t_{support})^{0.15} \leq P_{nvs}$ [Eq. S-1]

The nominal shear strength [resistance] for the Simpson XM Screw shall be determined in accordance with Eq. S-2a or S-2b:

For $t_{support} \leq 0.1875$ in $P_{nf} = 240 \cdot (t)^{1.5} \leq P_{nvs}$ [Eq. S-2a]

For $t_{support} > 0.1875$ in $P_{nf} = 53 \cdot t \leq P_{nvs}$ [Eq. S-2b]

The nominal shear strength [resistance] for the Simpson X1S1016 or XQ1S1016 shall be determined in accordance with Eq. S-3:

$P_{ns} = 20 \cdot t \leq 1.625$ [Eq. S-3]

The nominal shear strength [resistance] for the Simpson XU34B1016 shall be determined in accordance with Eq. S-4:

$P_{ns} = 25.2 \cdot t \leq 1.735$ [Eq. S-4]

Where:

t = Base steel thickness of panel (in.)
$t_{support}$ = Thickness of support (in.)
S_s = Sidelap connection flexibility (in/kip)
S_f = Structural support connection flexibility (in/k)
P_{nf} = Nominal shear strength [resistance] of a support connection (kips)
P_{ns} = Nominal shear strength [resistance] of a side-lap connection per fastener (kips)
P_{nvs} = Nominal shear strength [resistance] of screw (see page 13)
P_{nvp} = Nominal shear strength [resistance] of PAF (see page 13)
P_{not} = Nominal tensile strength [resistance] of a support connection per fastener controlled by pull-out (kips)

PROPRIETARY FASTENERS (Continued)

Pneutek

The nominal shear strength [resistance] for the Pneutek SDK61 PAF shall be determined in accordance with Eq. P-1a and P-1b:

For substrate thickness equal to 0.113"

$$P_{nf} = 0.735 \cdot t \cdot F_u(1 - 0.016 \cdot t \cdot F_u) \le P_{nvp} \qquad \text{[Eq. P-1a]}$$

For substrate thickness equal to 0.155"

$$P_{nf} = 0.788 \cdot t \cdot F_u(1 - 0.028 \cdot t \cdot F_u) \le P_{nvp} \qquad \text{[Eq. P-1b]}$$

For substrate thickness between 0.113" and 0.155", P_{nf} shall be determined by interpolation.

The nominal shear strength [resistance] for the Pneutek SDK63, K64 and K66 PAF shall be determined in accordance with Eq. P-2:

$$P_{nf} = 1.264 \cdot t \cdot F_u(1 - 0.053 \cdot t \cdot F_u) \le P_{nvp} \qquad \text{[Eq. P-2]}$$

The flexibility of the Pneutek SDK61 PAF shall be determined in accordance with Eq. P-3:

$$S_f = \frac{3}{1000\sqrt{t}} \qquad \text{[Eq. P-3]}$$

The flexibility of the Pneutek SDK63, K64 and K66 PAF shall be determined in accordance with Eq. P-4a and P-4b:

For substrate thickness less than 0.25"

$$S_f = \frac{3}{1000\sqrt{t}} \qquad \text{[Eq. P-4a]}$$

For substrate thickness equal to or greater than 0.25"

$$S_f = \frac{1}{1000\sqrt{t}} \qquad \text{[Eq. P-4b]}$$

The nominal tension strength [resistance] for the Pneutek SDK61, SDK63, K64 and K66 PAF controlled by pull-out shall be determined in accordance with Eq. P-5:

$$P_{not} = 18.37 \cdot t_{support} \le 4.811 \qquad \Omega = 2.45 \text{ (ASD)} \qquad \phi = 0.65 \text{ (LRFD)} \qquad \phi = 0.55 \text{ (LSD)} \qquad \text{[Eq. P-5]}$$

Where:

P_{not} = Nominal tensile strength [resistance] of a support connection per fastener controlled by pull-out (kips)

P_{nf} = Nominal shear strength [resistance] of a support connection per fastener (kips)

t = Base steel thickness of panel (in.)

F_u = Ultimate strength of sheet steel (ksi)

P_{nvp} = Nominal shear strength [resistance] of PAF (see page 13)

$t_{support}$ = Thickness of support (in.)

S_f = Structural support connection flexibility (in/k)

ϕ = Resistance Factor

Ω = Safety Factor

PROPRIETARY SUPPORT FASTENER PROPERTIES[1-4]

Specified Properties	Hilti		Pneutek				Simpson Strong-Tie	
	X-HSN 24	**X-ENP-19**	**SDK61**	**SDK63**	**K64**	**K66**	**XM Screw**	**XL Screw**
Minimum Substrate Thickness (in)	0.125	0.250	0.113	0.155	0.187	0.281	0.125	0.125
Maximum Substrate Thickness (in)	0.375	∞	0.155	0.250	0.312	∞	0.610	0.610
Shank Diameter (in)	0.157	0.177	0.144	0.173	0.181	0.199	0.216	0.216
Head or Washer Diameter (in)	0.474	0.591	0.500	0.500	0.500	0.500	0.483	0.625
Nominal Tensile Strength based on Material strength, P_{nts} (kip)[1]	5.033	6.397	3.909	5.641	6.175	7.465	4.985	4.985
	Ω = 2.65 (ASD) ϕ = 0.60 (LRFD) ϕ = 0.50 (LSD)		Ω = 2.65 (ASD) ϕ = 0.60 (LRFD) ϕ = 0.50 (LSD)				Ω = 3.00 (ASD) ϕ = 0.50 (LRFD) ϕ = 0.40 (LSD)	
Nominal Shear Strength of Screw based on Material Strength, P_{nvs} (kip)[2]	-	-	-	-	-	-	3.110	3.110
							Ω = 3.00 (ASD) ϕ = 0.50 (LRFD) ϕ = 0.40 (LSD)	
Nominal Shear Strength of PAF based on Material Strength, P_{nvp} (kip)[3]	3.020	3.838	2.345	3.385	3.705	4.479	-	-
	Ω = 2.65 (ASD) ϕ = 0.60 (LRFD) ϕ = 0.50 (LSD)		Ω = 2.65 (ASD) ϕ = 0.60 (LRFD) ϕ = 0.50 (LSD)					
Individual Fastener Shear Strength, P_{nf}[4]	Ω = 2.30 (ASD) ϕ = 0.70 (LRFD) ϕ = 0.55 (LSD)		Ω = 2.40 (ASD) ϕ = 0.65 (LRFD) ϕ = 0.55 (LSD)				Ω = 2.30 (ASD) ϕ = 0.70 (LRFD) ϕ = 0.55 (LSD)	

[1] Determined in accordance with AISI S100-16 (2020) w/S2-20 and AISI S100-16 Sections J5.2.1 and J4.4.3 or Sections E5.2.1 and E4.4.3 of AISI S100-07/S2-10 and AISI S100-12

[2] Determined in accordance with AISI S100-16 (2020) w/S2-20 and AISI S100-16 Section J4.3.2 or Section E4.3.2 of AISI S100-07/S2-10 and AISI S100-12

[3] Determined in accordance with AISI S100-16 (2020) w/S2-20 and AISI S100-16 Section J5.3.1 or Section E5.3.1 of AISI S100-07/S2-10 and AISI S100-12

[4] For use when calculating individual fastener shear strength in accordance with equations listed on pages 11-12 of this report.

[5] The shear strength of the connection shall be the minimum of the allowable strength for ASD, the design strength for LRFD, or the factored strength for LSD of the individual fastener shear strength and the shear strength based on material strength.

ITW BUILDEX SAMMYS X-PRESS CONNECTION[1-8]

SAMMYS X-Press Type			Deck Gage	Solid Material (Gr. 40)			Perforated Material (Gr. 40)		
Part Number	Model Number[2-4]	Rod Size (in.)		ASD P_{not}/Ω (lbs)	LRFD ϕP_{not} (lbs)	Max. Fire Sprinkler Pipe Size[9] (in.)	ASD P_{not}/Ω (lbs)	LRFD ϕP_{not} (lbs)	Max. Fire Sprinkler Pipe Size[9] (in.)
8181922 8150922 8294922 8272957	XP 200 XP 20 SXP 20 SXP 2.0	1/4 3/8 3/8 1/2	22	277	441	2	194	303	1 1/2
			20	337	535	2 1/2	235	368	2
			19	393	625	2 1/2	274	430	2
			18	446	709	3	311	488	2 1/2
8181922 8153299 8295922 8271957	XP 200 XP 35 SXP 35 SXP 3.5	1/4 3/8 3/8 1/2	16	562	894	4	392	615	3

1 For Solid: $P_{not} = 0.453 \cdot t \cdot F_u$ $\Omega = 2.65$ (ASD) $\phi = 0.60$ (LRFD)
For Perforated: $P_{not} = 0.340 \cdot t \cdot F_u$ $\Omega = 2.85$ (ASD) $\phi = 0.55$ (LRFD)
Where P_{not} = Nominal pullout strength of SAMMYS X-Press Connector, kips

2 XP 200 may not be used to support sprinkler pipe.

3 XP 200, XP 20 and XP 35 shall be installed and loaded perpendicular to the deck surface ± 5°.

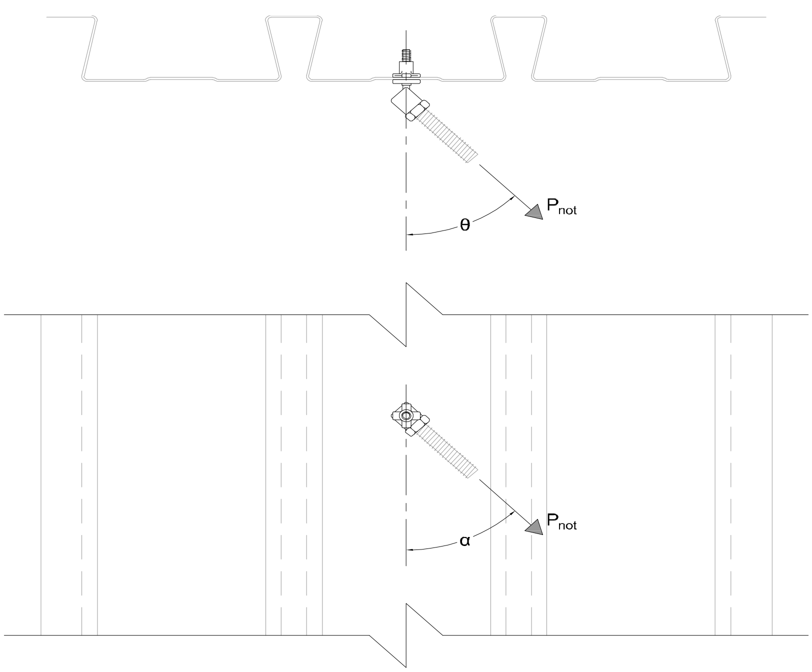
4 SXP 20, SXP 2.0, SXP 35 and SXP 3.5 may be installed in any flat portion of the bottom flange.
The load may be applied at any angle, Θ, from 0 to 90 degrees, 0° ≤ Θ ≤ 90°, relative to the axis of the base of the connector and any angle, α, from 0 to 360 degrees, 0° ≤ α ≤ 360°, relative to the ribs of the steel deck as shown below.

5 The allowable strength, P_n/Ω, shall be equal to or greater than the governing load combination for Allowable Stress Design (ASD) as stipulated in the IBC or ASCE/SEI 7.

6 The factored strength, ϕP_n, shall be equal to or greater than the governing load combination for Load and Resistance Factor Design as stipulated in the IBC or ASCE/SEI 7.

7 Maximum fire sprinkler pipe size in accordance with NFPA 13.

8 SAMMYS X-Press shall be installed per manufacturers instructions.



SAMMYS X-Press Swivel Head® Connector

WEDGE-NUT HANGING LOAD[1-8]				
Deck Type	Part Number	Max. Nominal Fire Sprinkler Pipe Size[9] (in.)	Connection Strength (lbs)	
			ASD P_n/Ω	LRFD ϕP_n
2.0D FormLok	2.0D-WN-3/8NC	4	1392	2297
	2.0D-WN-1/2NC	6		
3.5D FormLok	3.5D-WN-3/8NC	4	1996	3294
	3.5D-WN-1/2NC	8		

[1] Minimum compressive strength of normal (145 pcf) or light weight (≥110 pcf) concrete, f'_c = 2500 psi.

[2] The concentrated hanging load shall not exceed the bending strength and vertical shear strength of the 2.0D or 3.5D FormLok Composite Steel Deck-Slab.

[3] Hanging load shall not exceed the strength of the threaded rod or bolt provided by others.

[4] The hanging load shall be applied not more than 5 degrees from normal to the plane of deck.

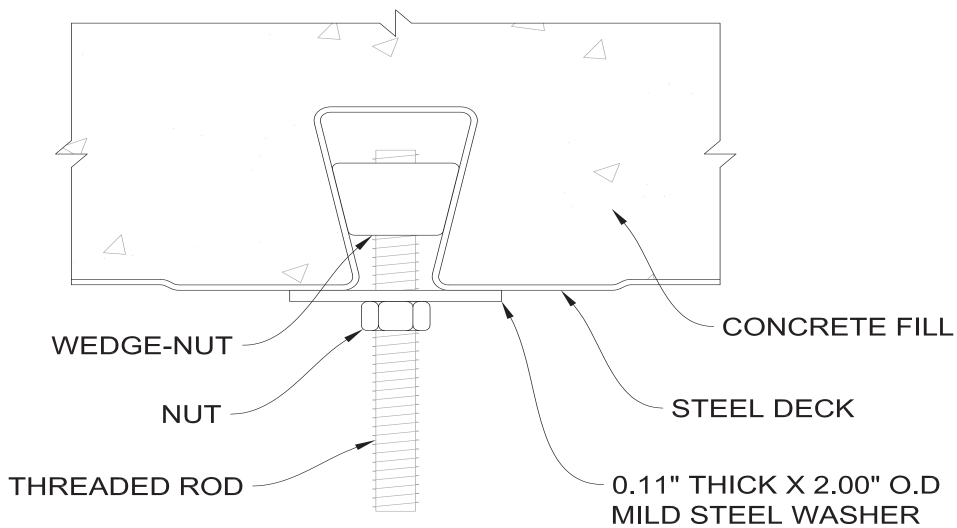
[5] The allowable strength, P_n/Ω, shall be equal to or greater than the governing load combination for Allowable Stress Design in the IBC or ASCE/SEI 7.

[6] The factored strength, ϕP_n, shall be equal to or greater than the governing load combination for Load and Resistance Factor Design in the IBC or ASCE/SEI 7.

[7] Safety and resistance factors are Ω = 2.75 (ASD) and ϕ = 0.60 (LRFD) respectively.

[8] Wedge-nuts shall be installed per manufacturer's instructions.

[9] Maximum fire sprinkler pipe size in accordance with NFPA 13.



Wedge-nut

20PT PINTAIL™ ANCHOR STRENGTH[1-9]										
Deck Type	Part Number	Threaded Rod Size	Max. Nominal Fire Sprinkler Pipe Size	Min. Spacing for Full Strength	Tension Only			Shear Only		
					ASD P_{nt}/Ω (lbs)	LRFD $\phi \cdot P_{nt}$ (lbs)	LSD $\phi \cdot P_{nt}$ (lbs)	ASD V_n/Ω (lbs)	LRFD $\phi \cdot V_n$ (lbs)	LSD $\phi \cdot V_n$ (lbs)
2.0DS-30 FL 2.0DF-30 FL	20PT3	3/8"-16	4 in.	9-3/8 in.	839	1385	1039	503	831	623
	20PT4	1/2"-13	5 in.							

Notes:

[1] The strengths listed apply to concrete unit weight ≥110 lb/ft^3, f'_c = 3000 psi, and a minimum anchor spacing of 9-3/8 in.

[2] For other conditions the following equations must be satisfied for design:

For ASD

$$\frac{P_t + V/0.6}{\alpha_c \cdot \alpha_s \cdot P_{nt}/\Omega} \leq 1.0 \quad \text{Eq. PT-1a} \qquad \frac{P_c + V/0.6}{\alpha_c \cdot \alpha_s \cdot P_{nc}/\Omega} \leq 1.0 \quad \text{Eq. PT-2a} \qquad \frac{V}{\alpha_c \cdot \alpha_s \cdot V_n/\Omega} \leq 1.0 \quad \text{Eq. PT-3a}$$

For LRFD and LSD

$$\frac{P_t + V/0.6}{\alpha_c \cdot \alpha_s \cdot \phi \cdot P_{nt}} \leq 1.0 \quad \text{Eq. PT-1b} \qquad \frac{P_c + V/0.6}{\alpha_c \cdot \alpha_s \cdot \phi \cdot P_{nc}} \leq 1.0 \quad \text{Eq. PT-2b} \qquad \frac{V}{\alpha_c \cdot \alpha_s \cdot \phi \cdot V_n} \leq 1.0 \quad \text{Eq. PT-3b}$$

Where:

Ω = 2.75 (ASD) ϕ = 0.60 (LRFD) ϕ = 0.45 (LSD)

P_t = Applied tension load (lbs)

P_{nt} = Nominal tension strength P_{nt} = 2667 lbs

P_c = Applied compression load (lbs)

P_{nc} = Nominal compression strength P_{nc} = 4877 lbs

V = Applied shear load (lbs)

V_n = Nominal shear strength V_n = 1600 lbs

α_c = Concrete adjustment factor

$\alpha_c = \sqrt{f'_c/4000} \leq 1.0$ Eq. PT-4

α_s = Anchor spacing adjustment factor

$\alpha_s = 0.029 \cdot S + 0.730 \leq 1.0$ Eq. PT-5a

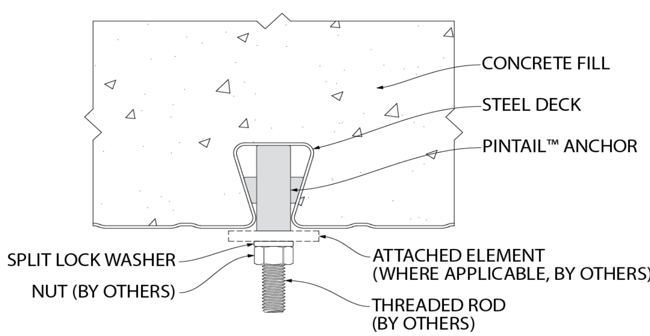
f'_c = Specified concrete compressive strength, psi

S = Anchor spacing, in. ≥ 2.380 in.

[3] Shear load may be applied in any direction.

[4] The allowable strength shall be equal to or greater than the governing nominal load or load combination for Allowable Stress Design (ASD) as stipulated in the IBC or ASCE/SEI 7.

[5] The factored strength shall be equal to or greater than the governing factored load or factored load combination for Load and Resistance Factor Design as stipulated in the IBC or ASCE/SEI 7.



PinTail™ Anchor

[6] Maximum fire sprinkler pipe size in accordance with NFPA 13 assuming minimum connector spacing for full capacity, f'_c = 3000 psi and no applied shear load.

[7] Applied loads shall not exceed the strength of the threaded rod or bolt provided by others.

[8] PinTail™ Anchor shall be installed per manufacturers instructions.

[9] The anchor spacing adjustment factor, α_s, applies to PinTail™ Anchors installed in the same or adjacent flute.

35PT PINTAIL™ ANCHOR STRENGTH[1-9]										
Deck Type	Part Number	Threaded Rod Size	Max. Nominal Fire Sprinkler Pipe Size	Min. Spacing for Full Strength	Tension Only			Shear Only		
					ASD P_{nt}/Ω (lbs)	LRFD $\phi \cdot P_{nt}$ (lbs)	LSD $\phi \cdot P_{nt}$ (lbs)	ASD V_n/Ω (lbs)	LRFD $\phi \cdot V_n$ (lbs)	LSD $\phi \cdot V_n$ (lbs)
3.5DS-24 FL 3.5DF-24 FL	35PT3	3/8"-16	4 in.	34-3/8 in.	2740	4521	3391	921	1520	1140
	35PT4	1/2"-13	8 in.							
	35PT5	5/8"-11	10 in.							
	35PT6	3/4"-10	10 in.							

Notes:

[1] The strengths listed apply to concrete unit weight ≥110 lb/ft^3, f'_c = 3000 psi, and a minimum anchor spacing of 34-3/8 in.

[2] For other conditions the following equations must be satisfied for design:

For ASD $\dfrac{P_t + V/0.6}{\alpha_c \cdot \alpha_s \cdot P_{nt}/\Omega} \le 1.0$ Eq. PT-1a $\dfrac{P_c + V/0.6}{\alpha_c \cdot \alpha_s \cdot P_{nc}/\Omega} \le 1.0$ Eq. PT-2a $\dfrac{V}{\alpha_c \cdot \alpha_s \cdot V_n/\Omega} \le 1.0$ Eq. PT-3a

For LRFD and LSD $\dfrac{P_t + V/0.6}{\alpha_c \cdot \alpha_s \cdot \phi \cdot P_{nt}} \le 1.0$ Eq. PT-1b $\dfrac{P_c + V/0.6}{\alpha_c \cdot \alpha_s \cdot \phi \cdot P_{nc}} \le 1.0$ Eq. PT-2b $\dfrac{V}{\alpha_c \cdot \alpha_s \cdot \phi \cdot V_n} \le 1.0$ Eq. PT-3b

Where:

Ω = 2.75 (ASD) ϕ = 0.60 (LRFD) ϕ = 0.45 (LSD)

P_t = Applied tension load (lbs)

P_{nt} = Nominal tension strength P_{nt} = 8702 lbs

P_c = Applied compression load (lbs)

P_{nc} = Nominal compression strength P_{nc} = 4877 lbs

V = Applied shear load (lbs)

V_n = Nominal shear strength V_n = 2926 lbs

α_c = Concrete adjustment factor

$\alpha_c = \sqrt{f'_c/4000} \le 1.0$ Eq. PT-4

α_s = Anchor spacing adjustment factor

$\alpha_s = 0.013 \cdot S + 0.553 \le 1.0$ Eq. PT-5b

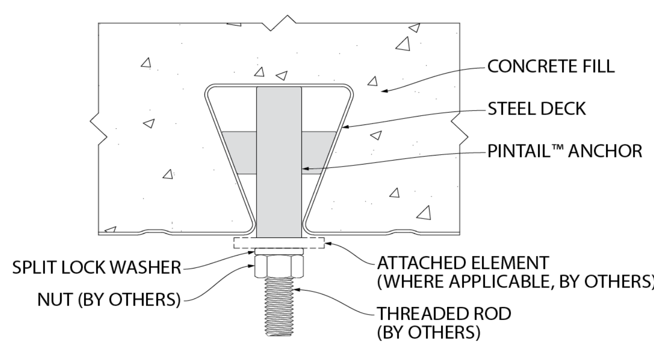
f'_c = Specified concrete compressive strength, psi

S = Anchor spacing, in. ≥ 4.134 in.

[3] Shear load may be applied in any direction.

[4] The allowable strength shall be equal to or greater than the governing nominal load or load combination for Allowable Stress Design (ASD) as stipulated in the IBC or ASCE/SEI 7.

[5] The factored strength shall be equal to or greater than the governing factored load or factored load combination for Load and Resistance Factor Design as stipulated in the IBC or ASCE/SEI 7.



PinTail™ Anchor

[6] Maximum fire sprinkler pipe size in accordance with NFPA 13 assuming minimum connector spacing for full capacity, f'_c = 3000 psi and no applied shear load.

[7] Applied loads shall not exceed the strength of the threaded rod or bolt provided by others.

[8] PinTail™ Anchor shall be installed per manufacturers instructions.

[9] The anchor spacing adjustment factor, α_s, applies to PinTail™ Anchors installed in the same or adjacent flute.

NOMINAL STRENGTH OF #12 SCREW INTO PERFORATED MATERIAL (lbs)[1-3]		
Deck Type	Shear Strength, P_{ns}	Pull-out Strength, P_{not}
2.0DA22	594	247
2.0DA20	715	322
2.0DA19	829	392
2.0DA18	934	458
2.0DA16	1170	604
3.5DA20	715	322
3.5DA19	829	392
3.5DA18	934	458
3.5DA16	1170	604
3.5DA14	1458	780

[1] Screw must be installed directly into perforation hole.

[2] Tabulated values are based on perforated material not in contact with the head of the screw. The connecting material in contact with the head of the screw must have a minimum thickness of 16 gage (0.0598") and maximum hole size measuring 1/4" x 5/8".

[3] Safety and resistance factors are Ω = 2.50 (ASD) and ϕ = 0.65 (LRFD) respectively.

NOMINAL PULL-OVER STRENGTH OF #12 SCREW THRU SOLID MATERIAL WITH SLOTTED HOLE[1-5]		
Gage	t in.	P_{nov} lbs
16	0.0598	971

[1] Maximum slotted hole size = 1/4" x 5/8"

[2] Tabulated values are based on a minimum effective pull-over resistance diameter, d'_w of 0.423".

[3] Tabulated values are based on a minimum tensile strength of steel, F_u of 65 ksi for solid material with slotted hole.

[4] For eccentrically loaded connections that produce a non-uniform pull-over force on the screw, the nominal pull-over strength shall be taken as 50 percent of P_{nov}

[5] Safety and resistance factors are Ω = 2.50 (ASD) and ϕ = 0.65 (LRFD) respectively.

COMBINED SHEAR AND TENSION EQUATIONS

The following design equations can be used to check shear and tension interaction for assemblies meeting the requirements of the tables shown above:

ASD: $$\frac{Q}{P_{ns}} + \frac{T}{\min(P_{not}, P_{nov})} \leq \frac{1.0}{\Omega}$$ $\Omega = 2.50$

LRFD: $$\frac{\bar{Q}}{P_{ns}} + \frac{\bar{T}}{\min(P_{not}, P_{nov})} \leq 1.0\phi$$ $\phi = 0.65$

Where:

Q = Required allowable shear strength per connection screw

T = Required allowable tension strength per connection screw

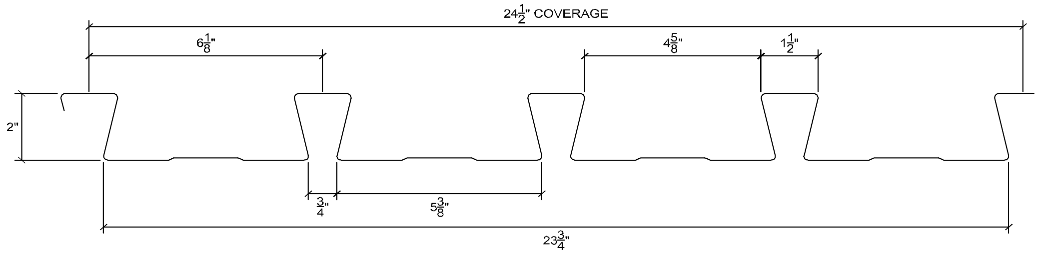
$\bar{Q}$ = Required shear strength per connection screw

$\bar{T}$ = Required tension strength per connection screw

DEFINITION OF SECTION PROPERTY SYMBOLS		
Symbol	**Definition**	**Units**
A_g	Gross area of cross-section	in^2/ft
A_{gbf}	Gross area of bottom flange	in^2
A_n	Net area of cross-section	in^2/ft
A_{sbf}	Cross-sectional area of bottom flange stiffener	in^2
b_{obf}	Overall flat width of stiffened bottom flange	in.
b_{pbf}	Largest sub-element flat of stiffened bottom flange	in.
c_p	Perforation hole center-to-center spacing	in.
c_{sbf}	Horizontal distance from edge of bottom flange to centerline of bottom flange stiffener	in.
d_p	Perforation hole diameter	in.
E	Modulus of elasticity of steel = 29,500	ksi
E_p	Width of perforated band in bottom flange	in.
F_u	Tensile strength of steel	ksi
F_y	Yield strength of steel	ksi
G	Shear modulus of steel = 11,300	ksi
h_w	Flat dimension of web measured in plane of web	in.
I_{d+}	Positive effective moment of inertia for deflection due to uniform loads, $I_{d+}=(2I_{e+}+I_x)/3$	in^4/ft
I_{d-}	Negative effective moment of inertia for deflection due to uniform loads, $I_{d-}=(2I_{e-}+I_x)/3$	in^4/ft
I_{e+}	Positive effective moment of inertia	in^4/ft
I_{e-}	Negative effective moment of inertia	in^4/ft
I_{spbf}	Moment of inertia of stiffener about centerline of flat portion of bottom flange	in^4
I_{xg}	Moment of inertia of fully effective section	in^4/ft
K_{min}	Minimum composite deck coefficient	-
M_{n+}	Nominal positive flexural strength of deck or panel	k-ft/ft
M_{n-}	Nominal negative flexural strength of deck or panel	k-ft/ft
M_{nxt+}	Nominal positive flexural strength with respect to centroidal axis in considering tension yielding	k-ft/ft
M_{nxt-}	Nominal negative flexural strength with respect to centroidal axis in considering tension yielding	k-ft/ft
R	Inside bend radius	in.
r	Radius of gyration of full unreduced section	in.
S_{e+}	Positive effective section modulus	in^3/ft
S_{e-}	Negative effective section modulus	in^3/ft
S_{xb}	Section modulus about the X axis for the extreme top fiber of gross section, $S_{xb}=I_{xg}/y_b$	in^3/ft
S_{xt}	Section modulus about the X axis for the extreme bottom fiber of gross section, $S_{xt}=I_{xg}/y_t$	in^3/ft
T_n	Nominal tensile axial strength of panel	k/ft
t	Base steel thickness of panel	in.
V_n	Nominal vertical shear strength of panel	k/ft
w_{bf}	Flat width of bottom flange	in.
w_{dd}	Weight of section	psf
w_{tf}	Flat width of top flange	in.
y_b	Distance from extreme bottom fiber to neutral axis of gross section	in.
y_t	Distance from extreme top fiber to neutral axis of gross section	in.
θ	Angle between plane of web and plane of bearing surface	deg.

Non-Composite Profiles
2.0D

Composite Profiles
2.0D FormLok



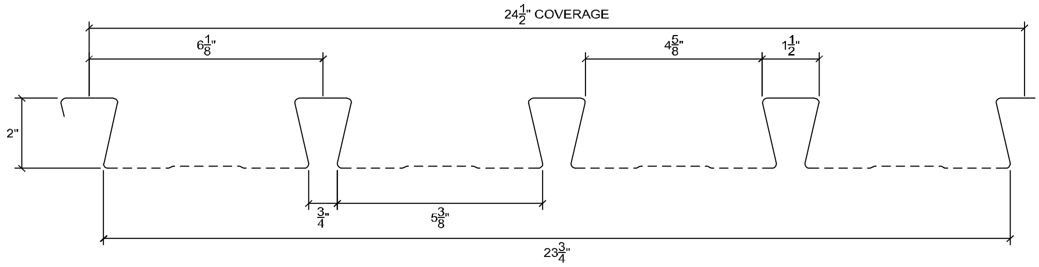
Gage	t in.	w_{dd} psf	A_g in^2/ft	I_{xg} in^4/ft	S_{xb} in^3/ft	S_{xt} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.	K_{min} -
22	0.0295	2.1	0.626	0.388	0.560	0.290	0.693	1.337	0.787	1.698	79.6	0.00
20	0.0358	2.6	0.761	0.472	0.677	0.353	0.697	1.339	0.788	1.691	79.4	0.00
19	0.0418	3.0	0.889	0.551	0.787	0.411	0.700	1.342	0.787	1.683	79.2	0.00
18	0.0474	3.4	1.009	0.626	0.889	0.466	0.704	1.343	0.788	1.677	78.9	0.00
16	0.0598	4.3	1.276	0.792	1.114	0.587	0.711	1.349	0.788	1.662	78.4	0.00

Gage	GRADE 40: F_y = 40 ksi, F_u = 55 ksi											
	I_{e+} in^4/ft	I_{e-} in^4/ft	I_{d+} in^4/ft	I_{d-} in^4/ft	S_{e+} in^3/ft	S_{e-} in^3/ft	M_{n+} k-ft/ft	M_{n-} k-ft/ft	M_{nxt+} k-ft/ft	M_{nxt-} k-ft/ft	V_n k/ft	T_n k/ft
22	0.386	0.345	0.387	0.359	0.272	0.272	0.907	0.907	1.867	0.967	4.633	25.04
20	0.472	0.435	0.472	0.447	0.343	0.334	1.143	1.113	2.257	1.177	5.596	30.44
19	0.551	0.523	0.551	0.532	0.406	0.394	1.353	1.313	2.623	1.370	6.499	35.56
18	0.626	0.605	0.626	0.612	0.463	0.450	1.543	1.500	2.963	1.553	7.335	40.36
16	0.792	0.791	0.792	0.791	0.587	0.576	1.957	1.920	3.713	1.957	9.156	51.04

R in.	w_{tf} in.	w_{bf} in.
0.125	1.188	5.000

Acoustic Profiles

2.0DA



Gage	t in.	w_{dd} psf	A_g in^2/ft	A_n in^2/ft	I_{xg} in^4/ft	S_{xb} in^3/ft	S_{xt} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.
22	0.0295	2.0	0.626	0.583	0.341	0.422	0.279	0.808	1.222	0.765	1.698	79.6
20	0.0358	2.4	0.761	0.708	0.415	0.512	0.339	0.811	1.225	0.766	1.691	79.4
19	0.0418	2.8	0.889	0.828	0.485	0.595	0.395	0.815	1.227	0.765	1.683	79.2
18	0.0474	3.2	1.009	0.940	0.551	0.674	0.448	0.818	1.229	0.766	1.677	78.9
16	0.0598	4.0	1.276	1.188	0.697	0.845	0.564	0.825	1.235	0.766	1.662	78.4

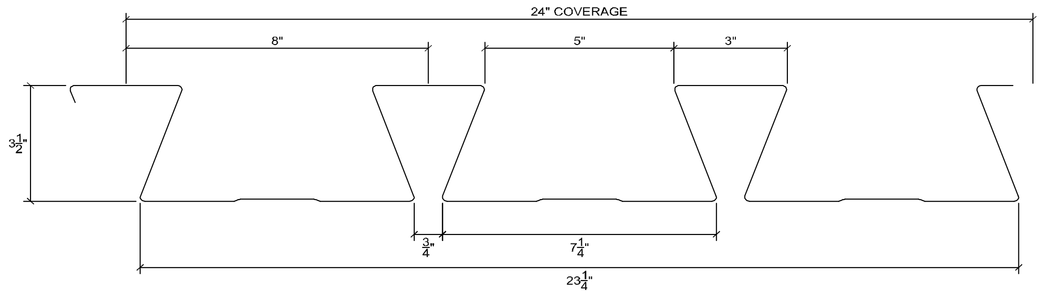
Gage	GRADE 40: F_y = 40 ksi, F_u = 55 ksi											
	I_{e+} in^4/ft	I_{e-} in^4/ft	I_{d+} in^4/ft	I_{d-} in^4/ft	S_{e+} in^3/ft	S_{e-} in^3/ft	M_{n+} k-ft/ft	M_{n-} k-ft/ft	M_{nxt+} k-ft/ft	M_{nxt-} k-ft/ft	V_n k/ft	T_n k/ft
22	0.339	0.294	0.340	0.310	0.261	0.258	0.870	0.860	1.407	0.930	4.633	23.32
20	0.415	0.370	0.415	0.385	0.330	0.317	1.100	1.057	1.707	1.130	5.596	28.32
19	0.485	0.445	0.485	0.458	0.391	0.374	1.303	1.247	1.983	1.317	6.499	33.12
18	0.551	0.516	0.551	0.528	0.445	0.427	1.483	1.423	2.247	1.493	7.335	37.60
16	0.697	0.677	0.697	0.684	0.564	0.546	1.880	1.820	2.817	1.880	9.156	47.52

R in.	w_{tf} in.	w_{bf} in.
0.125	1.188	5.000

d_p in.	c_p in.	E_p in.
0.154	0.375	4.654

Non-Composite Profiles
3.5D

Composite Profiles
3.5D FormLok



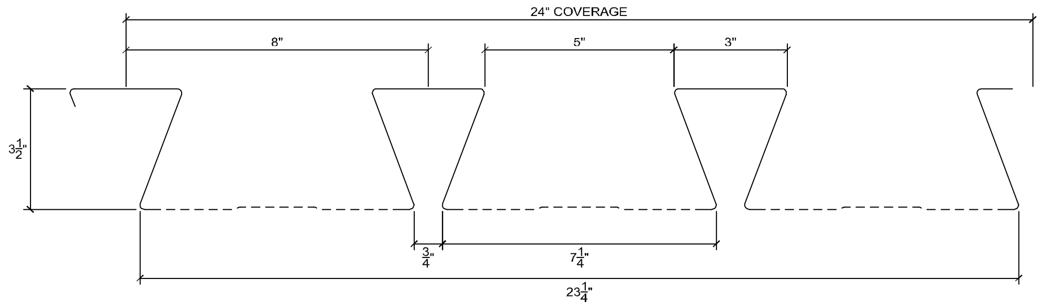
Gage	t	w_{dd}	A_g	I_{xg}	S_{xb}	S_{xt}	y_b	y_t	r	h_w	θ	K_{min}
	in.	psf	in^2/ft	in^4/ft	in^3/ft	in^3/ft	in.	in.	in.	in.	deg.	-
20	0.0358	3.3	0.955	1.891	1.361	0.881	1.389	2.147	1.407	3.293	71.6	0.00
19	0.0418	3.8	1.116	2.210	1.588	1.028	1.392	2.150	1.407	3.286	71.4	0.00
18	0.0474	4.3	1.266	2.508	1.798	1.165	1.395	2.152	1.407	3.280	71.3	0.00
16	0.0598	5.4	1.600	3.170	2.261	1.469	1.402	2.158	1.408	3.267	71.0	0.00

Gage	GRADE 40: F_y = 40 ksi, F_u = 55 ksi											
	I_{e+}	I_{e-}	I_{d+}	I_{d-}	S_{e+}	S_{e-}	M_{n+}	M_{n-}	M_{nxt+}	M_{nxt-}	V_n	T_n
	in^4/ft	in^4/ft	in^4/ft	in^4/ft	in^3/ft	in^3/ft	k-ft/ft	k-ft/ft	k-ft/ft	k-ft/ft	k/ft	k/ft
20	1.697	1.524	1.762	1.646	0.676	0.781	2.253	2.603	4.537	2.937	5.496	38.20
19	2.039	1.845	2.096	1.967	0.837	0.934	2.790	3.113	5.293	3.427	7.484	44.64
18	2.368	2.154	2.415	2.272	0.980	1.070	3.267	3.567	5.993	3.883	9.619	50.64
16	3.115	2.867	3.133	2.968	1.317	1.377	4.390	4.590	7.537	4.897	13.300	64.00

R	w_{tf}	w_{bf}
in.	in.	in.
0.125	2.688	6.850

Acoustic Profiles

3.5DA



Gage	t in.	w_{dd} psf	A_g in^2/ft	A_n in^2/ft	I_{xg} in^4/ft	S_{xb} in^3/ft	S_{xt} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.
20	0.0358	3.1	0.955	0.899	1.639	1.035	0.840	1.584	1.952	1.350	3.293	71.6
19	0.0418	3.6	1.116	1.050	1.915	1.206	0.980	1.588	1.954	1.350	3.286	71.4
18	0.0474	4.1	1.266	1.192	2.174	1.366	1.111	1.591	1.956	1.350	3.280	71.3
16	0.0598	5.1	1.600	1.506	2.748	1.720	1.401	1.598	1.962	1.351	3.267	71.0

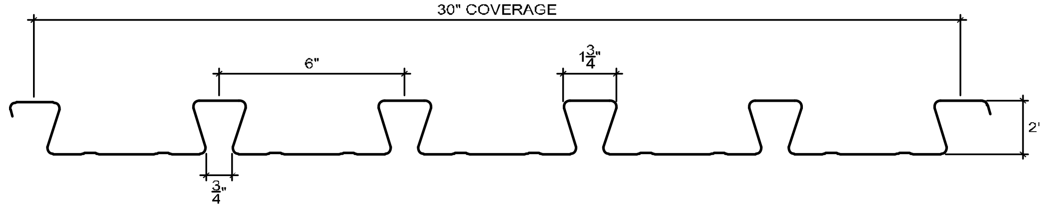
Gage	GRADE 40: F_y = 40 ksi, F_u = 55 ksi											
	I_{e+} in^4/ft	I_{e-} in^4/ft	I_{d+} in^4/ft	I_{d-} in^4/ft	S_{e+} in^3/ft	S_{e-} in^3/ft	M_{n+} k-ft/ft	M_{n-} k-ft/ft	M_{nxt+} k-ft/ft	M_{nxt-} k-ft/ft	V_n k/ft	T_n k/ft
20	1.477	1.325	1.531	1.430	0.655	0.657	2.183	2.190	3.450	2.800	5.496	35.96
19	1.775	1.587	1.822	1.696	0.797	0.794	2.657	2.647	4.020	3.267	7.484	42.00
18	2.060	1.838	2.098	1.950	0.934	0.928	3.113	3.093	4.553	3.703	9.619	47.68
16	2.704	2.425	2.719	2.533	1.255	1.241	4.183	4.137	5.733	4.670	13.300	60.24

R in.	w_{tf} in.	w_{bf} in.
0.125	2.688	6.850

d_p in.	c_p in.	E_p in.
0.156	0.375	6.344

Non-Composite Profiles
2.0DS-30

Composite Profiles
2.0DS-30 FL



Gage	t in.	w_{dd} psf	A_g in²/ft	I_{xg} in⁴/ft	S_{xb} in³/ft	S_{xt} in³/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.	K_{min} -
22	0.0299	2.2	0.661	0.433	0.584	0.336	0.742	1.288	0.809	1.542	75.6	0.00
21	0.0329	2.5	0.728	0.477	0.641	0.370	0.743	1.289	0.809	1.538	75.5	0.00
20	0.0359	2.7	0.795	0.520	0.698	0.403	0.745	1.291	0.809	1.534	75.3	0.00
19	0.0418	3.2	0.926	0.607	0.811	0.469	0.748	1.293	0.809	1.526	75.1	0.00
18	0.0478	3.6	1.061	0.695	0.924	0.536	0.752	1.296	0.809	1.518	74.8	0.00
17	0.0538	4.1	1.195	0.783	1.037	0.603	0.755	1.299	0.809	1.510	74.5	0.00
16	0.0598	4.5	1.330	0.872	1.149	0.670	0.759	1.301	0.810	1.502	74.2	0.00

Gage	GRADE 50: F_y = 50 ksi, F_u = 65 ksi											
	I_{e+} in⁴/ft	I_{e-} in⁴/ft	I_{d+} in⁴/ft	I_{d-} in⁴/ft	S_{e+} in³/ft	S_{e-} in³/ft	M_{n+} k-ft/ft	M_{n-} k-ft/ft	M_{nxt+} k-ft/ft	M_{nxt-} k-ft/ft	V_n k/ft	T_n k/ft
22	0.429	0.357	0.430	0.382	0.301	0.306	1.255	1.273	2.431	1.400	5.335	33.06
21	0.475	0.403	0.476	0.427	0.339	0.339	1.413	1.413	2.671	1.540	5.852	36.40
20	0.520	0.450	0.520	0.473	0.378	0.373	1.574	1.553	2.910	1.680	6.365	39.74
19	0.607	0.545	0.607	0.565	0.454	0.440	1.893	1.832	3.378	1.955	7.364	46.32
18	0.695	0.644	0.695	0.661	0.527	0.509	2.197	2.119	3.850	2.234	8.367	53.03
17	0.783	0.746	0.783	0.758	0.598	0.578	2.493	2.409	4.320	2.512	9.354	59.75
16	0.872	0.849	0.872	0.856	0.667	0.648	2.779	2.700	4.787	2.791	10.328	66.49

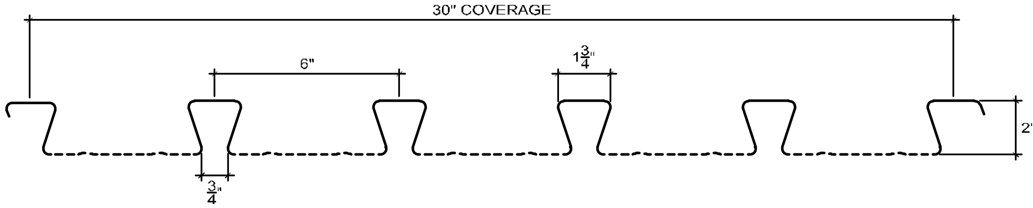
Gage	A_{gbf} in²	A_{sbf} in²	I_{spbf} in⁴
22	0.142	0.019	3.99E-05
21	0.156	0.021	4.43E-05
20	0.170	0.023	4.88E-05
19	0.198	0.027	5.80E-05
18	0.227	0.031	6.78E-05
17	0.255	0.035	7.83E-05
16	0.284	0.039	8.95E-05

R in.	w_{tf} in.	w_{bf} in.
0.188	1.275	4.704

b_{obf} in.	b_{pbf} in.	c_{sbf} in.
4.704	1.500	1.290

Acoustic Profiles

2.0DS-30 AC



Gage	t in.	w_{dd} psf	A_g in^2/ft	A_n in^2/ft	I_{xg} in^4/ft	S_{xb} in^3/ft	S_{xt} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.
22	0.0299	2.1	0.661	0.616	0.405	0.510	0.327	0.794	1.236	0.810	1.542	75.6
21	0.0329	2.3	0.728	0.679	0.446	0.560	0.360	0.795	1.238	0.810	1.538	75.5
20	0.0359	2.5	0.795	0.741	0.487	0.610	0.393	0.797	1.239	0.810	1.534	75.3
19	0.0418	2.9	0.926	0.864	0.567	0.709	0.457	0.800	1.241	0.810	1.526	75.1
18	0.0478	3.4	1.061	0.989	0.650	0.808	0.522	0.804	1.244	0.810	1.518	74.8
17	0.0538	3.8	1.195	1.115	0.732	0.907	0.587	0.807	1.247	0.810	1.510	74.5
16	0.0598	4.3	1.330	1.250	0.822	1.022	0.655	0.805	1.255	0.811	1.502	74.2

Gage	GRADE 50: F_y = 50 ksi, F_u = 65 ksi											
	I_{e+} in^4/ft	I_{e-} in^4/ft	I_{d+} in^4/ft	I_{d-} in^4/ft	S_{e+} in^3/ft	S_{e-} in^3/ft	M_{n+} k-ft/ft	M_{n-} k-ft/ft	M_{nxt+} k-ft/ft	M_{nxt-} k-ft/ft	V_n k/ft	T_n k/ft
22	0.352	0.295	0.370	0.331	0.281	0.252	1.170	1.050	2.124	1.364	5.335	30.82
21	0.390	0.338	0.408	0.374	0.316	0.294	1.318	1.223	2.334	1.500	5.852	33.94
20	0.426	0.383	0.446	0.417	0.352	0.337	1.465	1.405	2.544	1.636	6.365	37.05
19	0.497	0.476	0.520	0.506	0.415	0.412	1.728	1.717	2.953	1.904	7.364	43.19
18	0.569	0.575	0.596	0.600	0.481	0.482	2.006	2.010	3.368	2.175	8.367	49.46
17	0.641	0.676	0.671	0.695	0.543	0.553	2.263	2.304	3.780	2.447	9.354	55.73
16	0.737	0.778	0.765	0.793	0.617	0.624	2.572	2.600	4.257	2.728	10.328	62.50

Gage	A_{gbf} in^2	A_{sbf} in^2	I_{spbf} in^4
22	0.142	0.019	3.99E-05
21	0.156	0.021	4.43E-05
20	0.170	0.023	4.88E-05
19	0.198	0.027	5.80E-05
18	0.227	0.031	6.78E-05
17	0.255	0.035	7.83E-05
16	0.284	0.039	8.95E-05

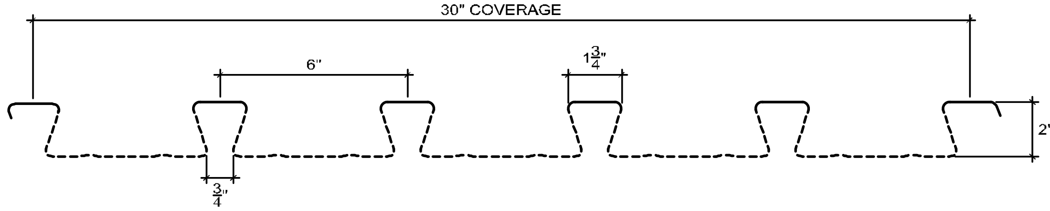
R in.	w_{tf} in.	w_{bf} in.
0.188	1.275	4.704

b_{obf} in.	b_{pbf} in.	c_{sbf} in.
4.704	1.500	1.290

d_p in.	c_p in.
0.156	0.375

Acoustic Profiles

2.0DS-30 ACW



Gage	t in.	w_{dd} psf	A_g in^2/ft	A_n in^2/ft	I_{xg} in^4/ft	S_{xb} in^3/ft	S_{xt} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.
22	0.0299	2.0	0.661	0.580	0.395	0.499	0.319	0.791	1.239	0.825	1.542	75.6
21	0.0329	2.1	0.728	0.628	0.426	0.541	0.343	0.789	1.244	0.824	1.538	75.5
20	0.0359	2.4	0.795	0.698	0.475	0.598	0.382	0.794	1.242	0.825	1.534	75.3
19	0.0418	2.8	0.926	0.814	0.554	0.694	0.445	0.798	1.244	0.825	1.526	75.1
18	0.0478	3.2	1.061	0.932	0.634	0.791	0.509	0.801	1.246	0.825	1.518	74.8
17	0.0538	3.6	1.195	1.050	0.715	0.888	0.572	0.805	1.249	0.825	1.510	74.5
16	0.0598	4.0	1.330	1.169	0.796	0.984	0.636	0.809	1.251	0.825	1.502	74.2

Gage	GRADE 50: F_y = 50 ksi, F_u = 65 ksi											
	I_{e+} in^4/ft	I_{e-} in^4/ft	I_{d+} in^4/ft	I_{d-} in^4/ft	S_{e+} in^3/ft	S_{e-} in^3/ft	M_{n+} k-ft/ft	M_{n-} k-ft/ft	M_{nxt+} k-ft/ft	M_{nxt-} k-ft/ft	V_n k/ft	T_n k/ft
22	0.330	0.266	0.352	0.309	0.268	0.213	1.116	0.889	2.080	1.328	3.508	29.02
21	0.348	0.296	0.374	0.340	0.286	0.241	1.193	1.004	2.253	1.428	3.848	31.41
20	0.398	0.358	0.423	0.397	0.331	0.301	1.380	1.253	2.491	1.594	4.185	34.90
19	0.464	0.446	0.494	0.482	0.391	0.385	1.630	1.602	2.891	1.854	4.842	40.68
18	0.531	0.543	0.565	0.573	0.452	0.453	1.885	1.889	3.297	2.120	5.501	46.59
17	0.598	0.642	0.637	0.666	0.511	0.522	2.128	2.175	3.699	2.385	6.151	52.50
16	0.666	0.741	0.709	0.759	0.568	0.591	2.369	2.461	4.100	2.649	6.791	58.44

Gage	A_{gbf} in^2	A_{sbf} in^2	I_{spbf} in^4
22	0.142	0.019	3.99E-05
21	0.156	0.021	4.43E-05
20	0.170	0.023	4.88E-05
19	0.198	0.027	5.80E-05
18	0.227	0.031	6.78E-05
17	0.255	0.035	7.83E-05
16	0.284	0.039	8.95E-05

R in.	w_{tf} in.	w_{bf} in.
0.188	1.275	4.704

b_{obf} in.	b_{pbf} in.	c_{sbf} in.
4.704	1.500	1.290

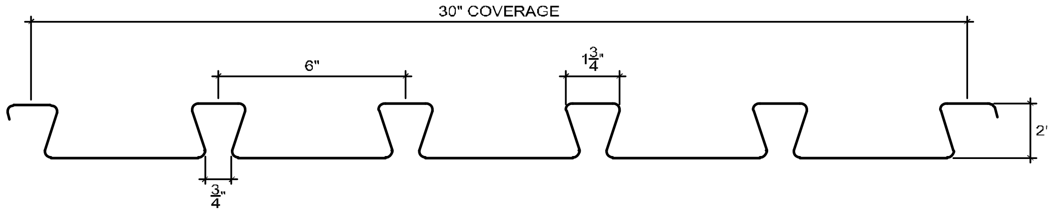
d_p in.	c_p in.
0.156	0.375

Non-Composite Profiles

2.0DF-30

Composite Profiles

2.0DF-30 FL



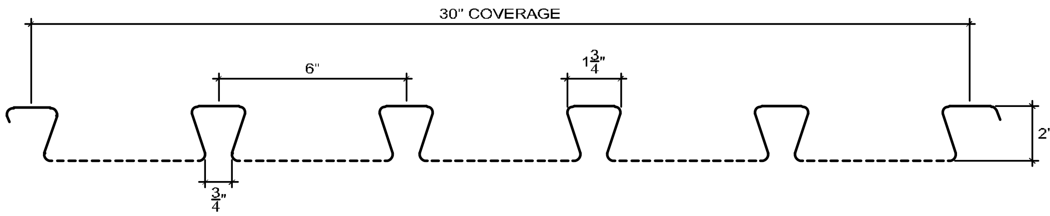
Gage	t in.	w_{dd} psf	A_g in^2/ft	I_{xg} in^4/ft	S_{xb} in^3/ft	S_{xt} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.	K_{min} -
22	0.0299	2.2	0.659	0.436	0.589	0.338	0.740	1.290	0.813	1.542	75.6	0.00
21	0.0329	2.5	0.725	0.480	0.647	0.372	0.742	1.291	0.813	1.538	75.5	0.00
20	0.0359	2.7	0.792	0.524	0.705	0.405	0.743	1.293	0.813	1.534	75.3	0.00
19	0.0418	3.1	0.923	0.611	0.818	0.472	0.747	1.295	0.813	1.526	75.1	0.00
18	0.0478	3.6	1.057	0.699	0.932	0.539	0.750	1.298	0.814	1.518	74.8	0.00
17	0.0538	4.1	1.191	0.788	1.046	0.606	0.754	1.300	0.814	1.510	74.5	0.00
16	0.0598	4.5	1.325	0.877	1.159	0.673	0.757	1.303	0.814	1.502	74.2	0.00

Gage	GRADE 50: F_y = 50 ksi, F_u = 65 ksi											
	I_{e+} in^4/ft	I_{e-} in^4/ft	I_{d+} in^4/ft	I_{d-} in^4/ft	S_{e+} in^3/ft	S_{e-} in^3/ft	M_{n+} k-ft/ft	M_{n-} k-ft/ft	M_{nxt+} k-ft/ft	M_{nxt-} k-ft/ft	V_n k/ft	T_n k/ft
22	0.432	0.347	0.433	0.377	0.303	0.264	1.262	1.100	2.454	1.407	5.335	32.94
21	0.478	0.393	0.479	0.422	0.341	0.303	1.421	1.263	2.695	1.548	5.852	36.26
20	0.523	0.441	0.524	0.468	0.380	0.344	1.582	1.434	2.936	1.689	6.365	39.59
19	0.611	0.537	0.611	0.562	0.457	0.422	1.902	1.758	3.408	1.965	7.364	46.15
18	0.699	0.640	0.699	0.660	0.530	0.491	2.208	2.046	3.884	2.245	8.367	52.83
17	0.788	0.743	0.788	0.758	0.601	0.561	2.506	2.337	4.358	2.525	9.354	59.53
16	0.877	0.846	0.877	0.857	0.670	0.632	2.793	2.632	4.829	2.805	10.328	66.24

R in.	w_{tf} in.	w_{bf} in.
0.188	1.275	4.704

Acoustic Profiles

2.0DF-30 AC



Gage	t in.	w_{dd} psf	A_g in^2/ft	A_n in^2/ft	I_{xg} in^4/ft	S_{xb} in^3/ft	S_{xt} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.
22	0.0299	2.1	0.659	0.614	0.407	0.514	0.329	0.792	1.238	0.814	1.542	75.6
21	0.0329	2.3	0.725	0.676	0.448	0.565	0.362	0.794	1.239	0.814	1.538	75.5
20	0.0359	2.5	0.792	0.739	0.490	0.615	0.395	0.796	1.240	0.814	1.534	75.3
19	0.0418	2.9	0.923	0.861	0.571	0.714	0.459	0.799	1.243	0.814	1.526	75.1
18	0.0478	3.4	1.057	0.986	0.654	0.815	0.525	0.802	1.246	0.814	1.518	74.8
17	0.0538	3.8	1.191	1.111	0.737	0.914	0.590	0.806	1.248	0.814	1.510	74.5
16	0.0598	4.2	1.325	1.236	0.820	1.013	0.655	0.809	1.251	0.814	1.502	74.2

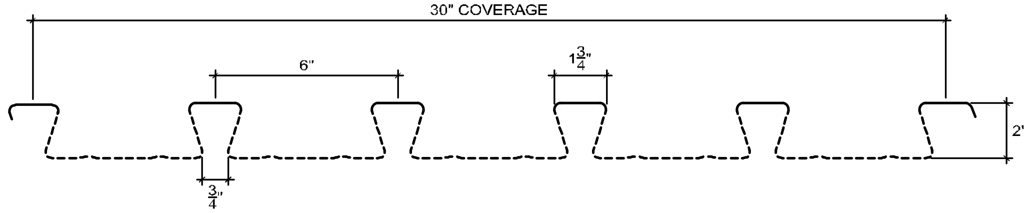
Gage	GRADE 50: F_y = 50 ksi, F_u = 65 ksi											
	I_{e+} in^4/ft	I_{e-} in^4/ft	I_{d+} in^4/ft	I_{d-} in^4/ft	S_{e+} in^3/ft	S_{e-} in^3/ft	M_{n+} k-ft/ft	M_{n-} k-ft/ft	M_{nxt+} k-ft/ft	M_{nxt-} k-ft/ft	V_n k/ft	T_n k/ft
22	0.354	0.317	0.372	0.347	0.282	0.235	1.175	0.979	2.142	1.371	5.335	30.72
21	0.392	0.359	0.411	0.389	0.318	0.269	1.324	1.122	2.353	1.508	5.852	33.82
20	0.428	0.401	0.449	0.431	0.353	0.306	1.471	1.275	2.564	1.644	6.365	36.93
19	0.499	0.486	0.523	0.514	0.417	0.384	1.736	1.601	2.977	1.913	7.364	43.05
18	0.572	0.573	0.599	0.600	0.483	0.469	2.014	1.953	3.394	2.186	8.367	49.29
17	0.644	0.663	0.675	0.688	0.546	0.540	2.273	2.252	3.809	2.459	9.354	55.54
16	0.717	0.751	0.752	0.774	0.608	0.614	2.534	2.559	4.222	2.731	10.328	61.81

R in.	w_{tf} in.	w_{bf} in.
0.188	1.275	4.704

d_p in.	c_p in.
0.156	0.375

Acoustic Profiles

2.0DF-30 ACW



Gage	t in.	w_{dd} psf	A_g in^2/ft	A_n in^2/ft	I_{xg} in^4/ft	S_{xb} in^3/ft	S_{xt} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.
22	0.0299	2.0	0.659	0.578	0.397	0.503	0.320	0.789	1.241	0.829	1.542	75.6
21	0.0329	2.2	0.725	0.637	0.438	0.553	0.352	0.791	1.242	0.829	1.538	75.5
20	0.0359	2.4	0.792	0.695	0.478	0.603	0.384	0.793	1.243	0.829	1.534	75.3
19	0.0418	2.8	0.923	0.811	0.557	0.700	0.447	0.796	1.245	0.829	1.526	75.1
18	0.0478	3.2	1.057	0.928	0.638	0.798	0.511	0.800	1.248	0.829	1.518	74.8
17	0.0538	3.6	1.191	1.046	0.719	0.895	0.575	0.804	1.250	0.829	1.510	74.5
16	0.0598	4.0	1.325	1.164	0.800	0.992	0.639	0.807	1.253	0.829	1.502	74.2

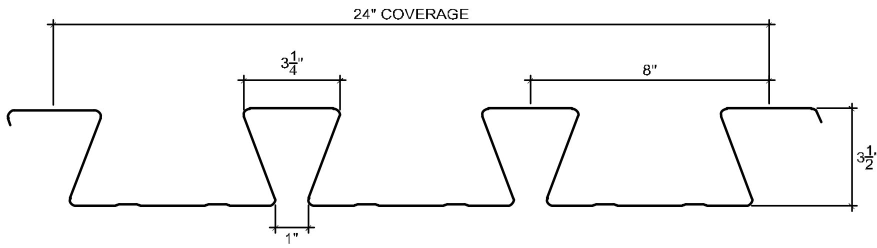
Gage	GRADE 50: F_y = 50 ksi, F_u = 65 ksi											
	I_{e+} in^4/ft	I_{e-} in^4/ft	I_{d+} in^4/ft	I_{d-} in^4/ft	S_{e+} in^3/ft	S_{e-} in^3/ft	M_{n+} k-ft/ft	M_{n-} k-ft/ft	M_{nxt+} k-ft/ft	M_{nxt-} k-ft/ft	V_n k/ft	T_n k/ft
22	0.332	0.296	0.354	0.330	0.269	0.211	1.121	0.880	2.098	1.335	3.508	28.92
21	0.366	0.336	0.390	0.370	0.302	0.245	1.258	1.022	2.305	1.468	3.848	31.84
20	0.400	0.376	0.426	0.410	0.333	0.281	1.386	1.172	2.511	1.602	4.185	34.77
19	0.466	0.457	0.497	0.490	0.393	0.358	1.638	1.491	2.915	1.864	4.842	40.54
18	0.534	0.540	0.569	0.573	0.454	0.443	1.894	1.847	3.323	2.130	5.501	46.42
17	0.602	0.625	0.641	0.657	0.513	0.514	2.139	2.142	3.729	2.397	6.151	52.31
16	0.670	0.709	0.713	0.739	0.571	0.586	2.380	2.440	4.133	2.663	6.791	58.22

R in.	w_{tf} in.	w_{bf} in.
0.188	1.275	4.704

d_p in.	c_p in.
0.156	0.375

Non-Composite Profiles
3.5DS-24

Composite Profiles
3.5DS-24 FL



Gage	t in.	w_{dd} psf	A_g in^2/ft	I_{xg} in^4/ft	S_{xb} in^3/ft	S_{xt} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.	K_{min} -
20	0.0359	3.4	0.991	2.126	1.386	1.062	1.534	2.002	1.465	3.124	71.1	0.00
19	0.0418	3.9	1.154	2.477	1.611	1.236	1.537	2.004	1.465	3.117	70.9	0.00
18	0.0478	4.5	1.321	2.835	1.840	1.412	1.541	2.007	1.465	3.110	70.8	0.00
17	0.0538	5.1	1.488	3.193	2.068	1.589	1.544	2.010	1.465	3.103	70.6	0.00
16	0.0598	5.6	1.656	3.552	2.296	1.765	1.548	2.012	1.465	3.097	70.5	0.00

Gage	GRADE 50: F_y = 50 ksi, F_u = 65 ksi											
	I_{e+} in^4/ft	I_{e-} in^4/ft	I_{d+} in^4/ft	I_{d-} in^4/ft	S_{e+} in^3/ft	S_{e-} in^3/ft	M_{n+} k-ft/ft	M_{n-} k-ft/ft	M_{nxt+} k-ft/ft	M_{nxt-} k-ft/ft	V_n k/ft	T_n k/ft
20	1.863	1.644	1.951	1.805	0.714	0.757	2.975	3.155	5.774	4.424	6.006	49.54
19	2.227	1.982	2.310	2.147	0.883	0.926	3.680	3.857	6.713	5.149	8.344	57.72
18	2.605	2.339	2.681	2.505	1.052	1.108	4.385	4.618	7.666	5.885	10.901	66.06
17	2.982	2.708	3.053	2.870	1.230	1.302	5.123	5.424	8.617	6.621	13.797	74.42
16	3.356	3.088	3.421	3.243	1.414	1.505	5.890	6.273	9.565	7.356	15.650	82.78

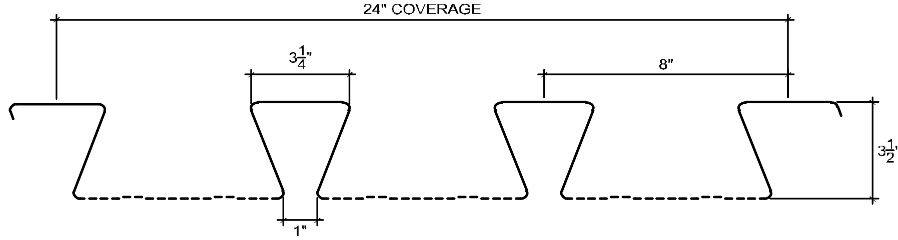
Gage	A_{gbf} in^2	A_{sbf} in^2	I_{spbf} in^4
20	0.233	0.028	6.54E-05
19	0.272	0.032	7.75E-05
18	0.311	0.037	9.05E-05
17	0.350	0.042	1.04E-04
16	0.389	0.046	1.19E-04

R in.	w_{tf} in.	w_{bf} in.
0.188	2.795	6.454

b_{obf} in.	b_{pbf} in.	c_{sbf} in.
6.454	1.750	1.977

Acoustic Profiles

3.5DS-24 AC



Gage	t in.	w_{dd} psf	A_g in^2/ft	A_n in^2/ft	I_{xg} in^4/ft	S_{xb} in^3/ft	S_{xt} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.
20	0.0359	3.2	0.991	0.936	1.978	1.219	1.034	1.623	1.913	1.454	3.124	71.1
19	0.0418	3.7	1.154	1.090	2.305	1.417	1.203	1.626	1.916	1.454	3.117	70.9
18	0.0478	4.2	1.321	1.248	2.638	1.619	1.375	1.629	1.918	1.454	3.110	70.8
17	0.0538	4.8	1.488	1.406	2.971	1.820	1.547	1.633	1.921	1.454	3.103	70.6
16	0.0598	5.3	1.656	1.564	3.306	2.021	1.718	1.636	1.924	1.454	3.097	70.5

Gage	GRADE 50: F_y = 50 ksi, F_u = 65 ksi											
	I_{e+} in^4/ft	I_{e-} in^4/ft	I_{d+} in^4/ft	I_{d-} in^4/ft	S_{e+} in^3/ft	S_{e-} in^3/ft	M_{n+} k-ft/ft	M_{n-} k-ft/ft	M_{nxt+} k-ft/ft	M_{nxt-} k-ft/ft	V_n k/ft	T_n k/ft
20	1.541	1.480	1.687	1.646	0.674	0.665	2.809	2.771	5.078	4.307	6.006	46.78
19	1.842	1.811	1.996	1.975	0.823	0.825	3.427	3.437	5.906	5.013	8.344	54.52
18	2.150	2.163	2.313	2.321	0.982	0.999	4.091	4.162	6.746	5.729	10.901	62.40
17	2.457	2.530	2.628	2.677	1.149	1.184	4.787	4.934	7.583	6.445	13.797	70.29
16	2.760	2.907	2.942	3.040	1.322	1.380	5.510	5.750	8.419	7.160	15.650	78.19

Gage	A_{gbf} in^2	A_{sbf} in^2	I_{spbf} in^4
20	0.233	0.028	6.54E-05
19	0.272	0.032	7.75E-05
18	0.311	0.037	9.05E-05
17	0.350	0.042	1.04E-04
16	0.389	0.046	1.19E-04

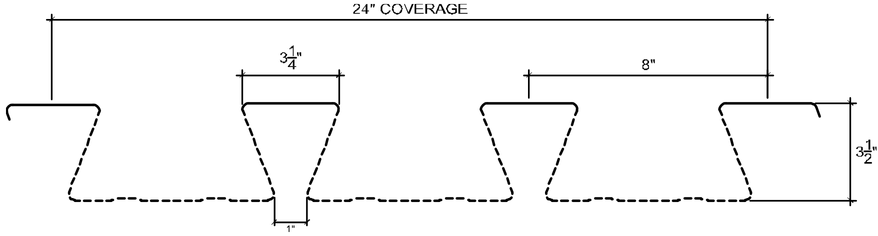
R in.	w_{tf} in.	w_{bf} in.
0.188	2.795	6.454

b_{obf} in.	b_{pbf} in.	c_{sbf} in.
6.454	1.750	1.977

d_p in.	c_p in.
0.156	0.375

Acoustic Profiles

3.5DS-24 ACW



Gage	t in.	w_{dd} psf	A_g in^2/ft	A_n in^2/ft	I_{xg} in^4/ft	S_{xb} in^3/ft	S_{xt} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.
20	0.0359	3.0	0.991	0.876	1.922	1.183	1.006	1.625	1.911	1.481	3.124	71.1
19	0.0418	3.5	1.154	1.021	2.240	1.375	1.171	1.629	1.913	1.481	3.117	70.9
18	0.0478	4.0	1.321	1.169	2.564	1.571	1.338	1.632	1.915	1.481	3.110	70.8
17	0.0538	4.5	1.488	1.316	2.888	1.766	1.506	1.636	1.918	1.481	3.103	70.6
16	0.0598	5.0	1.656	1.465	3.213	1.960	1.673	1.639	1.920	1.481	3.097	70.5

Gage	GRADE 50: F_y = 50 ksi, F_u = 65 ksi											
	I_{e+} in^4/ft	I_{e-} in^4/ft	I_{d+} in^4/ft	I_{d-} in^4/ft	S_{e+} in^3/ft	S_{e-} in^3/ft	M_{n+} k-ft/ft	M_{n-} k-ft/ft	M_{nxt+} k-ft/ft	M_{nxt-} k-ft/ft	V_n k/ft	T_n k/ft
20	1.431	1.347	1.595	1.539	0.632	0.570	2.634	2.376	4.927	4.192	3.950	43.80
19	1.707	1.680	1.885	1.867	0.774	0.727	3.225	3.027	5.730	4.879	5.486	51.05
18	1.988	2.015	2.180	2.198	0.927	0.885	3.861	3.689	6.544	5.577	7.168	58.43
17	2.267	2.371	2.474	2.543	1.087	1.062	4.528	4.424	7.356	6.275	9.072	65.82
16	2.542	2.736	2.766	2.895	1.253	1.249	5.222	5.204	8.166	6.972	10.291	73.23

Gage	A_{gbf} in^2	A_{sbf} in^2	I_{spbf} in^4
20	0.233	0.028	6.54E-05
19	0.272	0.032	7.75E-05
18	0.311	0.037	9.05E-05
17	0.350	0.042	1.04E-04
16	0.389	0.046	1.19E-04

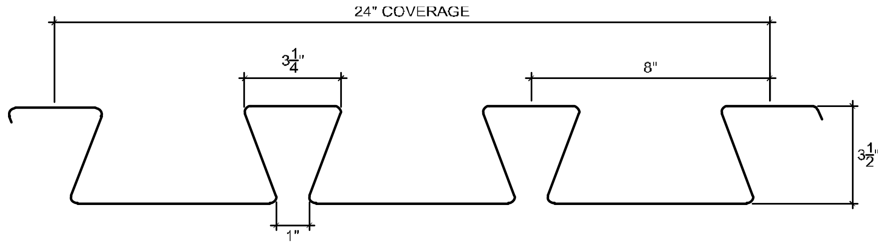
R in.	w_{tf} in.	w_{bf} in.
0.188	2.795	6.454

b_{obf} in.	b_{pbf} in.	c_{sbf} in.
6.454	1.750	1.977

d_p in.	c_p in.
0.156	0.375

Non-Composite Profiles
3.5DF-24

Composite Profiles
3.5DF-24 FL



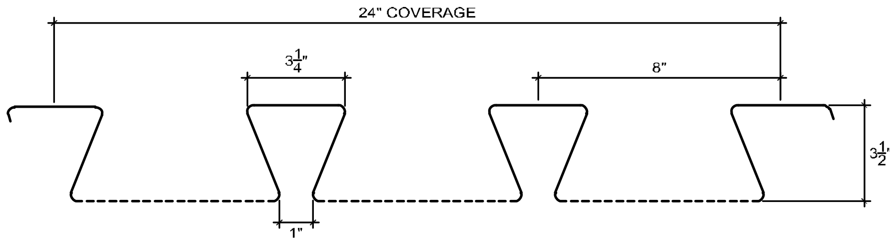
Gage	t in.	w_{dd} psf	A_g in^2/ft	I_{xg} in^4/ft	S_{xb} in^3/ft	S_{xt} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.	K_{min} -
20	0.0359	3.4	0.989	2.131	1.389	1.064	1.534	2.002	1.468	3.124	71.1	0.00
19	0.0418	3.9	1.152	2.483	1.615	1.239	1.537	2.005	1.468	3.117	70.9	0.00
18	0.0478	4.5	1.318	2.842	1.845	1.416	1.541	2.007	1.468	3.110	70.8	0.00
17	0.0538	5.1	1.485	3.201	2.073	1.593	1.544	2.010	1.468	3.103	70.6	0.00
16	0.0598	5.6	1.652	3.561	2.301	1.770	1.548	2.012	1.468	3.097	70.5	0.00

Gage	GRADE 50: F_y = 50 ksi, F_u = 65 ksi											
	I_{e+} in^4/ft	I_{e-} in^4/ft	I_{d+} in^4/ft	I_{d-} in^4/ft	S_{e+} in^3/ft	S_{e-} in^3/ft	M_{n+} k-ft/ft	M_{n-} k-ft/ft	M_{nxt+} k-ft/ft	M_{nxt-} k-ft/ft	V_n k/ft	T_n k/ft
20	1.868	1.594	1.956	1.773	0.716	0.628	2.982	2.615	5.789	4.435	6.006	49.43
19	2.233	1.948	2.316	2.126	0.886	0.774	3.690	3.227	6.730	5.162	8.344	57.59
18	2.612	2.323	2.688	2.496	1.055	0.935	4.397	3.897	7.686	5.900	10.901	65.91
17	2.990	2.709	3.060	2.873	1.233	1.107	5.136	4.612	8.638	6.637	13.797	74.25
16	3.364	3.104	3.430	3.256	1.417	1.289	5.905	5.372	9.588	7.374	15.650	82.59

R in.	w_{tf} in.	w_{bf} in.
0.188	2.795	6.454

Acoustic Profiles

3.5DF-24 AC



Gage	t in.	w_{dd} psf	A_g in^2/ft	A_n in^2/ft	I_{xg} in^4/ft	S_{xb} in^3/ft	S_{xt} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.
20	0.0359	3.2	0.989	0.934	1.982	1.222	1.036	1.623	1.913	1.457	3.124	71.1
19	0.0418	3.7	1.152	1.088	2.310	1.421	1.206	1.626	1.916	1.457	3.117	70.9
18	0.0478	4.2	1.318	1.245	2.644	1.622	1.378	1.629	1.918	1.457	3.110	70.8
17	0.0538	4.8	1.485	1.403	2.978	1.824	1.550	1.633	1.921	1.457	3.103	70.6
16	0.0598	5.3	1.652	1.561	3.313	2.025	1.722	1.636	1.924	1.457	3.097	70.5

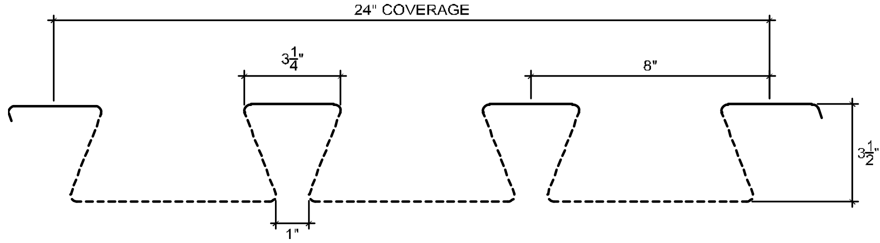
Gage	GRADE 50: F_y = 50 ksi, F_u = 65 ksi											
	I_{e+} in^4/ft	I_{e-} in^4/ft	I_{d+} in^4/ft	I_{d-} in^4/ft	S_{e+} in^3/ft	S_{e-} in^3/ft	M_{n+} k-ft/ft	M_{n-} k-ft/ft	M_{nxt+} k-ft/ft	M_{nxt-} k-ft/ft	V_n k/ft	T_n k/ft
20	1.545	1.446	1.690	1.624	0.676	0.565	2.816	2.354	5.090	4.317	6.006	46.69
19	1.846	1.755	2.001	1.940	0.825	0.694	3.436	2.890	5.919	5.024	8.344	54.41
18	2.155	2.080	2.318	2.268	0.984	0.834	4.101	3.476	6.760	5.742	10.901	62.27
17	2.461	2.420	2.634	2.606	1.151	0.985	4.798	4.102	7.599	6.459	13.797	70.15
16	2.765	2.764	2.948	2.947	1.325	1.144	5.523	4.768	8.437	7.176	15.650	78.04

R in.	w_{tf} in.	w_{bf} in.
0.188	2.795	6.454

d_p in.	c_p in.
0.156	0.375

Acoustic Profiles

3.5DF-24 ACW



Gage	t in.	w_{dd} psf	A_g in^2/ft	A_n in^2/ft	I_{xg} in^4/ft	S_{xb} in^3/ft	S_{xt} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.
20	0.0359	3.0	0.989	0.874	1.927	1.185	1.008	1.625	1.911	1.485	3.124	71.1
19	0.0418	3.5	1.152	1.019	2.245	1.378	1.174	1.629	1.913	1.485	3.117	70.9
18	0.0478	4.0	1.318	1.166	2.570	1.574	1.342	1.632	1.915	1.484	3.110	70.8
17	0.0538	4.4	1.485	1.303	2.864	1.738	1.503	1.648	1.906	1.482	3.103	70.6
16	0.0598	5.0	1.652	1.461	3.220	1.964	1.677	1.640	1.920	1.484	3.097	70.5

Gage	GRADE 50: F_y = 50 ksi, F_u = 65 ksi											
	I_{e+} in^4/ft	I_{e-} in^4/ft	I_{d+} in^4/ft	I_{d-} in^4/ft	S_{e+} in^3/ft	S_{e-} in^3/ft	M_{n+} k-ft/ft	M_{n-} k-ft/ft	M_{nxt+} k-ft/ft	M_{nxt-} k-ft/ft	V_n k/ft	T_n k/ft
20	1.435	1.305	1.599	1.512	0.634	0.485	2.641	2.022	4.939	4.202	3.950	43.71
19	1.711	1.596	1.889	1.812	0.776	0.607	3.233	2.527	5.743	4.890	5.486	50.94
18	1.992	1.905	2.185	2.127	0.929	0.741	3.871	3.086	6.559	5.590	7.168	58.30
17	2.171	2.132	2.402	2.376	1.070	0.845	4.457	3.523	7.242	6.262	9.072	65.17
16	2.548	2.549	2.772	2.773	1.256	1.040	5.234	4.332	8.184	6.988	10.291	73.07

R in.	w_{tf} in.	w_{bf} in.
0.188	2.795	6.454

d_p in.	c_p in.
0.156	0.375