NUCOR CORPORATION - VULCRAFT/VERCO GROUP

VULCRAFT GROUP
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STEEL DECK PANELS

CSI DIVISION: 05 00 00 – METALS
CSI SECTION: 05 31 00 – STEEL DECK
05 31 13 – STEEL FLOOR DECKING
05 31 23 – STEEL ROOF DECKING

1.0 RECOGNITION

Vulcraft steel deck recognized in this report has 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 characteristic and structural performance properties comply with the intent of the provisions of the following codes and regulations:

- 2018, 2015 and 2012 International Building Code® (IBC)
- 2018, 2015 and 2012 International Residential Code® (IRC)

2.0 LIMITATIONS

Use of the steel deck 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 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 The steel panels recognized in this report are produced by Vulcraft in Fort Payne, Alabama.

3.0 PRODUCT USE

3.1 General:

It is permissible to use steel deck panels to resist out-of-plane loads, in plane diaphragm shear loads, and axial loads.

3.2 Design:

3.2.1 Out-of-Plane Strength: Out-of-plane strength of deck panels shall be determined using engineering mechanics and deck panel properties presented in this report.

Deflections resulting from out-of-plane load 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-2017 using properties and composite coefficients in this report. In accordance with ACI 318-14 26.4.1.4.1(c) or ACI 318-11 3.6.4, calcium chloride or admixtures containing chloride from sources other than impurities in admixture ingredients are prohibited from use in concrete cast against stay-in-place galvanized steel deck.

3.2.3 Reactions: The strength of steel deck panels to resist reaction loads at supports and locations of concentrated loads shall be determined based on the either web crippling strength or web shear strength. Web crippling strength shall be determined in accordance with AISI S100-16 Section G5 and the properties in this report. Deck panel web shear strength of deck panel webs shall be determined in accordance with AISI S100-16 Section G2.1 and the properties in this report. The strength of web-perforated deck panels shall be determined in accordance with the equations in this report.

3.2.4 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.

3.2.5 Axial Strength: The axial strength or combined axial and bending strength of steel deck panels shall be determined in accordance with AISI S100-16 using the properties in this report.

3.2.6 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 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.

3.2.7 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.

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

3.2.9 Connections:

3.2.9.1 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.

3.2.9.2 Power Actuated Fasteners (PAF's): Power actuated fasteners 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.

3.2.9.3 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 S100-16 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.

3.2.9.4 Non-Piercing Button Punch: Non-piercing button punch may be used to attach the sidelaps of steel deck panels to each other in accordance with AISI S310-16.

3.2.9.5 PunchLok® II System: The PunchLok II system consists of PunchLok deck described in this report connected at sidelaps with the Vulcraft/Verco Group proprietary connection. Acoustical versions of the listed deck sections may also be used. The proprietary connection is referred to as the "Vulcraft/Verco Sidelap Connection 2" (VSC2), and is an interlocking connection between the male and female lips of the appropriate deck. A VSC2 connection is made in either direction relative to the female lip. A VSC2 connection is made when the sidelap material has been sheared and offset so the sheared surface of the steel deck panel male lip is visible. This punched portion measures 0.45 inch (11.4 mm) – 0.70 inch (17.8 mm) nominal width by 0.30 inch (7.6 mm) nominal height. The PunchLok II system shall be installed in accordance with Vulcraft/Verco Group instructions. The resulting VSC2 connection is illustrated on page 8 of this report.

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-2017, ANSI/SDI NC-2017 and ANSI/SDI C-2017 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 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).

3.4.2 Jobsite Welding: Periodic special inspection for welding shall be in accordance with IBC Section Chapter 17. 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 Periodic Special Inspection: Periodic special inspections for weld, screw and power-actuated fastener connections are required where the steel deck systems are used in a seismic-force-resisting system in structures assigned to Seismic Design Category C, D, E or F; or a wind-force resisting system in areas described in IBC Chapter 17.

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 having galvanized, phosphatized/painted, painted/painted, or mill finishes. Panel characteristics including profile designation, sidelap type, applicable sidelap fasteners and perforation 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. The phosphatized/painted, painted/painted, or mill finished steel deck panels are formed from either ASTM A1008 or A1039 steel. Phosphatized/painted deck panels have a phosphatized (uncoated) top surface and primer painted bottom surface.

Painted/painted deck panels have primer painted top and bottom surfaces. Mill-finished deck panels have no coating on either top or bottom surfaces.

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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. In accordance with ACI 318-14 26.4.1.4.1(c) or ACI 318-11 3.6.4, calcium chloride or admixtures containing chloride from sources other than impurities in admixture ingredients are prohibited from use in concrete cast against stay-in-place galvanized steel deck or embedded items. 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, one of the IAPMO ES Marks of Conformity noted below, and evaluation report number (ER-0652).

IAPMO ES ® or UES ®

IAPMO UES ER-0652

6.0 SUBSTANTIATING DATA

Data in accordance with the IAPMO Uniform Evaluation Service Evaluation Criteria EC007, adopted April 2019, Evaluation Criteria for Steel Composite, Non-composite, and Roof Deck Construction.

7.0 STATEMENT OF RECOGNITION

This evaluation report describes the results of research carried out by IAPMO Uniform Evaluation Service on Vulcraft Group Steel Floor Decking and Steel Roof Decking.

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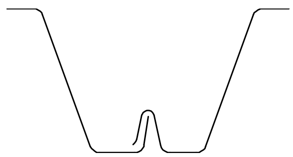
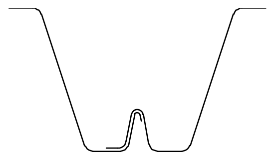
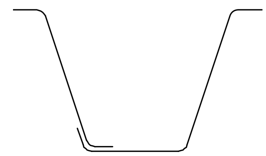
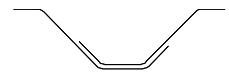
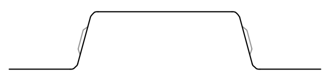
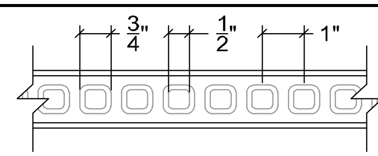
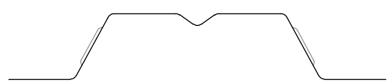
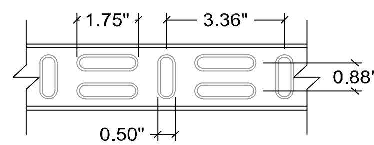
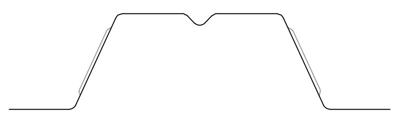
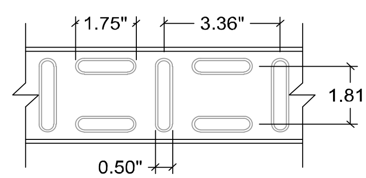
PROFILE CHARACTERISTICS									
Profile Designation(s)	Sidelap Type		Sidelap Fastener			Embossed	Cellular	Acoustic	
	Inter-locking	Nestable	VSC2	Screws	Other[1]			Web Perforated	Perforated Bottom Pan
1.5PLB-36, 3PLN-32	✓		✓						
1.5BI-36, 3NI-32, 3NI-24, 2C-36, 3C-36	✓				✓				
1.5B-30, 1.5B-36, 3NL-32, 3N-24, 1.3C-32 0.6C-35, 0.6C-30, 0.6C-36, 1.0C-32, 1.0C-33, 1.0C-36, 1.5C-30, 1.5C-36		✓		✓	✓				
1.5PLVLI-36, 2PLVLI-36, 3PLVLI-36	✓		✓			✓			
1.5VLI-36, 2VLI-36, 3VLI-36	✓				✓	✓			
2VLJ-36, 3VLJ-36	✓			✓		✓			
1.5VL-36, 1.5VLR-36		✓		✓	✓	✓			
1.5PLBA-36, 3PLNA-32	✓		✓					✓	
1.5BIA-36, 3NIA-32, 3NIA-24	✓				✓			✓	
1.5BA-36, 3NLA-32, 3NA-24		✓		✓				✓	

1. Other = Top arc seam sidelap welds or non-piercing button punch sidelap connections for interlocking profiles and arc spot or fillet welds for nestable profiles.

SIDELAP TYPES			
Standard Interlocking (PunchLok II, Other)	**J Style Interlocking** (Screwed Sidelap, Other)	**Nestable** (Screwed Sidelap)	**Nestable** (C Deck)
			

EMBOSSED PROFILES		
Profiles	**End View**	**Side View**
1.5PLVLI-36, 1.5VLI-36, 1.5VL-36		
2PLVLI-36, 2VLI-36, 2VLJ-36, 2VL-36		
3PLVLI-36, 3VLI-36, 3VLJ-36, 3VL-36		

PERFORATED PROFILES

Perforated Web Reduction Factor

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

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

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

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

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:

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

Where:

V_{np} = Vertical shear strength of profile with perforated web, kip/ft

n_w = Number of webs per foot

V_n = The nominal shear strength of solid web calculated in accordance with AISI S100-16 Sec. G2.1, 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 Sec. G5 with the following modifications:

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

[AISI S100-16 Eq. G5-1] *(Modified)*

All variables are as defined in AISI S100-16 Section G5

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}.

$$S_{np} = \text{minimum}\left(n_d P_{nf}\frac{12}{w_t}\right)$$ [Eq. D1-4a] *For Fluted Panels*

$$S_{np} = NP_{nf}$$ [Eq. D1-4b] *For Cellular Deck*

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, kip/ft

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, in.

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}.

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

$$S_{nl} = P_n\frac{d-e}{D_d}\left(\frac{12}{d}\right)$$ [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.

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

q_s = Perforated web reduction factor

D5.1.1 Stiffness of Fluted Panels

The diaphragm stiffness, G' shall be calculated in accordance with modified AISI S310-16 Eq. D5.1.1-1

$$G' = \left(\frac{Et}{1(1+\mu)\frac{s}{d}+\gamma_c \alpha D_n + C}\right)K$$ [Eq. D5.1.1-1]

Where α = 1.00 for panels with butted end laps at both ends
0.50 for panels with butted end laps at one end
0.00 for panels with lapped end laps at both ends

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

$$d_e \leq \frac{S_s}{S_f}d_s$$ [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)

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:

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

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

PROPRIETARY FASTENERS

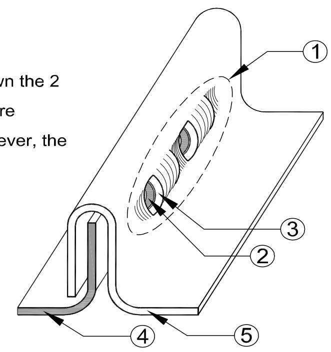
PunchLok II System

The nominal shear strength [resistance] for PunchLok II System (VSC2) connection shall be determined in accordance with Eq. PL-1:

$$P_{ns} = 137.42 \cdot t - 2.01 \qquad \text{[Eq. PL-1]}$$

The flexibility of PunchLok II System (VSC2) connection shall be determined in accordance with Eq. PL-2:

$$S_s = \frac{0.012}{1000 \cdot t^2} \qquad \text{[Eq. PL-2]}$$



① PunchLok® II system connection - as shown the 2 deformations of male and female sheets are projecting through the female sheet. However, the VSC2 may be made in either direction
② Sheared surface of male leg.
③ Sheared surface of female leg.
④ Male leg / sheet.
⑤ Female leg / sheet.

Simpson Strong-Tie

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

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

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

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

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

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

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

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

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 11)

PROPRIETARY FASTENERS (Continued)

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 and X-HSN24 PAF shall be determined in accordance with Eq. H-3:

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

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]

Where:

t = Base steel thickness of panel (in.)

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

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_{nvp} = Nominal shear strength [resistance] of PAF (see page 11)

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

ϕ = Resistance Factor

Ω = Safety Factor

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"

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

For substrate thickness equal to 0.155"

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

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:

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

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

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

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"

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

For substrate thickness equal to or greater than 0.25"

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

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:

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

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 11)

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

S_f = Structural support connection flexibility (in/k)

ϕ = Resistance Factor

Ω = Safety Factor

PROPRIETARY SUPPORT FASTENER PROPERTIES								
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
Minimum Spacing[1,2]	1"	1"	1"	1"	1"	1"	11/16"	11/16"
Minimum Edge Distance[1,2]	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	3/8"	3/8"
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
Tensile Strength based on Material strength (kip)	5.033	6.397	3.909	5.641	6.175	7.465	4.985	4.985
Nominal Shear Strength of Screw, P_{nvs} (kip)	-	-	-	-	-	-	3.110	3.110
Nominal Shear Strength of PAF, P_{nvp} (kip)	3.020	3.838	2.345	3.385	3.705	4.479	-	-

Notes:

1. Minimum spacing and edge distance for Screws are determined in accordance with AISI S100-16 Section J4.1 and J4.2 respectively.
2. Minimum spacing and edge distance for PAF's are determined in accordance with AISI S100-16 Table J5.1-1

MAXIMUM DIAPHRAGM SHEAR BETWEEN OPENINGS REINFORCED WITH COLD-FORMED STEEL CURBS[1,2a-f]							
Deck Profile	Deck Gage	ASD - Allowable Diaphragm Shear, S_n/Ω (plf)			ASD - Allowable Diaphragm Shear, ϕS_n (plf)		
		Span Length (ft-in)			Span Length (ft-in)		
		6'-0"	8'-0"	10'-0"	6'-0"	8'-0"	10'-0"
1.5PLB-36 1.5BI-36	22	1127	1116	-	1831	1814	-
	20	1408	1398	1313	2288	2272	2134
	18	1929	1920	1914	3135	3120	3110

[1] S_n = Nominal shear strength [resistance] per unit length of diaphragm system

[2] Roof openings may be reinforced with cold-formed steel curbs on top of the steel roof deck without below deck support frames, as shown below subject to the following conditions a-f:

[a] The diaphragm shear strengths shall not exceed the lesser of this table or the calculated shear strength.

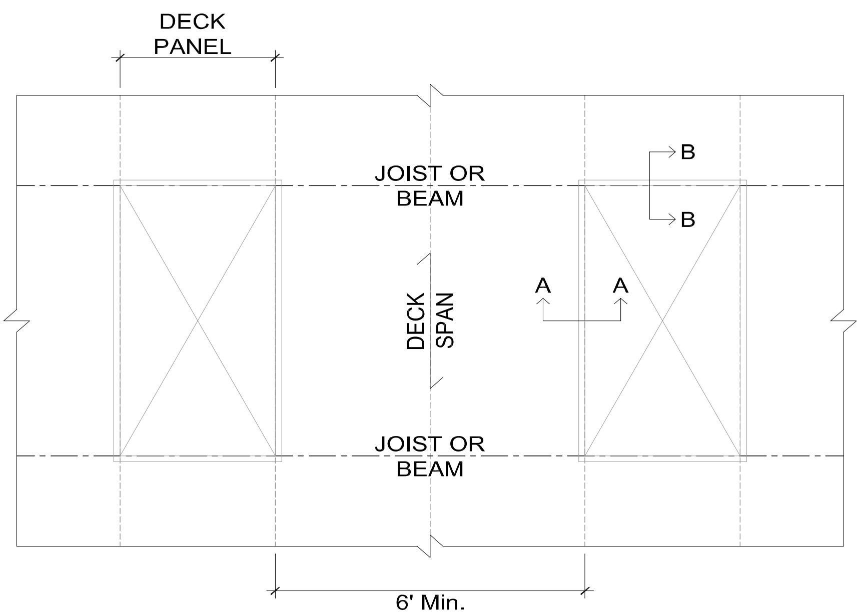
[b] Opening shall span between joists or beams shown in figure below.

[c] Cold-formed steel curbs be shall be a minimum of ASTM A653 Commercial Quality or equivalent steel specification.

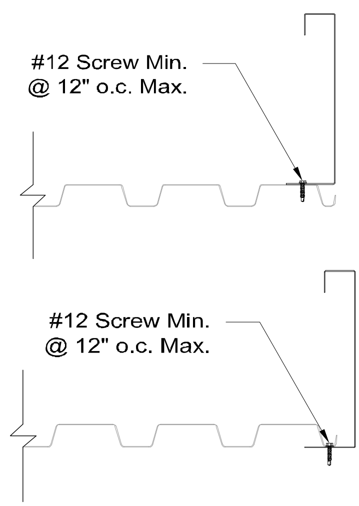
[d] Cold-Formed steel curbs shall meet the dimensions as shown in figure below.

[e] Cold-Formed steel curbs shall have the minimum attachments to the steel roof deck as shown in figure below.

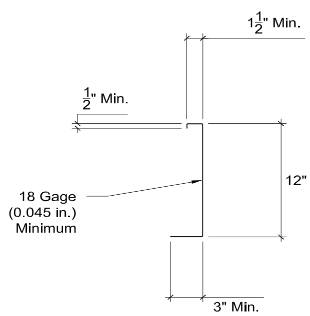
[f] Deck may be end lapped, butted, or continuous between openings.



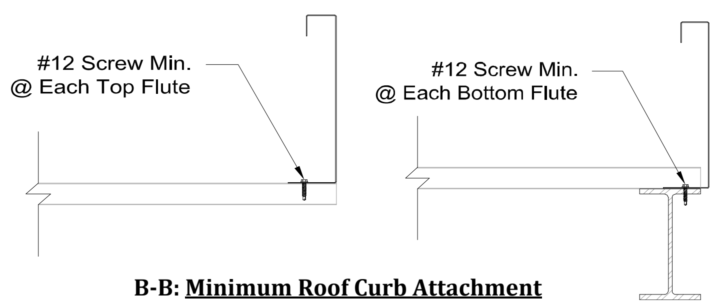
Recommended Opening Layout



A-A: Minimum Roof Curb Attachment
(Edge Parallel to Deck)



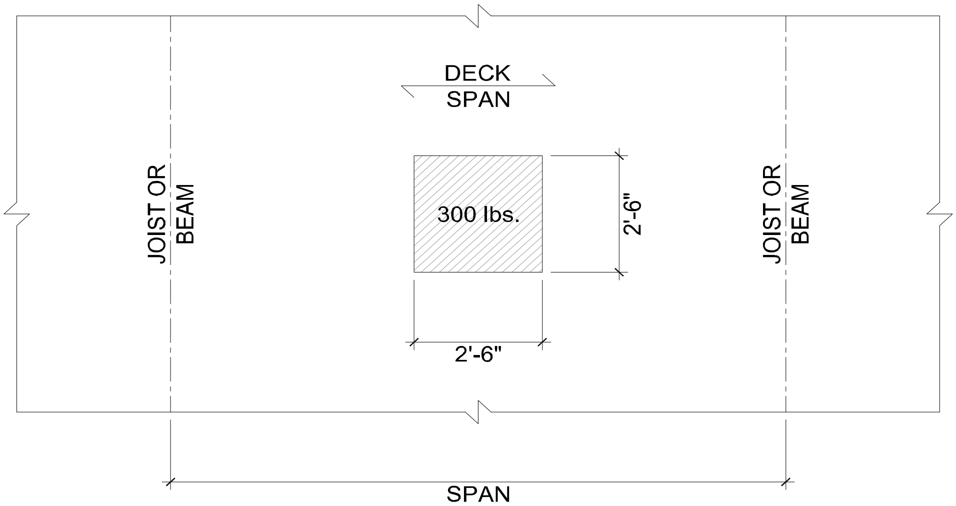
Minimum Roof Curb Dimensions



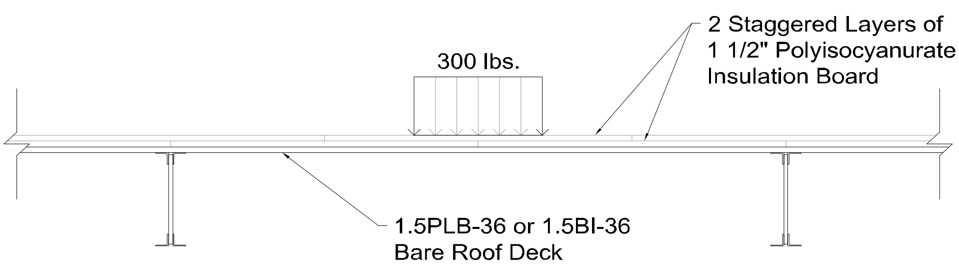
B-B: Minimum Roof Curb Attachment
(Edge Perpendicular to Deck)

1.5PLB-36 OR 1.5BI-36 ROOF DECK SPANS FOR CONCENTRATED LOADS[1-5]					
Deck Gage	Number of Spans	Maximum Span			
		Strength P_n/Ω	Insulation		
			L / 360	L / 240	L / 180
22	1	12'-1"	6'-5"	8'-1"	9'-10"
	2	16'-3"	7'-1"	10'-0"	11'-10"
	3	≥ 14'-0"	7'-2"	10'-0"	11'-10"
20	1	14'-9"	7'-4"	9'-9"	12'-0"
	2	19'-8"	9'-5"	12'-10"	14'-10"
	3	≥ 14'-0"	9'-8"	13'-3"	≥ 14'-0"
18	1	18'-8"	8'-10"	11'-8"	13'-8"
	2	≥ 21'-0"	11'-3"	14'-10"	16'-2"
	3	≥ 14'-0"	11'-3"	≥ 14'-0"	≥ 14'-0"
16	1	22'-7"	10'-4"	14'-6"	17'-9"
	2	≥ 21'-0"	13'-1"	18'-6"	20'-11"
	3	≥ 14'-0"	13'-4"	14'-0"	14'-0"

[1] Strength values based on a 300 lbs concentrated roof live load and 5 psf uniform dead load.
[2] Deflection values based on a 300 lbs concentrated roof live load.
[3] Concentrated load distributed over a 2-1/2 ft x 2-1/2 ft per IBC section 1607.4.
[4] Concentrated load deflections based on an assembly that includes a minimum of 2 layers of 1-1/2" ASTM C 1289, Type II, Class 1, Grade 2 (20 psi) polyisocyanurate insulation board on the steel deck.
[5] Table is limited to the maximum available sheet length of 42'-0". For longer sheet lengths, please contact Vulcraft.

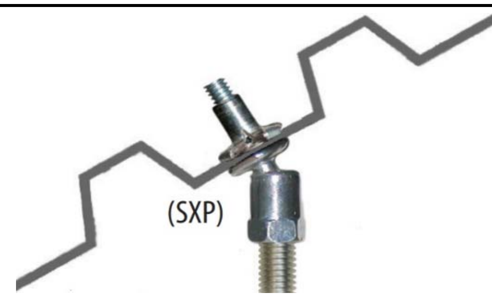


Load Placement Bare Deck - Plan View



Load Placement Bare Deck

ITW BUILDEX SAMMYS X-PRESS SWIVEL HEAD® CONNECTION[1-7]

Part Number	Model Number (Threaded Rod Size)	Deck Gage	Connection Strength (lbs) ASD P_{not}/Ω	Connection Strength (lbs) LRFD φP_{not}	Part Image
8294922 8272957	SXP 20 (3/8") SXP 2.0 (1/2)	22	200	320	
		20	240	390	
		19	280	460	
		18	320	520	
8295922 8271957	SXP 35 (3/8") SXP 3.5 (1/2")	16	400	660	
		14	500	820	

[1] P_{not} = Nominal pullout strength of SAMMYS X-Press Swivel Head® Connector

[2] Sammy X-press may be installed in any flat portion of the bottom flange, web or top flange as shown in figure below.

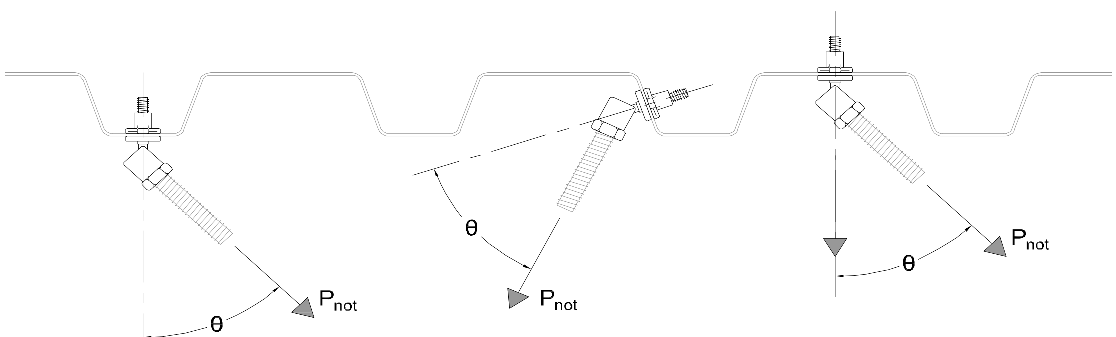
[3] The load may be applied at any angle, Θ, from 0 to 90 degrees, $0 \le \Theta \le 90$, relative to the axis of the base of the Sammy X-press as shown below.

[4] The load may be applied at any angle, α, from 0 to 360 degrees, $0 \le \alpha \le 360$, relative to the ribs of the steel deck as shown below.

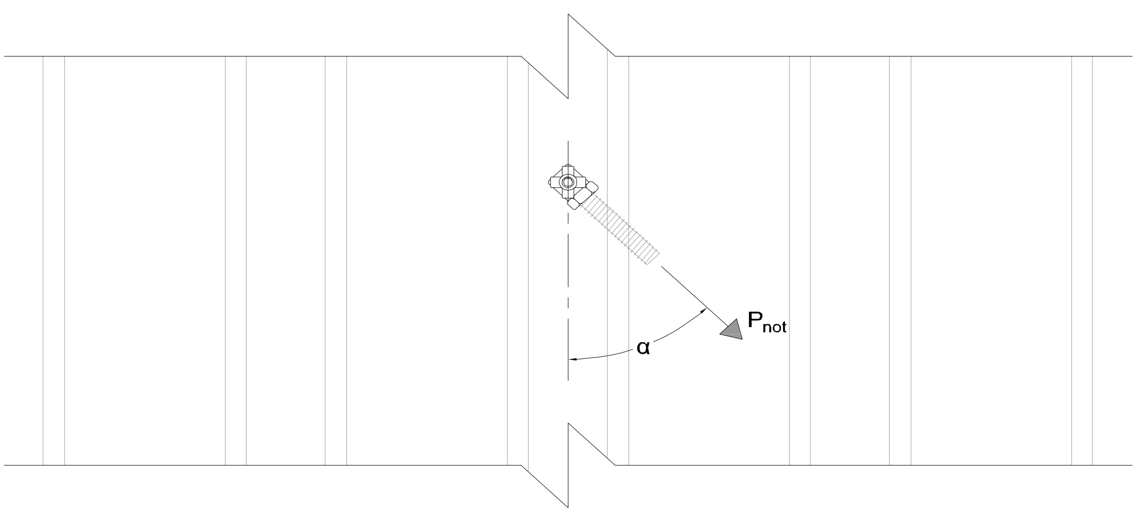
[5] The allowable strength, P_n/Ω, shall be equal to or greater than the governing nominal load or load combination for Allowable Stress Design (ASD) as stipulated in the IBC or ASCE/SEI 7.

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

[7] Safety and resistance factors included in the table are ASD: $\Omega = 2.5$ and LRFD $\phi = 0.65$ respectively.



Sammy X-Press Swivel Head® Connector



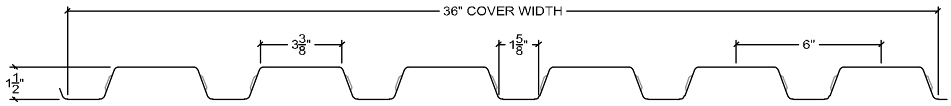
Sammy X-Press Swivel Head® Connector - Plan View

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_{gtf}	Gross area of top flange	in^2
A_n	Net area of cross-section	in^2/ft
A_{sbf}	Cross-sectional area of bottom flange stiffener	in^2
A_{stf}	Cross-sectional area of top flange stiffener	in^2
b_{obf}	Overall flat width of stiffened bottom flange	in.
b_{otf}	Overall flat width of stiffened top flange	in.
b_{pbf}	Largest sub-element flat of stiffened bottom flange	in.
b_{ptf}	Largest sub-element flat of stiffened top 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.
c_{stf}	Horizontal distance from edge of top flange to centerline of top flange stiffener	in.
d_p	Perforation hole diameter	in.
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_{sptf}	Moment of inertia of stiffener about centerline of flat portion of top flange	in^4
I_{xg}	Moment of inertia of fully effective section	in^4/ft
K	Composite deck-slab coefficient	-
M_{n+}	Nominal positive flexural strength of deck or panel, $M_{n+}=F_y \cdot S_{e+}$	k-ft/ft
M_{n-}	Nominal negative flexural strength of deck or panel, $M_{n-}=F_y \cdot S_{e-}$	k-ft/ft
M_{nxt+}	Nominal positive flexural strength with respect to centroidal axes in considering tension yielding	k-ft/ft
M_{nxt-}	Nominal negative flexural strength with respect to centroidal axes in considering tension yielding	k-ft/ft
q_s	Perforated web reduction factor	-
R	Inside bend radius	in.
r	Radius of gyration of gross section, $r=(I_{xg}/A_g)^{0.5}$	in.

DEFINITION OF SECTION PROPERTY SYMBOLS		
Symbol	**Definition**	**Units**
S_{e+}	Positive effective section modulus	in^3/ft
S_{e-}	Negative effective section modulus	in^3/ft
S_{ft+}	Positive section modulus of full unreduced section	in^3/ft
S_{ft-}	Negative section modulus of full unreduced section	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_p	Width of perforated band in web	in.
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.

Nestable Profiles
1.5B-36, 1.5B-30

Nestable Profiles (Embossed)
1.5VL-36



Interlocking Profiles
1.5BI-36, 1.5PLB-36

Interlocking Profiles (Embossed)
1.5VLI-36, 1.5PLVLI-36

Gage	t in.	w_{dd} psf	A_g in^2/ft	I_{xg} in^4/ft	S_{ft+} in^3/ft	S_{ft-} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.	K_{min} -
24	0.0239	1.3	0.387	0.147	0.165	0.244	0.892	0.602	0.616	1.279	70.3	-
22	0.0295	1.6	0.478	0.180	0.201	0.298	0.895	0.605	0.614	1.273	70.5	1.000
20	0.0358	2.0	0.580	0.217	0.242	0.357	0.898	0.608	0.612	1.266	70.7	1.000
19	0.0418	2.3	0.678	0.257	0.285	0.421	0.901	0.611	0.616	1.259	70.9	1.000
18	0.0474	2.6	0.769	0.290	0.321	0.472	0.904	0.614	0.614	1.252	71.1	1.000
16	0.0598	3.3	0.971	0.367	0.403	0.592	0.910	0.620	0.615	1.237	71.4	1.000

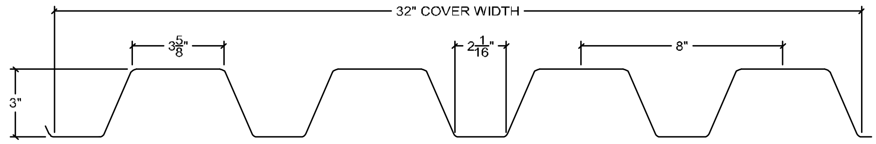
Gage	GRADE 50: F_y = 50 ksi, F_u = 65 ksi											
	I_{e+} in^4/ft	I_{e-} in^4/ft	I_{d+} in^4/ft	I_{d-} in^4/ft	S_{e+} in^3/ft	S_{e-} in^3/ft	M_{n+} k-ft/ft	M_{n-} k-ft/ft	M_{nxt+} k-ft/ft	M_{nxt-} k-ft/ft	V_n k/ft	T_n k/ft
22	0.143	0.177	0.155	0.178	0.169	0.179	0.704	0.746	0.838	1.242	4.247	23.90
20	0.187	0.217	0.197	0.217	0.224	0.229	0.933	0.954	1.008	1.488	5.131	29.00
19	0.230	0.257	0.239	0.257	0.266	0.278	1.108	1.158	1.188	1.754	5.964	33.90
18	0.270	0.290	0.277	0.290	0.306	0.318	1.275	1.325	1.338	1.967	6.735	38.45
16	0.363	0.367	0.364	0.367	0.393	0.402	1.638	1.675	1.679	2.467	8.417	48.55

Gage	GRADE 80: F_y = 60 ksi, F_u = 62 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
24	0.103	0.133	0.118	0.138	0.120	0.131	0.600	0.655	0.825	1.220	2.481	23.22
22	0.137	0.173	0.151	0.175	0.162	0.173	0.810	0.865	1.005	1.490	5.097	28.68
20	0.180	0.217	0.192	0.217	0.215	0.223	1.075	1.115	1.210	1.785	6.157	34.80
19	0.220	0.253	0.232	0.254	0.263	0.271	1.315	1.355	1.425	2.105	7.157	40.68
18	0.263	0.290	0.272	0.290	0.302	0.315	1.510	1.575	1.605	2.360	8.082	46.14

R in.	w_{tf} in.	w_{bf} in.
0.188	3.062	1.325

Nestable Profiles
3NL-32

Interlocking Profiles
3NI-32,
3PLN-32



Gage	t in.	w_{dd} psf	A_g in^2/ft	I_{xg} in^4/ft	S_{ft+} in^3/ft	S_{ft-} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.
22	0.0295	1.8	0.537	0.750	0.450	0.562	1.665	1.335	1.182	2.925	68.2
20	0.0358	2.2	0.652	0.911	0.546	0.681	1.668	1.338	1.182	2.919	68.3
19	0.0418	2.6	0.762	1.065	0.638	0.794	1.670	1.341	1.182	2.913	68.3
18	0.0474	2.9	0.864	1.208	0.722	0.899	1.673	1.344	1.182	2.907	68.4
16	0.0598	3.7	1.091	1.526	0.909	1.130	1.679	1.351	1.183	2.894	68.6

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	0.589	0.698	0.643	0.715	0.345	0.372	1.438	1.550	1.875	2.342	3.481	26.85
20	0.754	0.874	0.806	0.886	0.448	0.476	1.867	1.983	2.275	2.838	6.017	32.60
19	0.915	1.046	0.965	1.052	0.554	0.579	2.308	2.413	2.658	3.308	8.203	38.10
18	1.080	1.196	1.123	1.200	0.660	0.675	2.750	2.813	3.008	3.746	10.556	43.20
16	1.455	1.523	1.479	1.524	0.869	0.885	3.621	3.688	3.788	4.708	14.502	54.55

Gage	GRADE 80: F_y = 60 ksi, F_u = 62 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	0.578	0.686	0.635	0.707	0.335	0.346	1.675	1.730	2.250	2.810	3.481	32.22
20	0.735	0.859	0.794	0.876	0.434	0.463	2.170	2.315	2.730	3.405	6.238	39.12
19	0.893	1.028	0.950	1.040	0.536	0.563	2.680	2.815	3.190	3.970	8.986	45.72
18	1.050	1.189	1.103	1.195	0.637	0.659	3.185	3.295	3.610	4.495	11.563	51.84

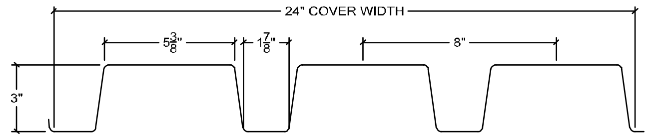
R in.	w_{tf} in.	w_{bf} in.
0.188	3.328	1.746

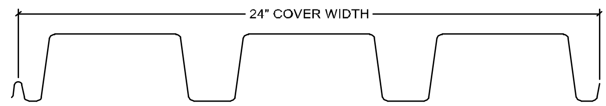
Nestable Profiles

3N-24

Interlocking Profiles

3NI-24





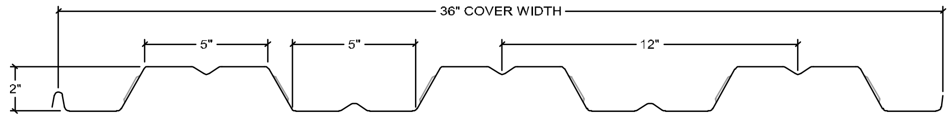
Gage	t in.	w_{dd} psf	A_g in^2/ft	I_{xg} in^4/ft	S_{ft+} in^3/ft	S_{ft-} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.
22	0.0295	2.0	0.595	0.882	0.463	0.746	1.907	1.182	1.218	2.731	82.5
20	0.0358	2.5	0.723	1.071	0.561	0.903	1.910	1.186	1.217	2.724	82.6
19	0.0418	2.9	0.845	1.252	0.654	1.053	1.913	1.189	1.217	2.718	82.7
18	0.0474	3.3	0.958	1.420	0.742	1.191	1.915	1.192	1.217	2.711	82.8
16	0.0598	4.1	1.210	1.795	0.934	1.497	1.921	1.199	1.218	2.697	83.0

Gage	GRADE 40: F_y = 40 ksi, F_u = 52 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	0.630	0.863	0.714	0.869	0.368	0.419	1.227	1.397	1.543	2.487	3.898	23.80
20	0.816	1.071	0.901	1.071	0.482	0.530	1.607	1.767	1.870	3.010	5.742	28.92
19	1.006	1.252	1.088	1.252	0.584	0.637	1.947	2.123	2.180	3.510	7.830	33.80
18	1.192	1.421	1.268	1.421	0.674	0.731	2.247	2.437	2.473	3.970	9.180	38.32
16	1.625	1.795	1.682	1.795	0.876	0.934	2.920	3.113	3.113	4.990	11.527	48.40

R in.	w_{tf} in.	w_{bf} in.
0.188	4.989	1.489

Embossed Profiles
2VLI-36, 2PLVLI-36, 2VLJ-36

Non-Embossed Profiles
2C-36



Gage	t	w_{dd}	A_g	I_{xg}	S_{ft+}	S_{ft-}	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.	-
22	0.0295	1.6	0.458	0.347	0.338	0.326	1.026	1.063	0.870	2.048	63.6	1.000
20	0.0358	1.9	0.556	0.420	0.408	0.394	1.030	1.066	0.869	2.041	63.7	1.000
19	0.0418	2.2	0.649	0.490	0.474	0.458	1.033	1.069	0.869	2.035	63.8	1.000
18	0.0474	2.5	0.736	0.557	0.538	0.520	1.036	1.072	0.870	2.030	63.9	1.000
16	0.0598	3.2	0.929	0.703	0.675	0.652	1.042	1.078	0.870	2.017	64.1	0.872

Gage	GRADE 50: F_y = 50 ksi, F_u = 65 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
22	0.313	0.313	0.324	0.324	0.244	0.255	1.017	1.063	1.408	1.358	2.626	22.90
20	0.403	0.400	0.409	0.407	0.326	0.337	1.358	1.404	1.700	1.642	3.870	27.80
19	0.490	0.487	0.490	0.488	0.409	0.421	1.704	1.754	1.975	1.908	4.581	32.45
18	0.557	0.557	0.557	0.557	0.485	0.500	2.021	2.083	2.242	2.167	5.184	36.80
16	0.703	0.703	0.703	0.703	0.643	0.652	2.679	2.717	2.813	2.717	6.511	46.45

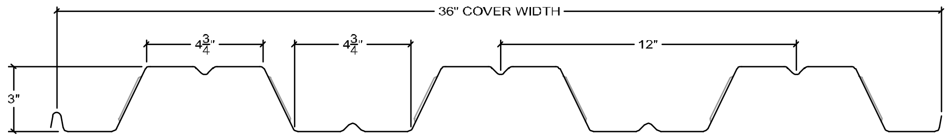
Gage	A_{gtf}	A_{stf}	I_{sptf}	A_{gbf}	A_{sbf}	I_{spbf}
	in^2	in^2	in^4	in^2	in^2	in^4
22	0.146	0.044	0.001	0.146	0.044	0.001
20	0.177	0.053	0.001	0.177	0.053	0.001
19	0.207	0.062	0.001	0.207	0.062	0.001
18	0.235	0.070	0.002	0.235	0.070	0.002
16	0.296	0.088	0.002	0.296	0.088	0.002

b_{otf}	b_{ptf}	c_{stf}	b_{obf}	b_{pbf}	c_{sbf}
in.	in.	in.	in.	in.	in.
4.727	1.739	2.364	4.727	1.739	2.364

R	w_{tf}	w_{bf}
in.	in.	in.
0.188	4.727	4.727

Embossed Profiles
3VLI-36, 3PLVLI-36, 3VLJ-36

Non-Embossed Profiles
3C-36



Gage	t in.	w_{dd} psf	A_g in^2/ft	I_{xg} in^4/ft	S_{ft+} in^3/ft	S_{ft-} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.	K_{min} -
22	0.0295	1.7	0.502	0.777	0.524	0.503	1.484	1.546	1.244	2.990	67.0	1.000
20	0.0358	2.1	0.610	0.943	0.634	0.609	1.487	1.549	1.243	2.984	67.1	1.000
19	0.0418	2.4	0.712	1.103	0.740	0.711	1.490	1.552	1.245	2.978	67.2	1.000
18	0.0474	2.7	0.808	1.253	0.839	0.806	1.493	1.555	1.245	2.972	67.2	1.000
16	0.0598	3.5	1.020	1.580	1.054	1.012	1.499	1.561	1.245	2.960	67.4	1.000

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	0.710	0.717	0.732	0.737	0.387	0.410	1.613	1.708	2.183	2.096	2.251	25.10
20	0.907	0.910	0.919	0.921	0.512	0.539	2.133	2.246	2.642	2.538	3.976	30.50
19	1.097	1.100	1.099	1.101	0.639	0.669	2.663	2.788	3.083	2.963	5.423	35.60
18	1.253	1.253	1.253	1.253	0.761	0.794	3.171	3.308	3.496	3.358	6.977	40.40
16	1.580	1.580	1.580	1.580	1.013	1.013	4.221	4.221	4.392	4.217	9.802	51.00

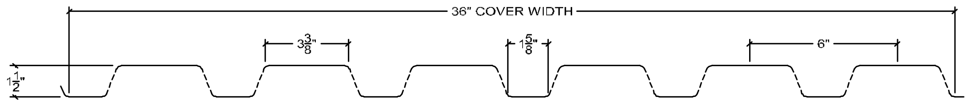
Gage	A_{gtf} in^2	A_{stf} in^2	I_{sptf} in^4	A_{gbf} in^2	A_{sbf} in^2	I_{spbf} in^4
22	0.140	0.038	0.001	0.140	0.038	0.001
20	0.170	0.046	0.001	0.170	0.046	0.001
19	0.199	0.054	0.001	0.199	0.054	0.001
18	0.225	0.061	0.002	0.225	0.061	0.002
16	0.284	0.078	0.002	0.284	0.078	0.002

b_{otf} in.	b_{ptf} in.	c_{stf} in.	b_{obf} in.	b_{pbf} in.	c_{sbf} in.
4.459	1.729	2.230	4.459	1.729	2.230

R in.	w_{tf} in.	w_{bf} in.
0.188	4.459	4.459

ACOUSTIC

Nestable Profiles
1.5BA-36, 1.5BA-30



Interlocking Profiles
1.5BIA-36, 1.5PLBA-36

Gage	t in.	w_{dd} psf	A_g in^2/ft	A_n in^2/ft	I_{xg} in^4/ft	S_{ft+} in^3/ft	S_{ft-} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.
22	0.0295	1.5	0.478	0.423	0.171	0.191	0.283	0.895	0.605	0.636	1.273	70.5
20	0.0358	1.9	0.580	0.513	0.206	0.229	0.339	0.898	0.608	0.634	1.266	70.7
19	0.0418	2.2	0.678	0.600	0.244	0.271	0.399	0.901	0.611	0.638	1.259	70.9
18	0.0474	2.5	0.769	0.680	0.276	0.305	0.450	0.904	0.614	0.637	1.252	71.1
16	0.0598	3.2	0.971	0.859	0.349	0.384	0.563	0.910	0.620	0.637	1.237	71.4

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	0.136	0.168	0.148	0.169	0.161	0.170	0.671	0.708	0.796	1.179	3.212	21.15
20	0.177	0.206	0.187	0.206	0.213	0.218	0.888	0.908	0.954	1.413	3.873	25.65
19	0.219	0.244	0.227	0.244	0.253	0.264	1.054	1.100	1.129	1.663	4.494	30.00
18	0.257	0.276	0.263	0.276	0.290	0.302	1.208	1.258	1.271	1.875	5.065	34.00
16	0.345	0.348	0.346	0.348	0.374	0.382	1.558	1.592	1.600	2.346	6.306	42.95

Gage	GRADE 80: F_y = 60 ksi, F_u = 62 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	0.130	0.164	0.144	0.166	0.154	0.164	0.770	0.820	0.955	1.415	3.854	25.38
20	0.171	0.206	0.183	0.206	0.204	0.212	1.020	1.060	1.145	1.695	4.647	30.78
19	0.209	0.240	0.221	0.241	0.250	0.257	1.250	1.285	1.355	1.995	5.392	36.00
18	0.250	0.276	0.259	0.276	0.287	0.299	1.435	1.495	1.525	2.250	6.078	40.80

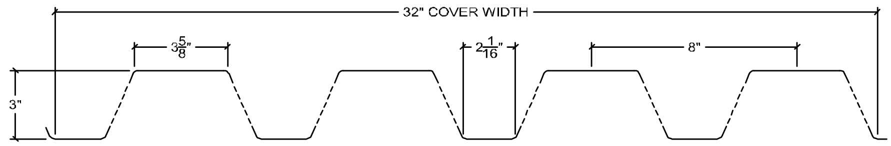
R in.	w_{tf} in.	w_{bf} in.
0.188	3.062	1.325

d_p in.	c_p in.	W_p in.
0.156	0.375	0.906

ACOUSTIC

Nestable Profiles
3NLA-32

Interlocking Profiles
3NIA-32,
3PLNA-32



Gage	t in.	w_{dd} psf	A_g in^2/ft	A_n in^2/ft	I_{xg} in^4/ft	S_{ft+} in^3/ft	S_{ft-} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.
22	0.0295	1.7	0.537	0.454	0.713	0.428	0.534	1.665	1.335	1.253	2.925	68.2
20	0.0358	2.1	0.652	0.552	0.865	0.519	0.646	1.668	1.338	1.252	2.919	68.3
19	0.0418	2.4	0.762	0.644	1.012	0.606	0.755	1.670	1.341	1.254	2.913	68.3
18	0.0474	2.8	0.864	0.731	1.148	0.686	0.854	1.673	1.344	1.253	2.907	68.4
16	0.0598	3.5	1.091	0.923	1.450	0.864	1.073	1.679	1.351	1.253	2.894	68.6

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	0.560	0.663	0.611	0.680	0.328	0.353	1.367	1.471	1.783	2.225	2.611	22.70
20	0.716	0.830	0.766	0.842	0.426	0.452	1.775	1.883	2.163	2.692	4.513	27.60
19	0.869	0.994	0.917	1.000	0.526	0.550	2.192	2.292	2.525	3.146	6.152	32.20
18	1.026	1.136	1.067	1.140	0.627	0.641	2.613	2.671	2.858	3.558	7.917	36.55
16	1.382	1.447	1.405	1.448	0.826	0.841	3.442	3.504	3.600	4.471	10.877	46.15

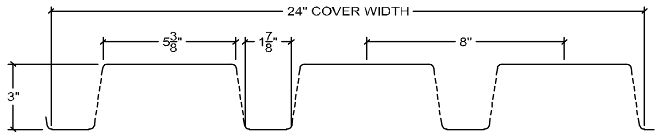
Gage	GRADE 80: F_y = 60 ksi, F_u = 62 ksi											
	I_{e+} in^4/ft	I_{e-} in^4/ft	I_{d+} in^4/ft	I_{d-} in^4/ft	S_{e+} in^3/ft	S_{e-} in^3/ft	M_{n+} k-ft/ft	M_{n-} k-ft/ft	M_{nxt+} k-ft/ft	M_{nxt-} k-ft/ft	V_n k/ft	T_n k/ft
22	0.549	0.652	0.604	0.672	0.318	0.329	1.590	1.645	2.140	2.670	2.611	27.24
20	0.698	0.816	0.754	0.832	0.412	0.440	2.060	2.200	2.595	3.230	4.679	33.12
19	0.848	0.977	0.903	0.989	0.509	0.535	2.545	2.675	3.030	3.775	6.740	38.64
18	0.998	1.130	1.048	1.136	0.605	0.626	3.025	3.130	3.430	4.270	8.672	43.86

R in.	w_{tf} in.	w_{bf} in.
0.188	3.328	1.746

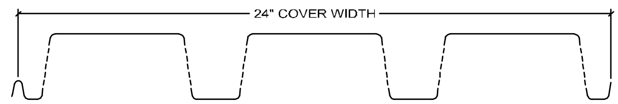
d_p in.	c_p in.	W_p in.
0.156	0.375	2.031

ACOUSTIC

Nestable Profiles
3NA-24



Interlocking Profiles
3NIA-24



Gage	t in.	w_{dd} psf	A_g in^2/ft	A_n in^2/ft	I_{xg} in^4/ft	S_{ft+} in^3/ft	S_{ft-} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.
22	0.0295	1.9	0.595	0.512	0.838	0.439	0.709	1.907	1.182	1.279	2.731	82.5
20	0.0358	2.4	0.723	0.622	1.017	0.532	0.858	1.910	1.186	1.279	2.724	82.6
19	0.0418	2.8	0.845	0.727	1.189	0.622	1.000	1.913	1.189	1.279	2.718	82.7
18	0.0474	3.1	0.958	0.825	1.349	0.704	1.132	1.915	1.192	1.279	2.711	82.8
16	0.0598	3.9	1.210	1.042	1.705	0.888	1.422	1.921	1.199	1.279	2.697	83.0

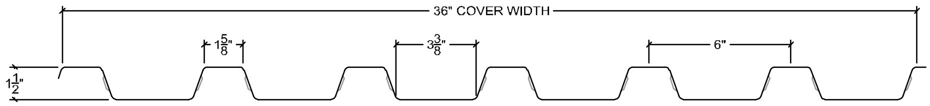
Gage	GRADE 40: F_y = 40 ksi, F_u = 52 ksi											
	I_{e+} in^4/ft	I_{e-} in^4/ft	I_{d+} in^4/ft	I_{d-} in^4/ft	S_{e+} in^3/ft	S_{e-} in^3/ft	M_{n+} k-ft/ft	M_{n-} k-ft/ft	M_{nxt+} k-ft/ft	M_{nxt-} k-ft/ft	V_n k/ft	T_n k/ft
22	0.599	0.820	0.679	0.826	0.349	0.398	1.163	1.327	1.463	2.363	2.905	20.48
20	0.775	1.017	0.856	1.017	0.458	0.503	1.527	1.677	1.773	2.860	4.276	24.88
19	0.955	1.189	1.033	1.189	0.555	0.605	1.850	2.017	2.073	3.333	5.826	29.08
18	1.132	1.350	1.204	1.350	0.640	0.695	2.133	2.317	2.347	3.773	6.825	33.00
16	1.544	1.705	1.598	1.705	0.832	0.887	2.773	2.957	2.960	4.740	8.554	41.68

R in.	w_{tf} in.	w_{bf} in.
0.188	4.989	1.489

d_p in.	c_p in.	W_p in.
0.156	0.375	2.031

Nestable Profiles
1.5C-36, 1.5C-30

Nestable Profiles (Embossed)
1.5VLR-36



Gage	t in.	w_{dd} psf	A_g in^2/ft	I_{xg} in^4/ft	S_{ft+} in^3/ft	S_{ft-} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.	K_{min} -
24	0.0239	1.3	0.387	0.147	0.244	0.165	0.602	0.892	0.616	1.279	70.3	-
22	0.0295	1.6	0.478	0.180	0.298	0.201	0.605	0.895	0.614	1.273	70.5	1.000
20	0.0358	2.0	0.580	0.217	0.357	0.242	0.608	0.898	0.612	1.266	70.7	1.000
18	0.0474	2.6	0.769	0.290	0.472	0.321	0.614	0.904	0.614	1.252	71.1	1.000
16	0.0598	3.3	0.971	0.367	0.592	0.403	0.620	0.910	0.615	1.237	71.4	1.000

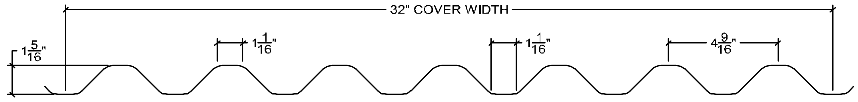
Gage	GRADE 50: F_y = 50 ksi, F_u = 65 ksi											
	I_{e+} in^4/ft	I_{e-} in^4/ft	I_{d+} in^4/ft	I_{d-} in^4/ft	S_{e+} in^3/ft	S_{e-} in^3/ft	M_{n+} k-ft/ft	M_{n-} k-ft/ft	M_{nxt+} k-ft/ft	M_{nxt-} k-ft/ft	V_n k/ft	T_n k/ft
22	0.177	0.143	0.178	0.155	0.179	0.169	0.746	0.704	1.242	0.838	4.247	23.90
20	0.217	0.187	0.217	0.197	0.229	0.224	0.954	0.933	1.488	1.008	5.131	29.00
18	0.290	0.270	0.290	0.277	0.318	0.306	1.325	1.275	1.967	1.338	6.735	38.45
16	0.367	0.363	0.367	0.364	0.402	0.393	1.675	1.638	2.467	1.679	8.417	48.55

Gage	GRADE 80: F_y = 60 ksi, F_u = 62 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
24	0.133	0.103	0.138	0.118	0.131	0.120	0.655	0.600	1.220	0.825	2.481	23.22

R in.	w_{tf} in.	w_{bf} in.
0.188	1.325	3.062

Non-Embossed Profiles

1.3C-32



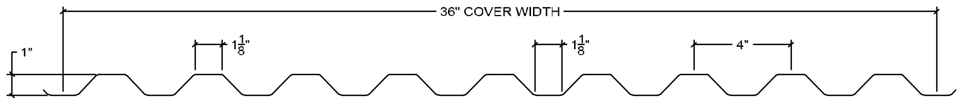
Gage	t in.	w_{dd} psf	A_g in^2/ft	I_{xg} in^4/ft	S_{ft+} in^3/ft	S_{ft-} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.
26	0.0179	0.9	0.278	0.070	0.108	0.100	0.647	0.701	0.502	1.371	47.1
24	0.0239	1.3	0.371	0.093	0.143	0.132	0.650	0.704	0.501	1.365	47.2
22	0.0295	1.6	0.458	0.116	0.178	0.164	0.653	0.707	0.503	1.360	47.3
20	0.0358	1.9	0.556	0.139	0.212	0.196	0.656	0.710	0.500	1.354	47.4

Gage	GRADE 80: F_y = 60 ksi, F_u = 62 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
26	0.065	0.065	0.067	0.067	0.080	0.089	0.400	0.445	0.540	0.500	2.275	16.68
24	0.093	0.092	0.093	0.092	0.126	0.130	0.630	0.650	0.715	0.660	4.060	22.26
22	0.116	0.116	0.116	0.116	0.163	0.163	0.815	0.815	0.890	0.820	5.570	27.48
20	0.139	0.139	0.139	0.139	0.197	0.197	0.985	0.985	1.060	0.980	6.738	33.36

R in.	w_{tf} in.	w_{bf} in.
0.500	0.607	0.607

Non-Embossed Profiles

1.0C-36



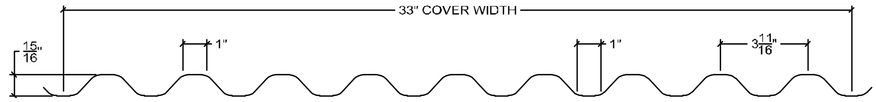
Gage	t in.	w_{dd} psf	A_g in²/ft	I_{xg} in⁴/ft	S_{ft+} in³/ft	S_{ft-} in³/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.
26	0.0179	0.9	0.271	0.042	0.086	0.081	0.486	0.520	0.394	1.146	48.3
24	0.0239	1.2	0.362	0.057	0.117	0.109	0.488	0.523	0.397	1.141	48.4
22	0.0295	1.5	0.447	0.070	0.143	0.133	0.491	0.526	0.396	1.136	48.5
20	0.0358	1.8	0.542	0.083	0.168	0.157	0.494	0.529	0.391	1.130	48.6

Gage	GRADE 80: F_y = 60 ksi, F_u = 62 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
26	0.038	0.038	0.039	0.039	0.065	0.068	0.325	0.340	0.430	0.405	2.650	16.26
24	0.057	0.057	0.057	0.057	0.099	0.103	0.495	0.515	0.585	0.545	4.406	21.72
22	0.070	0.070	0.070	0.070	0.129	0.131	0.645	0.655	0.715	0.665	5.423	26.82
20	0.083	0.083	0.083	0.083	0.160	0.160	0.800	0.800	0.840	0.785	6.560	32.52

R in.	w_{tf} in.	w_{bf} in.
0.188	0.944	0.944

Non-Embossed Profiles

1.0C-33



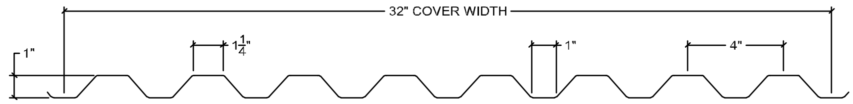
Gage	t in.	w_{dd} psf	A_g in²/ft	I_{xg} in⁴/ft	S_{ft+} in³/ft	S_{ft-} in³/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.
26	0.0179	0.9	0.272	0.037	0.078	0.073	0.472	0.506	0.369	0.807	49.0
24	0.0239	1.2	0.363	0.050	0.105	0.098	0.474	0.509	0.371	0.800	49.2
22	0.0295	1.5	0.448	0.062	0.130	0.121	0.477	0.512	0.372	0.793	49.3
20	0.0358	1.8	0.544	0.076	0.158	0.148	0.480	0.515	0.374	0.785	49.5

Gage	GRADE 80: F_y = 60 ksi, F_u = 62 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
26	0.036	0.035	0.036	0.036	0.065	0.068	0.325	0.340	0.390	0.365	2.570	16.32
24	0.050	0.049	0.050	0.049	0.096	0.097	0.480	0.485	0.525	0.490	3.409	21.78
22	0.062	0.062	0.062	0.062	0.121	0.120	0.605	0.600	0.650	0.605	4.181	26.88
20	0.076	0.076	0.076	0.076	0.147	0.146	0.735	0.730	0.790	0.740	5.037	32.64

R in.	w_{tf} in.	w_{bf} in.
0.500	0.536	0.536

Non-Embossed Profiles

1.0C-32



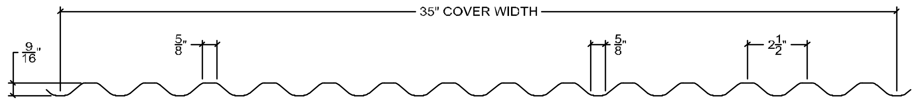
Gage	t in.	w_{dd} psf	A_g in^2/ft	I_{xg} in^4/ft	S_{ft+} in^3/ft	S_{ft-} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.
26	0.0179	0.9	0.273	0.044	0.086	0.087	0.514	0.503	0.401	1.203	49.0
24	0.0239	1.2	0.365	0.059	0.114	0.117	0.517	0.506	0.402	1.198	49.1
22	0.0295	1.5	0.450	0.071	0.137	0.139	0.520	0.509	0.397	1.194	49.2
20	0.0358	1.9	0.547	0.090	0.172	0.175	0.523	0.513	0.406	1.188	49.3

Gage	GRADE 80: F_y = 60 ksi, F_u = 62 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
26	0.039	0.042	0.041	0.043	0.067	0.071	0.335	0.355	0.430	0.435	2.676	16.38
24	0.056	0.058	0.057	0.058	0.098	0.103	0.490	0.515	0.570	0.585	4.675	21.90
22	0.071	0.071	0.071	0.071	0.130	0.134	0.650	0.670	0.685	0.695	5.756	27.00
20	0.090	0.090	0.090	0.090	0.168	0.166	0.840	0.830	0.860	0.875	6.965	32.82

R in.	w_{tf} in.	w_{bf} in.
0.125	1.128	0.888

Non-Embossed Profiles

0.6C-35, 0.6C-30



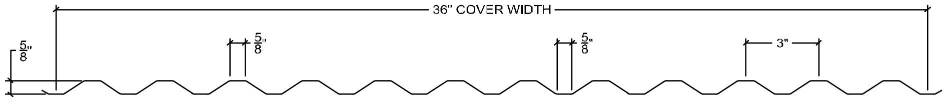
Gage	t in.	w_{dd} psf	A_g in^2/ft	I_{xg} in^4/ft	S_{ft+} in^3/ft	S_{ft-} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.
28	0.0149	0.7	0.215	0.011	0.038	0.036	0.290	0.304	0.226	0.609	42.6
26	0.0179	0.9	0.258	0.013	0.045	0.042	0.292	0.306	0.224	0.606	42.7
24	0.0239	1.2	0.345	0.017	0.058	0.055	0.295	0.309	0.222	0.600	42.9
22	0.0295	1.4	0.426	0.021	0.070	0.067	0.298	0.312	0.222	0.595	43.0

Gage	GRADE 80: F_y = 60 ksi, F_u = 62 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
28	0.011	0.011	0.011	0.011	0.033	0.034	0.165	0.170	0.190	0.180	2.122	12.90
26	0.013	0.013	0.013	0.013	0.042	0.042	0.210	0.210	0.225	0.210	2.542	15.48
24	0.017	0.017	0.017	0.017	0.056	0.056	0.280	0.280	0.290	0.275	3.371	20.70
22	0.021	0.021	0.021	0.021	0.069	0.068	0.345	0.340	0.350	0.335	4.134	25.56

R in.	w_{tf} in.	w_{bf} in.
0.310	0.372	0.372

Non-Embossed Profiles

0.6C-36



Gage	t in.	w_{dd} psf	A_g in^2/ft	I_{xg} in^4/ft	S_{ft+} in^3/ft	S_{ft-} in^3/ft	y_b in.	y_t in.	r in.	h_w in.	θ deg.
28	0.0149	0.7	0.210	0.012	0.038	0.036	0.317	0.333	0.239	0.960	35.5
26	0.0179	0.9	0.252	0.015	0.047	0.045	0.318	0.334	0.244	0.958	35.6
24	0.0239	1.1	0.337	0.020	0.062	0.059	0.321	0.337	0.244	0.954	35.6
22	0.0295	1.4	0.416	0.023	0.071	0.068	0.324	0.340	0.235	0.950	35.7

Gage	GRADE 80: F_y = 60 ksi, F_u = 62 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
28	0.012	0.012	0.012	0.012	0.034	0.035	0.170	0.175	0.190	0.180	1.905	12.60
26	0.015	0.015	0.015	0.015	0.043	0.043	0.215	0.215	0.235	0.225	2.751	15.12
24	0.020	0.020	0.020	0.020	0.058	0.058	0.290	0.290	0.310	0.295	3.825	20.22
22	0.023	0.023	0.023	0.023	0.071	0.071	0.355	0.355	0.355	0.340	4.709	24.96

R in.	w_{tf} in.	w_{bf} in.
0.200	0.492	0.492