



ICC Evaluation Service, Inc.
www.icc-es.org

Business/Regional Office ■ 5360 Workman Mill Road, Whittier, California 90601 ■ (562) 699-0543
Regional Office ■ 900 Montclair Road, Suite A, Birmingham, Alabama 35213 ■ (205) 599-9800
Regional Office ■ 4051 West Flossmoor Road, Country Club Hills, Illinois 60478 ■ (708) 799-2305

Legacy report on the 1997 Uniform Building Code™

DIVISION: 07—THERMAL AND MOISTURE PROTECTION
Section: 07410—Metal Roof and Wall Panels

VP BUILDINGS, INC., STEEL DECKS

VARCO PRUDEN BUILDINGS, INC.
3200 PLAYERS CLUB CIRCLE
MEMPHIS, TENNESSEE 38125

1.0 SUBJECT

VP Buildings, Inc., Steel Decks.

2.0 DESCRIPTION

2.1 General:

VP Buildings, Inc., Panel Rib Roof, Panel Rib Wall and Vee Rib Wall Panels are cold-formed from steel conforming to one of the following specifications:

- 1. ASTM A 653-00 SS Grade 50 Class 2 with G 90 zinc coating, and a minimum yield strength of 50 ksi (345 MPa).
2. ASTM A 653-00 Grade 80 with a G 90 zinc coating, a minimum yield strength of 80 ksi (551 MPa), and a minimum tensile strength of 82 ksi (565 MPa).
3. ASTM A 792-99 SS Grade 50B with an AZ 50 Minimum aluminum-zinc coating, and a minimum yield strength of 50 ksi (345 MPa).
4. ASTM A 792-99 Grade 80 with an AZ 50 Minimum aluminum-zinc coating, a minimum yield strength of 80 ksi (551 MPa), and a minimum tensile strength of 82 ksi (565 MPa).

The panels are rolled into 36-inch (914 mm) widths from No. 22, 24 or 26 gage steel [design base-metal thicknesses of 0.0273, 0.0220 or 0.0184 inch (0.69, 0.56, or 0.47 mm), respectively], with 1 3/16-inch (30.2 mm) ribs spaced 12 inches (305 mm) on center. See Figures 1 through 3.

2.2 Section and Strength Properties:

Panel section and strength properties are noted in Table 1. Allowable reactions based on web crippling are shown in Table 2.

2.3 Diaphragm:

2.3.1 General: The vertical and horizontal diaphragm capacities and shear stiffness are shown in Table 3. See Table 4 for deflection equations. See Table 5 for stiffness limitations.

2.3.2 Diaphragm Design Considerations: The diaphragm design must take into account the following considerations:

- 1. Diaphragm classification (flexible or rigid) must comply with Section 1630.6 of the 1997 Uniform Building Code™ (UBC); the diaphragm deflection (Δ) must be calculated using the equations noted in the Diaphragm Flexibility Limitations Table (Table 5).
2. Diaphragm flexibility limitations shall comply with Table 5.
3. Diaphragm deflection limits shall comply with Section 1633.2.9 of the UBC.

2.3.3 Panel Rib Roof and Panel Rib Wall Panels: Panel rib roof and panel rib wall panels are attached to intermediate steel supporting members spaced a maximum of 5 feet (1524 mm) on center with ITW Buildex No. 12-14 by 1 1/4-inch-long (31.7 mm) (wall) or 1 1/2-inch-long (38 mm) (roof) self-drilling, self-tapping, corrosion-resistant sheet metal screws at 12 inches (305 mm) on center. The steel supporting members must have a 0.059-inch (1.5 mm) minimum thickness and 55 ksi (379 MPa) minimum yield strength. The screws have a 5/16-inch (7.9 mm) hex washerhead. The washerhead diameter is approximately 9/16 inch (14 mm) and 3/8 inch (9.5 mm) for the screws used with the roof and wall panels, respectively. An additional 0.4375-inch-diameter-by-1/8-inch-thick (11.1 mm by 3.2 mm) EPDM washer is used with each fastener when attaching roof panels. Fasteners are spaced 12 inches (305 mm) on center, maximum, for diaphragm perimeter members which are parallel to the panel span. Panel-to-panel sidelap connections are ITW Buildex 1/4-14 by 7/8-inch-long (19.1 mm), self-drilling, self-tapping, corrosion-resistant screws with a 0.4375-inch-diameter-by-1/8-inch-thick (11.1 mm by 3.2 mm) EPDM washer (roof panels only), spaced at 30 inches (762 mm) on center. The screws have a 5/16-inch (7.9 mm) hex washerhead, with the washer having a diameter of approximately 9/16 inch (14 mm) or 3/8 inch (9.5 mm) for screws used with the roof or wall panels, respectively. See Figures 4 through 7. Roof panels and wall panels are overlapped 4 inches (102 mm) at panel ends.

2.3.4 Vee Rib Wall Panel: Vee Rib Wall Panels are attached together and to supports as described in Section 2.3.2 for the panel rib wall panels, except the Vee Rib panel ends are attached to the support members with one screw per foot (304.8 mm) of width.

2.4 Identification:

Bundles of panels bear a label or tag noting the manufacturer's name, the deck type, the gage, the ASTM specification and the evaluation report number (ER-4879).

ICC-ES legacy reports are not to be construed as representing aesthetics or any other attributes not specifically addressed, nor are they to be construed as an endorsement of the subject of the report or a recommendation for its use. There is no warranty by ICC Evaluation Service, Inc., express or implied, as to any finding or other matter in this report, or as to any product covered by the report.



3.0 EVIDENCE SUBMITTED

Data in accordance with the Acceptance Criteria for Steel Decks (AC43), dated January 2002, and quality control manuals.

4.0 FINDINGS

That VP Buildings, Inc., Steel Decks described in this report comply with the 1997 *Uniform Building Code*TM, subject to the following conditions:

4.1 Panels are manufactured and installed in accordance with this report and the manufacturer's instructions.

4.2 Allowable loads and deflections are as set forth in this report. The architect or engineer of record submits, to the building official for approval, calculations demonstrating that the applied loads comply with this report.

4.3 Where used as diaphragms:

4.3.1 A one-third increase in allowable shear values is not permitted for horizontal forces.

4.3.2 Allowable shear values for the type of deck involved are as set forth in Table 3.

4.3.3 Diaphragm deflections do not exceed the permitted relative deflections for walls between the diaphragm level and the floor below. See Table 5 for diaphragm flexibility and deflection limitations.

This report is subject to re-examination in one year.

TABLE 1—SECTION AND STRENGTH PROPERTIES^{1,2}

PANEL TYPE	METAL THICKNESS		DECK TOP IN COMPRESSION			DECK BOTTOM IN COMPRESSION		
	Gage	Inch	I (inch ⁴ /foot)	M_a (inch-kip/foot)	V_a (kip/foot)	I (inch ⁴ /foot)	M_a (inch-kip/foot)	V_a (kip/foot)
Panel Rib	26	0.0184	0.0332	1.100	0.724	0.0368	1.360	0.724
	24	0.0220	0.0417	1.421	1.032	0.0444	1.661	1.032
	22	0.0273	0.0547	1.723	1.498	0.0559	1.881	1.498
Vee Rip	26	0.0184	0.0201	0.866	0.222	0.0236	1.121	0.222
	24	0.0220	0.0226	0.988	0.378	0.0266	1.271	0.378
	22	0.0273	0.0263	1.176	0.724	0.0307	1.481	0.724

For SI: 1 inch = 25.4 mm, 1 in.⁴/ft. = 136.6 mm⁴/mm, 1 kip/foot = 1.46 × 10⁻² kN/mm, 1 inch-kip = 0.113 N-m, 1 kip = 4.45 kN, 1 kip-inch/foot = 0.371 kN/mm, 1 ksi = 6.89 MPa.

¹Combined stresses are to be considered in accordance with the following interaction formulas:

$$1.2(P/P_a) + (M/M_a) \leq 1.5$$

where:

P = Concentrated load or reaction (kip).

P_a = Allowable concentrated load or reaction based on Table 2 (kip).

M = Actual bending moment at or immediately adjacent to the point of application of the concentrated load or reaction (inch-kip).

M_a = Allowable bending moment based on Table 1 (inch-kip).

$$(V/V_a)^2 + (M/M_a)^2 \leq 1.0$$

where:

V = Actual shear force (kip).

V_a = Allowable shear force based on Table 1 (kip).

M = Actual bending moment (inch-kip).

M_a = Allowable bending moment based on Table 1 (inch-kip).

²Structural properties shall be based on $F_y = 50$ ksi, minimum.

TABLE 2—ALLOWABLE REACTIONS BASED ON WEB CRIPPLING¹

PANEL TYPE	BASE STEEL THICKNESS		MINIMUM BEARING LENGTH (inches)	ALLOWABLE LOAD (pounds/foot)	
	Gage	Inch		End Reaction or Load ² (P_a)	Interior Reaction or Load ² (P_a)
Panel Rib	26	0.0184	2 ¹ / ₂	132	296
	24	0.0220	2 ¹ / ₂	174	420
	22	0.0273	2 ¹ / ₂	246	630
Vee Ric	26	0.0184	2 ¹ / ₂	132	296
	24	0.0220	2 ¹ / ₂	174	420
	22	0.0273	2 ¹ / ₂	246	630

For SI: 1 inch = 25.4 mm, 1 pound/foot = 14.6 N/m.

¹Tabulated values are in accordance with web crippling requirements of the Specification for Design of Cold-formed Steel Structural Members, 1986 (with December 1989 Addendum), published by AISI, and referenced in Division VII, Chapter 22, of the UBC for locations of a concentrated load, or for a reaction acting either on the top or bottom flange when the clear distance between the bearing edges of the concentrated load and adjacent, opposite concentrated loads or reactions is greater than 1.5 times the deck depth.

²See Footnote 1 to Table 1.

TABLE 3—ALLOWABLE DIAPHRAGM SHEAR AND SHEAR STIFFNESS¹

PANEL TYPE	BASE STEEL THICKNESS		MAXIMUM DECK SPAN (feet)	SIDELAP FASTENER SPACING (inches)	SHEAR VALUE ^{2,3,4} (pounds per foot)	SHEAR STIFFNESS ⁴ G' (kips per inch)
	Gage	Inch				
Panel Rib Roof	26	0.0184	5 (Three continuous spans minimum)	20	192	42.8
	24	0.0220				
	22	0.0273				
Panel Rib Roof and Wall	26	0.0184		30	126	13.2
	24	0.0220				
	22	0.0273				
Panel Rib Wall	26	0.0184	2 feet 9 ³ / ₄ inches 5 feet 0 inch 7 feet 2 ¹ / ₄ inches	See Footnote 5	156	55.1
	24	0.0220				
	22	0.0273				
Vee Rib Wall	26	0.0184	2 feet 9 ³ / ₄ inches 5 feet 0 inch 7 feet 2 ¹ / ₂ inches	See Footnote 5	105	2.6
	24	0.0220				
	22	0.0273				
	26	0.0184	5 (Three continuous spans minimum)	30	105	
	24	0.0220				
	22	0.0273				

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound/foot = 14.59 N/m, 1 kip/inch = 175 kN/m.

¹See Figure 4 for end-support and intermediate-support fastening patterns.

²The one-third increase normally allowed for allowable stresses must not be used for resistance to horizontal forces due to earthquake or wind.

³For resistance to horizontal forces due to wind, the allowable shears must be permitted to be increased by a factor of 1.06.

⁴See Table 4 for diaphragm deflection computations.

⁵A minimum of one fastener is required between supports. Two fasteners are required when support spacing exceeds 60 inches. In addition, one fastener must be placed at each support.

TABLE 4—DEFLECTION OF SHEAR DIAPHRAGMS

TYPE OF DIAPHRAGM	LOADING CONDITION	BENDING DEFLECTION, Δ_b	SHEAR DEFLECTION, Δ_s
Simple Beam (at center)	Uniform Load	$\frac{5wL^4(12)^3}{384EI}$	$\frac{wL^2}{8G'b}$
Simple Beam (at center)	Load P applied at center	$\frac{PL^3(12)^3}{48EI}$	$\frac{PL}{4G'b}$
Simple Beam (at center)	Load P applied one-third points of span	$\frac{23PL^3(12)^3}{648EI}$	$\frac{PL}{3G'b}$
Cantilever Beam (at free end)	Uniform Load	$\frac{wa^4(12)^3}{8EI}$	$\frac{wa^2}{2G'b}$
Cantilever Beam (at free end)	Load P applied at free end	$\frac{Pa^3(12)^3}{3EI}$	$\frac{Pa}{G'b}$

For SI: 1 inch = 25.4 mm, 1 ksi = 6.89 MPa, 1 kip/inch = 175 kN/m, 1 foot = 304.8 mm, 1 kip = 4.448 kN, 1 kip/foot = 14.59 kN/m.

where:

- E = Modulus of elasticity of steel, 29,500 ksi.
- I = Moment of inertia of flange perimeter members about the centroidal axis of the diaphragm (inch⁴).
- G' = Shear stiffness of the diaphragm obtained from Table 3 (kip/inch).
- L = Span length of a simple beam (foot).
- a = Span length of cantilever beam (foot).
- b = Depth of analogous beam (foot).
- P = Concentrated load (kip).
- w = Uniform load (kip/foot).

NOTE: The total deflection of shear diaphragms consists of both the bending and shear deflections:

$$\Delta_{total} = \Delta_b + \Delta_s$$

where:

- Δ_{total} = Total deflection of shear diaphragm (inch).
- Δ_b = Bending deflection (inch).
- Δ_s = Shear deflection including the deflection due to seam slip and profile distortion (inch).

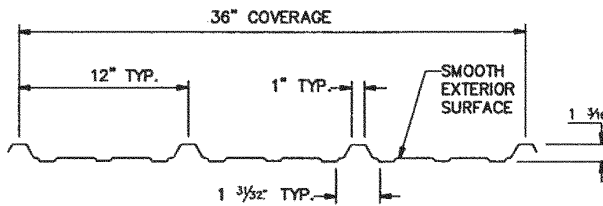
TABLE 5—DIAPHRAGM STIFFNESS LIMITATIONS²

STIFFNESS CATEGORY	SHEAR STIFFNESS G' (kip/inch)	MAXIMUM SPAN IN FEET FOR MASONRY OR CONCRETE WALLS	SPAN DEPTH LIMITATION			
			Rotation Not Considered in Diaphragm Design		Rotation Considered in Diaphragm Design	
			Masonry or Concrete Walls	Flexible Walls ¹	Masonry or Concrete Walls	Flexible Walls ¹
Very flexible	<7	Not used	Not used	2:1	Not used	1 1/2:1
Flexible	7-14	200	2:1 or as required for deflection	3:1	Not used	2:1
Semi-flexible	14-100	400	2 1/2:1 or as required for deflection	4:1	As required for deflection	2 1/2:1
Semi-stiff	100-1,000	No limitation	3:1 or as required for deflection	5:1	As required for deflection	3:1
Stiff	>1,000	No limitation	As required for deflection	No limitation	As required for deflection	3 1/2:1

For SI: 1 foot = 304.8 mm, 1 kip/inch = 175 kN/m.

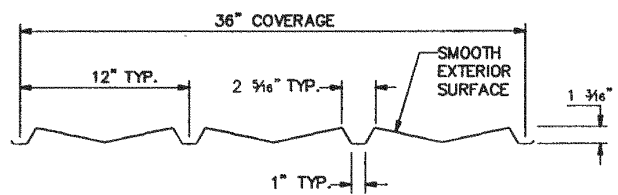
¹When applying these limitations to cantilever diaphragms, the span depth-ratio will be one-half that shown.

²Diaphragm classification (flexible or rigid) and deflection limits must comply with Section 2.3.2.



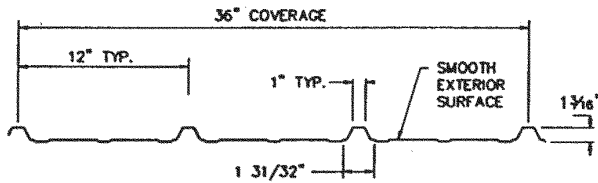
For SI: 1 inch = 25.4 mm.

FIGURE 1—PANEL RIB WALL PANEL



For SI: 1 inch = 25.4 mm.

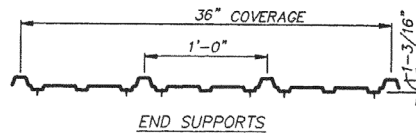
FIGURE 2—VEE RIB WALL PANEL



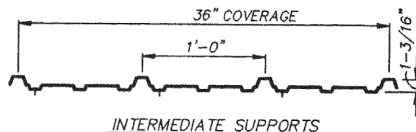
For SI: 1 inch = 25.4 mm.

FIGURE 3—PANEL RIB ROOF PANEL

PANEL RIB ROOF AND WALL PANELS

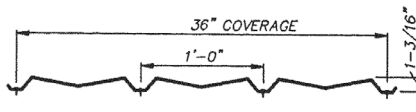


END SUPPORTS



INTERMEDIATE SUPPORTS

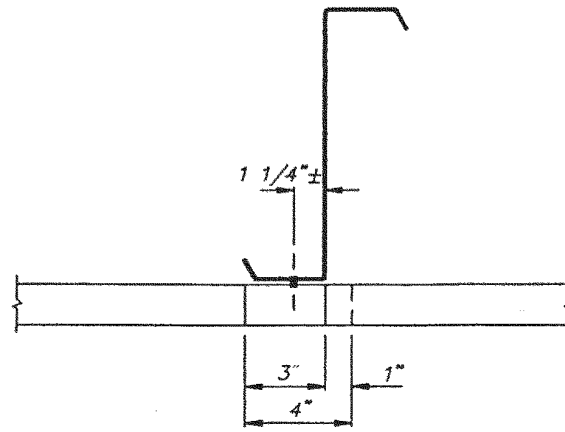
VEE RIB WALL PANELS



END SUPPORTS AND INTERMEDIATE SUPPORTS

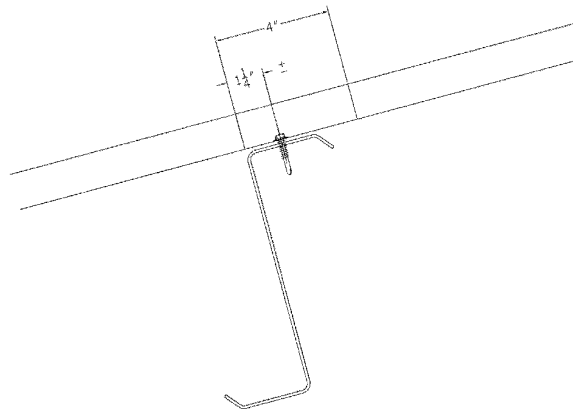
For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

FIGURE 4—END SUPPORT AND INTERIOR SUPPORT FASTENER PATTERNS



For SI: 1 inch = 25.4 mm.

FIGURE 5—PANEL RIB WALL, PANEL RIB ROOF, AND VEE RIB WALL END LAP



For SI: 1 inch = 25.4 mm.

FIGURE 6—PANEL RIB ROOF END LAP

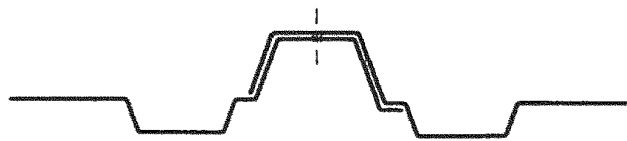


FIGURE 7—STITCH FASTENER AT SIDE LAP