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ANAB ACCREDITED ISO/IEC 17065 PRODUCT CERTIFICATION BODY

Technical Evaluation Report™

TER 2302-57

Insulated Concrete Panels in Roof, Floor, and Wall Applications

Vero Building Systems

Product:

Vero Wall, Floor and Roof Panels

Issue Date:

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March 22, 2024

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COMPANY INFORMATION:	ADDITIONAL LISTEES:

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DIVISION: 03 00 00 - CONCRETE	SECTION: 03 37 00 - Specialty Placed Concrete
SECTION: 03 11 19 - Insulating Concrete Forming	DIVISION: 07 00 00 - THERMAL AND MOISTURE PROTECTION
SECTION: 03 21 00 - Reinforcement Bars	SECTION: 07 21 00 - Thermal Insulation
SECTION: 03 31 16 - Lightweight Structural Concrete	

1 Innovative Products Evaluated[1,2]

1.1 Vero Wall, Floor and Roof Panels

2 Applicable Codes and Standards[3,4]

2.1 *Codes*

2.1.1 *IBC—15, 18, 21: International Building Code®*

2.1.2 *IRC—15, 18, 21: International Residential Code®*

2.1.3 *IECC—15, 18, 21: International Energy Conservation Code®*

2.1.4 *FBC-B—20, 23: Florida Building Code – Building[5]*

2.1.5 *FBC-R—20, 23: Florida Building Code – Residential[5]*

2.2 *Standards and Referenced Documents*

2.2.1 *ACI 318: Building Code Requirements for Structural Concrete*

2.2.2 *ACI 506R: Guide to Shotcrete*

2.2.3 *ANSI/ASHRAE/IES 90.1: Energy Standard for Buildings Except Low-Rise Residential Buildings*

2.2.4 *ASCE/SEI 7: Minimum Design Loads and Associated Criteria for Buildings and Other Structures*

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1 For more information, visit drjcertification.org or call us at 608-310-6748.

2 **Federal Regulation Definition.** 24 CFR 3280.2 "Listed or certified" means included in a list published by a nationally recognized testing laboratory, inspection agency, or other organization concerned with product evaluation that maintains periodic inspection of production of listed equipment or materials, and whose listing states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner. **International Building Code (IBC) Definition of Listed.** Equipment, materials, products or services included in a list published by an organization acceptable to the building official and concerned with evaluation of products or services that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services and whose Listing states either that the equipment, material, product or service meets identified standards or has been tested and found suitable for a specified purpose. **IBC Definition of Labeled**. Equipment, materials or products to which has been affixed a label, seal, symbol or other identifying mark of a nationally recognized testing laboratory, approved agency or other organization concerned with product evaluation that maintains periodic inspection of the production of the above-labeled items and whose labeling indicates either that the equipment, material or product meets identified standards or has been tested and found suitable for a specified purpose.

3 This Listing is a code defined research report, which is also known as a duly authenticated report, provided by an approved agency (see IBC Section 1703.1) and/or an approved source (see IBC Section 1703.4.2). An approved agency is "approved" when it is ANAB accredited. DrJ Engineering, LLC (DrJ) is listed in the ANAB directory). A professional engineer is "approved" as an approved source when that professional engineer is properly licensed to transact engineering commerce. Where sealed by a professional engineer, it is also a duly authenticated report certified by an approved source. (i.e., Registered Design Professional). DrJ is an ANAB accredited product certification body.

4 Unless otherwise noted, all references in this Listing are from the 2021 version of the codes and the standards referenced therein. This material, product, design, service and/or method of construction also complies with the 2000-2021 versions of the referenced codes and the standards referenced therein.

5 All references to the FBC-B and FBC-R are the same as the 2021 IBC and IRC unless otherwise noted in the Florida Supplement at the end of this TER.

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2.2.5 *ASTM C42: Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete*

2.2.6 *ASTM C387: Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar*

2.2.7 *ASTM C578: Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation*

2.2.8 *ASTM C1140: Standard Practice for Preparing and Testing Specimens from Shotcrete Panels*

2.2.9 *ASTM E72: Standard Test Methods of Conducting Strength Tests of Panels for Building Construction*

2.2.10 *ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials*

2.2.11 *BS EN 1365: Fire Resistance Tests for Loadbearing Elements – Walls*

3 Performance Evaluation

3.1 Tests, test reports, research reports, duly authenticated reports and related engineering evaluations are defined as intellectual property and/or trade secrets and protected by Defend Trade Secrets Act 2016 (DTSA).[6]

3.2 Testing and/or inspections conducted for this TER were performed an ISO/IEC 17025 accredited testing laboratory,[7] an ISO/IEC 17020 accredited inspection body,[8] which are internationally recognized accreditations through International Accreditation Forum (IAF), and/or a licensed Registered Design Professional (RDP).

3.3 Vero Wall, Floor and Roof Panels are concrete sandwich panel assemblies used in bearing and non-bearing concrete wall applications and in reinforced concrete floor and roof assembly applications.

3.3.1 The assemblies are used in both fire-rated and non-fire-rated construction.

3.4 Vero Wall, Floor and Roof Panels were tested to evaluate performance under the following conditions:

3.4.1 Structural performance under bending loading conditions for the purpose of determining:

3.4.1.1 The bending stiffness and strength for bending about each axis (strong and weak).

3.4.1.2 The shear stiffness and strength for bending about each axis.

3.4.1.3 The bearing reaction strength for bending about each axis.

3.4.2 Structural performance under concentric and eccentric compression loading conditions for the purpose of determining:

3.4.2.1 The compressive stiffness and strength about the strong axis.

3.4.3 Structural performance under concentric compression loading conditions for the purpose of determining the compressive bearing and shear capacity about the strong axis.

3.4.4 Structural performance under both bending and concentric compression loading conditions for the purpose of determining the second-order effects of combined bending and compression about the strong axis.

3.5 Vero Wall, Floor and Roof Panels were evaluated for fire endurance performance.

3.6 Vero Wall, Floor and Roof Panels were evaluated for thermal resistance properties.

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[6] https://www.law.cornell.edu/uscode/text/18/part-I/chapter-90. Given our professional duty to inform, please be aware that whoever, with intent to convert a trade secret (TS), that is related to a product or service used in or intended for use in interstate or foreign commerce, to the economic benefit of anyone other than the owner thereof, and intending or knowing that the offense will, injure any owner of that trade secret, knowingly without authorization copies, duplicates, sketches, draws, photographs, downloads, uploads, alters, destroys, photocopies, replicates, transmits, delivers, sends, mails, communicates, or conveys such information; shall be fined under this title or imprisoned not more than 10 years, or both. Any organization that commits any offense described in subsection (a) shall be fined not more than the greater of $5,000,000 or 3 times the value of the stolen trade secret to the organization, including expenses for research and design and other costs of reproducing the trade secret that the organization has thereby avoided. The federal government and each state have a public records act. As the National Society of Professional Engineers states, "Engineers shall not disclose, without consent, confidential information concerning the business affairs or technical processes of any present or former client or employer, or public body on which they serve." Therefore, to protect intellectual property (IP) and TS, and to achieve compliance with public records and trade secret legislation, requires approval through the use of Listings, certified reports, technical evaluation reports, duly authenticated reports and/or research reports prepared by approved agencies and/or approved sources. For more information, please review this website: Intellectual Property and Trade Secrets.

[7] Internationally recognized accreditations are performed by members of the International Accreditation Forum (IAF). Accreditation Body and Regional Accreditation Group Members of IAF are admitted to the IAF MLA only after a stringent evaluation of their operations by a peer evaluation team, which is charged to ensure that the applicant complies fully with both international standards and IAF requirements. Once an accreditation body is a signatory of the IAF MLA, it is required to recognise certificates and validation and verification statements issued by conformity assessment bodies accredited by all other signatories of the IAF MLA, with the appropriate scope.

[8] Ibid.

3.7 Vero Wall, Floor and Roof Panels were evaluated for use in high velocity hurricane zones (HVHZ).

3.8 Any building code and/or accepted engineering evaluations (i.e. research reports, duly authenticated reports, etc.) that are conducted for this Listing were performed by DrJ Engineering, LLC (DrJ), an ISO/IEC 17065 accredited certification body and a professional engineering company operated by RDPs / approved sources. DrJ is qualified[9] to practice product and code compliance services within its scope of accreditation and engineering expertise, respectively.

3.9 Engineering evaluations are conducted with DrJ's ANAB accredited ICS code scope, which are also its areas of professional engineering competence.

3.10 Any regulation specific issues not addressed in this section are outside the scope of this TER.

4 Product Description and Materials

4.1 These innovative products, Vero Insulated Concrete Panels, are prefabricated lightweight structural elements consisting of an Expanded Polystyrene (EPS) core sandwiched between two layers of galvanized steel welded wire mesh.

4.1.1 A steel wire connector is pierced completely through the EPS core and welded to each of the outer layers of galvanized steel welded wire mesh.

4.1.2 Where needed, deformed steel reinforcement bars are used.

4.1.3 A mortar achieving 4,000 psi at 28 days is sprayed onto each side of the panels at the jobsite to create monolithic wall, wall/slab, and wall/roof concrete elements.

4.1.4 Application equipment designed specifically for the application of mortar mixes is highly recommended.

4.2 *Material*

4.2.1 *EPS Core:*

4.2.1.1 The EPS foam core is made up of Type I EPS foam boards conforming to ASTM C578.

4.2.1.2 The EPS core is molded into proprietary shapes, which vary depending on the intended application (i.e., wall, floor, or roof application).

4.2.1.3 The EPS core thickness varies depending on the application.

4.2.1.4 The EPS core has the following characteristics:

4.2.1.4.1 Minimum Density: 0.9 pcf (the density can be increased to improve the thermal resistance)

4.2.1.4.2 Flame Spread Index:[10] 25 or less

4.2.1.4.3 Smoke Developed Index:[10] 450 or less

4.2.2 *Steel Welded Wire Mesh for PSM and PSS Panels:*

4.2.2.1 The galvanized steel welded wire mesh is made from steel with minimum ultimate tensile stress of 95 ksi and complies with ACI 318-19 Section 20.2.1.7 and IBC Section 1903.

4.2.2.2 Longitudinal, or principal, direction wires are 3.0 mm (11-gauge) in thickness and have an equivalent spacing of 3".

4.2.2.3 Transverse, or secondary, direction wires are 2.5 mm (12.5-gauge) in thickness and have a uniform spacing of 2.6" o.c.

4.2.2.4 The front and back wire mesh layers are tied together along the longitudinal direction in six (6) rows with 3.0 mm (11-gauge) wire.

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[9] Qualification is performed by a legislatively defined Accreditation Body. ANSI National Accreditation Board (ANAB) is the largest independent accreditation body in North America and provides services in more than 75 countries. DrJ is an ANAB accredited product certification body.

[10] When tested in accordance with ASTM E84 in a 4" thickness and maximum 1.0 pcf density.

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4.2.3 *Steel Welded Wire Mesh for PSG2 and PSG3:*

4.2.3.1 The galvanized steel welded wire mesh is made from steel with minimum fracture of 95 ksi, and complies with ACI 318-19 Section 20.2.1.7 and IBC Section 1903.

4.2.3.2 Longitudinal, or principal, direction wires are 2.5 mm (12.5-gauge) in thickness and have an equivalent spacing of 3".

4.2.3.3 Transverse, or secondary, direction wires are 2.5 mm (12.5-gauge) in thickness and have a uniform spacing of 3.9″ o.c.

4.2.3.4 The front and back wire mesh layers are tied together along the longitudinal direction in six (6) rows with 3.0 mm (11-gauge) wire.

4.2.4 *Other Reinforcement:*

4.2.4.1 Where required, deformed steel reinforcement bars are used, which have a minimum yield stress of 60 ksi and comply with ACI 318-19 Section 20.2.1.3 and IBC Section 1903.

4.2.5 *Structural Mortar Application:*

4.2.5.1 The mortar used must have the following characteristics:

4.2.5.1.1 Comply with: ASTM C387

4.2.5.1.2 Minimum compressive strength of 4,000 psi at 28 days according to ASTM C387

4.2.5.1.3 Maximum aggregate size: $^{3}/_{8}$"

4.2.5.1.4 Aggregate must conform to ACI 506R-05 Table 1.1

4.2.6 *Concrete:*

4.2.6.1 The placed concrete must be a normal weight complying with IBC Chapter 19 and have the following characteristics:

4.2.6.1.1 Minimum compressive strength of 3,500 psi at 28 days according to ASTM C387

4.2.6.1.2 Slump: minimum 2"

4.2.6.1.3 Maximum aggregate size: $^{1}/_{2}$"

4.3 *Vero PSM Wall Panels*

4.3.1 Vero wall panels designated PSM consist of a single layer of wire mesh on each side of an EPS core varying from 2.4" (60 mm) up to 9.4" (240 mm) in thickness. A typical section configuration is shown in Figure 1.

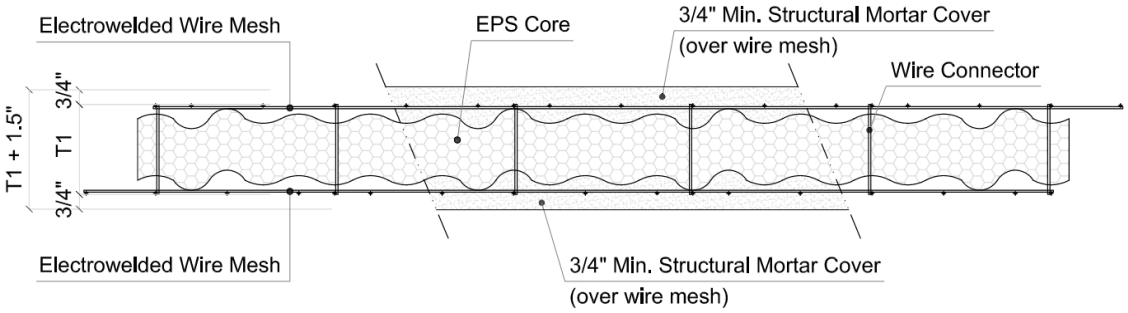


Figure 1. PSM Wall Section

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4.3.2 A minimum of 0.75" of mortar cover is required over the outer face of the wire mesh on each side, resulting in an average of 1.48" thick mortar cover on each side of the panel.

4.3.3 See Table 1 for a complete list of PSM wall panel dimensions.

Table 1. PSM Wall Panel Dimensions

Vero Panel Type	EPS Core Thickness		Wire-to-Wire Panel Thickness (T1) (in)	Finish Panel Thickness (in)	Self-Weight (psf)
	(mm)	(in)			
PSM60	60	2.36	3.82	5.32	34.77
PSM80	80	3.15	4.61	6.11	34.85
PSM100	100	3.94	5.39	6.89	34.93
PSM120	120	4.72	6.18	7.68	35.00
PSM140	140	5.51	6.97	8.47	35.08
PSM160	160	6.30	7.76	9.26	35.16
PSM180	180	7.09	8.54	10.04	35.24
PSM200	200	7.87	9.33	10.83	35.32
PSM220	220	8.66	10.12	11.62	35.40
PSM240	240	9.45	10.91	12.41	35.47
SI: 1 in = 25.4 mm, 1 lb = 4.45 N					

4.4 *Vero PSS Floor/Roof Slab Panels*

4.4.1 Vero floor slab or roof panels designated PSS consist of an EPS core varying from 3.1" (80 mm) up to 9.4" (240 mm) in thickness. A typical section configuration is shown in Figure 2.

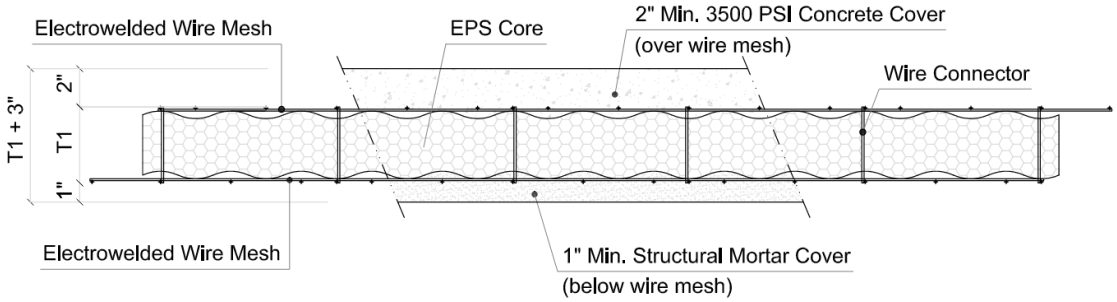


Figure 2. PSS Slab Section

4.4.2 Working as floor slabs or a roof system, the upper side is poured with a concrete layer (3,500 psi) and will be 2.4" thick with at least 2" over the wire mesh.

4.4.3 The lower side of the section requires a minimum of 1" of mortar cover under the outer face of the wire mesh for a total average depth of 1.4".

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4.4.4 See Table 2 for a complete list of PSS wall panel dimensions.

Table 2. PSS Slab Panel Dimensions

Vero Panel Type	EPS Core Thickness		Wire-to-Wire Panel Thickness (T1) (in)	Finish Panel Thickness (in)	Self-Weight (psf)
	(mm)	(in)			
PSS80	80	3.15	3.98	6.98	47.23
PSS100	100	3.94	4.76	7.76	47.30
PSS120	120	4.72	5.55	8.55	47.38
PSS140	140	5.51	6.34	9.34	47.46
PSS160	160	6.30	7.13	10.13	47.54
PSS180	180	7.09	7.91	10.91	47.62
PSS200	200	7.87	8.70	11.70	47.70
PSS220	220	8.66	9.49	12.49	47.78
PSS240	240	9.45	10.28	13.28	47.85
SI: 1 in = 25.4 mm, 1 lb = 4.45 N					

4.5 *Vero PSG2 Floor/Roof Slab Panels*

4.5.1 Vero floor slab or roof panels designated PSG2 consist of EPS cores with voids to form two (2) concrete joists for every 4' of width. A typical slab section configuration is shown in Figure 3.

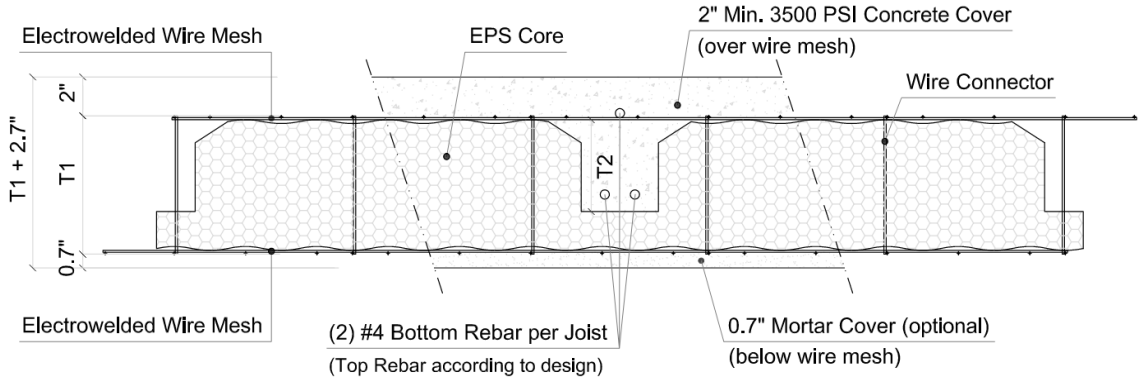


Figure 3. PSG2 Slab Section

4.5.2 The joist depth will vary from 3.15" (80 mm) up to 9.4" (240 mm), according to the structural requirements.

4.5.3 The joists have a width of 4″

4.5.4 The upper side of the slab is covered with a concrete layer (3,500 psi). The concrete cover shall be a minimum of 2.3" thick with at least 2" over the wire mesh.

4.5.4.1 The PSG2 slab panel allowable loads provided in Table 6 are based on a concrete strength of 3,500 psi. The concrete strength may be increased in order to improve the performance of the slab.

4.5.4.1.1 Where higher strength concrete is used, consult a licensed professional engineer for determining allowable design values. Alternately, the values in Table 6 may be conservatively used.

4.5.5 The mortar cover on the underside of the slab shall be a minimum cover of 0.7″ under the outer face of the wire mesh for a total average thickness of 1″.

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4.5.6 The allowable loads for the PSG2 slabs provided in Table 6 are calculated considering two (2) #4 rebar located on the tension (lower) side of each concrete joist. Two (2) #4 rebar are required to achieve the allowable loads provided in Table 6.

4.5.6.1 Where other rebar configurations are used, consult a licensed professional engineer for determining allowable design values.

4.5.6.2 When required by the building design, rebar is placed in the top concrete layer.

4.5.7 See Table 3 for a complete list of PSG2 wall panel dimensions.

Table 3. PSG2 Slab Panel Dimensions

Vero Panel Type	Joist Depth (T2)		Wire-to-Wire Panel Thickness (T1) (in)	Finish Panel Thickness (in)	Self-Weight (psf)
	(mm)	(in)			
PSG2-80	80	3.15	5.51	8.21	46.53
PSG2-100	100	3.94	6.30	9.00	48.24
PSG2-120	120	4.72	7.09	9.79	49.94
PSG2-140	140	5.51	7.87	10.57	51.65
PSG2-160	160	6.30	8.66	11.36	53.35
PSG2-180	180	7.09	9.45	12.15	55.06
PSG2-200	200	7.87	10.24	12.94	56.76
PSG2-220	220	8.66	11.02	13.72	58.46
PSG2-240	240	9.45	11.81	14.51	60.17
SI: 1 in = 25.4 mm, 1 lb = 4.45 N					

4.6 *Vero PSG3 Floor/Roof Slab Panels*

4.6.1 Vero floor slab or roof panels designated PSG3 consist of EPS cores with voids to form three (3) concrete joists for every 4' of width. A typical slab section configuration is shown in Figure 4.

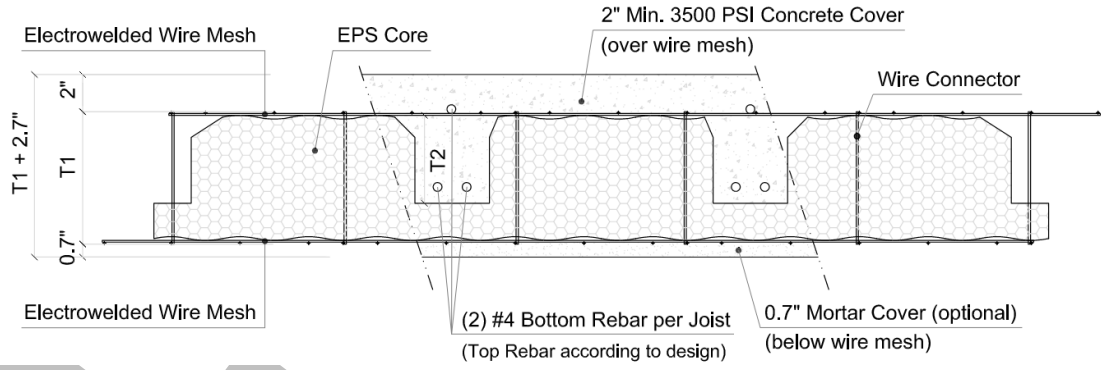


Figure 4. PSG3 Slab Section

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4.6.2 The joist depth varies from 3.15" (80 mm) up to 9.4" (240 mm), according to the requirements.

4.6.3 The joists have a width of 4″.

4.6.4 The upper side of the slab is covered with a concrete layer (3,500 psi). The concrete cover shall be a minimum of 2.3" thick with at least 2" over the wire mesh.

4.6.4.1 The PSG3 slab panel allowable loads provided in Table 6 are based on a concrete strength of 3,500 psi. The concrete strength may be increased in order to improve the performance of the slab.

4.6.4.1.1 Where higher strength concrete is used, consult a licensed professional engineer for determining allowable design values. Alternately, the values in Table 6 may be conservatively used.

4.6.5 The mortar cover on the underside of the slab shall be a minimum cover of 0.7″ under the outer face of the wire mesh for a total average thickness of 1″.

4.6.6 The allowable loads for the PSG3 slabs provided in Table 6 are calculated considering two (2) #4 rebar located on the tension (lower) side of each concrete joist. Two (2) #4 rebar are required to achieve the allowable loads provided in Table 6.

4.6.6.1 Where other rebar configurations are used, consult a licensed professional engineer for determining allowable design values.

4.6.6.2 When required by the building design, rebar may be placed in the top concrete layer.

4.6.7 See Table 4 for a complete list of PSG3 wall panel dimensions.

Table 4. PSG3 Slab Panel Dimensions

Vero Panel Type	Joist Depth (T2)		Wire-to-Wire Panel Thickness (T1) (in)	Finish Panel Thickness (in)	Self-Weight (psf)
	(mm)	(in)			
PSG3-80	80	3.15	5.51	8.21	49.79
PSG3-100	100	3.94	6.30	9.00	52.31
PSG3-120	120	4.72	7.09	9.79	54.83
PSG3-140	140	5.51	7.87	10.57	57.35
PSG3-160	160	6.30	8.66	11.36	59.86
PSG3-180	180	7.09	9.45	12.15	62.38
PSG3-200	200	7.87	10.24	12.94	64.90
PSG3-220	220	8.66	11.02	13.72	67.42
PSG3-240	240	9.45	11.81	14.51	69.94
SI: 1 in = 25.4 mm, 1 lb = 4.45 N					

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4.7 *Panel Section Properties*

4.7.1 Vero insulated concrete wall panels have the section properties given in Table 5.

Table 5. Material Properties for Vero Insulated Concrete Wall Panels

Vero Panel Type	Gross Section Bending Stiffness, EI [lb-in²/ft of Panel Width]	Cracked Section Bending Stiffness, EI [lb-in²/ft of Panel Width]	Cracking Moment, M_{cr} [ft.-lb/ft of Panel Width]	Nominal Flexural Strength, M_n [ft-lb/ft of Panel Width]	Nominal Shear Strength, V_n (lb/Q) [lb/ft of Panel Width]	Axial Stiffness, EA [lb/ft of Panel Width]	Nominal Compressive Strength, P_n [lb/ft of Panel Width]
PSM60	13,700,000	6,800,000	1,480	1,530	4,490	76,380,000	39,915
PSM80	19,000,000	9,500,000	1,190	1,800	4,490	76,380,000	39,915
PSM100	25,200,000	12,600,000	990	2,060	4,490	76,380,000	39,915
PSM120	32,300,000	16,200,000	840	2,330	4,490	76,380,000	39,915
PSM140	40,400,000	20,200,000	720	2,590	4,490	76,380,000	39,915
PSM160	49,300,000	24,600,000	630	2,860	4,490	76,380,000	39,915
PSM180	59,100,000	29,500,000	560	3,130	4,490	76,380,000	39,915
PSM200	69,800,000	34,900,000	500	3,390	4,490	76,380,000	39,915
PSM220	81,400,000	40,700,000	450	3,660	4,490	76,380,000	39,915
PSM240	93,900,000	47,000,000	410	3,920	4,490	76,380,000	39,915
SI: 1 in = 25.4 mm, 1 lb = 4.45 N							

4.7.2 Vero insulated concrete floor and roof panels have the section properties given in Table 6.

Table 6. Material Properties for Vero Insulated Concrete Floor and Roof Panels

Vero Panel Type	Gross Section Bending Stiffness, EI [lb-in²/ft of Panel Width]	Cracked Section Bending Stiffness, EI [lb-in²/ft of Panel Width]	Cracking Moment, M_{cr} [ft-lb/ft of Panel Width]	Nominal Flexural Strength, M_n [ft-lb/ft of Panel Width]	Nominal Shear Strength, V_n (lb/Q) [lb/ft of Panel Width]
PSS80	43,300,000	17,700,000	760	2,090	5,435
PSS100	43,300,000	17,700,000	760	2,350	5,435
PSS120	43,300,000	17,700,000	760	2,620	5,435
PSS140	43,300,000	17,700,000	760	2,880	5,435
PSS160	43,300,000	17,700,000	760	3,150	5,435
PSS180	43,300,000	17,700,000	760	3,410	5,435
PSS200	43,300,000	17,700,000	760	3,680	5,435
PSS220	43,300,000	17,700,000	760	3,950	5,435
PSS240	43,300,000	17,700,000	760	4,210	5,435
PSG2-80	163,000,000	82,000,000	502	6,510	3,270
PSG2-100	243,000,000	117,000,000	638	7,550	3,270
PSG2-120	349,000,000	159,000,000	803	8,590	3,350

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Vero Panel Type	Gross Section Bending Stiffness, EI [lb-in²/ft of Panel Width]	Cracked Section Bending Stiffness, EI [lb-in²/ft of Panel Width]	Cracking Moment, M_{cr} [ft-lb/ft of Panel Width]	Nominal Flexural Strength, M_n [ft-lb/ft of Panel Width]	Nominal Shear Strength, V_n (lb/Q) [lb/ft of Panel Width]
PSG2-140	484,000,000	208,000,000	995	9,630	3,750
PSG2-160	651,000,000	264,000,000	1,212	10,670	4,140
PSG2-180	853,000,000	325,000,000	1,453	11,710	4,530
PSG2-200	1,092,000,000	394,000,000	1,717	12,750	4,920
PSG2-220	1,371,000,000	469,000,000	2,004	13,880	5,320
PSG2-240	1,691,000,000	551,000,000	2,312	14,820	5,710
PSG3-80	210,000,000	113,000,000	679	8,370	3,270
PSG3-100	317,000,000	164,000,000	882	9,790	3,730
PSG3-120	459,000,000	225,000,000	1,123	11,220	4,230
PSG3-140	639,000,000	295,000,000	1,399	12,640	4,720
PSG3-160	859,000,000	376,000,000	1,709	14,070	5,220
PSG3-180	1,123,000,000	466,000,000	2,050	15,490	5,710
PSG3-200	1,435,000,000	567,000,000	2,423	16,920	6,210
PSG3-220	1,796,000,000	677,000,000	2,825	18,340	6,700
PSG3-240	2,211,000,000	797,000,000	3,256	19,770	7,200
SI: 1 in = 25.4 mm, 1 lb = 4.45 N					

4.7.3 An effective bending stiffness for calculating deflections of Vero insulated concrete panels can be determined following procedures in ACI 318-19 Section 24.2.3.5.

4.7.4 Additional long-term deflection resulting from creep and shrinkage can be determined by multiplying the immediate deflection due to sustained loads by the factor λ_Δ: (see ACI 318-19 Section 24.2.4.1.1)

$$\lambda_\Delta = \frac{\xi}{1 + 50\rho'}$$

where:

ξ = Time dependent factor for sustained loads = 2.0 (for 5 years or more)

ρ' = Reinforcement ratio for the compression steel

4.7.5 Vero insulated concrete panels may be cambered to reduce the immediate deflection due to dead load and the long-term deflection due to sustained loads.

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5 Applications

5.1 *Axial Loading*

5.1.1 Vero insulated concrete wall panels have the allowable axial service load capacity, using the controlling design condition of compressive strength or buckling, as shown in Table 7.

Table 7. Allowable Axial Service Load (plf) for Various Wall Heights (ft)

Vero Panel Type	Self-Weight (psf)	Allowable Axial Service Load (plf)						
		Wall Height (ft)						
		8	10	12	14	16	18	20
PSM60	35	12,930	8,275	5,745	4,220	3,230	2,550	2,065
PSM80	35	16,185	11,815	8,205	6,025	4,615	3,645	2,950
PSM100	35	16,185	16,010	11,120	8,170	6,255	4,940	4,000
PSM120	35	16,185	16,185	14,490	10,645	8,150	6,440	5,215
PSM140	35	16,185	16,185	16,185	13,455	10,300	8,135	6,590
PSM160	35	16,185	16,185	16,185	16,185	12,705	10,040	8,130
PSM180	35	16,185	16,185	16,185	16,185	15,370	12,145	9,835
PSM200	35	16,185	16,185	16,185	16,185	16,185	14,450	11,705
PSM220	35	16,185	16,185	16,185	16,185	16,185	16,185	13,735
PSM240	36	16,185	16,185	16,185	16,185	16,185	16,185	15,930

Values limited by buckling.

Values limited by compressive strength.

SI: 1 in = 25.4 mm, 1 lb/ft = 0.0146 kN/m

1. All loads applied to the wall are considered as live load.
2. Allowable service loads are calculated by dividing the design strength, φMn, by a load factor of 1.6 according to the load combinations in ACI 318-19 Section 5.3.
3. The capacities in this table are for pure compression only. Bending moments due to eccentric loads are not considered. See interaction diagrams for combined flexure and axial loads.

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5.2 *Transverse Wall Loading*

5.2.1 Vero insulated concrete wall panels have the allowable transverse service (i.e., wind, soil, pressure, etc.) load capacities listed in Table 8. The load capacities shown are limited by the controlling design condition of shear strength, bearing strength, bending strength, or deflection at L/240 for walls with brittle finishes.

Table 8. Allowable Transverse Service Load (psf) for Various Wall Heights (ft)

Vero Panel Type	Self-Weight (psf)	Allowable Transverse Service Load (psf)										
		Wall Height (ft)										
		6	8	10	12	14	16	18	20	24	28	32
PSM60	35	130	60	30	15	10	5	5	5	-	-	-
PSM80	35	180	80	40	25	15	10	5	5	5	-	-
PSM100	35	200	105	55	30	20	15	10	5	5	5	-
PSM120	35	200	135	70	40	25	15	10	10	5	5	-
PSM140	35	200	165	85	50	30	20	15	10	5	5	5
PSM160	35	200	195	105	65	40	25	20	15	10	5	5
PSM180	35	200	200	125	75	45	30	20	15	10	5	5
PSM200	35	200	200	150	90	55	40	25	20	10	5	5
PSM220	35	200	200	165	105	65	45	30	25	15	10	5
PSM240	35	200	200	175	115	75	50	35	25	15	10	5

Values limited by flexural capacity.

Values limited by deflection limit.

Allowable loads in this table are limited to 200 PSF. If greater resistance is needed, please contact Vero for professional engineering assistance.

SI: 1 in = 25.4 mm, 1 psf = 0.0479 kN/m^2

1. The deflection limit is L/240 for walls with brittle finishes per IBC Table 1604.3. Other deflection limits can be provided upon request.
2. All loads applied to the wall are considered as live load.
3. Allowable service loads are calculated by dividing the design strength, φMn, by a load factor of 1.6 according to the load combinations in ACI 318-19 Section 5.3.
4. Assumes that the panel is oriented with the strong axis in the vertical direction.

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5.3 *Allowable Floor/Roof Panel Loading*

5.3.1 Vero insulated concrete floor and roof panels have the allowable service live load (i.e., bedroom, office, snow load, etc.) capacities listed in Table 9. The load capacities shown are limited by the controlling design condition of shear strength, bearing strength, bending strength, or deflection (minimum code requirement for the floor) at L/360 for live load (LL) and L/240 for total load (TL).

Table 9. Allowable Service Live Load for Vero Insulated Floor/Roof Panels

Vero Panel Type	Self-Weight (psf)	Allowable Floor/Roof Service Live Load (psf) for 15 psf of DL and Floor or Roof Deflection Limits of L/360 for LL & L/240 for TL										
		Span Length (ft)										
		6	8	10	12	14	16	18	20	24	28	32
PSS80	47	200	110	55	25	10	-	-	-	-	-	-
PSS100	47	200	120	65	35	15	-	-	-	-	-	-
PSS120	47	200	120	65	35	20	5	-	-	-	-	-
PSS140	47	200	120	65	35	25	10	-	-	-	-	-
PSS160	48	200	120	65	35	25	15	5	-	-	-	-
PSS180	48	200	120	65	35	25	15	10	-	-	-	-
PSS200	48	200	120	65	35	25	15	10	-	-	-	-
PSS220	48	200	120	65	35	25	15	10	5	-	-	-
PSS240	48	200	120	65	35	25	15	10	10	-	-	-
PSG2-80	47	200	200	185	105	70	45	30	20	5	-	-
PSG2-100	48	200	200	200	155	95	65	45	35	15	5	-
PSG2-120	50	200	200	200	200	130	90	65	45	25	10	-
PSG2-140	52	200	200	200	200	170	115	80	60	35	15	-
PSG2-160	53	200	200	200	200	200	145	105	75	40	20	5
PSG2-180	55	200	200	200	200	200	160	120	90	50	25	10
PSG2-200	57	200	200	200	200	200	180	130	100	55	30	10
PSG2-220	58	200	200	200	200	200	200	145	110	65	35	15
PSG2-240	60	200	200	200	200	200	200	160	120	70	40	20
PSG3-80	47	200	200	200	150	95	65	45	35	15	5	-
PSG3-100	48	200	200	200	200	135	90	65	45	25	10	-
PSG3-120	50	200	200	200	200	185	125	90	65	40	20	5
PSG3-140	52	200	200	200	200	200	165	115	85	50	25	10
PSG3-160	53	200	200	200	200	200	200	145	110	65	35	15
PSG3-180	55	200	200	200	200	200	200	165	125	75	40	20
PSG3-200	57	200	200	200	200	200	200	185	140	80	45	25
PSG3-220	58	200	200	200	200	200	200	200	155	90	55	30
PSG3-240	60	200	200	200	200	200	200	200	170	100	60	35

Values limited by flexural capacity.

Values limited by deflection limit.

Allowable loads in this table are limited to 200 PSF. If greater resistance capacity is needed, please contact Vero for professional engineering assistance.

SI: 1 in = 25.4 mm, 1 psf = 0.0479 kN/m²

1. The deflection limit is based on the controlling case of L/240 for the dead load plus live load combination and L/360 for the live load combination per IBC Table 1604.3. Other deflection limits can be provided upon request.
2. Tabulated allowable live loads are in addition to 15 psf of dead load and the self-weight of the panels.

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5.3.2 Vero insulated concrete floor and roof panels have the allowable service live load (i.e., snow load) capacities listed in Table 10. The load capacities shown are limited by the controlling design condition of shear strength, bearing strength, bending strength, or deflection (minimum code requirement for the floor) at L/240 for live load (LL) and L/180 for total load (TL).

Table 10. Allowable Service Live Load for Vero Insulated Floor/Roof Panels

Vero Panel Type	Self-Weight (psf)	Allowable Service Live Load (psf) for 15 psf of DL Floor/Roof Deflection Limits of L/240 for LL and L/180 for TL										
		Span Length (ft)										
		6	8	10	12	14	16	18	20	24	28	32
PSS80	47	200	110	55	25	10	-	-	-	-	-	-
PSS100	47	200	125	65	35	15	-	-	-	-	-	-
PSS120	47	200	145	80	45	20	5	-	-	-	-	-
PSS140	47	200	165	90	50	25	10	-	-	-	-	-
PSS160	48	200	175	95	55	35	15	5	-	-	-	-
PSS180	48	200	175	95	55	35	20	10	-	-	-	-
PSS200	48	200	175	95	55	35	25	10	-	-	-	-
PSS220	48	200	175	95	55	35	25	15	5	-	-	-
PSS240	48	200	175	95	55	35	25	15	10	-	-	-
PSG2-80	47	200	200	200	160	100	70	50	30	10	-	-
PSG2-100	48	200	200	200	195	135	95	65	45	20	5	-
PSG2-120	50	200	200	200	200	155	110	80	55	25	10	-
PSG2-140	52	200	200	200	200	180	130	90	65	35	15	-
PSG2-160	53	200	200	200	200	200	145	105	75	40	20	5
PSG2-180	55	200	200	200	200	200	160	120	90	50	25	10
PSG2-200	57	200	200	200	200	200	180	130	100	55	30	10
PSG2-220	58	200	200	200	200	200	200	145	110	65	35	15
PSG2-240	60	200	200	200	200	200	200	160	120	70	40	20
PSG3-80	47	200	200	200	200	140	95	65	50	20	10	-
PSG3-100	48	200	200	200	200	185	130	95	70	35	15	-
PSG3-120	50	200	200	200	200	200	155	110	85	45	20	5
PSG3-140	52	200	200	200	200	200	175	130	95	55	25	10
PSG3-160	53	200	200	200	200	200	200	150	110	65	35	15
PSG3-180	55	200	200	200	200	200	200	165	125	75	40	20
PSG3-200	57	200	200	200	200	200	200	185	140	80	45	25
PSG3-220	58	200	200	200	200	200	200	200	155	90	55	30
PSG3-240	60	200	200	200	200	200	200	200	170	100	60	35
Values limited by flexural capacity.												
Values limited by deflection limit.												

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Vero Panel Type	Self-Weight (psf)	Allowable Service Live Load (psf) for 15 psf of DL Floor/Roof Deflection Limits of L/240 for LL and L/180 for TL										
		Span Length (ft)										
		6	8	10	12	14	16	18	20	24	28	32
Allowable loads in this table are limited to 200 PSF. If greater resistance capacity is needed, please contact Vero for professional engineering assistance.												

SI: 1 in = 25.4 mm, 1 psf = 0.0479 kN/m²

1. The deflection limit is based on the controlling case of L/180 for the dead load plus live load combination and L/240 for the live load combination per IBC Table 1604.3. Other deflection limits can be provided upon request.
2. Tabulated allowable live loads are in addition to 15 psf of dead load and the self-weight of the panels.

5.4 *Diaphragm Shear Load Capacity*

5.4.1 Vero insulated concrete floor and roof panels have the allowable diaphragm shear load capacity listed in Table 11.

Table 11. Diaphragm Shear Load Capacity

Vero Panel Type	Span (ft)	Diaphragm Shear Load (plf)	Deflection at Allowable Shear Load (in)
PSS	8	430	0.17

SI: 1 in = 25.4 mm, 1 lb/ft = 0.0146 kN/m

5.5 *Shear Walls*

5.5.1 Vero wall panels used to resist shear forces shall have the following reinforcement provided:

5.5.1.1 Vero wall panels shall be anchored to the foundation/floor slab with a minimum of 18" long #4 rebar placed 12" o.c., staggered, on each side of the panel, except on panel ends where two (2) rebar shall be placed side-by-side (across from each other). The rebar shall be provided with ¾" cover on all sides and shall be placed inside of the wire mesh reinforcement.

5.5.1.2 Vero wall panels shall have angled wire mesh connecting the wall panels to the roof/floor panels. The wire mesh shall be embedded a minimum of 6.5" into the structural mortar cover of each panel and shall be provided on both the top and bottom of the roof/floor panel.

5.5.1.2.1 For slab to wall connection detailing, see Detail B3 and Detail B5.

5.5.1.3 The edges of all Vero wall panels shall be provided with U-shaped wire mesh with 6" legs and a minimum of 1.5" of structural mortar cover.

5.5.1.4 Where adjoining pieces of angled or U-shaped wire mesh reinforcement are spliced, the pieces shall overlap by a minimum of two wire spaces.

5.5.1.5 A 7.8" x 2' piece of wire mesh installed at a 45° angle shall be provided at the corners of all openings on both sides of the Vero wall panels.

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5.5.2 The allowable racking shear (i.e., for lateral shear wall design) service load on Vero panel walls is limited to the capacities shown in Table 12.

Table 12. Maximum Allowable Racking Shear for Vero Insulated Concrete Panels[2]

Vero Panel Type	Wall Length (ft)	Racking Shear (plf)				Deflection at Maximum Allowable Shear Load (in)			
		Wall Height[1] (ft)							
		8	9	10	14	8	9	10	14
PSM	1.0	270	240	215	130	0.05	0.06	0.08	0.10
	1.5	395	355	305	190	0.04	0.05	0.05	0.08
	2.0	525	465	390	245	0.04	0.04	0.05	0.07
	2.5	650	580	480	305	0.03	0.04	0.04	0.06
	3.0	775	690	570	360	0.03	0.03	0.03	0.04
	4.0	1,030	915	745	475	0.01	0.02	0.02	0.02
	8.0	1,160	1,160	1,160	1,160	0.02	0.02	0.02	0.02

SI: 1 in = 25.4 mm, 1 lb/ft = 0.0146 kN/m

1. Interpolation between wall heights is permitted.
2. Allowable service loads are calculated by dividing the design strength, φMn, by a load factor of 1.6 according to the load combinations in Section 5.3 of ACI 318-19.

5.5.3 *Seismic Loading:*

5.5.3.1 Structures shall be designed for seismic forces in accordance with IBC Section 1613.

5.5.3.1.1 Seismic design for Vero Wall, Floor and Roof Panels shall not be required in buildings exempt from seismic design in accordance with IBC Section 1613.

5.5.3.2 Table 13 provides Seismic Design Coefficients (SDC) that conform to the requirements in ASCE 7 Section 12.2.1 and Table 12.2-1 for design of shear walls in buildings that require seismic design in accordance with ASCE 7 (i.e., all seismic design categories).

5.5.3.2.1 The response modification coefficient, R, system overstrength factor, Ω_0, and deflection amplification factor, C_d, indicated in Table 13 shall be used to determine the base shear, element design forces, and design story drift in accordance with ASCE 7 Chapter 12 and Section 14.5.

Table 13. Seismic Design Coefficients of Vero Insulated Concrete Wall Panels

Seismic Force-Resisting System	Vero Panel Type	Response Modification Factor, R[1]	System Overstrength Factor, Ω_0[2]	Deflection Amplification Coefficient, C_d[3]	Structural System Limitations & Building Height (ft) Limit[4]				
					Seismic Design Category				
					B	C	D	E	F
Special Reinforced Concrete Shear Walls (Bearing Wall System)	PSM	5	2.5	5	NL	NL	160	160	100

SI: 1 in = 25.4 mm

1. Response modification coefficient, R, for use throughout ASCE 7. Note: R reduces forces to a strength level, not an allowable stress level.
2. The tabulated value of the overstrength factor, Ω_0, is permitted to be reduced by subtracting one-half (0.5) for structures with flexible diaphragms.
3. Deflection amplification factor, C_d, for use with ASCE 7 Sections 12.8.6, 12.8.7, and 12.9.2
4. NL = Not Limited. Heights are measured from the base of the structure as defined in ASCE 7 Section 11.2.

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5.6 *Out-of-Plane Bending*

5.6.1 Vero insulated concrete panels have the design interaction diagrams for out-of-plane bending shown in Figure 5.

5.6.2 The interaction diagram shown in Figure 5 is for 1' of panel width and account for failure of the panels by concrete crushing. See Table 7 for the maximum axial load capacities of Vero wall panels that include limits due to buckling.

5.6.3 The moment and axial loads in the interaction diagram shown in Figure 5 shall be compared to factored loads in accordance with the load combinations of ACI 318-19 Section 5.3.



Figure 5. Interaction Diagrams for PSM Wall Panels

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5.7 *Thermal Resistance*

5.7.1 R-values and U-factors assigned to Vero panels, shown in Table 14.

Table 14. Vero Insulated Concrete Panel R-Values and U-Factors

Vero Panel Type	R-Value °F × h × ft²/Btu (°K×m²/W)	U-Factor Btu/°F × h × ft² (W/°K×m²)
PSM60	9.7	0.10
PSM80 and PSS80	12.5	0.08
PSM100 and PSS100	15.3	0.07
PSM120 and PSS120	18.0	0.06
PSM140 and PSS140	20.8	0.05
PSM160 and PSS160	23.6	0.04
PSM180 and PSS180	26.4	0.04
PSM200 and PSS200	29.2	0.03
PSM220 and PSS220	31.9	0.03
PSM240 and PSS240	34.7	0.03
PSG2-80	17.2	0.06
PSG2-100	19.6	0.05
PSG2-120	22.0	0.05
PSG2-140	24.3	0.04
PSG2-160	26.7	0.04
PSG2-180	29.1	0.03
PSG2-200	31.4	0.03
PSG2-220	33.8	0.03
PSG2-240	36.2	0.03
PSG3-80	17.2	0.06
PSG3-100	19.6	0.05
PSG3-120	22.0	0.05
PSG3-140	24.3	0.04
PSG3-160	26.7	0.04
PSG3-180	29.1	0.03
PSG3-200	31.4	0.03
PSG3-220	33.8	0.03
PSG3-240	36.2	0.03

1. Table values are calculated based on the sum of the R-values of the component parts of the Vero panels and include analysis of the conductance of the ties running through the EPS core.
2. The R-values are calculated based on ASHRAE 90.1.
3. Table values apply to Vero panels constructed as described in Table 1 through Table 4, and as shown in Figure 1 through Figure 4.

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5.8 *Foam Plastic Insulation*

5.8.1 The EPS core that is integral to Vero panels shall meet the requirements of IBC Section 2603 and IRC Section R316.4 as appropriate for this application.

5.8.2 *Thermal Barrier:*

5.8.2.1 An independent thermal barrier in accordance with IRC Section R316.4 or IBC Section 2603.4 is not required because the EPS core is covered in all cases, by mortar and is never exposed to the interior of the building.

5.9 *Fire Endurance Performance*

5.9.1 Fire resistance ratings of Vero Wall, Floor and Roof Panels may be calculated in accordance with IBC Section 722.

5.9.1.1 Vero wall fire endurance performance shall be calculated using the provisions for concrete walls with multiple wythes.

5.9.1.2 Vero floor/roof fire endurance performance shall be calculated using the provisions for concrete floor and roof slabs.

5.9.2 Vero walls constructed with an average of 1.38 inch thick (35 mm) structural mortar on each face have a two-hour fire resistance rating when tested according to ASTM E119 with a maximum axial compression load of 6720 plf (10 ton/m), exclusive of the weight of the wall.

5.10 *High Velocity Hurricane Zone (HVHZ)*

5.10.1 Where Vero panels are constructed with a 2" (51 mm) thick layer of mortar on the exterior face of the panel, the panel complies with FBC Section 1626 for use in HVHZ.

5.11 Where the application falls outside of the performance evaluation, conditions of use and/or installation requirements set forth herein, alternative techniques shall be permitted in accordance with accepted engineering practice and experience. This includes but is not limited to the following areas of engineering: mechanics or materials, structural, building science, and fire science.

6 Installation

6.1 Installation shall comply with the approved construction documents, the manufacturer installation instructions, this TER and the applicable building code.

6.2 In the event of a conflict between the manufacturer installation instructions and this TER, the more restrictive shall govern.

6.3 Installation, support and structural detailing required for connections will be provided by Vero for each project to assure a proper load path to the foundation.

6.3.1 Example details can be found in Appendix B.

6.3.2 Details shall be evaluated by the building designer for applicability to a specific building.

6.3.3 Installation shall be performed in accordance with the manufacturer installation instructions.

6.4 Support for Vero panels (i.e., foundation walls, footings, etc.) must be level and free of dirt and loose material.

6.5 Vero panels shall be installed and aligned in accordance with the plans designed and submitted to the building official per Section 9.

6.6 The high-strength mortar complying with Section 4.2.5 is applied to each face of the Vero wall panels and the underside of floor assemblies covering the welded wire mesh.

6.6.1 Mortar thickness is per the approved plans with a minimum cover of 1" ($^3/_4$" + $^1/_4$") over the wire mesh.

6.6.2 The tolerance is minus $^1/_4$".

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6.7 The high-strength mortar shall be applied using a low-velocity application process in accordance with the manufacturer installation instructions and this TER.

6.8 Where required, special inspection of the mortar application shall be in accordance with IBC Section 1908.1 and IBC Table 1705.3.

6.9 Where required, continuous inspection of poured concrete shall be in accordance with IBC Section 1705.3.

7 Substantiating Data

7.1 Testing has been performed under the supervision of a professional engineer and/or under the requirements of ISO/IEC 17025 as follows:

7.1.1 Material property testing including flexure, shear, and compression – weak axis and strong axis in accordance with ASTM C78/C78M and ASTM E72.

7.2 Information contained herein may include the result of testing and/or data analysis by sources that are approved agencies (i.e., ANAB accredited agencies), approved sources (i.e., RDPs), and/or professional engineering regulations. Accuracy of external test data and resulting analysis is relied upon.

7.3 Where pertinent, testing and/or engineering analysis is based upon provisions that have been codified into law through state or local adoption of codes and standards. The developers of these codes and standards are responsible for the reliability of published content. DrJ's engineering practice may use a code-adopted provision as the control sample. A control sample versus a test sample establishes a product as being equivalent to the code-adopted provision in terms of quality, strength, effectiveness, fire resistance, durability, and safety.

7.4 The accuracy of the provisions provided herein may be reliant upon the published properties of raw materials, which are defined by the grade mark, grade stamp, mill certificate, Listings, certified reports, duly authenticated reports from approved agencies, and research reports prepared by approved agencies and/or approved sources provided by the suppliers of products, materials, designs, assemblies and/or methods of construction. These are presumed to be minimum properties and relied upon to be accurate. The reliability of DrJ's engineering practice, as contained in this TER, may be dependent upon published design properties by others.

7.5 Testing and engineering analysis: The strength, rigidity and/or general performance of component parts and/or the integrated structure are determined by suitable tests that simulate the actual conditions of application that occur and/or by accepted engineering practice and experience.[11]

7.6 Where additional condition of use and/or code compliance information is required, please search for Vero Wall, Floor and Roof Panels on the DrJ Certification website.

8 Findings

8.1 As delineated in Section 3, Vero Wall, Floor and Roof Panels have performance characteristics that were tested and/or meet pertinent standards and is suitable for use pursuant to its specified purpose.

8.2 When used and installed in accordance with this TER and the manufacturer installation instructions, Vero Wall, Floor and Roof Panels shall be approved for the following applications:

8.2.1 Use in bearing and non-bearing concrete wall applications

8.2.2 Use in concrete floor and roof assembly applications

8.2.3 Use in both fire-rated and non-fire-rated construction

8.2.4 Use in HVHZ

8.3 Any application specific issues not addressed herein can be engineered by an RDP. Assistance with engineering is available from Vero Building Systems.

[11] See Code of Federal Regulations (CFR) Title 24 Subtitle B Chapter XX Part 3280 for definition.

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8.4 IBC Section 104.11 (IRC Section R104.11 and IFC Section 104.10[12] are similar) in pertinent part states:

> **104.11 Alternative materials, design and methods of construction and equipment.** The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code. Where the alternative material, design or method of construction is not approved, the building official shall respond in writing, stating the reasons the alternative was not approved.

8.5 **Approved**:[13] Building codes require that the building official shall accept duly authenticated reports[14] or research reports[15] from approved agencies and/or approved sources (i.e., licensed RDP) with respect to the quality and manner of use of new products, materials, designs, services, assemblies, or methods of construction.

8.5.1 Acceptance of an approved agency, by a building official, is performed by verifying that the agency is accredited by a recognized accreditation body of the International Accreditation Forum (IAF).

8.5.2 Acceptance of a licensed RDP, by a building official, is performed by verifying that the RDP and/or their business entity is listed by the licensing board of the relevant jurisdiction.

8.5.3 Federal law, Title 18 US Code Section 242, requires that where the alternative product, material, service, design, assembly, and/or method of construction is not approved, the building official shall respond in writing, stating the reasons why the alternative was not approved, as denial without written reason deprives a protected right to free and fair competition in the marketplace.

8.6 DrJ is an engineering company, employs RDPs and is an ISO/IEC 17065 ANAB-Accredited Product Certification Body – Accreditation #1131.

8.7 Through ANAB accreditation and the IAF Multilateral Agreements, this TER can be used to obtain product approval in any jurisdiction or country that has IAF MLA Members & Signatories to meet the Purpose of the MLA – "*certified once, accepted everywhere*." IAF specifically says, "*Once an accreditation body is a signatory of the IAF MLA, it is required to recognise certificates and validation and verification statements issued by conformity assessment bodies accredited by all other signatories of the IAF MLA, with the appropriate scope*."[16]

9 Conditions of Use

9.1 Material properties shall not fall outside the boundaries defined in Section 3.

9.2 As defined in Section 3, where material and/or engineering mechanics properties are created for load resisting design purposes, the resistance to the applied load shall not exceed the ability of the defined properties to resist those loads using the principles of accepted engineering practice.

9.3 Vero Wall, Floor and Roof Panels, as described in this TER are subject to the following conditions:

9.3.1 This TER, when required by the authority having jurisdiction, shall be submitted at the time of permit application.

9.3.2 Design drawings and calculations shall follow the requirements of this TER and be submitted to the building official for approval.

9.3.3 Where required by the statutes of the jurisdiction where the building is to be constructed, the design drawings shall be prepared by the RDP for the building licensed in the jurisdiction.

LEGACY

[12] 2018 IFC Section 104.9

[13] Approved is an adjective that modifies the noun after it. For example, Approved Agency means that the Agency is accepted officially as being suitable in a particular situation. This example conforms to IBC/IRC/IFC Section 201.4 where the building code authorizes sentences to have an ordinarily accepted meaning such as the context implies.

[14] https://up.codes/viewer/wyoming/ibc-2021/chapter/17/special-inspections-and-tests#1707.1

[15] https://up.codes/viewer/wyoming/ibc-2021/chapter/17/special-inspections-and-tests#1703.4.2

[16] https://iaf.nu/en/about-iaf-mla/#:~:text=required%20to%20recognise

9.3.4 When required by the applicable code, an underground water investigation shall be made. If a hydrostatic pressure condition exists, the foundation walls must be waterproofed in accordance with the code.

9.3.4.1 Evaluation of waterproofing materials is outside the scope of this TER.

9.3.5 The soil capacity of the building site must be consistent with the requirements of the applicable code.

9.3.5.1 For use with the IRC, the soil capacity of the site may be assumed to have the load-bearing capacities specified in IRC Table R401.4.1.

9.3.5.2 In this case, a separate geotechnical evaluation is not required.

9.3.6 Installation of the high-strength mortar and concrete, which require special inspection under the IBC, shall comply with Section 6.6 of this TER.

9.4 When required by adopted legislation and enforced by the building official, also known as the authority having jurisdiction (AHJ) in which the project is to be constructed:

9.4.1 Any calculations incorporated into the construction documents shall conform to accepted engineering practice, and, when prepared by an approved source, shall be approved when signed and sealed.

9.4.2 This TER and the installation instructions shall be submitted at the time of permit application.

9.4.3 These innovative products have an internal quality control program and a third-party quality assurance program.

9.4.4 At a minimum, these innovative products shall be installed per Section 6 of this TER.

9.4.5 The review of this TER, by the AHJ, shall be in compliance with IBC Section 104 and IBC Section 105.4.

9.4.6 These innovative products have an internal quality control program and a third party quality assurance program in accordance with IBC Section 104.4, IBC Section 110.4, IBC Section 1703, IRC Section R104.4 and IRC Section R109.2.

9.4.7 The application of these innovative products in the context of this TER are dependent upon the accuracy of the construction documents, implementation of installation instructions, inspection as required by IBC Section 110.3, IRC Section R109.2 and any other regulatory requirements that may apply.

9.5 The approval of this TER by the AHJ shall comply with IBC Section 1707.1, where legislation states in pertinent part, "*the building official shall accept duly authenticated reports from approved agencies in respect to the quality and manner of use of new materials or assemblies as provided for in Section 104.11*", all of IBC Section 104, and IBC Section 105.4.

9.6 Design loads shall be determined in accordance with the building code adopted by the jurisdiction in which the project is to be constructed and/or by the building designer (i.e., owner or RDP).

9.7 The actual design, suitability, and use of this TER, for any particular building, is the responsibility of the owner or the owner's authorized agent.

LEGACY

10 Identification

10.1 The innovative products listed in Section 1.1 are identified by a label on the board or packaging material bearing the manufacturer name, product name, TER number, and other information to confirm code compliance.

10.2 Additional technical information can be found at verobuildingsystems.com.

11 Review Schedule

11.1 This TER is subject to periodic review and revision. For the most recent version, visit drjcertification.org.

11.2 For information on the status of this TER, contact DrJ Certification.

12 Approved for Use Pursuant to US and International Legislation Defined in Appendix A

12.1 Vero Wall, Floor and Roof Panels are included in this TER published by an approved agency that is concerned with evaluation of products or services, maintains periodic inspection of the production of listed materials or periodic evaluation of services, and whose TER Listing states either that the material, product, or service meets identified standards or has been tested and found suitable for a specified purpose. This TER meets the legislative intent and definition of being acceptable to the AHJ.

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Appendix A

1 Legislation that Authorizes AHJ Approval

1.1 **Fair Competition**: State legislatures have adopted Federal regulations for the examination and approval of building code referenced and alternative products, materials, designs, services, assemblies and/or methods of construction that:

1.1.1 Advance Innovation,

1.1.2 Promote competition so all businesses have the opportunity to compete on price and quality in an open market on a level playing field unhampered by anticompetitive constraints, and

1.1.3 Benefit consumers through lower prices, better quality, and greater choice.

1.2 **Adopted Legislation**: The following local, state, and federal regulations affirmatively authorize Vero Wall, Floor and Roof Panels to be approved by AHJs, delegates of building departments, and/or delegates of an agency of the federal government:

1.2.1 Interstate commerce is governed by the Federal Department of Justice to encourage the use of innovative products, materials, designs, services, assemblies and/or methods of construction. The goal is to "protect economic freedom and opportunity by promoting free and fair competition in the marketplace."

1.2.2 Title 18 US Code Section 242 affirms and regulates the right of individuals and businesses to freely and fairly have new products, materials, designs, services, assemblies and/or methods of construction approved for use in commerce. Disapproval of alternatives shall be based upon non-conformance with respect to specific provisions of adopted legislation, and shall be provided in writing stating the reasons why the alternative was not approved, with reference to the specific legislation violated.

1.2.3 The federal government and each state have a public records act. In addition, each state also has legislation that mimics the federal Defend Trade Secrets Act 2016 (DTSA),[17] where providing test reports, engineering analysis and/or other related IP/TS is subject to prison of not more than 10 years[18] and/or a $5,000,000 fine or 3 times the value of[19] the Intellectual Property (IP) and Trade Secrets (TS).

1.2.3.1 Compliance with public records and trade secret legislation requires approval through the use of listings, certified reports, Technical Evaluation Reports, duly authenticated reports and/or research reports prepared by approved agencies and/or approved sources.

1.2.4 For new materials[20] that are not specifically provided for in any building code, the design strengths and permissible stresses shall be established by tests, where suitable load tests simulate the actual loads and conditions of application that occur.

1.2.5 The design strengths and permissible stresses of any structural material shall conform to the specifications and methods of design using accepted engineering practice.[21]

1.2.6 The commerce of approved sources (i.e., registered PEs) is regulated by professional engineering legislation. Professional engineering commerce shall always be approved by AHJs, except where there is evidence, provided in writing, that specific legislation has been violated by an individual registered PE.

1.2.7 The AHJ shall accept duly authenticated reports from approved agencies in respect to the quality and manner of use of new materials or assemblies as provided for in IBC Section 104.11.[22]

LEGACY

[17] http://www.drjengineering.org/AppendixC and https://www.drjcertification.org/cornell-2016-protection-trade-secrets.

[18] https://www.law.cornell.edu/uscode/text/18/1832#:~:text=imprisoned%20not%20more%20than%2010%20years

[19] https://www.law.cornell.edu/uscode/text/18/1832#:~:text=Any%20organization%20that,has%20thereby%20avoided

[20] https://up.codes/viewer/wyoming/ibc-2021/chapter/17/special-inspections-and-tests#1706.2

[21] IBC 2021, Section 1706.1 Conformance to Standards

[22] IBC 2021, Section 1707 Alternative Test Procedure, 1707.1 General

1.3 **Approved**[23] **by Los Angeles**: The Los Angeles Municipal Code (LAMC) states in pertinent part that the provisions of LAMC are not intended to prevent the use of any material, device, or method of construction not specifically prescribed by LAMC. The Department shall use Part III, Recognized Standards in addition to Part II, Uniform Building Code Standards of Division 35, Article 1, Chapter IX of the LAMC in evaluation of products for approval where such standard exists for the product or the material and may use other approved standards, which apply. Whenever tests or certificates of any material or fabricated assembly are required by Chapter IX of the LAMC, such tests or certification shall be made by a testing agency approved by the Superintendent of Building to conduct such tests or provide such certifications. The testing agency shall publish the scope and limitation(s) of the listed material or fabricated assembly.[24] The Superintendent of Building roster of approved testing agencies is provided by the Los Angeles Department of Building and Safety (LADBS). The Center for Building Innovation (CBI) Certificate of Approval License is TA24945. Tests and certifications found in a CBI Listing are LAMC approved. In addition, the Superintendent of Building shall accept duly authenticated reports from approved agencies in respect to the quality and manner of use of new materials or assemblies as provided for in the California Building Code (CBC) Section 1707.1.[25]

1.4 **Approved by Chicago**: The Municipal Code of Chicago (MCC) states in pertinent part that an Approved Agency is a Nationally Recognized Testing Laboratory (NRTL) acting within its recognized scope and/or a certification body accredited by the American National Standards Institute (ANSI) acting within its accredited scope. Construction materials and test procedures shall conform to the applicable standards listed in the MCC. Sufficient technical data shall be submitted to the building official to substantiate the proposed use of any product, material, service, design, assembly and/or method of construction not specifically provided for in the MCC. This technical data shall consist of research reports from approved sources (i.e., MCC defined Approved Agencies).

1.5 **Approved by New York City**: The NYC Building Code 2022 (NYCBC) states in pertinent part that an approved agency shall be deemed[26] an approved testing agency via ISO/IEC 17025 accreditation, an approved inspection agency via ISO/IEC 17020 accreditation, and an approved product evaluation agency via ISO/IEC 17065 accreditation. Accrediting agencies, other than federal agencies, must be members of an internationally recognized cooperation of laboratory and inspection accreditation bodies subject to a mutual recognition agreement[27] (i.e., ANAB, International Accreditation Forum (IAF), etc.).

1.6 **Approved by Florida**: Statewide approval of products, methods, or systems of construction shall be approved, without further evaluation, by 1) A certification mark or listing of an approved certification agency, 2) A test report from an approved testing laboratory, 3) A product evaluation report based upon testing or comparative or rational analysis, or a combination thereof, from an approved product evaluation entity; 4) A product evaluation report based upon testing or comparative or rational analysis, or a combination thereof, developed and signed and sealed by a professional engineer or architect, licensed in Florida. For local product approval, products or systems of construction shall demonstrate compliance with the structural wind load requirements of the Florida Building Code (FBC) through one of the following methods; 1) A certification mark, listing, or label from a commission-approved certification agency indicating that the product complies with the code; 2) A test report from a commission-approved testing laboratory indicating that the product tested complies with the code; 3) A product-evaluation report based upon testing, comparative or rational analysis, or a combination thereof, from a commission-approved product evaluation entity which indicates that the product evaluated complies with the code; 4) A product-evaluation report or certification based upon testing or comparative or rational analysis, or a combination thereof, developed and signed and sealed by a Florida professional engineer or Florida registered architect, which indicates that the product complies with the code; 5) A statewide product approval issued by the Florida Building Commission. The Florida Department of Business and Professional Regulation (DBPR) website provides a listing of companies certified as a Product Evaluation Agency (i.e., EVLMiami 13692), a Product Certification Agency (i.e., CER10642), and as a Florida Registered Engineer (i.e., ANE13741).

[23] See Section 8 for the distilled building code definition of **Approved**

[24] Los Angeles Municipal Code, SEC. 98.0503. TESTING AGENCIES

[25] https://up.codes/viewer/california/ca-building-code-2022/chapter/17/special-inspections-and-tests#1707.1

[26] New York City, The Rules of the City of New York, § 101-07 Approved Agencies

[27] New York City, The Rules of the City of New York, § 101-07 Approved Agencies

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1.7 **Approved by Miami-Dade County (i.e., Notice of Acceptance [NOA])**: A Florida statewide approval is an NOA. An NOA is a Florida local product approval. By Florida law, Miami-Dade County shall accept the statewide and local Florida Product Approval as provided for in Florida legislation 553.842 and 553.8425.

1.8 **Approved by New Jersey**: Pursuant to Building Code 2018 of New Jersey in IBC Section 1707.1 General,[28] it states: "In the absence of approved rules or other approved standards, the building official shall accept duly authenticated reports from approved agencies in respect to the quality and manner of use of new materials or assemblies as provided for in the administrative provisions of the Uniform Construction Code (N.J.A.C. 5:23)".[29] Furthermore N.J.A.C 5:23-3.7 states: Municipal approvals of alternative materials, equipment, or methods of construction. **(a) Approvals**: Alternative materials, equipment, or methods of construction shall be approved by the appropriate subcode official provided the proposed design is satisfactory and that the materials, equipment, or methods of construction are suitable for the intended use and are at least the equivalent in quality, strength, effectiveness, fire resistance, durability and safety of those conforming with the requirements of the regulations. 1. A field evaluation label and report or letter issued by a nationally recognized testing laboratory verifying that the specific material, equipment, or method of construction meets the identified standards or has been tested and found to be suitable for the intended use, shall be accepted by the appropriate subcode official as meeting the requirements of (a) above. 2. Reports of engineering findings issued by nationally recognized evaluation service programs, such as, but not limited to, the Building Officials and Code Administrators (BOCA), the International Conference of Building Officials (ICBO), the Southern Building Code Congress International (SBCCI), the International Code Council (ICC), and the National Evaluation Service, Inc., shall be accepted by the appropriate subcode official as meeting the requirements of (a) above. The New Jersey Department of Community Affairs has confirmed that technical evaluation reports, from any accredited entity listed by ANAB, meets the requirements of item 2 given that the listed entities are no longer in existence and/or do not provide "reports of engineering findings".

1.9 **Approved by the Code of Federal Regulations Manufactured Home Construction and Safety Standards**: Pursuant to Title 24, Subtitle B, Chapter XX, Part 3282.14[30] and Part 3280,[31] the Department encourages innovation and the use of new technology in manufactured homes. The design and construction of a manufactured home shall conform with the provisions of Part 3282 and Part 3280 where key approval provisions in mandatory language follow: 1) "All construction methods shall be in conformance with accepted engineering practices"; 2) "The strength and rigidity of the component parts and/or the integrated structure shall be determined by engineering analysis or by suitable load tests to simulate the actual loads and conditions of application that occur."; and 3) "The design stresses of all materials shall conform to accepted engineering practice."

1.10 **Approval by US, Local, and State Jurisdictions in General**: In all other local and state jurisdictions, the adopted building code legislation states in pertinent part that:

1.10.1 For new materials that are not specifically provided for in this code, the design strengths and permissible stresses shall be established by tests.[32]

1.10.2 For innovative alternative products, materials, designs, services and/or methods of construction, in the absence of approved rules or other approved standards…the building official shall accept duly authenticated reports (i.e., listing and/or research report) from approved agencies with respect to the quality and manner of use of new materials or assemblies.[33] A building official approved agency is deemed to be approved via certification from an accreditation body that is listed by the International Accreditation Forum[34] or equivalent.

LEGACY

[28] https://up.codes/viewer/new_jersey/ibc-2018/chapter/17/special-inspections-and-tests#1707.1

[29] https://www.nj.gov/dca/divisions/codes/codreg/ucc.html

[30] https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3282/subpart-A/section-3282.14

[31] https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280

[32] IBC 2021, Section 1706 Design Strengths of Materials, 1706.2 New Materials. Adopted law pursuant to IBC model code language 1706.2.

[33] IBC 2021, Section 1707 Alternative Test Procedure, 1707.1 General. Adopted law pursuant to IBC model code language 1707.1.

[34] Please see the ANAB directory for building official approved agencies.

1.10.3 The design strengths and permissible stresses of any structural material…shall conform to the specifications and methods of design of accepted engineering practice performed by an approved source.[35] An approved source is defined as a PE subject to professional engineering laws, where a research and/or a technical evaluation report certified by a PE, shall be approved.

1.11 **Approval by International Jurisdictions**: The USMCA and GATT agreements provide for approval of innovative materials, products, designs, services, assemblies and/or methods of construction through the Technical Barriers to Trade agreements and the International Accreditation Forum (IAF) Multilateral Recognition Arrangement (MLA), where these agreements:

1.11.1 Permit participation of conformity assessment bodies located in the territories of other Members (defined as GATT Countries) under conditions no less favourable than those accorded to bodies located within their territory or the territory of any other country,

1.11.2 State that conformity assessment procedures (i.e., ISO/IEC 17020, 17025, 17065, etc.) are prepared, adopted, and applied so as to grant access for suppliers of like products originating in the territories of other Members under conditions no less favourable than those accorded to suppliers of like products of national origin or originating in any other country, in a comparable situation.

1.11.3 State that conformity assessment procedures are not prepared, adopted, or applied with a view to or with the effect of creating unnecessary obstacles to international trade. This means that conformity assessment procedures shall not be more strict or be applied more strictly than is necessary to give the importing Member adequate confidence that products conform to the applicable technical regulations or standards.

1.11.4 **Approved**: The purpose of the IAF MLA is to ensure mutual recognition of accredited certification and validation/verification statements between signatories to the MLA, and subsequently acceptance of accredited certification and validation/verification statements in many markets based on one accreditation for the timely approval of innovative materials, products, designs, services, assemblies and/or methods of construction. Accreditations granted by IAF MLA signatories are recognised worldwide based on their equivalent accreditation programs, therefore reducing costs and adding value to businesses and consumers.

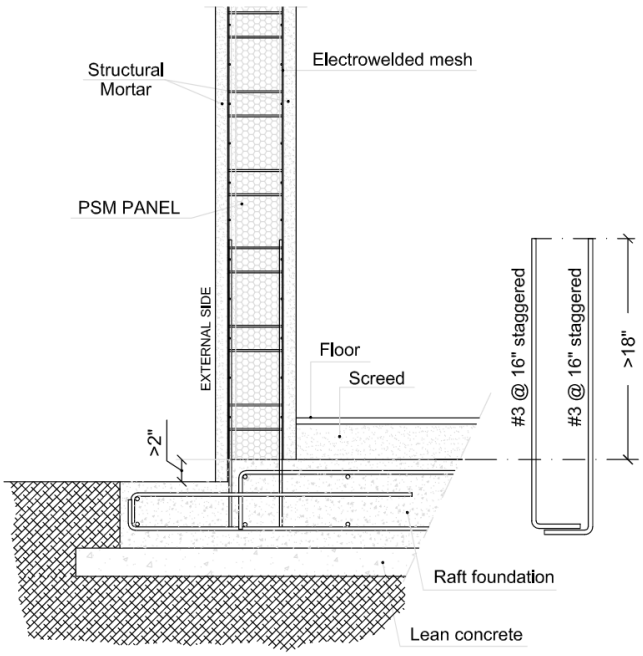
LEGACY

[35] IBC 2021, Section 1706 Design Strengths of Materials, Section 1706.1 Conformance to Standards Adopted law pursuant to IBC model code language 1706.1.

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Appendix B

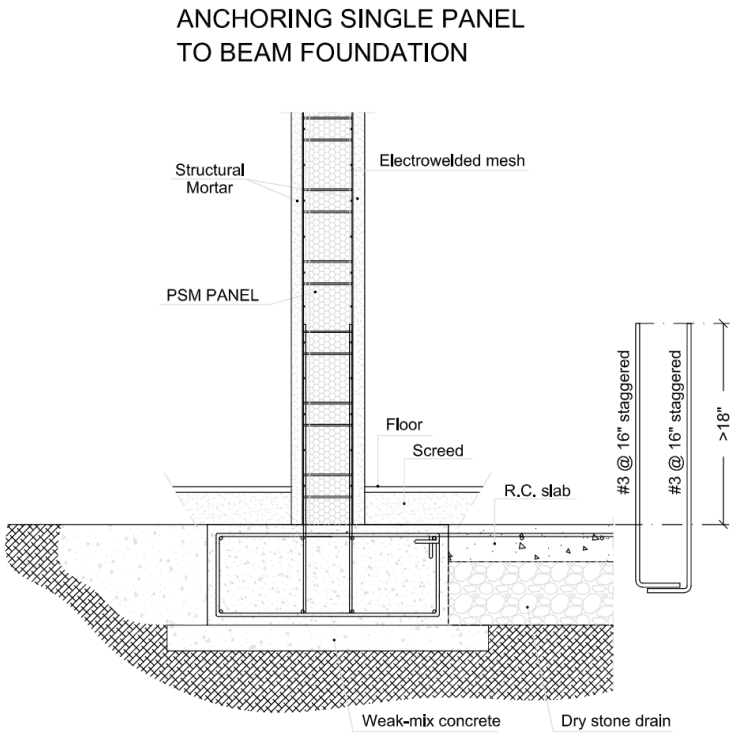
ANCHORING SINGLE PANEL
TO RAFT FOUNDATION



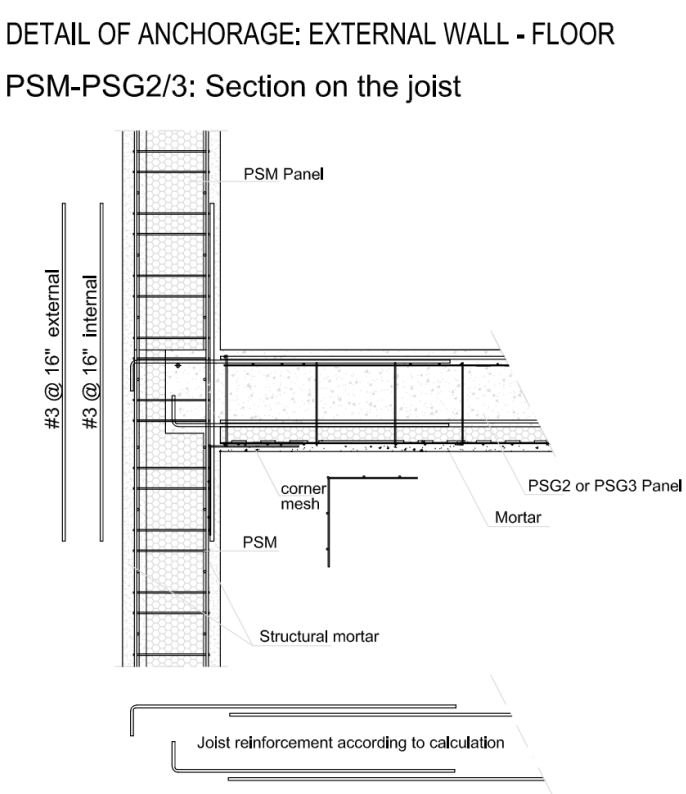
Detail B1. Anchoring to a Raft Foundation

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Detail B2. Anchoring to a Beam Foundation

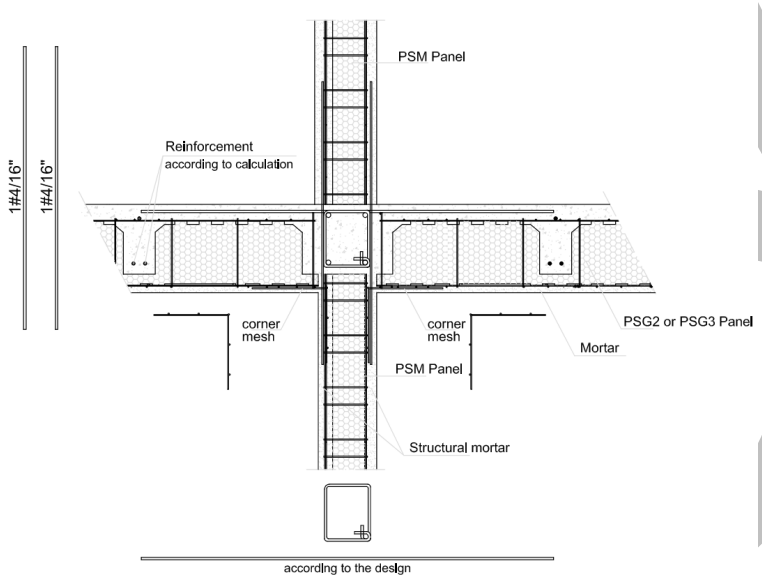


Detail B3. Slab to External Wall Connection (Elevation View)

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DETAIL OF ANCHORAGE: INTERNAL WALL - FLOOR

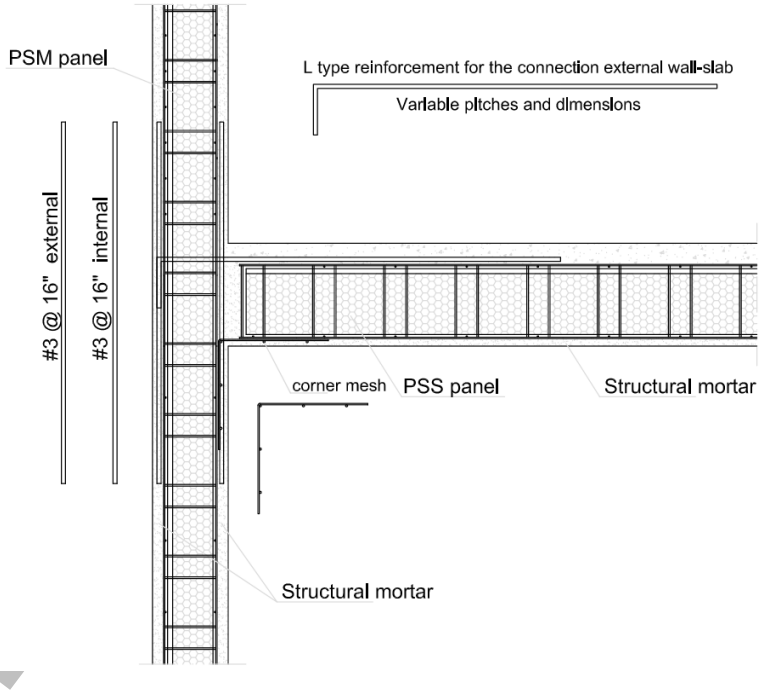
PSM-PSG2/3: Section perpendicular to the joist



Detail B4. Slab to Internal Wall Connection (Elevation View)

DETAIL OF ANCHORAGE: EXTERNAL WALL - FLOOR

PSM-PSS: Vertical section

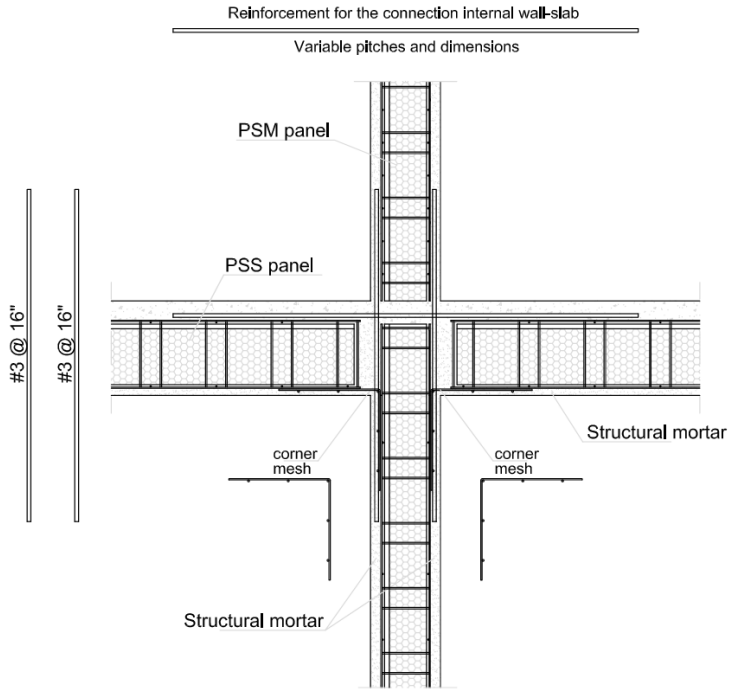


Detail B5. Slab to External Wall Connection (Plan View)

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DETAIL OF ANCHORAGE: INTERNAL WALL - FLOOR

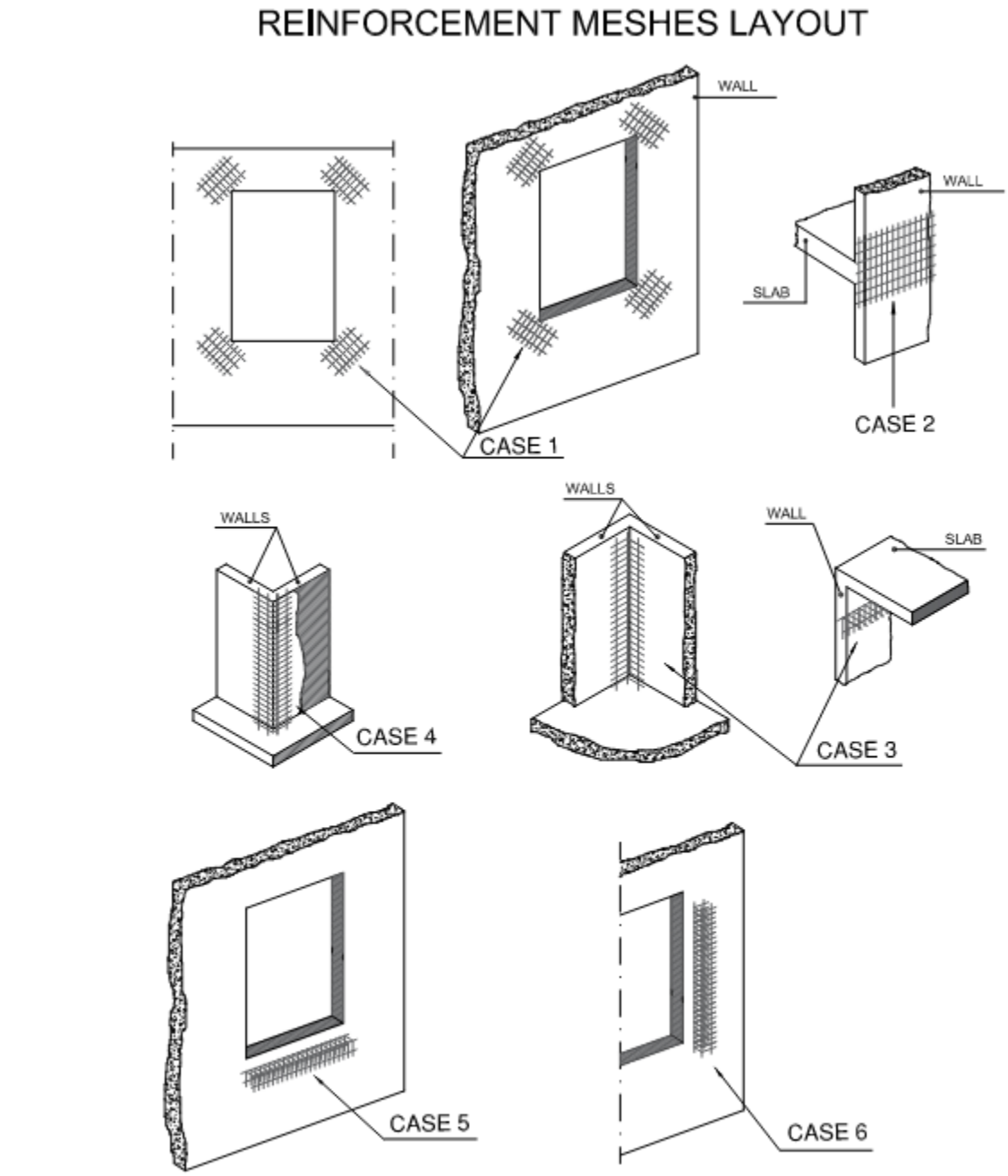
PSM-PSS: Vertical section



Detail B6. Slab to Internal Wall Connection (Plan View)

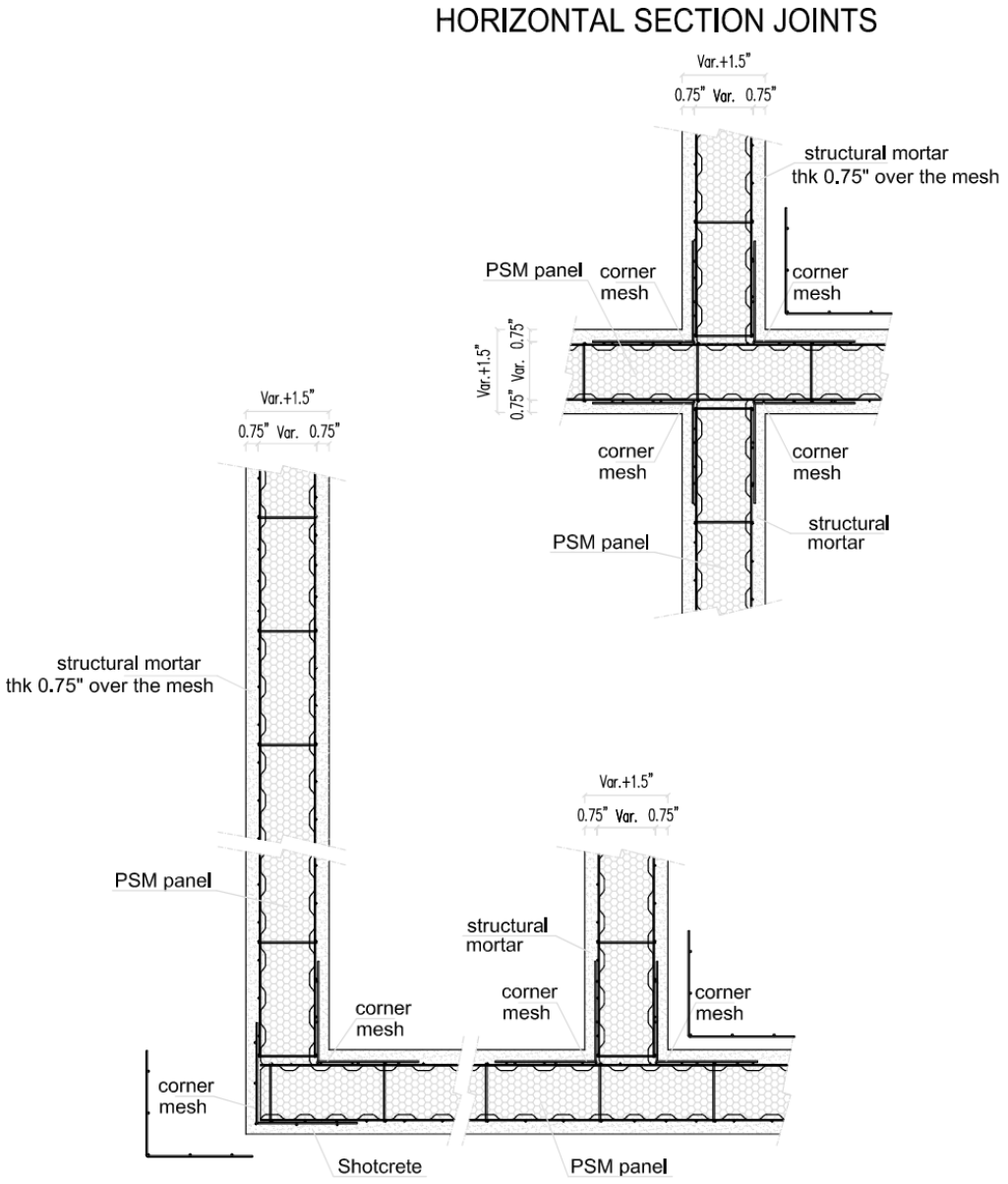
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Detail B7. Mesh Reinforcement Cases

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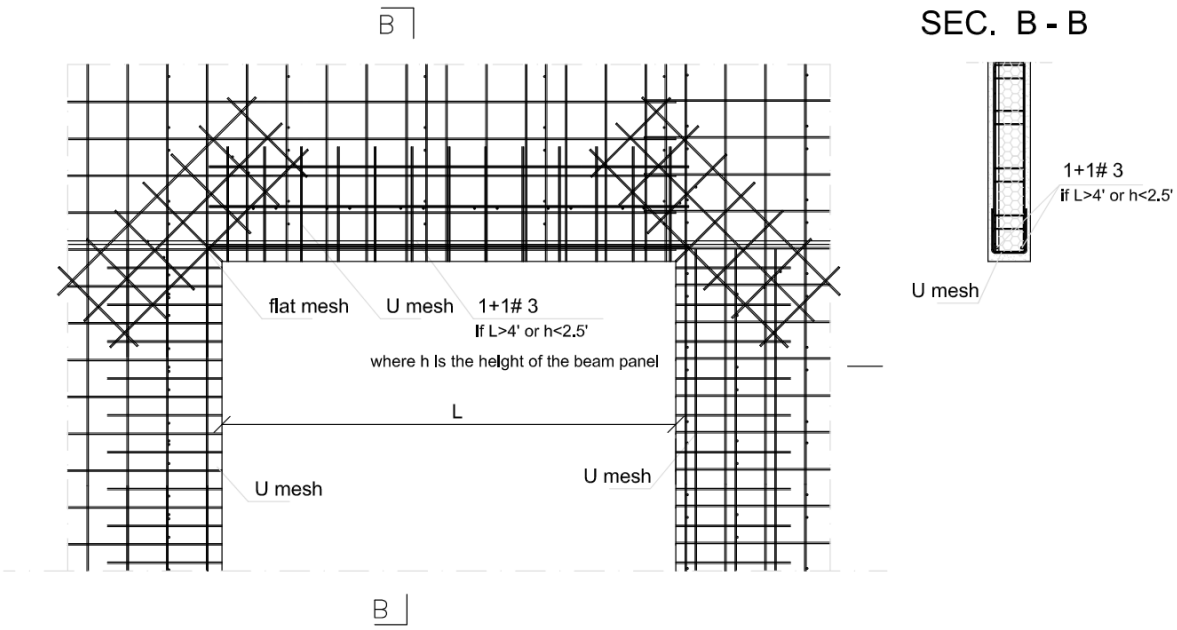


Detail B8. Wall Intersection Details

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OPENINGS REINFORCEMENT DETAIL

FRONTAL VIEW



Detail B9. Window and Door Opening Reinforcement

LEGA

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Issue Date: September 20, 2022
Subject to Renewal: March 22, 2024

FBC Supplement to TER 2302-57

REPORT HOLDER: Vero Building Systems

1 Evaluation Subject

1.1 Vero Wall, Floor and Roof Panels

2 Purpose and Scope

2.1 Purpose

2.1.1 The purpose of this Technical Evaluation Report (TER) supplement is to show Vero Wall, Floor and Roof Panels, recognized in TER 2302-57, has also been evaluated for compliance with the codes listed below as adopted by the Florida Building Commission.

2.2 *Applicable Code Editions*

2.2.1 *FBC-B—20, 23: Florida Building Code – Building*

2.2.2 *FBC-R—20, 23: Florida Building Code – Residential*

3 Conclusions

3.1 Vero Wall, Floor and Roof Panels, described in TER 2302-57, complies with the FBC-B and FBC-R and is subject to the conditions of use described in this supplement.

3.2 Where there are variations between the IBC and IRC and the FBC-B and FBC-R applicable to this TER, they are listed here:

3.2.1 FBC-B Section 104.4 and Section 110.4 are reserved.

3.2.2 FBC-R Section R104 and Section R109 are reserved.

4 Conditions of Use

4.1 Vero Wall, Floor and Roof Panels, described in TER 2302-57, must comply with all of the following conditions:

4.1.1 All applicable sections in TER 2302-57.

4.1.2 The design, installation, and inspections are in accordance with additional requirements of FBC-B Chapter 16 and Chapter 17, as applicable.

LEGACY

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