Listing and Technical Evaluation Report™

A Duly Authenticated Report from an Approved Agency

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Shear Wall Performance of Carlisle® Coatings and Waterproofing R2+® BASE and R2+® BASE (Class A)

Trade Secret Report Holder:

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CSI Designations:

DIVISION: 06 00 00 - WOOD, PLASTICS AND COMPOSITES

Section: 06 12 00 - Structural Panels

Section: 06 12 19 - Shear Wall Panels

Section: 06 16 00 - Sheathing

DIVISION: 07 00 00 - THERMAL AND MOISTURE PROTECTION

Section: 07 27 00 - Air Barriers

1 Innovative Products Evaluated[1]

1.1 R2+ BASE and R2+ BASE (Class A)

2 Product Description and Materials

2.1 The innovative products evaluated in this report are shown in **Figure 1**.

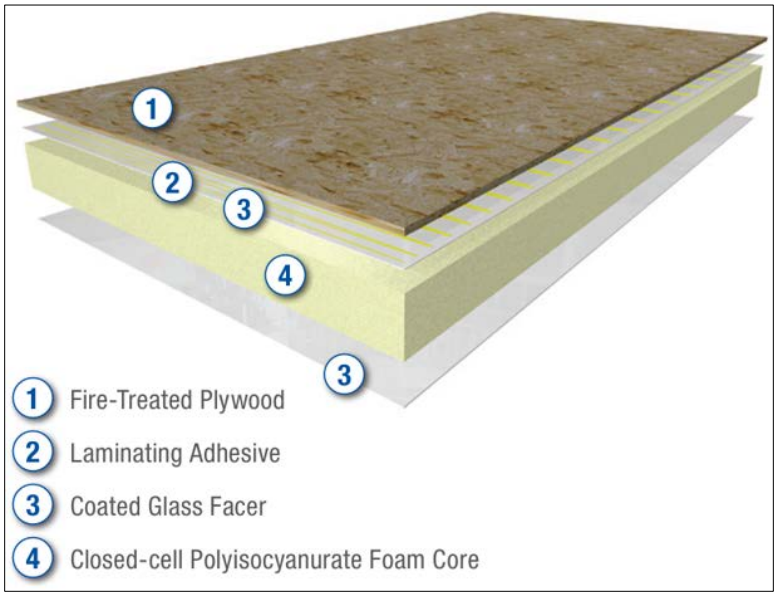

Figure 1. R2+ BASE and R2+ BASE (Class A)

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2.2 R2+ BASE and R2+ BASE (Class A) are an insulating nail base designed for use in commercial construction above-grade wall applications and conforms to ASTM C1289 Type V.

2.2.1 R2+ BASE and R2+ BASE (Class A) consist of a closed-cell polyisocyanurate foam core with premium performance coated glass facers on both sides and laminated to a 5/8" or 3/4" fire-retardant treated (FRT), APA-TECO rated plywood on one side.

2.2.2 R2+ BASE and R2+ BASE (Class A) are permitted for use in Types I-IV construction in accordance with IBC Section 2603.5 to provide continuous insulation within the building envelope.

2.3 *Material Availability*

2.3.1 R2+ BASE and R2+ BASE (Class A) are available with either a 5/8" or 3/4" fire-retardant treated plywood and 1" through 3 1/2" coated glass polyiso.

2.3.1.1 *Total Thickness with 5/8" FRT Plywood:*

2.3.1.1.1 1 5/8" through 4 5/8"

2.3.1.2 *Total Thickness with 3/4" FRT Plywood:*

2.3.1.2.1 1 3/4" through 4 3/4"

2.3.2 *Standard Product Width:*

2.3.2.1 48" (1,219 mm)

2.3.3 *Standard Product Length:*

2.3.3.1 96" (2,438 mm)

2.4 As needed, review material properties for design in **Section 6** and the regulatory evaluation in **Section 8**.

3 Definitions[2]

3.1 New Materials[3] are defined as building materials, equipment, appliances, systems, or methods of construction, not provided for by prescriptive and/or legislatively adopted regulations, known as alternative materials.[4] The design strength and permissible stresses shall be established by tests[5] and/or engineering analysis.[6]

3.2 Duly authenticated reports[7] and research reports[8] are test reports and related engineering evaluations that are written by an approved agency[9] and/or an approved source.[10]

3.2.1 This report utilizes intellectual property and/or trade secrets to create public domain material properties for commercial end-use.

3.2.1.1 This report protects confidential Intellectual Property and trade secrets under the regulation, 18.US.Code.90, also known as Defend Trade Secrets Act of 2016 (DTSA).[11]

3.3 An approved agency is *"approved"* when it is ANAB ISO/IEC 17065 accredited. DrJ Engineering, LLC (DrJ) is accredited and listed in the ANAB directory.

3.4 An approved source is *"approved"* when a professional engineer (i.e., Registered Design Professional, hereinafter RDP) is properly licensed to transact engineering commerce. The regulatory authority governing approved sources is the state legislature via its professional engineering regulations.[12]

3.5 Testing and/or inspections conducted for this duly authenticated report were performed by an ISO/IEC 17025 accredited testing laboratory, an ISO/IEC 17020 accredited inspection body, and/or a licensed RDP.

3.5.1 The Center for Building Innovation (CBI) is ANAB[13] ISO/IEC 17025 and ISO/IEC 17020 accredited.

3.6 The regulatory authority shall enforce[14] the specific provisions of each legislatively adopted regulation. If there is a non-conformance, the specific regulatory section and language of the non-conformance shall be provided in writing[15] stating the nonconformance and the path to its cure.

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3.7 The regulatory authority shall accept duly authenticated reports from an approved agency and/or an approved source with respect to the quality and manner of use of new materials or assemblies as provided for in regulations regarding the use of alternative materials, designs, or methods of construction.[16]

3.8 ANAB is an International Accreditation Forum (IAF) Multilateral Recognition Arrangement (MLA) signatory. Therefore, recognition of certificates and validation statements issued by conformity assessment bodies accredited by all other signatories of the IAF MLA with the appropriate scope shall be approved.[17] Thus, all ANAB ISO/IEC 17065 duly authenticated reports are approval equivalent,[18] and can be used in any country that is an MLA signatory found at this link: https://iaf.nu/en/recognised-abs/

3.9 Approval equity is a fundamental commercial and legal principle.[19]

4 Applicable Local, State, and Federal Approvals; Standards; Regulations[20]

4.1 *Local, State, and Federal*

4.1.1 Approved in all local jurisdictions pursuant to ISO/IEC 17065 duly authenticated report use, which includes, but is not limited to, the following featured local jurisdictions: Austin, Baltimore, Broward County, Chicago, Clark County, Dade County, Dallas, Detroit, Denver, DuPage County, Fort Worth, Houston, Kansas City, King County, Knoxville, Las Vegas, Los Angeles City, Los Angeles County, Miami, Nashville, New York City, Omaha, Philadelphia, Phoenix, Portland, San Antonio, San Diego, San Jose, San Francisco, Seattle, Sioux Falls, South Holland, St. Louis County, Texas Department of Insurance, and Wichita.[21]

4.1.2 Approved in all state jurisdictions pursuant to ISO/IEC 17065 duly authenticated report use, which includes, but is not limited to, the following featured states: California, Florida, New Jersey, Oregon, New York, Texas, Washington, and Wisconsin.[22]

4.1.3 Approved by the Code of Federal Regulations Manufactured Home Construction: Pursuant to Title 24, Subtitle B, Chapter XX, Part 3282.14[23] and Part 3280[24] pursuant to the use of ISO/IEC 17065 duly authenticated reports.

4.1.4 Approved means complying with the requirements of local, state, or federal legislation.

4.2 *Regulations*

4.2.1 *IBC – 18, 21, 24: International Building Code®*

4.2.2 *IRC – 18, 21, 24: International Residential Code®*

4.2.3 *IECC – 18, 21, 24: International Energy Conservation Code®*

4.3 *Standards*

4.3.1 *ANSI/AWC SDPWS: Special Design Provisions for Wind and Seismic*

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

4.3.3 *ASTM C1289: Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board*

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

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

4.3.6 *ASTM E564: Standard Practice for Static Load Test for Shear Resistance of Framed Walls for Buildings*

4.3.7 *ASTM E2126: Standard Test Methods for Cyclic (Reversed) Load Test for Shear Resistance of Vertical Elements of the Lateral Force Resisting Systems for Buildings*

4.3.8 *ASTM E2178: Standard Test Method for Air Permeance of Building Materials*

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4.4 Structural performance for shear wall assemblies used as lateral force resisting systems in Seismic Design Categories A through F have been tested and evaluated in accordance with the following standards:

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

4.4.2 *ASTM D7989: Standard Practice for Demonstrating Equivalent In-Plane Lateral Seismic Performance to Wood-Frame Shear Walls Sheathed with Wood Structural Panels*

4.4.2.1 ASTM D7989 is accepted engineering practice used to establish Seismic Design Coefficients (SDC).

4.4.2.2 Tested data generated by ISO/IEC 17025 approved agencies and/or professional engineers, which use ASTM D7989 as their basis, are defined as intellectual property and/or trade secrets.

4.4.2.3 All professional engineering evaluations are defined as an independent design review (i.e., listings, certified reports, duly authenticated reports from approved agencies, and/or research reports, are prepared independently by approved agencies and/or approved sources, when signed and sealed by licensed professional engineer pursuant to registration law.

4.4.3 *ASTM E564: Standard Practice for Static Load Test for Shear Resistance of Framed Walls for Buildings*

4.4.4 *ASTM E2126: Standard Test Methods for Cyclic (Reversed) Load Test for Shear Resistance of Vertical Elements of the Lateral Force Resisting Systems for Buildings*

5 Listed[25]

5.1 Equipment, materials, products, or services included in a List published by a nationally recognized testing laboratory (e.g., CBI), an approved agency (e.g., CBI and DrJ), and/or an approved source (e.g., DrJ), or other organization(s) concerned with product evaluation (e.g., DrJ), that maintains periodic inspection (e.g., CBI) 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.

6 Tabulated Properties Generated from Nationally Recognized Standards

6.1 R2+ BASE and R2+ BASE (Class A) may be used in the following applications:

6.1.1 Wall sheathing in buildings constructed in accordance with IBC and IRC for light-frame wood construction.

6.1.2 Structural wall sheathing to provide lateral load resistance (wind and seismic) for braced wall panels used in light-frame wood construction.

6.1.3 Structural wall sheathing in buildings constructed in accordance with the IBC requirements for Type V light frame construction.

6.1.4 Structural wall sheathing to provide resistance to transverse loads for wall assemblies used in light-frame wood construction.

6.2 *Structural Applications*

6.2.1 Except as otherwise described in this report, R2+ BASE and R2+ BASE (Class A) shall be installed in accordance with the applicable building codes listed in **Section 4** using the provisions set forth herein for the design and installation of Wood Structural Panels (WSP).

6.2.1.1 R2+ BASE and R2+ BASE (Class A) are permitted to be designed in accordance with SDPWS for the design of shear walls using the methods set forth therein, including the perforated shear wall methodology, and are subject to SDPWS boundary conditions, except as specifically allowed in this report.

6.2.2 Anchorage for in-plane shear shall be provided to transfer the induced shear force into and out of each shear wall. Shear wall anchorage shall be in accordance with the applicable code referenced in **Section 4**.

6.2.3 Installation is permitted for single top plate or double top plate applications.

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6.2.4 *Prescriptive IBC Conventional Light-Frame Wood Construction:*

6.2.4.1 R2+ BASE and R2+ BASE (Class A) may be used to brace exterior walls of buildings as an equivalent alternative to Method WSP of the IBC when installed with blocked or unblocked $^1/_2$" gypsum fastened with a minimum 5d cooler nail (0.086" diameter x $1^5/_8$") or #6 type W or S screw spaced a maximum of 16" o.c. at panel edges and 16" o.c. in the field. Bracing shall be in accordance with the conventional light frame construction method of IBC Section 2308.10[26] and this report.

6.2.5 *Performance-Based Wood-Frame Construction:*

6.2.5.1 R2+ BASE and R2+ BASE (Class A) used in wall assemblies designed as shear walls are permitted to be designed in accordance with the methodology used in SDPWS for WSP using the capacities shown in **Table 1** and **Table 2**.

6.2.5.2 R2+ BASE and R2+ BASE (Class A) shear walls are permitted to resist horizontal wind load forces using the allowable shear loads (in pounds per linear foot) set forth in **Table 1**.

6.2.6 R2+ BASE and R2+ BASE (Class A) shear walls that require seismic design in accordance with IBC Section 1613, shall use the seismic allowable unit shear capacities set forth in **Table 2**.

6.2.7 The response modification coefficient, R, system overstrength factor, Ω_0, and deflection amplification factor, C_d, indicated in **Table 2**, shall be used to determine the base shear, element design forces, and design story drift in accordance with ASCE 7 Chapter 12 and ASCE 7 Section 14.5.

6.2.7.1 See **Table 3** for the specified shear strength, ductility, and overstrength factors for Limit States Seismic Design.

Table 1. R2+ BASE and R2+ BASE (Class A) Allowable Stress Design (ASD) Capacity (Wind)

Product[1,4]	Fastener[2]	Maximum Stud Spacing (in)	Gypsum Wallboard[3] (GWB)	GWB Fastener Spacing (edge:field) (in)	Allowable Unit Shear Capacity (plf)
R2+ BASE and R2+ BASE (Class A)	0.131" Diameter Smooth Shank Nails Spaced 3":12"	16" o.c.	No GWB	N/A	325
			$^1/_2$" GWB	8:8	350
R2+ BASE and R2+ BASE (Class A) ($^5/_8$" FRT Plywood + 1" Polyiso)			No GWB	N/A	700

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

1. For R2+ BASE and R2+ BASE (Class A) design values shall be reduced in accordance with the fire-retardant treatment manufacturer published strength design reduction factors for fasteners.
2. R2+ BASE and R2+ BASE (Class A) attached with a minimum $3^1/_2$" x 0.131" smooth shank nail for $2^5/_8$" thick product, and a minimum $3^1/_4$" x 0.131" smooth shank nail for $2^7/_{16}$" thick product. Fasteners are to be spaced a maximum of 3" o.c. at the edges and 12" o.c. in the field with a minimum edge distance of $^3/_8$". Minimum fastener penetration of $^3/_4$" required. Maximum product thickness is $2^5/_8$" (2" foam plus $^5/_8$" wood structural panel).
3. Gypsum attached with minimum 5d cooler nail or #6 type W or S screws $1^1/_4$" long. Fastener spacing shall be as required above.
4. R2+ BASE and R2+ BASE (Class A) joints shall be butted at framing members and a single row of fasteners must be applied to each panel edge into the stud below.

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Table 2. R2+ BASE and R2+ BASE (Class A) Allowable Stress Design (ASD) Capacity and Seismic Design Coefficients[1,2,3,10]

Seismic Force-Resisting System	Maximum Stud Spacing (in)	GWB[9]	Seismic Allowable Unit Shear Capacity (plf)[4]	Apparent Shear Stiffness, G_a (kips/in)	Response Modification Factor, R[5]	System Overstrength Factor, Ω_0[6]	Deflection Amplification Coefficient C_d[7]	Structural System Limitations and Building Height Limit (ft)				
								Seismic Design Category				
								B	C	D	E	F
Light-Frame (Wood) Walls Sheathed with R2+ BASE and R2+ BASE (Class A)	16 o.c.	1/2" GWB	280	9.4	6.5	3	4	NL[8]	NL	65	65	65
		No GWB	260	3.7								

SI: 1 in = 25.4 mm, 1 lb/ft = 0.0146 kN/m, 1 kips/in = 175.13 kN/m

1. For R2+ BASE and R2+ BASE (Class A) design values shall be reduced in accordance with the fire-retardant treatment manufacturer published strength design reduction factors for fasteners.
2. R2+ BASE and R2+ BASE (Class A) attached with a minimum $3^1/_2$" x 0.131" smooth shank nail for $2^5/_8$" thick product, and a minimum $3^1/_4$" x 0.131" smooth shank nail for $2^7/_{16}$" thick product. Fasteners are to be spaced a maximum of 3" o.c. at the edges and 12" o.c. in the field with a minimum edge distance of $^3/_8$". Minimum fastener penetration of $^3/_4$" required. Maximum product thickness is $2^5/_8$" (2" foam plus $^5/_8$" wood structural panel).
3. All seismic design coefficients follow the equivalency procedures as defined in Section 4 and Section 8 of this report.
4. Allowable unit shear capacity is based on the methodology found in ASTM D7989.
5. Response modification coefficient, R, for use throughout ASCE 7. *Note:* R reduces forces to a strength level, not an allowable stress level.
6. 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.
7. Deflection amplification factor, C_d, for use with ASCE 7 Section 12.8.6, ASCE 7 Section 12.8.7, and ASCE 7 Section 12.9.2
8. NL = Not Limited. Heights are measured from the base of the structure as defined in ASCE 7 Section 11.2.
9. Gypsum attached with minimum #6 type W or S screws $1^1/_4$" long spaced 8" o.c. at panel edges and in the field. Maximum stud spacing is 16" o.c.
10. Drift limits are required to be checked, in accordance with, and shall not exceed, those as allowed by ASCE 7 Table 12.12-1.

Table 3. R2+ BASE and R2+ BASE (Class A) Limit States Design Capacity and Seismic Design Coefficients (Seismic)[1,2,3]

Seismic Force-Resisting System	Maximum Stud Spacing (in)	Gypsum Wallboard (GWB)	Seismic Specified Shear Strength (plf)	Ductility, R_d	Overstrength Factor, R_0
Light-Frame (Wood) Walls Sheathed with R2+ BASE and R2+ BASE (Class A)	16 o.c.	1/2" GWB	370	4.0	1.7
		No GWB	350	3.0	1.7

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

1. For R2+ BASE and R2+ BASE (Class A) design values shall be reduced in accordance with the fire-retardant treatment manufacturer published strength design reduction factors for fasteners.
2. R2+ BASE and R2+ BASE (Class A) attached with a minimum $3^1/_2$" x 0.131" smooth shank nail for $2^5/_8$" thick product, and a minimum $3^1/_4$" x 0.131" smooth shank nail for $2^7/_{16}$" thick product. Fasteners are to be spaced a maximum of 3" o.c. at the edges and 12" o.c. in the field with a minimum edge distance of $^3/_8$". Minimum fastener penetration of $^3/_4$" required. Maximum product thickness is $2^5/_8$" (2" foam plus $^5/_8$" wood structural panel).
3. Gypsum attached with minimum #6 type W or S screws $1^1/_4$" long spaced 8" o.c. at panel edges and in the field. Maximum stud spacing is 16" o.c.

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6.3 *Transverse Wind Loading*

6.3.1 Transverse wind load design shall be in accordance with IBC Section 2304.6.1. Fasteners must be minimum 6d common nail (0.113" diameter) with $1^1/_2$" minimum penetration or 8d common nail (0.131" diameter) with $1^3/_4$" minimum penetration.

6.4 *Perforated Shear Walls*

6.4.1 R2+ BASE and R2+ BASE (Class A) shear walls are permitted to be designed in accordance with the methodology found in SDPWS Section 4.3.3.5, with the following exceptions:

6.4.1.1 *2015 SDPWS:*

6.4.1.1.1 C_o, as determined in SDPWS for the perforated shear wall methodology shall be permitted to be calculated using the equation presented below:

Equation 1.

$$C_o = \frac{r}{(0.6 + 0.4 \times r)} \times \frac{L_{tot}}{\sum L_i}$$

$$r = \frac{1}{1 + \frac{A_o}{h\Sigma L_i}}$$

Where:

C_o	=	shear resistance adjustment factor
r	=	sheathing area ratio
L_{tot}	=	total length of the perforated shear wall (including the lengths of perforated shear wall segments, and the lengths of segments containing openings), [ft]
A_o	=	total area of openings, [ft^2]
h	=	height of wall, [ft]
ΣL_i	=	sum of the length of full-height sections, [ft]

6.4.1.2 *2021 SDPWS:*

6.4.1.2.1 For perforated shear wall design in accordance with SDPWS-2021, the shear capacity adjustment factor, C_o (used with SDPWS Equation 4.3-5), shall be permitted to be calculated using **Equation 1** of this report, in place of the C_o determination method in SDPWS-2021 (including SDPWS Table 4.3.5.6, where applicable). All other SDPWS-2021 boundary conditions and detailing requirements for perforated shear walls shall apply unless specifically modified.

6.4.1.2.2 The following example shows how to calculate the capacity of a perforated shear wall with R2+ BASE and R2+ BASE (Class A) using 2015 SDPWS:

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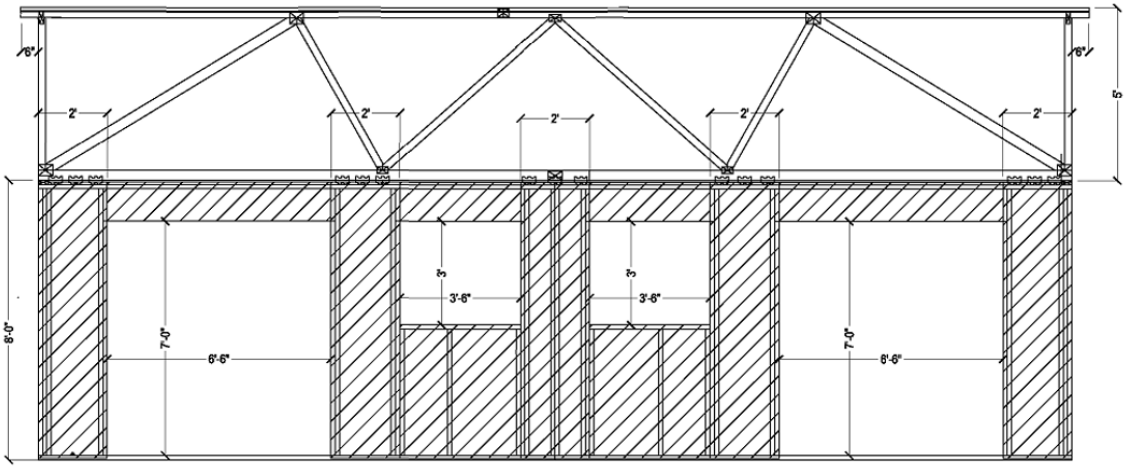

1. The total length of the perforated shear wall, L_{tot}, is 30'.
2. The height of the perforated shear wall, h, is 8'.
3. The sum of the perforated shear wall segment lengths, ΣL_i, is 10'.
4. The total area of the openings, A_o, is:
   - 4.1 Two (2) 7' x 6' 6" openings – 45.5 sq. ft. x 2 = 91 sq. ft.
   - 4.2 Two (2) 3' x 3' 6" openings – 10.5 sq. ft. x 2 = 21 sq. ft.
   - 4.3 Total opening area is: 91 + 21 = 112 sq. ft.
5. Using SDPWS Equation 4.3-6, the sheathing area ratio, r, is:

$$r = \frac{1}{1 + \frac{A_o}{h\Sigma L_i}} = \frac{1}{1 + \frac{112}{8 \times 10}} = 0.417$$

6. Using Equation 1, the shear capacity adjustment factor, C_o, is:

$$C_o = \frac{r}{0.6 + 0.4 \times r} \times \frac{L_{tot}}{\Sigma L_i} = \frac{0.417}{0.6 + 0.4 \times 0.417} \times \frac{30}{10} = 1.63$$

7. From Table 1, the allowable unit shear capacity, v, is: 325-plf.

   Since the aspect ratio (h/w) of the 2' segments is 8/2 = 4, which is greater than 2, the aspect ratio adjustment factor ($2w/h$) must be applied to the unit shear capacity per SDPWS Section 4.3.4.

$$Vadjusted = v \times \left(\frac{2w}{h}\right) = 325\,plf \times \left(\frac{4}{8}\right) = 162.5\,plf$$

8. In accordance with SDPWS Section 4.3.3.5, the total ASD shear capacity of this perforated shear wall, $V_{perforated}$, is:

$$V_{perforated} = v \times \Sigma L_i \times C_o = 162.5\,plf \times 10\,ft. \times 1.63 = 2649\,lbs.$$

Figure 2. Example of a Perforated Shear Wall

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6.5 *Air Barrier*

6.5.1 R2+ BASE and R2+ BASE (Class A) were evaluated in accordance with ASTM E2178 and met the requirements of IRC Section N1101.10.5, IECC Section R303.1.5, and IECC Section C402.6.2.3.1.[27]

6.5.2 R2+ BASE and R2+ BASE (Class A) are permitted for use as an air barrier material or part of an air barrier assembly, when installed in accordance with the manufacturer installation instructions and this report. All seams including the top and bottom edges shall be taped. See **Table 4**.

Table 4. Air Permeability[1,2]

Product Name	Air Pressure (Pa)	Air Permeability [L/(s·m²)]
R2+ BASE	75	< 0.02
R2+ BASE (Class A)		

Imperial Units: 1 Pa = 0.000145-psi, 1 L/(s·m²) = 0.2 cfm/ft²

1. Foam core tested in accordance with ASTM E2178.
2. Air pressure and permeability numbers shown represent air-permeability compliance and are not intended to represent the performance under actual conditions.

6.6 *Fire Safety Performance*

6.6.1 *Surface Burning Characteristics:*

6.6.1.1 R2+ BASE and R2+ BASE (Class A) were evaluated to assess performance with regard to flame spread and smoke developed index as shown in **Table 5**.

Table 5. Surface Burning Characteristics[1,2]

Product Name	Flame Spread Index	Smoke-Developed Index	Classification
R2+ BASE	≤ 75	≤ 450	Class B
R2+ BASE (Class A)	≤ 25	≤ 450	Class A

1. Foam core tested in accordance with ASTM E84.
2. Flame spread and smoke-developed indexes are shown for comparison purposes only and are not intended to represent the performance under actual fire conditions.

6.7 Alternative techniques shall be permitted in accordance with accepted engineering practice and experience. These provisions for the use of alternative materials, designs, and methods of construction are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed herein. This includes, but is not limited to, the following areas of engineering: mechanics of materials, structures, building science, and fire science.

7 Certified Performance[28]

7.1 All construction methods shall conform to accepted engineering practices to ensure durable, livable, and safe construction and shall demonstrate acceptable workmanship reflecting journeyman quality of work of the various trades.[29]

7.2 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.[30]

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8 Regulatory Evaluation and Accepted Engineering Practice

8.1 R2+ BASE and R2+ BASE (Class A) comply with the following legislatively adopted regulations and/or accepted engineering practice for the following reasons:

8.1.1 Structural performance for shear wall assemblies used as lateral force resisting systems in Seismic Design Categories A through F, have been tested and evaluated in accordance with the following standards:

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

8.1.1.2 ASTM D7989: Standard Practice for Demonstrating Equivalent In-Plane Lateral Seismic Performance to Wood-Frame Shear Walls Sheathed with Wood Structural Panels

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

8.1.1.4 ASTM E564: Standard Practice for Static Load Test for Shear Resistance of Framed Walls for Buildings

8.1.1.5 ASTM E2126: Standard Test Methods for Cyclic (Reversed) Load Test for Shear Resistance of Vertical Elements of the Lateral Force Resisting Systems for Buildings

8.1.2 Lateral force resisting systems for use in both wind and seismic applications follow the performance-based provisions of IBC Section 2306.1, IBC Section 2306.3, and/or SDPWS Section 4.3, for light-frame wood wall assemblies.

8.1.2.1 **Table 2** provides Seismic Design Coefficients (SDC) that conform to the requirements in ASCE 7 Section 12.2.1, ASCE 7 Section 12.2.1.1, and ASCE 7 Table 12.2-1 for design of wall assemblies in buildings that require seismic design.

8.1.3 Structural performance under lateral load conditions for use as an alternative to the conventional wall bracing provisions of IBC Section 2308.10,[31] Method WSP.

8.1.4 Structural performance under lateral load conditions for both wind and seismic loading for use with the IBC performance-based provisions IBC Section 2306.1 and IBC Section 2306.3 for light-frame wood wall assemblies.

8.1.4.1 **Table 2** provides SDC that conform to the requirements of ASCE 7 Section 12.2.1 and ASCE 7 Table 12.2-1 for design of wall assemblies in buildings that require seismic design in accordance with ASCE 7 (i.e., all seismic design categories).

8.1.4.2 The basis for equivalency testing is outlined in Section 12.2.1.1 of ASCE 7:

> Use of seismic force-resisting systems not contained in Table 12.2-1 shall be permitted contingent on submittal to and approval by the Authority Having Jurisdiction and independent structural design review of an accompanying set of design criteria and substantiating analytical and test data. The design criteria shall specify any limitations on system use, including Seismic Design Category and height; required procedures for designing the system's components and connections; required detailing; and the values of the response modification coefficient, R; overstrength factor Ω_0; and deflection amplification factor, C_d.

8.1.4.3 ASTM D7989 is accepted engineering practice used to establish SDC. Test data generated by ISO/IEC 17025 approved agencies and/or professional engineers and all associated professional engineering evaluations which use ASTM D7989 as their basis, are defined as intellectual property and/or trade secrets and are also defined as an independent design review (i.e., Listings, certified reports, duly authenticated reports from approved agencies, and/or research reports prepared by approved agencies and/or approved sources).

8.1.5 Structural performance under lateral load conditions for use as an alternative to SDPWS Section 4.3 Wood Frame Shear Walls.

8.1.6 Structural performance under lateral load conditions for use as a perforated shear wall.

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8.1.7 Resistance to transverse loads for wall assemblies imposed by the wind speed in accordance with IBC Section 1609.1.1.

8.1.8 Performance for use as an air barrier in accordance with IRC Section N1101.10.5, IECC Section R303.1.5, and IECC Section C402.6.2.3.1.[32]

8.1.9 Performance in accordance with ASTM E84 for flame spread and smoke-developed index ratings in accordance with IBC Section 2603.3, IBC Section 2603.5.4, and IRC Section R303.3.[33]

8.2 Fire resistance-rated wall assemblies in accordance with IBC Section 2603.5.1 are outside the scope of this report.

8.3 Any building code, regulation and/or accepted engineering evaluations (e.g., research reports, duly authenticated reports, etc.) that are conducted for this Listing were performed by DrJ, which is an ISO/IEC 17065 accredited certification body and a professional engineering company operated by RDP or approved sources. DrJ is qualified[34] to practice product and regulatory compliance services within its scope of accreditation and engineering expertise,[35] respectively.

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

9 Installation

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

9.2 In the event of a conflict between the manufacturer installation instructions and this report, contact the manufacturer for counsel on the proper installation method.

9.3 *Installation Procedure*

9.3.1 Protect surrounding areas and surfaces from damage.

9.3.2 A water resistive barrier complying with IBC Section 1403.2 and IRC Section R703.2 shall be installed over the R2+ BASE and R2+ BASE (Class A).

9.3.3 R2+ BASE and R2+ BASE (Class A) shall not be applied over walls while they are vulnerable to water intrusion from above or behind.

9.3.4 Do not block flashing, weeps, or other drainage paths with R2+ BASE and R2+ BASE (Class A).

9.3.5 Do not span expansion joints with R2+ BASE and R2+ BASE (Class A).

9.3.6 During installation, take precautions to minimize moisture intrusion behind insulation.

9.3.7 Beginning at the base of the wall, apply R2+ BASE and R2+ BASE (Class A) horizontally or vertically using maximum board lengths to minimize the number of joints.

9.3.8 Pre-cut R2+ BASE and R2+ BASE (Class A) to fit openings and penetrations.

9.3.9 Offset R2+ BASE and R2+ BASE (Class A) board joints a minimum of 6". Do not form four-corner intersections.

9.3.10 Form a *"corner lock"* pattern by staggering vertical joints at inside and outside corners.

9.3.11 Fill gaps greater than $^1/_8$" between R2+ BASE and R2+ BASE (Class A) boards with expanding spray foam or approved sealant and strike flush. Expanding spray foam may also be applied onto the R2+ BASE and R2+ BASE (Class A) board edges during installation.

9.3.12 Abut all joints tightly and ensure an overall flush, level surface.

9.3.13 Verify all materials are installed in accordance with current manufacturer published literature and local code requirements.

9.3.14 Additional information on the installation and detailing of R2+ BASE and R2+ BASE (Class A) can be found at www.henry.com/commercial/products/polyiso-insulation/wall-insulation/r2-base.

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9.3.15 *Fastener Type:*

9.3.15.1 Minimum 3 1/2" (89 mm) x 0.131" (3.3 mm) smooth shank nail with the underside of the head flush with the surface of the sheathing.

9.3.16 *Fastener Spacing:*

9.3.16.1 Maximum 3" o.c. at the perimeter and 12" o.c. in the field with minimum 3/8" from board edges.

9.3.17 *Gypsum Wallboard (GWB):*

9.3.17.1 Where required, GWB shall be installed with a minimum:

9.3.17.1.1 #6 x 1 1/4" (32 mm) Type W or S screws

9.3.17.1.2 5d cooler nails

10 Substantiating Data

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

10.1.1 Flame spread and smoke developed ratings in accordance with ASTM E84

10.1.2 Lateral load testing in accordance with ASTM E2126

10.1.3 Air permeability testing in accordance with ASTM E2178

10.2 Information contained herein may include the result of testing and/or data analysis by sources that are approved agencies, approved sources, and/or an RDP. Accuracy of external test data and resulting analysis is relied upon.

10.3 Where applicable, testing and/or engineering analysis are based upon provisions that have been codified into law through state or local adoption of regulations and standards. The developers of these regulations and standards are responsible for the reliability of published content. DrJ's engineering practice may use a regulation-adopted provision as the control. A regulation-endorsed control versus a simulation of the conditions of application to occur establishes a new material as being equivalent to the regulatory provision in terms of quality, strength, effectiveness, fire resistance, durability, and safety.

10.4 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, or duly authenticated reports from approved agencies and/or approved sources provided by the supplier. These are presumed to be minimum properties and relied upon to be accurate. The reliability of DrJ's engineering practice, as contained in this duly authenticated report, may be dependent upon published design properties by others.

10.5 *Testing and Engineering Analysis*

10.5.1 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.[36]

10.6 Where additional condition of use and/or regulatory compliance information is required, please search for R2+ BASE and R2+ BASE (Class A) on the DrJ Certification website.

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11 Findings

11.1 As outlined in **Section 6**, R2+ BASE and R2+ BASE (Class A) have performance characteristics that were tested and/or meet applicable regulations. In addition, they are suitable for use pursuant to its specified purpose.

11.2 When used and installed in accordance with this duly authenticated report and the manufacturer installation instructions, R2+ BASE and R2+ BASE (Class A) shall be approved for the following applications:

11.2.1 Lateral load resistance due to wind and seismic loads carried by shear walls.

11.2.2 Transverse load resistance due to components and cladding pressures on building surfaces.

11.2.3 Performance for use as an air barrier material in accordance with IRC Section N1101.10.5, IECC Section R303.1.5, and IECC Section C402.6.2.3.1.[37]

11.3 Unless exempt by state statute, when R2+ BASE and R2+ BASE (Class A) are to be used as a structural and/or building envelope component in the design of a specific building, the design shall be performed by an RDP.

11.4 Any application specific issues not addressed herein can be engineered by an RDP. Assistance with engineering is available from Henry, A Carlisle Company.

11.5 IBC Section 104.2.3[38] (IRC Section R104.2.2[39] and IFC Section 104.2.3[40] are similar) in pertinent part state:

> 104.2.3 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, provided that any such alternative is not specifically prohibited by this code and has been approved.

11.6 **Approved:**[41] Building regulations require that the building official shall accept duly authenticated reports.[42]

11.6.1 An approved agency is *"approved"* when it is ANAB ISO/IEC 17065 accredited.

11.6.2 An approved source is *"approved"* when an RDP is properly licensed to transact engineering commerce.

11.6.3 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. Denial without written reason deprives a protected right to free and fair competition in the marketplace.

11.7 DrJ is a licensed engineering company, employs licensed RDPs and is an ANAB Accredited Product Certification Body – Accreditation #1131.

11.8 Through the IAF Multilateral Arrangement (MLA), this duly authenticated report can be used to obtain product approval in any jurisdiction or country because all ANAB ISO/IEC 17065 duly authenticated reports are equivalent.[43]

12 Conditions of Use

12.1 As defined in **Section 6**, 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.

12.2 This report and the installation instructions, when required by a code official, shall be submitted at the time of permit application.

12.3 When R2+ BASE and R2+ BASE (Class A) are not installed for use as wall bracing as described in this report, the walls shall be braced by other materials, in accordance with the applicable code.

12.4 When used as part of a continuous air barrier assembly, all sheathing panel edges at the top and bottom of the wall assemblies and all joints between sheathing panels, shall be sealed with an approved construction tape.

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12.5 When used in accordance with the IBC in Seismic Design Categories C, D, E, or F, special inspections shall comply with IBC Section 1705.13.[44]

12.6 When used in accordance with the IBC in high wind areas, special inspections shall comply with IBC Section 1705.12.[45]

12.7 Loads applied shall not exceed those recommended by the manufacturer as follows:

12.7.1 Allowable shear loads do not exceed values in **Table 1** for wind loads and **Table 2** for seismic loads.

12.7.2 Transverse design loads shall not exceed those imposed by the wind loads shown in IBC Section 2304.6.1, unless an approved exterior wall covering capable of separately resisting loads perpendicular to the face of the walls is installed over the sheathing.

12.8 The manufacturer installation instructions shall be available on the jobsite for inspection.

12.9 When used in shear wall applications, all panel edges shall be supported by wall framing or solid blocking a minimum of 2" (51 mm) nominal in thickness.

12.10 When installed in areas where the probability of termite infestation is designated as *"very heavy"*, installation shall meet the requirements of IBC Section 2603.8 and IRC Section R303.7.[46]

12.11 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:

12.11.1 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.

12.11.2 This report and the installation instructions shall be submitted at the time of permit application.

12.11.3 At a minimum, these innovative products shall be installed per **Section 9**.

12.11.4 The review of this report by the AHJ shall comply with IBC Section 104.2.3.2 and IBC Section 105.3.1.

12.11.5 These innovative products have an internal quality control program and a third party quality assurance program in accordance with IBC Section 104.7.2, IBC Section 110.4, IBC Section 1703, IRC Section R104.7.2, and IRC Section R109.2.

12.11.6 The application of these innovative products in the context of this report is 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.

12.12 The approval of this report by the AHJ shall comply with IBC Section 1707.1, where legislation states in part, *"the building official shall make, or cause to be made, the necessary tests and investigations; or 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 104.2.3"*, all of IBC Section 104, and IBC Section 105.3.

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

12.14 The actual design, suitability, and use of this report for any particular building, is the responsibility of the owner or the authorized agent of the owner.

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13 Identification

13.1 R2+ BASE and R2+ BASE (Class A), as listed in **Section 1.1**, are identified by a label on the board or packaging material bearing the manufacturer name, product name, this report number, and other information to confirm code compliance.

13.2 Additional technical information can be found at www.henry.com/commercial/products/polyiso-insulation/wall-insulation/r2-base.

14 Review Schedule

14.1 This report is subject to periodic review and revision. For the latest version, visit www.drjcertification.org.

14.2 For information on the status of this report, please contact DrJ Certification.

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Notes

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

2 Capitalized terms and responsibilities are defined pursuant to the applicable building code, applicable reference standards, the latest edition of TPI 1, the NDS, AISI S202, US professional engineering law, Canadian building code, Canada professional engineering law, Qualtim External Appendix A: Definitions/Commentary, Qualtim External Appendix B: Project/Deliverables, Qualtim External Appendix C: Intellectual Property and Trade Secrets, definitions created within Design Drawings and/or definitions within Reference Sheets. Beyond this, terms not defined shall have ordinarily accepted meanings as the context implies. Words used in the present tense include the future; words stated in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural, the singular.

3 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1702

4 Alternative Materials, Design and Methods of Construction and Equipment: The provisions of any regulation code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by a regulation. Please review https://www.justice.gov/atr/mission and https://up.codes/viewer/mississippi/ibc-2024/chapter/1/scope-and-administration#104.2.3

5 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1706.2:~:text=the%20design%20strengths%20and%20permissible%20stresses%20shall%20be%20established%20by%20tests

6 The design strengths and permissible stresses of any structural material shall conform to the specifications and methods of design of accepted engineering practice. https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1706.1:~:text=Conformance%20to%20Standards-,The%20design%20strengths%20and%20permissible%20stresses,-of%20any%20structural

7 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1707.1:~:text=the%20building%20official%20shall%20make%2C%20or%20cause%20to%20be%20made%2C%20the%20necessary%20tests%20and%20investigations%3B%20or%20the%20building%20official%20shall%20accept%20duly%20authenticated%20reports%20from%20approved%20agencies%20in%20respect%20to%20the%20quality%20and%20manner%20of%20use%20of%20new%20materials%20or%20assemblies%20as%20provided%20for%20in%20Section%20104.2.3.

8 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1703.4.2

9 https://up.codes/viewer/mississippi/ibc-2024/chapter/2/definitions#approved_agency

10 https://up.codes/viewer/mississippi/ibc-2024/chapter/2/definitions#approved_source

11 https://www.law.cornell.edu/uscode/text/18/1832 (b) 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. To follow DTSA and comply state public records and trade secret legislation requires approval through ANAB ISO/IEC 17065 accredited certification bodies or approved sources. For more information, please review this website: Intellectual Property and Trade Secrets.

12 https://www.nspe.org/resources/issues-and-advocacy/professional-policies-and-position-statements/regulation-professional AND https://apassociation.org/list-of-engineering-boards-in-each-state-archive/

13 https://www.cbitest.com/accreditation/

14 https://up.codes/viewer/mississippi/ibc-2024/chapter/1/scope-and-administration#104.1:~:text=directed%20to%20enforce%20the%20provisions%20of%20this%20code

15 https://up.codes/viewer/mississippi/ibc-2024/chapter/1/scope-and-administration#104.2.3 AND https://up.codes/viewer/mississippi/ibc-2024/chapter/1/scope-and-administration#105.3.1

16 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1707.1

17 https://iaf.nu/en/about-iaf-mla/#:~:text=Once%20an%20accreditation%20body%20is%20a%20signatory%20of%20the%20IAF%20MLA%2C%20it%20is%20required%20to%20recognise%20certificates%20and%20validation%20and%20verification%20statements%20issued%20by%20conformity%20assessment%20bodies%20accredited%20by%20all%20other%20signatories%20of%20the%20IAF%20MLA%2C%20with%20the%20appropriate%20scope

18 True for all ANAB accredited product evaluation agencies and all International Trade Agreements.

19 https://www.justice.gov/crt/deprivation-rights-under-color-law AND https://www.justice.gov/atr/mission

20 Unless otherwise noted, the links referenced herein use un-amended versions of the 2024 International Code Council (ICC) 2024 International Code Council (ICC) model codes as foundation references. Mississippi versions of the IBC 2024 and the IRC 2024 are un-amended. This material, product, design, service and/or method of construction also complies with the 2000-2012 versions of the referenced codes and the standards referenced therein. As pertinent to this technical and code compliance evaluation, CBI and/or DrJ staff have reviewed any state or local regulatory amendments to assure this report is in compliance.

21 See Adoptions by Publisher for the latest adoption of a non-amended or amended model code by the local jurisdiction. https://up.codes/codes/general

22 See Adoptions by Publisher for the latest adoption of a non-amended or amended model code by state. https://up.codes/codes/general

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

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

25 https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280#p-3280.2(Listed%20or%20certified); https://up.codes/viewer/mississippi/ibc-2024/chapter/2/definitions#listed AND https://up.codes/viewer/mississippi/ibc-2024/chapter/2/definitions#labeled

26 2021 IBC Section 2308.6

27 2021 IECC Section C402.5.1.3 AND 2018 IECC Section C402.5.1.2.1

28 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1703.4

29 https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280#:~:text=All%20construction%20methods%20shall%20be%20in%20conformance%20with%20accepted%20engineering%20practices%20to%20insure%20durable%2C%20livable%2C%20and%20safe%20housing%20and%20shall%20demonstrate%20acceptable%20workmanship%20reflecting%20journeyman%20quality%20of%20work%20of%20the%20various%20trades

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30 https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280#:~:text=The%20strength%20and%20rigidity%20of%20the%20component%20parts%20and/or%20the%20integrated%20structure%20shall%20be%20determined%20by%20engineering%20analysis%20or%20by%20suitable%20load%20tests%20to%20simulate%20the%20actual%20loads%20and%20conditions%20of%20application%20that%20occur

31 2021 IBC Section 2308.6

32 2021 IECC Section C402.5.1.3 AND 2018 IECC Section C402.5.1.2.1

33 2021 IRC Section R316.3

34 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.

35 https://anabpd.ansi.org/Accreditation/product-certification/AllDirectoryDetails?prgID=1&orgID=2125&statusID=4#:~:text=Bill%20Payment%20Date-,Accredited%20Scopes,-13%20ENVIRONMENT.%20HEALTH

36 See Code of Federal Regulations (CFR) Title 24 Subtitle B Chapter XX Part 3280 for definition: https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280

37 2021 IECC Section C402.5.1.3 AND 2018 IECC Section C402.5.1.2.1

38 2021 IBC Section 104.11

39 2021 IRC Section R104.11

40 2018: https://up.codes/viewer/wyoming/ifc-2018/chapter/1/scope-and-administration#104.9 AND 2021: https://up.codes/viewer/wyoming/ibc-2021/chapter/1/scope-and-administration#104.11

41 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 (https://up.codes/viewer/mississippi/ibc-2024/chapter/2/definitions#201.4) where the building code authorizes sentences to have an ordinarily accepted meaning such as the context implies.

42 https://up.codes/viewer/mississippi/ibc-2024/chapter/17/special-inspections-and-tests#1707.1

43 Multilateral approval is true for all ANAB accredited product evaluation agencies and all International Trade Agreements.

44 2018 IBC Section 1705.12

45 2018 IBC Section 1705.11

46 2021 IRC Section R316.7

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