Evaluation Report CCMC 14075-R
ZIP System® R-sheathing

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1. Opinion

It is the opinion of the Canadian Construction Materials Centre (CCMC) that "ZIP System® R-sheathing," when used as insulating wood sheathing panels in lumber stud braced wall panels[1] in accordance with the conditions and limitations stated in Section 3 of this Report, complies with the National Building Code (NBC) of Canada 2015:

- Clause 1.2.1.1.(1)(a), Division A, using the following acceptable solutions from Division B:
  - Article 9.23.17.2., Thickness, Rating and Material Standards (Wall Sheathing)
  - Article 9.25.2.2., Insulation Materials

- Clause 1.2.1.1.(1)(b), Division A, as an alternative solution that achieves at least the minimum level of performance required by Division B in the areas defined by the objectives and functional statements attributed to the following applicable acceptable solutions:
  - Article 4.3.1.1., Design Basis for Wood (CSA O86, "Engineering Design in Wood")
  - Subsection 9.23.13., Bracing to Resist Lateral Loads Due to Wind and Earthquake

This opinion is based on the CCMC evaluation of the technical evidence in Section 4 provided by the Report Holder.

2. Description

This Report addresses the performance of Huber Engineered Woods LLC's proprietary "ZIP System® R-sheathing" as insulating wood sheathing panels in lumber stud braced wall panel applications to resist lateral loads due to wind or earthquake.

Evaluation Scope

This proprietary insulating sheathing results in the nail's head being offset a distance from the lumber stud. This leads to the reduction in the lateral resistance of the braced wall. This evaluation provides proprietary design values for high wind and seismic loadings in accordance with Part 4, Structural Design, and alternative solutions for Part 9, Housing and Small Buildings, of Division B of the NBC 2015.

Product

"ZIP System® R-sheathing" is a panel product that consists of a 11-mm (7/16-in.) OSB structural sheathing bonded to a sheathing membrane on one side and to a rigid foam insulation material on the other. It is installed with the foam insulation facing the studs. Hence, the nail heads are offset a distance from the lumber stud, separated by the wood-based sheathing and the thickness of the foam insulation. Figure 1 shows a typical installation of "ZIP System® R-sheathing." Note that this Report only covers the use of this product as insulating wood sheathing panels; its use for a sheathing membrane function is covered in CCMC 14019-R.

1. "Braced wall panel" is building code terminology for "shearwall" as used in "*CWC 2014, Engineering Guide for Wood Frame Construction*" by The Canadian Wood Council (CWC).

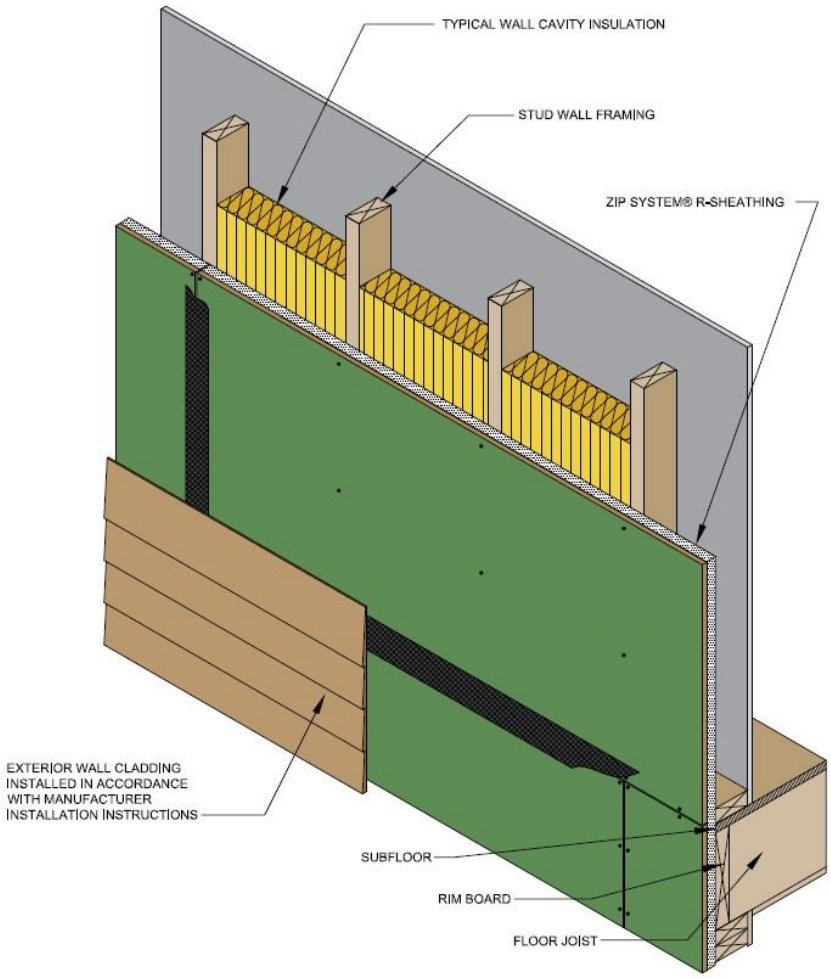

Figure 1: Typical installation of "ZIP System® R-sheathing," whereby the insulation is facing the lumber studs. (The figure is for pictorial purposes only. Refer to the manufacturer's installation manual for the actual nailing schedule.)

The wood-based structural sheathing component of this product is an 11-mm (7/16 in.) OSB panel complying with CSA O325, "Construction Sheathing," for exterior wall applications for the requisite stud spacing. The OSB has an in-plant laminated sheathing membrane, which is a polymer-modified sheet overlay applied during the OSB manufacturing process. The rigid foam insulation material component of this product is a polyisocyanurate insulation panel, "ACFoam®-III/Stucco-Shield® II/Rboard™" (CCMC 12423-L), which meets the requirements of CAN/ULC-S704-11, "Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced," as specified in the NBC 2015. The product is available with different thicknesses of rigid foam insulation, 12.7 mm (1/2 in.), 25.4 mm (1 in.), 38.1 mm (1 1/2 in.) and 50.8 mm (2 in.) as shown in Table 2.1. The sheet panel is available in nominal 1 219 mm (4 ft.) in width and 2 438 mm (8 ft.), 2 743 mm (9 ft.), 3 048 mm (10 ft.), 3 353 mm (11 ft.) and 3 658 mm (12 ft.) in length.

Table 2.1: "ZIP System® R-sheathing" Product Line

ZIP System® R-sheathing Type (Nominal R-value)	Thickness (mm)		RSI[(1)] (Thermal Resistance Value)
	Rigid Foam Insulation	OSB	$m^2 \cdot °C \cdot W^{-1}$ (R-value)
R-3	12.7	11	0.522 (R2.96)
R-6	25.4	11	1.044 (R5.92)
R-9	38.1	11	1.567 (R8.90)
R-12	50.8	11	2.089 (R11.9)

Note to Table 2.1:

1. The RSI values are taken from CCMC 12423-L for design purposes and Code-compliance. Those values are for rigid foam insulation only. When determining the Ratio of Outboard to Inboard Thermal Resistance, the RSI value of 0.108 (R0.61) for 11-mm OSB shall be added to the RSI values shown for rigid foam insulation.

Adhesive

The adhesive used to bond the wood-based panel and insulation was not being subjected to long-term durability testing and therefore is not part of this evaluation. However, the testing was also conducted with and without the adhesive and showed no impact on the structural test results.

Low Permeance Material

In addition, as the insulation plus the integral sheathing membrane OSB possesses a water vapour permeance of less than 60 ng/(Pa·s·m^2), when measured in accordance with Procedure A (Desiccant Method) of ASTM E96/E96M-13, "Water Vapor Transmission of Materials," the "ZIP System® R-sheathing" is a low air and water vapour permeance material installed on the cold side. As a result, the exterior wall assembly complies with Subsection 9.25.5, "Properties and Position of Materials in the Building Envelope," of Division B of the NBC 2015 with respect to the outboard insulation in accordance with Table 9.25.5.2., Ratio of Outboard to Inboard Thermal Resistance, of Division B of the NBC 2015 for the respective heating degree-day (HDD) of the geographical location of the building using the RSI values in Table 2.1 of this Report.

3. Conditions and Limitations

The CCMC compliance opinion in Section 1 is bound by "ZIP System® R-sheathing" being used in accordance with the conditions and limitations set out below:

- The thickness and thermal resistance of the product shall meet the requirement in Table 9.25.5.2 of Division B of the NBC 2015 for the respective HDD of the building location.
- The product is limited for use in high wind and low seismic applications where the 1-in-50 hourly wind pressure is less than 1.2 kPa and the seismic spectral response acceleration, $S_a(0.2)$, is not more than 0.5. An engineering design is required for higher wind and seismic loads in accordance with CSA O86 and Part 4 of Division B of the NBC 2015.
- Braced wall panels utilizing insulating wood sheathing shall be detailed in accordance with Subsection 9.23.13. of Division B of the NBC 2015.
- Braced wall panels are subject to the requirements and limitations in Subsection 9.23.13. of Division B of the NBC 2015, except for Article 9.23.13.6., Materials in Braced Wall Panels, of the NBC 2015.
- Double-sheathed walls (walls with insulating wood sheathing and structural wood-based sheathing nailed on opposite faces) are not allowed.
- The nail diameter for sheathing-to-framing connections in any wall shall not exceed 3.8 mm.
- The wood-based panel thickness shall be within the range of 9.5 mm (3/8 in.) – 12.5 mm (1/2 in.).
- The maximum thickness of insulation shall be 51 mm (2 in.).
- A minimum nail penetration into lumber studs shall be 12.5 times the specified nail diameter for insulating sheathing.
- Fasteners shall be as specified in Table 4.1.1 of this Report.
- Use of this product for a sheathing membrane function is covered under a separate CCMC Evaluation Report (see CCMC 14019-R). "ZIP System® R-sheathing" is composed of "ZIP System® Sheathing and Tape" with rigid foam insulation panel bonded to the opposite side of the integral sheathing membrane of "ZIP System® Sheathing and Tape."
- The panels shall be installed in conformance with the manufacturer's installation manual.
- The product shall be clearly identified with the phrase "CCMC 14075-R".

4. Technical Evidence

The Report Holder has submitted two sets of technical documentations for the CCMC evaluation:

a) Part 9 application in low seismic zones ($S_a(0.2) \leq 0.5$): The corresponding technical results of monotonic loading test are presented in Section 4.1 of this Report. Testing was conducted at an independent laboratory recognized by CCMC.

b) Part 9 application in higher seismic zones ($S_a(0.2) > 0.5$) and Part 4 Structural Design: The corresponding technical results of the reversed cyclic loading test are presented in Section 4.2 of this Report. Testing was conducted at an independent laboratory recognized by CCMC.

4.1 Performance Requirements for Part 9 Application in Low Seismic Zones

Table 4.1.1 Summary of Construction Details of Braced Wall for Monotonic Loading Test (ASTM E72-15)

ZIP System® R-sheathing Type(1)	Framing Lumber			Fasteners				Number of Specimens
	Stud Materials	Stud Size	Stud Spacing	Specification	Length	Nail Spacing (Interior Stud)	Nail Spacing (Edge)	
		in.	mm		mm	mm	mm	
R-3	Spruce-Pine-Fir No. 2	2 × 4	600	3.2 mm shank nail	76	300	150	2
R-9	Spruce-Pine-Fir No. 2	2 × 4	600	3.2 mm shank nail	102	300	150	2
R-12	Spruce-Pine-Fir No. 2	2 × 4	600	3.2 mm shank nail	102	300	150	3

Note to Table 4.1.1:

1. See Table 2.1 for the product description.

Table 4.1.2 Results of Monotonic Loading Test (ASTM E72-15) and Characteristic Shear Strength

Loading, $q_{1/50}$ (kPa) and $S_a(0.2)$(1)	ZIP System® R-sheathing Type(3)	Specimen ID	Peak Load, P_{peak}	Lateral Load at 5.1 mm Deflection, $P_{5.1}$	Initial Stiffness, K	Ultimate Shear Strength, v'	Lateral Load at 5.1 mm Deflection, v_{draft}	Characteristic Shear Strength(4), v_k
			kN	kN	kN/mm	kN/m	kN/m	kN/m
$q_{1/50} \le 1.2$ and $S_a(0.2) \le 0.5$(2)	R-3	R-3 #1	15.09	5.69	1.03	4.18	4.42	
		R-3 #2	15.90	6.70	1.37	4.41	5.20	
	Mean		**15.50**	**6.20**	**1.20**	**4.30**	**4.81**	**4.30 (> 2.50(2))**
	R-9	R-9 #1	14.03	3.97	0.42	3.89	3.08	
		R-9 #2	12.94	5.91	1.74	3.59	4.59	
	Mean		**13.49**	**4.94**	**1.08**	**3.74**	**3.83**	**3.74 (> 2.50(2))**
	R-12	R-12 #1	10.51	3.29	0.42	2.91	2.55	
		R-12 #2	10.57	3.94	0.69	2.93	3.06	
		R-12 #3	12.61	3.42	0.36	3.50	2.65	
	Mean		**11.23**	**3.55**	**0.49**	**3.11**	**2.76**	**2.76 (> 2.50(2))**

Notes to Table 4.1.2:

1. $q_{1/50}$ is 1-in-50 year hourly wind pressure in kPa and $S_a(0.2)$ is the seismic spectral response acceleration. Wind and seismic loading conditions were derived in conjunction with Table C1a of the CWC's Engineering Guide for Wood Frame Construction (2014 Edition) as per Clause 9.23.13.2.(2)(c), Requirements for High Wind and Seismic Forces, of Division B of the NBC 2015.
2. The required shear strength of 2.50 kN/m is a benchmarked value for 9.5-mm (3/8-in.) OSB (400 mm o.c.) as an acceptable solution, in conjunction with Table C1a of the CWC's "Engineering Guide for Wood Frame Construction (2014 Edition) as per Clause 9.23.13.2.(2)(c) of Division B of the NBC 2015.
3. See Table 2.1 of this Report for the product description.
4. The product provides better performance than the NBC acceptable solution when the fasteners are used as shown in Table 4.1.1 of this Report.

4.2 Performance Requirements for Part 9 Application in Higher Seismic Zones and for Part 4

Table 4.2.1 Summary of Construction Details of Braced Wall for Reversed Cyclic Loading Test (ASTM E2126-11)

ZIP System® R-sheathing Type (1)	Framing Lumber			Fasteners				Number of Specimens
	Stud Materials	Stud Size	Stud Spacing	Specification	Length	Nail Spacing (Interior Stud)	Nail Spacing (Edge)	
		in.	mm		mm	mm	mm	
R-3	Spruce-Pine-Fir No. 2	2 × 4	600	3.2 mm shank nail	76	300	75	2
	Douglas Fir-Larch No. 2	2 × 4	600	3.2 mm shank nail	76	300	75	2
R-6	Spruce-Pine-Fir No. 2	2 × 4	600	3.2 mm shank nail	76	300	75	2
	Douglas Fir-Larch No. 2	2 × 4	600	3.2 mm shank nail	76	300	75	2
R-9	Spruce-Pine-Fir No. 2	2 × 4	600	3.2 mm shank nail	102	300	75	2
	Douglas Fir-Larch No. 2	2 × 4	600	3.2 mm shank nail	102	300	75	2
R-12	Spruce-Pine-Fir No. 2	2 × 4	600	3.2 mm shank nail	102	300	75	3
	Douglas Fir-Larch No. 2	2 × 4	600	3.2 mm shank nail	102	300	75	2

Note to Table 4.2.1:

1. See Table 2.1 of this Report for the product description.

Table 4.2.2 Specified Shear Strength of Assemblies Based on Reversed Cyclic Loading Test (ASTM E2126-11) for Part 9 Application in Higher Seismic Zones and Part 4 Design

ZIP System® R-sheathing Type(1)	Assembly Applicability Outlined in Table 4.2.1 of this Report(2)			
	Part 9 (Housing and Small Buildings)(3)		Part 4 (Structural Design)(5) For Seismic Zone > *[Column 1]* and *[Column 2]*	
	Maximum Seismic Zone Applicability		Specified Shear Strength(6) (kN/m)	
	[Column 1] Stud Materials Spruce-Pine-Fir No. 2	*[Column 2]* Stud Materials Douglas Fir-Larch No. 2	Stud Materials Spruce-Pine-Fir No. 2	Stud Materials Douglas Fir-Larch No. 2
R-3	$0.5 < S_a(0.2) \leq 1.0$	$0.5 < S_a(0.2) \leq 1.0$	7.73	8.80
R-6	$S_a(0.2) \leq 0.5$(4)	$S_a(0.2) \leq 0.5$(4)	6.88	6.83
R-9	$S_a(0.2) \leq 0.5$	$S_a(0.2) \leq 0.5$	5.90	5.02
R-12	$S_a(0.2) \leq 0.5$	$S_a(0.2) \leq 0.5$	5.23	4.87

Notes to Table 4.2.2:

1. See Table 2.1 of this Report for the product description.
2. The values listed apply to the construction details of assemblies (i.e., fastening schedule) outlined in Table 4.2.1 of this Report.
3. Limited to hourly wind pressure $q_{1/50} \leq 1.2$ kPa.
4. Based on the test results, the ZIP System® R-sheathing "R-6" was close to being qualified for the next seismic zone. As such, CCMC

would deem it acceptable for the use up to $S_a(0.2) = 0.61$.

5. According to CSA O86. For calculation of shear wall deflection according to Clause 11.7.1.2, the nail deformation, e_n, for a 3.2mm diameter nail can be calculated as follows:

$$e_n = \exp^{(2.65 \times \ln(P) + 0.047 \times T + 1.90)}$$

   Where:
   e_n = nail deformation, mm;
   P = lateral load per nail, kN; and
   T = thickness of insulation between 12.5 and 50.8, mm, (See Table 2.1 of this Report for the thickness of insulation)

6. Based on 3.2-diam nail at 75 mm spacing at panel edges with a minimum point-side penetration of 12.5d. $R_d = 3.0$ and $R_0 = 1.7$ are permitted for seismic design.

Report Holder

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