



Evaluation Report CCMC 14045-R Royal Celect Cladding

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1. Opinion

It is the opinion of the Canadian Construction Materials Centre (CCMC) that “Royal Celect Cladding,” when used as a foamed cellular polyvinyl chloride (PVC) cladding system in new and retrofit constructions falling under Part 9 of the NBC 2015 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 1.1.3.1., Climatic and Seismic Values
 - Sentence 4.1.7.1.(4), Specified Wind Load
 - Sentence 5.6.1.1.(1), Required Protection from Precipitation
 - Sentence 9.27.1.1.(6), General (Cladding)
 - Article 9.27.2.1., Minimizing and Preventing Ingress and Damage
 - Sentence 9.27.2.2.(1), Minimum Protection from Precipitation Ingress
 - Sentence 9.27.2.2.(4), Minimum Protection from Precipitation Ingress
 - Sentence 9.27.2.2.(5), Minimum Protection from Precipitation Ingress
 - Sentence 9.27.2.2.(6), Minimum Protection from Precipitation Ingress
 - Sentence 9.27.2.3.(1), First and Second Planes of Protection
 - Article 9.27.3.1., Elements of the Second Plane of Protection
 - Sentence 9.27.5.1.(1), Attachment (Attachment of Cladding)
- 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:
 - Sentence 9.27.12.1.(1), Material Standard (Vinyl Siding)

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

2. Description

The product is an exterior cladding system supplied in planks measuring 216 mm (8.5 in.) and 137 mm (5.4 in.) wide with an exposure of 178 mm (7 in.) and 100 mm (4 in.), respectively; a nominal length of 3 759 mm (12 ft. 4 in.); and a nominal thickness of 8.7 mm (0.34 in.). The product is made of cellular PVC. The panels are profiled along the top and edges so that the horizontal and vertical joints are clipped together creating a shiplap joint. The exterior face of the panels is embossed to provide a wood-like pattern. The panels are available in different colours.

The product must be installed in accordance with the manufacturer’s specifications and limitations listed below. The horizontal cladding product must be installed using 50 mm (2 in.) long hot-dipped galvanized roofing nails with a minimum spacing of 406 mm (16 in.) on center (o.c.).

The product can be installed directly over the Code acceptable sheathing and sheathing membrane in non-coastal applications with a moisture index [MI] of < 1. In coastal regions with a MI of > 1, the product must be installed over furring.

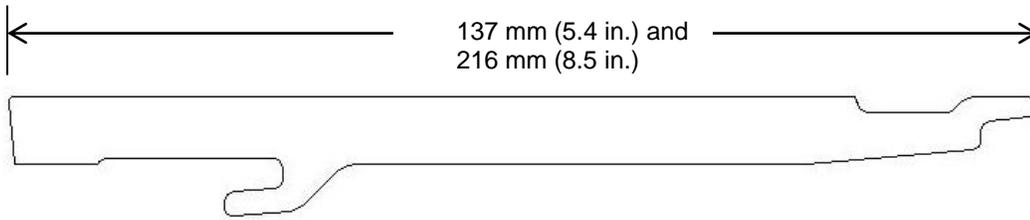


Figure 1. Profile of a “Royal Celect Cladding” plank for 100 mm (4 in.) and 178 mm (7 in.) exposures

3. Conditions and Limitations

The CCMC compliance opinion in Section 1 is bound by “Royal Celect Cladding” being used in accordance with the conditions and limitations set out below:

- The cladding system is intended for use as an exterior cladding applied to vertical walls made of plywood or oriented strandboard (OSB) sheathing installed over wood or steel framing in new constructions.
- The cladding system is intended for use on buildings not exceeding 12 m or 3 storeys high.
- The product can be installed directly to the sheathing in non-coastal areas ($MI \leq 1$) as defined by Sentence 9.27.2.2.(5) of Division B of the NBC 2015 with conformance to Sentence 9.27.2.2.(6).
- Based on the test data and the computer modeling summarized in this Report, it was determined that the product must be installed over furring in coastal areas ($MI > 1$) as defined by Sentence 9.27.2.2.(5) of Division B of the NBC 2015 in conformance with Article 9.27.5.3., Furring, of Division B of the NBC 2015, and in conjunction with a minimum vented air space or capillary break of 10 mm (0.39 in.) conforming to Clause 9.27.2.2.(1)(a) and Sentence 9.27.2.2.(2) of Division B of the NBC 2015.
- The cladding system must be installed in conjunction with an acceptable sheathing with a thickness of no less than 11 mm (0.43 in.) as defined in Article 9.23.17.2., Thickness, Rating and Material Standards, of Division B of the NBC 2015.
- The cladding system must be installed in conjunction with a Code acceptable sheathing membrane as defined in Article 9.27.3.2., Sheathing Membrane Material Standard, of Division B of the NBC 2015.
- The cladding must be installed in accordance with the following fastening pattern:
 - Horizontal clapboard – 50 mm (2 in.) hot-dipped galvanized roofing nails with maximum spacing of 406 mm (16 in.).
- Fasteners for the cladding must be corrosion resistant, compatible with the cladding material, and positioned to permit expansion and contraction due to temperature changes.
- The attachment of the cladding system must conform to Sentence 9.27.5.1.(1), Article 9.27.5.5., Fastener Materials, and Sentence 9.27.5.7.(2), Penetration of Fasteners, of Division B of the NBC 2015. For any other mode of attachment to the sheathing, the structural sufficiency of the sheathing and backing wall in conjunction with the type of fasteners must be in accordance with Part 4 of Division B of the NBC 2015.
- The cladding must be installed with a suitable flashing that will drain water to the exterior and protect the exposed top edge of the cladding. Installed flashing must be in accordance with the requirements of Article 9.27.3.7., Flashing Materials, of Division B of the NBC 2015.
- At least one layer of sheathing membrane conforming to Article 9.27.3.1. of Division B of the NBC 2015 must be applied beneath the cladding. The sheathing membrane must be applied in accordance with Article 9.27.3.3., Required Sheathing Membrane and Installation, of Division B of the NBC 2015.
- The installation of the cladding products with mechanical fasteners as indicated in Table 4.2.2.1 is limited to geographical areas where the wind value is $Q_{50} < 1.0$ kPa.
- The product must be installed in accordance with the manufacturer’s current installation instructions.
- This Evaluation Report is applicable only to products identified with the phrase “CCMC 14045-R” on the packaging.

4. Technical Evidence

The Report Holder has submitted technical documentation for the CCMC evaluation. Testing was conducted at laboratories recognized by CCMC. The corresponding technical evidence for this product is summarized below.

4.1 Prescriptive Requirements

4.1.1 Cladding Material Characteristics

Table 4.1.1.1 Results of Testing the Cladding Material Characteristics of the Product

Property	Unit	Requirement	Result
Density	kg/m ³	Report value	477.7
Tensile modulus	MPa	Report value	7.9
Compressive strength at 10% deformation	MPa	Report value	6.754
Tensile strength at yield	MPa	Report value	10.14
Coefficient of linear expansion	cm/cm/°C	< 0.000081	0.000005
Flexural strength	MPa	Report value	19.64
Loss of flexural strength after ultraviolet (UV) resistance	%	≤ 25	8.2
Loss of flexural strength after freeze-thaw resistance	%	≤ 15	1.7
Hardness of panel	–	Report value	45.5 Shore D

4.1.2 Dimensional Tolerance

Table 4.1.2.1 Results of Testing the Dimensional Tolerance of the Product

Property	Unit	Requirement	Result
Length	mm	±10	Pass
Width	mm	±2	Pass
Thickness	mm	±1.6	Pass
Squareness	mm	±4.0	Pass
Edge straightness	mm/m	≤ 1.8/m of length	Pass

4.2 Performance Requirements

4.2.1 Cladding System Impact and Weathering

Table 4.2.1.1 Results of Testing the Cladding System Impact and Weathering of the Product

Property	Requirement	Result
Impact resistance	The cladding system must be capable of withstanding the applied impact loads without deterioration in the performance or safety of the system.	Pass
Accelerated weathering resistance	The cladding system must show no visual surface and physical change such as cracking, flaking or any other deleterious effects.	Pass

4.2.2 Cladding System Wind Load Resistance

Table 4.2.2.1 Results of Testing the Wind Load Resistance – Horizontal Siding of the Product¹

Reference Wind Pressure (kPa)	Sustained		Cycling		Gust		Deflection Test		
	P ₁ ,P' ₁ (Pa)		P ₂ ,P' ₂ (Pa)		P ₃ ,P' ₃ (Pa)		Test Pressure (Pa) 2.18 P ₁ ,P' ₁	Measured Maximum Net Mid-Span Deflections (mm)	
								Stud Height 3 050 mm	Sheathing ² Span 406 mm
Q ₅₀ < 0.25	±250	Pass	±365	Pass	±540	Pass	+540	0.0	-0.3
							-540	-0.2	3.1
Q ₅₀ < 0.50	±500	Pass	±730	Pass	±1 090	Pass	+1 090	0.0	-0.1
							-1 090	0.4	6.3
Q ₅₀ < 0.75	±750	Pass	±1 090	Pass	±1 630	Pass	+1 630	1.3	-0.4
							-1 630	-1.3	1.7
Q ₅₀ < 1.00	±1 000	Pass	±1 460	Pass	±2 180	Pass	+2 180	1.5	1.0
							-2 180	-0.9	0.1

Notes to Table 4.2.2.1:

1. The horizontal siding material was fastened using 50-mm-long hot-dipped galvanized roofing nails spaced at 406 mm o.c.
2. The horizontal siding material was fastened into the 11-mm-thick sheathing.

4.2.3 Durability under Environmental Cyclic Conditions

Table 4.2.3.1 Determination of Hygrothermal Properties of Cladding for the Product (with respect to Code Solution – Vinyl Siding)

Property	Unit	Result	
		Royal Building Products	Code Benchmark Vinyl Siding ¹
Thickness of siding	mm	8.95	1.2
Density	kg/m ³	477 ²	1 500
Thermal conductivity	W/m·K	0.0555	0.16
Heat capacity	J/(kg·K)	1 260 ³	1 260 ³
Water vapour permeance	ng/m ² ·s·Pa	XD ⁴ 33.88	XD 7.11
		YD ⁵ 14.4	–
Air permeability (at 75 Pa)	L/m·s	XD 0.06	XD 0.00476
Water absorption coefficient	kg·m ⁻² ·s ^{-1/2}	0.00011	–

Notes to Table 4.2.3.1:

1. Determined to be the benchmark cladding for alternative solution compliance of the “Royal Celect Cladding” in accordance with Sentence 9.27.2.2.(1) of Division B of NBC 2015. Properties provided below are based on the NRC report “Moisture Management Evaluation of Royal Building Product Celect Siding Products – Development of Hygrothermal Properties,” August 18, 2016.
2. Based on testing from the NRC report, “Moisture Management Evaluation of Royal Building Product Celect Siding Products – Development of Hygrothermal Properties,” August 18, 2016.
3. Determined to be the same value for “Royal Celect Cladding” and the Code benchmark vinyl siding based on the NRC report, “Moisture Management Evaluation of Royal Building Product Celect Siding Products – Development of Hygrothermal Properties,” August 18, 2016.
4. X direction.
5. Y direction.

Table 4.2.3.2 Results of Test Simulation for Condensation Resistance of the Product (Code Solution – Vinyl Siding)

Property	Zone	Code Benchmark Vinyl Siding	Royal Building Products ¹
Diffuse air moisture transfer	Zone 6 – Halifax, NS MI > 1	Acceptable	Not at risk of formation of condensation on the interior surface of the sheathing panel
	Zone 7A – Winnipeg, MB MI < 1	Acceptable	Not at risk of formation of condensation on the interior surface of the sheathing panel
	Zone 8 – Iqaluit, NU MI < 1	Acceptable	Not at risk of formation of condensation on the interior surface of the sheathing panel
Moisture transfer by diffused air movement and an air leakage path	Zone 6 – Halifax, NS MI > 1	Acceptable	Not at risk of formation of condensation on the interior surface of the sheathing panel
	Zone 7A – Winnipeg, MB MI < 1	Acceptable	Not at risk of formation of condensation on the interior surface of the sheathing panel
	Zone 8 – Iqaluit, NU MI < 1	Acceptable	Not at risk of formation of condensation on the interior surface of the sheathing panel

Note to Table 4.2.3.2:

1. Simulation for the condensation resistance of the product was conducted without the Code acceptable capillary break to verify performance and installation of the product directly to the sheathing.

Table 4.2.3.3 Results of Water Entry Testing under Pressure for the Product (with respect to Code Solution – Vinyl Siding)

Property	Unit	Requirement	Horizontal Siding	
Water penetration	L	Report water quantity	Introduced	8 L
			Drained	Less than vinyl siding ¹
			Retained	More than vinyl siding ²

Notes to Table 4.2.3.3:

1. Due to the fact that the water amounts drained and retained behind the cladding are greater than the Code benchmark solution of vinyl siding, hygrothermal simulation was undertaken to determine the effect of the moisture on the sheathing and the backup wall. The results of this analysis are found in the NRC report, “Moisture Management Evaluation of Royal Building Products Cladding – Results from Simulation to Evaluate Response for Wall Assembly to Water Entry,” September 15, 2016. Based on the findings of the hygrothermal analysis report prepared by the NRC, September 19 and 23, 2016, the “Royal Select Cladding” is deemed to perform in non-coastal areas ($MI \leq 1$) and must be installed over strapping in coastal areas ($MI > 1$).
2. Retained moisture requires modeling to ensure that there is no adverse effects to the components of the wall assembly. Results of the modeling are presented in Tables 4.2.4.1 and 4.2.4.2.

4.2.4 Modeling Results

Table 4.2.4.1 Results of Testing the Moisture Modeling for Retained Water Entry (Code Solution – Vinyl Siding) for Zones with MI > 1

Zone	Relative Humidity (RH) Based on Temperature	Code Benchmark Vinyl Siding	Royal Building Products	Result ¹
Zone 6 – Halifax, NS (MI = 1.49)	RHT 80	8 949	9 253	Product to be installed over strapping
	RHT 92	3 571	3 690	
	RHT 95	2 227	2 299	
Zone 6 – St. John’s, NL (MI = 1.41)	RHT 80	5 643	5 359	Product to be installed over strapping
	RHT 92	2 253	2 140	
	RHT 95	1 406	1 335	
Zone 5 – Vancouver, BC (MI = 1.69)	RHT 80	11 049	11 489	Product to be installed over strapping
	RHT 92	4 536	4 536	
	RHT 85	2 797	2 797	

Note to Table 4.2.4.1:

1. Based on the findings of the hygrothermal analysis report prepared by the NRC, “Moisture Management Evaluation of Royal Building Products Cladding – Results from Simulation to Evaluate Response for Wall Assembly to Water Entry,” September 15, 2016.

Table 4.2.4.2 Results of Testing the Moisture Modeling for Water Entry (Code Solution – Vinyl Siding) for Zones with MI < 1

Zone	RH Based on Temperature	Code Benchmark Vinyl Siding	Code Benchmark Stucco Wall	Royal Building Products	Result ¹
Zone 6 – Chatham, NB (MI = 0.97)	RHT 80	8 726	8 834	8 817	Product to be installed directly over the sheathing
	RHT 92	3 413	3 528	3 326	
	RHT 95	2 085	2 202	1 953	

Note to Table 4.2.4.2:

1. Based on the findings of the hygrothermal analysis report prepared by the NRC, “Moisture Management Evaluation of Royal Building Products Cladding – Results from Simulation to Evaluate Response for Wall Assembly to Water Entry,” September 15, 2016.

4.2.5 Fire Performance

The product conforms to Clause 3.1.5.5.(1)(a), Combustible Cladding on Exterior Walls, of the NBC 2015 by meeting the requirements of CAN/ULC-S102.2, “Standard Method of Fire Test of Exterior Wall Assemblies,” as tested by Exova, Report No. 15-002-605, October 15, 2015.

Table 4.2.5.1 Results of Testing the Fire Performance

Test	Result
Flame spread	85
Smoke development	580

Report Holder

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