

# Objective Based Code Analysis

## StoTherm® ci MVES

July 2022

### OVERVIEW

#### 1. Background and Rationale

**i** Currently, manufactured stone veneer is outside of the National Building Code's list of cladding materials described in Article 9.27.1.1. While masonry is referenced and has its own Part 9 Section, the type, use and related standards under Subsection 9.20.2. "Masonry Units" does not encompass adhered veneers as addressed in this analysis. StoTherm ci Systems represent a range of Exterior Insulation and Finish Systems (EIFS) and for the purpose of this analysis, StoTherm ci system combinations compliant with Sentence 9.27.13.1.(1). However, this provision would not be wholly applicable to StoTherm ci EIFS where manufactured veneers (outside of the scope of CAN/ULC S716.1-12) are utilized as the finish material. As such, a code user is directed to comply with Part 5. A reasonable starting point in Part 5 would be Article 5.9.4.1. addressing EIFS use. Sentence 5.9.4.1.(1) accommodates the design and use of an EIFS assembly, outside of the scope of S716.1, but not outside of the objectives of its noted provisions:

- 1) *Exterior insulation finish systems and their components shall comply with*
  - a) *Subsection 5.1.4. and Sections 5.3. to 5.6., and*
  - b) *CAN/ULC-S716.1, "Exterior Insulation and Finish Systems (EIFS) -Materials and Systems," where covered in the scope of that standard. (See Note A-5.9.4.1.(1).)*

This Sentence describes what can be understood as performance expectations to be realized through, or otherwise present when utilizing an EIFS assembly on an exterior wall meant to separate dissimilar environments. It is not expected that these functions be fulfilled exclusively by the EIFS, but rather where EIFS is used to form part of an environmental separator, the wall assembly is to behave as a functional whole, with attributes assigned to given control layer(s) and/or structural component(s) as appropriate. That said, a finish material must be compatible with the EIFS. Meaning, while Sentence 5.9.4.1.(1) allows for design solutions outside of the scope of S716.1, the design must still fulfil the related performance attributes of the provisions cited in Clause 5.9.4.1.(1)(a).

#### 2. Terms of Reference

**i** An *Objective Based Analysis* can be understood as an unpacking of reasons **why** a Division B (*acceptable solutions*) code provision includes **what** it does through the review/analysis of Division A's Functional Statements and Objectives. In other words, *acceptable solutions* express the **want**, or **what** of the code, an *Objective Based Analysis* explores the reasons **why**. In doing so, a user is able to evaluate their design solution, or their "**how**" against the of the relevant objective(s) of the code. In most cases, this process is used to demonstrate how an *alternative solution* conforms with the objectives of the code's *acceptable solutions*. Exterior Insulation and Finish Systems are addressed in Division B of the code and its use is not considered an *alternative solution*. Nevertheless, questions can rightly arise with regard to the use of adhered veneers as a finish material, as opposed to field applied renders more traditionally associated with EIFS finishes within the scope of CAN/ULC-S716.1-12. As such, *their* use may be seen as an alternative, but provided the balance of the wall assembly conforms with the objectives of Clause 5.9.4.1.(1)(a), the assembly as a whole should not be seen as an *alternative solution*. The below is meant to set out the limits within which the combination of manufactured stone and or masonry veneers and StoTherm ci sustains the requisite attributes expected of an EIFS assembly per the provisions of the National Building Code of Canada – 2015 Edition, as well as Provincial codes where EIFS' National standards have been adopted.

### 3. StoTherm ci MVES (Manufactured Veneer Engineered System) Overview

The StoTherm ci MVES is a combining of two technologies, specifically, StoTherm ci Exterior Insulation and Finish Systems with Manufactured Stone Veneers (MSV), or Adhered Masonry Veneer (AMV). As with all construction technology, certain limits must be applied so that the intended function is maintained and uses within the capacity of the technology/material (e.g., floor joist use within its span and load limits, windows not used as skylights, etc.). Currently, the use of MSV/AMV in combination with StoTherm ci system is limited to MSV products meeting ASTM C1670 “Standard Specification for Adhered Manufactured Stone Masonry Veneer (AMSMV) Units”, or AMV (“thin brick”) produced in accordance with standards referenced in Clauses 9.20.2.1.(1) (a) – (d) and within the below limits:

- 1) No face dimension to exceed 914 mm (36 in.) and surface area  $\leq 0.46 \text{ m}^2$  ( $< 5 \text{ ft}^2$ )
- 2) Average thickness no less than 16 mm (5/8 in.) and at no time exceeding 68 mm (2-5/8 in.) for manufactured stone veneer units, and not to exceed 45 mm (1-3/4 in) thick for thin brick.
- 3) Unit weight not to exceed  $73 \text{ kg/m}^2$  (15 lb/ft<sup>2</sup>), meaning saturated weight as established by ASTM C1670).
- 4) Dark veneers with a LRV (Light Reflective Value)  $< 20$  and not recommended unless analyzed by a design professional to determine veneers with a lower LRV do not result in an EPS service temperature condition above  $73.8^\circ\text{C}$  ( $165^\circ\text{F}$ ).
- 5) Bedding mortar/MSV Adhesive – StoColl unless otherwise approved by Sto Corp.
- 6) Pointing Mortar/grout shall conform to ANSI 118.7.

Other design limitations as expressed in this analysis and Sto Guide Specification 5700 StoTherm ci MVES are applicable. With regard to the StoTherm ci System to which the veneer is adhered it shall include:

- 1) An LA-WRB (Liquid Applied Water Resistive Barrier) meeting the requirements of ULC S716.1 and forming part of the Water Resistive Barrier System. Specifically, StoGuard consisting of Sto Gold Coat with joint and rough opening treatment per StoGuard application requirements to render a secondary plane of protection conforming to the requirements of Sentences 9.27.3.1.(1), (3) and (4).
- 2) The insulation to be a GDDC type, conforming to the requirements of Clause 9.27.13.1.(1)(b) and no less than 50 mm thick (2 in.), and a maximum thickness of 102 mm (4 in.).
- 3) A reinforcing mesh with weight of  $200 \text{ g/m}^2$  (commonly referred to as 6 oz mesh). Heavier mesh may be used as determined appropriate for MSV with a thickness greater than 16 mm and approved by Sto.
- 4) All components to conform to CAN/ULS-S716.1. Installation as per application requirements of CAN/ULC - S716.2 following project design per CAN/ULC-S716.3 with additional requirements as described in this analysis.
- 5) The adhesive attachment of the system to the substrate is to be supplemented by a combination of corrosion resistant fasteners and washers installed through the prepared base coat and mesh.
  - a. Fastener/washer combination to be installed into each framing member spaced at 406 mm (typical 16 inch o/c framing) and at vertical spacings no more than 914 mm (36 in.). These fasteners within 150 mm (6 in.) of the system's vertical or horizontal terminations.

### 4. StoTherm ci MVES and Code Cross Reference

As described in the preceding Sections of this analysis, StoTherm ci MVES is a joining of cladding technologies. However, as a composite, they combine to provide a single cladding solution that within the context of this report, is considered an EIFS assembly. As such, the scope of this analysis is appropriately limited to the attributes assigned to EIFS functions as expressed in in Clause 5.9.4.1.(1)(a). Further, this analysis and use of StoTherm ci MVES is limited to buildings/applications permitted to be of combustible construction and applications where conformance to Clause 3.1.5.5.(1)(b) does not apply. It should also be noted that the primary role of the finish material is considered aesthetic. While it may contribute to the system's attributes as it relates to resistance to damage and water deflection, it is not relied upon to deliver these attributes as sought by the code's Objectives and Functional Statements and applicable to the wall assembly. Nevertheless, it should not detract from the assembly's ability to satisfy those requirements and provide a level of performance as reasonably expected of a cladding. This analysis is therefore divided into two parts with the first,

related to the underlying Exterior Insulation and Finish System and the second, how conformance with expected EIFS attributes is sustained where MSV/AMV is applied.

Code Provisions			
<b>Div. A</b> <b>Sentence 1.2.1.1.(1)</b> <b>Compliance with this Code</b>	1) Compliance with this Code shall be achieved by a) complying with the applicable acceptable solutions in Division B (see Note A-1.2.1.1.(1)(a)), or b) using alternative solutions that will achieve at least the minimum level of performance required by Division B in the areas defined by the objectives and functional statements attributed to the applicable acceptable solutions (see Note A-1.2.1.1.(1)(b)).		
<b>Div. B</b> <b>Exterior Insulation and Finish Systems</b> <b>Sentence 5.9.4.1.(1)</b>	1) Exterior insulation finish systems and their components shall comply with a) Subsection 5.1.4. and Sections 5.3. to 5.6., and b) CAN/ULC-S716.1, "Exterior Insulation and Finish Systems (EIFS) -Materials and Systems," where covered in the scope of that standard. (See Note A-5.9.4.1. (1).)		
Component	Description	Code	Objective Based Analysis
StoTherm ci System	Exterior Insulation and Finish System meeting the CAN/ULC-S716.1	Div. B Clause 5.9.4.1.(1)(b)	Not Required as per Div. A – clause 1.2.1.1.(1)(a)
StoTherm ci MVES	Manufactured Stone Veneer/Adhered Masonry Veneer over EIFS	Div. B Clause 5.9.4.1.(1)(a)	See Section 5

## 5. Objective Based Analysis – StoTherm ci MVES Characteristics

### Division B Table 5.10.1.1. Attributions to Acceptable Solutions

Table 1 – Attributions

Acceptable Solution	Objectives and Functional Statements	
<b>5.1.4.1.</b>	<b>Structural and Environmental Loads</b>	
5.1.4.1.(1)	[F55, F61, F63 – OH1.1, OH1.2, OH1.3]	
	(a)	[F61, F63-OS2.3]
	(b)	[F20-OS2.1] [F21, F22-OS2.3]
5.1.4.1.(3) <sup>1</sup>	[F20] [F21, F22-OS2.3] [F20, F21, F22-OH1.1, OH1.2]	
5.1.4.1.(5)	[F20, F21, F22-OH1.1, OH1.2, OH1.3]	
	(a)	[F20-OS2.3]
	(b)&(c)	[F21, F22-OS2.3]

<sup>1</sup> Note the reference to Sentence 5.1.4.1.(3) is also meant to capture the applicable requirements of Subsection 5.2.2. as cited within the subject Sentence and required to demonstrate conformity to the same *Functional Statements* and *Objectives*.

<b>5.1.4.2.</b>	<b>Resistance to Deterioration</b>	
5.1.4.2.(1)	[F80, F81-OH1.1, OH1.3] [F80, F81-OS2.3]	
<b>5.3.1.1.</b>	<b>Required Resistance to Heat Transfer</b>	
5.3.1.1.(1)	[F63-OH1.1] [F51, F63-OH1.2] [F63-OS2.3]	
5.3.1.2.(1)	(a)&(b)	[F51, F63-OH1.1] [F51, F63-OS2.3]
	(c)	[F51-OH1.2]
<b>5.4.1.</b>	<b>Air Barrier Systems</b>	
<b>5.4.1.1.</b>	<b>Required Resistance to Air Leakage</b>	
5.4.1.1.(1)	(a)(b)(f)	[F51, F52, F54, F55-OH1.2]
	(a)(b)(c)(e)	[F40, F55-OH1.1]
	(c) (d)	[F55, F61, F63-OH1.3] [F61, F62, F63, F55-OS2.3]
<b>5.4.1.2.</b>	<b>Air Barrier System Properties</b>	
5.4.1.2.(1)	[F55-OH1.1, OH1.2, OH1.3] [F55-OS2.3]	
<b>5.5.1.1.</b>	<b>Required Resistance to Vapour Diffusion</b>	
5.5.1.1.(1), 5.5.1.1.(2)	[F63-OH1.1, OH1.2] [F63-OS2.3]	
5.5.1.2.(1)	[F63-OH1.1, OH1.2] [F63-OS2.3]	
<b>5.6.1.1</b>	<b>Required Protection from Precipitation</b>	
5.6.1.1(1)	[F61-OH1.1, OH1.2, OH1.3] [F61-OS2.3]	
<b>5.6.1.2</b>	<b>Installation of Protective Materials</b>	
5.6.1.2.(3)	[F61-OH1.1, OH1.2, OH1.3] [F61-OS2.3]	
<b>5.6.2.1.</b>	<b>Sealing and Drainage</b>	
5.6.2.1.(1)	[F61, F62-OH1.1, OH1.3] [F61, F62-OS2.3]	

**Table 2 - Functional Statements as per NBC Division A- Section 3.2.**

No.	Function
F20	To support and withstand expected loads and forces.
F21	To limit or accommodate dimensional change.
F22	To limit movement under expected loads and forces.

F51	To maintain appropriate air and surface temperatures
F52	To maintain appropriate relative humidity.
F54	To limit drafts.
F55	To resist the transfer of air through environmental separators.
F61	To resist the ingress of precipitation, water or moisture from the exterior, or from the ground.
F62	To facilitate the dissipation of water and moisture from the building.
F63	To limit moisture condensation.
F80	To resist deterioration resulting from expected service conditions.
F81	To minimize the risk of malfunction, interference, damage, tampering, lack of use or misuse.

## StoTherm ci MVES Functional Characteristics

### F20, F22 – Wind Load Resistance and Construction

StoTherm ci System assemblies have undergone various wind-load resistance tests including those required for CCMC compliance and the more typically utilized ASTM E330. Insulation is a Type 1 or 2 EPS having a minimum compressive strength of 170 kPa (15 psi). Insulation is adhered to the substrate using Sto and S716.2 installation requirements. StoTherm ci MVES is limited to regions where Q50 hourly wind pressure is  $\leq 0.85$  kPa and a design pressure of  $\leq 1.2$  kPa. Height and edge conditions as applicable to stay within this design pressure limit, with a maximum height no greater than 3 storeys or 10 m (33 ft.) when measured from finished grade to ceiling of third storey. Supporting wall assembly to be constructed as per Section 9.23 of the building code and providing for a maximum deflection of L/360. Shear bond strength of StoColl as measured in accordance with ANSI 118.4 is  $> 1.37$  N/mm (200 lb/in<sup>2</sup>). Installation of MSV/AMV to the prepared and dry StoTherm ci base coat to be in strict accordance with StoColl product bulletin.

### F21 – Dimensional Tolerances

Installation of StoTherm ci MVES requires incorporation of expansion and/or perimeter joints at the following locations:

- Floor lines
- Where there is a change in substrate deflection and/or movement behavior (e.g., a more rigid wall), or changes in wall type (e.g., masonry vs. framed assembly)
- At changes in building height (shear joint) and other areas of stress concentration
- Where joints occur in the underlying substrate
- Through system expansion joints sized to correspond with anticipated movement (min. 3:1) or 19 mm (3/4 in.) whichever is greater. Perimeter joints at penetrations a minimum 12.7 mm (1/2 in.) wide.
- Where MVES abuts a dissimilar material, be it an alternative cladding or through system penetration such as fenestrations and mechanical systems
- To create wall areas no greater than 13.4 m<sup>2</sup> (144 ft<sup>2</sup>) with no planar dimension exceeding 3.6 m (12 ft) for ceramic tile, and not more than 5.5 m (18 ft) for brick or stone, with no length/height or height/length ratio greater than 2.5 to 1

All Joints other than those required to limit continuous areas of the veneer are to be through system joints as depicted in StoTherm ci MVES 57s series of Technical Illustrations. Sealant tested for compatibility as per ASTM C 1382 with

minimum 50% elongation post conditioning. Note: joints in substrate to be treated as per StoGuard installation requirements for air and moisture barrier continuity.

#### **F51 - Maintain Appropriate Air and Surface Temperatures**

This function is seen as attributable to the entire wall assembly as it seeks to satisfy requirements in relation to both heat loss resistance and condensation control. Although Sentence 9.27.13.1.(2) directs a user to Part 5, this direction is applicable to the use of EIFS outside the scope of Sentence (1) and should not be seen as removing the entire building/wall assembly requirements outside of Part 9. As such, relevant provisions of Section 9.25. Heat Transfer, Air Leakage, and Condensation Control remain applicable to the overall design. StoTherm ci MVES is not seen as an impediment to conformance by the user. Where Section 9.36 has been adopted, its requirements would also be seen as applicable.

#### **F52 - Maintain Appropriate Relative Humidity**

As with F51, this attribute is seen as applicable to the wall assembly as a whole. The user should be familiar with basic wall assembly's characteristics (e.g., air leakage, U-value) and balance with the building's use/occupancy and mechanical systems so to maintain an appropriate interior environment.

#### **F54, F55 – Limit Drafts, Resist Transfer of Air Through Environmental Separators**

As noted in previous sections of this analysis, much of the StoTherm ci MVES control function attributes are provided by the StoTherm ci system to which the MSV/AMV is applied. CAN/ULC-S716.2 requires that the EIFS WRB be applied in such a manner so to provide a continuous barrier (over the field of the wall and across joint and transitions) against water penetration. The StoGuard System applied in a like continuous manner has been evaluated to CAN/ULC-S742 "Standard for Air Barrier Assemblies" and achieved an A1 Rating (no greater than  $0.05 \text{ L(s}\cdot\text{m}^2) @ 75 \text{ Pa}$  pressure difference). As such, a user may identify the StoGuard System's control layer as part (above grade wall assembly) of the air barrier system as per Subsection 9.25.3. - Air Barrier Systems.

#### **F61: Resist the Ingress of Precipitation, Water or Moisture from the Exterior**

As part S716.1 and CCMC conformity assessment, StoTherm ci EIFS undergo the "Environmental Cyclic Durability Test. The test specimen includes areas of the EIFS to which no finish is applied, as well as typical service and window penetration. This cyclical exposure includes a 1 h water spray at 1200 Pa pressure. During this period and throughout the entire 60 cycles, the test specimen may not experience any water penetration to the interior (i.e., beyond the second plane of protection.). Upon completion of the Guide's requisite testing, CCMC extended an Opinion of conformity to the StoTherm ci systems, which includes:

- Article 9.27.2.1. - Minimizing and Preventing Ingress and Damage
- Sentence 9.27.2.2.(4) Minimum Protection from Precipitation Ingress
- Sentence 9.27.2.3.(1) First and Second Plane of Protection

Further, the StoGuard System as described above has undergone a wide variety of test protocols including S741, S742 and all S716.1 criteria applicable to water resistive barriers and drainage efficiency. The use of MSV over StoTherm ci Systems within the limits of this analysis is not seen as reducing the system's (specifically, its water resistive barrier) capacity to satisfy the noted provisions and objectives of F61.

**F63: Limit Moisture Condensation**

Conformity to this attribute is seen as applicable to the wall assembly as a whole and not a cladding function. That said, the cladding must not create conditions that could lead to uncontrolled rates of condensation. Users of StoTherm ci MVES should consider the following:

- Placement of majority of required insulation on the exterior side of the wall. At minimum conform to the requirements Subsection 9.25.5. "Properties and Position of Materials in the Building Envelope"
- Where all or majority of insulation cannot be placed on the exterior, complete dew point analysis to ensure condensation rates (should it occur) are within assembly's ability to tolerate or occur within the exterior insulating layer.

**F80: Resist Deterioration Resulting from Expected Service Conditions**

Insofar as the StoTherm ci System, for the purpose of this analysis the question of resistance to mechanisms that may cause deterioration is addressed through the completion of CAN/ULC-S716.1 evaluation, leaving the question of the applied MSV/AMV's capacity to resist deterioration due to exterior exposure. The StoTherm ci MVES requires the use of ASTM C1670 compliant veneers, or brick slips produced using masonry units meeting the requirements of Clauses 9.20.2.1.(1) (a) – (d). Either material choice is to be adhered to the prepared StoTherm ci lamina using StoColl adhesive and within the stated limits of this analysis and related Sto specifications. Application as described is not seen as impacting the durability of the MSV or AMV units.

**F81: Minimize the Risk of Malfunction, Interference, Damage, Tampering, Lack of Use or Misuse**

Sto produces support literature (specifications, technical illustrations, product datasheets and bulletins, etc.) for the user community instructing them on application requirements and limitations of StoTherm ci MVES and the related products. It should also be noted that Sto provides ongoing training and education programs for the designer and contractor communities. Further, the installation and related techniques for the underlying StoTherm ci are consistent with standardized EIFS installation practices as outlined in CAN/ULC-S716.2 – Exterior Insulation and Finish Systems – Installation Standard.

**Table 3 – Objectives as applicable to StoTherm ci MVES**

Category	Number	Objective
Safety	OS	An objective of this Code is to limit the probability that, as a result of (a) the design, construction or demolition of the building or facility, or (b) specific circumstances related to the building or facility, a person in or adjacent to the building or facility will be exposed to an unacceptable risk of injury.
Safety - Structural Safety	OS2	An objective of this Code is to limit the probability that, as a result of the design or construction of the building or facility, a person in or adjacent to the building or facility will be exposed to an unacceptable risk of injury due to structural failure. The risks of injury due to structural failure addressed in this Code are those caused by—
	OS2.3	- damage to or deterioration of building or facility elements

Category	Number	Objective
Health	OH	An objective of this Code is to limit the probability that, as a result of (a) the design or construction of the building or facility, or (b) specific circumstances related to the building or facility, a person will be exposed to an unacceptable risk of illness.
OH1 – Indoor Conditions	OH1	An objective of this Code is to limit the probability that, as a result of the design or construction of the building or facility, a person in the building or facility will be exposed to an unacceptable risk of illness due to indoor conditions. The risks of illness due to indoor conditions addressed in this Code are those caused by —
	OH1.1	- inadequate indoor air quality
	OH1.2	- inadequate thermal comfort
	OH1.3	An objective of this Code is to limit the probability that, as a result of the design or construction of a building, a person in the building will be exposed to an unacceptable risk of illness due to high levels of vibration or deflection of building elements.

Having capacity to conform to the Functional Statements as described above, when used in accordance with those descriptions, the StoTherm ci MVES is not seen as an impediment to the exterior wall's conformance with these objectives.

## 6. Limits and Use of this Analysis

Applicability of this analysis is subject to any and all limitations expressed in this report and StoTherm ci MVES related literature (available here: [StoTherm ci MVES](#)). The decision to use any product is the sole responsibility of the user with approval of the authority having jurisdiction. Sto Canada and/or Sto Corp. accepts no responsibility or liability for the use or installation of this product on any particular project excepted as expressed in notices to users contained in all related literature as available at the above link. Submission of this analysis is to be in its entirety and without omission of any kind and may require supplemental forms and/or information as directed by the authority having jurisdiction.

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