Evaluation Report CCMC 14008-R
Shouldice Fusion Stone

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1. Opinion

It is the opinion of the Canadian Construction Materials Centre (CCMC) that "Shouldice Fusion Stone", when used as an exterior cladding in accordance with the conditions and limitations stated in Section 3 of this Report, complies with the National Building Code 2010:

- Clause 1.2.1.1.(1)(a), Division A, using the following acceptable solutions from Division B:
  - Sentence 9.27.1.1.(5), General (Cladding, Application)
  - Sentence 9.27.2.1.(1), Minimizing and Preventing Ingress and Damage
  - Clause 9.27.2.2.(1)(b), 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
  - Article 9.27.2.3., First and Second Planes of Protection
  - Article 9.27.3.1., Elements of the Second Plane of Protection

- 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 9.27.1.1.(1), General (Cladding, Application)
  - Sentence 9.27.5.1.(1), Attachment (Attachment of Cladding)

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

2. Description

The product is a concrete stone veneer cladding that is attached mechanically to structural wood sheathing.

The product is composed of Portland cement, natural aggregates, and mineral oxide pigments. Other additives such as water repellant and air entraining agents could be added to the mix. The product is cast in moulds having rectangular or square shapes that reflect different textures. The finished product is available in different sizes, varying from 203 mm to 508 mm long, 95 mm to 190 mm wide, 32 mm to 56 mm thick.

Corner stones are plant-manufactured using two stones cut at 45 degree angles and fixed together with an adhesive (see Figure 3).

The concrete stones are affixed individually to the structural wood sheathing using metal anchors/clips and metal screws. The metal anchors/clips are Type 304 stainless steel, that are 50 mm long and 0.61 mm thick. The fasteners are #8 - 19-mm-long Robertson head stainless steel wood screws. One screw is used per anchor/clip. A metal starter strip anchor is affixed to the bottom of the first row of stones. Contrary to a conventional brick veneer, the first row of the product is not sitting over the foundation wall, but instead is attached independently to the structural sheathing. The top and bottom edges of the concrete stones include grooves to clip the anchors that are attached to the wood sheathing.

Once installed, the joints between the concrete stones could be grouted or left ungrouted (dry-stack) depending on the chosen design.

Figure 1 shows the product units, and Figure 2 shows the product system construction.

Figure 1. "Shouldice Fusion Stone"

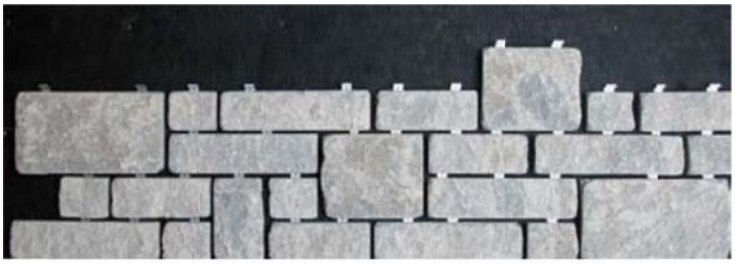

Figure 2. "Shouldice Fusion Stone" system construction

Figure 3. Corner piece of "Shouldice Fusion Stone" assembly

3. Conditions and Limitations

CCMC's compliance opinion in Section 1 is bound by the "Shouldice Fusion Stone" being used in accordance with the conditions and limitations set out below.

- The product is intended for use as an exterior cladding in new and retrofit construction, applied to vertical walls of masonry, concrete, as well as on structural grade wood sheathing boards that are attached to wood or steel framing.
- The product is limited to installation on buildings not exceeding 10 m in height to the midpoint of the roof.
- The product is limited to installations in geographical areas where the 1/50 design wind load pressure is ≤ 0.85 kPa and the building is category 2 for internal pressure as defined in the NBC 2010. The wind design value has been validated for the product installed over plywood or oriented strandboard (OSB) structural sheathing having a minimum thickness of 12.5 mm for plywood and 11 mm for OSB.
- The product must be applied in geographical areas where the spectral response acceleration $S_a(0.2)$ is 1.2 or less, and the building is on a Class C site or better.
- The product is permitted for use in coastal and non-coastal areas. Coastal areas are defined in the NBC 2010 as areas

where:
    - the number of degree-days is less than 3 400 and the moisture index is greater than 0.90, or
    - the number of degree-days is 3 400 or more, and the moisture index is greater than 1.0.
- The product must not support any structural element or equipment (the cladding system is supporting only its own weight).
- The product is permitted to be installed in either a grouted and/or dry-stack design.
- The product is permitted in the construction of buildings required to be of combustible or noncombustible construction in accordance with Article 3.1.5.1., Noncombustible Materials, of Division B of the NBC 2010.
- The metal anchors/clips must be of austenitic stainless steel (Type 304).
- When used in conjunction of wood framing and wood sheathing, the stud wall must consist of 38-mm × 140-mm stud grade Spruce-Pine-Fir (SPF). The stud spacing must not exceed 406 mm. A hole not greater than 25 mm in diameter is permitted at the centreline of the stud. The plates used in the framing of the backup wall must be No. 2 grade SPF plates. The sheathing panels must be Douglas Fir Plywood having a minimum thickness of 12.5 mm, or 1R24/2F16 OSB structural grade having a having a minimum thickness of 11 mm. The structural sheathing must be installed with the strong axis (face grain) oriented horizontally. The sheathing panels must be at least 610 mm wide (vertical height when installed), and be continuous over three or more spans.
- When used in conjunction of wood framing, the installation of the product must be in accordance with the engineering analysis as prepared by Quaile Engineering Ltd., Report 13-166-2, dated January 27, 2014 and from which the Tables 4.3.1 to 4.3.5 in this Evaluation Report have been reproduced. When the product is used outside the scope and limitations of the said report, a special engineering analysis must be carried out by a licensed professional engineer skilled in structural design who must sign and seal the related analysis confirming its conformance to Part 4 of Division B of the NBC 2010.
- The anchor clips must be attached to a minimum 11-mm-thick OSB that is supported by untreated wood studs spaced at 406 mm or less, or 12.5-mm plywood sheathing conforming to CSA O121, “Douglas Fir Plywood” or CSA O151, “Canadian Softwood Plywood.”
- A horizontal joint must be provided in the stone at each floor level as indicated in Figure 6.
- The maximum anchor clip spacing along the horizontal joints between stone rows is 150 mm for both the grouted and the dry-stack applications.
- For dry-stack applications, the cladding is installed so that there is at least one row of 95-mm stone above and below any 190-mm stones.
- When used in conjunction with wood sheathing, the fastening screws used to secure the cladding through the anchors/clips must be # 8 - 19-mm-long Robertson head stainless steel wood screws.
- The attachment of the product must be in conformance with Sentence 9.27.5.1.(1), Article 9.27.5.5., Fastener Materials, and Article 9.27.5.7., Penetration of Fasteners, of Division B of the NBC 2010. For any other modes of attachment of the system to sheathing, the structural sufficiency of the sheathing, the whole backing, in conjunction with the anchors/clips and type of fasteners must be in accordance with the engineering analysis as prepared by Quaile Engineering Ltd., Report 13-166-2, dated January 27, 2014.
- When used in conjunction with metal framing, the structural sufficiency of the backing wall (framing and sheathing), as well as the attachment of the concrete stone cladding through the metal anchors/clips to the backup wall must be established through a detailed engineering analysis prepared by a professional engineer in accordance with Part 4 of the NBC 2010.
- When used in conjunction with metal framing, the metal fasteners, in conjunction with the designs of the cladding system and the rest of the thermal characteristics of the wall assembly, must be investigated for the potential of thermal bridging leading to corrosion at the fastener/stud interface. When used in conjunction with metal framing, the proponent must provide evidence through modelling or testing that the potential of thermal bridging will not lead to condensation at the fastener/stud interface.
- For applications over concrete, or masonry, the wind design value corresponding to the type and size of fasteners recommended by the manufacturer must be determined by a licensed professional engineer skilled in structural and cladding designs and licensed to practice under the appropriate provincial or territorial legislation in accordance with Part 4 of the NBC 2010.
- The 10-mm air space that is created by the anchors must remain unobstructed to form a clear drainage layer behind the product.
- At least one layer of wall sheathing membrane conforming to Article 9.27.3.2., Sheathing Membrane Material Standard, of Division B of the NBC 2010 must be applied beneath the cladding products. 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 2010.
- The product must be installed with suitable flashing to drain water from the drainage layer to the exterior and to protect the exposed top edge of the cladding.
- Flashing installed must be in accordance with the requirements of Articles 9.27.3.7., Flashing Materials, and 9.27.3.8., Flashing Installation, of Division B of the NBC 2010.
- The impact resistance of the product makes it susceptible to hard and soft body impacts. However, the ease of replacement of the product makes it suitable for normal use in upper floors and protected ground floors. When used at ground floors exposed to high impacts, special precautions must be taken such as guardrails or raised gardens.
- The requirements of the NBC 2010 regarding fire stops must be implemented.
- The product must be installed in accordance with the manufacturer’s current instructions. A high level of quality control at all stages of the exterior wall construction is imperative for obtaining an acceptable performance.
- This Evaluation Report is applicable only to products identified by the phrase “CCMC 14008-R.”

4. Technical Evidence

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

4.1 Material Requirements

Table 4.1.1 Results of Testing of the Material and Physical Properties (Stone)

Property		Requirement	Results
Dimensions (mm)	**length**	≤ 900	510
	width	≤ 900	128
	thickness	≤ 70	47
Area (m^2)		≤ 0.26	0.07
Deviation from plane of the back face (mm)		≤ 1.0	0.67
Warpage/out-of-square (mm)		Parallel edge dimensions, and out-of-square I any direction ≤ 2	0.01
Dimensional tolerances (mm)	**length**	±3.0	+1.6
	height	±2.0	+0.9
	thickness	±2.0	Pass
Groove thickness (mm)		Report value	1.72
Groove thickness tolerance (mm)		+2.0, –1.0 from specified thickness	0.19 Pass
Weight (kg/m^2)		≤ 75.0	70
Density (kg/m^3)		Report value	1 860
Moisture properties	**water absorption (24 h) (%)**	Report value	5
	water vapour transmission (if any water repellent coating or additive is used) ($kg/m^2 \cdot s \cdot Pa$)	Report value	NA[(1)]
	coefficient of water absorption ($kg/m^2/sec^{½}$)	Report value	0.012[(2)] 0.011[(3)]
Drying shrinkage (mm/m)		≤ 0.65	0.43
Strength (MPa)	**flexural**	Report value	2.31
	compressive	15	28
Freeze-thaw resistance	**Loss of weight (%)**	≤ 1	−0.9
	Visual observation	Specimen must not show any deleterious effects such as spalling, cracking, or crazing	None

Notes to Table 4.1.1:

(1) Not applicable.
(2) Back side.
(3) Face side.

Table 4.1.2 Results of Testing of the Materials and Physical Properties (Clip/Anchor)

Property	Requirements	Results		Comments
		P_{ult}	Factored Resistance[1]	
Pullout Test (N)	≥ 1000	464[2]	278	Pass
Pullout Test (N)	≥ 1000	427[2]	256	Pass
Shear Bending (N)	Report Value	45	27	Pass

Notes to Table 4.1.2:

(1) Factored resistance calculated as per Section 9.4.2.1.1 of CAN/CSA-A370-04,"Connectors for Masonry Welding Requirements," using ϕ =0.6 (buckling failure of the clip).

(2) The specified minimum pullout strength of 1 000 N has been based on the requirements of CAN/CSA-A370 that cover specific types of masonry and anchors/clips that fall within the intent of the said standard. As the spacing for the product is much closer than the standard veneer ties covered by CAN/CSA-A370, and through the engineering analysis provided for the product, the obtained ultimate and factored resistance of the product's clip/anchors are deemed to meet the intent of the established requirements.

4.2 Performance Requirements

Table 4.2.1 Results of Testing for Impact Resistance of the Product

Impact Body		Dynamic Mass (kg)	Energy (N•m)	Results
Safety Impact	**Large soft**	50	100	Pass
	Hard	1	10	Pass
Retention of Performance Impact	**Large soft**	50	34	Deemed to pass
	Small soft	30	60	Fail[1]
	Hard	1	10	Fail[1]

Notes to Table 4.2.1:

(1) The product is susceptible to small soft and hard impacts related to the energy levels stated in Table 4.2.1. Consequently, the cladding must be sheltered from such impact energies and, in the event of any damage resulting from such impact, the cladding units must be replaced immediately.

Table 4.2.2 Results of Testing of Wind Load Resistance of the Product

Cycle	Pressure (Pa) $Q_{50} \leq 0.85$ kPa @ 20 m	Deflection at Midspan of Specimen
Sustained loads (P_1, P_1')	± 235	+0.2/−0.2
	± 470	+0.2/−0.2
	± 705	+0.1/−0.1
	± 940 (P_1)	+0.5/+0.5
	Residual	+1.3/0.0
Cyclic loads (P_2, P_2')	0 to ± 1 370 (P_2)	+0.5/0.0
	Residual	+1.3/+2.1
Gust loads (P_3, P_3')	0 to ± 2 050 (P_3)	+1.0/+0.6
	Residual	0.0/0.0

4.3 Pre-engineered Design Solutions

The pre-engineered solutions must be in full accordance with the engineering analysis as prepared by Quaile Engineering Ltd., Report 13-166-2, dated January 27, 2014. Tables 4.3.1 to 4.3.3 provide the main pre-engineering solutions. Figure 4 shows a section of the stud wall with the construction details.

Table 4.3.1 Maximum Stud Spacing (mm) for Walls with Dry-Stack Design of the Product[(1)]

Design Snow Load (kPa)	Wall Height (m)	1/50 yr Hourly Wind Pressure (kPa)						
		0.4	0.45	0.5	0.55	0.6	0.65	0.7
1	2.4	400	400	400	400	300	300	300
	2.7	400	400	400	300	300	300	–
	3.0	400	400	300	300	300	–	–
1.5	2.4	400	400	400	400	300	300	300
	2.7	400	400	400	300	300	300	–
	3.0	400	400	300	300	300	–	–
2	2.4	300	300	300	300	300	300	300
	2.7	300	300	300	300	300	300	–
	3.0	300	300	300	300	300	–	–
2.5	2.4	300	300	300	300	300	300	300
	2.7	300	300	300	300	300	300	–
	3.0	300	300	300	300	300	–	–
3	2.4	–	–	–	–	–	–	–
	2.7	–	–	–	–	–	–	–
	3.0	–	–	–	–	–	–	–

Notes to Table 4.3.1:

(1) The values in this table are applicable to:
stud materials = 38 mm × 140 mm stud grade SPF;
stud wall supporting roof only;
top plate = 2 – 38 mm No. 2 Grade SPF;
maximum roof truss span = 12 m;
bottom plate = 1 – 38 mm × 140 mm No. 2 Grade SPF.

Table 4.3.2 Maximum Stud Spacing (mm) for Walls with Dry-Stack Design of the Product[(1)]

Design Snow Load (kPa)	Wall Height (m)	1/50 yr Hourly Wind Pressure (kPa)						
		0.4	0.45	0.5	0.55	0.6	0.65	0.7
1	2.4	400	400	400	400	300	300	300
	2.7	400	400	400	300	300	300	–
	3.0	400	400	300	300	300	–	–
1.5	2.4	400	400	400	400	300	300	300
	2.7	400	400	400	300	300	300	–
	3.0	400	400	300	300	300	–	–
2	2.4	400	400	400	400	300	300	300
	2.7	400	400	400	300	300	300	–
	3.0	400	400	300	300	300	–	–
2.5	2.4	400	400	400	400	300	300	300
	2.7	400	400	400	300	300	300	–
	3.0	400	400	300	300	300	–	–
3	2.4	400	400	400	400	300	300	300
	2.7	400	400	400	300	300	300	–
	3.0	400	400	300	300	300	–	–

Notes to Table 4.3.2:

(1) The values in this table are applicable to:
stud materials = 38 mm × 140 mm stud grade SPF;
stud wall supporting roof only;
top plate = 3 – 38 mm No. 2 Grade SPF;
maximum roof truss span = 12 m;
bottom plate = 2 – 38 mm × 140 mm No. 2 Grade SPF.

Table 4.3.3 Maximum Stud Spacing (mm) for Walls with Dry-Stack Design of the Product(1)

Design Snow Load (kPa)	Wall Height(m)	1/50 yr Hourly Wind Pressure (kPa)						
		0.4	0.45	0.5	0.55	0.6	0.65	0.7
1	2.4	400	400	400	400	300	300	300
	2.7	400	400	300	300	300	300	–
	3.0	400	300	300	300	300	–	–
1.5	2.4	400	400	400	400	300	300	300
	2.7	400	400	300	300	300	300	–
	3.0	400	300	300	300	300	–	–
2	2.4	400	400	400	400	300	300	300
	2.7	400	400	300	300	300	300	–
	3.0	400	300	300	300	300	–	–
2.5	2.4	400	400	400	400	300	300	300
	2.7	400	400	300	300	300	300	–
	3.0	400	300	300	300	300	–	–
3	2.4	400	400	400	400	300	300	300
	2.7	400	400	300	300	300	300	–
	3.0	300	300	300	300	300	–	–

Notes to Table 4.3.3:

(1) The values in this table are applicable to:
stud materials = 38 mm × 140 mm stud grade SPF;
stud wall supporting roof only;
top plate = 3 – 38 mm No. 2 Grade SPF;
bottom plate = 2 – 38 mm × 140 mm No. 2 Grade SPF;
maximum floor joist span = 8 m.

Table 4.3.4 Nail Spacing for 11-mm OSB or 12.5-mm Plywood Sheathing Fastened to 38 mm × 140 mm SPF Studs(1)

Stud spacing (mm)	Spiral nail size		Maximum nail spacing (mm)					
			1/50 yr hourly wind pressure (kPa)					
	Length (mm)	Diameter (mm)	0.45	0.5	0.55	0.6	0.65	0.7
300	63	2.77	150	150	150	150	140	–
	76	3.1	150	150	150	150	150	–
400	63	2.77	140	130	120	110	105	95
	76	3.1	150	150	150	150	145	135

Notes to Table 4.3.4:

(1) Nails to be spaced as shown in Figure 5 along edges of panels and all intermediate studs.

Table 4.3.5 Maximum Lintel Span[(1)]

Design snow load (kPa)	Maximum Lintel Clear Span (m)					
	Lintel supporting roof only			Lintel supporting roof and 1 floor		
	3 – 38 mm × 184 mm	3 – 38 mm × 235 mm	3 – 38 mm × 286 mm	3 – 38 mm × 184 mm	3 – 38 mm × 235 mm	3 – 38 mm × 286 mm
1	1.97	2.43	2.79	1.29	1.59	1.82
1.5	1.72	2.13	2.44	1.27	1.58	1.80
2	1.55	1.91	2.20	1.21	1.50	1.71
2.5	1.42	1.75	2.01	1.14	1.37	1.62
3	1.32	1.63	1.86	1.08	1.19	1.53

Notes to Table 4.3.5:

(1) Applicable to No. 2 grade SPF, with a maximum roof truss span of 12 m and a maximum floor joist span of 8 m.

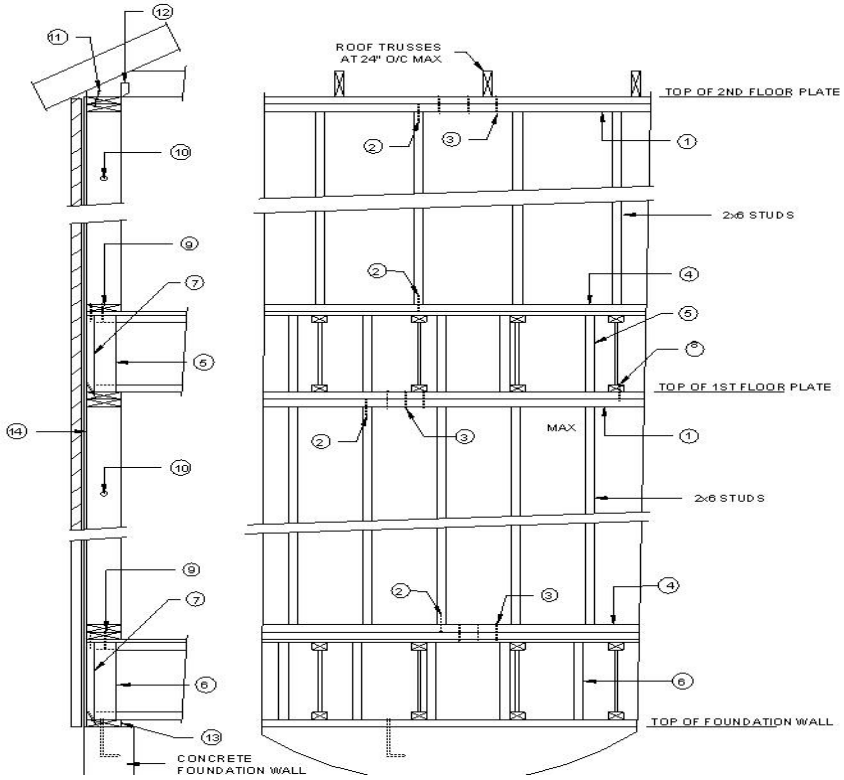

Figure 4. Stud wall construction for the product (wall elevation, interior face)

1. **2 × 6 top plate (2 or 3 ply as per stud tables)**
2. **3 – 82-mm end nails per stud**
3. **3 – 82-mm plate-to-plate nails between studs**
4. **2 × 6 bottom plate (1 or 2 ply as per stud tables)**
5. **2 × 4 squash block aligned with wall studs below (maximum 76-mm offset from stud below)**
6. **2 × 4 squash blocks above foundation at the same spacing as the studs in the wall above**
7. **minimum 28-mm engineered rim board fastened with 82-mm toe nails at 150 mm o.c.**
8. **floor joist or blocking at maximum of 406 mm o.c., fastened with 3 – 82-mm nails**
9. **bottom plate fastened to floor with 82-mm nails at 150 mm o.c.**
10. **maximum 25-mm diameter hole at centre of stud**
11. **3 – 82-mm toe nails from truss to plate**
12. **Simpson strong G-Tie H 10A anchor on each truss**
13. **2 × 6 sill plate**
14. **11-mm 1 R 24/2f 16 OSB or 12.5-mm softwood or Douglass Fir Plywood fastened as per Table 4.3.4.**

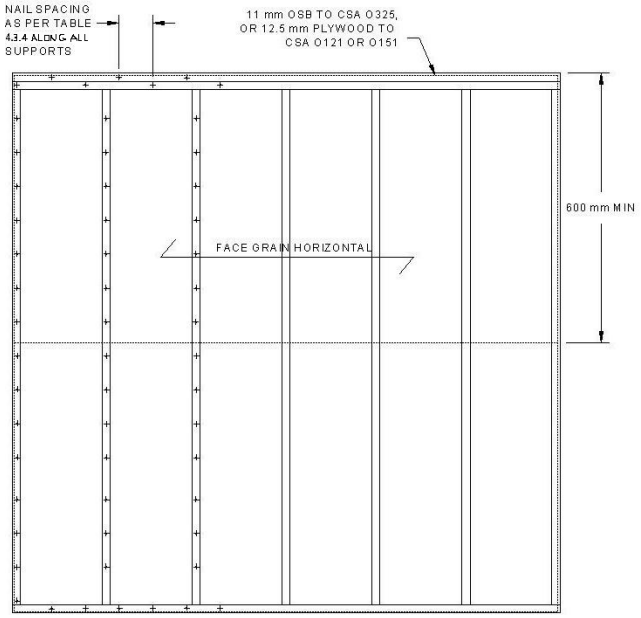

Figure 5. Exterior sheathing and fastening for the product

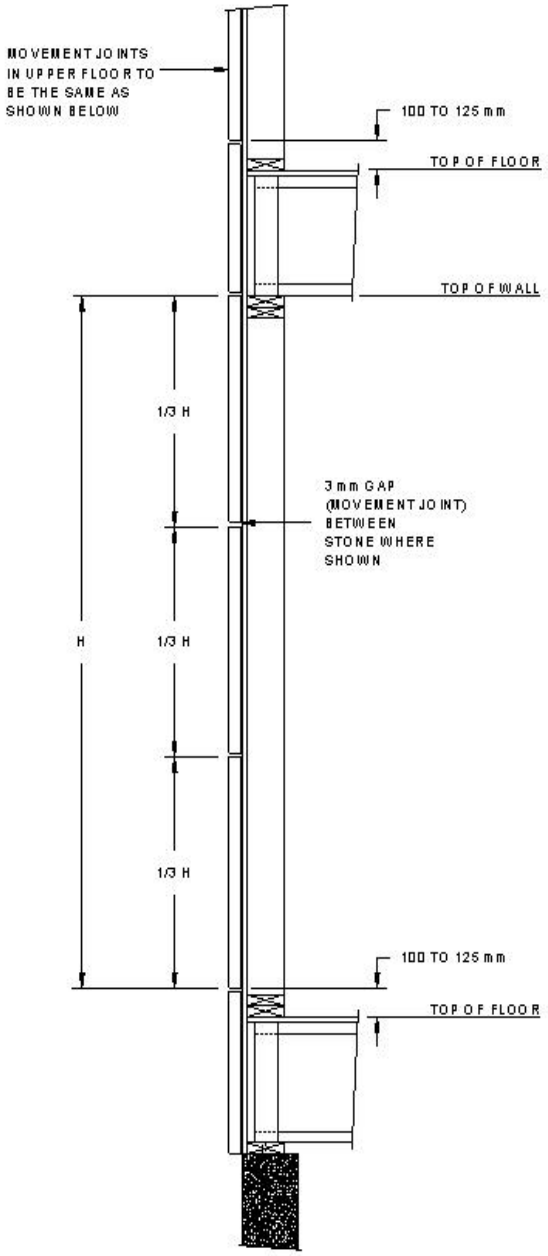

Figure 6. Required movement joints in applications for the product

Note: The construction details in Figures 4 to 6 have been designed to accommodate the worst case forces for the range of conditions covered by the pre-engineered tables 4.3.1 to 4.3.5.

Report Holder

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Plant(s)

Shallow Lake, ON

Disclaimer

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