January 30, 2020 MH Ref: 2000692.00

Quik-Therm Insulation Solutions Inc.
Raymond Belanger
Manager/Technical Sales Specialist
#3 – 1680 Sargent Ave.
Winnipeg, MB, R3H 0C2 raymondb@quiktherm.com

Dear Mr. Belanger:

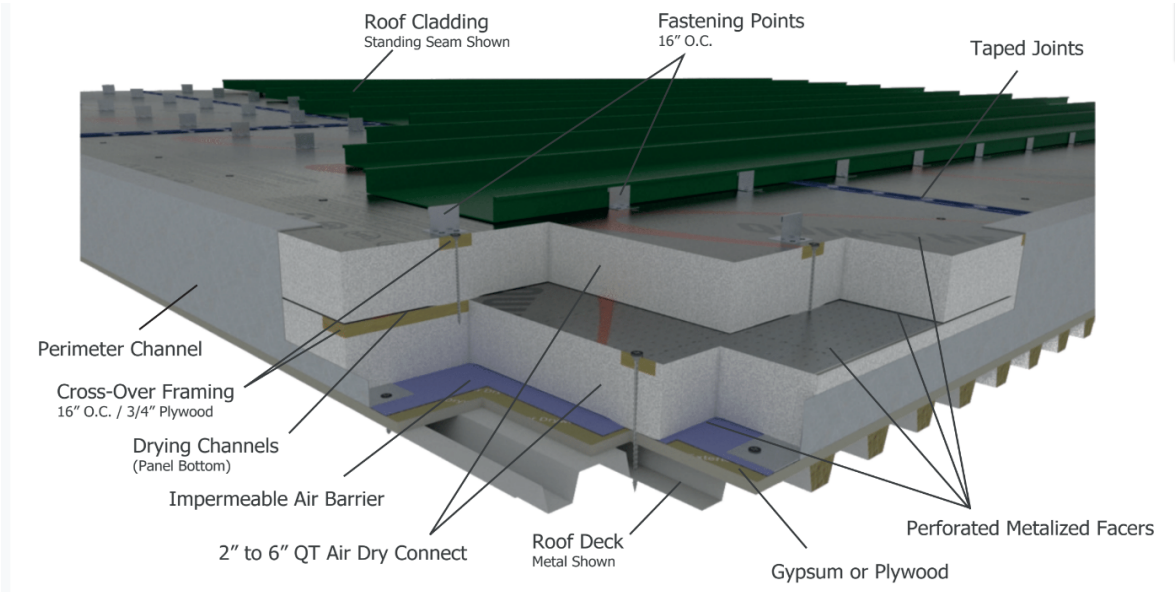
Re: Structural Review of Quik-Therm Matrix Insulated Roofing System

Morrison Hershfield Ltd. (MH) was retained by Quik-Therm Insulation Solutions Inc. (Quik-Therm) to provide a structural review for the Matrix Insulated Roofing System. This report is a summary of the review which was based on information provided to MH by Quik-Therm.

The scope of the review has been limited to structural aspects, and has not considered combustibility, durability, building science or other aspects.

SYSTEM DESCRIPTION

The Matrix Insulated Roofing System is a composite roofing system which consists of Quik-Therm's Air Dry Connect expanded polystyrene (EPS) insulation with embedded plywood or cold-formed steel battens which are installed in two orthogonal layers. The ¾" x 2½" plywood or 2½" x ½" 18ga steel C-channel battens are spaced at 16" on center and are embedded so that they are flush with the insulation. The lowest layer of insulation is secured through the battens to the roof sheathing or metal decking and upper layer is secured to the layer below it. See Quik-Therm's literature for a complete system description.



STRUCTURAL REVIEW

The structural review was primarily focused on the ability of the system presented to MH to resist wind uplift and snow loads for typical buildings as outlined in the National Building Code of Canada. Part of this review included a structural analysis of the sample system configuration outlined below. MH has also recently undertaken hygrothermal analysis and Mark Lawton, P.Eng. of MH performed an R-value review for the Quik-Therm Solar Dry System.

Sample Systems evaluated:

- Roof Substrates: ¾" plywood sheathing and 18ga metal fluted deck.
- Two layers of Quik-Therm Air Dry Connect EPS insulation installed in orthogonal directions with ¾" x 2½" plywood battens embedded at 16" spacing.
- Generic fasteners in a range of sizes fully penetrating the plywood roof sheathing and embedded battens (sizes #8 to #14).
- Roofing material.

Analysis Assumptions:

- The location of the fastener from the upper layer into the lower layer coincides closely with the location of the fastener from the lower layer into the roof sheathing. A maximum offset of 6" was assumed.
- Point loads from roofing hold-down clips (if applicable) are similarly installed within 6" to the top layer fasteners.
- The self-weight of the system is ignored.
- The roofing material does not contribute to the uplift resistance.

Due to the high compressive strength of the Quik-Therm EPS insulation (19.7 kPa (411 psf)) will not crush under snow loads.

Table 1: Allowable Pull-Out Fastener Loads for Generic Fasteners Used in Analysis:

	Allowable Pull-Out Resistance (ASD) (lbf)			
Screw Diameter	#8	#10	#12	#14
20 gauge steel	50.6	58.6	66.6	74.7
18 gauge steel	65.9	76.4	86.8	97.3
16 gauge steel	125.4	145.3	165.2	185.1
3/4" plywood	71.0	83.0	94.0	105.0

**Values for steel stud allowable withdrawal are based on a safety factor of 3.0 in accordance to CSA S136.*
**Values for plywood allowable withdrawal are based on a recommended safety factor of 5.0 in accordance with APA Technical Note #E830E*

Table 1: Windload Resistance (Uplift) for Matrix System with Plywood Battens Installed Over ¾" Thick Plywood Sheathing

	Screw Size Used in System			
	#8	**#10**	**#12**	**#14**
Maximum Uplift (Unfactored) **kPa** (psf)	**1.9** (40)	**2.2** (46)	**2.5** (52)	**2.8** (58)
Maximum Uplift (Factored) **kPa** (psf)	**2.6** (54)	**3.0** (63)	**3.5** (73.0)	**3.9** (81)

Table 2: Windload Resistance (Uplift) for Matrix System with Plywood Battens Installed Over 18 gauge Metal Fluted Decking

	Screw Size Used in System			
	#8	**#10**	**#12**	**#14**
Maximum Uplift (Unfactored) **kPa** (psf)	**1.7** (36)	**2.0** (42)	**2.3** (48)	**2.6** (54)
Maximum Uplift (Factored) **kPa** (psf)	**2.3** (48)	**2.8** (58)	**3.2** (67)	**3.6** (75)

The results of Tables 1 and 2 are intended to give an understanding of the uplift resistance for typical system build-ups. It should be noted that battens spaced at 12" x 12" and/or additional fasteners would achieve higher windload resistances.

If using the Air Dry Connect panels with plywood battens, care and planning should be taken during the installation to ensure the load path from the roofing through the fasteners and into the roof structure is as direct as possible to reduce the potential for bending and deflection in the battens. If the fasteners of the various layers are not close to coincident, the embedded plywood battens would be subjected to bending under wind uplift loads which could affect the performance. Fasteners should be less than 6" away from the fastener below to minimize the bending induced on the embedded battens.

Depending on the project specific wind uplift, the size and spacing of fasteners and the type and spacing of embedded battens used in the system should be evaluated by a professional registered in the project jurisdiction.

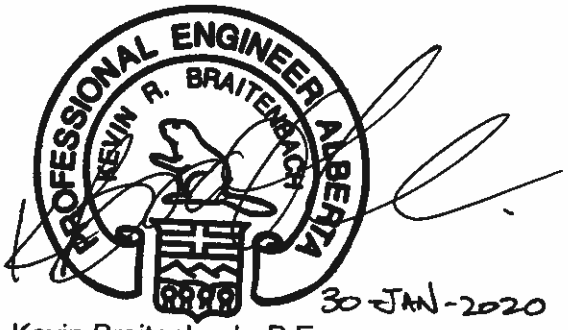
CONCLUSIONS

Based on our review, The Quik-Therm Matrix Insulated Roofing System will be able to resist the loads as outlined in the National Building Code of Canada for typical, moderately tall buildings throughout Canada. Buildings with high roof uplift wind loads could still potentially use the system with concerted detailing of the fasteners and embedded battens.

The system appears to be well researched and should perform well if installed correctly. The orthogonal support provided by the cross-over framing will aid in the overall stability of the system. The thermal bridging would be minimal as we have seen for similar mechanically fastened roof systems (for example See detail 9.1.9 in BETB Guide Version 3) with an effective thermal performance similar to the system's nominal value.

We trust that this report meets your objectives for evaluating the structural performance of the Quik-Therm Matrix Insulated Roofing System. If you have any questions or comments related to the above, please do not hesitate to contact the undersigned.

Yours truly,
MORRISON HERSHFIELD



Kevin Braitenbach, P.Eng.
Façade Specialist

Brett Pattrick, P.Eng.
Façade Specialist