INSULATED MASONRY VENEER SYSTEM

TEST STUDY ON SEISMIC AND RACKING PERFORMANCE

BUILDING TRUST

INTRODUCTION

Sika Facades, manufactures a variety of construction products and systems including Exterior Insulation and Finish Systems (EIFS) which are exterior wall claddings for above grade walls of commercial and residential buildings. EIFS with drainage are multi-layer systems comprised of an air/water-resistive barrier, mechanically or adhesively attached thermal rigid insulation board (ci), glass fiber mesh embedded in base coat and a finish coat which provides the final appearance. EIFS are a popular cladding because of recognized benefits such as high thermal properties provided by the external continuous insulation, cost effectiveness and design flexibility.

Throughout the years, the sole option for the outermost layer was a relatively thin textured finish with a wide variety of colors and textures which enabled numerous design options. Over the years ongoing product innovations resulted in new, but still relatively thin finish coat options that provide additional choices including the appearance of other cladding materials such as brick, wood, stone, and metal panels.

More recently, actual veneer materials such as ceramic tile, masonry stone veneer, thin brick and natural stone have become of design interest for the exterior finish layer. These veneers can be used in conjunction with traditional EIFS finishes to create a multi-clad building look. Unlike the original thin finish layer used with EIFS, these veneers are relatively thick and often weigh up to 15 lbs. per sq. ft. which results in additional considerations for attachment and overall performance when used as a finish layer for EIFS and other applications.

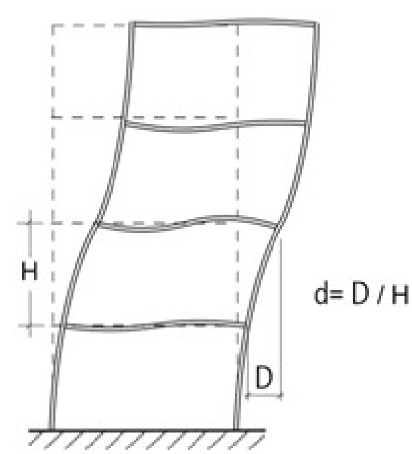
Sika Facades has introduced the Insulated Masonry Veneer System which enables tile, manufactured stone veneer, thin brick and natural stone veneer materials to be substituted for the typical finish coat in what is otherwise a traditional EIFS application. This innovation, which has undergone rigorous fire and other performance-based testing, helps satisfy recent design interests while maintaining the recognized benefits of EIFS.

BACKGROUND

Lateral movement of a building structure during a seismic event is commonly referred to as seismic drift (Figure 1). A common value for in service building sway is the building story height divided by 300 (H/300) but higher deflection can be tolerated for extreme seismic or wind events. ASCE 7 (Standard Minimum Design Loads for Buildings and Other Structures) provides allowable seismic drifts based on factors that include occupancy category and type of superstructure.

Veneer claddings such as the Insulated Masonry Veneer System by Sika Facades are not intended to provide resistance to seismic loads or drift as this is a function of the building support and superstructure system. The scale and impact of a seismic or racking load, if any, on a cladding will depend on factors such as structural or superstructure type and design, nature and intensity of the seismic event, building geometry, attachment system and more.

Figure 1



TEST AND STUDY OBJECTIVES

In order to understand the ability of the system to resist seismic loads, a 3rd party study was carried out by RDH Building Science. A primary objective of the third-party laboratory testing and study was to understand the performance of Sika Facades' Insulated Masonry Veneer System when applied to a metal stud framed sheathed assembly and subjected to a static, lateral load parallel to the wall plane as might occur during a seismic or racking event. As baselines and means of comparison, the study also included tests of several different base walls including a code compliant (2021 IBC Section 1404.10.1.4) assembly comprised of a water resistive barrier, lath, mortar scratch coat and adhered masonry veneer. There are numerous types of veneer materials available (tile, brick, stone, and more), thickness, weight (typically 15 PSF max) and size which range from small tiles to large stones. As part of the test study, all base wall assemblies were tested with both a large veneer (18" x 18" granite tile) and small veneer (approximately 3" x 8" thin brick) for insight on the relationship of veneer size and performance.

The study was based on static loading only and not intended to address other performance aspects such as wind load perpendicular to the wall plane or dynamic seismic response.

TEST ASSEMBLY DESCRIPTIONS

Figures 2a/b, 3a/b, and 4a/b respectively show the components of the Sika Facades' Insulated Masonry Veneer System and base walls. The Insulated Masonry Veneer System includes SikaWall-1000 MaxGrip Veneer Adhesive, a high-strength setting bed mortar. The supporting framing and sheathing is identical for all wall assemblies therefore the only variable is the veneer component which supports relative comparison of seismic racking performance. Detailed descriptions of the assemblies are summarized in Table 1.

TABLE 1

System	**Framing/ Sheathing** (1)	VENEER COMPONENTS					
		AWRB	**Exterior Insulation** (CI)	**Lath/Base Coat** (2)	**Reinforcing Mesh/Base Coat**	**Veneer Adhesive**	**Veneer** (3)
Sika Facades IMVS See Figure 2 a/b	Steel framing/ gypsum sheathing	Sika Facades' Fluid applied	2" EPS adhesively attached with approved base coat	N/A	SikaWall Intermediate 12 reinforcing mesh & Base Coat	SikaWall-1000 MaxGrip Veneer Adhesive	2a Granite 2b Thin Brick
Base Wall See Figure 3 a/b	Steel framing/ gypsum sheathing	Building Paper	None	3a Lath w/ 1/2" scratch coat - SikaWall Stucco Base 3b Lath w/ 1/2" scratch coat – Type NS Mortar	N/A	3a SikaWall-1000 MaxGrip Veneer Adhesive 3b Type NS Mortar	3a Granite 3b Thin Brick
Base Wall See Figure 4 a/b	Steel framing/ gypsum sheathing	Building Paper	2" EPS	Lath w/1/2" scratch coat - SikaWall Stucco Base	N/A	SikaWall-1000 MaxGrip Veneer Adhesive	3a Granite 3b Thin Brick

Notes and details
(1) Steel framing is 6" deep, 18 gauge and spaced 16" o.c. 18. ASTM C 1177 Gypsum Sheathing was screw attached to framing at 8" o.c.
(2) Lath is 2.5# galvanized metal screw attached 7" o.c. to the framing
(3) Granite tiles are 3/8" thick x 18" x 18". Brick is 3" x 8" (prox) General Shale Thin brick

BASE COAT ADHESIVE BEHIND EPS, SIKAWALL-1000 MAXGRIP VENEER ADHESIVE

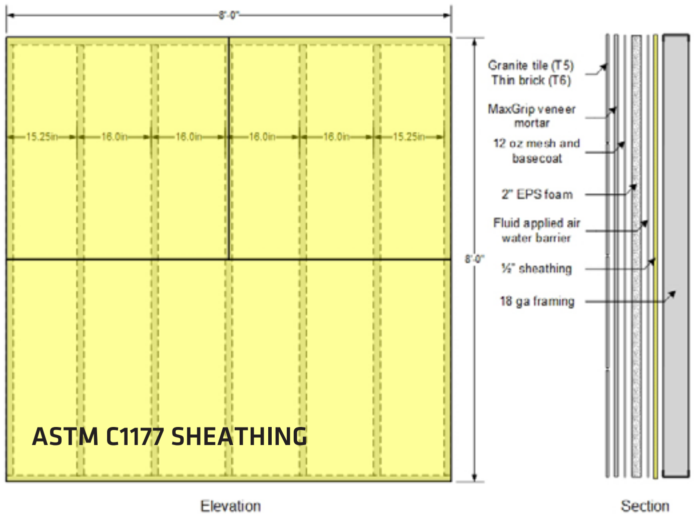


FIGURE 2A/B

Panel T5/2a – Granite, Panel T6/2b thin brick

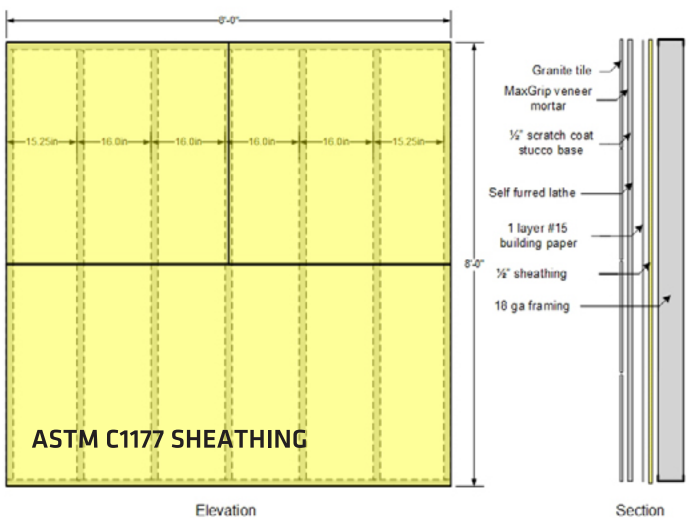


FIGURE 3A/B

Panel 3a – Granite, Panel 3b thin brick

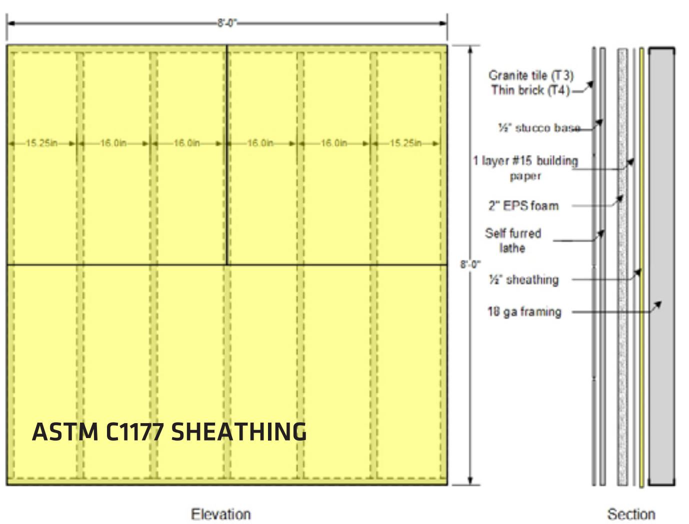


FIGURE 4A/B

Panel T3/4a granite, Panel T4/4b thin brick

TEST PROTOCOL AND METHODOLOGY

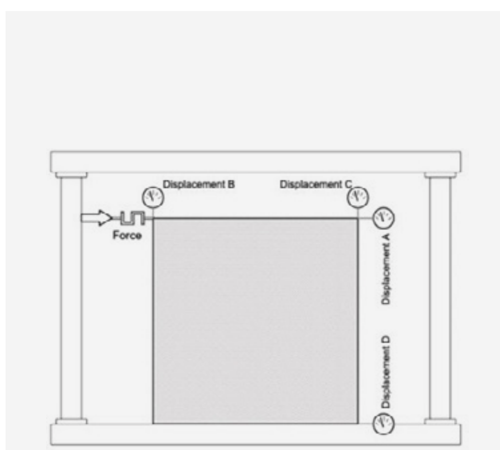
The test protocol following ASTM E-72, was developed by RDH and used their Advanced Cyclic Testing Frame Apparatus (Figure 5) for all testing. A hydraulic ram imposed loads parallel to the plane of the wall and along the top of the specimen. Resulting displacements were measured and recorded from four locations (Figure 6) with location A being of primary interest since it measured lateral displacement which is a key component of the study. Loads were applied until the target displacements shown in Table 2 were achieved in both directions (positive and negative). Once the loads were achieved, the displacement was reversed in the opposite direction to complete the cycle. This procedure was performed until all eight cycles were completed.

TABLE 2

TEST CYCLES AND DISPLACEMENT				
Cycle	**Fraction/ratio (d)**	**(H/D)**	**Displacement**	
			Inch	**MM**
1	.002	500	.19	4.88
2	.003	300	.32	8.13
3	.005	200	.48	12.2
4	.10	100	.96	24.4
5	.15	66.7	1.44	36.6
6	.20	50	1.92	48.8
7	.25	40	2.40	61.0
8	.30	33.3	2.88	73.2

Figure 5

Figure 6



RESULTS AND CONCLUSIONS

Table 3 summarizes the results for each of the specimens in terms of maximum loads, deflection and failure mode. None of the test specimens exhibited any detachment or cracking of the brick or granite veneer even with overall displacements of just over 3" in either direction. There were no observed performance differences in terms of whether specimens incorporated large or small veneers. In every test, the metal stud frame failed and testing was stopped when the wall could not resist any further loading. (Figure 7)

Figure 7

SUMMARY RESULTS				
System (see Table 1)	**Max Load (lbs)** (right) / (left)	**Max Deflection (IN)** (right) / (left)	**Number of Cycles** (see Table 2)	**Failure Mode**
2a	2142/-2764	3.06/-3.06	8	Framing Deflection
2b	2814/-2278	2.93/-2.91	8	Framing Deflection
3a	2587/-2962	2.90/-2.89	8	Framing Deflection
3b	2090/-1859	2.88/-2.95	8	Framing Deflection
4a	2089/-1862	2.89/-2.95	8	Framing Deflection
4b	1800/-1791	2.93/-2.94	8	Framing Deflection

Overall, the Insulated Masonry Veneer System using SikaWall-1000 MaxGrip Veneer Adhesive performed as well as other traditional, code-compliant masonry veneer assemblies and the metal stud framing in the assembly failed before the masonry veneer.

REFERENCES

RDH Building Science Laboratories Project 12016.002 dated August 16, 2019 – Racking Testing Report

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