

August 18, 2016

Mr. Moffette Tharpe
Easi-Set Worldwide
5119 Catlett Road
P.O. Box 400
Midland, VA 22728

RE: Engineering Analysis for SlenderWall Exterior Wall Cladding System Demonstrating Compliance with NFPA 285 (Revised)
JENSEN HUGHES Project No.: 1AJP00202.000

Dear Mr. Tharpe:

JENSEN HUGHES, Inc. has completed our analysis providing the technical justification for the compliance of the Easi-Set SlenderWall Exterior Wall Cladding System with NFPA 285, *Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components*, when utilizing a closed cell (CC) sprayed polyurethane foam (SPF).

Section 2603.5.5 of the International Building Code (2006, 2009, 2012, and 2015 editions) requires that exterior wall systems on buildings of any height in Type I, II, III or IV construction that incorporate foam plastic insulation shall meet the requirements of NFPA 285. The following analysis evaluates the various components within the SlenderWall Prefabricated Wall Cladding System and the overall fire performance of the system in accordance with the conditions of acceptance in NFPA 285.

1.0 EXTERIOR WALL ASSEMBLY

The proposed exterior wall system construction being evaluated for compliance is shown in Figure 1 and will be constructed as follows (interior to exterior):

1. A single layer of 5/8-inch thick Type X gypsum wallboard
2. Minimum 16 gauge 6-inch or 14 gauge 4-inch deep steel studs spaced a maximum of 24-inches on center
3. Nominal 1/2-inch to 2 1/2-inch air gap filled with an approved CC SPF that meets the specifications below, completely filling the air gap
4. Stainless steel anchors attaching the precast concrete panel to the light gauge metal framing
5. Nominal 2-inch thick reinforced concrete panel
6. Uncoated steel plate/bar or steel angle gravity clips supporting each wall panel back to the concrete floor slab or steel structure.

1.1 Base Wall Assembly

The proposed base wall assembly consists of either 16-gauge, 6-inch or 14-gauge, 4-inch deep steel studs spaced 24-inches on center. A single layer of 5/8-inch thick Type X gypsum wallboard is installed as the interior face of the base wall construction. In the same manner as with fire-resistance rated assemblies, a similar steel stud/gypsum wallboard base wall assembly incorporating heavier gauge (i.e., thicker) studs, decreased stud spacing, and/or deeper studs will provide improved fire performance of the

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wall assembly. Commentary in the front of the UL Fire Resistance Directory as well as Section 12.5 of ASTM E2032, *Standard Guide for Extension of Data from Fire Endurance Tests*, support this conclusion.

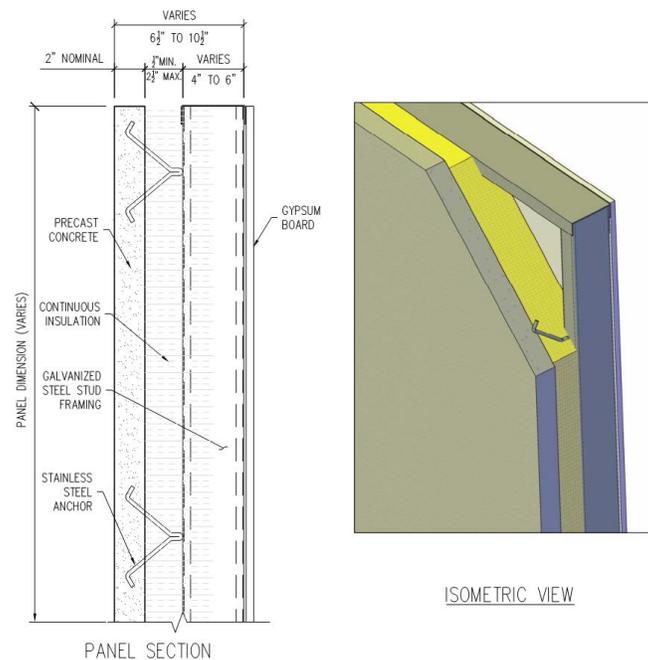


Figure 1. SlenderWall Exterior Wall Cladding panel schematic

1.2 Floorline Firestopping

When the SlenderWall Exterior Wall Cladding panel is installed directly up against the edge of the concrete floor slab, each wall stud cavity (opposite the floor edge) is required to be filled with minimum 4-inch thickness of minimum 4 lbs/ft³ (pcf) compressed mineral wool insulation. The mineral wool will need to be continuous from the interior face of the concrete wall panel to the floor slab edge (completely filling the wall stud cavities and providing a break in the foam application). This mineral wool insulation installation will prevent uncontrolled vertical burning of the SPF inside the wall assembly. When installed off the edge of the concrete floor slab, the perimeter fire barrier systems installation (described below in Section 1.3) will satisfy this requirement.

1.3 Perimeter Fire Barrier System

Most exterior wall assemblies incorporating SPF are installed directly up against the edge of the concrete floor slab, in a manner similar to many NFPA 285 testing procedures. In the cases where the exterior wall assembly is set off the edge of the concrete floor slab, the linear gap width is required per Section 715.4 of the 2015 International Building Code (IBC) to be filled with a perimeter fire barrier system tested in accordance with ASTM E2307, *Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-Story Test Apparatus*. The specific system selection and installation details shall be determined based on the exterior wall configuration and the specific installation requirements. Figure 2 shows a representative perimeter fire barrier system installation for wall configurations off-set from the edge of the concrete floor slab.

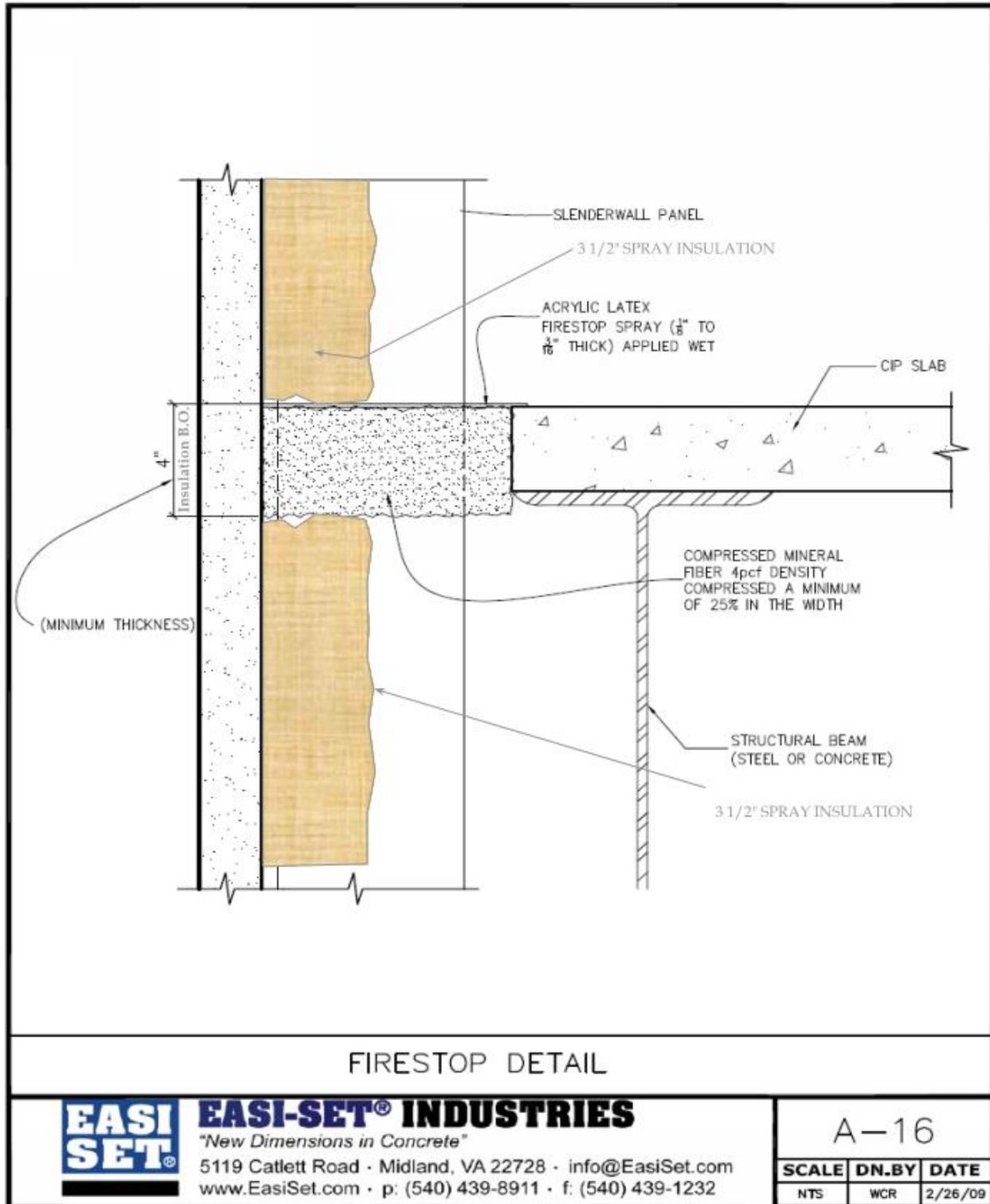


Figure 2. Firestop detail between the SlenderWall and edge of concrete slab.

1.4 Sprayed Polyurethane Foam

The basic wall panel assembly will incorporate an air gap between the interior face of the concrete wall panel and the metal framing ranging from ½-inch to 2½-inches. A CC SPF product will be applied in each wall cavity using the concrete wall panel as the spraying substrate. The SPF is commonly applied at a thickness ranging from 3-½ inches to 6-½ inches, completely filling the air gap and extending into the wall stud cavities. A minimum thickness equal to the air gap between the interior face of the concrete wall panel and the exterior face of the base wall studs must be applied to all wall panel assemblies. By applying the SPF all the way to the steel studs, a free air cavity laterally along the wall will no longer exist. Thus, the base wall studs inherently provide a fire barrier aimed at preventing lateral flame spread across the entire SPF surface.

Acceptable CC SPF must have a minimum nominal density of 2-lbs/ft³ and meet following testing criteria:

1. The CC SPF shall have been successfully tested in accordance with NFPA 285 in a base wall configuration constructed using light gauge metal framing with a single layer of ½-inch thick Type X gypsum wallboard installed on the interior face of the metal wall studs and a single layer of ½-inch thick Type X exterior gypsum sheathing installed on the exterior side. The CC SPF is installed in each wall stud cavity applied using the exterior gypsum sheathing as the substrate.
2. The CC SPF must have also passed a NFPA 285 test when applied to the exterior side of a steel stud/gypsum wallboard base wall assembly with a standard nominal 4-inch thick clay brick veneer exterior wall covering.

These two NFPA 285 qualification tests demonstrate the acceptability of the proposed CC SPF in meeting the conditions of acceptance of NFPA 285 with respect to excessive vertical and lateral burning.

1.5 Exterior Wall Covering Material

In the NFPA 285 test, the function of the exterior wall covering material is to provide a material to separate the SPF insulation from the exterior fire exposure during the 30-minute test. The exterior wall covering material must be capable of shielding the SPF from the external fire exposure (i.e., flame barrier) and limit excessive heat migration through the wall covering to the SPF below to prevent the onset of significant pyrolysis and ultimately ignition.

As detailed in Table 1 of the National Concrete Masonry Association (NCMA) TEK Guide 7-1C, *Fire Resistance Rating of Concrete Masonry Assemblies*, provides the minimum concrete thicknesses for various hourly fire-resistance ratings. A normal calcareous or siliceous gravel concrete wall/panel with a minimum thickness of 2-inches will provide a 30-minute fire-resistance rating; a rating equal to the duration of the NFPA 285 test. In this particular case, the SlenderWall Prefabricated Wall Panel/System utilizes a nominally 2-inch thick precast reinforced concrete panel as the exterior assembly component. By providing a 30-minute fire-resistance rated element between the external fire exposure and the underlying SPF insulation, the concrete panel will be able to protect the SPF from being exposed to the direct flame impingement generated by the exterior burner. This protection will reduce the vertical flame spread of the entire assembly.

1.6 Panel to Panel Joint System

The SlenderWall Exterior Wall Cladding Systems are prefabricated wall panels which are brought onto the jobsite and installed on the project building. A maximum ¼-inch wide concrete panel to concrete panel joint is maintained between panels during installation. The concrete panel to concrete panel joint shall be protected as follows to maintain the joint integrity for the duration of the 30 minute NFPA 285 exposure by not allowing fire penetration to the CC SPF and ensure vertical fire propagation does not occur up a vertical joint line:

1. Open or closed cell polyurethane foam backer rod shall be installed into the joint opening as a permanent form. Foam backer rod shall be recessed a minimum of $\frac{3}{4}$ -inch into the joint to accommodate the required caulk thickness.
2. A minimum $\frac{3}{4}$ -inch thickness of Dow Corning 790 Silicone Building Sealant or Dow Corning 795 Silicone Building Sealant (or approved equivalent) shall be applied within the joint, flush with the concrete panel surface.

Experience with the Dow Corning 790 Silicone sealants and Dow Corning 795 Silicone sealants indicate that the fire will not burn through the thickness of the silicone caulk back into the CC SPF and minimal vertical flaming of the caulk along the vertical joint will occur.

1.7 Wall Penetrations

Where the concrete wall panels are penetrated for building utilities or accessories (canopies, standpipes, ventilation, air conditioning units, etc.), the area around the penetration shall be sealed in a manner similar to the concrete panel to concrete panel joints using the backer rod and Dow Corning 790 Silicone Building Sealant or Dow Corning 795 Silicone Building Sealant (or approved equivalent) system described above in Section 1.6. The CC SPF shall be applied/repared around these penetrations as required from the interior side of the exterior wall to meet the minimum installation requirements established above in Section 1.4.

1.8 Window Header Details

Standard window details are provided in Easi-Set Drawing A-2 (attached at the end of this report). In the standard window detail, the edge of the concrete wall panel terminates at the window opening line. Minimum $\frac{3}{4}$ -inch thick shim or blocking is provided by the general contractor to finish the opening to accept the window assembly. An optional window return detail is also provided where the concrete wall panel returns in approximately $4\frac{1}{2}$ -inches, behind the light gauge metal framing. Wood blocking is again installed by the general contractor to finish the opening. In both window details, the wood blocking needs to be brought tight to or up against the concrete wall panel to close off the air gap between the concrete panel and the metal framing, filled with the CC SPF.

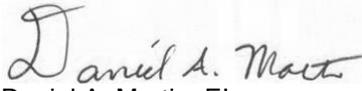
2.0 CONCLUSION

Based on the analysis describe above, the use of an approved CC SPF (a spray foam compliant with NFPA 285 when tested in a steel stud/gypsum wallboard base wall assembly and in a wall assembly with a brick veneer) in the wall panel assembly as shown in Figure 1 will comply with the building code requirements in Section 2603.5.5 for exterior walls incorporating a foam plastic insulation material. The foam plastic insulation material is required to be applied in each wall stud cavity using the concrete wall panel as the substrate to a thickness at least equal to the air gap between the concrete panel and the steel wall framing. Once installed on the building, the panel to panel joint (maximum $\frac{3}{4}$ -inch) shall be filled with a minimum $\frac{3}{4}$ -inch thickness of Dow Corning 790 Silicone Building Sealant, or Dow Corning 795 Silicone Building Sealant (or approved equivalent) to ensure no fire penetration through the joint to the underlying foam occurs. Around window openings, minimum $\frac{3}{4}$ -inch thick wood shims shall be installed by the general contractor to accept the window assembly installation and shall be tight to or up against the concrete wall panel to seal off the foam filled air gap in the wall panel assembly.

This analysis does not address performance characteristics such as fire-resistance, weatherability, durability or structural issues.

We trust that this information is of assistance and if you have any questions, please feel free to contact us at (410) 737-8677.

Prepared by:



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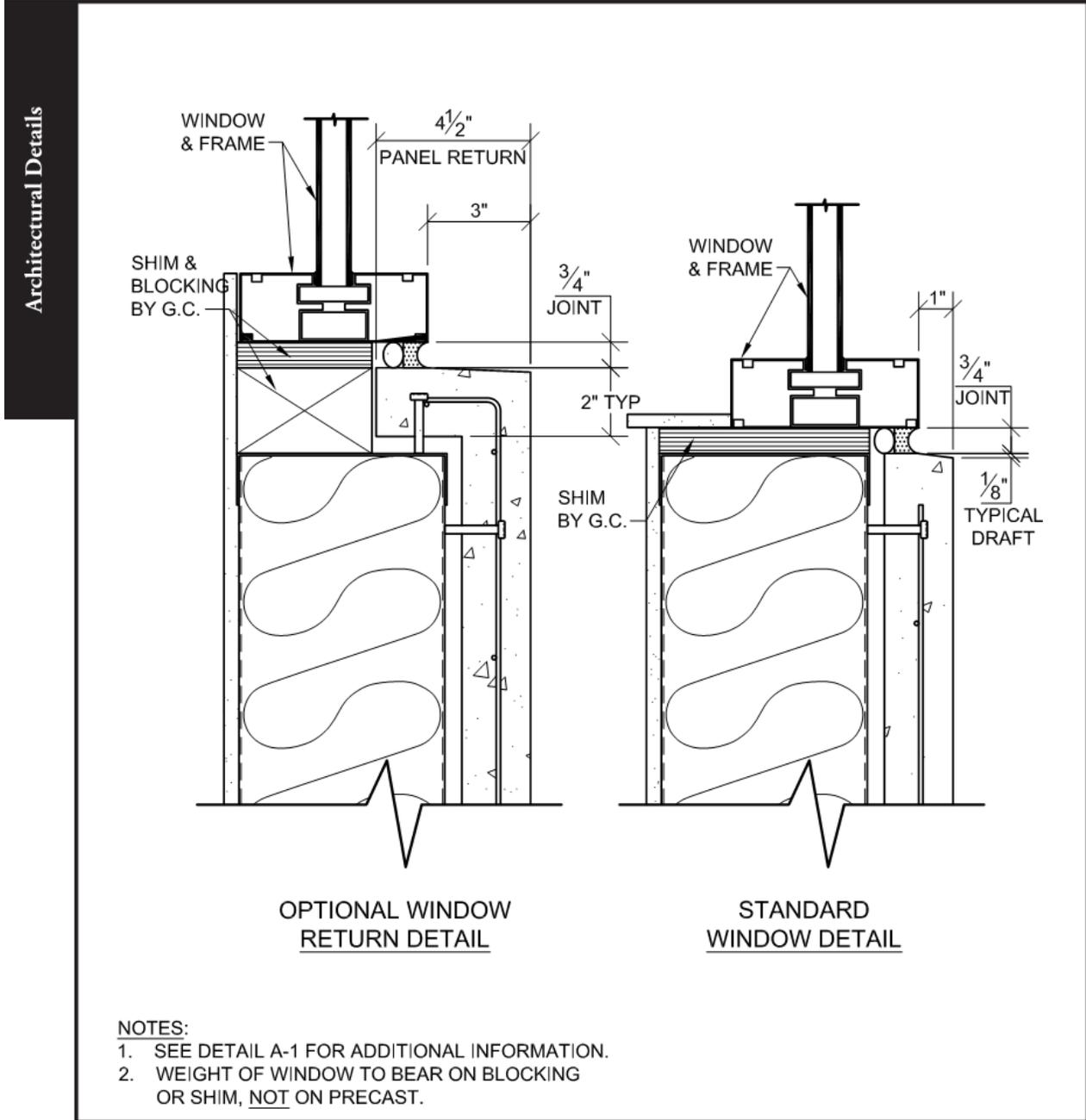
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A-2

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 3" = 1'-0" CEK 5/1/06

These details are provided solely as an example and should not be relied on for use in architectural or engineering drawings unless approved by a qualified professional based on project requirements.