

August 17, 2020

Brick Industry Association
12007 Sunrise Valley Drive, Suite 430
Reston, VA 20191-3446

RE: Alternate Exterior Wall Constructions Incorporating Thin Brick Veneer Systems Complying with NFPA 285 and ASTM E119 (Revised)
Jensen Hughes Project No. 1AJP00240.000

BIA Engineering and Research Staff:

The Brick Industry Association (BIA) sponsored a series of fire tests to demonstrate compliance of a wall assembly with NFPA 285, *Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components*, and ASTM E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*.

Section 2603.5.5 of the *International Building Code* (2000 through 2018 editions) requires exterior wall assemblies incorporating foam plastic insulation materials meet the requirements of NFPA 285. Further, if the wall is required to be fire-resistance rated per Chapter 6 of the *International Building Code*, then it must meet the requirements of ASTM E119.

BIA sponsored one NFPA 285 test and two 1-hour ASTM E119 fire resistance tests on an insulated exterior wall assembly incorporating a thin set thin brick veneer system (see Figure 1). These tests include:

1. NFPA 285 Fire Test – An insulated exterior wall assembly incorporating a thin set thin brick veneer system, Intertek Final Report Number I8508.01-121-24-R2, Revision date November 18, 2019.
2. ASTM E119 Fire Test – 1-hour ASTM E119 interior face fire exposure of an insulated exterior wall assembly incorporating a thin set thin brick veneer system, Intertek Final Report Number I8509.01-121-24-R3, Revision date November 18, 2019.
3. ASTM E119 Fire Test – 1-hour ASTM E119 exterior face fire exposure of an insulated exterior wall assembly incorporating a thin set thin brick veneer system, Intertek Final Report Number I8509.02-121-24-R3, Revision date November 11, 2019.

Intertek Letter of Results for all testing are available from BIA for distribution with this engineering analysis letter.

A post-test inspection of the NFPA 285 exterior wall test assembly showed minimal thermal damage (melting) to the polymeric drainage mat and the foam plastic insulation materials and no char. The temperature data measured in the areas where the drainage mat and foam plastic insulation had melted confirmed that there was no burning of these materials, only melting. During the ASTM E119 testing, minimal heat transfer through the wall assembly was measured when the interior side of the wall assembly (gypsum wallboard side) was exposed

to the fire. When the thin set thin brick side of the wall assembly was exposed to the fire (exterior exposure), minimal heat transfer through the wall was measured and the wall assembly did not exceed the unexposed surface temperature limits.

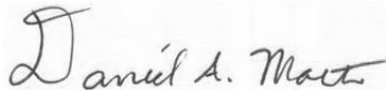
Based on the results of the NFPA 285 test and the ASTM E119 tests, additional testing of water-resistive barrier materials per ASTM E1354, *Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products using an Oxygen Consumption Calorimeter*, and our experience with the NFPA and ASTM E119 fire test standards, it is our opinion that the various configurations of exterior walls shown in Figure 1 and as described in Tables 1 and 2 will meet the performance requirements of NFPA 285 and will provide a 1-hour fire resistance rating for exterior and interior fire exposure in accordance with ASTM E119. The technical justification for the wall constructions shown in Tables 1 and 2 meeting NFPA 285 and ASTM E119 is provided at the end of this letter.

This analysis is based on the specific construction materials installed in the manner described in the referenced test reports. Changes or modifications to the construction and/or materials other than discussed in the engineering analysis report may result in a different fire performance and may change this analysis.

The analysis only addresses compliance of the wall assembly with NFPA 285 and ASTM E119. This analysis also does not address performance characteristics such as weatherability, durability or structural issues.

Should you have any questions, please feel free to contact us at (410) 737-8677.

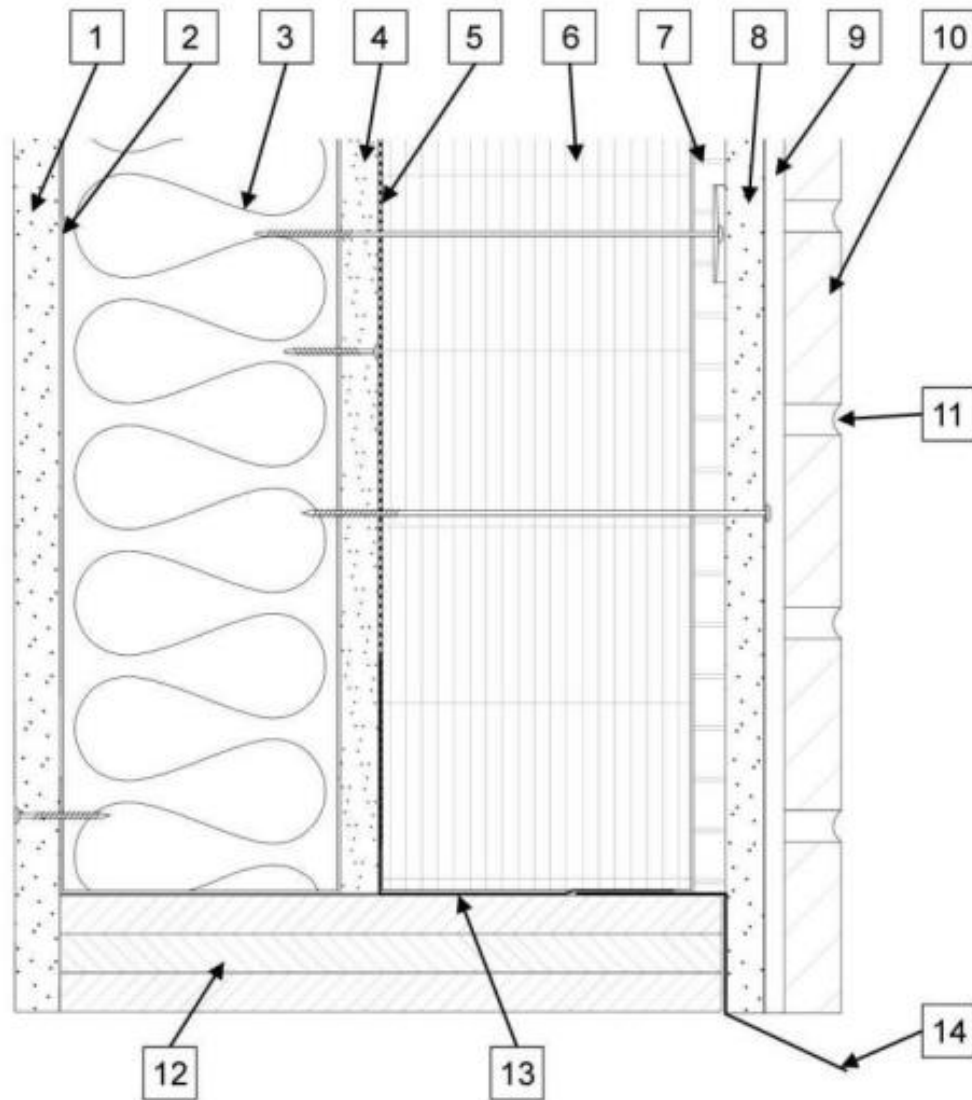
Sincerely,



Daniel A. Martin, P.E., CFEI, CVFI
Fire Protection Engineer



Arthur J. Parker, P.E.
Sr. Fire Protection Engineer



1. Gypsum board (interior side) - One layer 5/8 in. thick National Gypsum Gold Bond ® Fire-Shield ® gypsum board
2. Cold-formed metal framing - 3-5/8 in. wide No. 18 (43 mil) gauge galvanized cold-formed metal studs and track
3. Batt insulation - R-11 Johns-Mansville unfaced fiberglass batt insulation
4. Exterior gypsum sheathing (exterior side) - One layer 1/2 in. thick National Gypsum Gold Bond ® eXP ® Extended Exposure Gypsum Sheathing with glass mat facing
5. Water-resistive barrier / air barrier - Tremco ® ExoAir ® 230 fluid-applied, synthetic air & vapor permeable membrane applied to a thickness of 0.048 in. (48 wet mils)
6. Exterior insulation - 4 in. thick Kingspan ® GreenGuard ® Type IV 25 psi Extruded Polystyrene (XPS) Insulation Board
7. Drainage mat - Keene Building Products Driwall™ Rainscreen 10 mm
8. Cement board - 1/2 in. thick PermaBase ® Cement Board
9. Mortar bed - Laticrete ® MVIS™ Thin Brick Mortar polymer modified mortar
10. Clay thin brick - 1/2 in. thick Glen-Gery clay thin brick
11. Mortar joints - Glen-Gery Color Mortar Blend
12. Wood buck - three layers 1/2 in. thick plywood nailing buck
13. Flashing tape - Self-adhered flashing tape
14. Flashing - 26 gauge sheet metal flashing

B SECTION AT HEAD

Figure 1. Wall assembly tested in accordance with NFPA 285 and ASTM E119

Table 1. Thin Brick Exterior Veneer Wall System – NFPA 285 and ASTM E119 Compliant Wall Assemblies

Wall Component	Materials
Base Wall System – Use either 1, 2, 3, or 4	<ol style="list-style-type: none"> Concrete wall (see Note 2) Concrete Masonry wall (see Note 2) 1 layer of 5/8-inch thick Type X gypsum wallboard installed on the interior side of minimum 3-5/8 inch deep minimum 18-gauge thick steel studs spaced a maximum of 24-inch on center. Lateral bracing installed minimum every 4 ft. vertically or as required. Minimum 4 lbs/ft³ mineral wool (e.g. Thermafiber) shall be friction fit between steel wall studs at each floorline. Height of mineral wool insulation shall be the same as the floor slab thickness. For walls which are not required to be fire-resistance rated, 1 layer of 5/8-inch thick Type X gypsum wallboard installed on the interior side of minimum 2x4 wood studs spaced a maximum of 24-inch on center. Lateral bracing installed as required. Minimum 4 lbs/ft³ mineral wool (e.g. Thermafiber) shall be friction fit between wood wall studs at each floorline. Height of mineral wool insulation shall be the same as the floor slab thickness.
Perimeter Fire Barrier System	Perimeter fire barrier system complying with Section 715.4 of the 2018 IBC shall be installed, as applicable, to fill the void between the edge of the building floor slab and the interior surface of the exterior wall assembly (see Note 1).
Stud Cavity Insulation – Use either 1, 2, or 3	<ol style="list-style-type: none"> None (for Base Wall Systems 1 and 2 only) Unfaced fiberglass batt insulation Unfaced mineral wool insulation
Exterior Sheathing – Use either 1 or 2	<ol style="list-style-type: none"> 1/2-inch thick exterior type gypsum sheathing (for Base Wall Systems 3 and 4 above). 5/8-inch thick Type X exterior type gypsum sheathing (for Base Wall Systems 3 and 4 above).
Water-Resistive Barrier (WRB) Material – Use either 1 or 2	<ol style="list-style-type: none"> Tremco ExoAir 230. Any WRB material as shown in Table 2
Exterior Insulation – Use either 1, 2, or 3	<ol style="list-style-type: none"> Maximum 4-inch thickness of Kingspan® GreenGuard® Type IV 25 psi extruded polystyrene (XPS) foam plastic insulation (R-value = 20). For NFPA 285 compliance, ASTM C578 Type IV or Type X XPS foam plastic insulation with a potential heat (per NFPA 259) not exceeding the tested XPS foam (Item 1). The calculated maximum thickness shall not exceed 4-inches. <ol style="list-style-type: none"> DuPont™ Styrofoam™ Type IV or Type X Kingspan® GreenGuard® Type X Owens Corning™ FOAMULAR® Type IV or Type X Other Type IV or Type X XPS products manufactured by XPSA members. For ASTM E119 compliance, ASTM C578 Type IV or Type X XPS foam plastic insulation with a potential heat (per NFPA 259) not exceeding the tested XPS foam (Item 1) AND a total XPS R-value not exceeding 20 (Item 1). The calculated maximum thickness shall not exceed 4-inches. <ol style="list-style-type: none"> DuPont™ Styrofoam™ Type IV or Type X Kingspan® GreenGuard® Type X Owens Corning™ FOAMULAR® Type IV or Type X Other Type IV or Type X XPS products manufactured by XPSA members. <p>Note (Items 2 and 3): Maximum allowable thicknesses of alternate XPS foam plastic insulations offered by DuPont™, Kingspan®, or Owens Corning™ identified in XPSA engineering extension letter (https://xpsa.com/technical-information/nfpa-285-astm-e119/).</p>
Drainage Mat	Keene Building Products 10-mm thick Driwall™ Rainscreen drainage mat
Exterior Thin Brick Veneer System – Use either 1 or 2	<ol style="list-style-type: none"> Thin Set Thin Brick Veneer System <ol style="list-style-type: none"> Minimum 1/2-inch thick National Gypsum PermaBase cement board (or equivalent) ASTM C1325, Type A Nominal 3/8-inch thick Laticrete® MVIS™ Thin Brick polymer modified mortar (or equivalent), ANSI A118.4 or A118.15 Minimum 1/2-inch thick Glen-Gery clay thin brick (or equivalent), ASTM C1088 Glen-Gery Color Mortar Blend mortar installed between the brick units (or equivalent), ASTM C270, Type N Thick Set Thin Brick Veneer System <ol style="list-style-type: none"> Reinforcing lath <ol style="list-style-type: none"> 1/4-inch grid glass fiber Minimum 2.5 lb/square yard self-furring metal lath meeting ASTM C847 Welded wire lath meeting ASTM C847 or ASTM C933 Minimum 18-gauge woven wire lath meeting ASTM C1032 Non-metallic lath meeting ASTM C1788 Lath products meeting ICC-ES AC275 Nominal 1/2-inch thick polymer modified mortar scratch coat meeting ANSI A118.4 or A118.15, or mortar scratch coat meeting ASTM C270 Type S Nominal 3/8-inch thick polymer modified mortar bond coat meeting ANSI A118.4 or A118.15, or mortar bond coat meeting ASTM C270 Type S Minimum 1/2-inch thick Glen-Gery clay thin brick (or equivalent), ASTM C1088 Glen-Gery Color Mortar Blend mortar installed between the brick units (or equivalent), ASTM C270, Type N

Opening Header	Three (3) layers of minimum ½-inch thick plywood nailing buck mechanically attached wall framing. Minimum 26-gauge sheet metal flashing drip edge attached to top of plywood nailing buck at opening header
Flashing of window, door and other exterior wall penetrations.	As an option, flash around window, door and other exterior penetrations with limited amounts of maximum 12-inch wide flashing tape (acrylic, asphalt or butyl-based) or liquid-applied membrane material with or without fiber mesh reinforcement.

Note 1: Building code section references may change in different editions of the IBC.

Note 2: Fireblocking per Section 718 of the 2018 IBC and thermal barrier material requirements must be met for Base Wall Systems 1 and 2, as required by specific wall construction details when combustible concealed space is created on interior side of exterior wall assembly

Table 2. Allowable Water-Resistive Barrier (WRB) Materials

WRB Product
3M – Air and Vapor Barrier 3015
BASF Wall Systems + Enershield HP/MasterSeal AWB 660 (7 mils DFT) + Senershield-R (20 mils DFT) + Senershield-VB (22 mils DFT)
Berry Plastics + Typar HouseWrap + Typar MetroWrap
Carlisle + Barritech NP + Barritech VP + CCW 705 FR Silver
Dorken Systems + Delta-Vent S/Plus + Delta-Fassade S + Delta-Foxx/Plus + Delta-Maxx/Plus
DuPont™ + DuPont™ Tyvek® CommercialWrap® + DuPont™ Tyvek® CommercialWrap® D + DuPont™ Tyvek® Fluid Applied WB+™ - nominal 25 wet mil thickness
Note: Air/Water barrier to be installed in accordance with manufacturers recommended installation instructions. Maximum 12" wide flashing may be used with primer (if applicable), unless otherwise noted by manufacturer.
Dow Corning + DefendAir 200 + DefendAir 200 LT
GCP Applied Technologies + Aluminum Wall Membrane + Perm-A-Barrier VP 20 + Perm-A-Barrier VPS LT
Henry Weather Barrier + AirBloc 31 MR + AirBloc 33 MR + Blueskin VP 160 + Foilskin
Hohmann & Barnard – Enviro-Barrier VP
JX Nippon + JX ALTA Commercial Wrap + JX ALTL HP Wrap + JX ALTA LP Wrap
Kingspan + GreenGuard Max + GreenGuard HPW + GreenGuard C500 + GreenGuard C200 + GreenGuard C2000 + GreenGuard C2000A + GreenGuard RainDrop 3D + GreenGuard Classic Wrap
Momentive + GE SEC2500 Silshield AWB + GE SEC2600 Silshield AWB + GE SEC2600-R Silshield AWB + S2 WRB
Polyguard – Airllok Flex

<i>WRB Product</i>
Prosoco + R-Guard Spray Wrap + R-Guard MVP + R-Guard VB + R-Guard CAT-5
STO Weather Barrier + Gold Coat + Emerald Coat + StoGuard VaporSeal + StoExtra Seal
TK Products + AirMax 2101 NP SB (HydroMax 2001 SB) + AirMax 2103 NP WB (HydroMax 2003 WB) + AirMax 2104 VP WB + Climate Tech 2206
Tremco + ExoAir 230 + Securock ExoAir 430
Vaproshield + WrapShield + WallShield + RevealShield + BlockShield SA + SlopeShield Plus + RevealShield SA + WrapShield SA
WR Meadows + Air-Shield LMP (Gray) + Air-Shield LMP(Black) + Air-Shield TMP + Air-Shield LSR

TECHNICAL JUSTIFICATION

The information below provides the technical justification for the insulated exterior wall assembly incorporating a thin brick veneer system comprised of the components listed in Tables 1 and 2 above as maintaining compliance with NFPA 285 and providing a 1-hour interior and exterior fire-resistance rating in accordance with ASTM E119.

1.0 Base Wall System

The as-tested base wall assemblies consisted of 3-⁵/₈ inch deep, 18-gauge steel studs spaced 24-inches on center with a single layer of ⁵/₈-inch thick Type X gypsum wallboard installed on the interior surface of the base wall construction.

1.1 Modified Steel Stud Base Wall Assembly. Improved fire performance of a similar steel stud/gypsum wallboard base wall assembly can be provided by incorporating heavier gauge (i.e., thicker) studs, by decreasing stud spacing, and/or by use of deeper studs. 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.

1.2 Concrete and Concrete Masonry Base Wall Assembly. In an NFPA 285 test, a wall constructed of concrete or concrete masonry (using concrete masonry units (CMU)) will provide improved protection to the XPS installed on the exterior side from the room fire based on the non-combustibility of the concrete or concrete masonry, its increased rigidity, significantly higher thermal mass, and increased level of fire performance. Construction of the base wall assembly using concrete or concrete masonry will also result in a much more stable and thermally massive wall assembly to maintain compliance with ASTM E119 for a 1-hour non-load bearing fire-resistance rating.

Table 1 of the National Concrete Masonry Association (NCMA) TEK Guide 7-1C, *Fire Resistance Rating of Concrete Masonry Assemblies*, provides minimum masonry thicknesses required for various hourly fire-resistance ratings. A normal calcareous or siliceous gravel concrete wall 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. Any exterior wall assembly constructed of concrete or concrete masonry will require a thickness greater than 2-inches for structural reasons. Based on the documented fire performance of concrete construction, a concrete or CMU base wall assembly will provide the same or better fire performance than the tested steel stud/gypsum wallboard base wall assembly.

1.3 Wood Stud Base Wall Assembly. Specific to the NFPA 285 base wall construction only, when the exterior wall assembly is not required to be fire-resistance rated, the base wall assembly can be constructed using minimum 2x4 wood studs spaced a maximum of 24-inches on center. NFPA 285 testing experience on wood framed exterior walls protected on both faces with a layer of gypsum wallboard has shown that the wood studs do not experience significant burning or charring. Since this is a non-load bearing wall assembly, the wood stud framing retains enough of its cross-sectional area to maintain the structural integrity of the wall assembly. Experience shows that some burning and charring of the wood framing does occur, particularly around the window opening. However, this was not enough to compromise the structural integrity of the wall framing and no involvement of the wood framing above the window opening was observed.

Based on the observed fire performance of the tested wall assembly along with other testing experience of wood framed walls in accordance with NFPA 285, it is our conclusion that replacing the tested steel stud framing with comparable wood stud framing will not adversely impact the fire performance of the wall assembly and the wall will maintain compliance with NFPA 285. When the exterior wall assembly is required to provide a fire-resistance rating, wood stud framing is not permitted for this application.

2.0 Stud Cavity Insulation

The base wall stud cavities in the tested assembly were filled with unfaced fiberglass batt insulation. Removing the fiberglass insulation from the wall cavities will not adversely impact the overall wall fire performance in an NFPA 285 test. Replacing the fiberglass insulation with any other non-combustible unfaced insulation (such as mineral wool insulation) will not reduce the fire performance of the wall during an NFPA 285 fire test. A wall with any other non-combustible unfaced insulation (such as mineral wool insulation) will provide a 1-hour non-load bearing wall fire-resistance rating when tested in accordance with ASTM E119. Non-combustible unfaced insulation may actually improve the overall wall fire performance as mineral wool insulation is used in many fire-resistance-rated wall assemblies.

3.0 Exterior Sheathing

The tested wall assembly incorporated a single layer of non-rated ½-inch thick exterior gypsum sheathing within the wall assembly.

3.1 Modified Sheathing on Steel Stud Base Wall Assembly. Replacing the tested non-rated ½-inch thick exterior gypsum sheathing with a layer of ⅝-inch thick Type X exterior gypsum sheathing on Base Wall Systems 3 and 4 will improve the overall wall fire performance as the Type X gypsum core will slow heat progression through the tested assembly, resulting in improved fire performance of the wall during an NFPA 285 fire test. This modification will also retain the 1-hour ASTM E119 non-load bearing wall fire-resistance rating.

3.2 Concrete and Concrete Masonry Base Wall Assembly. Exterior gypsum sheathing (either type) is not required for the concrete or CMU wall as these base wall systems possess adequate structural strength to support the other wall construction materials and do not need an additional layer of an insulative material for the wall to meet the fire performance criteria of NFPA 285 or to remain compliant with ASTM E119 to provide a 1-hour non-load bearing wall fire-resistance rating.

4.0 Water Resistive Barrier (WRB) Materials

The tested wall assembly included the Tremco ExoAir 230 WRB material applied over the exterior gypsum sheathing (see Figure 1). Replacing the tested WRB material with a different WRB material having the same or lower flammability characteristics will result in an improvement in the overall wall assembly fire performance. Other acceptable WRB materials with flammability performance characteristics the same as or less than the tested Tremco ExoAir 230 are provided in Table 2.

Jensen Hughes has conducted proprietary testing on many WRB materials using the ASTM E1354 Cone Calorimeter test apparatus with the samples subjected to a uniform incident heat flux of 50 kW/m². Various flammability properties such as time to ignition, average effective Heat of Combustion, peak heat release rate, and total heat release rate are compared and used to assess the overall relative flammability of each material. Testing experience has indicated that WRB materials with lower flammability properties contribute less combustible material to the wall assembly and will not contribute to increasing the burning of other combustibles. Knowing that less flammable materials result in improvements in the overall wall fire performance, the use of the WRB materials listed in Table 2 will result in maintaining compliance of the wall assembly with NFPA 285. Use of any WRB materials in Table 2 will also result in a 1-hour ASTM E119 non-load bearing fire-resistance rated wall assembly.

5.0 Exterior Insulation Materials

A maximum 4-inch thickness of the Kingspan® GreenGuard® Type IV 25 psi XPS insulation material was included in the successful NFPA 285 wall assembly test. Other XPS foam plastic insulation materials can be substituted in the wall assembly and maintain compliance with NFPA 285 as long as the XPS foam plastic

conforms to ASTM C578 Type IV or Type X with a combustible content not exceeding the tested Kingspan® GreenGuard® Type IV 25 psi XPS insulation. The maximum foam thickness shall not exceed 4-inches.

In an ASTM E119 complaint exterior wall assembly, the tested XPS insulation can be substituted for an ASTM C578 Type IV or Type X XPS foam plastic with a combustible content not exceeding the tested Kingspan® GreenGuard® Type IV 25 psi XPS insulation AND an R-value (per inch) not exceeding the tested Kingspan® GreenGuard® Type IV 25 psi XPS insulation. The maximum foam thickness shall not exceed 4-inches.

6.0 Exterior Thin Brick System

The tested wall assembly incorporated the thin set thin brick veneer system, as shown in Figure 1. Thin brick veneer can also be installed using the thick set method. The thick set thin brick veneer system will incorporate the reinforcing mesh, ½-inch thick mortar scratch coat, ¼-inch thick bond coat, the ½-inch thick thin clay brick units and the mortar between the units. The biggest difference between the thin set and thick set thin brick systems is the thin set system incorporates a ½-inch thick cement board and the thick set system incorporates a ½-inch thick mortar scratch coat. Both systems are nominally the same thickness and incorporate similar materials. The mortar scratch coat and the cement board will both similarly delay heat transfer through the system from the exterior fire source (window burner) as well as thermally protecting combustible materials located behind these materials. Based on the similar thickness, composition, and location within the wall of these two products, it is our opinion that a wall finished with the thick set thin brick veneer system will attain the same fire performance as the tested assembly and maintain compliance with NFPA 285 and remain compliant with ASTM E119 to provide a 1-hour non-load bearing wall fire-resistance rating.