December 17, 2025
Renewal Scheduled: December 17, 2027

DuPont Performance Building Solutions
1501 Larkin Center Drive
Midland, MI 48642

RE: **NFPA 285 Compliance: 4.25-inch DuPont™ Thermax™ with Non-Combustible Cladding** (Rev 01a)
Jensen Hughes Project No. 1JJB05306.011

To Whom It May Concern:

Compliance with NFPA 285, *Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components*, (2023 Edition) is required by the building codes for exterior wall assemblies containing combustible materials, such as the DuPont™ Thermax™ Brand Insulation, to ensure excessive vertical and lateral exterior flame spread will not occur during a fire event. Use of a foam plastic insulation in an exterior wall assembly is a trigger requiring compliance with NFPA 285. Specifically, Section 2603.5.5 of the 2024 and prior editions of the International Building Code (IBC) require exterior wall systems of any height incorporating foam plastic insulation materials to meet the requirements of NFPA 285 on buildings of Types I, II, III, and IV construction.

DuPont has conducted multiple NFPA 285 tests of exterior wall assemblies incorporating the Thermax Brand Insulation with various cavity insulation materials and exterior cladding systems. The NFPA 285 test reports listed in the “References” section in Appendix A are the basis for the NFPA 285 compliance table herein.

Based on NFPA 285 test data, ASTM E1354 test data of WRB materials, and our experience with NFPA 285, it is our opinion that the various configurations of exterior walls described in Table 1 with floor line firestopping details as shown in Figures 1 through 4 will meet the performance requirements of NFPA 285 when installed in accordance with the manufacturer’s installation instructions. The opening construction details shown in Figures 5 through 8 are required for compliance for Table 1 assemblies.

This analysis is based on the specific construction materials installed in the manner described in the referenced test report(s). Changes or modifications to the construction or materials used in the tested assembly may result in a different fire performance and may change this analysis. This analysis does not address performance characteristics such as weatherability, durability, or structural issues.

We trust this engineering analysis will be of use to DuPont. Should you have any questions regarding our analysis, please contact us at 443-313-9891 or at aparker@jensenhughes.com.

Sincerely,

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Table 1 – NFPA 285 Compliance: 4.25-inch DuPont™ Thermax™ with Non-Combustible Cladding

Wall Component	*Materials (Select only one item per wall component row)*
Interior Wall Covering	1) **Interior Gypsum Wallboard Panel**: Minimum one layer of ⅝-inch thick Type X gypsum wallboard complying with ASTM E1396 installed continuously from top of structural floor below to underside of structural floor above and is required for all compliant Steel Stud Framing or Wood Stud Framing Base Wall Systems. Interior gypsum wallboard panels must extend above drop or lay in ceilings to underside of the floor/ceiling structure above. Gypsum wallboard joints shall receive at a minimum a Level 2 finish with all fasteners covered with joint compound. 2) **None:** Interior gypsum wallboard not required for Concrete or CMU Base Wall Systems.
Base Wall System	3) **Concrete** 4) **Concrete Masonry Unit (CMU)** 5) **Steel Stud Framing:** Minimum 3⅝-inch deep, minimum 20-gauge at a maximum spacing of 24-inch OC. 6) **Fire-Retardant Treated (FRT) Wood Stud Framing** – Nominal 2-inch × 4-inch or greater FRT wood studs spaced at a maximum of 24-inch OC. Minimum two top plates at top of wall. a. FRT Wood Stud Framing requires a minimum of one layer ⅝-inch thick Type X gypsum wallboard on interior and exterior sides of wall framing. Any thickness of plywood or OSB sheathing may be installed on the exterior face of wood studs under exterior gypsum sheathing. b. FRT Wood Stud Framing does not permit Spray Polyurethane Foam Stud Cavity Insulation.
Floor Line Firestopping	7) **Infill Wall Construction**: Minimum 4 lb/ft^3 mineral wool insulation installed between the edge of concrete floor slab and the interior face of Thermax full slab depth. Gaps less than ¼-inch measured from the slab edge face to interior face of Thermax do not require mineral wool (see Figure 1). 8) **Platform-Framed Construction**: Exposed foam of Thermax foam in floor interstitial space to be covered by minimum 4-inch thick, minimum 4 lb./cu ft. mineral wool insulation mechanically attached to floor framing or minimum 1¾-inch thick rim joist. Thermax does not require additional protection on the interior face (see Figure 2). 9) **Curtainwall and Balloon-Framed Construction**: Minimum 4 lb./cu ft. mineral wool friction fit in each stud cavity, at each floor line, full slab depth from the between the edge of concrete floor slab and the interior face of Thermax (see Figures 3 and 4). When applicable, perimeter fire barrier/containment system required to be installed in linear gap between edge of slab and interior face of exterior wall as required by 2024 IBC Section 715.4. 10) **None:** Floor line firestopping not required for Concrete or CMU Base Wall Systems. Perimeter fire barrier/containment system is still required to be installed where a linear gap between edge of slab and interior face Concrete or CMU base walls exists, as required by 2024 IBC Section 715.4.
Interior Air and Vapor Control Layer	11) **None** 12) **Interior Air and Vapor Control Membrane**: Any maximum 6-mil thick film of polyethylene (PE), polyamide, polyethylene terephthalate (PET) installed per manufacturer's recommendations to interior face of framing.

Wall Component	*Materials (Select only one item per wall component row)*
Stud Cavity Insulation	13) **None**: Screw end of fasteners that protrude into the stud cavity may be covered with a maximum of 1½-inch diameter plug of DuPont™ Froth-Pak Class A rated per ASTM E84 14) **Fiberglass**: blown-in or batt insulation (faced or unfaced) 15) **Mineral Wool**: blown-in or batt insulation (faced or unfaced) 16) **Closed-Cell Spray Polyurethane Foam** (ccSPF): Spray Polyurethane Foam is not permitted with FRT Wood Stud Framing Base Wall System. Where permitted, a minimum 1¾-inch thickness of ccSPF with ccSPF applied using sheathing or insulation as substrate and covering the width of the wall stud cavity and inside of the stud flange. Approved products include: a. BASF WALLTITE LWP or MAX ccSPF per Intertek CCRR-0374; or b. Huntsman Building Solutions Heatlok HFO Pro ccSPF per IAPMO UES Evaluation Report No. ER-565
Exterior Sheathing	17) **None.** 18) **Exterior Gypsum Sheathing**: ½-inch thick or ⅝-inch thick, Type X exterior gypsum sheathing panels complying with ASTM C1177. a. Wood Stud Framing Base Wall Systems require one layer of ⅝-inch thick, Type X exterior gypsum sheathing installed on exterior face of wood studs. b. Any thickness of plywood or OSB may be installed on exterior face of stud framing under exterior gypsum sheathing. c. Exterior Gypsum sheathing panels may include a factory applied water-resistive barrier (WRB) below the ASTM E1354 limits identified in the WRB Applied to Exterior Sheathing.
Air and Water Resistive Barrier Applied to *Exterior Sheathing*	19) **None**. 20) **DuPont Air and Water Resistive Barriers**, including: a. DuPont™ Tyvek® Fluid Applied WB+™ b. DuPont™ Tyvek® CommercialWrap® c. DuPont™ Tyvek® CommercialWrap® D 21) **Other Air and Water Resistive Barriers**: WRB's not listed above demonstrating a Class A rating when tested in accordance with ASTM E84 and combustible contribution per ASTM E1354 when tested in the horizontal orientation at the maximum thickness intended for use and at an incident radiant heat flux of 50 kW/m^2 equal to or less than: a. Peak Heat Release Rate: 335 kW/m^2 b. Total Heat Release Rate: 15 MJ/m^2 c. Effective Heat of Combustion: 17.5 MJ/kg Compliance with ASTM E84 and ASTM E1354 requirements shall be demonstrated with qualified third-party test data submitted to code official.
Continuous Insulation	22) **Thermax™ Brand Insulation**: Total thickness to be a maximum of **4.25-inches**. Exterior insulation joints and veneer tie penetrations may be treated with one of the following: a. DuPont™ LiquidArmor™ - LT Flashing and Sealant – max. 35-mil wet thickness, max. 4-inch width. b. DuPont™ LiquidArmor™ - QS Flashing and Sealant – max. 50-mil wet thickness, max. 4-inch width c. DuPont™ Tyvek® Fluid Applied Flashing & Joint Compound+ – max. 25-mil wet thickness, max. 3-inch width d. Great Stuff Pro™ - Use on joints that are ≤ ¼-inch width, vertical joints must be staggered & remove significant excess from the face of the Thermax™ Brand Insulation. A small amount of spray primer installed per manufacturer's installation instructions may be used to aid in adhesion; maximum 4-inch width.

Wall Component	*Materials (Select only one item per wall component row)*
Air and Water Resistive Barrier Applied to *Continuous Insulation*	23) **None**. 24) **DuPont Air and Water Resistive Barriers**, including: a. DuPont™ Tyvek® CommercialWrap® b. DuPont™ Tyvek® CommercialWrap® D 25) **Other Air and Water Resistive Barriers**: WRB's not listed above demonstrating a Class A rating when tested in accordance with ASTM E84 and combustible contribution per ASTM E1354 when tested in the horizontal orientation at the thickness intended for use and at an incident radiant heat flux of 50 kW/m^2 equal to or less than: a. Peak Heat Release Rate: 115 kW/m^2 b. Total Heat Release Rate: 3.5 MJ/m^2 c. Effective Heat of Combustion: 8 MJ/kg Compliance with ASTM E84 and ASTM E1354 requirements shall be demonstrated with qualified third-party test data submitted to code official.
Drainage Mat Applied to *Continuous Insulation*	26) **None**. 27) **Mortar Collection** - Mortar drop and drainage nets and meshes can be installed at base of wall and at shelf angles to permit water drainage. Maximum 12-inch high installed only over wall openings (i.e. shall not be full wall coverage).
Exterior Cladding	28) **Brick**: Standard nominal 4-inch thick, clay brick with standard brick veneer anchors, installed maximum 24-inches OC vertically on each stud. Air gap between exterior insulation and brick to be a maximum of 2½-inches. Any standard non-open jointed installation technique can be used. 29) **Concrete or Precast Concrete Panels**: Minimum 1½-inch thick panel. Air gap between exterior insulation and concrete or precast concrete panels to be a maximum of 2-inches. Any standard non-open jointed installation technique can be used. 30) **Concrete Masonry Units (CMU):** Minimum 4-inch thick CMU, with a 2-inch maximum air gap between exterior insulation and the interior face of the exterior CMU. Any standard non-open jointed installation technique can be used. 31) **Natural Stone or Artificial Stone Veneer**: Minimum 2-inch thick natural stone veneer or minimum1½-inch thick cast artificial stone veneer. Air gap between exterior insulation and natural or artificial stone cladding to be a maximum of 2-inches. Any standard non-open jointed installation technique can be used. 32) **Adhered Natural Stone, Artificial Stone, or Thin Brick**: Minimum ¾-inch thick fully adhered with cement plaster (stucco) and lath. A secondary water-resistive barrier may be installed where the secondary water-resistive barrier is not an asphalt or butyl-based self-adhered membrane. 33) **Stucco:** Minimum ¾-inch thick, exterior cement plaster (stucco) and lath. A secondary water-resistive barrier may be installed between the exterior insulation and the lath. The secondary water-resistive barrier can be 1 or 2 layers of asphalt building paper but shall not be full-coverage asphalt or butyl-based self-adhered membranes. 34) **Terracotta Cladding**: Minimum 1¼-inch thick terracotta cladding system in which terracotta is minimum 1¼-inch thick. Air gap between exterior insulation and Terra cotta cladding to be a maximum of 2-inches. Any standard non-open jointed installation technique can be used.
Flashing of Windows, Doors, and Other Exterior Wall Penetrations	35) Air and water protection around wall openings shall be installed per manufacturers installation instructions utilizing allowable available material which does not extend more than 6-inches onto the exterior face of the assembly.

Wall Component	*Materials* *(Select only one item per wall component row)*
Opening Protection	36) All wall openings (windows, doors, etc.) are required to be protected with one of the following details to protect the head, jamb, and sill (sill is optional for door openings) of all openings. a. One layer of ⅝-inch thick Type X gypsum wallboard covering stud framing and cut edges of Thermax insulation (header and jambs only) with a minimum 18-gauge “L” shaped steel flashing spanning full wall depth (header, jambs, and sill), see Figure 5. b. Two layers of ⅝-inch Type X gypsum wallboard covering stud framing and cut edges of Thermax insulation (header and jambs only) and min 4-inch depth of 4-pcf mineral wool compressed and filling the gap between Thermax insulation and interior face of exterior cladding, see Figure 6. c. One layer of nominal 2x lumber or two layers of ¾-inch thick FRT plywood covering stud framing and extending out to interior face of exterior cladding, see Figure 7. d. One layer of nominal 2x lumber or two layers of ¾-inch thick FRT plywood covering stud framing and cut edges of Thermax insulation and min 4-inch depth of 4-pcf mineral wool compressed and filling the gap between Thermax insulation and interior face of exterior cladding, see Figure 8.

IN-FILL FRAMED
Concrete Floor

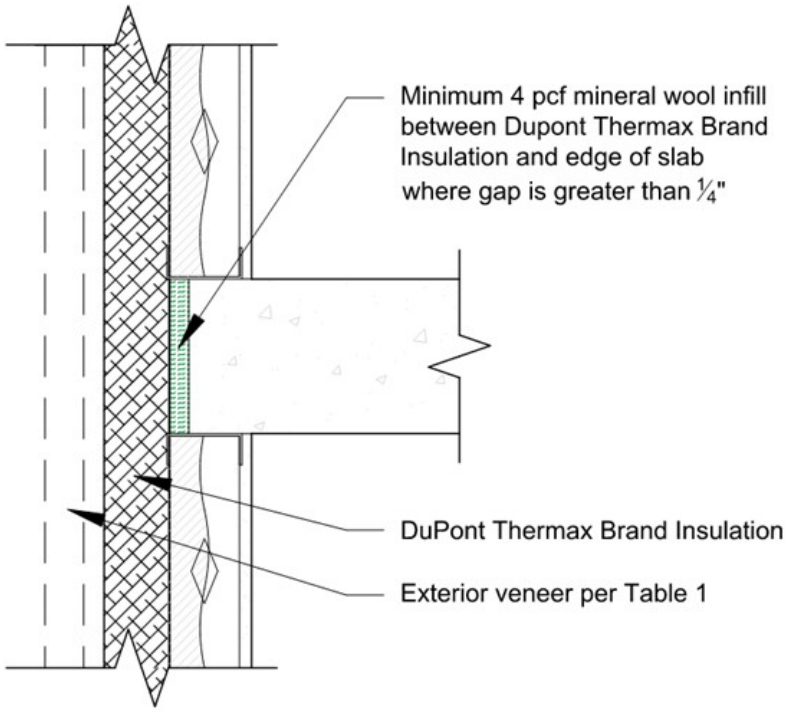

Figure 1. In-fill frame construction floor line condition

PLATFORM FRAMED
FRT Wood Framing

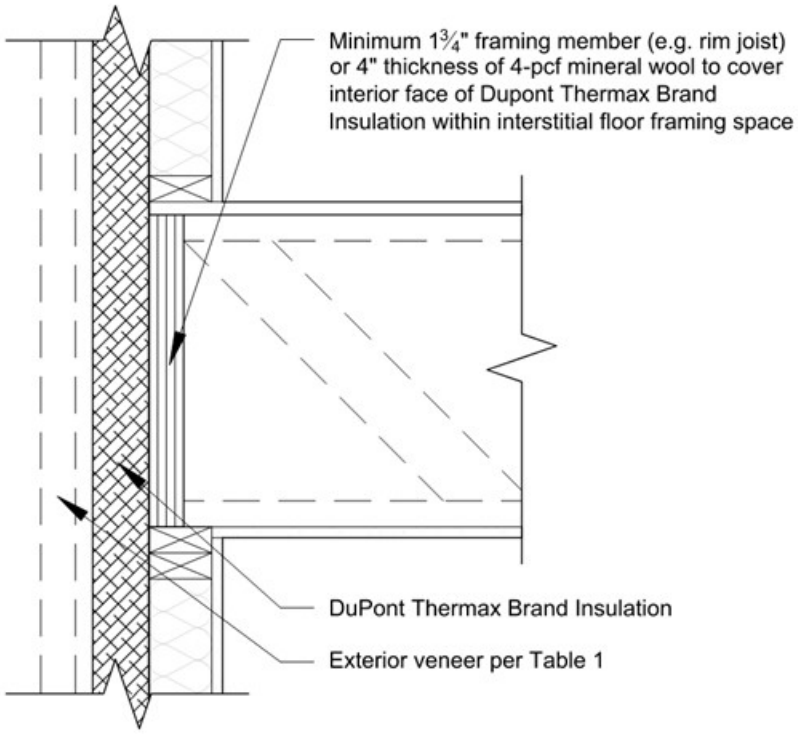

Figure 2. Platform frame construction floor line condition

CURTAINWALL FRAMED
Concrete Floor

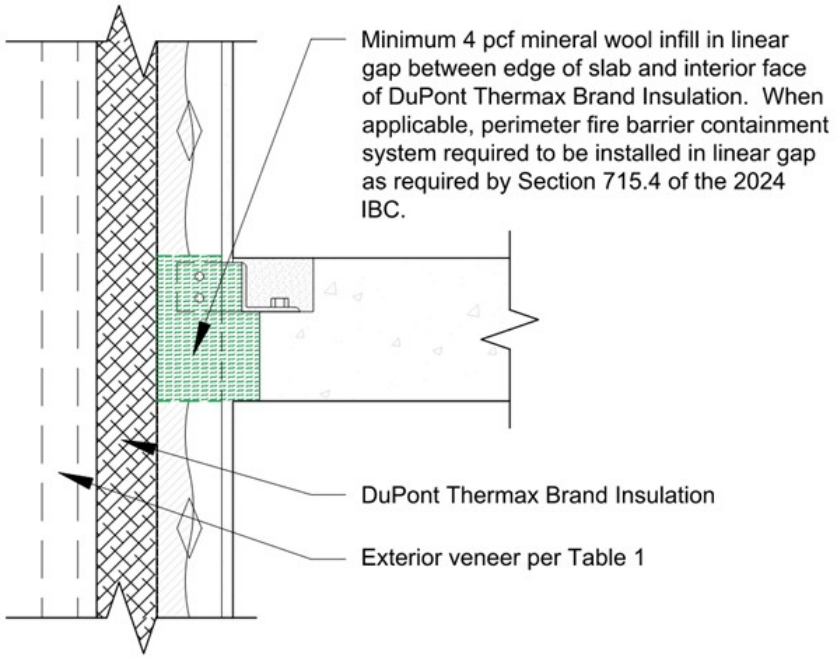

Figure 3. Curtain wall frame construction floor line condition

CURTAINWALL/BALLOON FRAMED
Steel Framing

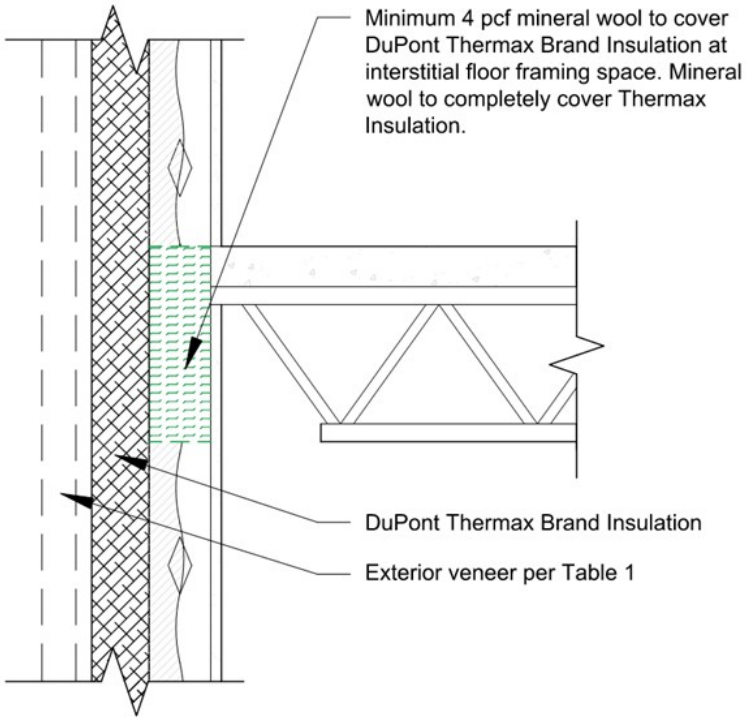

Figure 4. Balloon frame construction floor line condition

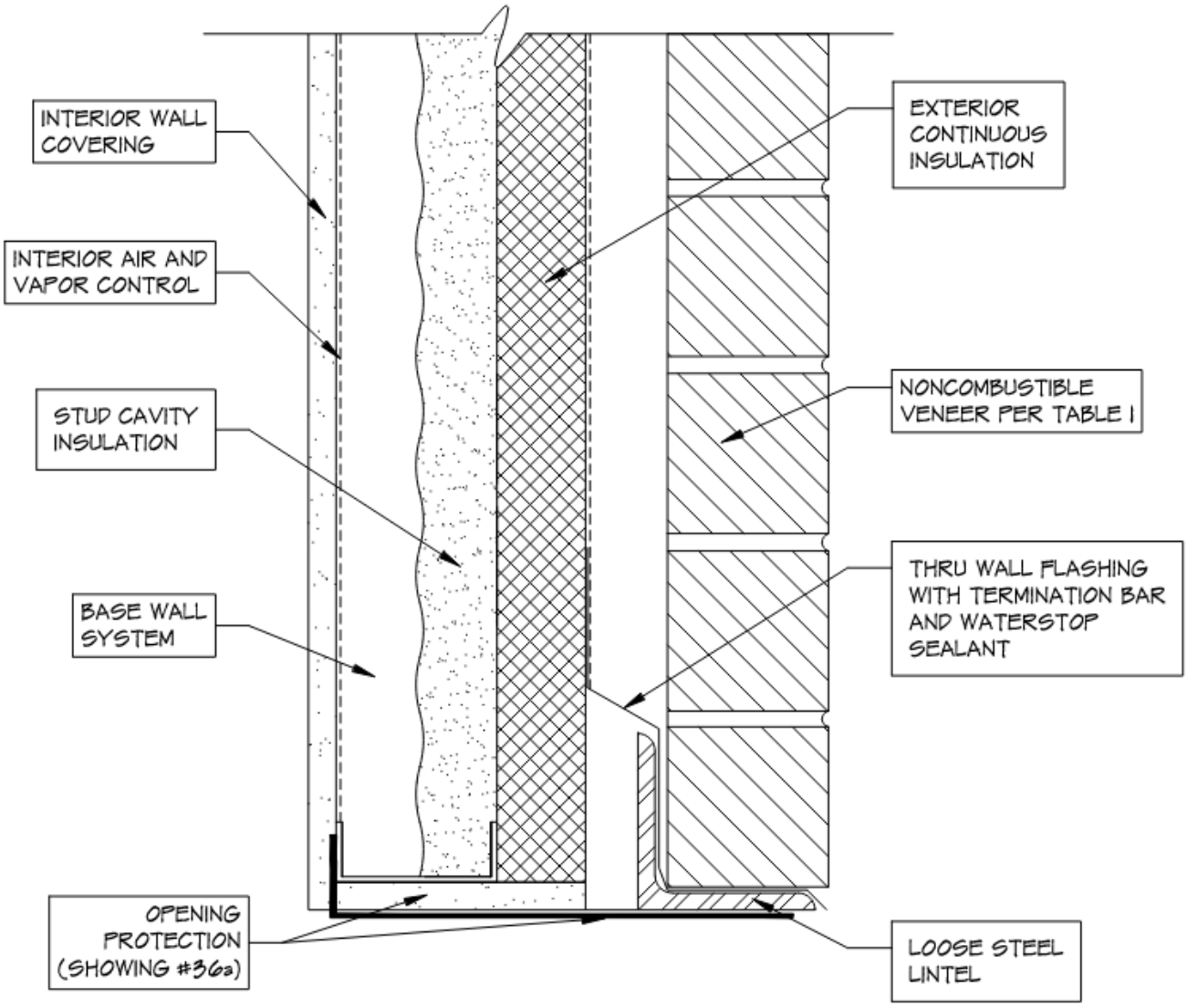

Figure 5. Exterior Wall Construction – Thermax and ccSPF Spray Foam (Table 1 Opening Protection Item #36a)

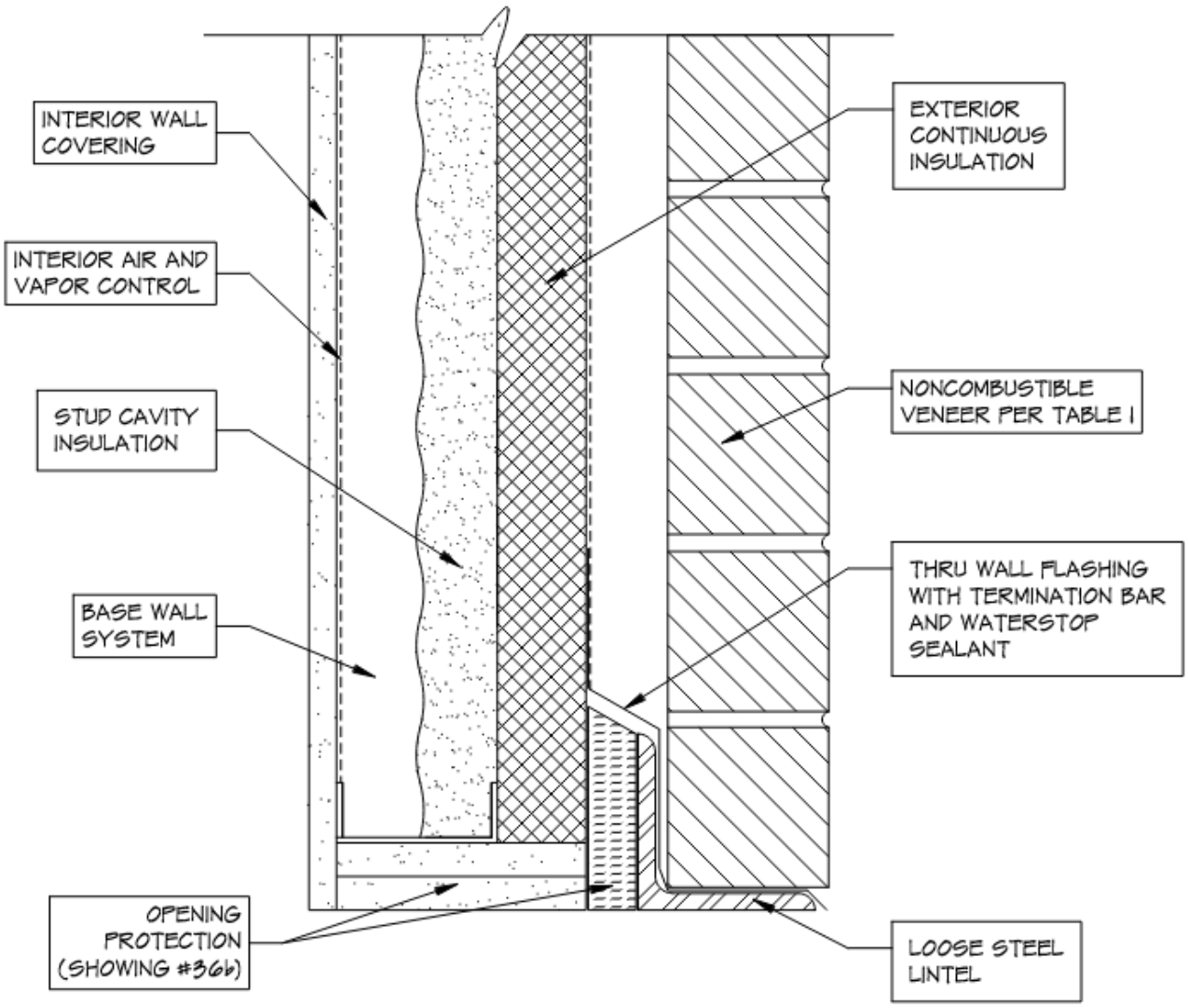

Figure 6. Exterior Wall Construction – Thermax and ccSPF Spray Foam (Table 1 Opening Protection Item #36b)

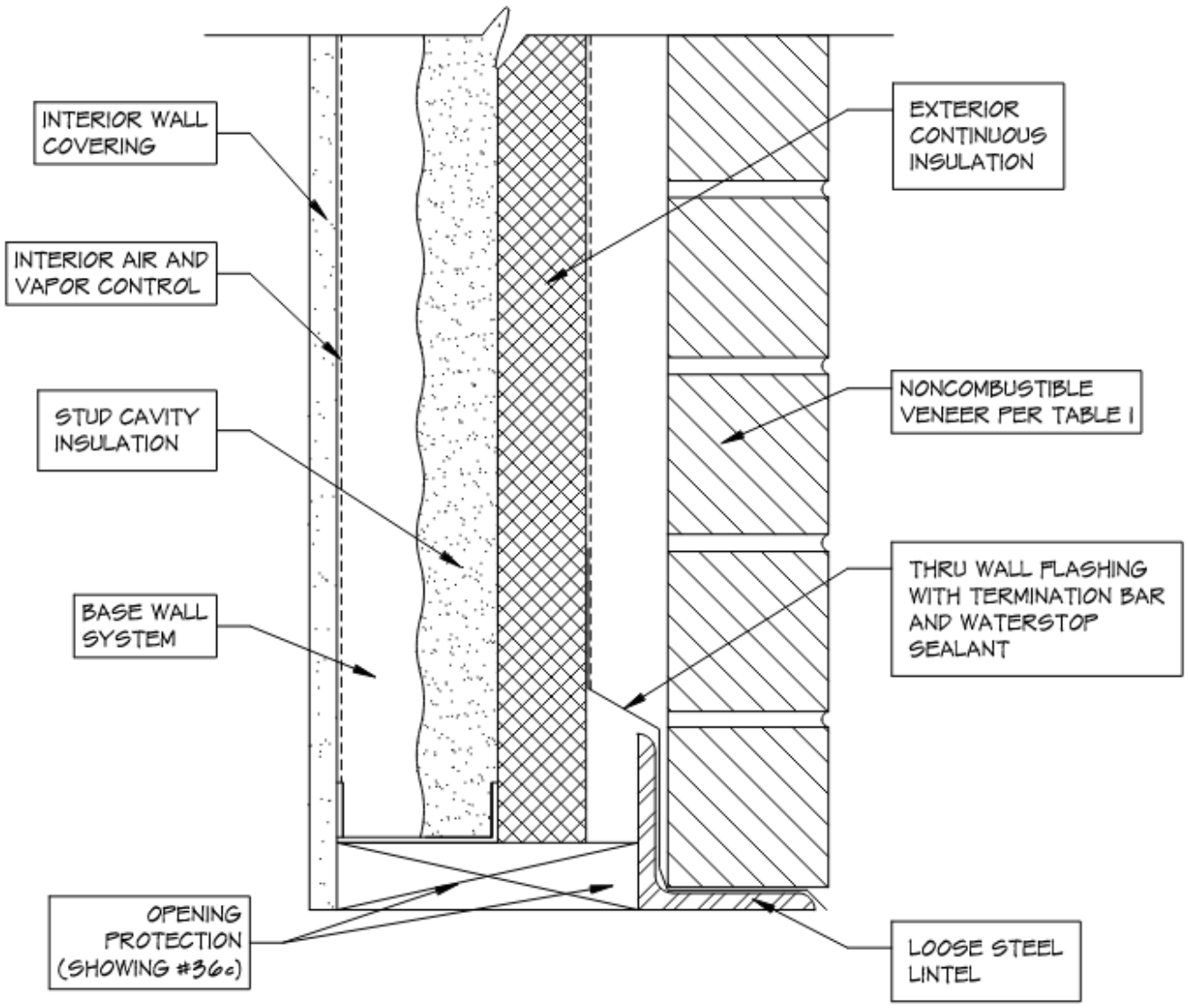

Figure 7. Exterior Wall Construction – Thermax and ccSPF Spray Foam (Table 1 Opening Protection Item #36c)

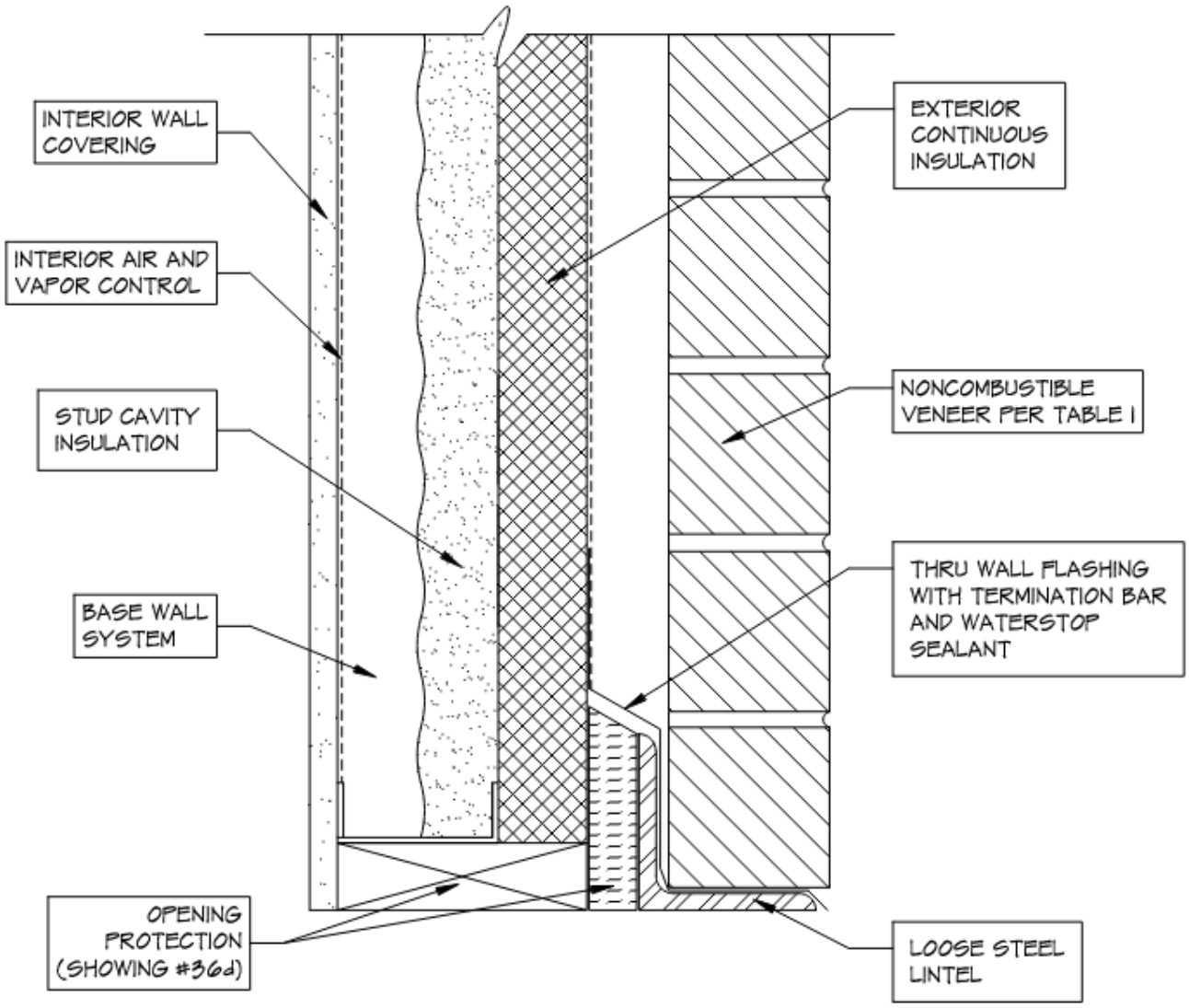

Figure 8. Exterior Wall Construction – Thermax and ccSPF Spray Foam (Table 1 Opening Protection Item #36d)

Appendix A: Engineering Analysis

The engineering analyses contained in Appendix A are based on the successful tests that DuPont has performed, which is summarized in the list of referenced test reports at the end of this letter.

The successful NFPA 285 test assemblies used various exterior claddings (brick masonry, fiber cement board, and aluminum composite panels), varying insulation thicknesses, and wall opening perimeter conditions. The analyses in the following sections provide the technical rationale for modifications to different components of the tested wall assemblies.

ALTERNATE BASE WALL ASSEMBLY CONSTRUCTION

Concrete and CMU Block Walls

The majority of the referenced NFPA 285 test assemblies used Thermax directly installed over the exterior face of steel studs with a single layer of ⅝-inch thick Type X gypsum wallboard installed continuously over the interior face of the studs. In this installation scenario the only material protecting the interior face of the Thermax insulation (or the cc-SPF for the assemblies which included it) is the interior ⅝-inch thick Type X gypsum wallboard. Concrete and a concrete masonry unit (CMU) walls are included as acceptable alternate base wall assemblies in Table 1 as they would provide improved interior face protection to the combustible wall components from the burn room fire exposure compared to the single gypsum wallboard layer based on their increased rigidity, significantly higher thermal mass, and increased level of fire performance compared to a steel stud and gypsum wallboard base wall. Table 1 of the Concrete Masonry & Hardscapes Association (CMHA) TEK 07-01D, *Fire Resistance Rating of Concrete Masonry Assemblies* [T1], provides minimum concrete thicknesses 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. Exterior wall assemblies will typically require a concrete wall thickness greater than 2-inches for structural reasons. Table 2 of CMHA TEK 07-01D states that the equivalent thickness of nominal typical 4-inch-thick hollow CMU blocks is 2.7 inches and increases for blocks of greater nominal thickness. Based on these typical thicknesses of concrete and CMU block walls, and the fire resistance performance of concrete construction, a concrete or concrete block base wall assembly will provide the same or better fire performance than the typical test condition of steel studs with a single interior layer of ⅝-inch-thick Type X gypsum wallboard.

Steel Stud Wall Assemblies

The typical Thermax test condition [R4, R5, R9, R12, R13, R14] consisted of steel stud wall assemblies utilizing 3⅝-inch deep, 20-gauge steel stud spaced at 24 inches on center with a single layer of ⅝-inch thick Type X gypsum wallboard covering the interior face of the studs. A steel stud/gypsum wallboard base wall assembly incorporating heavier gauge studs, decreased stud spacing, and/or deeper studs will provide improved fire performance of the 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*, supports this conclusion. Therefore, Table 1allows for studs of greater depth than 3⅝ inches, gauge thicknesses of 20-gauge or greater, and stud spacings of maximum 24-inches on center.

Wood Stud-Framed Walls

Table 1 allows for the use of minimum 2×4-inch dimensional fire-retardant treated wood (FRTW) lumber studs, spaced at maximum 24-inches on center. Through Jensen Hughes' experience from conducting and witnessing NFPA 285 tests, we have observed that when wood studs are used within a base wall assembly that has ⅝-inch thick, Type X interior and exterior gypsum coverings, minimal char damage is sustained by the wood studs

throughout an NFPA 285 test. This typical observed performance was consistent with the assembly from referenced test report [R11]. Since the wood studs only experience minimal char damage during an NFPA 285 test, vertical and lateral flame propagation does not occur from the compartment of fire origin such that failure criteria are observed. Based on this observed test assembly performance, it is Jensen Hughes' opinion that FRTW wood studs can be used as the framing for the base wall assembly as long as one layer of ⅝-inch thick, Type X gypsum is used on both the interior and exterior faces of the assembly.

When FRTW wood studs are used to frame an exterior wall, one layer of ⅝-inch thick Type X exterior gypsum sheathing is also required, as noted in Table 1 (i.e. Thermax may not be installed directly to the wood studs). This will ensure sufficient protection is afforded to the FRTW wood stud framing from both the interior and the exterior face.

Table 1 also allows for plywood or OSB to be installed on the exterior face of the wood studs if it is also covered by the exterior gypsum sheathing. When located behind the exterior gypsum sheathing, and in the wall stud cavity, the additional layer of plywood or OSB will not adversely impact the compliance of the wall assembly with NFPA 285 as it will be protected by the interior and exterior layers of gypsum wallboard. The optional use of plywood in fire-resistance rated wall assemblies is included in a number of UL fire resistance design listings (e.g., UL Designs U302, V419, and V423). Wall assemblies tested to the more severe ASTM E119 fire resistance test standard has determined that this added combustible layer does not adversely impact the wall fire resistance performance. In an NFPA 285 wall assembly incorporating wood studs, the plywood is protected in the same manner as the wood studs with gypsum wallboard on the interior and exterior sides of the base wall assembly, shielding the plywood or OSB from direct flame impingement during the 30-minute NFPA 285 test.

FLOOR LINE FIRESTOPPING CONDITIONS

The installation configuration of an NFPA 285 test assembly on the test apparatus mimics a curtainwall construction scenario in that the steel studs of the test assembly are continuous past the edge of the apparatus 2nd floor concrete slab. The configuration is similar to Figure 3 except that the concrete slab is flush against the interior face of the studs and there is no block out in the concrete slab. Test assemblies always contain firestopping within the stud cavity of the wall assembly, which typically consists of 4-pcf mineral wool, equal to the depth of the floor slab (i.e. 8 inches), friction fit into the stud cavities. The interior gypsum wallboard is continuous up to the underside of the 2nd floor slab and continues above the slab. This typical test condition is constructed to represent the firestopping that would be required in actual field installations.

The floor line firestopping section of Table 1 and corresponding Figures 1 through 4 provide floor line conditions where exterior walls constructed to comply with Table 1, intersect with floor assemblies of varying types and provide construction methods that will maintain compliance with NFPA 285.

Infill Wall Construction

The infill construction scenario differs from the test configuration in that the concrete floor slab penetrates either partially or completely through the wall stud cavity. The interruption of the stud cavity by the floor slab creates a more conservative condition with regards to potential flame spread through the stud cavity as the concrete slab will aid in stopping flame spread.

The interruption of the stud cavity introduces runner track at the top and bottom surfaces of the floor slab. Since these are made of light-gauge steel, they form a barrier which will not allow flame to pass during the 30-minute NFPA 285 test. The gap between the edge of the concrete slab and the interior face of the Thermax™ Brand Insulation is filled with 4-pcf mineral wool, unless the gap is less than ¼-inch wide, in which case it is not practical to compress mineral wool to this size and fill this gap.

Platform Framed Construction

The platform framed construction is similar to the infill wall construction, in that the floor assemblies fully penetrate through the exterior wall stud cavity, creating a complete interruption of the continuous stud space. The walls have double top plates and single sole plates. A minimum 1¾-inch thick framing member (typically a rim joist) is specified to be installed at the interface of the floor assembly with the interior face of the Thermax™ Brand Insulation.

This construction scenario relies on the experimentally determined char/burn rate of wood as determined by the US Department of the Agriculture's Forest Products Laboratory (FPL). Testing of various species of wood demonstrated that the char rate for wood is approximately 1½ in./hr when subjected to the ASTM E119/UL 263 fire exposure [T4]. This study was performed on various types of wood, and although the char rates varied slightly, the study concluded that the char rate of 1½ in./hr was accurate and independent of the species of wood. Combined with the knowledge that wood begins to char within a temperature range of 536 to 572°F [T5], it can be concluded on the amount of protection that a wood member will provide to a concealed material beneath. Since the NFPA 285 test is a 30-minute test, that would correlate to approximately ¾-inch of char formation on the interior face of the floor assembly perimeter rim board, which will prevent an interior fire from involving the Thermax™ Brand Insulation.

This analysis conservatively omits the fact that the gypsum wallboard ceiling of the floor/ceiling assembly will typically provide at least 20 to 25 minutes of protection to the floor assembly interstitial space, depending on the rating of the floor and the type of wallboard used for the ceiling membrane. Therefore, the wood rim joist is not the only protective material to the interior face of the Thermax™ Brand Insulation. Therefore, it is the opinion of Jensen Hughes that floor/exterior wall interfaces constructed in accordance with Figure 2 for platform framed construction will maintain NFPA 285 compliance of the exterior wall.

Curtainwall-Framed Construction

As noted earlier, the floor assembly/exterior wall configuration shown in Figure 3 is very similar to the NFPA 285 test assembly configuration when installed on the test apparatus. The only difference is that the edge of the concrete slab in Figure 3 does not extend flush to the interior face of the exterior wall studs. Therefore, a gap exists between the interior face of the wall and the edge of the slab. This construction scenario is addressed in Section 715.4 of the 2024 IBC (section varies depending on the version of the code), which states that an approved perimeter fire containment system must be installed at this location. If a perimeter fire containment system is properly installed at this location, this floor assembly/exterior wall interface scenario will not adversely affect the NFPA 285 compliance of the exterior wall assembly.

Balloon-Framed Construction

Figure 4 is also similar to the NFPA 285 test assembly configuration when installed on the test apparatus as the interior gypsum wallboard is continuous to the concrete floor slab both on the underside and topside of the concrete floor assembly. Similar to the curtainwall-framed scenario, if a gap exists between the interior face of the exterior wall and the edge of the concrete slab, a fire-rated perimeter fire containment system must be installed at this location. However, if mineral wool fire stopping is fit within the stud cavities of the exterior wall, this scenario does not differ from the tested condition and the NFPA 285 compliance of the exterior wall will be maintained.

INTERIOR AIR AND VAPOR CONTROL LAYER

Table 1 permits the use of maximum 6-mil thick film of polyethylene (PE), polyamide, polyethylene terephthalate (PET) air and vapor control layers installed between the stud framing and the interior gypsum wallboard of a

wall. Although this is not a component typically included in NFPA 285 assemblies, it is the opinion of Jensen Hughes that the use of these materials will not adversely affect the NFPA 285 compliance of wall assemblies due to their minimal mass, and consequently, their corresponding low heat content. Several of Dupont's NFPA 285 tests [R1, R2, R4, R5, R13, R14] included 1¾ inches of cc-SPF in the stud cavities, which presents a much greater fuel loading of the stud cavity than the use of a 6-mil thick vapor barrier.

Many UL fire-resistance rated wall designs (e.g. UL Designs U303, U308, U404, V306, etc.) permit the optional use of vapor retarders or barriers within the stud cavity of rated wall assemblies, indicating that their inclusion does not detract from the fire-resistance performance of the wall assembly.

Therefore, it is the opinion of Jensen Hughes that inclusion of a maximum 6-mil thick polyethylene (PE), polyamide, or polyethylene terephthalate (PET) air and vapor control layers will not adversely affect the NFPA 285 compliance of wall assemblies constructed in accordance with Table 1.

STUD CAVITY INSULATION MATERIALS

CC SPF Insulations

Several of the successfully tested NFPA 285 wall assemblies which formed the basis for this engineering analysis [R1, R13, R14] incorporated the BASF Walltite PLUS/Max SPF in the stud cavities, applied to the interior side of the Thermax™ Brand Insulation at a nominal thickness of 1¾-inches. Another NFPA 285 compliant wall assembly which formed the basis for this engineering analysis [R2] incorporated the Huntsman Building Solutions' Heatlok HFO PRO SPF applied in the stud cavities, applied to the interior side of the Thermax™ Brand Insulation, also at a nominal thickness of 1¾-inches. These NFPA 285 compliant test assemblies support the use of the BASF Walltite PLUS/Max or Huntsman Heatlok HFO PRO SPFs when protected from the interior with a single layer of ⅝-inch thick Type X gypsum wallboard and the wall uses non-combustible exterior cladding materials.

Fiberglass, Mineral Wool, or other Non-Combustible Batt Insulation Materials

Based on the performance of the referenced NFPA 285 wall assemblies that contained the combustible CC SPF within the wall stud cavities [R1, R2, R4, R5, R13, R14] and the experience of Jensen Hughes personnel in conducting and witnessing NFPA 285 tests, the inclusion of any fiberglass, mineral wool, or other non-combustible insulation will not adversely impact NFPA 285 compliance of a wall assembly. Rather, the inclusion of one of these non-combustible insulations in the stud cavity of an exterior wall typically improves the overall wall fire performance. When compared to an empty stud cavity, the inclusion of fiberglass or mineral wool insulation will increase the amount of insulation and thermal protection that the stud wall provides to the exterior combustible components; especially when the Thermax™ Brand Insulation is installed directly to studs and does not have exterior sheathing separating it from the stud cavity. When compared to foam plastic insulation, fiberglass and mineral wool do not have the heat content that foam plastic insulation does and therefore will reduce the overall combustible load within the wall assembly and will not contribute to a fire that reaches the stud cavity.

This is further supported by many fire-resistance rated wall designs from the UL Online Fire Resistance Directory, which permit the inclusion of fiberglass or mineral wool in the stud cavity as an optional wall component. The optional inclusion of the stud cavity insulations indicates that their inclusion will not adversely impact the fire-resistance rating of the assembly. An increase in the fire resistance performance of a wall assembly will result in the base wall assembly providing a greater degree of thermal protection to the exterior combustible components from an interior fire exposure.

The fiberglass or mineral wool insulation can be faced or unfaced. The minimal amount of fuel loading added to the assembly by these facer materials is very low and the facers are protected on both sides by the interior gypsum wallboard or the exterior gypsum sheathing.

EXTERIOR SHEATHING MATERIALS

Exterior Grade Gypsum Sheathing

The referenced test assemblies had no exterior gypsum sheathing as the Thermax™ Brand Insulation was installed directly to the studs. When a wall assembly is compared to the tested assembly that had the Thermax™ Brand Insulation direct to the studs, it is the opinion of Jensen Hughes that the installation of gypsum sheathing underneath the Thermax™ Brand Insulation is a more conservative installation scenario. Exterior gypsum sheathing will provide additional thermal separation between the Thermax™ Brand Insulation and any spray foam insulation installed in the stud cavity and will also provide a greater degree of protection to the Thermax™ Brand Insulation from an interior fire source. The use of exterior gypsum sheathing may warrant the use of a combustible WRB material, and in this case the WRB shall comply with the flammability limits established in Table 1. Therefore, it is the opinion of Jensen Hughes that the wall assemblies approved under Table 1 may use Thermax™ Brand Insulation direct to the studs, or the Thermax™ Brand Insulation installed over ½- or ⅝-inch thick exterior gypsum sheathing.

However, ⅝-inch thick exterior gypsum sheathing is required over the exterior face of the stud framing when the wall assembly uses FRT wood studs or FRT exterior sheathing.

ALTERNATE WRB MATERIALS

WRB Materials Installed Over Exterior Gypsum Sheathing and Under Exterior Insulation

In the referenced test [R9], DuPont™ Tyvek® Fluid Applied WRB was installed over the exterior gypsum sheathing and under the Thermax™ Brand Insulation. Alternate DuPont sheet good WRB products having similar or better flammability properties as the tested WRB are listed in Table 1for installation over exterior sheathing and under the Thermax™ Brand Insulation. Comparative fire performance properties were either developed by testing conducted by Jensen Hughes on these materials in accordance with ASTM E1354 (Cone Calorimeter apparatus) or by ASTM E1354 test reports provided to Jensen Hughes. Table 1also allows any WRB material that has lower peak heat release rate, total heat release rate, and effective heat of combustion than the DuPont Fluid Applied WRB to be used based on ASTM E1354 results. Given that these alternate materials would be expected to perform similarly based on comparative fire performance properties, it is our engineering opinion that the materials listed in Table 1 will not adversely impact the overall wall fire performance and will maintain compliance with NFPA 285.

WRB Materials Installed Over Exterior Continuous Insulation

Referenced tests [R1, R2, R10, R11, R12, R13, R14] incorporated DuPont™ Tyvek® CommercialWrap® over the continuous Thermax™ Brand Insulation exterior insulation. Therefore, alternate sheet good WRB products having similar flammability properties as the tested WRB are included in Table 1 for use over Thermax™ Brand Insulation in NFPA 285 compliant exterior wall assemblies. Comparative fire performance properties were developed by testing conducted by Jensen Hughes on these materials in accordance with ASTM E1354 (Cone Calorimeter apparatus). Other sheet good WRB products with comparable or lower flammability parameter based on testing conducted in accordance with ASTM E1354 are permitted. Given that these alternate materials would be expected to perform similarly based on comparative fire performance properties, it is our engineering

opinion that the materials listed in Table 1will not adversely impact the overall wall fire performance and will maintain compliance with NFPA 285.

EXTERIOR INSULATION MATERIAL

The Thermax™ Brand Insulation material is approved up to a maximum installation thickness of 4¼ inches in Table 1. Referenced test assemblies [R6, R13] were tests that included 4 inches of Thermax insulation covered by a clay brick veneer. Other referenced test assemblies [R3, R4] also evaluated Thermax covered by a brick veneer but evaluated the Thermax at lesser insulation thicknesses. The clay brick veneer along with the specific wall opening jamb and header conditions in these tests prevented flame spread along the exterior face of the Thermax insulation. Specifically with referenced test assemblies [R6, R13], when the Thermax was evaluated at a 4-inch thickness, there was no ignition of the Thermax insulation within the exterior air gap.

Based on the observed performance of the Thermax sheathing evaluated at a thickness of 4 inches along with the wall opening header and jamb details, it is the opinion of Jensen Hughes that an increase of the Thermax insulation to a thickness of 4¼ inches will not adversely affect the NFPA 285 compliance of wall assemblies using heavy masonry veneers and the wall opening details as specified in Table 1, and corresponding Figures 5 through 8.

EXTERIOR CLADDING MATERIALS

Brick

Common clay brick is a typical material used in NFPA 285 tests to evaluate the ability of wall systems to comply with NFPA 285 when heavy masonry claddings are installed over the exterior face of the wall assembly. DuPont's referenced test assemblies [R3, R4, R6, and R13] used exterior clay brick veneers as the exterior wall covering materials in those tests. Therefore, common clay brick is an acceptable material for use as the exterior wall covering.

The referenced tested wall assemblies with brick veneers incorporated a 2-inch air space between the back of the brick and the face of the Thermax Brand Insulation. A review of the thermocouple data from these tests confirmed that the temperatures within the air cavity space were very low, indicating that minimal burning of the Thermax™ Brand Insulation occurred. This is an expected wall fire performance as the brick provides significant thermal protection to the underlying foam plastic insulation materials from the exterior fire source. Further, when the wall opening header/jamb conditions specified in Table 1 and Figures 5 through 7 are installed around the wall opening perimeter (header and jambs, sill), no fire penetration and minimal heating of the Thermax™ Brand Insulation occurs. Based on the performance of the NFPA 285 brick faced wall assemblies, it is our engineering opinion that increasing the air cavity space between the brick and the Thermax™ Brand Insulation to 2½-inches will continue to result in the wall assembly maintaining compliance with NFPA 285. This increase in the air cavity space is only applicable to exterior wall assemblies incorporating a brick veneer.

Stucco

Table 8 of the CMHA TEK 07-01D [T1] indicates that a ¾-inch thickness of Portland cement-sand plaster will provide 20 minutes of fire-resistance in accordance with ASTM E119. The fire exposure conditions to the exposed side of a wall assembly tested in accordance with ASTM E119 are more severe than the fire exposure conditions experienced by the exterior wall covering material in an NFPA 285 test (as indicated in Table 8.1.6 of NFPA 285 for the calibration test).

The time-temperature curve within the test furnace during an ASTM E119 fire exposure is 1,000°F (538°C) at 5 minutes, 1,300°F (704°C) at 10 minutes, and 1,550°F (843°C) at 30 minutes. In an NFPA 285 test, the

average centerline temperatures measured 1-ft above the window opening are required to be 602°F (317°C) during the first 5 minutes, 870°F (466°C) between 5 and 10 minutes, 992°F (533°C) between 15 and 20 minutes, and 1,078°F (581°C) between 25 and 30 minutes into the test. The heat flux developed within the test furnace during an ASTM E119 fire exposure has been measured to be approximately 20 kW/m^2 at 5 minutes, 65 kW/m^2 at 15 minutes, and 88 kW/m^2 at 30 minutes [T2]. Comparatively, the exposed surface heat fluxes generated during an NFPA 285 test 2-ft above the window opening are 9 to 19 kW/m^2 during the first 10 minutes of the test, 25 to 29 kW/m^2 during the middle 10 minutes of the test, and 34 to 38 kW/m^2 during the last 10 minutes of the test.

Therefore, a material which provides a nominal 20 minutes of fire-resistance when subjected to the fire exposure conditions specified in ASTM E119 will demonstrate better fire-resistance performance in terms of remaining in-place, restricting heat passage to the unexposed surface, and preventing pyrolysis and ignition of materials on the unexposed surface during an NFPA 285 test. Additionally, during the NFPA 285 test, the exterior wall cladding is only subjected to flame impingement from the window burner for 25 minutes.

In a Portland cement-sand plaster (stucco) on metal lath wall system, no air gap would exist between the stucco and the insulation board. In DuPont's NFPA 285 tests incorporating brick veneers over the Thermax™ Brand Insulation, a nominal 2-inch air gap existed between the insulation board and the brick. This gap remained open as the aluminum window flashing melted and hot gases and flame from the first floor burn room flowed into this air cavity. Even with an air gap, the Thermax™ Brand Insulation complied with the NFPA 285 acceptance criteria. Thus, if the gap does not exist (as in a typical stucco exterior wall covering system), the insulation will exhibit less fire spread/damage, as there is no air space present to allow for flame progression to develop.

Jensen Hughes has also participated in and witnessed NFPA 285 tests of ¾-inch thick Stucco systems installed over extruded polystyrene insulation (XPS). XPS is a thermoplastic insulation material that melts at low temperatures, which in the case of a Stucco wall system, would create an air gap between the Stucco veneer and the exterior sheathing of the wall system (which typically has a combustible WRB applied to it). It is the opinion of Jensen Hughes that the use of Stucco over Thermax™ Brand Insulation is a more conservative conditions as the Thermax is a thermoset polyisocyanurate insulation. When subjected to fire thermoset insulations char and remain in place. Since thermoset insulation materials will not melt and flow like a thermoplastic insulation (i.e. XPS), no air gap will form between the Stucco insulation and the Thermax insulation when exposed to an exterior fire. Therefore, sustained surface flame spread cannot occur over the exterior face of the Thermax insulation.

Based on the above analysis, it is the opinion of Jensen Hughes that a minimum ¾-inch thickness of Portland cement-sand plaster (stucco) may be used in lieu of the tested 4-inch common clay brick without adversely affecting the NFPA 285 compliance of exterior wall assemblies including Thermax™ Brand Insulation as described by Table 1.

Concrete, Precast Panels, and Concrete Masonry Units

The fire-resistance provided by concrete can be calculated per Table 1 of the CMHA TEK 07-01D [T1]. As detailed previously in the Stucco technical discussion section, fire-resistance ratings in accordance with ASTM E119 are developed based on more severe exposure conditions than the exterior wall exposure of the NFPA 285 test. Therefore, a material that provides a fire-resistance rating equal to or greater than the duration of the NFPA 285 test will provide sufficient protection to underlying combustible when it is used as the exterior covering material over an exterior wall needing to comply with NFPA 285.

Assuming siliceous concrete, a minimum 2-inch thickness will provide approximately 30 minutes of fire-resistance. Thus, based on the 25-minute exterior fire exposure to the exterior wall covering in the NFPA 285

test, the 2-inch thickness of concrete will protect the Thermax™ Brand Insulation and can be used in lieu of the tested brick veneer condition.

The fire-resistance provided by concrete masonry units (CMU) can also be calculated per Table 1 of the CMHA TEK 07-01D guide [T1]. The same as with a cast concrete wall, assuming siliceous aggregate concrete, a minimum 2-inch equivalent thickness of CMU block will provide approximately 30 minutes of fire-resistance. Table 2 of CMHA TEK 07-01D states that the typical equivalent thickness of nominal 4-inch thick CMU blocks is 2.7 inches, based on typical 75% solid units. Thus, based on the 25-minute exterior fire exposure to the exterior wall covering in the NFPA 285 test, it is the opinion of Jensen Hughes that nominal 4-inch thick CMU will provide sufficient protection to the Thermax™ Brand Insulation to maintain NFPA 285 compliance and can be used in lieu of the tested brick veneer.

The concrete, precast, or CMU walls may be constructed such that an air gap of up to 2 inches may exist between the concrete or CMU and the Thermax™ Brand Insulation, as this matches the 2-inch wide air gap from the compliant NFPA 285 tested assemblies. The concrete or CMU must be installed as a solid veneer without open joints (vertical or horizontal) as was with the tested brick veneer. The occurrence of open gaps, separations, etc. will provide a potential path for the fire to enter the wall cavity and spread within it. The concrete and concrete masonry veneers are subject to the same header and jamb installation requirements as the brick veneer, as detailed by Figures 5 through 8.

Based on this analysis, it is concluded that a minimum 2-inch thickness of concrete or a 4-inch thick concrete masonry unit with a maximum 2-inch air gap between it and the Thermax™ Brand Insulation may be used in lieu of the tested 4-inch clay brick and still meet the test conditions specified in NFPA 285.

Natural Stone Materials

Several UL Design Listings allow minimum 2-inch thick natural stone as an optional exterior wall covering material. Stone such as granite, limestone, marble, and sandstone are naturally occurring and provide fire-resistance based on their thickness, density, and composition.

One means to assess the thermal performance of a material is to develop a thermal inertia value. The thermal inertia is the product of the thermal conductivity, k (W/m·K), density, ρ (kg/m3), and specific heat capacity, c_p (kJ/kg·K). A material which has a higher thermal inertia will absorb more heat and transfer the heat at a slower rate than a material with a lower thermal inertia. In order to provide the technical justification for the substitution of the minimum 2-inch thickness of natural stone materials in lieu of the tested 4-inch standard clay brick, the thermal inertia values for the materials were calculated.

Published literature values for the thermal conductivity, specific heat capacity, and density for standard clay brick and limestone are provided below in Table 2 [T3]. Table 2 also includes the calculated thermal inertia ($k\rho c_p$) for each material.

Table 2 – Thermal Properties for Brick, Various Natural Stone Materials, and Select Metals

Material	Thermal Conductivity (W/m·K)	Density (kg/m^3)	Specific Heat Capacity (kJ/kg·K)	Thermal Inertia ($W^2 \cdot s/m^4 \cdot K^2$)
Clay brick	0.69	1600	0.84	927
Limestone	1.26 – 1.33	2500	0.9	2,835 – 2,933
Granite	1.73 – 3.98	2640	0.82	3,745 – 8,616

Sandstone	1.83	2160 – 2300	0.71	2,806 – 2,988
Marble	2.07 – 2.94	2500 – 2700	0.80	4,140 – 6,350

The thermal inertia values for the natural stones range from more than double to more than nine times greater than standard clay brick. Therefore, a minimum 2-inch thickness of natural stone would be expected to provide improved thermal protection to the Thermax™ Brand Insulation when compared to the tested standard clay brick.

Natural stone may be applied such that either no air gap or a very limited air would exist between the stone and the Thermax™ Brand Insulation. In the compliant NFPA 285 tests using the Thermax™ Brand Insulation and clay brick veneers, a nominal 2-inch-wide air gap was constructed between the Thermax™ Brand Insulation and the brick. The natural stone must be installed as a solid veneer without open joints (vertical or horizontal) as was tested with the brick veneer. The occurrence of open gaps, separations, etc. will provide a potential path for the fire to enter the wall cavity and spread within it. The natural stone veneers are subject to the same header and jamb installation requirements as the brick veneer, as detailed by Figures 5 through 8.

Therefore, it is the opinion of Jensen Hughes that a non-open jointed, minimum 2-inch thickness of natural stone (limestone, granite, sandstone, and marble) may be used in lieu of the tested 4-inch clay brick and still meet the test acceptance criteria specified in NFPA 285; as reflected in Table 1.

Artificial Cast Stone

Artificial cast stone is typically a Portland cement-based precast concrete product manufactured to simulate natural stone. The fire-resistance provided by concrete can be calculated per Table 1 of the CMHA TEK 07-01D guide [T1]. Assuming siliceous concrete, a minimum 2-inch thickness will provide approximately a 30 minute fire-resistance rating and a minimum 1½-inches will provide approximately an 18 minute fire-resistance rating. The fire-resistance ratings specified in the CMHA TEK 07-01D guide are based on an ASTM E119 fire exposure.

As detailed in the technical rationale for Stucco wall covering, the fire exposure conditions to the exposed side of a wall assembly tested in accordance with ASTM E119 are significantly more severe than the fire exposure conditions experienced by the exterior wall covering material in an NFPA 285 test. While the 1½-inch thick artificial cast stone (assuming siliceous concrete) will only provide approximately 18 minutes of fire-resistance, the artificial stone will only be exposed to the fire conditions of the window burner for 25 minutes during the NFPA 285 test and the exposure conditions will be significantly less.

Artificial cast stone can also be applied over a metal lath such that either no air gap or a very limited gap would exist between the stone and the foam insulations, as opposed to DuPont's successfully brick veneer NFPA 285 tests, where a nominal 2-inch wide air gap existed between the Thermax™ Brand Insulation and the veneer.

The cast stone must be installed as a solid veneer without open joints (vertical or horizontal) as was with the brick veneer. The occurrence of open gaps, separations, etc. will provide a potential path for the fire to enter the wall cavity and spread within it. The artificial stone veneers are subject to the same header and jamb installation requirements as the brick veneer, as detailed by Figures 5 through 8.

Therefore, it is the opinion of Jensen Hughes that a non-open jointed minimum 1½-inch thickness of artificial stone will provide comparable fire performance as the tested 4-inch clay brick in an NFPA 285 fire exposure and will meet the acceptance criteria specified in NFPA 285.

Adhered Natural Stone and Artificial Stone

The natural and artificial stone described in previous sections may be installed at a thickness of ¾-inch when fully adhered in a minimum ⅜-inch thick stucco bed used as an adhering medium. It was previously established in the Stucco section that a ¾-inch thick stucco veneer is an acceptable for use over Thermax™ Brand Insulation to maintain NFPA 285 compliance. The use of natural or artificial stone effectively allows the thickness of the stucco veneer to be reduced, as the stone materials will account for any thermal performance lost by reducing the stucco thickness. This installation configuration assumes the same configuration as the stucco veneer analysis in that there will be no air gap between the Thermax™ Brand Insulation and the stucco veneer with adhered stone. The absence of an air gap will ensure vertical and lateral flame not occur as there is no air space present to allow for flame progression to develop.

Terra cotta Cladding

Terra cotta is included in Table 1 based on the successful testing documented in DuPont's referenced test report [R7], which included 3-inches of Thermax™ Brand Insulation and BASF Spraytite® insulation in the stud cavity of the wall assembly. The exterior wall covering for this NFPA 285 wall assembly consisted of an ACM panel cladding system. It can be seen from photographic documentation provided in referenced report [R7] that the ACM panel located directly above the window opening in the test melted and allowed the insulation underneath to be exposed to direct exterior flames and combust, leading to further elevated temperatures on the exterior face of the wall. This is typical performance of ACM panel systems in NFPA 285 tests, where approximately 20 to 25 minutes into the test the exterior cladding is compromised, allowing combustible materials beneath the cladding to burn and potentially contribute to exterior flame spread over the assembly.

Terra cotta is a clay-based material similar to the clay brick. According to Table 3 of the CMHA TEK 07-01D guide [T1] a solid 1¼-inch thickness of non-open jointed terra cotta would be expected to provide nominally 28 minutes of fire-resistance (in accordance with ASTM E119) by interpolating the information in Table 3. In an NFPA 285 test, the terra cotta exterior veneer would be required to provide only 25 minutes of protection as the window burner is not ignited until 5 minutes into the test. Based on the data in Table 3 of the CMHA TEK 07-01D guide, a minimum 1¼-inch thickness of terra cotta would be expected to provide more than 25 minutes of fire-resistance when subjected to the fire conditions described in ASTM E119.

Based on this technical rationale, it is expected that 1¼-inch thick terra cotta cladding would perform superior to the ACM panel cladding used in the DuPont referenced test report [R7]. As noted in the referenced test report, the ACM panel melted and exposed the insulation underneath to fire, while the terra cotta is a masonry type material that would not melt in an NFPA 285 test. Terra cotta veneers are subject to the same header and jamb installation requirements as the brick veneer, as detailed by Figures 5 through 8.

Therefore, terra cotta is included in Table 1 for use with maximum 3-inch thick Thermax™ Brand Insulation.

MISCELLANEOUS MATERIALS

Exterior Insulation Joint Flashing

Referenced test [R7] used DuPont™ LiquidAmor™ flashing over the board joints at a 50 mil thickness and 4-inch wide strip. Based on ASTM E1354 test data, various LiquidArmor flashing products are approved for use over the board joints at maximum installed thicknesses and widths that are equal to or less than the tested condition.

DuPont utilizes the LiquidArmor flashing products to seal the board joints on a Thermax™ wall system. Cone calorimeter testing has been conducted on the LiquidArmor flashing products and the Dow Corning DefendAir 200 WRB product. The testing indicated that the LiquidArmor flashing products have higher flammability

properties than the DefendAir 200 WRB (proprietary testing conducted for Dow Corning), which is normally applied full wall coverage. Given this comparative analysis, it is Jensen Hughes' opinion that the use of the Dowsil DefendAir 200 or Dowsil DefendAir 200C products used as flashing materials will not adversely impact compliance with NFPA 285.

Additionally, the IBC specifically states that flashing materials are not to be considered part of the water-resistive barrier product when assessing compliance of products in an exterior wall assembly. Through our extensive testing experience, we have never seen flashing products applied in small quantities over the face of the exterior wall assembly contribute to excessive vertical and/or lateral flame spread. Flashing materials are simply not applied in sufficient quantities and do not contain excessively high amounts of heat energy when applied over the board joints to contribute significantly to increasing the overall wall combustibility; especially when applied over foam plastic materials which, due to their nature, contain high amounts of heat energy. Knowing that flashing products do not contribute to excessive burning and do not support flame spread in a wall assembly, it is our opinion that the wall flashing materials, in the limits specified in the report, will not adversely impact the compliance with NFPA 285.

Drainage Mat

The Tyvek® DrainVent™ Rainscreen product was included in DuPont's FRTW wall test [R11] and demonstrated that when located directly behind the exterior cladding material (Hardie® Plank Lap Siding), no significant vertical or lateral flame spread occurred. Subsequent cone calorimeter testing was conducted on the same Tyvek® DrainVent™ product tested in the FRTW wall assembly and the flammability properties were mid-range of WRB materials Jensen Hughes has evaluated when tested in accordance with ASTM E1354.

Mortar Net

Mortar net products are similar in construction to the Tyvek® DrainVent™ product and are placed at the bottom of the wall and along brick shelf angles to maintain open water drainage. Similar to flashing materials, these products are not used as full wall coverage and are placed in strips within the air cavity of the wall assembly, behind a masonry veneer. There are not adequate quantities of material to support vertical and lateral flame propagation within a masonry clad exterior wall assembly.

Jensen Hughes has conducted proprietary cone calorimeter testing on various mortar net type products and the flammability properties of these products are less than the Tyvek® DrainVent™ product tested in the FRTW wall assembly. In the FRTW wall assembly, the Tyvek® DrainVent™ was installed full wall coverage. The mortar net products are limited to a maximum 12-inch high strip of material located at the base of the wall and at brick shelf angles (which are typically installed every 3 floors). Given the relatively small amounts of mortar net material installed in a wall assembly, it is Jensen Hughes' opinion that the use of these products will not adversely impact the overall wall fire performance.

WALL OPENING PERIMETER PROTECTION

The exterior wall assembly successfully tested in accordance with NFPA 285 described above at the beginning of the Engineering Analysis section was constructed with one layer of ⅝-inch thick Type X gypsum wallboard installed at the header and jambs and 18-gauge "L" shaped steel flashing installed around the entire wall opening perimeter – header, jambs, and sill. This gypsum wallboard and 18-guage flashing installed around the opening perimeter protected the Thermax Brand Insulation at the test wall opening from the fire and hot gases from the burn room exiting through the wall opening. The perimeter of all openings in the exterior wall assembly (windows, doors, loading docks, etc.) must be protected with the ⅝-inch thick Type X gypsum wallboard and the

18-gauge “L” shaped steel flashing to ensure adequate protection of the Thermax Brand Insulation inside the wall assembly is provided. Sills do not need to be protected at door openings.

CONCLUSION

DuPont has conducted two successful NFPA 285 tests on an exterior wall assembly incorporating their Thermax™ Brand Insulation covered by $^{5}/_{16}$-inch thick Hardie® Plank Lap Siding with SPF in the wall stud cavities. Additional successful NFPA 285 testing has been conducted on wall assemblies incorporating the Thermax™ Brand Insulation covered by either clay brick masonry veneers or ACM panel systems. Based on this successful testing, alternative wall constructions were developed as detailed in Table 1 of this letter. The additional wall construction features will result in wall assemblies which will still meet NFPA 285 and provide a comparable level of fire performance as the tested wall assemblies. The technical justification for the use of additional wall system components is provided above to support their use in an exterior wall assembly which will continue to meet the conditions of acceptance of NFPA 285.

TECHNICAL LITERATURE REFERENCES

T1. Concrete Masonry & Hardscapes Association (CMHA) TEK 07-01D, “Fire Resistance Rating of Concrete Masonry Assemblies,” Herndon, VA, 2018.

T2. Sultan, M.A., “Fire Resistance Furnace Temperature Measurements: Plate Thermometer vs. Shielded Thermocouples,” *Fire Technology*, 42, pp 253-267, 2006.

T3. National Fire Protection Association, Appendix B, *The SFPE Handbook of Fire Protection Engineering*, Fourth Edition, DiNenno, P.J. (ed.), National Fire Protection Association, Quincy, MA, 2008, pp. A-32 to A-33.

T4. Forest Products Laboratory, General Technical Report FPL-GTR-113, “Wood Handbook – Wood as An Engineering Material,” Madison, WI, U.S. Department of Agriculture, p17-10

T5 Kodur, V. K. R. and Harmathy, T.Z., “Properties of Building Materials,” The SFPE Handbook of Fire Protection Engineering, P.J. DiNenno editor, Bethesda, MD, pg. 1-164, 2002.

TEST REPORT REFERENCES

These NFPA 285 compliance tables are generated based on the following test reports:

R1. Fiber Cement Board exterior wall construction – Reported in Intertek Testing Final Report No. N4815.01-121-24, dated June 9, 2022.

R2. Fiber Cement Board exterior wall construction – Reported in ICC-NTA Testing Final Report No, DDPS082422-45, dated August 24, 2022.

R3 Brick exterior wall construction – Reported in Southwest Research Institute Final Report No. 01.05805.01.001, dated November 1, 2002.

R4 Brick exterior wall construction – Reported in Southwest Research Institute Final Report No. 01.13104.01.001c, dated September 5, 2008.

R5. Metal Composite Material Panel exterior wall construction – Reported in Southwest Research Institute Final Report No. 01.13104.01.001d, dated September 5, 2008.

R6. Brick exterior wall construction - Reported in Southwest Research Institute Final Report No. 01.15822.01.001, dated September 9, 2010.

R7. Aluminum Composite Material (ACM) Panel exterior wall construction – Reported in Intertek Testing Final Report No. J0651.01-121-24-R0, dated April 24, 2019.

R8. Aluminum Composite Material (ACM) Panel exterior wall construction – Reported in Intertek Testing Final Report No. G101240263SAT-001, dated August, 29, 2013.

R9. Aluminum Composite Material (ACM) Panel exterior wall construction – Reported in Southwest Research Institute Final Report No. 16046.01.610b, dated November, 30 2012.

R10. Fiber Cement Board exterior wall construction – Reported in Intertek Building and Construction Final Report No. M7537.01-121-24, dated January 27, 2022.

R11. Fiber Cement Board exterior wall construction – Reported in Intertek Building and Construction Final Report No. M4492.03-121-24-R0, dated December 15, 2021.

R12. Aluminum Composite Material (ACM) Panel exterior wall construction – Reported in Intertek Testing Final Report No. Q9301.06-121-24 R0, dated April, 7, 2025

R13. Brick exterior wall construction – Reported in Intertek Testing Final Report No. R4070.01-121-24 R0, dated October 1, 2025

R14. Fiber Cement Board exterior wall construction – Reported in Intertek Testing Final Report No. R4070.02-121-24 R0, dated October 1, 2025