

May 4, 2018

Dow Building Solutions
The Dow Chemical Company
1605 Joseph Drive
Midland, MI 48642

RE: Analysis and Extension of NFPA 285 Tests – STYROFOAM™ XPS
Project No.1JJB05306.011

To Whom It May Concern:

This letter provides a summary of NFPA 285 tests that incorporated extruded polystyrene foam plastic insulation (XPS) and the extension of those results to Dow Chemical's STYROFOAM™ XPS and to include other various exterior wall configurations which will meet the requirements of NFPA 285.

Section 2603.5.5 of the International Building Code (2000 through 2108 Editions) requires that exterior wall systems that incorporate foam plastic insulation shall meet the requirements of NFPA 285 "Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components."

Several NFPA 285 tests that incorporated XPS have been conducted under the auspices of the Extruded Polystyrene Foam Association (XPSA). These tests were successful and met the requirements of NFPA 285. The results of the tests do apply to STYROFOAM™ XPS, and XPSA has given authorization to Dow Chemical to use these tests and reports. These tests are reported in the following test reports:

1. Southwest Research Institute, Final Report No. 01.06440.01.001, dated May 2003;
2. Underwriters Laboratories, Inc. Final Report 05CA2541, NC2650, dated January 10, 2005; and,
3. Southwest Research Institute, Final Report No. 01.13537.01.106, dated September 26, 2008.

Based on the results of these tests, additional NFPA 285 testing by Sto Corp. and Dryvit Systems, Inc., as well as additional small-scale tests of the weather-resistive barriers, and my experience with the NFPA 285 fire test, it is my judgment that the various configurations of exterior walls shown in Figures 1 and 2 and described in the attached Tables/Figures will meet the performance requirements of NFPA 285.

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 and/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. If you have any questions, please feel free to contact me.

Sincerely,



Jesse J. Beitel, FSFPE
Senior Scientist

O: +1 410-737-8677
F: +1 410-737-8688

3610 Commerce Drive | Suite 817
Baltimore, MD 21227 USA

jensenhughes.com

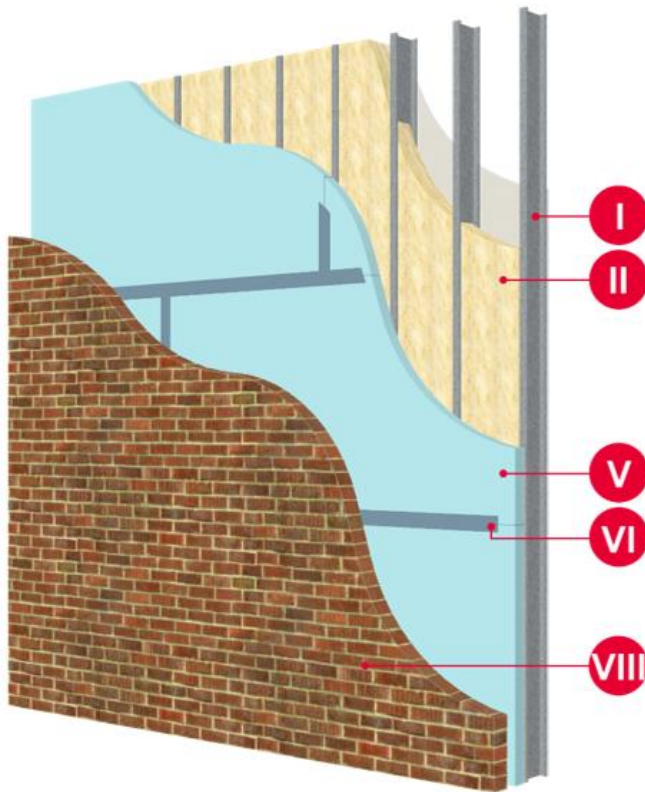


Figure 1 (Left): Typical Layer Assembly

Image shows a typical wall assembly using STYROFOAM™ brand XPS with numerals that correspond to Tables 1-6.

Note that not all layers shown here are required in assembly, not all possible layers are shown, and layers have several different material selection options.

See Tables 1-6 for all layer and material selection options, and Figure 2 for examples of other common layer assemblies.

Figure 2 (Below): Example Layer Assemblies

Images in Figures 2-1 through 2-4 show four common layer assemblies. Note that not all assembly options are shown. See Tables 1-6 for layer and assembly options.

Figure 1

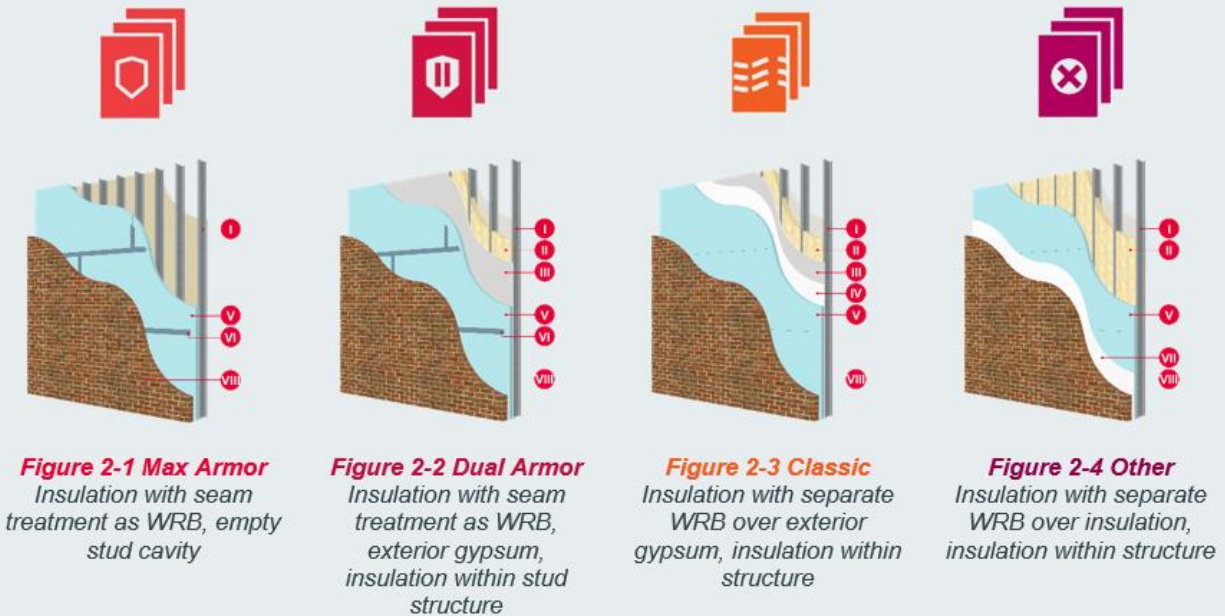


Figure 2-1 Max Armor
Insulation with seam treatment as WRB, empty stud cavity

Figure 2-2 Dual Armor
Insulation with seam treatment as WRB, exterior gypsum, insulation within stud structure

Figure 2-3 Classic
Insulation with separate WRB over exterior gypsum, insulation within structure

Figure 2-4 Other
Insulation with separate WRB over insulation, insulation within structure

Figure 2

Table 1 – Walls Containing STYROFOAM™ XPS Insulation

Layer	Wall Component	Materials
I	Base wall system – Use either 1, 2, or 3	1 – Concrete wall 2 – Concrete Masonry wall 3 – 1 layer – 5/8-inch thick, Type X, Gypsum wallboard on interior, installed over steel studs: minimum 3 5/8-inch depth, minimum 20-gauge at a maximum of 16-inch OC with lateral bracing every 4 ft. vertically
REQ	Floor line Firestopping	4 lb./cu ft. mineral wool (e.g. Thermafiber) in each stud cavity and at each floorline – attached with Z-clips or equivalent
II	Cavity Insulation – Use either 1, 2, or 3	1 – None 2 – Fiberglass batt insulation (faced or unfaced) 3 – Any noncombustible insulation (faced or unfaced)
III	Exterior sheathing – Use either 1, 2, 3 or 4	1 – None 2 – 1/2-inch thick, exterior type gypsum sheathing 3 – 5/8-inch thick, Type X, exterior type gypsum sheathing 4 – 5/8-inch thick DensElement™ sheathing – The joints of the DensElement™ sheathing may be sealed with R-Guard® FastFlash® Liquid Flashing or approved equivalent.
IV	Weather-resistive barrier applied to gypsum sheathing – Use either 1 or 2	1 – None 2 – Any shown in Table 2
V	Exterior insulation	1 – STYROFOAM™ Type IV or Type X per ASTM C578 – Total thickness to be a minimum of 1/2 inch to maximum of 3 inches when installed using Special Conditions (see below)
VI	Sealing of exterior insulation – Use either 1 or 2	1 – None 2 - Seal all exterior insulation joints and as an option veneer tie penetrations with either: a) Dow LIQUIDARMOR™ - CM Flashing and Sealant – max. 60-mil wet thickness, max. 5-inch width b) Dow LIQUIDARMOR™ - LT Flashing and Sealant – max. 35-mil wet thickness, max. 5-inch width c) Acrylic, asphalt or butyl-based sealing tape – max. 4-inch width d) Dow Great Stuff Pro™ - Use on joints that are ≤ 1/4-inch, vertical joints must be staggered & remove significant excess from the face of the XPS
VII	Weather-resistive barrier applied to exterior insulation – Use either 1 or 2	1 – None 2 – Any shown in Table 3
VIII	Exterior Veneer – Use either 1, 2, 3, 4, 5, 6 or 7	1 – Brick – Standard nominal 4-inch thick, clay brick. Brick veneer anchors – standard types – installed maximum 24 inches OC vertically on each stud. Maximum 2-inch air gap between exterior insulation and brick. 2 – Concrete – 2 inches thick or greater. Maximum 2-inch air gap between exterior insulation and concrete. Any standard non-open-joint installation technique can be used. 3 – Concrete masonry units – 4 inches thick or greater. Maximum 2-inch air gap between exterior insulation and CMU. 4 – Stone Veneer – Minimum 2-inch thick, Limestone or natural stone veneer or minimum 1-1/2 inch thick cast artificial stone veneer. Any standard non-open-joint installation technique such as ship-lap, etc. can be used.

		<p>5 – Stucco – Minimum ¾-inch thick, 2- or 3-coat stucco and lath. This wall construction shall be as described in Table 4.</p> <p>6 – StoTherm® ci XPS System. This wall construction shall be as described in Table 5.</p> <p>7 – Dryvit Outsulation X™ System. This wall construction shall be as described in Table 6</p>
REQ	Special Conditions	Use any header treatment shown in Figures 2–12 for all window and door openings in wall.
	Flashing of window, door and other exterior wall penetrations.	<p>As an option, flash window, door and other exterior penetrations with either:</p> <p>a) Dow LIQUIDARMOR™ - CM Flashing and Sealant – max. 60-mil wet thickness, max. 12-inch width.</p> <p>b) Dow LIQUIDARMOR™ - LT Flashing and Sealant – max. 35-mil wet thickness, max. 12-inch width.</p> <p>c) Limited amounts of acrylic, asphalt or butyl-based flashing tape – max. 12-inch width.</p> <p>Note: Flashing tape used in wall openings may extend the wall width plus extend up to a maximum of 4-inches onto the exterior face of the sheathing. Flashing tape may be used on sheathing exterior corners where the flashing tape may extend a maximum of 4-inches onto the sheathing face on either side of the corner.</p>

Table 2. Allowed Water-resistive Barriers Applied Over Sheathing and Under Foam Insulation – Layer IV

3M™ – 3M™ Self-Adhered Air and Vapor Barrier 3015
BASF – <ul style="list-style-type: none"> • Enershield HP • Enershield I
Carlisle – <ul style="list-style-type: none"> • CCW-705FR w/ Primers • Barritech™ VP • Barritech™ NP
Cosella-Dörken – <ul style="list-style-type: none"> • Delta®-Foxy • Delta®-Foxy Plus • Delta®-Fassade S • Delta®-Vent S/Plus • Delta®-Maxx Plus
Dow Chemical – <ul style="list-style-type: none"> • WeatherMate™ • WeatherMate™ Plus
Dow Corning® - DefendAir 200
Dryvit - Backstop® NT
DuPont – <ul style="list-style-type: none"> • DuPont™ Tyvek® CommercialWrap® • DuPont™ Tyvek® CommercialWrap® D • DuPont™ Tyvek® ThermaWrap™ • DuPont™ Tyvek® Fluid Applied WB+ – nominal 25 wet mil thickness
Henry Company – <ul style="list-style-type: none"> • Air-Bloc® 32MR • Air-Bloc® 31MR • Air-Bloc® 33MR • BlueskinVP™ 160 • Air-Bloc® 21 FR • Metal Clad™ • Foilskin®
Hohmann & Barnard – <ul style="list-style-type: none"> • Enviro-Barrier™ • Enviro-Barrier™ VP
JX Nippon ANCI, Inc. <ul style="list-style-type: none"> • JX ALTA Commercial Wrap • JX Alta HP Wrap • JX ALTA LP Wrap
Momentive Performance Materials – <ul style="list-style-type: none"> • GE SEC2500 SilShield* AWB • GE SEC2600 SilShield* AWB • GE SEC2600-R SilShield* AWB

Table 2. Allowed Water-resistive Barriers Applied Over Sheathing and Under Foam Insulation – Layer IV (continued)

<p>Kingspan -</p> <ul style="list-style-type: none"> • Kingspan® GreenGuard® Max™ Building Wrap • Kingspan® GreenGuard® Classic Building Wrap • Kingspan® GreenGuard® C2000 Building Wrap • Kingspan® GreenGuard® Raindrop® 3D Building Wrap • Kingspan® GreenGuard® HPW™ Building Wrap
<p>Polyguard Products –</p> <ul style="list-style-type: none"> • Airllok Flex® applied at a maximum 40 mils WFT • Airllok Flex® WG applied at a maximum 20 mils WFT • Airllok Flex® VP applied at a maximum 32 mils WFT
<p>Sto Corp –</p> <ul style="list-style-type: none"> • Sto Gold Coat® with StoGuard Fabric • Sto Emerald Coat® with StoGuard Fabric • Sto ExtraSeal™ w StoGuard Mesh
<p>STS, Inc. - Wall Guardian™ FW-100A</p>
<p>VaproShield –</p> <ul style="list-style-type: none"> • WallShield® • WrapShield® • RevealShield™ • RevealShield SA™
<p>W.R. Grace –</p> <ul style="list-style-type: none"> • Perm-A-Barrier® Aluminum Wall Membrane • Perm-A-Barrier® VPL • Perma-A-Barrier® VPL LT • Perm-A-Barrier® VPS • Perm-A-Barrier® NPL
<p>W.R. Meadows –</p> <ul style="list-style-type: none"> • Air-Shield™ LMP (Gray) • Air-Shield™ LMP (Black) • Air-Shield™ TMP • Air-Shield™ LSR

Note: all barriers to be installed at indicated or recommended application rates and per manufacturer's installation instructions.

**Table 3. Allowed Water-Resistive Barriers
Installed Over the Foam Insulation – Layer VII**

Dow Chemical – <ul style="list-style-type: none"> • WeatherMate™ • WeatherMate™ Plus
DuPont – <ul style="list-style-type: none"> • DuPont™ Tyvek® CommercialWrap® • DuPont™ Tyvek® CommercialWrap® D • DuPont™ Tyvek® ThermaWrap™
Kingspan - <ul style="list-style-type: none"> • Kingspan® GreenGuard® Max™ Building Wrap • Kingspan® GreenGuard® Classic Building Wrap • Kingspan® GreenGuard® C2000 Building Wrap • Kingspan® GreenGuard® Raindrop® 3D Building Wrap • Kingspan® GreenGuard® HPW™ Building Wrap
VaproShield – <ul style="list-style-type: none"> • RevealShield™ • RevealShield SA™

Note: all barriers to be installed at indicated or recommended application rates and per manufacturer's installation instructions.

Table 4– Exterior Walls with Stucco and STYROFOAM™ XPS Insulation

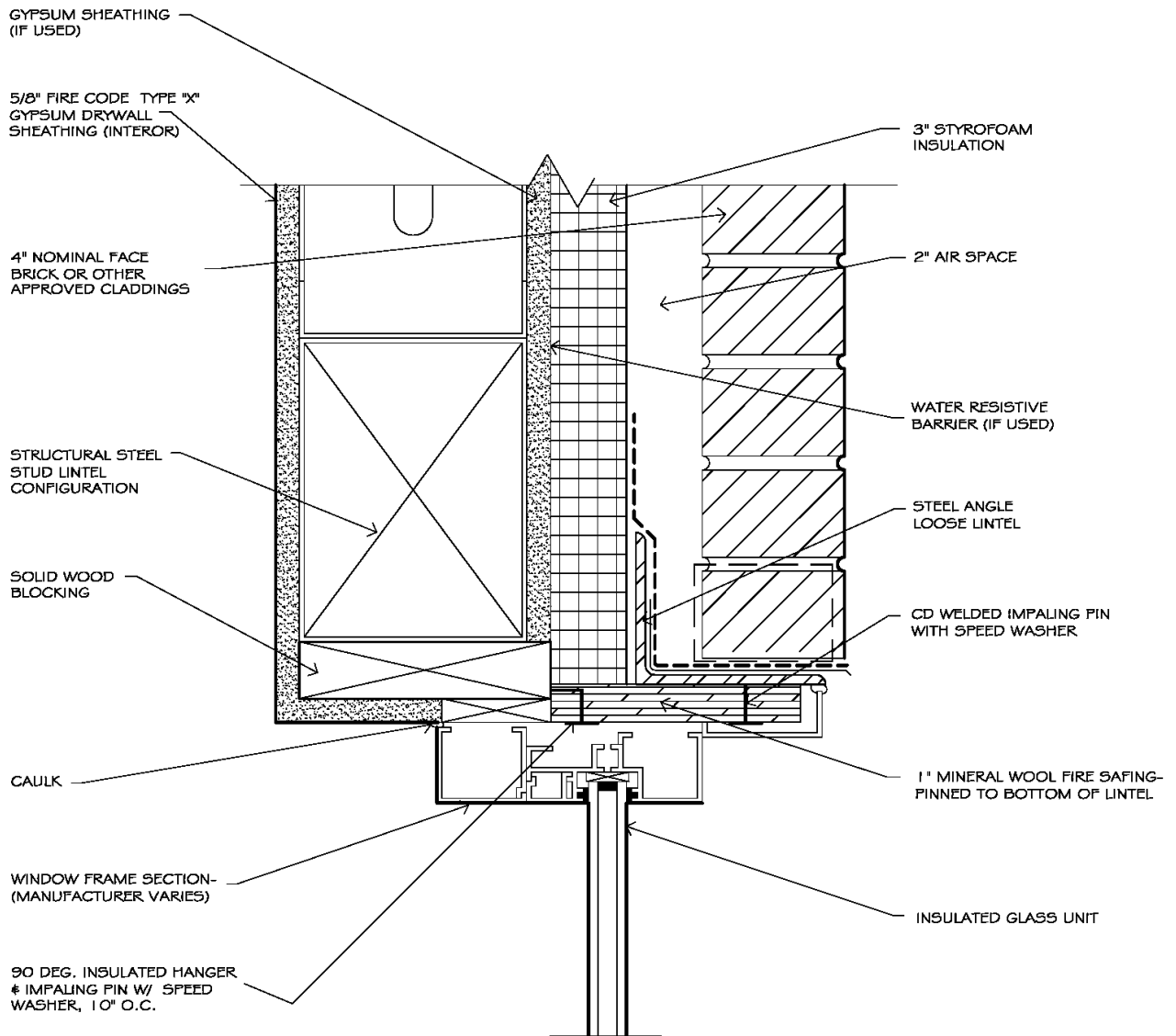
Layer	Wall Component	Materials
I	Base wall system – Use either 1, 2 or 3	1 – Concrete wall 2 – Concrete Masonry wall 3 – 1 layer – 5/8-inch thick Type X Gypsum Wall Board (on interior), installed over steel studs (minimum 3 5/8-inch deep, minimum No. 18-gauge, maximum of 16-inch O.C.)
REQ	Floor line Firestopping	4 lb/cu ft. mineral wool (e.g. Thermafiber) in each stud cavity and at each floorline – attached with Z-clips or equivalent
II	Stud Cavity Insulation – Use either 1, 2 or 3	1 – None 2 – Fiberglass batt insulation (faced or unfaced) 3 – Any noncombustible material
III	Exterior sheathing – Use either 1 or 2. Exterior sheathing is optional for Base wall systems No. 1 & 2.	1 – 5/8-inch thick, Type X glass mat gypsum sheathing 2 – 1/2-inch thick, glass mat gypsum sheathing <i>Note: Seal sheathing joints with materials and procedures that are provided in ESR-1233</i>
IV	Air Barrier and weather-resistive barrier membrane applied to exterior sheathing or Base wall systems No. 1 & 2 without exterior sheathing – Use either 1 or 2 or 3.	1 – Sto Gold Coat® 2 – Sto Emerald Coat® 3 – Sto ExtraSeal™
NOT SHOWN	Continuous insulation adhesive – Use either 1, 2 or 3	1 – None 2 – Sto TurboStick Adhesive 3 – Sto ExtraSeal 4 – Dow INSTA-STIK™ quick set polyurethane adhesive
V	Continuous insulation	ASTM C578 Type IV STYROFOAM™ insulation board: 1/2-inch (minimum) to 3-inch (maximum). Insulation board joints may be covered with 4-inch (maximum) wide asphalt or butyl-based flashing tape.
VI	Sealing of exterior insulation – Use either 1 or 2	1 – None 2 - Seal all exterior insulation joints and as an option veneer tie penetrations with either: <ul style="list-style-type: none"> • Dow LIQUIDARMOR™ - CM Flashing and sealant – max. 60-mil wet thickness, max. 5-inch width • Dow LIQUIDARMOR™ - LT Flashing and sealant – max. 35-mil wet thickness, max. 5-inch width • Acrylic, asphalt or butyl-based sealing tape – max. 4-inch width • Dow Great Stuff Pro™ - Use on joints that are ≤ 1/4-inch, vertical joints must be staggered & remove significant excess from the face of the XPS
VII	Secondary weather-resistive barrier membrane – Use either 1, 2 or 3	1 – None 2 – No. 15 Grade D building paper 3 – Asphalt felt in compliance with ASTM D 226
VIII	Drainage Mat – Use either 1 or 2	1 – None 2 – Sto DrainScreen - installed over Air Barrier and weather-resistive barrier membrane or over continuous insulation
	Exterior Veneer	Stucco – Minimum 3/4-inch thick, 2- or 3-coat Stucco complying with ASTM C 926 applied over 2 1/2-lb/yd ² galvanized steel diamond mesh lath complying with ASTM C 1063/C 847. As an option, adhered masonry veneer, such as: Thin brick, manufactured stone, ceramic or porcelain tile may be installed over the Stucco.

Table 5– Exterior Walls with StoTherm® ci and STYROFOAM™ XPS Insulation

Layer	Wall Component	Materials
I	Base wall system – Use either 1, 2 or 3	1 – Concrete wall 2 – Concrete Masonry wall 3 – 1 layer – 5/8-inch thick Type X Gypsum Wall Board (on interior), installed over steel studs (minimum 3 5/8-inch deep, minimum No. 18-gauge, maximum of 16-inch O.C.)
REQ	Floor line Firestopping	4 lb./cu ft. mineral wool (e.g. Thermafiber) in each stud cavity and at each floorline – attached with Z-clips or equivalent
II	Stud Cavity Insulation – Use either 1, 2 or 3	1 – None 2 – Fiberglass batt insulation (faced or unfaced) 3 – Any noncombustible material
III	Exterior sheathing – Use 1. Exterior sheathing is optional for Base wall systems No. 1 & 2.	1 – 5/8-inch thick, Type X glass mat gypsum sheathing <i>Note: Seal sheathing joints with materials and procedures that are provided in ESR-1233</i>
IV	Air Barrier and weather-resistive barrier membrane applied to exterior sheathing or Base wall systems No. 1 & 2 without exterior sheathing – Use either 1 or 2 or 3.	1 – Sto Gold Coat® 2 – Sto Emerald Coat® 3 – Sto ExtraSeal™
NOT SHOWN	Continuous insulation adhesive – Use either 1, 2, 3, 4, 5, 6 or 7	1 – None 2 – Sto TurboStick™ Adhesive 3 – Sto BTS® Plus – Use with Base coats #1, #2 or #3 and Finish coats #1 or #2 4 – Sto BTS Xtra - Use with Base coats #1, #2 or #3 and Finish coats #1 or #2 5 – Dow INSTA-STIK™ quick set polyurethane adhesive 6 - Sto Primer/Adhesive – Use with Base coats #4 or #5 & Finish coat #3 7 - Sto Primer/Adhesive-B – Use with Base coats #4 or #5 & Finish coat #3
V	Continuous insulation	ASTM C578, Type X STYROFOAM™ Panel Core 20: 1/2-inch (minimum) to 6-inch (maximum). Insulation board joints may be covered with 4-inch (maximum) wide asphalt, acrylic, or butyl-based flashing tape.
VIII	Base Coat – Use either 1, 2, 3, 4, or 5	1 – Sto BTS Plus – Use with Finish coats #1 and #2 2 – Sto BTS Xtra - Use with Finish coats #1 and #2 3 – Sto RFP - Use with Finish coats #1 and #2 4 - Sto Primer/Adhesive – Use with Finish coat #3 5 - Sto Primer/Adhesive-B – Use with Finish coat #3
	Mesh	Sto Mesh – embedded in base coat
	Finish coat – Use either 1, 2 or 3	1 – Sto Textured Finish - Stolit® Lotusan® 2 – Sto Textured Finish - Stolit® 3 – Sto Textured Finish: Sto Essence DPR

Table 6 – Exterior Walls with Dryvit Outsulation X™ and STYROFOAM™ XPS Insulation

Layer	Wall Component	Materials
I	Base wall system – Use either 1, 2 or 3	1 – Concrete wall 2 – Concrete Masonry wall 3 – 1 layer – 5/8-inch thick Type X Gypsum Wall Board (on interior), installed over steel studs (minimum 3 5/8-inch deep, minimum No. 18-gauge, maximum of 16-inch O.C.)
REQ	Floor line Firestopping	4 lb./cu ft. mineral wool (e.g. Thermafiber) in each stud cavity and at each floorline – attached with Z-clips or equivalent
II	Stud Cavity Insulation – Use either 1, 2 or 3	1 – None 2 – Fiberglass batt insulation (faced or unfaced) 3 – Any noncombustible material
III	Exterior sheathing – Use 1 or 2. Exterior sheathing is optional for Base wall systems No. 1 & 2.	1 – 1/2-inch thick exterior type gypsum sheathing 2 – 5/8-inch thick, Type X gypsum sheathing <i>Note: Seal sheathing joints with materials and procedures that are provided in ESR-3295</i>
IV	Air Barrier and weather-resistant barrier membrane applied to exterior sheathing or Base wall systems No. 1 & 2 without exterior sheathing – Use either 1 or 2.	1 – Dryvit Backstop NT Texture 2 – Dryvit Backstop NT Smooth
	Continuous insulation installation	Genesis® - applied in vertical ribbons plus mechanical fasteners. See ESR-3295 for details
V	Continuous insulation	ASTM C578, Type X, Dow XENERGY™ Rigid Insulation: 1/2-inch (minimum) to 4-inch (maximum). Insulation board joints may be covered with 4-inch (maximum) wide asphalt, acrylic, or butyl-based flashing tape.
VIII	Base Coat	Genesis®
	Mesh	Standard Plus Reinforcing Mesh (6.0 oz./yd ² – embedded in base coat
	Finish coat – Use either 1 or 2	1 – Dryvit DPR 2 – Dryvit PMR

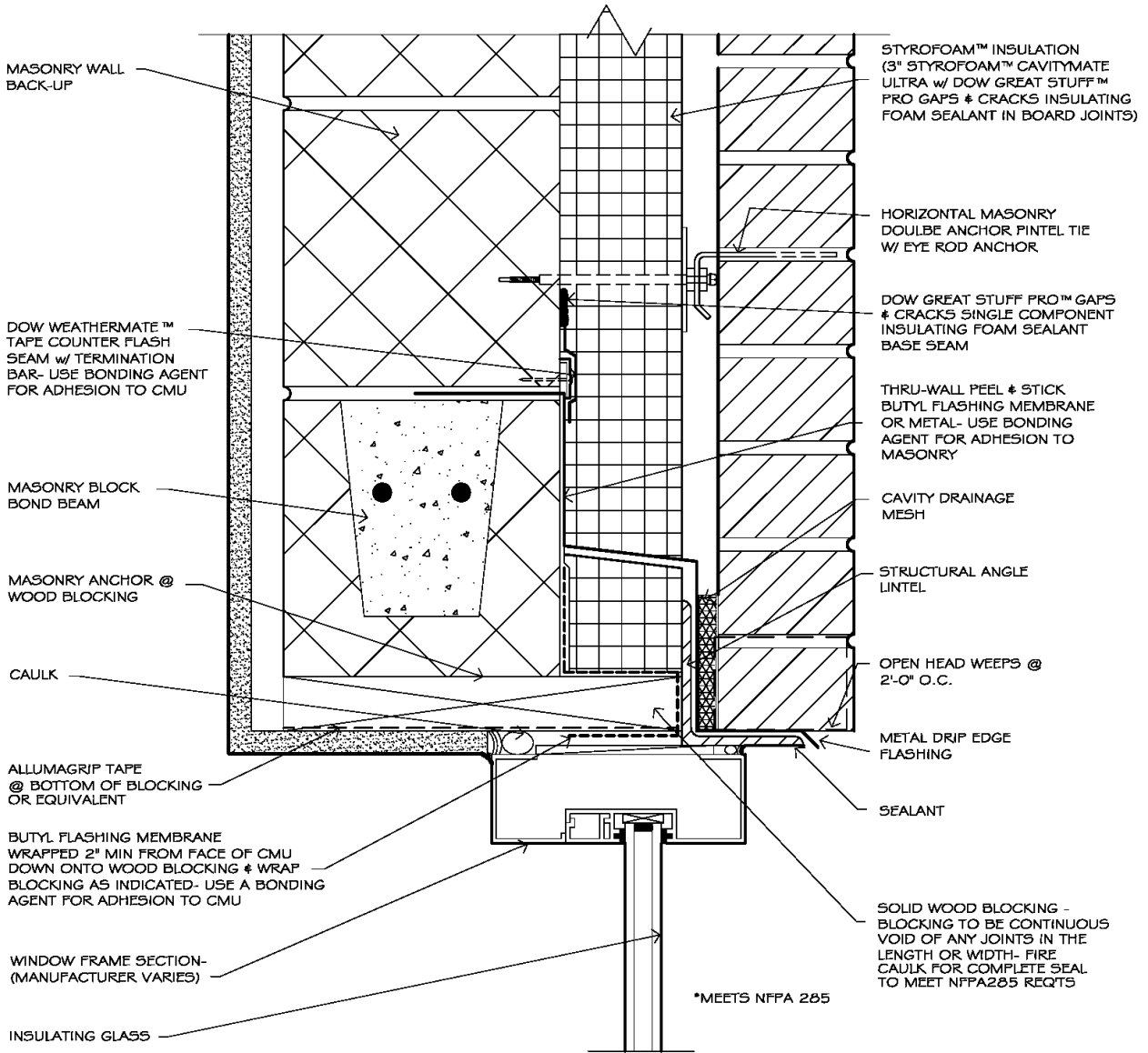


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STEEL STUD/BRICK VENEER - WINDOW SILL & JAMB DETAIL

REFERENCE DETAIL: REGISTERED PROFESSIONAL TO REVIEW PRIOR TO USE

Figure 3 – Window/Door Opening Detail – Mineral Wool



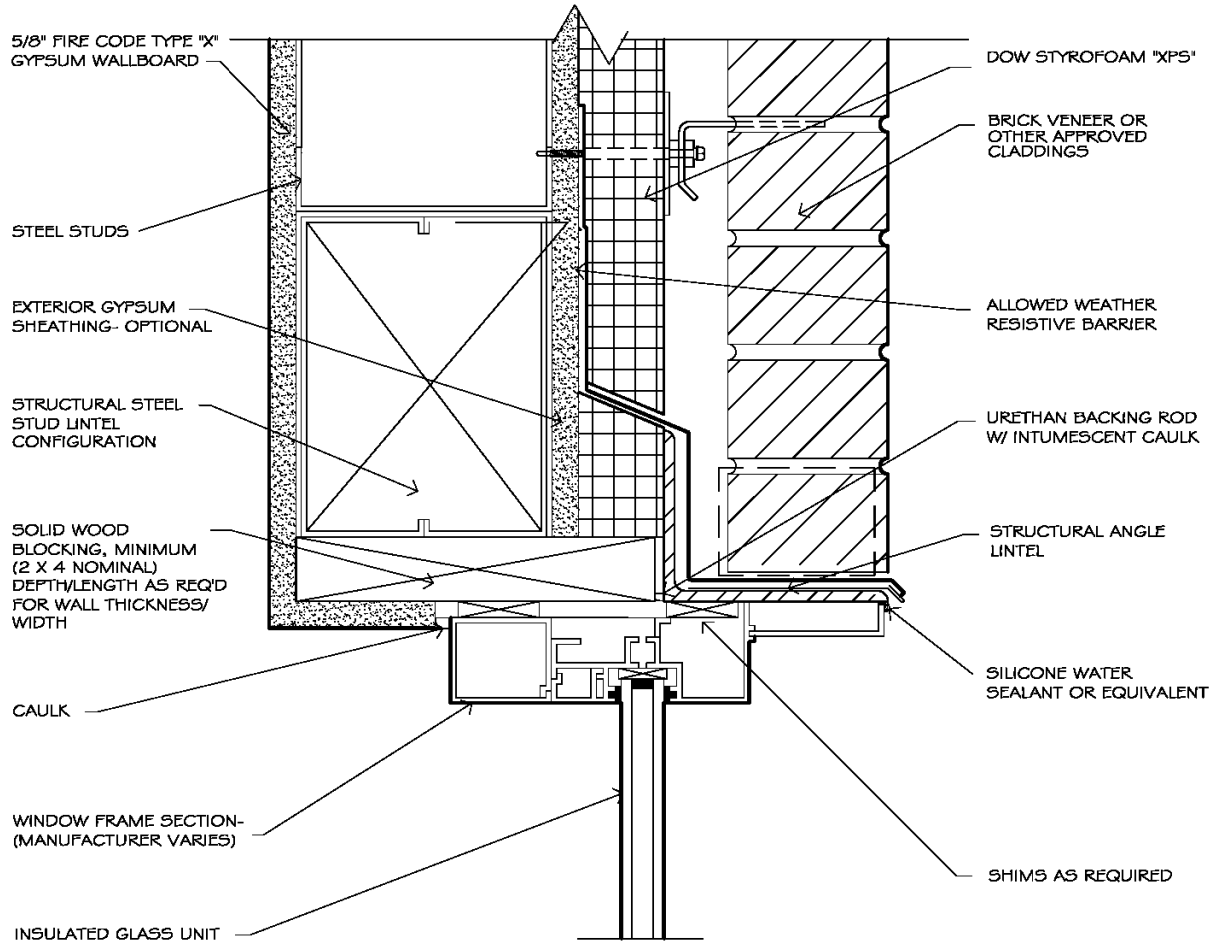
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ULTRA WALL - WINDOW HEAD DETAIL w/ FIRE TREATED FULL WOOD BLOCKING



REFERENCE DETAIL: REGISTERED PROFESSIONAL TO REVIEW PRIOR TO USE

Figure 4 – Window / Door Header Detail with FR Wood Blocking



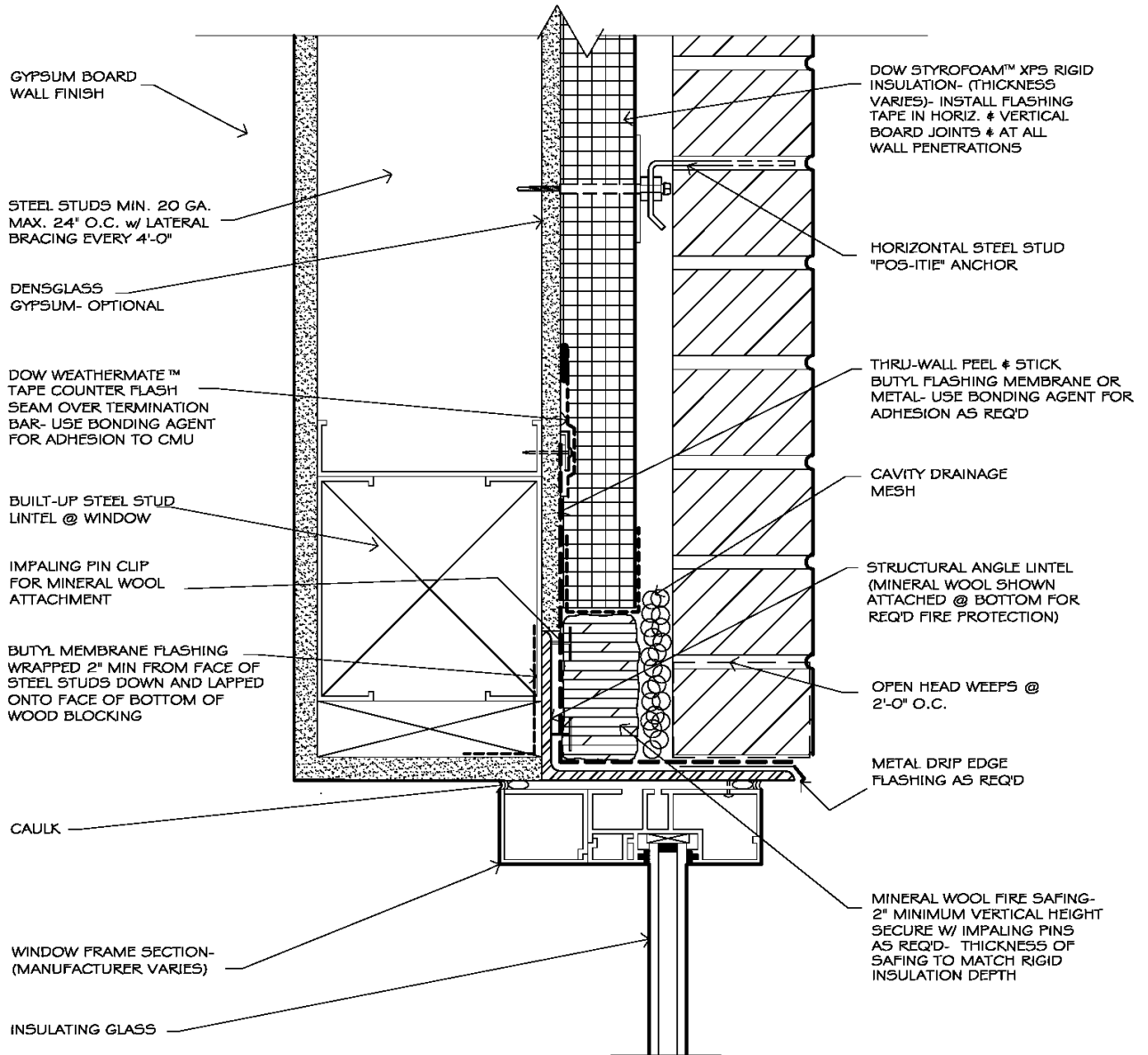
**WINDOW HEAD- STEEL LINTEL BRICK SHELF
w/ FIRE TREATED WOOD BLOCKING**

REFERENCE DETAIL: REGISTERED PROFESSIONAL TO REVIEW PRIOR TO USE

*MEETS NFPA 285

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Figure 5 – Window / Door Header Detail with FR Wood Blocking



**STUD WALL w/ STYROFOAM™ XPS INSULATION-
WINDOW HEAD w/ MINERAL WOOL FIRE SAFING & BRICK-
FLASH BEHIND RIGID FOAM INSULATION**

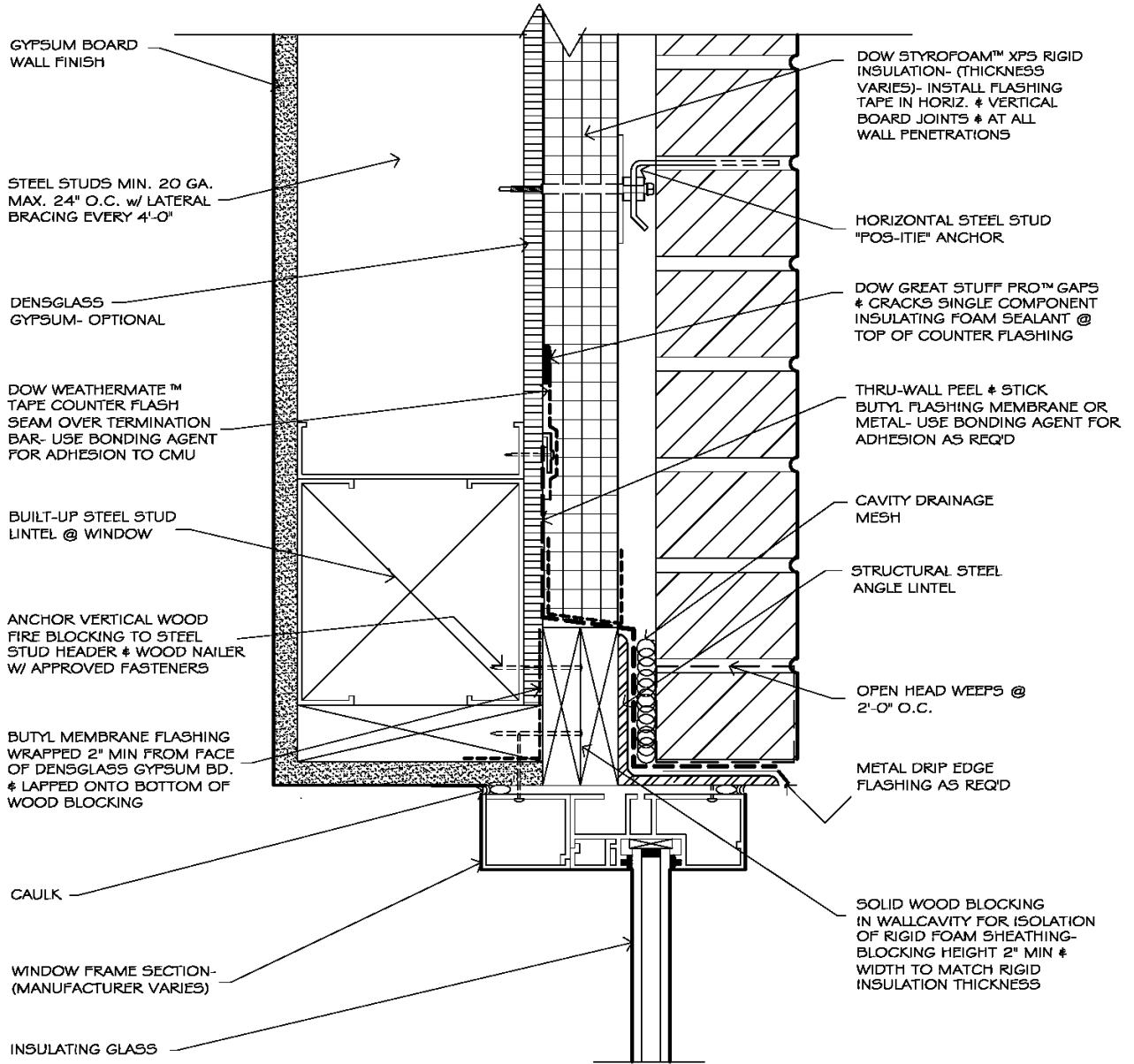


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Figure 6 – Window Head with Mineral Safing



**STUD WALL w/ STYROFOAM™ XPS INSULATION-
 WINDOW HEAD w/ FIRE TREATED WOOD BLOCKING &
 BRICK- FLASH BEHIND RIGID FOAM INSULATION**

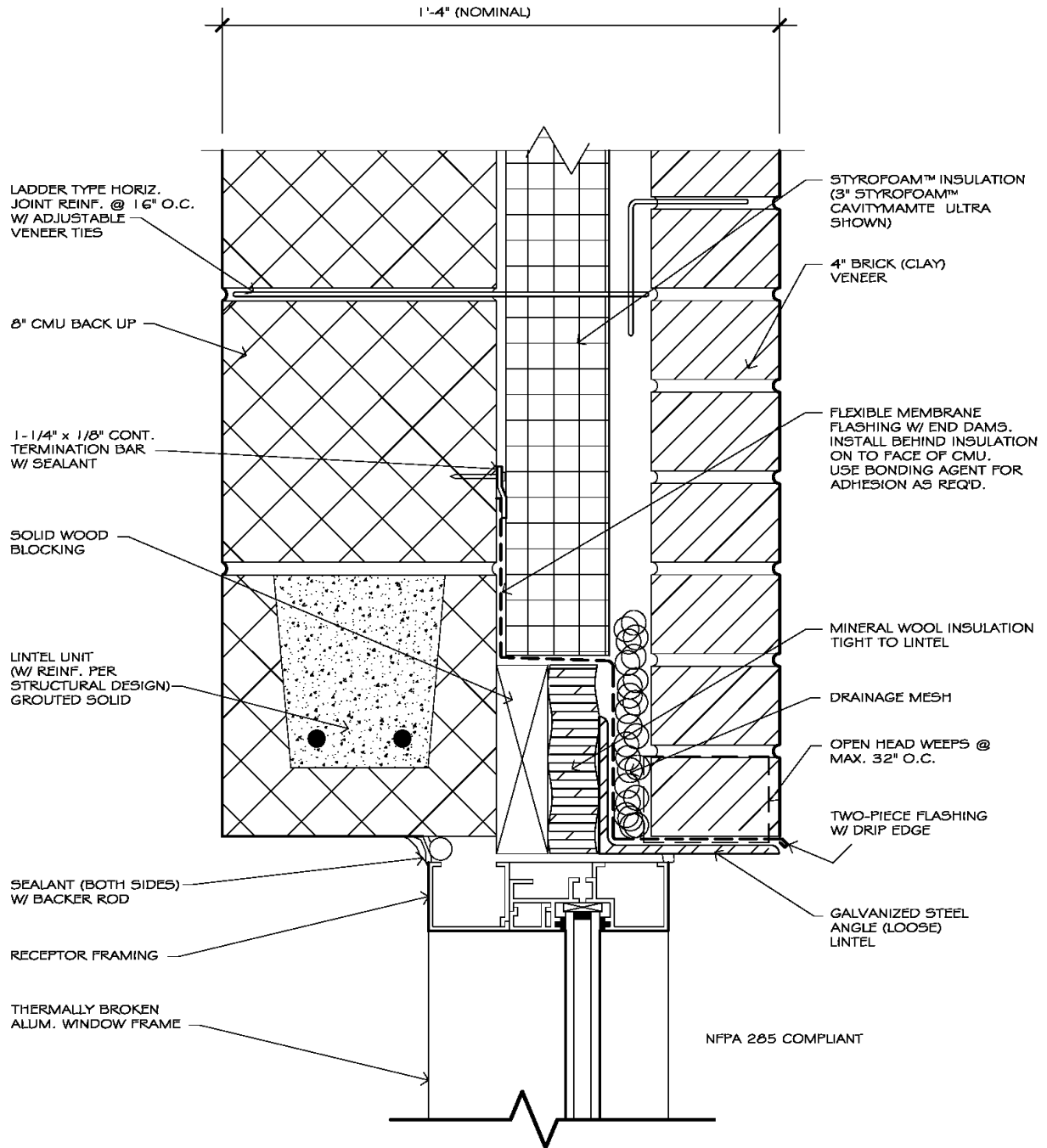


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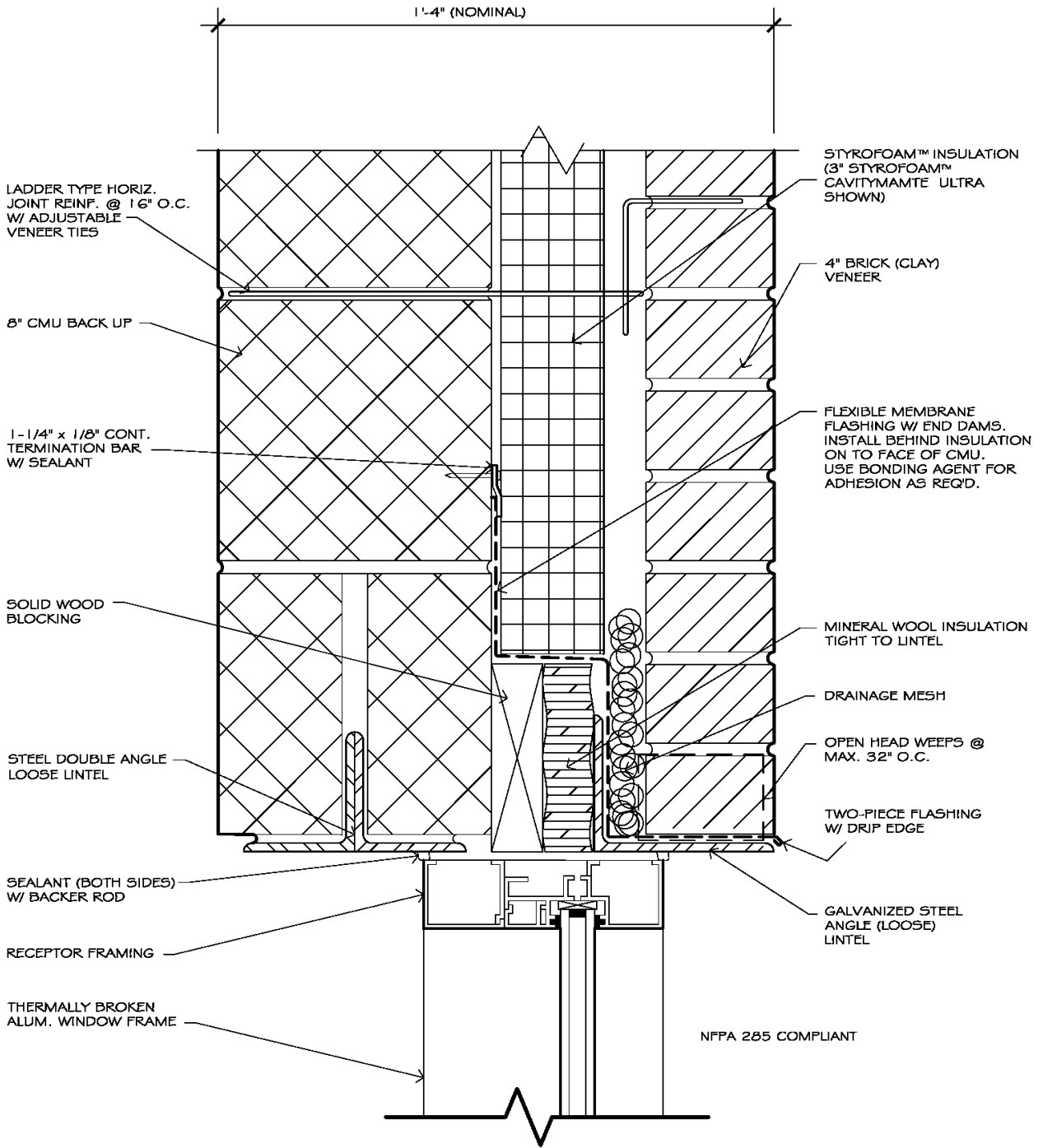
Figure 7 – Window Head with Fire Treated Wood Blocking



SHORT SPAN MASONRY LINTEL FOR RECEPTOR STYLE WINDOWS

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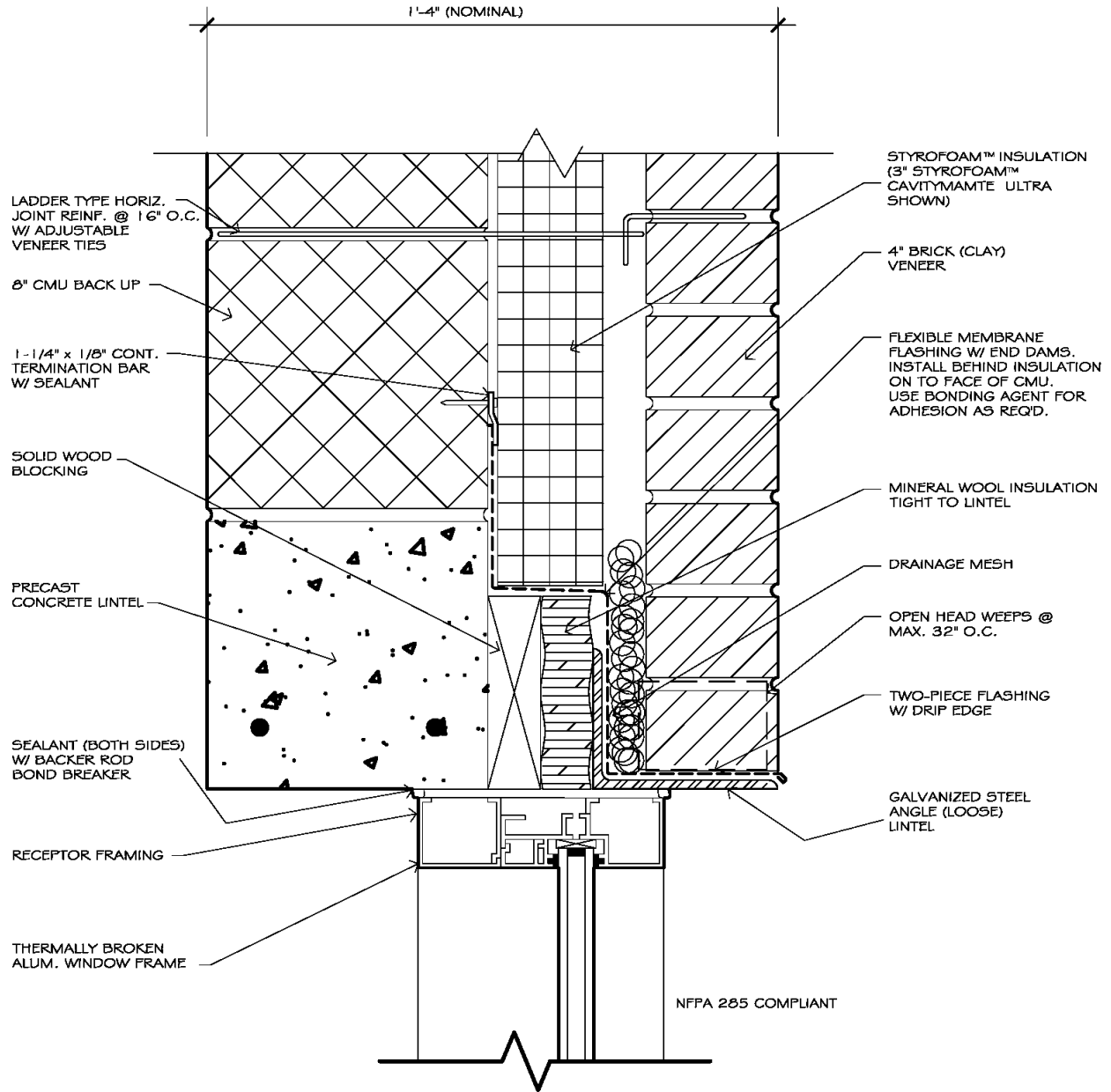
Figure 8 – Window / Door Opening Detail w/Mineral Wool & Fire Treated Wood Blocking



SHORT SPAN STEEL LINTEL FOR RECEPTOR STYLE WINDOWS

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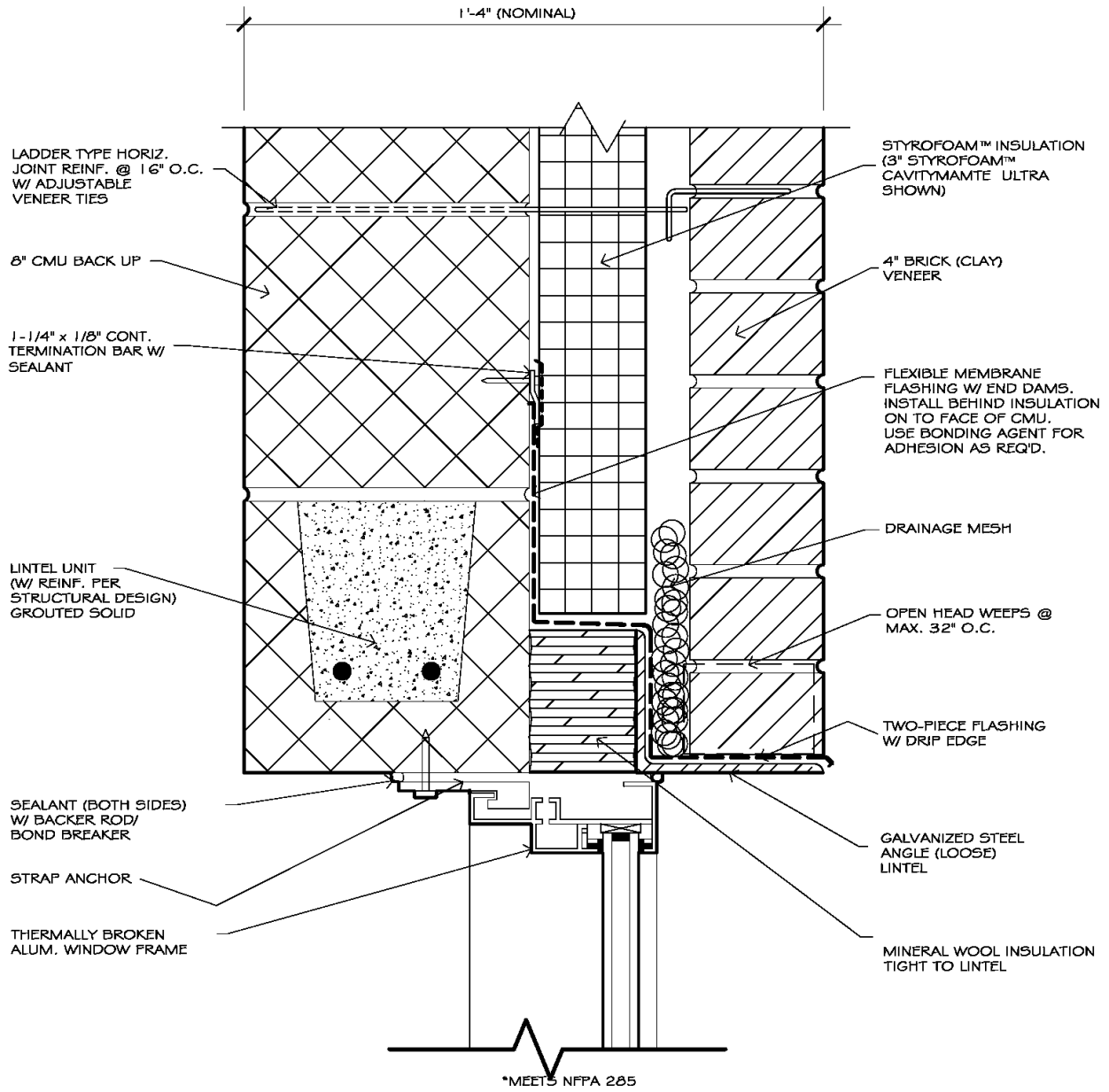
Figure 9 – Window / Door Opening Detail w/Mineral Wool & Fire Treated Wood Blocking



SHORT SPAN PRE-CAST LINTEL FOR RECEPTOR STYLE WINDOWS

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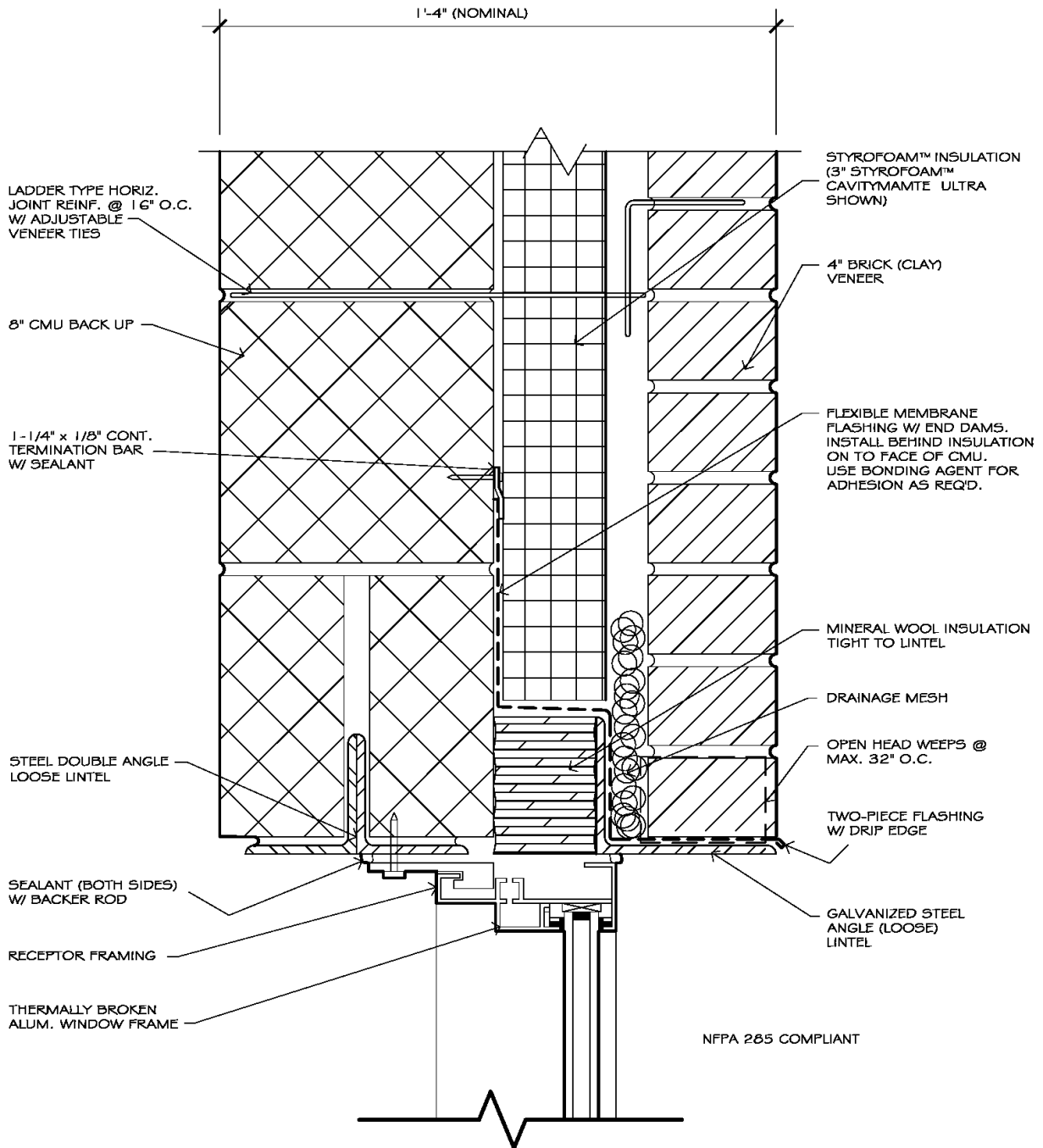
Figure 10 – Window / Door Opening Detail w/Mineral Wool & Fire Treated Wood Blocking



SHORT SPAN MASONRY LINTEL FOR STRAP STYLE WINDOWS

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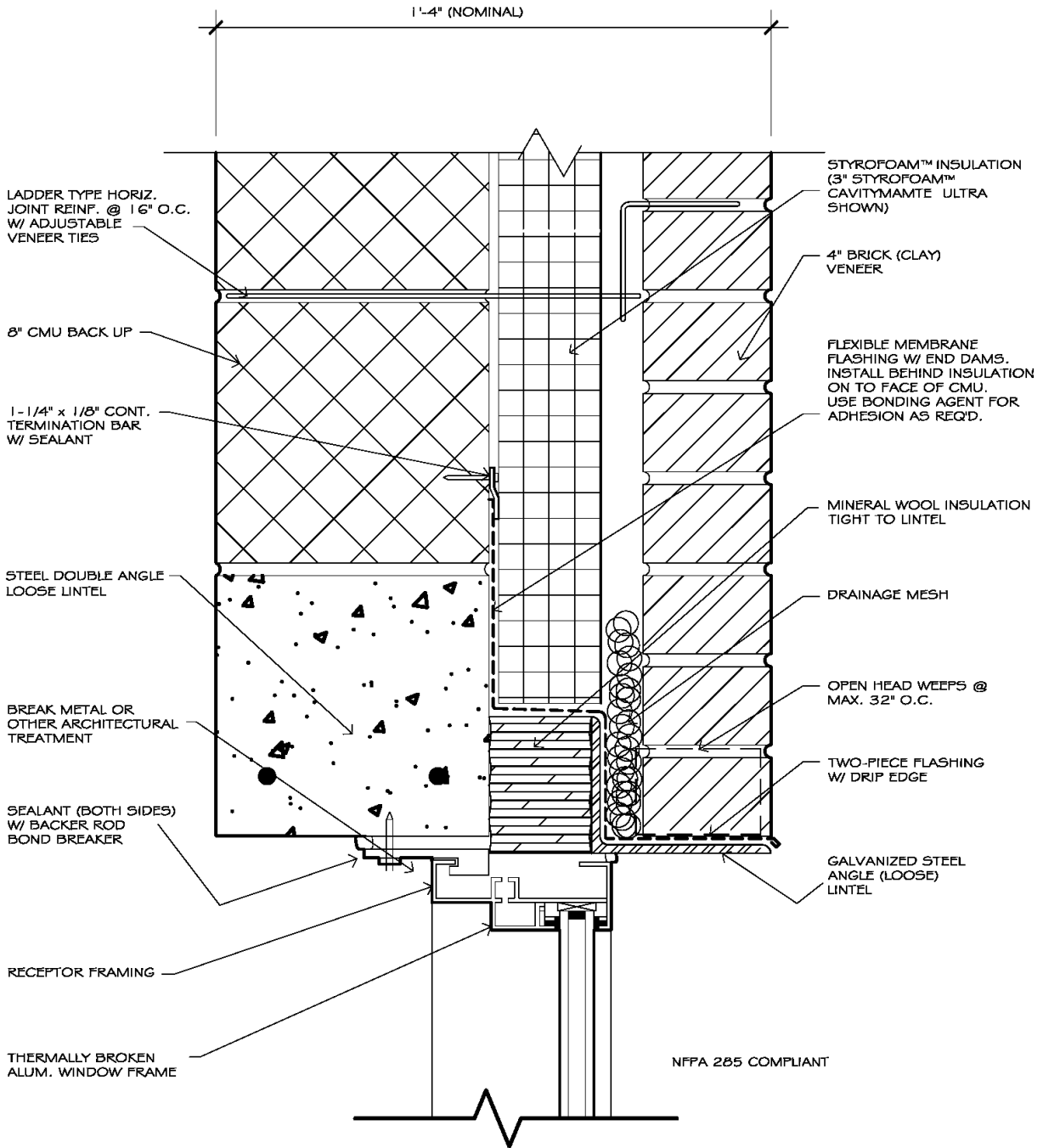
Figure 11 – Window / Door Opening Detail – Mineral Wool



SHORT SPAN STEEL LINTEL FOR RECEPTOR STYLE WINDOWS

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Figure 12 – Window / Door Opening Detail w/Mineral Wool



**SHORT SPAN PRE-CAST LINTEL
FOR STRAP STYLE WINDOWS**
REFERENCE DETAIL: REGISTERED PROFESSIONAL TO REVIEW PRIOR TO USE

Figure 13 – Window / Door Opening Detail w/Mineral Wool