



Evaluation Report CCMC 14127-R HP+™ E and X Series – Air Barrier System

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1. Opinion

It is the opinion of the Canadian Construction Materials Centre (CCMC) that “HP+™ E and X Series – Air Barrier System,” when used as an air barrier system (ABS) for exterior walls of buildings in accordance with the conditions and limitations stated in Section 3 of this Report, complies with the National Building Code (NBC) of Canada 2010 and NBC 2015:

- Clause 1.2.1.1.(1)(a) of Division A, as an acceptable solution from Division B:
 - Article 9.25.3.1., Required Barrier to Air Leakage (exterior walls only)
 - Sentence 9.25.3.2.(1), Air Barrier System Properties (effective barrier to air infiltration and exfiltration)
 - Article 9.25.3.3., Continuity of the Air Barrier System (exterior walls only)
 - Clause 9.36.2.9.(1)(b), Airtightness (exterior walls only)
- Clause 1.2.1.1.(1)(b) of Division A, as an alternative solution that achieves at least the minimum level of performance required by Division B in the areas defined by the objectives and functional statements attributed to the following applicable acceptable solutions:
 - Sentence 9.25.3.2.(2), Air Barrier System Properties (alternative to 6 mil polyethylene air barrier)

This opinion is based on CCMC's evaluation of the technical evidence in Section 4 provided by the Report Holder.

2. Description

This Report addresses the performance of “HP+™ E and X Series – Air Barrier System” as a proprietary ABS designated by BASF Canada Inc.

2.1 General Description of the Assemblies

- “HP+™ E Series”: “WALLTITE® v.3”⁽¹⁾ polyurethane foam sprayed between wood studs (installed at 406 mm (16 in.) o.c. and 609 mm (24 in.) o.c.) and over “Neopor® Graphite Polystyrene (GPS)” board. Figures 1, 2 and 3 in Appendix A show the assembly.
- “HP+™ X Series”: the same wall assembly as “HP+™ E Series” with the exception of a wood sheathing installed between the wood stud and the “Neopor® Graphite Polystyrene (GPS)” board. Figures 1, 2 and 3 in Appendix A show the assembly.

2.2 Principal Material and Accessories

2.2.1 Principal Material in the Plane of Airtightness

- “WALLTITE® v.3” (CCMC 13588-L) spray-applied, polyurethane foam insulation by BASF Canada Inc.

When installed as part of the designated ABS, “WALLTITE® v.3” spray-applied polyurethane foam serves a double function in the wall assembly:

1. as the principal plane of airtightness of the designated ABS; and
2. as a thermal insulation.

The use of the spray-applied polyurethane foam as a thermal insulation is evaluated in CCMC 13588-L. The foam insulation consists of two components:

- “Elastospray® 8000A” isocyanate; and
- a polyurethane resin identified as “WALLTITE® v.3.”

The two components are mixed on-site by an installer approved by BASF Canada Inc. to install the insulation product. The resulting product is a Type 2 spray-applied polyurethane with an assigned long-term thermal resistance value of 2.14 (m²·K)/W per 50 mm. The colour of the finished product is purple. When the foam insulation serves as the principal component in the BASF Canada Inc. proprietary ABS, it must be installed at a minimum thickness and density, which are specified in Section 3.1 of this Report.

2.2.2 Accessories for Continuity of the ABS

- transition membrane at frame rough openings (see Figures 7, 8a, 8b and 9 in Appendix A):⁽²⁾
 - “3M™ Air and Vapour Barrier 3015,” a proprietary elastomeric flashing with acrylic adhesive manufactured by 3M Canada Company; or
 - “HP+™ Flash,” a one-component elastomeric liquid-flashing membrane manufactured by BASF used in conjunction with “Tyvek® HomeWrap™ Breather Type Sheathing Membrane” (CCMC 12808-R).
- sealant: (see Figures 1, 2, 3, 5 and 6 in Appendix A):
 - “MasterSeal® NP1™,” a one-component elastomeric polyurethane sealant manufactured by BASF, for use on the exterior side of the wood frame along the horizontal joint between:
 - the sill plate and rim board;
 - the rim board and subfloor;
 - the subfloor and bottom plate;
 - the bottom plate and studs; and
 - the top plates.

“MasterSeal® NP1™” is also for use along the vertical joint between:

- the studs;
- the header lumbers; and
- at corners of the window/door rough frame opening.

The use of “MasterSeal® NP1™” on the interior side is along the joint between the frame of the windows and doors, and the rough frame opening.

2.2.3 Component for Wind Load Resistance

- in the “HP+™ E Series”: “Neopor® Graphite Polystyrene (GPS)⁽³⁾,” a moulded expanded polystyrene board with bead technology manufactured by BASF used as a backing for the installation of “WALLTITE® v.3.” See Figure 4 in Appendix A for “Neopor® Graphite Polystyrene (GPS)” attachment.
- in the “HP+™ X Series”: 6 mm thick (1/4 in.) plywood or OSB sheathing used as a backing for the installation of “WALLTITE® v.3.”

-
- (1) “WALLTITE® CM01” is deemed to be an adequate foam option when installed with a minimum field density (also called “in-place density”) of 39 kg/m³ for air barrier application. The use of “WALLTITE® CM01” as a thermal insulation is evaluated in CCMC 14100-L.
 - (2) The original full-scale testing was carried out with two transition membranes: the “3M™ Air and Vapour Barrier 3015” and the “HP+™ Flash” used in conjunction with “Tyvek® HomeWrap™ Breather Type Sheathing Membrane.” Other polyethylene-based membrane evaluated by CCMC can be used in conjunction with the “HP+™ Flash.”
 - (3) “Neopor® Graphite Polystyrene (GPS)” has demonstrated compliance with CAN/ULC-S701-11, “Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering,” based on QAI Laboratories’ Building Products Listing Program. Packaging must be labeled with the QAI certification mark.
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3. Conditions and Limitations

CCMC’s compliance opinion in Section 1 is bound by the “HP+™ E and X Series – Air Barrier System” being used in accordance with the conditions and limitations set out below.

3.1 Air Barrier System

The durability assessment of “WALLTITE® v.3” (the principal material of the ABS) has demonstrated sufficiently low air permeance at a thickness of 25.4 mm and a minimum field density of 39 kg/m³ (also called in-place density), which meets the intent of Subsection 9.25.3., Air Barrier Systems, of Division B of the NBC 2010 and NBC 2015 for buildings with an indoor relative humidity (RH) of 35% or less. For buildings with a higher RH (e.g., swimming pools and museums), additional assessment is required in accordance with Part 5, Environmental Separation, of Division B of the NBC 2010 and NBC 2015.

The evaluation of “HP+™ E and X Series – Air Barrier System” is limited to wood-frame construction meeting the requirements of Part 9, Housing and Small Buildings, of Division B of the NBC 2010 and NBC 2015. The air leakage rate of the tested wall assemblies, following structural aging, met the rating A1 (less than 0.05 L/(s·m²) at pressure difference of 75 Pa) when tested in accordance with CAN/ULC-S742-11, “Air Barrier Assemblies – Specification.” The wall assemblies have demonstrated sufficient strength to resist wind loads so it can be used in Part 9 buildings in geographical locations where the wind pressure is $Q_{1/50} \leq 1\,000$ Pa for a maximum building height of 12 m. The $Q_{1/50}$ corresponds to the 1-in-50-year wind pressure return period published in Appendix C of Division B of the NBC 2010 and NBC 2015. For applicability of the ABS rating and durability of the components, in wood frame construction beyond Part 9, the stamp of an engineer is required for acceptance by the authorities having jurisdiction (AHJs). See Section 5.0 of this Report.

For ensuring air leakage control and strength in the field, the ABS must be installed in locations where the wind pressure is equal to or lower than the aforementioned wind pressure limits and installed in the field by BASF-trained installers/contractors following the BASF Canada Inc.-specified ABS installation manual entitled “HP+™ Wall System – Technical Installation Manual (revision date 8 May 2019).” Additional construction details and drawings provided in “HP+™ Wall System – 3D Field Assembly Guide (version 2019-05-01)” for the “HP+™ E Series” and “HP+™ X Series” must also be followed. Additional field installation requirements are described in Sections 3.2 and 3.3 of this Report. A copy of the BASF Canada Inc. installation instructions must be available on the job site at all times during the installation for review by building officials. All installers of “WALLTITE® v.3” must present their Caliber certification card upon request by the building official.

See Appendix A of this Report for examples of the tested wall assemblies.

The product must be identified with the manufacturer’s name and logo, and the phrase “CCMC 14127-R.”

3.2 Air Barrier System – Field Quality Assurance

When “HP+™ E and X Series – Air Barrier System” is applied as the designated ABS, BASF Canada Inc. requires that the installer be BASF Canada Inc.-trained and that Caliber conducts the necessary follow-up inspections to ensure that the certified contractors are performing the necessary field quality control (for example, on the application of the transition membrane, sealant and spray foam as per CAN/ULC-S705.2-05, “Thermal Insulation – Spray Applied Rigid Polyurethane Foam, Medium Density – Application”).

Caliber conducts periodic audits to ensure:

- the approved accessories are being used;
- proper installation of the transition membrane by conducting periodic tension testing as part of the BASF Canada Inc.-specified quality control;
- proper continuity details and substrate conformance as part of the quality control procedure for the product;
- proper application of the “WALLTITE® v.3” spray-applied polyurethane foam insulation; and
- the daily work records are maintained for the ABS installation.

All results must be recorded on the Caliber daily worksheet for the “HP+™ E and X Series – Air Barrier System.”

3.3 Thermal Insulation – Field Quality Assurance

When “WALLTITE® v.3” is applied as a spray-foam insulation, the material must be manufactured on site by qualified installers trained by BASF Canada Inc. with field inspections carried out by Caliber. Caliber certifies BASF Canada Inc.’s training program and provides follow-up inspections to ensure installations are in accordance with CAN/ULC-S705.2.”

The product must be installed in accordance with the manufacturer’s installation manual. A copy of this manual must be available on the job site at all times during the installation. All installers must present their Caliber certification card and daily work record upon request by the building officials.

Note: the BASF Canada Inc. field quality assurance program calls for periodic audits of the installers. These audits usually consist of random inspections. Some larger projects are subject to mandatory inspections. Building officials may contact BASF Canada Inc. (866-474-3538) and request an inspection for a specific job site if they deem it necessary. In cases where the installation is deemed non-conforming by Caliber/BASF Canada Inc. and the non-conformance is not remedied by the installer, Caliber/BASF Canada Inc. will inform the owner/architect/building official of the non-conforming installation.

See CCMC 13588-L for additional limitations on the installation of the “WALLTITE® v.3” spray-foam product.

“Elastospray® 8000A” isocyanate and the polyurethane resin “WALLTITE® v.3” must have their containers (i.e., drums) identified by the phrase “CCMC 14127-R” and “CCMC 13588-L,” respectively.

4. Technical Evidence

The Report Holder has submitted technical documentation for CCMC’s evaluation. Testing was conducted at laboratories recognized by CCMC. The corresponding technical evidence for this product is summarized below.

4.1 Performance Requirements

The results of the air leakage tests conducted on three representative wall assemblies are summarized in Table 4.1.1.1. The durability test results of the ABS components are summarized in Table 4.1.2.1. The performance of the product has been tested in accordance with the CCMC Technical Guide for qualification for use as an ABS.

To qualify, a conforming ABS must:

- have an acceptable low air leakage rate;
- be continuous;
- be durable;
- have sufficient strength to resist the anticipated air pressure load; and
- be buildable in the field.

4.1.1 Air Leakage Rate

Table 4.1.1.1 Results of Testing the “HP+™ E and X Series – Air Barrier System”

Type of Wall ⁽⁴⁾ (see Figures 1 to 3 in Appendix A of this Report)	Air Leakage Requirement (ULC-S742 Classification)	Result ⁽¹⁾	
		Air Leakage Rate After Wind Loading at 75 Pa ΔP	Air Leakage Rate After Wind Loading at –20°C and at 75 Pa ΔP
“HP+™ E Series”	A1 ⁽³⁾ ≤ 0.05 L/(s·m ²)	0.029 L/(s·m ²)	0.039 L/(s·m ²) ⁽²⁾
“HP+™ X Series”		0.036 L/(s·m ²)	0.042 L/(s·m ²) ⁽²⁾

Notes to Table 4.1.1.1:

- (1) The air leakage rate of the wall assemblies was determined after the specimens were exposed to structural aging. Aging of the ABS was conducted considering the target sustained wind pressure difference of $Q_{1/50} = 1\,000$ Pa (P_1) and a maximum building height of 12 m for Part 9 buildings. Therefore, the wall assemblies were subjected to the following loading schedule:
 - one-hour sustained positive and negative pressure set at 1 000 Pa (P_1);
 - 2 000 cycles of positive and negative pressure set at 1 460 Pa (P_2);
 - wind gust of positive and negative pressure set at 2 180 Pa (P_3); and
 - deflection loading at 1 460 Pa held for ten seconds.
- (2) The air leakage rate was determined in accordance with ASTM E 1424, “Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure and Temperature Differences Across the Specimen,” at an air temperature of –20°C to verify any deformation causing air leakage at low temperature.
- (3) The air leakage rate requirement is based on Table 4.1.1.2, Permissible Air Leakage Rate, developed by CCMC/NRC with input from an industry consortium. The table is deemed to meet the intent of the NBC 2010 and NBC 2015 with regard to ABS performance. Considering that the maximum air leakage rate of the tested wall specimens (see Table 4.1.1.1) is lower than 0.05 L/(s·m²), the water vapour permeance of the outermost layer, in this case, “Neopor®,” can be between 15 and 60 ng/(Pa·s·m²) or higher.
- (4) The tested wall assemblies did not lose their integrity during the wind pressure loading.

Table 4.1.1.2 Permissible Air Leakage Rate

Water Vapour Permeance (WVP) of Outermost Layer of Wall Assembly (ng/(Pa·s·m ²))	Maximum Permissible Air Leakage Rate of ABS (L/s·m ²) @ 75 Pa ΔP
15 < WVP ≤ 60	0.05
60 < WVP ≤ 170	0.10
170 < WVP ≤ 800	0.15
> 800	0.20

For more information on the CCMC Technical Guide requirements and how they relate to those of the NBC 2010 and NBC 2015, please see the NRC publication ISBN 0-60-16862-6, “Air Barrier Systems for Walls of Low-Rise Buildings: Performance and Assessment.”

4.1.2 Durability of Air Barrier System Components

Table 4.1.2.1 Results of Durability Testing of Components in the “HP+™ E and X Series – Air Barrier System”

Property		Requirement	Result
Spray-applied polyurethane foam insulation	“WALLTITE® v.3” by BASF Canada Inc.	air permeance before and after aging (ASTM D 726): < 10% increase	Passed
		thermal resistance after heat aging and weathering (ASTM C 518) 90% retention	Passed
Transition membrane	“3M™ Air and Vapour Barrier 3015” by 3M Canada Company	physical properties before and after aging: 85% retention	Passed
	or “HP+™ Flash” a liquid flashing by BASF used in conjunction with “Tyvek® HomeWrap™ Breather Type Sheathing Membrane”		
Sealant	“MasterSeal® NP1™” by BASF	complies with ASTM C 920	Passed

5. Additional Data

Data in this section does not form part of CCMC’s opinion in Section 1.

The following test data are provided for information purposes only as CCMC opinion of the product compliance with NBC 2010 and NBC 2015 stated in this Report is limited to a maximum building height of 12 m for Part 9 buildings. For the applicability of the ABS rating and durability of the components, in wood frame construction beyond Part 9, the stamp of an engineer is required for acceptance by the authorities having jurisdiction (AHJs).

The third-party testing laboratory that conducted the air leakage tests in compliance with CAN/ULC-S742 also reported the following sustained hourly wind pressure loads and its corresponding building heights other than 12 m:

1. Q_{1/50} sustained hourly wind pressure load 0.450 kPa (450 Pa) and building height of 60 m;
2. Q_{1/50} sustained hourly wind pressure load 0.550 kPa (550 Pa) and building height of 20 m;
3. Q_{1/50} sustained hourly wind pressure load 0.650 kPa (650 Pa) and building height of 20 m;
4. Q_{1/50} sustained hourly wind pressure load 0.750 kPa (750 Pa) and building height of 20 m; and
5. Q_{1/50} sustained hourly wind pressure load 0.850 kPa (850 Pa) and building height of 20 m.

The tested wall specimens did not lose their integrity during the wind pressure loading.

Report Holder

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Date modified:
2019-09-18

APPENDIX A

Specimens Tested for Qualifying System Details

Figures 1 to 4 outline the original full-scale wall specimens tested with “WALLTITE® v.3,” which represent typical construction details to be reproduced in the field as part of the installation of BASF Canada Inc.’s proprietary “HP+™ E and X Series – Air Barrier System.” Figures 5 to 10 depict the continuity details of the ABS at penetrations. The representative specimens tested also contained defects (e.g., “Neopor® Graphite Polystyrene (GPS)” defects, etc.) to verify the sensitivity of the ABS to these possible field defects and allow for tolerances. See the “HP+™ Wall System – Technical Installation Manual (revision date 8 May 2019)” and “HP+™ Wall System – 3D Field Assembly Guide (version 2019-05-01)” for complete details.

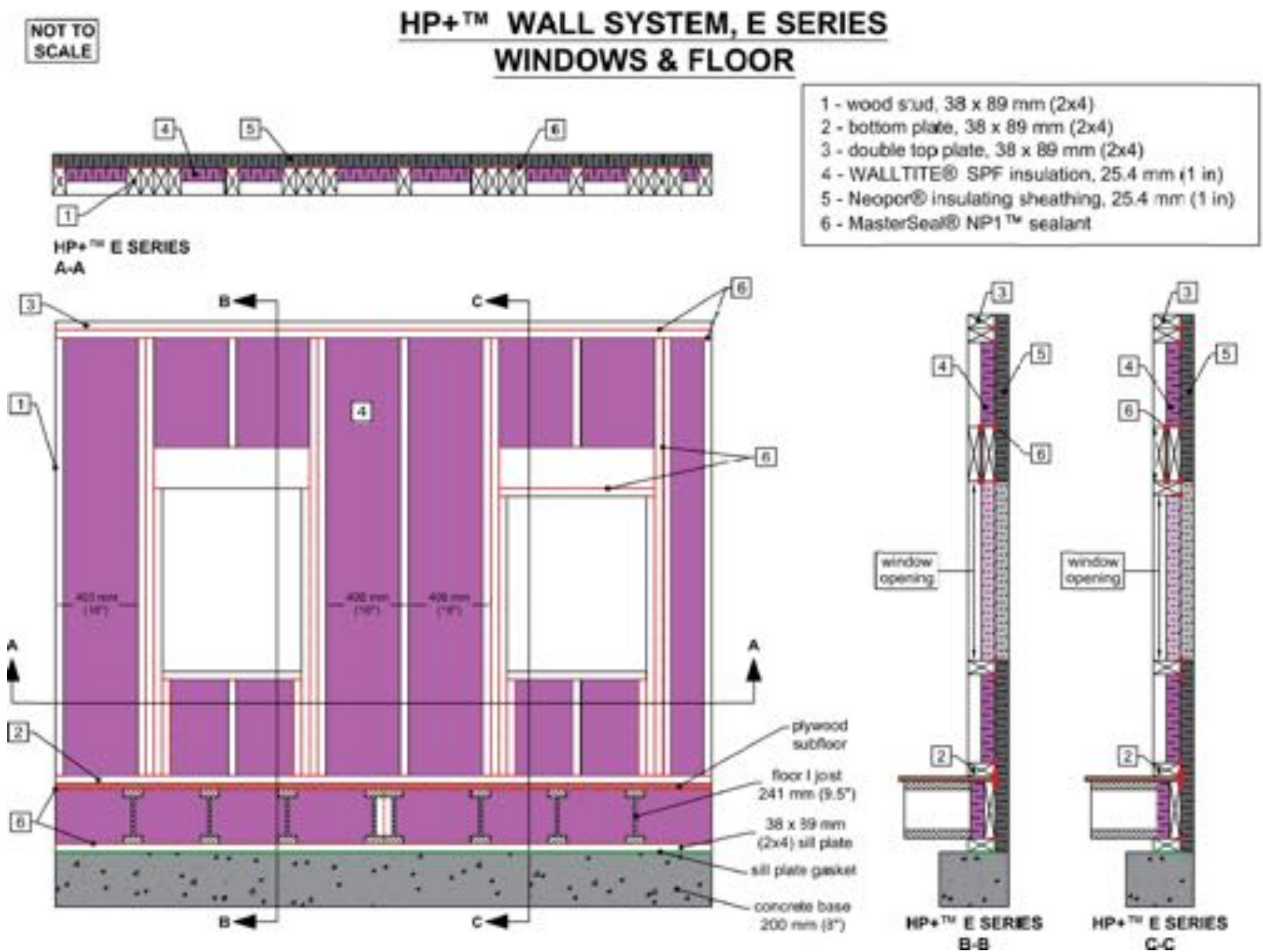


Figure 1. Tested wall specimen “HP+™ E Series” with windows, floor and concrete base

Since a concrete base is built as part of the tested wall specimens to represent the foundation wall, a sill plate gasket was installed at the joint between the concrete base and wood sill plate to comply with Sentence 9.23.7.2.(2), Levelling and Sealing of Sill Plates, of Division B of the NBC 2010 and NBC 2015.

Masonry veneer anchors and service penetrations (pipe, electrical box and steel duct) were introduced in the tested wall specimen “HP+™ E Series.”

The joint between rim boards must be sealed with “MasterSeal® NP1™.” Figure 1 shows a rim board joint that has been sealed (vertical red line) in the area where two I-Joists were installed side by side. See Figure 5 for further details.

HP+™ WALL SYSTEM, E AND X SERIES OPAQUE WALL

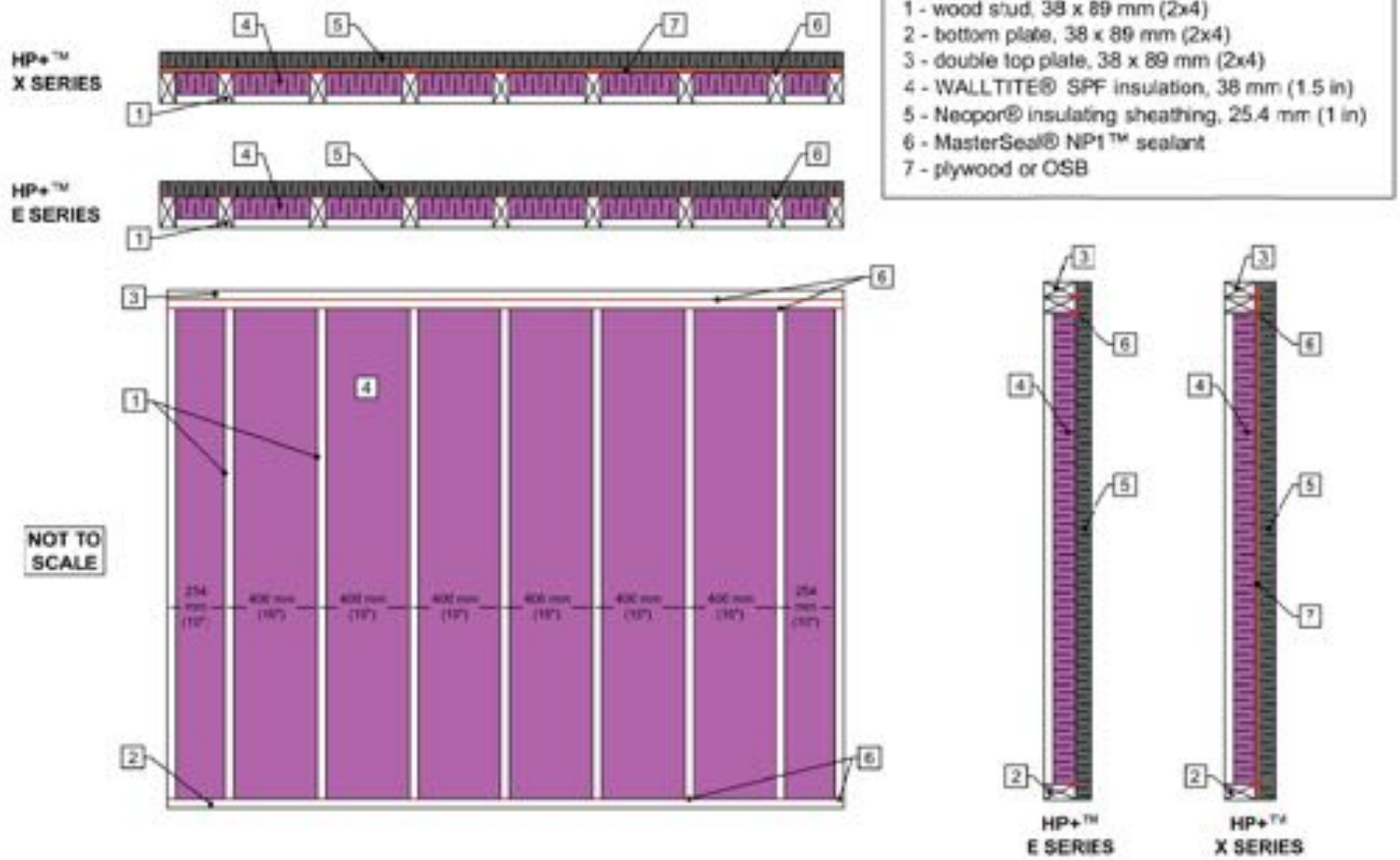


Figure 2. Tested wall specimens “HP+™ E and X Series” opaque wall

HP+™ WALL SYSTEM, E AND X SERIES WINDOW & FLOOR

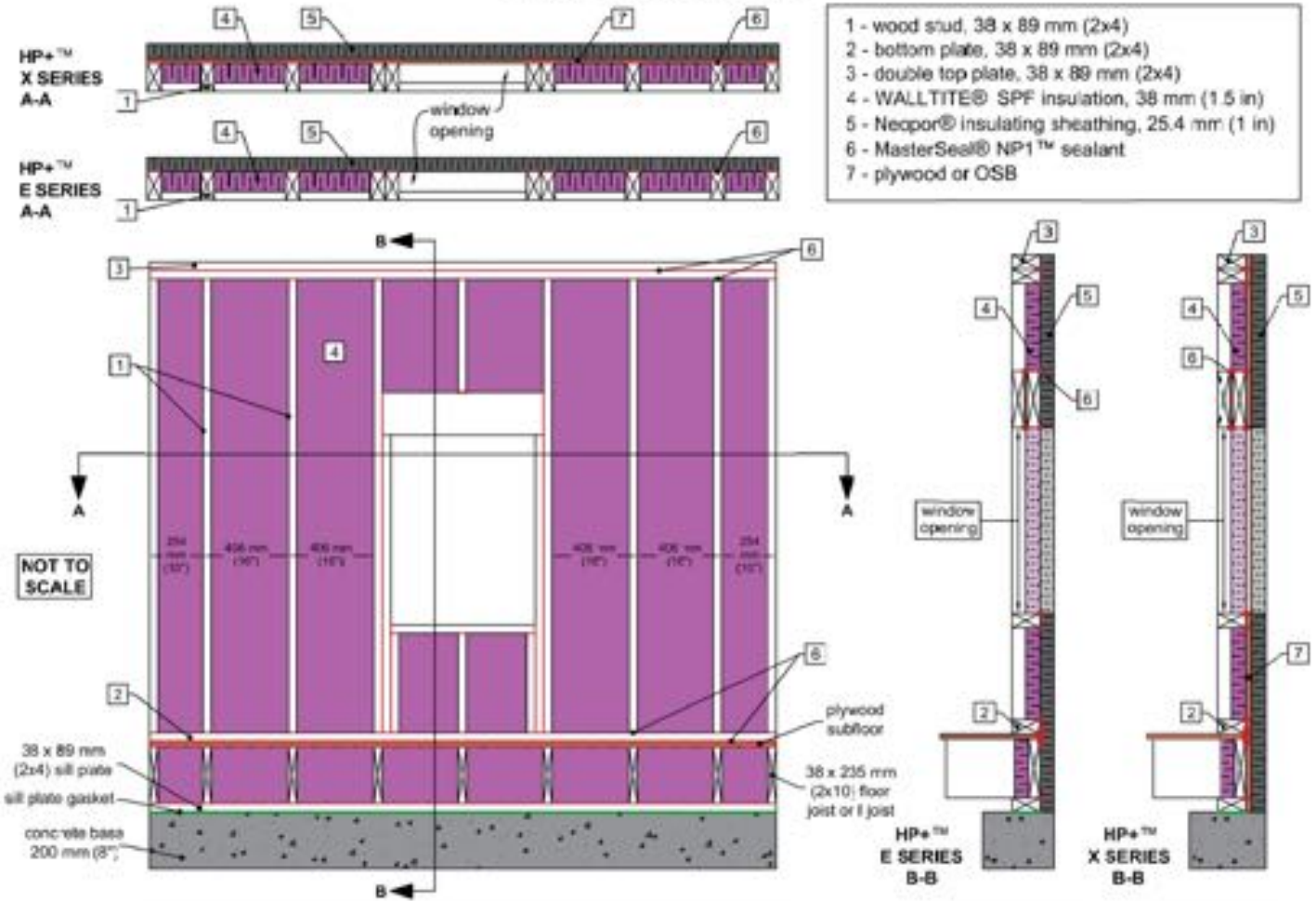


Figure 3. Tested wall specimens “HP+™ E” and “HP+™ X Series” with windows, floor and concrete base

Since a concrete base is built as part of the tested wall specimens to represent the foundation wall, a sill plate gasket was installed at the joint between the concrete base and wood sill plate to comply with Sentence 9.23.7.2.(2) of Division B of the NBC 2010 and NBC 2015.

Masonry veneer anchors and service penetrations (various types of pipe) were introduced in the tested wall specimen “HP+™ E and X Series.”

HP+™ Wall System, E Series
Neopor Attachment (exterior view)

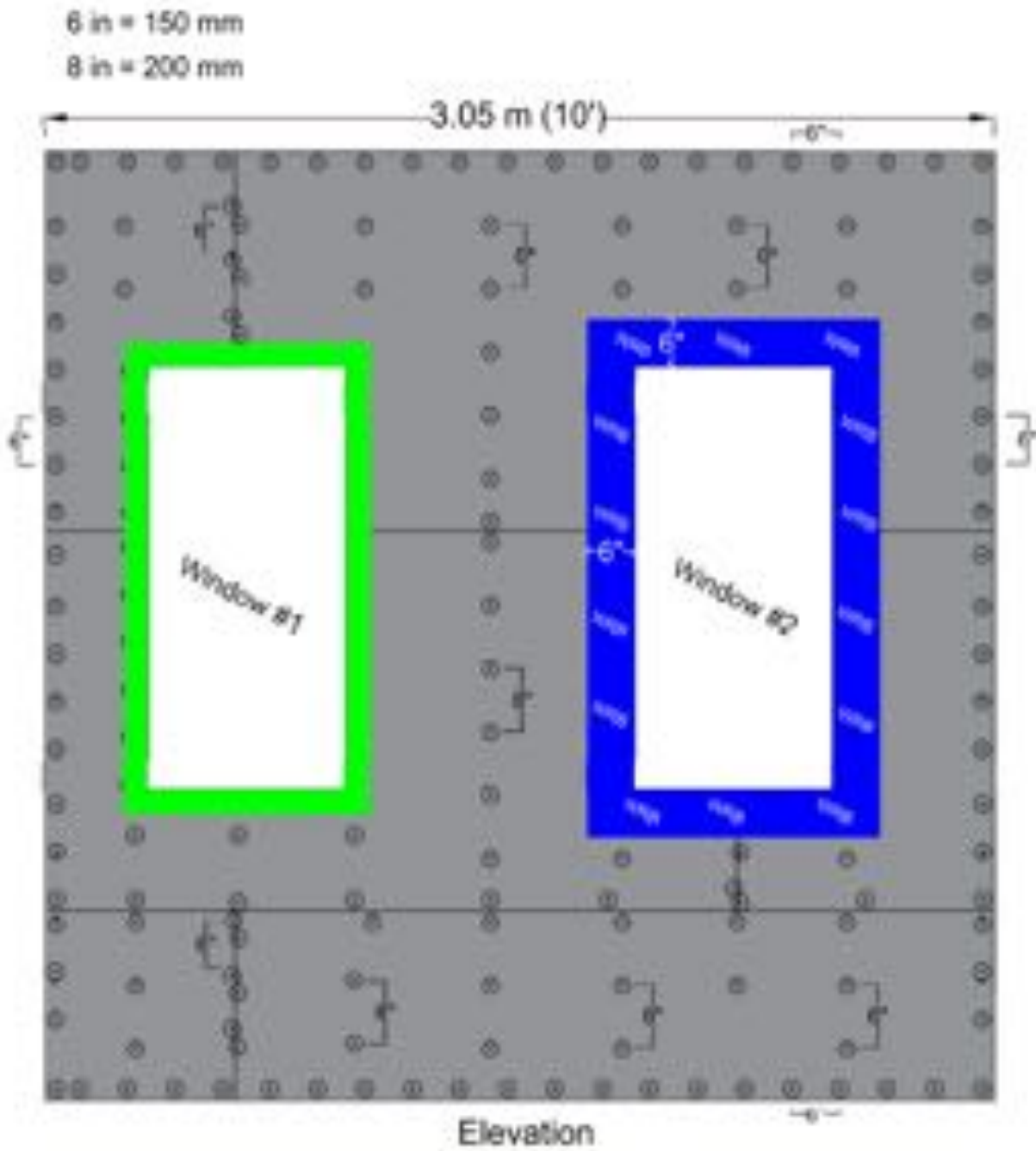


Figure 4. “Neopor® Graphite Polystyrene (GPS)” attachment

HP+™ Wall System, E Series Wall Framing

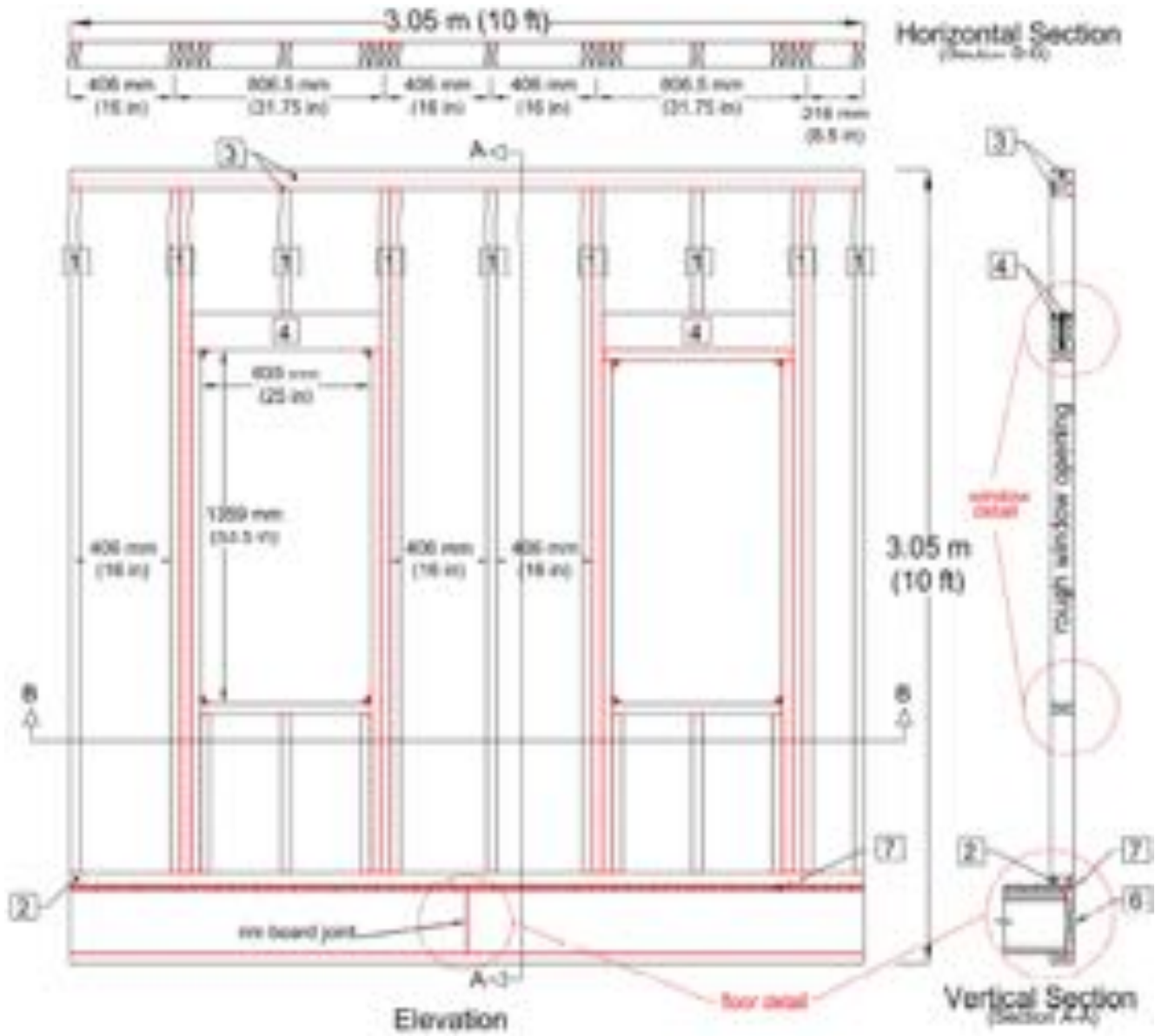


Figure 5. “MasterSeal® NP1™” at wood frame joints

HP+™ Wall System, E and X Series, Wall/Window Details
MasterSeal Sealant (caulking) and Self-Adhesive Membrane

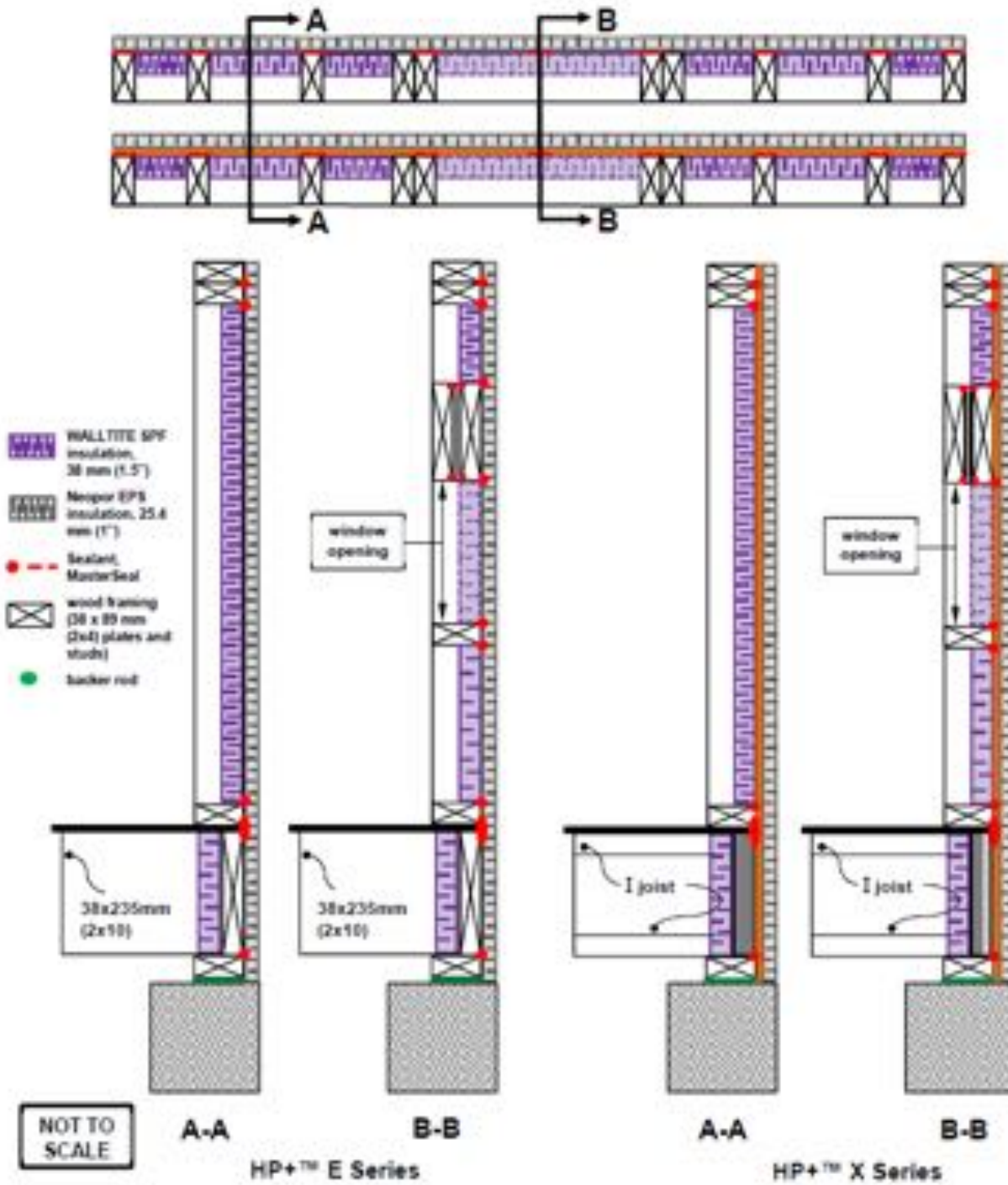


Figure 6. Additional details of “MasterSeal® NPI™” at wood frame joints

HP+™ Wall System, E and X Series, Wall/Window Details
MasterSeal Sealant (caulking) and Self-Adhesive Membrane

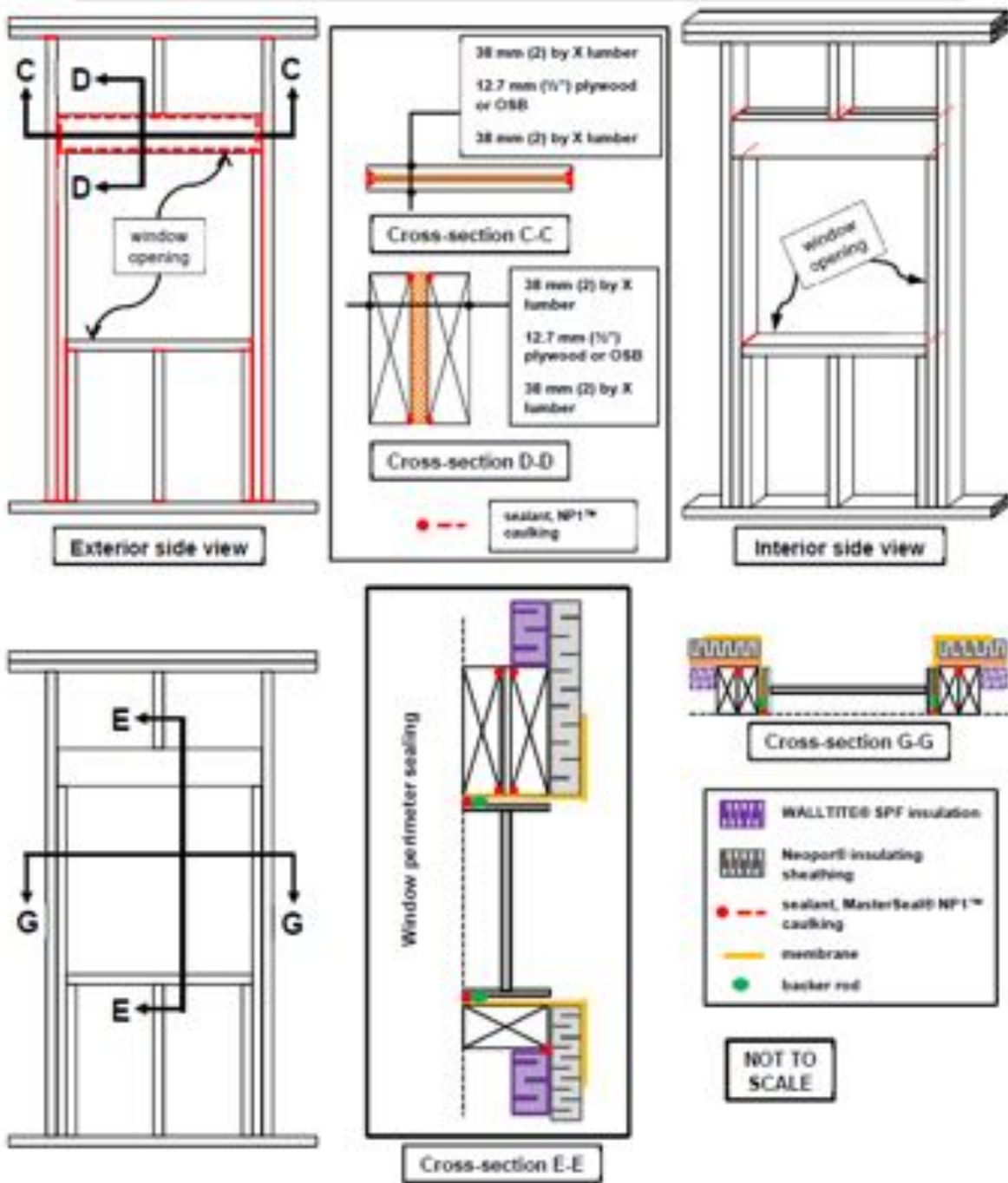
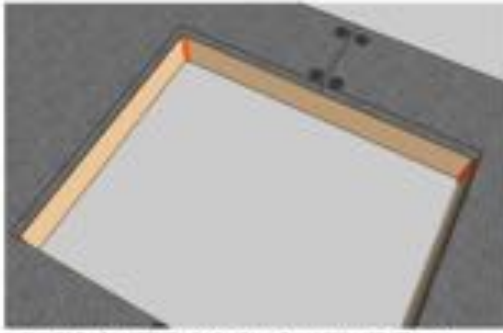


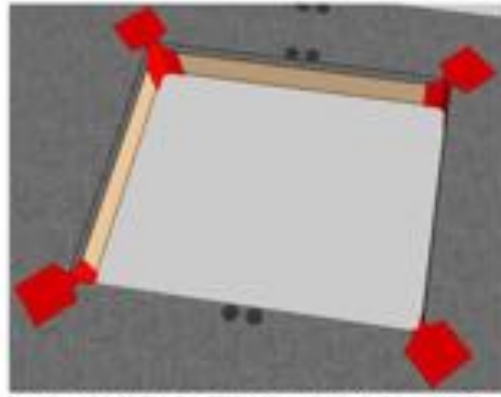
Figure 7. Accessories to address the continuity at window/door penetrations for the “HP+™ E Series” and “HP+™ X Series”

HP+™ Wall System, E and X Series, Wall/Window Details
MasterSeal Sealant (caulking) and Self-Adhesive Membrane

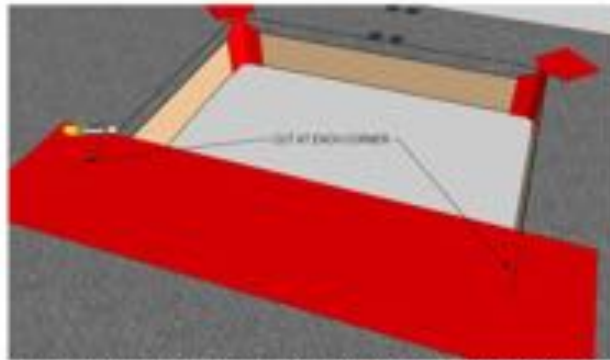
STEP 9A - AIR / WATER TIGHTNESS OF OPENINGS



A - ENSURE THAT MASTERSEAL™ NP1 SEALANT HAS BEEN APPLIED IN ALL CORNERS OF OPENINGS



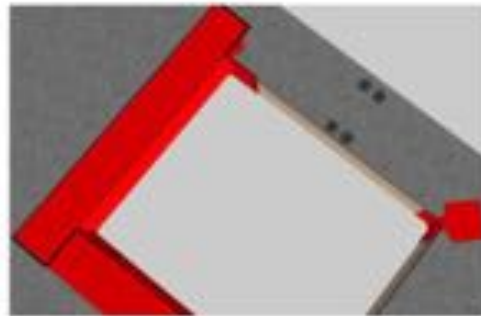
B - INSTALL AIR BARRIER AND WATERPROOFING MEMBRANE AT EACH CORNER, COVERING SEALANT INSTALLED IN STEP T



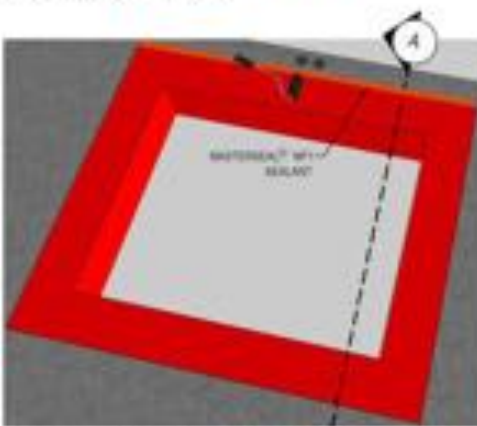
C - STARTING ALONG BOTTOM EDGE, INSTALL MEMBRANE AROUND ENTIRE PERIMETER OF OPENINGS



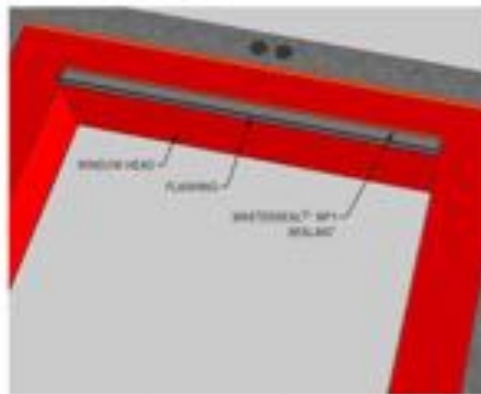
D - FOLD MEMBRANE INTO OPENING



E - INSTALL MEMBRANE ALONG VERTICAL EDGES OF OPENINGS



F - WHEN REQUIRED BY MANUFACTURER USE ROLLER TO APPLY PRESSURE AND SEAL MEMBRANE TO SUBSTRATE

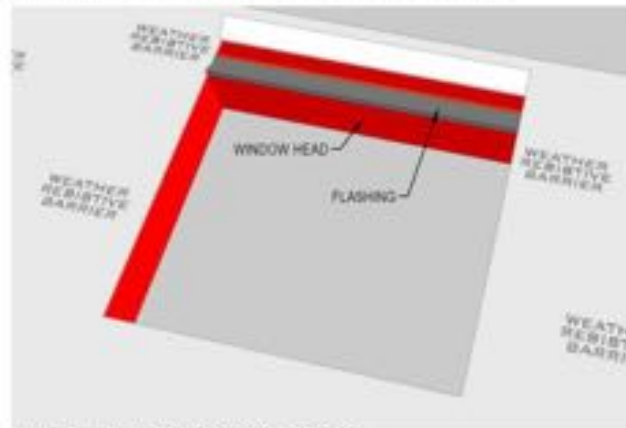


G - INSTALL THE WINDOW HEAD FLASHING

Figure 8a. Transition membrane to address the continuity at window/door penetrations for the “HP+™ E Series” and “HP+™ X Series”

STEP 9B - AIR / WATER TIGHTNESS OF OPENINGS - WEATHER-RESISTIVE BARRIER OPTION

EXECUTE STEPS "A TO G" AND CONTINUE WITH THE FOLLOWING STEPS WHEN USING A WEATHER-RESISTIVE BARRIER



H - INSTALL THE WEATHER-RESISTIVE BARRIER



I - INSTALL A SELF-ADHESIVE TAPE ALONG THE EDGES OF THE WEATHER-RESISTIVE BARRIER

Figure 8b. Transition membrane to address the continuity at window/door penetrations for the “HP+™ E Series” and “HP+™ X Series”

HP+™ Wall System, E and X Series, Wall/Window Details “HP+™ Flash” with “Tyvek® HomeWrap™ Breather Type Sheathing Membrane”

STEP 9C - AIR / WATER TIGHTNESS OF OPENINGS - WEATHER-RESISTIVE BARRIER + LIQUID MEMBRANE OPTION

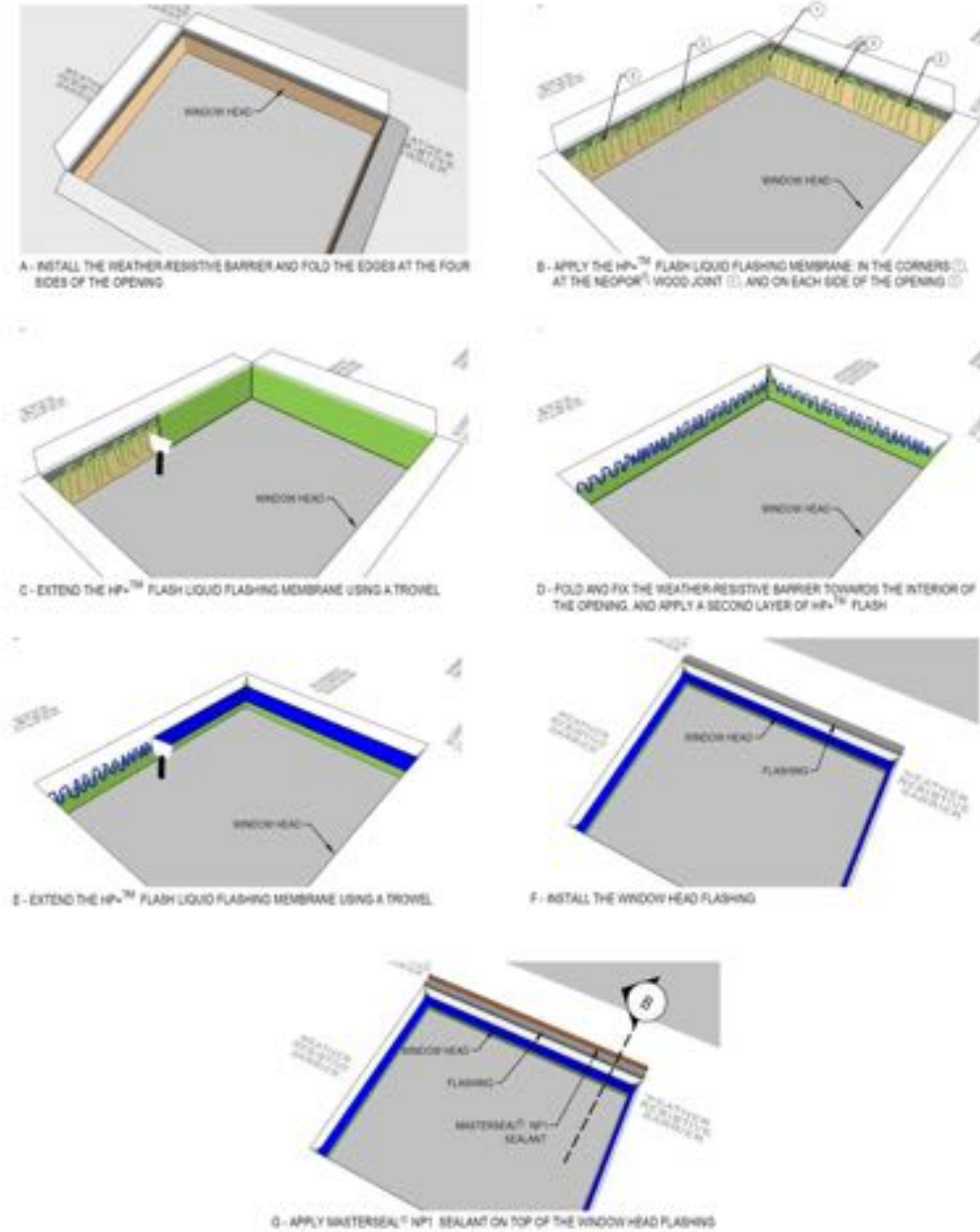


Figure 9. Transition membrane to address the continuity at window/door penetrations for the “HP+™ XR and XR-S Series”

HP+™ WALL SYTEM, E, X AND XR SERIES PENETRATION DETAILS

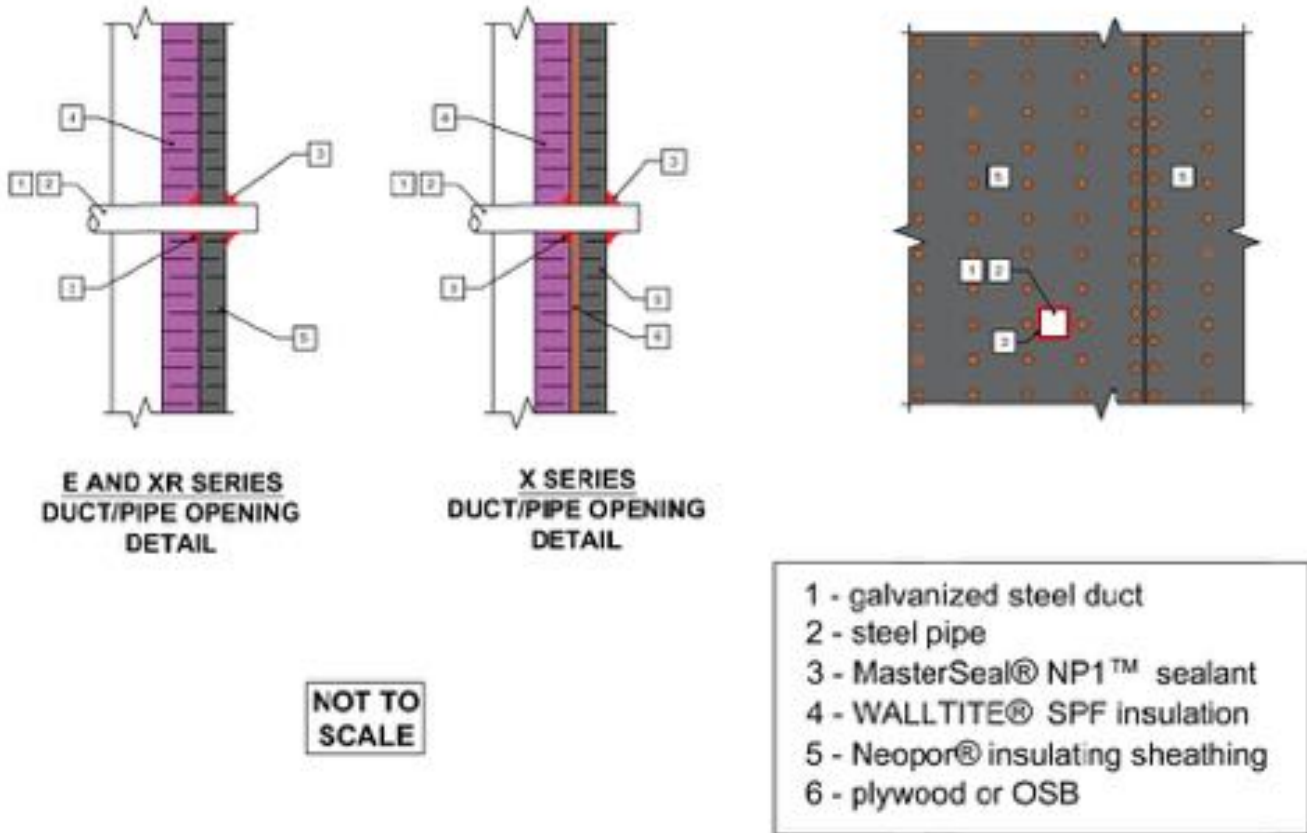


Figure 10. Sealant “MasterSeal® NP1™” to address the continuity at penetrations for the “HP+™ E Series” and “HP+™ X Series”