Technical Evaluation Report
TER 1403-02
BASF HP+ Wall X Series

BASF Corporation

Product:
BASF Corporation HP+ Wall X Series utilizing WALLTITE® HP+ SPF in combination with Neopor® Graphite Polystyrene FPIS laminated to 7/16" OSB with BASF-approved adhesive

Issue Date:
December 21, 2015
Revision Date:
December 19, 2019
Subject to Renewal:
January 1, 2021
1 PRODUCT EVALUATED

1.1 BASF Corporation HP+ Wall X Series utilizing WALLTITE® HP+ SPF in combination with Neopor® Graphite Polystyrene FPIS laminated to 7/16” OSB with BASF-approved adhesive

2 APPLICABLE CODES AND STANDARDS

2.1 Codes

2.1.1 IBC—12, 15, 18: International Building Code®

2.1.2 IRC—12, 15, 18: International Residential Code®

2.1.3 IECC—12, 15, 18: International Energy Conservation Code®

2.1.4 IFC—14, 17: International Fire Code®
2.2 Standards and Referenced Documents

2.2.1 AATCC TM127: Water Resistance: Hydrostatic Pressure Test
2.2.2 ACC: Guidance on Best Practices for the Installation of Spray Polyurethane Foam
2.2.3 ACC: Ventilation Considerations for Spray Polyurethane Foam
2.2.4 ANSI/AWC SDPWS: Special Design Provisions for Wind and Seismic
2.2.5 ASCE/SEI 7: Minimum Design Loads and Associated Criteria for Buildings and Other Structures
2.2.7 ASTM C578: Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
2.2.8 ASTM D1622: Standard Test Method for Apparent Density of Rigid Cellular Plastics
2.2.9 ASTM D1623: Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics
2.2.10 ASTM D2126: Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
2.2.11 ASTM D2842: Standard Test Method for Water Absorption of Rigid Cellular Plastics
2.2.12 ASTM D6226: Standard Test Method for Open Cell Content of Rigid Cellular Plastics
2.2.13 ASTM E2126: Standard Test Methods for Cyclic (Reversed) Load Test for Shear Resistance of Vertical Elements of the Lateral Force Resisting Systems for Buildings
2.2.14 ASTM E2178: Standard Test Method for Air Permeance of Building Materials
2.2.15 ASTM E283: Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
2.2.16 ASTM E330: Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
2.2.17 ASTM E331: Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
2.2.18 ASTM E564: Standard Practice for Static Load Test for Shear Resistance of Framed Walls for Buildings
2.2.19 ASTM E72: Standard Test Methods of Conducting Strength Tests of Panels for Building Construction
2.2.20 ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials
2.2.21 ASTM E96: Standard Test Methods for Water Vapor Transmission of Materials
2.2.22 NFPA 286: Standard Methods of Fire Test for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth
2.2.23 SBCA: Guide for Handling, Installing & Temporary Bracing of Wall Panels

3 PERFORMANCE EVALUATION

3.1 BASF HP+ Wall X Series was evaluated to determine:

3.1.1 Structural performance under lateral load conditions for use as an alternative to the IRC Continuous Wall Bracing provisions of IRC Section R602.10.4, Method CS-WSP (Continuously Sheathed Wood Structural Panel).
3.1.2 Structural performance under lateral load conditions for use as an alternative to the Conventional Wall Bracing provisions of IBC Section 2308.6.3, Method 3, for Type V construction.
3.1.3 Structural performance under lateral load conditions for both wind and seismic loading for use with the performance-based provisions of IBC Section 2306.1 and Section 2306.3 for light-frame wood wall assemblies.

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3.1.3.1 Table 5 provides seismic design coefficients (SDC) that conform to the requirements in ASCE 7 Section 12.2.1.1\(^5\) and Table 12.2-1 for design of wall assemblies in buildings that require seismic design in accordance with ASCE 7 (i.e., all seismic design categories).

3.1.3.2 The basis for equivalency testing is outlined in ASCE 7 Section 12.2.1.1:\(^6\)

**Alternative Structural Systems.** Use of seismic force-resisting systems not contained in Table 12.2-1 shall be permitted contingent on submittal to and approval by the Authority Having Jurisdiction and independent structural design review of an accompanying set of design criteria and substantiating analytical and test data. The design criteria shall specify any limitations on system use, including Seismic Design Category and height; required procedures for designing the system's components and connections; required detailing; and the values of the response modification coefficient, R; overstrength factor, Ω; and deflection amplification factor, C_d.

3.1.3.3 The SDC evaluation uses the approach found in documentation entitled “Equivalency Characteristics and Parameters for Proprietary Shear Walls Used in Wood Framed or Cold-formed Steel Construction”\(^7\) and “Seismic Design Coefficients: How they are determined for light-frame components”\(^8\) using code-defined accepted engineering procedures, experience, and good technical judgment.

3.1.4 Structural performance under lateral load conditions for use as an alternative to SDPWS Section 4.3 Wood-Frame Shear Walls.

3.1.5 Structural performance under uplift and gravity loads for use with single top plates in accordance with IBC Section 1604 and IRC Section R301.1.

3.1.6 Structural performance under transverse load conditions for use as an exterior wall covering in accordance with IBC Chapter 14 and IRC Chapter 7.

3.1.7 Continuous insulated sheathing requirements for thermal resistance (R-value) complying with the provisions of IRC Section N1102 and IECC Section C402.

3.1.8 Performance for use as a component of the air barrier in accordance with IRC Section N1102.4.1 and IECC Section R402.4.1.1 and Section C402.5.1.\(^9\)

3.1.9 Surface burn characteristics complying with the provisions of IBC Section 2603.3 and IRC Section R316.3.

3.2 Performance of the HP+ Wall X Series or any of its component materials for use as a water-resistive barrier (WRB) assembly or WRB material is outside the scope of this TER.

3.3 Performance of the HP+ Wall X Series or any of its component materials as used in the normal construction process is outside the scope of this TER.

3.3.1 This includes storage, weather conditions, durability considerations, handling, installing, restraining, and bracing of the HP+ Wall X Series system through the shipping, storing, and construction means and methods process.

3.4 Use of BASF HP+ Wall X Series in a portal frame is outside the scope of this TER.

3.5 Any code compliance issues not specifically addressed in this section are outside the scope of this TER.

3.6 Any engineering evaluation conducted for this TER was performed on the dates provided in this TER and within DrJ’s professional scope of work.

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\(^5\) 2010 ASCE 7 Section 12.2.1

\(^6\) 2010 ASCE 7 Section 12.2.1

\(^7\) Ronald F. "Rawn" Nelson, S.E.; Establishing Seismic Equivalency for Proprietary Prefabricated Shear Panels (2008)

\(^8\) SBC Magazine; Seismic Design Coefficients: How they are determined for light-frame components (2014)

\(^9\) 2012 IECC Section C402.4.1
4 PRODUCT DESCRIPTION AND MATERIALS

4.1 BASF HP+ Wall X Series is a proprietary wall system consisting of BASF WALLTITE® HP+ Spray Polyurethane Foam (SPF) combined with Neopor® Foam Plastic Insulating Sheathing (FPIS) and 7/16” Oriented Strand Board (OSB) (Figure 1 and Figure 2).

4.1.1 The BASF HP+ Wall X Series described in this TER contains a combination of the following materials:

4.1.1.1 1½” WALLTITE® HP+ SPF
4.1.1.2 9/16” or 11/16” Neopor® FPIS laminated to 7/16” OSB

FIGURE 1. ILLUSTRATION OF HP+ WALL X SERIES SYSTEM
5 APPLICATIONS

5.1 BASF HP+ Wall X Series is used in buildings constructed in accordance with the IBC requirements for Type V light-frame construction.

5.2 BASF HP+ Wall X Series is used in buildings constructed in accordance with the IRC for light-frame wood construction.

5.3 BASF HP+ Wall X Series is used to provide the following:

5.3.1 Lateral load resistance (wind and seismic) for braced HP+ Wall X Series panels used in light-frame wood construction.

5.3.2 Transverse load resistance (wind pressure) for braced HP+ Wall X Series panels used in light-frame wood construction.

5.3.3 Thermal resistance in the exterior wall component of the building thermal envelope.

5.3.4 Resistance to uplift and gravity loads in single top plate applications for HP+ Wall X Series assemblies used in light-frame wood construction.

5.4 Structural Applications

5.4.1 Except as otherwise described in this TER, the BASF HP+ Wall X Series shall be installed in accordance with the applicable building codes listed in Section 2 using the provisions set forth therein for the design and installation of wood structural panels (WSP).

5.4.1.1 BASF HP+ Wall X Series is permitted to be designed in accordance with SDPWS for the design of shear walls using the methods set forth therein, including the perforated shear wall methodology, and subject to the SDPWS boundary conditions except as specifically allowed in this TER.

5.4.2 Anchorage for in-plane shear shall be provided to transfer the induced shear force into and out of each shear wall.

5.4.2.1 For wind design, anchor bolt spacing shall not exceed 6’ o.c. (1829 mm).

5.4.2.2 For seismic design, anchor bolt spacing shall not exceed 4’ o.c. (1219 mm).

5.4.3 The maximum aspect ratio for full height BASF HP+ Wall X Series braced wall segments shall be 4:1.

5.4.4 The minimum full height panel width shall be 24” (610 mm).

5.4.5 All Neopor® panel edges shall be supported with dimensional lumber or blocking a minimum 2” (51 mm) nominal in the least dimension.
5.4.6 Where the application exceeds the limitations set forth herein, design shall be permitted in accordance with accepted engineering procedures, experience, and technical judgment.

5.4.7 Prescriptive IRC Bracing Applications:

5.4.7.1 For wind design, BASF HP+ Wall X Series may be used to brace walls of buildings as an alternative to the IRC Continuous Wall Bracing provisions, IRC Section R602.10.4 (CS-WSP), in accordance with the bracing amounts shown in Table 1, as adjusted in accordance with IRC Table R602.10.3(2).

5.4.7.2 For seismic design, required braced wall panel lengths for BASF HP+ Wall X Series shall be as shown in Table 2, and shall be used in conjunction with IRC Table R602.10.3(4), which provides the required adjustments.

5.4.7.3 Where a building, or portion thereof, does not comply with one or more of the bracing requirements within the prescriptive section of the IRC, those portions shall be designed and constructed in accordance with IRC Section R301.1.
<table>
<thead>
<tr>
<th>Condition</th>
<th>Braced Wall Line Spacing (ft)</th>
<th>Minimum Total Length (ft) of Braced Wall Panels Required Along Each Braced Wall Line with Continuous Sheathing</th>
<th>Ultimate Design Wind Speed, ( V_{\text{ul}} ) (mph)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HP+ Wall X Series(^2)</td>
<td>WSP Structural Sheathing(^2)</td>
<td>( \leq 110 )</td>
</tr>
<tr>
<td>One Story or the Top of Two or Three Stories</td>
<td>10</td>
<td>1.1</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>2.3</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>3.4</td>
<td>3.4</td>
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<td></td>
<td>40</td>
<td>4.2</td>
<td>4.6</td>
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<td>5.3</td>
<td>5.7</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>6.1</td>
<td>6.8</td>
</tr>
<tr>
<td>First Story of Two Stories or Second Story of Three Stories</td>
<td>10</td>
<td>2.3</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>4.2</td>
<td>4.9</td>
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<td>12.9</td>
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<td>10</td>
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<td>6.5</td>
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<td>16.0</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>17.5</td>
<td>19.0</td>
</tr>
</tbody>
</table>

\( \text{SI: } 1 \text{ in} = 25.4 \text{ mm}, 1 \text{ mph} = 1.61 \text{ km/h} \)

1. Linear interpolation is permitted.
2. BASF HP+ Wall X Series and WSP structural sheathing installed on 2x4 or 2x6 studs spaced 24” o.c. and fastened with nails spaced 6” o.c. at panel edges and 12” o.c. in the field of the panels.
3. Demonstrates equivalency to \textit{IRC Table R602.10.3(1)}. All adjustment factors from \textit{IRC Table R602.10.3(2)} shall be applied.
4. Minimum 1/2” gypsum wallboard shall be installed as part of the wall assembly and fastened with a minimum 5d cooler nails or 11/4” #6 type W or S screws spaced 16” o.c. at panel edges and 16” o.c. in the field of the panels. Where gypsum wallboard is not applied to the interior side of the wall assembly, bracing lengths shall be multiplied by a factor of 1.3.
5. Bracing lengths are the result of comparative equivalency testing and analysis using both tested and published design values as points of comparison. DrJ relies upon the design values published in the codes and standards listed in Section 2 that are adopted into law and that the manufacturers of those products stand behind. DrJ performs all equivalency analysis based on legally defined design values, the responsibility for which is the manufacturer of those products or the members of the associations that publish those design values.
6. Wind speeds are \( V_{\text{ul}} \) in accordance with \textit{ASCE 7-16}. To convert to equivalent \( V_{\text{assd}} \) wind speed for use with 2012 \textit{IBC}: \( V_{\text{assd}} = V_{\text{ul}}/\sqrt{1.6} \).
<table>
<thead>
<tr>
<th>Condition</th>
<th>Braced Wall Line Spacing (ft)</th>
<th>Minimum Total Length (ft) of Braced Wall Panels Required Along Each Braced Wall Line with Continuous Sheathing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>HP+ Wall X Series&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C</td>
</tr>
<tr>
<td>One Story or the Top of Two or Three Stories</td>
<td>10</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>3.1</td>
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<tr>
<td></td>
<td>40</td>
<td>4.1</td>
</tr>
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<td></td>
<td>50</td>
<td>5.2</td>
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<td>First Story of Two Stories or Second Story of Three Stories</td>
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<td>2.0</td>
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<td>3.8</td>
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<td>First Story of Three Stories</td>
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<tr>
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<td>8.7</td>
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<td>40</td>
<td>11.6</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>14.5</td>
</tr>
</tbody>
</table>

Sl: 1 in = 25.4 mm, 1 mph = 1.61 km/h
1. Linear interpolation is permitted.
2. BASF HP+ Wall X Series and WSP structural sheathing installed on 2x4 or 2x6 studs spaced 24” o.c. and fastened with nails spaced 6” o.c. at panel edges and 12” o.c. in the field of the panels.
3. Demonstrates equivalency to IRC Table R602.10.3(1). All adjustment factors from IRC Table R602.10.3(2) shall be applied.
4. Tabulated bracing lengths are based on the following:
   - Soil Class D
   - Wall height= 10’
   - 10 psf floor dead load
   - 15 psf roof/ceiling dead load
   - Braced wall line spacing ≤ 25’
5. Minimum 1/2” gypsum wallboard shall be installed as part of the wall assembly and fastened with a minimum 5d cooler nails or 11/4” #6 type W or S screws spaced 16” o.c. at panel edges and 16” o.c. in the field of the panels. Where gypsum wallboard is not applied to the interior side of the wall assembly, bracing lengths shall be multiplied by a factor of 1.3.
6. Bracing lengths are the result of comparative equivalency testing and analysis using both tested and published design values as points of comparison. DrJ relies upon the design values published in the codes and standards listed in Section 2 that are adopted into law and that the manufacturers of those products stand behind. DrJ performs all equivalency analysis based on legally defined design values, the responsibility for which is the manufacturer of those products or the members of the associations that publish those design values.
5.4.8  Alternative Prescriptive IRC Bracing Applications:

5.4.8.1  As an alternative to Section 5.7.2, the following provisions are permitted:

5.4.8.1.1  BASF HP+ Wall X Series may be used to brace walls of buildings as an alternative to the Continuous Wall Bracing provisions of IRC Section R602.10.4, when installed in accordance with this TER.

5.4.8.1.2  Required braced wall panel lengths for BASF HP+ Wall X Series shall be as determined by the equivalency factor shown in Table 2 and IRC Table R602.10.3(1) or IRC Table 602.10.3(3) including all footnotes.

5.4.8.1.2.1  Bracing lengths in these tables for Method CS-WSP shall be multiplied by the equivalency factor listed in Table 3.

### TABLE 3. BRACED WALL LINE LENGTH EQUIVALENCY FACTOR3

<table>
<thead>
<tr>
<th>Wall Assembly</th>
<th>Gypsum Sheathing1</th>
<th>Max. Stud Spacing2 (in)</th>
<th>Fastener</th>
<th>Fastener Spacing</th>
<th>Equivalency Factor to IRC CS-WSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASF HP+ Wall X Series</td>
<td>None</td>
<td>24 o.c.</td>
<td>0.131&quot; x 3&quot;</td>
<td>6:12</td>
<td>0.71</td>
</tr>
<tr>
<td></td>
<td>½&quot; GWB</td>
<td>24 o.c.</td>
<td>0.131&quot; x 3&quot;</td>
<td>6:12</td>
<td>0.76</td>
</tr>
</tbody>
</table>

St: 1 in = 25.4 mm
1. Gypsum sheathing installed with Type W screws at 16".16" spacing. Where gypsum wallboard is not applied to the interior side of the HP+ Wall X Series assembly, bracing lengths shall be multiplied by a factor of 1.3.
2. SPF framing
3. Multiply the bracing lengths in IRC Table R602.10.3(1) and IRC Table R602.10.3(2) Method WSP or CS-WSP as applicable, including all footnotes, by the factors shown here to establish the required bracing length.
4. Valid for single and double top plate HP+ Wall X Series installations
5. For factory-built applications only. Wall panels to be spray foamed in the horizontal position only.

5.4.8.1.2.2  These braced wall line length equivalency factors are based on equivalency testing and are used to comply with Method CS-WSP of the IRC.

5.4.8.1.2.3  BASF HP+ Wall X Series tested equivalency factors in Table 3 allow the user to determine the length of bracing required by multiplying the factor from Table 2 by the length shown in the CS column in IRC Table R602.10.3(1) or IRC Table 602.10.3(3) as modified by all applicable factors in IRC Table R602.10.3(2) or IRC Table R602.10.3(4), respectively.

5.4.8.1.3  All IRC prescriptive bracing minimums, spacing requirements, and rules must still be met.

5.4.9  Prescriptive IBC Conventional Light-Frame Wood Construction:

5.4.9.1  BASF HP+ Wall X Series may be used to brace exterior walls of buildings as an equivalent alternative to Method 3 of the IBC when installed continuously along the length of the braced wall line with ⅝" (13 mm) gypsum on the interior fastened with a minimum 5d cooler nail or #6 type W or S screw spaced a maximum of 16" o.c. (203 mm) at panel edges and 16" o.c. in the field. Bracing shall be in accordance with the conventional light-frame construction method of IBC Section 2308.6.3 and this TER.

5.4.10  Performance-Based Wood-Framed Construction:

5.4.10.1  BASF HP+ Wall X Series designed as shear walls are permitted to be designed in accordance with the methodology used in SDPWS for WSP using the capacities shown in Table 4, Table 5, Table 6, and Table 7.

5.4.10.2  BASF HP+ Wall X Series shear walls are permitted to resist horizontal wind load forces using the allowable shear loads (in pounds per linear foot) set forth in Table 4.
TABLE 4. ALLOWABLE STRESS DESIGN (ASD) CAPACITY FOR WIND

<table>
<thead>
<tr>
<th>Wall Assembly</th>
<th>Fastener</th>
<th>Max. Stud Spacing (in)</th>
<th>Fastener Spacing&lt;sup&gt;3&lt;/sup&gt; (edge:field) (in)</th>
<th>Gypsum Wallboard (GWB)</th>
<th>GWB Fastener Spacing&lt;sup&gt;3&lt;/sup&gt; (edge:field) (in)</th>
<th>Allowable Unit Shear Capacity (plf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASF HP+ Wall X Series</td>
<td>0.131” x 3” Nails</td>
<td>24 o.c.</td>
<td>6:12</td>
<td>None</td>
<td>N/A</td>
<td>475</td>
</tr>
<tr>
<td></td>
<td>½” GWB</td>
<td>16:16</td>
<td></td>
<td></td>
<td></td>
<td>515</td>
</tr>
</tbody>
</table>

St: 1 in = 25.4 mm, 1 lb/ft = 0.0146 kN/m
1. Minimum fastener size and spacing are as shown above with a minimum panel edge distance of 3/8”.
2. Sheathing used in BASF HP+ Wall X Series shall have joints butted at framing members, and a single row of fasteners must be applied to each panel edge into the stud below.
3. Fasteners may be spaced at 48:48, when applied in a factory setting with the panels spray foamed in the horizontal position.
4. Gypsum attached with minimum #6 type W or S screws 1¼” long.

5.4.10.3 BASF HP+ Wall X Series shear walls that require seismic design in accordance with IBC Section 1613 shall use the seismic allowable unit shear capacities set forth in Table 5.

5.4.10.3.1 The response modification coefficient, R, system overstrength factor, Ω<sub>0</sub>, and deflection amplification factor, C<sub>d</sub>, indicated in Table 5 shall be used to determine the base shear, element design forces, and design story drift in accordance with ASCE 7 Chapter 12 and Section 14.5.

TABLE 5. SEISMIC ALLOWABLE UNIT SHEAR & DESIGN COEFFICIENTS

<table>
<thead>
<tr>
<th>Seismic Force Resisting System</th>
<th>Max. Stud Spacing (in)</th>
<th>Gypsum Wallboard&lt;sup&gt;6&lt;/sup&gt; (GWB)</th>
<th>Seismic Allowable Unit Shear Capacity&lt;sup&gt;1&lt;/sup&gt; (plf)</th>
<th>Apparent Shear Stiffness, G&lt;sub&gt;s&lt;/sub&gt; (kips/in)</th>
<th>Response Modification Factor&lt;sup&gt;2&lt;/sup&gt;, R</th>
<th>System Overstrength Factor&lt;sup&gt;3&lt;/sup&gt;, Ω&lt;sub&gt;0&lt;/sub&gt;</th>
<th>Deflection Amplification Coefficient&lt;sup&gt;4&lt;/sup&gt;, C&lt;sub&gt;d&lt;/sub&gt;</th>
<th>Structural System Limitations and Building Height Limit&lt;sup&gt;5&lt;/sup&gt; (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASF HP+ Wall X Series</td>
<td>24 o.c.</td>
<td>None</td>
<td>380</td>
<td>10</td>
<td>6.5</td>
<td>3</td>
<td>4</td>
<td>NL</td>
</tr>
<tr>
<td></td>
<td>½” GWB</td>
<td>410</td>
<td>14</td>
<td>6.5</td>
<td>3</td>
<td>4</td>
<td>NL</td>
<td>65</td>
</tr>
</tbody>
</table>

St: 1 in = 25.4 mm, 1 lb/ft = 0.0146 kN/m
1. Allowable unit shear capacity is based on a safety factor of 2.5, in accordance with ASCE 7 Chapter 12.
2. Response modification coefficient, R, for use throughout ASCE 7. Note: R reduces forces to a strength level, not an allowable stress level.
3. The tabulated value of the overstrength factor, Ω<sub>0</sub>, is permitted to be reduced by subtracting 0.5 for structures with flexible diaphragms.
4. Deflection amplification factor, C<sub>d</sub>, for use with ASCE 7 Section 12.8.6, 12.8.7, and 12.9.2
5. NL = Not Limited. Heights are measured from the base of the structure as defined in ASCE 7 Section 11.2.
6. Gypsum attached with minimum #6 type W or S screws 1¼” long spaced 16” o.c. at panel edges and in the field. Maximum stud spacing is 24” o.c.

5.5 Axial loading

5.5.1 BASF HP+ Wall X Series has been tested for both uplift and compression on single top plate applications.

5.5.2 Table 6 shows the maximum allowable uplift and compression forces allowed in this application.

5.5.2.1 Designs using the allowable loads in Table 6 shall have a load path capable of transferring loads from their point of origin to their final point of resistance, in accordance with IRC Section R301.1.

5.5.2.2 Installation is permitted for single top plate (advanced framing method) or double top plate applications.

5.5.2.2.2 Where truss reactions are less than or equal to the values in Table 6, trusses can be set anywhere along the top plate as needed to frame the roof system.
TABLE 6. ALLOWABLE ROOF FRAMING REACTIONS ON BASF HP+ WALL X SERIES TOP PLATE

<table>
<thead>
<tr>
<th>Wall Assembly</th>
<th>Fastener Type</th>
<th>Spacing (in)</th>
<th>Interior Sheathing Material</th>
<th>Max. Roof Framing Reactions (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASF HP+ Wall X Series</td>
<td>0.131” x 3” Nail</td>
<td>6:12</td>
<td>None</td>
<td>1050</td>
</tr>
</tbody>
</table>

SI: 1 in = 25.4 mm, 1 lb = 4.45 N

1. Applies to placement anywhere along the wall top plate.
2. Maximum allowable load assumes load is concentrated at the mid-span of the top plate between studs.
3. HP+ Wall X Series assemblies are a maximum 24” o.c. stud spacing utilizing a single top plate. All stud cavities are filled with 1.5” BASF SPF.
4. All other framing connections are in accordance with the applicable building code.

5.5.2.2.2 Where a single top plate of No. 3, standard or stud grade dimensional lumber is used, studs below are spaced 24” o.c., and floor or roof framing members are spaced a maximum of 24” o.c., such members shall be located within 3” of the center of the studs below.

5.5.2.2.3 Where a single top plate of No. 2 SPF dimensional lumber or equivalent is used, studs below are spaced 24” o.c., and floor or roof framing members are spaced a maximum of 24” o.c., such members shall be located within 5” of the center of the studs below.

5.5.2.2.4 Uplift capacities are permitted to be increased through the use of mechanical connectors of the top plate to stud and sole plate to stud connections.

5.5.2.2.5 All other framing conditions shall be in accordance with the applicable code.

5.6 Perforated Shear Walls

5.6.1 BASF HP+ Wall X Series shear walls are permitted to be designed in accordance with the methodology found in SDPWS Section 4.3.3.5 with the following exceptions:

5.6.1.1 SDPWS Equation 4.3-5 for $C_o$ shall be replaced with the equation from Table 7.

<table>
<thead>
<tr>
<th>Wall Assembly</th>
<th>Replace SDPWS Eq. 4.3-5 with the Following</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASF HP+ Wall X Series</td>
<td>$C_o = \frac{r}{(1.1 - 0.1 \times r)} \times \frac{L_{tot}}{\sum L_i}$</td>
</tr>
</tbody>
</table>

5.6.1.2 Figure 3 shows how to calculate the capacity of a perforated shear wall with the BASF HP+ Wall X Series system using Table 7.
1. The total length of the perforated shear wall, $L_{tot}$, is 30'.
2. The height of the perforated shear wall, $h$, is 8'.
3. The sum of the perforated shear wall segment lengths, $\Sigma L_i$, is 10'.
   a. The total area of the openings, $A_o$, is:
   b. Two (2) 7' x 6' 6" openings – 45.5 sq. ft. x 2 = 91 sq. ft.
   c. Two (2) 3' x 3' 6" openings – 10.5 sq. ft. x 2 = 21 sq. ft.
   d. Total opening area is: 91 + 21 = 112 sq. ft.
4. Using SDPWS Equation 4.3-6, the sheathing area ratio, $r$, is:
   $$ r = \frac{1}{1 + \frac{A_o}{h \Sigma L_i}} = \frac{1}{1 + \frac{112}{8 \times 10}} = 0.417 $$
5. Using Table 7, the shear capacity adjustment factor, $C_o$, is:
   $$ C_o = \frac{r}{1 - 0.1 \times r} \times \frac{L_{tot}}{\Sigma L_i} = \frac{0.417}{1 - 0.1 \times 0.417} \times \frac{30}{10} = 1.18 $$
6. From Table 6, the allowable unit shear capacity, $v$, for the HP+ Wall X Series system is: 475 plf.
7. In accordance with SDPWS Section 4.3.3.5, the total ASD shear capacity of this perforated shear wall, $V_{perforated}$, is:
   $$ V_{perforated} = v \times \Sigma L_i \times C_o = 475 \text{ plf} \times 10 \text{ ft} \times 1.18 = 5605 \text{ lb} $$

**Figure 3. Example of a Perforated Shear Wall**

5.7 Transverse Wind Loading

5.7.1 BASF HP+ Wall X Series installed over exterior framing spaced a maximum of 24" o.c. without an interior covering can resist allowable wind loads (Table 8) and wind speeds (Table 9). Required components and cladding loads to be resisted are found in IBC Section 1609.1.1 and IRC Table R301.2(2) and Table R301.2(3).
### Table 8. Transverse (Out-of-Plane) Wind Load Resistance

<table>
<thead>
<tr>
<th>Wall Assembly</th>
<th>Maximum Stud Spacing (in)</th>
<th>Fastener Schedule²</th>
<th>Allowable Design Value (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASF HP+ Wall X Series</td>
<td>24 o.c.</td>
<td>0.131&quot; x 3&quot; nail, 48&quot;.48&quot; o.c. to edge:field</td>
<td>100</td>
</tr>
</tbody>
</table>

St: 1 in = 25.4 mm, 1 psf = 0.0479 kN/m²
1. Applicable to both the positive and negative direction
2. The attachment of the sheathing to the framing is primarily through the adhesion of the SPF to the framing and Neopor®. Average depth is 1.5".

### Table 9. Basic Wind Speed for Use in Exterior Wall Covering Assemblies²,³

<table>
<thead>
<tr>
<th>Wall Assembly</th>
<th>Allowable Components &amp; Cladding Basic Wind Speed¹ (mph)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ASCE 7-05 (Vasd)</td>
<td>ASCE 7-10 and 7-16 (Vult)</td>
</tr>
<tr>
<td>BASF HP+ Wall X Series with 5/8&quot; or 1½&quot; Neopor®</td>
<td>160</td>
<td>205</td>
</tr>
</tbody>
</table>

St: 1 mph = 1.61 km/h
1. Allowable wind speeds are based on the following: Mean roof height 30’, Exposure B, 10 sq. ft. effective wind area, corner zone 5.
2. 24" o.c. framing
3. BASF HP+ Wall X Series fastened with 0.131" x 3" nail, 48".48" o.c. to edge:field

5.8 Water-Resistive Barrier (WRB)
5.8.1 BASF HP+ Wall X Series shall be covered with a code-compliant WRB in accordance with IBC Section 1404.2¹⁰ and IRC Section R703.2.
5.8.2 Flashing shall be installed at all sheathing penetrations and shall comply with the applicable code sections.

5.9 Thermal Resistance (R-Value)
5.9.1 BASF HP+ Wall X Series meets the continuous insulated sheathing requirements complying with the provisions of IRC Section N1102 and IECC Section C402.
5.9.2 BASF HP+ Wall X Series has the thermal resistance as shown in Table 10.

### Table 10. Thermal Resistance Properties

<table>
<thead>
<tr>
<th>Product</th>
<th>Thickness (in)</th>
<th>R-Value (F<em>ft²</em>hr/Btu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/16&quot; Neopor® with 7/16&quot; OSB</td>
<td>1</td>
<td>3.2</td>
</tr>
<tr>
<td>1½&quot; Neopor® with 7/16&quot; OSB</td>
<td>1½</td>
<td>5.3</td>
</tr>
<tr>
<td>BASF WALLTITE® HP+ SPF</td>
<td>1½</td>
<td>10.0</td>
</tr>
</tbody>
</table>

St: 1 in = 25.4 mm
1. Tested at a mean temperature of 75°F. Assumes an 0.5 R-value for OSB

¹⁰ 2015 IBC Section 1405.2
5.10 **Air Barrier**

5.10.1 BASF HP+ Wall X Series meets the requirements of *IECC Section C402* for use as a component of the air barrier when installed in accordance with the manufacturer’s installation instructions and this TER, shown in Table 11.

**TABLE 11. AIR BARRIER PROPERTIES**

<table>
<thead>
<tr>
<th>Product</th>
<th>Air Permeance [L/(s*m²)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASF WALLTITE® HP+ SPF</td>
<td>&lt; 0.02</td>
</tr>
</tbody>
</table>

1. Tested in accordance with ASTM E2178
2. Testing conducted on SPF material only
3. Minimum 1½” thickness of SPF

5.11 **Surface Burn Characteristics**

5.11.1 BASF HP+ Wall X Series panels have the flame spread characteristics shown in Table 12.

**TABLE 12. SURFACE BURN CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Product</th>
<th>Flame Spread</th>
<th>Smoke Developed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neopor®</td>
<td>&lt; 25</td>
<td>&lt; 450</td>
</tr>
<tr>
<td>BASF WALLTITE® HP+ SPF</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Tested in accordance with ASTM E84

5.12 **Thermal Barrier Requirements – Attic, Crawlspace, or Other Uninhabitable Space Applications**

5.12.1 Installation shall be fully protected from the interior of the building by an approved 15-minute thermal barrier or ignition barrier as required by *IBC Section 2603.4* and *IRC Section R316.4*.

6 **Installation**

6.1 BASF HP+ Wall X Series shall be installed in a workmanlike manner subject to industry-accepted tolerances.

6.2 A copy of the manufacturer’s published installation instructions shall be available at all times on the jobsite during installation.

6.2.1 Frame walls in accordance with the construction documents and the applicable building codes.

6.2.2 Wall panel/section shall be square and true prior to sheathing with Neopor®/OSB.

6.2.3 The building designer is responsible for all temporary bracing. Please consult SBCA’s *Guide for Handling, Installing & Temporary Bracing of Wall Panels* for further information.

6.3 Where required, gypsum wallboard shall be a minimum ½” (13 mm) thickness.

6.4 Refer to the HP+ Wall X Series quality assurance (QC) procedures and installation manual for construction means and methods support.

6.4.1 Storage, weather conditions, durability considerations, handling, installing, restraining, and bracing of the panels are defined in the QC procedures and installation process to support proper construction means and methods.

6.5 Installation shall comply with the manufacturer’s installation instructions and this TER. In the event of a conflict between the manufacturer’s installation instructions and this TER, the more restrictive shall govern.
6.6 Neopor®/OSB Installation

6.6.1 Neopor®/OSB must be installed over studs having a nominal thickness of not less than 2” (51 mm) in the least dimension and spaced a maximum of 24” (610 mm) o.c. (Figure 4).

![Figure 4. Fastening of Neopor®/OSB & Gypsum Sheathing](image)

6.6.2 Neopor®/OSB must be installed vertically with the length dimension of the panels parallel to the framing behind and all panel edges supported by framing or blocking.

6.6.3 Neopor®/OSB shall be installed with minimum 0.113” shank diameter nail with a minimum 3/8” diameter head.

6.6.4 Fasteners shall be of sufficient length to penetrate the framing a minimum of ¾” and shall be installed with the head flush with the surface of the sheathing.

6.6.5 Fasteners shall be spaced a minimum of 6” o.c. (152 mm) at panel edges and 12” o.c. (305 mm) in the field.

6.6.6 Fasteners are intended to provide a temporary connection until the SPF is cured. Ensure tight connection between the Neopor®/OSB and framing. Alternate methods of providing this restraint are acceptable.

6.7 SPF Installation

6.7.1 SPF shall be installed only by persons trained in accordance with the BASF Quality Assurance and Training Program (QATP).

6.7.2 SPF sets almost immediately. Ensure wall is square and true prior to SPF application.

6.7.3 Ensure Neopor®/OSB is fastened tightly to the stud to prevent spray foam from entering and expanding between the stud and Neopor®/OSB.

6.7.4 Take care to protect area and personnel from overspray.

6.7.5 Reference Guidance on Best Practices for the Installation of Spray Polyurethane Foam and the Technical Product Data to understand how to properly process WALLTITE® HP+ at various conditions.

6.7.6 Use a properly functioning high pressure proportioning spray equipment to process WALLTITE® HP+. All parts of the spray gun need to function as intended and be clean and free of debris.

6.7.7 Substrate shall be clear of debris and dry to the touch before applying WALLTITE® HP+.

6.7.8 Measure the temperature of the Neopor® surface with an infrared gun. Substrate temperature shall be a minimum of 30°F and maximum of 105°F.

6.7.9 For proper processing of SPF components, refer to the WALLTITE® HP+ Technical Product Data.
6.7.9.1 Spray the initial pass of WALLTITE® HP+ to the Neopor® so that enough material is laid down to wet the surface without running or sagging.

6.7.9.2 WALLTITE® HP+ first pass should not exceed ½" thickness.

6.7.9.3 Allow wetted surface to foam completely and cool before subsequent 1.5" thick applications.

6.7.9.4 Lapse time between passes will be dependent on the Neopor® or foam substrate layer temperature.

6.7.10 Panels may be handled immediately after spraying. Full strength develops after 24 hours.

6.7.11 For more detailed installation guidelines, see Guidance on Best Practices for the Installation of Spray Polyurethane Foam and Ventilation Considerations for Spray Polyurethane Foam.

6.7.12 For enhanced automation processes, contact BASF.

6.7.13 Contractor must be BASF Quality Assurance Training Program certified.

6.8 Gypsum Wallboard Installation

6.8.1 Where required, gypsum wallboard shall be a minimum ½" (13 mm) thickness and shall be installed with a minimum of either of the following:

6.8.1.1 #6 x 1¼" (32 mm) type W or S screws

6.8.1.2 5d cooler nails

6.8.2 For IBC and IRC prescriptive applications, gypsum fasteners shall be spaced a maximum of 16" (406 mm) o.c. at panel edges and 16" o.c. at intermediate framing. For engineered design, see Table 3.

6.8.3 Fastener edge distance is a minimum of 3/8" (10 mm).

7 TEST ENGINEERING SUBSTANTIATING DATA

7.1 Lateral load testing in accordance with ASTM E2126

7.2 Transverse wind load testing in accordance with ASTM E330

7.3 Uplift load testing in accordance with ASTM E72

7.4 Gravity load testing for single top plate applications in accordance with ASTM E72

7.5 Strength testing for Neopor® with BASF SPF in accordance with ASTM E72

7.6 Strength testing for OSB with BASF SPF in accordance with ASTM E72

7.7 Strength testing for OSB in accordance with ASTM E72

7.8 Surface burning testing for Neopor® in accordance with ASTM E84

7.9 Material property testing for Neopor® in accordance with ASTM C578

7.10 Uniform static air testing for Neopor® in accordance with ASTM E330

7.11 Material property testing for BASF SPF in accordance with ASTM D1623, D1622, D2842, D2126, D6226, E2178, C518 and E96

7.12 Water resistance properties of BASF SPF in accordance with AATCC TM 127

7.13 Air leakage properties of BASF SPF in accordance with ASTM E283

7.14 Thermal transmission properties of BASF SPF in accordance with ASTM C518

7.15 Water penetration properties of BASF SPF in accordance with ASTM E331

7.16 Surface burning testing of BASF SPF in accordance with ASTM E84

7.17 Heat release and flame spread testing of BASF SPF in accordance with NFPA 286

7.18 Some information contained herein is the result of testing and/or data analysis by other sources which conform to IBC Section 1703 and relevant professional engineering law. DrJ relies on accurate data from these sources to perform engineering analysis. DrJ has reviewed and found the data provided by other professional sources to be credible.
7.19 Where appropriate, DrJ’s analysis is based on design values that have been codified into law through codes and standards (e.g., *IBC*, *IRC*, *NDS®*, and *SDPWS*). This includes review of code provisions and any related test data that aids in comparative analysis or provides support for equivalency to an intended end-use application. Where the accuracy of design values provided herein is reliant upon the published properties of commodity materials (e.g., lumber, steel, and concrete), DrJ relies upon the grade mark, stamp, and/or design values provided by raw material suppliers to be accurate and conforming to the mechanical properties defined in the relevant material standard.

8 FINDINGS

8.1 When installed in accordance with the manufacturer installation instructions and this TER, BASF HP+ Wall X Series complies with, or is a suitable alternative to, the applicable sections of the codes listed in Section 2 for the following applications:

8.1.1 Lateral load resistance due to wind and seismic loads carried by shear walls in accordance with Table 1, Table 2, Table 3, Table 4, and Table 7.

8.1.2 Resistance to axial and uplift loads in single top plate applications in accordance with Table 6.

8.1.3 Transverse wind load resistance in accordance with Table 8 and Table 9.

8.1.4 Thermal resistance properties in accordance with Table 10.

8.1.5 Air barrier properties in accordance with Table 11.

8.1.6 Surface burning characteristics in accordance with Table 12.

8.2 *IBC* Section 104.11 (*IRC* Section R104.11 and *IFC* Section 104.9 are similar) states:

104.11 Alternative materials, design and methods of construction and equipment. The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code...Where the alternative material, design or method of construction is not approved, the building official shall respond in writing, stating the reasons the alternative was not approved.

8.3 This product has been evaluated in the context of the codes listed in Section 2 and is compliant with all known state and local building codes. Where there are known variations in state or local codes applicable to this evaluation, they are listed here.

8.3.1 No known variations

9 CONDITIONS OF USE

9.1 When BASF HP+ Wall X Series is not installed for use as wall bracing, as described in this TER, the walls shall be braced by other materials, in accordance with the applicable code.

9.2 When used in accordance with the *IBC* in Seismic Design Categories C, D, E, or F, special inspections shall comply with *IBC* Section 1705.12.11

9.3 When used in accordance with the *IBC* in high wind areas, special inspections shall comply with *IBC* Section 1705.11.12

9.4 Loads applied shall not exceed those recommended by the manufacturer as follows:

9.4.1 Allowable shear loads do not exceed values in Table 1, Table 2, Table 3, and Table 4 as applicable.

9.4.2 Allowable axial loads do not exceed values in Table 6.

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11 2012 *IBC* Section 1705.11

12 2012 *IBC* Section 1705.10
9.4.3 Allowable transverse loads do not exceed values in Table 8.
9.4.4 Allowable wind speeds do not exceed values in Table 9.
9.5 All panel edges shall be supported by wall framing or solid blocking a minimum of 2" (51 mm) nominal thickness in the least dimension.
9.6 The manufacturer’s installation instructions shall be available on the jobsite for inspection.
9.7 Refer to the HP+ Wall X Series quality assurance (QC) procedures and installation manual for construction means and methods support.
9.7.1 Storage, weather conditions, durability considerations, handling, installing, restraining, and bracing of the panels are defined in the QC procedures and installation process to support proper construction means and methods.
9.7.2 The contractor or wall installer is responsible for following the HP+ Wall X Series QC procedures, installation instructions, and all means and methods of construction.
9.7.3 Contact BASF for additional information regarding means and methods.
9.8 Where required by the building official, also known as the authority having jurisdiction (AHJ) in which the project is to be constructed, this TER and the installation instructions shall be submitted at the time of permit application.
9.9 Any generally accepted engineering calculations needed to show compliance with this TER shall be submitted to the AHJ for review and approval.
9.10 Design loads shall be determined in accordance with the building code adopted by the jurisdiction in which the project is to be constructed and/or by the Building Designer (e.g., owner or registered design professional).
9.11 At a minimum, this product shall be installed per Section 6 of this TER.
9.12 This product is manufactured under a third-party quality control program in accordance with IBC Section 104.4 and 110.4 and IRC Section R104.4 and R109.2.
9.13 The actual design, suitability, and use of this TER, for any particular building, is the responsibility of the owner or the owner's authorized agent. Therefore, the TER shall be reviewed for code compliance by the building official for acceptance.
9.14 The use of this TER is dependent on the manufacturer’s in-plant QC, the ISO/IEC 17020 third-party quality assurance program and procedures, proper installation per the manufacturer’s instructions, the building official’s inspection, and any other code requirements that may apply to demonstrate and verify compliance with the applicable building code.

10 IDENTIFICATION

10.1 Each Neopor® sheathing panel described in this TER is identified by a label bearing the manufacturer’s name, product name, label of the third-party inspection agency, and other information to confirm code compliance.
10.2 BASF spray foam components are identified by a label on the containers bearing the manufacturer’s name, product name, label of the third-party inspection agency, and other information to confirm code compliance.
10.3 Additional technical information can be found at basf.com.

11 REVIEW SCHEDULE

11.1 This TER is subject to periodic review and revision. For the most recent version of this TER, visit drjcertification.org.
11.2 For information on the current status of this TER, contact DrJ Certification.