June 5, 2018

Paul Grahovac
Build SMART, LLC
3701 Greenway Circle
Lawrence, KS 66046

Re: PAC Project No. 10622, Revision 1
ASTM E119 Compliance for the Build SMART Prefabricated Wall Systems in Type V Construction

Dear Sir/Madam:

The purpose of this analysis is to justify the incorporation of specific design components in the Build Smart exterior wall system to provide for 1 hour fire resistance (interior and exterior) in Type VA construction.

Two design options are addressed. These allow for the use of either 1-sided or 2-sided LP FlameBlock as exterior sheathing. The rationale for these options is based on design allowances described in two LP fire rated design listings, Intertek Design No. LPB/WPPS 60-01 and UL Design No. W408. Previous Priest & Associates Consulting (PAC) engineering evaluations are also referenced. LP® FlameBlock fire rated OSB sheathing is described in ICC ES ESR-1365 (Ref. 1).

This document is intended to provide an expert opinion on the properties of the materials, products, or assemblies identified in this report as related to meeting a specific code or standard; other properties, such as (but not limited to) acoustical, weather resistance, durability, toxicity level of smoke developed during combustion, etc., are not addressed nor implied.

DESCRIPTION

The basic nonrated Build SMART prefabricated panel system is depicted in Figure 1. The proposed amendments to this system necessary to provide for a 1 hour rated assembly from both sides include the substitution of FlameBlock for regular OSB sheathing fastened to the exterior side of the framing, ¾ in. type X gypsum wallboard (GWB) attached to the interior side of the framing, minimum 2.5 pcf mineral fiber batt insulation at full stud cavity width, 3½ in. EPS foam insulation sandwiched between the FlameBlock and 7/16 in. Huber Zip System sheathing. The Huber Zip panel is mechanically-fastened to the wood framing by SIP screws of the appropriate length. The Build Smart exterior wall design utilizes 2x lumber framing (in the present case, 2x6). Various types of exterior claddings are installed over the Huber Zip sheathing. All fastening details for the FlameBlock and GWB are as described in the relevant design listing.

Design Option 1 – Based on LP/WPPS 60-01

LPB/WPPS 60-01 (Ref. 2) is a nonsymmetrical loadbearing design (restricted load1) 2x6 wood stud exterior wall construction rated for 1 hour from both sides. One layer of ¾ in. type X GWB is installed on the interior face of wood framing, and the stud cavities are insulated with nominal 2.5 pcf mineral wool insulation. One-sided LP FlameBlock™ sheathing is installed on the exterior face of the studs and combustible and noncombustible claddings are included in the listing. A code-compliant continuous exterior foam insulation system (EPS or other without limitation to thickness) may be installed without

1 Limited to design load for 2x4 construction per national design criteria ANSI/AF&PA NDS
detracting from the design’s fire rating based on the reasoning given in LP Engineering Letter 10288-36 (Ref. 2) and later in this document.

The LP 60-01 design is summarized below (beginning from the interior):

1. Gypsum Wallboard (GWB): 1 layer ⅝ in. type X oriented vertically
2. Framing: Nominal 2 x 6 wood studs spaced 16 in. on center (OC), cross-braced at mid-height
3. Insulation: Mineral fiber batt insulation, nom. 2.5 pcf and 5½ in. thick friction fit between the studs
4. Exterior Sheathing: 1-Sided LP FlameBlock® Fire-Rated OSB Sheathing, nom. 7/16 in. thickness, installed with the coated surface facing out (Ref. 2).
5. Exterior Cladding:
   a. Uninsulated steel siding
   b. T1-11 wood structural panel siding
   c. Fiber cement board
   d. Wood fiber panel siding
   e. One-coat stucco

![Figure 1](image)

With the LPB/WPPS 60-01 design as the base wall, and the addition of 3½ in. EPS foam, the Huber Zip System sheathing and exterior cladding as noted above, the Build SMART prefabricated panel system is expected to provide 1 hour of fire resistance from both sides under the conditions of the ASTM E119 standard.
Design Option 2 – Based on W408 Exterior Exposure

LP has UL Design Listing W408 (Ref. 4) which incorporates LP FlameBlock 2-sided sheathing. The published listing provides for a 2 hour fire rating from the interior, and a 1 hour rating when tested from the exterior. For the purposes of this analysis, the assembly construction conditions for fire exposure from the exterior are used. The installation of continuous exterior foam insulation is allowed without restriction as discussed for Option 1.

The UL W408 exterior wall design includes the following components and allowances for exterior facings when the 1 hour exposure from the exterior is considered (beginning from the interior):

1. Interior wall membrane - 2 layers of ¾ in. type X gypsum wallboard USG Sheetrock® Brand Firecode® type X gypsum wallboard (GWB)²
2. Nominal 2x4 wood studs - spaced 16 inches on center (OC), or 2x6 wood studs spaced a maximum of 24 in. OC. Nominal 2x4 or 2x6 lateral bracing at 96 in. OC.
3. Wall cavity insulation (UL W408 Item #4) – minimum 2.5 pcf mineral fiber insulation, full cavity thickness
4. Exterior sheathing - 2-sided Category 7/16 in. LP FlameBlock, applied as described in W408
5. Exterior Sidings
   a. Exterior Wood Siding – minimum 11/32 in. plywood siding panels, or 7/16 in. OSB siding panels
   b. Exterior OSB Lap Siding – minimum 7/16 in.
   c. Cementitious Stucco – minimum 3/8 in. thickness
   d. Fiber Cement Siding – lap or panel siding, minimum 5/16 in.
   e. Brick
   f. Steel Wall Panels

This option provides for the use of 2-sided FlameBlock to allow for a maximum 24 in. OC 2x6 stud spacing. It is similar in all other respects to Design Option 1. Furthermore, there is no load restriction as required for Option 1. Expanded Polystyrene exterior insulation is allowed along with the Huber Zip System without detrimental effect.

Rationale for the Allowance of Continuous Foam Insulation

In the case of walls insulated with rigid polystyrene foam boards, the construction typically consists of wood or steel studs, EPS insulation between the exterior side of the studs and exterior cladding, mineral wool or fiber glass cavity insulation, interior fire rated gypsum wallboard (GWB), and exterior cladding. Exterior wall assemblies can be fire rated from one or both sides (interior only or interior and exterior). The melting point of polystyrene-based foams is nominally 230°C, with the glass transition temperature somewhat lower. In cases where the polystyrene foam insulation is incorporated within the wall assembly, the heat from the E119/UL263 test penetrates the wall system and once the melting point is reached the polystyrene foam insulation will melt and pool at the base of the wall. As the heat increases, the EPS vapors escape from joints in the wall assembly as the interior wall pressure increases. The vapors will not ignite in the wall cavity since the off-gassing produces a positive pressure, fuel-rich environment with little or no air available for combustion. The furnace is operated under negative pressure and vapors are drawn into the furnace instead of being pushed out of the wall to the exterior. The ignition of off-gases on the fire side of the wall does not increase the fuel load since the furnace gas must be reduced to compensate for the increased fuel in the furnace to maintain the prescribed temperature exposure. The presence of EPS foam insulation on the non-fire ("cold") side of the test assembly will not adversely affect the fire endurance test, since the temperature rise limits of the standard are well below the ignition temperatures of the insulation.

² For fire exposure from the exterior, the absence of the second layer of GWB will not significantly detract from the 1 hour rating
The argument presented above and the allowance for the use of combustible foam plastic insulation as continuous exterior insulation on a rated base wall construction without detracting from the assigned fire rating is consistent with Rule 2 of Harmathy’s Ten Rules of Fire Endurance (Ref. 5):

*The fire endurance of a construction does not decrease with the addition of further layers.*

**General Comments on the Build SMART Design**

The application of Prosoco R-Guard Cat 5 or Spray Wrap MVP WRBs may be incorporated in the assembly without detracting from the fire rating.

Fire rated joint/seam sealant shall be applied at the junction of the prefabricated panels during field assembly.

**Conclusion**

Priest & Associates Consulting has provided the technical justification for two options for the Build SMART prefabricated panel system allowing for a 1 hour rated assembly from both the interior and exterior sides. The use of 1-sided FlameBlock is justified based on LP 60-01, with 2x6 stud spacing limited to 16 in. OC, and with attention given to the load restriction specified for the design. 2-Sided FlameBlock substituted for 1-sided allows for the increase in stud spacing to 24 in. OC as prescribed for the exterior fire exposure of the W408 assembly. Based on Harmathy’s Rule No. 2, and the behavior of the foam plastic insulation described above, Priest & Associates Consulting has judged that code-approved continuous rigid foam insulation can be justified for use as continuous exterior insulation without detracting from the fire resistance classification when tested in accordance with ASTM E119.

**References**

1. LP FlameBlock ICC-ES ESR 1365
2. Intertek LP Wall Design No. LPB/WPPS 60-01
5. ASTM E2032 Standard Guide for Extension of Data from Fire Resistance Tests Conducted in Accordance with ASTM E119

If you have any comments or questions, please let us know.

Submitted by, 

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Reviewed and Approved, 

Deg Priest  
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