PRIEST & ASSOCIATES CONSULTING, LLC

ENGINEERING EVALUATION

Siga WRB's and Atlas Polyiso Foam Insulation in NFPA 285 Assemblies

Project No. 10561A

Prepared for:

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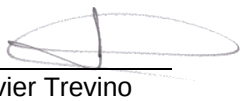
Abstract

Atlas has granted use of their NFPA 285 Engineering Evaluation (and related data) to determine Engineering Extensions of alternate WRB products manufactured by Siga. This evaluation, along with NFPA 285 and Cone Calorimeter (ASTM E1354) data from Atlas and Siga were used to create a matrix of constructions using various combinations of Atlas/Siga products which could meet NFPA 285 with specific limitations.

The conclusions reached by this evaluation are true and correct, within the bounds of sound engineering practice. All reasoning for our decisions is contained within this document.

Submitted by,



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January 8, 2018

INTRODUCTION

The purpose of this evaluation is to allow use of Siga WRB products in previously evaluated Atlas NFPA 285 assemblies that can meet the requirements of NFPA 285 (Ref. 1). Cone Calorimeter (Ref. 3) and NFPA 285 data were submitted to evaluate Siga WRB products to various Atlas constructions in EEV 10126 Ref. 4).

REFERENCED DOCUMENTS

1) *NFPA 285-12 Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-loadbearing Wall Assemblies Containing Combustible Components*
2) *Babrauskas, V., Lucas, D., Eisenberg, D., Singla, V., Dedeo, M., & Blum, A. (2012). Flame retardants in building insulation: a case for re-evaluating building codes. Building Research & Information. doi:10.1080/09613218.2012.744533*
3) *Cone Calorimeter and NFPA 285 Data for Siga and Atlas – Data Confidential btw Siga, Atlas and Priest & Associates*
4) *Priest and Associates EEV 10126 – Atlas NFPA 285 Evaluation*
5) *DRJ Engineering TER 1306-03 Atlas Approved NFPA 285 Assemblies*
6) *Lindholm et al. Cone Calorimeter – a Tool for Measuring Heat Release* *http://www.ffrc.fi/FlameDays_2009/4B/LindholmPaper.pdf*
7) *Babrauskas et al., 10 Years of Heat Release Research NIST Publication* *http://fire.nist.gov/bfrlpubs/fire93/PDF/f93048.pdf*

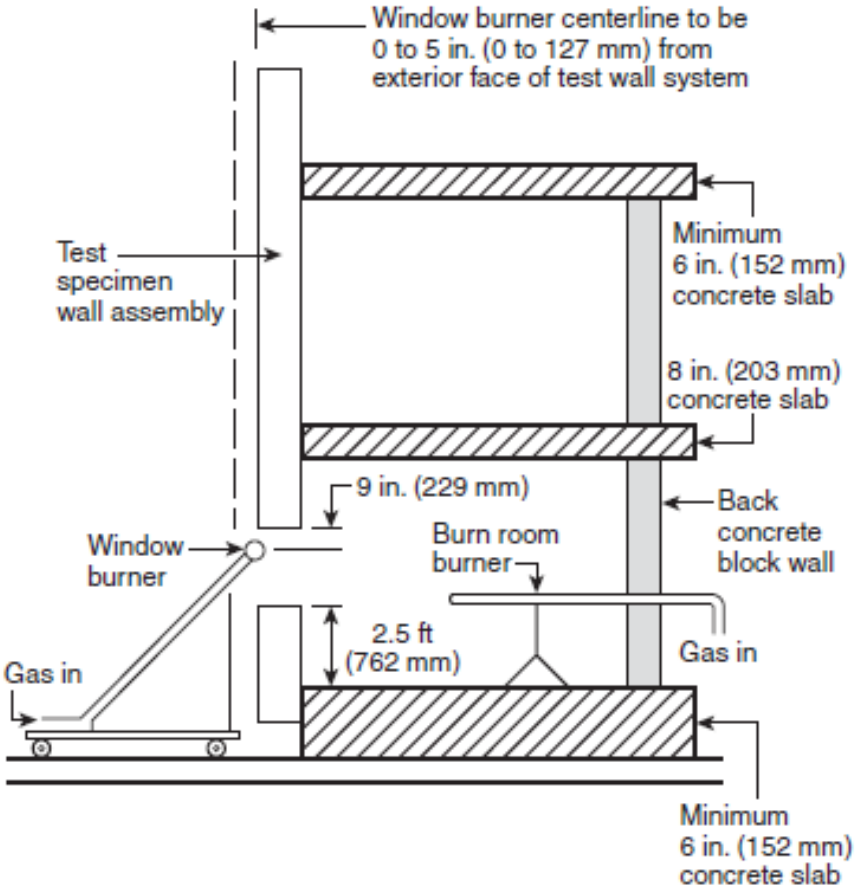
EVALUATION METHOD

NFPA 285 Criteria

The NFPA 285 fire test (Ref. 1) is designed to test the flame spread properties of exterior walls containing combustible components. Two noncombustible rooms are stacked to simulate two stories of a multi-story building. The wall assembly is then attached to the exterior face of the rooms. A typical test wall measures 14 ft x 18 ft with a 30 in. x 78 in. window opening placed on the bottom floor.

During a test, a calibrated fire starts in the bottom room. After 5 minutes, the exterior burner is ignited to produce a specific heat flux/temperature pattern on the exterior of the wall. Both burners remain ignited during the 30 minute test. Personnel monitor flame spread visually during the course of the test. A computer data acquisition system monitors and records the thermocouples temperatures. The criteria for passing (Ref. 1) are as follows (reworded in simple terms for this analysis):

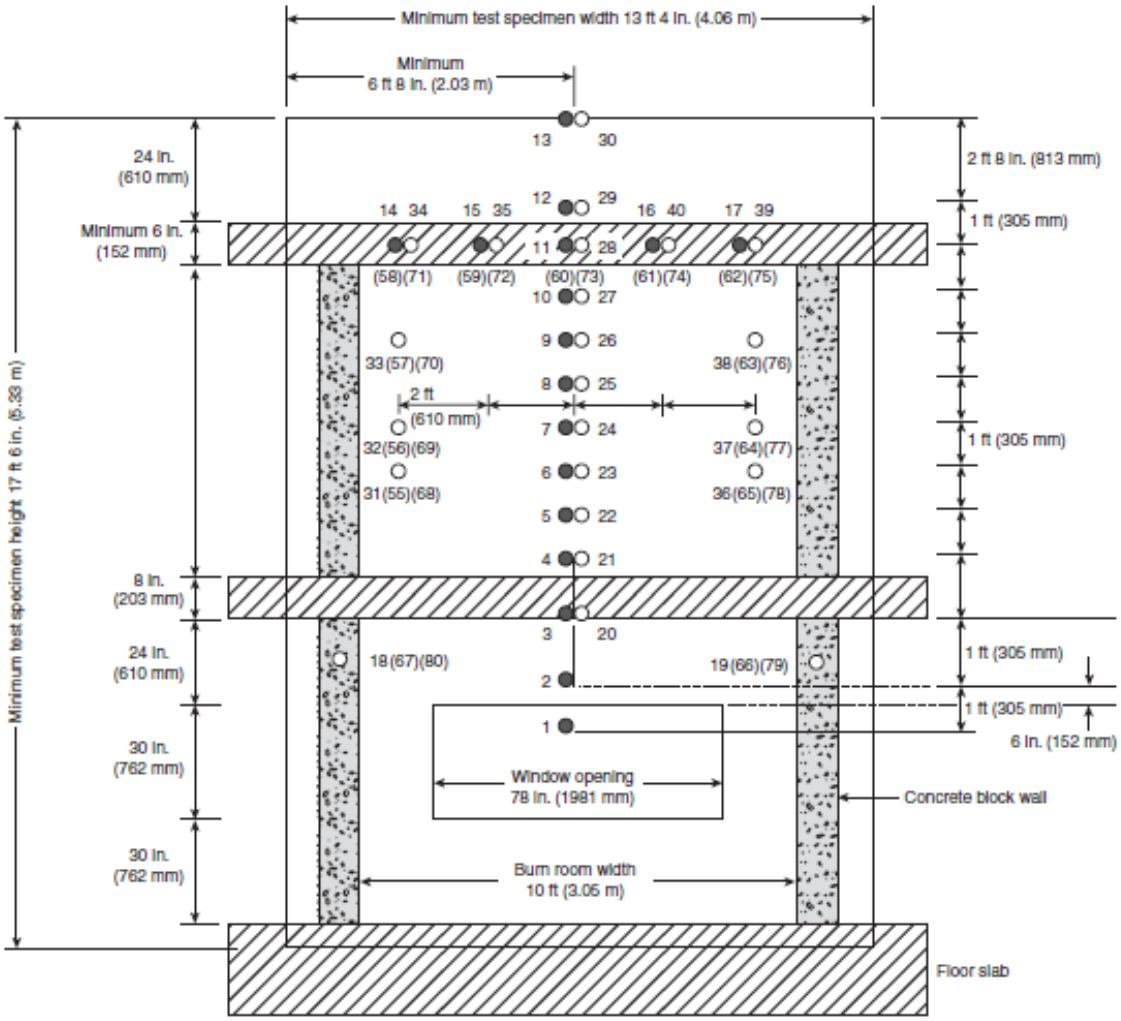
1) Flames shall not spread vertically 10 ft above the window opening as determined visually or by thermocouples located at the 10 ft level. Failure occurs when thermocouples 11 or 14 - 17 exceed 1000°F.
2) Flames shall not spread (visually) horizontally 5 ft on either side of the centerline of the window opening.
3) Flames shall not spread inside the wall cavity as determined by thermocouples placed within the wall cavity insulation and air-gaps if present. Failure occurs when thermocouples 28 or 31 - 40 or 55 - 65 and 68 - 79 exceed 750°F above ambient.
4) Flames shall not spread horizontally within the wall cavity past the interior room dimension as determined by wall cavity thermocouples. Failure occurs when thermocouples 18 - 19, or 66 - 67, or 79 - 80 exceed 750°F above ambient.
5) Flames shall not spread to the second story room as determined by interior wall surface thermocouples. Failure occurs when thermocouples 49 - 54 exceed 500°F above ambient.
6) Flames shall not occur in the second story (visually).
7) Flames shall not escape (visually) from the interior to the exterior at the wall/wall intersection of the bottom story room.



Two burners are ignited to produce a specific time-temperature profile in the room and on the exterior face of the wall.

Thermocouples are placed at strategic locations to monitor temperature as an indicator of flame spread.

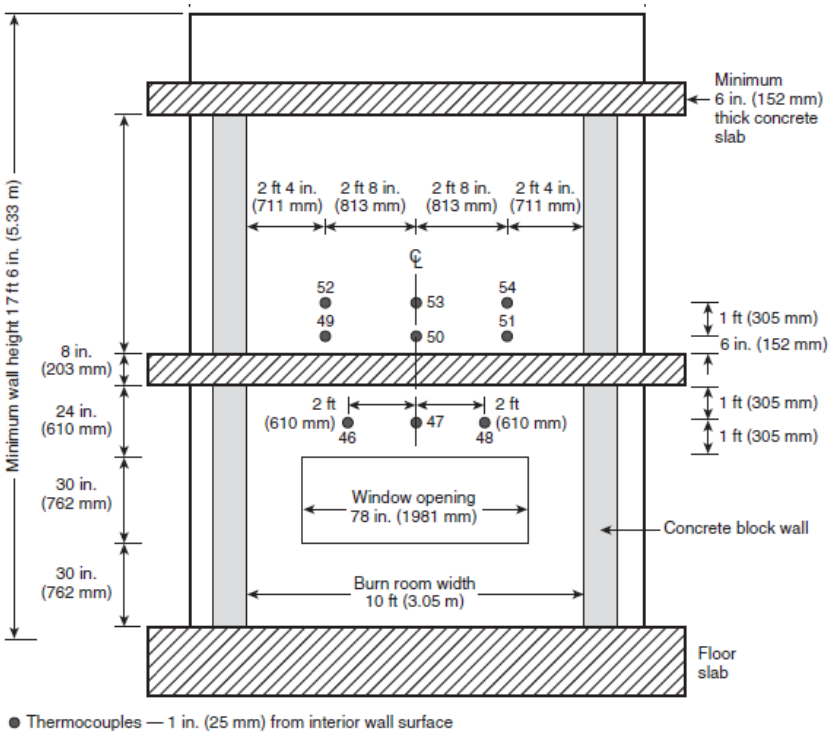
In the depictions below, thermocouples 1 - 10, and 20 - 27 are not used for compliance purposes. The remainders are used to monitor flame spread.



● Thermocouples — 1 in. (25 mm) from exterior wall surface

○ Thermocouples — in the wall cavity air space or the insulation, or both, as shown in Figure 6.1(b) Details A through I.

( ) Thermocouples — Additional thermocouples in the insulation or the stud cavity, or both, where required for the test specimen construction being tested, as shown in Figure 6.1(b) Details C through I.



Constructions Tested

This evaluation is based on Atlas EEV 10126 (Ref. 4) as the basis document. The EEV was based on several NFPA 285 tests deemed as worst case assemblies allowing various component options based on the testing. Each report describes a specific construction tested per NFPA 285. The specific constructions are confidential, but included various combinations of wall components. These include cavity insulation, exterior sheathing, water resistive barrier (WRB), exterior insulation, exterior WRB, air gap, claddings and window details.

Additionally, Cone Calorimeter tests conducted by Siga were used for this analysis.

WRB Analysis

If a new WRB is less flammable than the NFPA 285 tested WRB, it is allowed as an alternate component. Cone calorimeter data (Ref. 3) was submitted to evaluate substitutions of the WRB products.

When analyzing cone calorimeter data, two sets of numbers are typically used. These are: the time to ignition (T_{ign}) at a given heat flux; and, the peak heat release rate (Pk. HRR). Clearly, smaller Peak Heat Release Rate (Pk. HRR) values and longer time to ignition (T_{ign}) values are considered to be improvements (i.e., less flammable) when comparing materials using the Cone Calorimeter. However, some data for a given comparison are conflicting. To resolve these types of discrepancies, researchers (Ref. 7) have used a ranking system to organize cone calorimeter data for flammability comparison.

The expression $Rank = \frac{Pk.HRR}{T_{ign}}$ resolves inconsistencies in relative flammability data when using the Cone Calorimeter. Lower HRR and longer T_{ign} make the rank smaller. So, smaller rank materials are considered less flammable than higher rank materials.

With that understood, it should be noted that the accepted relative error [of the HRR] in cone calorimeters is “approximately 20 - 30% for 1 kW fires, 10% for 3 kW fires and less than 10% for 5 kW fires” (Ref. 6).

WRB under Foam Insulation
The Siga WRB products listed below are less flammable (peak HRR or improved Rank) than at least one of the WRB's in the EEV (Ref. 4) or TER report (Ref. 5) for WRB's used under the exterior insulation (over the base wall surface).

Majvest 500 SA

WRBs over Exterior Insulation
Cone Calorimeter data has been analyzed (Ref. 3) for this condition. The WRB products listed above are less flammable than at least one if the WRB's listed for this location (with specific claddings) and may be used over the exterior insulation – only under specific masonry claddings.

WRB Conclusions
The data were analyzed with the following conclusions. Only the claddings in EEV 10126 are allowed as the claddings for this report.

WRB	Allowed Location
Majvest 500 SA	Ok under foam, with all claddings listed
	Ok over foam, only with Claddings 1 – 6 (heavy masonry)

CONCLUSIONS

Based on the discussion above, the following Table of NFPA 285 Assemblies (Ref. Atlas EEV 10126) shall apply to Siga. We allow Mineral Fiber (Mineral Wool) Insulation to replace the polyiso insulation since mineral wool is noncombustible.

TABLE OF SUBSTITUTIONS

Wall Component	
Base Wall – Use either 1, 2 or 3	1) 1" min. Cast Concrete Walls 2) 1" min. CMU Concrete Walls 3) 20 GA (min.) 3⅝" (min.) steel studs spaced 24" OC (max.) ⅝ in. type X Gypsum Wallboard Interior
Fire-Stopping in Stud Cavity at floor lines	1) None 2) 4 lb/cu ft mineral wool (e.g., Thermafiber) in each stud cavity at each floor line – attached with Z-clips or equivalent
Cavity Insulation Use either 1, 2, 3, 4, 5, 6, 7, 8 or 9 Note: Cavity Insulations 5 - 9 must use floor line fire-stopping Item 2 and ⅝" exterior gypsum sheathing.	1) None 2) Any noncombustible insulation per ASTM E136 3) Any mineral fiber (Board type Class A ASTM E84 faced or unfaced) 4) Fiberglass (Batt type Class A ASTM E84 faced or unfaced) 5) 5½" (max.) Icynene LD-C-50 spray foam in 6" deep studs (max.) full fill without an air gap 6) 5½" (max.) Icynene MD-C-200, 2 pcf spray foam in 6" deep studs (max.) full fill without an air gap 7) 5½" (max.) Icynene MD-R-210, 2 pcf spray foam in 6" deep studs (max.) full fill without an air gap 8) 6" (max.) SWD Urethane QS 112, 2 pcf spray foam in 6" deep studs (max.) or partial fill with a maximum 2½" air gap 9) 3½" (max.) Gaco Western 183M spray foam in 3⅝" deep studs (max.) 10) Gaco Western F1850 (3½" max.). Use with ⅝" exterior sheathing in 3⅝" deep studs (max.) 11) Demilec Sealection 500 (3⅝" max). Use with ⅝" exterior sheathing in 3⅝" deep studs (max.)

	12) Demilec HeatLok Soy 200 Plus (3.4" max). Use with ⅝" exterior sheathing in 3⅝" deep studs (max.) 13) Bayer Bayseal (3" max). Use with ⅝" exterior sheathing. 14) Lapolla FoamLok FL 2000 (3" max). Use with ⅝" exterior sheathing in 3⅝" deep studs (max.) 15) BASF SprayTite 81206 or WallTite (US & US-N) (3⅝" max). Use with ⅝" exterior sheathing in 3⅝" deep studs (max.)
Exterior Sheathing – Use either 1 or 2 When SPF is used in cavity, exterior sheathing must be used. See specific sheathing thicknesses above.	1) ½" or thicker exterior gypsum sheathing 2) 2" precast concrete panels attached to structural elements of building
WRB Over Sheathing Use item 1 or 2	1) None 2) Majvest 500 SA
Exterior Insulation – Use either 1, 2, 3, 4 or 5 Item 1 – "None" may only be used with specific claddings It is assumed mineral wool is 2 pcf (min) 1 inch (min.) thickness	1) None (only with Claddings 1 - 6 when WRB #2 above is used) 2) 4" (max.) EnergyShield Pro (or Pro2). 3) 4" (max.) RBoard Pro (or EnergyShield CGF Pro) 4) 4¾" (max.) EnergyShield Ply Pro (4" EnergyShield CGF Pro w/ ⅝" or ¾" FRT Plywood) 5) Mineral wool
WRB Over Exterior Insulation – Use any item 1 or 2 Item 2 may only be used with specific claddings	1) None 2) Majvest 500 SA (only with Claddings 1 - 6)
Exterior Cladding – Use either 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 or 13 Note: Cladding 8 (Zinc) may only be used with EnergyShield Pro or Pro2).	1) Brick – Nominal 4" clay brick or veneer with maximum 2" air gap behind the brick. Brick Ties/Anchors 24" OC (max.) 2) Stucco – minimum ¾" thick exterior cement plaster and lath. A secondary WRB (WRB items above allowed over foam) can be installed between the insulation and lath and must not be full coverage asphalt or butyl based self-adhering membranes. 3) Limestone – minimum 2" thick 4) Natural Stone Veneer – minimum 2" thick 5) Cast Artificial Stone – minimum 1½" thick complying with ICC-ES AC 51 6) Terra Cotta Cladding – minimum 1¼" thick 7) Any ACM that has successfully passed NFPA 285 8) Uninsulated sheet metal building panels including aluminum, steel, copper or zinc (see note) 9) Uninsulated fiber-cement siding (min. ¼" thick) 10) Stone/Aluminum honeycomb composite building panels that have successfully passed NFPA 285 criteria 11) Autoclaved-aerated-concrete (AAC) panels (min. 1½" thick) 12) Reynobond ZCM Zinc metal composite panel 13) Terreal Zephir Evolution Rainscreen System (terra cotta), minimum $^{9}/_{16}$" thick

~ End of Report ~