ENGINEERING EVALUATION

Engineering Extensions based on NFPA 285 Test

Project No. 10809B, Revision 1

Prepared for:

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Abstract

An NFPA 285 test report was used to determine Engineering Extensions on wall components of NFPA 285 wall designs for Nichiha USA. These include base wall assemblies, exterior sheathing, water resistive barrier (WRB), exterior insulation and claddings. We have determined that Engineering Extensions on these various components of the tested wall designs can meet the criteria of 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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March 9, 2020
INTRODUCTION

An NFPA 285 test was conducted on a configuration of a Nichiha Architectural Wall Panel (AWP) exterior wall design. The design incorporated many components including base wall assembly, exterior insulation, WRB, and worst case foam covering. Additionally, cone calorimeter data is referenced for analysis to allow specific WRB materials to replace the tested WRB without negatively affecting expected NFPA 285 test results.

Nichiha Architectural Wall Panels and Siding products are described in Intertek CCRR-0299.

The purpose of this evaluation is to determine Engineering Extensions for the components that can meet the requirements of NFPA 285.

From the wall system tested, an analysis is conducted on the components tested. This will form a base wall system from which replacement components can be interchanged.

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.

TABLE OF SUBSTITUTIONS

The results of this analysis are presented in the following table which lists the allowable substitutions based on the tests submitted and Engineering Extensions.

<table>
<thead>
<tr>
<th>Wall Component</th>
<th>1) Cast Concrete Walls</th>
<th>2) CMU Concrete Walls</th>
<th>3) 20 GA (min.) 3¾ in. (min.) steel studs spaced 24 in. OC (max.) ¾ in. (min.) type X Special Fire Resistant Gypsum Wallboard Interior</th>
<th>4) FRTW (Fire-retardant-treated wood) studs: min. nominal 2 x 4 dimension, spaced 24” OC (max.) a. ¾ in. type X Gypsum Wallboard Interior b. Bracing as required by code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Wall – Use either 1, 2, 3 or 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire-Stopping in Stud Cavity at floor lines</td>
<td></td>
<td></td>
<td></td>
<td>1) Any approved mineral fiber based safing insulation in each stud cavity at floor line. Safing thickness must match stud cavity depth. 2) Solid FRTW fire blocking at floor line in accordance with building code requirements for Type III construction.</td>
</tr>
<tr>
<td>Cavity Insulation – Use either 1, 2, 3, or 4</td>
<td>1) None</td>
<td>2) Any noncombustible insulation per ASTM E136</td>
<td>3) Any Mineral Fiber (Board type Class A ASTM E84 faced or unfaced)</td>
<td>4) Any Fiberglass (Batt Type Class A ASTM E84 faced or unfaced)</td>
</tr>
<tr>
<td>Exterior Sheathing</td>
<td>½ in. or thicker exterior gypsum sheathing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WRB over Base Wall Surface – Use 1 or 2</td>
<td>1) Soprema SOPRASEAL® STICK 1100T</td>
<td>2) Any WRB which has been tested per ASTM E1354 (at a minimum of 50 kW/m² heat flux) and shown by analysis to be less flammable (improved Tign, Pk. HRR) than that listed above</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exterior Insulation – Mounted within vertical steel Z-girts spaced 24 in. OC</td>
<td>1) 4 in. thick (max.) Xci CG (Class A), Xci Foil (Class A) or Xci-286</td>
<td>2) 4 pcf mineral wool</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cladding</td>
<td>% in. (16mm) Nichiha Architectural Wall Panels (AWP) mechanically fastened to vertical steel Z-girts using Nichiha mounting system</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Window Headers/jambs for all constructions shall incorporate 25 GA. L flashing
REFERENCED DOCUMENTS

1) Priest & Assoc. Test Plan 10809A for Nichiha
2) ITS Test Report 10415299SAT-001 NFPA 285 Rmax TSX-8500 w/ Alpolic ACM

EVALUATION METHOD

NFPA 285 Criteria

The NFPA 285 fire test (Ref. 3) 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.

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.
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. 3) are as follows (reworded in simpler 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.
Construction Tested

The table below outlines the report submitted for analysis (Ref. 2). For the tested system, critical components are listed. These include interior sheathing, steel studs, exterior insulation, air gaps, claddings and window details. Some details such as faster patterns, application rates, etc. are not included. For those details, the descriptions in the referenced reports should be used.

### Report Submitted

<table>
<thead>
<tr>
<th>Interior sheathing</th>
<th>Stud</th>
<th>Cavity Insulation</th>
<th>Exterior Sheathing</th>
<th>WRB</th>
<th>Exterior Insulation</th>
<th>Air Gap</th>
<th>Exterior Covering</th>
</tr>
</thead>
<tbody>
<tr>
<td>⅝” type X gypsum wallboard</td>
<td>20 GA. 3⅝” steel studs spaced 24 in. OC</td>
<td>None</td>
<td>⅝” DensGlass</td>
<td>Sopraseal</td>
<td>Hunter Panels 4” Xci CG (Class A)</td>
<td>None</td>
<td>⅝” Nichiha AWP shiplap panels, mounted with Nichiha starter track and Ultimate Clips</td>
</tr>
</tbody>
</table>

*Note: Window Header/Jambs used 25 GA. L flashing*

### Analysis of Components

When making flammability comparisons of NFPA 285 wall systems, the elements which could potentially cause increased flame spread should be considered.

1) **Interior Gypsum Wallboard** – The test incorporated ⅝ in. type X gypsum wallboard. Experience has shown that using ⅛ in. regular gypsum wallboard causes failures of Thermocouples 18 and 19. Therefore, use of ⅝ in. regular gypsum board is not permitted as the interior sheathing.

2) **Steel Studs** – The test incorporated 3⅝ in. steel studs 20 GA. spaced 24 in. OC. Field applications typically use 16 or 24 in. OC spacing and these are allowed. Wider spacing is worst case since the wall is potentially more flexible and prone to warping. Wider studs are allowed.

3) **Cavity Insulation** – The test did not incorporate cavity insulation. However, any noncombustible insulation or listed fiberglass (faced or unfaced) may be used since this does not increase flammability.
4) **Exterior Sheathing** – The test used ½ inch Densglass exterior sheathing. Exterior sheathing (min. ½ in.) may be used.

5) **WRB over Exterior Sheathing** – The construction tested used Sopraseal Stick 1100T applied to exterior gypsum sheathing.

6) **Exterior Insulation** – The test used 4 inch Hunter Xci CG (Class A). This represents a maximum thickness for the Hunter panel product. **Allow** the use of Hunter Xci Foil (Class A) or Xci 286 at a thickness of 4 inches or less based on fuel load. The exterior insulation panels were friction-fit within vertically oriented steel Z-girts spaced 24 in. OC and extending the height of the wall structure. This vertical orientation allowed for unprotected gaps between the foam panel and the edges on one side of the opposing girts and is considered a more onerous condition than horizontally-mounted girts (which can serve as potential fire blocks to the vertical spread of flame). Nichiha has indicated that the vertical Z-girts are necessary for current methods of AWP Panel attachment.

7) **Air Gap** – The construction utilized a nominal ¾ in. (10 mm) air gap between the Nichiha cladding and the surface of the exterior insulation. The air gap is allowed to be reduced since smaller air gaps typically tend to spread flame less than larger air gaps.

8) **Exterior Cladding** – Nichiha Architectural Wall Panels (AWP), VintageWood Panel, ⅝ in. thick

**Engineering Extensions**

**Base Walls**

Since the test submitted (Ref. 2) utilized steel stud (minimum 20 GA., other base wall types which tend to perform the same or better are allowed. These include:

1) Cast Concrete Walls
2) CMU Concrete Walls
3) 20 GA, min. 3⅜" (min.) steel studs spaced 24" OC (max.)
   a. ⅝" type X Gypsum Wallboard Interior
   b. ½" Exterior Gypsum Sheathing
   c. Lateral Bracing every 4 ft
   d. Any approved mineral fiber based safing insulation in each stud cavity at floor line. Safing thickness must match stud cavity depth.
4) FRTW studs: min. nominal 2 x 4 dimension, spaced 24" OC (max.)
   a. ⅝ in. type X Gypsum Wallboard Interior
   b. Braced as required by code
   c. Fire blocking at floor line in accordance with code.

The use of Fire-retardant-treated wood (FRTW) framing covered under IBC Section 2303.2 is allowed in Type III construction within bearing and nonbearing exterior walls with required fire ratings of two hours or less. Type II construction also allows for FRT framing in non-bearing exterior walls where a fire rating is not required. The use of FRT framing in the exterior wall with specific limitations as described in this EEV is not expected to detract from the NFPA 285 performance of the allowed Nichiha wall systems for the following reasons:

1) In ASTM E1354 Cone calorimeter testing, the initial Peak Heat Release Rate (Pk. HRR) for FRT plywood is comparable to gypsum sheathing (Ref. 4).
2) From the literature (Ref. 5), it has been established that steel stud walls exhibit fire resistance behavior similar to wood stud walls.
3) The building code allowance for the use of FRT framing in lieu of noncombustible materials is predicated on its Class A flame spread rating and the fact that it does not support progressive combustion during the ASTM E84 30 minute fire test. In essence, FRTW will not support combustion once the flame source is removed.
Cavity Insulation

The test submitted (Ref. 2) did not utilize stud cavity insulation. Any noncombustible cavity insulation may be utilized in the referenced designs. Additionally, any listed faced or unfaced fiberglass insulation may be utilized.

The list of approved cavity insulations is below:

1) None
2) Any noncombustible insulation per ASTM E136
3) Any Mineral Fiber (Board type Class A, ASTM E84 faced or unfaced)
4) Any Fiberglass (Batt Type Class A, ASTM E84 faced or unfaced)

Exterior Sheathing

The test used ½ inch Densglass exterior sheathing. Exterior sheathing (min. ⅝ in.) may be used. Approved sheathings are listed below:

½ in. or thicker exterior gypsum sheathing

WRB over Base Wall

The test included Soprema SOPRASEAL® STICK 1100T applied to the exterior gypsum sheathing. Any WRB which has been tested per ASTM E1354 (at a minimum of 50 kW/m² heat flux) and shown by analysis to be less flammable (improved $T_{ig}$, Pk, HRR). Comparisons based on NFPA potential heat calculations may also be used.

Exterior Insulation

Based on the flammability characteristics and allowances described for Hunter Panels Xci products in their DrJ Technical Evaluation Report TER 1402-01, the testing with 4 in. thick Xci CG (Class A) allows the substitution of Xci Foil (Class A) and Xci 286.

Mineral wool exterior insulation may be substituted for polyisocyanurate exterior continuous insulation based on its noncombustibility.

Claddings

Based on the analysis of components, the following is allowed:

Minimum ⅝ in. Nichiha AWP panels listed in Table 2 of Intertek CCRR-0299

CONCLUSIONS

An NFPA 285 test was conducted on a Nichiha exterior wall design with a 4 in. thickness of Hunter Panels polyisocyanurate sheathing.

The purpose of this evaluation was to determine Engineering Extensions for the components that can meet the requirements of NFPA 285. From the wall system submitted, an analysis was conducted on the components tested. This allowed us to form a base wall system from which replacement components can be interchanged.

In conclusion, we have determined that Engineering Extensions on various components of the tested wall designs as shown herein can meet the criteria of NFPA 285 with specific limitations.