Block 8L

Column in 2 Hour Exterior Wall Assembly Analysis

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Tuesday, March 3, 2015
Project Overview

Ankrom Moisan Architects is designing Block 8L in the city of Portland, Oregon. The building is a Type IIIB construction. The wood column at some locations is partially enclosed in the exterior wall which is required to have structural stability for the 2-hour fire duration since part of the column is outside of the wall membrane.

Code Unlimited has been asked to provide analysis of the proposed column to ensure that structural stability is provided for at least 2-hour duration for the wall as required by code.

Applicable Codes

2014 Oregon Structural Specialty Code (OSSC)
2014 Oregon Fire Code (OFC)

Approach

- The existing wall assembly has been analyzed in accordance with OSSC §703.3 Alternative Methods for Determining Fire Resistance.
- The column in exterior wall assembly shall be established as having 2 hour fire-resistance, as required by OSSC 705.6.
- A more detailed analysis of the assembly follows this section. Each analysis consists of a graphical and tabular comparison of assemblies, followed by a narrative of notable assembly differences and an explanation of fire resistance equivalency.
Proposed Designs
Assembly Analysis

The proposed wall assemblies were compared to UL U301, tested for 2 hour fire resistive construction (pictured below).
<table>
<thead>
<tr>
<th>Element</th>
<th>UL U301</th>
<th>Proposed Wall Assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Nailheads</td>
<td>Exposed or covered with joint compound</td>
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<td></td>
<td>and paper tape. Joint compound and paper tape may be omitted when square edge boards are used. As an alternate, nom 3/32 in. thick gypsum veneer plaster may be applied to the entire surface of Classified veneer baseboard with the joints reinforced with paper tape.</td>
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<td>3. Nails</td>
<td>6d cement coated nails 1-7/8 in. long, 0.0915 in. shank diam, 1/4 in. diam heads, and 8d cement coated nails 2-3/8 in. long, 0.113 in. shank diam, 9/32 in. diam heads.</td>
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<tr>
<td>4. Gypsum Board</td>
<td>5/8 in. thick, two layers applied either horizontally or vertically. Inner layer attached to studs with the 1-7/8 in. nails spaced 6 in. OC. Outer layer attached to studs over inner layer with the 2-3/8 in. long nails spaced 8 in. OC. Vertical joints located over studs. All joints in face layers staggered with joints in base layers. Joints of each base layer offset with joints of base layer on opposite side.</td>
<td>The interior side is a single layer gypsum board and exposed side of the glulam structure member. Based on char rate analysis, this provides 2 hour structural stability and sufficient amount of unimpaired cross sectional area of the column. (See the fire char analysis below) Outer layer protected by three layers of 5/8” Type ‘X’ gypsum board.</td>
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**Fire Resistance**

| 2-hour | 2-hour |

**Char Analysis**

The cross-sectional area of the glulam column unimpaired by fire exceeds the cross-sectional area required to provide structural support based on structural engineering analysis.
**NOTE:**

1. COLUMN 2 HOUR RATED ASSEMBLY PROVIDED WITH COMBINATION GYPSUM AND CHAR RATE.
2. ALL WOOD IN EXTERIOR WALL TO BE PRW.
3. SHOWN AT 3RD, 4TH AND 5TH.
4. DIME, AT CORNERS, WRAP (1) LAYERS TYPE "X" W GYPSUM SHEATHING AT EXTERIOR.

**CALCULATED CHAR RATE:**

\[ C = 2.58 \times 10^{-13} \text{ PER HOUR CHAR RATE DEPTH} \]

**CALCULATED AS SHOWN:**

**GLUED LAMINATED COLUMN (2 HOUR CHAR RATE SHOWN DASHED)**

**FIRE CAULK - BOTH SIDES**

**3/8" GYPSUM**

**MINIMUM (2) 2" WALL FRAMING BOTH SIDES**

**FOIL FACED SELF-ADHERED MEMBRANE**

**3/8" TYPE "X" MR GYPSUM SHEATHING AT EXTERIOR OF COLUMN (2 LAYERS)**

**MINERAL FIBERBOARD INSULATION**

**BRICK VENEER**
An analysis was performed at the following three locations of the column:

1. Exposed interior side of the column
2. Sides of column located in wall
3. Exterior wall side of column


1. Protection of the exposed side of column on the interior side analyzed by char rate calculations.
   a. Char rate analysis
      i. Base Formula: \( c = 2.58 \beta_n t^{0.813} \)
      ii. Values
         \( \beta_n \) is charring rate = 0.635mm/m (1.5 in/hr)
         \( t \) is time = 120 minutes (2 hour)
         \( c \) is char thickness in millimeters
      iii. Calculation:
          \( c = 2.58 \beta_n t^{0.813} \)
          \( c = 2.58 \times (0.635)(120)^{0.813} \)
          \( c = 80.3 \text{mm or } 3.16 \text{ inch} \)

2. Protection of the column in wall is protected by:
   a. 1 layers of 5/8” gypsum board provides 20 minutes of fire rating (OSSC 722.2.1.4(a))
b. Minimum (2) FRTW 2 x members provides 2 hour protection of column based on industry standard char rate of 1.5 inches per hour.
c. Fire Caulk protects joint at column /gypsum wallboard connection exceeding 2 hours.

3. Protection of the column in wall is protected by:
   a. Protection of the column
      i. 3 layers of 5/8" gypsum wallboard Type 'X' provides 120 minutes (3 x 40 minutes) of protection per O SSC 721.2.1.4(2).
      ii. Mineral fiber board not included.
      iii. Exterior finish not included.

Based on the above analysis, a two hour fire exposure on the column will result in the loss of usable material (as shown in the shaded area of the drawings above). The unaffected area of the column in the exterior wall assembly exceeds the area required for the structural member.

Conclusions

The proposed column at exterior wall assembly will provide structural stability for a 2 hour fire duration and exceeds the minimum fire resistance requirements of a 2 hour fire rated UL U301 assembly for exposure to fire from the exterior side.

Therefore it is our opinion that the proposed design for the column-in-wall assembly at Block 8L will meet the requirements for the installation.

Samir Mokashi
Principal/Code Analyst
Code Unlimited

Franklin Callfas
Fire Protection Engineer/Owner
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