Block 8L
Beam at 2 Hour Rated Stair Wall
Assembly Analysis

Prepared By:
Code Unlimited LLC
12655 SW Center Street, Suite 350
Beaverton, Oregon 97005

Thursday, February 12, 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 beam at some locations is partially enclosed in a rated stair wall which is required to have 2-hour fire protection.

Code Unlimited has been asked to provide analysis of the proposed beam in shaft wall assembly to ensure that at least 2-hour structural stability will be provided to the beam 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 beam in stair wall assembly shall be established as having 2 hour fire-resistance, as required by OSSC 708.
- 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 assembly was compared to UL 301, tested for 2 hour fire resistive construction (pictured below).

<table>
<thead>
<tr>
<th>Element</th>
<th>U301</th>
<th>Proposed Wall Assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Nailheads</td>
<td>Exposed or covered with joint compound.</td>
<td>Exposed or covered with joint compound.</td>
</tr>
<tr>
<td>2. Joints</td>
<td>Exposed joints covered with joint compound 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>
<td>Exposed joints covered with joint compound 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>
</tr>
<tr>
<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>
<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>
</tr>
<tr>
<td>Element</td>
<td>U301</td>
<td>Proposed Wall Assembly</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------</td>
</tr>
<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. When used in widths other than 48 in., gypsum board to be installed horizontally.</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. When used in widths other than 48 in., gypsum board to be installed horizontally.</td>
</tr>
<tr>
<td>Fire Resistance</td>
<td>2-hour</td>
<td>2-hour</td>
</tr>
</tbody>
</table>

**Char Analysis**

The cross-sectional area of the glulam beam unimpaired by fire exceeds the cross-sectional area required to provide structural support based on structural engineering analysis.
An analysis was performed on all three sides of the beam:


1. Protection of beam at the stair shaft side analyzed by fire resistance analysis and char rate calculations.
   a. 2 layers of 5/8” gypsum Type ‘X’ provides 80 minutes of fire rating (OSSC 722.2.1.4(a))
   b. 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 = 120min - 80min (1”gyp) = 40 minutes (.67 hour)
          \( c \) is char thickness in millimeters
      iii. Calculation:
          \( c = 2.58 \beta_n t^{0.813} \)
          \( c = 2.58 \times 0.635 \times 40^{0.813} \)
          \( c = 32.9 \text{mm or 1.3 inch} \)

Based on the above fire resistive rating and char depth analysis, it was determined that a two hour fire exposure will result in the loss of usable material (as shown in the shaded area of the drawings above) of the glulam beam.
Conclusions

The proposed beam in wall assembly provides structural stability for 2 hour fire duration and exceeds the minimum fire resistance requirements of a 2 hour fire rated UL U301 assembly for exposure to fire. Therefore it is our opinion that the proposed design for the beam in wall assembly at Block 8L will provide at least 2-hour structural stability for the beam.

Samir Mokashi
Principal/Code Analyst
Code Unlimited

Franklin Callfas
Fire Protection Engineer/Owner
Intuitive Engineering Services LLC