Block 8L

2 Hour Rated Exterior Beam

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

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Project Overview

Ankrom Moisan Architects is designing Block 8L in the city of Portland, Oregon. The building is a Type IIIB construction. The glulam beam is partially enclosed in a rated exterior wall and is required to have 2-hour fire protection.

Code Unlimited has been asked to provide analysis of the proposed beam in 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-wall assembly shall be established as having 2 hour fire-resistance, as required by OSSC 705.
- A more detailed analysis of the assembly follows this section. The 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 Design

NOTE:
1. BEAM 2-HOUR RATED ASSEMBLY PROVIDED WITH COMBINATION GYPSUM AND CHAR RATE.
2. ALL WOOD IN EXTERIOR WALL TO BE FRT.
3. SHOWN AT WINDOW AND DOOR OPENINGS.
4. SHOWN AT 3RD, 4TH AND 5TH.
5. SIMILAR AT 6TH.

DEFLECTION TOP TRACK FILL VOID WITH MINERAL WOOL
MIN. (2) 2x BLOCKING AT TOP OF WINDOW AND AT WALL DEPARTURES
SOLID BLOCKING AS REQUIRED

BEAM/HEADER PER STRUCTURAL
STRUCTURE BEYOND
FIRE CAULK
SEALANT CHAMFER
4x10 MIN. FRTW CONTINUOUS COORDINATE WITH SHELF ANGLE SUPPORT SYSTEM
G465 F ANGIF SUPPORT SYSTEM
CALCULATED CHAR RATE:
C = 2.58 Brn\textsuperscript{0.813} PER HOUR CHAR RATE DEPTH CALCULATED AS SHOWN
FIRE CAULKING - BOTH SIDES

MINERAL FIBERBOARD INSULATION
(3) LAYERS 5/8" TYPE "A" MS 250G/LM SHEATHING
BRICK VENEER
SEALANT CHAMFER
TYP. UNO
AT ALLEY
GOAT C1
STAT C1
Assembly Analysis

The proposed wall assembly was 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. Nail heads</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>
</tbody>
</table>
4. Gypsum Board

**Proposed Wall Assembly**

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.

*(Provides 2 hour rating)*

**Beam-** glulam beam

4x FRTW

*(2 hour structural stability, see char analysis)*

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**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 at the following four locations of the beam:

1. Exposed side of beam at interior
2. Exterior wall side of beam
3. Above wall header/below beam
4. At wood floor decking.


1. Exposed side of beam at interior
   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:
         \[ c = 2.58 \beta_n t^{0.813} \]
         \[ c = 2.58 (0.635)(120)^{0.813} \]
         \[ c = 80.3mm \text{ or } 3.16\text{ inch} \]

2. Exterior wall side of beam
   a. 3 layer of 5/8" Type ‘X’ provides 120 minutes of fire rating (OSSC 722.6.2(1))
   b. 4x FRTW member provides 2 hour protection of column based on industry standard char rate of 1.5 inches per hour.
   c. Exterior finish and mineral fiberboard not included.

3. Above wall header/below beam
   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.

4. Wood floor decking.
   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:
         \[ c = 2.58 \beta_n t^{0.813} \]
         \[ c = 2.58 (0.635)(120)^{0.813} \]
         \[ c = 80.3mm \text{ or } 3.16\text{ inch} \]

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 81 will meet the requirements for the installation.

Samir Mokaeshi  
Principal/Code Analyst  
Code Unlimited

Franklin Calfas  
Fire Protection Engineer/Owner  
Intuitive Engineering Services LLC