Block 8L Mixed Use Floor Assembly

Fire Rated Horizontal Assembly Analysis

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Project Overview

Ankrom Moisan Architects is designing the Block 8L Mixed Use in Portland, OR. The building consists of apartments and office spaces.

Building construction is of Type IIB construction. The building is fully protected by fire sprinklers, fire and smoke detection and a fire alarm system. A two-hour fire rated horizontal assembly is required to separate the shaft.

Code Unlimited has been asked to provide analysis of the proposed floor assembly to ensure it will provide at least two-hour fire rated separation as required by code.

Applicable Code

2014 Oregon Structural Specialty Code
2014 Oregon Fire Code

Approach

- The proposed floor decking assembly has been analyzed in accordance with OSSC chapter 7.
- The floor assembly has been compared against testing conducted by Mario Fontana and Andrea Frangi and published in “Fire Behavior of Timber-Concrete Composite Slabs”, International Association of Fire Safety Science.
- The fire resistance based on the charring rate was calculated using the document ‘Calculating the fire resistance of exposed wood members’. AFPA (1999) Technical Report No. 10n, American Forest and Paper Association Inc., Washington DC.
Proposed Design

The proposed design uses 3” reinforced concrete over acoustic isolation mat, supported by 3” tongue and groove decking.

Assembly Analysis

The proposed floor assembly was analyzed per “Structural Design for Fire Safety” by Andrew H. Buchanan. Section 10.7.6 states that fire performance of timber-concrete structures can be based on the charring rate of the timber part of the structure.

The test assembly was investigated by Fontana and Frangi (1999) and published in “Fire Behavior of Timber-Concrete Composite Slabs”. The fire test was performed with a timber-concrete composite slab made of 3” to 4” sawn timber planks and 3” thick reinforced concrete layer. The composite slab was exposed to minimum 90 minutes of ISO-fire from below the composite slab, and showed no failure. An average charring rate of about 0.72 mm/min was measured.

Calculations based on 0.72 mm/min for 2-5/8” wood decking were used in a formula in the AFPA document to provide the fire resistance of the floor assembly.

The proposed floor assembly has 1) 2 layers of 5/8” gypsum board Type X and 2) 2-5/8” (66.675 mm) tongue and groove wooden deck. An analysis of the fire resistance from the 2 layers of gypsum board and a char rate analysis of the wooden decking provides a combined fire resistance of 162 minutes, which exceeds the required two-hour fire resistance.

1. 2 layers of 5/8” gypsum board Type ‘X’ provides 80 minutes (2 x 40 minutes) per OSSC 722.2.1.4(a)
2. 3x T&G decking
      i. Base Formula: \( c = 2.58 \beta_n t^{0.813} \)
      ii. Values
         \( \beta_n \) is charring rate = 0.72mm/m
         \( t \) is time in minutes
$c$ is char thickness = 66mm/m (2.63 inch)

iii. Calculation:

\[
c = 2.58 \beta_n t^{0.813}
\]

\[
66 = 2.58 (0.72)(t)^{0.813}
\]

\[
t = 82 \text{ min}
\]

**Conclusions**

The 82 minutes to burn through the wood decking of the proposed design exceeds the one-hour fire rated assembly requirements. Basing fire resistance rating on char rate through the wood in a wood-concrete slab design is based on testing published by International Association of Fire Safety Science.

Therefore it is our opinion that the proposed design for the floor assembly at Block 8L Mixed Use will provide at least one hour fire rated separation between the stories.

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Fire Protection Engineer/Owner  
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