Development Services

From Concept to Construction

Phone: 503-823-7300 Email: bds@portlandoregon.gov 1900 SW 4th Ave, Portland, OR 97201
More Contact Info (http://www.portlandoregon.gov//bds/article/519984)

APPEAL SUMMARY

Status: Decision Rendered - Held over from ID 15915, item 2 (10/4/17) for additional information

Appeal ID: 16062	**Project Address:** 318 NE Couch St
Hearing Date: 11/1/17	**Appellant Name:** Tom Jaleski
Case No.: B-014	**Appellant Phone:** 5034885651
Appeal Type: Building	**Plans Examiner/Inspector:** John Cooley, Amit Kumar
Project Type: commercial	**Stories:** 5 **Occupancy:** B, M, S **Construction Type:** III-A
Building/Business Name: Block 76W	**Fire Sprinklers:** Yes - Throughout
Appeal Involves: Reconsideration of appeal	**LUR or Permit Application No.:**
Plan Submitted Option: pdf [File 1] [File 2] [File 3] [File 4]	**Proposed use:** Commercial Building

APPEAL INFORMATION SHEET

Appeal item 1

Code Section OSSC table 601, 602.3, 715.4

Requires

Table 601
The floor construction and associated secondary members are required to provide minimum 1 –Hour fire resistance protection in a type III A building.

§ 602.3
The exterior walls are of noncombustible materials and the interior building elements are of any material permitted by this code.

§ 715.4
Where fire resistance-rated floor or floor/ceiling assemblies are required, voids created at the intersection of the exterior curtain wall assemblies and such floor assemblies shall be sealed with an approved system to prevent the interior spread of fire. Such systems shall be securely installed and tested in accordance with ASTM E2307 to provide an F-rating for a time period at least equal to the fire resistance rating of the floor assembly.
Exception: Voids created at the intersection of the exterior curtain wall assemblies and such floor assemblies where the vision glass extends to the finished floor level shall be permitted to be sealed with an approved material to prevent the interior spread of fire. Such material shall be securely installed and capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste where subjected to ASTM E 119 time-temperature fire conditions under a minimum positive pressure differential of 0.01 inch (0.254 mm) of water column (2.5 Pa) for the time period at least equal to the fire-resistance rating of the floor assembly.

Proposed Design

Block 76W is a 5-story commercial building with Type IIIA construction. The building is fully

protected by automatic fire sprinklers, fire and smoke detection and a fire alarm system. A 1-hour rated floor assembly is required per 2014 OSSC table 601.

The proposed floor assembly intersects a non–load bearing and non-rated exterior wall. The assembly is analyzed for fire resistance in accordance with chapter 7, § 715.4. A char rate analysis for the 5-ply Cross-Laminated Timber horizontal assembly is performed. See attached engineering judgement analysis report (EJ) for details.

_____

Reconsideration Text

This is a reconsideration of Appeal 15915, Item #2 that is currently being held for additional information. The additional information requested by the City of Portland's Senior Structural Engineer pertains to the loading used for structural calculations during a 1-hour fire. Attached is a letter from Catena addressing the city's request for information and clarifying that the CLT floor panel will support the full dead + live load for the full 1-hour fire. The ASTM E119 test data for the panels is also attached.

Reason for alternative

The floor is permitted to be wood construction and required to be 1 hour as addressed by the attached EJ. The exterior wall is not required to be rated but required to be non-combustible as constructed. The support beam is required to be 1 hour and meets the prescriptive requirement for HT, therefore not addressed in the attached EJ.

Floor: We have evaluated the floor fire resistance per 2014 OSSC Section. 715.4. The proposed floor assembly is evaluated to provide a 1 hour fire-resistance rating. The NDS calculation from Table 16.2.1B confirms that 1.9" of CLT wood will provide the minimum cover for 1 hour of fire resistance. The remaining CLT wood (5.1") after 1-hour of fire exposure exceeds the minimum required thicknesses to provide structural integrity (see attached project structural engineer report).

The 7", 5-ply CLT floor assembly is 1-hour rated per the attached EJ letter developed by a registered Oregon Fire Protection Engineer, and will meet the minimum 1 hour fire resistance requirement per OSSC for this building. Therefore, we urge you to approve this appeal.

_____

Reconsideration Text

Attached is a letter from Catena addressing the city's request for information and clarifying that the CLT floor panel will support the full dead + live load for the full 1-hour fire. The ASTM E119 test data for the panels is also attached.

APPEAL DECISION

Alternate one hour floor / ceiling assembly with engineering analysis: Granted provided structural calculations are found to be acceptable during plan review.

Appellant may contact Amit Kumar (503-823-7561) with questions.

The Administrative Appeal Board finds with the conditions noted, that the information submitted by the appellant demonstrates that the approved modifications or alternate methods are consistent with the intent of the code; do not lessen health, safety, accessibility, life, fire safety or structural requirements; and that special conditions unique to this project make strict application of those code sections impractical.

Pursuant to City Code Chapter 24.10, you may appeal this decision to the Building Code Board of Appeal within 180 calendar days of the date this decision is published. For information on the appeals process and costs,

including forms, appeal fee, payment methods and fee waivers, go to www.portlandoregon.gov/bds/appealsinfo, call (503) 823-7300 or come in to the Development Services Center.

CODE UNLIMITED, LLC

Block 76W

CLT Floor EJ Letter

Client Name: Skylab Architecture

Client Address: 413 SW 13th Ave #200, Portland, OR 97205

Date: August 31, 2017

TABLE OF CONTENTS

Project Overview

Skylab Architecture is designing the Block 76W project that will consist of a 5-story commercial building of Type IIIA construction. The building is fully protected by automatic fire sprinklers, fire and smoke detection, and a fire alarm system. A one-hour fire rated floor assembly is required per Table 601 of the 2014 OSSC.

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

Applicable Codes

- 2014 Oregon Structural Specialty Code (OSSC)
- 2014 Oregon Fire Code (OFC)
- 2015 American Wood Council Technical Report No.10 (NDS TR-10)

Approach

The proposed floor assembly at the intersection of the floor and non-load bearing exterior wall is analyzed for fire-resistance in accordance with the following:

- The fire and smoke protection features detailed in OSSC Chapter 7.
- The specific floor/exterior wall intersection requirements of OSSC Section 715.4.
- A char rate analysis for the 5-ply Cross-Laminated Timber horizontal assembly.

Proposed Design

The proposed horizontal assembly is composed of Cross-Laminated Timber (CLT) panels for floor framing topped with ½" acoustic mat and 1-1/2" of gypcrete. The 5-ply CLT panel supports the non-load bearing exterior wall over a window assembly. A detail of the intersection of the floor with non-load bearing exterior wall is shown in Figure 1.

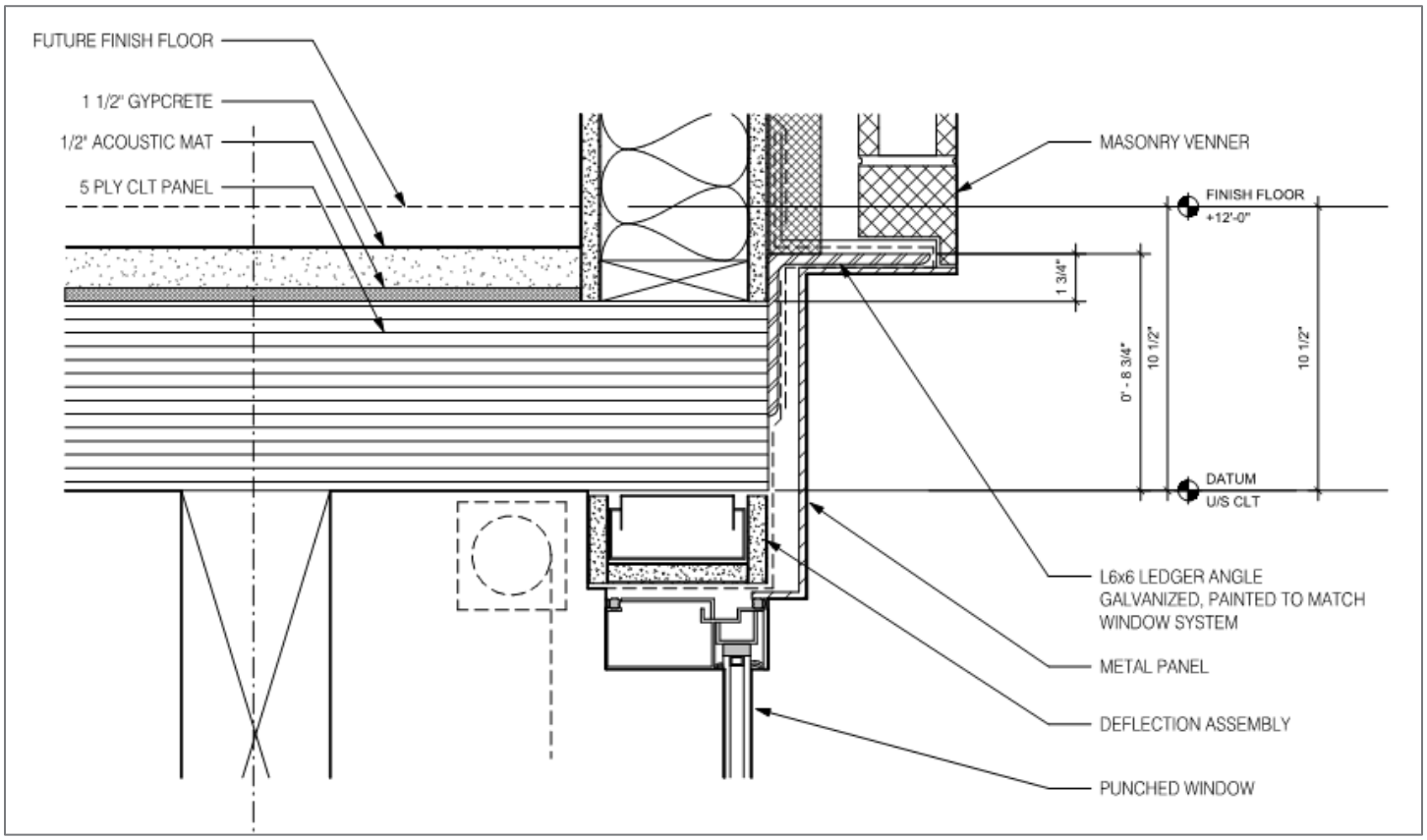


Figure 1: Proposed floor assembly at the intersection between floor and non-load bearing exterior wall.

Assembly Analysis

The floor assembly will be protected with the 7", 5-ply CLT panel.. The fire resistance of wood is permitted by OSSC §722.1 to be calculated using Chapter 16 of *National Design Specification for Wood Construction (NDS)*. Table 16.2.1B of the document shows the calculated effective char depth corresponding to the fire resistance of the wood (Figure 2). Per Table 16.2.1B, the 7" 5-ply CLT panel with 1-3/8" layer thickness provides the required 1-hour fire protection with an effective char depth of 1.9". The structural analysis from the project structural engineer confirms that the remaining 5.1" thick CLT after the 1-hr char rate (1.9") will be sufficient to maintain the structural integrity of the floor/building (see attached).

Table 16.2.1B Effective Char Depths (for CLT with β_n=1.5in./hr.)

Required Fire Endurance (hr.)	Effective Char Depths, a_{char} (in.) lamination thicknesses, h_{lam} (in.)								
	5/8	3/4	7/8	1	1-1/4	1-3/8	1-1/2	1-3/4	2
1-Hour	2.2	2.2	2.1	2.0	2.0	1.9	1.8	1.8	1.8
1½-Hour	3.4	3.2	3.1	3.0	2.9	2.8	2.8	2.8	2.6
2-Hour	4.4	4.3	4.1	4.0	3.9	3.8	3.6	3.6	3.6

Figure 2 Table 16.2.1B of the NDS for Wood Construction.

Conclusions

The floor assembly is protected through 7”, 5-ply CLT panels for the required 1-hour fire rating per the calculations in the NDS for Wood Construction, complying with §722.1 of the 2014 OSSC. The proposed assembly will maintain a protection equivalent to 1-hour fire resistance, meeting the minimum required for floor fire ratings in Type IIIA construction. The 5-ply CLT after 1 hour char with 5.1” will exceed the minimum required thickness to maintain the structural integrity of the floor/building.

Franklin Callfas
Principal/Fire Protection Engineer
Code Unlimited

September 20, 2017

Mrs. Jill Asselineau
Skylab Architecture
413 SW 13th Avenue, Suite 200
Portland, OR 97205

RE: Block 76W Mixed-Use, Portland, Oregon

catena project number: 2017003.00

Dear Jill:

The attached calculations verify that the DR Johnson Grade V1 5-ply CLT panels for the Block 76W project located at the corner of NE Couch & East Burnside in Portland, OR, meet the requirements of the 2014 Oregon Structural Specialty Code. These panels have been evaluated for both typical loading, as well as catastrophic loading in a post-char event.

Sincerely,

catena consulting engineers

EXPIRES: 06/30/2018

Jason M. Thompson, P.E., S.E.
Principal

Shawn Evilsizor, P.E.
Engineer

- DR Johnson, Grade VI, Layup #5
  - Major strength
    - $F_b = 900 psi$
    - $E = 1.6 \times 10^6 psi$
    - $F_v = 180 psi$
  - Minor strength
    - $F_b = 525 psi$
    - $E = 1.4 \times 10^6 psi$
    - $F_v = 180 psi$
- $d = 5 \cdot 1.375'' = 6.875''$
- $F_b S_{eff} = 4800$ lb-ft/ft
- $EI_{eff} = 415 \times 10^6$ lb-in^2/ft
- Char calcs (1-hr)
  - $a_{char} = 1.9in$
  - $d_{fire} = d - a_{char} = 4.975in \Rightarrow$ (2) full strong-axis plies left
- $I_{fire} = I_{cm} + Ad^2 = 2\left[\frac{1}{12}(12in)(1.375in)^3\right] + 2\left[(12in \cdot 1.375in)(1.375in)^2\right] = 67.58 in^4/ft$
- $y_t = 1.5 \cdot 1.375in = 2.0625in$
- $S_{fire} = I_{fire}/y_t = 32.77 in^3/ft$
- Charred moment capacity: $F_b S_{fire} K = 900psi \cdot 32.77 in^3/ft \cdot 2.85/12in/ft = 7004$ lb-ft/ft
- Shear capacity $= (6.875in \cdot 12in)(180 psi)\frac{2}{3} = (14850 lb/ft)\frac{2}{3} = 9.9$ k/ft
- Charred shear capacity $= \frac{2}{3}(14850 lb/ft)(4.975in/6.875in) = 10746$ lb/ft $= 7.164$ k/ft
- Summary
  - Normal
    - $M_R = 4.8$ k-ft/ft
    - $V_R = 9.9$ k/ft
    - $EI = 415 \times 10^6$ lb-in^2/ft
  - Charred
    - $M_{R_{fire}} = 7$ k-ft/ft
    - $V_{R_{fire}} = 7.164$ k/ft
-

Loads	Dead	Live
L2	78	100
L3	44	100
L4, L5	44	80
Roof	25	25+drift

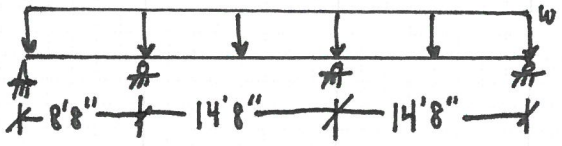
← lb/ft^2

- Load Combinations

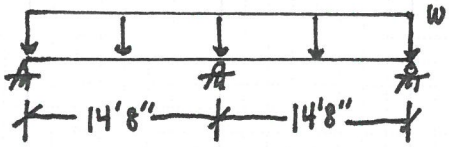
1) Normal: D+L or D+S

2) Charred: D + 0.5L or D + 0.2S

Level 2 Worst-Case Span Conditions



OR



$M = 4131$ lb-ft/ft ✓

$M_{fire} = 2971$ lb-ft/ft ✓

$V = 1586$ lb ✓

$V_{fire} = 1140$ lb ✓

$M = (178)(14.67)^2/8 = 4787$ lb-ft/ft

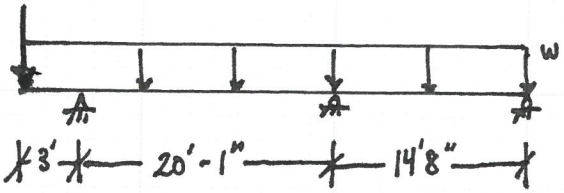
$M_{fire} = (128)(14.67)^2/8 = 3442$ lb-ft/ft

$V = (178)(14.67)(5/8) = 1632$ lb

$V_{fire} = (128)(14.67)(5/8) = 1173$ lb

Level 3 Worst-Case Span Conditions

$P = 45$ psf $\cdot$ 12ft $\cdot$ 1ft $= 540$ lb



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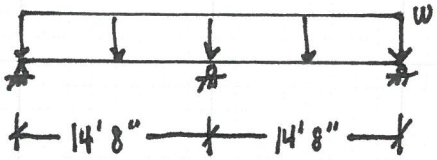


$M = 4970$ lb-ft/ft ✓

$M_{fire} = 3087$ lb-ft/ft ✓

$V = 1549$ lb/ft ✓

$V_{fire} = 975$ lb/ft ✓

$M = (144)(14.67)^2/8 = 3872$ lb-ft/ft

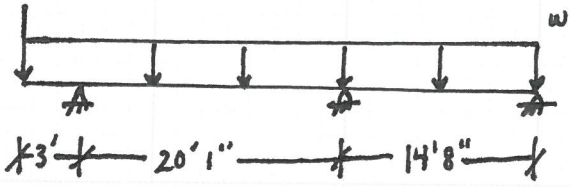
$M_{fire} = (94)(14.67)^2/8 = 2526$ lb-ft/ft

$V = (144)(14.67)(5/8) = 1320$ lb/ft

$V_{fire} = (94)(14.67)(5/8) = 862$ lb/ft

Levels 4/5 Worst-Case Span Conditions

P = 540 lb



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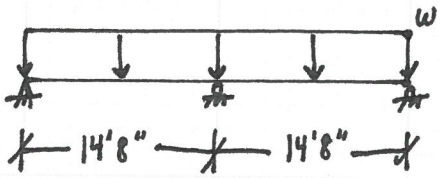


M = 4217 lb-ft/ft ✓

M_{fire} = 2710 lb-ft/ft ✓

V = 1319 lb/ft ✓

V_{fire} = 860 lb/ft ✓

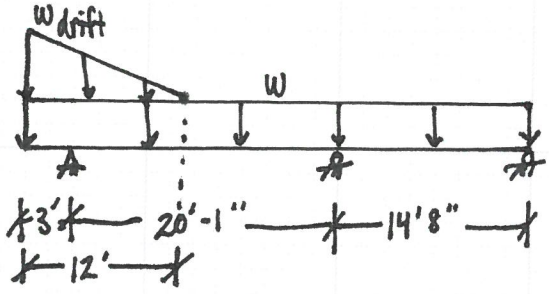
$M = (124)(14.67)^2/8 = 3335$ lb-ft/ft

$M_{fire} = (84)(14.67)^2/8 = 2259$ lb-ft/ft

$V = (124)(14.67)(5/8) = 1137$ lb/ft

$V_{fire} = (84)(14.67)(5/8) = 770$ lb/ft

Roof Worst-Case Span Condition



M = 1962 lb-ft/ft

M_{fire} = 1146 lb-ft/ft

V = 593 lb/ft

V_{fire} = 348 lb/ft

Snow Drift calc

l_u = 142'4"

p_g = 25 psf

$h_d = 0.43 l_u^{1/3}(p_g+10)^{1/4} - 1.5 \approx 4$ ft

drift height = $0.75 h_d$ = 3 ft

$\gamma = 0.13 p_g + 14 = 17.25$ lb/ft^3

$h_b = p_g/\gamma = 1.45$ ft

$h_c = h_{parapet} - h_b = 9.5\text{ft} - 1.45\text{ft} = 7.55$ ft

drift height $< h_c \Rightarrow w = 4h_d = 12$ ft

$S_{drift} = 3\text{ft} \cdot 25\text{psf} / 1.45\text{ft} = 52$ psf

If 0.75 kip point load is added to the middle of the 20'1" bay, this will still work.

M = 4494 lb-ft/ft V = 1047 lb/ft

M_{fire} = 3823 lb-ft/ft V_{fire} = 802 lb/ft

Deflections

$\Delta = 5wL^4/384EI = 0.0301w$ where w is in lb/in

- $L = 14'8'' = 176$ in
- $EI = 415 \times 10^6$ lb-in^2/ft

- L2
  - $w_{D+L} = 178$ lb/ft $\Rightarrow \Delta_{D+L} = 0.45$ in $\sim L/390$ ✓
  - w_L : $\Delta_L = 100\Delta_{D+L}/178 = 0.25$ in $\sim L/700$ ✓
- L3
  - w_{D+L} : 144 lb/ft $\Rightarrow \Delta_{D+L} = 0.36$ in $\sim L/480$ ✓
  - w_L : $\Delta_L = 100\Delta_{D+L}/144 = 0.25$ in $\sim L/700$ ✓
- L4, L5
  - w_{D+L} : 124 lb/ft $\Rightarrow \Delta_{D+L} = 0.31$ in $\sim L/560$ ✓
  - w_L : $\Delta_L = 80\Delta_{D+L}/124 = 0.20$ in $\sim L/880$ ✓
- Roof
  - w_{D+L} : 50 lb/ft $\Rightarrow \Delta_{D+L} = 0.13$ in $\sim L/1350$ ✓
  - w_L : $\Delta_L = \Delta_{D+L}/2 = 0.06$ in $\sim L/2700$ ✓

catena consulting engineers

MEMORANDUM

TO:	Jill Asselineau (Skylab Architecture)	**DATE:** October 11, 2017	
FROM:	Jason Thompson	**PROJECT:**	Block 76W
CC:		**PROJECT NUMBER:**	2017003.00

Jill,

See below for our responses to Amit Kumar's comments regarding the CLT char calculations provided as part of your appeal process via Code Unlimited.

1) ***The applicant needs to provide manufacturers data that provides the reduced section properties per Section 16.2.1.5 of NDS 2015 which states that "For cross - laminated timber, reduced section properties shall be calculated using equations provided by the cross laminated timber manufacturer based on actual layup used in the manufacturing process."***
    a. See the attached fire testing reports for the DR Johnson panels in which a two-hour fire rating was achieved with the spline connection that is currently shown in our drawings. Also attached is email correspondence with the DR Johnson lead engineer regarding the reduced section properties requested. It is noted within the email that "the generic equations used per the NDS and the CLT handbook are conservative for our panels. The standard equations are based on the testing of panels produced by Nordic in Canada – DR Johnson panels have consistently outperformed the Nordic panels when fire tested". The standard equations were used for our calculations, meaning that the capacities noted are conservative and remain structurally adequate.

2) ***The load combination used in the calculations for catastrophic events, which reduces the applied live load, are not contained in or referenced by the OSSC.***
    a. Refer to the response to comment #3 & #4 for further explanation.

3) ***The proposed load combination (noted in comment #2) may not be consistent with the NDS method that already significantly increases the strength of the wood member. It is not clear in the code language or commentary if a reduced live load has already been considered by NDS when providing the significant strength increase. It is premature to accept the new load combination until the NDS has had a chance to review the reduced live load and possibly adjust the strength increase. The standard of practice has been to use full live load in combination with the 2.85 increase allowed in bending stresses in the NDS.***
    a. The char capacities (M_{Rfire} and V_{Rfire}) noted on page 1 of the calculations exceed the maximum moment and shear demand (V and M) for the full D+L combination for all configurations noted on the remaining calculation pages. Therefore, even if the "catastrophic event" case with reduced live loading is not considered, the CLT panels remain structurally adequate. Note that although the NDS permits the 2.85 multiplier for bending stress, it does not

have a factor for shear stress. Therefore, per this comment, it is being requested that the calculation still consider shear stresses from full live load while the CLT panel thickness has experienced the reduction from char from a completed 1-hour fire event. See response to comment #4 for further information.

4) ***The load combination referenced is for "following" the damaging event in ASCE -7-10. The code check for fire is meant to be "during" the damaging event.***
   a. Per the response to comment #3, these panels, in conjunction with the 2.85 multiplier for bending stress, meets the full D+L demands for a 1-hr fire event. We still feel as though considering the full dead and live load, while also greatly reducing the effective thickness (and section modulus) for the CLT panel, is unreasonably conservative and does not meet the intent of the code. Given that a large percentage of the 80 psf (for office) and 100 psf (for assembly) live loading will surely evacuate with the first few minutes any building is actively on fire, it seems wholly reasonable to mandate full design live load in concert with a char thickness expected after a full hour has expired.

EXPIRES: 06/30/2018

Jason M. Thompson, P.E., S.E.
Principal

Shawn Evilsizor, P.E.
Engineer

Shawn Evilsizor

From: Levi Huffman <LeviH@drjlumber.com>
Sent: Wednesday, October 11, 2017 6:59 PM
To: Shawn Evilsizor
Cc: Michael Clark; Todd Black
Subject: Re: B76W CLT Char Reduced Section Properties

Shawn,

My apologies, I was planning on giving you a call today before I left the office for a week plus.

We are still developing the information the city has requested. The generic equations used per the NDS and the CLT Handbook are conservative for our panels. The standard equations are based on the testing of panels produced by Nordic in Canada - DR Johnson panels have consistently outperformed the Nordic panels when fire tested. All laminations are of equal thickness with no unequal lamination thickness in any of our panels. Further explanation of how the standard equations were developed can be found in AWC Technical Report 10 section 2.8.6. The city should allow you to use the standard equations for this project.

What we can send you is our fire testing data. This data proves the 2-hr fire rating of our panels. I understand that this is not the information you are explicitly looking for.

I will touch base when I return.

Todd - please send Shawn the fire rating report.

Thanks,

Levi Huffman P.E.

On Oct 11, 2017, at 4:58 PM, Shawn Evilsizor <evilsizor@catenaengineers.com> wrote:

> Levi,
>
> Do you have a timetable for when you think you can provide this information? I was hoping to get a letter back to the city by the end of the week. Do you feel as though that is feasible?
>
> Thanks,
> Shawn J. Evilsizor, P.E.
> catena consulting engineers
> 1500 ne irving street, suite 412
> portland, or 97232
> 503.467.4980 - office
> a connected series of related elements
>
> ---
>
> **From:** Levi Huffman [mailto:LeviH@drjlumber.com]
> **Sent:** Monday, October 09, 2017 4:41 PM

To: Shawn Evilsizor <evilsizor@catenaengineers.com>
Cc: Michael Clark <MikeClark@catenaengineers.com>
Subject: RE: B76W CLT Char Reduced Section Properties

Shawn,

I received your email but need a little bit of time before I'm able to respond. I'll send a response soon.

Thanks for your understanding.

Levi Huffman, P.E.
D.R. Johnson Wood Innovations
541.874.2231 Office
541.860.8021 Cell
LeviH@drjlumber.com

<image001.jpg>

oregonclt.com

From: Shawn Evilsizor [mailto:evilsizor@catenaengineers.com]
Sent: Monday, October 9, 2017 11:39 AM
To: Levi Huffman <LeviH@drjlumber.com>
Cc: Michael Clark <MikeClark@catenaengineers.com>
Subject: B76W CLT Char Reduced Section Properties

Levi,

We have received a comment from the city regarding our CLT char calculations in which they are requesting that we "provide manufacturers data that provides the reduced section properties per Section 16.2.1.5 of NDS 2015 which states "For cross-laminated timber, reduced section properties shall be calculated using equations provided by the cross laminated timber manufacturer based on actual layup used in the manufacturing process""

Is this something you could provide to us? We used generic equations for the CLT design guide, but want to make sure what you have meets/exceeds these values.

Thanks.
Shawn J. Evilsizor, P.E.
catena consulting engineers
1500 ne irving street, suite 412
portland, or 97232
503.467.4980 - office
a connected series of related elements