## **Development Services**

## From Concept to

om Concept to Construction			
ne: 503-823-7300 Email: bds@portlandoregon.gov 1900 SW 4th Ave, Portland, OR 97201 e Contact Info (http://www.portlandoregon.gov//bds/article/519984)			
APPEAL SUMMARY			
Status: Hold for Additional Information - Held over from	ID 23284 (1/8/20) for additional information		
Appeal ID: 23415	Project Address: 5325 N Interstate Ave		
Hearing Date: 2/5/20	Appellant Name: Ryan Miyahira		
Case No.: B-010	Appellant Phone: 5038921320		
Appeal Type: Building	Plans Examiner/Inspector: Chris Pagnotta, Corey Stanley		
Project Type: commercial	Stories: 7 Occupancy: R-2, B, S-1, S-2 Construction		
	Type: III-A over I-A		
Building/Business Name: Interstate and Willamette	Fire Sprinklers: Yes - full building		
Apartments			
Appeal Involves: Reconsideration of appeal	LUR or Permit Application No.: 16-279600-CO		

Proposed use: Apartments

Plan Submitted Option: pdf [File 1] [File 2] [File 3] [File 4] [File 5]

#### APPEAL INFORMATION SHEET

#### Appeal item 1

Code Section	703.3, 722.1 2018 NDS Technical Report No. 10
Requires	<ul> <li>703.3 Alternative methods for determining fire resistance</li> <li>The required fire resistance of a building element, component or assembly shall be permitted to be established by any of the following methods or procedures.</li> <li>Alternative protection methods as allowed by section 104.11 Alternative materials, design methods of construction and equipment.</li> <li>722.1 Calculated Fire resistance General. The calculated fire resistance of exposed wood members and wood decking shall be permitted in accordance with Chapter 16 of ANSI/AF&amp;P National Design Specification for wood construction.</li> </ul>
Code Modification or Alternate Requested	Alternate method to determine 2 hour rated fire resistance rating.
Proposed Design	Original Appeal text: The building is a Type IIIA over IA. A non-fire treated glulam beam has been installed in the Type IIIA portion of the building at an intersection of the floor, roof and lower portion of exterior wall. OSSC 703.3, 4 allows a comparison method for fire resistance ratings. See enclosed analysis from Fire Protection Consulting dated December 11, 2019. The alternate design is as follows:

#### Appeals | The City of Portland, Oregon

Wrapping the beam with two layers of 5/8-inch Type x gypsum wallboard to provide additional protection.

A char analysis of the beam prepared by the project structural engineer is enclosed showing the beams are adequate for 2-hour rating. Also, a follow up letter indication that the V4 beam has additional laminates addressing the city checksheets.

Fire sprinklers in the truss space open to the beam are provided.

**Reconsideration Text:** 

A revised letter from the fire protection engineer dated January 23, 2020 has been enclosed.

The alternate design is as follows:

Wrapping the beam with three layers of 5/8-inch Type x gypsum wallboard to provide additional protection.

A char analysis of the beam prepared by the project structural engineer is enclosed showing the beams are adequate for 2-hour rating. Also, a follow up letter indication that the V4 beam has additional laminates addressing the city checksheets.

Fire sprinklers in the truss space open to the beam are provided.

#### Reason for alternative Original Appeal text:

The enclosed revised letter from the fire protection engineer provides three methods to determine the fire resistance rating and concludes the combination of gypsum wallboard, glulam beam and sprinklers is equivalent to the fire resistance required by code.

The enclosed analysis from the structural engineer shows the adequacy of theinstalled glulam beam with only two layers of gypsum wallboard to meet a minimum of 2-hour required fire rating. Also the follow up letter indicated that the beam is a V4 beam with 4 laminations,

The proposed design complies with the intent of the provisions of the code and is equivalent of the prescribed code requirement for fire resistance.

#### Reconsideration text:

The enclosed revised letter from the fire protection engineer provides four methods to determine the amount of fire resistance. The four methods are detailed to determine the amount of fire resistance that the three layers of Gypsum wallboard provide for the glulam beam. The last two methods most closely demonstrates what would happen in a ASTM E 119 test and provides at least 120 minutes of fire resistance. With 120 minutes of fire resistance provided by the GWB none of the beam would be consumed by char during a 2-hour test.

The enclosed analysis from the structural engineer shows the adequacy of the glulam beam with only two layers of gypsum wallboard, so three layers of gypsum wallboard will provide additional protection above the two hour requirement.

The proposed design complies with the intent of the provisions of the code and is equivalent of the prescribed code requirement for fire resistance.

#### APPEAL DECISION

Alternate 2 hour fire rated beam assembly with engineering analysis: Hold for additional information. Appellant may contact John Butler (503 823-7339) with questions.

Additional information is submitted as a no fee reconsideration, following the same submittal process and using the same appeals form as the original appeal. Indicate at the beginning of the appeal form that you are filing a reconsideration and include the original assigned Appeal ID number. The reconsideration will receive a new appeal number.

Include the original attachments and appeal language. Provide new text with only that information that is specific

to the reconsideration in a separate paragraph(s) clearly identified as "Reconsideration Text" with any new attachments also referenced. No additional fee is required.



3115 NW 132<sup>nd</sup> Place, Portland, OR 97229-7037 Phone 503-531-8717 email djgessert@gmail.com

## Letter

Date:	January 23, 2020
То:	Ankrom Moisan Architects, Inc. 38 NW Davis / Suite 300 Portland, OR 97209
Attention:	Ryan Miyahira Managing Principal
From:	David Gessert, P. E. Fire Protection Engineer
Subject/Project:	Interstate & Willamette Apartments Glulam Beam – Appeal Revision 1
Job No.:	2019-53

Total Pages: 6

#### Introduction/Executive Summary

Three layers of 5/8-inch Type X gypsum wallboard (GWB) protect a glued laminated timber (glulam) beam. This untreated beam was inadvertently delivered and installed even through it was required by code to be fire-resistance treated. An alternate design is proposed to show that the GWB provides a satisfactory design.

Four methods are detailed below to determine the amount of fire resistance the three layers of GWB provide for the glulam beam. The last two methods most closely demonstrates what would happen in a ASTM E 119 test and provides at least 120 minutes of fire resistance. With 120 minutes of fire resistance provided by the GWB none of the beam would be consumed by char during a 2-hour test.

#### **Glulam Beam Fire Resistance – Alternate Design**

A standard glulam beam that is not fire resistance treated has been installed in the Interstate and Willamette Apartments project. Code requires this beam to be fire resistance treated since Type III construction shall have exterior walls of noncombustible materials. See *Oregon Structural Specialty Code* (OSSC), 2014 Edition, 602.3.

Letter to Ryan Miyahira January 23, 2020 Page **2** of **6** 

An alternate design is proposed for this noncombustible construction requirement. The alternate design has two parts. These two parts are:

Char analysis of the beam prepared by the project structural engineer. This analysis by the project structural engineer has been previously submitted to the City of Portland.

And

Wrapping the beam with three layers of 5/8-inch Type X GWB. This report analyzes the fire resistance provided by the GWB.

#### Method 1 for Determining Fire Resistance of the GWB

For each layer of 5/8-inch Type X GWB 40 minutes of fire resistance is assigned. See OSSC (2014) Table 722.6.2(1).

For three layers of 5/8-inch Type X GWB the fire resistance assigned is the sum of the individual layers is 120 minutes ( $40 \times 2$ ) but is reduced to 60 minutes by code. See OSSC (2014) 722.6.2.1 and 722.6.1.1.

#### Method 2

The Component Additive Method (CAM) for the determining the fire resistance of an assembly is described in Chapter 55, Analytical Methods for Determining Fire Resistance of Timber Members in the *SFPE Handbook of Fire Protection Engineering*. Both the CAM and the method of determining fire resistance described in OSSC (2014) 722.9.2.1 yield the same numeric results. However the CAM method described in the Handbook has been obtained in tests up to 90 minutes. Based on the CAM and the Handbook the three layers of 5/8-inch Type X GWB protecting the glulam beam are assigned a fire resistance of 90 minutes.

#### Method 3 Alternative Method for Determining Fire Resistance

This method of determining the fire resistance of the three layers of GWB covering the glulam beam most closely represents what would happen during a fire.

To determine fire resistance engineering analysis based on comparison of building element, component or assemblies designs having fire-resistance ratings as determined by the test procedures set forth in ASTM E 119 or UL 263. See OSSC (2014) 703.3 4.

Harmathy's Rule 1 of fire endurance:

Rule 1: The "thermal" fire endurance of a construction consisting of a number of parallel layers is greater than the sum of the "thermal" fire endurances characteristic of the individual layers when exposed separately to fire.

See *International Existing Building Code*, 2018 Edition, Resource A, Guidelines on Fire Rating on Archaic Materials and Assemblies.

Refer to OSSC (2014) Table 721.1(2) Item Number 14-1.5. This assembly consists of two layers of 5/8 inch Type X gypsum wall board over conventional light wood frame construction. If this assembly is analyzed for fire resistance per OSSC (2014) 722.6.2.1 the result is:

#### OSSC (2014) Table 721.1(2) Item Number 14-1.5 Fire Resistance Method per 722.6.2.1

Assembly Element	Fire Resistance (minutes)
Two layers 5/8 inch GWB (2 x 40)	80 <sup>1</sup>
Wood frame	20 <sup>2</sup>
Total fire Resistance	100

Table Notes:

- 1. See OSSC (2014) Table 722.6.2(1) for value
- 2. See OSSC (2014) Table 722.6.2(2) for value

However OSSC assigns 120 minutes (2 Hours) fire resistance to this assembly not the 100 minutes per 722.6.2.1 shown above. Where does the additional 20 minutes of fire resistance come from?

Code wise the wood frame of Item Number 14-1.5 is assigned 20 minutes per Table 722.6.2(2). So the two layers of 5/8 inch GWB must have 100 minutes of fire resistance (120 - 20). Since these wallboard layers are in contact with each other they have a synergistic effect that increases their fire resistance from 80 to 100 minutes. This effect is described in Harmathy's Rule 1 of fire resistance as shown above. See the Appendix for more information.

If a third layer of 5/8 inch Type X GWB is added to OSSC (2014) Table 721.1(2) Item Number 14-1.5, the three layers protecting the light wood framing will have more than 2 hours (120 minutes) of fire resistance (100 + 40 = 140 minutes).

#### Method 4 Alternative Method for Determining Fire Resistance

To determine fire resistance engineering analysis based on comparison of building element, component or assemblies designs having fire-resistance ratings as determined by the test procedures set forth in ASTM E 119 or UL 263. See OSSC (2014) 703.3 4.

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Please refer to the following GA File No. WP 2925. This proprietary design uses three layers of 5/8 inch Type X Gold Bond Brand Fire-Shield gypsum board manufactured by National Gypsum Company. This assembly provides 3 hours of fire resistance using steel stubs.

GA FILE NO. WP 2925	PROPRIETARY*	3 HOUF	50 to 54 STC
GYPSUM WALLBOARD, STEEL STUDS		FIRE	SOUND
Base layer 5/8" proprietary type X gg parallel to each side of 15/8" steel s Second layer 5/8" proprietary type X parallel to each side with 15/8" Type type X gypsum wallboard or gypsuu with 25/8" Type S drywall screws 12	ypsum wallboard or gypsum veneer base applied tuds 24" o.c. with 1" Type S drywall screws 24" o.c. ( gypsum wallboard or gypsum veneer base applied S drywall screws 24" o.c. Face layer 5/s" proprietary m veneer base applied at right angles to each side " o.c.		
Joints staggered 24" on opposite side layers.	es and between layers. Screws offset 6" between	Thickness:	5 <sup>3</sup> /8"
Sound tested with 15/s" glass fiber insulation friction fit in stud space. (NLB)		Approx. Weight:	14 psf
PROPRIET National Gypsum Company	ARY GYPSUM BOARD - 5/8" Gold Bond® Brand FIRE-SHIELD® Gyneum Board	Fire Test:	UL R3501, 03NK32889, 10-30-03, UL Design V438

While this is a proprietary design, discussion with National Gypsum Company representative revealed that their 5/8 inch Type X Gold Bond Brand Fire-Shield is similar to other manufactures 5/8 inch Type X GWB. Note that Gold Bond Brand Fire-Shield is available with either Type X or Type C cores. GA File No. WP 2925 specifically calls for the more common Type X core.

Fire-resistant material with a gypsum core will not support combustion or transmit temperatures greatly in excess of 212°F (100°C) until completely calcined, a slow process.

Once the three layers of GWB are consumed during the ASTM E119 fire test, the steel studs are exposed. They will rapidly heat and reach their failure temperature of 1100°F. The test furnace is not at approximately 1,900°F. The three layers of GWB are required to protect the steel studs for at least three hours.

Based on comparison of the 3-hour GA File No. WP 2925 assembly, three layers of 5/8 inch Type X GWB will provide at least two hours of protection to the subject glulam beam.

#### Fire Sprinkler Protection – Combustible Concealed Space (Truss Space)

Part of the subject glulam beam is exposed to a combustible concealed space that contains trusses. This concealed space will have fire sprinkler protection. For the beam to be exposed to fire from this concealed space the fire sprinkler system would have to fail to perform its design function. Complete fire sprinkler protection per NFPA 13 is designed for the Interstate and Willamette Apartments project.

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#### Conclusion

In ASTM E 119 fire test conditions, the three layers of 5/8-inch Type X GWB will provide at least 120 minutes of fire resistance based on OSSC's alternate method of determining fire resistance. The actual fire resistance in test conditions may be greater than 120 minutes since the base layer of wallboard is in full contact with the glulam beam. This greater than 120 minute fire reissuance claim is supported by Harmathy's Rule 1 of fire endurance. Not only are the three layers of wallboard in contact with each other but the base layer is in contact with the glulam beam.

This analysis shows that none of the glulam beam would be lost to char during a 2-hour fire exposure.

#### Appendix

Refer to OSSC (2014) Table 721.1(2) Item number 14.1.3. This assembly has a single layer of 5/8-inch Type X GWB over conventional light wood frame construction. When GWB is exposed to fire the water that is chemically bound up in the gypsum is slowly driven off. This is an endothermic reaction which delays the heating of the wallboard. As water is driven off the wallboard material shrinks and cracks form. Type X GWB has glass fibers that make the panel stronger and helps control crack formation and growth.

Over time the GWB continues to be eroded away by the fire conditions. Eventually the single layer of GWB will become thin enough that it is no longer self-supporting and collapses. At this point the assembly has not failed since the light wood frame and the GWB on the far side are still in place. After a period of time (20 minutes per Table 722.6.2(2)) enough of the wood frame has burned away and is no longer self-supporting. At this point the remaining assembly is assumed to collapse and the assembly fails.

Refer to OSSC (2014) Table 721.1(2) Item number 14.1.5. This assembly has two layers of 5/8inch Type X GWB over conventional light wood frame construction. When the exposed layer of GWB panel would collapse on its own the underlying layer will delay the collapse. This is the basis of Harmathy's Rule 1 of fire endurance as applied to GWB and why this assembly has a 120 minute (2-hour) fire resistance rating rather than a 100 minute rating.

Another way for looking at this issue is to compare OSSC (2014) Table 721.1(2) Item number 14.1.3 and Item Number 14-1.5. These two assemblies are similar expect 14-1.3 has a single layer of 5/8-inch GWB and a 60 minute rating while 14-1.5 has two layers of GWB and a 120 minute rating. If a single layer of GWB were added to 14-1.3 per 722.6.2.1 the assembly would have 40 more minutes of fire resistance or 100 minutes (60 + 40). However 14-1.5 is rated for 120 minutes.

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#### References

Data Sheet, National Gypsum Gold Bond Brand, Fire Shield Gypsum Board, 09 29 00NHGC, National Gypsum Company, Charlotte, North Carolina

International Existing Building Code, 2018 Edition, International Code Council, Country Club Hills, Illinois

National Fire Protection Association 13, *Standard for the Installation of Sprinkler Systems*, 2016 Edition, National Fire Protection Association, Quincy, Massachusetts

*Oregon Structural Specialty Code*, 2014 Edition, International Code Council, Country Club Hills, Illinois

*SFPE Handbook of Fire Protection Engineering*, Fifth Edition, 2016, Springer Science+Business Media LLC, New York

End of Report



October 24, 2019

Matthew Jorzak Fairfield Residential 7000 SW Hampton St., #215 Portland, OR 97223

Re: GLB Rated Beam 16-279600-REV-04-CO #2

Per our previous Calculations, the beams are adequate as provided and are already in compliance with Figure 4-1 of the AWC-TR10.

AWC-TR10 covers many different conditions and options. The requirements outlined in the figure are for unprotected glue laminated beams per the testing outlined in section 3.6. With protection providing the balance of the rating, even though it is not specifically required, we already meet the middle picture (b.) requirements for the one hour condition.

The City Bulletin is in implicitly in recognition of this fact since there are three options (we are option 3), and the bulletin specifically states that we may both add protection combined with char time calculations following "the methods of AWC-TR10", but does not explicitly state that we are to conform to all the other non-calculation provisions of AWC-TR10.

Regardless, by calculation and specification, a V3 beam would suffice (this would be picture (a.) with 3 tension laminates). By default we (SES) always specify minimum V4 laminates on all of our beam lay-ups. Therefore we already have the additional laminate per the required diagram.

Everything is compliant and there is no justification to replace or otherwise modify the beams.

Sincerely,

Paul Feather, PE SE President SE-Solutions, Inc. dba Structural Engineering Solutions





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# STRUCTURAL ENGINEERING SOLUTIONS





PRODUCT 204-1 (Single Sheets) 205-1 (Padded)



$\frac{RAPET}{31' - 2"}$ $\frac{RUSS}{7' - 3"}$ $\frac{RETE}{57' - 3"}$ $\frac{RETE}{57' - 2"}$	INTERSTATE AND WILLAMETTE APARTN 5327 N INTERSTATE AVE / PORTLAND, OR 97217	FAIRFIELD RESIDENTIAL
	REVISION DATE	REASON FOR ISSUE
	1 08.25.17 D	DELTA 1
<u>.REIE)</u> 37' - 0"	20 04.11.18 R	FI 0087
	29 06.04.18 R	FI 0105
<u>SLAB)</u> 5' - 10" 5' - 10"		
		SECTIONS
<u>SLAB)</u> 2' - 10"		
	CONSTRU	ICTION SET
<u>SLAB)</u> 92' - 2"	DATE	REVISION
	8/25/2017	56
	PROJECT NUMBER 161900	SHEET NUMBER
	SCALE	⊢ A4.01
	As indicated	

