

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

Appeal ID: 21947	Project Address: 4804 SE Woodstock Blvd
Hearing Date: 10/2/19	Appellant Name: Charles Kidwell
Case No.: B-008	Appellant Phone: 5032282840
Appeal Type: Building	Plans Examiner/Inspector: David Bartley
Project Type: commercial	Stories: 5 Occupancy: B, R-2, S-2 Construction Type: I-A, III-B
Building/Business Name: Modera Woodstock Apartments	Fire Sprinklers: Yes - Throughout
Appeal Involves: Erection of a new structure	LUR or Permit Application No.: 19-117964-EA
Plan Submitted Option: pdf [File 1] [File 2] [File 3] [File 4]	Proposed use: Multi-Family Residential

APPEAL INFORMATION SHEET

Appeal item 1

Code Section 510.2 & 510.4

Requires

Code Section being appealed: 510.2 Horizontal Building Separation Allowance.

Regulation Requirement: A building shall be considered as separate and distinct buildings for the purpose of determining area limitations, continuity of fire walls, limitation of number of stories & type of construction where all of the following conditions are met:

The buildings are separated with a horizontal assembly having a fire-resistance rating of not less than 3 hours. Where vertical offsets are provided as part of a horizontal assembly, the vertical offset and the structure supporting the vertical offset shall have a fire-resistance rating of not less than 3 hours.

The building below, including the horizontal assembly, is of Type IA construction.

Shaft, stairway, ramp and escalator enclosures through the horizontal assembly shall have not less than a 2-hour fire-resistance rating with opening protectives in accordance with Section 716.

Code Section being appealed: 510.4 Parking beneath Group R.

Regulation Requirement: Where a maximum one story above grade plane Group S-2 parking garage, enclosed or open, or combination thereof, of Type I construction or open of Type IV construction, with grade entrance, is provided under a building of Group R, the number of stories to be used in determining the minimum type of construction shall be measured from the floor above such a parking area.

The floor assembly between the parking garage and the Group R above shall comply with the type of construction required for the parking garage and shall also provide a fire- resistance rating not less than the mixed occupancy separation required in Section 508.4.

Proposed Design

The Design consists of a 5 Story Type IIIB Construction Residential building above a 1-level Type IA

Construction 'Parking Garage Basement'. The building consists primarily of residential group R-2 apartments above the S-2 Parking Garage. The building is fully protected by an NFPA 13 automatic

sprinkler system, fire alarms and detection system.

The horizontal (floor) assembly between the Basement Level parking garage and the Group R apartment occupancy above will be a 3-hour rated concrete slab (Type 1A construction).

Proposed Item for Appeal consideration:

- The walls and floor/ceiling that form the enclosure around the automobile ramp from the street level down to the basement level Parking Garage will be 2-hour rated construction in accordance with code section 510.2 condition #3. The proposed enclosure surrounding the automobile ramp to the basement level Parking Garage will be code compliant.

- The proposed walls and floor/ceiling assemblies forming the enclosure surrounding the automobile ramp will be 2-Hour rated wood framed construction. The assemblies will be protected with non-combustible mineral wool insulation (in lieu of the Fire Retardant Treated wood framing) as explained in the attached Engineering Judgement Report by Code Unlimited. See the attached building plans, section and details that illustrate the construction of the proposed enclosure surrounding the automobile ramp.

Also see the attached white paper by Code Unlimited documents explaining the benefit of using non-combustible mineral wool insulation in the proposed fire rated assemblies.

Reason for alternative As indicated in the Engineering Judgement Report by Code Unlimited, the proposed 2-Hour rated wood framed construction surrounding the automobile ramp to the basement level Parking Garage will be a code compliant equivalent means of construction.

In addition, the attached white paper by Code Unlimited provides a fire analysis that supports the use of mineral wool insulation in the cavities of untreated wood framing as an alternate to FRT wood stud framing permitted by the OSSC section 602.3.

The conclusion of these two reports is that the proposed 2-hour rated assemblies are equivalent to non-combustible construction.

The proposed design is in compliance with the provisions of code section 510.2 condition #3 and code section 510.4 Parking beneath Group R.

We believe an equivalent level of fire protection has been provided for this project.

Hence, we urge you to approve this appeal.

APPEAL DECISION

Use of 2 hour combustible vertical and horizontal separation between 1A and IIIB construction: Denied. Proposal does not provide equivalent Life Safety protection.

Appellant may contact John Butler (503 823-7339) with questions.

Pursuant to City Code Chapter 24.10, you may appeal this decision to the Building Code Board of Appeal within 90 calendar days of the date this decision is published. For information on the appeals process, go to www.portlandoregon.gov/bds/appealsinfo, call (503) 823-7300 or come in to the Development Services Center.



APPEALS
City of Portland
Bureau of Development Services
1900 SW 4th Ave., Suite 5000 (5th floor)
Portland, Oregon 97201
(503) 823-7335

Building Code Appeal Form (Project Information Sheet)

BLD

To Appellant:

These forms must be filled out completely. If you need assistance, consult with the Plans Examiner or Inspector assigned to your project or with a Plans Examiner in the Development Services Center. Details of each appealed item must be included, and drawings must be submitted that clearly indicate the area and the conditions of each appealed item. Supplemental information such as photos, test data, etc., can be helpful if they are pertinent to the appealed item. Each appealed item requires a separate Appeal Information Sheet. As many items as desired may be submitted with one Project Information Sheet.

The fee, relevant drawings (**exclusive of any plans submitted for permit processing**) and any supplemental information must be submitted with these forms. Checks are to be made payable to "Treasurer, City of Portland". Fees are listed below:

\$227 for one and two family dwellings
Plus \$113 each for each appeal item over four

\$477 for all other conditions (four appeal items or less)
Plus \$113 each for each appeal item over four

Mail or hand-delivered appeals must be received by 5:00 PM on Friday. Electronic appeals must be received by 9:00 AM on Monday. (The fee, drawings and supplemental information for electronic appeals may be delivered separately by 9:00 AM on Monday.) In most cases, appeals submitted by these deadlines will be considered the following Wednesday. However, an appeal may be deferred to a later date depending on the number of appeals scheduled, the complexity of the appeal, or other unforeseen factors. Appeal decisions are mailed and are also usually available the following day at http://www.portlandonline.com/bds/index.cfm?c=34196#cid_105495, or by calling the Appeal Board Support Staff at (503) 823-7335.

Project Information (questions in **BOLD** cannot be left blank):

This appeal involves (check at least one below)

- | | |
|---|---|
| <input checked="" type="checkbox"/> Erection of a new structure | <input type="checkbox"/> Change of Occupancy: from _____ to _____ |
| <input type="checkbox"/> Alteration of an existing structure | <input type="checkbox"/> Other (specify): _____ |
| <input type="checkbox"/> Addition to an existing structure | <input type="checkbox"/> Reconsideration of Appeal ID # _____ |

Proposed Use of Structure (e.g., single-family dwelling, office, etc.) Multi-Family Residential

Project Street Address 4804 SE Woodstock Blvd.

Owner Name <u>Sam Rodriguez</u>	Company <u>Mill Creek Residential Trust</u>
Address <u>220 NW 2nd Ave., Suite 900</u>	City <u>Portland</u> State <u>OR</u> Zip <u>97209</u>
Phone <u>5039574271</u>	Email <u>srodriguez@MCRTrust.com</u>

Related Permit Application #, LUR Case #, or if none, check Preliminary

Permit # _____ LUR Case # EA 19-117964 ☐ Preliminary

Number of stories 5 **Occupancy Group** B, R2, S2 **Construction Type** IA, IIIB

Fire Sprinklers ☐ No ☒ Yes > Location: Throughout

Plans Examiner/Inspector assigned to project _____

I am the property owner, or the property owner's agent. In accordance with City Code Section 24.10.075, I am authorized to submit an appeal for an alternative material, design or method of construction or equipment or a modification to the strict interpretation of the Building Code as adopted by the City of Portland as outlined in the attached information. I hereby acknowledge that the City is not liable for any damages that result from or relate to any formal decision rendered by the City with respect to this appeal.

Appellant Name <u>Charles Kidwell</u>	Company <u>Leeb Architects</u>
Address <u>308 SW First Ave., Suite 200</u>	City <u>Portland</u> State <u>OR</u> Zip <u>97204</u>
Phone <u>503.228.2840</u>	Email <u>ckidwell@leebarc.com</u>

Appellant signature  **Date** 26 Sept 2019



APPEALS
City of Portland
Bureau of Development Services
1900 SW 4th Ave., Suite 5000 (5th floor)
Portland, Oregon 97201
(503) 823-7335

Building Code Appeal Form (Appeal Information Sheet)

BLD

Appeal: Construction Assemblies at Automobile Ramp

To Appellant:

Each item you are appealing requires a separate Appeal Information Sheet to be filled out. All requested information is to be filled out completely with as much detail as possible. Failure to do so may cause your appeal to be held over until adequate information is received. For help in filling out these forms, consult with the Plans Examiner assigned to your project or with a Plans Examiner in the Development Services Center.

Any alternative method or modification of a Building Code requirement requires an appeal. A reasonable degree of equivalent health, accessibility, structural capacity, energy conservation, life safety or fire protection must be demonstrated before an appeal may be considered.

Code Section being appealed: 510.2 Horizontal Building Separation Allowance.

Regulation Requirement: A building shall be considered as separate and distinct buildings for the purpose of determining area limitations, continuity of fire walls, limitation of number of stories & type of construction where all of the following conditions are met:

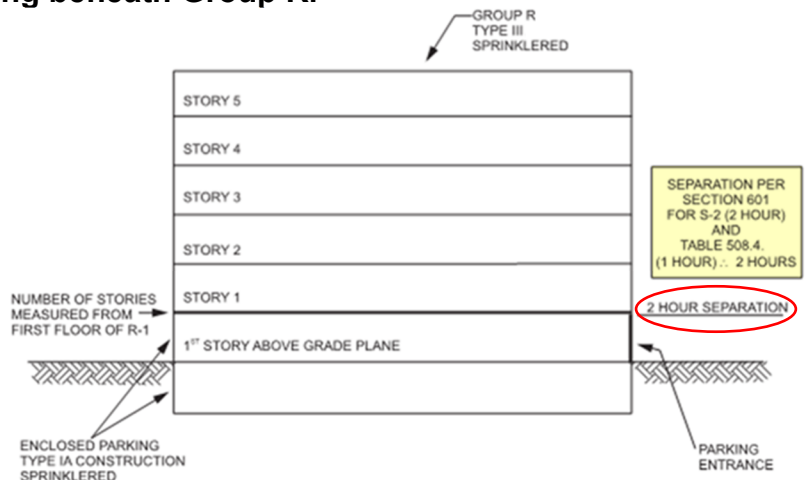
1. The buildings are separated with a horizontal assembly having a fire-resistance rating of not less than 3 hours. Where vertical offsets are provided as part of a horizontal assembly, the vertical offset and the structure supporting the vertical offset shall have a fire-resistance rating of not less than 3 hours.
2. The building below, including the horizontal assembly, is of Type IA construction.
3. **Shaft, stairway, ramp and escalator enclosures through the horizontal assembly shall have not less than a 2-hour fire-resistance rating with opening protectives in accordance with Section 716.**

Code Section being appealed: 510.4 Parking beneath Group R.

Regulation Requirement:

Where a maximum one story above grade plane Group S-2 parking garage, enclosed or open, or combination thereof, of Type I construction or open of Type IV construction, with grade entrance, is provided under a building of Group R, the number of stories to be used in determining the minimum type of construction shall be measured from the floor above such a parking area.

The floor assembly between the parking garage and the Group R above shall comply with the type of construction required for the parking garage and shall also provide a fire-resistance rating not less than the mixed occupancy separation required in Section 508.4.



Commentary Figure 510.4

**TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)**

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A	B	A	B	HT	A	B
Primary structural frame ^f (see Section 202)	3 ^{a,b}	2 ^{a,b}	1 ^b	0	1 ^b	0	HT	1 ^b	0
Bearing walls									
Exterior ^{e,f}	3	2	1	0	2	2	2	1	0
Interior	3 ^a	2 ^a	1	0	1	0	1/HT	1	0
Nonbearing walls and partitions	See Table 602								
Exterior									
Nonbearing walls and partitions									
Interior ^d	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary members (see Section 202)	2	2	1	0	1	0	HT	1	0
Roof construction and associated secondary members (see Section 202)	1 1/2 ^b	1 ^{b,c}	1 ^{b,c}	0 ^c	1 ^{b,c}	0	HT	1 ^{b,c}	0



Building Code Appeal Form (Appeal Information Sheet)

BLD

Appeal: Construction Assemblies at Automobile Ramp

Proposed Design: *(Describe the alternate methods or materials of construction to be used or that exist. Be as specific as possible)*

The Design consists of a 5 Story Type IIIB Construction Residential building above a 1-level Type IA Construction 'Parking Garage Basement'. The building consists primarily of residential group R-2 apartments above the S-2 Parking Garage. The building is fully protected by an NFPA 13 automatic sprinkler system, fire alarms and detection system.

The horizontal (floor) assembly between the Basement Level parking garage and the Group R apartment occupancy above will be a 3-hour rated concrete slab (Type 1A construction).

Proposed Item for Appeal consideration:

- The walls and floor/ceiling that form the enclosure around the automobile ramp from the street level down to the basement level Parking Garage will be 2-hour rated construction in accordance with code section 510.2 condition #3. **The proposed enclosure surrounding the automobile ramp to the basement level Parking Garage will be code compliant.**
- **The proposed walls and floor/ceiling assemblies forming the enclosure surrounding the automobile ramp will be 2-Hour rated wood framed construction. The assemblies will be protected with non-combustible mineral wool insulation (in lieu of the Fire Retardant Treated wood framing) as explained in the attached Engineering Judgement Report by Code Unlimited.**

See the attached building plans, section and details that illustrate the construction of the proposed enclosure surrounding the automobile ramp.

Also see the attached white paper by Code Unlimited documents explaining the benefit of using non-combustible mineral wool insulation in the proposed fire rated assemblies.

Reason for Alternate: *(Describe why the alternate is required and how it will provide equivalent health, accessibility, structural capacity, energy conservation, life safety or fire protection to what the code requires).*

As indicated in the Engineering Judgement Report by Code Unlimited, the proposed 2-Hour rated wood framed construction surrounding the automobile ramp to the basement level Parking Garage will be a code compliant equivalent means of construction.

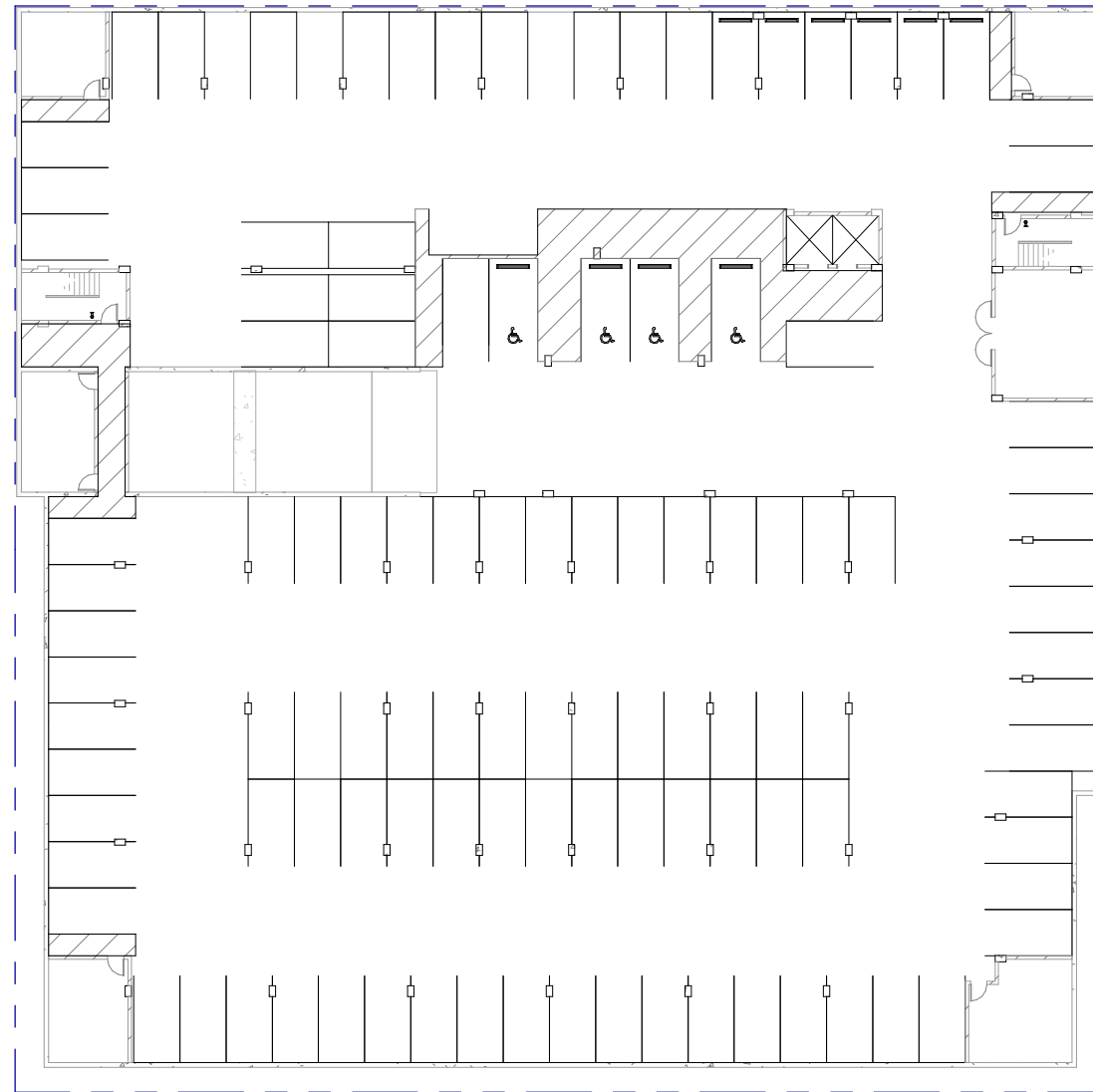
In addition, the attached white paper by Code Unlimited provides a fire analysis that supports the use of mineral wool insulation in the cavities of untreated wood framing as an alternate to FRT wood stud framing permitted by the OSSC section 602.3.

The conclusion of these two reports is that the proposed 2-hour rated assemblies are equivalent to non-combustible construction.

The proposed design is in compliance with the provisions of code section 510.2 condition #3 and code section 510.4 Parking beneath Group R.

We believe an equivalent level of fire protection has been provided for this project.

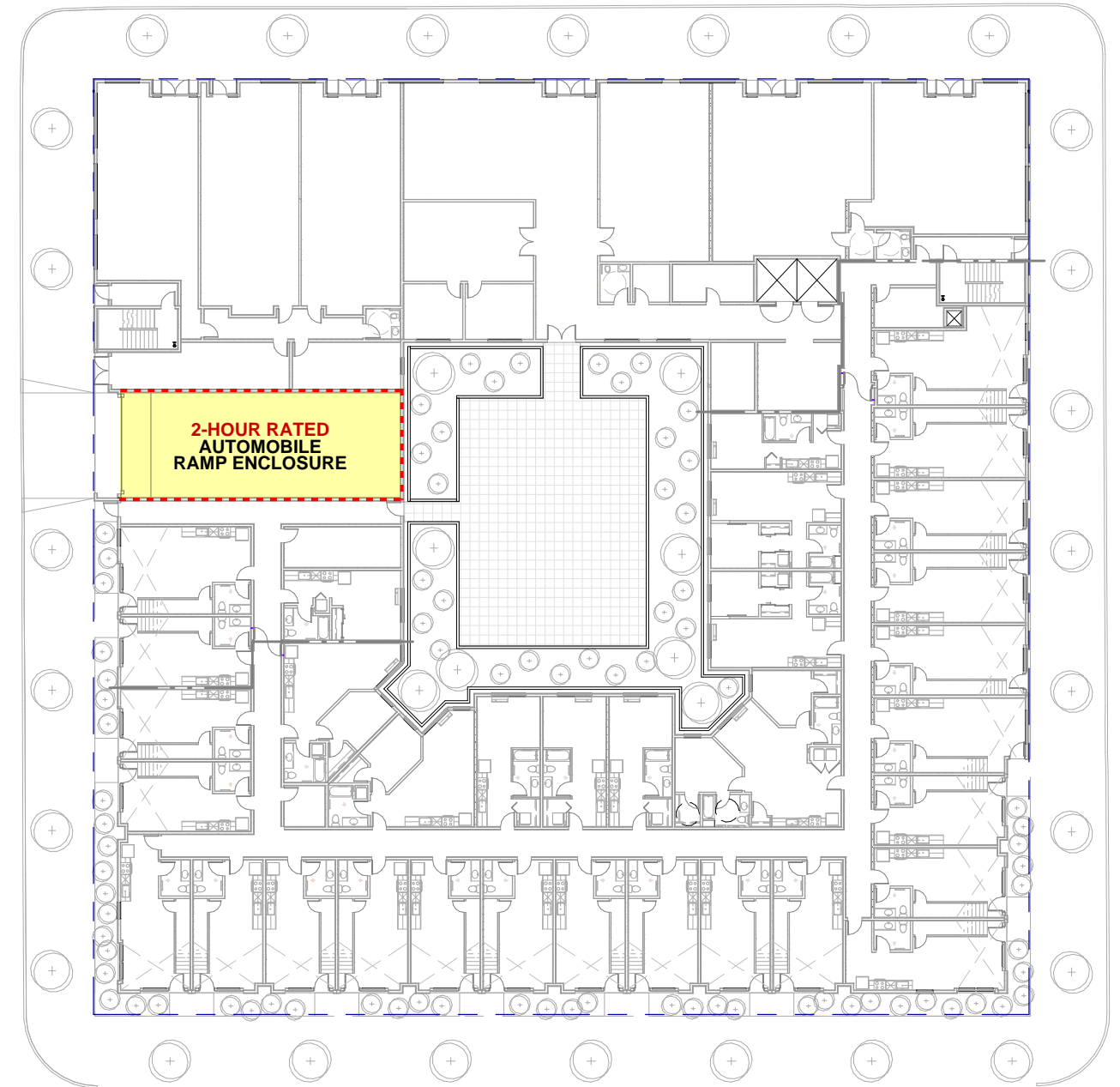
Hence, we urge you to approve this appeal.



1
01

FLOOR PLANS - LEVEL 0 PARKING

SCALE: 1/32" = 1'-0"



FLOOR PLAN LEVEL 1

SCALE: 1/32" = 1'-0"

0 8' 32' 64'



LEEB Architects © 2019

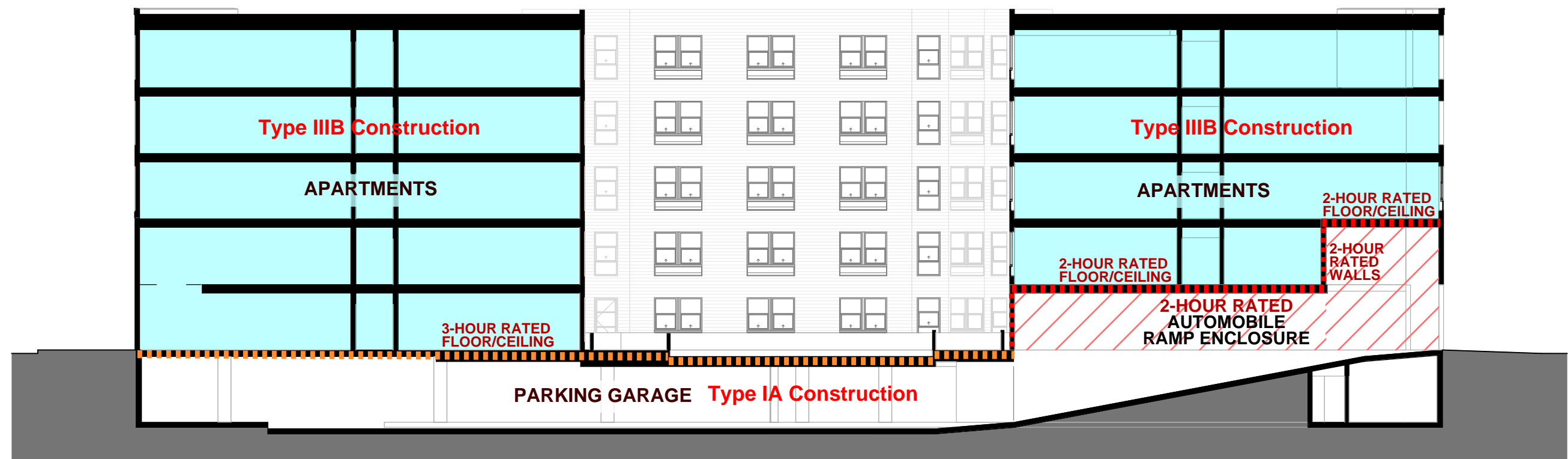
leeb

Leeb Architects
308 SW 1st Ave, # 200 Portland, Or 97204
Phone: 503.228.2840 Fax: 503.228.2907
leebarc.com

MODERA WOODSTOCK

CODE APPEAL
08.09.19

01



1
05

BUILDING SECTION - WEST TO EAST

leeb

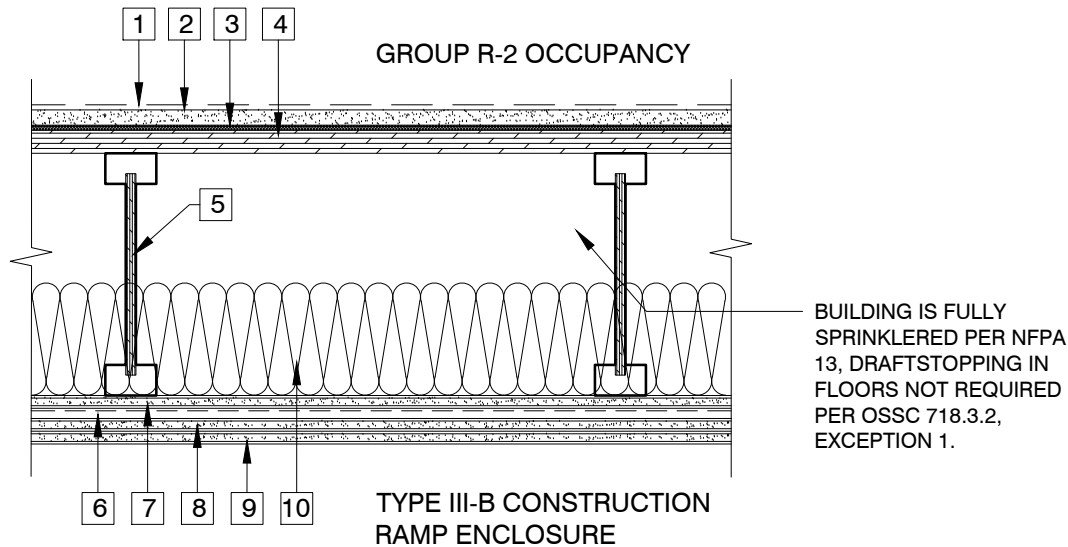
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MODERA WOODSTOCK

CODE APPEAL
08.09.19

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04



ASSEMBLY LEGEND:

- 1 09 00 00, FINISH FLOOR COVERING. VARIES, SEE PLANS FOR MATERIAL AND LOCATIONS.
- 2 03 52 00, GYPSUM CEMENTITIOUS UNDERLAYMENT, 1-INCH THICK.
- 3 03 52 00, SOUND CONTROL MATTING.
- 4 06 16 00, WOOD STRUCTURAL PANEL FLOOR SHEATHING, FOR THICKNESS AND FASTENING SEE STRUCTURAL FRAMING PLANS.
- 5 06 17 40, WOOD WEB JOISTS, FOR SIZE AND SPACING SEE STRUCTURAL FRAMING PLANS.
- 6 09 25 10, CLARK DIETRICH RCSD INSTALLED PER MANUF RECOMMENDATIONS. APPLIED AT RIGHT ANGLE TO JOISTS AT 16 INCH CENTERS, 1/2-INCH, NO. 25 GAUGE, FASTEN TO EACH JOIST WITH 1-7/8" LONG TYPE S DRYWALL SCREWS.
- 7 09 25 10, BASE LAYER OF 5/8" TYPE X GYPSUM BOARD APPLIED AT RIGHT ANGLE TO JOISTS, FASTENED WITH 1-5/8" LONG TYPE S DRYWALL SCREWS SPACED AT 8-INCH CENTERS.
- 8 09 25 10, SECOND LAYER OF 5/8" TYPE X GYPSUM BOARD APPLIED AT RIGHT ANGLE TO RESILIENT CHANNEL AND FASTENED WITH 1 1/4" LONG TYPE S-12 DRYWALL SCREWS SPACED AT 8-INCH CENTERS. EDGE JOINTS OFFSET 24 INCHES FROM BASE LAYER EDGE JOINTS.
- 9 09 25 10, FACE LAYER OF 5/8" TYPE X GYPSUM BOARD APPLIED AT RIGHT ANGLE TO JOISTS AND FASTENED WITH 1 7/8" LONG TYPE S-12 DRYWALL SCREWS SPACED AT 8-INCH CENTERS. EDGE JOINTS OFFSET MIN 16 INCHES FROM SECOND LAYER EDGE JOINTS.
- 10 09 52 10, ACOUSTIC INSULATION, 3-1/2 INCH THICKNESS.

TYPE F12, COMBUSTIBLE WOOD WEB JOIST FLOOR-CEILING				
MARK	FIRE		SOUND ATTENUATION	
	RATING	RATING SOURCE	STC RATING	RATING SOURCE
F12	2-HR	UL L538	62	RAL-OT03-05/06

LEEB Architects © 2019

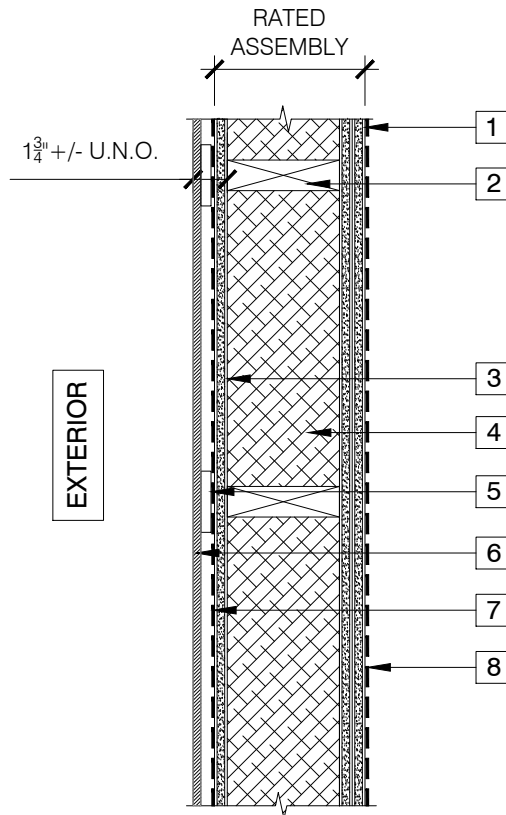


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308 SW 1st Ave, # 200 Portland, Or 97204
Phone: 503.228.2840 Fax: 503.228.2907
leebarc.com

MODERA WOODSTOCK

CODE APPEAL
08.09.19

F12



ASSEMBLY LEGEND:

- 1 09 25 10, (2) LAYERS 5/8" TYPE X GYPSUM BOARD FOR FIRE-RESISTANT USE
- 2 06 11 00, 2x6 NON-FRT WOOD FRAMING, SIZE AND SPACING AS SCHEDULED PER STRUCTURAL
- 3 06 16 00, (1) LAYER 5/8" EXTERIOR GYPSUM SHEATHING
- 4 07 21 00, MINERAL WOOL INSULATION FIT TIGHT TO CAVITY, R-21, INS-2
- 5 07 46 00, NON-COMBUSTIBLE VERTICAL FURRING
- 6 07 46 00, NON-COMBUSTIBLE FIBER CEMENT SIDING
- 7 07 27 10, WEATHER RESISTANT BARRIER
- 8 09 90 00, INTERIOR FINISH PAINT OVER PRIMER - VAPOR RETARDER

WALL TYPE 10 - EXTERIOR WOOD FRAME WALL W/ FSD $X > 10$

LOCATION(S): LVLS 1-5, EXTERIOR LOAD BEARING WALL W/ NON-COMBUSTIBLE EXTERIOR WALL COVERING

MARK	STUD SIZE	FIRE		SOUND ATTENUATION	
		RATING	RATING SOURCE	STC RATING	RATING SOURCE
10	2x6	2-HR	CODE GUIDE*	NA	

* 2 HOUR RATED IN ACCORDANCE WITH CITY OF PORTLAND CODE GUIDE - TYPE III CONSTRUCTION - OSSC/6/#4.

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leebe

Leeb Architects

308 SW 1st Ave, # 200 Portland, Or 97204
Phone: 503.228.2840 Fax: 503.228.2907
leebarc.com

MODERA WOODSTOCK

CODE APPEAL

08.09.19

W10



Modera Woodstock

Engineering Judgment Report

Client Name: Mill Creek Residential Trust

Client Address: LEEB Architects 308 SW First Avenue Suite 200 Portland, Oregon 97204

Date: 8/12/2019

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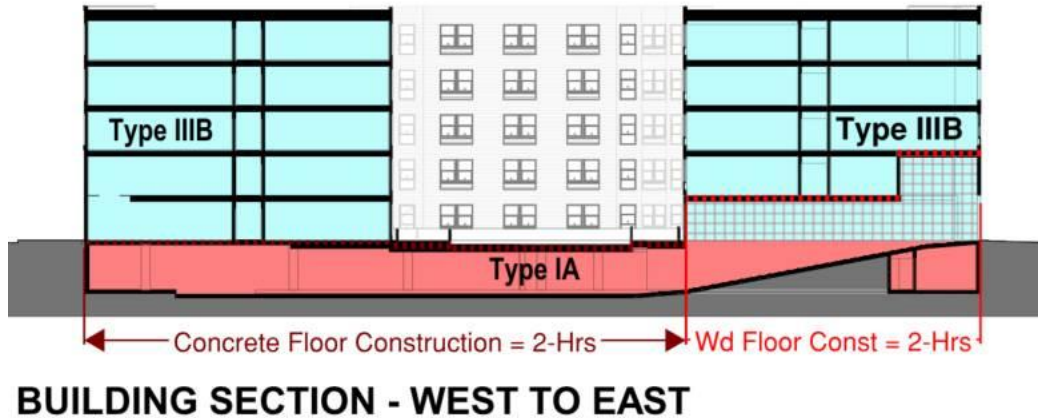
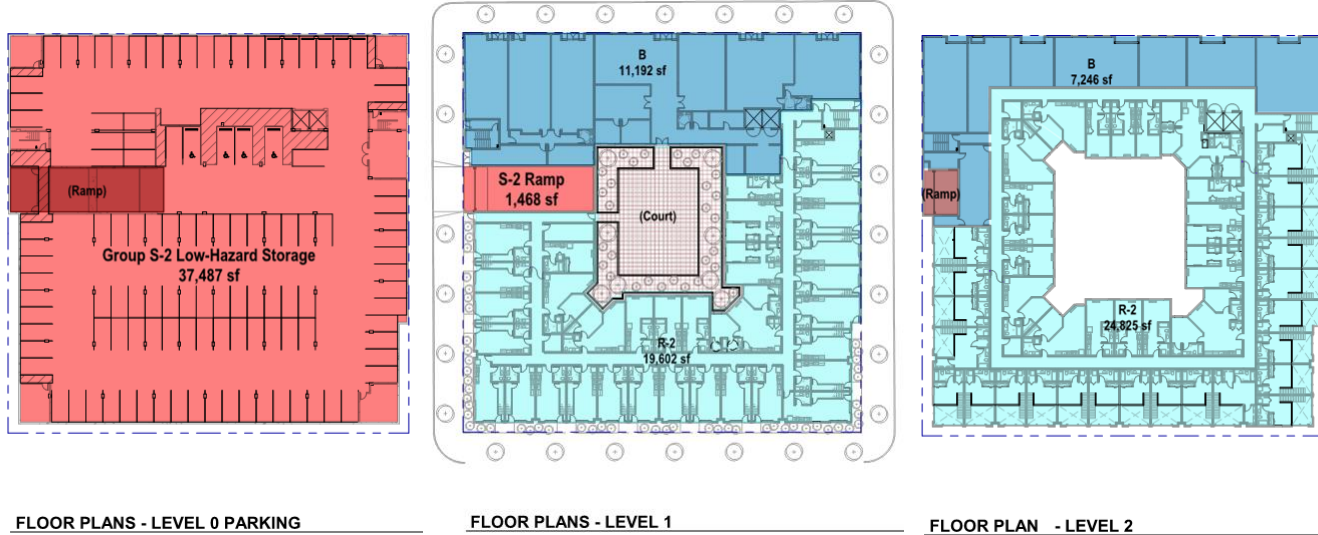
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1 PROJECT OVERVIEW

Leeb Architects is designing Modera Woodstock, a new multifamily residential and retail building in Portland, OR. This will be a 5-story building with 5-stories of Type IIIB construction over 1-story (basement below grade plane) of Type IA construction. Occupancy groups will be Group R-2 Residential – Apartments, Group B Business, and Group S-2 Parking Garage per the diagrams below.



Code Unlimited has been asked to provide analysis of the fire-resistant rated horizontal separation between Stories 00 & 01 (S-2, Type IA) and Stories 01 & 02 (B and R-2, Type IIIA) of the parking garage's ramp lid to ensure that the construction meets and/or exceed the 2014 OSSC for noncombustible requirements of Type IA.

2 APPLICABLE CODES, STANDARDS, AND GUIDES

- 2014 Oregon Structural Specialty Code (OSSC) including Appendix N

3 DISCUSSION

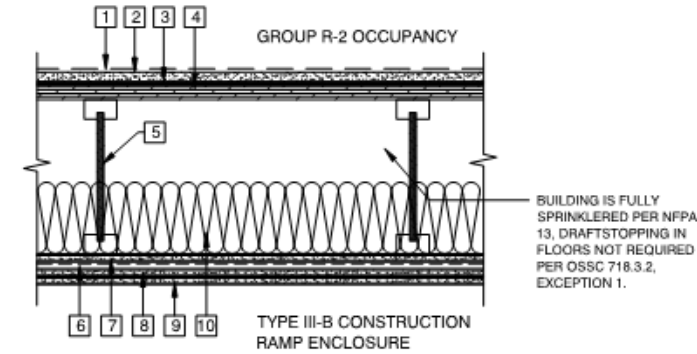
The on-grade access of the enclosed parking garage (Story 00) occurs at the west side at Story 01.

The horizontal separation between Type IA construction (concrete building elements) and Type IIIB construction (wood building elements) occur at Stories 01 and 02. The building elements of the (2) types of construction include the primary structural frame, floor construction and associated secondary elements, and roof construction and associated secondary elements.

The ramp lid above the parking garage ramp extends partially to the underside of Story 01's and Story 02's floor construction. Other than at the parking garage ramp, Story 01's concrete floor construction separates the Type IA for the basement (Story 00) from the Type IIIB on Stories 01 through 05.

4 PROPOSED DESIGN

Per OSSC Section 602.2, "*Types I and II construction are those types of construction in which the building elements listed in Table 601 are of noncombustible materials ...*". Because there is not a continuous fire-resistant rated horizontal assembly that separates the Type IA and Type IIIB construction above the parking garage's ramp, Leeb Architects is proposing to provide a 2-hour fire-resistant rated horizontal assembly (see below assembly) at this construction type separation.

**ASSEMBLY LEGEND:**

- 1 09 00 00, FINISH FLOOR COVERING. VARIES, SEE PLANS FOR MATERIAL AND LOCATIONS.
- 2 03 52 00, GYPSUM CEMENTITIOUS UNDERLAYMENT, 1-INCH THICK.
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TYPE F12, COMBUSTIBLE WOOD WEB JOIST FLOOR-CEILING				
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	RATING	RATING SOURCE	STC RATING	RATING SOURCE
F12	2-HR	UL L538	62	RAL-OT03-05/06

5 ASSEMBLY ANALYSIS

For the required 2-hour fire resistance rating of the ramp lid, the UL-listed assembly will provide equivalent thermal and fire survivability performance to the Type 1 construction of the remainder of the garage structure.

The tested horizontal fire-resistance rated assembly utilizes two (2) layers of 5/8" Type X gypsum board, resilient channel and another layer of 5/8" Type X gypsum board. Gypsum board is considered a non-combustible material and the 3 layers with resilient channel provide a thermal barrier that will prevent the unexposed side of the last layer of gypsum board to remain well below the ignition temperature of the wood TJIs. Since the main concern of this design is the prevention of failure of the floor/roof assembly above the ramp, the ability of the UL listed assembly to maintain the TJI/gypsum interface below 250°F (a primary criteria of the UL listing based on ASTM E-119 testing) means that, for the required 2-hour fire resistance period, the TJIs will not reach the ignition temperature or charring point and will retain the structural integrity for at least the required time.

6 CONCLUSION

The gypsum board face of the assembly at the ramp lids between the Type IA and Type IIIB portions of the building construction constitutes and non-combustible separation with a minimum fire resistance rating of 2 hours, based on fire performance of the UL assembly in an ASTM E-119 test and the parameters for pass/fail of that test (maximum 250°F at the unexposed face of the gypsum portion of the assembly).



EXPIRES: 12/31/2019

Vincent L. Collins

Principal//Fire Protection Engineer

Modera Woodstock



Experienced.
Innovative.
Trusted.

CODE UNLIMITED, LLC

White Paper - Fire Analysis of Fire Retardant Treated Wood Alternate

Project Name: Modera Woodstock Apartments

Client: Mill Creek Residential Trust

Prepared by: Code Unlimited

Address: 12655 SW Center Street, Suite 350, Beaverton, OR 97005

Date: 8/9/2019

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1. OVERVIEW

1.1 Project Overview

The Modera Woodstock Apartments is a new project being constructed in Portland, OR. The project includes five (5) stories of Type IIIB construction over one (1) story of Type IA construction. The building is fully protected by automatic sprinklers, fire alarms and detection system.

Type IIIB construction requires that exterior walls be of noncombustible construction or of Fire-Retardant Treated Wood (FRTW) construction if the exterior wall can be 2 hour rated or less. The project proposes to use conventional wood studs without the Fire Retardant Treatment (FRT). There are structural and environmental benefits for this approach.

1.2 Executive Summary

Fire-retardant treated (FRT) wood framing is permitted by code within exterior Type III wall assemblies with a fire-resistance rating of 2 hours or less. This is based on the improved fire spread performance of treated wood compared to untreated wood of the same species. FRT of wood delays ignition and resists flame spread once it reaches ignition temperature. The proposed design of the exterior wall assembly uses compressed mineral wool insulation between non-treated wood framing members to provide equivalent protection to Fire Retardant Treated (FRT) wood wall assembly.

Code Unlimited has analyzed the issue of using non-FRT wood in place of FRT wood on multiple projects. This has been driven by many stakeholders within the Pacific Northwest region; local and state governments, universities and other research groups, manufacturers, real estate developers, and design and construction industry professionals. This white paper is the most current knowledge on this subject, based on rigorous analysis, review, and input from senior fire protection engineers and code experts.

The white paper will provide the following information to show that the use of non-treated wood in Type III exterior wall assemblies with compacted mineral wool insulation is equivalent to FRT wood allowed in Type III exterior walls:

- A detailed understanding of the code regulations that are driving the requirement for FRT in Type III exterior walls, with excerpts from the International Building Code (IBC) commentary to clarify intent where necessary.
- Code citations in the Oregon Structural Specialty Code (OSSC) and the IBC where the use of mineral wool delays ignition and inhibits flame migration.

Many code provisions have evolved from traditional construction practices and then undergo rigorous analysis and/or testing to substantiate performance in those applications. This white paper follows that time tested path by including a rigorous performance analysis based on currently available test data in support of non-FRT wood in an exterior wall assembly of a Type III construction building.

Our analysis found that the fire performance of a non-FRT wood framed wall with mineral wool insulation is equal or superior to a FRT wood framed wall. Research from other authorities shows that this approach also reduces the potential for chemical exposure to the environment and to the occupants of these buildings compared to the current practice of using FRT wood.

1.3 Applicable Codes and Standards

Applicable Code or Standard

2014 Oregon Structural Specialty Code (OSSC)

2009 ASTM E-84 Test Methods for Surface Burning characteristics of Building Materials – American Society for Testing and Materials

2007 ASTM E-119 standard Test Methods for Fire Tests of Building Construction and Materials – American Society for Testing and Materials

1.4 Additional References

- ¹ 2007 Performance of a non-load-bearing steel stud gypsum board wall assembly: Experiments and modelling”, Samuel L. Manzello, et al, Fire and Materials (Issue 31, pp 297-310)
- ² 2015 A Model for predicting heat transfer through insulated steel-stud wall assemblies exposed to fire, Sultan, M. A.; Alfawakhiri, F.; Bénichou, N., Fire and Materials - 2001 International Conference, San Francisco, January 22-24, 2001, pp. 495-506
- ³ 2007 Analysis of Inter-laboratory Testing of Non-loadbearing Gypsum/Steel-Stud Wall Assemblies, William Grosshandler, Samuel L. Manzello, Alexander Maranghides - Building and Fire Research Laboratory, Tensei Mizukami - Center for Better Living
- ⁴ 1977 Effect of fire-retardant treatments on performance properties of wood. In: Goldstein, I.S., ed. Wood technology: Chemical aspects. Proceedings, ACS symposium Series 43. Washington, DC: American Chemical Society.
- ⁵ 1992 Charring Rate of Wood for ASTM E119 Exposure, Fire Technology Volume 28, Number 1, Robert H. White and Eric V. Nordheim
- ⁶ 1977 National Board of Standards Technical Note 945: An Investigation of the Fire Environment in the ASTM E 84 Tunnel Test
- ⁷ 2016 Calculating the Fire Resistance of Exposed Wood Members, Technical Report No 10, American Forest & Paper Association, Inc, American Wood Council, 1111 19th St., NW, Suite 800, Washington, DC 20036
- ⁸ 2010 Wood Handbook, Wood as an Engineering Material, Chapter 17 Fire Safety, Robert H. White and Mark A. Diertenberger, Forest Product Laboratory, United States Department of Agriculture Forest Service, Madison Wisconsin

2. PROPOSED WALL ASSEMBLY

The proposed design is to provide a 2-hour exterior wall assembly that consists of untreated wood stud framing with one or two layers of 5/8" thick type X gypsum board on the interior and one layer of 5/8" type X gypsum sheathing or concrete masonry units on the exterior side of the wall (Non-Symmetric wall) for walls that are further than 10 feet from the property line. Rockwool insulation will be friction fit between studs to fill the entire 6-inch nominal wall cavity. The conclusions of this report are limited to the proposed Wall type shown in Figures 1-4 attached in Appendix A of this white paper.

3. ROCKWOOL USE PERMITTED IN CURRENT CODES

The 2014 OSSC Section 602.3 for Type III exterior wall construction permits the use of fire-retardant treated wood (FRTW) in lieu of non-combustible materials if wall is 2-hour rated or less.

Rockwool has been allowed as a means to retard or prevent the ignition of wood in concealed spaces in the following code sections:

1. OSSC 803.11.1.1 allows untreated wood to be used for furred walls or ceilings where non-combustible or fire rated construction is required when the cavity is filled with a Class A material like mineral wool.
2. OSSC 718.2.1(7) allows mineral wool batts to be used as fireblocking to cut off concealed draft openings.
3. OSSC 718.3.1 permits the use of mineral wool batts as an approved draft stopping material.
4. ORSC 316.5.3 permits the use of 1.5 inch thick mineral wool to satisfy the requirements for an ignition barrier.
5. NFPA 13 Section 8.15.1.2.17 allows untreated wood joist to be treated as FRT wood when the cavity is filled with mineral wool insulation.
6. OSSC 722.6 contains procedures by which the fire resistance ratings of wood assemblies are established by calculations.

IBC Section 722.6 Commentary states:

"Rockwool insulation provides additional protection to wood studs by shielding the studs from exposure to the furnace, thus delaying the time of collapse."

OSSC table 722.6.2(5) allows glass fiber, or mineral wool, or cellulosic fill within stud cavity prescriptively to increase the fire resistance of a wall assembly by 15 minutes.

7. IBC Section 602.2 Commentary:

"Fire Retardant-treated wood (FRTW), although combustible, is permitted in limited uses in building of Type I and Type II construction... it is not assumed to be fire-resistance rated, and generally does not afford any higher fire-resistance rating than untreated wood material."

4. PERFORMANCE BASED ANALYSIS AND VERIFICATION

Premise of Analysis

The list of prescriptive provisions in Section 3 establishes the code history of use of mineral wool insulation to improve the fire performance of wood wall and ceiling assemblies. These provisions are an outgrowth of tradition and historical construction practice. The values assigned to these are generic values, based on historical data. These are valuable in establishing precedence and intent of the code requirements. Our analysis is based on the full-scale test data documented in the research papers #1 and #2 listed in Section 1.4 in this white paper. The remaining references, #3, #4, #5, #6, #7 and #8, provide supporting evidence for the methodology used in this analysis as well as some other key metrics used in the analysis. The full-scale testing was performed with 4 inch metal stud wall assemblies, while the wall assemblies analyzed in this white paper are nominal 6 inch wood assemblies. Wood is a non-conductor of heat and a superior performer compared to metal within the context of this analysis. The test data includes wall assemblies with both fiber glass and mineral wool insulation within the stud cavity. Mineral wool out performs fiber glass insulation at higher temperatures in terms of sag and ability to retain protection of the framing members. Our analysis takes the conservative value when there are multiple data points available.

Building structural component fire performance is predicated on the type of fire exposure. Most commonly, fire from combustible building contents or furnishings expose the components, such as walls of structural frame, to heat from the fire, causing loss of structural integrity of the wall and its eventual collapse. The point at which the load-bearing components of a Type III wall (in this case, the wall studs) are exposed to heat from the fire, the building would have long since been evacuated and the space become untenable, as the temperature required to breach the gypsum board membrane would be beyond occupant survivability. In this case, the sole concern is for the preservation of structural stability, to protect emergency personnel, and reduce spread of fire to adjacent structures. The studs of the walls provide the necessary structural, load-bearing capability to support the exterior wall. Gypsum board or other sheathing is solely relied on to provide resistance to the fire exposure in order to protect the load-bearing members, its contribution to the structural strength of the wall is negligible. The Commentaries to section 722.6 of the IBC state “It is assumed that once the structural members fail, the entire assembly fails.”

OSSC section 602.3 defines Type III construction as “that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of any material permitted by this code. *Fire-retardant-treated wood* framing complying with Section 2303.2 shall be permitted within *exterior wall* assemblies of a 2-hour rating or less.”

Fire retardant treatment of wood does not prevent the wood from decomposing and charring under fire exposure. The rate of fire penetration through treated wood approximates the rate through untreated wood. Fire-retardant-treated wood used in walls can slightly improve fire endurance of these walls, but most of this improvement is associated with the reduction in surface flammability rather than any changes in charring rates.

Performance of FRT Wood

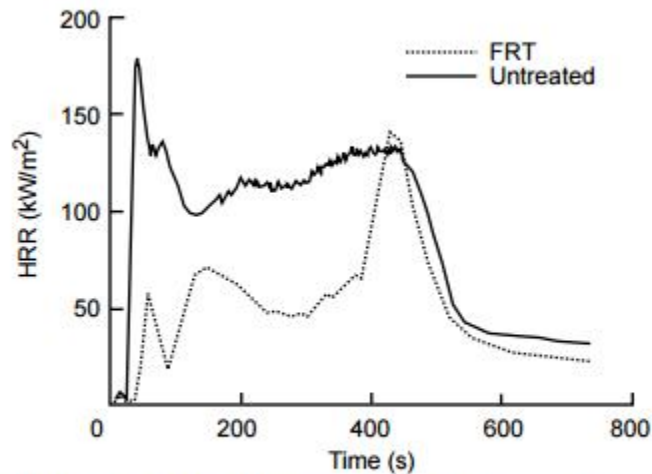


Figure 17-1. Heat release curves for untreated and FRT plywood exposed to 50-kW/m² radiance.

Fig.1. E84 Test Comparison (Wood Handbook Chapter 17)

Fire retardant treatment is a pressure applied surface treatment that slows ignition by interfering with heat transfer to the material and chemically interferes with combustion. It does so by converting combustible gases and tars to carbon char at temperatures below 550°F^{4,8} and releases carbon dioxide and water vapor which dilutes the combustible gases. Above temperatures of 550°F, outgassing and pyrolysis effects of the FRT exceed the limits where the treatment inhibits ignition. Above 550°F, FRT heat release rate and burning rates become equivalent to untreated wood of the same species. Charts of the ASTM E84 (Standard Test Method for Surface Burning Characteristics of Building Materials) heat release rates (Fig. 1) show that at about 420 seconds (7 minutes), the heat release rate (HRR) for FRT wood and non-FRT wood are virtually identical, indicating that, after the fire retardant treatment has been exhausted, the non-FRT and FRT wood studs will provide the same level of protection of structural integrity for fire migration and for ignition. The amount of additional wood charred in non-FRT wood is .105" (less than 1/8") than FRT wood.

Once the gypsum layers are compromised, the fire is free to attack the exposed studs. However, charring and consumption of the studs begins before failure of the gypsum membrane, as heat is conducted to the edge face of the studs and to the stud wall cavity by conduction through the gypsum board. In the stud wall cavity, the temperatures are already well over the auto ignition temperature of wood and the point at which FRTW becomes ineffective (550°F) by the time the two gypsum board layers have been compromised. Although the standard stud begins charring sooner than the FRTW stud, total time to fail for the standard stud is much longer due to the insulative effects of the mineral wool, slowing progressive char over the longer dimension (side) faces of the stud by preventing heat transfer to the stud cavity.

Above 550°F, FRTW studs behave similar to standard wood studs and charring continues until it fails in load. Char rates for softwoods such as used in framing lumber are at an average rate of 1.5 in/hr⁶. By calculating the heated perimeter of the wood studs for an uninsulated, code-accepted FRTW stud and a mineral-wool insulated standard stud, and using the average char rate, a time to failure of the two studs can be determined.

The effective heated perimeter of a 2" x 6" nominal FRTW stud is 12.5 inches at the point of its ignition. The effective heated perimeter of a mineral wool insulated stud is only 1.5 inches at the same point, although the point of ignition is approximately 7 minutes earlier due to the effects of FRT and the delay of ignition of the FRTW stud. As the studs are consumed by charring, the 3-sided attack⁶ on the FRTW stud results in much more material loss due to charring and more rapid reduction in load-bearing capability. While there is some charring of the sides of the standard stud, especially nearest the exposed edge, the insulative properties of the mineral wool significantly slow charring and loss of material.

Code Basis of Engineered Design Performance

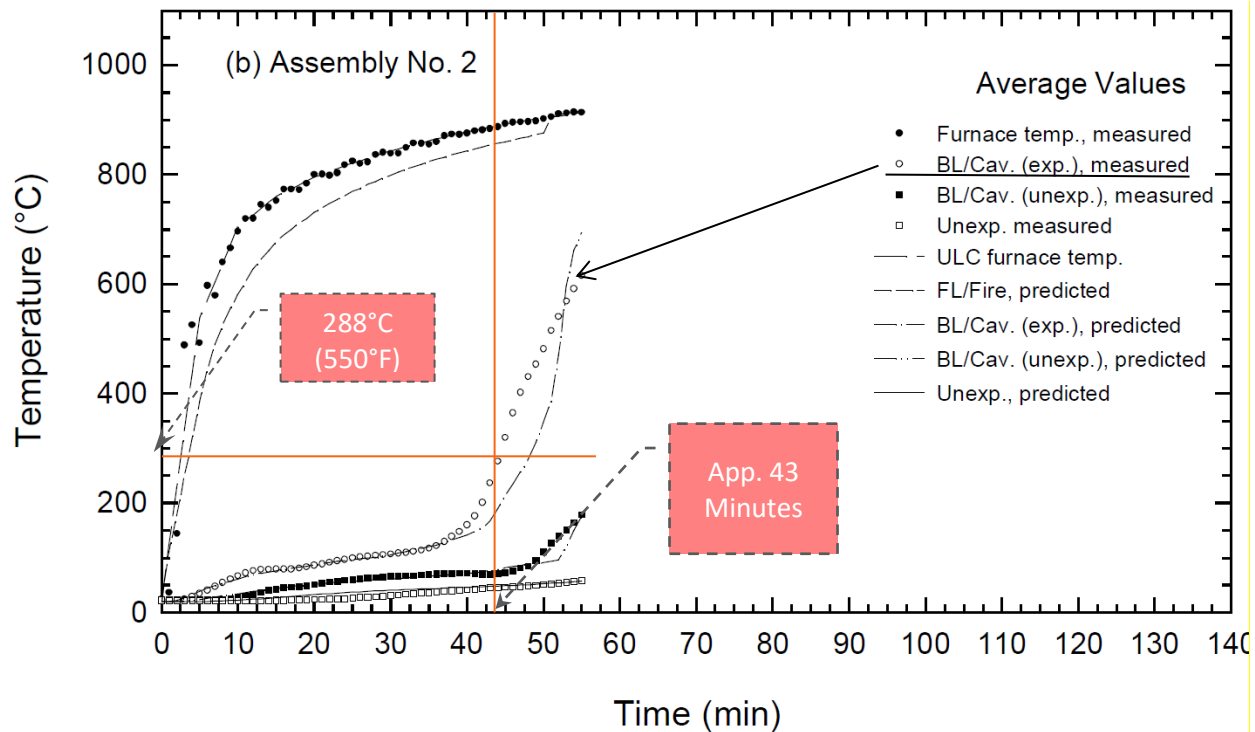
OSSC Table 722.6.2(2) states that the time assigned for contribution of the wood frame to fire resistance is 20 minutes. Within that time, the fire is assumed to consume sufficient of the stud framing to compromise its structural strength such that it fails under load. Thus it was assumed that, once the FRTW studs reach the point where the fire retardant treatment no longer interferes with charring, the stud will have 20 minutes of load-bearing capability before failure. This occurs with approximately 25% of the original stud cross-section remaining after charring. A similar failure point was used for analysis.

OSSC Table 722.6.2(5) notes that "Additional Protection" can be provided to a wall for fire rating purposes by the addition of mineral wool insulation at a specified minimum density. The Commentaries for IBC section 722.6 note that "Mineral wool insulation provides additional protection to wood studs by shielding the studs from exposure to the furnace, thus delaying the time of collapse." Mineral wool does this by insulating the sides of the studs from direct heat and flame exposure and by interfering with flame spread by conduction, radiation and convection within the wall cavity. In this respect, the assembly is superior to FRTW with only fiberglass insulation, in that its ability to interfere with ignition is not compromised by high exposure temperatures. Mineral wool has a melting point of 2150°F and can withstand a 4 hour test per ASTM E119 time-temperature curve, where the fire temperature reaches a maximum temperature of 2000°F, well above the temperatures expected in a flashover fire condition.

Unlike a simple, 2-hour rated FRTW stud wall, mineral wool provides protection on the sides of the studs, ensuring the main route of burn-through to be in the longest dimension of the lumber (See Fig 4-6). In FRTW, fire attack, once the thermal membrane has been compromised, is on three sides of the stud and burn through of the stud is much more rapid. Use of mineral wool insulation is specified as it has greater refractory qualities, higher installed density and remains in place long after fiberglass insulation has melted away.

Clearly, there is an advantage to the use of mineral wool in the wall that an ordinary FRTW assembly does not match.

Rational Analysis



Legend

SL - Gypsum Board Single Layer BL - Gypsum Board Base Layer FL - Gypsum Board Face Layer
 Std. - Stud Cav. - Cavity Exp. - Exposed Side Unexp. - Unexposed Side Fire - Directly exposed to furnace

Figure 2: Time vs temperature curve – Double Layer 5/8" Gypsum Board, Studs 16" O.C.⁷

Note: Line (open dots) for temperature at inner surface of base layer, exposed side. This is the temperature of stud cavity/edge of stud.

Derivation Calculation

Utilizing test data from reference document #7, (equation #10) and Fig. 2 above. The calculated stud surface temperature can be derived and graphed.

Eq. 10⁷

$$T_m^{j+1} = T_m^j + \frac{\Delta t}{(\rho_i c_i)_m (\Delta y)^2} \left\{ \left[\frac{(k_i)_m^j + (k_i)_{m+1}^j}{2} \right] (T_{m-1}^j - T_m^j) - \left[\frac{(k_i)_m^j + (k_i)_{m+1}^j}{2} \right] (T_m^j - T_{m+1}^j) \right\}$$

The calculated time to autoignition temperature for several depth increments into the mineral wool insulation (long direction of stud) are displayed below. (See Fig. 2A)

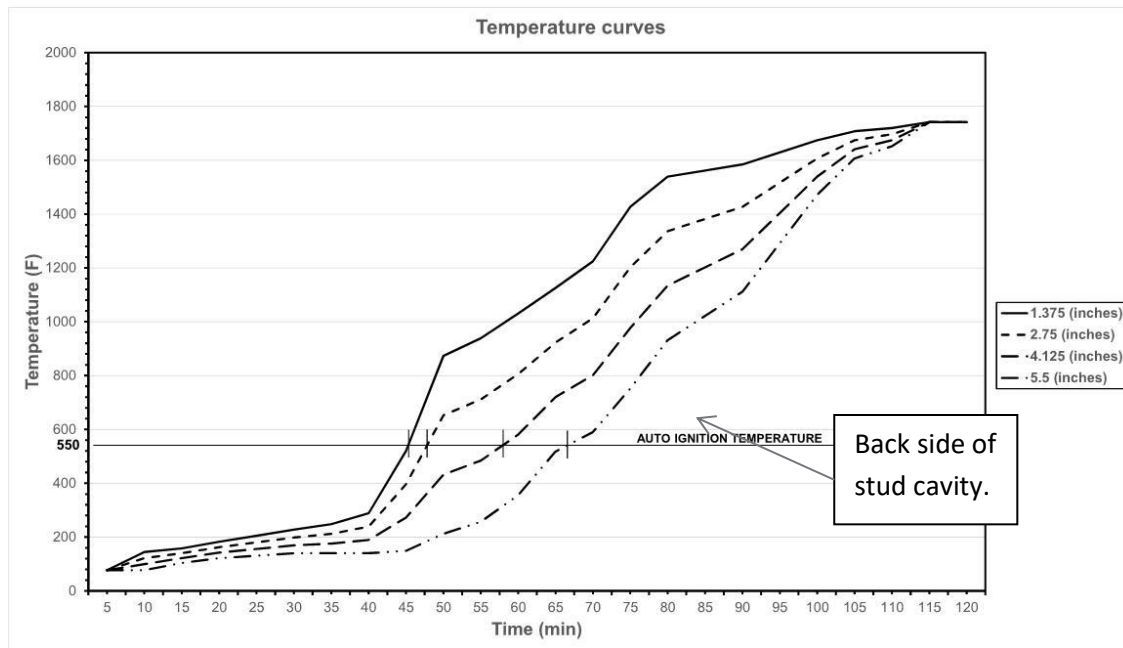


Figure 2A: Time vs Stud Surface Temperature curve – Calculated per Eq. 10.7

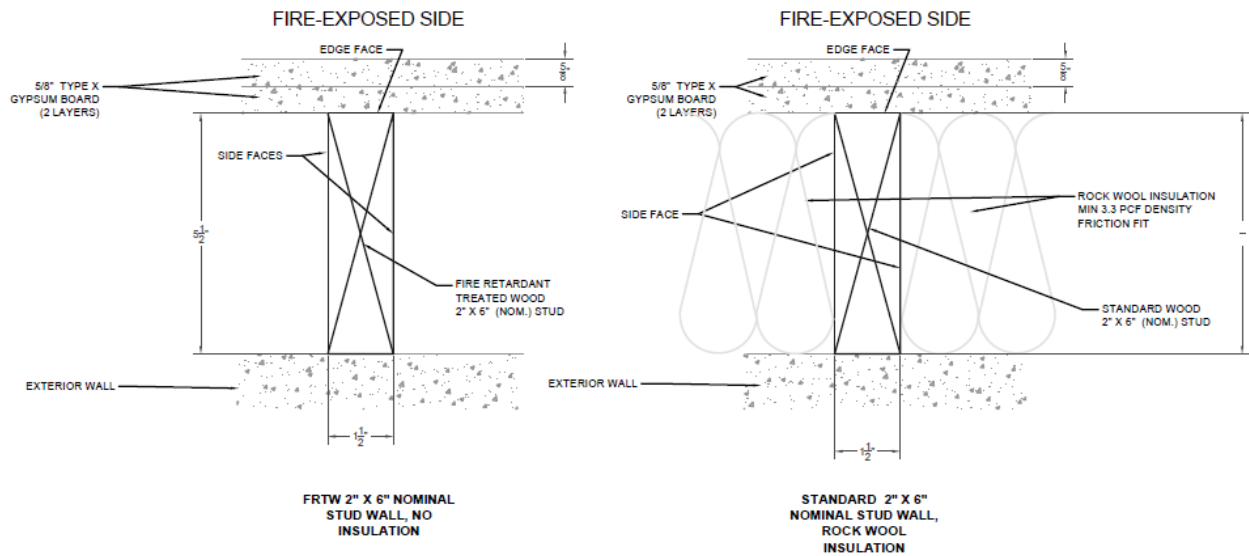


Figure 3: FRTW and Mineral Wool Stud Walls

Note: Figures 3-6 do not show composition of the exterior (non-fire exposed) side, as other constructions, allowed by code for non-fire exposed assemblies, may be used. All wall types shall be 2-hour rated as shown in Appendix A. In all cases addressed by this report, the Fire Separation Distance is greater than 10' and fire resistance rating may be calculated from the fire exposed side only in accordance with OSSC section 705.5.

5. FIRE RESISTANCE COMPARISON

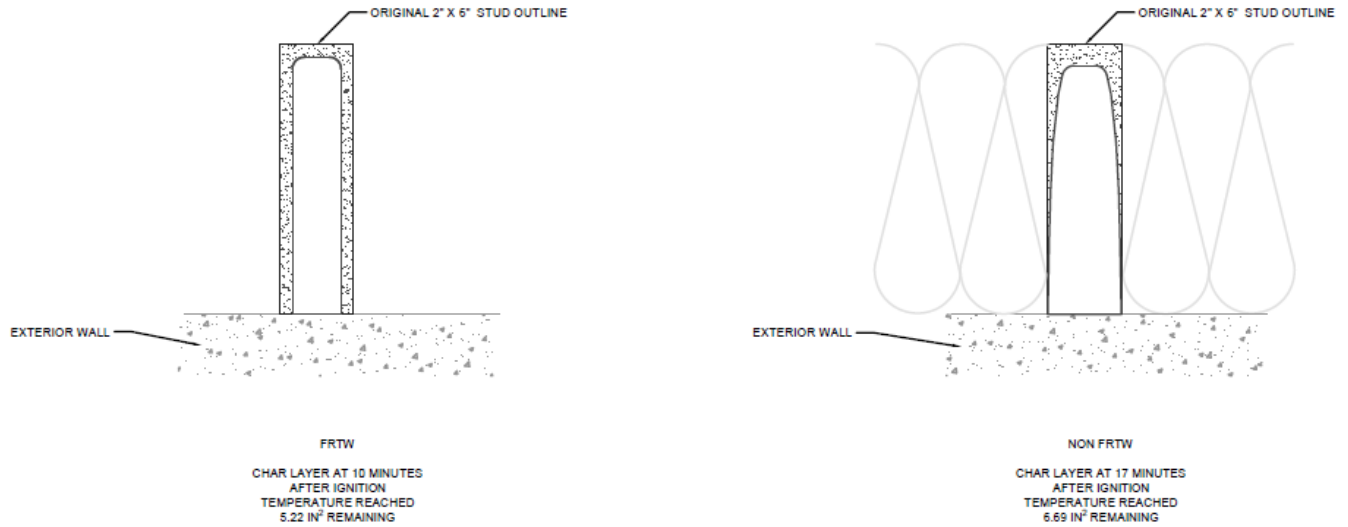
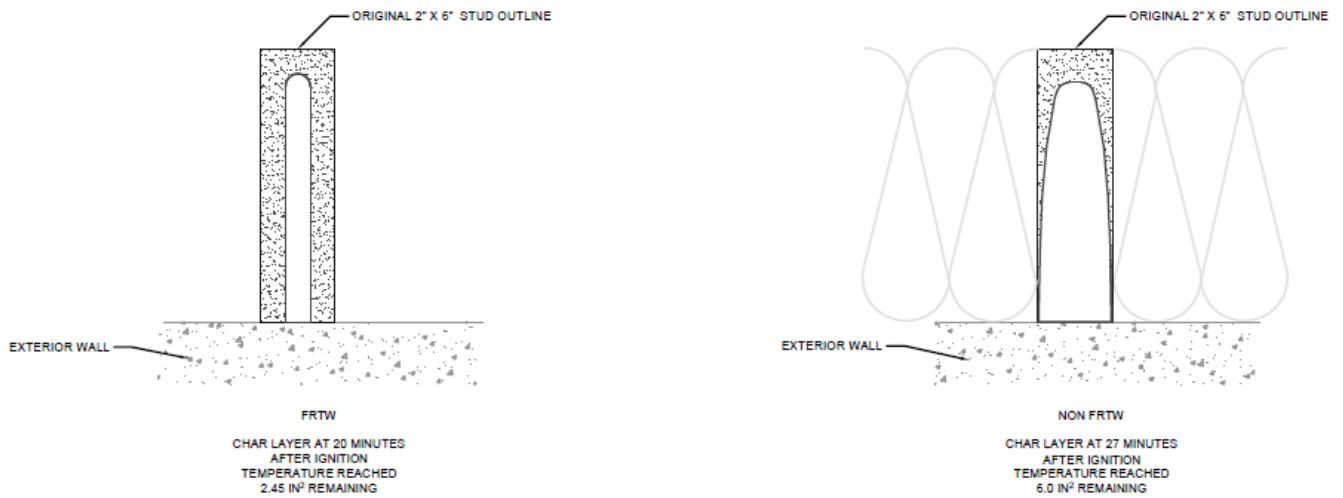


Fig 4: FRTW and non-FRTW Stud Wall at 60 Minutes After Fire Exposure of Gypsum Board Wall



*Figure 5: FRTW and Non-FRTW Stud Walls at 70 Minutes After Fire Exposure of Gypsum Board Wall
Point of FRTW Wall Failure*

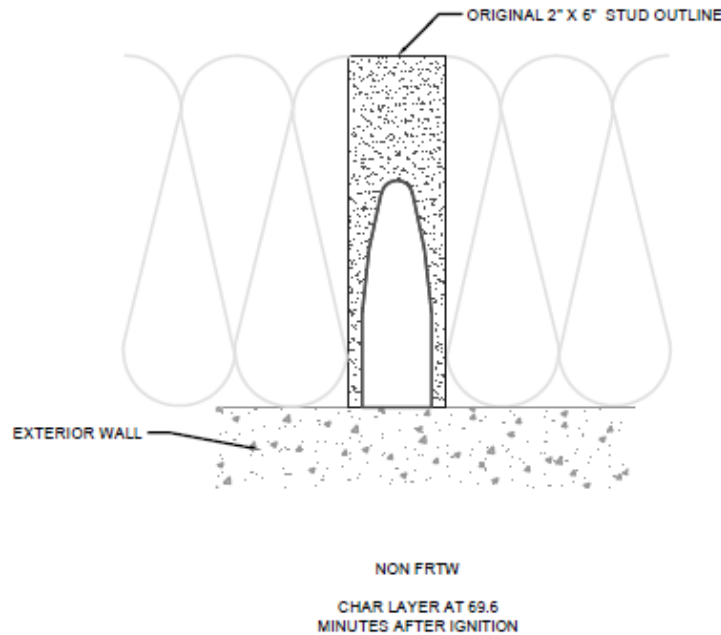


Figure 6: Non-FRTW Stud Wall at Failure at 112 Minutes – Reduced Cross Sectional Area Equivalent to FRTW at Failure

Charring and loss of load-supporting cross-section of the wood studs begins at approximately 43 minutes after exposure of the wall to fire, as heat conducts through the gypsum board and the temperature at the inside face of the gypsum board wall reaches the auto ignition temperature of wood. Ignition of the FRTW is delayed by approximately 7 minutes by the action of the fire retardant treatment. By approximately 50 minutes after exposure, both studs are experiencing charring.

At 60 minutes after exposure, approximately 50% of the allowable cross-section of the FRTW stud has been consumed by charring. Somewhat less (27%) of the insulated non-FRTW stud has been consumed at the same point, due to the effects of mineral wool in limiting heat transfer to the wood.

At 70 minutes, the FRTW has lost sufficient cross section that it fails in load. At this point, approximately 25% of the original FRTW stud cross-section remains. However, only 39% of the insulated stud has been consumed.

At approximately 112 minutes, charring of the insulated non-FRTW stud reaches the point at which less than 25% of the original cross-section remains and the stud fails.

The table below provides a comparative analysis that clearly shows that standard wood framing with mineral wool insulation performs better than FRT wood framing under fire conditions.

Time Interval (minutes)	Description	FRTW Stud Reaction	Standard Stud with Mineral Wool Insulation Reaction
t = 0	Gypsum board face of wall is first exposed to flames/heat, interior of stud wall at ambient temperature	None	None
t = 43	Temperature at edge face of stud attached to gypsum board exceeds autoignition point of wood (500°F), stud cavity of FRTW exceeds autoignition point of wood (500°F) (See Fig. 2)	FRT of wood stud inhibits ignition of FRT studs	Charring begins on narrow edge of stud (1.5" wide)
t=50	Chemical and mechanical inhibition of ignition of FRT wood exhausted	Charring begins on narrow edge of stud (1.5" wide) and along both exposed long faces (5.5" wide each)	Charring along wide faces nearest to the gypsum board
t=60		Charring has consumed 50% of allowable	Charring has consumed approximately 27% of allowable
t =70		Char layer exceeds allowable, insufficient cross-section of stud available to support load, stud fails	Charring has consumed approximately 39% of allowable
t = 112.6			Char layer exceeds allowable, insufficient cross-section of stud available to support load, stud fails

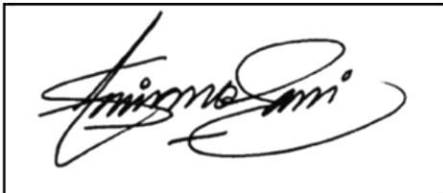
6. ADDITIONAL BENEFITS

- Depending on the species, type of product (stud, joist, plywood, beam), and its application (wall, floor, roof), the strength originally associated with wood is reduced when treated with a fire retardant. Therefore, the FRTW manufacturer is required to provide strength adjustments based on the intended use of the wood. This reduction in strength must be factored in to the structural design of the building. The effective spans and bearing capacity of the lumber is reduced, so beams are over-sized and more lumber is used in the project than required with standard studs. Hence non-treated wood consumes less of the available resources and is structurally stronger than FRTW.

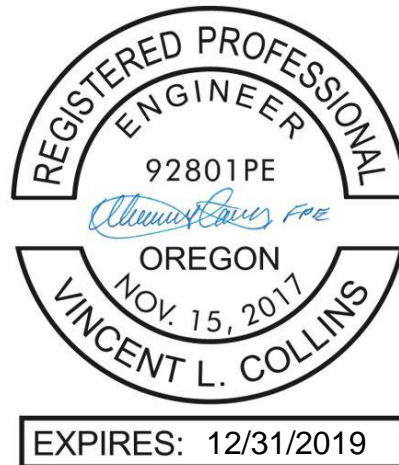
2. The process of pressure-impregnating chemicals into wood to achieve FRT lumber has a negative environmental impact, due to increased use of virgin chemicals and more waste chemicals that need to be treated before discharge into the sewer system. Additionally, there are health impact concerns to the occupants of the building from a long-term exposure to the chemicals used in pressure impregnation. Unlike the chemical FRT process, mineral wool is made from an inorganic fiber that does not have adverse impacts on the environment or individual health of occupants.
3. Due to the potential corrosion of steel, hot-dipped galvanized fasteners are required over standard zinc-plated type when using FRT wood. Mineral wool is made from inorganic fiber, it does not reduce the strength of the wood, and does not require hot dipped galvanized fasteners. Hence, it is a better alternative for the environment and overall structural design.

7. CONCLUSION

Mineral wool batt insulation friction fit between the 2x6 studs and filling the entire depth of the wall cavity will provide better protection than FRT wood framing as permitted by OSSC 2303.2 and 603.2. The architect is proposing to use comfort batt insulation by Roxul Company. The batt insulation will be 5.5 inches thick and will be friction fit within the stud cavity. This product is within the parameters of our analysis and the proposed wall assembly will exceed the performance of an FRT wood framed wall assembly. Code does not prohibit the use of better quality products than what is mandated. As this proposed assembly exceeds the base code criteria, it will satisfy the code requirements.



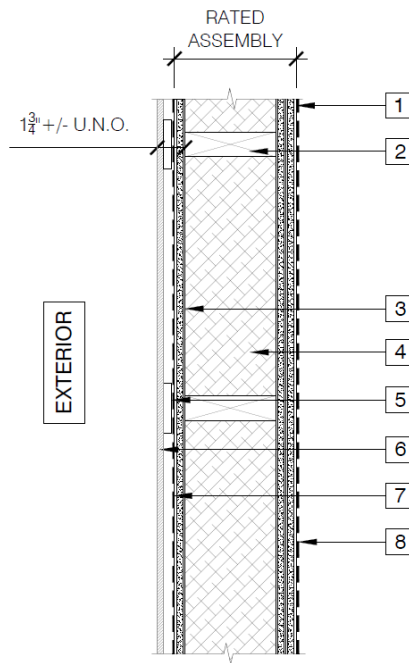
Samir Mokashi
Principal/Code Analyst
Code Unlimited



Vincent Collins
Fire Protection Engineer
Principal/Code Unlimited

Appendix A

Proposed Wall Section

**ASSEMBLY LEGEND:**

- 1 09 25 10, (2) LAYERS 5/8" TYPE X GYPSUM BOARD FOR FIRE-RESISTANT USE
- 2 06 11 00, 2x6 NON-FRT WOOD FRAMING, SIZE AND SPACING AS SCHEDULED PER STRUCTURAL
- 3 06 16 00, (1) LAYER 5/8" EXTERIOR GYPSUM SHEATHING
- 4 07 21 00, MINERAL WOOL INSULATION FIT TIGHT TO CAVITY, R-21, INS-2
- 5 07 46 00, NON-COMBUSTIBLE VERTICAL FURRING
- 6 07 46 00, NON-COMBUSTIBLE FIBER CEMENT SIDING
- 7 07 27 10, WEATHER RESISTANT BARRIER
- 8 09 90 00, INTERIOR FINISH PAINT OVER PRIMER - VAPOR RETARDER

WALL TYPE 10 - EXTERIOR WOOD FRAME WALL W/ FSD X > 10

LOCATION(S): LVLS 1-5, EXTERIOR LOAD BEARING WALL W/ NON-COMBUSTIBLE EXTERIOR WALL COVERING

MARK	STUD SIZE	FIRE		SOUND ATTENUATION	
		RATING	RATING SOURCE	STC RATING	RATING SOURCE
10	2x6	2-HR	CODE GUIDE*	NA	

* 2 HOUR RATED IN ACCORDANCE WITH CITY OF PORTLAND CODE GUIDE - TYPE III CONSTRUCTION - OSSC/6/#4.



Leeb Architects
 308 SW 1st Ave, # 200 Portland, Or 97204
 Phone: 503.228.2840 Fax: 503.228.2907
 leebarc.com

MODERA WOODSTOCK

CODE APPEAL
 08.09.19

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W10*Appendix A; Figure 1: Exterior Wall*