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APPEAL SUMMARY

Status: Decision Rendered - Reconsideration of ID 23742

Appeal ID: 23809	Project Address: 25 N Fargo St
Hearing Date: 6/10/20	Appellant Name: Tom Jaleski
Case No.: B-016	Appellant Phone: 971-238-5266
Appeal Type: Building	Plans Examiner/Inspector: David Bartley
Project Type: commercial	Stories: 7 Occupancy: R-2, A-2 Construction Type: I-A, III-A
Building/Business Name: VC Fargo Building	Fire Sprinklers: Yes - Throughout
Appeal Involves: Erection of a new structure, Reconsideration of appeal	LUR or Permit Application No.: 19-217418-CO
Plan Submitted Option: pdf [File 1] [File 2] [File 3]	Proposed use: Multi-Family Residential

APPEAL INFORMATION SHEET

Appeal item 1

Code Section	602.3 Type III
Requires	Type III construction is 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.
Code Modification or Alternate Requested	This appeal proposes the use of non-fire resistant treated wood studs in the exterior walls of a Type III building with mineral wool insulation to provide an equivalent wall assembly to a prescriptively allowed FRT stud wall.
Proposed Design	<p>We are submitting this request for the use of regular wood stud framing with the stud cavity filled with mineral wool batt insulation instead of the Fire Retardant Treatment (FRT). The proposed design includes one (1) exterior wall assembly included in the appendix section of the attached white paper prepared by an Oregon Fire Protection Engineer.</p> <p>In addition to the above proposal the project will also satisfy the following conditions:</p> <p>Exterior bearing walls shall be protected based on their fire separation distance as defined in the OSSC and as indicated in the attached white paper.</p> <p>All exterior wall coverings shall be of non-combustible material.</p> <p>Combustible roof sheathing and framing shall be protected from exposure to fire from above with gypsum-based products, fire-retardant-treated wood sheathing or similar UL tested products installed above or below the roofing membrane and/or rigid insulation.</p>

Selective smoke detection coverage shall be provided in the Type III portion of the building per NFPA 72, National Fire Alarm Code, beginning at the access point to the path of egress and continuing until reaching all exits. If the exit passes through a lobby or other intervening space, selective smoke detection coverage requirements shall be extended to such spaces until reaching the exit discharge.

At least one operable exterior window shall be provided in each dwelling unit with a minimum opening width of 3-1/2 inches.

Walls and floor assemblies separating dwelling units shall have tested fire resistance ratings of not less than 1-hour.

The base allowable building area specified in the OSSC for R occupancies in Types III-A and III-B construction shall not exceed 12,000 square feet. Area increases in accordance with the OSSC are allowed.

All required egress stairs shall include access to the roof. Such access may be via any method listed in OSSC Chapter 10 for roof access.

All penetrations through the exterior wall covering will be fire-stopped at the exterior sheathing. "Penetrations" for purposes of this appeal includes elements such as conduits and piping and does not include "openings" such as doors, windows or wall-mounted HVAC units and louvers.

Ducts and vents penetrating exterior walls shall be 26 gage minimum.

No unprotected penetrations are permitted through the underside of fire-rated exterior wall projections that are required to be rated, including cornices, eaves, bays, exterior balconies, and similar projections extending beyond the exterior wall.

Elevator hoistways opening directly into corridors shall be pressurized or have smoke tight protection as required for doors opening into fire-resistive corridors.

Framing connections at walls, floors, ceilings, roofs, and with the proposed exterior wall will be constructed as specified in the detail drawings numbered 0 - 19 contained in the City of Portland Code Guide OSSC/6/#4, unless greater fire resistance is provided, except that no sacrificial stud will be provided. 2-hour rated walls will be provided at these conditions. Conditions not covered in the guide will be constructed in accordance with the 2019 OSSC.

RECONSIDERATION TEXT (added text)

Regarding OSSC/6/#4 condition #11, aerial fire apparatus access cannot be provided due to overhead power lines, so the design will meet the conditions of the "Alternate to Aerial Fire Apparatus Rods as prescribed in the "Portland Fire & Rescue: Fire & Life Safety Requirements for Fire Department Access and Water Supplies." The proposed design meets those conditions as follows:

- 1-The building will be equipped with an approved NFPA 13 automatic sprinkler system throughout.
- 2-There are no combustible concealed attic spaces (upright sprinkler heads within the joist cavities of the roof trusses satisfy this requirement)
- 3-All stairway enclosures have a fire-resistance rating of not less than 2-hours.
- 4-The roof slope is essentially flat with a slope of 3/8" per foot (less than 33% slope).
- 5-Approved access is provided to the roof from all the stairways. Each stairway extends to the roof within a 2-hour enclosure and a compliant roof hatch.

Each stairwell is equipped with a standpipe. Both terminate at the roof

Reason for alternative The attached white paper provides the fire analysis that supports the use of mineral wool (aka Rock Wool) insulation in the wall cavity of untreated wood stud framing as an alternate to FRT

wood stud framing permitted by the OSSC section 602.3. The analysis is based on published temperature data from full scale testing of multiple configurations of fire rated stud walls. The assemblies tested included 1 hour and 2 hour rated assemblies, with and without insulation, insulations included fiberglass and Rock wool types.

The analysis incorporates test data with the fire science fundamentals of gypsum calcification, pyrolysis of wood, and thermal conductivity of materials, accepted by the Society of Fire Protection Engineers, The National Bureau of Standards, and the American Wood Council. These are the accepted industry standards for this type of analysis.

The appeal includes additional conditions requested by the City of Portland. The equivalency analysis included in the white paper is a straight comparison between untreated wood and FRT wood framed wall assemblies, without any benefit from these additional conditions. The analysis documented in the attached white paper concludes that untreated wood framed walls with mineral wool insulation will outperform FRT wood framed walls without such insulation.

Therefore, as detailed in the attached White Paper, the performance of mineral wool filled wood stud framed walls with these additional conditions will far exceed the code intent of FRT wood framing.

Hence, we urge you to approve this appeal request.

RECONSIDERATION TEXT

Reason for alternate is unchanged.

APPEAL DECISION

Use of Type III Code Guide with roof access to be provided per prescriptive requirements of Portland Fire and Rescue Guide: Denied. Proposal does not provide equivalent Life Safety protection. Appellant may contact John Butler (503 823-7339) or e-mail at John.Butler@portlandoregon.gov 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.



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CODE UNLIMITED, LLC

White Paper - Fire Analysis of Fire Retardant Treated Wood Alternate

Project Name: VC Fargo

Client: Solterra Canopy

Prepared by: Code Unlimited

Address: 13515 SW Millikan Way, Beaverton, OR 97005

Date: 5/12/2020

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1. OVERVIEW

1.1 Project Overview

The Fargo building is a new project to be constructed at 25 North Fargo Street in Portland, Oregon. It will be under the jurisdictional review of the City of Portland. The proposed design is five stories of Type IIIA wood construction over two (2) stories of concrete Type IA podium construction. The building includes 100 residential units with parking, retail, and resident amenities.

Type IIIA construction requires that exterior walls be of noncombustible construction or of Fire Retardant Treated Wood (FRTW) construction. The project proposes to use wood without the Fire Retardant Treatment (FRT). There are significant 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 a 2 hours or less. This is based on the improved fire performance of such wood compared to regular wood of same species. FRT of wood delays ignition and resists “flame spread” once ignited. The proposed design uses tightly packed rock wool insulation between non-treated wood framing members in lieu of Fire Retardant Treated Wood (FRTW) to achieve equal or better fire performance.

Over the last three years Code Unlimited has analyzed this particular issue, namely the use of non-FRT wood in place of FRTW 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 within our company.

The white paper is structured to give the reader a detailed understanding of the code regulations that are driving this requirement along with excerpts from the International Building Code (IBC) commentary to clarify intent where necessary. We also provide other code citations where prescriptively the Oregon Structural Specialty Code (OSSC) and the IBC permits the use of rock wool (aka mineral wool) as a means to delay ignition or fire and flame migration. This is provided as documentation of established tradition. Many code provisions have evolved initially out of traditional construction practices and then undergo rigorous analysis and/or testing to substantiate its 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 of a type IIIA construction building.

Our analysis found that the fire performance of a non-FRTW framed wall with rock wool insulation is equal or superior to a FRTW framed wall. We also found support for the argument that this approach reduces the potential for chemical exposure to the environment and to the occupants of these buildings compared to the current practice of using FRTW.

1.3 Applicable Codes and Standards

Applicable Code or Standard

2019 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 2003 Ignition Handbook: Principles and Applications to Fire Safety Engineering, Fire Investigation, Risk Management and Forensic Science, Dr. Vytenis Babrauskas - Fire Science Publishers
- ² 2006 Performance of a Non-load Bearing Steel Stud Gypsum Board Wall Assembly: Experiments and Modelling, Samuel Manzello, Richard Gann, Scott Kukuck, Kuldeep Prasad, and Walter Jones - Building and Fire Research Laboratory (BFRL), National Institute of Standards and Technology (NIST), Weapons and Materials Research Directorate, US Army Research Laboratory, APG.
- 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 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) (this is an updated version of reference #2 above)
- ⁸ 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

- ⁹ 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
- ¹⁰ 2010 Wood Handbook, Wood as an Engineering Material, Chapter 17 Fire Safety, Robert H. White and Mark A. Dietenberger, 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 two layers of 5/8" thick type X gypsum board on the interior and one or two layers (depending on the fire separation distance) of 5/8" type X gypsum sheathing on the exterior side of the wall. Rock wool insulation will be friction fit between studs to fill the entire 6 inch nominal wall cavity. Details of the proposed wall sections are in the attached Appendix A. The conclusions of this report are limited to the proposed exterior wall types included in Appendix A of this white paper.

§705.5 of the 2019 OSSC states the exterior wall assembly is required to be rated for fire exposure from the interior only if the fire separation distance (FSD) is greater than 10 feet, and is required to be rated from both sides if the FSD is less than or equal to 10 feet from the property line. Per §705.5, the proposed assembly includes one layer of 5/8" thick type X gypsum board on the exterior side where the FSD is greater than 10 feet, and two layers of 5/8" thick type X gypsum board on the exterior side where the FSD is less than or equal to 10 feet from the property line.

3. ROCK WOOL USE PRESCRIPTIVELY PERMITTED IN CURRENT CODE

The 2019 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.

Rock wool barriers have been allowed in the codes as a means to retard or prevent the ignition of wood in concealed spaces, for some time now:

1. OSSC 803.15.1.1 allows untreated wood to be used for furred walls or ceilings where Non-Combustible construction is required when the cavity is filled with rock wool insulation.
2. OSSC 718.2.1(7) allows rock wool batts to be used as fireblocking to cut off concealed draft openings.
3. OSSC 718.3.1 permits the use of rock wool batts as an approved draft stopping material.
4. ORSC 316.5.3 permits the use of 1.5 inch thick rock 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 rock 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:

“Rock wool 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 rock 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

The list of prescriptive provisions in section 3 establishes the code history 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 #2, #7, and #9 listed in section 1.4 in this white paper. The remaining references #1, #3, #4, #5, #6, #8, and #10, 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 superior performer to metal within the context of this analysis. Our test data includes wall assemblies with both fiberglass and mineral wool insulation within the stud cavity. Mineral wool outperforms fiber glass insulation at higher temperatures. In these two cases as well as in all other cases, 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 survivability. In this case, the sole concern is for the preservation of structural stability and protect firefighters and 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

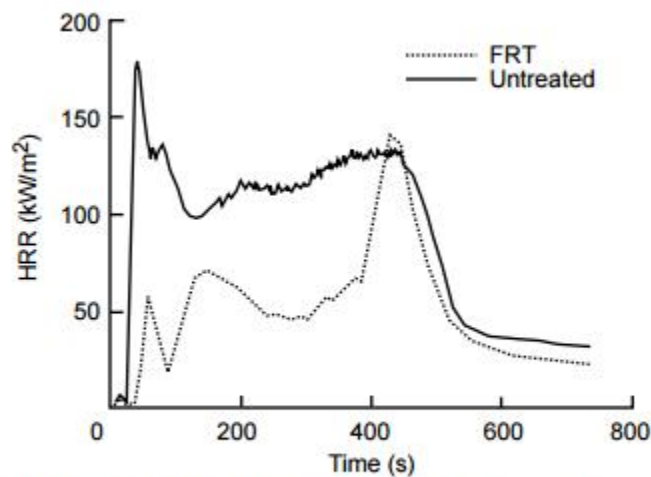


Figure 17-1. Heat release curves for untreated and FRT plywood exposed to 50-kW/m² radiance.

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

The surface layer of FRTW is a fire retardant 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^{4,10} and releases carbon dioxide and water vapor which dilute the combustible gases. However, above temperatures of 550°F, outgassing and pyrolysis effects exceed the limits whereby ignition is interfered and FRT heat release and burning rates compare to untreated wood of the same variety. 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 releases rate (HRR) for FRTW and non-FRTW are virtually identical, indicating that, after the fire retardant treatment has been exhausted, the non-FRT and FRT wood studs will perform similarly.

In a 2-hour fire rated wall, 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 autoignition 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 assembly is much longer due to the insulative effects of the rock 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 a 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/hr⁸. By calculating the heated perimeter of the wood studs for an uninsulated, code-accepted FRTW stud and a rock-wool insulated standard stud, and using the average char rate, a time to failure of the two studs can be determined.

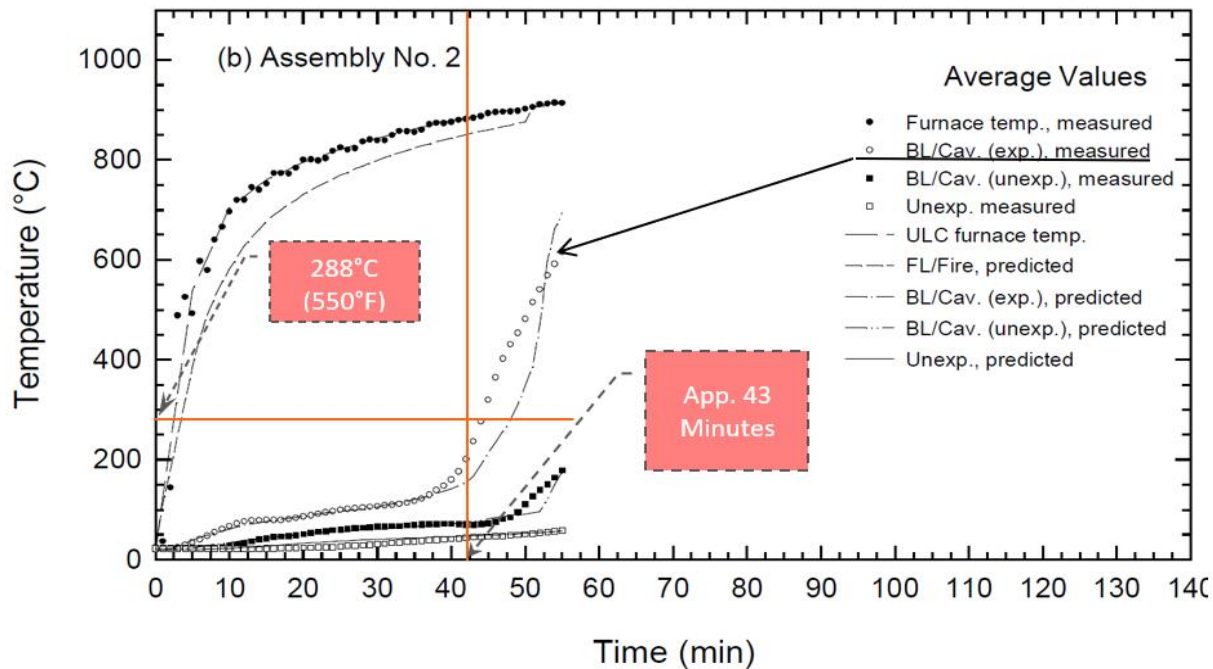
The effective heated perimeter of a 2" x 6" nominal FRTW stud is 12.5 inches at the point of its ignition. The effective heated perimeter of a rock wool insulated stud is only 1.5 inches at the same point, although the point of ignition is approximately 7 minutes earlier due to the effects of FRT and the delay of ignition of the FRTW stud. As the studs are consumed by charring, the 3-sided attack⁸ 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 rock wool significantly slow charring and loss of material.

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 rock wool insulation at a specified minimum density. The Commentaries for IBC section 722.6 note that "Rock wool insulation provides additional protection to wood studs by shielding the studs from exposure to the furnace, thus delaying the time of collapse." Rock 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. Rock 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, rock 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 rock 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 rock wool in the wall that an ordinary FRTW assembly does not match.



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.⁹

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

Derivation Calculation

Utilizing test data from reference document #9, (equation #10) and Fig. 2 above. The calculated stud surface temperature can be derived and graphed.

Eq. 10⁹

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

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)

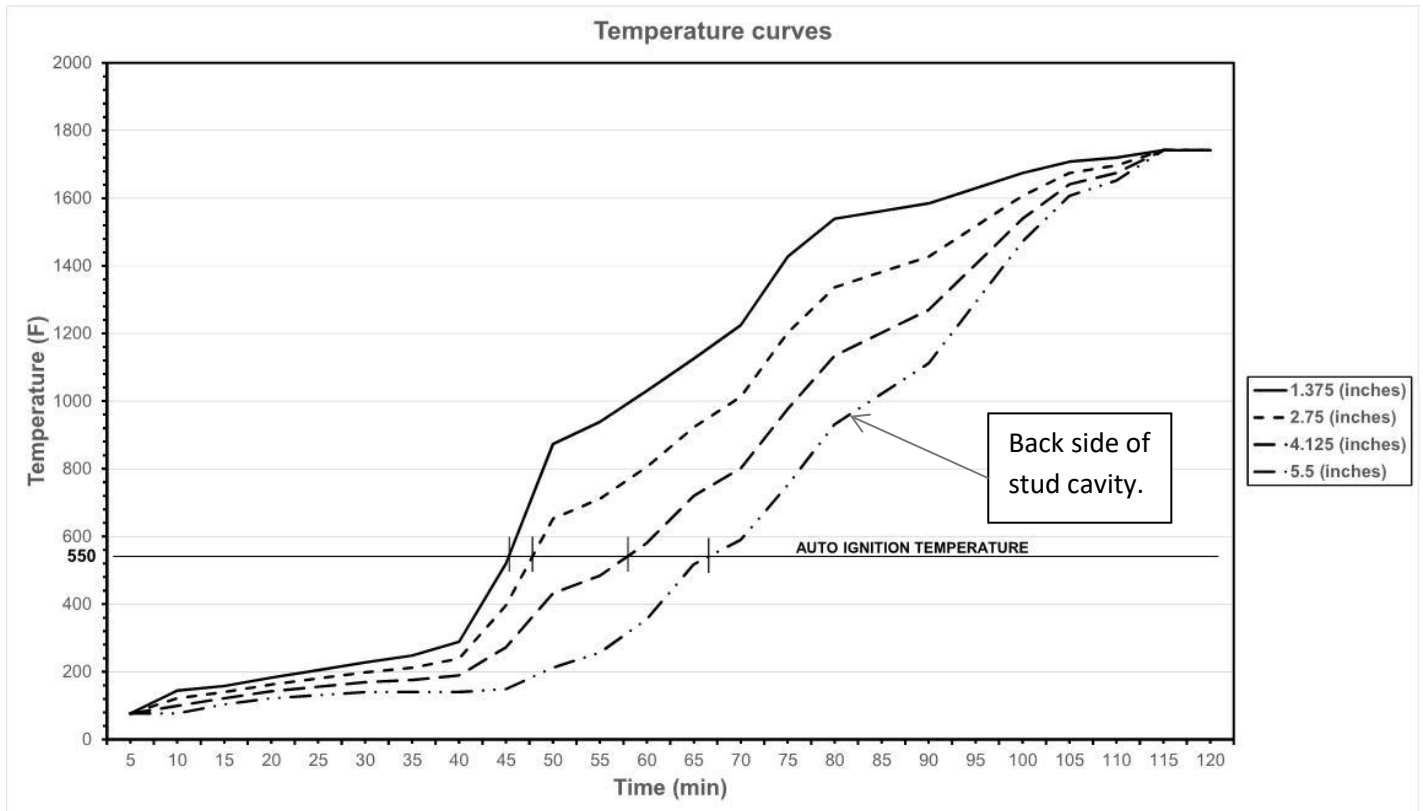


Figure 2A: Time vs Stud Surface Temperature curve – Calculated per Eq. 10.⁹

5. FIRE RESISTANCE COMPARISON

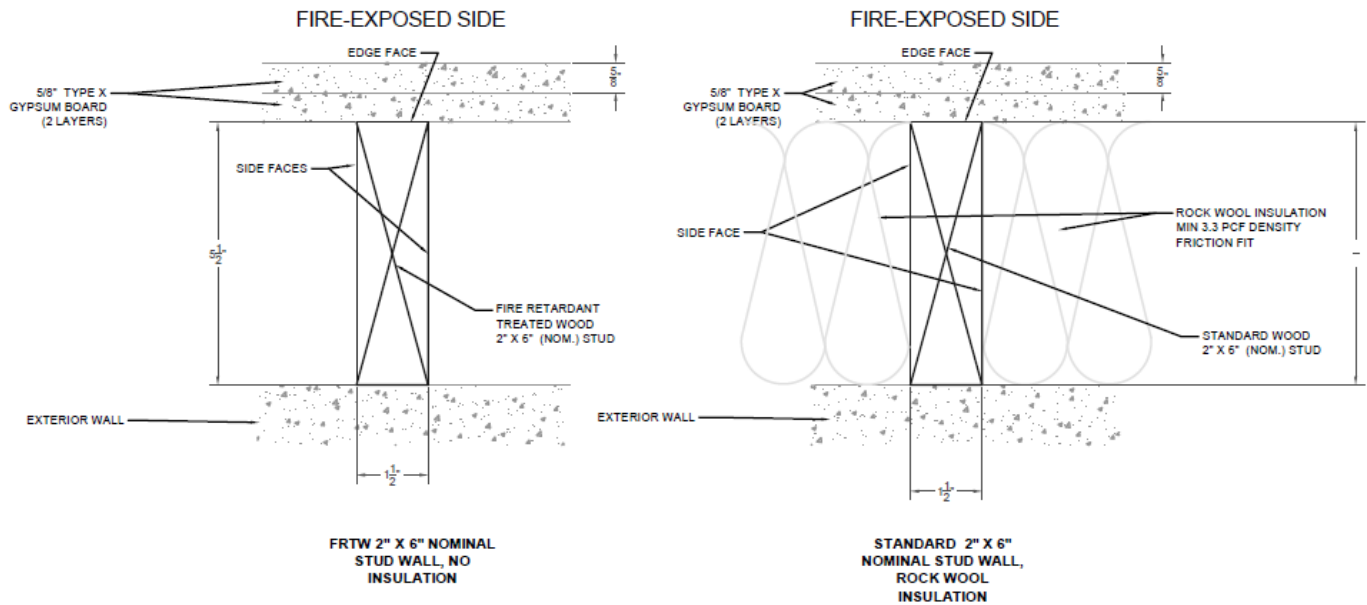


Figure 3: FRTW and Mineral Wool Stud Walls

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-Hr rated as shown in Appendix A. For the fire separation distance less than 10 feet, an additional layer of 5/8" type X gypsum board is required on the exterior side of the wall.

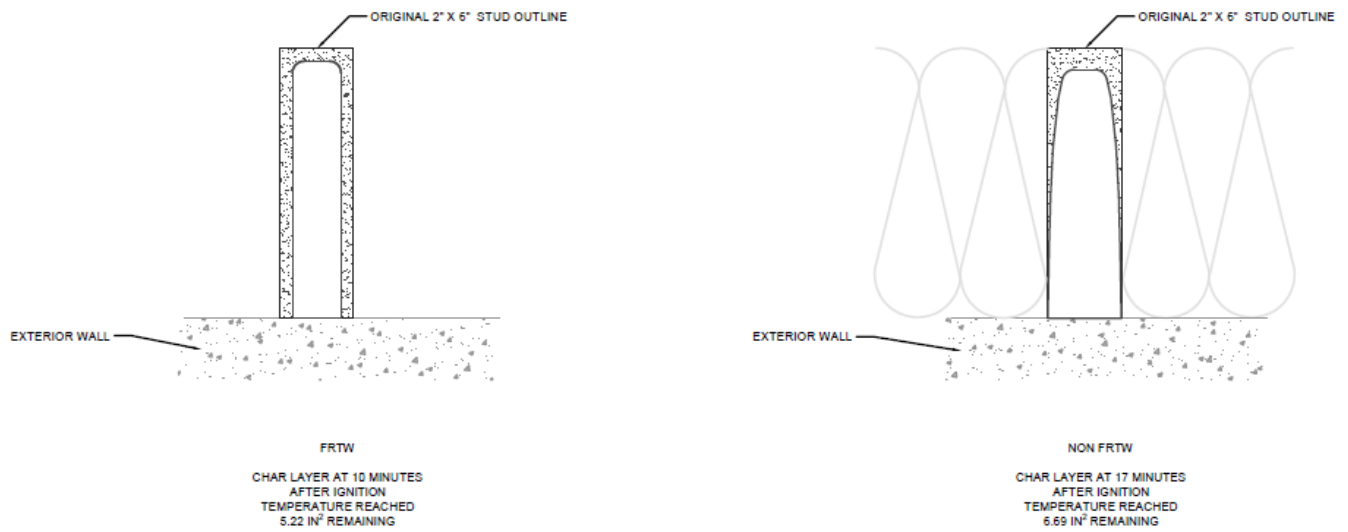


Fig 4: FRTW and non-FRTW Stud Wall at 60 Minutes After Fire Exposure of Gypsum Board Wall

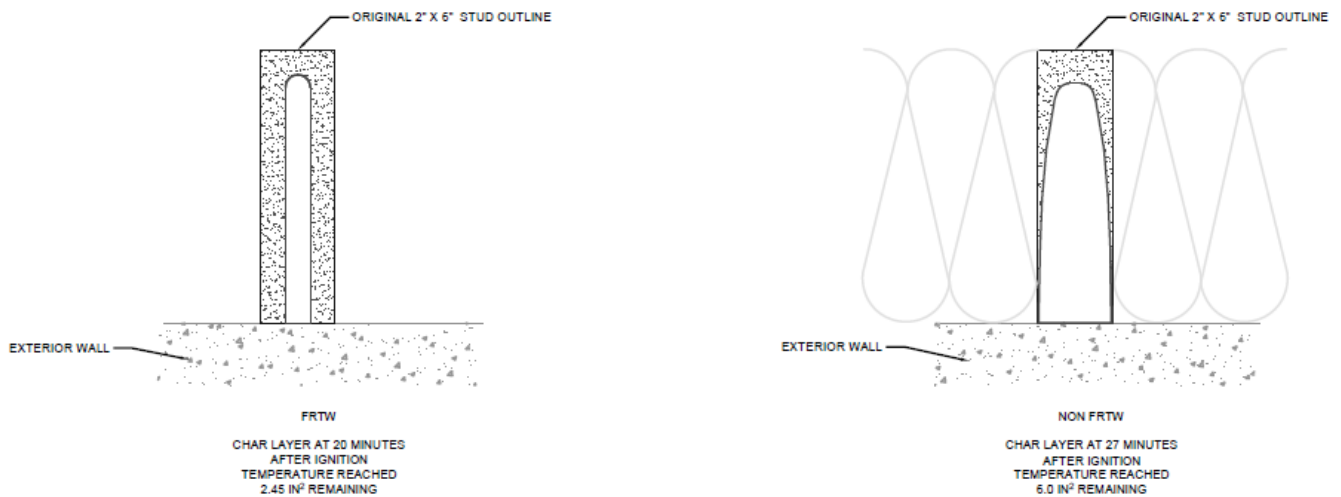


Figure 5: FRTW and Non-FRTW Stud Walls at 70 Minutes After Fire Exposure of Gypsum Board Wall
Point of FRTW Wall Failure

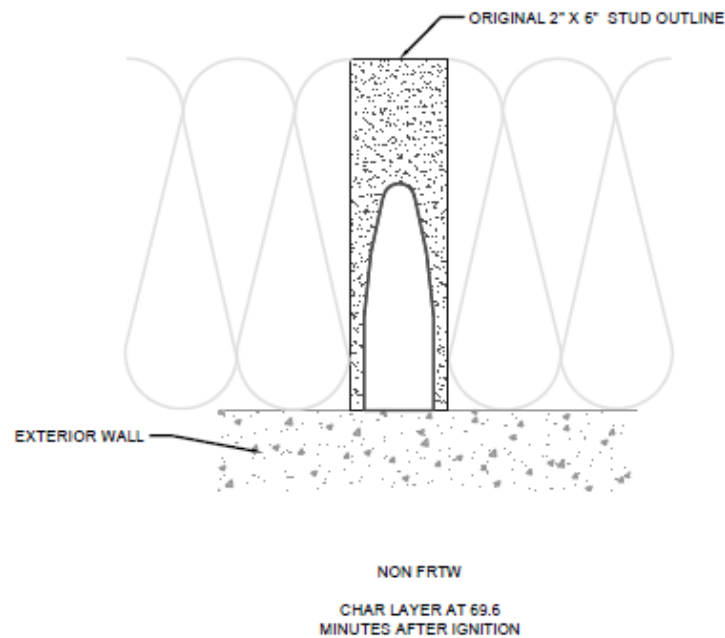


Figure 6: Non-FRTW Stud Wall at Failure at 112 Minutes – Reduced Cross Sectional Area Equivalent to FRTW at Failure

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 autoignition 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 rock wool of rock 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 rock wool insulation performs better than FRT wood framing under fire conditions.

Time Interval (minutes)	Description	FRTW Stud Reaction	Standard Stud with Rock 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 stub 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 (Autoignition temperature boundary at 2.75" depth)
t=60		Charring has consumed 50% of allowable	Charring has consumed approximately 27% of allowable (Autoignition temperature boundary at 4.125" depth)
t =70		Char layer exceeds allowable, insufficient cross-section of stud available to support load, stud fails	Charring has consumed approximately 39% of allowable (Autoignition temperature boundary at full depth)
t = 112.6			Char layer exceeds allowable, insufficient cross-section of stud available to support load, stud fails

6. ADDITIONAL BENEFITS

1. 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

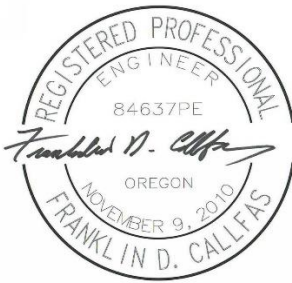
spans and bearing capacity of the lumber is reduced, so beams are over-sized and more lumber is used in the project than required with standard studs. Hence non-treated wood consumes less of the available resources and is structurally stronger than FRTW.

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 needs to be treated before it is discharged into the sewer system. Additionally, there are health impact concerns regarding to the occupants of the building from a long term exposure to the chemicals used in pressure impregnation. Unlike the chemical FRT process, rock 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. Rock 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

Rock wool batt insulation will be friction fit between the 2x6 studs. 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 comfortbatt insulation product 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

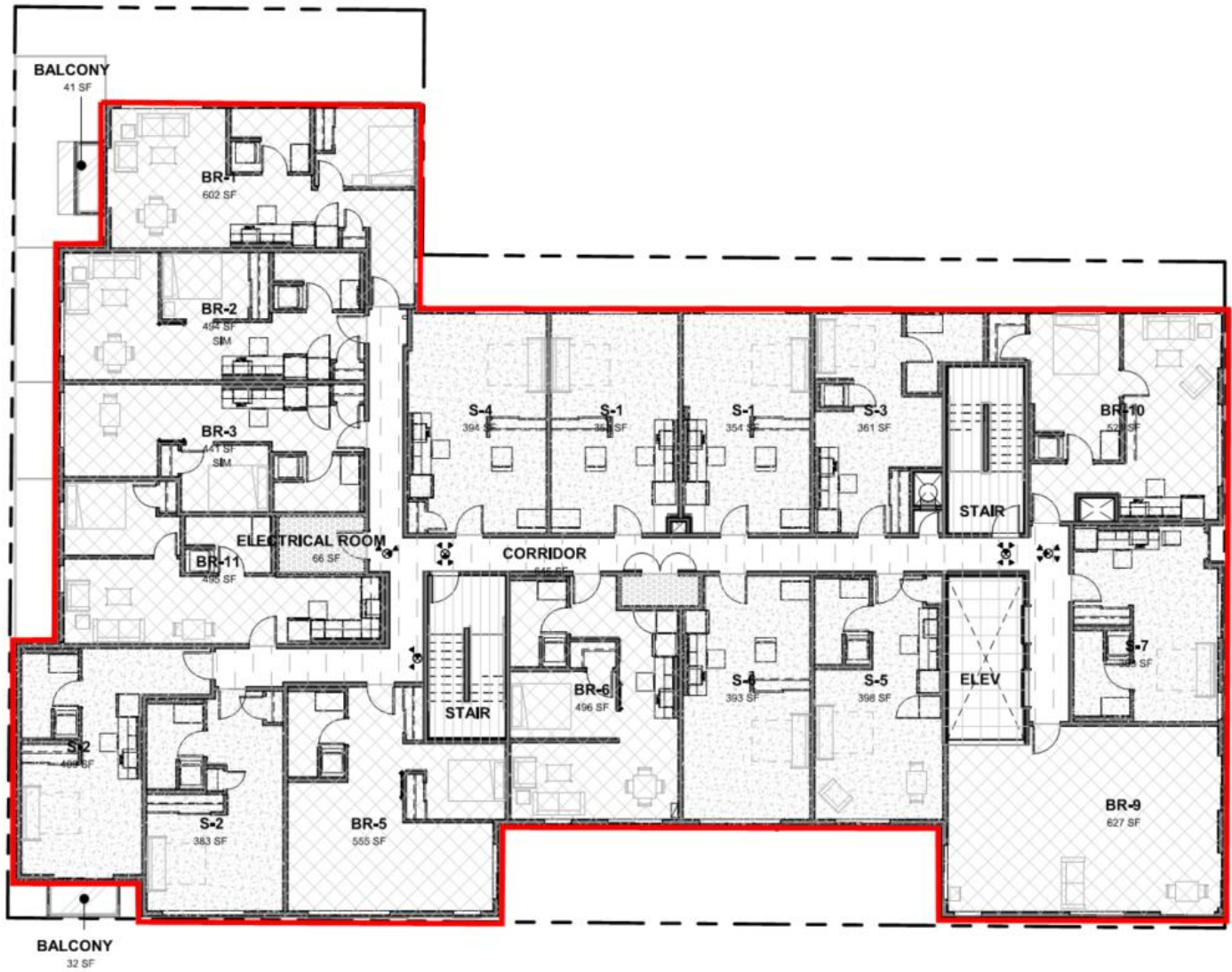


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Franklin Callfas
Principal/Code Unlimited
Fire Protection Engineer
Code Unlimited

Appendix A

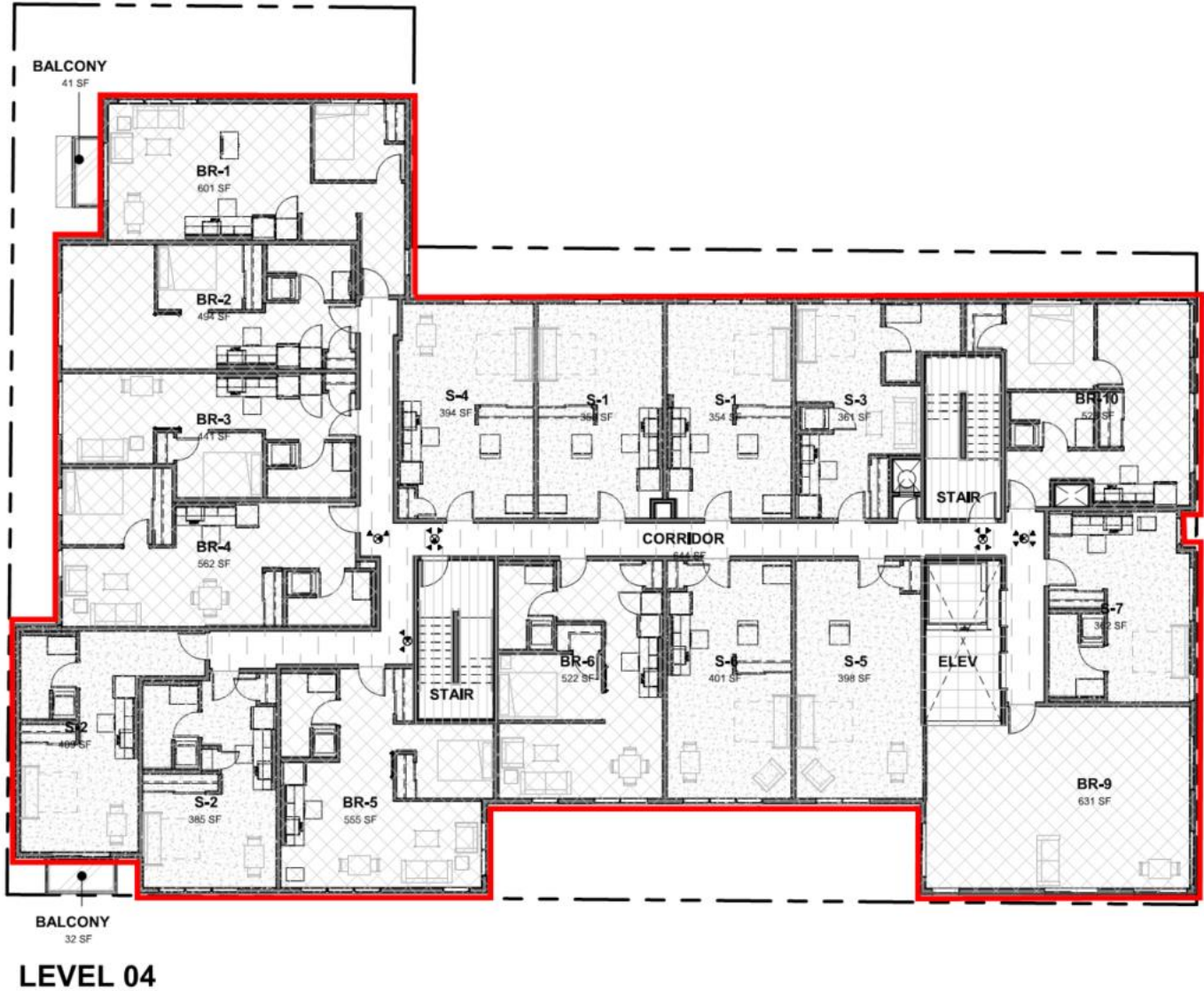
Proposed Wall Sections



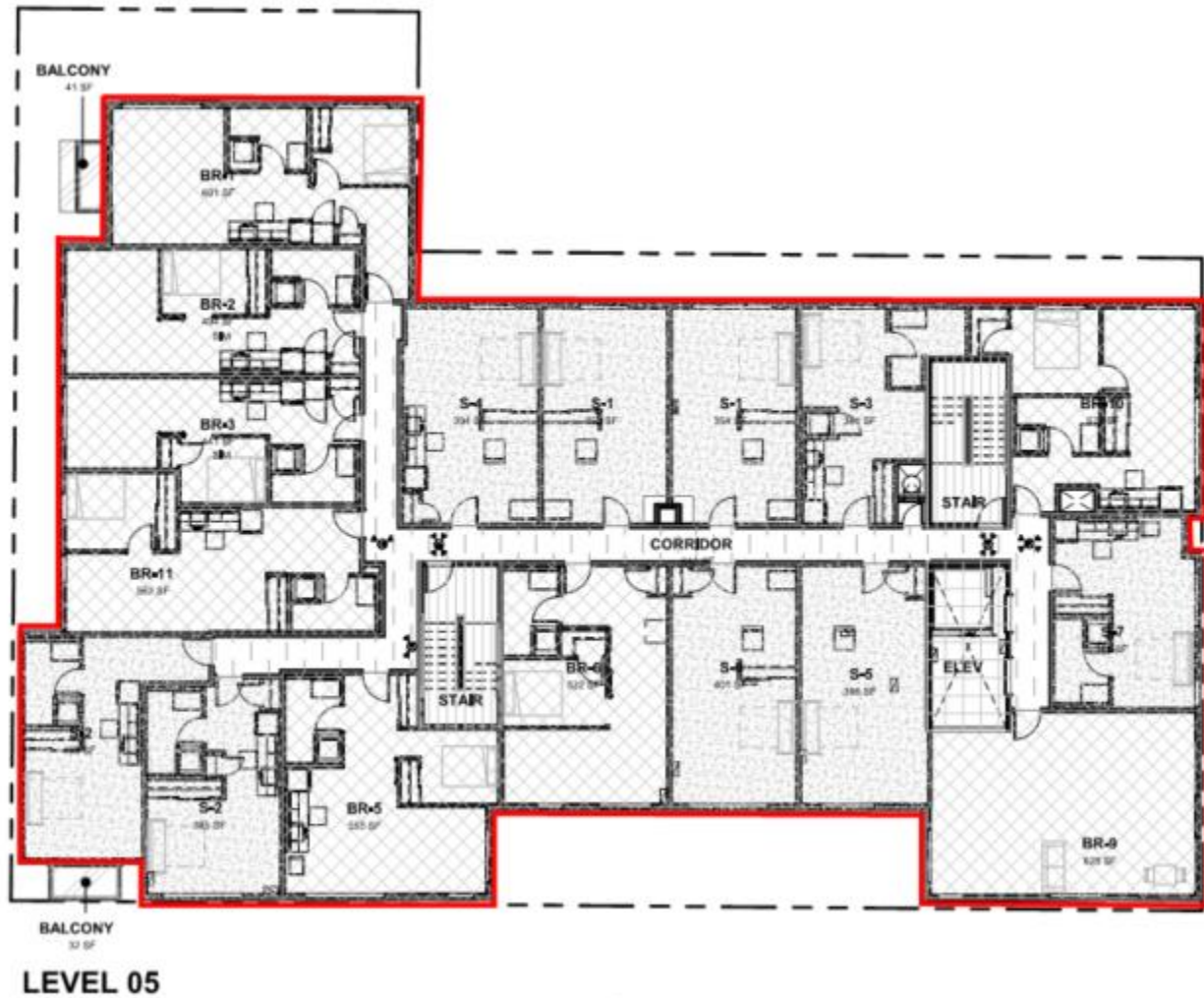
LEVEL 03

— EXTENT OF MINERAL WOOL INSULATION

Appendix A Figure 1: Floor 3

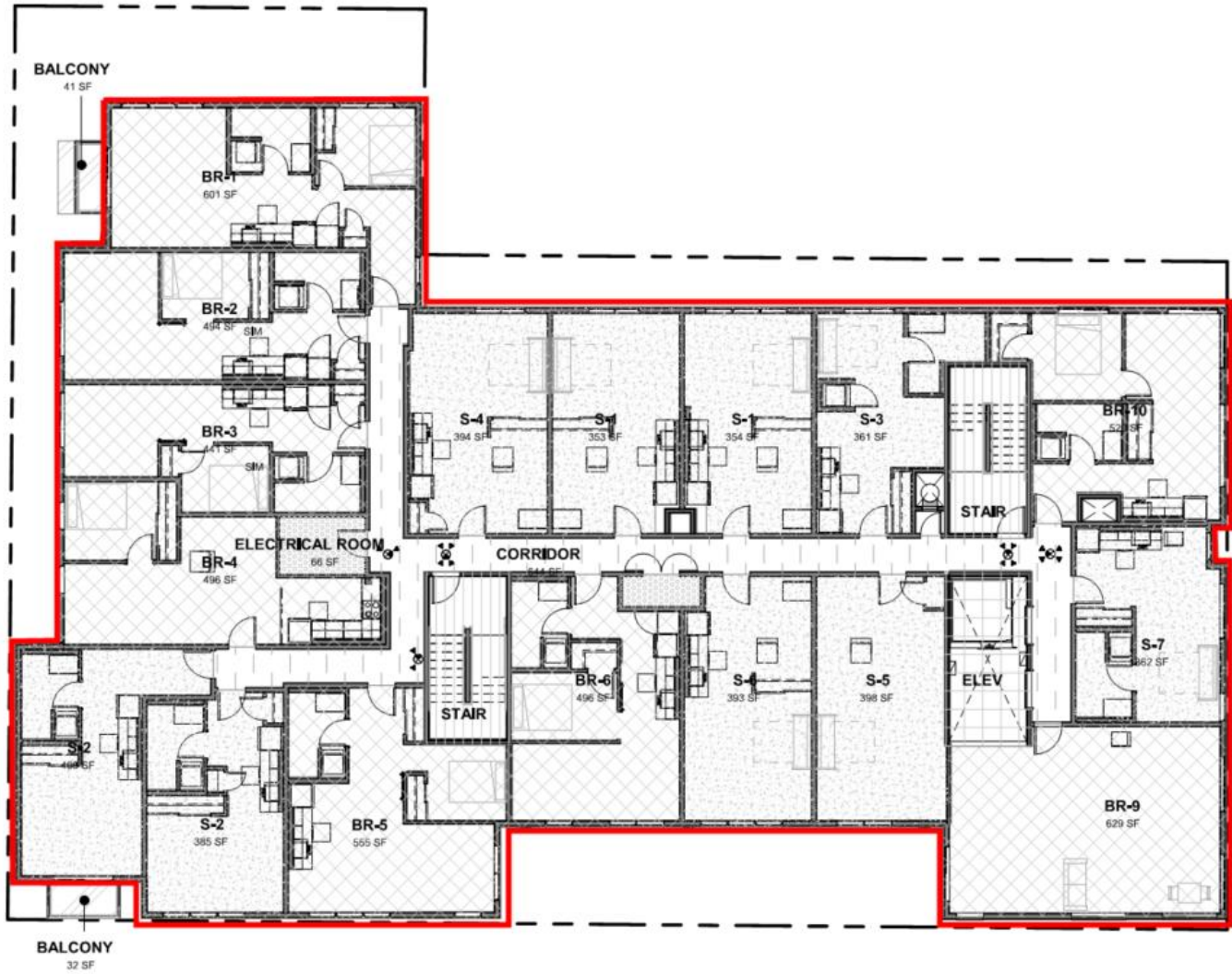


Appendix A Figure 2: Floor 4



— EXTENT OF MINERAL WOOL INSULATION

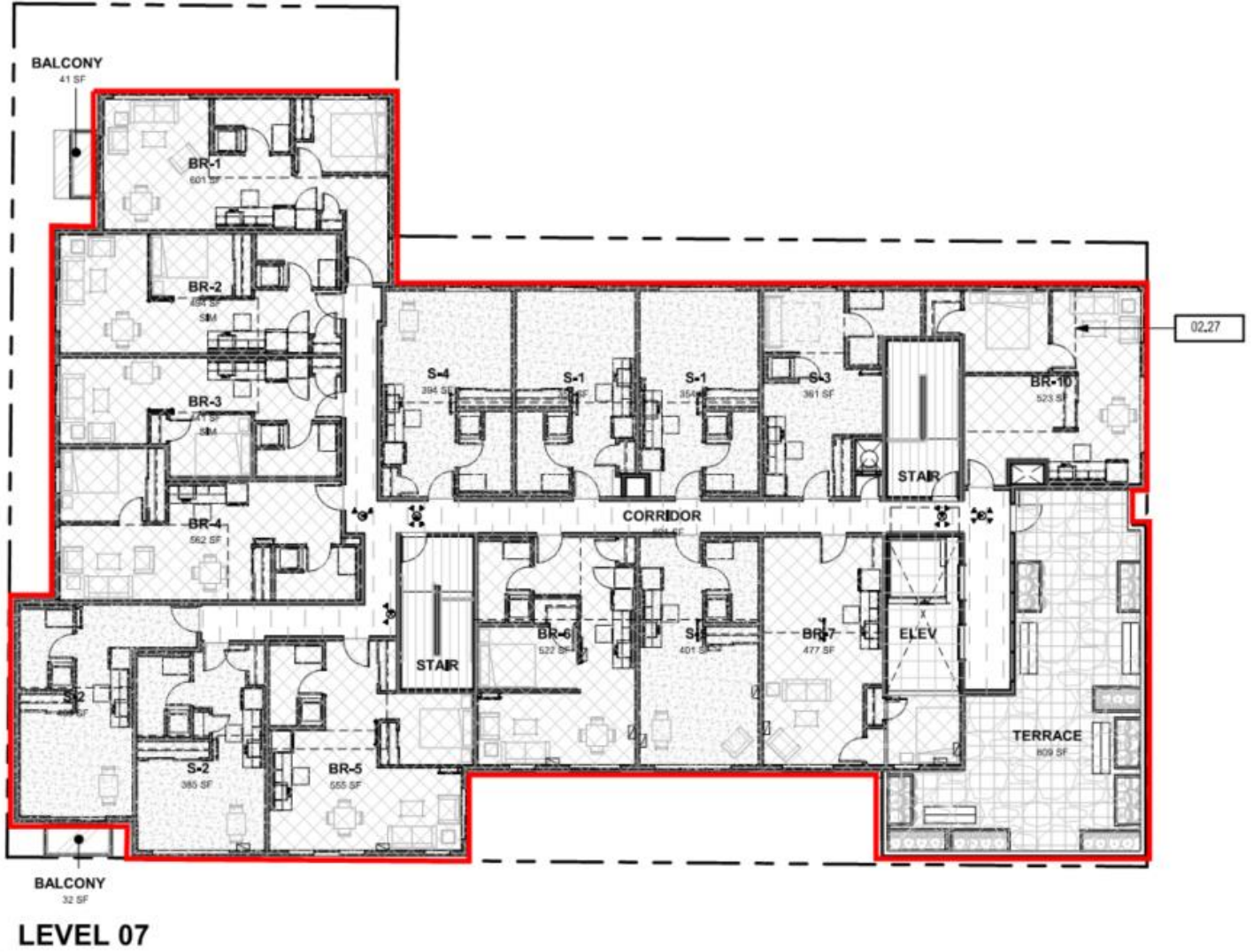
Appendix A Figure 3: Floor 5



LEVEL 06

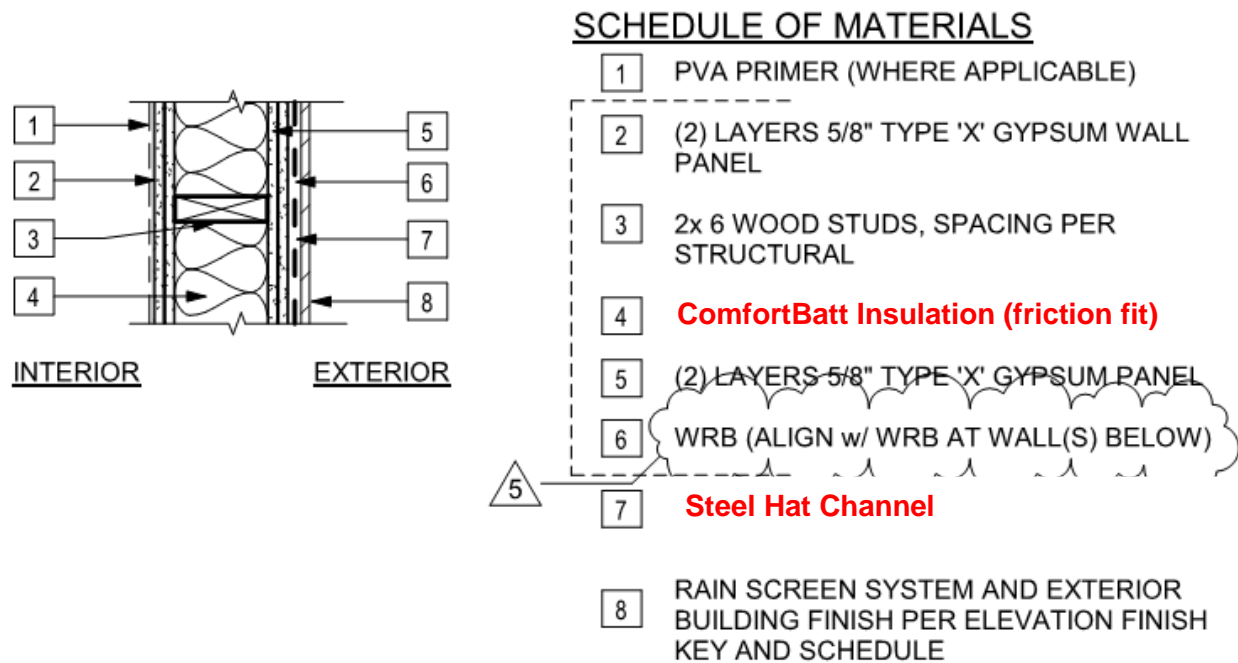
— EXTENT OF MINERAL WOOL INSULATION

Appendix A Figure 4: Floor 6



— EXTENT OF MINERAL WOOL INSULATION

Appendix A Figure 5: Floor 7



<u>FIRE RESISTANCE RATING:</u>	2-HR
<u>FIRE TEST:</u>	WP 4135 (FM WP 360. 9-27-74)
<u>INSULATION:</u>	ComfortBatt Insulation
<u>SOUND RATING:</u>	40-44
<u>SOUND TEST:</u>	NGC 2363, 4-1-70
<u>INSTALLED PER:</u>	GA FILE NO. WP 8415 SIM

W1.0 - 2HR EXTERIOR WALL

Appendix A Figure 6: Typical Exterior Wall Type

Attachment #3



Technical Data Sheet

Batt Insulation 07210*
Blanket Insulation 07 21 16**

ROXUL COMFORTBATT®

Thermal Batt Insulation

Product Description & Application

ROXUL COMFORTBATT® is a mineral wool batt insulation designed for thermal resistance in wood and steel framing.

	Performance	Test Standard
Compliance	Mineral Fiber Blanket Insulation - Type I Compliant	ASTM C665
Reaction to Fire	Flame spread index = 0 ; Smoke developed index = 0 Behavior of materials at 750°C - Non Combustible	ASTM E84 (UL 723) ASTM E136
Density	> 2 lbs/ft³ (>32 kgs/m³)	ASTM C167
Thermal Resistance	Wood Stud R 15 - 3.5" thick (89mm) R 23 - 5.5" thick (140mm) R 30 - 7.25" thick (184 mm) Steel Stud R 10 - 2.5" thick (64mm) R 15 - 3.5" thick (89mm) R 24 - 6" thick (152mm) R 30 - 7.25" thick (184mm)	ASTM C518
Dimensions	Wood Stud 16" (406mm) on center: 15.25" x 47" (387mm x 1194mm) Wood Stud 24" (610mm) on center: 23" x 47" (584mm x 1194mm) Steel Stud 16" (406mm) on center: 16.25" x 48" (413mm x 1219mm) Steel Stud 24" (610mm) on center: 24.25" x 48" (616mm x 1219mm)	



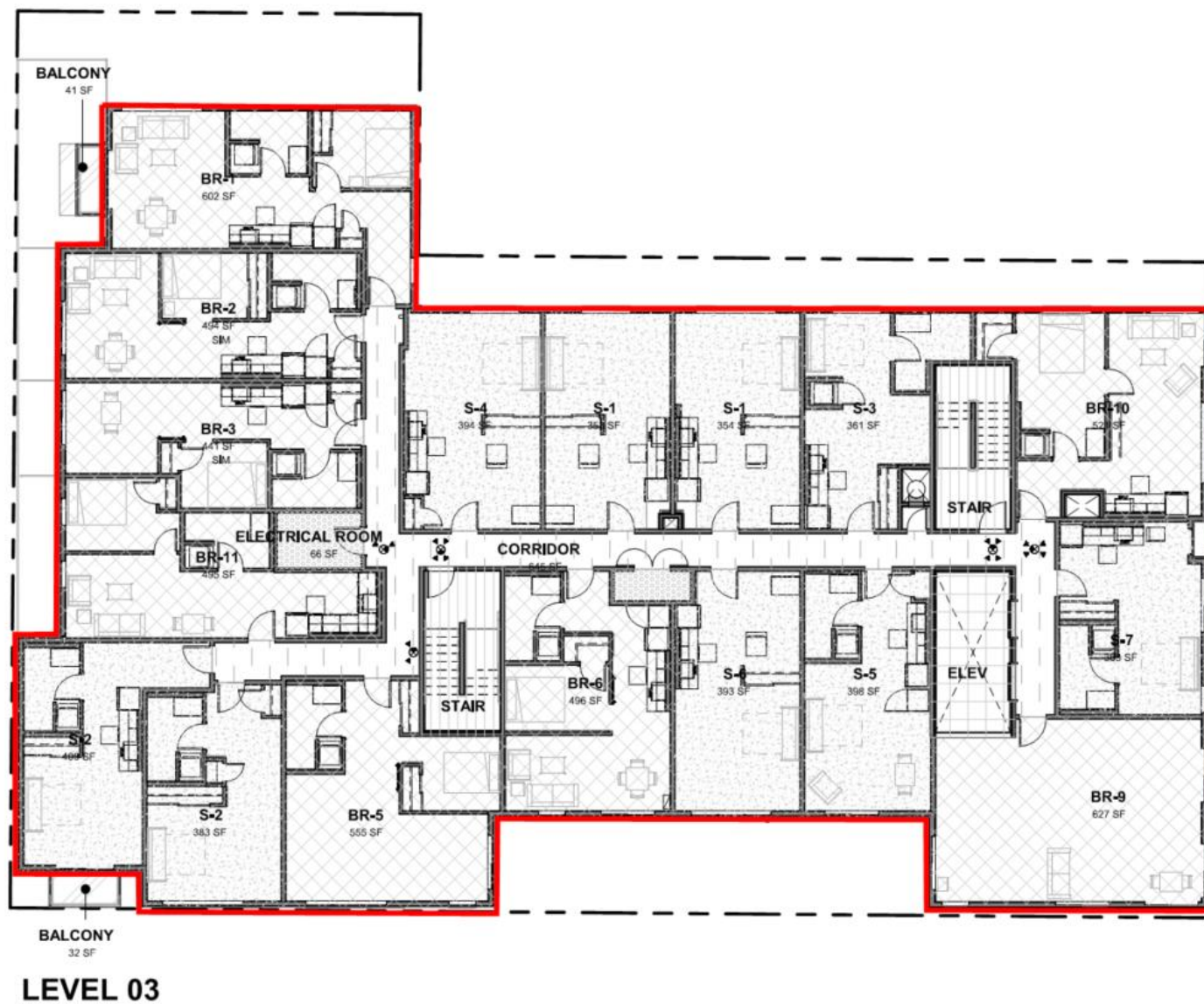
Issued 04-01-16
Supersedes 06-26-13

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ROXUL®
The Better Insulation™

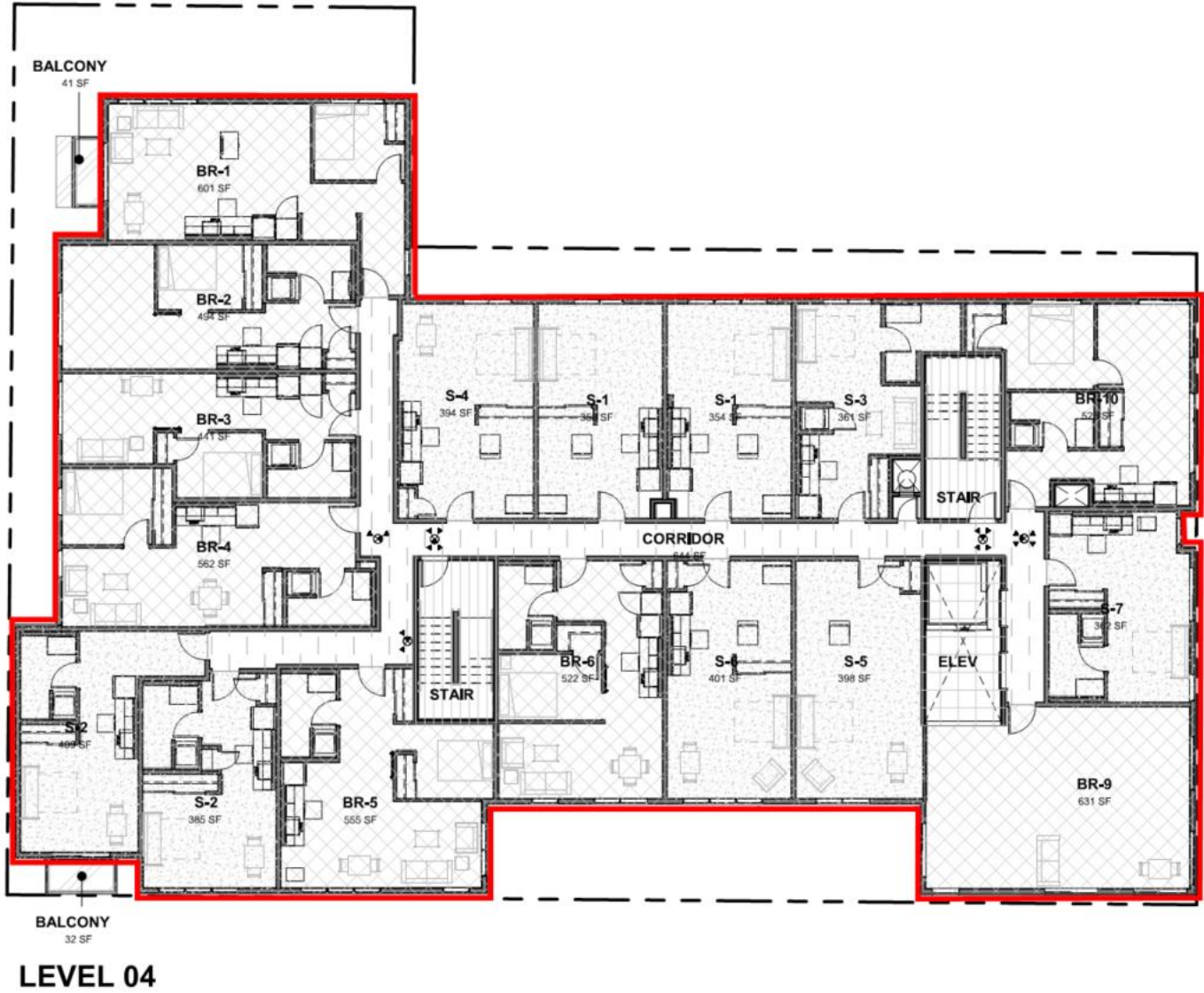
ROXUL INC
8024 Esquesing Line
Milton, On. L9T 6W3
tel: 800-265-6878
fax: 800-991-0110
www.roxul.com

Attachment #2



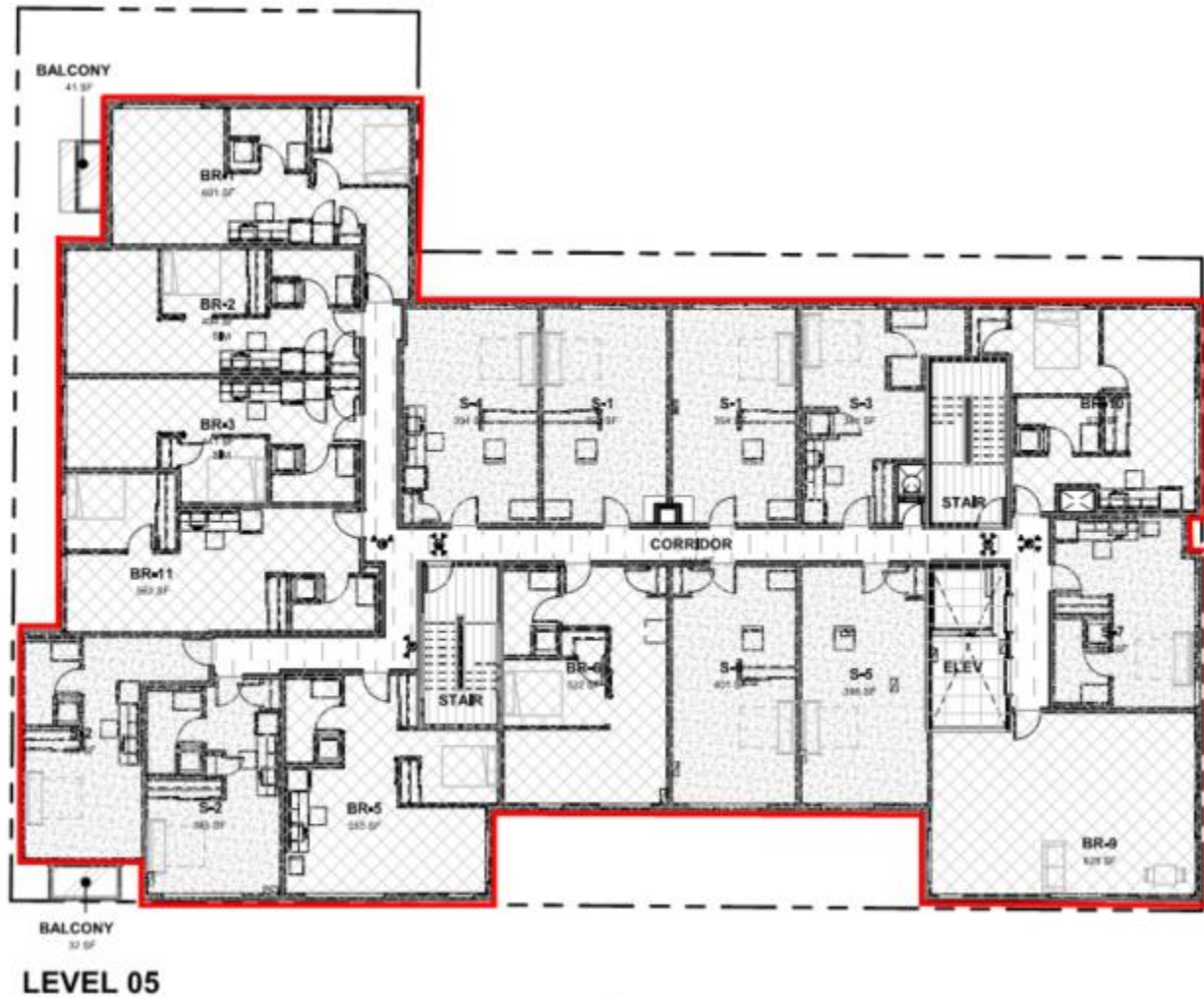
— EXTENT OF MINERAL WOOL INSULATION

Appendix A Figure 1: Floor 3



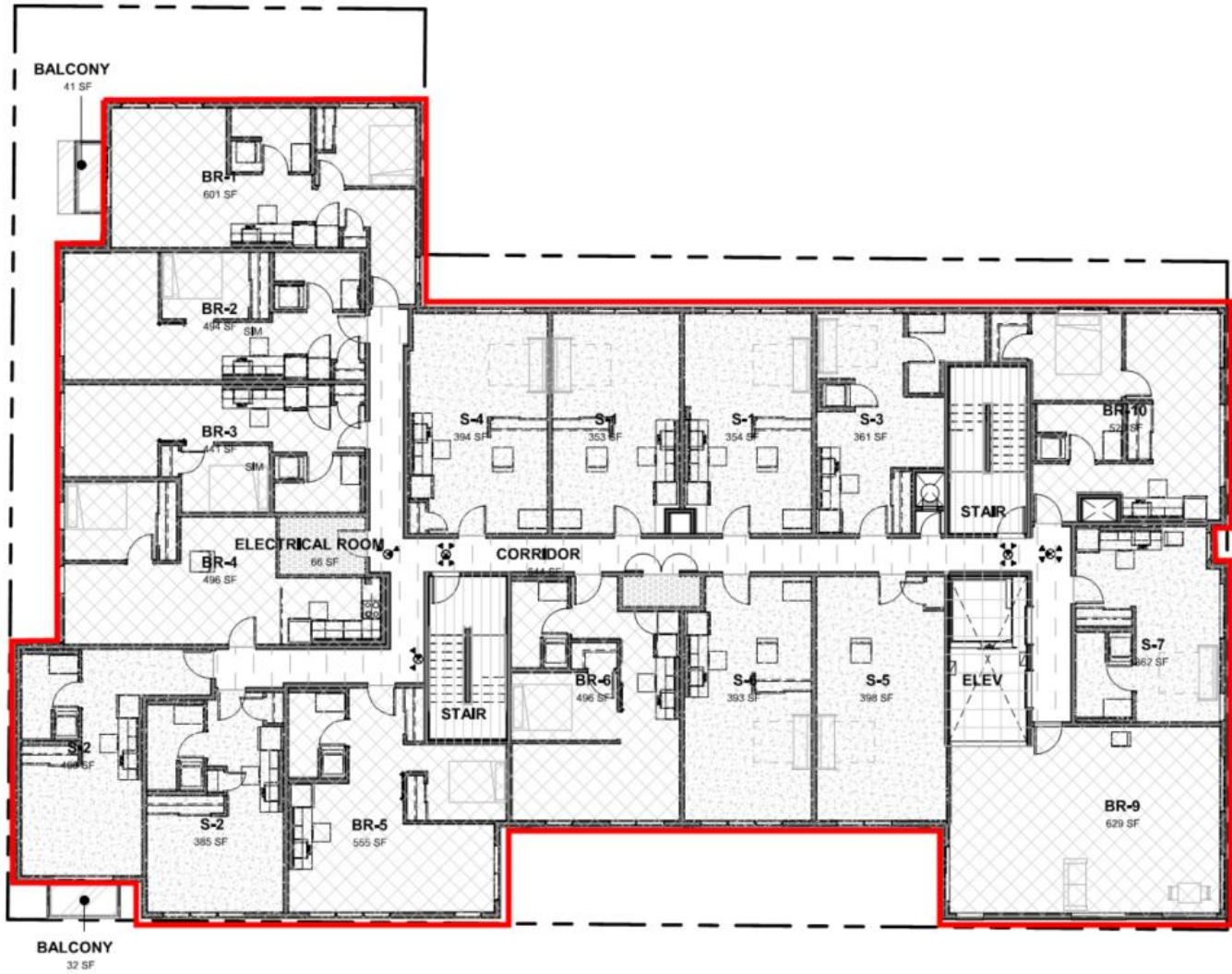
— EXTENT OF MINERAL WOOL INSULATION

Appendix A Figure 2: Floor 4



— EXTENT OF MINERAL WOOL INSULATION

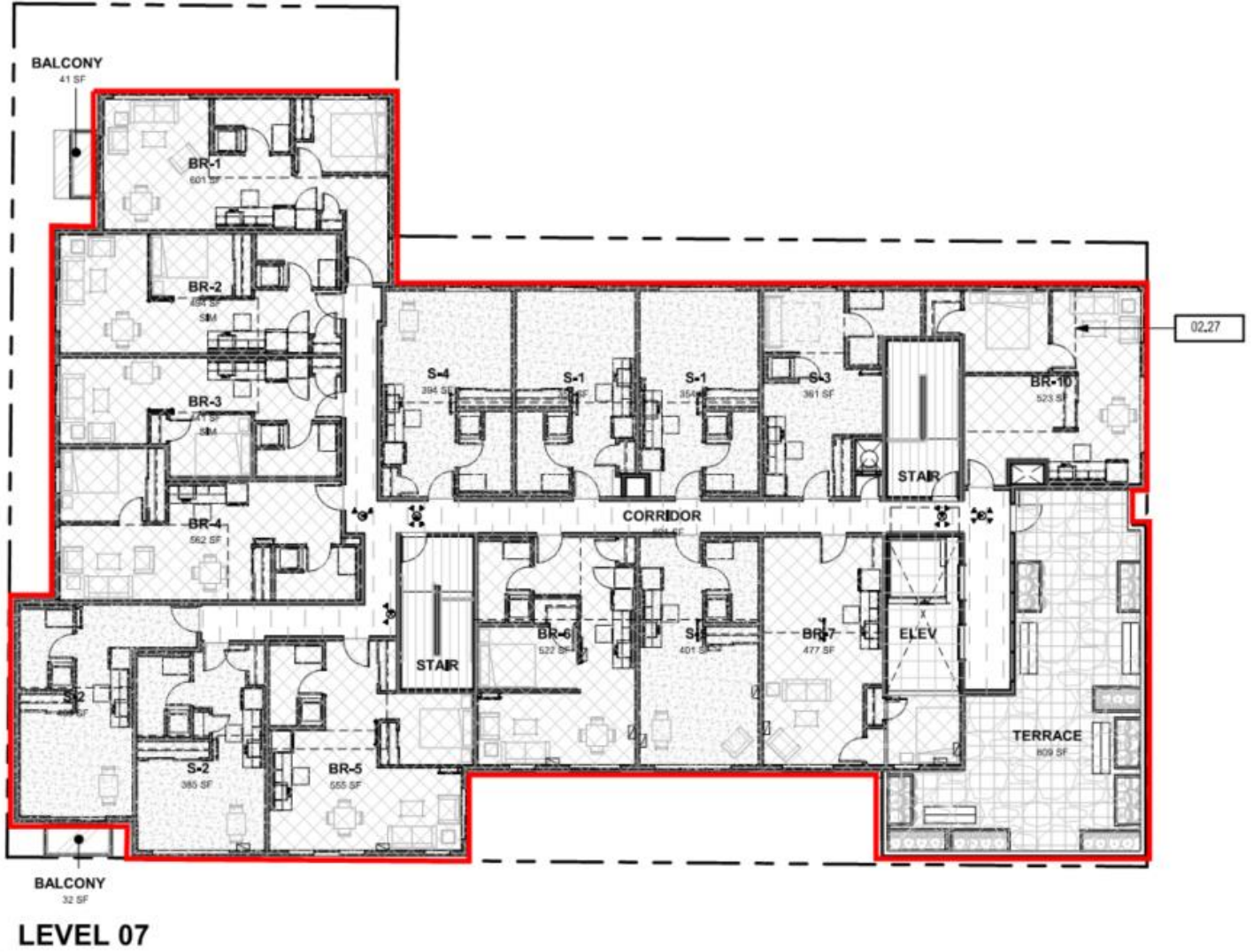
Appendix A Figure 3: Floor 5



LEVEL 06

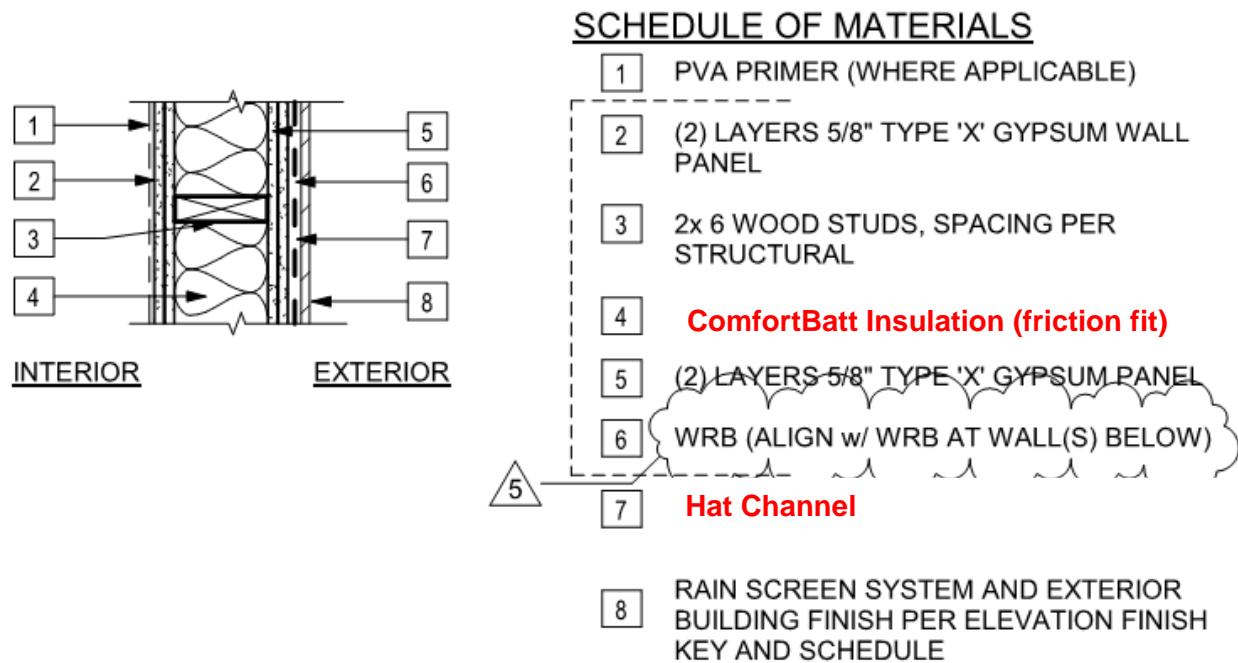
— EXTENT OF MINERAL WOOL INSULATION

Appendix A Figure 4: Floor 6



— EXTENT OF MINERAL WOOL INSULATION

Appendix A Figure 5: Floor 7



<u>FIRE RESISTANCE RATING:</u>	2-HR
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<u>SOUND RATING:</u>	40-44
<u>SOUND TEST:</u>	NGC 2363, 4-1-70
<u>INSTALLED PER:</u>	GA FILE NO. WP 8415 SIM

W1.0 - 2HR EXTERIOR WALL

Appendix A Figure 6: Typical Exterior Wall Type