

TimberView

**Tall Mass Timber in Portland:
An Insider's Look at Prescriptive
Type IV-C Design**



Disclaimer: This presentation was developed by a third party and is not funded by WoodWorks or the Softwood Lumber Board



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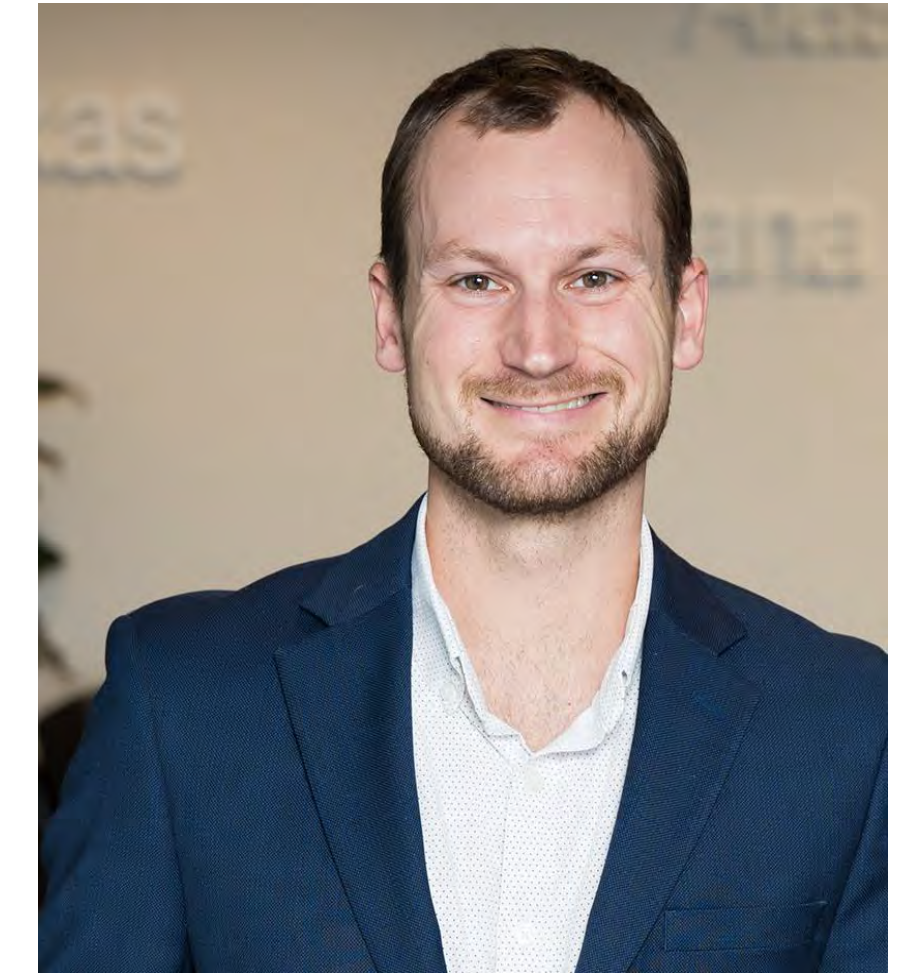
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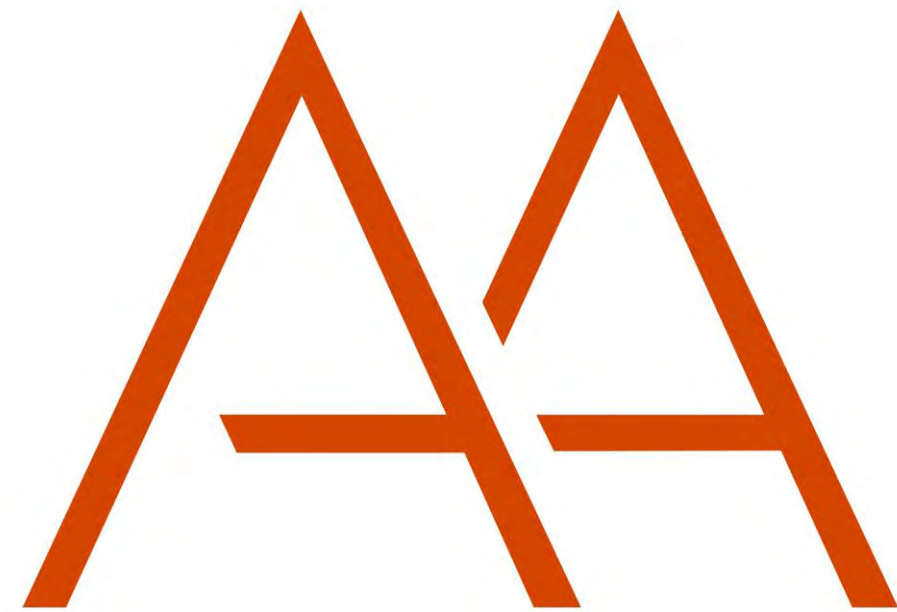


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ACCESS ARCHITECTURE FIRM OVERVIEW

Designing
Connected
Communities





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PROJECT OVERVIEW

TimberView **PROJECT INTRODUCTION**

PROGRAM

105 Units of 60% AMI affordable housing

2,600 sf of Retail (future food hall)

OTHER PROJECT TEAM MEMBER

Developer: C&J Property Development

General Contractor: Truebeck Constuction

CODE: Type IV-C, 2019 OSSC Appendix P, Prescriptive

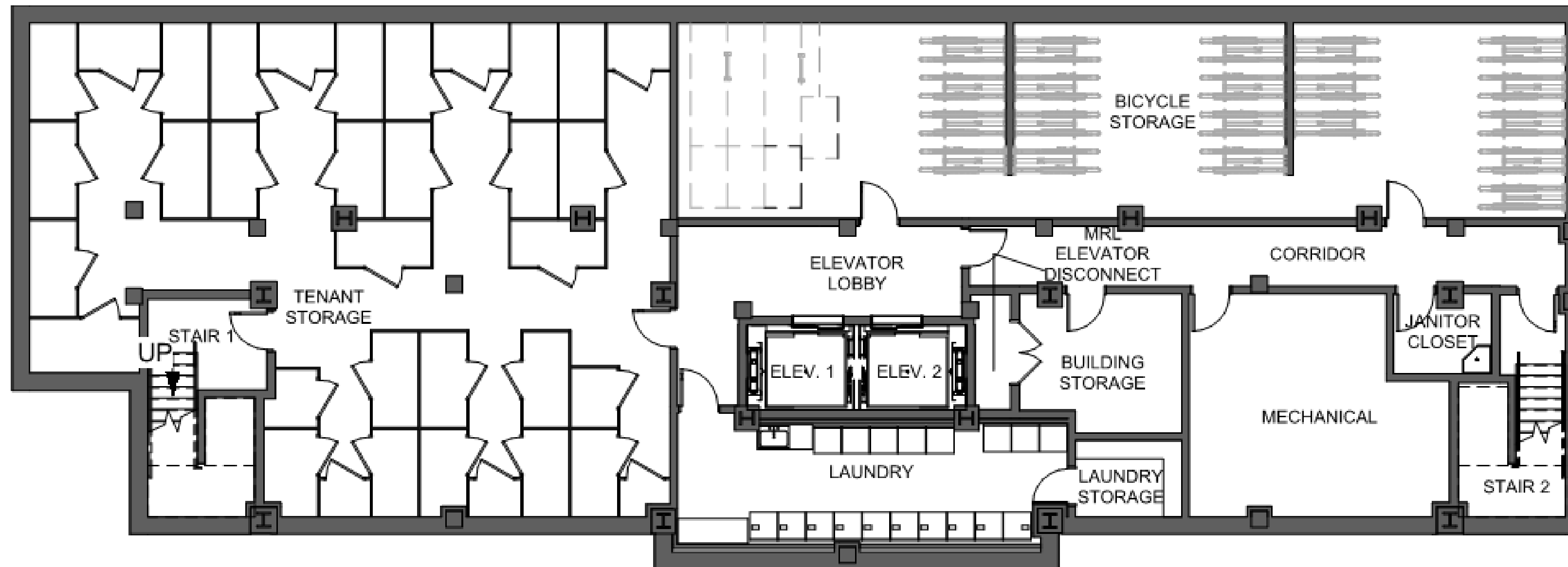


TimberView **BUILDING OVERVIEW**

BASEMENT

Eight floors above grade with basement & mechanical penthouse

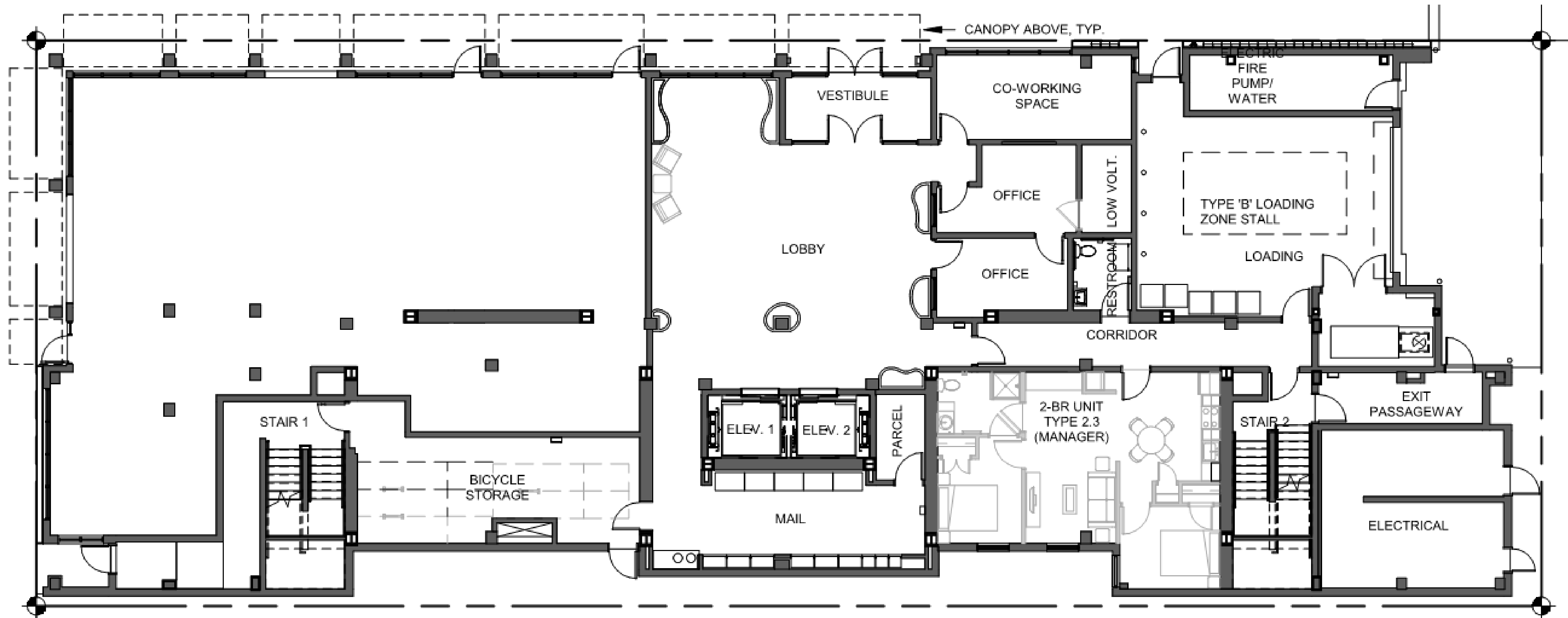
Basement: Service spaces, bike storage, & laundry



TimberView **BUILDING OVERVIEW**

FIRST FLOOR

Retail space, entry, offices and co-working space, service spaces



TimberView **BUILDING OVERVIEW**

SECOND – SEVENTH FLOOR (TYPICAL UPPER FLOOR)

Residential units



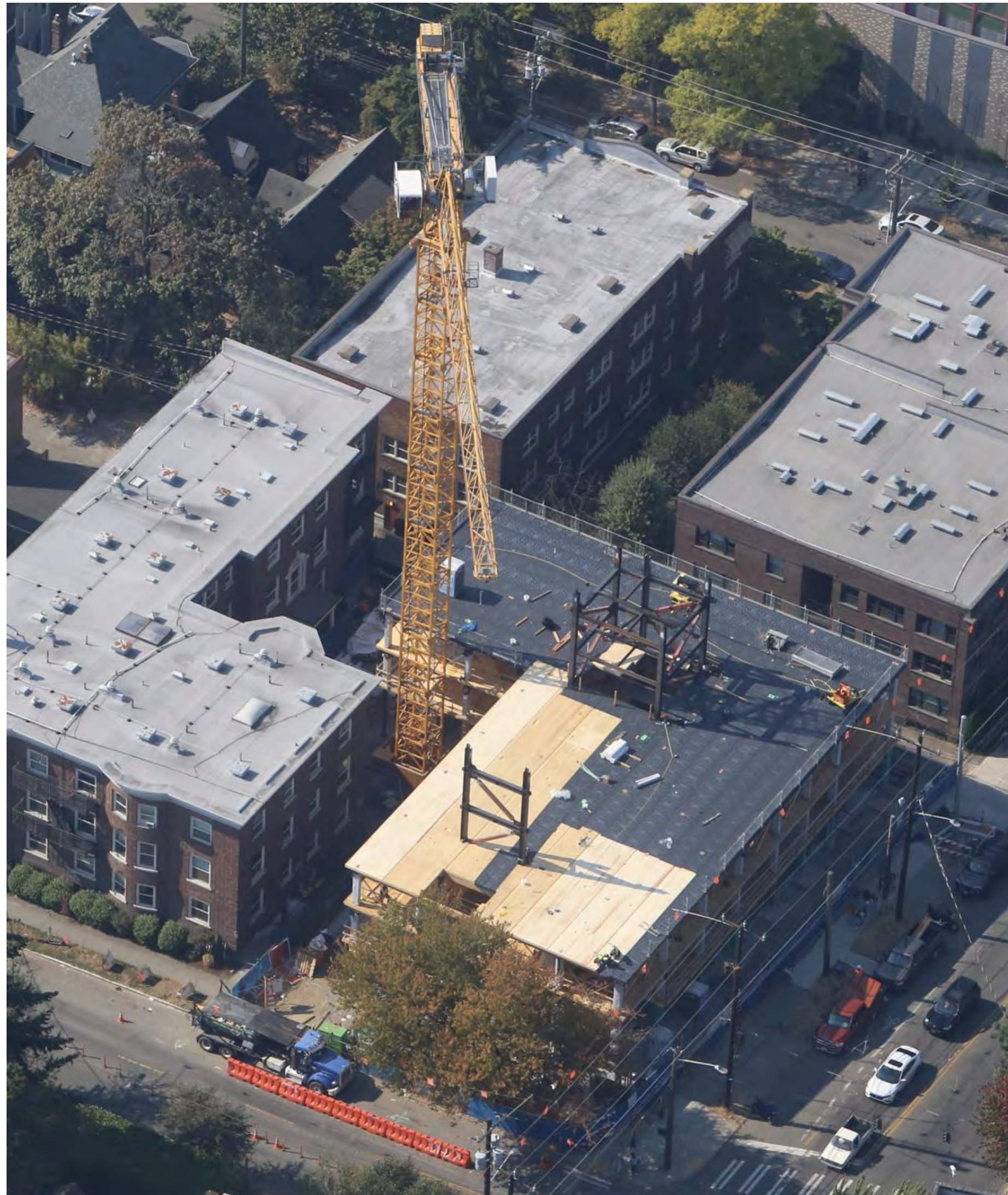
TimberView **BUILDING OVERVIEW**

EIGHTH FLOOR

Community room and deck, additional units



TimberView **STRUCTURAL SYSTEM**



- Project Goal:
 - To build 8 story affordable housing units to provide product for the city's housing needs
 - Opportunity to use sustainable materials
 - Construction affordability
 - Speed to market

- Options considered: steel frame vs concrete frame vs mass timber (highest total values)

Goal	Steel Framed	Concrete Framed	Mass Timber
8 story structure, no podium	3	3	3
Sustainable materials	2	1	3
Construction Cost	1	3	3
Speed to market	2	1	3

- Other considerations:
 - Small footprint
 - Site located at intersection of major streets
 - Noise
 - Low soil bearing values (1800psf at grade, 4000psf at basement)
 - Adjacent building impact to shoring (less FDN means less excavation)

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**ARCHITECTURAL
CONSIDERATIONS**

TimberView **WHERE TO EXPOSE WOOD FIBER**

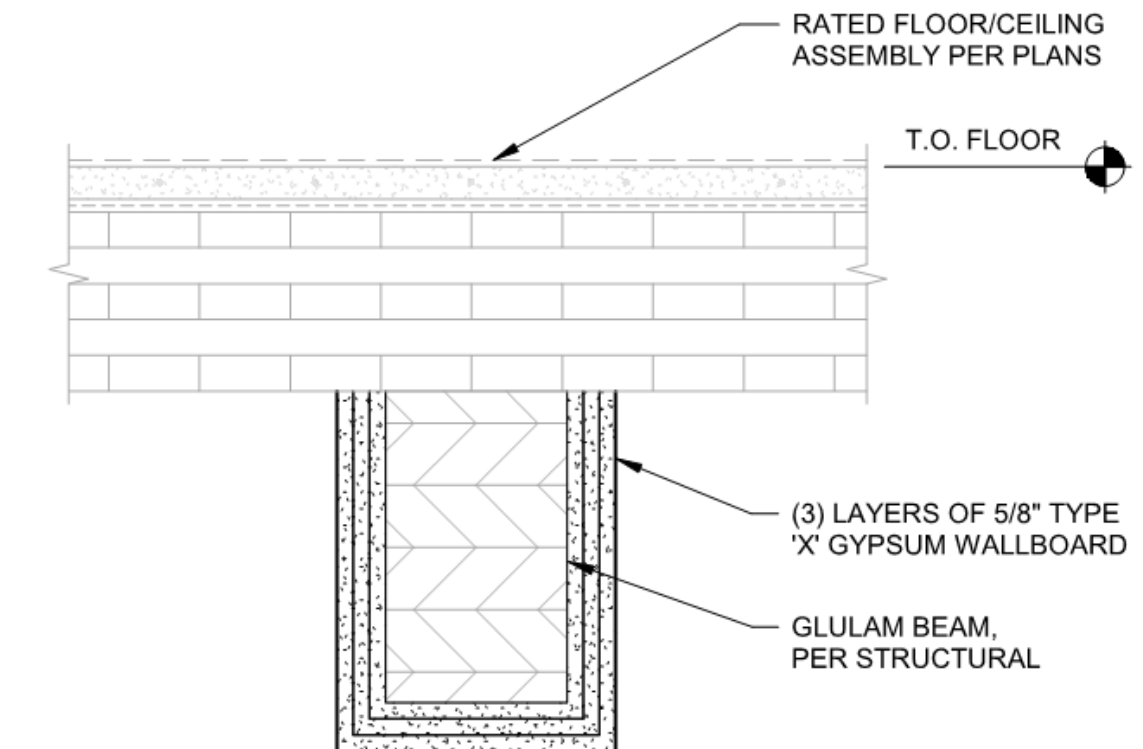
TYPE IV-C ALLOWS FULL EXPOSURE OF WOOD STRUCTURE

ANALYSIS TO DETERMINE COST EFFECTIVE METHOD TO PROVIDE 2-HOUR PROTECTION.

Additional wood thickness

Gypsum wallboard wrap

OPTIMIZE THE USE AND VISUAL IMPACT OF THE EXPOSED STRUCTURE

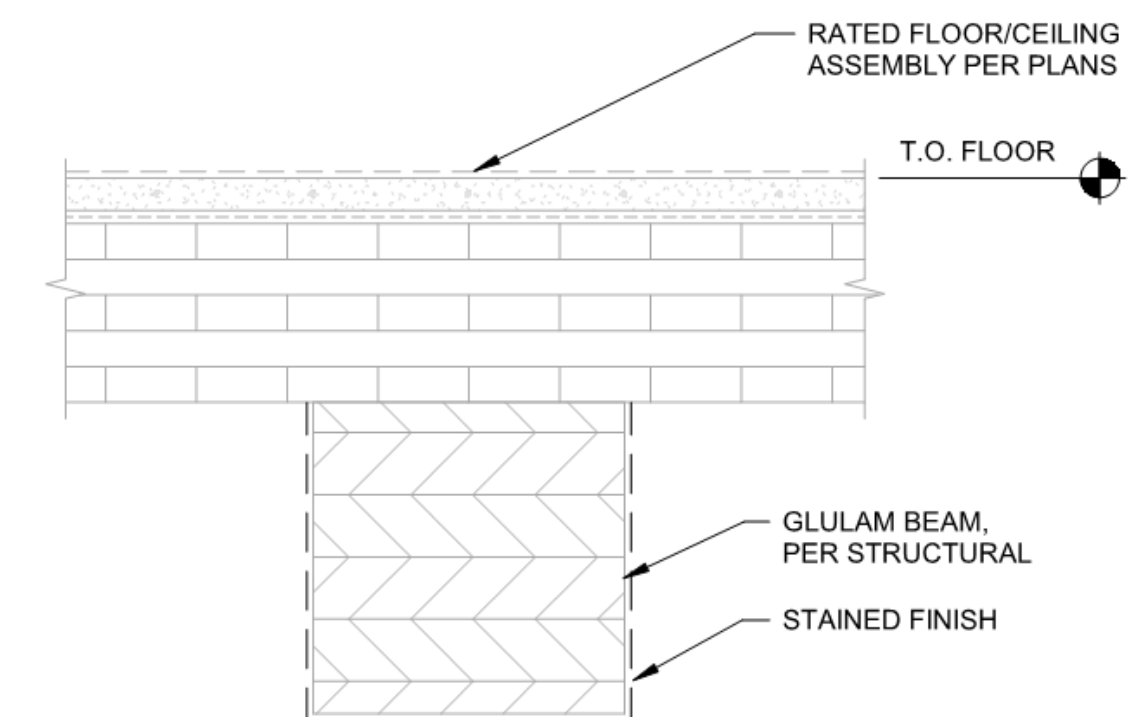


FIRE RESISTANCE RATING: 2 HOUR BASED ON GYP RATING (PER OSSC P722.7)

BEAM TYPE 1

1 1/2" = 1'-0"

OCCURS AT WRAPPED INTERIOR BEAM



FIRE RESISTANCE RATING: 2 HOUR PER CHAR CALCS

BEAM TYPE 2

1 1/2" = 1'-0"

OCCURS AT EXPOSED INTERIOR BEAM

TimberView **BEAM DEPTHS & SPACE DESIGN**

BUILDING HEIGHT

Type IV-C

Without additional budget consideration of a high rise building, limited to 75'

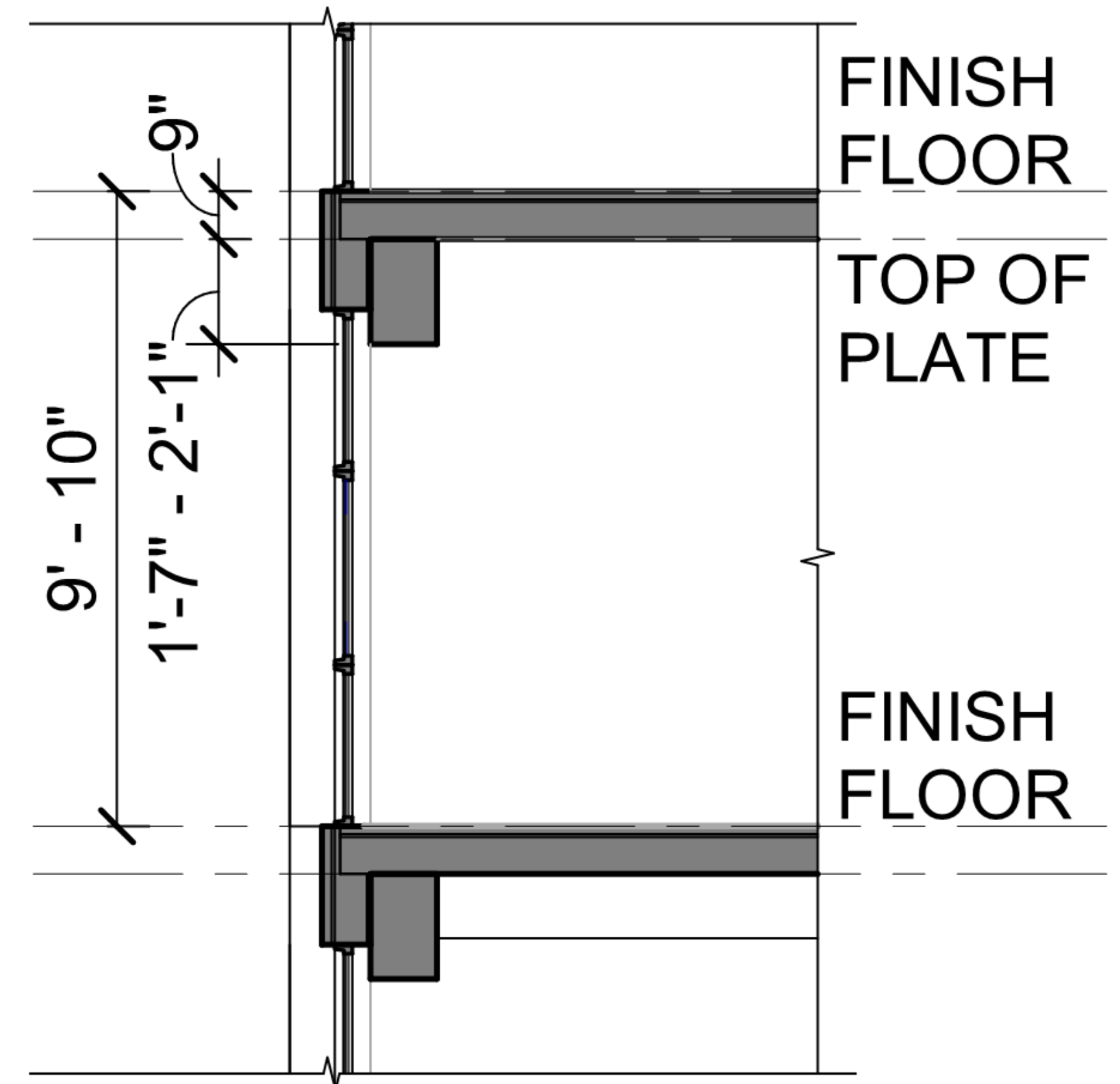
Zoning code requires 12' to underside of framing at ground floor

RESULTING IN A FLOOR TO FLOOR HEIGHT OF 9'-10"

9": Floor assembly

7'-6" or 7'-0": Code minimum required head height

1'-7" to 2'-1": Resulting allowable beam depth



TimberView **BEAM DEPTHS & SPACE DESIGN**

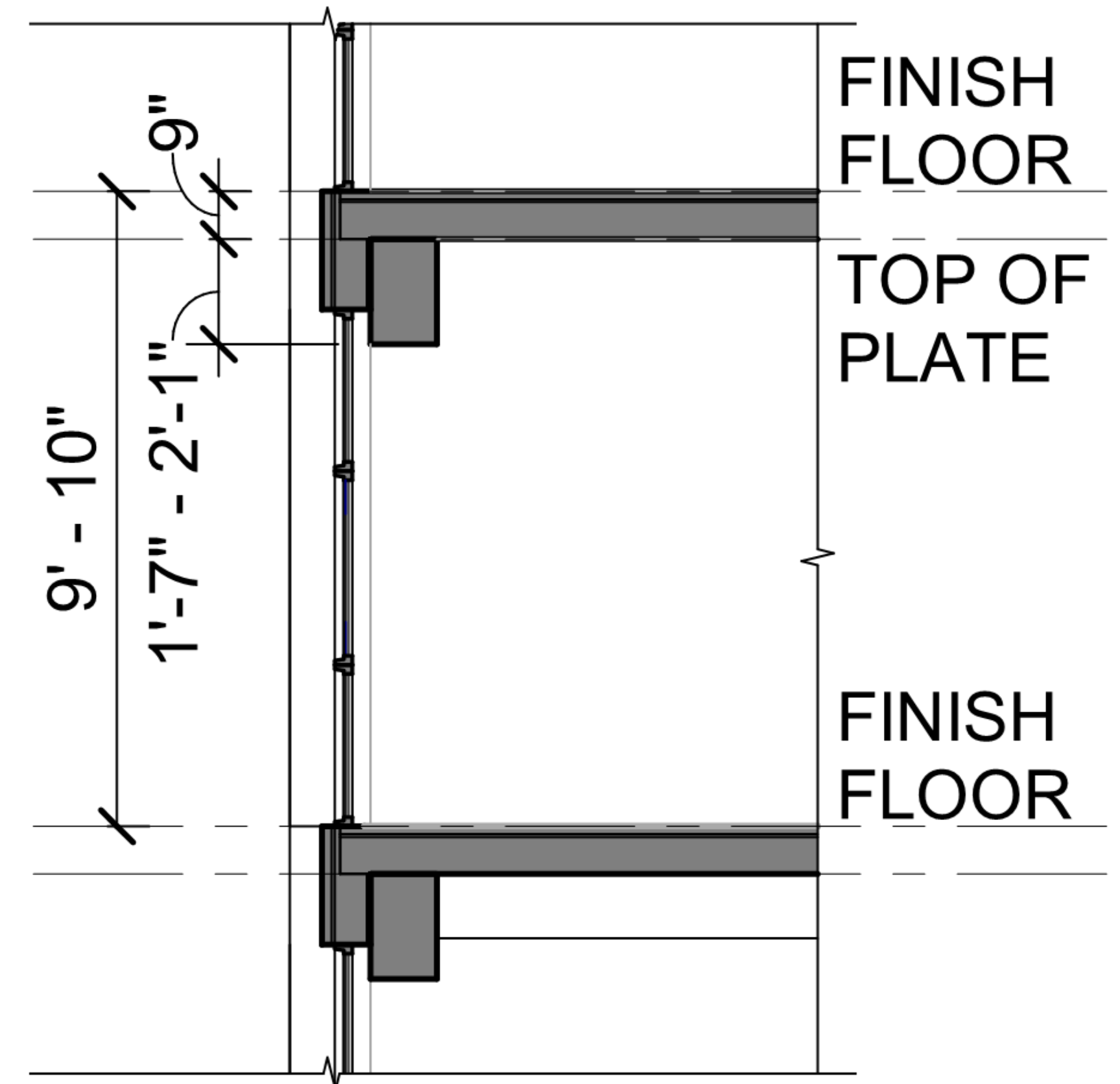
POSSIBLE SOLUTIONS TO EXPLORE ON FUTURE PROJECTS

Utilize 2-way spanning capability of CLT and remove beams entirely

Reduce beam spans

Explore high-rise and Type IV-B construction options

Use alternate beam system (steel)



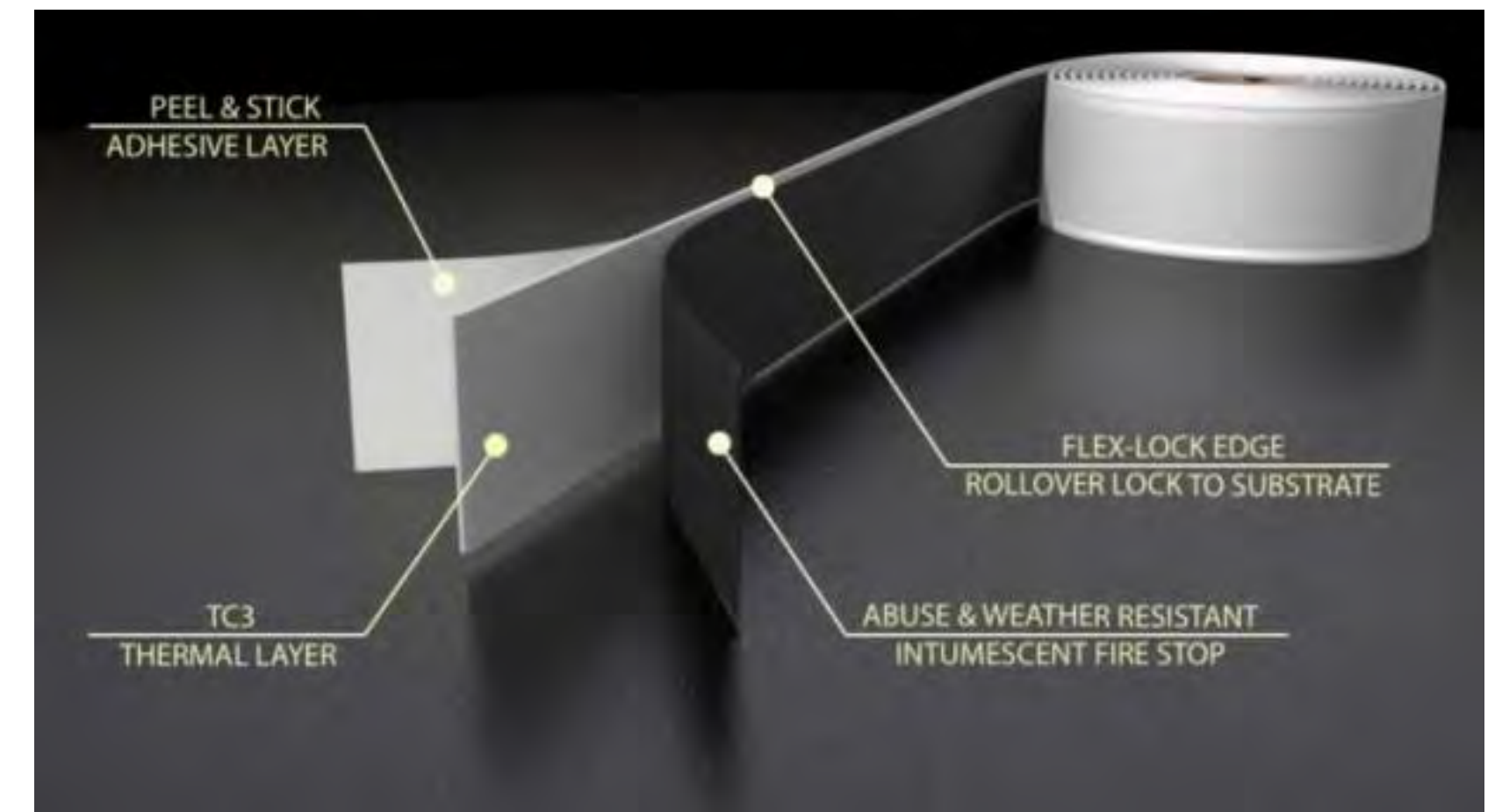
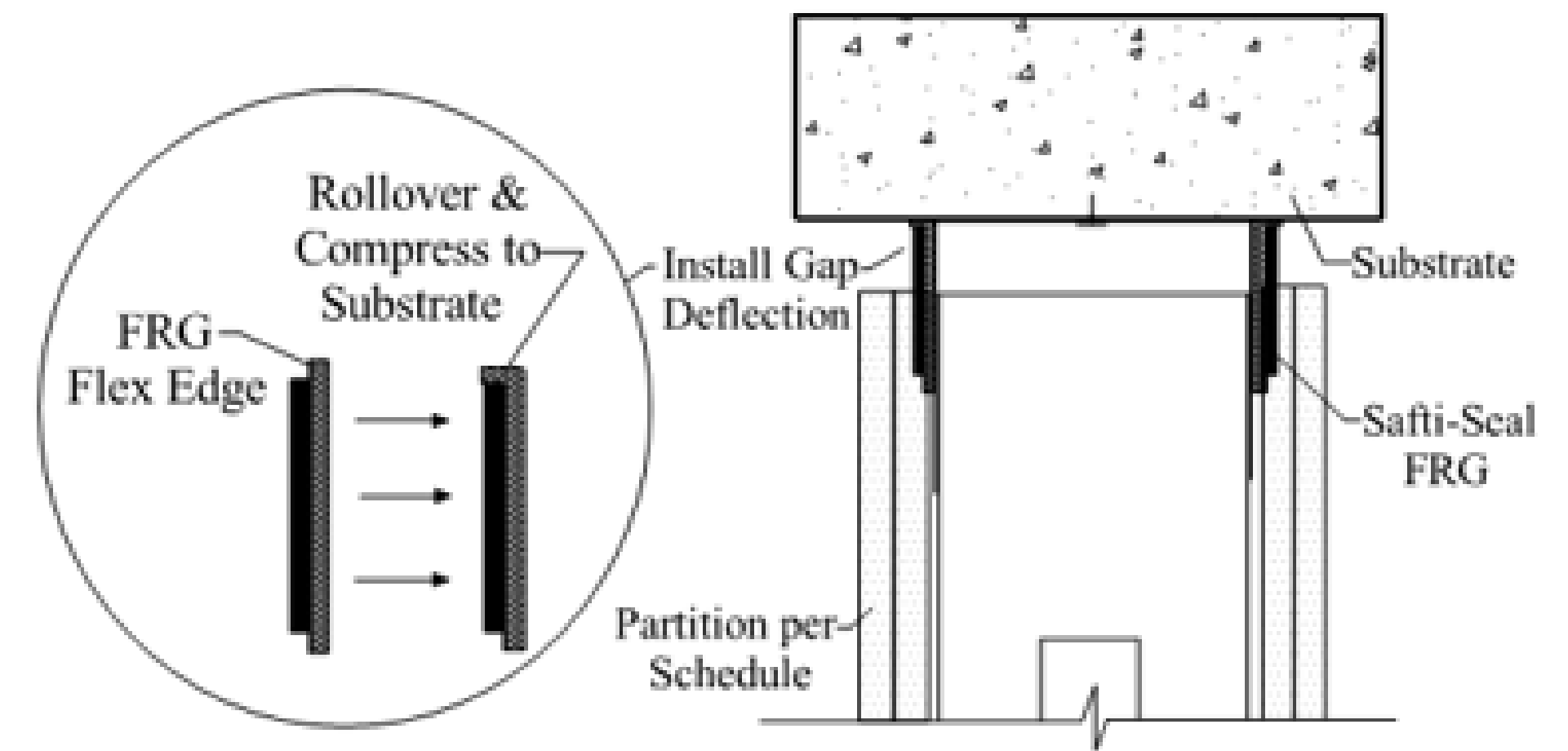
TimberView **DETAILING FOR DEFLECTION**

GLULAM BEAMS LIKE OTHER STRUCTURAL SYSTEMS ARE SUBJECT TO DEFLECTION

Because the glulam beams and columns provide all of the structure the exterior and interior walls need to allow for plus/minus 1" deflection or a total 2" travel

Rated walls adjoin directly to the exposed structure of the CLT decking and need to maintain fire rating.

Due to desire to expose the underside of the CLT, Wall/ceiling intersections cannot be concealed or covered in G.W.B. or a dropped ceiling as is common in other construction.



Safti Seal, Fire Rated Gasket "FRG" Flex Lock Edge Joint Protection

TimberView **MASS TIMBER DESIGN IS RAPIDLY EVOLVING**

DESPITE THE PROJECT FALLING UNDER A PRESCRIPTIVE CODE PATH, THE CODE, ENGINEERING, AND JURISDICTIONAL VIEWPOINTS PROGRESSED AS THE PROJECT UNDERWENT DESIGN DEVELOPMENT, CONSTRUCTION DOCUMENTS, AND PERMITTING

Engineering documentation for structural hangers

Interpretation and explicitness of proper methods to maintain fire rating left gray area that required an appeal to resolve

Sound ratings for floor-ceiling assemblies are rapidly being added as well as being revised



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**STRUCTURAL
CONSIDERATIONS**

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GRAVITY SYSTEM

Floor Assembly

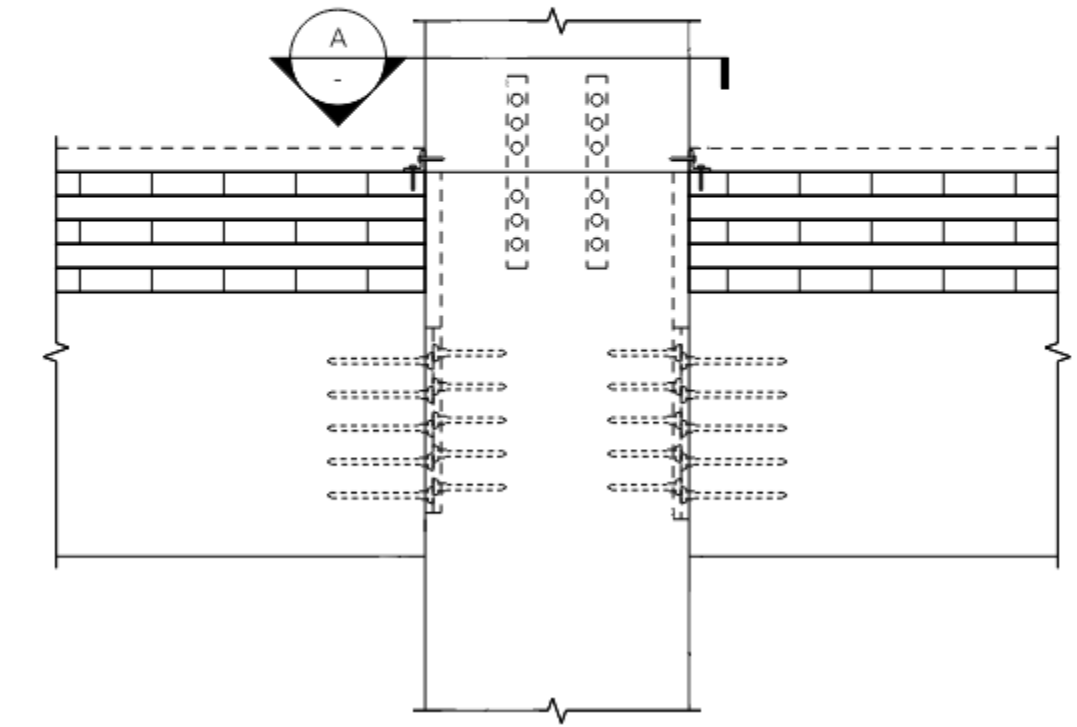
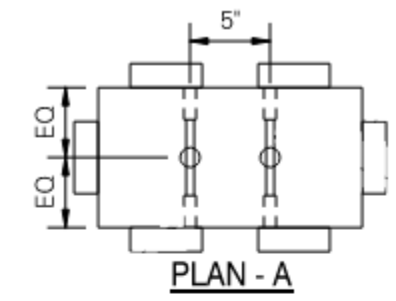
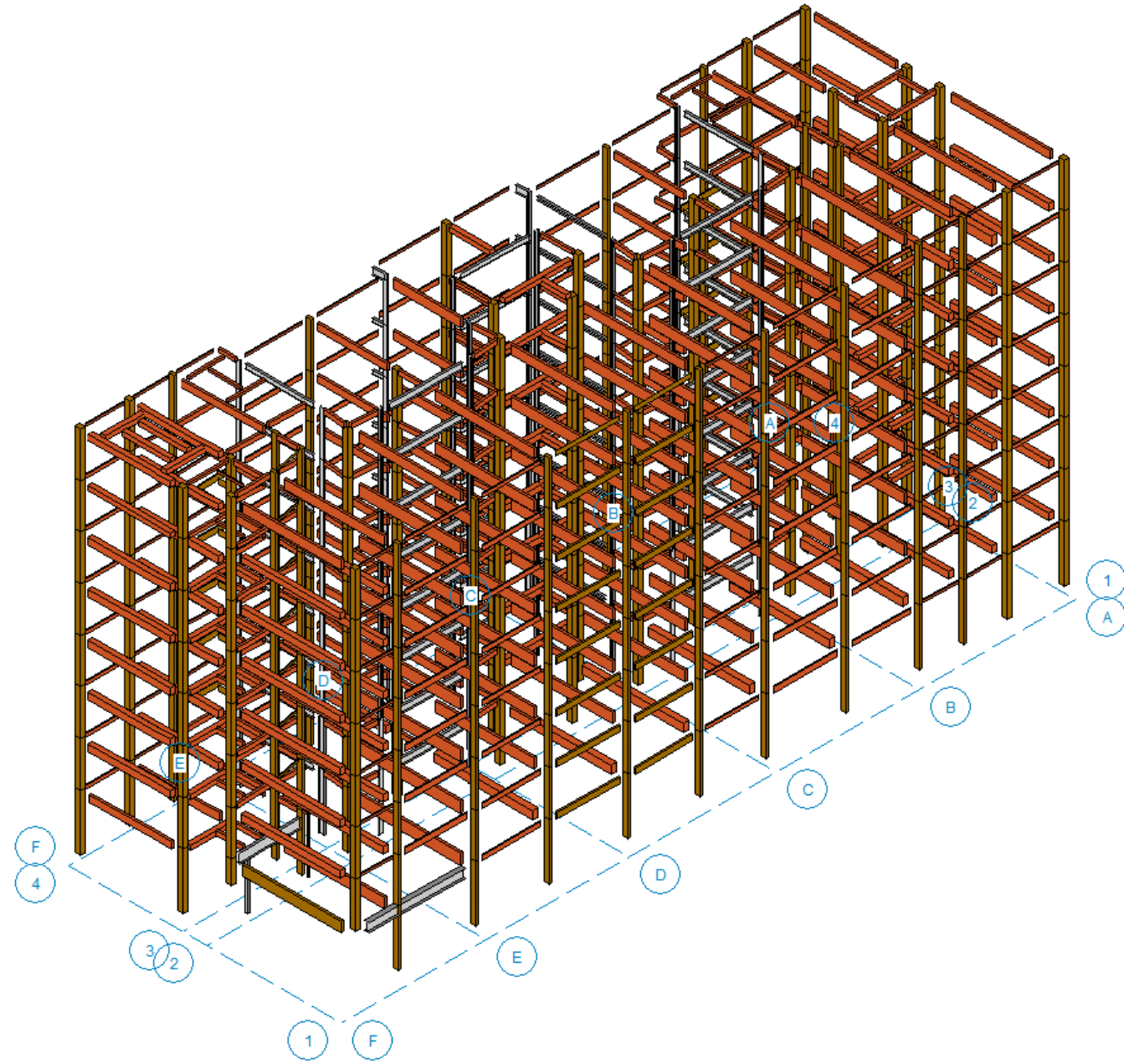
- 5-Ply 6 7/8" E1 grade CLT (2-Hour Fire), V1 grade at Roof (1-Hour Fire)
- 1 1/2" Gypcrete Topping
- Mild reinforced concrete slab at ground floor (over basement)

Glulam Beams

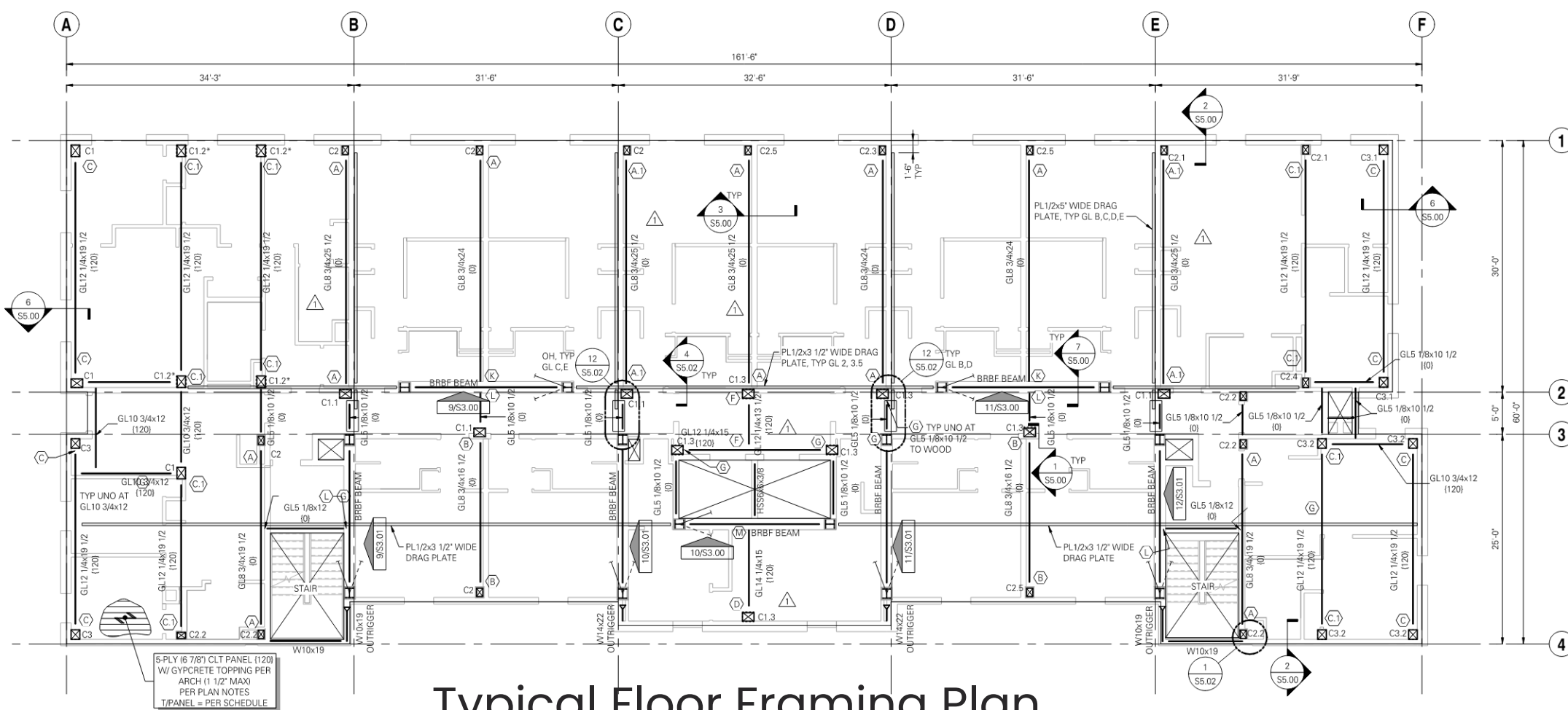
- Clear-span across double loaded corridor
- Approx 16' to 18' on center
- Typical sizing 8 3/4" Width x 25 1/2" Deep
- Ricon S VS Series Hangers
- Steel Wide Flange Beams at 2nd Floor and sporadically at typical floor, where needed

Glulam Columns

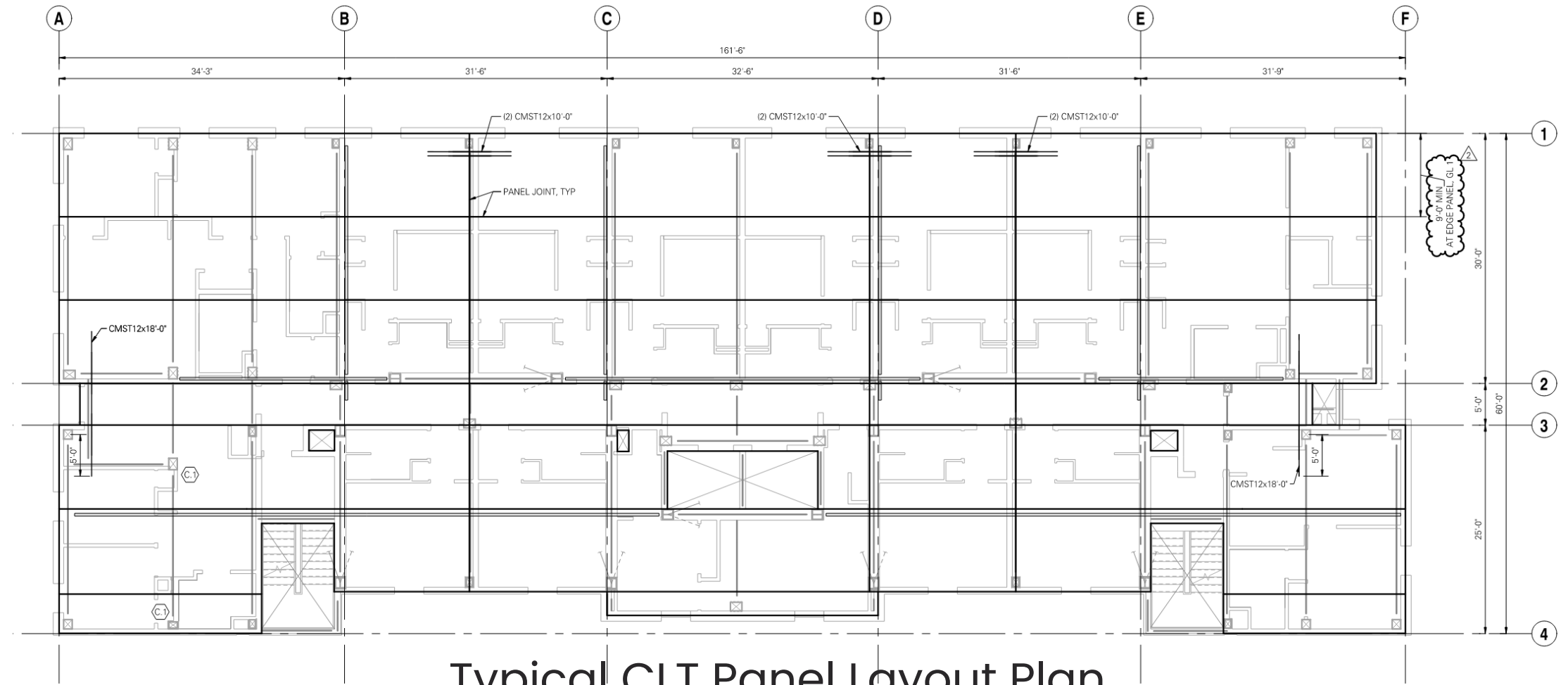
- Typical sizing 14 1/4" Width x 16 1/2" Deep
- Supported by concrete columns from foundation to ground floor



Typical Beam/Column Connection

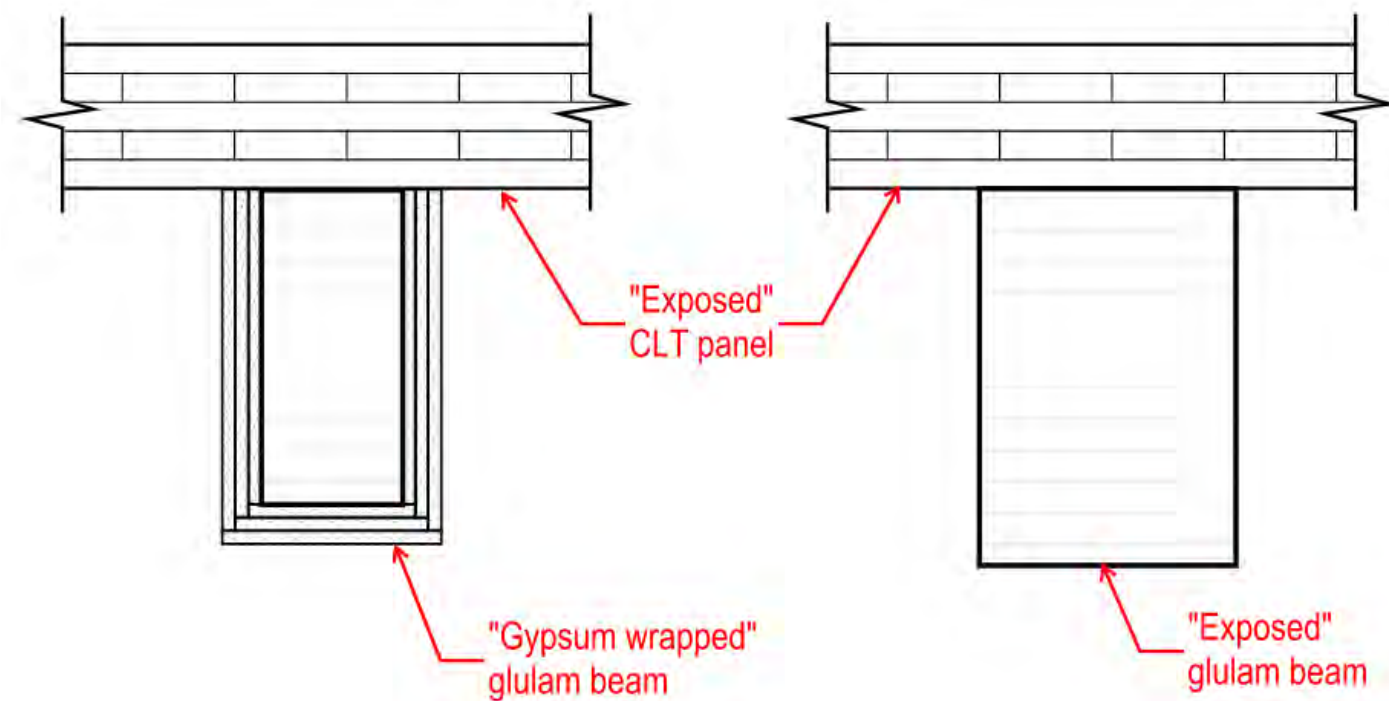


Typical Floor Framing Plan



Typical CLT Panel Layout Plan

TimberView FIRE RATING

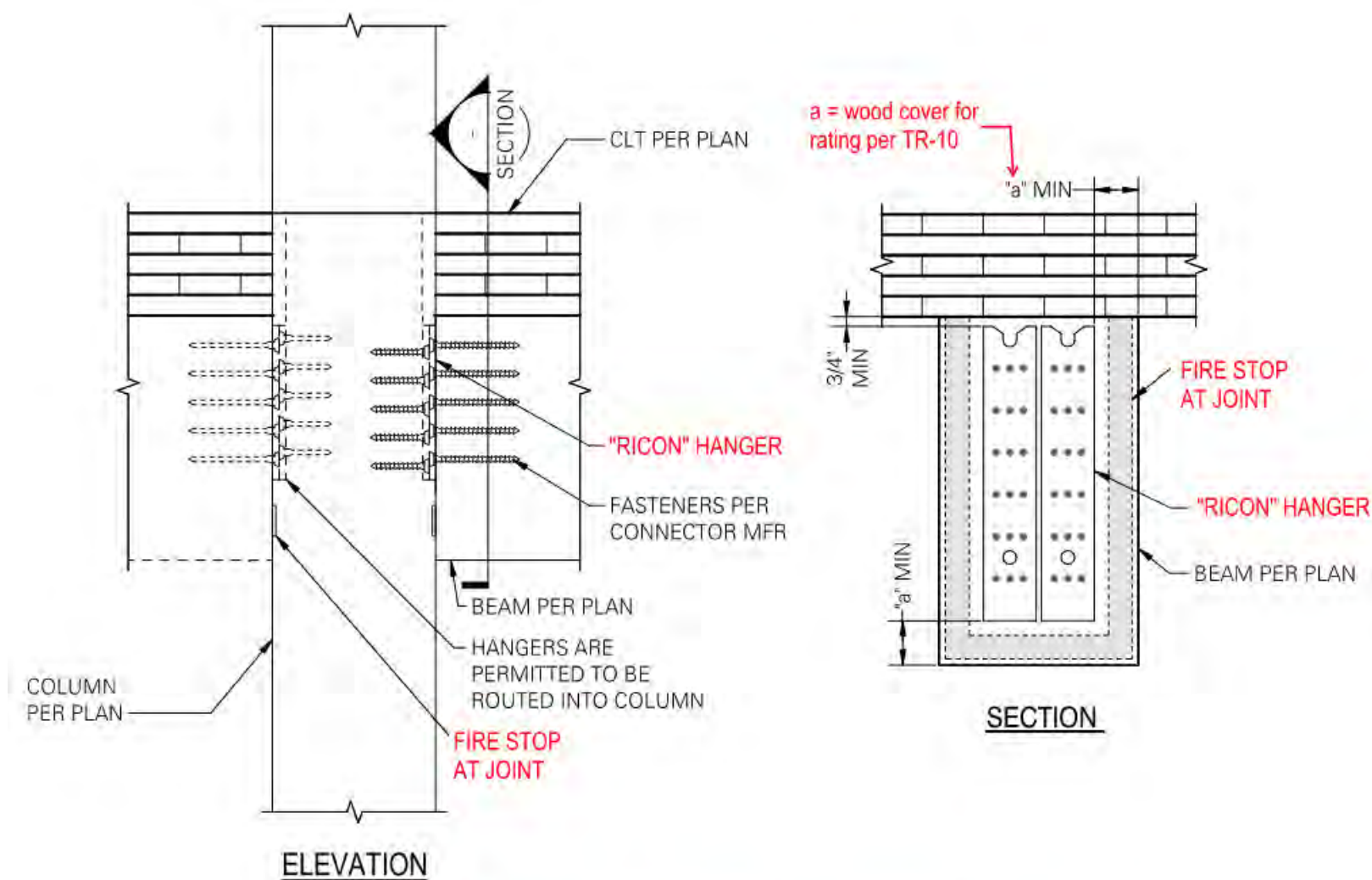


Beams, Columns and CLT Panels

- Type IV-C “primary structural frame” and “floor construction” elements are 2hr rated
- Rating achieved with two methods:
 1. Gypsum Protection – (3) layers of direct applied 5/8” type X gypsum board (40 minutes per layer, per 2021 IBC)
 2. Char of Exposed Mass Timber – calculated methods prescribed in NDS
- Beams & Columns used a combination of these two methods
- 5-ply CLT panel achieved rating solely from char, allowing for exposed CLT ceilings

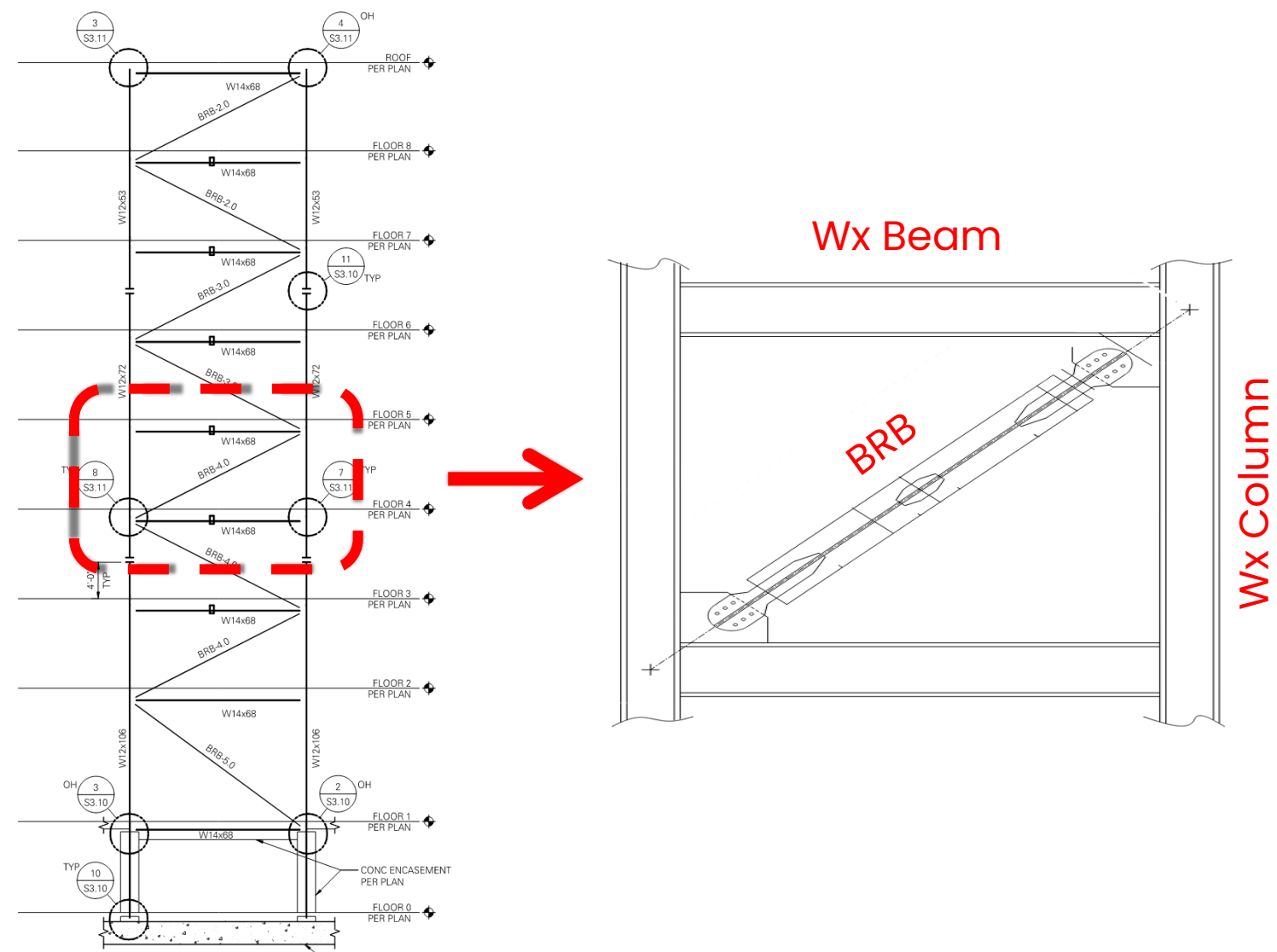
Connections

- 2021 IBC contains fire resistance rating requirements for connections
 - Based on limiting temperature rise for the connection
- The analysis followed guidelines in American Wood Council’s Technical Report 10 “Calculating Fire Resistance of Wood Members and Assemblies” (TR-10)
- City of Portland was amenable and worked through this approach with the design team
- The city still required an appeal for some provisions that lacked specific paths of compliance
- Engineering judgement letter from fire stop product manufacturer was used in conjunction with the analysis

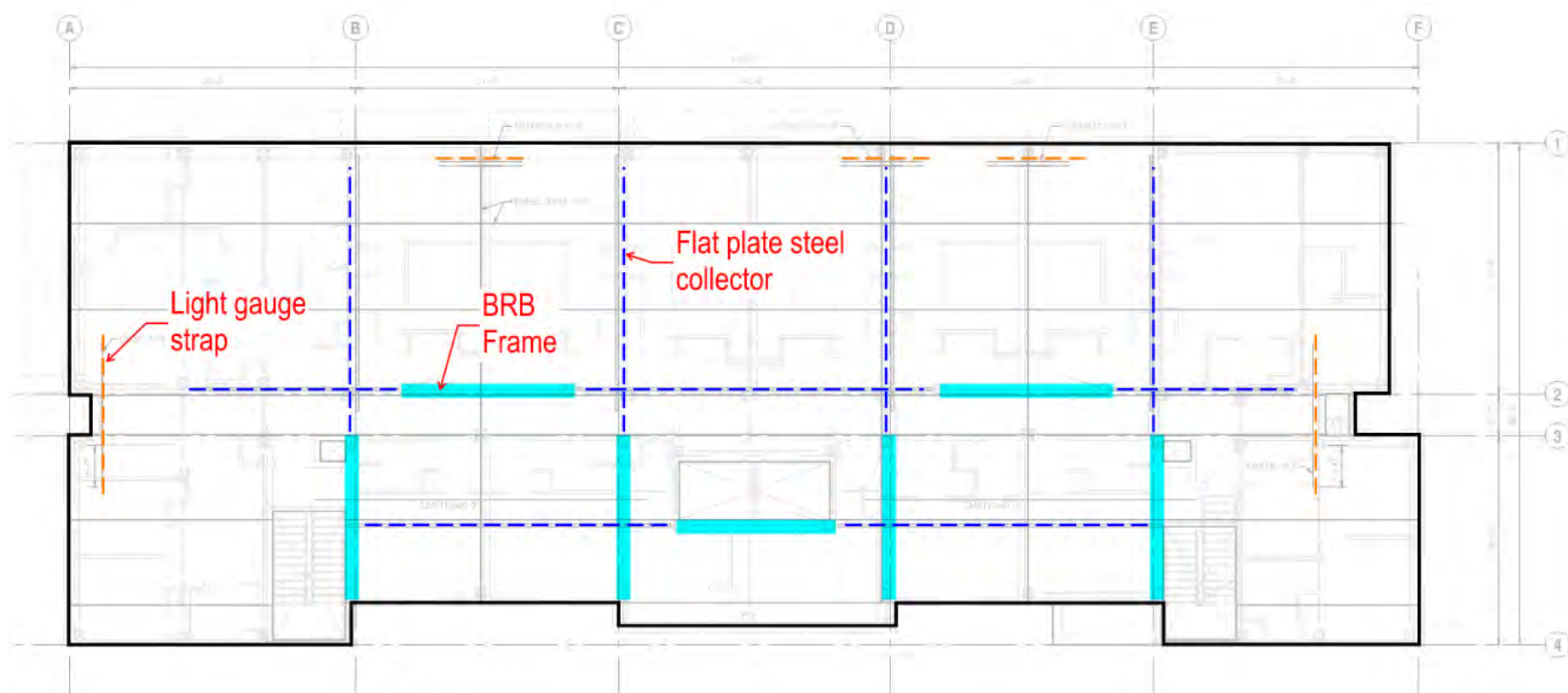


TYPICAL BEAM TO COLUMN CONNECTION

TimberView LATERAL SYSTEM



Typical BRB Frame Elevation



Typical Floor Plan – Lateral System Elements

Buckling Restrained Braced Frames (BRBF)

- Portland is in a high seismic region, so seismic design requirements govern lateral system selection
 - For an 8-story building, current code prescribed systems are either steel or concrete based
- Benefits of BRBFs compared to other steel/concrete systems:
 - Higher ductility system (higher R value), which reduces forces to other elements (e.g. columns, foundations) resulting in smaller sizes of those members
 - Flexible brace frame layout & orientation

CLT Diaphragms

- City of Portland allowed use of new “CLT diaphragm” provisions
 - Provisions are part of the 2021 AWC “Special Design Provisions for Wind and Seismic” (SDPWS), officially adopted as a reference standard in the 2021 IBC
- No structural concrete topping required
- Flat steel plates & light gauge straps used for chords, collectors, and panel splines – all concealed in non-structural gypcrete topping

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Thank you!



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