

TimberView

Pulling Back the Curtain on Designing Portland's First Prescriptive Type IV-C Building



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



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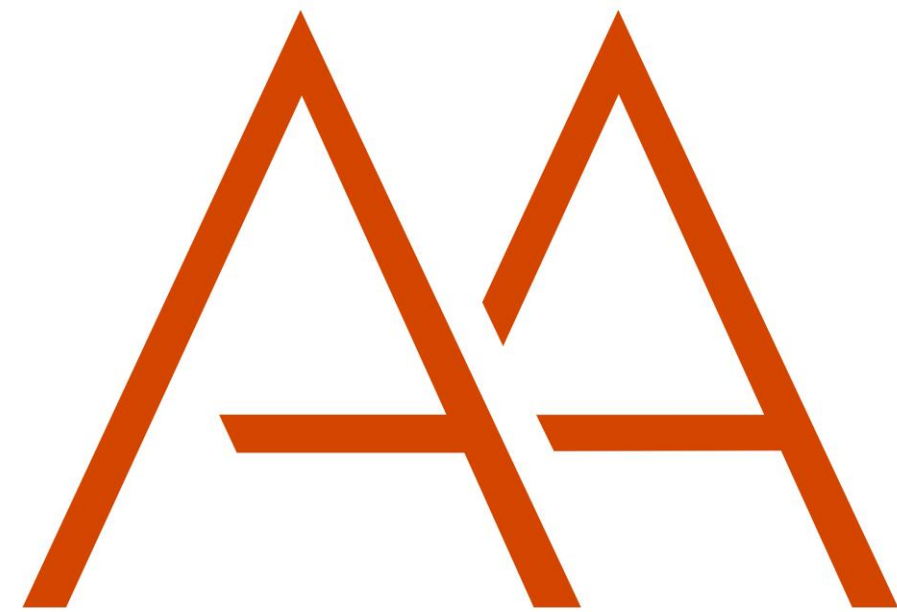
Project Manager
DCI Engineers

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ACCESS ARCHITECTURE

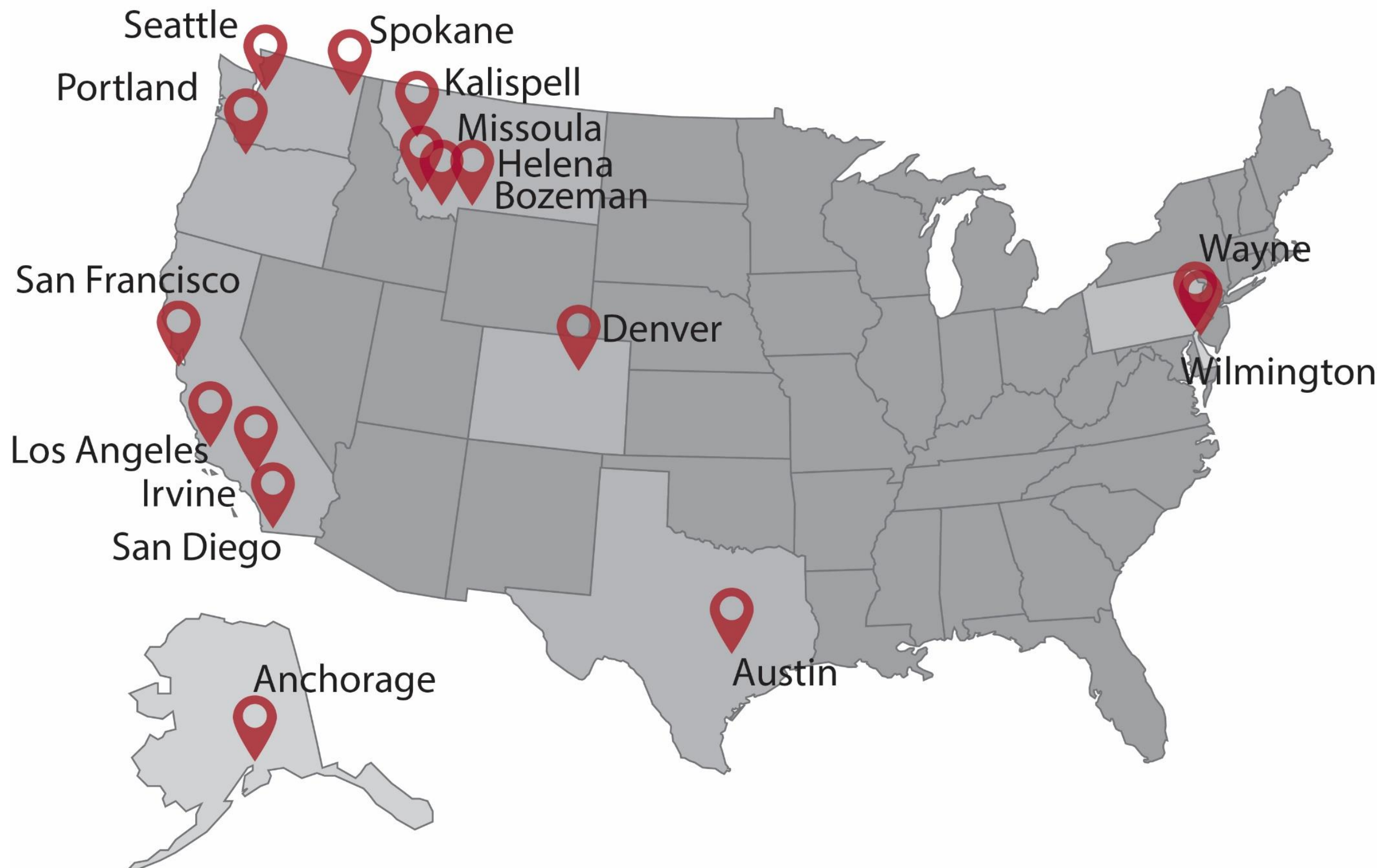
FIRM OVERVIEW

**Designing
Connected
Communities**





WHO WE ARE



420+
employees
nationwide

22
offices

50
States
licensed in
(+multiple
Canadian
provinces)

50
Mass timber
projects in
the U.S.

DCI ENGINEERS

DCI's fundamental philosophy is to provide **Service, Innovation,** and **Value** to our clients and team members

TimberView

PROJECT INTRODUCTION

TimberView **PROJECT INTRODUCTION**

PROGRAM

105 Units of 60% AMI affordable housing

2,600 sf of Retail (future food hall)

OTHER PROJECT TEAM MEMBERS

Developer: C&J Property Development

General Contractor: Truebeck Constuction

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

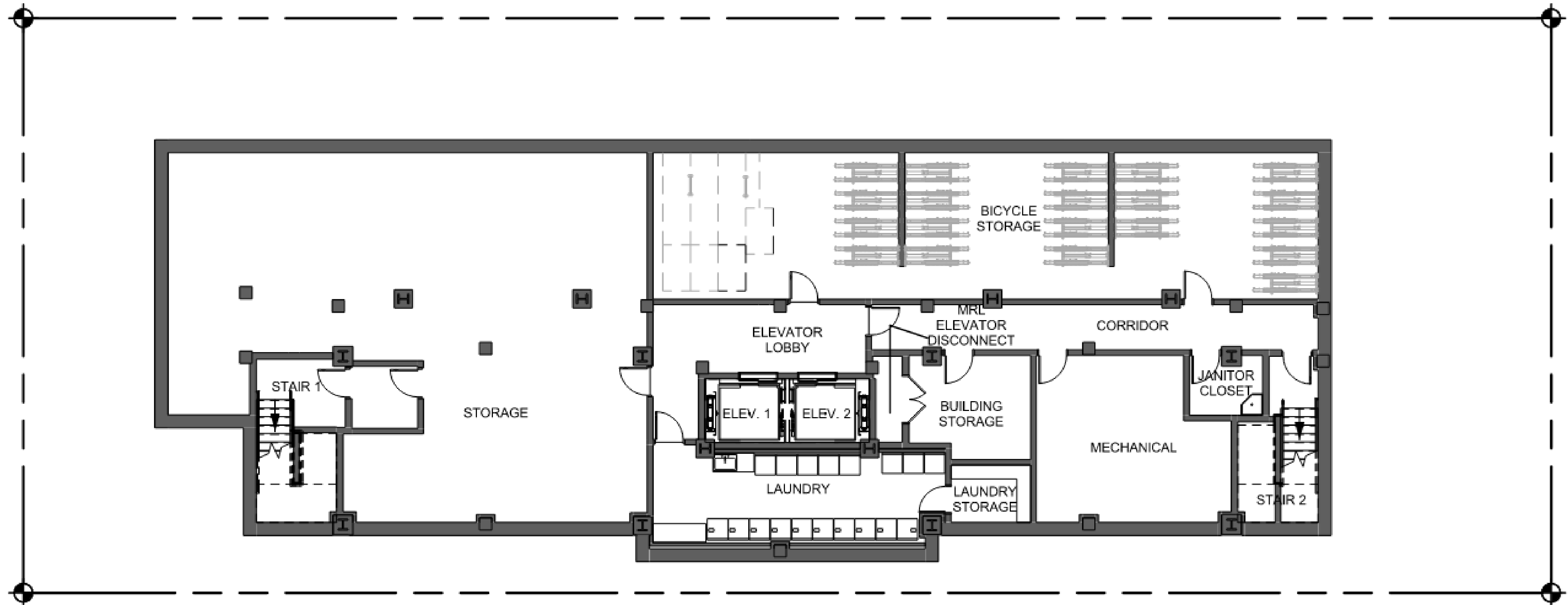


TimberView **PROJECT INTRODUCTION**

BASEMENT

Eight floors above grade with basement & mechanical penthouse

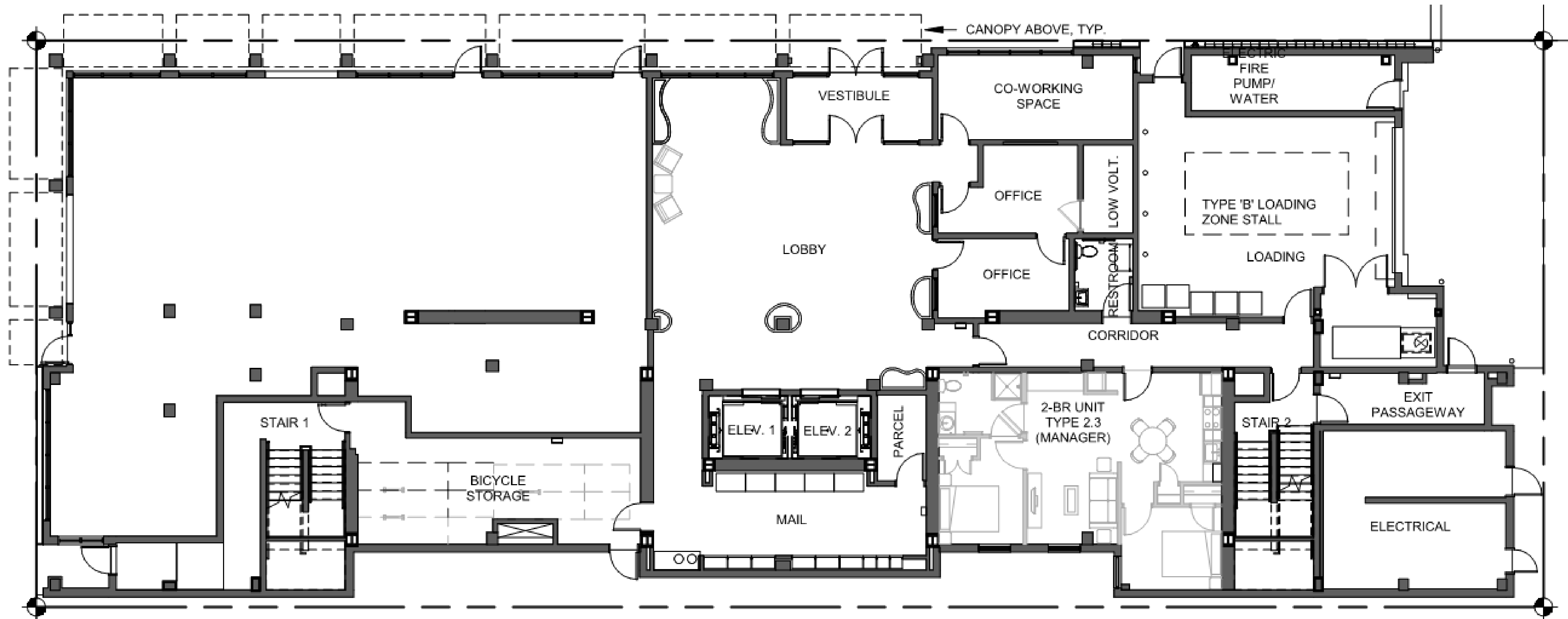
Basement: Service spaces, bike storage, & laundry



TimberView PROJECT INTRODUCTION

FIRST FLOOR

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



TimberView **PROJECT INTRODUCTION**

SECOND – SEVENTH FLOOR (TYPICAL UPPER FLOOR)

Residential units



TimberView **PROJECT INTRODUCTION**

EIGHTH FLOOR

Community room and deck, additional units



TimberView PROJECT INTRODUCTION

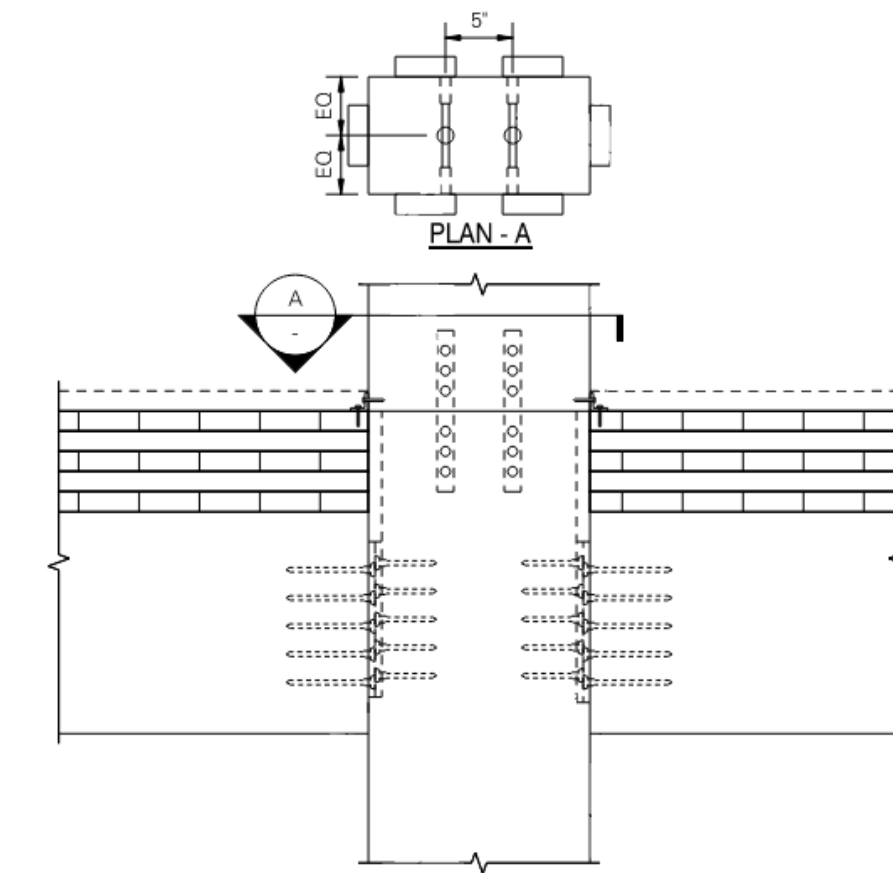
STRUCTURAL SYSTEMS

Gravity System

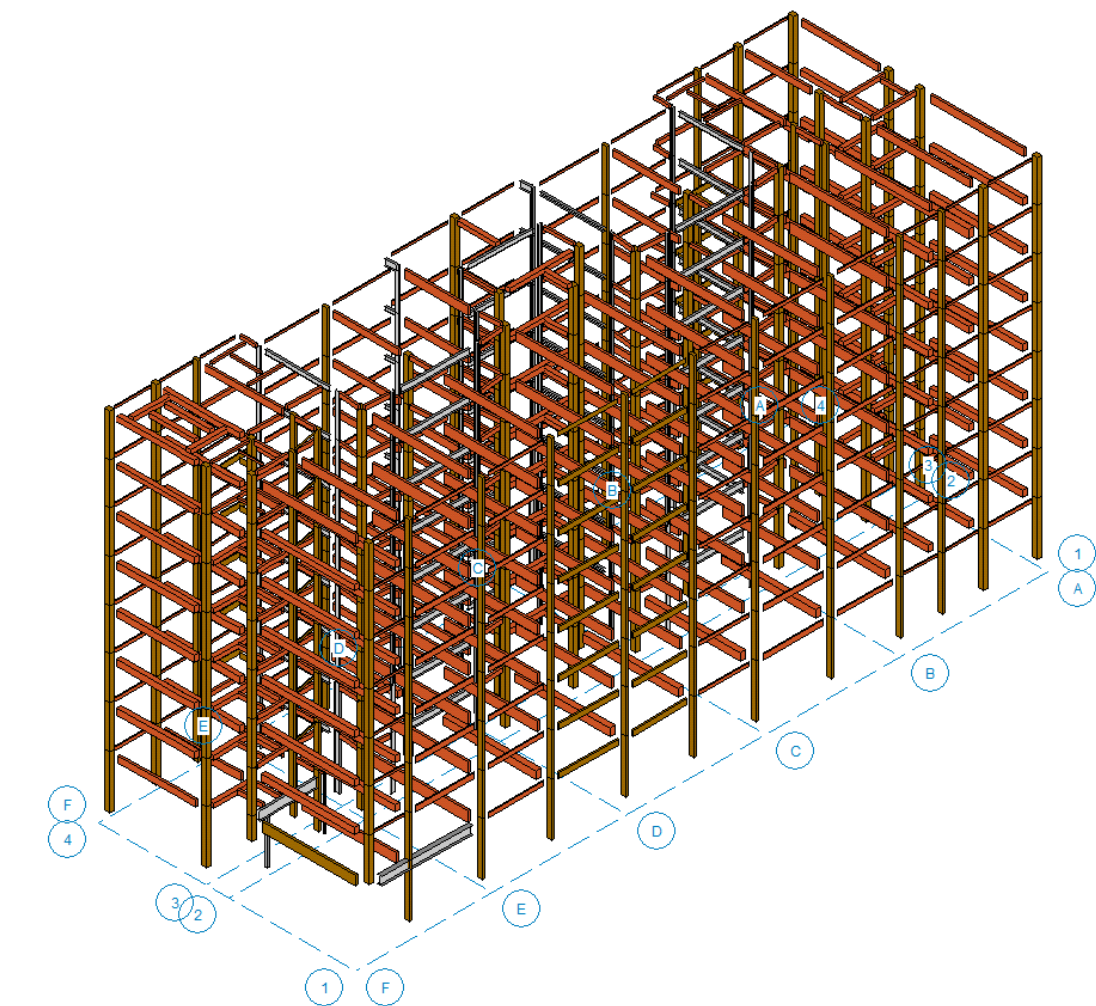
- 5-Ply 6 7/8" E1 grade CLT floor panels with gypcrete topping
- Glulam beams with concealed hanger connection to columns (RICON S VS series)
- Glulam columns
- Fire resistance rating of wood floors, beams and columns achieved using a combination of gypsum protection and char of exposed mass timber
- Mild reinforced concrete slab at ground floor (over basement)

Lateral System

- Buckling Restrained Braced Frames (BRBF)
- CLT diaphragm without structural concrete topping



Typical Beam/Column Connection



3D Analysis Model of Framing

TimberView

WHAT WE DID RIGHT

TimberView **WHAT WE DID RIGHT**

SELECTION OF MASS TIMBER CONSTRUCTION AND HOW WE GOT THERE



- 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)

timberView WHAT WE DID RIGHT

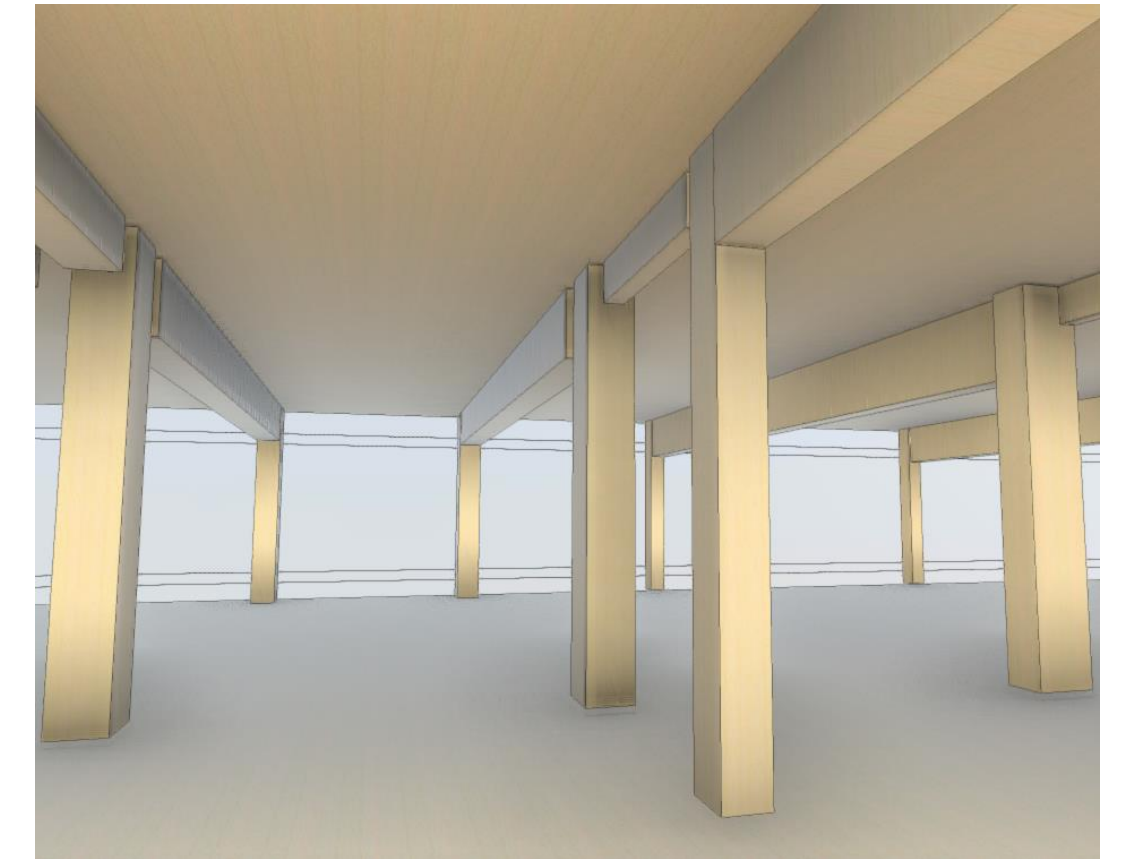
STRUCTURAL SYSTEM DECISIONS

Optimizing 5-ply CLT and framing layout

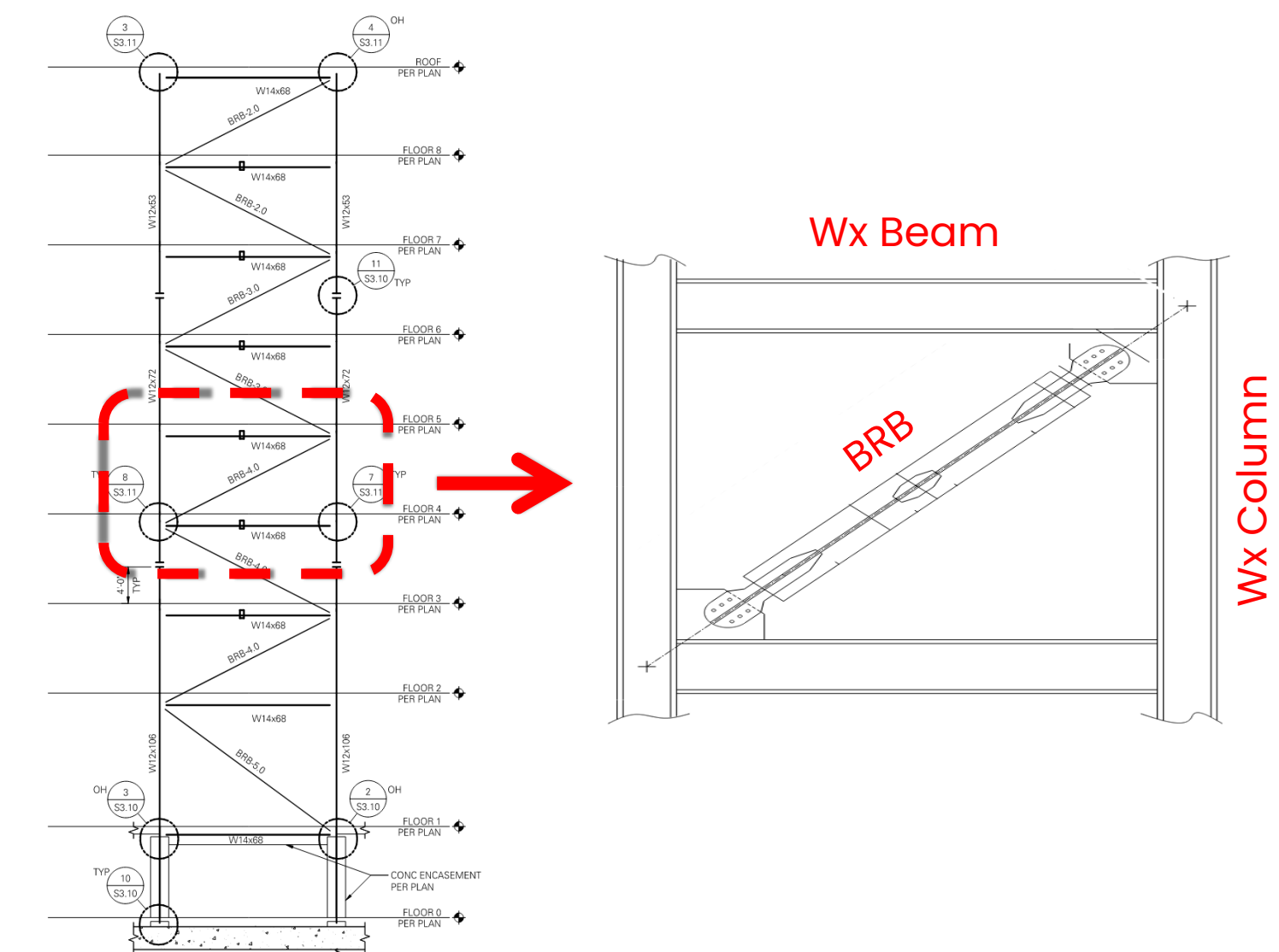
- The majority of wood fiber on the project is in the CLT panels, so optimizing its use is important for overall efficiency
- 5-ply CLT with exposed underside can span around 16' while simultaneously achieving a 2hr fire rating and meeting floor vibration recommendations
- Other floor panel options (e.g. 7-ply panels) were discussed early on with ownership and the design team to determine the best fit for the project
- Beam locations
 - Approximately 16' spacing to maximize panel
 - Beams only in one direction ("one-way" framing system)
 - Shallow beams at corridor

Selection of BRBF for lateral system

- 8-story buildings in a high seismic region typically require a steel or concrete based lateral system
- High ductility system (high R value) reduces forces to other elements (e.g. columns, foundations) resulting in smaller sizes for those members
- Flexible brace frame layout and orientation



“One-way” framing system



Typical BRB Frame Elevation

TimberView **WHAT WE DID RIGHT**

WE DESIGNED A BUILDING THAT ALL THE STAKEHOLDERS ARE EXCITED ABOUT

Stakeholders:

- Ownership
- Jurisdiction
- Design Team
- Contractor and Trade Partners

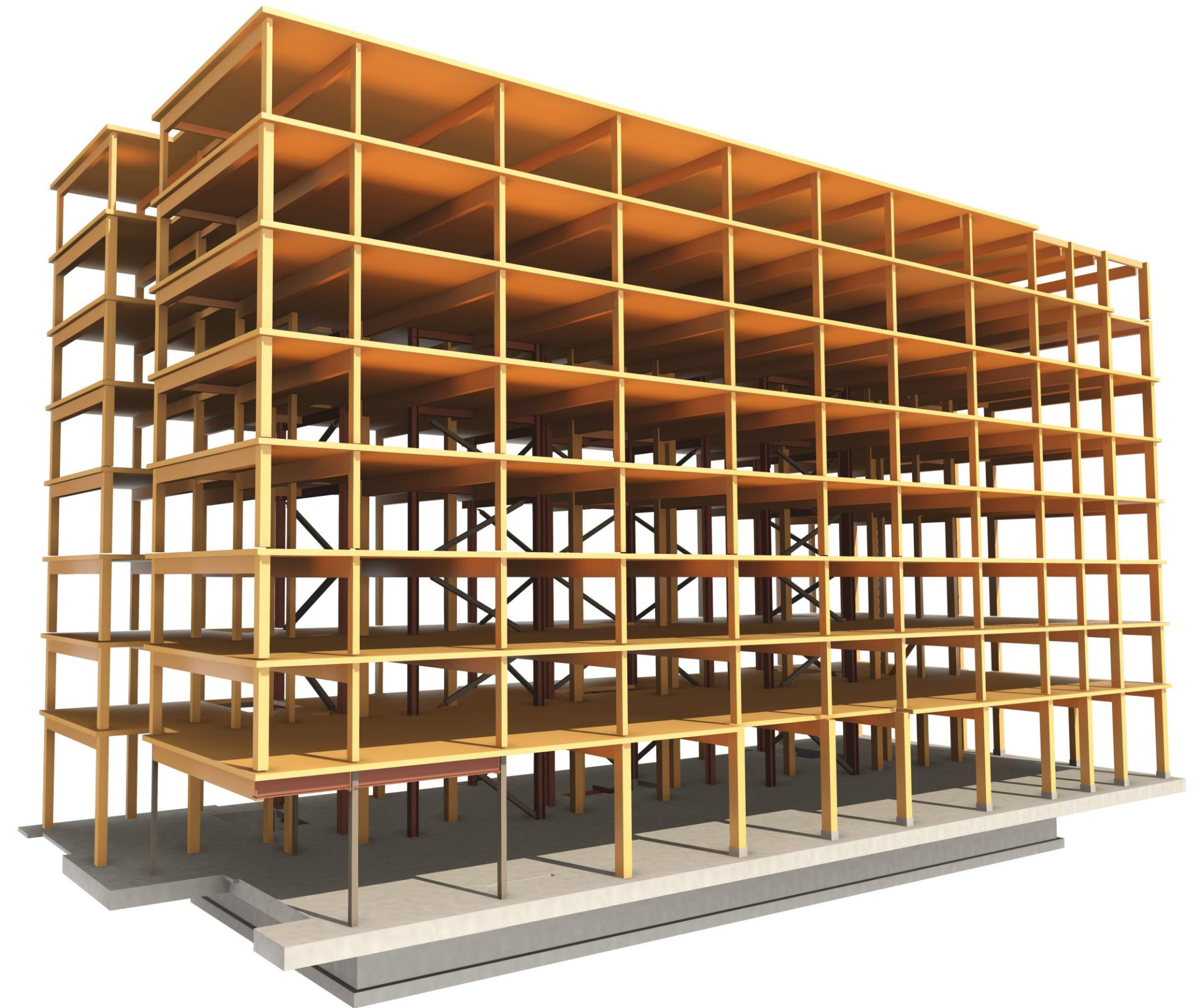
With the stakeholders eager to see this project as a successful, completed building, all parties have additional incentive to overcome the inevitable obstacles that will happen when working on a new typology



TimberView **WHAT WE DID RIGHT**

WE FOUND PARTNERS THAT BRING SOLUTIONS, KNOWLEDGE AND INNOVATION TO THE TABLE

- We don't know what we don't know, so find partners that can fill in the gaps
- Build a team that can and is excited to innovate
- On the flip side, build a team that is stubborn when they need to be



TimberView **WHAT WE DID RIGHT**

WE FOCUSED OUR EFFORTS AND DESIGN CHOICES TOWARDS MAXIMIZING THE FINAL OUTCOME

- Increased level of coordination with MEPF engineers to declutter the ceiling in key areas
- Providing wall sconce fixtures instead of ceiling mounted allowed for reduction of metal electrical conduit
- Ownership prioritized providing the units with hydronic heating, knowingly incurring up front cost to reduce long-term operation and maintenance cost



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WHAT WE WOULD DO DIFFERENTLY

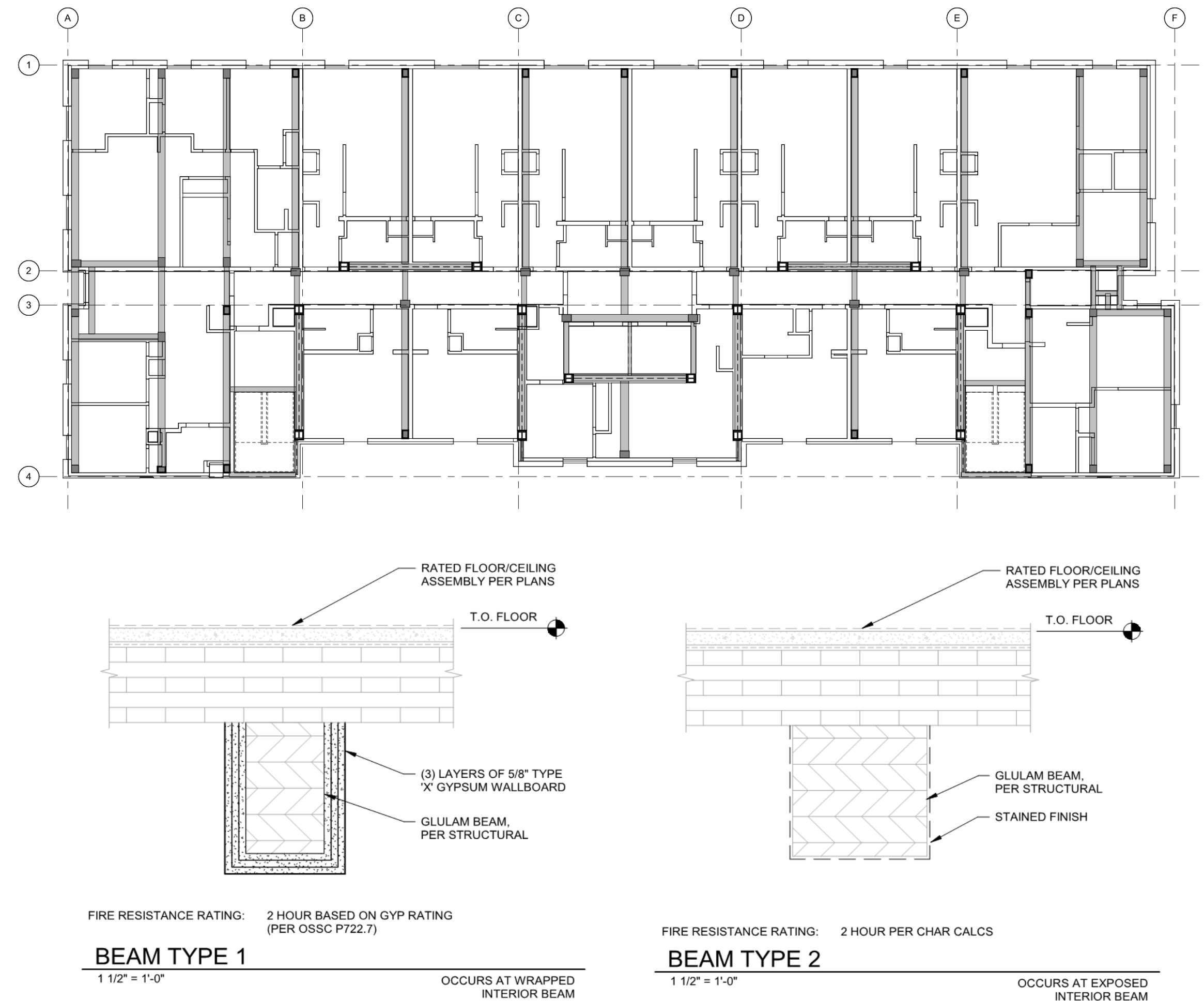
TimberView WHAT WE WOULD DO DIFFERENTLY

WE WOULD EXPOSE MORE OF THE WOOD STRUCTURE

We performed an analysis to determine cost effective methods to provide 2-hour protection in early spring of 2022, during a volatile wood market

- Additional wood thickness
- Gypsum wallboard wrap

OPTIMIZE THE USE AND VISUAL IMPACT OF THE EXPOSED STRUCTURE



TimberView **WHAT WE WOULD DO DIFFERENTLY**

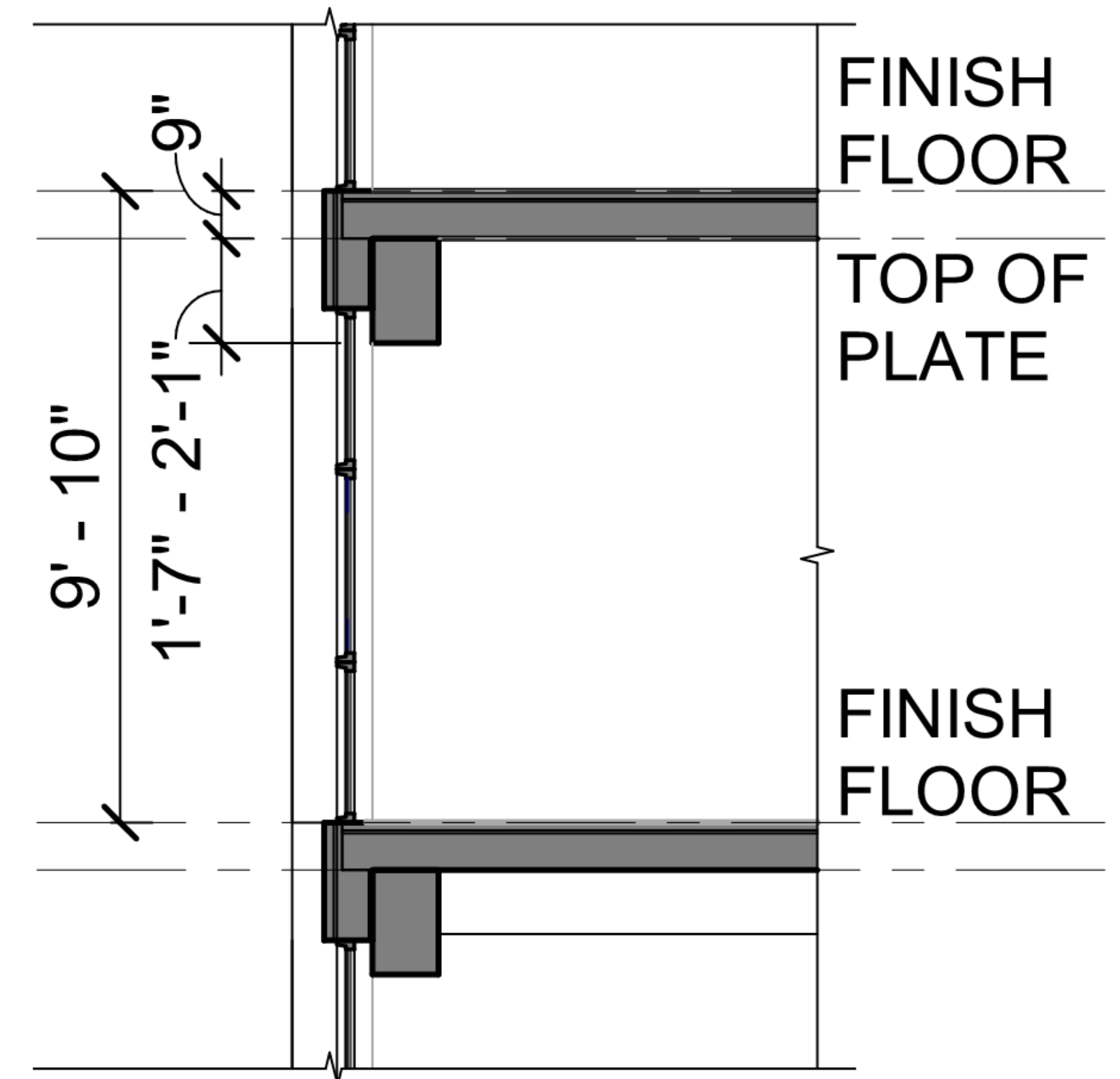
WE WOULD ACCOUNT FOR BEAM DEPTHS EARLIER IN THE PROJECT AND ANTICIPATE INCREASES

Building Height

- Type IV-C allows for 85', 8 story buildings
- 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"

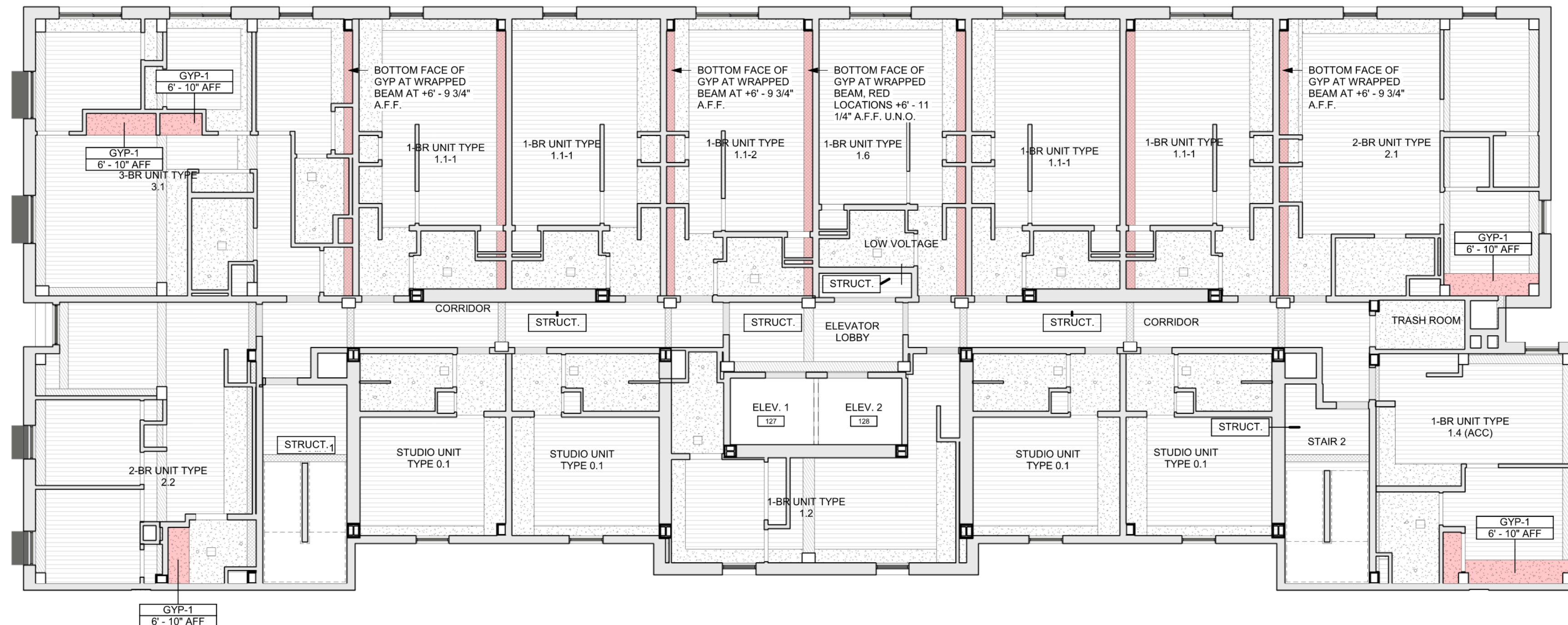
- 9": Floor assembly
- 7'-6" or 7'-0": Code minimum required head height
- 1'-7" to 2'-1": Resulting allowable beam depth



TimberView **BEAM DEPTHS & SPACE DESIGN**

POSSIBLE SOLUTIONS TO EXPLORE ON FUTURE PROJECTS

- Utilize 2-way spanning capability of CLT and remove beams entirely
- Anticipate beam size and MEP routing changes and reduce beam spans while it is still viable
- Explore high-rise and Type IV-B construction options
- Use alternate beam system (steel)



TimberView **WHAT WE WOULD DO DIFFERENTLY**

WE WOULD BUILD AND FINALIZE OUR TEAM EARLIER IN THE PROJECT TIMELINE

Contractor – SD Phase

Mechanical – Mid DD Phase

MT Supply – Late DD or Early CD Phase

Finalizing the team early can have significant coordination and time savings, but limit savings in the bidding process



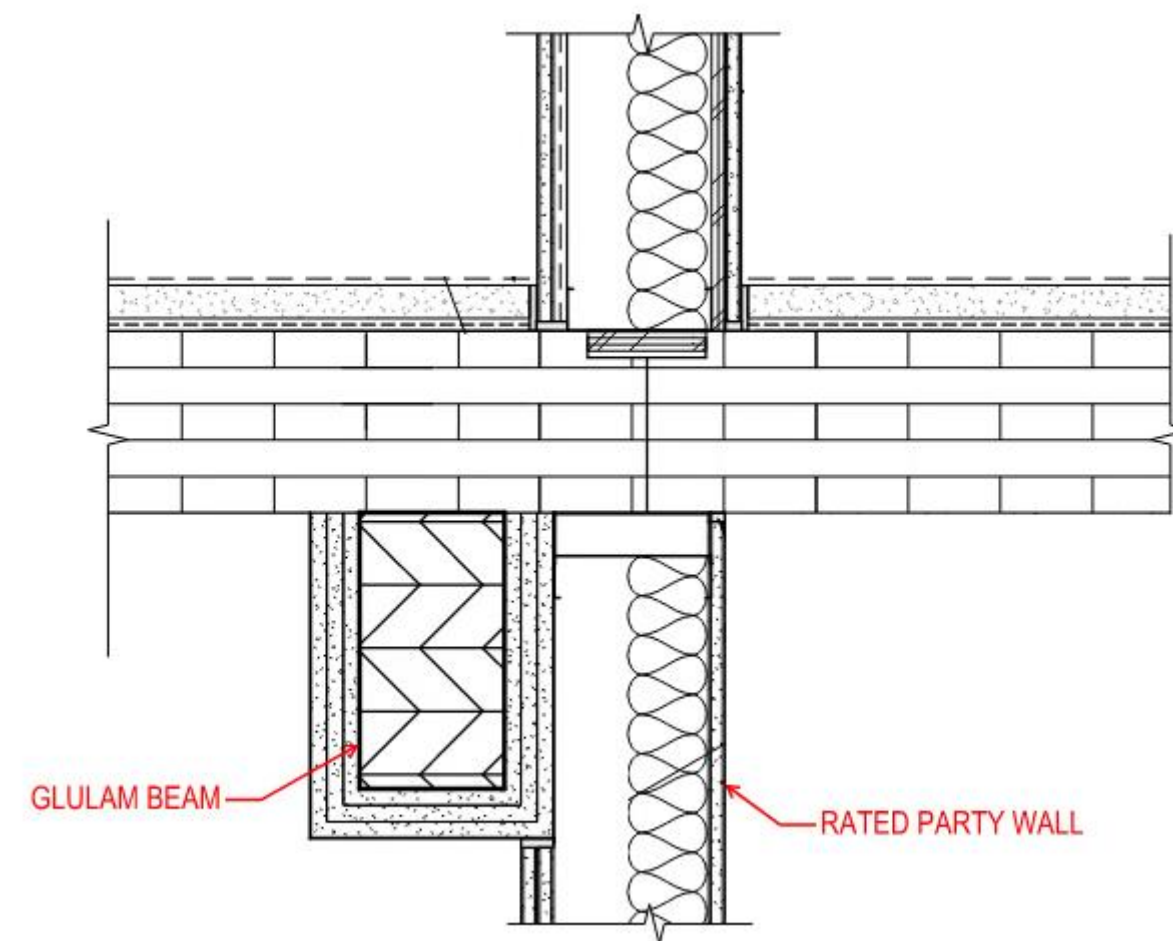
TimberView **WHAT WE WOULD DO DIFFERENTLY**

WE WOULD DESIGN THE PROJECT AS MASS TIMBER FROM THE GROUND UP

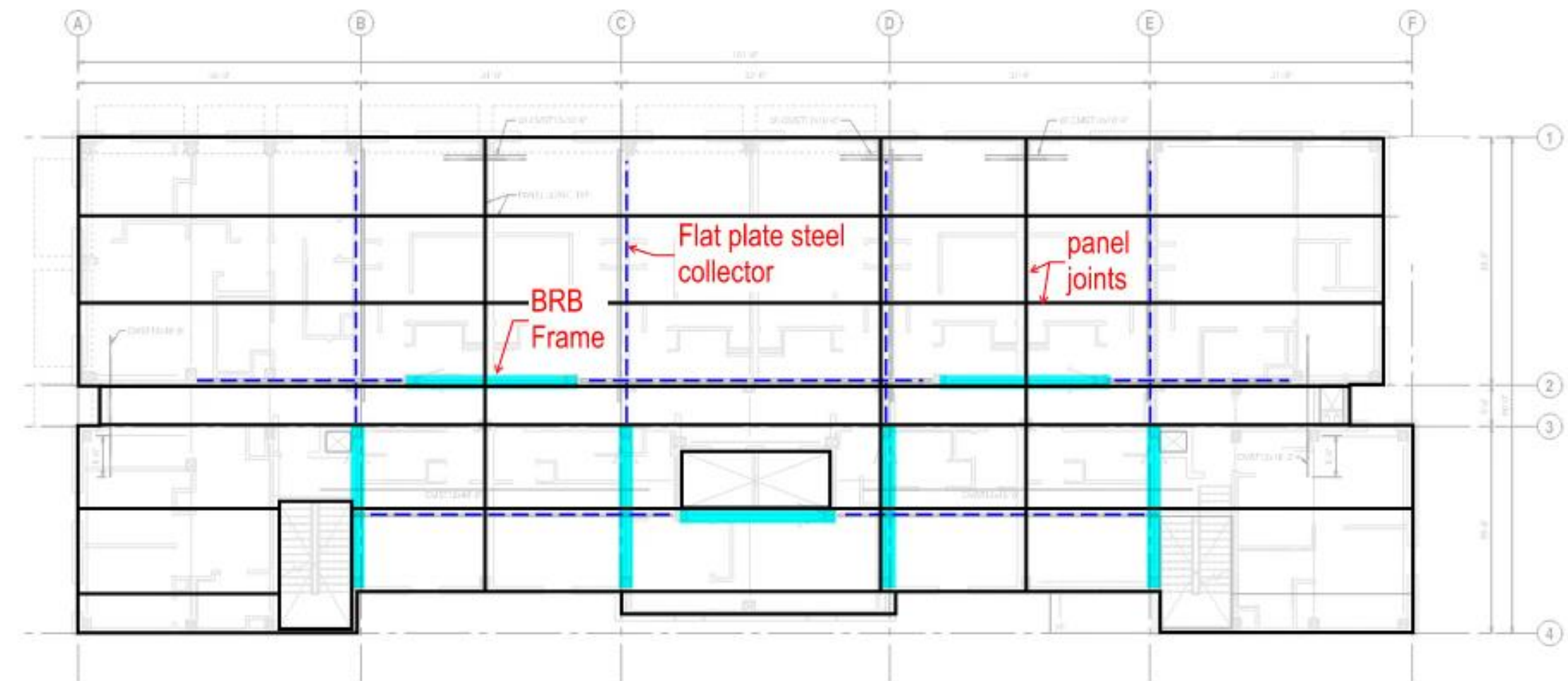
The design initiated as a structurally nondescript floor plan into which a mass timber structure was inserted

Although mass timber was chosen early on, there are detailed relationships between non-structural and structural elements that are unique to mass timber construction

Consider detailed relationship between mass timber elements and structural steel elements



Beam and party wall relationship



Panel layout vs Steel BRBF layout

TimberView WHAT WE WOULD DO DIFFERENTLY

WE WOULD ADD MORE STORIES AS ALLOWED BY TYPE IV-B

Recent code change that is part of the 2024 IBC (already early adopted in 2022 OSSC) allows for more exposed mass timber vs original type IV-B rules

Most notably, it's possible for the CLT ceiling to be fully exposed

IV-B can achieve up to 12 stories (4 more than IV-C) and achieve similar design aesthetic

602.4.2.2.2 Protected area.

Interior faces of *mass timber* elements, including the inside face of exterior *mass timber* walls and *mass timber* roofs, shall be protected in accordance with Section 602.4.2.2.1.

Exceptions: Unprotected portions of *mass timber* ceilings and walls complying with Section 602.4.2.2.4 and the following:

1. Unprotected portions of mass timber ceilings and walls complying with one of the following:
 - 1.1. Unprotected portions of mass timber ceilings, including attached beams, shall be permitted and shall be limited to an area less than or equal to 100 percent of the floor area in any dwelling unit or fire area.
 - 1.2. Unprotected portions of mass timber walls, including attached columns, shall be permitted and shall be limited to an area less than or equal to 40 percent of the floor area in any dwelling unit or fire area.
 - 1.3. Unprotected portions of both walls and ceilings of mass timber, including attached columns and beams, in any dwelling unit or fire area shall be permitted in accordance with Section 602.4.2.2.3.
2. Mass timber columns and beams that are not an integral portion of walls or ceilings, respectively, shall be permitted to be unprotected without restriction of either aggregate area or separation from one another.

Excerpt from 2022 OSSC

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WHAT SURPRISED US

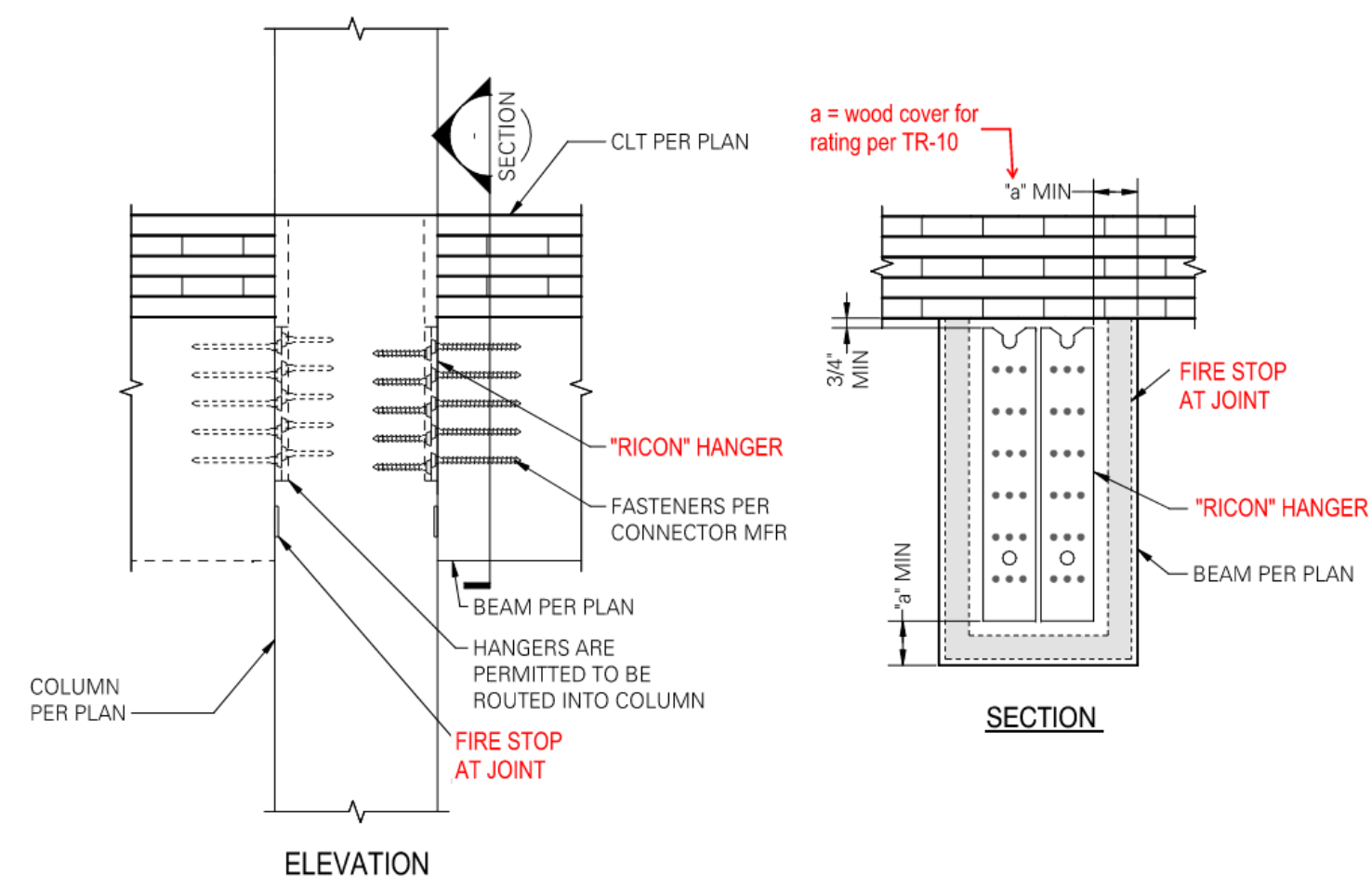
TimberView **WHAT SURPRISED US**

DOCUMENTATION IS RAPIDLY BEING CREATED AND UPDATED BY THE INDUSTRY AND MANUFACTURERS

This impacted structural hangers and fire protection method on our project

Despite providing a prescriptive Type IV-C design, we needed to file an appeal for fire rated connections as a mechanism for multiple jurisdictional departments to collaborate on the review and approval

Prescriptive code provisions that are currently adopted need to be balanced with “future” code adoptions that are either currently in debate or approved for a later code cycle



Typical Beam to Column Connection
(on this project)



Example fire test of a beam to column connection
(MTC Solutions)

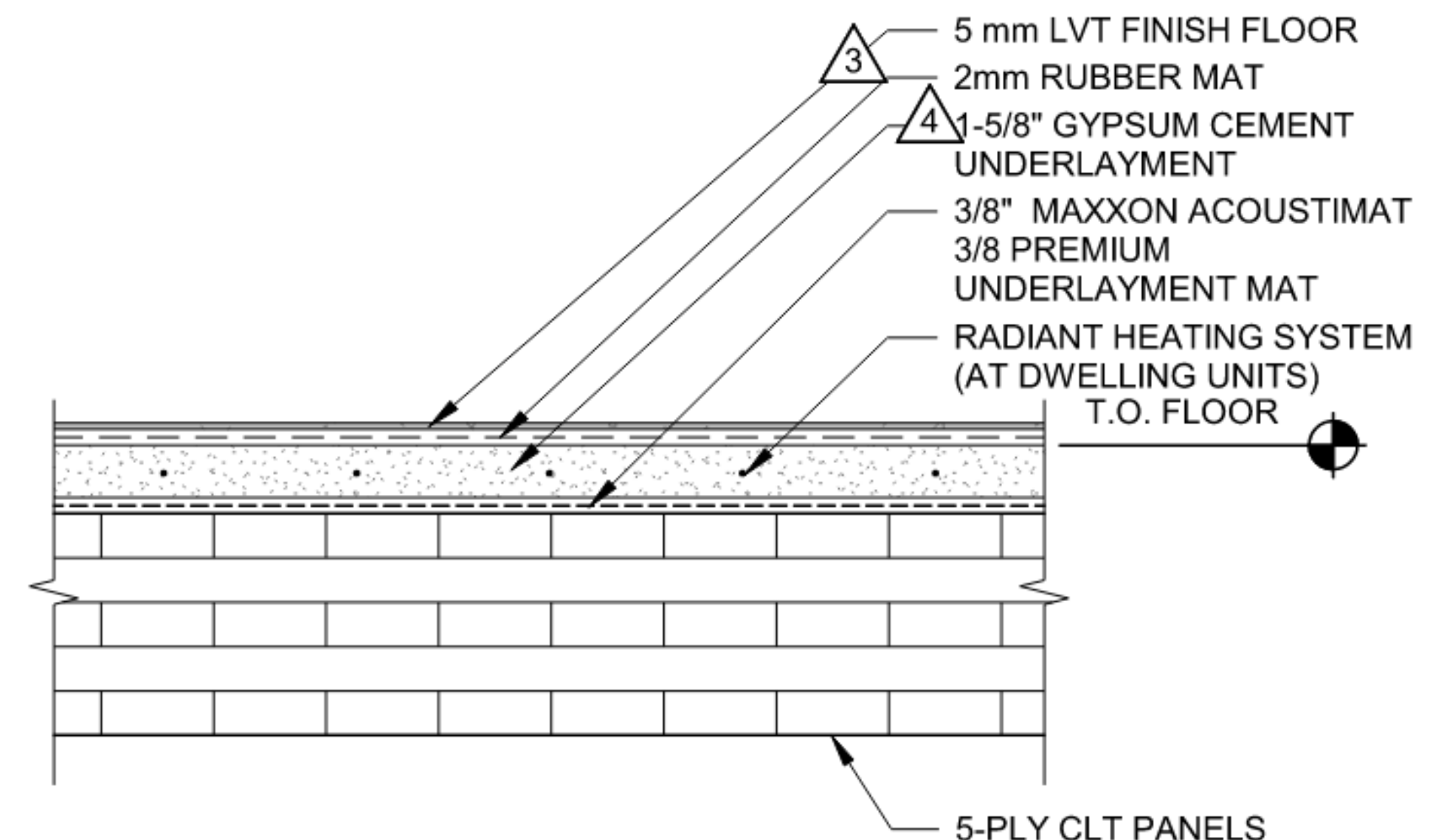
TimberView WHAT SURPRISED US

ACOUSTIC ASSEMBLIES WERE ALSO IMPACTED ON OUR PROJECT BY RAPIDLY EVOLVING DOCUMENTATION

Permit received late 2022 with sound engineer analysis commissioned early 2022

- General Contractor discovered warranty conflict with gypsum cement underlayment
- Structural system could not accommodate additional gypsum weight without redesign
- Additional proprietary sound testing documentation was issued by the manufacturer

A second sound engineering analysis had to be commissioned which resulted in additional sound mats being added to the assembly



FIRE RESISTANCE RATING: 2 HOUR, PER CHAPTER 16 ANSI/AWC
NDS FOR WOOD CONSTRUCTION
STC RATING: 50 (MIN), PER ACOUSTIC ENG
IIC RATING: 50 (MIN), PER ACOUSTIC ENG

FC01 FLOOR/CEILING ASSEMBLY

1 1/2" = 1'-0"

OCCURS AT
TYPICAL FLOORS

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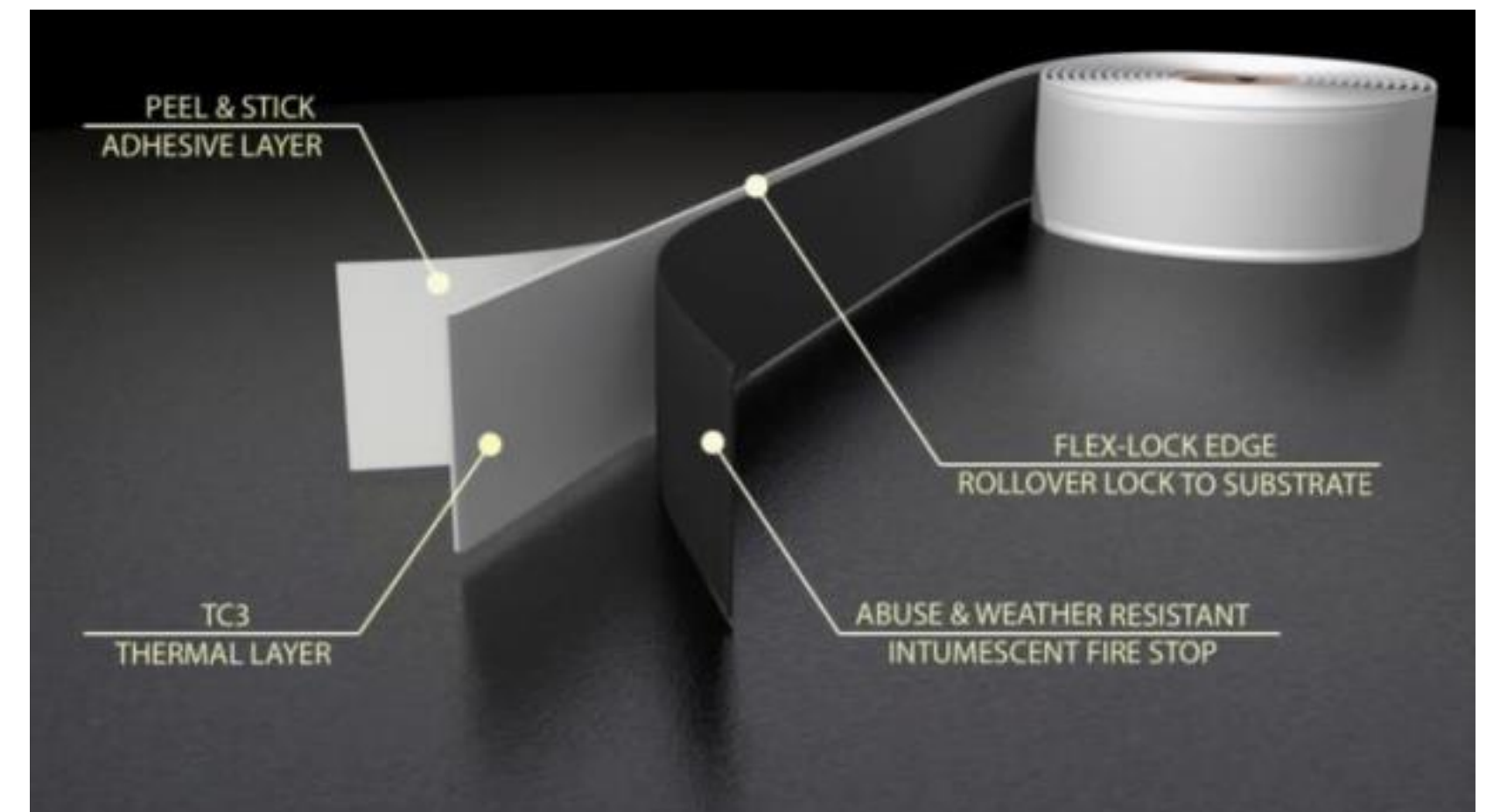
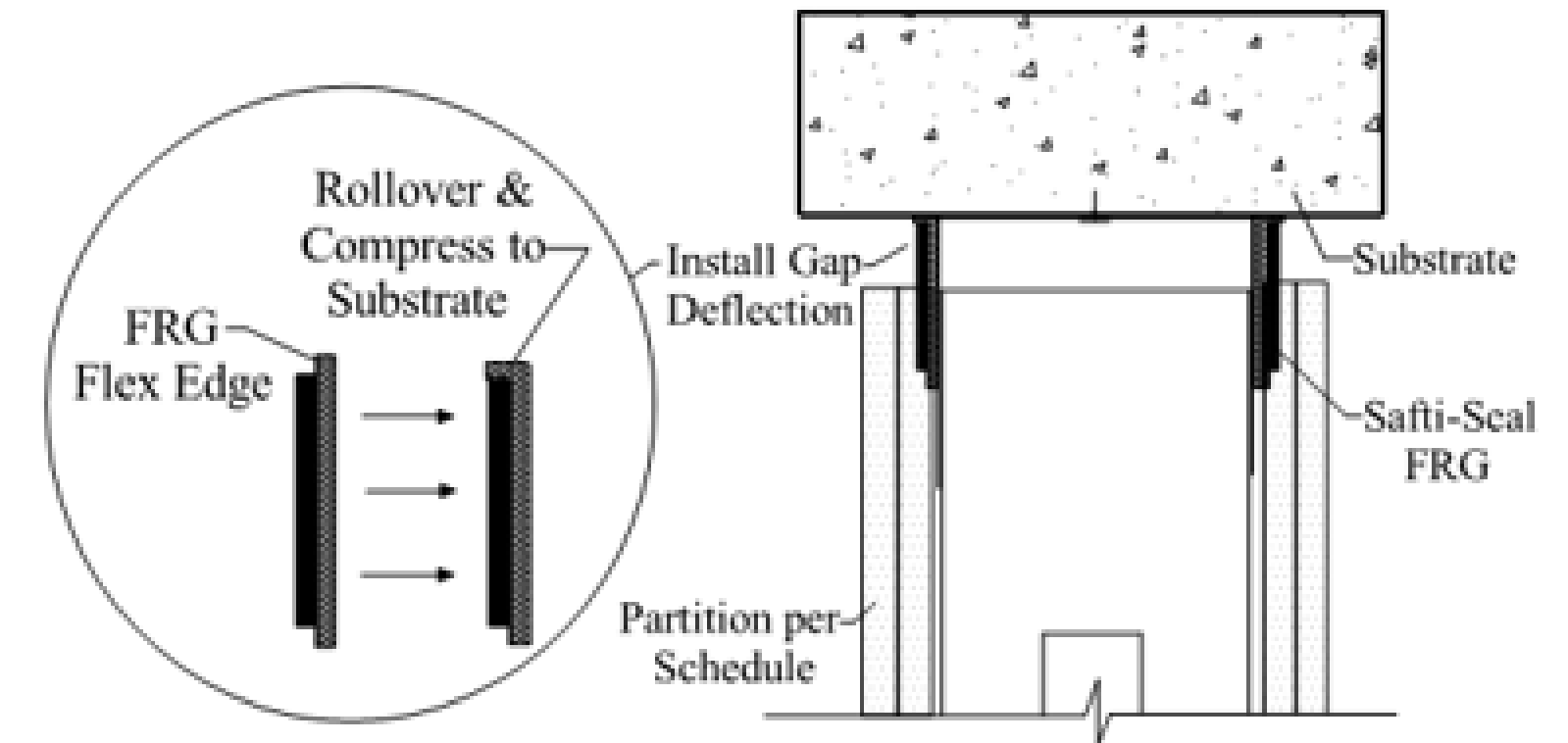
DETAILING FOR DEFLECTION REQUIRES SPECIAL CARE

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

The non-bearing wall and structural ceiling joint is exposed to the occupant and not concealed by dropped ceilings

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

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Thank you!



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