Mary Ellen McCormack Building B

Mass Timber Accelerator Grant | July 15, 2022

The Team

Developer/Proponent : **WinnDevelopment**

Master Planner and Architect - Building B: **CBT**

Structural Engineer: **Thornton Tomasetti**

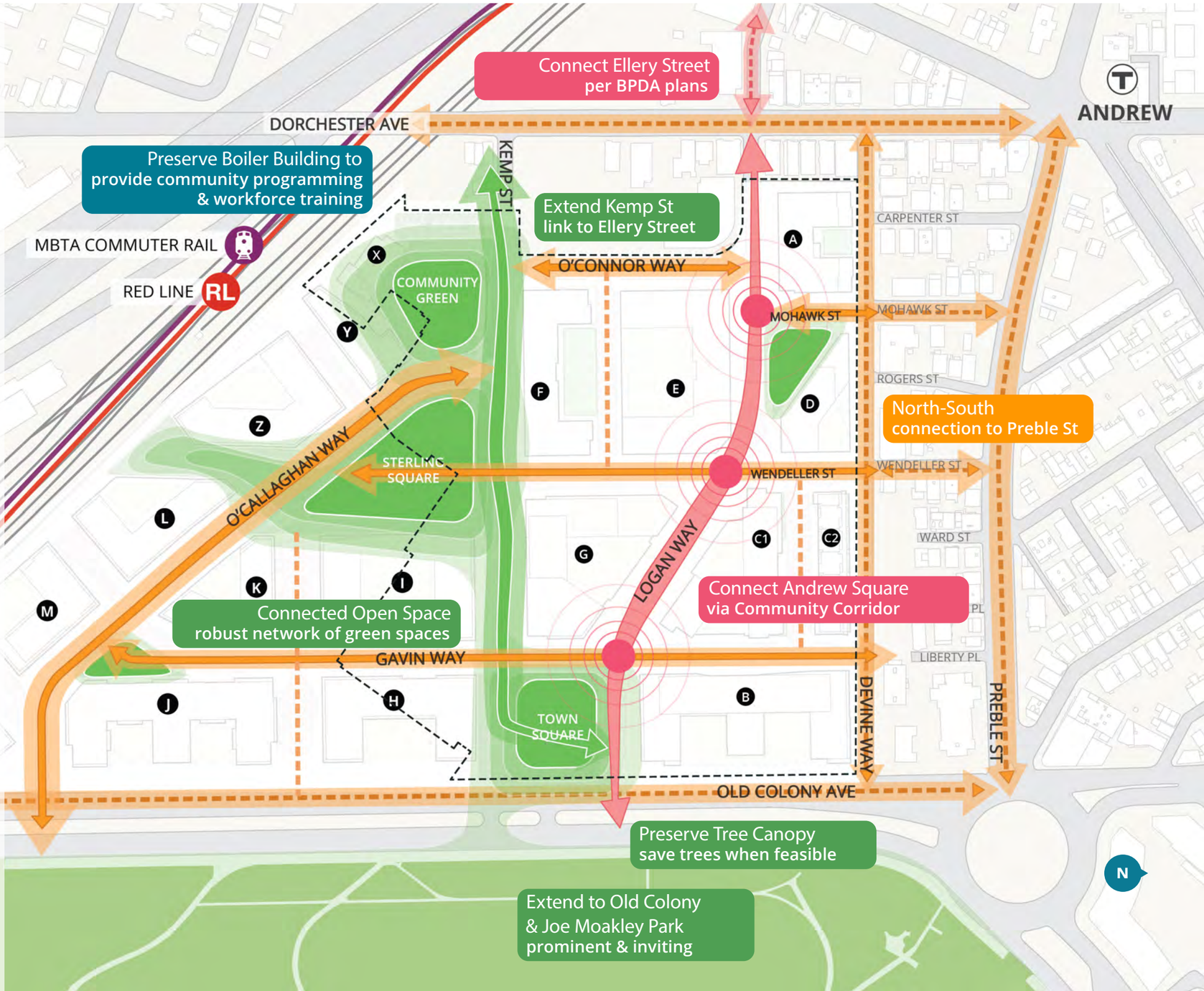
Code Consultant: **CodeRed**

Pre-Construction Manager: **Lee Kennedy/ Janey**

MASTERPLAN DESIGN PRINCIPLES

Sustainability Commitments

- **High Performance Building Design**
  - o Passive House Institute US - 2021 Certification
  - o Modeled performance < 1.8 kgCO2/W sf/year (50% better than code)
  - o **Low-carbon design,** all-electric ready
  - o Energy Star Multifamily New Construction Certification
  - o EPA Indoor airPLUS Certification
- **Sustainable Site Planning**
  - o Multi-modal Transit Oriented Development
  - o Local & Resilient Landscaping
  - o Tree Preservation & Heat Island Mitigation
  - o LEED v4 Certifiable
- **Maximizing solar PV, energy storage, and load flexibility**
  - o Resilience Hub Planning Underway
- **Prioritizing long-term community and environmental health**
- **Rigorous 3rd party verification & certification process**



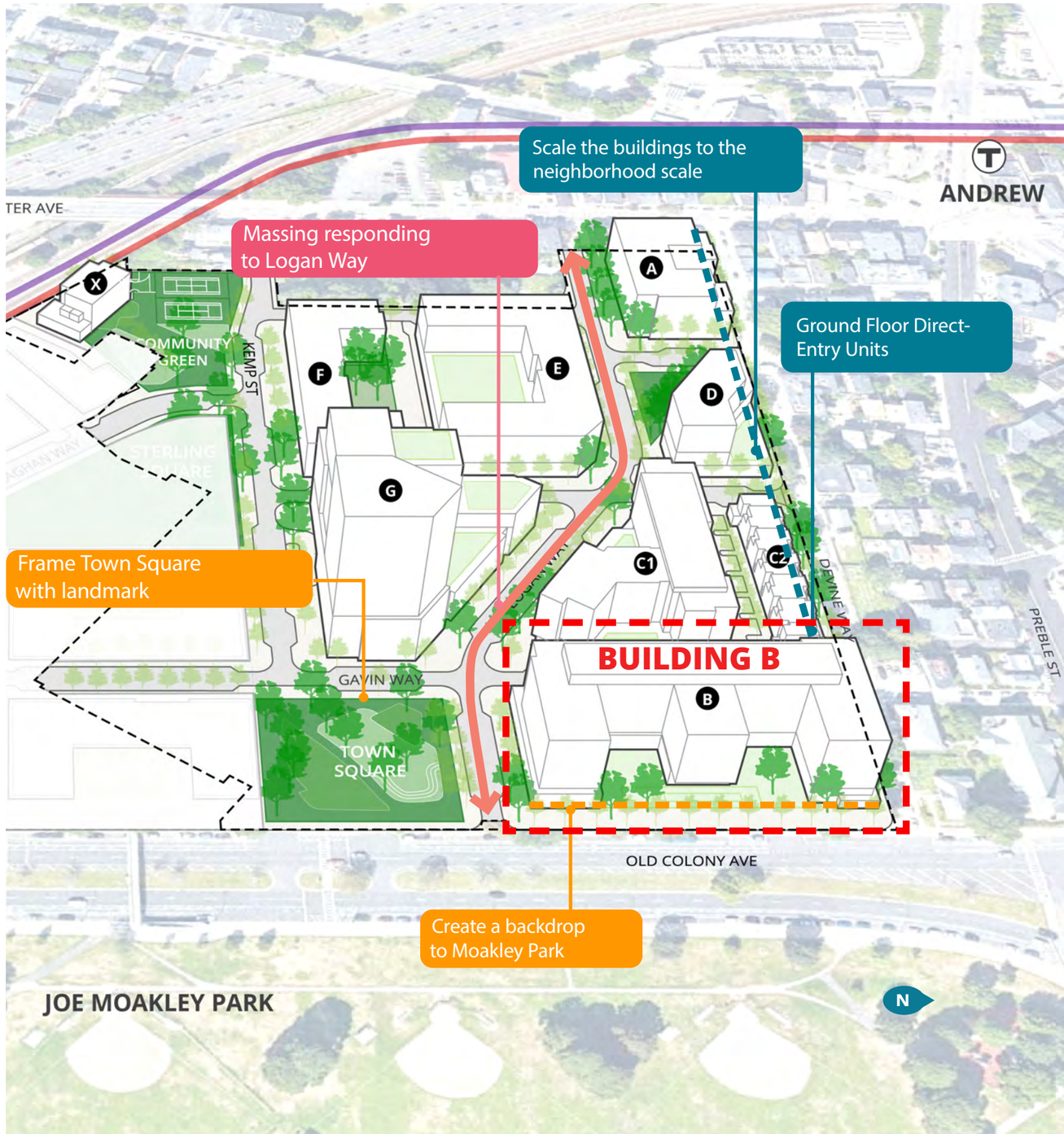
PROPOSED SITE PLAN AND MASSING (PHASE 1)

Number of buildings **9**

Total GFA **1,449,000**

Residential Units **1,365**

Open Space (acres) **2.3**

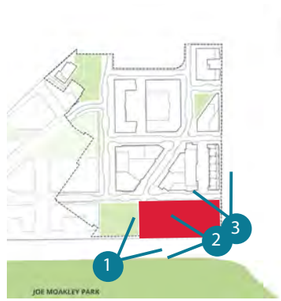


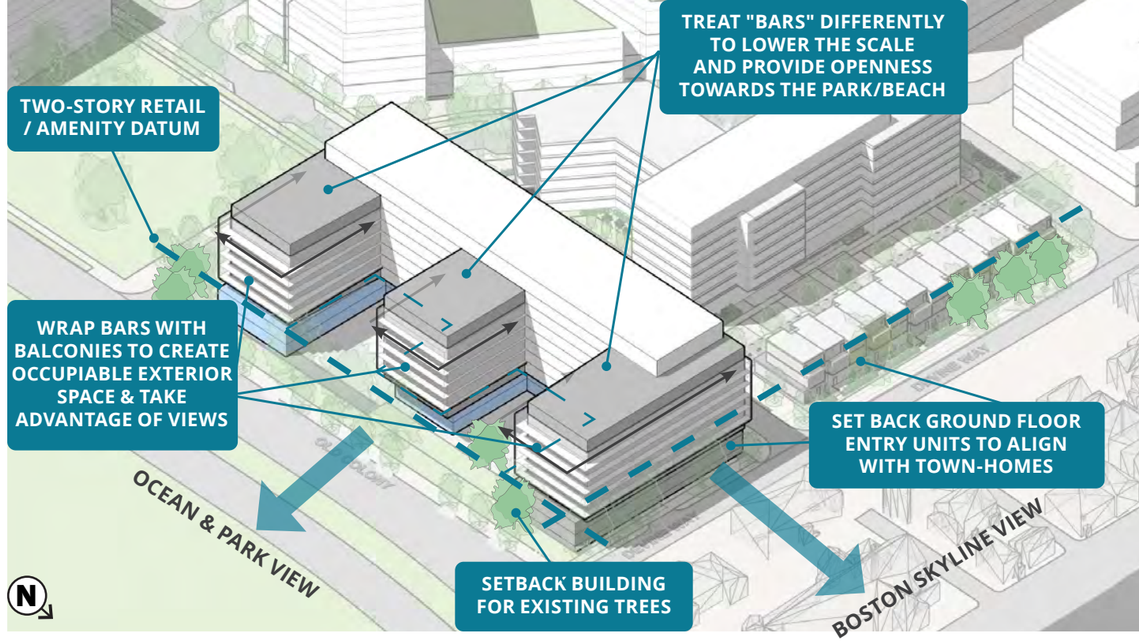
BUILDING B SUMMARY

Mixed-Income Apartments

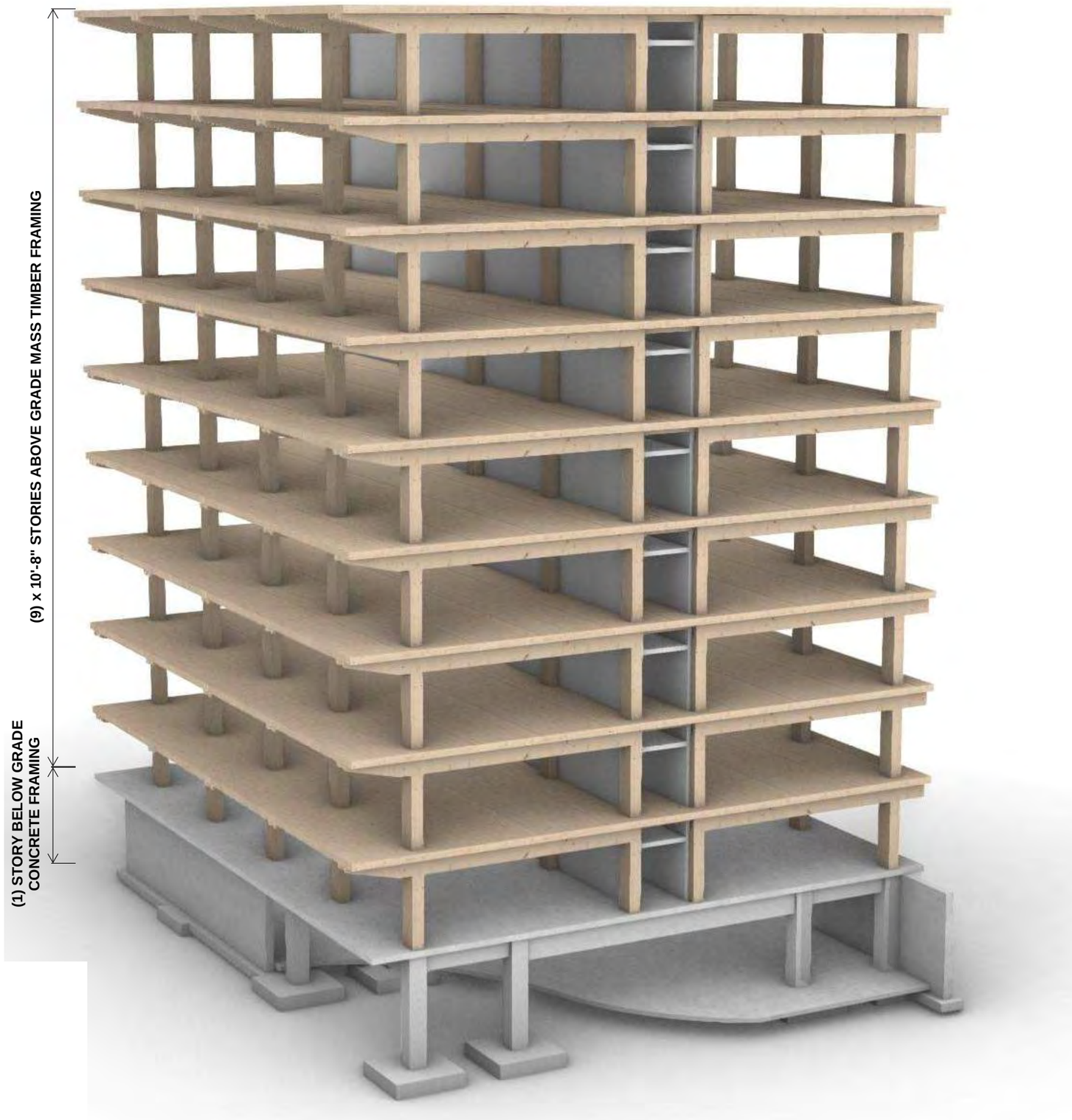
(Including 20% Boston Housing Authority Replacement Units)

322,000 sf | 302 Units





STRUCTURAL DIAGRAM



CODE SUMMARY (IBC 2021 AND 2024)

2021 IBC Requirements

The 2021 IBC contains the following major provisions relative to Type IV-B buildings:

- Cross-laminated timber is required to be labeled as conforming to the 2019 edition of the ANSI/APA PRG 320 standard (2021 IBC 602.4).

- Exterior walls are required to be of (1) noncombustible construction, (2) mass timber construction, or (3) Type IV-HT construction in accordance with 2021 IBC Section 602.4.4. Where exterior walls are of mass timber construction or Type IV-HT construction, the outside face of the exterior walls are required to be protected with noncombustible materials with a minimum assigned time of 40-minutes (i.e. 5/8" Type X Gypsum Board) as specified in 2021 IBC Table 722.7.1(1). Combustible exterior wall coverings are not permitted except water-resistance barriers having a peak heat release rate of less than 150 kW/m² (2021 IBC 602.4.2.1).

- In general, the interior faces of all mass timber elements, including the inside face of exterior mass timber walls and mass timber roofs, must be protected by noncombustible materials (2021 IBC 602.4.2.2). The protection time must contribute to a time equal to 2/3 of the fire-resistance rating of the building element, but not less than 80 minutes. Notable exceptions include the following:
  - Areas of mass timber ceilings not more than 20% of the floor area are permitted to be exposed.
  - Areas of mass timber walls not more than 40% of the floor area are permitted to be exposed unless serving as an incidental separation per 780 CMR Section 509.

    These provisions apply on a per sleeping unit or per fire area basis. A 'sum of the ratios' type equation allows for a combination of the exposed ceilings and walls to be exposed. Unprotected areas of ceilings and walls are required to be separated by at least 15 ft horizontally. Where mass timber beams exist below a mass timber ceiling, or mass timber columns exits inboard of mass timber walls, all three surfaces of such exposed members are required to be included in the exposed area calculations (2021 IBC 602.4.2.2.2).

- The floor assembly must contain a noncombustible material not less than 1" in thickness above the mass timber (2021 IBC 602.4.2.3).

- The interior surfaces of roof assemblies must be protected by noncombustible materials (2021 IBC 602.4.2.4).

- Concealed spaces are not permitted to contain combustibles other than MEP equipment permitted in plenums in accordance with IMC 602. Combustible construction forming concealed spaced must be protected with noncombustible materials with a minimum assigned time of 40-minutes (2015 IBC 602.4.3.5).

- No exposed mass timber is permitted on the inside and outside surfaces of exit enclosures and elevator hoistways in high-rise buildings (2021 IBC 602.4.2.6). Interior faces of shaft enclosures must be protected by noncombustible materials (2021 IBC 602.4.1.2 & 602.4.2.6).

- Sealant or adhesive meeting ASTM C920 or D3498, respectively, is required to be provided to resist the passage of air in the following locations (2021 IBC 703.7):
  - At abutting edges and intersections of mass timber building elements required to be fire-resistance rated
  - At abutting intersections of mass timber building elements and building elements of other materials where both are required to be fire-resistance rated

There is a change to the 2021 **IFC** (Section 3303.5) which requires certain features to be provided during construction, including installation of required protective gypsum board layers when construction has exceeded six stories above a given floor. We note that the IFC is not adopted in Massachusetts unless specifically referenced by 780 CMR, such that these requirements are not directly applicable. We are not aware of the MA Fire Code (527 CMR) being modified to include such requirements.

Increase in Exposed Ceiling Area (2024 IBC)

Although not officially finalized or published, there is a proposed code change for the 2024 IBC that has been preliminarily 'approved as submitted' that is worth noting. Via Code Change G147-21, the aforementioned limit to the amount of **ceiling area** that can be exposed will be increased from 20% to 100%. Given the common desire for wood to be exposed at the ceiling, this change would dramatically affect the aesthetic flexibility of residential unit design. Please note that, even when finalized in the printed 2024 IBC, this provision would not be a part of the 10th edition of 780 CMR, which will be based on the 2021 IBC. Additional approval/relief would have to be sought to utilize these provisions.

CODE SUMMARY - IBC 2021 EXCERPTS

TABLE 504.3
ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE[a]

OCCUPANCY CLASSIFICATION	See Footnotes	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
A, B, E, F, M, S, U	NS[b]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	270	180	85	85	70	60
H-1, H-2, H-3, H-5	NS[c, d]	UL	160	65	55	65	55	120	90	65	65	50	40
	S												
H-4	NS[c, d]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	140	100	85	85	70	60
I-1 Condition 1, I-3	NS[d, e]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
I-1 Condition 2, I-2	NS[d, e, f]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85									
I-4	NS[d, g]	UL	160	65	55	65	55	65	65	65	65	50	40
	S	UL	180	85	75	85	75	180	120	85	85	70	60
R[h]	NS[d]	UL	160	65	55	65	55	65	65	65	65	50	40
	S13D	60	60	60	60	60	60	60	60	60	60	50	40
	S13R	60	60	60	60	60	60	60	60	60	60	60	60
	S	UL	180	85	75	85	75	270	180	85	85	70	60

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	A	B	C	HT	A	B
Primary structural frame[f] (see Section 202)	3[a, b]	2[a, b, c]	1[b, c]	0[c]	1[b, c]	0	3[a]	2[a]	2[a]	HT	1[b, c]	0
Bearing walls												
Exterior[e, f]	3	2	1	0	2	2	3	2	2	2	1	0
Interior	3[a]	2[a]	1	0	1	0	3	2	2	1/HT[g]	1	0
Nonbearing walls and partitions Exterior	See Table 705.5											
Nonbearing walls and partitions Interior[d]	0	0	0	0	0	0	0	0	0	See Section 2304.11.2	0	0
Floor construction and associated secondary structural members (see Section 202)	2	2	1	0	1	0	2	2	2	HT	1	0
Roof construction and associated secondary structural members (see Section 202)	$1^1/_2$[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	$1^1/_2$	1	1	HT	1[b,c]	0

TABLE 705.5 FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE[a, d, g]

FIRE SEPARATION DISTANCE = X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP H[e]	OCCUPANCY GROUP F-1, M, S-1[f]	OCCUPANCY GROUP A, B, E, F-2, I, R[i], S-2, U[h]
X < 5[b]	All	3	2	1
5 ≤ X < 10	IA, IVA	3	2	1
	Others	2	1	1
10 ≤ X < 30	IA, IB, IVA, IVB	2	1	1[c]
	IIB, VB	1	0	0
	Others	1	1	1[c]
X ≥ 30	All	0	0	0

For SI: 1 foot = 304.8 mm.

a. Load-bearing exterior walls shall also comply with the fire-resistance rating requirements of Table 601.
b. See Section 706.1.1 for party walls.
c. Open parking garages complying with Section 406 shall not be required to have a fire-resistance rating.
d. The fire-resistance rating of an exterior wall is determined based upon the fire separation distance of the exterior wall and the story in which the wall is located.
e. For special requirements for Group H occupancies, see Section 415.6.
f. For special requirements for Group S aircraft hangars, see Section 412.3.1.
g. Where Table 705.8 permits nonbearing exterior walls with unlimited area of unprotected openings, the required fire-resistance rating for the exterior walls is 0 hours.
h. For a building containing only a Group U occupancy private garage or carport, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet (1523 mm) or greater.
i. For a Group R-3 building of Type II-B or Type V-B construction, the exterior wall shall not be required to have a fire-resistance rating where the fire separation distance is 5 feet (1523 mm) or greater.

TABLE 504.4—continued
ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE[a, b]

OCCUPANCY CLASSIFICATION	See Footnotes	TYPE OF CONSTRUCTION											
		Type I		Type II		Type III		Type IV				Type V	
		A	B	A	B	A	B	A	B	C	HT	A	B
R-1[h]	NS[d]	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4									4	3
	S	UL	12	5	5	5	5	18	12	8	5	4	3
R-2[h]	NS[d]	UL	11	4	4	4	4	4	4	4	4	3	2
	S13R	4	4	4								4	3
	S	UL	12	5	5	5	5	18	12	8	5	4	3
R-3[h]	NS[d]	UL	11	4	4	4	4	4	4	4	4	3	3
	S13D	4	4									3	3
	S13R	4	4									4	4
	S	UL	12	5	5	5	5	18	12	5	5	4	4
R-4[h]	NS[d]	UL	11	4	4	4	4	4	4	4	4	3	2
	S13D	4	4									3	2
	S13R	4	4									4	3
	S	UL	12	5	5	5	5	18	12	5	5	4	3
S-1	NS	UL	11	4	2	3	2	4	4	4	4	3	1
	S	UL	12	5	4	4	4	10	7	5	5	4	2
S-2	NS	UL	11	5	3	4	3	4	4	4	5	4	2
	S	UL	12	6	4	5	4	12	8	5	6	5	3
U	NS	UL	5	4	2	3	2	4	4	4	4	2	1
	S	UL	6	5	3	4	3	9	6	5	5	3	2

TYPE IV-B MASS TIMBER LAYOUT

9 STORIES WOOD OVER 1 STORY CONCRETE

FIRE RATING REQUIREMENTS FOR STRUCTURAL ELEMENTS (PER IBC 2021)

Primary Structural Frame	2 hrs
Bearing Walls	2 hrs
Floor Construction	2 hrs
Roof Construction	1 hr

WOOD VOL / SF:
5-PLY CLT = 990 in^3/sf
Glulam Beams = 196 in^3/sf
Glulam Columns = 159 in^3/sf

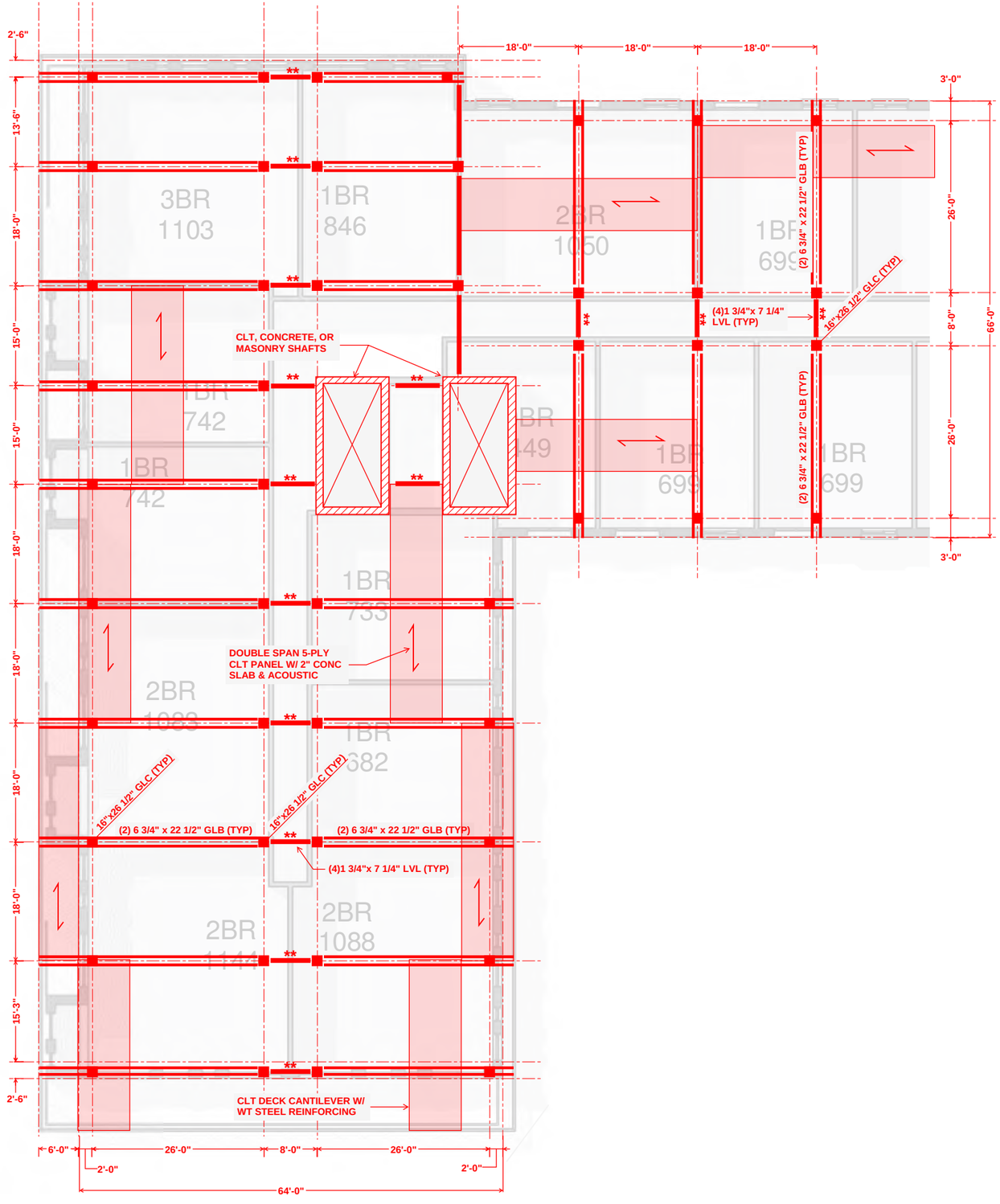
TOTAL = 1345 in^3/sf
% of framing in total wood volume = 26%

Material Assumptions:
CLT Floor and Roof Panels: *Grade E1*
Glulam Beam Framing: *Western Species Grade 24F-1.8E*
Glulam Column Framing: *Western Species Grade 2 DF-L2*

DESIGN CRITERIA:

FLOOR DEAD LOAD = 65 psf (including CLT weight)
FLOOR LIVE LOAD = 40 psf

DRAWING NOTES:
1. ⇄ Indicates double span of 5-PLY Grade E1 CLT topped with 2" concrete slab and acoustic layer.
2. Column sizes reported for lowest level of wood, resulting in maximum column size. Column sizes at upper stories likely to decrease in depth.
3. ** tag on beam indicates member assumed to be fully fire protected by architectural finishes.



FLR/FLR HEIGHTS - CORRIDOR STUDY

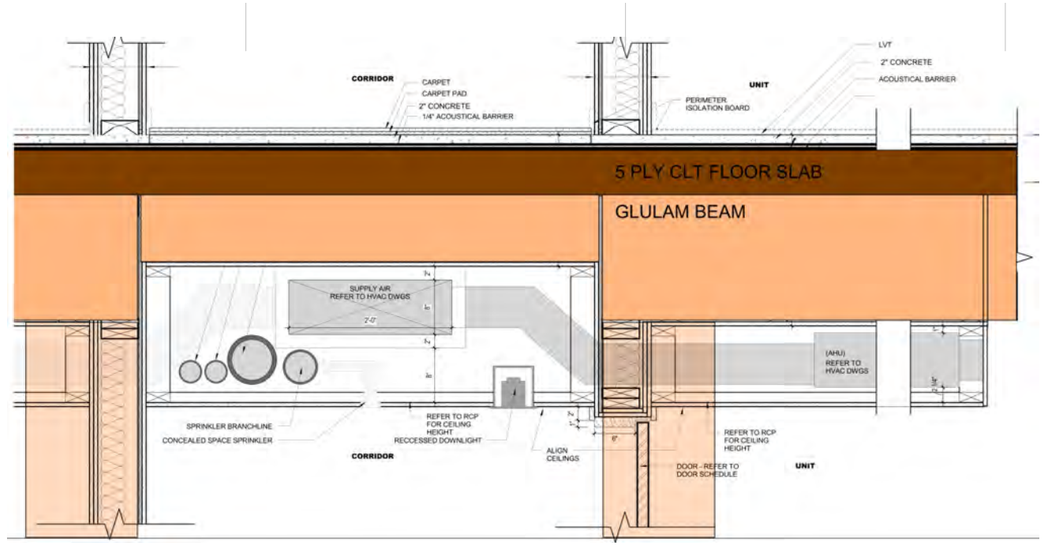
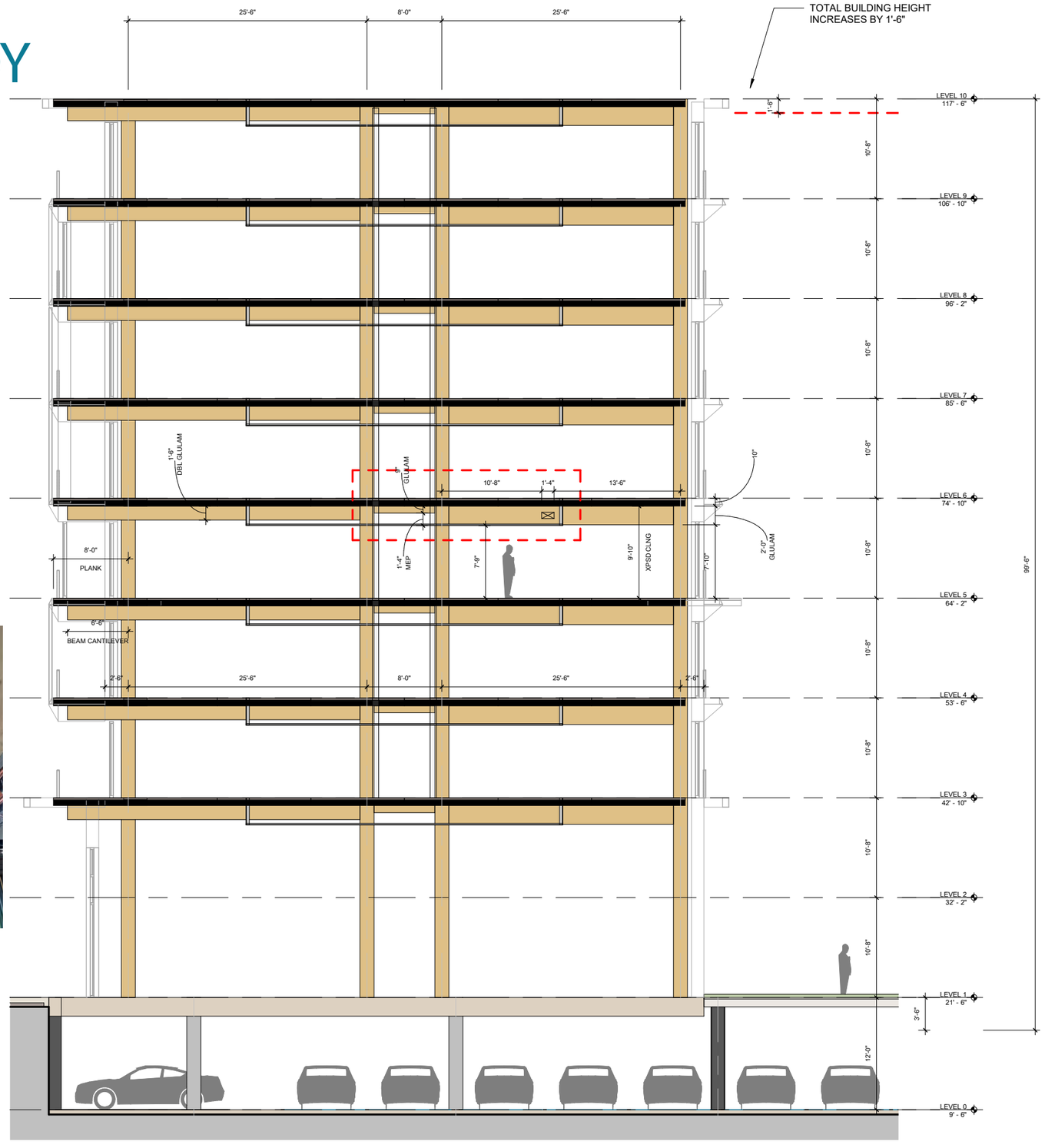


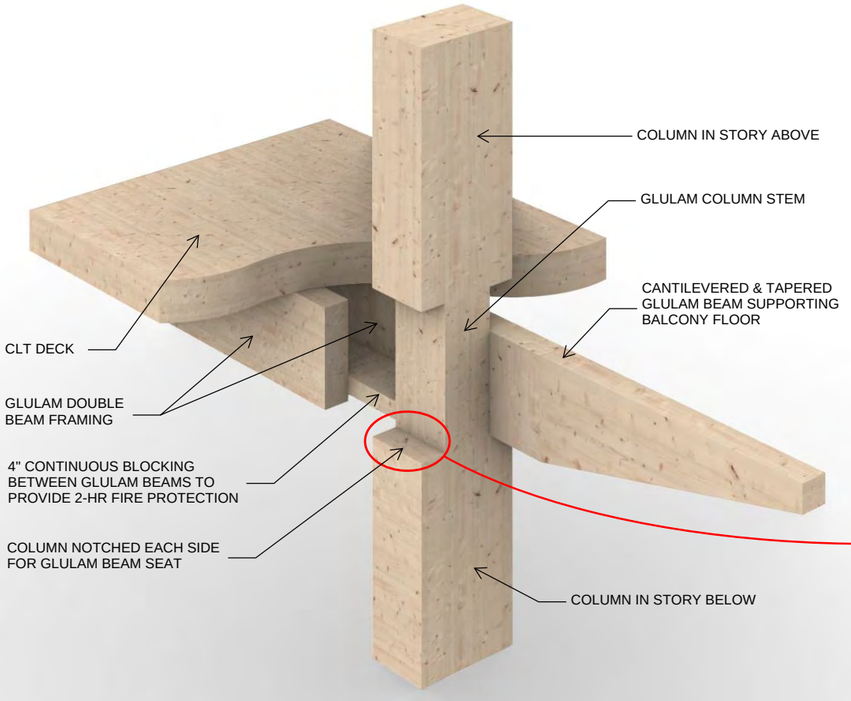
photo: WoodWorks

T3 Minneapolis utilizes a rectangular 20x25-ft grid with 2x8-ft NLT panels spanning 20 ft between glulam beams in order to allow main MEP truck lines to circulate around the central core with service trunk lines branching out in each bay as necessary. This minimizes the need for glulam beam penetrations.

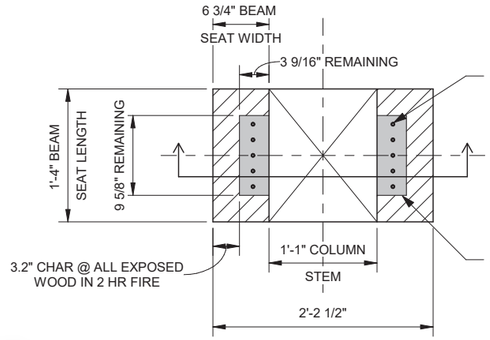
11 E Lenox corridor and beam penetrations precedent



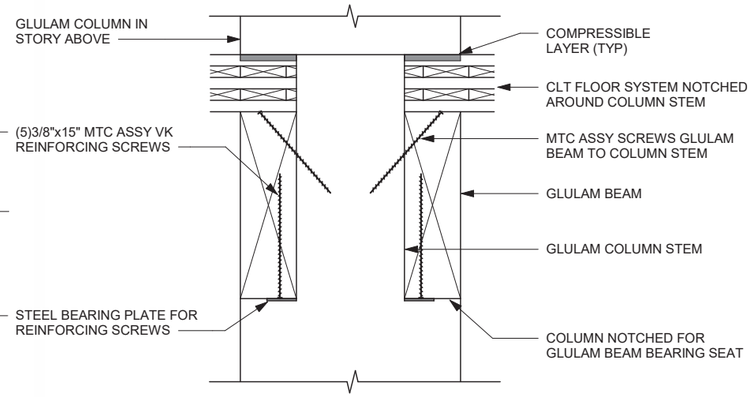
DOUBLE BEAM BALCONY CONCEPT



BEAM TO COLUMN CONNECTION



TOP OF COLUMN PLAN VIEW W/ 2-HR FIRE CHAR DEVELOPMENT



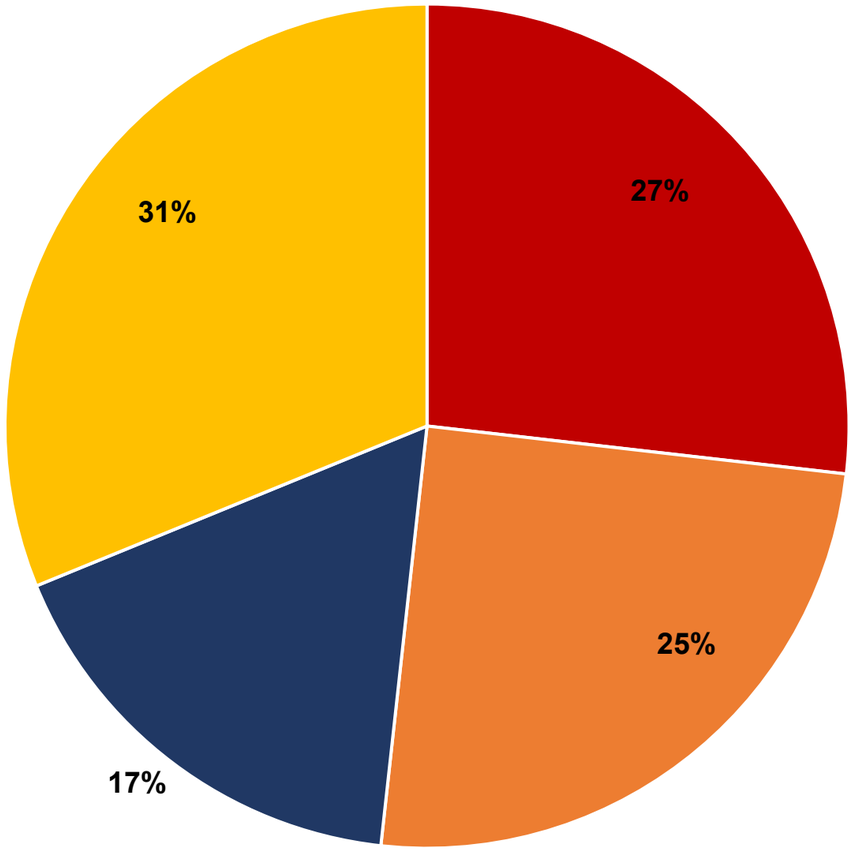
COLUMN SECTION VIEW

TYPICAL REINFORCED BEARING CONNECTION

EMBODIED CARBON COMPARISON

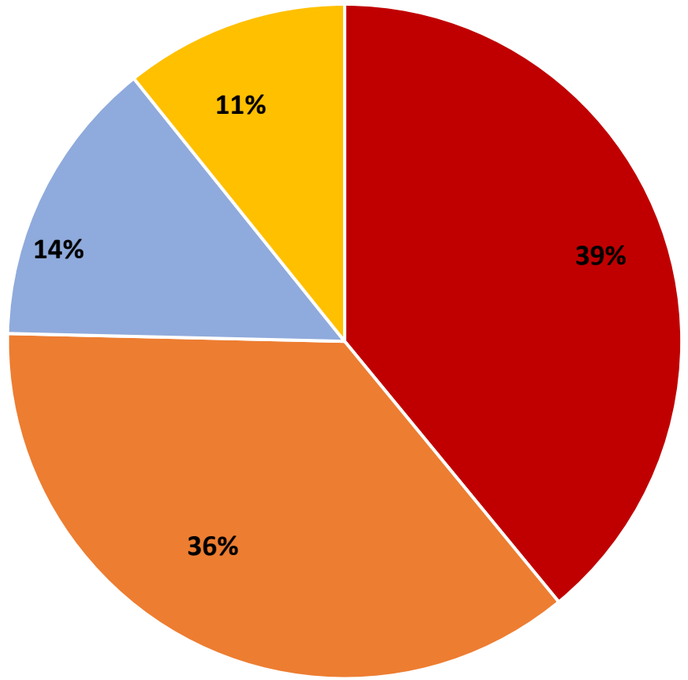
STEEL: COMPOSITE CONCRETE SLAB ON STEEL DECK ON STEEL FRAME

20.8 kg CO2e / SF



HYBRID: CLT DECK WITH 2" CONCRETE TOPPING ON STEEL FRAME

14.3 kg CO2e / SF



MASS TIMBER: CLT DECK WITH 2" CONCRETE TOPPING ON GLULAM FRAME

4.1 kg CO2e / SF