INTRO Cleveland

Using the new tall wood building code to design one of the country's largest and tallest mass timber residential buildings.

Presented by: John Mitchell

Hartshorne Plunkard Architecture

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

LEARNING OBJECTIVES

1. Outline the Tall Wood Building code changes in the 2021 IBC, and how these were used in a new construction mass timber project.
2. Explain some of the fire resistance requirements, considerations, and limitations for the project.
3. Discuss how these factors were reviewed and discussed with the local code authorities.

THE PROJECT

PROJECT TEAM:

OWNER -	Harbor Bay Real Estate Advisors
ARCHITECT -	Hartshorne Plunkard Architecture
STRUCTURAL ENGINEER -	Forefront Structural Engineers
MASS TIMBER ENGINEER -	Fast + Epp
MEP ENGINEER -	Windsor Engineers
CIVIL ENGINEER -	GPD Group
CODE CONSULTANT -	WISS JANNEY ELSTNER ASSOCIATES, INC.

PROGRAM:

-New construction building, or collection of buildings, on a multi-acre urban site in Cleveland

-Residential, retail, event space, and required parking

-From early concepts, mass timber was part of the conversation

THE NEIGHBORHOOD -OHIO CITY

SOURCE: GOOGLE MAPS

THE NEIGHBORHOOD - OHIO CITY

SOURCE: VSTUDIOS

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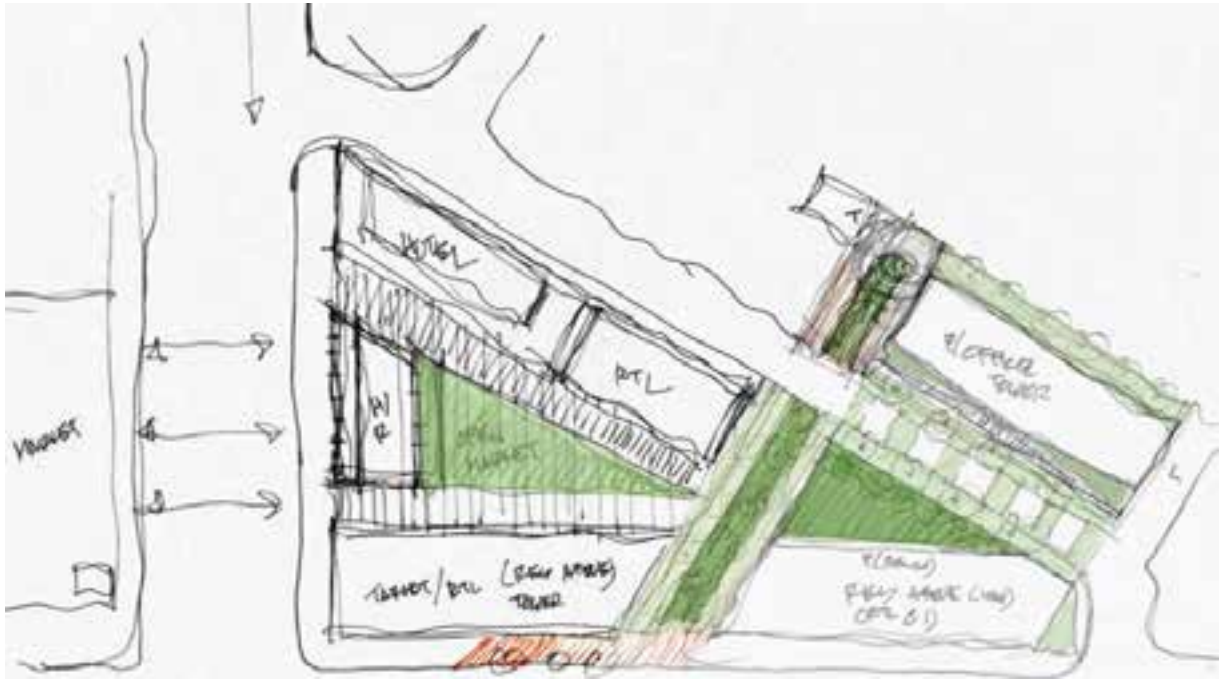
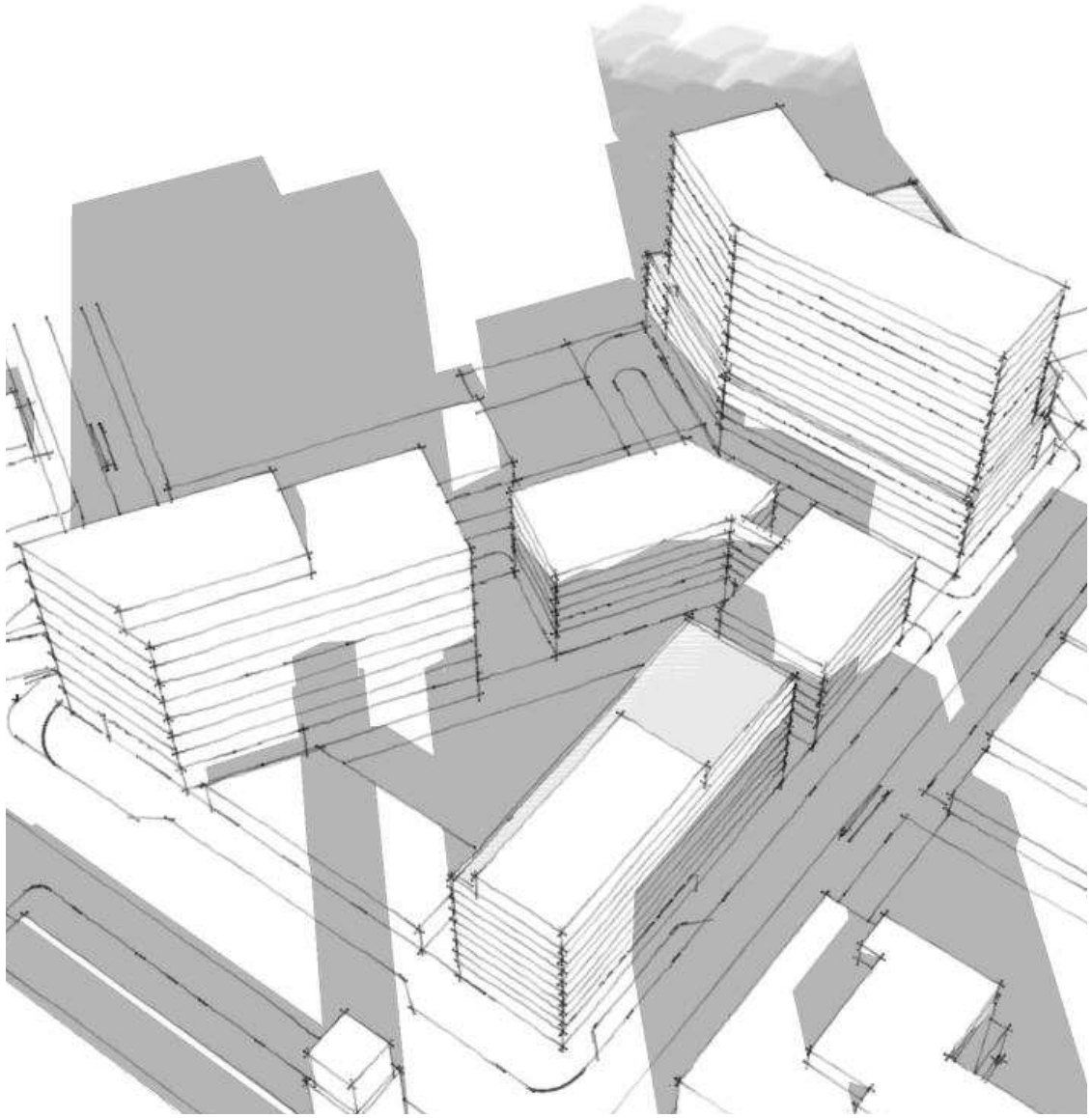
PROGRAMMING AND EARLY DESIGN CONCEPTS





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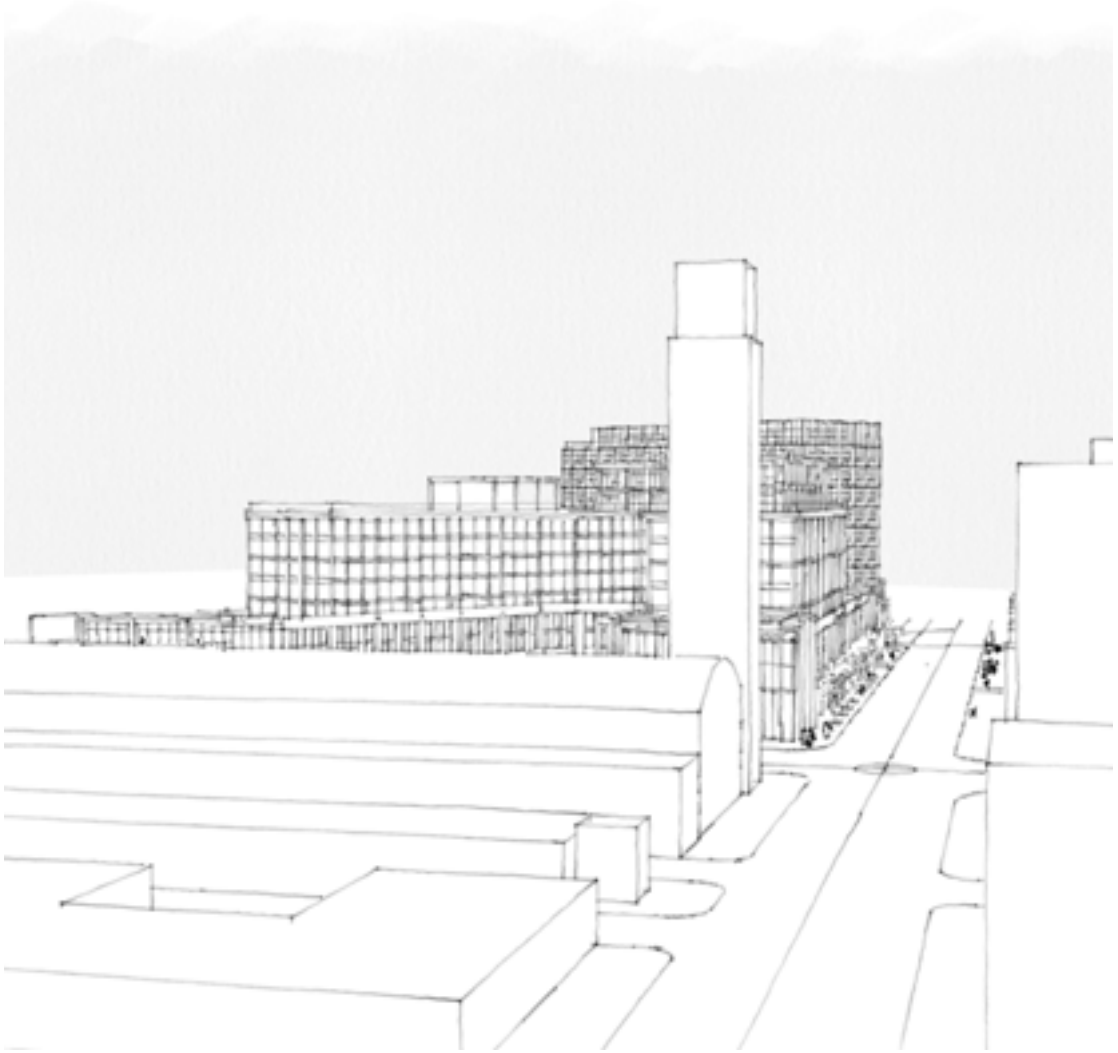
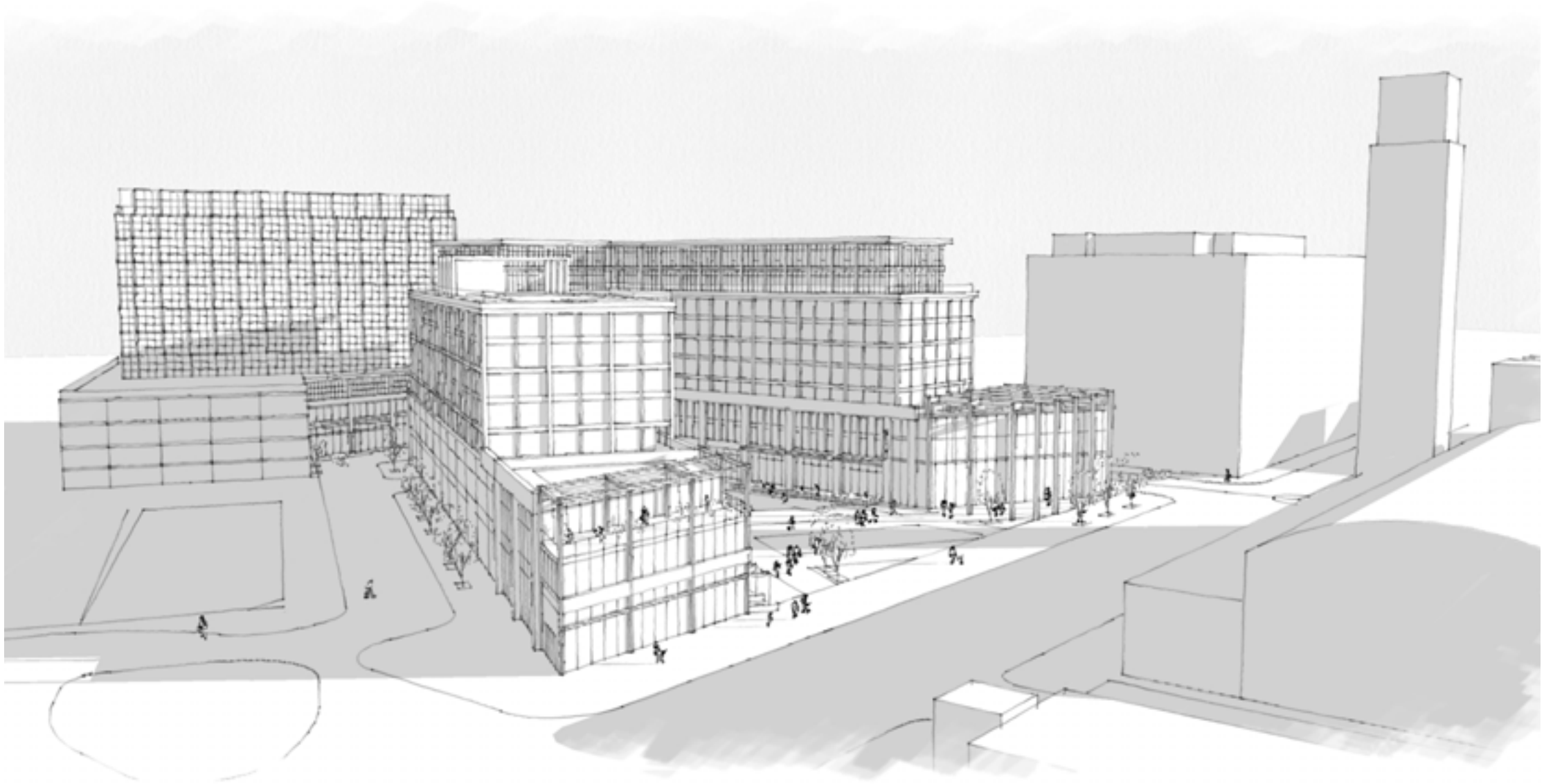
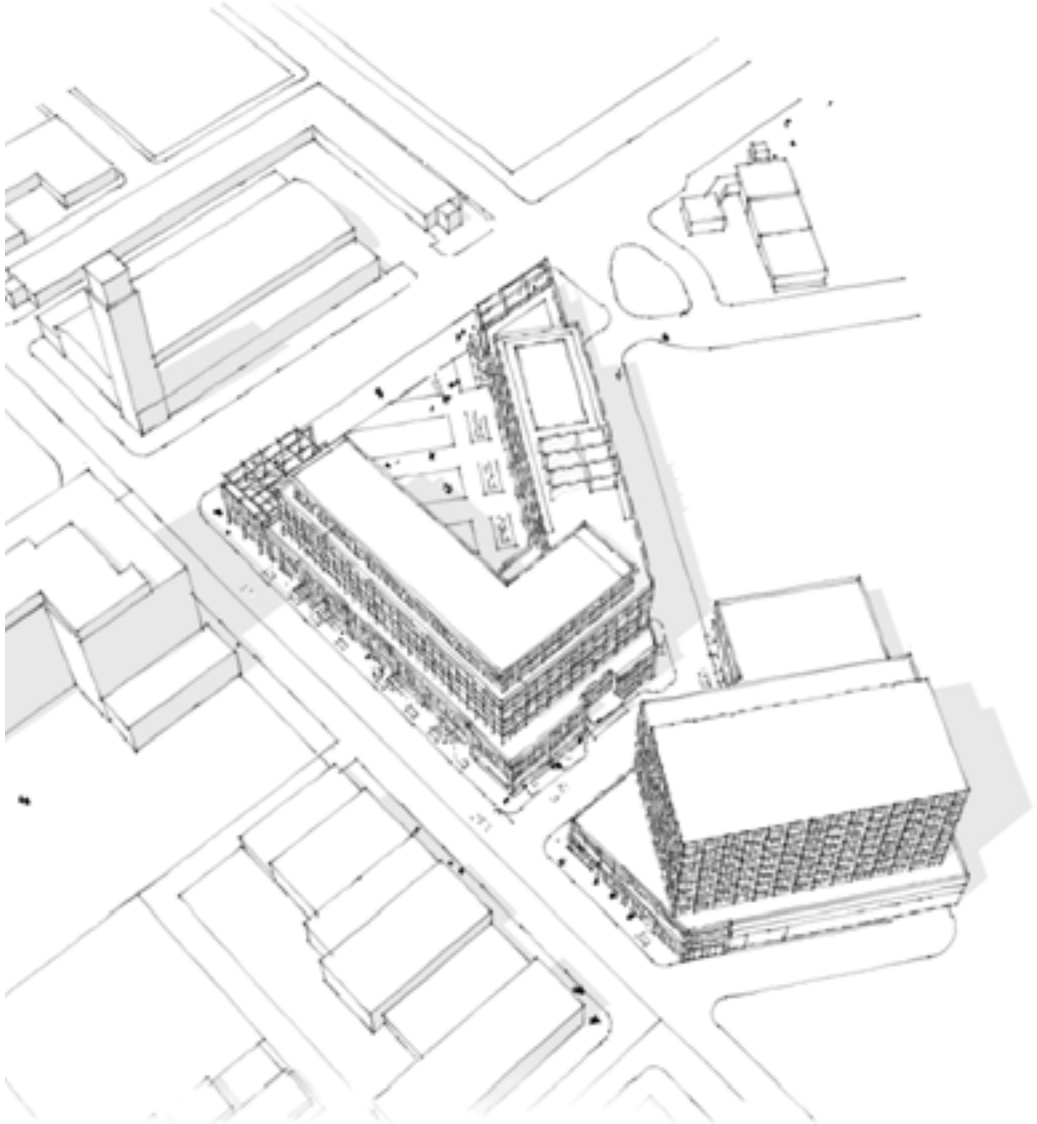


PROGRAMMING AND EARLY DESIGN CONCEPTS



PROGRAMMING AND EARLY DESIGN CONCEPTS



PART I - MASS TIMBER CODE REQUIREMENTS

2021 IBC TALL WOOD BUILDING CODE SUMMARY

Type of Construction Comparison

Feature	Type IVA	Type IVB	Type IVC
Description of new Type IV types	100 % Noncombustible (NC) protection on all surfaces of Mass Timber (MT)	100% NC protection on all surfaces of mass timber (MT) except for limited exposed mass timber (MT) elements	100% exposed mass timber (MT) except: shafts, concealed spaces, and outside of exterior walls.
Permitted Materials			
structural building elements	MT or NC	MT or NC	MT or NC
Nonloadbearing Exterior Walls	MT or NC	MT or NC	MT, NC
Nonloadbearing Interior Walls	MT or NC	MT or NC	MT, NC
Shaft and Exit Enclosures			
Highrise* to 12 stories or 180 feet: Above 12 stories or 180 feet: *see IBC definition of highrise	NC or MT protected with 2 (or 3 when 3 hr FRR) layers of 5/8" type X; NC	NC or MT protected with 2 layers of 5/8" type X gypsum or equiv each side of enclosure; NC	NC or MT protected with one layer of 5/8" type X gypsum each side of shaft or enclosure. Not Permitted
Interior Protection			
Req'd 3 hr FRR Req'd 2 hr FRR Req'd 1 hr FRR	3 layers of 5/8" type X gypsum 2 layers of 5/8" type X gypsum 1 layer of 5/8" type X gypsum	SAME AS TYPE IV-A FOR PROTECTED MT. Limited exposed MT elements must have same FRR but done by Calculated FRR of Section 722 (exposed MT is oversized to meet FRR of table 601).	All MT is allowed to be exposed except for 1 layer of 5/8" type x on outside surfaces of exterior walls, inside and outside of shafts and exit enclosures, and in concealed spaces.
Exterior Protection			
	Minimum of 1 layer of 5/8" type X gypsum	Minimum of 1 layer of 5/8" type X gypsum	Minimum of 1 layer of 5/8" type X gypsum

Type of Construction Comparison

Feature	Type IVA	Type IVB	Type IVC
Floor Surface	1 inch of NC protection	1 inch of NC protection	No protection required
Roof	No NC protection on exterior roof surface, 2 layers of 5/8" type X gypsum on interior roof surfaces.	No NC protection on exterior roof surface, 2 layers of 5/8" type X gypsum on inside of roof deck.	No protection on roof surface or inside of roof deck is required (unless concealed space).
Concealed Spaces	No exposed MT in concealed spaces. NC protection in concealed spaces.	No exposed MT in concealed spaces. NC protection in concealed spaces.	No exposed MT in concealed spaces. One layer of 5/8" type x gypsum NC protection in concealed spaces.
Table 601, FRR			
Primary frame or bearing Wall: Floors: Roof:	3 hr FRR; 2 hr FRR; 1.5 hr FRR;	2 hr FRR; 2 hr FRR; 1 hr FRR;	2 hr FRR; 2 hr FRR; 1 hr FRR;
Fire Resistance Rating trade off	NO FRR reduction for sprinkler in 4.3.2.1	NO FRR reduction for sprinkler in 4.3.2.1	NO FRR reduction for sprinkler in 4.3.2.1

SOURCE: INTERNATIONAL CODE COUNCIL

2021 IBC TALL WOOD BUILDING CODE SUMMARY

TABLE 504.4 - ALLOWABLE NUMBER OF STORIES ABOVE GRADE PLANE					
	NS=Nonsprinklerd S= Sprinklered	Type IV-A	Type IV-B	Type IV-C	Type IV-HT
A-1	NS	3	3	3	3
	S	9	6	4	4
A-2	NS	3	3	3	3
	S	18	12	6	4
A-3	NS	3	3	3	3
	S	18	12	6	4
A-4	NS	3	3	3	3
	S	18	12	6	4
A-5	NS	1	1	1	1
	S	UL	UL	UL	UL
B	NS	5	5	5	5
	S	20	12	9	6
M	NS	4	4	4	4
	S	12	8	6	5
R-1	NS	4	4	4	4
	S	18	12	9	5
R-2	NS	4	4	4	4
	S	18	12	9	5
R-3	NS	4	4	4	4
	S	18	12	5	5
R-4	NS	4	4	4	4
	S	18	12	5	5
S-1	NS	4	4	4	4
	S	10	7	5	5
S-2	NS	4	4	4	4
	S	12	8	5	5
U	NS	4	4	4	4
	S	9	6	5	5

SOURCE: INTERNATIONAL CODE COUNCIL

2021 IBC TALL WOOD BUILDING CODE SUMMARY

Table 504.3
ALLOWABLE BUILDING HEIGHT IN FEET ABOVE GRADE PLANE[a, d]

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, d]	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	UL											
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								70	60
I-4	NS[d, g]	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
R[h]	NS[d]	UL	160	65	55	65	55	65	65	65	65	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

For SI: 1 foot = 304.8 mm
UL = Unlimited; NS = Buildings not equipped throughout with an automatic sprinkler system; S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1; S13R = Buildings

SOURCE: INTERNATIONAL CODE COUNCIL

2021 IBC TALL WOOD BUILDING CODE SUMMARY

Table 506.2
ALLOWABLE AREA Factor (A_t=NS, S1, SM) in SQUARE FEET

Use Group	NS - non sprklrd S1 -1 story sprnklrd SM - >1 story sprklrd	Type I-A	Type I-B	Type II-A	Type II-B	Type IV-A	Type IV-B	Type IV-C	Type IV-HT	Type V-A	Type V-B
A-1	NS	UL	UL	15,500	8,500	45,000	30,000	18,750	15,000	11,500	5,500
	S1	UL	UL	62,000	34,000	180,000	120,000	75,000	60,000	46,000	22,000
	SM	UL	UL	46,500	25,500	135,000	90,000	56,250	45,000	34,500	16,500
A-2	NS	UL	UL	15,500	9,500	45,000	30,000	18,750	15,000	11,500	6,000
	S1	UL	UL	62,000	38,000	180,000	120,000	75,000	60,000	46,000	24,000
	SM	UL	UL	46,500	28,500	135,000	90,000	56,250	45,000	34,500	18,000
B	NS	UL	UL	37,500	23,000	108,000	72,000	45,000	36,000	18,000	9,000
	S1	UL	UL	150,000	92,000	432,000	288,000	180,000	144,000	72,000	36,000
	SM	UL	UL	112,500	69,000	324,000	216,000	135,000	108,000	54,000	27,000
M	NS	UL	UL	21,500	12,500	61,500	41,000	25,625	20,500	14,000	9,000
	S1	UL	UL	86,000	50,000	246,000	164,000	102,500	82,000	56,000	36,000
	SM	UL	UL	64,500	37,500	184,500	123,000	76,875	61,500	42,000	27,000
R-2	NS S13R	UL	UL	24,000	16,000	61,500	41,000	25,625	20,500	12,000	7,000
	S1	UL	UL	96,000	64,000	246,000	164,000	102,500	82,000	48,000	28,000
	SM	UL	UL	72,000	48,000	184,500	123,000	76,875	61,500	36,000	21,000
S-2	NS	UL	79,000	39,000	26,000	115,500	77,000	48,125	38,500	21,000	13,500
	S1	UL	316,000	156,000	104,000	462,000	308,000	192,500	154,000	84,000	54,000
	SM	UL	237,000	117,000	78,000	346,500	231,000	144,375	115,500	63,000	40,500

SOURCE: INTERNATIONAL CODE COUNCIL

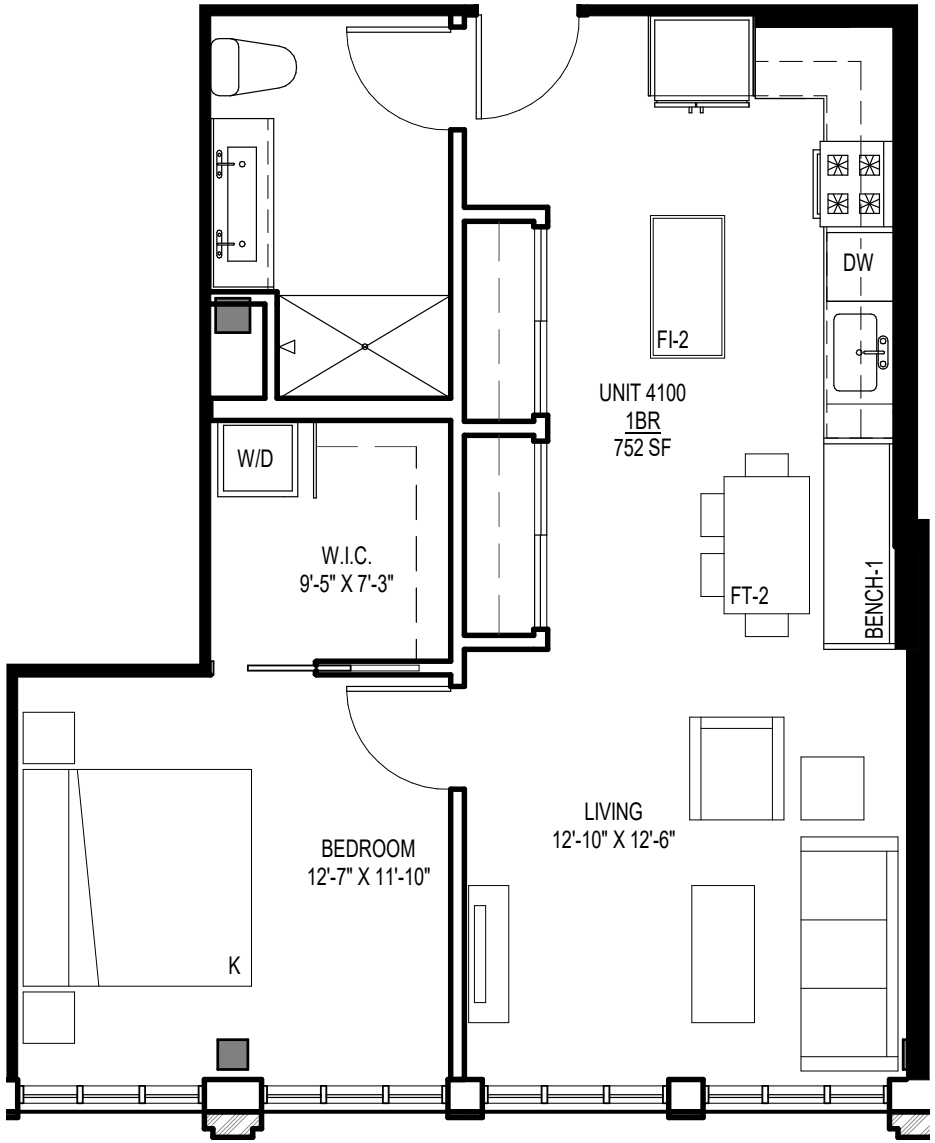
PART II - APPLICATION

TIMBER CODE ANALYSIS - SUMMARY

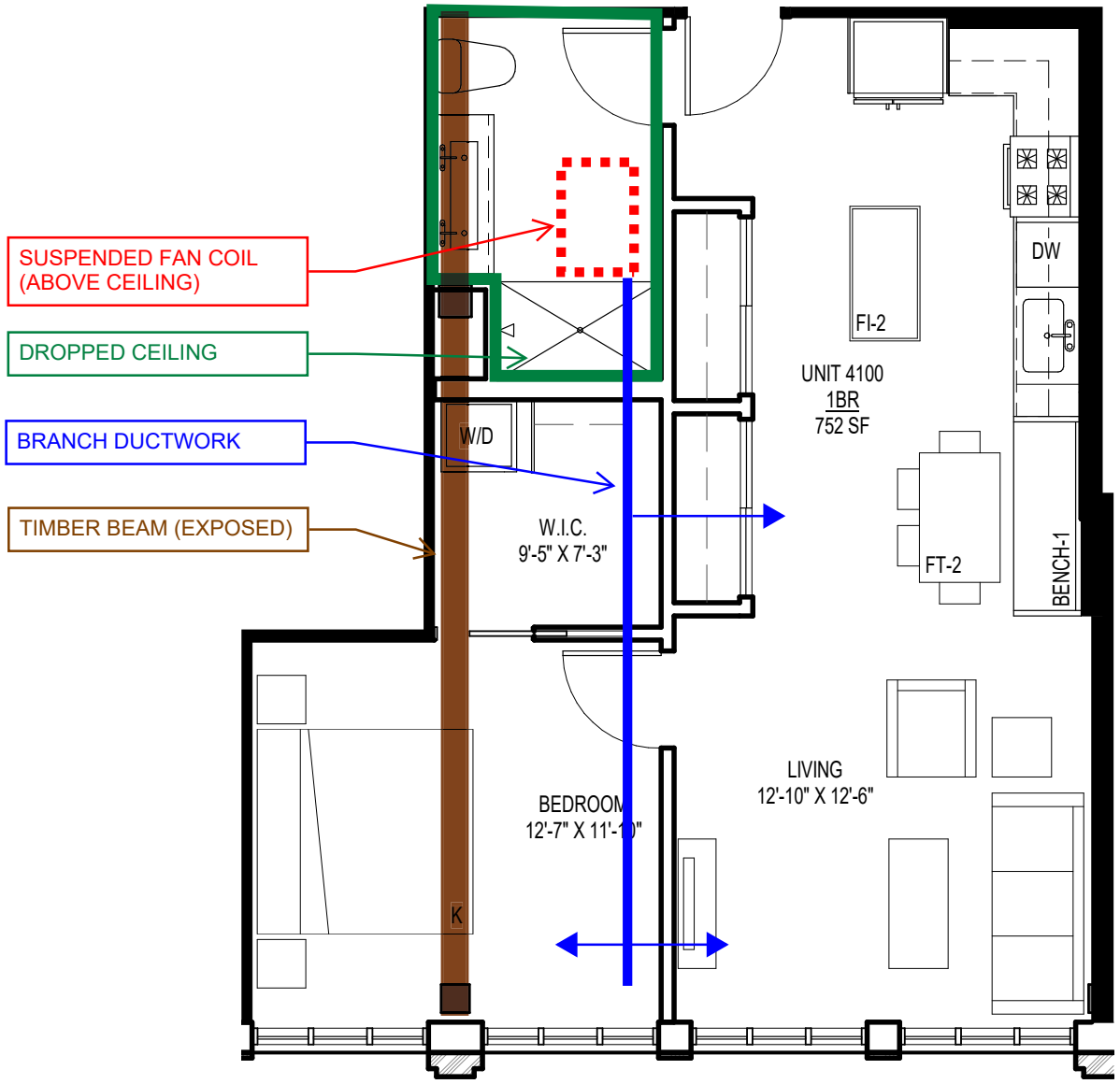
CONSTRUCTION TYPE = IV-B (I-A GARAGE AND 1ST FLOOR)

TOPIC	ALLOWED	PROPOSED
HEIGHT =	180’	115’
STORIES =	12	9
AREA (MIXED USE) =	6 53,000 SF	5 12,000 SF
TIMBER COVERAGE =	80% CEILINGS	LESS THAN 80% CEILINGS
	OR 60% WALLS	NO TIMBER WALLS

TYPICAL 1-BEDROOM UNIT

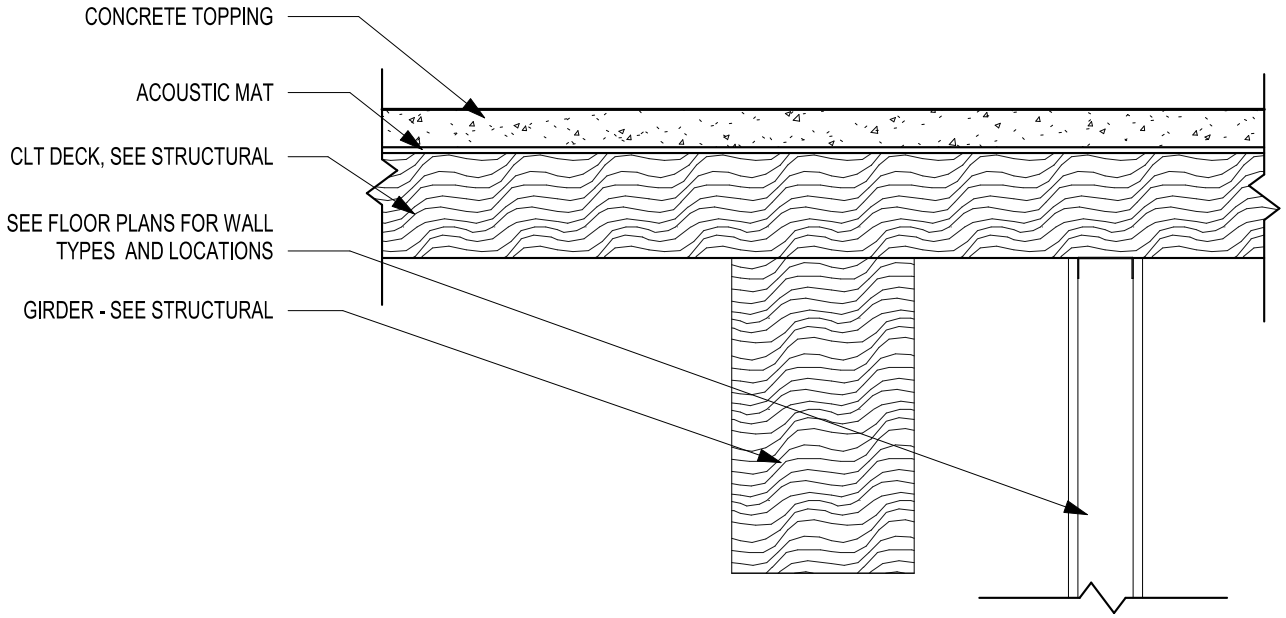


TYPICAL 1-BEDROOM UNIT - CEILING OVERLAY

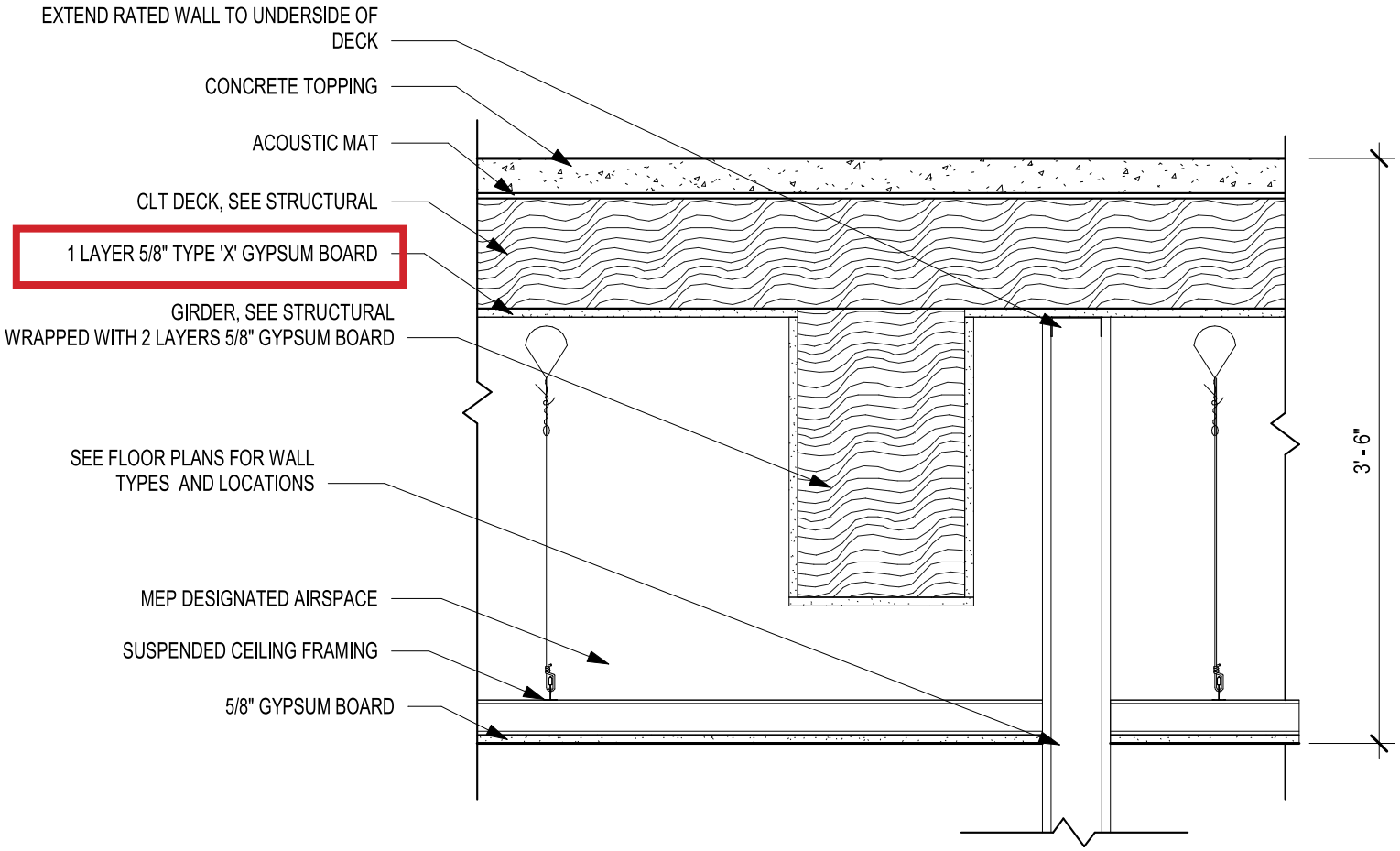


TYPICAL FLOOR ASSEMBLY - EXPOSED TIMBER

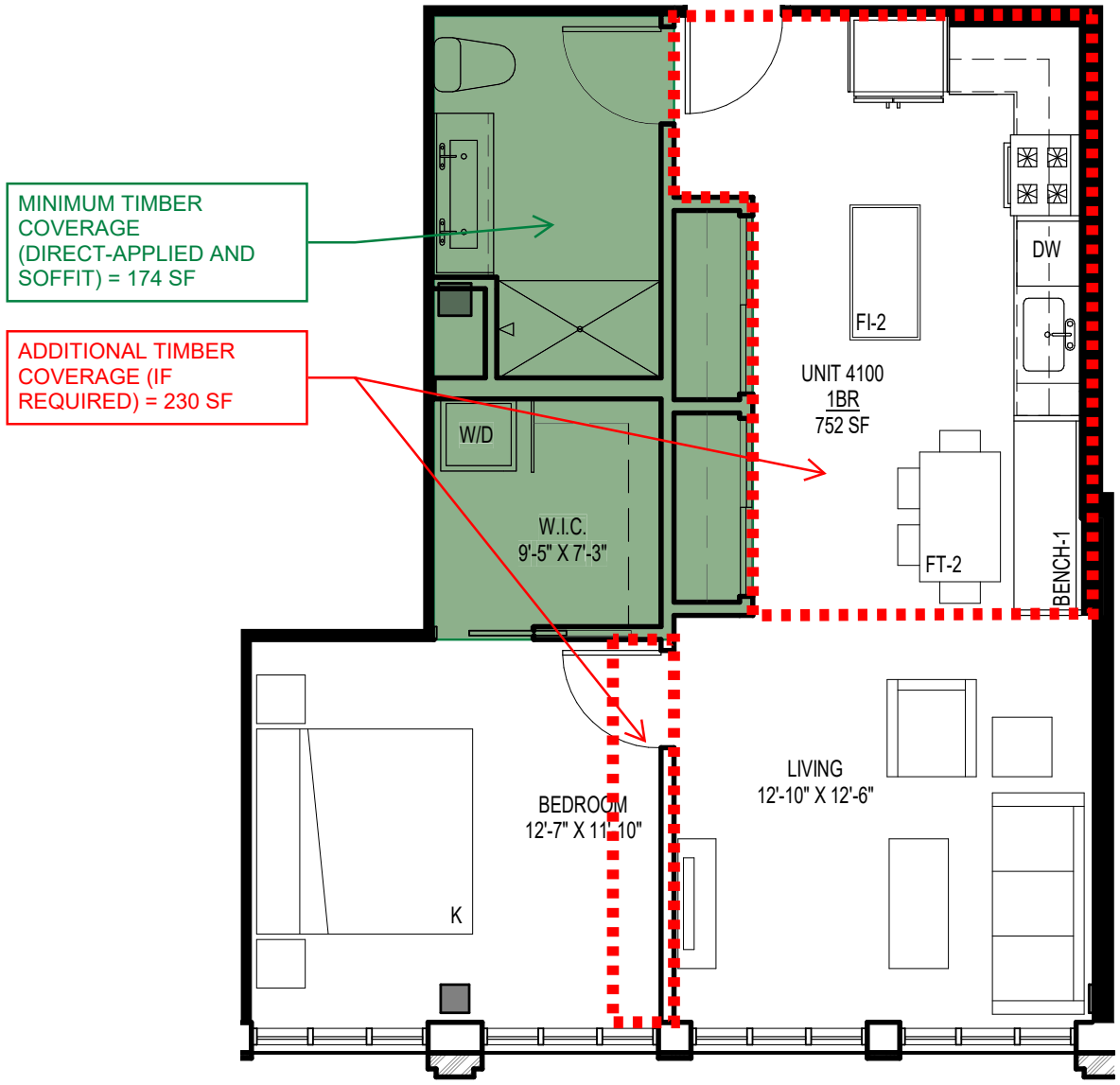
*SEE BUILDING SECTION SHEETS
FOR FLOOR ASSEMBLIES



TYPICAL FLOOR ASSEMBLY - UNPROTECTED TIMBER WITH CONCEALED SPACE



TYPICAL 1-BEDROOM UNIT - PROPOSED TIMBER COVERAGE



UNIT AREA = 752 SF

80% MIN. CEILING COVERAGE (PER CODE) = 602 SF

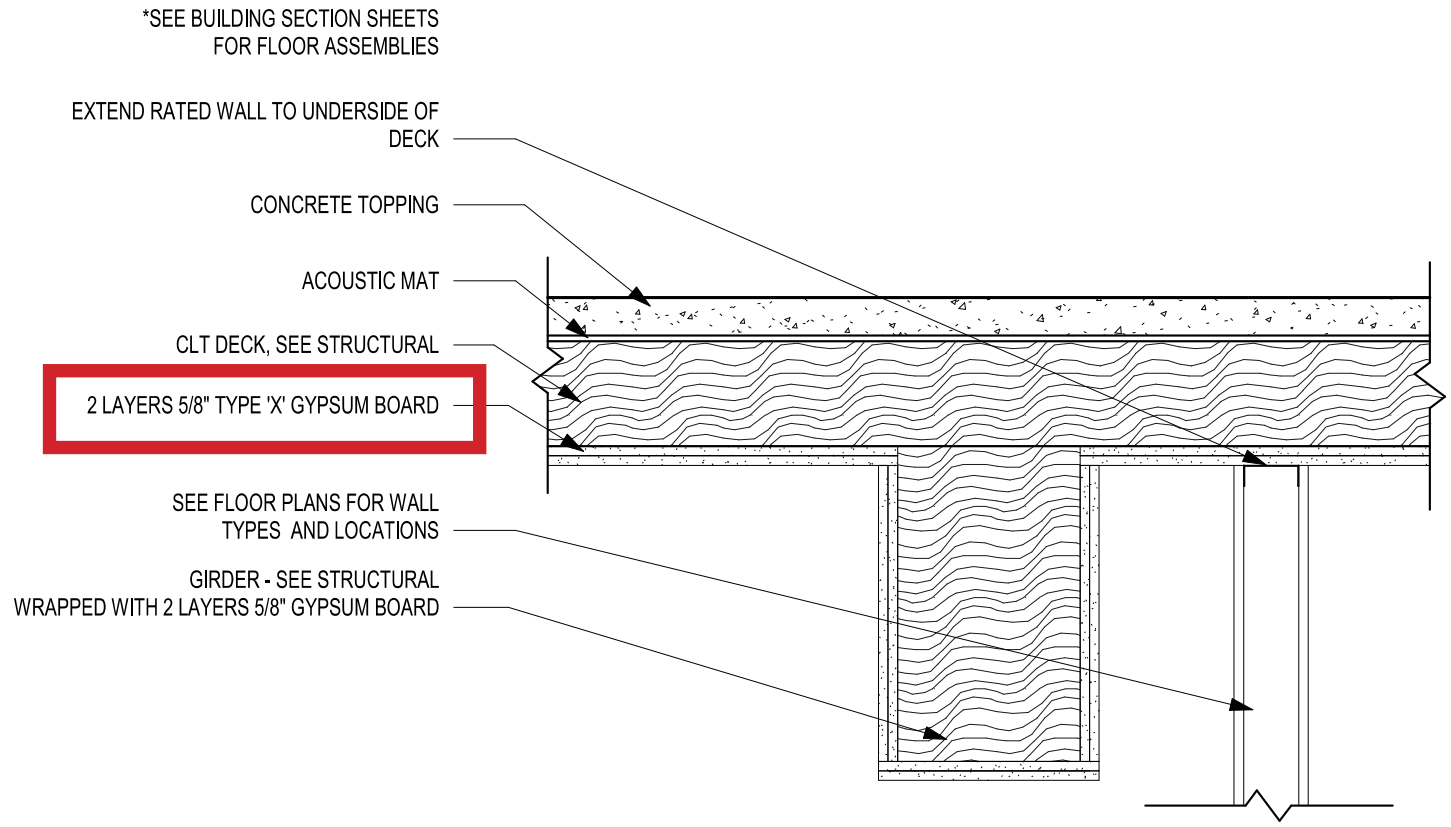
MINIMUM TIMBER COVERAGE = 174 SF (23%)

MINIMUM + ADDITIONAL = 404 SF (54%)

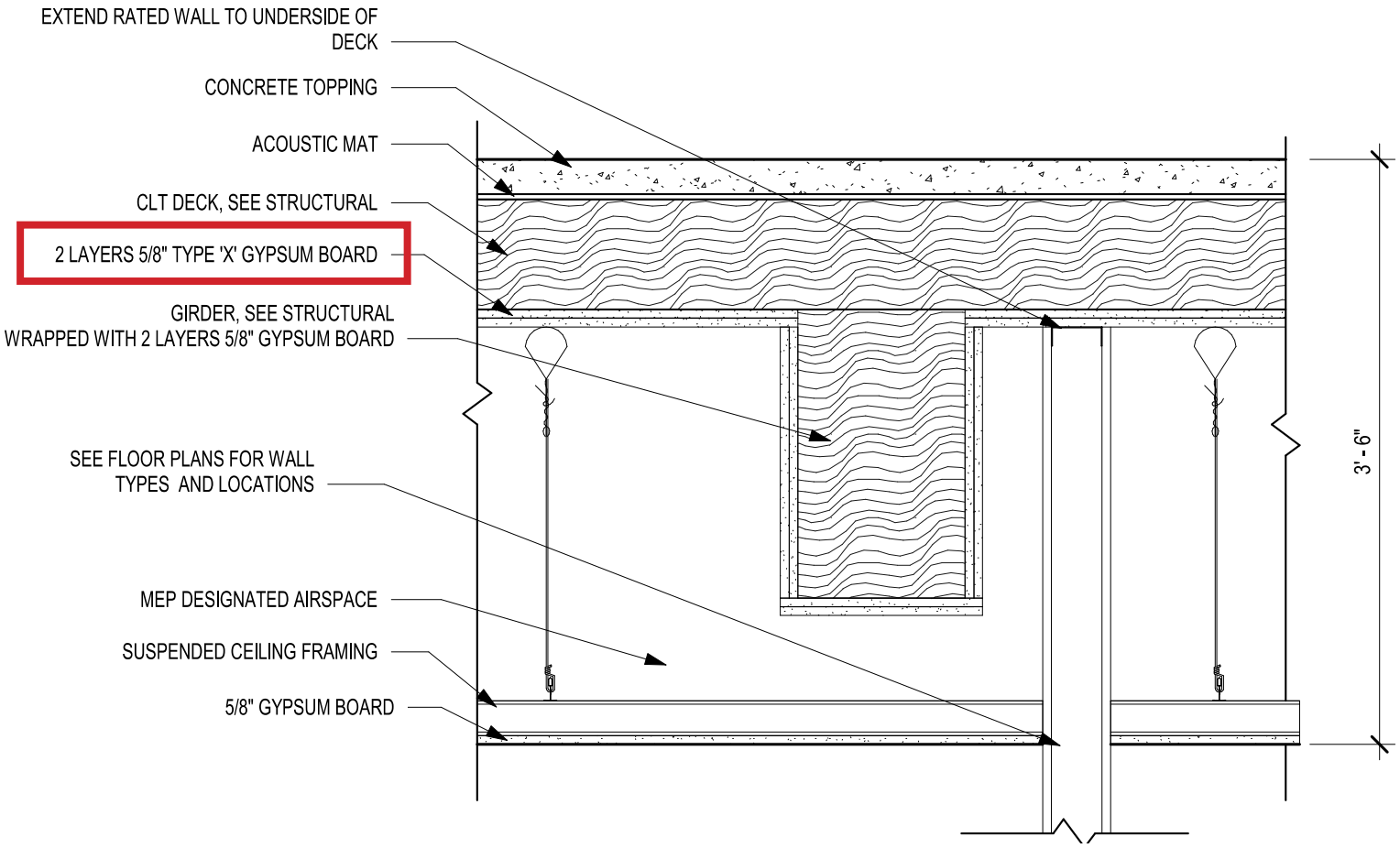
TYPICAL FLOOR ASSEMBLY - PROTECTED TIMBER

PER IBC SEC. 602.4.2.2.1, 2/3 OF THE HOURLY RATING NEEDS TO BE FROM NONCOMBUSTIBLE PROTECTION (GYP BOARD OR SFRM).

HOWEVER, EACH TIMBER MEMBER WILL BE SIZED FOR THE WORST-CASE SCENARIO; SO IF ANY PART OF THE PLANK OR BEAM IS EXPOSED, THE ENTIRE MEMBER NEEDS TO BE 2HR.



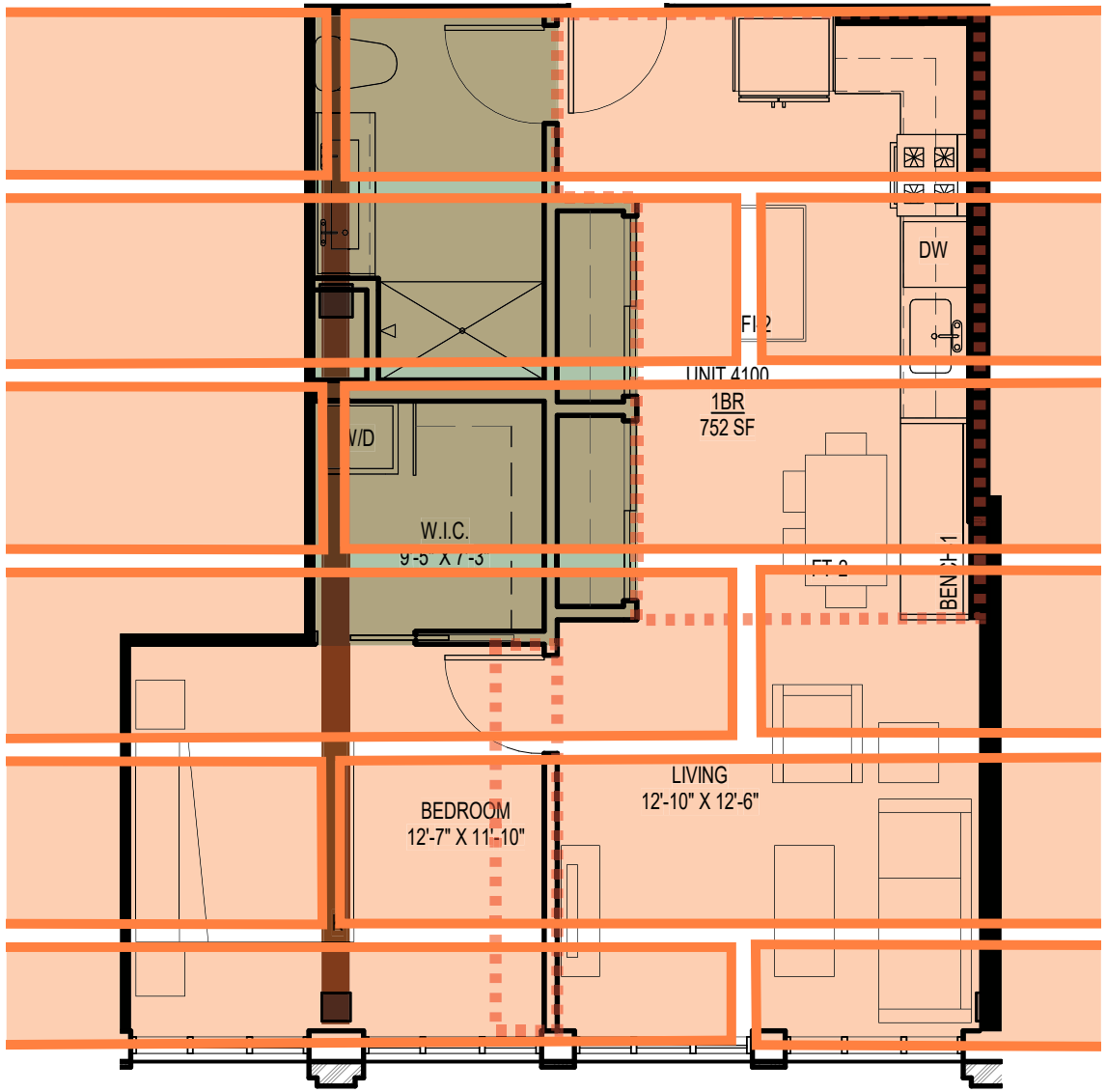
TYPICAL FLOOR ASSEMBLY - PROTECTED TIMBER WITH CONCEALED SPACE



TIMBER COVERAGE

TYPICAL PLANK IS 40’ LONG (SPANS 2 STRUCTURAL BAYS) AND RUNS PARALLEL TO THE EXTERIOR WALL.

PLANKS ARE STAGGERED IN A RUNNING BOND PATTERN.



CODE APPROVAL PATH - ALTERNATIVELY ENGINEERED DESIGN

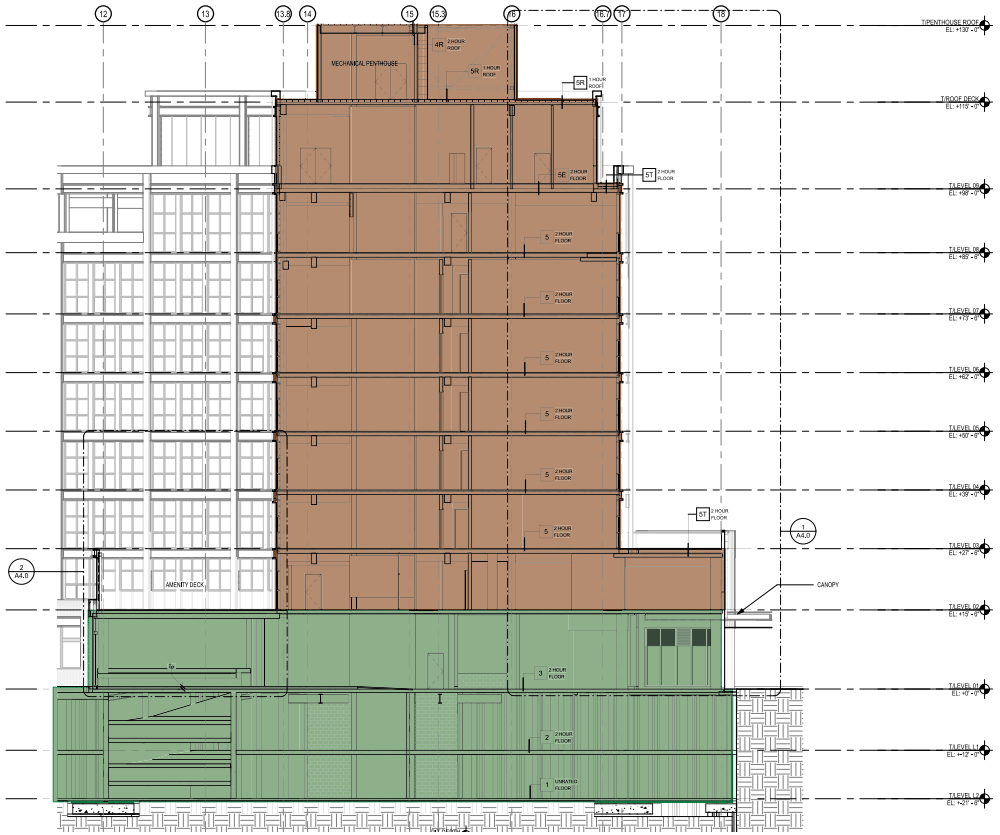
CONSTRUCTION TYPE = IV-B (I-A GARAGE AND 1ST FLOOR)

TOPIC	ALLOWED	PROPOSED
HEIGHT =	180’	115’
STORIES =	12	9
AREA (MIXED USE) =	6 53,000 SF	5 12,000 SF*
TIMBER COVERAGE =	80% CEILINGS	54% CEILINGS (MAX.)
	OR 60% WALLS	NO TIMBER WALLS

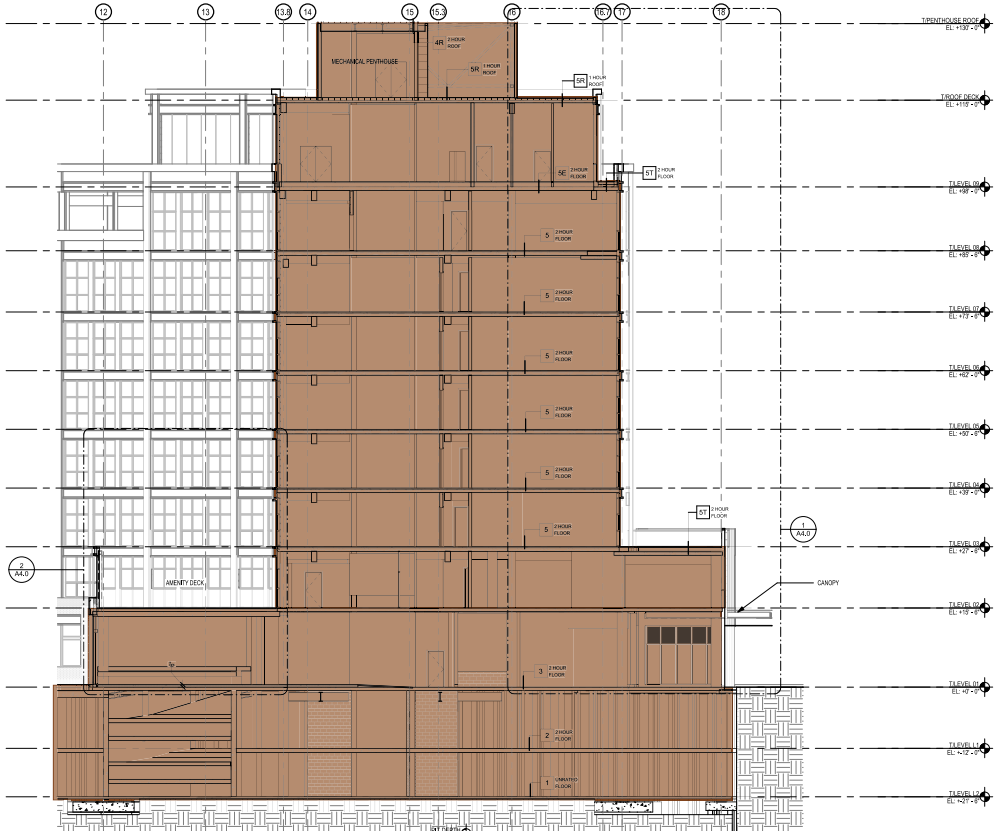
*ONLY 304,000 SF OF THE BUILDING IS TYPE IV-B TIMBER (LL2 THRU 2ND FLOOR ARE CONCRETE), SO THE BUILDING COULD BE SUBSTANTIALLY LARGER AS-OF-RIGHT.

CODE APPROVAL PATH - ALTERNATIVELY ENGINEERED DESIGN

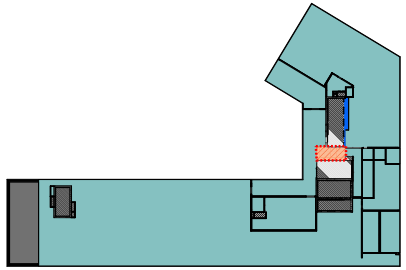
PROPOSED BUILDING:
-LL2-2ND FLOOR SLAB: TYPE I-A (CONCRETE)
-2ND FLOOR-ROOF: TYPE IV-B (TIMBER)
-FLOOR AREA: AS PROPOSED



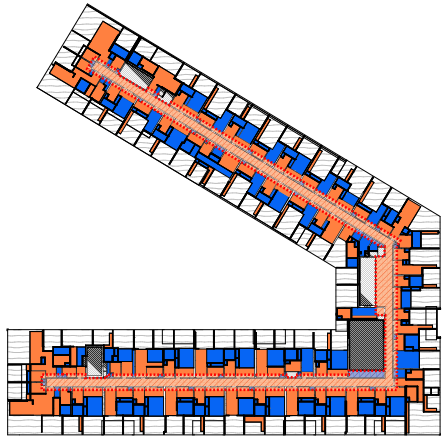
THEORETICAL MAXIMUM AREA BUILDING:
-LL2-ROOF: TYPE IV-B (TIMBER)
-FLOOR AREA: MAXIMUM ALLOWABLE BASED ON PROPOSED BUILDING FOOTPRINT, USES, AND # FLOORS



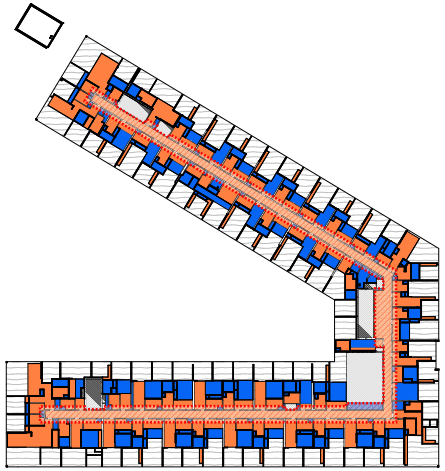
TIMBER COVERAGE DIAGRAMS



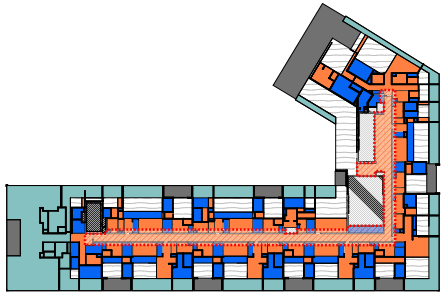
6 LEVEL 09 · TIMBER COVERAGE PLAN
SCALE: 1" = 30'-0"



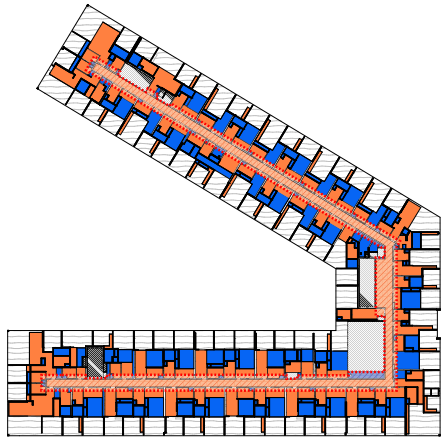
4 LEVEL 07 · TIMBER COVERAGE PLAN
SCALE: 1" = 30'-0"



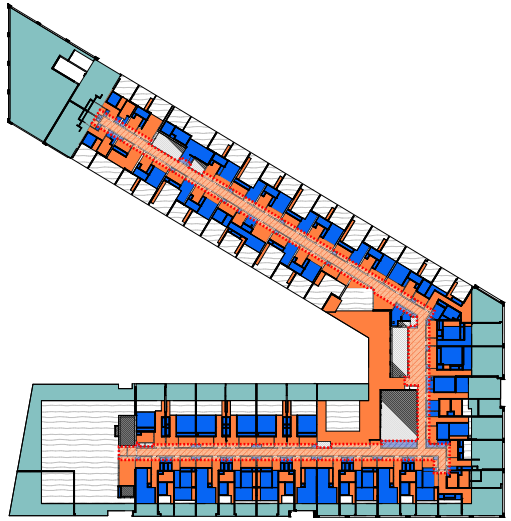
2 LEVEL 03 · TIMBER COVERAGE PLAN
SCALE: 1" = 30'-0"



5 LEVEL 08 · TIMBER COVERAGE PLAN
SCALE: 1" = 30'-0"



3 LEVELS 04, 05 & 6 · TIMBER COVERAGE PLAN
SCALE: 1" = 30'-0"



1 LEVEL 02 · TIMBER COVERAGE PLAN
SCALE: 1" = 30'-0"

PART III - THE DESIGN

3D VIEWS

INTRO - 25TH AND LORAIN, CLEVELAND, OH

3D VIEWS

INTERIOR VIEW

SOURCE: VSTUDIOS

QUESTIONS?

This concludes The American Institute of Architects Continuing Education Systems Course

John Mitchell

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