

# M5, Vancouver and Terraine, San Jose: Lessons Learned from Conception to Construction

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CTBUH 2022  
Steel-Timber Conference

# WHY HYBRID?

LESSONS FROM CONCEPTION TO CONSTRUCTION

MAY 24, 2022

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# WHY HYBRID?

## HYBRID TYPES

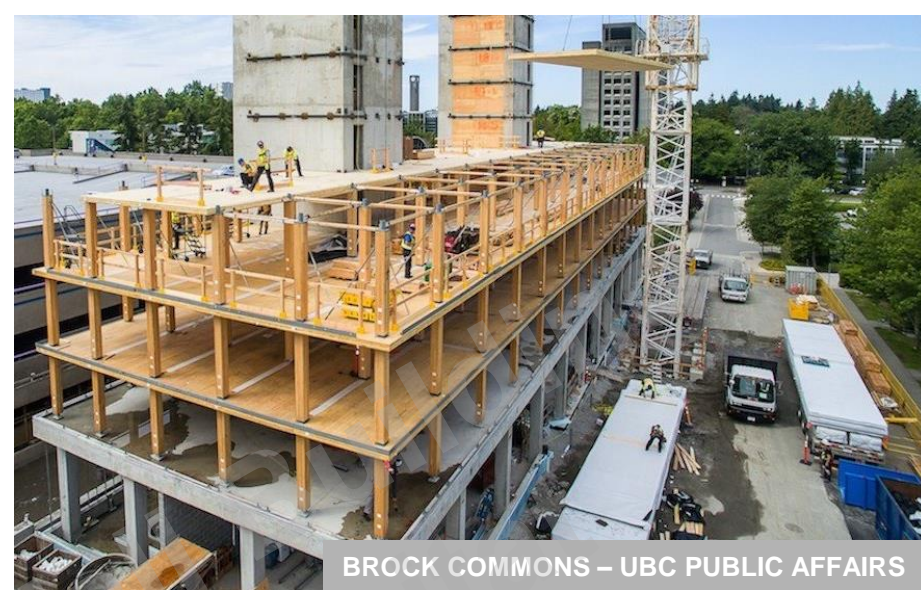
- GRAVITY SYSTEMS
- LATERAL SYSTEMS
- GRAVITY & LATERAL SYSTEMS



CCA – STUDIO GANG



SOM



BROCK COMMONS – UBC PUBLIC AFFAIRS



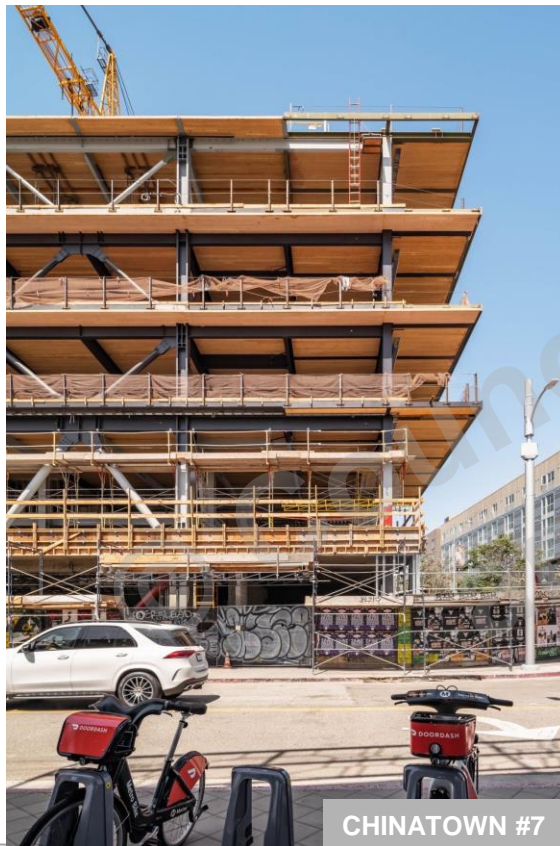
CHINATOWN #7



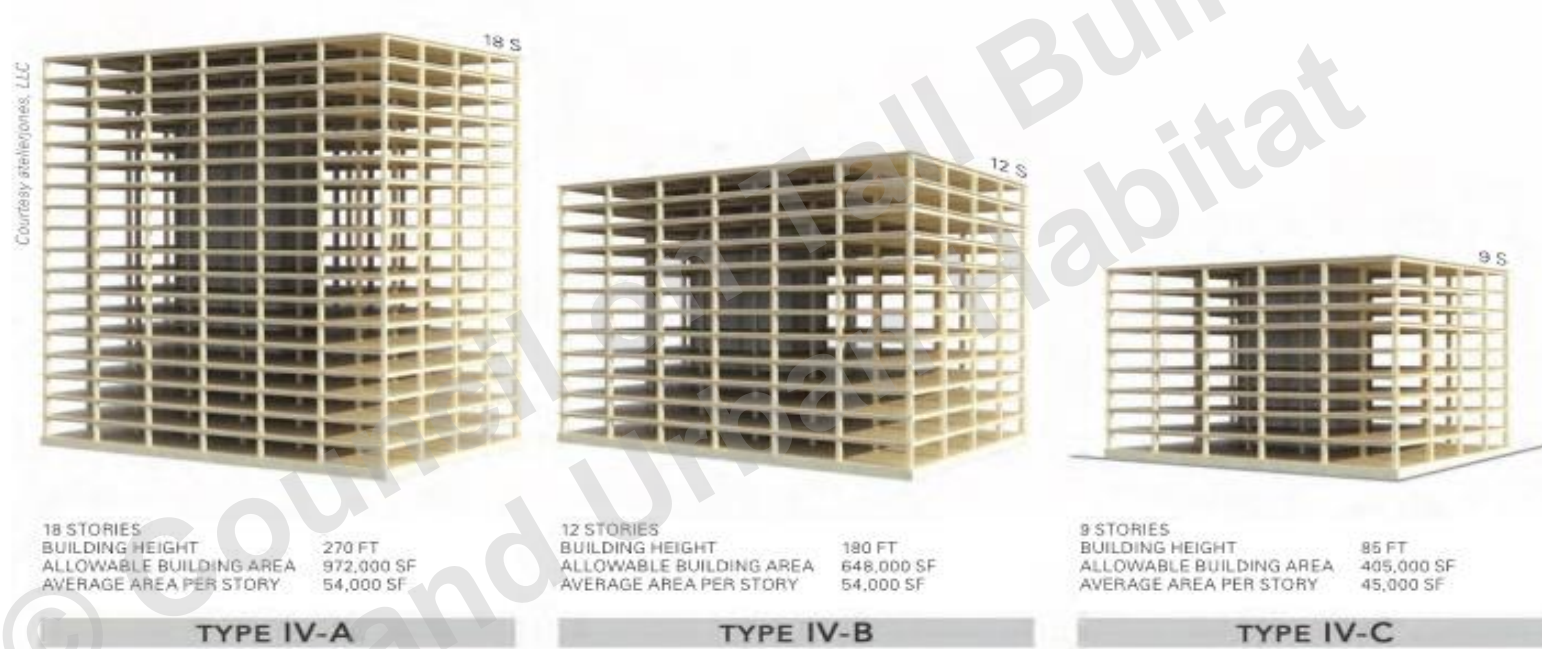
# WHY HYBRID?

## DRIVERS FOR HYBRID

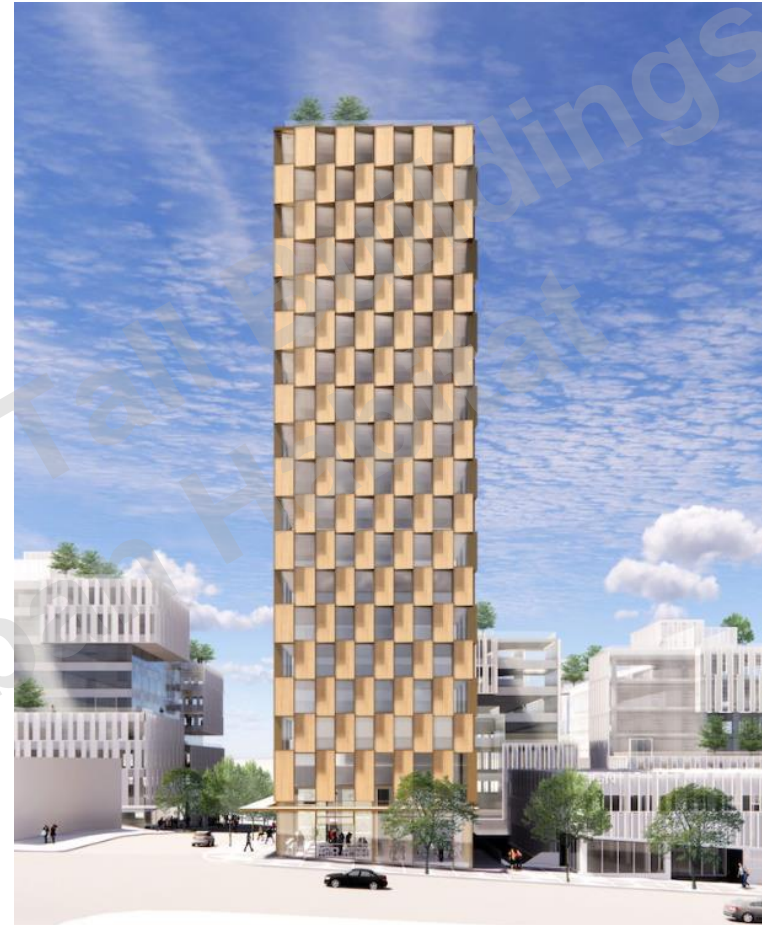
- PROGRAMMING & FUNCTIONALITY
- ARCHITECTURAL DESIGN
- CODE LIMITATIONS
- INSURANCE OR “PERFORMANCE”
- COST?
- OTHERS?



# WHY HYBRID? GETTING TALLER WITH TIMBER

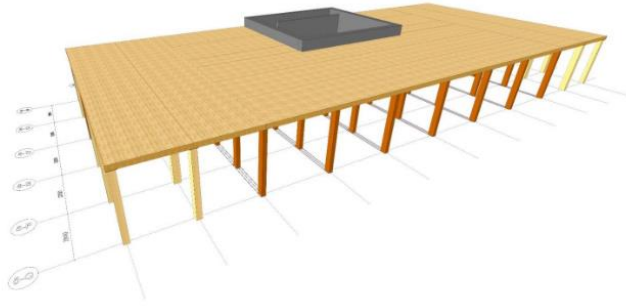






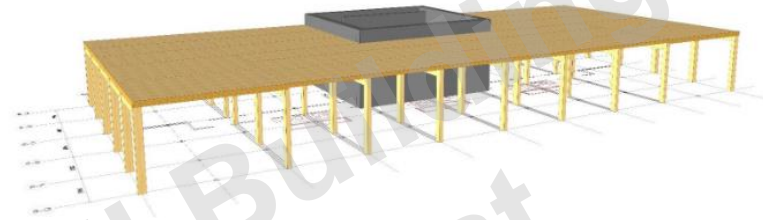
MAIN ALLEY PROTOTYPE MASS TIMBER TOWER WITH HPA ARCHITECTS  
(VANCOUVER, BC)

# WHY HYBRID? SYSTEMS CONSIDERED



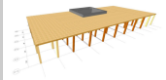
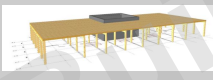

POINT-SUPPORTED CLT SYSTEM

- PANEL-ONLY SYSTEM SPANNING TO TIMBER OR STEEL
- GRID IS LIMITED (10'x12" MAX)
- THICKER PANEL REQUIRED
- HOTEL/DORMITORY APPLICATIONS



POST, BEAM AND PANEL SYSTEM

- PANELS SPANNING TO BEAMS AND POSTS
- MORE GRID FLEXIBILITY
- RESIDENTIAL AND OFFICE APPLICATIONS

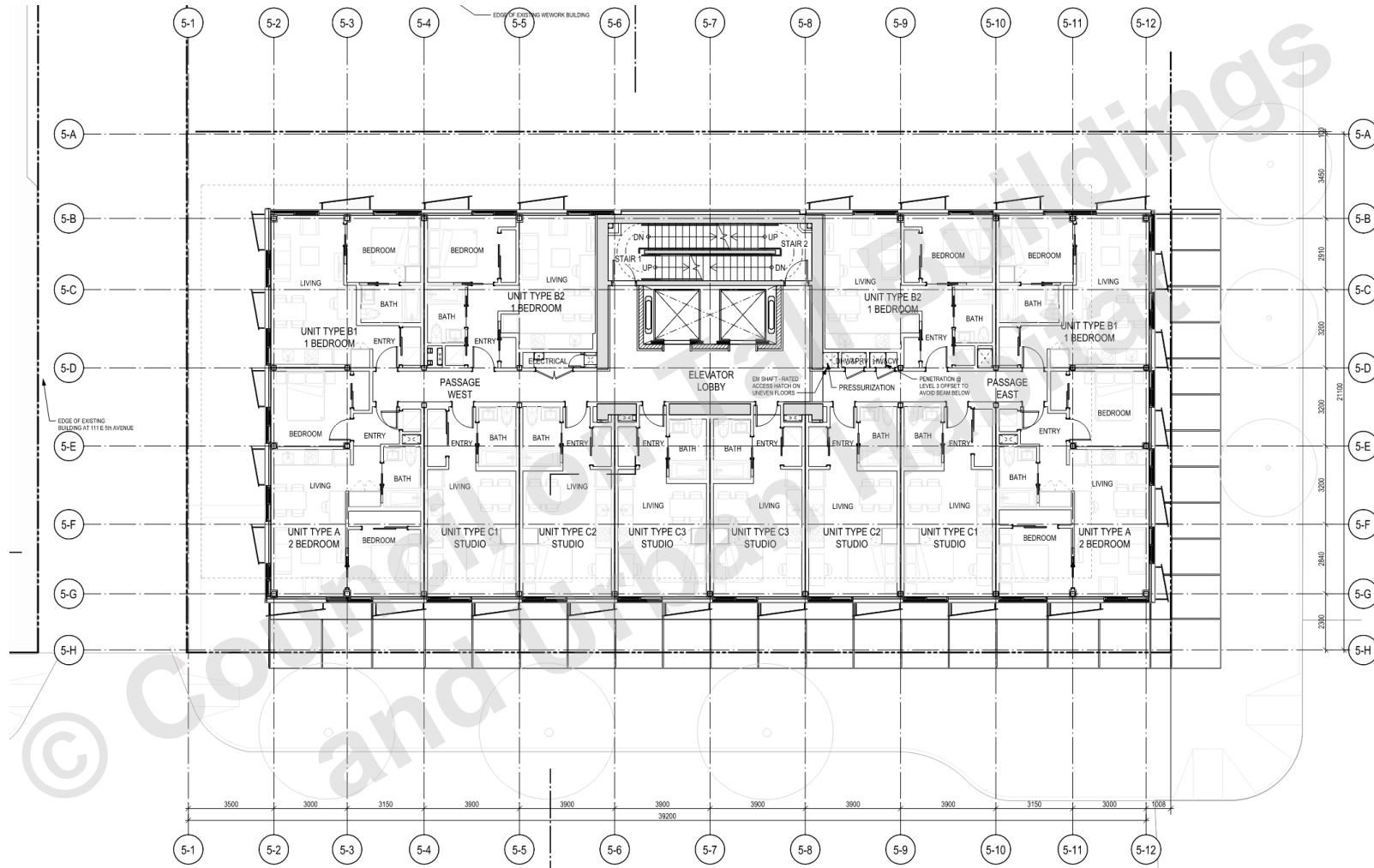
COST PER FLOOR			
	TIMBER		HYBRID
	POST + PANEL 	POST, BEAM PANEL 	POST, BEAM, PANEL 
CLT Area (m <sup>2</sup> per floor)	495	495	
CLT Volume (m <sup>3</sup> per floor)	99	109	99
Glulam Column Volume (m <sup>3</sup> per floor)	15	8	0
Glulam Beam Volume (m <sup>3</sup> per floor)	0	7	0
Steel Column (kg per floor)	0	0	5043
Steel Beam (kg per floor)	0	0	6326
Timber	195900	211900	158400
Steel	0	0	102321
	<b>\$ 195,900.00</b>	<b>\$ 211,900.00</b>	<b>\$ 260,721.00</b>

\* Assumes a unit rate of 9 CAD/kg Steel, 1600 CAD/m<sup>3</sup> CLT supply & 2500 CAD/m<sup>3</sup> Glulam Supply

\*\* Costs do not include install, but installation costs should be similar



# WHY HYBRID? FUNCTIONAL REQUIREMENTS







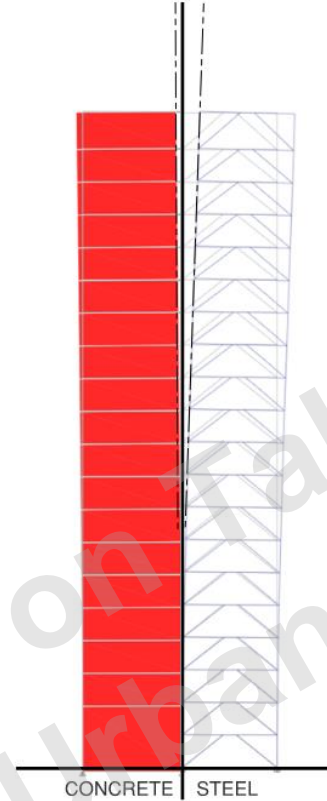
## WHY HYBRID? FUNCTIONAL REQUIREMENTS



# WHY HYBRID? LATERAL SYSTEM



SPECIAL REINFORCED  
CONCRETE SHEAR WALLS

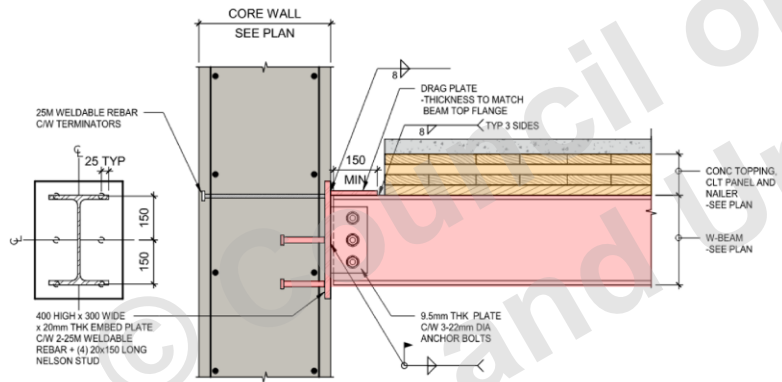
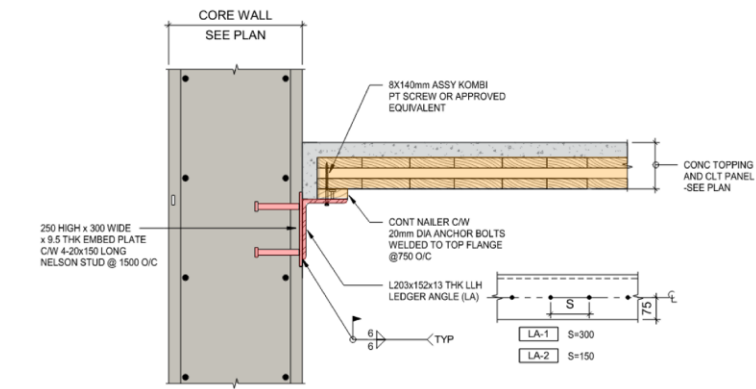


STRUCTURAL STEEL BRACED FRAME

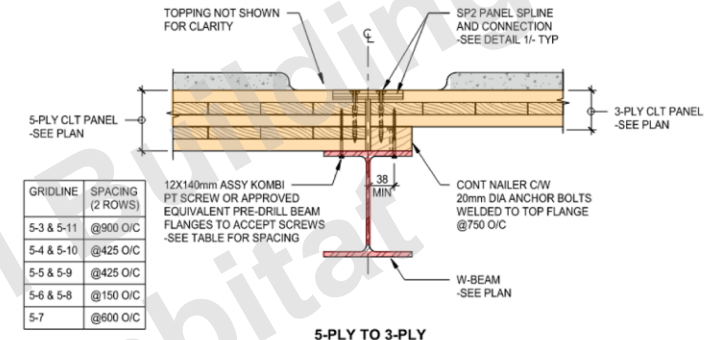
- REQUIRED STIFFNESS
- FIRE-RATING REQUIREMENTS
- MEMBER SIZING AND COSTING
- ARCHITECTURAL PROGRAM CONSTRAINTS
- CONSTRUCTION SEQUENCING



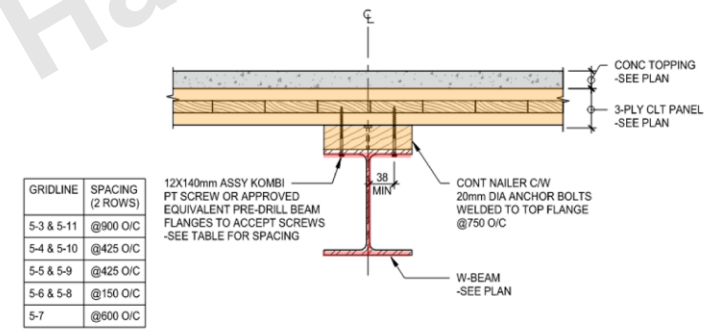
# WHY HYBRID? MIXING AND MATCHING MATERIALS



4 STEEL BEAM TO CORE WALL CONNECTION DETAIL  
S208.1 1:10 HMG/STH



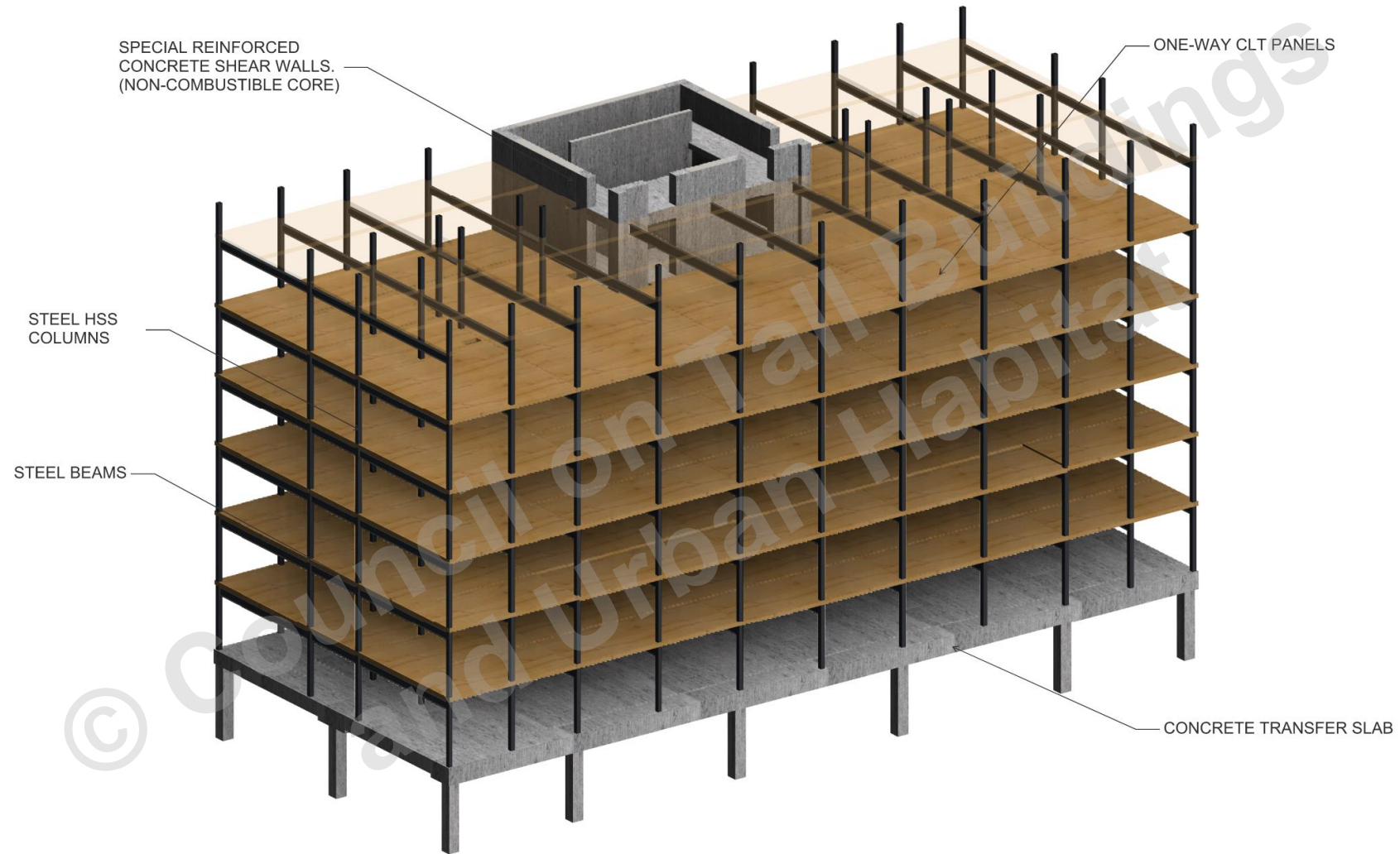
5-PLY TO 3-PLY



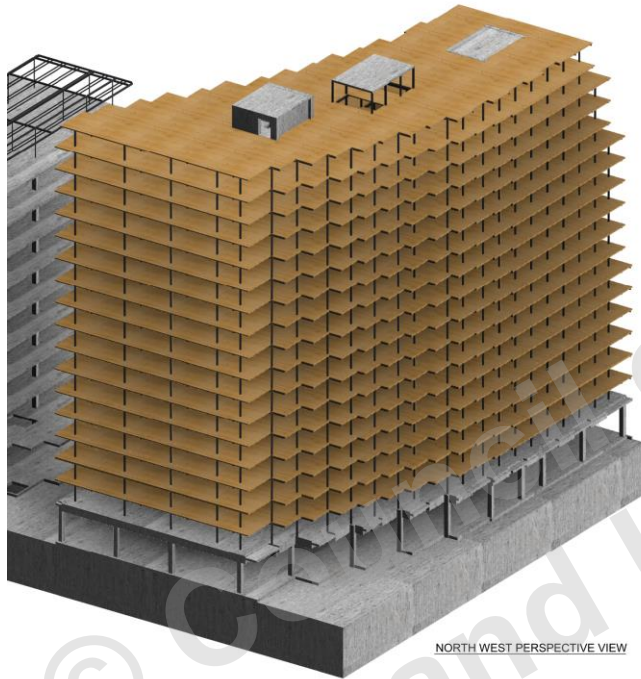
3-PLY BOTH SIDES

2 CLT PANELS TO STEEL BEAM CONNECTION DETAIL  
S208.1 1:10 HMG/STH

# WHY HYBRID? STRUCTURAL PLAN

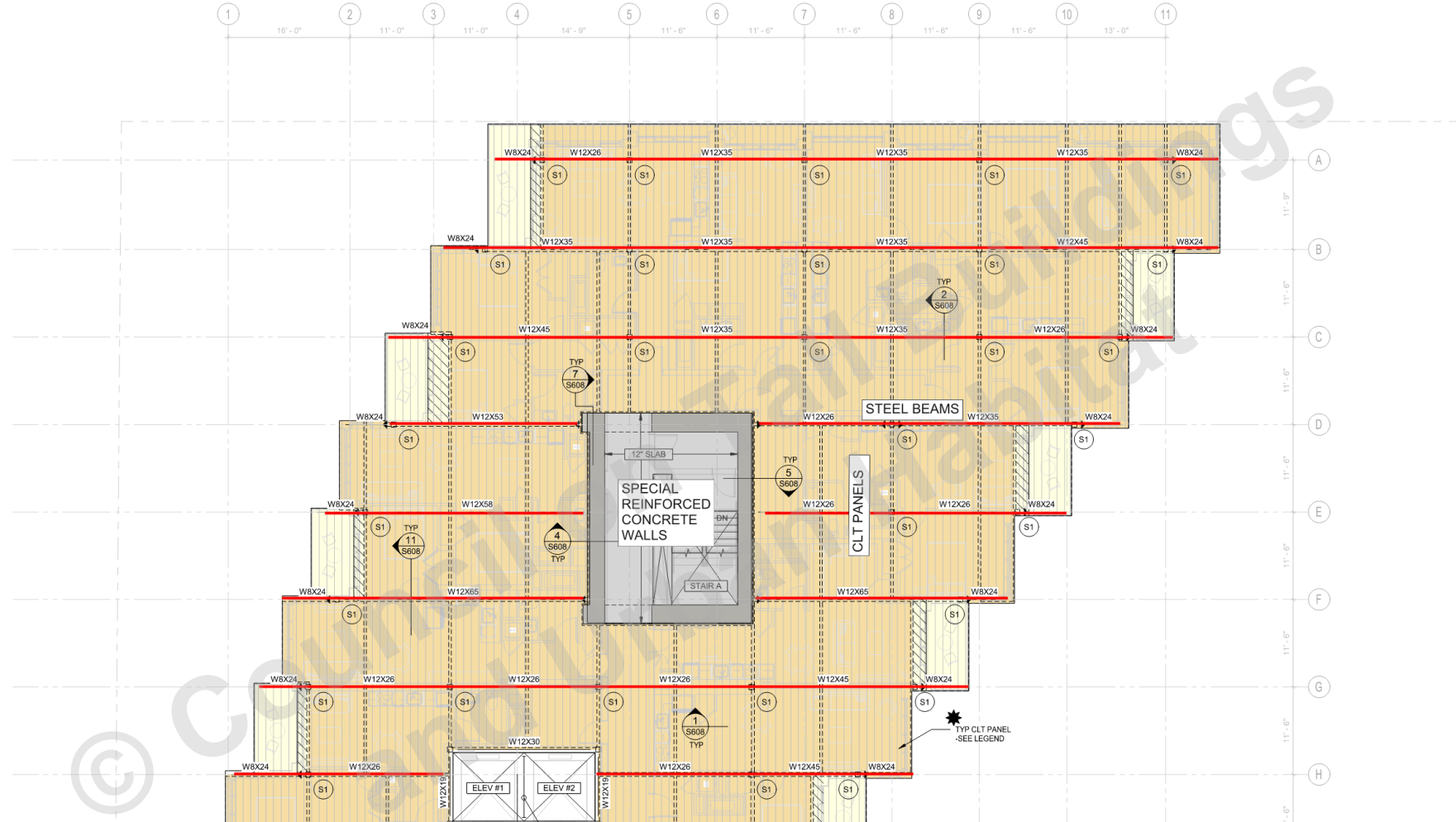






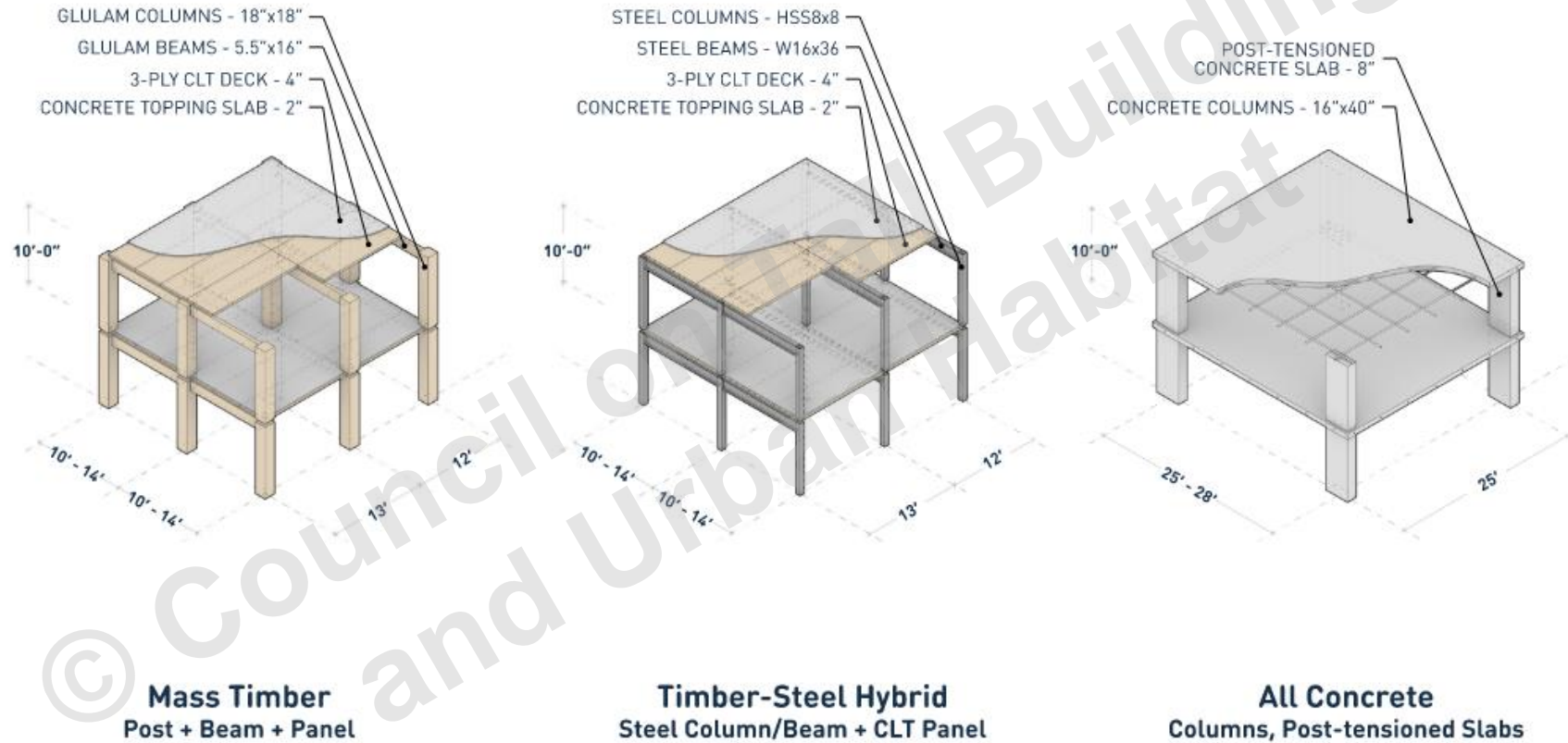
TERRAINE WITH STUDIO GANG (SAN JOSE, CA)



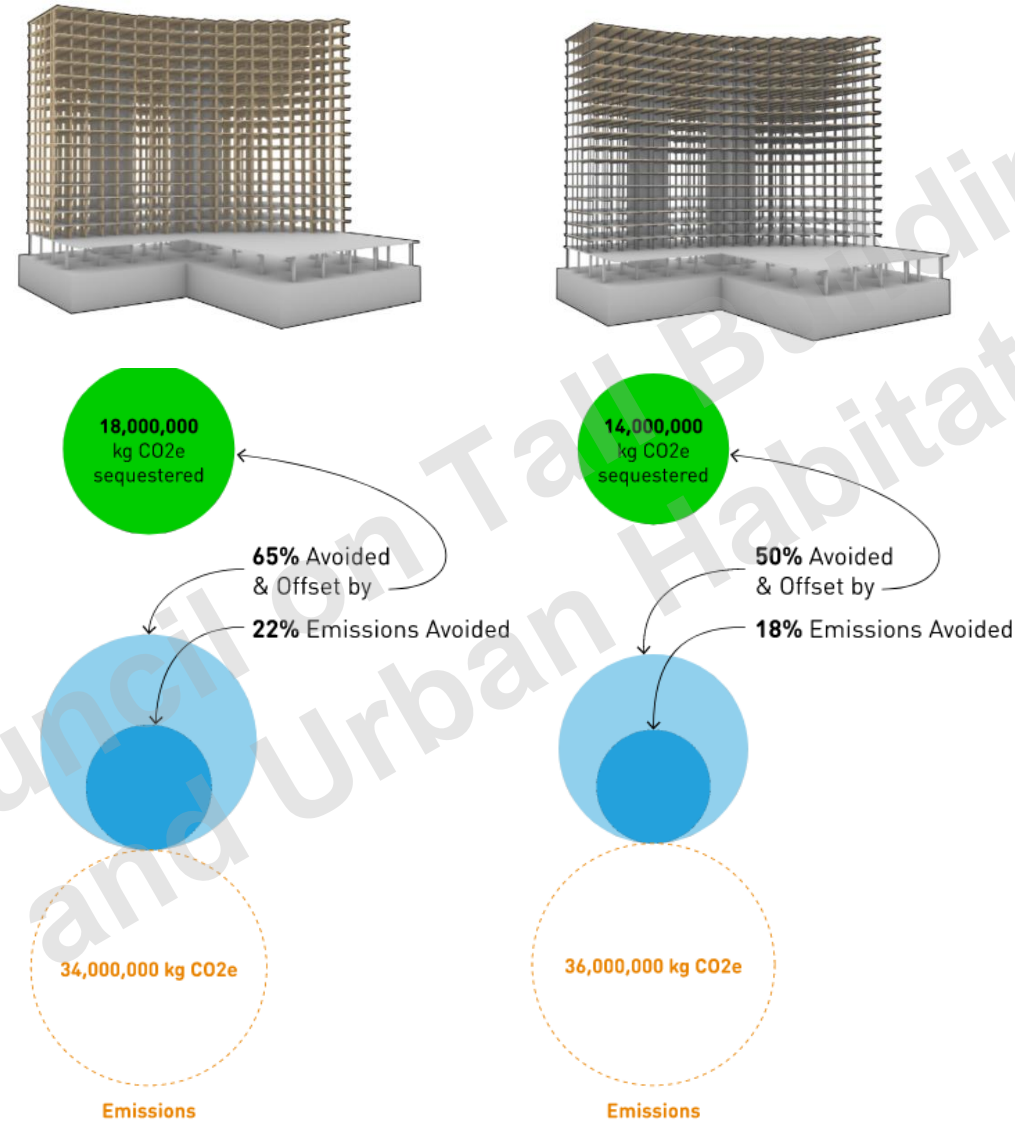




# WHY HYBRID? EXPLORING THE ALTERNATIVES



# WHY HYBRID? EMBODIED CARBON BENEFITS



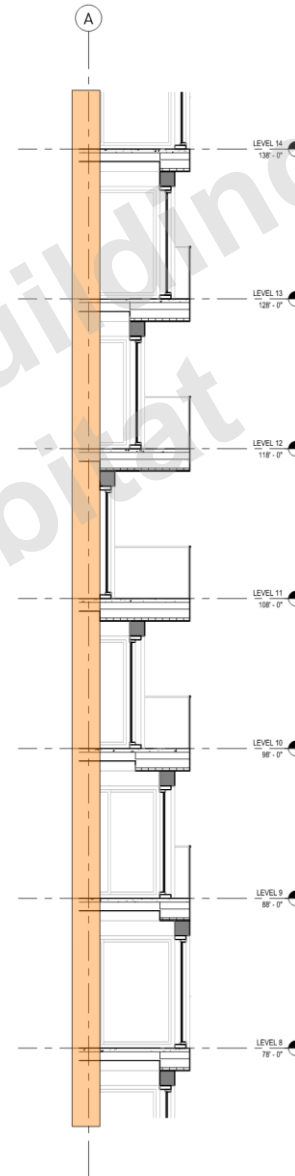
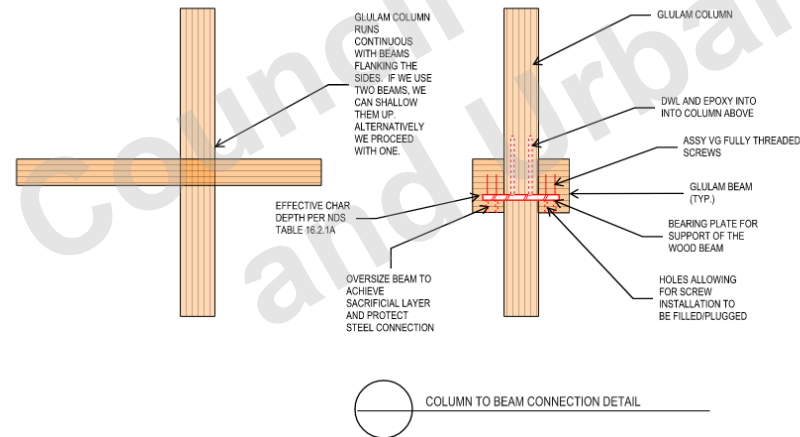
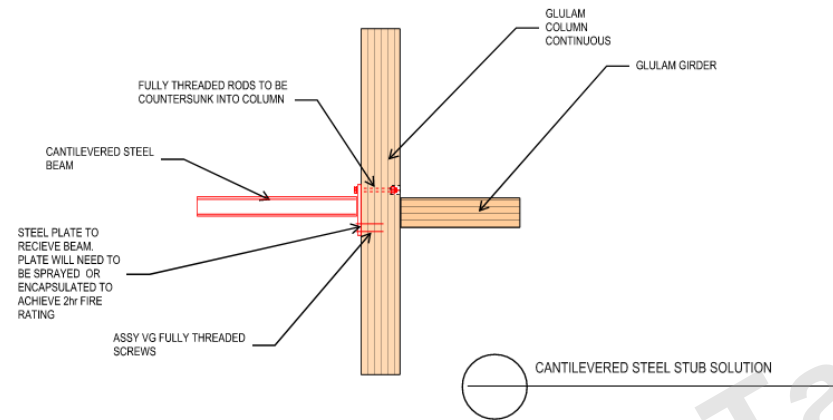
## WHY HYBRID? OVERCOMING MASSING CHALLENGES





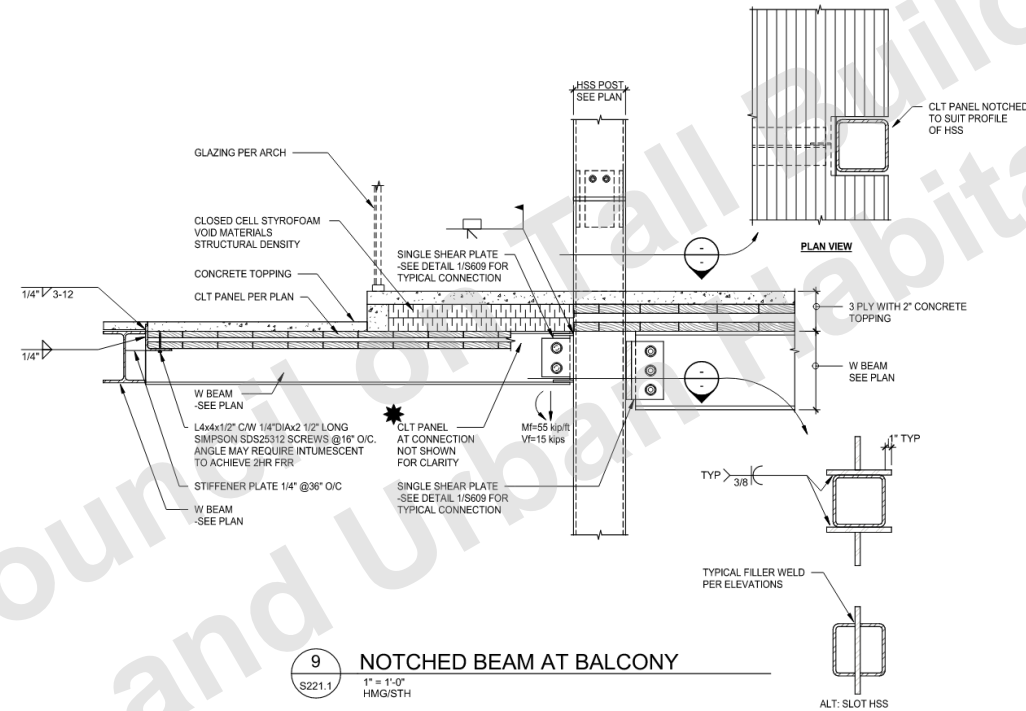
# WHY HYBRID? OVERCOMING MASSING CHALLENGES

## CANTILEVERING IN MASS TIMBER



# WHY HYBRID? OVERCOMING MASSING CHALLENGES

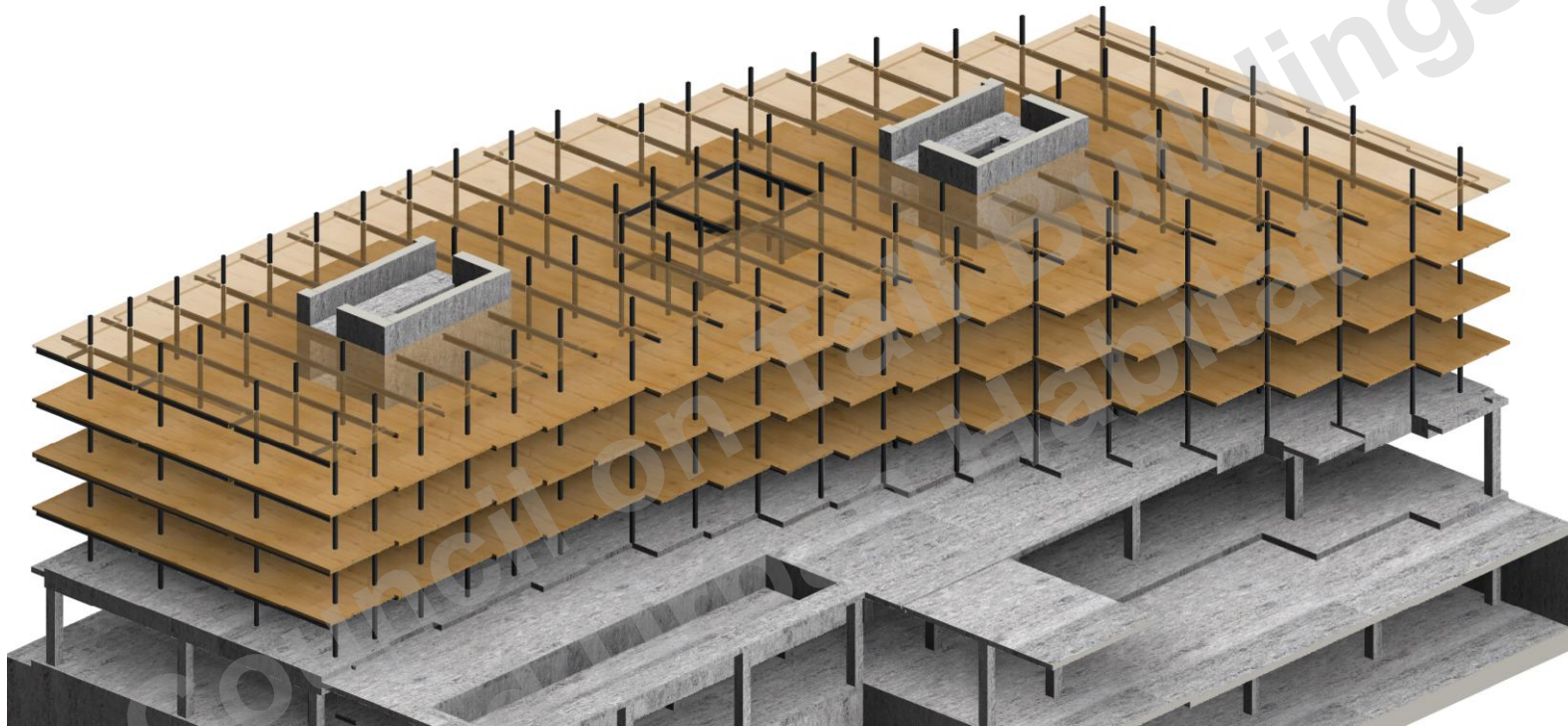
## CANTILEVERING IN MASS TIMBER



## WHY HYBRID? COLUMN SIZING AND DIFFERENTIAL SHRINKAGE









## CHINATOWN #7

### HYBRID GRAVITY

- P1-L2, RC SLABS + COLUMNS
- L2-ROOF, CLT SLABS + STEEL FRAME

### HYBRID LATERAL

- P1-L2, RC SHEARWALLS + RC DIAPHRAGMS
- L2-ROOF, STEEL SCBFS + RC DIAPHRAGMS





# WHY HYBRID?

## HYBRID GRAVITY

- PODIUM (3HR SEPARATION, 1A OVER IIIB)
- BELOW GRADE PARKING & EXISTING COLUMN GRIDS
- BALCONY DESIGN INTENT
- EXTERIOR CONNECTOR DESIGN INTENT
- STAIR/ELEVATOR CORE DESIGN INTENT

## HYBRID LATERAL

- CODE LIMITATIONS (SEISMICITY)
- DESIGN INTENT

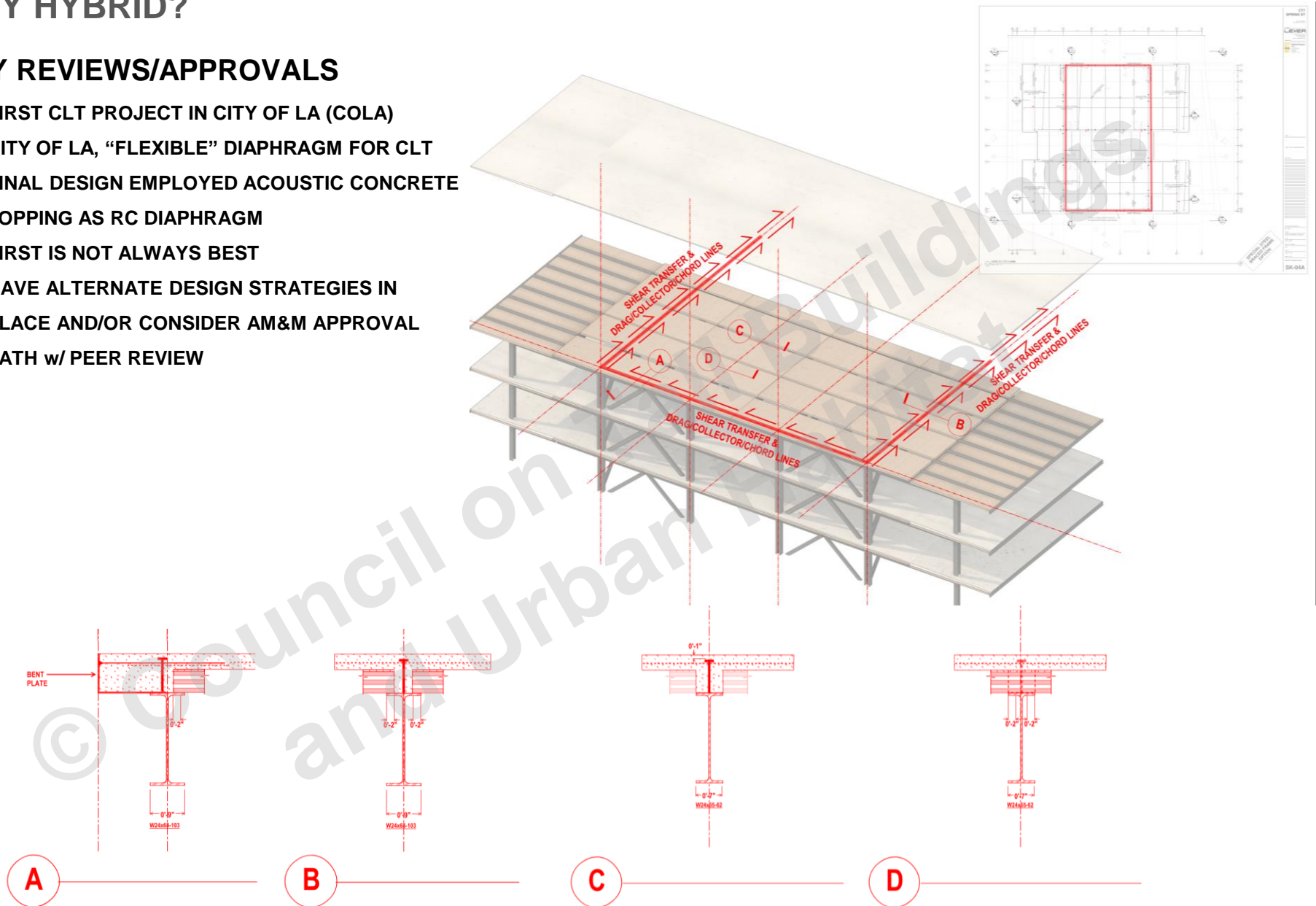




# WHY HYBRID?

## CITY REVIEWS/APPROVALS

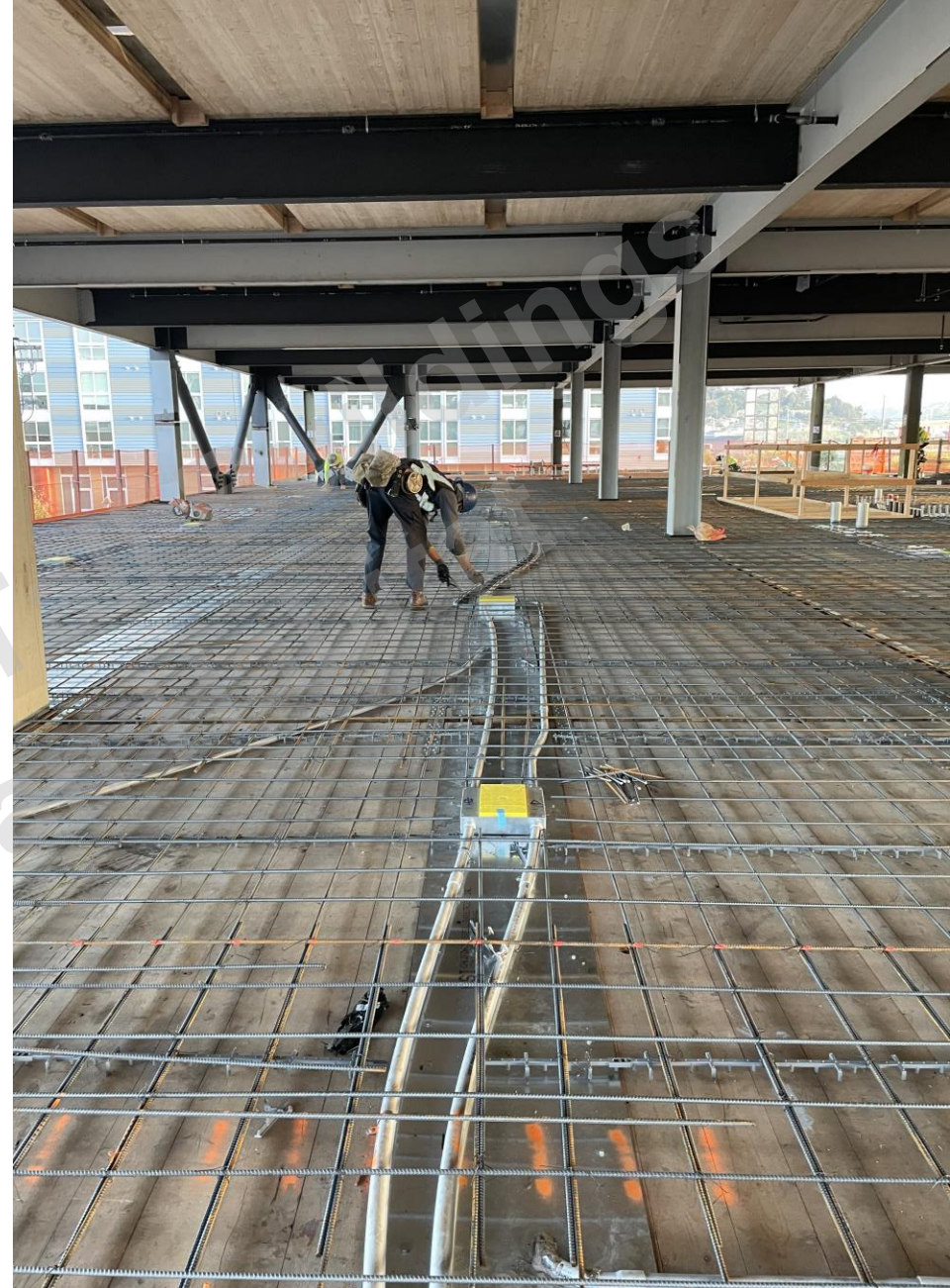
- FIRST CLT PROJECT IN CITY OF LA (COLA)
- CITY OF LA, “FLEXIBLE” DIAPHRAGM FOR CLT
- FINAL DESIGN EMPLOYED ACOUSTIC CONCRETE TOPPING AS RC DIAPHRAGM
- FIRST IS NOT ALWAYS BEST
- HAVE ALTERNATE DESIGN STRATEGIES IN PLACE AND/OR CONSIDER AM&M APPROVAL PATH w/ PEER REVIEW



# WHY HYBRID?

## CHALLENGES & DRAWBACKS

- MORE MATERIALS = MORE TRADES = GREATER POTENTIAL FOR SCOPE GAPS
- DIRECT CONVERSATIONS WITH GC TO UNDERSTAND WHO IS DOING WHAT, SIMPLE SCOPES CAN BE AN OVERSIGHT

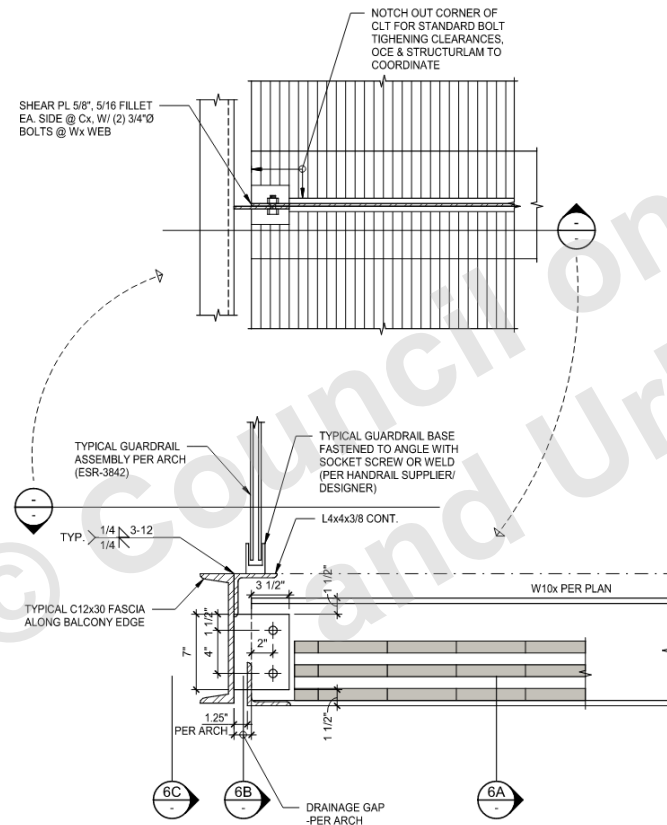




# WHY HYBRID?

## CHALLENGES & DRAWBACKS

- MORE MATERIALS = MORE TRADES = GREATER POTENTIAL FOR SEQUENCING & CONSTRUCTABILITY CHALLENGES
- GC AND SUBS MUST COORDINATE DETAILS AND SEQUENCING





WHY HYBRID?

THANK YOU