BUILDINGENERGY NYC

CLT Passive House Confidential: The Financial and Logistical Synergy of PH and Mass Timber

Christina Aßmann and Michael Hindle, Passive to Positive
Alex Yoon, Monte French Design Studio
Matthew Richardson, BKSK

Curated by Sara Bayer (MAP) and Aidan Mayer (Northeastern University)

Northeast Sustainable Energy Association (NESEA)
September 15, 2022

MASS TIMBER - PASSIVE HOUSE *CONFIDENTIAL-*

How PH + mass timber synergies yield financial + logistical viability

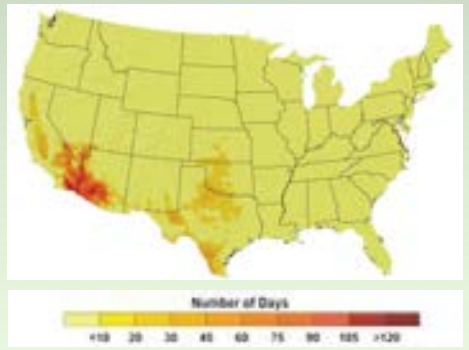
MONTE FRENCH
DESIGN STUDIO
ARCHITECTURE + PLANNING
BKSK
Passive to POSITIVE
PASSIVE HOUSE AND LOW IMPACT DESIGN

Image credit: Oregon Public Broadcasting

OUR CLIMATE IS CHANGING FASTER THAN ANTICIPATED

1 DEGREE TEMPERATURE RISE RESULTS IN 10% LOWER AGRICULTUTRAL YIELDS

Recent Past, 1961 - 1979



Lower Emissions Scenario, 2080-2099

Higher Emissions Scenario, 2080-2099

temperature map images: U.S. Global Change Research Program

WE NEED MORE COURAGE!

INCREMENTALISM =

Image credit: Oregon Public Broadcasting

MASS TIMBER AND PASSIVE HOUSE
BENEFITS

Carbon 12 Condominium Building, Portland Oregon, Kaiser Path

The Bullitt Center, The Miller Hull Partnership, DCI Engineers, (Photo: John Stamets)

AESTHETICS AND BIOPHILIA

It just looks better.

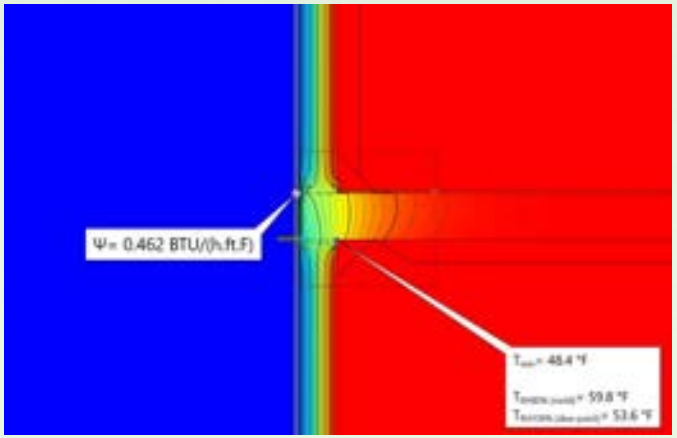
MASS TIMBER AND PASSIVE HOUSE
BENEFITS

THERMAL BRIDGES COMPARISON:

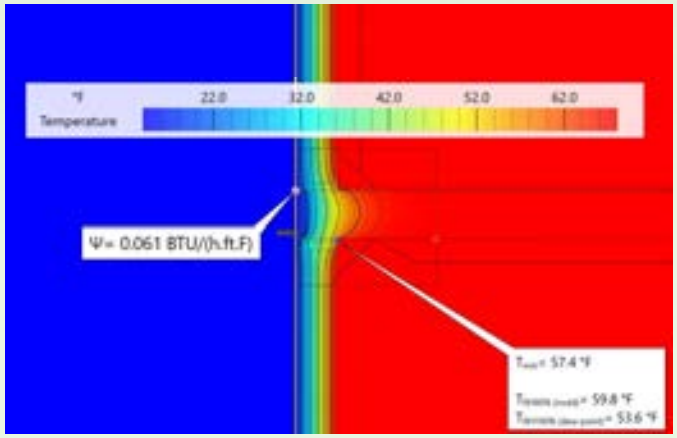
CONCRETE DECK FLOOR SLAB EDGE WITH STEEL STUD AND 2" CI + BRICK ANGLE

VS.

CLT FLOOR PLATE AND FRT FRAME WALLS WITH 2"CI + BRICK ANGLE



ISOTHERM VIEW **CONCRETE**



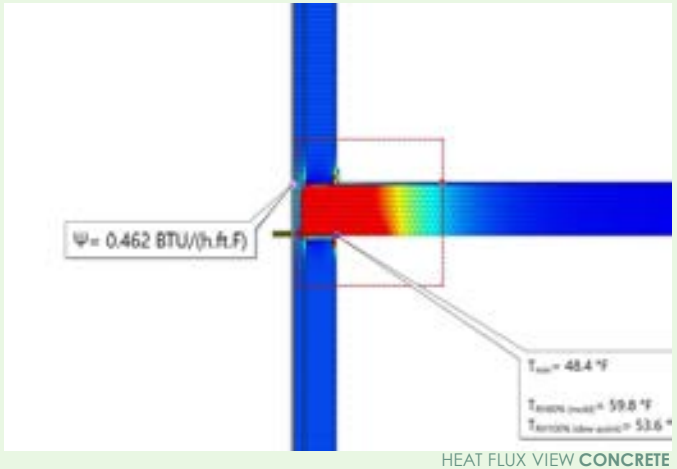
ISOTHERM VIEW **TIMBER**

IMPACTS:

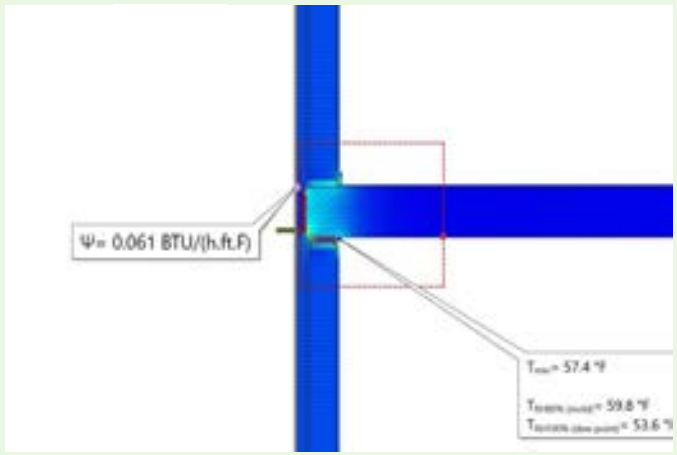
HEAT LOSS IS REDUCED BY 87%

INTERIOR SURFACE TEMPERATURES INCREASE BY 9° F

CORRESPONDINGLY REDUCES RISK OF MOLD GROWTH

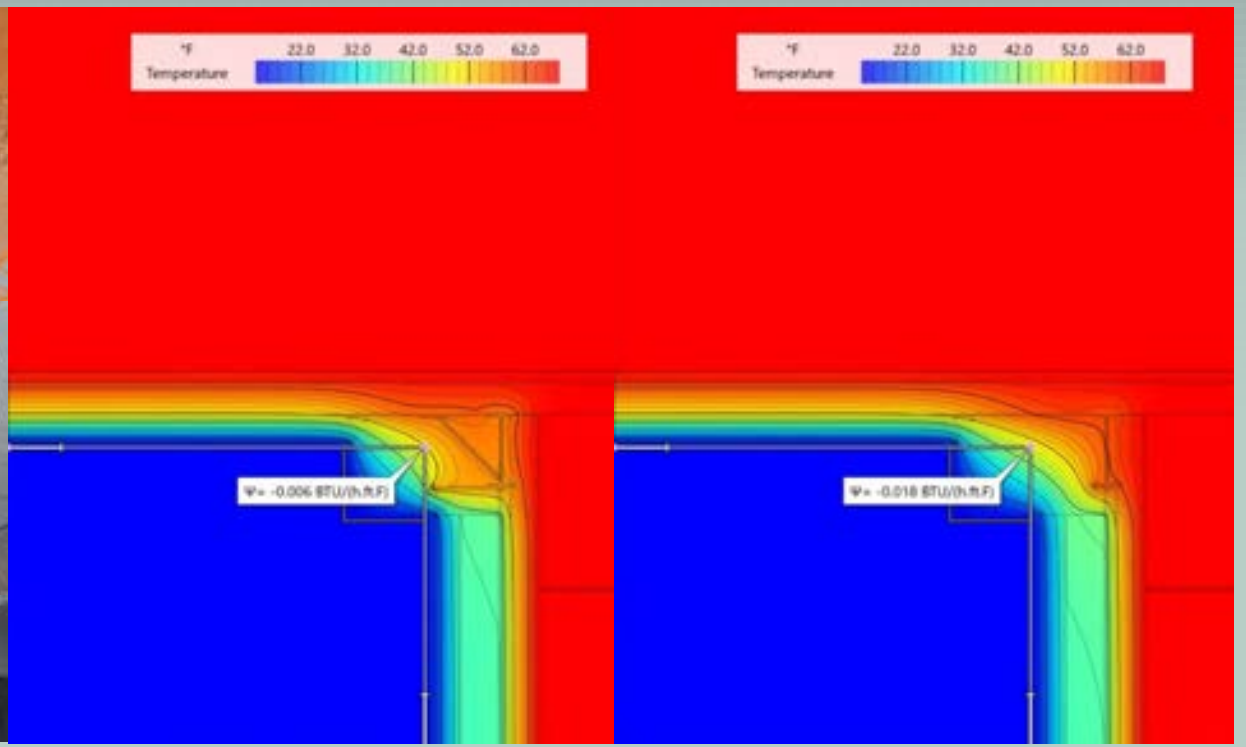


HEAT FLUX VIEW **CONCRETE**



HEAT FLUX VIEW **TIMBER**

MASS TIMBER AND PASSIVE HOUSE
BENEFITS

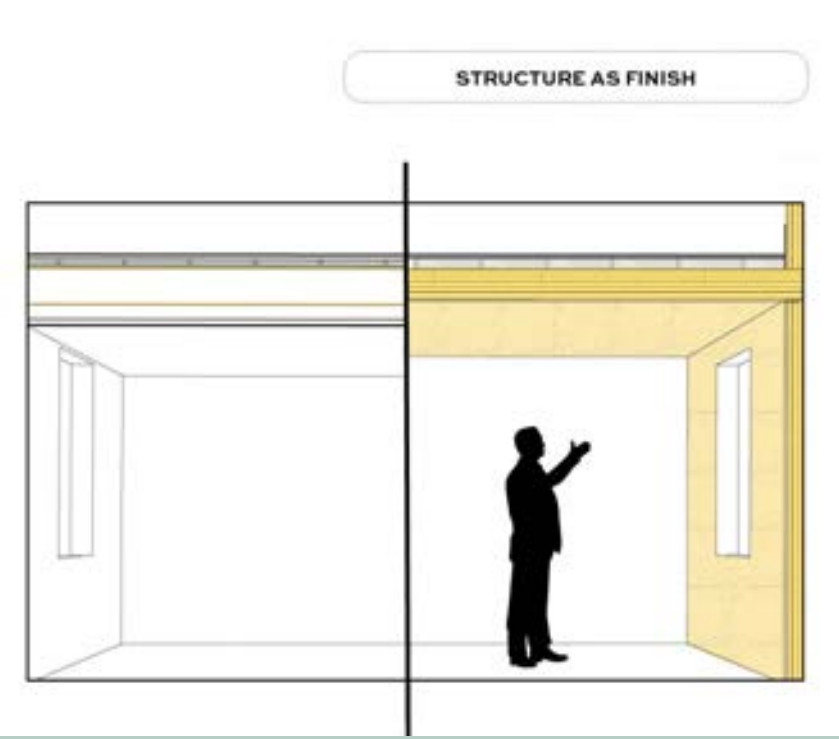


ENERGY AND THERMAL BRIDGES

MASS TIMBER AND PASSIVE HOUSE
BENEFITS

IAQ AND CONDENSATION RISK

MASS TIMBER AND PASSIVE HOUSE
BENEFITS



BUILDING AS USUAL WOULD CONSUME:

189,000 lbs of gypsum wall board and **3,000 lbs** of paint for finish ceilings.

An additional **212,500 lbs** of gypsum wall board [3,035 sheets] and **3,200 lbs** of paint for the finish face of the exterior walls.

additional fireproofing and sound insulation required

79 KING STREET AIMS TO REDUCE:

50% of ceiling materials and nearly 100% of finishes at exterior walls

fireproofing is integral to timber elements

REDUCED USE OF FINISHES

MATERIAL SELECTION FOR REGENERATIVE IMPACT








THE NEW CARBON ARCHITECTURE
CAPTURE AND STORE CARBON

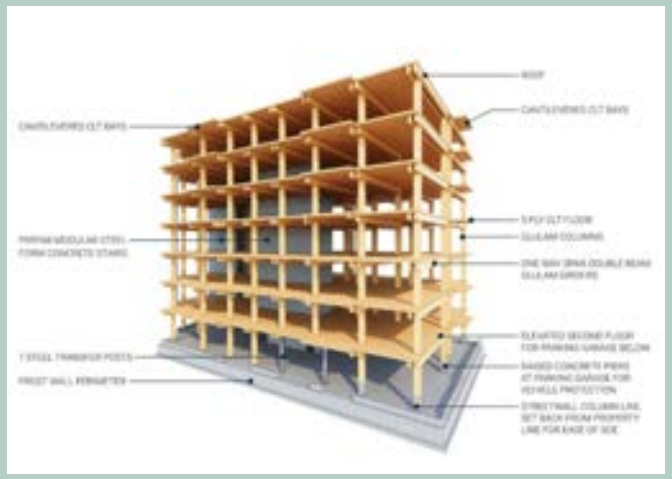
LOWER EMBODIED CARBON

THE NEW CARBON ARCHITECTURE
CAPTURE AND STORE CARBON

SHORTER CONSTRUCTION DURATION

11 EAST LENOX ST. ROXBURY, MA

DEVELOPER: BOSTON REAL ESTATE COLLABORATIVE
ARCHITECT; MONTE FRENCH DESIGN STUDIO A+P
GC: HAYCON
CLT: NORDIC STRUCTURES



7 STORIES – 37 APARTMENTS

CLT PODIUM AND SUPER STRUCTURE

LOW CARBON ENVELOPE

PASSIVE HOUSE

PV ARRAY

GROUNDWATER RECHARGE

79 KING STREET, NORTHAMPTON, MA

DEVELOPER: SPIRITOS PROPERTIES
ARCHITECT: BKSK
STRUCTURAL: HOLMES STRUCTURES
MEP: BLW ENGINEERS
GC: WESTERN BUILDERS

66 UNIT MULTI-FAMILY

MASS TIMBER STRUCTURE, CLT SHELL + CORE

LOW CARBON ENVELOPE

LOW-REFRIGERANT MEP

PASSIVE HOUSE

ROOF PV ARRAY

11 E Lenox

Boston’s First Ground-up Mass Timber Building

Project Summary

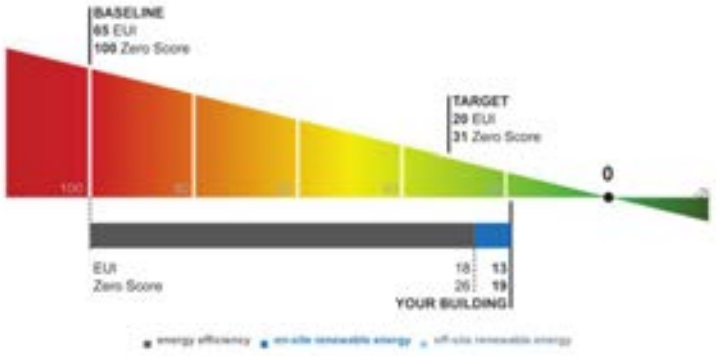
- Market-rate multifamily
  - 34 units, standard size units
  - 8 parking spaces
- 43,500gsf
- 7 stories, 70ft
- PHIUS+ 2018 PreCertified
- Type IV construction
  - 2015 IBC code variance project
- Under construction,
  Q4 2022 completion

11 E Lenox

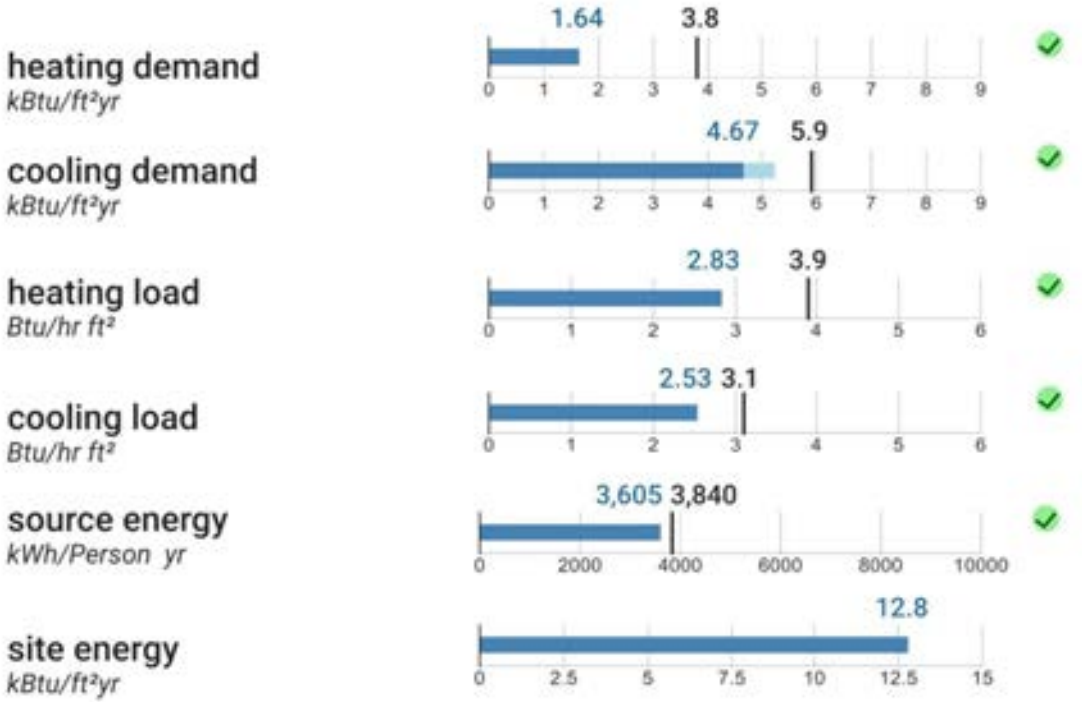
Energy Summary:

- PHIUS+ 2018 PreCertified
- 12.8 pEUI
- 81% reduction over 2030 Challenge baseline
- 45 kW PV system

2030 Challenge



PHIUS+ 2018 Metrics



11 E Lenox

Building Systems Summary

- Mass timber structure with modular prefab composite cores
- Shallow foundations with no basement
- Non-load bearing wood stud rainscreen exterior wall
- Per unit ERV fresh air, centralized heat pump heating/cooling, semi-decentralized heat pump hot water

11 E Lenox

Building Systems: Structure

- Mass timber structure (by Nordic)
  - Glulam mass timber posts and beams
  - Cross laminated timber slabs

Volume of wood products used:
950 cubic meters (33,549 cubic feet)

U.S. and Canadian forests grow this much wood in:
3 minutes

Carbon stored in the wood:
844 metric tons of carbon dioxide

Avoided greenhouse gas emissions:
327 metric tons of carbon dioxide

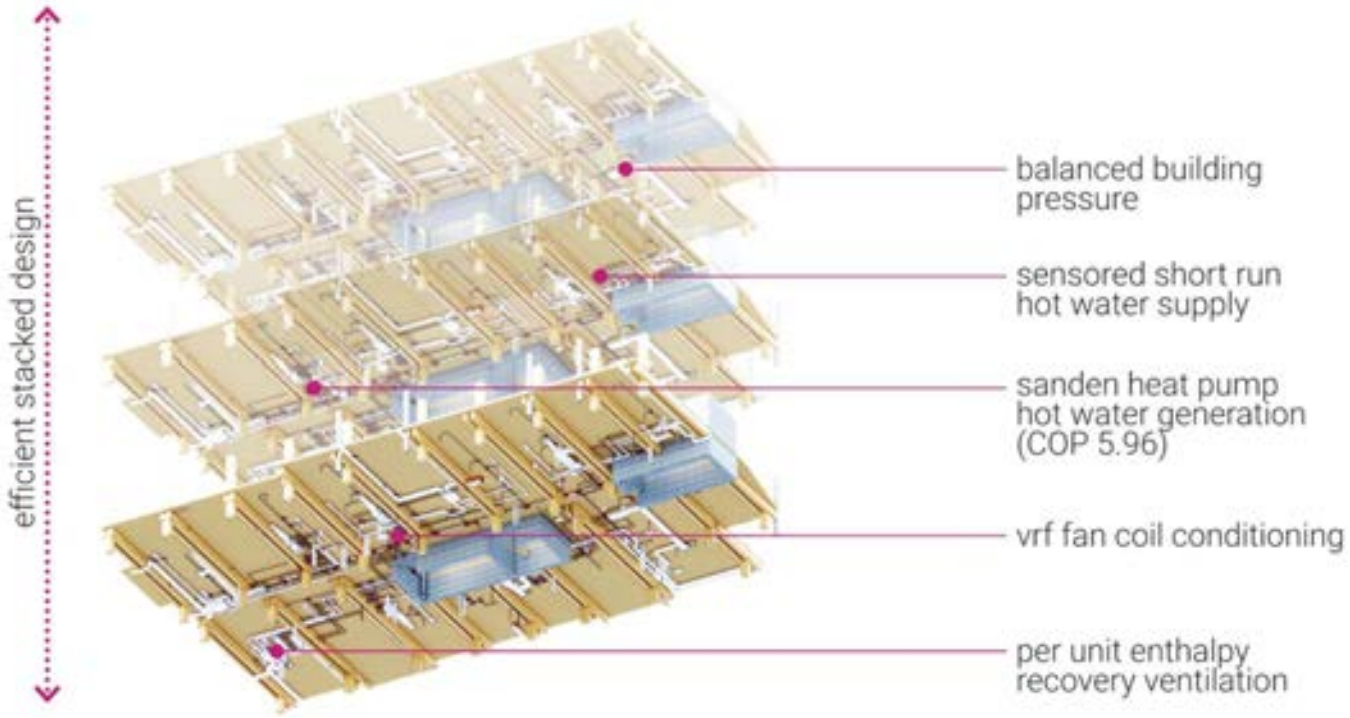
Total potential carbon benefit:
1171 metric tons of carbon dioxide

- Prefabricated modular steel vertical cores with CIP
- 7 steel transfer members at grade
- Shallow foundation system with rammed aggregate piers

11 E Lenox

Building Systems: MEP

- **Fresh air:**
  Per unit decentralized Panasonic ERVs
- **Heating / Cooling:**
  Centralized Daikin VRF system with wall mount ductless and ceiling mount ducted units
- **Hot water:**
  SANCO2 heat pump
- **PV generation:**
  40,000 kWh/yr



Building Systems: Envelope & Assemblies

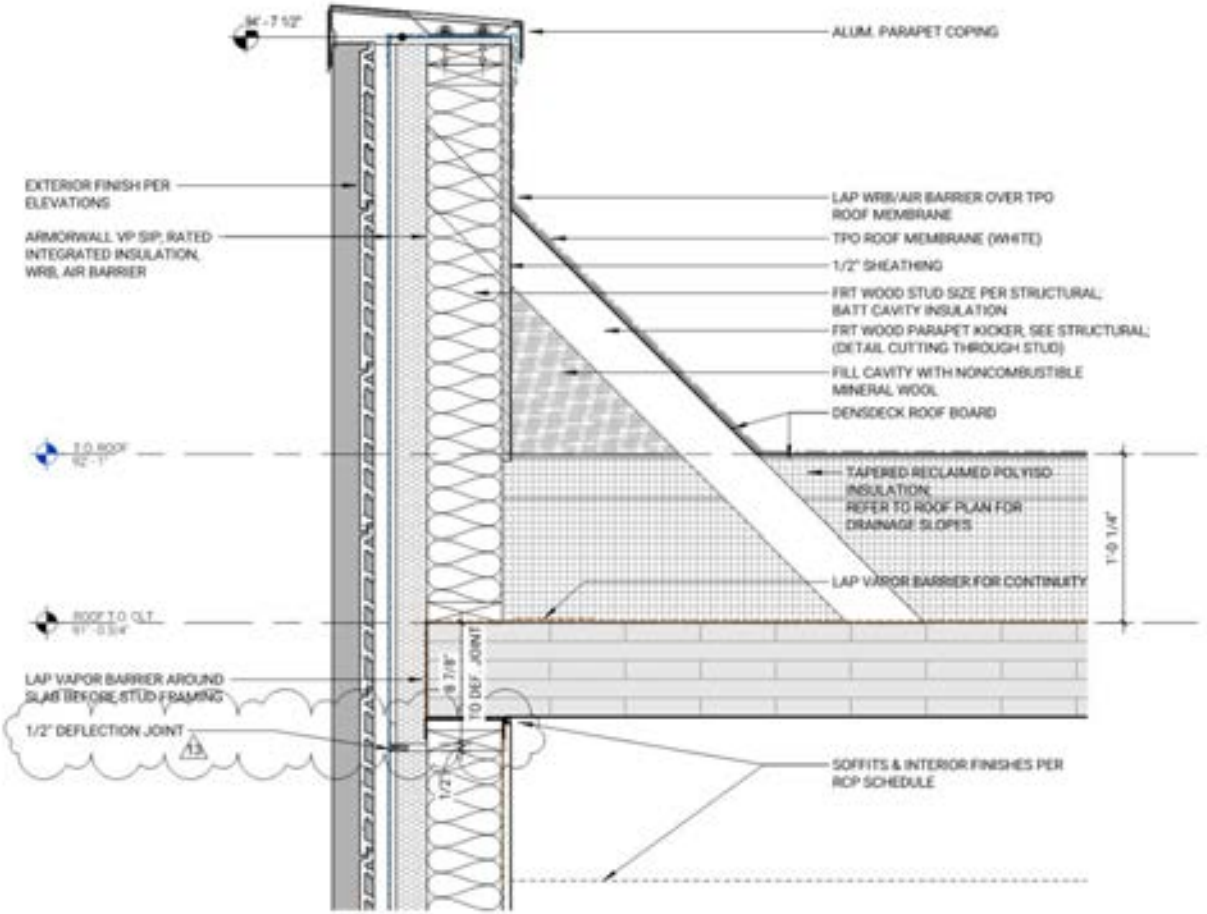
- Subgrade
  - 2ft min. glass aggregate gravel (R-40 min) insulated backfill
  - Recycled XPS frost wall insulation

- Exterior Wall
  - Terrracotta & fiber cement rainscreen cladding system
  - 2-3/4” Armorwall VP structural insulating panel, integrated vapor permeable air and water barrier, R-15 continuous
  - 2x6 FRT wood stud with R-21 fiberglas batt cavity insulation

11 E Lenox

Building Systems: Envelope

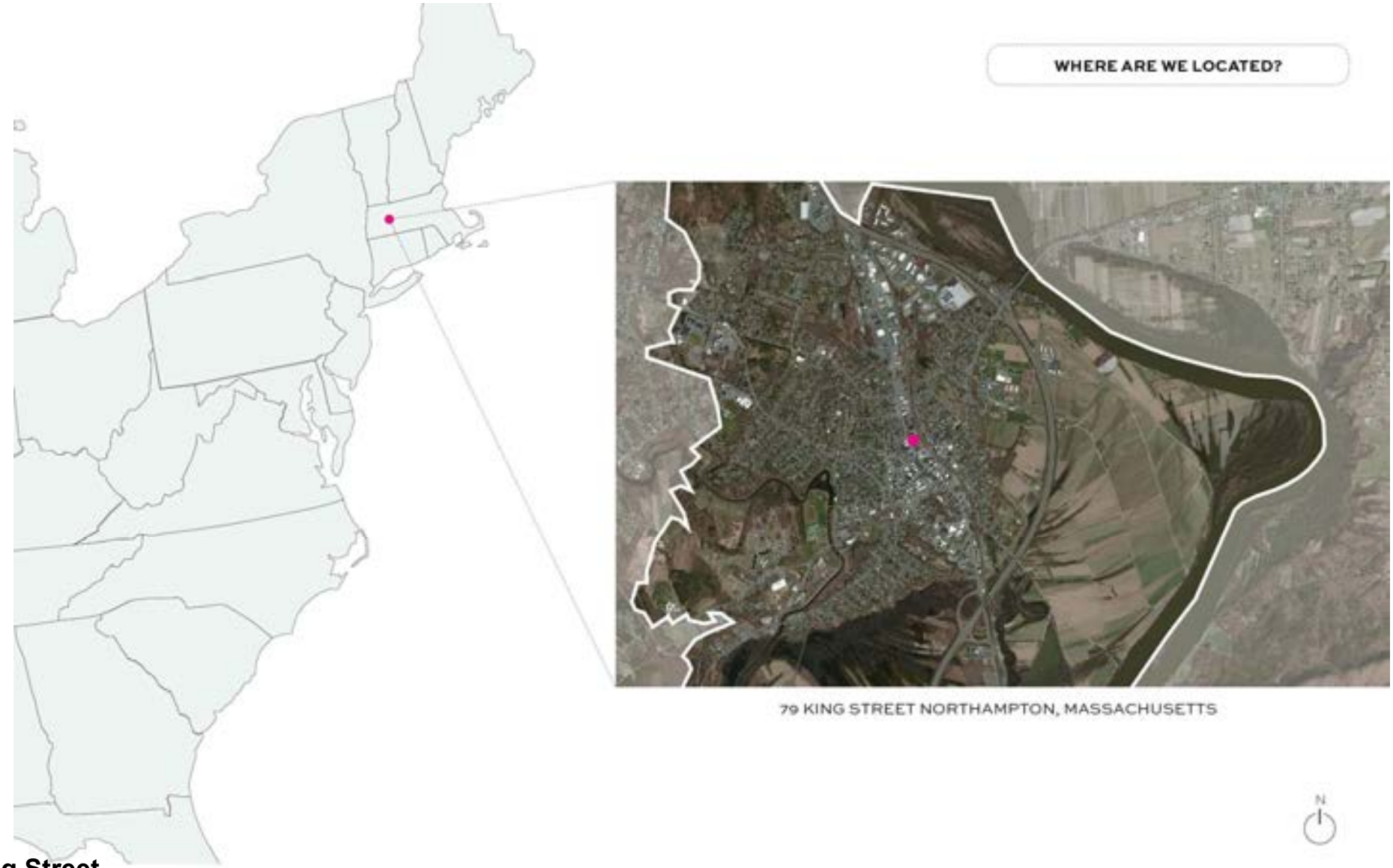
- Roof
  - TPO roof membrane
  - Protection board
  - Min. 2” tapered XPS insulation board (R-9)
  - 9” recycled polyiso board insulation (R-42)
  - Vapor barrier
  - 7” CLT slab



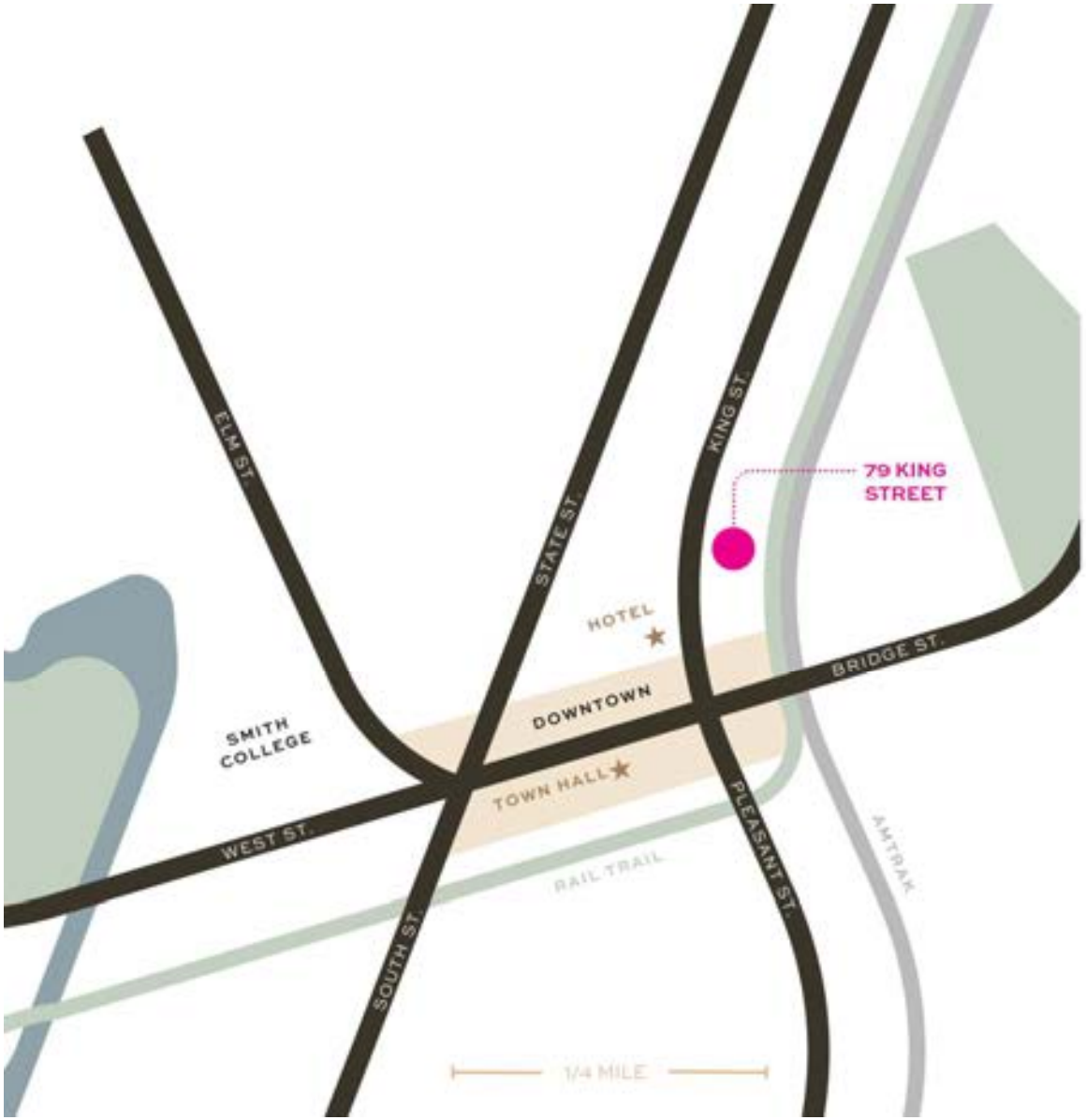
1 Typ. Parapet Detail
SCALE: 1 1/2" = 1'-0"

11 E Lenox


79 King Street
Downsizing with Massive Timber



79 King Street



NATURALLY OCCURRING RETIREMENT COMMUNITY (NORC)

DYNAMIC COLLEGE COMMUNITY

eclectic restaurants, lively arts and music scene known as "Cambridge West"

FIVE COLLEGE LEARNING IN RETIREMENT

(based at Smith College) offers lifelong learning, lectures, and special interest programs

BORDERING BIKE TRAIL

active lifestyles, scenic beauty
walk score = 96 bike score = 97

SHORTAGE OF ACTIVE ADULT 55+ HOUSING

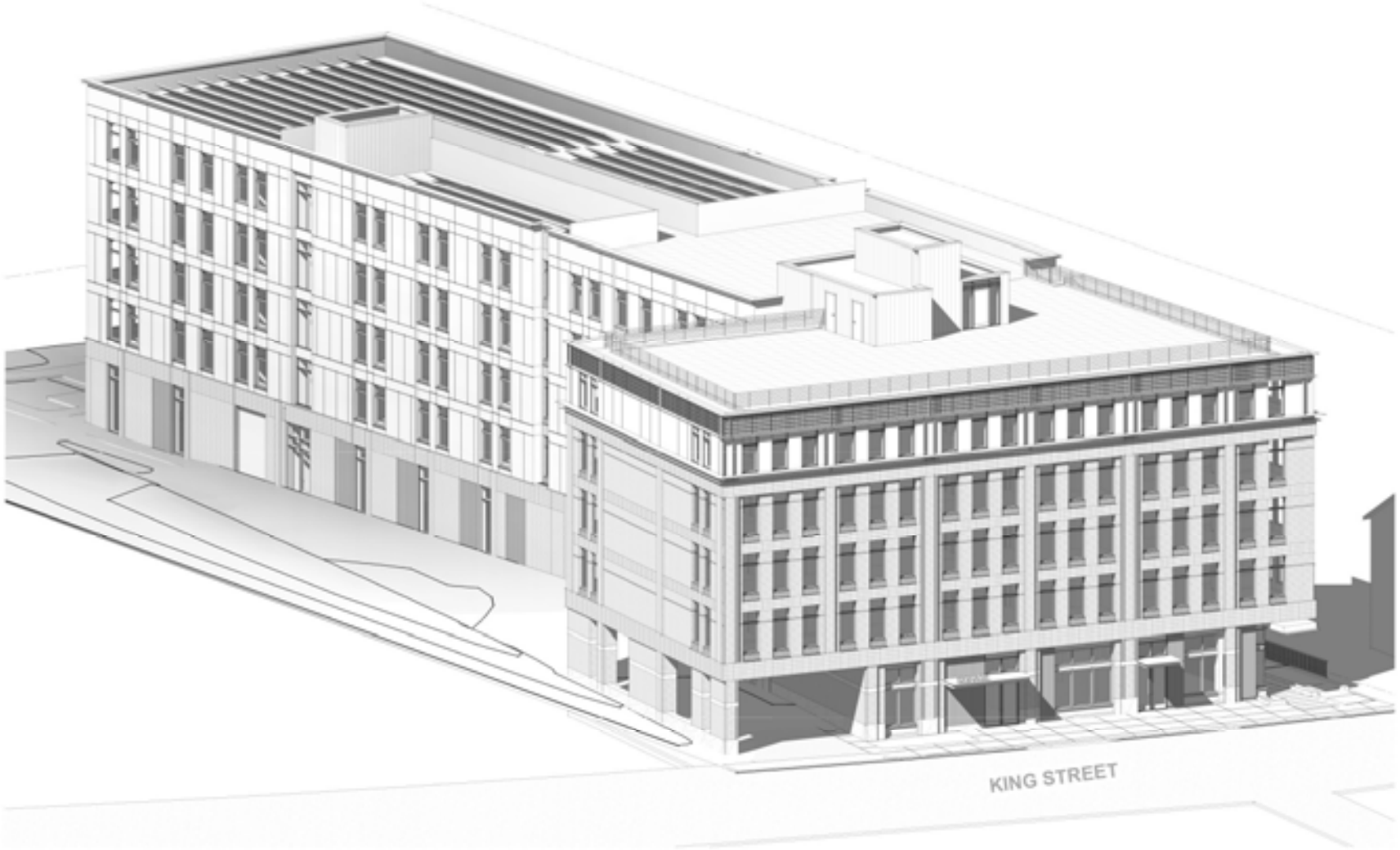
Northampton and surrounding communities have not yet delivered 55+ market multifamily opportunities

EASILY ACCESSIBLE

1.5 miles to I-91 | 50 mins to Hartford, CT & Bradley Int'l Airport | Amtrak station in walking distance

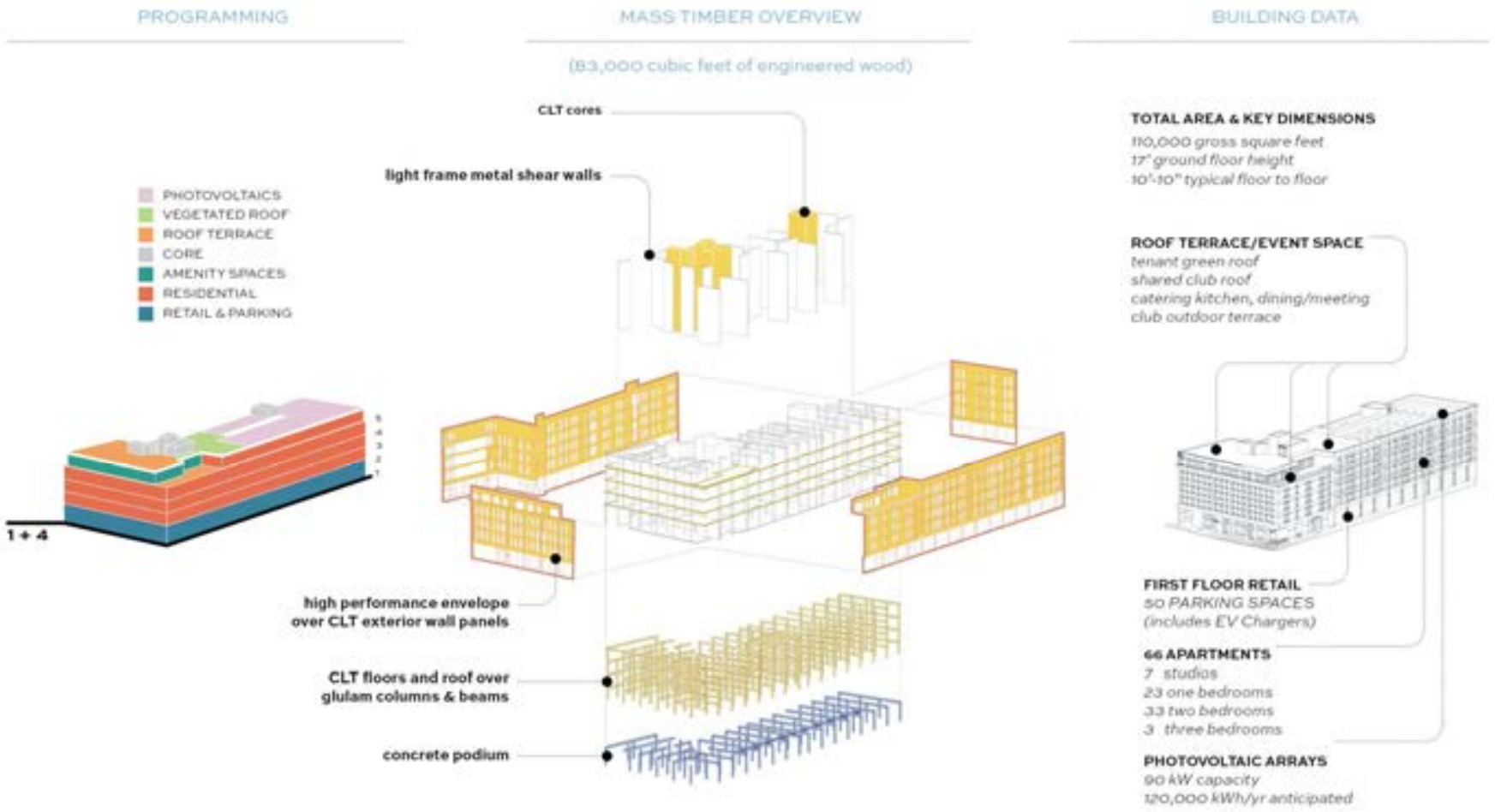
N

79 King Street



79 King Street

Project Summary



79 King Street

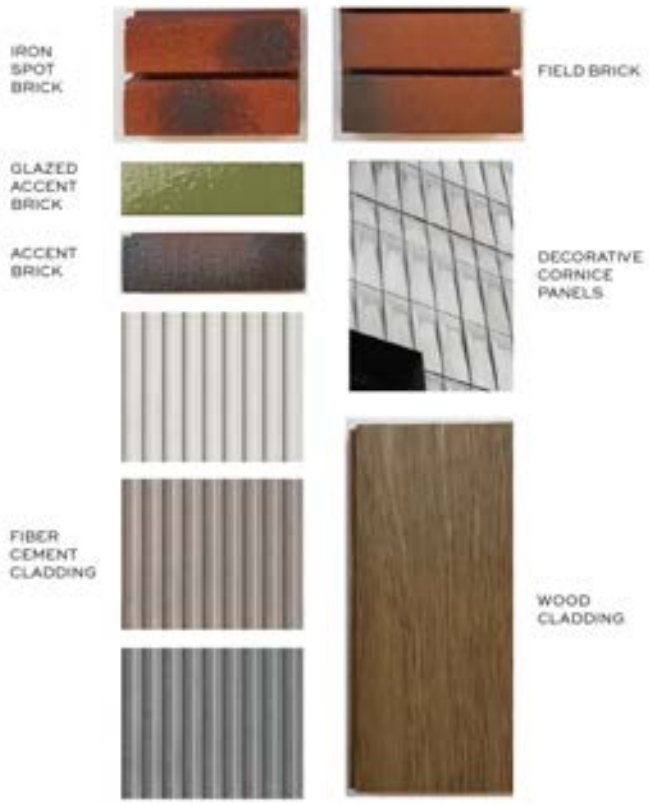
FACADE AT KING STREET

79 King Street

EXTERIOR MATERIAL PALETTE

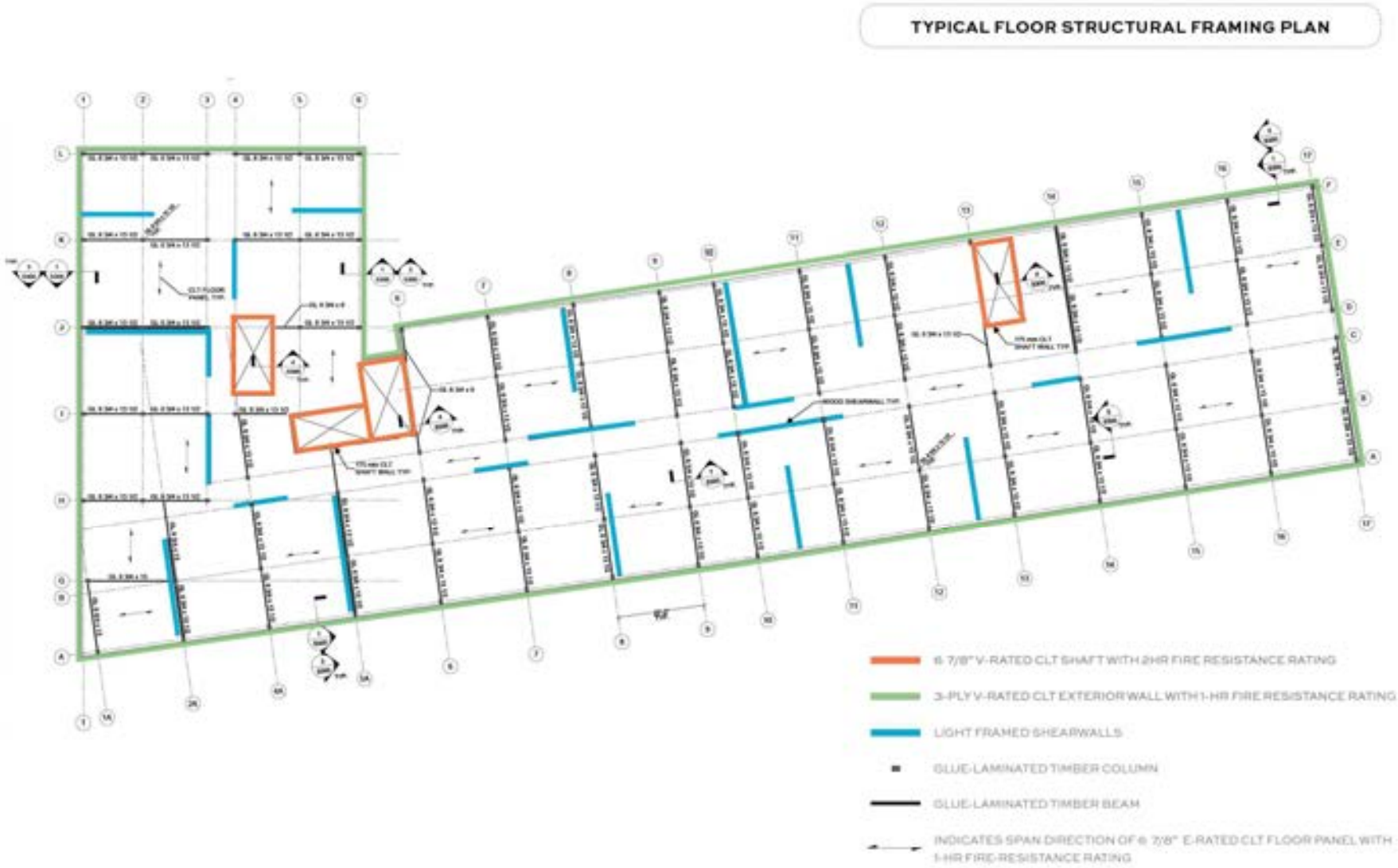
79 King Street

EXTERIOR MATERIAL PALETTE

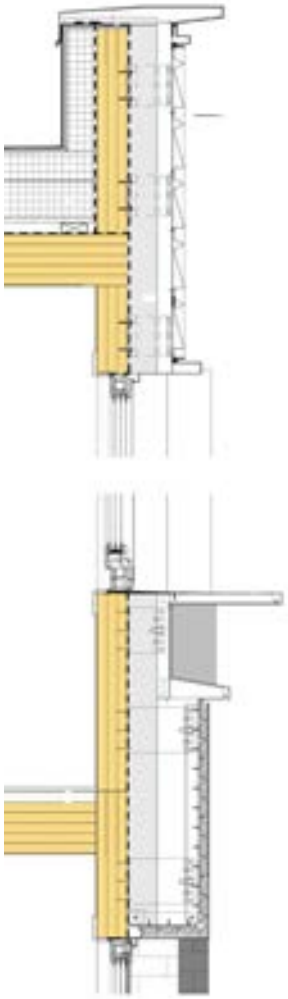


FLOOR PLANS

79 King Street

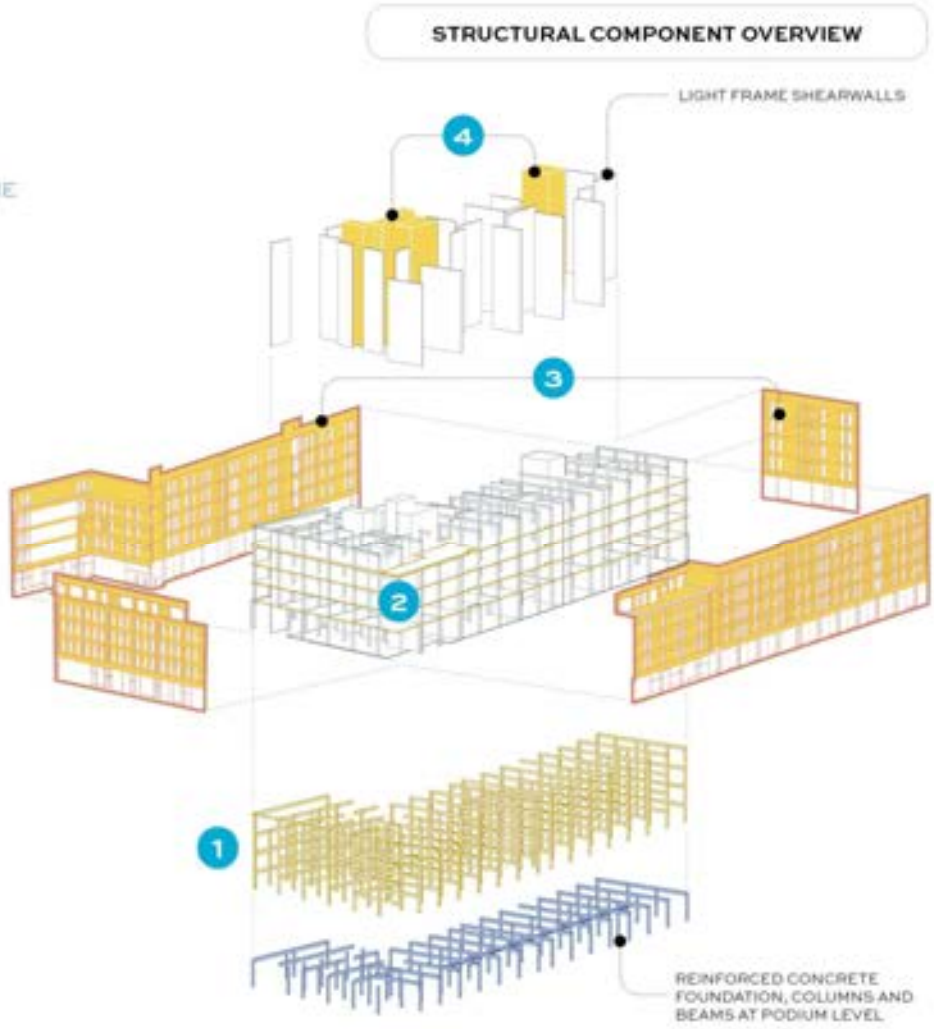


79 King Street



EXPECTED MEMBER SIZES AND VOLUMES

	FIBER VOLUME
1 - COLUMNS AND BEAMS	
GLULAM COLUMNS GL 8 3/4 x 13 1/2	3,287 FT³
GLULAM BEAMS 8 3/4 x 13 1/2	4,410 FT³
2 - FLOOR AND ROOF SLABS	
6 7/8" E-RATED CLT FLOOR PANEL WITH 1-HR FIRE-RESISTANCE RATING	62,352 FT³
3 - EXTERIOR WALLS (60% solid)	
3-PLY V-RATED CLT WITH 1-HR FIRE RESISTANCE RATING	7,040 FT³
4 -STAIR, ELEVATOR CORES AND SHAFTS	
6 7/8" V-RATED CLT SHAFT WALL WITH 2-HR FIRE-RESISTANCE RATING	5,802 FT³
	82,892 FT³



79 King Street

79 King Street

79 King Street

TESTING & INNOVATION

79 King Street


CARBON

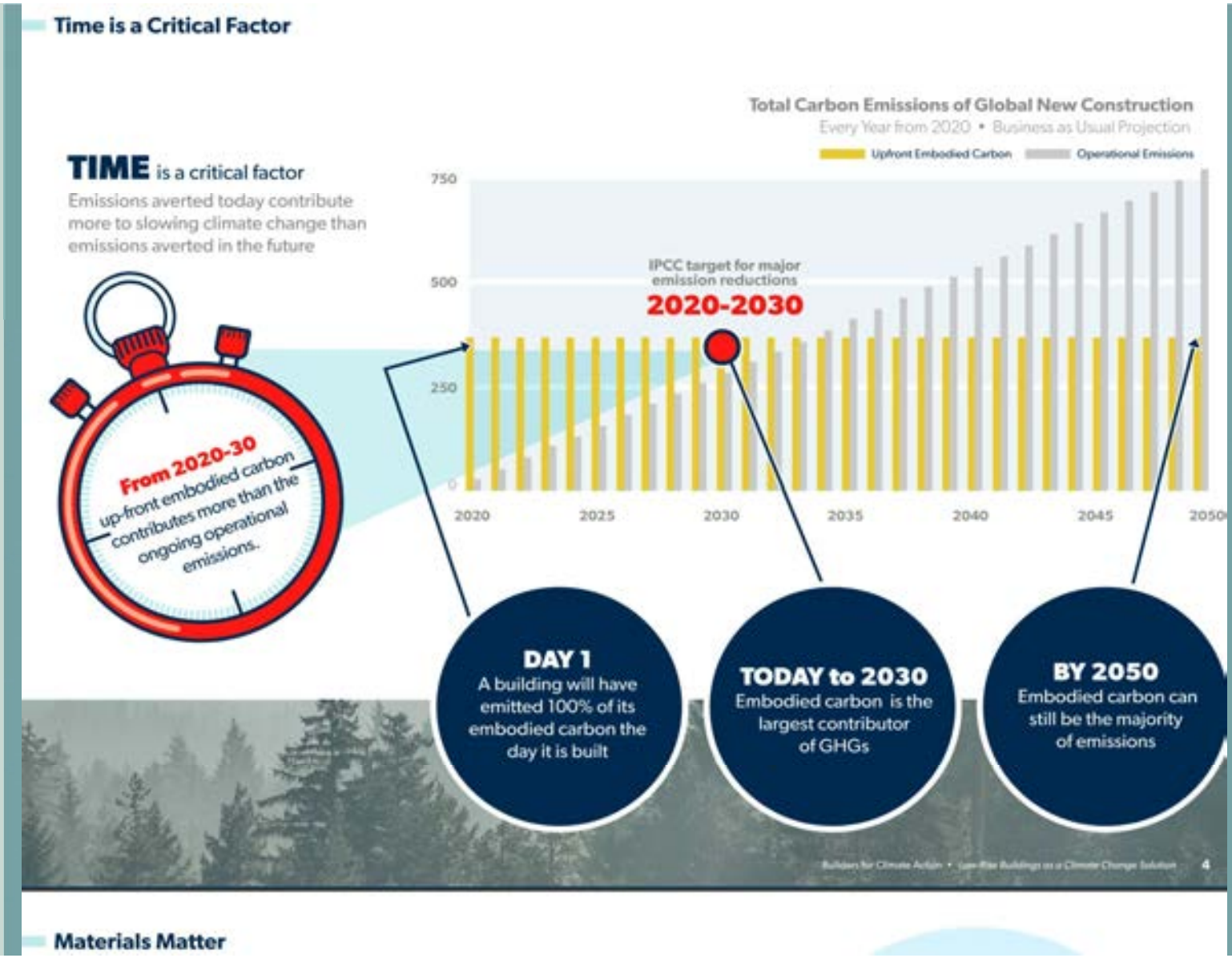
WE NEED THREE **PLANETS**

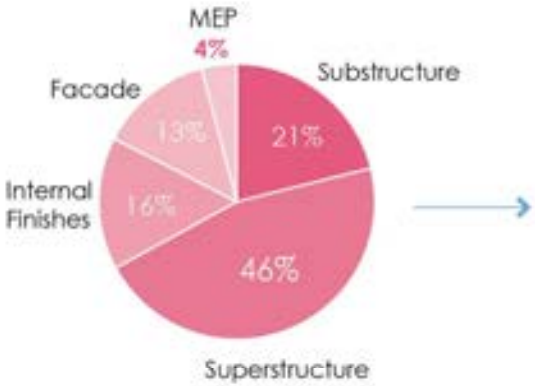
CARBON LIFE-CYCLE STAGES

SOURCE: ARCHDAILY

REDUCING OPERATIONAL ENERGY DEMAND IS NOT ENOUGH

THE TIME VALUE OF CARBON





COMMON EMISSIONS IMPACT
MEDIUM SCALE RESIDENTIAL

Source: LETI Embodied Carbon Primer

PUTTING EMISSIONS IN PERSPECTIVE: UPFRONT CARBON + HIGH PERFORMANCE BUILDING DESIGN

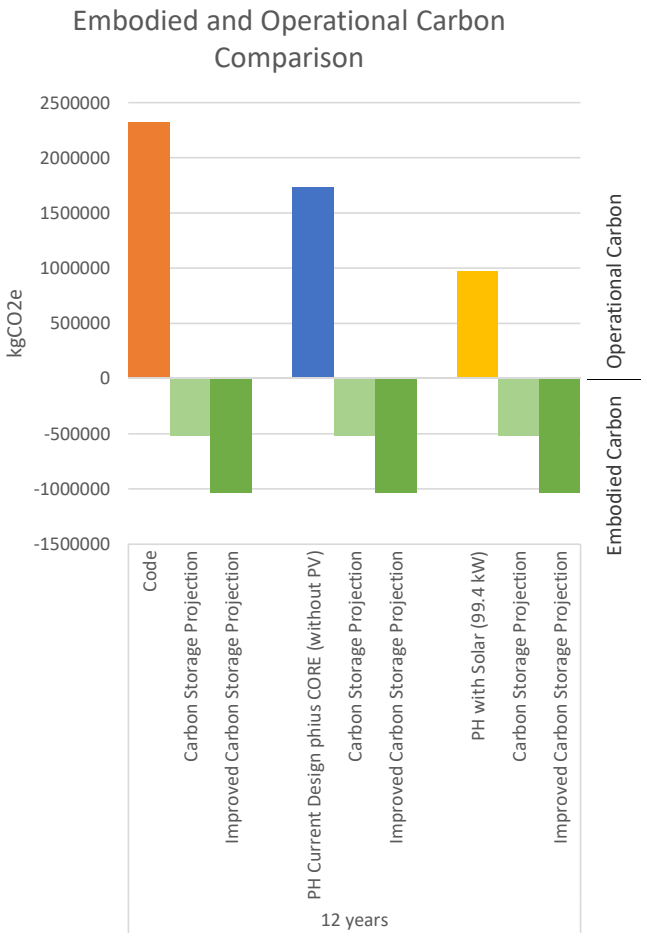
As building systems become more efficient, the short term impact of materials rise to the surface.

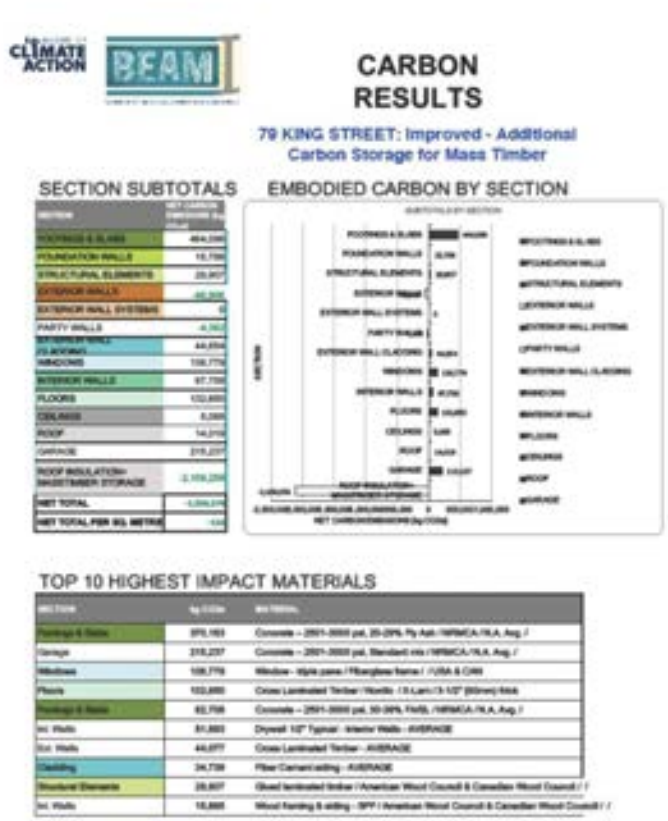
60 year lifespan
code building

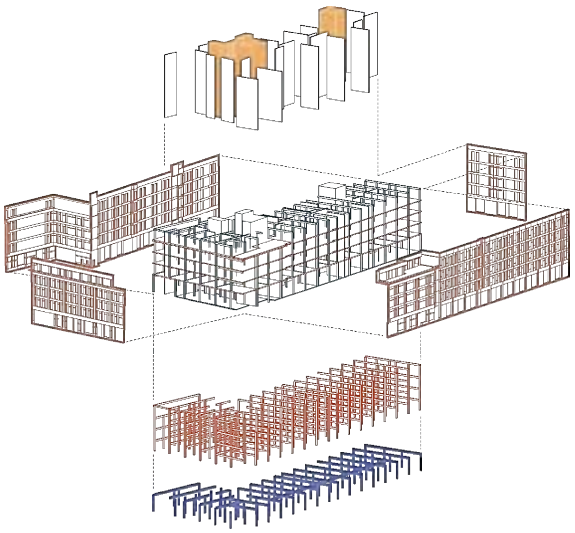
60 year lifespan
high performance building

10 year lifespan
high performance building

Source: adapted from K. Simonen, *Life Cycle Assessment*, 2014





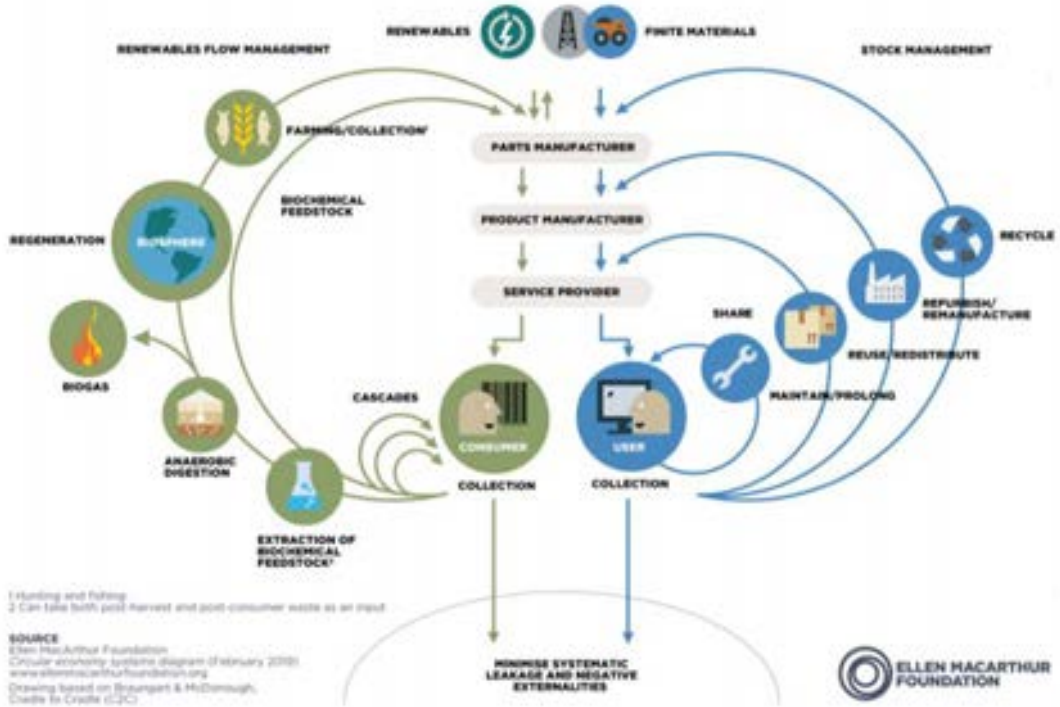


CARBON ARCHITECTURE

CAPTURE AND STORE CARBON

THE NECESSARY PARADIGM SHIFT

THE CIRCULAR ECONOMY SYSTEM DIAGRAM



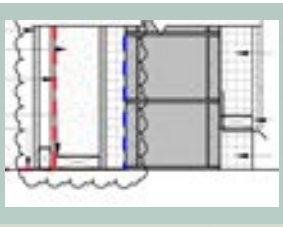
At the Ellen MacArthur Foundation we have tried to capture the essence of the circular economy in the diagram above, which is somewhat understandably nicknamed the 'butterfly diagram'.

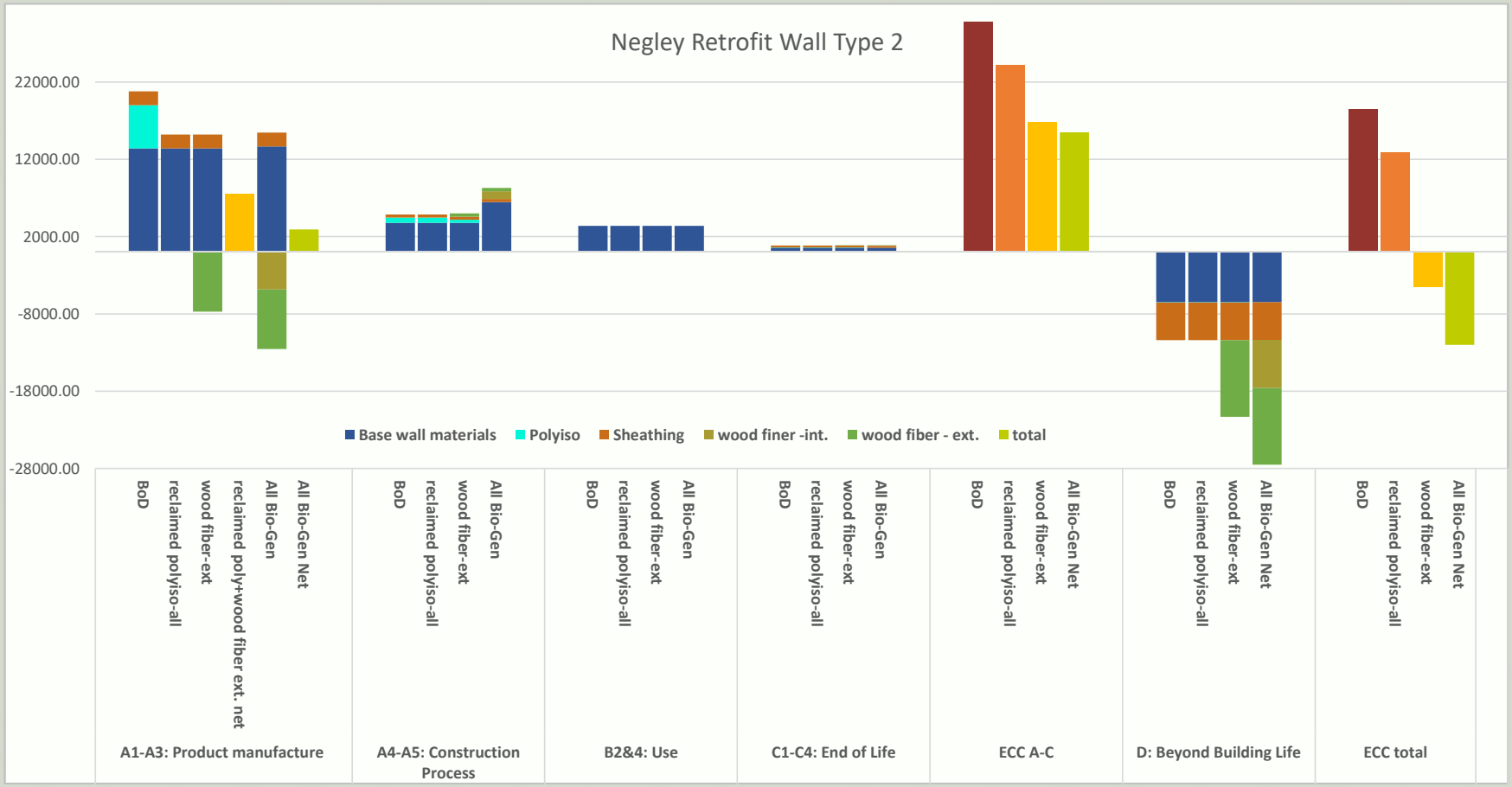
The diagram tries to capture the flow of materials, nutrients, components, and products, whilst adding an element of financial value. It builds on several schools of thought, but is perhaps most recognisably influenced by Cradle to Cradle's two material cycles.

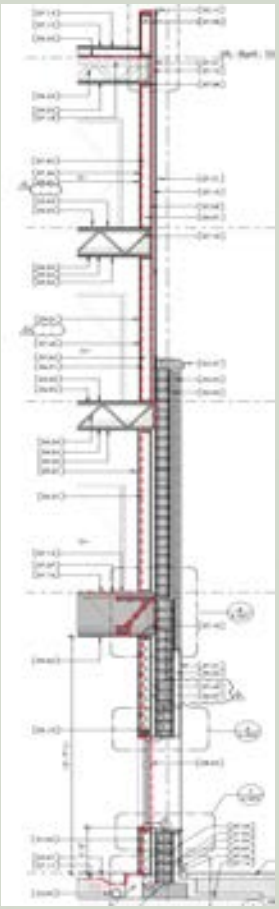
WE NEED THREE **PLANETS**

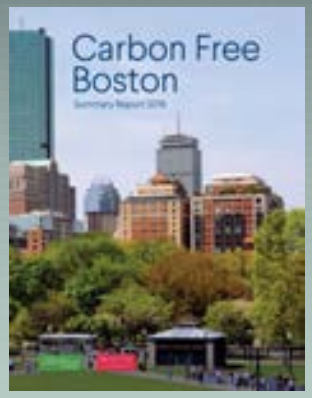
RETROFIT WITH POLYISO vs. BIOGENIC INSULATION

NEGLEY RETROFIT WALL COMPARISON









CARBON FREE BOSTON

City of Boston

BERDO 2.0

City of Boston

MASS TIMBER ACCELERATOR

City of Boston

MASS SAVE REBATES

Massachusetts State Utilities Collaborative & MA DOER

Local Laws 31 and 32 (2016)

NYC Public Buildings

CLIMATE MOBILIZATION ACT (2019)

New York City

Low-Embodied-Carbon Concrete Leadership Act

New York State

PANEL DISCUSSION

BOSTON AND NYC POLICY

INCREASING HOUSING DEMAND

LEADING TO DENSITY

HOUSING BOOM, LAND SCARCITY, INCREASING LAND COSTS

TRIPLE DECKERS > PODIUM > MIDRISE/HIGHRISE

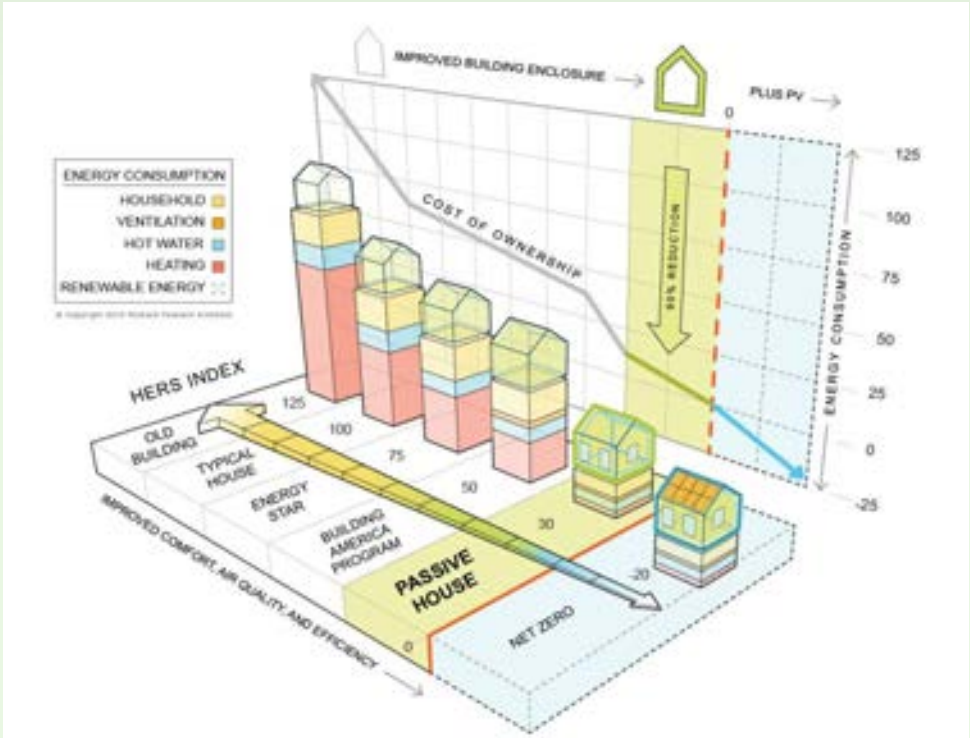
WOOD FRIENDLY MARKET

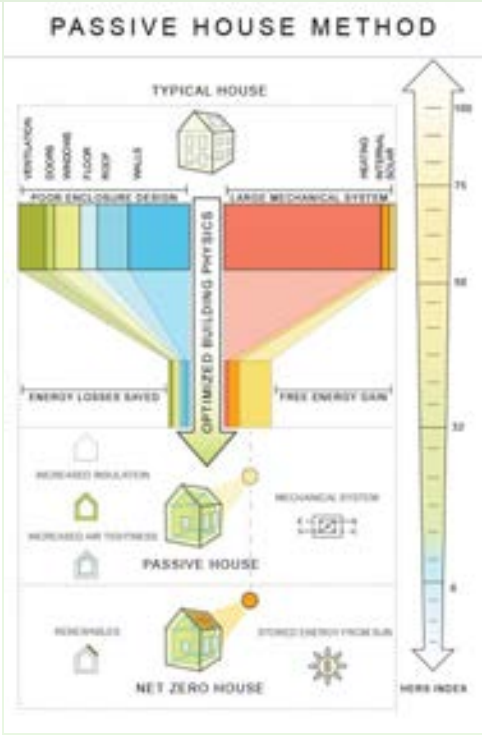
VAST MAJORITY OF NON-HIGH-RISE CONSTRUCTION IS WOOD

(Type III & V)

PANEL DISCUSSION

MARKET CONDITIONS



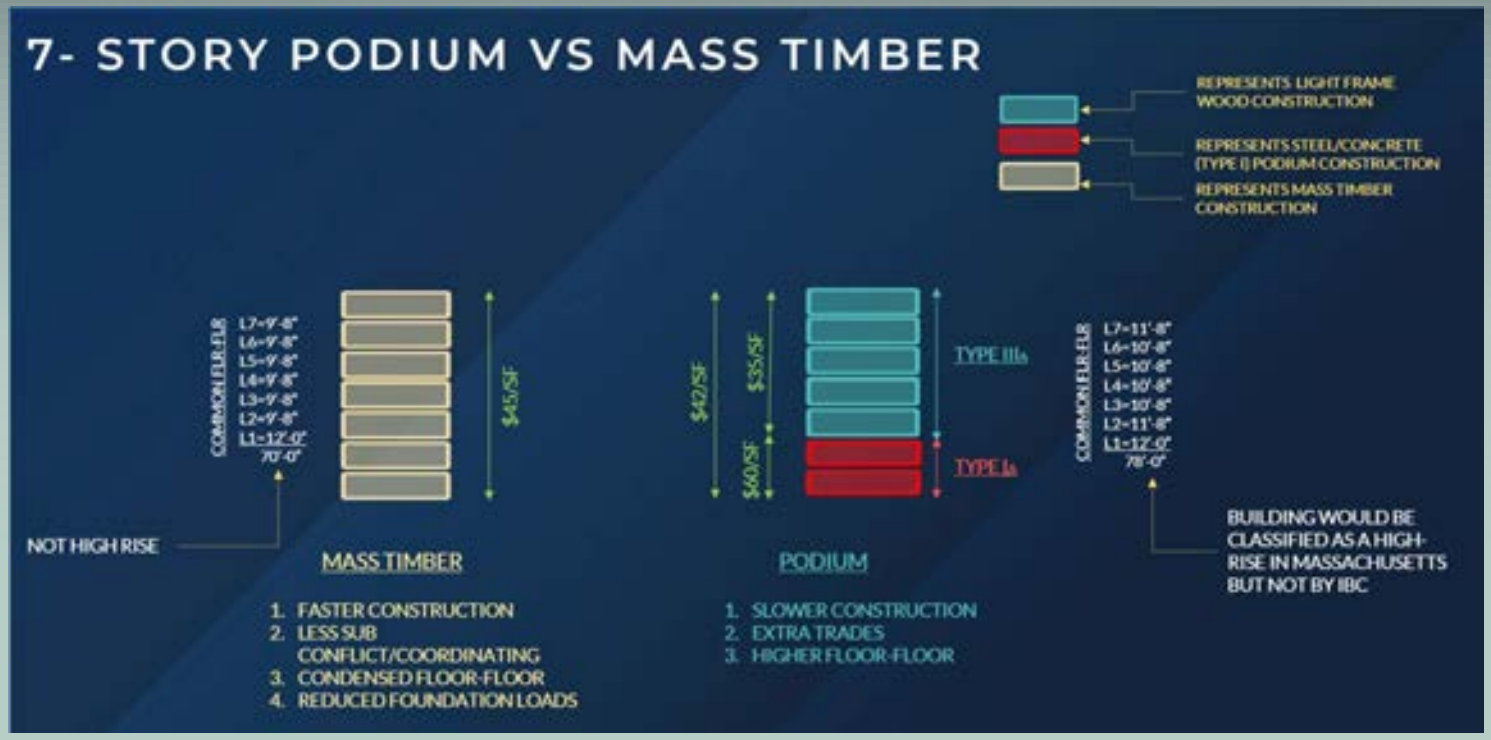


GRAPHICS COURTESY OF RICHARD PEDRANTI ARCHITECTS

PANEL DISCUSSION

MASS TIMBER & PASSIVE HOUSE SYNERGIES

11 E LENOX – DENSITY FEASIBILITY WITH SYSTEMS EFFICIENCY



- **SPACE IS A BIGGER COST PREMIUM THAN MEP SYSTEMS**
- **MINIMAL RIGHT SIZE SYSTEM**
- **MINIMAL PLENUMS AND CHASES**
- **MINIMIZED STRUCTURAL PENETRATIONS**

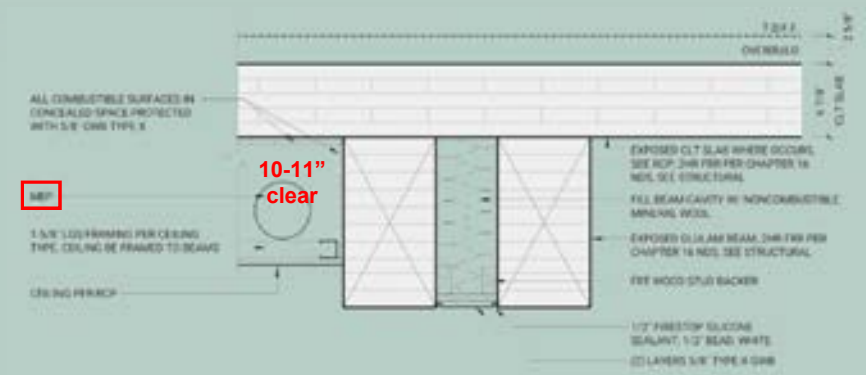
PANEL DISCUSSION

MASS TIMBER & PASSIVE HOUSE SYNERGIES

11 E LENOX – DENSITY FEASIBILITY WITH SYSTEMS EFFICIENCY

MINIMAL PLENUMS

- **11 E LENOX < 70FT TALL**
- **9’-8” FLOOR-TO-FLOOR**
- **MASS TIMBER STRUCTURALLY ALLOWS FOR 7 UNDER 70**
- **PHIUS DESIGN MINIMIZED PLENUM DEPTHS TO 10” - 11” CLEAR**



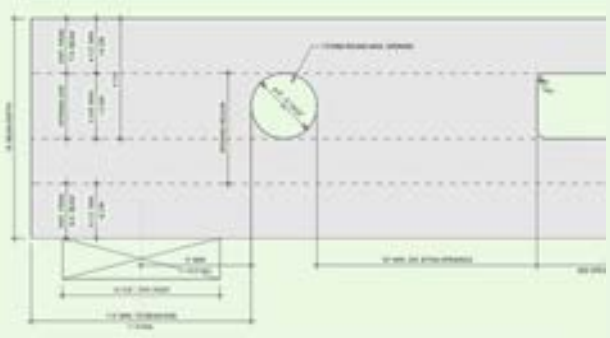
PANEL DISCUSSION

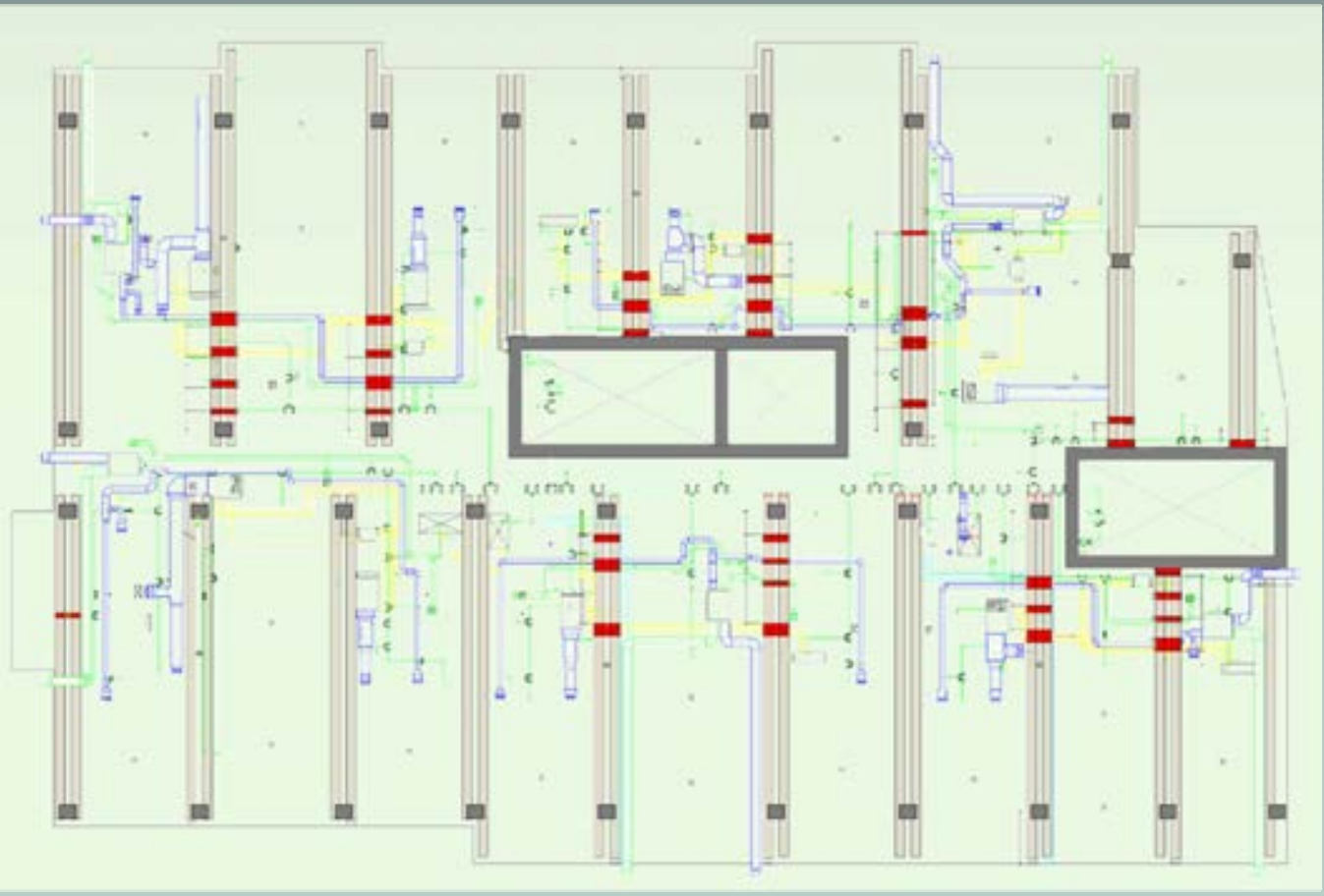
MASS TIMBER & PASSIVE HOUSE SYNERGIES

11 E LENOX – DENSITY FEASIBILITY WITH SYSTEMS EFFICIENCY

MINIMIZED STRUCTURAL PENETRATIONS

- **BEAM PENETRATIONS REQUIRED**
- **LARGEST PENETRATION H= 5 3/8”**
- **LARGEST DUCT Ø=4”**





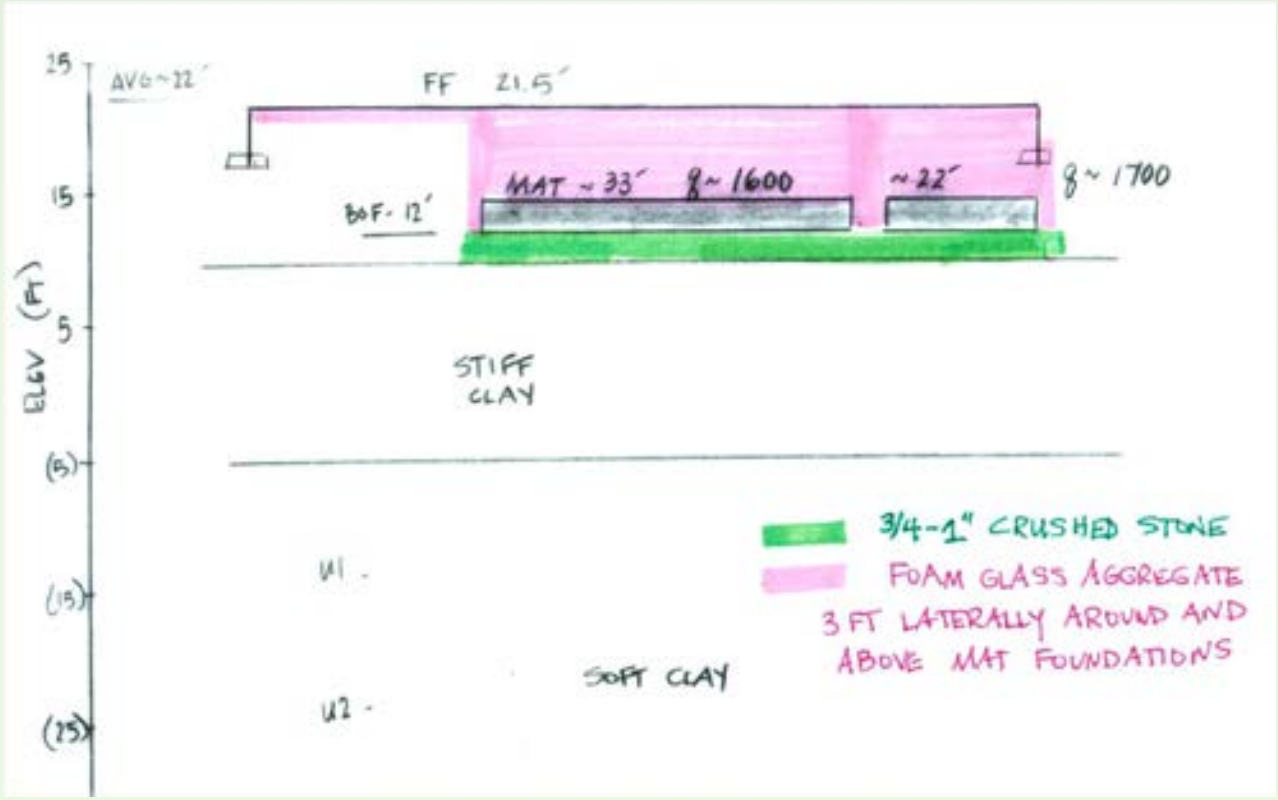
PANEL DISCUSSION

MASS TIMBER & PASSIVE HOUSE SYNERGIES

11 E LENOX – DENSITY FEASIBILITY WITH SYSTEMS EFFICIENCY

BUILDING WEIGHT & GROUND IMPROVEMENT REDUCTIONS

- **LIGHTWEIGHT MASS TIMBER STRUCTURE & FOAM GLASS AGGREGATE BACKFILL ALLOWED FOR SHALLOW FOUNDATION SYSTEM**
- **ALTERNATE WAS MORE COSTLY SOIL REPLACEMENT OR HELICAL PILES**



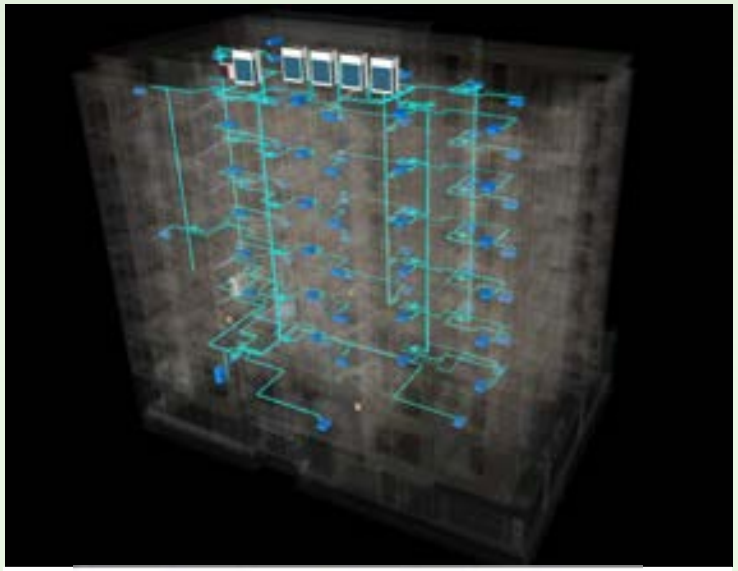
PANEL DISCUSSION

MASS TIMBER & PASSIVE HOUSE SYNERGIES

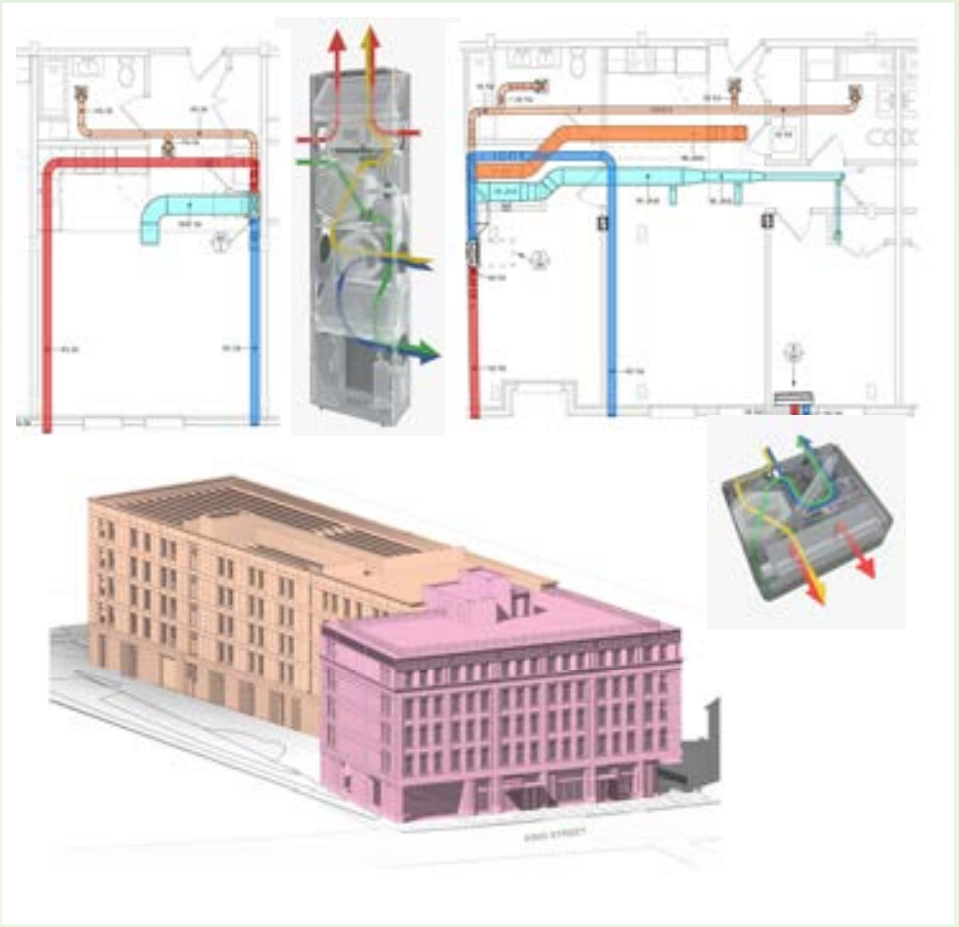
PANEL DISCUSSION

UNIQUE PROJECT FEATURES

HVAC SYSTEMS - REFRIGERANT + EFFICIENCY AND OTHER CONSTRAINTS

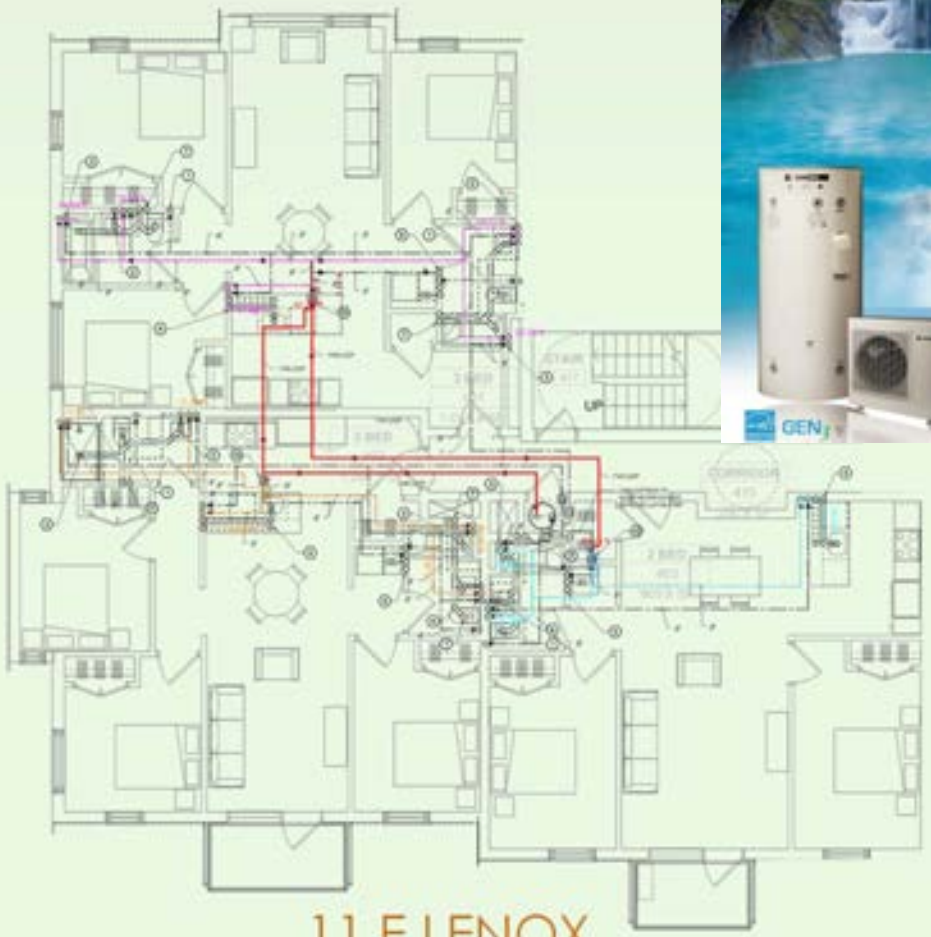


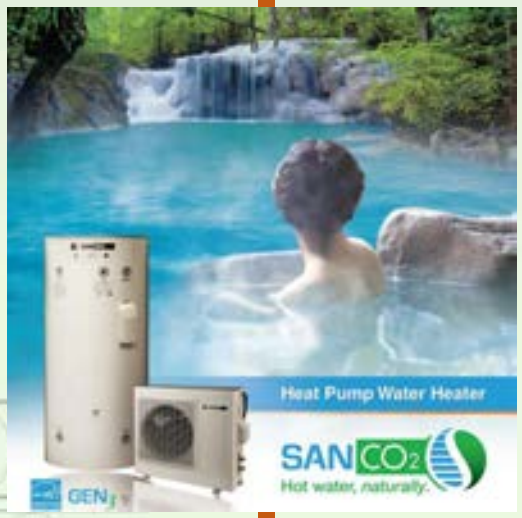
11 E LENOX



79 KING STREET

DOMESTIC HOT WATER – SANDEN CO_2 PLUMBING LAYOUTS

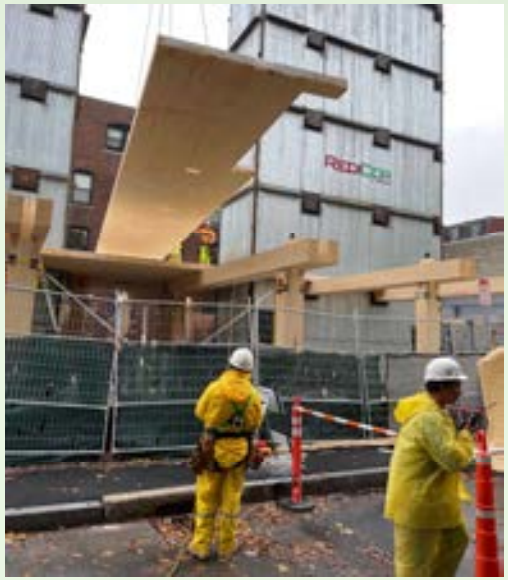




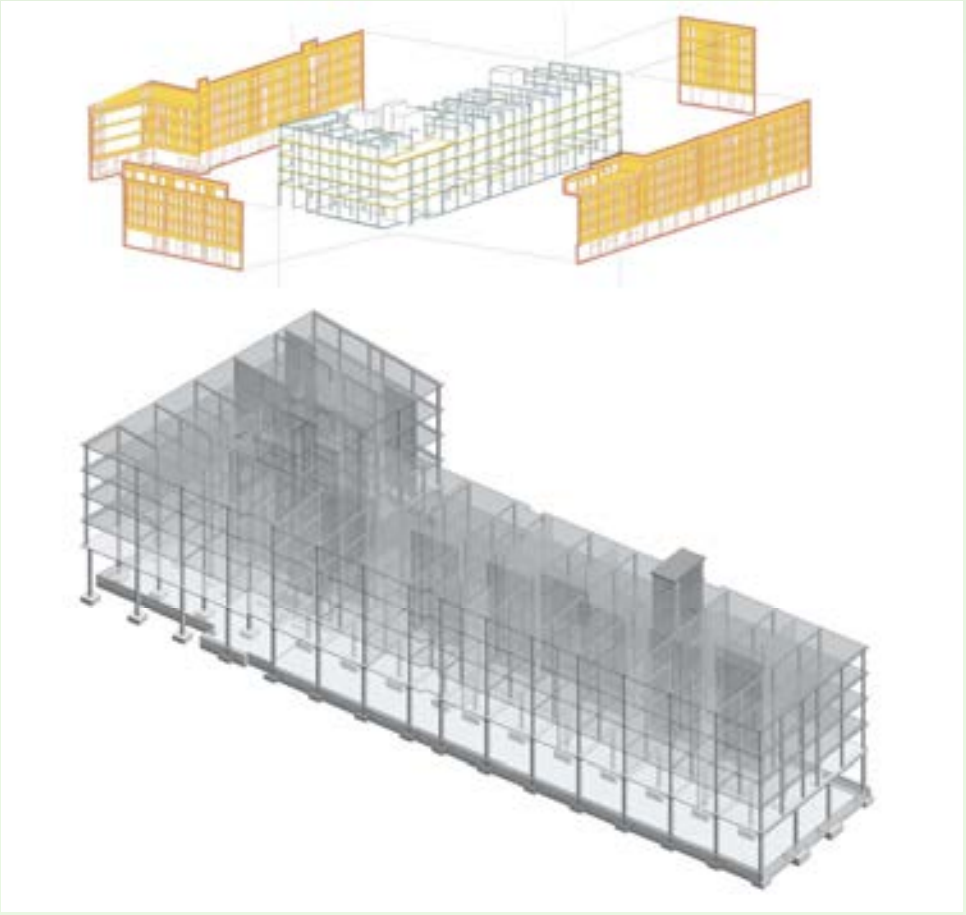
11 E LENOX

79 KING STREET

PODIUM – CROSS-LAMINATED TIMBER AND CONCRETE COMPOSITE DECK



11 E LENOX



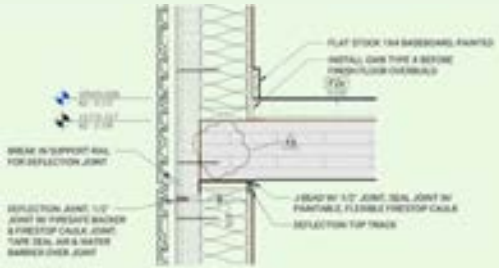
79 KING STREET

VERTICAL CORES – COMPOSITE PREFAB MODULES AND CLT CORES

11 E LENOX

79 KING STREET

EXTERIOR WALLS – LIGHT WEIGHT TIMBER FRAMING AND CLT WALLS



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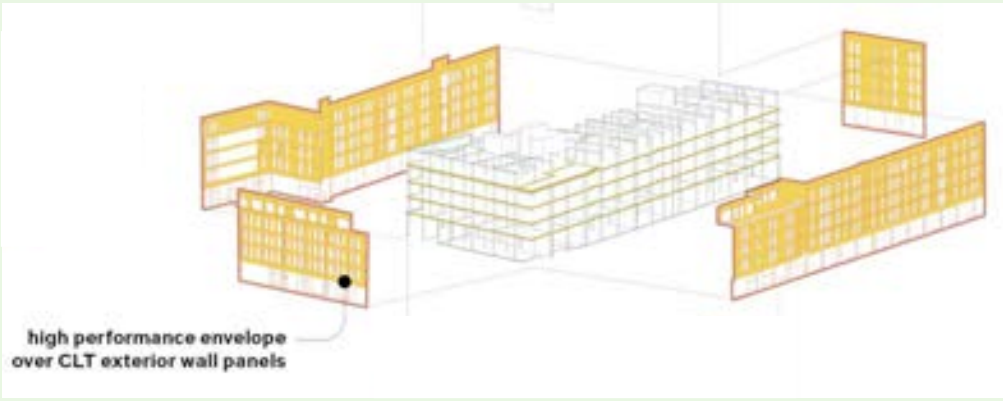
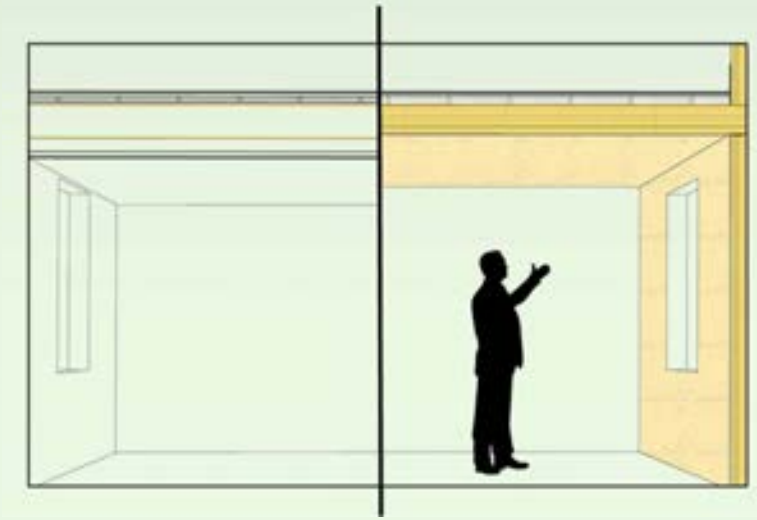


79 KING STREET

EXTERIOR WALLS – INTERIOR FINISHES

11 E LENOX



79 KING STREET

THANK YOU

MONTE FRENCH
DESIGN STUDIO
ARCHITECTURE + PLANNING

BKSK

Passive to POSITIVE
PASSIVE HOUSE AND LOW IMPACT DESIGN

MASS TIMBER - PASSIVE HOUSE *CONFIDENTIAL-*

How PH + mass timber synergies yield financial + logistical viability