# **BUILDINGENERGY BOSTON**

## **Modular Multifamily Passive House: Design, Build, and Verify**

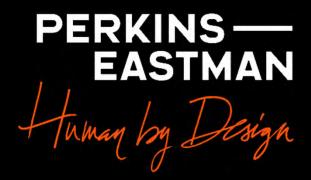
**Stuart Lachs, Perkins Eastman Tony Lisanti, Integral Building and Design** John Loercher, Northeast Projects / Phius

Curated by Kurt Carlson and Ilka Cassidy

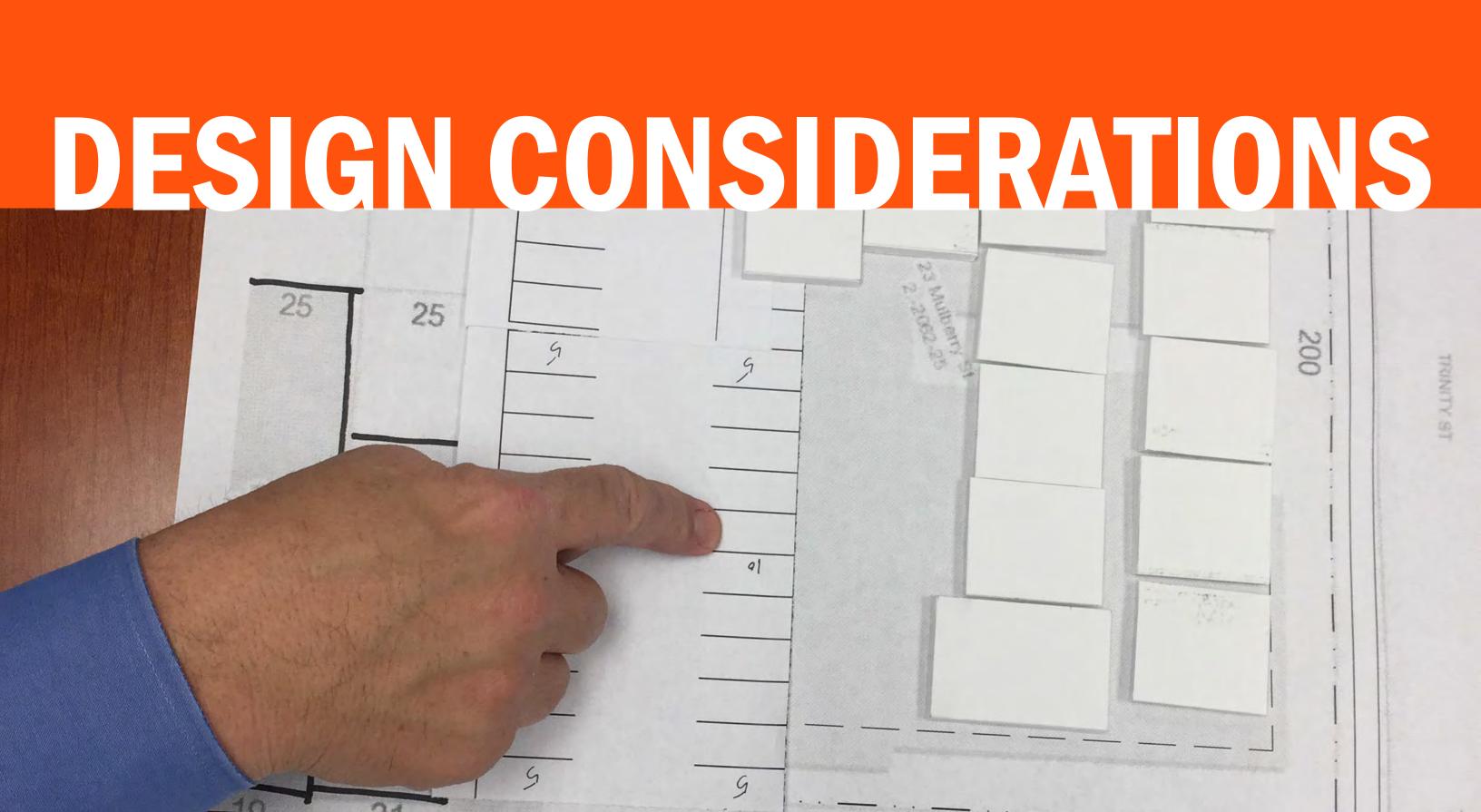
**Northeast Sustainable Energy Association (NESEA)** | March 20, 2025

**NORTHEAST SUSTAINABLE ENERGY ASSOCIATION (NESEA) BUILDINGENERGY BOSTON** 

# **MODULAR MULTIFAMILY PASSIVE HOUSE:** DESIGN, BUILD, AND VERIFY







### **ORIGINAL SITE CONDITIONS**



### **FORMER LONGFELLOW SCHOOL – DEMOLISHED CIRCA 2007**



## **FORMER LONGFELLOW SCHOOL – DEMOLISHED CIRCA 2007**



### **SITE AS DELIVERED 2019**























PERKINS EASTMAN - NORTHEAST PROJECTS – INTEGRAL BUILDING + DESIGN





**BUILDINGENERGY BOSTON 2025** 

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## PROGRAM

- 34,848 sf site (.8 acres)
- Sixty affordable rental apartments for 55-and-over
- Fully-adapted (Type B) and hearing-impaired units
- 60,000 Gross SF building area
- On-site resident parking (1/2 space per apt req'd)
- Community Room with Kitchen
- Two Business Rooms
- Fitness Room
- Landscaped Courtyard
- Landscaped Roof Deck
- Furnished Lobbies on Two Levels
- Central Laundry facilities
- In-unit stacking laundry available on request
- Building-wide WIFI
- Smart locks at entrances and apartment entries
- Resident storage
- Bicycle Storage
- Management Office



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### **DESIGN STRATEGY**

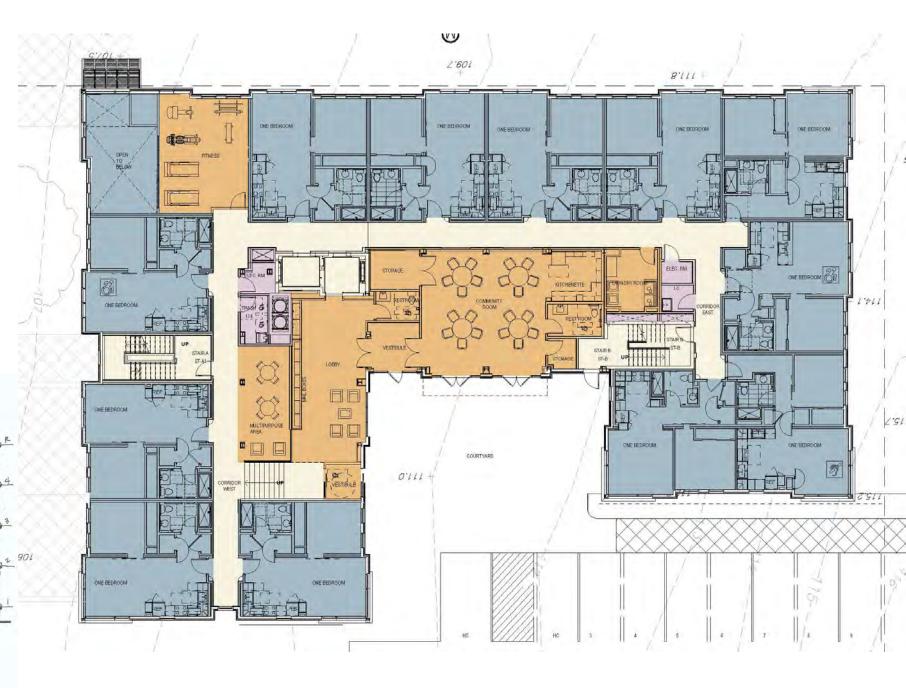
- Speaks to local vernacular of row-houses and two-family dwellings.
- Parapets create undulating roof line.
- Wall surface undulates to create a sense of depth.

WEST ELEVATION STUDY

RO SENIOR HOUGING

PERKINS -

• Provide spaces for gathering to create community.

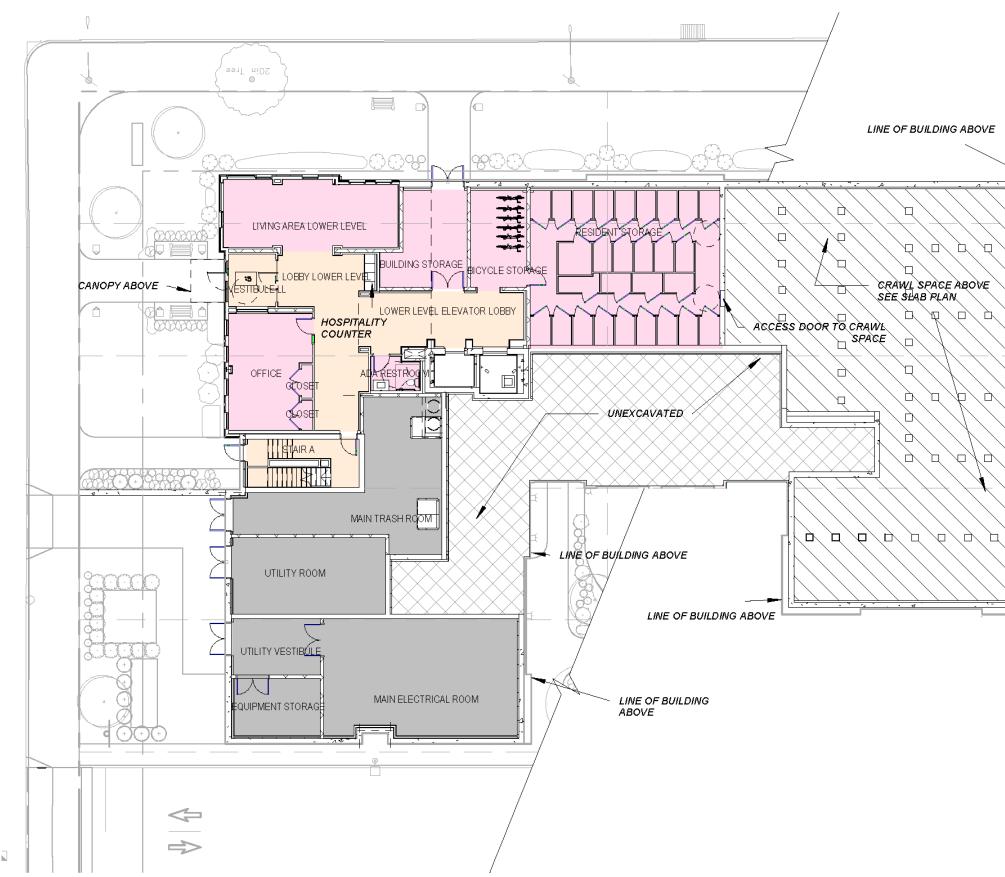


WIDER STALL

10



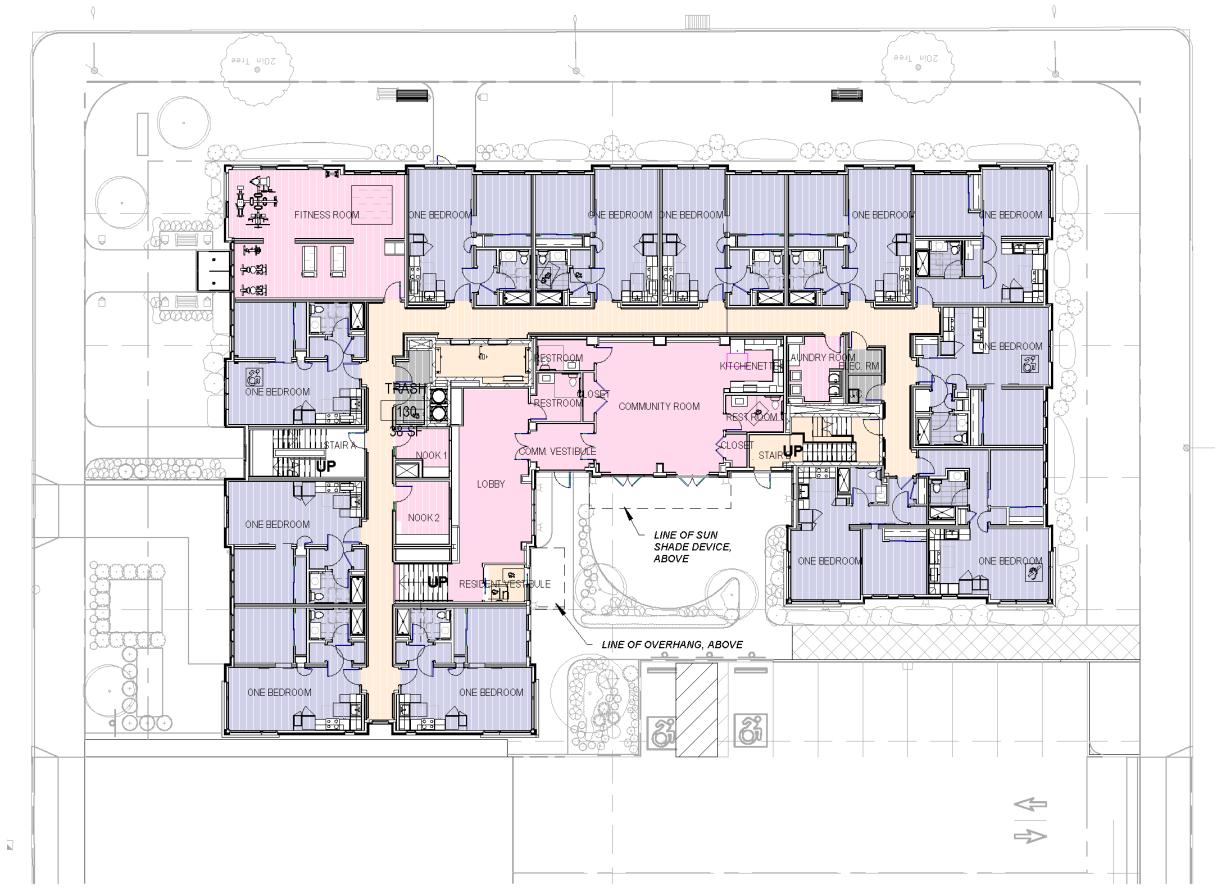
### BASEMENT



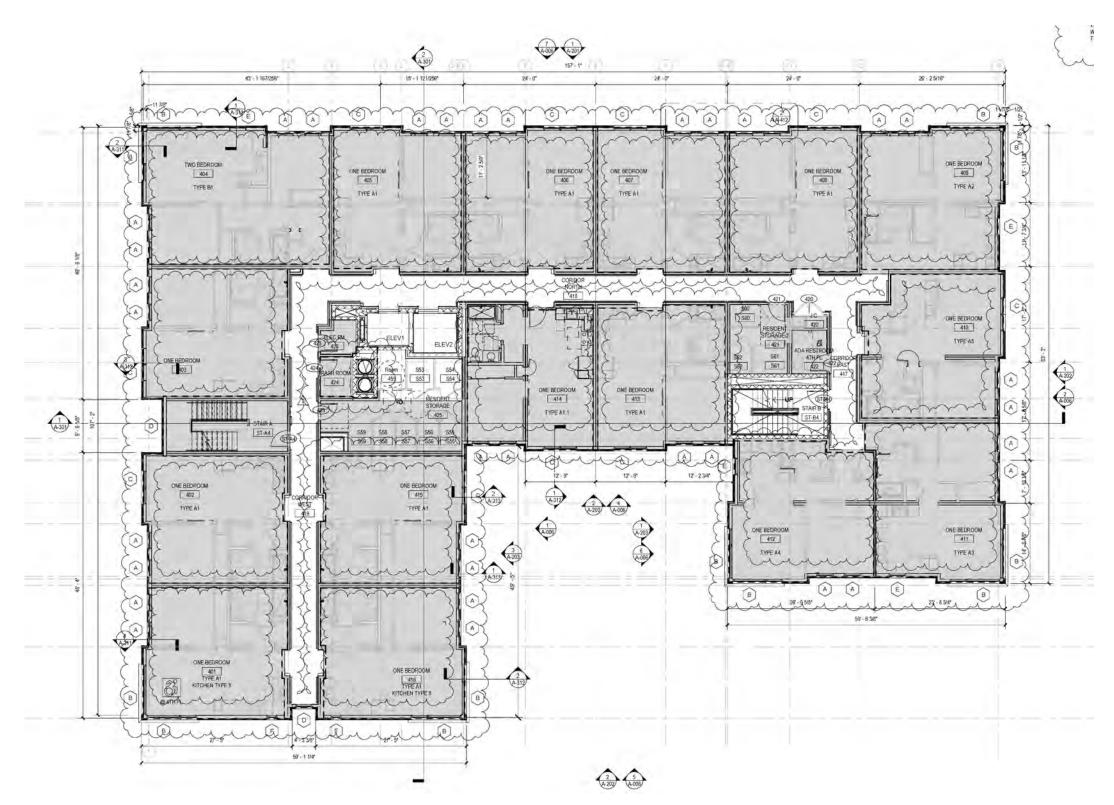


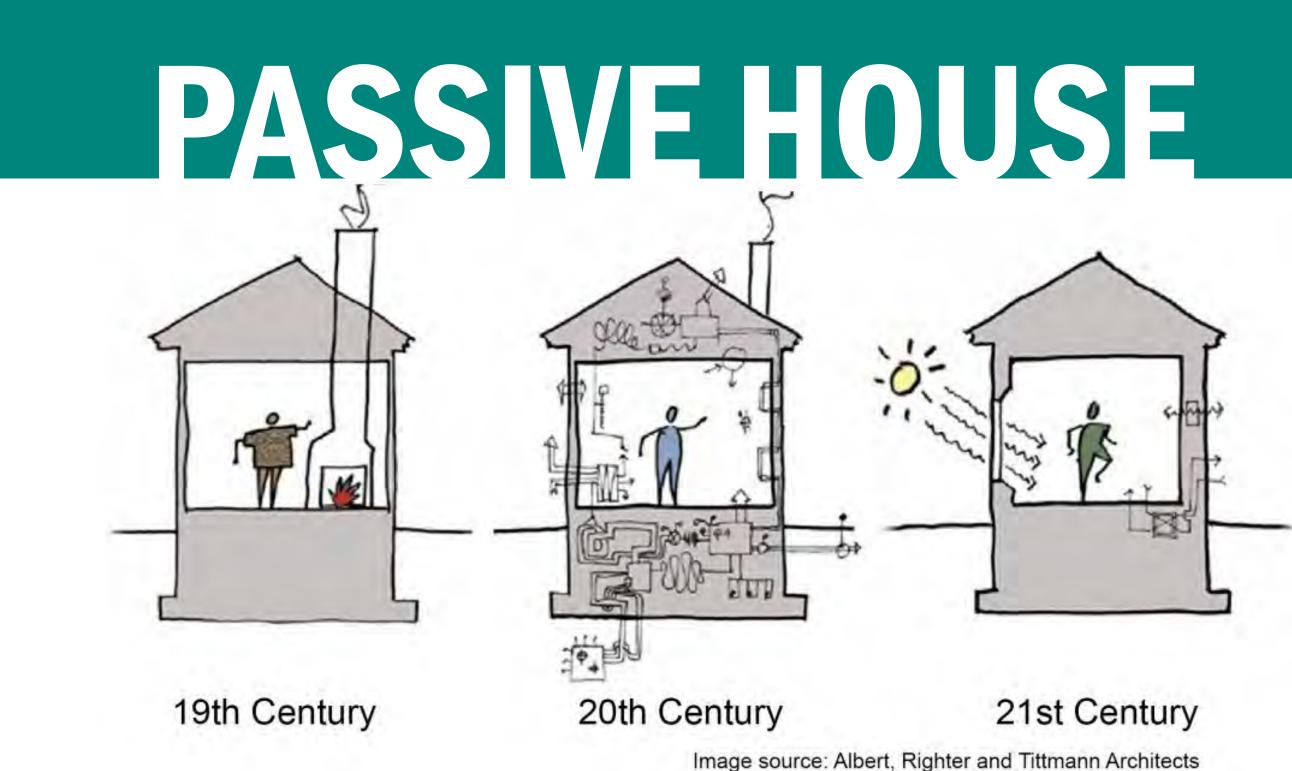
4" CONT EPS INSULATION DOWN

### **FIRST FLOOR**



**TYPICAL FLOOR** 



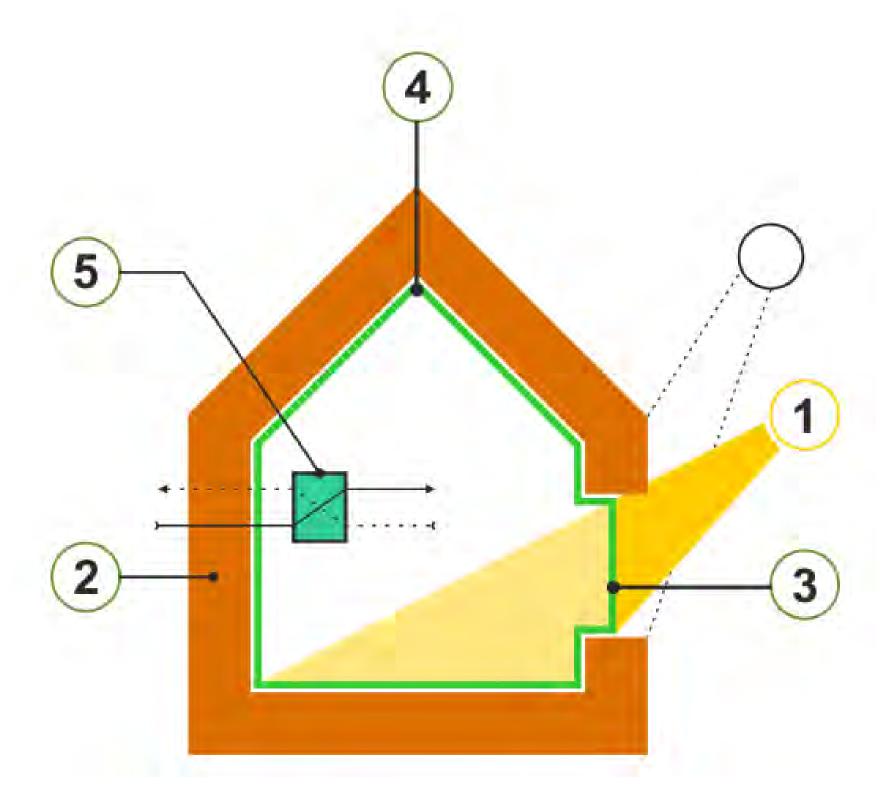


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## **PASSIVE HOUSE DESIGN PRINCIPALS**



- **2. Airtight Construction**
- - Bridging

# **1. Super Insulated Envelope 3. High-Performance Glazing** 4. Eliminate/Reduce Thermal

## **5. Energy Recovery Ventilation**

### CERTIFICATIONS

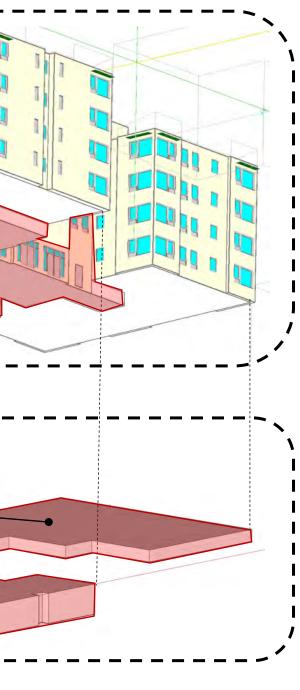
					Renewable Energy to Get to Zero
				Electrification Readiness	No Fossil-Fuel Combustion On-Site
				Electric Vehicle Readiness	Electric Vehicle Readiness
				Balanced Ventilation HRV/ERV	Balanced Ventilation HRV/ERV
			SOLAR READY Depends on climate	SOLAR READY ALWAYS	SOLAR READY ALWAYS
			Eff. Comps. & H2O Distrib	Eff. Comps. & H <sub>2</sub> O Distrib	Eff. Comps. & H <sub>2</sub> O Distrib
			EPA Indoor airPLUS VI	EPA Indoor airPLUS VI	EPA Indoor airPLUS VI
			Ducts in Condit. Space	Ducts in Condit. Space	Ducts in Condit. Space
	HVAC QI w/WHV	HVAC QI w/WHV	HVAC QI w/WHV	Micro-load HVAC QI	Micro-Ioad HVAC QI
	Water Management	Water Management	Water Management	Water Management	Water Management
	Independent HERS Verification	Independent HERS Verification	Independent HERS Verification	Independent HERS Verification	Independent HERS Verification
IECC 2012 Enclosure	IECC 2012 Enclosure	IECC 2012 Enclosure	IECC 2015/18 Encl./ES Win.	Ultra-Efficient Enclosure	Ultra-Efficient Enclosure
HERS 70-80	HERS 60-70	HERS 50-60	HERS 35-45	HERS 30-40	HERS < 0
IECC 2012	ENERGY STAR v3	ENERGY STAR v3.1	ZERH	@ phius	@ phius

IECC

## **ENVELOPE: DEFINING PHIUS BOUNDARIES**

- Site-built elements vs Modular
- Stair wells
- Elevator shafts
- Utility Rooms Apartments (Modular) Stairs (Site) **PHIUS ENCLOSURE** (subject to heating/cooling targets & all co-requisite programs) Elevator (Site) Trash chute (Site) Crawlspace (Site) **NON-CERTIFIED** (Not subject to Phius targets, but is subject to ALL other co-requisite programs) Mechanical (Site)

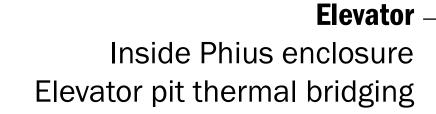




## **'OUT-OF-ENVELOPE' SPACES ARE NOT OFF THE HOOK...**

### **EPA Indoor AirPlus**

- Foundation Wall / Slab: Code min. insulation (or R5)
- Airtightness
- Space conditioning

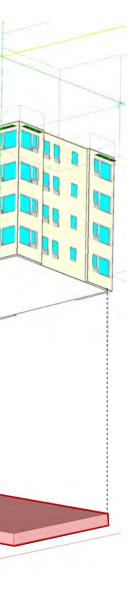


### **Crawlspace**

Space heating / dehumidification Pier thermal bridging

### Trash chute / Electric room

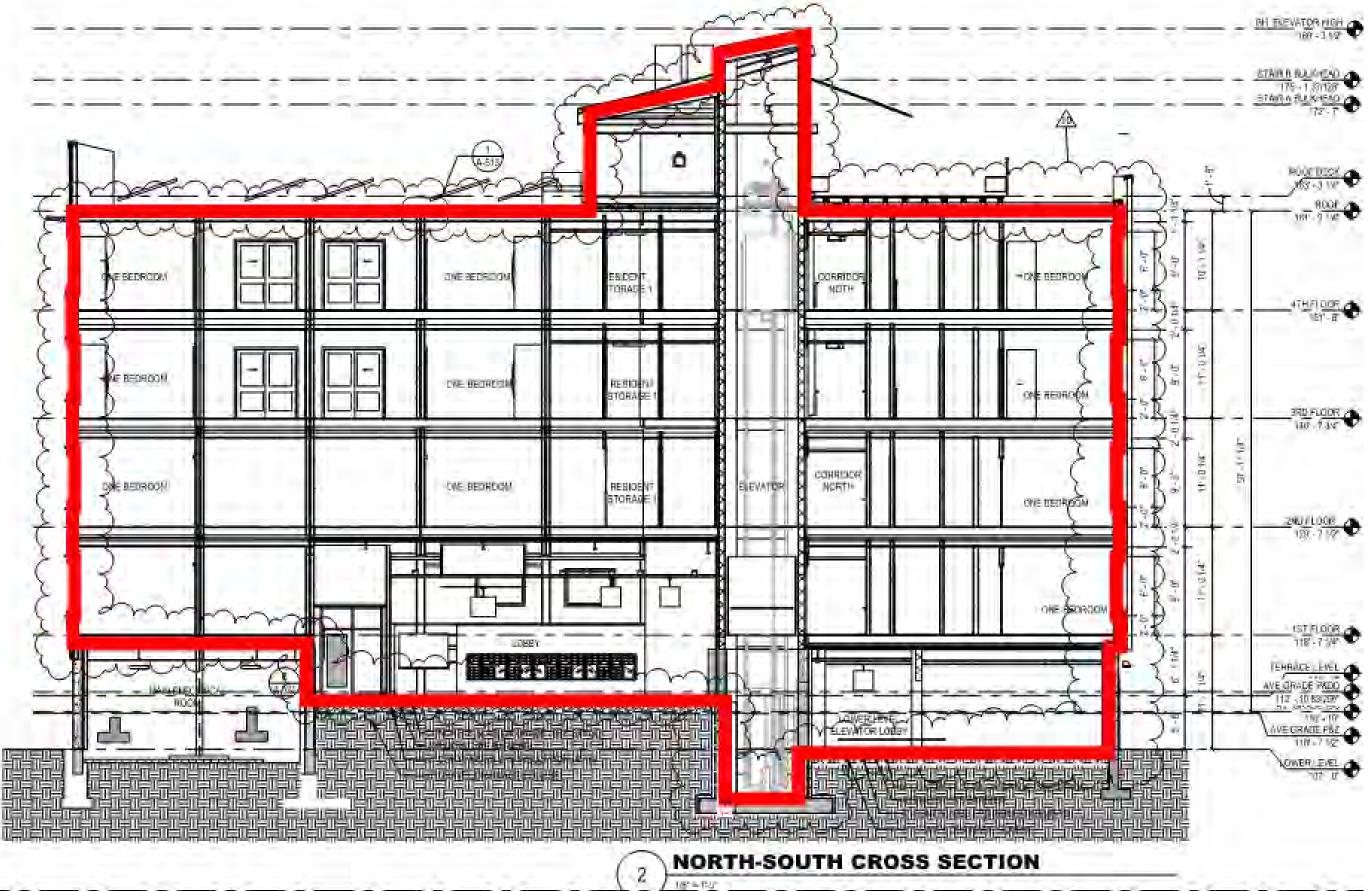
Space heating / dehumidification Ventilation





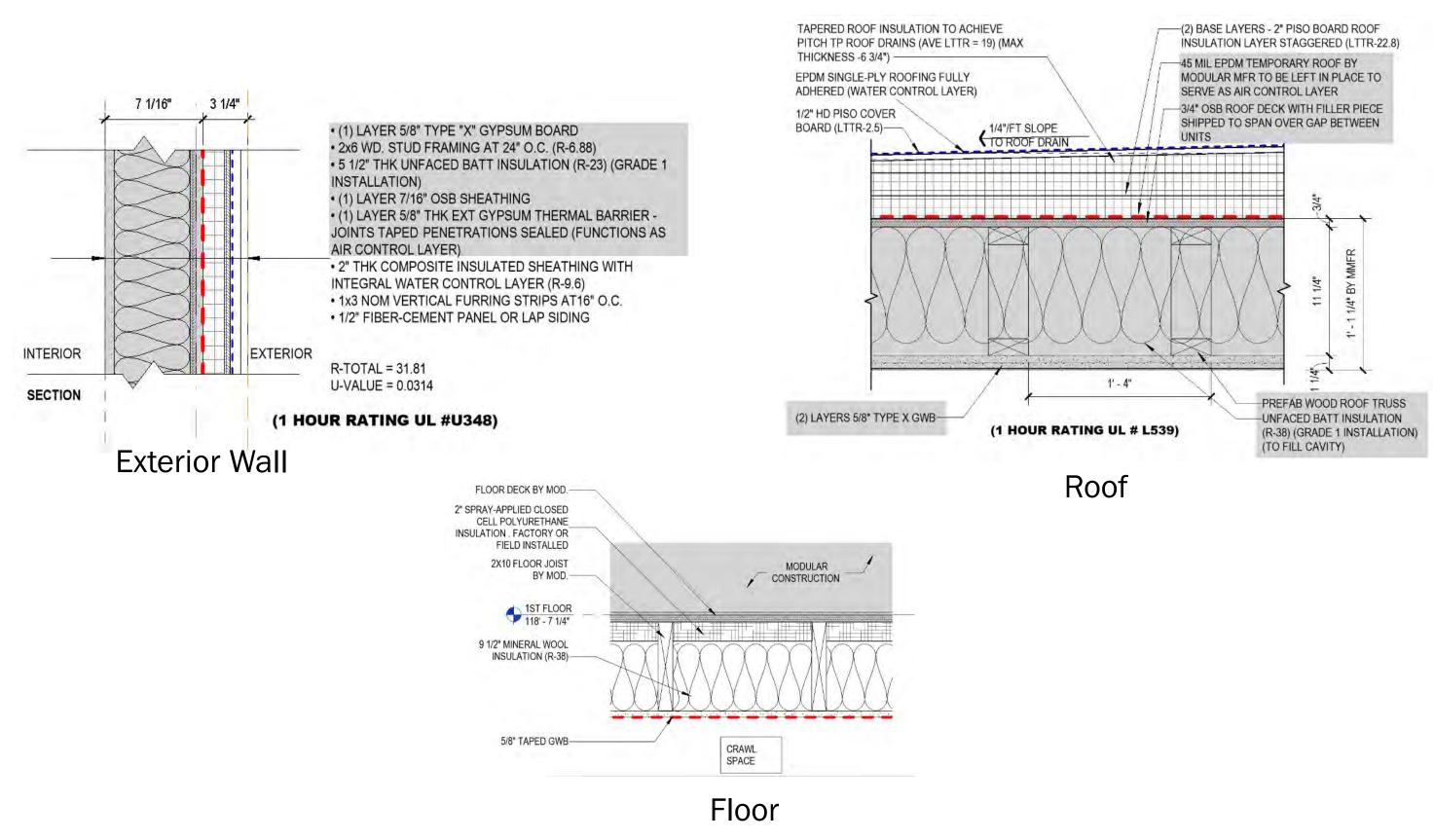
Site-built

### **ENVELOPE: IDENTIFY BOUNDARY IN DOCUMENTS**

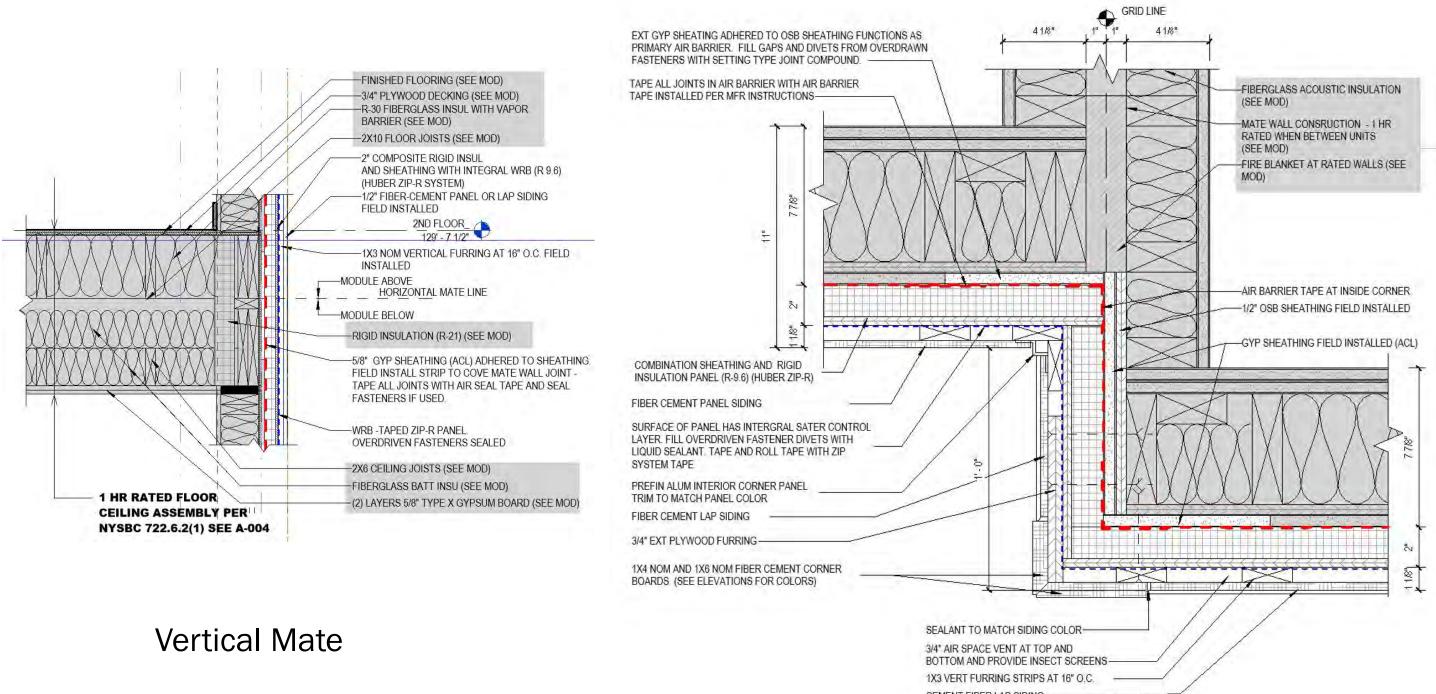


PERKINS EASTMAN - NORTHEAST PROJECTS – INTEGRAL BUILDING + DESIGN

## **ENVELOPE: IDENTIFY BOUNDARY IN DOCUMENTS**



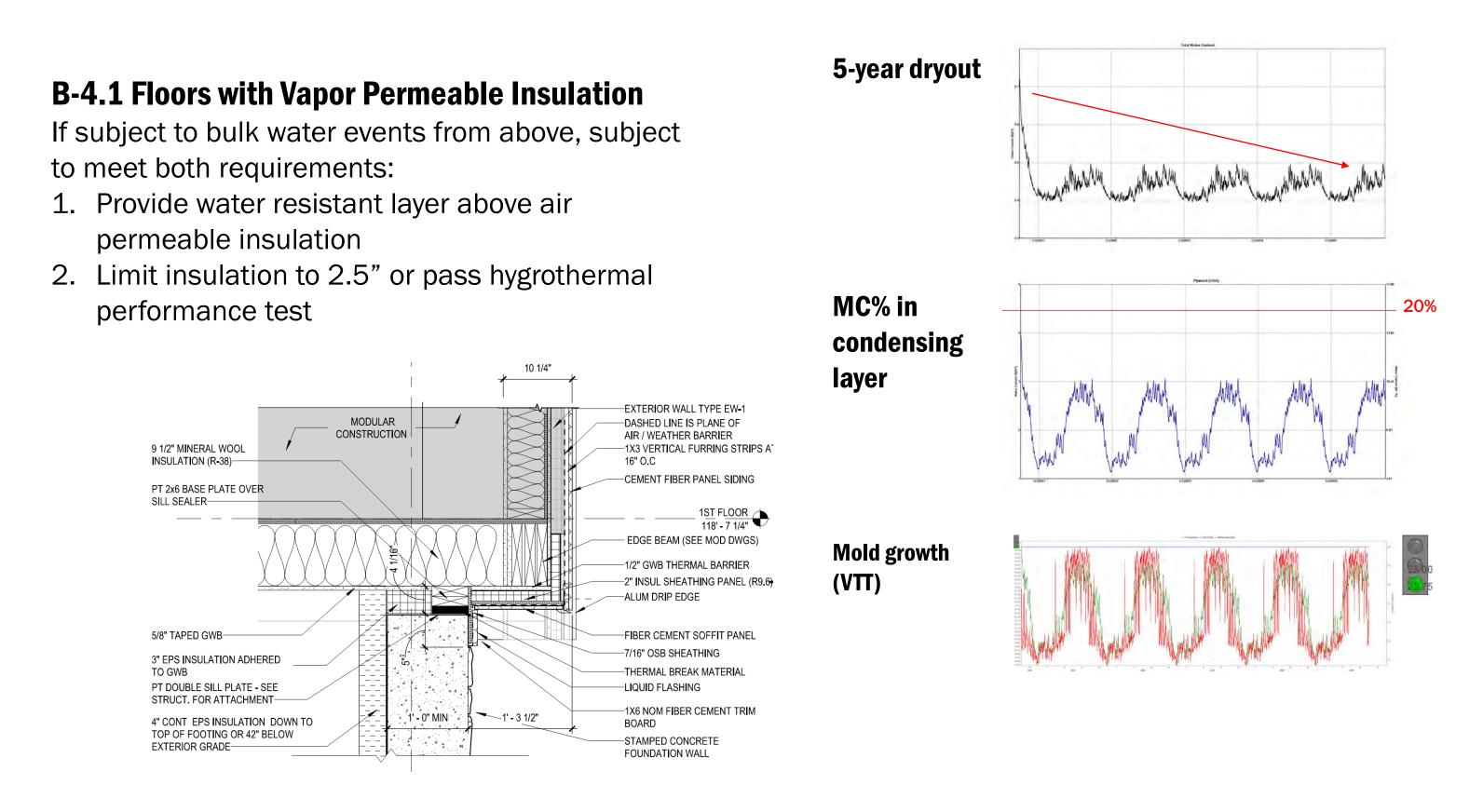
## **AIR-TIGHT CONSTRUCTION: DETAIL CONDITIONS WHERE BOXES JOIN**



CEMENT FIBER LAP SIDING

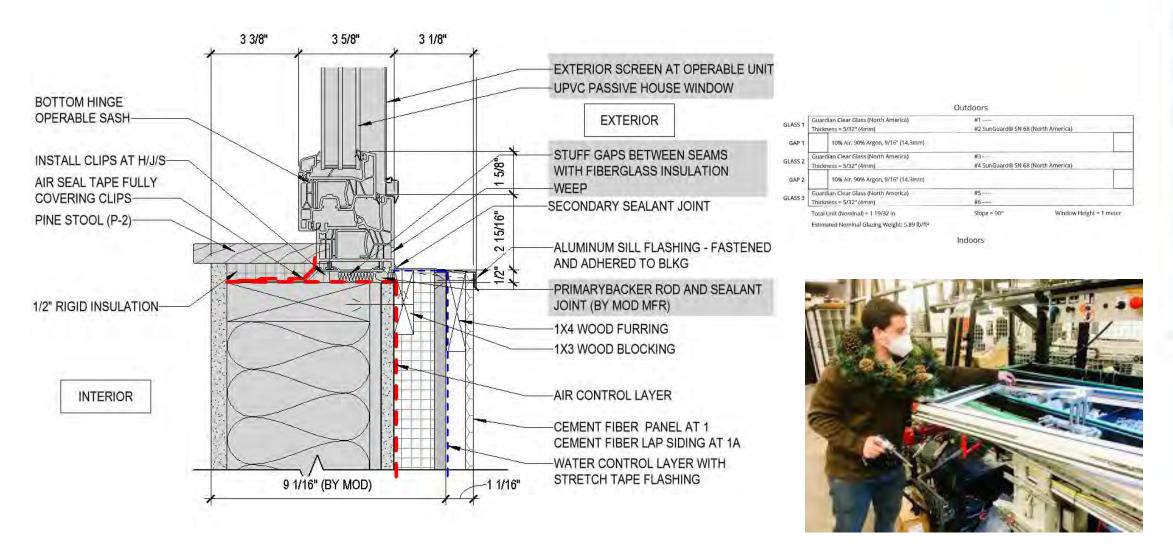
Horizontal Mate

## PHIUS MOISTURE CONTROL GUIDELINES: 'FLUFFY FLOORS



## **HIGH-PERFORMING GLAZING: WINDOWS**

- Steel reinforced UPVC frames.
- American made triple-pane glass by Guardian.
- Thermal transmittance = 0.1482 to 0.1729 Btu/h per square foot °F
- Frame profiles imported from Europe, but fabricated in Ramsey, NJ using robotic equipment.
- Can feed the modular factory during assembly reduces need for storage.







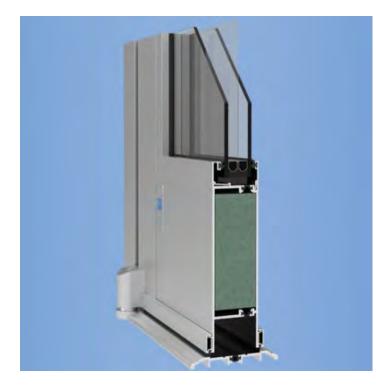
**BUILDINGENERGY BOSTON 2025** 

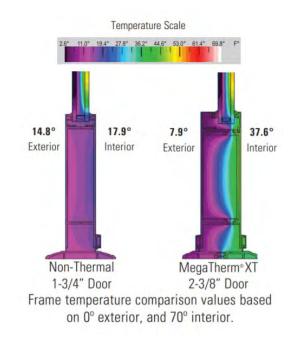
24

## **THERMAL BRIDGING: STOREFRONT**

### **Terrace Level Amenity Areas**

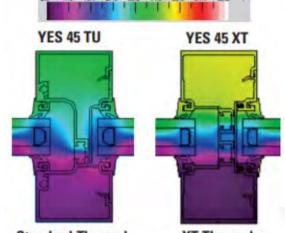
- Snap in pressure fit sealing lower on-site labor cost
- **Thermally Broken Framing and Sill Profiles**
- Double-pane insulated glass with Low-E argon filled
- Entrances have thermally-broken panel faces, frames and thresholds; double sweep and self rising pivot hinges



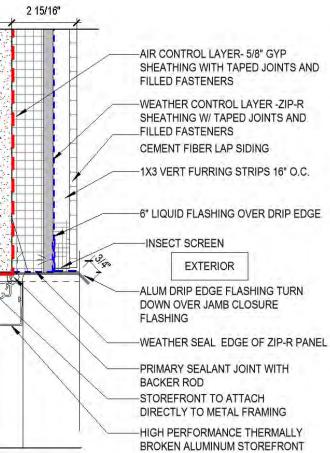


FILL NEADER WITH MINERAL WOOL INSULATION-AIR SEAL TAPE TO COVER TRACK AND TRACK/ /HEADER JUNCTURE INTERIOR 5/8" GWB-CIC: 3/4" RIGID INSULATION INTERIOR SEALANT JOINT FILL BETWEEN SHIMS WITH LOW-EXPANSION EXPANDABLE FOAM Temperature Scale 19.4" 27.8" 36.2" 44.6" 53.0" 61.4" (9.8" **YES 45 TU** 

7 1/4



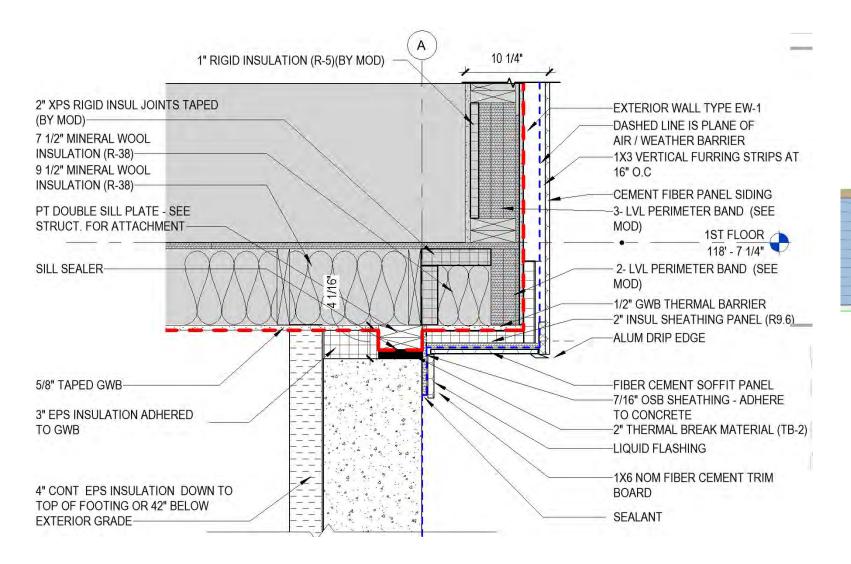
**Standard Thermal** Frame comparison values based on approximately 0° exterior, and 70° interior ambient air temperatures.

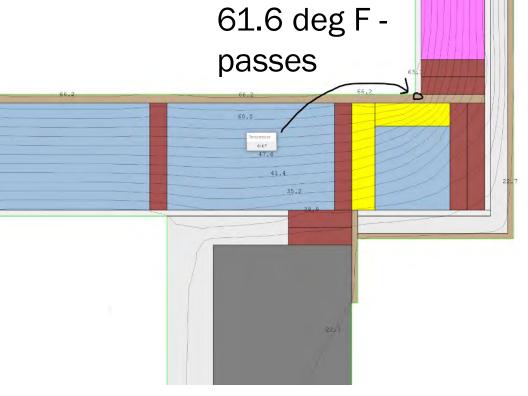




**XT** Thermal

### **THERMAL BRIDGING: MODULAR**



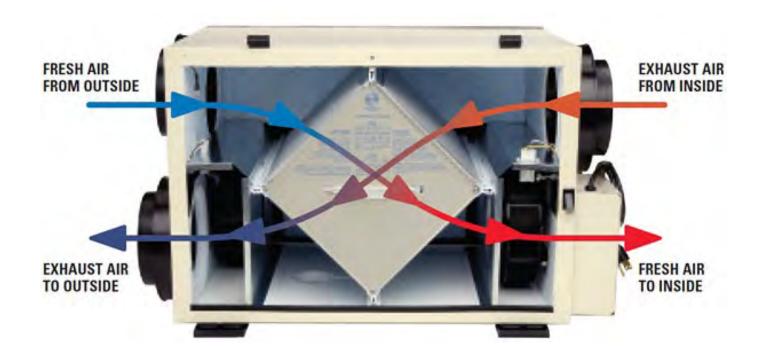


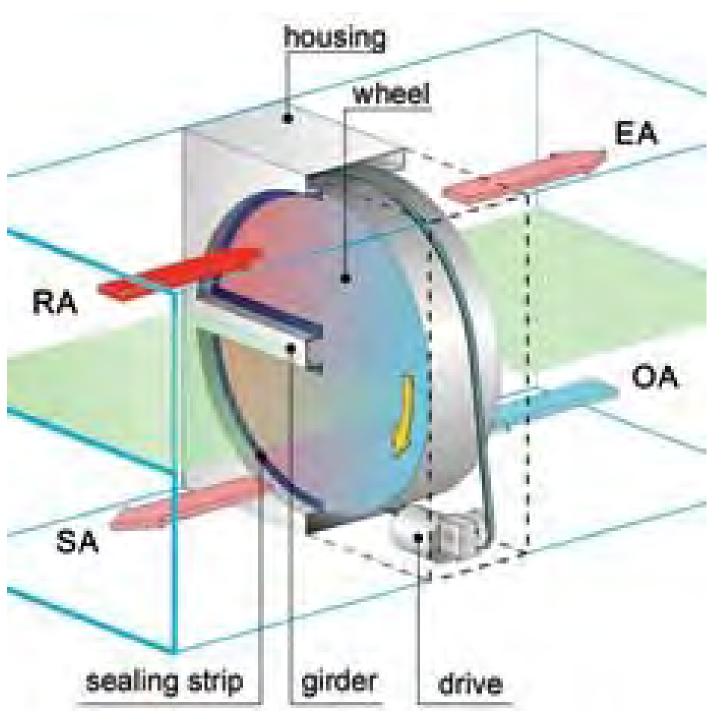
Condensation **Risk analysis** 

### Modular Overhang

## **ENERGY RECOVERY VENTILATION**

- Centralized Rooftop Units with Enthalpy Wheel
- Operates 24/7
- Exhausts Kitchen and bathroom
- Supplies to Living Room and Bedrooms
- MERV 13 filtration
- No inter-mixing of air between units alleviates COVID concern.





### **ENERGY RECOVERY VENTILATION**



### **OTHER PASSIVE HOUSE CONSIDERATIONS: ELECTRIC HEAT-PUMP HOT WATER**

### **ORIGINAL FOSSIL-FUEL FREE DESIGN**

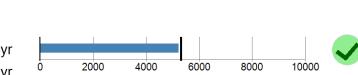
### Source energy 5,275 kWh/person.yr total: 642,193.41 kWh/yr 838.942.02 kWh/yr total: specific: 5,221 kWh/Person yr specific: 6,821 kWh/Person yr target: 3,840 kWh/Person yr target: 5,325 kWh/Person yr total: 2,862,306.46 kBtu/yr total: 2,191,038.58 kBtu/yr 53.26 kBtu/ft<sup>2</sup>yr specific: specific: 39.63 kBtu/ft<sup>2</sup>yr 900000 - Conventional electric resistance hot water 81,539.7 - Conventional ERU's with low recovery efficiency (<70% SRE) - resistance reheat 91,260.3 - DX coils for preconditioning -24% (ERU efficiency) 62,087.1 - 2+ W/cfm 600000 - Limited site access for renewable energy, - Complications -**15%** (HPWH) 77,837.2 293,101.7 mixing on and offsite renewables in City of Yonkers [kWh/yr] 137,413.3 Space heating -54% (ERU preheat) Space cooling 300000 113,539,7 111,053.7 -3% (Appliances) Hot water 128.251.8 -10% (Lighting Calcs) 116,371.8 Auxiliary energy/fans 111,900.6 111,900.6 Appliances Not renewable Not renewable Lighting Miscellaneous loads





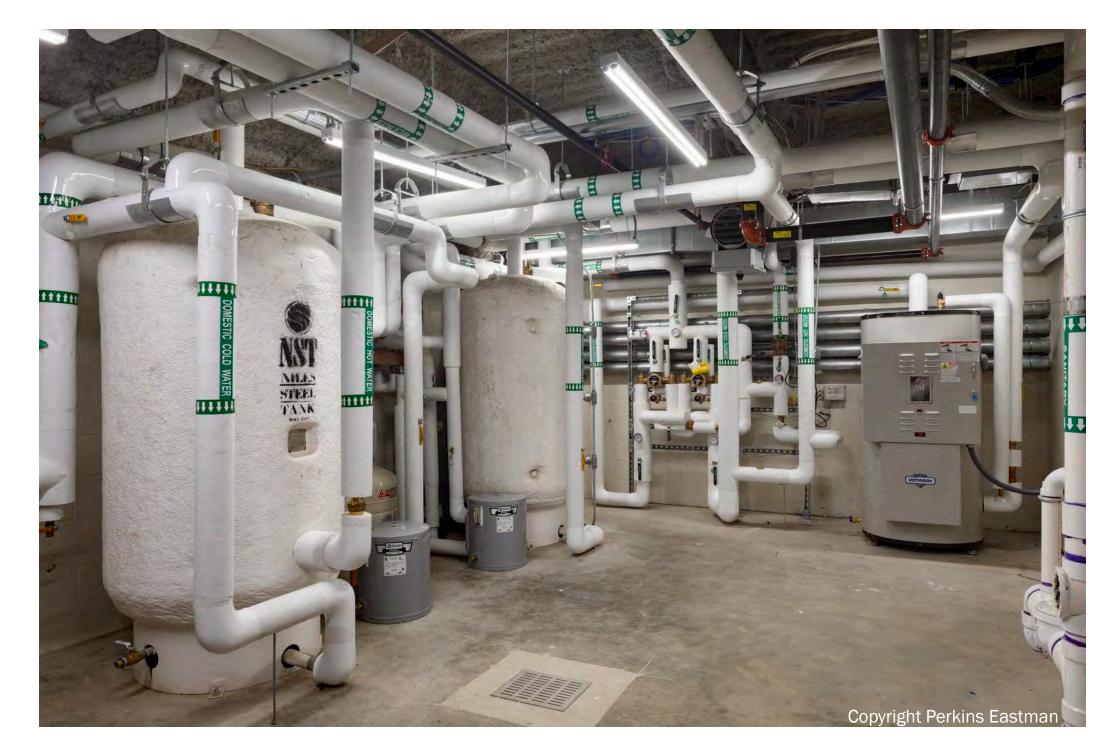
**OPTIMIZED FOSSIL-FUEL FREE DESIGN** 

- Heat Pump Hot Water design - High efficiency ERU -.74 W/cfm (measured) - Refined appliance specifications - Custom LPD calculations
- 2000 4000 6000 8000 10000



### OTHER PASSIVE HOUSE CONSIDERATIONS: ELECTRIC HEAT-PUMP HOT WATER

- Hot Water becomes major electrical load
- Exterior Heat pumps greatly improve efficiency from electric resistance water heaters.
- Estimated \$20,000/year electrical savings.
- Required to achieve phius/NYSERDA Tier 3.
- New technology at a commercial scale.
- Domestic source Washington State



### **APARTMENT MECHANICAL SYSTEM: SPLIT SYSTEM HEAT PUMP**

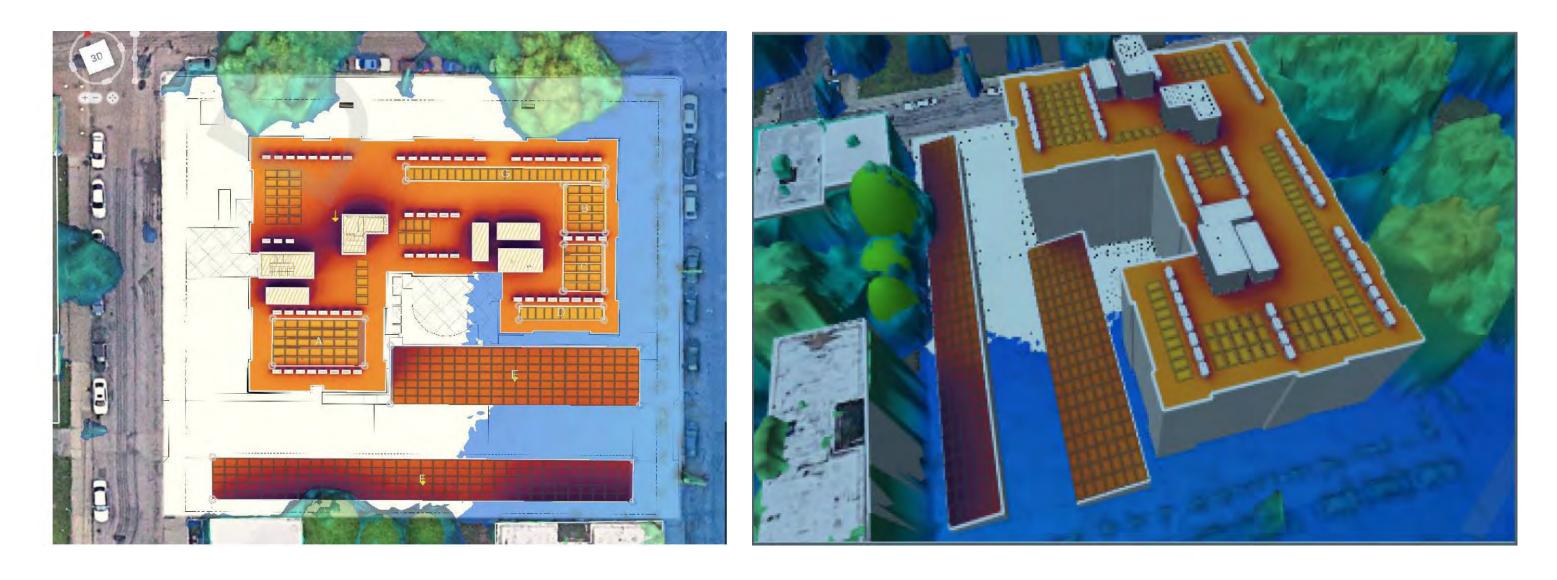
- All electric two per unit
- One-to one connection
- Field installed
- No ductwork

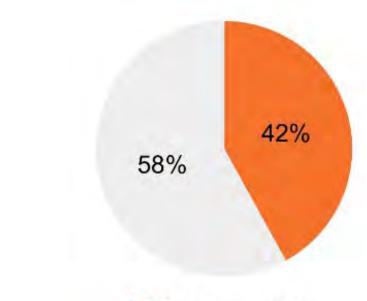




## SOLAR (PHOTOVOLTAIC)

- Roof and parking canopies considered
- System Size: 140.8 kW
- Yearly Production 137,127kWh 42% of annual load
- 440 Modules
- Required for Passive House certification 24,000 kWh/ year.
- Considered, but deferred for future installation when ROI is more reasonable





### Solar Utility



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## **MODULAR CONSTRUCTION**

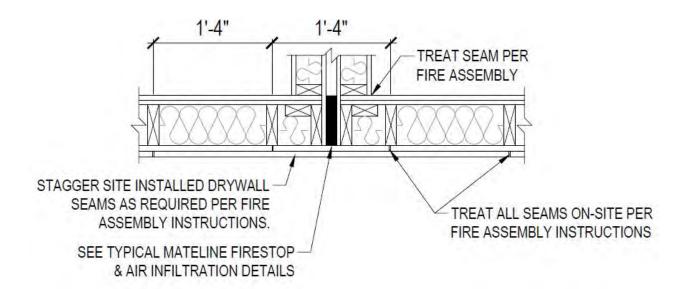
92 Separate boxes

Delivered to the site in two batches (West and East stacks) Modular Manufacturer is Architect of Record for boxes Permit review by NYS Department of State Local authorities only review/approve field-built portions

^		DESIGN PROFESSIONALS	DISET #	1
SIGNATURE	1004 Springbrook Avenue, Moosic, Pa. 18507 Tel. (570) 774-1000 Fax. (570) 774-1010	ARCHITECT of RECORD: PERKING EASTMAN 817 WADHNOTON BLVD. BUTE 107 81745-1040, CT 0901 81745-1040, CT 0901 81755-1040, CT 09000, CT 0900, CT 0900, CT 0900, CT 0900, CT 0900	3      3      3      3      4      3      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4      4	
DU ICADI E STATE DUIL DING CODES: EXTEDIOD ENVELOPE INFORMATION-	GENERAL NOTES:	MECHANICAL, ELECTRICAL, PLUMBING, SPRINKLER ENGINEER : SNITH MELEE ASSOCIATES	Get TYPE REFERENCES AND PLACE     Get TYPE REFERENCES AND PLACE     Get TYPE ENCODENCE PLACE     Get TYPE ENCODENCE PLACE     Get TYPE ENCODENCE PLACE	
PLICABLE STATE BUILDING CODES:         EXTERIOR ENVELOPE INFORMATION:           INFORMATION AND ALLER CODES:         INSTERIOR ENVELOPE INFORMATION:           INFORMATION CODE OF INT:         INSTERIOR ENVELOPE INFORMATION:           INFORMATION CODE OF INT:         INSTERIOR ENVELOPE INFORMATION FOR ALLER CODE           INFORMATION CODE OF INT:         INSTERIOR ENVELOPE INFORMATION FOR ALLER CODE           INFORMATION CODE OF INT:         INSTERIOR ENVELOPE INFORMATION FOR ALLER CODE           INFORMATION CODE OF INT:         INSTERIOR ENVELOPE INFORMATION FOR ALLER CODE           INFORMATION CODE OF INT:         INSTERIOR ENVELOPE INFORMATION ALLER CODE           INFORMATION CODE OF INT:         INSTERIOR ENVELOPE INFORMATION ALLER CODE           INFORMATION CODE OF INT:         INSTERIOR ENVELOPE INFORMATION           INFORMATION CODE OF INTERIOR ENVELOPE INFORMATION </td <td><ul> <li>GENERAL NOTES:</li> <li>Instrumental and instrumental and index index instruction devices a second and any second any second and any second any second and any second a</li></ul></td> <td>Burner Muller ASSOciates 38 NORTH AMURE ASSOCIATES 19 NORTH AMUNISTREET 19 NORTH AMUNISTREET 19 NORTH AMUNISTREET 19 NORTH AMUNISTREET 20 NORTH AMUN</td> <td>1.4.         INTERPENDENT AND AND AND AND AND AND AND AND AND AND</td> <td></td>	<ul> <li>GENERAL NOTES:</li> <li>Instrumental and instrumental and index index instruction devices a second and any second any second and any second any second and any second a</li></ul>	Burner Muller ASSOciates 38 NORTH AMURE ASSOCIATES 19 NORTH AMUNISTREET 19 NORTH AMUNISTREET 19 NORTH AMUNISTREET 19 NORTH AMUNISTREET 20 NORTH AMUN	1.4.         INTERPENDENT AND	
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## **MODULAR CONSTRUCTION**



7/16" OSB SHEATHING TO WALL STUDS PER SHEAR PLANS

> 2x6 5PF #2 WALL STUDS @ 16" O.C.

BOTTOM PLATE TO FLOOR: (3) 0.131" x 3" NAILS PER BAY SEE CHARTS ON SHEET 7¢ FOR SPACING.

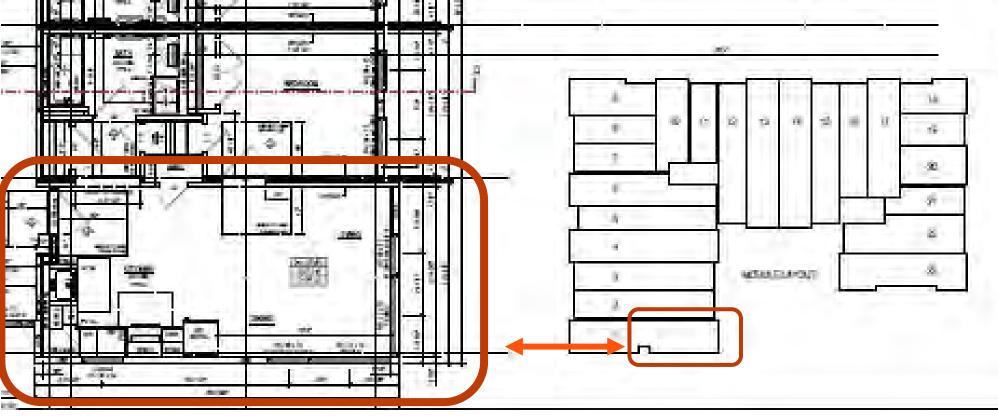
SHEATHING FROM WALL STUDS TO PERIMETER BAND: FASTEN WITH (2) ROWS OF 0.131" x 2.5" NAILS @ 6" O.C. STAGGERED

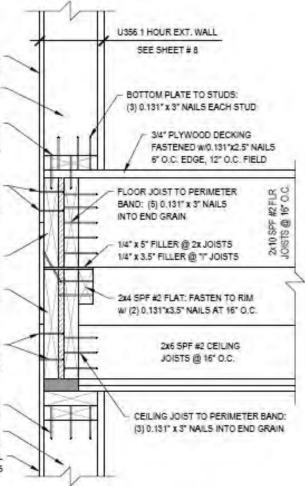
> (2) 2x10 SPF #2 FLR PERIMETER BAND5 w/ 1/2" OSB FILLER

> (2) 2x12 SPF #2 FLR PERIMETER BAND5 w/ 1/2" OSB FILLER

SHEATHING FROM WALL STUDS TO PERIMETER BAND: FASTEN WITH (2) ROWS OF 0.131" x 2.5" NAILS (2) 6" O.C. STAGGERED

> TOP PLATE TO STUDS: (3) 0.131" x 3" NAILS EACH STUD 2x6 SPF #2 WALL STUDS @ 16" O.C. 7/16" OSB SHEATHING TO WALL STUDS PER SHEAR PLANS



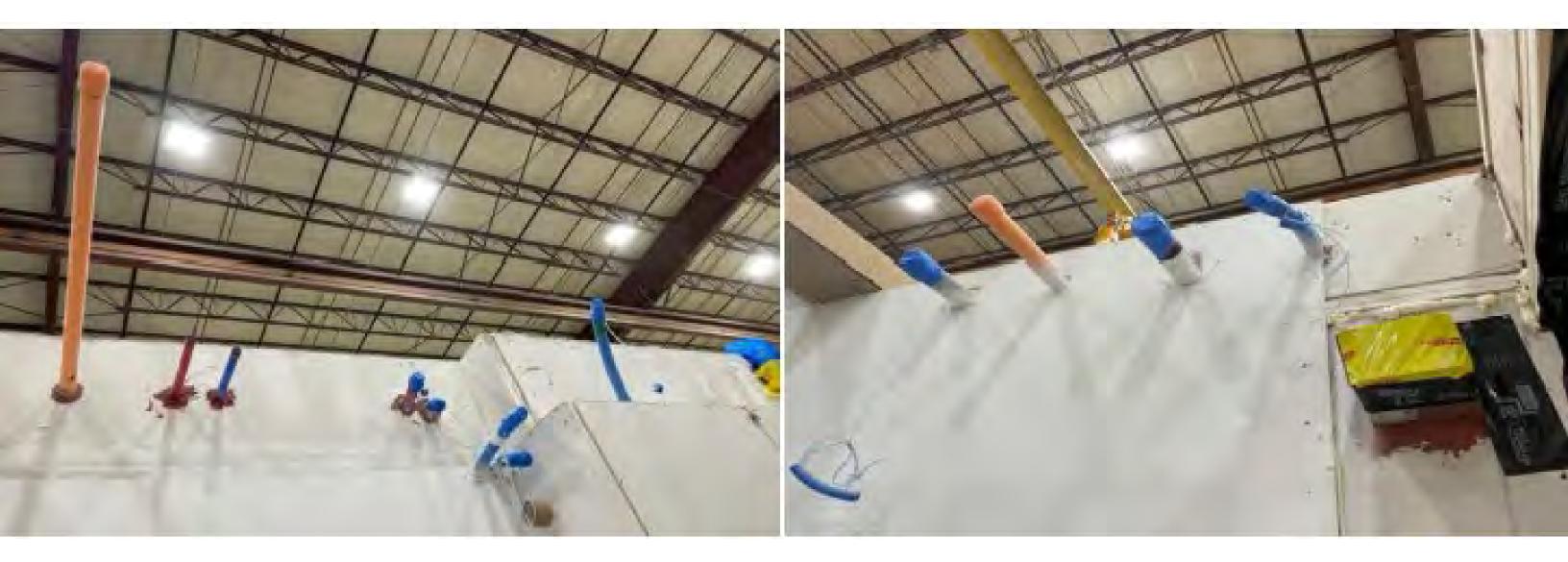


### **MODULAR: FACTORY FABRICATION**









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#### phius Field Verification

#### In factory inspections Division of work-Factory vs. Site:

6. Mate wall gaps were taped for the testing with the exception of the mate line at the floor level as we could not access it and which will provide similar challenges onsite.

As you can see in photo above there are strips of R13 batt at the perimeter of all mate lines and at each cross-over opening. It is my understanding that this is part of the fire-code and that batts were used in place of Albi Clad (rock wool board) due to dimensional restrictions. Either, alone, will allow air to cross the mate lines. This is not a problem at your ceiling and vertical wall mates but is a problem at your floor mates as you will not have access to these as boxes are swung together. The test numbers shown in this report reflect only the R13 in the floor mate line, so if all else can be replicated onsite you could still achieve passing numbers with just batt in this floor mate line. Despite getting good numbers there was still a significant amount of air moving thru the floor mate line. We discussed adding a traditional gasket above the R13 at the floor level but there was still concern about horizontal dimensions expanding too much. My concern is when setting the boxes, they use a wedging technique which will likely further compromise the floor level R13 strip vs. how we just pushed them together in the plant. There are ways to reinforce this area using expanding foam, copious amounts of caulk, zip tape, but will somewhat depend on the site/set situation and how the floor joists line up with the ceiling joists in box below. Need to be prepared to tackle this onsite with multiple means, but once you can see the site situation it can be figured out quickly.



#### phius Field Verification

In factory inspections Division of work-Factory vs. Site:

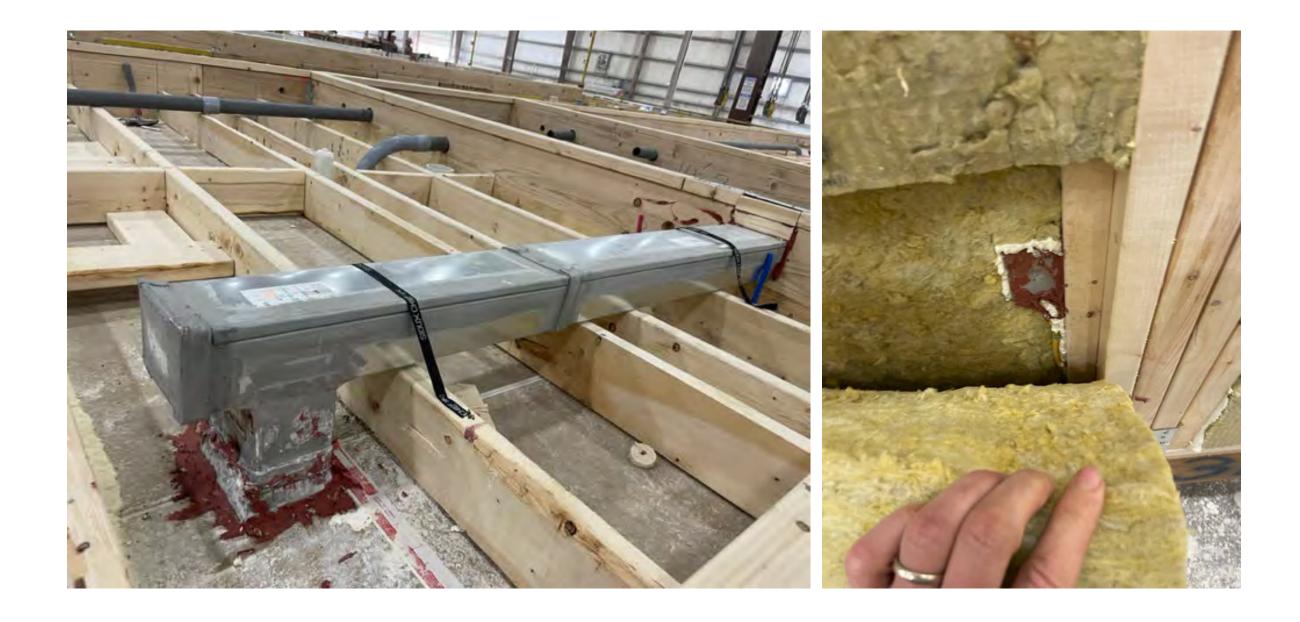


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#### **phius Field Verification**

In factory inspections Division of work-Factory vs. Site:



# **MODULAR CONSTRUCTION**

- Wood Frame Boxes sized for transport 16 ft x 60 ft
- Windows, millwork, finished bathrooms prime painted walls and ceilings shipped with units.
- 2" gap horizontally and 3" gap vertically required for erection. Must be air-sealed on-site.



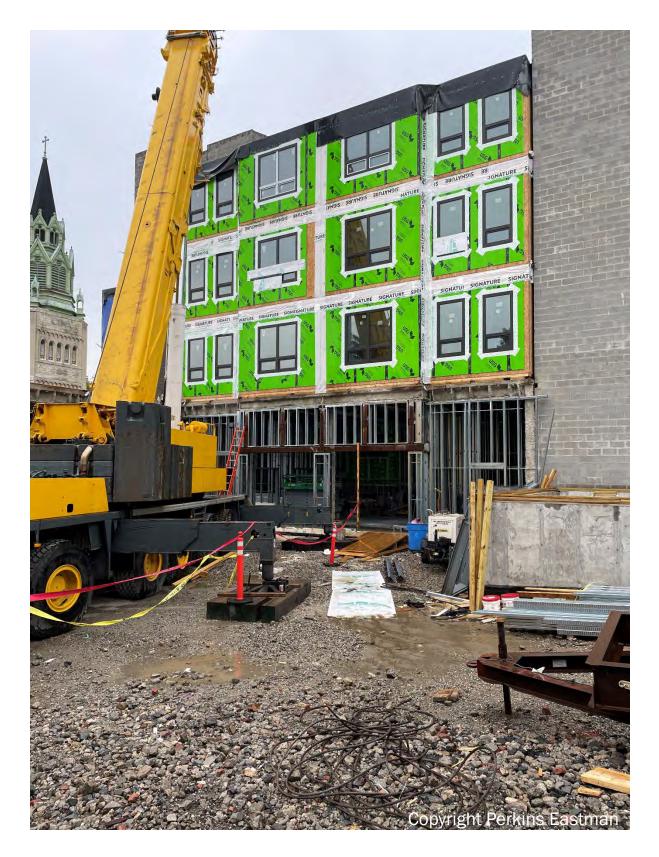


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# **MODULES ARRIVE ON SITE WITH KITCHEN CABINETS INSTALLED**









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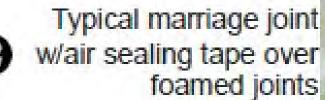
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Exposed marriage joints prior to sealing and concealment behind fireproof sheathing (green)







Completed air barrier (prior to ZIP-R cladding / insulation / weather barrier install)

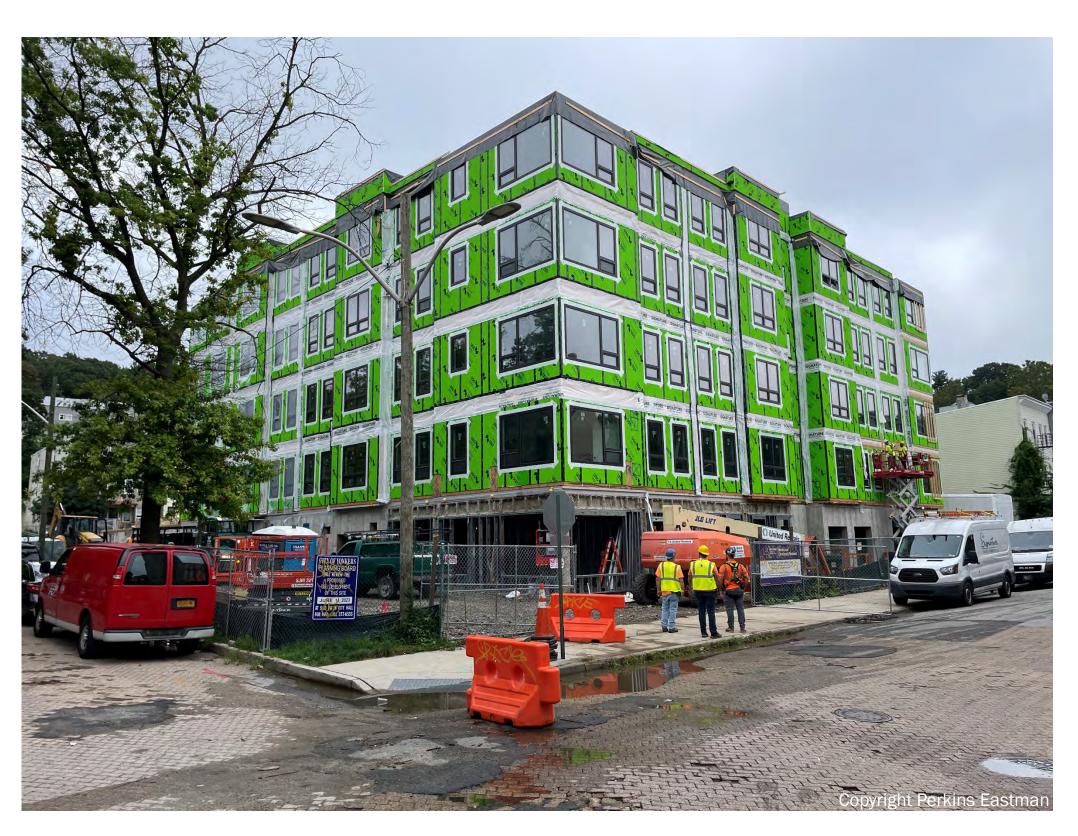


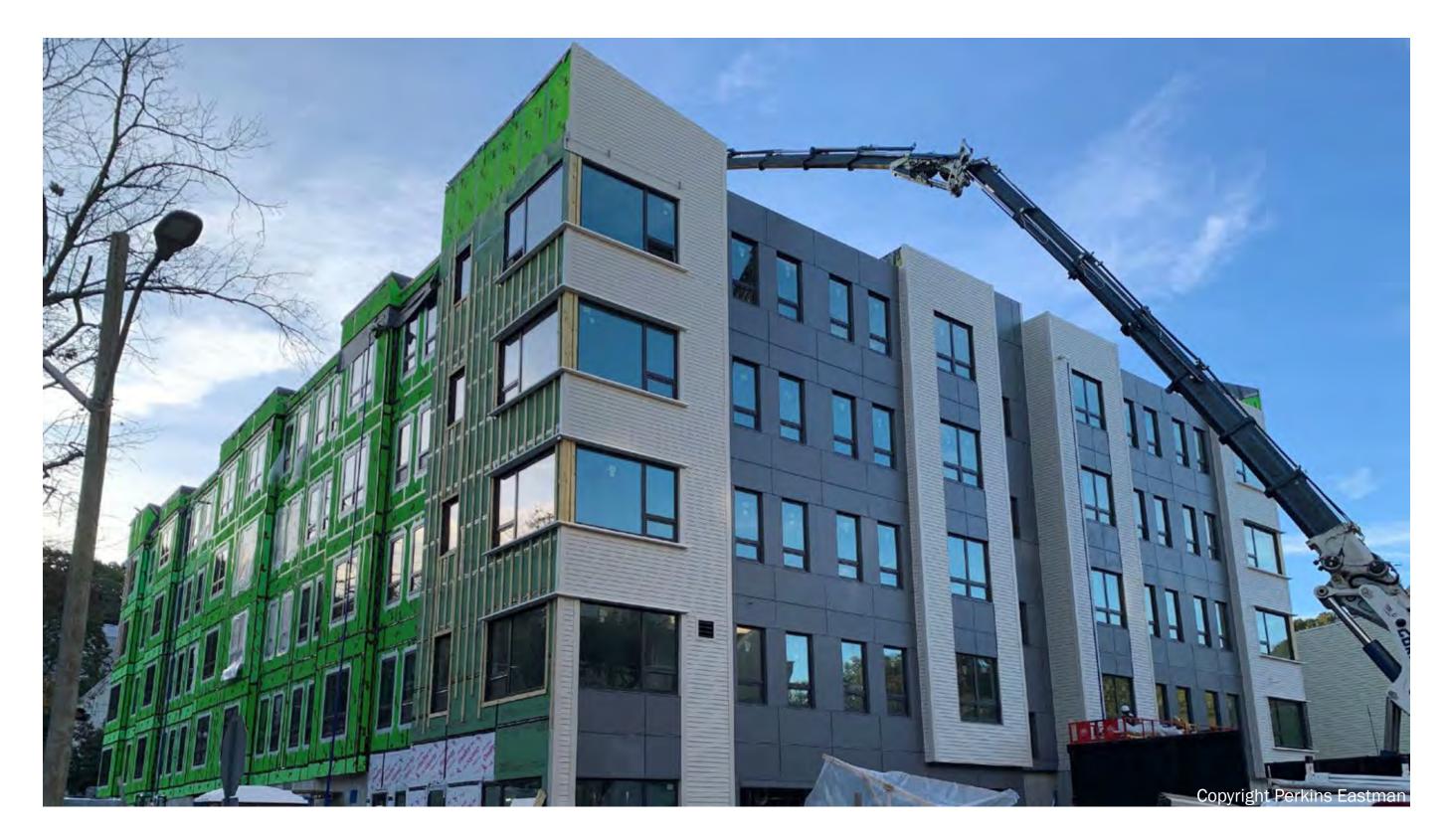
3 podium with Airtight Tape being applied



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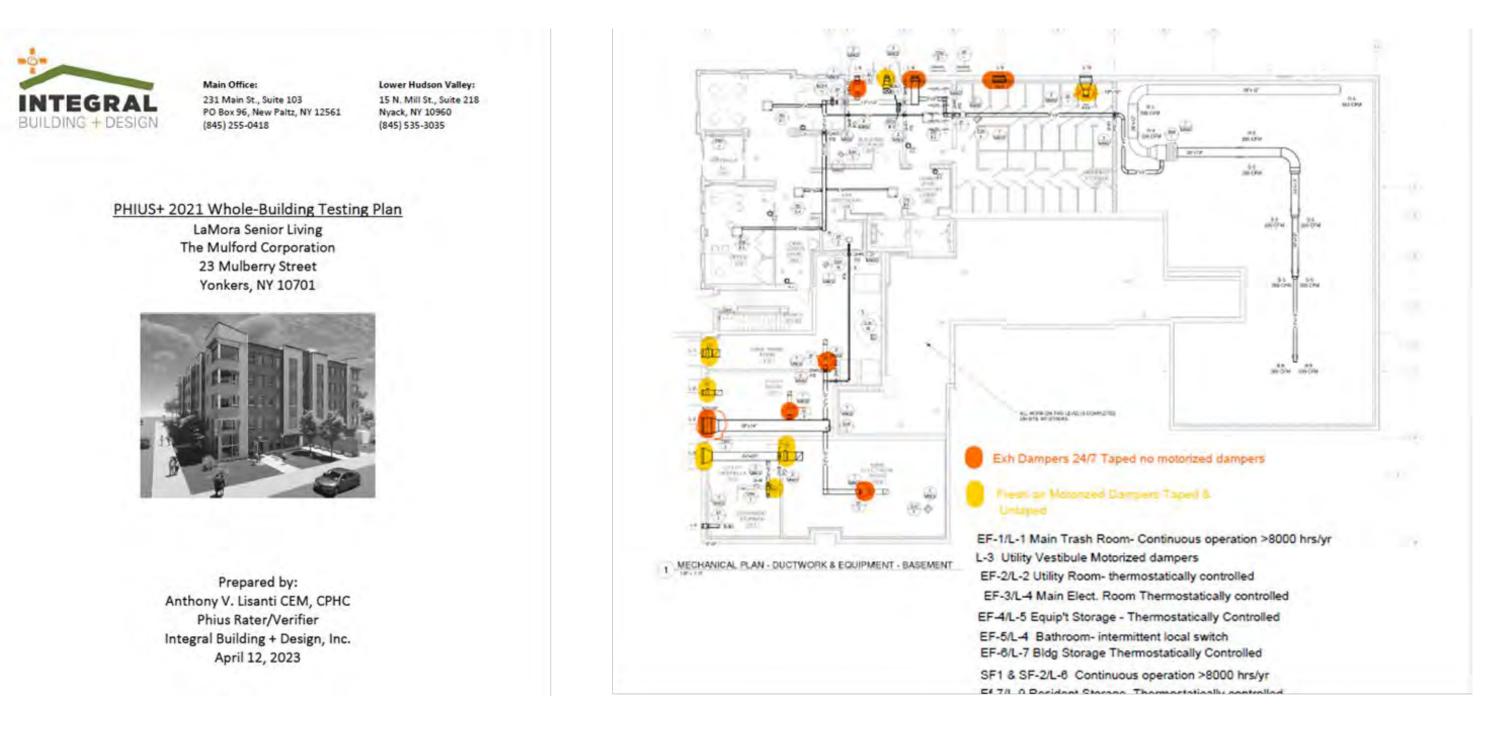
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### **FIELD VERIFICATION**



# FIELD VERIFICATION: BLOWER DOOR TEST PLAN

FINAL TESTING: WHOLE BUILDING AIR TIGHTNESS TARGET = 3654 CFM @ -50PA

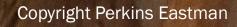


## FIELD VERIFICATION: BLOWER DOOR TESTING



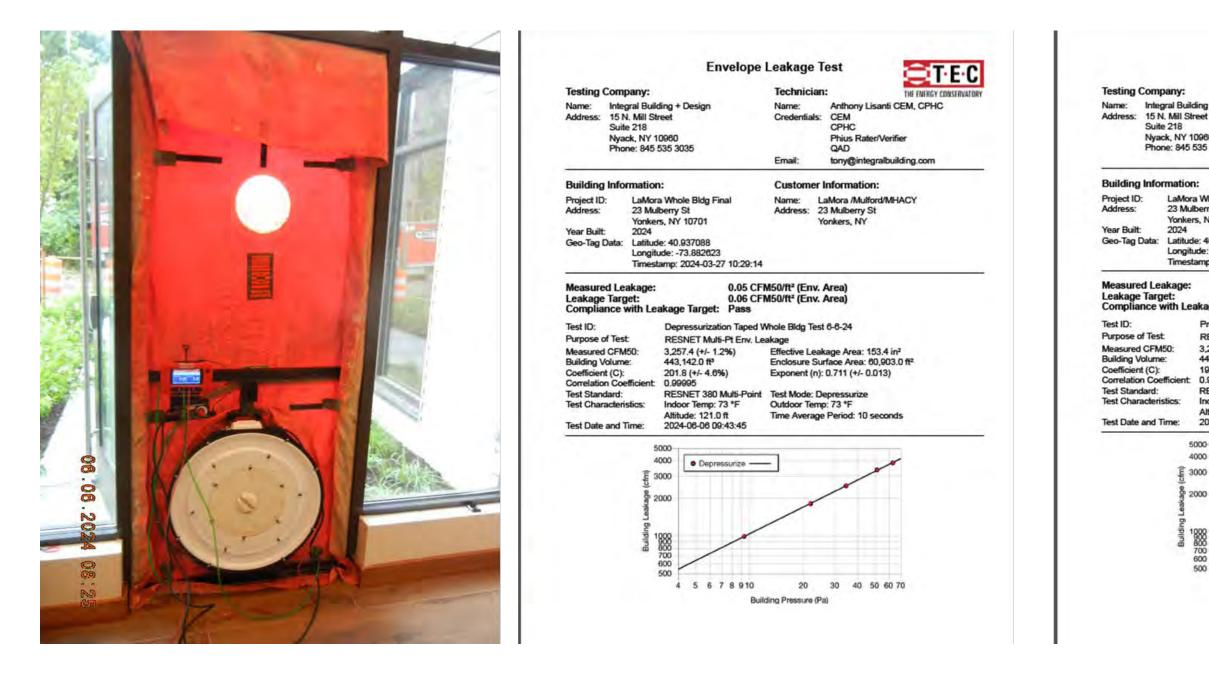
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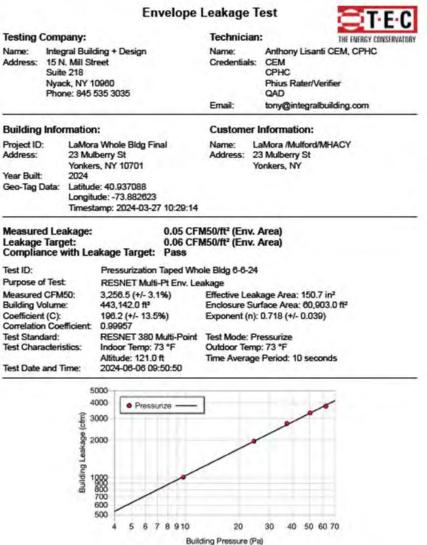




AFROBARRIER

### **FIELD VERIFICATION: BLOWER DOOR TESTING & RESULTS**





# WHOLE BUILDING AIR TIGHTNESS FINAL TESTING

- Whole Building Air Tightness Target = 3654 CFM @ -50 Pa (0.06 CFM/SF)
- •Test 1 = 0.12 CFM
- Test 2 = 0.08 CFM
- Test 3 = 0.07 CFM
- Final = 0.053 CFM avg depressurization/pressurization
   0.061 CFM untaped

#### Testing Company:

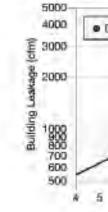
Name:	Integral Building + De
Address:	15 N. Mill Street
	Suite 218
	Nyack, NY 10980
	Phone: 845 535 3035

#### **Building Information:**

Semania mistrine stu	
Project ID: Address:	LaMora Whole Bl 23 Mulberry St
Year Built:	Yonkers, NY 1070 2024
Geo-Tag Data:	Latitude: 40.9370 Longitude: -73.88
	Timestamp: 2024

#### Measured Leakage: Leakage Target: Compliance with Leakage Ta

Test ID:	Depressu
Purpose of Test:	RESNET
Measured CFM50:	3,257.4 (+
Building Volume:	443,142.0
Coefficient (C):	201.8 (+/-
Correlation Coefficient:	0.99995
Test Standard:	RESNET:
Test Characteristics:	Indoor Ter
Test Date and Time:	Altitude: 1 2024-06-0



	Leakage T	E.C.C		
sign	Technician Name: Credentials:	Anthony Lisanti CEM, CPHC CEM CPHC Phius Rater/Ventier QAD		
	Email:	tony@integralbuilding.com		
	Customer I	Information:		
ildg Final 101 088 82623 4-03-27 10:29:14	Address: 2: Yi	aMora /Mulford/MHACY 3 Mulberry St onkers, NY		
	M50/ft² (Env. ) M50/ft² (Env. ) Vhole Bldg Test	Area)		
T Multi-Pt Env. Les				
(+/- 1.2%) .0 ft³ /- 4.6%)	Effective Leakage Area: 153.4 in <sup>2</sup> Enclosure Surface Area: 60,903.0 fl <sup>2</sup> Exponent (n): 0.711 (+/- 0.013)			
1 380 Multi-Point emp: 73 °F	Test Mode: Depressurize			
	1.0 ft Time Average Period: 10 seconds			
121.0 ft -06 09:43:45				
121.0 ft	-1	1		

Building Pressure (Pa)

### **PHIUS CERTIFICATION ACHIEVED IN OCTOBER 2024**



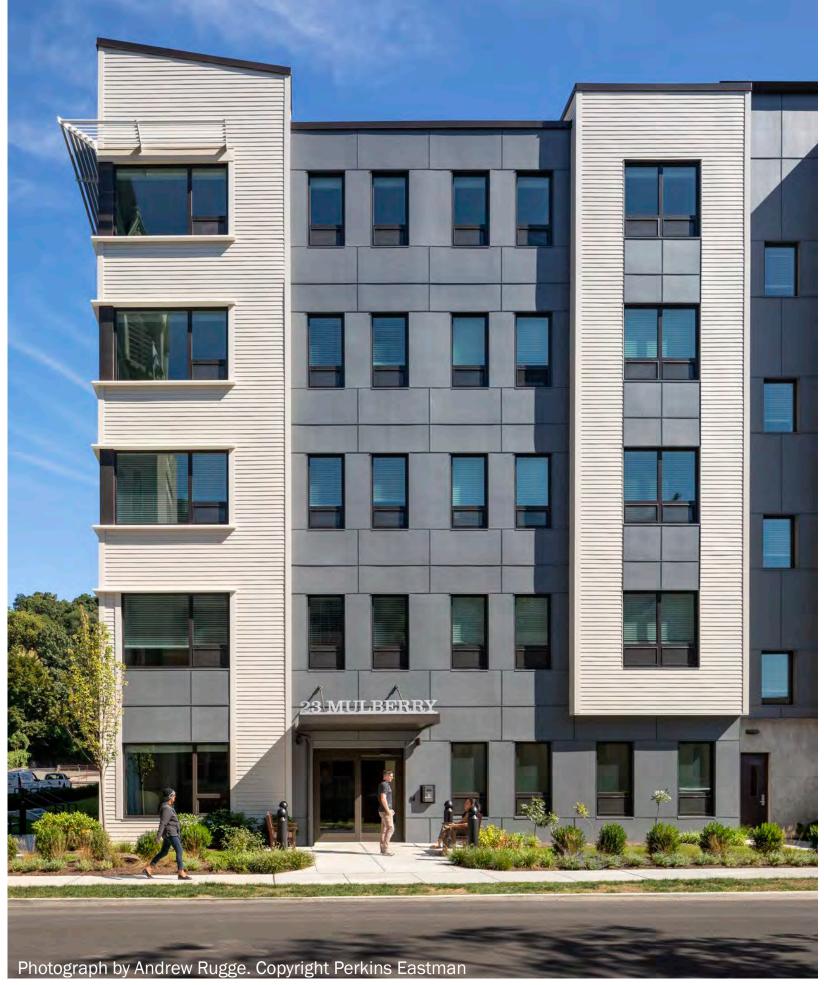
### **ENTRY CORNER**



## **SOUTH ELEVATION VIEW**

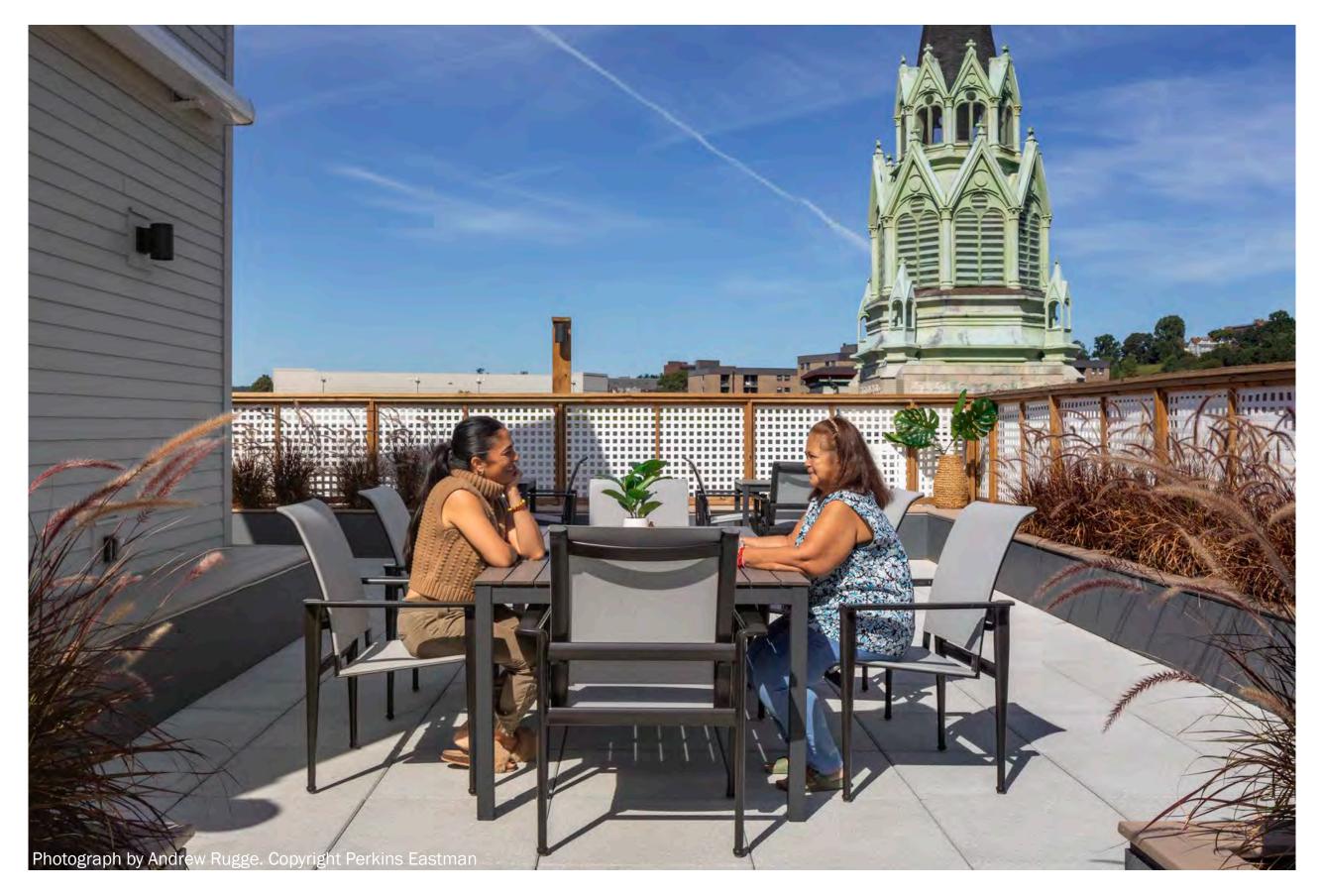


### **MAIN ENTRANCE**

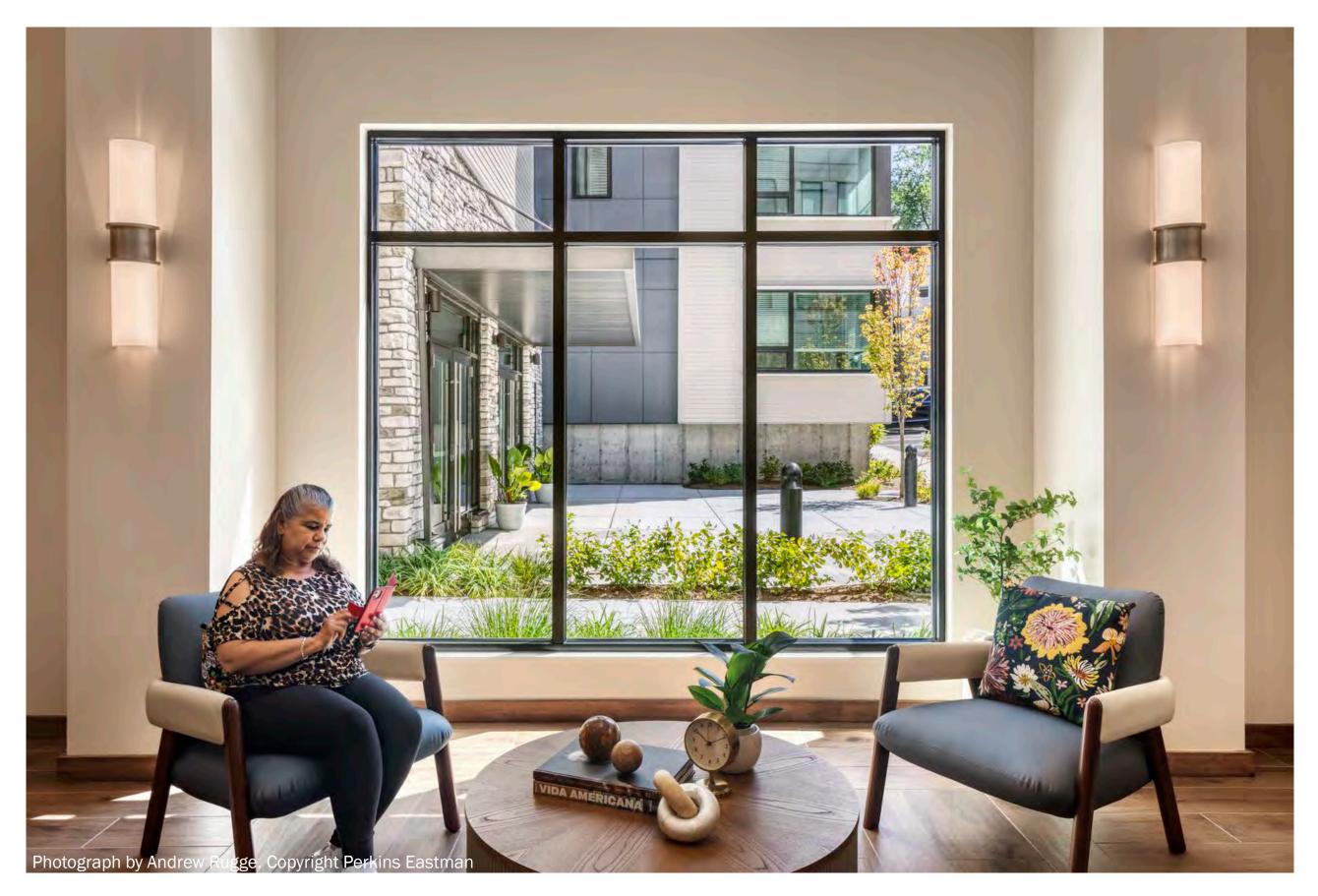


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### **ROOF DECK**

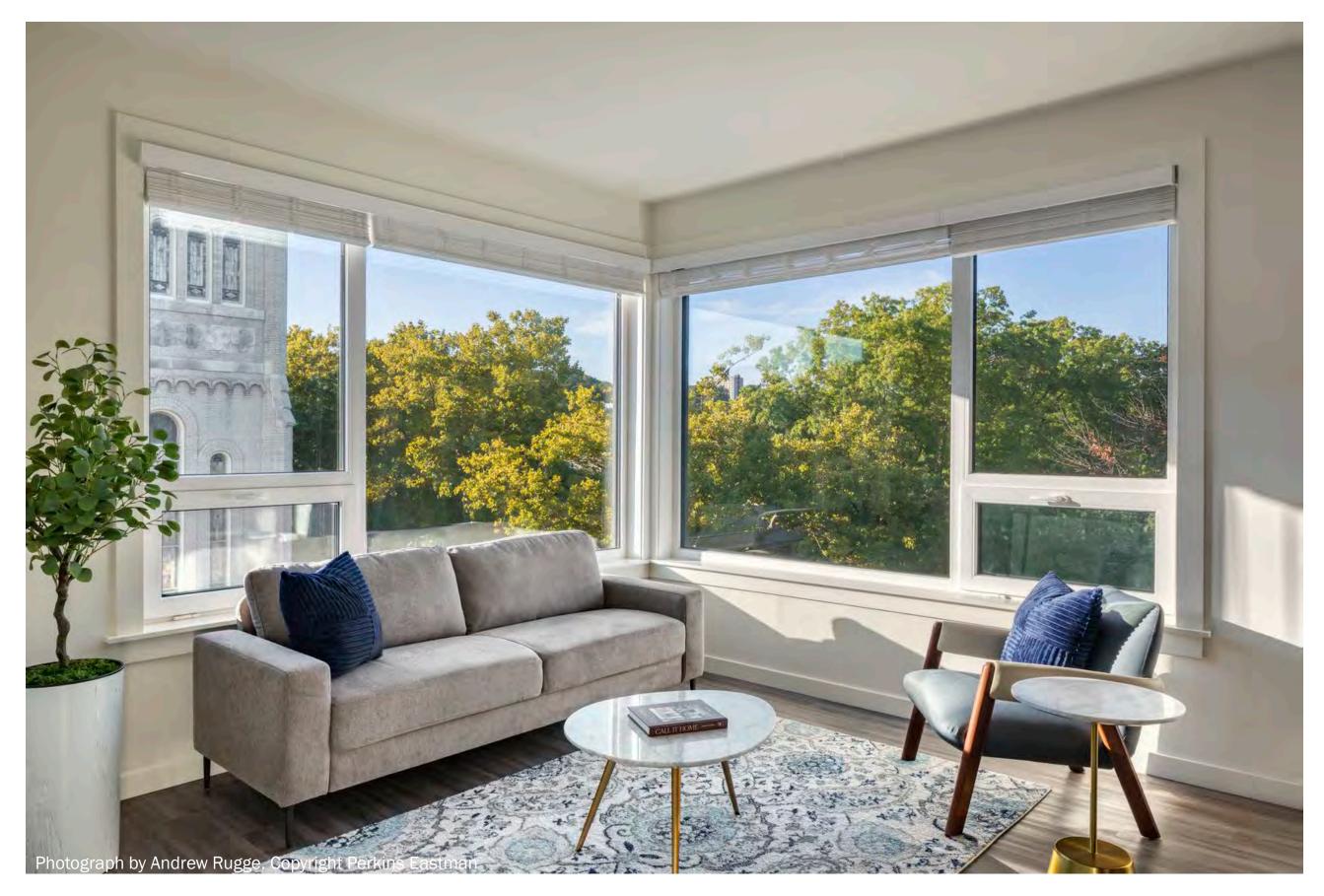


### **RESIDENT LOBBY**



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### **CORNER APARTMENT VIEW**



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# ESSONS EARNED

# AIA® Document G701 – 2017

#### Change Order

PROJECT: (Name and address) La Mora Senior Living 23 Mulberry Street Yonkers, NY 10710

OWNER: (Name and address) La Mora LLC 1511 Central Park Avenue Yonkers, NY 10710 CONTRACT INFORMATION: Contract For: General Contracting

Date: 06/16/2022

ARCHITECT: (Name and address) Perkins Eastman 677 Washington Boulevard Stamford, CT 06901 CHANGE ORDER INFORMATION: Change Order Number: 007

Date: 06/23/2023

CONTRACTOR: (Name and address) Andron Construction 21Anderson Lane Goldens Bridge, NY 10526

# **LESSONS LEARNED & TAKE-AWAYS**

- Better to use consultants who have prior Passive House experience
- Allow time in the design schedule for the design team to refine and revise documents based on reviews by the CPHC (i.e. WUFI analysis) – and make sure CHPC performs the reviews on schedule.
- Make sure Passive House requirements are well defined in the Construction Documents
  - Detail the continuous envelope make it clear
  - Include diagrams Don't just rely on plans/sections/details
  - Use color to highlight critical membranes and air control layers
  - Include required testing (and related scheduling) in Specifications
  - Define contractor's responsibilities regarding passing necessary tests

# **LESSONS LEARNED & TAKE-AWAYS**

- Engage the Rater/Verifier early in the design phase- not after construction scope is completed to ensure co-requisite programs are integrated into the design process
- Optimize building envelope/air barrier design did we need three layers of sheathing on the bldg.? Possibly minimize layering and maintain the fireproofing qualities with two layers- i.e. eliminate the ZIP- R and the USG Green Board in favor of Rockwool panels with battens over factory applied OSB/Plywood
- Understand the limitations of central ventilation systems inability to boost airflow, difficulty with air balancing/commissioning
- Redefine phius boundaries i.e. including crawl space within Phius envelope.
- Renew effort to optimize how water distribution system i.e.- decrease pipe volume, time-to-to hot, ultimately reducing installation costs.
- Include power monitoring systems in work scope for critical equipment- DWH, back up storage tanks, recirc pumps, ERU's, apartment level consumption for ASHP's, exhaust fans
- There was no comprehensive post construction lessons learned, trading of information to make improved design decisions directly with ownership. The cost of learning was steepwhy not leverage that for any future projects?

# **LESSONS LEARNED & TAKE-AWAYS**

- Identify the phius certified enclosure quickly and with the input of the air-testing agent. Areas of attention in large buildings: trash chutes, laundry rooms, egress stairs and elevator shafts
- Trash chutes cost benefit analysis between 1. the detailing required to cut it out of the phius enclosure 2. including it in the enclosure and taking the energy hit from ventilation requirements
- Laundry rooms how will make up air be provided for direct-exhaust dryers. Does it make sense to cut the laundry room out of the enclosure to reduce heat loss in the rest of the building
- Egress stair / Elevators how do these connect the phius enclosure to non-enclosure spaces and what level or airtightness is required for doors, etc.
- Active systems in large buildings have more pump, fan and aux energy that will need to be accounted for - potentially jeopardizing the source energy phius target
- Insulated floors must adhere to the Certification guidebook appendix B moisture control requirements generally they must follow the same guidelines as wells, however floors with vapor-open "fluffy" insulation must ALSO pass a bulk-wetting test if 'wet' programs are located above
- Modular construction may require different detailing than stick-built. For instance, the mating joint between floor and ceiling of modular units was double-framed and the connection must be designed to provide air, vapor and thermal continuity when joined onsite

