Solar Decathlon

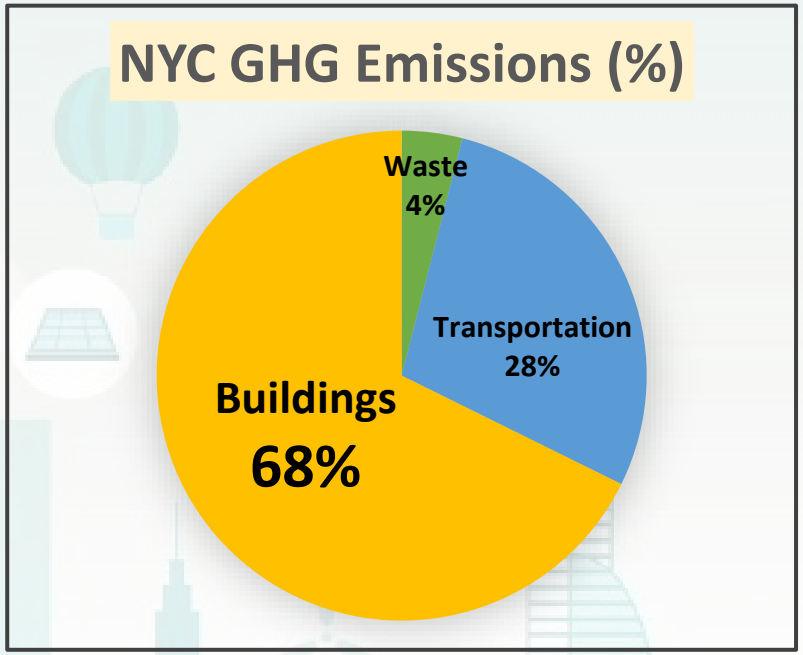
Cooper Union
Solar Decathlon Semifinal Presentation

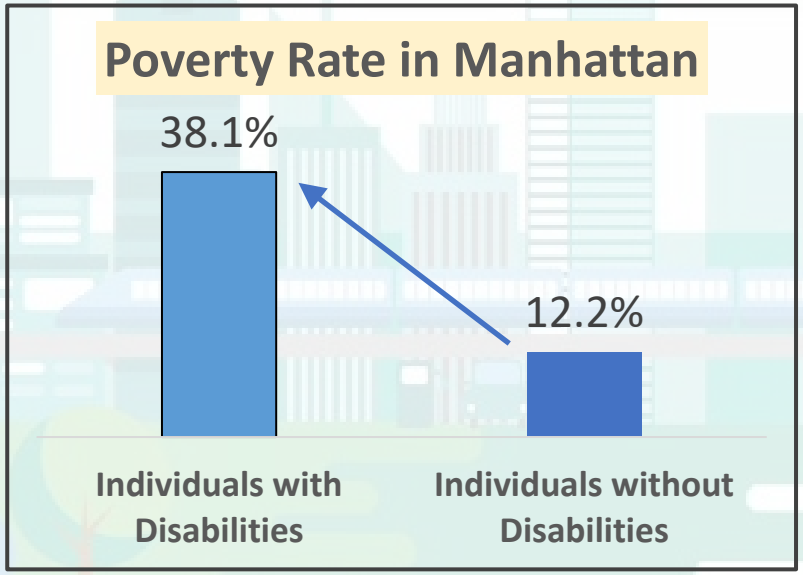
Freedom Village for Barrier Free Living

THECOOPERUNION

NYC Housing and Climate Crises

- Buildings account for 70% of GHG emissions in New York
- 60,000 New Yorkers in homeless shelters every night
- Individuals with disabilities & domestic violence victims disproportionately affected





Design Partners and Site

barrier free living

Mission: Support individuals to live dignified lives free of all forms of abuse and bias

JCJARCHITECTURE

Designing new facility with transitional housing, administration offices, community spaces and terrace

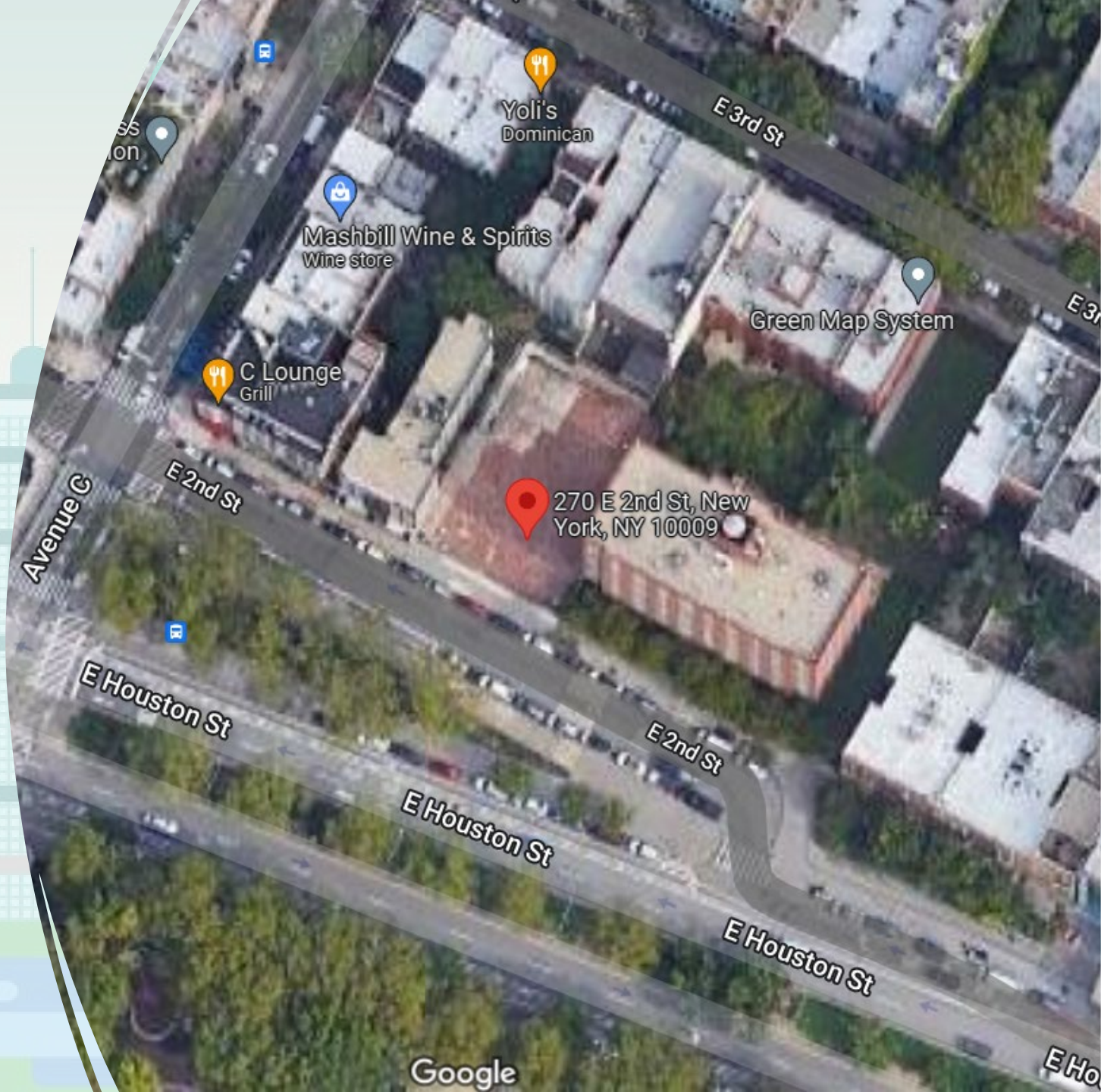
270 East 2nd Street: Freedom Village Project

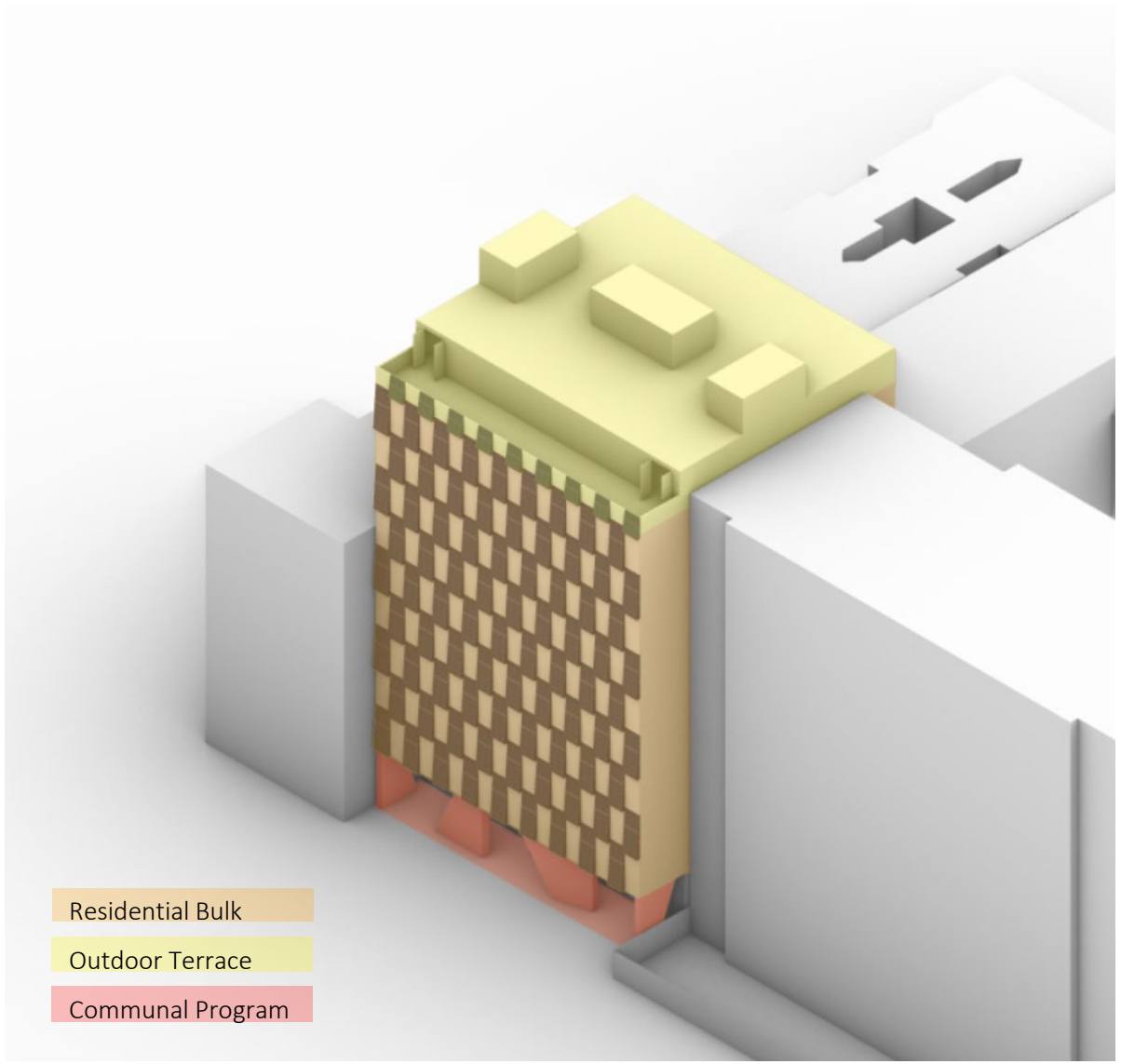
Redesign for climate performance and breaking the perception of affordable housing project so victims of domestic violence with disabilities can rebuild their lives

Zoning - R8A

Medium Density Contextual Residence District

- Max Building Height of 120 ft
- FAR of 6.02
- Easily accessible to subway and public transportation



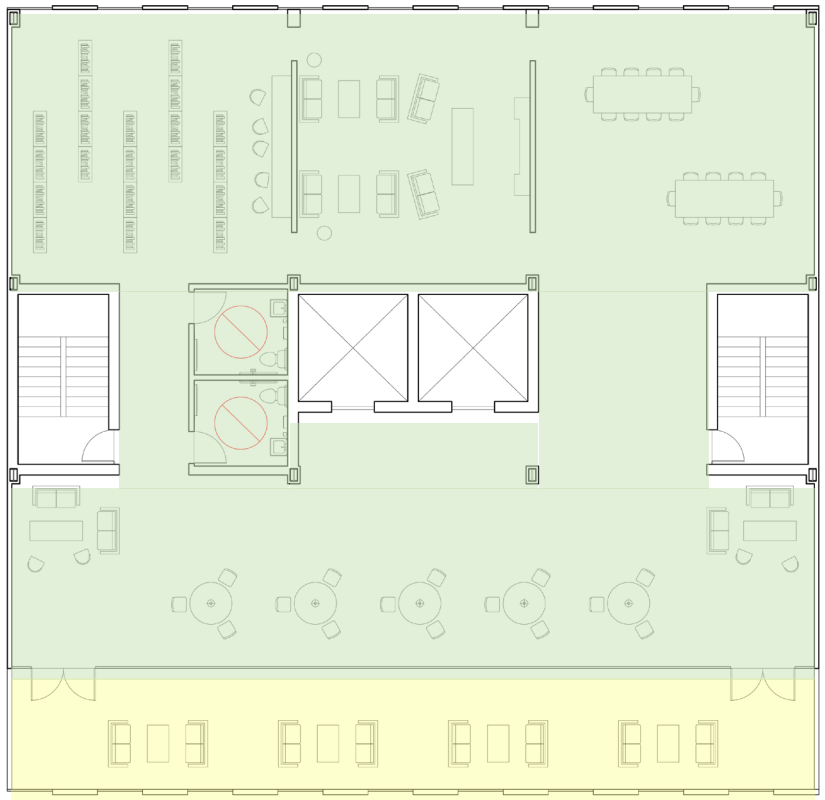

Residential Bulk
Outdoor Terrace
Communal Program

Common Areas

Communal Space

BFL Programming

Ground Floor Level



Communal Space

Outdoor Terrace

Rooftop Plan

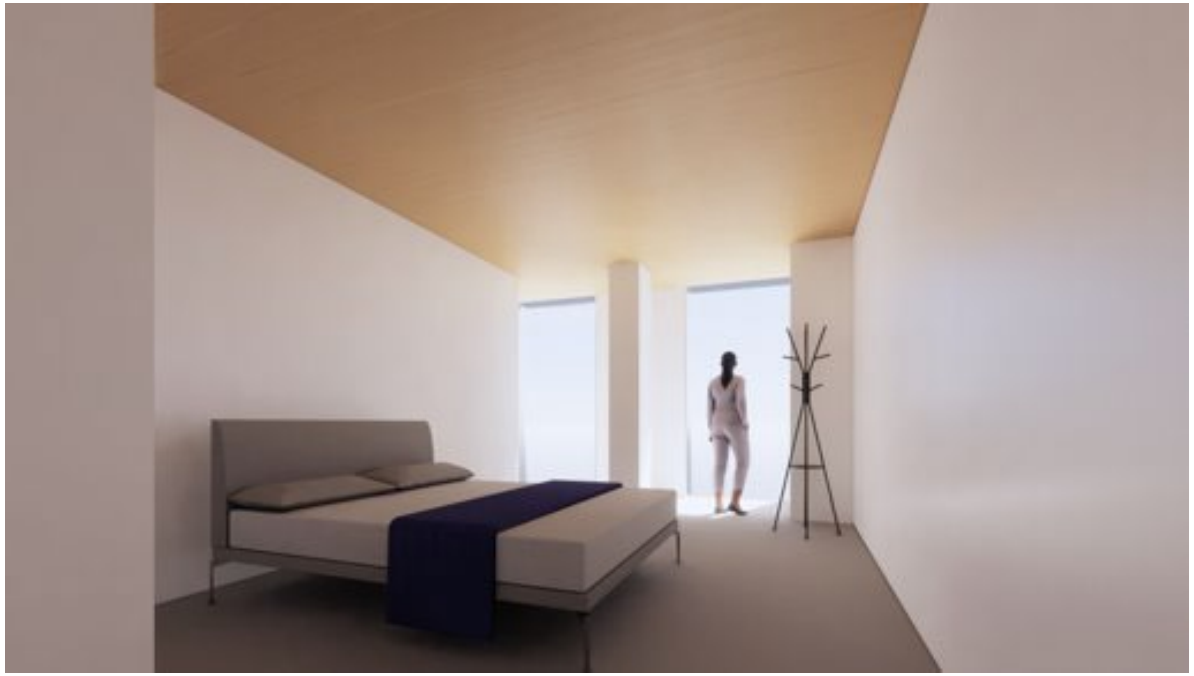
0 5' 10' 20'

Studio

2B1B

1B1B

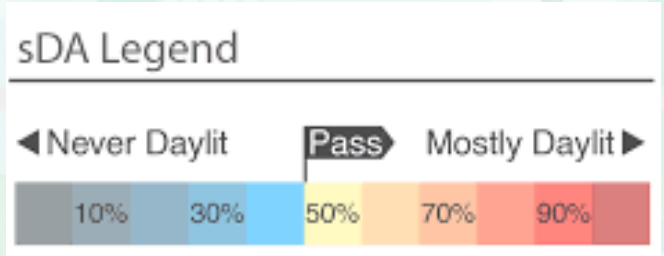
Typical Residential Floorplan

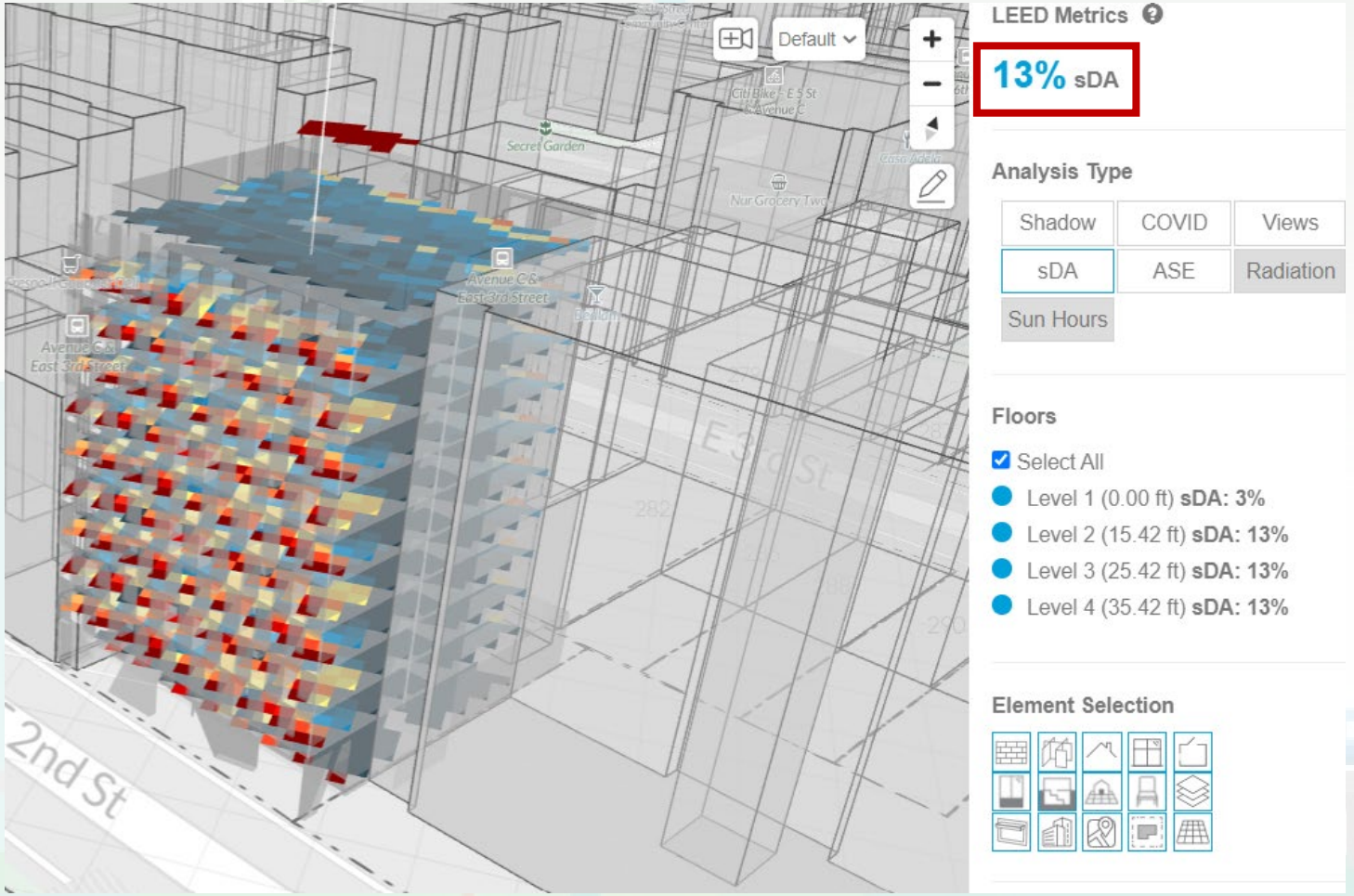


0 5' 10' 20'

Occupant Experience: Spatial Daylight Autonomy (sDA)

- sDA metric: Percent of total floor area which receives >300 lux of daylight for 50% of the time from 8:00 to 18:00
- All residential levels receive around 13% sDA

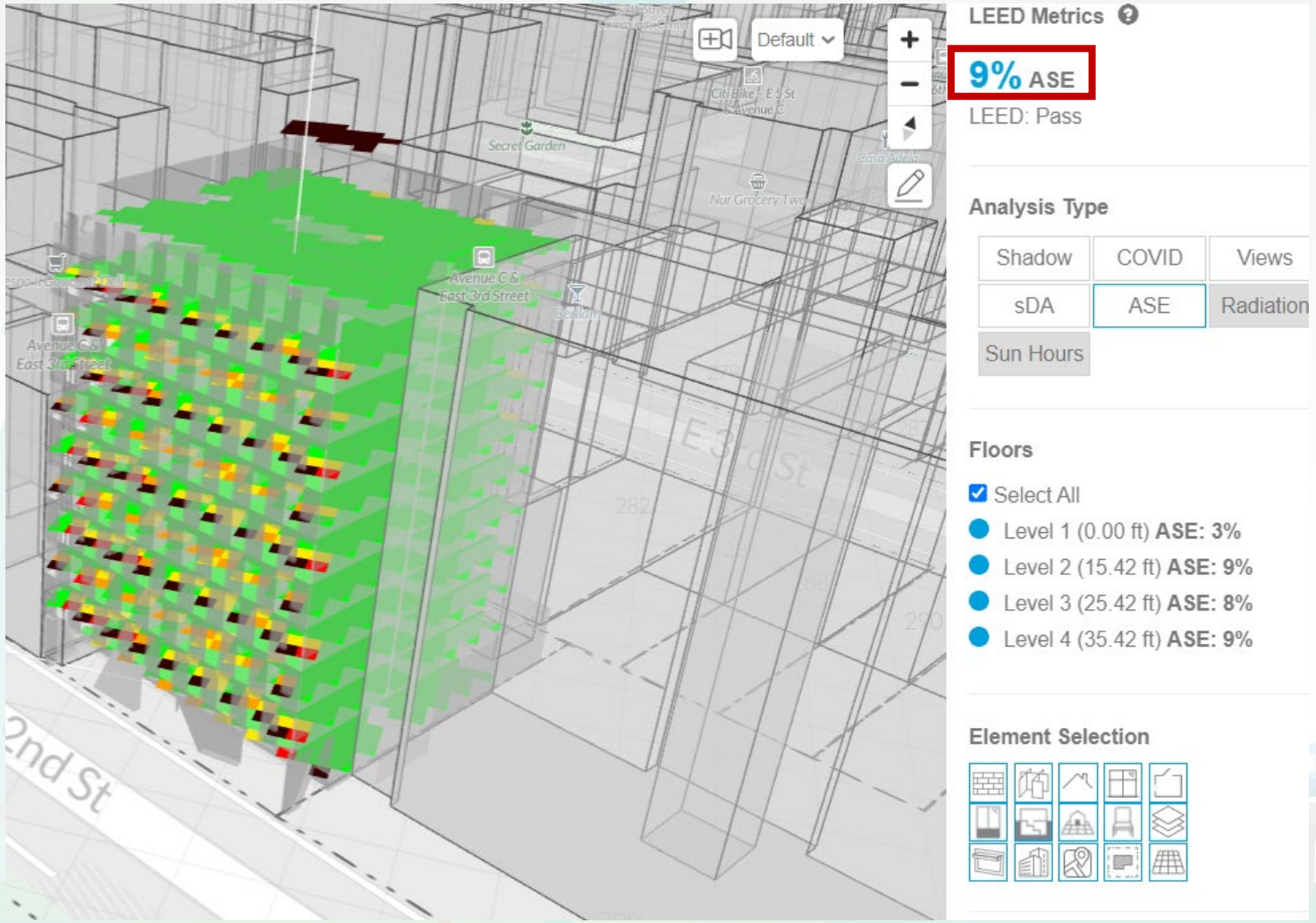


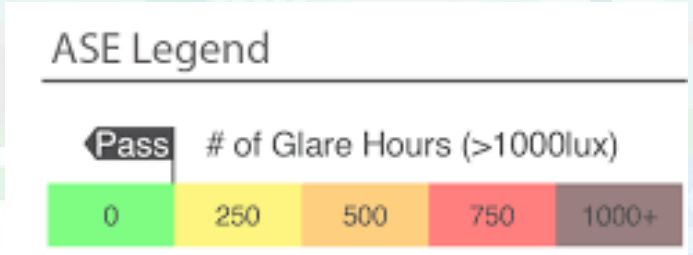


cove.tool

Occupant Experience: Annual Sunlight Exposure (ASE)

- (ASE) determines areas of the building which will receive excessive glare during certain times of the year
- Only 9% of total floor area exposed to glare: qualifying for LEED Pass





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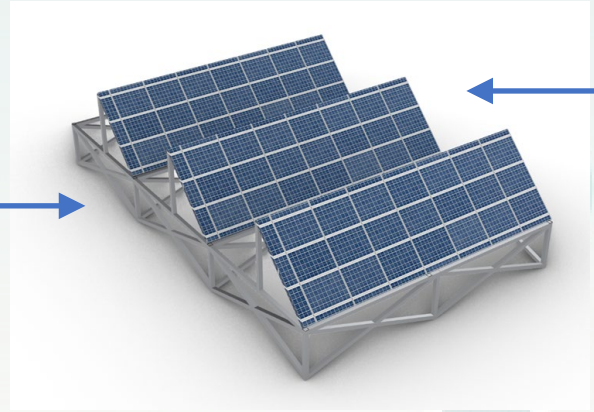
Solar Energy

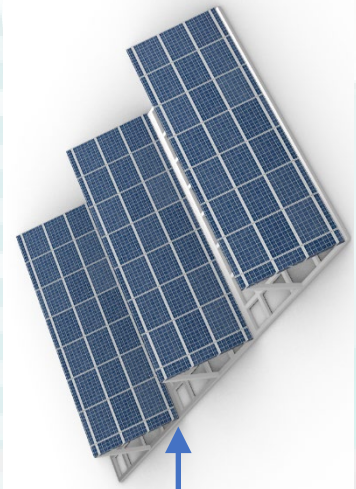
Total Output:
97,900 – 139,000 kWh/year

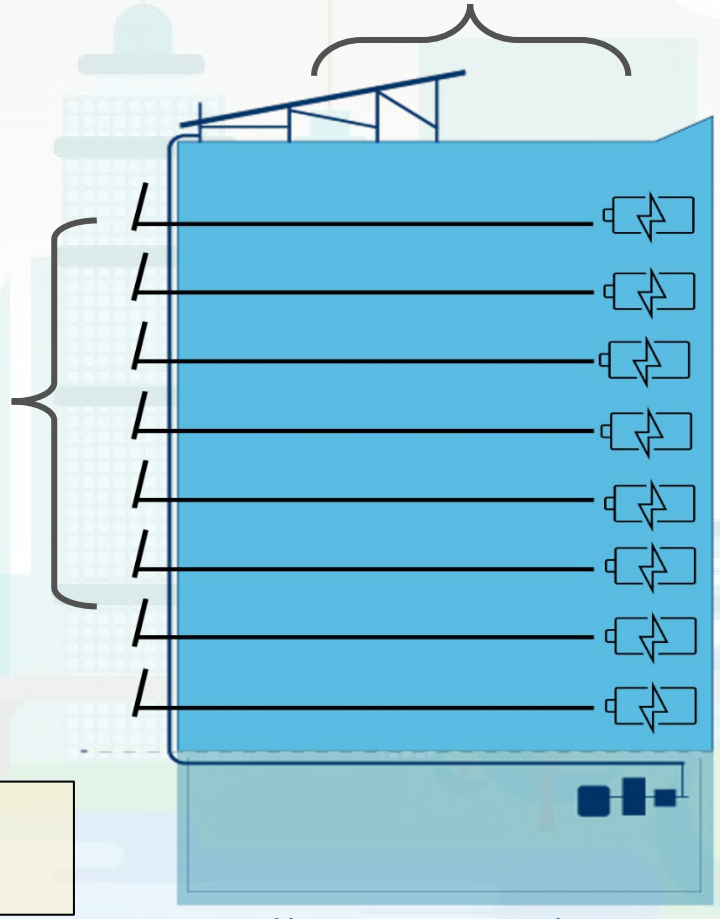
Canopy system for maneuverable space and fire department access



Roof: 60 kW DC System
Output: 84,100 kWh/year

NREL PVWatts® Calculator

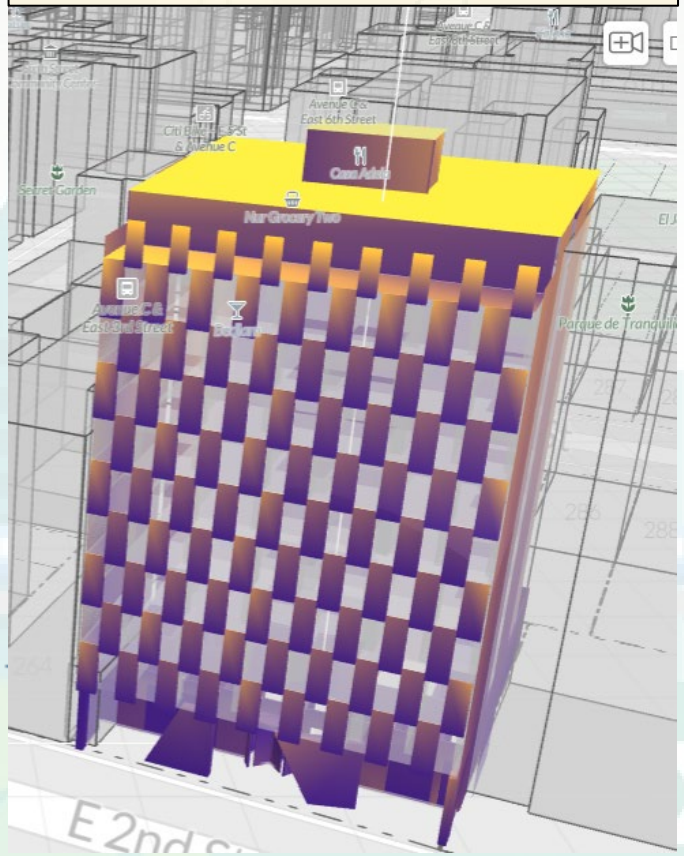




Façade: 53 kW DC System
Output: 13,800 – 54,900 kWh/year

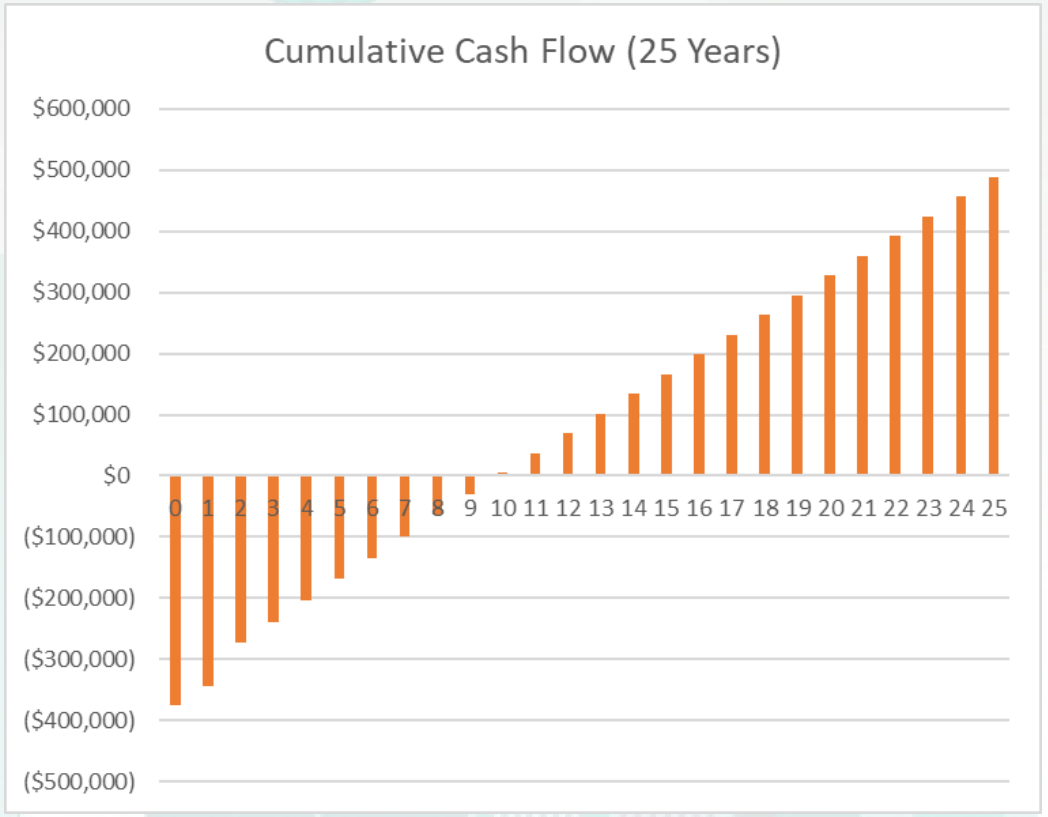
https://pvwatts.nrel.gov/pvwatts.php

cove.tool **Radiation Analysis**



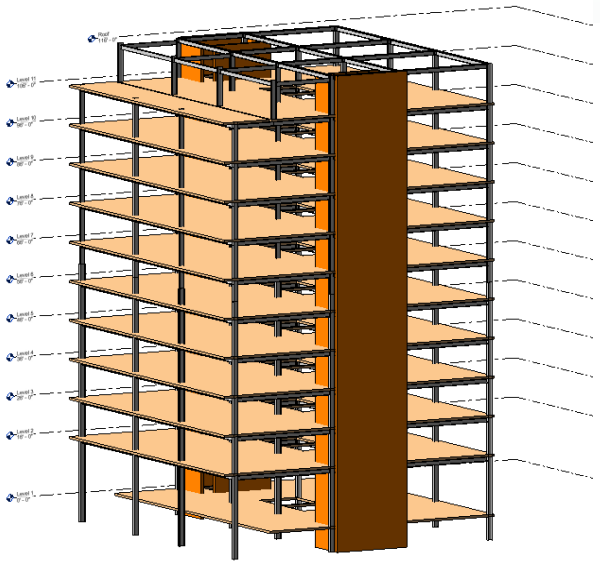
Solar Cost Analysis

- The upfront cost factoring in incentives is $375,900
- Additional low-income housing incentives are distributed over a 10-year period
- The energy savings are ~$23,000-32,000/year
- The solar array payback period is 10 - 11 years

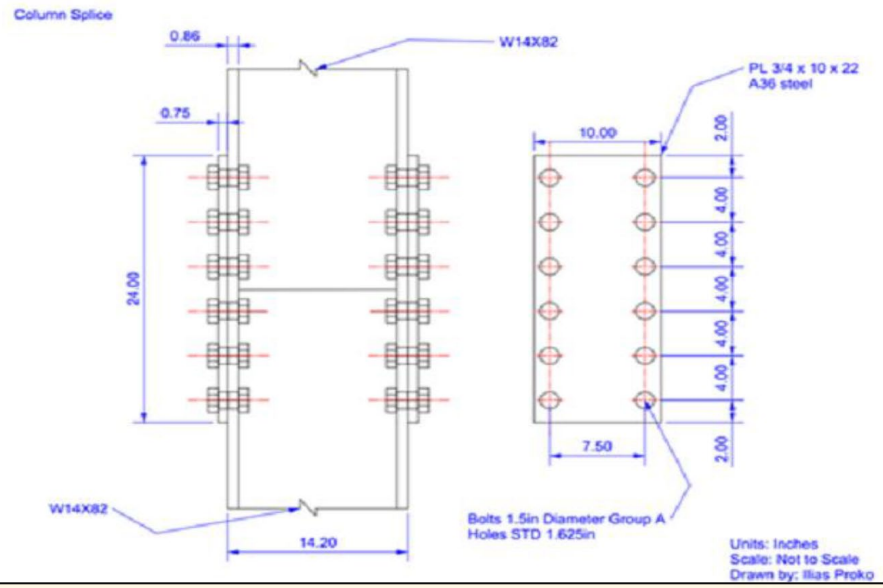


Structural: Floor Plan and Superstructure

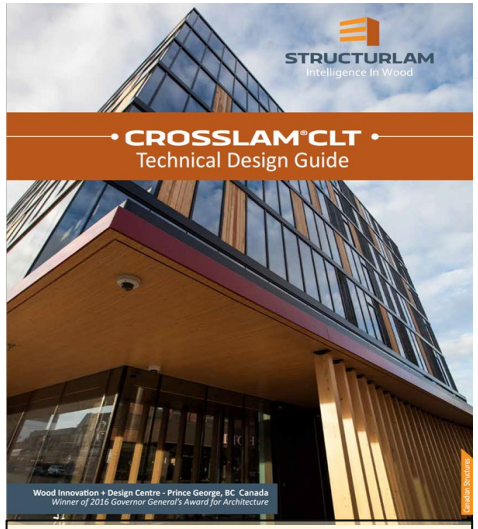
- Columns and Beams made of Recycled Steel and varied across the floors to reduce weight
- 6.87in CLT flooring in order to minimize carbon footprint (175E lumber)
- Stairwell cores will serve as shear walls (12 inch thick, 315E lumber)



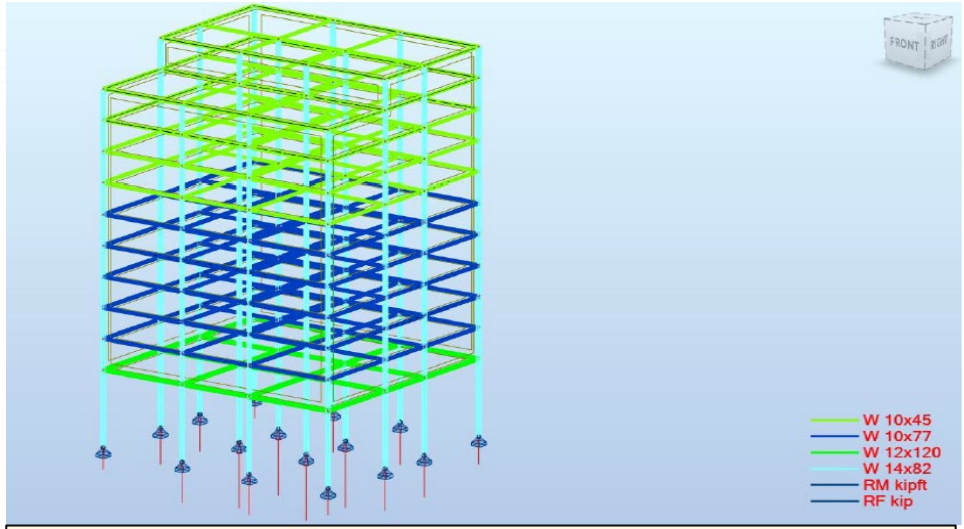
Hybrid Structural Framing:
Steel Beams & Columns
CLT Shear Walls & Floor Slabs



Column Splice



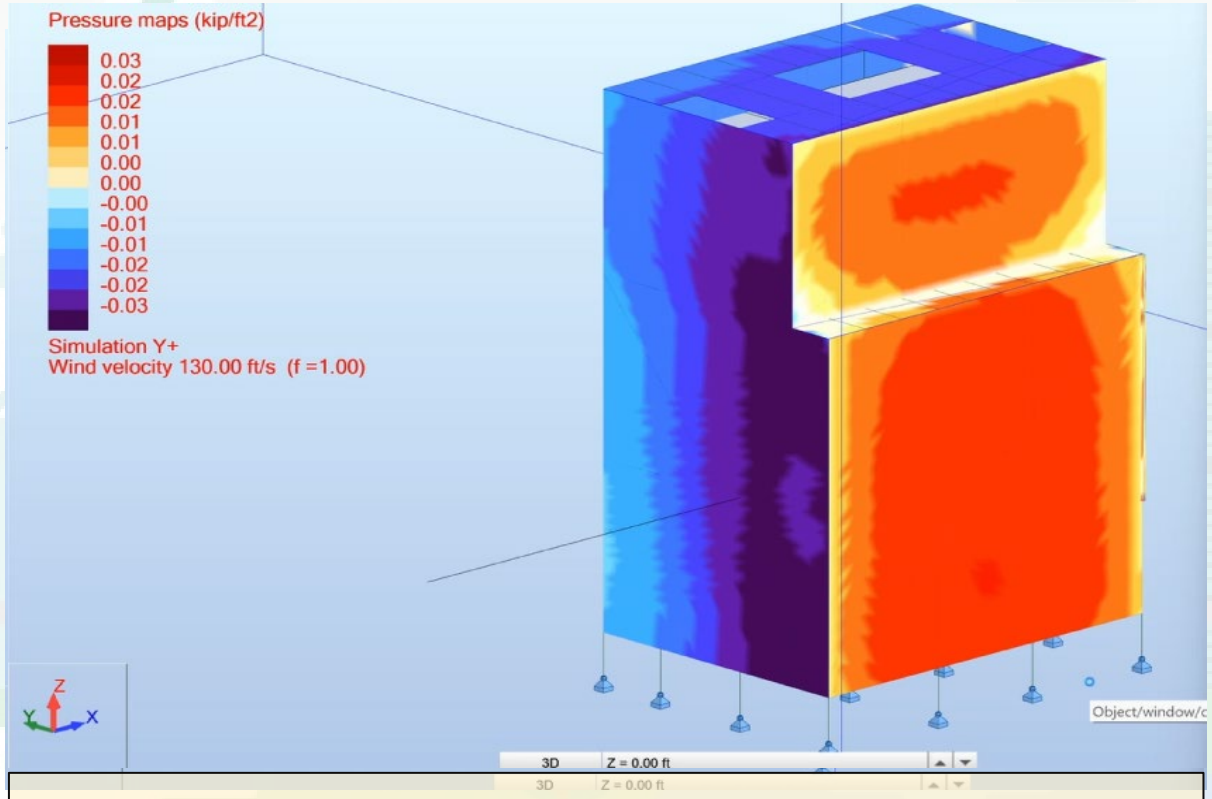
CLT Floor Slab manufacturer



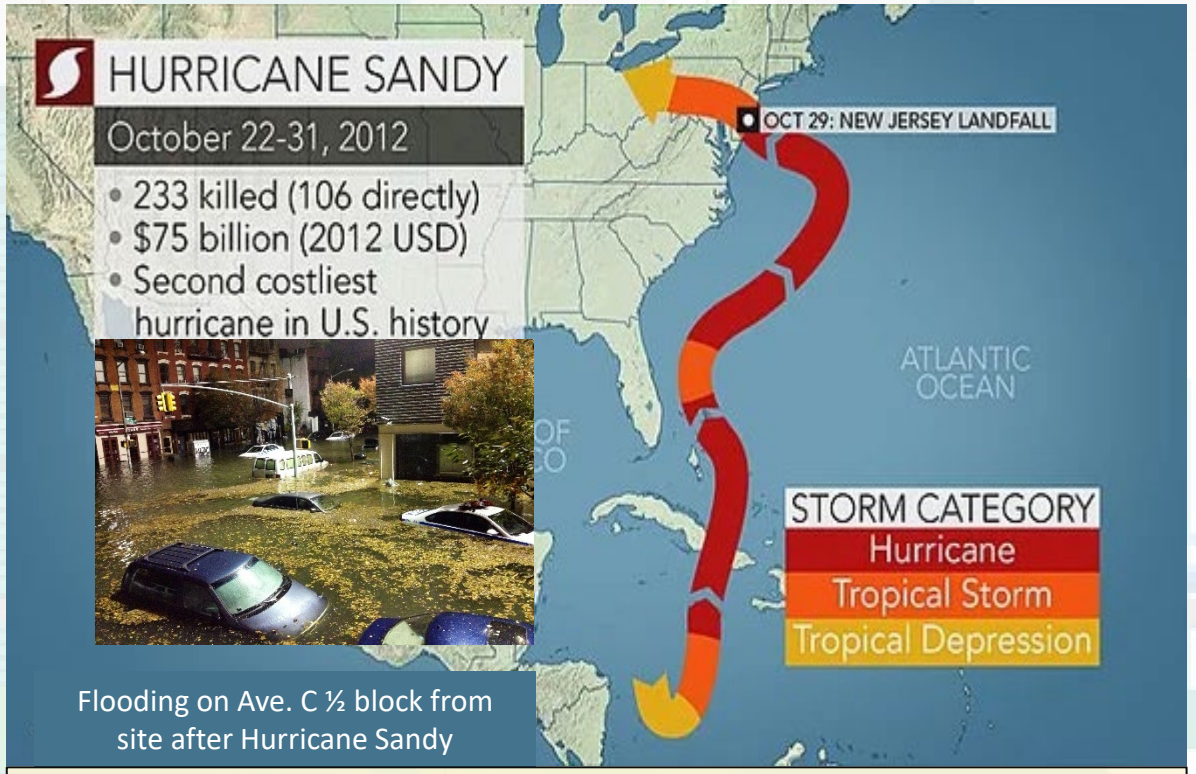
Finite Element Analysis:
Color coded members

Durability & Resilience

- Different wind directions and angles of attack, 130 MPH wind (ASCE 7-16)
- Active pumping and mat slab drainage
- Emergency power generation from battery backup



CFD Model for High Winds:
Wind pressure contours



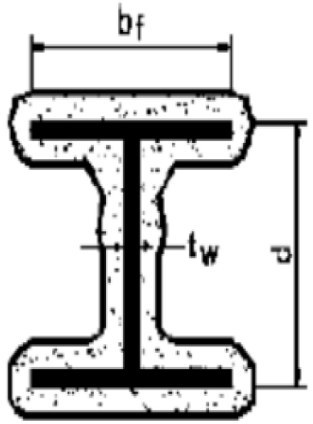
Flooding on Ave. C ½ block from site after Hurricane Sandy

Hurricane Sandy
Severity of flood

Friction Pile Foundation & Fireproofing

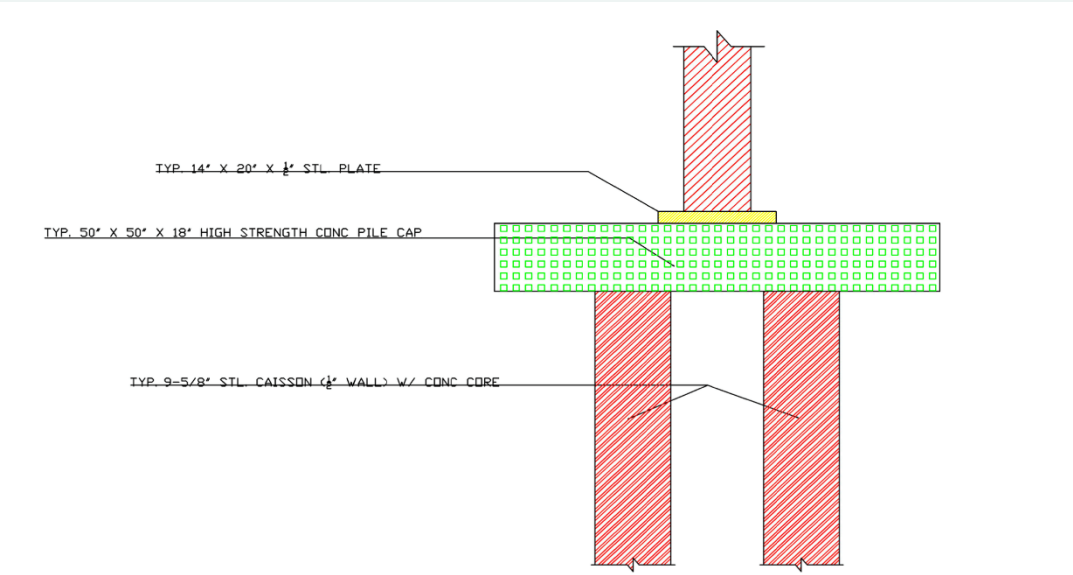
- Micro Pile Foundation
  - Deep bedrock (103ft)
    - Mechanical equipment mounted on second floor exterior walls
      - Steel members encased in fire resisting materials
        - 4 9-5/8” bored steel piles

Outdoor Heat Pumps

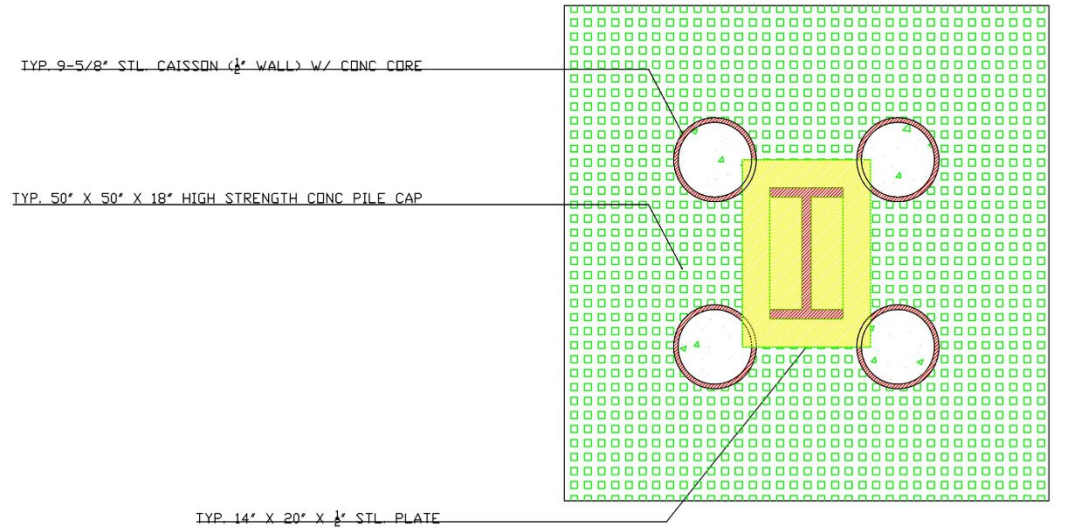


$D=4b_f+2d-2t_w$

Fireproofing of steel frame



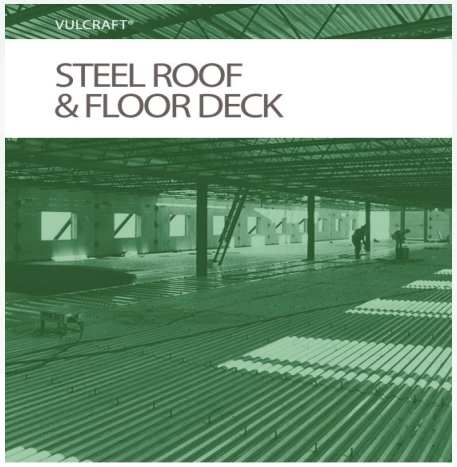
Micro Pile Foundation:
Side view



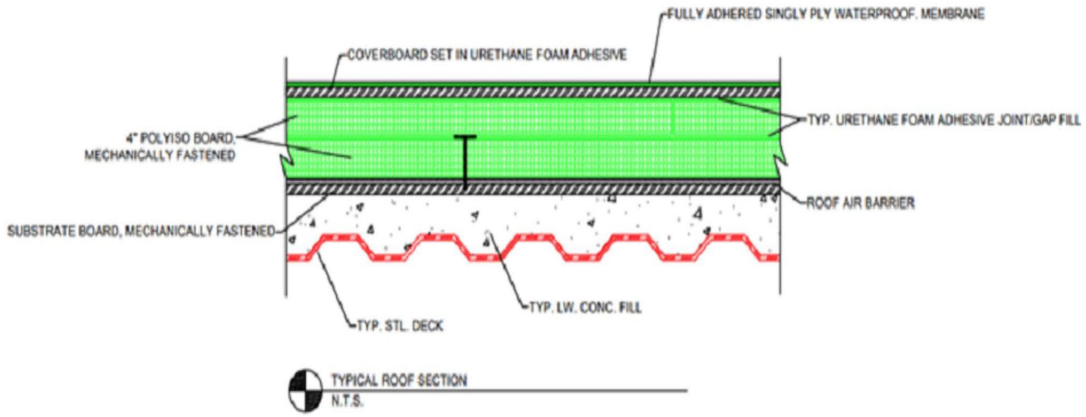
Micro Pile Foundation:
Top view

Roof - Steel Framing with Metal Deck

- Composite section minimizes future maintenance costs
  - 3.5in concrete slab
  - Accessible roof



Steel Deck Supplier



Typical Roof Detail
Side view

VULCRAFT®

1.5VL / 1.5VLI COMPOSITE DECK

SECTION PROPERTIES

Deck Gauge	Design Thickness (in.)	Deck Weight (psf)	Section Properties I_p (in⁴/ft)	S_p (in³/ft)	I_n (in⁴/ft)	S_n (in³/ft)	V_a (lbs/ft)	F_y (ksi)
22	0.0295	1.67	0.139	0.167	0.173	0.177	2626	50
20	0.0358	2.03	0.182	0.218	0.216	0.226	3171	50
19	0.0418	2.37	0.224	0.259	0.252	0.275	3685	50
18	0.0474	2.69	0.265	0.298	0.286	0.314	4160	50
16	0.0598	3.40	0.362	0.389	0.362	0.396	4156	40

(N = 9.35) NORMAL WEIGHT CONCRETE (145 PCF)

Inserting image...

TOTAL SLAB DEPTH	DECK TYPE	SDI Max. Unshored Clear Span 1 SPAN	2 SPAN	3 SPAN	Superimposed Live Load (PSF) Clear Span (ft-in.) 5'-0	5'-6	6'-0	6'-6	7'-0	7'-6	8'-0	8'-6	9'-0	9'-6	10'-0	10'-6	11'-0	11'-6	12'-0
3.50 (t=2.00) 33 psf	1.5VL22	6'-4	7'-5	7'-6	314	279	250	206	186	169	154	141	130	120	111	100	87	76	67
	1.5VL20	7'-7	8'-10	9'-0	345	306	275	249	227	208	171	157	144	134	124	108	94	82	73
	1.5VL19	8'-1	9'-10	10'-0	372	330	296	268	244	224	207	171	157	146	134	116	101	88	78
	1.5VL18	8'-7	10'-6	10'-9	395	351	315	285	260	238	220	204	168	156	142	123	107	94	82
	1.5VL16	9'-5	10'-5	10'-10	397	353	316	286	261	239	221	205	190	156	145	135	119	104	92

Corrugated Steel Deck

Construction Cost Estimate

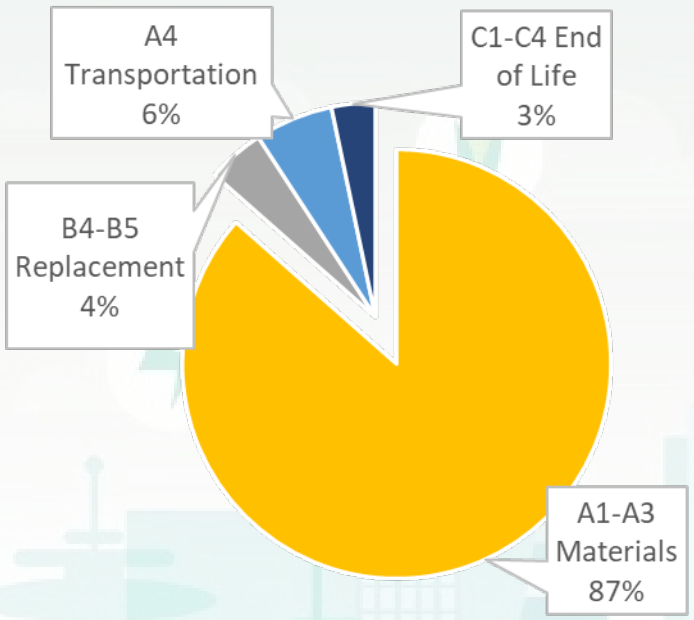
RSMeans

$21,309,571.48 Building Cost	**NEW YORK, NY** Location	**10** Stories (Ea.)	**Yes** Basement
$378.46 Cost per S.F.	**56,306** Floor Area	**10.00** Story Height	**$999,824.00** Additive Cost

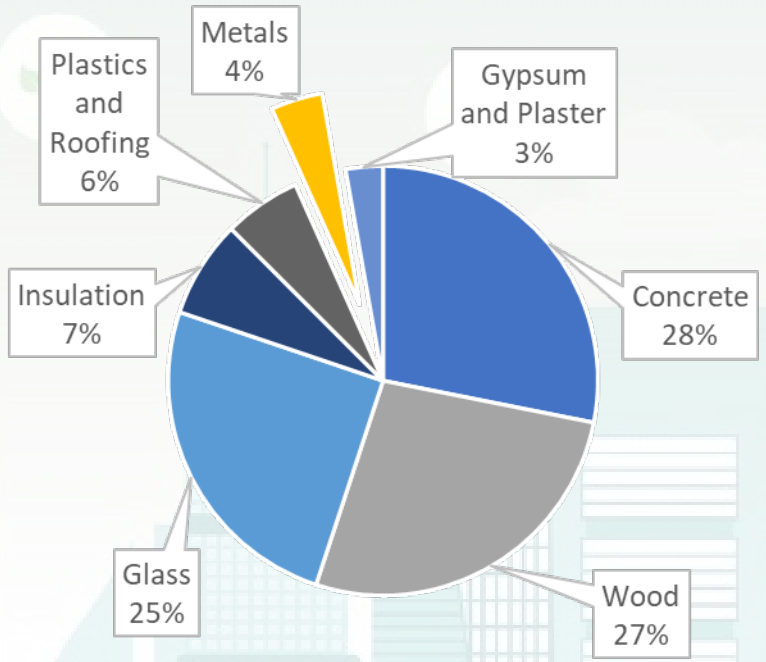
The construction costs are estimated to be $378/sq ft - $460/sq ft

RSMeans data from GORDIAN®

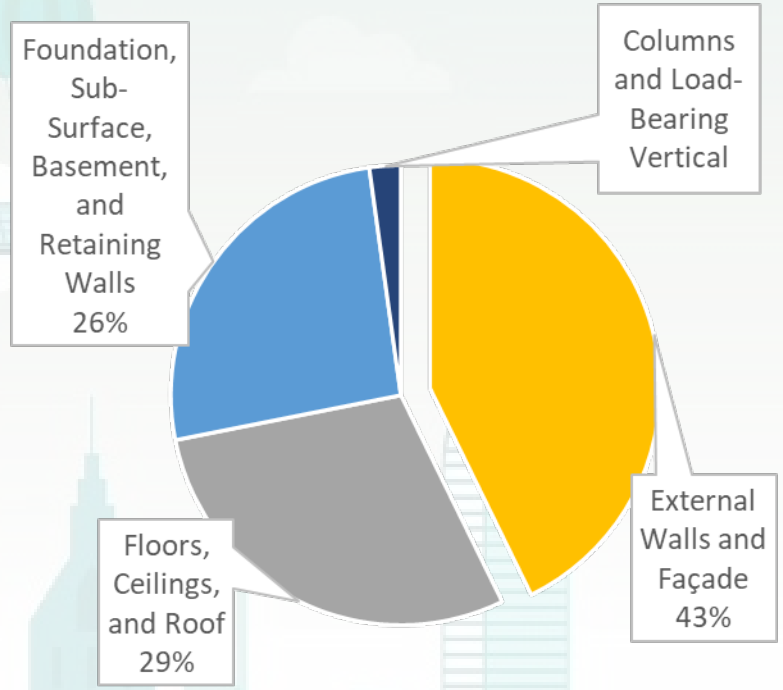
CO2 Emissions by Life Cycle Stage



CO2 Emissions by Resource Type



CO2 Emissions By Structural Element

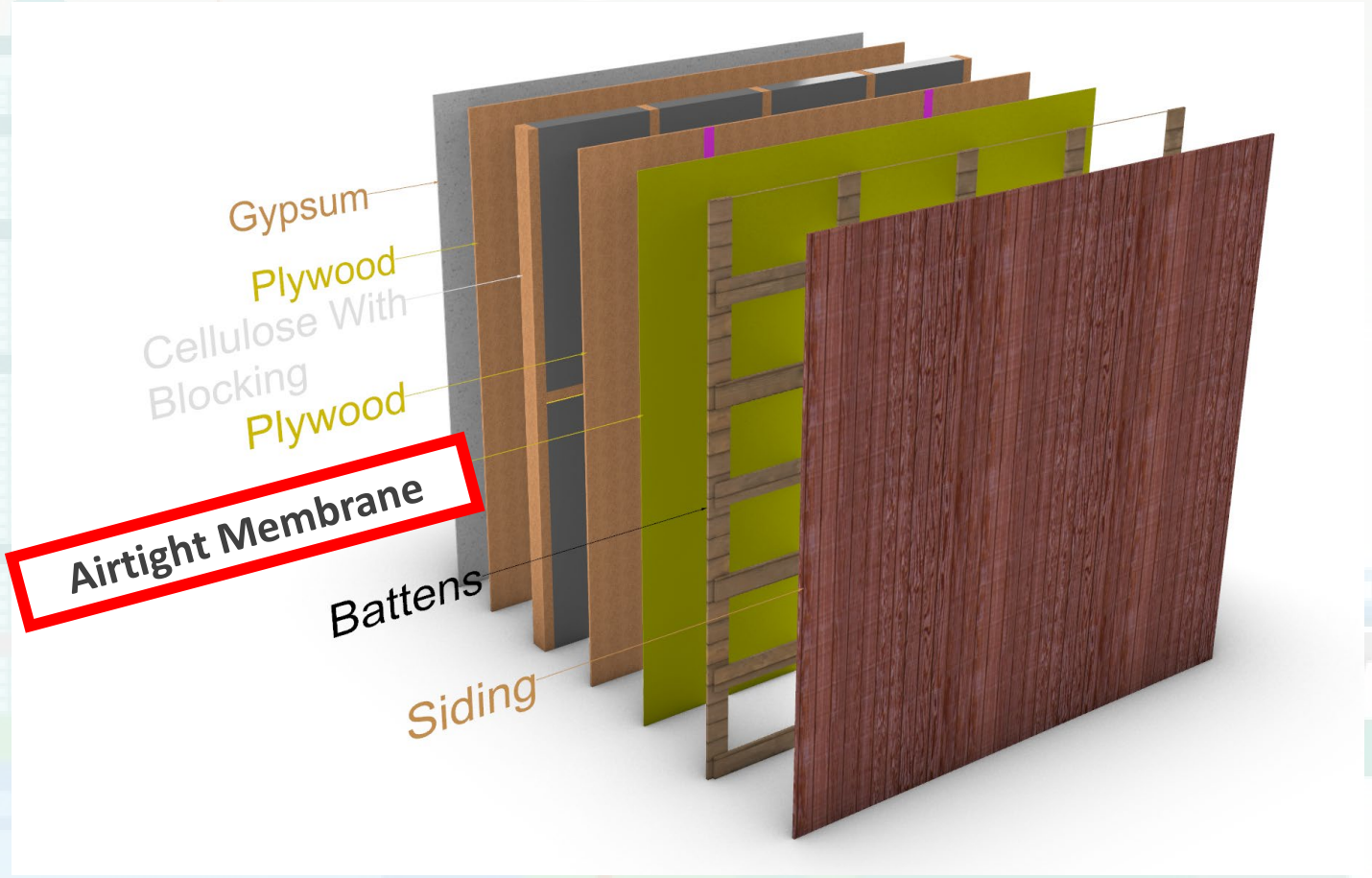


Embodied Environmental Impact

LCA of Major Structural Elements and Material Justifications

Thermally Resistant, Airtight Envelope

- Above required insulation levels
  - Roof R-50 (> R-49)
  - Walls R-28 (> R-20)
  - Foundation R-38
- Triple pane windows
- Maximum of 0.6 ACPH at 50 Pa

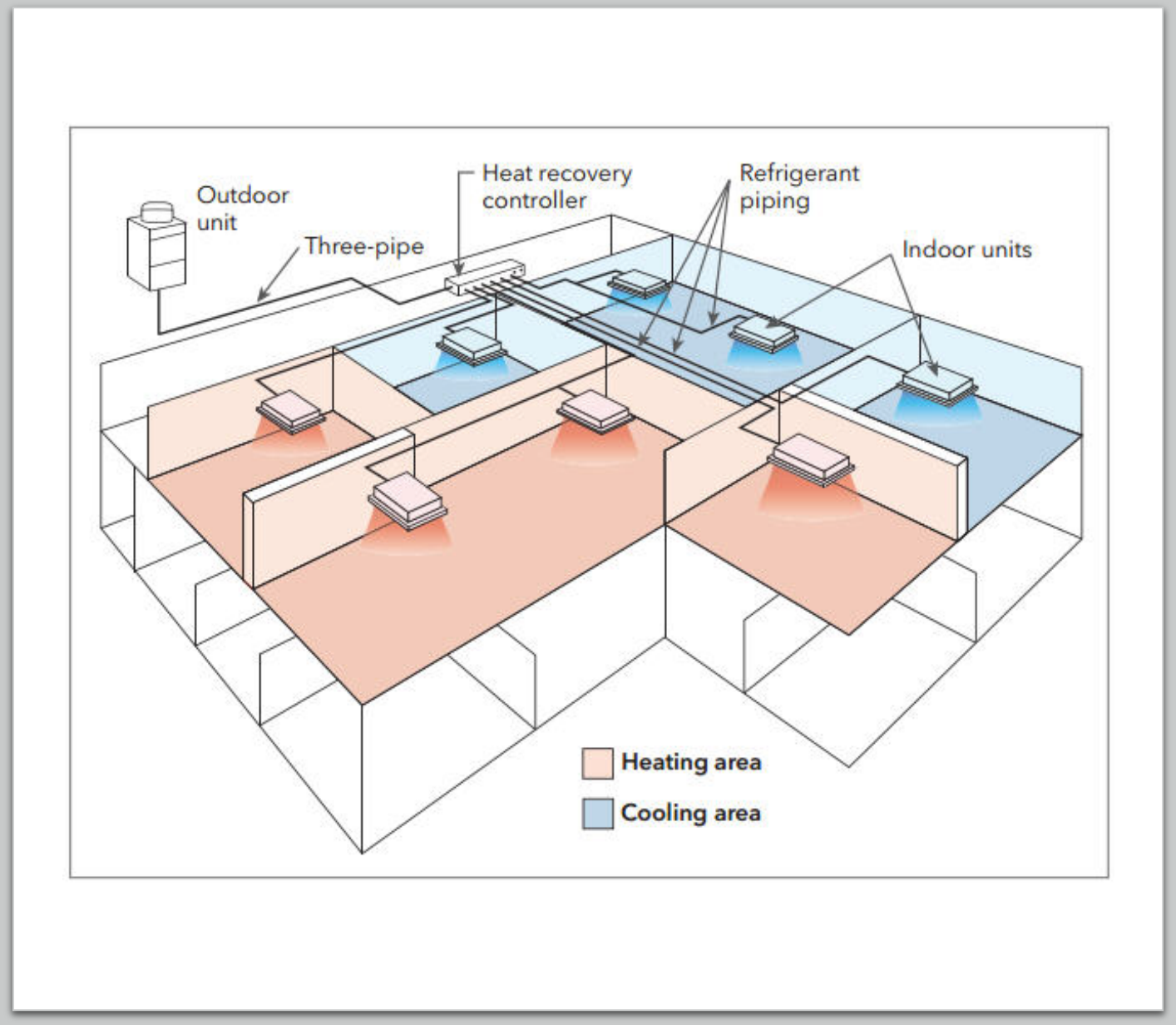


Variable Refrigerant Flow (VRF) System

- Air-Source Heat Pumps (COP = 4)
- Compatible with PV panels and increasingly sustainable electric grid

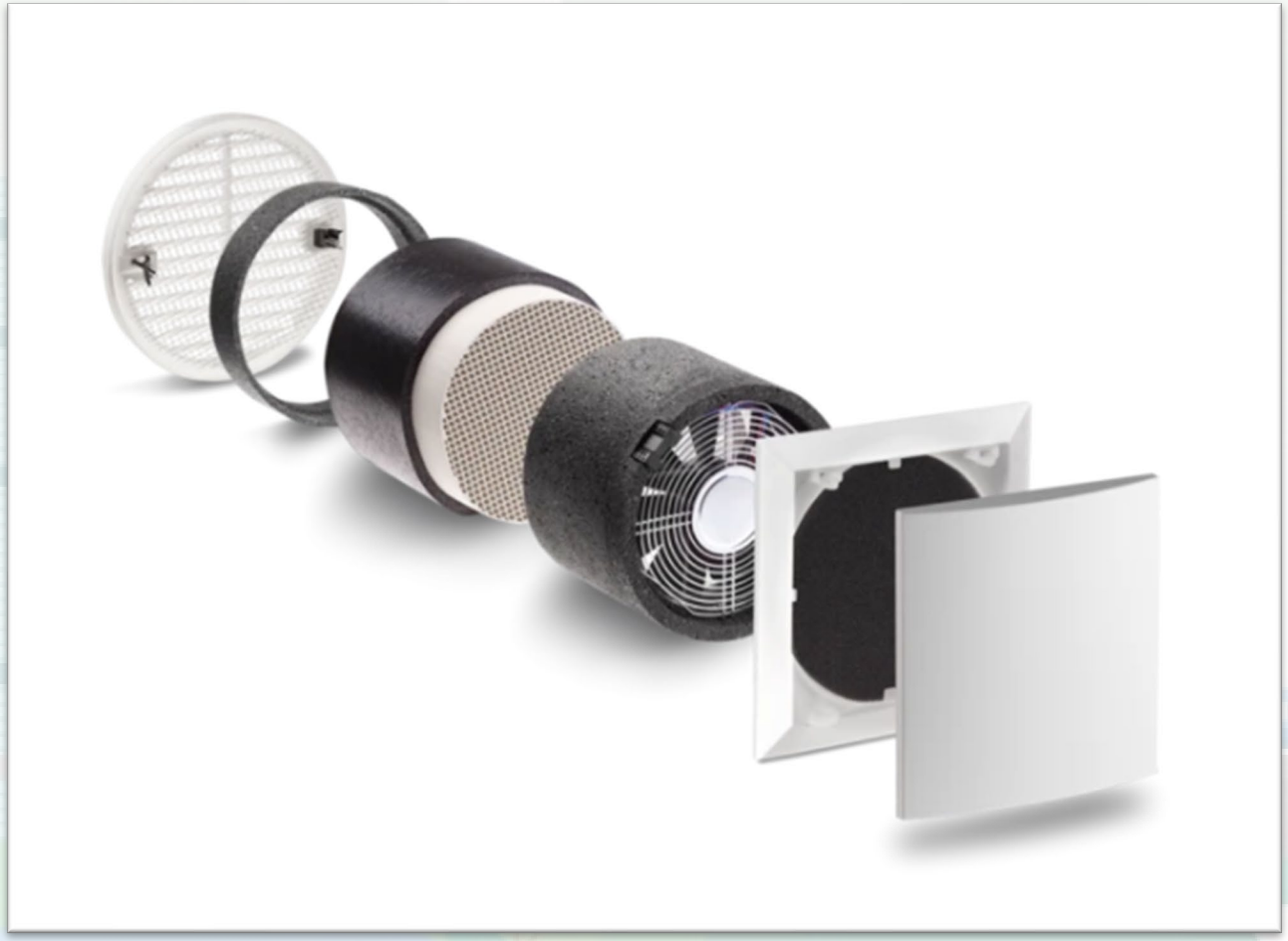
TAR-FL32MA-E
Wireless MA
Wireless Remote Controller

kumo cloud®
App-based Controller



Ventilation: Fixed-Bed Regenerator

- Ductless ventilation system
- Supply fresh, filtered air
- Heat exchanging effectiveness in the range of 80%-90%
- Humidity recovery of about 20-30%
- Standard sound pressure difference is 42 dB



https://lunoscanada.com/pages/technology

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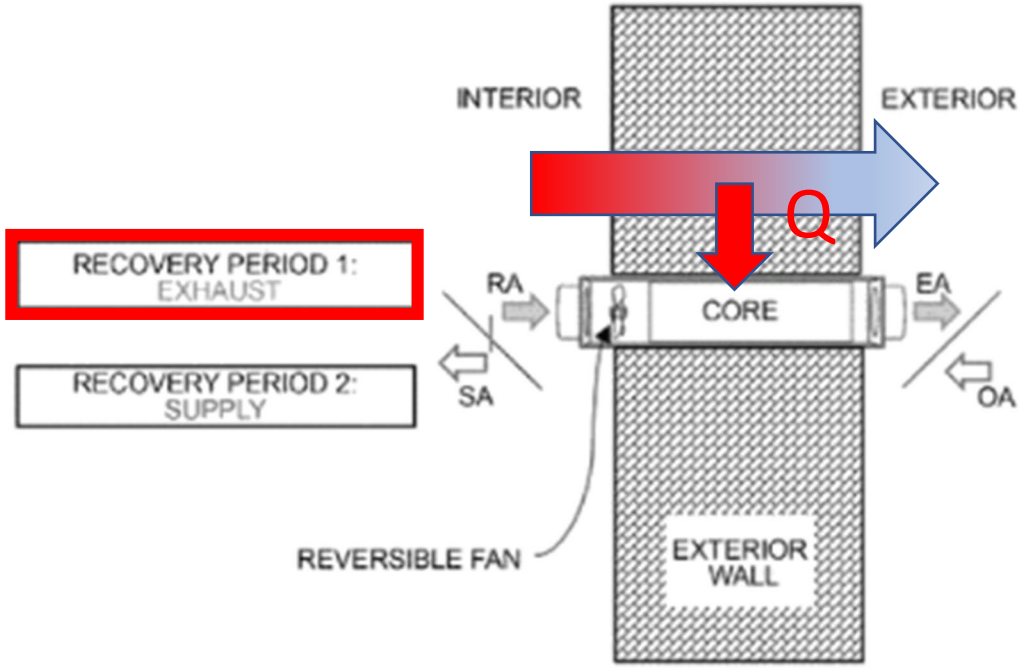

Fig. 23 Single-Core Fixed-Bed Regenerator

2020 ASHRAE Handbook

Ventilation: Fixed-Bed Regenerator

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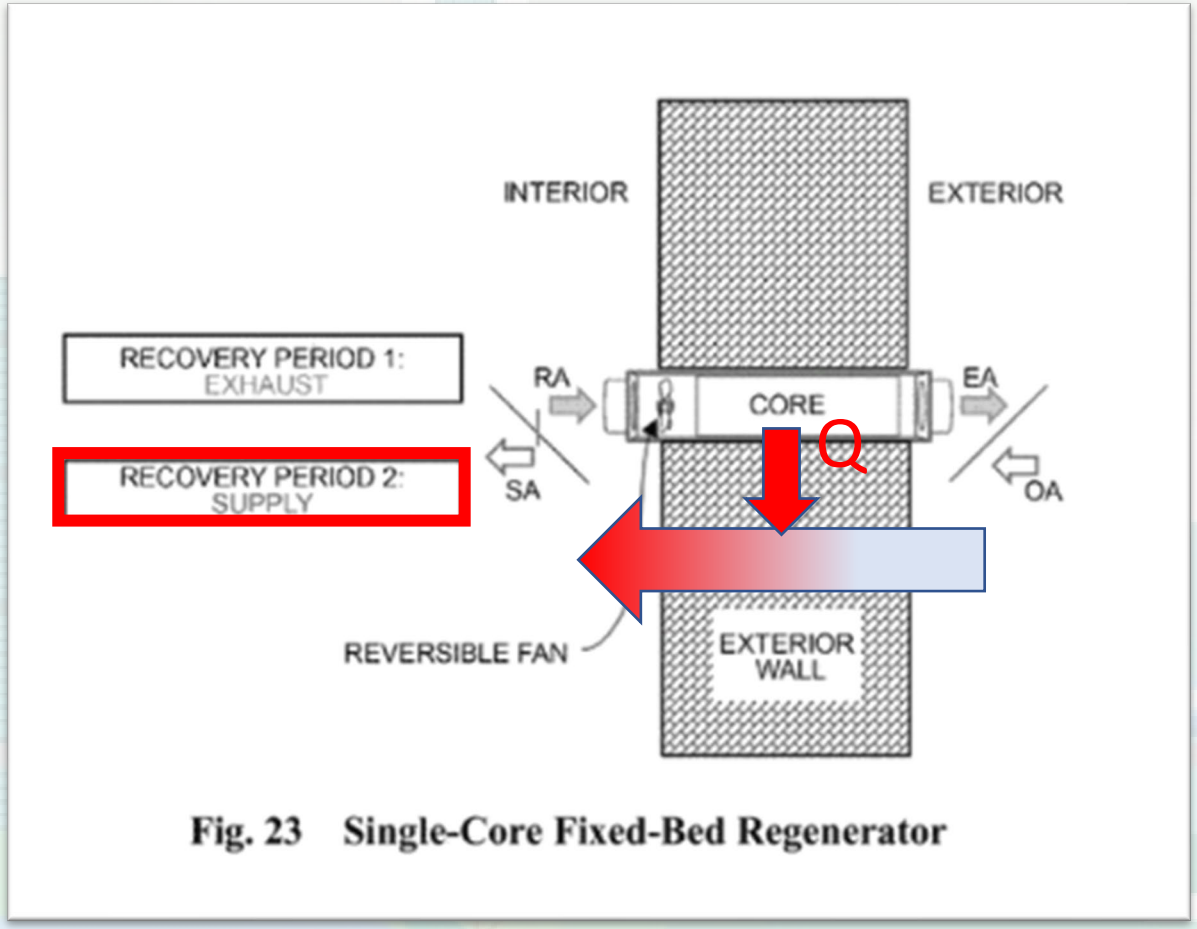
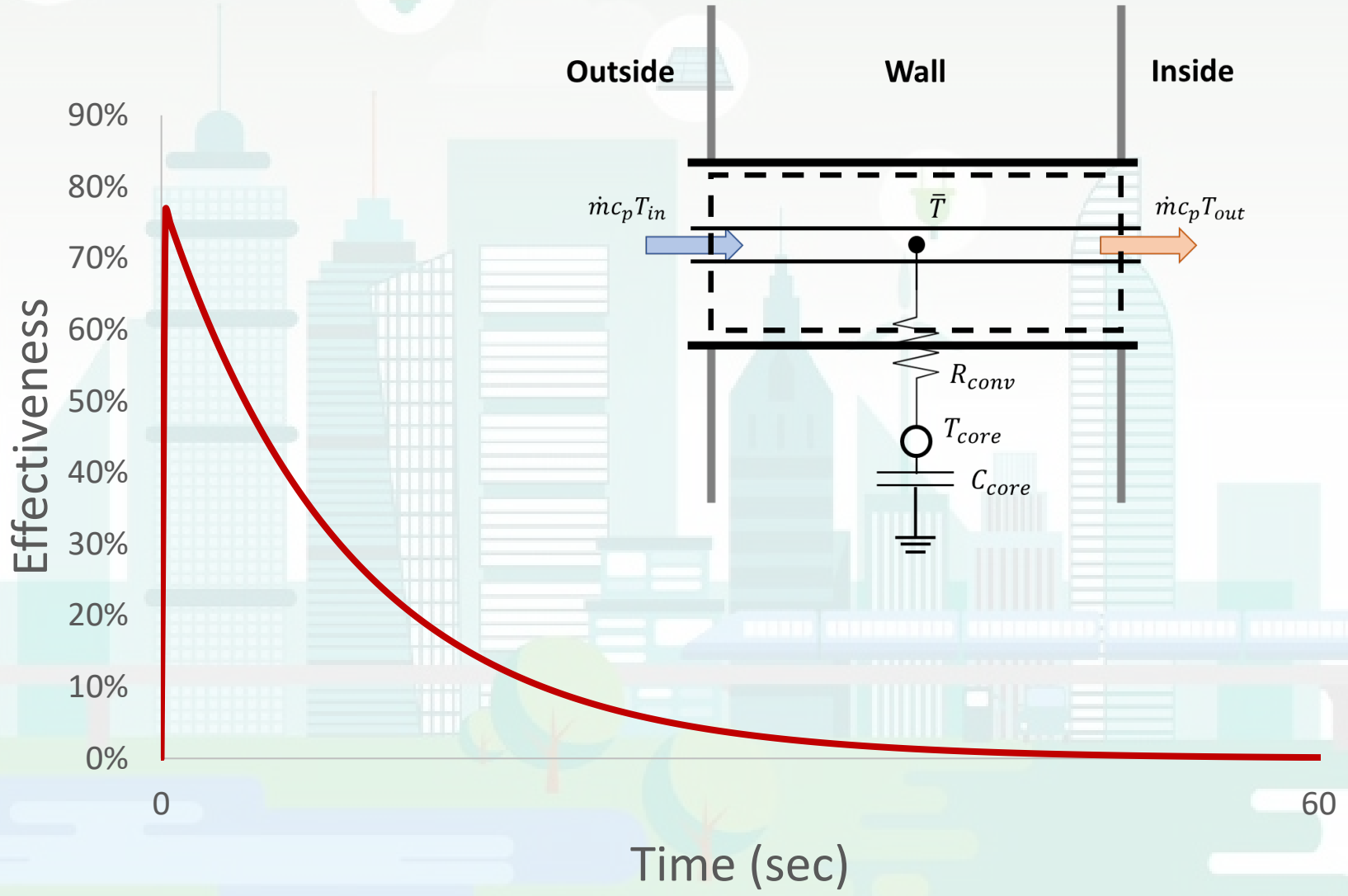


Fig. 23 Single-Core Fixed-Bed Regenerator

2020 ASHRAE Handbook

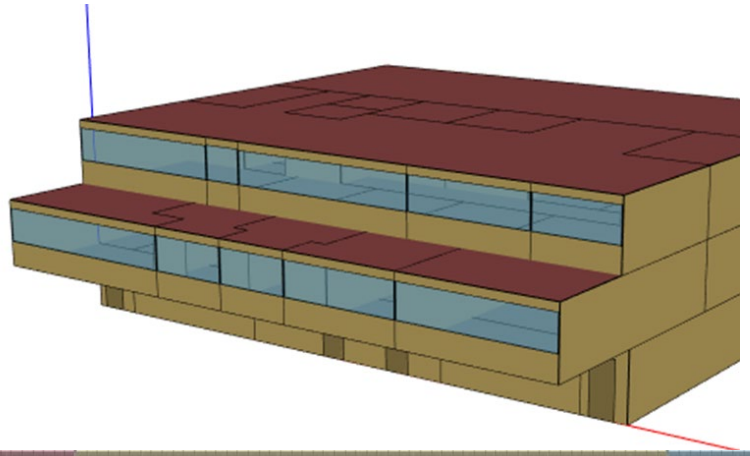
Fixed-Bed Regenerator 1-node Well-Mixed Model

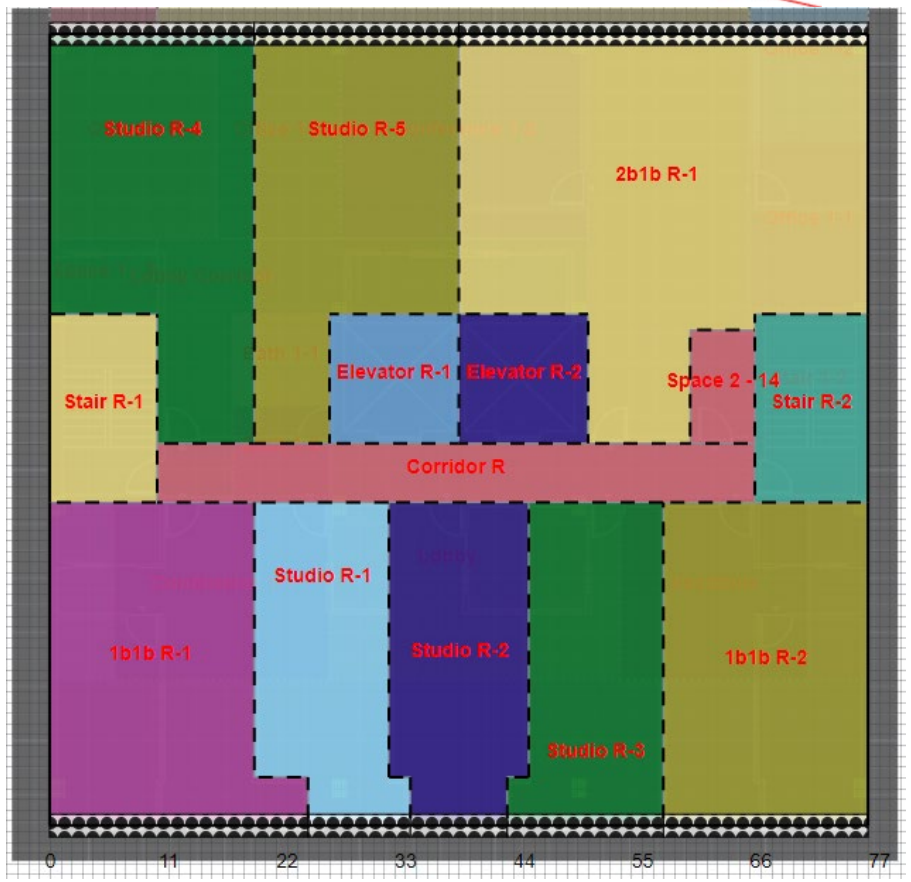
- Effectiveness decreases transiently
- Overall average effectiveness assumed to be 40%-50% (latent effectiveness 25%-35%)
- 70% heating and cooling savings compared to ASHRAE Baseline



Lighting, Appliances, and Fixtures

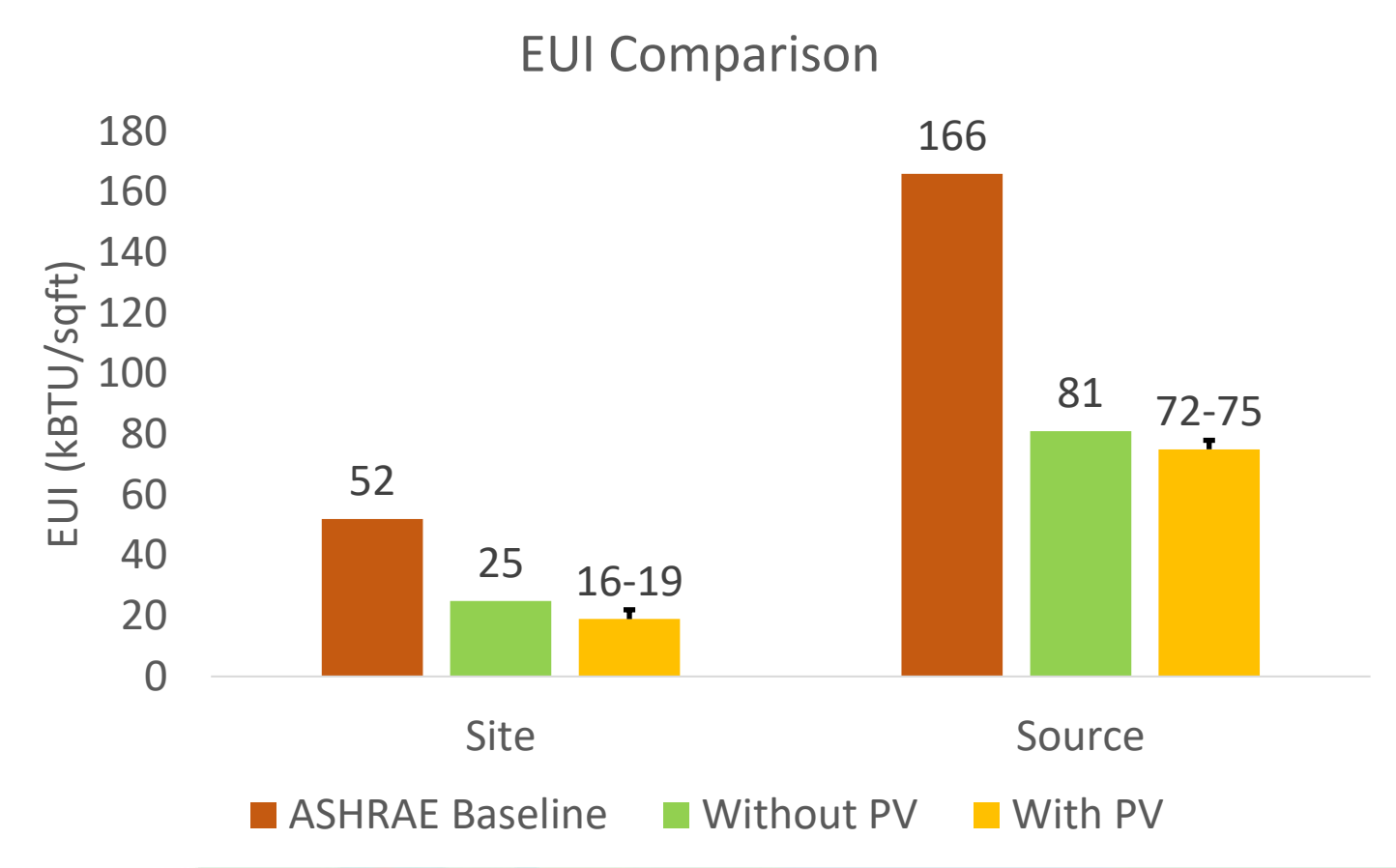
- ADA compliant
- Energy Star rated
- Tankless Electric water heaters
  - Capable of handling large variations in water demand
- Smart-home integration
- Accessible Controls, Dimmers, Occupancy/Vacancy Sensors,





Energy Modeling: OpenStudio EnergyPlus

Energy Model Results



Thermal Comfort:

- No more than 5% of hours in a year over 76°F or under 68°F

Energy and Carbon Footprint:

- 50% energy reduction without renewables
- 70% energy reduction with renewables
- ~11,000 kWh per resident (43% lower than US average)
- Total utility cost of $4800 per month
- 75-89 $\frac{tCO_{2e}}{year}$ based on **current** emission coefficients
- Below 2034 NYC Local Law 97 carbon target and will be net zero by 2040

ACCESSIBILITY | AFFORDABILITY| SUSTAINABILITY

Our design integrates these themes to help our residents reestablish their lives and to create a renewable, green future for them and for us all.

Team Members

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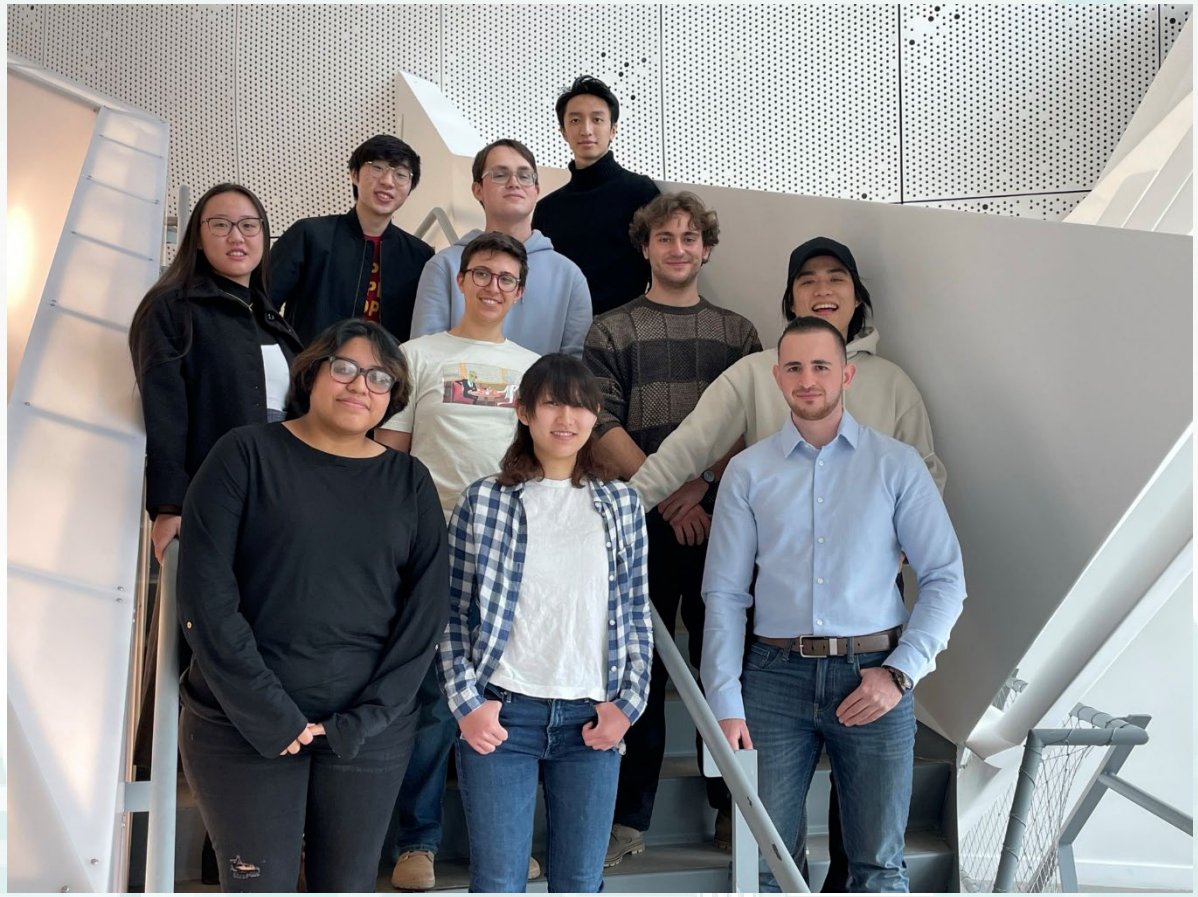
Grace Ee (BSE ‘25)



Faculty Advisors

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Alumni Design Mentors

Nick Triano
Eric Ringold
Neil Muir
Manny Feris

Multifamily Division Design Challenge

barrier free living

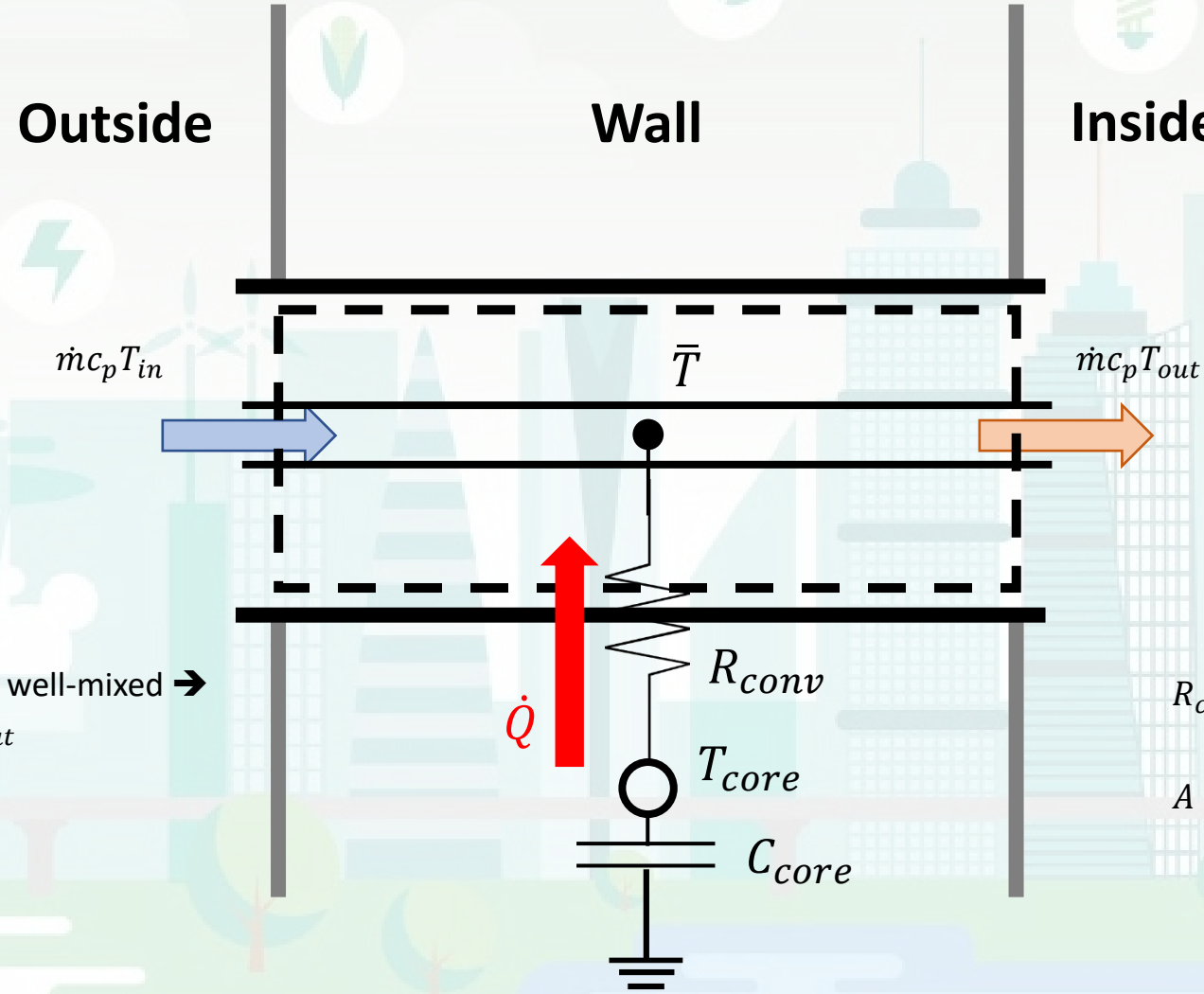
Solar Decathlon

THECOOPERUNION

Freedom Village for Barrier Free Living

Appendices

Heat Transfer Model (supply air period)



Assume well-mixed ➔
$\bar{T} = T_{out}$

$$\dot{Q} = C_{core}\frac{dT_{core}}{dt}$$

(1) Discharge of capacitor through a resistor

$$= \frac{T_{core} - \bar{T}}{R_{conv}}$$

(2) Ohm's Law (voltage ΔT, current $\dot{Q}$, resistance R_{conv}

$$= \dot{m}c_p(T_{out} - T_{in})$$

(3) Advective current source and sink

$$R_{conv} = \frac{1}{hA}$$

$$A = n_{tubes}\pi dL$$

Solve for $\bar{T}$ and Apply Euler's Method

Equations (2) and (3) ➔ $\bar{T} = \frac{\dot{m}c_p T_{in}}{\dot{m}c_p + \frac{1}{R_{conv}}} + \frac{T_{core}}{R_{conv}\dot{m}c_p + 1}$

Equations (1) and (2) ➔ $\frac{dT_{core}}{dt} = \frac{T_{core} - \bar{T}}{R_{conv}C_{core}}$

$$\dot{Q} = C_{core}\frac{dT_{core}}{dt}$$ *(1) Discharge of capacitor through a resistor*

$$= \frac{T_{core} - \bar{T}}{R_{conv}}$$ *(2) Ohm's Law (voltage ΔT, current $\dot{Q}$, resistance R_{conv}*

$$= \dot{m}c_p(\bar{T} - T_{in})$$ *(3) Advective current source and sink*

Euler's Method ➔ $T_{core}^{(p+1)} = T_{core}^{(p)} + \left(\frac{dT_{core}}{dt}\right)^{(p)} \Delta t$

$$\tau = R_{conv}C_{core}$$

$$\Delta t = \frac{\tau}{10}$$

➔ $\bar{T}^{(p+1)} = \frac{\dot{m}c_p T_{in}}{\dot{m}c_p + \frac{1}{R_{conv}}} + \frac{T_{core}^{(p+1)}}{R_{conv}\dot{m}c_p + 1}$

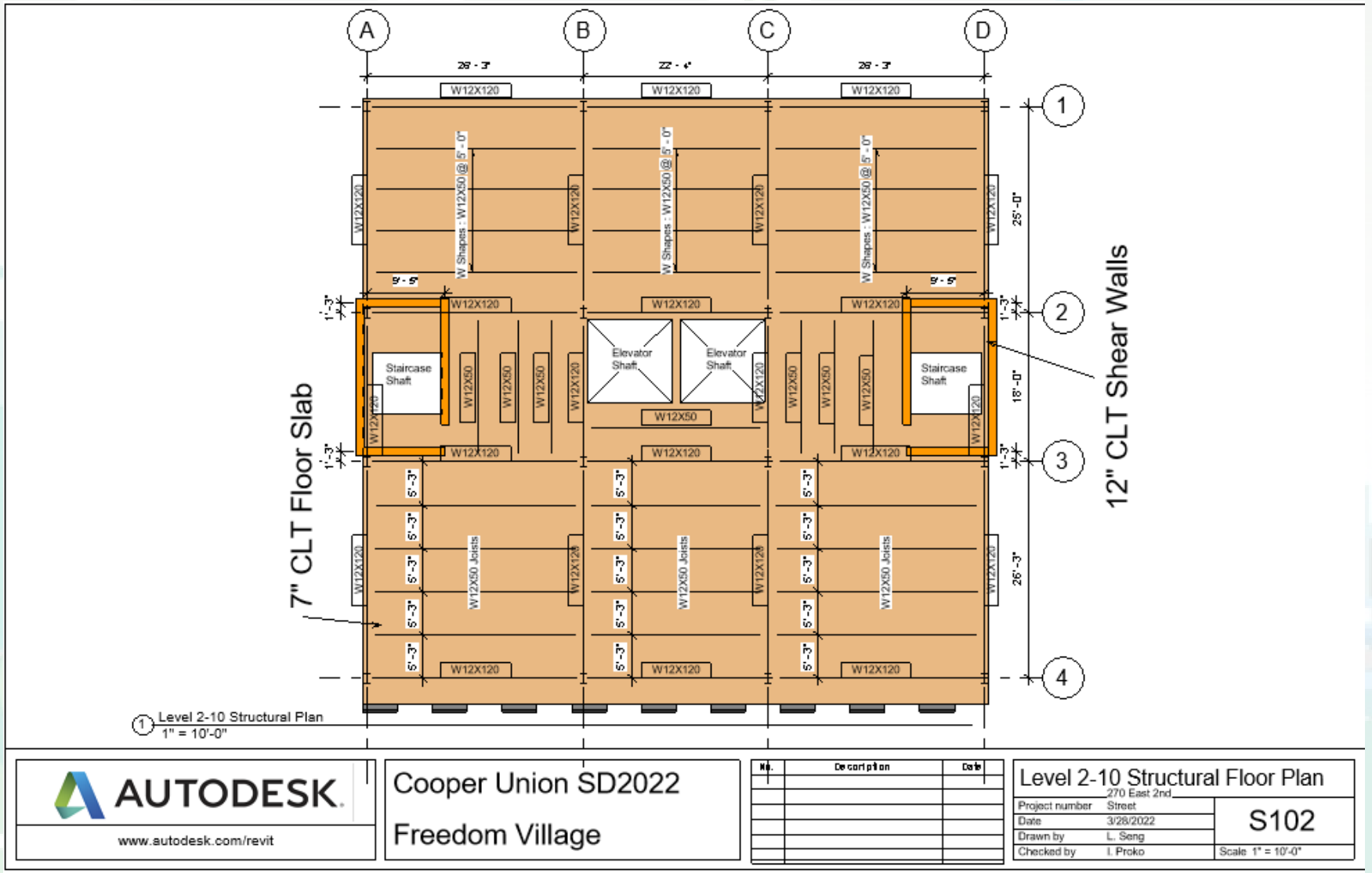
➔ $\frac{dT_{core}}{dt}^{(p)} = \frac{T_{core}^{(p)} - \bar{T}^{(p)}}{R_{conv}C_{core}}$

Heat Transfer Model Inputs

INPUTS		
V_flow	0.005	m^3/s
roh	1.204	kg/m^3
cp_air	1.005	kJ/kg-K
T_in	5	oC
T_room	20	oC
h	0.005	kW/m^2-K
d_tube	0.005	m
L	0.243	m
m_core	3	kg
cp_core	0.903	kJ/kg-K

DERIVED PARAMETERS		
m_dot	0.00602	m^3/s
C_core	2.71	kJ/K
A_FBR	0.0206	m^2
A_tube	0.0000196	m^2
n_tubes	1050	
A	4.01	m^2
R	49.9	K/kW

Sample Structural Floor Plan



Structural Members and Efficiency

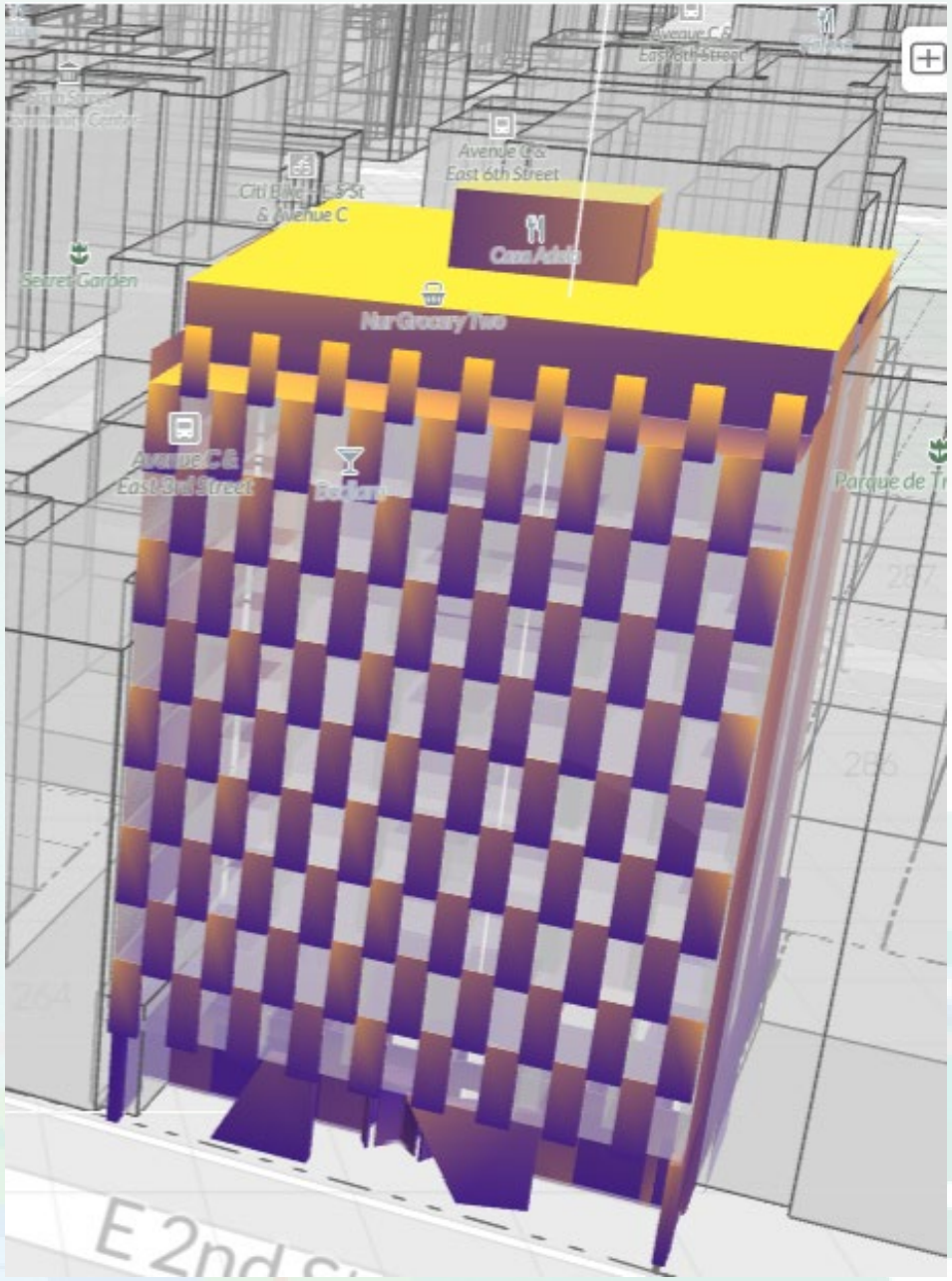
Table 1: Structural Steel Members and Associated Efficiencies

Structural Member	Weight (lb/ft)	Efficiency of Structural Member
W10X45	45	90%
W10X77	77	85%
W12X120	120	98%
W14X82	82	90%
W14X30	30	84%

CoveTool Radiation Gradient

Section	Radiation Exposure	Total kWh
Roof	100%	84,000
Top 25% of Façade	70%	4,125
Bottom 75% of Facade	10%	9,625
		97,750

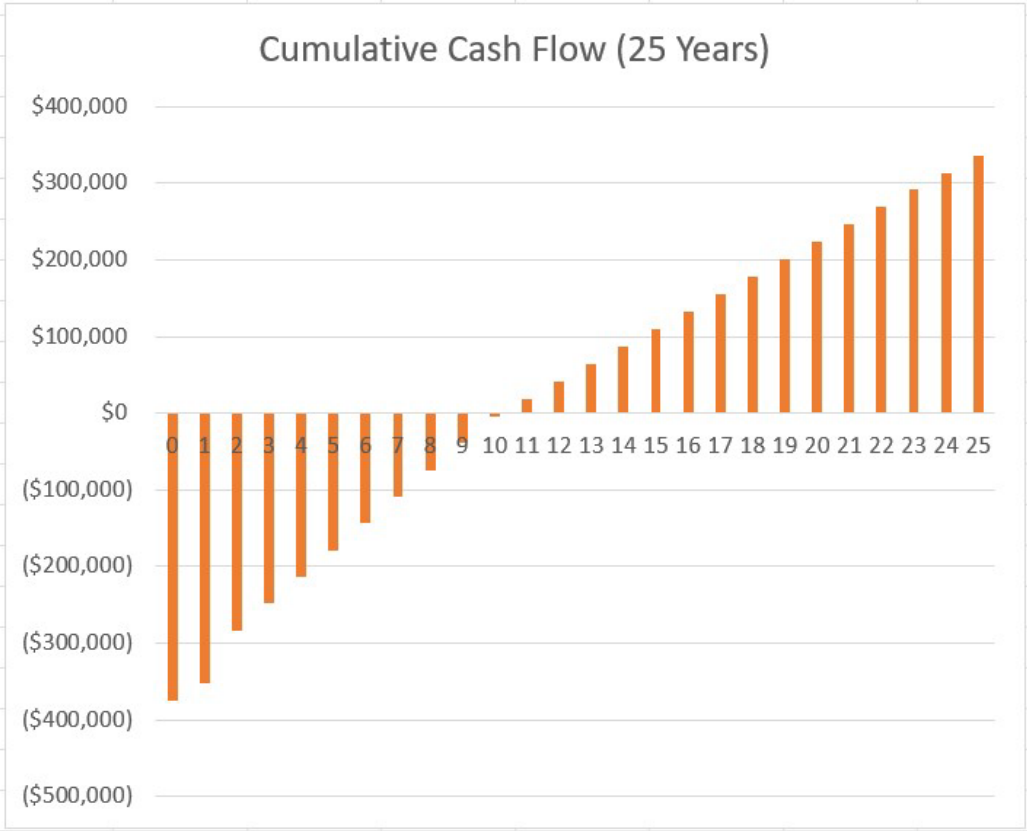
Calculation
55,000 kWh * 10% * 75% area = 4,125
55,000 kWh * 70% * 25% area = 9,625



Retail Electricity Rate	0.232	$/kWh	

	Rooftop	Façade	Total
Year one production	84145	13800	97945
Total Cost	259500	229400	488900
NY-SUN Incentive	60000	53000	113000
Upfront Cost	199500	176400	-375900
Incentives			
Federal Investment Tax Credit	51865	45859	97724
Low-Income Housing Tax Credit	93419	82581	176000
NYC Property Tax Abatement	39900	35280	75180
Total Incentives	185184	163720	348904
Total Cost	14316	12680	26996
Yearly Expected Savings	19521.6	3201.6	22723.2
Yearly Expected Savings	19531	12763	32294

Years	Cost
0	-375900
1	-353177
2	-283396
3	-248506
4	-213615
5	-178725
6	-143834
7	-108944
8	-74053.6
9	-39163.2
10	-4272.76
11	18450.5
12	41173.7
13	63897
14	86620.2
15	109343
16	132067
17	154790
18	177513
19	200236



be ex building energy exchange

NYC LL97 Carbon Emissions Calculator

FIND BUILDING | DEMO

Building Inputs

	Building Type ?	Area (SF)	
1	R-2 (Residential	55,624	X

+ Add Building Type

Utility Inputs

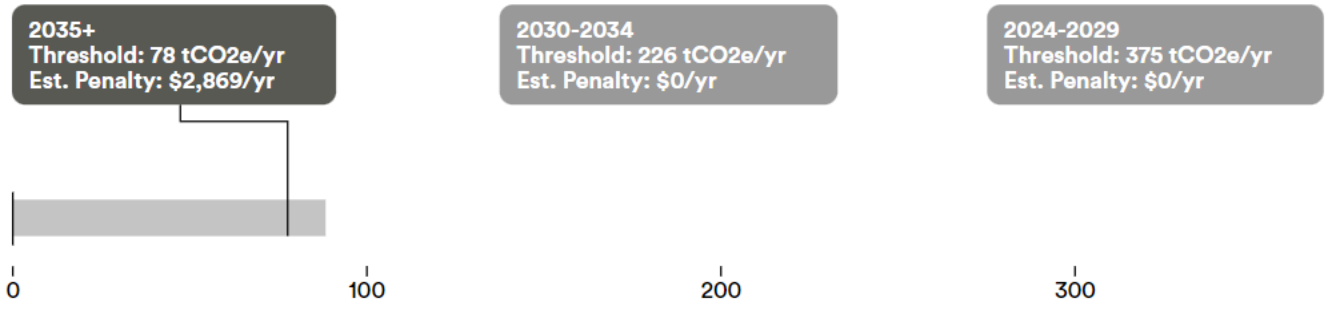
Use Default Rates ?

	$/kWh
Electricity - kWh: 306,545	0.22
Natural Gas - therms	0.997
Steam - mLbs	35
Fuel Oil 2 - gal	1.65
Fuel Oil 4 - gal	$/gal

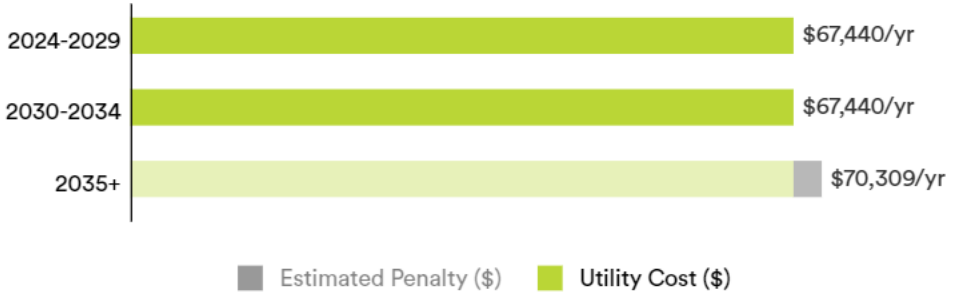
Estimated Carbon Summary

89 tCO2e/yr

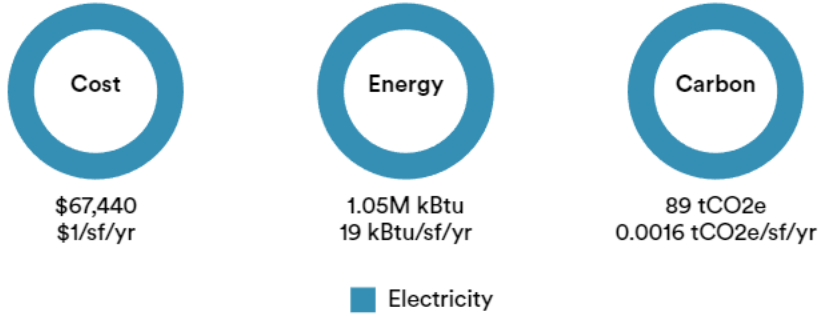
0.0016 tCO2/sf/yr



Estimated Annual Cost Summary



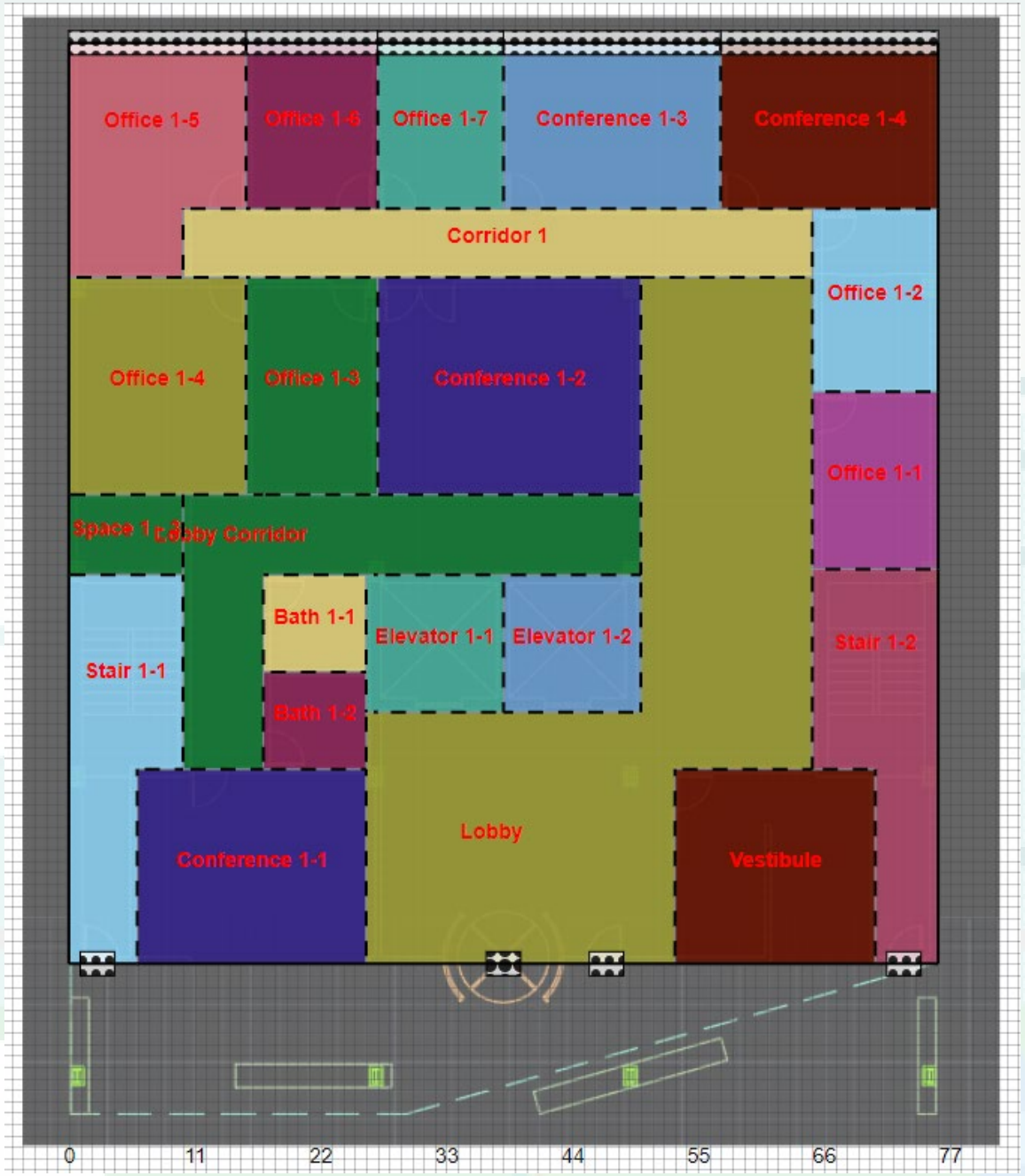
Estimated Building Metrics

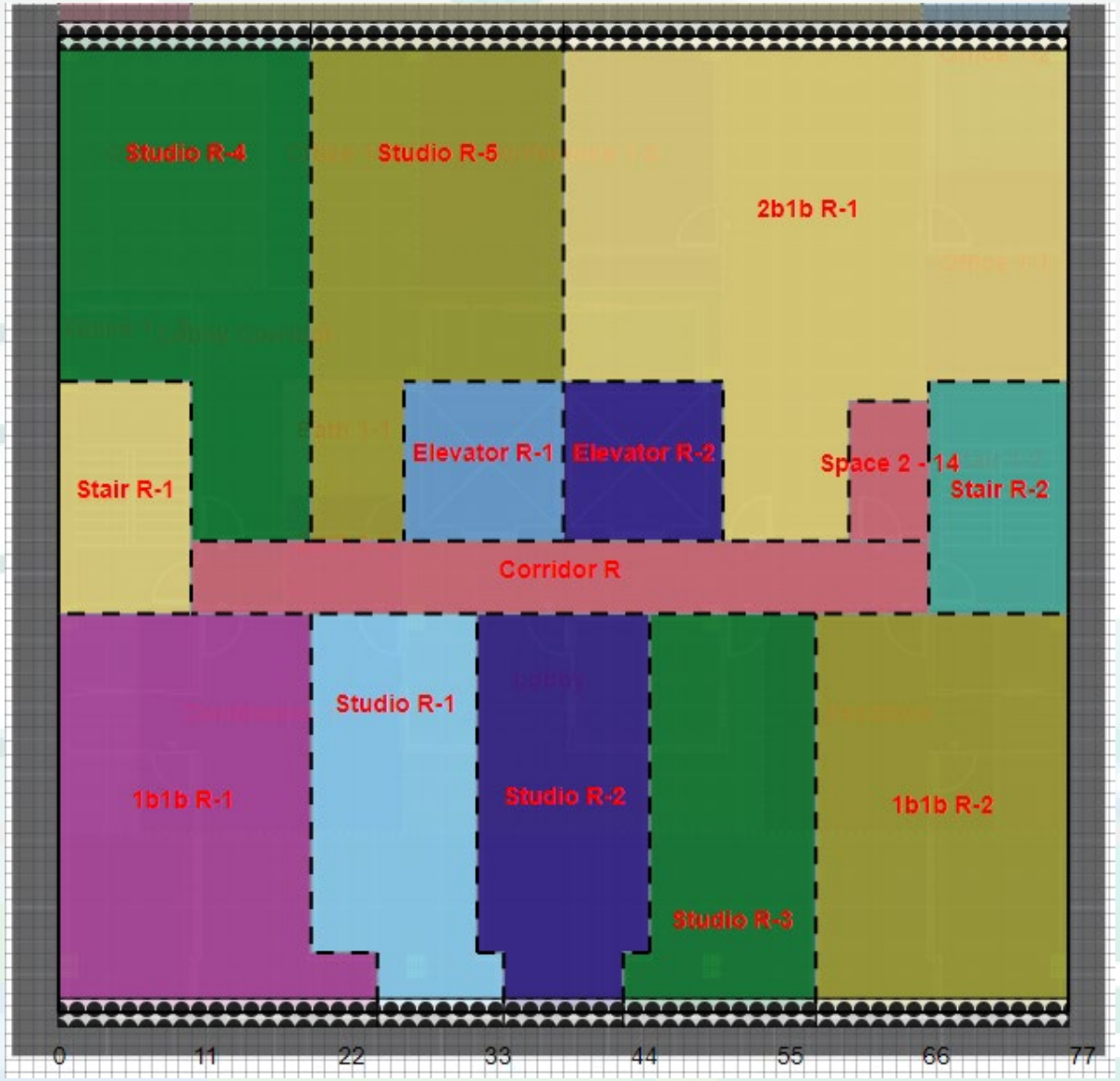


What now? Visit **NYC Accelerator** for free, personalized advisory services to improve building energy efficiency and lower carbon emissions.

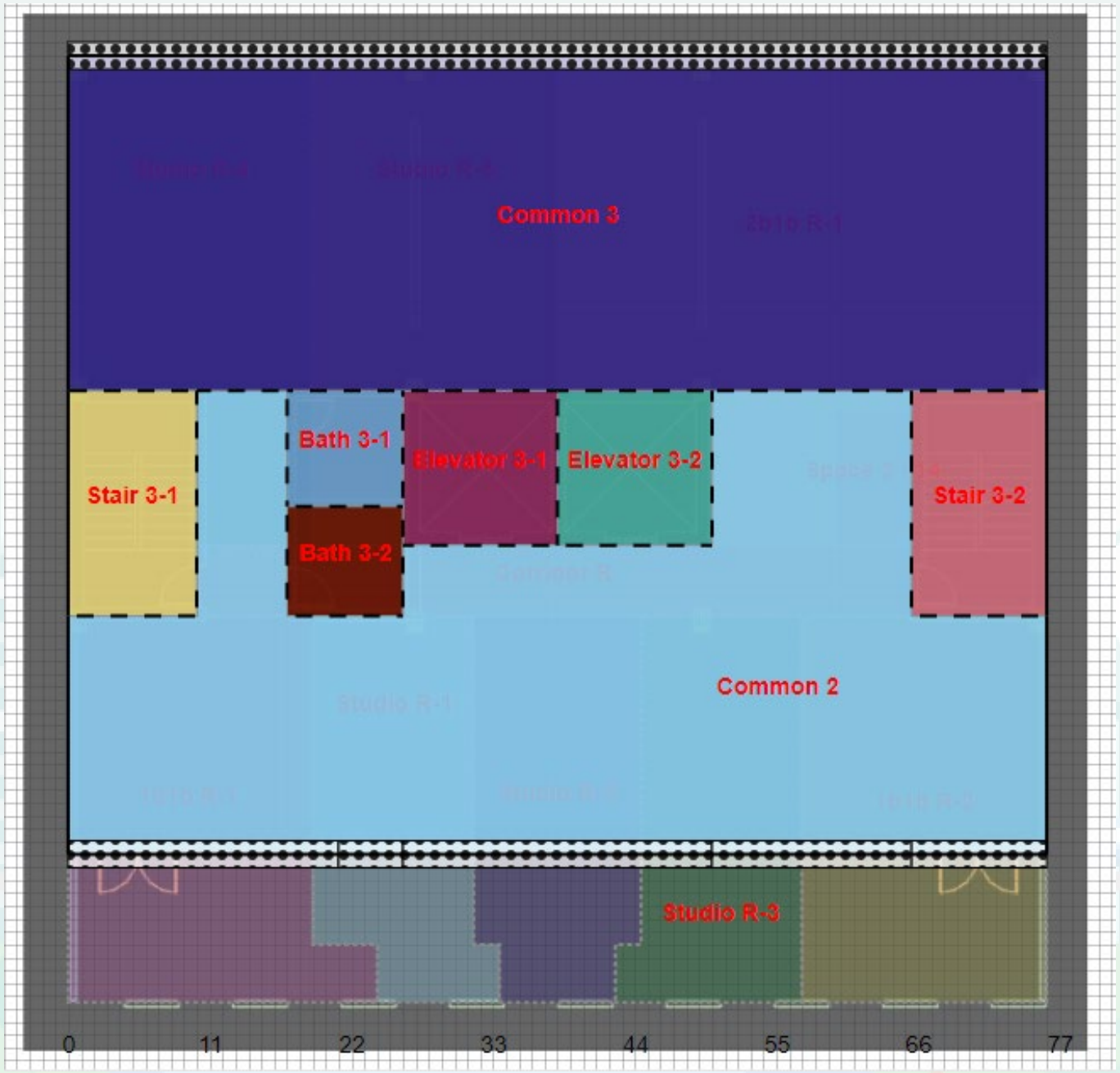
Calculator engine by AKF Group LLC

Zoning

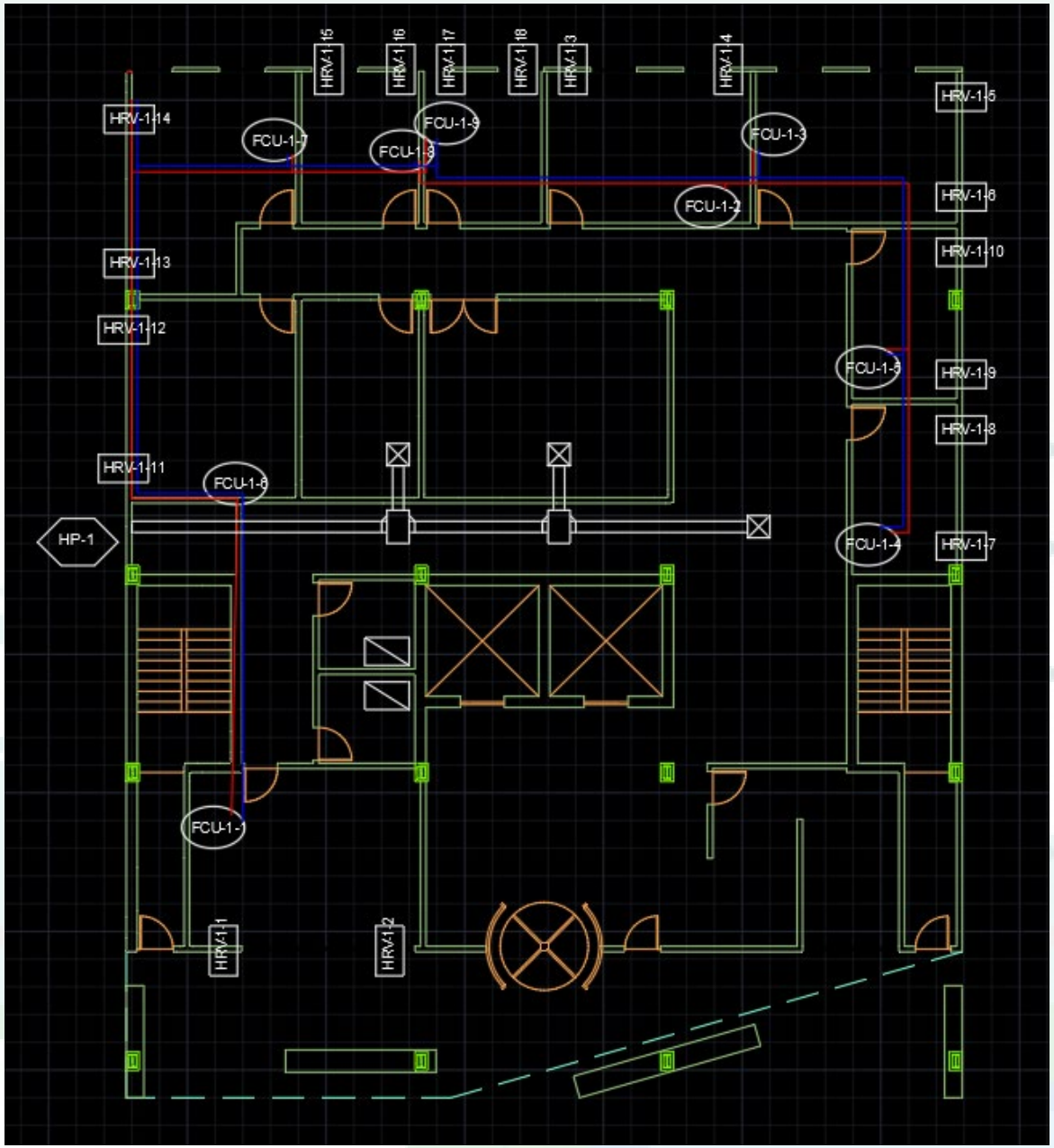

Office 1-5
Office 1-6
Office 1-7
Conference 1-3
Conference 1-4
Corridor 1
Office 1-2
Office 1-4
Office 1-3
Conference 1-2
Office 1-1
Space 1-3
Lobby Corridor
Bath 1-1
Elevator 1-1
Elevator 1-2
Stair 1-2
Stair 1-1
Bath 1-2
Conference 1-1
Lobby
Vestibule
0
11
22
33
44
55
66
77

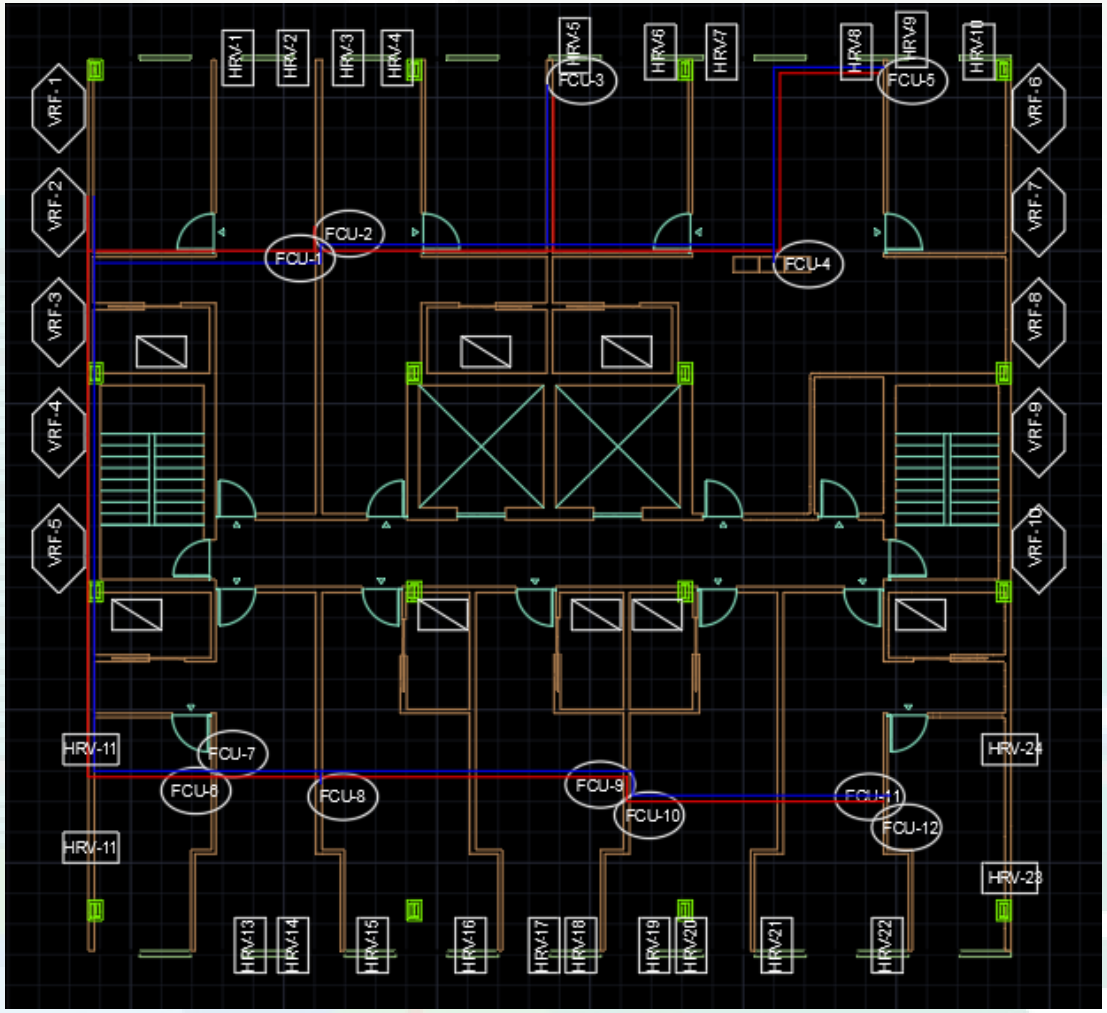

Studio R-4
Studio R-5
2b1b R-1
Stair R-1
Elevator R-1
Elevator R-2
Space 2 - 14
Stair R-2
Corridor R
Studio R-1
1b1b R-1
Studio R-2
1b1b R-2
Studio R-3
0
11
22
33
44
55
66
77

Zoning

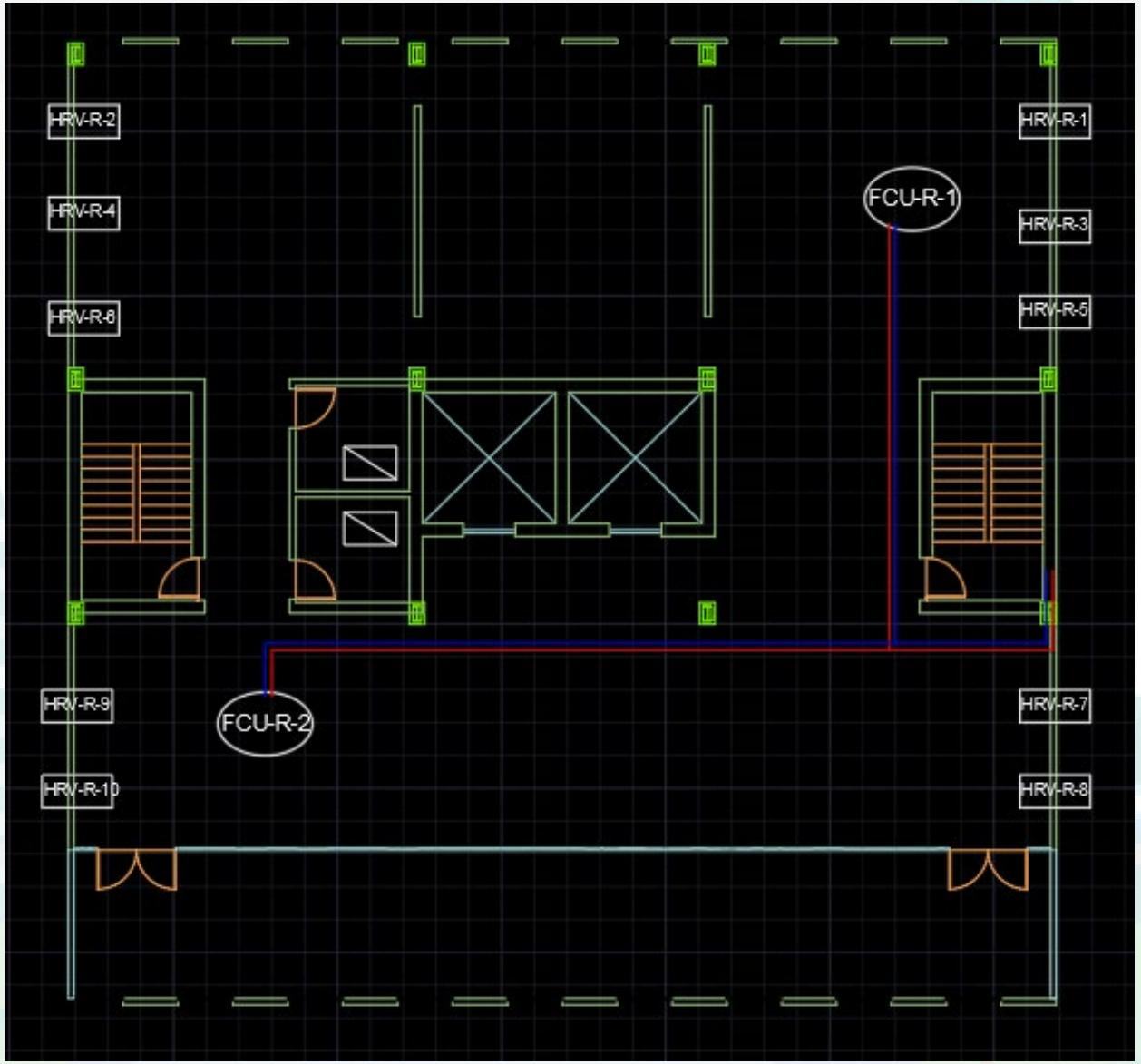

Common 3
Stair 3-1
Bath 3-1
Bath 3-2
Elevator 3-1
Elevator 3-2
Stair 3-2
Common 2
Studio R-3
0
11
22
33
44
55
66
77

Mechanical Plans





Mechanical Plans



Outdoor Unit Heat Pump Schedules

					Capacity		Fan			Dimensions					Indoor Unit		Operating Temperature Range		
Designation on Drawings	Location	Indoor Units Served	Manufacturer	Model #	Cooling (BTUH)	Heating (BTUH)	Airflow Rate (CFM)	Motor Output (kW)	Refrigerant	Height (In)	Width (In)	Depth (in)	Net Weight	Sound Pressure Levels (dB(A))	Total Capacity	Quantity	Cooling	Heating	COP
VRF-1	Floor 2 West Wall	Floor 1 Offices and Conference Rooms (along outer perimeter)	TRANE/MITSUBISHI ELECTRIC	TUMYP 0361AK43(NA/BA)	36,000	42,000	3885	2.8	R410A	52 - 11/16	41 - 11/32	13	267	49/53	50 –130% of Outdoor Unit Capacity	P05-P36 / 1-12	5° to 115° F D.B.	-13° to +59° F W.B.	4
VRF-2	Floor 2 West Wall	Floor 2 Residential Spaces	TRANE/MITSUBISHI ELECTRIC	TUMYP 0361AK43(NA/BA)	36,000	42,000	3885	2.8	R410A	52 - 11/16	41 - 11/32	13	267	49/53	50 –130% of Outdoor Unit Capacity	P05-P36 / 1-12	5° to 115° F D.B.	-13° to +59° F W.B.	4
VRF-3	Floor 2 West Wall	Floor 3 Residential Spaces	TRANE/MITSUBISHI ELECTRIC	TUMYP 0361AK43(NA/BA)	36,000	42,000	3885	2.8	R410A	52 - 11/16	41 - 11/32	13	267	49/53	50 –130% of Outdoor Unit Capacity	P05-P36 / 1-12	5° to 115° F D.B.	-13° to +59° F W.B.	4
VRF-4	Floor 2 West Wall	Floor 4 Residential Spaces	TRANE/MITSUBISHI ELECTRIC	TUMYP 0361AK43(NA/BA)	36,000	42,000	3885	2.8	R410A	52 - 11/16	41 - 11/32	13	267	49/53	50 –130% of Outdoor Unit Capacity	P05-P36 / 1-12	5° to 115° F D.B.	-13° to +59° F W.B.	4
VRF-5	Floor 2 West Wall	Floor 5 Residential Spaces	TRANE/MITSUBISHI ELECTRIC	TUMYP 0361AK43(NA/BA)	36,000	42,000	3885	2.8	R410A	52 - 11/16	41 - 11/32	13	267	49/53	50 –130% of Outdoor Unit Capacity	P05-P36 / 1-12	5° to 115° F D.B.	-13° to +59° F W.B.	4
VRF-6	Floor 2 East Wall	Floor 6 Residential Spaces	TRANE/MITSUBISHI ELECTRIC	TUMYP 0361AK43(NA/BA)	36,000	42,000	3885	2.8	R410A	52 - 11/16	41 - 11/32	13	267	49/53	50 –130% of Outdoor Unit Capacity	P05-P36 / 1-12	5° to 115° F D.B.	-13° to +59° F W.B.	4
VRF-7	Floor 2 East Wall	Floor 7 Residential Spaces	TRANE/MITSUBISHI ELECTRIC	TUMYP 0361AK43(NA/BA)	36,000	42,000	3885	2.8	R410A	52 - 11/16	41 - 11/32	13	267	49/53	50 –130% of Outdoor Unit Capacity	P05-P36 / 1-12	5° to 115° F D.B.	-13° to +59° F W.B.	4
VRF-8	Floor 2 East Wall	Floor 8 Residential Spaces	TRANE/MITSUBISHI ELECTRIC	TUMYP 0361AK43(NA/BA)	36,000	42,000	3885	2.8	R410A	52 - 11/16	41 - 11/32	13	267	49/53	50 –130% of Outdoor Unit Capacity	P05-P36 / 1-12	5° to 115° F D.B.	-13° to +59° F W.B.	4
VRF-9	Floor 2 East Wall	Floor 9 Residential Spaces	TRANE/MITSUBISHI ELECTRIC	TUMYP 0361AK43(NA/BA)	36,000	42,000	3885	2.8	R410A	52 - 11/16	41 - 11/32	13	267	49/53	50 –130% of Outdoor Unit Capacity	P05-P36 / 1-12	5° to 115° F D.B.	-13° to +59° F W.B.	4
VRF-10	Floor 2 East Wall	Rooftop Common Areas	TRANE/MITSUBISHI ELECTRIC	TUMYP0481AK42(NA/BA)	48,000	54,000	3885	3.3	R410A	52 - 11/16	41 - 11/32	13	267	51/54	50 –130% of Outdoor Unit Capacity	P05-P54 / 1-12	5° to 115° F D.B.	-13° to +59° F W.B.	4

Heat Pump with DOAS

					Fan				Refrigerant			
Designation on Drawings	Location	Location Served	Manufacturer	Model #	Capacity (BTUH)	Outdoor Fan FL (Amps)	Fan HP	Fan Dia (In)	Dimensions H x W x D Crated (In)	Refrigerant R-410A	Liquid (High Pressure) (In)	Gas (Low Pressure) (In)
HP-1	First Floor Outdoors	Lobby, Office 3, Conference Room 2	TRANE/MITSUBISHI ELECTRIC	4TWR5018H1000A	18000	0.54	44573	19.1	30.1 x 30 x 26.7	6 lbs	3/8 Flare	3/4 Flare

Heat Recovery Ventilators Schedule

Designation on Drawings	Manufacturer	Model #	Efficiency	Flow Rate	Power Consumption (W)	Supply Voltage/Frequency	Humidity Recovery	Measuring Surface Sound Pressure Level (dB)	Standard Sound Pressure Difference D_n,W,open	Length	Core Hole Diameter
HRV	Lunos	LUNOS e2 HRV	90.6	18/ 31/ 38 m³/h	1,4/ 2,8/ 3,3	12V DC	20-30%	16,5/ 19,5/ 26	42 dB	243 mm	162 mm

Indoor Unit Schedules

					Capacity		Dimensions					Refrigerant Pipe Dimensions		
Designation on Drawings	Location	Manufacturer	Model #	Type	Cooling (BTUH)	Heating (BTUH)	Height (In)	Width (In)	Depth (in)	Airflow Rate (CFM)	Air Filter	Liquid (High Pressure)	Gas (Low Pressure)	Sound Pressure Levels (dB(A))
FCU-1-1	Conference 1	TRANE/MITSUBISHI ELECTRIC	TPKFYP006LM140A	Wall Mounted	6000	6700	11 - 25/32	30-7/16	9 - 11/32	141-155-173-191	PP Honeycomb	1/4 Flare	1/2 Flare	22-26-29-31
FCU-1-2	Conference 3	TRANE/MITSUBISHI ELECTRIC	TPKFYP006LM140A	Wall Mounted	6000	6700	11 - 25/32	30-7/16	9 - 11/32	141-155-173-191	PP Honeycomb	1/4 Flare	1/2 Flare	22-26-29-31
FCU-1-3	Conference 4	TRANE/MITSUBISHI ELECTRIC	TPKFYP006LM140A	Wall Mounted	6000	6700	11 - 25/32	30-7/16	9 - 11/32	141-155-173-191	PP Honeycomb	1/4 Flare	1/2 Flare	22-26-29-31
FCU-1-4	Office 1	TRANE/MITSUBISHI ELECTRIC	TPKFYP006LM140A	Wall Mounted	6000	6700	11 - 25/32	30-7/16	9 - 11/32	141-155-173-191	PP Honeycomb	1/4 Flare	1/2 Flare	22-26-29-31
FCU-1-5	Office 2	TRANE/MITSUBISHI ELECTRIC	TPKFYP006LM140A	Wall Mounted	6000	6700	11 - 25/32	30-7/16	9 - 11/32	141-155-173-191	PP Honeycomb	1/4 Flare	1/2 Flare	22-26-29-31
FCU-1-6	Office 4	TRANE/MITSUBISHI ELECTRIC	TPKFYP006LM140A	Wall Mounted	6000	6700	11 - 25/32	30-7/16	9 - 11/32	141-155-173-191	PP Honeycomb	1/4 Flare	1/2 Flare	22-26-29-31
FCU-1-7	Office 5	TRANE/MITSUBISHI ELECTRIC	TPKFYP006LM140A	Wall Mounted	6000	6700	11 - 25/32	30-7/16	9 - 11/32	141-155-173-191	PP Honeycomb	1/4 Flare	1/2 Flare	22-26-29-31
FCU-1-8	Office 6	TRANE/MITSUBISHI ELECTRIC	TPKFYP006LM140A	Wall Mounted	6000	6700	11 - 25/32	30-7/16	9 - 11/32	141-155-173-191	PP Honeycomb	1/4 Flare	1/2 Flare	22-26-29-31
FCU-1-9	Office 7	TRANE/MITSUBISHI ELECTRIC	TPKFYP006LM140A	Wall Mounted	6000	6700	11 - 25/32	30-7/16	9 - 11/32	141-155-173-191	PP Honeycomb	1/4 Flare	1/2 Flare	22-26-29-31
FCU-1	Studio 1	TRANE/MITSUBISHI ELECTRIC	TPKFYP004LM140A	Wall Mounted	4000	4500	11 - 25/32	30-7/16	9 - 11/32	117-124-134-148	PP Honeycomb	1/4 Flare	1/2 Flare	22-24-26-28
FCU-2	Studio 2	TRANE/MITSUBISHI ELECTRIC	TPKFYP004LM140A	Wall Mounted	4000	4500	11 - 25/32	30-7/16	9 - 11/32	117-124-134-148	PP Honeycomb	1/4 Flare	1/2 Flare	22-24-26-28
FCU-3	2b1b	TRANE/MITSUBISHI ELECTRIC	TPFFYP006CS140A	Floor Standing	6000	6700	24 - 13/16	41 - 11/32	8 - 11/16	194-229	Standard Filter	1/4 Flare	1/2 Flare	36-41
FCU-4	2b1b	TRANE/MITSUBISHI ELECTRIC	TPLFYP 008FM140A	Ceiling Cassette	8000	9000	8 - 3/16	22 - 7/16	22 - 71/6	230-265-280	PP Honeycomb	1/4 Flare	1/2 Flare	26-30-33
FCU-5	2b1b	TRANE/MITSUBISHI ELECTRIC	TPFFYP006CS140A	Floor Standing	6000	6700	24 - 13/16	41 - 11/32	8 - 11/16	194-229	Standard Filter	1/4 Flare	1/2 Flare	36-41
FCU-6	1b1b	TRANE/MITSUBISHI ELECTRIC	TPFFYP006CS140A	Floor Standing	6000	6700	24 - 13/16	41 - 11/32	8 - 11/16	194-229	Standard Filter	1/4 Flare	1/2 Flare	36-41
FCU-7	1b1b	TRANE/MITSUBISHI ELECTRIC	TPKFYP004LM140A	Wall Mounted	4000	4500	11 - 25/32	30-7/16	9 - 11/32	117-124-134-148	PP Honeycomb	1/4 Flare	1/2 Flare	22-24-26-28
FCU-8	Studio 3	TRANE/MITSUBISHI ELECTRIC	TPKFYP004LM140A	Wall Mounted	4000	4500	11 - 25/32	30-7/16	9 - 11/32	117-124-134-148	PP Honeycomb	1/4 Flare	1/2 Flare	22-24-26-28
FCU-9	Studio 4	TRANE/MITSUBISHI ELECTRIC	TPKFYP004LM140A	Wall Mounted	4000	4500	11 - 25/32	30-7/16	9 - 11/32	117-124-134-148	PP Honeycomb	1/4 Flare	1/2 Flare	22-24-26-28
FCU-10	Studio 5	TRANE/MITSUBISHI ELECTRIC	TPKFYP004LM140A	Wall Mounted	4000	4500	11 - 25/32	30-7/16	9 - 11/32	117-124-134-148	PP Honeycomb	1/4 Flare	1/2 Flare	22-24-26-28
FCU-11	1b1b	TRANE/MITSUBISHI ELECTRIC	TPKFYP004LM140A	Wall Mounted	4000	4500	11 - 25/32	30-7/16	9 - 11/32	117-124-134-148	PP Honeycomb	1/4 Flare	1/2 Flare	22-24-26-28
FCU-12	1b1b	TRANE/MITSUBISHI ELECTRIC	TPFFYP006CS140A	Floor Standing	6000	6700	24 - 13/16	41 - 11/32	8 - 11/16	194-229	Standard Filter	1/4 Flare	1/2 Flare	36-41
FCU-R-1	Rooftop Common Area	TRANE/MITSUBISHI ELECTRIC	TPCFYP030KM140B	Ceiling Suspended	30000	34000	9 - 1/16	63	16 - 3/4	703–777–883–989	PP Honeycomb	3/8 Flare	5/8 Flare	34–37–40–43
FCU-R-2	Rooftop Common Area	TRANE/MITSUBISHI ELECTRIC	TPCFYP030KM140B	Ceiling Suspended	30000	34000	9 - 1/16	63	16 - 3/4	703–777–883–989	PP Honeycomb	3/8 Flare	5/8 Flare	34–37–40–43