Decarb Lunch Series

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PASSIVEHOUSE CANADA
Build better. Feel better.

University of Victoria's Housing and Dining Complex

Thu Jun 13, 2024,
from 12- 1pm PDT
Free Webinar I zebx.org

mood provided by: Alex Lustig
song: Energy

CITY OF VANCOUVER

BC Hydro
Power smart

ZEIC's Building Decarbonization Programs

ZEIC
ZERO EMISSIONS INNOVATION CENTRE

zebx
ZERO EMISSIONS BUILDING EXCHANGE

CLF Carbon Leadership Forum British Columbia

BC Retrofit ACCELERATOR

B2E Building to Electrification Coalition

NearZero

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Systems

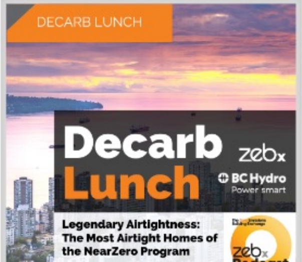
- [ ] Mechanical
- [ ] Building Enclosure
- [ ] Solar Energy
- [ ] Geothermal
- [ ] Domestic Hot Water Heat Pump

Subjects

Decarb Lunch: Nov 2022, The OSO Residential Development

Decarb Lunch: Oct 2022, UBC's Latest & Greatest: Passive House, All-Electric and Solar

Decarb Lunch: Sep 2022, Getting Unstuck: Homeowner and Contractor perspectives on home electrification



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Step Codes monthly newsletter

WINNING PROJECTS

CLEANBC NET ZERO ENERGY READY CHALLENGE

UVIC STUDENT HOUSING

THE NARROWS

McHardy

OSO

825 PACIFIC STREET

SKEENA RESIDENCE

SFU PARCEL 21

2150 KEITH DRIVE

PEATT COMMONS PHASE 2

CARRINGTON VIEW – BUILDING A

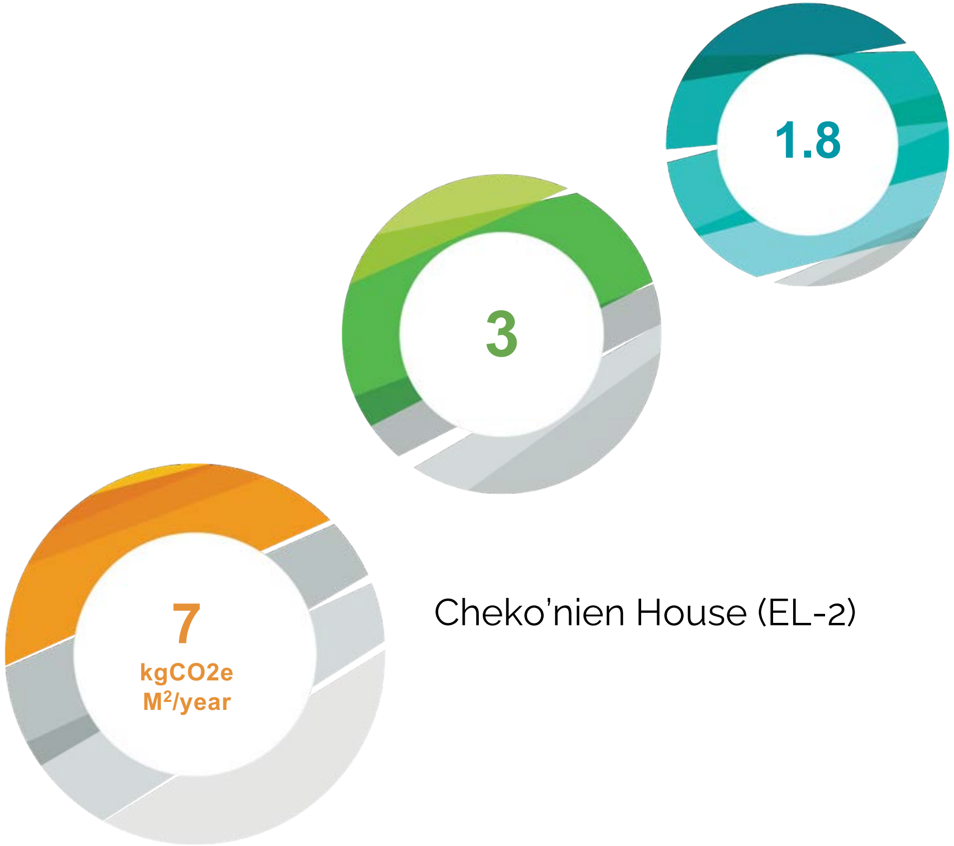
Cheko'nien House

- 8 storeys
- 398 rooms
- 175,000 SF
- dining hall and commercial kitchen
- window-to-wall ratio: 23%
- final energy demand: 610 kWh/m²yr
- GHGI: 6.71 kg CO_2eq/m²yr

Sngequ House

- 11 storeys
- 385 rooms
- 157,000 SF
- window-to-wall ratio: 14%
- final energy demand: 161 kWh/m²yr
- GHGI: 1.77 kg CO_2eq/m²yr

Zero Carbon Step Code for Part 3 Residential Buildings



Sngequ House (EL-4)

Cheko'nien House (EL-2)

Maximum GHG intensity per building per year

Passive House Canada

A national force for building better.

Presented by:

Chris Ballard
CEO

June 13, 2024

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Photo courtesy of Naikoon Contracting, Hemsworth Architecture & Ema Peter Photography

Passive House Canada

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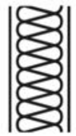
Passive House Canada

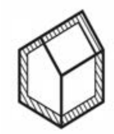
- Passive House Canada is a national, non-profit, building professional association that advocates for and teaches the Passive House high-performance building standard.
- Our mission is to make the International Passive House standard of building performance understood, achievable, and adopted by government, industry, professionals, and the public across Canada through education, advocacy, events, and building projects.
- The Passive House standard has Candian roots
- www.passivehousecanada.com

- Our members are building professionals, trades, contractors, government and manufacturers.
- We are a UN Global Centre of Excellence for High Performance Buildings.
- Our standard is a verifiable, net-zero ready, and ready to meet Canada’s 2030 model building code.
- An open-source standard that lends itself perfectly to modular and offsite construction.

Five Principles of Passive House Design

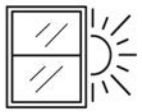


1. Super Insulated

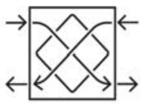


2. Airtight construction

3. Thermal bridge free



4. High-quality Windows



5. Ventilation system

What is the Passive House Standard?

- Passive House is a building standard to ensure buildings of all sizes and forms are super energy efficient, climate resilient, comfortable and healthy.
- It costs about the same as a code-built home and is built to outlast current buildings. Passive House is not a brand name, but a tried-and-true construction concept backed by 30+ years of science that can be applied by anyone, anywhere.
- Passive House new build can achieve a 90% reduction in energy use, and a retrofitted building can hit about 75%.

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Benefits of Passive House Buildings

Healthy

Improved air quality helps reduce the spread of infectious diseases and leads to better health outcomes overall

Comfortable

With no drafts, cold spots, or outside noise, along with excellent air quality, high-end comfort is achieved by design

Durable

Long-lasting (85+ years) certified materials ensures buildings stay efficient longer and require less upkeep

Net-zero Efficient

Uses 90% less energy than compared to code and 75% less energy in retrofit compared to original

Climate Resilient

Superior air quality and air sealing locks in thermal security and clean air during acute climate emergencies.

Low Cost

Going to net-zero has a cost, but the financial return in energy cost savings and other benefits significantly reduce the up-front cost

Thank You

For more information:

Visit	passivehousecanada.com
Email	info@passivehousecanada.com
Call	1-778-265-2744
Socials	@PassiveHouseCan

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Photo Credit - Ema Peter

Introba

ZEBx Decarb Lunch: University of Victoria's Housing and Dining Complex

CHRIS DOEL

Regional Director, Canada

Chris.doel@introba.com

Perkins&Will

University of Victoria

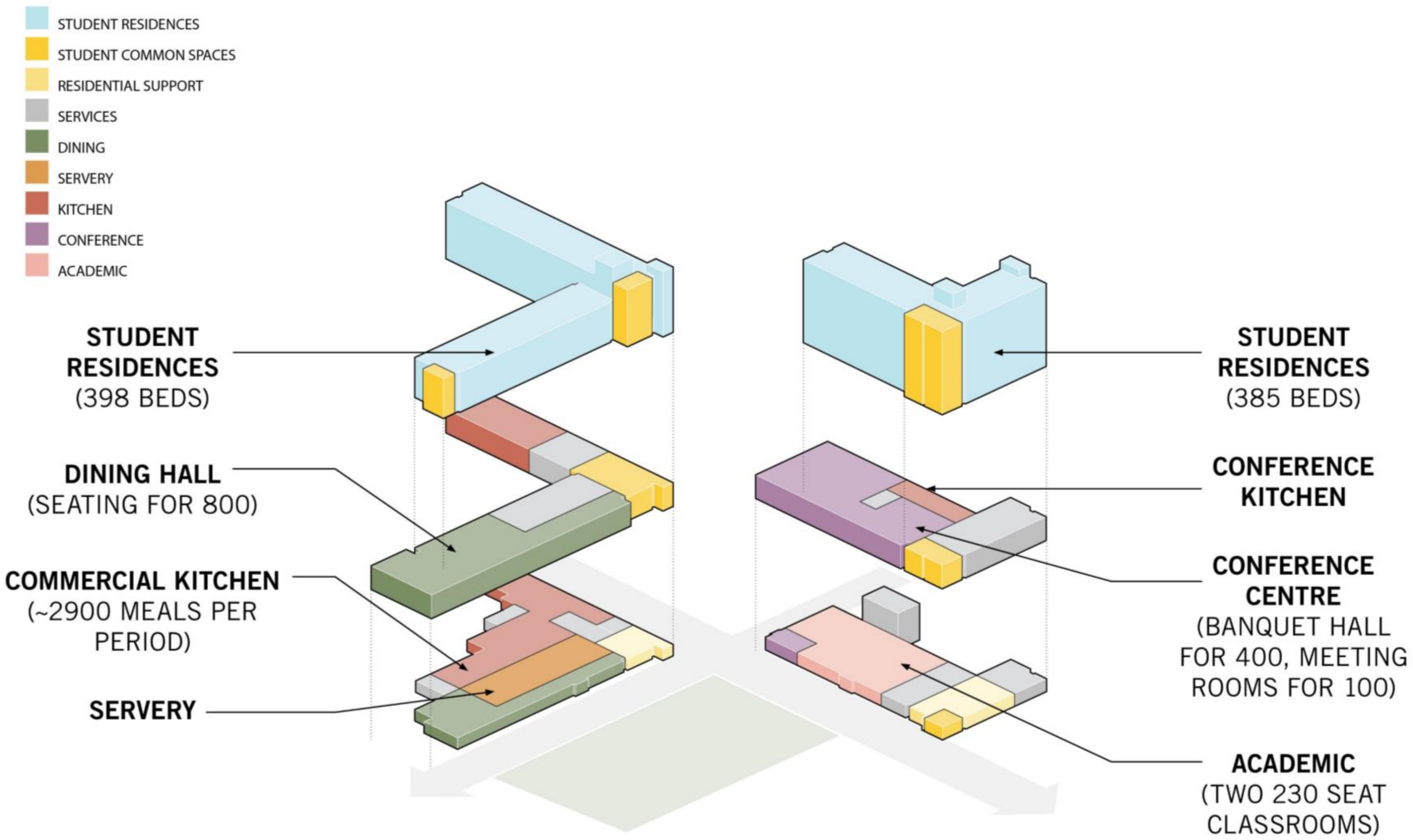
Agenda

1. Project Context and Mechanical System overview
2. Climate Resilience and Thermal Comfort
3. Carbon Reduction Solutions
   - -Low Carbon Kitchen Design
   - -Low Carbon Domestic Hot Water

Introba

Project Context

1. Energy Performance and student experience a key focus
2. Designed to meet Passive house requirements
3. All Electric Building (almost)
4. DHW generated using heat pumps, with back-up from DES
5. High-performance heat recovery ventilation
6. Electric baseboard and VRF for heating and cooling



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Why Consider Resilience and Passive house?

- Public sector requirements as per BC Climate Change Accountability Act
- Alignment with organizational climate goals
- Complementary with other green building standards (Passive House, LEED)
- Net increase in number of beds on campus while reducing energy and carbon use

BRITISH COLUMBIA | cleanBC BETTER BUILDINGS

Climate Resilience and Thermal Comfort

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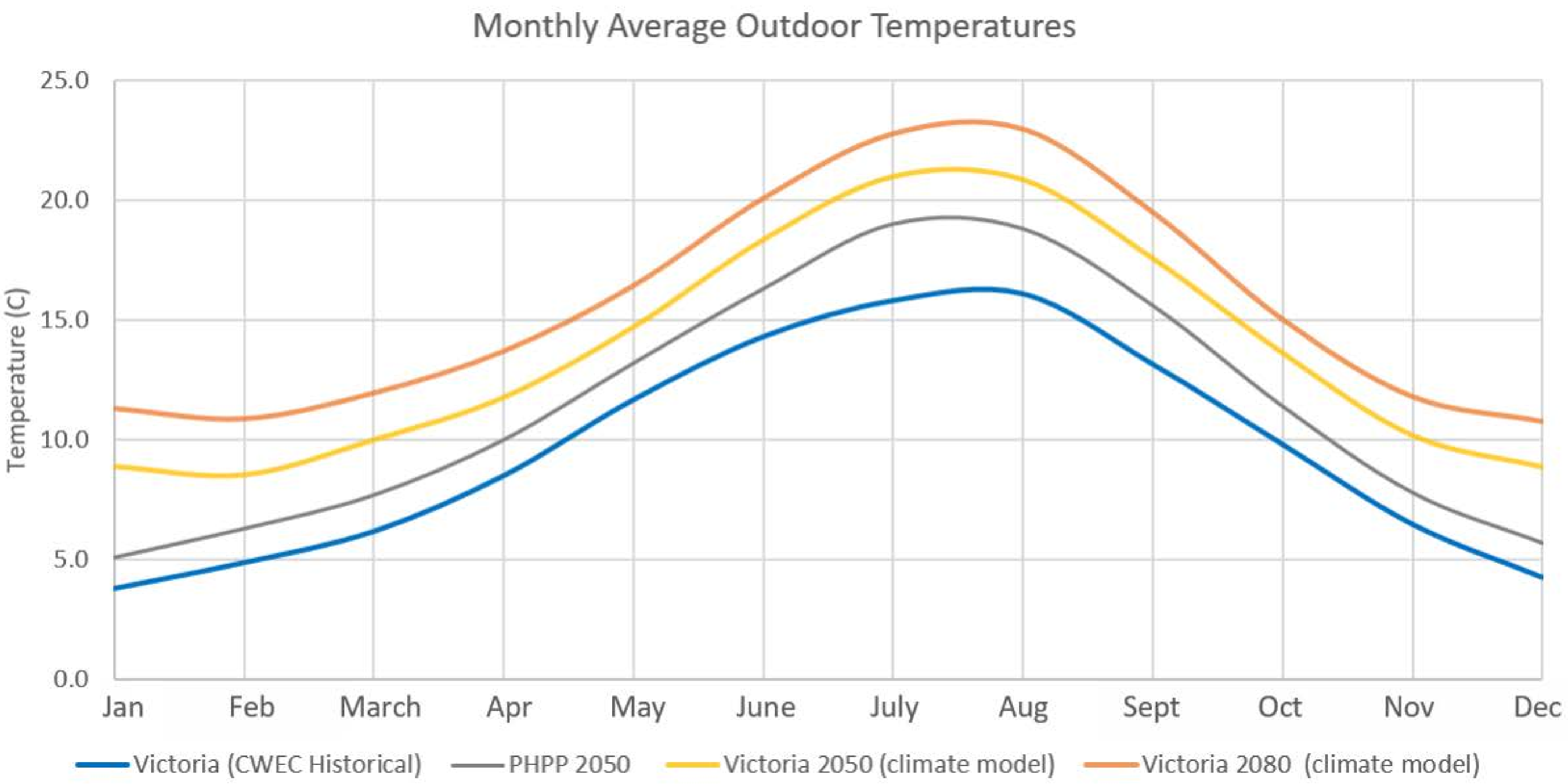
Left: Itkasanmages Right: @jspvisuals/Instagram

Future Climate Modeling



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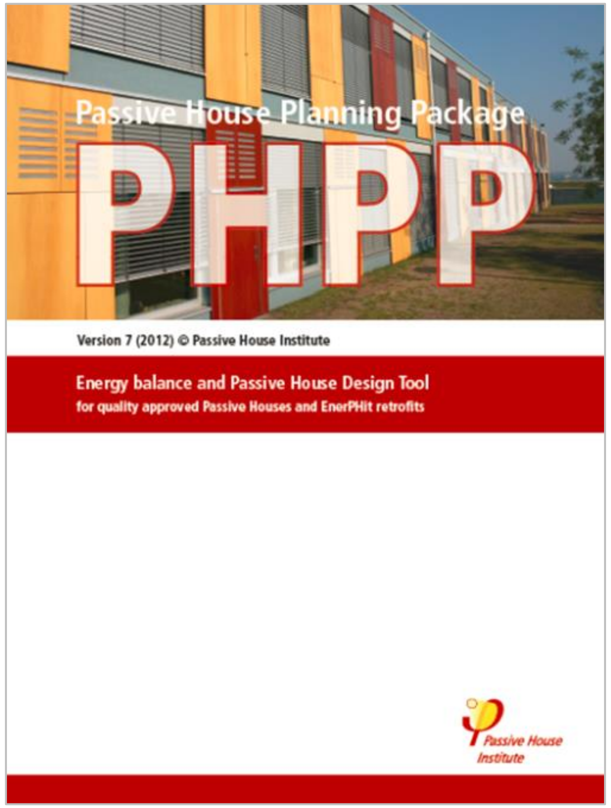
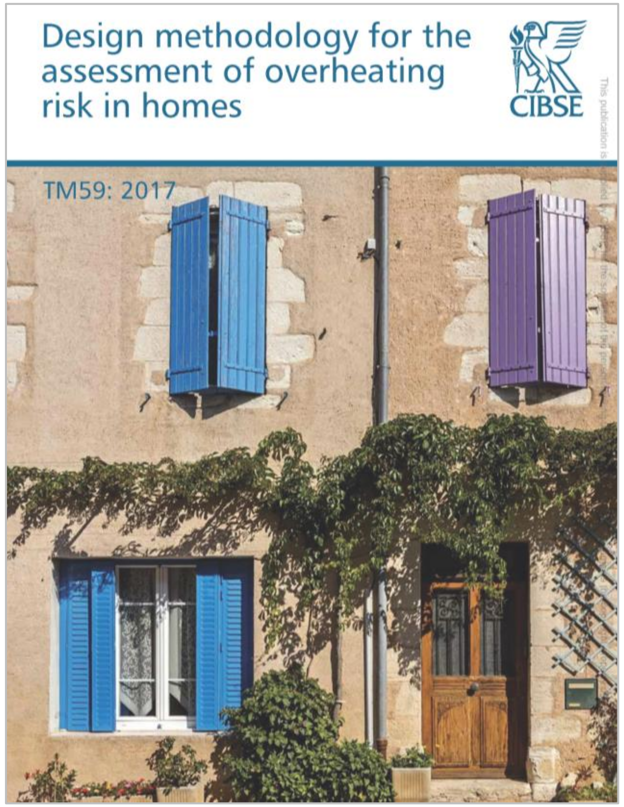
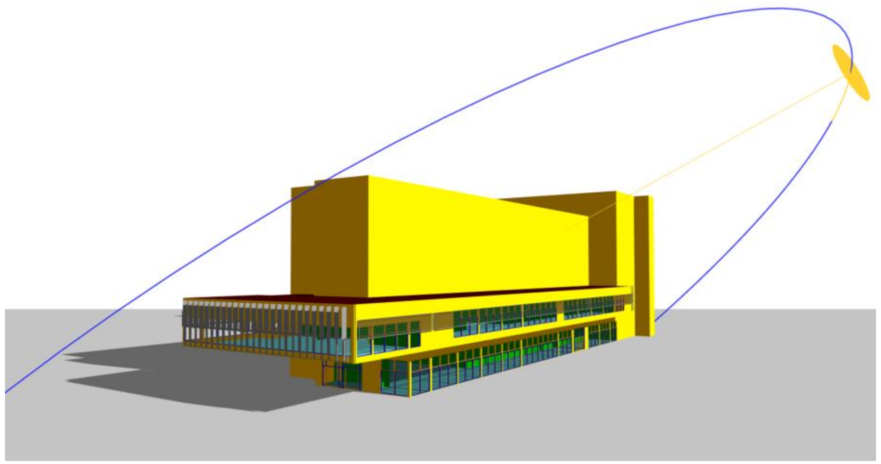
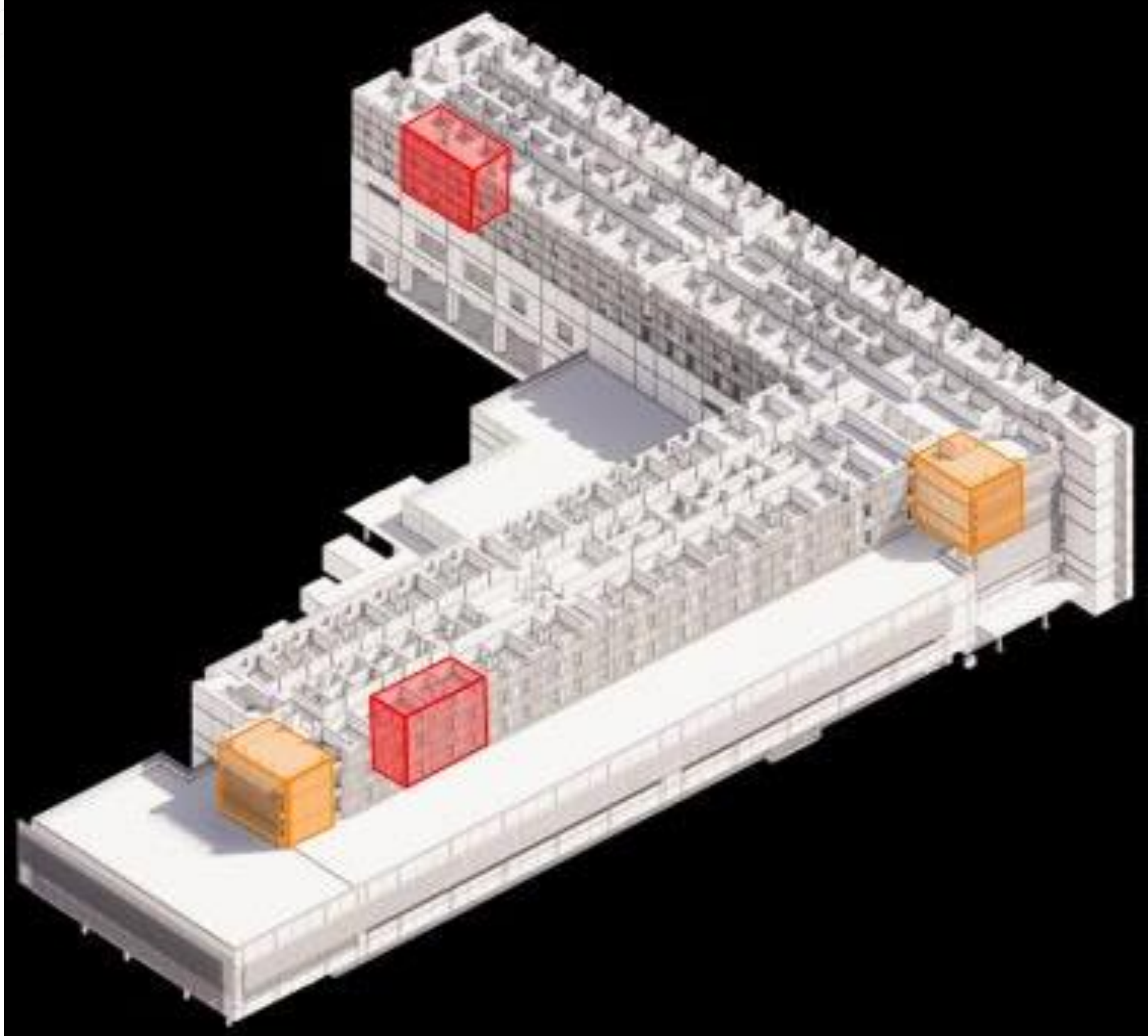
Thermal Comfort Standards - Rigor





Modeling Approach





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Student Bedrooms

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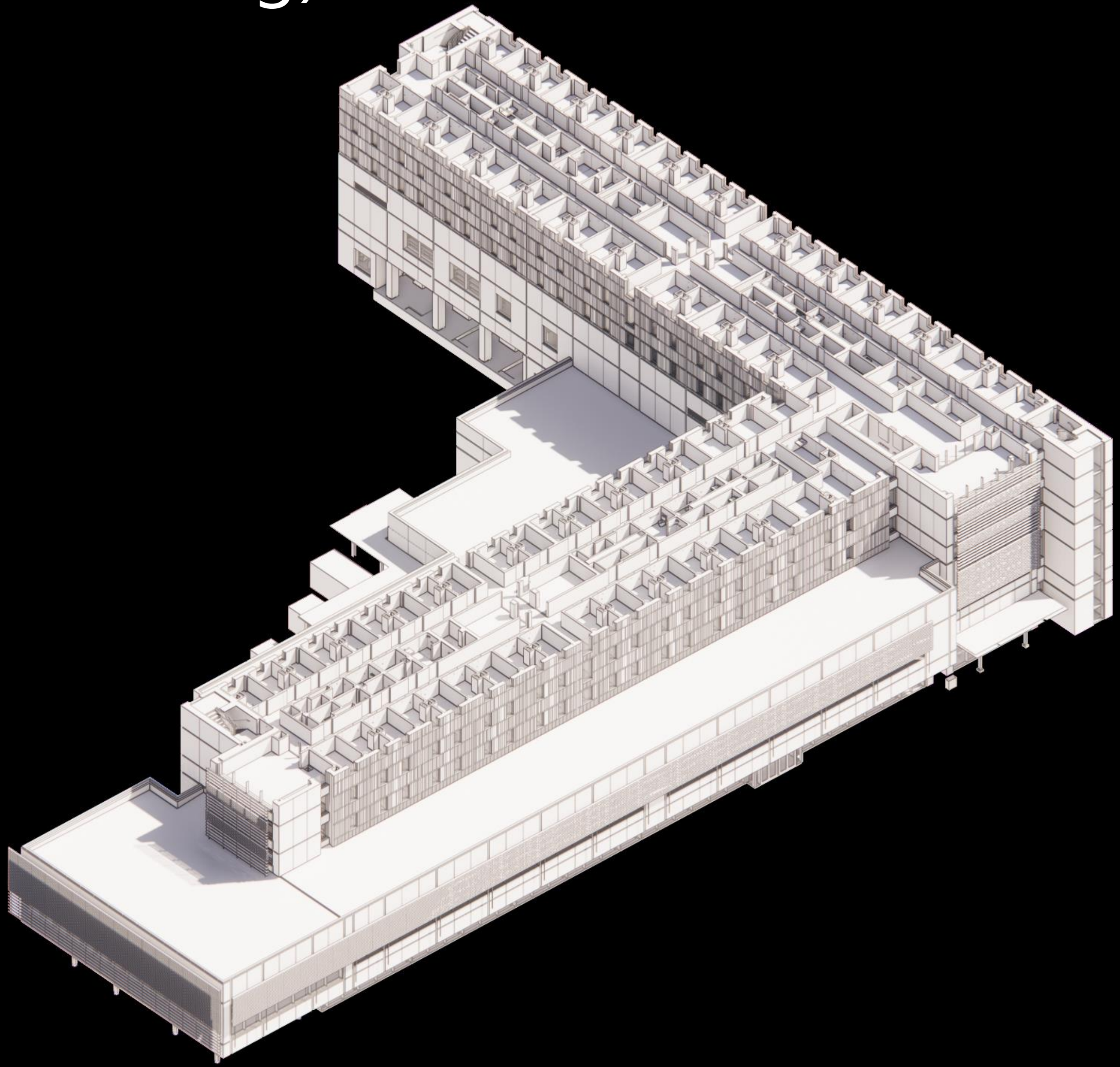
Level 05 (Typical Housing)



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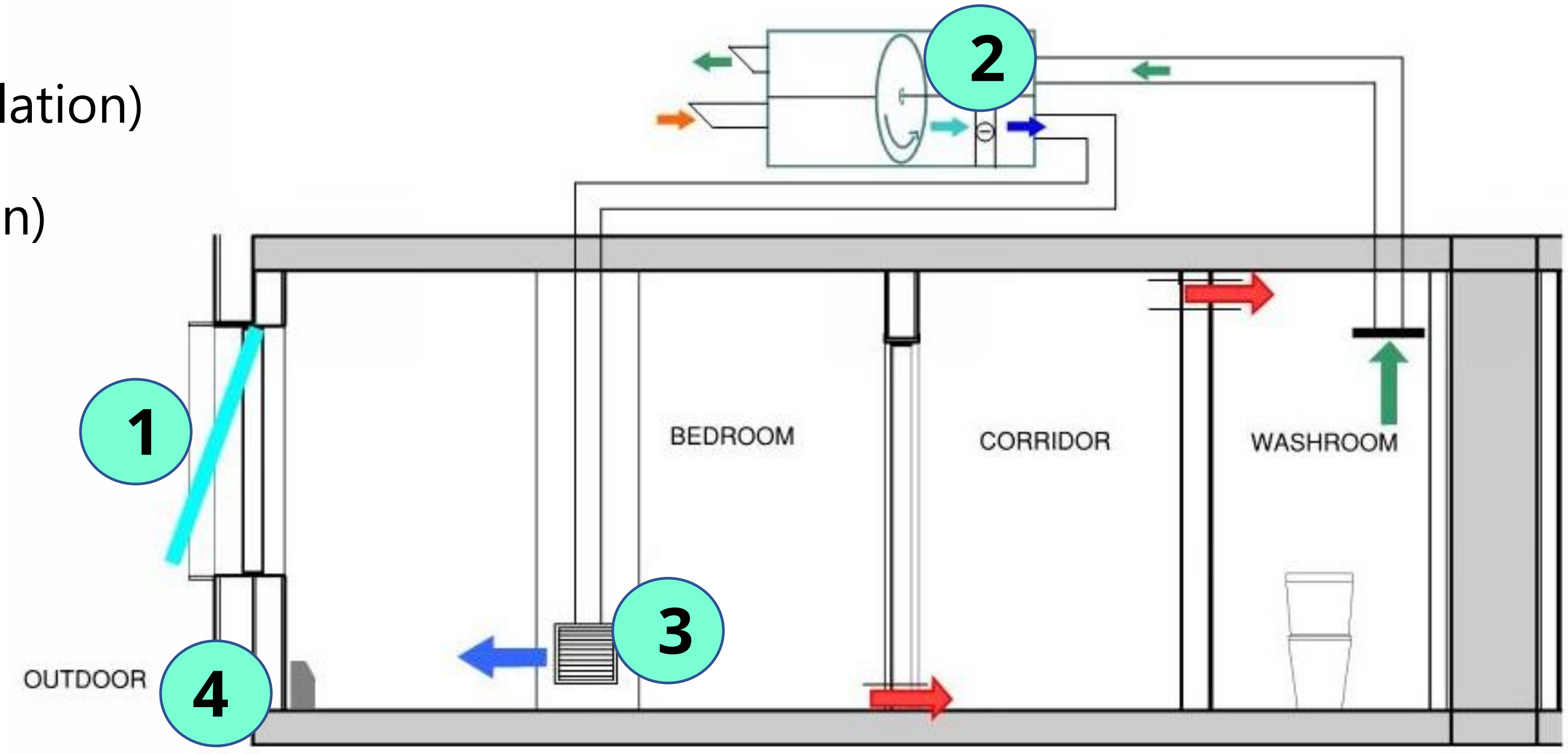
Options

1. Passive Cooling
2. Hybrid Cooling (Minimum Ventilation)
3. Hybrid Cooling (200% Ventilation)
4. Full Mechanical Cooling



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	Thermal Comfort (Line 1 – CIBSE compliance) (Line 2 – PHPP results)			Cost
	Current Climate	2050	2080	
Passive Cooling	✓	X	X	$
	0%	1%	7%	
Hybrid Cooling (Minimum Ventilation)	✓	✓	X	$$
	0%	1%	7%	
Hybrid Cooling (200% Ventilation)	✓	✓	X	$$
	0%	1%	5%	
Mechanical Cooling	✓	✓	✓	$$$
	0%	0%	0%	

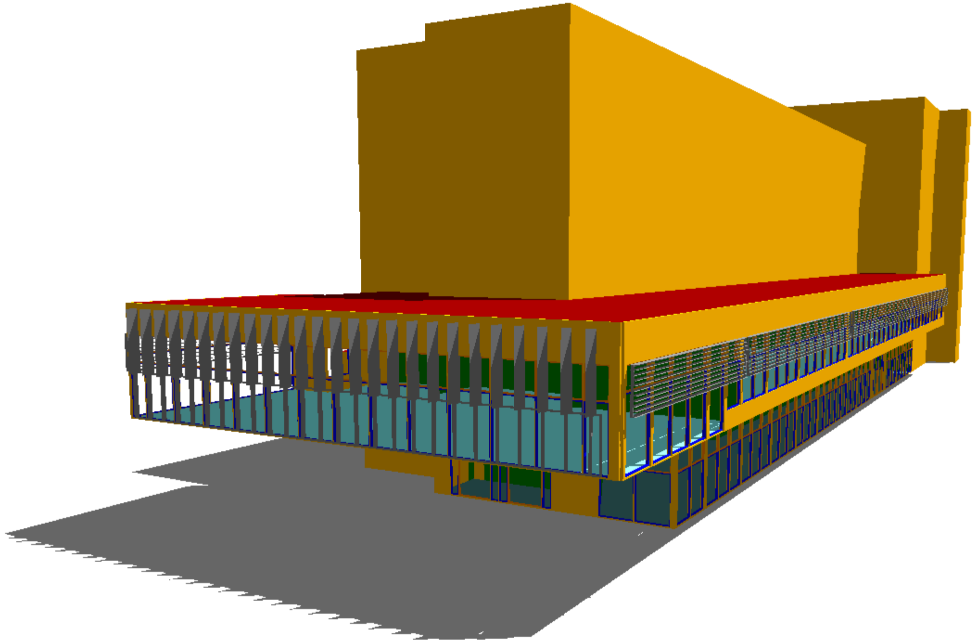
	Thermal Comfort (Line 1 – CIBSE compliance) (Line 2 – PHPP results)			Cost
	Current Climate	2050	2080	
Passive Cooling	✓ 0%	X 1%	X 7%	$
Hybrid Cooling (Minimum Ventilation)	✓ 0%	✓ 1%	X 7%	$$
Hybrid Cooling (200% Ventilation)	✓ 0%	✓ 1%	X 5%	$$
Mechanical Cooling	✓ 0%	✓ 0%	✓ 0%	$$$

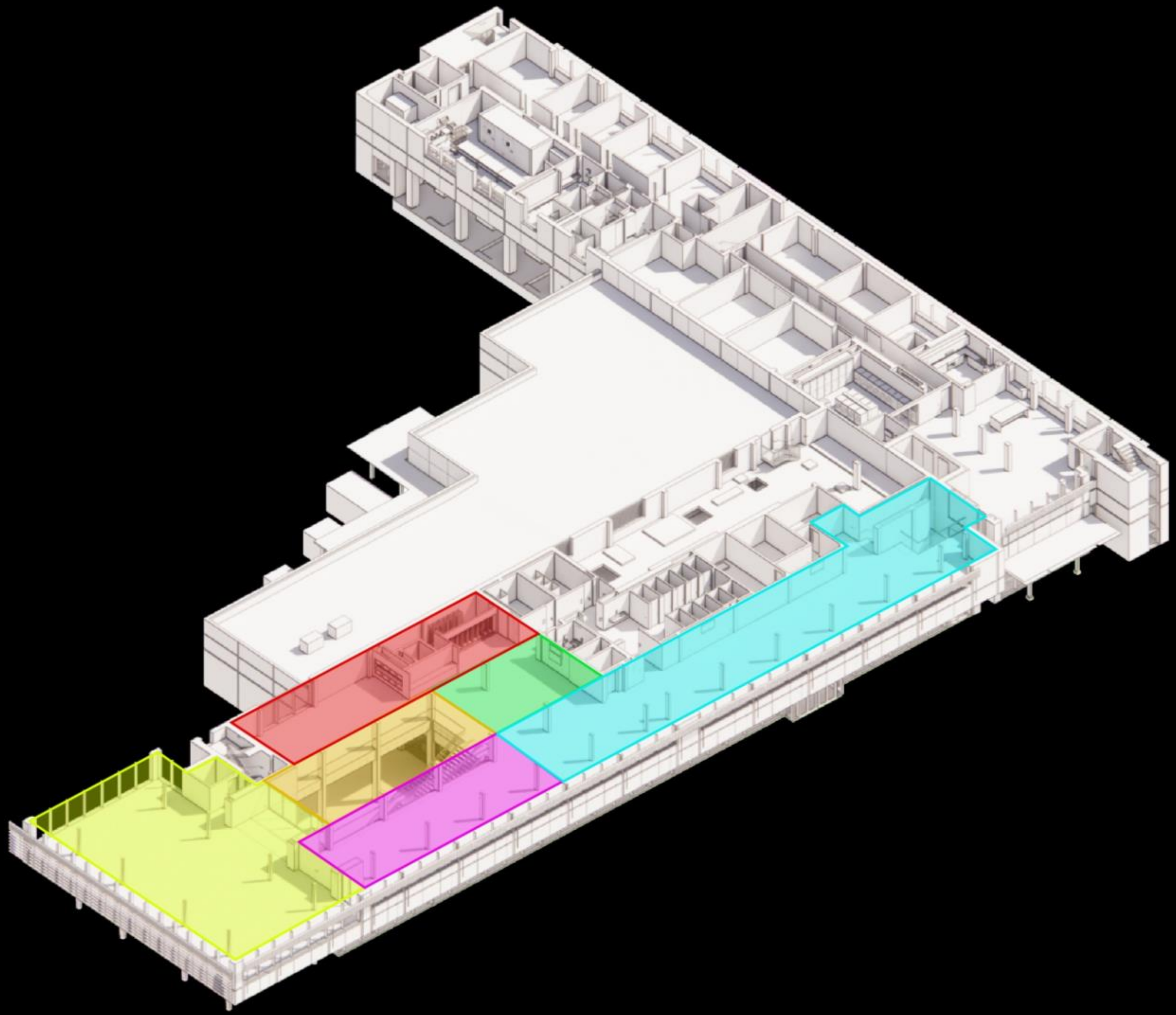
Introba

Dining Hall

Introba

Design Analytics





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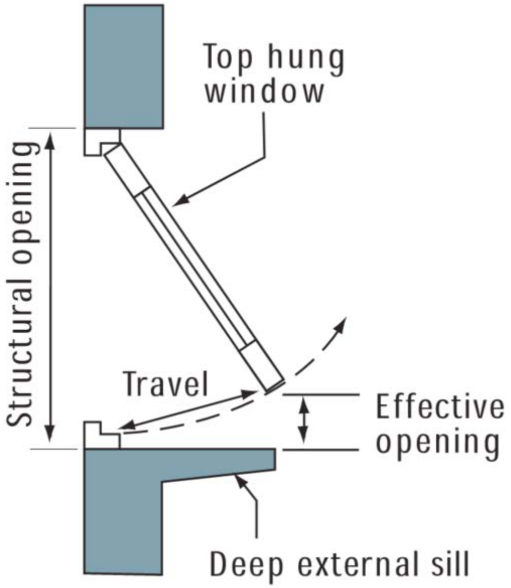
Mix Your Mode



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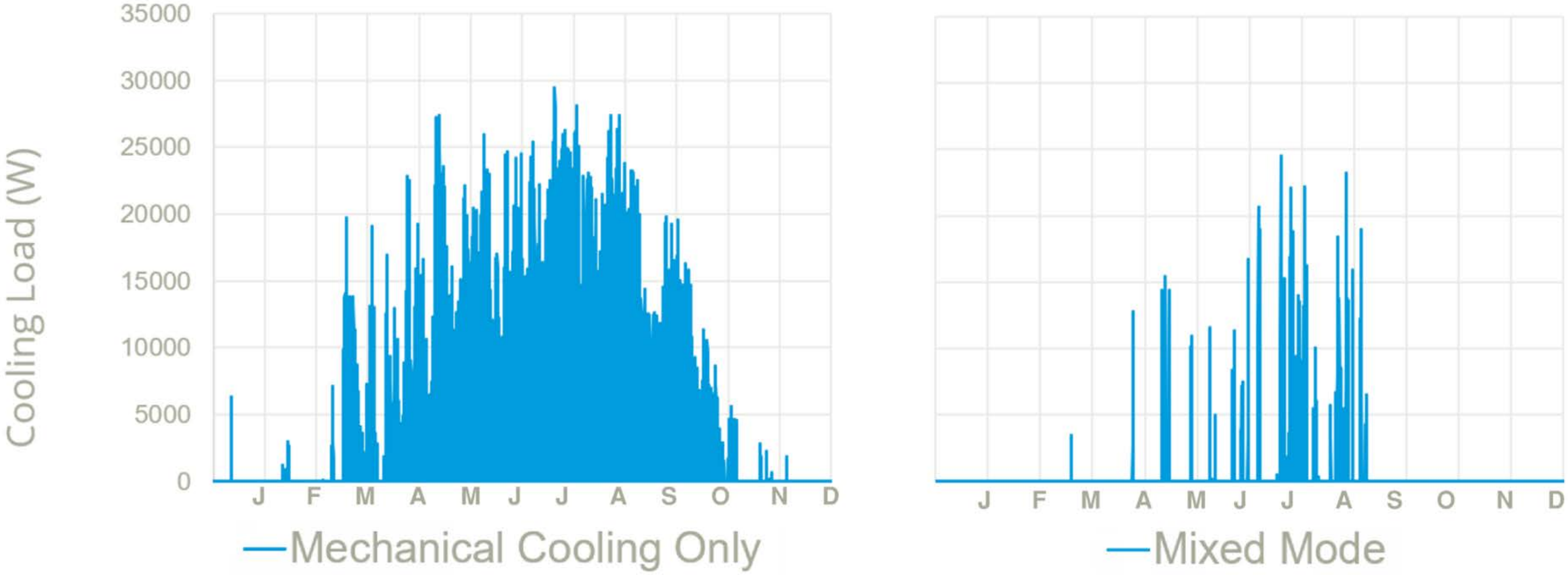
INTEGRAL GROUP

Mix to reduce



~80% REDUCTION in Cooling Energy

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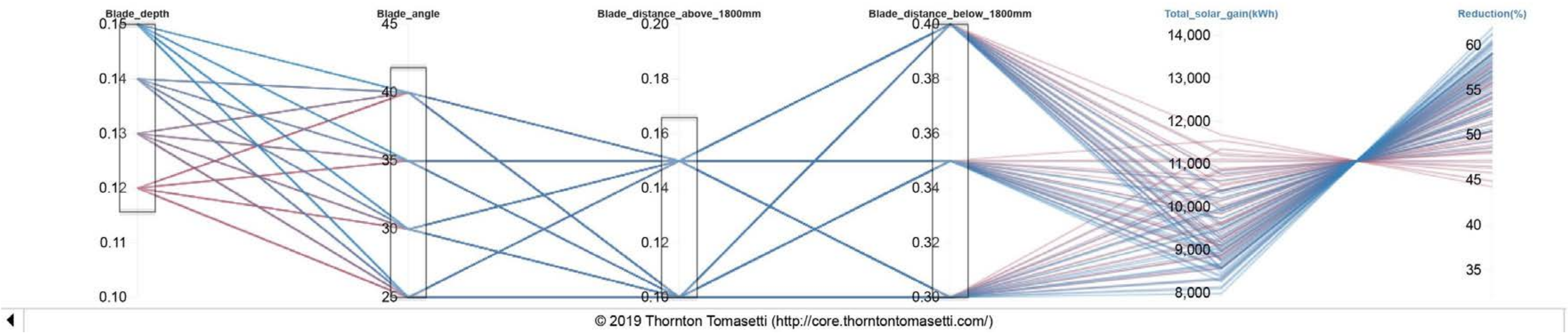
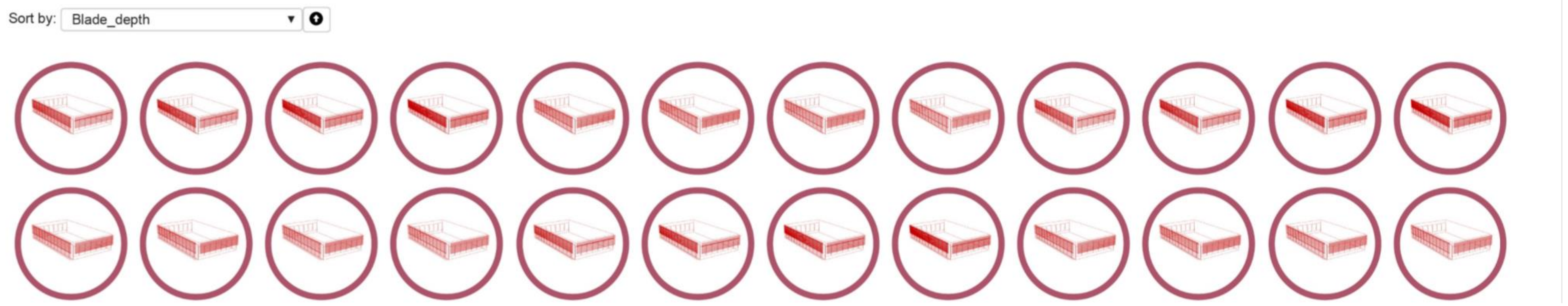
Design Tools





Exterior shading

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Dining Hall – Level 2

Low Carbon
Kitchen Design

Introba

Kitchen Energy Use

Business as Usual

Kitchen type	Good practice	Typical practice	Basis of benchmark	
CIBSE TM50 'Traditional Restaurant'[1]	4.15	4.7	kWh/meal	CIBSE Guide F 'restaurants with bar'[3] kWh/m^2 benchmark is multiplied by the area to support one place setting (m^2) and then divided by number of meals per place setting

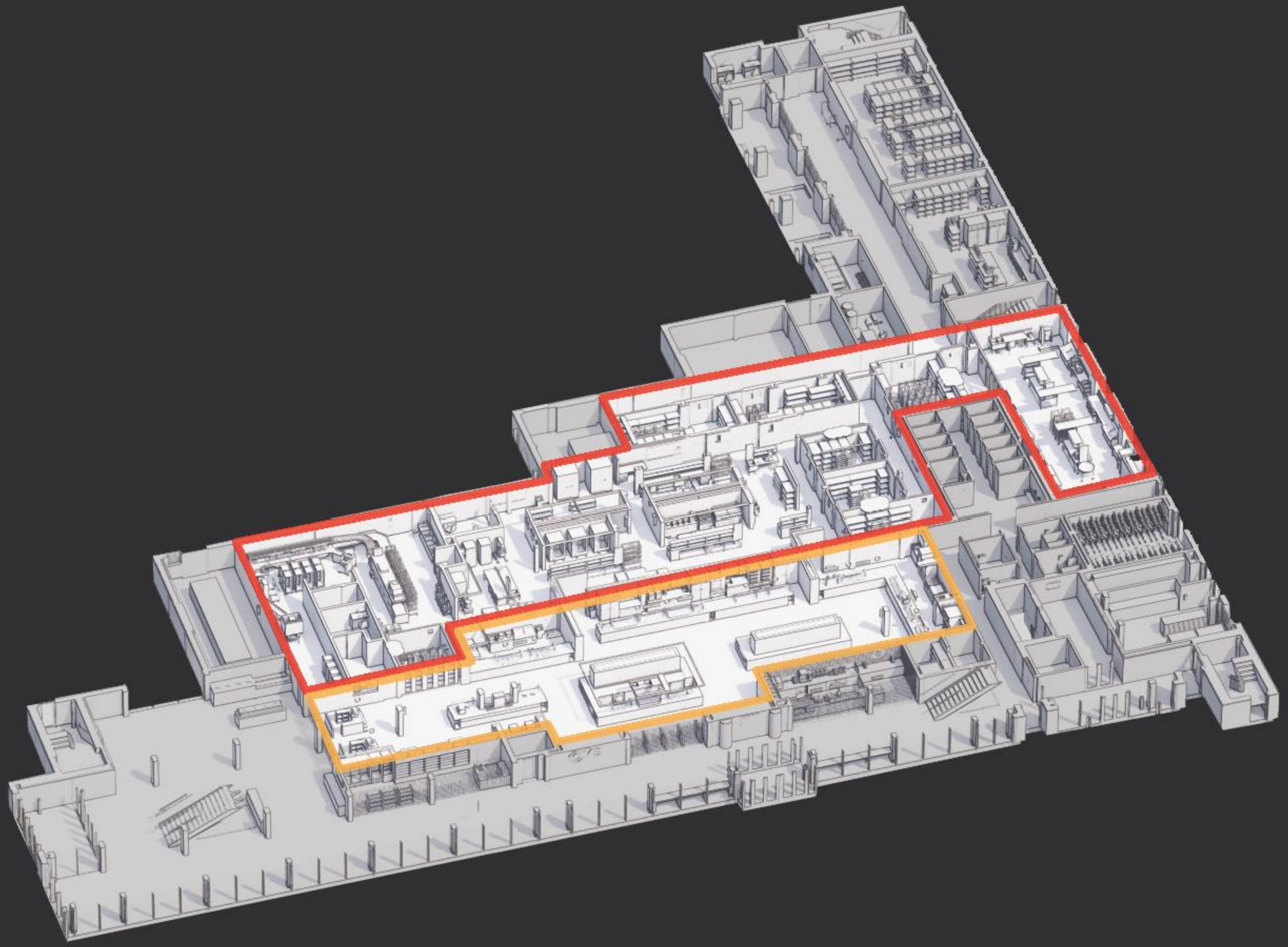
4.15 - 4.7 kWh/meal

Passive House

0.94 kWh/meal

Kitchen Planning

1. Majority of cooking equipment is electric – 83% reduction in emissions
2. Grouping appliances with similar cooking schedules under one hood.
3. Shielding exhaust hoods on 3 sides.
4. Variable volume control on hood exhaust
5. Borrowed ventilation.



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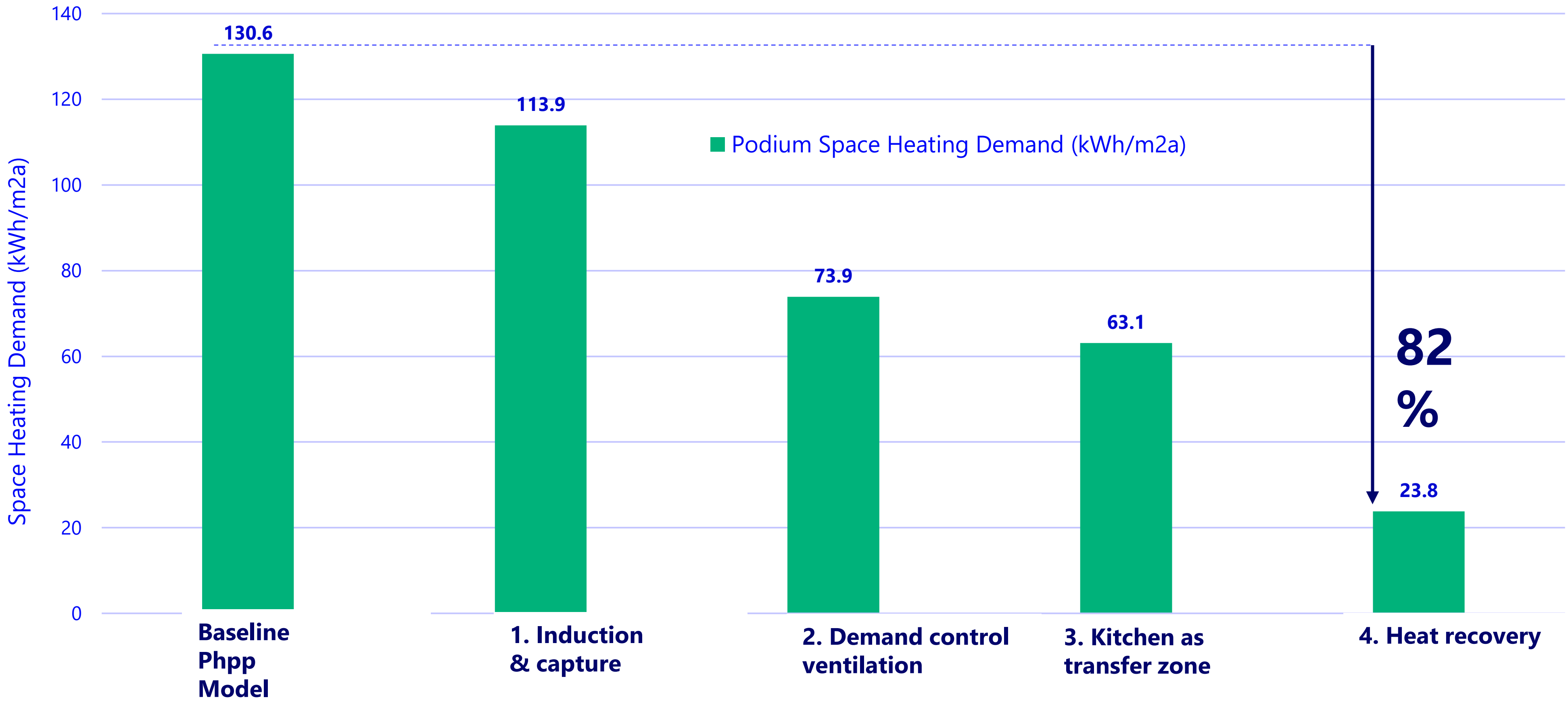
Kitchen Ventilation Strategy Results

Impact of Kitchen Design Efficiency on Space Heating Demand



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Kitchen Exhaust Heat Recovery

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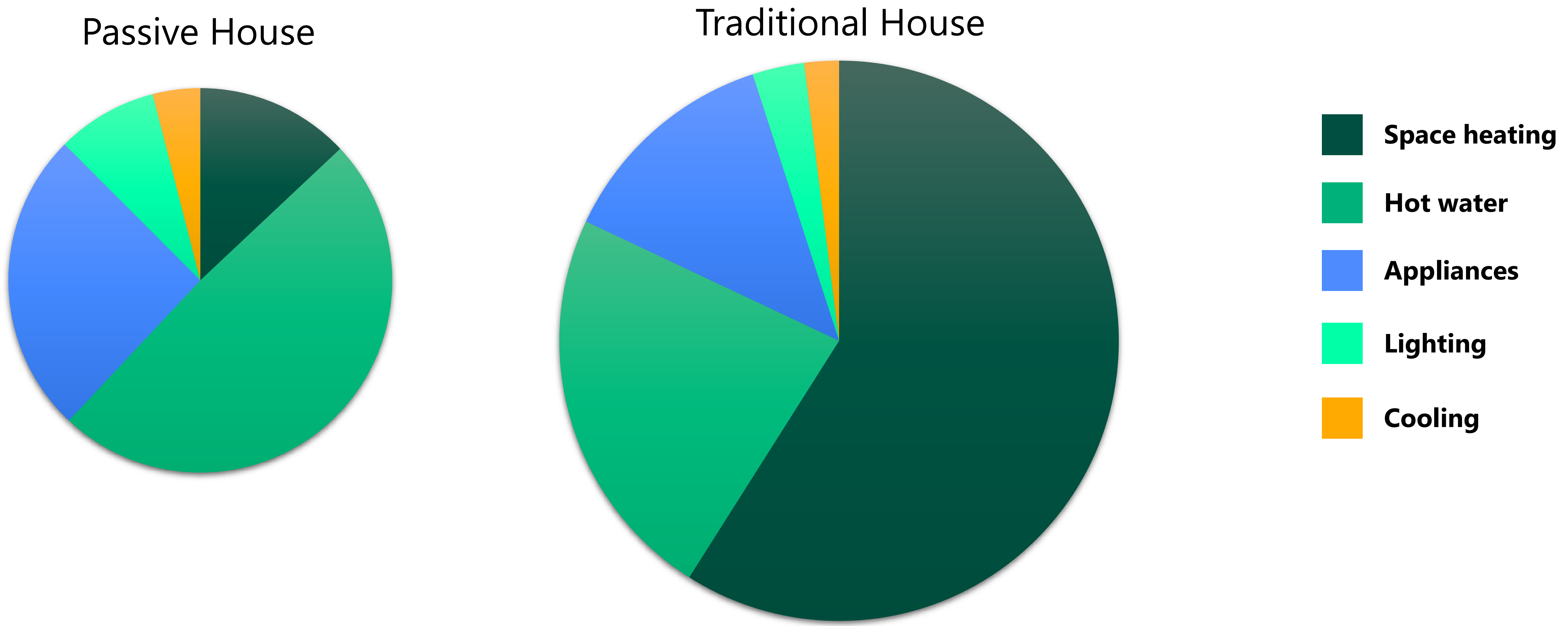
Low Carbon
Domestic Hot Water

Introba

Domestic Hot Water - Load



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Data gathered by the Energy Saving Trust from over 86,000 household

GHG Reduction from ASHP (Electrification of DHW)

88% GHG Reduction

Additional operational cost of $36,336 per year


Introba

JUNE 13TH, 2024

“Tidbits" from an Enclosure, Airtightness Testing, and Passive House Consulting Perspective

Torsten Ely | M.Sc, Dipl-Ing, CPHD
Senior Energy and Sustainability Analyst

RDH

And many more….

Airtightness Testing

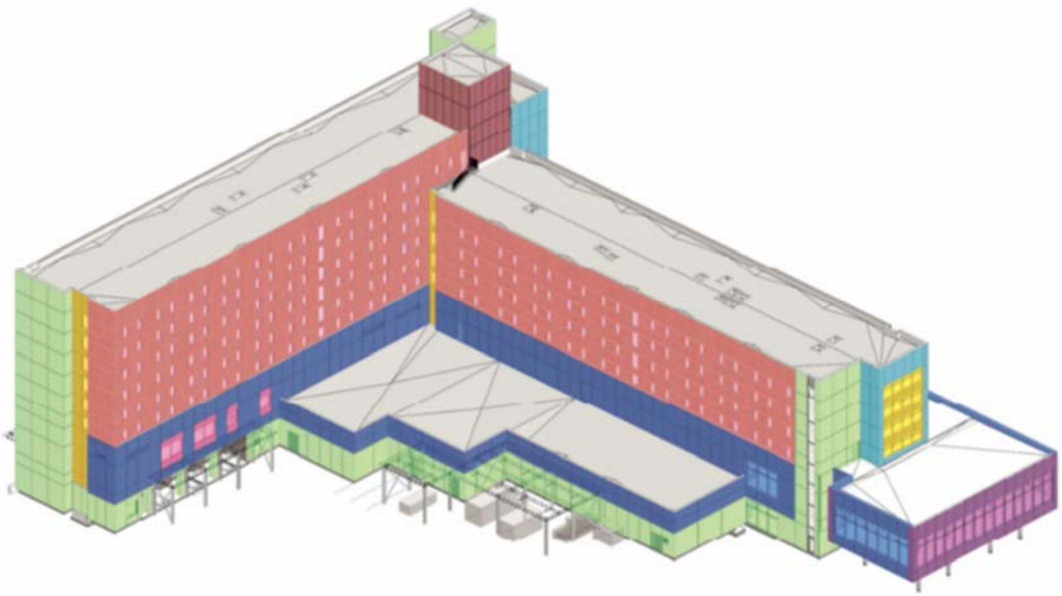
Design/Passive House Requirements

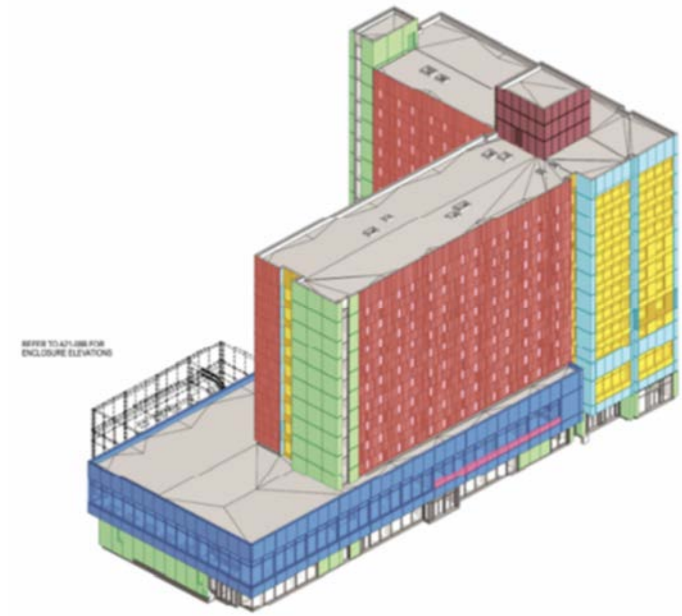
Value Engineering

ACH 0.40

PHI

ACH 0.60





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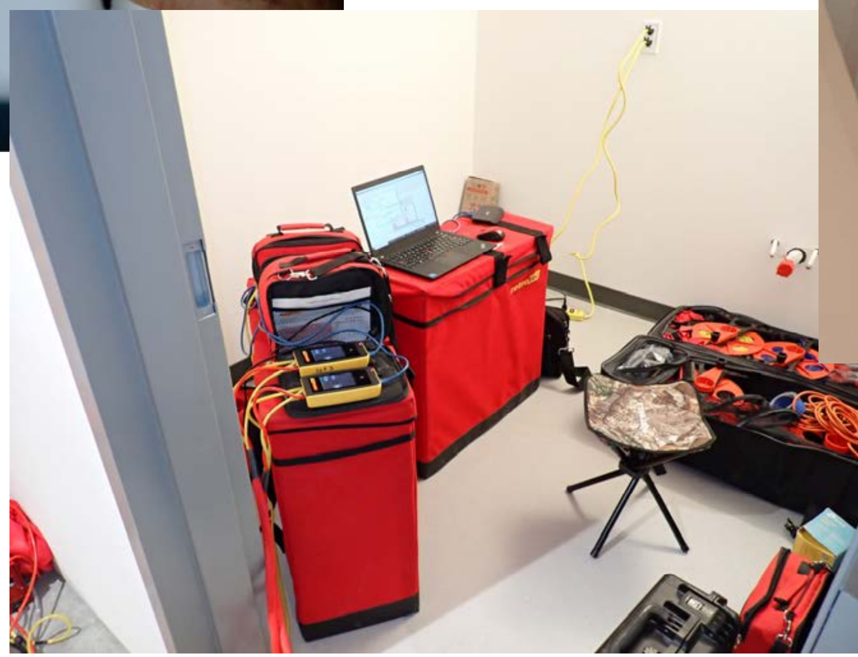

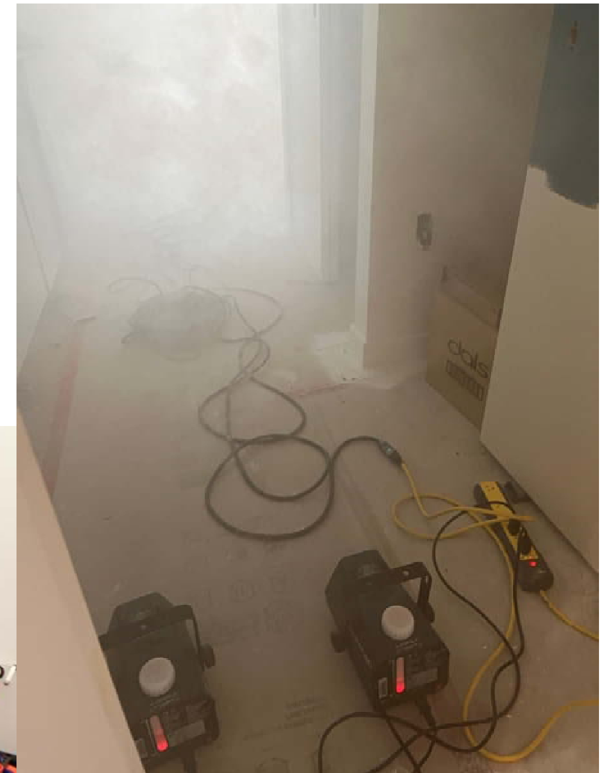

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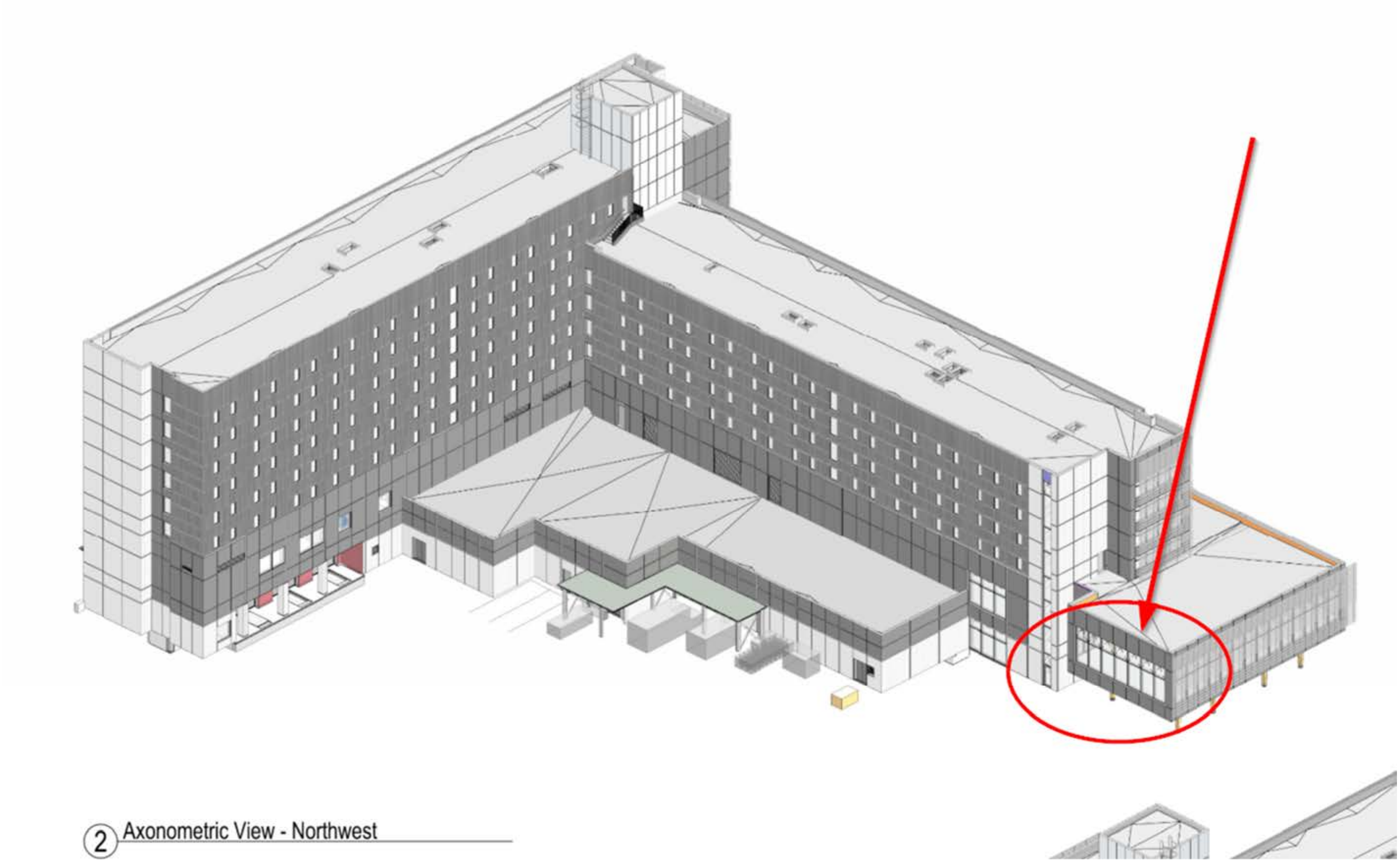

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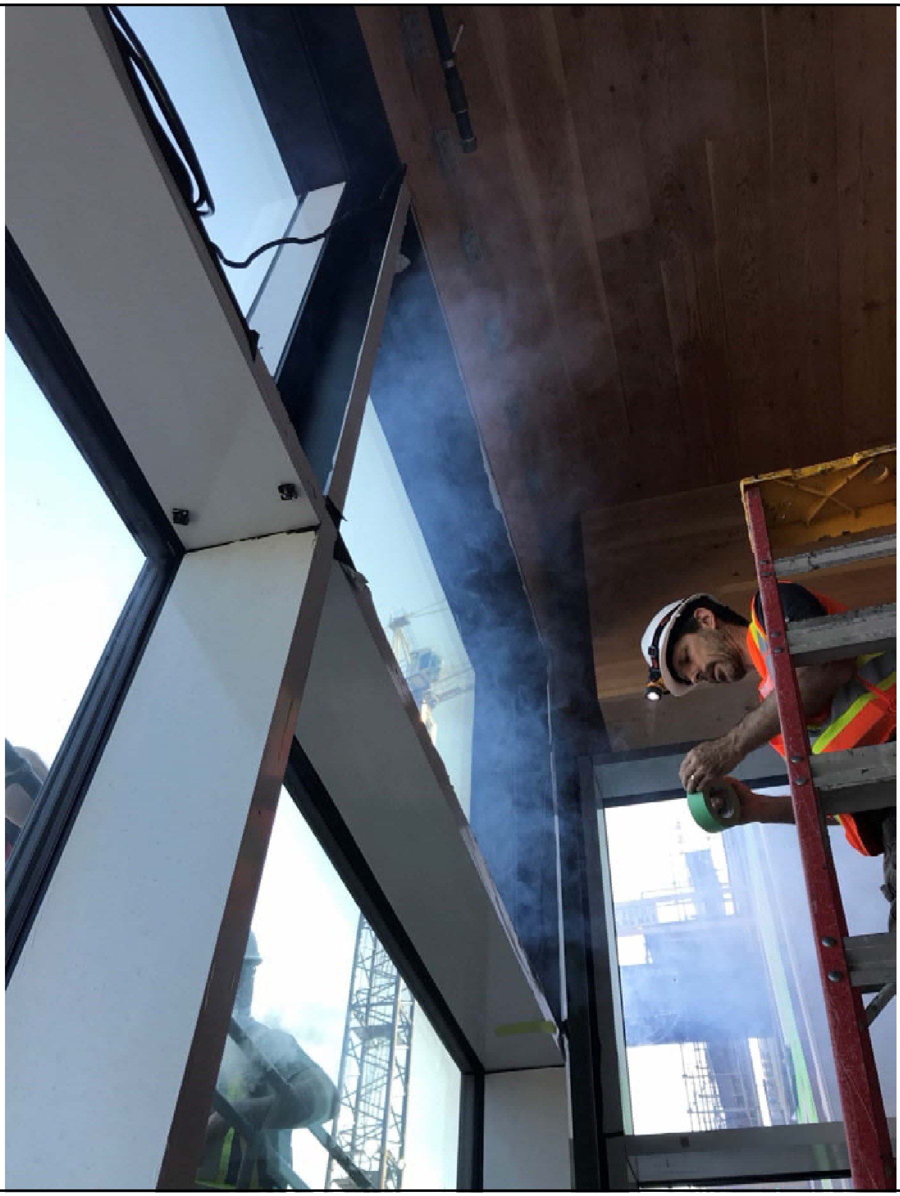
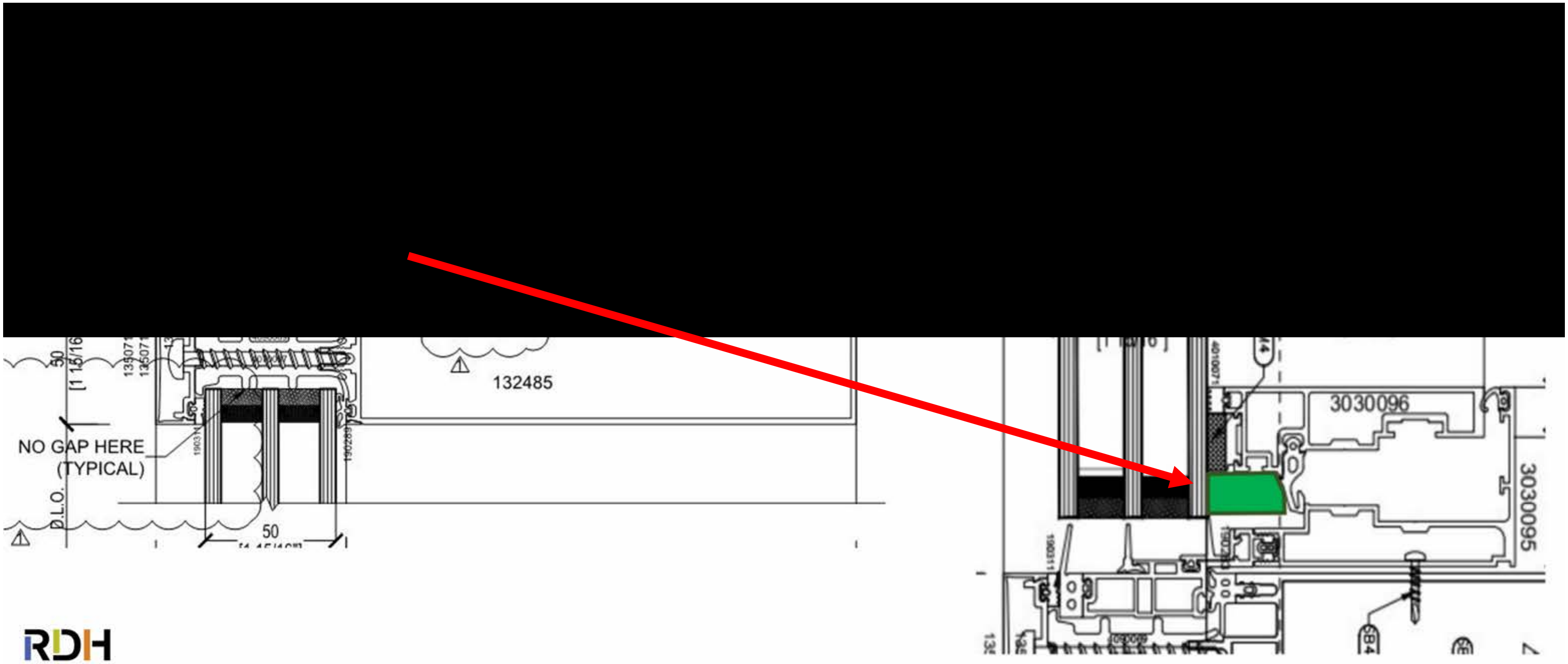
② Axonometric View - Northwest



Vent Perimeter Seal – Leakage & Fix

[redacted]



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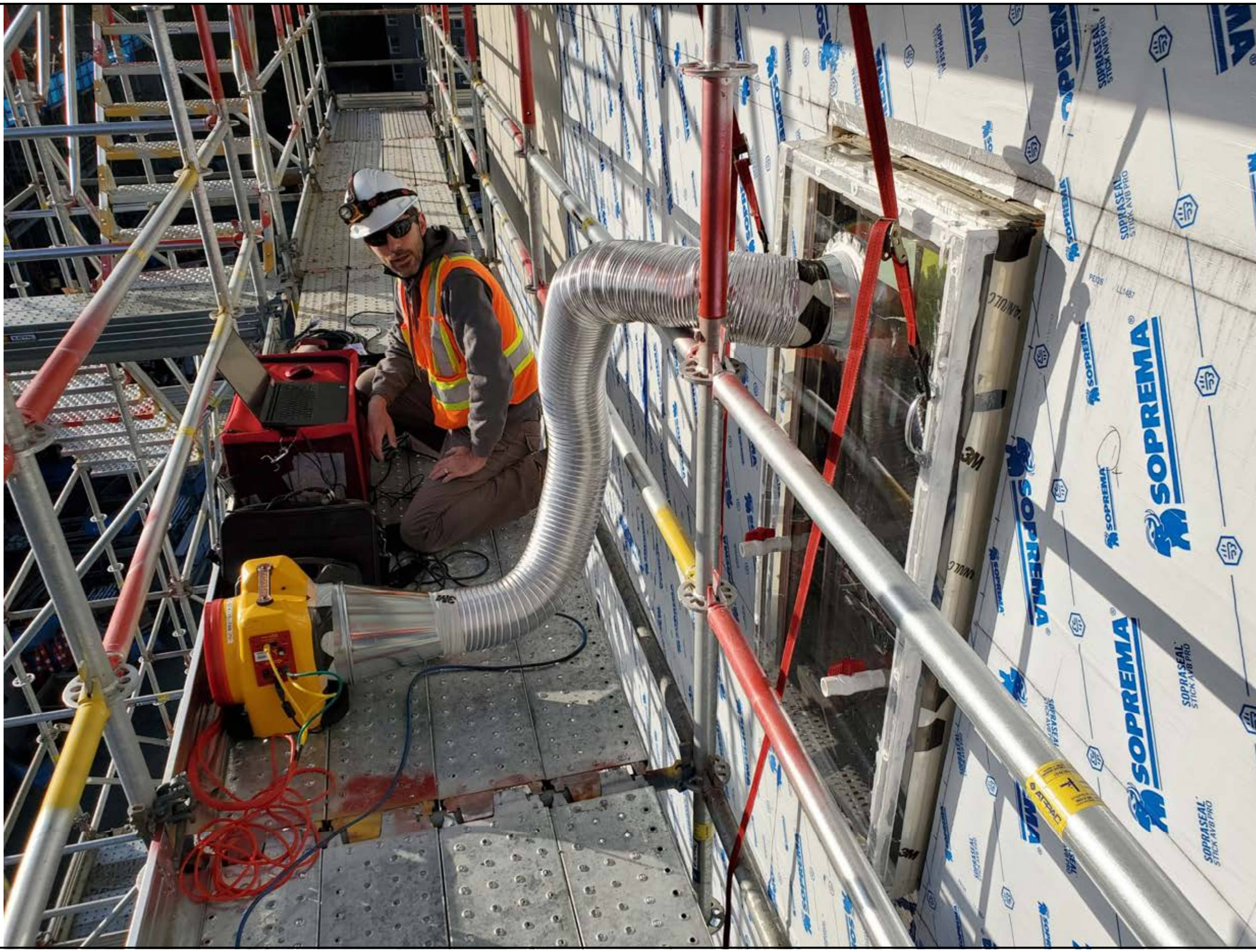

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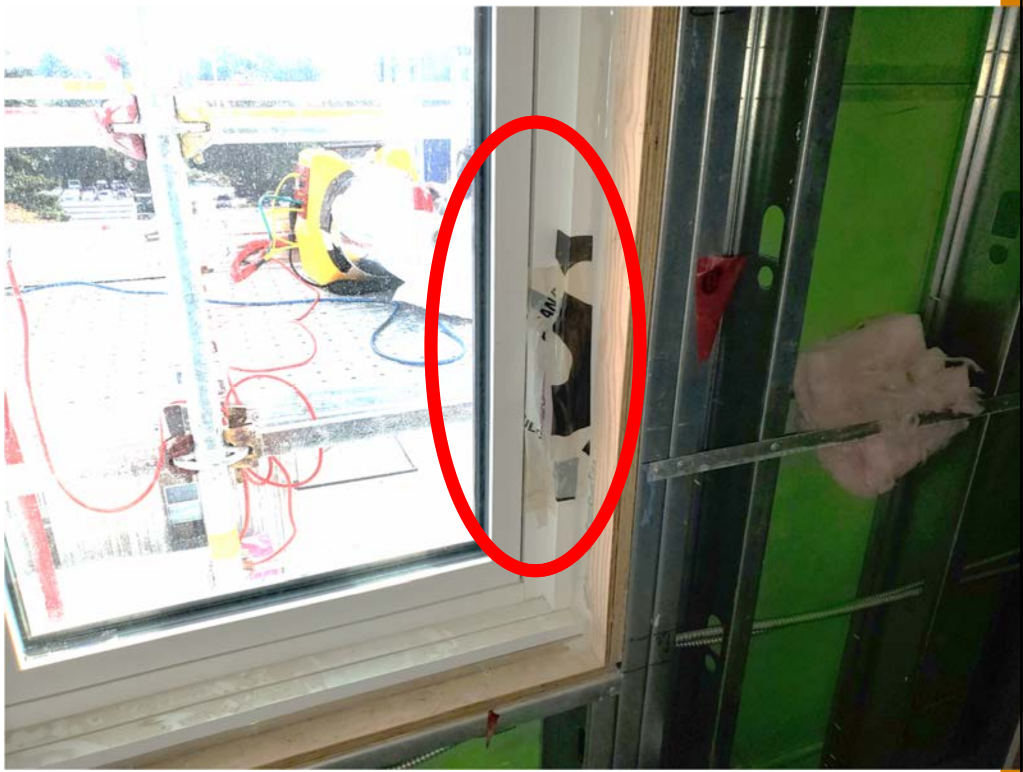

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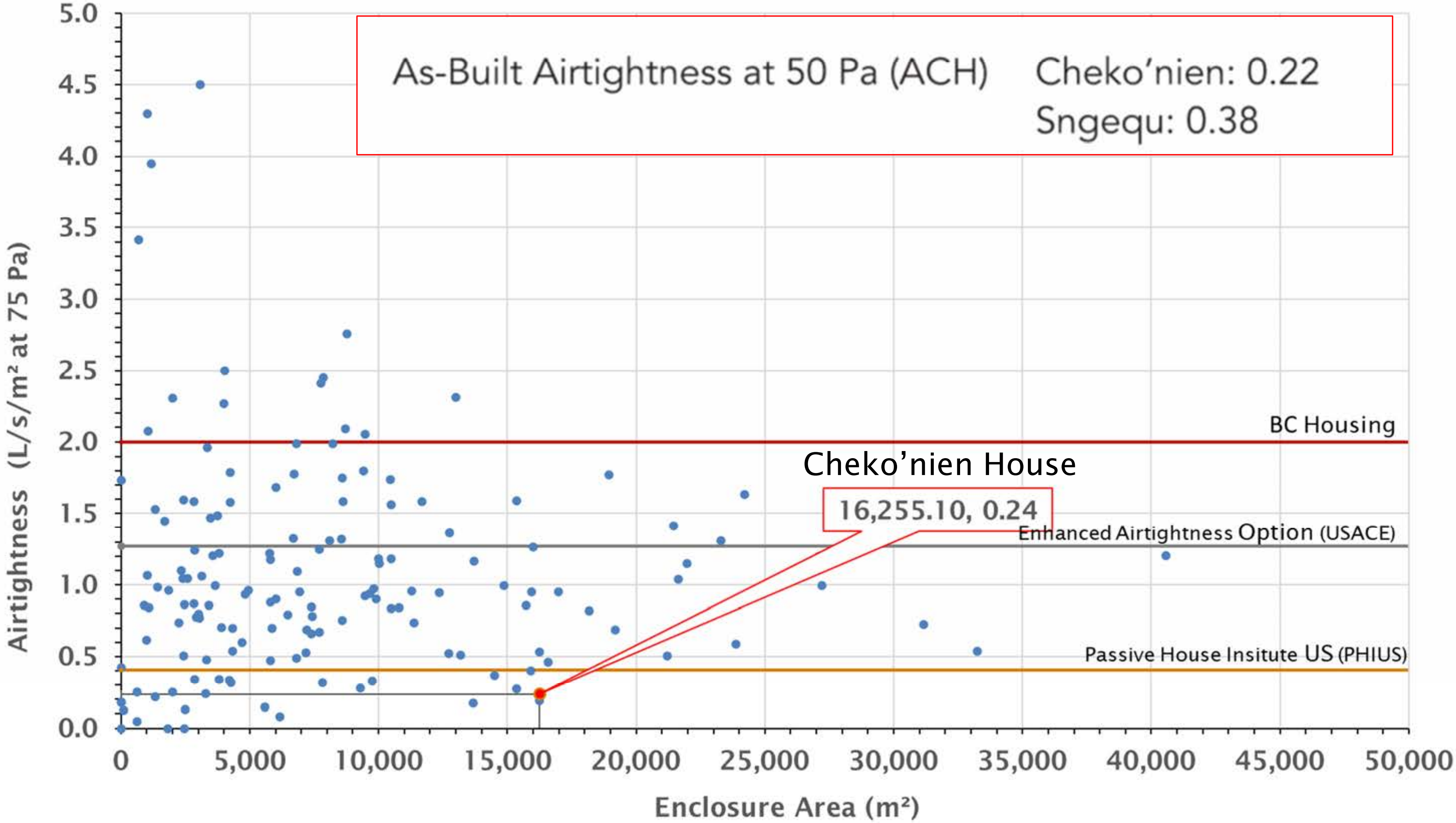

As-Built Airtightness at 50 Pa (ACH)
Cheko'nien: 0.22
Sngequ: 0.38
BC Housing
Cheko'nien House
16,255.10, 0.24
Enhanced Airtightness Option (USACE)
Passive House Insitute US (PHIUS)
Airtightness (L/s/m² at 75 Pa)
Enclosure Area (m²)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
5,000
10,000
15,000
20,000
25,000
30,000
35,000
40,000
45,000
50,000

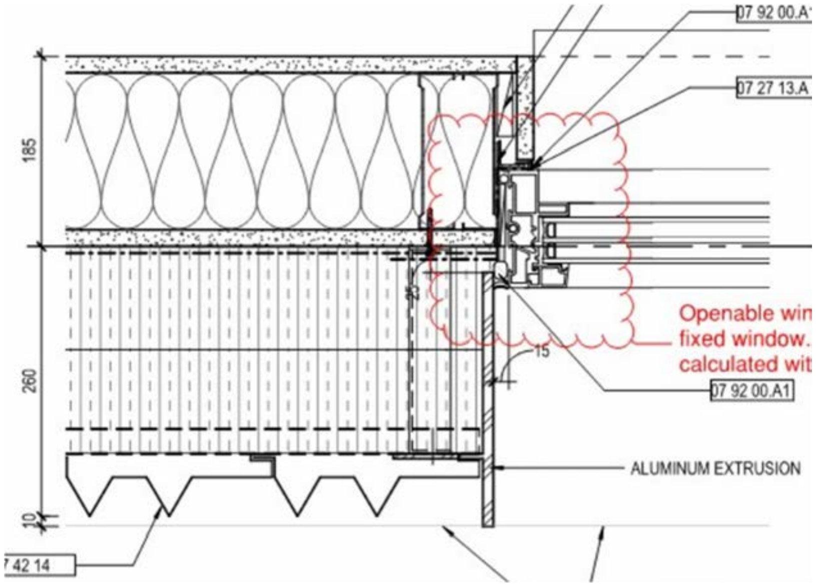

EDK
EDK
RDH
EDK
RDH

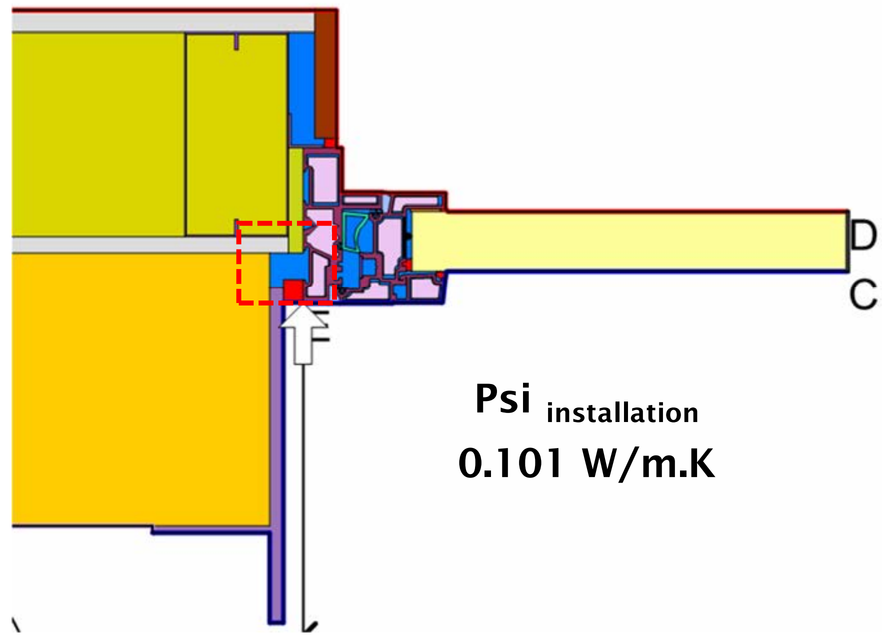
Thermal Bridging

RDH

RDH

PW Jamb Installation – Initial (As detailed)

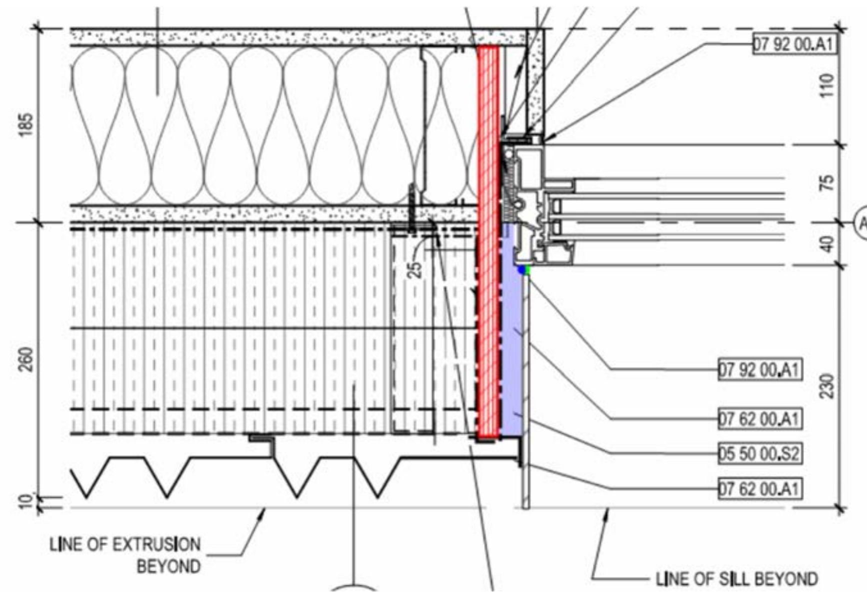


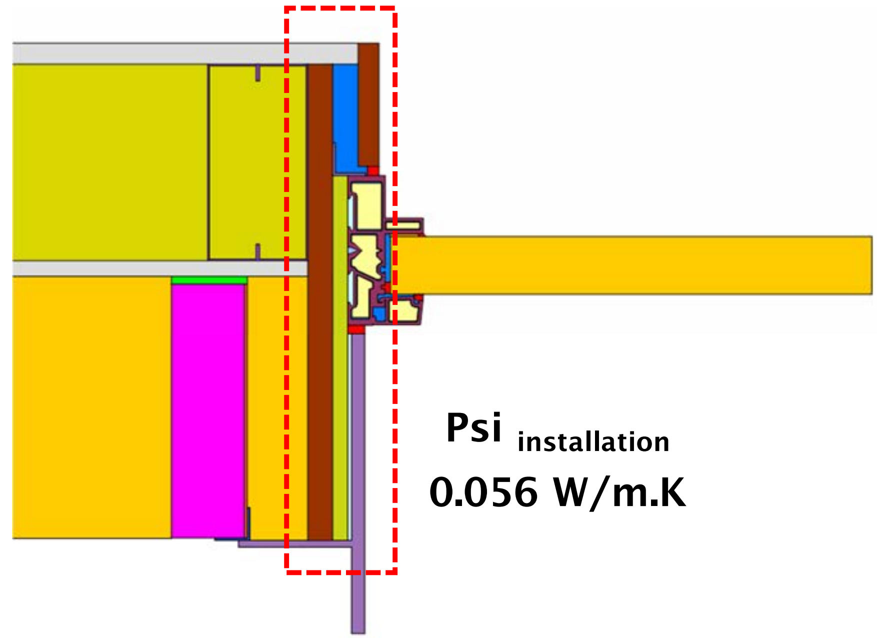


Psi $_{installation}$
0.101 W/m.K

- Gap in insulation, no external insulation at rough opening
- Mineral wool insulation in rough opening (jamb and head)

Jamb Installation – Much Improved Detail





- Plywood buck around rough opening, extending out to support flashing and trim
- Mineral wool insulation between (jamb and head)

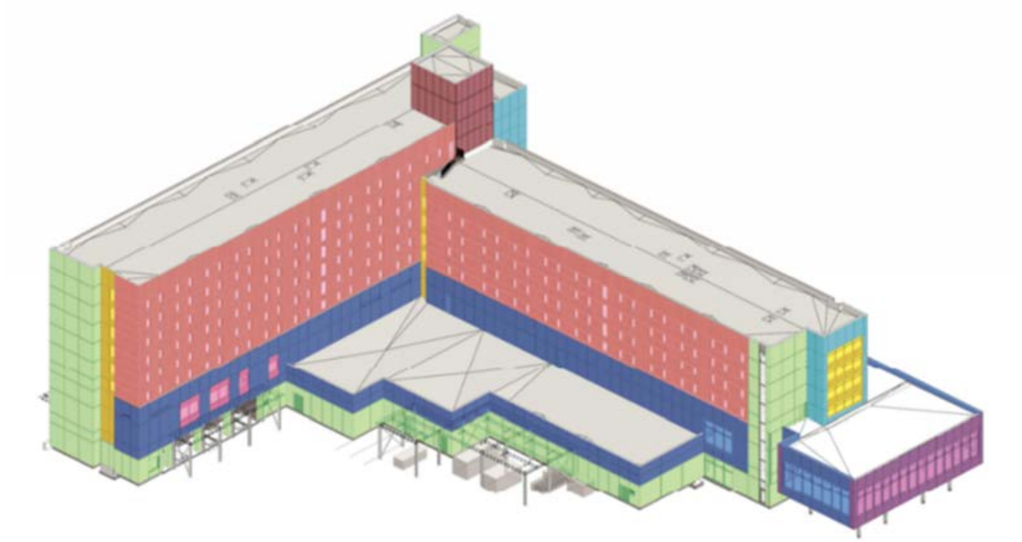

CGC
SECUROCK® Brand
UltraLight Glass-Mat Sheathing

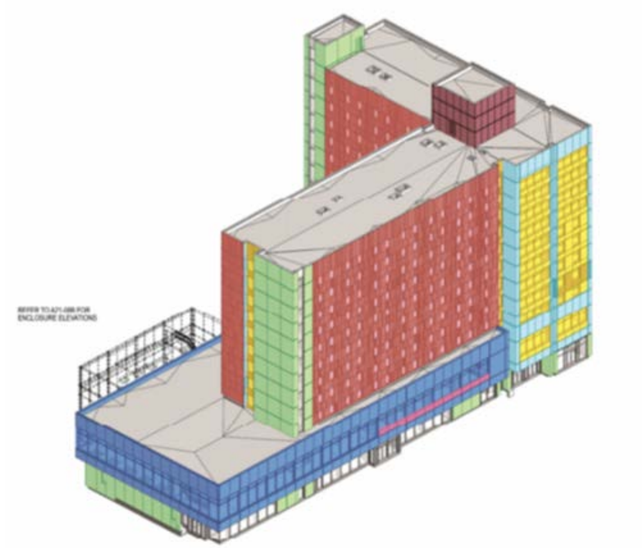
RDH

RDH

Passive House Consulting

PHPP x4





PHPP Progress Tracker

Decription	Fabric (kWh/m2.yr) [Losses]	Ventilation (kWh/m2.yr) [Losses]	Total (kWh/m2.yr) [Losses]	Solar (kWh/m2.yr) [Gains]	Internal (kWh/m2.yr) [Gains]	Total Useful (kWh/m2.yr) [Gains]	Space Heating Demand (kWh/m2.yr) [Results]	Heat Load (W/m2) [Results]	Summer Overheating (%) [Results]	Daily Temp. Swing (<3K) [Results]	Ventilation Capacity (W/m2) [Results]	Space Cooling Demand (kWh/m2.yr) [Results]	PER Demand (kWh/m2.yr) [Results]	PE Demand (kWh/m2.yr) [Results]
Current Model	**20.5**	**9.3**	**29.8**	**6.6**	**23.9**	**25.9**	**3.9**	**8.0**	**0.0**	**1.7**	**21.0**	**0.0**	**81.8**	**176.0**

#	Description iterations		Kept	Date	Fabric (kWh/m2.yr) [Losses]	Ventilation (kWh/m2.yr) [Losses]	Total (kWh/m2.yr) [Losses]	Solar (kWh/m2.yr) [Gains]	Internal (kWh/m2.yr) [Gains]	Total Useful (kWh/m2.yr) [Gains]	Space Heating Demand (kWh/m2.yr) [Results]	Heat Load (W/m2.) [Results]	Summer Overheating (%) [Results]	Daily Temp. Swing (<3K) [Results]	Ventilation Capacity (W/m2.) [Results]	Space Cooling Demand (kWh/m2.yr) [Results]	PER Demand (kWh/m2.yr) [Results]	PE Demand (kWh/m2.yr) [Results]
1	[Baseline]	DD draft report	x	08.02.2019	24.7	45.5	45.5	13.4	35.9	35.8	9.7	12.0	0.0	4.8	36.2	3.5	314.0	136.6
2	[Spacers]	Adjustment 0.021 to 0.020 on some fixed windows	x	13.03.2019	24.7	45.5	45.5	13.4	35.9	35.8	9.7	12.0	0.0	4.8	36.2	3.5	314.0	136.6
3	[Windows]	Adjustment of window dim. in stairwells (1.2m width)	x	06.05.2019	24.2	45.0	45.0	12.0	35.9	35.3	9.7	11.9	0.0	4.5	36.2	3.5	314.0	136.6
4	[Variants]	Adjustment window variants to outward swing baseline, inward swing variant (B762, B763 in Variants)	x	06.05.2019	24.4	45.2	45.2	12.0	35.9	35.3	9.8	11.9	0.0	4.5	36.2	3.5	314.3	137.0
5	[DHW]	Adjustment shower flow rate from 8 to 5.7 L/min (DHW demand from 18 to 13.3 L/person.day)	x	12.05.2019	24.4	45.2	45.2	12.0	35.9	35.3	9.8	11.9	0.0	4.5	36.2	3.5	298.2	137.0
6	[Electricity]	Addition of 2 tower elevators (13,500 kWh/year each)	x	12.05.2019	24.4	45.2	45.2	12.0	35.9	35.3	9.8	11.9	0.0	4.5	36.2	3.5	303.2	147.6
7	[Electricity]	Adjustment of fridge energy consumption from 1.0 to 0.78 kWh/day	x	12.05.2019	24.4	45.2	45.2	12.0	35.9	35.3	9.8	11.9	0.0	4.5	36.2	3.0	297.1	134.8
8	[Electricity]	Adjustment of fridge numbers from 100% to 50% of students	x	12.05.2019	24.4	45.2	45.2	12.0	35.9	35.3	9.8	11.9	0.0	4.5	36.2	2.2	286.3	112.1
9	[Electricity]	Addition of corridor lighting (5W/m2, 50% diversity for 2,500 m2)	x	12.05.2019	24.4	45.2	45.2	12.0	35.9	35.3	9.8	11.9	0.0	4.5	36.2	3.4	296.8	134.2
10	[HP]	Adjustment of HP control from 1. On/Off to 2. Ideal	x	12.05.2019	24.4	45.2	45.2	12.0	35.9	35.3	9.8	11.9	0.0	4.5	36.2	3.4	296.5	133.6
11	[HP]	Adjustment of HP type from typical air-to-water HP (#1) to Mitsubishi Multi City (#4) (w. 9K delta sink)	x	12.05.2019	24.4	45.2	45.2	12.0	35.9	35.3	9.8	11.9	0.0	4.5	36.2	3.4	293.8	129.0
12	[PER]	Adjustment of HP CoP Heating from PHPP defined to user defined (3.9)	x	12.05.2019	24.4	45.2	45.2	12.0	35.9	35.3	9.8	11.9	0.0	4.5	36.2	3.4	285.9	115.8
13	[District]	Addition of 90% gas only DES (no CHP)	x	12.05.2019	24.4	45.2	45.2	12.0	35.9	35.3	9.8	11.9	0.0	4.5	36.2	3.4	288.4	210.9
14	[DHW]	Adjustment of SDWHR (HR eff. result changed from 29 to 27%)	x	12.05.2019	24.4	45.2	45.2	12.0	35.9	35.3	9.8	11.9	0.0	4.5	36.2	3.4	289.8	211.5
15	[DHW]	Adjustment shower flow rate back from 5.7 to 8 L/min (DHW demand from 13.3 to 17.8 L/person.day)	x	13.05.2019	24.4	45.2	45.2	12.0	35.9	35.3	9.8	11.9	0.0	4.5	36.2	3.4	306.2	218.2
16	[DHW]	Adjusment of circulation + distribution pipe lenghts (Integral update)	x	13.05.2019	24.4	45.2	45.2	12.0	35.9	35.3	9.8	11.9	0.0	4.5	36.2	0.9	172.0	162.4
17	[Aux. Elec]	Addition of DHW recirculation + 41% of whole building pumps	x	13.05.2019	24.4	45.2	45.2	12.0	35.9	35.3	9.8	11.9	0.0	4.5	36.2	1.2	179.5	178.9
18	[Area]	Adjustment of HLA from DSR plans/elevations from PW	x	18.06.2019	23.7	44.5	44.5	11.9	35.9	35.1	9.4	11.8	0.0	4.5	36.2	1.2	179.5	179.0
19	[U-values]	Adjustment of Roof U-value (R78 to R76)	x	16.07.2019	23.8	44.6	44.6	12.0	35.9	35.1	9.5	11.8	0.0	4.5	36.2	1.2	179.5	178.8
20	[U-values]	Adjustment of Wall U-values (R29 to R25 for E1.A, 2.A & 4.A) (R33 to R29 for E3.A)	x	16.07.2019	25.4	46.3	46.3	12.3	35.9	35.8	10.5	12.2	0.0	4.5	36.2	1.2	179.7	179.2
21	[U-values]	Adjustment of Roof U-value (R78 to R76) - with component tab linked back to U-value tab	x	18.07.2019	25.3	46.1	46.1	12.2	35.9	35.7	10.4	12.2	0.0	4.5	36.2	1.2	179.7	179.1
22	[Areas]	Adjustment TFA (PW DSR submission)	x	09.08.2019	25.8	47.0	47.0	12.4	35.9	36.0	10.9	12.5	0.0	4.6	36.9	1.3	183.1	182.5
23	[Windows]	Adjustment of glazing (PW DSR submission)	x	16.08.2019	25.4	46.7	46.7	12.0	35.9	35.8	10.8	12.4	0.0	4.5	36.9	1.3	183.2	182.6
24	[Ventilation]	Adjustment of operation factor (100% boost, rather than 33% of time)	x	09.09.2019	25.4	49.2	49.2	12.0	35.9	36.6	12.6	13.1	0.0	4.8	43.5	1.4	186.5	189.0
25	[Ventilation]	Adjustment of HRV boost flow rate from DD (24,270 m3/hr) to CD (22,844 m3/hr)	x	09.09.2019	25.4	48.3	48.3	12.0	35.9	36.3	11.9	12.8	0.0	4.7	41.0	1.4	185.2	186.4
26	[Ventilation]	Adjustment of HRV duct diameter & length (inc. mistake of duct diameter in mm rather than m)	x	09.09.2019	25.4	48.9	48.9	12.0	35.9	36.5	12.4	13.0	0.0	4.7	41.1	1.3	185.3	186.5
27	[Ventilation]	Addition of laundry ventilation requirements	x	09.09.2019	25.3	54.0	54.0	12.0	35.9	37.9	16.1	14.3	0.0	4.8	44.3	1.4	187.1	189.5
28	[Verification]	Adjustment of occupancy (from 398 to back to PHPP default 409.4)	x	09.09.2019	25.3	54.0	54.0	12.0	35.9	37.9	16.1	14.3	0.0	4.8	44.3	1.4	189.7	191.1
29	[PER]	Adjusmtment of DHW energy source from DES to ASHP	x	10.09.2019	25.3	54.0	54.0	12.0	35.9	37.9	16.1	14.3	0.0	4.8	44.3	1.4	91.3	194.9
30	[DHW]	Adjustment of DHW demand for certification (17.8 L/person to default 23.0L/person)	x	10.09.2019	25.3	54.0	54.0	12.0	35.9	37.9	16.1	14.3	0.0	4.8	44.3	1.5	100.7	215.4
31	[DHW]	Adjustment of DHW circulation pipework length and diameter (from 786m to 792m total)	x	10.09.2019	25.3	54.0	54.0	12.0	35.9	37.9	16.1	14.3	0.0	4.8	44.3	1.6	100.6	215.3
32	[DHW]	Adjustment of DHW circulation pipework insulation performance (from 0.040 to 0.033 W/m.K)	x	10.09.2019	25.3	54.0	54.0	12.0	35.9	37.9	16.1	14.3	0.0	4.8	44.3	1.5	98.9	211.6
33	[DHW]	Adjustment of DHW circulation pipework operation hours (from 24 to 18 hr/day)	x	10.09.2019	25.3	54.0	54.0	12.0	35.9	37.9	16.1	14.3	0.0	4.8	44.3	1.4	96.3	205.8
34	[DHW]	Adjustment of DHW distribution pipework length and diameter (from m to 336m total)	x	10.09.2019	25.3	54.0	54.0	12.0	35.9	37.9	16.1	14.3	0.0	4.8	44.3	1.3	94.2	201.2
35	[DHW]	Adjustment of DHW storage information (with a 25% only heat loss rate, as 75% DHW in podium)	x	10.09.2019	25.3	54.0	54.0	12.0	35.9	37.9	16.1	14.3	0.0	4.8	44.3	1.3	93.9	200.7
36	[Aux. Elec]	Adjustment of ERV summer ventilation (fan moved from 90 to 55% in thermal envelope)	x	10.09.2019	25.3	54.0	54.0	12.0	35.9	37.9	16.1	14.3	0.0	4.8	44.3	1.0	93.8	200.5
37	[Aux. Elec]	Adjustment of pump power information (with a 25% only usage factor, as 75% DHW in podium)	x	10.09.2019	25.3	54.0	54.0	12.0	35.9	37.9	16.1	14.3	0.0	4.8	44.3	1.2	97.4	207.9
38	[Electricity]	Adjustment of mini-fridge quantity (0 rather than 50% of bedrooms)	x	10.09.2019	25.3	54.0	54.0	12.0	35.9	37.9	16.1	14.3	0.0	4.8	44.3	0.8	86.6	185.4
39	[Electricity]	Addition of washing machines & dryers (cold connection)	x	10.09.2019	25.3	54.0	54.0	12.0	35.9	37.9	16.1	14.3	0.0	4.8	44.3	1.0	105.2	224.2

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Decription	Losses			Gains			Results							
	Fabric (kWh/m2.yr)	Ventilation (kWh/m2.yr)	Total (kWh/m2.yr)	Solar (kWh/m2.yr)	Internal (kWh/m2.yr)	Total Useful (kWh/m2.yr)	Space Heating Demand (kWh/m2.yr)	Heat Load (W/m2)	Summer Overheating (%)	Daily Temp. Swing (<3K)	Ventilation Capacity (W/m2)	Space Cooling Demand (kWh/m2.yr)	PER Demand (kWh/m2.yr)	PE Demand (kWh/m2.yr)
Current Model	**20.5**	**9.3**	**29.8**	**6.6**	**23.9**	**25.9**	**3.9**	**8.0**	**0.0**	**1.7**	**21.0**	**0.0**	**81.8**	**176.0**

	Description iterations		Kept	Date	Losses			Gains			Results							
					Fabric (kWh/m2.yr)	Ventilation (kWh/m2.yr)	Total (kWh/m2.yr)	Solar (kWh/m2.yr)	Internal (kWh/m2.yr)	Total Useful (kWh/m2.yr)	Space Heating Demand (kWh/m2.yr)	Heat Load (W/m2.)	Summer Overheating (%)	Daily Temp. Swing (<3K)	Ventilation Capacity (W/m2.)	Space Cooling Demand (kWh/m2.yr)	PER Demand (kWh/m2.yr)	PE Demand (kWh/m2.yr)
184	[Electricity]	Adjustment of elevator energy consumption (from 13,500 to 8,500 kWh/yr.car)	x	19.10.2020	22.3	10.9	33.2	7.1	23.9	27.3	5.9	9.7	0.0	1.7	21.0	0.1	87.3	187.8
185	[Aux. Elec.]	Adjustment of VFD pumps (except DCW booster set) from 66 to 40%	x	19.10.2020	22.3	10.9	33.2	7.1	23.9	27.3	5.9	9.7	0.0	1.7	21.0	0.1	87.1	187.2
186	[DHW]	Upgrade of DHW pipe fixings/valves from "moderate" to "good" insulation	x	19.10.2020	22.3	10.9	33.2	7.1	23.9	27.3	5.9	9.7	0.0	1.7	21.0	0.1	86.0	184.9
187	[Aux. Elec.]	Adjustment of VFD pumps for DCW booster set from 66 to 40%	x	19.10.2020	22.3	10.9	33.2	7.1	23.9	27.3	5.9	9.7	0.0	1.7	21.0	0.1	85.1	183.0
188	[Areas]	Removal of 0.5% TFA margin		20.10.2020	22.2	10.8	33.0	7.1	23.9	27.2	5.8	9.7	0.0	1.7	20.9	0.1	84.6	182.1
189	[HP]	Updated DHW heat pump info with values from Colmac	x	18.11.2020	22.3	10.9	33.2	7.1	23.9	27.3	5.9	9.7	0.0	1.7	21.0	0.1	84.6	182.1
190	[DHW]	Change of DHW circulation/distribution pipes w/ uninsulated PEX pipes		14.12.2020	22.3	10.9	33.2	7.1	23.9	27.3	5.9	9.7	0.0	1.7	21.0	0.1	86.2	185.4
191	[DHW-Distribution]	Change of insulation thickness for recirculation lines at slab penetrations	x	17.12.2020	22.3	10.9	33.2	7.1	23.9	27.3	5.9	9.7	0.0	1.7	21.0	0.1	84.7	182.1
192	[DHW-Distribution]	Change of DHW distribution - Circulation loop temp 60 to 58C (PEX in slab w/ IG PHPP input)	x	21.01.2021	22.3	10.9	33.2	7.1	23.9	27.3	5.9	9.7	0.0	1.7	21.0	0.1	83.6	179.9
193	[DHW-Distribution]	Change of DHW distribution - Change in pipe length, diameter & ins. (PEX in slab w/ IG PHPP input)	x	21.01.2021	22.3	10.9	33.2	7.1	23.9	27.3	5.9	9.7	0.0	1.7	21.0	0.1	85.7	184.3
194	[DHW-Distribution]	Change of DHW distribution - Change in circulation time 18 to 16h/day (PEX in slab w/ IG PHPP input)	x	21.01.2021	22.3	10.9	33.2	7.1	23.9	27.3	5.9	9.7	0.0	1.7	21.0	0.1	84.1	180.9
195	[Areas]	TB62a - Tower L07 HRV steel dunnage supports [Tower] [15] -increased # from 28 to 145, chi value 0.093 as per BET(	x	17.03.2021	22.4	10.9	33.3	7.1	23.9	27.3	6.0	9.8	0.0	1.7	21.0	0.1	84.2	181.0
196	[U-Values]	Switch taper to polyiso and new max height	x	27.04.2021	22.3	10.9	33.2	7.1	23.9	27.3	5.9	9.7	0.0	1.7	21.0	0.1	84.1	180.9
197	[Components]	Psi punched window installation top from 0.065 to 0.101 (per R-11168_000 2020 05 02 UVic - TB PW 02.pptx)	x	27.04.2021	22.4	10.9	33.3	7.1	23.9	27.3	6.0	9.8	0.0	1.7	21.0	0.1	84.2	181.1
198	[Electricity]	Updated elevator energy consumption based on ISO 25745 reports	x	28.04.2021	22.4	10.9	33.3	7.1	23.9	27.3	6.0	9.8	0.0	1.7	21.0	0.0	83.0	178.6
199	[Areas]	Added TB63b - Roof anchors as per "TRA 341 - B1 Roof Anchor" [Tower] [15], chi value 0.093 as per BETGG 10.3.4	x	05.05.2021	22.5	10.9	33.4	7.1	23.9	27.4	6.0	9.8	0.0	1.7	21.0	0.0	83.0	178.7
200	[U-Value]	Updating Chi value and spacing for clips as per TRA 354	x	19.05.2021	20.5	10.9	31.3	6.9	23.9	26.6	4.8	9.2	0.0	1.7	21.0	0.0	82.3	177.2
201	[Components]	Psi punched window installation (per RDH Flixo - Baihan Guo)	x	10.08.2021	20.8	10.9	31.6	6.9	23.9	26.7	5.0	9.3	0.0	1.7	21.0	0.0	82.5	177.4
202	[DHW-Distribution]	Change of DHW distribution - Circulation loop temp 60 to 58C (PEX in slab w/ IG PHPP input)		09.09.2021	20.8	10.9	31.6	6.9	23.9	26.7	5.0	9.3	0.0	1.7	21.0	0.0	83.6	179.8
203	[DHW-Distribution]	Change of Insulation Quality of Fittings to moderate		24.11.2021	20.8	10.9	31.6	6.9	23.9	26.7	5.0	9.3	0.0	1.7	21.0	0.0	84.1	180.9
204	[Aux. Elec]	TRA502 - 122 Change in DHW pump (P-2B) size from 0.4 HP to 0.157 HP	x	08.12.2021	20.8	10.9	31.6	6.9	23.9	26.7	5.0	9.3	0.0	1.7	21.0	0.0	82.2	176.9
205	[Aux. Elec]	TRA502 - 122 Change in DHW pump (P-6/7) size from 0.5 HP to 0.75 HP	x	08.12.2021	20.8	10.9	31.6	6.9	23.9	26.7	5.0	9.3	0.0	1.7	21.0	0.0	82.3	177.1
206	[U-Values] [Areas]	Added assembly 07 and adjusted areas to allow modelling of reduced insulation as per RFI 762.2		27.12.2021	21.8	10.9	32.7	6.9	23.9	27.1	5.6	9.6	0.0	1.7	21.0	0.0	82.7	178.1
207	[Windows]	Adjusted curtain wall sizes to match curtain wall shop drawings	x	15.02.2022	20.8	10.9	31.7	6.8	23.9	26.7	5.0	9.3	0.0	1.7	21.0	0.0	82.3	177.1
208	[Components]	Updated curtain wall SHGC and U-value to match curtain wall shop drawings	x	28.02.2022	20.7	10.9	31.5	6.7	23.9	26.6	5.0	9.3	0.0	1.7	21.0	0.0	82.4	177.3
209	[Areas]	Reduced insulation as per RFI 1325 (area number 46 & 67)	x	31.05.2022	20.7	10.9	31.5	6.7	23.9	26.6	5.0	9.3	0.0	1.7	21.0	0.0	82.30	177.1
210	[Ventilation]	Updated ACH from 0.4 to tested value of 0.51		04.07.2022	20.7	11.8	32.5	6.7	23.9	26.9	5.6	10.0	0.0	1.7	21.0	0.0	82.60	177.8
211	[Ventilation]	Updated ACH from 0.4 to tested value of 0.22	x	15.08.2022	20.7	9.3	30.0	6.7	23.9	26.0	4.0	8.1	0.0	1.7	21.0	0.0	81.83	176.1
212	[Areas]	Changed TB63a - Roof anchors as per "RFI TP4-1434 B1B2 Roof Anchor Thermal Break Thickness" [Podium] [15], -	x	15.08.2022	20.8	9.3	30.1	6.7	23.9	26.0	4.0	8.1	0.0	1.7	21.0	0.0	81.84	176.1
213	[U-Values], [Areas]	Adding cavity insulation as per CN033 (Added 08ud; applied to West/North (L3-8, A-15-A-3; A-C to A-I)	x	30.08.2022	20.4	9.3	29.7	6.6	23.9	25.9	3.9	8.0	0.0	1.7	21.0	0.0	81.7	175.9
214	[Components]	Updating installation Psi for punched windows as per RDH calculations	x	30.08.2022	20.5	9.3	29.8	6.6	23.9	25.9	3.9	8.0	0.0	1.7	21.0	0.0	81.8	175.9
215	[DHW-Distribution]	Change of DHW distribution - Circulation loop temp 58 to 60C (email Integral September 9, 2021 1:10 PM)	x	13.09.2022	20.5	9.3	29.8	6.6	23.9	25.9	3.9	8.0	0.0	1.7	21.0	0.0	82.9	178.3
216	[Areas]	TB64 - Mounting Box for Lightning Protection Rod	x	20.09.2022	20.5	9.3	29.8	6.6	23.9	25.9	3.9	8.0	0.0	1.7	21.0	0.0	82.9	178.3
217	[Aux. Elec.]	Removal of P-12 Kitchen HR pump (double counted in Tower/Podium PHPP + kitchen calcs)	x	24.10.2022	20.5	9.3	29.8	6.6	23.9	25.9	3.9	8.0	0.0	1.7	21.0	0.0	82.5	177.6
218	[Aux. Elec.]	Update of laundry fan SFP, increased post-construction (item #24, 28-Jan-21)	x	25.10.2022	20.5	9.3	29.8	6.6	23.9	25.9	3.9	8.0	0.0	1.7	21.0	0.0	83.1	178.8
219	[HP]	Change of Colmac ASHP for DHW: performance/COP map as per shop drawing. COP DHW from 2.04 to 2.26 (verific	x	01.11.2022	20.5	9.3	29.8	6.6	23.9	25.9	3.9	8.0	0.0	1.7	21.0	0.0	81.8	176.0

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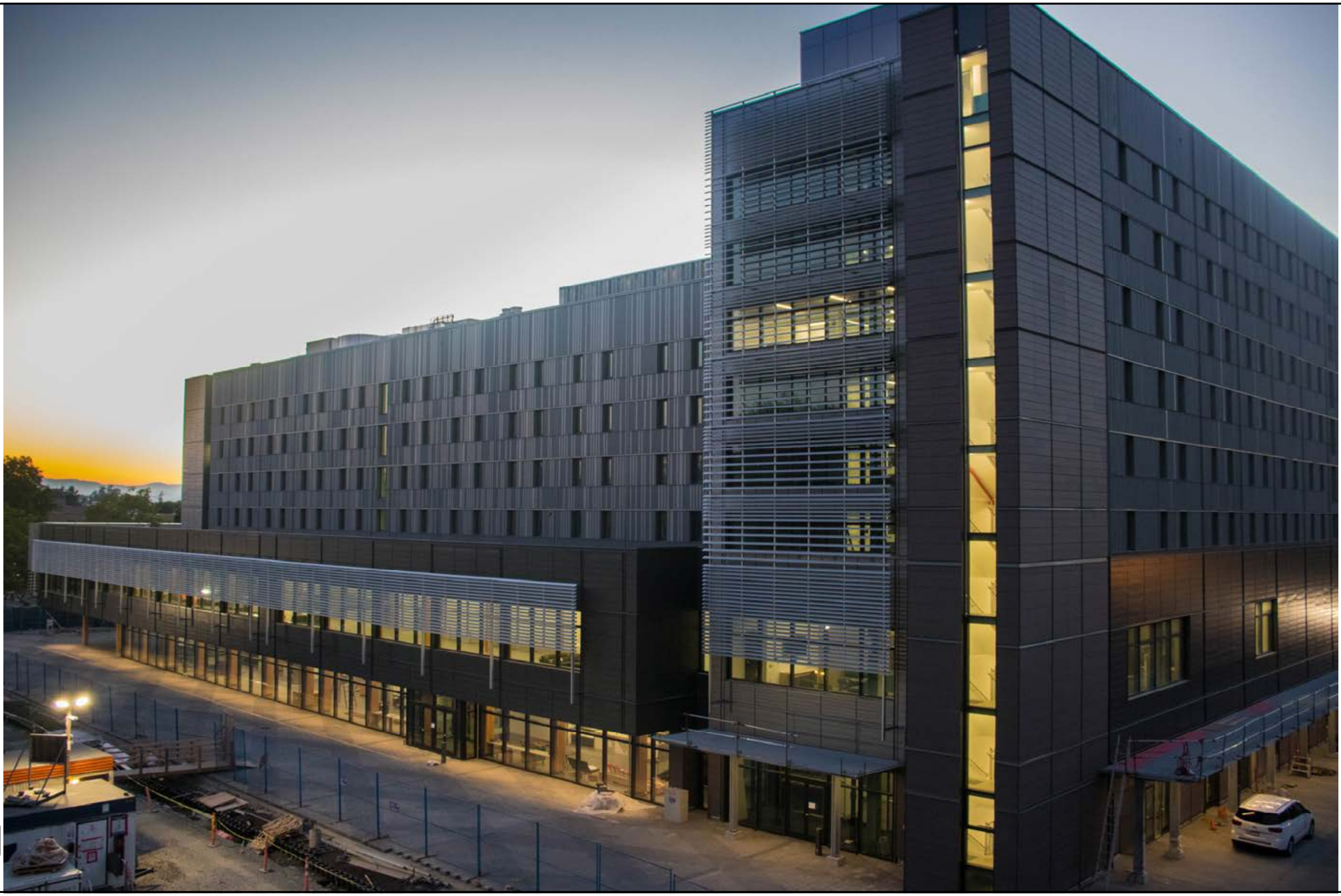

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