Warmer, Wetter, and Windier:

Future Proofing Your Building Enclosure for Extreme Weather Events

Redefining possible.

Jillian Burgess, RA Technical Director & Associate Principal

March 20, 2024

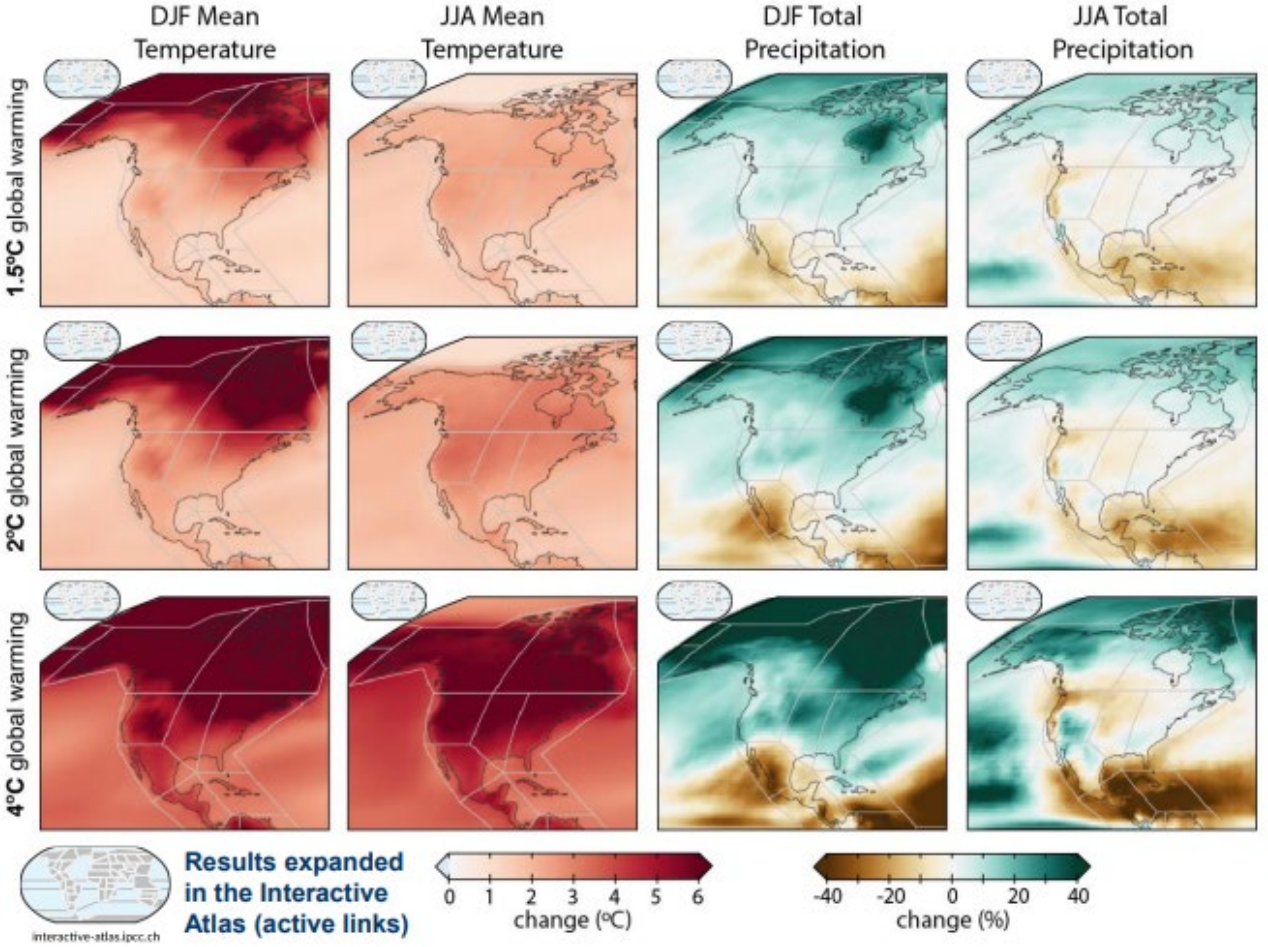
Climate and performance expertise. When you need it.

UN IPCC Report on Climate Change, 2021

Rising Temperatures

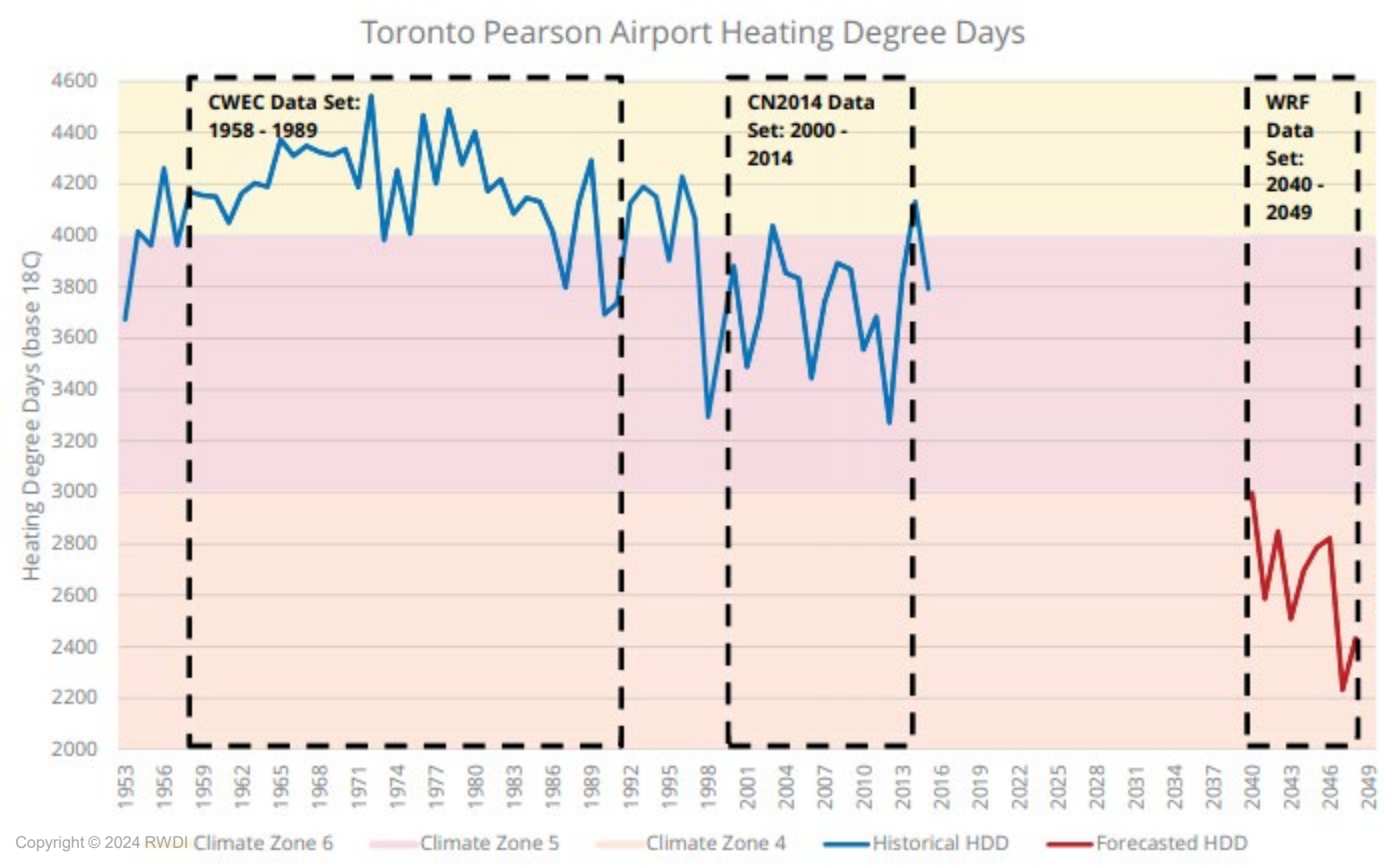
Extreme Precipitation

Increased Wind Speed



Projected changes in seasonal (Dec–Feb, DJF, and Jun–Aug, JJA) mean temperature and precipitation at 1.5°C, 2°C, and 4°C (in rows) global warming relative to 1850–1900.

Based on CMIP6 using the SSP5 8.5 scenario to compute the warming levels.



Weather Futures

WARMER

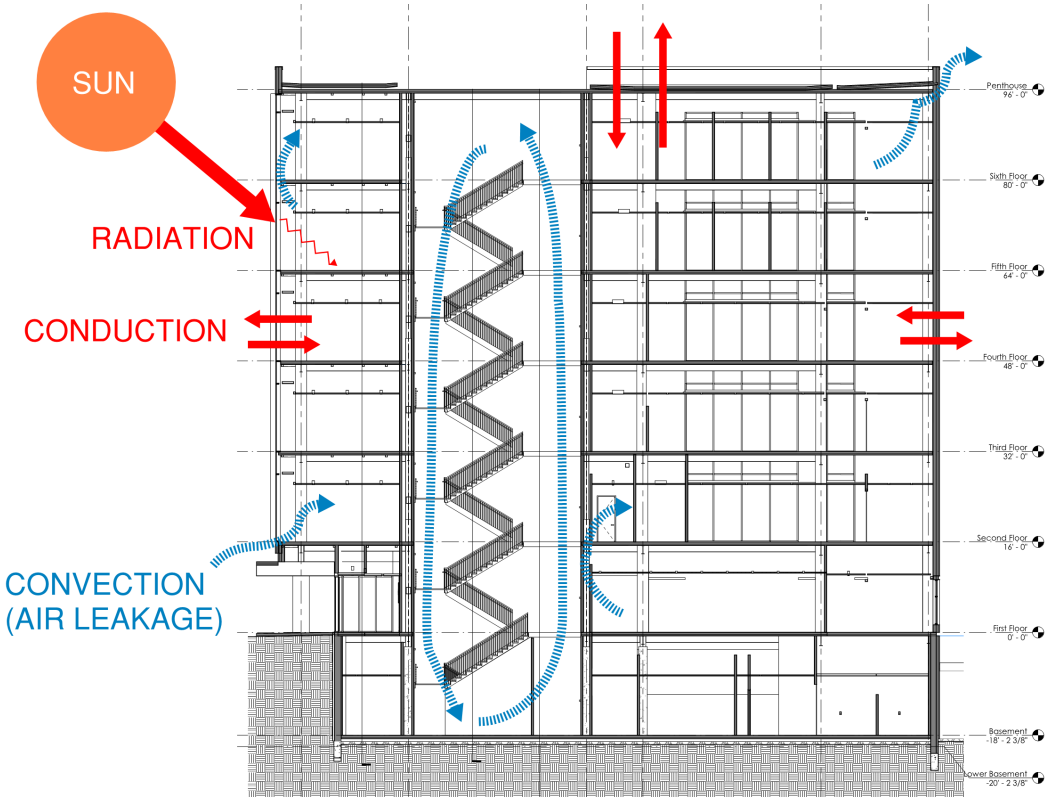
Control of Heat

Insulation is the primary thermal control.

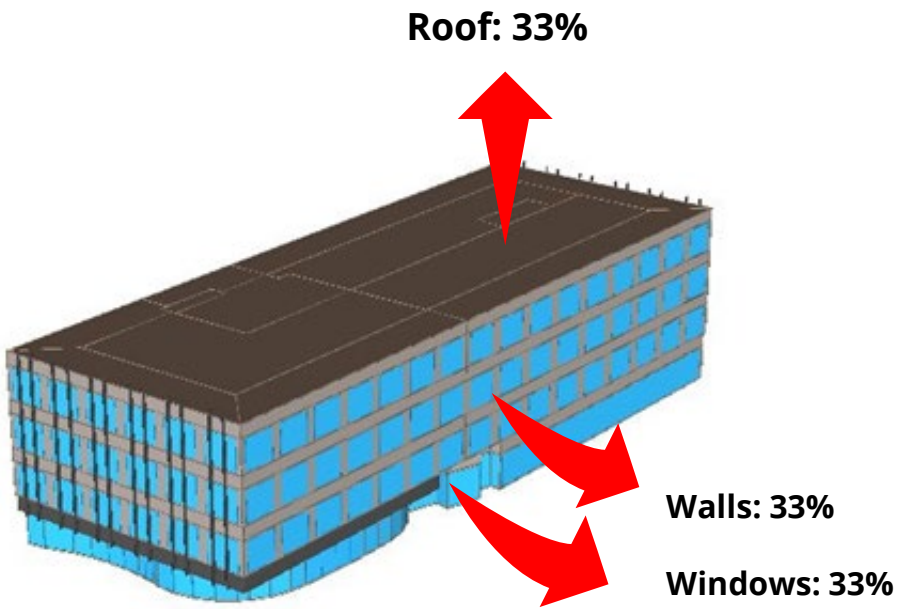
Determining ‘real’ thermal values is crucial.

Radiation through glass can be controlled with low-e coatings.

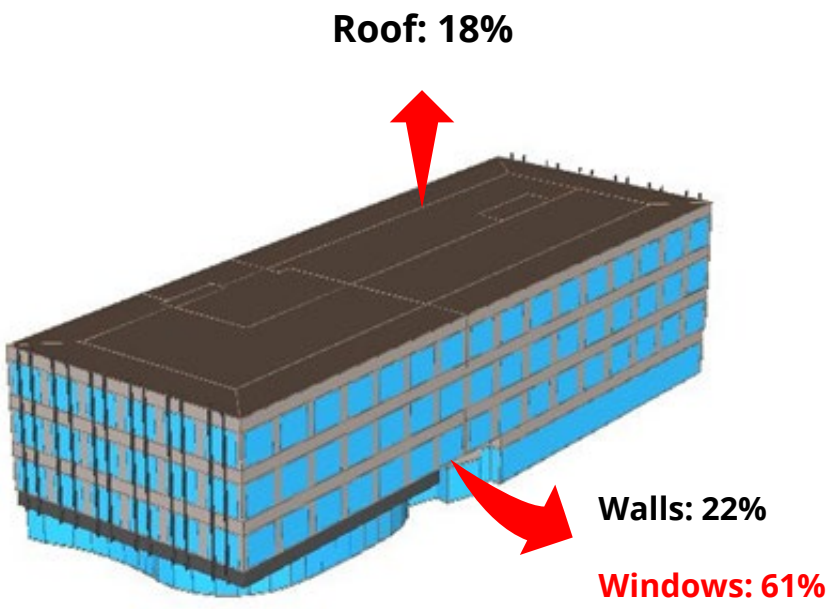
Conductive heat loss through glass is significant.



Case Study: 50% WWR



SURFACE AREA



HEAT LOSS

Glass Technologies

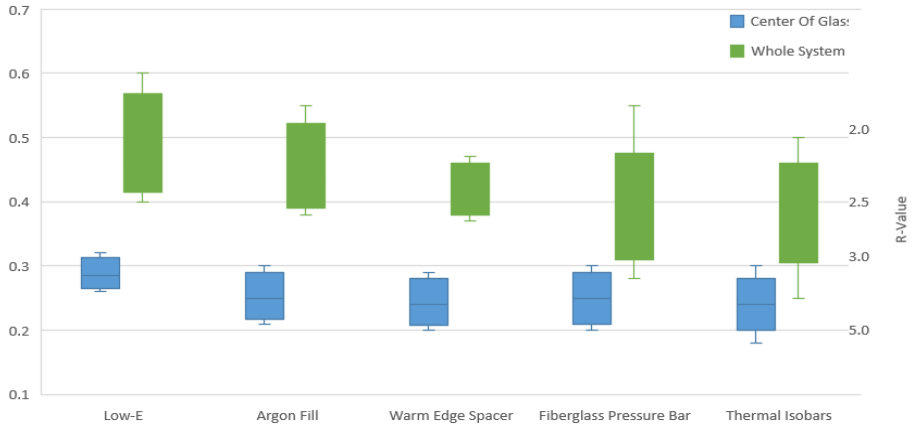
Silvercoat

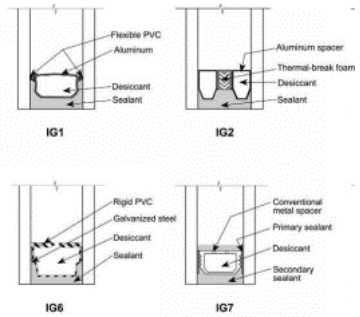
Warm Edge Spacers

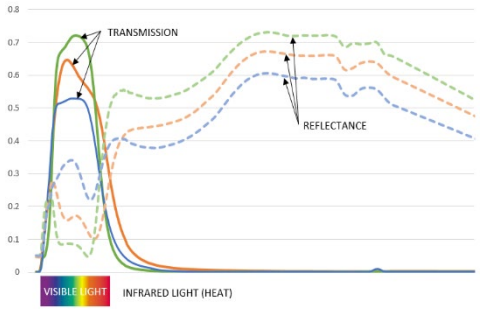
Argon Fill

“Thermally Broken” System

Fiberglass Components







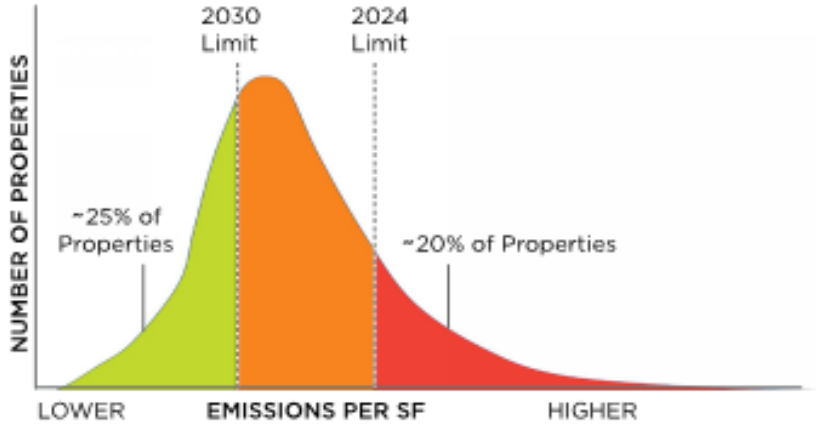
Carbon Emission Limits: NYC

- The worst ~20% must do something by 2024
- By 2030, ~75% of buildings are affected

	2024-29 (Kg Co2/sf)	2030-34 (Kg Co2/sf)
Occupancy Type H (Laboratories)	23.8	11.9
Occupancy Type B (Offices)	8.5	4.5
Occupancy Type E (Educational)	7.6	3.4
Occupancy Type S (Storage)	4.3	1.1

FIGURE 3

Emissions Distribution of Covered Properties

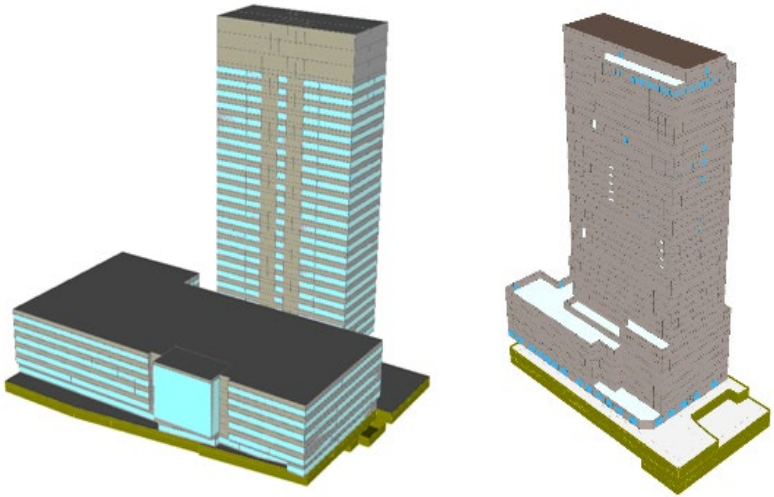


This graph is meant as a conceptual aid and does not represent actual properties or emissions limits.

Types of Modeling

Comparative

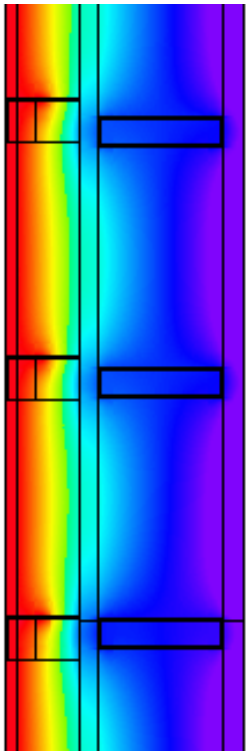
Understand relative value of various options

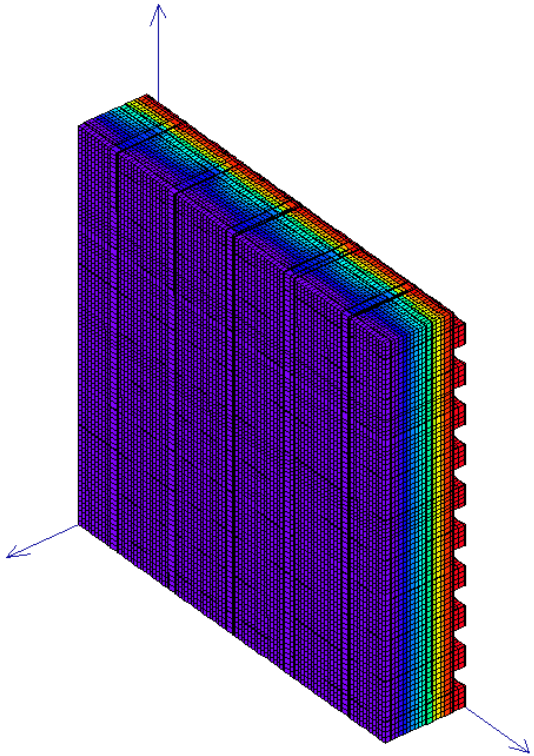


Predictive

Establish expectations for actual consumption

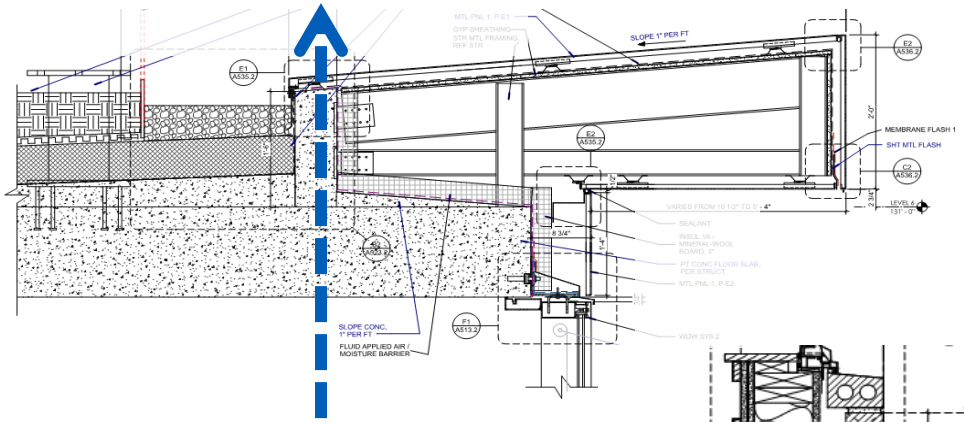
Accurately Predicting Thermal Performance

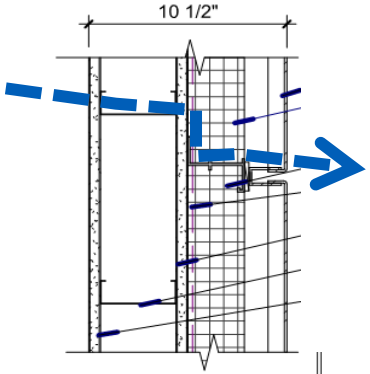


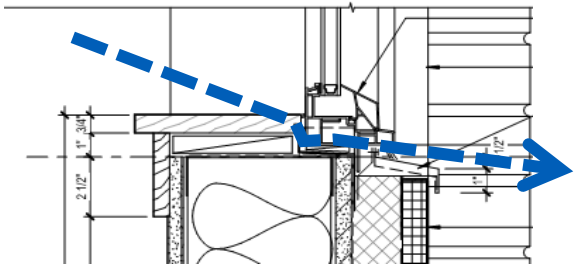


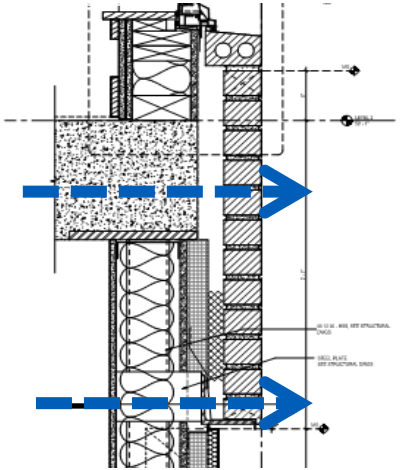
1D Series	U- 0.030
1D ASHRAE	U - 0.047
2D Modeled	U - 0.044
2D Zones	U – 0.053
3D Modeled	**U – 0.057**

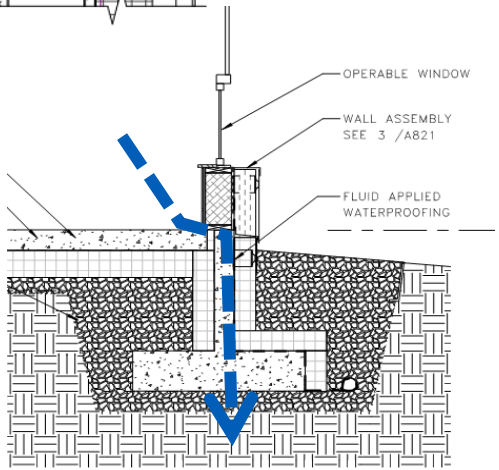
Thermal Bridges



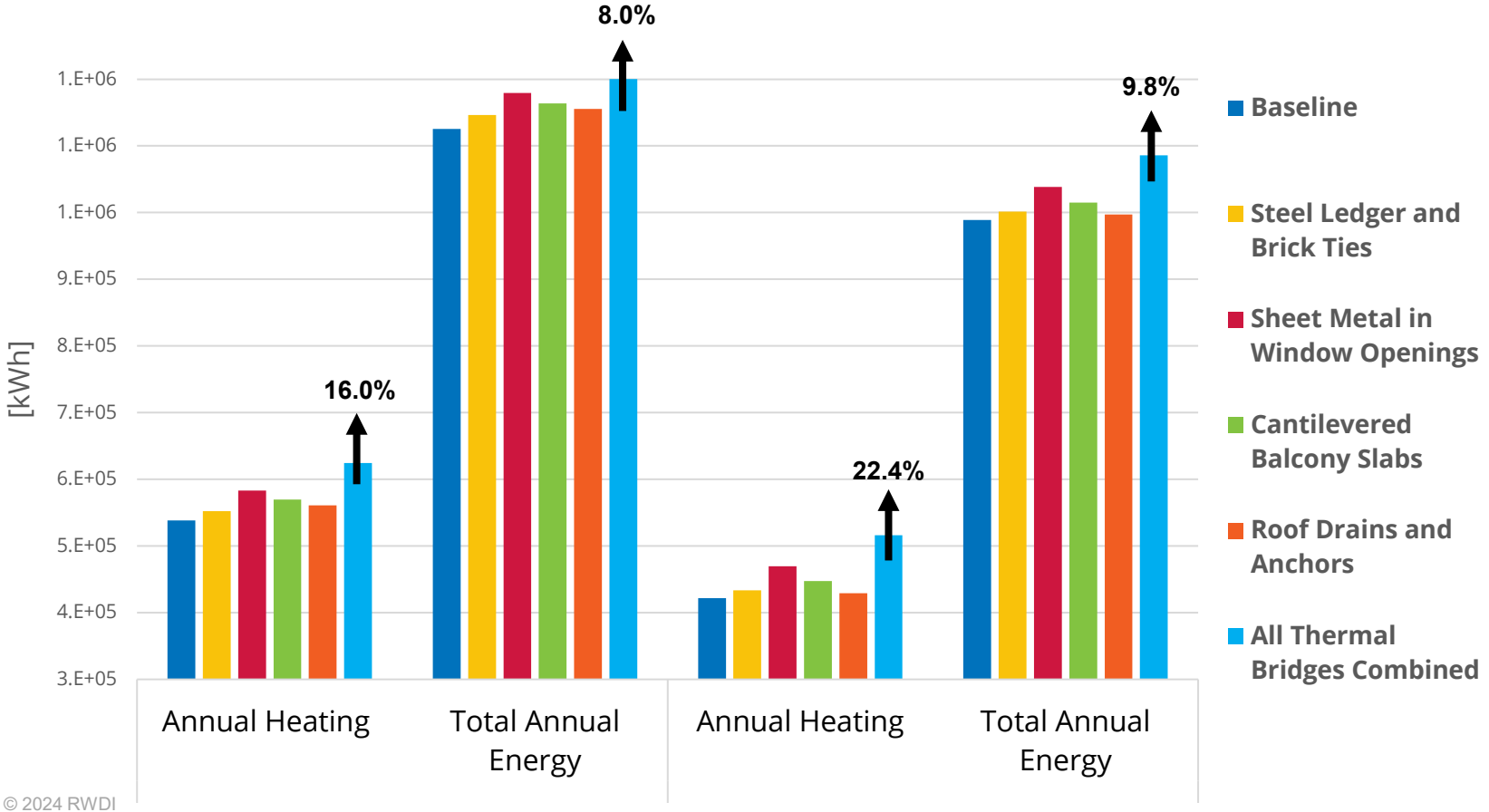








ENERGY IMPACTS OF THERMAL BRIDGES

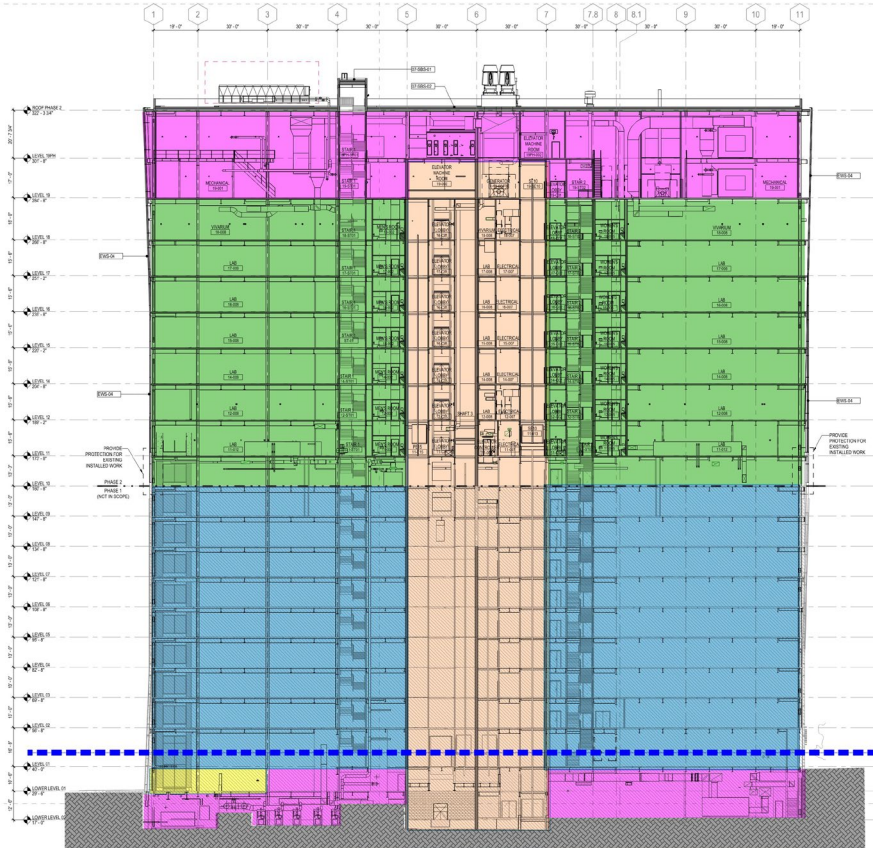


6 WETTER

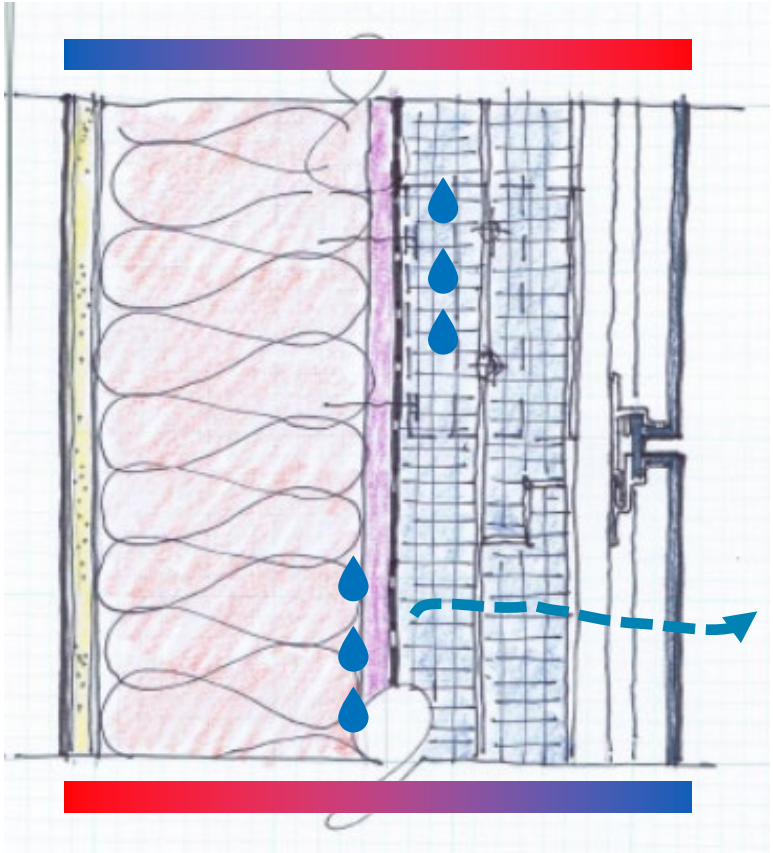
FLOODING


21ST ST
WRONG WAY
Broad Street
Central Phila
1/2 MILE
EXIT ONLY
1/2
1 1/4
IDA'S IMPACT
GIANT

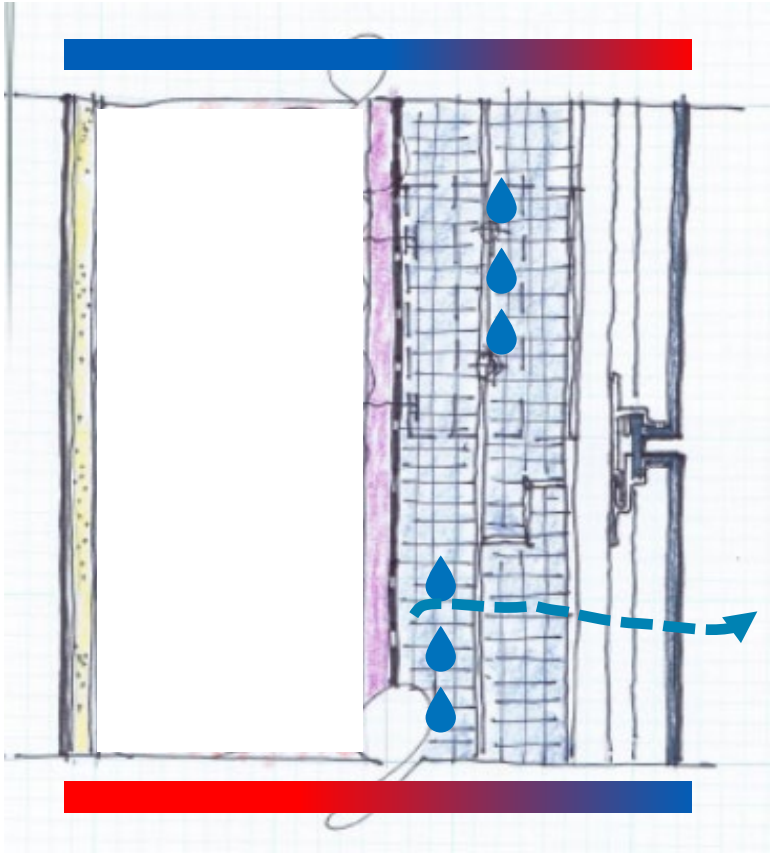
PRIMARY MEP EQUIPMENT



SPLIT INSULATION RAINSCREENS

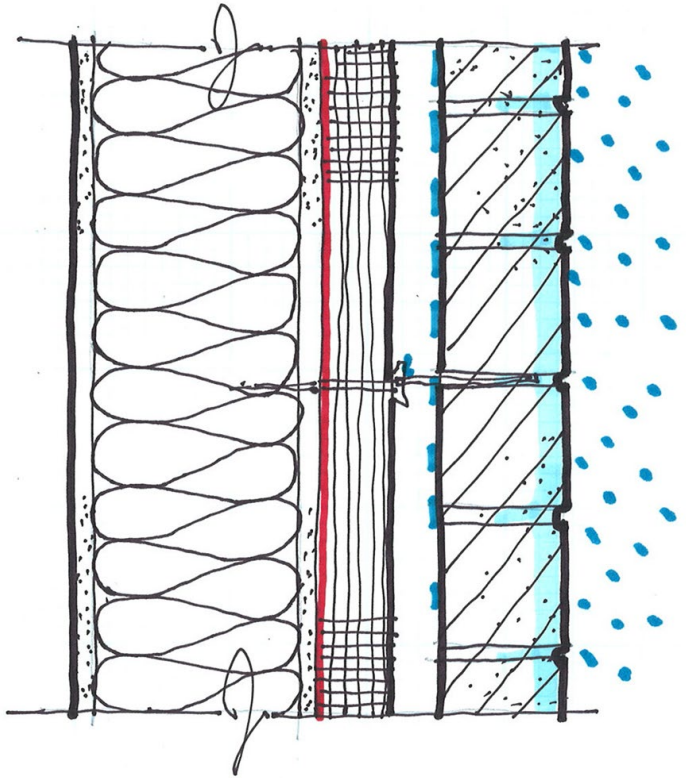


SPLIT INSULATION RAINSCREENS



MASONRY RESERVOIR CLADDING

More rain followed by longer periods of higher temps creates prolonged inward vapor drives

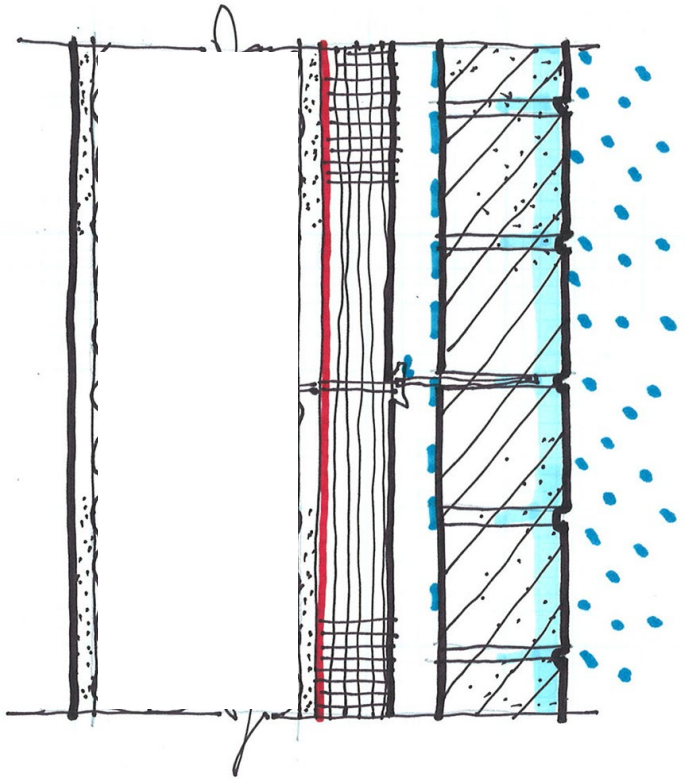


MASONRY RESERVOIR CLADDING

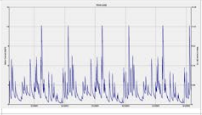
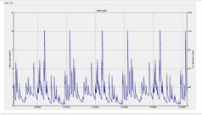
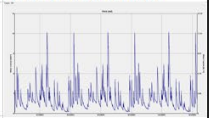
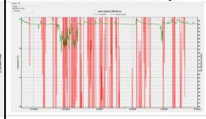
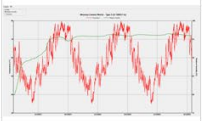
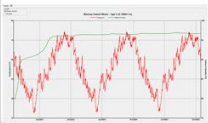
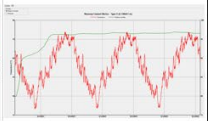
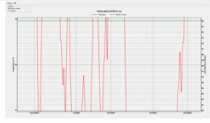
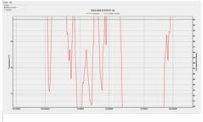
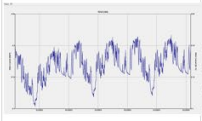
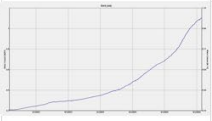
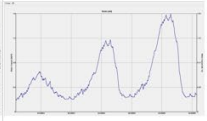
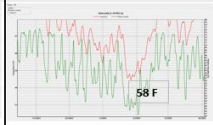
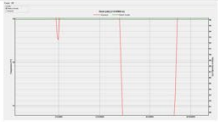
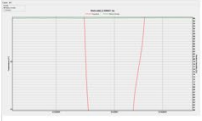
Change Air Barrier to vapor impermeable

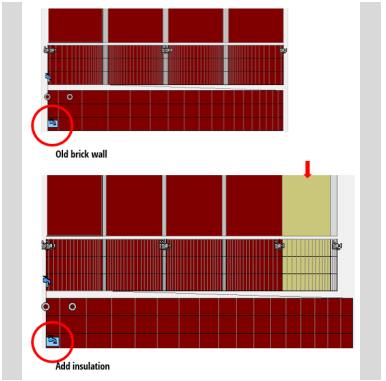
Eliminate interior batt insulation.

Ventilate cavity.



WUFI result summary chart

	Case 1: old brick wall	Case 2: spray foam	Case 3: mineral wool	Case 1: FreezeThaw/ yr	Case 2: FreezeThaw/ yr	Case 3: FreezeThaw/ yr
face brick						
peak WC lbs/ft3	12.18	12.20	2.18	46	56	62
center						
peak RH	96%	97%	97%	0	5	6
interior brick						
peak WC lbs/ft3	0.22	1.10	1.59	0	1	1

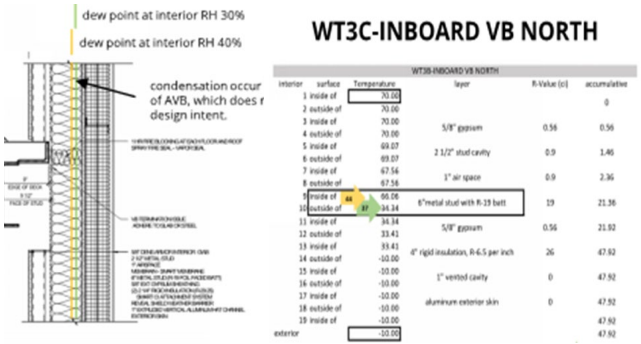


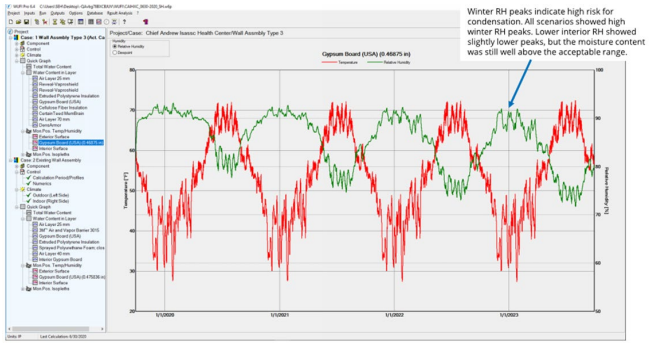
CONDENSATION ANALYSIS

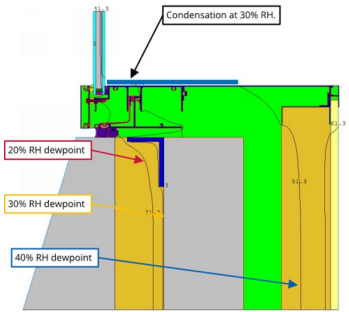
LEVELS OF ANALYSIS

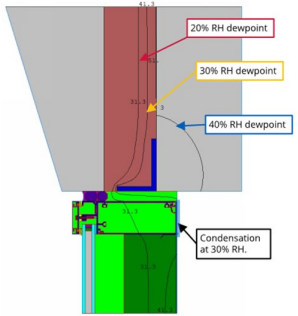
1. Desktop Calculation
2. Transient 1D (WUFI)
3. Steady-State 2D (THERM)
4. Transient 3D (CFD/Siemens/ Open Foam)

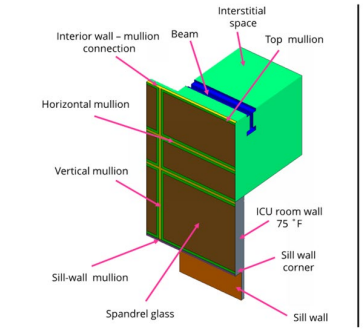
Multi-Dimensional Analysis

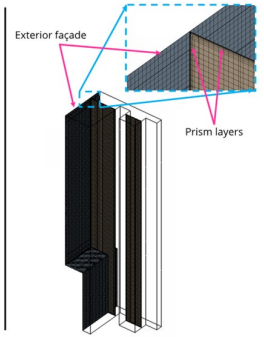






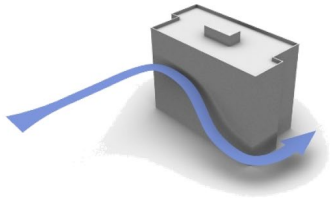


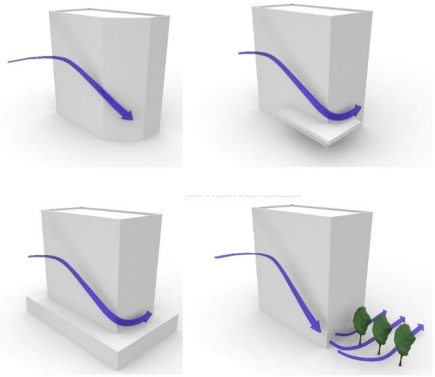


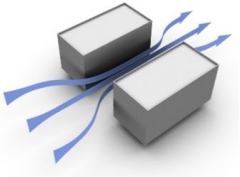


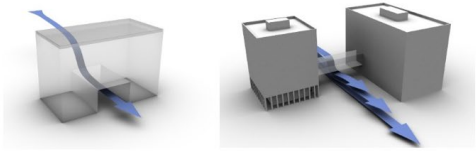
WINDIER

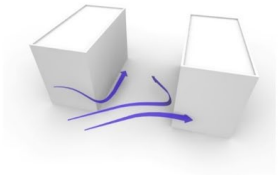
Wind flow patterns and the resulting load effects are complex...

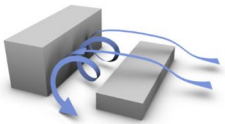


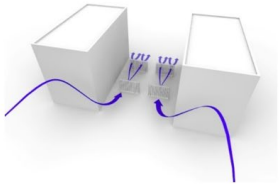


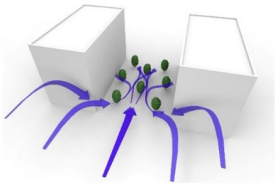


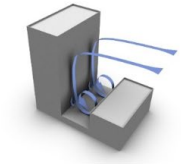


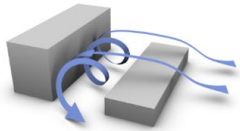


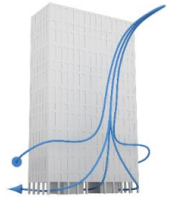


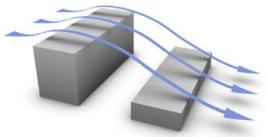


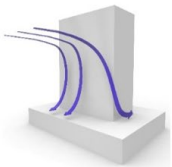


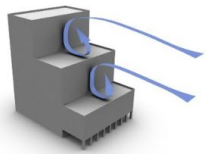


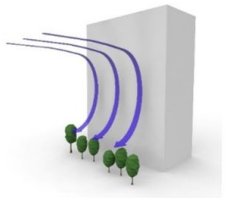


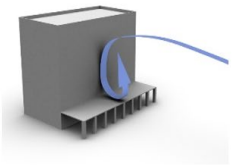




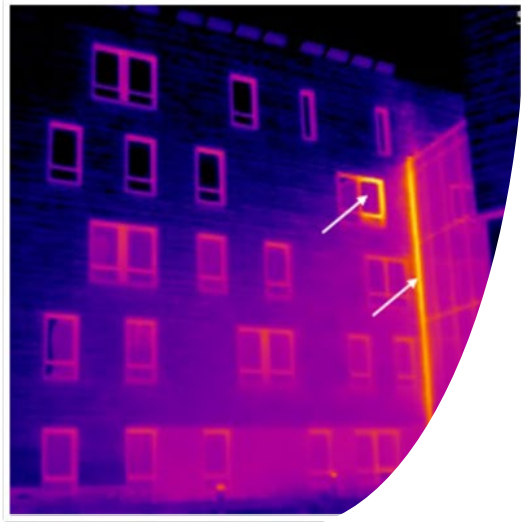


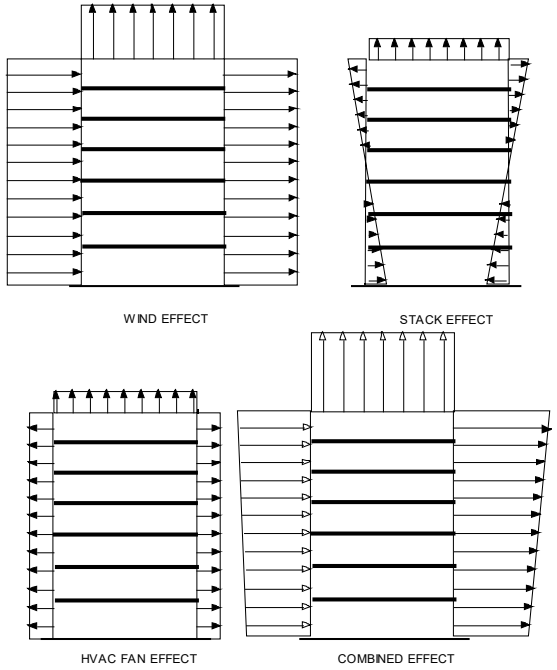




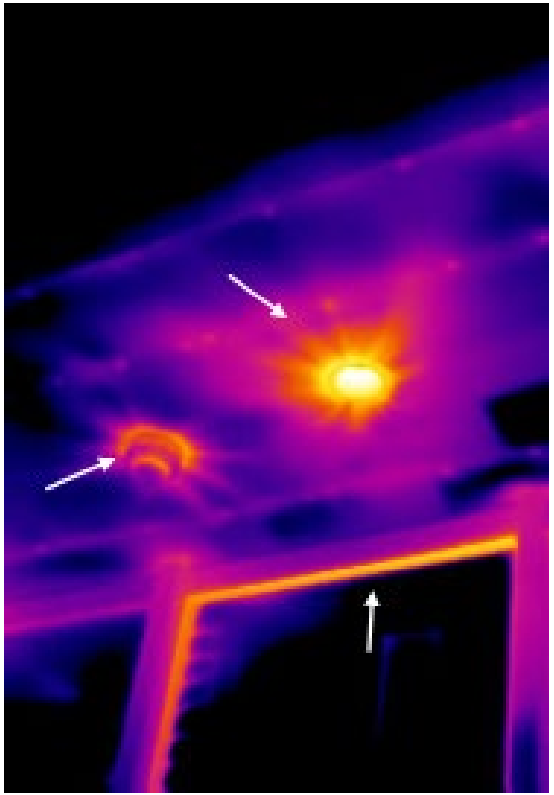


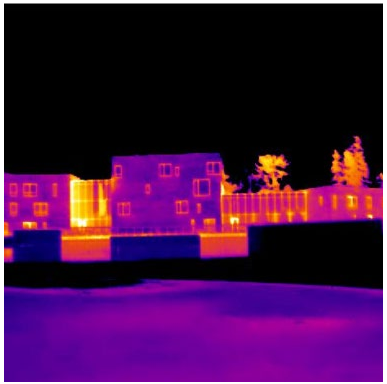
Air Leakage

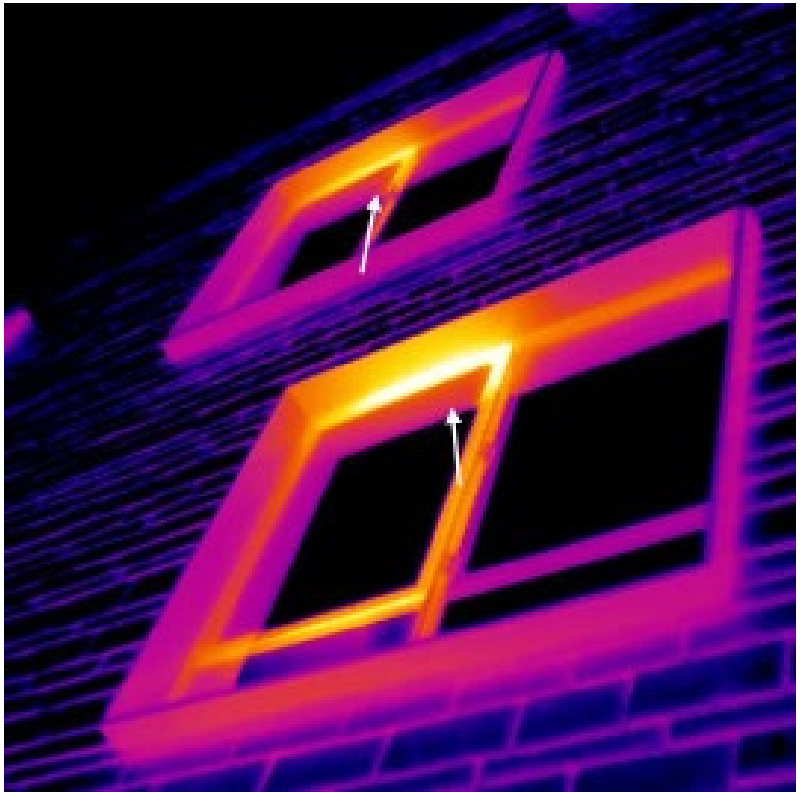




Whole-Building Testing, IECC C402.5







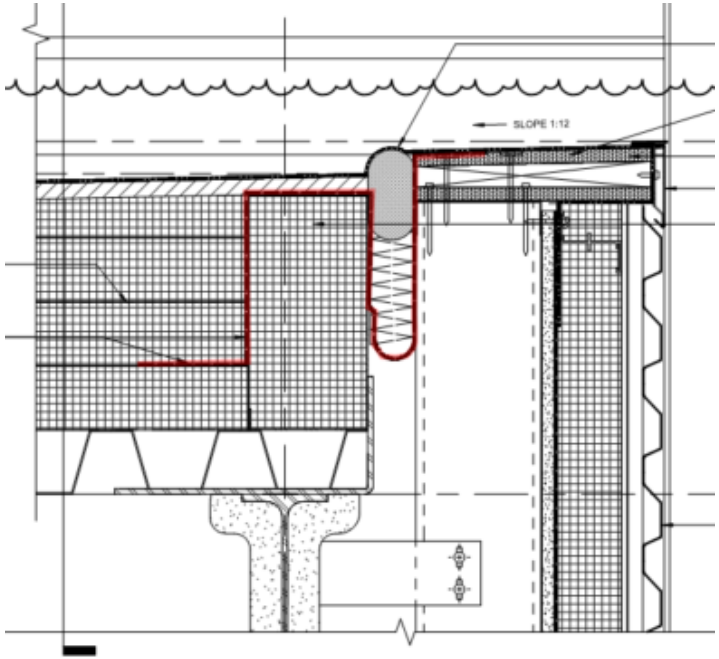
Air Quality

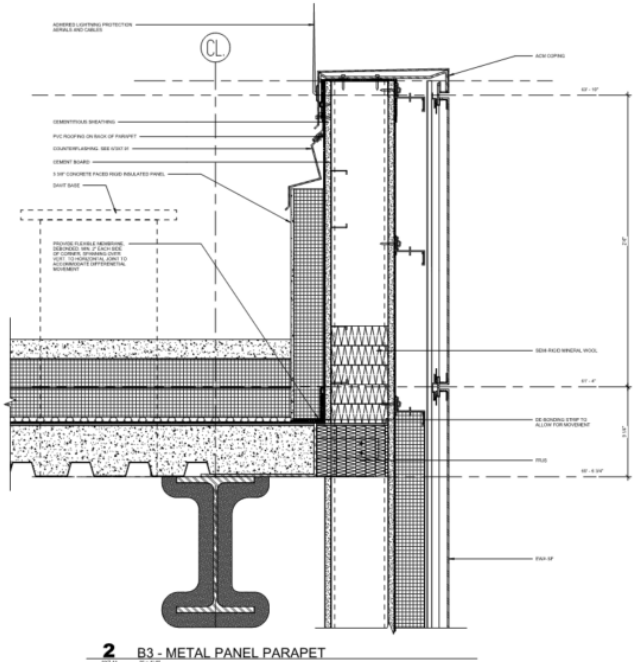
Increased Air Tightness

+

Higher Moisture from Climate

Continuity of the Air Control at Parapets

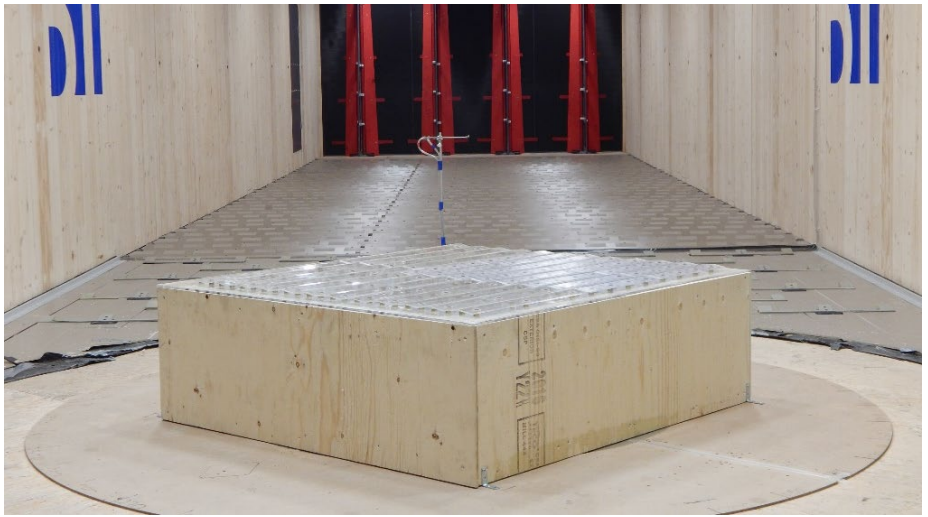




2 B3 - METAL PANEL PARAPET

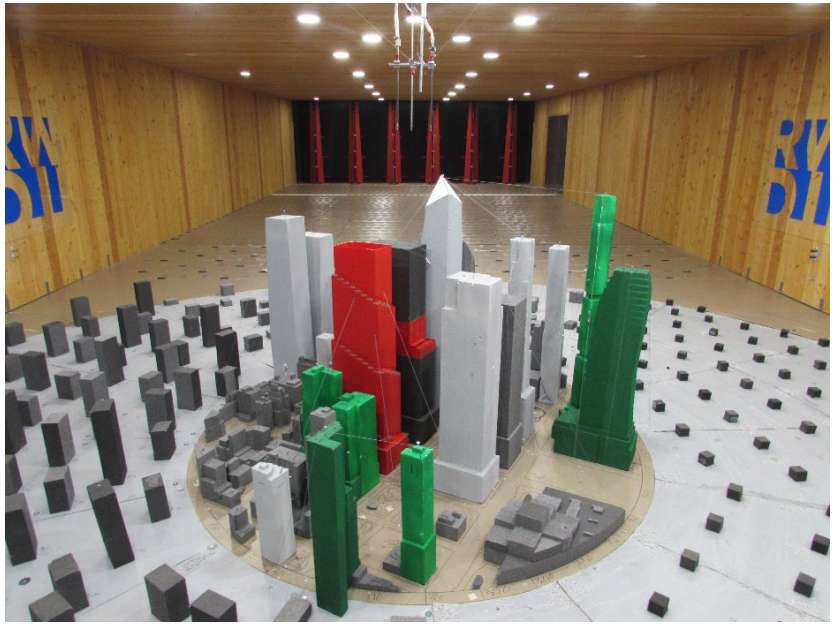
Wind Testing

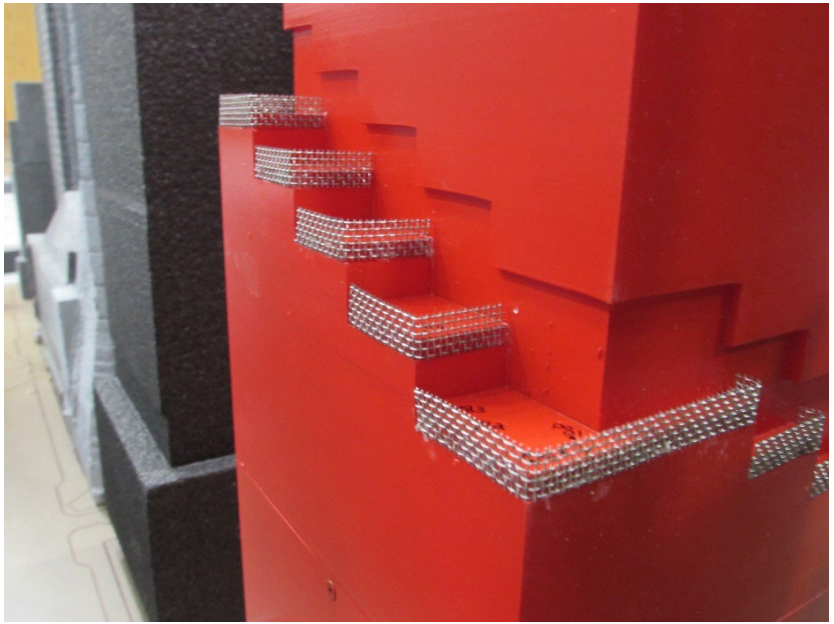
Ballasted roof-top solar arrays



Wind Testing

Wind loads on roof paver systems and impact of mitigation





Wind Testing

Behavior of outdoor furnishings under strong winds

5

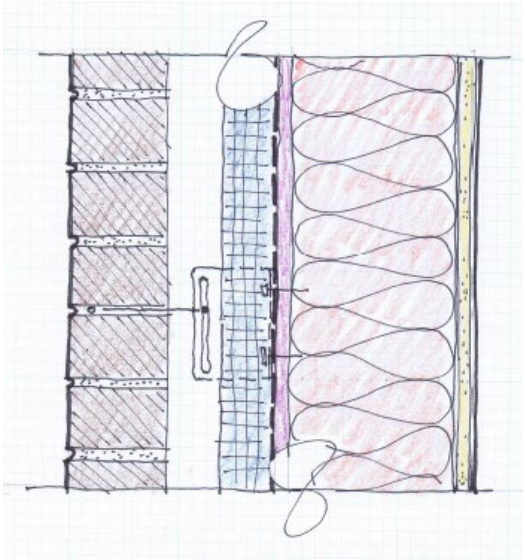
RESILIENCY

Resiliency

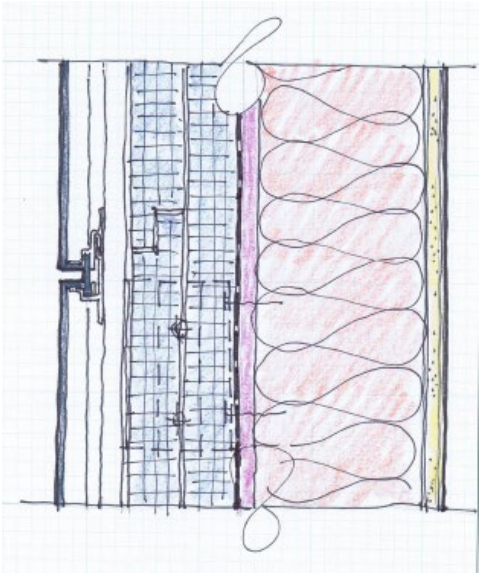
	Durability	Environmental Impact	Future Casting
	Energy Use		Carbon Emissions Thermal Efficiency Solar Gains
	Maintenance and Reliability		Embodied Carbon Disruption of Use Air and Water Leakage
	Catastrophic Event Function		Longevity of Occupancy Loss of Functionality
	Security Requirements and Risks		Impact Resistance Air Quality Internal Isolation

Maintenance & Reliability

Drained Cavity Wall

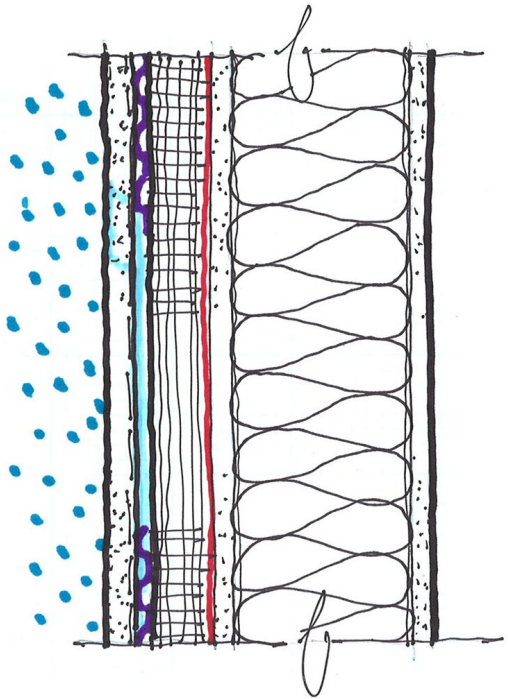


Rainscreens

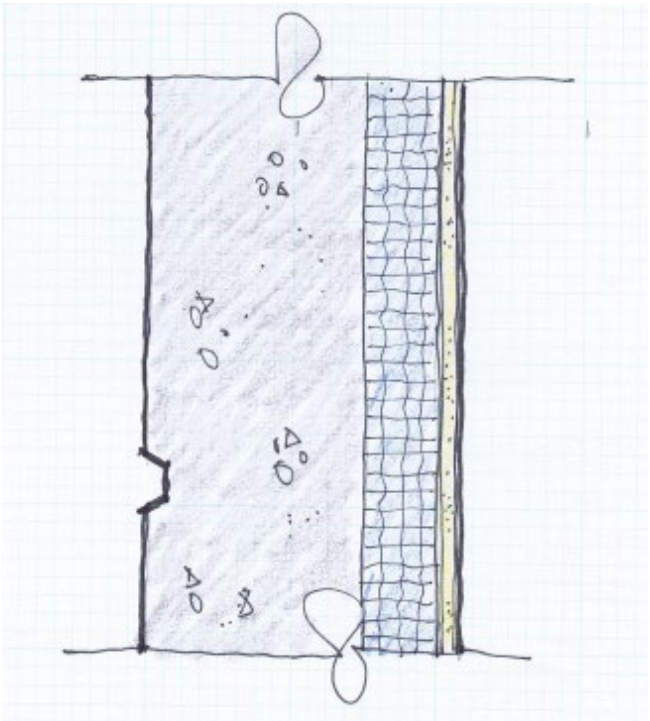


Unproven Reliability

Drainage Plane Walls



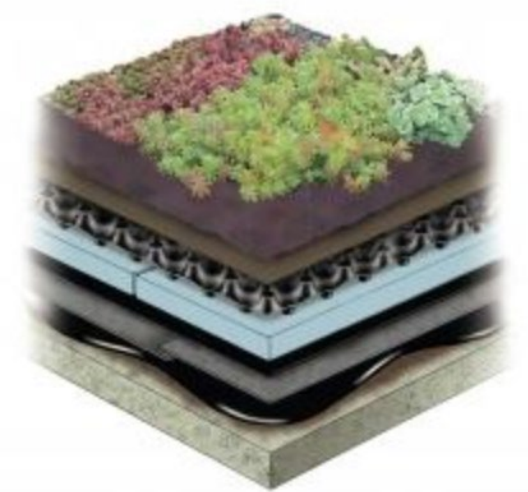
Mass Walls



Reliable Roofs

Design for reliability, maintenance, and continuity

Recommend an IRMA assembly with highly reliable waterproofing membrane



Summary

WARMER

Changing energy goals

Predictive Performance

WETTER

Reliability of Enclosure

Condensation and Vapor control

WINDIER

Air leakage control

Durability and Robustness

RESILIENCY

Reliable and Robust Systems

Passive survivability

Redefining possible.

Thank You

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