BEST6

TEACHING PERFORMANCE

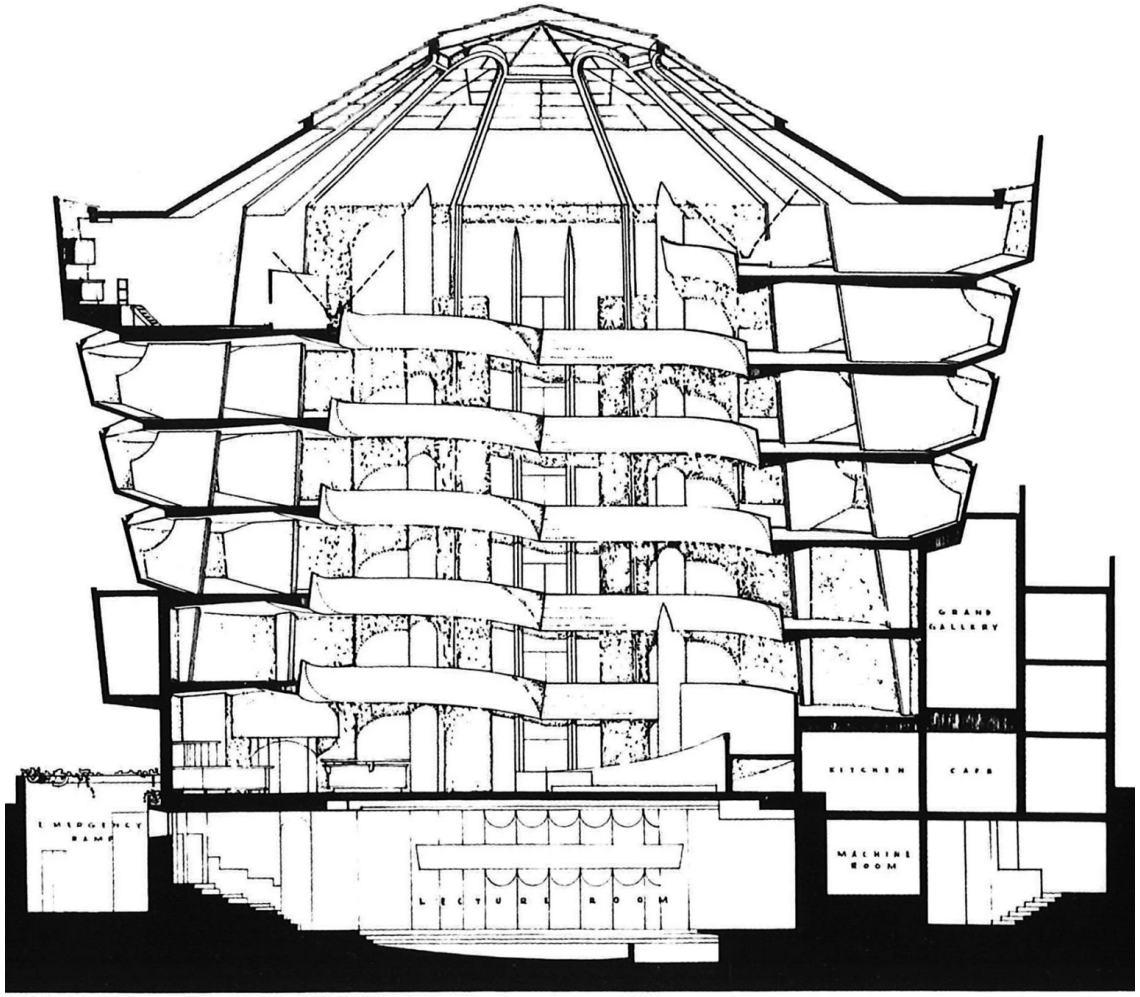
Architectural Simulation in the Studio

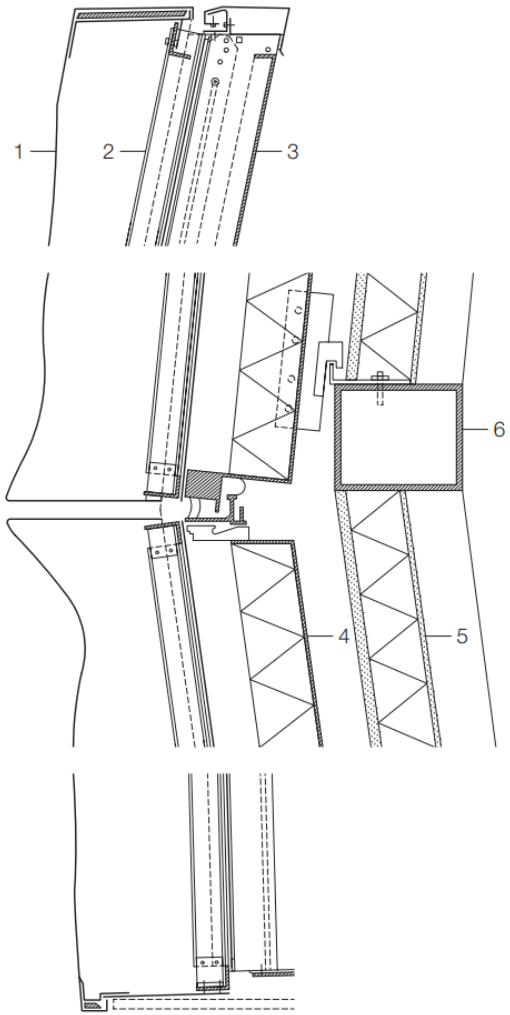
Clarke Snell, RA
Associate Professor of Architecture, New York Institute of Technology

CONTEXT

Architecture school curriculum is not in sync with contemporary building performance requirements.


GENHEIM
THE SOLOMON R GUGGENHEIM
USEUM
NYC TAXI


GRAND GALLERY
KITCHEN
CAFE
MACHINE ROOM
LECTURE ROOM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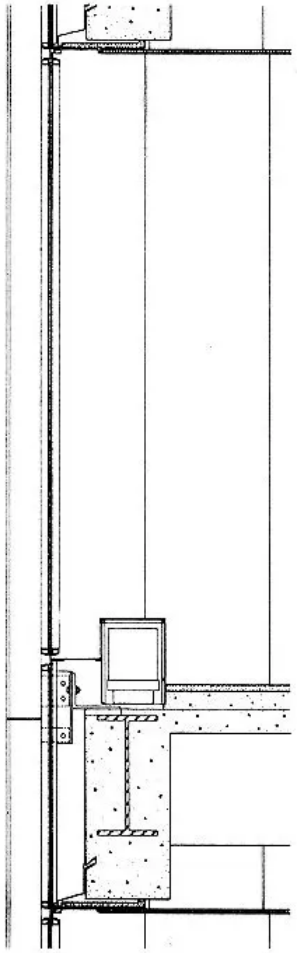

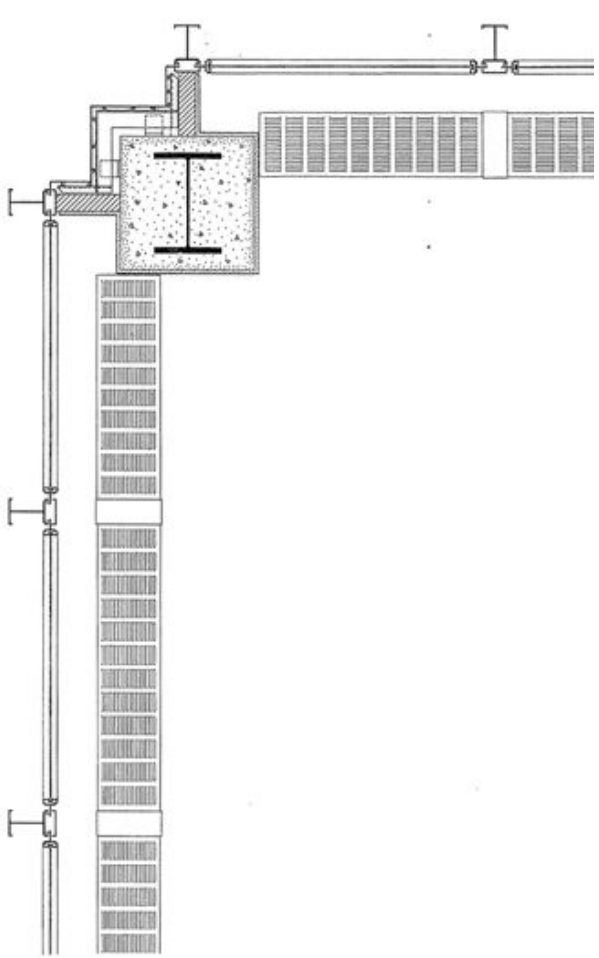

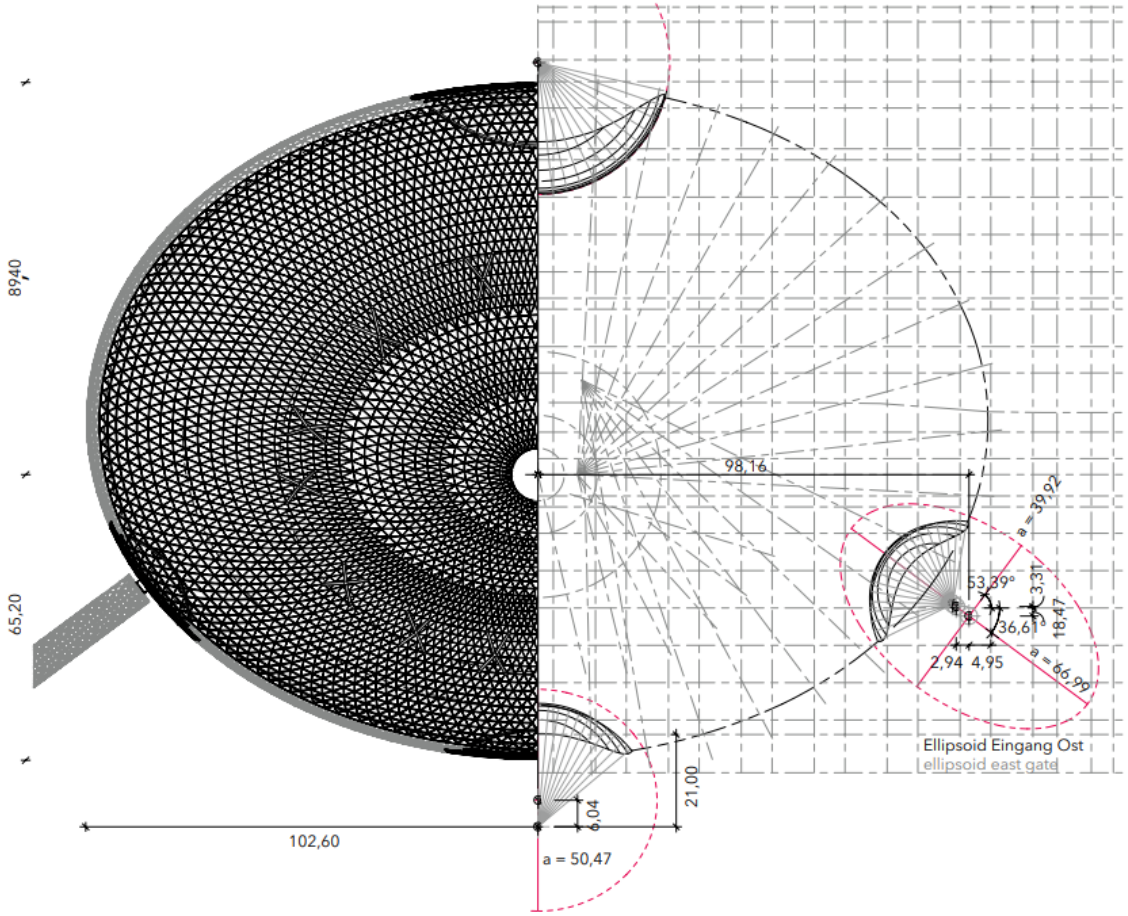
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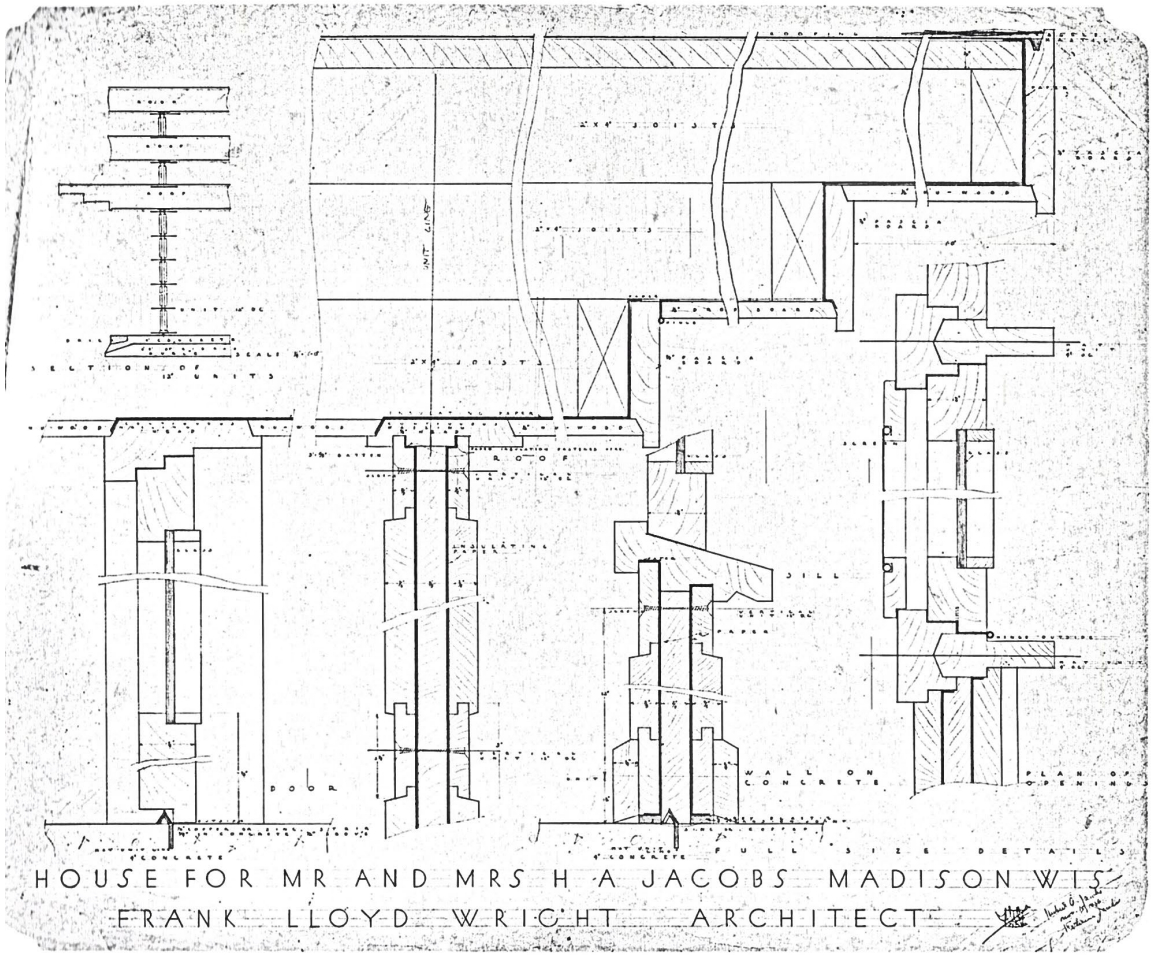
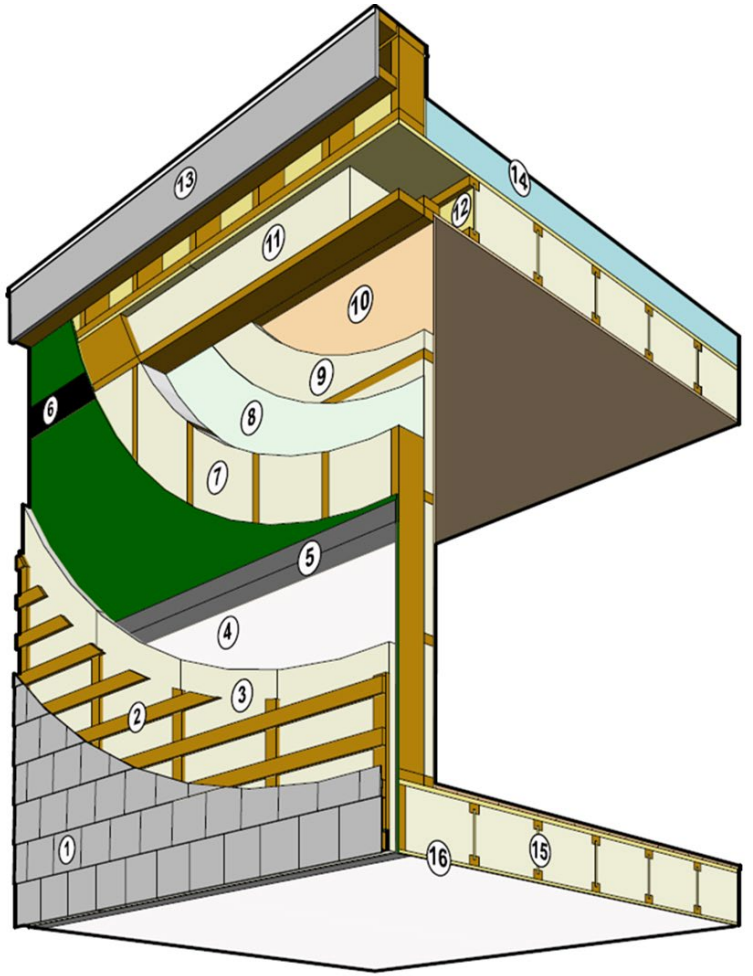

HOUSE FOR MR AND MRS H A JACOBS MADISON WIS
FRANK LLOYD WRIGHT ARCHITECT

1. Vapour permeable skin
2. Rainscreen furring
3. Exterior mineral wool
4. ABS sheet floodproofing
5. Marine caulk and tape detail
6. Vapour open sheathing taped at joints
7. Stud frame with mineral wool
8. Continuous vapour open air barrier taped at seams
9. Interior insulated chase
10. Interior finish
11. Roof cavity insulation
12. I-Joist to limit break in insulation
13. Parapet frame and fascia
14. Typical roof membrane system with sloped insulation
15. Floor and wall structure designed to resist flood buoyancy forces
16. ABS floodproofing continuous under the floor system



NYCEEC

Local Law 97 – Building Emissions Limits

Executive Summary

Local Law 97 of 2019, as amended by Local Law 147 of 2019 and Local Law 95 of 2020 (the "Law") designates **annual building emissions intensity limits** which cap the amount of greenhouse gas emissions large buildings in New York City can produce. Buildings covered by the law will be required to report their greenhouse gas emissions intensity to the City for 2024 and every subsequent year. Starting in 2025, penalties will be assessed for exceeding a building's emissions intensity limit for the prior year. These penalties are intended to be costlier than renovating the building to emit less. Read Local Law 97.

Overview

Under the Law, emissions are described in metric tons of carbon dioxide equivalent (tCO2e). Building emissions intensity is a measure of building emissions per square foot of building area (tCO2e/sf). Buildings' emissions intensity limits will be calculated based on their occupancy types and fuel sources. Penalties of $268 per tCO2e will be assessed for buildings that exceed their building emissions intensity limit. Visit the NYC Accelerator online to access the Local Law 97 Emissions Calculator and other resources: https://www1.nyc.gov/site/nycaccelerator/index.page. For additional information, visit the Urban Green Council online (https://www.urbangreencouncil.org/content/projects/all-about-local-law-97).

What is covered

- Any building in New York City that exceeds 25,000 square feet
- Two or more buildings on the same tax lot that together exceed 50,000 square feet
- Two or more buildings held in condominium ownership that are governed by the same board of managers and that together exceed 50,000 square feet

What isn't covered

- Power generating facilities
- City-owned property
- New York City Housing Authority property
- Property owned by a Housing Development Fund Corporation
- Dedicated places of worship
- Certain types of condominiums of no more than three stories, as described in the Law

Mechanics

Building emissions intensity limits will be calculated based on each calendar year's twelve months of utility data, so buildings that are already subject to New York City's benchmarking law (Local Law 84 of 2009) will be familiar with the reporting obligations under Local Law 97.

Compliance Dates

- **(2024 – 2029)** An estimated 25% of covered buildings must reduce energy consumption to meet annual building emissions intensity limits established in 2024.
- **(2030 – 2034)** An estimated 75% of covered buildings must reduce energy consumption to meet the stricter limits established in 2030. The annual building emissions limits align with the City's goal of reducing greenhouse gas emissions citywide 40% by 2030.
- **(Future dates)** No later than January 1, 2023, the City will establish annual building emissions intensity limits applicable for subsequent years.

NYC Buildings

Energy Star Portfolio Manager (ESPM) Property Types	Building Code (BC)	Section 28-320.3.1 Item #	2024 – 2029 BC Building Emissions Intensity Limit (tCO2e/sf)	Section 28-320.3.1 Item #	2024 – 2029 ESPM Building Emissions Factor (tCO2e/sf)
Adult Education	B	2	0.00846	3	0.00758
Ambulatory Surgical Center	B*	6	0.02381	7	0.01181
Automobile Dealership	B	2	0.00846	9	0.00675
Bank Branch	B	2	0.00846	8	0.00987
Bowling Alley	A-3	1	0.01074	5	0.00574
College/University	B	2	0.00846	8	0.00987
Convenience Store without Gas Station	M	7	0.01181	9	0.00675
Courthouse	A-3	1	0.01074	10	0.00426
Data Center	B	2	0.00846	6	0.02381
Distribution Center	S	10	0.00426	5	0.00574
Enclosed Mall	M	7	0.01181	1	0.01074
Financial Office	B	2	0.00846	2	0.00846
Fitness Center/Health Club/Gym	A-3	1	0.01074	8	0.00987
Food Sales	M	7	0.01181	7	0.01181
Food Service	M	7	0.01181	7	0.01181
Hospital (General Medical & Surgical)	I-2	6	0.02381	6	0.02381
Hotel	R-1	8	0.00987	8	0.00987
K-12 School	E	3	0.00758	9	0.00675
Laboratory	B*	6	0.02381	6	0.02381
Library	B	2	0.00846	9	0.00675
Lifestyle Center	M	7	0.01181	2	0.00846
Mailing Center/Post Office	B	2	0.00846	10	0.00426
Manufacturing/Industrial Plant	F	5	0.00574	3	0.00758
Medical Office	B	2	0.00846	1	0.01074
Movie Theater	A-1	1	0.01074	7	0.01181
Multifamily Housing	R-2	9	0.00675	9	0.00675
Museum	A-3	1	0.01074	7	0.01181
Non-Refrigerated Warehouse	S-1	10	0.00426	10	0.00426
Office	B	2	0.00846	3	0.00758
Other - Education	B	2	0.00846	2	0.00846
Other - Entertainment/Public Assembly	A-3	1	0.01074	8	0.00987
Other - Lodging/Residential	R-1	8	0.00987	3	0.00758
Other - Mall	M	7	0.01181	1	0.01074

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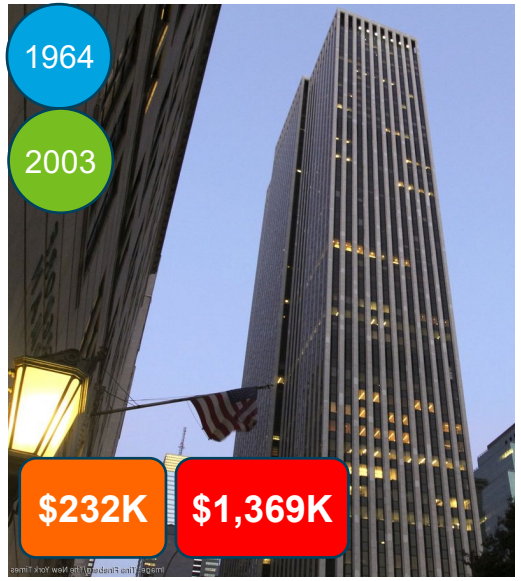
GUGGENHEIM

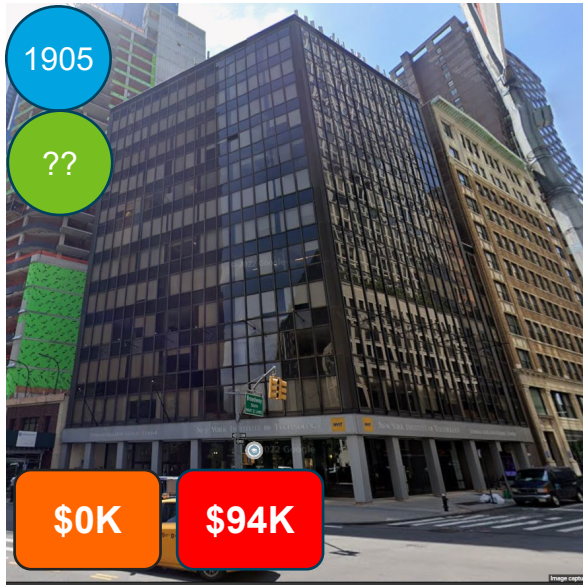


GENERAL MOTORS

BARCLAY'S

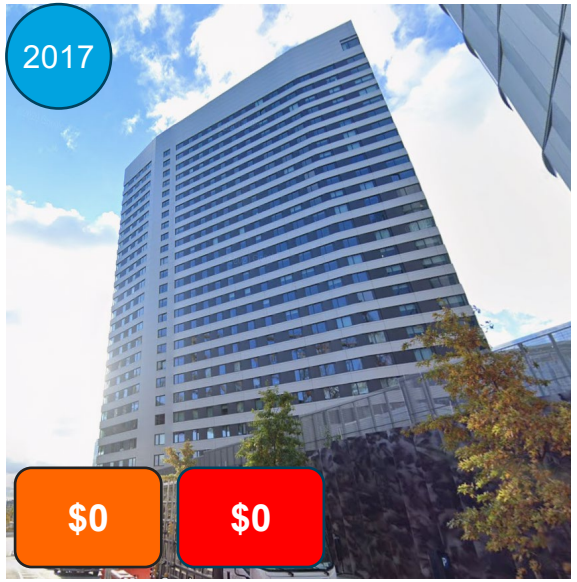
NYC LOCAL LAW 97

- constructed
- remodeled
- 2024 fine
- 2030 fine



NEW YORK TECH

BLOOMBERG CENTER



THE HOUSE AT CORNELL TECH

PROBLEM

How do we teach aspiring architects to design to current building performance standards?

OUR APPROACH

Teach performance simulation workflows that are tied to specific quantitative professional benchmarks.

Combine architectural simulations as a corequisite with comprehensive design studio so that workflows are immediately applied as inputs to an iterative design process.

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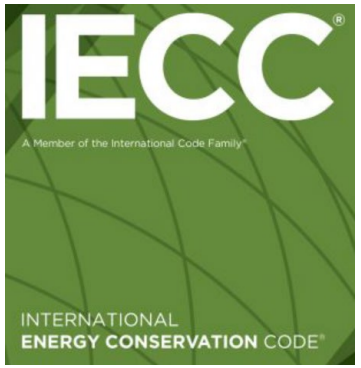
Combine architectural simulations as a corequisite with comprehensive design studio so that workflows are immediately applied as inputs to an iterative design process.


IBC
INTERNATIONAL
BUILDING
CODE


LIVING
BUILDING
CHALLENGE


U.S. GREEN BUILDING COUNCIL
LEED
USGBC
LEED
V4


IECC
A Member of the International Code Family
INTERNATIONAL
ENERGY CONSERVATION CODE


NYC
LOCAL LAW
97

Performance included in the studio project program. For this example:

<u>Design a 45,000sf office building that meets:</u>

1. Local building code
2. Living Building Challenge zero net water usage
3. LEED 4.1 Option 1 Daylighting (3 points)
4. NYC Local Law 97 compliance.


EnergyPlus


O S


Windows & Daylighting Group
LBNL
Therm
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All rights reserved. This program is protected by U.S. and
International copyright laws as described in the About box.
Funded by the U.S. Department of Energy


eQUEST


DesignBuilder
SOFTWARE


cove.tool


VECTORWORKS


flixo


SketchUp


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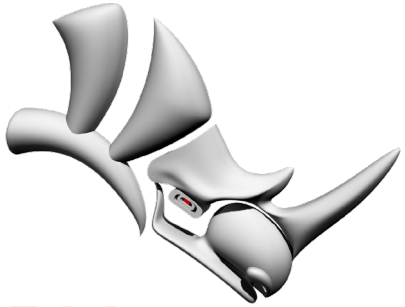
Rhinoceros


Pollination


EnergyPlus

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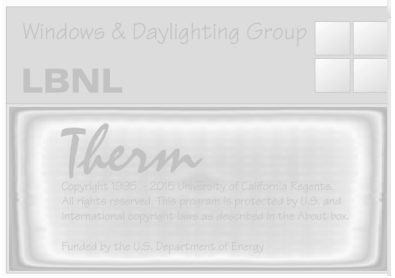
Windows & Daylighting Group
LBNL
Therm


eQUEST


DesignBuilder
SOFTWARE


cove.tool


VECTORWORKS


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SketchUp


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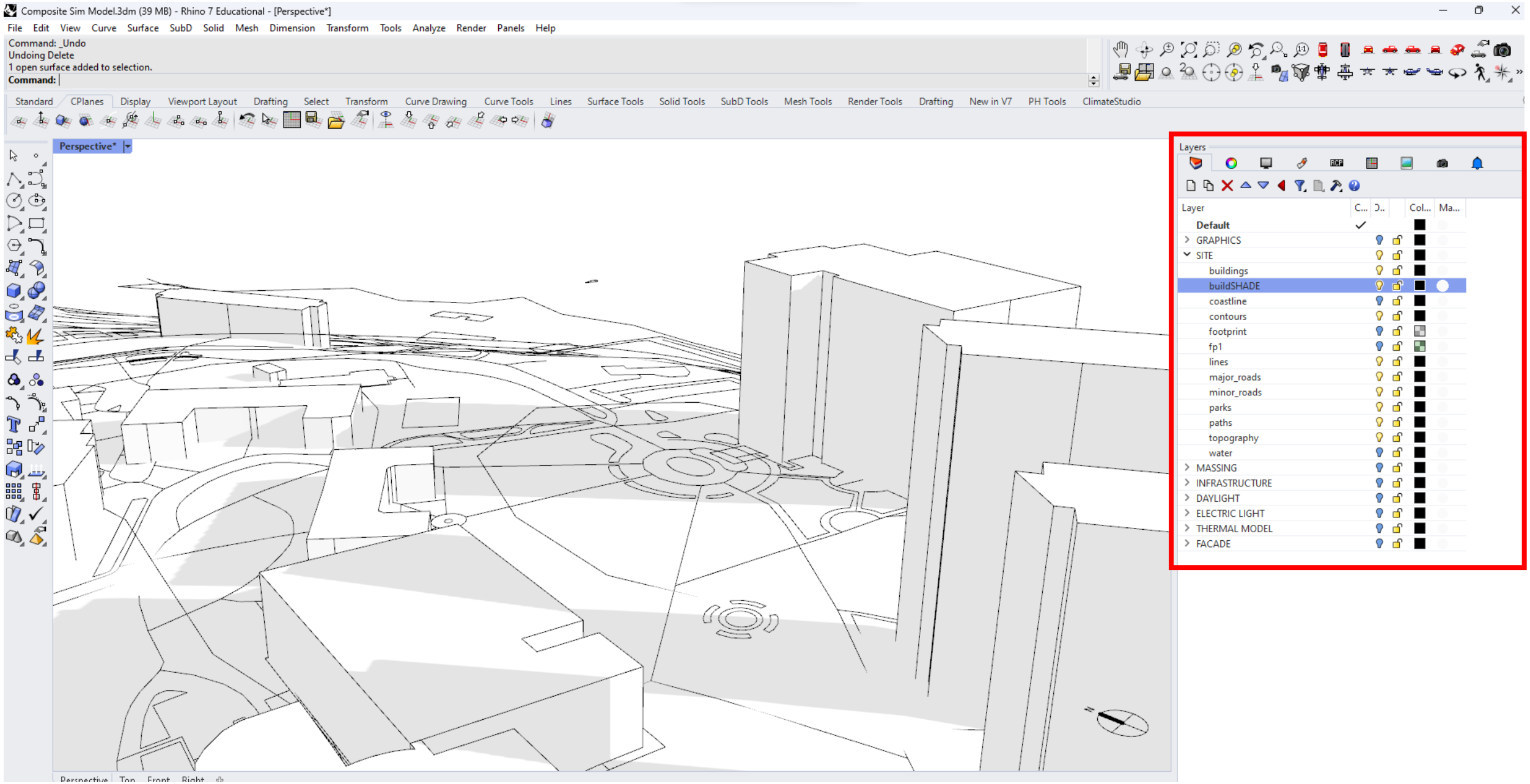
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Undoing Delete
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Perspective*
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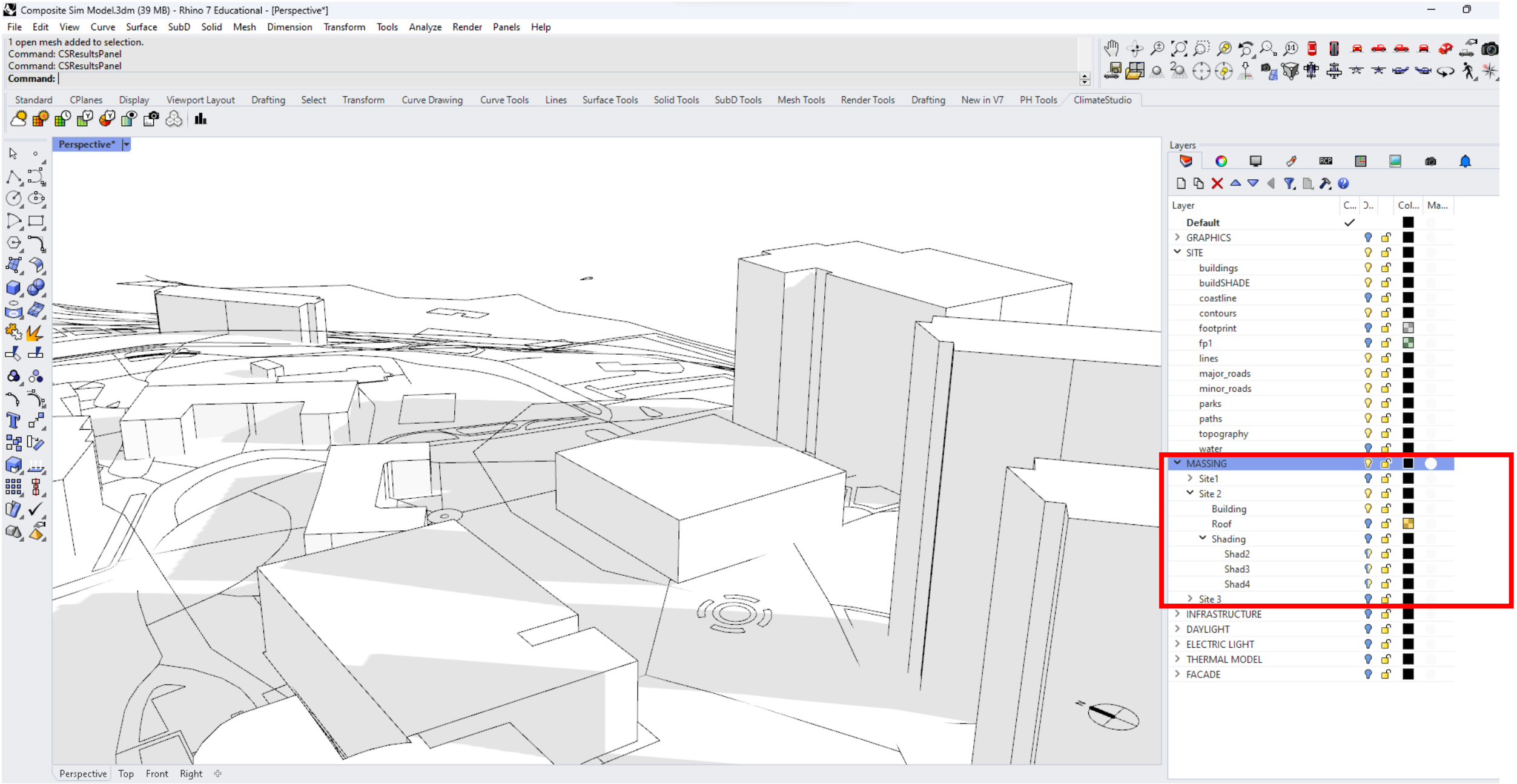
MASSING
INFRASTRUCTURE
DAYLIGHT
ELECTRIC LIGHT
THERMAL MODEL
FACADE
Perspective Top Front Right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Perspective*
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paths
topography
water
MASSING
Site1
Site 2
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Roof
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DAYLIGHT
ELECTRIC LIGHT
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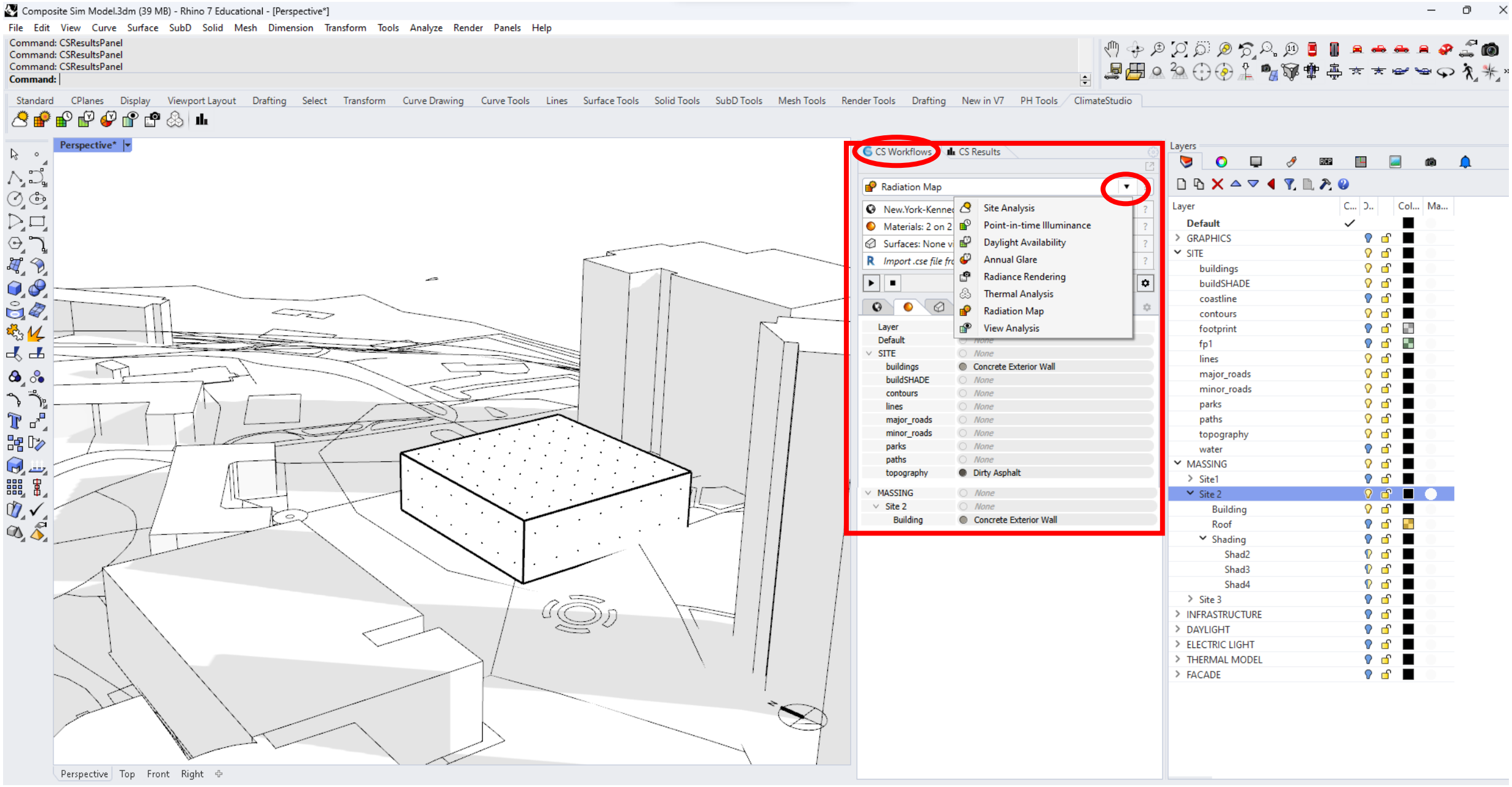
FACADE
Perspective Top Front Right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Perspective*
CS Workflows
CS Results
Radiation Map
Site Analysis
Point-in-time Illuminance
Daylight Availability
Annual Glare
Radiance Rendering
Thermal Analysis
Radiation Map
View Analysis
Layer
Default
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contours
lines
major_roads
minor_roads
parks
paths
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MASSING
Site 2
Building
Concrete Exterior Wall
Dirty Asphalt
None
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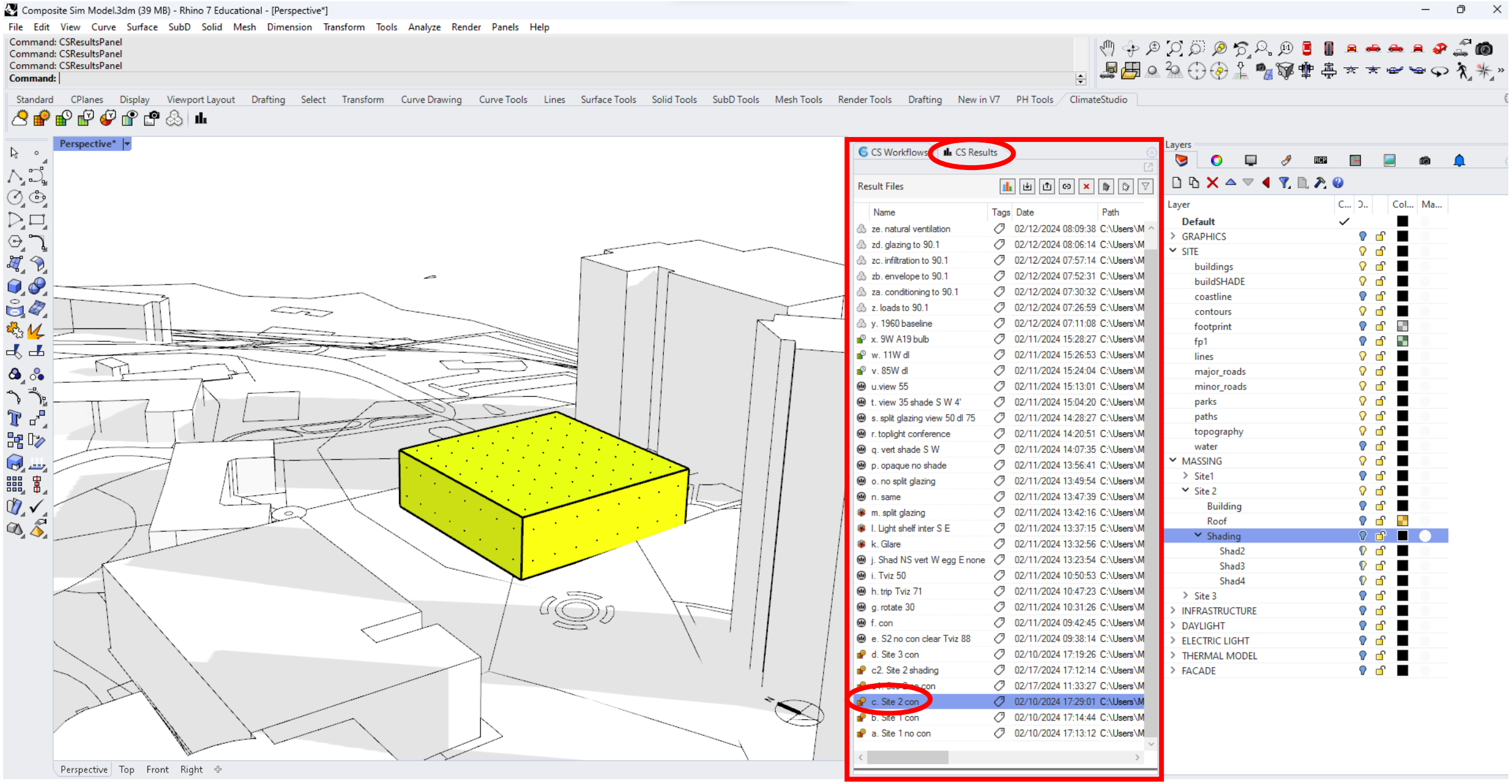
FACADE
Perspective Top Front Right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Perspective*
Perspective Top Front Right
CS Workflows
CS Results
Result Files
Name Tags Date Path
ze. natural ventilation 02/12/2024 08:09:38 C:\Users\M
zd. glazing to 90.1 02/12/2024 08:06:14 C:\Users\M
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v. 85W dl 02/11/2024 15:24:04 C:\Users\M
u.view 55 02/11/2024 15:13:01 C:\Users\M
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s. split glazing view 50 dl 75 02/11/2024 14:28:27 C:\Users\M
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n. same 02/11/2024 13:47:39 C:\Users\M
m. split glazing 02/11/2024 13:42:16 C:\Users\M
l. Light shelf inter S E 02/11/2024 13:37:15 C:\Users\M
k. Glare 02/11/2024 13:32:56 C:\Users\M
j. Shad NS vert W egg E none 02/11/2024 13:23:54 C:\Users\M
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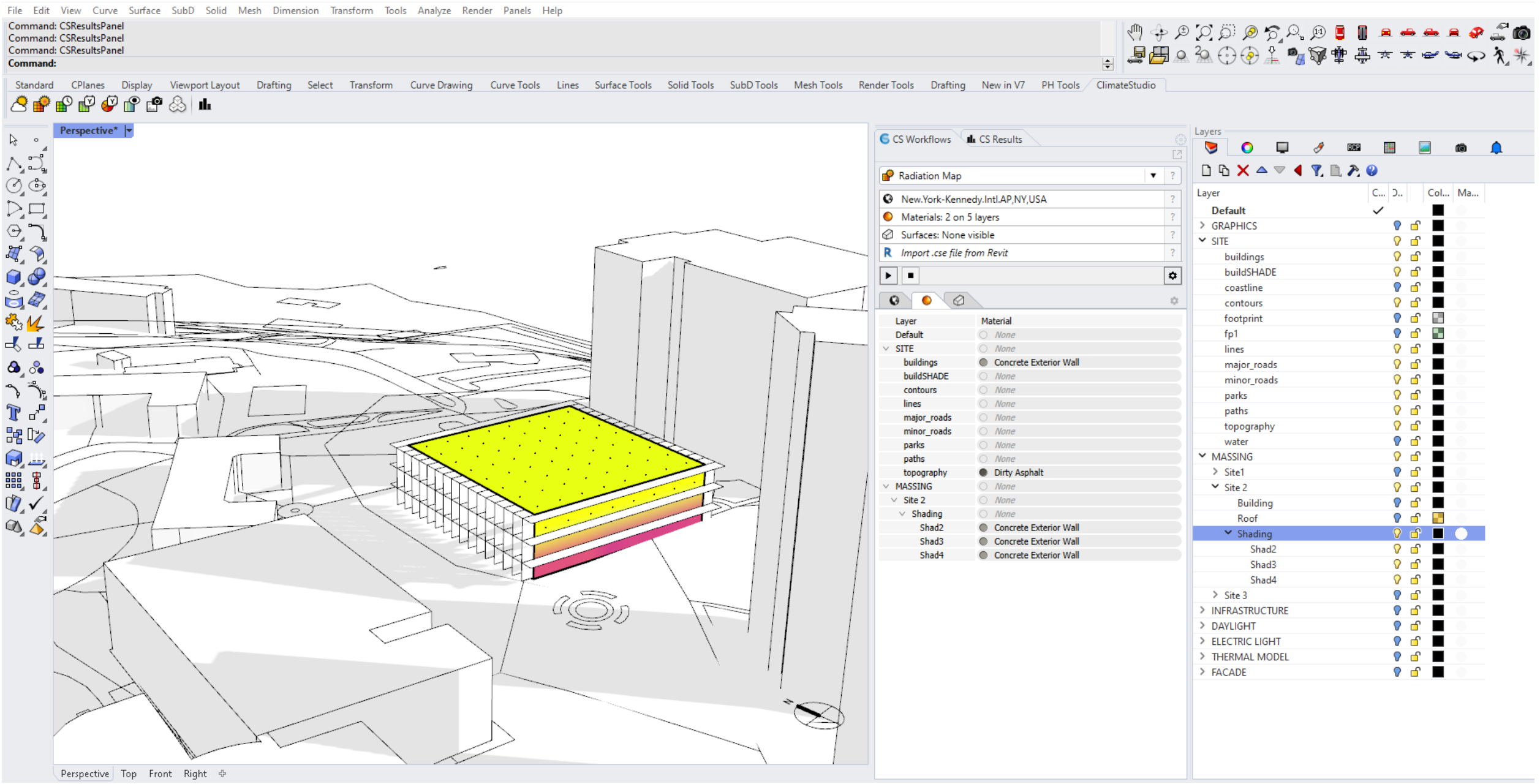
f. con 02/11/2024 09:42:45 C:\Users\M
e. S2 no con clear Tviz 88 02/11/2024 09:38:14 C:\Users\M
d. Site 3 con 02/10/2024 17:19:26 C:\Users\M
c2. Site 2 shading 02/17/2024 17:12:14 C:\Users\M
02/17/2024 11:33:27 C:\Users\M
c. Site 2 con 02/10/2024 17:29:01 C:\Users\M
b. Site 1 con 02/10/2024 17:14:44 C:\Users\M
a. Site 1 no con 02/10/2024 17:13:12 C:\Users\M
Layers
Layer C... D... Col... Ma...
Default
GRAPHICS
SITE
buildings
buildSHADE
coastline
contours
footprint
fp1
lines
major_roads
minor_roads
parks
paths
topography
water
MASSING
Site1
Site 2
Building
Roof
Shading
Shad2
Shad3
Shad4
Site 3
INFRASTRUCTURE
DAYLIGHT
ELECTRIC LIGHT
THERMAL MODEL
FACADE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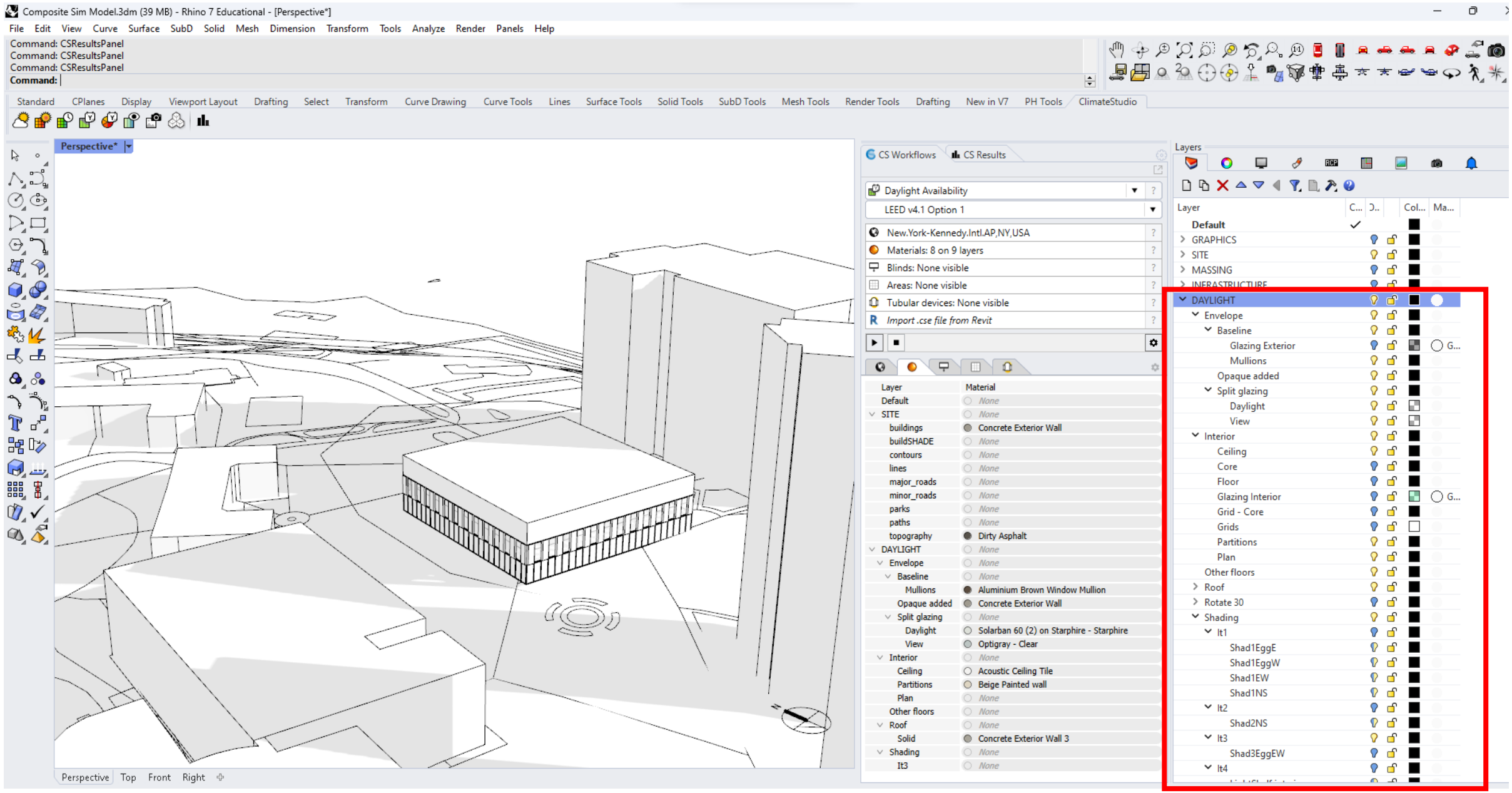
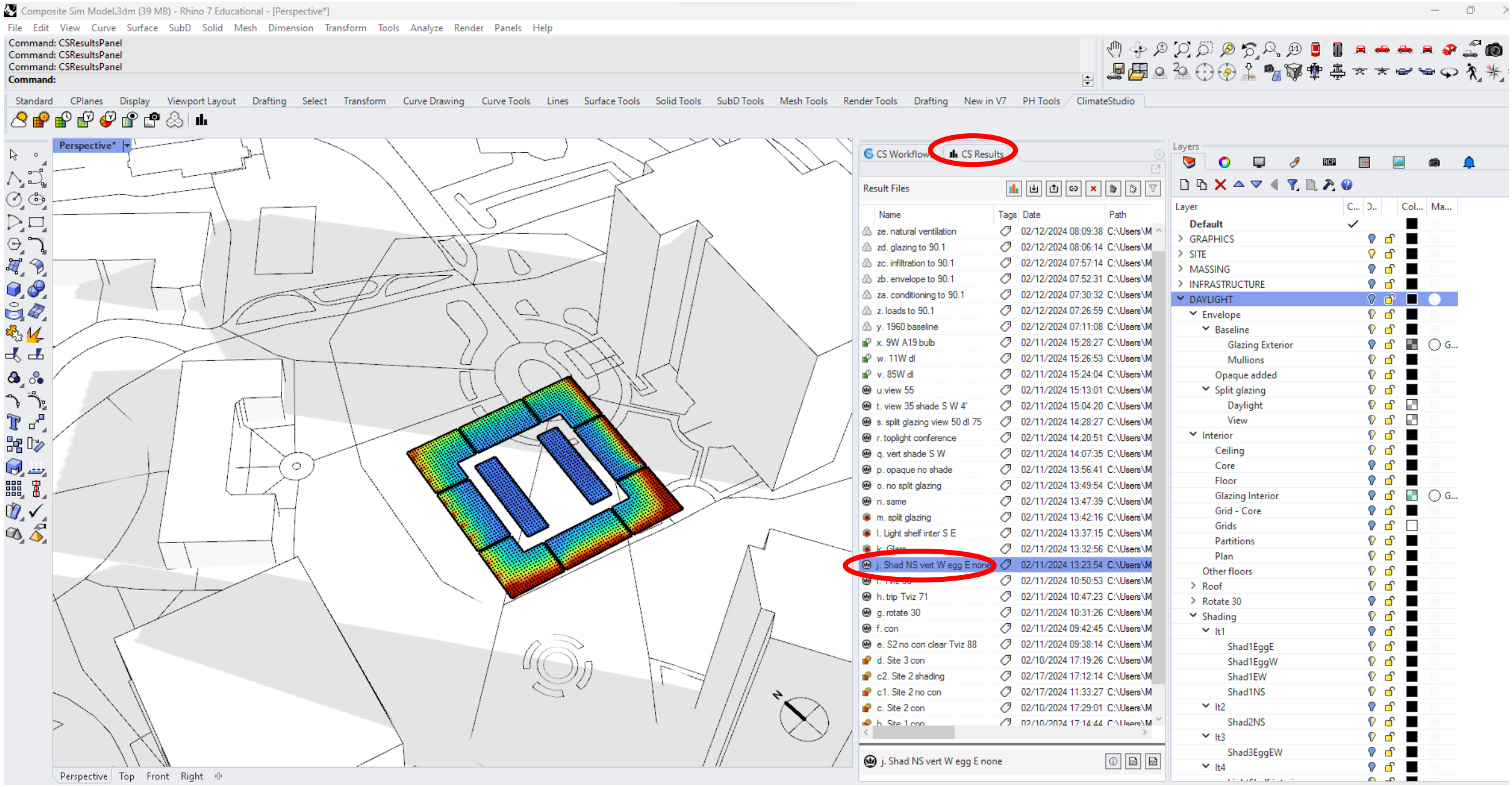
Command: CSResultsPanel
Command: CSResultsPanel
Command: CSResultsPanel
Command:
Standard CPlanes Display Viewport Layout Drafting Select Transform Curve Drawing Curve Tools Lines Surface Tools Solid Tools SubD Tools Mesh Tools Render Tools Drafting New in V7 PH Tools ClimateStudio
Perspective*
Perspective Top Front Right
CS Workflows
CS Results
Radiation Map
New.York-Kennedy.Intl.AP,NY,USA
Materials: 2 on 5 layers
Surfaces: None visible
Import .cse file from Revit
Layer Material
Default None
SITE None
buildings Concrete Exterior Wall
buildSHADE None
contours None
lines None
major_roads None
minor_roads None
parks None
paths None
topography Dirty Asphalt
MASSING None
Site 2 None
Shading None
Shad2 Concrete Exterior Wall
Shad3 Concrete Exterior Wall
Shad4 Concrete Exterior Wall
Layers
Layer C... D.. Col... Ma...
Default
GRAPHICS
SITE
buildings
buildSHADE
coastline
contours
footprint
fp1
lines
major_roads
minor_roads
parks
paths
topography
water
MASSING
Site1
Site 2
Building
Roof
Shading
Shad2
Shad3
Shad4
Site 3
INFRASTRUCTURE
DAYLIGHT
ELECTRIC LIGHT
THERMAL MODEL
FACADE


Composite Sim Model.3dm (39 MB) - Rhino 7 Educational - [Perspective*]
File Edit View Curve Surface SubD Solid Mesh Dimension Transform Tools Analyze Render Panels Help
Command: CSResultsPanel
Command: CSResultsPanel
Command: CSResultsPanel
Command:
Standard CPlanes Display Viewport Layout Drafting Select Transform Curve Drawing Curve Tools Lines Surface Tools Solid Tools SubD Tools Mesh Tools Render Tools Drafting New in V7 PH Tools ClimateStudio
Perspective*
Perspective Top Front Right
CS Workflows
CS Results
Daylight Availability
LEED v4.1 Option 1
New.York-Kennedy.Intl.AP,NY,USA
Materials: 8 on 9 layers
Blinds: None visible
Areas: None visible
Tubular devices: None visible
Import .cse file from Revit
Layer Material
Default None
SITE None
buildings Concrete Exterior Wall
buildSHADE None
contours None
lines None
major_roads None
minor_roads None
parks None
paths None
topography Dirty Asphalt
DAYLIGHT None
Envelope None
Baseline None
Mullions Aluminium Brown Window Mullion
Opaque added Concrete Exterior Wall
Split glazing None
Daylight Solarban 60 (2) on Starphire - Starphire
View Optigray - Clear
Interior None
Ceiling Acoustic Ceiling Tile
Partitions Beige Painted wall
Plan None
Other floors None
Roof None
Solid Concrete Exterior Wall 3
Shading None
It3 None
Layers
Layer C... Col... Ma...
Default
GRAPHICS
SITE
MASSING
DAYLIGHT
Envelope
Baseline
Glazing Exterior
Mullions
Opaque added
Split glazing
Daylight
View
Interior
Ceiling
Core
Floor
Glazing Interior
Grid - Core
Grids
Partitions
Plan
Other floors
Roof
Rotate 30
Shading
It1
Shad1EggE
Shad1EggW
Shad1EW
Shad1NS
It2
Shad2NS
It3
Shad3EggEW
It4


Composite Sim Model.3dm (39 MB) - Rhino 7 Educational - [Perspective*]
File Edit View Curve Surface SubD Solid Mesh Dimension Transform Tools Analyze Render Panels Help
Command: CSResultsPanel
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Command: CSResultsPanel
Command:
Standard CPlanes Display Viewport Layout Drafting Select Transform Curve Drawing Curve Tools Lines Surface Tools Solid Tools SubD Tools Mesh Tools Render Tools Drafting New in V7 PH Tools ClimateStudio
Perspective*
CS Workflow
CS Results
Result Files
Name Tags Date Path
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zd. glazing to 90.1 02/12/2024 08:06:14 C:\Users\M
zc. infiltration to 90.1 02/12/2024 07:57:14 C:\Users\M
zb. envelope to 90.1 02/12/2024 07:52:31 C:\Users\M
za. conditioning to 90.1 02/12/2024 07:30:32 C:\Users\M
z. loads to 90.1 02/12/2024 07:26:59 C:\Users\M
y. 1960 baseline 02/12/2024 07:11:08 C:\Users\M
x. 9W A19 bulb 02/11/2024 15:28:27 C:\Users\M
w. 11W dl 02/11/2024 15:26:53 C:\Users\M
v. 85W dl 02/11/2024 15:24:04 C:\Users\M
u.view 55 02/11/2024 15:13:01 C:\Users\M
t. view 35 shade S W 4' 02/11/2024 15:04:20 C:\Users\M
s. split glazing view 50 dl 75 02/11/2024 14:28:27 C:\Users\M
r. toplight conference 02/11/2024 14:20:51 C:\Users\M
q. vert shade S W 02/11/2024 14:07:35 C:\Users\M
p. opaque no shade 02/11/2024 13:56:41 C:\Users\M
o. no split glazing 02/11/2024 13:49:54 C:\Users\M
n. same 02/11/2024 13:47:39 C:\Users\M
m. split glazing 02/11/2024 13:42:16 C:\Users\M
l. Light shelf inter S E 02/11/2024 13:37:15 C:\Users\M
j. Shad NS vert W egg E none 02/11/2024 13:23:54 C:\Users\M
h. trip Tviz 71 02/11/2024 10:47:23 C:\Users\M
g. rotate 30 02/11/2024 10:31:26 C:\Users\M
f. con 02/11/2024 09:42:45 C:\Users\M
e. S2 no con clear Tviz 88 02/11/2024 09:38:14 C:\Users\M
d. Site 3 con 02/10/2024 17:19:26 C:\Users\M
c2. Site 2 shading 02/17/2024 17:12:14 C:\Users\M
c1. Site 2 no con 02/17/2024 11:33:27 C:\Users\M
c. Site 2 con 02/10/2024 17:29:01 C:\Users\M
j. Shad NS vert W egg E none
Layers
Layer C... D.. Col... Ma...
Default
GRAPHICS
SITE
MASSING
INFRASTRUCTURE
DAYLIGHT
Envelope
Baseline
Glazing Exterior
Mullions
Opaque added
Split glazing
Daylight
View
Interior
Ceiling
Core
Floor
Glazing Interior
Grid - Core
Grids
Partitions
Plan
Other floors
Roof
Rotate 30
Shading
lt1
Shad1EggE
Shad1EggW
Shad1EW
Shad1NS
lt2
Shad2NS
lt3
Shad3EggEW
lt4
Perspective Top Front Right

OUR APPROACH

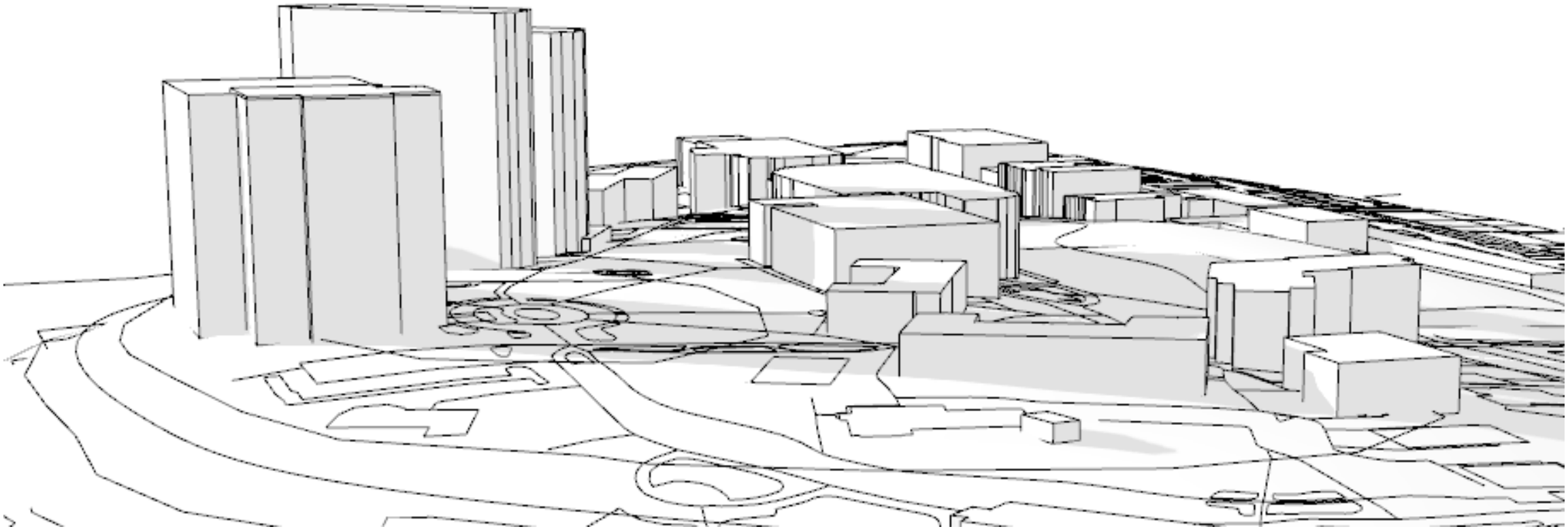
Teach performance simulation workflows that are tied to specific quantitative professional benchmarks.

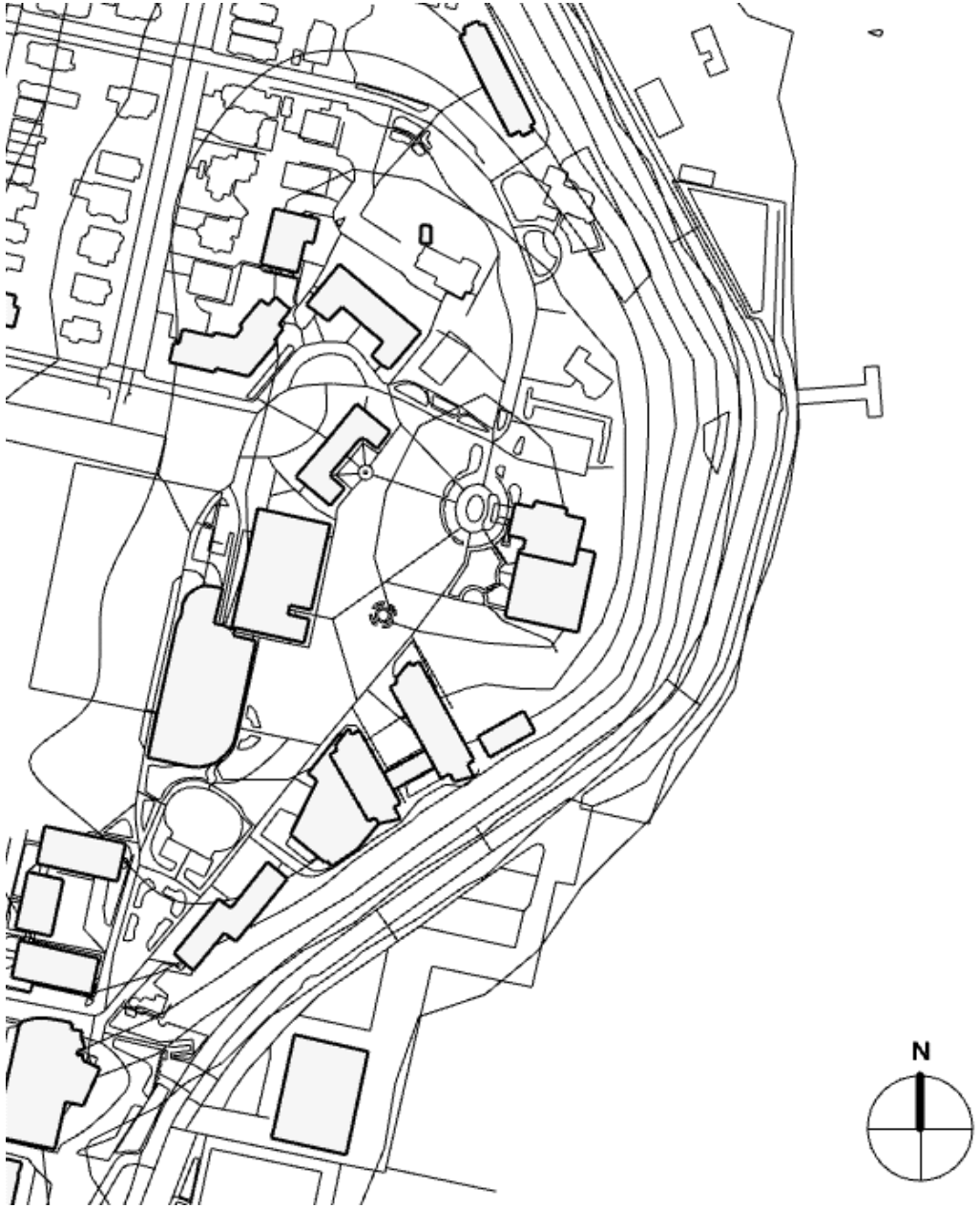
Combine architectural simulations as a corequisite with comprehensive design studio so that workflows are immediately applied as inputs to an iterative design process.

CO-REQUISITE SYLLABUS DRAFT FOR ARCH 401 AND 413								
1st Day of Week	ARCH 401		ARCH 413					
	Class	Content	Class	Lecture and Modeling	Assign.	Description	Benchmark	Video Resource
9/6	1	intro site visit	1	Intro: Why simulate?; benchmarking; building science review; climate studio overview; specific Rhino tips	Ex.1	Design a simple detached house that can be reconfigured as an apartment	—	link
9/13	2	precedent	2	Basics of daylighting; daylighting benchmarking; glazing intro; Model: Ex2	Ex.2	Lighting 1: Iterate daylighting in the house and apartment	LEED 4.1	link
	3	program/site						
9/20	4	light/energy	3	Light vs. heat: sample modeling illustrating this dynamic; Model: Ex.3	Ex.3	Lighting 2: Iterate daylighting in a Medium Office Building	LEED 4.1	link
	5	enery/water/solar						
9/27	6	review with study models	4	Climate summary data review; Model: creating a context site; Discussion: using simulations to inform studio projects	Ex.4	Site: Daylighting studies on studio study models set on project context site	LEED 4.1	link
	7							
10/4	8	structure/materials	5	Intro to Grasshopper and custom parametric simulation; Model Ex.5	Ex.5	Systems 1: Simulate and iterate parametric façade options in Grasshopper	—	link
	9							
10/11	10	circulation/egress	6	Geometry of systems and circulation (HVAC, water, and egress); Model: Ex.6	Ex. 6	Systems 2: GH egress tool; Simulating water collection and usage	Living Building Challenge	link
	11							
10/18	12	project development	7	Electric lighting and controls basics; intro to skylights; Model: Ex.12	Ex. 7	Lighting 3: Simulate skylights, electric lighting, and controls	LEED 4.1	link
	13							
10/25	14	mid-review: program/structure/material	8	Review of IEQ and human comfort; Model Ex.8	Ex.8	Thermal 1: Iterate simple box with a single window: orientation, glazing, shading	—	link
	15	systems and energy						
11/1	16	project developement	9	Review of envelope basics; Model Ex.9	Ex.9	Thermal 2: Iterate house/apartment through envelope and zoning variations.	ASHREA 90.1; Passive House; Local Law 97	link
	17							
11/8	18	envelope and energy - facade and detailing	10	Hi-performance design (thermal bridging, etc.); Model Ex.10	Ex.10	Thermal 3: Iterate larger building thorugh envelope and zoning variations.	ASHREA 90.1; Passive House; Local Law 97	link
	19	project development						
11/15	20	review: passive/active energy: models	11	Review of renewables; intro to natural ventilation; Local Law 97 crash course; Model: Ex.11	Ex.11	Thermal 4: Simulate natural ventilation and PV; Benchmark runs to Local Law 97	ASHREA 90.1; Passive House; Local Law 97	link
	21	project development and detailing						
11/22	22	open space detailing		THANKSGIVING				
	23	THANSKGIVING						
11/29	24	synthesis	12	Review of mechanical systems: Model: Ex.12	Ex.12	Systems 3: Simulate mechanical systems for comparison; choose one and size	Local Law 97	
	25	comp: physical and digital energy model						
12/6	26	final redline pin up	13	Summary: why simulate: studio project work day	Ex.13	Integration: Review and integrate simulations to date; check-in with studio projects	Comprehensive Studio Program	
	27	production						
12/12	28	final review - MA	14	Final presentations	Ex. 13	Integration: Present simulation iterations from studio project. Focus: What changes were made based on iterative simulation process?	All	
	29	final review - OW						

SIMS: SITE ANALYSIS

Change from visual, rule of thumb to quantitative analysis.




N


N

winter
solstice
9 12 3

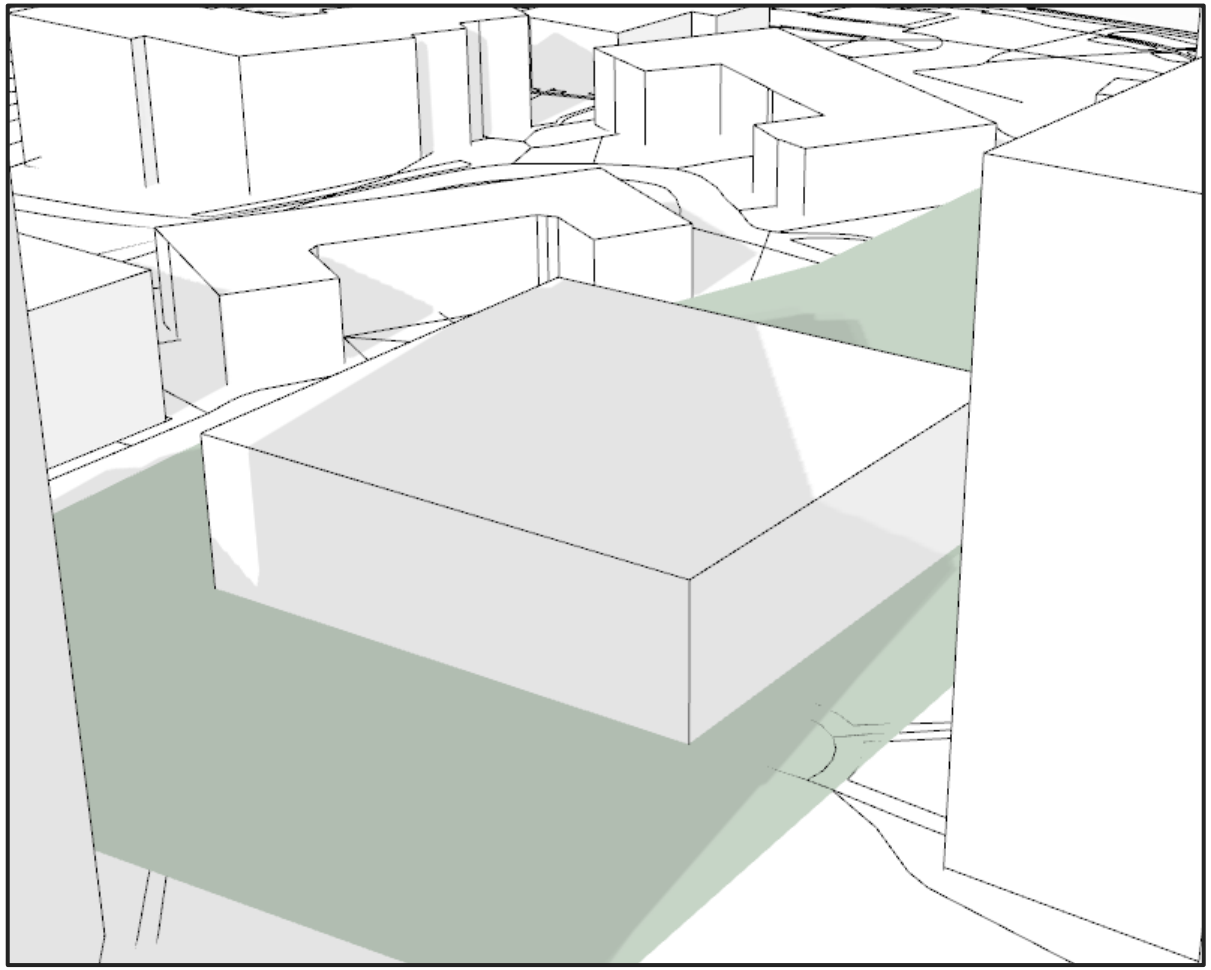
vernal
equinox
9 12 3

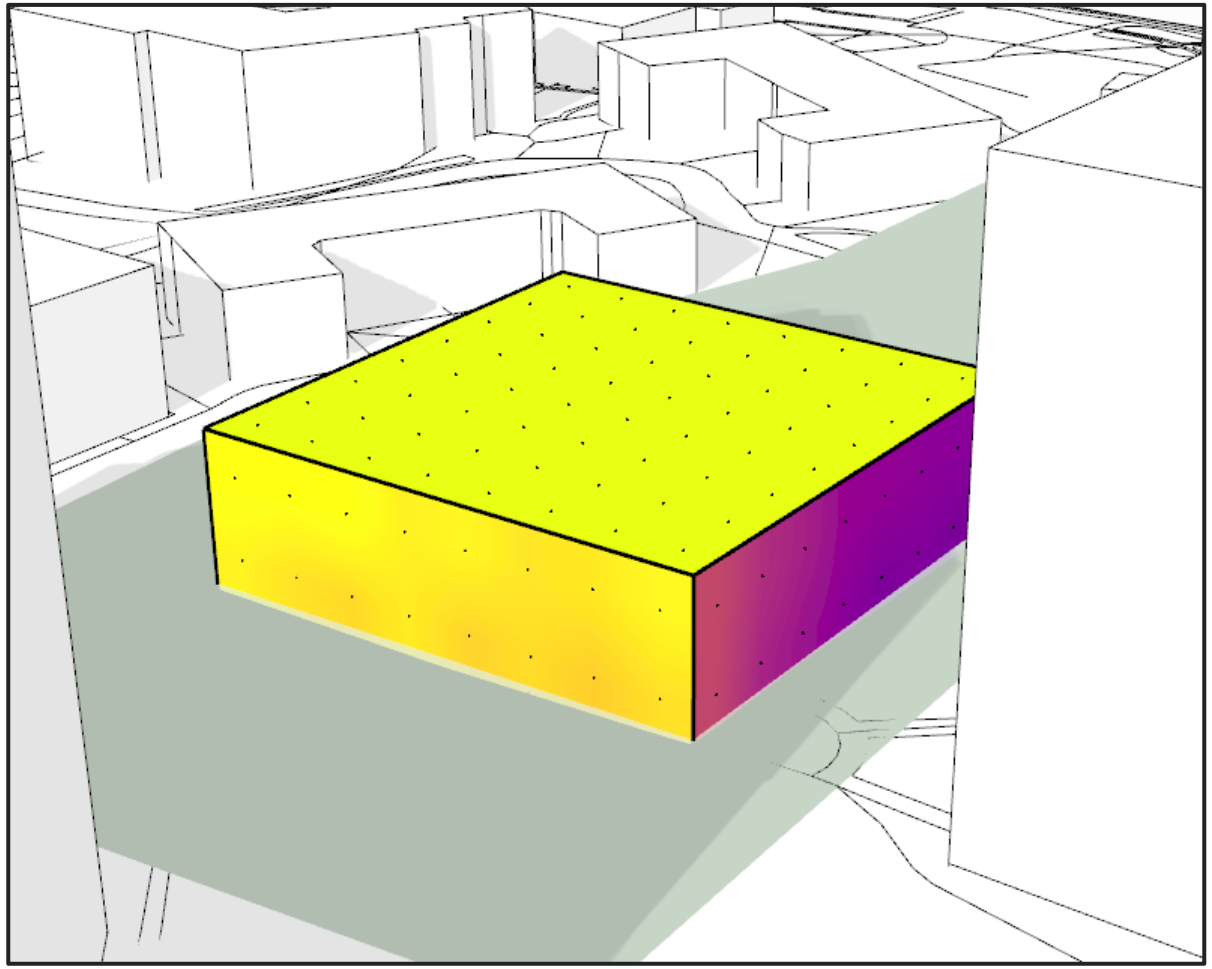
summer
solstice
9 12 3

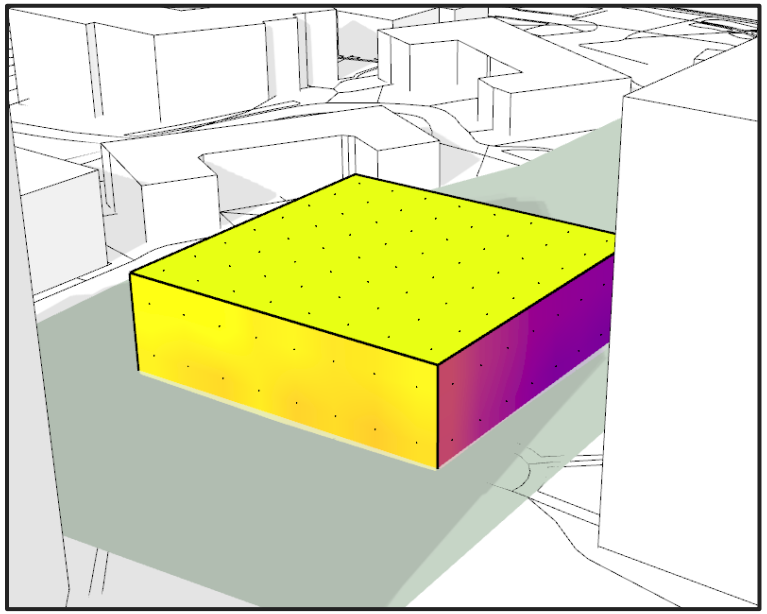
winter
solstice
9 12 3

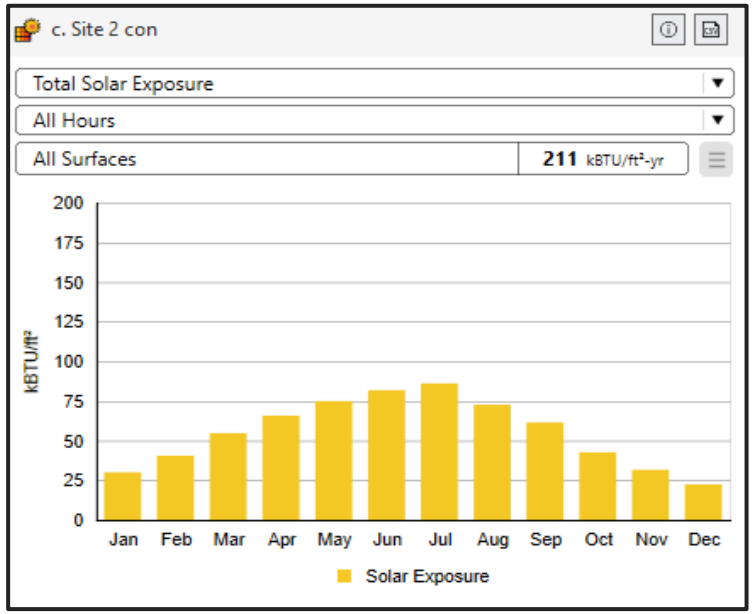
vernal
equinox
9 12 3

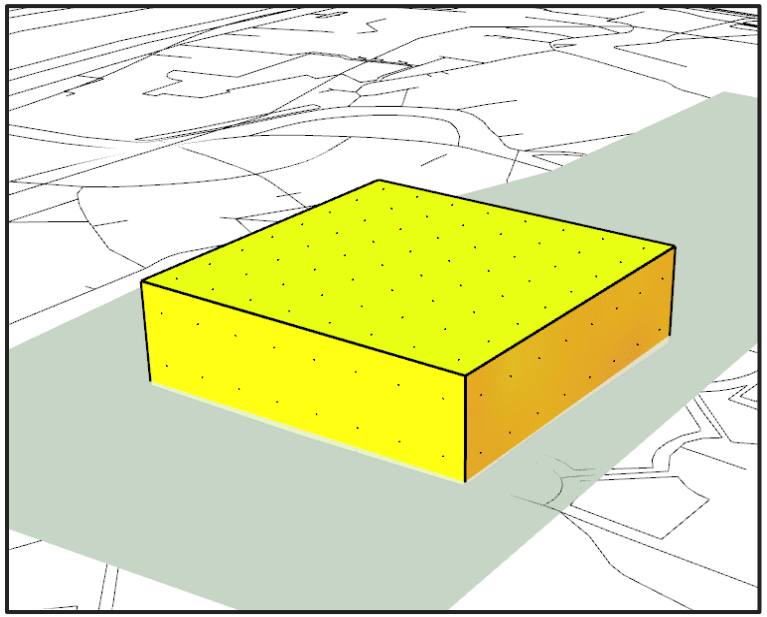
summer
solstice
9 12 3

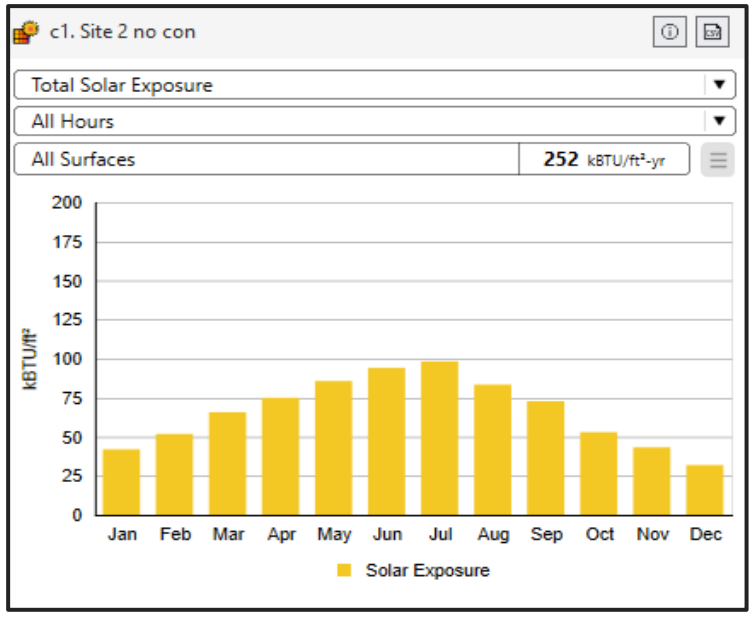








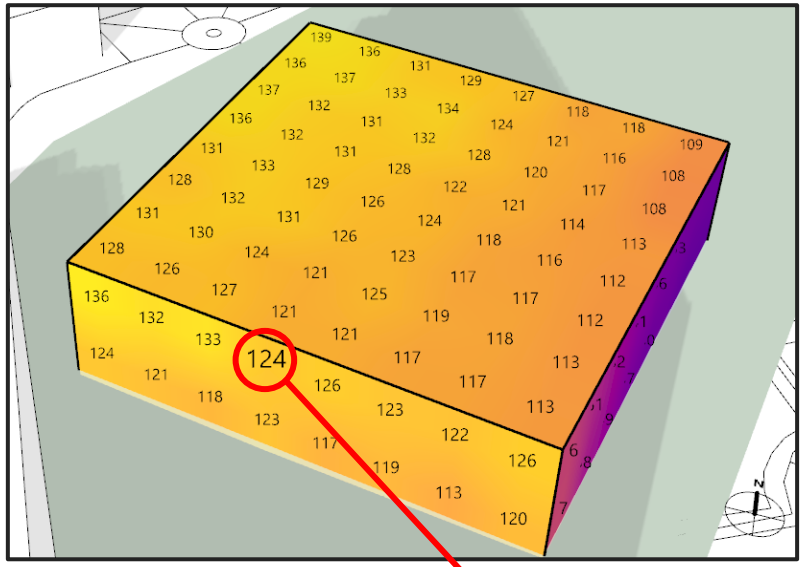


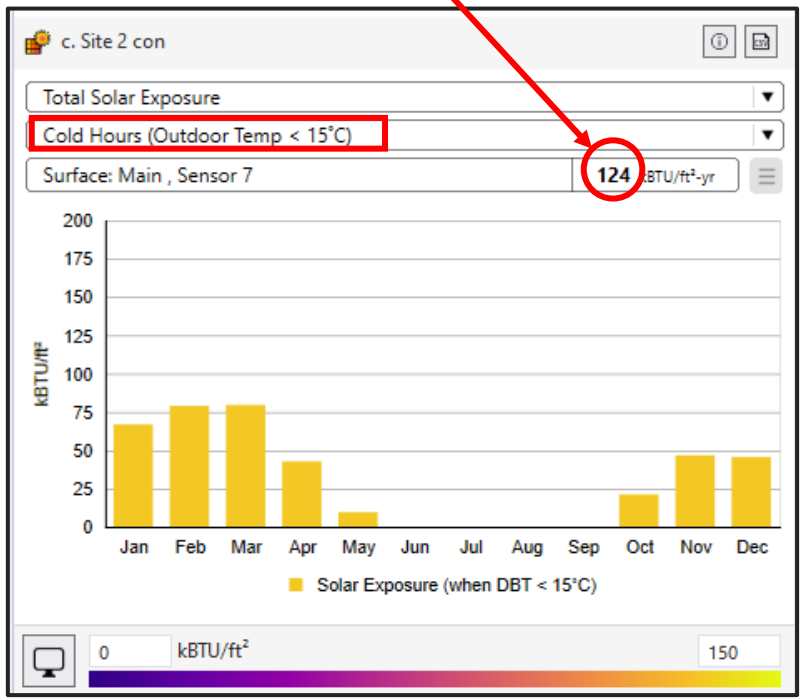


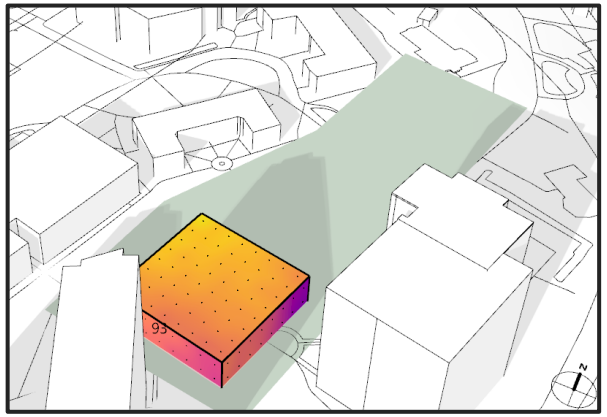
CONTEXT BUILDINGS
211 kBTU/sf/yr

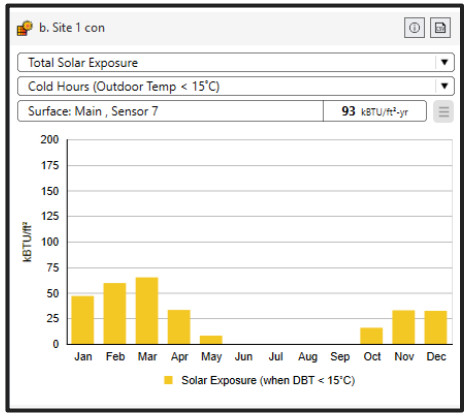
16% difference

NO CONTEXT BUILDINGS
252 kBTU/sf/yr

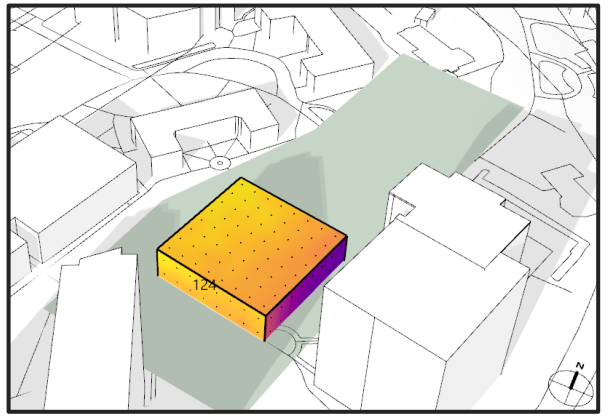


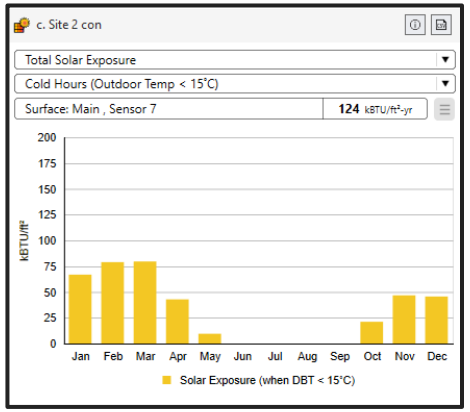




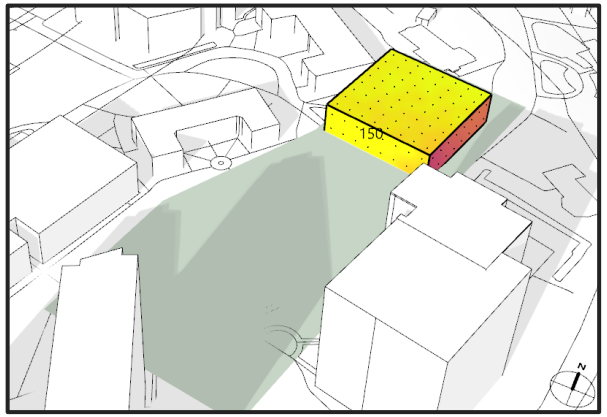


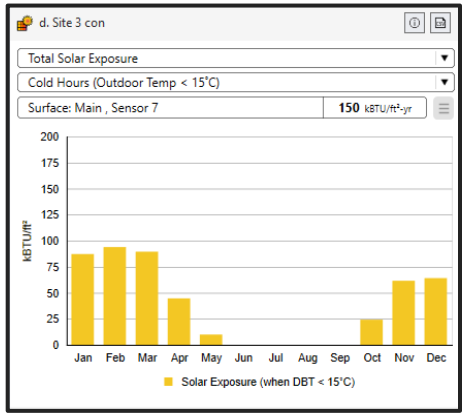
93
baseline





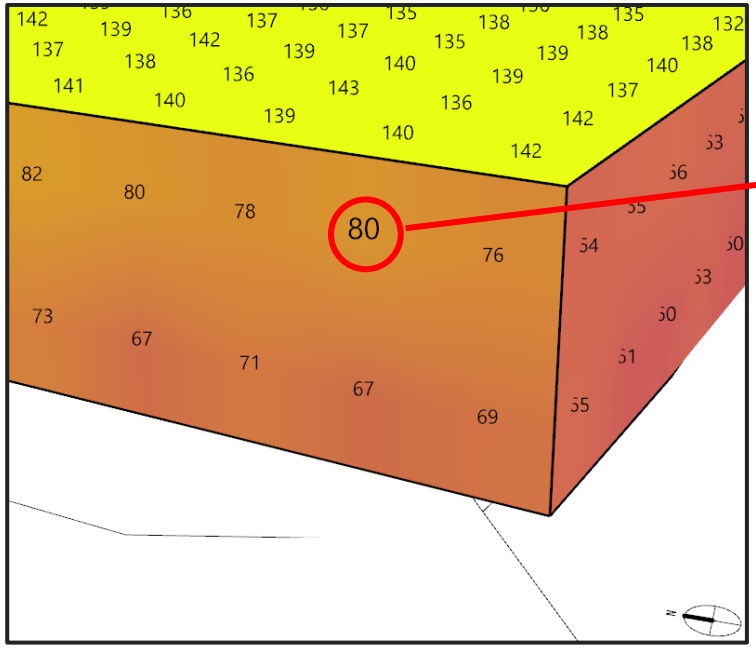
124
+25%

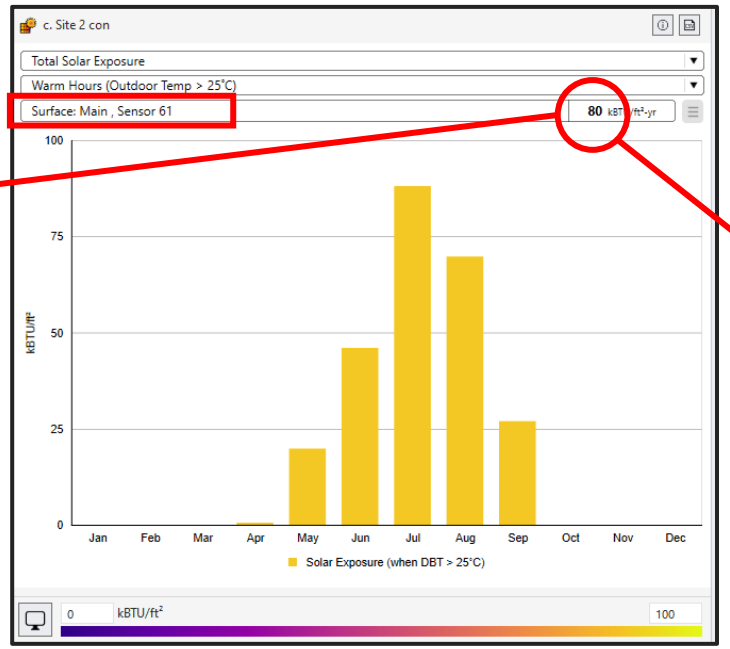




150
+38%

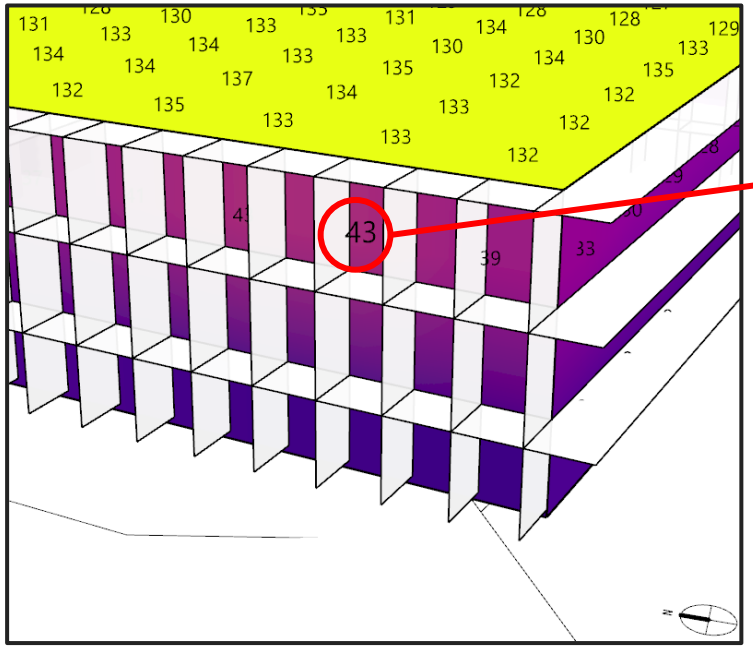
WEST –
NO SHADING

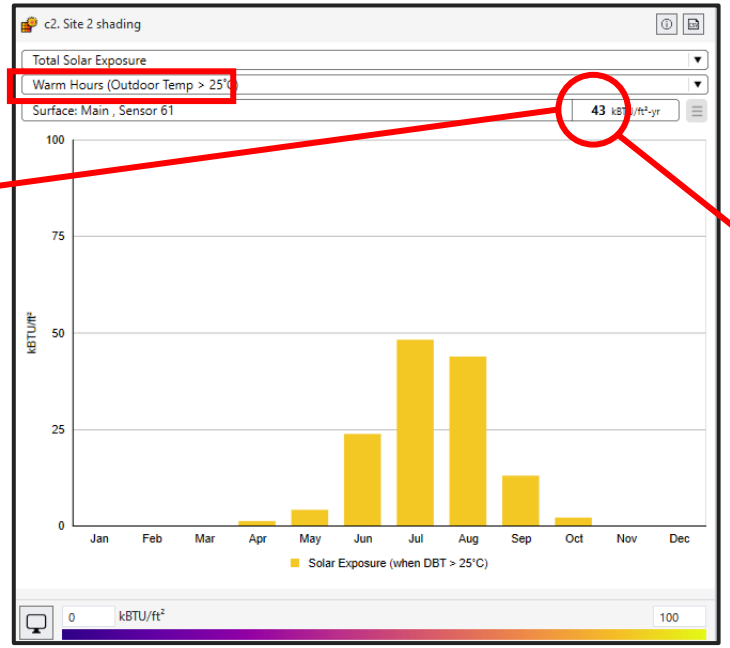




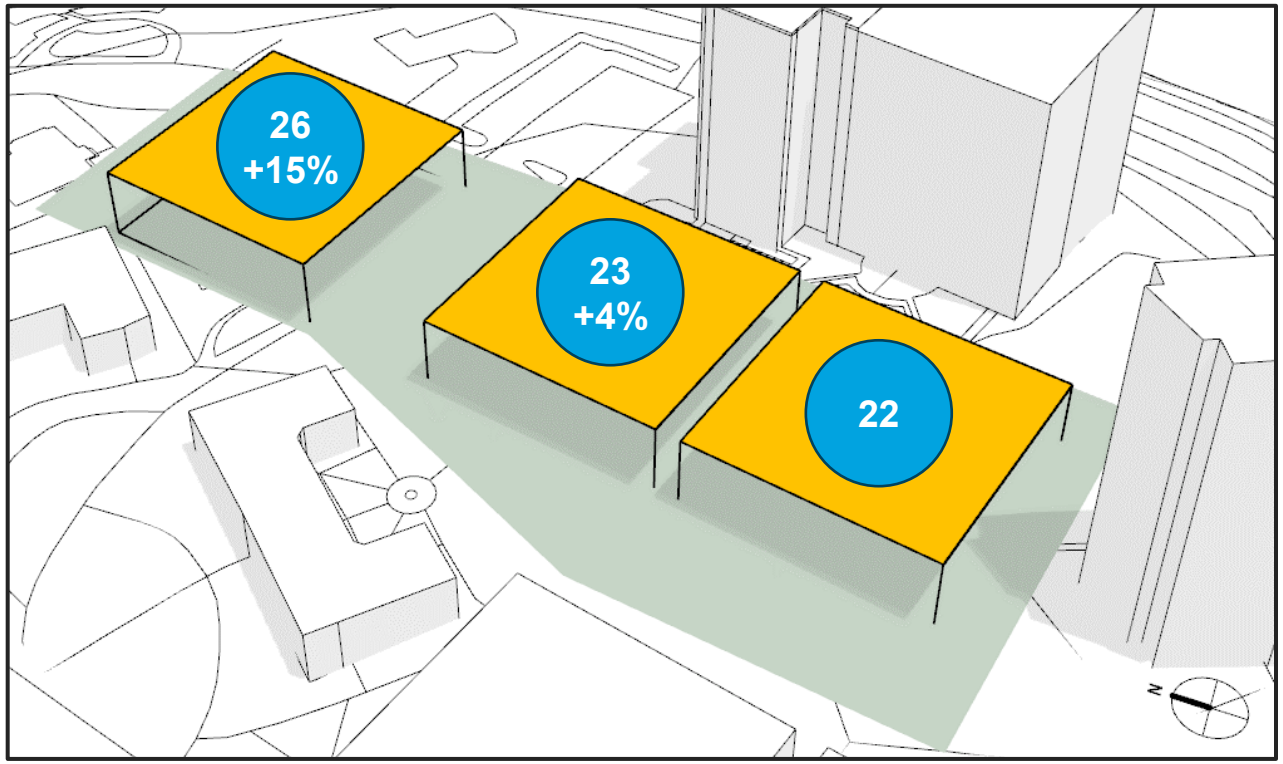
80 baseline

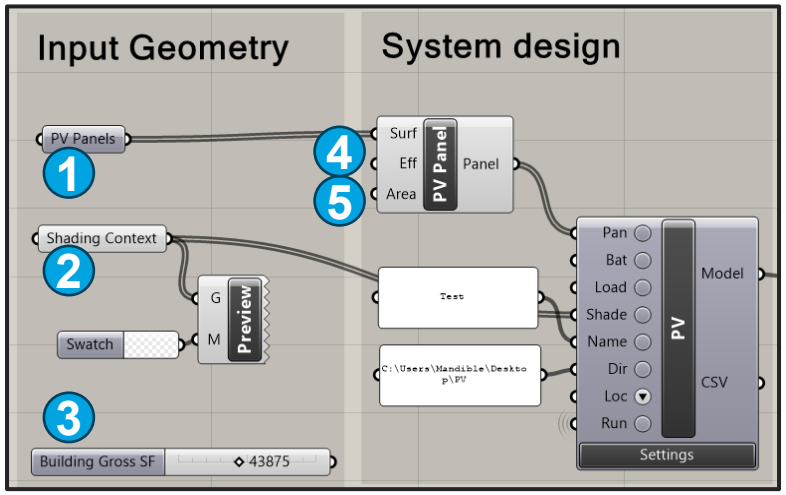
WEST –
SHADING



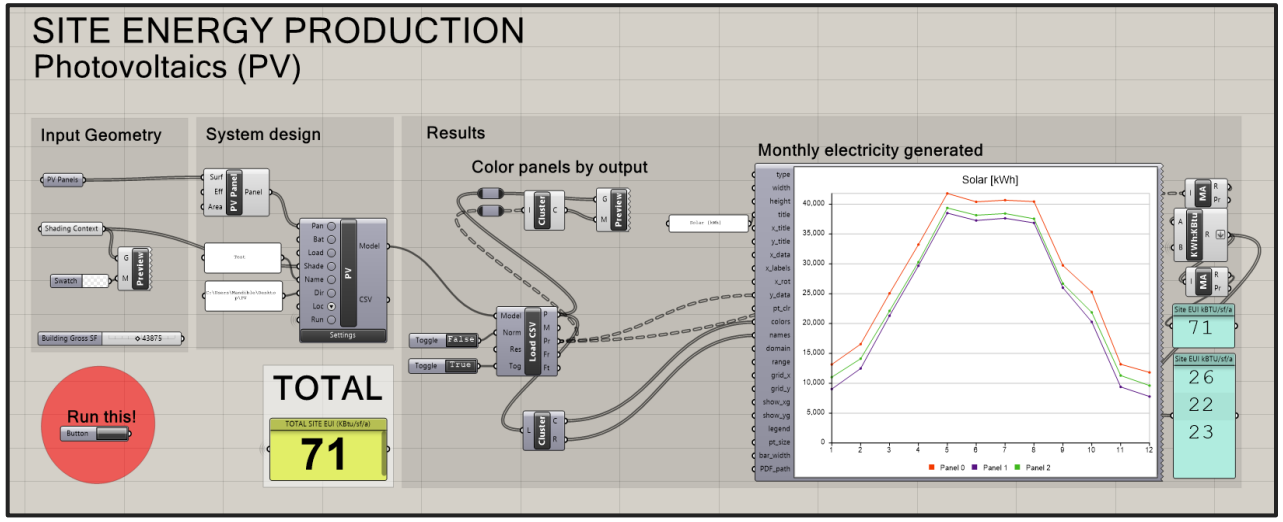


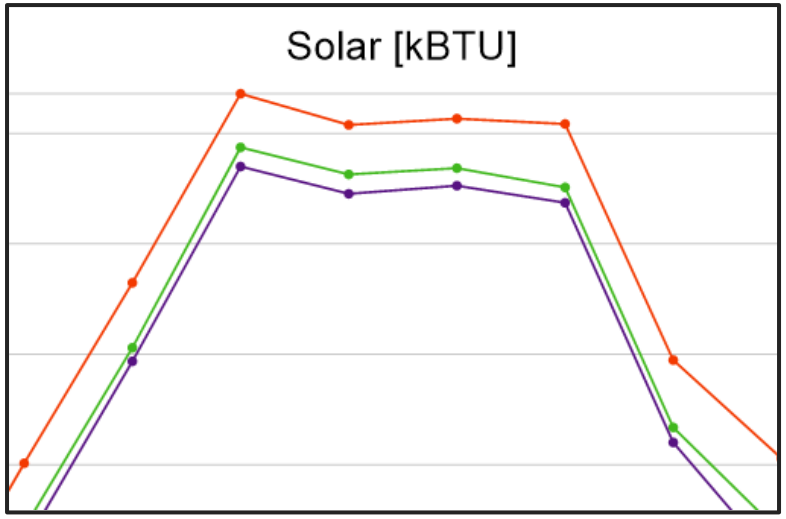
43 **- 47%**



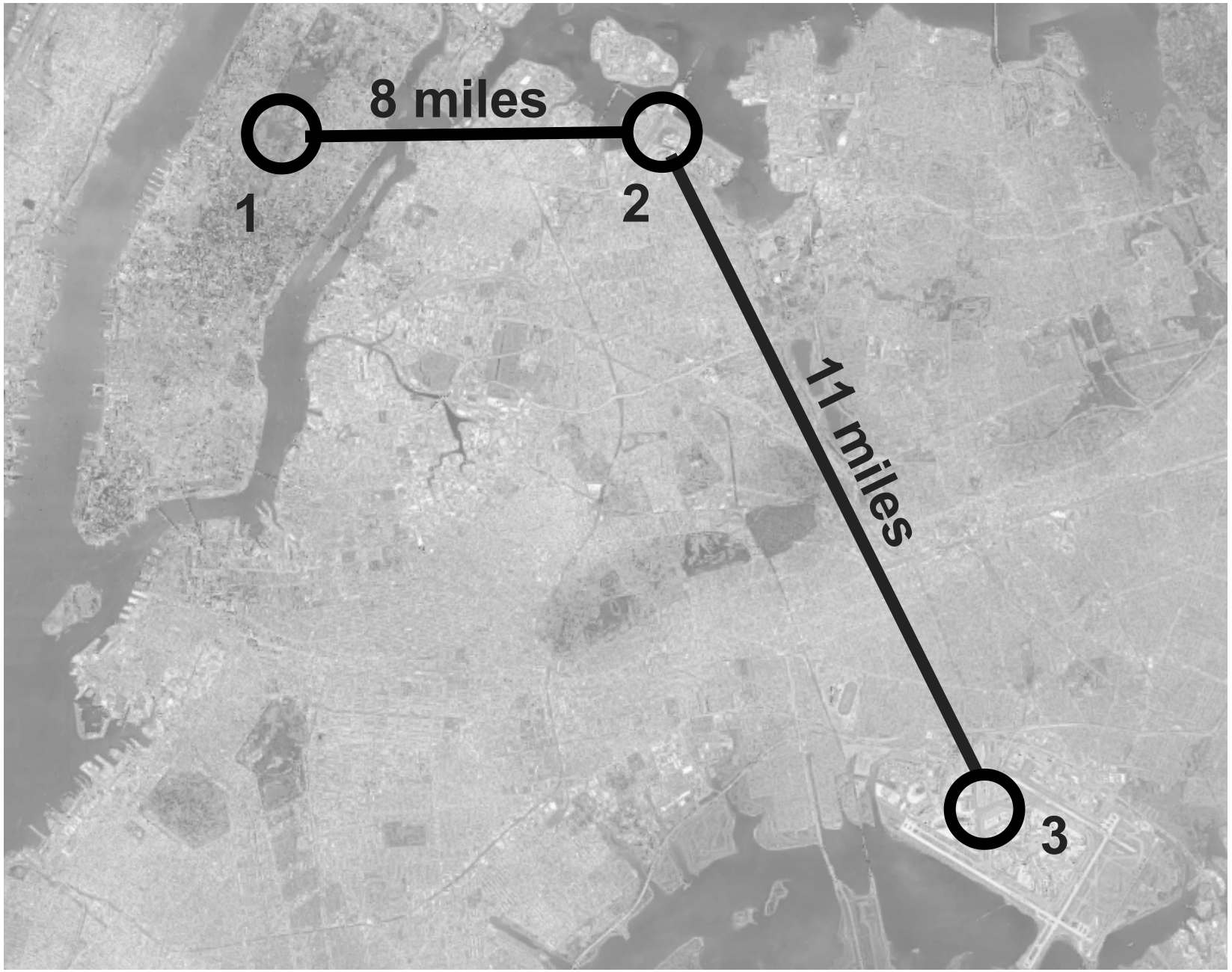


1 collection geometry from model
2 shading geometry from model
3 building usable square footage
4 panel efficiency
5 actual % of collection area that is PV

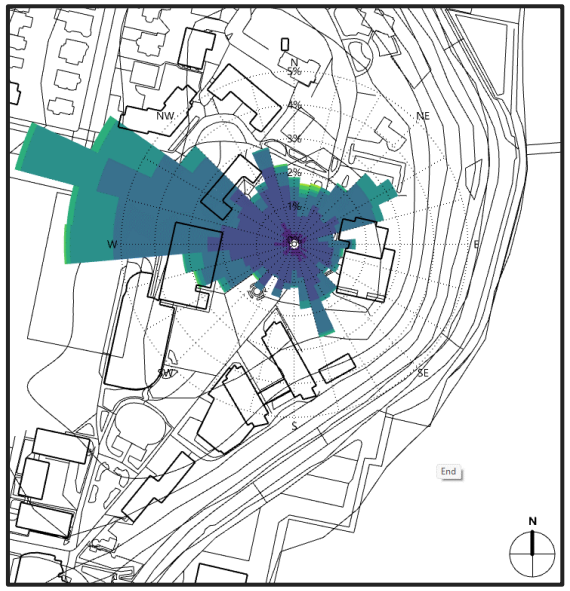


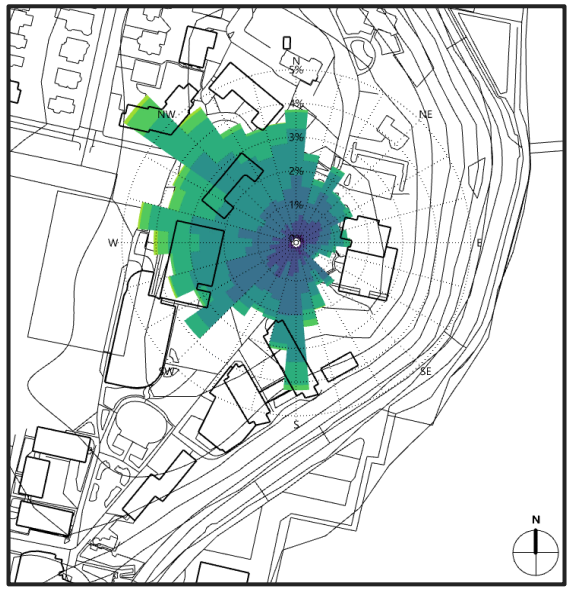


NYC



COOLING
jun/sept
24 hours





HEATING
jun/sept
24 hours

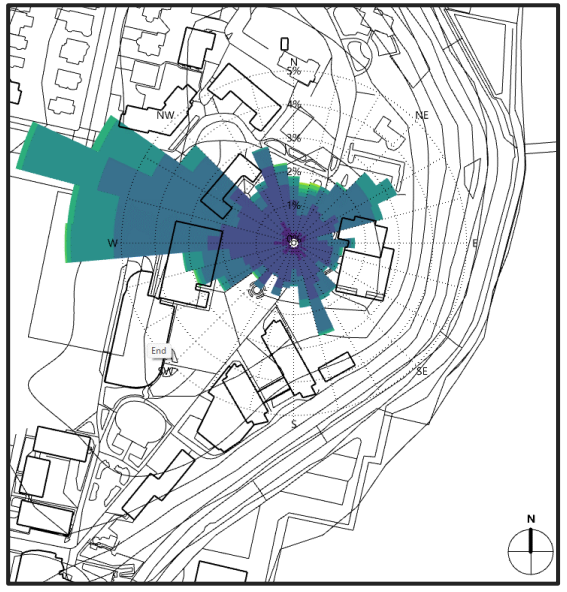
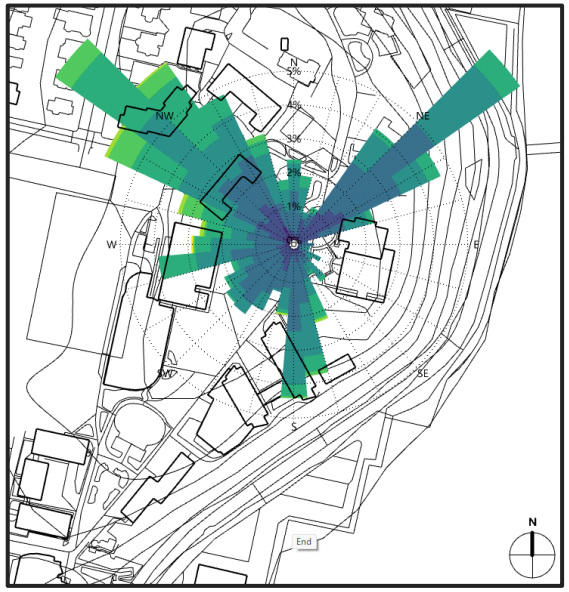
CENTRAL PARK

LA GUARDIA

KENNEDY



COOLING
jun/sept
8 hours

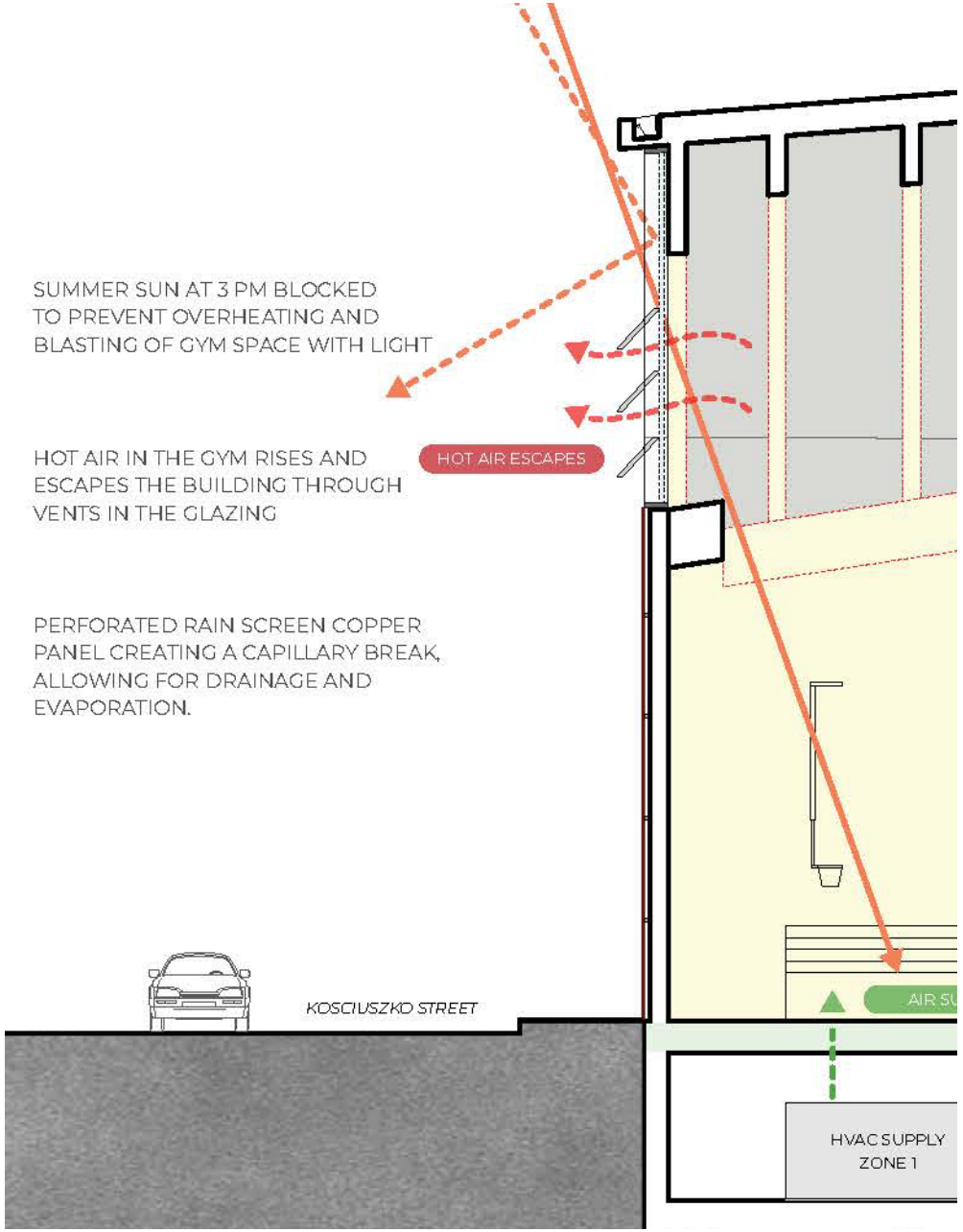



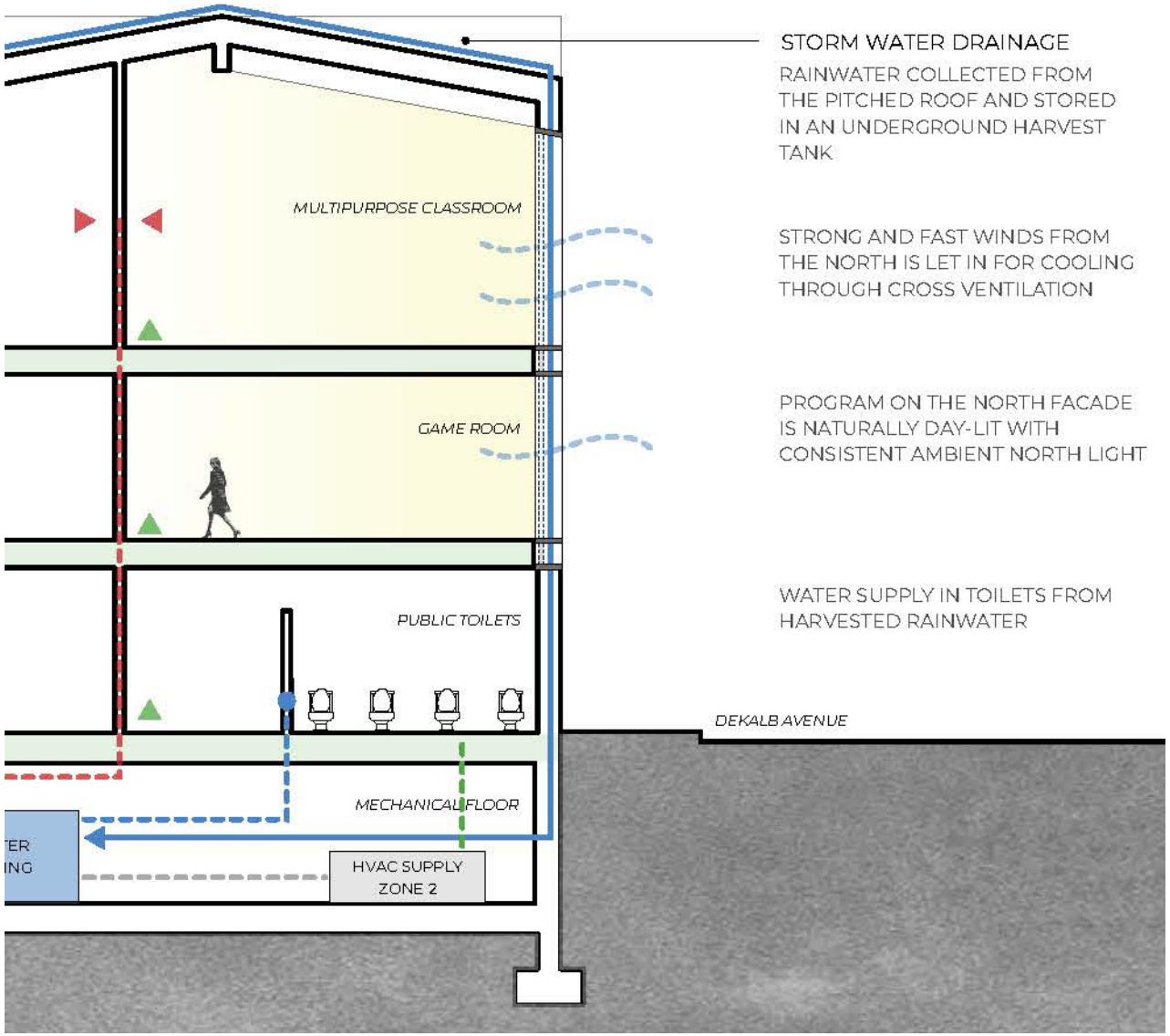

HEATING
oct/may
8 hours

CENTRAL PARK

LA GUARDIA

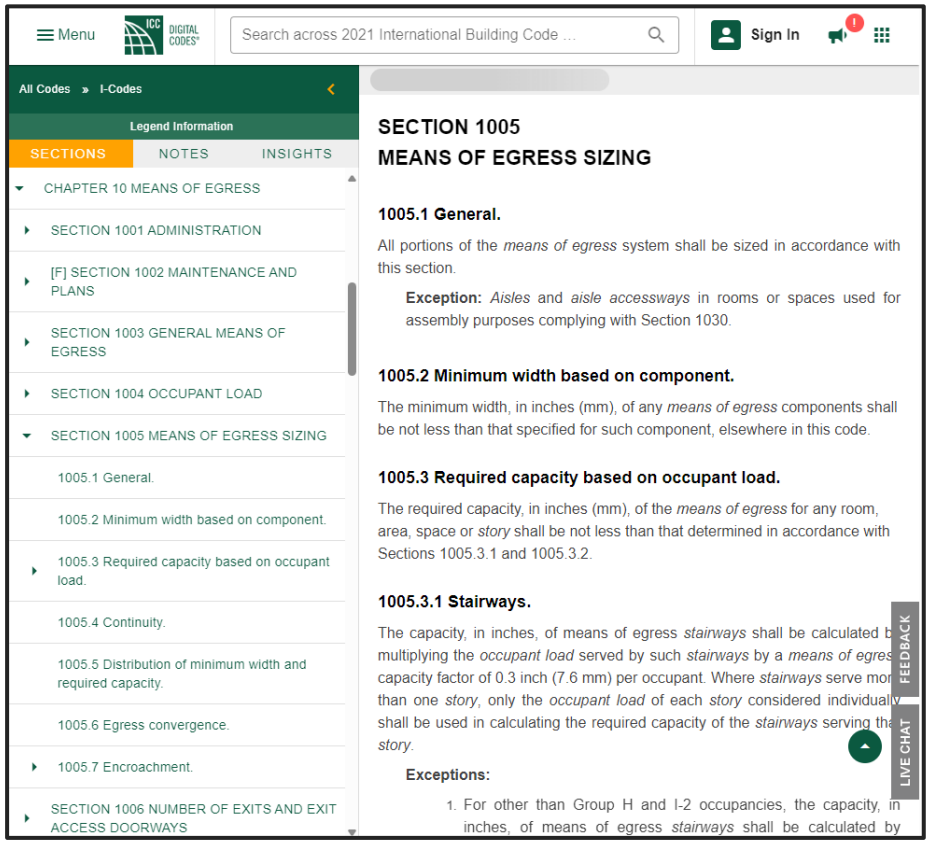
KENNEDY


SUMMER SUN AT 3 PM BLOCKED TO PREVENT OVERHEATING AND BLASTING OF GYM SPACE WITH LIGHT
HOT AIR IN THE GYM RISES AND ESCAPES THE BUILDING THROUGH VENTS IN THE GLAZING
HOT AIR ESCAPES
PERFORATED RAIN SCREEN COPPER PANEL CREATING A CAPILLARY BREAK, ALLOWING FOR DRAINAGE AND EVAPORATION.
KOSCIUSZKO STREET
HVAC SUPPLY ZONE 1

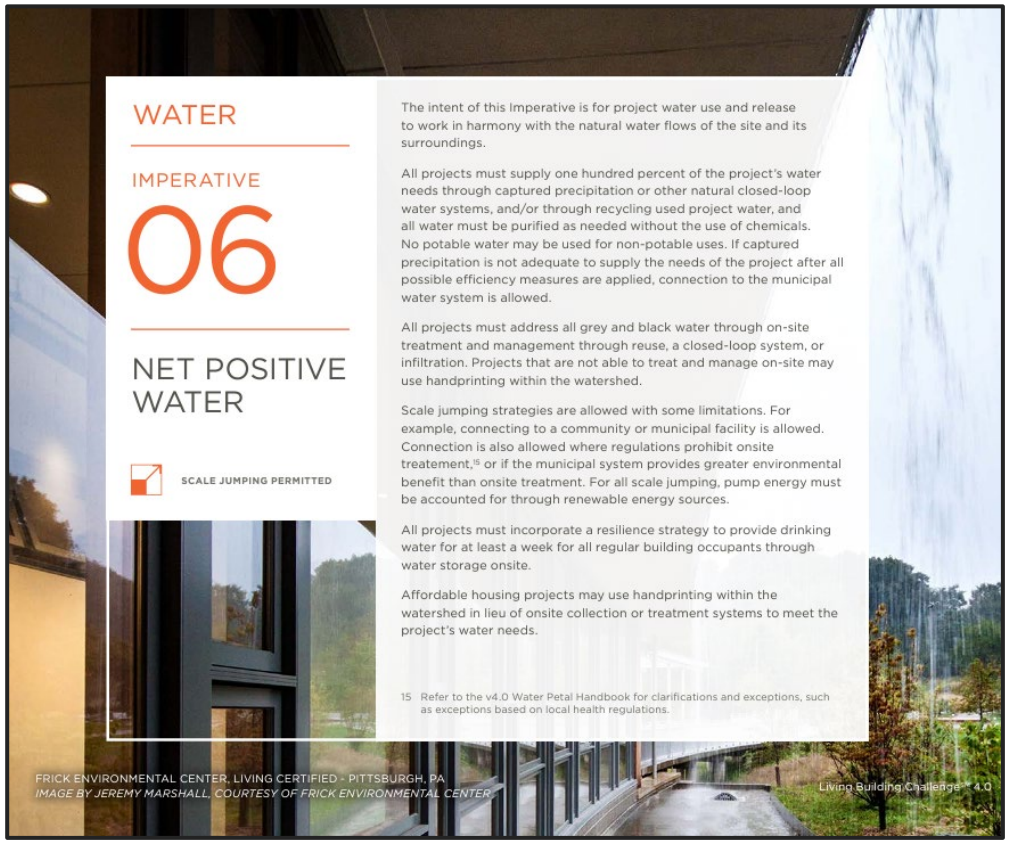

STORM WATER DRAINAGE
RAINWATER COLLECTED FROM THE PITCHED ROOF AND STORED IN AN UNDERGROUND HARVEST TANK
MULTIPURPOSE CLASSROOM
STRONG AND FAST WINDS FROM THE NORTH IS LET IN FOR COOLING THROUGH CROSS VENTILATION
GAME ROOM
PROGRAM ON THE NORTH FACADE IS NATURALLY DAY-LIT WITH CONSISTENT AMBIENT NORTH LIGHT
PUBLIC TOILETS
WATER SUPPLY IN TOILETS FROM HARVESTED RAINWATER
DEKALB AVENUE
MECHANICAL FLOOR
HVAC SUPPLY ZONE 2

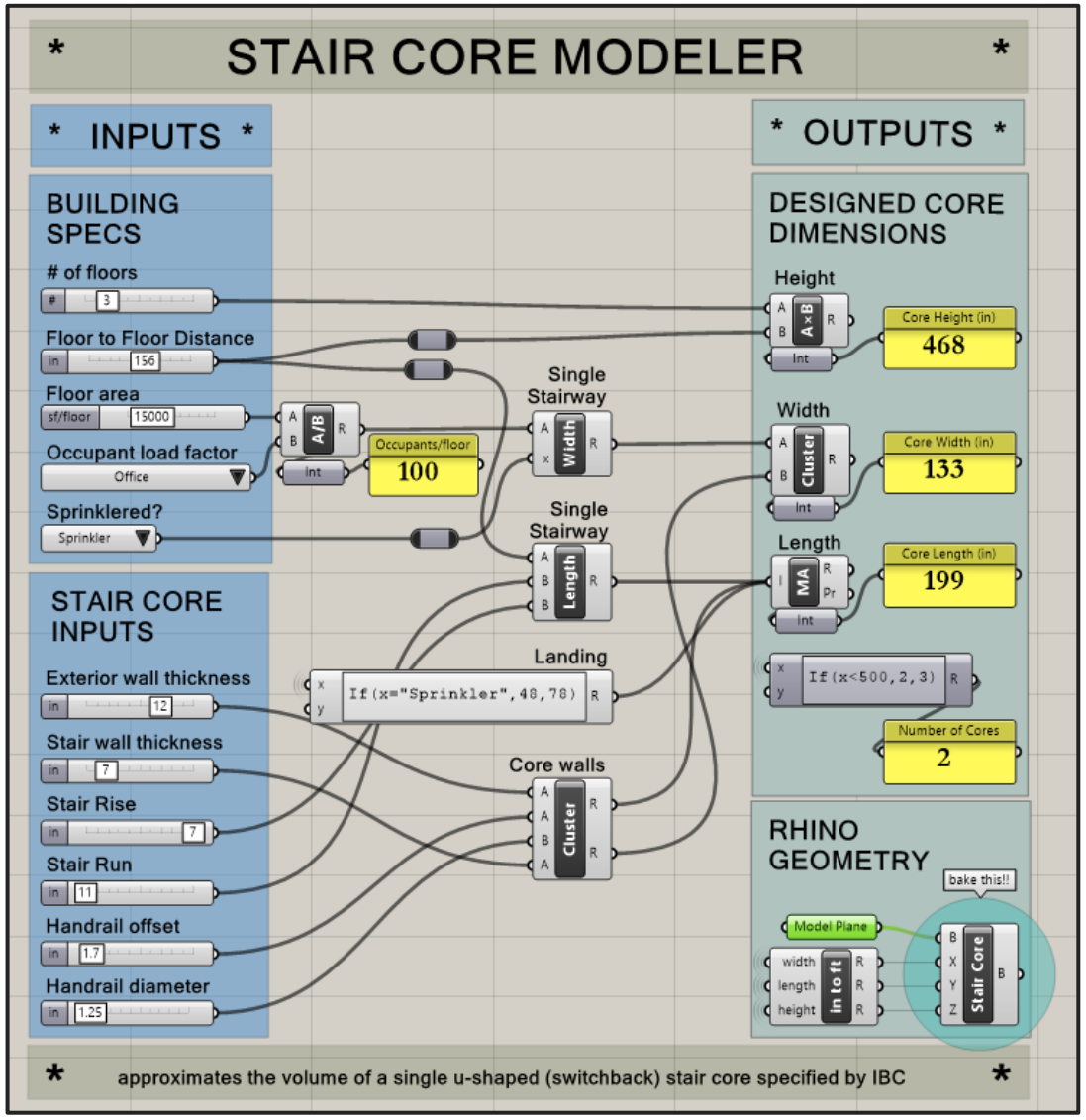
IBC®

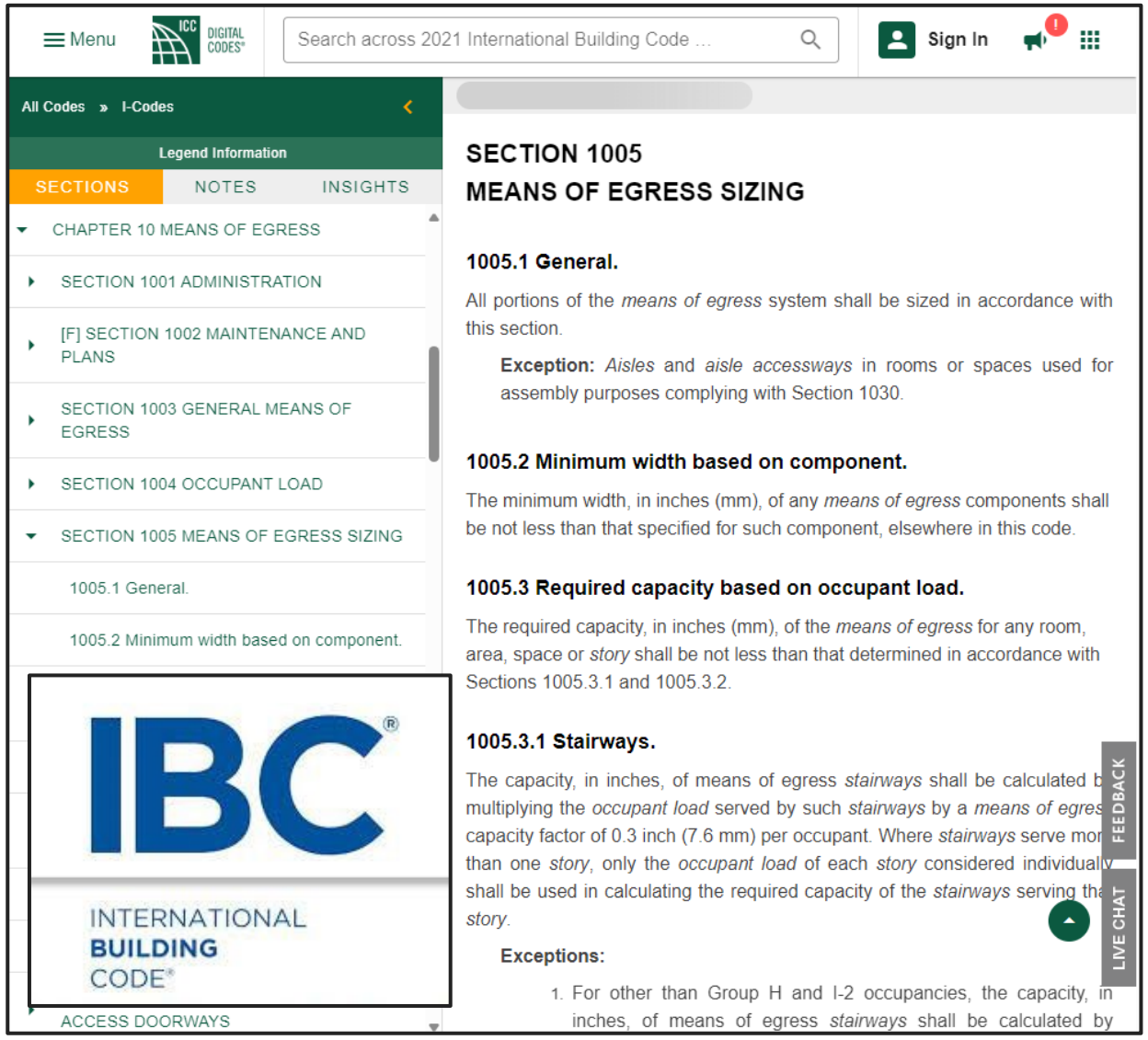
INTERNATIONAL BUILDING CODE®



LIVING BUILDING CHALLENGE℠




STAIR CORE MODELER
INPUTS
BUILDING SPECS
# of floors
3
Floor to Floor Distance
156
Floor area
15000
Occupant load factor
Office
Sprinklered?
Sprinkler
STAIR CORE INPUTS
Exterior wall thickness
12
Stair wall thickness
7
Stair Rise
7
Stair Run
11
Handrail offset
1.7
Handrail diameter
1.25
OUTPUTS
DESIGNED CORE DIMENSIONS
Height
Core Height (in)
468
Width
Core Width (in)
133
Length
Core Length (in)
199
Number of Cores
2
Occupants/floor
100
Single Stairway
Single Stairway
Landing
Core walls
If(x="Sprinkler",48,78)
If(x<500,2,3)
RHINO GEOMETRY
bake this!!
Model Plane
Stair Core
approximates the volume of a single u-shaped (switchback) stair core specified by IBC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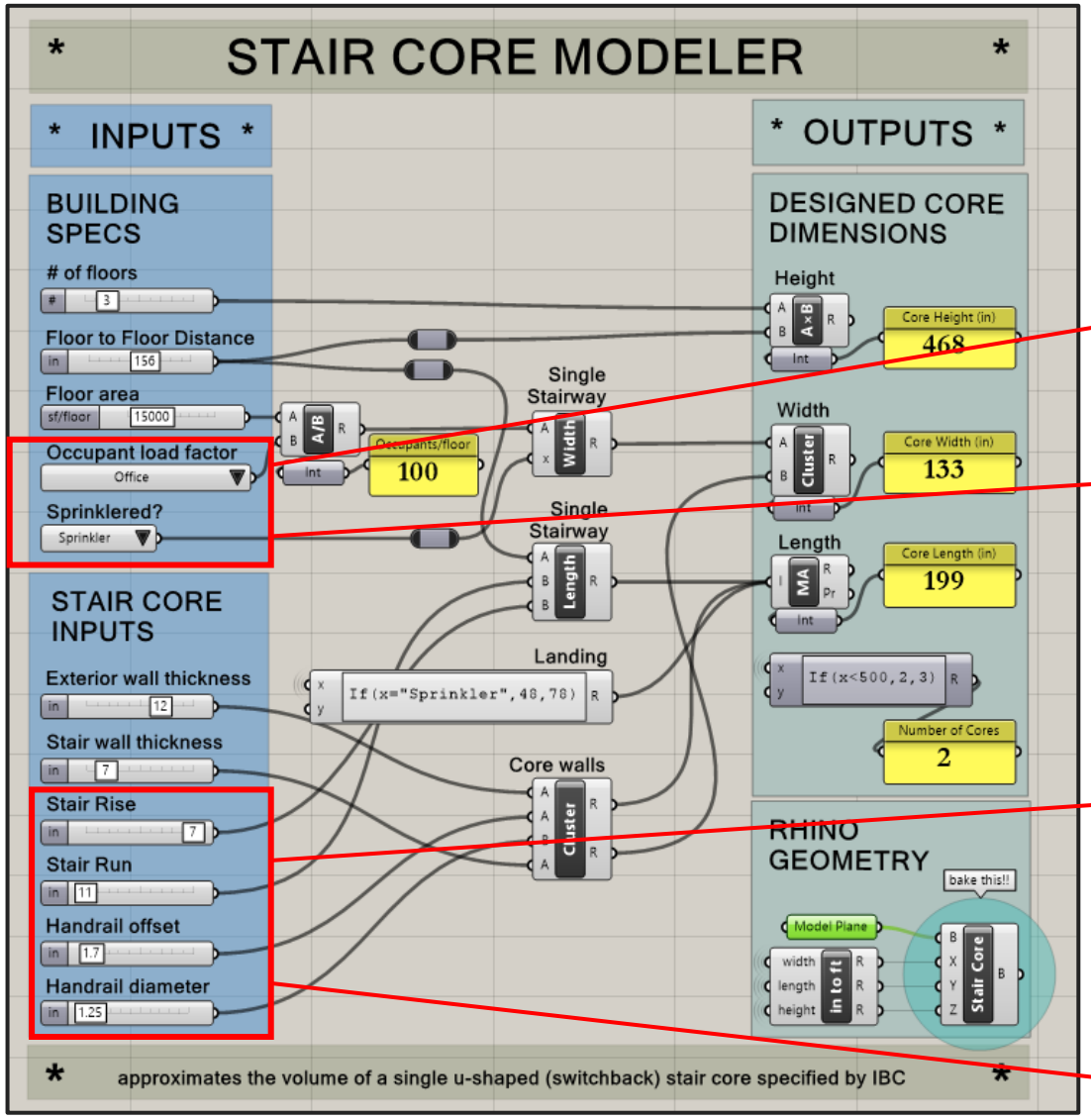
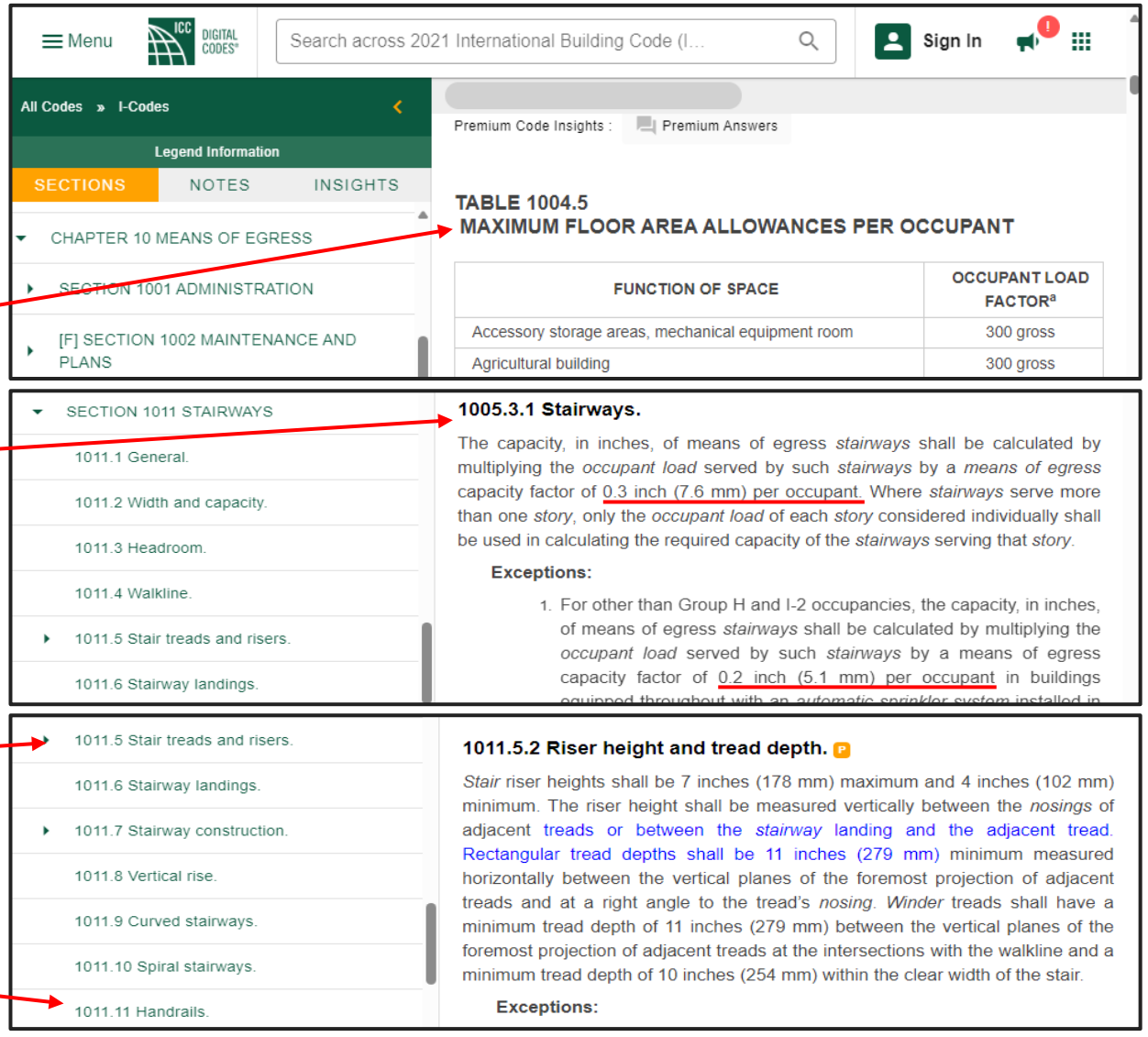
CHAPTER 10 MEANS OF EGRESS
SECTION 1001 ADMINISTRATION
[F] SECTION 1002 MAINTENANCE AND PLANS
SECTION 1003 GENERAL MEANS OF EGRESS
SECTION 1004 OCCUPANT LOAD
SECTION 1005 MEANS OF EGRESS SIZING
1005.1 General.
1005.2 Minimum width based on component.
ACCESS DOORWAYS
IBC
INTERNATIONAL BUILDING CODE
SECTION 1005
MEANS OF EGRESS SIZING
1005.1 General.
All portions of the means of egress system shall be sized in accordance with this section.
Exception: Aisles and aisle accessways in rooms or spaces used for assembly purposes complying with Section 1030.
1005.2 Minimum width based on component.
The minimum width, in inches (mm), of any means of egress components shall be not less than that specified for such component, elsewhere in this code.
1005.3 Required capacity based on occupant load.
The required capacity, in inches (mm), of the means of egress for any room, area, space or story shall be not less than that determined in accordance with Sections 1005.3.1 and 1005.3.2.
1005.3.1 Stairways.
The capacity, in inches, of means of egress stairways shall be calculated b
multiplying the occupant load served by such stairways by a means of egres
capacity factor of 0.3 inch (7.6 mm) per occupant. Where stairways serve mor
than one story, only the occupant load of each story considered individuall
shall be used in calculating the required capacity of the stairways serving tha
story.
Exceptions:
1. For other than Group H and I-2 occupancies, the capacity, in inches, of means of egress stairways shall be calculated by
FEEDBACK
LIVE CHAT


* STAIR CORE MODELER *
* INPUTS *
BUILDING SPECS
# of floors
3
Floor to Floor Distance
156
Floor area
15000
Occupant load factor
Office
Sprinklered?
Sprinkler
STAIR CORE INPUTS
Exterior wall thickness
12
Stair wall thickness
7
Stair Rise
7
Stair Run
11
Handrail offset
1.7
Handrail diameter
1.25
A/B
Occupants/floor
100
Single Stairway
Width
Single Stairway
Length
Landing
If(x="Sprinkler",48,78)
Core walls
Cluster
* OUTPUTS *
DESIGNED CORE DIMENSIONS
Height
A×B
Core Height (in)
468
Width
Cluster
Core Width (in)
133
Length
MA
Core Length (in)
199
If(x<500,2,3)
Number of Cores
2
RHINO GEOMETRY
bake this!!
Model Plane
width
length
height
in to ft
Stair Core
* approximates the volume of a single u-shaped (switchback) stair core specified by IBC *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CHAPTER 10 MEANS OF EGRESS
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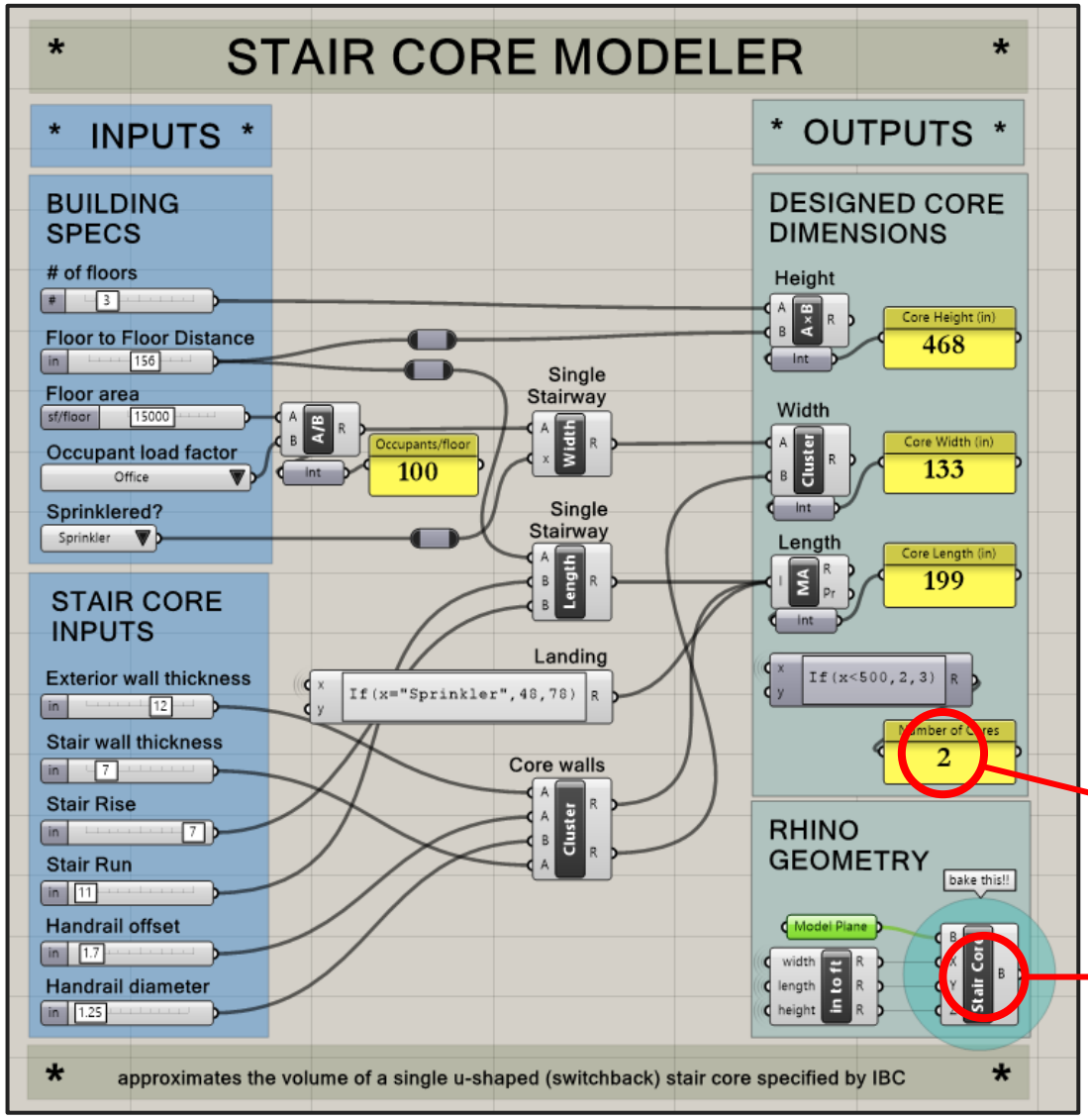
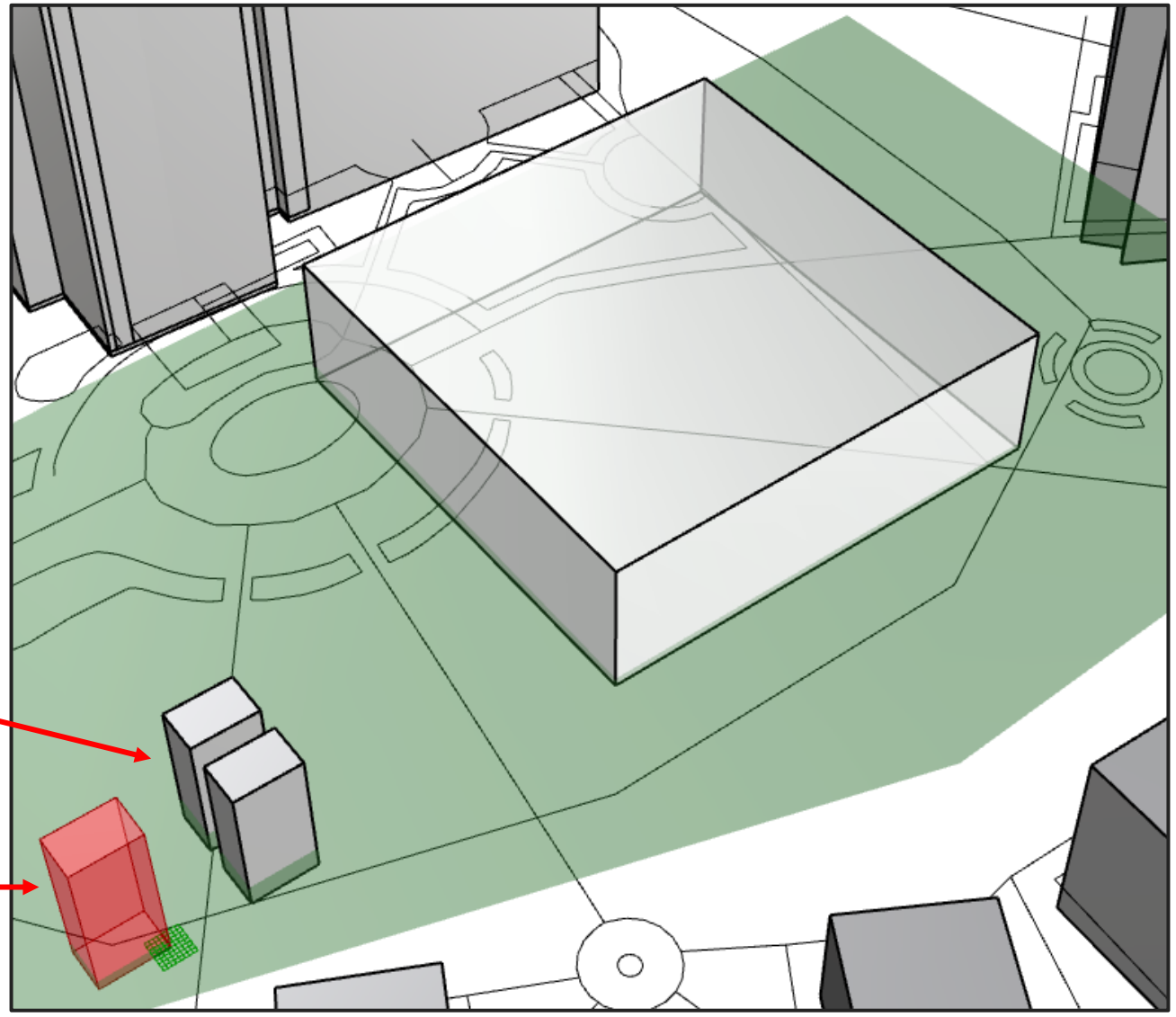
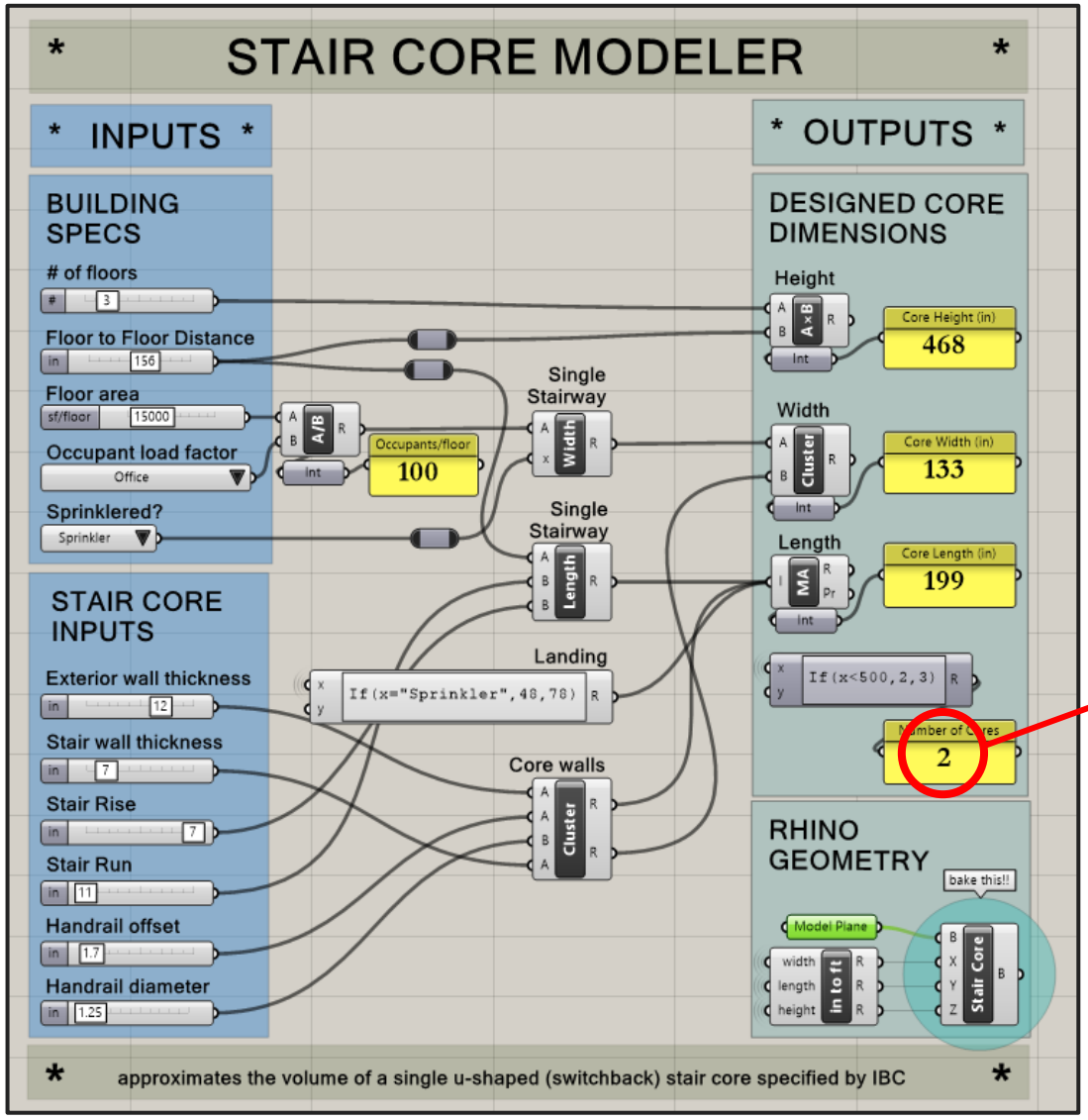
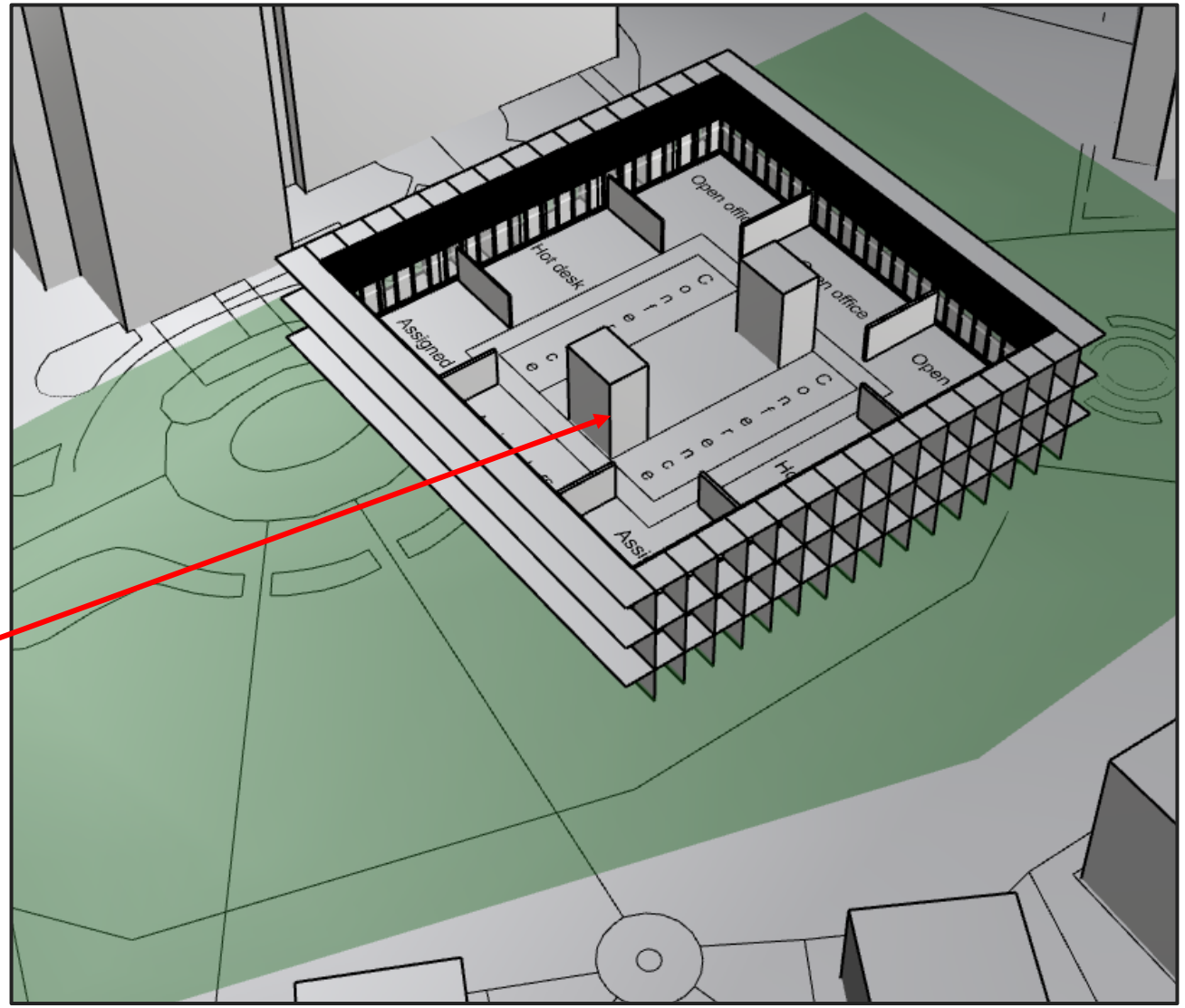
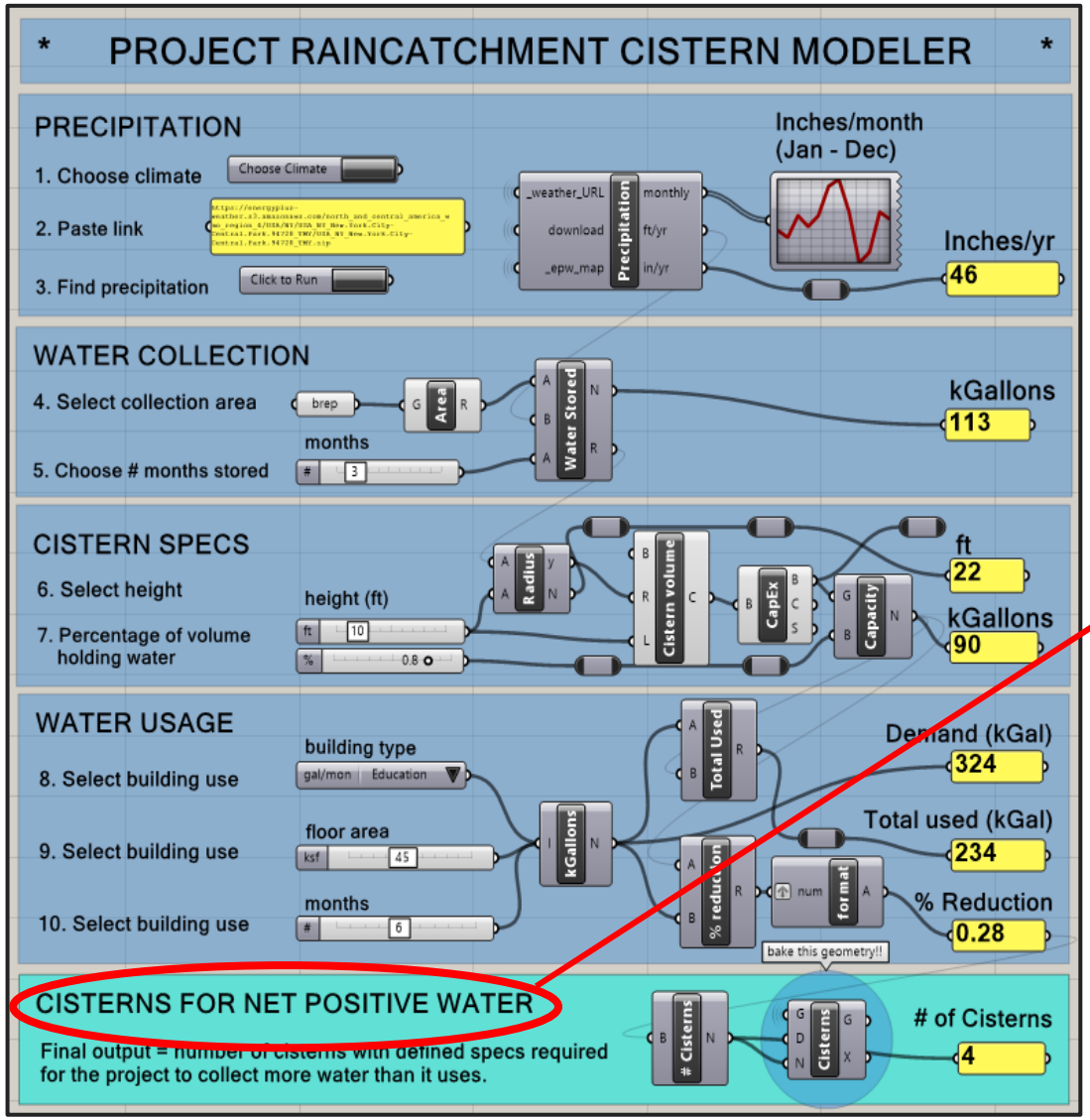
[F] SECTION 1002 MAINTENANCE AND PLANS
Premium Code Insights :
Premium Answers
TABLE 1004.5
MAXIMUM FLOOR AREA ALLOWANCES PER OCCUPANT
FUNCTION OF SPACE
OCCUPANT LOAD FACTOR[a]
Accessory storage areas, mechanical equipment room
300 gross
Agricultural building
300 gross
SECTION 1011 STAIRWAYS
1011.1 General.
1011.2 Width and capacity.
1011.3 Headroom.
1011.4 Walkline.
1011.5 Stair treads and risers.
1011.6 Stairway landings.
1005.3.1 Stairways.
The capacity, in inches, of means of egress stairways shall be calculated by multiplying the occupant load served by such stairways by a means of egress capacity factor of 0.3 inch (7.6 mm) per occupant. Where stairways serve more than one story, only the occupant load of each story considered individually shall be used in calculating the required capacity of the stairways serving that story.
Exceptions:
1. For other than Group H and I-2 occupancies, the capacity, in inches, of means of egress stairways shall be calculated by multiplying the occupant load served by such stairways by a means of egress capacity factor of 0.2 inch (5.1 mm) per occupant in buildings
1011.5 Stair treads and risers.
1011.6 Stairway landings.
1011.7 Stairway construction.
1011.8 Vertical rise.
1011.9 Curved stairways.
1011.10 Spiral stairways.
1011.11 Handrails.
1011.5.2 Riser height and tread depth.
Stair riser heights shall be 7 inches (178 mm) maximum and 4 inches (102 mm) minimum. The riser height shall be measured vertically between the nosings of adjacent treads or between the stairway landing and the adjacent tread. Rectangular tread depths shall be 11 inches (279 mm) minimum measured horizontally between the vertical planes of the foremost projection of adjacent treads and at a right angle to the tread's nosing. Winder treads shall have a minimum tread depth of 11 inches (279 mm) between the vertical planes of the foremost projection of adjacent treads at the intersections with the walkline and a minimum tread depth of 10 inches (254 mm) within the clear width of the stair.
Exceptions:

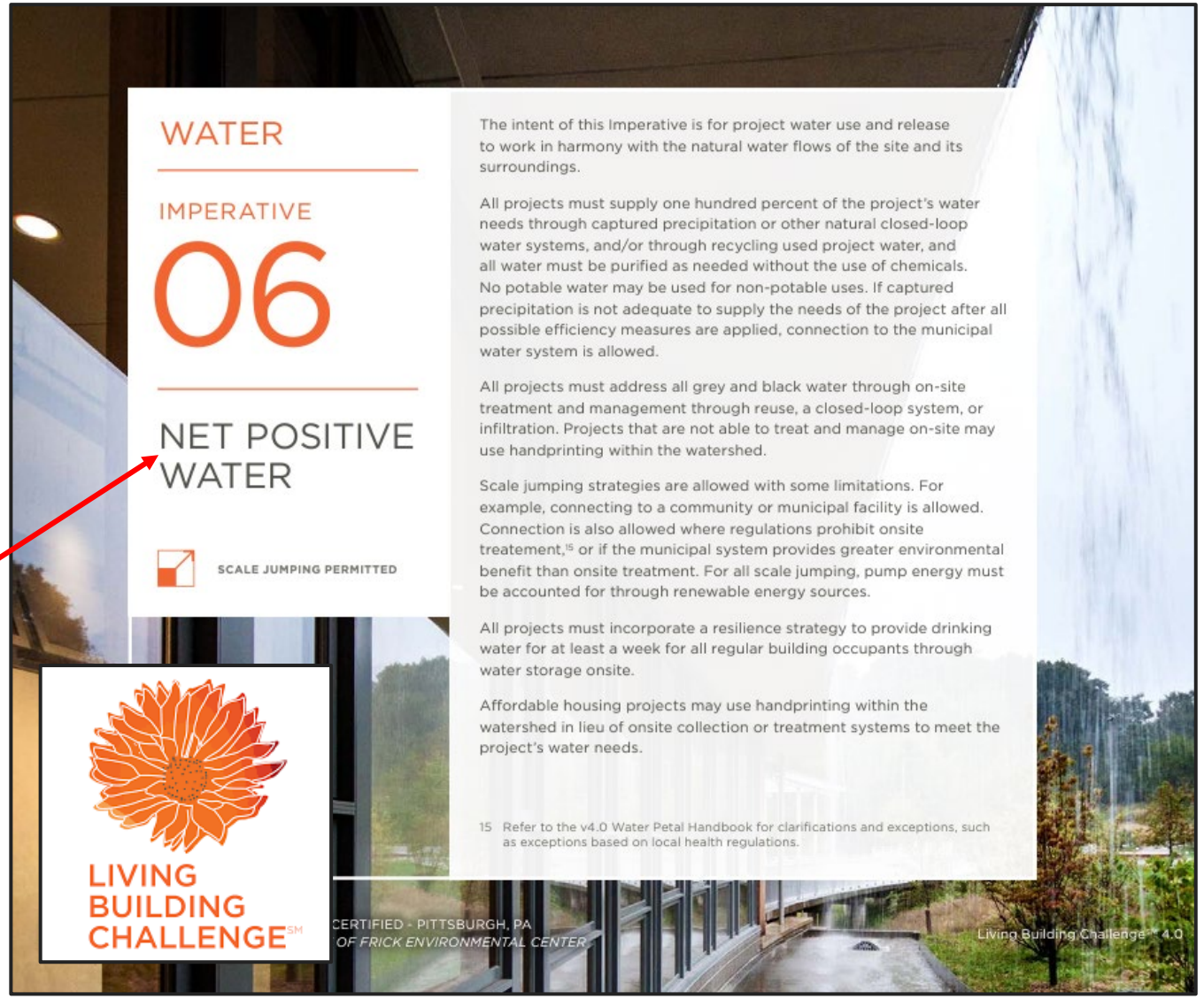

* STAIR CORE MODELER *
* INPUTS *
BUILDING SPECS
# of floors
3
Floor to Floor Distance
156
Floor area
15000
Occupant load factor
Office
Sprinklered?
Sprinkler
STAIR CORE INPUTS
Exterior wall thickness
12
Stair wall thickness
7
Stair Rise
7
Stair Run
11
Handrail offset
1.7
Handrail diameter
1.25
A/B
Int
Occupants/floor
100
Single Stairway
Width
Single Stairway
Length
Landing
If(x="Sprinkler",48,78)
Core walls
Cluster
* OUTPUTS *
DESIGNED CORE DIMENSIONS
Height
A×B
Int
Core Height (in)
468
Width
Cluster
Int
Core Width (in)
133
Length
MA
Int
Core Length (in)
199
If(x<500,2,3)
2
RHINO GEOMETRY
bake this!!
Model Plane
width
length
height
in to ft
Stair Core
* approximates the volume of a single u-shaped (switchback) stair core specified by IBC *

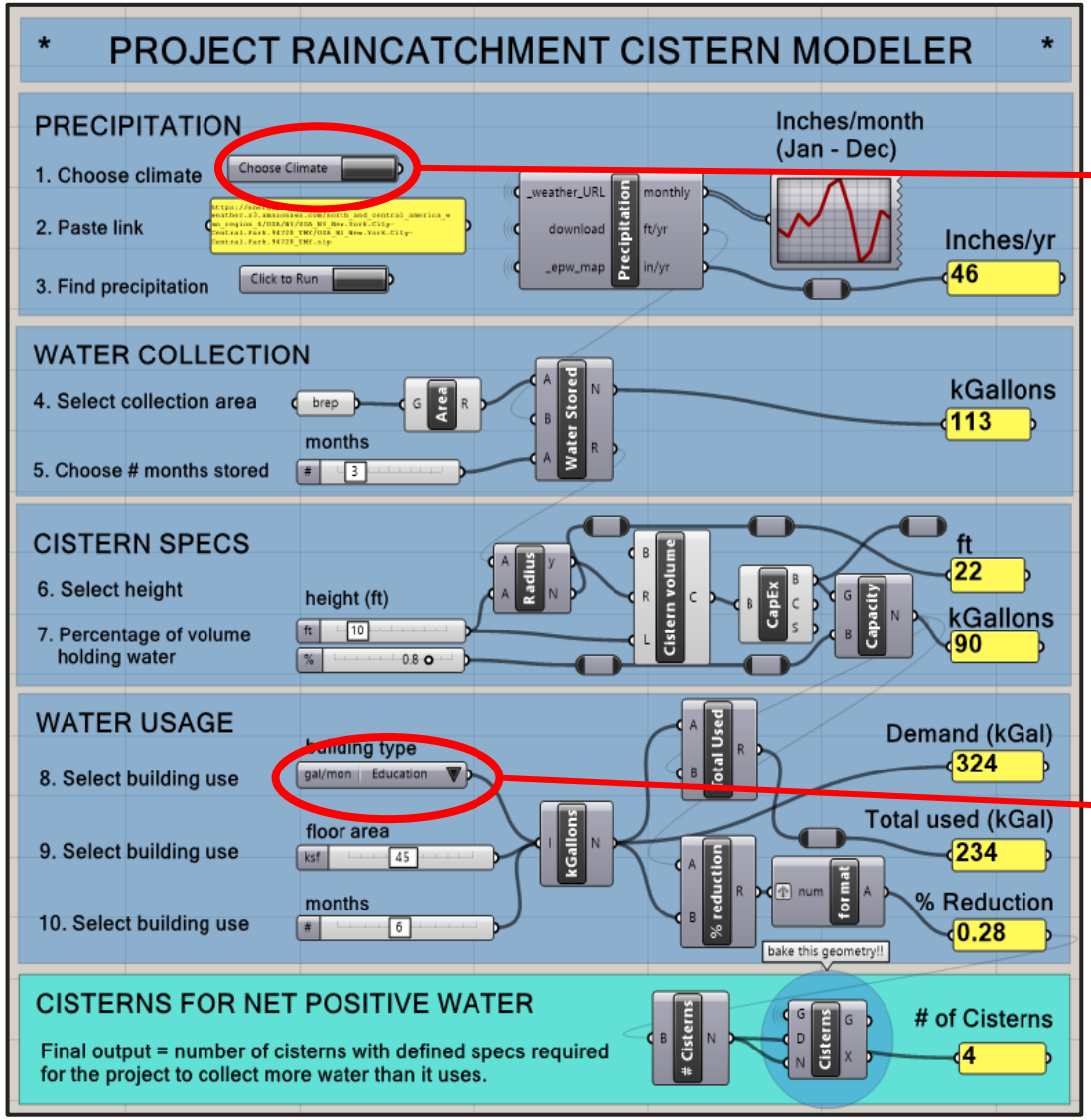


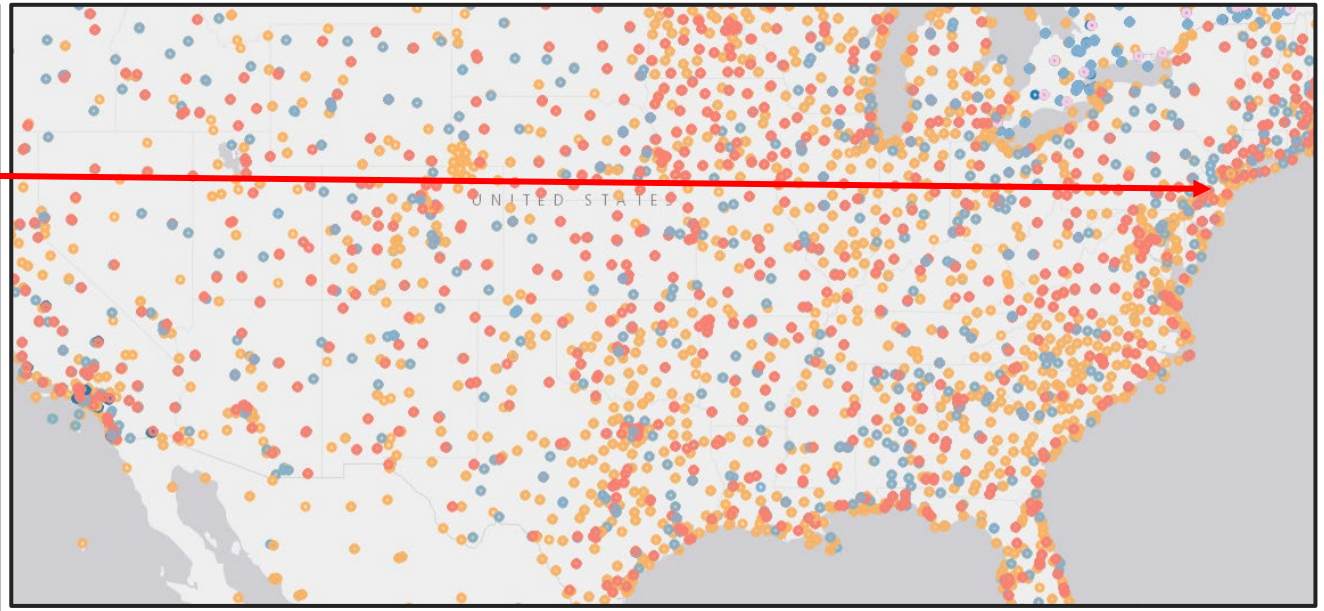

* STAIR CORE MODELER *
* INPUTS *
BUILDING SPECS
# of floors
3
Floor to Floor Distance
156
Floor area
15000
Occupant load factor
Office
Sprinklered?
Sprinkler
STAIR CORE INPUTS
Exterior wall thickness
12
Stair wall thickness
7
Stair Rise
7
Stair Run
11
Handrail offset
1.7
Handrail diameter
1.25
A/B
Int
Occupants/floor
100
Single Stairway
Width
Single Stairway
Length
Landing
If(x="Sprinkler",48,78)
Core walls
Cluster
* OUTPUTS *
DESIGNED CORE DIMENSIONS
Height
A×B
Int
Core Height (in)
468
Width
Cluster
Int
Core Width (in)
133
Length
MA
Int
Core Length (in)
199
If(x<500,2,3)
2
RHINO GEOMETRY
bake this!!
Model Plane
width
length
height
in to ft
Stair Core
* approximates the volume of a single u-shaped (switchback) stair core specified by IBC *

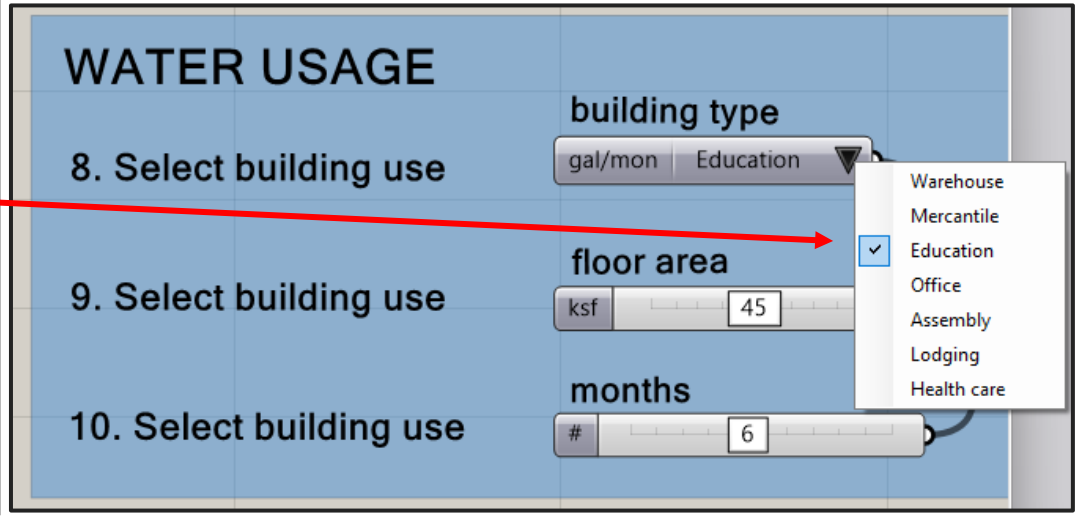

Open office
Hot desk
Assigned
Open

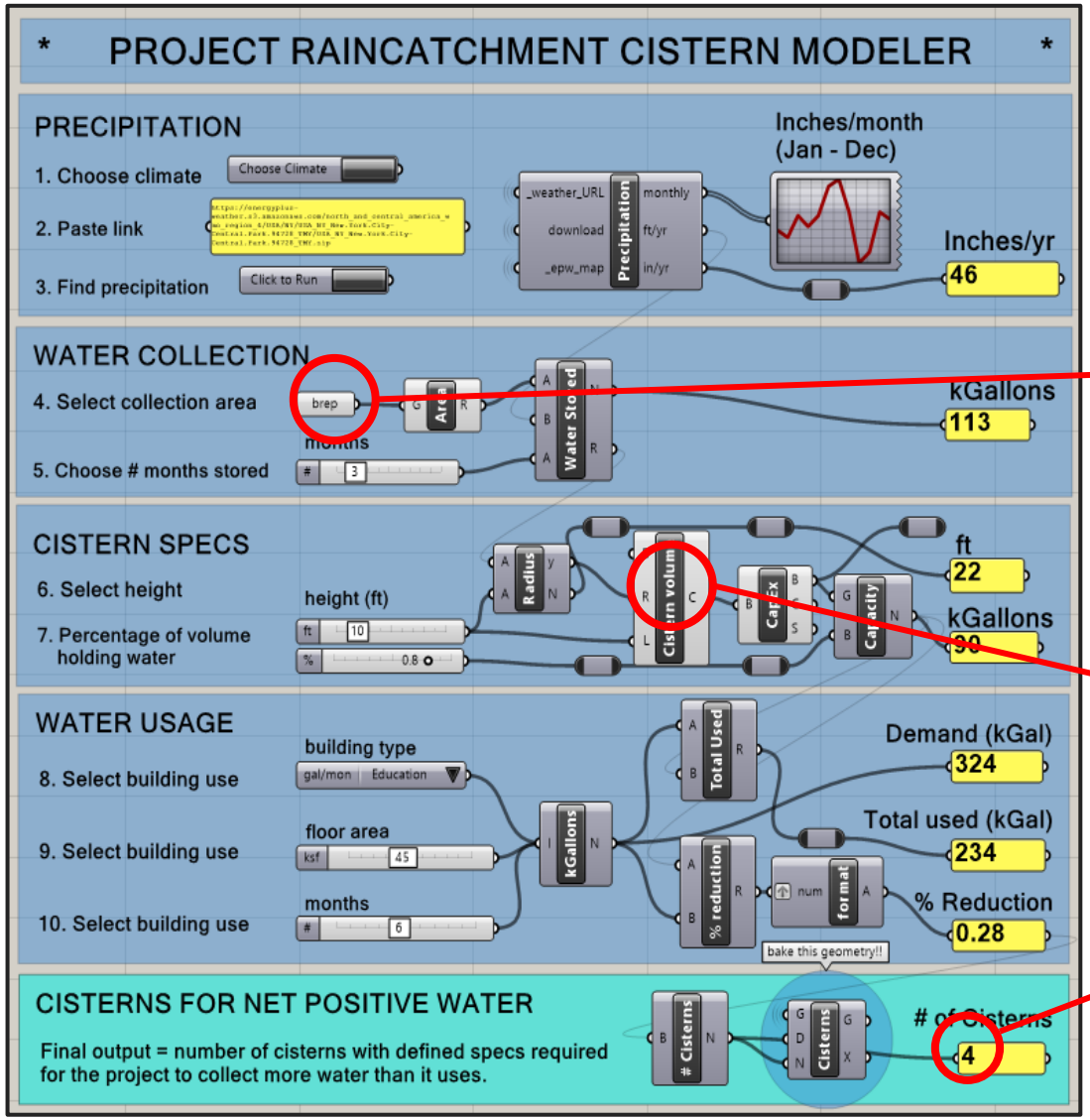

* PROJECT RAINCATCHMENT CISTERN MODELER *
PRECIPITATION
1. Choose climate
Choose Climate
2. Paste link
3. Find precipitation
Click to Run
_weather_URL
download
_epw_map
Precipitation
monthly
ft/yr
in/yr
Inches/month (Jan - Dec)
Inches/yr
46
WATER COLLECTION
4. Select collection area
brep
Area
5. Choose # months stored
months
3
Water Stored
kGallons
113
CISTERN SPECS
6. Select height
height (ft)
10
7. Percentage of volume holding water
0.8
Radius
Cistern volume
CapEx
Capacity
ft
22
kGallons
90
WATER USAGE
8. Select building use
building type
gal/mon
Education
9. Select building use
floor area
ksf
45
10. Select building use
months
6
kGallons
Total Used
% reduction
num
format
Demand (kGal)
324
Total used (kGal)
234
% Reduction
0.28
bake this geometry!!
CISTERNS FOR NET POSITIVE WATER
Final output = number of cisterns with defined specs required for the project to collect more water than it uses.
Cisterns
Cisterns
# of Cisterns
4

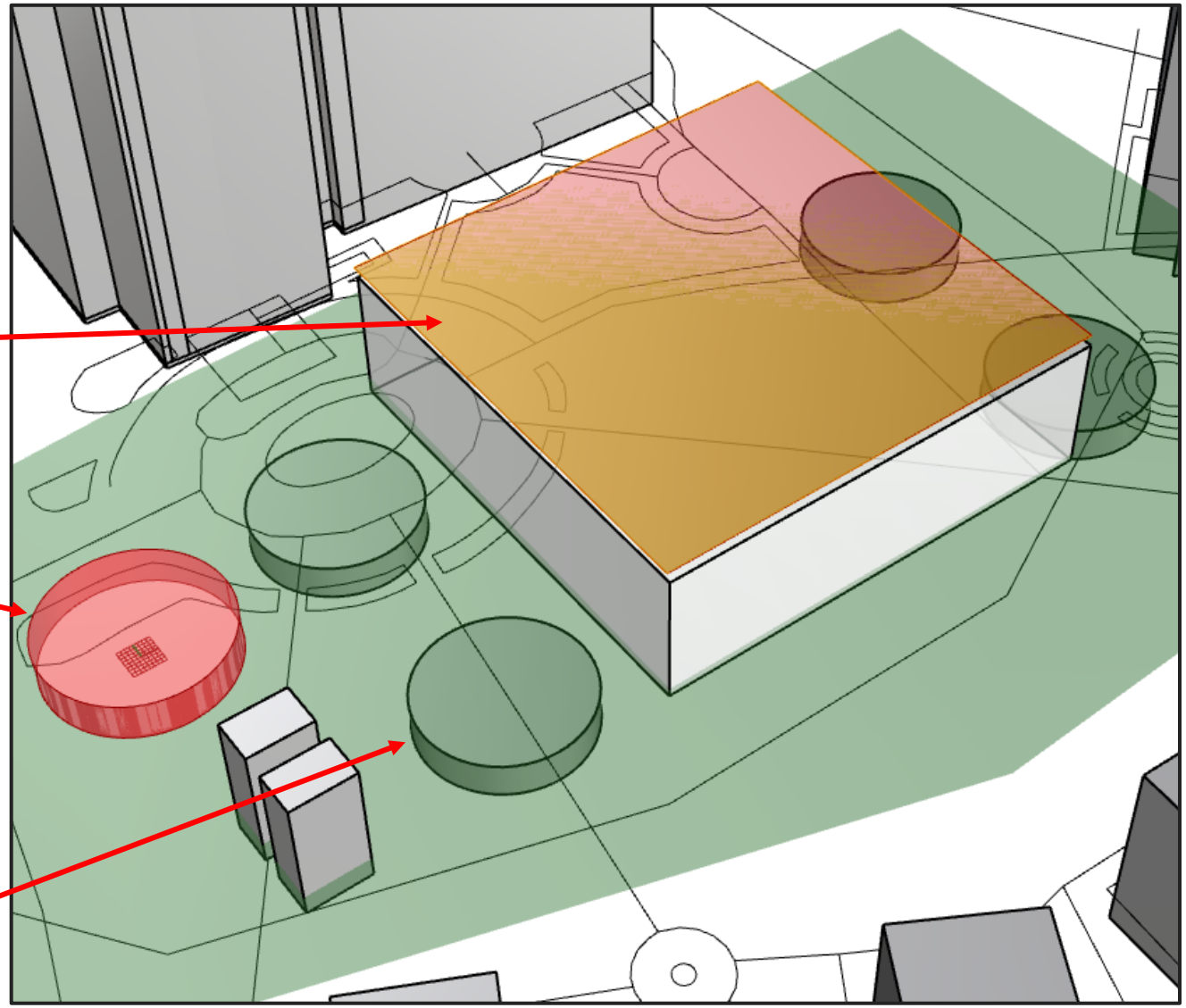

WATER
IMPERATIVE
06
NET POSITIVE WATER
SCALE JUMPING PERMITTED
The intent of this Imperative is for project water use and release to work in harmony with the natural water flows of the site and its surroundings.
All projects must supply one hundred percent of the project's water needs through captured precipitation or other natural closed-loop water systems, and/or through recycling used project water, and all water must be purified as needed without the use of chemicals. No potable water may be used for non-potable uses. If captured precipitation is not adequate to supply the needs of the project after all possible efficiency measures are applied, connection to the municipal water system is allowed.
All projects must address all grey and black water through on-site treatment and management through reuse, a closed-loop system, or infiltration. Projects that are not able to treat and manage on-site may use handprinting within the watershed.
Scale jumping strategies are allowed with some limitations. For example, connecting to a community or municipal facility is allowed. Connection is also allowed where regulations prohibit onsite treatement,[15] or if the municipal system provides greater environmental benefit than onsite treatment. For all scale jumping, pump energy must be accounted for through renewable energy sources.
All projects must incorporate a resilience strategy to provide drinking water for at least a week for all regular building occupants through water storage onsite.
Affordable housing projects may use handprinting within the watershed in lieu of onsite collection or treatment systems to meet the project's water needs.
15 Refer to the v4.0 Water Petal Handbook for clarifications and exceptions, such as exceptions based on local health regulations.
LIVING BUILDING CHALLENGE℠
CERTIFIED - PITTSBURGH, PA
OF FRICK ENVIRONMENTAL CENTER
Living Building Challenge 4.0

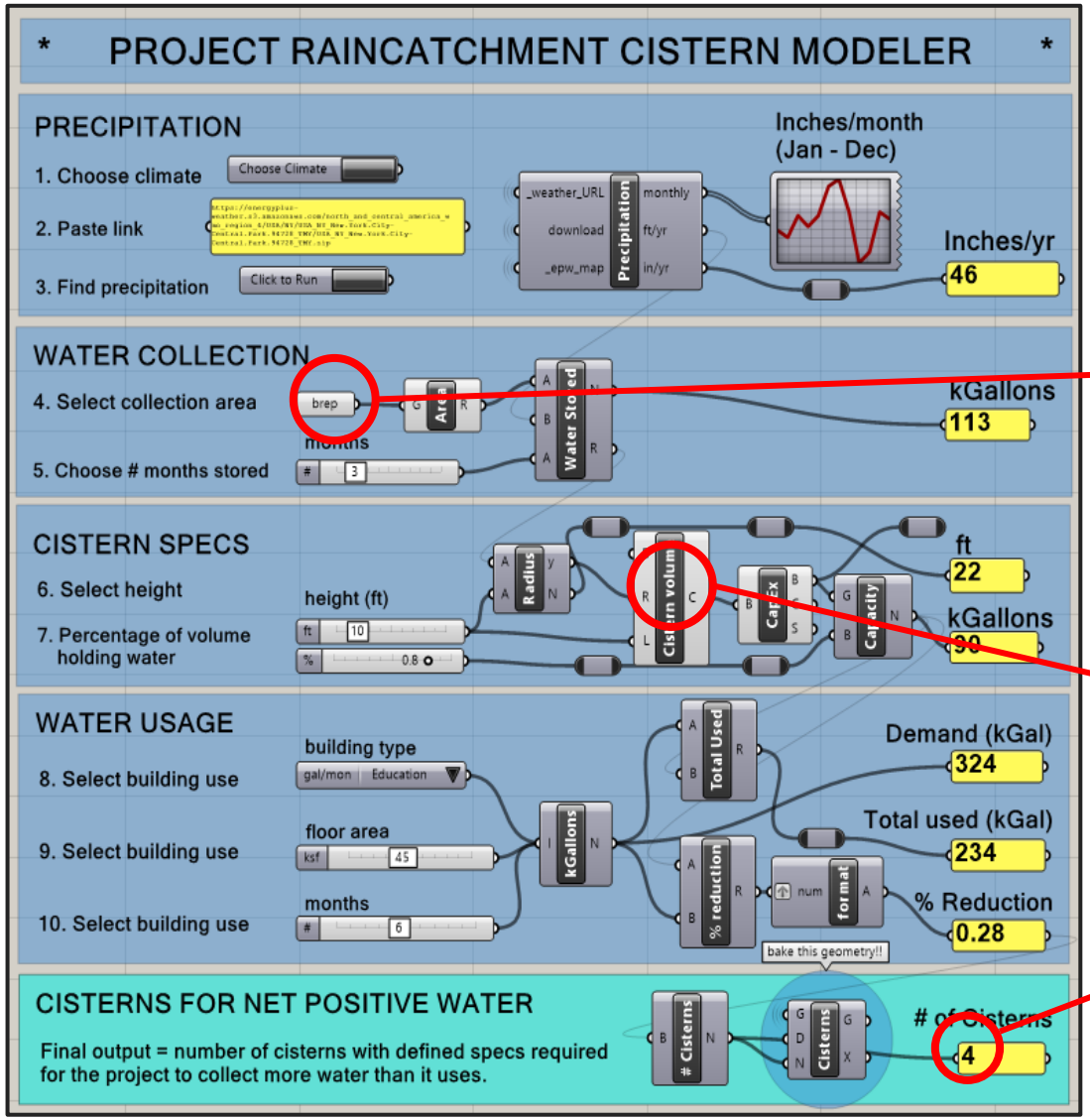

* PROJECT RAINCATCHMENT CISTERN MODELER *
PRECIPITATION
1. Choose climate
Choose Climate
2. Paste link
3. Find precipitation
Click to Run
_weather_URL
download
_epw_map
Precipitation
monthly
ft/yr
in/yr
Inches/month (Jan - Dec)
Inches/yr
46
WATER COLLECTION
4. Select collection area
brep
Area
5. Choose # months stored
months
3
Water Stored
kGallons
113
CISTERN SPECS
6. Select height
height (ft)
10
7. Percentage of volume holding water
0.8
Radius
Cistern volume
CapEx
Capacity
ft
22
kGallons
90
WATER USAGE
8. Select building use
building type
gal/mon
Education
9. Select building use
floor area
ksf
45
10. Select building use
months
6
Total Used
kGallons
% reduction
num
format
Demand (kGal)
324
Total used (kGal)
234
% Reduction
0.28
bake this geometry!!
CISTERNS FOR NET POSITIVE WATER
Final output = number of cisterns with defined specs required for the project to collect more water than it uses.
Cisterns
Cisterns
# of Cisterns
4

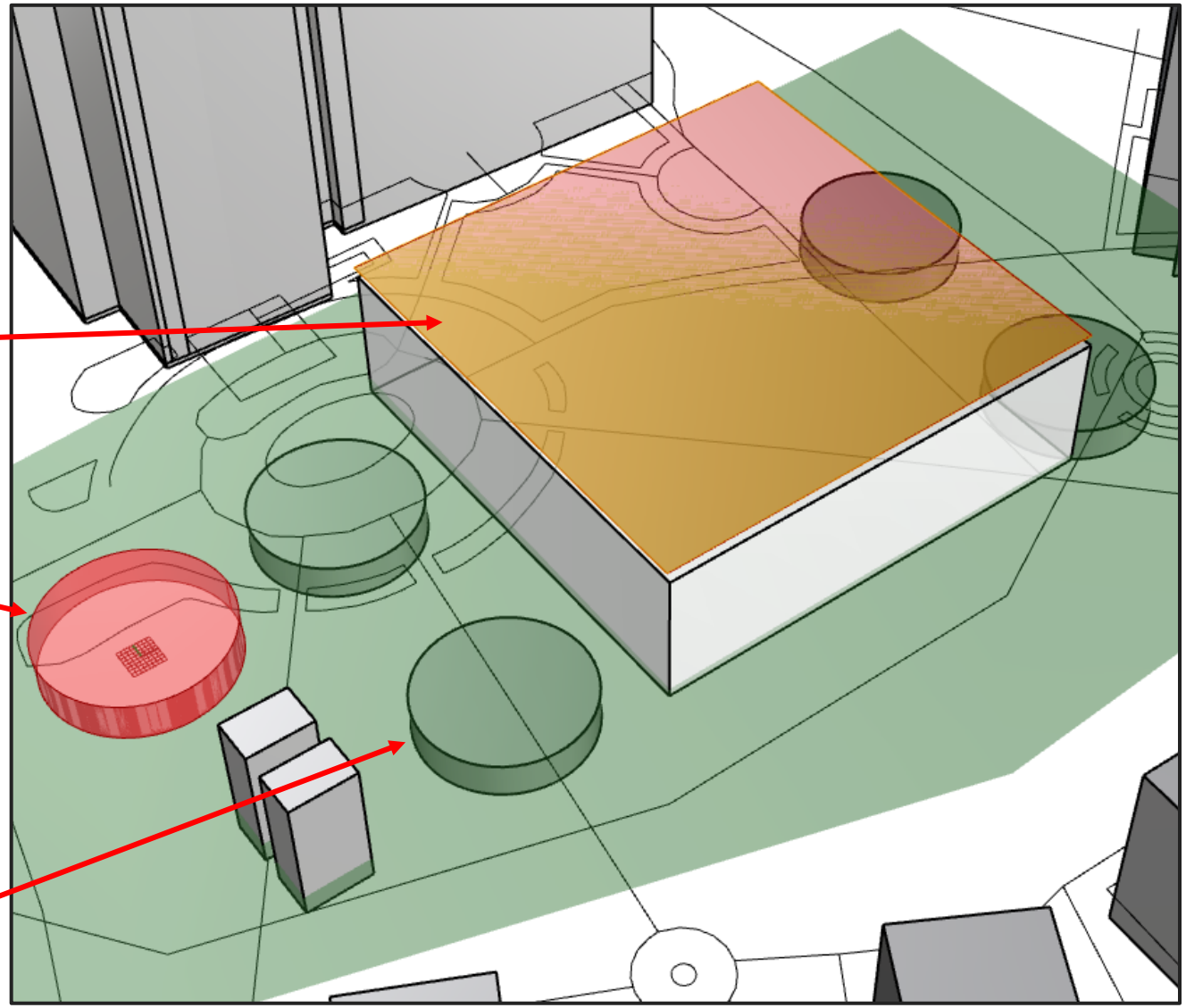

UNITED STATES

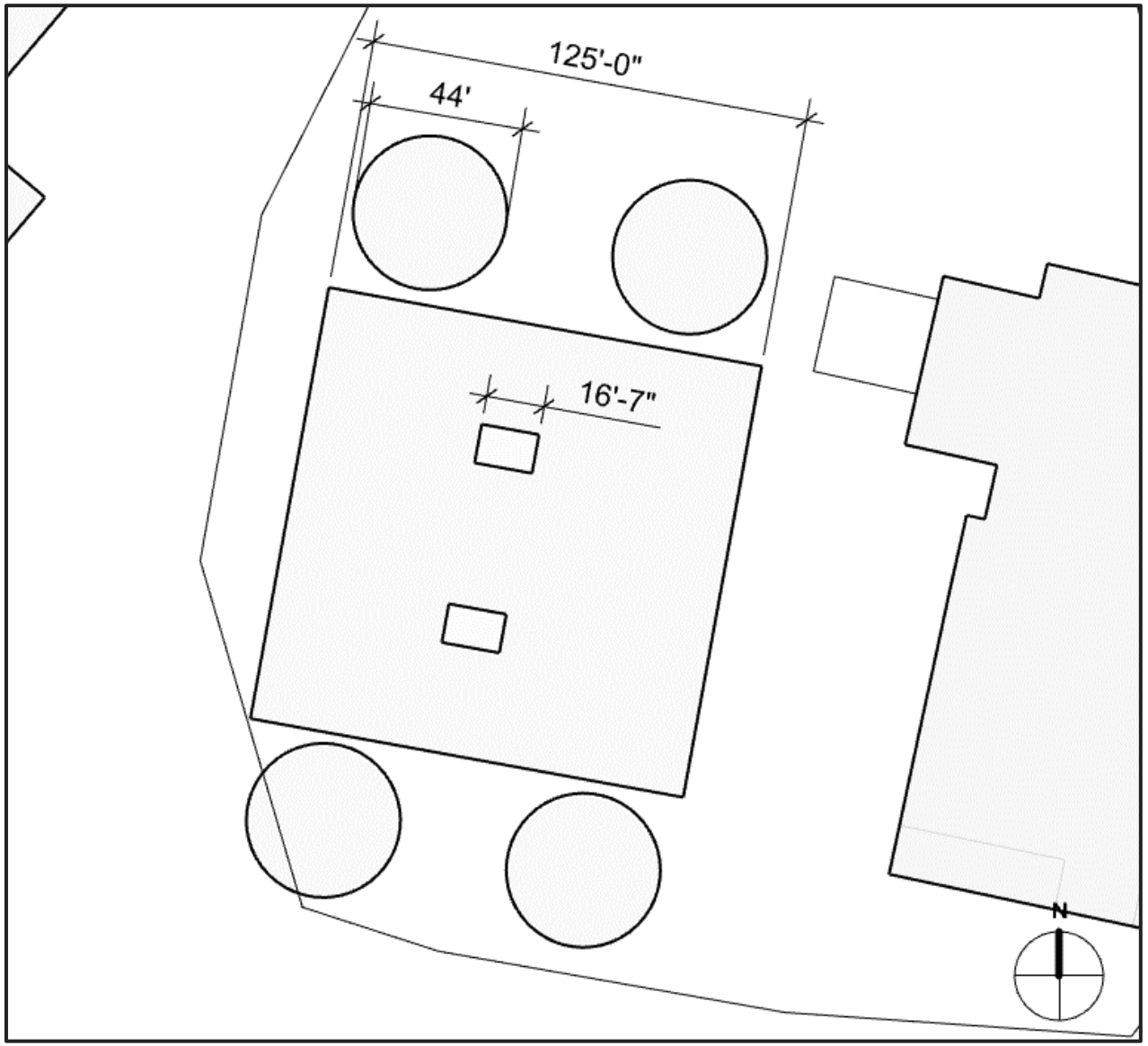

WATER USAGE
8. Select building use
building type
gal/mon
Education
9. Select building use
floor area
ksf
45
10. Select building use
months
#
6
Warehouse
Mercantile
Education
Office
Assembly
Lodging
Health care

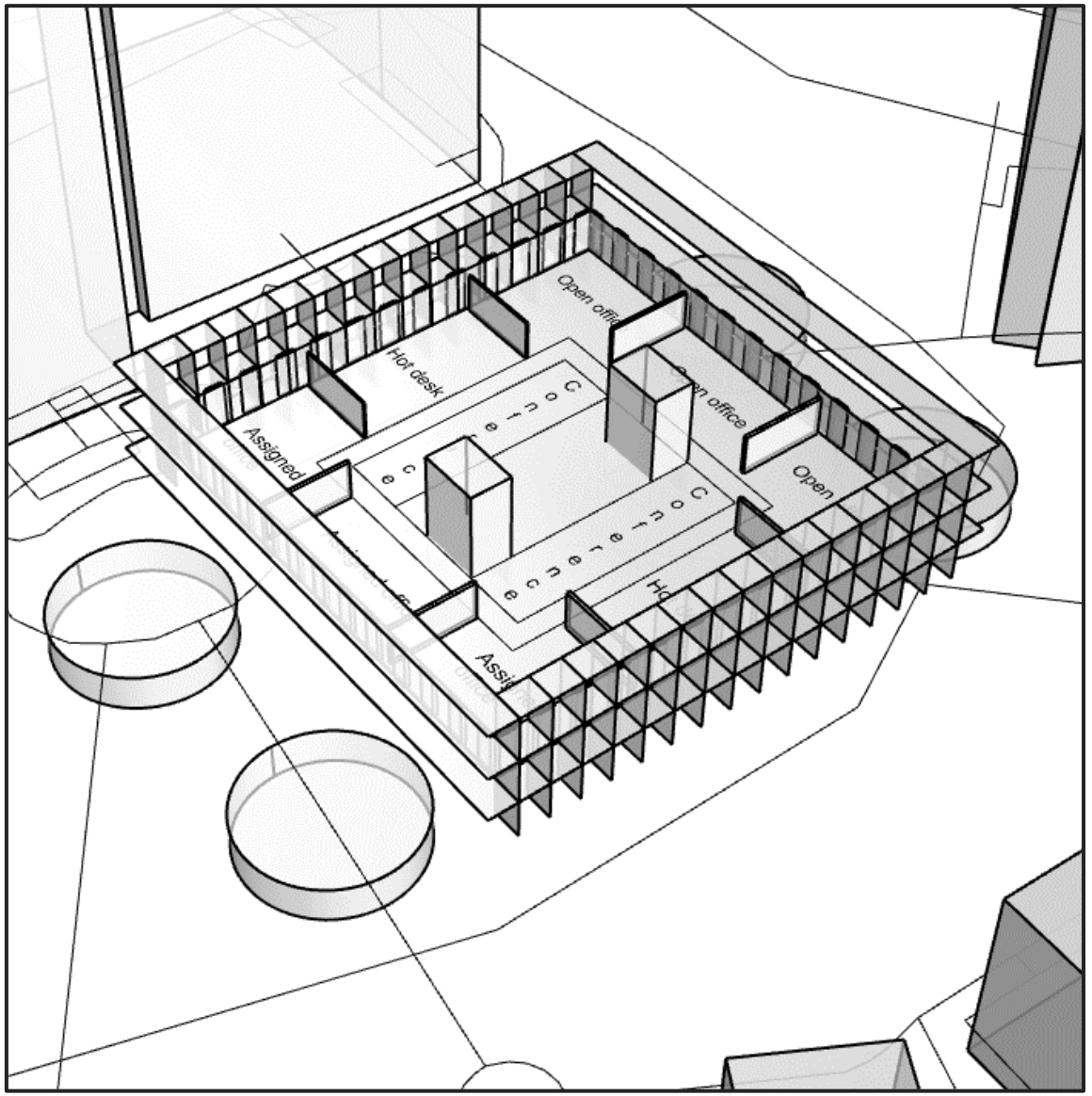

* PROJECT RAINCATCHMENT CISTERN MODELER *
PRECIPITATION
1. Choose climate
Choose Climate
2. Paste link
3. Find precipitation
Click to Run
_weather_URL
download
_epw_map
Precipitation
monthly
ft/yr
in/yr
Inches/month (Jan - Dec)
Inches/yr
46
WATER COLLECTION
4. Select collection area
brep
Area
Water Stored
kGallons
113
months
5. Choose # months stored
3
CISTERN SPECS
6. Select height
height (ft)
Radius
Cistern volume
Capacity
ft
22
kGallons
7. Percentage of volume holding water
10
0.8
WATER USAGE
8. Select building use
building type
gal/mon
Education
Total Used
Demand (kGal)
324
9. Select building use
floor area
ksf
45
kGallons
% reduction
Total used (kGal)
234
10. Select building use
months
6
num
format
% Reduction
0.28
bake this geometry!!
CISTERNS FOR NET POSITIVE WATER
Final output = number of cisterns with defined specs required for the project to collect more water than it uses.
Cisterns
Cisterns
# of Cisterns
4




* PROJECT RAINCATCHMENT CISTERN MODELER *
PRECIPITATION
1. Choose climate
Choose Climate
2. Paste link
3. Find precipitation
Click to Run
_weather_URL
download
_epw_map
Precipitation
monthly
ft/yr
in/yr
Inches/month (Jan - Dec)
Inches/yr
46
WATER COLLECTION
4. Select collection area
brep
Area
Water Stored
kGallons
113
months
5. Choose # months stored
3
CISTERN SPECS
6. Select height
height (ft)
10
7. Percentage of volume holding water
0.8
Radius
Cistern volum
Capacity
ft
22
kGallons
30
WATER USAGE
8. Select building use
building type
gal/mon
Education
9. Select building use
floor area
ksf
45
10. Select building use
months
6
kGallons
Total Used
% reduction
num format
Demand (kGal)
324
Total used (kGal)
234
% Reduction
0.28
bake this geometry!!
CISTERNS FOR NET POSITIVE WATER
Final output = number of cisterns with defined specs required for the project to collect more water than it uses.
Cisterns
Cisterns
# of Cisterns
4




125'-0"
44'
16'-7"
N


Open office
Hot desk
Open office
Open
Assigned

SIMS: DAYLIGHTING

Change from the knee-jerk all glass façade (typical for architecture students) to a nuanced daylighting for health, energy efficiency and comfort.

Option 1. Simulation: Spatial Daylight Autonomy and Annual Sunlight Exposure (1–3 points, 1-2 points Healthcare)

Perform annual computer simulations for spatial daylight autonomy$_{300/50\%}$ (sDA$_{300/50\%}$), and annual sunlight exposure$_{1000,250}$ (ASE$_{1000,250}$) as defined in IES LM-83-12 for each regularly occupied space. Healthcare projects must use each regularly occupied space located in the perimeter area determined under EQ Credit Quality Views. Additionally, calculate the average sDA$_{300/50\%}$ value for the total regularly occupied floor area.

For any regularly occupied spaces with ASE$_{1000,250}$ greater than 10%, identify how the space is designed to address glare.

Points are awarded according to Table 1.

Table 1. Points for Option 1

	New Construction, Core and Shell, Schools, Retail, Data Centers, Warehouses and Distribution Centers, Hospitality	Healthcare
The average sDA$_{300/50\%}$ value for the regularly occupied floor area is at least **40%**	1 point	1 point
The average sDA$_{300/50\%}$ value for the regularly occupied floor area is at least **55%**	2 points	2 points
The average sDA$_{300/50\%}$ value for the regularly occupied floor area is at least **75%**	3 points	Exemplary performance

Spatial Daylight Autonomy

(sDA) = enough daylight?

- regularly occupied spaces
- 300lux for 50% of time
- 75% of spaces (average)

Annual Sunlight Exposure

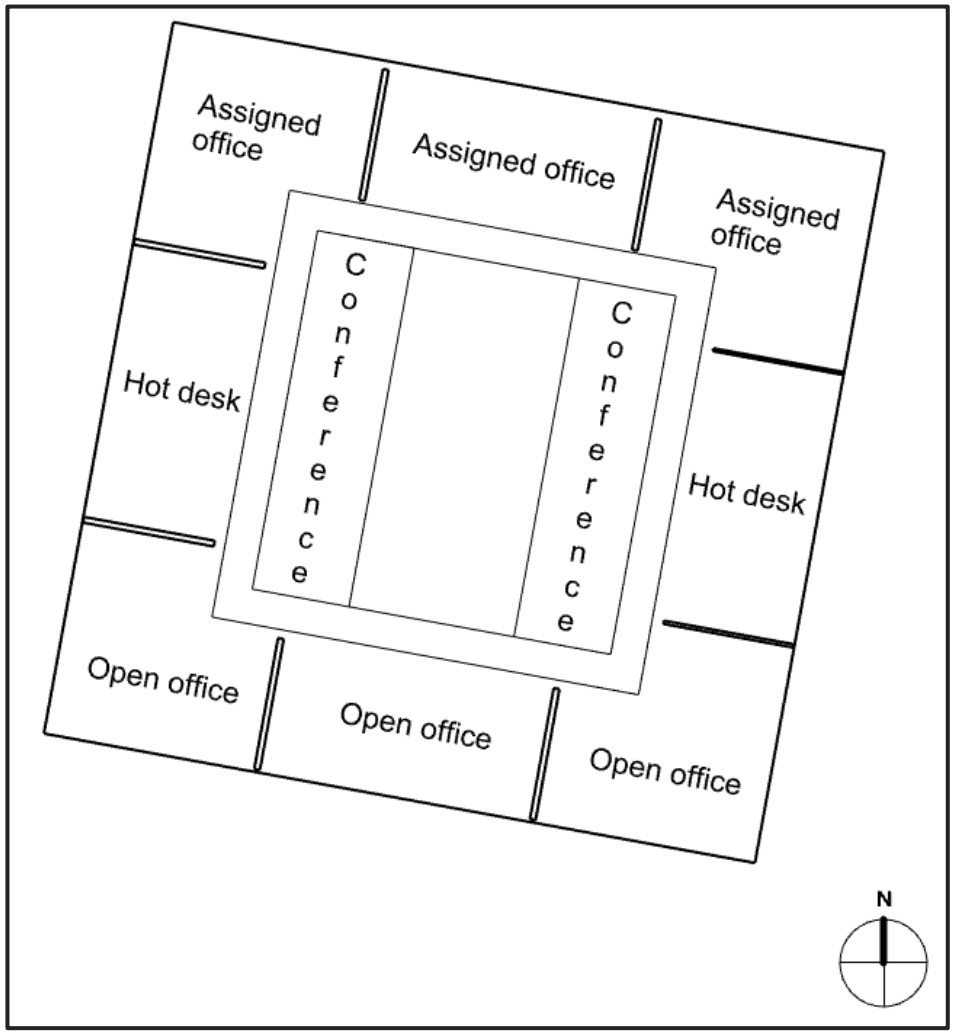
(aSE) = too much?

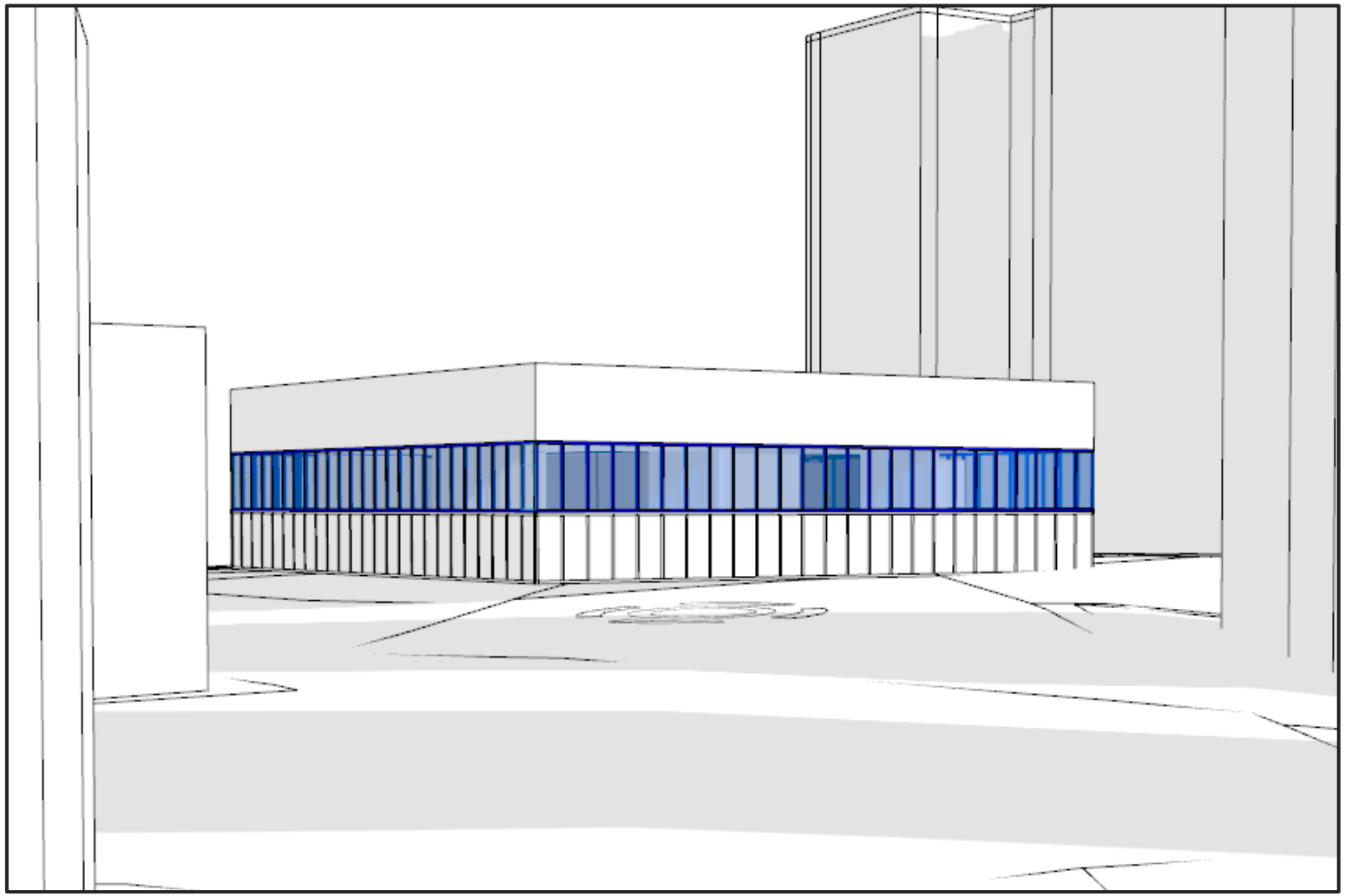
- regularly occupied spaces
- 1,000lux for 250 hours/yr in 10% of space
- each space (not average)

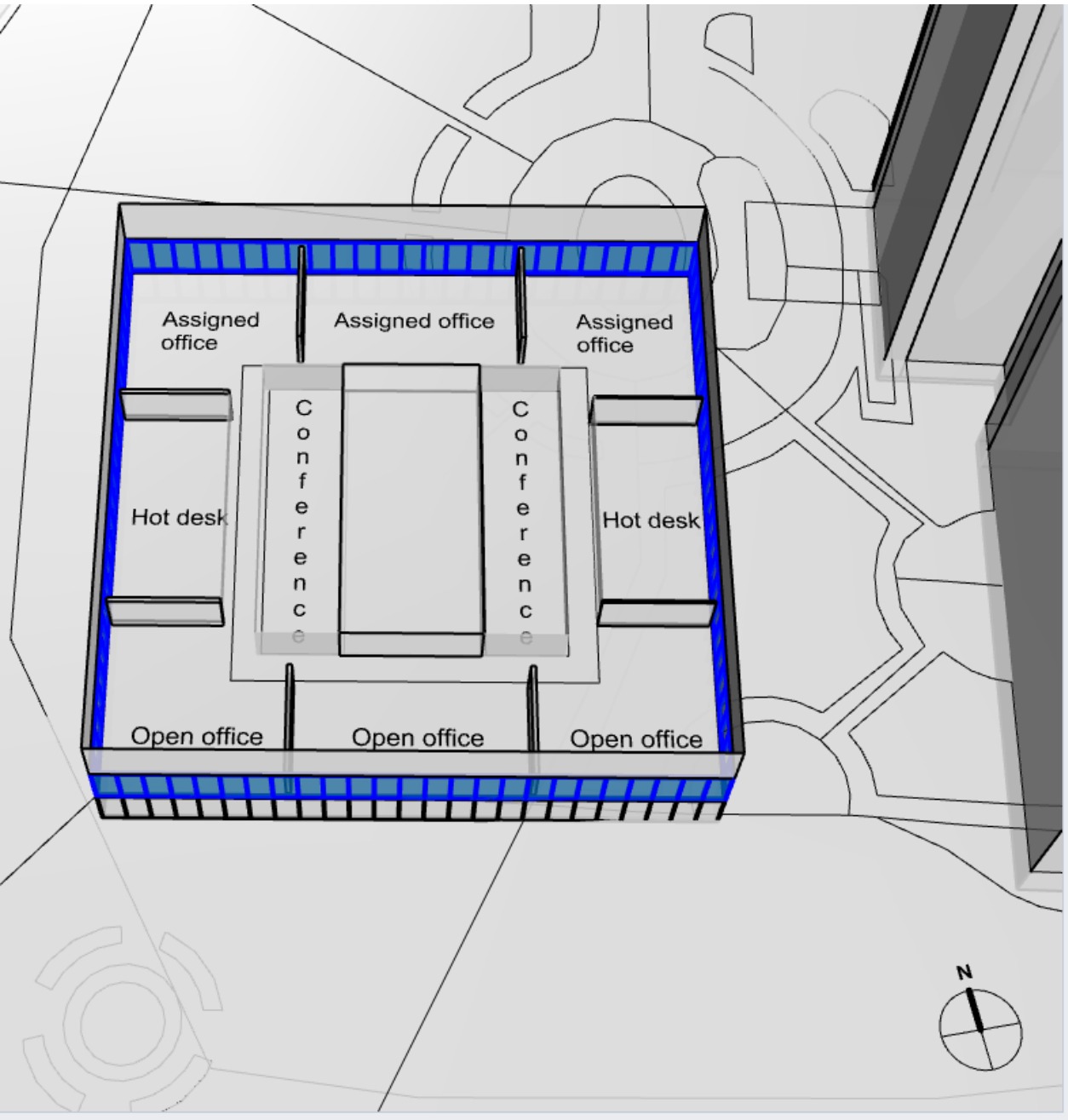
Annual Disturbing Glare

(sDG) = how about comfort?

- not specifically covered by LEED
- math tweaked by human comfort experiments
- once light inside, how do humans perceive it
- amount of light on work surface


Assigned office
Assigned office
Assigned office
Hot desk
Conference
Conference
Hot desk
Open office
Open office
Open office
N





CS Workflows | CS Results

Daylight Availability

LEED v4.1 Option 1

New.York-Kennedy.Intl.AP,NY,USA

Materials: 6 on 7 layers

Blinds: None visible

Areas: None visible

Tubular devices: None visible

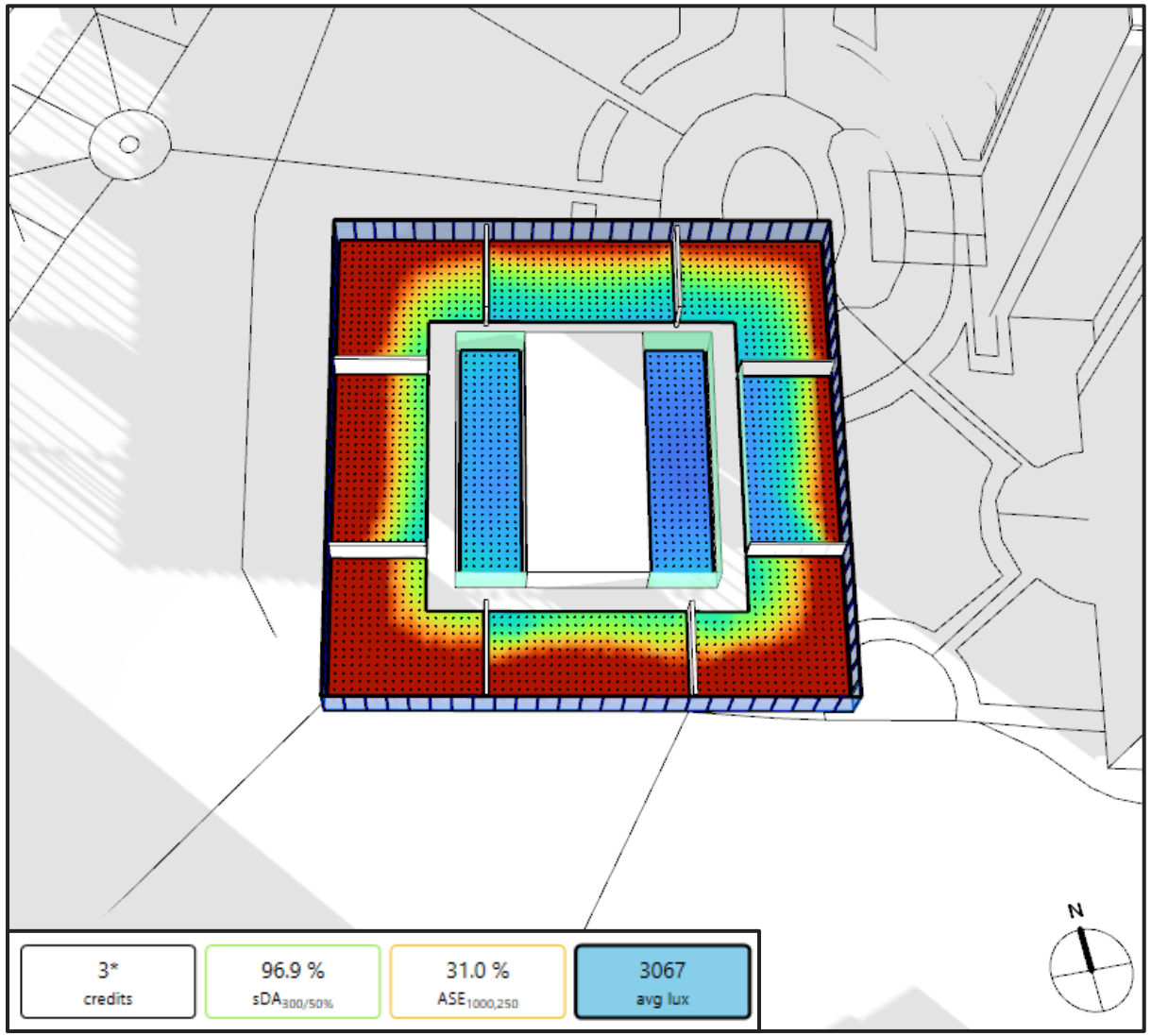
Import .cse file from Revit

Layer	Material
Default	None
SITE	None
parks	None
minor_roads	None
buildings	Concrete Exterior Wall
major_roads	None
water	None
contours	None
coastline	None
topography	Dirty Asphalt
lines	None
paths	None
DAYLIGHT	None
Interior	None
Plan	None
Core	Beige Painted wall
Partitions	Beige Painted wall
Glazing Interior	Clear
Envelope	None
Baseline	None
Mullions	Aluminium Brown Window Mullion
Glazing Exterio	Solarban 90 (2) - Clear (Argon)
Other floors	None

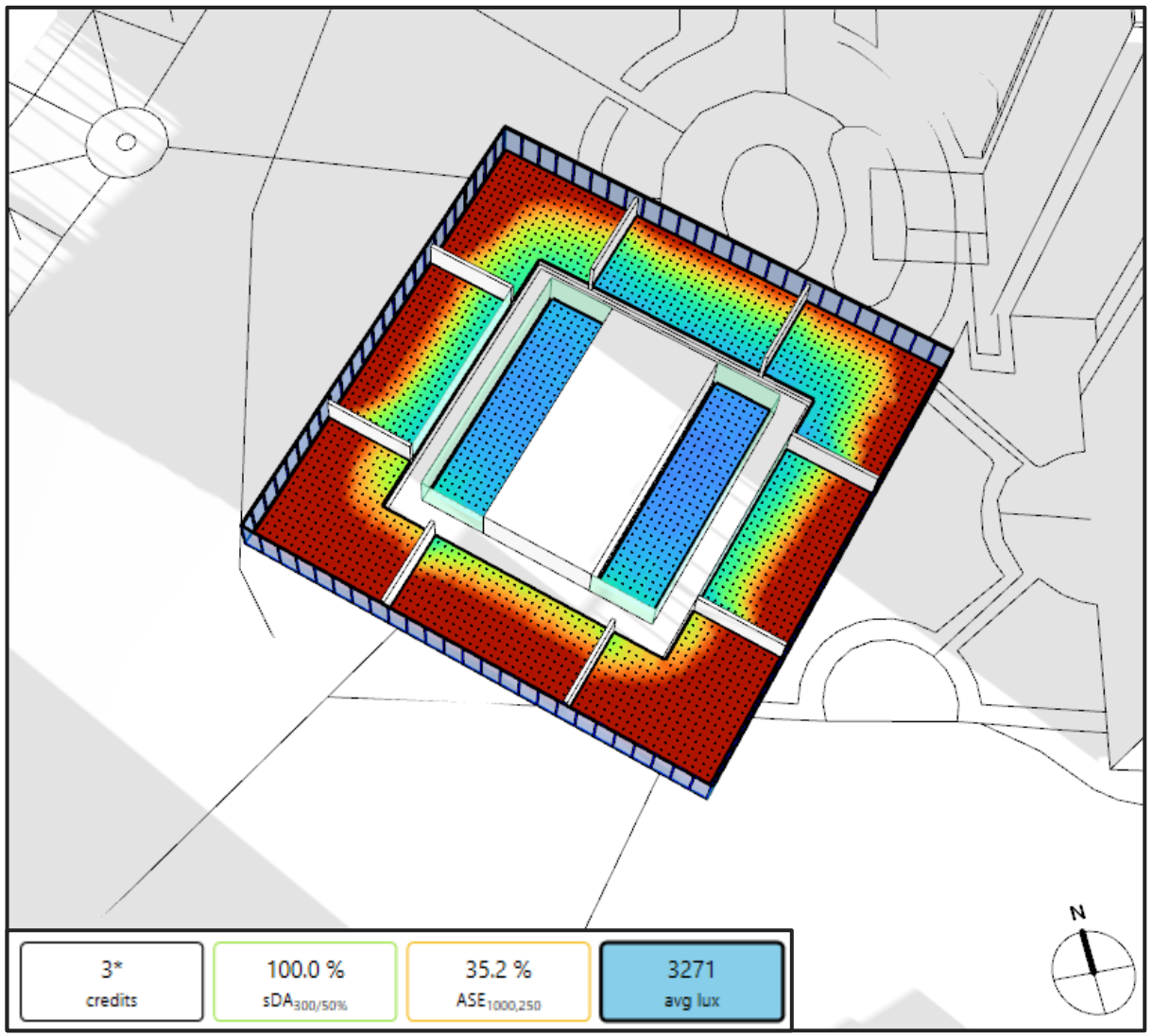
Layers

Layer | C... | D.. | Col..

- Default
- GRAPHICS
- SITE
- MASSING
- INFRASTRUCTURE
- DAYLIGHT
  - Envelope
    - Baseline
      - Glazing Exterior
      - Mullions
    - Opaque added
    - Split glazing
      - Daylight
      - View
  - Interior
    - Ceiling
    - Core
    - Floor
    - Glazing Interior
    - Grid - Core
    - Grids
    - Partitions
    - Plan
  - Other floors
  - Roof
    - Solid
    - Wire
  - Rotate 30
  - Shading
    - It1
      - Shad1EggE
      - Shad1EggW
      - Shad1EW
      - Shad1NS
    - It2
    - It3
    - It4
    - It5

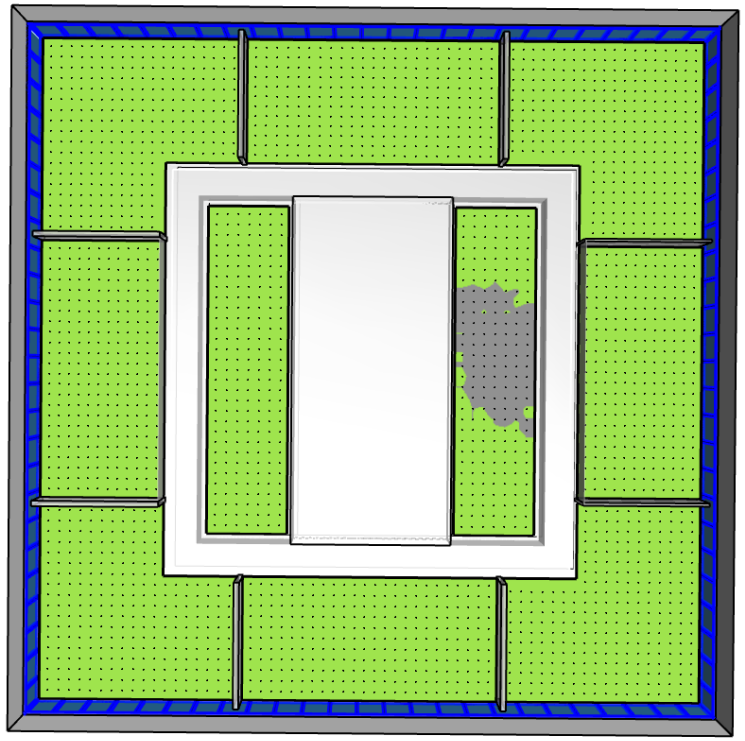


BASELINE



ROTATED 30°

ENOUGH?

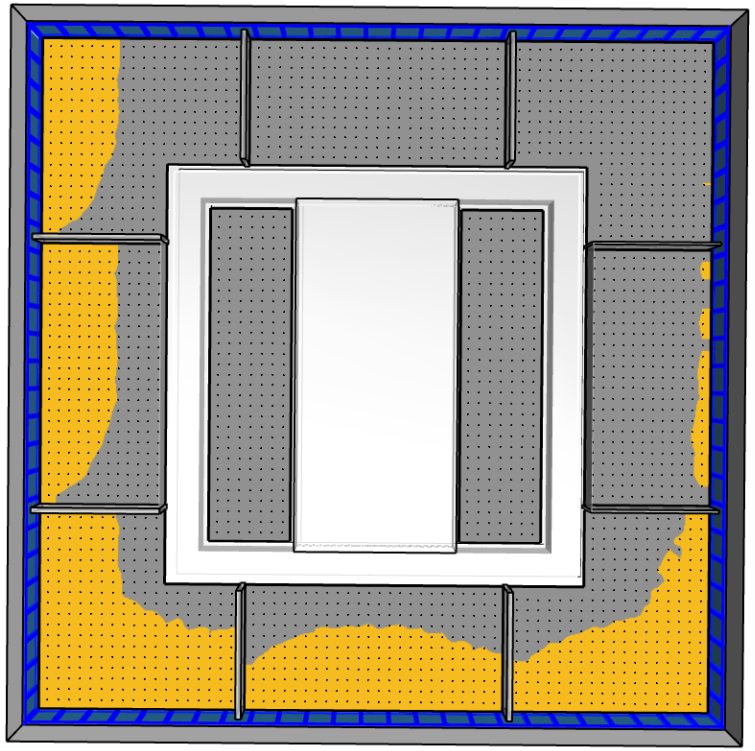


3*	96.9 %	31.0 %	3067	-
credits	$sDA_{300/50\%}$	$ASE_{1000,250}$	avg lux	blinds open

* ASE > 10% in one or more spaces. Glare control strategy must be explained.

average of all
frequently occupied spaces

TOO MUCH?



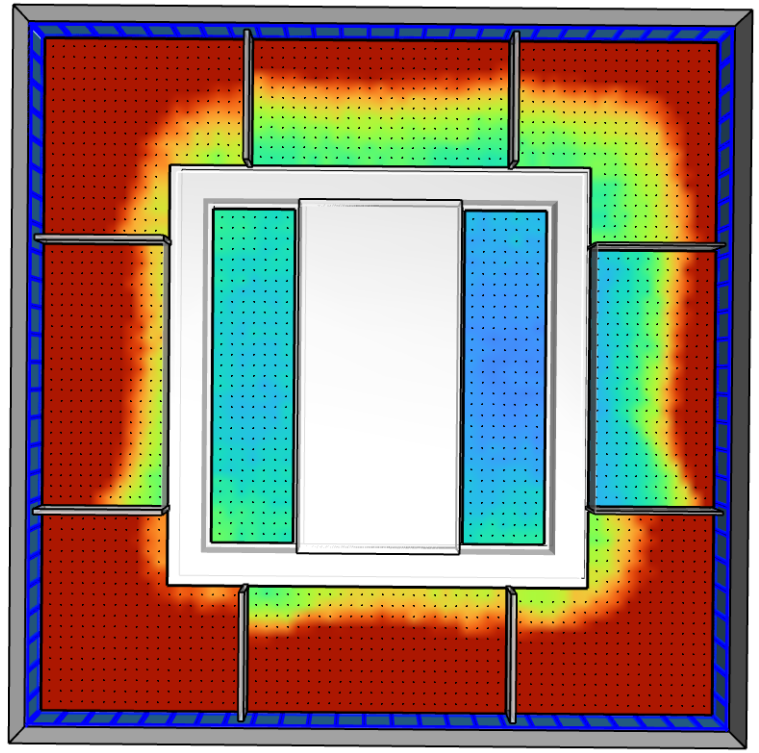
3*	96.9 %	31.0 %	3067	-
credits	$sDA_{300/50\%}$	$ASE_{1000,250}$	avg lux	blinds open

* ASE > 10% in one or more spaces. Glare control strategy must be explained.

ID	Description	Tags	Sq.ft	Spacing[ft]	sDA	ASE	ASE.blinds	Avg.Lux	Blinds	DynamicGlass
E			1078	2.0	100.00 %	6.88 %	6.88 %	1431	N	N
Emeet			915	2.0	63.33 %	0.00 %	0.00 %	367	N	N
N			1080	2.0	100.00 %	0.00 %	0.00 %	1533	N	N
NE			1175	2.0	100.00 %	0.34 %	0.34 %	1930	N	N
NW			1164	2.0	100.00 %	37.41 %	37.41 %	3840	N	N
S			1092	2.0	100.00 %	59.47 %	59.47 %	4791	N	N
SE			1169	2.0	100.00 %	62.59 %	62.59 %	4893	N	N
SW			1158	2.0	100.00 %	77.82 %	77.82 %	6356	N	N
W			1101	2.0	100.00 %	51.74 %	51.74 %	3787	N	N
Wmeet			915	2.0	100.00 %	0.00 %	0.00 %	560	N	N

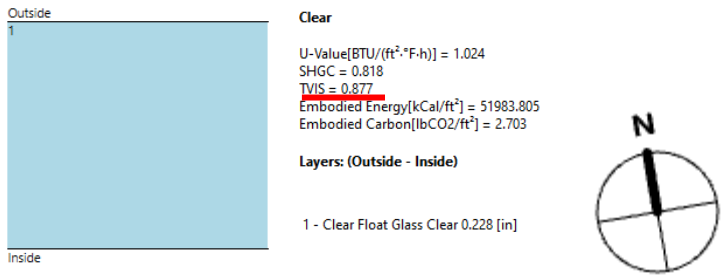
each space calculated individually

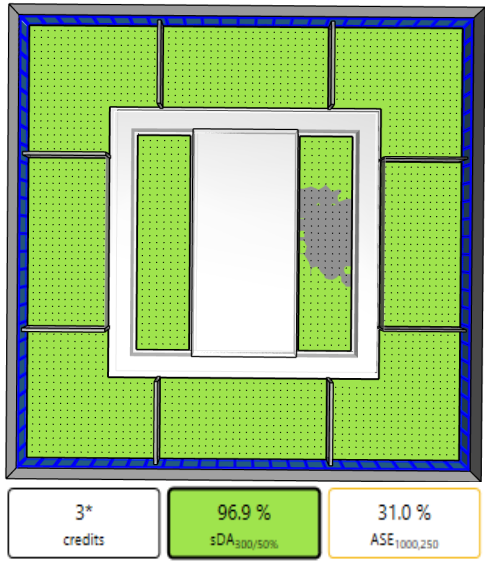
COMFORT?

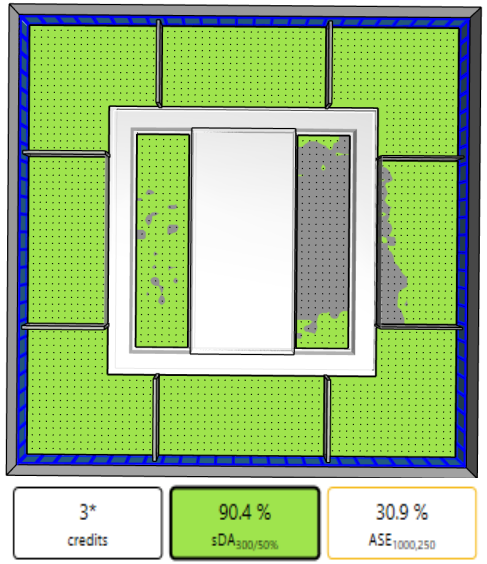


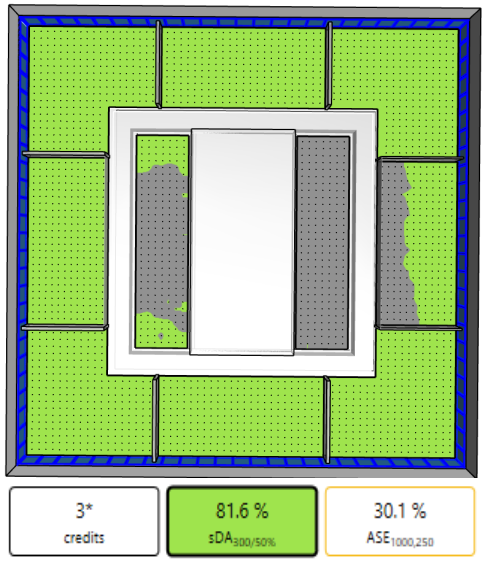
3*	96.9 %	31.0 %	3067	-
credits	$sDA_{300/50\%}$	$ASE_{1000,250}$	avg lux	blinds open

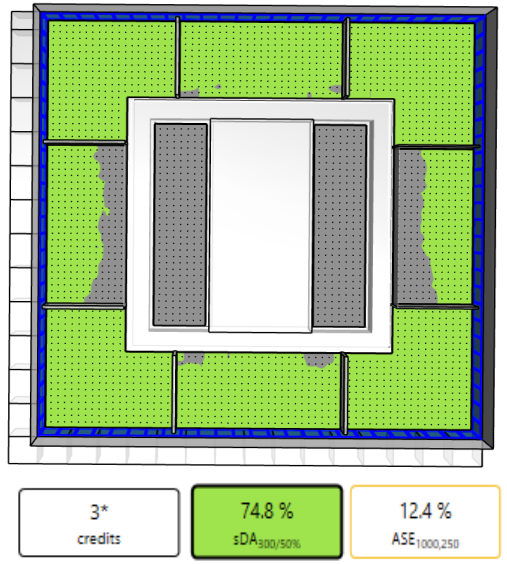
* ASE > 10% in one or more spaces. Glare control strategy must be explained.

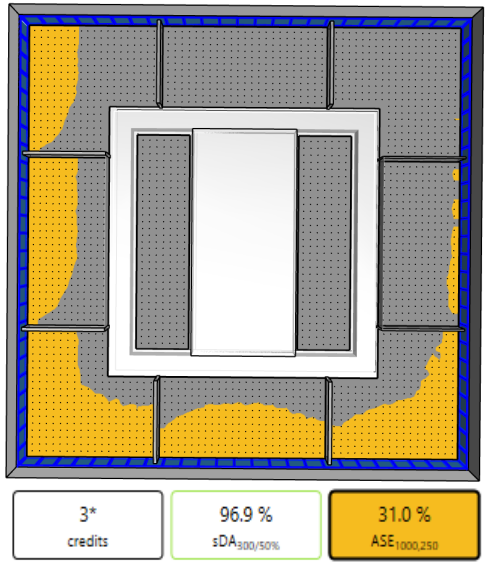


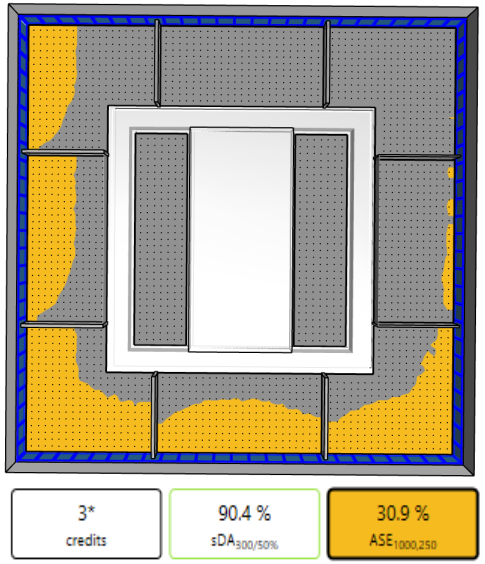


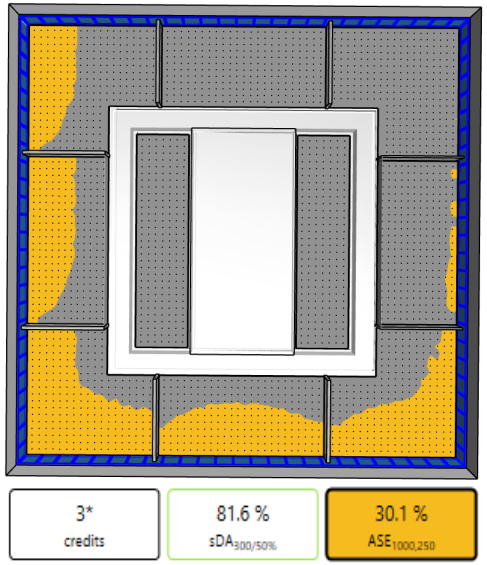


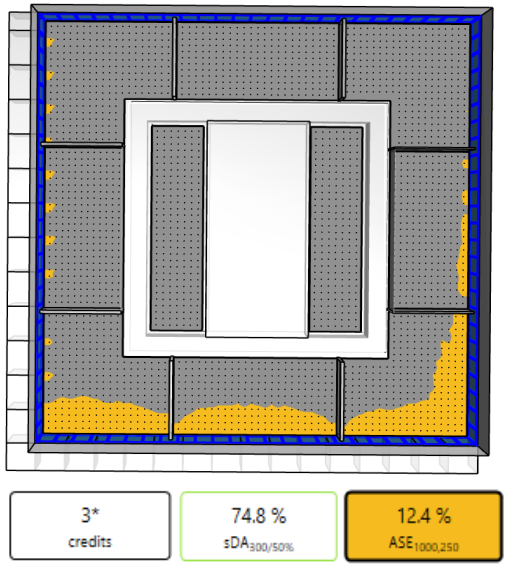












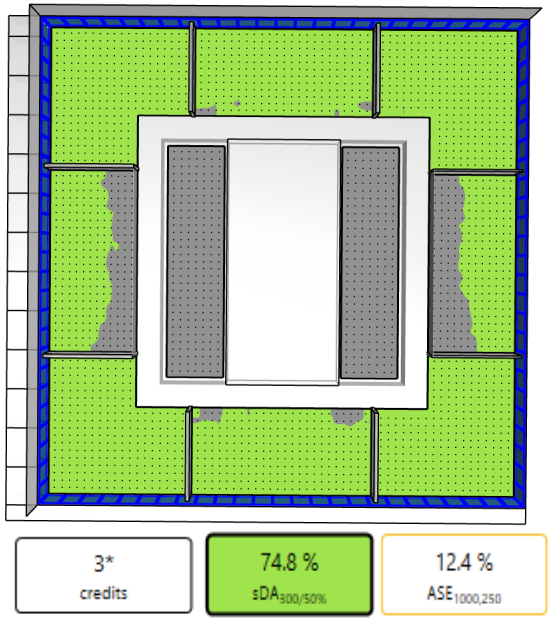
Single Tvis .87

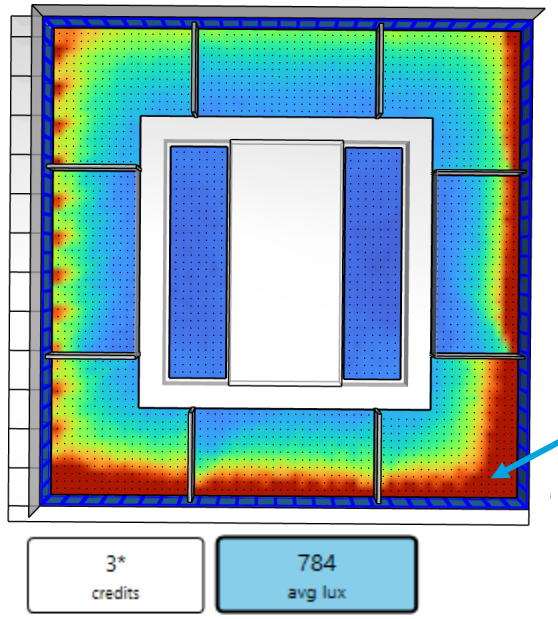
Triple Tvis .71

Double Tvis .50

Shading Tvis .50

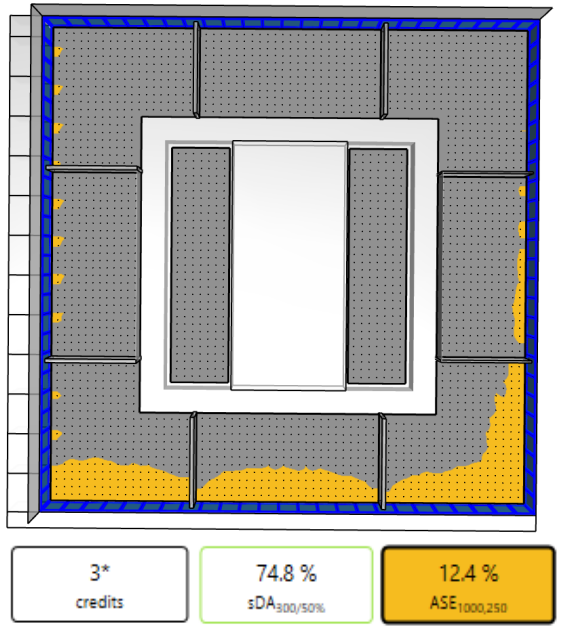
LEED 4.1 DAYLIGHTING COMPLIANT

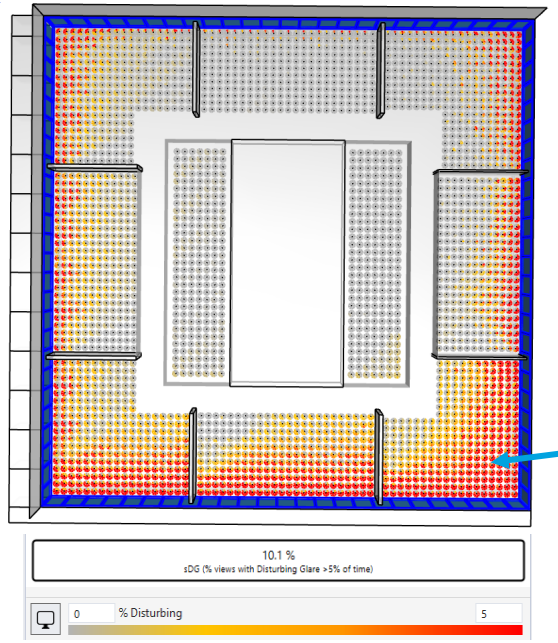




almost 3,000 lux

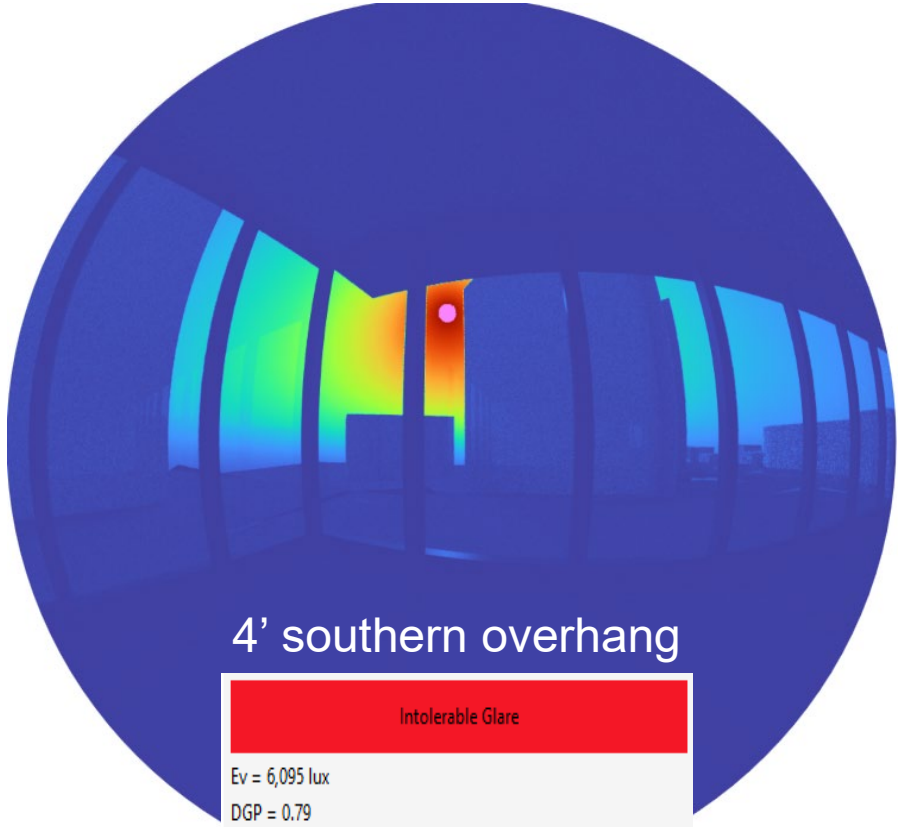
WHAT ABOUT COMFORT?



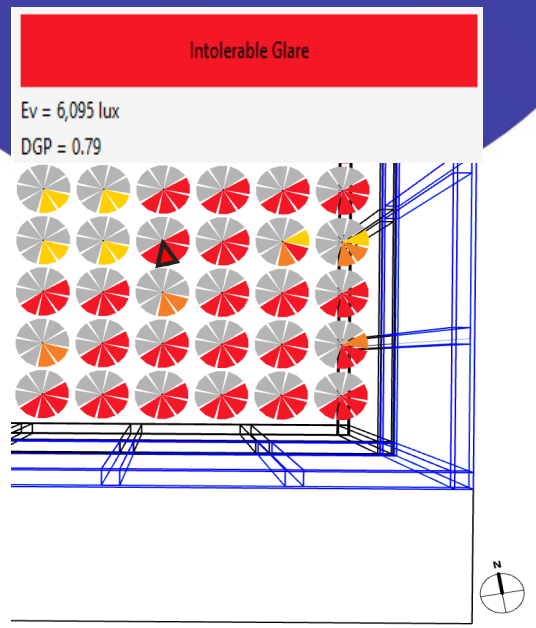


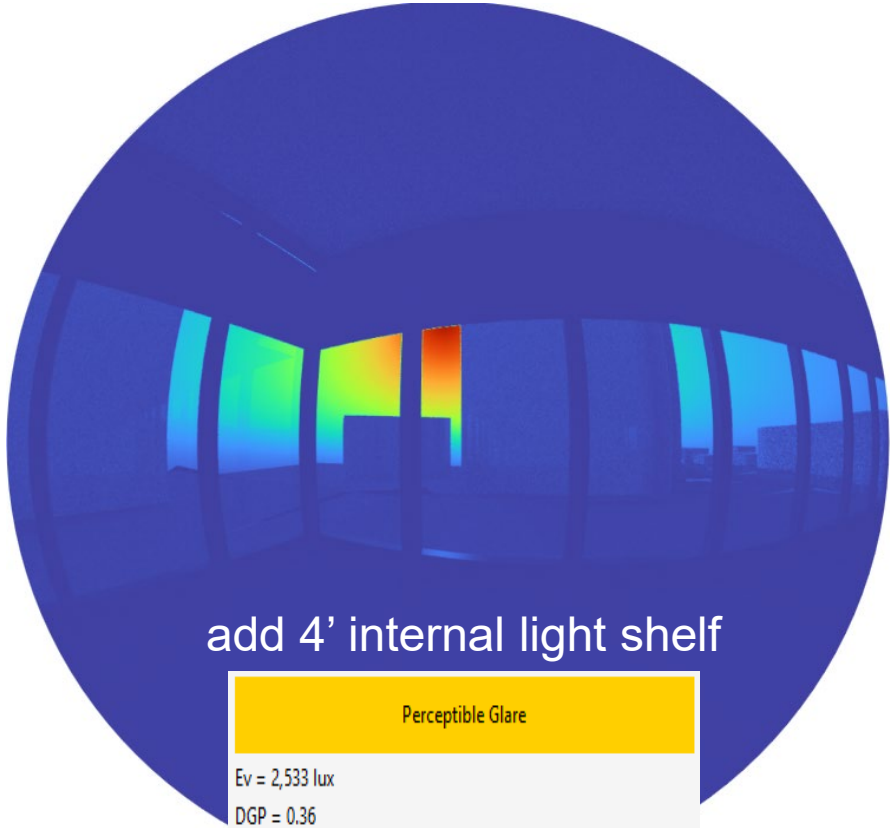
areas of intolerable glare

Shading Tvis .50

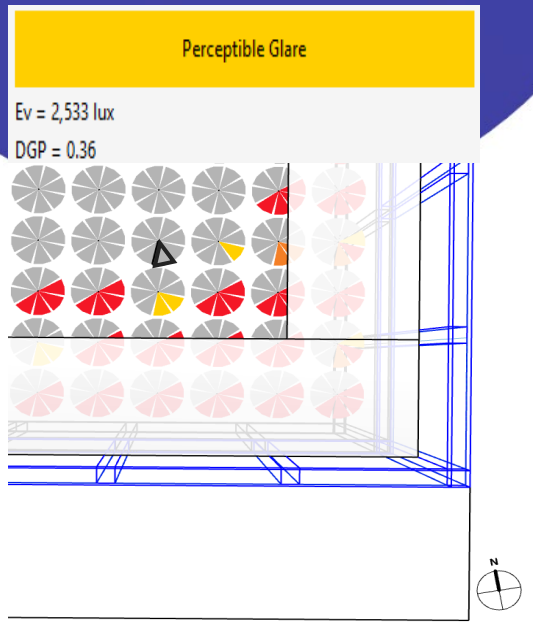


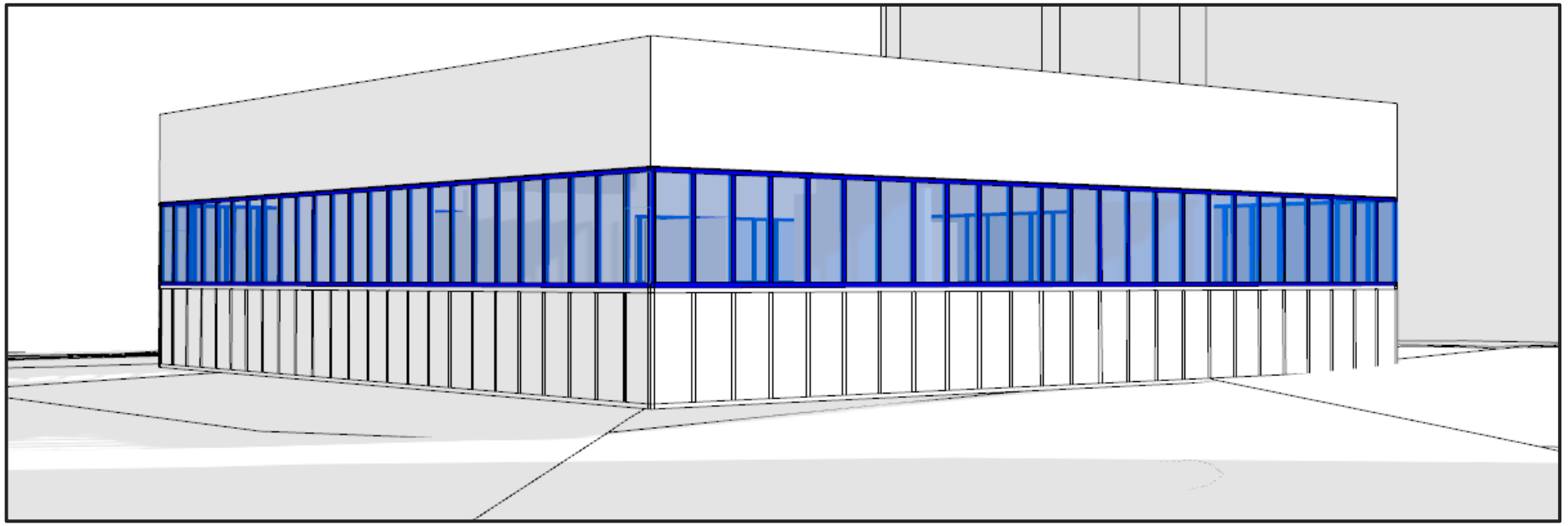
4’ southern overhang

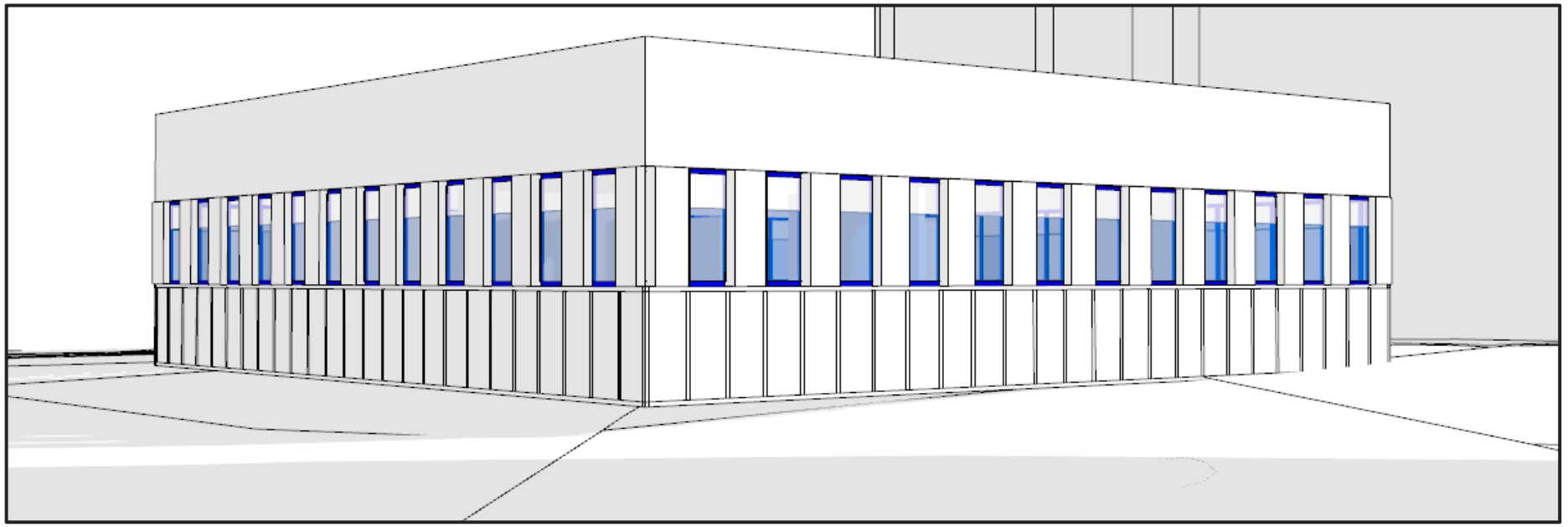


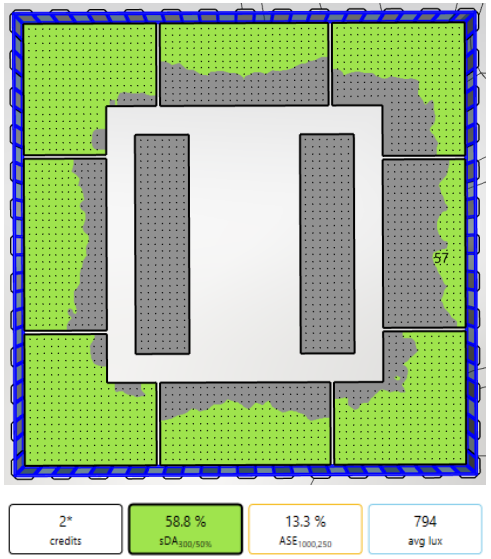


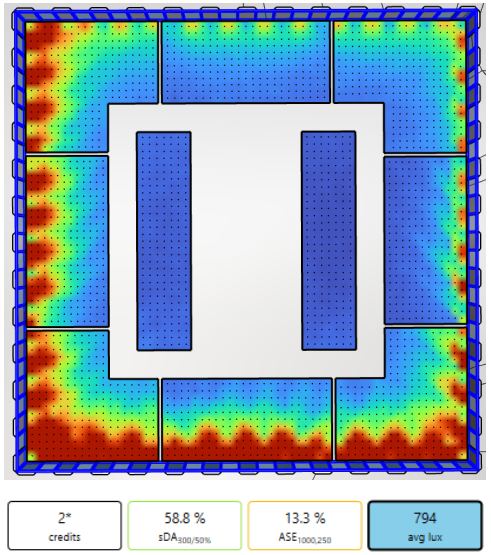
add 4’ internal light shelf



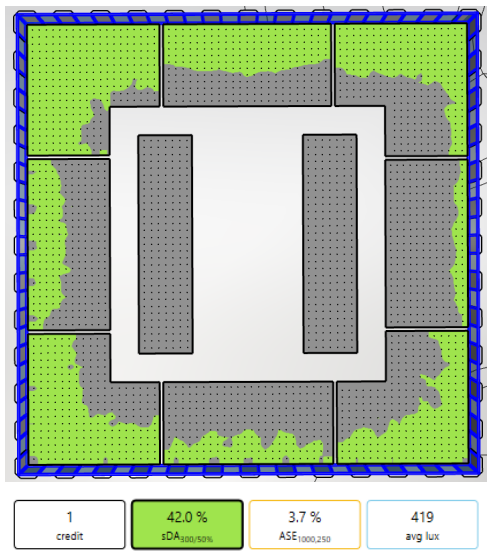


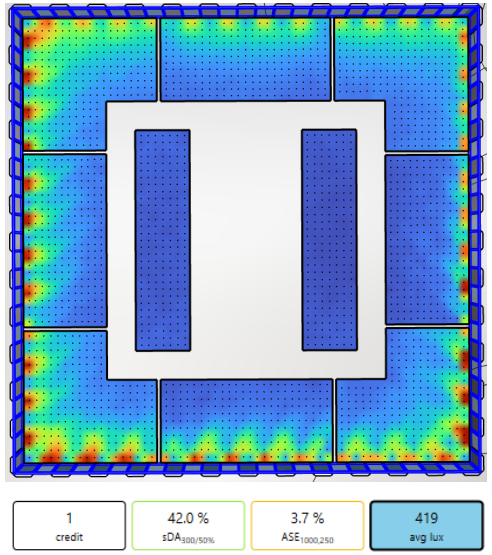




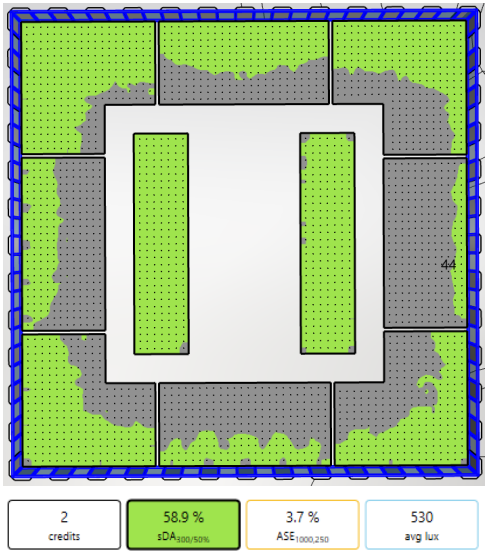


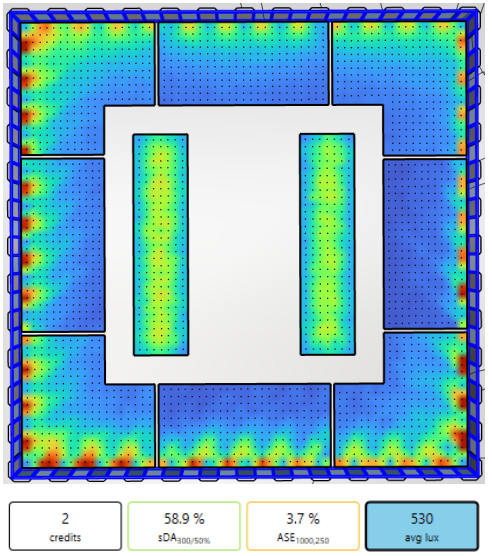
Tvis .50
50% opaque envelope



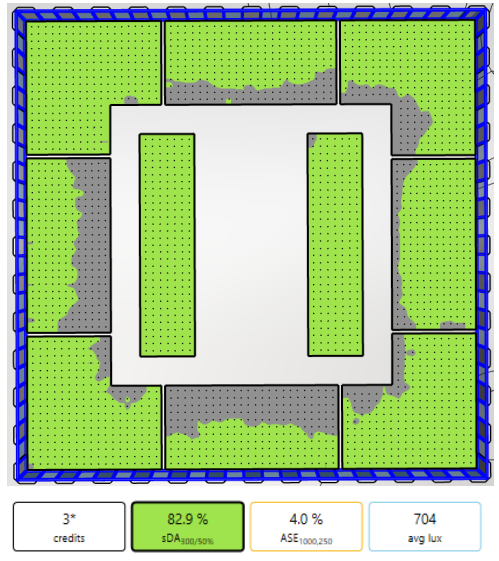


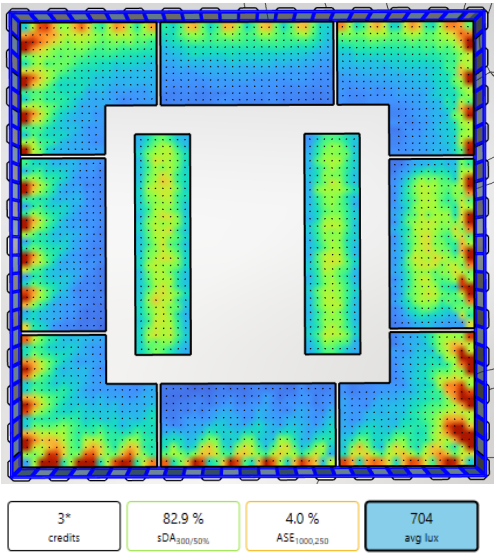
Shading 4' horiz S&W
Internal light shelf



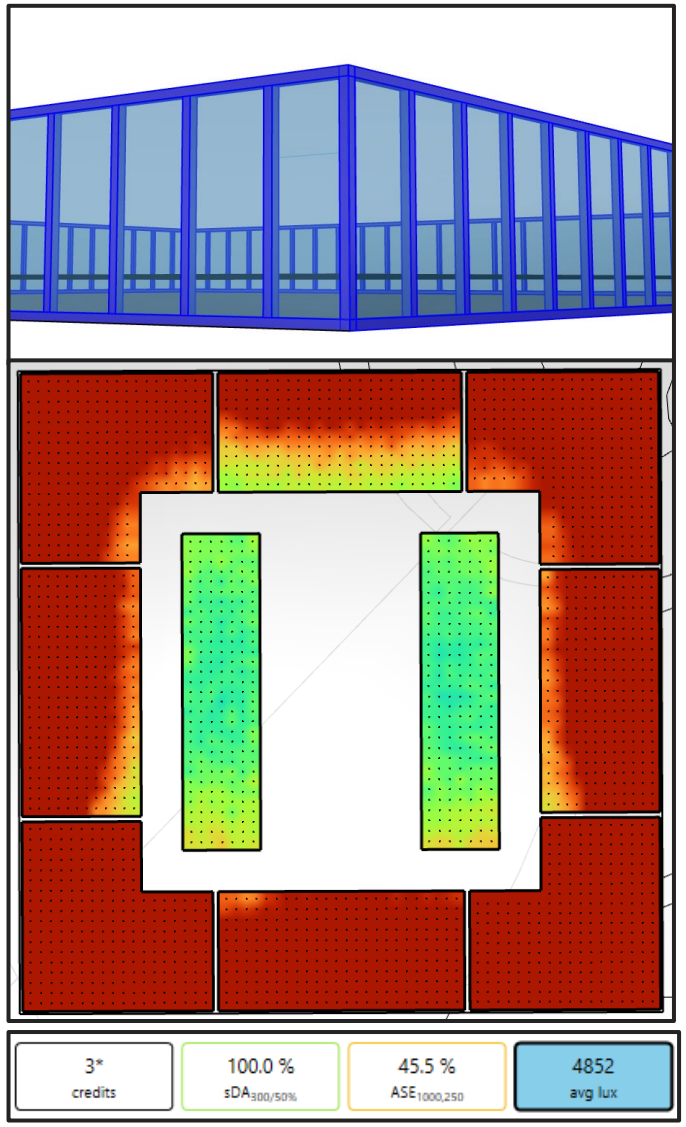


Tubular skylights
in conference rooms

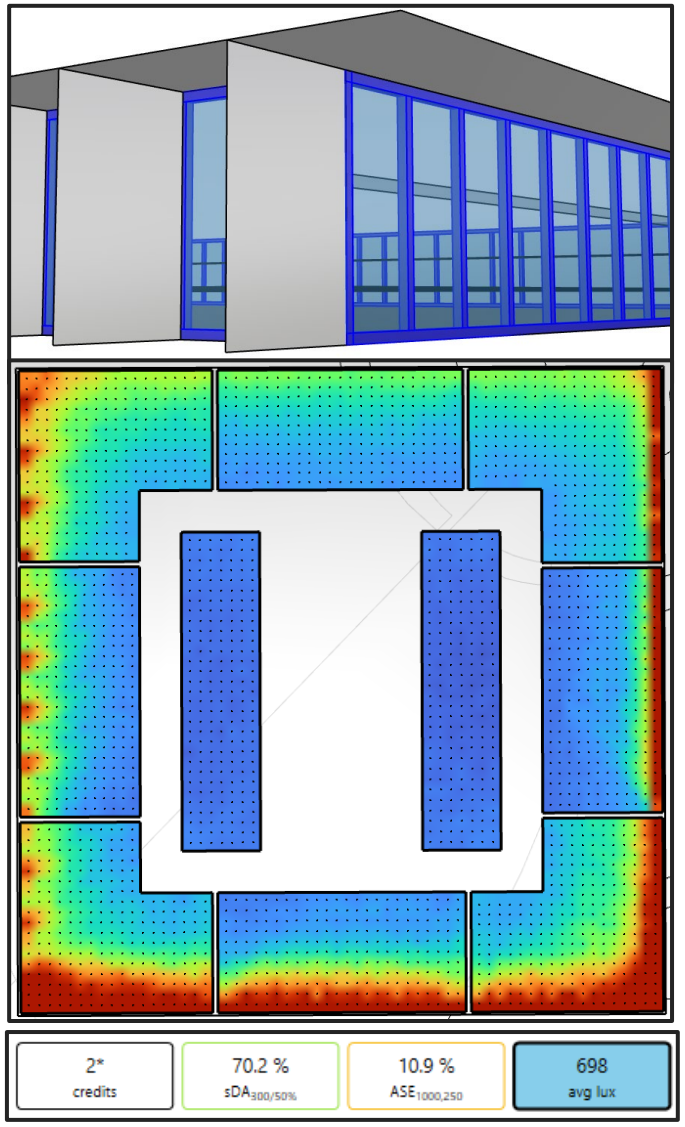




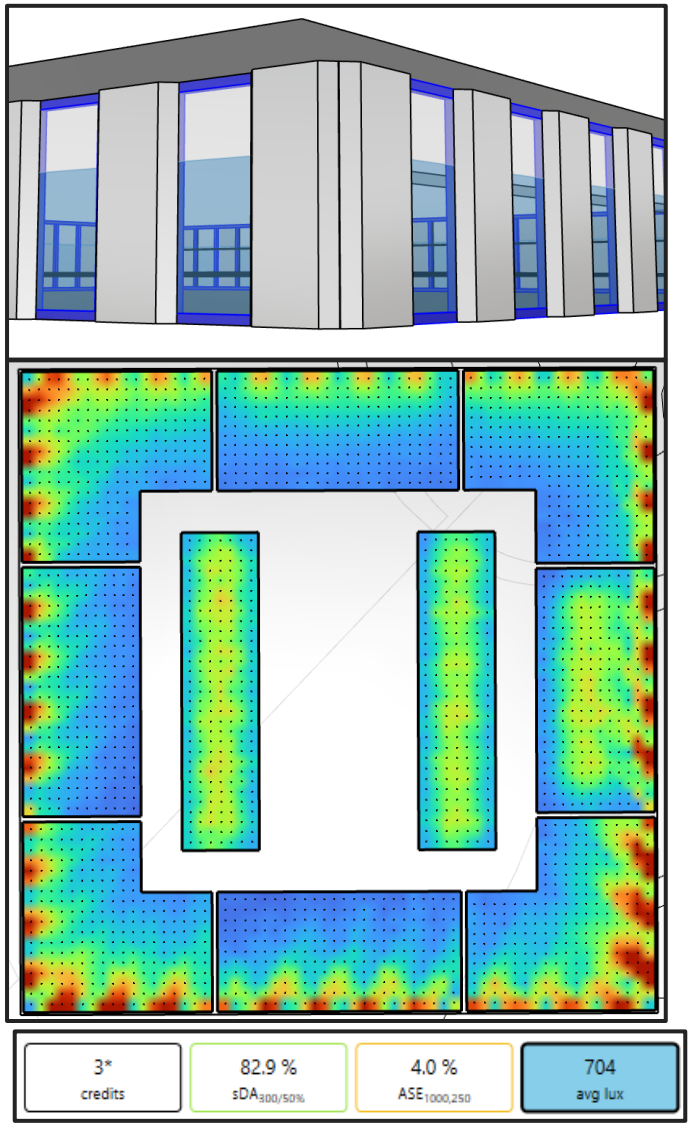
Tvis .55/.74 (split glazing)
Skylights in E&W offices



Tvis .87



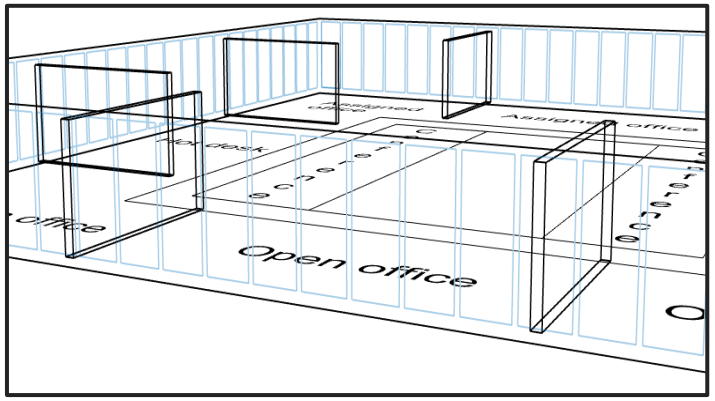
Tvis .50
shading 8' vert S; egg W
interior S&E light shelf



Tvis .74/.55 (split glazing)
50% opaque envelope
shading 4' S&W; tubular skylights

SIMS: ELECTRIC LIGHTING

Change from lighting design being ignored to task-based illumination design studies. Outputs also feed the energy analysis simulation.

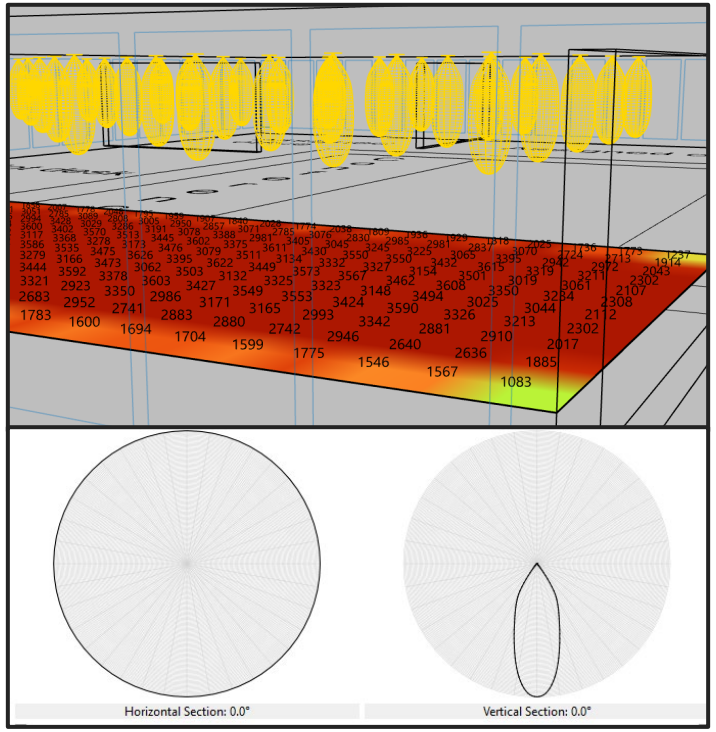


work plane illuminance target lux

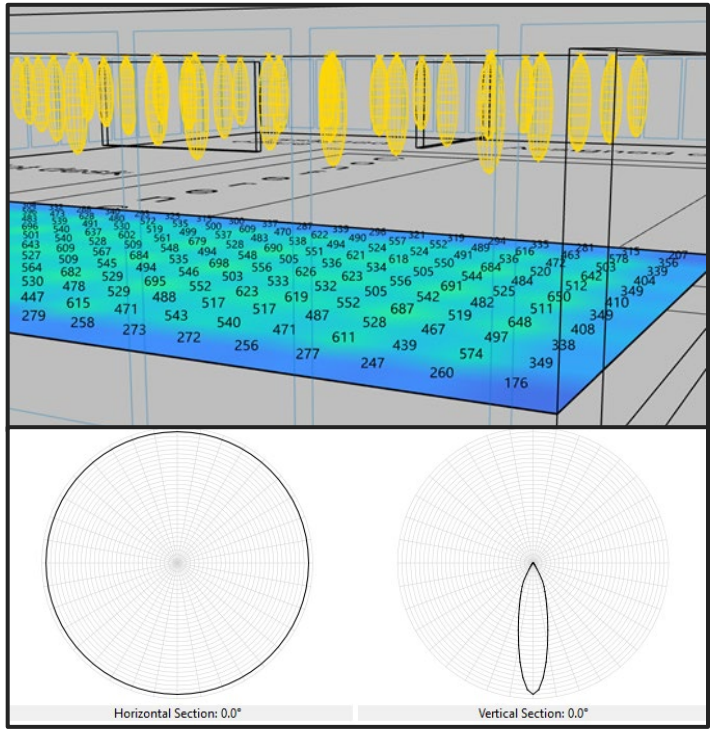
Mechanical / Electrical Room	20-50 FC	200-500 lux
Office - Open	30-50 FC	300-500 lux
Office - Private / Closed	30-50 FC	300-500 lux

design lighting layout and fixtures to deliver target lux

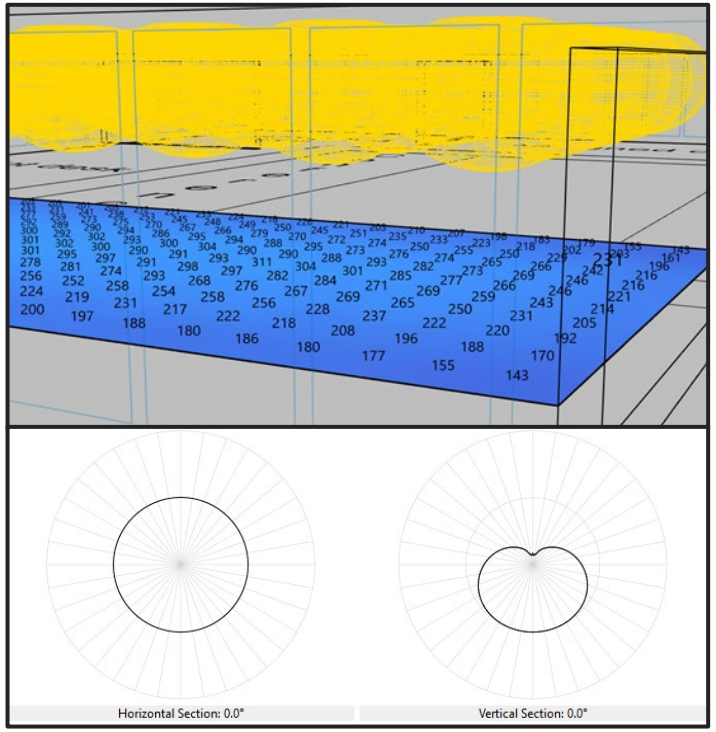
information informs lighting power density in energy use analysis



circular downlight; 6”, 85W, 5788 lm
2,849 lux (mean)



circular downlight; 4”, 11W, 965 lm
485 lux (mean)



A19 bulb; 9W, 860 lm
245 lux (mean)

SIMS: ENERGY USE

Change from an R-value chart to a full system based project site EUI and carbon footprint analysis.

2021 International Energy Conservation Code (IECC) and ANSI/ASHRAE/IES Standard 90.1-2019

Version: Jan 2021

CONTENTS | NOTES

- Chapter 4 [CE] Commercial Energy Efficiency
  - Section C401 General
  - Section C402 Building Envelope Requirements
    - C402.1 General.
      - C402.1.1 Low-Energy Buildings and Greenhouses.
      - C402.1.2 Equipment Buildings.
      - C402.1.3 Insulation Component R-Value-Based Method. R
      - C402.1.4 Assembly U-Factor, C-Factor or F-Factor-Based Method. U C F
        - C402.1.4.1 Roof/Ceiling Assembly.
        - C402.1.4.2 Thermal Resistance of Cold-Formed Steel Walls.
      - C402.1.5 Component Performance Alternative.
    - C402.2 Specific Building Thermal Envelope Insulation Requirements.
      - C402.2.1 Roof Assembly.
      - C402.2.2 Above-Grade Walls.

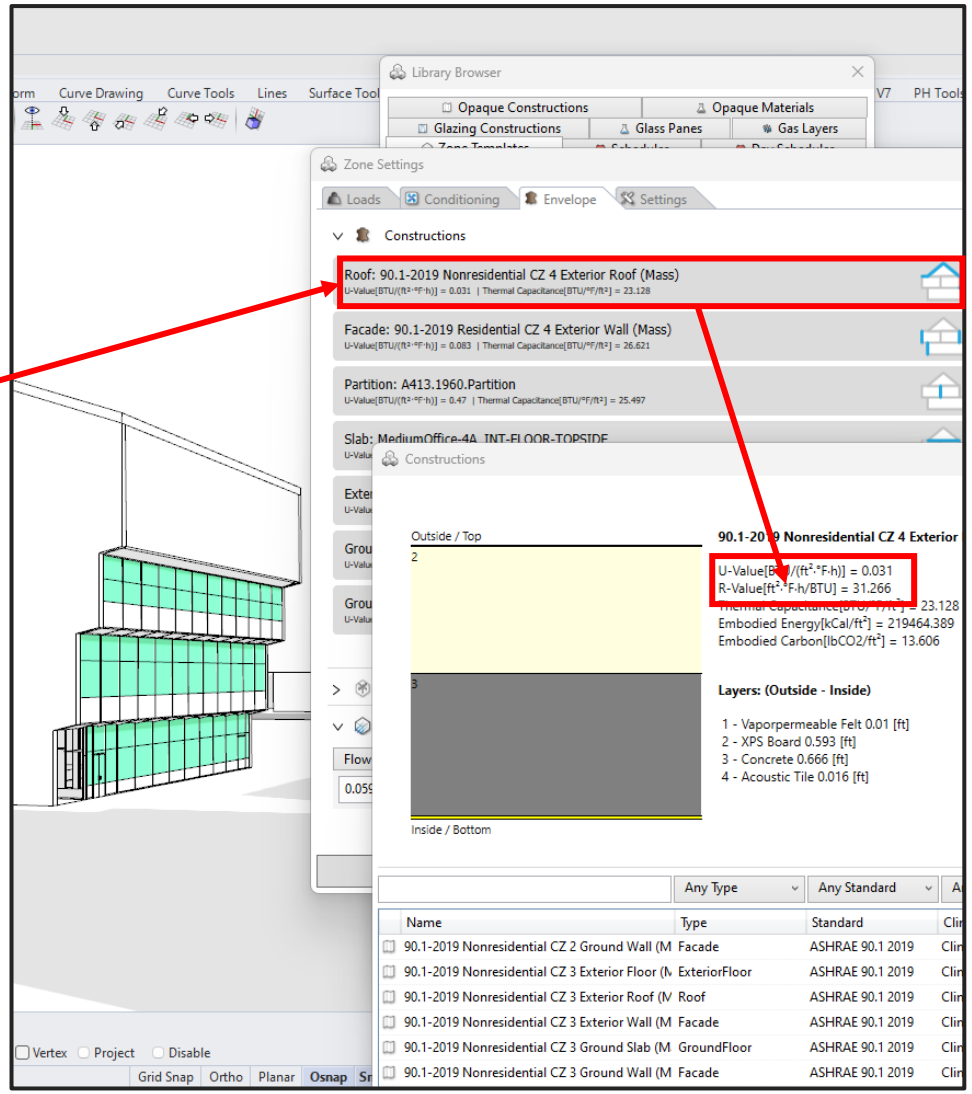
Codes / I-Codes /

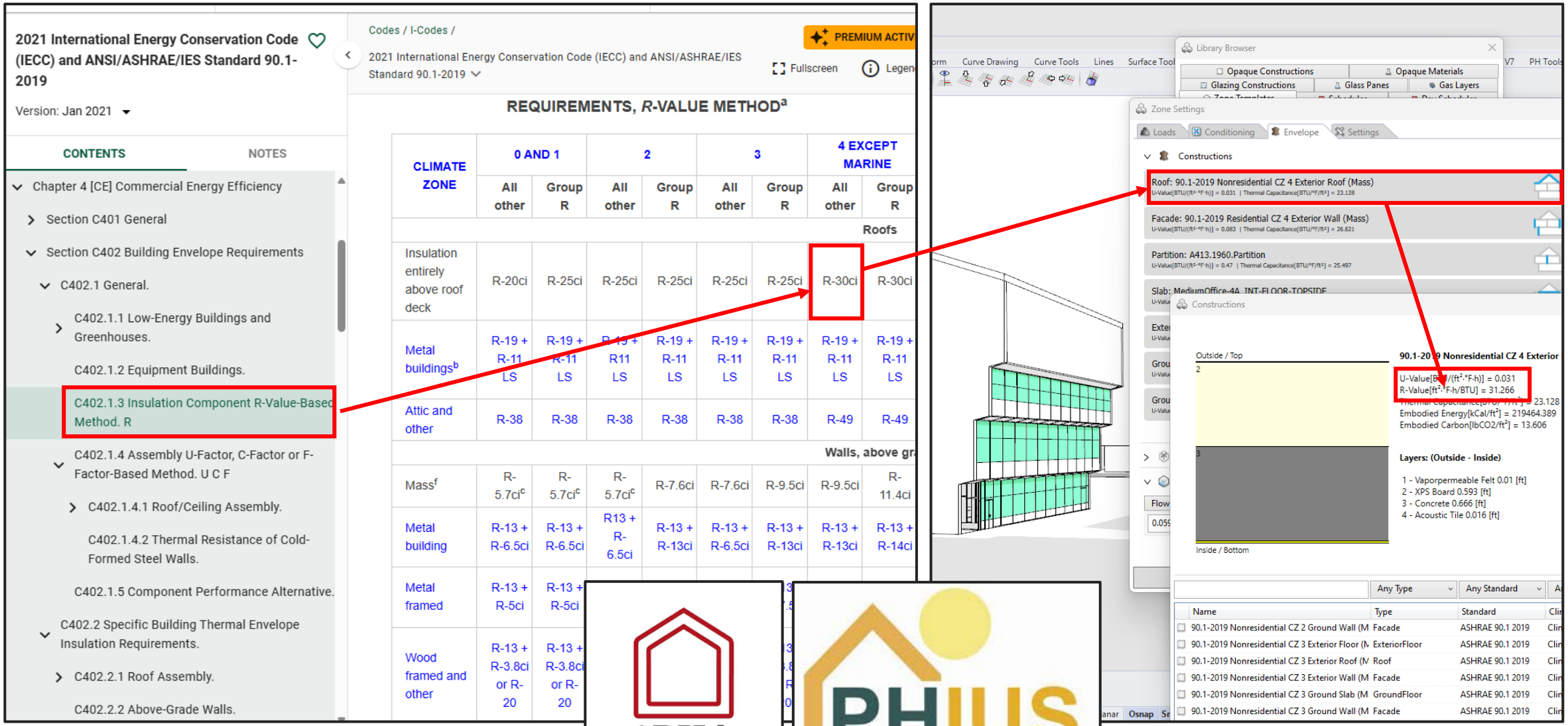
2021 International Energy Conservation Code (IECC) and ANSI/ASHRAE/IES Standard 90.1-2019

PREMIUM ACTIV | Fullscreen | Legen

REQUIREMENTS, *R*-VALUE METHOD[a]

CLIMATE ZONE	0 AND 1		2		3		4 EXCEPT MARINE	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R
								Roofs
Insulation entirely above roof deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci
Metal buildings[b]	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-49	R-49
								Walls, above gr
Mass[f]	R-5.7ci[c]	R-5.7ci[c]	R-5.7ci[c]	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci
Metal building	R-13 + R-6.5ci	R-13 + R-6.5ci	R13 + R-6.5ci	R-13 + R-13ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-14ci
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci
Wood framed and other	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20




2021 International Energy Conservation Code (IECC) and ANSI/ASHRAE/IES Standard 90.1-2019
Version: Jan 2021
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C402.1.2 Equipment Buildings.
C402.1.3 Insulation Component R-Value-Based Method. R
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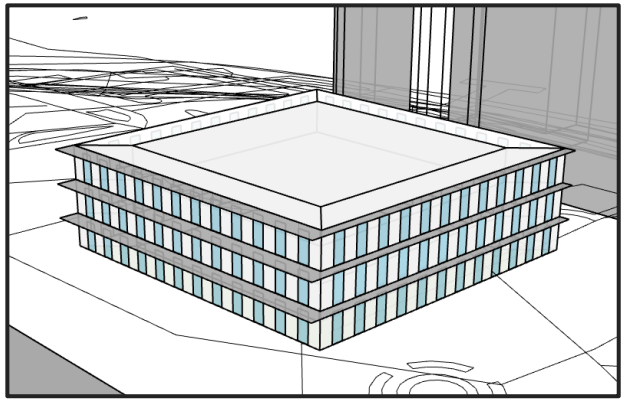
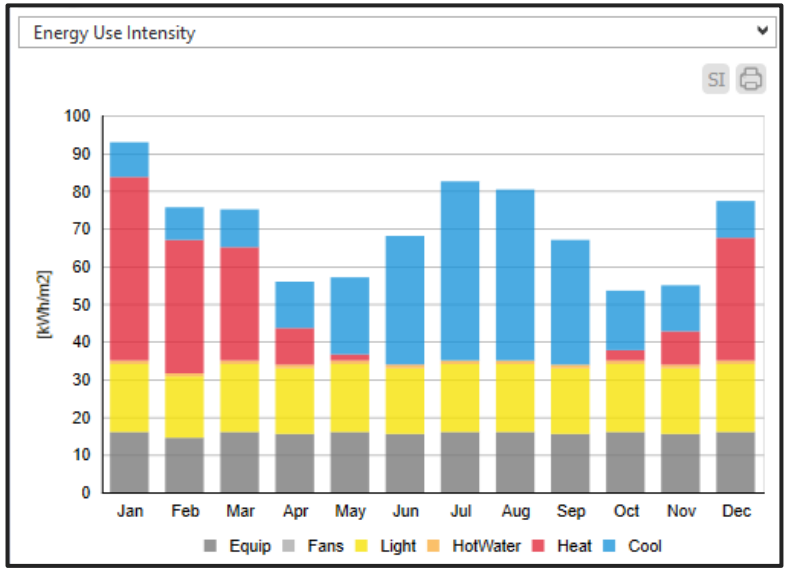
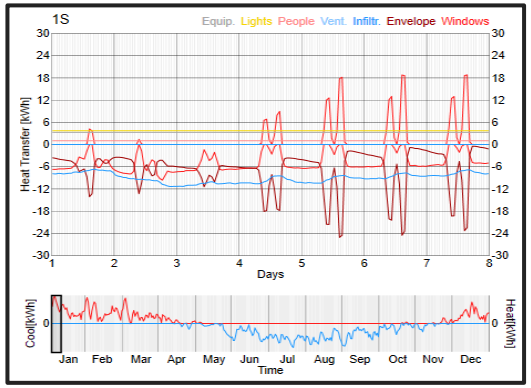
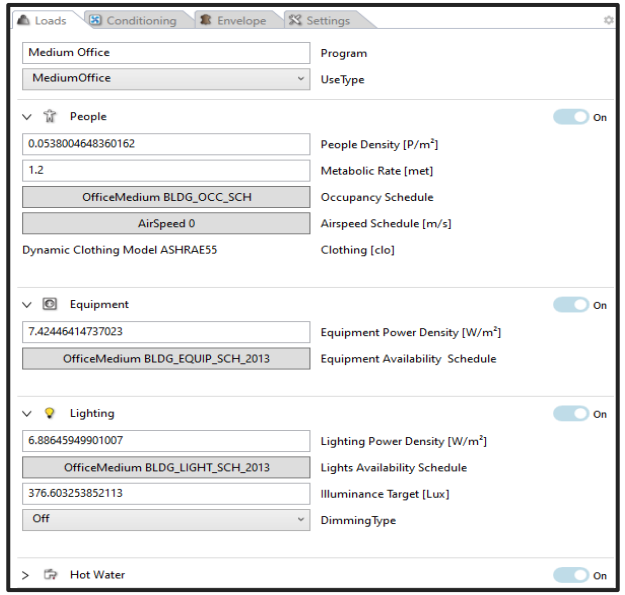
2021 International Energy Conservation Code (IECC) and ANSI/ASHRAE/IES Standard 90.1-2019
Fullscreen
REQUIREMENTS, R-VALUE METHOD[a]
CLIMATE ZONE
0 AND 1
2
3
4 EXCEPT MARINE
All other
Group R
Roofs
Insulation entirely above roof deck
R-20ci
R-25ci
R-30ci
Metal buildings[b]
R-19 + R-11 LS
Attic and other
R-38
R-49
Walls, above gr
Mass[f]
R-5.7ci[c]
R-7.6ci
R-9.5ci
R-11.4ci
Metal building
R-13 + R-6.5ci
R-13 + R-13ci
R-13 + R-14ci
Metal framed
R-13 + R-5ci
Wood framed and other
R-13 + R-3.8ci or R-20
Library Browser
Opaque Constructions
Opaque Materials
Glazing Constructions
Glass Panes
Gas Layers
Zone Settings
Loads
Conditioning
Envelope
Settings
Constructions
Roof: 90.1-2019 Nonresidential CZ 4 Exterior Roof (Mass)
Facade: 90.1-2019 Residential CZ 4 Exterior Wall (Mass)
Partition: A413.1960.Partition
Outside / Top
Inside / Bottom
Embodied Energy[kCal/ft²] = 219464.389
Embodied Carbon[lbCO2/ft²] = 13.606
Layers: (Outside - Inside)
1 - Vaporpermeable Felt 0.01 [ft]
2 - XPS Board 0.593 [ft]
3 - Concrete 0.666 [ft]
4 - Acoustic Tile 0.016 [ft]
Any Type
Any Standard
Name
Type
Standard
90.1-2019 Nonresidential CZ 2 Ground Wall (M Facade ASHRAE 90.1 2019
90.1-2019 Nonresidential CZ 3 Exterior Floor (M ExteriorFloor ASHRAE 90.1 2019
90.1-2019 Nonresidential CZ 3 Exterior Roof (M Roof ASHRAE 90.1 2019
90.1-2019 Nonresidential CZ 3 Exterior Wall (M Facade ASHRAE 90.1 2019
90.1-2019 Nonresidential CZ 3 Ground Slab (M GroundFloor ASHRAE 90.1 2019
90.1-2019 Nonresidential CZ 3 Ground Wall (M Facade ASHRAE 90.1 2019
iPHA
PHIUS

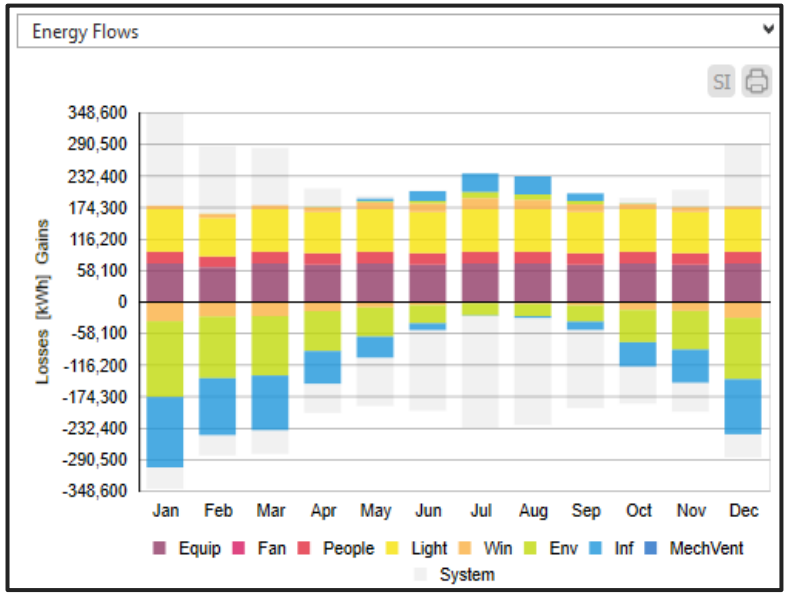


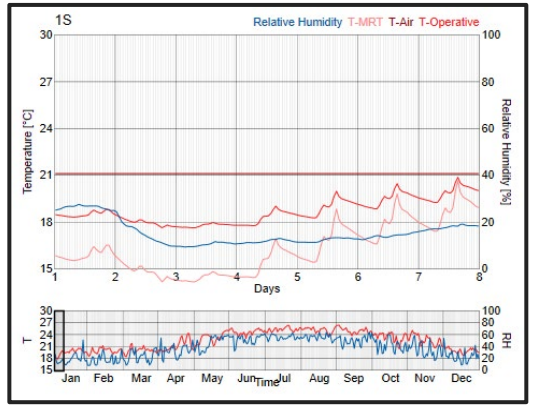
840	520	313	None	284
Site EUI kWh/m²	Op. Carbon kgCO²/m²	Energy Cost $/m²	Saved Vs. Baseline	Baseline EUI kWh/m²

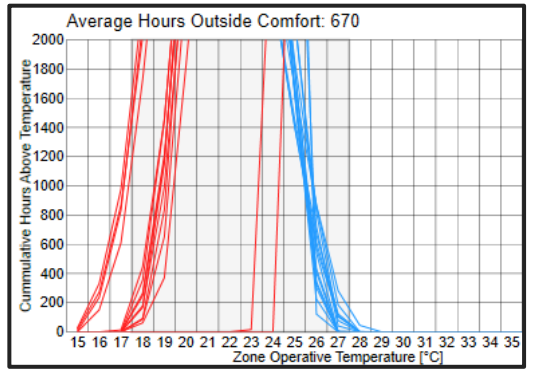




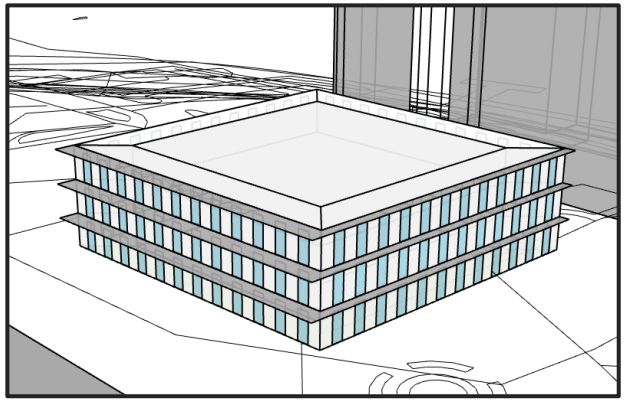




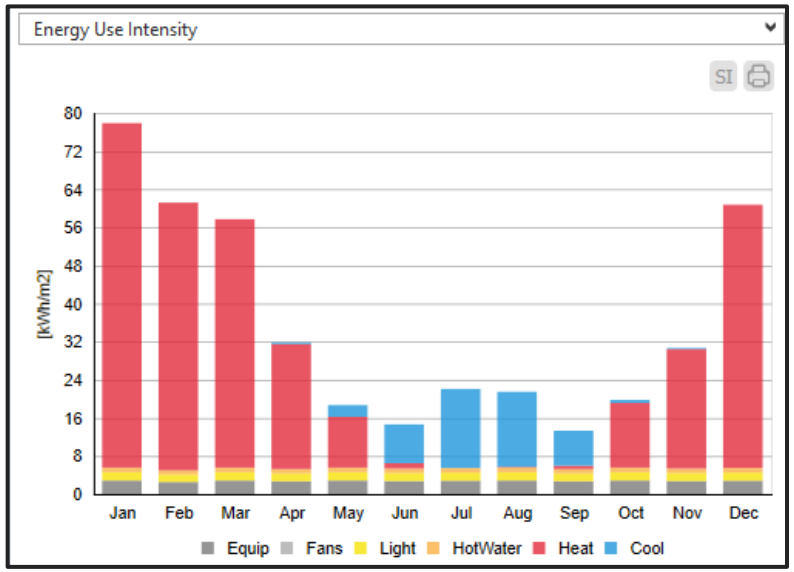


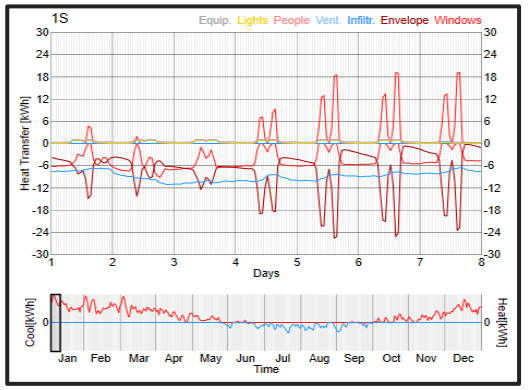


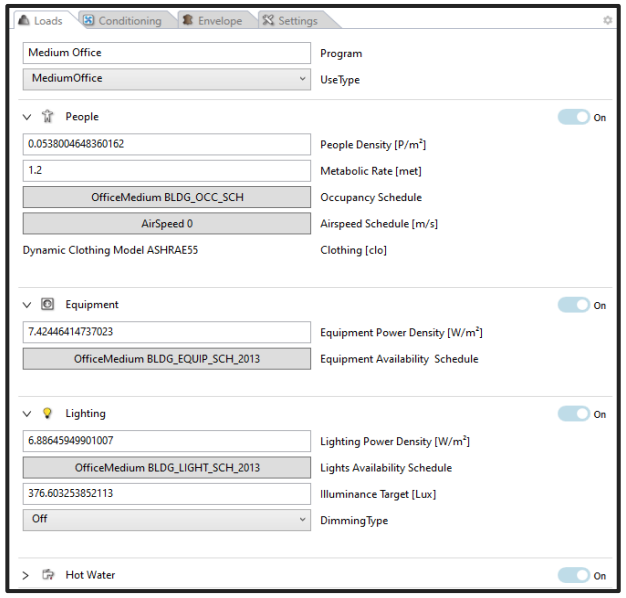
ENERGY USE: BASELINE “1960” BUILDING

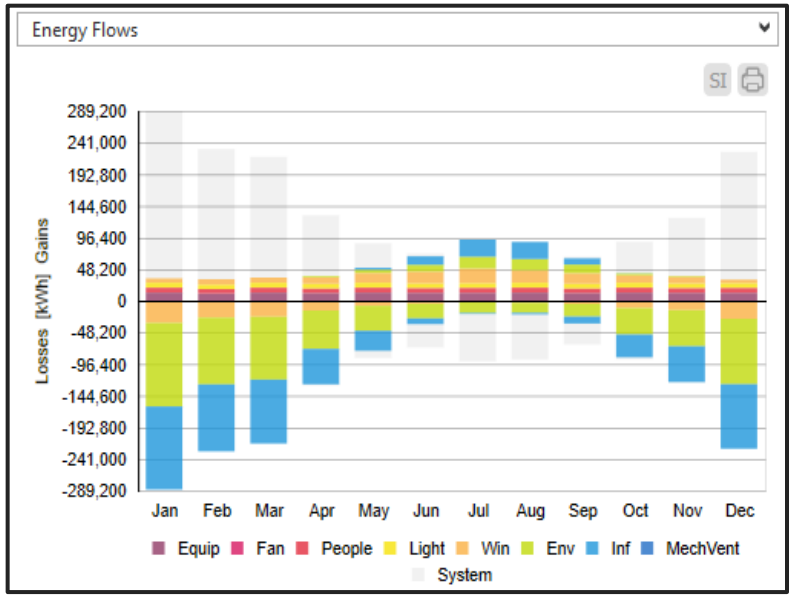


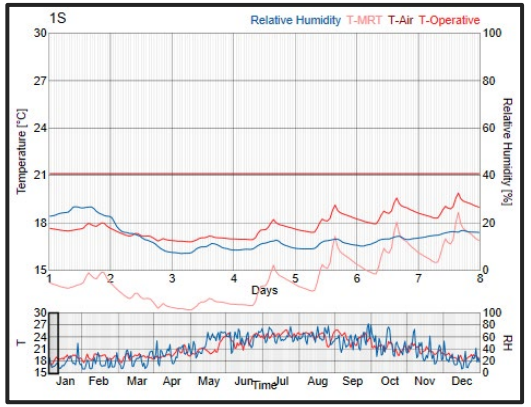
430	247	325	None	284
Site EUI kWh/m²	Op. Carbon kgCO²/m²	Energy Cost $/m²	Saved Vs. Baseline	Baseline EUI kWh/m²

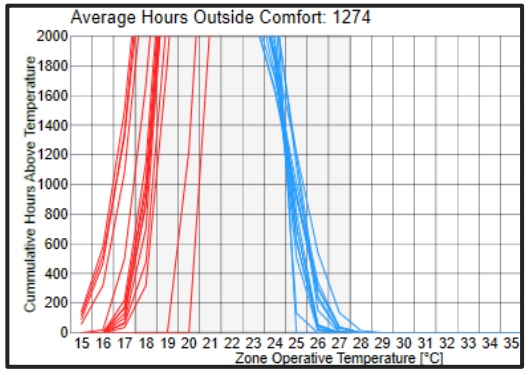




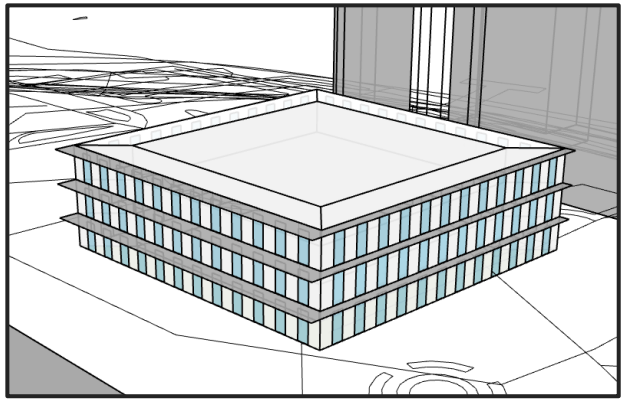




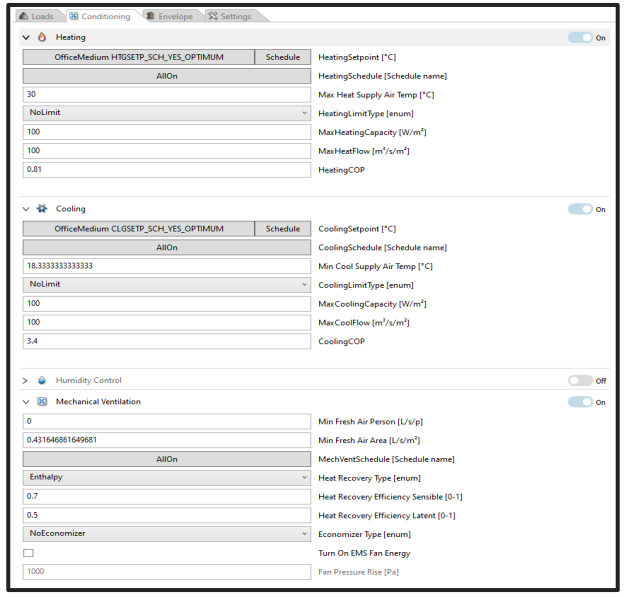


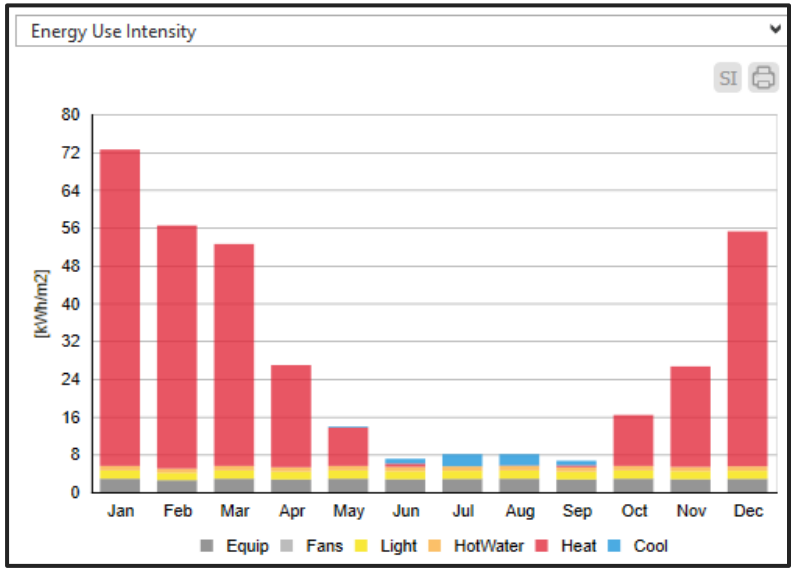


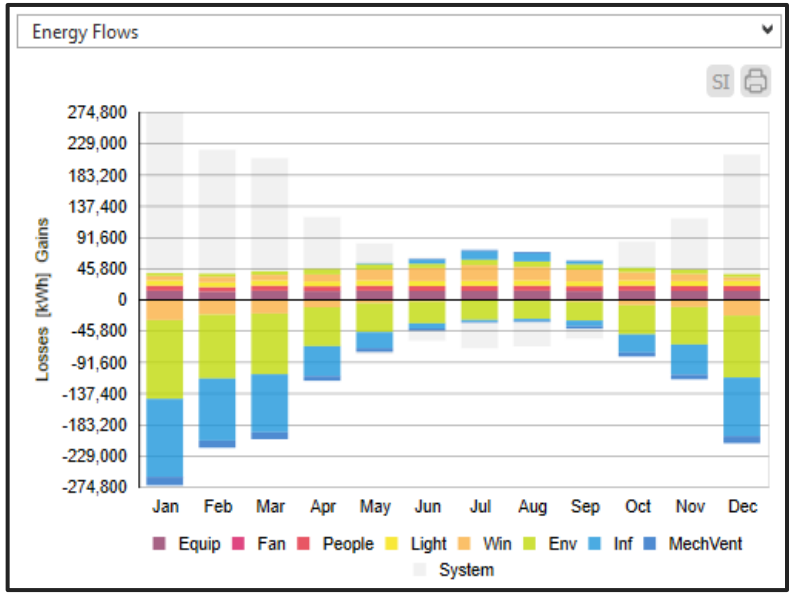
ENERGY USE: LOADS TO 90.1

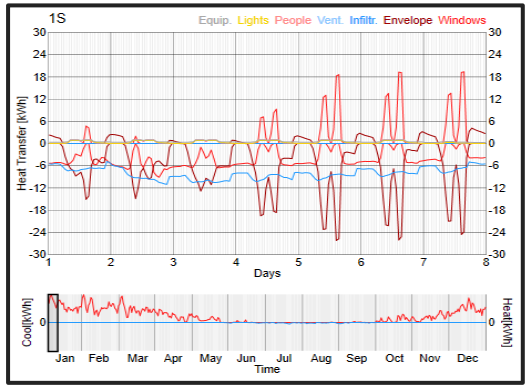


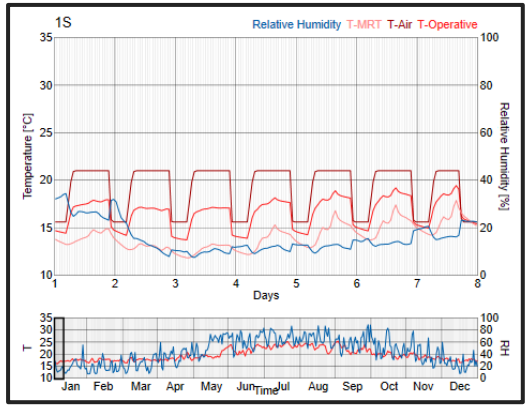
350	200	283	None	284
Site EUI	Op. Carbon	Energy Cost	Saved	Baseline EUI
kWh/m²	kgCO²/m²	$/m²	Vs. Baseline	kWh/m²

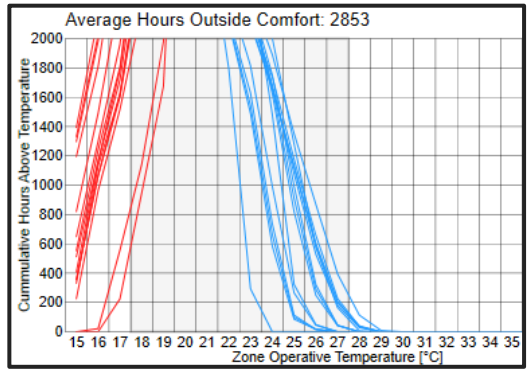




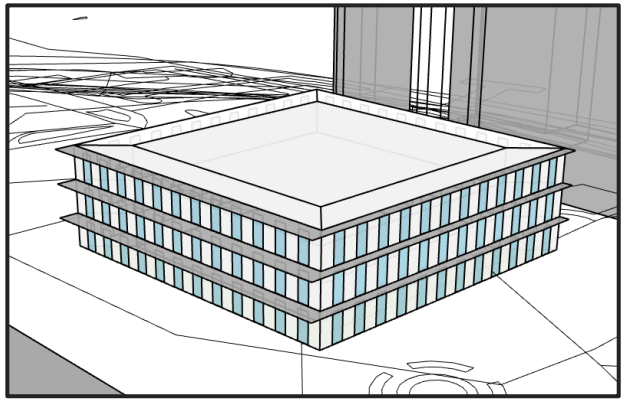




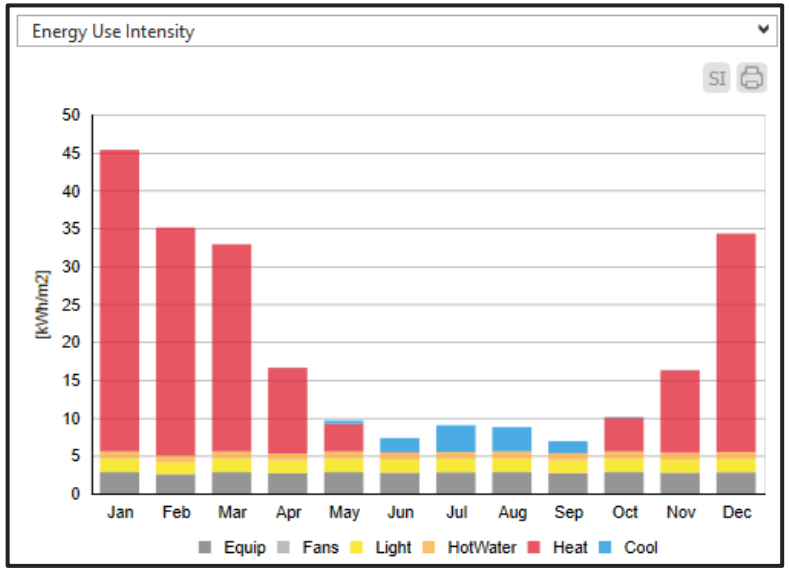


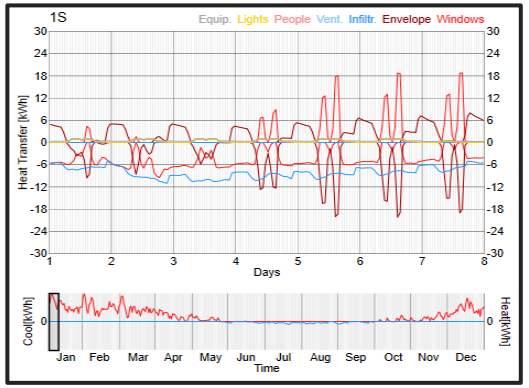


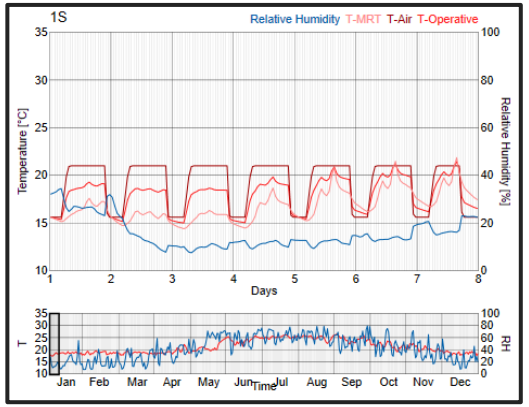
ENERGY USE: CONDITIONING TO 90.1

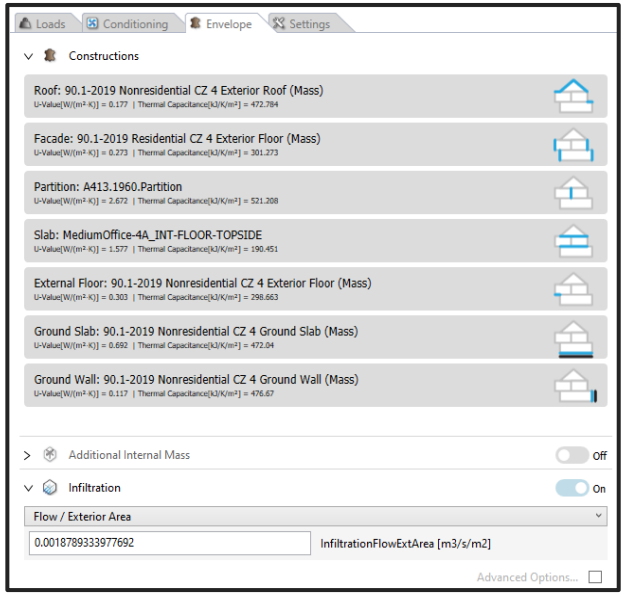


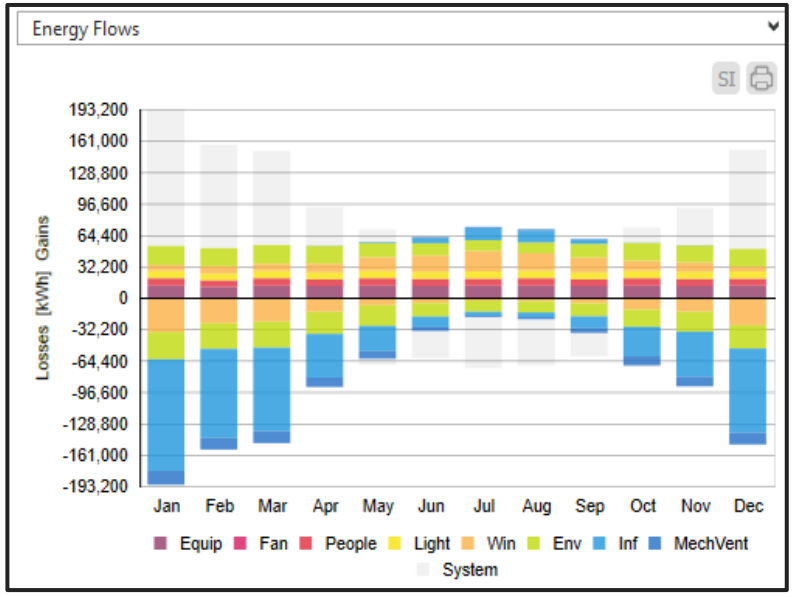
232	134	170	18%	284
Site EUI kWh/m²	Op. Carbon kgCO²/m²	Energy Cost $/m²	Saved Vs. Baseline	Baseline EUI kWh/m²

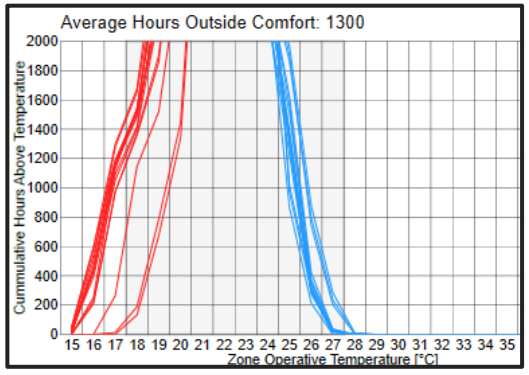




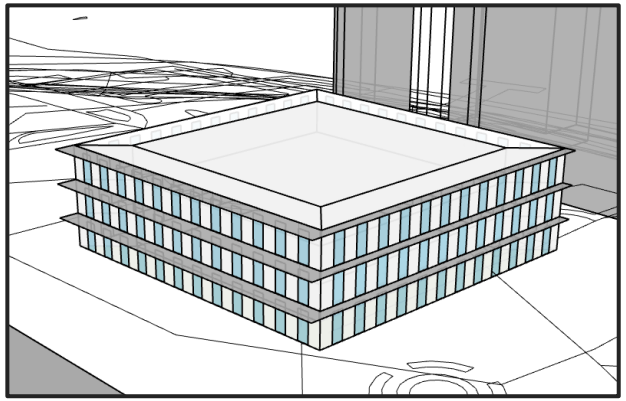




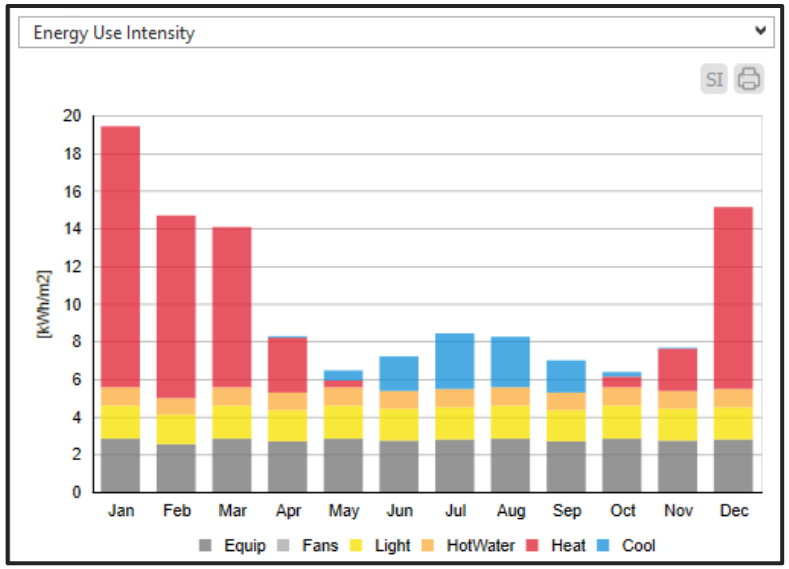


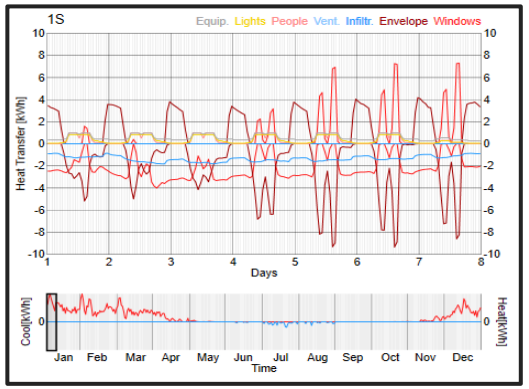


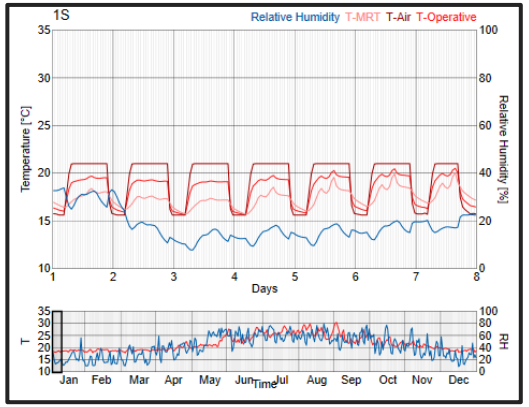
ENERGY USE: ENVELOPE TO 90.1

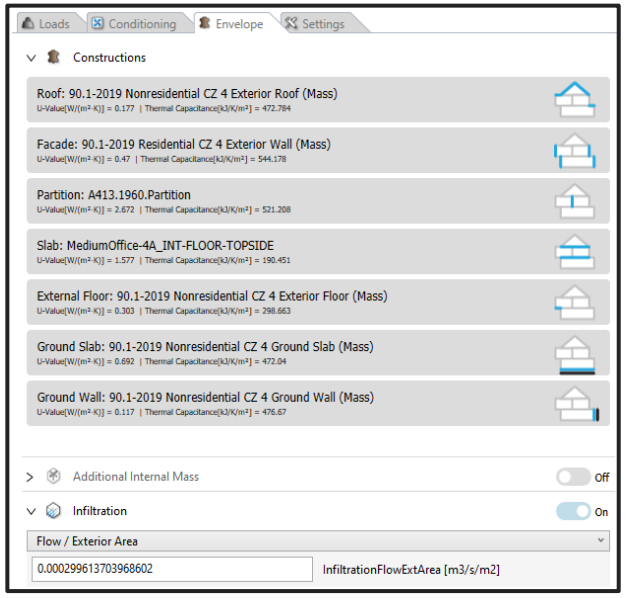


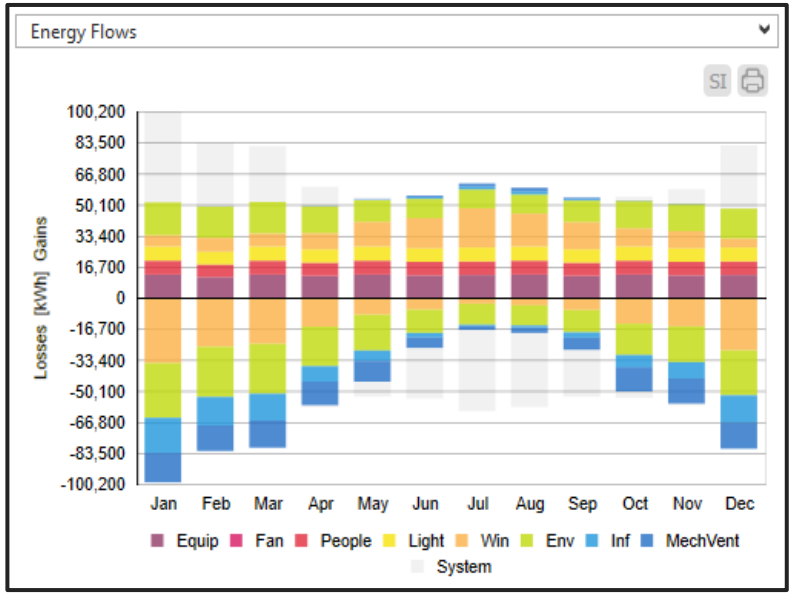
123	73	69	57%	284
Site EUI	Op. Carbon	Energy Cost	Saved	Baseline EUI
kWh/m²	kgCO²/m²	$/m²	Vs. Baseline	kWh/m²

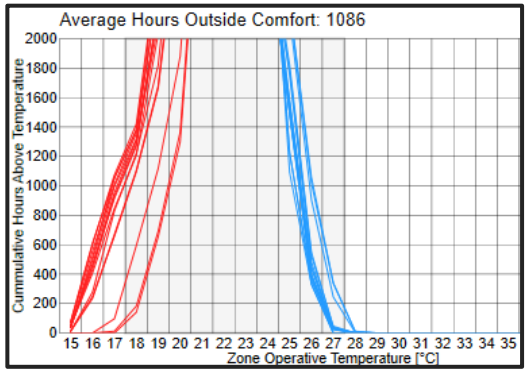




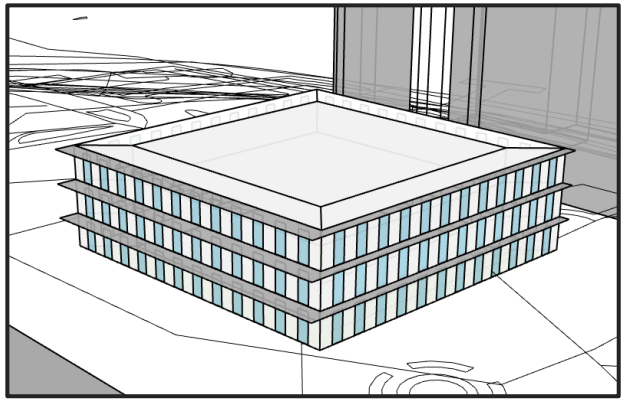




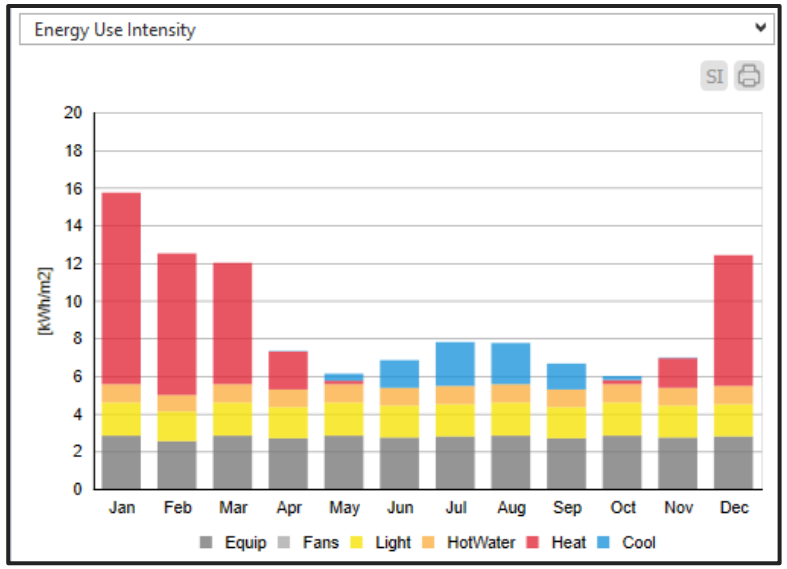


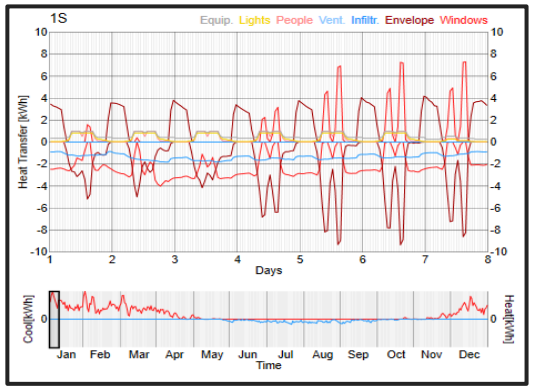


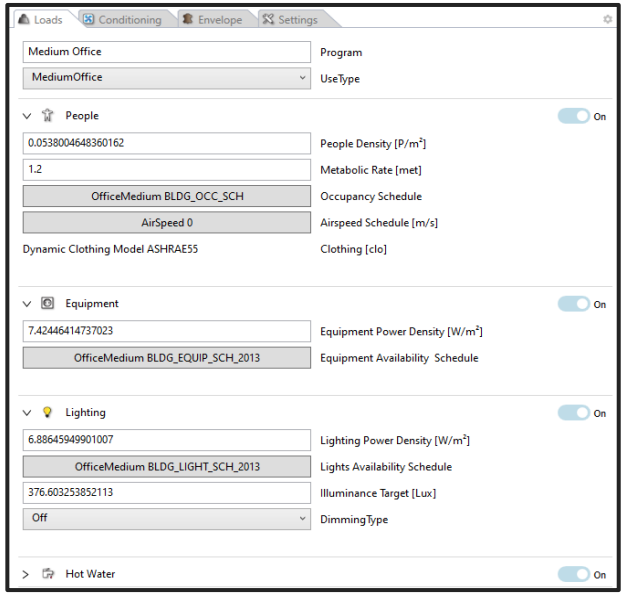
ENERGY USE: INFILTRATION TO 90.1

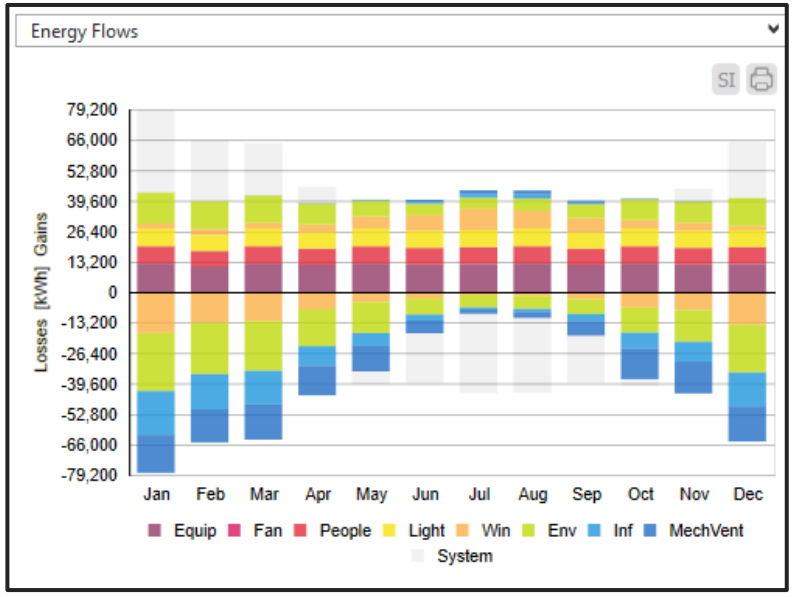


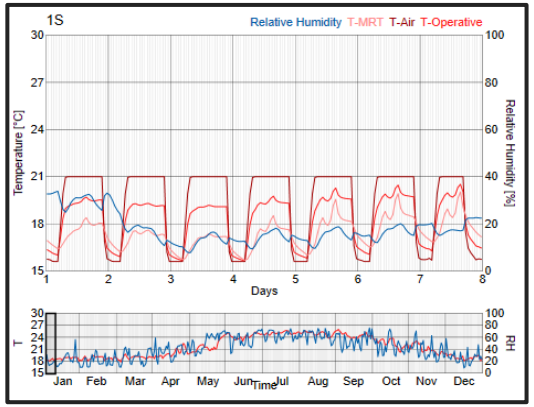
108	65	57	62%	284
Site EUI kWh/m²	Op. Carbon kgCO²/m²	Energy Cost $/m²	Saved Vs. Baseline	Baseline EUI kWh/m²

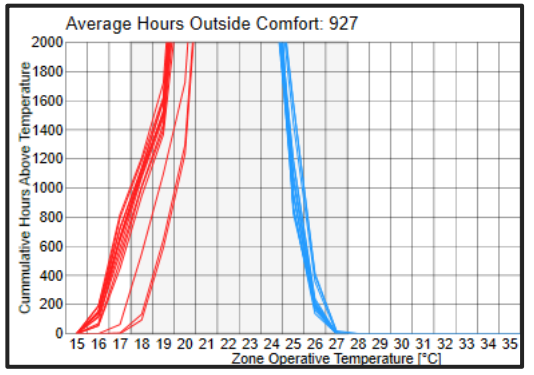




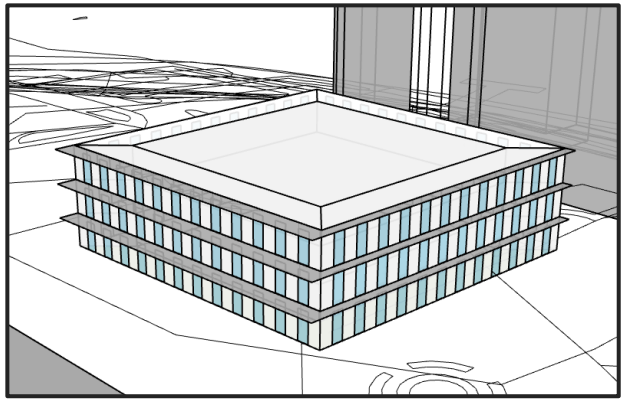




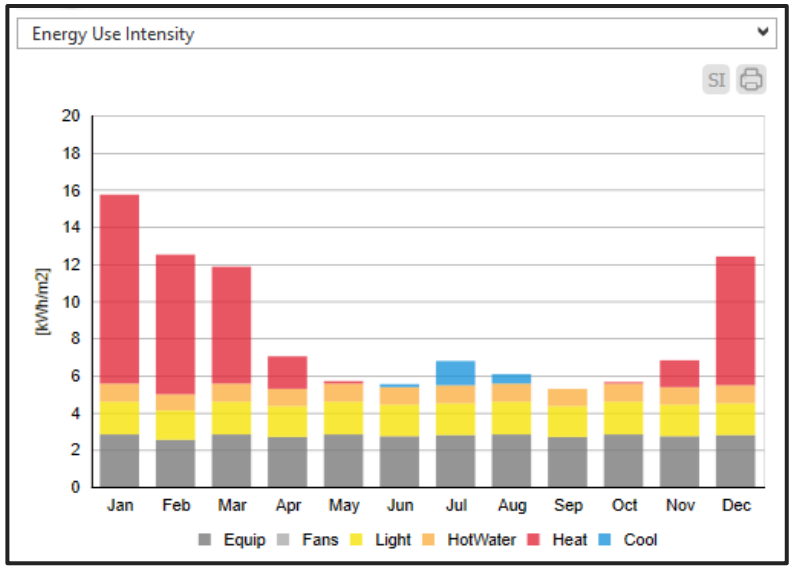


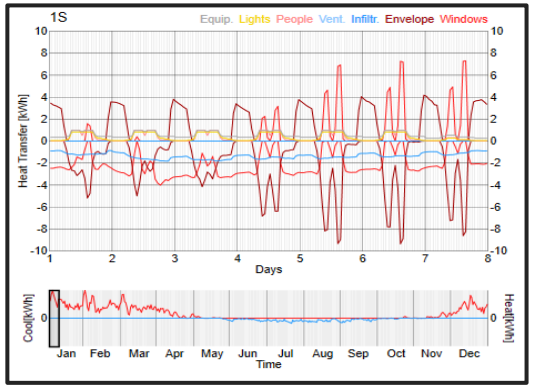


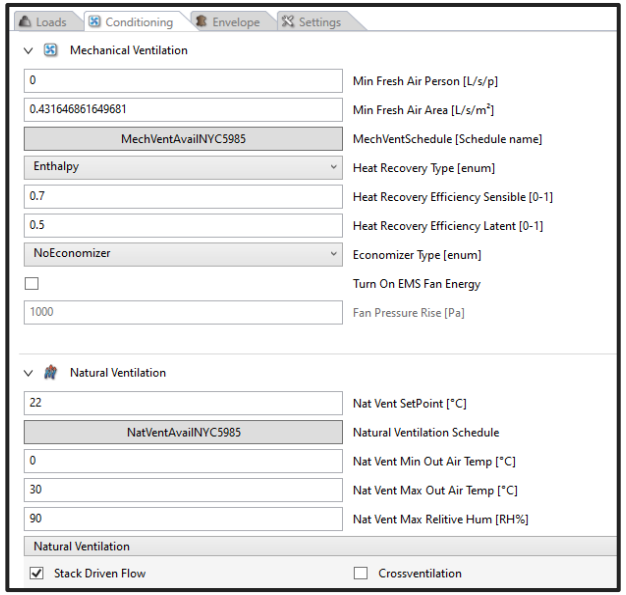
ENERGY USE: GLAZING TO 90.1

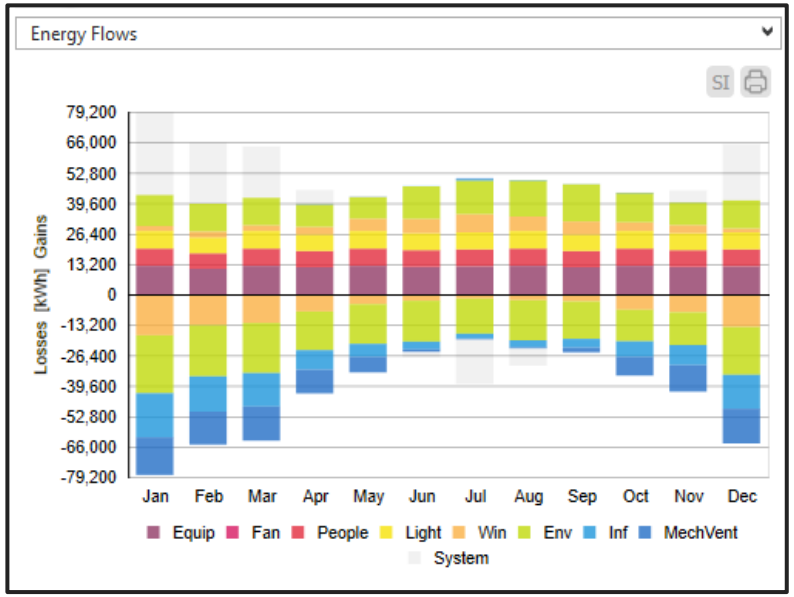


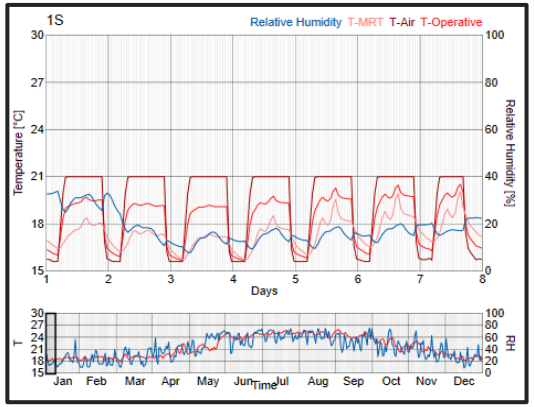
101	61	55	64%	284
Site EUI kWh/m²	Op. Carbon kgCO²/m²	Energy Cost $/m²	Saved Vs. Baseline	Baseline EUI kWh/m²

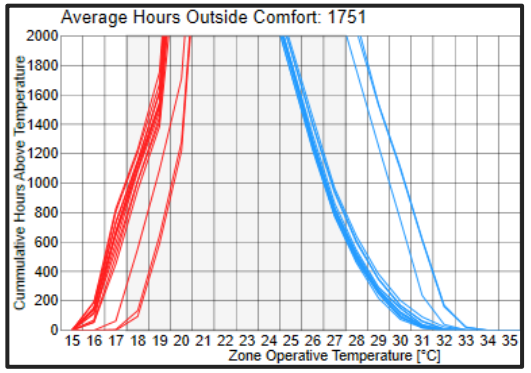




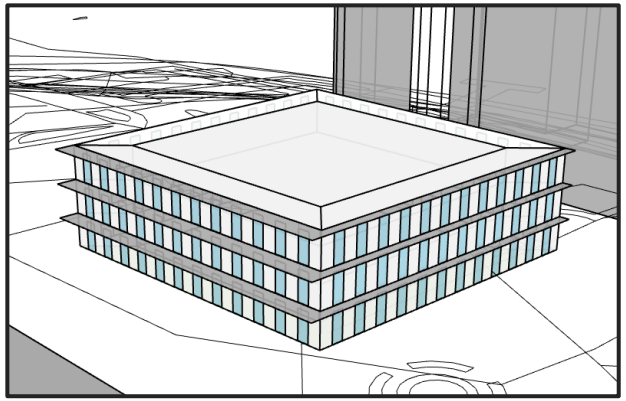




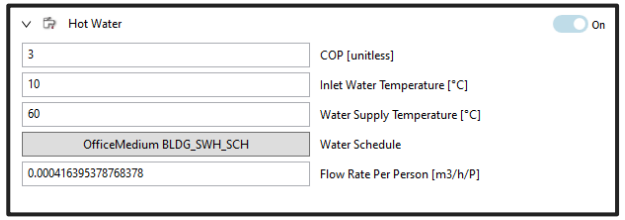


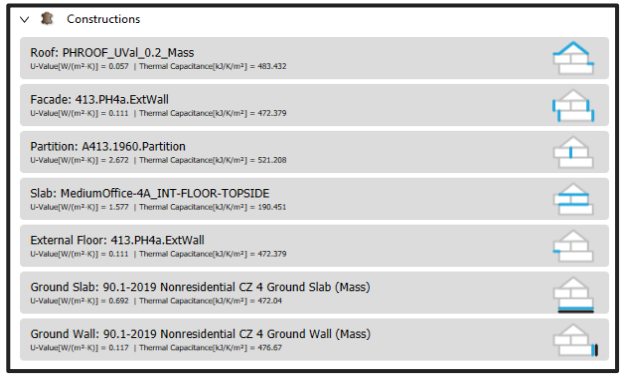


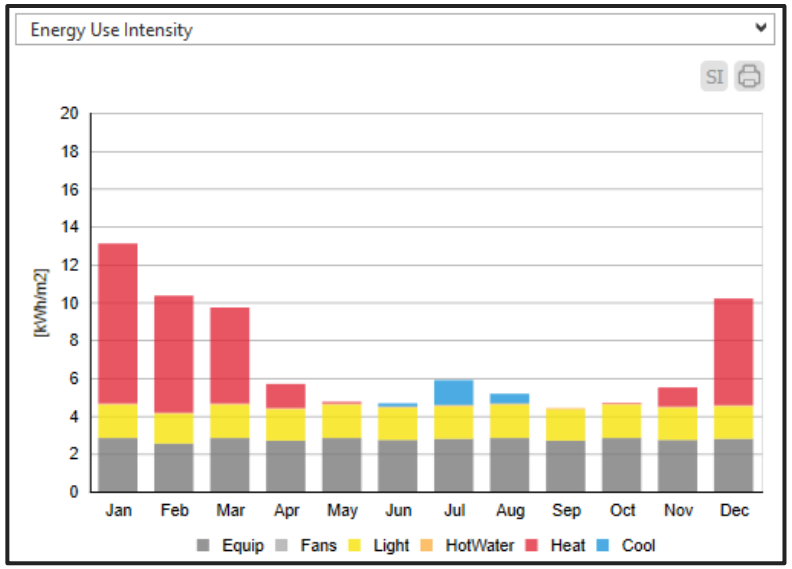
ENERGY USE: NATURAL VENTILATION

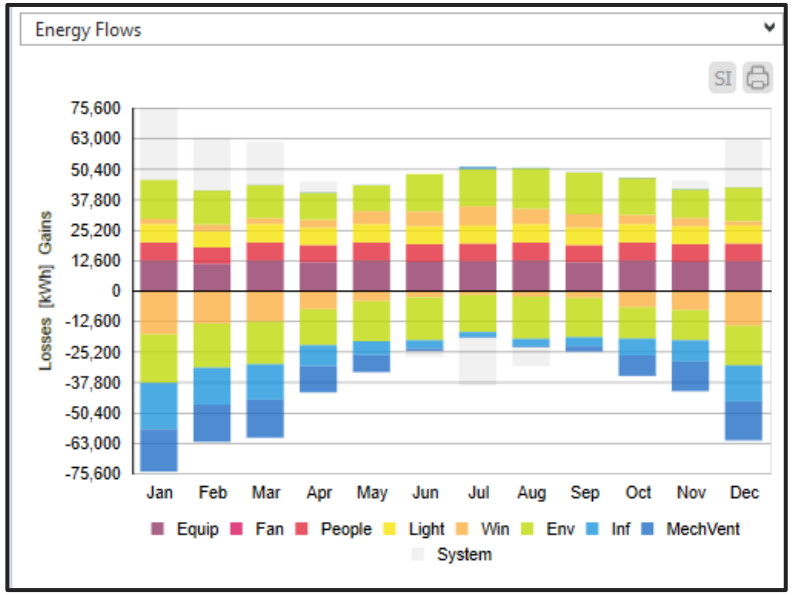


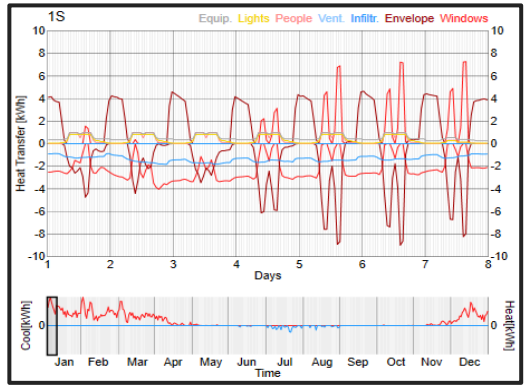
84	51	39	70%	284
Site EUI kWh/m²	Op. Carbon kgCO²/m²	Energy Cost $/m²	Saved Vs. Baseline	Baseline EUI kWh/m²

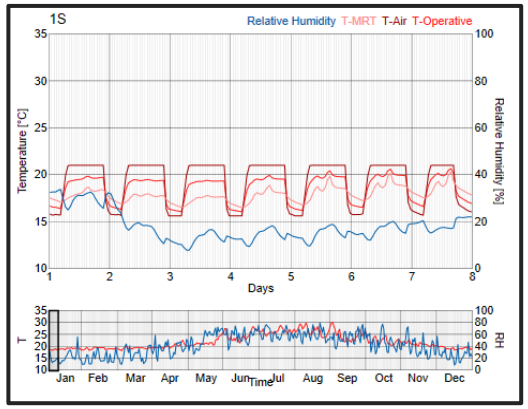


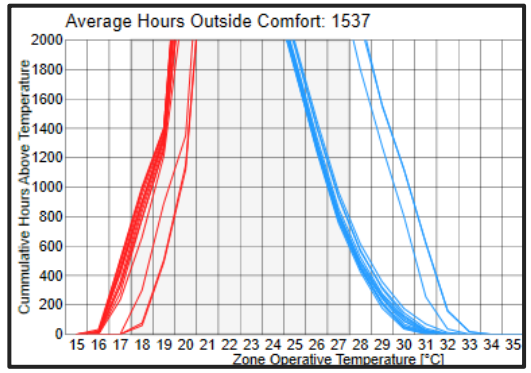




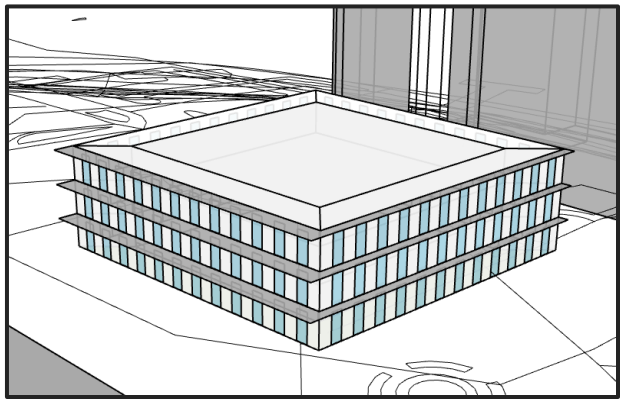


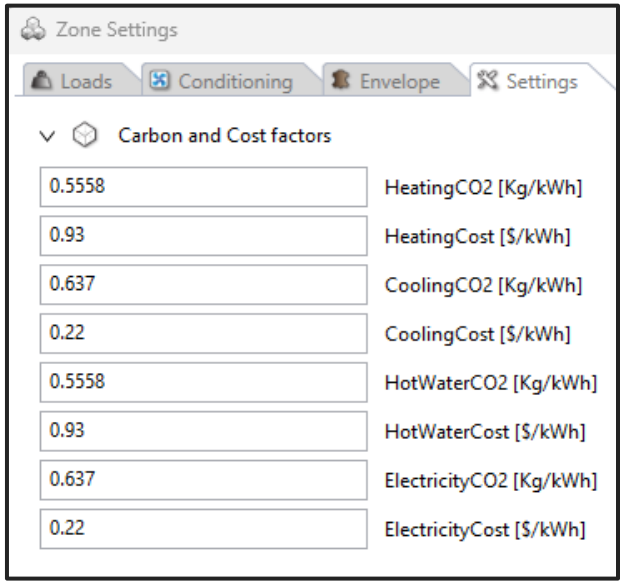


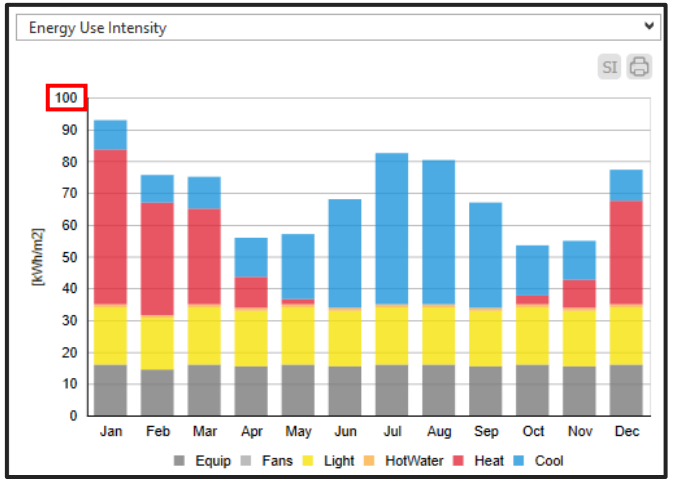


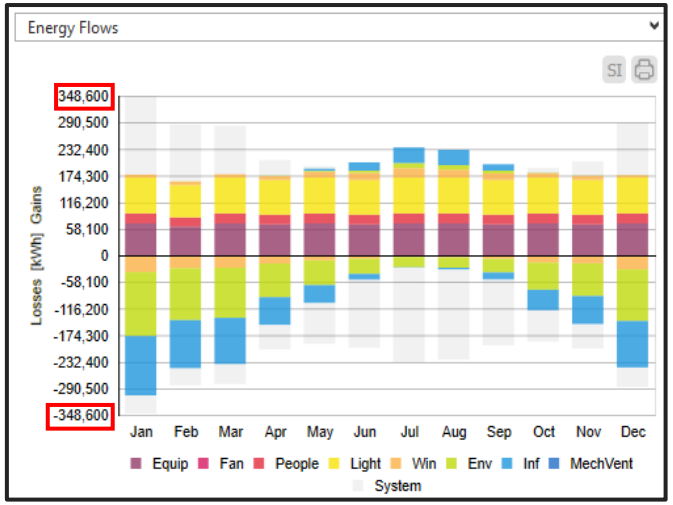


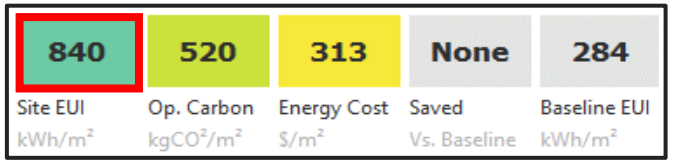
ENERGY USE: OPTIMIZATION TWEAKS



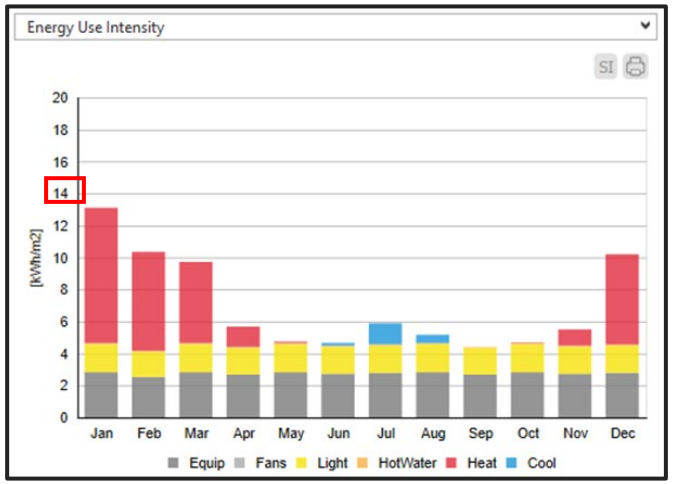


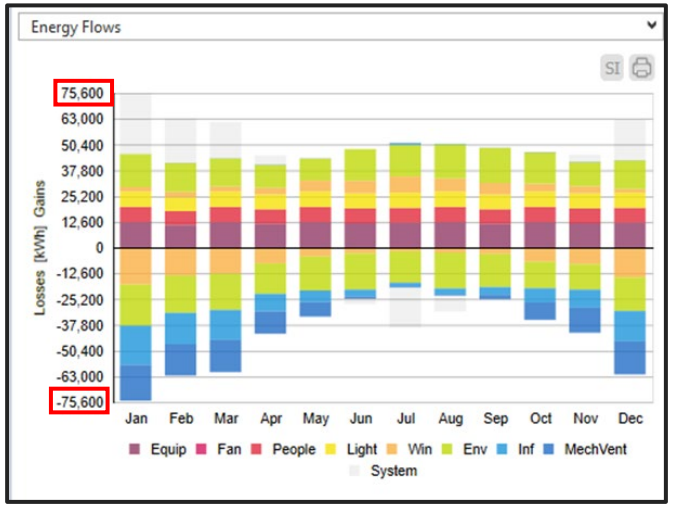


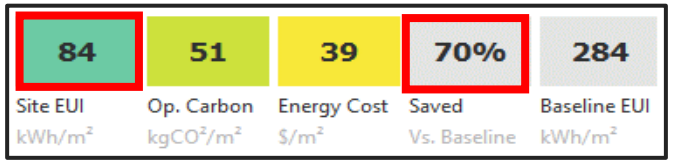




BASELINE OLD SCHOOL







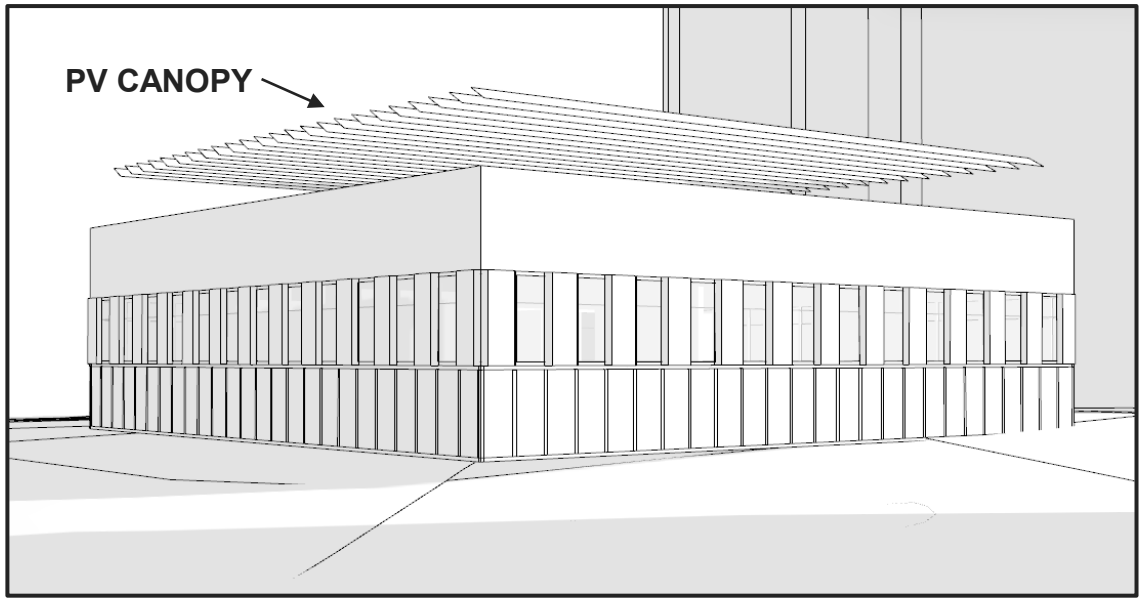
90.1 PLUS TWEAKS

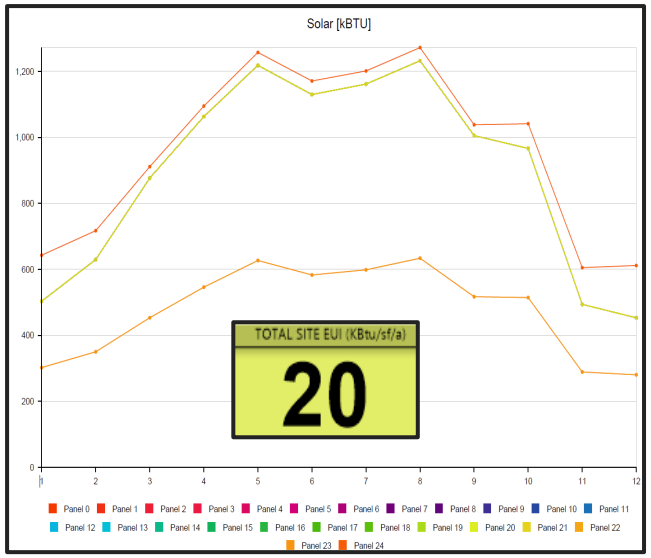
No change in form required to achieve considerable reduction in operational energy footprint

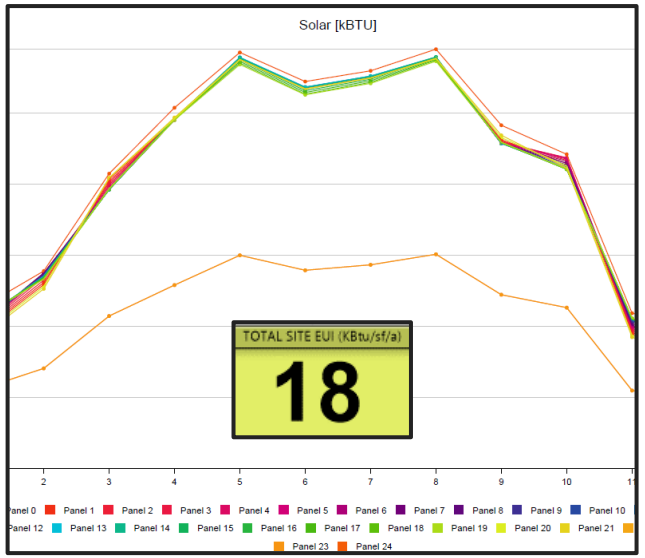
SIMS: ENERGY BALANCE

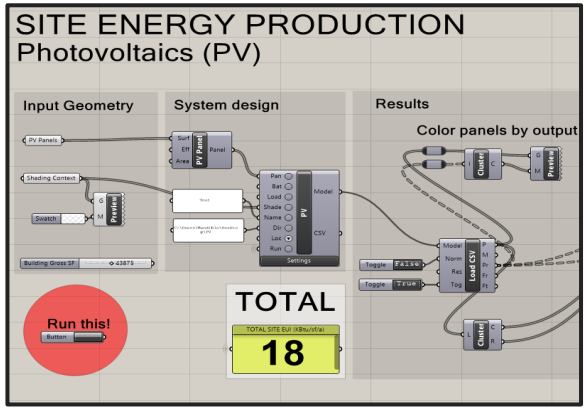
Change from no consideration to a quantified analysis of energy and carbon footprint in the context of NYC Local Law 97 compliance.

Energy Star Portfolio Manager (ESPM) Property Types	Building Code (BC)	Section 28-320.3.1 Item #	2024 – 2029 BC Building Emissions Intensity Limit (tCO2e/sf)	Section 28-320.3.1 Item #	2024 – 2029 ESPM Building Emissions Factor (tCO2e/sf)
Museum	A-3	1	0.01074	7	0.01181
Non-Refrigerated Warehouse	S-1	10	0.00426	10	0.00426
Office	B	2	0.00846	3	0.00758
Other - Education	B	2	0.00846	2	0.00846
Other - Entertainment/Public Assembly	A-3	1	0.01074	8	0.00987
Other - Lodging/Residential	R-1	8	0.00987	3	0.00758
Other - Mall	M	7	0.01181	1	0.01074

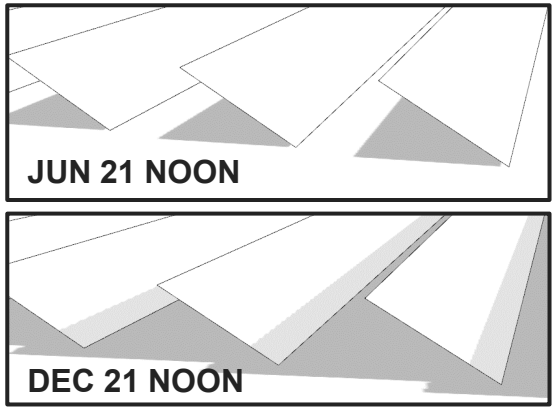




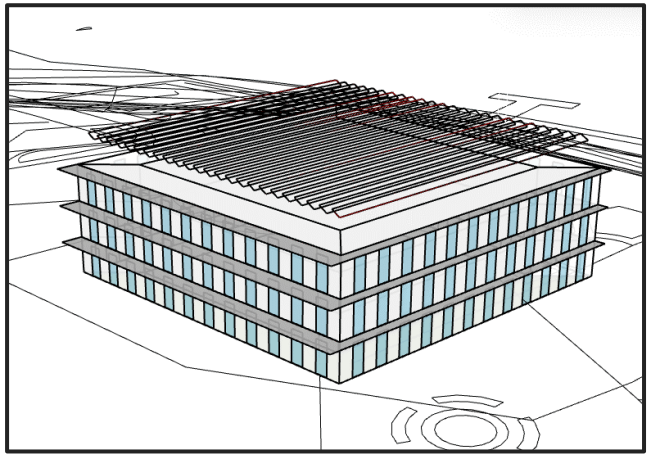




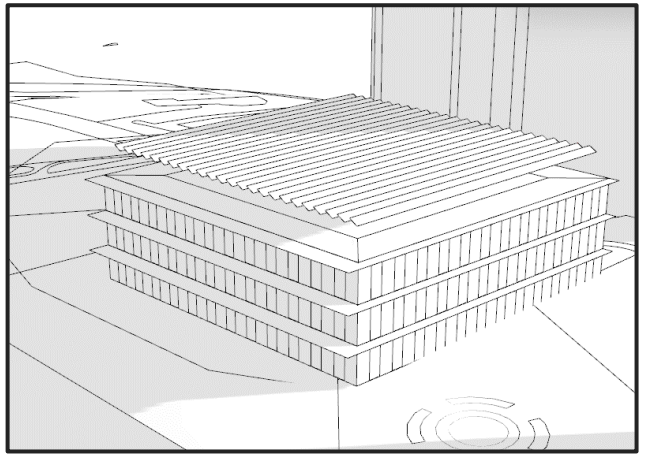
GEOM / EFFICIENCY / SHAD



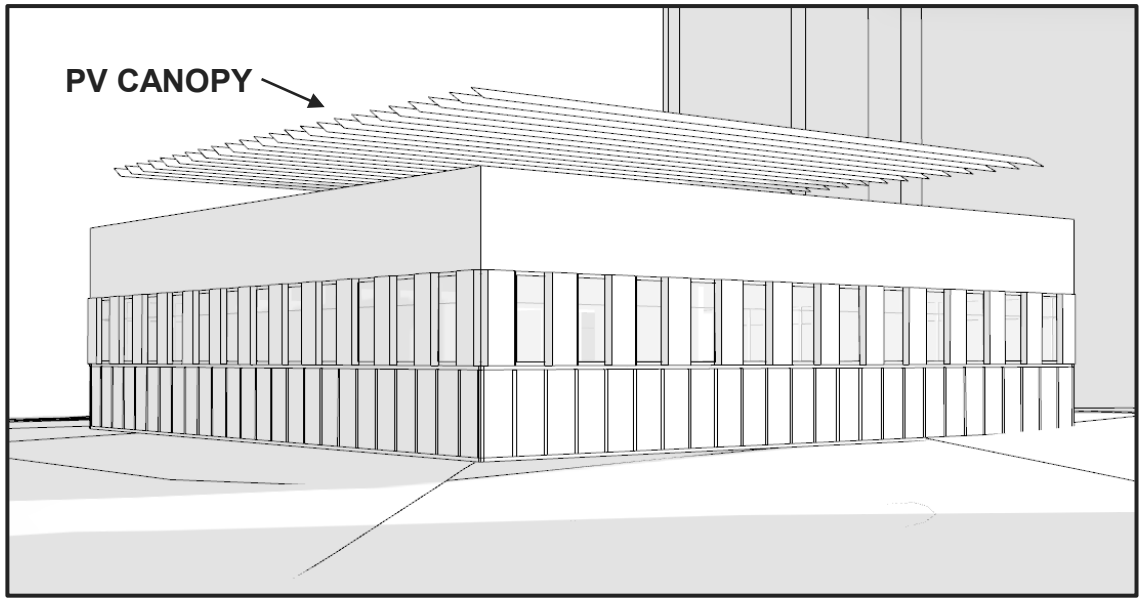
PANELS AT 30° TILT

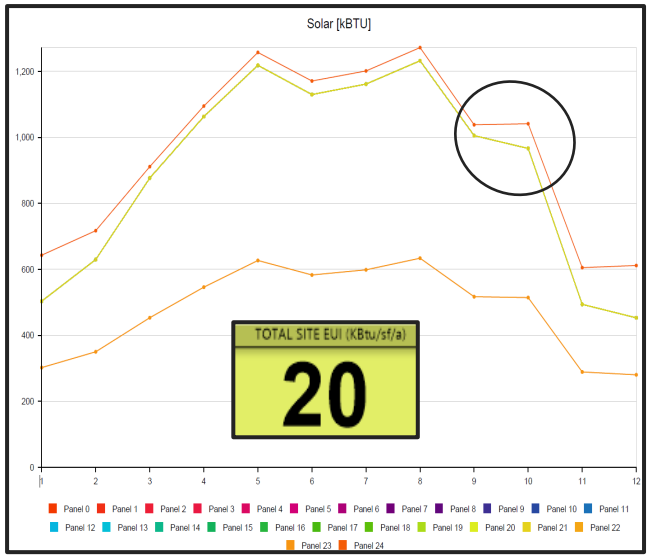


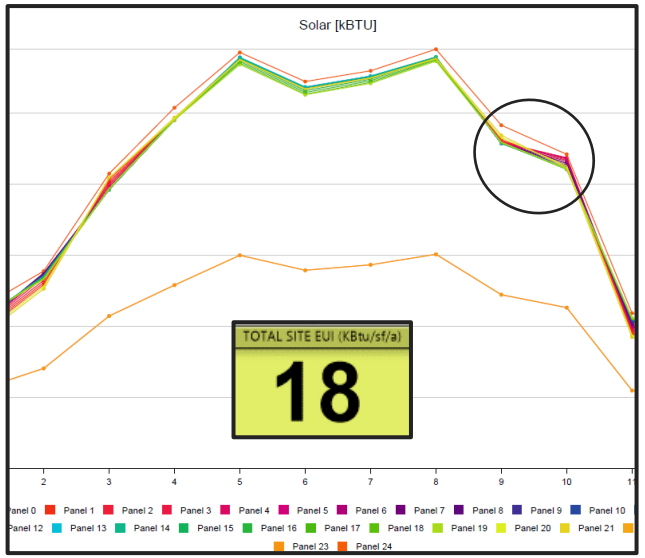
NO CONTEXT SHADING

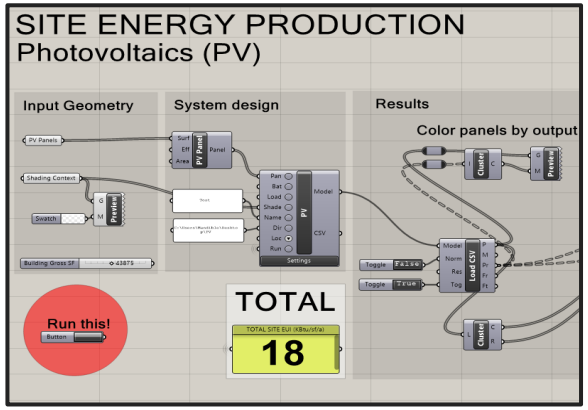


CONTEXT SHADING

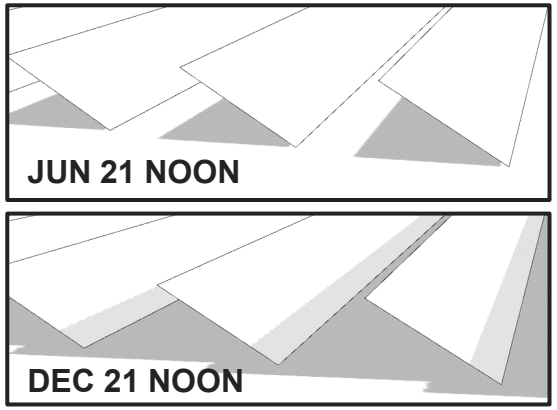




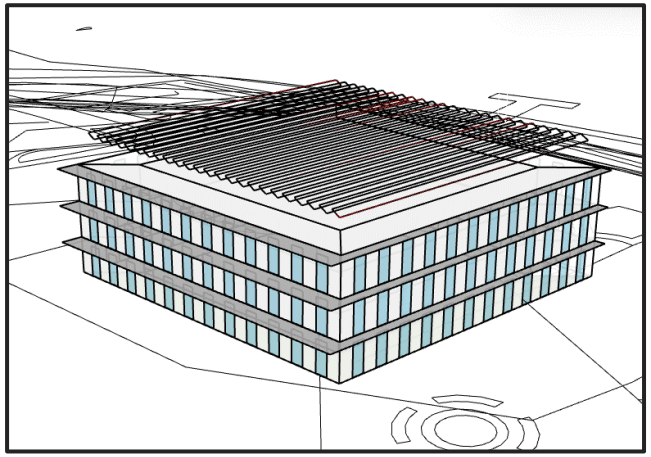




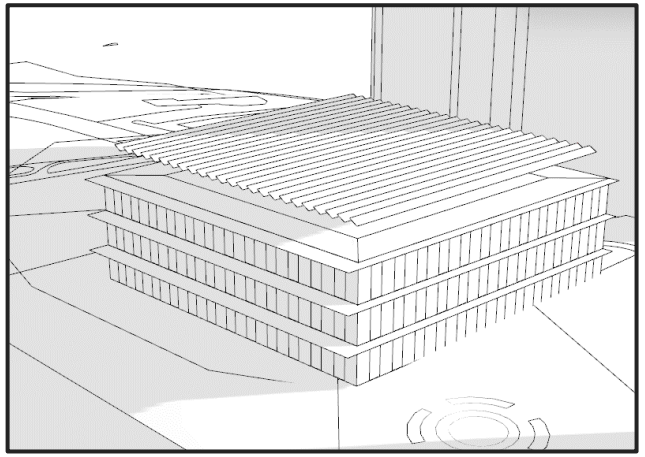
GEOM / EFFICIENCY / SHAD



PANELS AT 30° TILT



NO CONTEXT SHADING



CONTEXT SHADING

NYC LL97

Energy Star Portfolio Manager (ESPM) Property Types	Building Code (BC)	Section 28-320.3.1 Item #	2024 – 2029 BC Building Emissions Intensity Limit (tCO2e/sf)	Section 28-320.3.1 Item #	2024 – 2029 ESPM Building Emissions Factor (tCO2e/sf)
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Non-Refrigerated Warehouse	S-1	10	0.00426	10	0.00426
Office	B	2	0.00846	3	0.00758
Other - Education	B	2	0.00846	2	0.00846
Other - Entertainment/Public Assembly	A-3	1	0.01074	8	0.00987
Other - Lodging/Residential	R-1	8	0.00987	3	0.00758
Other - Mall	M	7	0.01181	1	0.01074

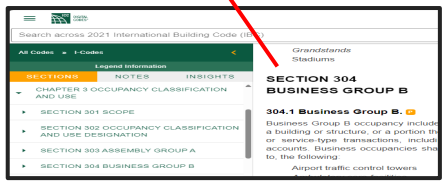
CONVERSION

Building C02e Limits (lbCO2/sf/a)								
Code Occup	2024		2030		35-49	2050	
	tCO_2e/sf	$lbCO_2/sf$	tCO_2e/sf	$lbCO_2/sf$		tCO_2e/sf	$lbCO_2/sf$
A	0.01074	23.68	0.0042	9.26	TBD	0.0014	3.09
B	0.00846	18.65	0.00453	9.99		0.0014	3.09
E	0.00758	16.71	0.00344	7.58		0.0014	3.09
I	0.01136	25.09	0.00598	13.18		0.0014	3.09
F	0.00574	12.65	0.00167	3.68		0.0014	3.09
M	0.01181	26.04	0.00403	8.88		0.0014	3.09
R2	0.00675	14.88	0.00407	8.97		0.0014	3.09
S/U	0.00426	9.39	0.0011	2.43		0.0014	3.09

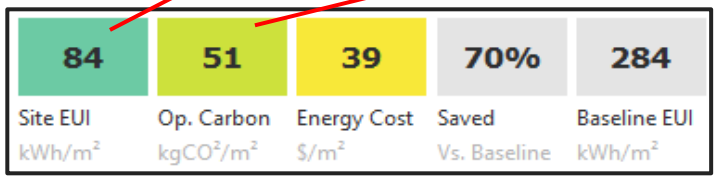
LL97 COMPLIANCE WORKSHEET

Sim #	Allowed Operation Carbon ($lbCO_2/sf$)					Design			SiteEUI					Operational Carbon Emissions				Compliance			
	Occup	2024	2029	2035	2050	Run Description	Build area (sf)	LL97 applies	Usage (kWh/m^2)	Usage kWh	Usage (kBTU/sf)	PV (kBTU/sf)	Total (kBTU/sf)	From Loads (kg/m^2)	From Loads (lb/sf)	Coeff CO_2/kBTU	Total CO_2 (lb/sf)	2024	2029	2035	2050
y	B	18.65	9.99	TBD	3.09	1960 baseline	43,875	YES	840	3,428,372	267		267	520	106	0.40	106.42	NO	NO	TBD	NO
z	B	18.65	9.99	TBD	3.09	90.1 loads	43,875	YES	430	1,755,000	136		136	247	51	0.37	50.55	NO	NO	TBD	NO
za	B	18.65	9.99	TBD	3.09	90.1 conditioning	43,875	YES	350	1,428,488	111		111	200	41	0.37	40.93	NO	NO	TBD	NO
zb	B	18.65	9.99	TBD	3.09	90.1 envelope	43,875	YES	231	942,802	73		73	134	27	0.37	27.42	NO	NO	TBD	NO
zc	B	18.65	9.99	TBD	3.09	90.1 infiltration	43,875	YES	123	502,012	39		39	73	15	0.38	14.94	YES	NO	TBD	NO
zd	B	18.65	9.99	TBD	3.09	90.1 glazing	43,875	YES	108	440,791	34		34	65	13	0.39	13.30	YES	NO	TBD	NO
ze	B	18.65	9.99	TBD	3.09	natural ventilation	43,875	YES	101	412,221	32		32	61	12	0.39	12.48	YES	NO	TBD	NO
zf	B	18.65	9.99	TBD	3.09	HWHP PH envelope	43,875	YES	84	342,837	27		27	51	10	0.39	10.44	YES	NO	TBD	NO
zf	B	18.65	9.99	TBD	3.09	add PV	43,875	YES	84	342,837	27	18	9	51	10	0.39	3.39	YES	YES	TBD	NO
zf	B	18.65	9.99	TBD	3.09	improve PV	43,875	YES	84	342,837	27	20	7	51	10	0.39	2.61	YES	YES	TBD	YES

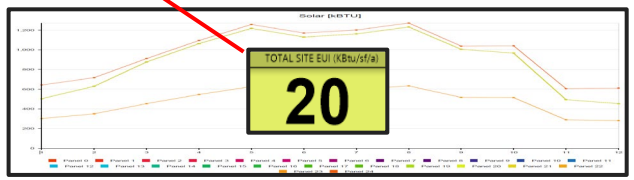
IS IT LEGAL?



BUILDING CODE



CLIMATE STUDIO ENERGY USE



PV ANALYSIS

LL97 COMPLIANCE WORKSHEET

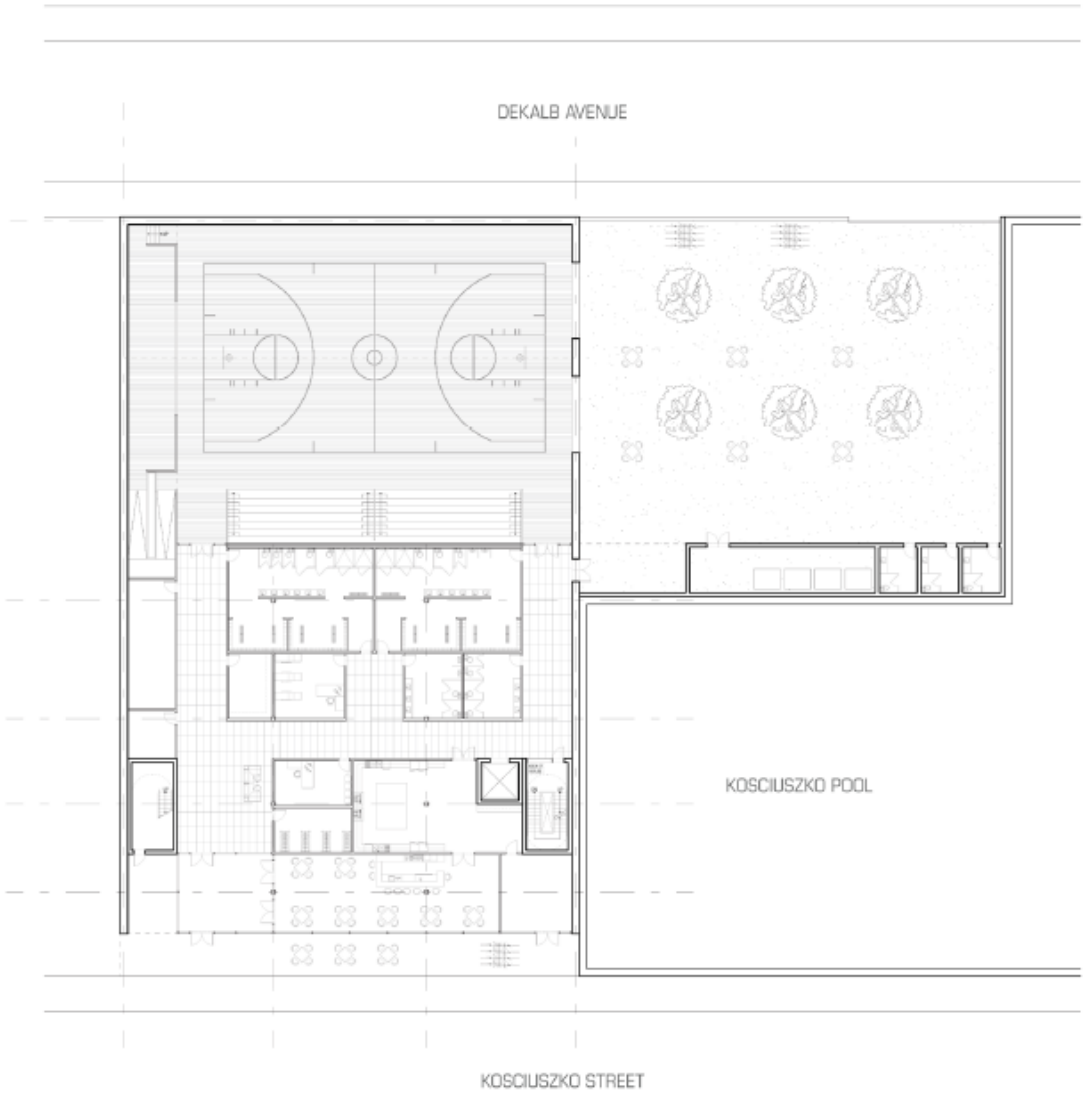
Sim #	Allowed Operation Carbon ($lbCO_2/sf$)					Design			SiteEUI					Operational Carbon Emissions				Compliance			
									Usage			PV	Total	From Loads		Coeff	Total CO_2				
	Occup	2024	2029	2035	2050	Run Description	Build area (sf)	LL97 applies	(kWh/m^2)	kWh	(kBTU/sf)	(kBTU/sf)	(kBTU/sf)	(kg/m^2)	(lb/sf)	CO_2/kBTU	(lb/sf)	2024	2029	2035	2050
y	B	18.65	9.99	TBD	3.09	1960 baseline	43,875	YES	840	3,428,372	267		267	520	106	0.40	106.42	NO	NO	TBD	NO
z	B	18.65	9.99	TBD	3.09	90.1 loads	43,875	YES	430	1,755,000	136		136	247	51	0.37	50.55	NO	NO	TBD	NO
za	B	18.65	9.99	TBD	3.09	90.1 conditioning	43,875	YES	350	1,428,488	111		111	200	41	0.37	40.93	NO	NO	TBD	NO
zb	B	18.65	9.99	TBD	3.09	90.1 envelope	43,875	YES	231	942,802	73		73	134	27	0.37	27.42	NO	NO	TBD	NO
zc	B	18.65	9.99	TBD	3.09	90.1 infiltration	43,875	YES	123	502,012	39		39	73	15	0.38	14.94	YES	NO	TBD	NO
zd	B	18.65	9.99	TBD	3.09	90.1 glazing	43,875	YES	108	440,791	34		34	65	13	0.39	13.30	YES	NO	TBD	NO
ze	B	18.65	9.99	TBD	3.09	natural ventilation	43,875	YES	101	412,221	32		32	61	12	0.39	12.48	YES	NO	TBD	NO
zf	B	18.65	9.99	TBD	3.09	HWHP PH envelope	43,875	YES	84	342,837	27		27	51	10	0.39	10.44	YES	NO	TBD	NO
zf	B	18.65	9.99	TBD	3.09	add PV	43,875	YES	84	342,837	27	18	9	51	10	0.39	3.39	YES	YES	TBD	NO
zf	B	18.65	9.99	TBD	3.09	improve PV	43,875	YES	84	342,837	27	20	7	51	10	0.39	2.61	YES	YES	TBD	YES

RESULTS: STUDENT WORK

We ran the course for the first time last Fall semester as a co-requisite with the 4th comprehensive studio. This pairing is now required for all undergrad and grad professional architecture degree students.


BED-STUY COMMUNITY CENTER
RENDERING: STREET VIEW

BED-STUY COMMUNITY CENTER
PLANS



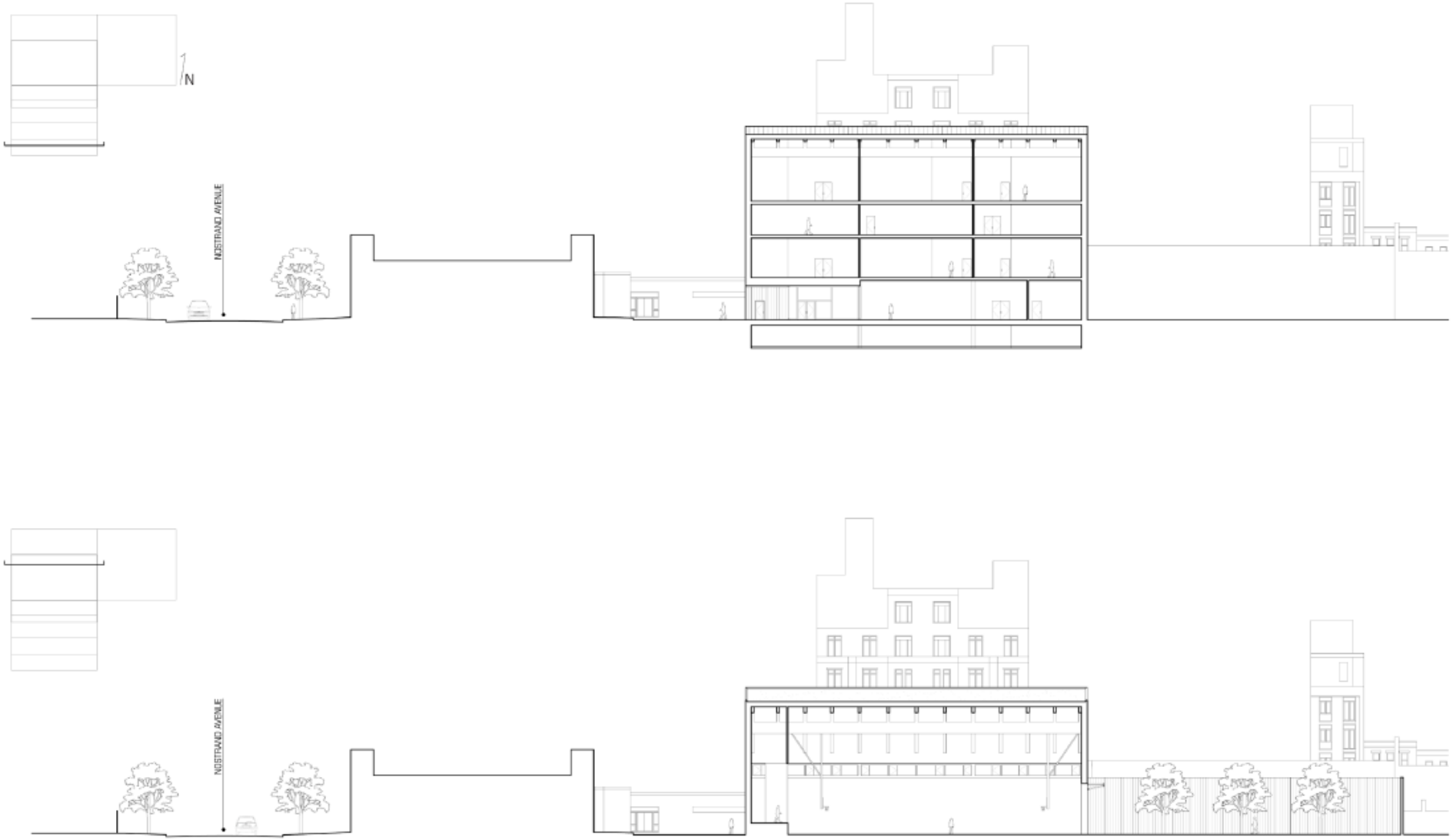
LEGEND:
LEVEL 1

- CIRCULATION/EGRESS 3,300FT²
- GYMNASIUM 7,600FT²
- PERFORMANCE STAGE 1,100FT²
- SPECTATOR SEATING 1,100FT²
- TABLE STORAGE 500FT²
- LOCKER ROOM(S) 1,000FT² EACH
- TICKET OFFICE 250FT²
- FIRST AID OFFICE 300FT²
- JANITOR/STORAGE CL. 200FT²
- COMMUNITY CAFE 1,200FT²
- ENTRY VESTIBULE 500FT²
- ENTRY LOBBY 600FT²
- COMMUNITY KITCHEN 900FT²
- RECEIVING/STORAGE 400FT² TOTAL
- PUBLIC RESTROOM(S) 250FT² EACH
- COMMUNITY GARDEN 9,400FT²
- OUTDOOR MECHANICAL 600FT²
- OUTDOOR RESTROOM(S) 120FT² EACH

SCALE:
0 20 40
N

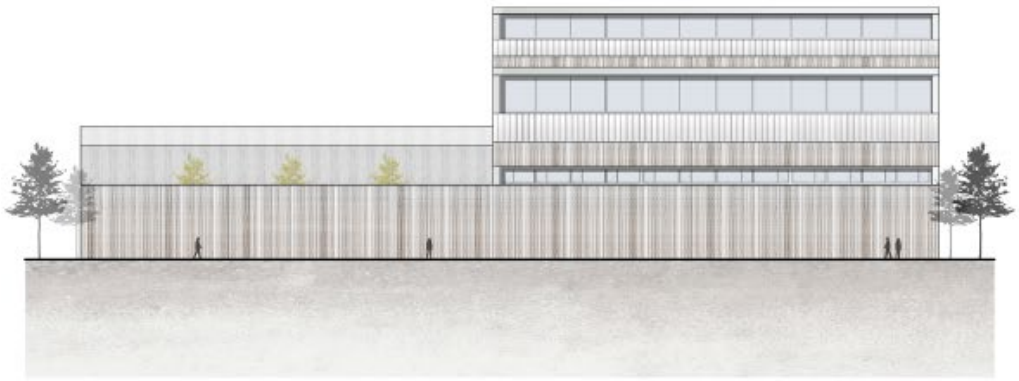
BED-STUY COMMUNITY CENTER

SECTIONS



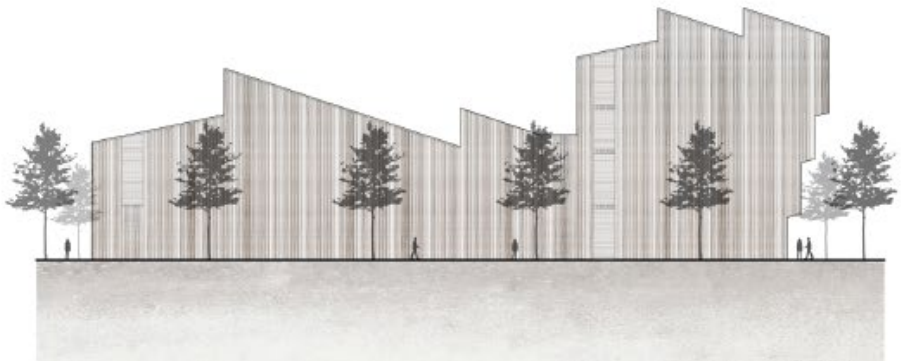
BED-STUY COMMUNITY CENTER

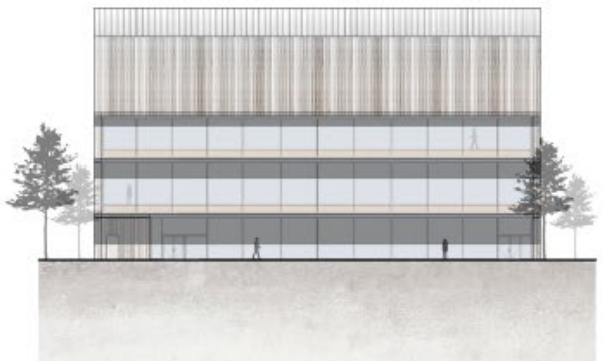
RENDERED ELEVATIONS



NORTH

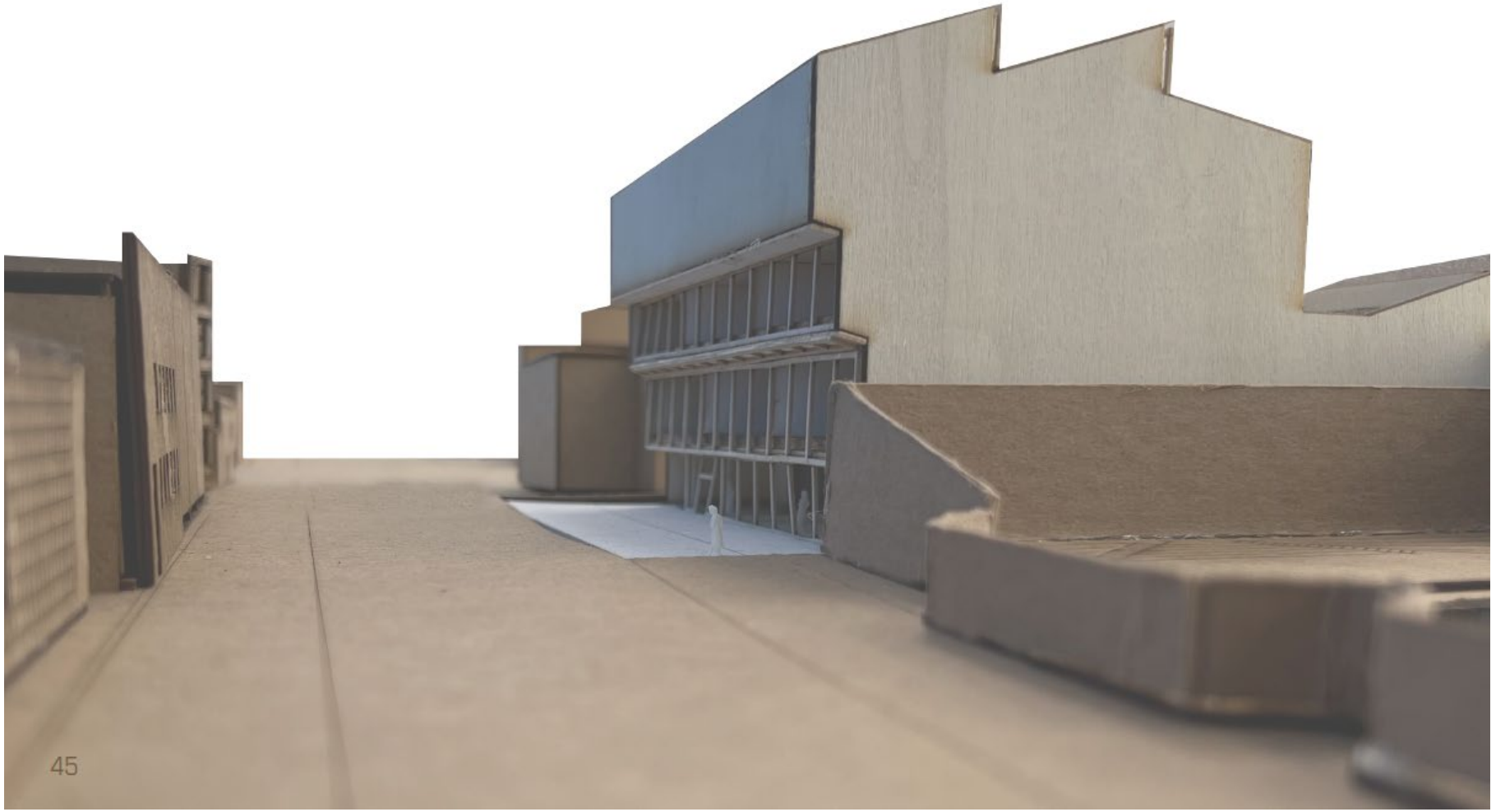
EAST





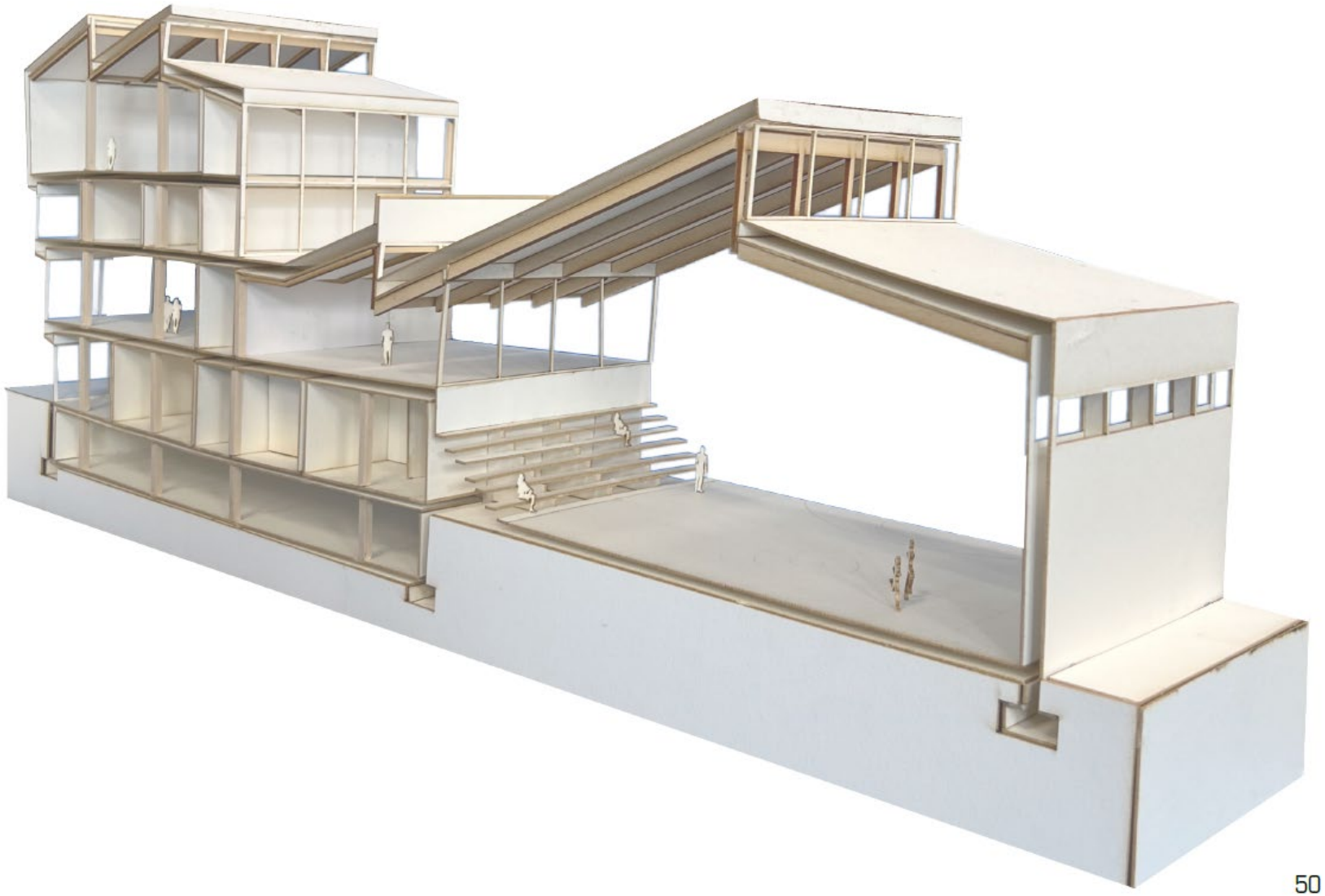
BED-STUY COMMUNITY CENTER

PHYSICAL MODEL



BED-STUY COMMUNITY CENTER

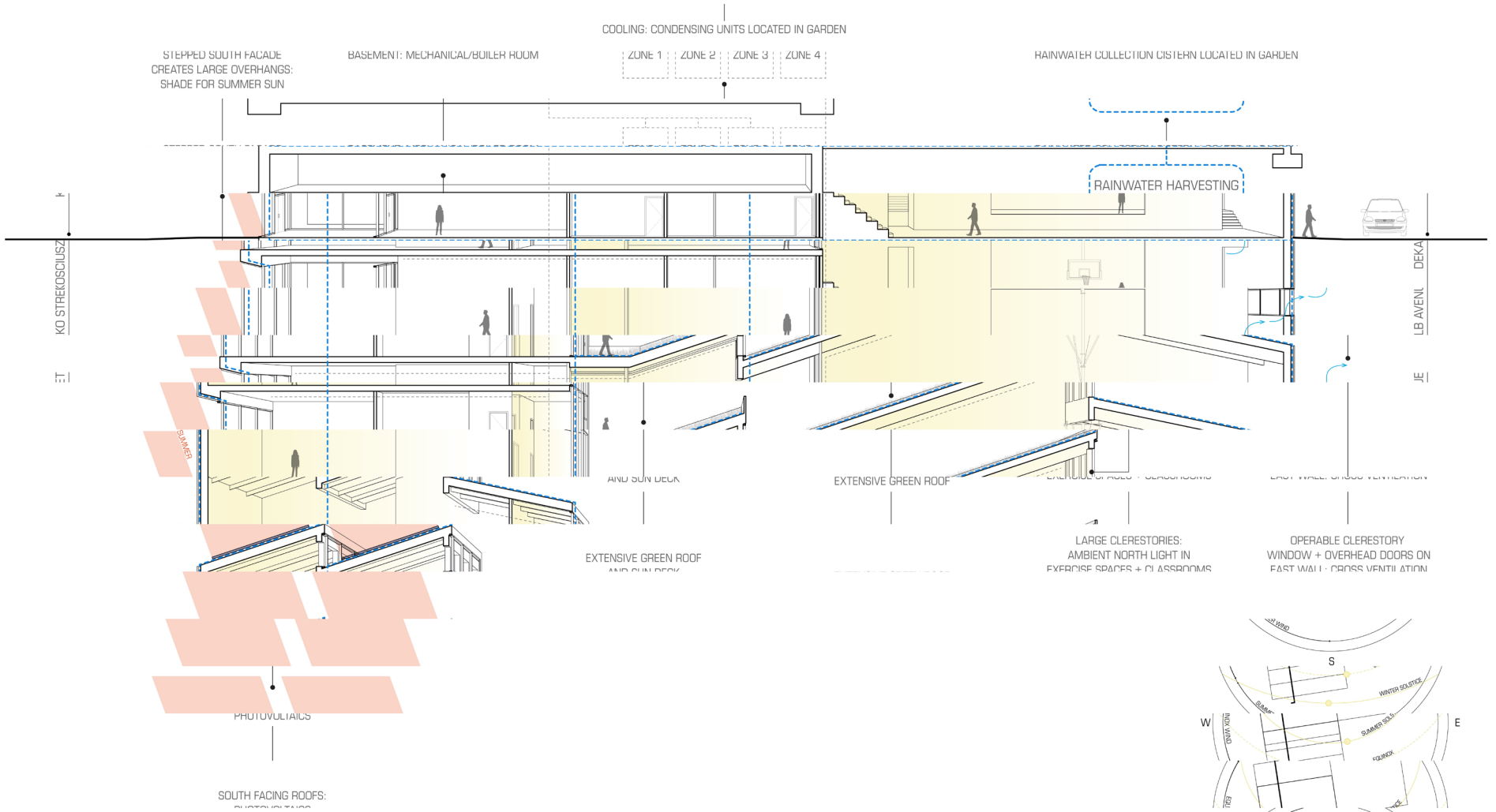
PHYSICAL MODEL: SECTION



50

COMPREHENSIVE SECTION (SUMMER)

SCALE: 1/8" = 1'-0"

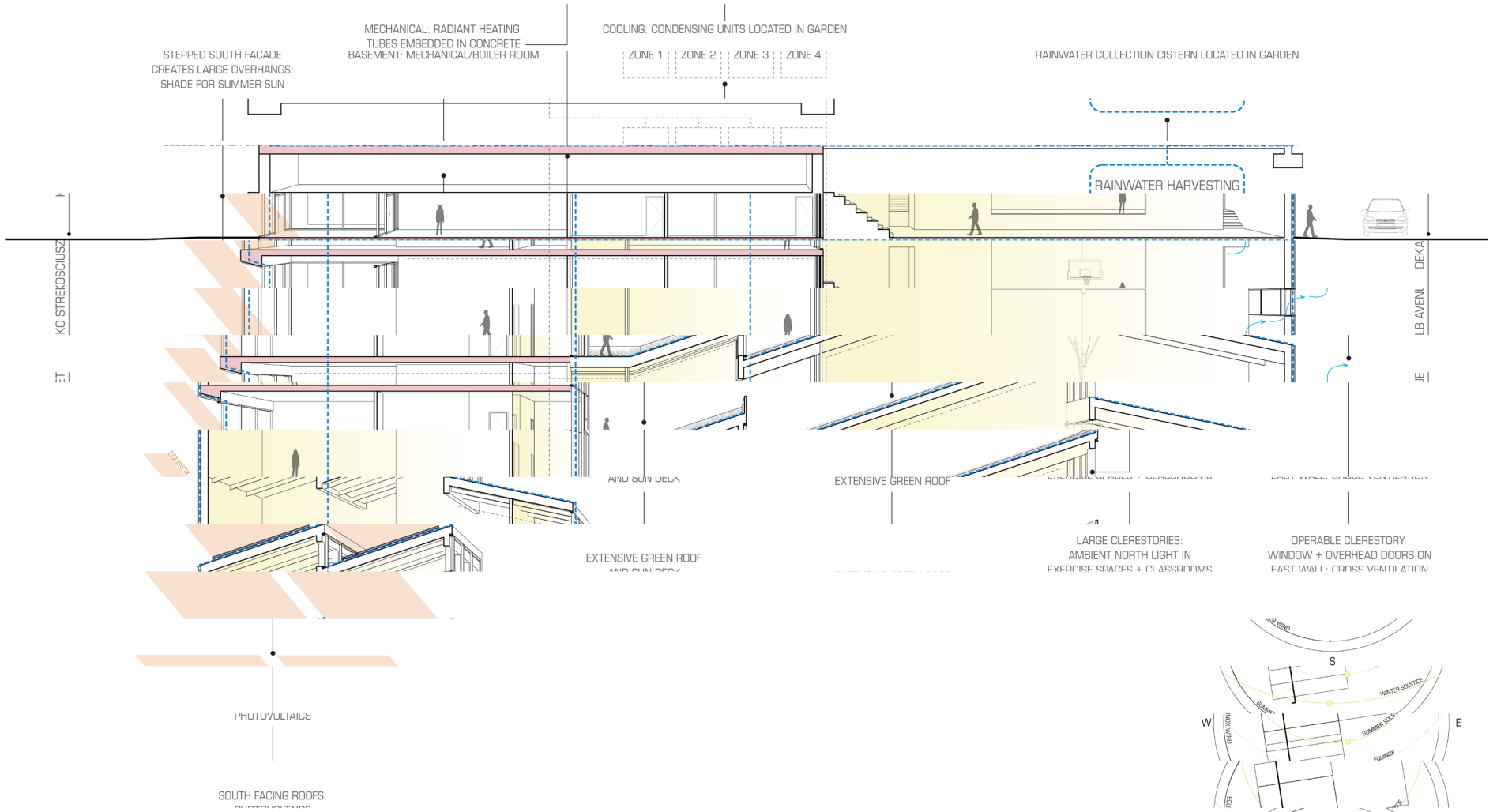


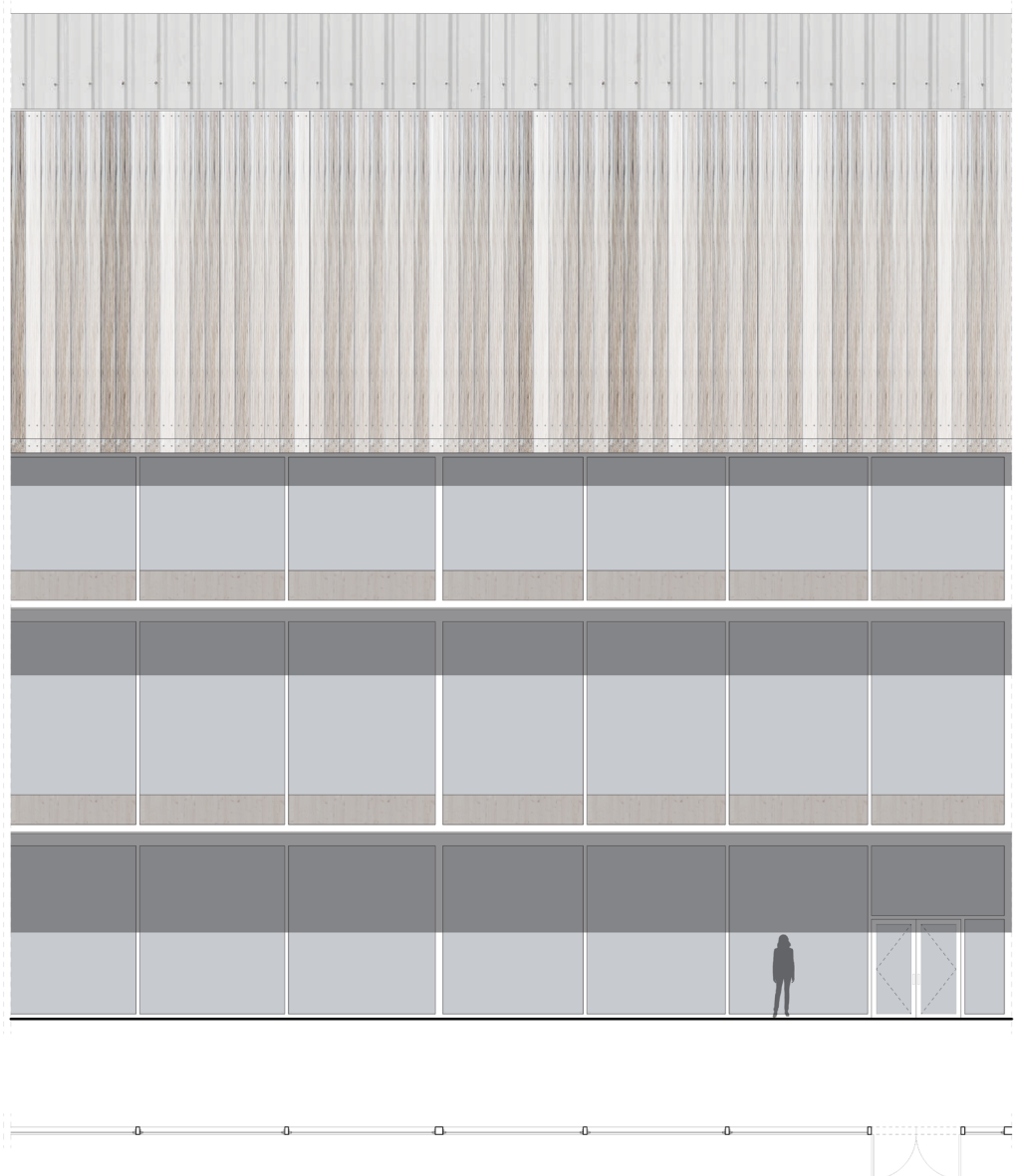
BED-STUY COMMUNITY CENTER | BROOKLYN, NY | SABRINA INNAMORATO

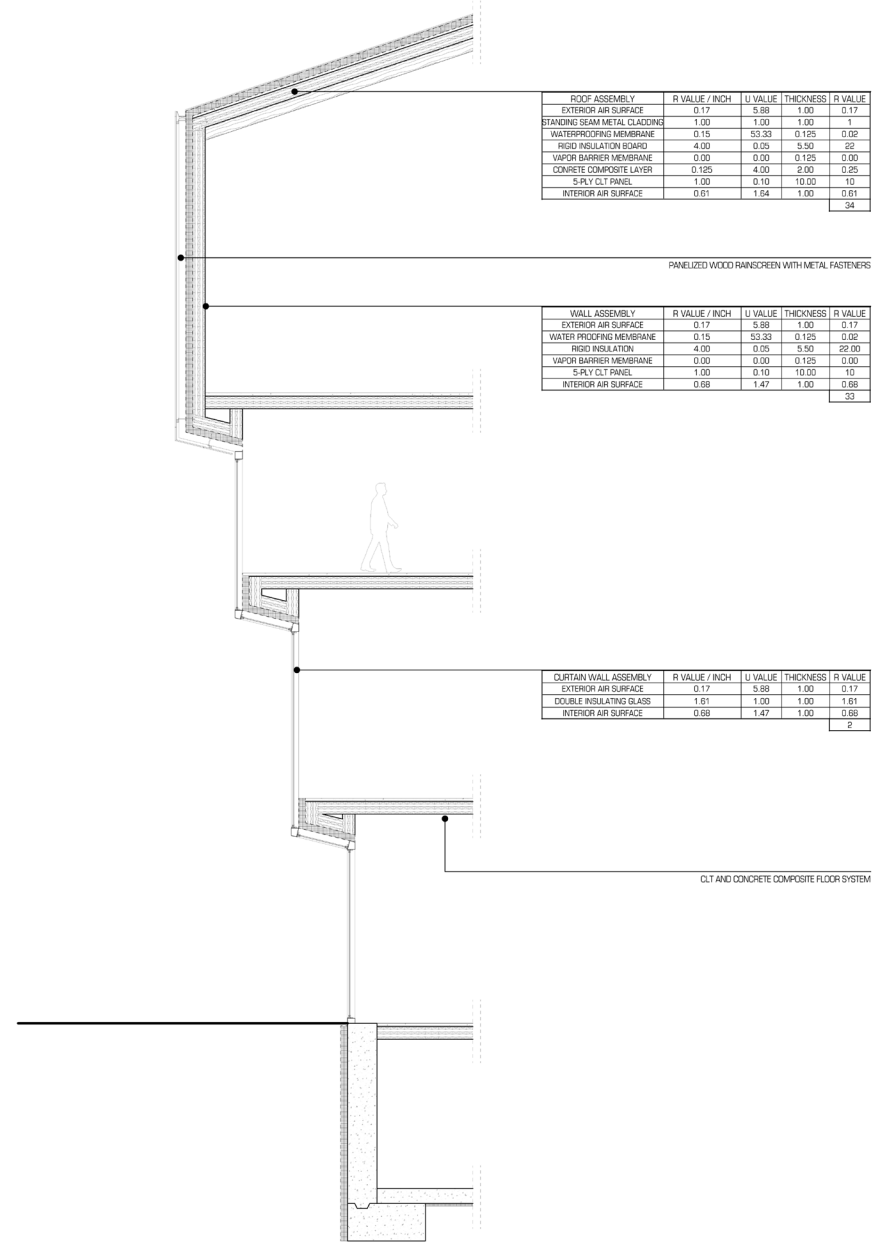
COMPREHENSIVE SECTION (EQUINOX)

SCALE: 1/8" = 1'-0"

COMPOSITE SLAB O/ CLT PANELS







ROOF ASSEMBLY	R VALUE / INCH	U VALUE	THICKNESS	R VALUE
EXTERIOR AIR SURFACE	0.17	5.88	1.00	0.17
STANDING SEAM METAL CLADDING	1.00	1.00	1.00	1
WATERPROOFING MEMBRANE	0.15	53.33	0.125	0.02
RIGID INSULATION BOARD	4.00	0.05	5.50	22
VAPOR BARRIER MEMBRANE	0.00	0.00	0.125	0.00
CONRETE COMPOSITE LAYER	0.125	4.00	2.00	0.25
5-PLY CLT PANEL	1.00	0.10	10.00	10
INTERIOR AIR SURFACE	0.61	1.64	1.00	0.61
				34

PANELIZED WOOD RAINSCREEN WITH METAL FASTENERS

WALL ASSEMBLY	R VALUE / INCH	U VALUE	THICKNESS	R VALUE
EXTERIOR AIR SURFACE	0.17	5.88	1.00	0.17
WATER PROOFING MEMBRANE	0.15	53.33	0.125	0.02
RIGID INSULATION	4.00	0.05	5.50	22.00
VAPOR BARRIER MEMBRANE	0.00	0.00	0.125	0.00
5-PLY CLT PANEL	1.00	0.10	10.00	10
INTERIOR AIR SURFACE	0.68	1.47	1.00	0.68
				33

CURTAIN WALL ASSEMBLY	R VALUE / INCH	U VALUE	THICKNESS	R VALUE
EXTERIOR AIR SURFACE	0.17	5.88	1.00	0.17
DOUBLE INSULATING GLASS	1.61	1.00	1.00	1.61
INTERIOR AIR SURFACE	0.68	1.47	1.00	0.68
				2

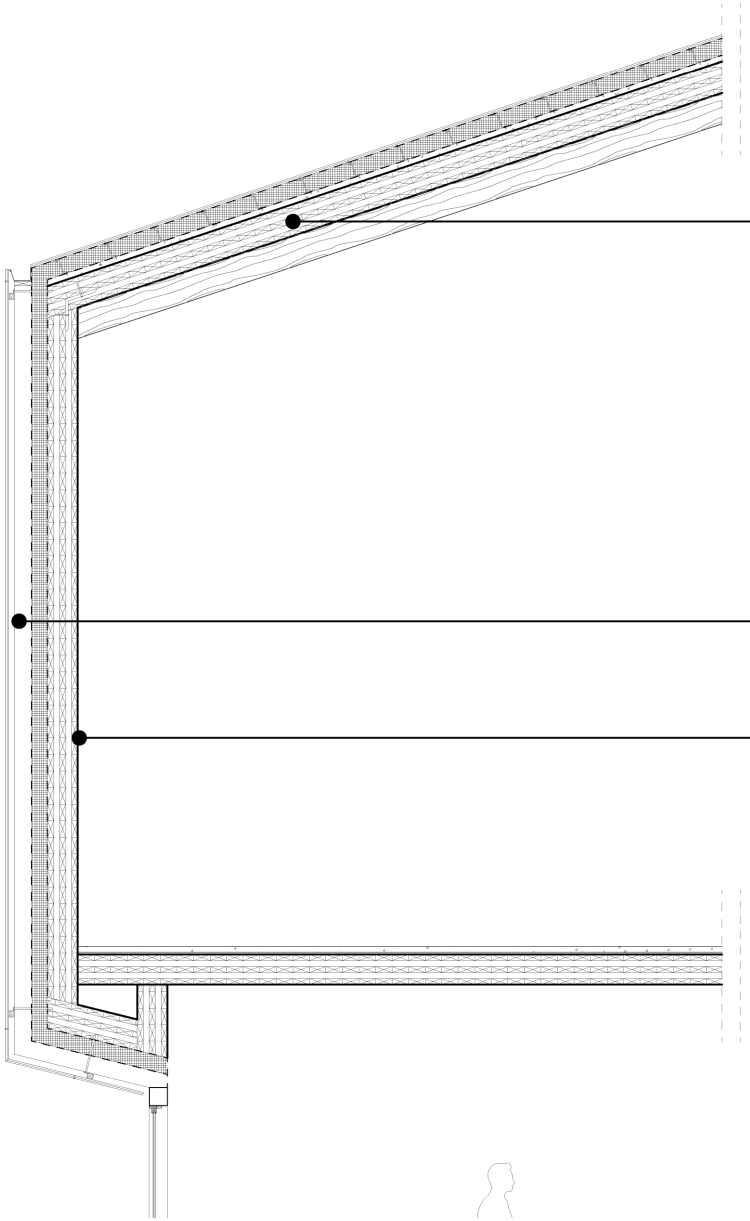
CLT AND CONCRETE COMPOSITE FLOOR SYSTEM

DETAIL WALL SECTION (SOUTH)

SCALE: 1/4" = 1'-0"

0 5 10

BED-STUY COMMUNITY CENTER | BROOKLYN, NY | SABRINA INNAMORATO



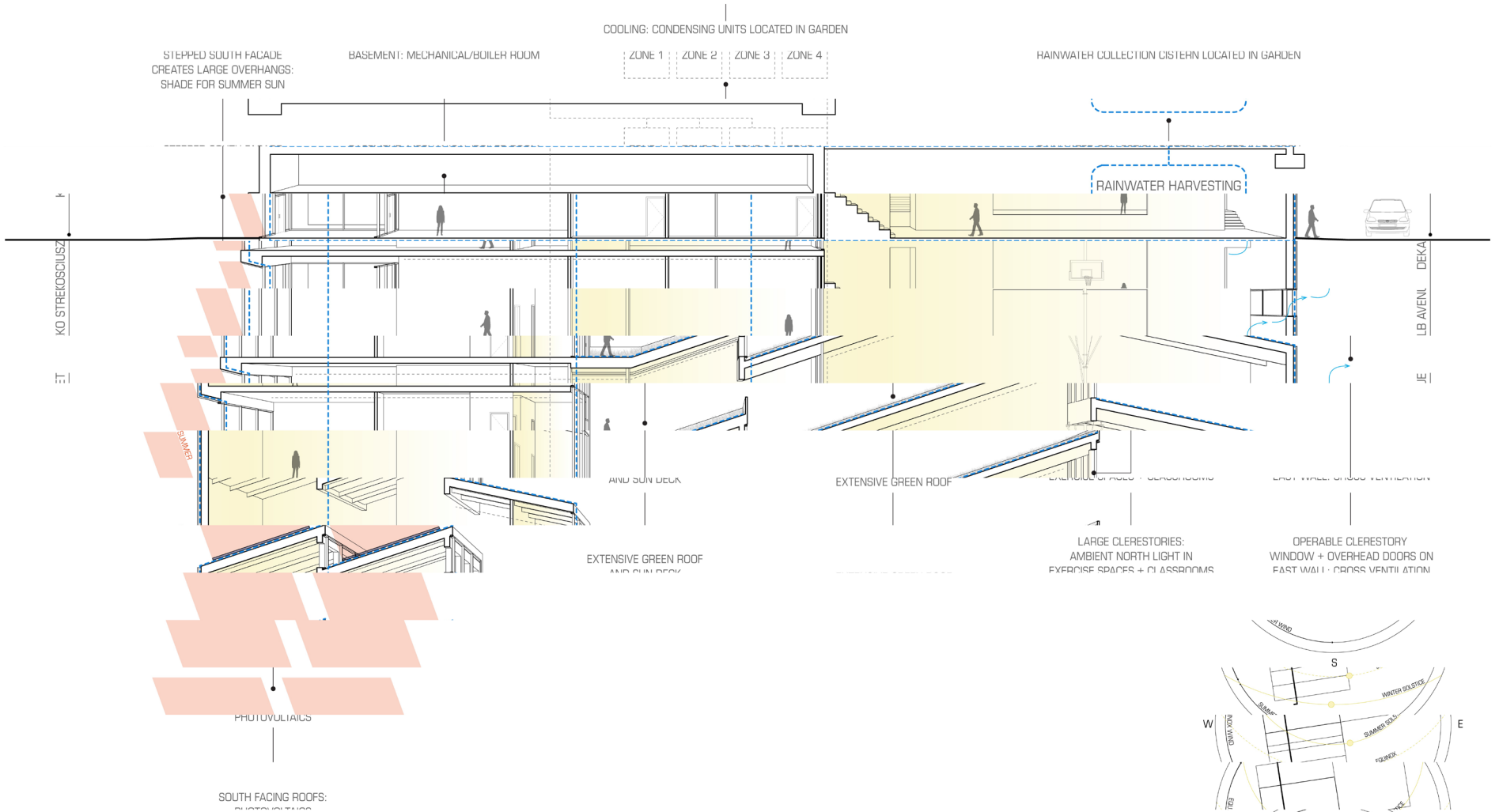
ROOF ASSEMBLY	R VALUE / INCH	U VALUE	THICKNESS	R VALUE
EXTERIOR AIR SURFACE	0.17	5.88	1.00	0.17
STANDING SEAM METAL CLADDING	1.00	1.00	1.00	1
WATERPROOFING MEMBRANE	0.15	53.33	0.125	0.02
RIGID INSULATION BOARD	4.00	0.05	5.50	22
VAPOR BARRIER MEMBRANE	0.00	0.00	0.125	0.00
CONRETE COMPOSITE LAYER	0.125	4.00	2.00	0.25
5-PLY CLT PANEL	1.00	0.10	10.00	10
INTERIOR AIR SURFACE	0.61	1.64	1.00	0.61
				34

PANELIZED WOOD RAINSCREEN WITH METAL FASTENERS

WALL ASSEMBLY	R VALUE / INCH	U VALUE	THICKNESS	R VALUE
EXTERIOR AIR SURFACE	0.17	5.88	1.00	0.17
WATER PROOFING MEMBRANE	0.15	53.33	0.125	0.02
RIGID INSULATION	4.00	0.05	5.50	22.00
VAPOR BARRIER MEMBRANE	0.00	0.00	0.125	0.00
5-PLY CLT PANEL	1.00	0.10	10.00	10
INTERIOR AIR SURFACE	0.68	1.47	1.00	0.68
				33

COMPREHENSIVE SECTION (SUMMER)

SCALE: 1/8" = 1'-0"

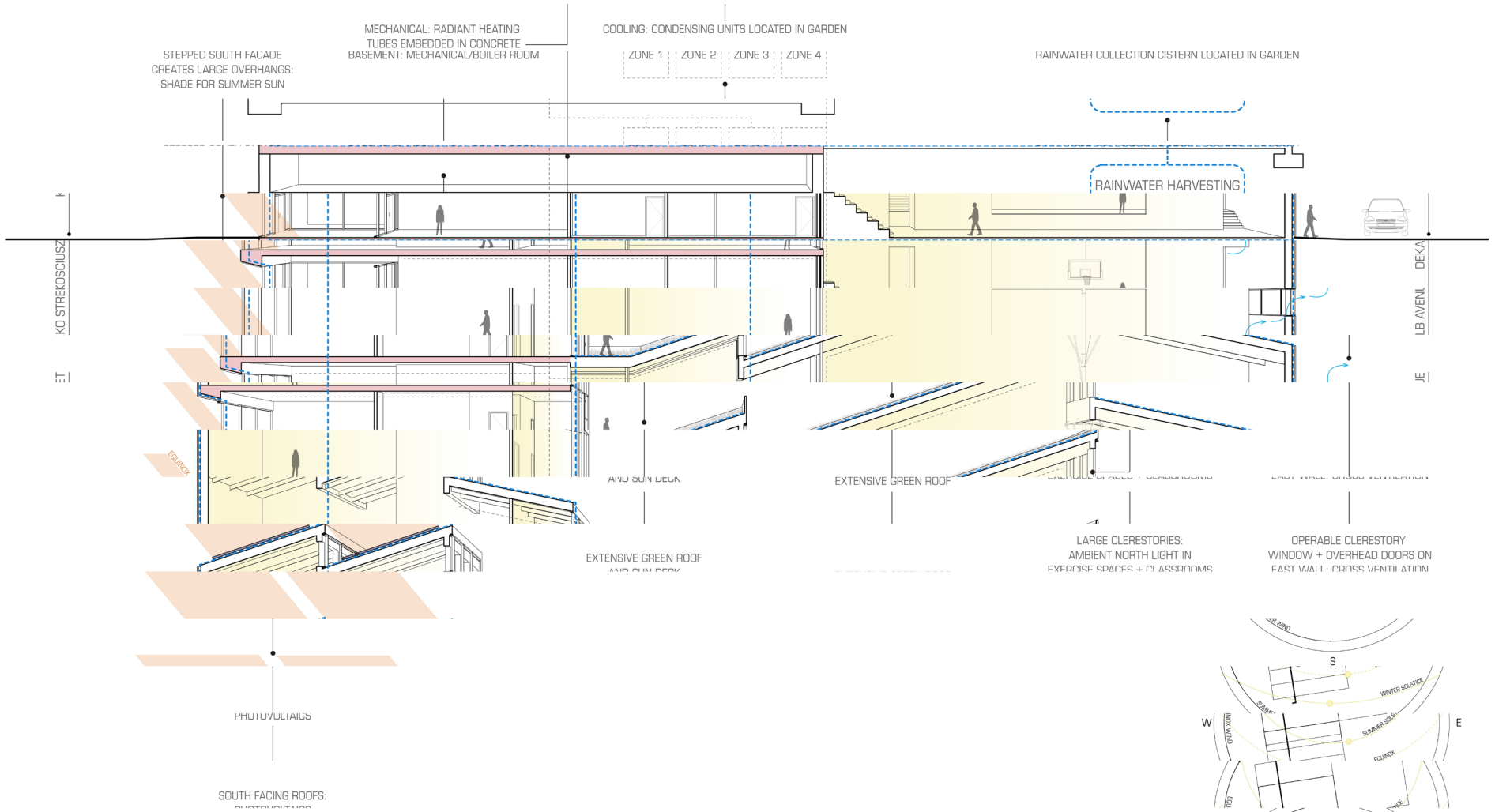


BED-STUY COMMUNITY CENTER | BROOKLYN, NY | SABRINA INNAMORATO

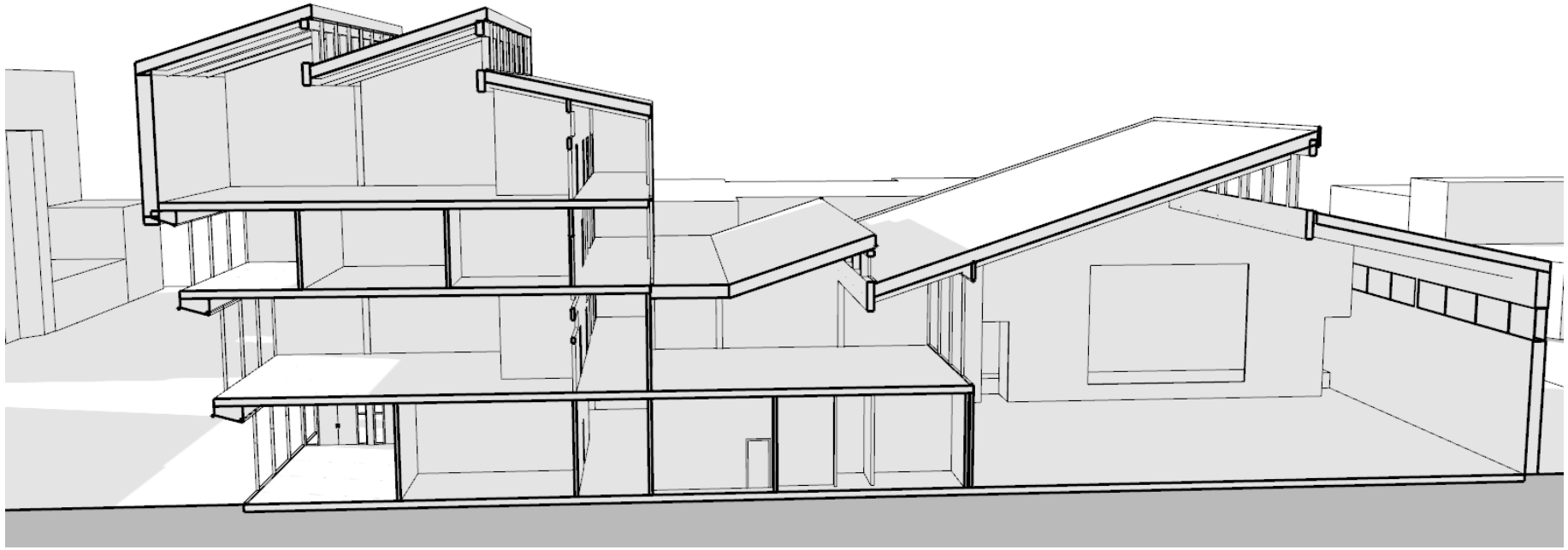
COMPREHENSIVE SECTION (EQUINOX)

SCALE: 1/8" = 1'-0"

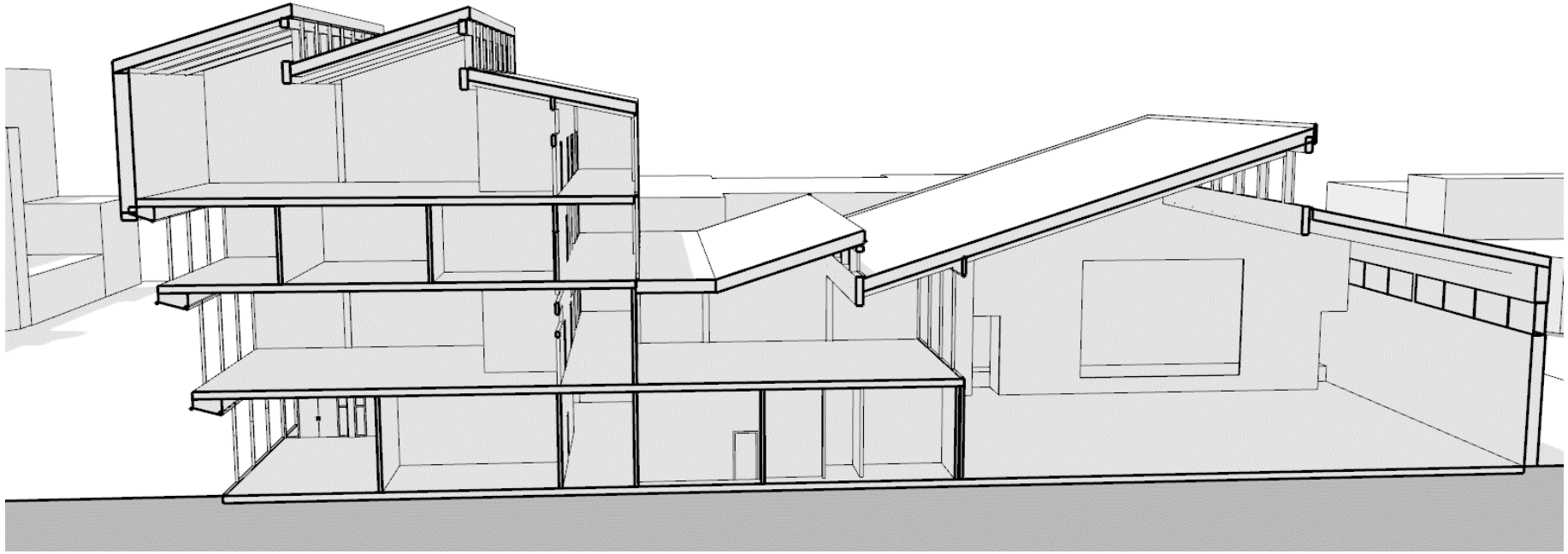
COMPOSITE SLAB O/ CLT PANELS



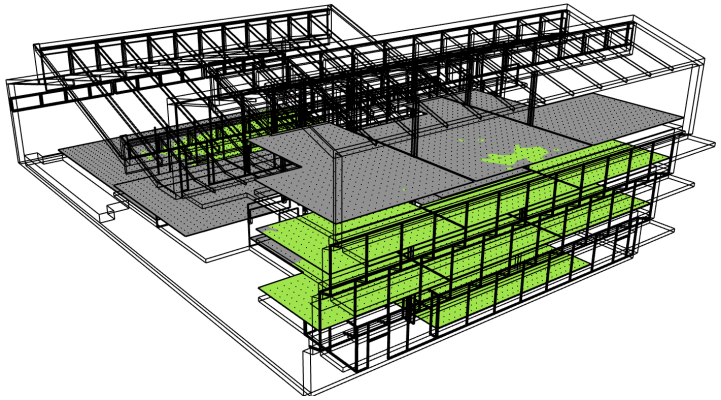
winter solstice
noon

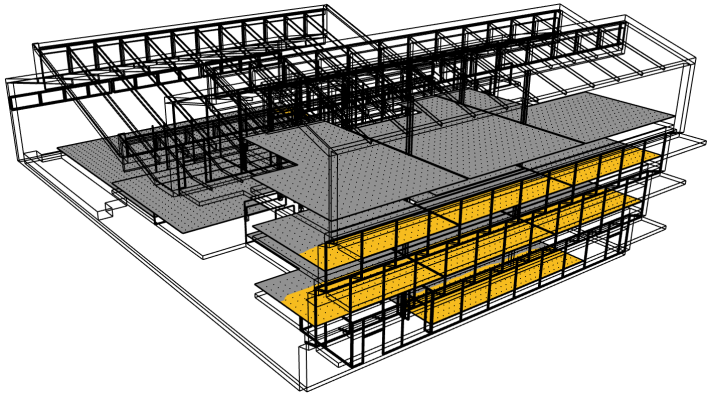


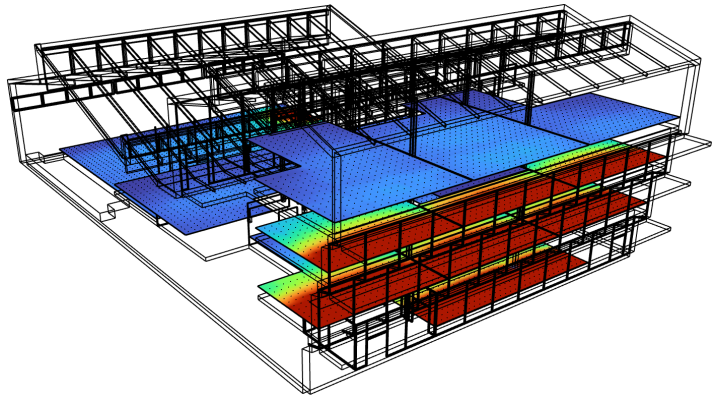
summer solstice
noon



ORIGINAL DESIGN

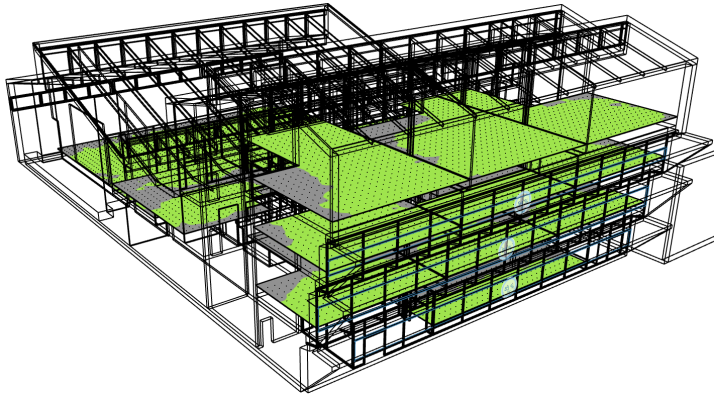


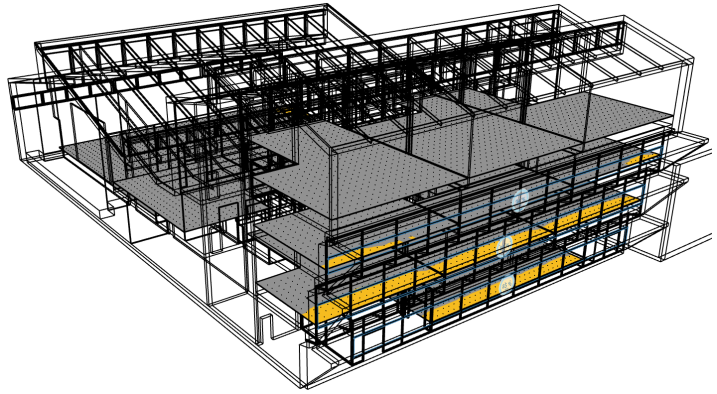


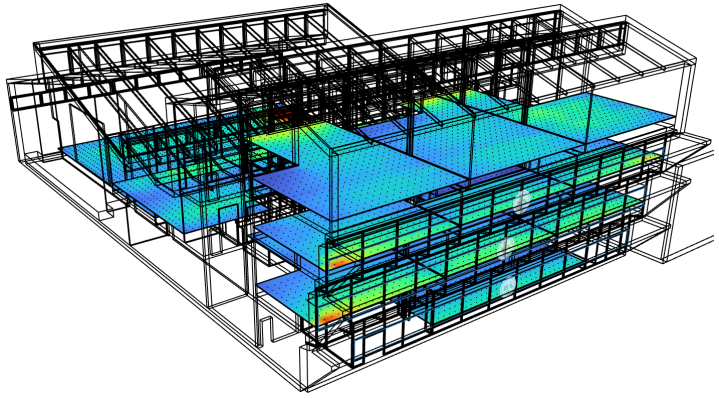


0 credits	38.4 % $sDA_{300/50\%}$	13.1 % $ASE_{1000,250}$	889 avg lux	- blinds open

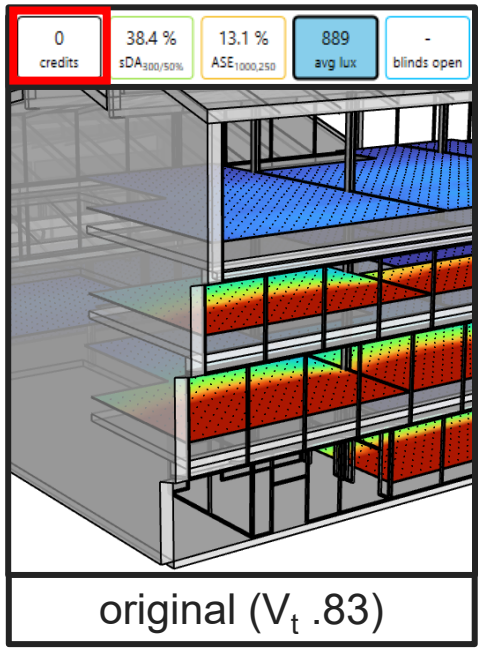
ITERATED DESIGN



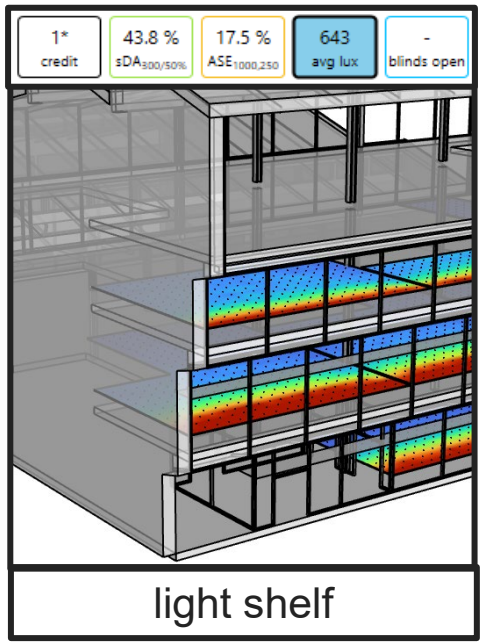




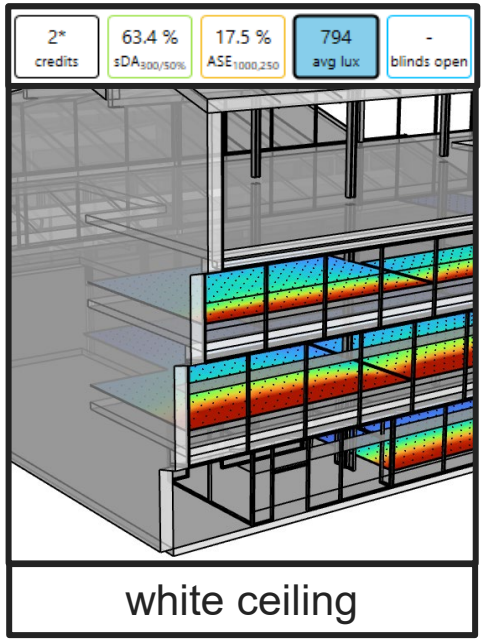
3* credits	76.0 % $sDA_{300/50\%}$	3.9 % $ASE_{1000,250}$	506 avg lux	86.5 % blinds open



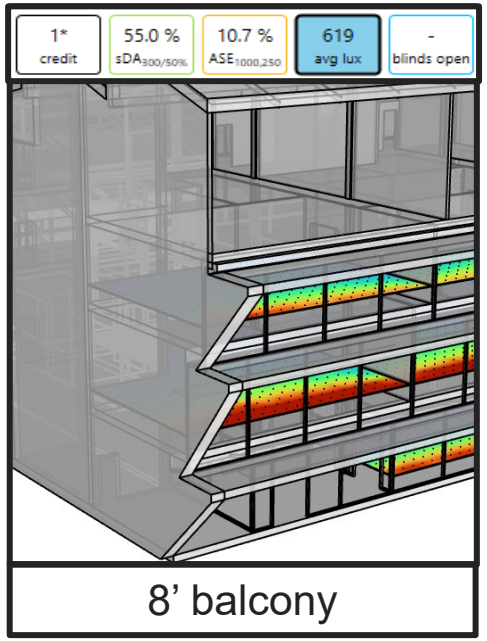
original (V_t .83)



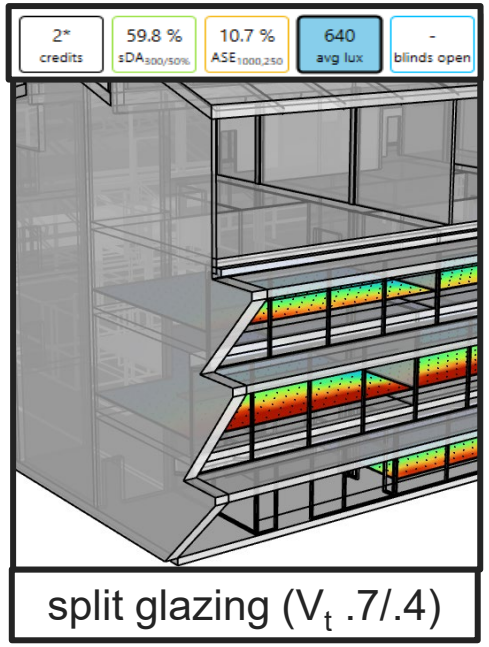
light shelf



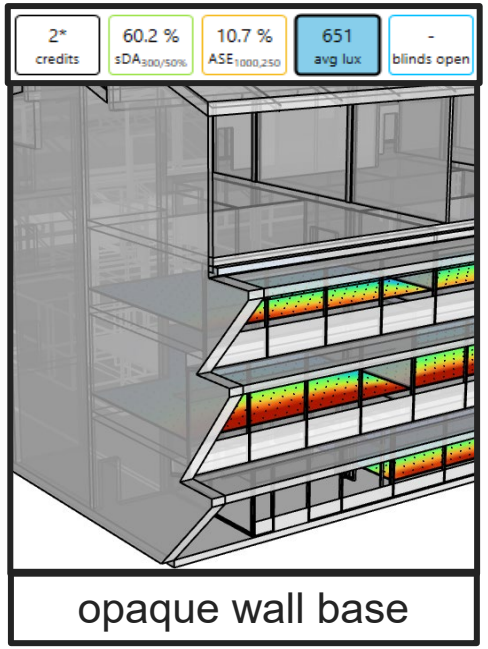
white ceiling



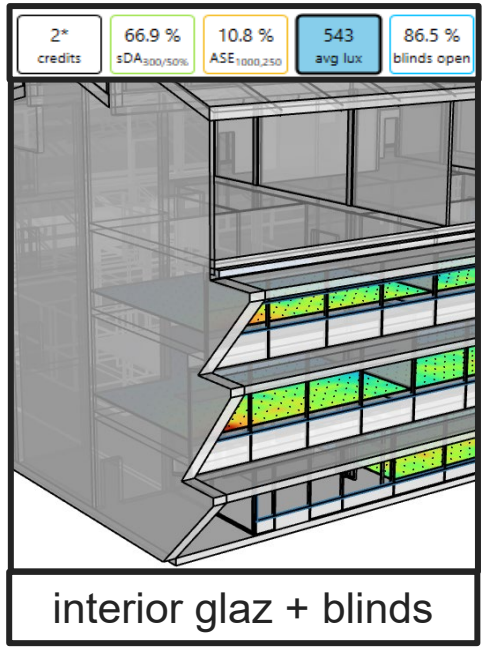
8’ balcony



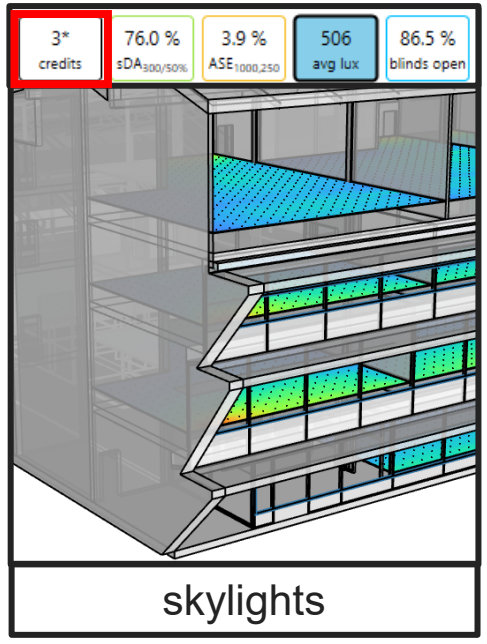
split glazing (V_t .7/.4)



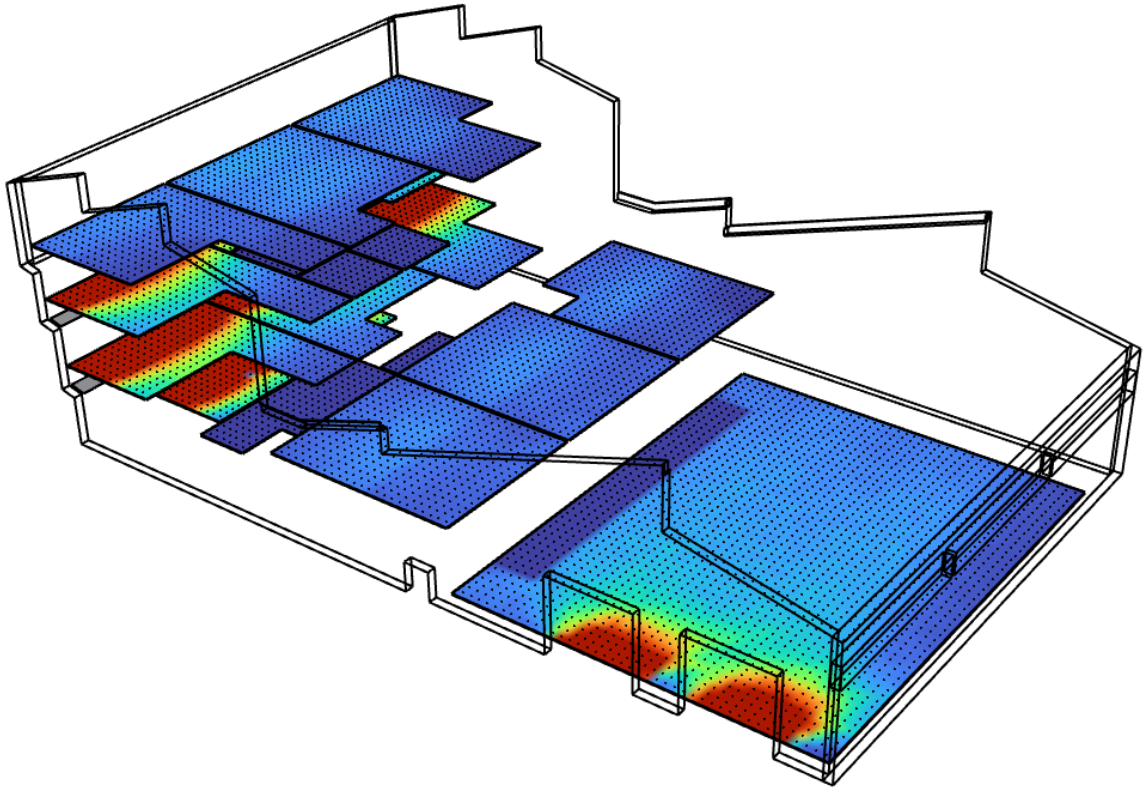
opaque wall base



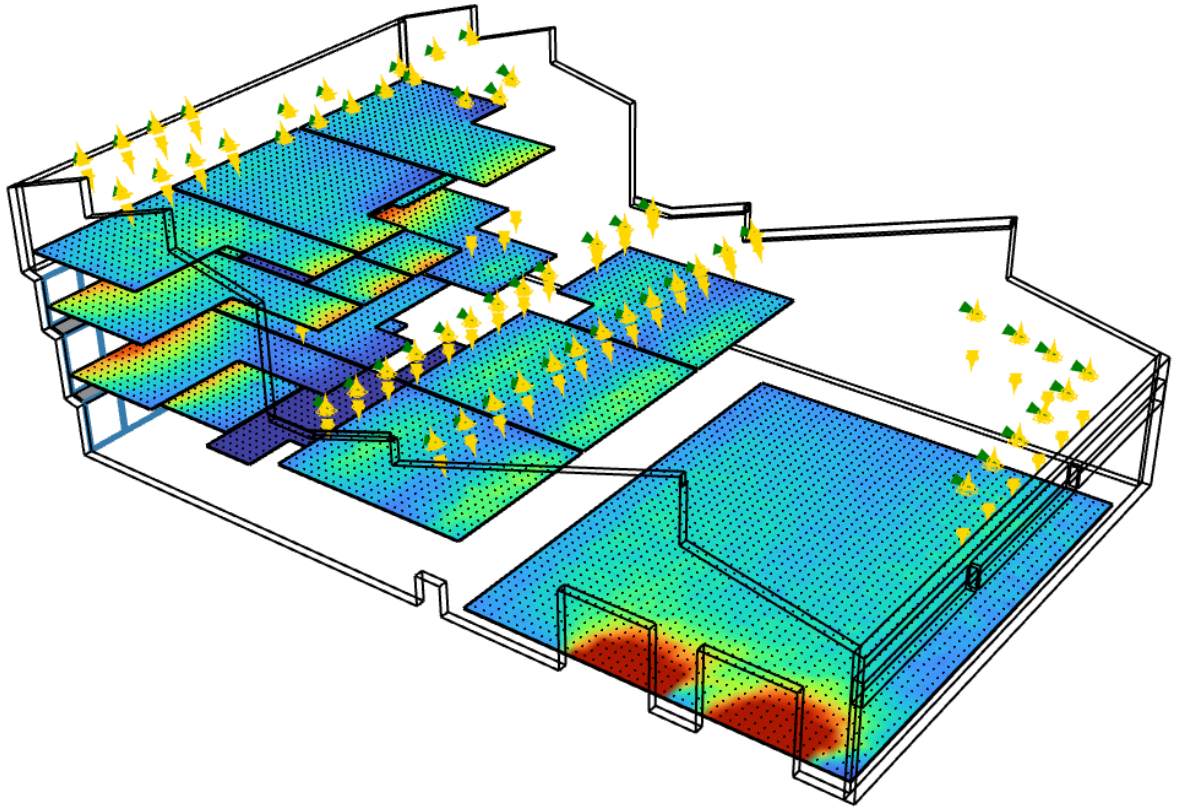
interior glaz + blinds



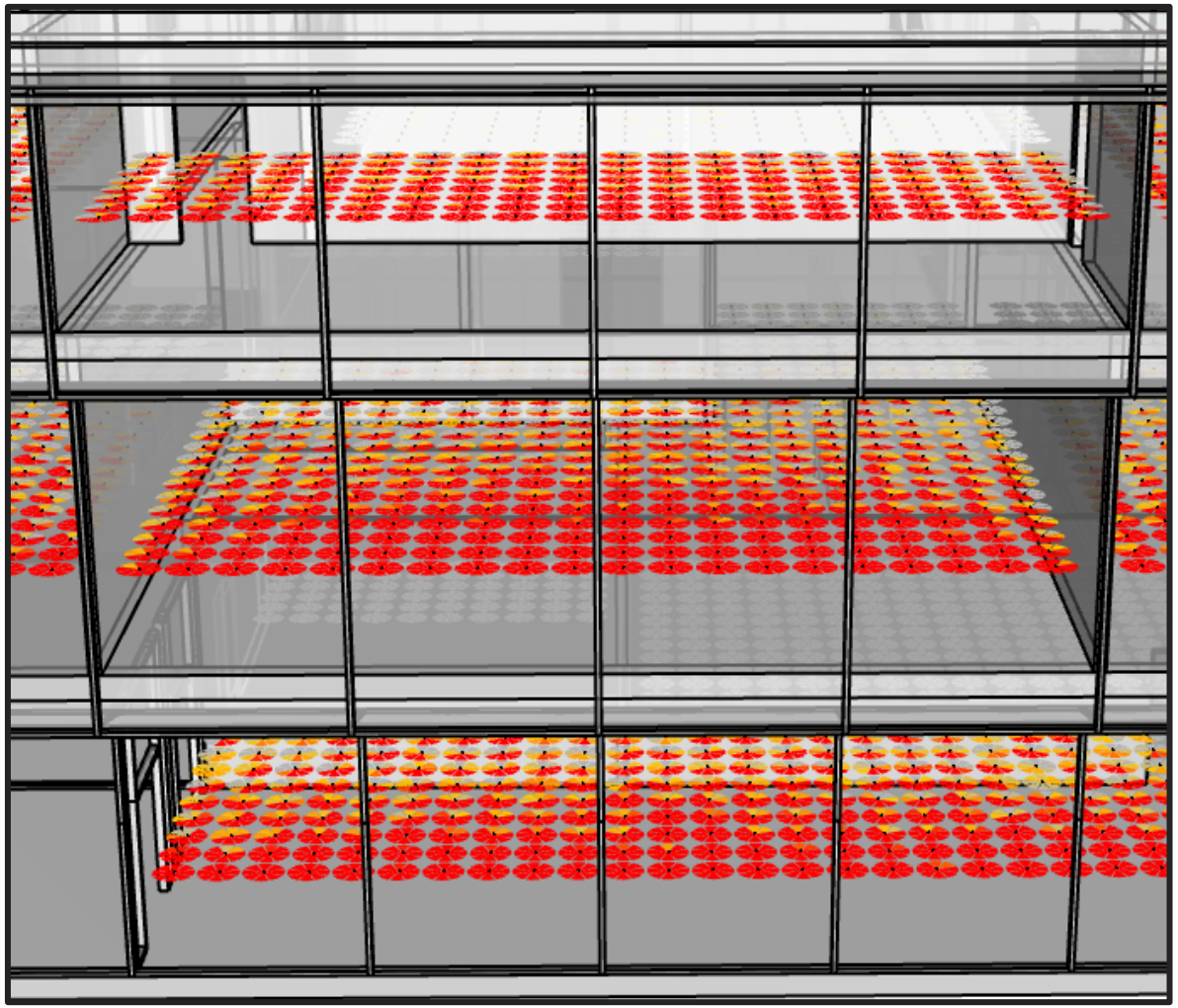
skylights



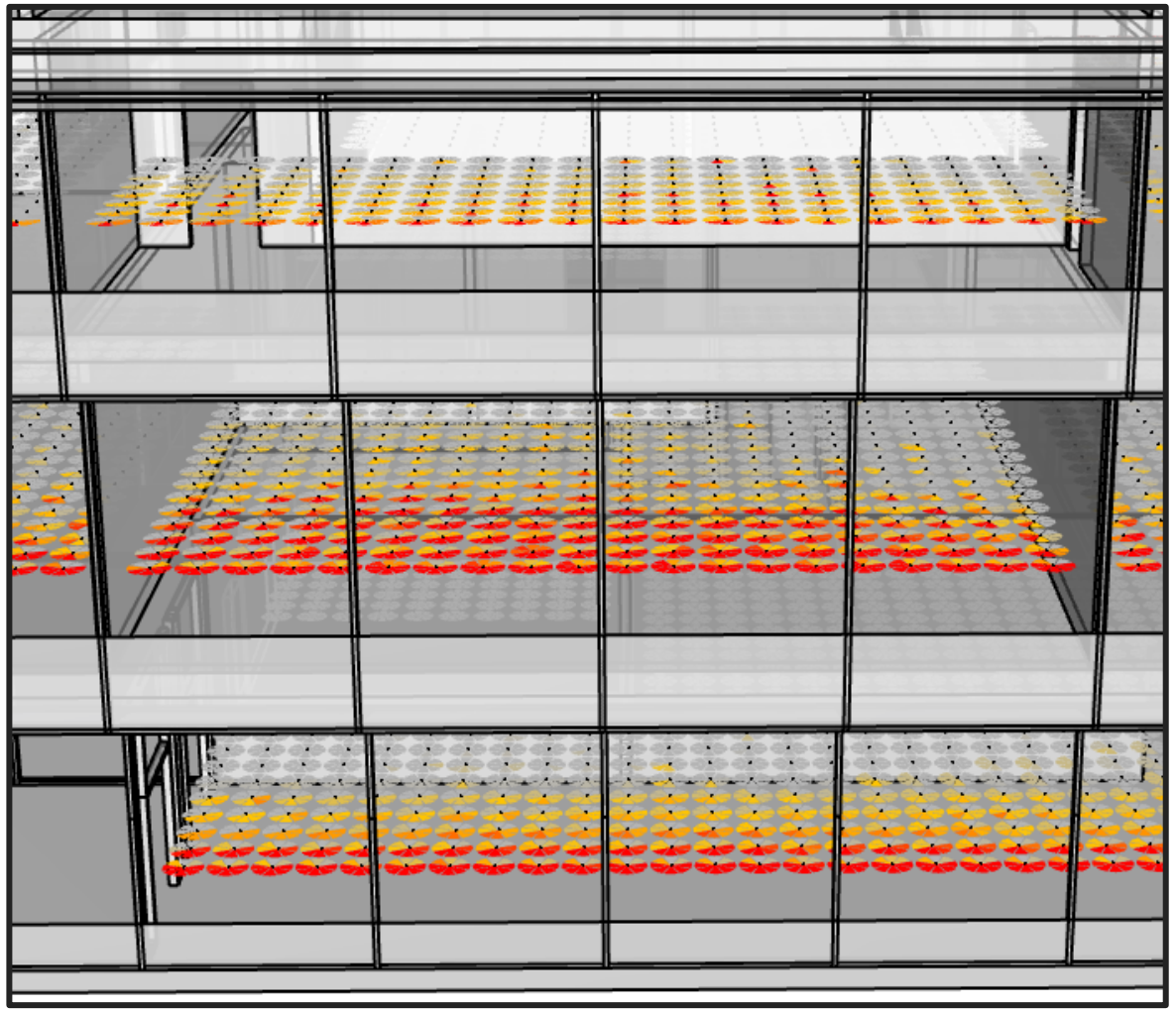
ORIGINAL



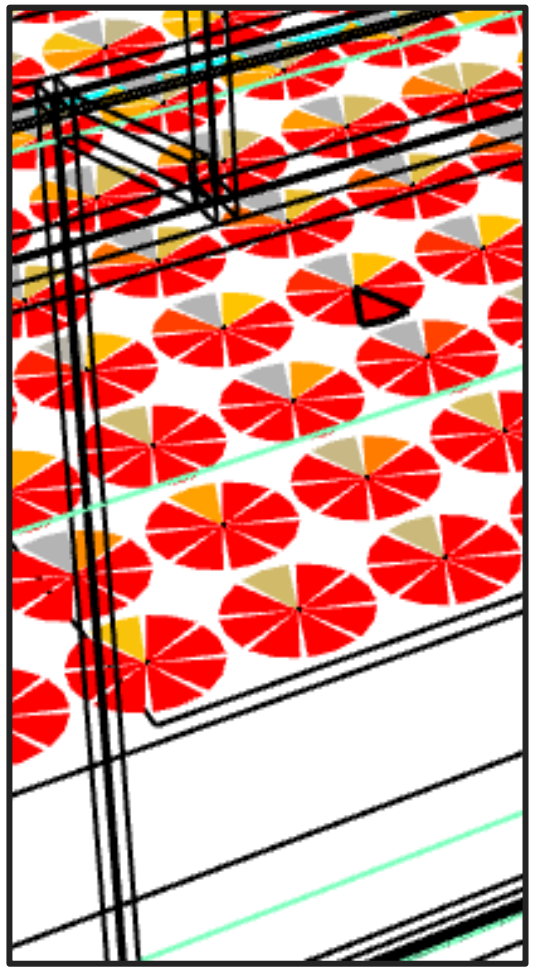
ITERATED WITH SKYLIGHTS



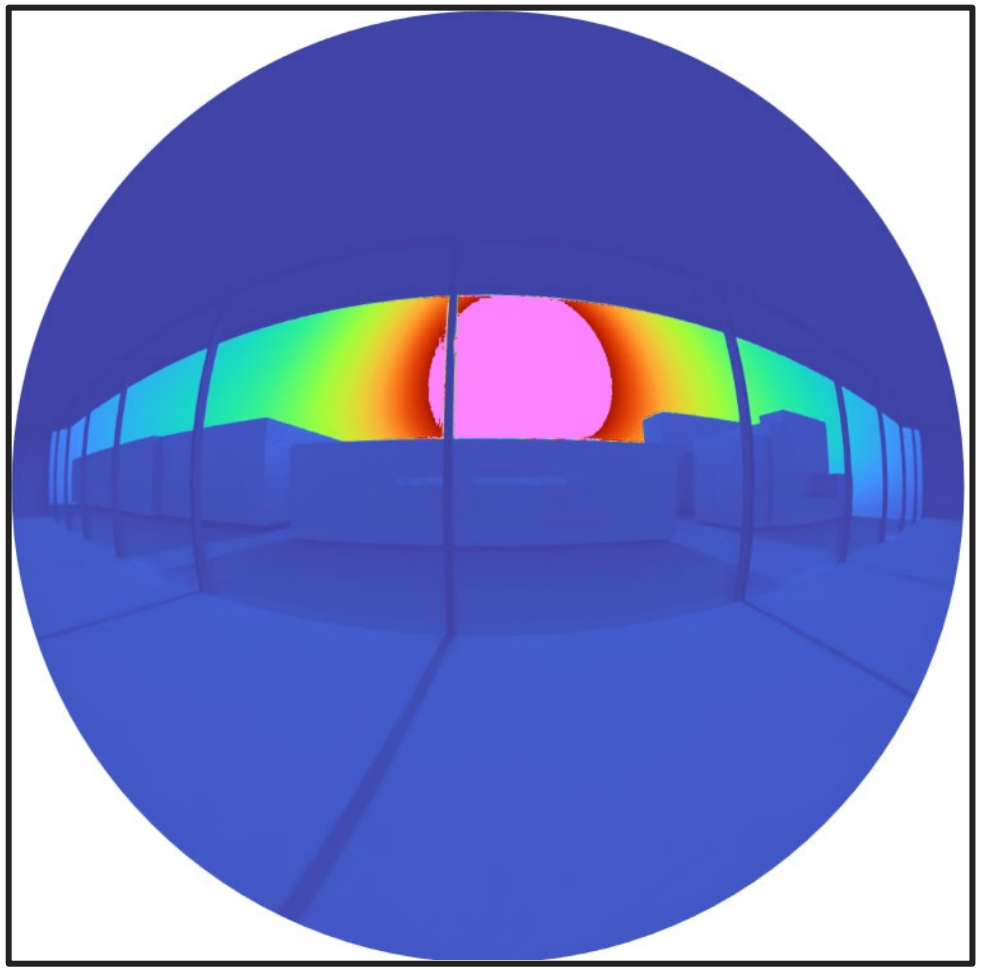
ORIGINAL GLAZED CURTAIN WALL



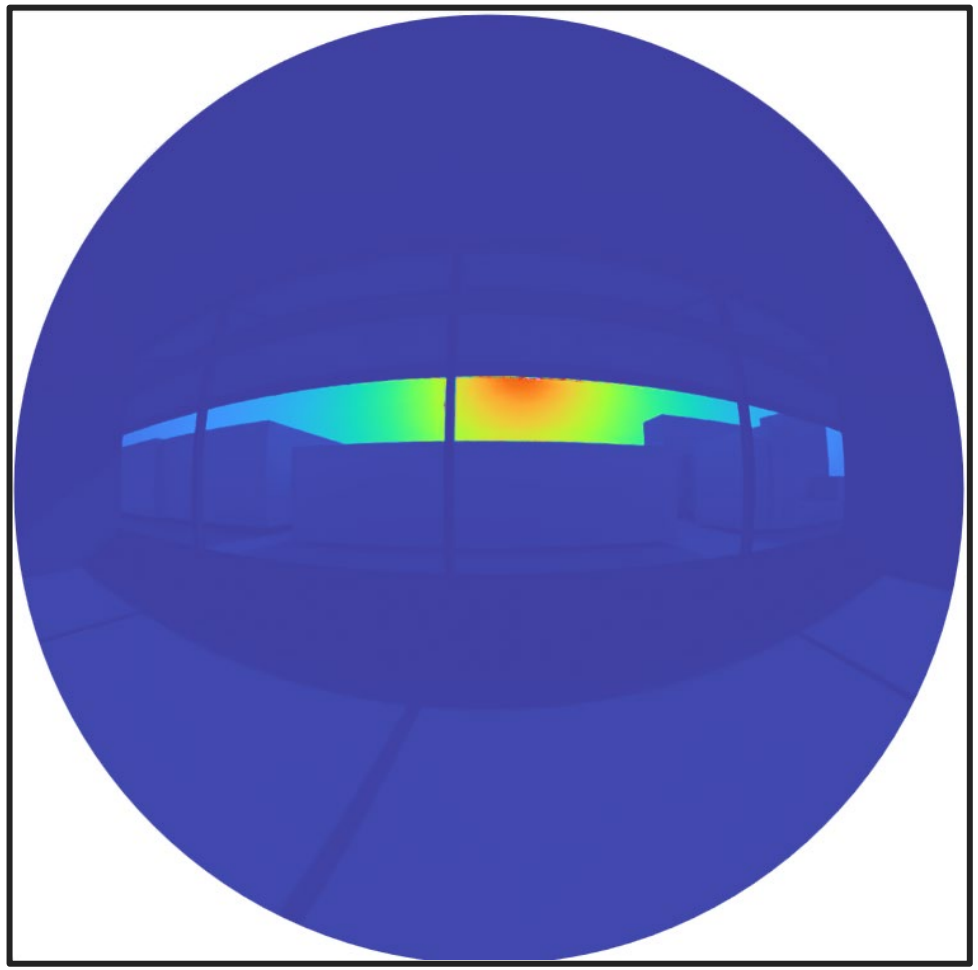
LOWER OPAQUE WALL SECTION ADDED



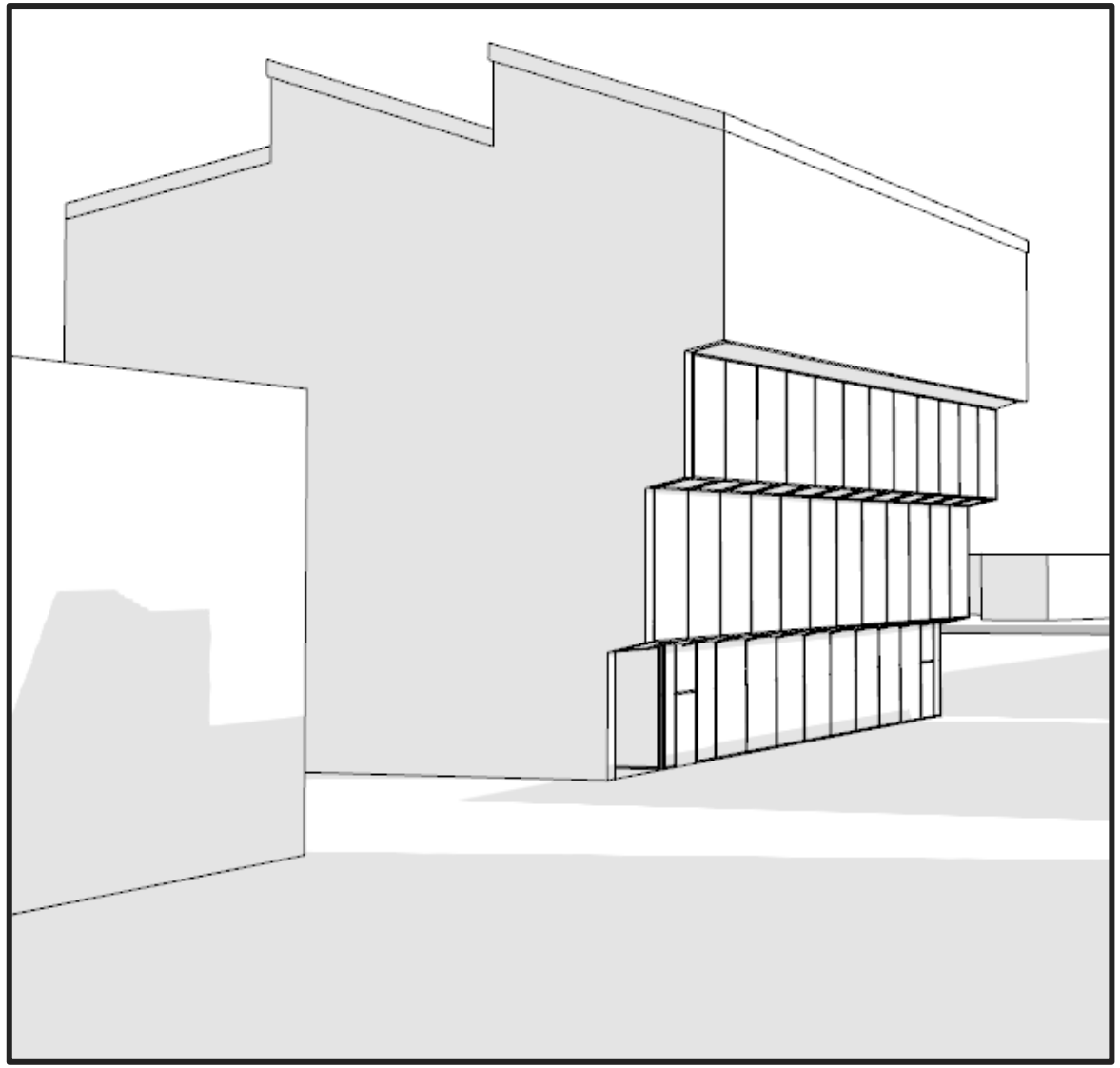
VIEW PLACEMENT



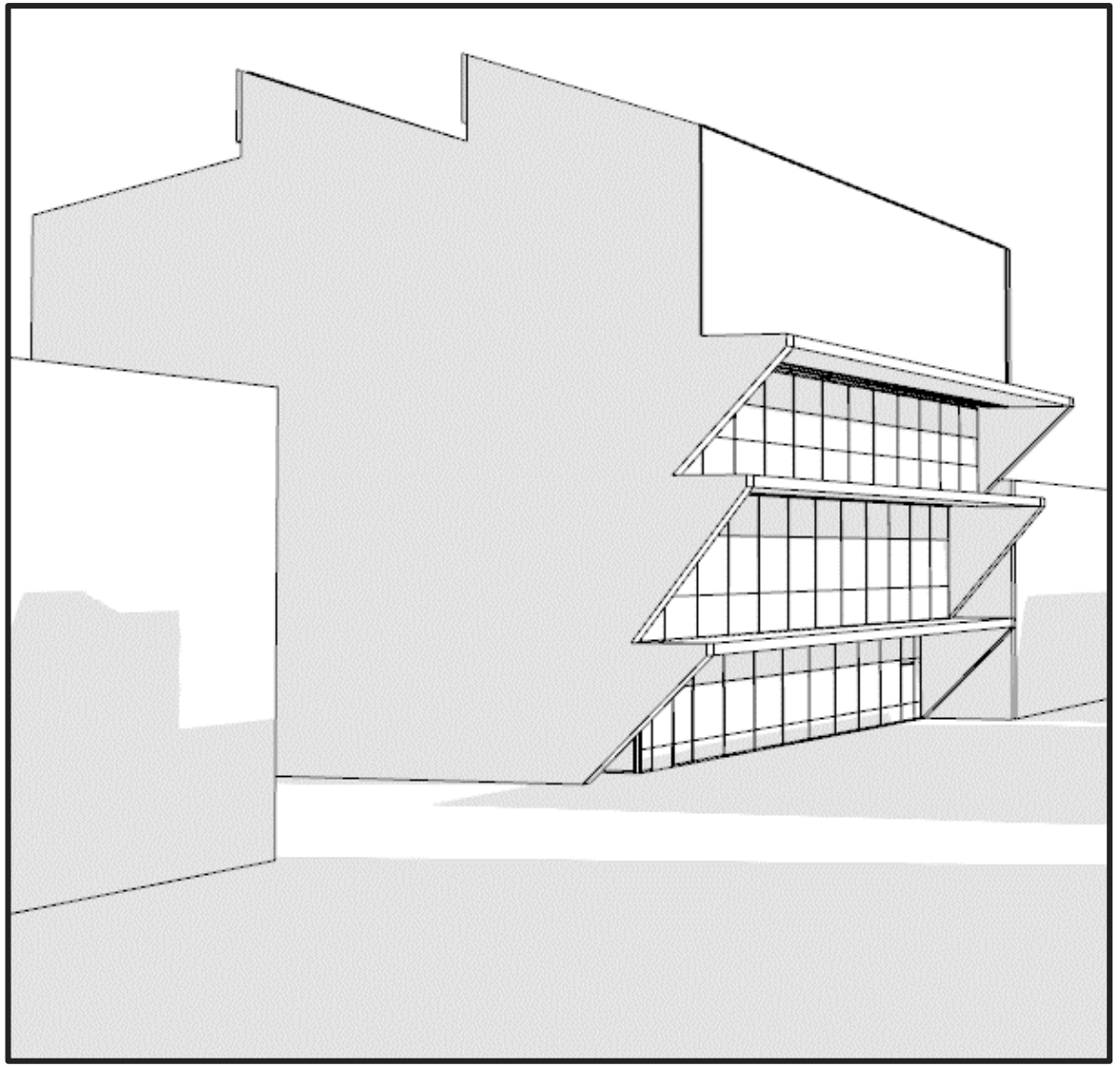
NO BALCONY



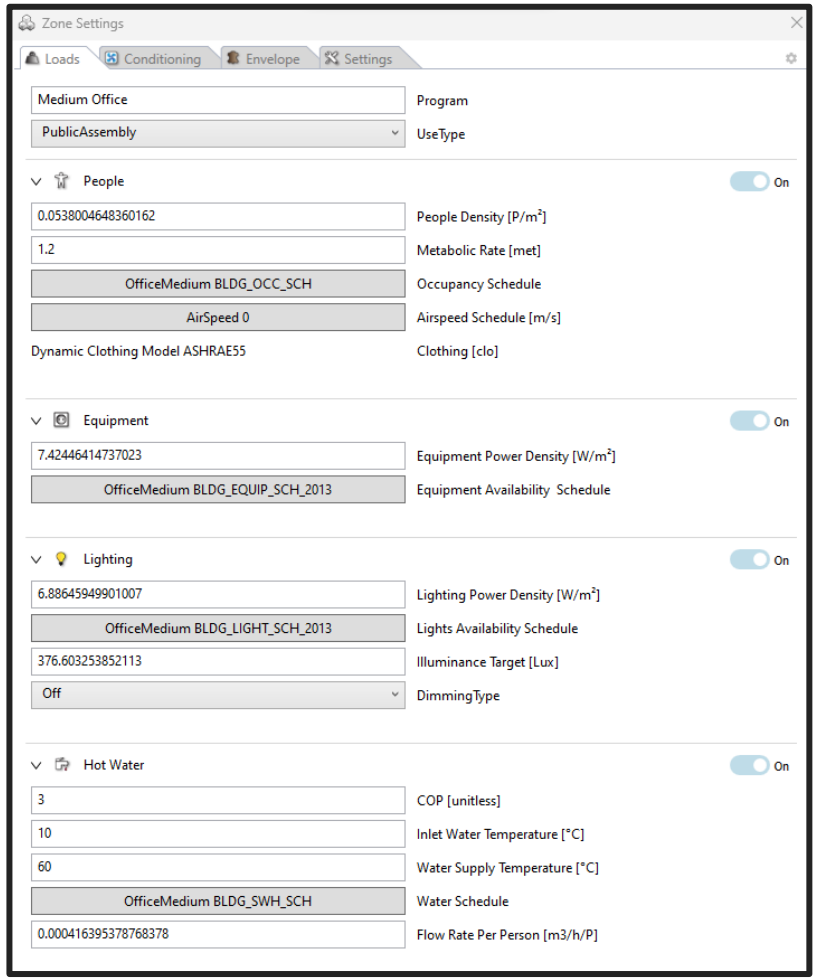
8’ BALCONY



ORIGINAL



ITERATED


Zone Settings
Loads
Conditioning
Envelope
Settings
Medium Office
Program
PublicAssembly
UseType
People
On
0.0538004648360162
People Density [P/m²]
1.2
Metabolic Rate [met]
OfficeMedium BLDG_OCC_SCH
Occupancy Schedule
AirSpeed 0
Airspeed Schedule [m/s]
Dynamic Clothing Model ASHRAE55
Clothing [clo]
Equipment
On
7.4244641473702 3
Equipment Power Density [W/m²]
OfficeMedium BLDG_EQUIP_SCH_2013
Equipment Availability Schedule
Lighting
On
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Lighting Power Density [W/m²]
OfficeMedium BLDG_LIGHT_SCH_2013
Lights Availability Schedule
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Illuminance Target [Lux]
Off
DimmingType
Hot Water
On
3
COP [unitless]
10
Inlet Water Temperature [°C]
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Water Supply Temperature [°C]
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Water Schedule
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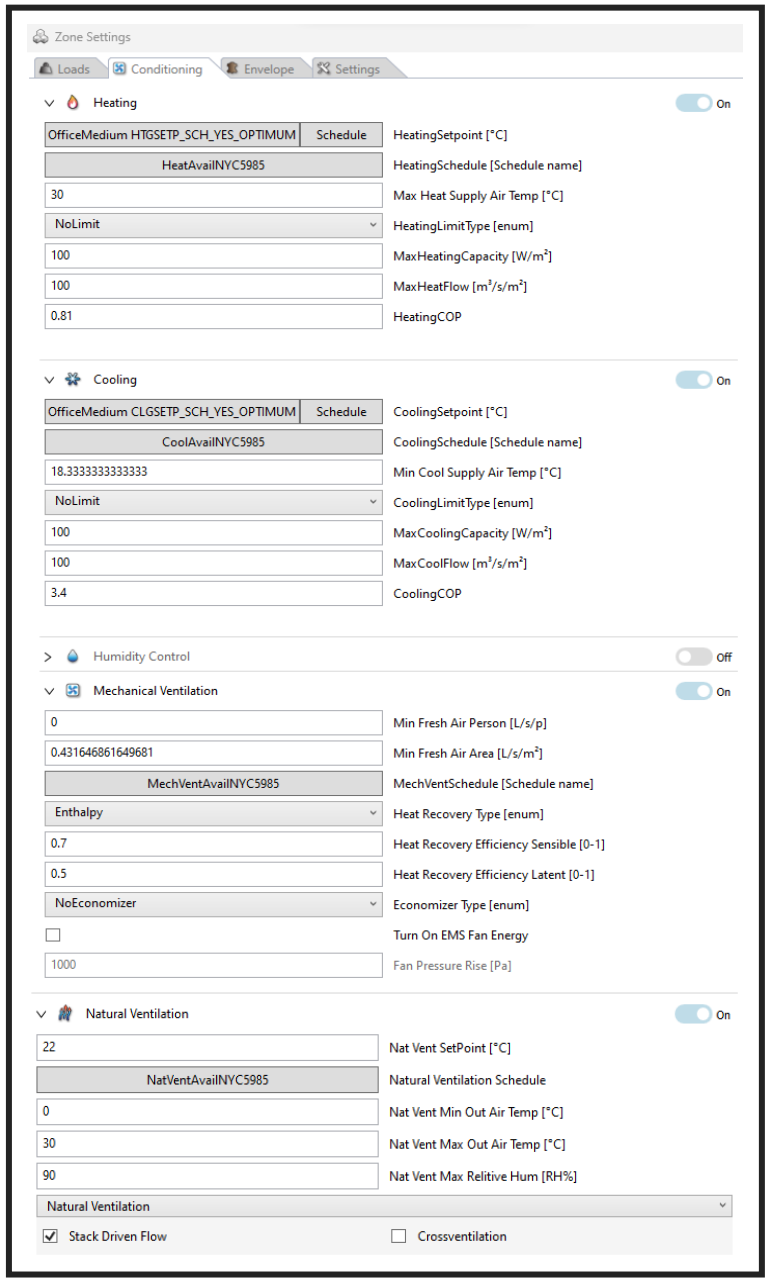
Flow Rate Per Person [m3/h/P]


Zone Settings
Loads
Conditioning
Envelope
Settings
Heating
On
OfficeMedium HTGSETP_SCH_YES_OPTIMUM
Schedule
HeatingSetpoint [°C]
HeatAvailNYC5985
HeatingSchedule [Schedule name]
30
Max Heat Supply Air Temp [°C]
NoLimit
HeatingLimitType [enum]
100
MaxHeatingCapacity [W/m²]
100
MaxHeatFlow [m³/s/m²]
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HeatingCOP
Cooling
On
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CoolingSchedule [Schedule name]
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CoolingLimitType [enum]
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MaxCoolFlow [m³/s/m²]
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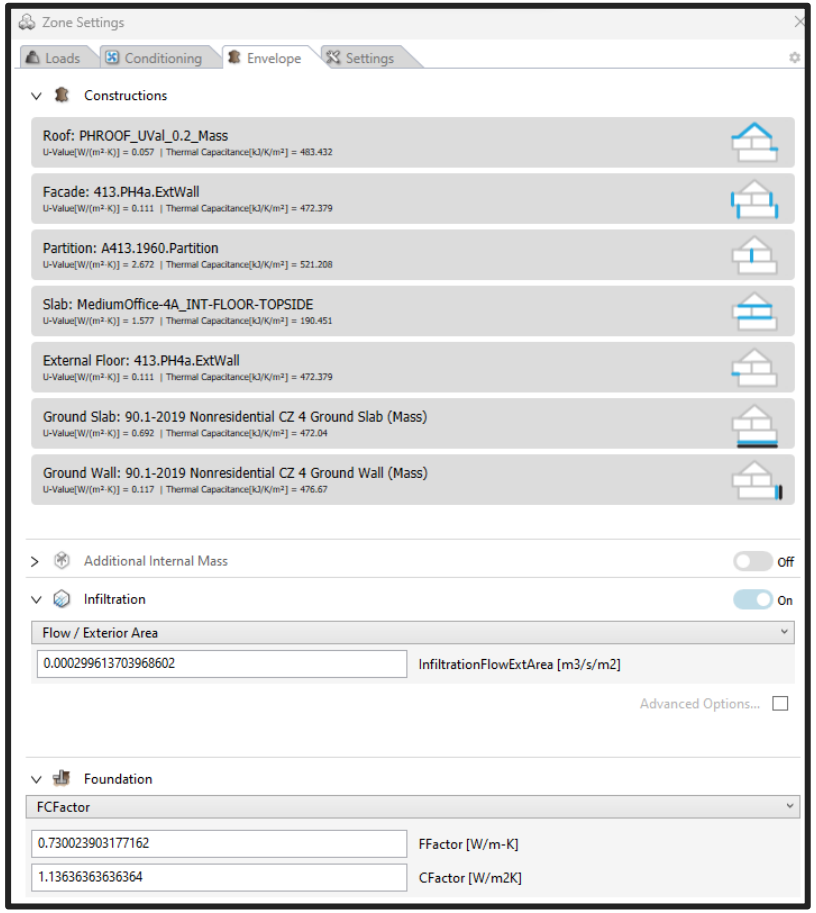
CoolingCOP
Humidity Control
Off
Mechanical Ventilation
On
0
Min Fresh Air Person [L/s/p]
0.431646861649681
Min Fresh Air Area [L/s/m²]
MechVentAvailNYC5985
MechVentSchedule [Schedule name]
Enthalpy
Heat Recovery Type [enum]
0.7
Heat Recovery Efficiency Sensible [0-1]
0.5
Heat Recovery Efficiency Latent [0-1]
NoEconomizer
Economizer Type [enum]
Turn On EMS Fan Energy
1000
Fan Pressure Rise [Pa]
Natural Ventilation
On
22
Nat Vent SetPoint [°C]
NatVentAvailNYC5985
Natural Ventilation Schedule
0
Nat Vent Min Out Air Temp [°C]
30
Nat Vent Max Out Air Temp [°C]
90
Nat Vent Max Relitive Hum [RH%]
Natural Ventilation
Stack Driven Flow
Crossventilation


Zone Settings
Loads
Conditioning
Envelope
Settings
Constructions
Roof: PHROOF_UVal_0.2_Mass
U-Value[W/(m²·K)] = 0.057 | Thermal Capacitance[kJ/K/m²] = 483.432
Facade: 413.PH4a.ExtWall
U-Value[W/(m²·K)] = 0.111 | Thermal Capacitance[kJ/K/m²] = 472.379
Partition: A413.1960.Partition
U-Value[W/(m²·K)] = 2.672 | Thermal Capacitance[kJ/K/m²] = 521.208
Slab: MediumOffice-4A_INT-FLOOR-TOPSIDE
U-Value[W/(m²·K)] = 1.577 | Thermal Capacitance[kJ/K/m²] = 190.451
External Floor: 413.PH4a.ExtWall
U-Value[W/(m²·K)] = 0.111 | Thermal Capacitance[kJ/K/m²] = 472.379
Ground Slab: 90.1-2019 Nonresidential CZ 4 Ground Slab (Mass)
U-Value[W/(m²·K)] = 0.692 | Thermal Capacitance[kJ/K/m²] = 472.04
Ground Wall: 90.1-2019 Nonresidential CZ 4 Ground Wall (Mass)
U-Value[W/(m²·K)] = 0.117 | Thermal Capacitance[kJ/K/m²] = 476.67
Additional Internal Mass
Off
Infiltration
On
Flow / Exterior Area
0.000299613703968602
InfiltrationFlowExtArea [m3/s/m2]
Advanced Options...
Foundation
FCFactor
0.730023903177162
FFactor [W/m-K]
1.13636363636364
CFactor [W/m2K]

1960 ENV .25cfm/sf

90.1 ENVELOPE

NECB GLAZING

90.1 TEMPLATE

DAYLIGHT DESIGN

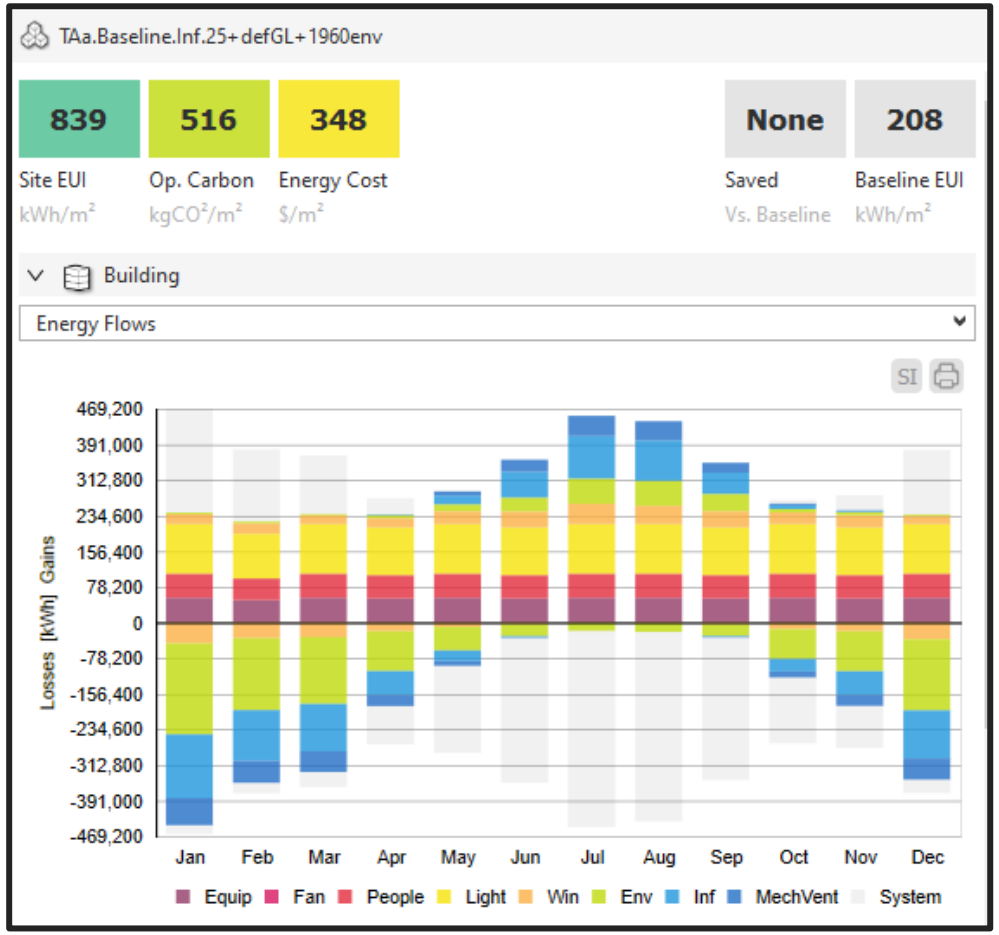
NATURAL VENTILATION

ALL ELECRTRIC/ HWHP/ LPD PH ENVELOPE

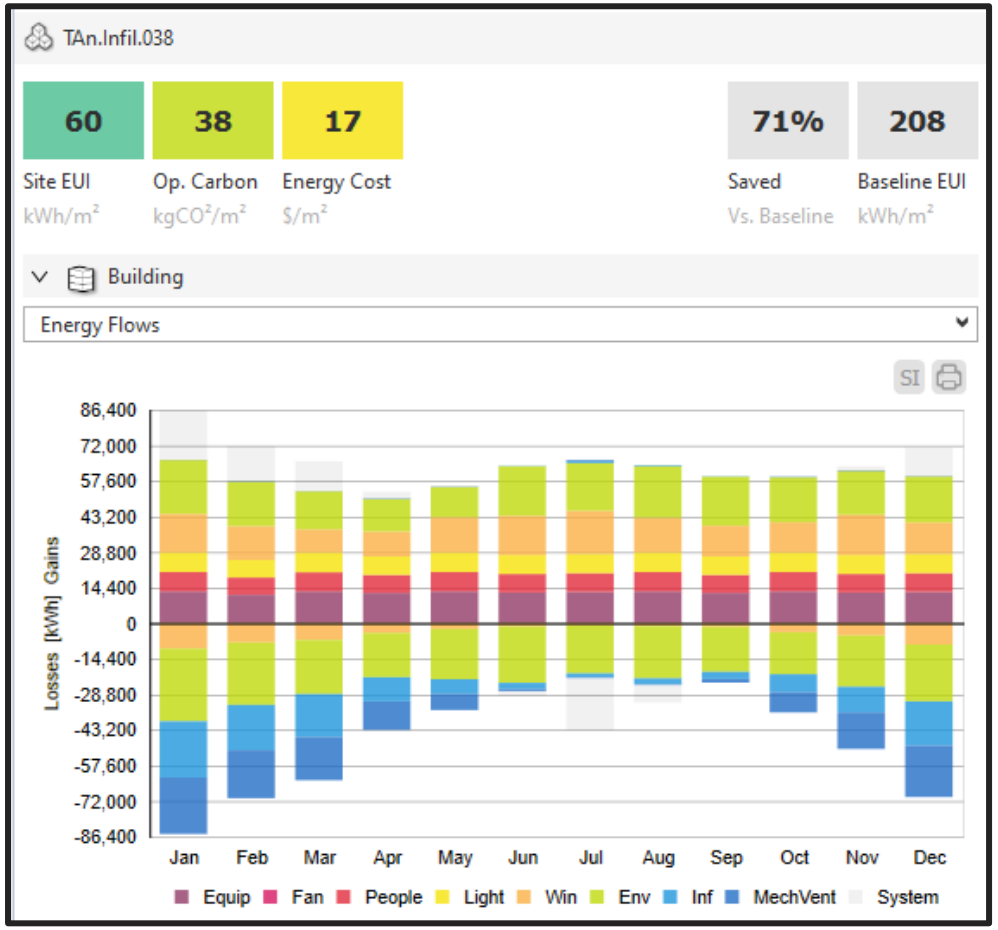
PH SUBSLAB INSUL

HI PERF GLAZING

IDEAL INFILTRATION



1960 ENV .25cfm/sf



IDEAL INFILTRATION

ITERATED SITE EUI IS 7% OF THE BASELINE

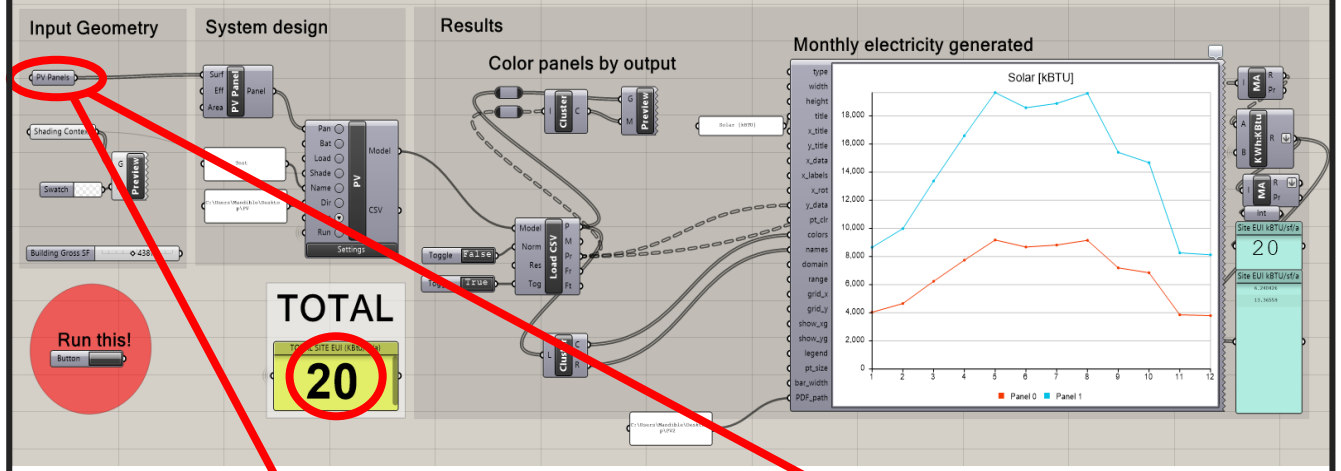
LL97 COMPLIANCE WORKSHEET

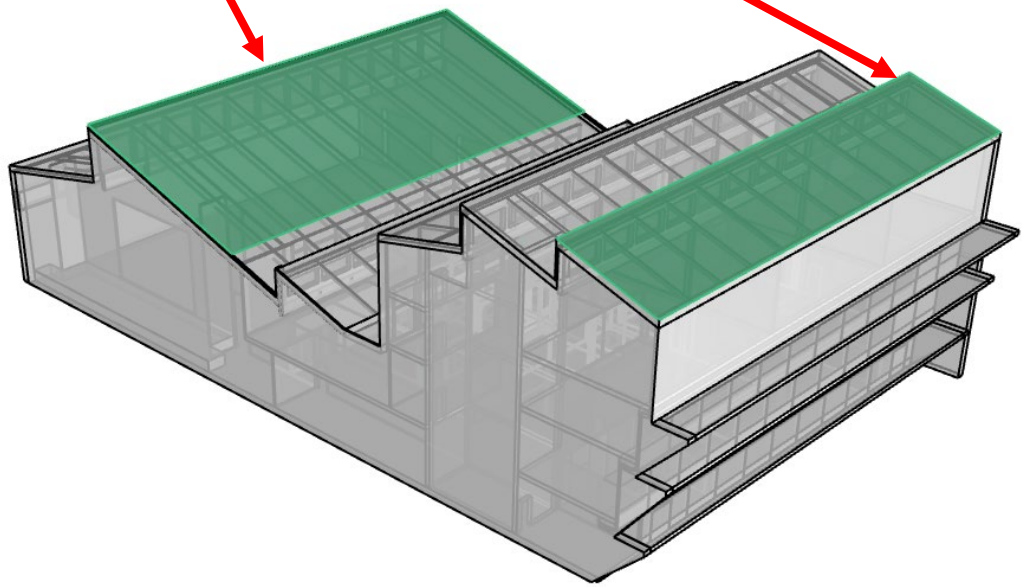
Sim #	Allowed Operation Carbon ($lbCO_2/sf$)					Design			SiteEUI					Operational Carbon Emissions				Compliance				
						Run Description	Build area	LL97	Usage			PV	Total	From Loads		Coeff	Total CO_2					PV needed
	Occup	2024	2029	2035	2050		(sf)	applies	(kWh/m^2)	kWh	(kBTU/sf)	(kBTU/sf)	(kBTU/sf)	(kg/m^2)	(lb/sf)	CO_2/kBTU	(lb/sf)	2024	2029	2035	2050	
TA1	E	16.71	7.58	TBD	3.09	TAa.Baseline.Inf1.8+defGL+1960env	60,000	YES	2028	11,319,070	644		644	1189	243	0.38	243.33	NO	NO	TBD	NO	637
TA2	E	16.71	7.58	TBD	3.09	TAa1.Baseline.Inf.25+defGL+1960env	60,000	YES	872	4,866,977	277		277	534	109	0.39	109.28	NO	NO	TBD	NO	270
TA3	E	16.71	7.58	TBD	3.09	TAb.NYCECC. Env	60,000	YES	746	4,163,721	237		237	466	95	0.40	95.37	NO	NO	TBD	NO	230
TA4	E	16.71	7.58	TBD	3.09	TAc.Gl .92.33.84	60,000	YES	722	4,029,767	229		229	454	93	0.41	92.91	NO	NO	TBD	NO	222
TA5	E	16.71	7.58	TBD	3.09	TAd.NECB.90.1	60,000	YES	124	692,093	39		39	75	15	0.39	15.35	YES	NO	TBD	NO	32
TA6	E	16.71	7.58	TBD	3.09	TAe.Kalwall in gym	60,000	YES	133	742,326	42		42	80	16	0.39	16.37	YES	NO	TBD	NO	35
TA7	E	16.71	7.58	TBD	3.09	TAf.DL shading	60,000	YES	133	742,326	42		42	80	16	0.39	16.37	YES	NO	TBD	NO	35
TA8	E	16.71	7.58	TBD	3.09	TAg.Opt. Natural ventilation	60,000	YES	119	664,186	38		38	71	15	0.38	14.53	YES	NO	TBD	NO	31
TA9	E	16.71	7.58	TBD	3.09	TAh.Opt. Various	60,000	YES	94	524,651	30		30	57	12	0.39	11.67	YES	NO	TBD	NO	23
TA10	E	16.71	7.58	TBD	3.09	TAi.Opt. PHsubslabinsul	60,000	YES	94	524,651	30		30	57	12	0.39	11.67	YES	NO	TBD	NO	23
TA11	E	16.71	7.58	TBD	3.09	TAj.Opt. Gl Vt.51.SHGC.22	60,000	YES	87	485,581	28		28	53	11	0.39	10.85	YES	NO	TBD	NO	21
TA12	E	16.71	7.58	TBD	3.09	TAk.Opt. Hi SHGC S	60,000	YES	79	440,930	25		25	49	10	0.40	10.03	YES	NO	TBD	NO	18
TA13	E	16.71	7.58	TBD	3.09	TAl.Opt. Infiltration	60,000	YES	70	390,698	22	15	7	43	9	0.40	2.86	YES	YES	TBD	YES	15

LL97 COMPLIANCE WORKSHEET

Sim #	Allowed Operation Carbon ($lbCO_2/sf$)					Design			SiteEUI					Operational Carbon Emissions				Compliance				
						Run Description	Build area	LL97	Usage			PV	Total	From Loads		Coeff	Total CO_2					
	Occup	2024	2029	2035	2050		(sf)	applies	(kWh/m^2)	kWh	(kBTU/sf)	(kBTU/sf)	(kBTU/sf)	(kg/m^2)	(lb/sf)	CO_2/kBTU	(lb/sf)	2024	2029	2035	2050	PV needed
TA1	E	16.71	7.58	TBD	3.09	TAa.Baseline.Inf1.8+defGL+1960env	60,000	YES	2028	11,319,070	644		644	1189	243	0.38	243.33	NO	NO	TBD	NO	637
TA2	E	16.71	7.58	TBD	3.09	TAa1.Baseline.Inf.25+defGL+1960env	60,000	YES	872	4,866,977	277		277	534	109	0.39	109.28	NO	NO	TBD	NO	270
TA3	E	16.71	7.58	TBD	3.09	TAb.NYCECC. Env	60,000	YES	746	4,163,721	237		237	466	95	0.40	95.37	NO	NO	TBD	NO	230
TA4	E	16.71	7.58	TBD	3.09	TAc.Gl .92.33.84	60,000	YES	722	4,029,767	229		229	454	93	0.41	92.91	NO	NO	TBD	NO	222
TA5	E	16.71	7.58	TBD	3.09	TAd.NECB.90.1	60,000	YES	124	692,093	39		39	75	15	0.39	15.35	YES	NO	TBD	NO	32
TA6	E	16.71	7.58	TBD	3.09	TAe.Kalwall in gym	60,000	YES	133	742,326	42		42	80	16	0.39	16.37	YES	NO	TBD	NO	35
TA7	E	16.71	7.58	TBD	3.09	TAf.DL shading	60,000	YES	133	742,326	42		42	80	16	0.39	16.37	YES	NO	TBD	NO	35
TA8	E	16.71	7.58	TBD	3.09	TAg.Opt. Natural ventilation	60,000	YES	119	664,186	38		38	71	15	0.38	14.53	YES	NO	TBD	NO	31
TA9	E	16.71	7.58	TBD	3.09	TAh.Opt. Various	60,000	YES	94	524,651	30		30	57	12	0.39	11.67	YES	NO	TBD	NO	23
TA10	E	16.71	7.58	TBD	3.09	TAi.Opt. PHsubslabinsul	60,000	YES	94	524,651	30		30	57	12	0.39	11.67	YES	NO	TBD	NO	23
TA11	E	16.71	7.58	TBD	3.09	TAj.Opt. Gl Vt.51.SHGC.22	60,000	YES	87	485,581	28		28	53	11	0.39	10.85	YES	NO	TBD	NO	21
TA12	E	16.71	7.58	TBD	3.09	TAk.Opt. Hi SHGC S	60,000	YES	79	440,930	25		25	49	10	0.40	10.03	YES	NO	TBD	NO	18
TA13	E	16.71	7.58	TBD	3.09	TAl.Opt. Infiltration	60,000	YES	70	390,698	22	15	7	43	9	0.40	2.86	YES	YES	TBD	YES	15

SITE ENERGY PRODUCTION
Photovoltaics (PV)



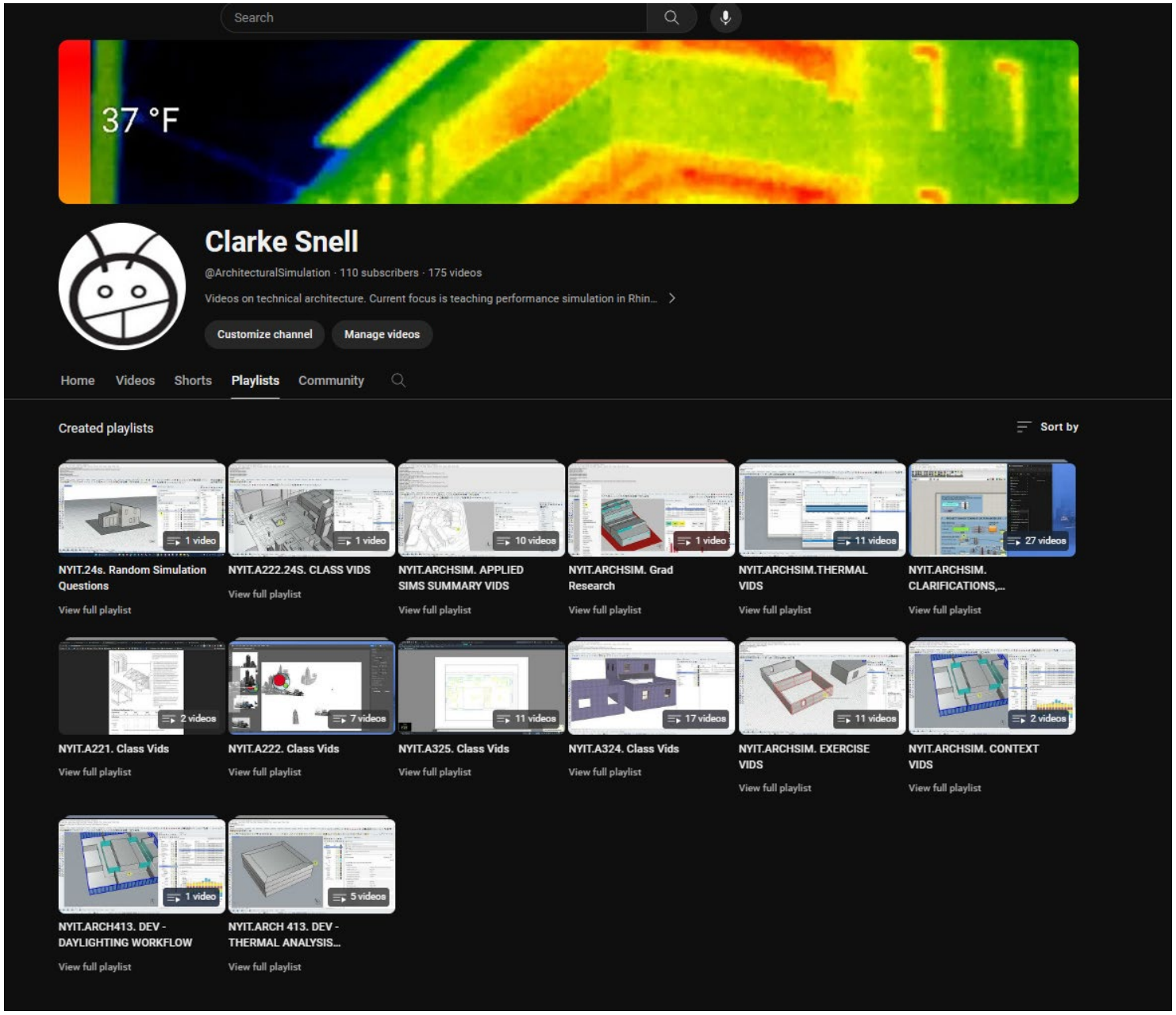


SiteEUI			Operational Carbon Emissions				Compliance				
	PV	Total	From Loads		Coeff	Total CO_2					
(kBTU/sf)	(kBTU/sf)	(kBTU/sf)	(kg/m^2)	(lb/sf)	CO_2/kBTU	(lb/sf)	2024	2029	2035	2050	PV needed
644		644	1189	243	0.38	243.33	NO	NO	TBD	NO	637
277		277	534	109	0.39	109.28	NO	NO	TBD	NO	270
237		237	466	95	0.40	95.37	NO	NO	TBD	NO	230
229		229	454	93	0.41	92.91	NO	NO	TBD	NO	222
39		39	75	15	0.39	15.35	YES	NO	TBD	NO	32
42		42	80	16	0.39	16.37	YES	NO	TBD	NO	35
42		42	80	16	0.39	16.37	YES	NO	TBD	NO	35
38		38	71	15	0.38	14.53	YES	NO	TBD	NO	31
30		30	57	12	0.39	11.67	YES	NO	TBD	NO	23
30		30	57	12	0.39	11.67	YES	NO	TBD	NO	23
28		28	53	11	0.39	10.85	YES	NO	TBD	NO	21
25		25	49	10	0.40	10.03	YES	NO	TBD	NO	18
22	15	7	43	9	0.40	2.86	YES	YES	TBD	YES	15

CONCLUSIONS AND NEXT STEPS

Successful prototype.

Plan to expand.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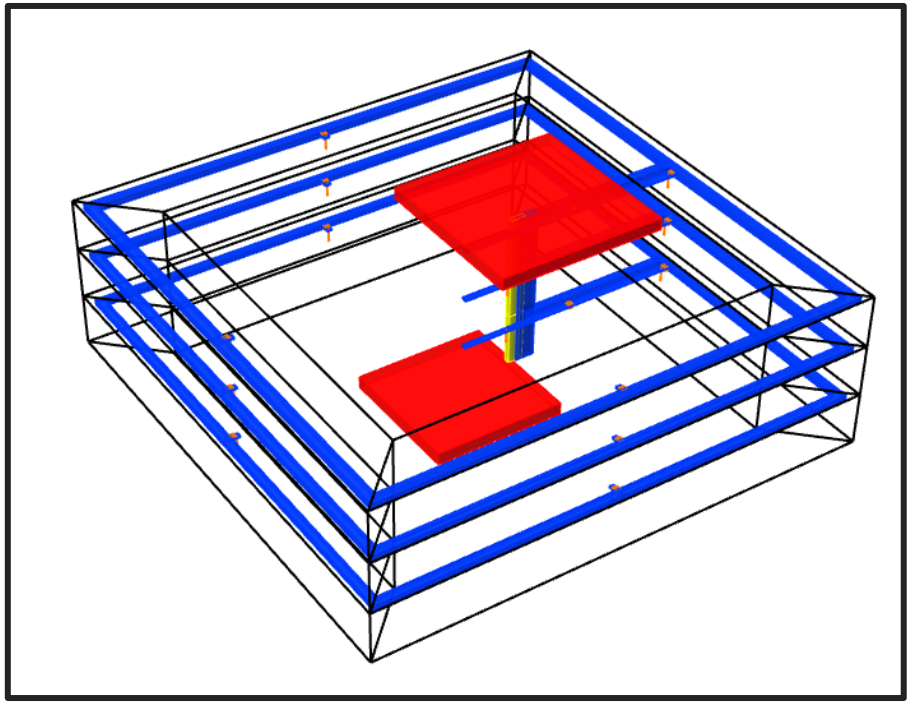

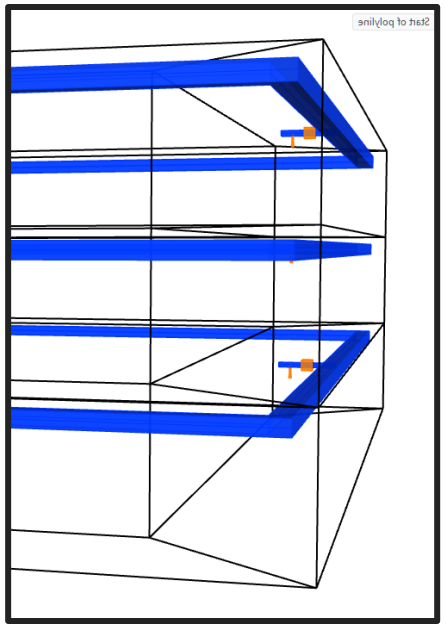

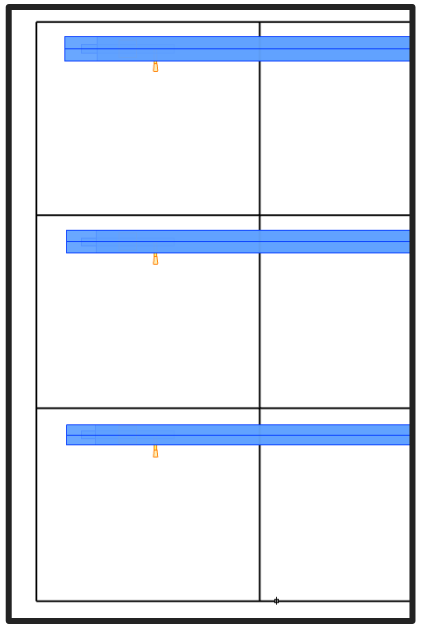

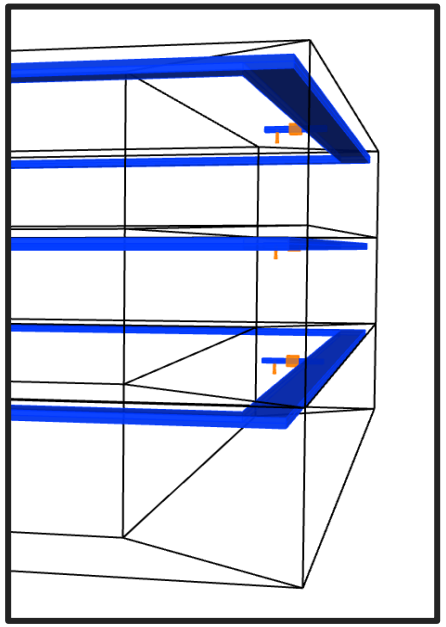

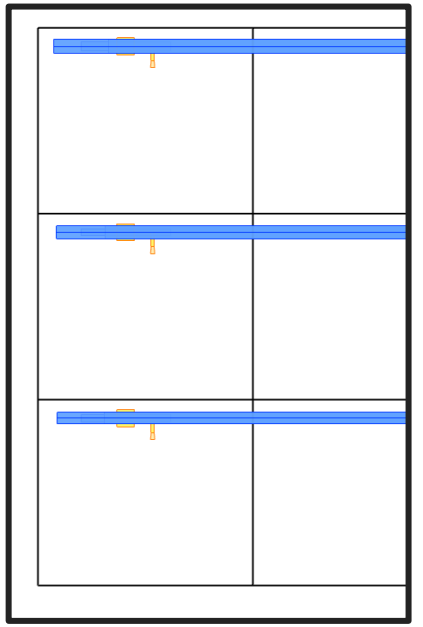

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