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EMEA 2024

Europe, the Middle East & Africa

FRIDAY - SATURDAY

NOVEMBER 22-23, 2024

@ 9:00-18:00

SESSIONS:

- SUSTAINABILITY
- HEALTH & SAFETY
- DECARBONIZATION
- TECHNICAL SOLUTIONS
- DIGITAL ENVIRONMENT
- POLICIES & LEGISLATION
- ENERGY EFFICIENCY FIRST
- RESILIENCE TO CLIMATE CRISIS

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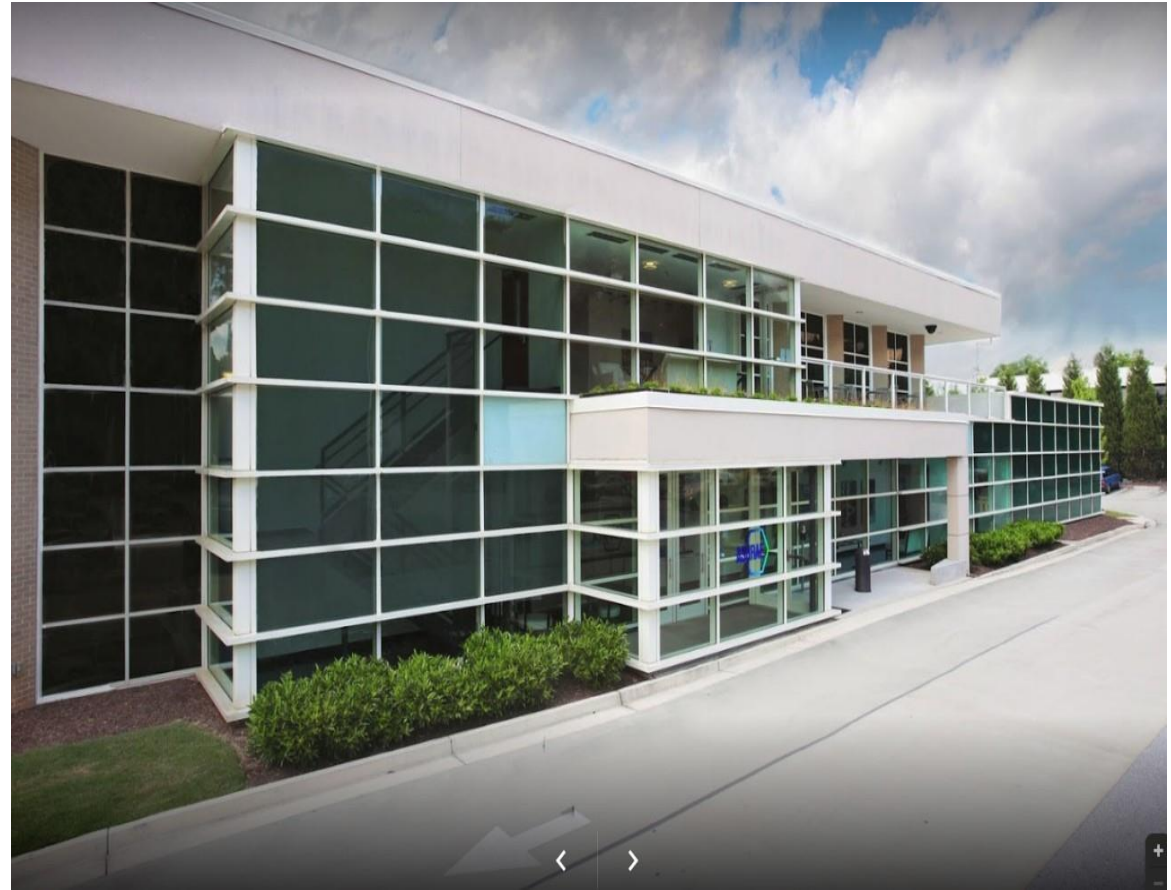
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**Achieving Net Zero Operation in an Existing Building
Retrofit – The ASHRAE Headquarters Experience**

Legacy ASHRAE Headquarters

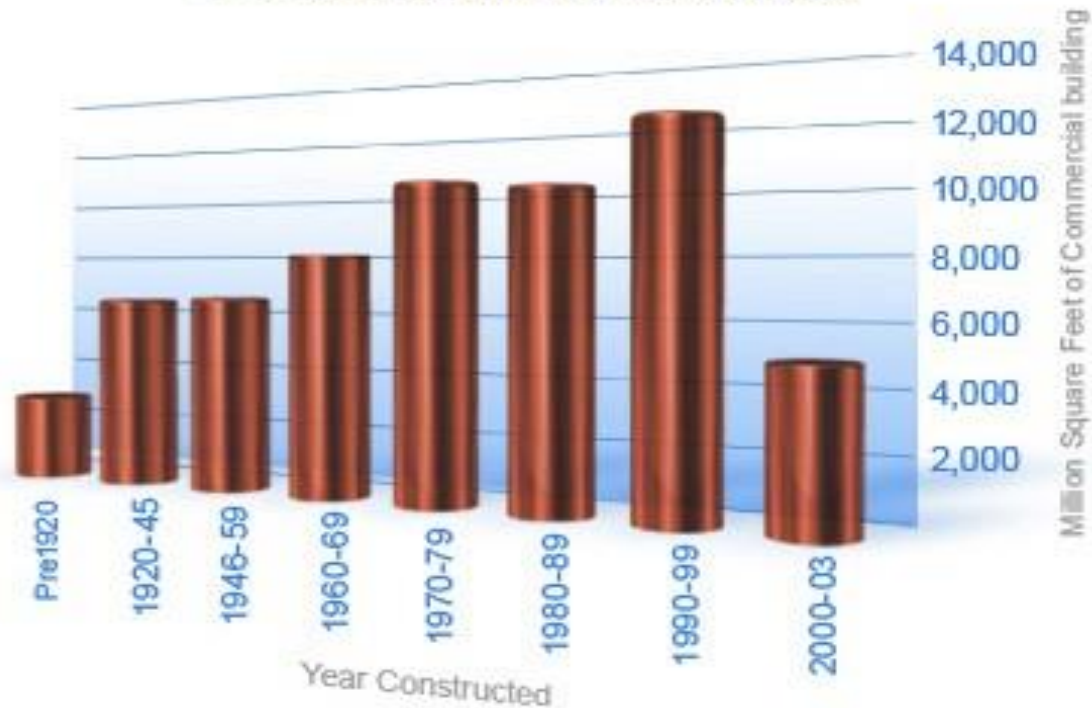


- *1791 Tullie Circle NE, Atlanta, GA*
- *35,000 sq. ft. building – 2 stories with learning center on 1st level*
- *Renovated in 2008 to LEED Platinum level*



Project Goal

U.S. Commercial Building Space by Age



Institute for Building Efficiency
Source: EIA CBECS 2003

In developed economies, at least half of the buildings that will be in use in 2050 have *already been built*.^{4,5} According to a recent survey by the U.S. [Energy Information Agency](#), 72 percent of floorstock in the U.S., or 46 billion square feet, belongs to buildings over twenty years old.⁶

Project Goal:

To renovate a 1970's building into a high-performing net-zero-ready facility in a cost-effective method that can be replicated in the industry.

What is our Story?

“Our organization relies on harvesting the technical knowledge, volunteer energy, and expertise of our members. We want this space to inspire visitors to participate and honor them for their volunteer service and commitment.”

– Jeff Littleton, Executive VP for ASHRAE



New ASHRAE Headquarters



- *180 Technology Parkway, Peachtree Corners, GA*
- *66,000 sq. ft. building – 3 stories*
- *Built in 1970's*
- *Purchased by ASHRAE in December 2018*



Owner's Project Requirements

- Owner's Project Requirements (OPR) document establishes owner goals:
- Mission Critical Items:
 - **SAFETY** – Safe and healthy work environment
 - **AFFORDABLE** – Constructed within the available funding
 - **ASHRAE STANDARDS** – Meet or exceed applicable ASHRAE Standards
 - **ACCOUSTICS** – Exceed Acoustical levels for Office Environments
 - **NET ZERO ENERGY READY** – Requires low EUI levels

Draft Owner's Project Requirements

ASHRAE HEADQUARTERS
Atlanta, GA

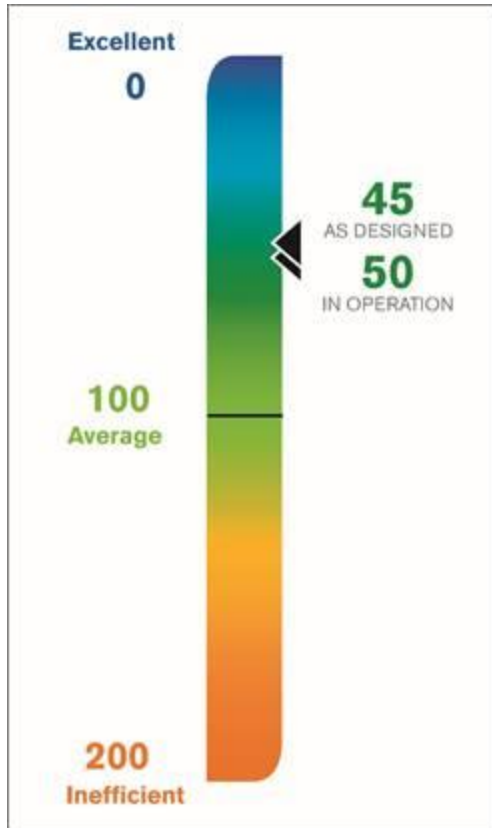
Date: January 3, 2019
Approved By: _____



Owner's Project Requirements (OPR)

Item	OPR
ASHRAE 189.1-2017	Exceed Requirements
Demand Side Site Energy Consumption	21.4 kBTU/SF/year 15 kBTU/SF/year (stretch)
Water Efficiency	Obtain 11 of 11 LEED Water Use Efficiency Points
Daytime Plug Load	0.04 W/SF
Acoustics	Exceed office requirements by 3-5 NC/RNC
Outside Air Rate	1.3 times ASHRAE 62.1
Outside Air Control	Demand Control Ventilation (DCV) for high occupancy spaces
Daylighting	Majority of Occupants achieve generous daylighting 55% of the time
Resiliency	Achieve resiliency in OPR

OWNER PROJECT REQUIREMENTS



Certification Programs Considered

- LEED
- Green Globes
- WELL Building
- FitWel
- Living Building Challenge
- **ASHRAE Building EQ**

Draft Owner's Project Requirements

ASHRAE HEADQUARTERS
Atlanta, GA

Date: January 3, 2019
Approved By: _____



How Do We Achieve Our Project Goals?

1. Set Construction Budget
2. Set Project Schedule: Move out October 2020
3. Set Project Criteria: OPR
4. Hire the right team!



Request for Proposal for Planning and Design
Services

ASHRAE
New Headquarters Building
Peachtree Corners, GA

January 4, 2019

TABLE OF CONTENTS

1. Introduction and Project Description
2. Proposal Requirements
3. Instructions



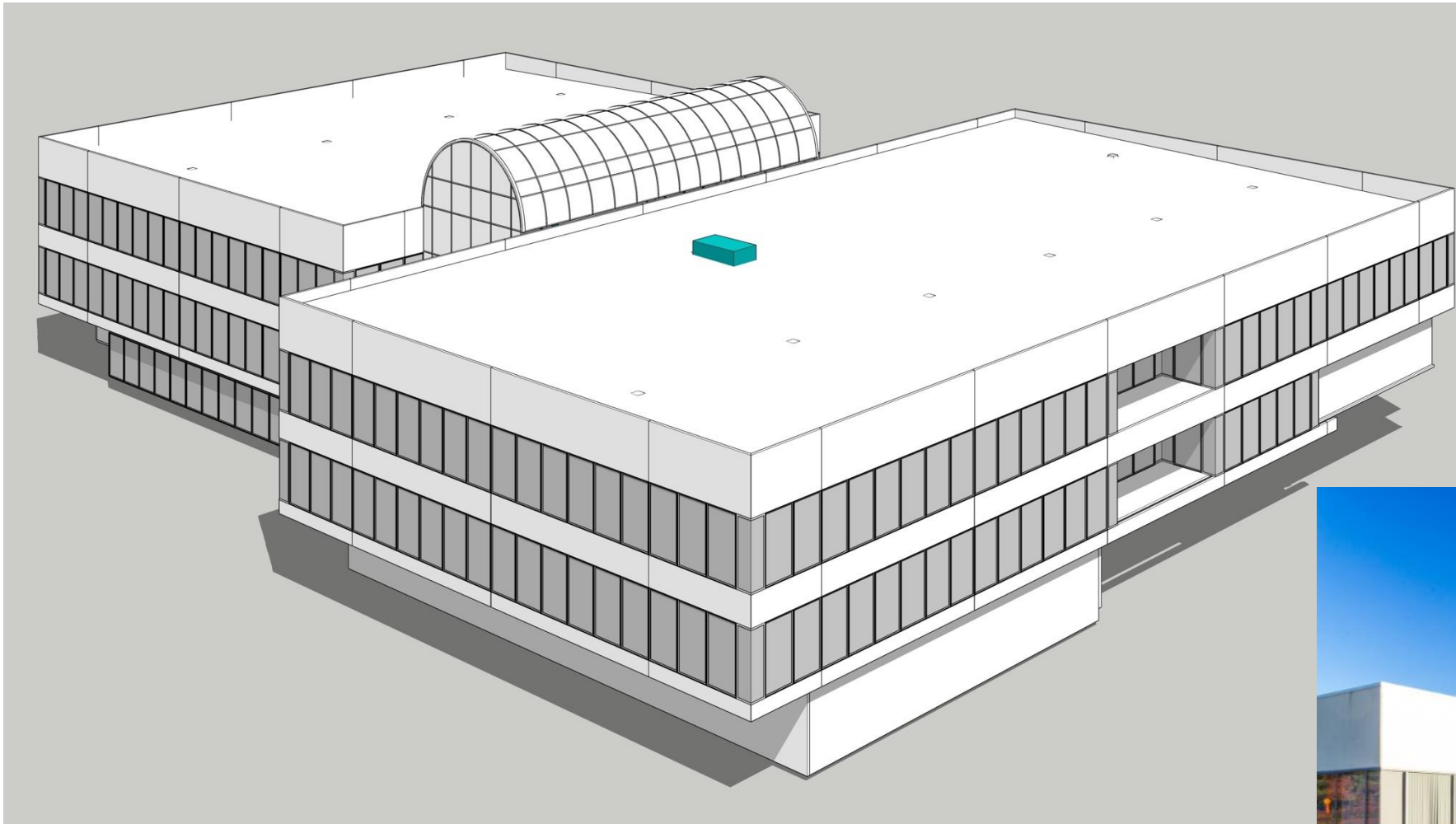
Project Execution Method

- *Decision #1:* Utilize a Project Manager
 - ASHRAE does not have Project Managers on staff
 - Needed to have day to day management of design team and contractor team
 - Ad Hoc developed an RFQ for a Project Manager
- *Decision #2:* Utilize Construction Manager at Risk
 - Wanted early contractor involvement
 - Atlanta market not familiar with Integrated Project Delivery
- *Decision #3:* Hire Project Team
 - Project Manager helped manage RFP's and select Design, Commissioning and Construction Manager

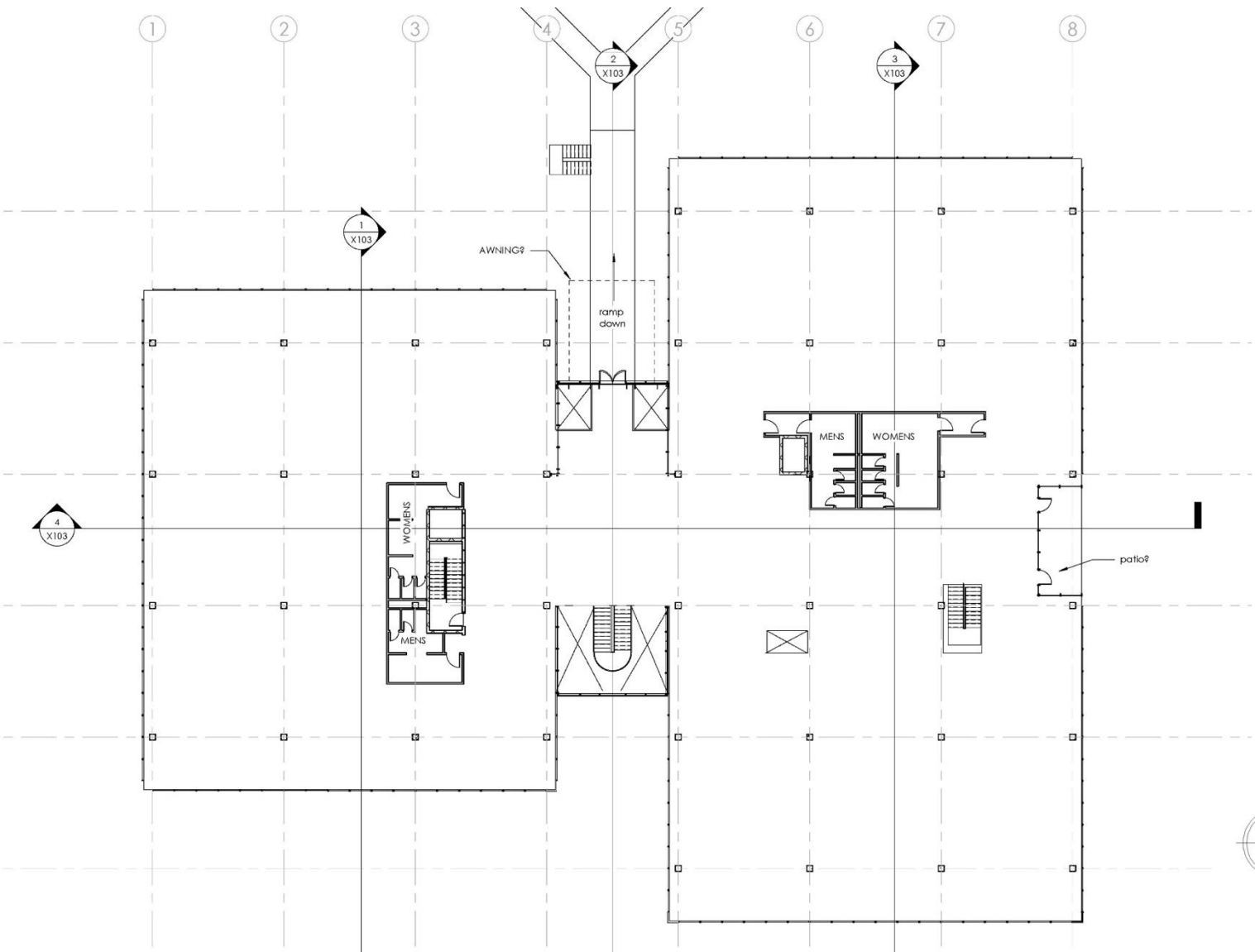




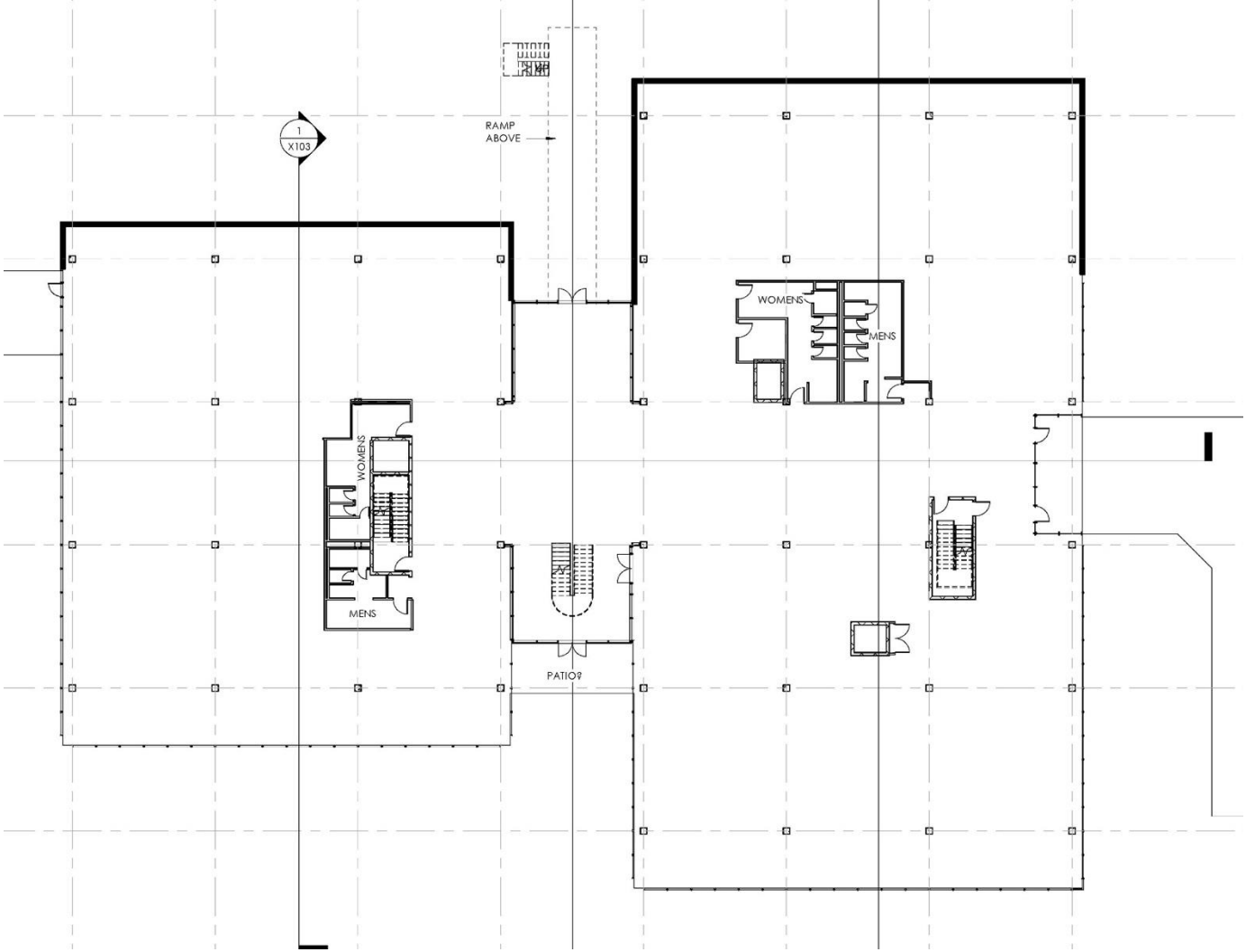
Existing Structure



Existing Upper Level Floor Plan



Existing Middle Level Floor Plan



Primary Envelope Factors

Window to Wall Ratios (WWR)

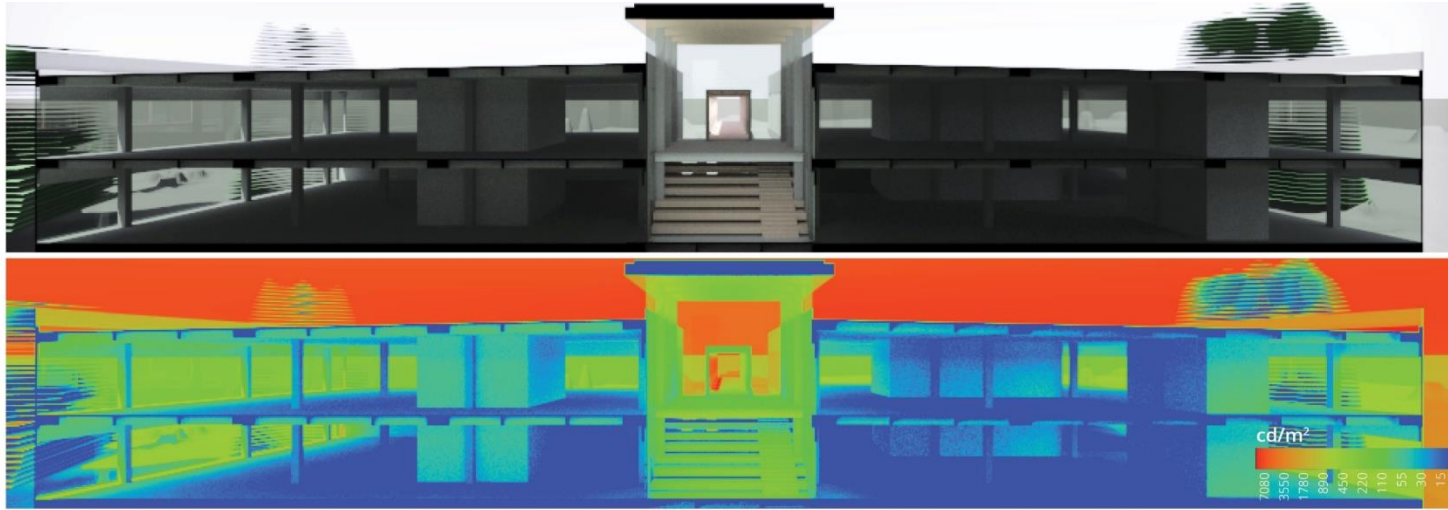
- Important to define the optimum area of openings relative to achieving daylight autonomy goals, as well as maximize the thermal efficiency of the wall.

Air Infiltration and Insulation

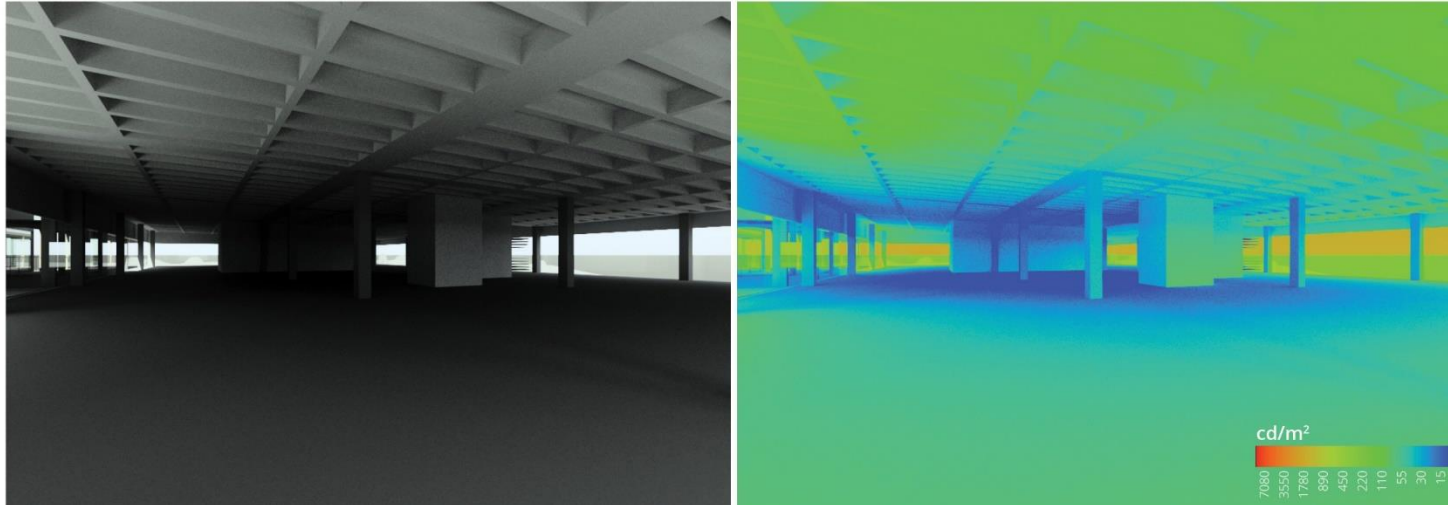
- Where was the optimal R-Value for each part of the exterior envelope and how were we containing air infiltration.

Daylight Patterns - Existing

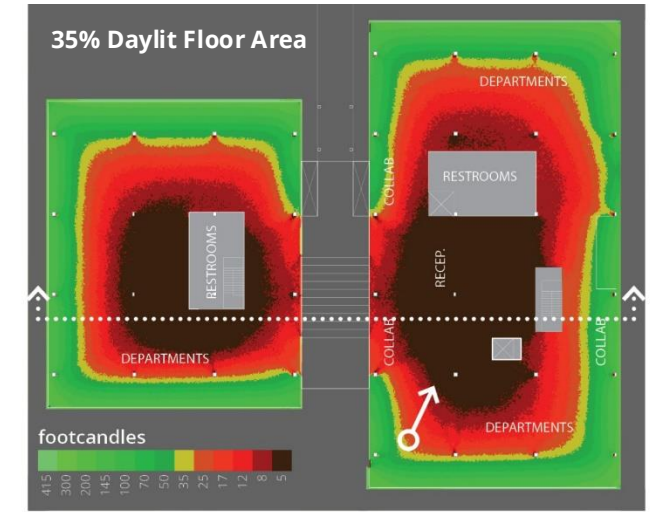
Section View and Falsecolor Luminance Map, Equinox at 12pm, Clear Sky with Sun



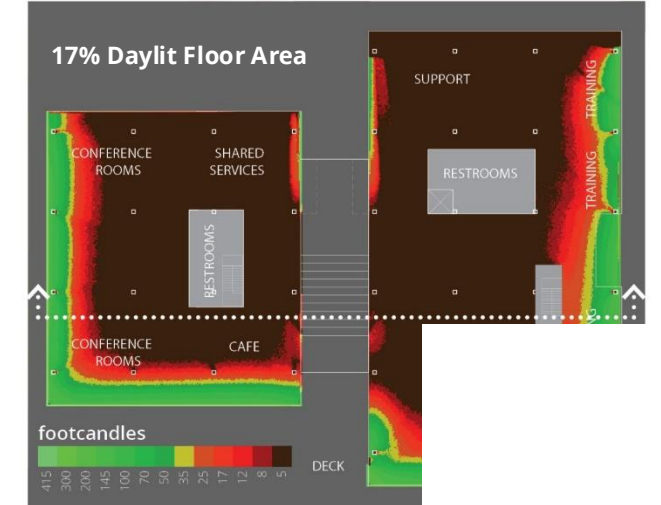
Perspective View and Falsecolor Luminance Map, Equinox at 12pm, Clear Sky with Sun



Daylight Illuminance, Uniform Overcast Sky - Top Floor

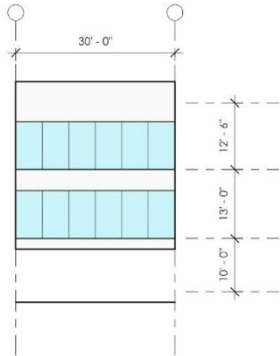


Daylight Illuminance, Uniform Overcast Sky - Mid Floor



Final Window Wall Ratios

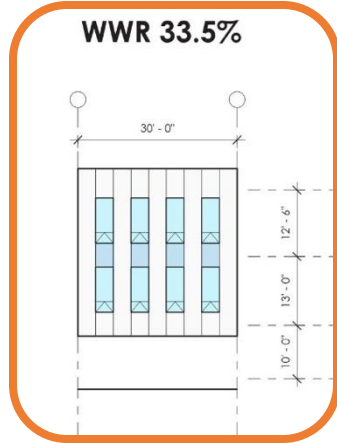
EXISTING
WWR 79.9%



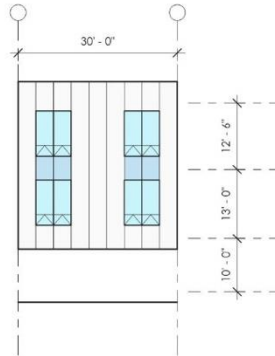
Optimo Panel Widths: 24, 30, 36, 40
Karrier Panel Widths: 24, 30, 36, 40, 42

East and West

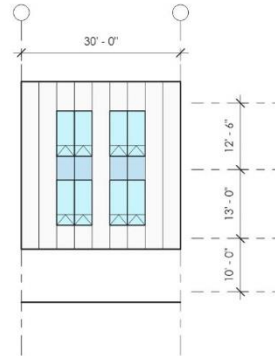
WWR 33.5%



WWR 33.5%

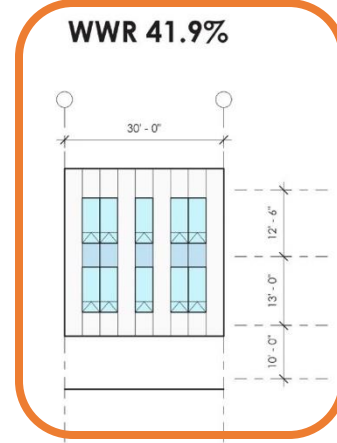


WWR 33.5%

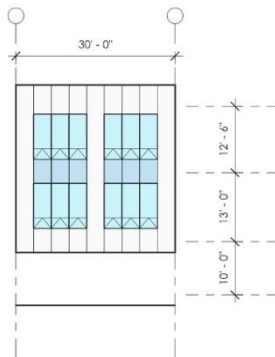


North and South

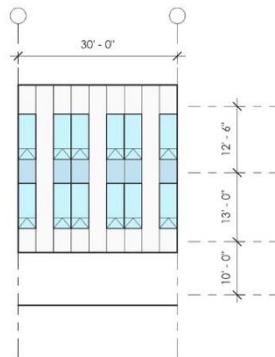
WWR 41.9%



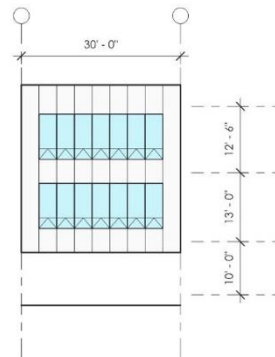
WWR 50.3%



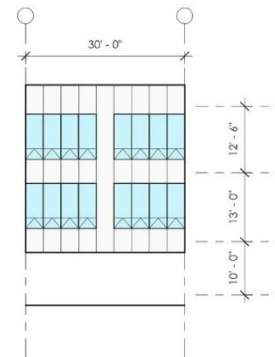
WWR 50.3%



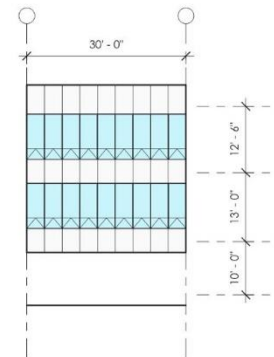
WWR 58.7%



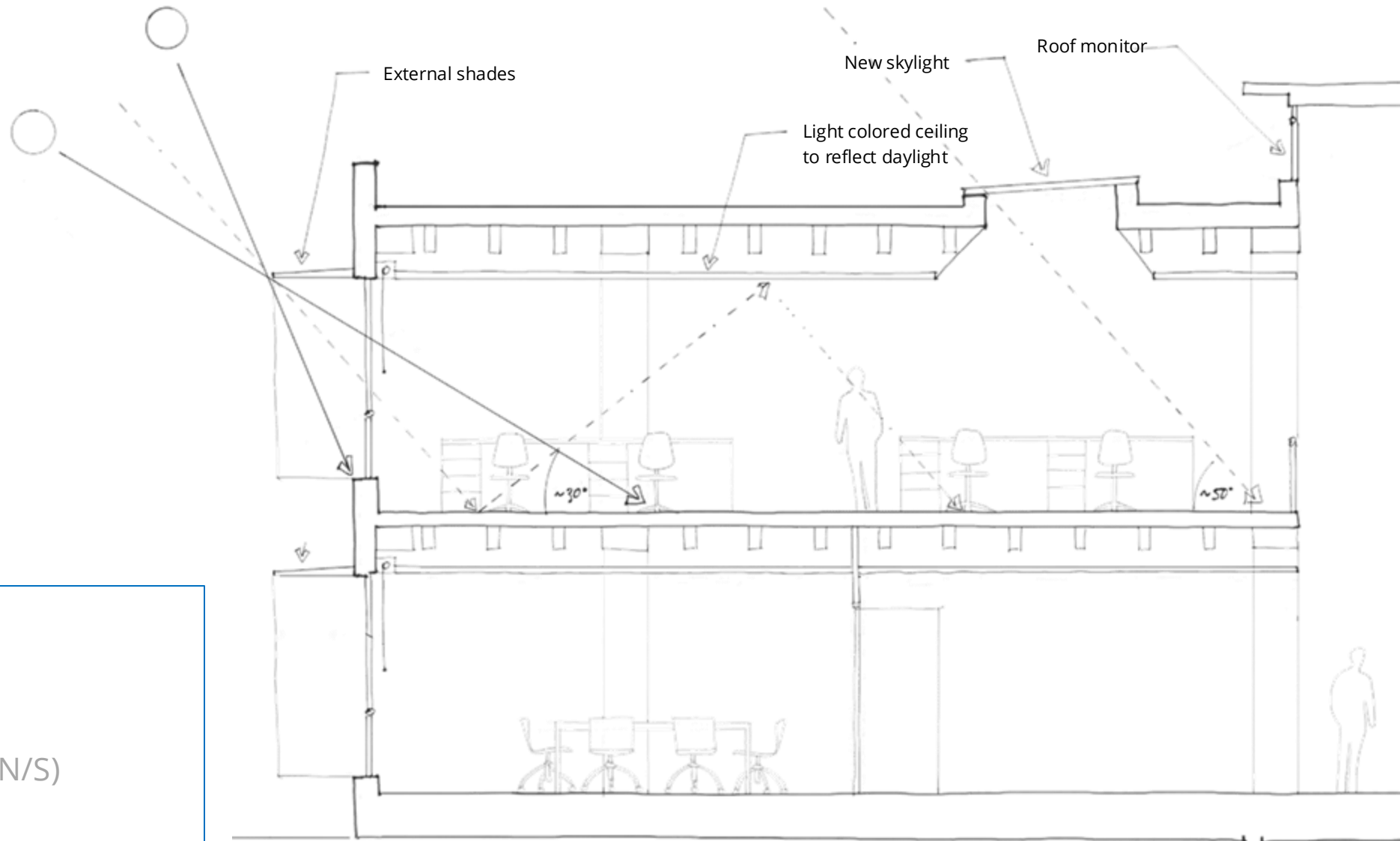
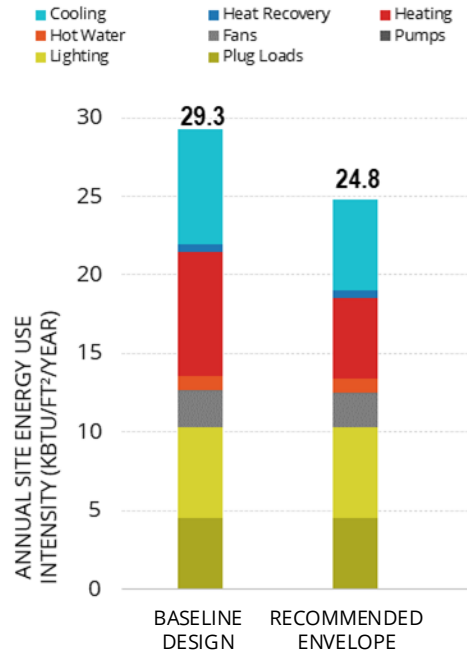
WWR 67.1%



WWR 75.4%



High Performance Envelope



Recommended Envelope

R17 Walls | R35 Roof

U-0.4 | SHGC-0.25

~32% WWR (30% E/W, 40% N/S)

Minimum 1' overhangs

Infiltration < 0.1 cfm/sf façade @ 75 pa

Daylight Strategies

Skylights

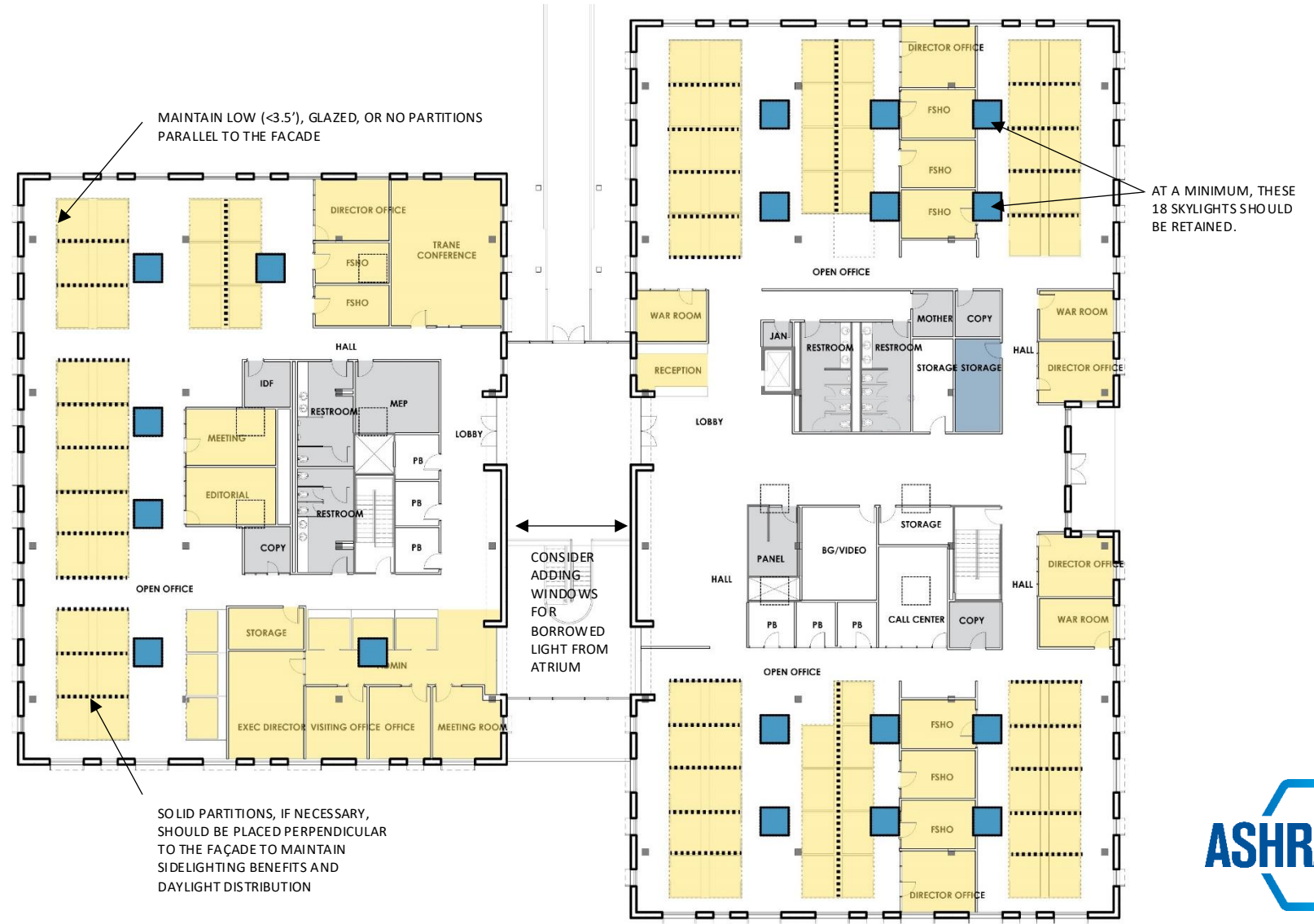
- Doubles the daylit floor area on the upper floor
- Provides useful daylight illuminance to 70% of work areas
- Offers significant opportunity for electric light dimming.
- The 18 skylights shown at right (in blue) provided the best impact according to ASHRAE's consultant

Raised Windows

- Raising the window height increases the daylit floor area percentage from 36-46%.

Interior Desk Layout

- Tall and/or opaque desk partitions running parallel to the façade must be avoided in order to maintain side-lighting benefits.



Daylight Strategies – 18 Skylights

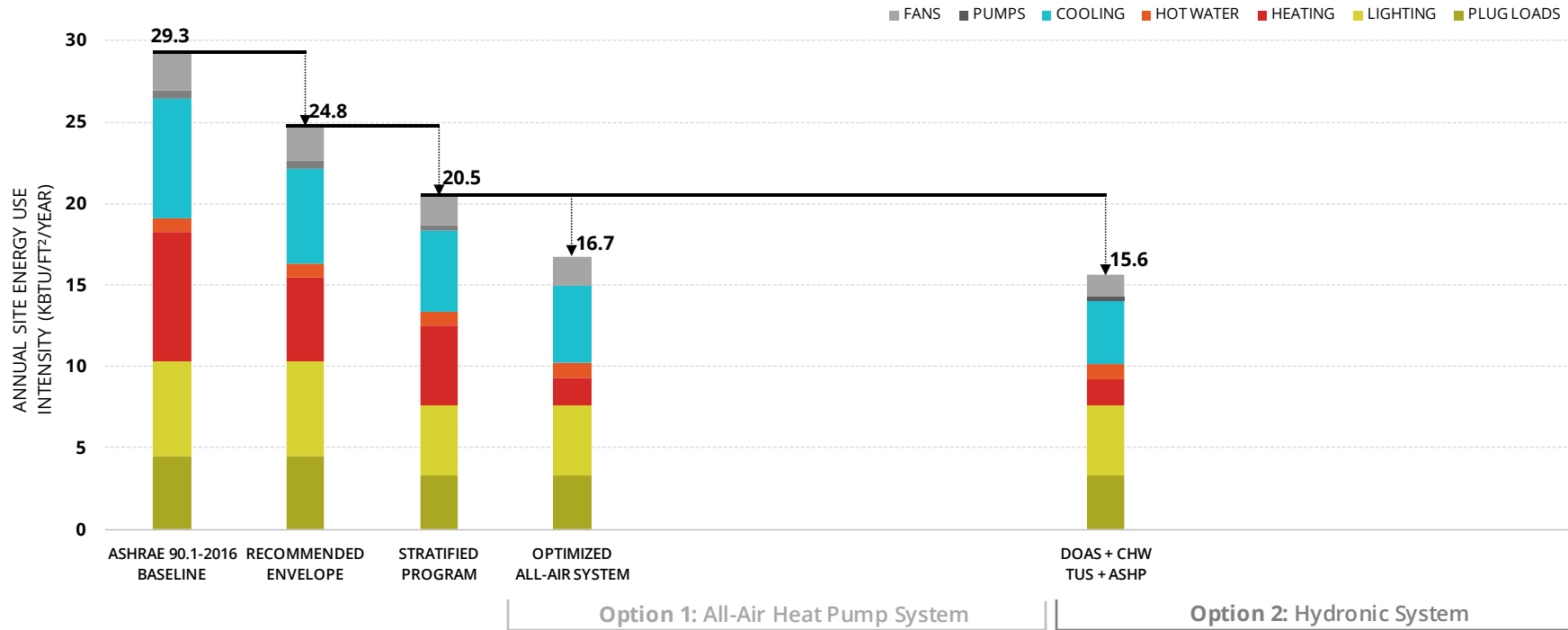
57%

Percentage of regularly occupied work spaces on the upper level with useful daylight illuminance (>300 lux) at the work plane



All-Air Heat Pump vs Hydronic System

ANNUAL SITE ENERGY USE



Path to NZE Recap

NZE Target **21.4** kBTU/ft²/yr

Stretch Target **15.0** kBTU/ft²/yr



HVAC Concept Overview

Resulting System Needs

- Hydronic Systems reduce energy - Radiant
- Smaller, modular control – control valves and ceiling fans vs VAV terminal units and ductwork
- Simultaneous heating and cooling – Heat Pump and/or heat recovery machines
- Decouple temperature from humidity – DOAS
- Recover energy whenever possible

System Overview

Outdoor Air-Cooled Modular Heat Pump

Staged Pumping

Air Cooled DOAS decoupled from waterside systems

Water source heat pumps for transient or potentially humid spaces utilize chilled water return.

Overhead Radiant Panels for heating/cooling at exterior zones, cooling only at interior zones.

Ceiling Fans to induce cooling and improve environmental comfort.



HVAC Option 2: Hydronic Systems

DOAS

With enthalpy heat recovery and DCV

Option 1A: Add desiccant wheel

Option 1B: Add DX Trim Coil

CW Terminal Unit Options

Radiant Ceiling Panels

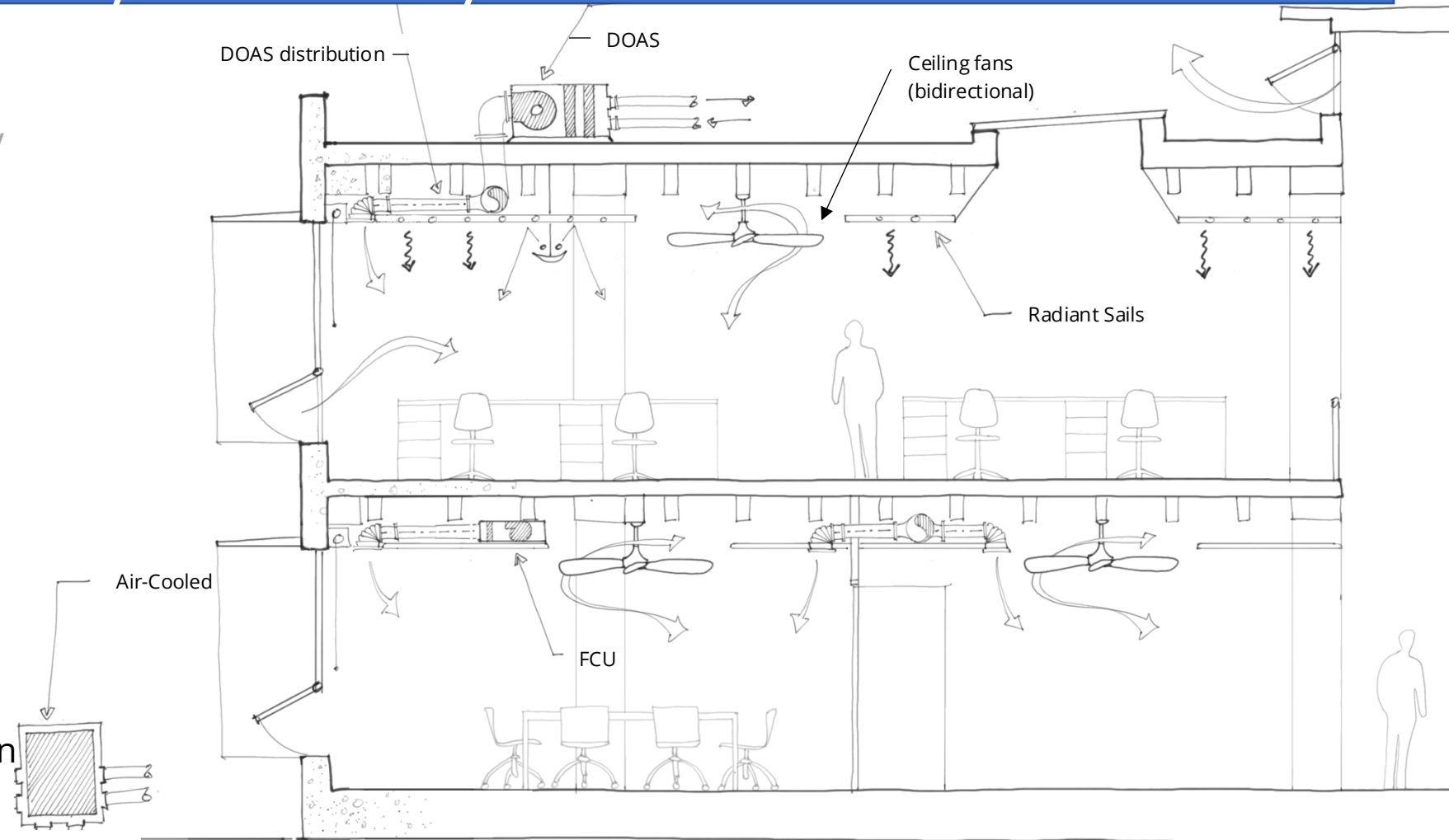
Sensible Fan Terminal Units

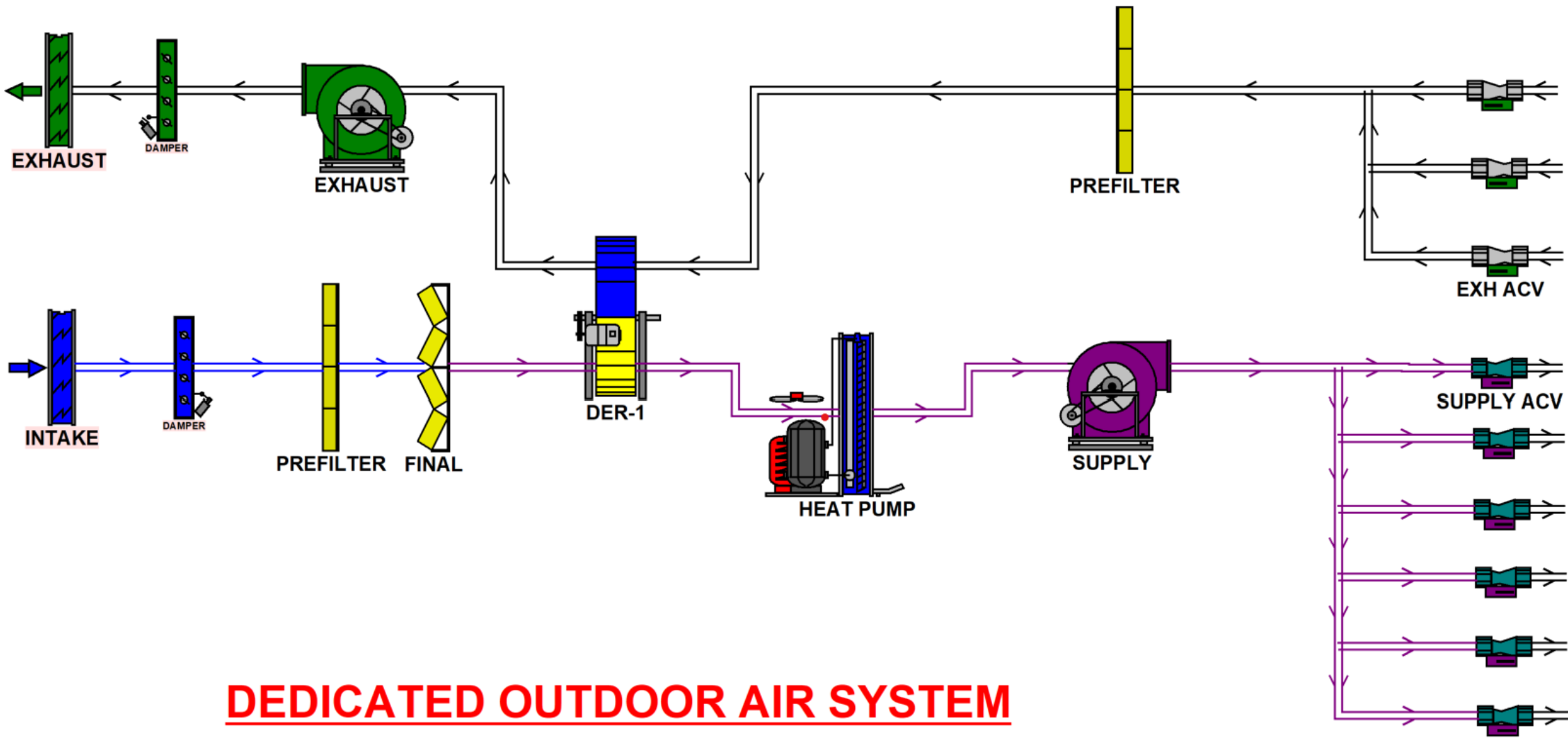
Heat Pump Options

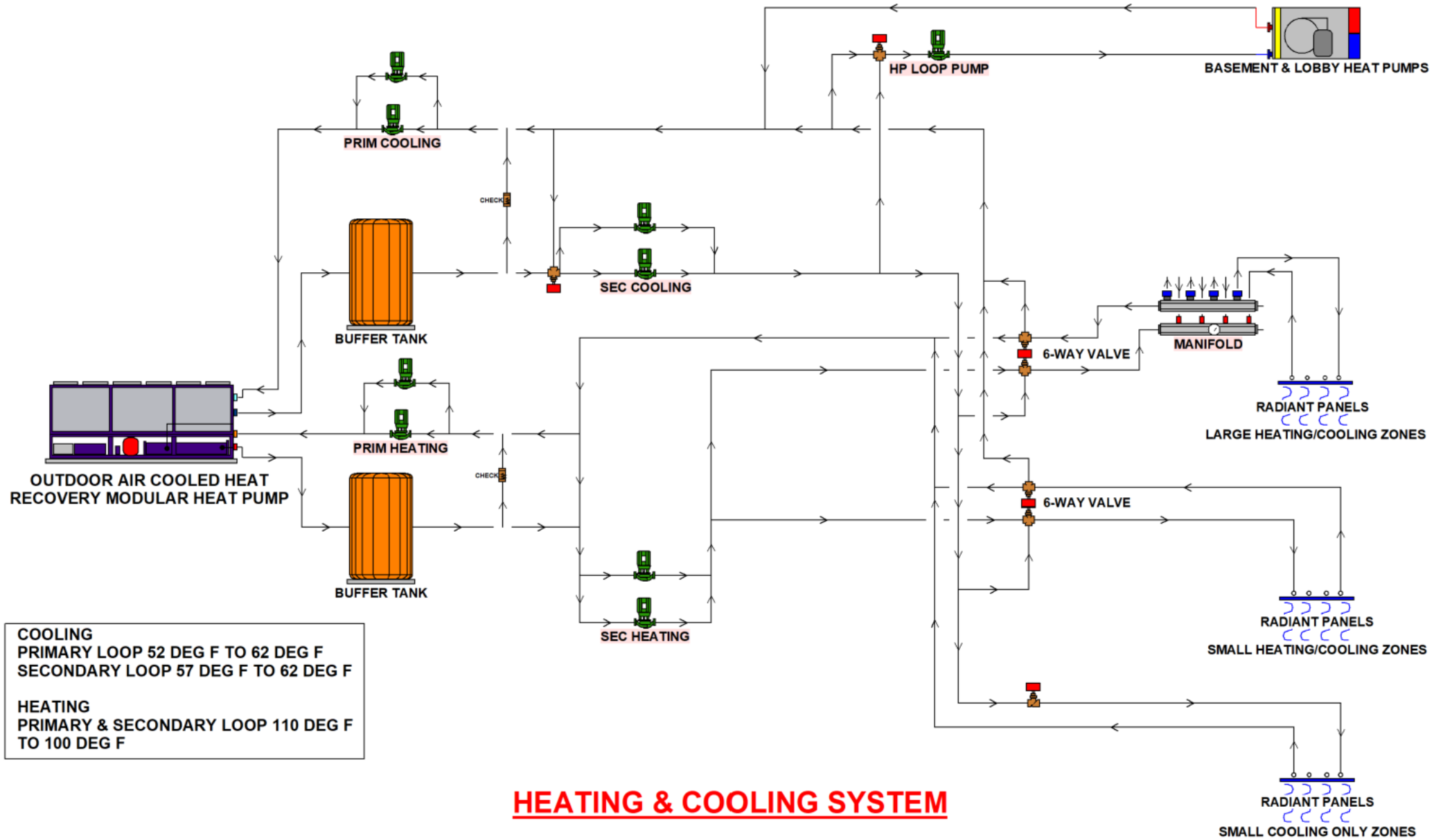
Air-Cooled HP

Night-Flush & Mixed-Mode Ventilation

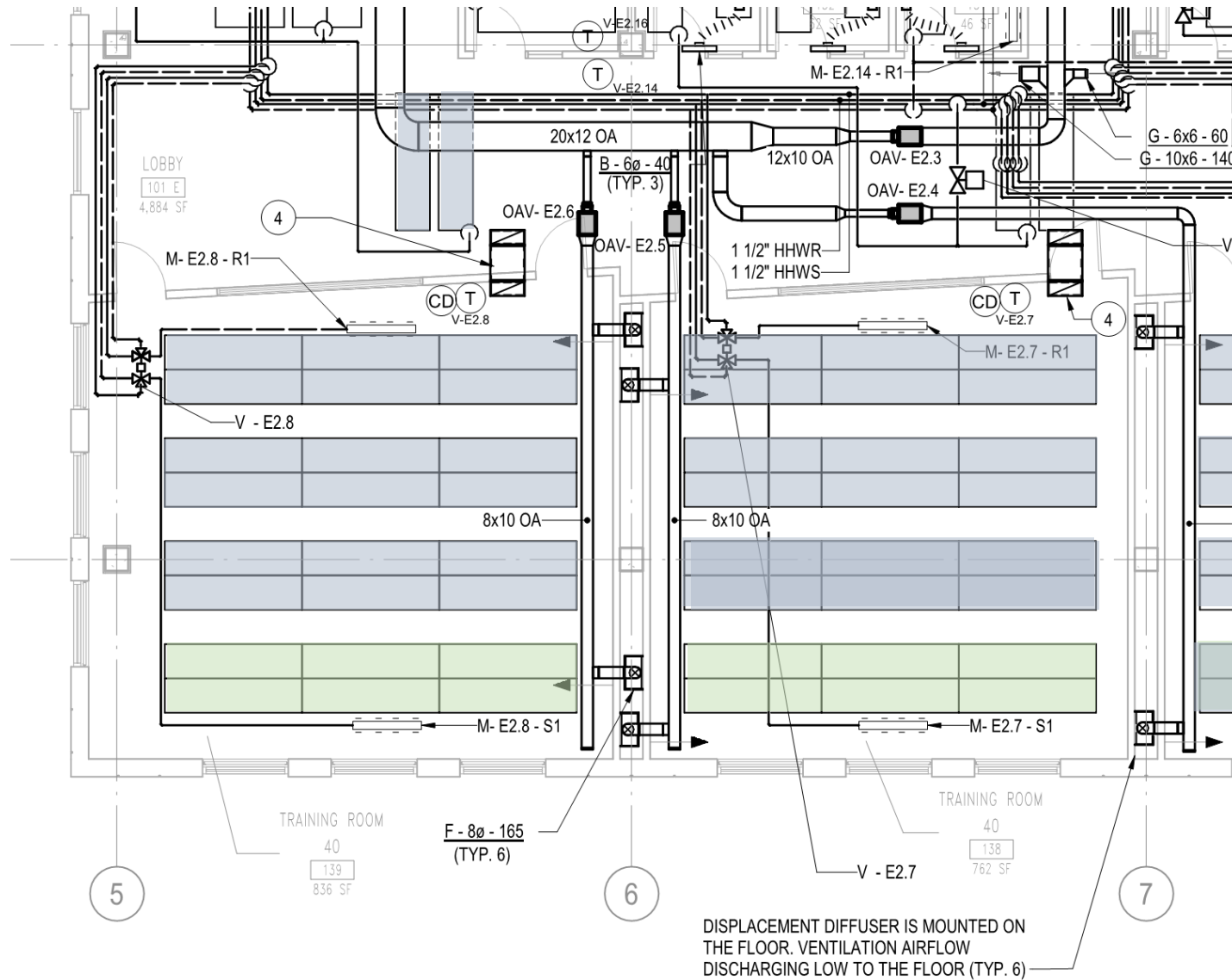
See Previous



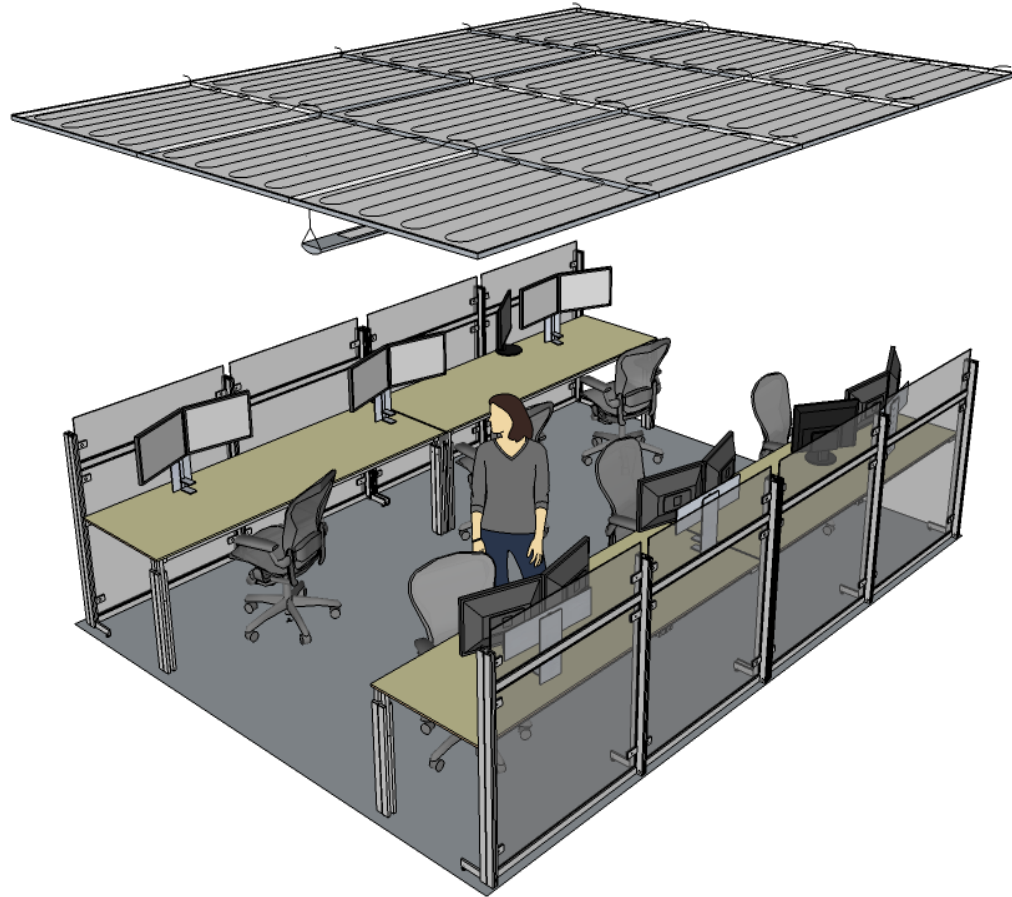




Classroom HVAC



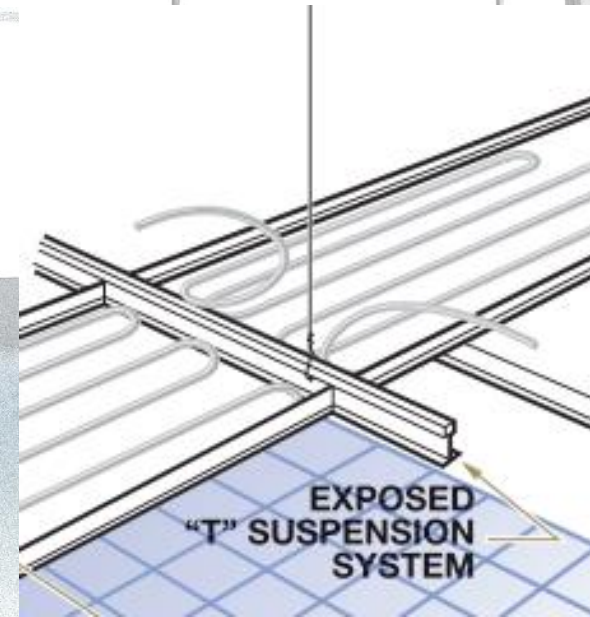
Overhead Radiant Systems



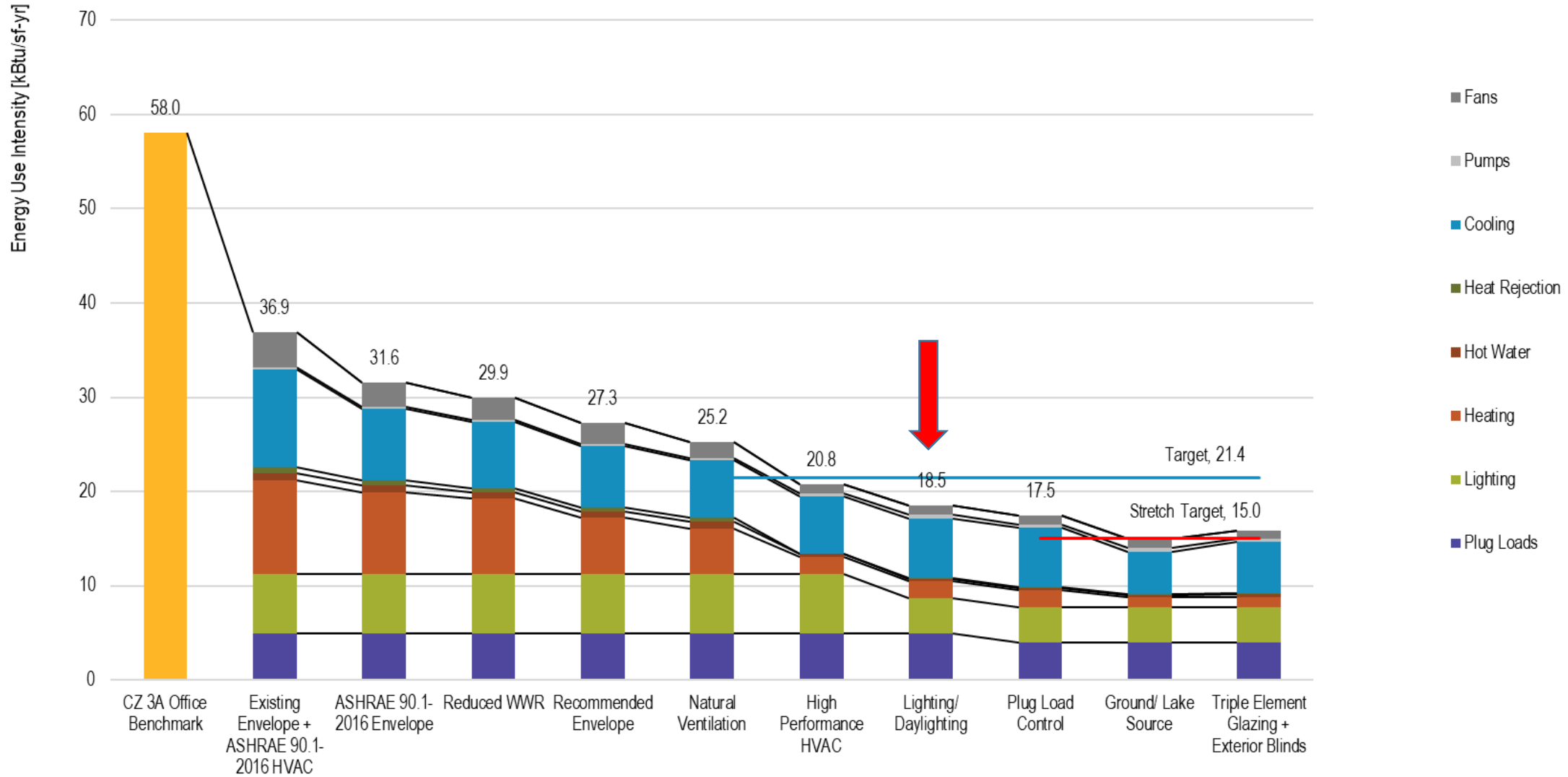
- Radiant Panels form clouds above the occupied spaces
- All heating and cooling in these spaces are provided by the panels.
- Ventilation is cool/neutral temperature air delivered directly to the space and not directly responsible for temperature control within the zone.

Open Office Overhead Radiant Systems

- Areas between the clouds are open to structure
- Rigid piping in exposed areas for aesthetic reasons.
- Insulation on supply piping only.
- Duct distribution is only for ventilation quantities only (about 0.15 cfm/sf)
- Constant volume air distribution with Fabric Duct
- Ceiling fans increase air mixing and induce capacity.








Path to Net Zero



Upper Level



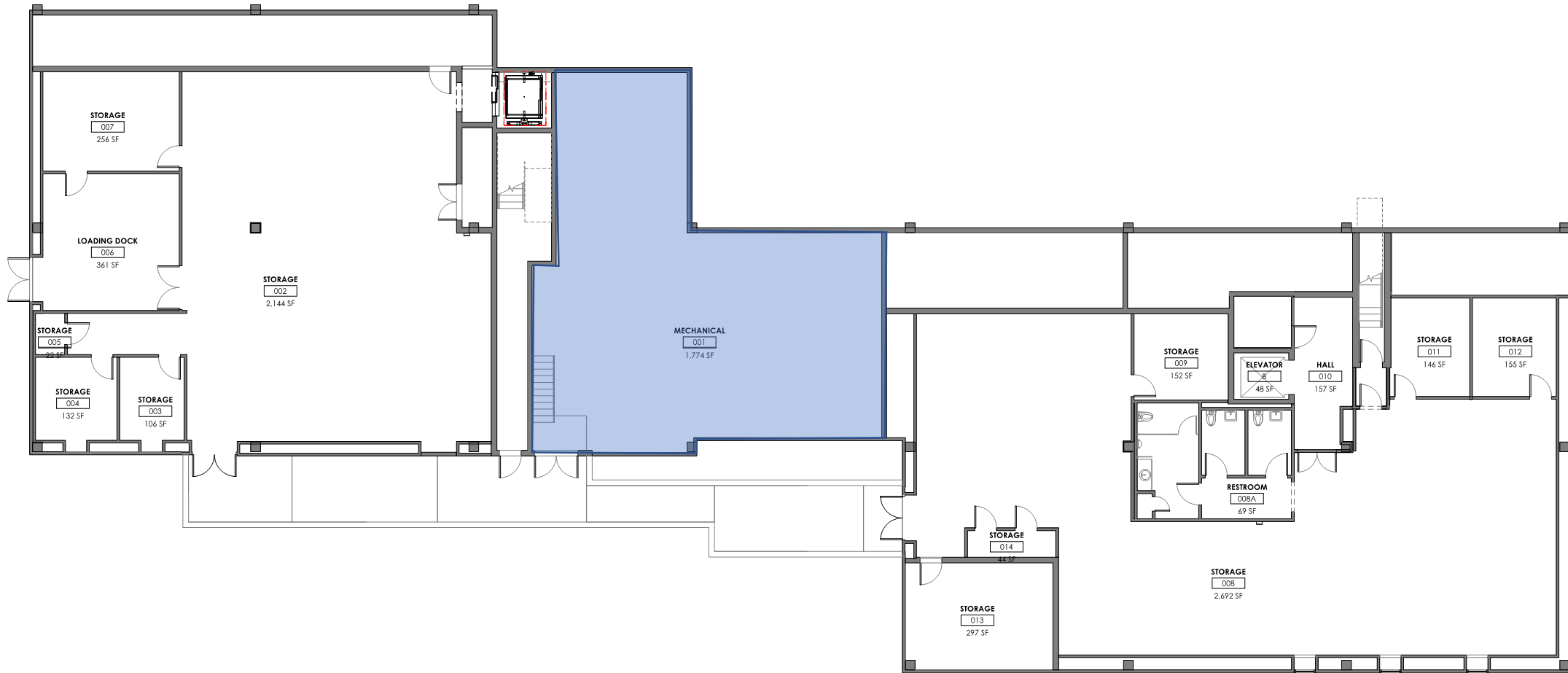
-  (1) Large Conference Room
-  (3) Medium Conference Room
-  (1) Small Conference Room
-  (7) FSHO
-  (2) WAR Room (Small Conference)

Middle Level



-  (7) Medium Conference Room
-  (1) Small Conference Room
-  (1) Large Training Room
-  (1) Standard Training Room
-  (2) Simple Training Room

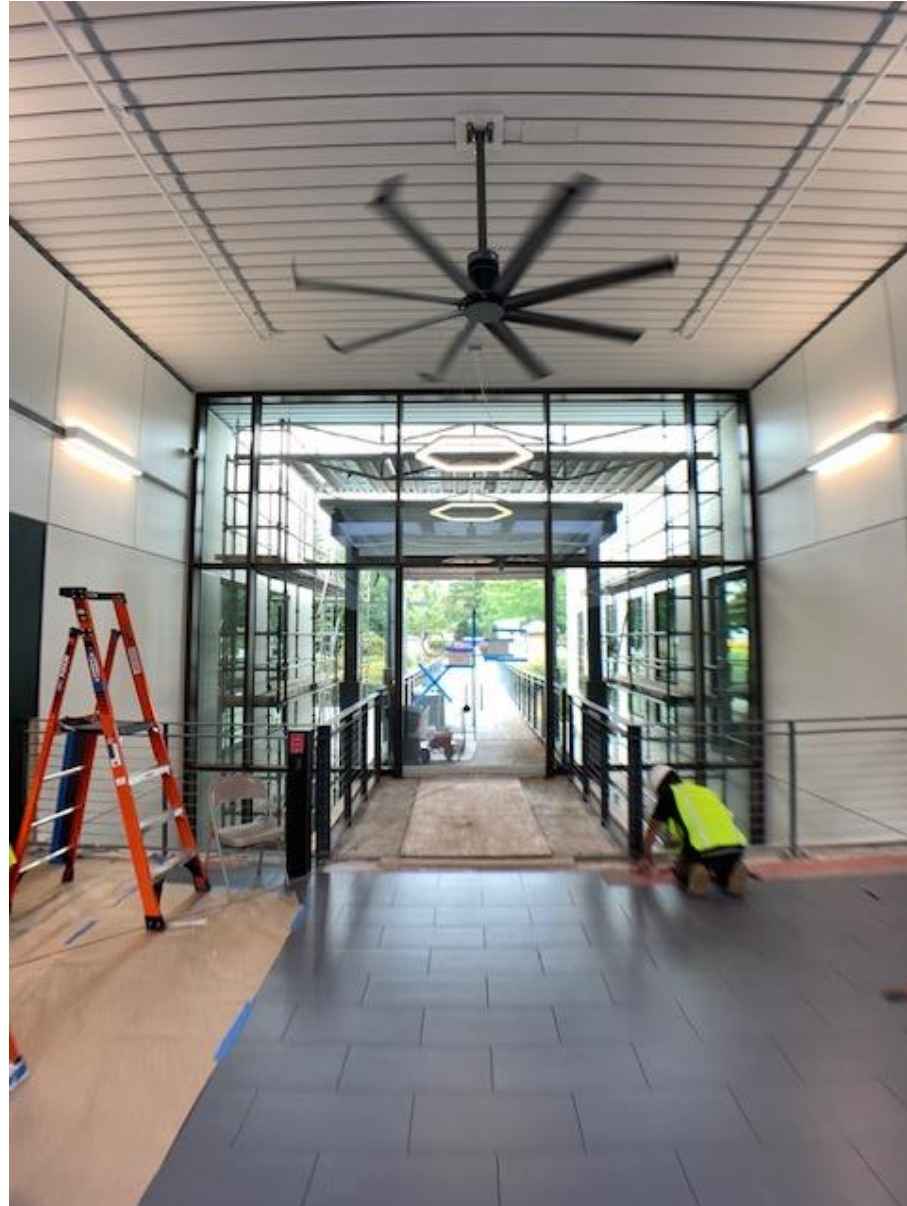
Lower Level



Construction Photos – January 2020



Construction Photos – July 2020



Construction Photos – August 2020



Construction Photos – August 2020



Construction Photos – August 2020



Project Budget

	Pre-Design November 2018	Mid-Design July 2019	GMP November 2019
Pre-Development Costs	\$4,750,000	\$4,750,000	\$4,733,950
Consulting Services	\$1,375,000	\$1,375,000	\$1,551,780
Construction*	\$7,800,000	\$10,155,000	\$12,349,837
FF&E	\$675,000	\$675,000	\$904,682
Admin & Misc	\$50,000	\$50,000	\$30,000
Contingency	<u>\$1,100,000</u>	<u>\$1,100,000</u>	<u>\$429,751</u>
Total	\$15,750,000	\$18,105,000	\$20,000,000

* Less donated equipment

Note: Solar PV not included in project scope



Construction – Adding Solar PV

System Size

331.88 kW DC



Capacity:

- 250kW AC
- Capped by Georgia Power Net Metering

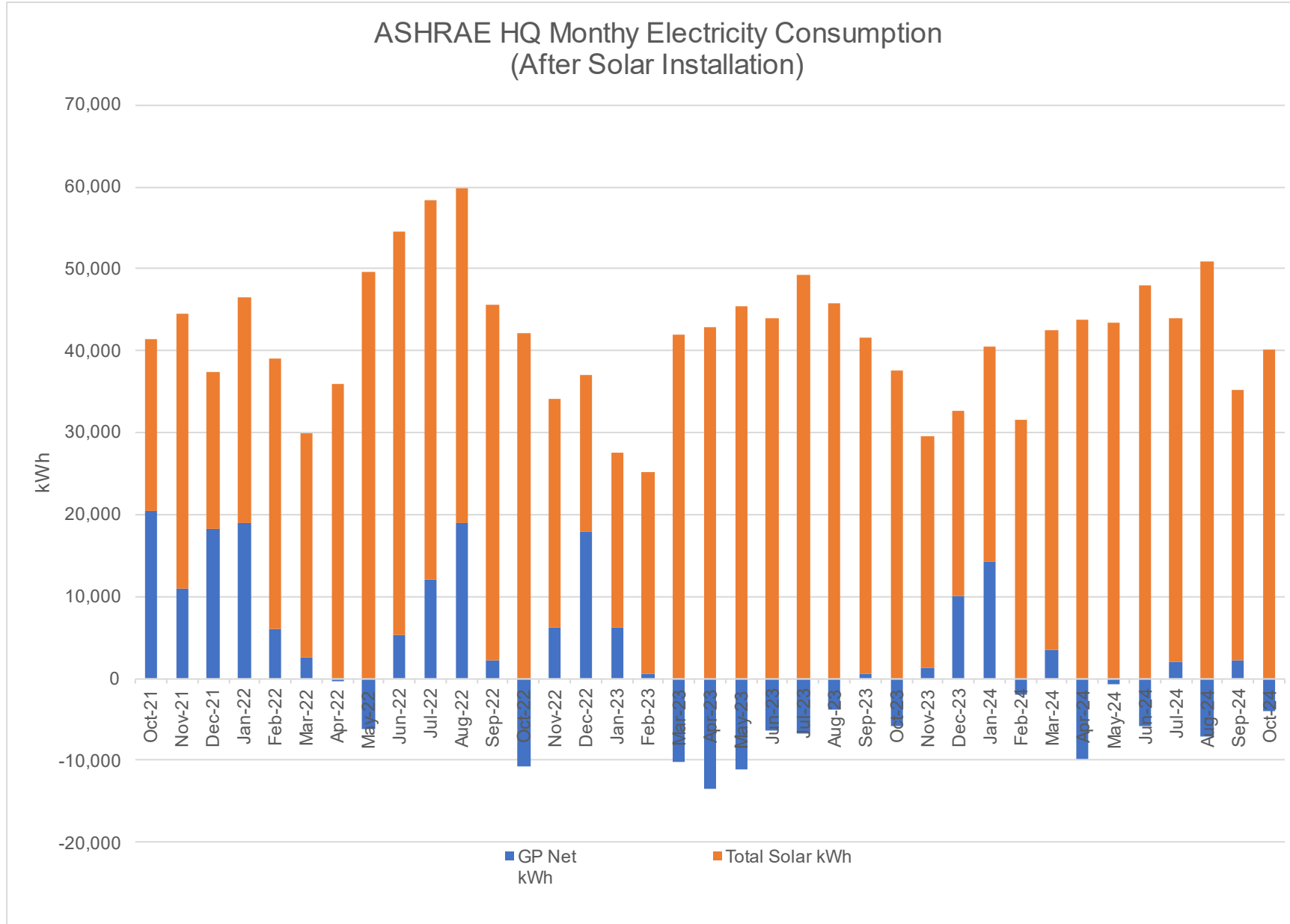
Costs:

- PV \$500,000
- Site \$50,000
- Total \$550,000



Estimated Energy Production (Year 1): **457,713 kWh**

Actual Operating



Key Design Features

- 18 new skylights and reconfigured window/wall ratio.
- Radiant ceiling panel system: This is used for heating and cooling & dedicated outdoor air system for outdoor air ventilation with enthalpy heat recovery.
- Overhead fresh air distribution system augmented with reversible ceiling fans in the open office areas and displacement distribution in the learning center.
- Six water source-heat pumps (WSHPs): There are four on basement level and two on upper level atrium that will be used to condition these spaces.
- A Building Automation System with remote access.
- A robust IT backbone network
- Demand Control Ventilation (DCV): This will be used for high occupancy spaces in the meeting and learning center.
- On-site electric vehicle charging stations available for guests and staff.



Building Operations

- Smart Building
- Building analytics and fault detection
- Demonstration of the use of Automated System Optimization
- Building EQ evaluation
- IEQ monitoring
- Building intelligence evaluation using Building IQ



What is ASHRAE's Building EQ

- Free Web-based Portal
- Benchmarks energy performance
- Calculates building EUI based on Climate Zone
- Includes Operational Carbon Metrics
- Assists with ASHRAE Level 1 Energy Audit
- Provides data to improve energy performance



Building EQ Works with Level 1 Energy Audit

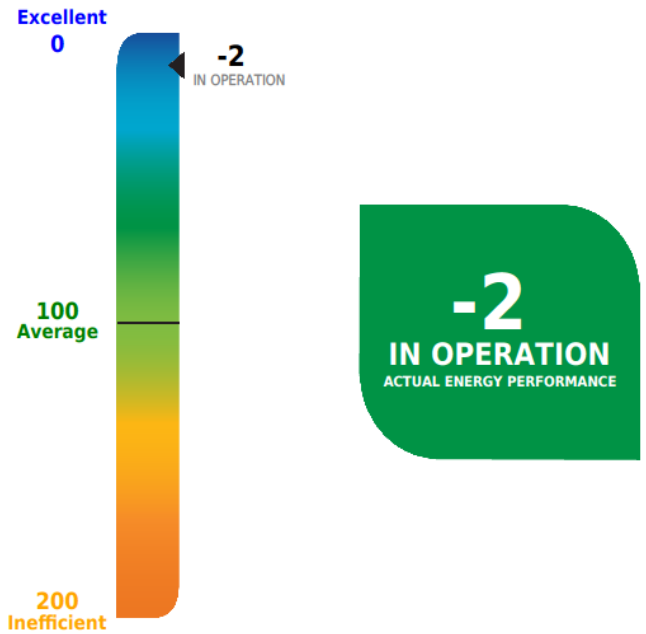
- In Operation Assessment
- Uses metered energy bills for energy usage
- Reflects how the building is designed, used, and operated
- Most common application
- Rating from 0 (zero net energy) to 200 (energy inefficient)
- Allows for tracking of improvements and comparing building to itself over time Building EQ Complies with Standard 21



Building EQ Scores for ASHRAE Headquarters

- Building EQ Energy Performance Score: -2

ASHRAE Global Headquarters
180 Technology Parkway NW, Peachtree Corners, GA, 30092
Jan 2024



Building Energy Quotient
Building Performance Score



Automated Systems Optimization

Automated System Optimization (ASO)

“Tools used to dynamically modify Building Automation System (BAS) control settings to optimize HVAC system energy usage while maintaining occupant comfort.”

“Two-way communication with the BAS is the distinguishing feature of ASO solutions.

ASO technologies are the newest in the EMIS family...”

- From: “A Primer on Organizational Use of Energy Management and Information Systems (EMIS)”,
- Lawrence Berkeley National Laboratory, U.S. Department of Energy, Better Buildings Initiative



Other Programs Being Considered

- Building Owners and Managers Association (BOMA) 360
- Green Globes Existing Building (EB)
- LEED Existing Building Operation and Maintenance (EBOM)



Owner's Project Requirements (OPR) Comparison

Item	OPR	Actual
ASHRAE 189.1-2017	Exceed Requirements	Achieved?
Demand Side Site Energy Consumption	21.4 kBTU/SF/year 15 kBTU/SF/year (stretch)	18.5 kBTU/SF/year
Water Efficiency	Obtain 11 of 11 LEED Water Use Efficiency Points	Unknown, LEED rating not sought
Daytime Plug Load	0.04 W/SF	Achieved?
Acoustics	Exceed requirements by 3-5 NC/RNC	Achieved?
Outside Air Rate	1.3 times ASHRAE 62.1	1.3 times achieved?
Outside Air Control	Demand Control Ventilation (DCV) for high occupancy spaces	Achieved?
Daylighting	Majority of Occupants achieve generous daylighting 55% of the time	57% on upper level >300 lux 23% on middle level >300 lux
Resiliency	Achieve resiliency in OPR	Achieved?

Conclusions

- Design for effective operations.
- Know your local construction market – capabilities, capacity, pricing, etc.
- Carefully examine all existing building systems and infrastructure. Be realistic about their condition.
- Coordination = communication. Always be communicating.
- Do not drop the ball after completion: focus on getting the building to operate as intended.

Building for People and Performance.

KEY COMPONENTS OF THIS GUIDE:

Best-practice design processes • Total cost of ownership • Key performance indicators
Sustainability • Operator-first mindset • Internet of Things • Operational analytics



Caleb Haynes, PE • Abby Perri



- Designing for Operational Excellence- Intentional Design for Effective Operation and Maintenance
 - Key Components of the Guide:
 - Best-practice design processes
 - Total cost of ownership
 - Key performance indicators
 - Sustainability
 - Operator first mindset
 - Internet of Things
 - Operational analytics



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@ 9:00-18:00

THANK YOU! Q & A

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