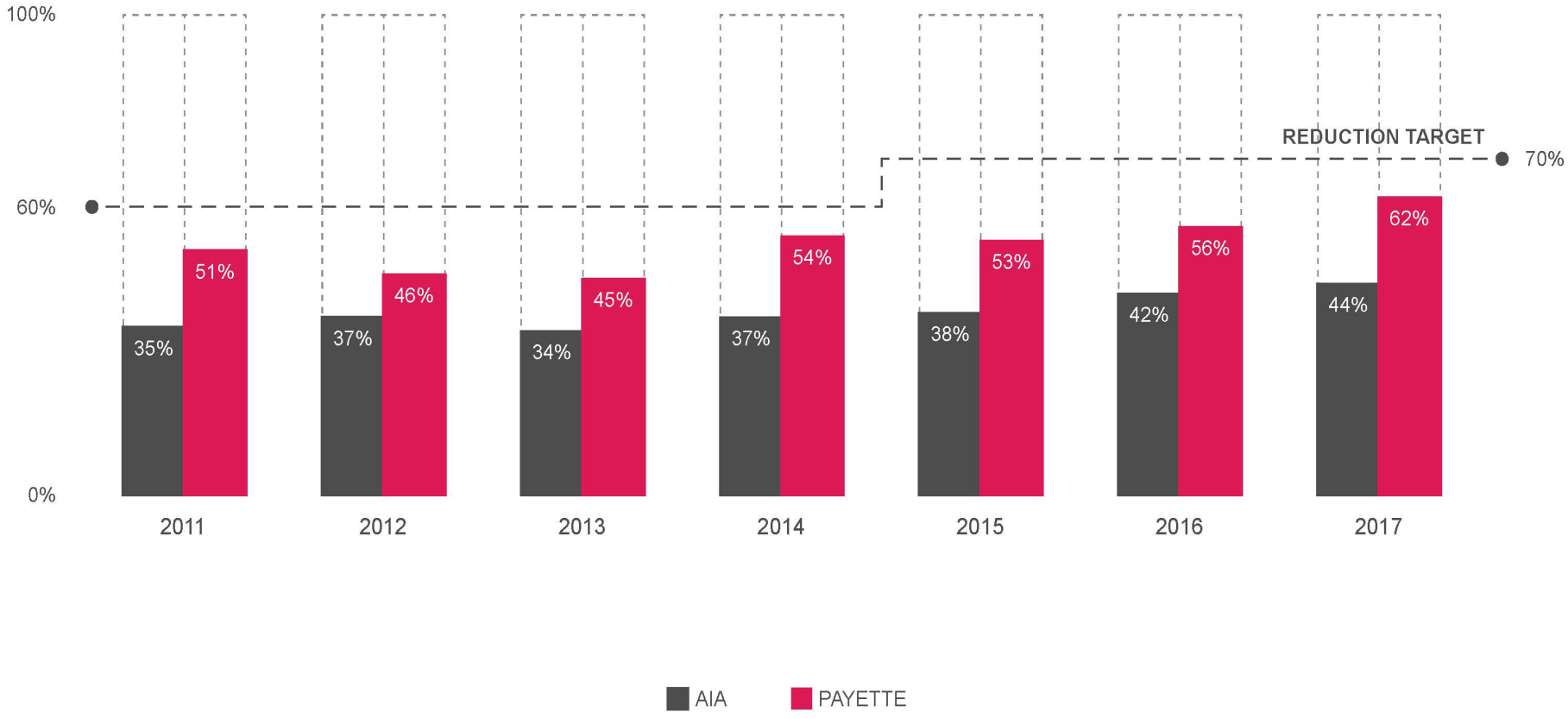
# New Paradigm: Architect/ Engineer Collaborative Energy Models

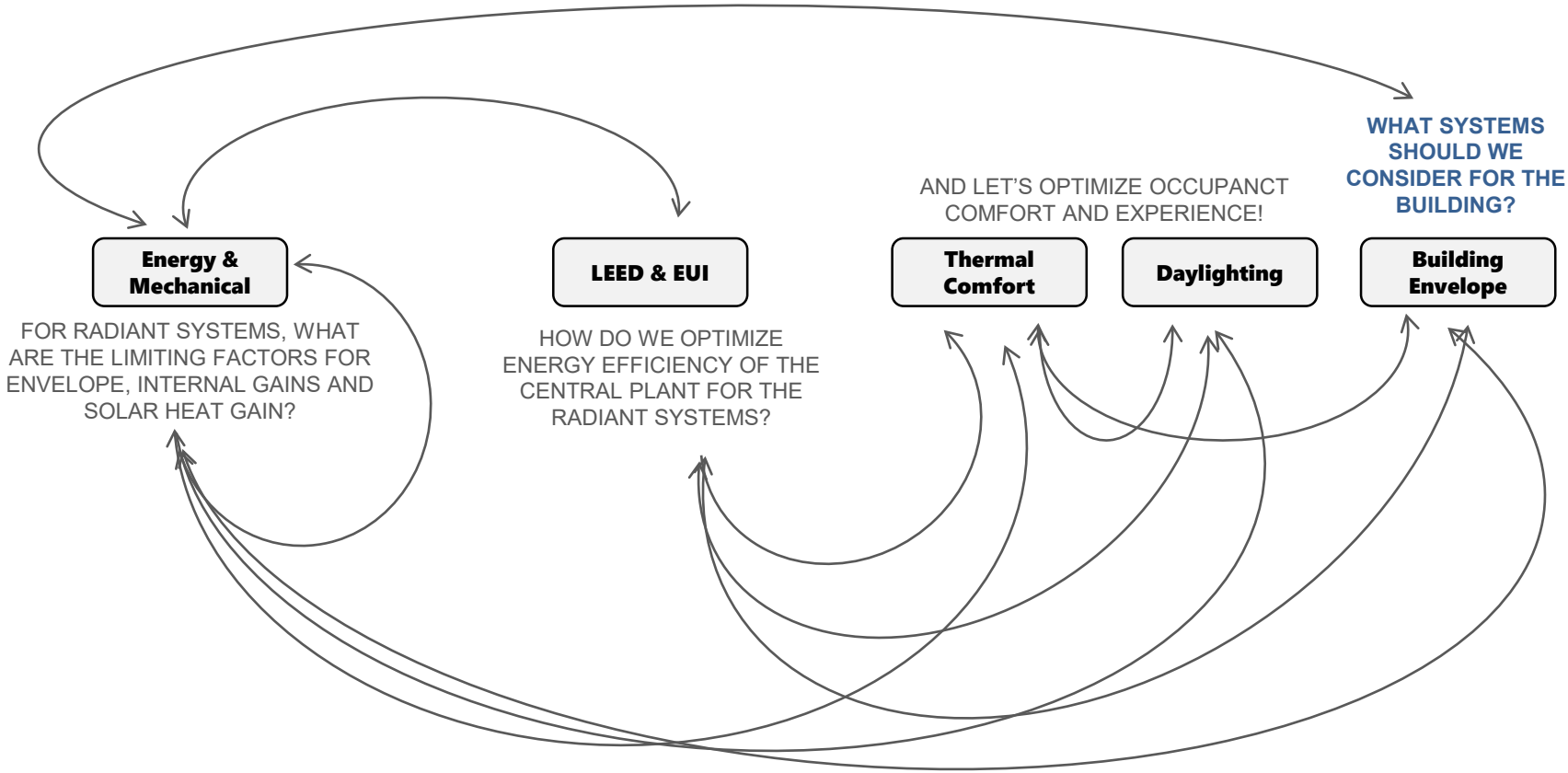
PAYETTE

# 2030 COMMITMENT – ENERGY REDUCTION GOALS



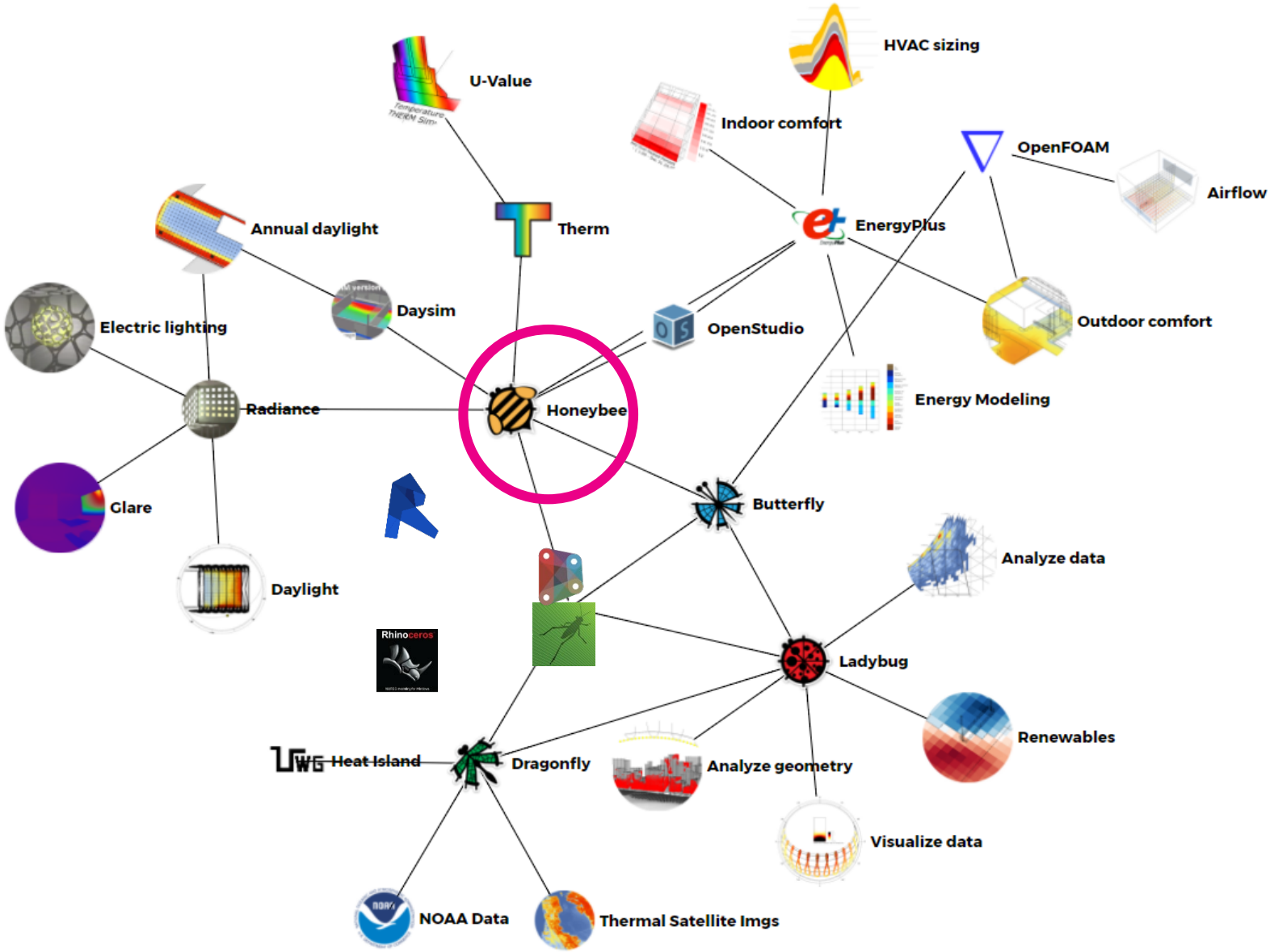
# TYPICAL ARCHITECT – ENGINEER WORKFLOW

# COLLABORATIVE ARCHITECT – ENGINEER WORKFLOW



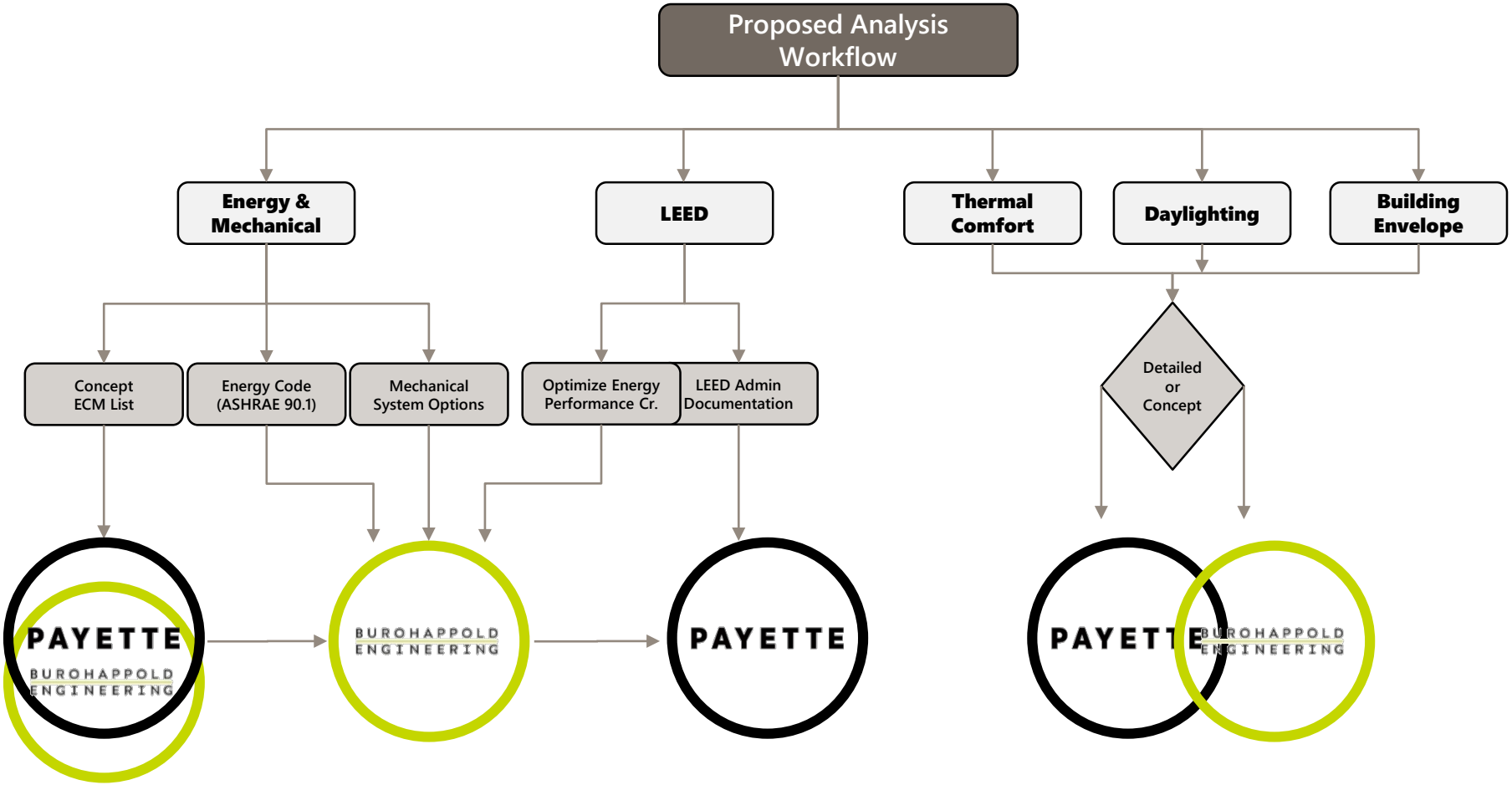

**FEEDBACK LOOPS**

# NEW INTEGRATED TOOLKIT - LADYBUG



# MUSEUM

# INTEGRATED PERFORMANCE MODELLING



# MECHANICAL SYSTEMS – RADIANT FLOORS

**Central Plant Heating**

Conventional Boiler

Condensing Boiler

Geothermal Heat Pump

**Central Plant Cooling**

Packaged/Dx Units

Air-cooled Chiller

Water-cooled Chiller

River Water Heat Exchanger

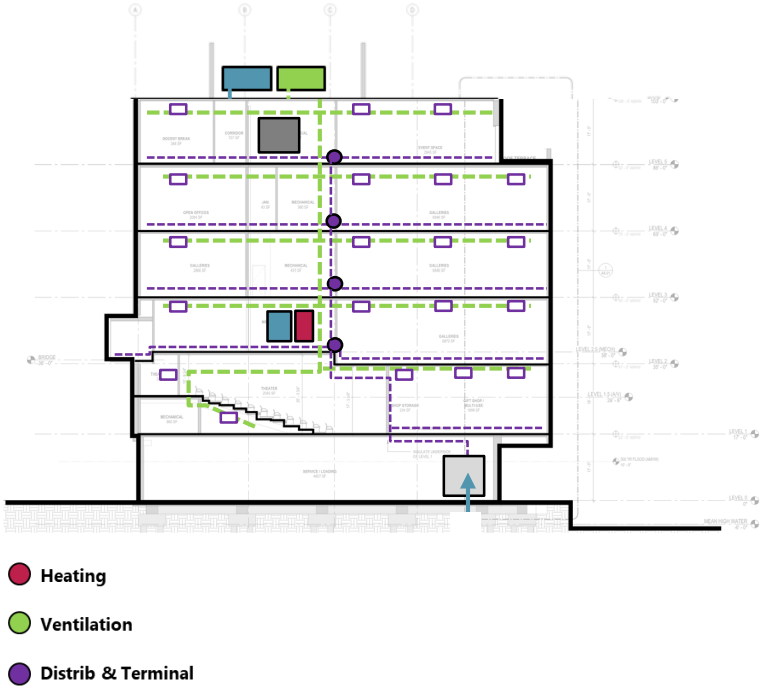
Geothermal Heat Pump

**Distribution/Terminal**

Conventional VAV

Dedicated Outdoor Air System with Fan Coils

Dedicated Outdoor Air System with Radiant Floors



## PARAMETRIC STUDIES: RADIANT SLAB

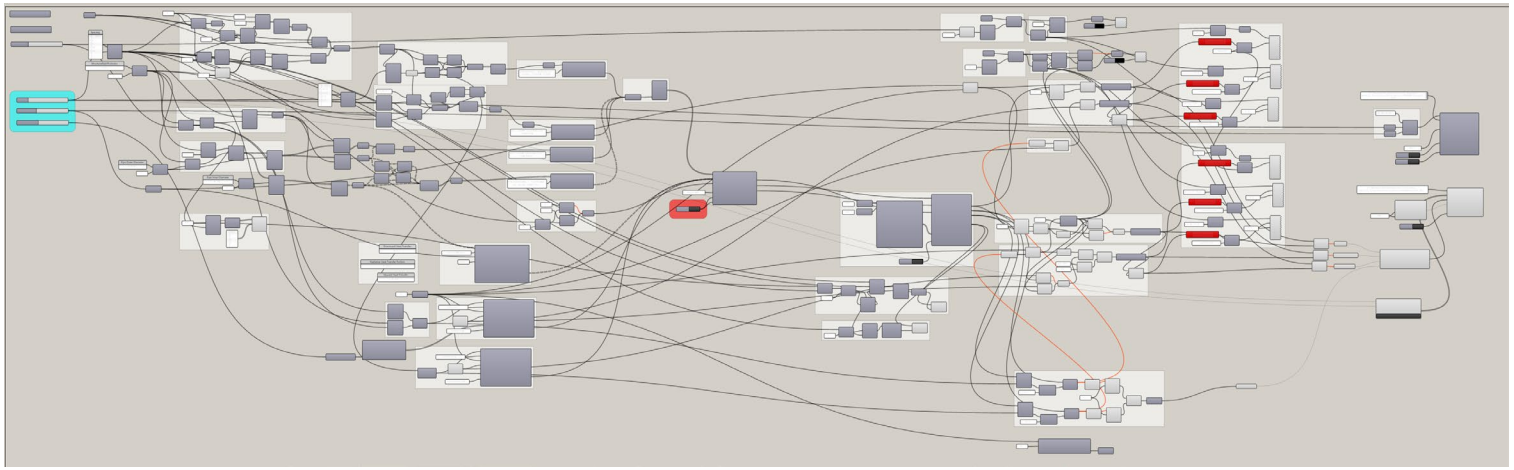
INPUTS:

- Top Slab Thickness (3”)
- Pipe Spacing (6”, 9”, 12”, 18”)
- Water Temperature (50F, 51F, 52F, 53F, 54F, 55F, 56F, 57F, 58F, 59F, 60F)
- Solar Load (0 btu/sf, 10 btu/sf, 20 btu/sf, 30 btu/sf, 40 btu/sf, 50 btu/sf, 60 btu/sf, 70 btu/sf, 80 btu/sf, 90 btu/sf, 100 btu/sf)

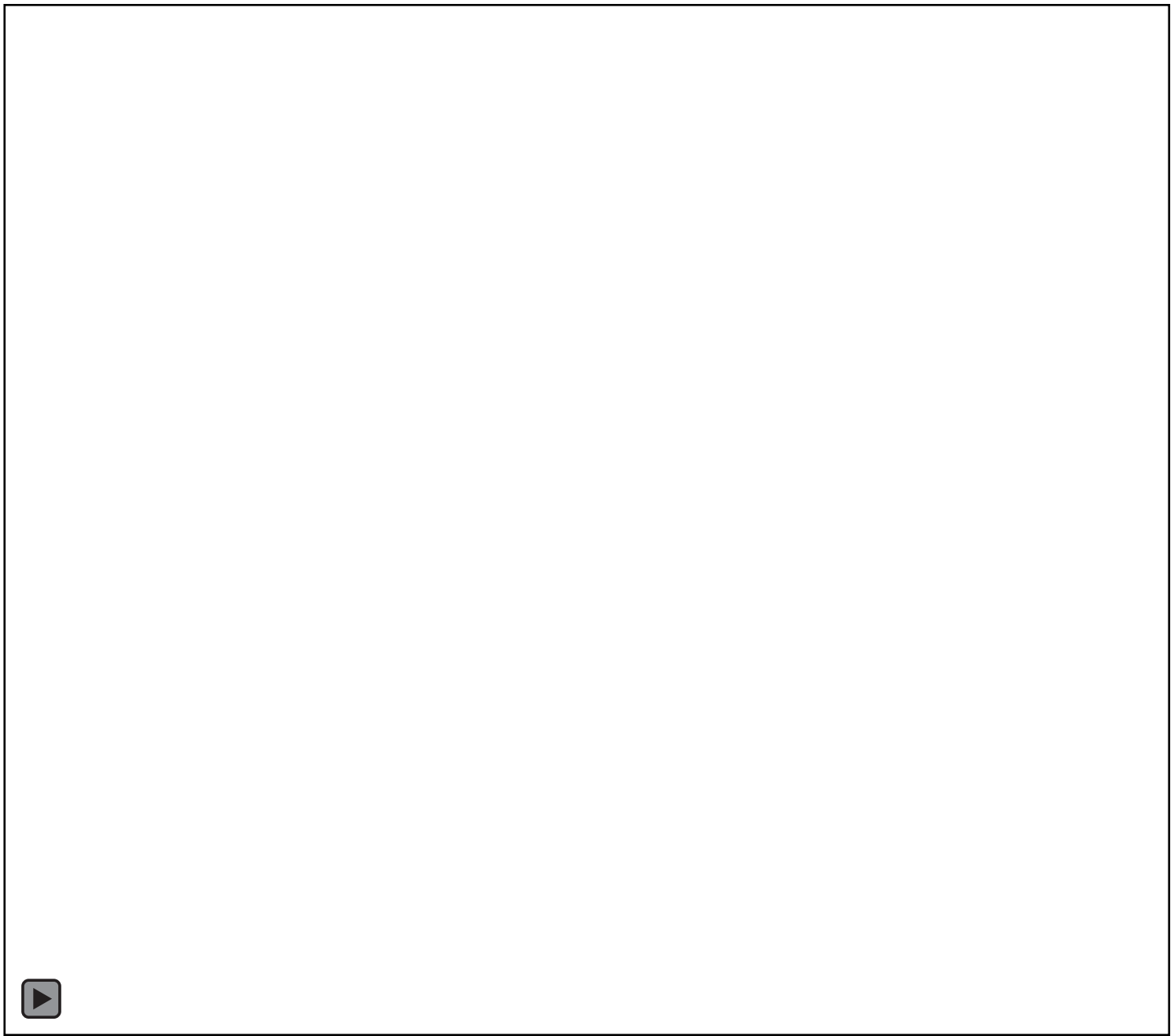
**= 484 SIMULATIONS**

OUTPUTS:

- Total Heat Removed
- Radiant Heat Removed
- Convective Heat Removed
- Degrees from Condensing

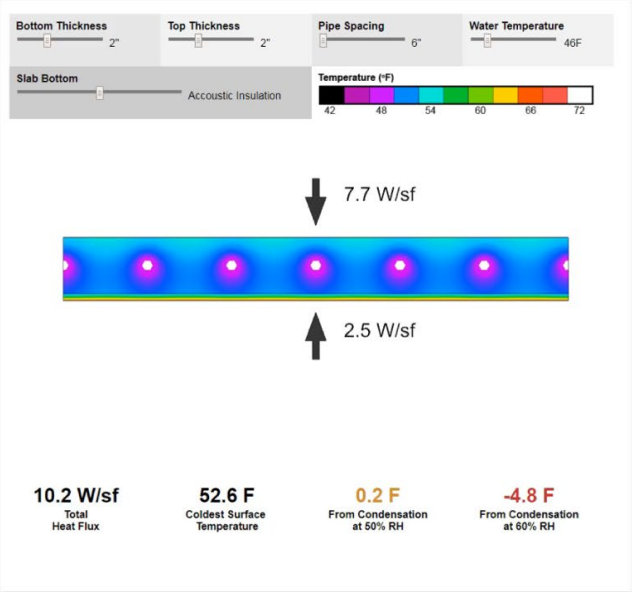


# RADIANT SLAB STUDIES

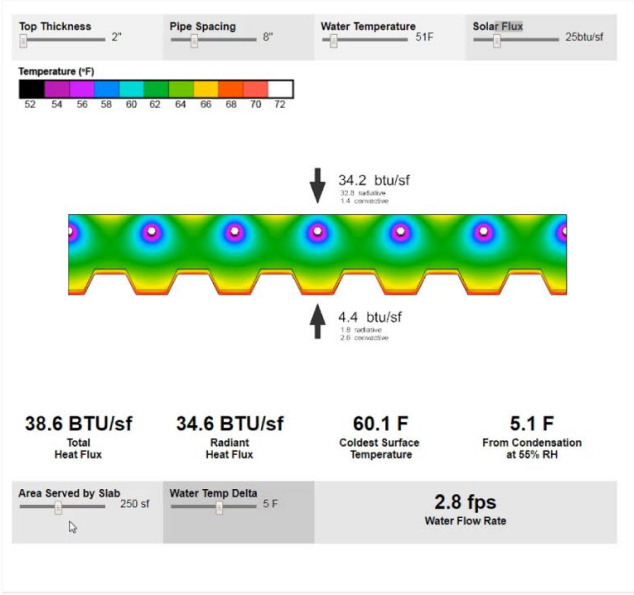


# ITERATIVE RADIANT SLAB STUDIES

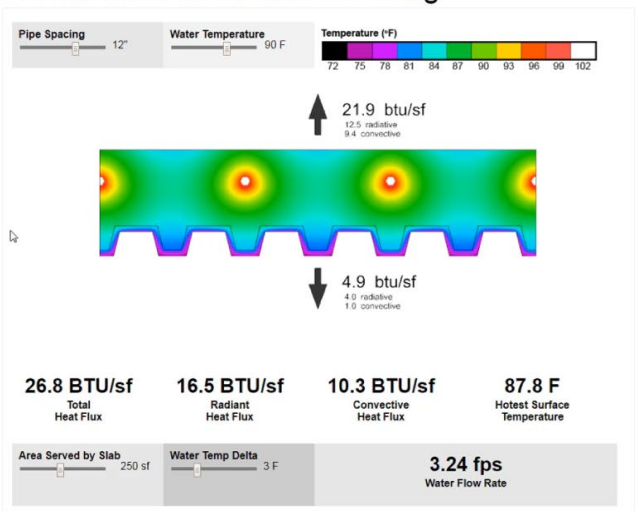
## Parametric THERM Model



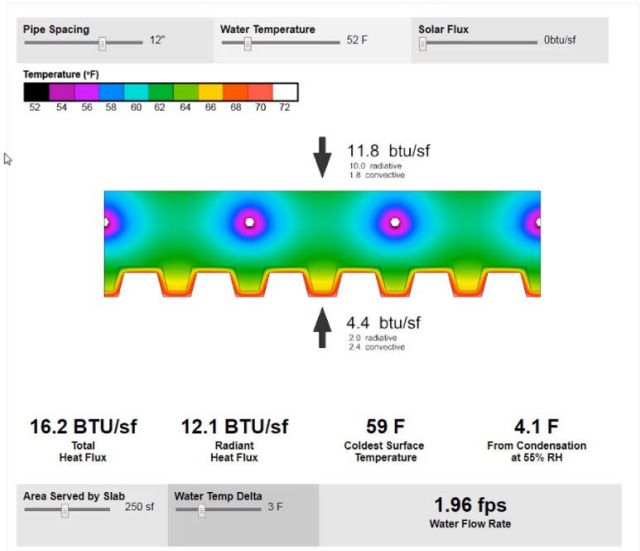

## Parametric THERM Radiant Slab



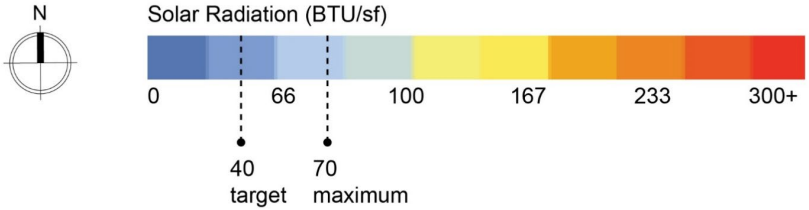

## Parametric Radiant Slab - Heating



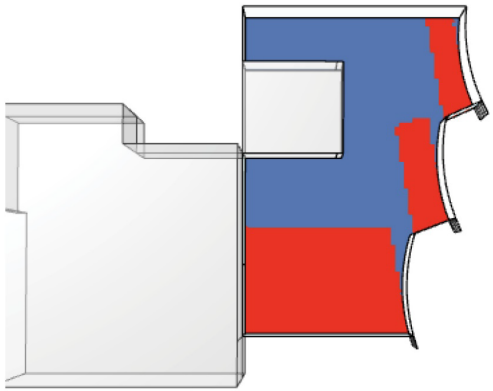

## Parametric Radiant Slab - Cooling



# PEAK SOLAR LOADS ON SLAB



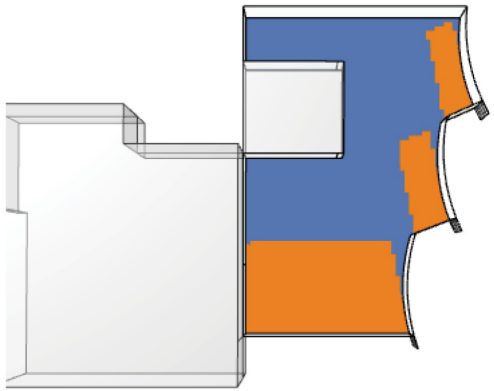

**CURRENT DESIGN**
SHGC: 0.35
Frit: none
Shading: none



Maximum Solar Radiation:
224 BTU/sf on October 30th at 11 am

EXCEEDS TARGET

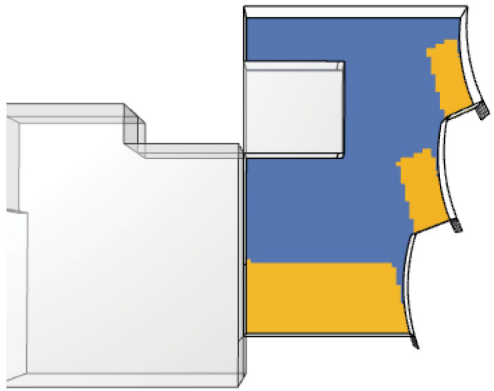
**OPTION 1**
SHGC: 0.35
Frit: 50% (equivalent SHGC: 0.175)
Shading: none



Maximum Solar Radiation:
99 BTU/sf on October 17th at 11 am

EXCEEDS TARGET

**OPTION 2**
SHGC: 0.35
Frit: 65% (equivalent SHGC: 0.1225)
Shading: none

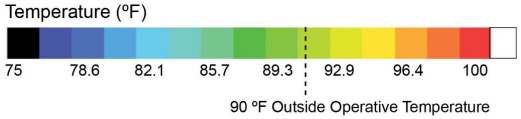


Maximum Solar Radiation:
65 BTU/sf on September 30th at 11 am

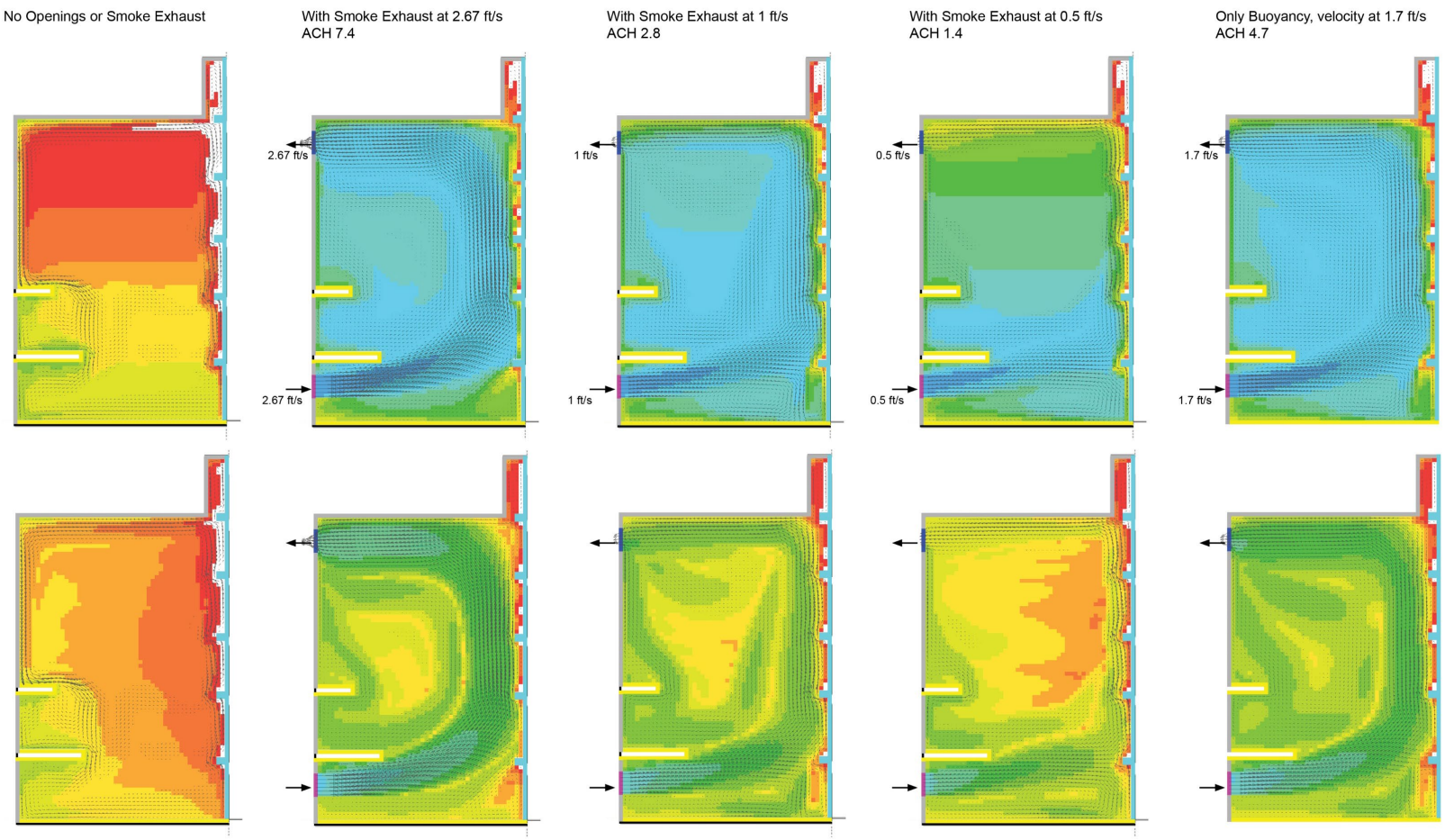
MEETS TARGET

# ATRIUM COMFORT

*Hottest Week*
*Average peak outdoor operative temperature = 90 ºF*
*Outdoor Air temperature = 80 ºF*
*2.67 ft/s is approx acceptable highest air speed*

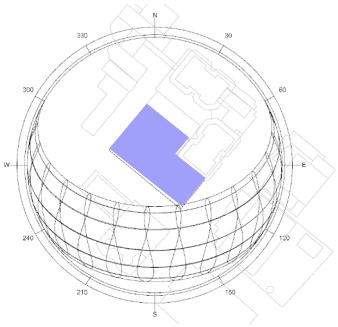



## NATURAL VENTILATION



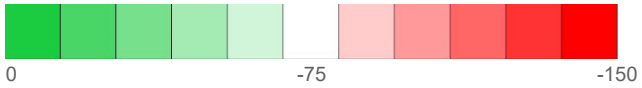
# HOSPITAL PATIENT ROOM

# OPTIMIZING MASSING | SOLAR BENEFIT STUDY




NET RADIATION (kWh/m2)

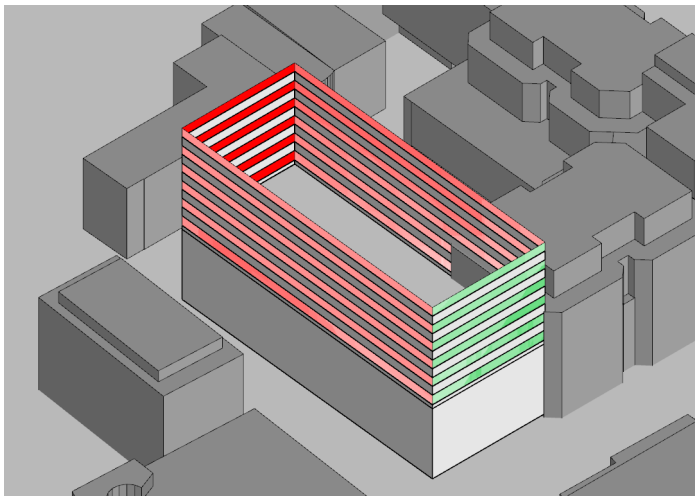
Beneficial Radiation — Harmful Radiation

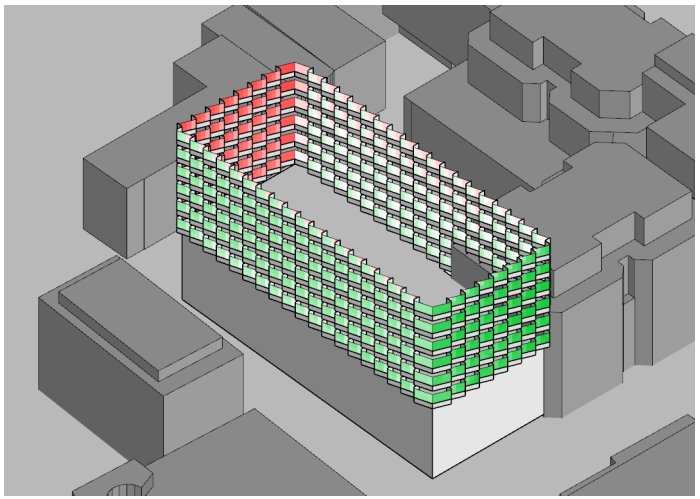



**6%**
Reduction in patient room energy

**15%**
Reduction in peak solar load

**54%**
Decrease in direct solar radiation





# PARAMETRIC EARLY ENERGY MODEL

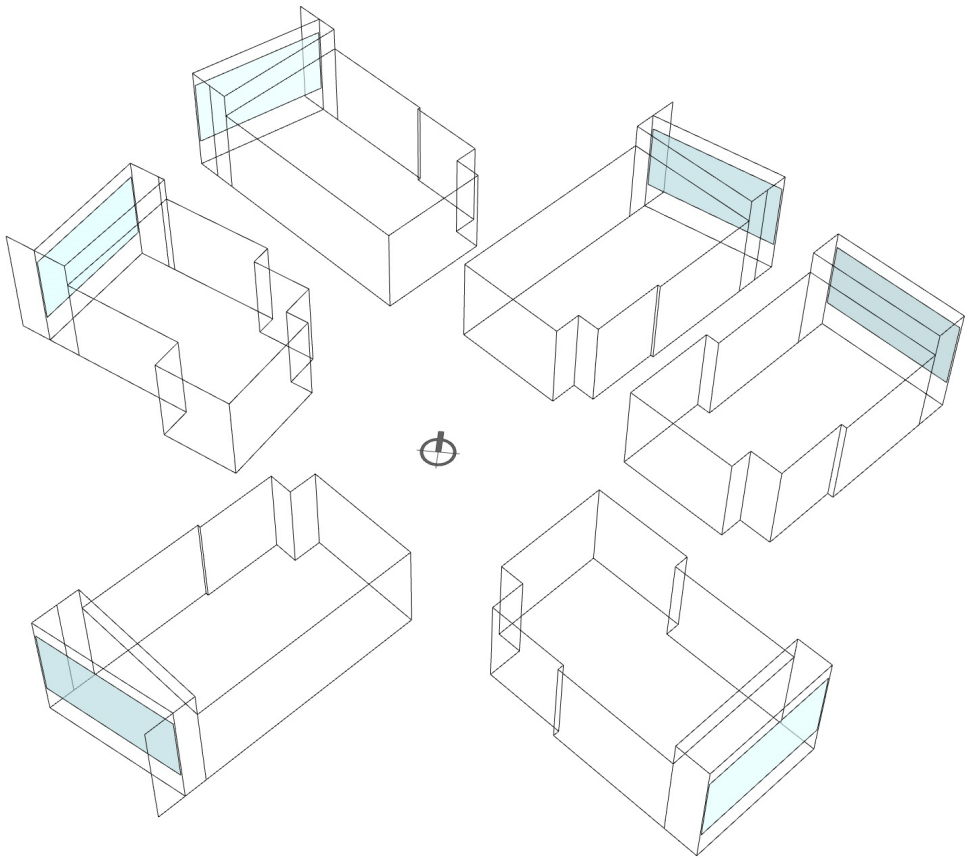
INPUTS:

- Glazing Ratio (40%, 50%, 60%, 70%)
- R-Value (spandrel, solid)
- Glazing U-Value (0.4, 0.25)
- Exterior Vertical Fins (0”, 15”, 30”)
- Orientation
- HVAC Type (VAV, Hydronic)

**= 576 SIMULATIONS**

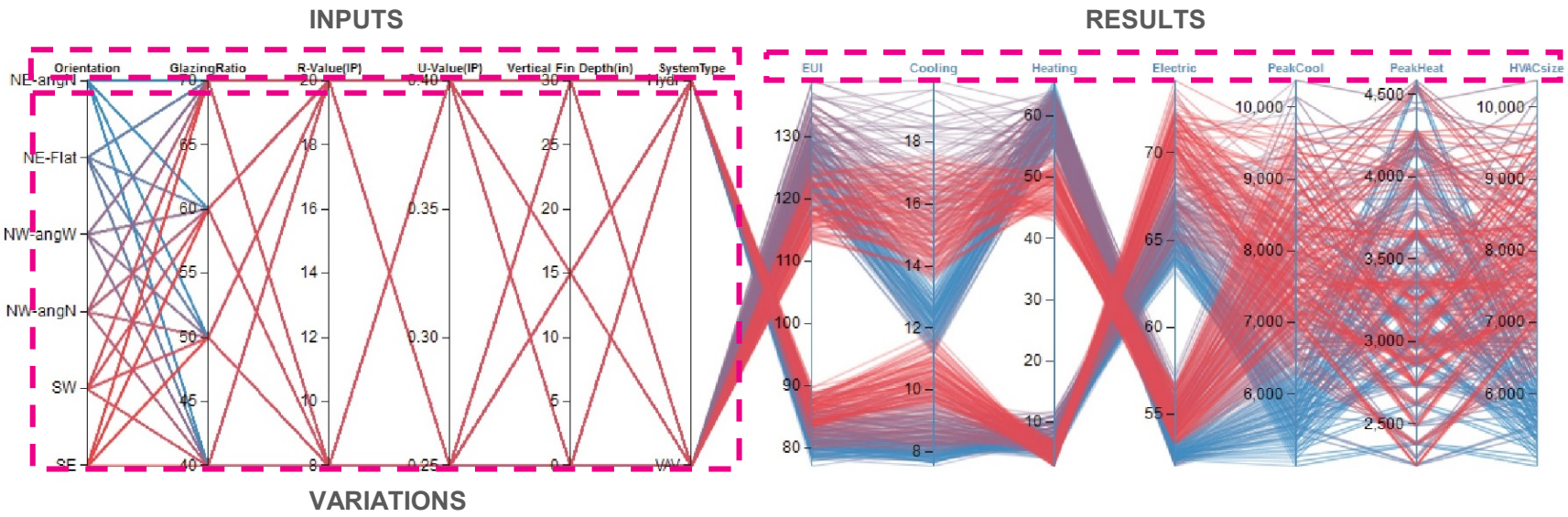
OUTPUTS:

- EUI
- Peak Cooling
- Peak Heating
- HVAC Size

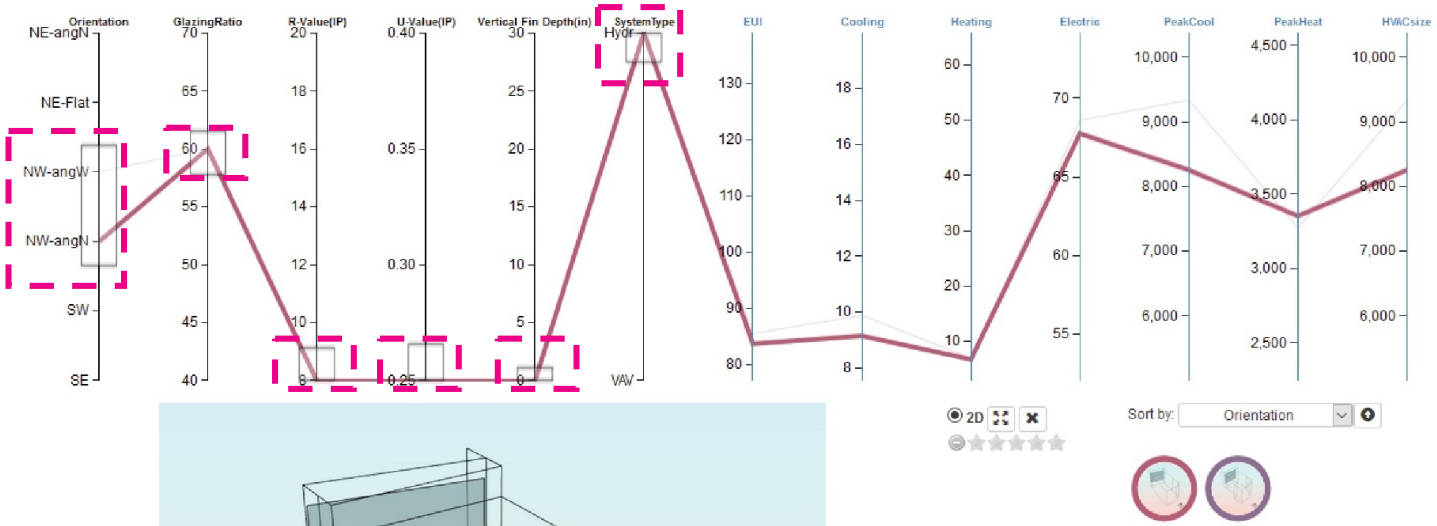


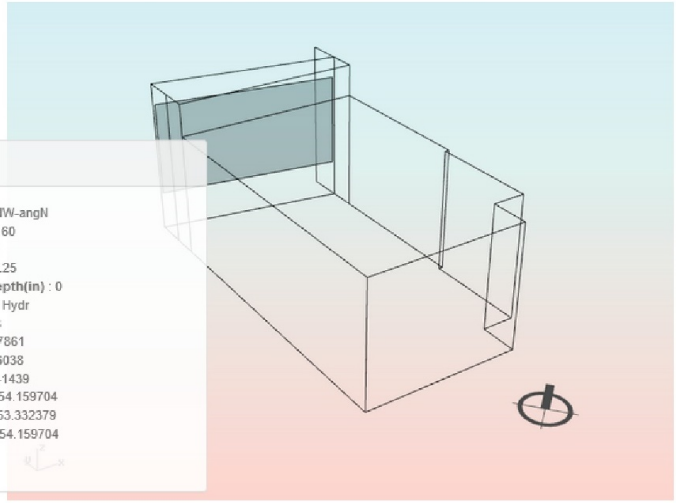
# PARAMETRIC EARLY ENERGY MODEL

DesignExplorer



# PARAMETRIC EARLY ENERGY MODEL

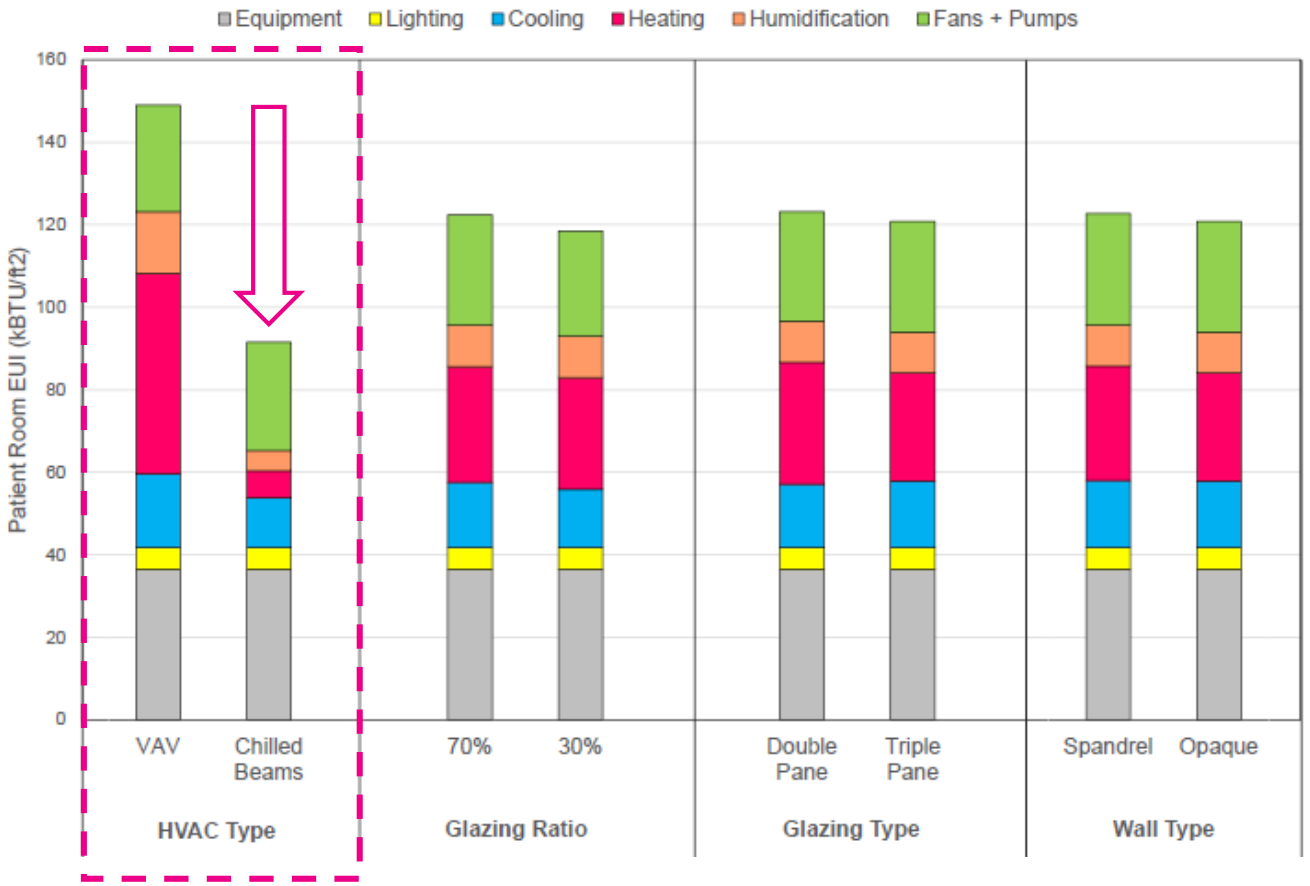


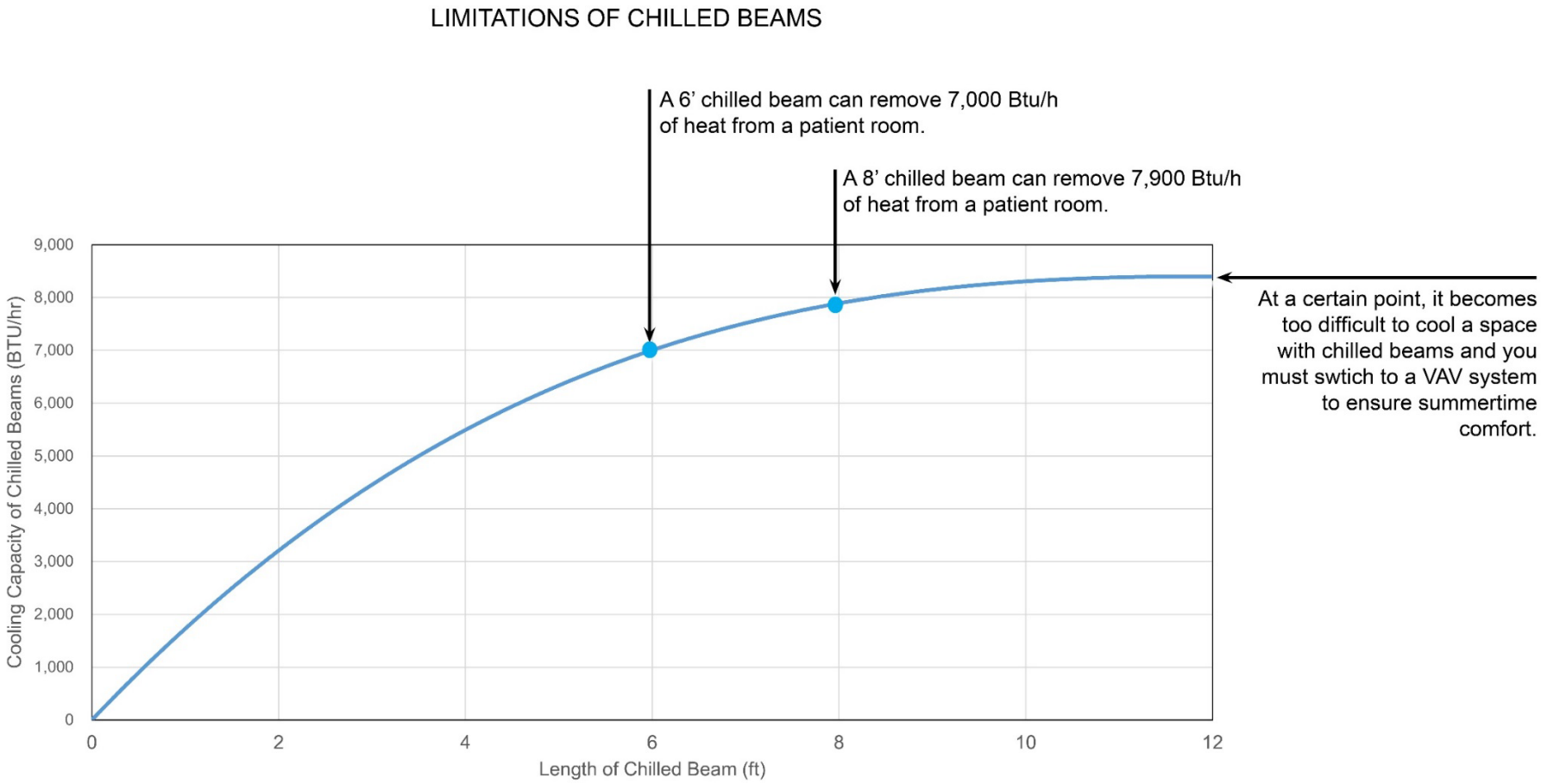
Attributes

**Orientation** : NW-angN
**GlazingRatio** : 60
**R-Value(IP)** : 8
**U-Value(IP)** : 0.25
**Vertical Fin Depth(in)** : 0
**SystemType** : Hydr
**EUI** : 83.785338
**Cooling** : 9.157861
**Heating** : 6.886038
**Electric** : 67.741439
**PeakCool** : 8254.159704
**PeakHeat** : 3353.332379
**HVACsize** : 8254.159704
**Rating** : 0

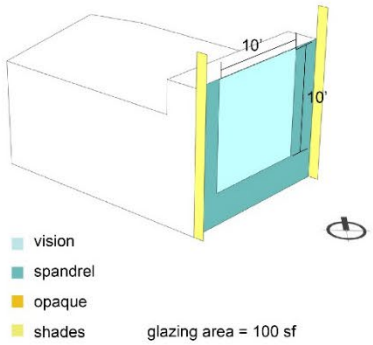
# THE IMPACT OF PARAMETERS

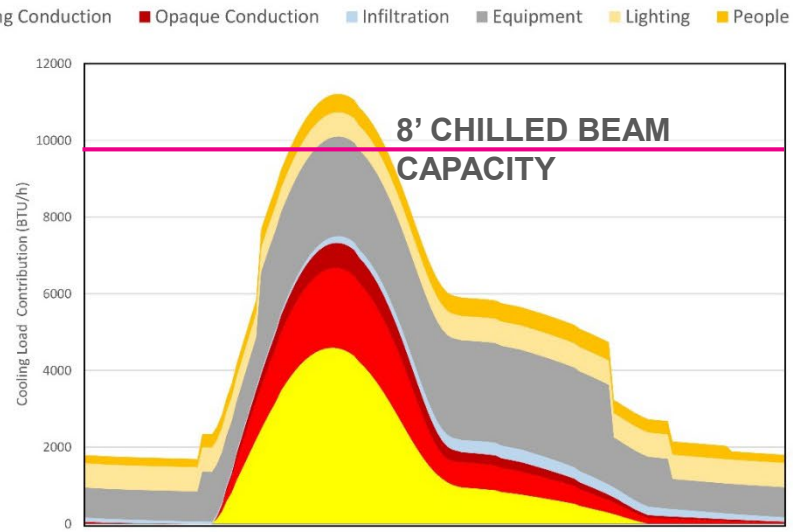


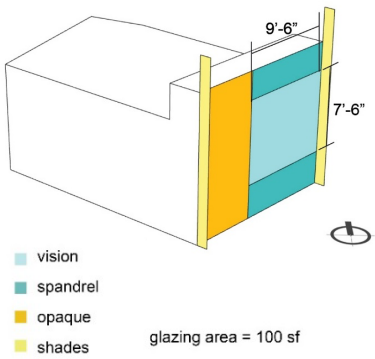
# PEAK LOADS & ENVELOPES

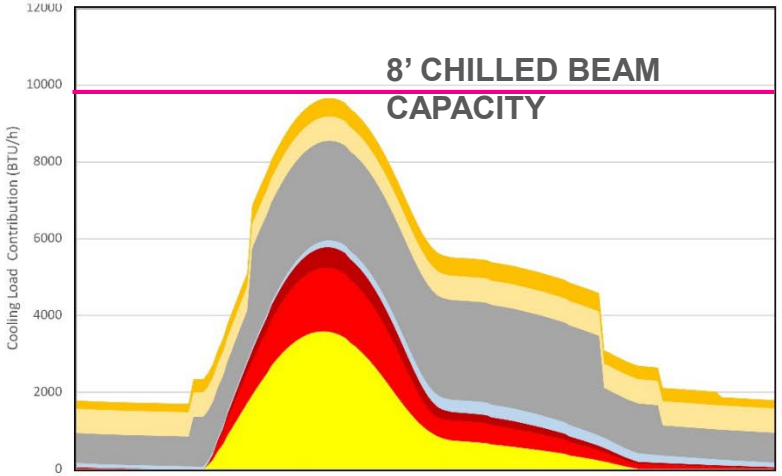


# PEAK LOADS & ENVELOPES

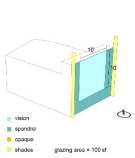


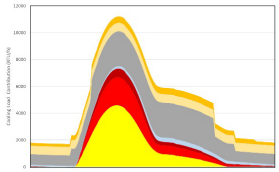



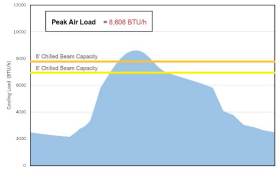



# ITERATING THROUGH DESIGN OPTIONS



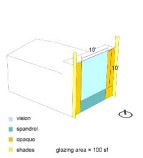

**SHGC** = 0.35
**U-Value** = 0.25 (triple pane)
**R-Value** (opaque) = 20
**R-Value** (spandrel) = 8

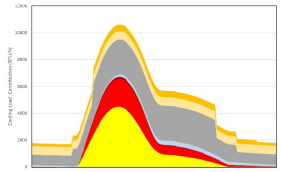
**Facade Breakdown** (from floor-to-floor)
40% vision
60% spandrel
0% opaque

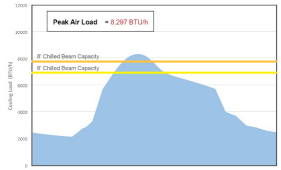
**Strategies to Explore to Meet Chilled Beam Capacity:**
Fritting on glazing to lower SHGC
SHGC of 0.26 brings peak air load to 7,489

AND/OR

CB with Variable Volume provides +/- 2,000 BTU/h additional cooling load



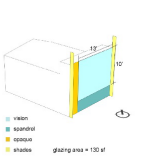

**SHGC** = 0.35
**U-Value** = 0.25 (triple pane)
**R-Value** (opaque) = 20
**R-Value** (spandrel) = 8

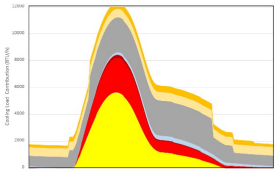
**Facade Breakdown** (from floor-to-floor)
39% vision
23% spandrel
38% opaque

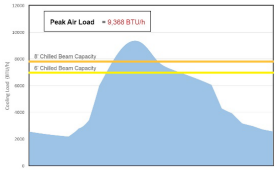
**Strategies to Explore to Meet Chilled Beam Capacity:**
Fritting on glazing to lower SHGC
SHGC of 0.26 brings peak air load to 7,203

AND/OR

CB with Variable Volume provides +/- 2,000 BTU/h additional cooling load



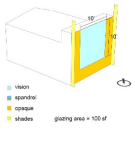

**SHGC** = 0.35
**U-Value** = 0.25 (triple pane)
**R-Value** (opaque) = 20
**R-Value** (spandrel) = 8

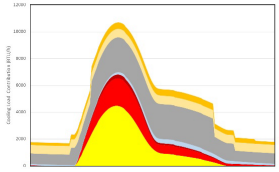
**Facade Breakdown** (from floor-to-floor)
50% vision
30% spandrel
20% opaque

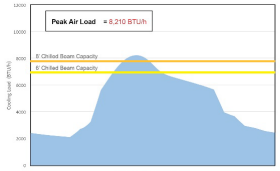
**Strategies to Explore to Meet Chilled Beam Capacity:**
Fritting on glazing to lower SHGC
SHGC of 0.26 brings peak air load to 7,977

AND

CB with Variable Volume provides +/- 2,000 BTU/h additional cooling load



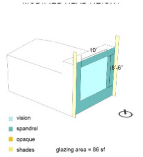

**SHGC** = 0.35
**U-Value** = 0.25 (triple pane)
**R-Value** (opaque) = 20
**R-Value** (spandrel) = 8

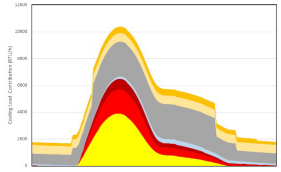
**Facade Breakdown** (from floor-to-floor)
40% vision
0% spandrel
60% opaque

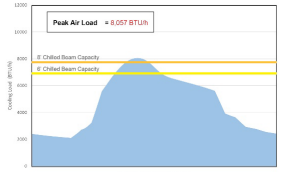
**Strategies to Explore to Meet Chilled Beam Capacity:**
Fritting on glazing to lower SHGC
SHGC of 0.26 brings peak air load to 7,115

AND/OR

CB with Variable Volume provides +/- 2,000 BTU/h additional cooling load



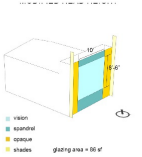

**SHGC** = 0.35
**U-Value** = 0.25 (triple pane)
**R-Value** (opaque) = 20
**R-Value** (spandrel) = 8

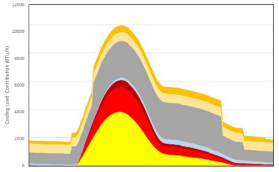
**Facade Breakdown** (from floor-to-floor)
34% vision
0% spandrel
0% opaque

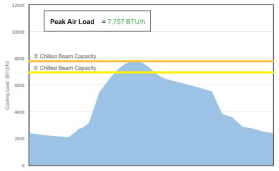
**Strategies to Explore to Meet Chilled Beam Capacity:**
Fritting on glazing to lower SHGC
SHGC of 0.26 brings peak air load to 7,106

AND/OR

CB with Variable Volume provides +/- 2,000 BTU/h additional cooling load



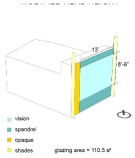



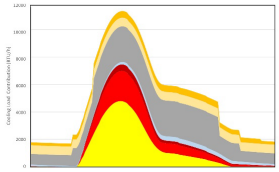



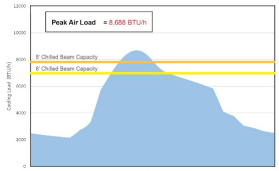

**SHGC** = 0.35
**U-Value** = 0.25 (triple pane)
**R-Value** (opaque) = 20
**R-Value** (spandrel) = 8

**Facade Breakdown** (from floor-to-floor)
34% vision
26% spandrel
38% opaque

**Strategies to Explore to Meet Chilled Beam Capacity:**
Fritting on glazing to lower SHGC
SHGC of 0.26 brings peak air load to 6,828



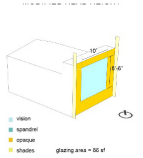

**SHGC** = 0.35
**U-Value** = 0.25 (triple pane)
**R-Value** (opaque) = 20
**R-Value** (spandrel) = 8

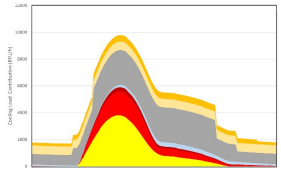
**Facade Breakdown** (from floor-to-floor)
43% vision
37% spandrel
20% opaque

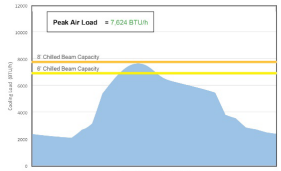
**Strategies to Explore to Meet Chilled Beam Capacity:**
Fritting on glazing to lower SHGC
SHGC of 0.26 brings peak air load to 7,505

AND/OR

CB with Variable Volume provides +/- 2,000 BTU/h additional cooling load



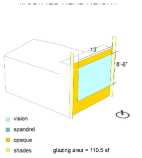



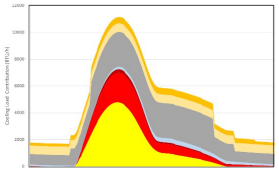



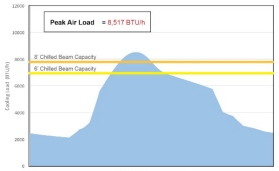

**SHGC** = 0.35
**U-Value** = 0.25 (triple pane)
**R-Value** (opaque) = 20
**R-Value** (spandrel) = 8

**Facade Breakdown** (from floor-to-floor)
34% vision
0% spandrel
66% opaque

**Strategies to Explore to Meet Chilled Beam Capacity:**
Fritting on glazing to lower SHGC
SHGC of 0.26 brings peak air load to 6,695




**SHGC** = 0.35
**U-Value** = 0.25 (triple pane)
**R-Value** (opaque) = 20
**R-Value** (spandrel) = 8

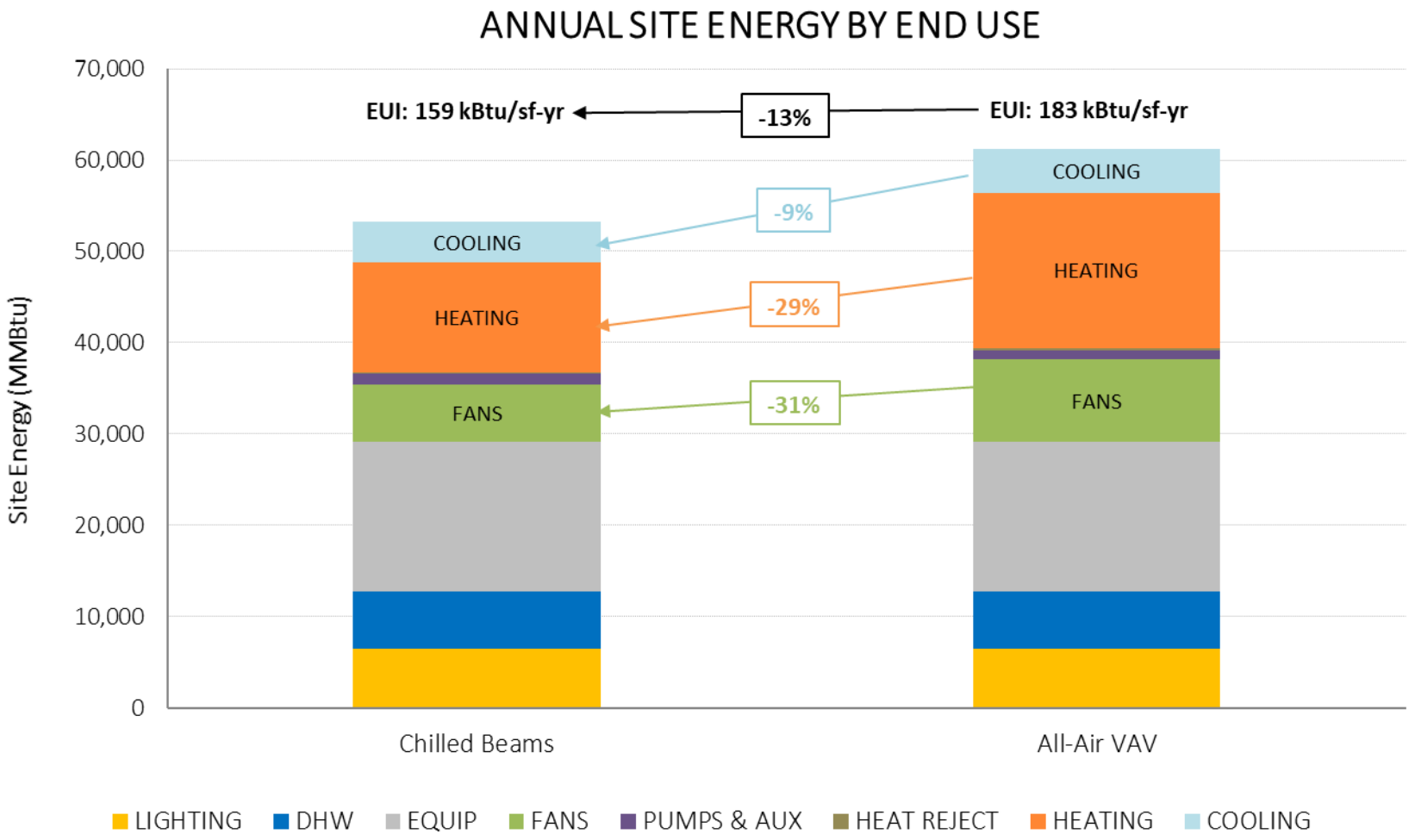
**Facade Breakdown** (from floor-to-floor)
43% vision
0% spandrel
57% opaque

**Strategies to Explore to Meet Chilled Beam Capacity:**
Fritting on glazing to lower SHGC
SHGC of 0.26 brings peak air load to 7,333

AND/OR

CB with Variable Volume provides +/- 2,000 BTU/h additional cooling load

# ENERGY SAVINGS FOR OPTIMIZED DESIGN



# SUMMARY OF LESSONS LEARNED

- Communication
  - Internal
  - With consultants
  - With Owner
- Iterative Process
- Specialize in what you know best - right tools for right people on the team
- Focus efforts on critical components