

N C I   P H O E N I X

MAJED ALBAKR  
MUNAZZA BHATTI



PHOENIX, AZ

1.51 MILLION

38



POPULATION

WALK SCORE

BLOCK SIZE

DENSITY

TRANSPORTATION



PHILADELPHIA, PA

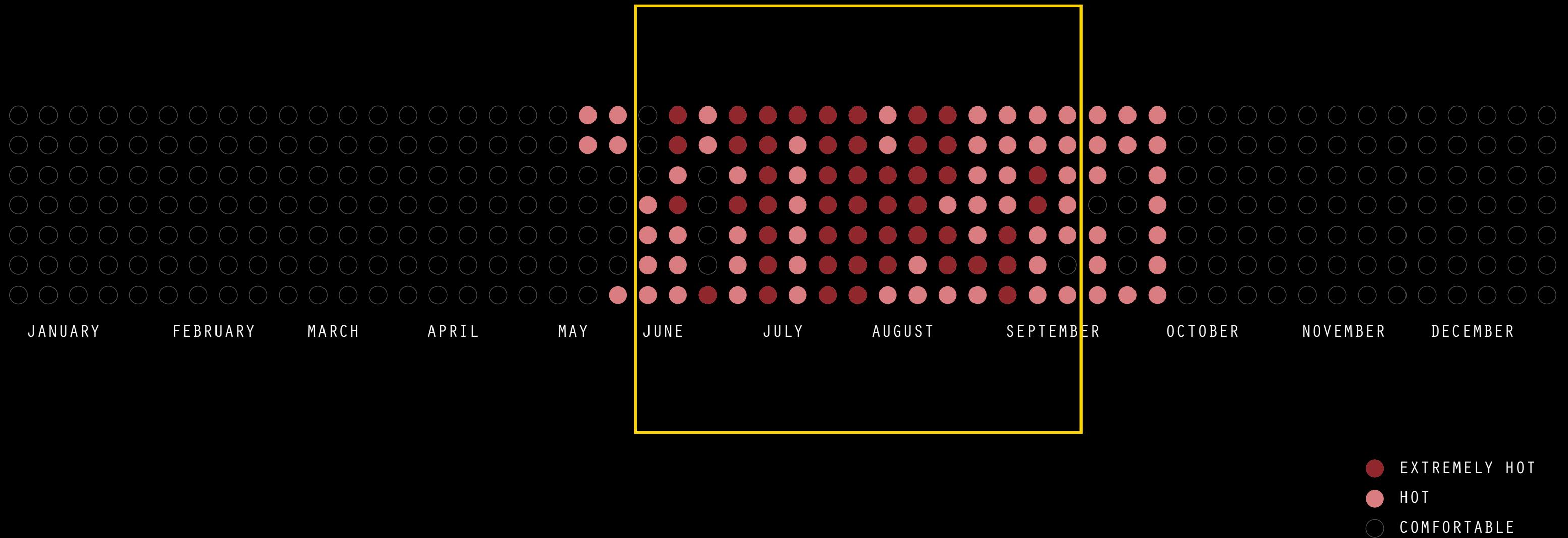
1.55 MILLION

77

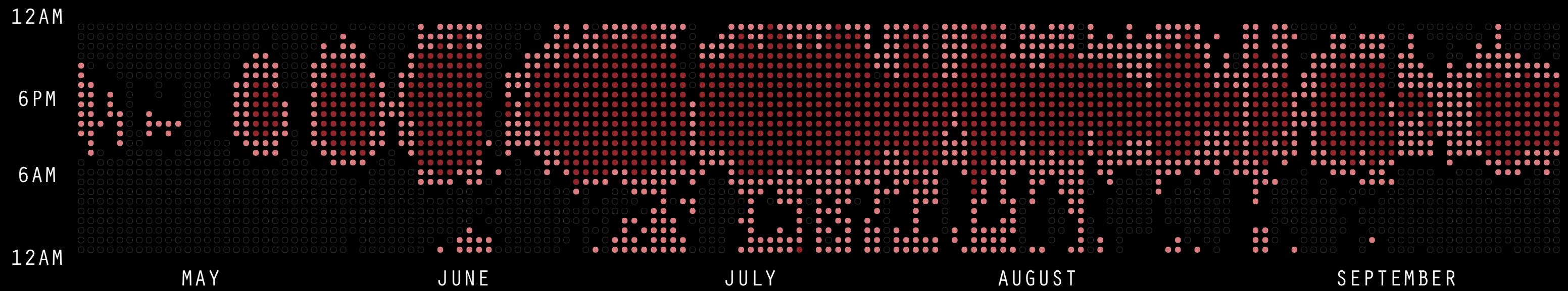




# OUTDOOR COMFORT



# UNDER SHADE COMFORT

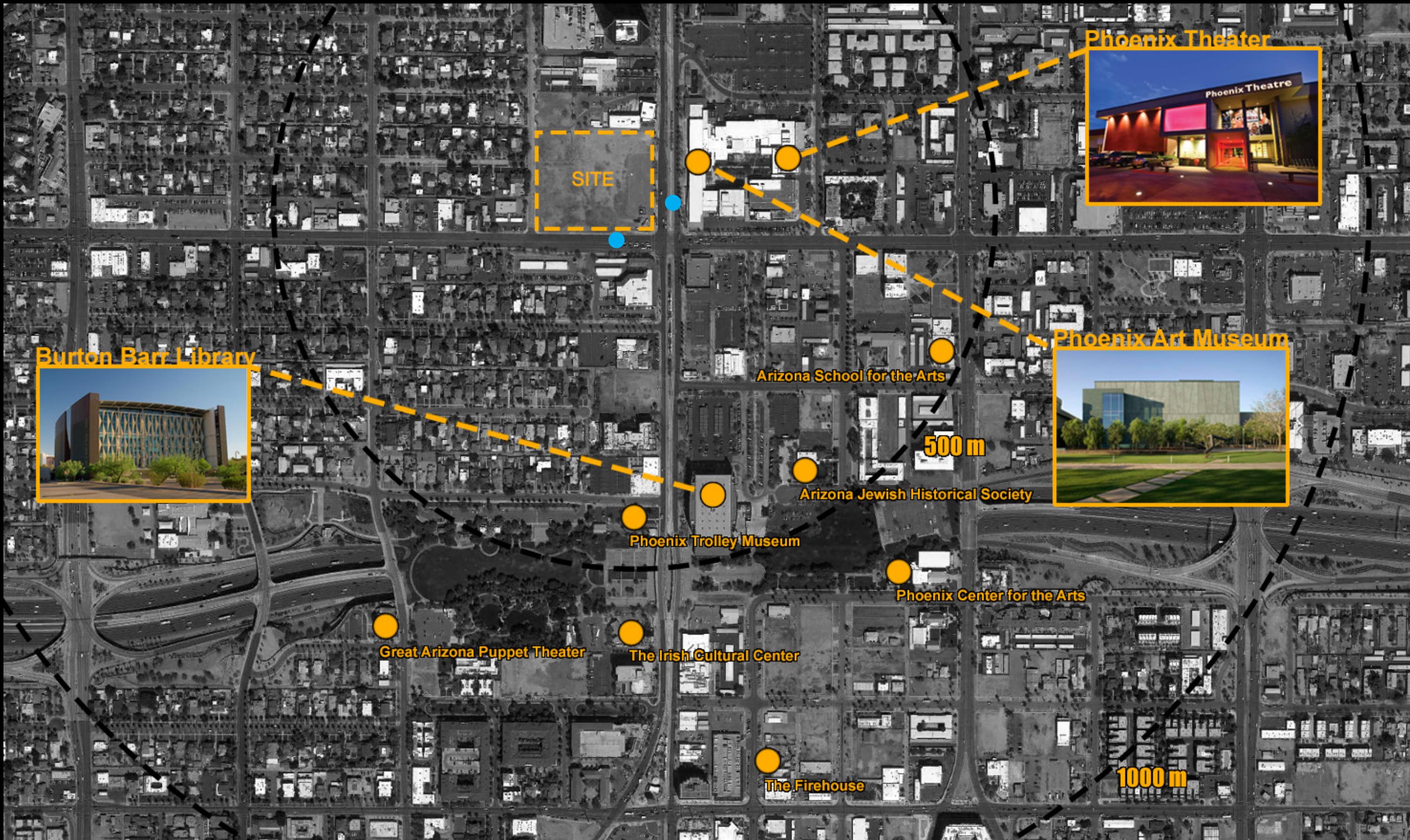


BETWEEN MAY AND SEPTEMBER  
30.5% TIME COMFORTABLE

- EXTREMELY HOT
- HOT
- COMFORTABLE

# SITE & PROGRAM



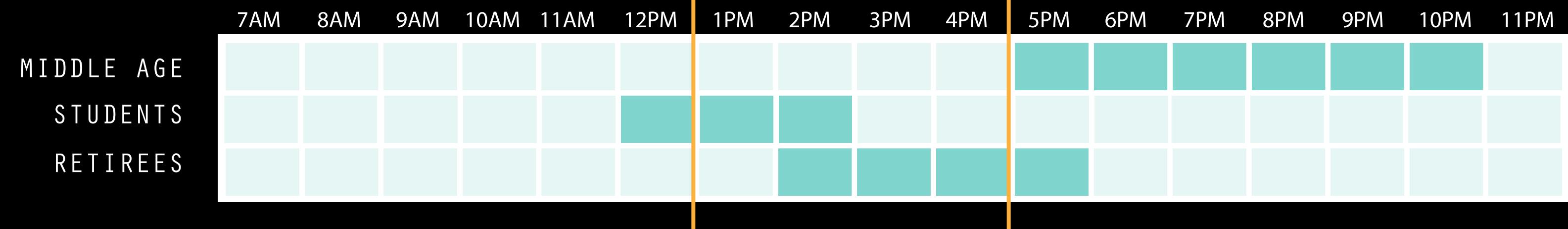


37.7% 0 - 24  
53.3% 25 - 64  
9.1% 65 AND OVER

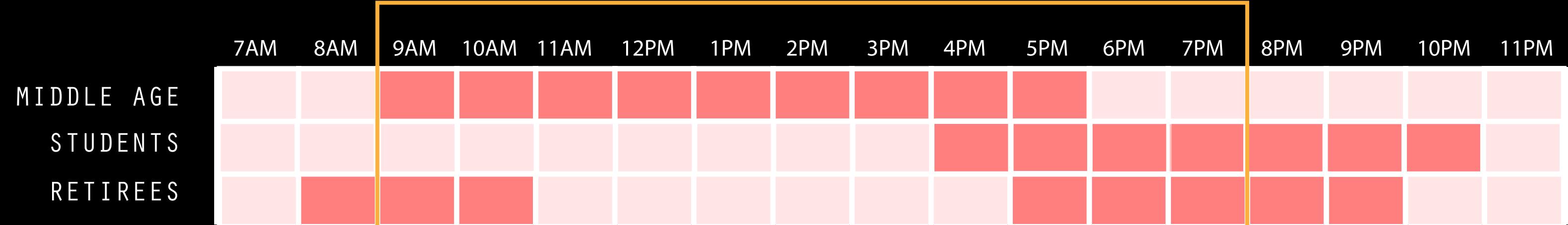
### WINTER WEEKDAY SCHEDULES



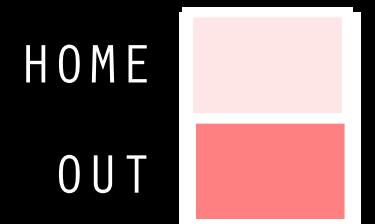
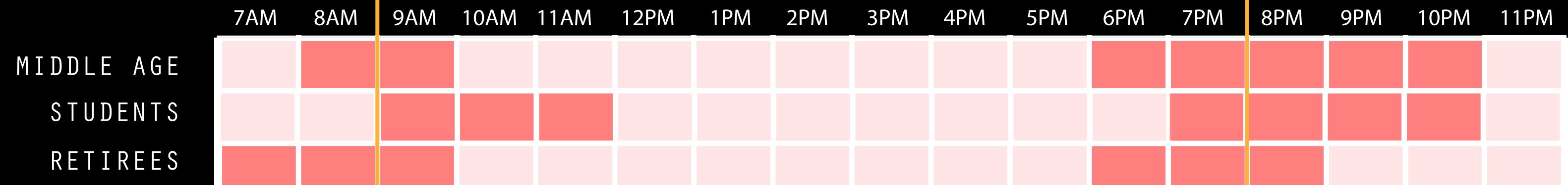
### WINTER WEEKEND SCHEDULES



## SUMMER WEEKDAY SCHEDULES



## SUMMER WEEKEND SCHEDULES



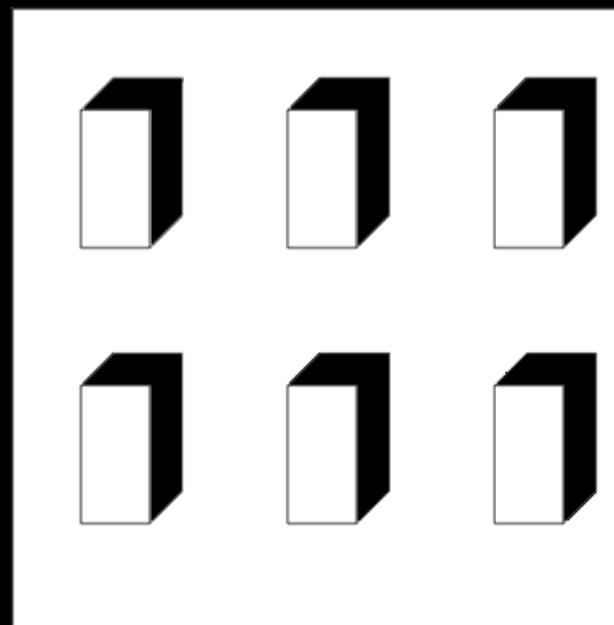


CONNECTION

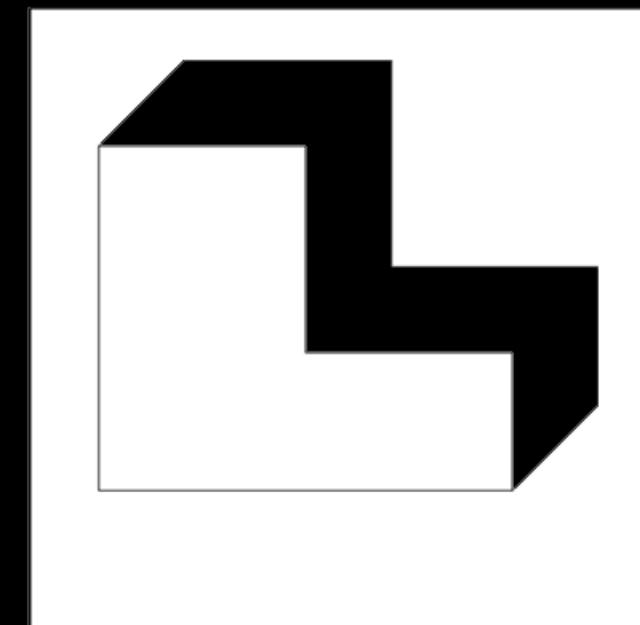
Image: Landsat

Google Earth

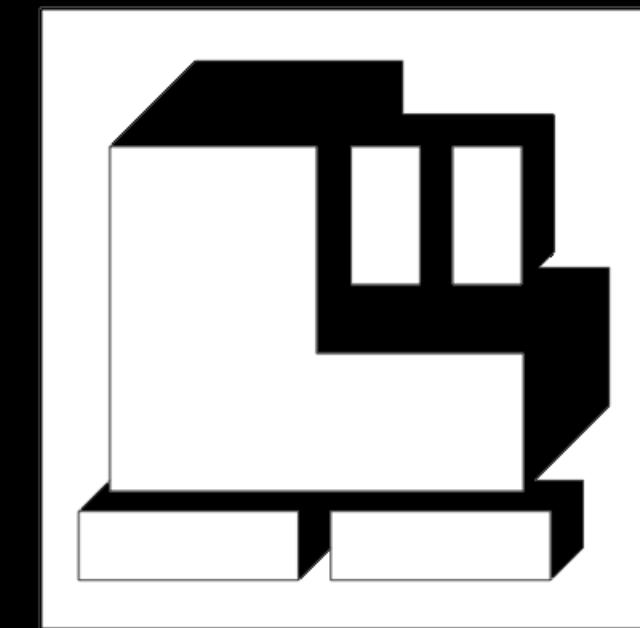
# URBAN DENSITY



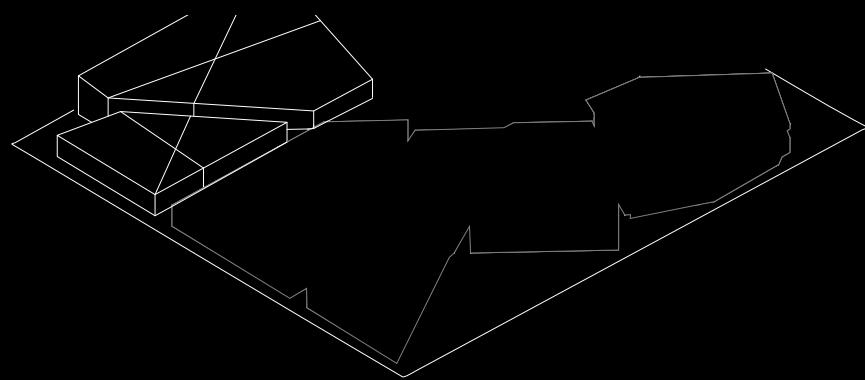
TYPICAL RESIDENTIAL FABRIC  
(MINIMAL SHADING)

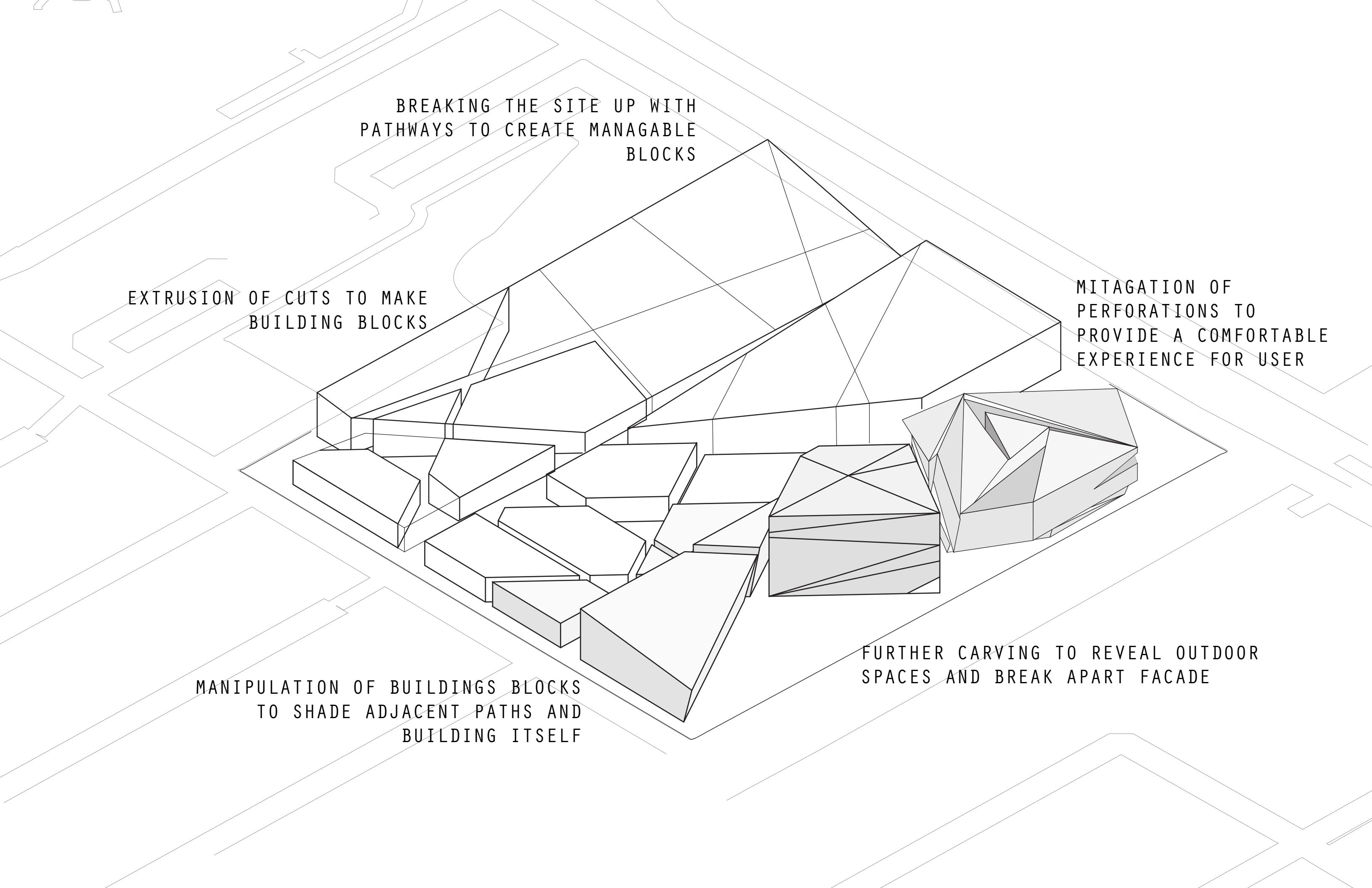


TYPICAL COMMERCIAL BUILDING  
(ACCEPTABLE SHADING)

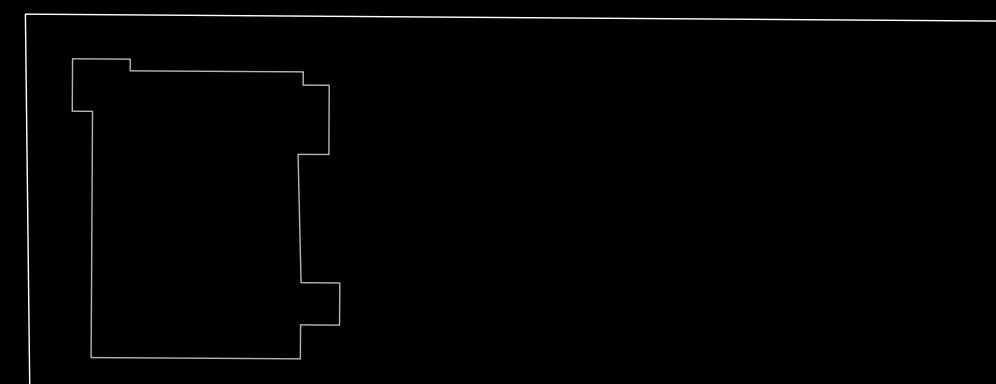
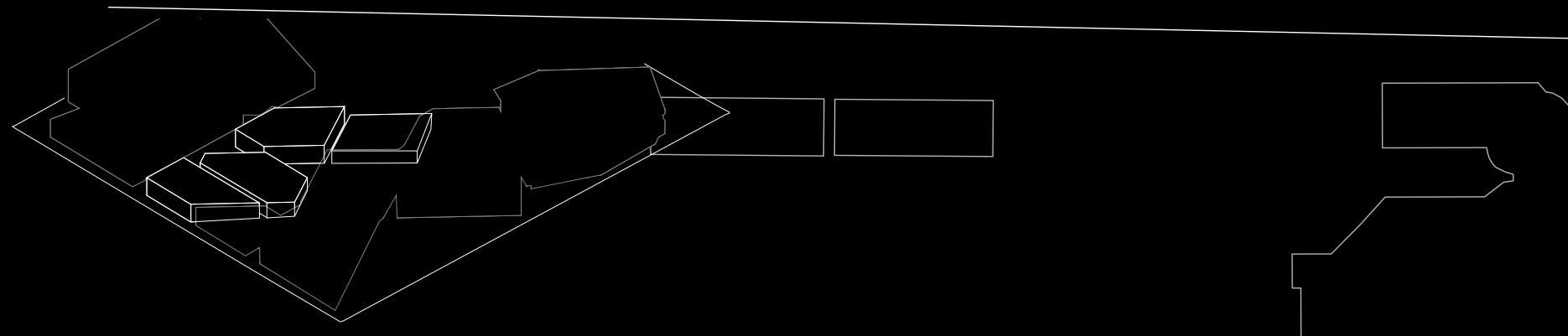
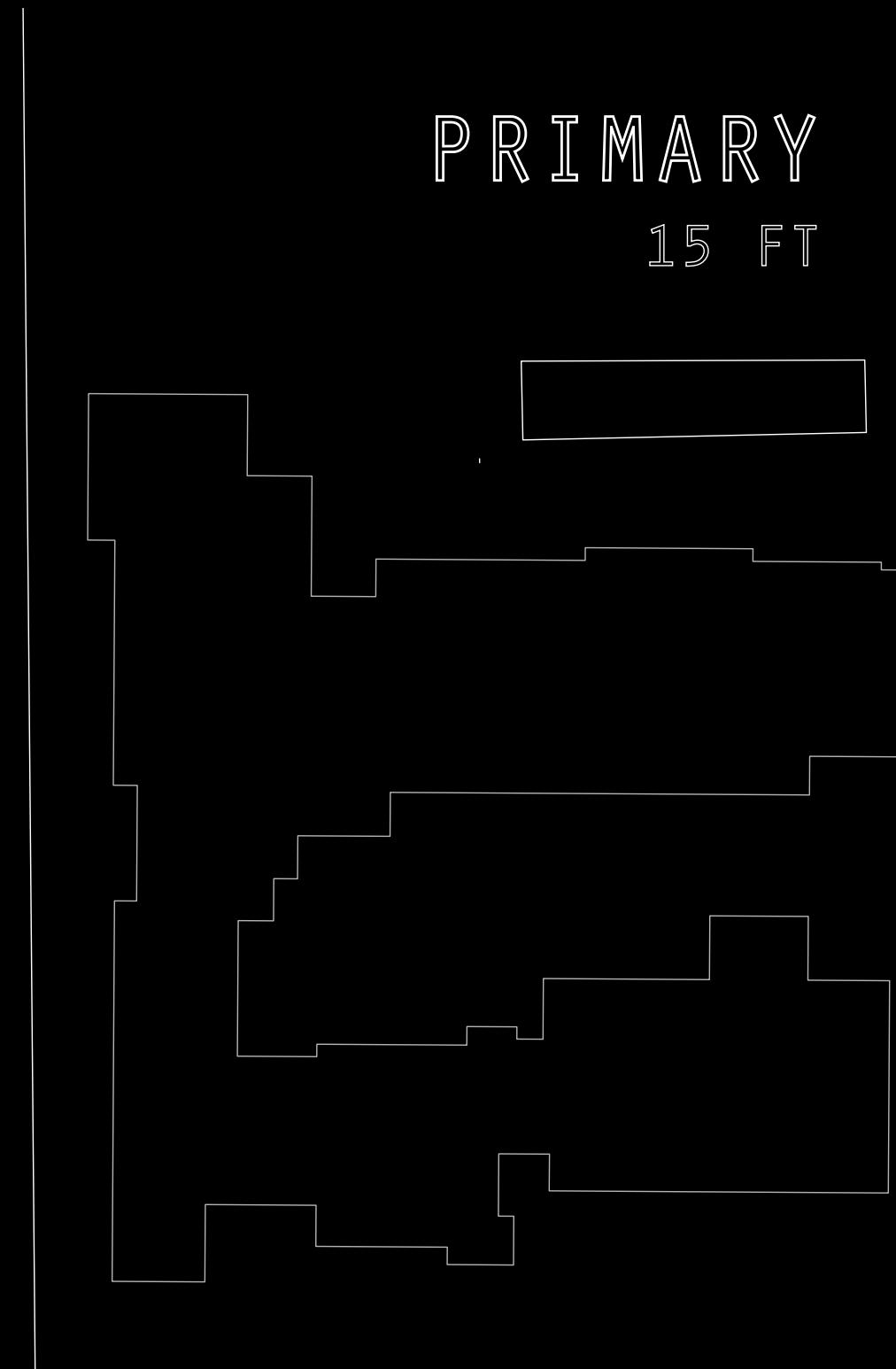
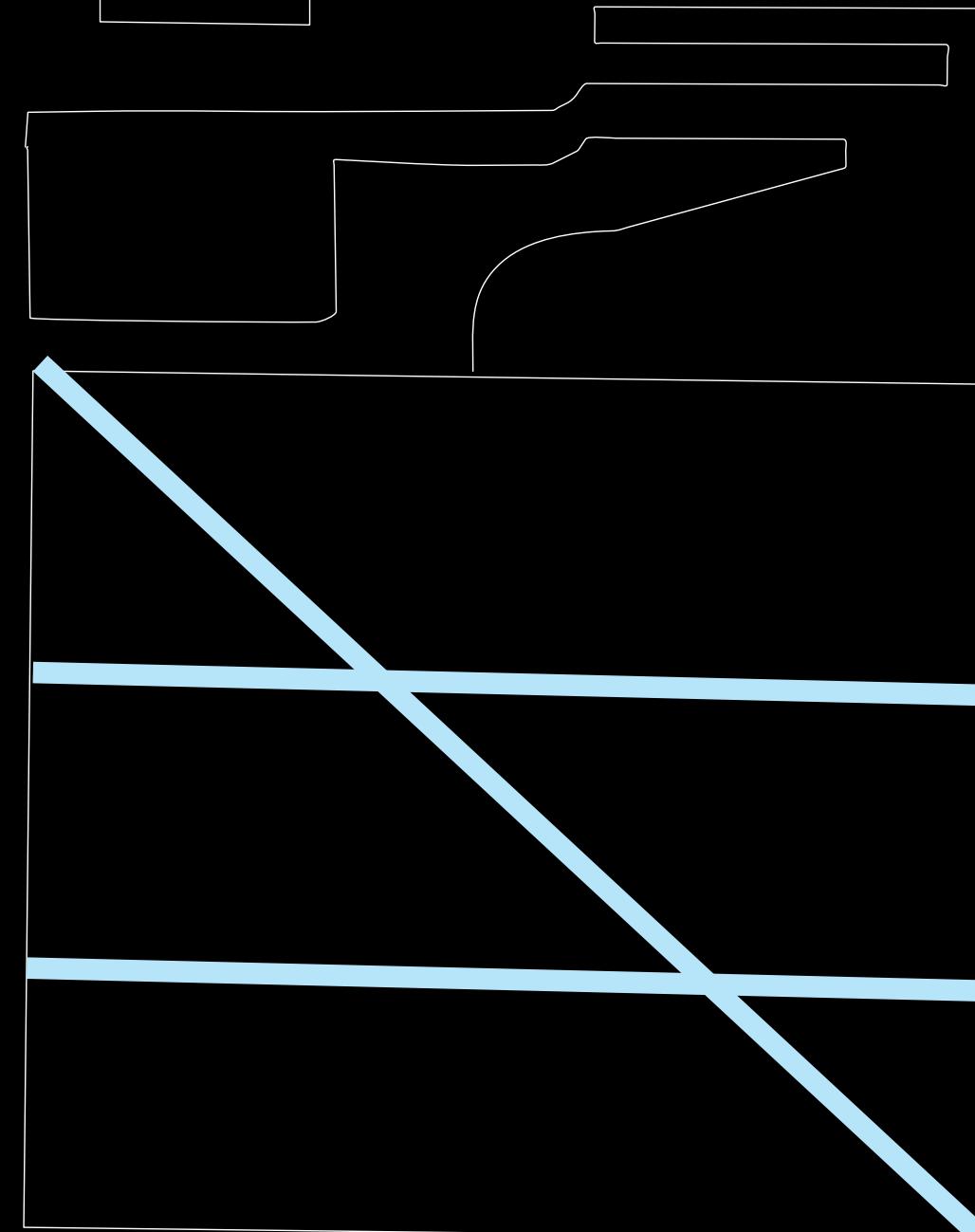


NARROW FABRIC OF MULTIPLE  
BUILDINGS  
(SUFFICIENT SHADING)



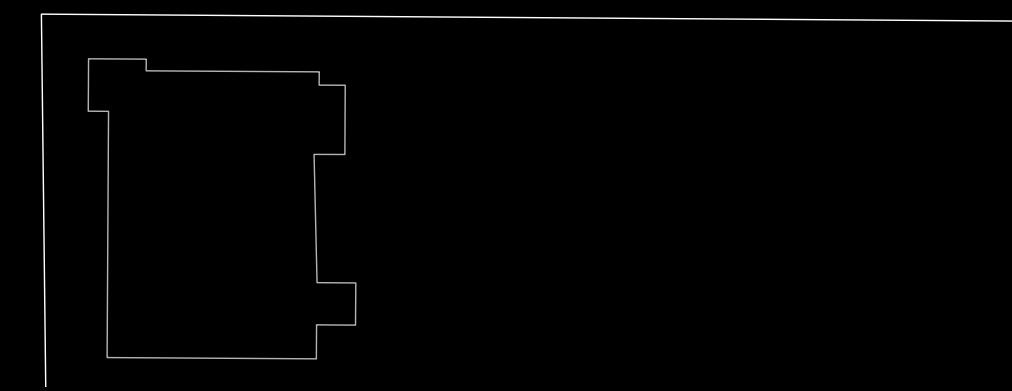
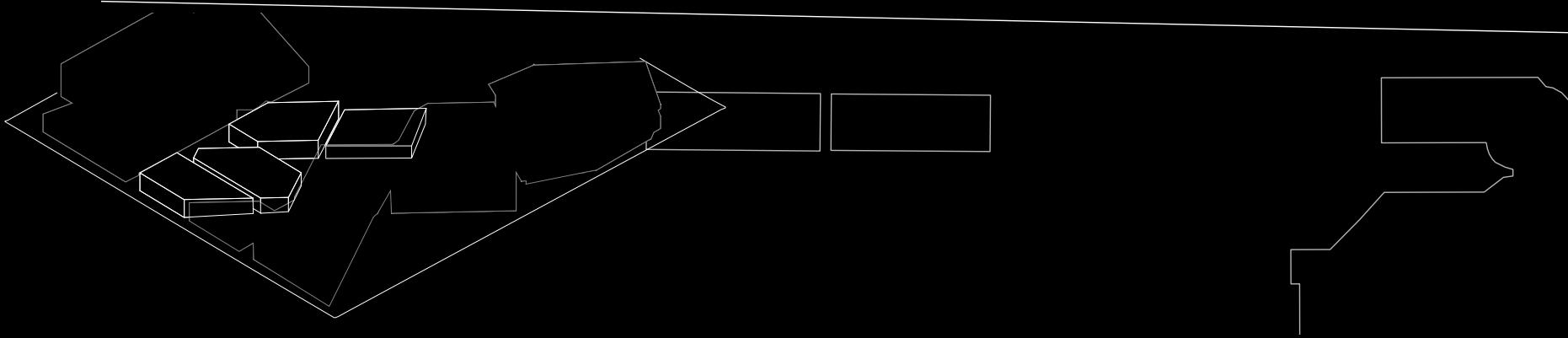
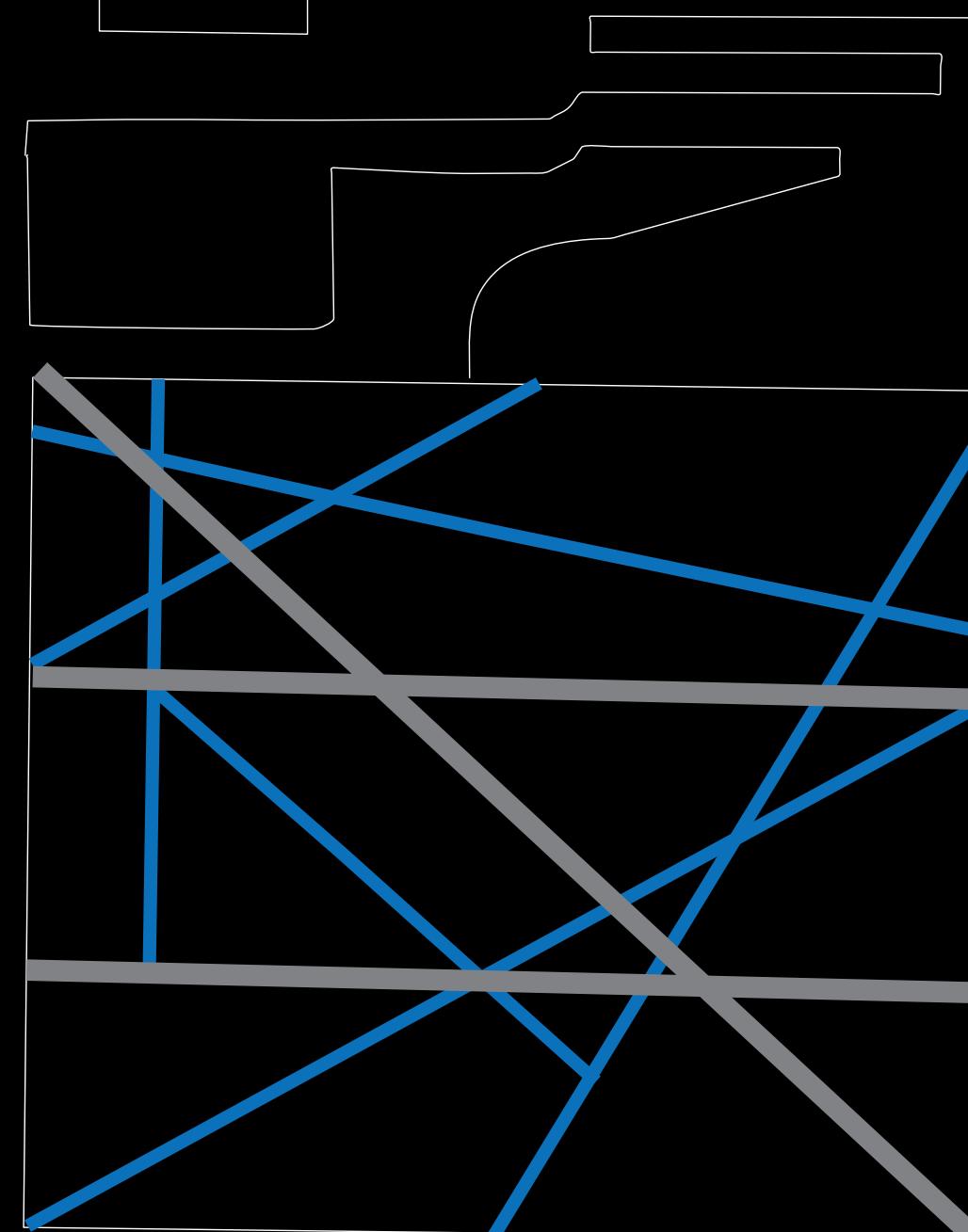


PRIMARY  
15 FT



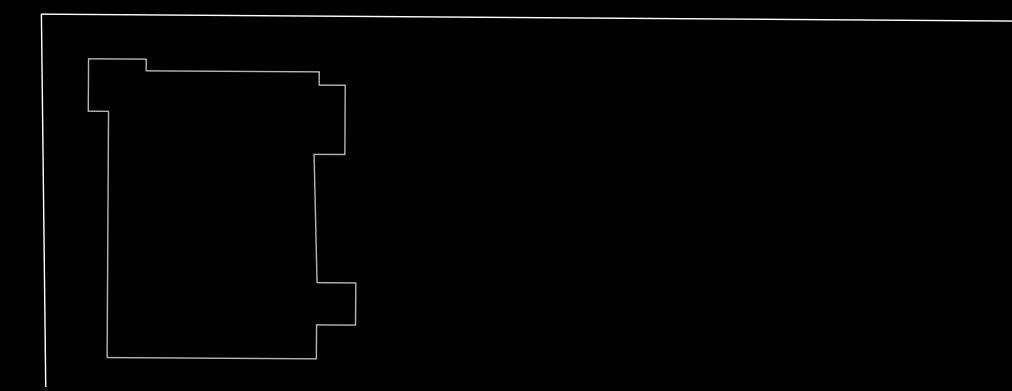
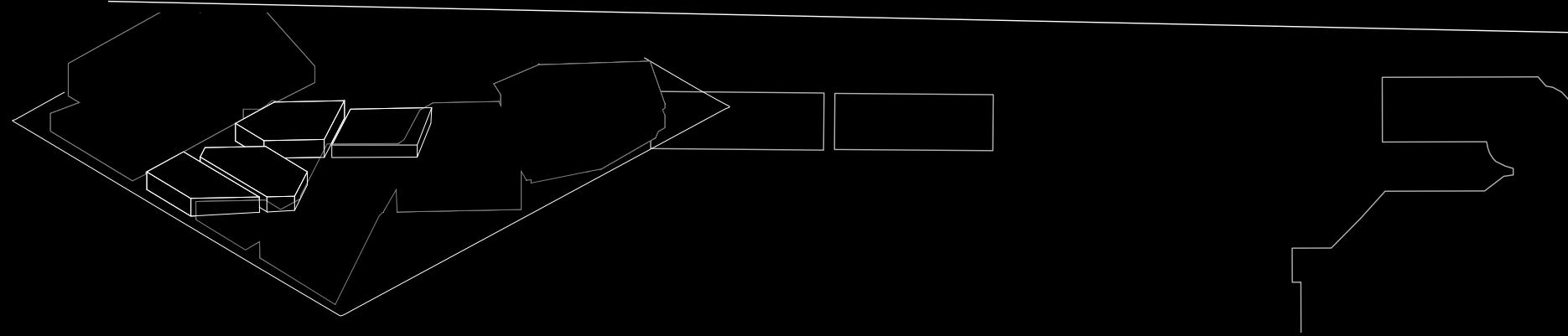
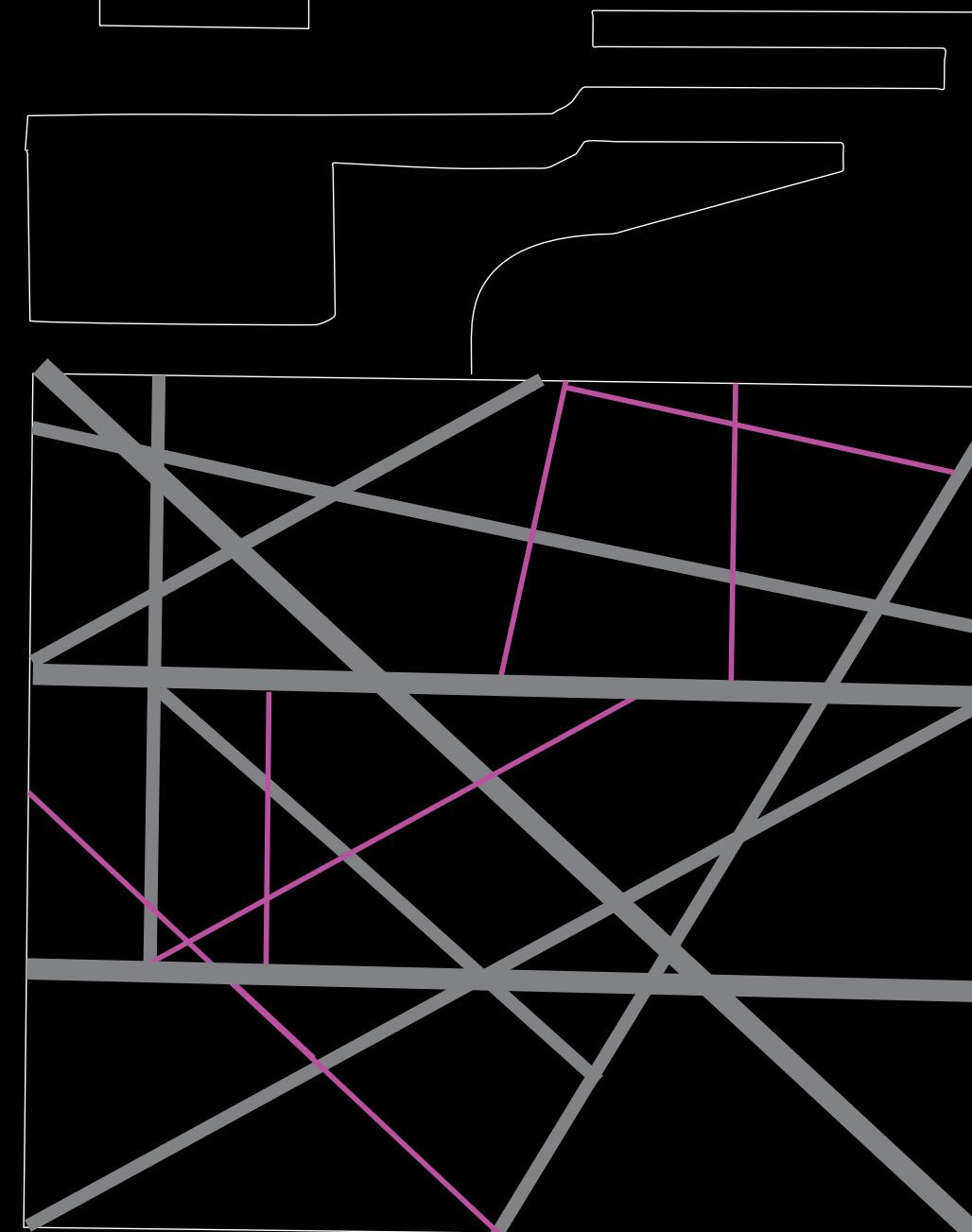
SECONDARY

12 FT



TERTIARY

9 FT

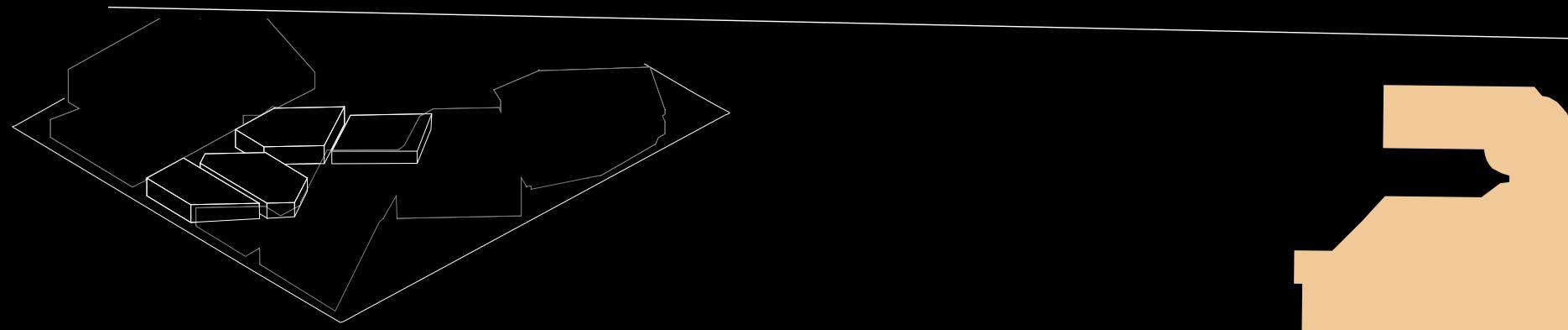
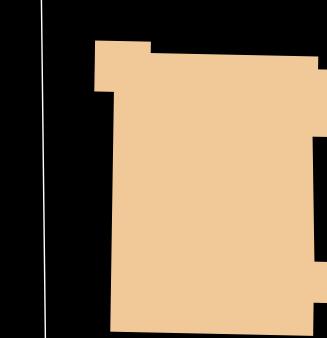
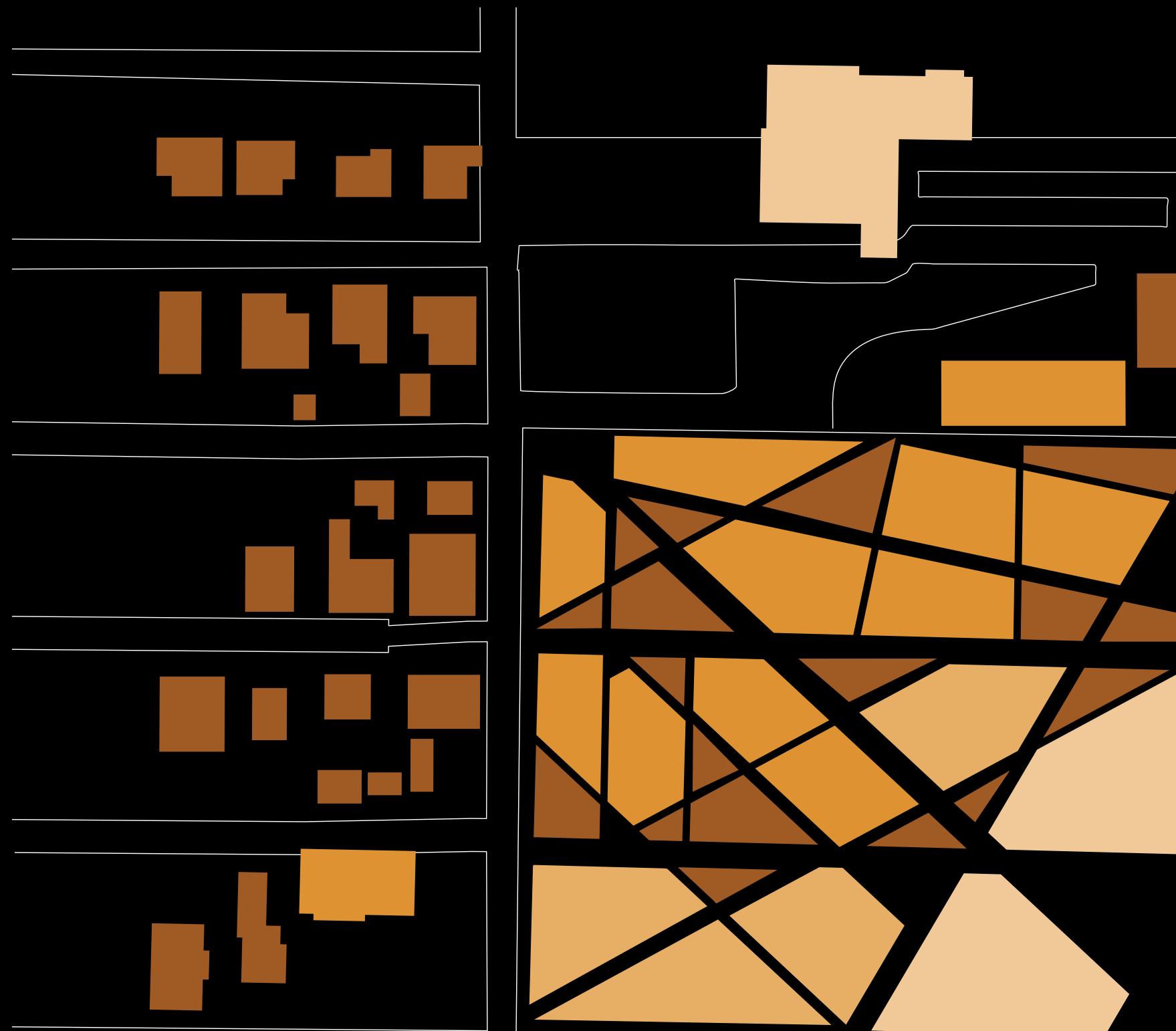


# BUILDING SIZE

< 5,000 sqft



> 15,000 sqft

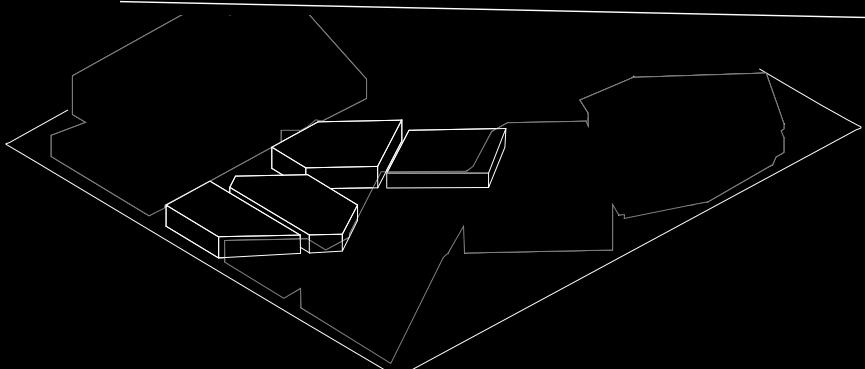
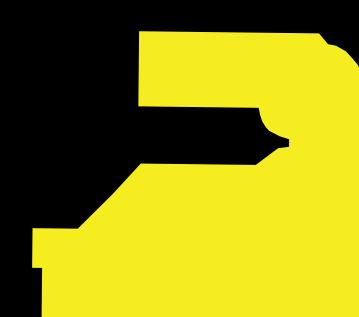
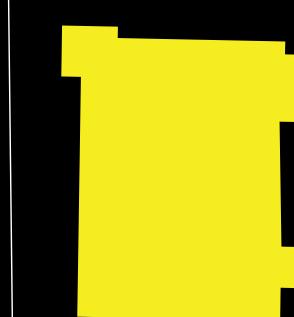
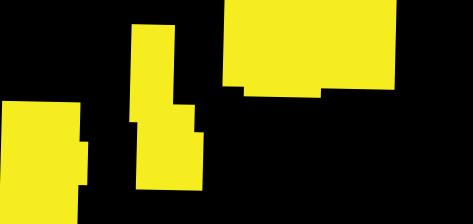
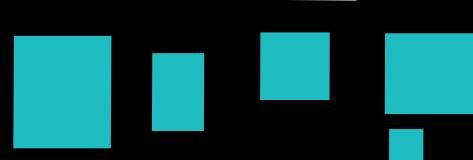
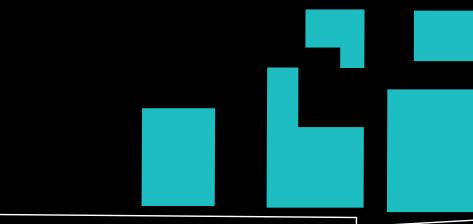
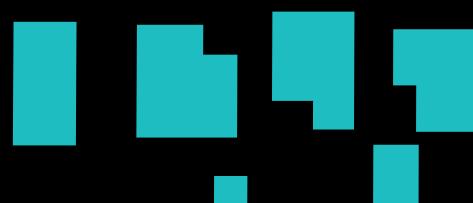


# PROGRAM

RESIDENTIAL



COMMERCIAL



# ENVIRONMENTAL SOLUTIONS

- 1 MANAGE SOLAR GAIN
- 2 INCREASE AIR FLOW

TO OBTAIN A FURTHER UNDERSTANDING ABOUT ON HOW TO CREATE THE IDEAL CONDITIONS IN THE SITE, AN INVESTIGATION HAS BEEN CONDUCTED USING "DESIGN EXPLORER" TO DETERMINE WHICH COMBINATION OF VARIABLES ARE CAPABLE OF ACHIEVING THE DESIRED CONDITIONS, WHICH ARE:

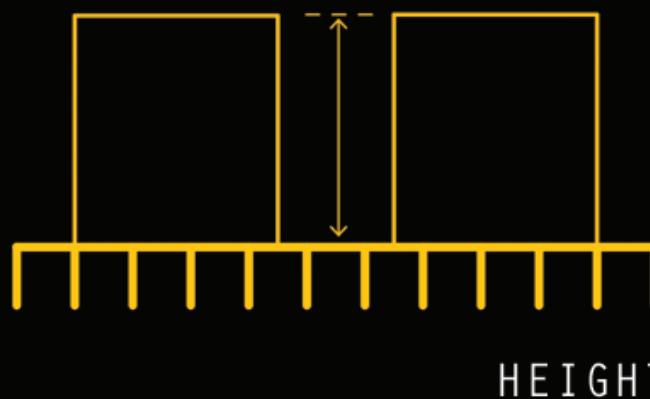
- INCREASING OUTDOOR COMFORT
- DECREASING HEAT STRESS
- SUFFICIENT INDOOR DAYLIGHTING

## OUTPUTS

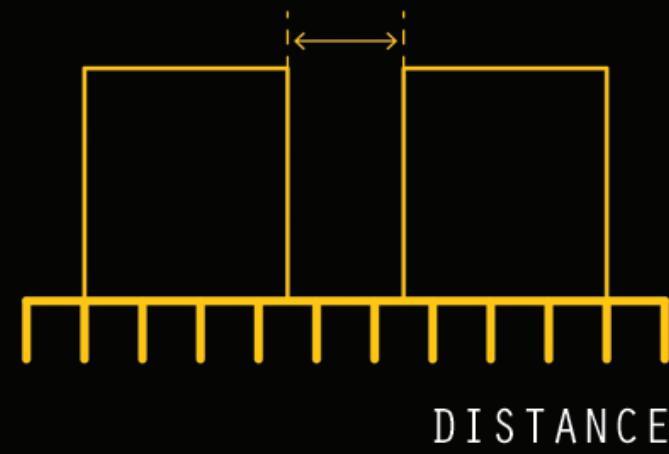
BUILDING A : AVG  
DAYLIGHT FACTOR ABOVE 2%

BUILDING B : AVG  
DAYLIGHT FACTOR ABOVE 2%

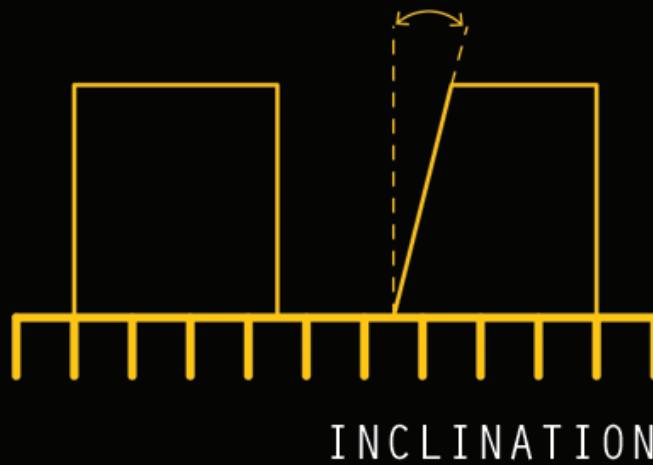
## PARAMETERS TO INVESTIGATE:



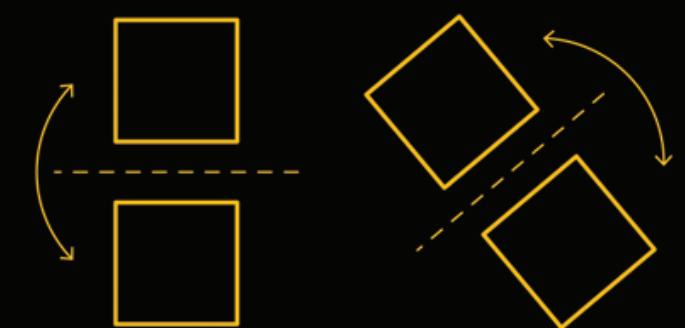
HEIGHT



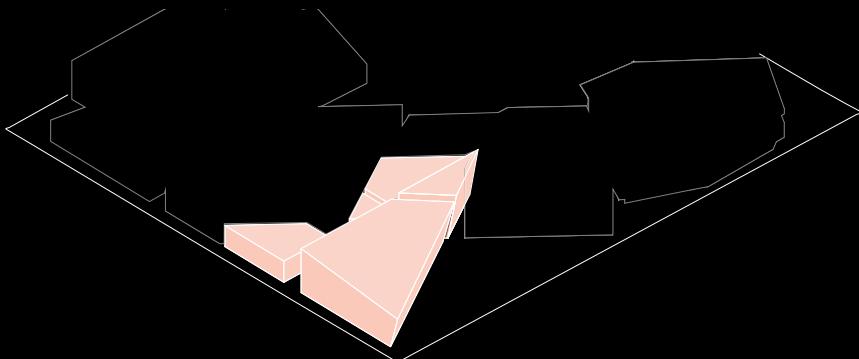
DISTANCE

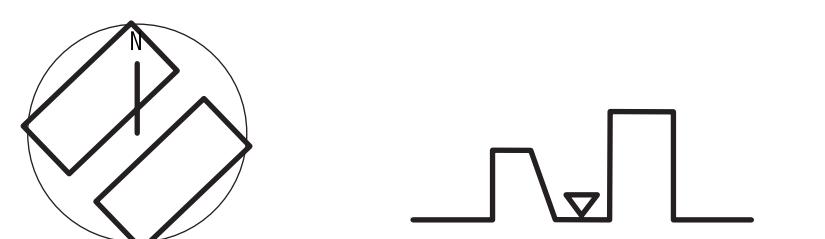
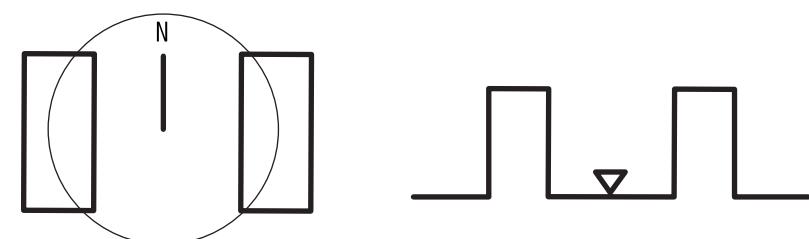
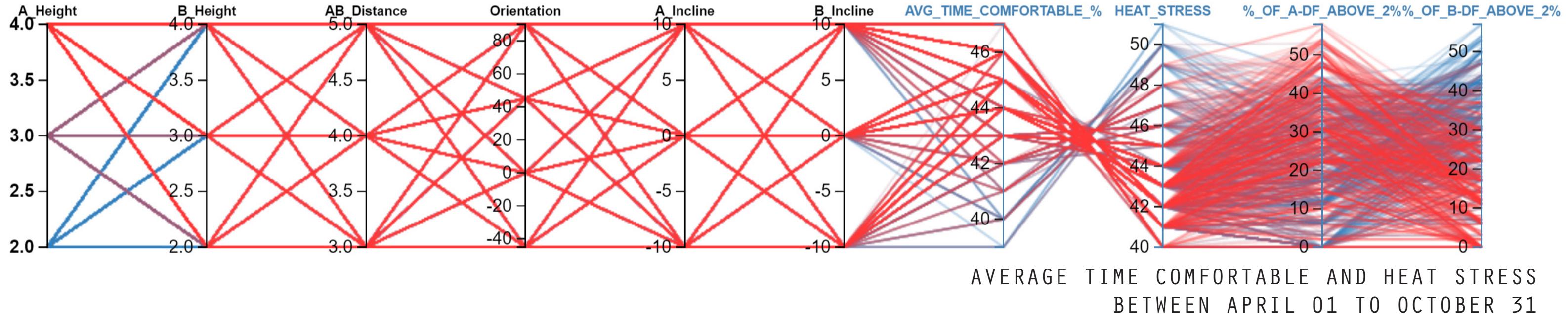


INCLINATION



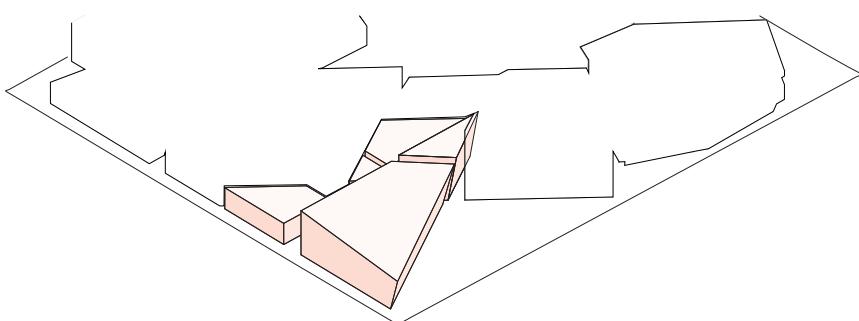
ORIENTATION





BETWEEN APRIL 01 TO OCTOBER 31  
AVG TIME COMFORTABLE : 37%  
HEAT STRESS : 53%

BETWEEN APRIL 01 TO OCTOBER 31  
AVG TIME COMFORTABLE : 46%  
HEAT STRESS : 42%

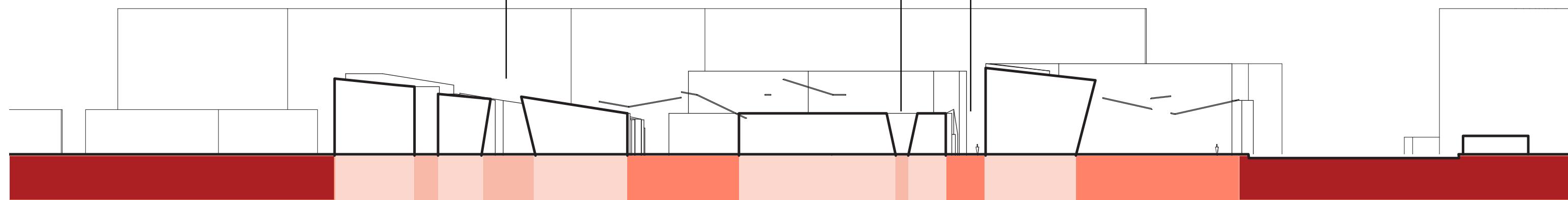


BUILDING  
TYPE

WIDE PATH  
INWARD

NARROW PATH  
OUTWARD

PERPENDICULAR

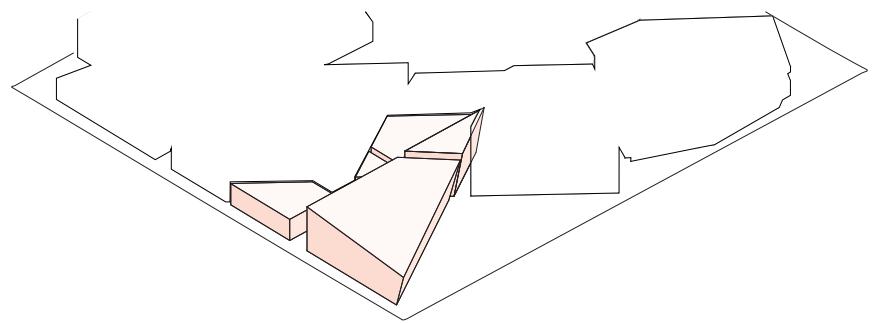


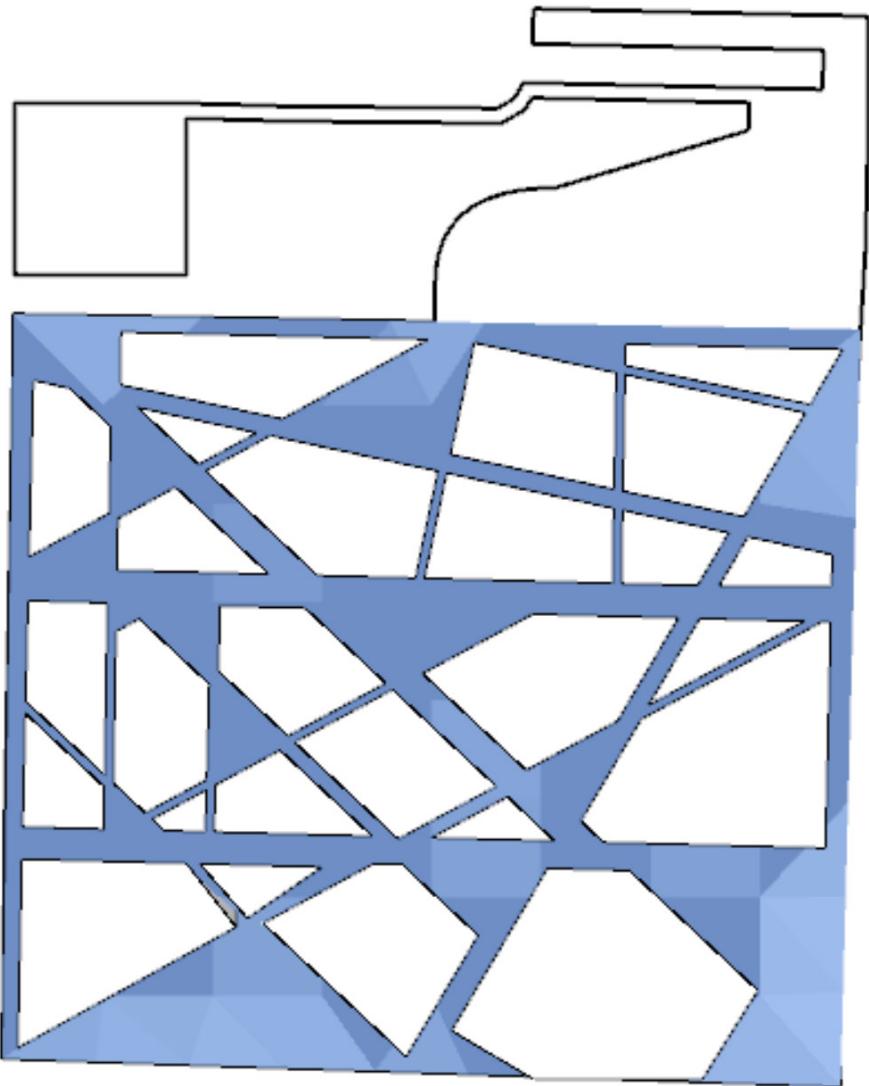
HEAT STRESS

43 - 45%

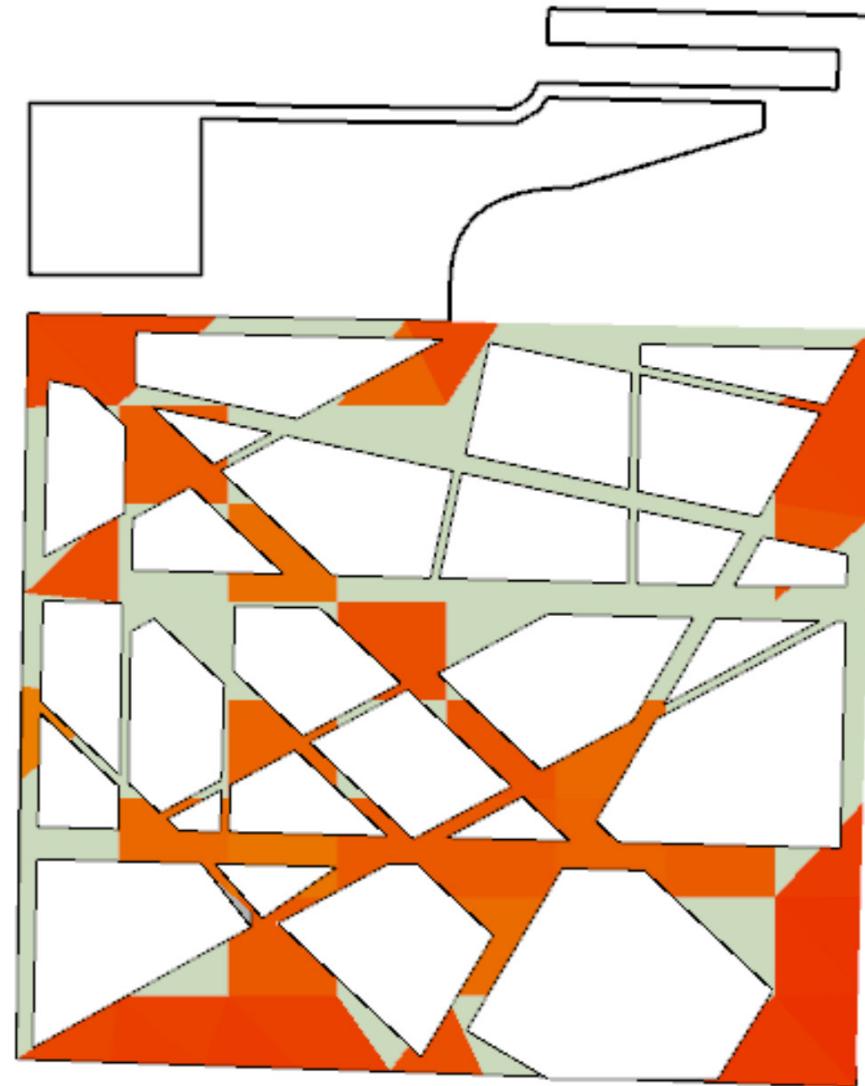
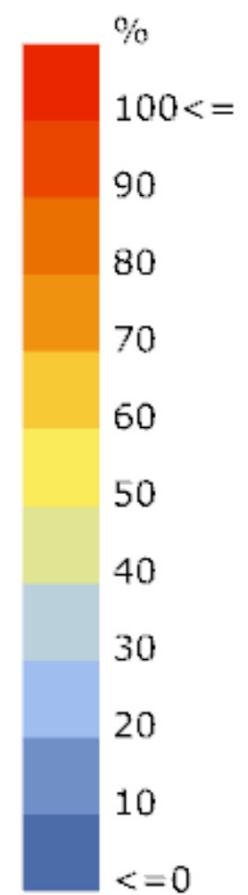
46 - 49%

>50%

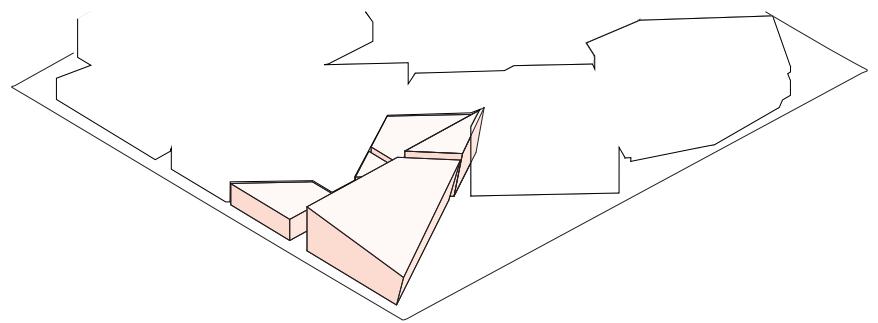
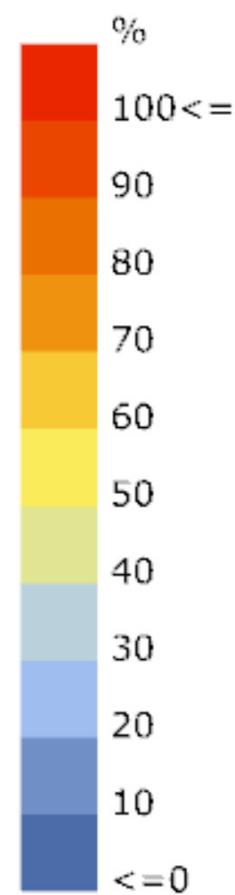


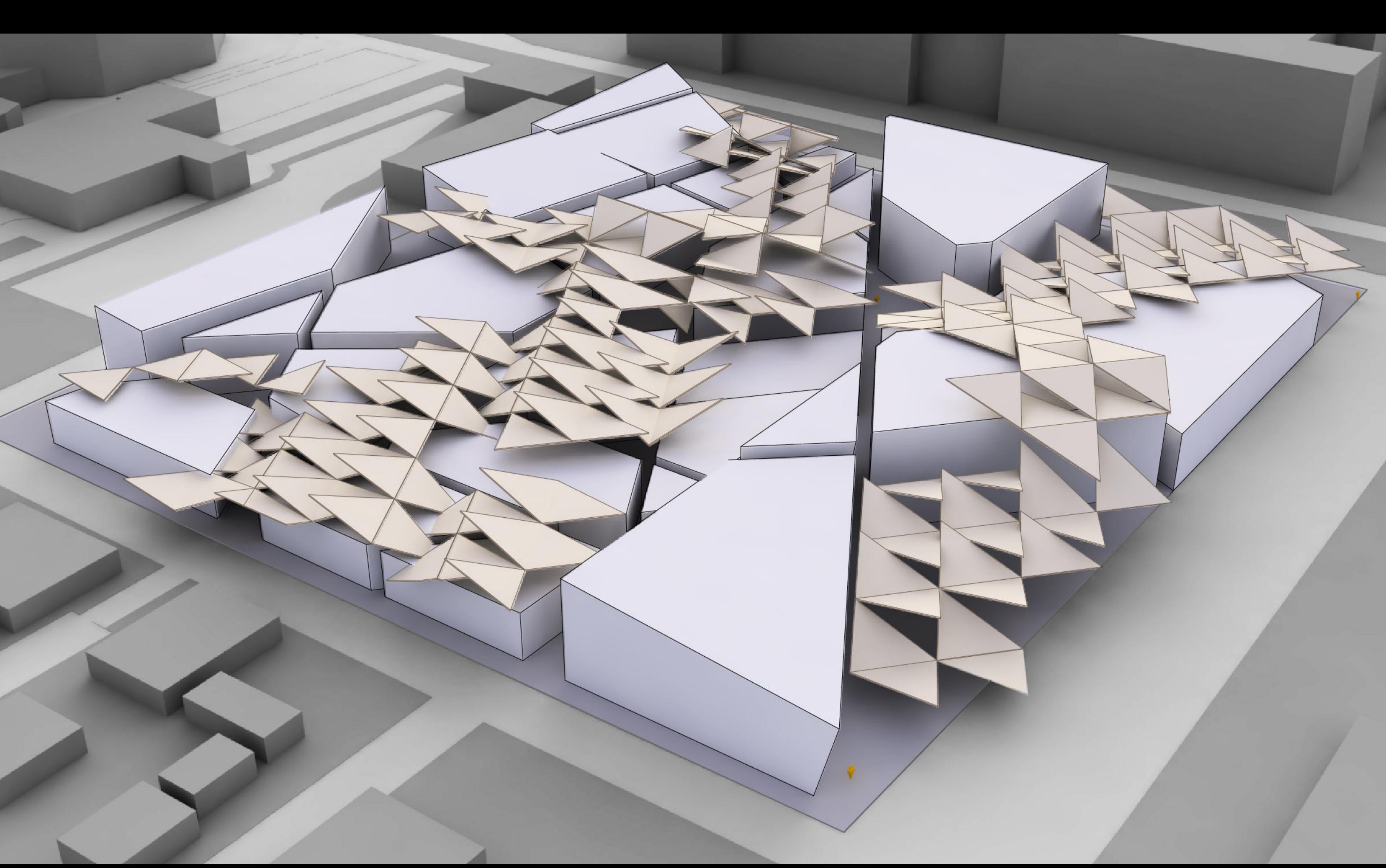


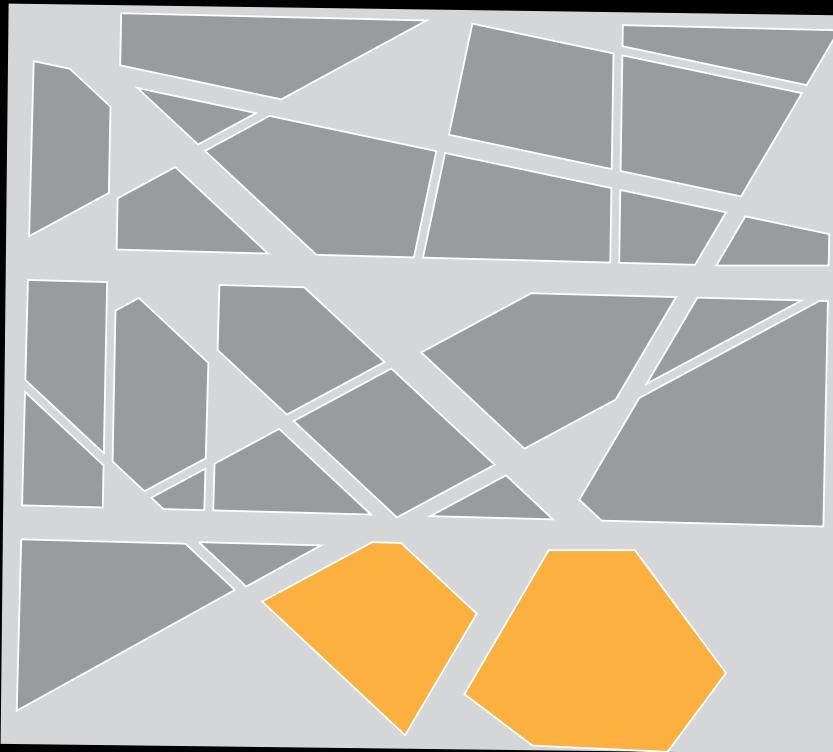
WINTER HEAT STRESS %



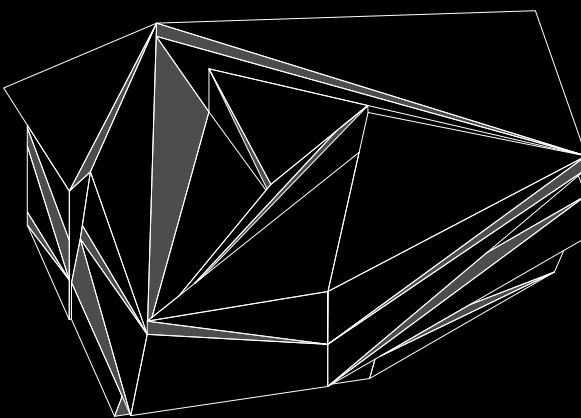
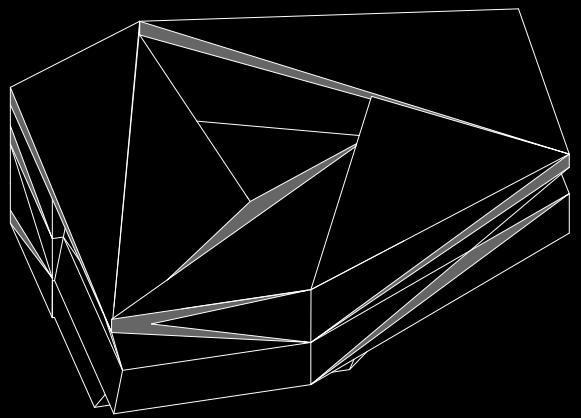
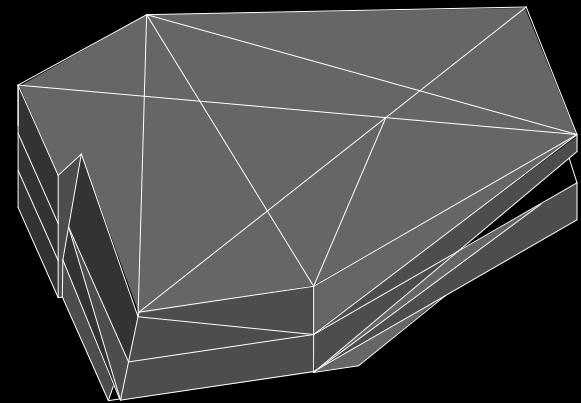
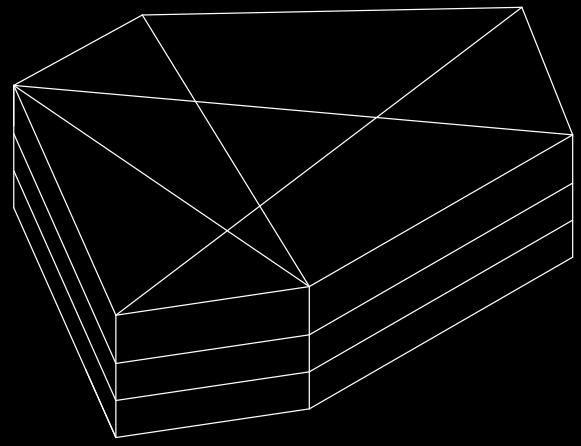
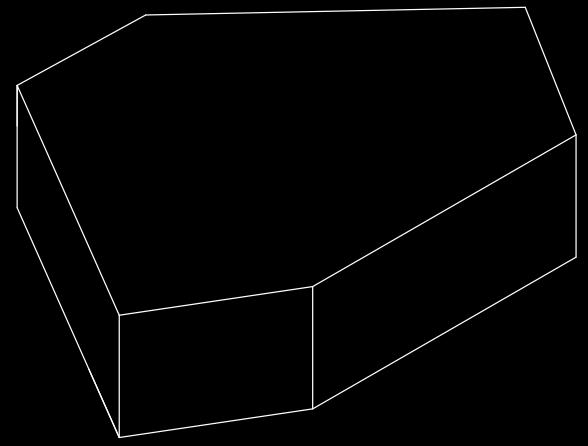
SUMMER HEAT STRESS %



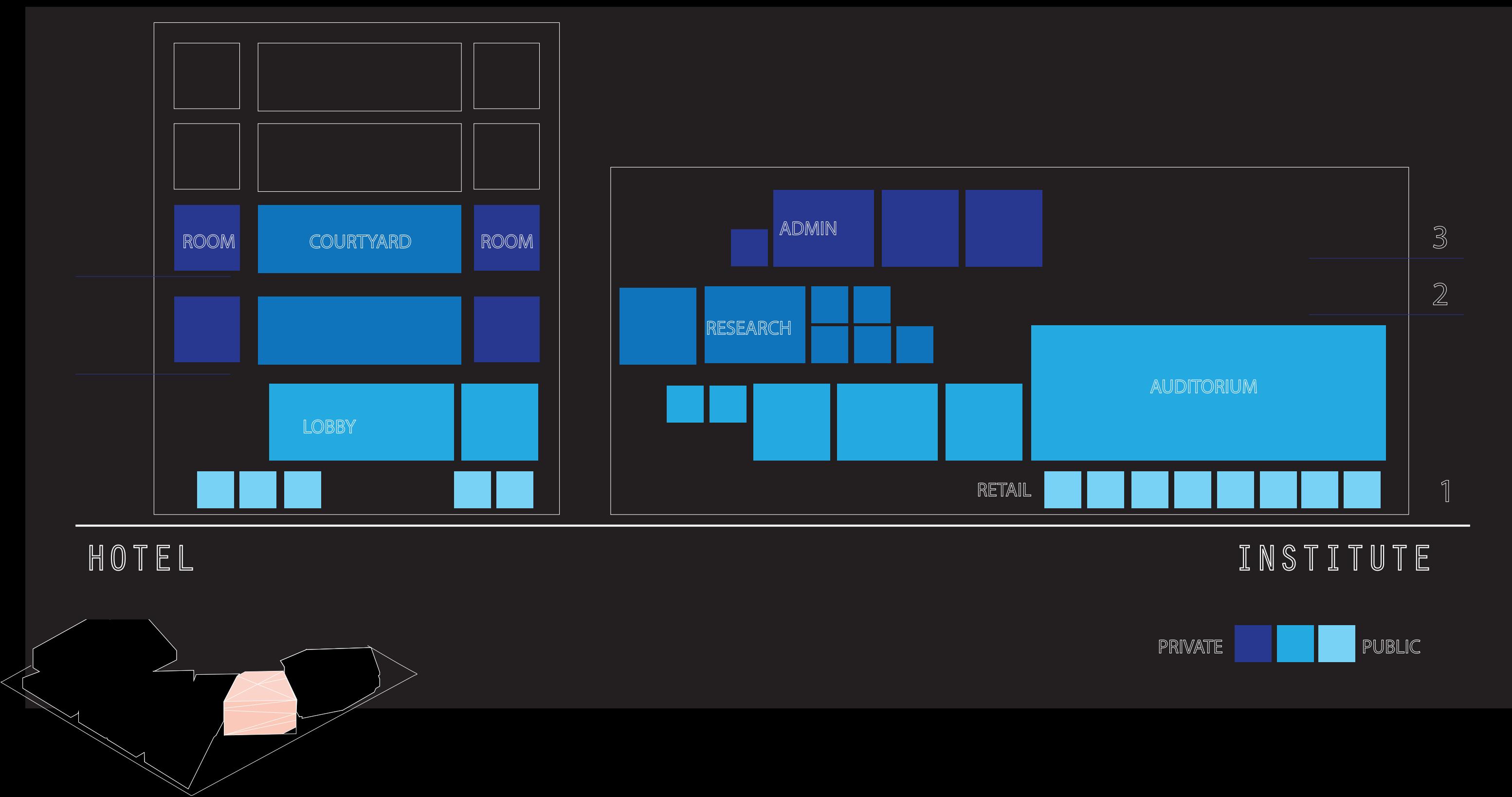


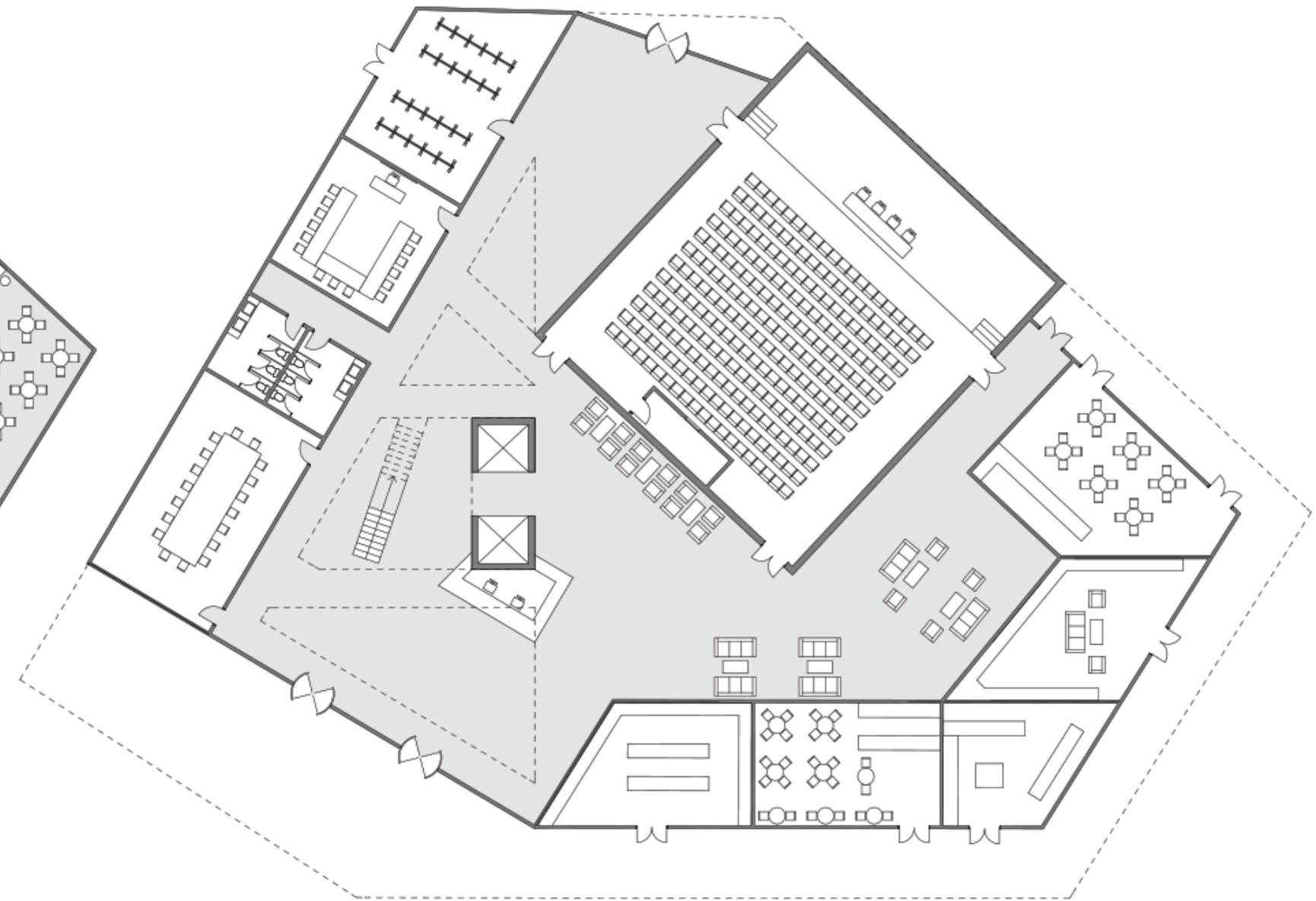
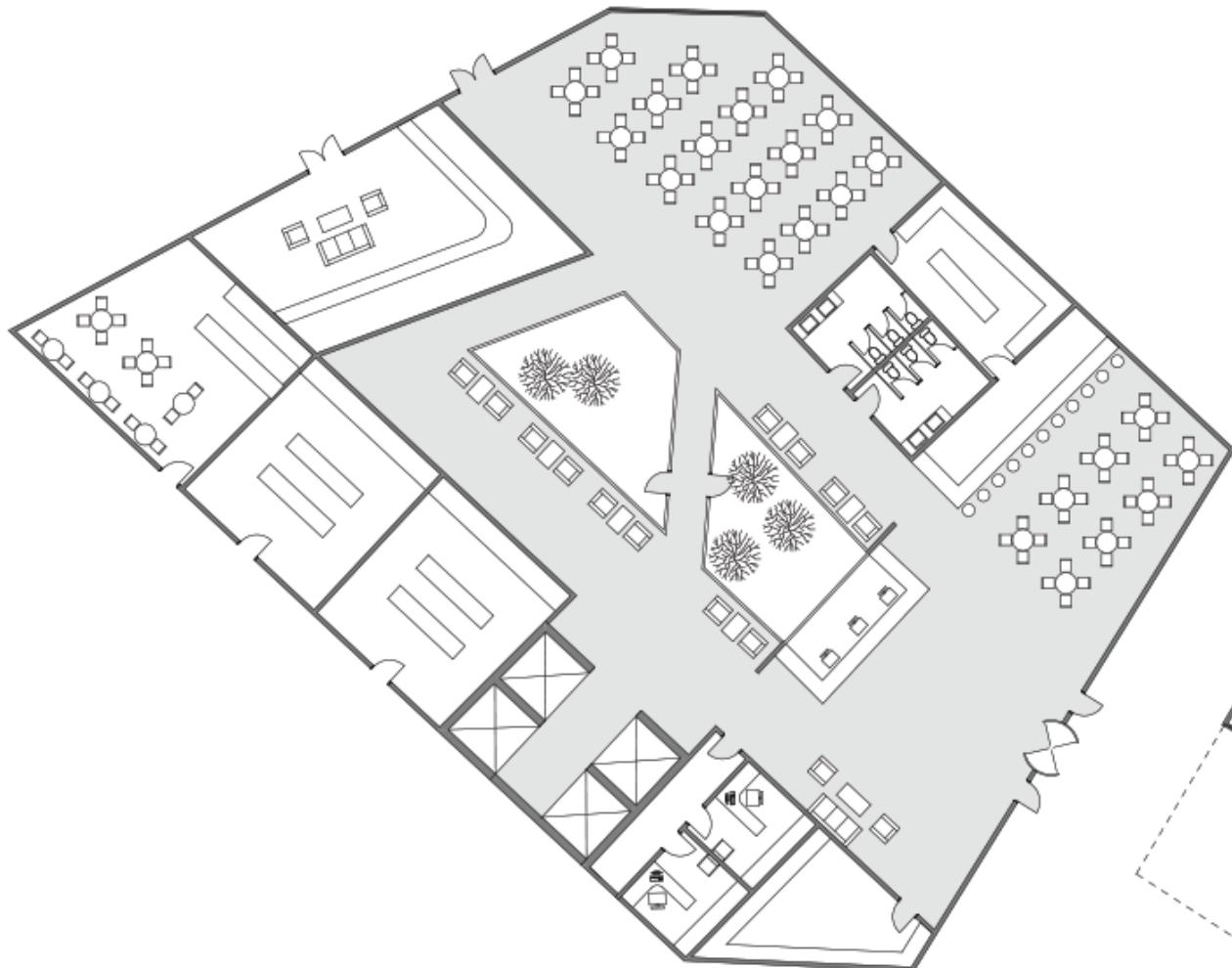
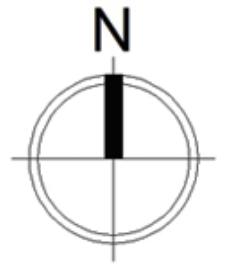


THE INSTITUTE

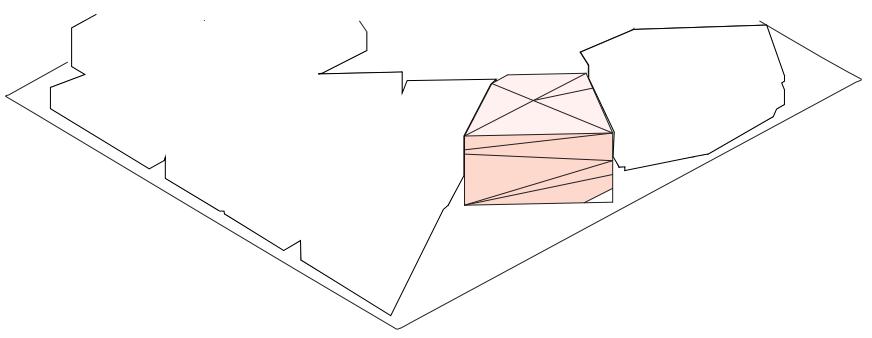


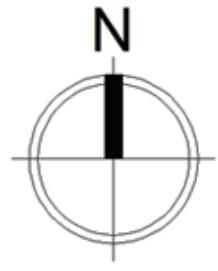
# PROGRAM MASSING SECTION



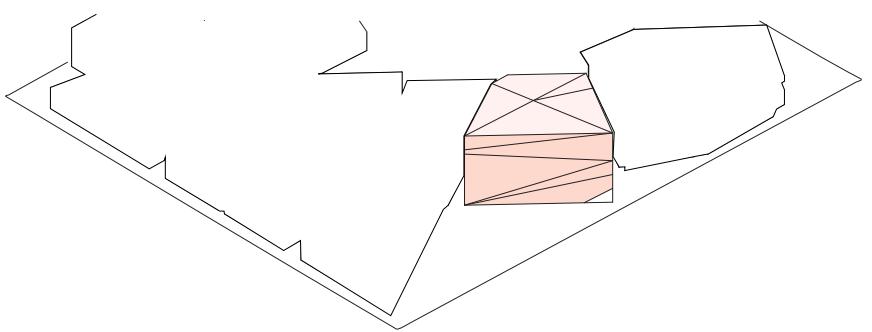


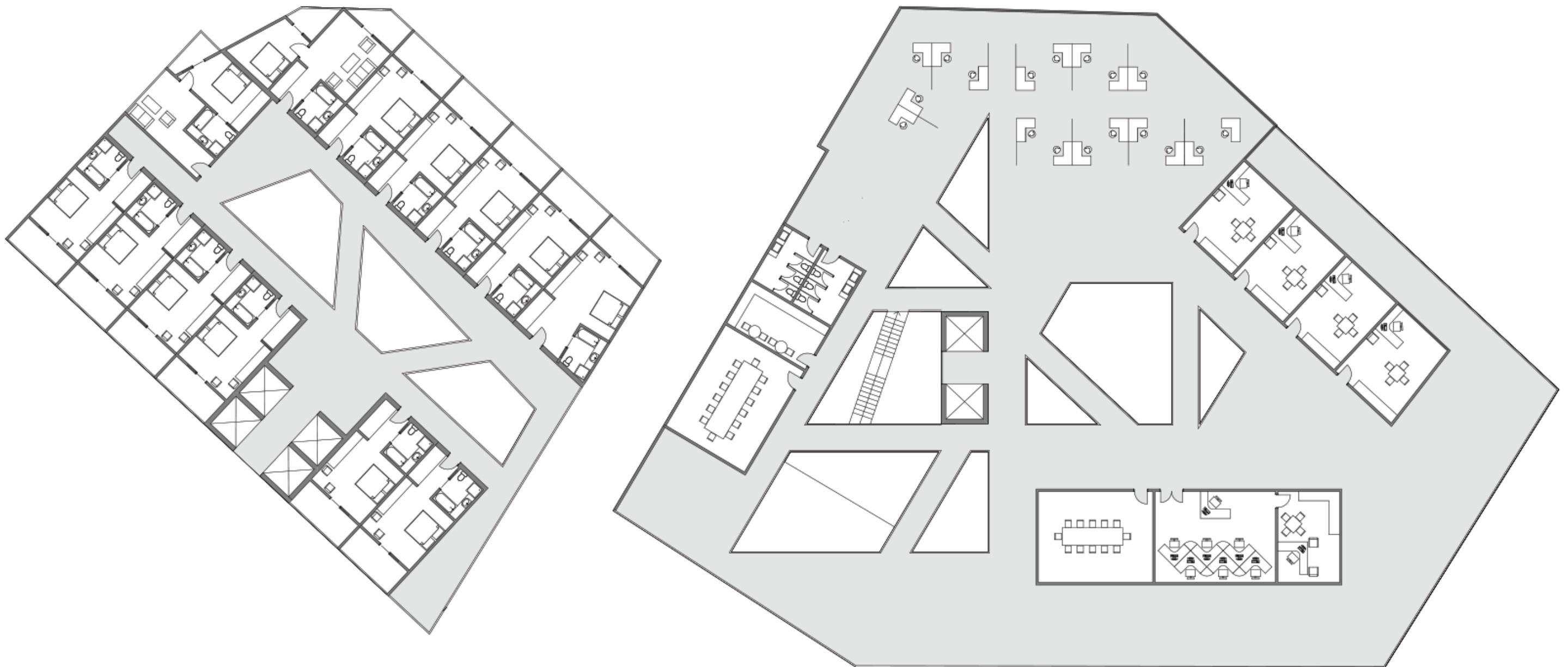
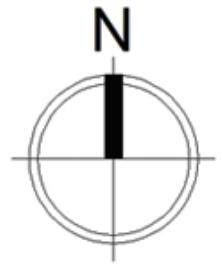
FIRST FLOOR PLANS



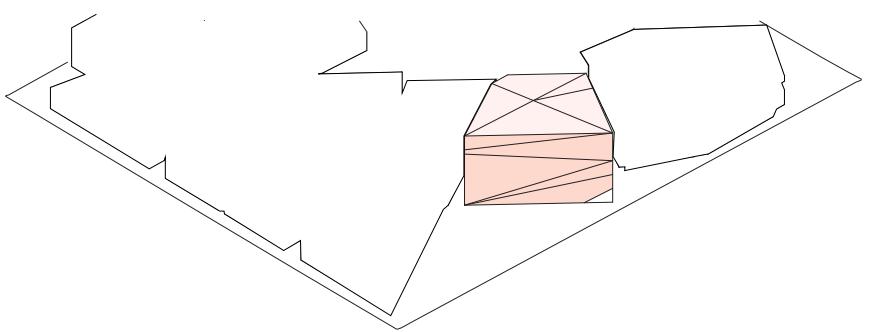


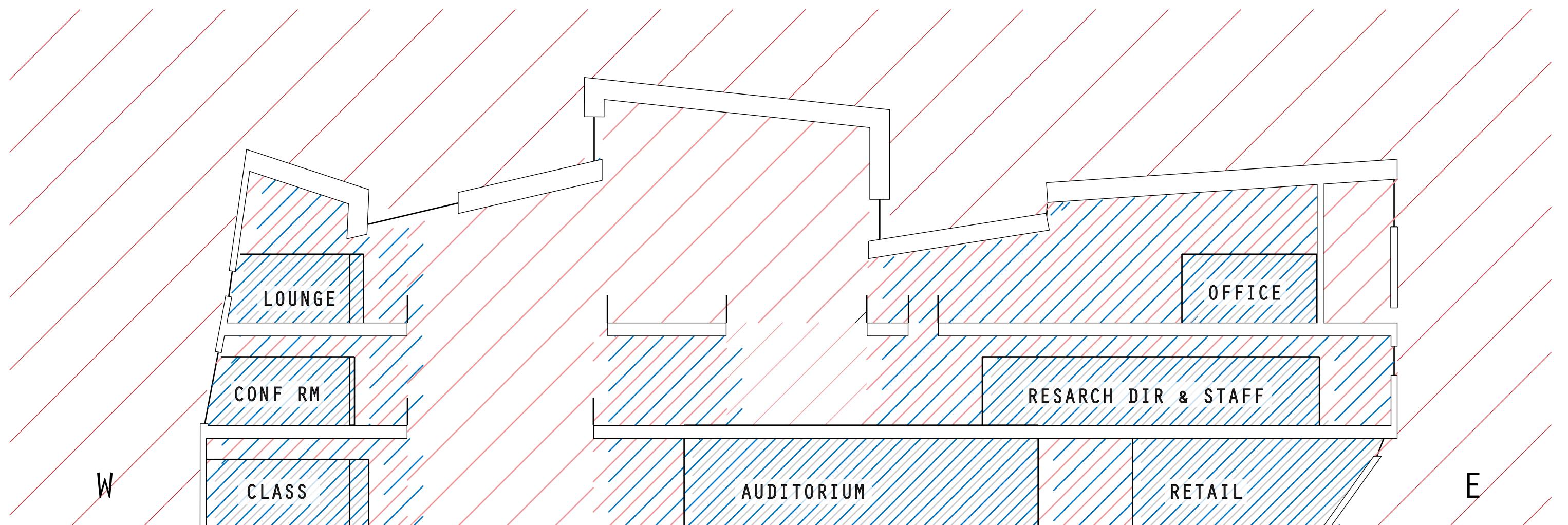
SECOND FLOOR PLANS



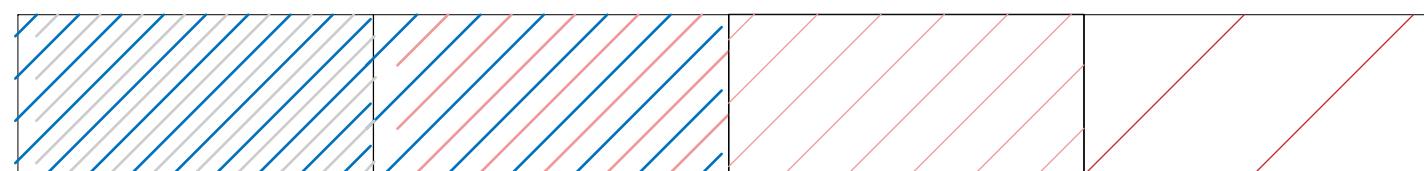


THIRD FLOOR PLANS

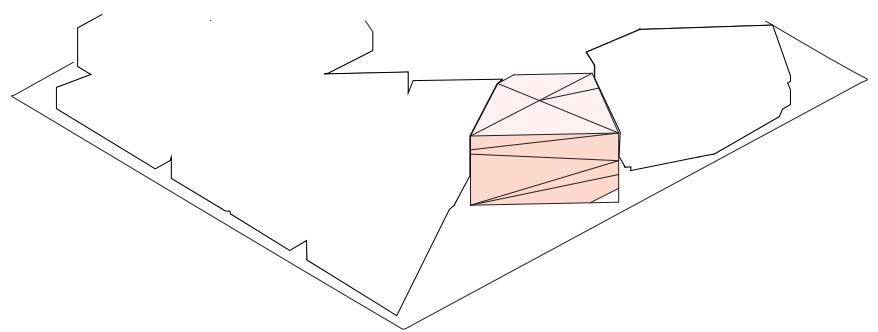




INDOOR  
CONTROLLED

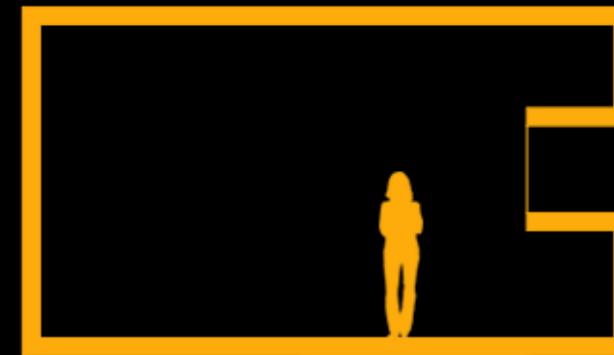


OUTDOOR  
NOT CONTROLLED

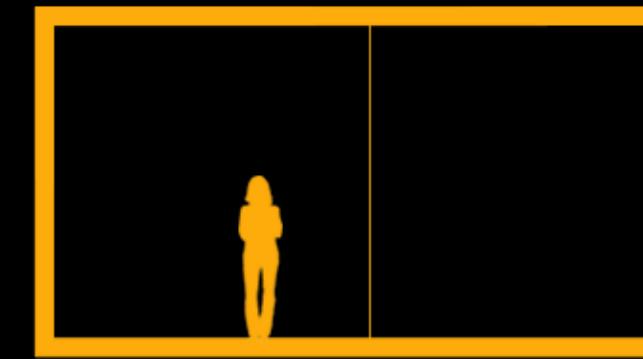




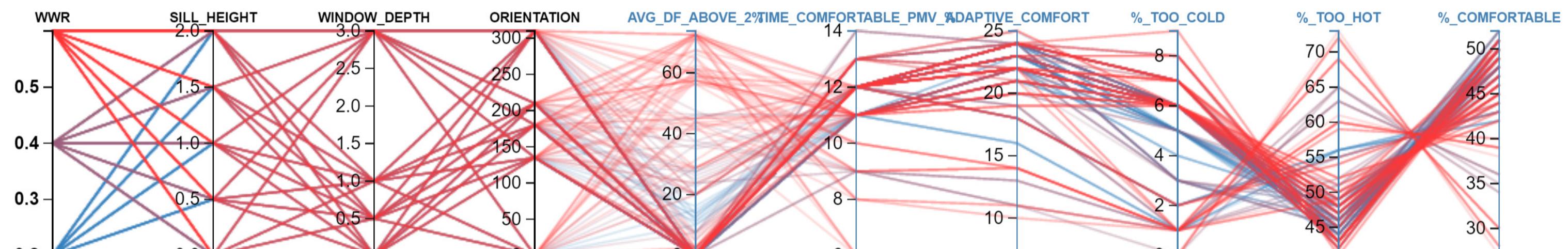
CONTROL SITUATION



NARROW OPENING



BALCONY



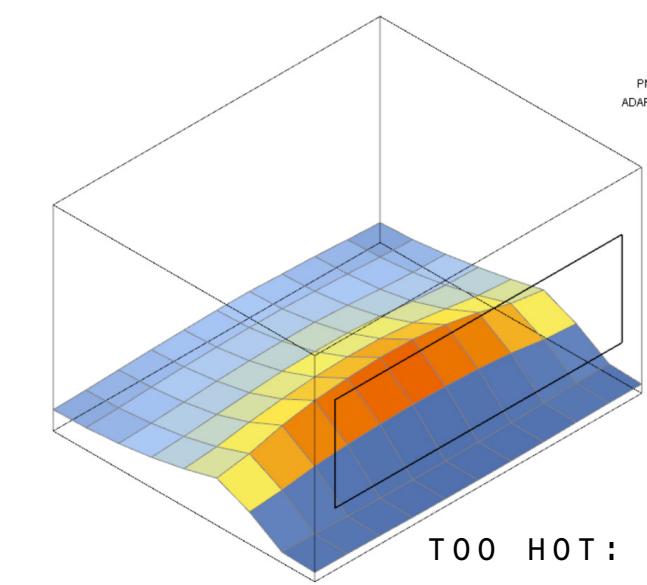
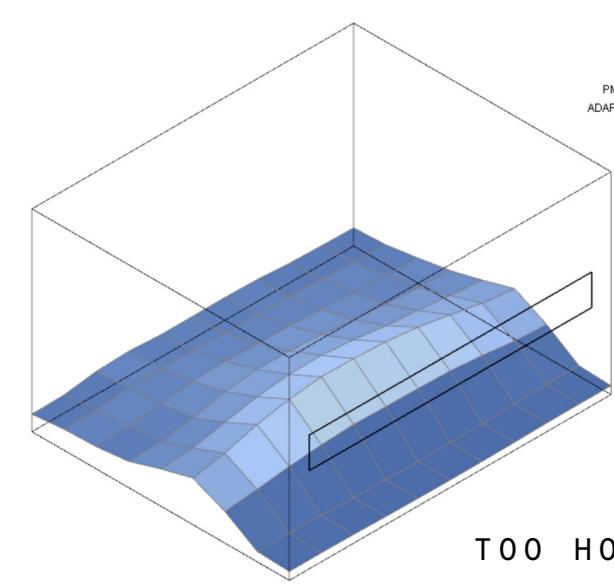
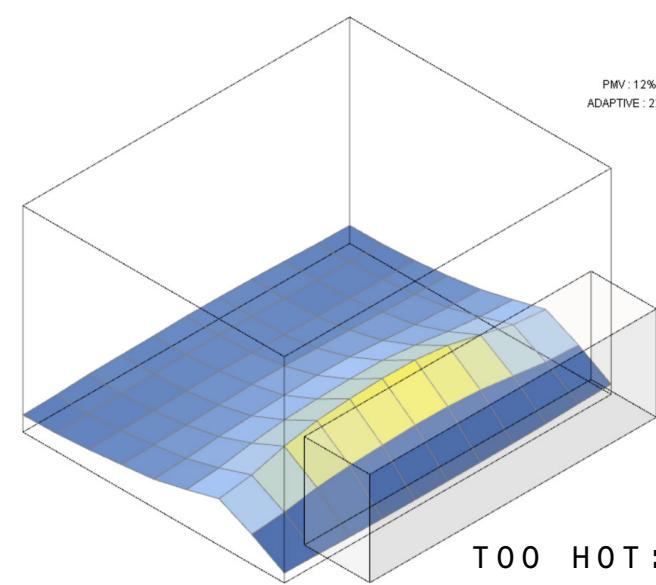
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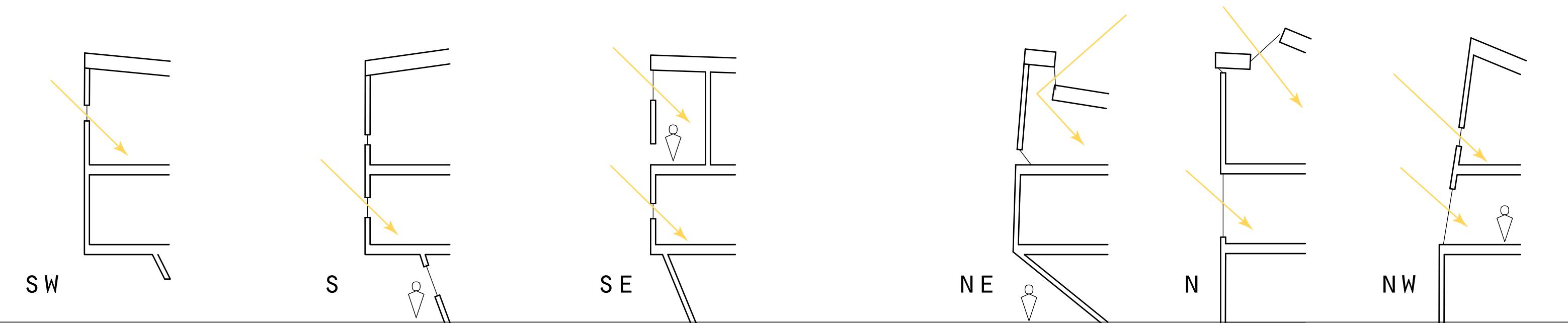
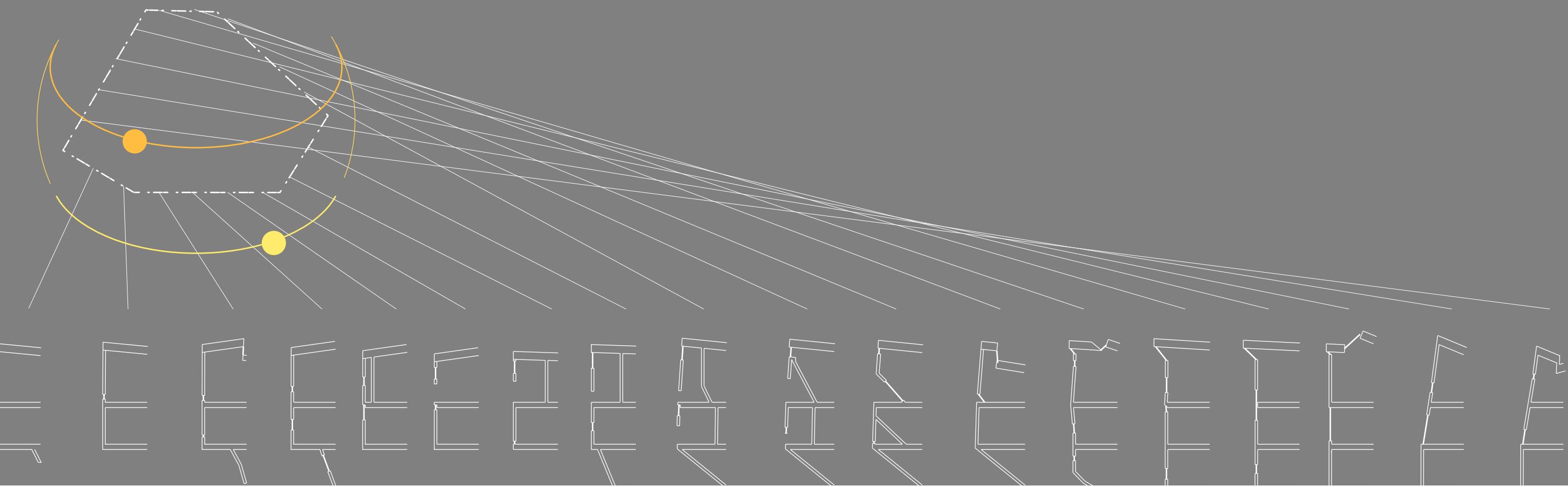
WWR  
SILL HEIGHT

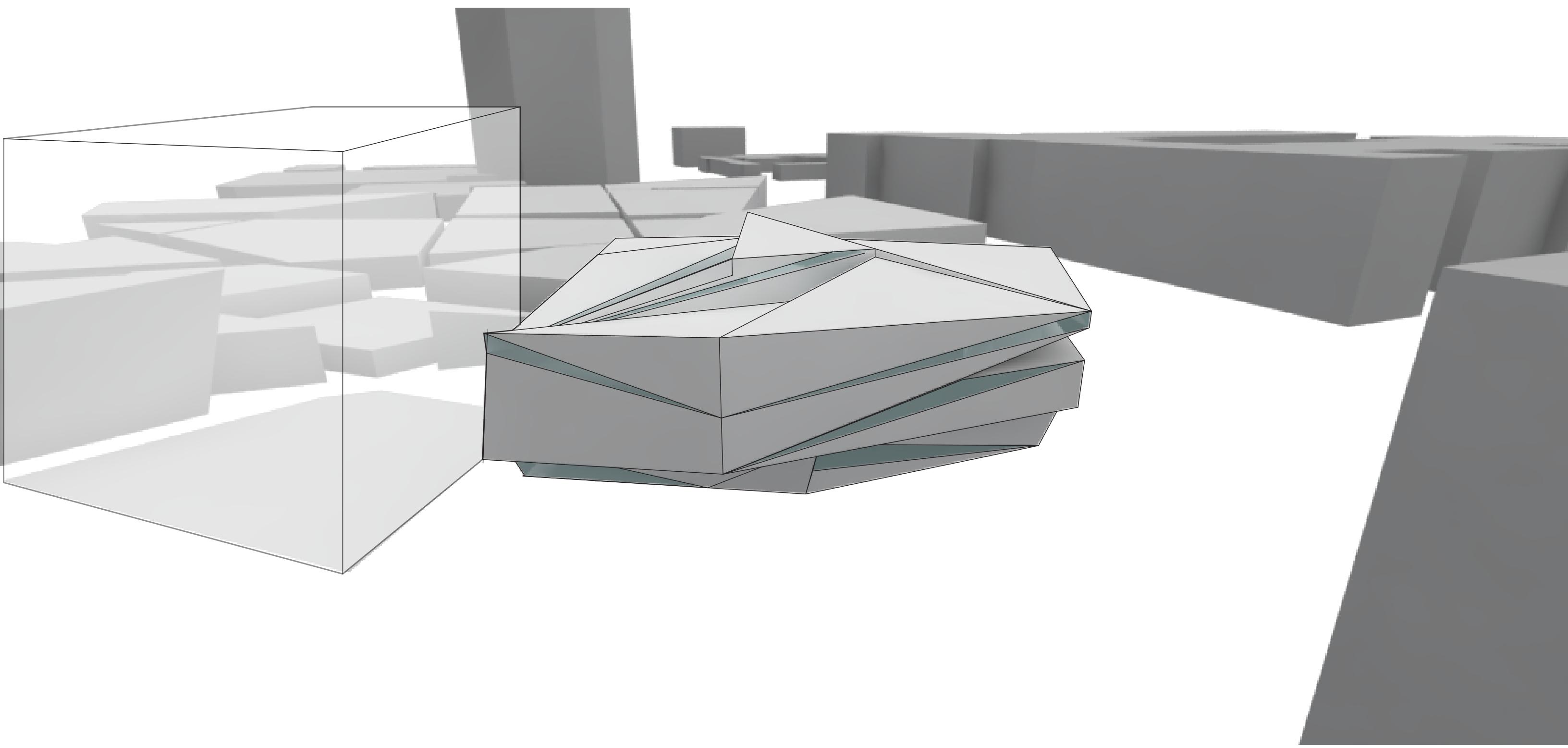
WINDOW DEPTH  
ORIENTATION

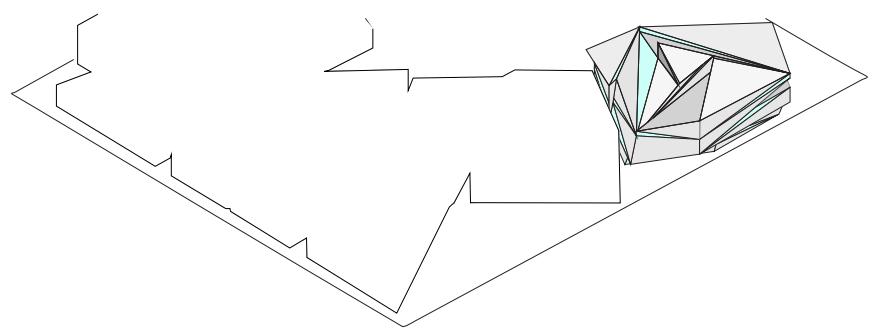
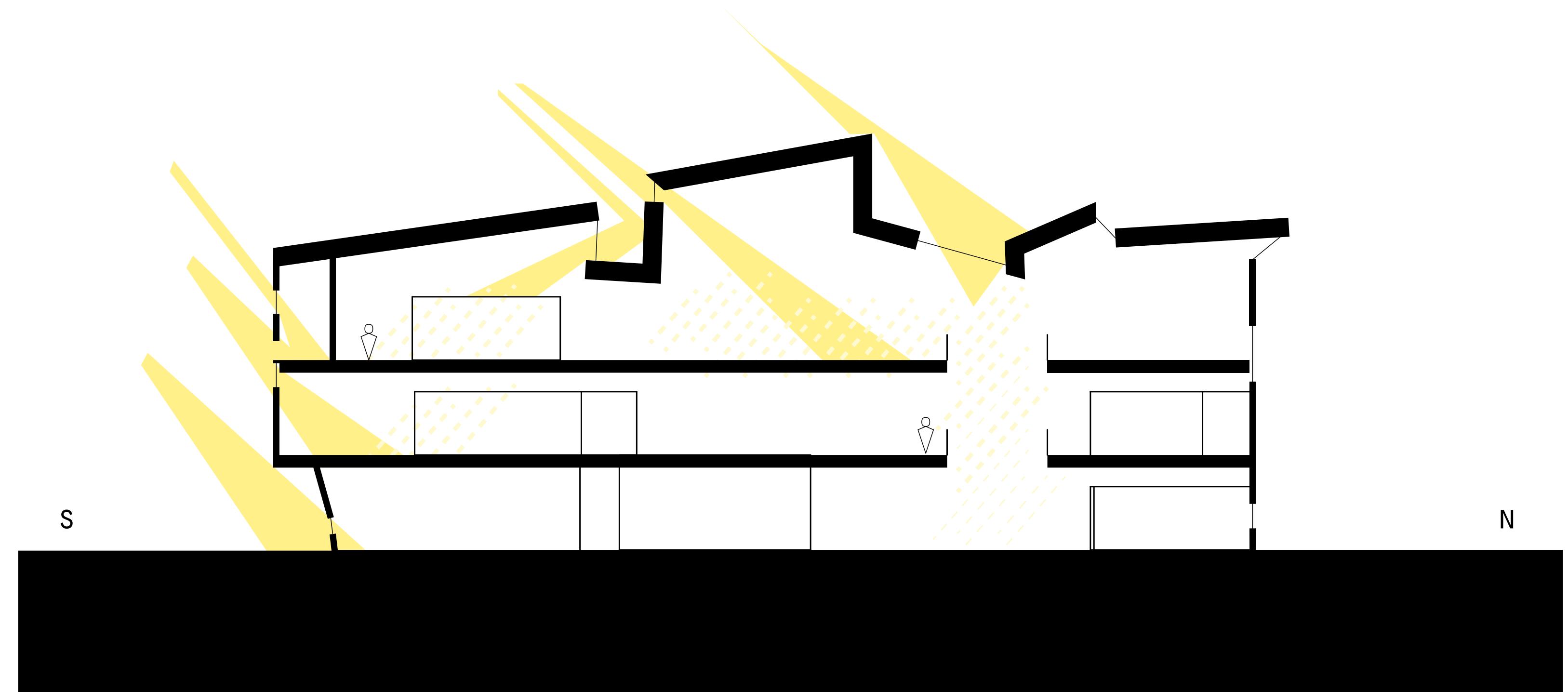
Avg Time DF Above 2%  
Time Comfortable % (PMV)  
Adaptive Comfort %

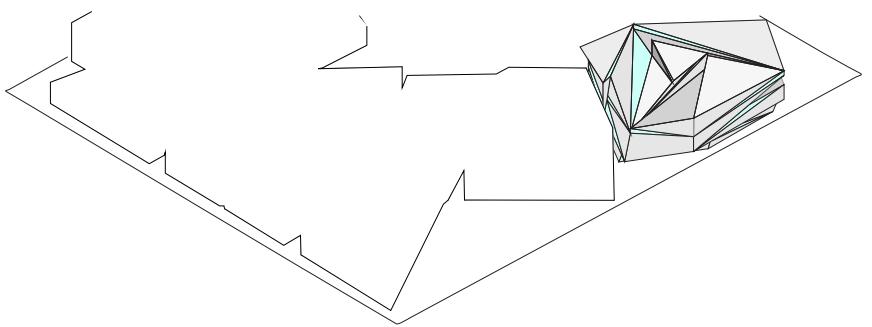
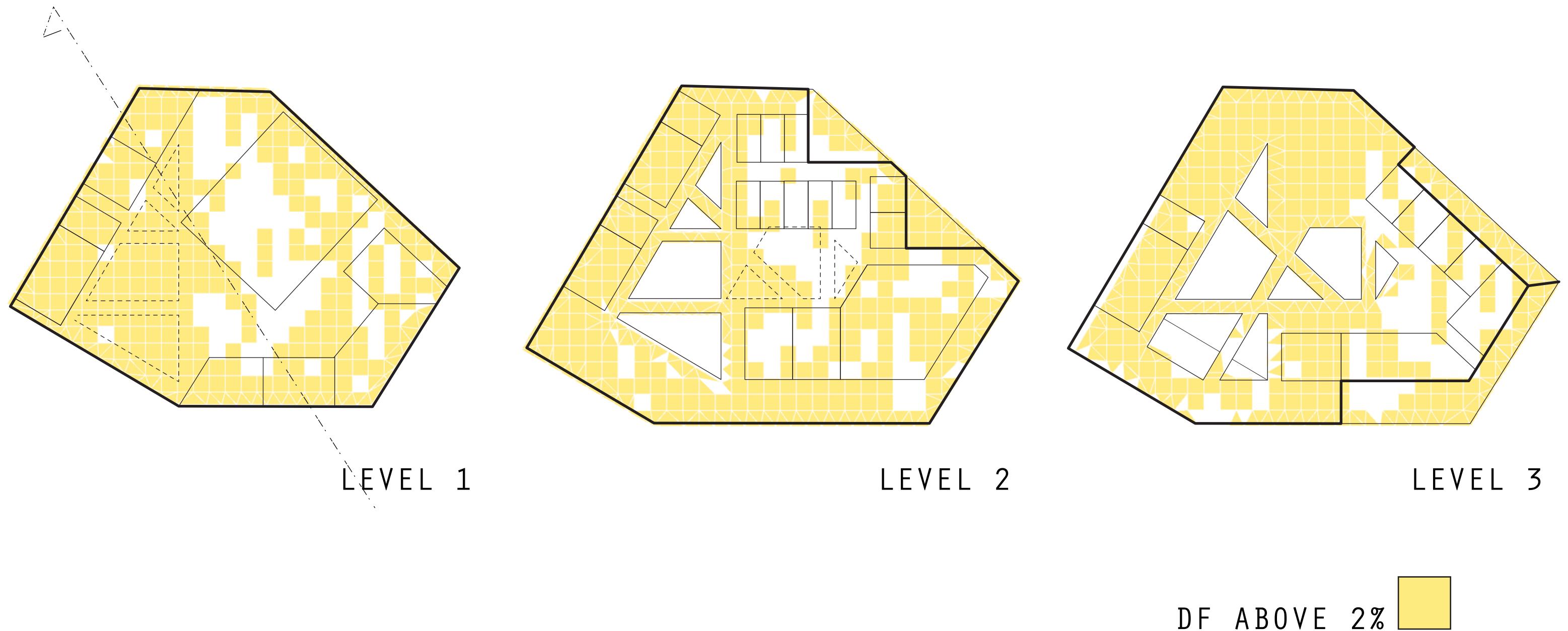
## OUTPUTS

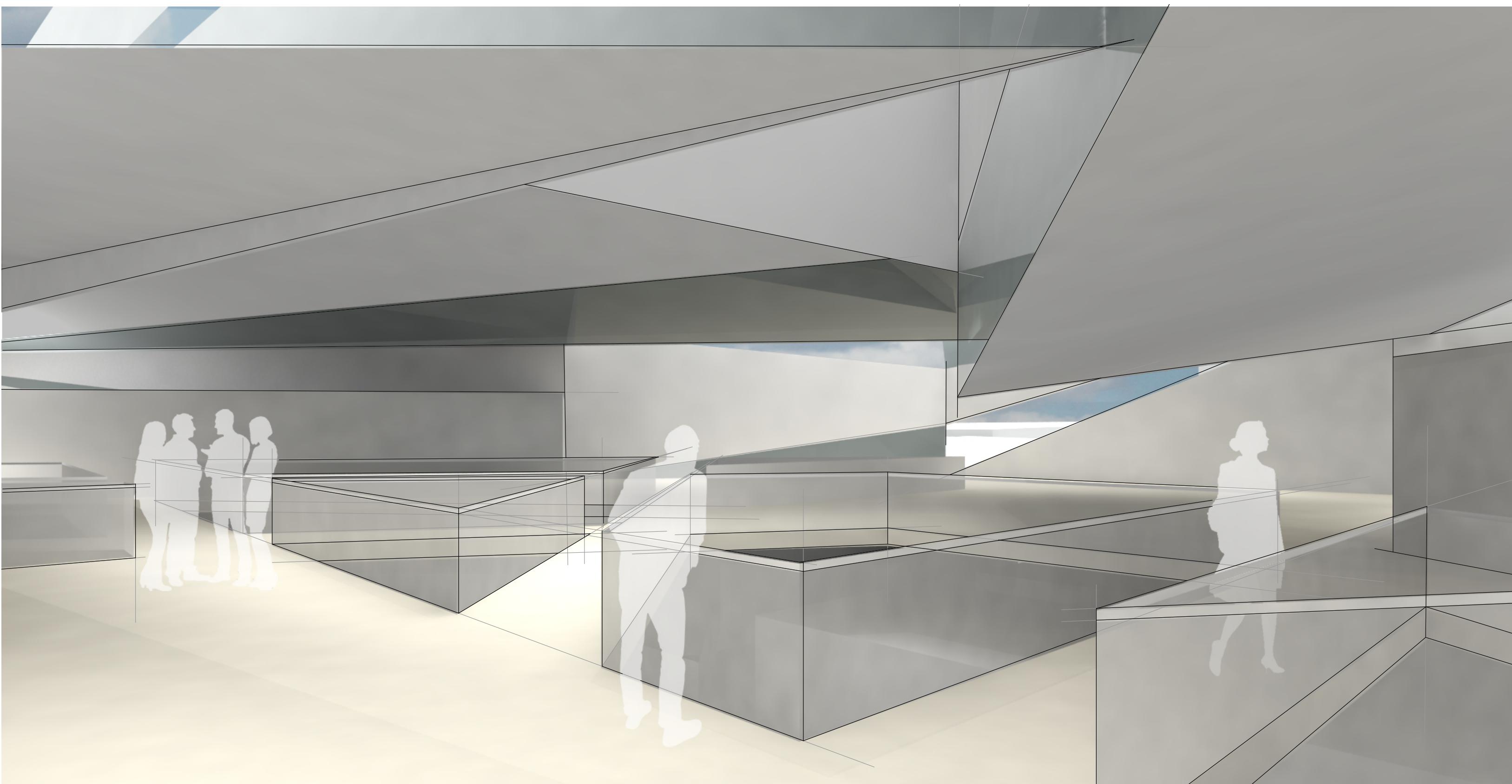








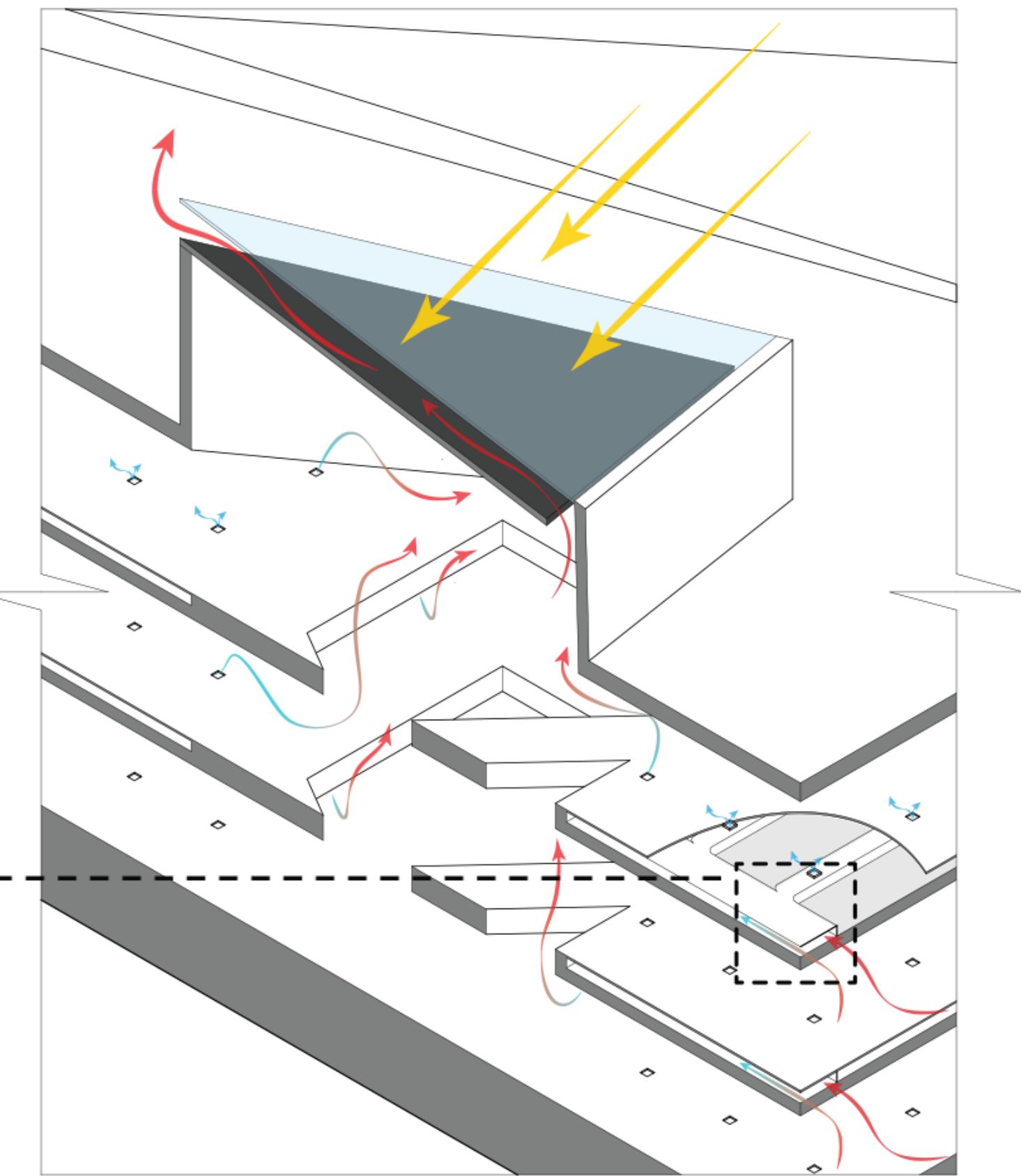
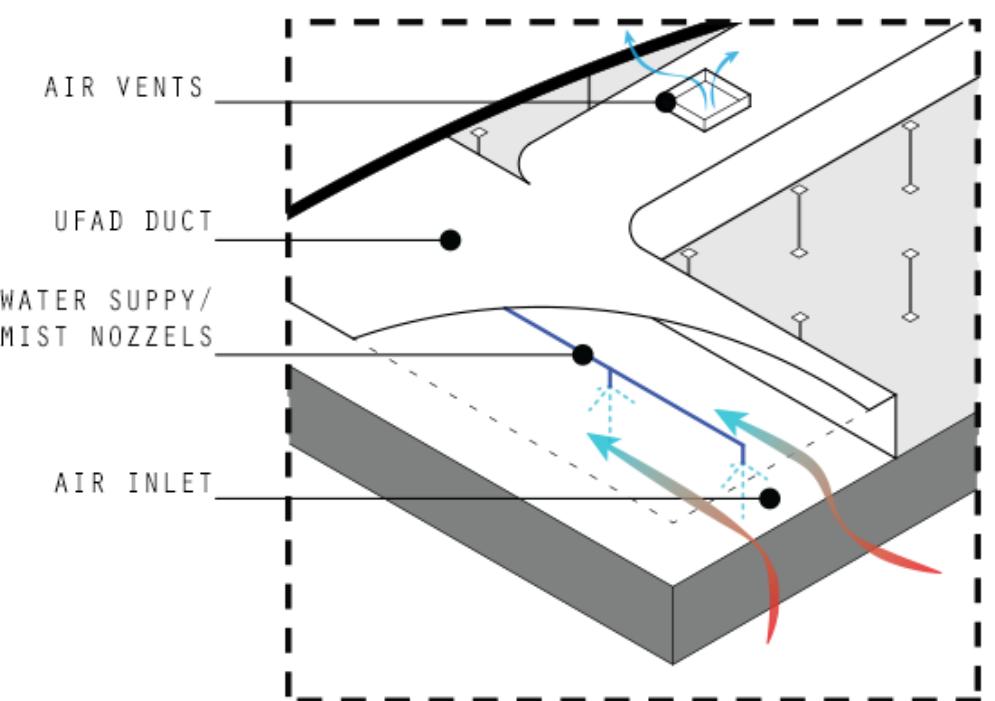




## STACK-DRIVEN EVAPORATIVE COOLING:

THE INDOOR AIRFLOW SHALL BE CREATED BY A BUOYANCY-DRIVEN, UNDERFLOOR AIR DISTRIBUTION SYSTEM THAT IS ACHIEVED BY PV PANELS THAT SERVE AS A HEAT SOURCE FOR THE SOLAR CHIMNEY. THE SYSTEM COULD POTENTIALLY ALLOW FOR CONDUCTION TO OCCUR THROUGH THE RAISED FLOOR AND SLAB.

DUE TO THE HIGH TEMPERATURE OF OUTDOOR AIR, IT IS USEFUL TO COOL DOWN THE AIR PRIOR TO ENTERING INDOOR SPACES BY PASSING IT FIRST THOUGH A MISTING SYSTEM BEFORE THE AIR MAKES ITS WAY OUT THROUGH THE SOLAR CHIMNEY.



## CFD ANALYSIS:

TO INVESTIGATE THE PERFORMANCE OF THIS PROPOSED SYSTEM, A CFD ANALYSIS WAS CONDUCTED TO DETERMINE THE EFFECTIVENESS IN INCREASING INDOOR THERMAL COMFORT.

THE INPUT PARAMETERS...

DATE **8/15**

TIME **13:00**

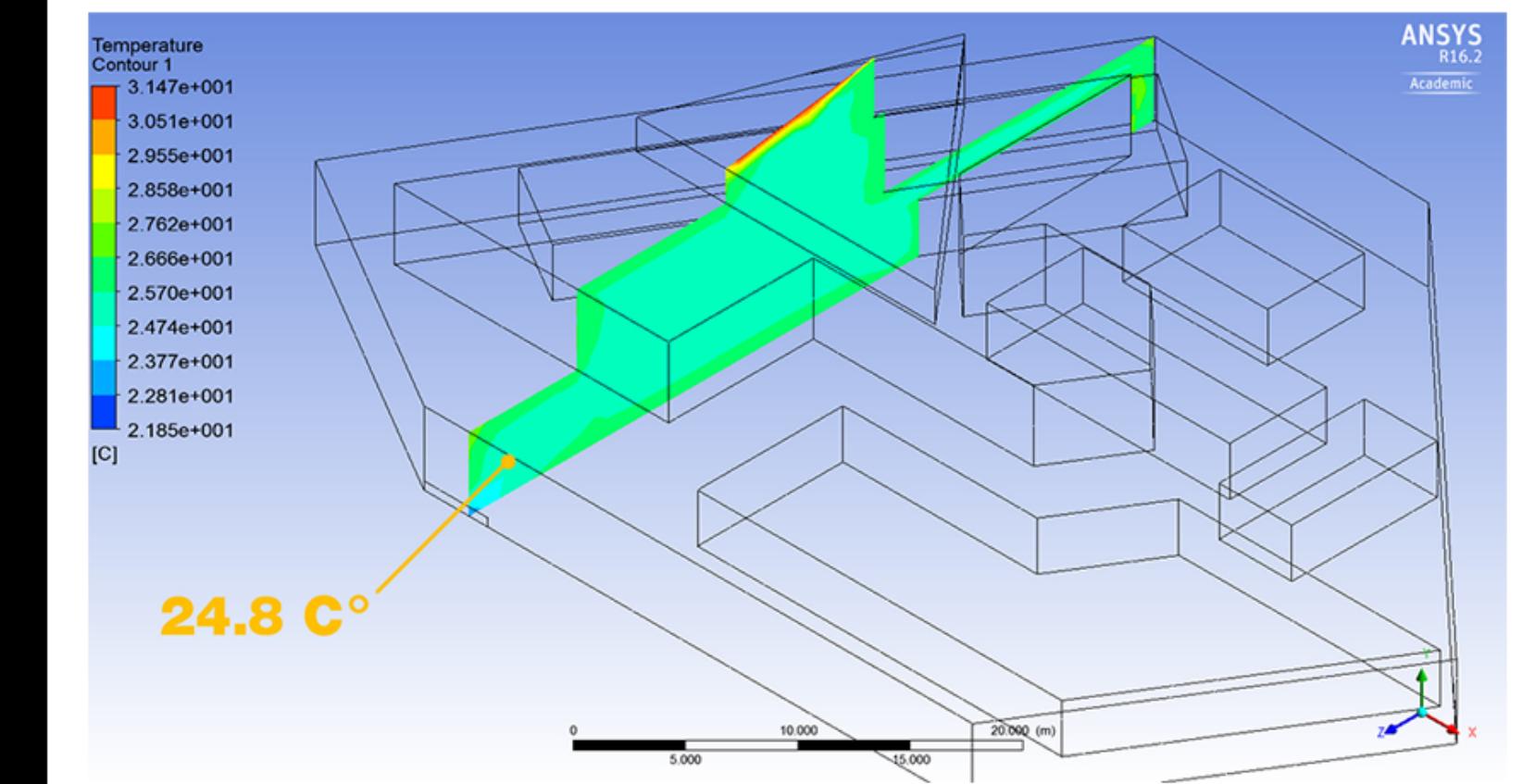
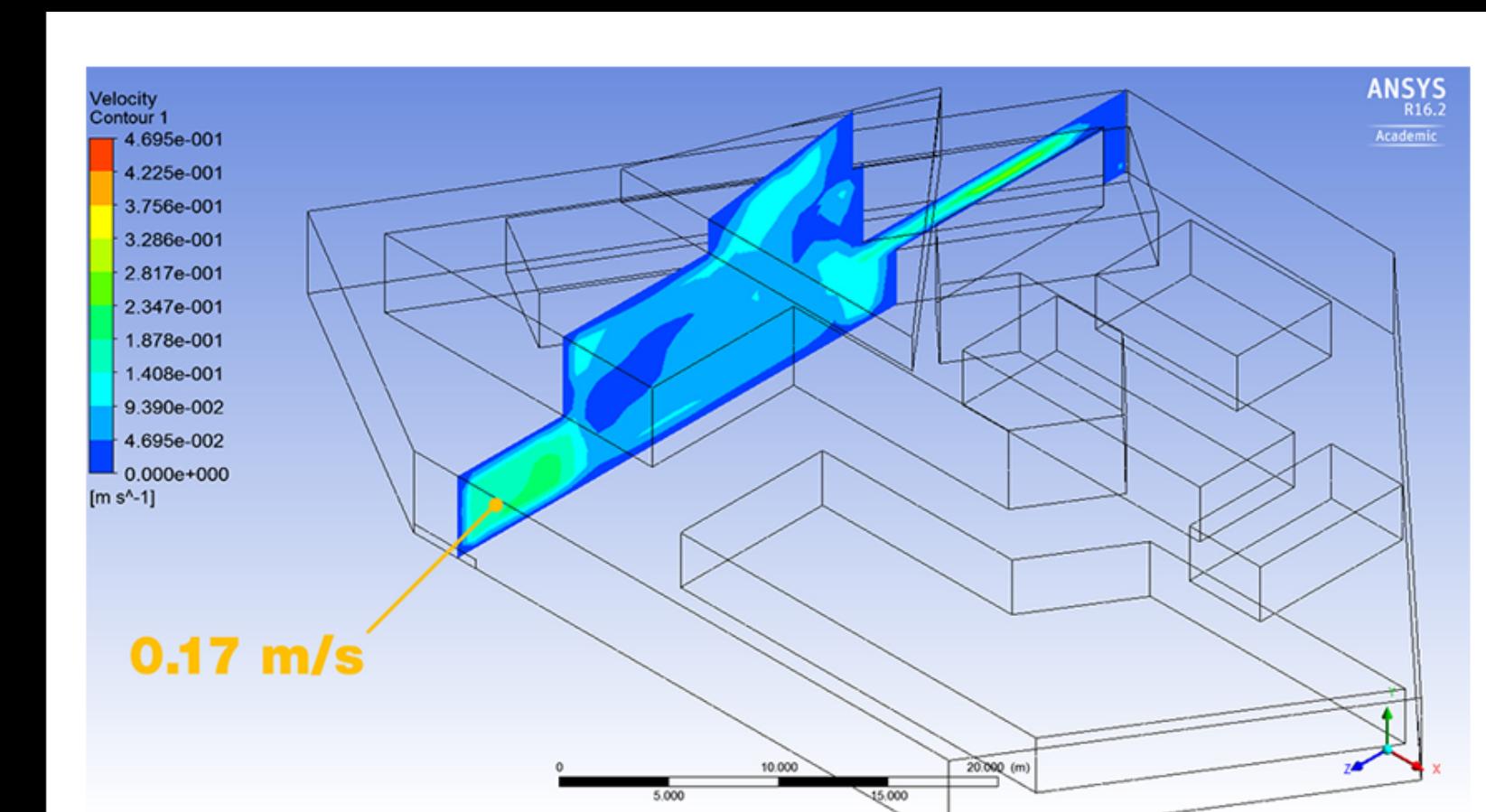
OUTDOOR TEMP **37C**

OUTDOOR AIR HUMIDITY **36%**

TEMP. IN INLET **22C**

AIR VELOCITY IN INLET **0.2 m/s**

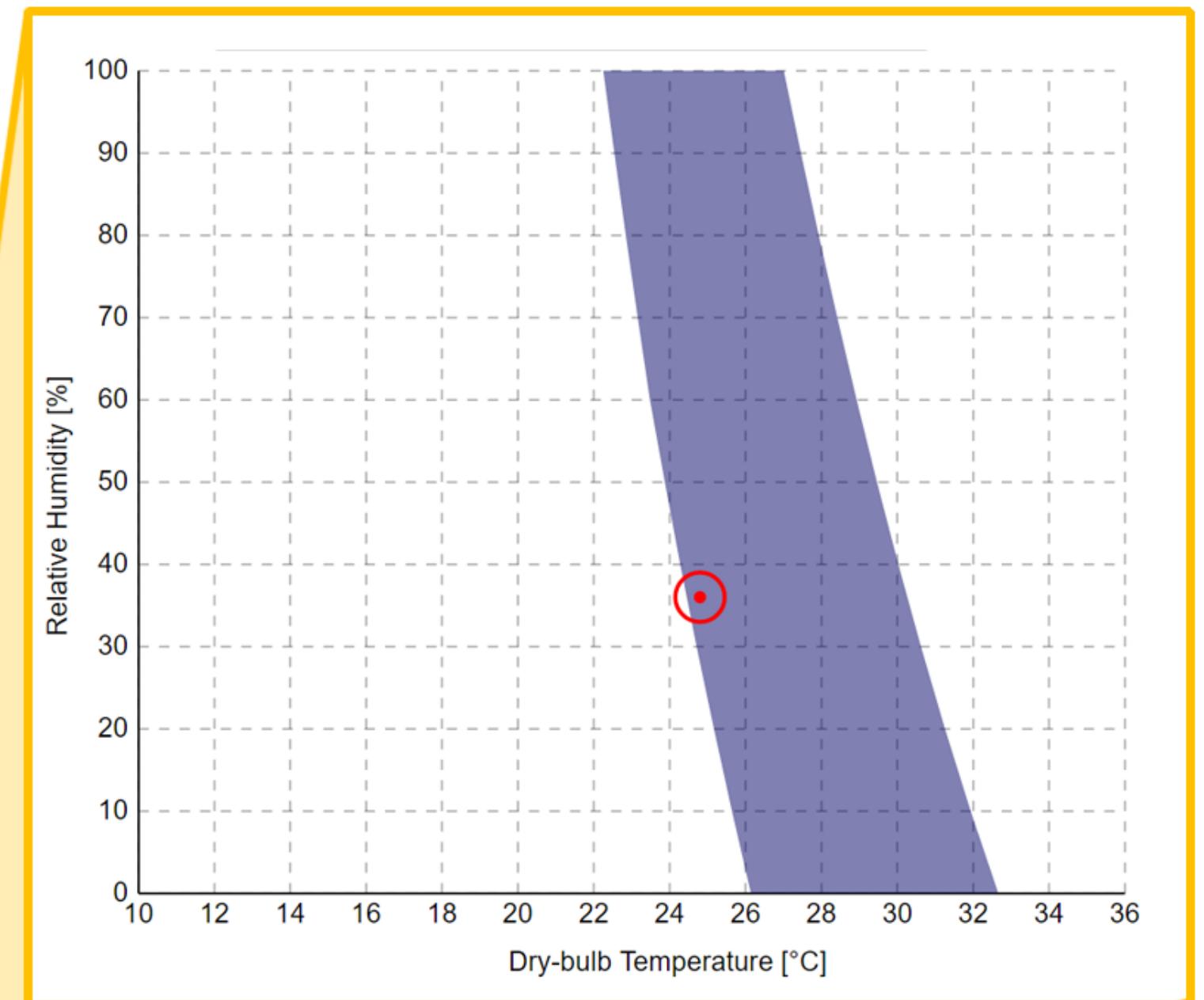
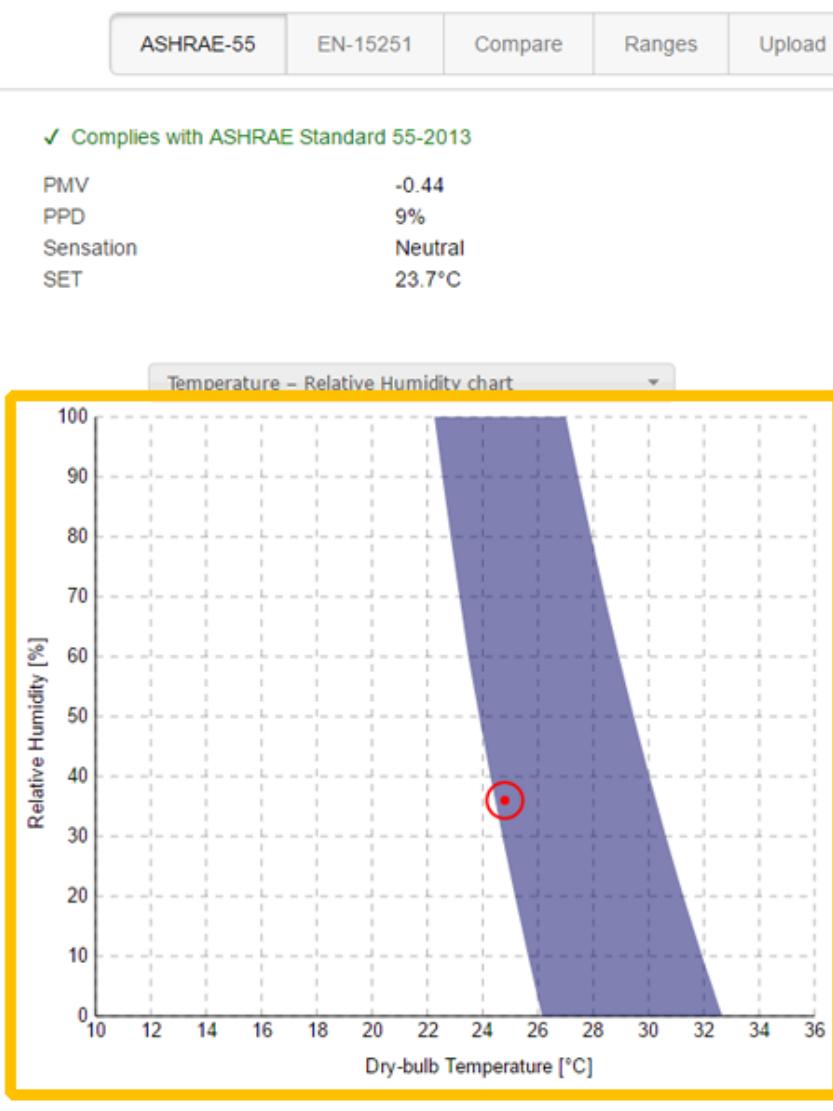
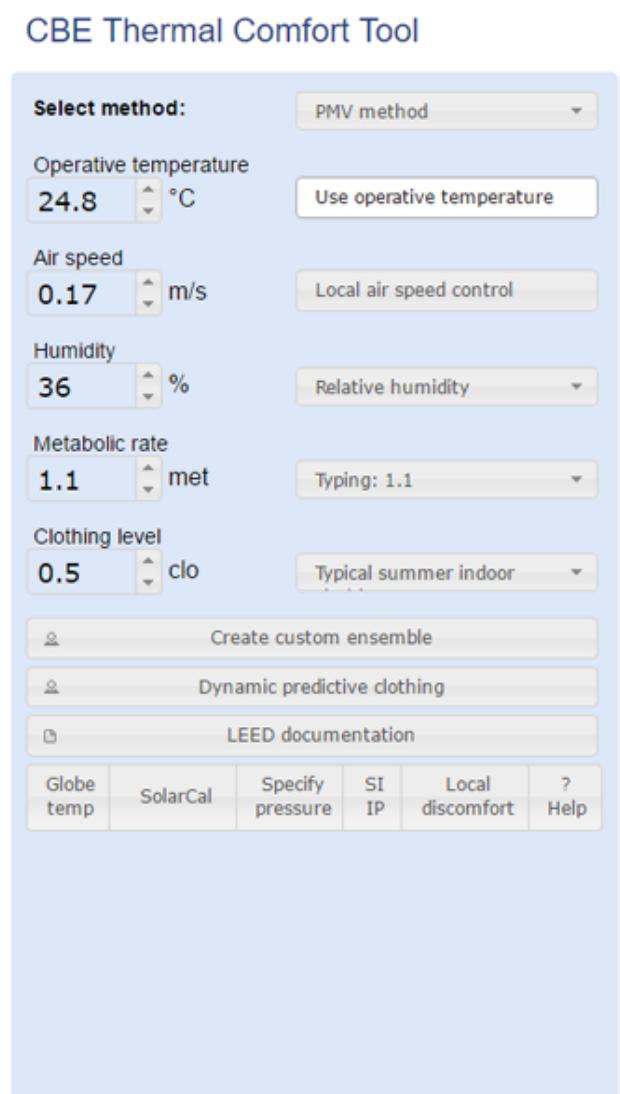
CHOOSING A SINGLE POINT WITHIN THE SPACE, THE AIRFLOW SPEED DECREASES UPON ENTERING INDOOR SPACES. THE TEMPERATURE IS INCREASED IN THE PROCESS.

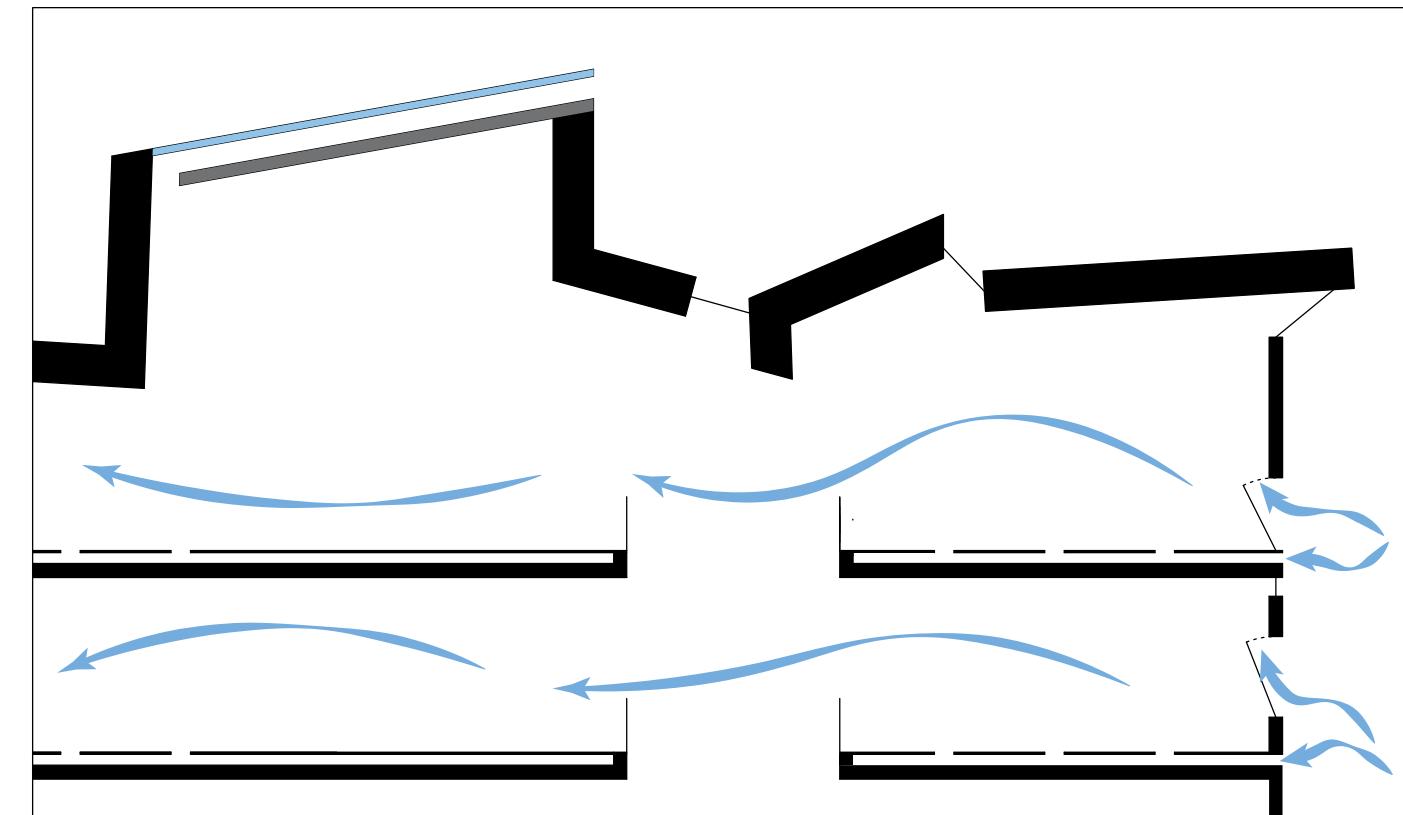
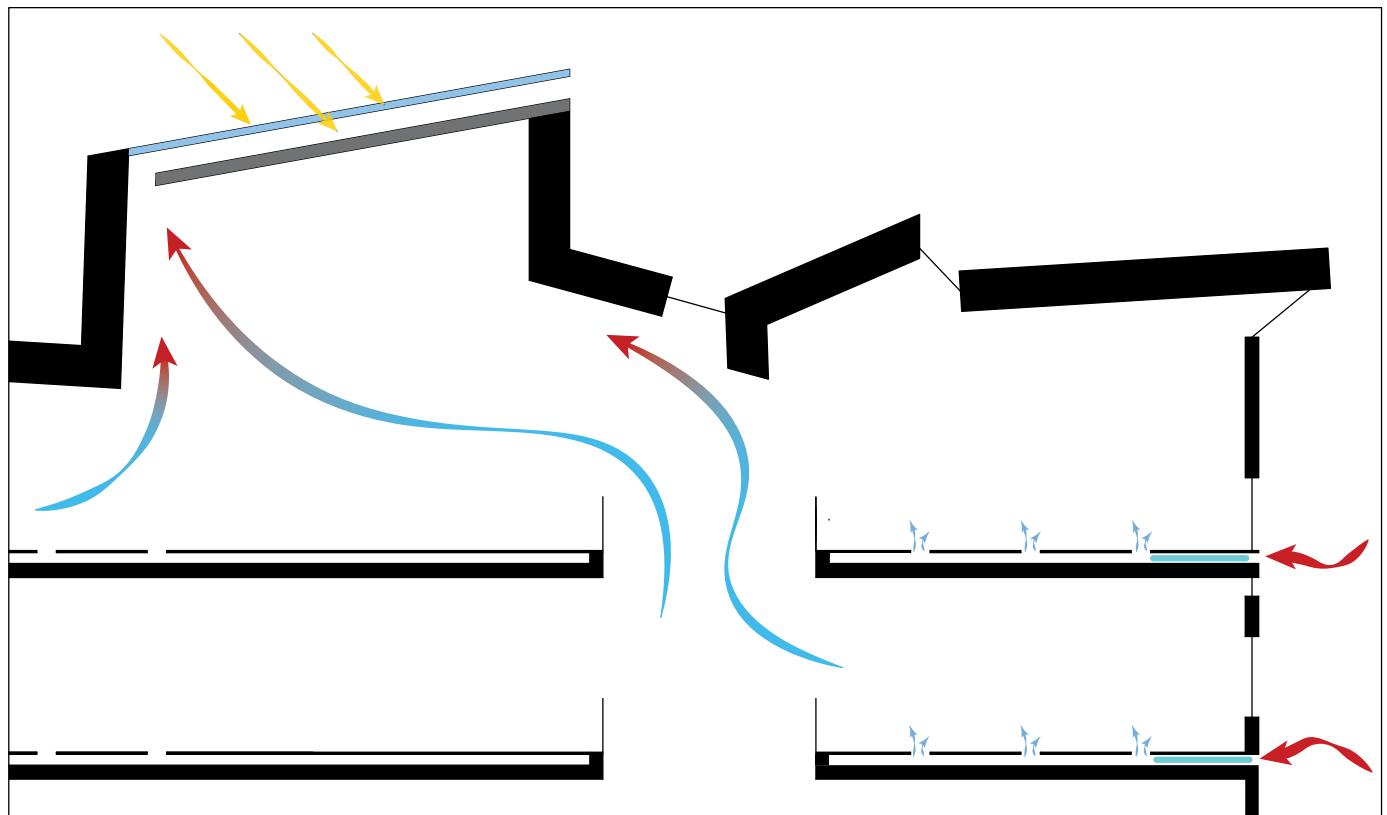


# CFD ANALYSIS RESULTS

To further interpret the results and what they resemble in regards to indoor thermal comfort, the Center for Built Environment (CBE) comfort tool was utilized to analyze the results based on ASHRAE 55-2013 standards.

It was determined that the results at the specified test point comply with ASHRAE comfort standard.





SUMMER COOLING CONDITION:  
THE HOT/DRY DESERT AIR ENTERS THROUGH THE UNDERFLOOR AIR DISTRIBUTION SYSTEM WHERE IT IS  
COOLED BY MISTING PRIOR TO ENTERING INDOOR SPACES

THIS SYSTEM IS DRIVEN BY A PV HEAT SOURCED SOLAR CHIMNEY CREATING AIR BUOYANCY

