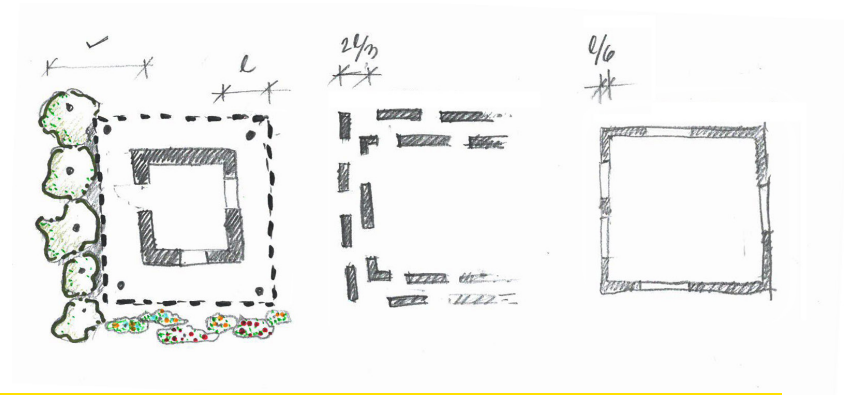




LOW TECH, HIGH IMPACT BUILDING SKIN DESIGN FOR DHAKA, BANGLADESH

ESHITA RAHMAN
Mentor: Matthias Rammig

16th September, 2014

[WHY]

LOW TECH, HIGH IMPACT BUILDING SKIN DESIGN FOR DHAKA, BANGLADESH

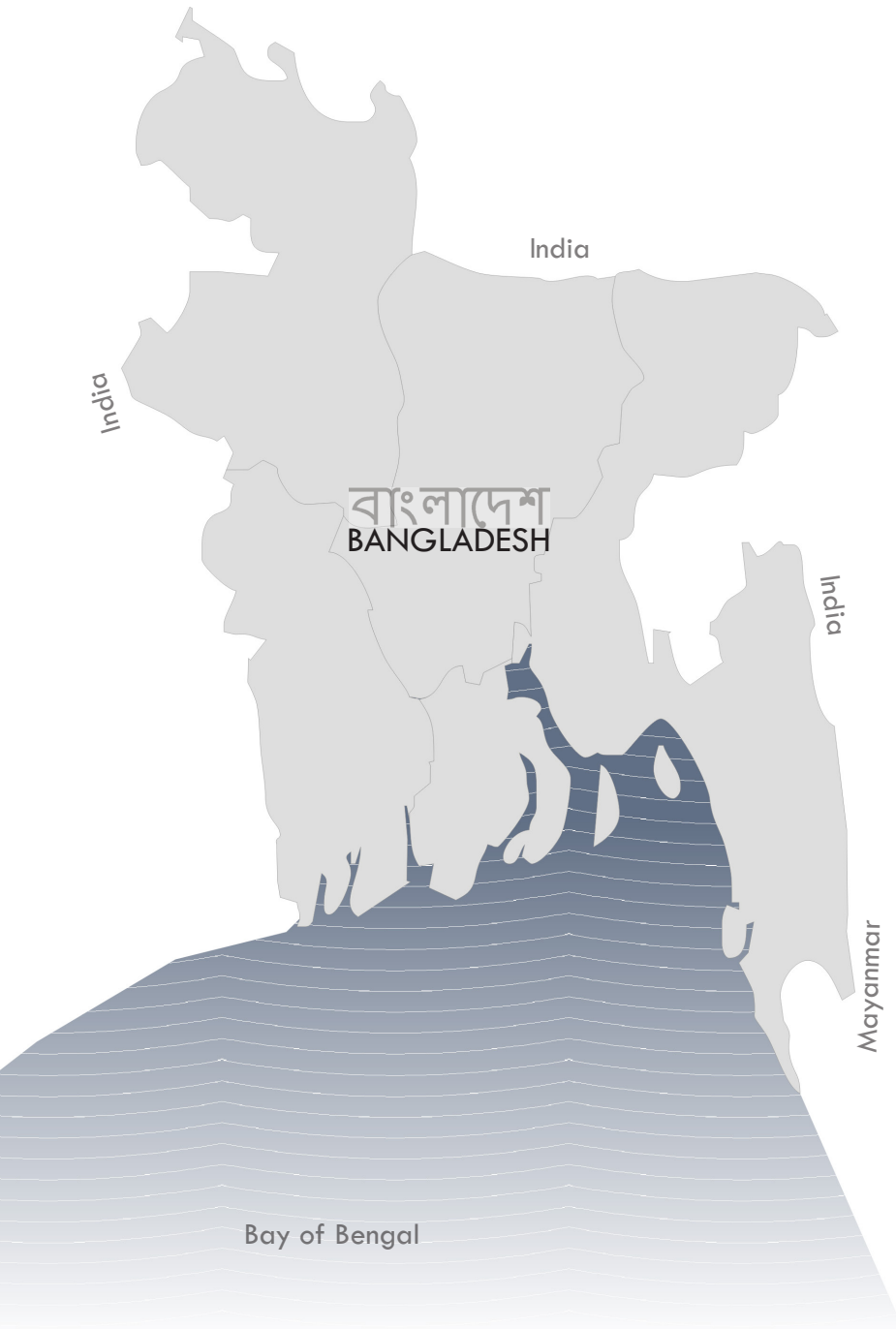
[HOW]

LOW TECH, HIGH IMPACT BUILDING SKIN DESIGN FOR DHAKA, BANGLADESH

[WHAT]

LOW TECH, HIGH IMPACT BUILDING SKIN DESIGN FOR DHAKA, BANGLADESH

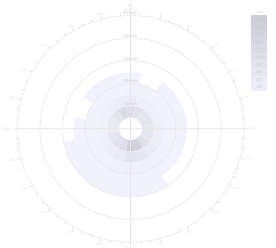
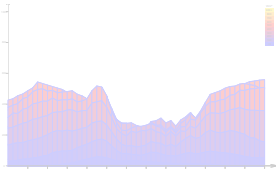
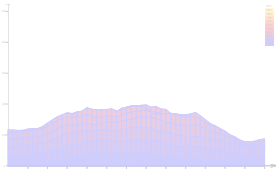
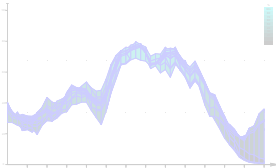
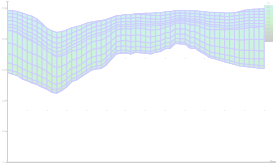
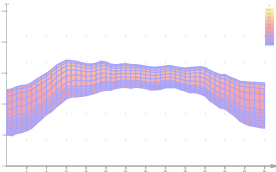




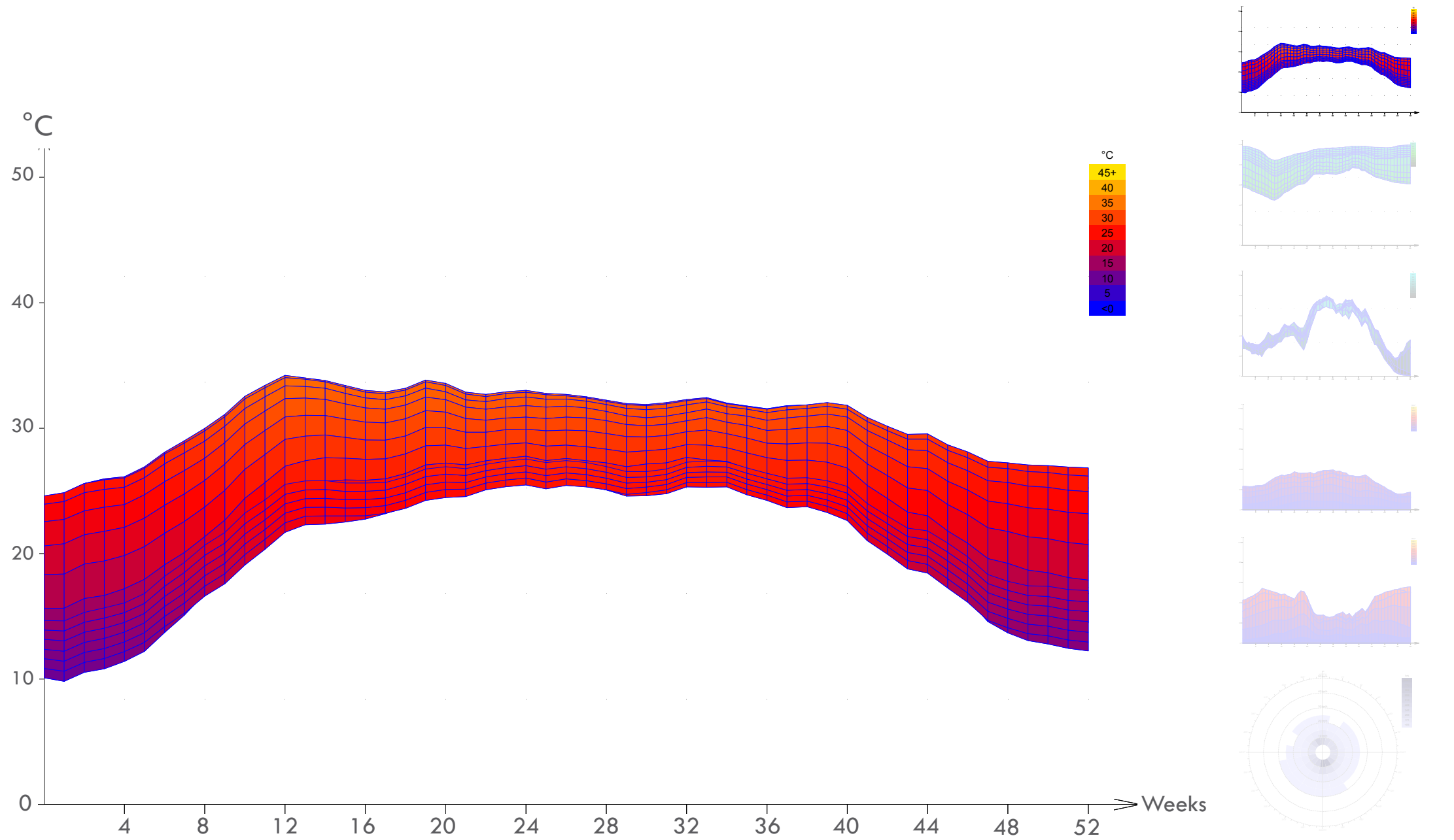
Area > 147,000 km²

Population > 156.6 Mill (2013)

Terrain > Flat, alluvial plains, hilly in SouthEast

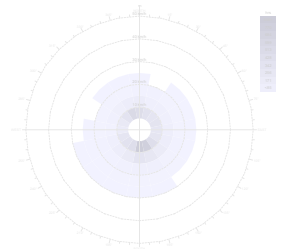
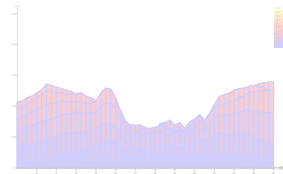
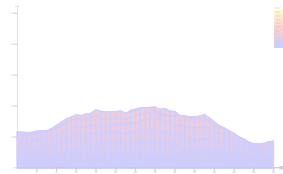
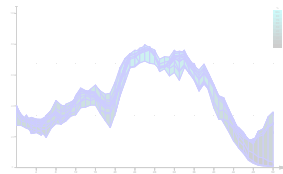
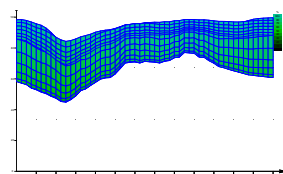
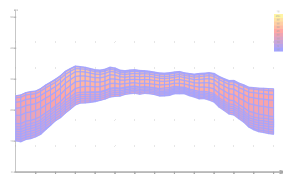
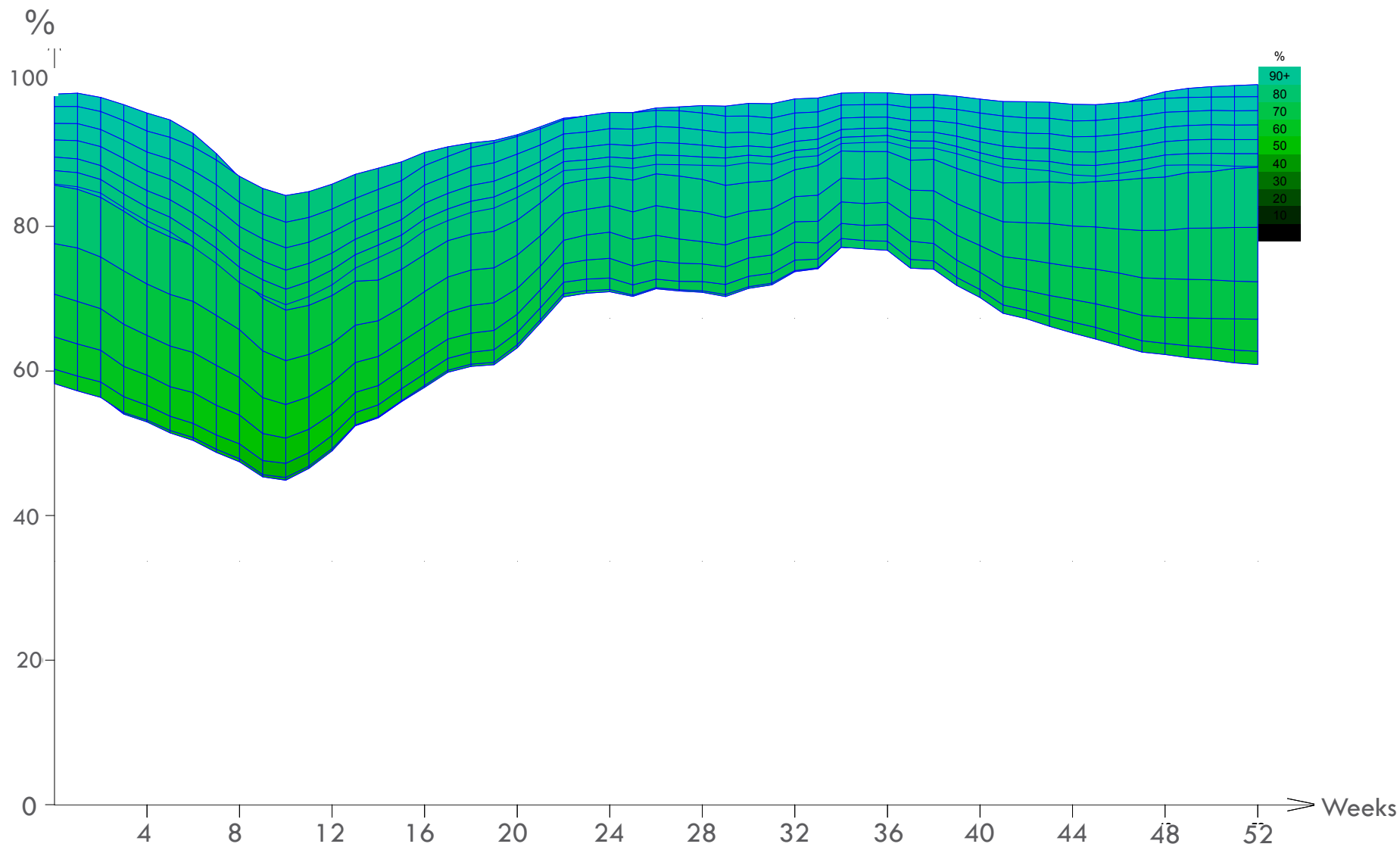


Temperatures 10 - 36°C



Temperatures 10 - 36°C

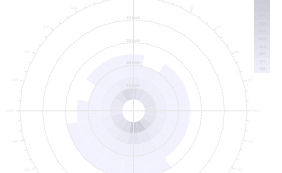
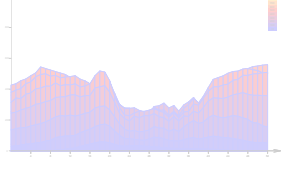
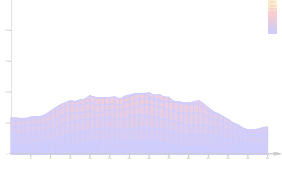
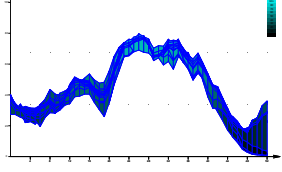
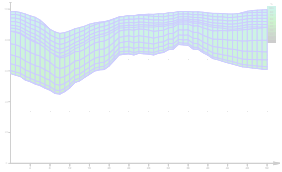
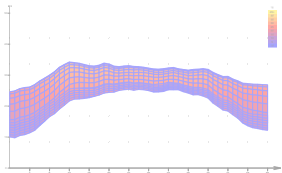
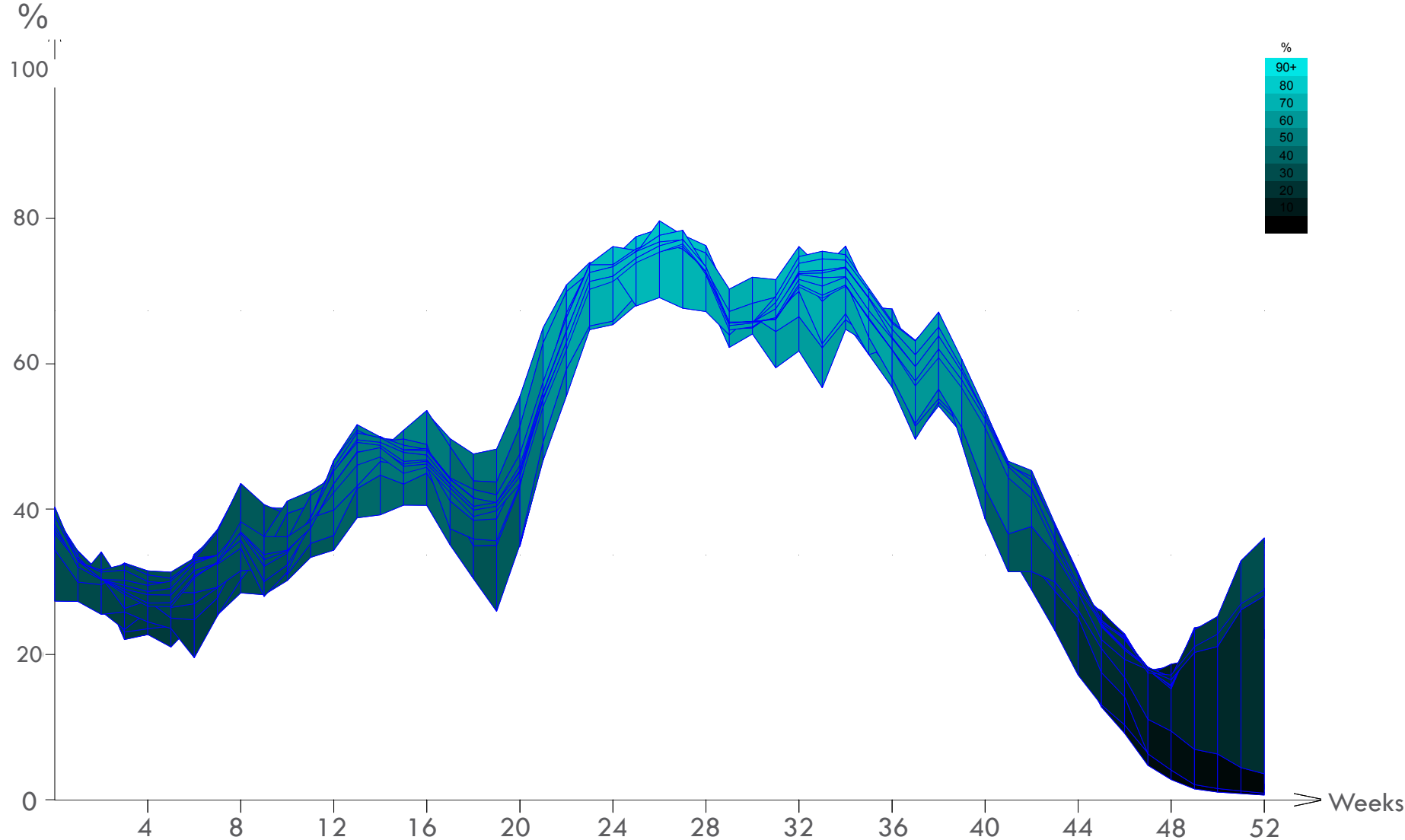
Relatile Humidity 60 - 95%

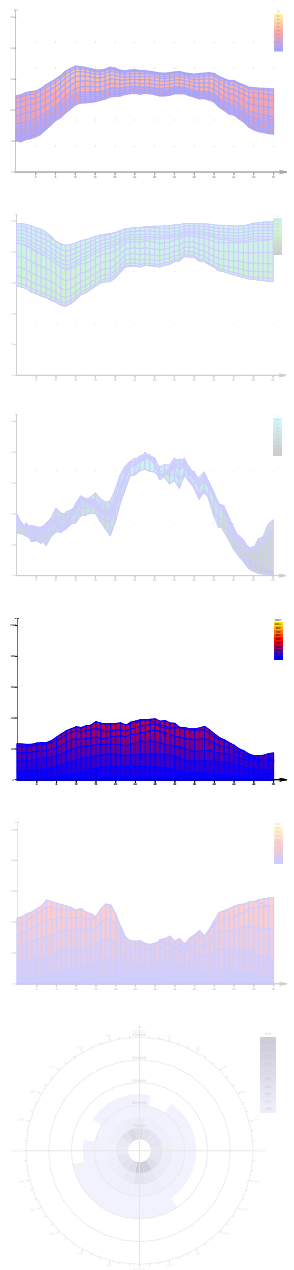
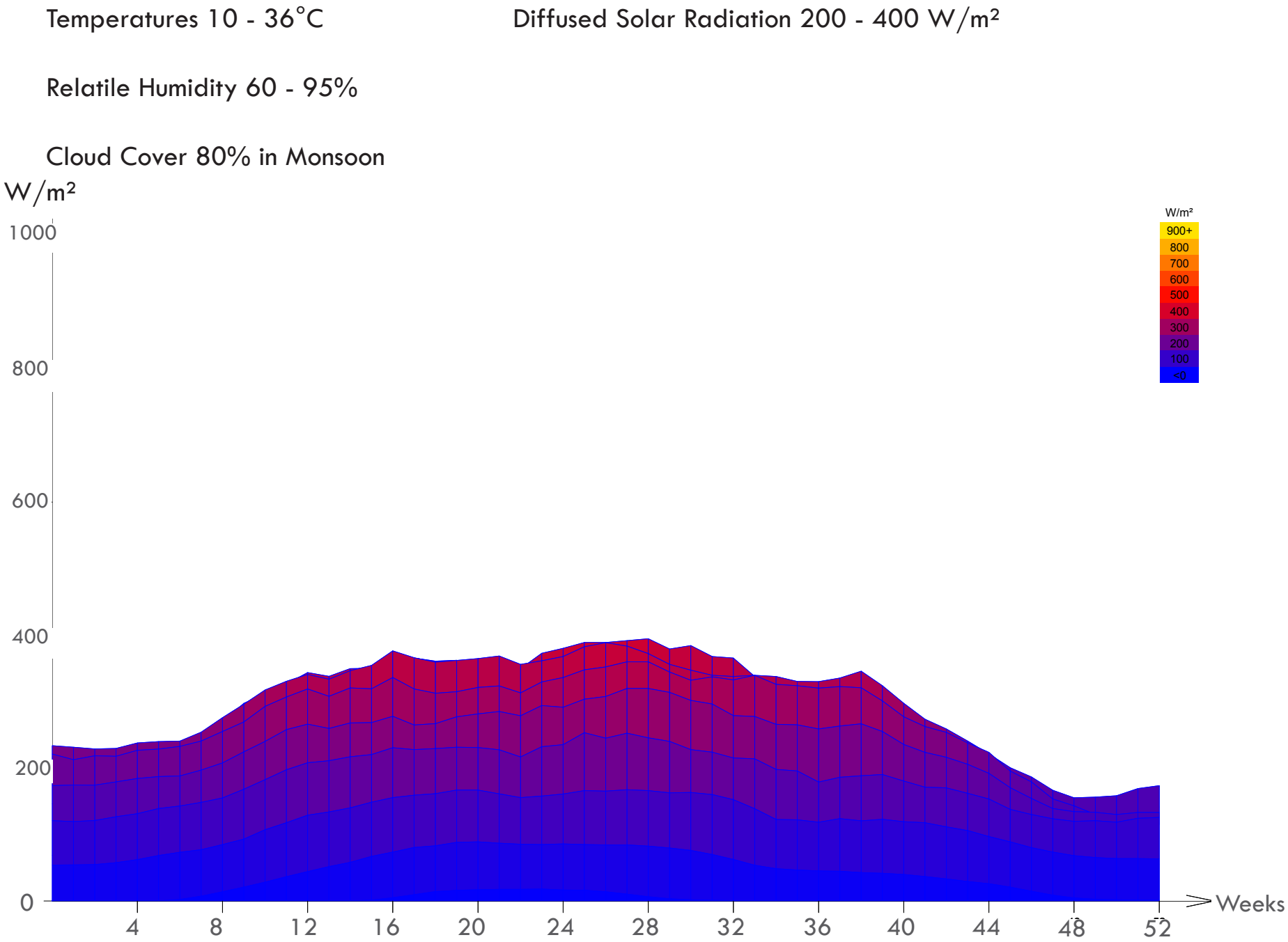


Temperatures 10 - 36°C

Relatile Humidity 60 - 95%

Cloud Cover 80% in Monsoon





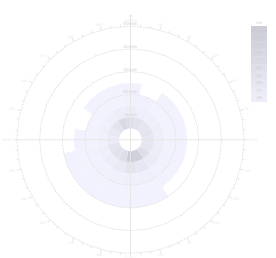
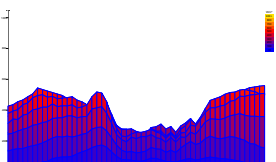
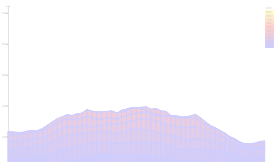
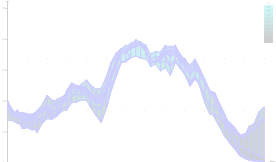
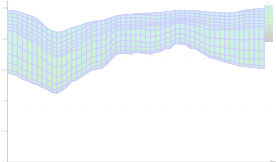
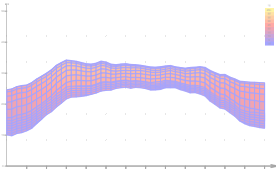
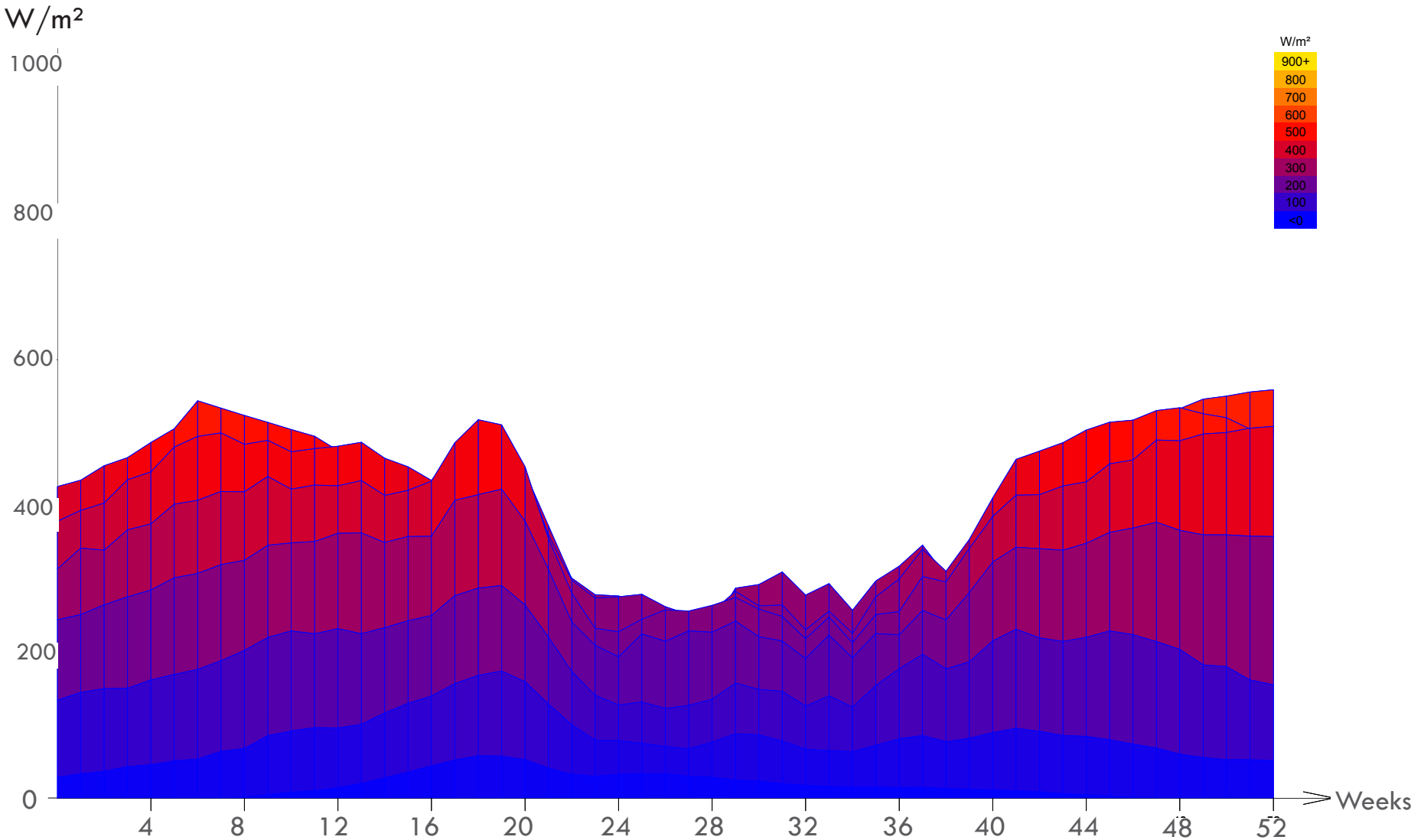
Temperatures 10 - 36°C

Diffused Solar Radiation 200 - 400 W/m²

Relatile Humidity 60 - 95%

Direct Solar Radiation During Cooler Months

Cloud Cover 80% in Monsoon



Temperatures 10 - 36°C

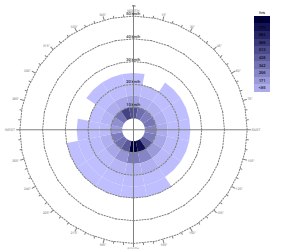
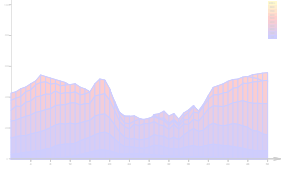
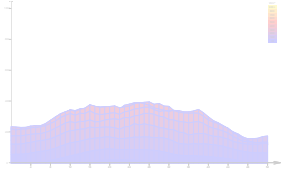
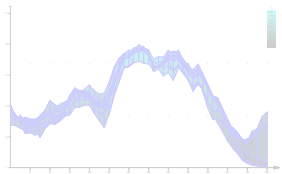
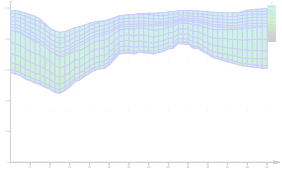
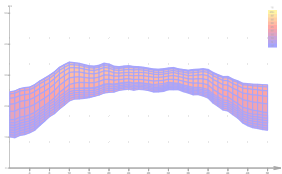
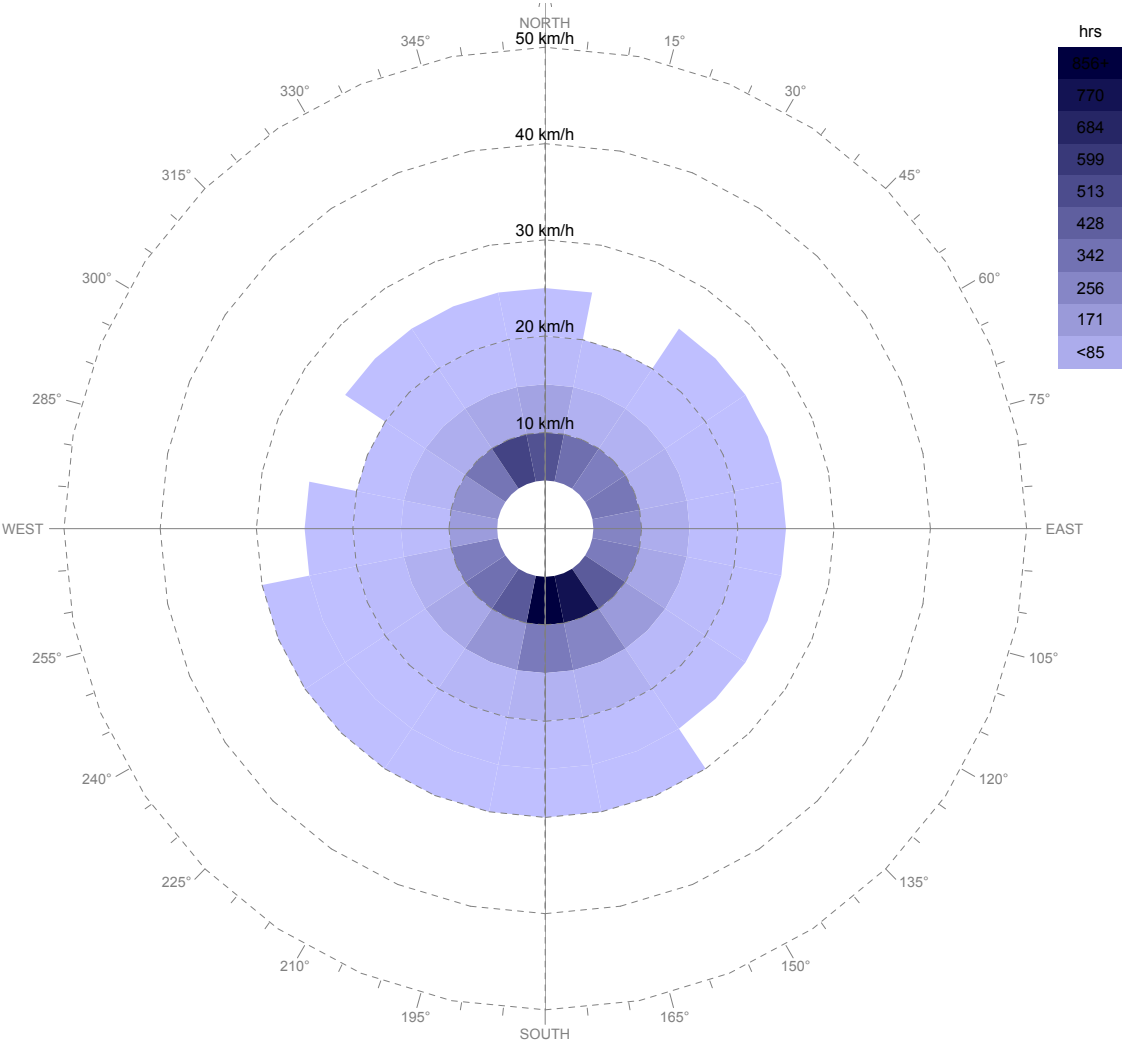
Diffused Solar Radiation 200 - 400 W/m²

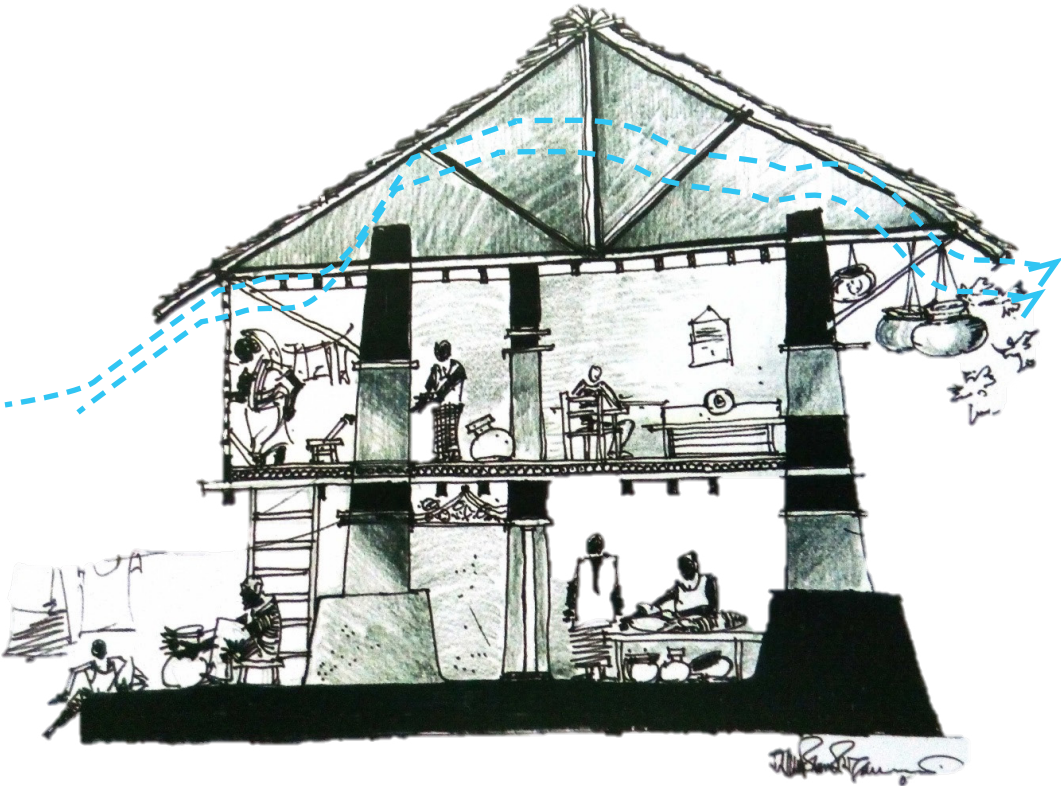
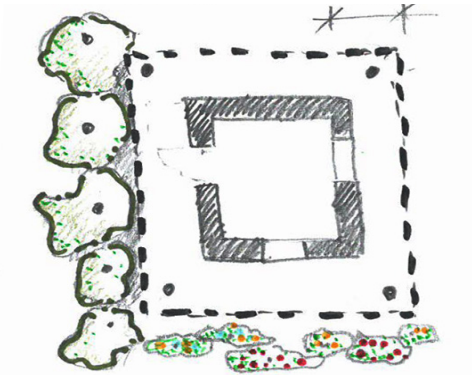
Relative Humidity 60 - 95%

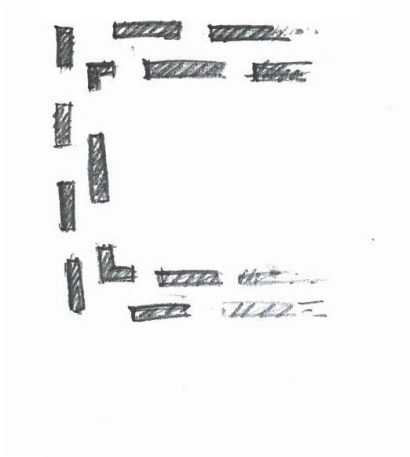
Direct Solar Radiation During Cooler Months

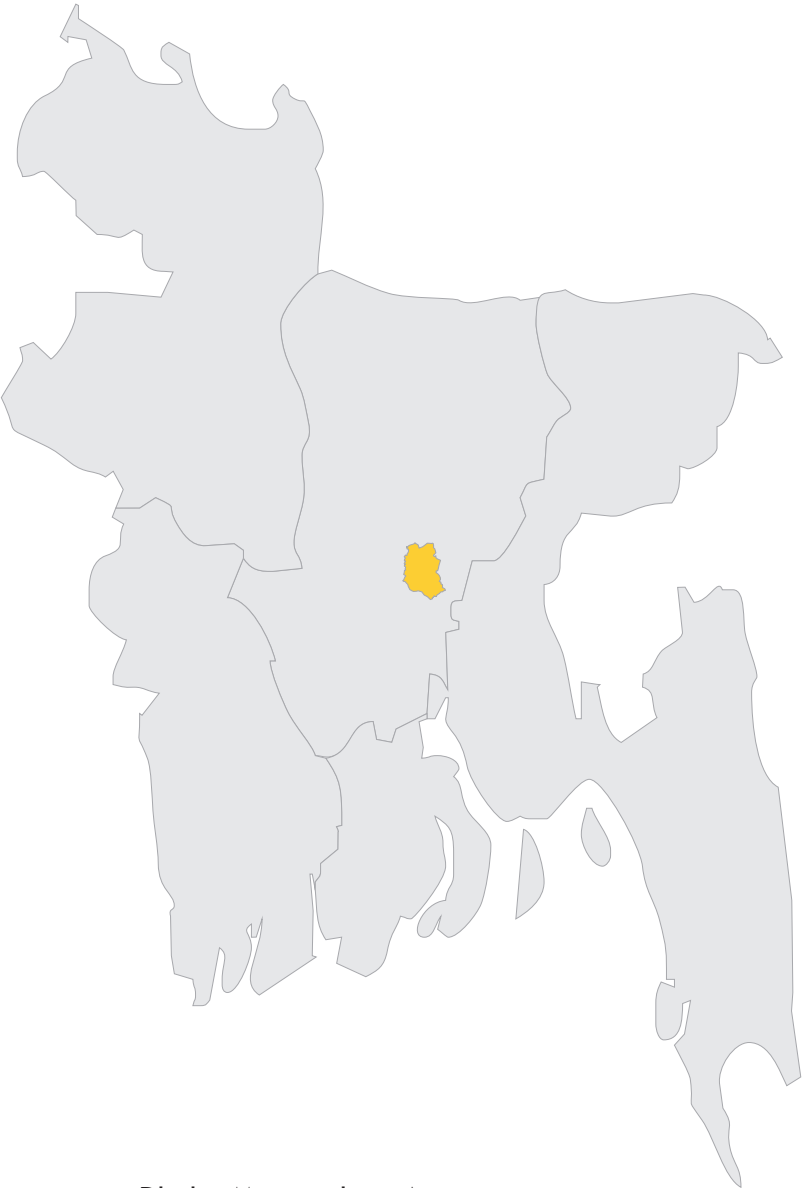
Cloud Cover 80% in Monsoon

Wind from South and Southwest









■ Dhaka Metropolitan Area

Dhaka Metropolitan Area > 360 km²

Population > 7,000,940

Density > 19000 per sqkm

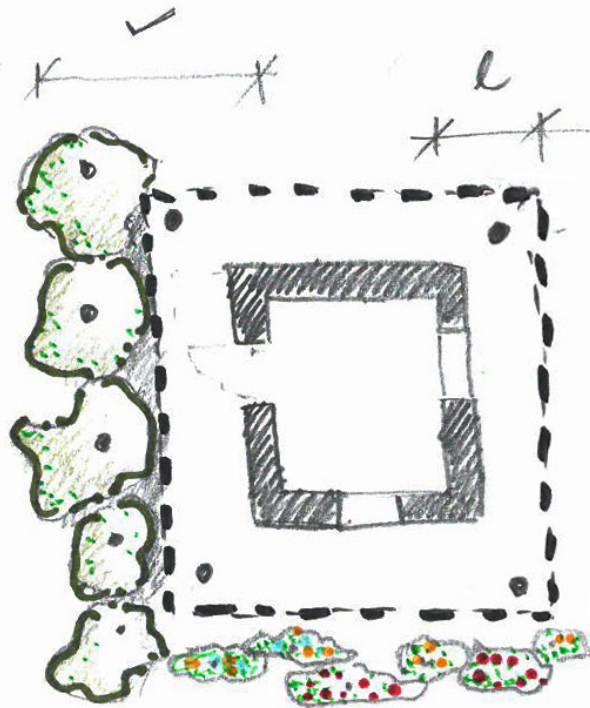
(Berlin is 3900 per sqkm)

Average Cost of Residential Floor >

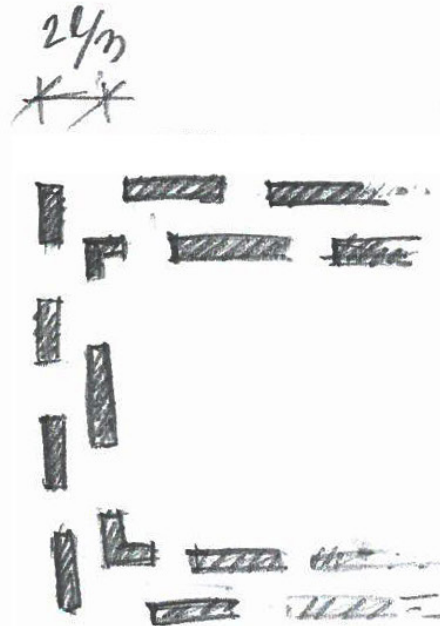
1,000€/sqm vs GDP per capita 1600€

(Berlin 3200€/sqm vs GDP per capita 30300€)

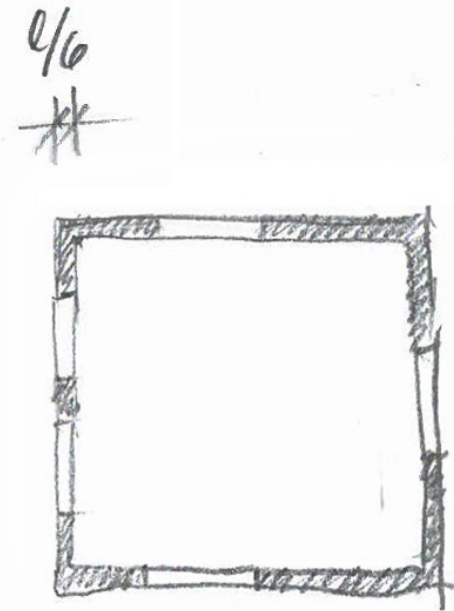




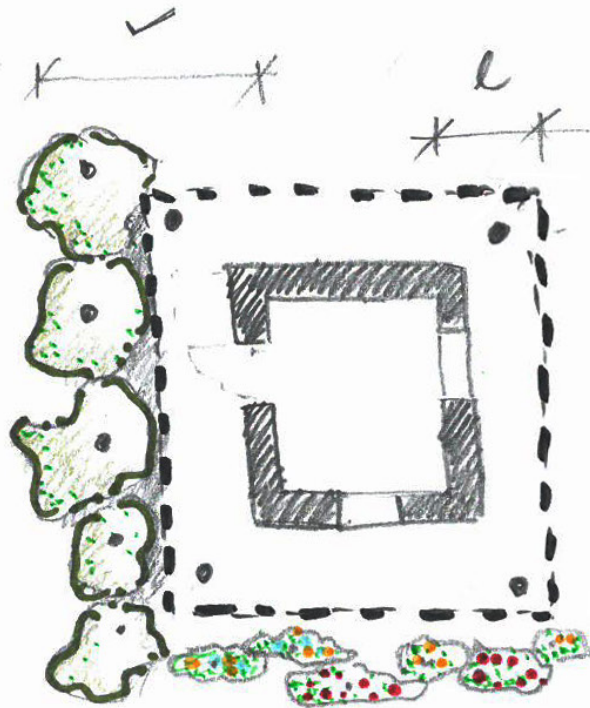
Vernacular Hut



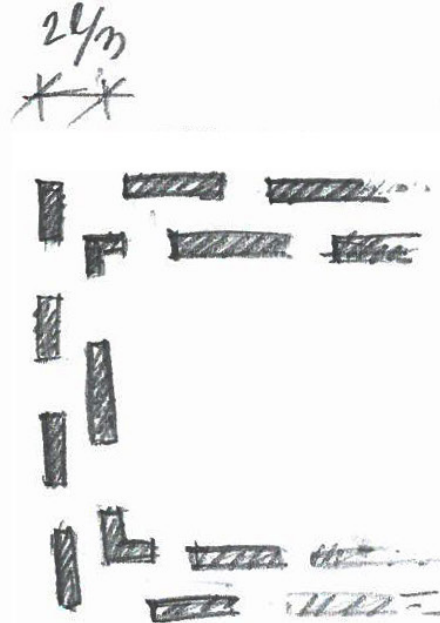
Double Facades/Verandahs
1950's - 70's



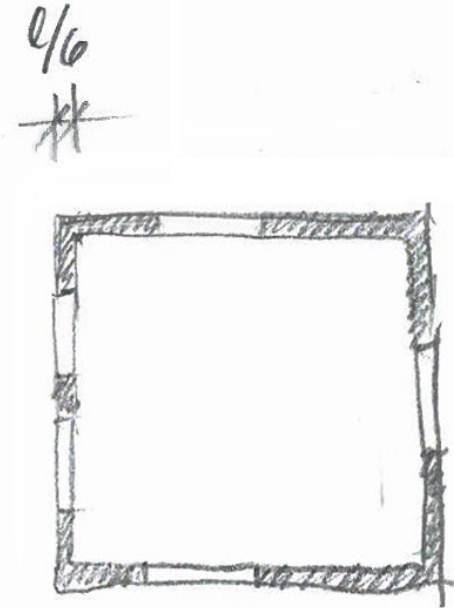
2014 - ?



Vernacular Hut



Double Facades/Verandahs
1950's - 70's



2014 - ?

LOW TECH, HIGH IMPACT BUILDING SKIN DESIGN FOR DHAKA, BANGLADESH

[HOW]

COMFORT > NOT Air Temperature

COMFORT > NOT Air Temperature

SET

[Standard Effective Temperature]
Code according to ASHRAE Standard
55-2013, Appendix G1

PMV

[Predicted Mean Vote]
Code according to ISO 7730 and ASHRAE Standard
55-2013, Appendix G (PMV for elevated air speed)

COMFORT > NOT Air Temperature

SET

[Standard Effective Temperature]
Code according to ASHRAE Standard
55-2013, Appendix G1

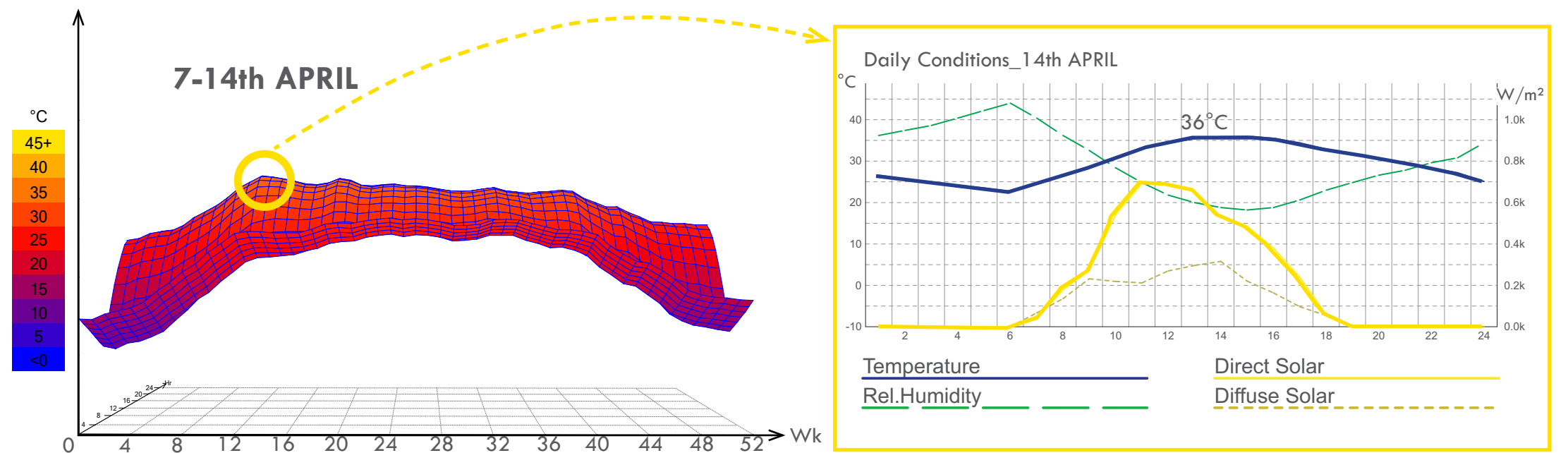
PMV

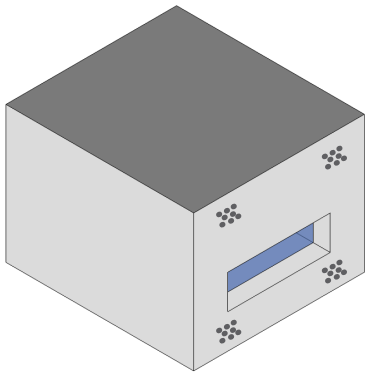
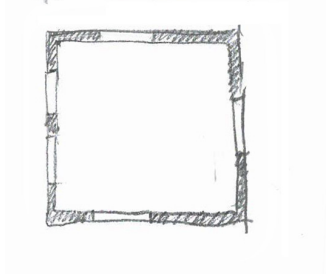
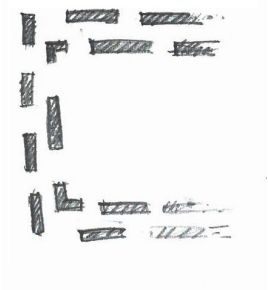
[Predicted Mean Vote]
Code according to ISO 7730 and ASHRAE Standard
55-2013, Appendix G (PMV for elevated air speed)

Elevated Air Velocity

Adiabatic Cooling

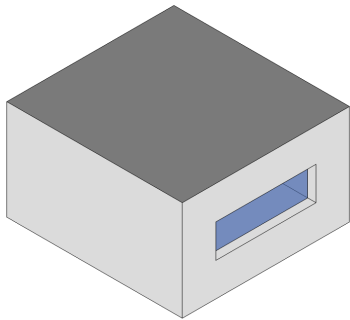
Adaptive Clothing





Post Colonial Building
(reference case)

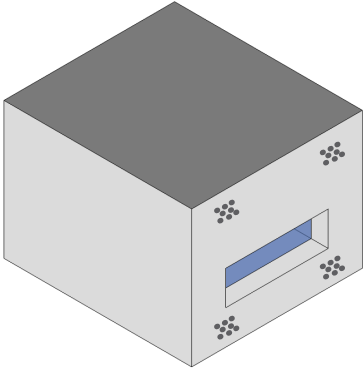
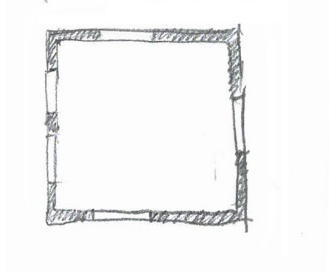
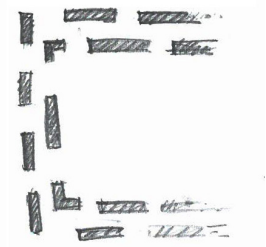
Dim - 5m(l) x 5m(w)x 4m(h)
WW - 15%
Wall - 400mm Brick
ACH - 5
INFIL - 1



Present Day Building
(base case)

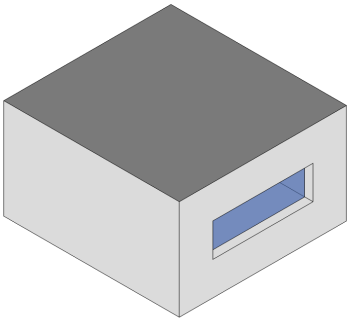
FIXED
Dim - 5m(l) x 5m(w)x 3m(h)
Window at South

VARIABLE
WW - 20%
SF - 0%
Wall - 250mm Brick
ACH - 3
INFIL - 0.5



Post Colonial Building
(reference case)

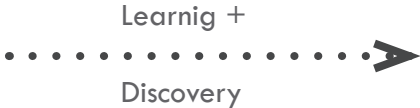
Dim - 5m(l) x 5m(w)x 4m(h)
WW - 15%
Wall - 400mm Brick
ACH - 5
INFIL - 1



Present Day Building
(base case)

FIXED
Dim - 5m(l) x 5m(w)x 3m(h)
Window at South

VARIABLE
WW - 20%
SF - 0%
Wall - 250mm Brick
ACH - 3
INFIL - 0.5



New Building Skin Design

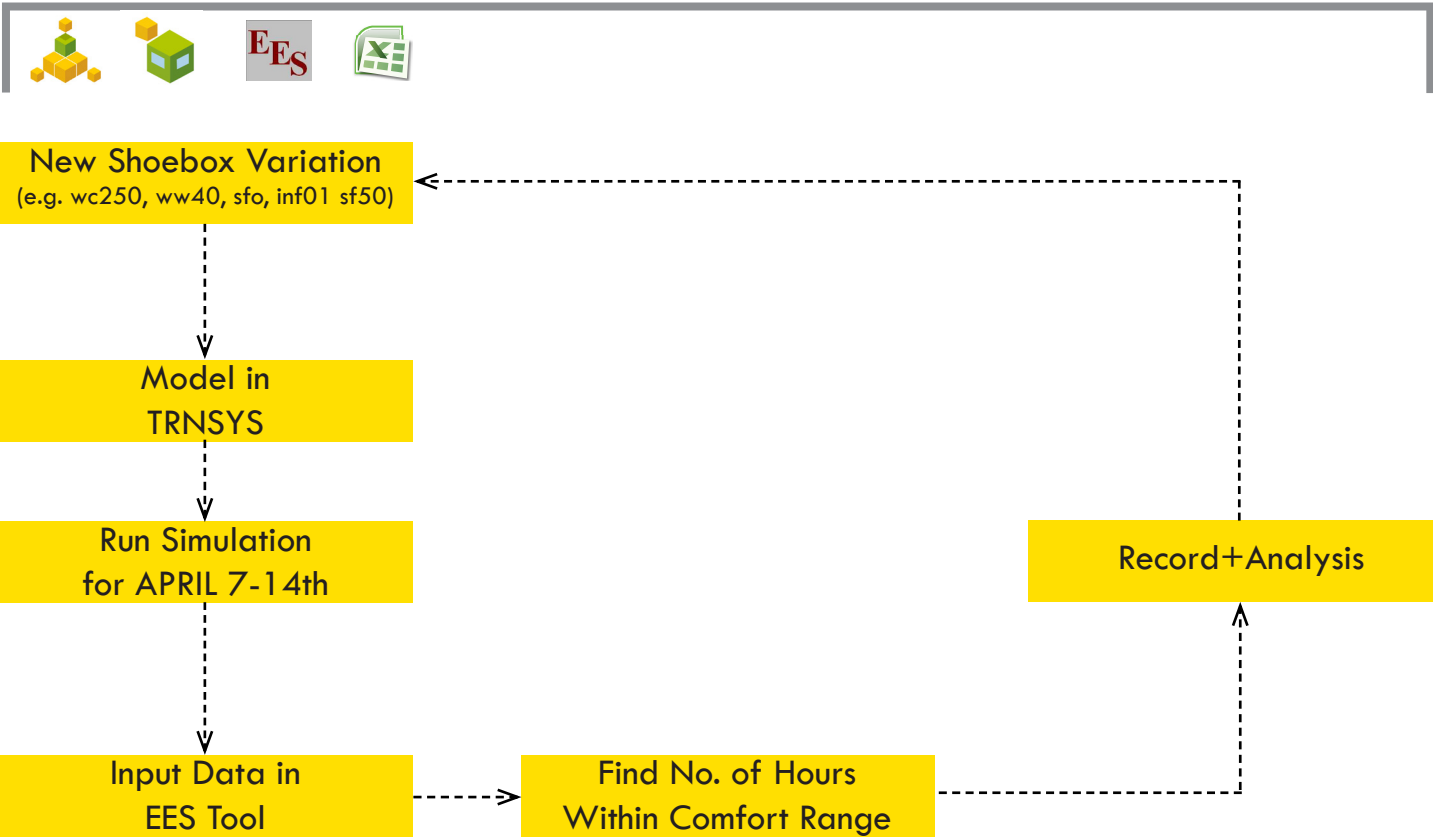
Climate Data
Design Innovation
Local Materials
...etc

LOW TECH

HIGHER COMFORT
(Thermal + Visual)

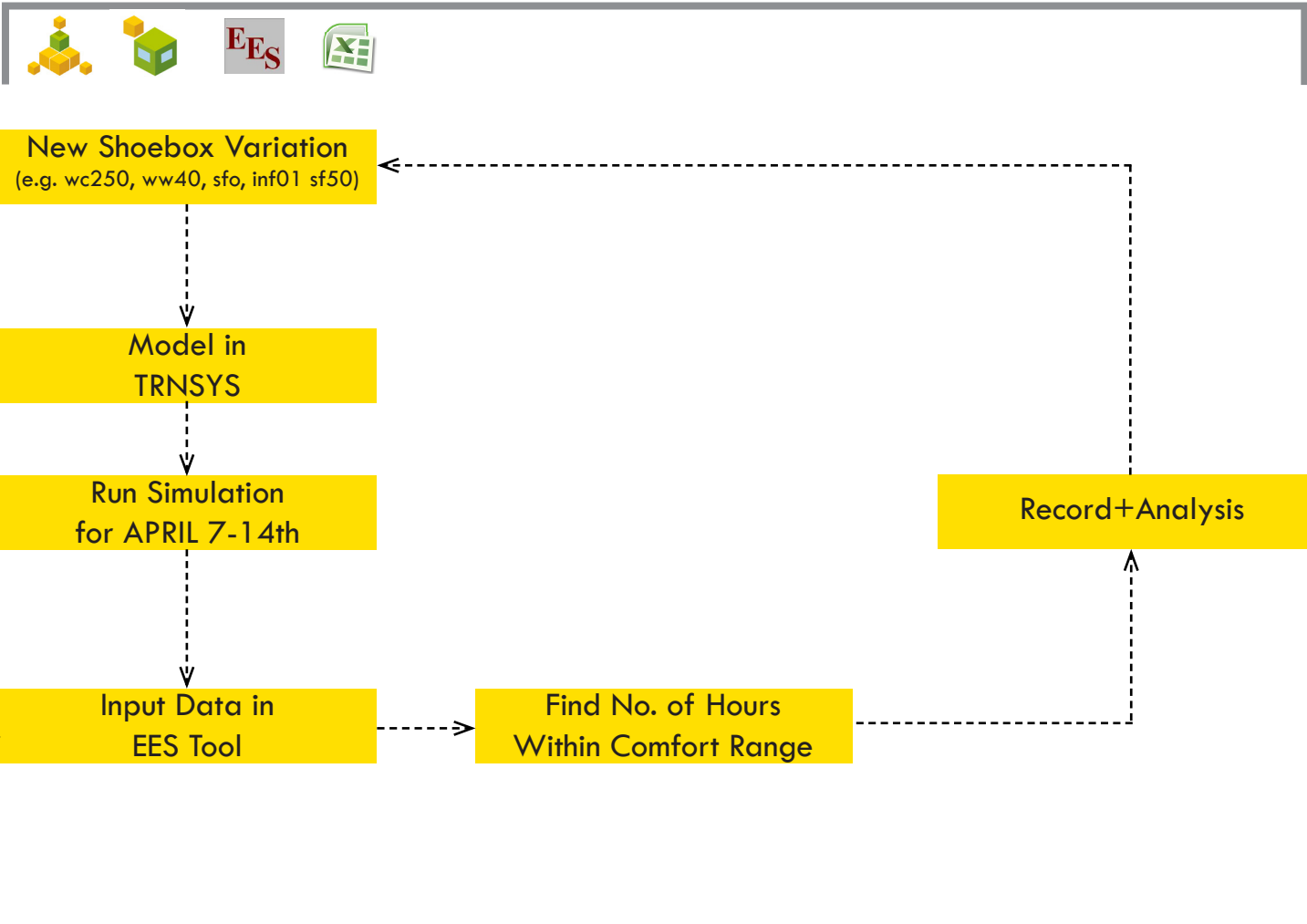
DAYLIGHT STUDY

THERMAL STUDY



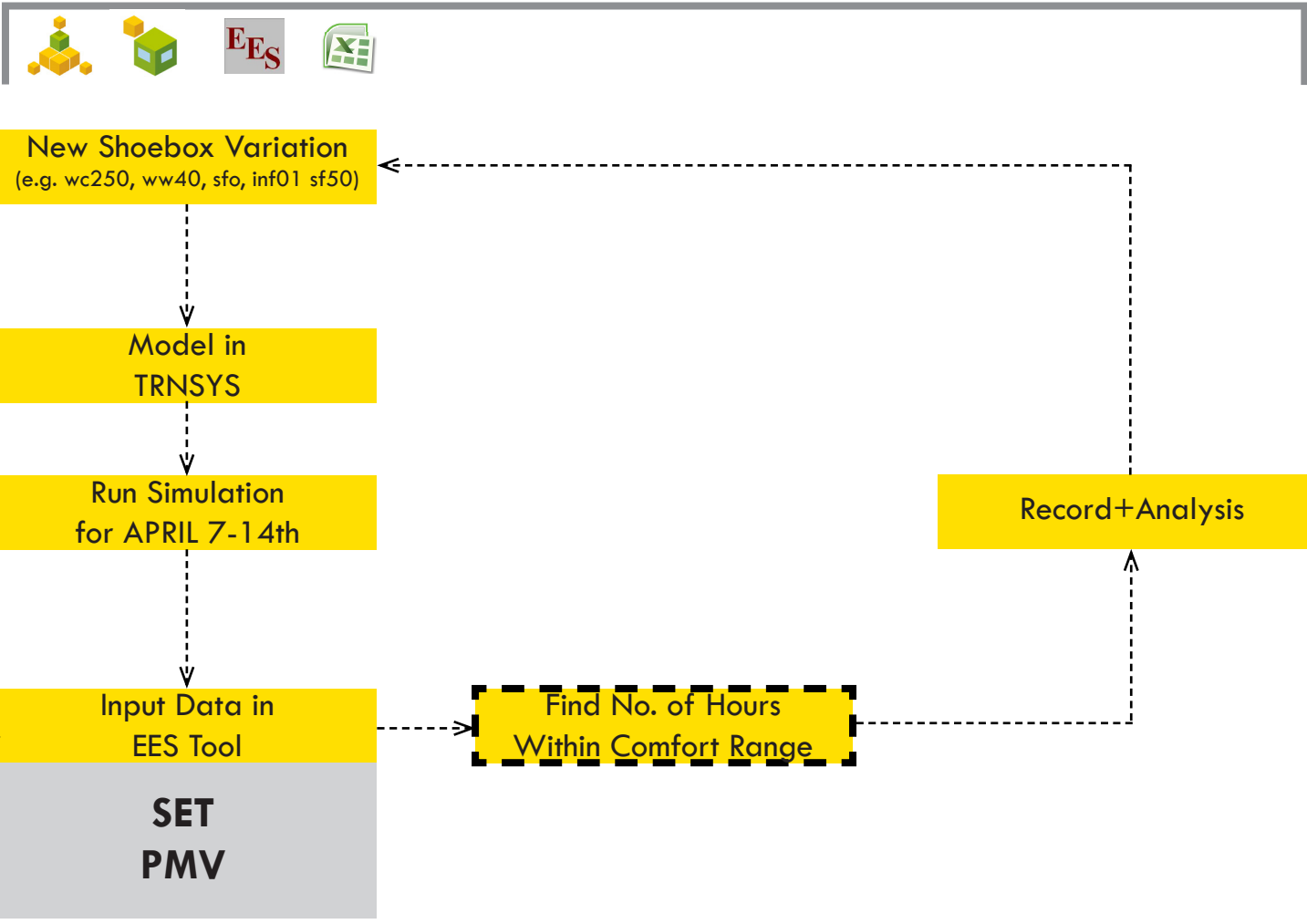
DAYLIGHT STUDY

THERMAL STUDY

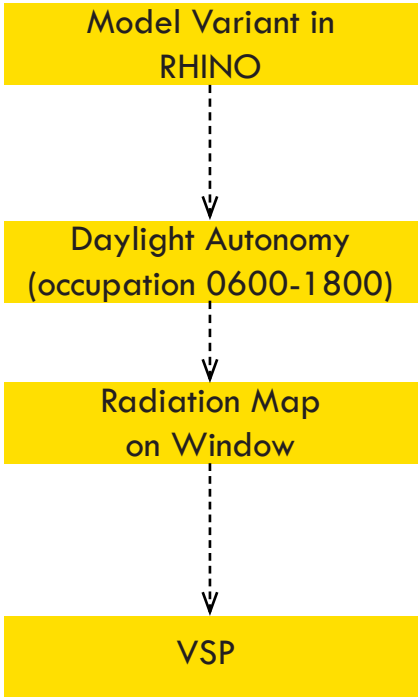


DAYLIGHT STUDY

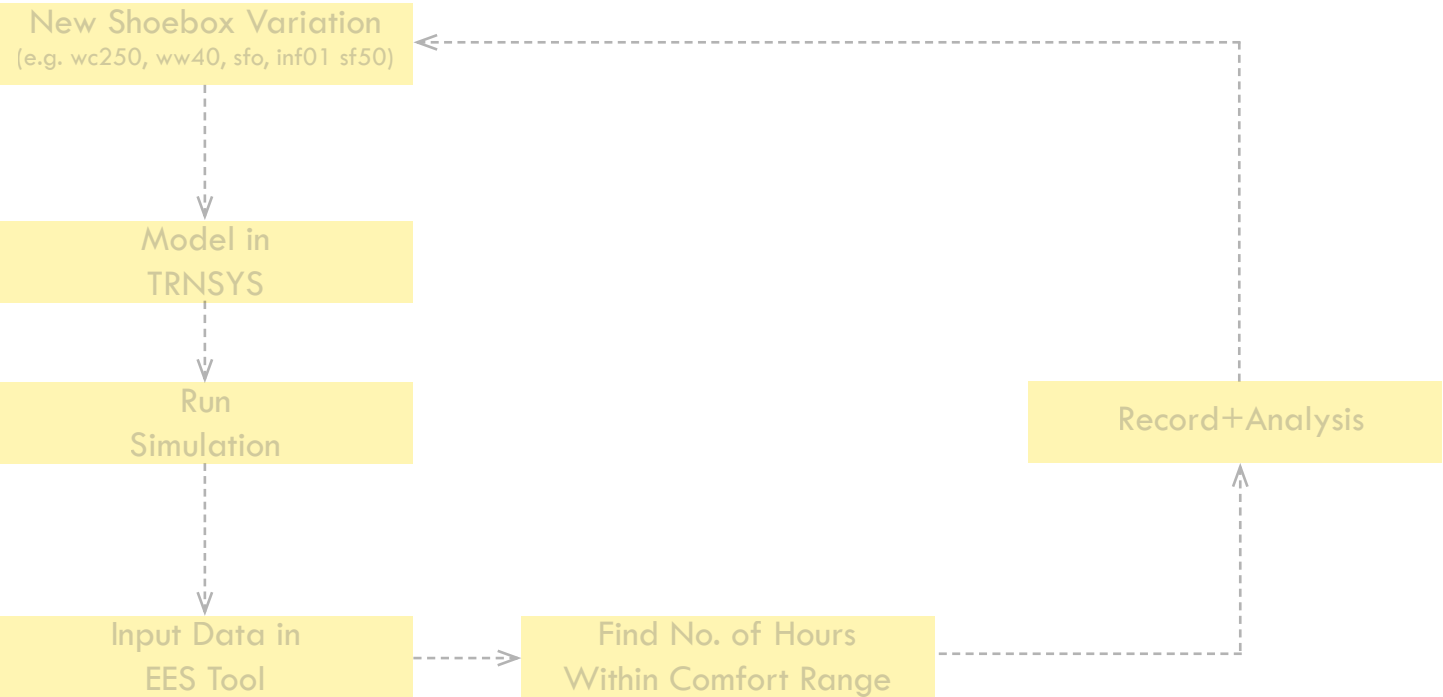
THERMAL STUDY



DAYLIGHT STUDY

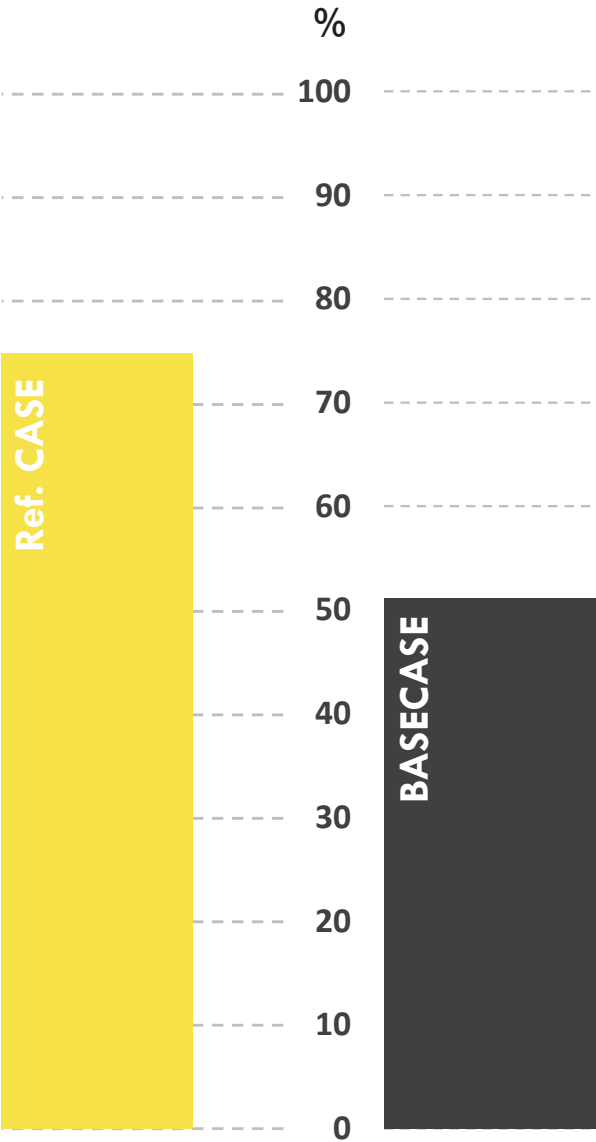


THERMAL STUDY

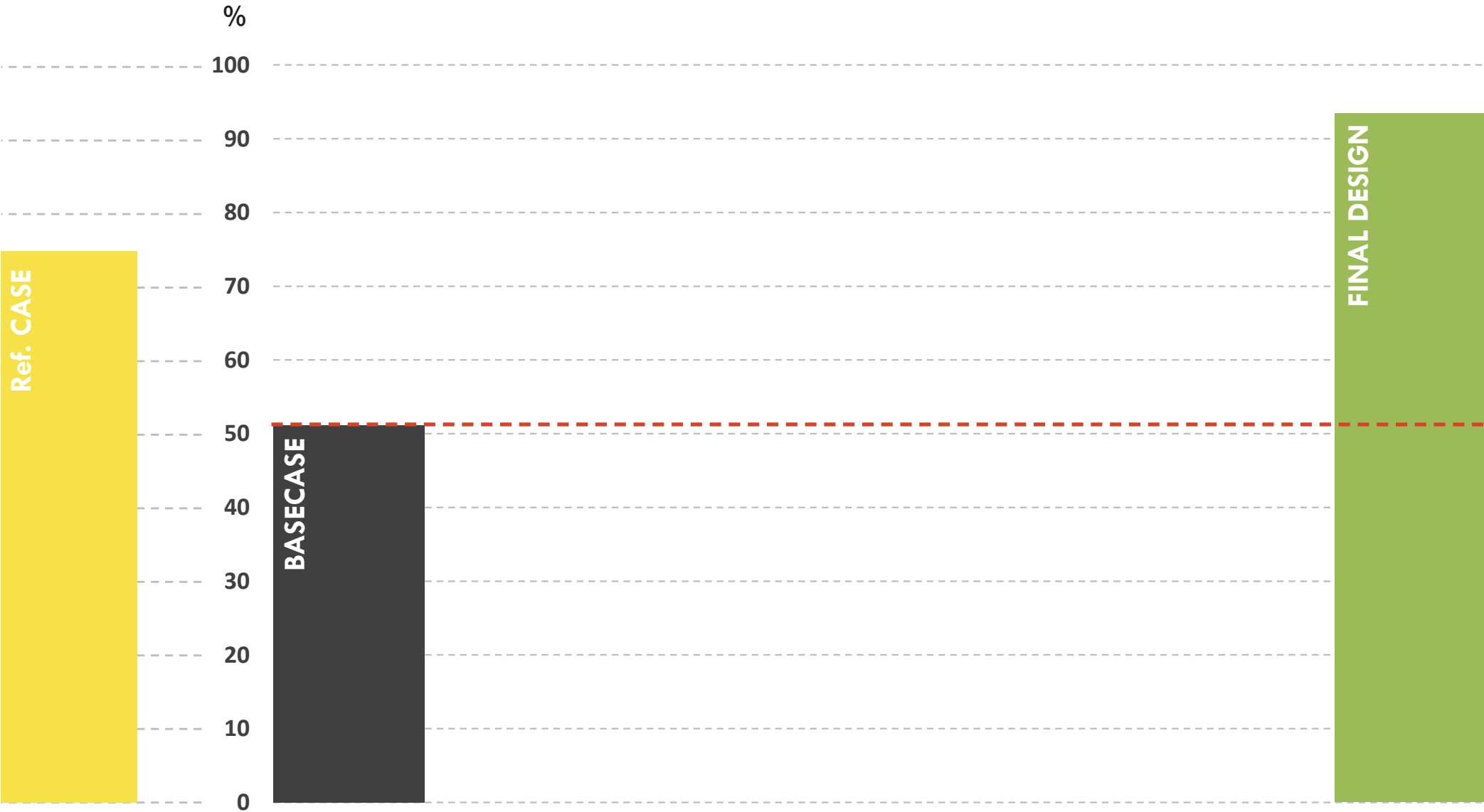


[WHAT]

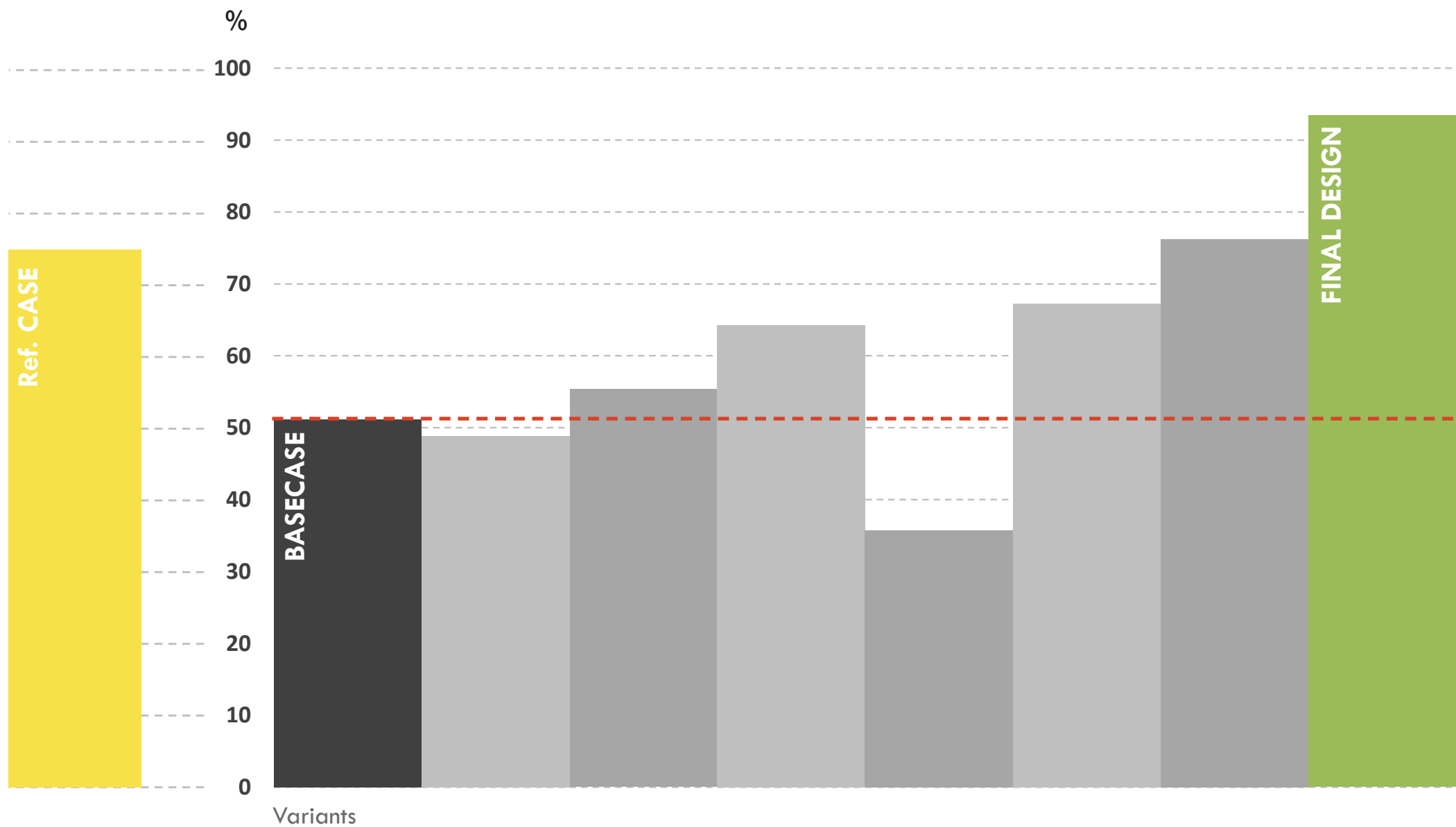
Percentage of Time Within Comfort Range



Percentage of Time Within Comfort Range

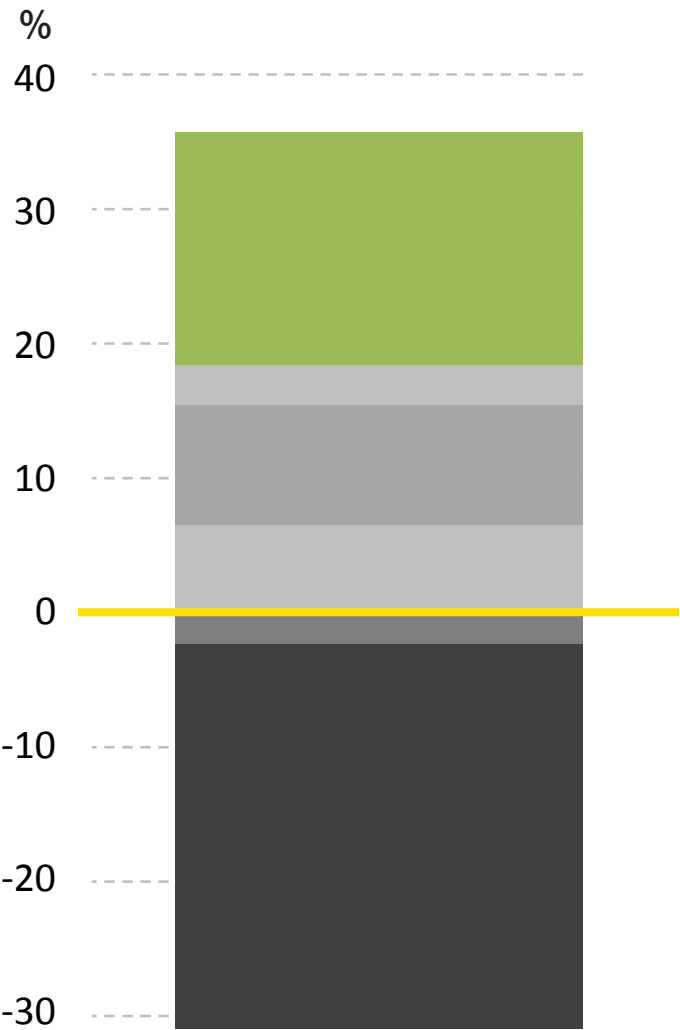


Percentage of Time Within Comfort Range



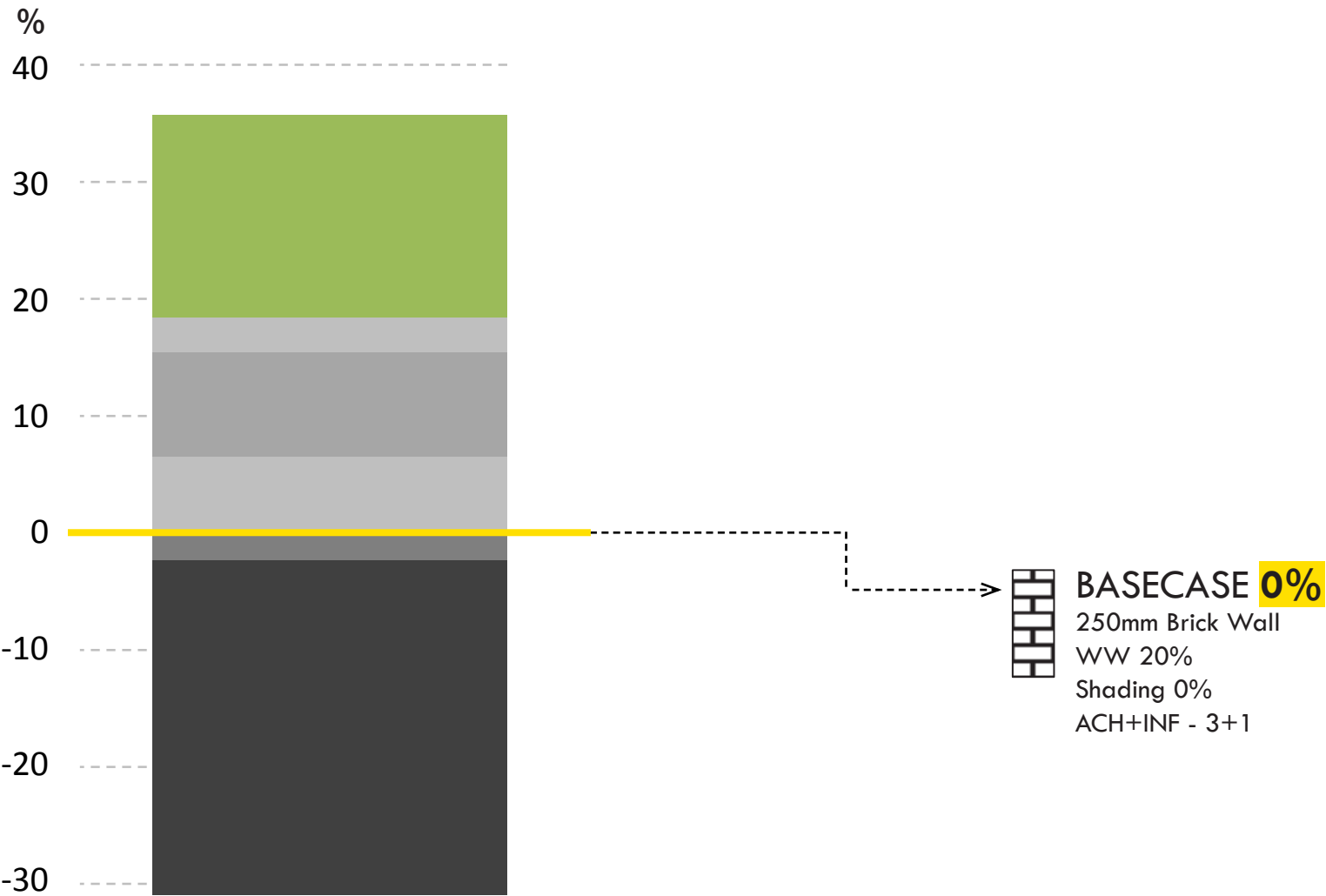
Thermal_New Building Skin Performance

Percentage Comfortable Hours Gained/Lost
(April 7-14)



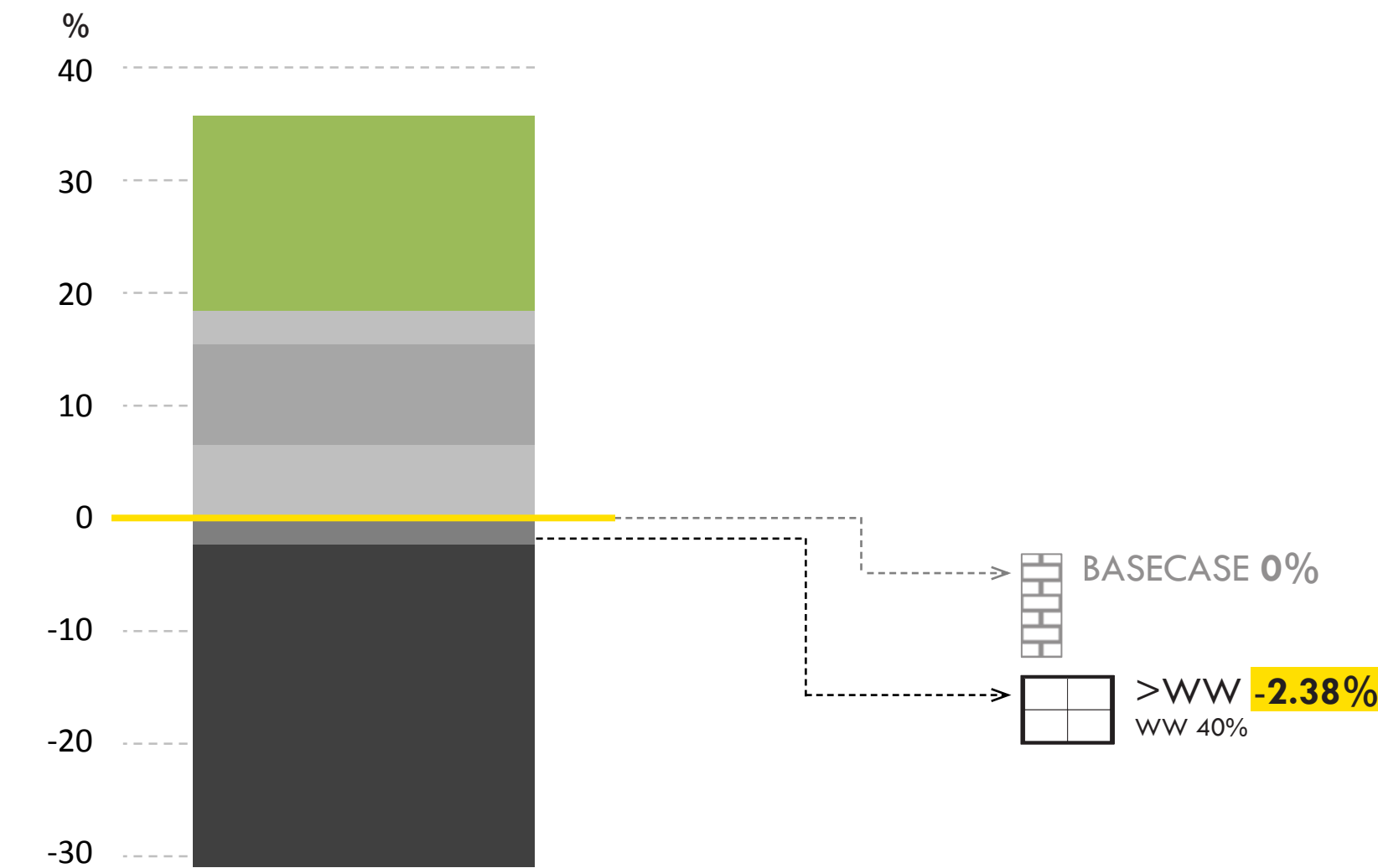
Thermal_New Building Skin Performance

Percentage Comfortable Hours Gained/Lost
(April 7-14)

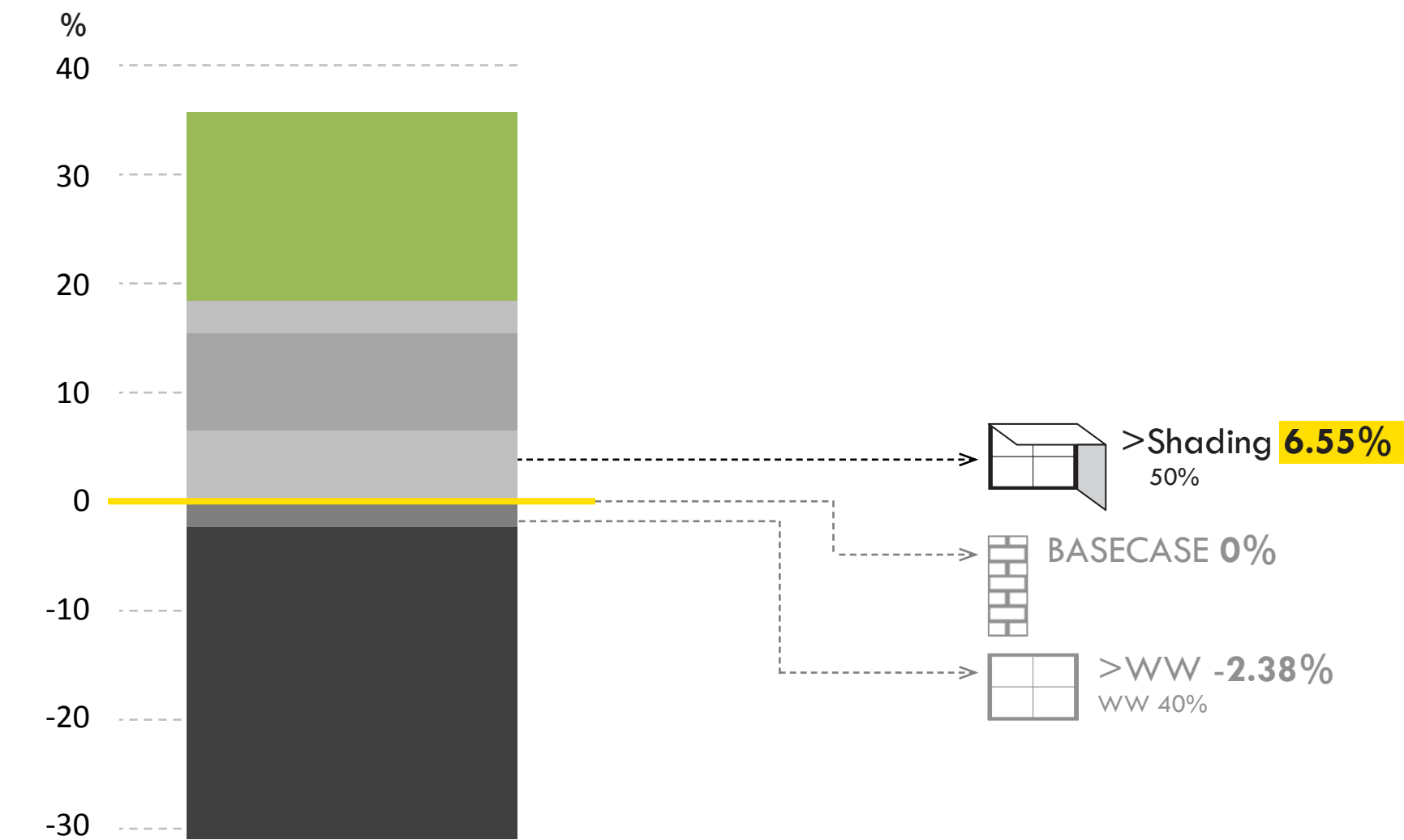


Thermal_New Building Skin Performance

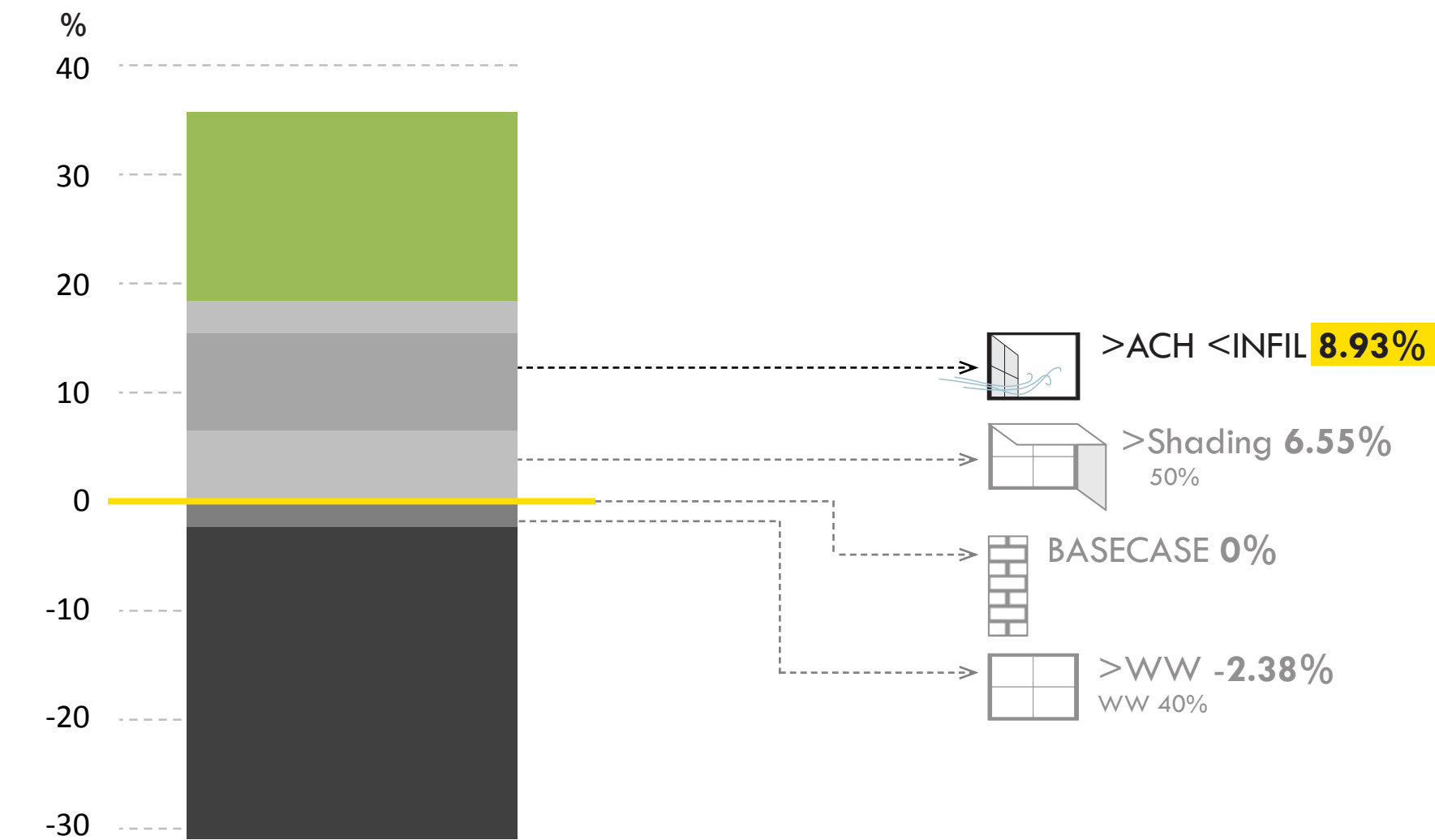
Percentage Comfortable Hours Gained/Lost
(April 7-14)



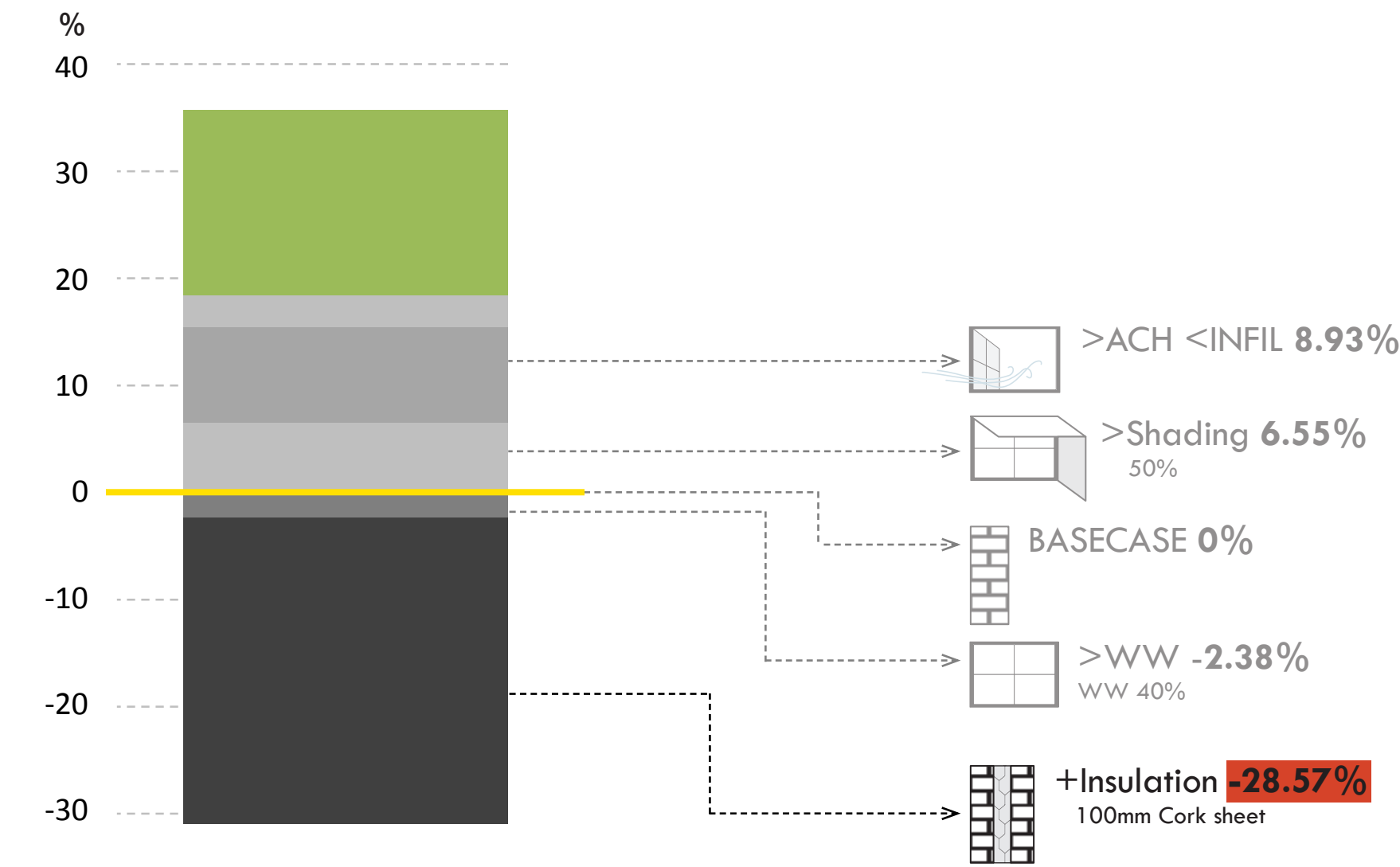
Percentage Comfortable Hours Gained/Lost
(April 7-14)



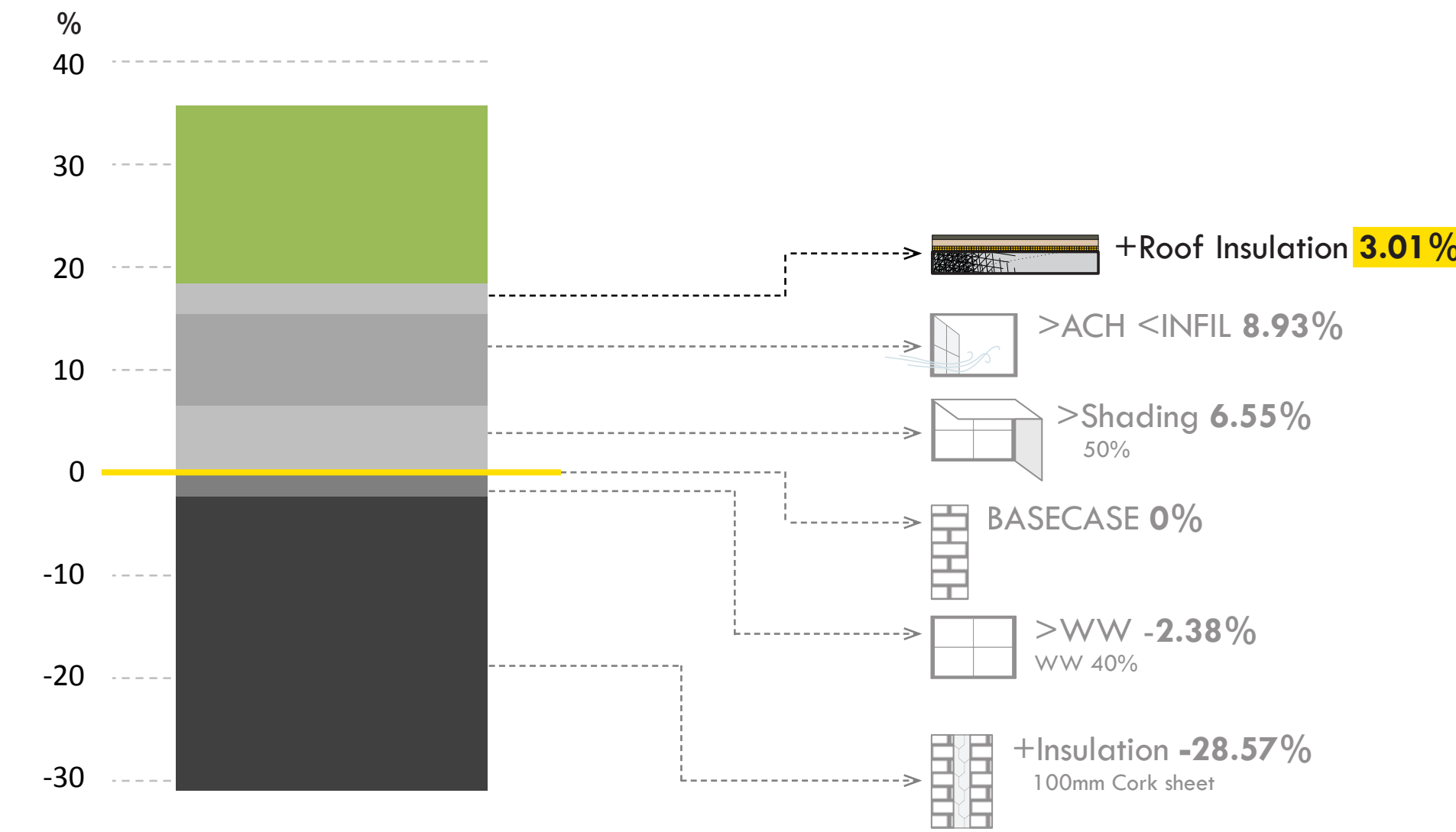
Percentage Comfortable Hours Gained/Lost
(April 7-14)



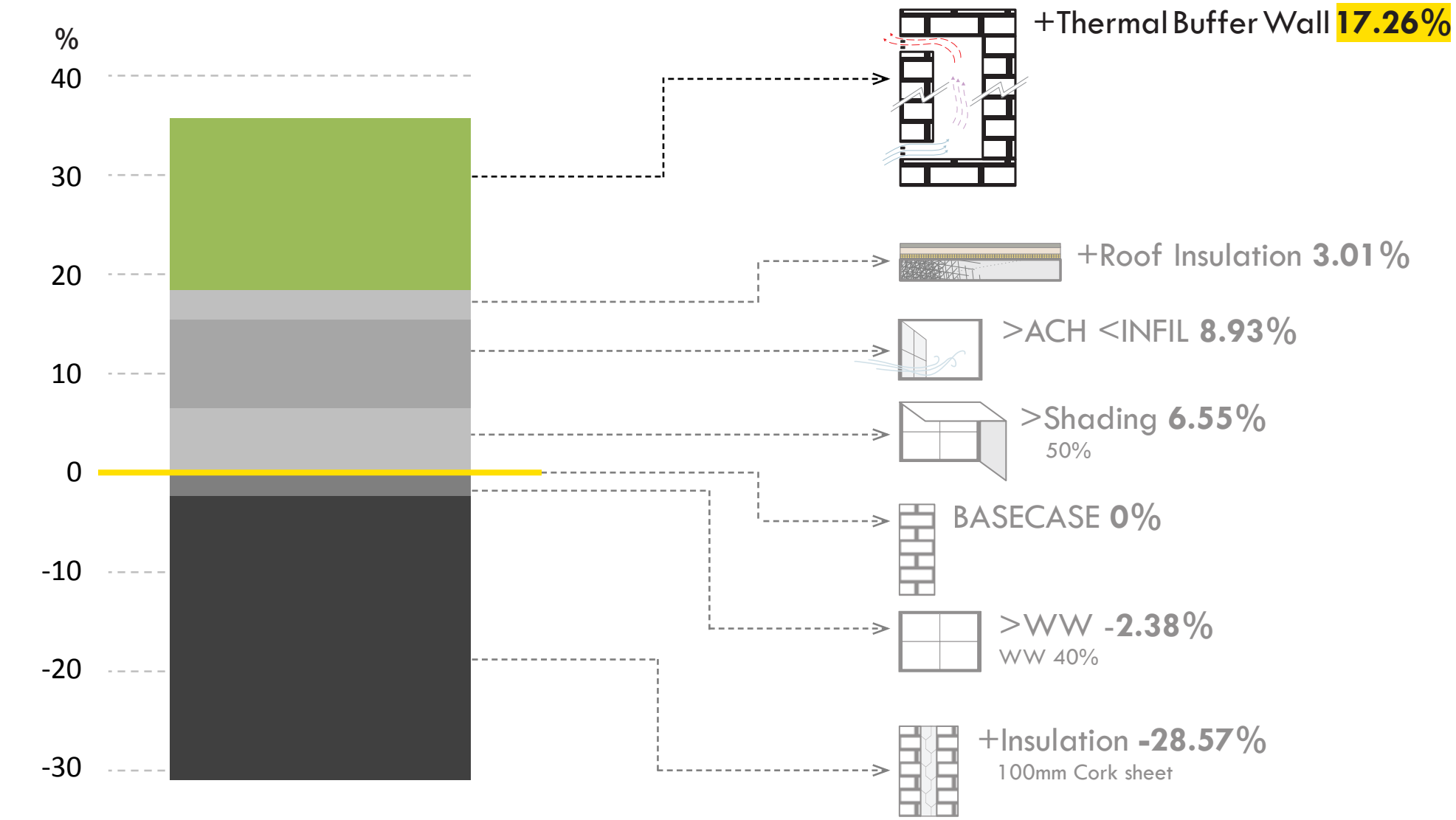
Percentage Comfortable Hours Gained/Lost
(April 7-14)



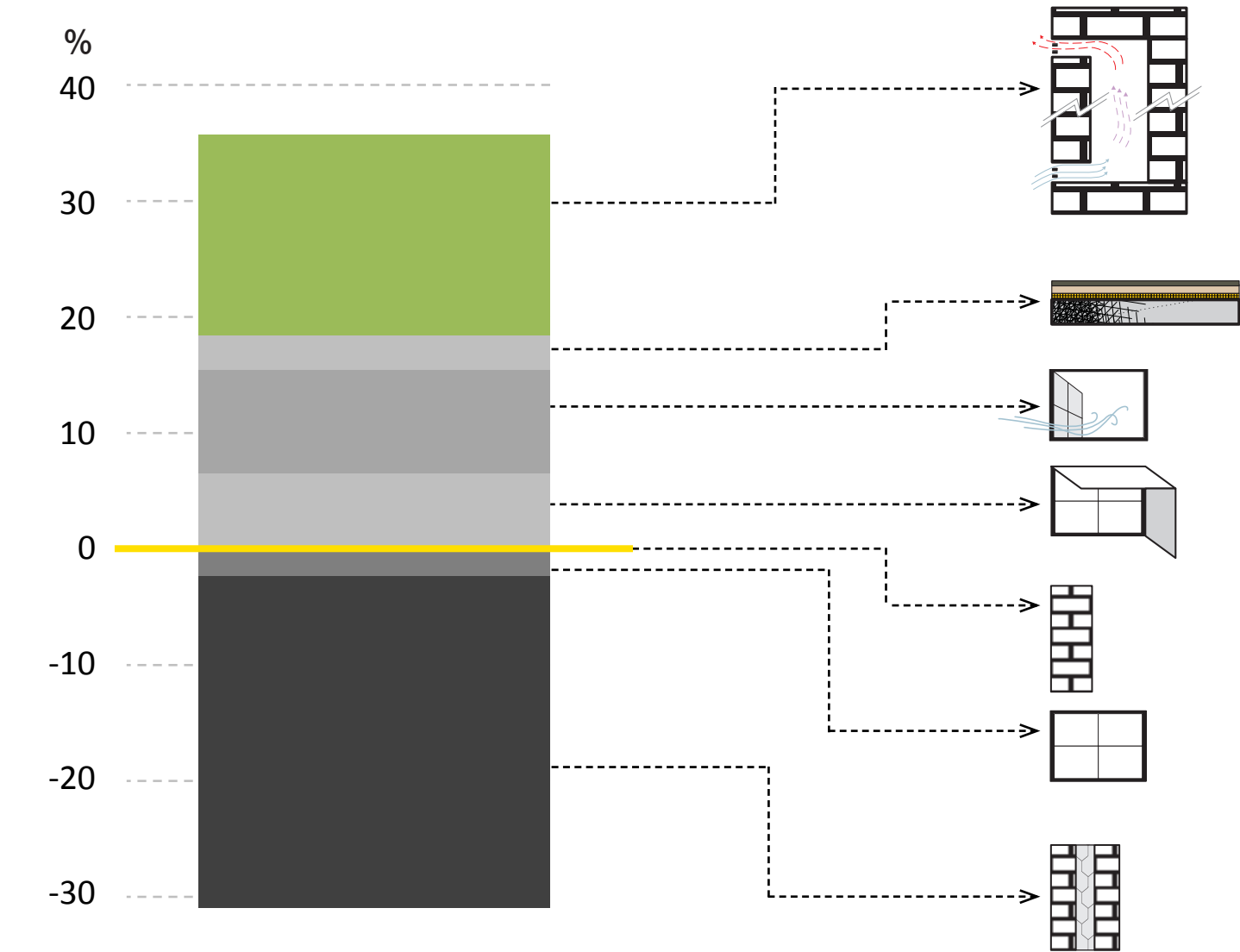
Percentage Comfortable Hours Gained/Lost
(April 7-14)



Percentage Comfortable Hours Gained/Lost
(April 7-14)

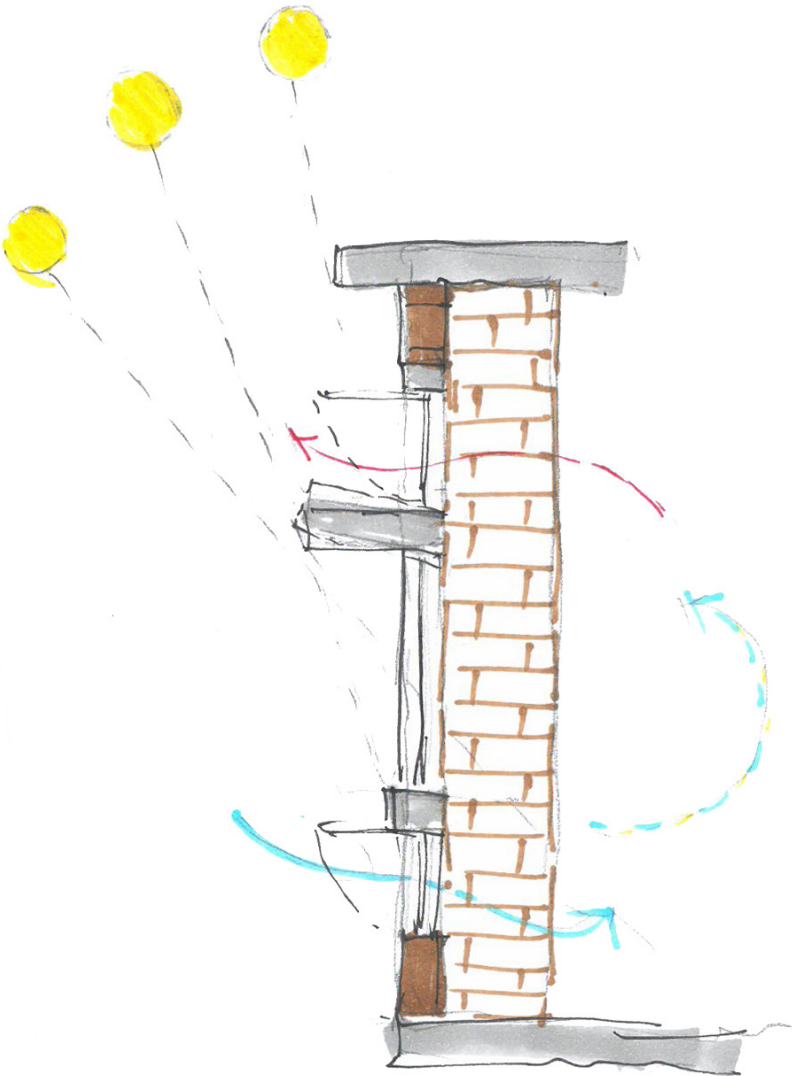
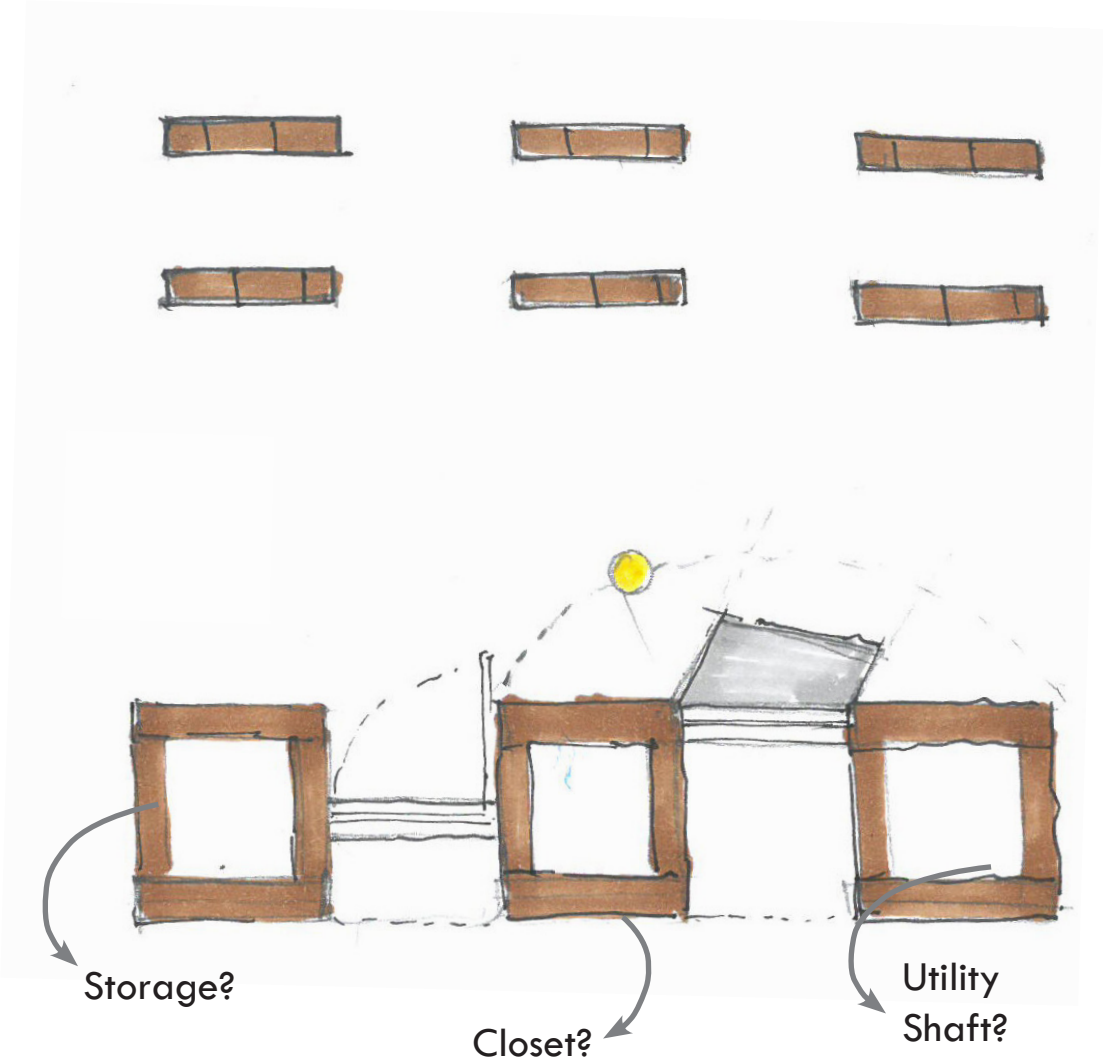


Percentage Comfortable Hours Gained/Lost
(April 7-14)



Total Gain in Comfort
35.75%

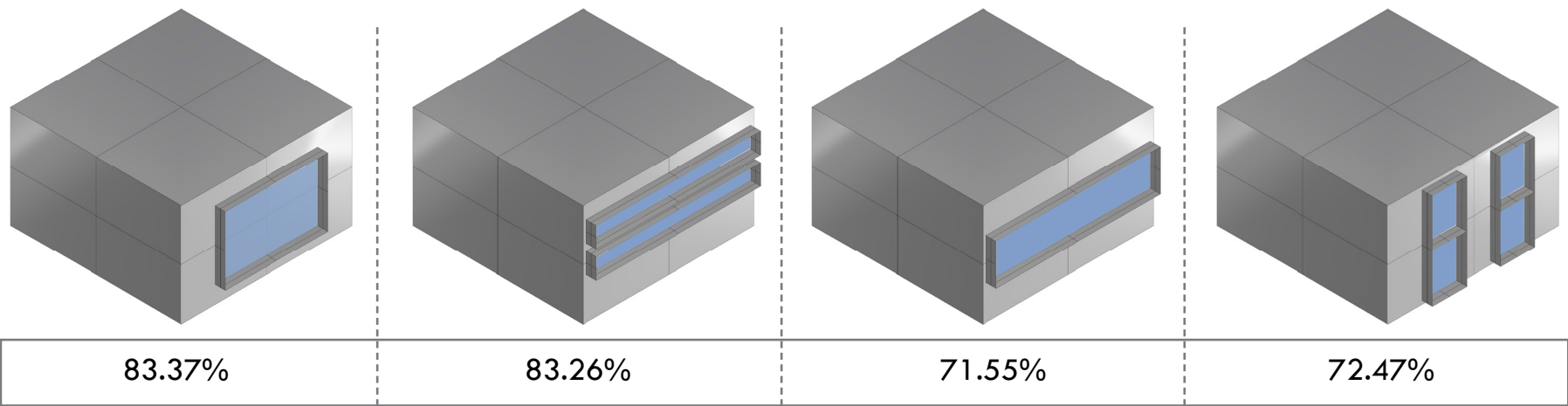
Due Only to Building Skin



Window : Wall

40%

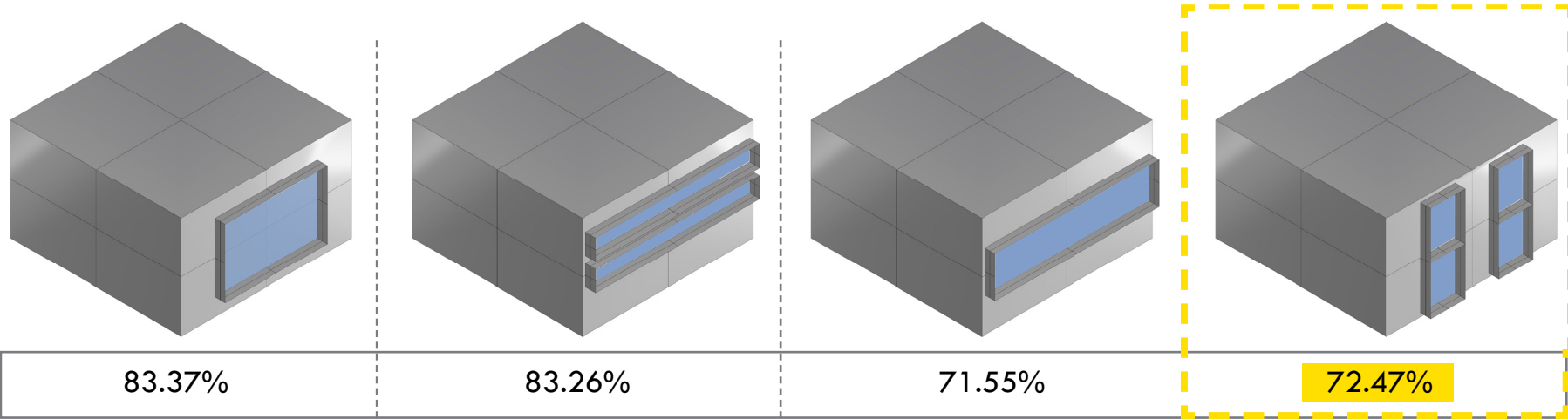
Daylight
Autonomy

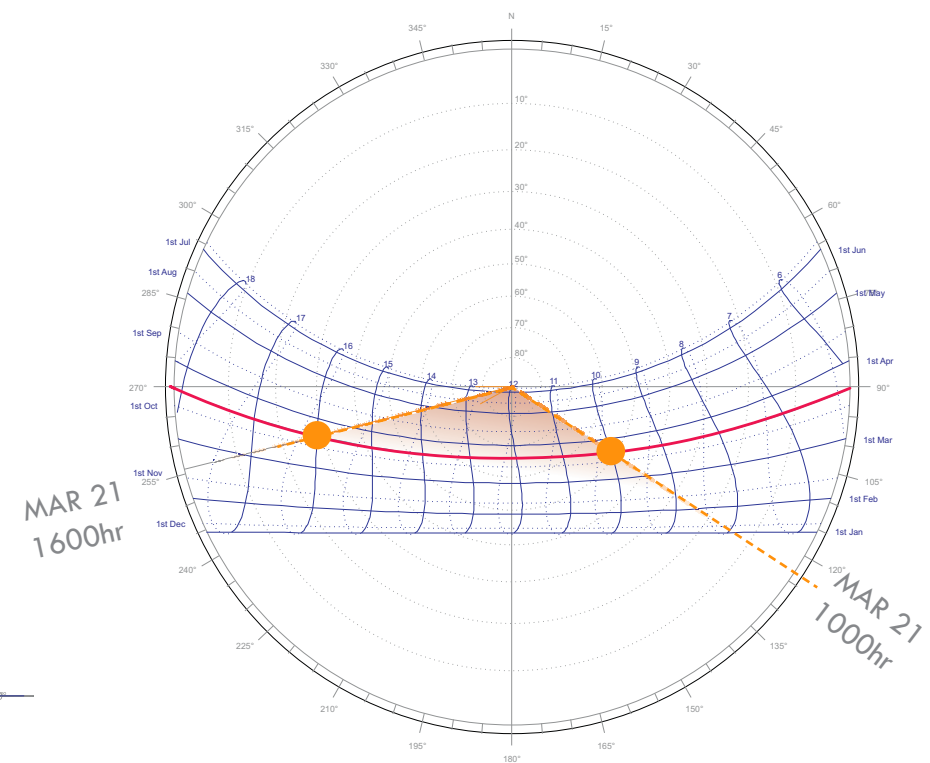
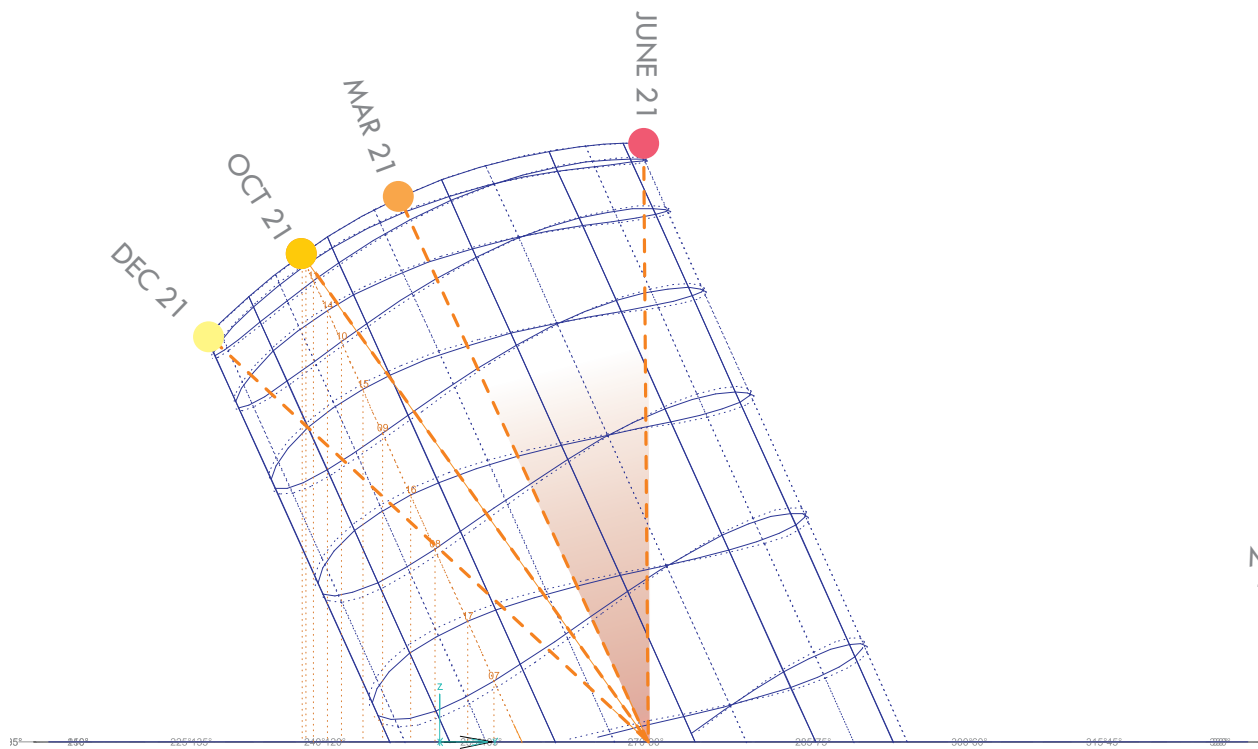


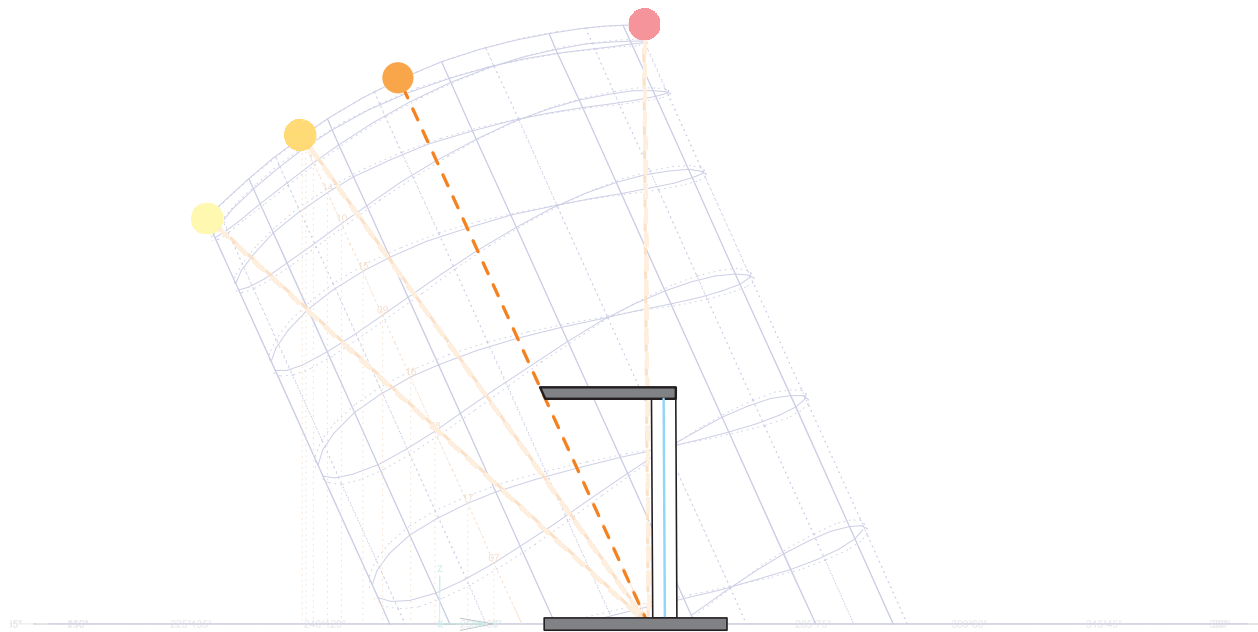
Window : Wall

40%

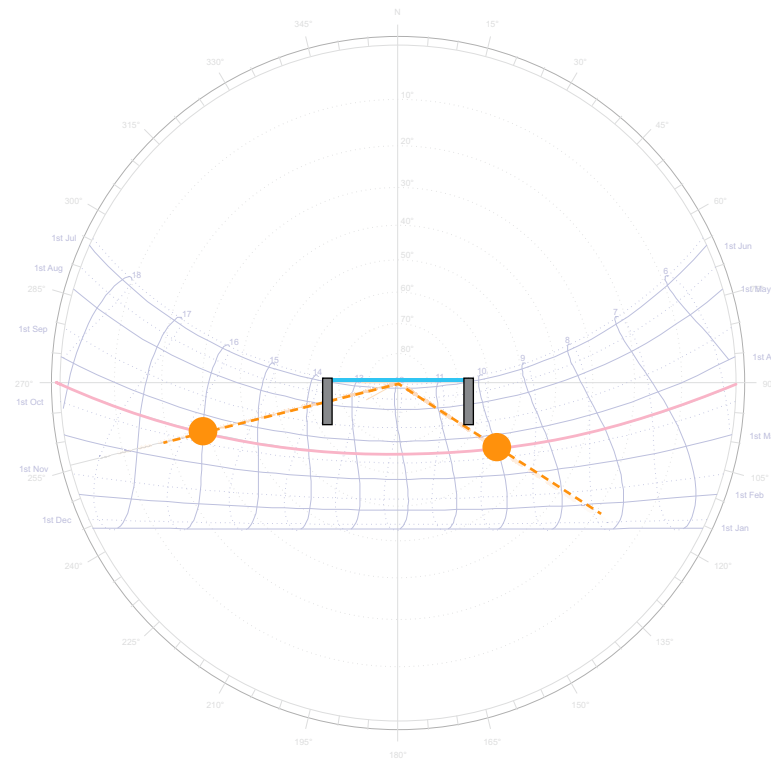
Daylight
Autonomy



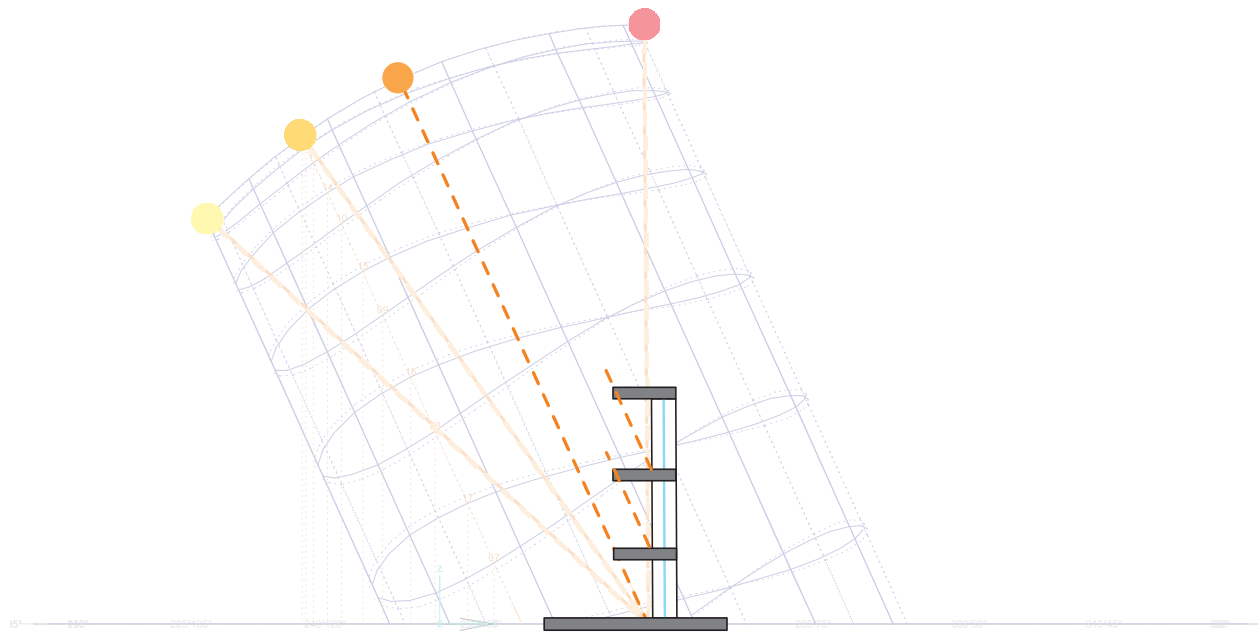




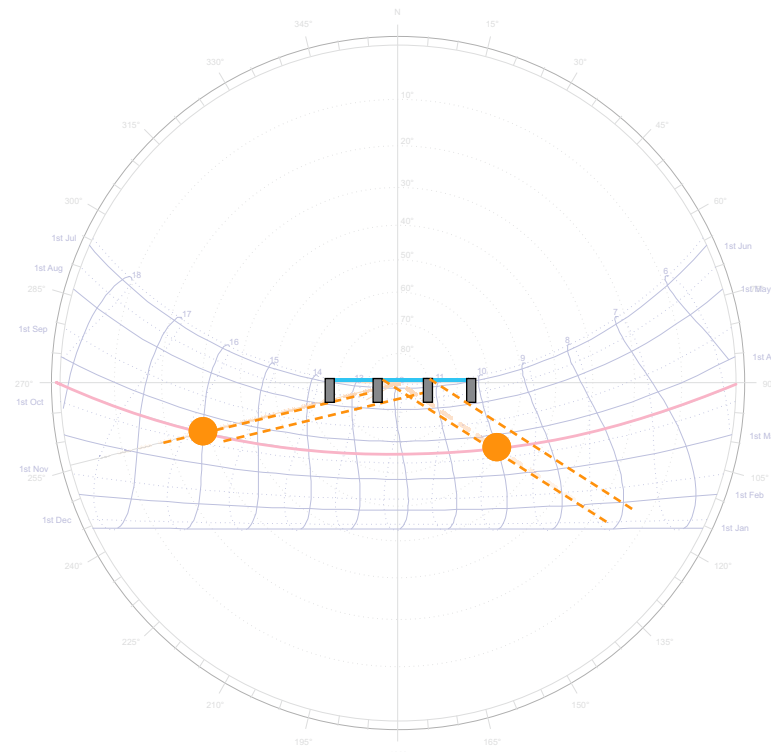
Horizontal Shading



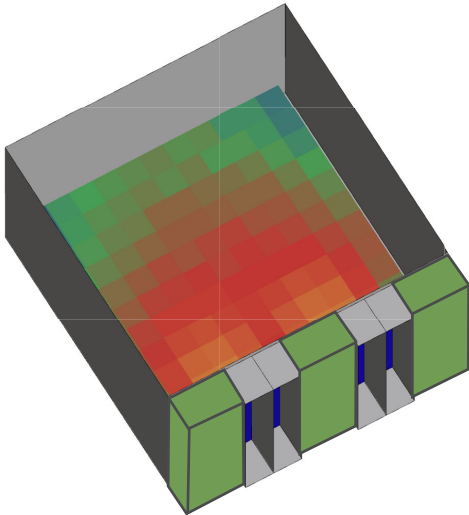
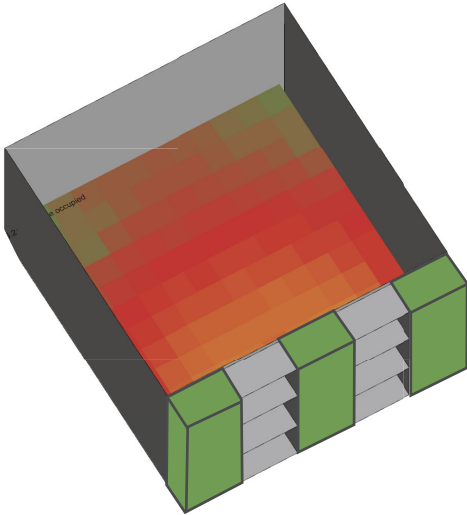
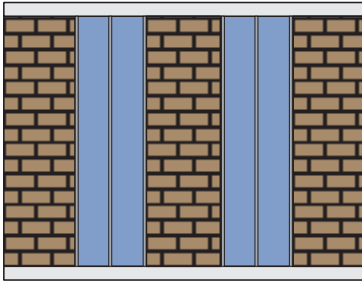
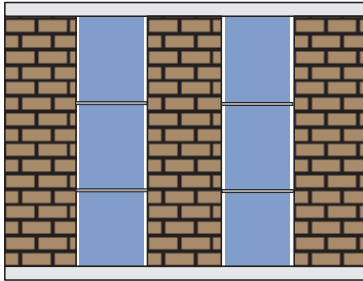
Vertical Shading



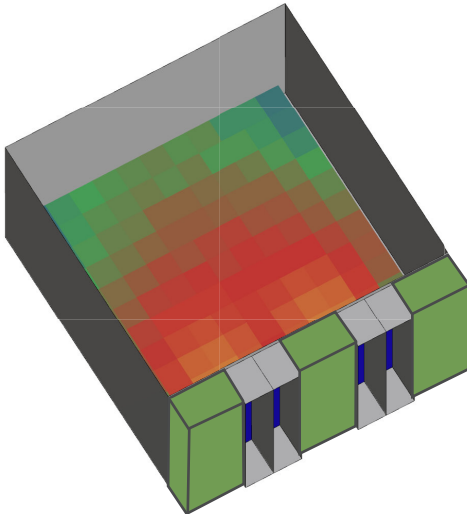
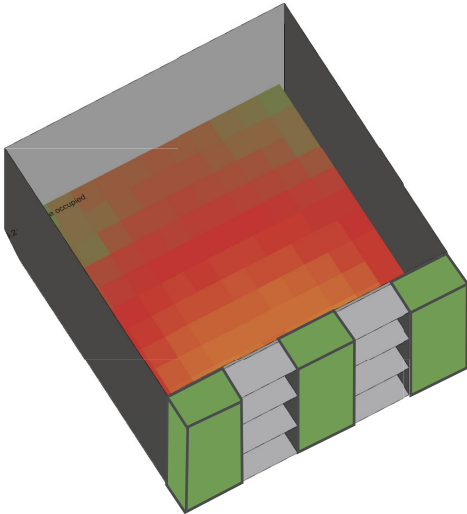
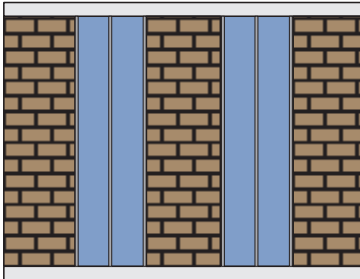
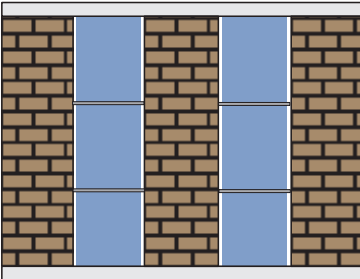
Horizontal Shading



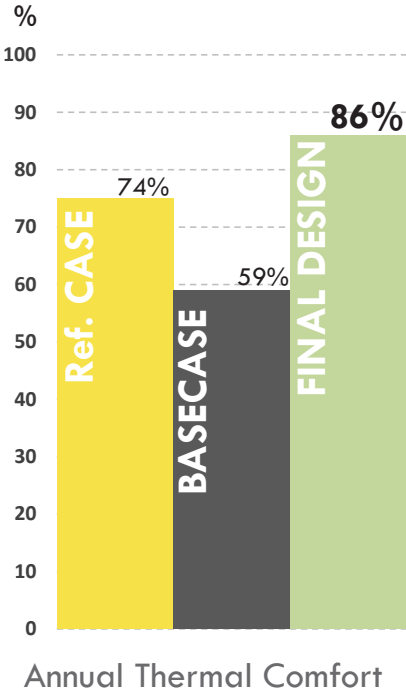
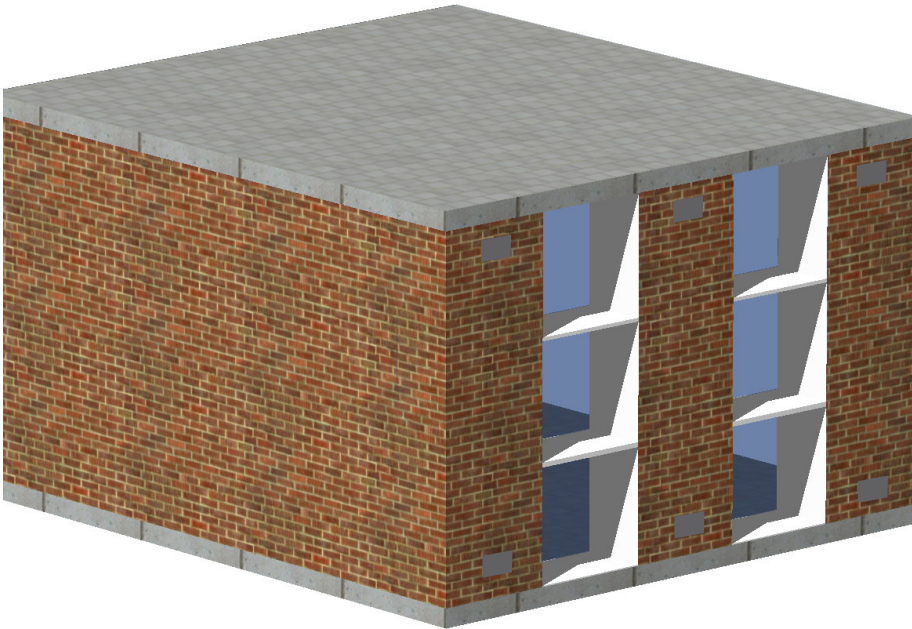
Vertical Shading



Daylight Autonomy	74.48%	66.21%
Thermal Comfort (Apr 7-14)	93%	91%



Daylight Autonomy	74.48%	66.21%
Thermal Comfort (Apr 7-14)	93%	91%



Final Design

- WW - 40%
- SF - 58%
- Wall - 125mm Brick + 420mm Buffer + 25mm Particle Board
- ACH (7pm to 8 am) - 6 (R), 12 (W)
- INFIL - 0.5

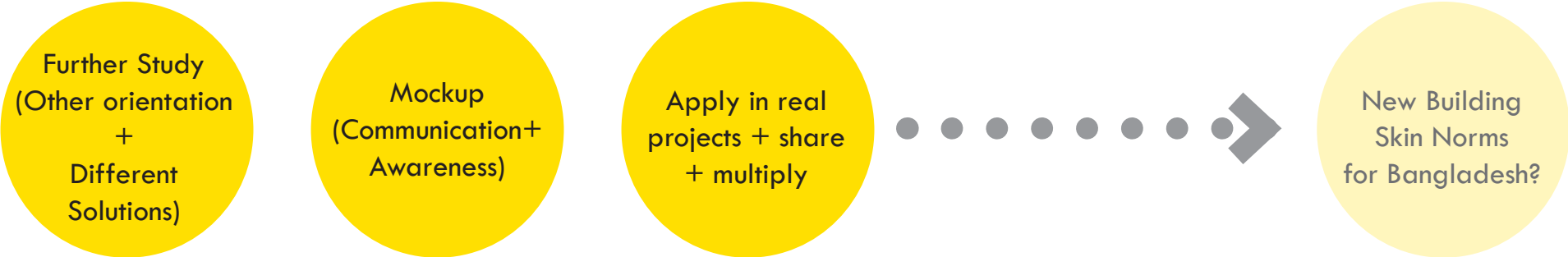
What's Next?

Further Study
(Other orientation
+
Different
Solutions)

Mockup
(Communication+
Awareness)

Apply in real
projects + share
+ multiply

What's Next?



ধন্যবাদ
(DHONNOBAD)

DANKE