Behind the Manhattanist Facade

Towards an reassessment of the energy performance
of the atrium in the Seattle Public Library Building

Architectural Association
Environmental and Technical Studies
Singular Artefacts
Joana Gonçalves, Anna Font

Students: Chengxuan Li, Yue Cao, Yilun Jiang

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Introduction

In the heroic period of Modernism, architects dreamt of the International Style, simple, pure, sun-giving architecture. In the middle of the last century, in the relics and remnants of the foregoers' positive avant-gardes, architects and theoreticians propose the well-tempered interior as the universally applicable form of built environment and standard of comfort. The year 1989 has perhaps marked the era of neoliberalism in the post-Communist world, that one of capitalism which deregulates at all levels of market economy, that one which produces, as its primary effect in the built environment, not grands projets so much as Junkspace, the lifeless proliferation of the dull, uninteresting, featureless "well-tempered" interior of desire, fetish, and ecstasy: a world-interior of capital. With building materials and building components becoming increasingly modular, universally applicable, predigitised, prefabricated, standardised, and globally available, such ubiquity is pyrrhic: now that we all (strive to) live in air-conditioned tiny little interiors, nobody could remember experiences and environments without them. The international standardisation of indoor comfort standards is perhaps one of the best achievements in the field of climatic control ever since, and what is also viably true is that it has become the most remarkably taunting failure, a farce, a beautifully-crafted vandalism and has also engendered chains of environmental issues and crisis. The psychedelic, illusory capitalism of today has clearly become a fait accompli, powered by the continuous, spectacular landscape of the almost immaterialised, artificially climatised building interiors.

"Masterpiece has become a definitive sanction, a semantic space that saves the object from criticism, leaves its qualities unproven, its performance untested, its motives unquestioned." (Koolhaas)

This project challenges a "masterpiece" – the Seattle Library Building by Koolhaas. It analyses the performance of an as-found artefact inside the library atrium and, through a series of variations and simulations, demonstrates that the as-found condition successfully delivers a well-tempered interior space as a civic building. However, in order to challenge the idea of a well-tempered, homogeneous interior, this project blasts out several singular, discrete, and anomaly points from the homogeneous field of comfort and boredom. It investigates the space 3-dimensionally and transcends the restrictions of current means of simulation based on a 2D meshed plane. The proposed design intervention reacts to the spatial distribution of the singular/anomaly points and encases a threshold zone of activities

Case Study: Seattle Public Library

Research

In the heroic period of Modernism, architects dreamt of the International Style, simple, pure, sun-giving architecture. In the middle of the last century, in the relics and remnants of the foregoers' positive avant-gardes, architects and theoreticians propose the well-tempered interior as the universally applicable form of built environment and standard of comfort.
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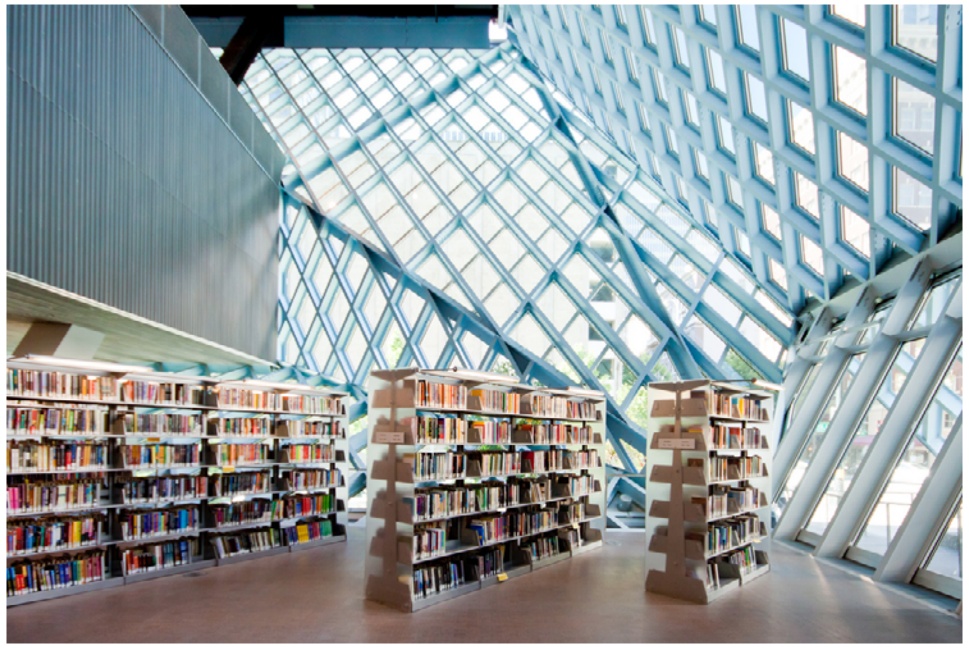
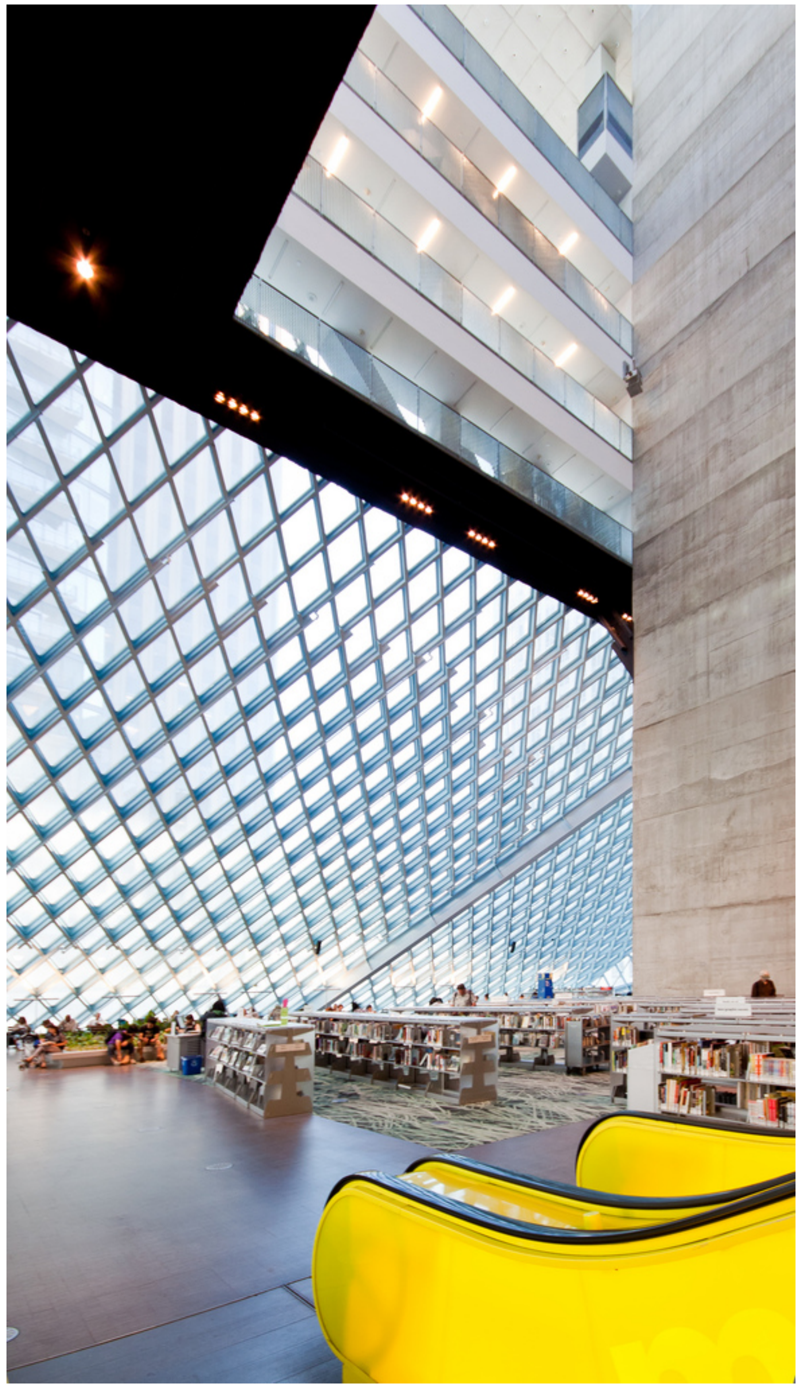
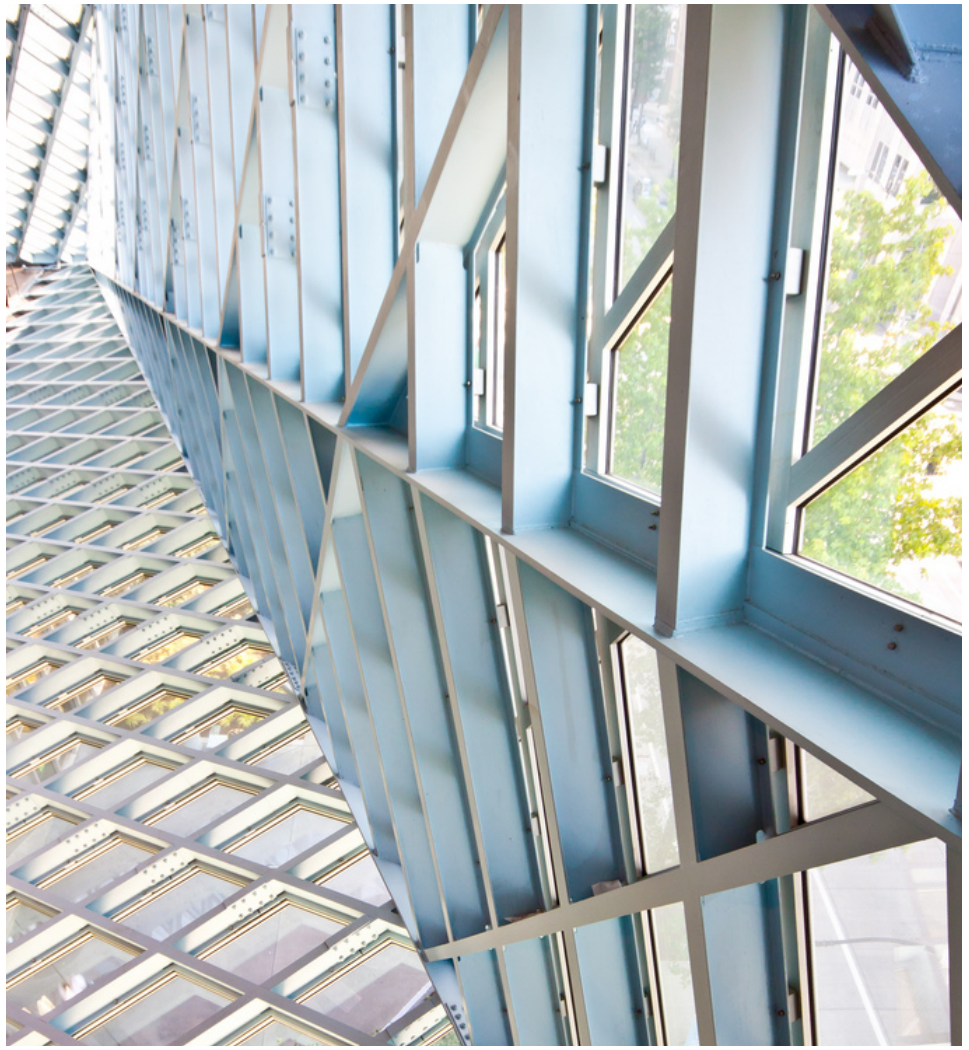
Case Study Documentations
Atrium Envelope



Living Room Area
Space and Functions



Patio Detail



Facade Detail

BY DAVID BADDERS/ P-I ARTIST

INSIDE THE NEW LIBRARY

AN ENGINEERING CHALLENGE

The building's vast open spaces and cantilevered platforms were made possible through the innovative use of vertical and sloped columns, trusses, and a steel diamond-shaped outer grid.

VERTICAL FORCES: GRAVITY AND WEIGHT

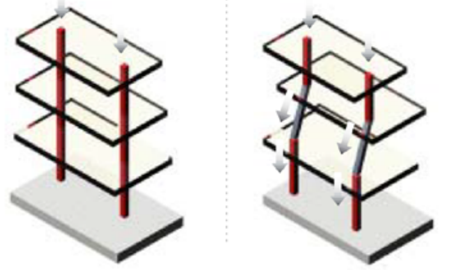
Because of its unconventional design and the "floating" nature of cantilevered floors, engineers minimized the use of true vertical columns (there are only 20 in the entire structure) and introduced a series of sloped columns on its perimeter to help support the building's weight.

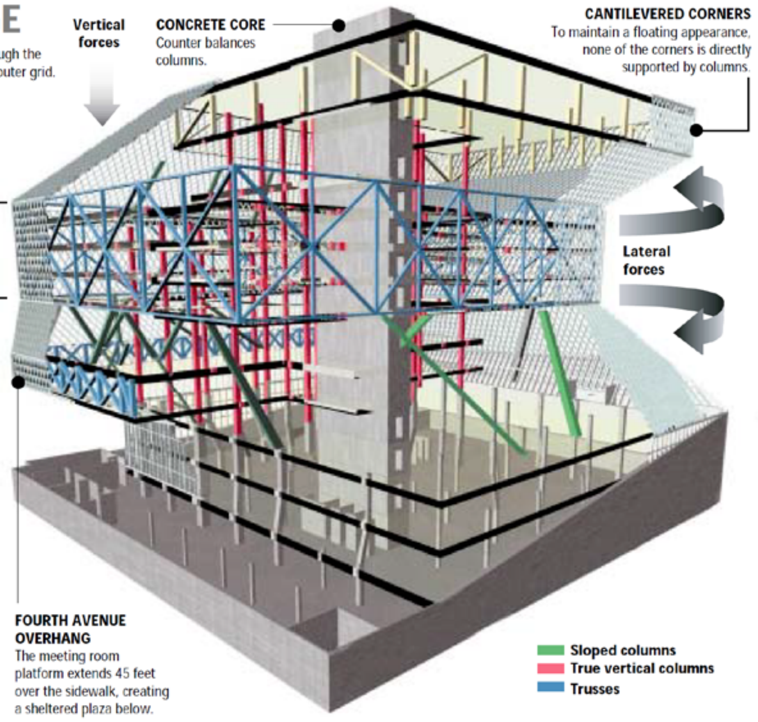
THE ANCHOR

The floors that make up the Books Spiral and Reading Room (floors 6-10) use sloped columns to support not only the weight of all that area, but they also support the floors directly above and below. The trusses directly support each of the floors within "The Anchor" and transfer its weight from sloping column to sloping column.

True vertical columns
These columns are typically spaced 30 to 36 feet apart in a grid determined by the column layout of the underground parking and extend the entire height of the building.

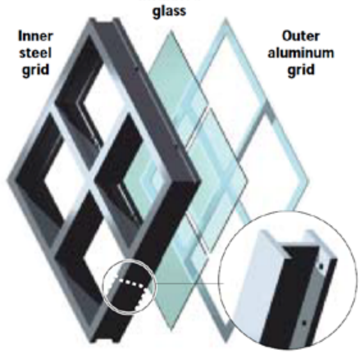
Sloped columns
These unconventional columns are angled to create open spaces while supporting platforms that are not in straight vertical alignment. They are as strong but typically bigger and longer than true vertical columns.





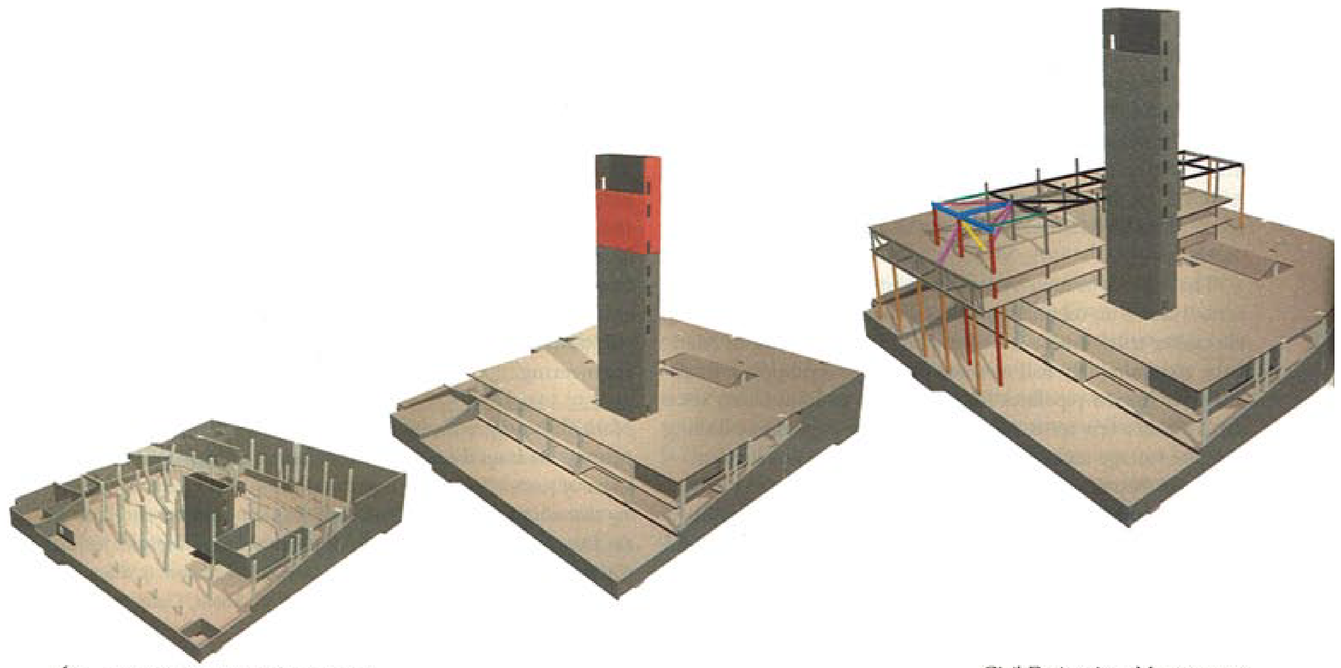
LATERAL FORCES: WIND AND EARTHQUAKES

The diamond-shaped steel grid that encloses the building not only provides resistance to wind and earthquake forces but also helps hold the building's glass system, or curtain wall, in place. Conventional buildings require separate seismic and curtain wall support systems but in this case the steel grid serves both functions. The grids collect wind and earthquake forces and transfer them down to the next platform until they are absorbed by the concrete base.



CLEANING ALL THAT GLASS

Taking into consideration Seattle's love of the outdoors and plethora of rock-climbers, the architects installed metal carabiner clips around the building for daring window washers to traverse the building.



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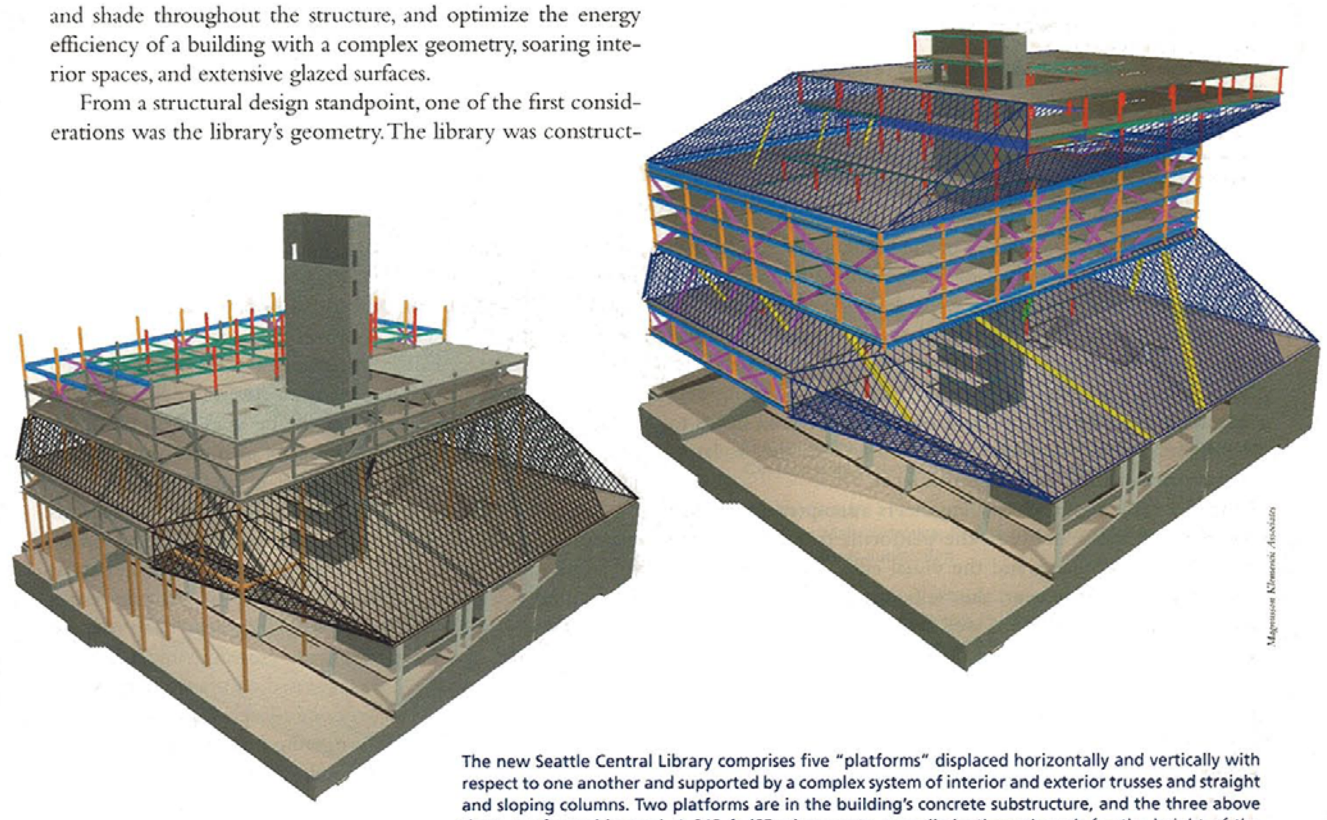
and shade throughout the structure, and optimize the energy efficiency of a building with a complex geometry, soaring interior spaces, and extensive glazed surfaces.

From a structural design standpoint, one of the first considerations was the library's geometry. The library was construct-

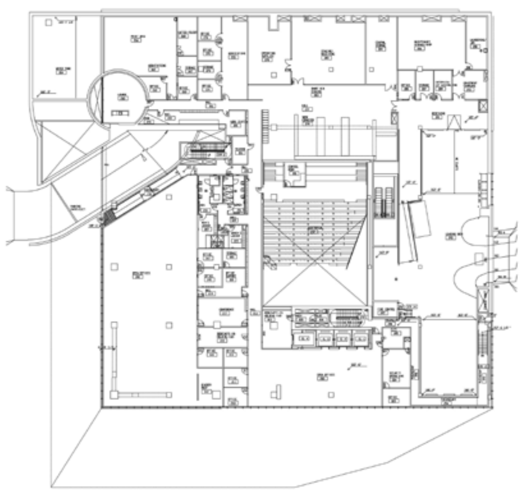


Magnusson Klemencic Associates

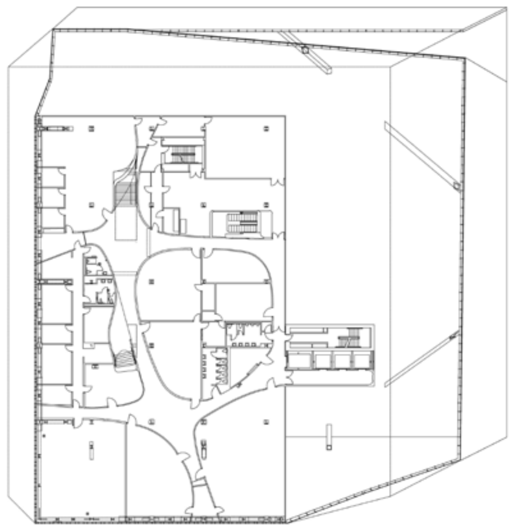
The new Seattle Central Library comprises five "platforms" displaced horizontally and vertically with respect to one another and supported by a complex system of interior and exterior trusses and straight and sloping columns. Two platforms are in the building's concrete substructure, and the three above them are framed in steel. A 213 ft (65 m) concrete core climbs through each for the height of the building. The platforms are connected at their perimeters by an envelope of steel latticework that functions both as the building's facade and as its primary resistance to lateral loads. Engineers used airflow and sunlight studies to maximize the energy efficiency of the building's expansive glazed surfaces and open spaces.

Case Study Documentations

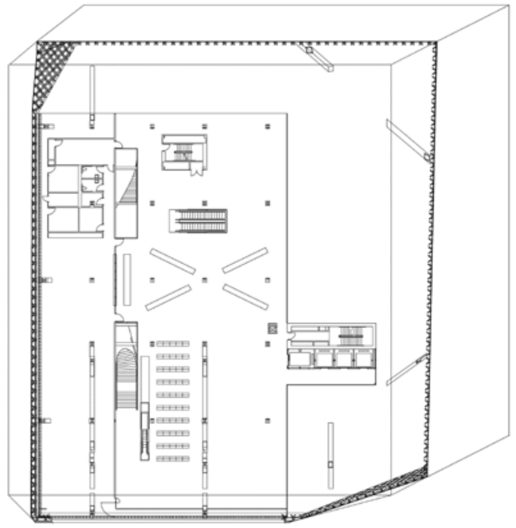
Drawings



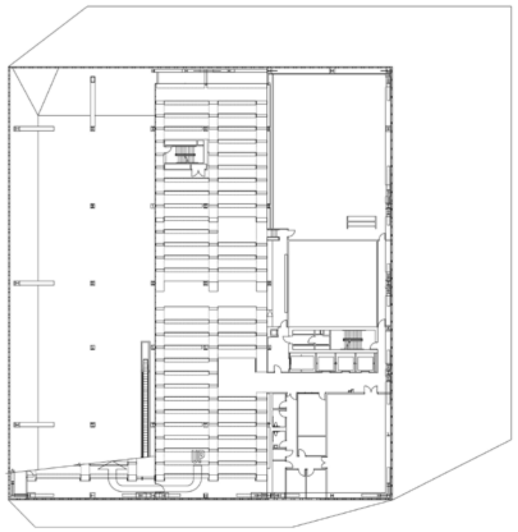
Basement



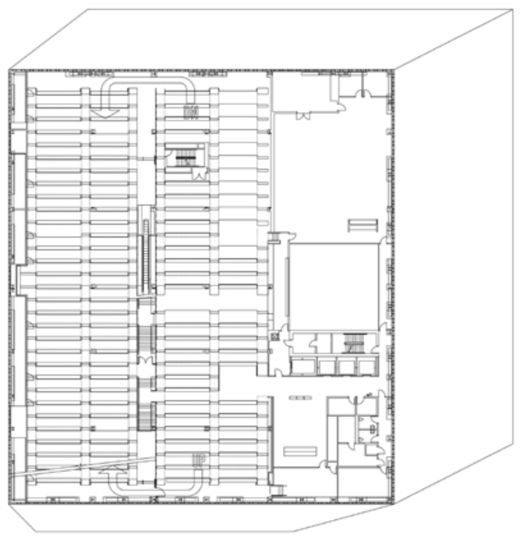
Ground Floor Lobby



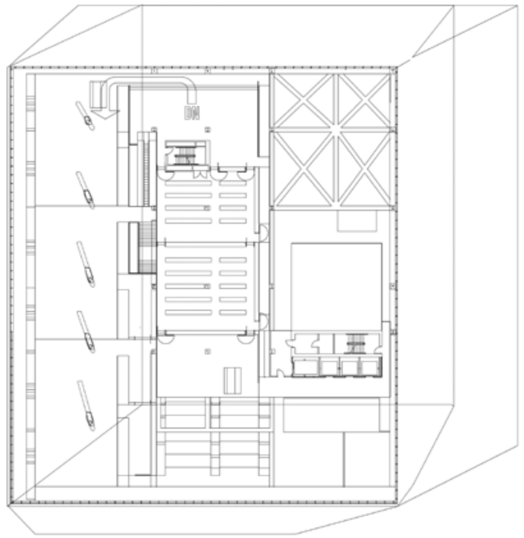
2nd Floor Commons



Upper Floor Archives



Upper Floor Archives



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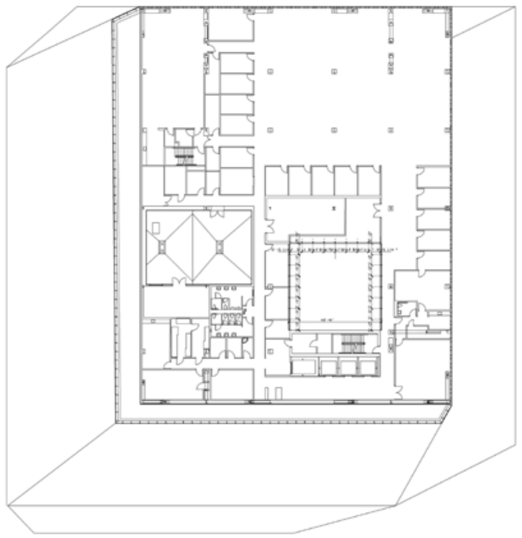
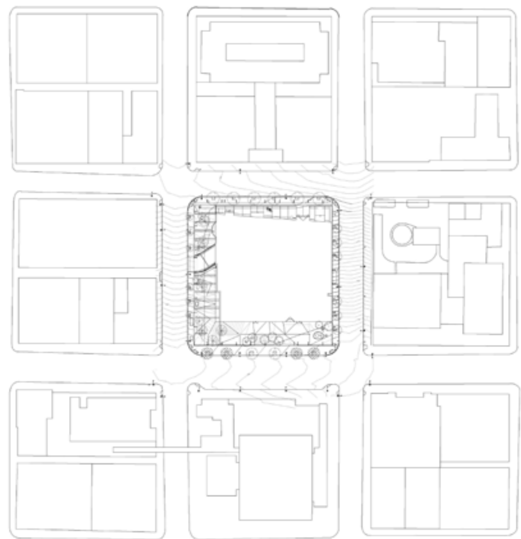


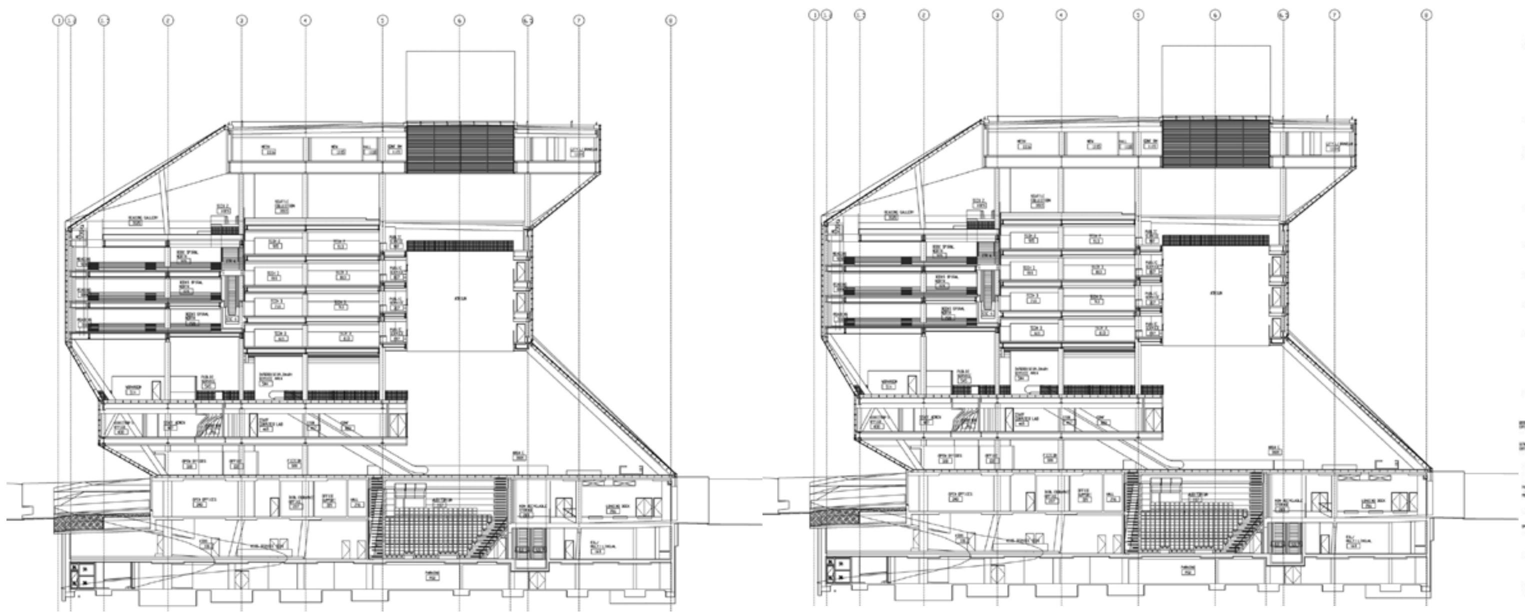
Upper Floor Office



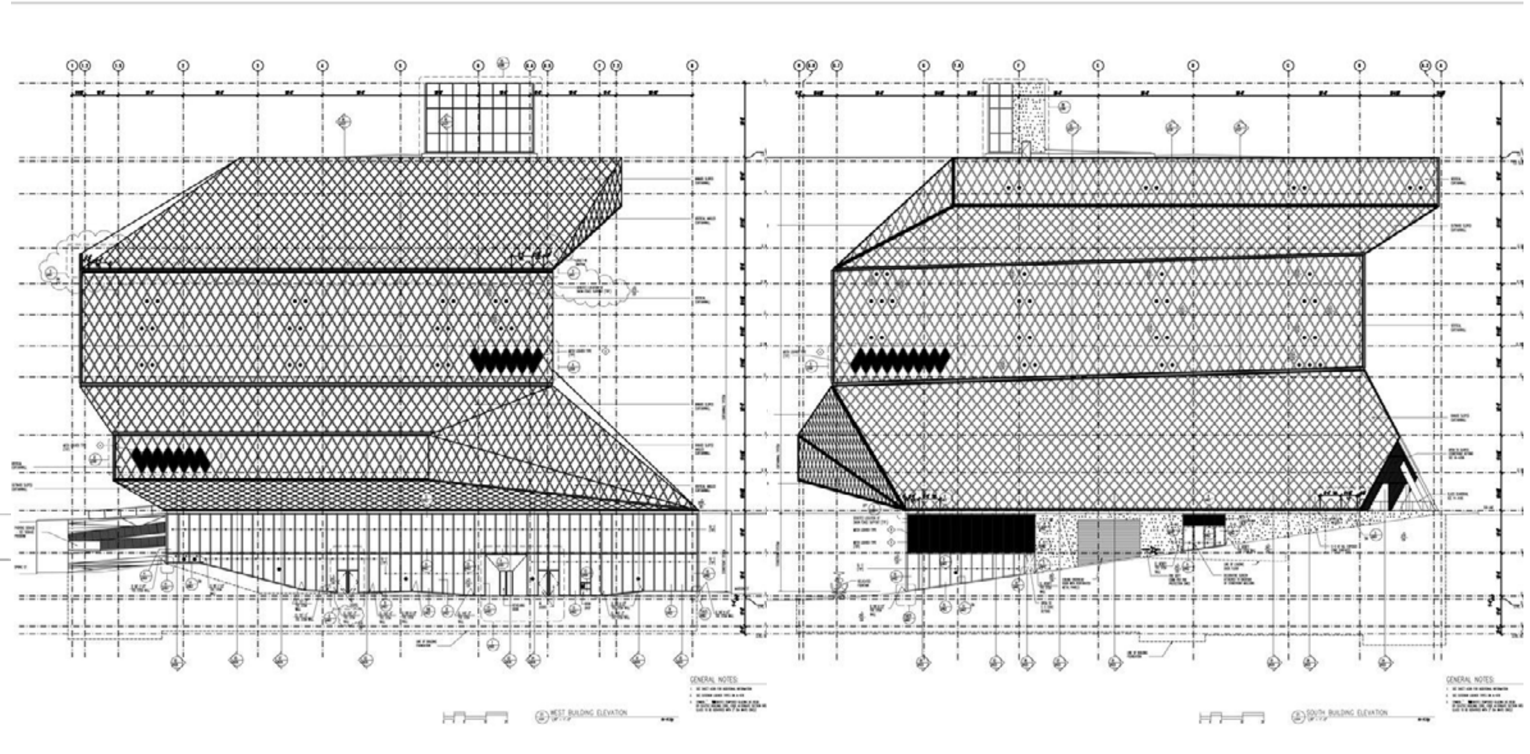
Site Plan

Case Study Documentations

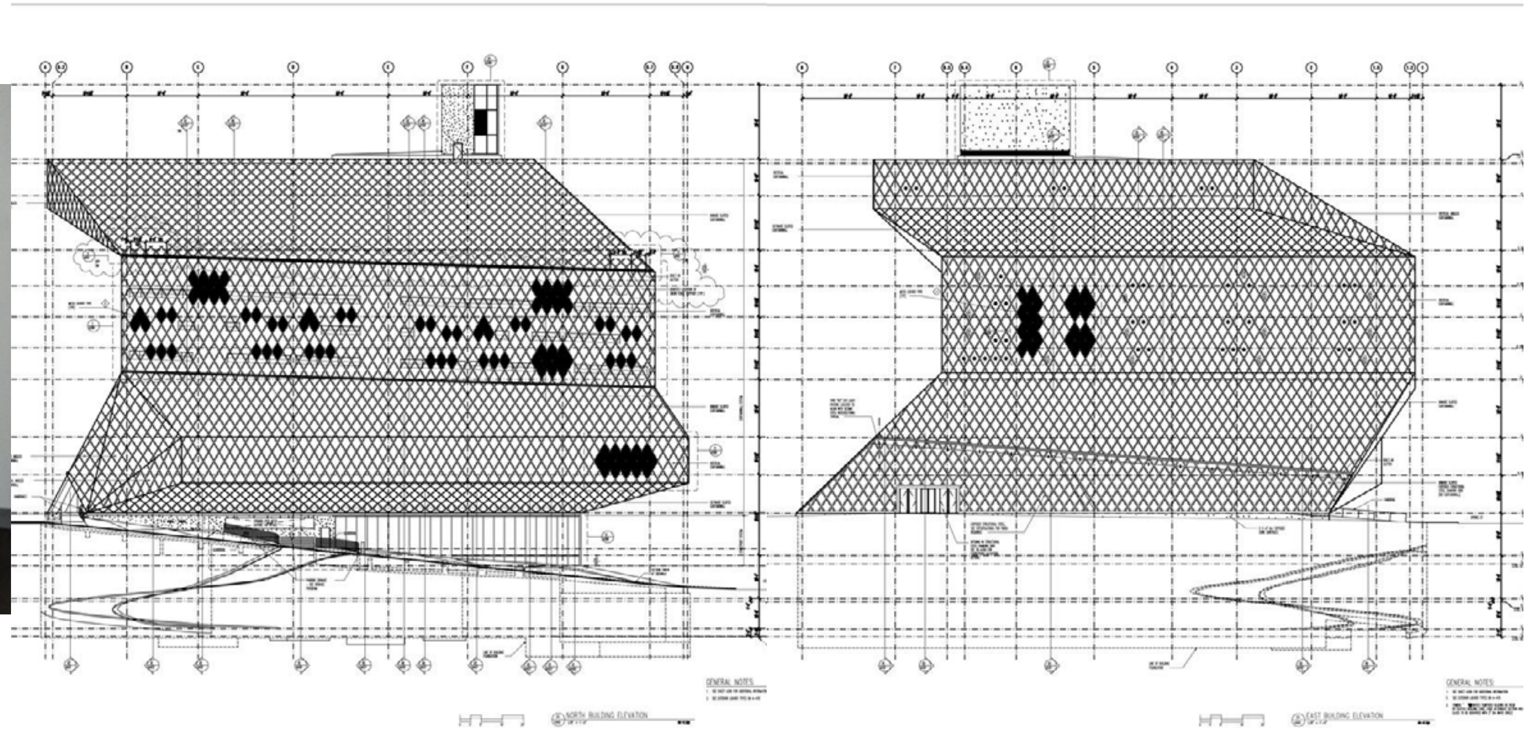
Drawings

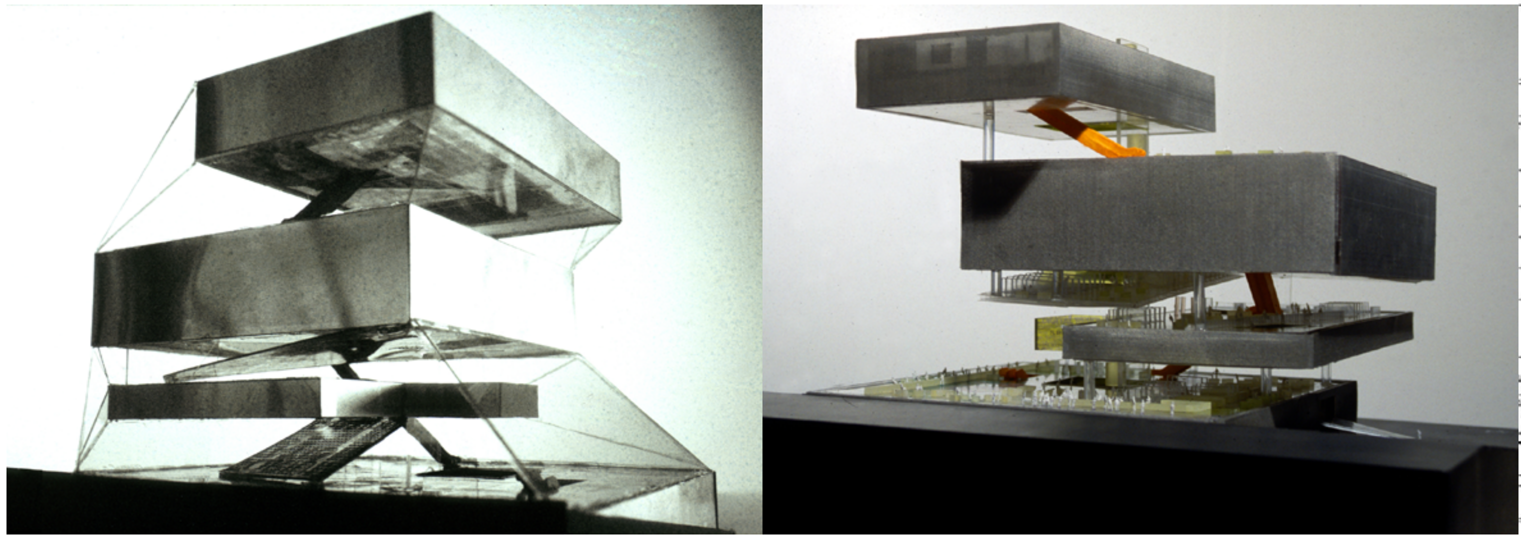


Sections



Elevations



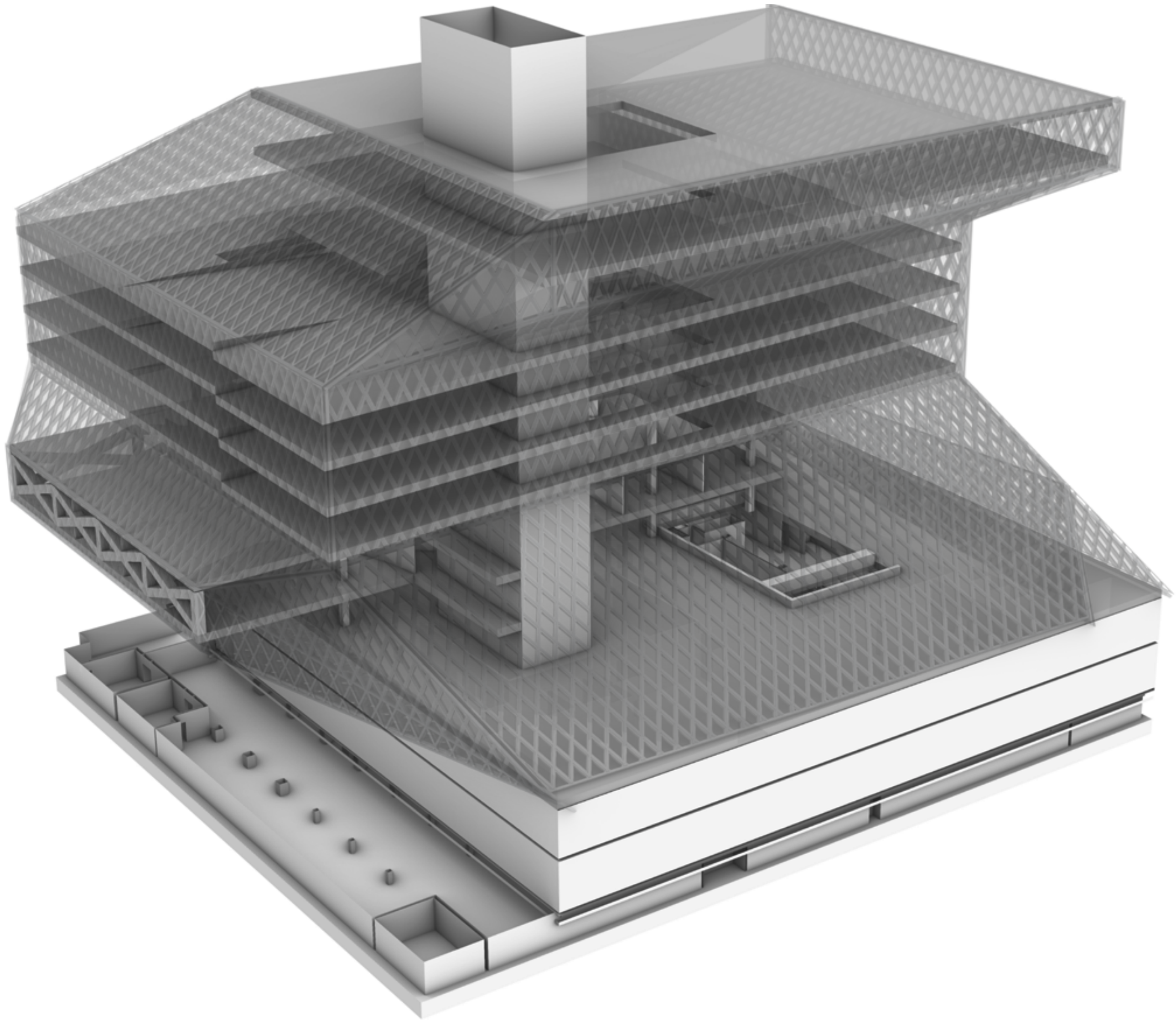


Massing Models

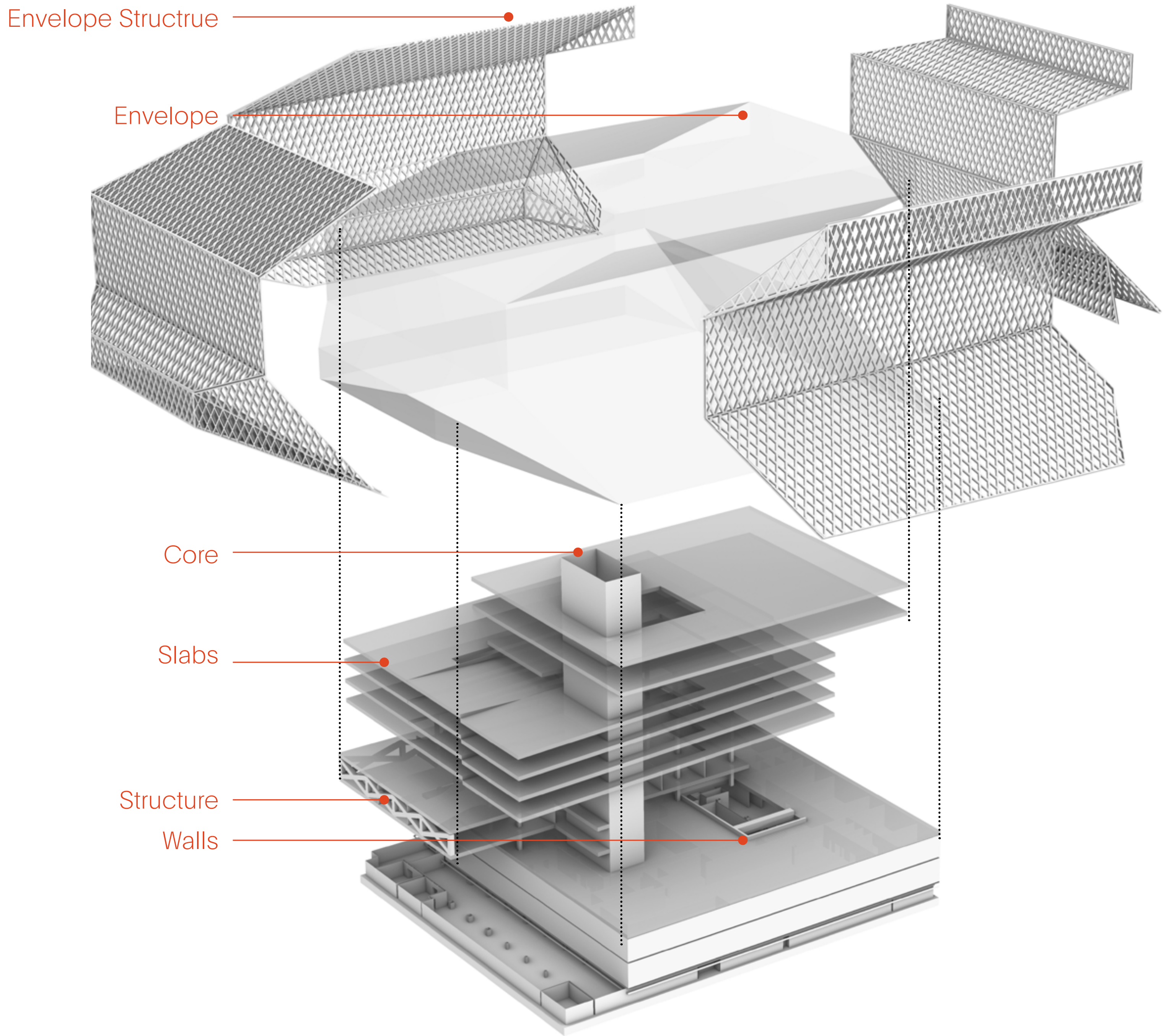
PRIMITIVE ARTEFACT -- SEATTLE PUBLIC LIBRARAY

Primitive Artefact: Seattle Public Library Digital Model

Digital Model – Main Elements of Space

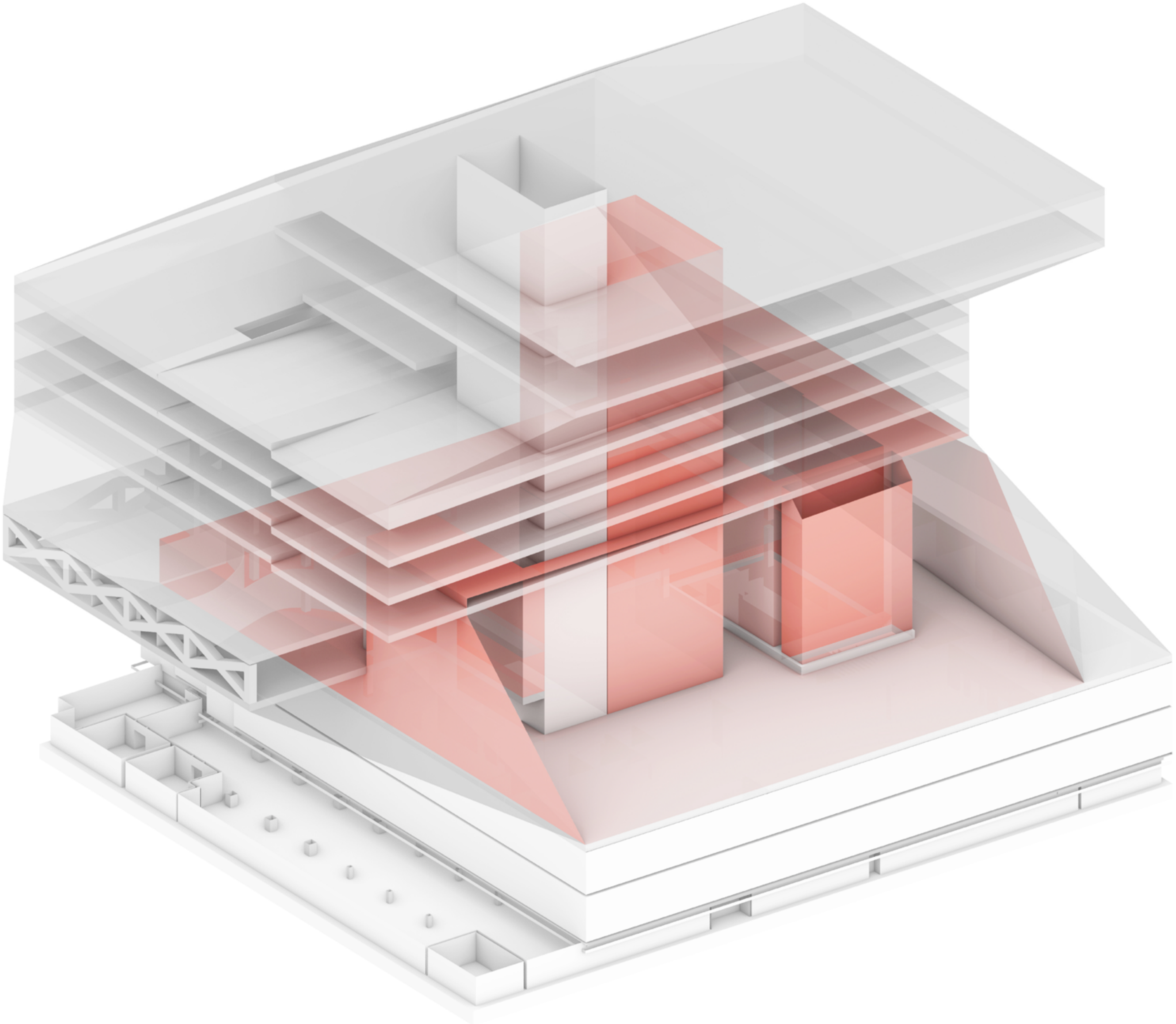


Model of Seattle Library



Layers of Model

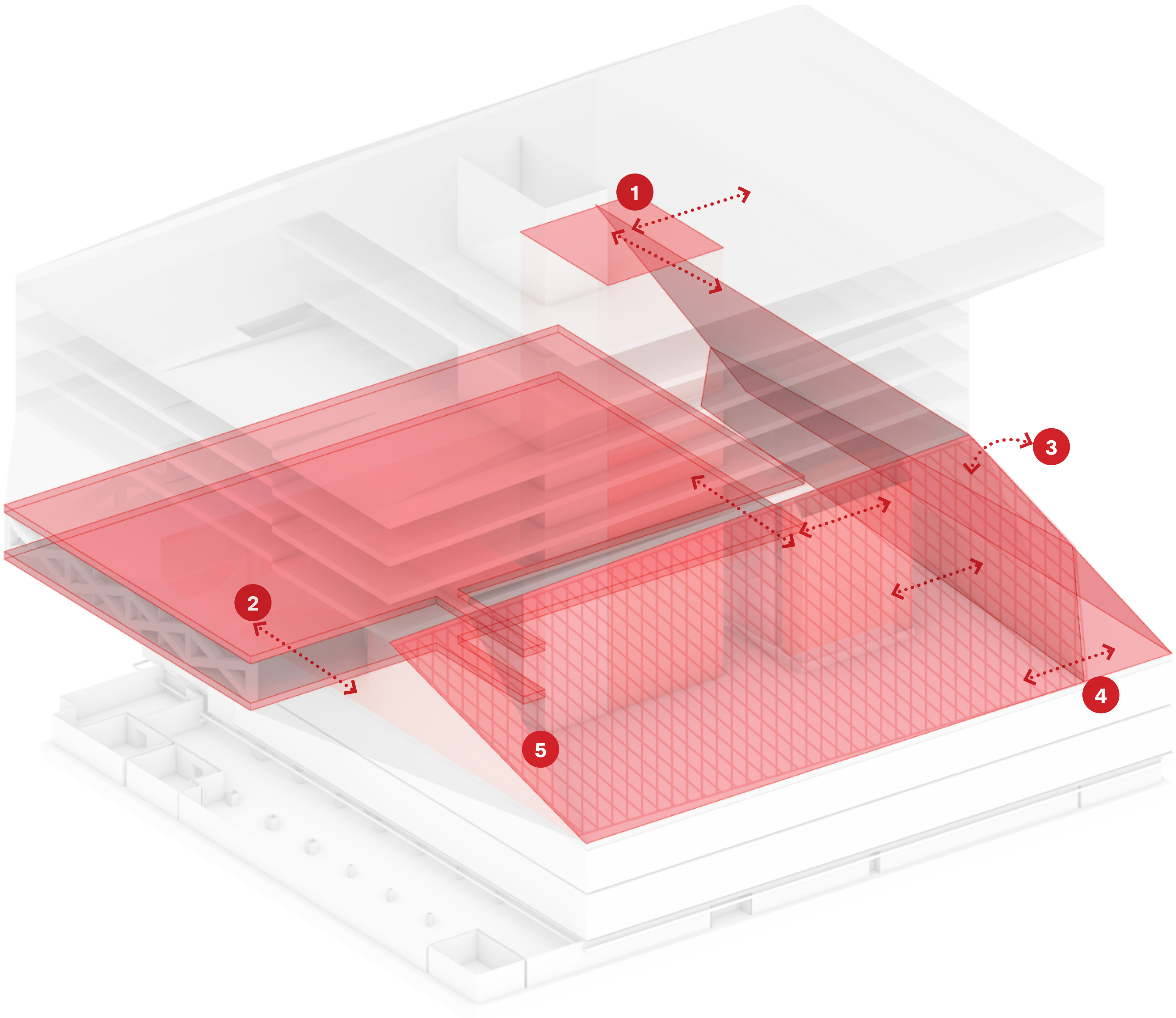
Primitive Artefact: Seattle Public Library Digital Model
Single Artifact : Atrium



Atrium area

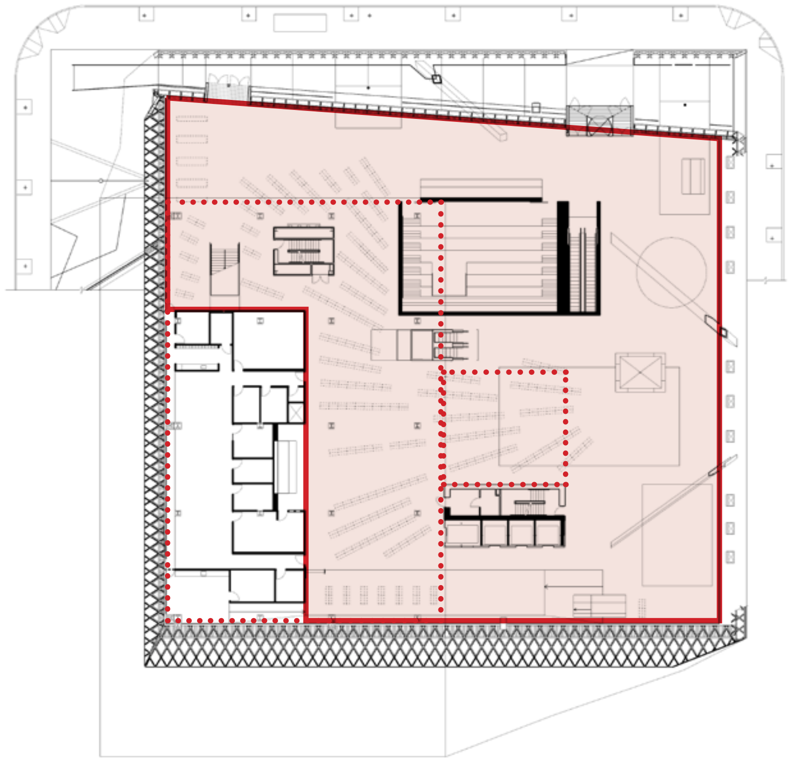
Primitive Artefact: Seattle Public Library Digital Model

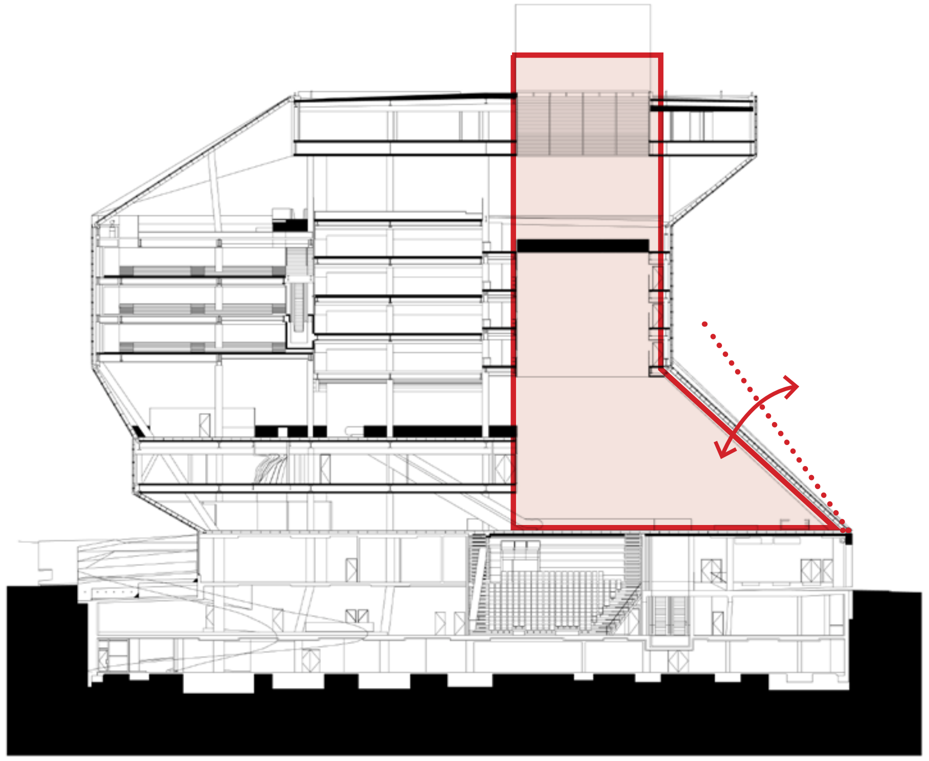
Factors on Artefact

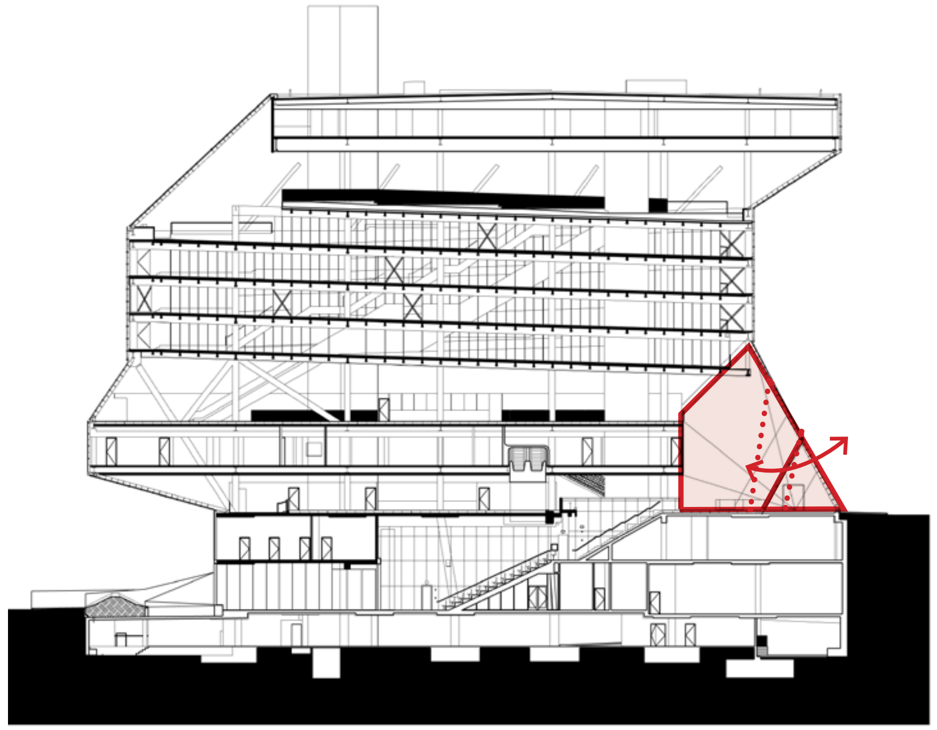


Elements affect on artifacte

Primitive Artefact: Seattle Public Library Digital Model
Plan & Section of Atrium

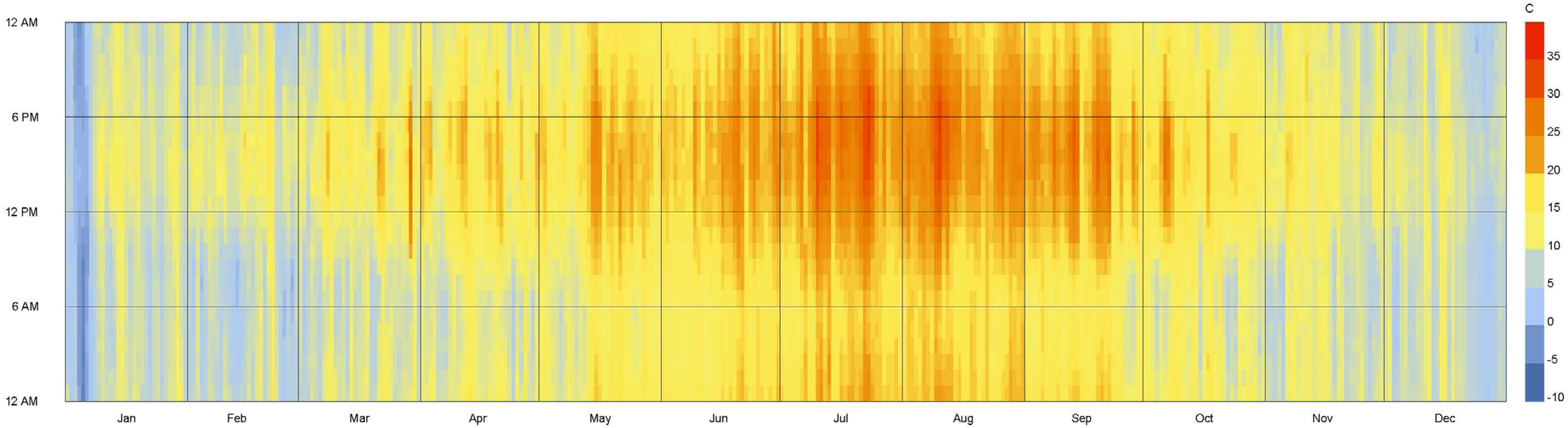






Simulations: Climate Charts

Annual Temperature Profile



Dry Bulb Temperature (C)
1/1 to 12/31 between 0 and 23 @1
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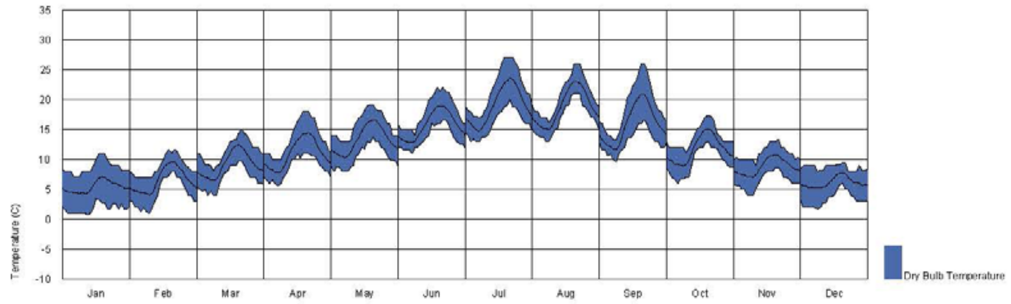
country: USA
time-zone: -8.0
source: TMY3



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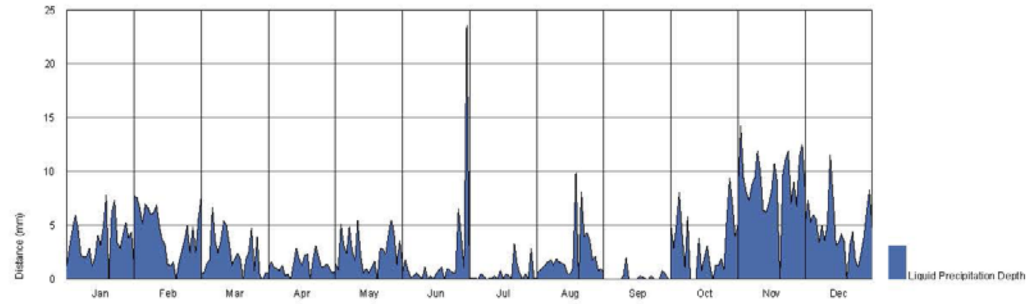
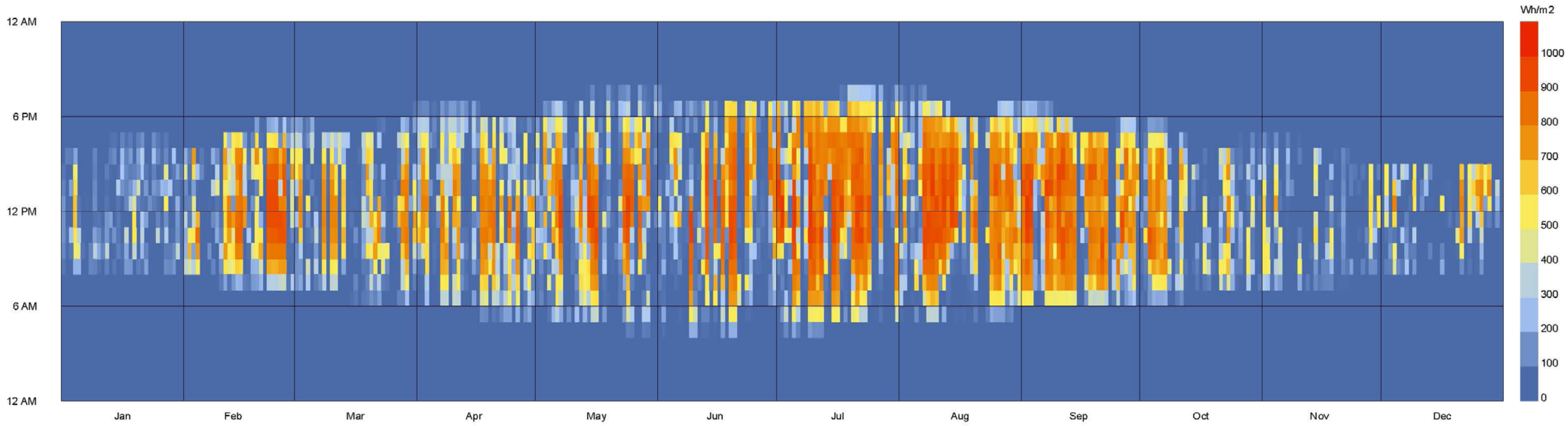


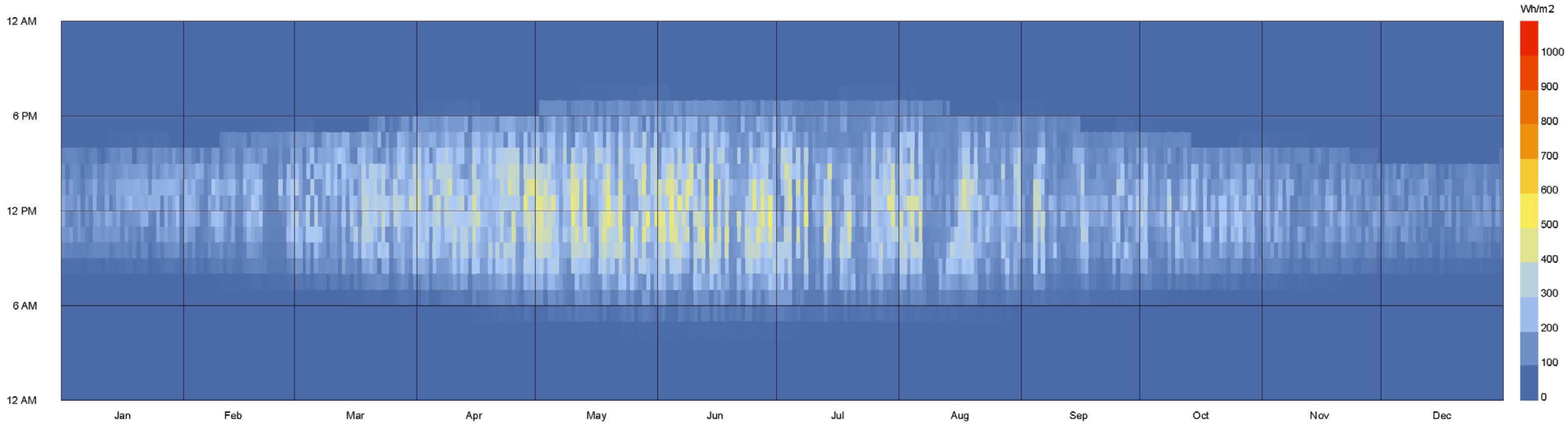
city: Seattle-King County Intl AP-Boeing Field
country: USA
time-zone: -8.0
source: TMY3

Climate Charts

Irradiation and sky condition
Radiation



Direct Normal Radiation (Wh/m2)



Diffuse Horizontal Radiation (Wh/m2)
1/1 to 12/31 between 0 and 23 @1
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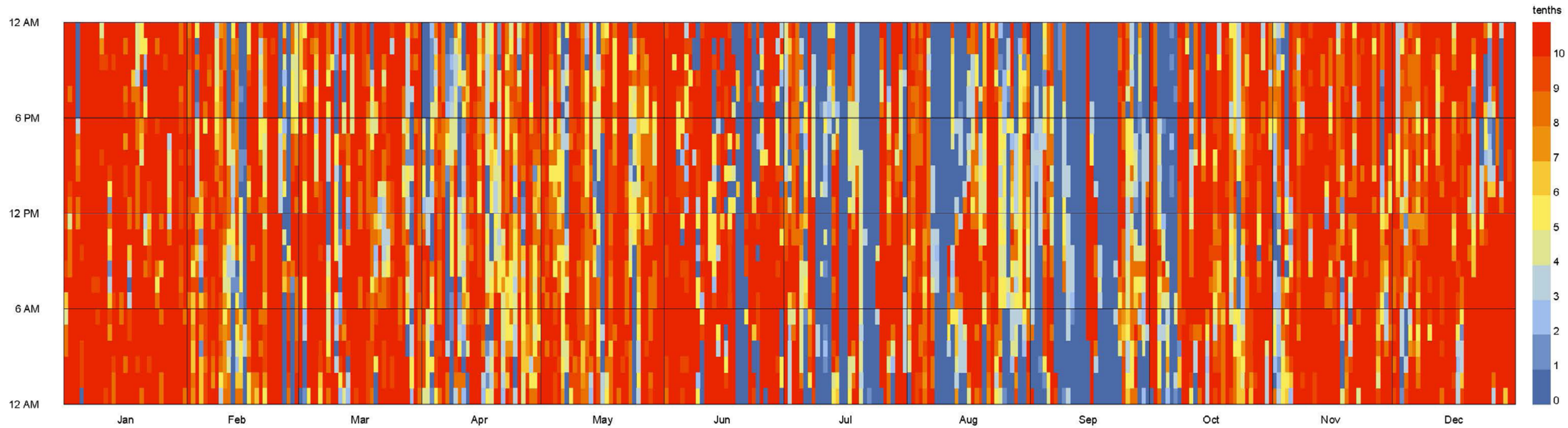
country: USA
time-zone: -8.0
source: TMY3

Climate Charts

Irradiation and sky condition
Total Sky Cover



Total Sky Cover (tenths)
1/1 to 12/31 between 0 and 23 @1
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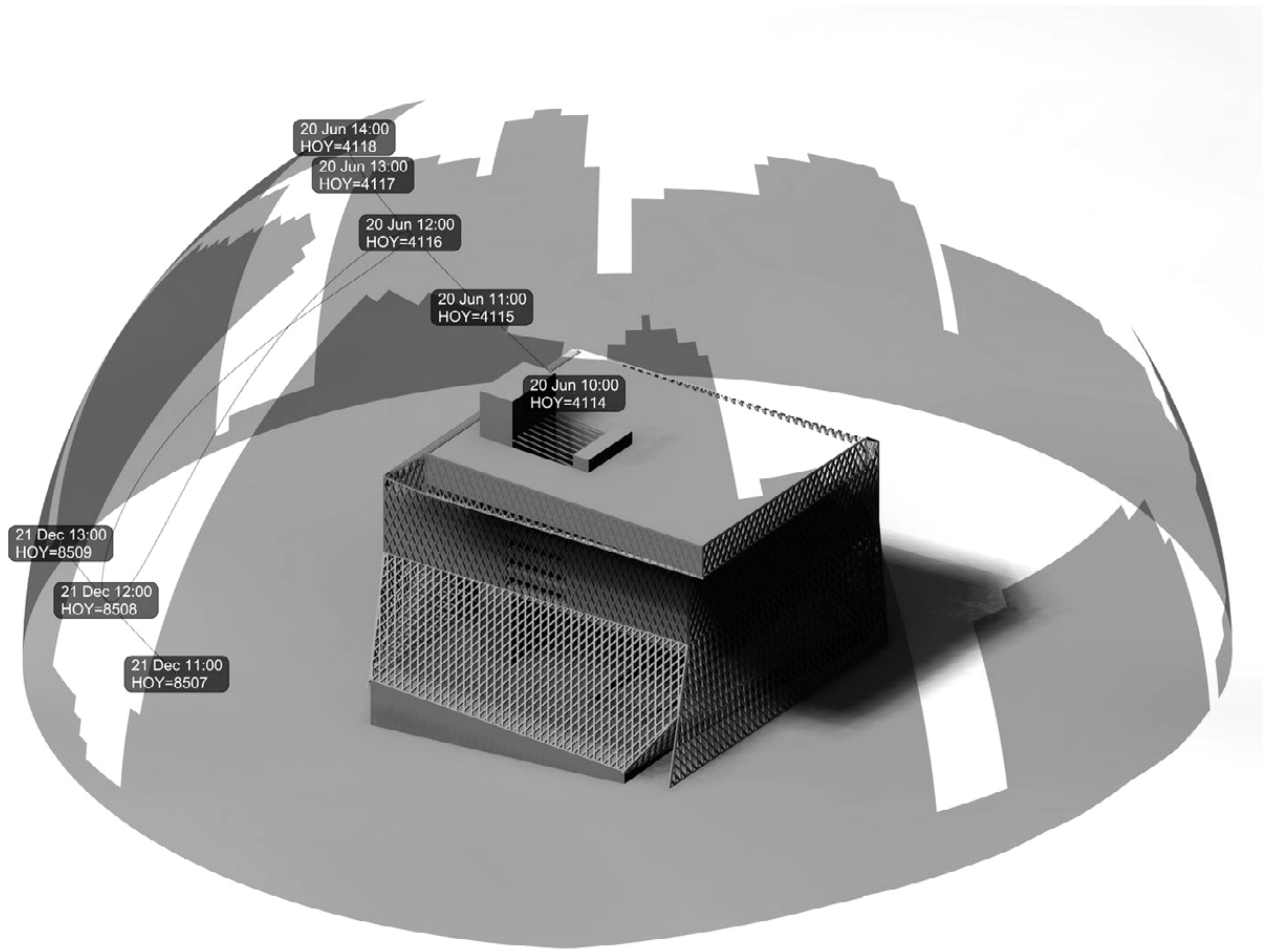
country: USA
time-zone: -8.0
source: TMY3

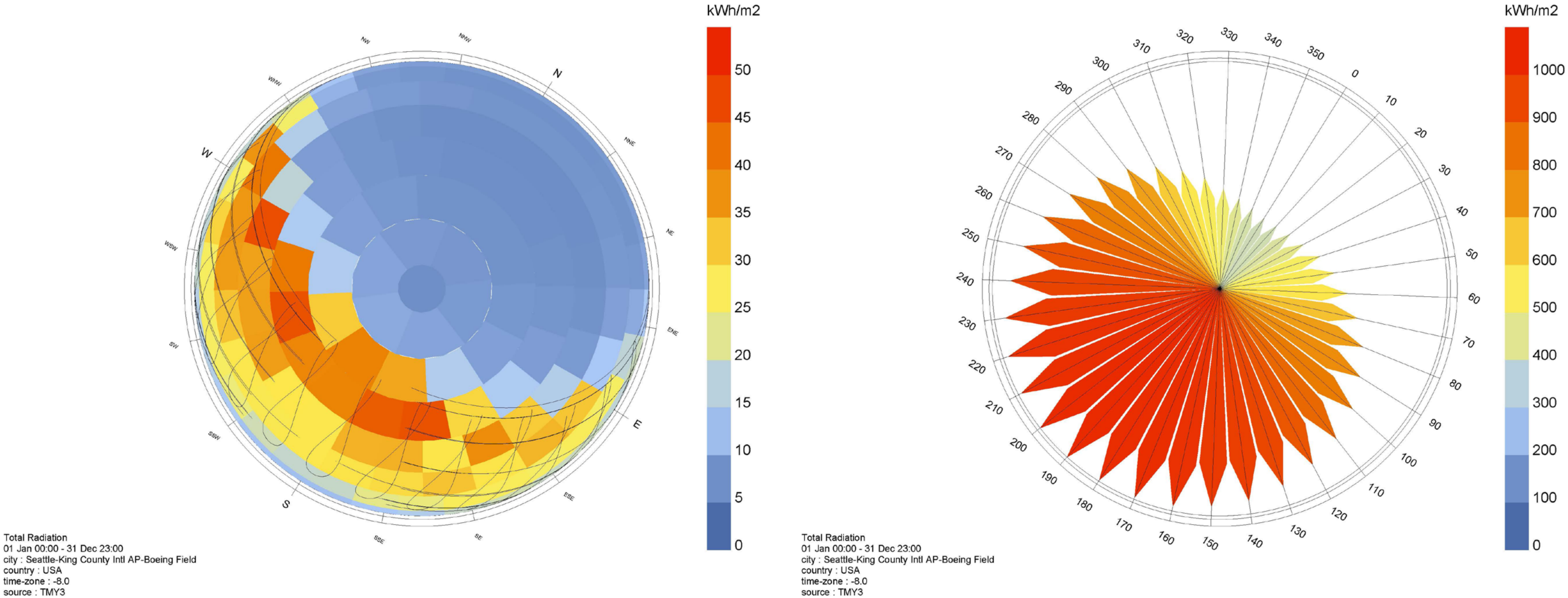
Climate Charts

Irradiation and sky condition
Sky Visibility within Site Context



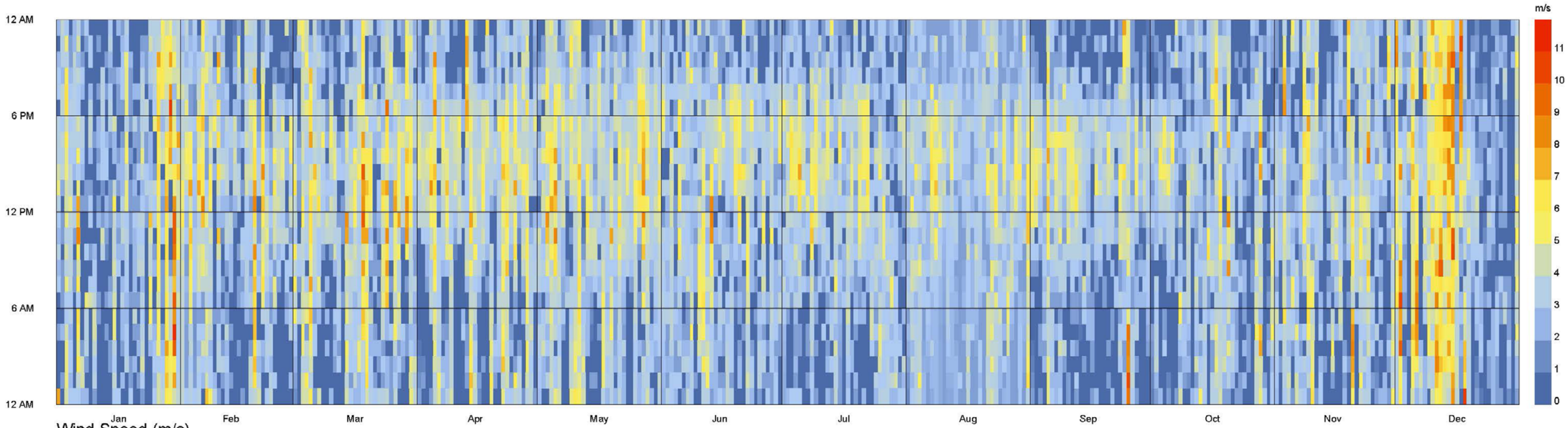
Climate Charts

Sun Path - Ladybug climate chart



Climate Charts

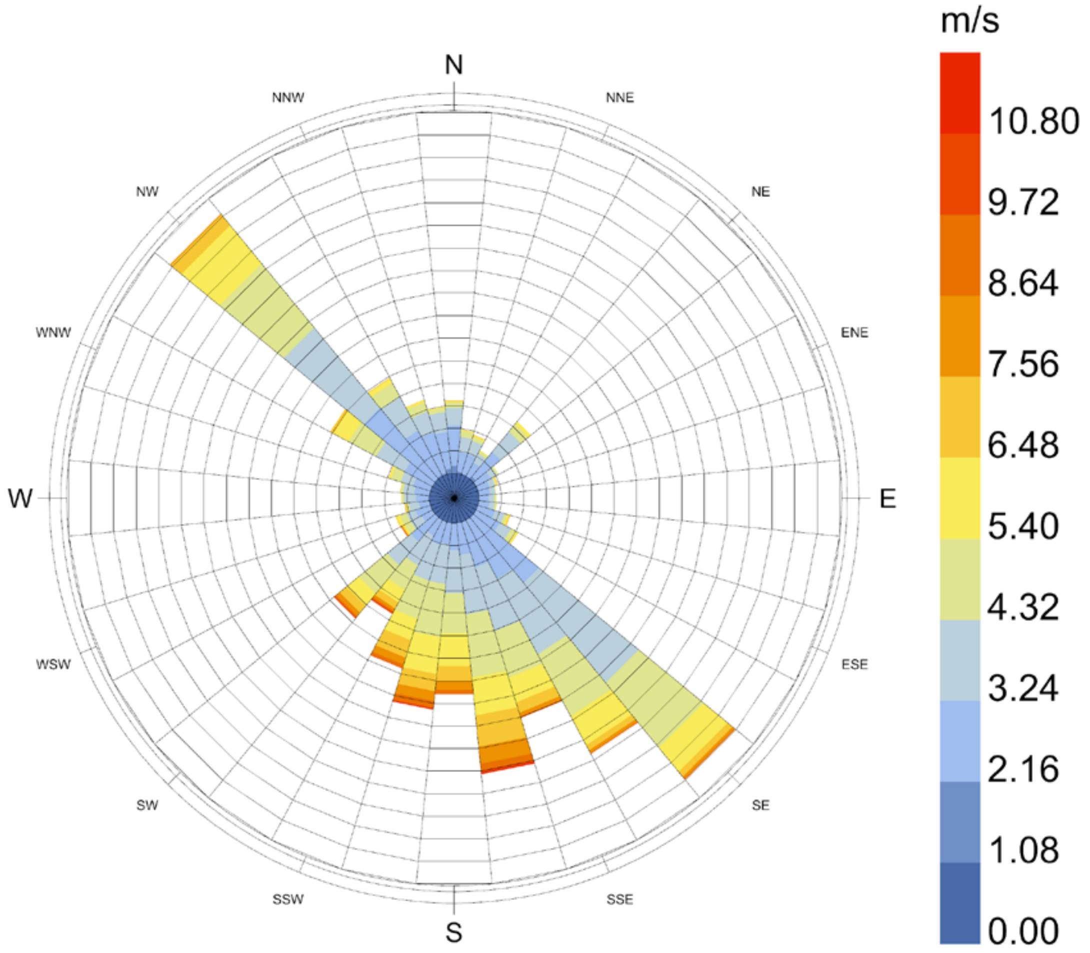
Wind Speed



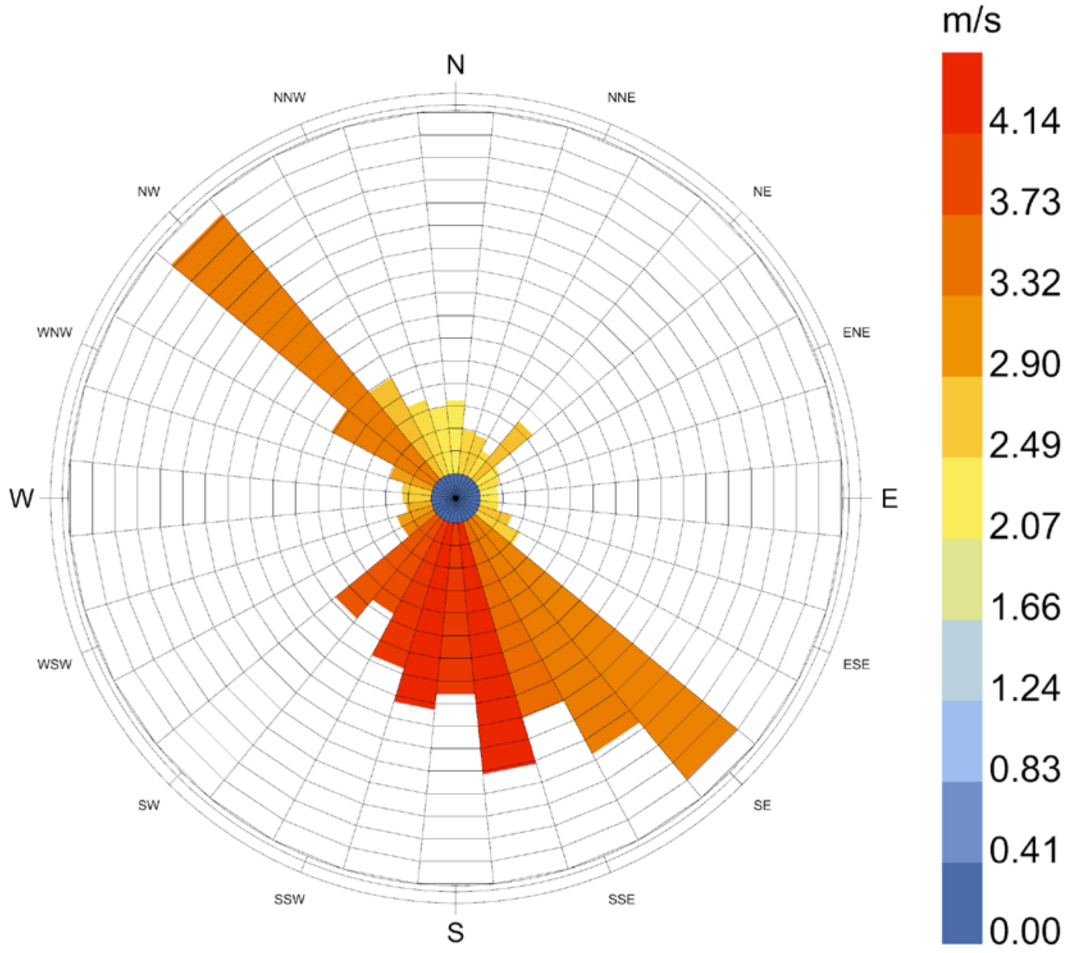
Wind Speed (m/s)
1/1 to 12/31 between 0 and 23 @1
city: Seattle-King County Intl AP-Boeing Field
country: USA
time-zone: -8.0
source: TMY3

Climate Charts

Wind Direction - Ladybug climate chart



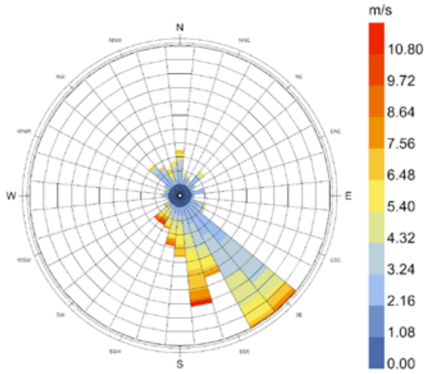
Wind Speed (m/s)
city: Seattle-King County Intl AP-Boeing Field
country: USA
time-zone: -8.0
source: TMY3
period: 1/1 to 12/31 between 0 and 23 @1
Calm for 19.97% of the time = 1749 hours.
Each closed polyline shows frequency of 0.7% = 50 hours.



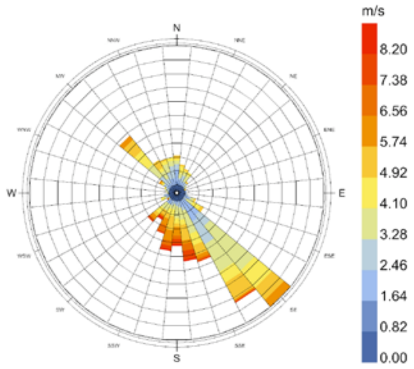
Wind Speed - Average (m/s)
city: Seattle-King County Intl AP-Boeing Field
country: USA
time-zone: -8.0
source: TMY3
period: 1/1 to 12/31 between 0 and 23 @1
Calm for 19.97% of the time = 1749 hours.
Each closed polyline shows frequency of 0.7% = 50 hours.

Climate Charts

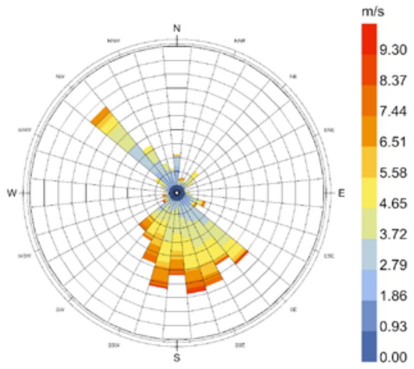
Wind Direction - Ladybug climate chart



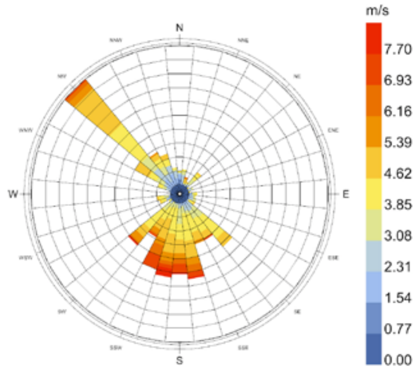
Wind Speed (m/s)
city: Seattle-King County Intl AP-Boeing Field
country: USA
time-zone: -8.0
source: TMY3
period: 1/1 to 1/31 between 0 and 23 @1
Calm for 27.28% of the time = 203 hours.
Each closed polyline shows frequency of 1.6% = 8 hours.



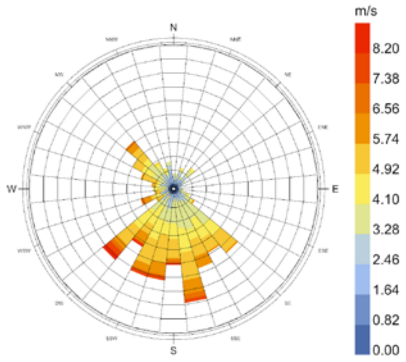
Wind Speed (m/s)
city: Seattle-King County Intl AP-Boeing Field
country: USA
time-zone: -8.0
source: TMY3
period: 2/1 to 2/28 between 0 and 23 @1
Calm for 21.88% of the time = 147 hours.
Each closed polyline shows frequency of 1.6% = 8 hours.



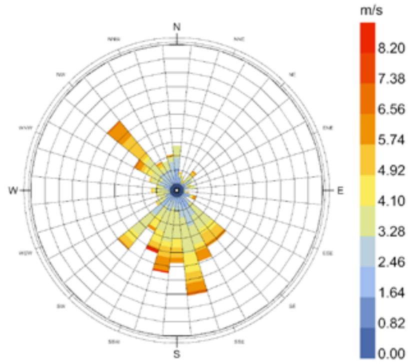
Wind Speed (m/s)
city: Seattle-King County Intl AP-Boeing Field
country: USA
time-zone: -8.0
source: TMY3
period: 3/1 to 3/31 between 0 and 23 @1
Calm for 18.68% of the time = 139 hours.
Each closed polyline shows frequency of 1.3% = 8 hours.



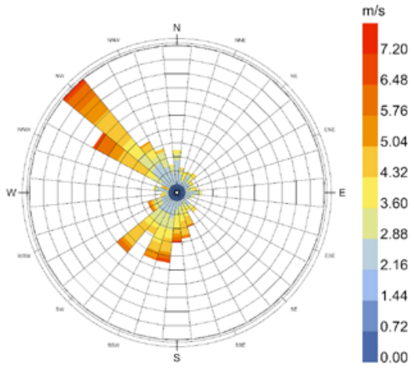
Wind Speed (m/s)
city: Seattle-King County Intl AP-Boeing Field
country: USA
time-zone: -8.0
source: TMY3
period: 4/1 to 4/30 between 0 and 23 @1
Calm for 23.33% of the time = 168 hours.
Each closed polyline shows frequency of 1.5% = 8 hours.



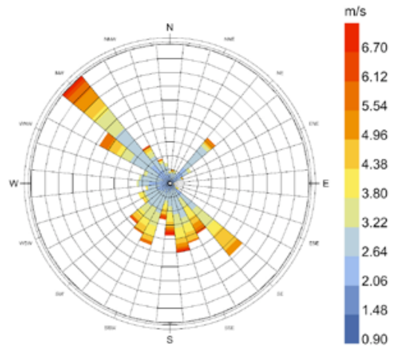
Wind Speed (m/s)
city: Seattle-King County Intl AP-Boeing Field
country: USA
time-zone: -8.0
source: TMY3
period: 5/1 to 5/31 between 0 and 23 @1
Calm for 11.96% of the time = 89 hours.
Each closed polyline shows frequency of 1.2% = 8 hours.



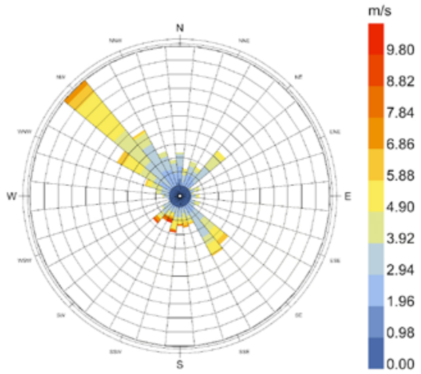
Wind Speed (m/s)
city: Seattle-King County Intl AP-Boeing Field
country: USA
time-zone: -8.0
source: TMY3
period: 6/1 to 6/30 between 0 and 23 @1
Calm for 16.94% of the time = 122 hours.
Each closed polyline shows frequency of 1.3% = 8 hours.



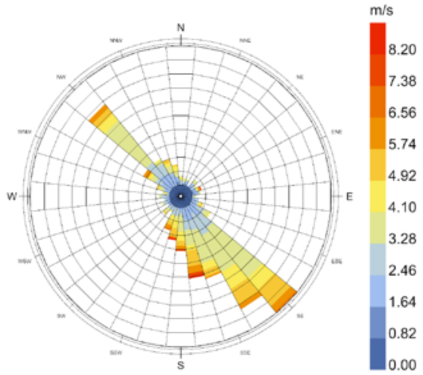
Wind Speed (m/s)
city: Seattle-King County Intl AP-Boeing Field
country: USA
time-zone: -8.0
source: TMY3
period: 7/1 to 7/31 between 0 and 23 @1
Calm for 20.03% of the time = 149 hours.
Each closed polyline shows frequency of 1.4% = 8 hours.



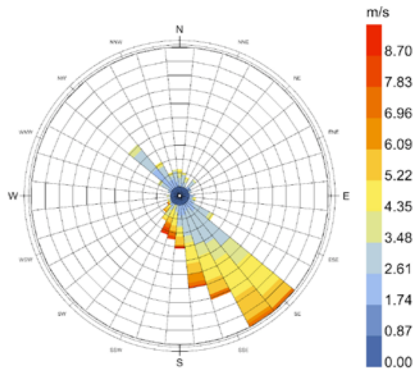
Wind Speed (m/s)
city: Seattle-King County Intl AP-Boeing Field
country: USA
time-zone: -8.0
source: TMY3
period: 8/1 to 8/31 between 0 and 23 @1
Calm for 0.0% of the time = 0 hours.
Each closed polyline shows frequency of 1.1% = 8 hours.



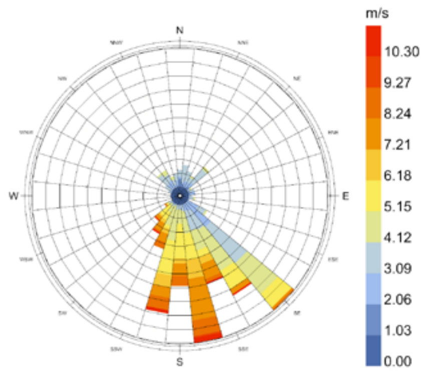
Wind Speed (m/s)
city: Seattle-King County Intl AP-Boeing Field
country: USA
time-zone: -8.0
source: TMY3
period: 9/1 to 9/30 between 0 and 23 @1
Calm for 27.08% of the time = 195 hours.
Each closed polyline shows frequency of 1.7% = 8 hours.



Wind Speed (m/s)
city: Seattle-King County Intl AP-Boeing Field
country: USA
time-zone: -8.0
source: TMY3
period: 10/1 to 10/31 between 0 and 23 @1
Calm for 27.96% of the time = 208 hours.
Each closed polyline shows frequency of 1.6% = 8 hours.



Wind Speed (m/s)
city: Seattle-King County Intl AP-Boeing Field
country: USA
time-zone: -8.0
source: TMY3
period: 11/1 to 11/30 between 0 and 23 @1
Calm for 23.75% of the time = 171 hours.
Each closed polyline shows frequency of 1.6% = 8 hours.



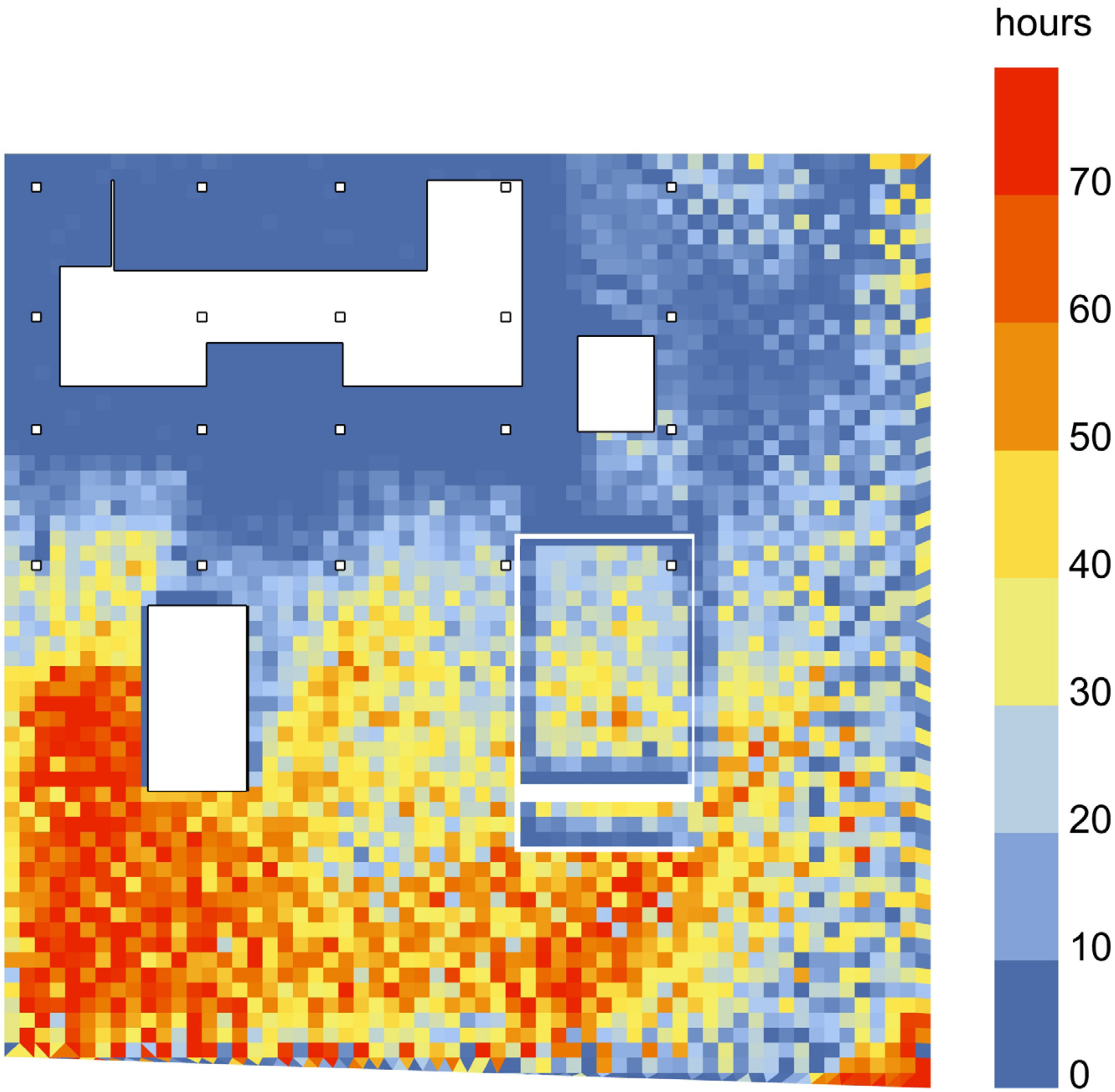
Wind Speed (m/s)
city: Seattle-King County Intl AP-Boeing Field
country: USA
time-zone: -8.0
source: TMY3
period: 12/1 to 12/31 between 0 and 23 @1
Calm for 21.24% of the time = 158 hours.
Each closed polyline shows frequency of 1.4% = 8 hours.

Plan

Rhino Model

Plan

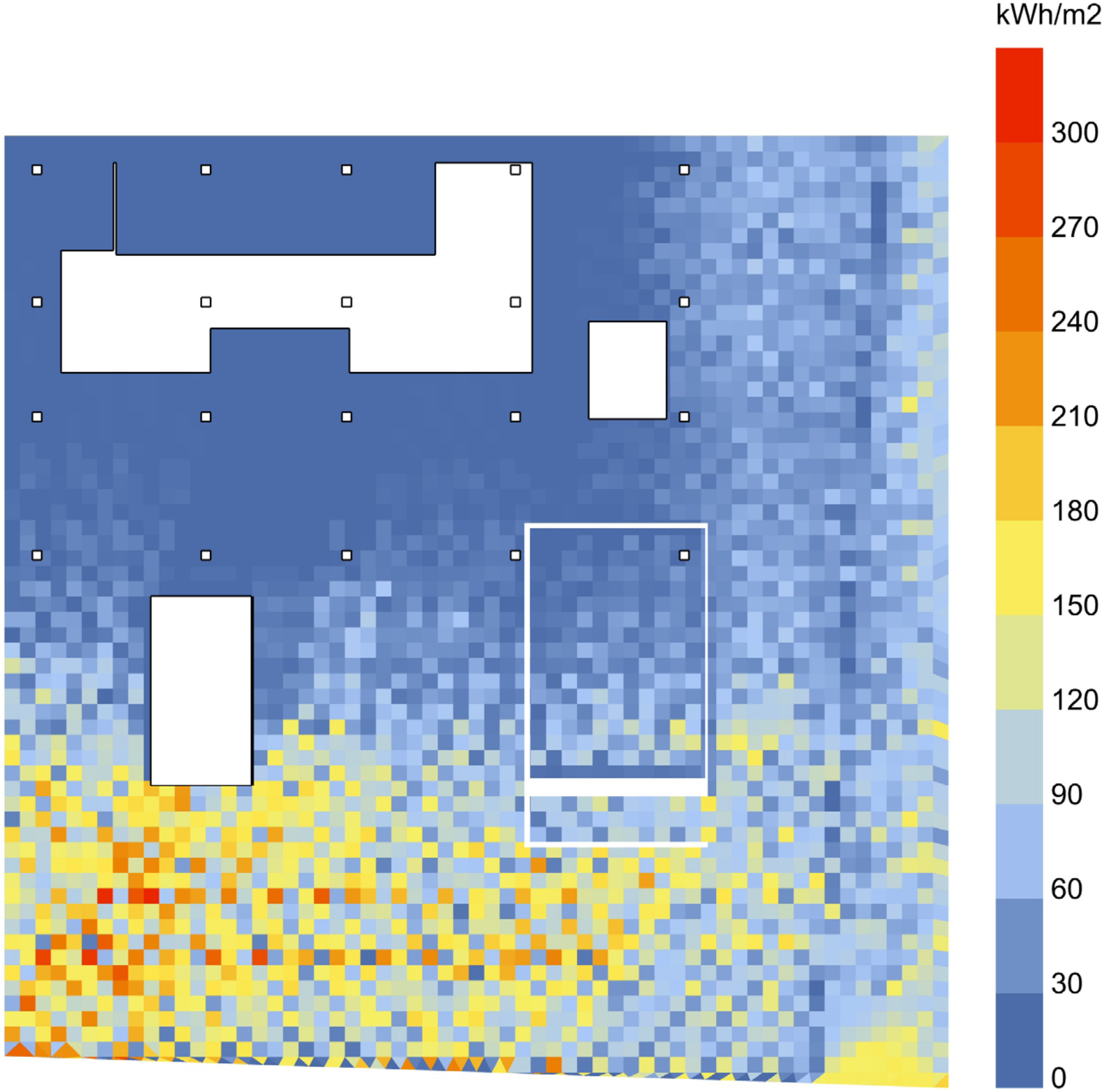
Sun Hours Simulation



Direct Sun Hours

Plan

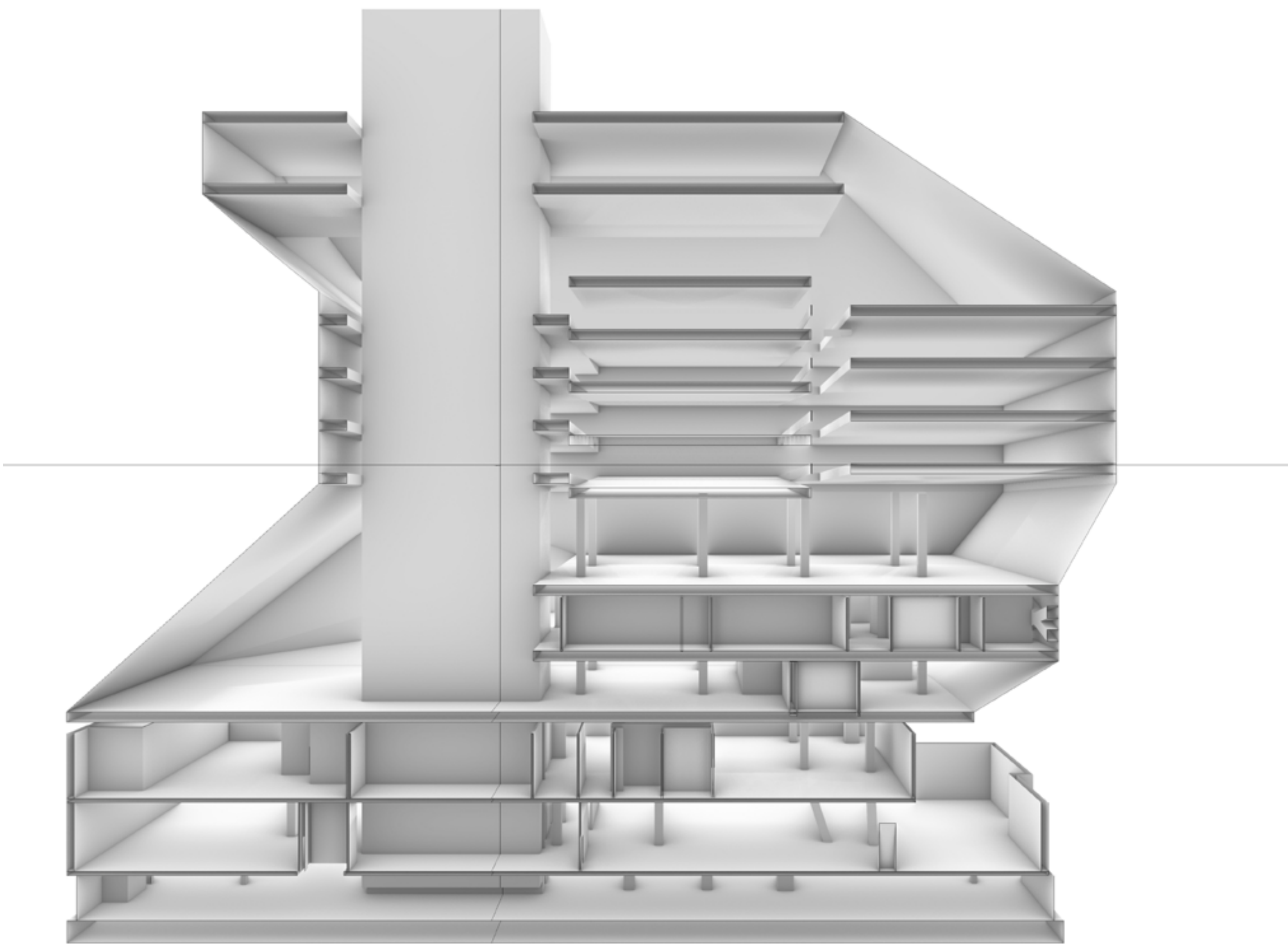
Irradiation Simulation

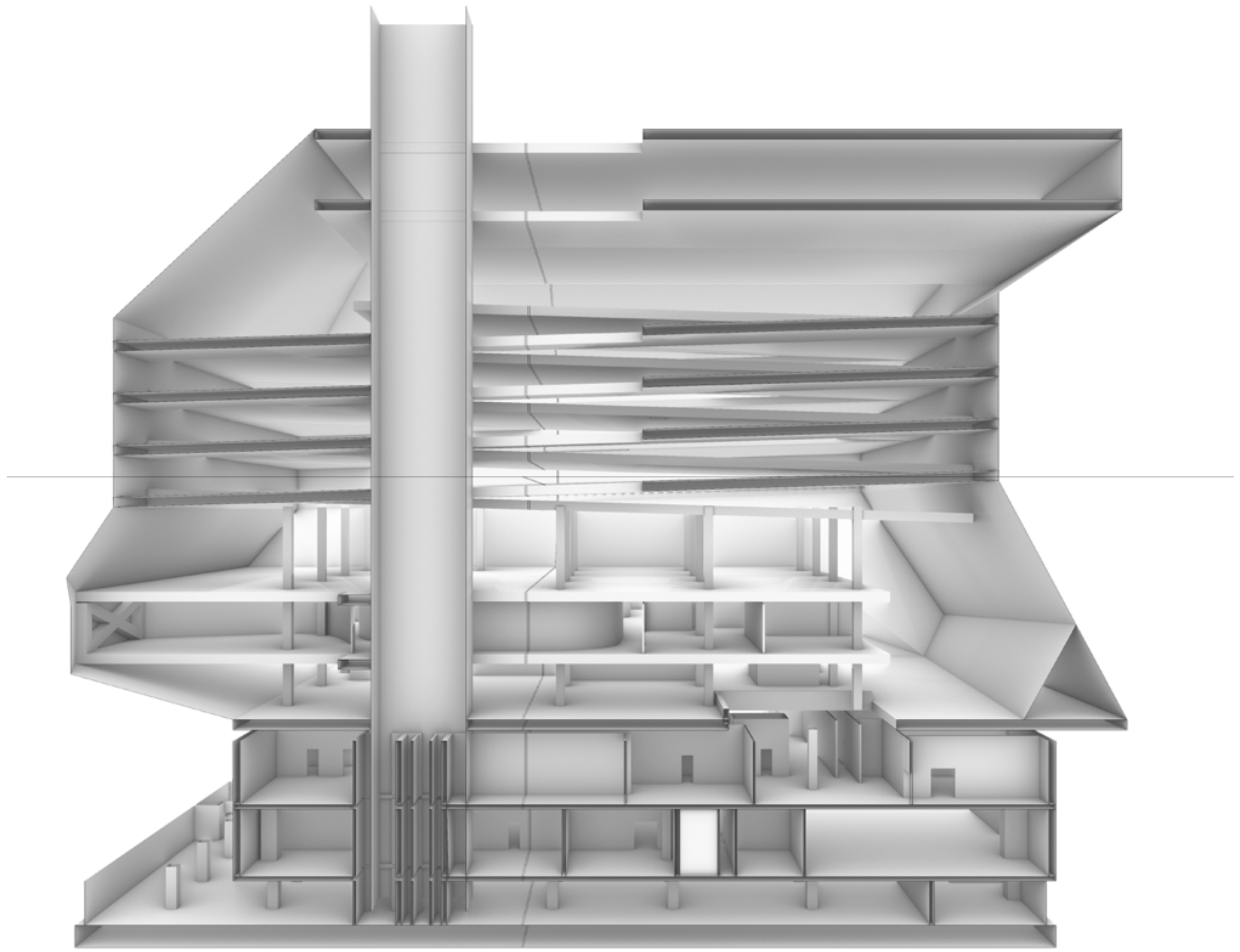


Incident Radiation

Section

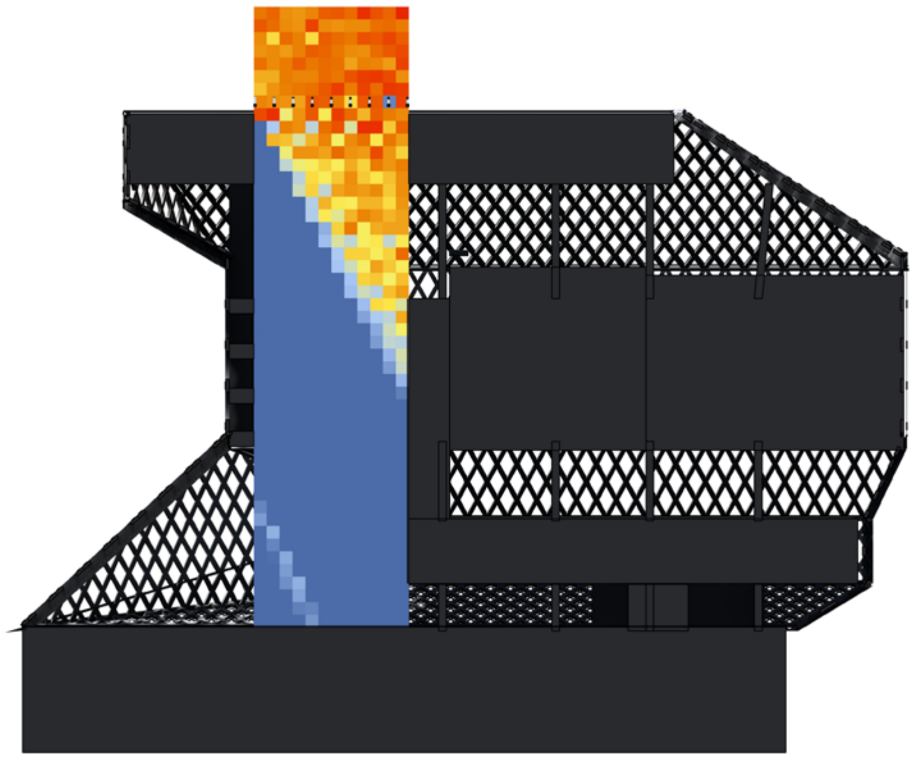
Rhino Model

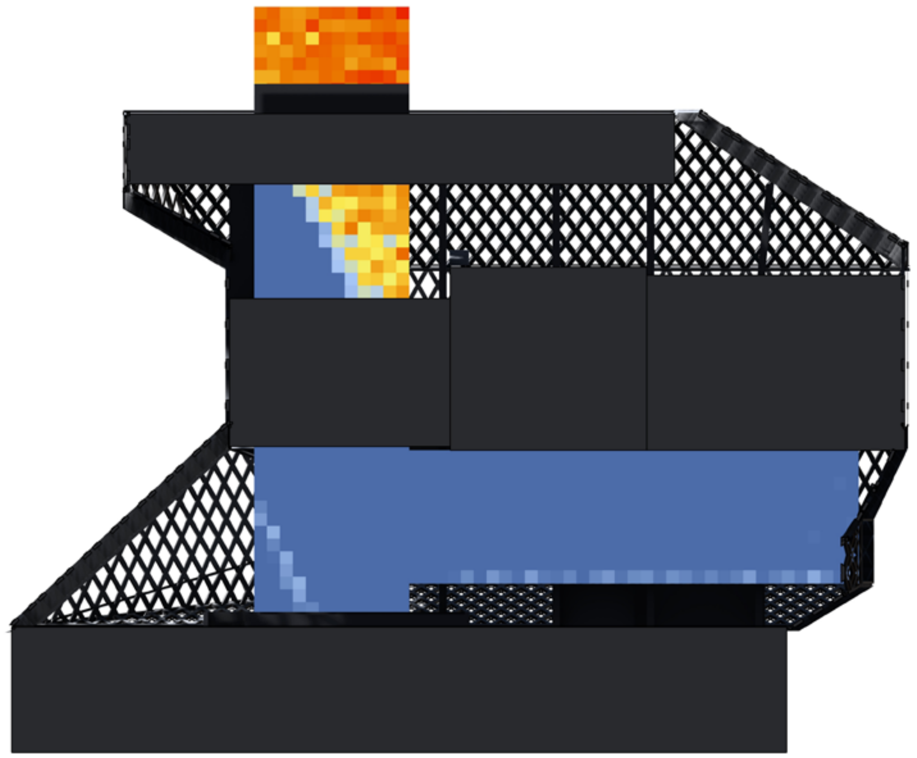


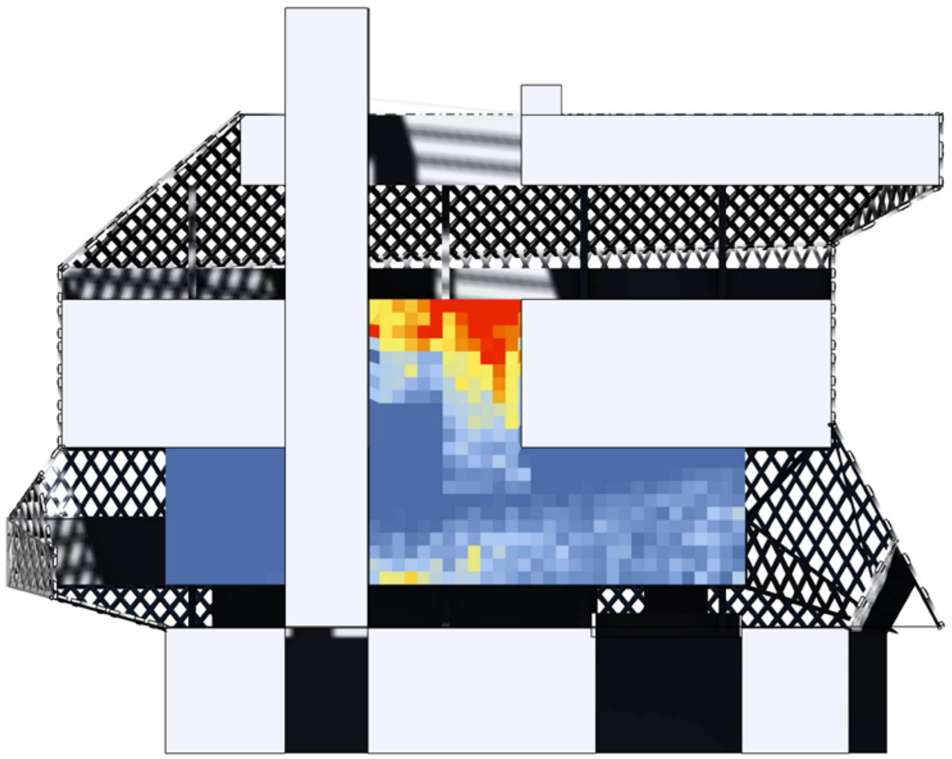


Section

Sun Hours Simulation

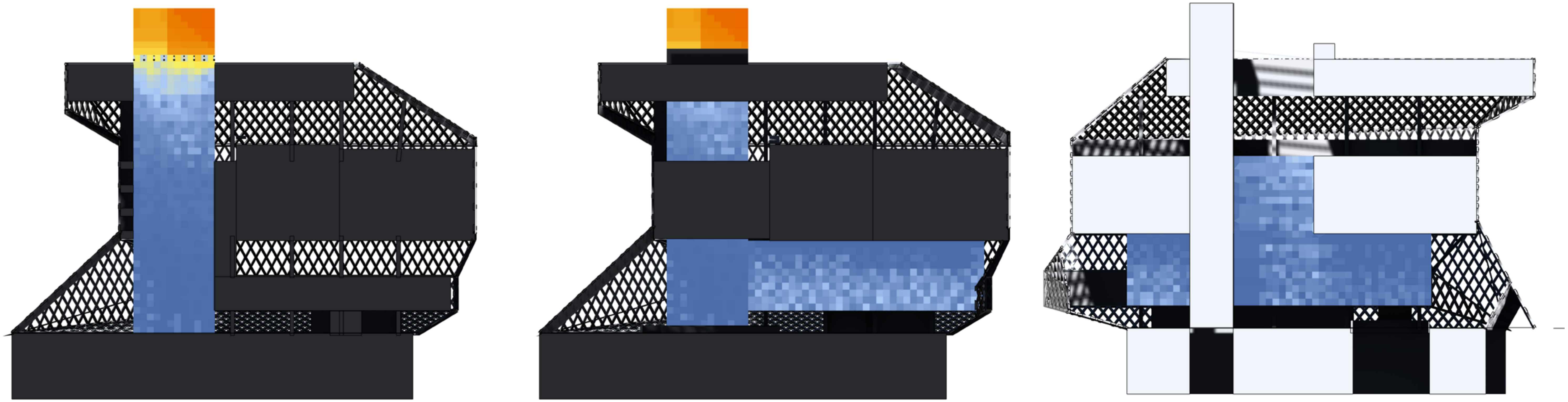






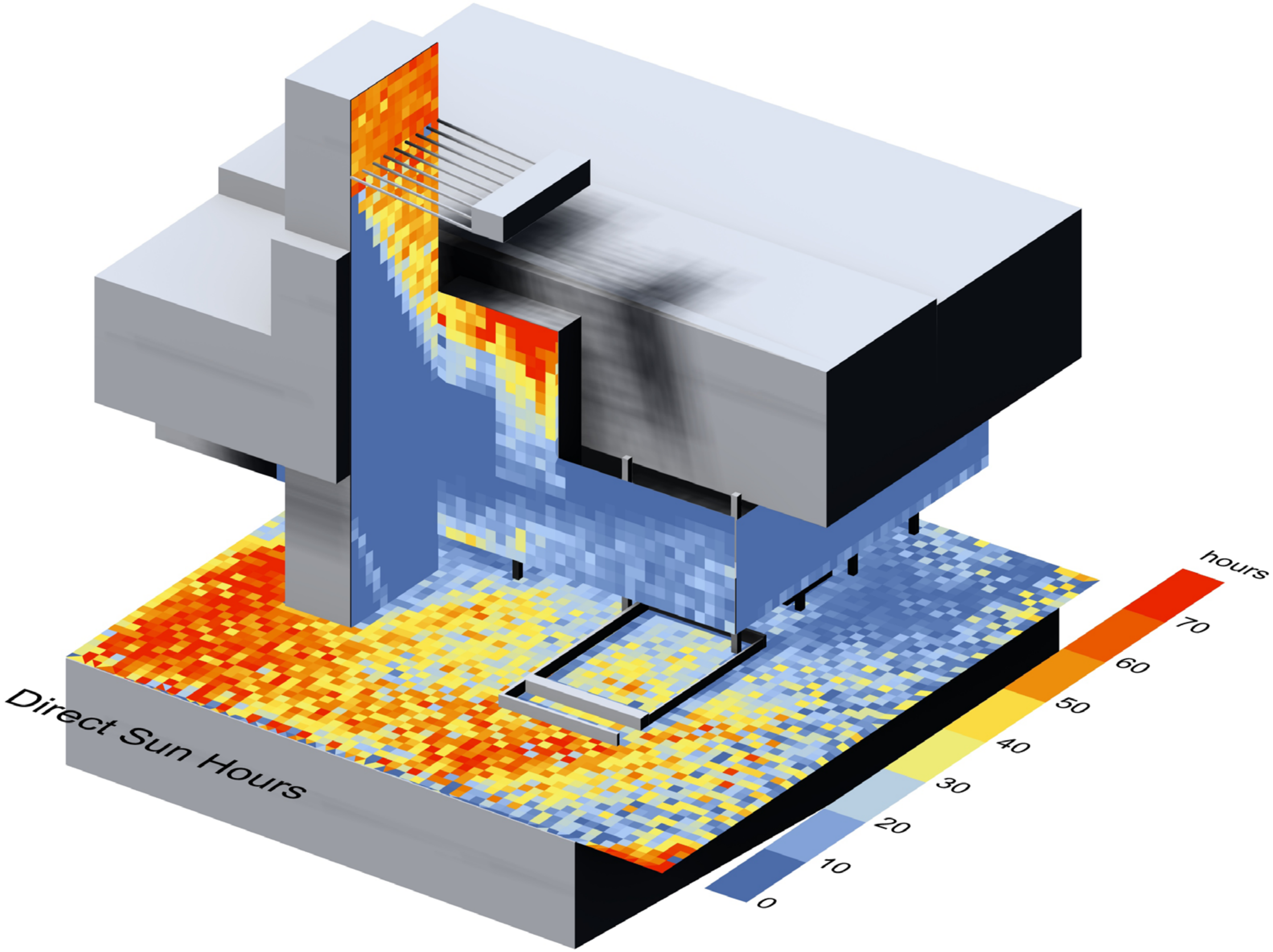
Section

Irradiation Simulation



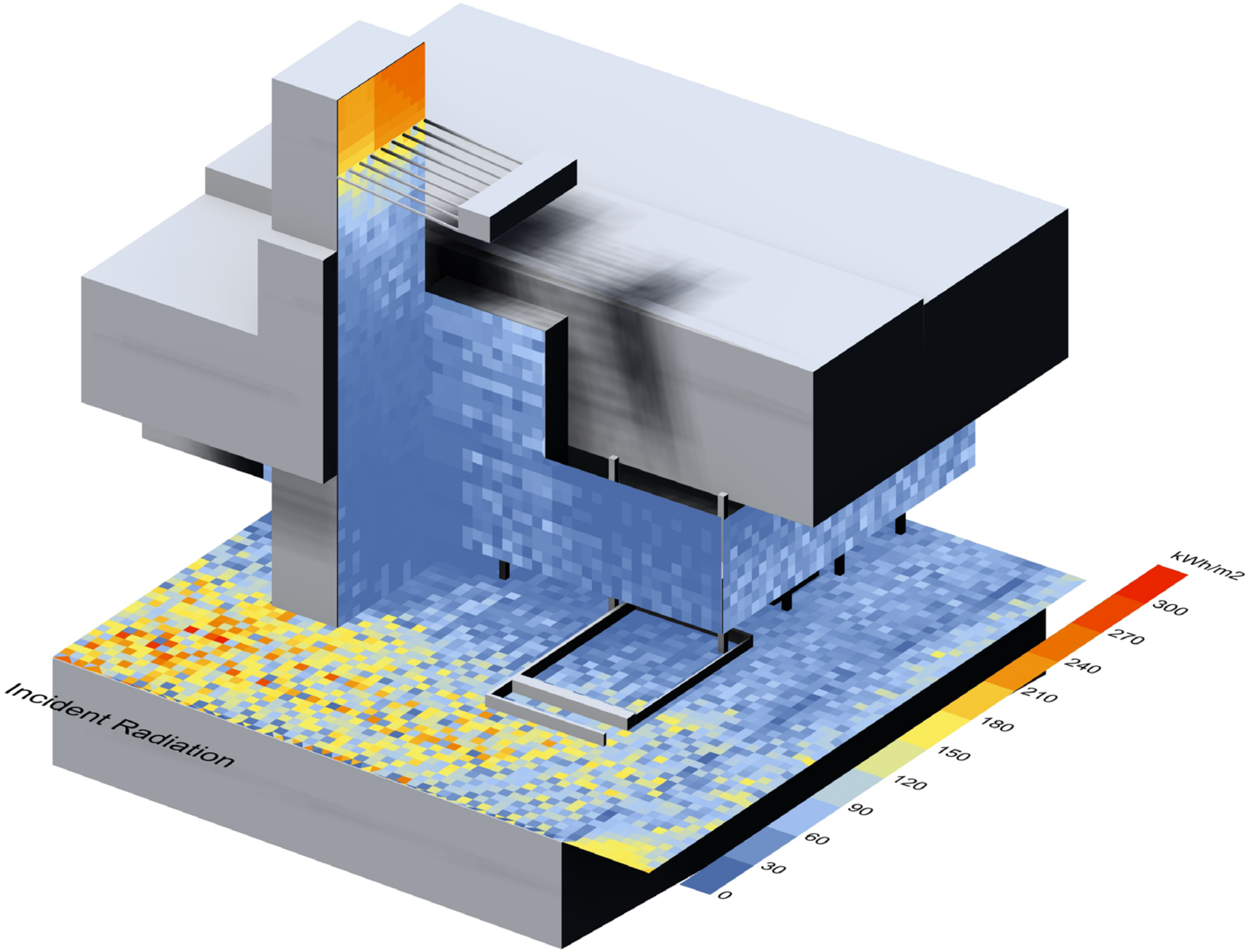
Axonometry

Sun Hours Simulation



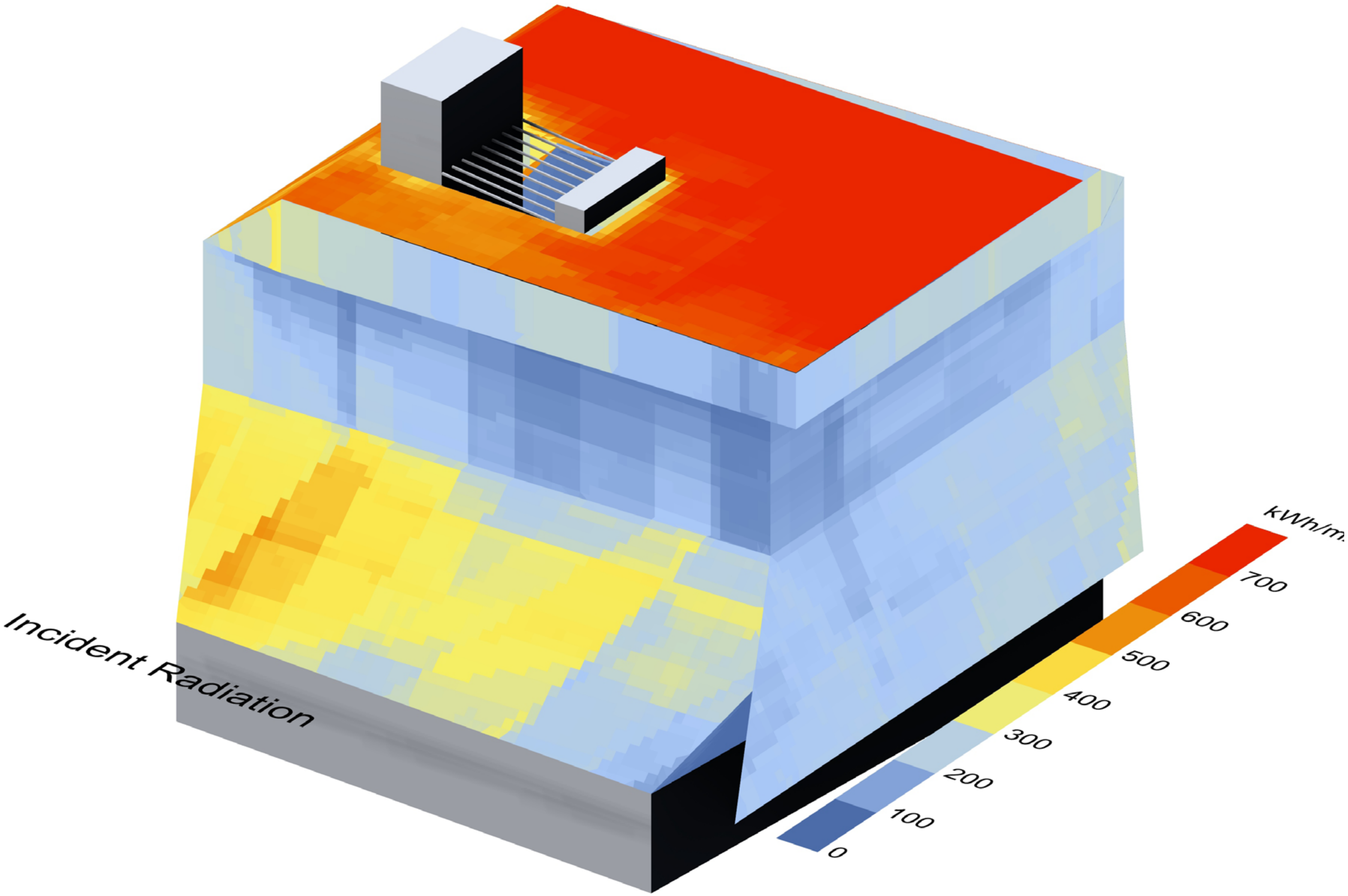
Axonometry

Irradiation Simulation - Atrium



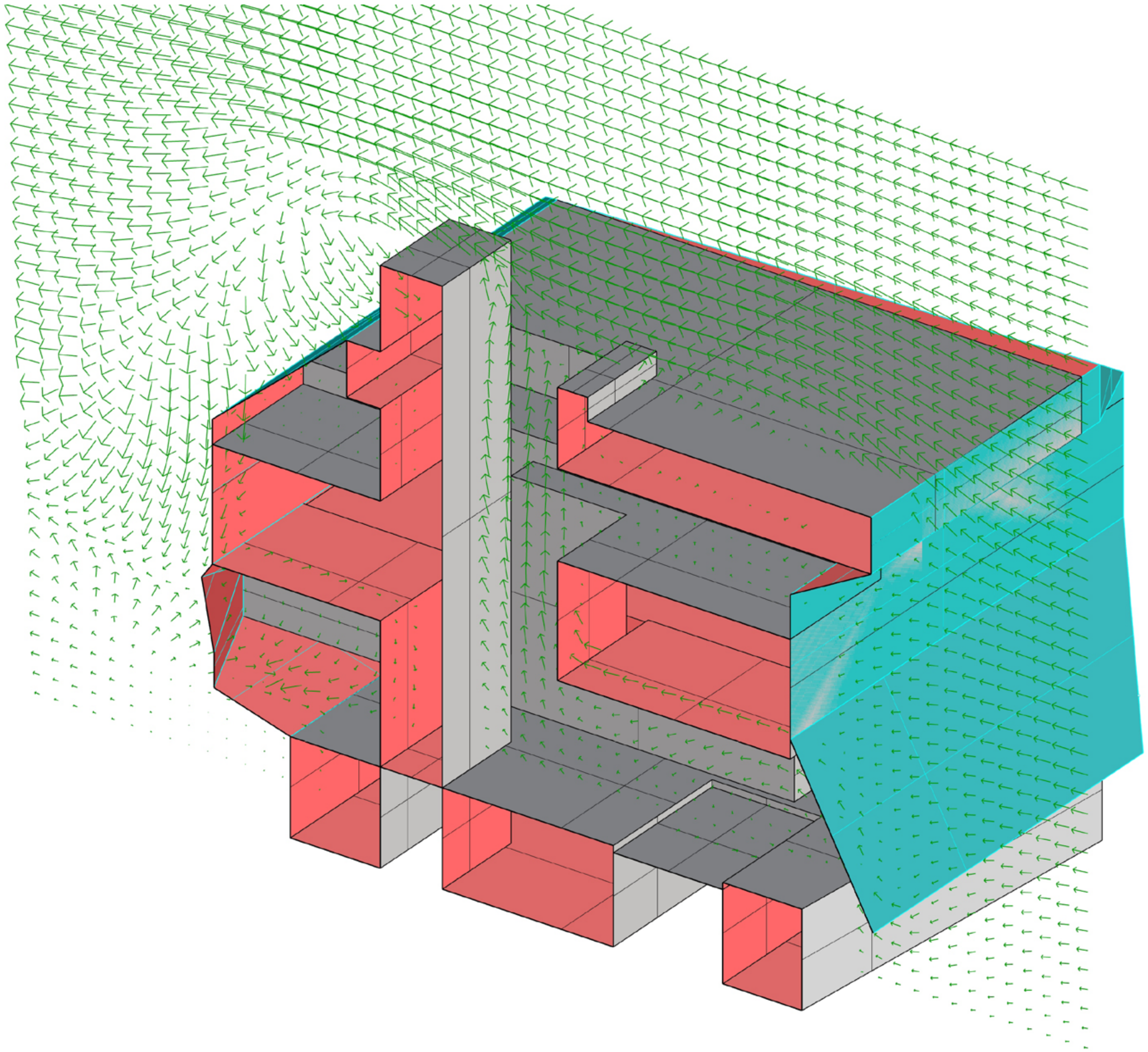
Axonometry

Irradiation Simulation - Envelope



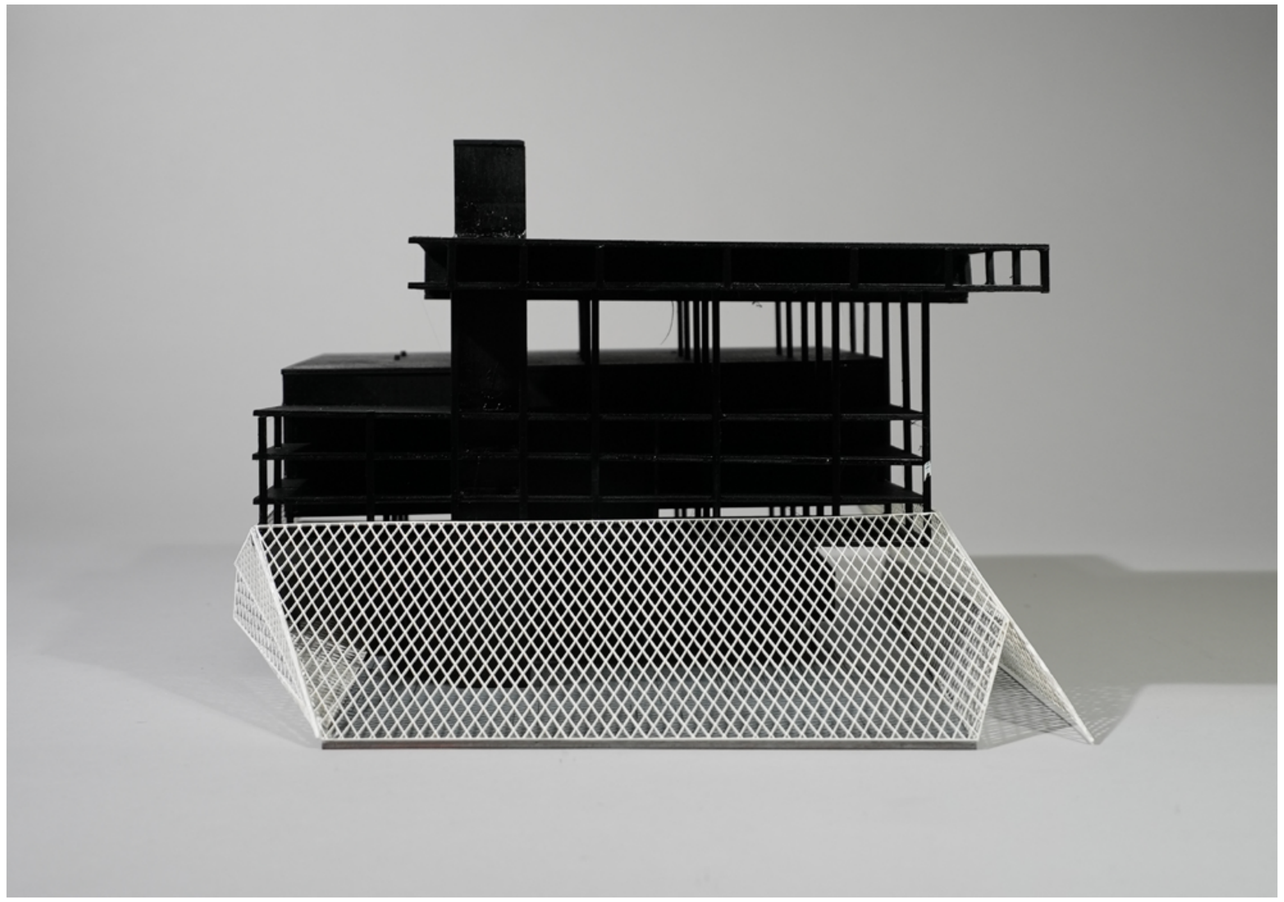
Axonometry

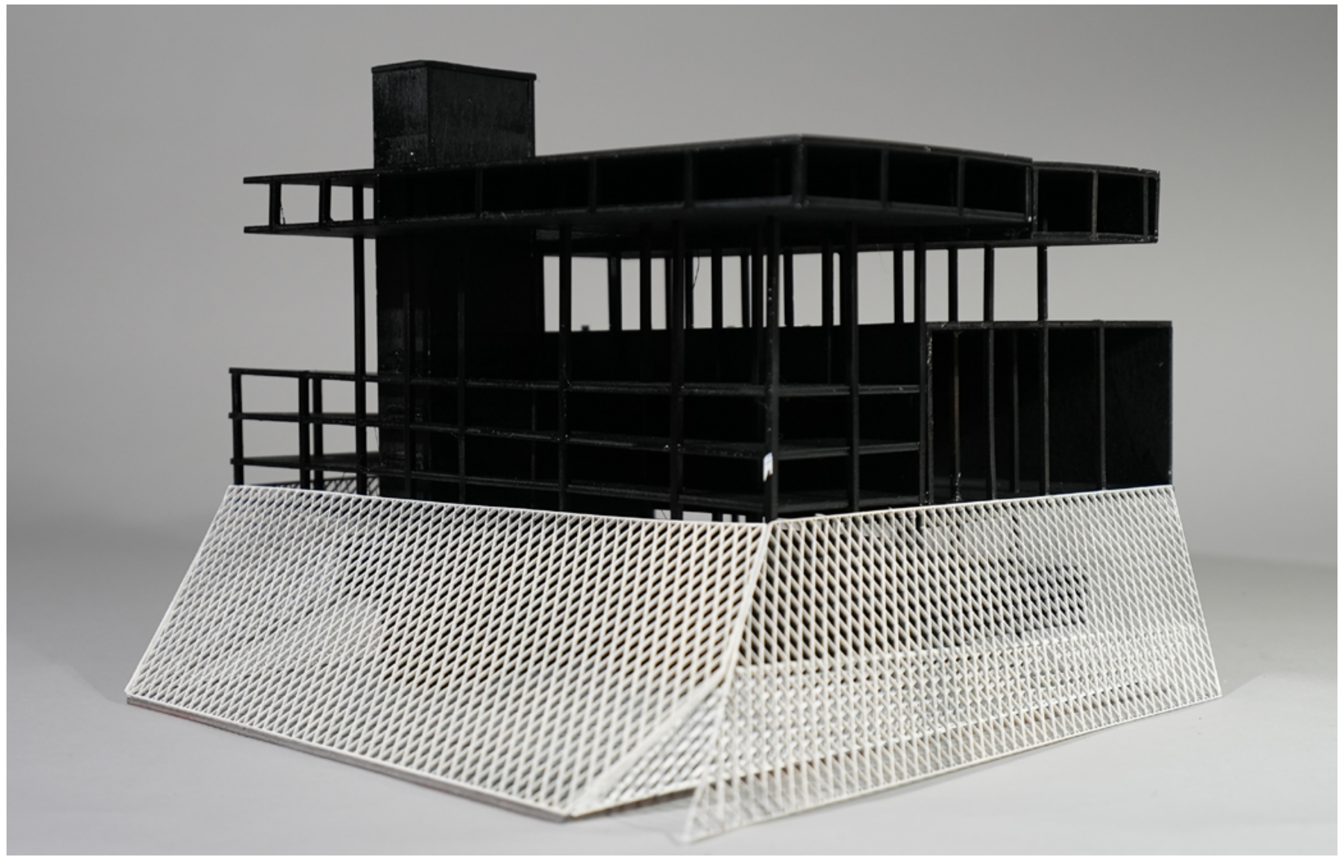
Wind simulation



Physical Model

Primitive Artefact - Seattle Public Library





VARIATIONS

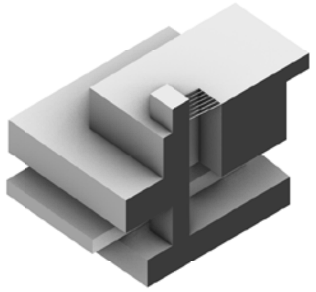
00: As-found Annual Simulations
01: Facade Tilting Angles
02: Atrium Vertical and Horizontal Dimensions
03: Mezzaine Depths

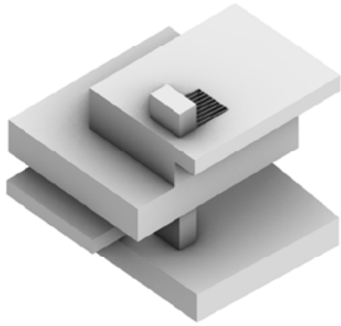
Variation 00 : As-Found Annual Simulations

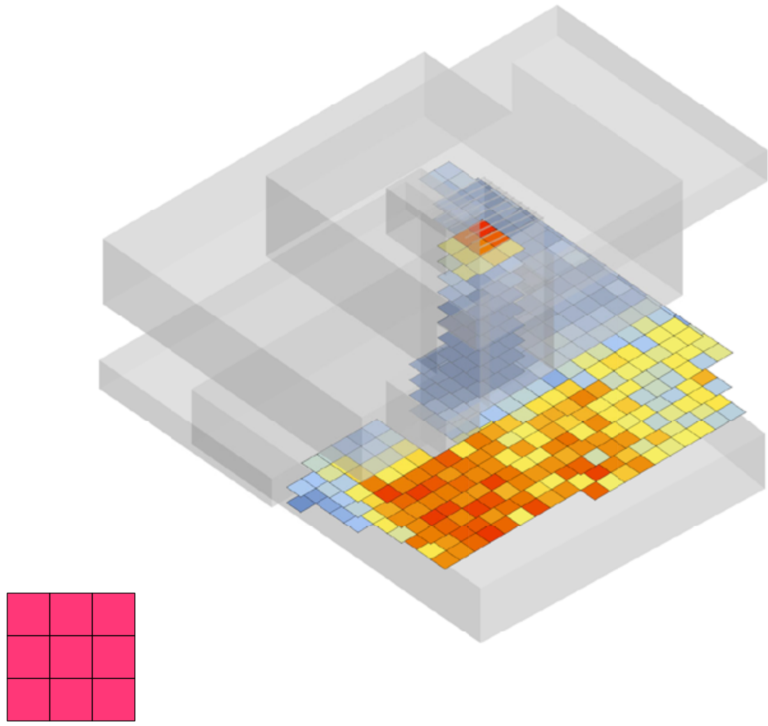
From the Coarse Grid to the Singularised Grid

Variation No.0: As-Found

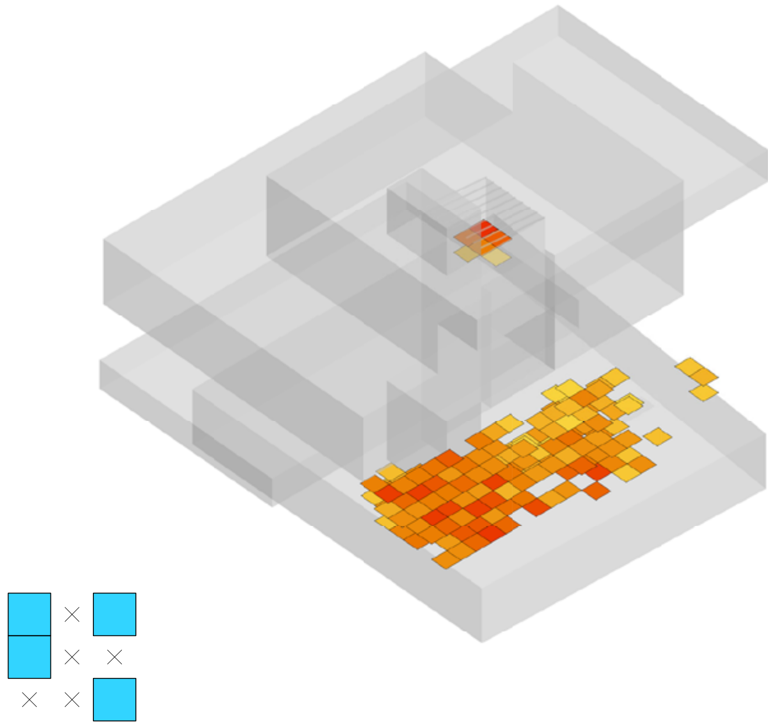
Simulation Period: *DirSunHrs@1 JAN 00:00 [HOY=0] - 31 DEC 23:00 [HOY=8759]*
Variation Parameters:
Facade Tilt: *+0 deg*
Atrium X: *12m*
Atrium Y: *12m*
Mezzanine Offset: *0m*



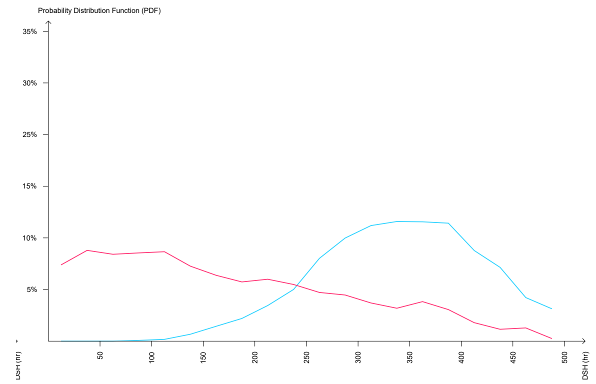




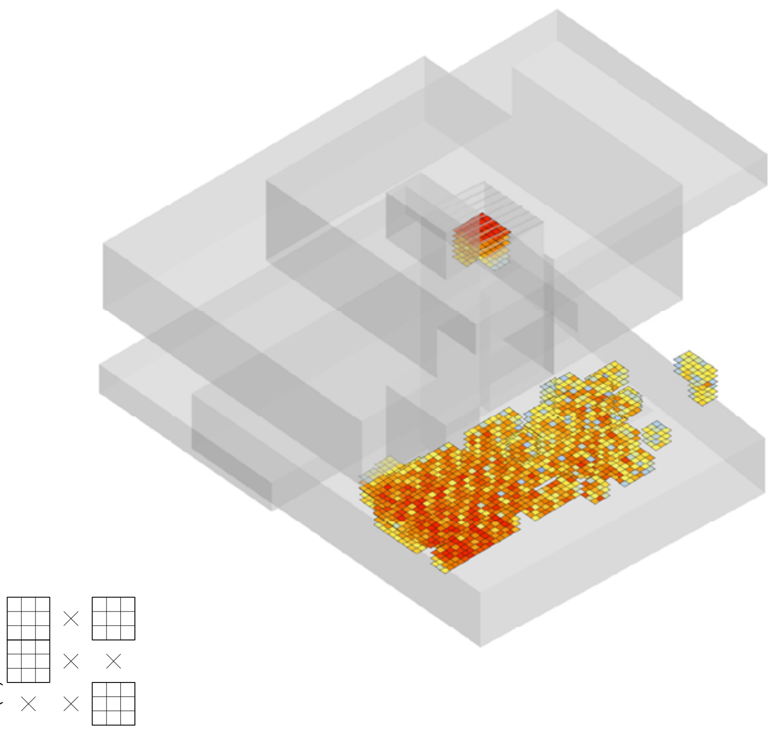
Coarse Grid 3m x 3m x 3m



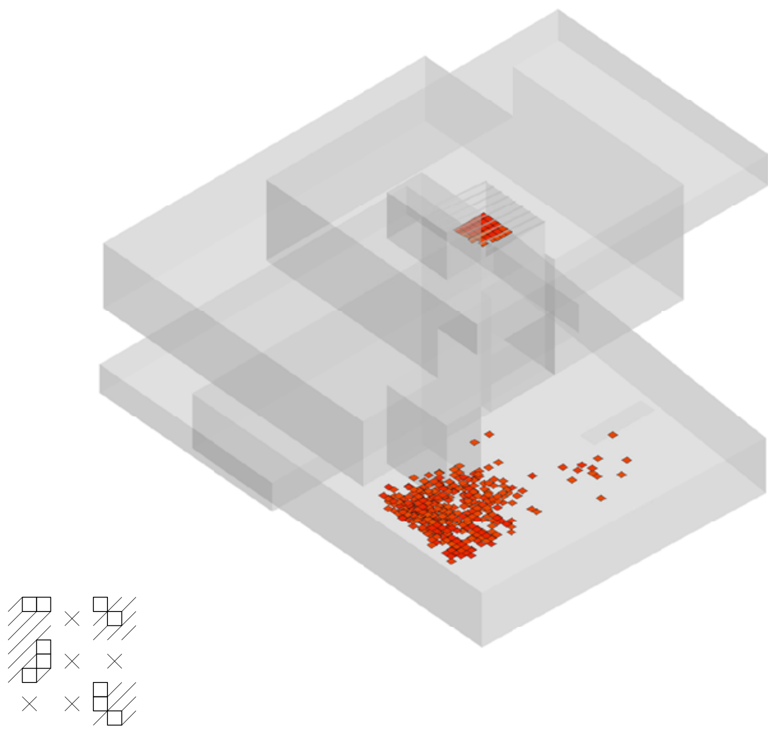
Top 20% of the Coarse Grid



Distribution of DSH Results



Top 20% of the Coarse Grid - Tessellated Grid 1m x 1m x 1m

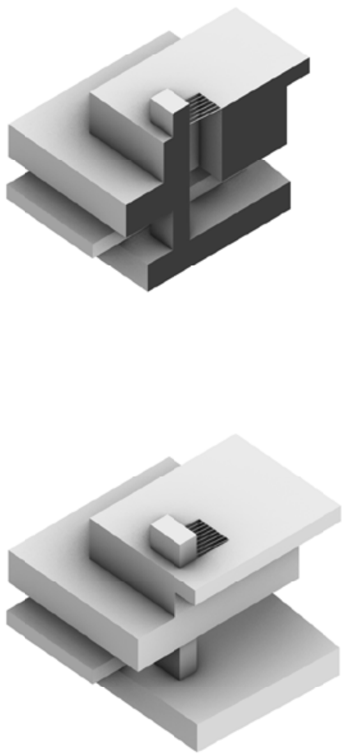


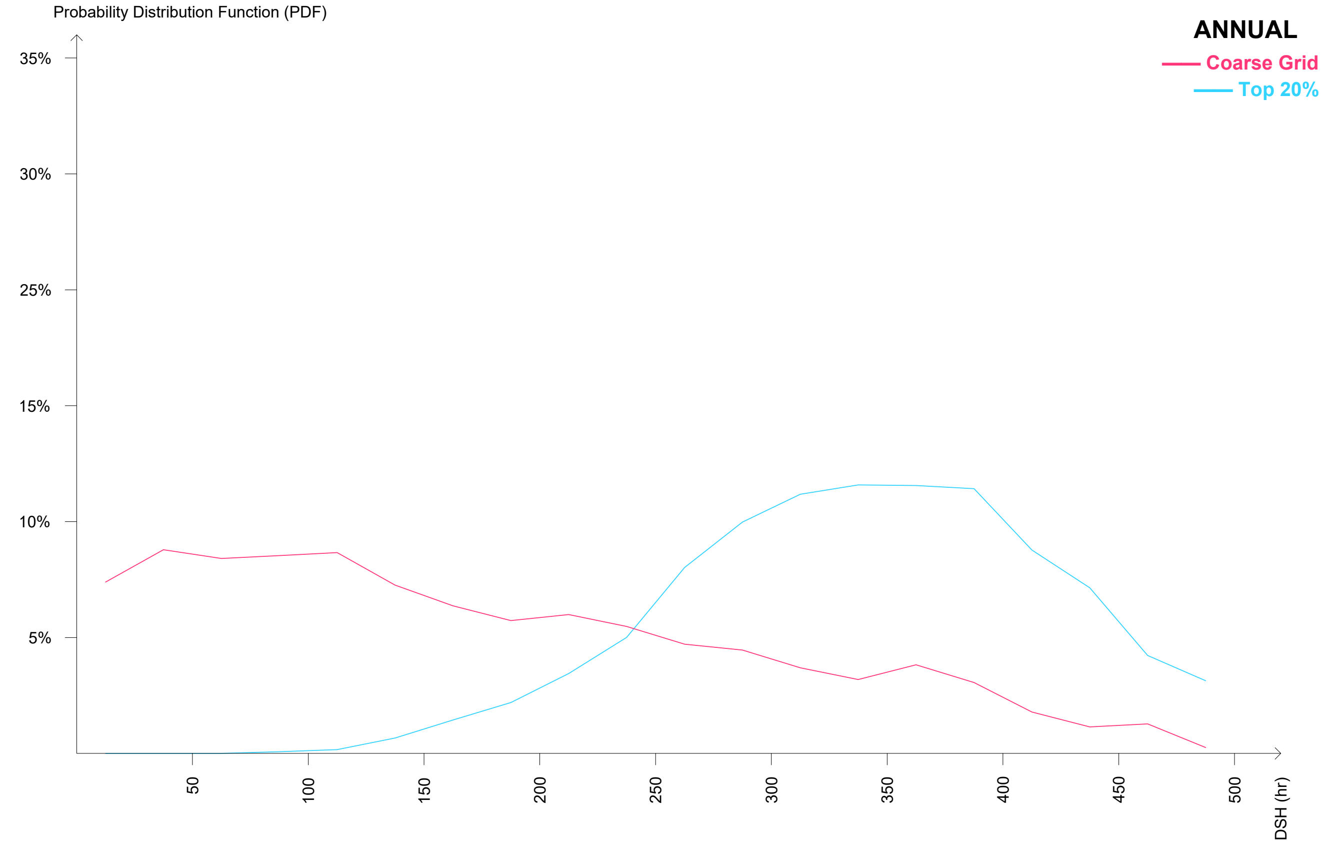
Top 10% of the Tessellated Grid - Singularised Grid 1m x 1m x 1m

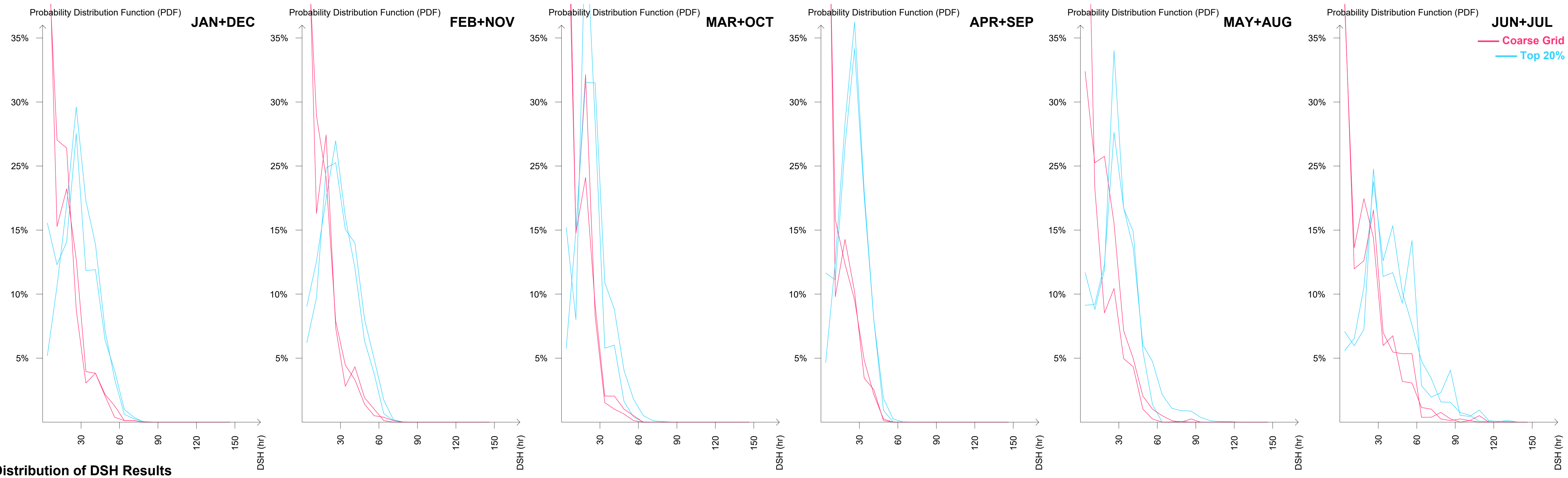
From the Coarse Grid to the Singularised Grid

Variation No.0: As-Found

Simulation Period: *DirSunHrs@1 JAN 00:00 [HOY=0] - 31 DEC 23:00 [HOY=8759]*
Variation Parameters:
- **Facade Tilt:** *+0 deg*
- **Atrium X:** *12m*
- **Atrium Y:** *12m*
- **Mezzanine Offset:** *0m*





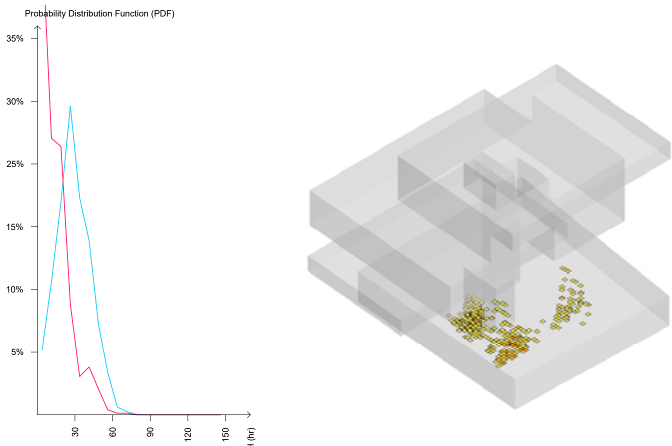


Distribution of DSH Results

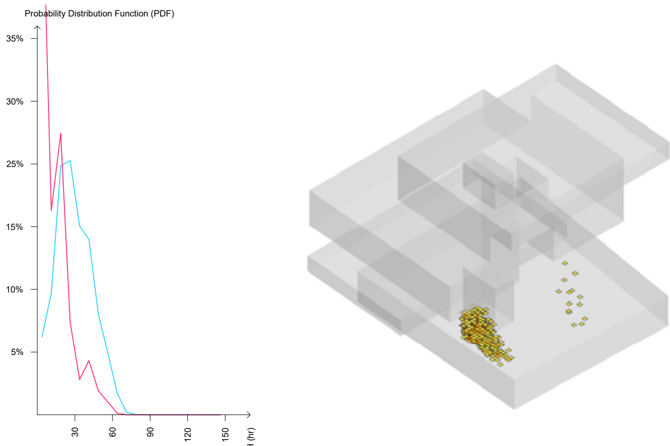
From the Coarse Grid to the Singularised Grid

Variation No.0: As-Found

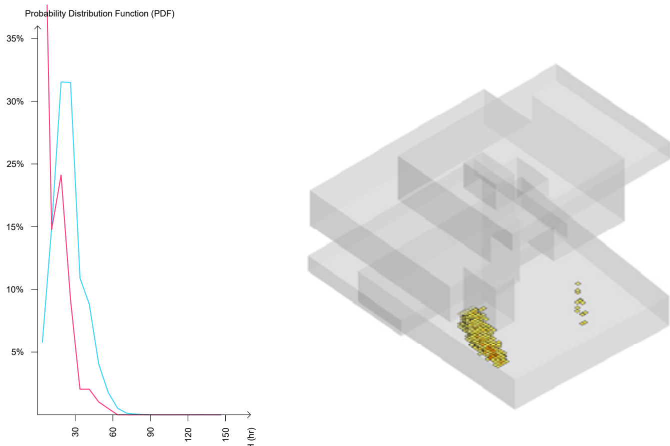
Simulation Period: *DirSunHrs@1 JAN 00:00 [HOY=0] - 31 DEC 23:00 [HOY=8759]*
Variation Parameters:
Facade Tilt: *+0 deg*
Atrium X: *12m*
Atrium Y: *12m*
Mezzanine Offset: *0m*



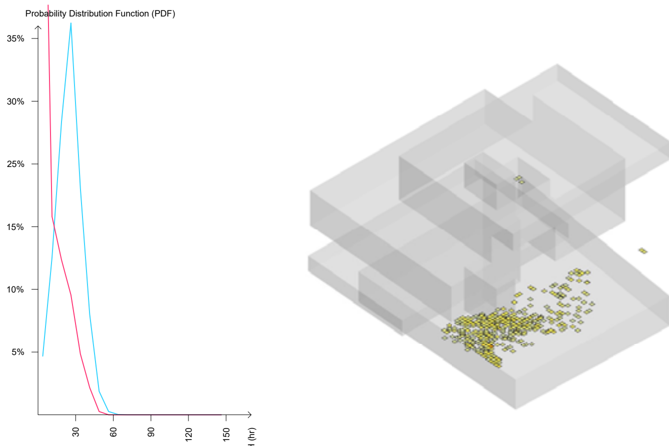
January



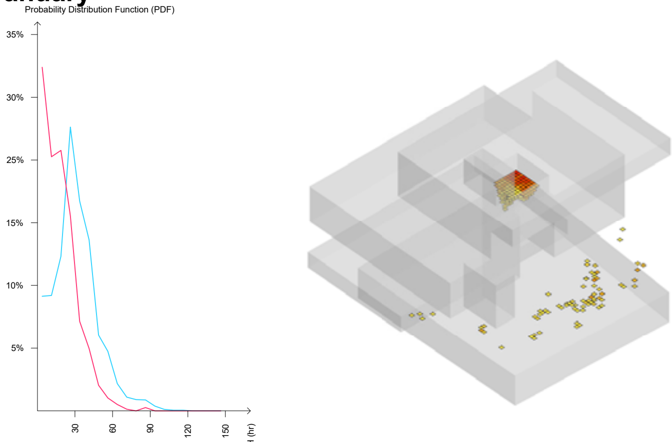
February



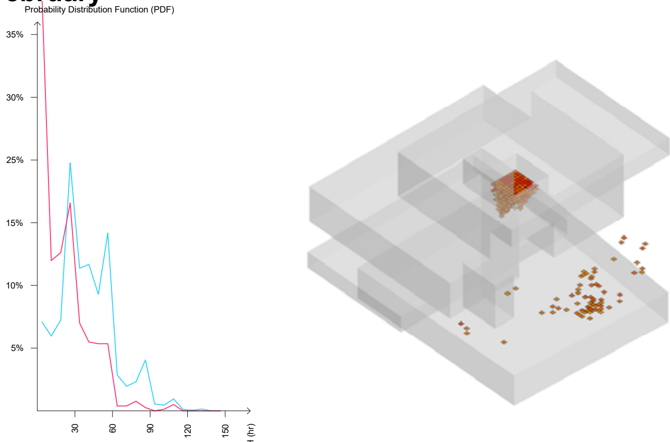
March



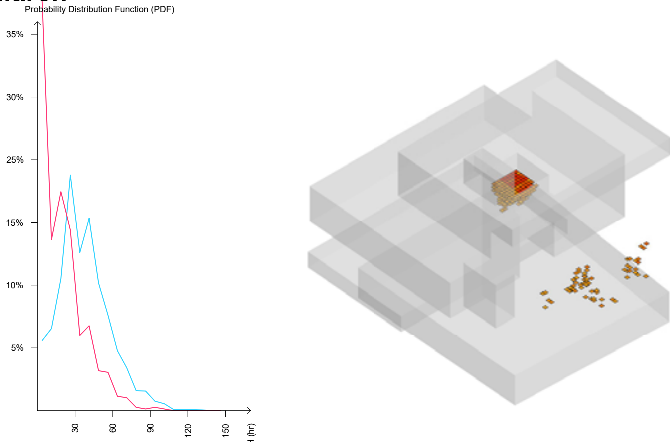
April



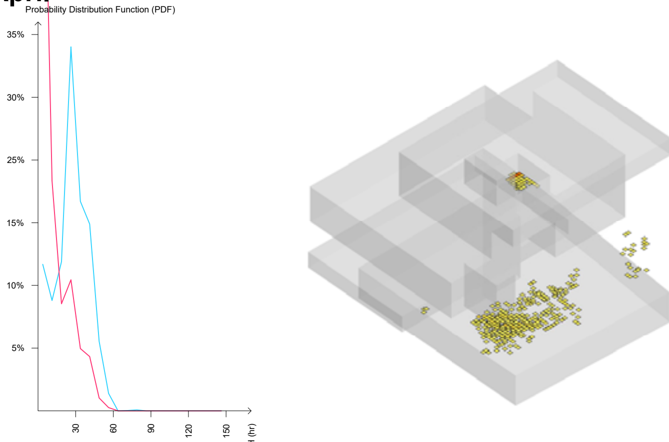
May



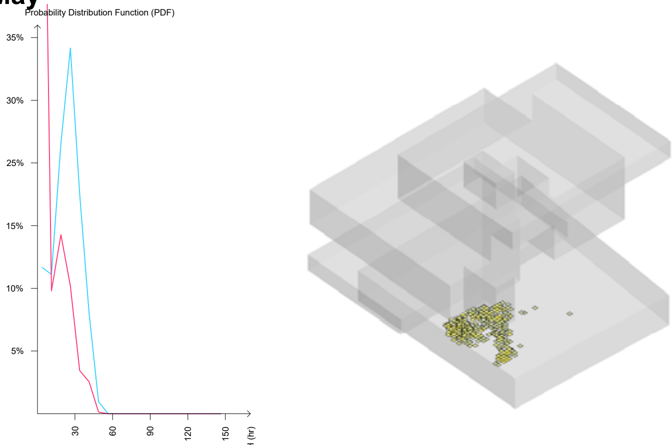
June



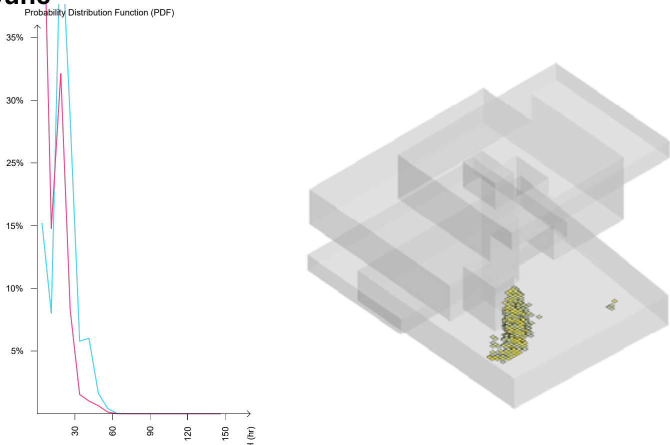
July



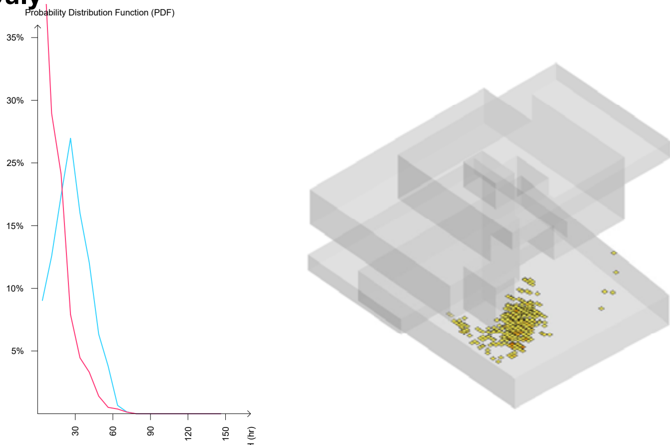
August



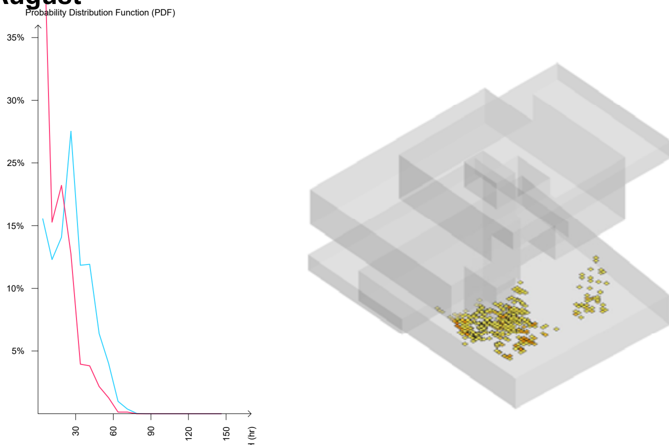
September



October



November



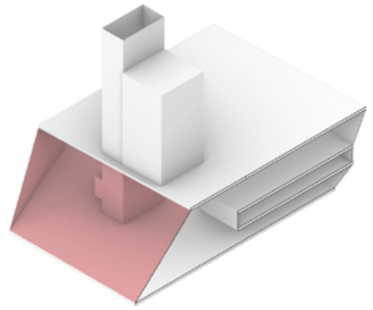
December

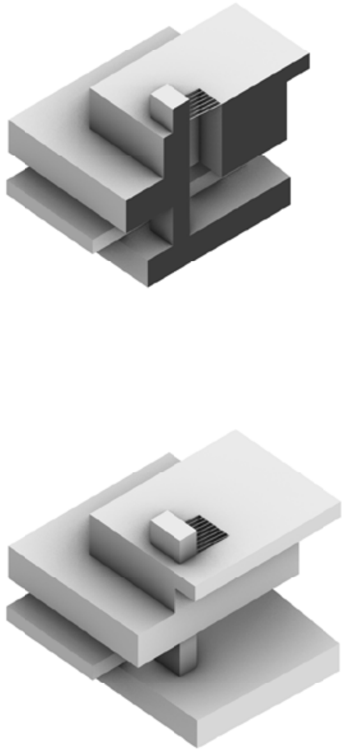
Variation 01 : Facade Tilting Angles

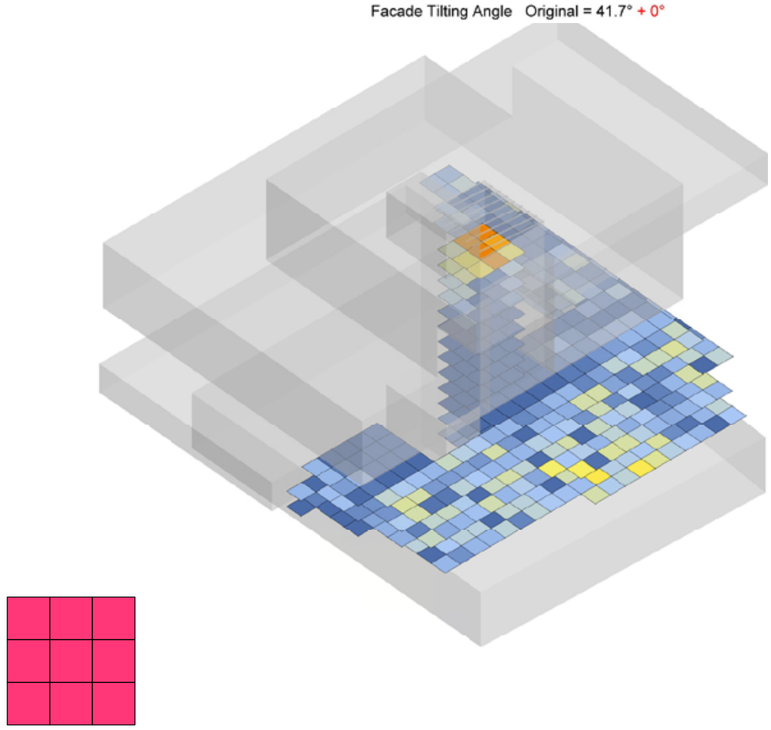
From the Coarse Grid to the Singularised Grid

Variation No.0: As-Found

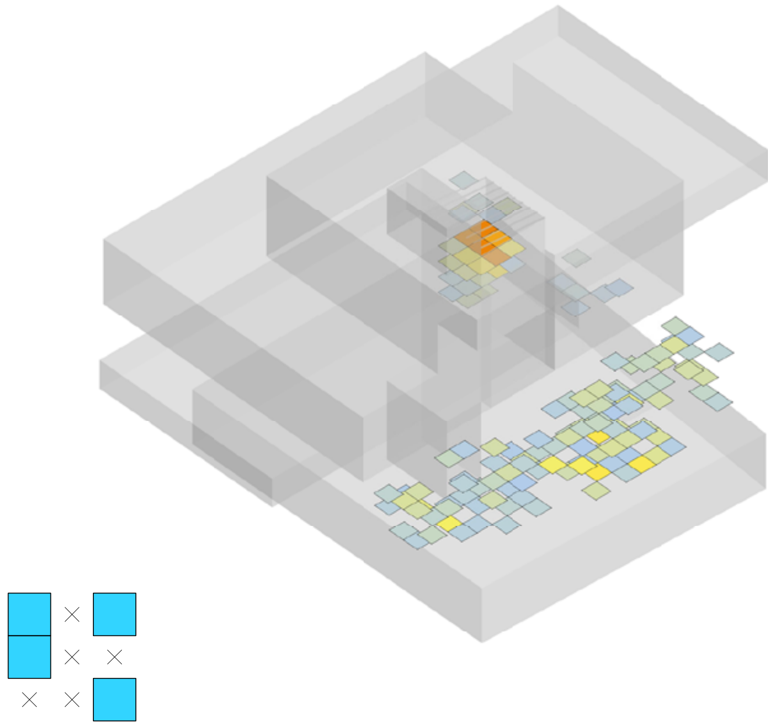
Simulation Period: *DirSunHrs@1 JUN 00:00 [HOY=3624] - 28 JUN 23:00 [HOY=4295]*
Variation Parameters:
- **Facade Tilt:** *+0 deg*
- **Atrium X:** *12m*
- **Atrium Y:** *12m*
- **Mezzanine Offset:** *0m*



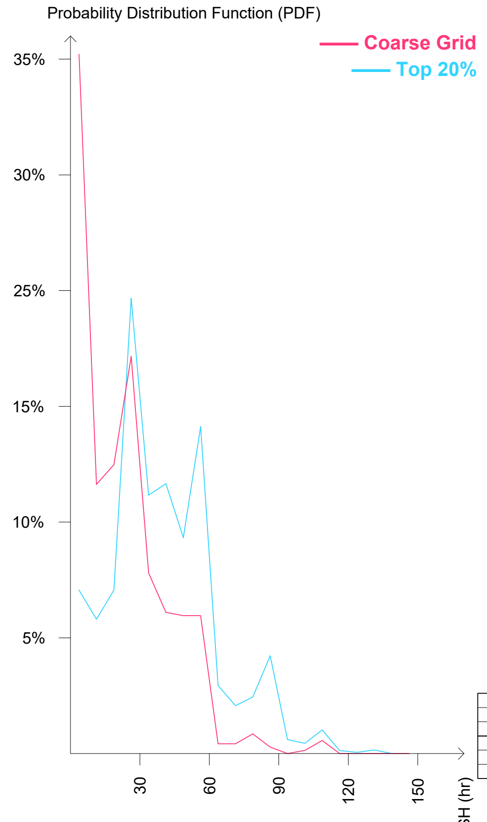




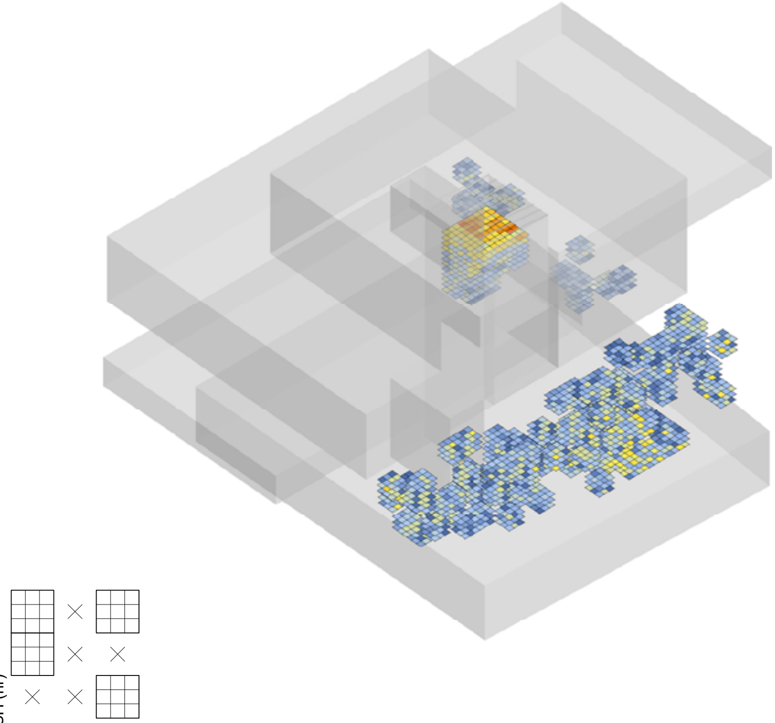
Coarse Grid 3m x 3m x 3m



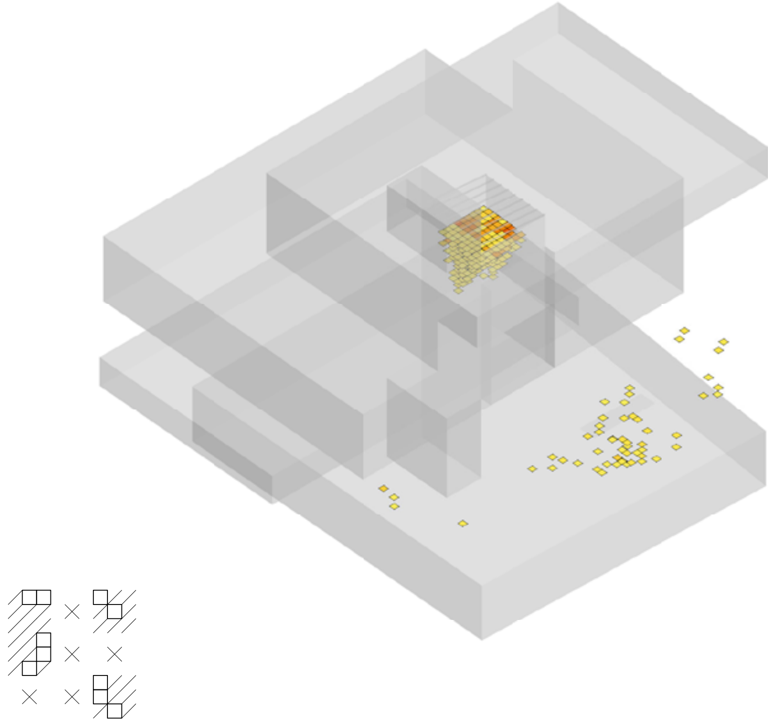
Top 20% of the Coarse Grid



Distribution of DSH Results



Top 20% of the Coarse Grid - Tessellated Grid 1m x 1m x 1m



Top 10% of the Tessellated Grid - Singularised Grid 1m x 1m x 1m

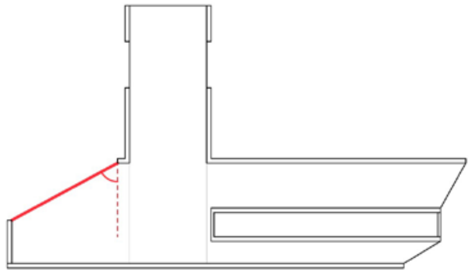
From the Coarse Grid to the Singularised Grid

Variation No.1: Facade Tilt +15 deg

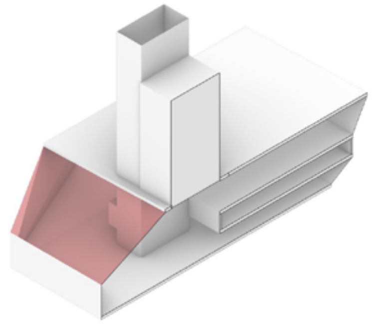
Simulation Period: *DirSunHrs@1 JUN 00:00 [HOY=3624] - 28 JUN 23:00 [HOY=4295]*

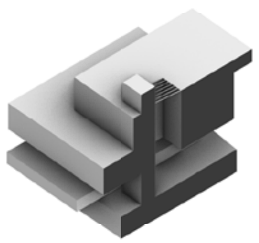
Variation Parameters:

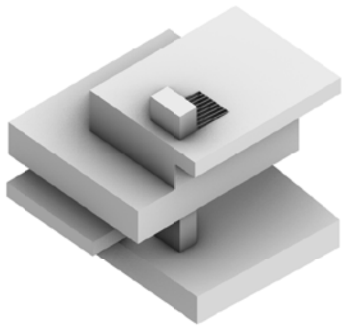
Facade Tilt:	*+15 deg*
Atrium X:	*12m*
Atrium Y:	*12m*
Mezzanine Offset:	*0m*

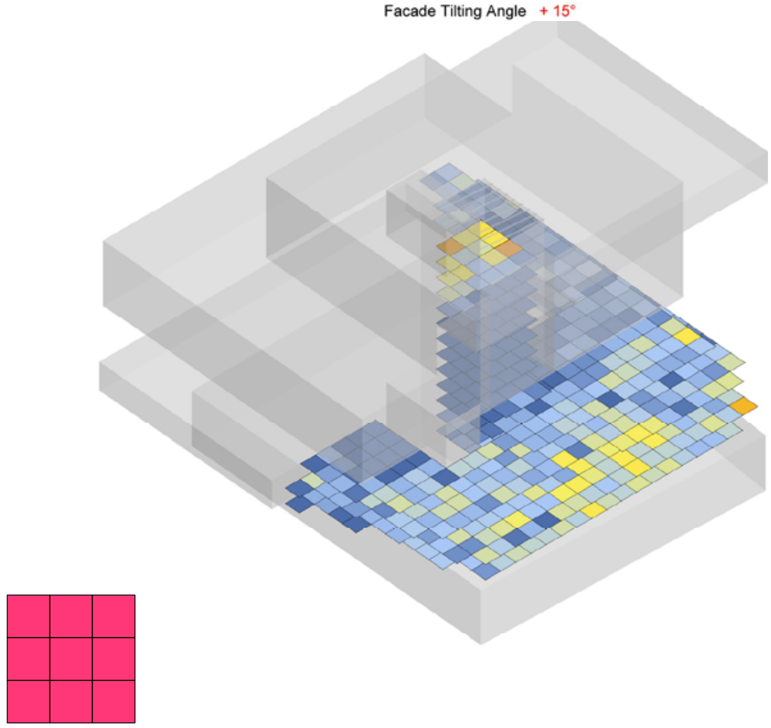


Facade Tilting Angle + 15°

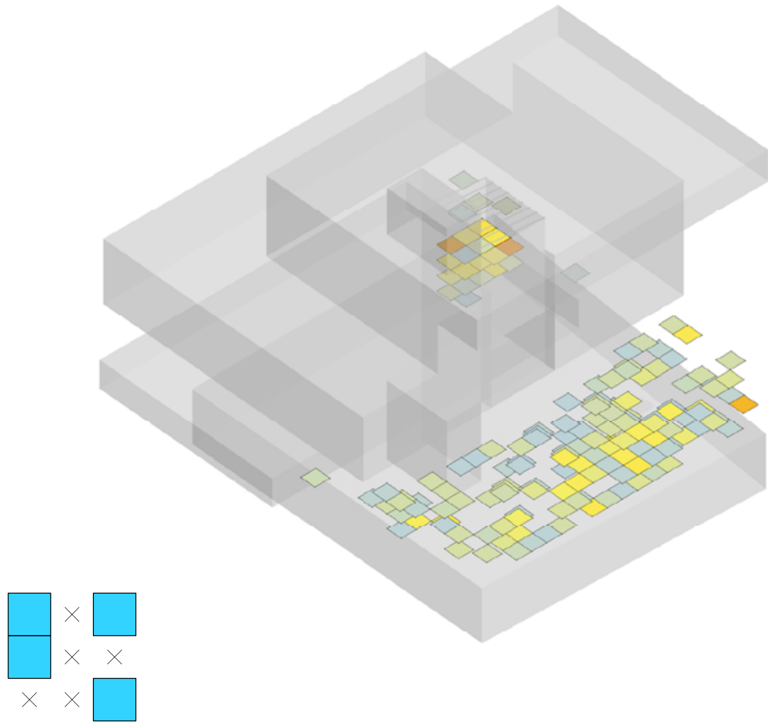




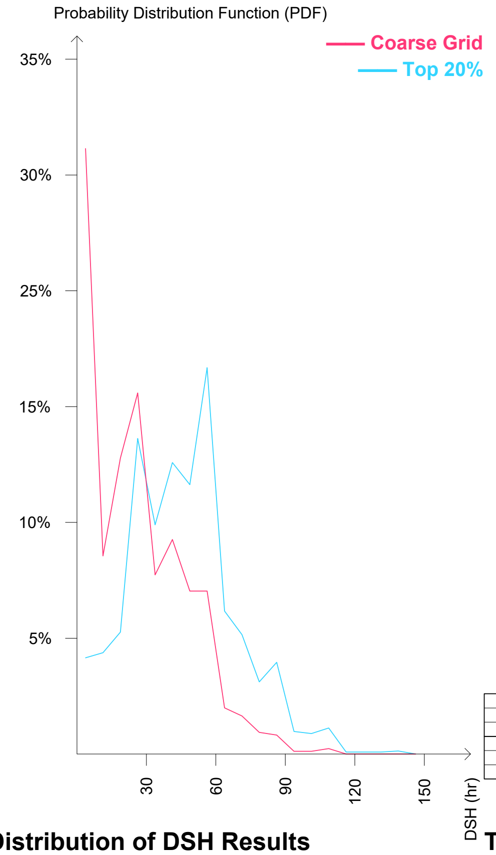




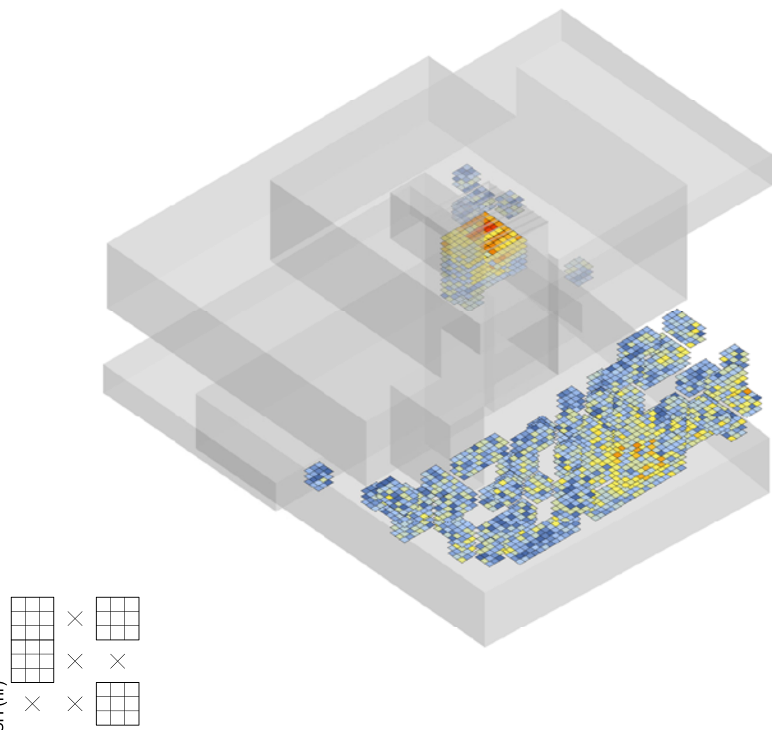
Coarse Grid 3m x 3m x 3m



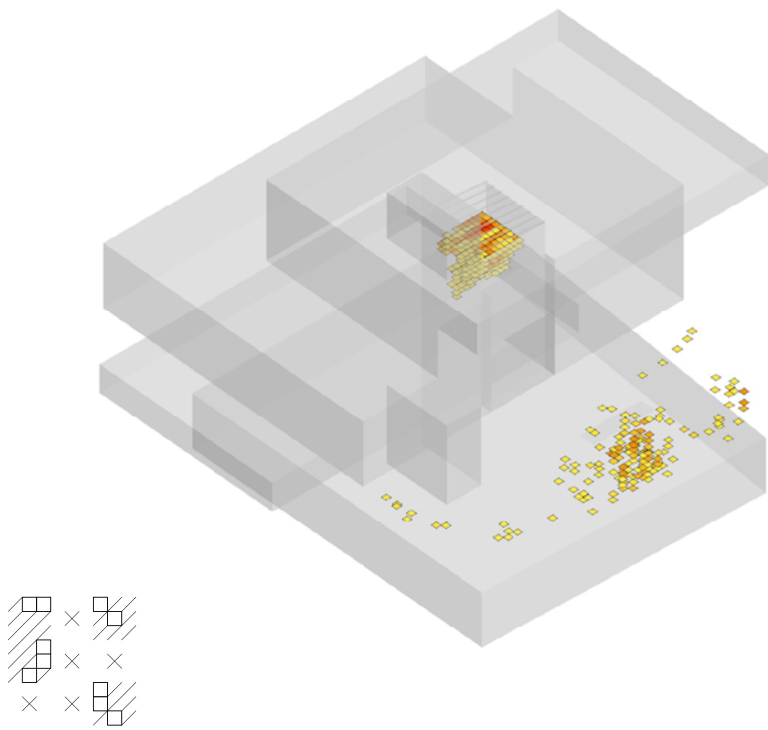
Top 20% of the Coarse Grid



Distribution of DSH Results



Top 20% of the Coarse Grid - Tessellated Grid 1m x 1m x 1m



Top 10% of the Tessellated Grid - Singularised Grid 1m x 1m x 1m

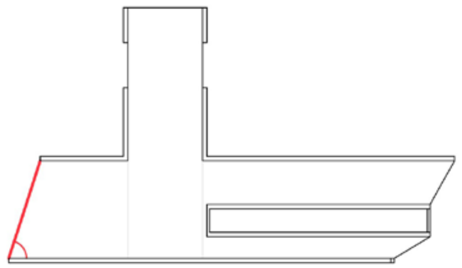
From the Coarse Grid to the Singularised Grid

Variation No.2: Facade Tile + 30 deg

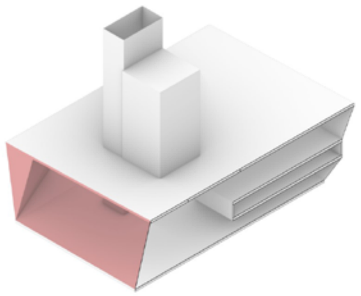
Simulation Period: *DirSunHrs@1 JUN 00:00 [HOY=3624] - 28 JUN 23:00 [HOY=4295]*

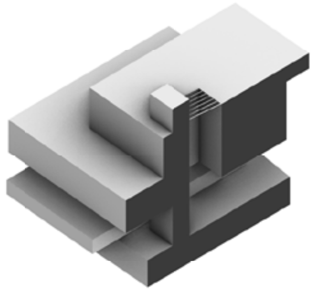
Variation Parameters:

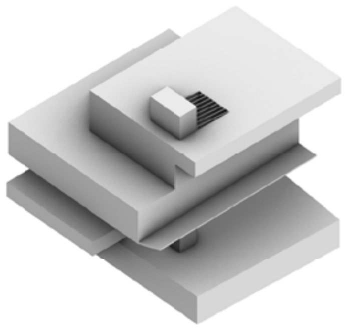
- **Facade Tilt:** *+30 deg*
- **Atrium X:** *12m*
- **Atrium Y:** *12m*
- **Mezzanine Offset:** *0m*

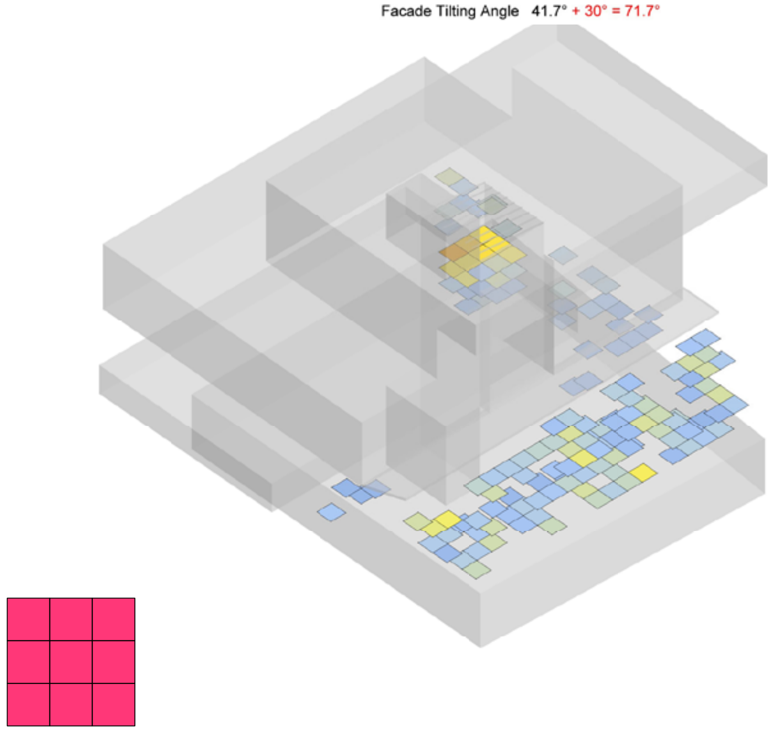


Facade Tilting Angle 41.7° + 30° = 71.7°

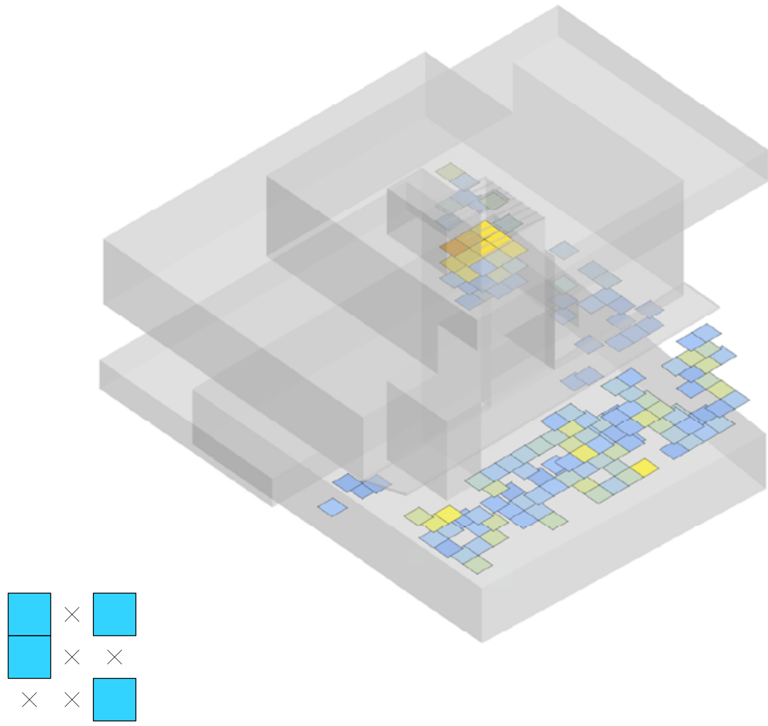




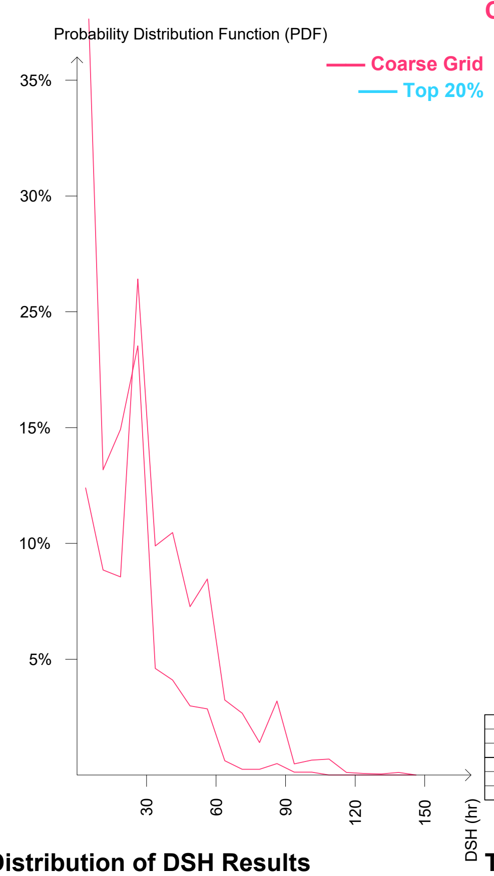




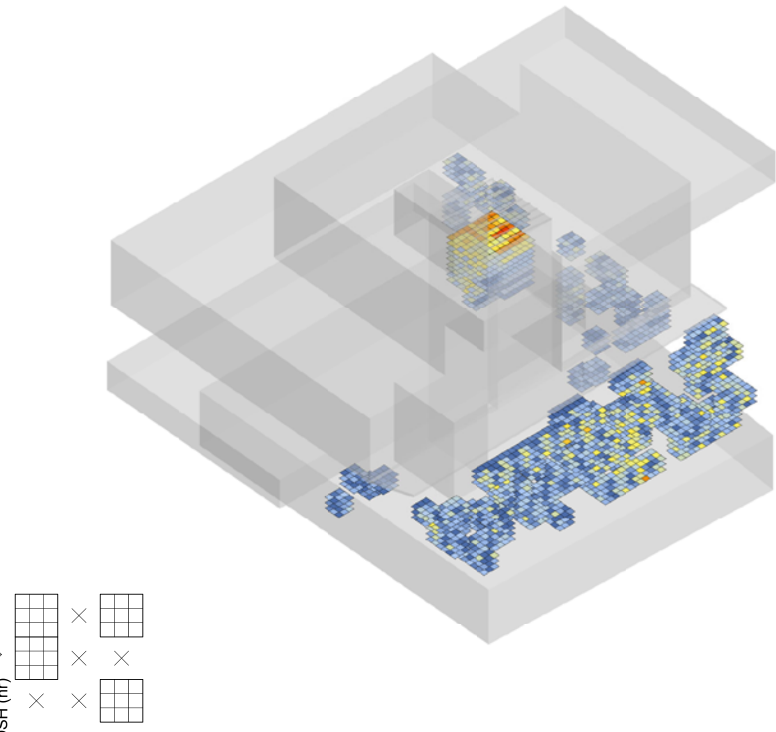
Coarse Grid 3m x 3m x 3m



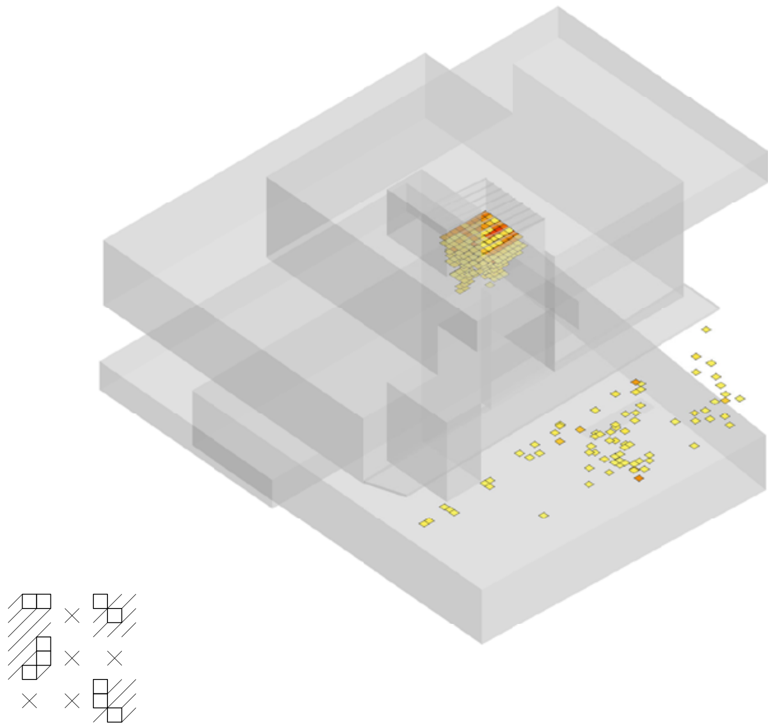
Top 20% of the Coarse Grid



Distribution of DSH Results



Top 20% of the Coarse Grid - Tessellated Grid 1m x 1m x 1m

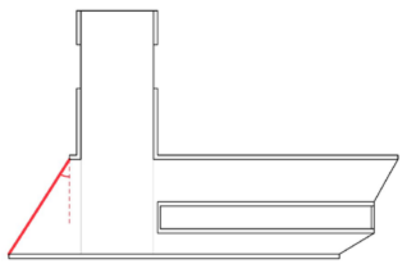


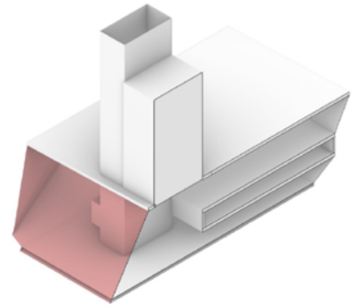
Top 10% of the Tessellated Grid - Singularised Grid 1m x 1m x 1m

From the Coarse Grid to the Singularised Grid

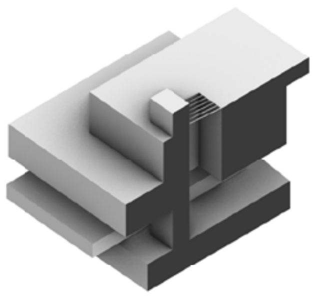
Variation No.3: Facade Tilt -15 deg

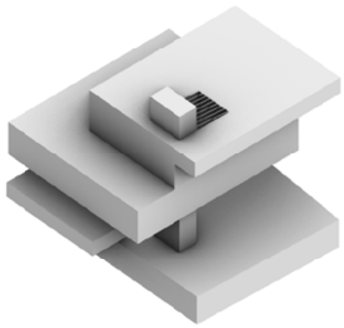
Simulation Period: *DirSunHrs@1 JUN 00:00 [HOY=3624] - 28 JUN 23:00 [HOY=4295]*
Variation Parameters:
- **Facade Tilt:** *-15 deg*
- **Atrium X:** *12m*
- **Atrium Y:** *12m*
- **Mezzanine Offset:** *0m*

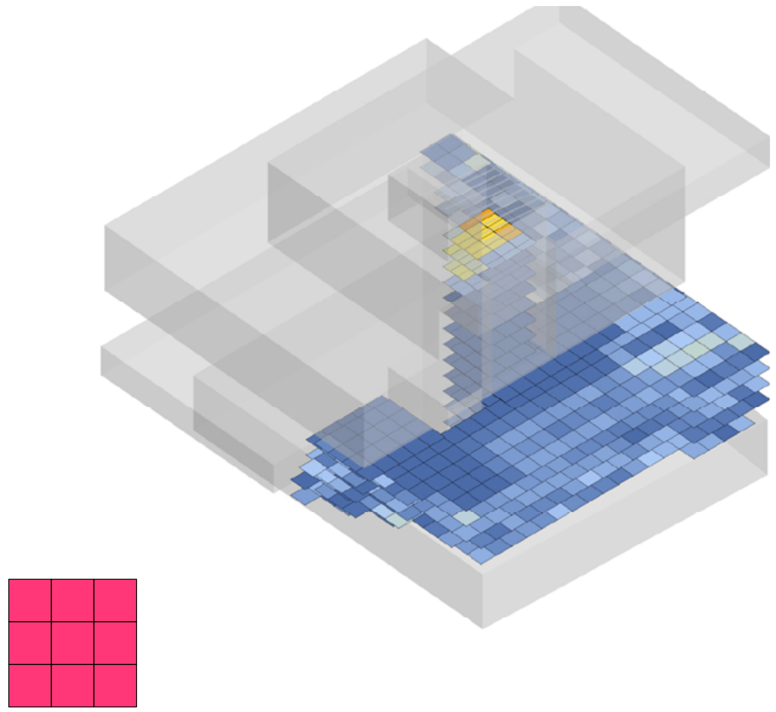




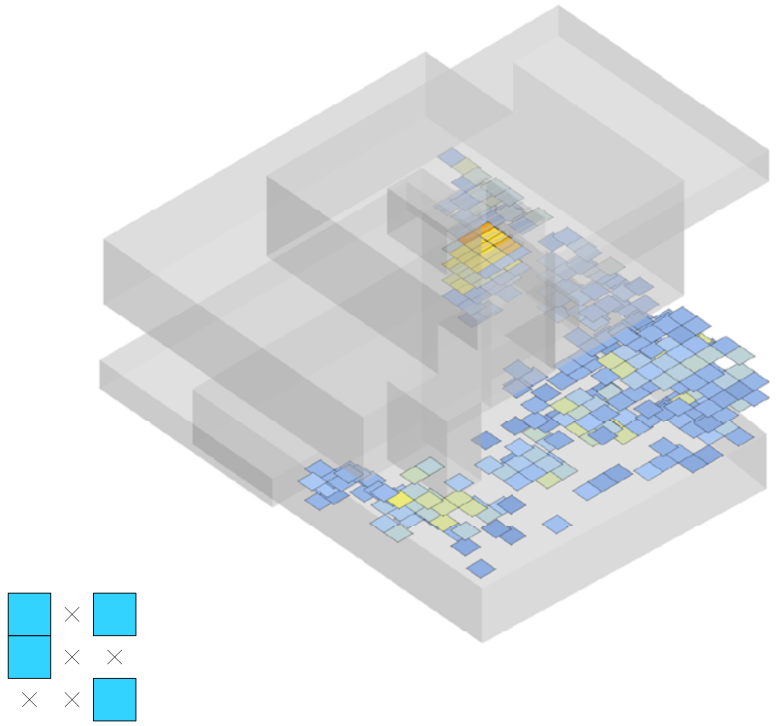
Facade Tilting Angle - 15°



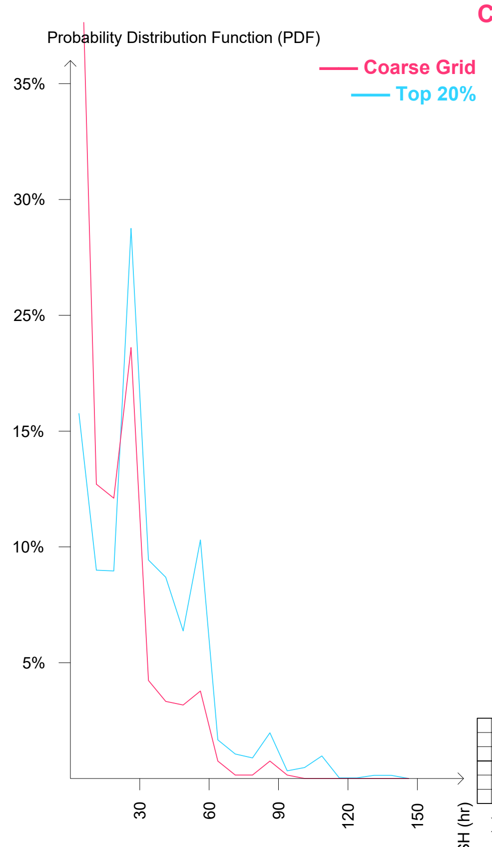




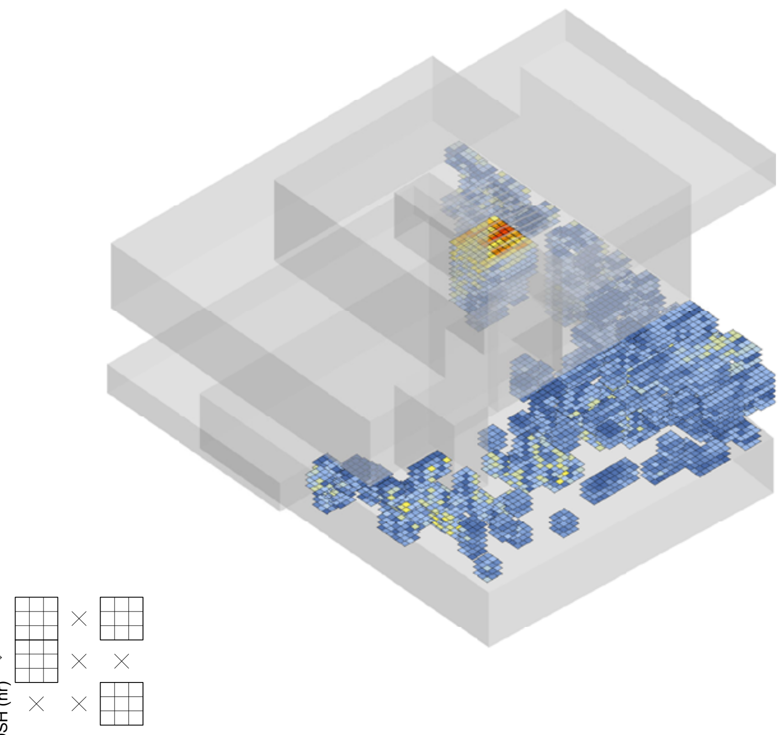
Coarse Grid 3m x 3m x 3m



Top 20% of the Coarse Grid



Distribution of DSH Results



Top 20% of the Coarse Grid - Tessellated Grid 1m x 1m x 1m

Top 10% of the Tessellated Grid - Singularised Grid 1m x 1m x 1m

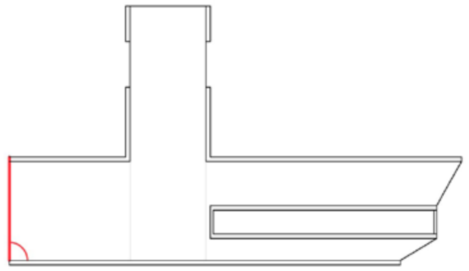
From the Coarse Grid to the Singularised Grid

Variation No.4: Vertical Facade

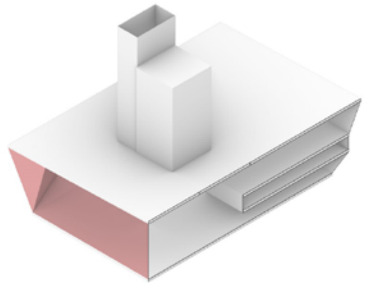
Simulation Period: *DirSunHrs@1 JUN 00:00 [HOY=3624] - 28 JUN 23:00 [HOY=4295]*

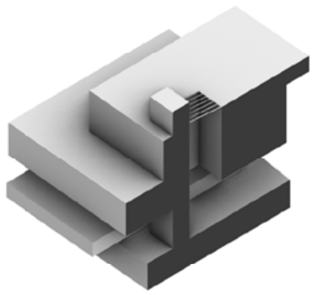
Variation Parameters:

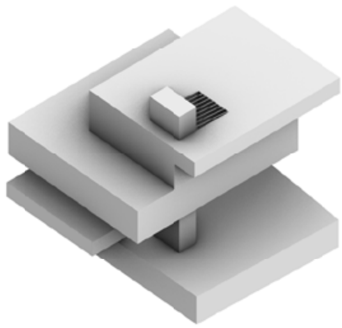
- **Facade Tilt:** *Force Vertical*
- **Atrium X:** *12m*
- **Atrium Y:** *12m*
- **Mezzanine Offset:** *0m*

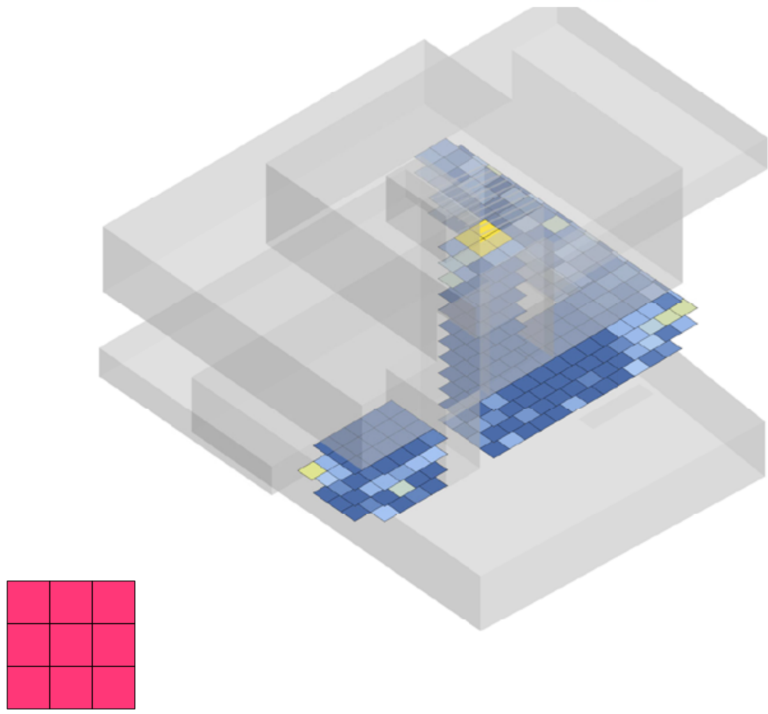


Facade Tilting Angle 41.7° + 48.3° = 90°

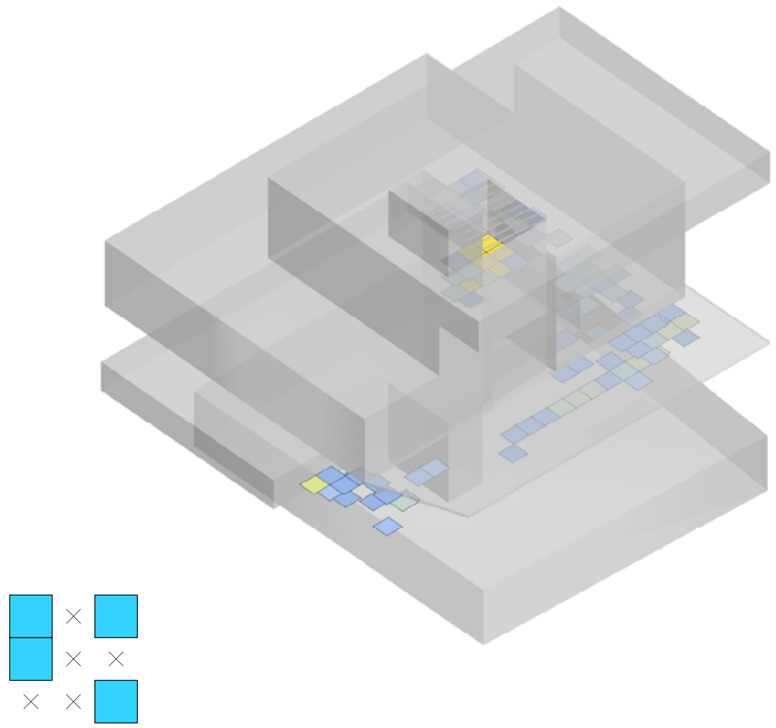




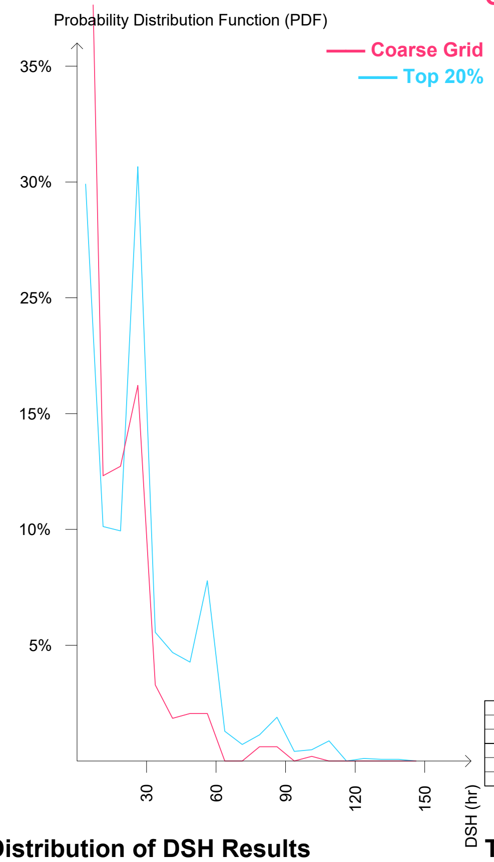




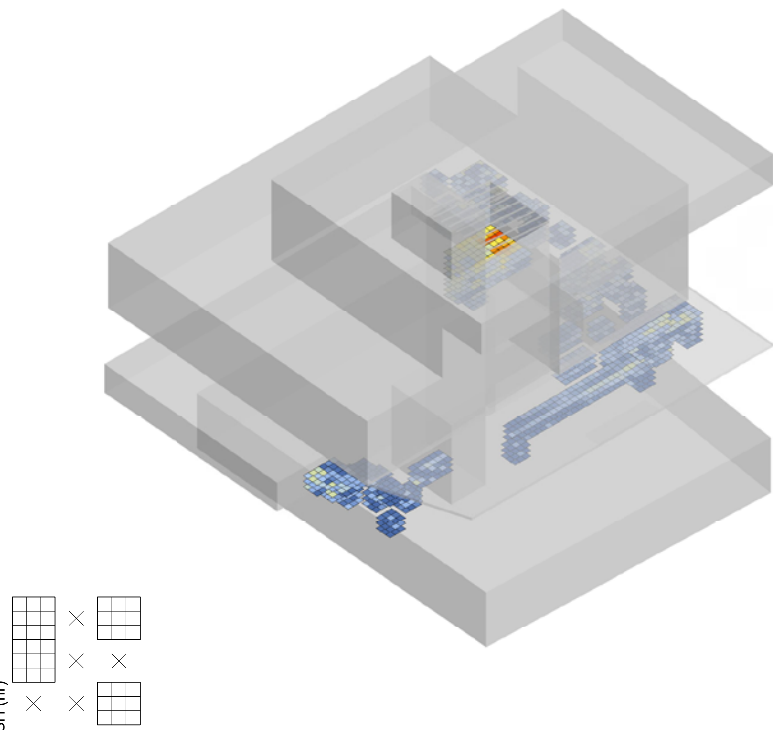
Coarse Grid 3m x 3m x 3m



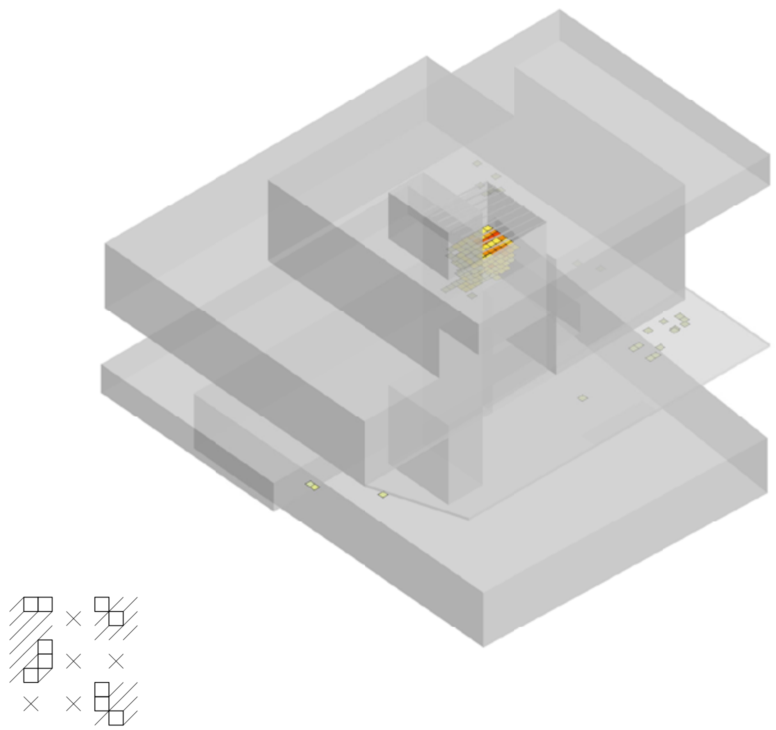
Top 20% of the Coarse Grid



Distribution of DSH Results



Top 20% of the Coarse Grid - Tessellated Grid 1m x 1m x 1m



Top 10% of the Tessellated Grid - Singularised Grid 1m x 1m x 1m

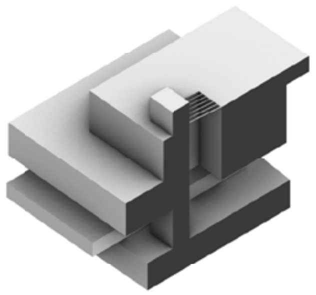
Variation 02 -- Atrium: Vertical and Horizontal Dimensions

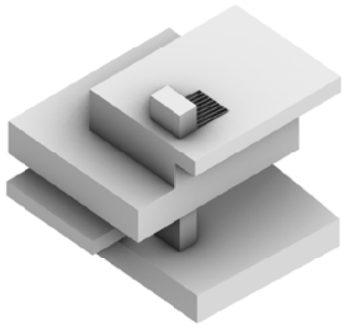
From the Coarse Grid to the Singularised Grid

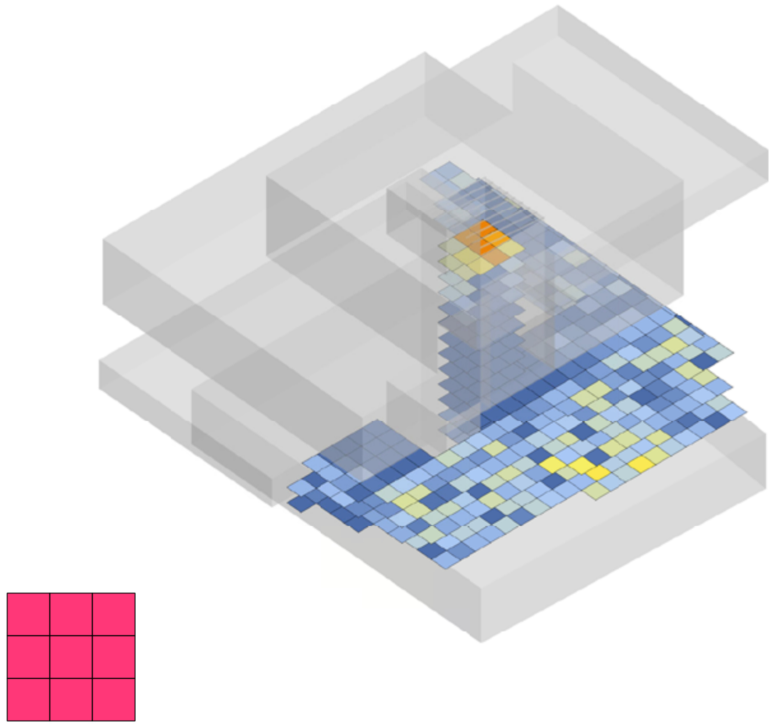
Variation No.0: As-Found

Simulation Period: *DirSunHrs@1 JUN 00:00 [HOY=3624] - 28 JUN 23:00 [HOY=4295]*

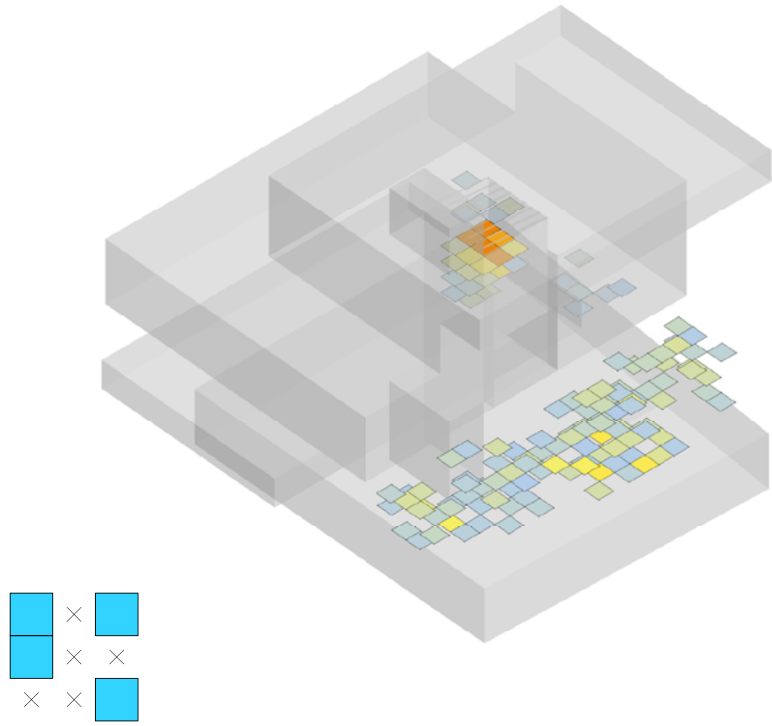
Variation Parameters:
- **Facade Tilt:** *+0 deg*
- **Atrium X:** *12m*
- **Atrium Y:** *12m*
- **Mezzanine Offset:** *0m*



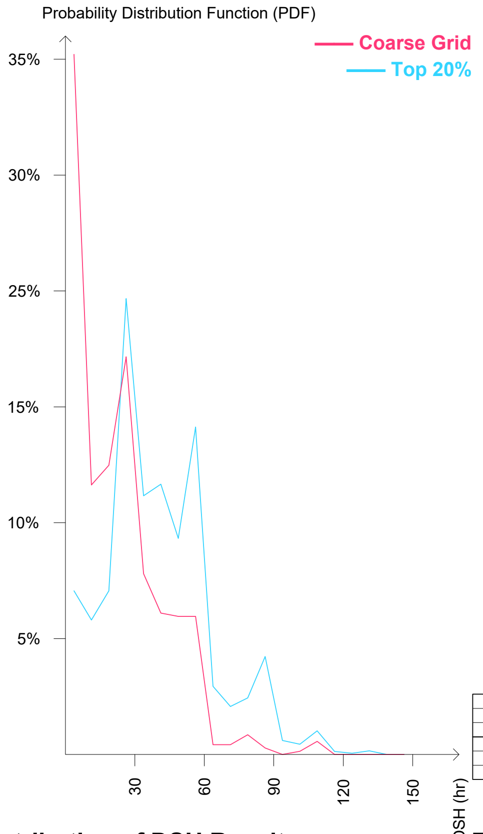




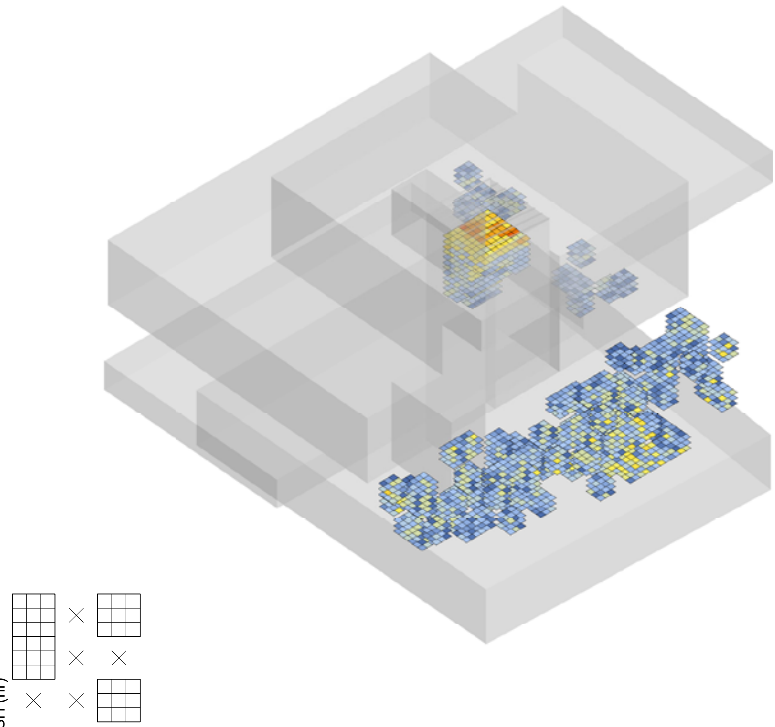
Coarse Grid 3m x 3m x 3m



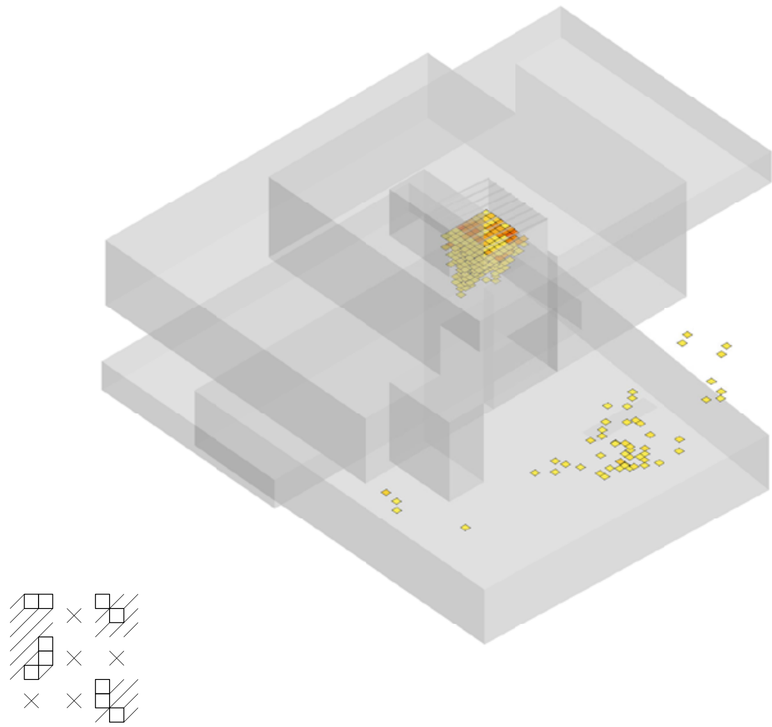
Top 20% of the Coarse Grid



Distribution of DSH Results



Top 20% of the Coarse Grid - Tessellated Grid 1m x 1m x 1m

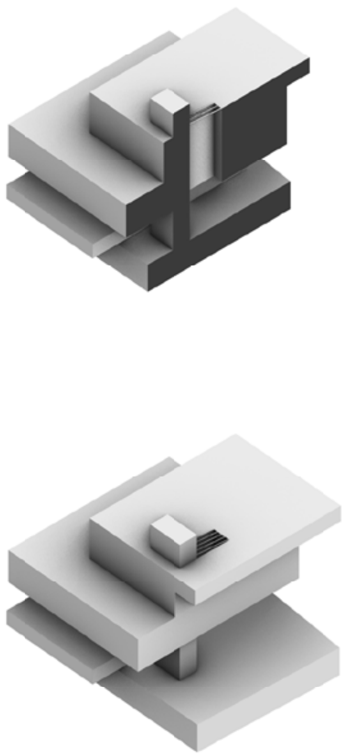


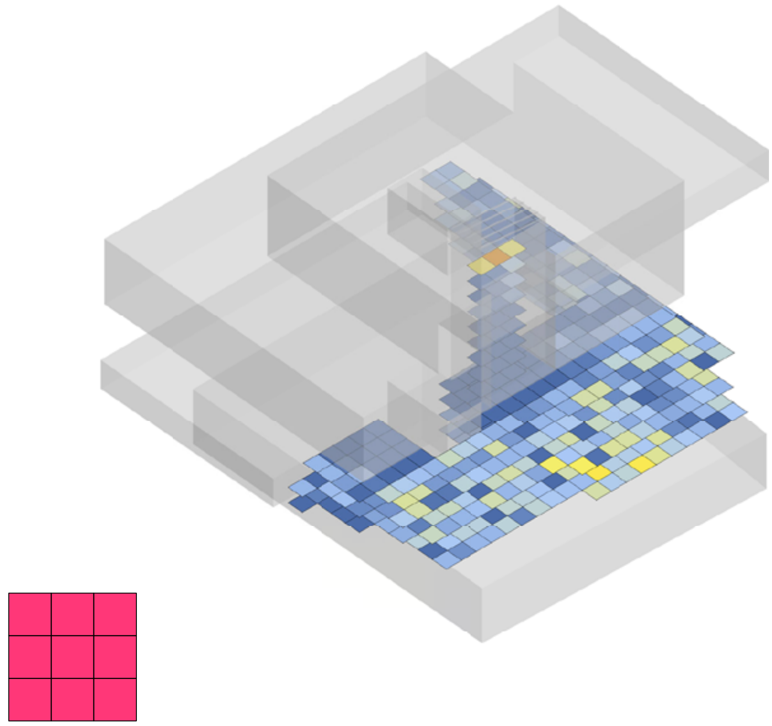
Top 10% of the Tessellated Grid - Singularised Grid 1m x 1m x 1m

From the Coarse Grid to the Singularised Grid

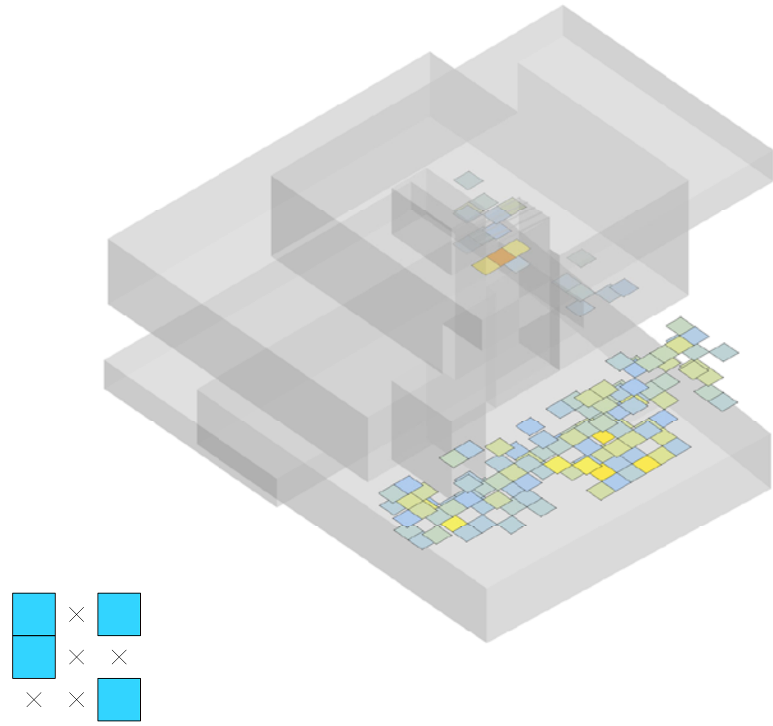
Variation No.5: 6x12 Atrium

Simulation Period: *DirSunHrs@1 JUN 00:00 [HOY=3624] - 28 JUN 23:00 [HOY=4295]*
Variation Parameters:
- **Facade Tilt:** *+0 deg*
- **Atrium X:** *6m*
- **Atrium Y:** *12m*
- **Mezzanine Offset:** *0m*

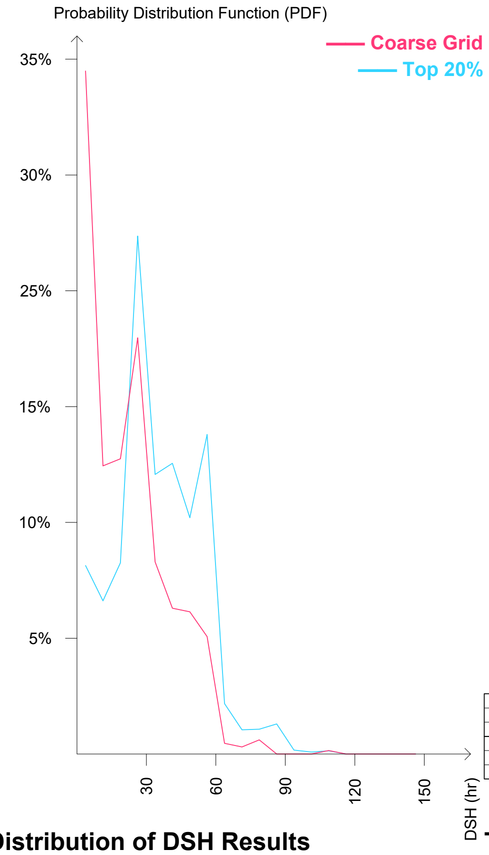




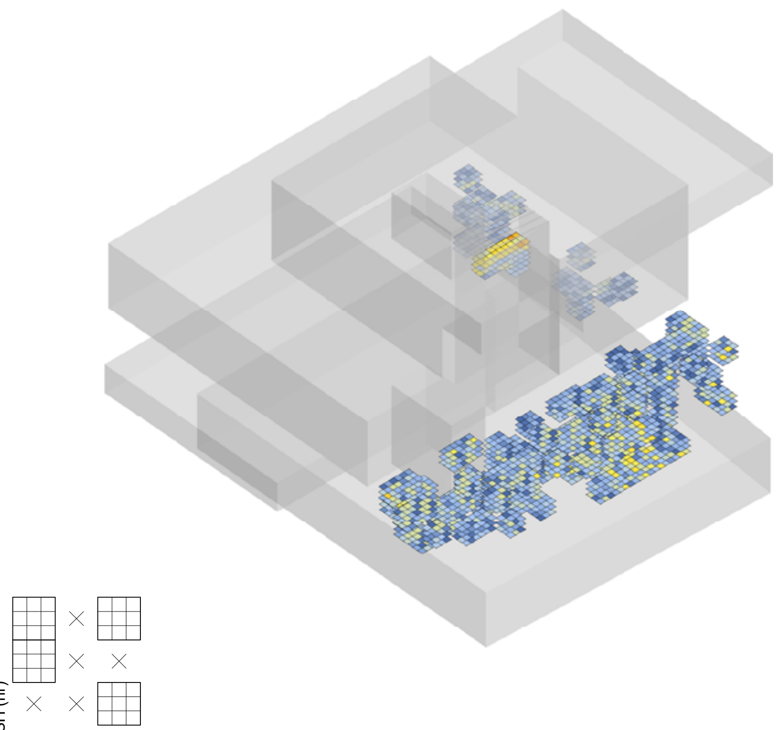
Coarse Grid 3m x 3m x 3m



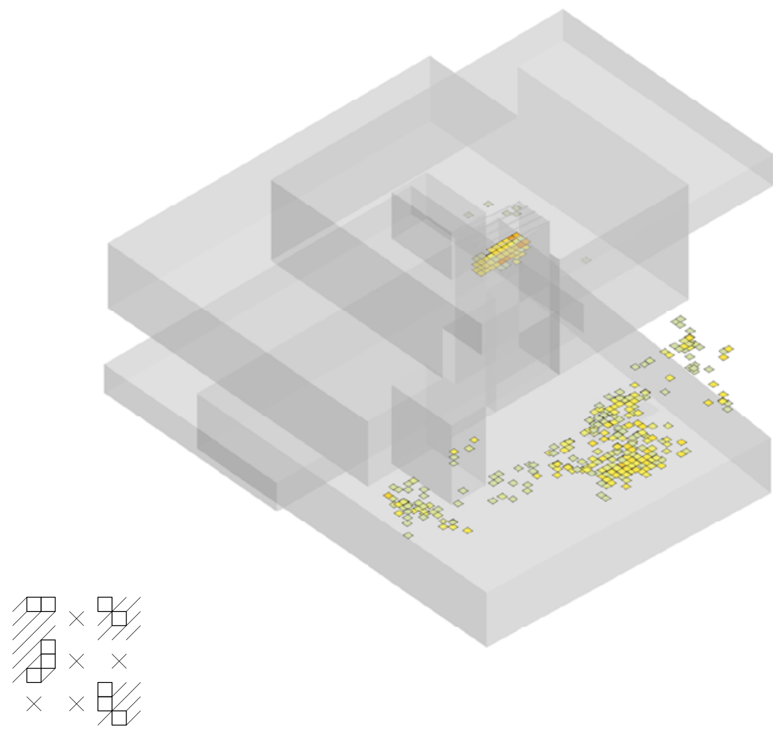
Top 20% of the Coarse Grid



Distribution of DSH Results



Top 20% of the Coarse Grid - Tessellated Grid 1m x 1m x 1m

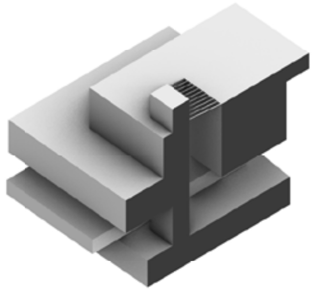


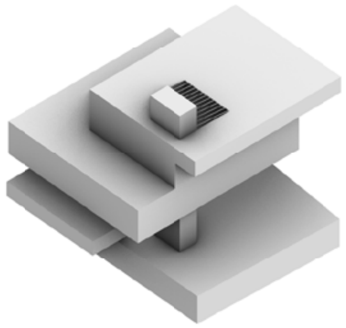
Top 10% of the Tessellated Grid - Singularised Grid 1m x 1m x 1m

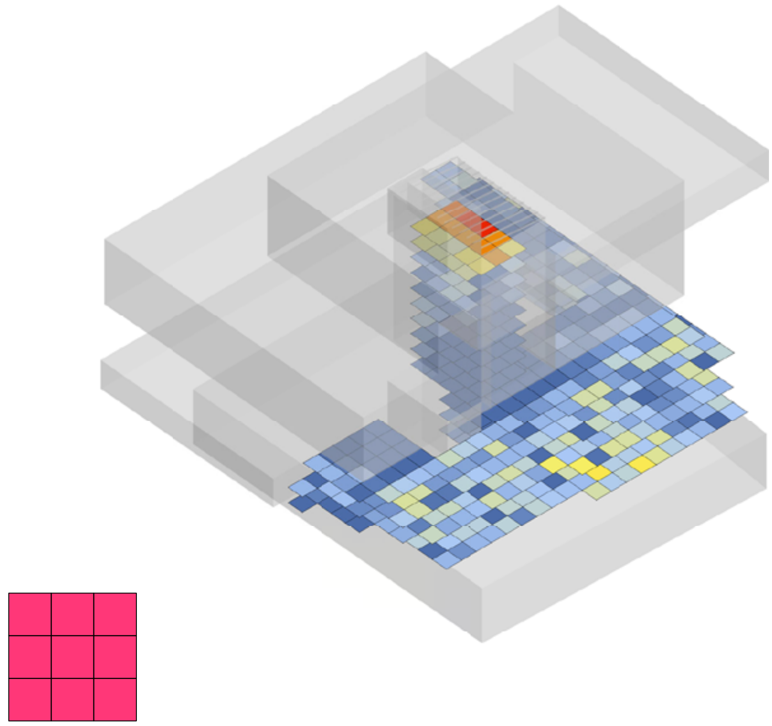
From the Coarse Grid to the Singularised Grid

Variation No.6: 18x12 Atrium

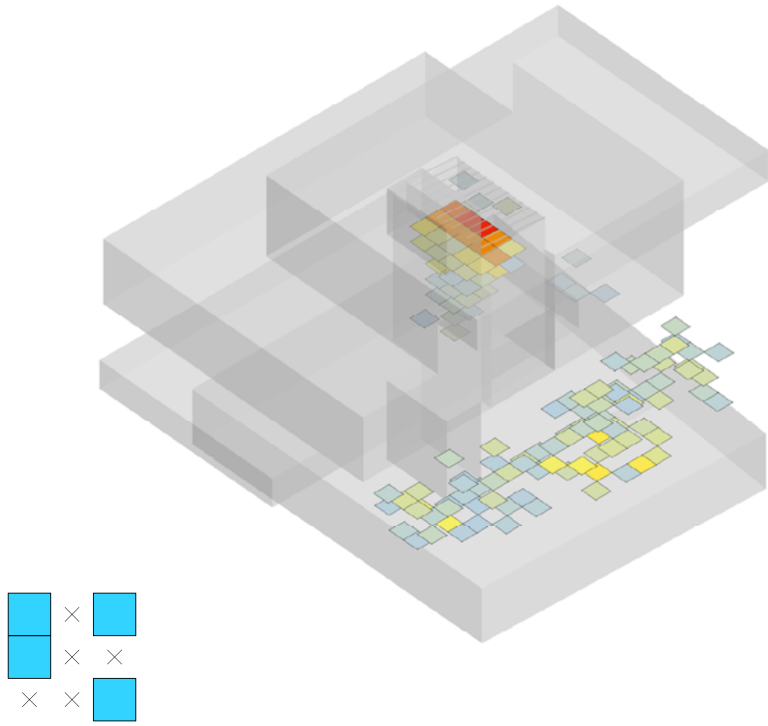
Simulation Period: *DirSunHrs@1 JUN 00:00 [HOY=3624] - 28 JUN 23:00 [HOY=4295]*
Variation Parameters:
Facade Tilt: *+0 deg*
Atrium X: *18m*
Atrium Y: *12m*
Mezzanine Offset: *0m*



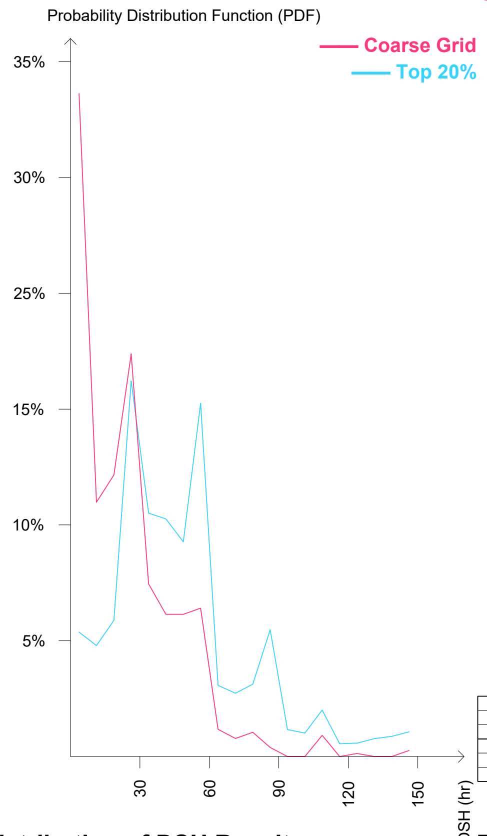




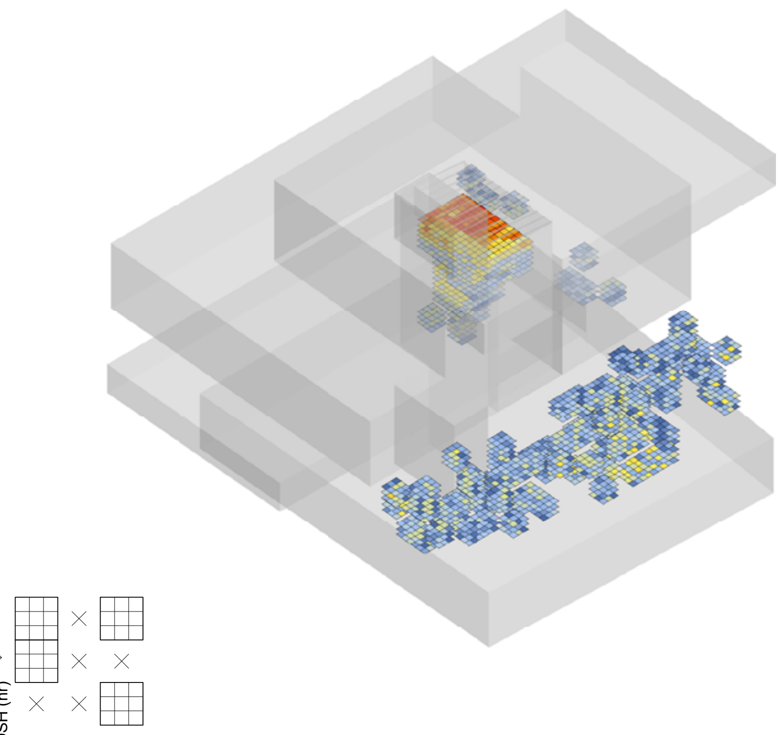
Coarse Grid 3m x 3m x 3m



Top 20% of the Coarse Grid



Distribution of DSH Results



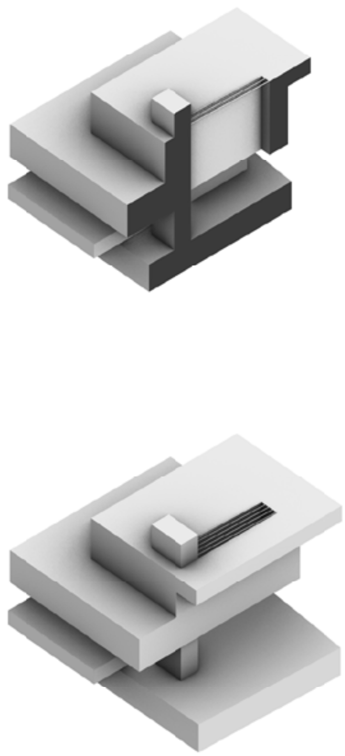
Top 20% of the Coarse Grid - Tessellated Grid 1m x 1m x 1m

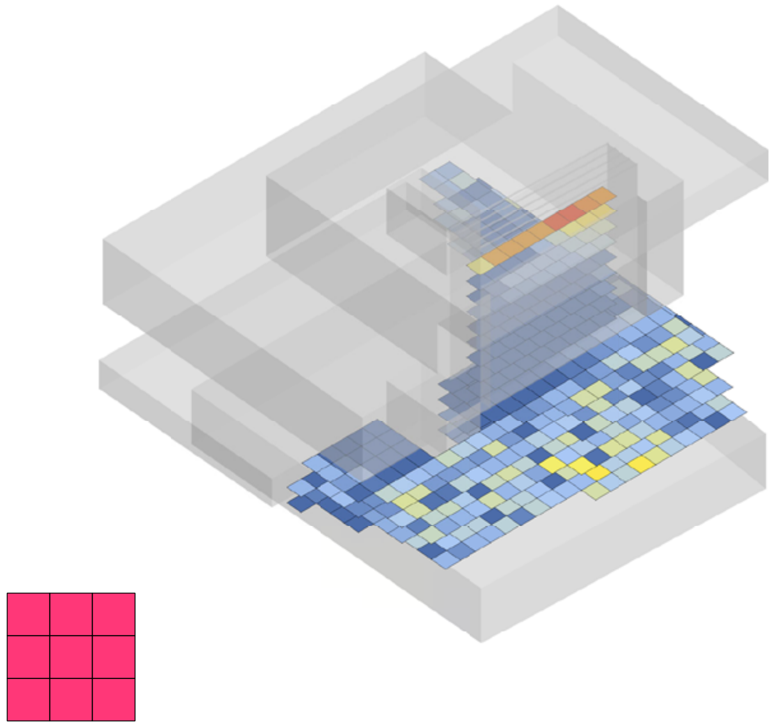
Top 10% of the Tessellated Grid - Singularised Grid 1m x 1m x 1m

From the Coarse Grid to the Singularised Grid

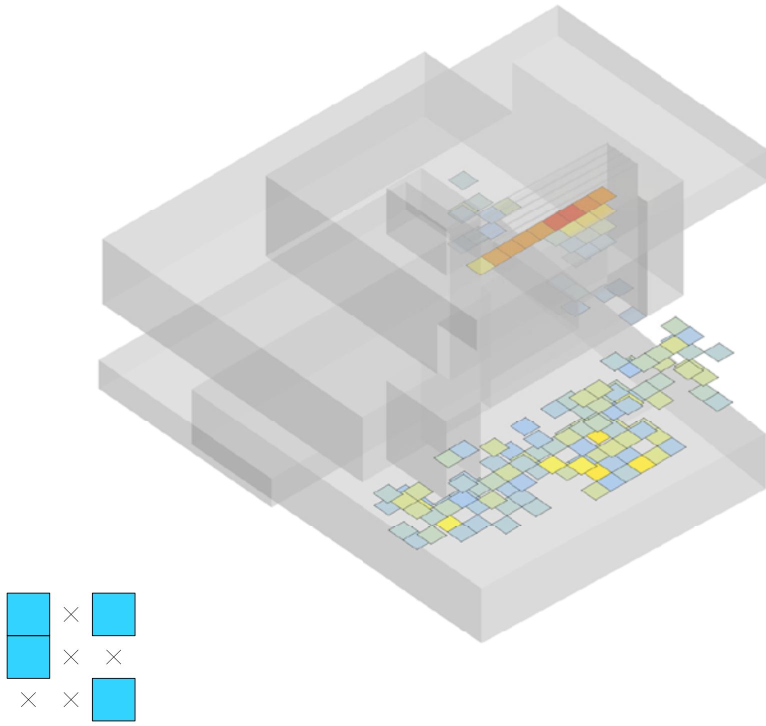
Variation No.7: 6x30 Atrium

Simulation Period: *DirSunHrs@1 JUN 00:00 [HOY=3624] - 28 JUN 23:00 [HOY=4295]*
Variation Parameters:
- **Facade Tilt:** *+0 deg*
- **Atrium X:** *6m*
- **Atrium Y:** *30m*
- **Mezzanine Offset:** *0m*

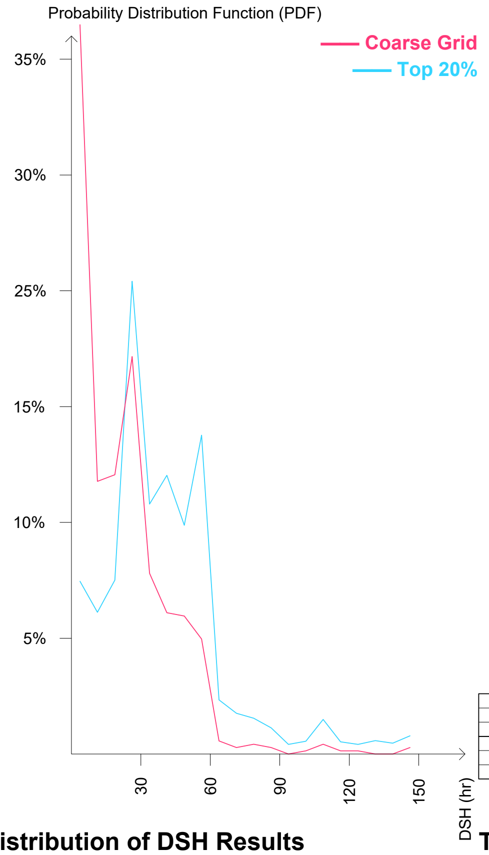




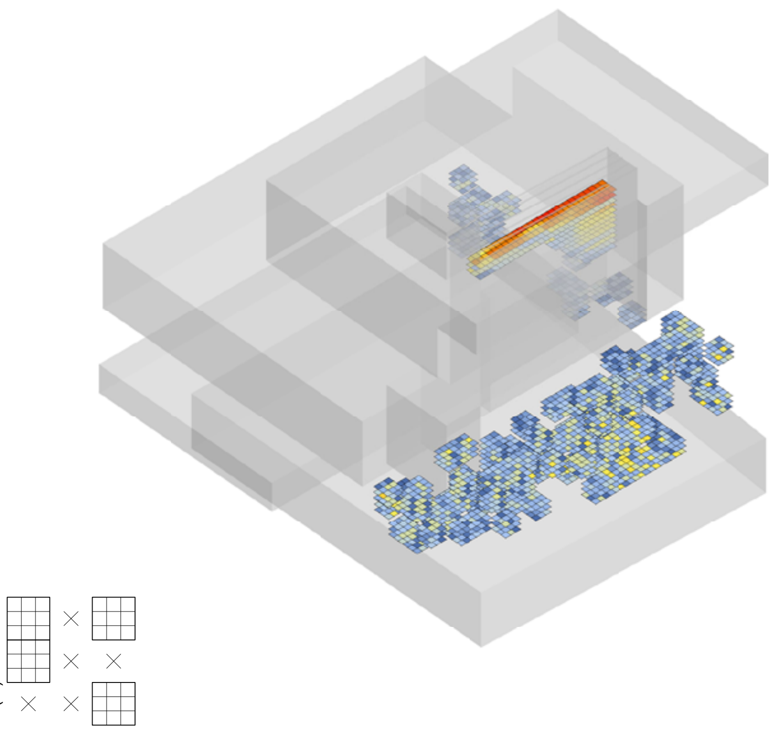
Coarse Grid 3m x 3m x 3m



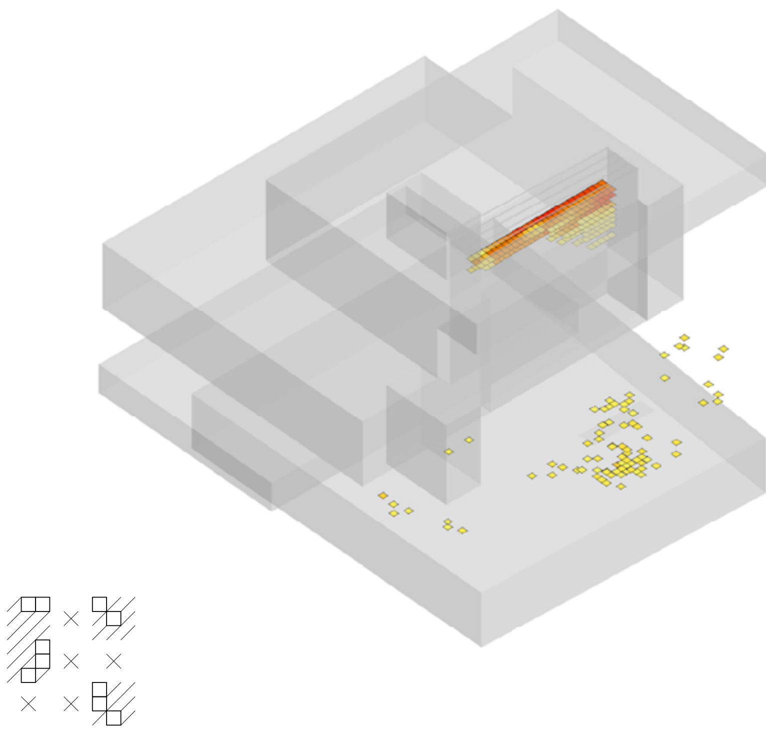
Top 20% of the Coarse Grid



Distribution of DSH Results



Top 20% of the Coarse Grid - Tessellated Grid 1m x 1m x 1m

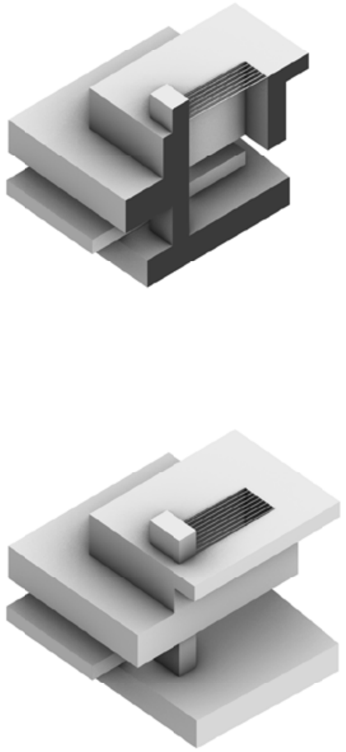


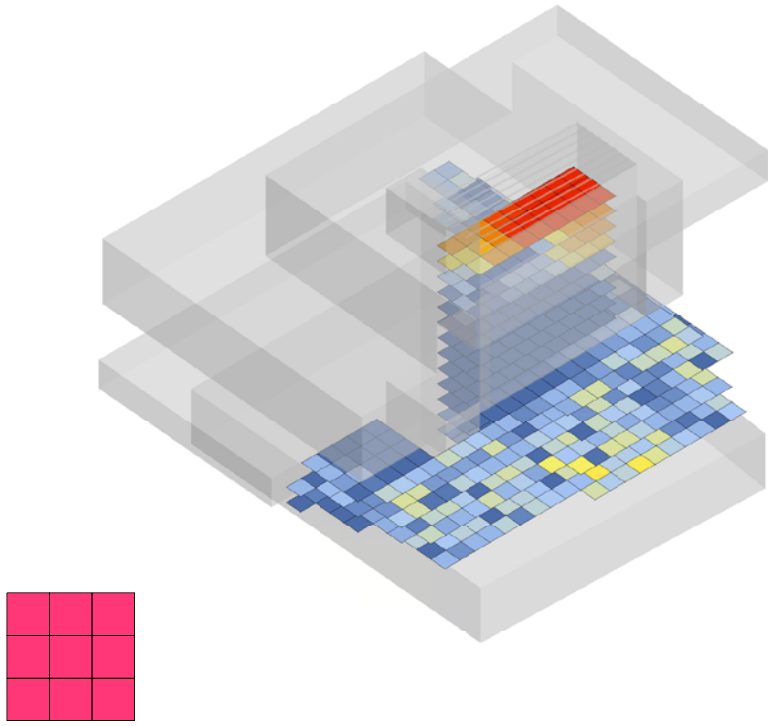
Top 10% of the Tessellated Grid - Singularised Grid 1m x 1m x 1m

From the Coarse Grid to the Singularised Grid

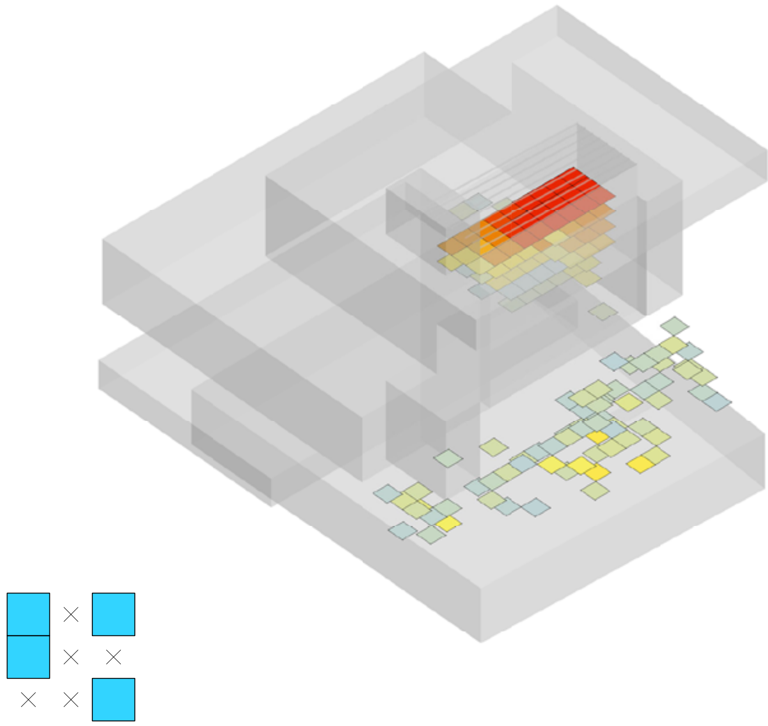
Variation No.8: 12x30 Atrium

Simulation Period: *DirSunHrs@1 JUN 00:00 [HOY=3624] - 28 JUN 23:00 [HOY=4295]*
Variation Parameters:
Facade Tilt: *+0 deg*
Atrium X: *12m*
Atrium Y: *30m*
Mezzanine Offset: *0m*

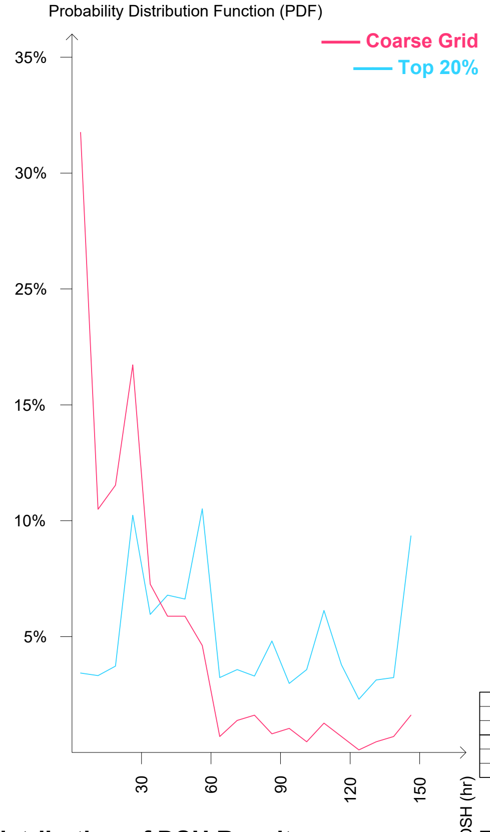




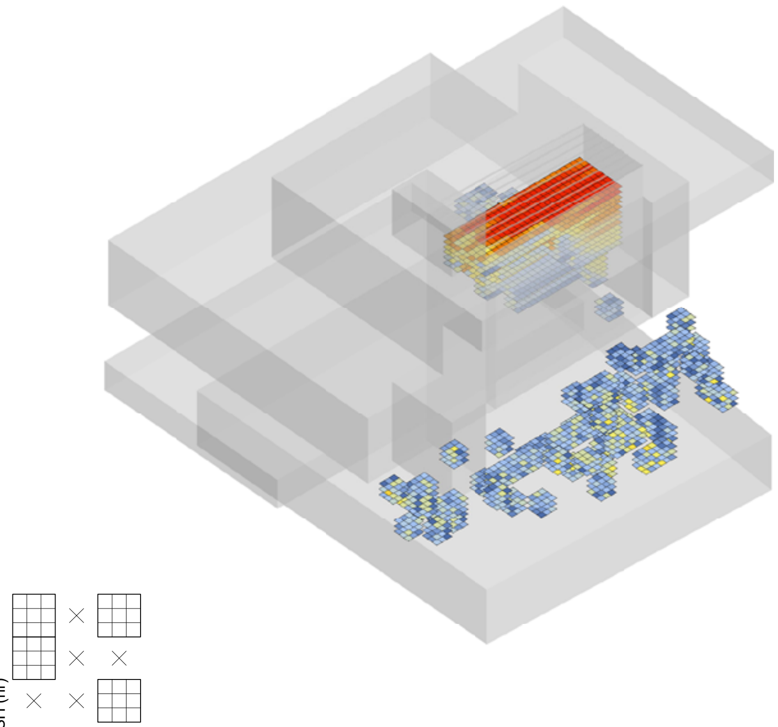
Coarse Grid 3m x 3m x 3m



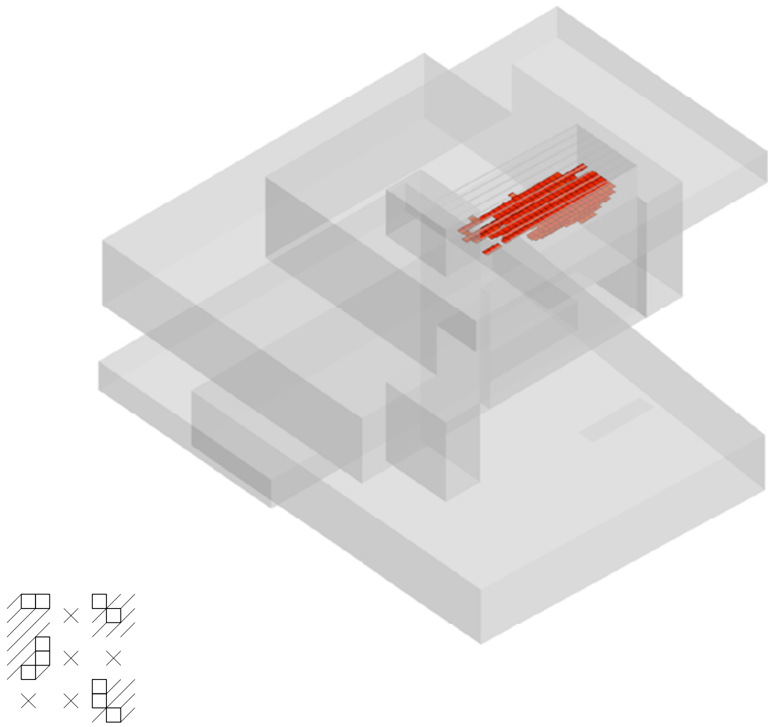
Top 20% of the Coarse Grid



Distribution of DSH Results



Top 20% of the Coarse Grid - Tessellated Grid 1m x 1m x 1m

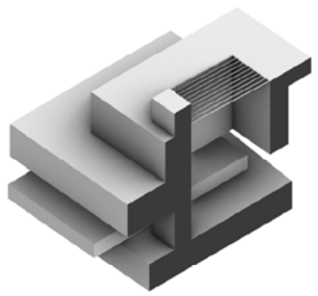


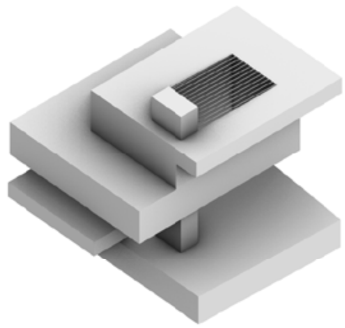
Top 10% of the Tessellated Grid - Singularised Grid 1m x 1m x 1m

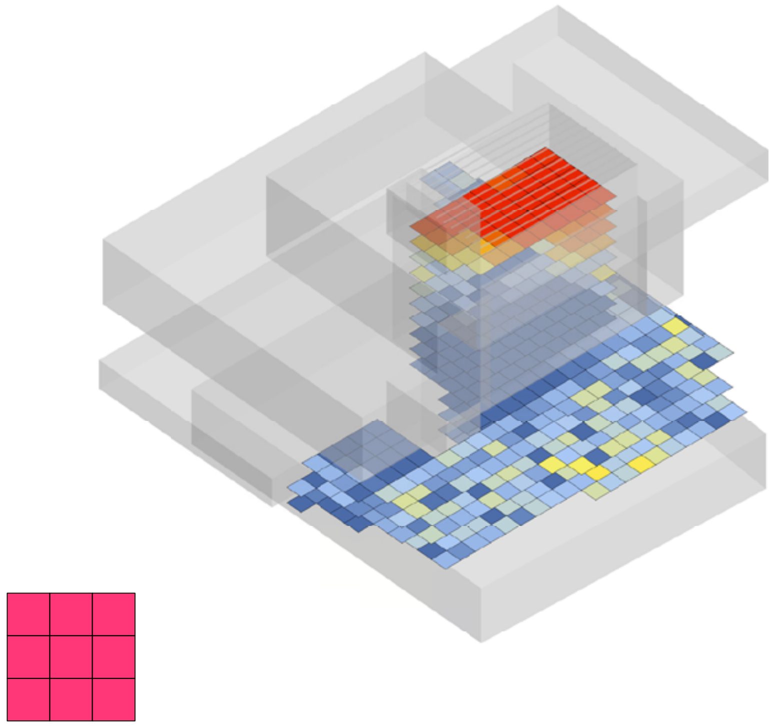
From the Coarse Grid to the Singularised Grid

Variation No.9: 18x30 Atrium

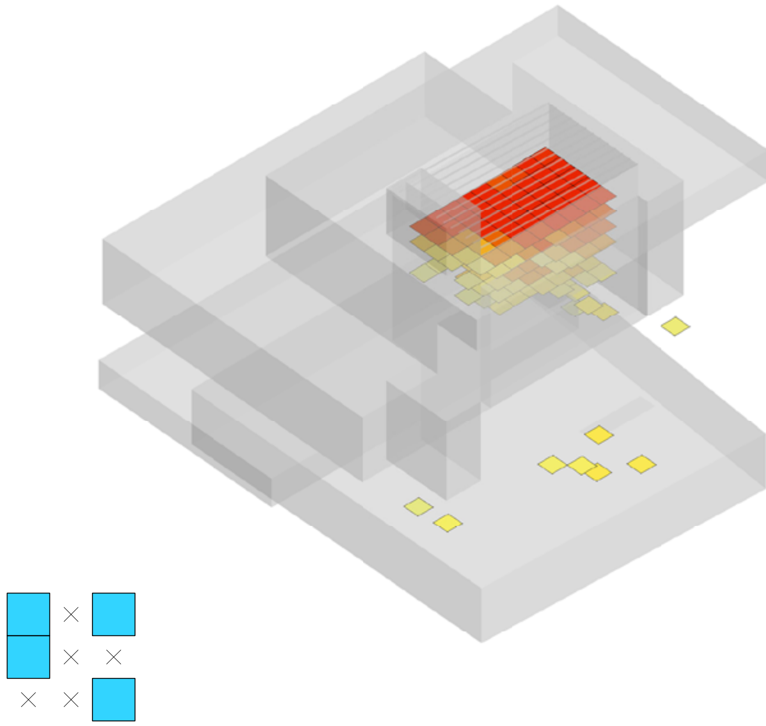
Simulation Period: *DirSunHrs@1 JUN 00:00 [HOY=3624] - 28 JUN 23:00 [HOY=4295]*
Variation Parameters:
- **Facade Tilt:** *+0 deg*
- **Atrium X:** *18m*
- **Atrium Y:** *30m*
- **Mezzanine Offset:** *0m*



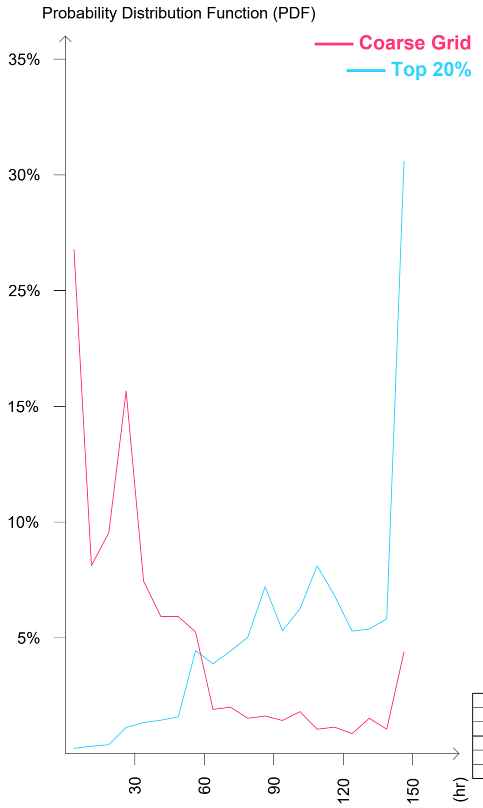




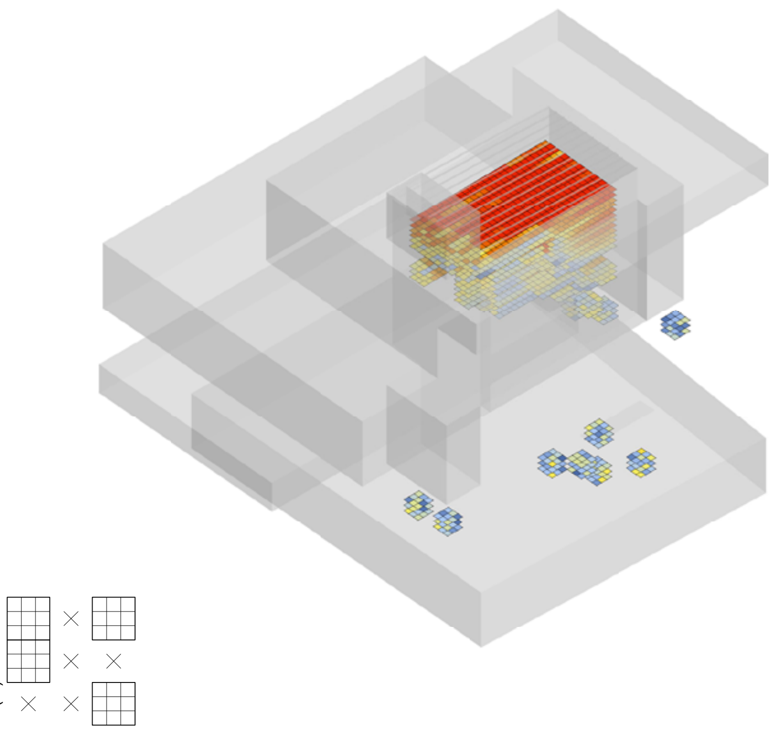
Coarse Grid 3m x 3m x 3m



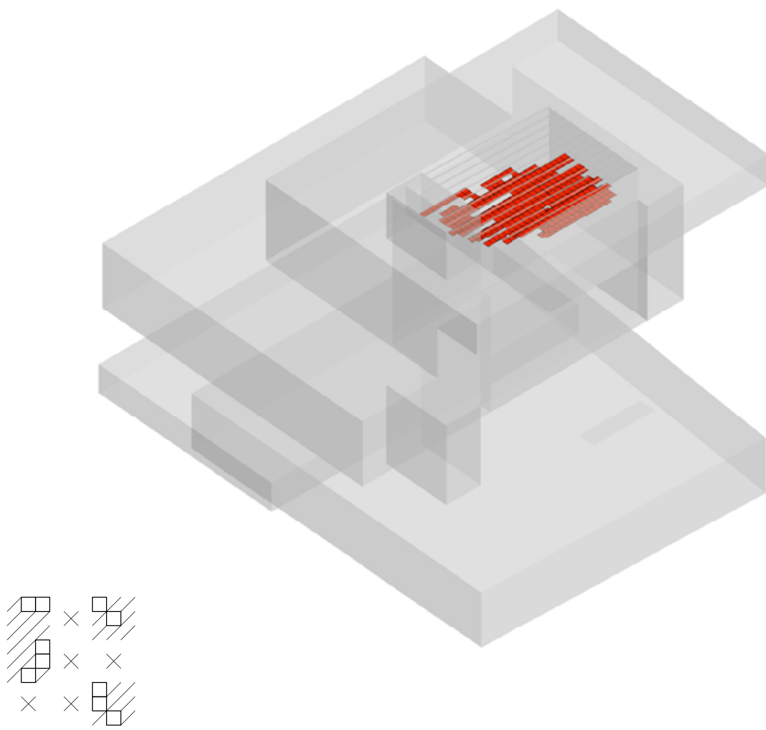
Top 20% of the Coarse Grid



Distribution of DSH Results



Top 20% of the Coarse Grid - Tessellated Grid 1m x 1m x 1m

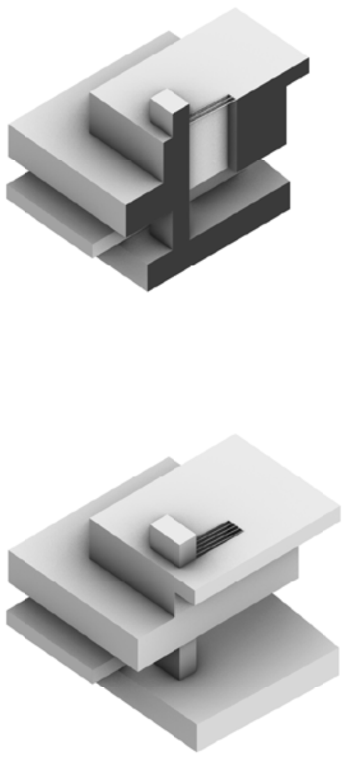


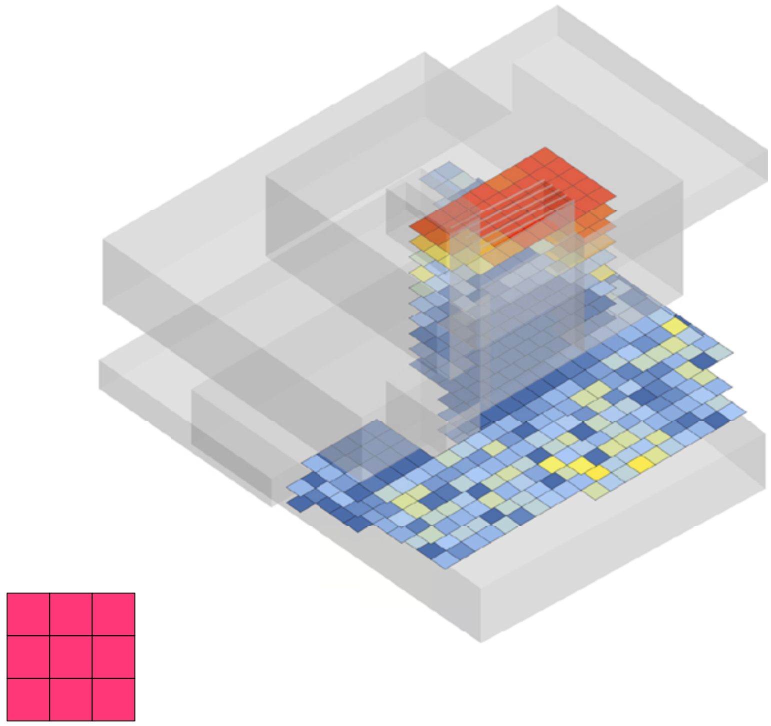
Top 10% of the Tessellated Grid - Singularised Grid 1m x 1m x 1m

From the Coarse Grid to the Singularised Grid

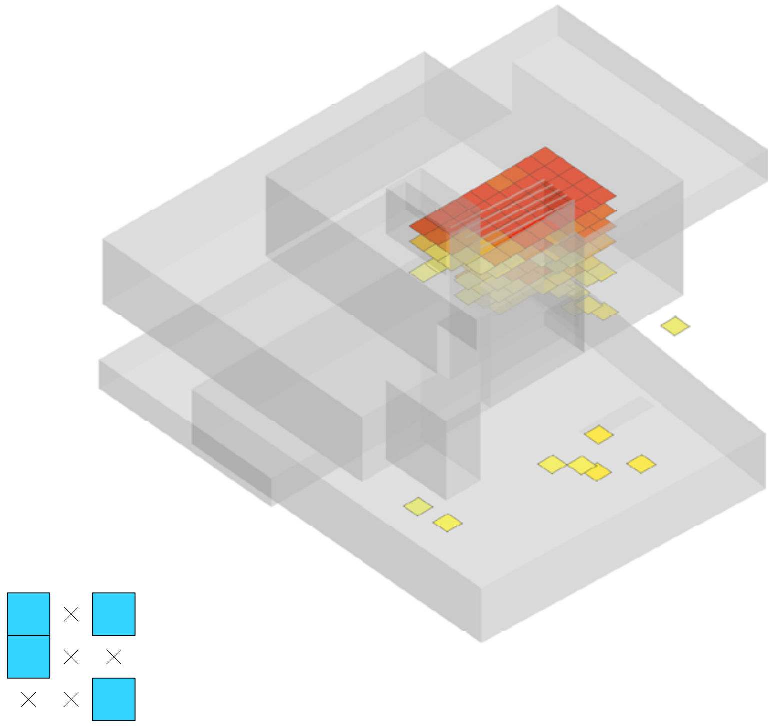
Variation No.10: 6x18 Atrium

Simulation Period: *DirSunHrs@1 JUN 00:00 [HOY=3624] - 28 JUN 23:00 [HOY=4295]*
Variation Parameters:
Facade Tilt: *+0 deg*
Atrium X: *6m*
Atrium Y: *18m*
Mezzanine Offset: *0m*

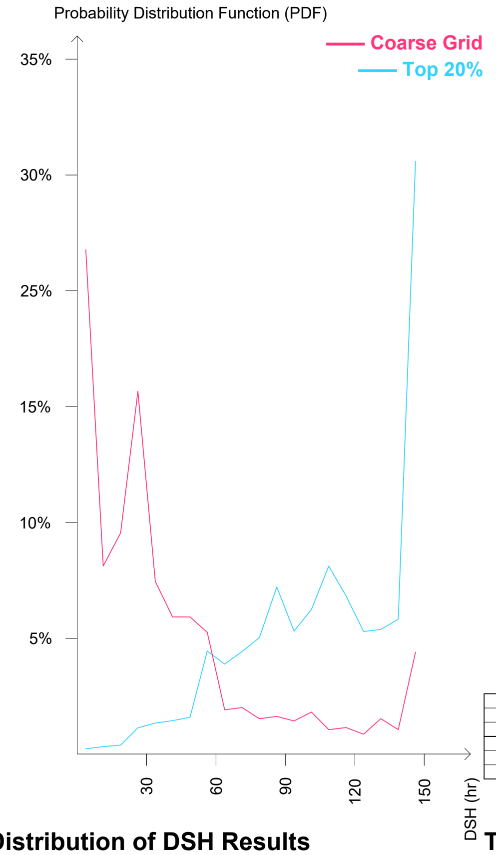




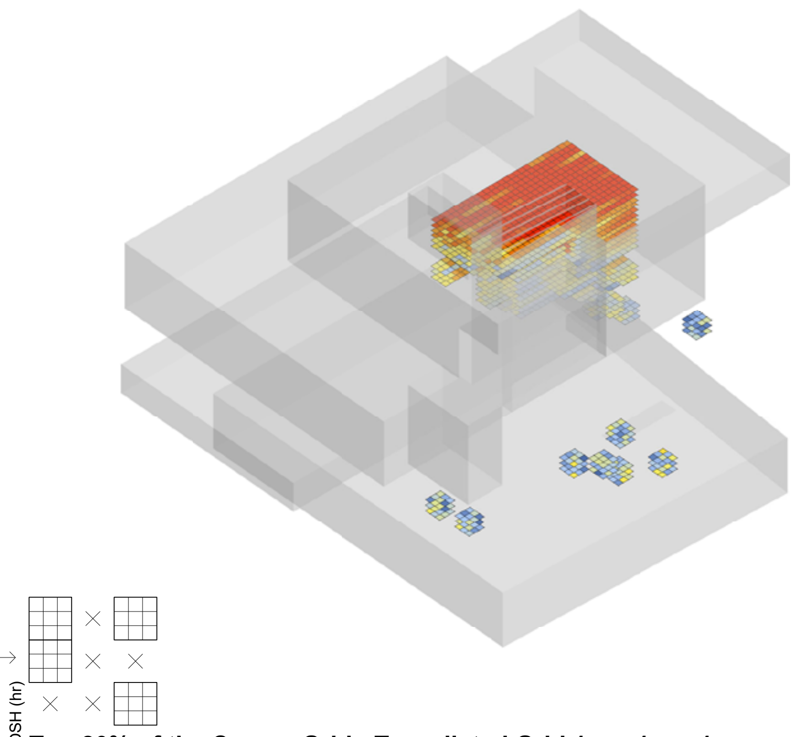
Coarse Grid 3m x 3m x 3m



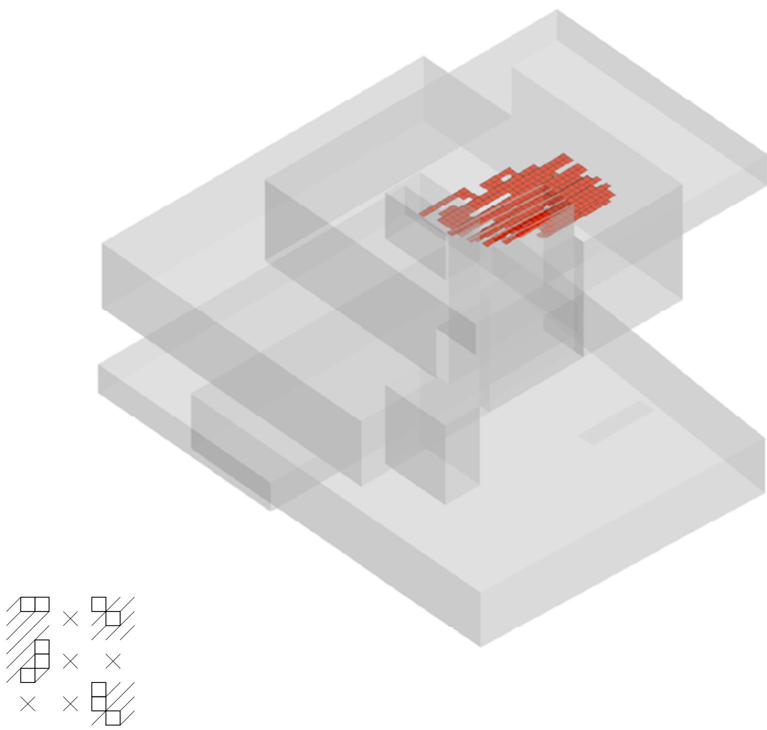
Top 20% of the Coarse Grid



Distribution of DSH Results



Top 20% of the Coarse Grid - Tessellated Grid 1m x 1m x 1m

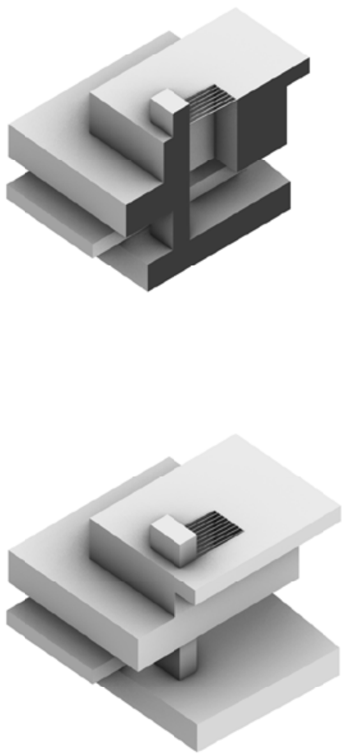


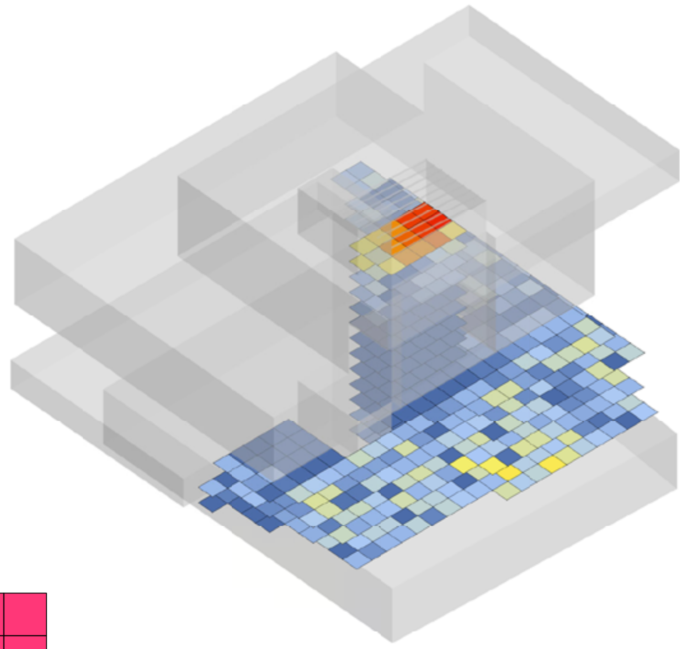
Top 10% of the Tessellated Grid - Singularised Grid 1m x 1m x 1m

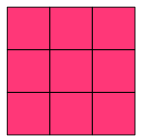
From the Coarse Grid to the Singularised Grid

Variation No.11: 12x18 Atrium

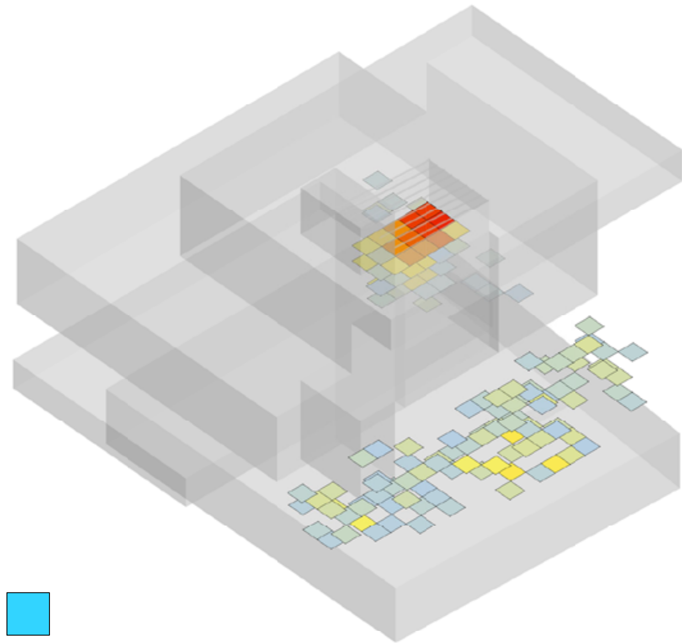
Simulation Period: *DirSunHrs@1 JUN 00:00 [HOY=3624] - 28 JUN 23:00 [HOY=4295]*
Variation Parameters:
Facade Tilt: *+0 deg*
Atrium X: *12m*
Atrium Y: *18m*
Mezzanine Offset: *0m*

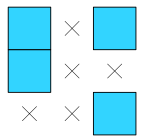




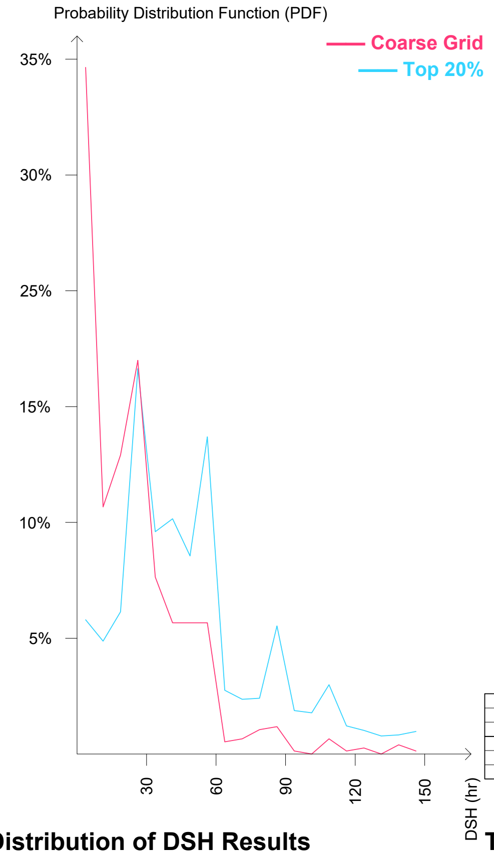


Coarse Grid 3m x 3m x 3m

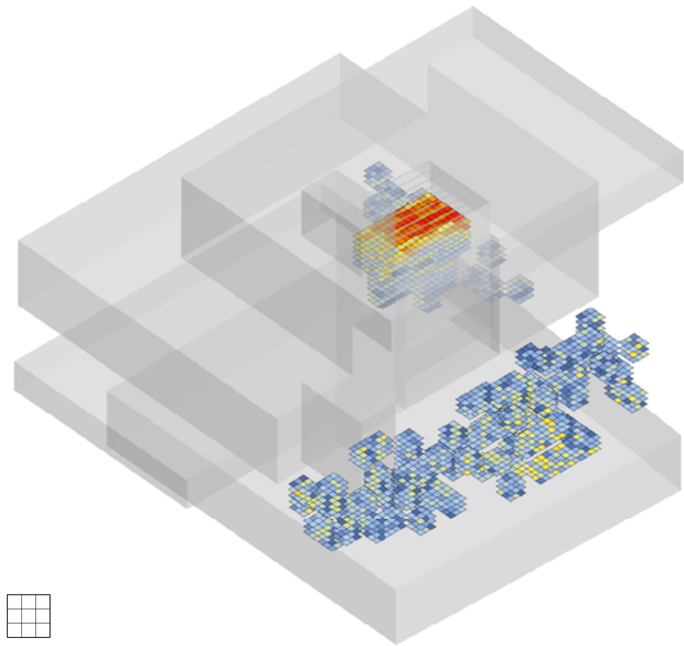


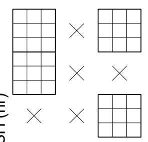


Top 20% of the Coarse Grid

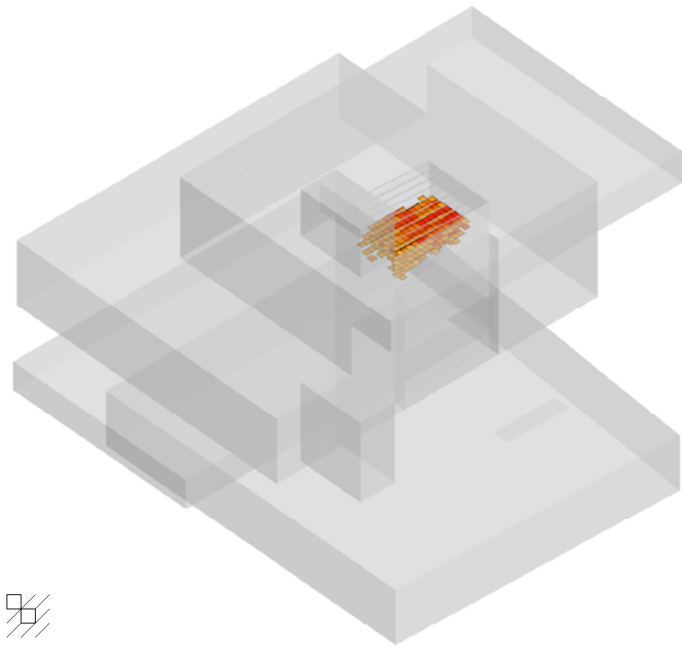


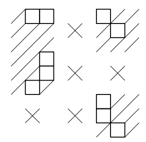
Distribution of DSH Results





Top 20% of the Coarse Grid - Tessellated Grid 1m x 1m x 1m



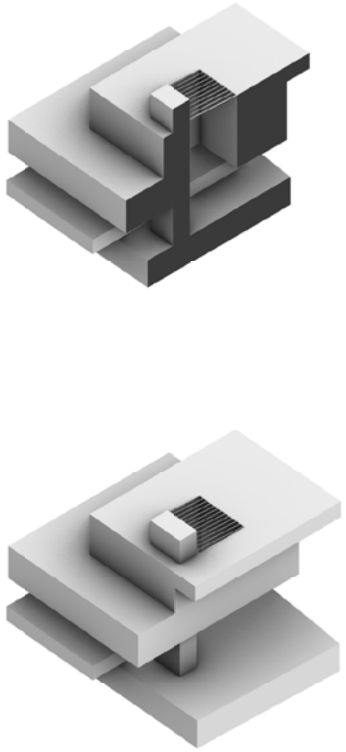


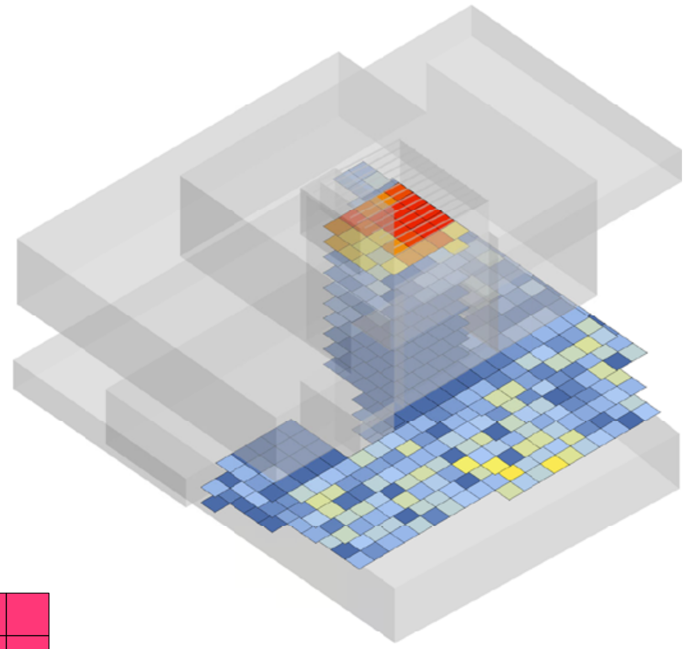
Top 10% of the Tessellated Grid - Singularised Grid 1m x 1m x 1m

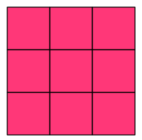
From the Coarse Grid to the Singularised Grid

Variation No.12: 18x18 Atrium

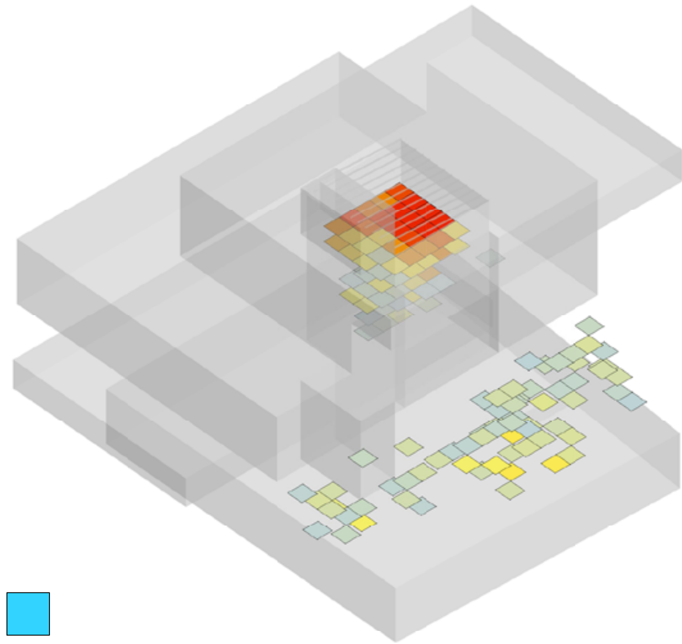
Simulation Period: *DirSunHrs@1 JUN 00:00 [HOY=3624] - 28 JUN 23:00 [HOY=4295]*
Variation Parameters:
Facade Tilt: *+0 deg*
Atrium X: *18m*
Atrium Y: *18m*
Mezzanine Offset: *0m*

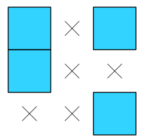




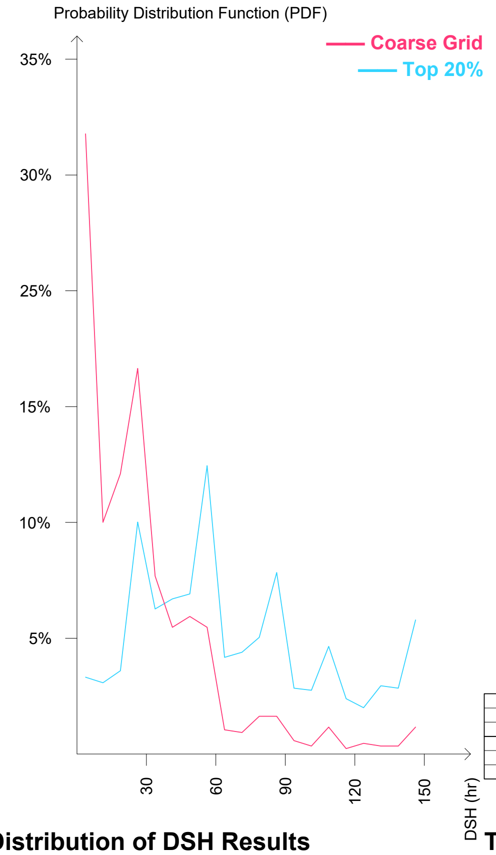


Coarse Grid 3m x 3m x 3m

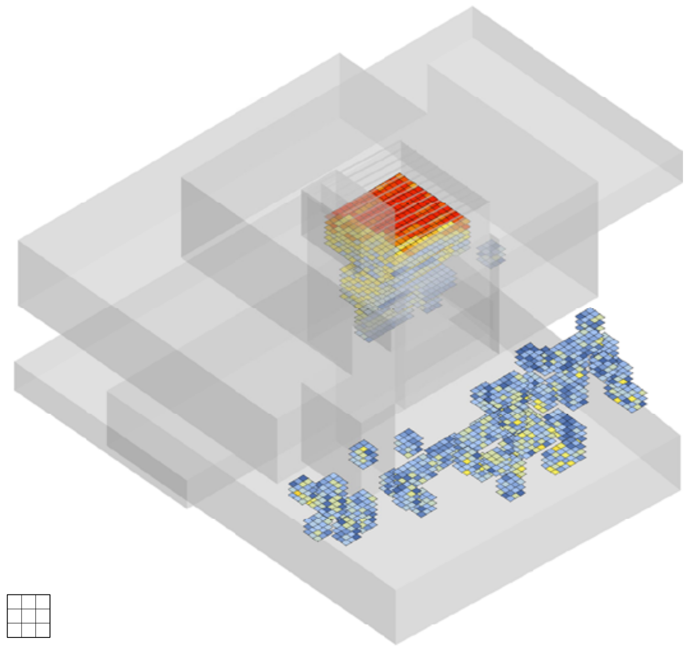


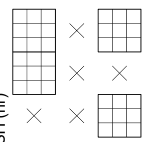


Top 20% of the Coarse Grid

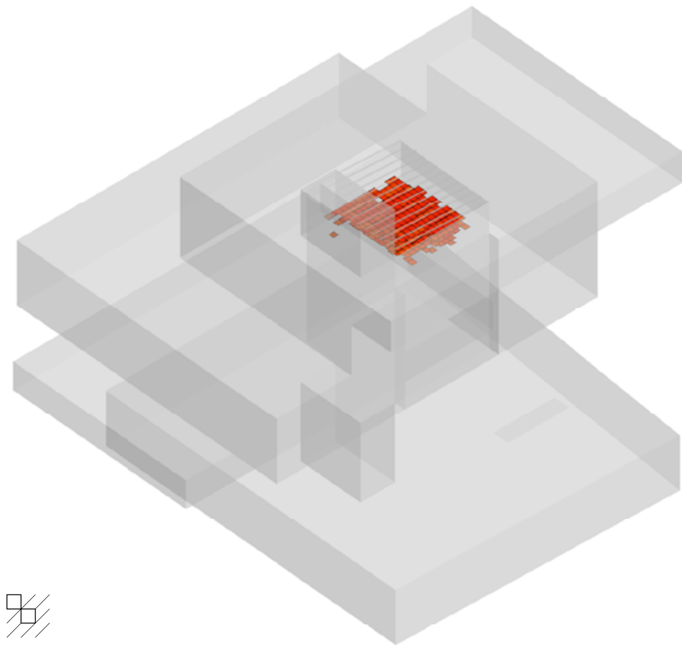


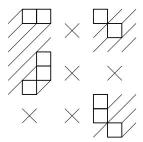
Distribution of DSH Results





Top 20% of the Coarse Grid - Tessellated Grid 1m x 1m x 1m



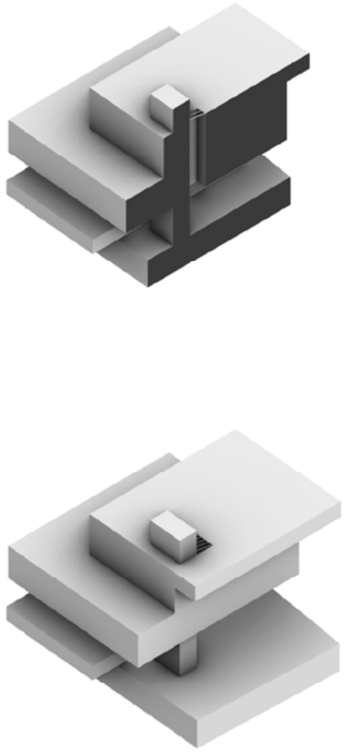


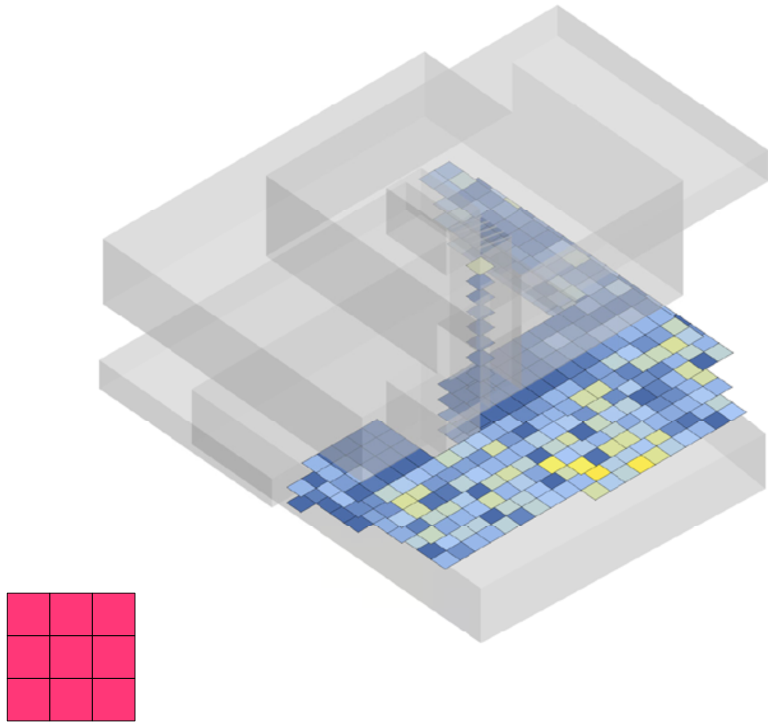
Top 10% of the Tessellated Grid - Singularised Grid 1m x 1m x 1m

From the Coarse Grid to the Singularised Grid

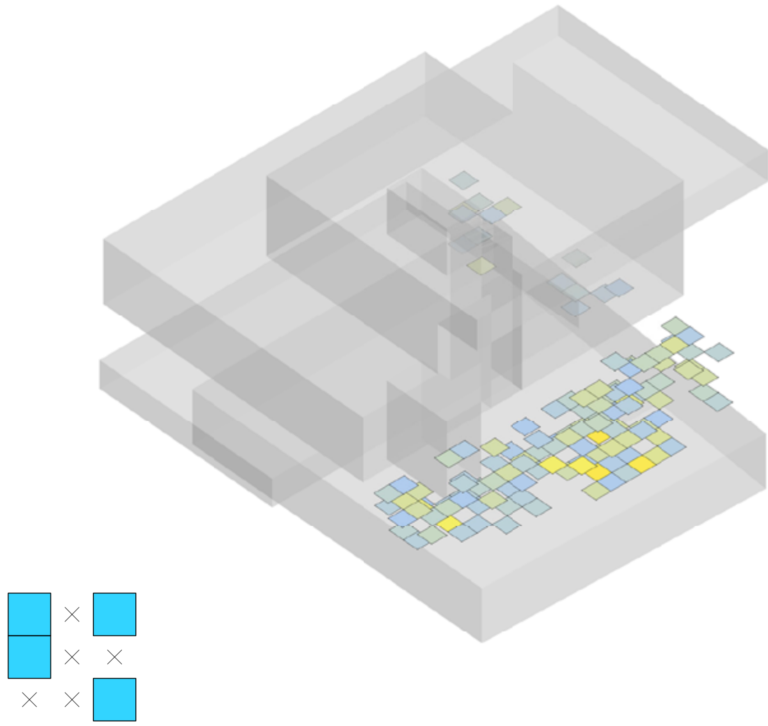
Variation No.13: 6x6 Atrium

Simulation Period: *DirSunHrs@1 JUN 00:00 [HOY=3624] - 28 JUN 23:00 [HOY=4295]*
Variation Parameters:
- **Facade Tilt:** *+0 deg*
- **Atrium X:** *6m*
- **Atrium Y:** *6m*
- **Mezzanine Offset:** *0m*

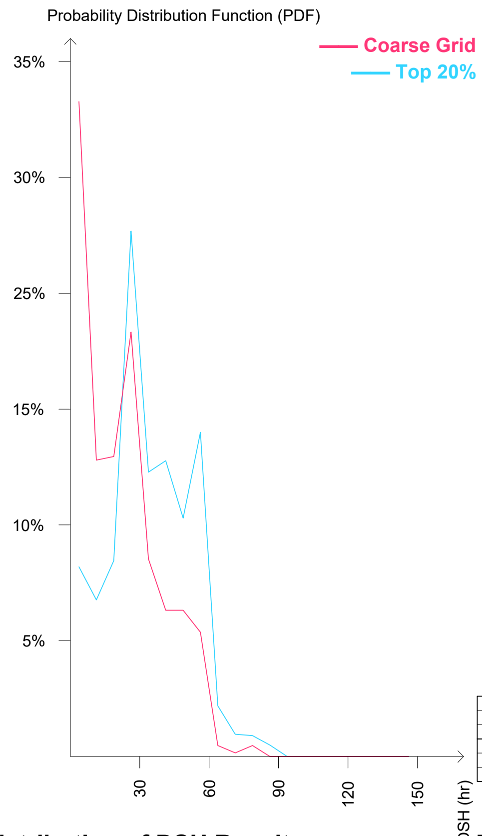




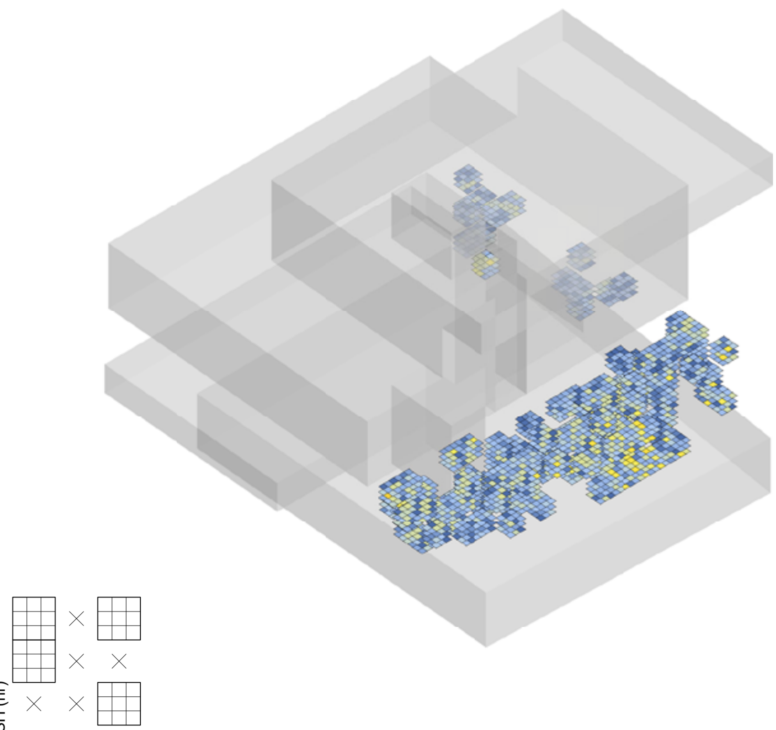
Coarse Grid 3m x 3m x 3m



Top 20% of the Coarse Grid



Distribution of DSH Results



Top 20% of the Coarse Grid - Tessellated Grid 1m x 1m x 1m

Top 10% of the Tessellated Grid - Singularised Grid 1m x 1m x 1m

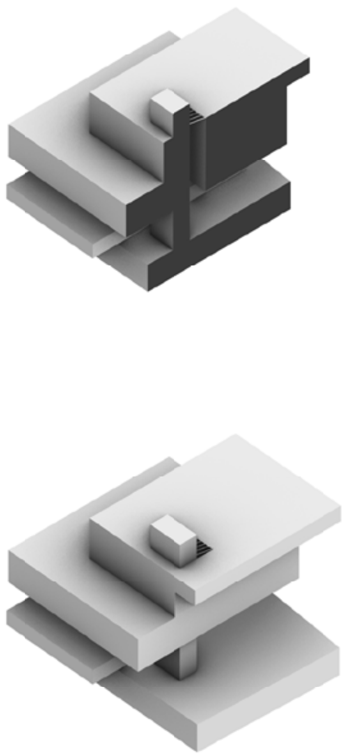
From the Coarse Grid to the Singularised Grid

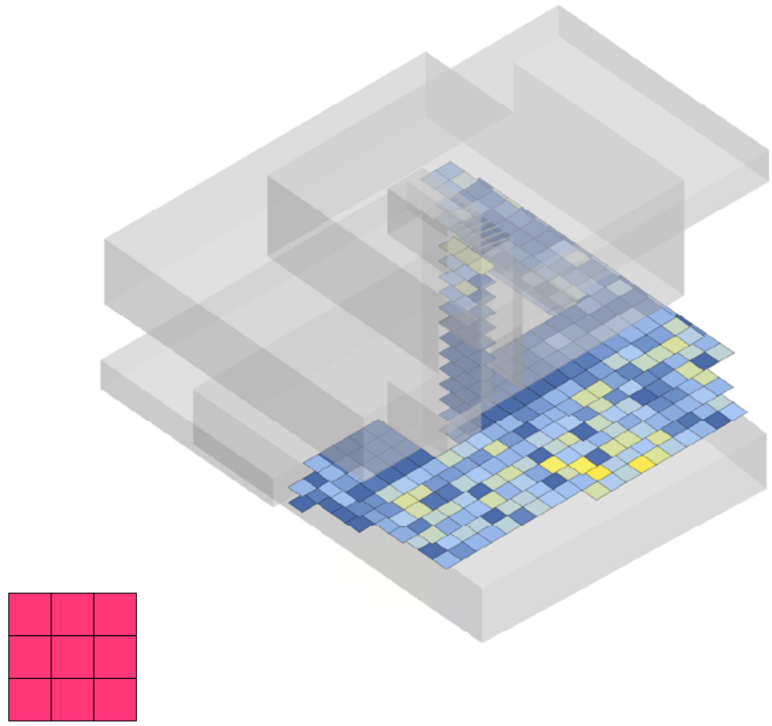
Variation No.14: 12x6 Atrium

Simulation Period: *DirSunHrs@1 JUN 00:00 [HOY=3624] - 28 JUN 23:00 [HOY=4295]*

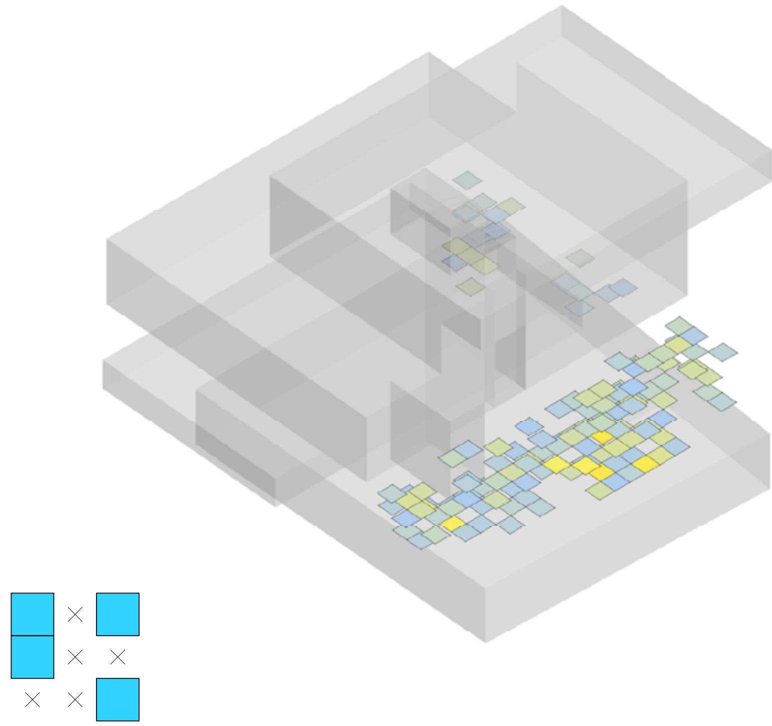
Variation Parameters:

- **Facade Tilt:** *+0 deg*
- **Atrium X:** *12m*
- **Atrium Y:** *6m*
- **Mezzanine Offset:** *0m*

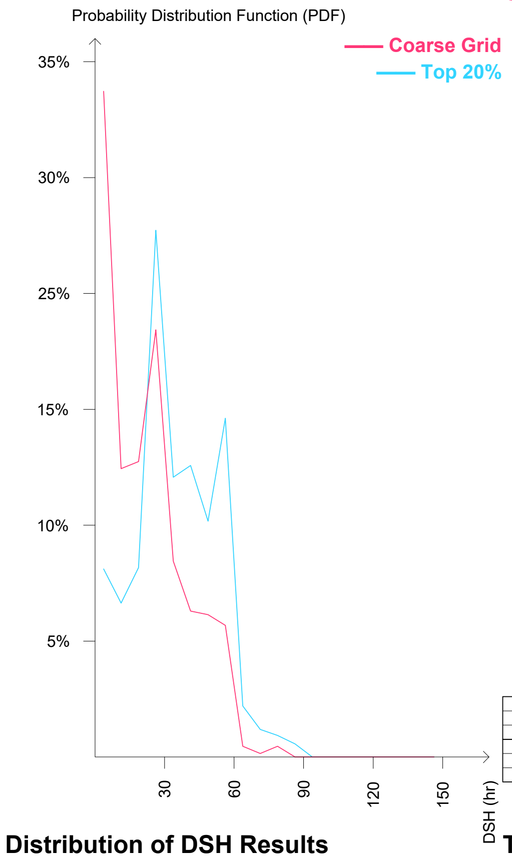




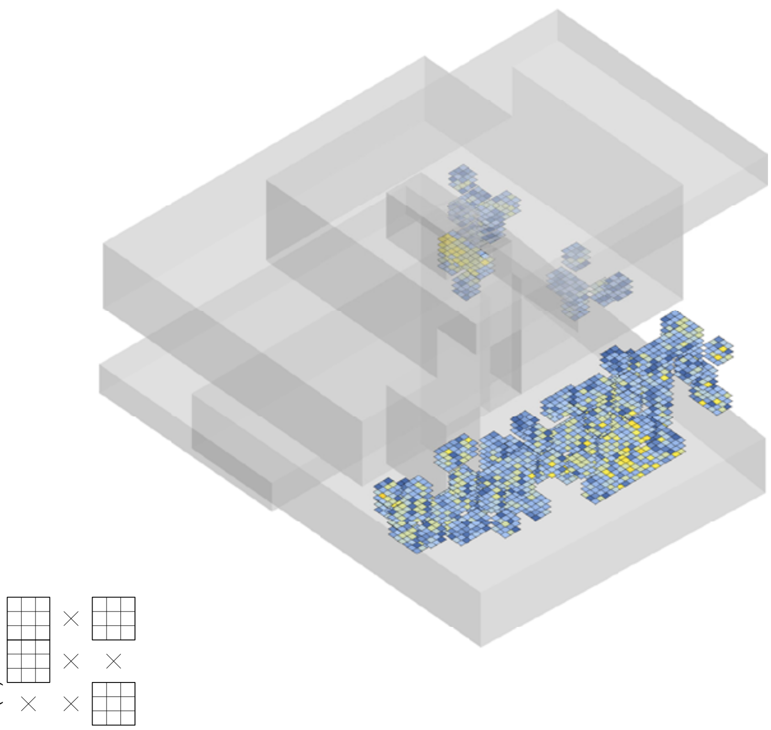
Coarse Grid 3m x 3m x 3m



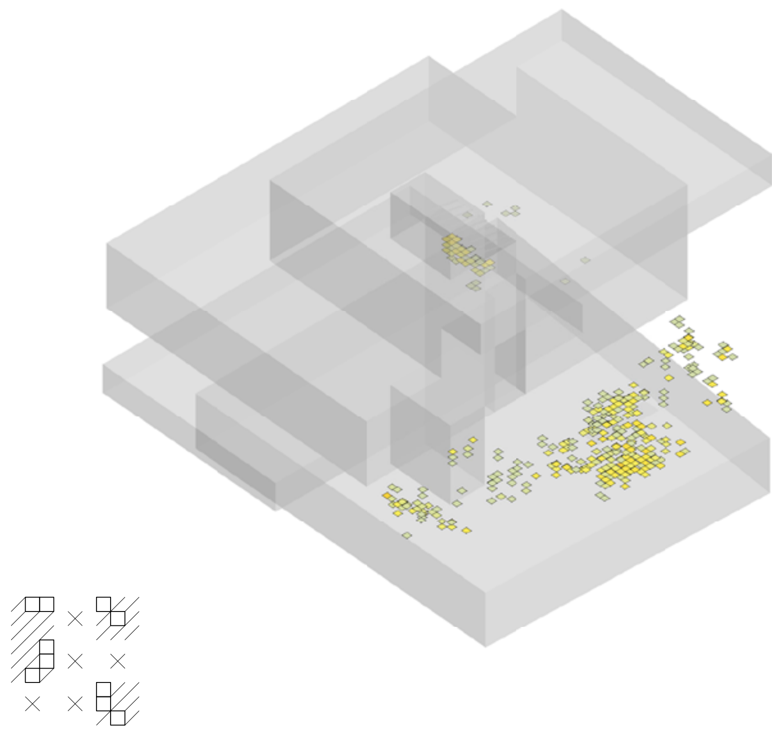
Top 20% of the Coarse Grid



Distribution of DSH Results



Top 20% of the Coarse Grid - Tessellated Grid 1m x 1m x 1m

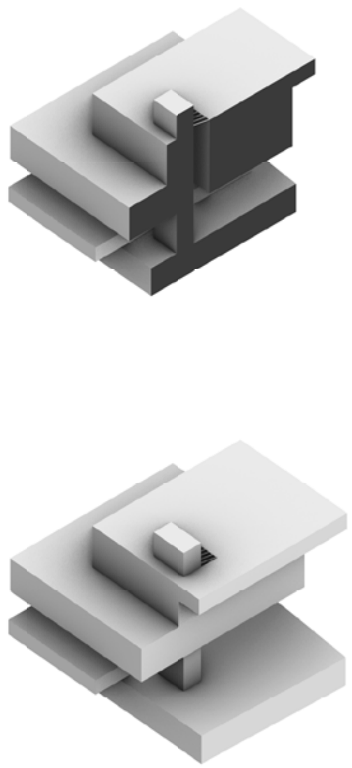


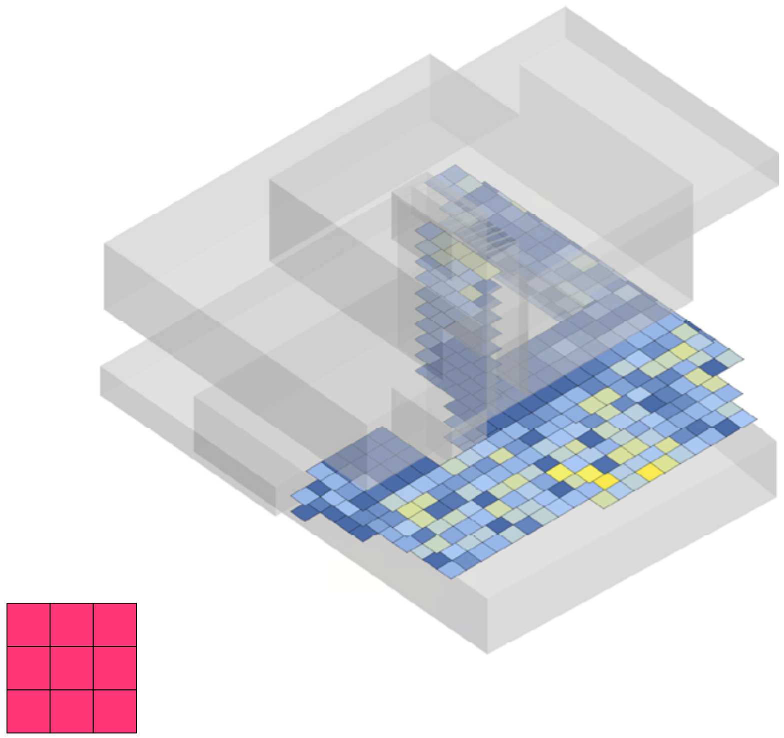
Top 10% of the Tessellated Grid - Singularised Grid 1m x 1m x 1m

From the Coarse Grid to the Singularised Grid

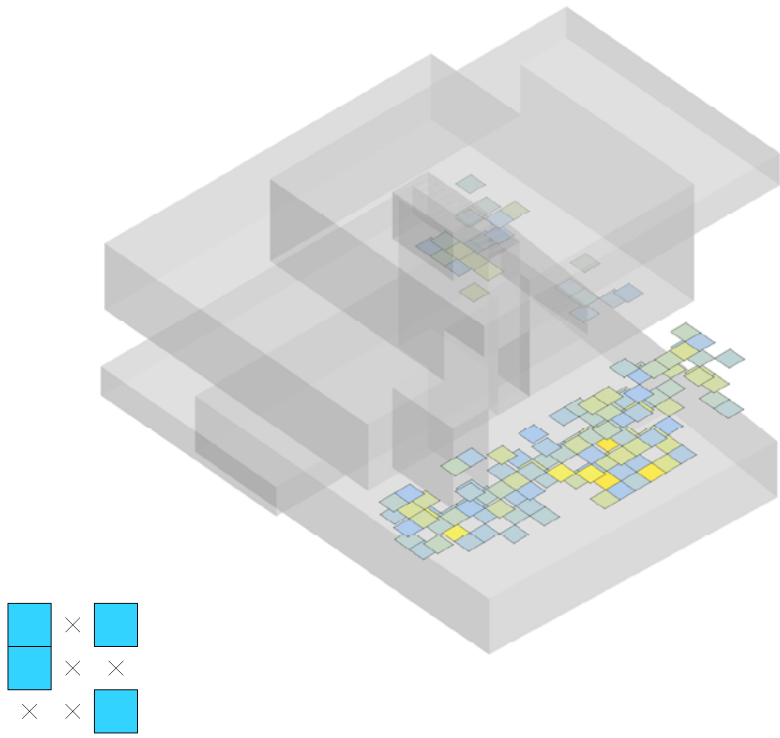
Variation No.15: 18x6 Atrium

Simulation Period: *DirSunHrs@1 JUN 00:00 [HOY=3624] - 28 JUN 23:00 [HOY=4295]*
Variation Parameters:
Facade Tilt: *+0 deg*
Atrium X: *18m*
Atrium Y: *6m*
Mezzanine Offset: *0m*

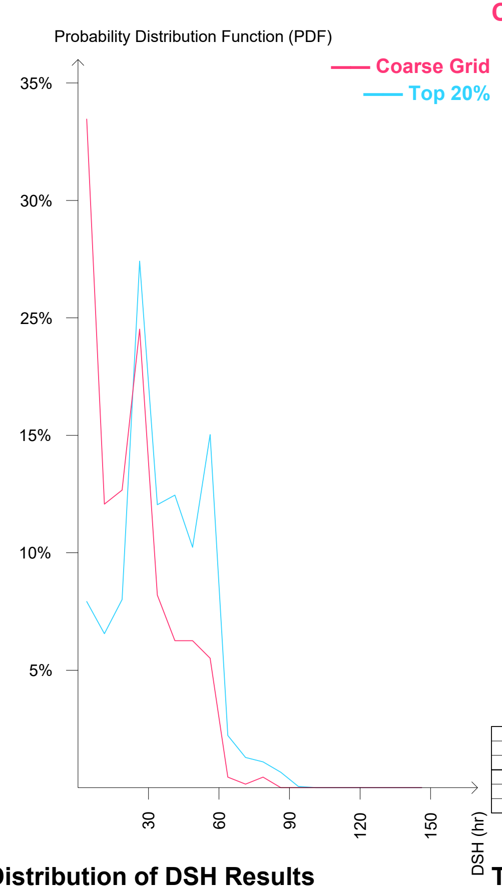




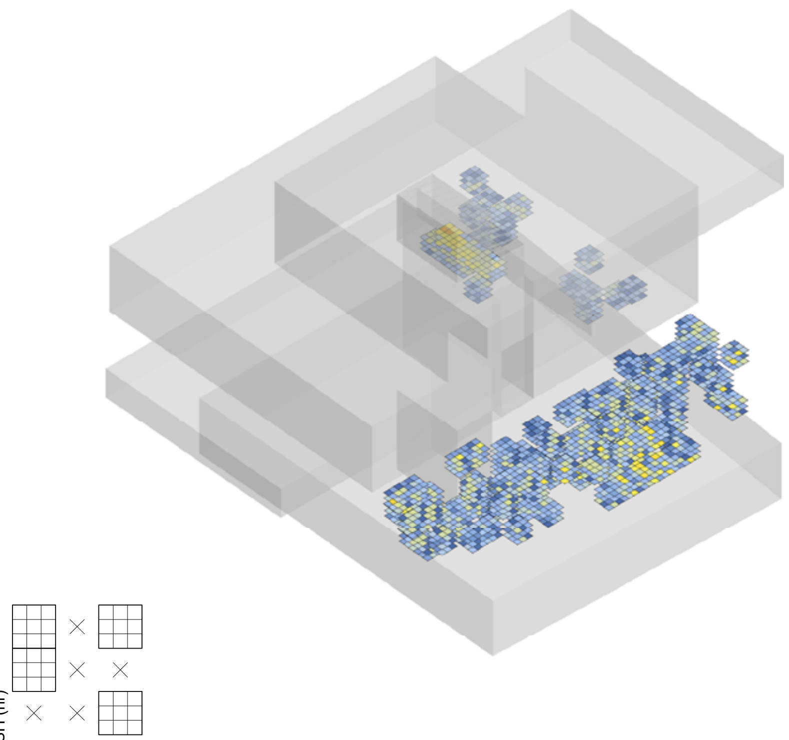
Coarse Grid 3m x 3m x 3m



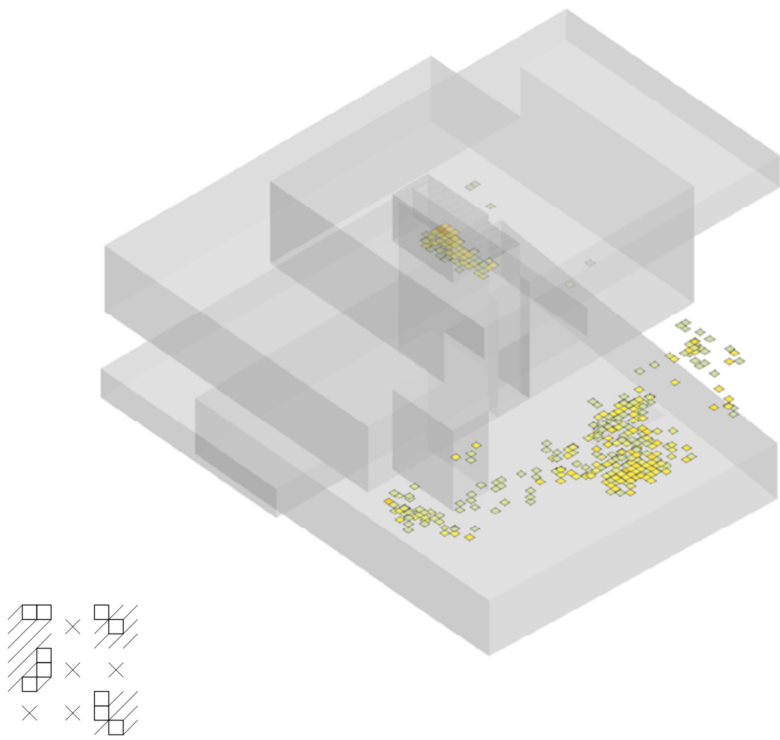
Top 20% of the Coarse Grid



Distribution of DSH Results



Top 20% of the Coarse Grid - Tessellated Grid 1m x 1m x 1m



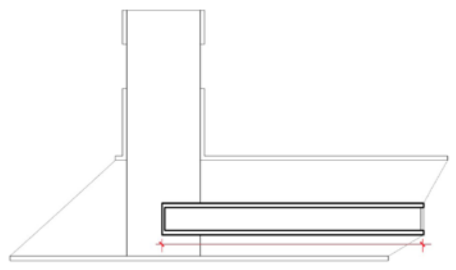
Top 10% of the Tessellated Grid - Singularised Grid 1m x 1m x 1m

Variation 03 -- Mezzaine Depths

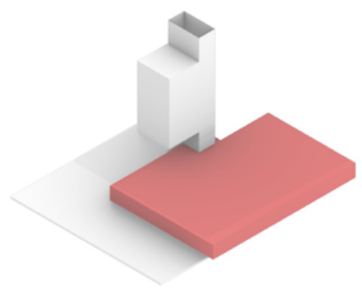
From the Coarse Grid to the Singularised Grid

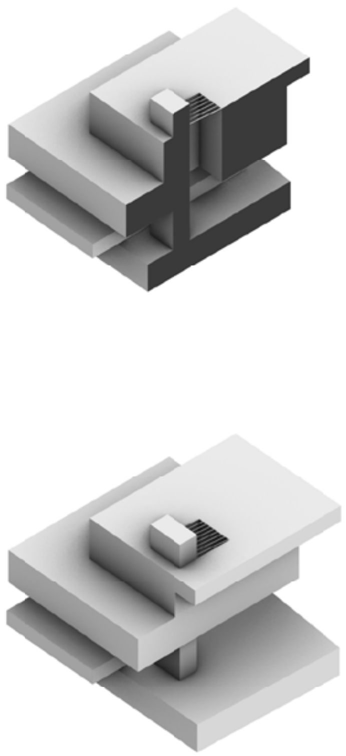
Variation No.0: As-Found

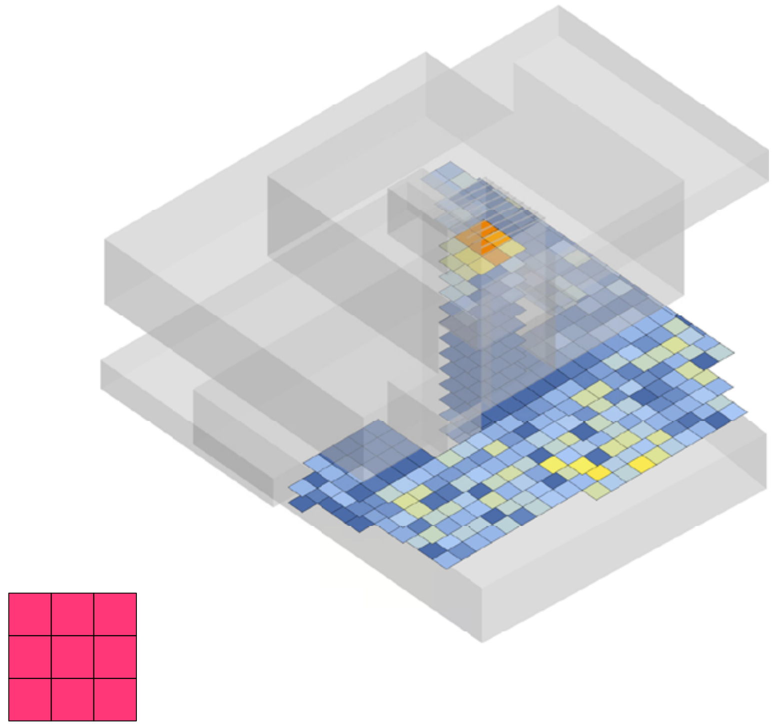
Simulation Period: *DirSunHrs@1 JUN 00:00 [HOY=3624] - 28 JUN 23:00 [HOY=4*
Variation Parameters:
- **Facade Tilt:** *+0 deg*
- **Atrium X:** *12m*
- **Atrium Y:** *12m*
- **Mezzanine Offset:** *0m*

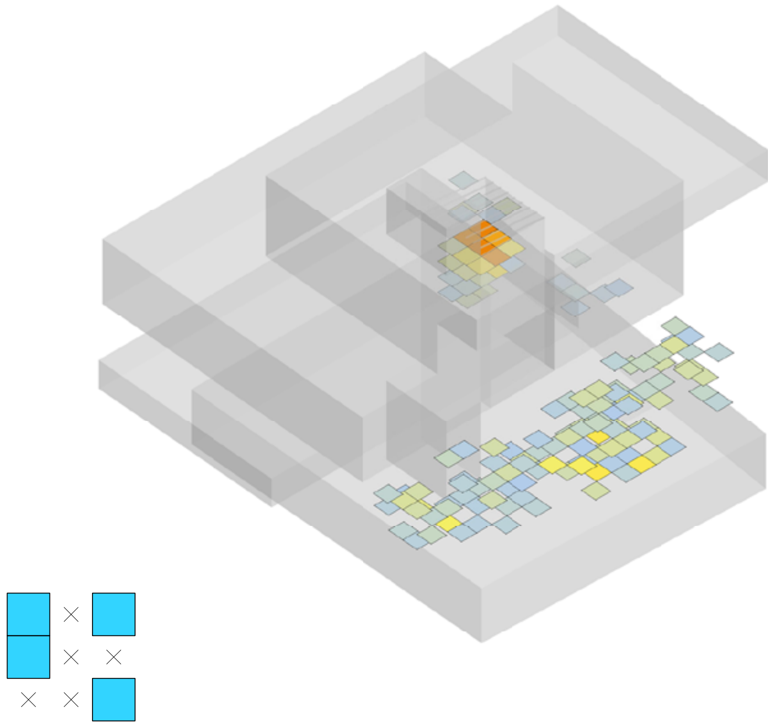


Depth of Mezzaine 48800mm



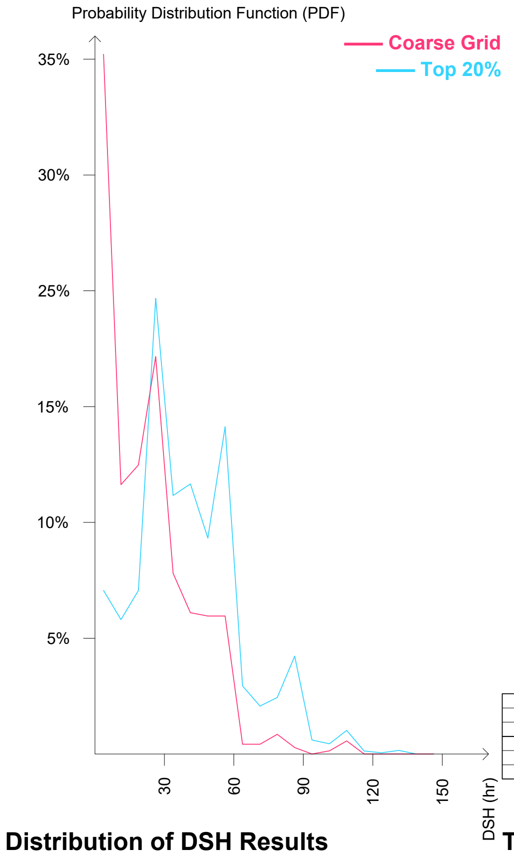




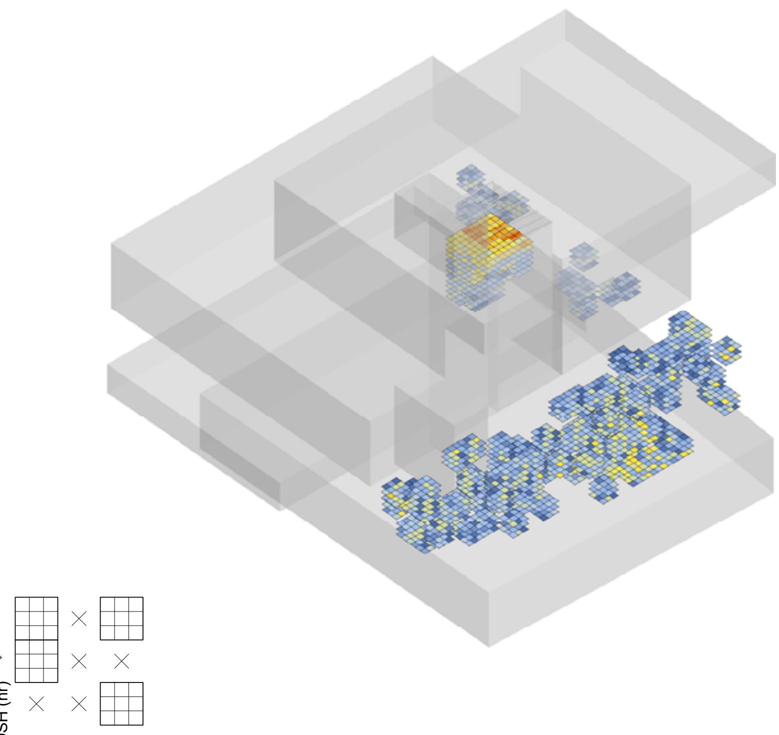


Coarse Grid 3m x 3m x 3m

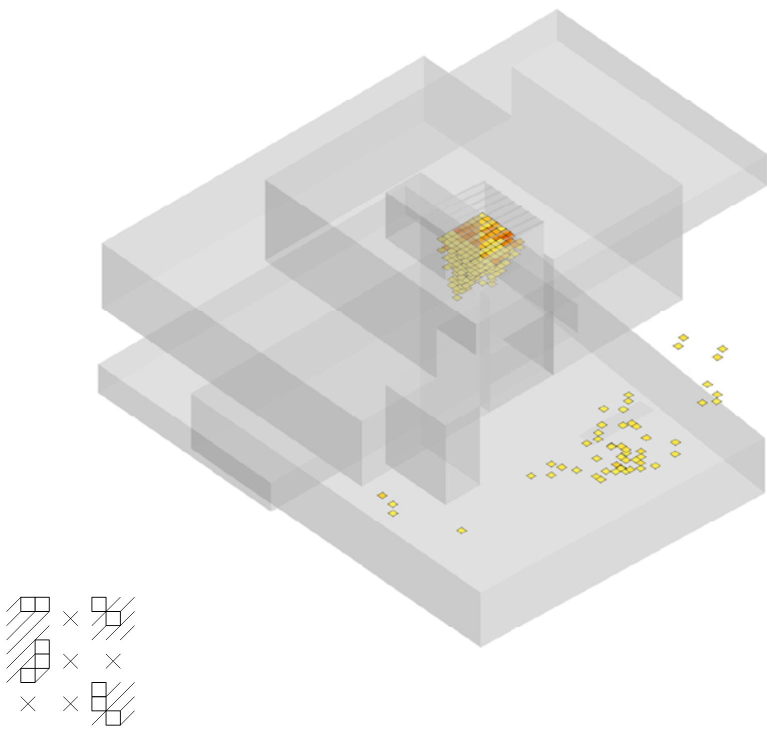
Top 20% of the Coarse Grid



Distribution of DSH Results



Top 20% of the Coarse Grid - Tessellated Grid 1m x 1m x 1m

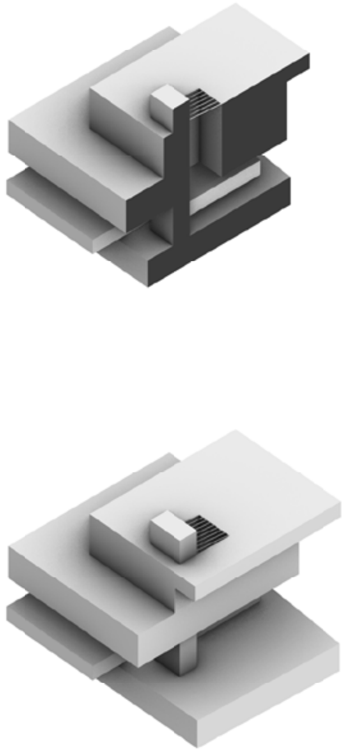


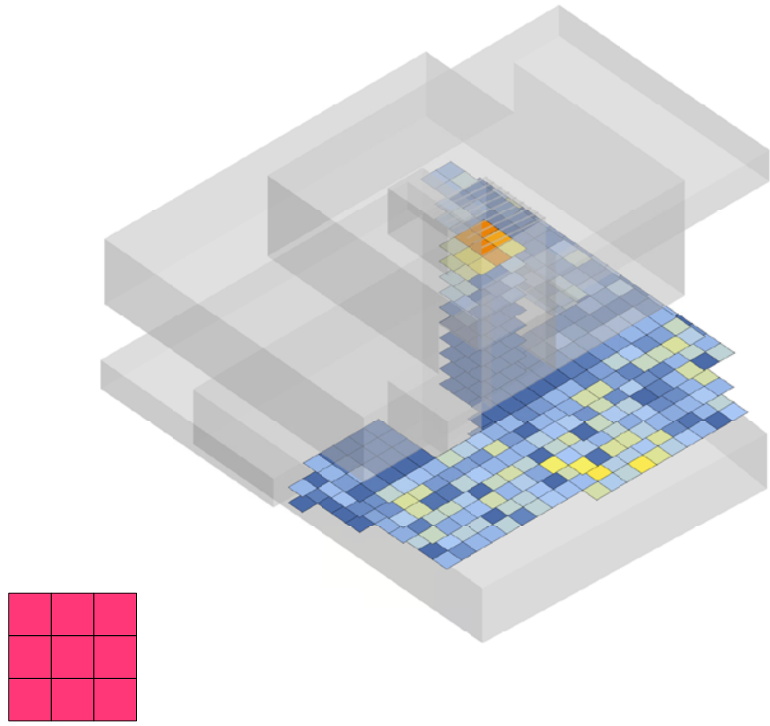
Top 10% of the Tessellated Grid - Singularised Grid 1m x 1m x 1m

From the Coarse Grid to the Singularised Grid

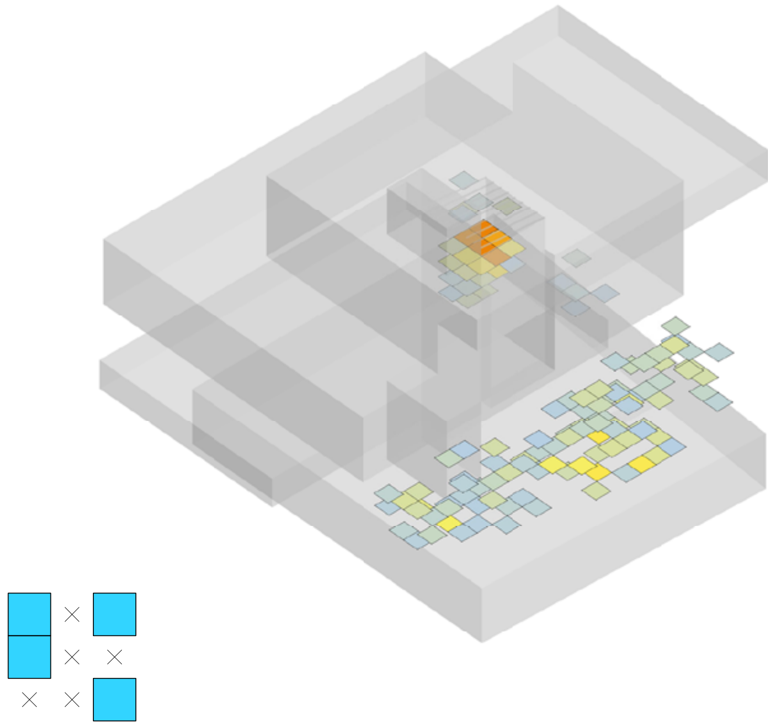
Variation No.16: Mezzanine -6m Offset

Simulation Period: *DirSunHrs@1 JUN 00:00 [HOY=3624] - 28 JUN 23:00 [HOY=4295]*
Variation Parameters:
- **Facade Tilt:** *+0 deg*
- **Atrium X:** *12m*
- **Atrium Y:** *12m*
- **Mezzanine Offset:** *-6m*

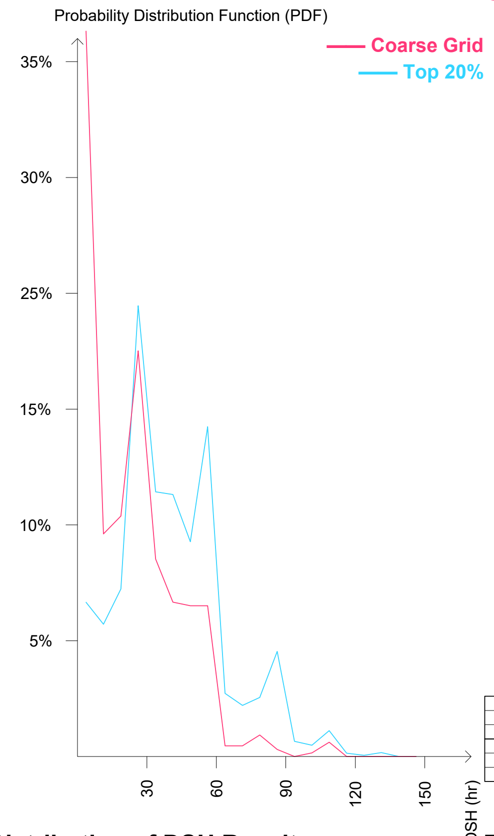




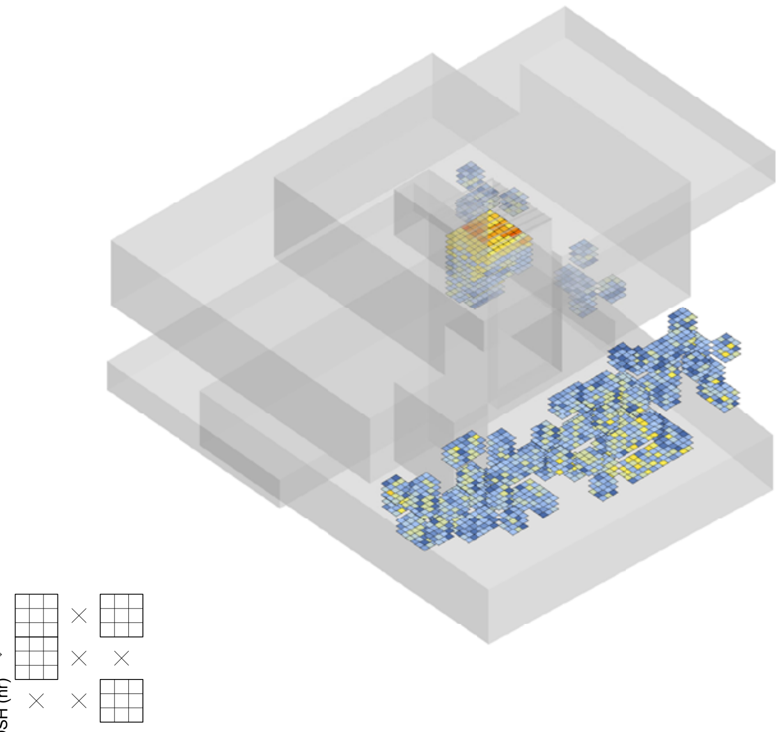
Coarse Grid 3m x 3m x 3m



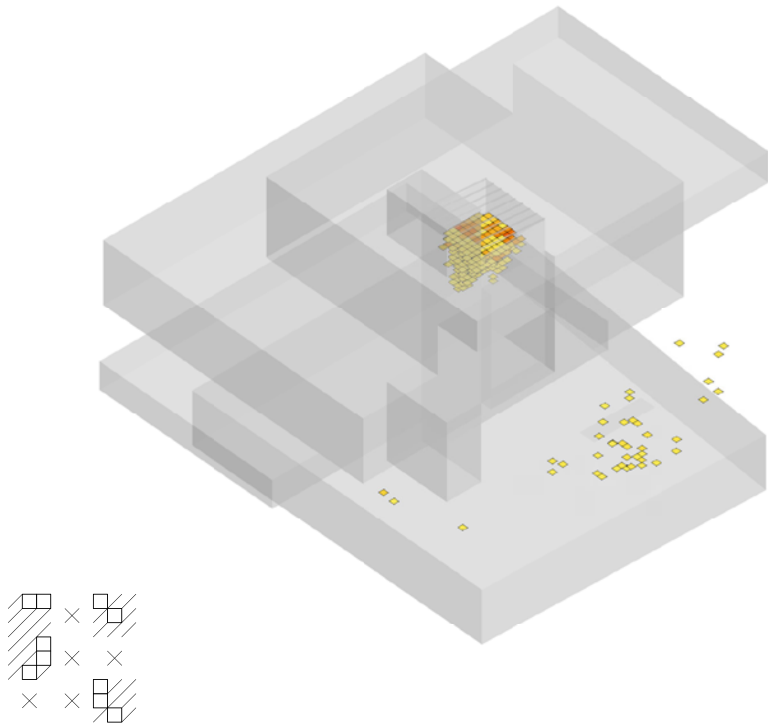
Top 20% of the Coarse Grid



Distribution of DSH Results



Top 20% of the Coarse Grid - Tessellated Grid 1m x 1m x 1m



Top 10% of the Tessellated Grid - Singularised Grid 1m x 1m x 1m

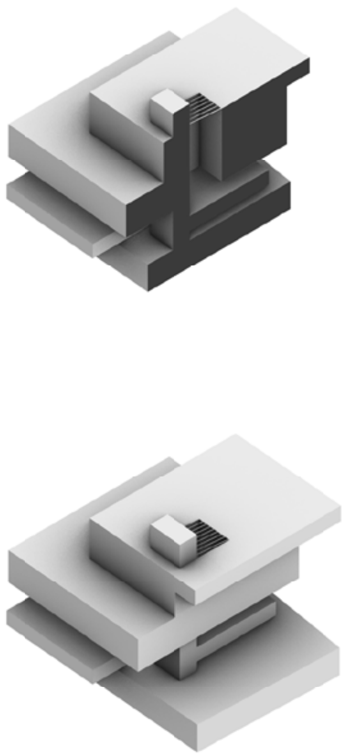
From the Coarse Grid to the Singularised Grid

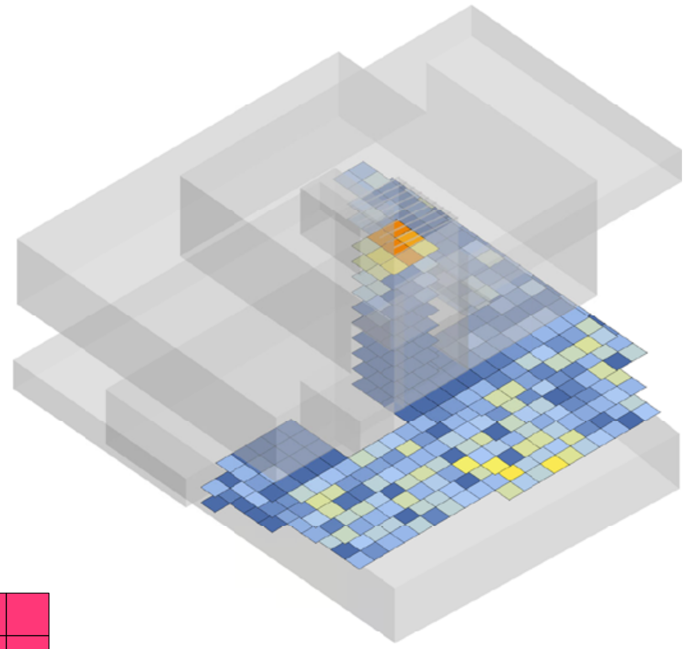
Variation No.17: Mezzanine -12m Offset

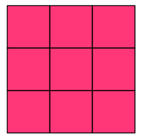
Simulation Period: *DirSunHrs@1 JUN 00:00 [HOY=3624] - 28 JUN 23:00 [HOY=4295]*

Variation Parameters:

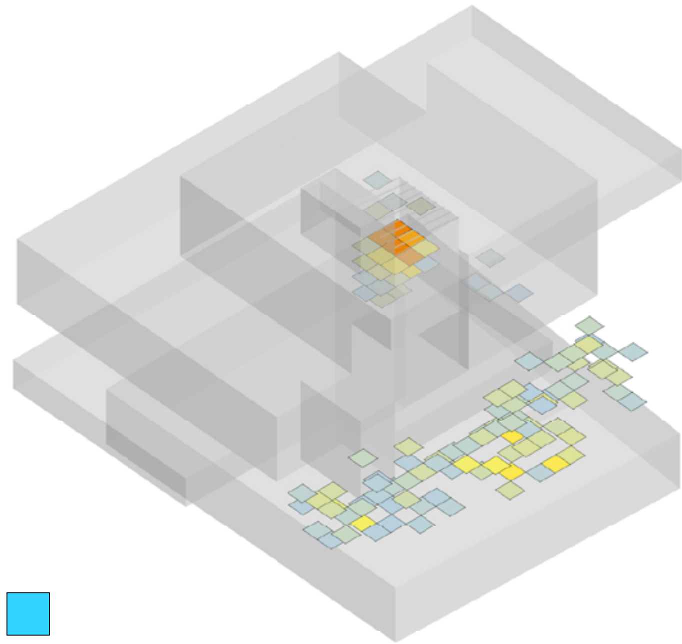
- **Facade Tilt:** *+0 deg*
- **Atrium X:** *12m*
- **Atrium Y:** *12m*
- **Mezzanine Offset:** *-12m*

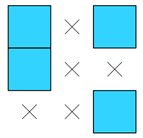




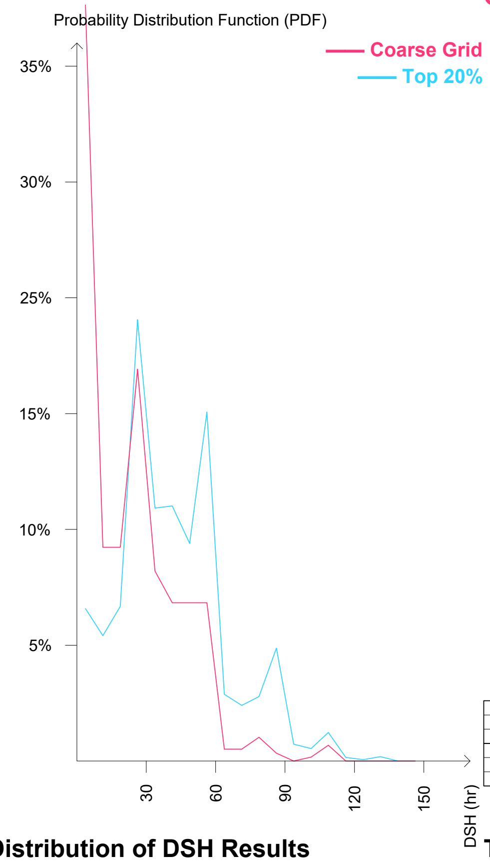


Coarse Grid 3m x 3m x 3m

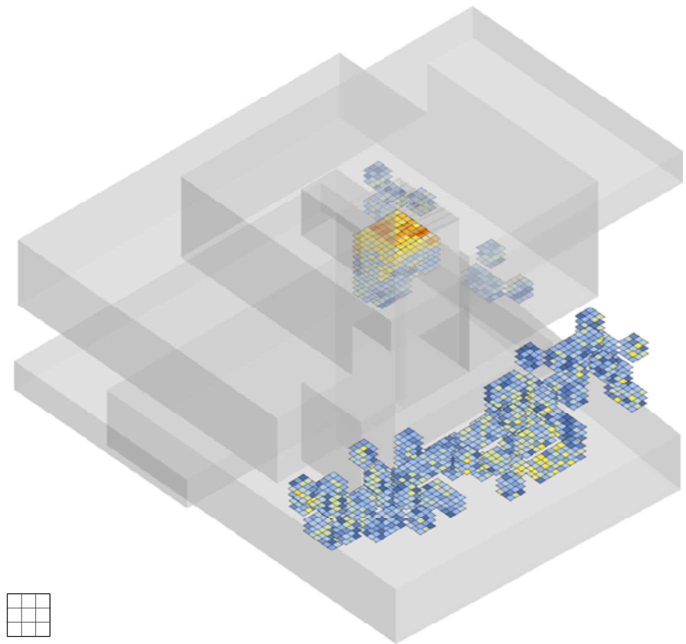


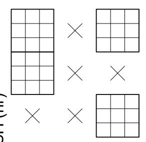


Top 20% of the Coarse Grid

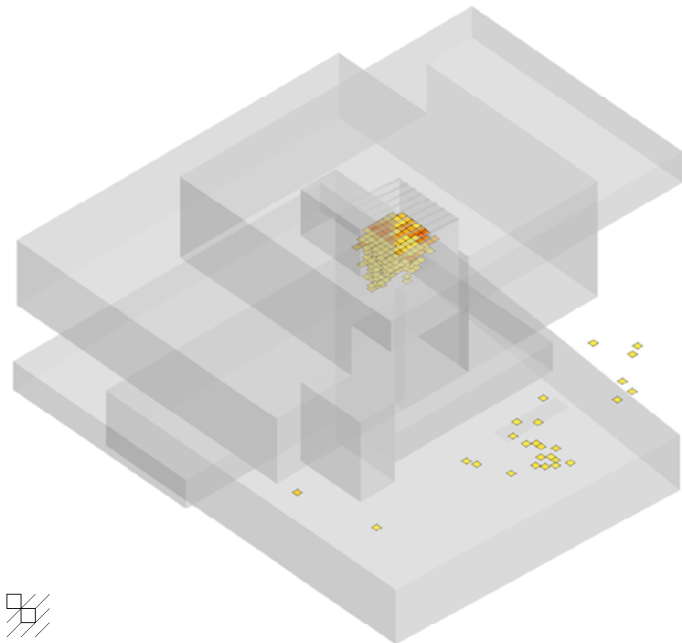


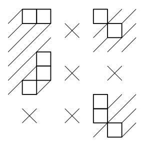
Distribution of DSH Results





Top 20% of the Coarse Grid - Tessellated Grid 1m x 1m x 1m



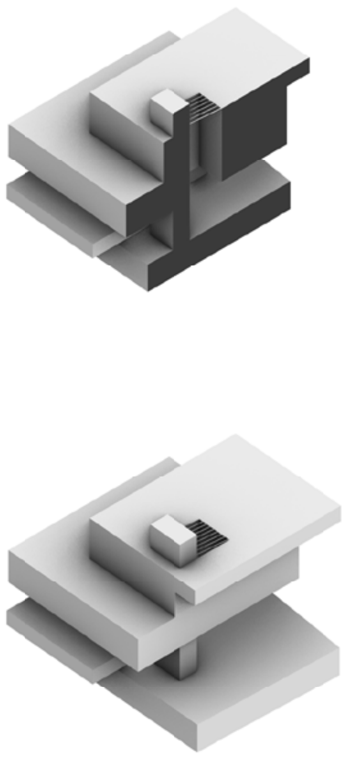


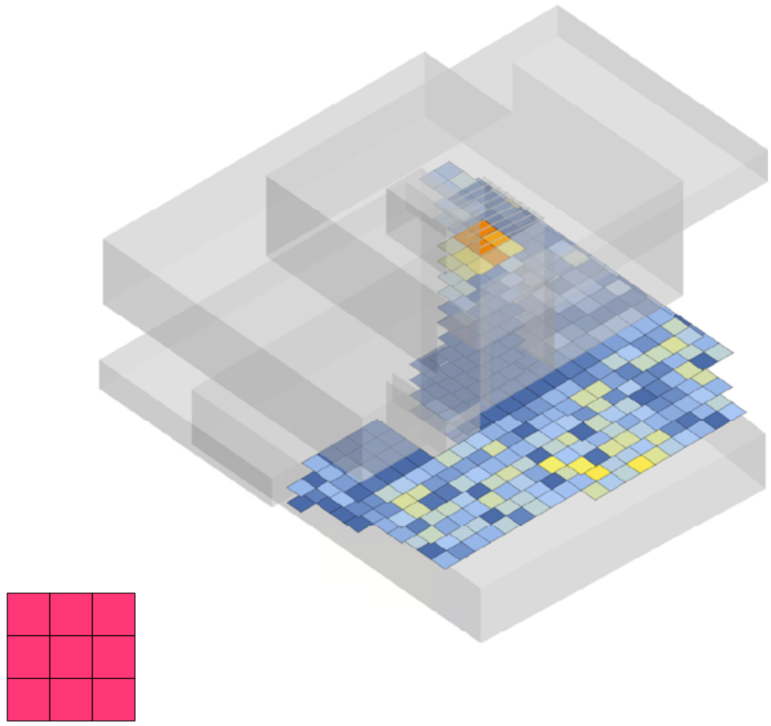
Top 10% of the Tessellated Grid - Singularised Grid 1m x 1m x 1m

From the Coarse Grid to the Singularised Grid

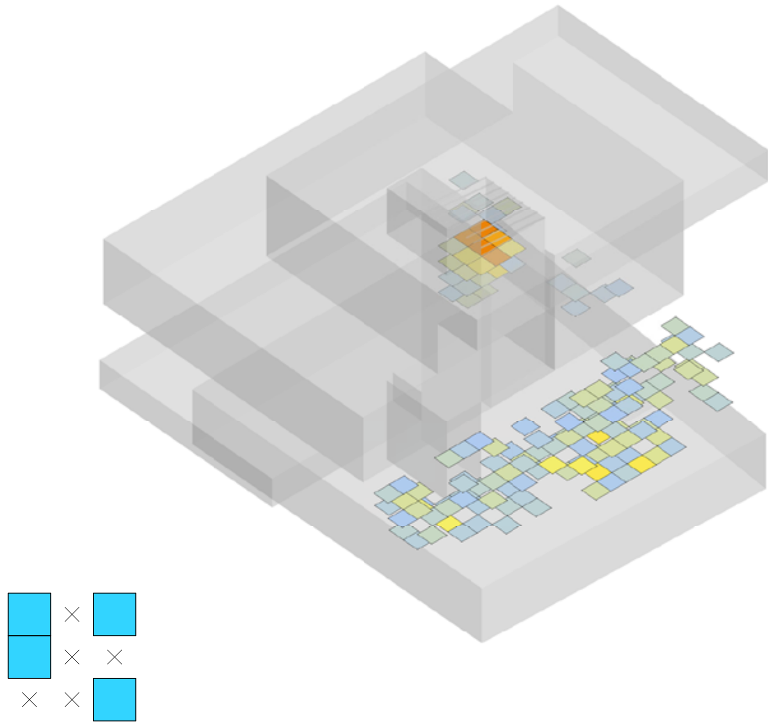
Variation No.18: Mezzanine +6m Offset

Simulation Period: *DirSunHrs@1 JUN 00:00 [HOY=3624] - 28 JUN 23:00 [HOY=4295]*
Variation Parameters:
Facade Tilt: *+0 deg*
Atrium X: *12m*
Atrium Y: *12m*
Mezzanine Offset: *+6m*

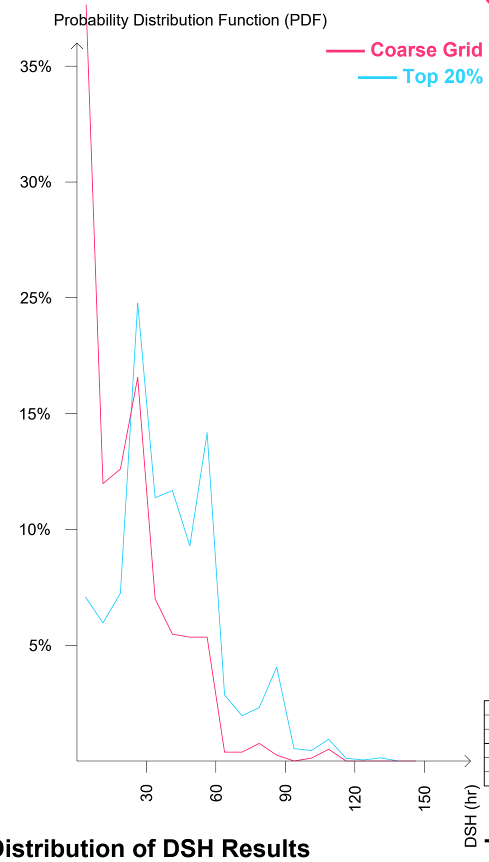




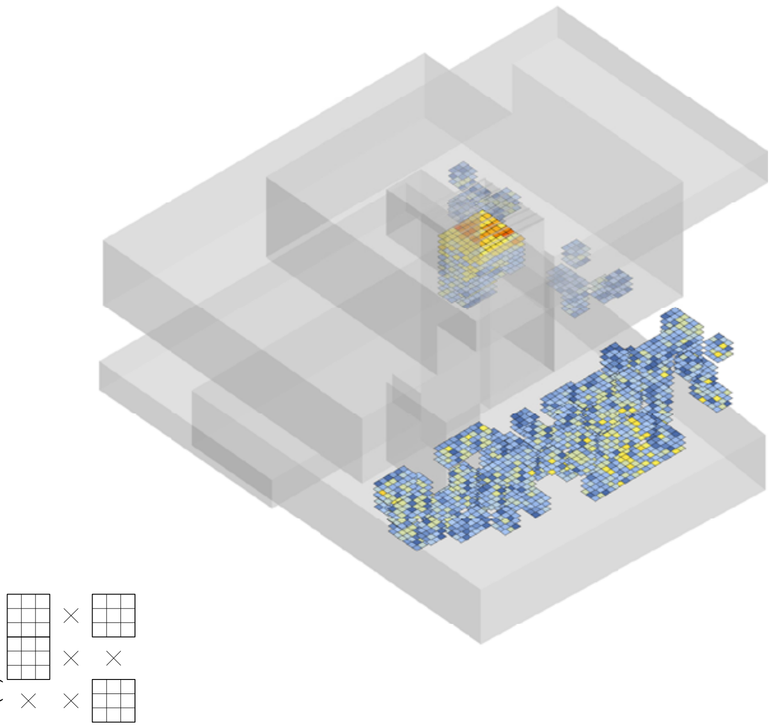
Coarse Grid 3m x 3m x 3m



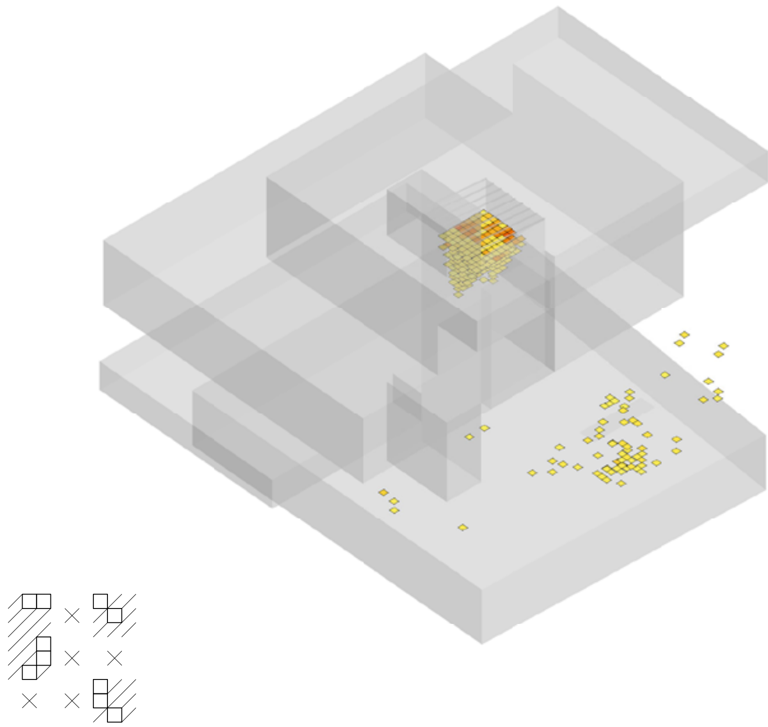
Top 20% of the Coarse Grid



Distribution of DSH Results



Top 20% of the Coarse Grid - Tessellated Grid 1m x 1m x 1m

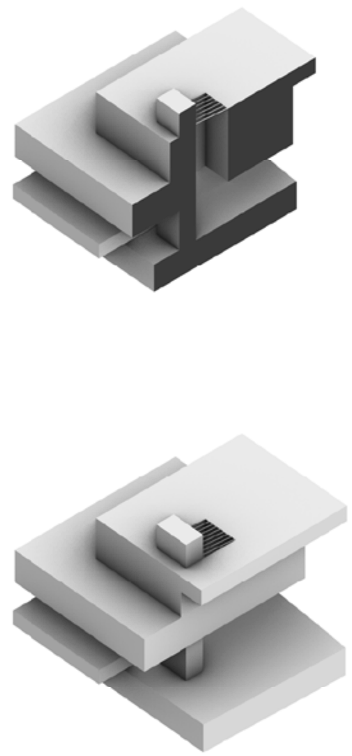


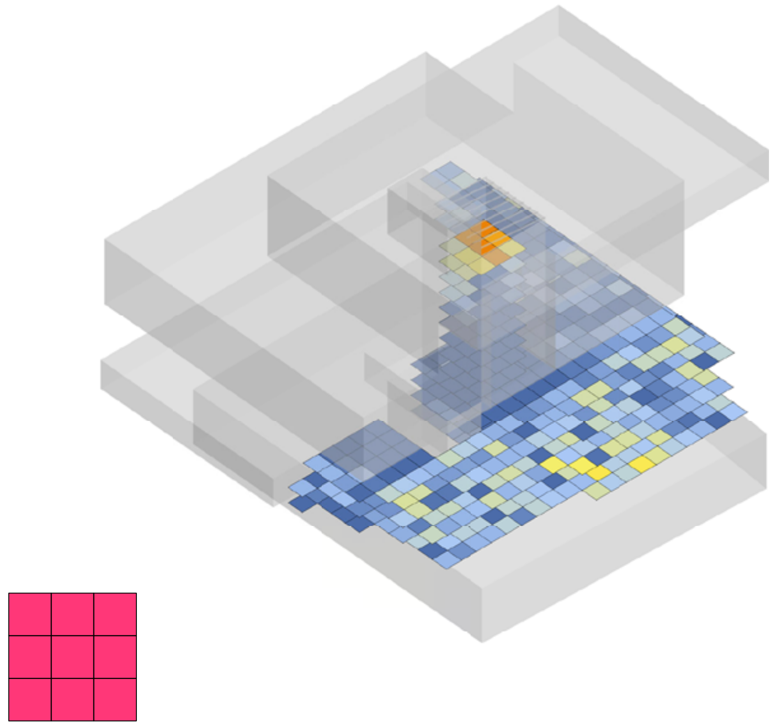
Top 10% of the Tessellated Grid - Singularised Grid 1m x 1m x 1m

From the Coarse Grid to the Singularised Grid

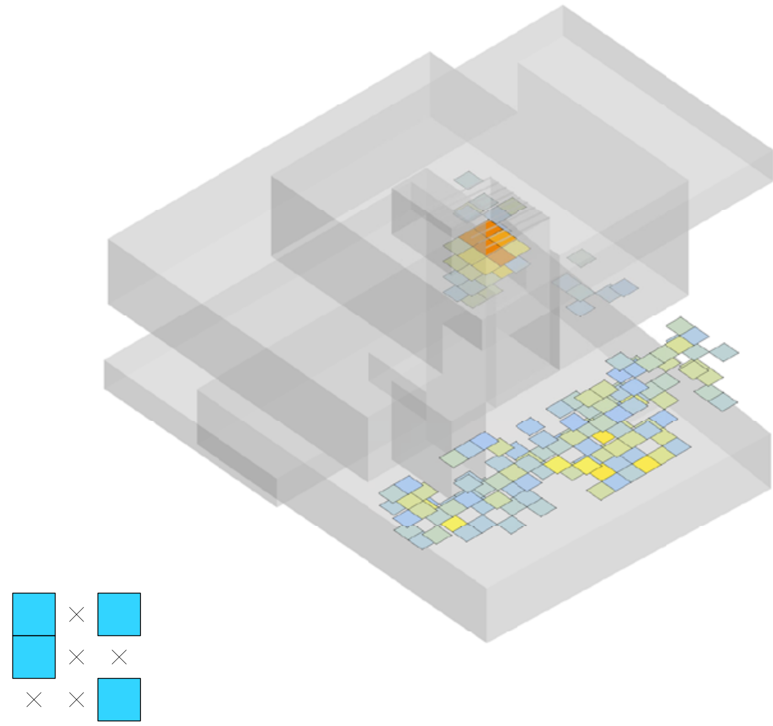
Variation No.19: Mezzanine +12m Offset

Simulation Period: *DirSunHrs@1 JUN 00:00 [HOY=3624] - 28 JUN 23:00 [HOY=4295]*
Variation Parameters:
Facade Tilt: *+0 deg*
Atrium X: *12m*
Atrium Y: *12m*
Mezzanine Offset: *+12m*

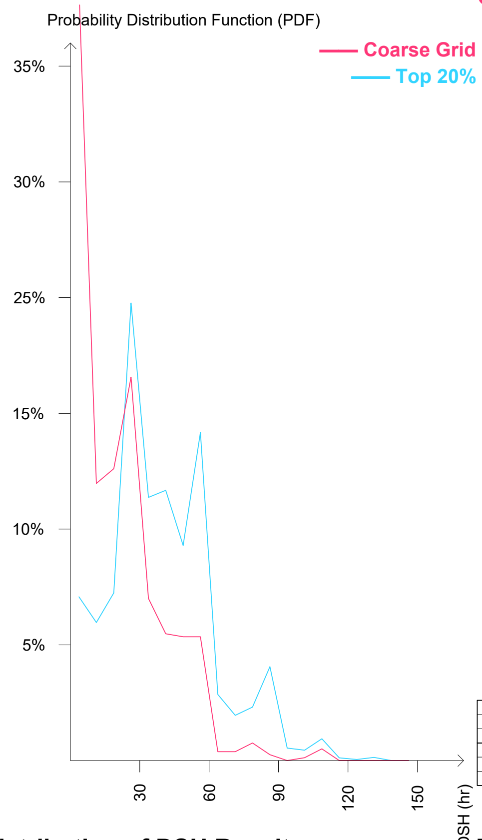




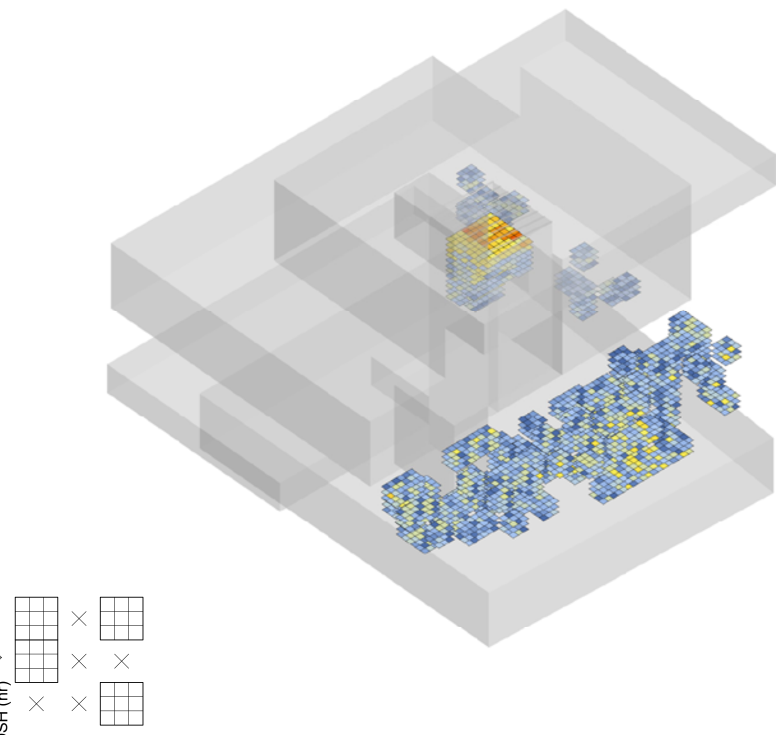
Coarse Grid 3m x 3m x 3m



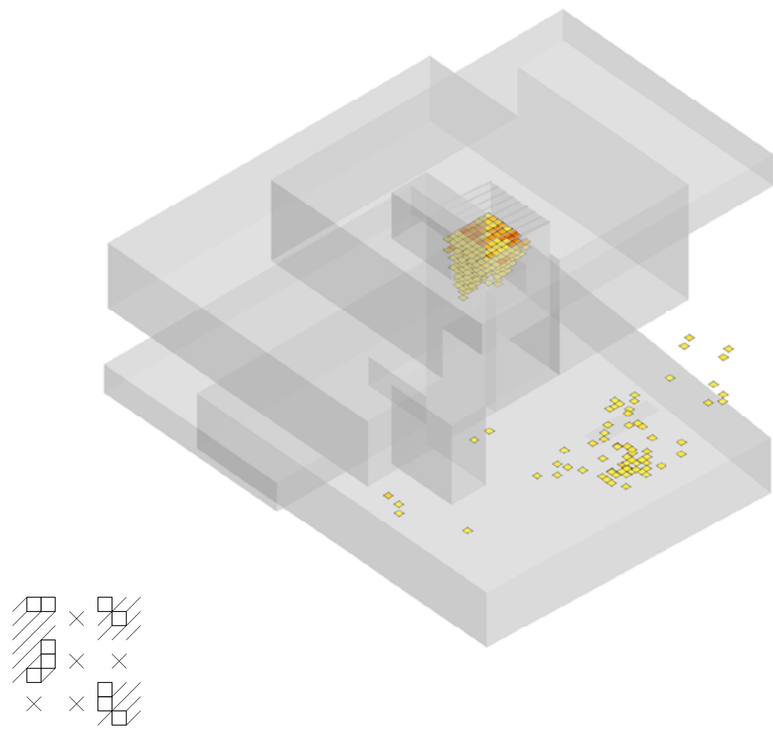
Top 20% of the Coarse Grid



Distribution of DSH Results



Top 20% of the Coarse Grid - Tessellated Grid 1m x 1m x 1m



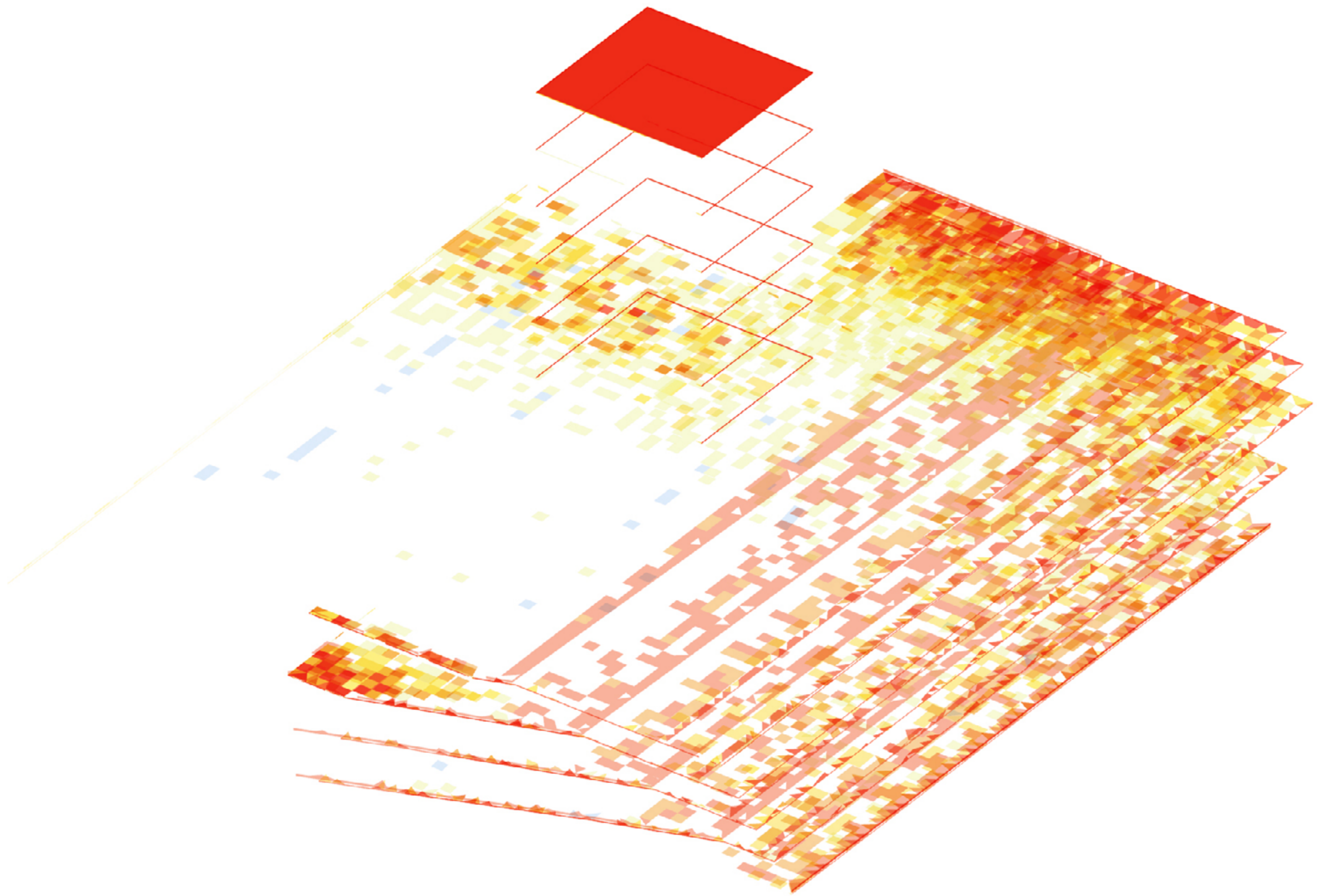
Top 10% of the Tessellated Grid - Singularised Grid 1m x 1m x 1m

SINGULAR ARTEFACT

00: Singularization Pathmap
01: Digital Model
02: Simulations
03: Physical Model

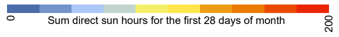
Singularization Pathmap

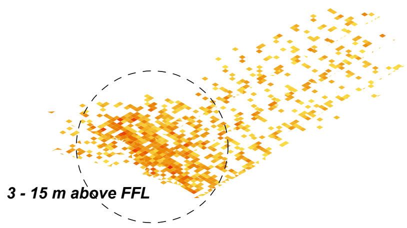
Facade Tilting Angle -- Direct Sun Hours



00: Singularization Pathmap

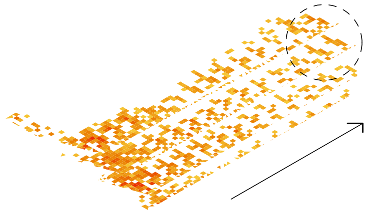
Facade Tilting Angle -- Annual Direct Sun Hours



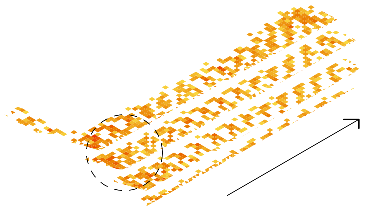


January
It is noticed that there is a concentration of points of anormaly around the corner in the south.

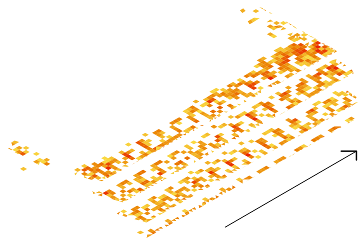
February
Direct solar exposure is decreasing even for anormaly points in the south, and such trend relates to the general reduction in direct solar exposure for the overal volume. Contributing factors to this phenomenon is therefore presumed as the rise of sun altitute angle which increases the amount of direct rays blocked by the overhead building volumes and shading devices.



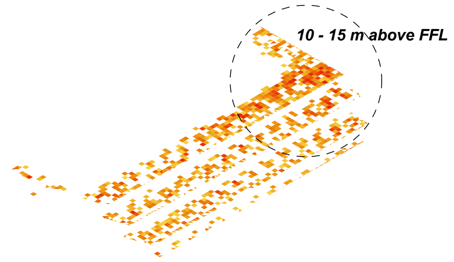
March
It is observed that there is an increase of solar gain at the north end and the general pattern of direct sun access presents a shift towards the northern part of the volume.



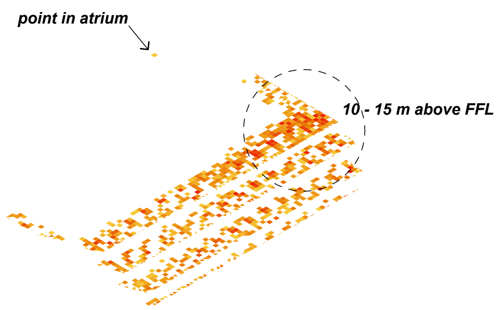
April
In this month the access to direct sun could be regarded as almost homogeous throughout the volume.



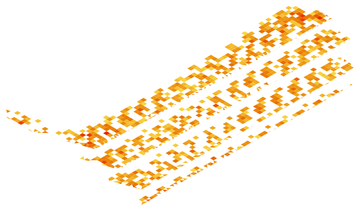
May
As points of anormaly continuously shift northwards, it is noticed a difference in direct solar access at two ends of the volume.



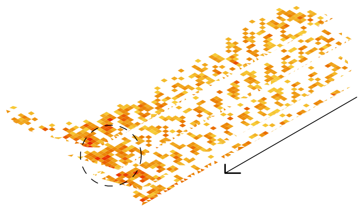
June
It is noticed that there is a concentration of anormaly points with considerable access to direct sun throughout the month, and such concentration are distributed in the north end of the volume. Specficially, typical locations range from 10 metres to 15 metres above the finished floor level of the lobby.



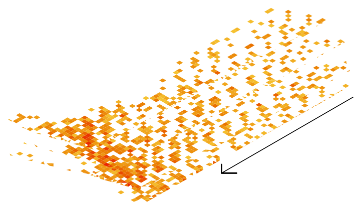
July
In July, it follows almost the same pattern as in June, and it is also predicted that for the rest of the year the distribution of anormaly points would regress backwards to the south as is the opposite to the first half of the year.



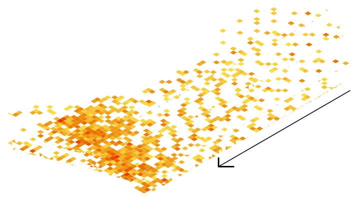
August
In this month the anormaly points became again homogeneously distributed.



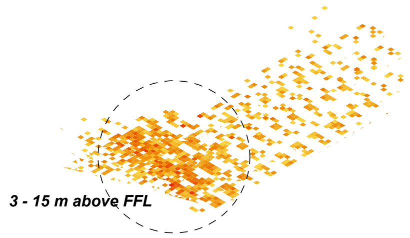
September
As the points of anormaly move southwards, there is a rise in such points of strong direct solar access in the southern corner.



October
The anormaly points in the north almost disappears as they rise in the south, ranging from 3m to 15m above thefinished floor level.



November
The scope of anormaly points in the south expand spatially, while the extreme values gradually blend into the overal increase of direct solar access.



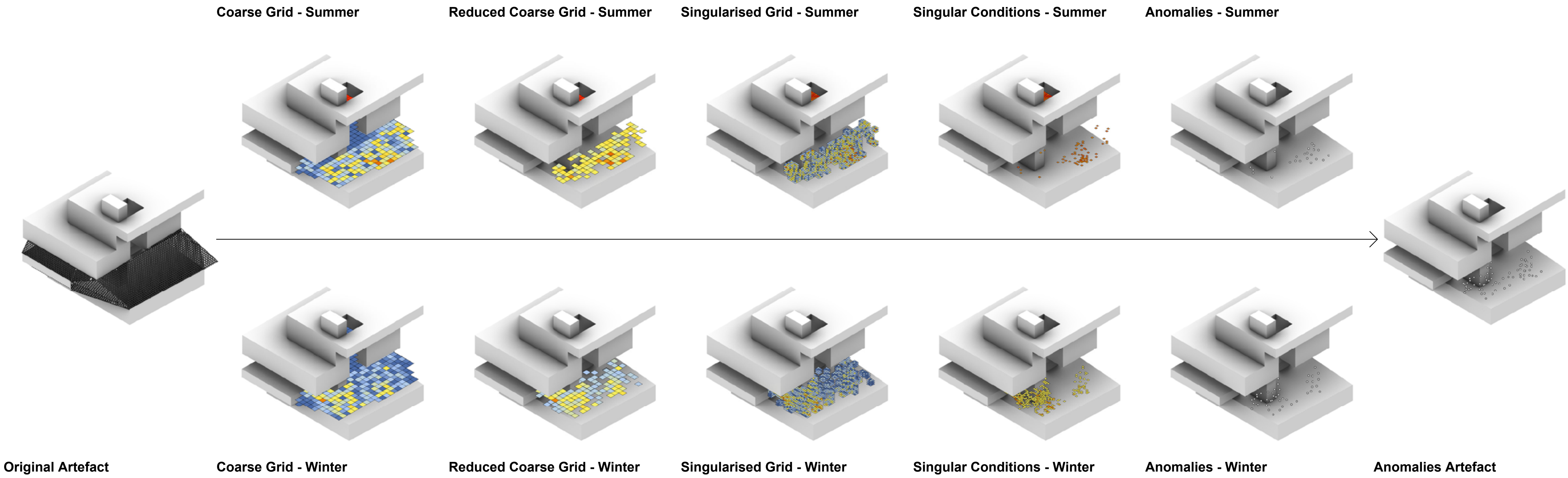
December
Again in December there is a concentration of points of anormaly with effective access to direct sun light in the south part of the volume, ranging from 3 m to 15 m above the finished floor level.

From the Coarse Grid to the Singularised Grid

Singularisation Pathmap (1)

Variation Parameters:

Facade Tilt:	*+0 deg*
Atrium X:	*12m*
Atrium Y:	*12m*
Mezzanine Offset:	*0m*

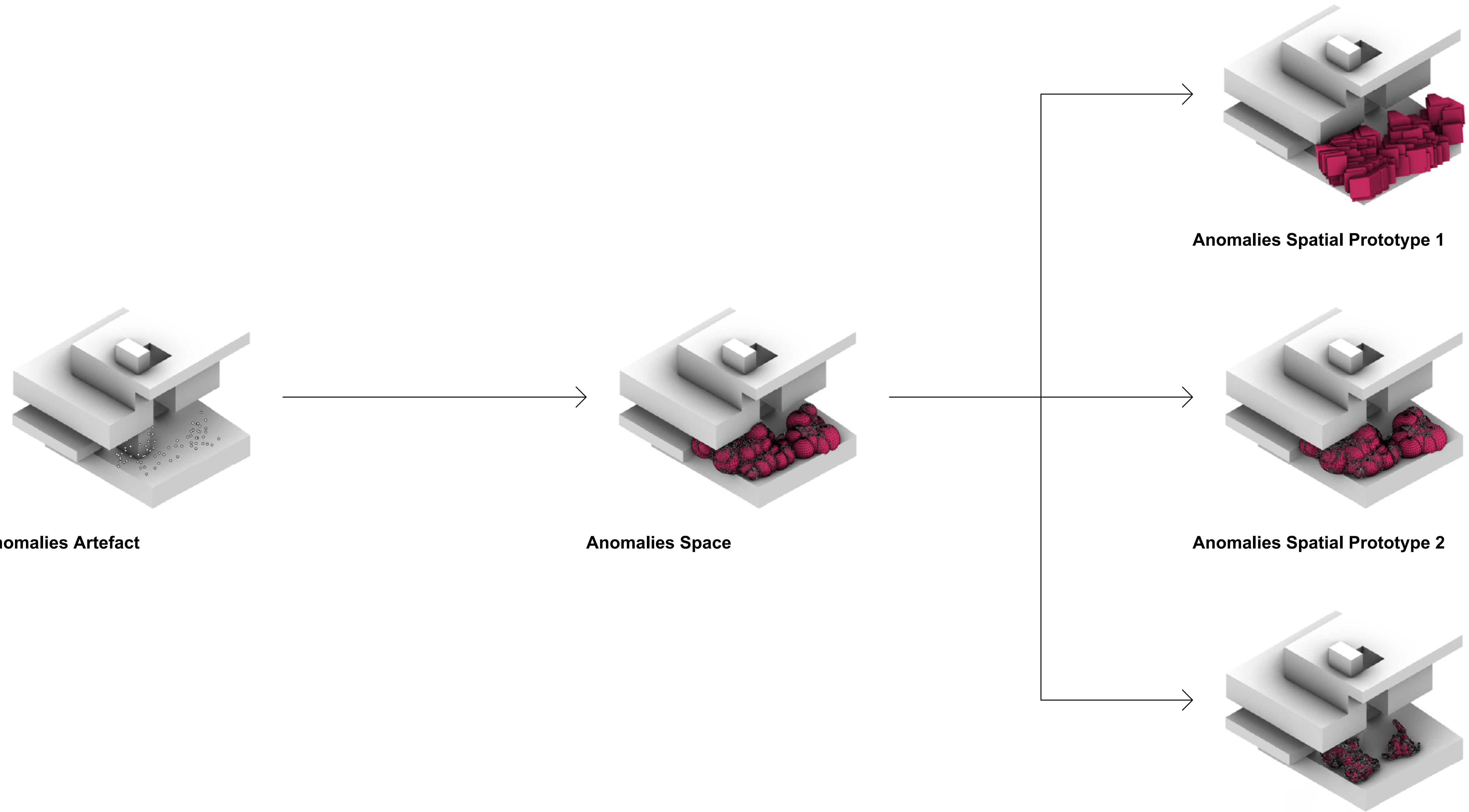


From the Coarse Grid to the Singularised Grid

Singularisation Pathmap (2)

Variation Parameters:

Facade Tilt:	*+0 deg*
Atrium X:	*12m*
Atrium Y:	*12m*
Mezzanine Offset:	*0m*



Anomalies Artefact

Anomalies Space

Anomalies Spatial Prototype 1

Anomalies Spatial Prototype 2

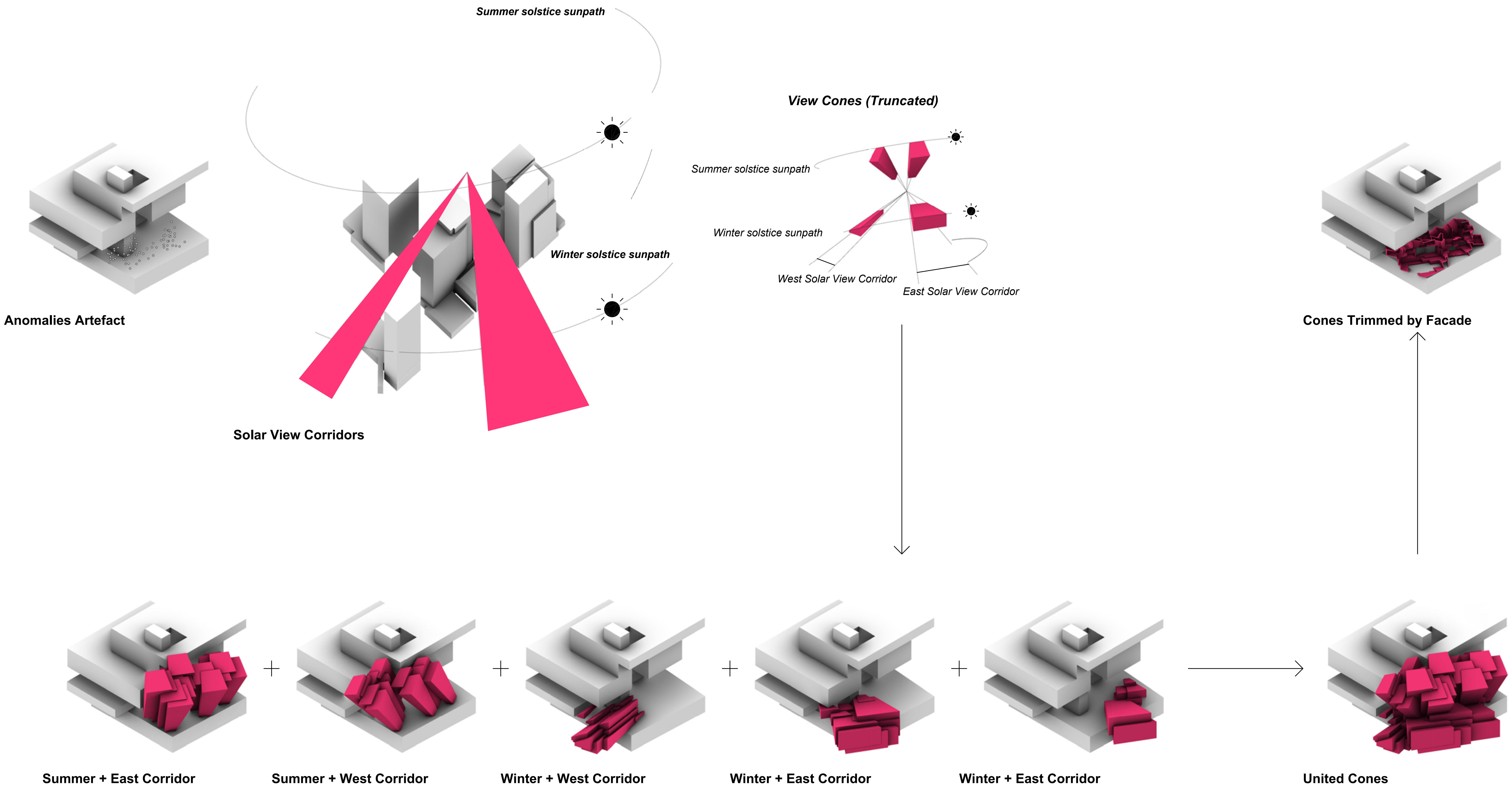
Anomalies Spatial Prototype 3

From the Coarse Grid to the Singularised Grid

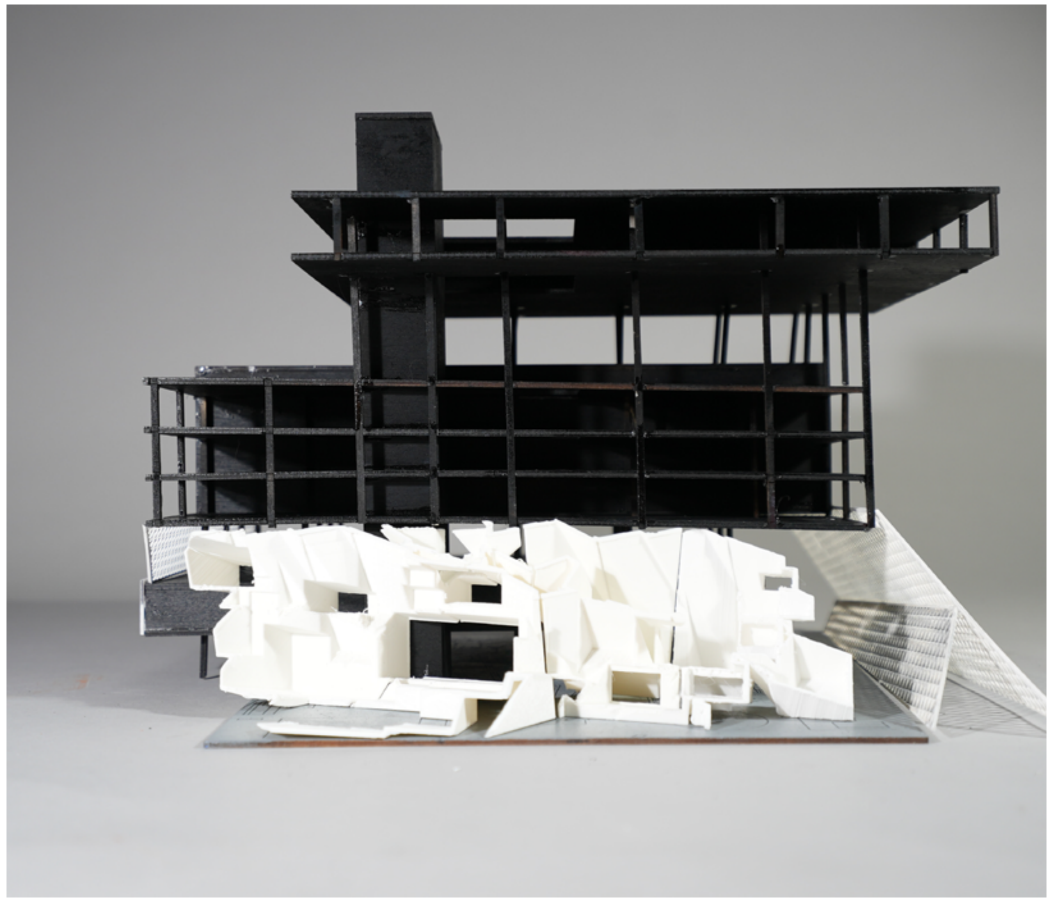
Singularisation Pathmap (3)

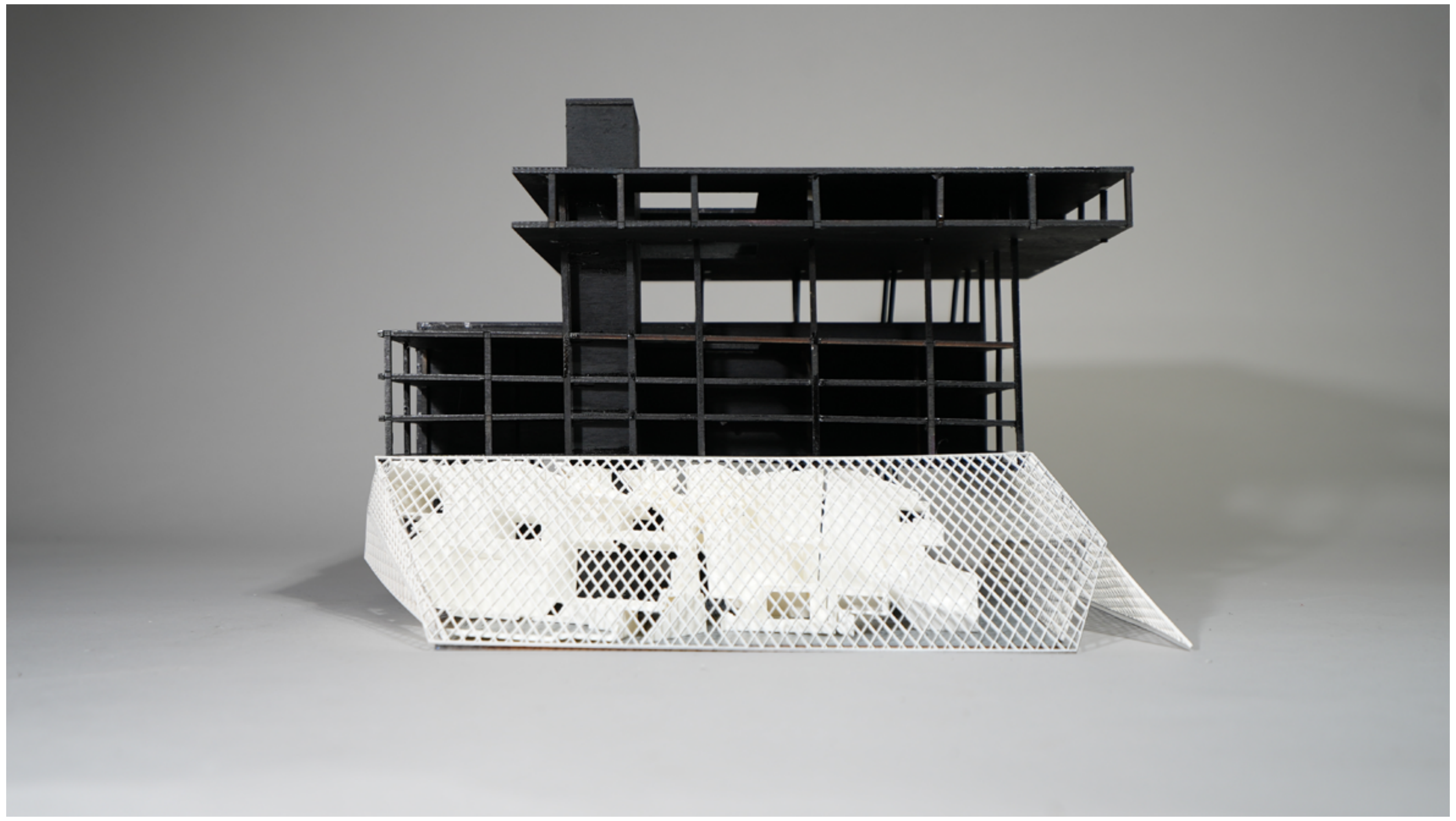
Variation Parameters:

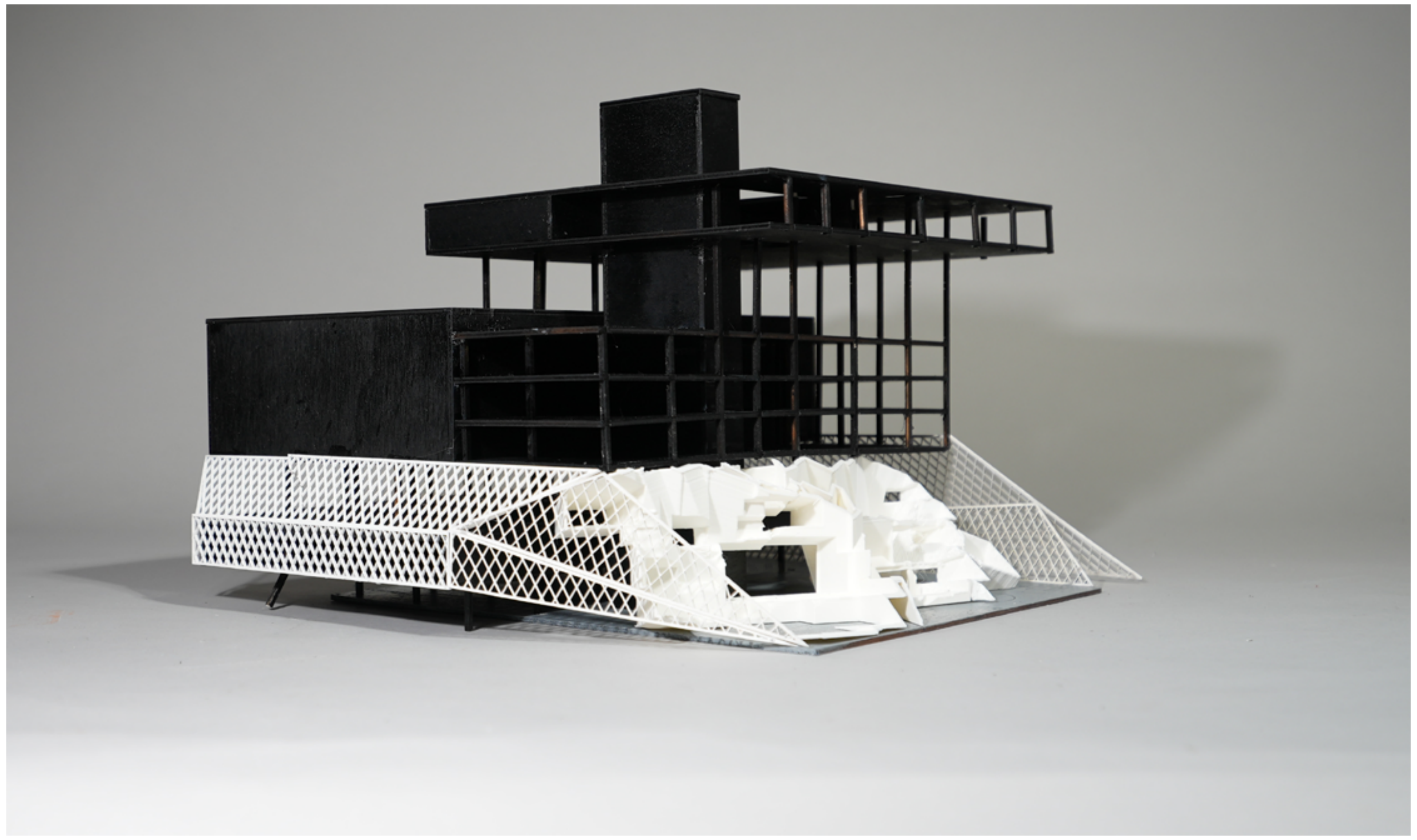
Facade Tilt:	*+0 deg*
Atrium X:	*12m*
Atrium Y:	*12m*
Mezzanine Offset:	*0m*



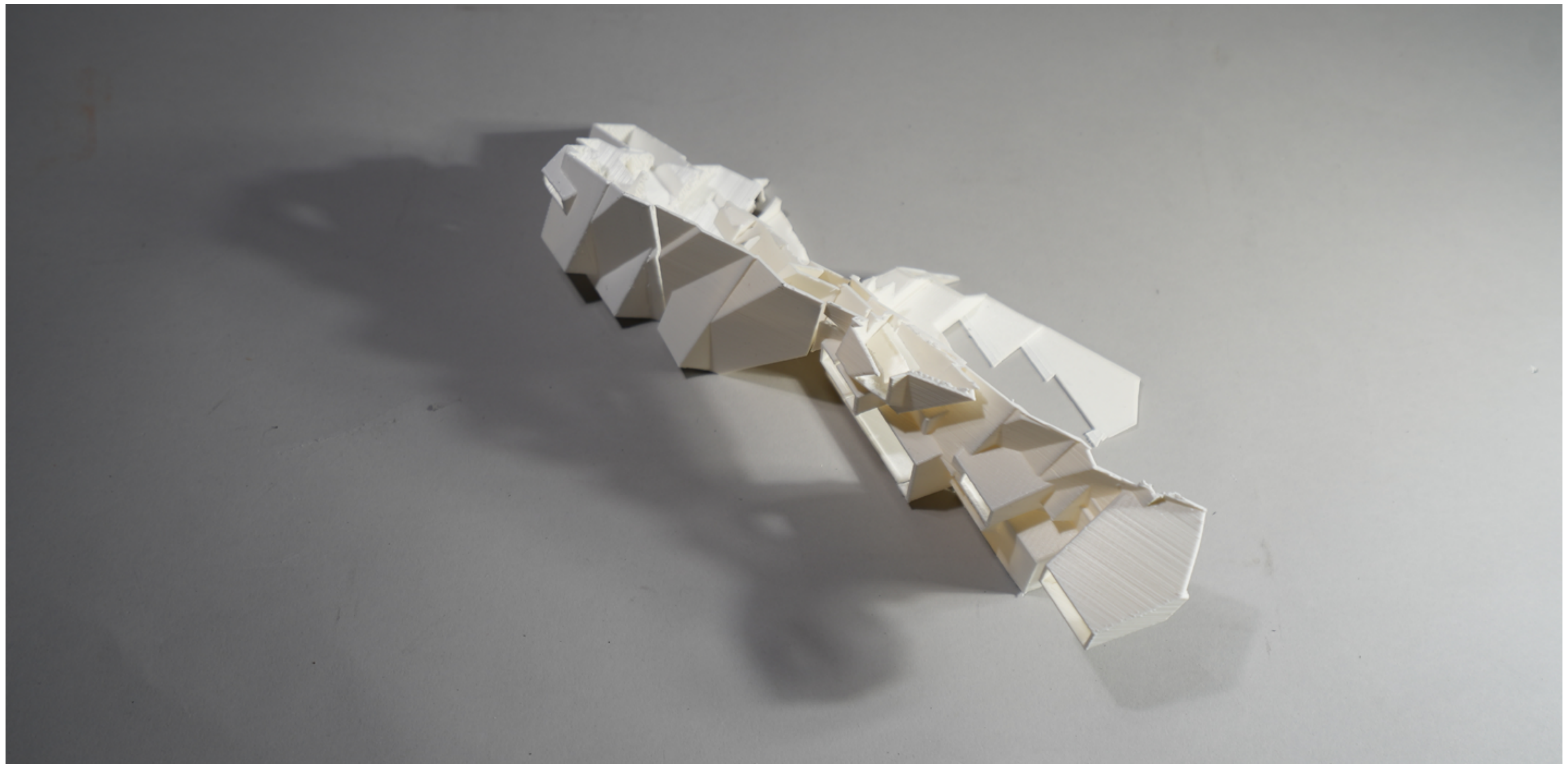
01: Physical Model







01: Physical Model




directory
welcome


welcome