SINGLE STOREY COURTHOUSE

Issue

The nature of ths courthouse program requires secured envelops and restricted opening profiles. The programs located on the east and south parts of the site including semi-secure and secure areas particularly secure circulations, judge's chambers, archives, jury's lounges and holding cells are subject to this issue. Though the need of openings for natural light is challenged by this aspect.

Solution

a) Openings/ perforation for natural light to be placed on roof with typologies of courtyard, light well
b) Windows along the perimeter of the site to be placed above human eye level

Objectives

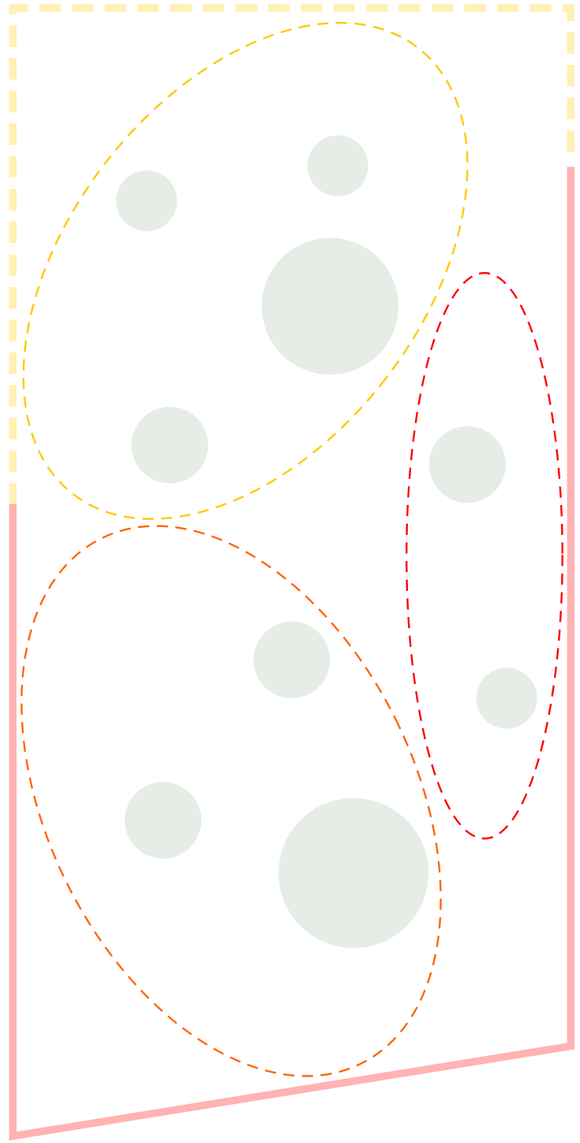
a) Size and placement of windows on exterior walls determined to block the visual contact from the street level
b) Interior glazing for courtyards and light wells to be to provide enough natural light into the interior
c) Daylight factor to be larger than 2% and smaller than 20% in overall

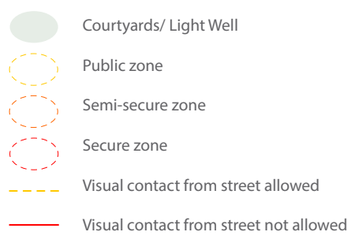
Analytical approach

a) Break down the base geometry into floor, ceiling, wall, glazing (interior + exterior) and assign them relative materials using Honeybee + Grasshopper
b) Generate test points using Honeybee + Grasshopper
c) With the test points run the Daylight Factor Simulation using Honeybee + Grasshopper
d) Run Daylight Analysis using Honeybee
e) Create a color map of the result for visualization using Ladybug
f) Calculate Daylight Factor using Grasshopper
g) Re-categorize the glazing into interior + exterior using Honeybee + Grasshopper
h) Re-create the exterior glazing with sill height of 4 and a parameter of window to wall ratio using Honeybee + Grasshopper
i) Generate exterior glazing iterations with 10% increment of window to wall ratio using Colibri + Grasshopper

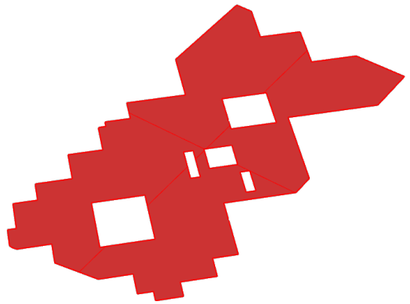
Result

When both interior and exterior windows are at 100% the ratio of daylight factor is 0.51935, but polarization of daylight factors between interior and perimeter of the site occur; most parts of interior except for the areas around courtyards and lightwells are below 2% and the perimeters of the site are above 20%. Though the low daylight factor for the most of interior areas is necessary as those areas include courtrooms. Still, the excessive amount of sunlight on the perimeter needs to be controlled. According to Colibri results, the exterior window to wall ratio 50 and 60% show reasonable amount of sunlight for the perimeter, although the daylight factors of some parts like south entrance are above 20%.

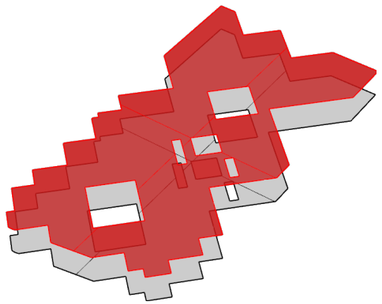




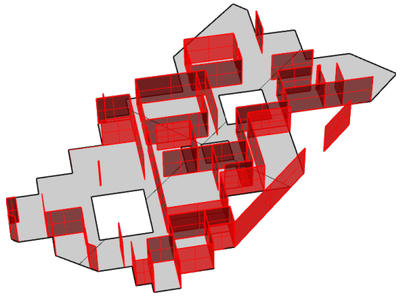
BASE GEOMETRY



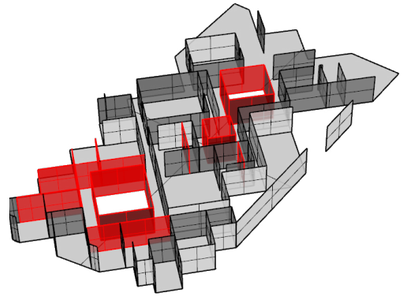
FLOOR



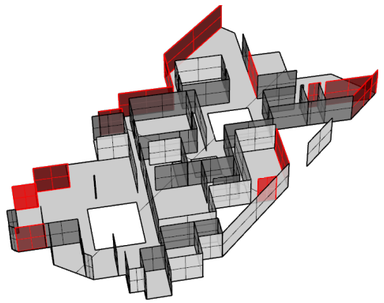
CEILING



WALL

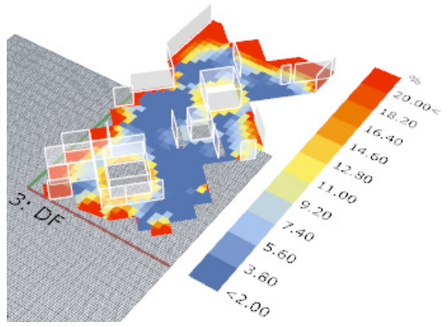


INTERIOR GLAZING

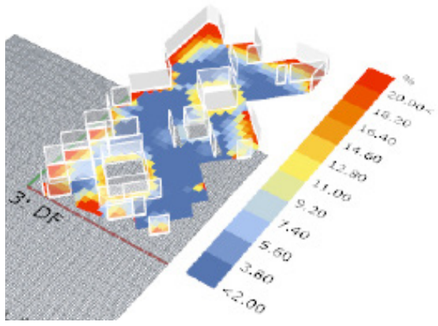


EXTERIOR GLAZING

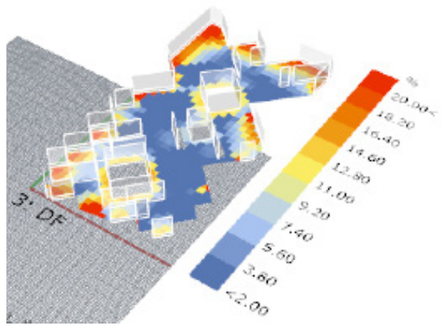
DAYLIGHT FACTOR ANALYSIS



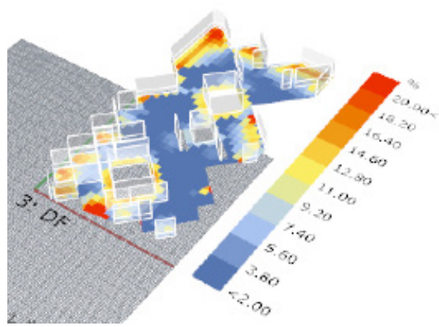
RATIO OF GLZING 100%
RATIO OF DF 0.51935



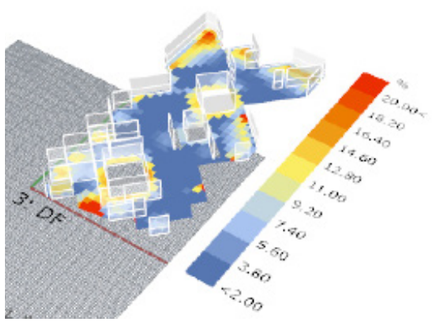
RATIO OF EXTERIOR GLAZING 90%\
RATIO OF DF 0.588094



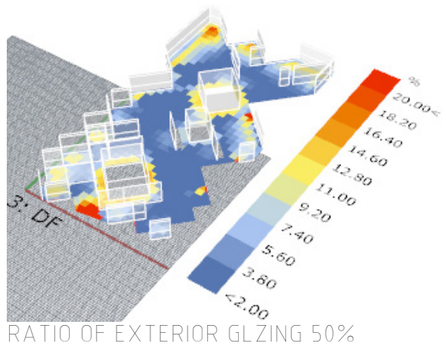
RATIO OF EXTERIOR GLAZING 80%
RATIO OF DF 0.631594



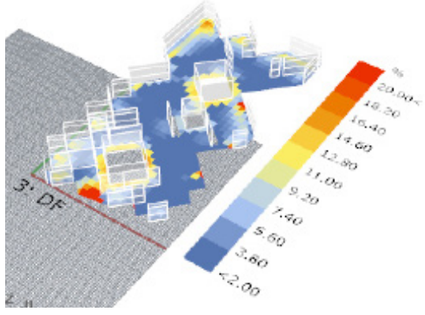
RATIO OF EXTERIOR GLAZING 70%
RATIO OF DF 0.638368



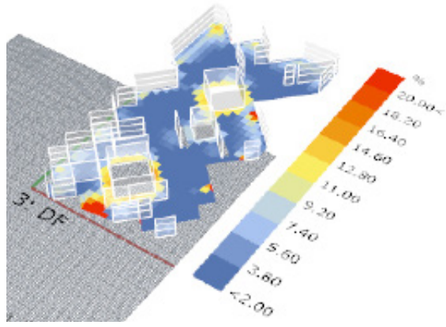
RATIO OF EXTERIOR GLAZING 60%
RATIO OF DF 0.632459



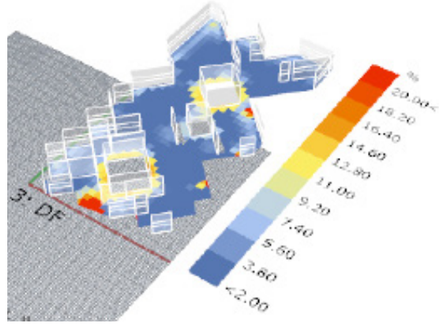
RATIO OF EXTERIOR GLZING 50%
RATIO OF DF 0.618354



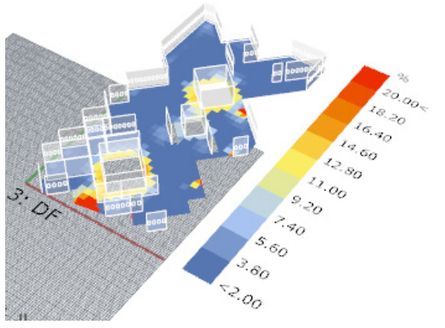
RATIO OF EXTERIOR GLAZING 40%
RATIO OF DF 0.598306



RATIO OF ETERIOR GLAZING 30%
RATIO OF DF 0.562048



RATIO OF EXTERIOR GLAZING 20%
RATIO OF DF 0.509238



RATIO OF EXTERIOR GLAZING 10%
RATIO OF DF 0.3571

Honeybee + Grasshopper

Break down the base geometry into floor, ceiling, wall, glazing (interior + exterior) and assign them relative materials

Honeybee + Grasshopper

Generate test points

Honeybee + Grasshopper

Daylightfactorsimulation

Honeybee + Grasshopper

Daylight Analysis

Ladybug

Visualization of Daylight analysis

Grasshopper

Calculate Daylight factor

Honeybee + Grasshopper

Re-categorize the glazing into interior + exterior

Honeybee + Grasshopper

Re-create the exterior glazing with sill height and window to wall ratio as parameters

Colibli

Generate exterior glazing iterations with 10% increment of window to wall ratio