Fall 2021

Spatial Daylight Autonomy Study

Portland State University. School of Architecture

SRG Architects

Spatial Daylight Autonomy Study

For LEED V 4.1 Daylighting Credits | Matthew Dascomb and Naomi Hess | In collaboration with SRG

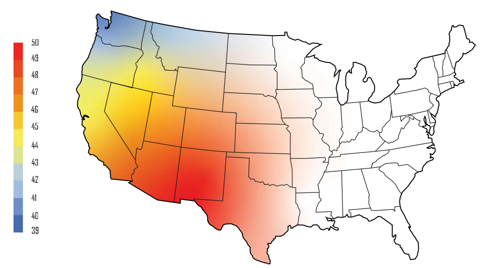
PORTLAND STATE UNIVERSITY ::
SCHOOL OF ARCHITECTURE

Premise

SRG has run into a problem with the current LEED V4.1 when it comes to achieving daylighting credits for mid-rise buildings in the Pacific Northwest. The higher in latitude a structure is on the globe, the less potential sunlight will reach it. In order to calculate how much sunlight enters a space we partnered with SRG to create a tool to help determine how much usable daylighting enters a space. From this tool we want to collect data from different latitudes to show discrepancies in the possible daylighting conditions in these locations, and then finally organize this data in a meaningful way that can be used in lighting design phases of future SRG projects.

Standard Daylight Autonomy

Standard daylight autonomy is a measurement of determining if a space is suitable for human occupancy over an extended period of time. The hope is that if a space is well lit, then it provides a healthier experience for the human occupants who use the area for extended periods of time. It is typically used for working in office settings, because individuals are usually stationed in a single place for an extended period of time. standard daylight autonomy is calculated by measuring the percentage of floor area that has workable lighting during fifty percent of the work day.

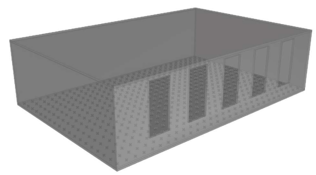


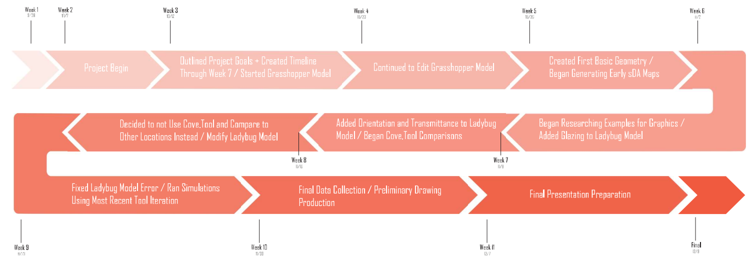
Geometry

For the simulations, we first started with the analysis of a baseline geometry, and from that point we changed parameters as required to fulfil the requirements for desired daylighting analysis. The Grasshopper script was designed by the team in order to maintain certain constants in glazing in order to maintain a likely building typology that fits into SRGs ideology. The baseline parameters of the geometry are as follows.

Floor to ceiling bay height - 15 feet
Bay depth - 40 feet
Bay width - 60 feet
Window spacing - 10 feet
Sill height - 42 inches
Window height from ceiling - 6 inches
Glazing percentage - 30 percent
Window transmittance - 65 percent
Orientation - East
All wall, floor, and wall thickness are set to 5 inches

Through the various plugins we are able to gather weather data, as well as calculate daylighting that can enter into the space, which can be interpreted by the program in order to see which areas fit within the required range to achieve spatial daylight autonomy.
All aspects above can be changed through the workflow put together by our team in Rhino. Working in this way will take away some known factors, such as shade cast by surrounding buildings, and other outside factors should be considered when using this tool.



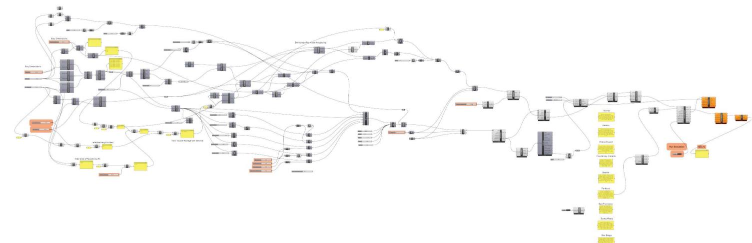


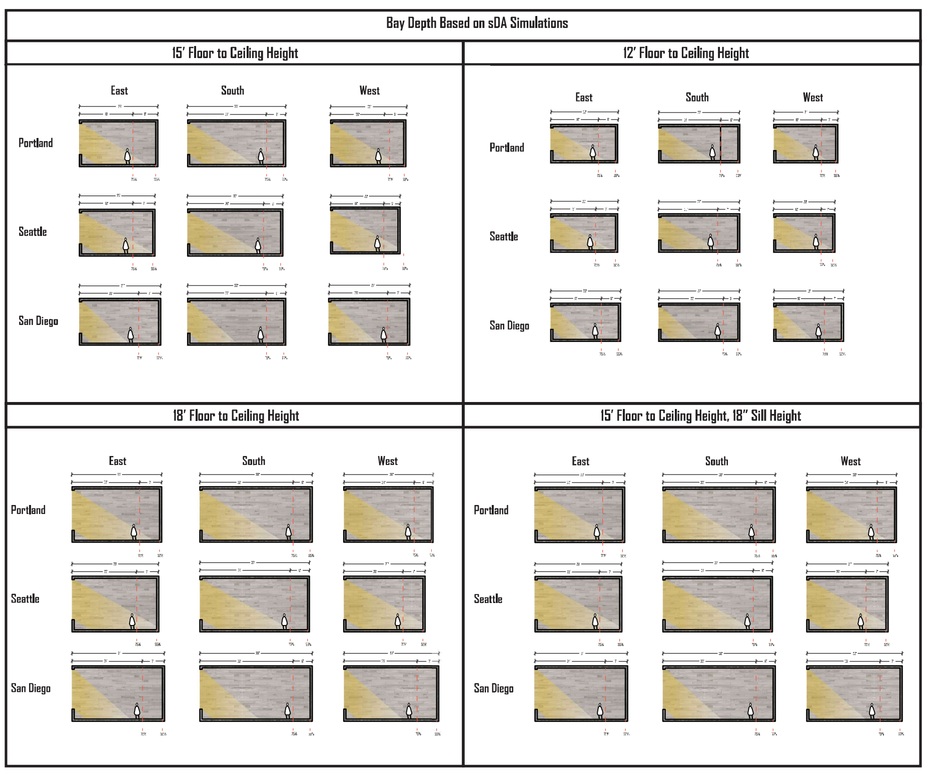
Rhinoceros
Base program that allows for the visual representation of geometries

Grasshopper
Built in extension of Rhino used to create easily changeable geometry based on a workflow

Ladybug
Organizes weather data collected from airports and weather stations, and provides the sun path

Honeybee
Generates sDA and adds the ability to modify glass type to more accurately calculate daylighting conditions in an enclosed envelope





LEED Daylighting Credits

Spatial daylight autonomy is the percentage of floor area that has workable lighting during fifty percent of the work day.
LEED V4.1 :
Option 1- Simulate Spatial Daylight Autonomy: Using computer simulations show that spatial daylight autonomy can be achieved with between 300 lux and 1,000 lux for 9 a.m. and 3 p.m
sDA of 55% of the floorspace - 2 points
sDA of 75% of the floorspace - 3 points
Option 2- Simulation: Illuminance Calculations through computer modeling that illuminance levels will be between 300 lux and 3,000 lux for 9 a.m. and 3 p.m.
75% illuminance - 1 point
90%illuminance - 2 points
Option 3- If the building is already completed, the lighting can be calculated using specialized equipment. Equipment measurement should fall between 300 lux and 3,000 lux.
75% of the area achieves illuminance - 2 points
90% of the area achieves illuminance - 3 points

In order to achieve daylighting credits from LEED it is important to note that either manual or automatic shading devices are required in order to control the amount of glare entering into the building. This aspect of the process is not shown within our model, but without this, the building will now fulfill the requirements.

Process

Using the completed Grasshopper workflow we were able to determine the bay sizes that would qualify for reaching both the 55% and 75% of floor space that would obtain spatial daylight autonomy based on our parameters. Data was collected for various locations, floor to ceiling heights, and a change in the sill height in order to how it would affect the overall bay depth. With these bay depths, a rough shape of a building can be put together that fulfills the requirements for full point in spatial daylight autonomy. Spaces that are on the north side of the building that do not meet the minimum requirements for spatial daylight autonomy can be used for areas not occupied by people.

The graphics shown show the location, parameters, and the percentage of space within the 60 foot by 60 foot block that fulfills the requirements of spatial daylight autonomy.

Additional Information

There was an attempt to find a tool that we could compair ours to in order to find the accuracy. It was through compairing our work with that of Cove.Tool that we found out our numbers where far from what they were suppost to be, however knowing this we were able to fix the issues with our model and create one that is much closer to that of which it should be.

While closer to the results of Cove.Tool, our simulations were comming up off. from the simulations we compaired it seemed that the results were not off by a common percentage, but rather they were off by a constant integer of five.