Volta

BORA
ARCHITECTURE & INTERIORS

Project

This project aims to renovate the existing building, both the exterior and interior. For this renovation, BORA has committed to meeting ambitious sustainability goals. Among these is to convert the building into a net-zero energy (NZE) building. The research this term supported this NZE effort by studying the existing building and testing strategies to improve its performance. The team identified multiple opportunities to implement passive strategies, but decided to go with daylighting strategies.

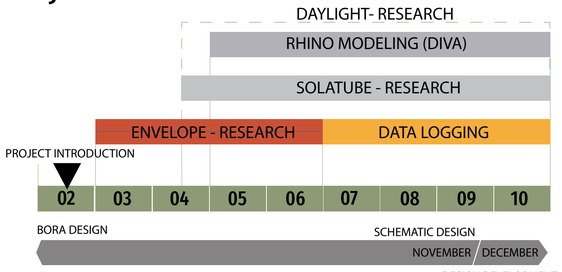
SOFTWARE USED

HOBO® Data Loggers

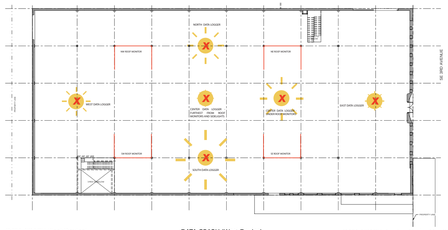
DIVA

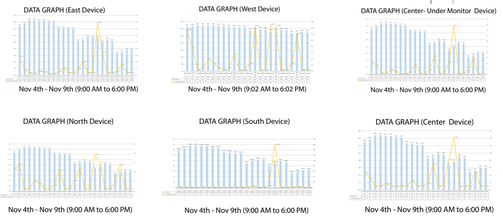
SOLATUBE®

Project timeline



Light and Temperature Levels

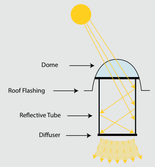




The data extracted from the HOBO data loggers were selected to target the light and temperature levels in the building during working hours. These graphs contain 5 min readings for the period of six days, the compiled data corresponds with Boar's working hours from 9:00 AM to 5:00 pm. Shown on the plan are the measured light intensity, which indicates higher levels on the South, North, and under the monitors as high as 1615.4 Lum/ft2. However, lower light levels are found from the Center, East, and West as low as 0.4 Lum/ft2. Whereas, temperature levels are relatively the same throughout the building.

Portland State UNIVERSITY

Solar tubes Data



Solar tubes are pipes that transport and distribute natural light. A light tube uses highly reflective material or plastic optical fiber to lead the light rays through a building. It can also be a prism light guide distributing light uniformly over its length.

Solar Tube Components

-Dome
Can be glass or acrylic dome. It's purpose is to collect sunlight, with new advanced technology the sunlight is captured throughout the day and functions to harvest low angle sunlight. Some domes include thermal insulation panels to reject intense sunlight from entering.

-Flashing
Flashings offer protection to the rooftop, It is used to ensure a leak proof piece to ensure seamless performance.

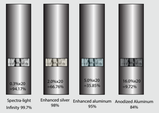
-Tubes
Transmits light using reflective materials such as; spectra-light infinity, enhanced silver, enhanced aluminum, and anodized aluminum

-Diffusers
Are lenses that controls light diffusion and can provide light control using daylight dimmer

Residential Spaces:
- Bathroom
- Closet
- Kitchen
- Entry
- Hallway
- Laundry room
- Living area
- Stairs

Commercial Spaces:
- Office
- Retail
- Sport facility
- Warehouse
- Education facility
- Airports
- Military

Percentage of light after 20 Bounces

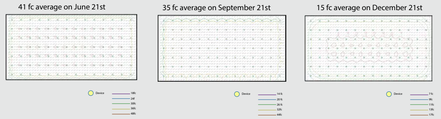


	Solar Tubes	Desirable effect	Undesirable effect
Installation	The installation is generally simpler than skylights.	●	
Energy Efficiency	No loss of cooling and heating energy.	●	
UV Rays	UV rays are blocked at the solar dome before entering the tube.	●	
Water Condensation	Condensation can be an issue inside the tube in climates with high humidity. However, there are latest modifications to include ventilators.		●
View	No view of exterior skylight.		●
Glare	No glare, since the space is not exposed to direct sunlight.	●	
Maintenance	No maintenance needed except for the up keeping of the dome	●	

SOLATUBE Studies

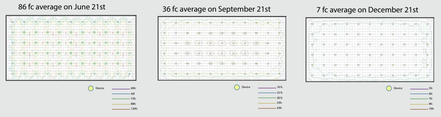
- Option 1

750DSO (21")
98 Devices
Rows: 7
Row Spacing: 14.0 ft
Columns: 14
Column Spacing: 14.0 ft



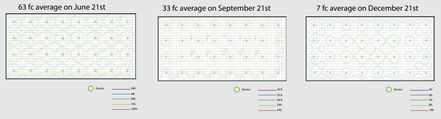
- Option 2

M74DSO (29" tubing)
66 Devices
Rows: 6,
Row Spacing: 16.0 ft
Columns: 11,
Column Spacing: 18.0 ft



- Option 3

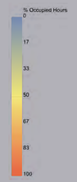
M74DSO (29" tubing)
Collector 32 devices
Rows: 4
Row Spacing: 25.0 ft
Columns: 8
Column Spacing: 25.0 ft

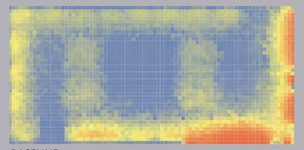


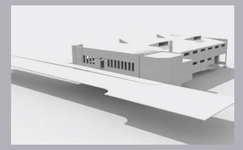
Monitors Data

The Design Team studied different options for the roof monitors, to achieve maximum spatial daylight autonomy (sDA) deep into the center of the building.

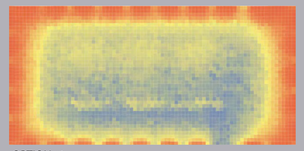
Spatial Daylight Autonomy (SDA) is the percentage of floor area that receives at least 300 lux (30 fc) for 50% or more of the annual occupied hours. ASE evaluates if a space receives too much direct sunlight, which could cause visual discomfort or increase cooling loads. ASE is measured as a percentage of the total floor area. This option requires that the project's Annual sunlight exposure (ASE) is 1000,250 (1000 lux for at least 250 hours) for no more than 10% of the project floor area.



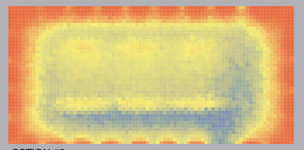




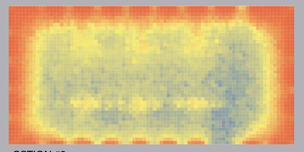
BASELINE:
As is, clerestory windows around perimeter and four (4) roof monitors.



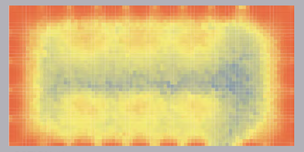
OPTION #1:
Bring perimeter window sills down to 30" above finish floor, and add two (2) monitors in between existing monitors.

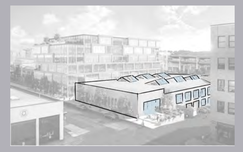


OPTION #2:
Same as option #1, but add glazing to side of all roof monitors.



OPTION #3:
Same as option #1, but double the height of all monitor glazing from 5ft to 10ft.





OPTION #3:
Same as window sill heights as option #1, add two (2) monitors in between existing monitors, orientate all monitors to the north, and tilt the glazing back 30-degrees from the vertical axis.

The client was most intreged by option #3, so the design team will further investigate this option.

Potential Issues and Glazing Properties

At this time there is concern for glare at the side-lites. Glare is difficulty of seeing in the presence of bright light such as direct or reflected sunlight, due to the size of the side-lites. Important factors to consider when evaluating glare and daylighting are the properties of the window glazing, and the materials within the space being lit. Visible Light Transmittance (VT) is a material property of glass and is the amount of visible that passes through a glazing material. A higher VT means more daylight can enter a space through the window. If designed properly, this can help offset electric lighting and its associated cooling loads.

Conclusion

Solar Tubes might be a viable option for core lighting but they due have some equity issues. Does a person in the center of the building feel like they have the same kind of natural daylight as someone at the perimeter of the building?

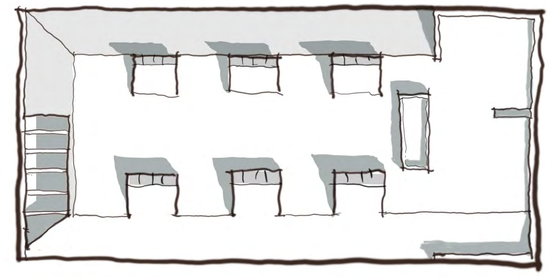
Also there is a cost to solar tubes, if 66 were installed on this project at $782.50 a unit, that would be $51,645 not including taxes .

Lastly, there is the cost of rebuilding and building new roof monitors. The glazing will the tilted, which will introduce leakage problems, as well as upgraded structure.

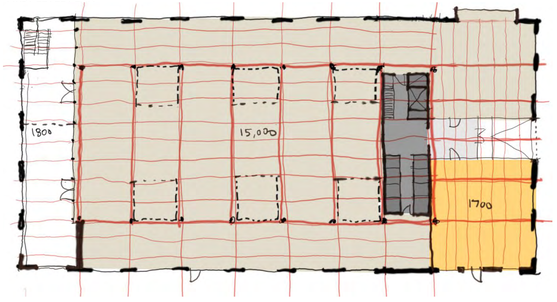
Once Schematic Design has been completed, everyone has agreed on the scale and scope of the design and the general direction that a project will take. As Bora moves into Design Development phase, there will still be many details to work out. After doing most of their schematic design work by hand, they generally will translate the design to the computer so that we can be more accurate with dimensions – make sure everything fits.

Below you can find Bora's Schematic Design for the Volta Project.

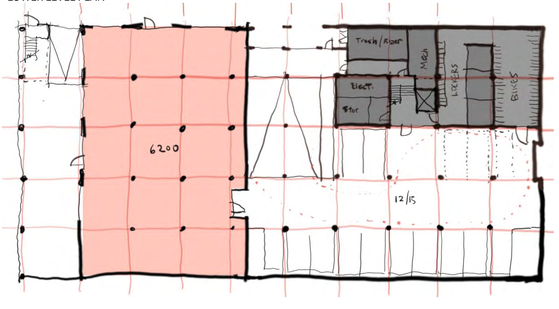
ROOF PLAN



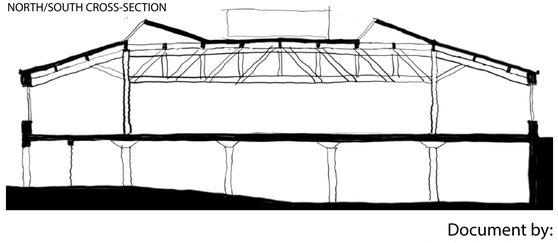
FIRST LEVEL PLAN



LOWER LEVEL PLAN



NORTH/SOUTH CROSS-SECTION



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