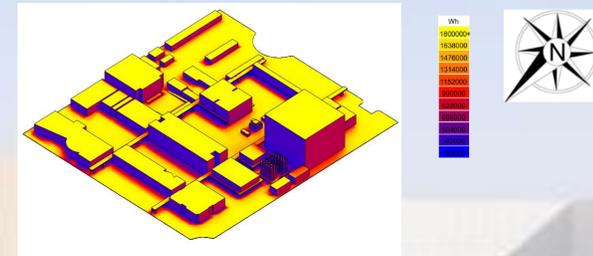


ENERGY AND DESIGN CLASS

Aram Al-Shareef, Abrar Bohassan, Yasmeen Ghaleb

Effat Campus Solar Radiation Analysis

Because all the top surfaces are hot, we recommend to provide shade for the walking areas. Especially, the exposed courtyards, like the one between the restaurant and the engineering building, and the one between the engineering building and the humanities building.



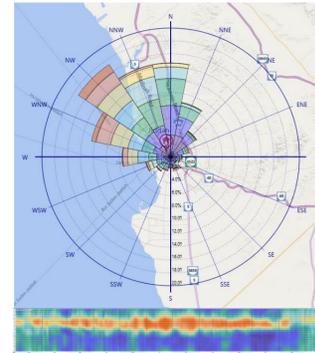
(1) Obtain Weather Data (Jeddah City)



The project chosen for the sun and shadow analysis is Effat University campus. It's located in Saudi Arabia, in the western area, Jeddah city.

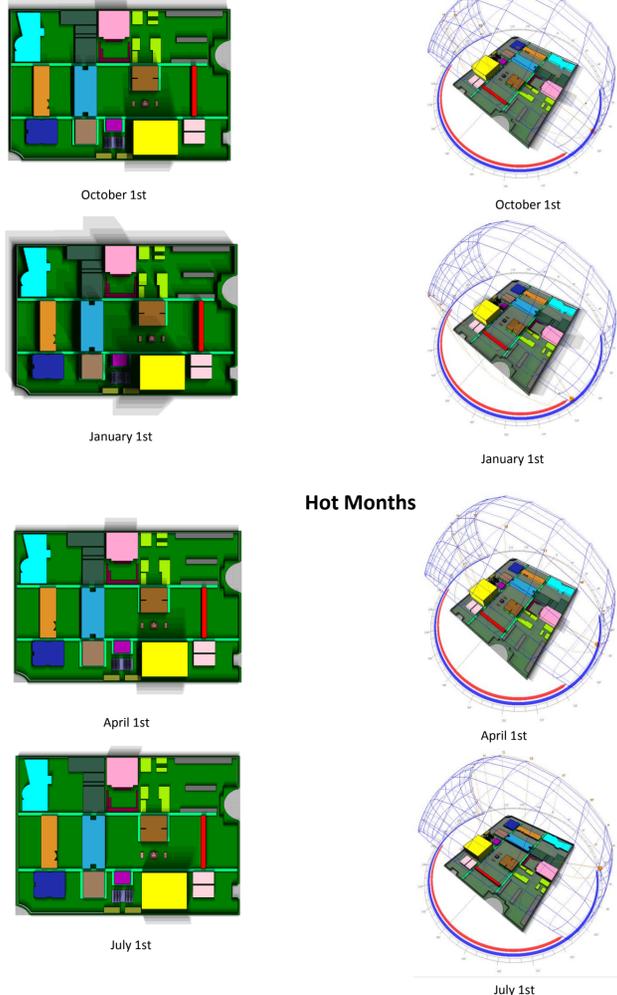
Climate data for Jeddah													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °C (°F)	34.5 (94.1)	36.0 (96.8)	40.2 (104.4)	44.5 (112.1)	48.2 (118.8)	49.0 (120.2)	45.0 (113)	44.0 (111.2)	48.0 (118.4)	44.5 (112.1)	39.0 (102.2)	36.0 (96.8)	49 (120.2)
Average high °C (°F)	29.0 (84.2)	28.8 (83.8)	31.1 (88)	33.4 (92.1)	35.4 (95.7)	36.9 (98.4)	37.6 (99.7)	37.2 (99)	36.1 (97)	35.0 (90.1)	32.3 (90.1)	29.8 (85.6)	33.55 (92.38)
Daily mean °C (°F)	25.0 (77)	23.5 (74.3)	25.1 (77.2)	27.6 (81.7)	29.6 (85.3)	30.3 (86.5)	32.4 (90.3)	32.1 (89.8)	30.7 (87.3)	29.1 (84.4)	27.0 (80.6)	24.7 (76.5)	28.09 (82.57)
Average low °C (°F)	21.0 (69.8)	18.4 (65.1)	20.1 (68.2)	22.1 (71.8)	24.1 (75.4)	24.9 (76.8)	26.3 (79.3)	27.1 (80.8)	25.9 (78.6)	23.8 (74.8)	22.2 (72)	19.9 (67.8)	22.98 (73.37)
Record low °C (°F)	11.4 (52.5)	11.5 (52.7)	11.0 (51.8)	13.5 (56.3)	16.4 (61.5)	20.0 (68)	20.5 (68.9)	22.0 (71.6)	17.0 (62.6)	15.6 (60.1)	15.0 (59)	11.4 (52.5)	11 (51.8)
Rainfall mm (inches)	13.9 (0.547)	5.6 (0.22)	1 (0.04)	5.1 (0.201)	1.5 (0.059)	0 (0)	0.2 (0.008)	0 (0)	0 (0)	2.4 (0.094)	11.9 (0.469)	11.9 (0.469)	53.5 (2.107)
% humidity	73	61	60	60	60	61	57	62	69	67	64	59	62.8

Source: NOAA (1961-1990)



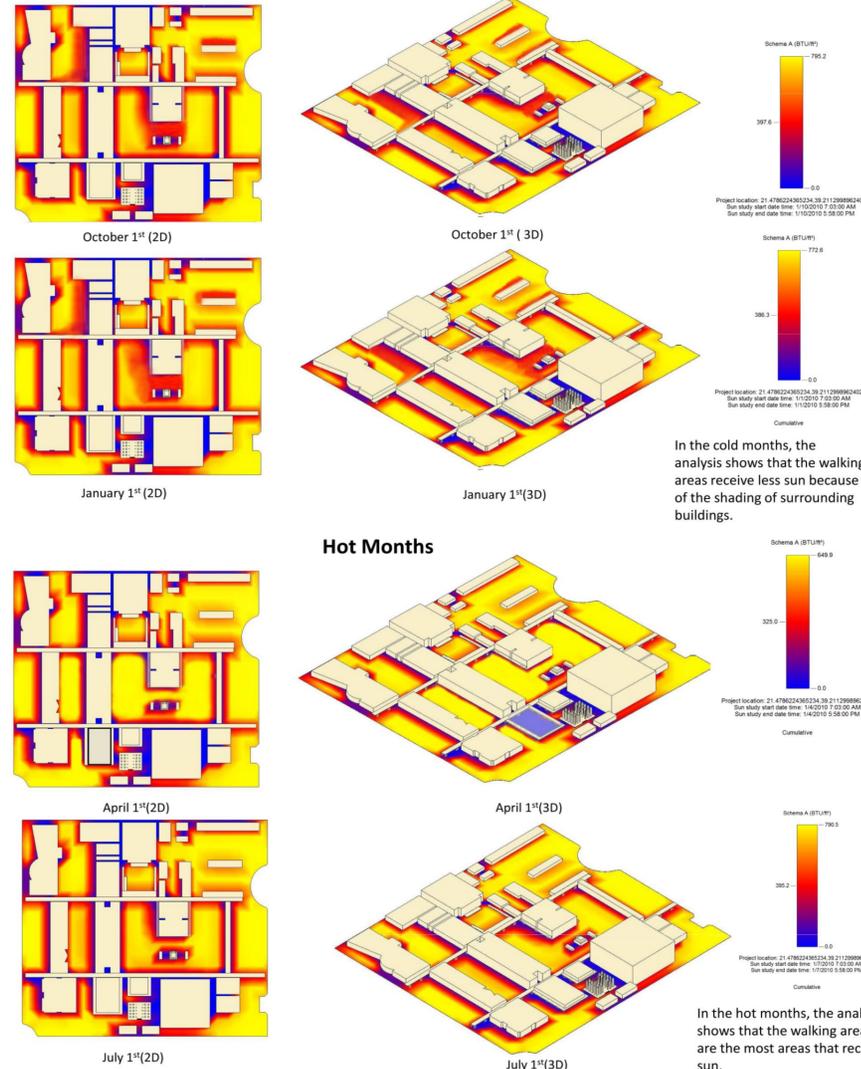
(2) Annual Shadow Range and Sun Position Analysis

Cold Months



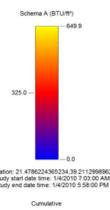
(3) Solar Radiation Analysis

Cold Months



In the cold months, the analysis shows that the walking areas receive less sun because of the shading of surrounding buildings.

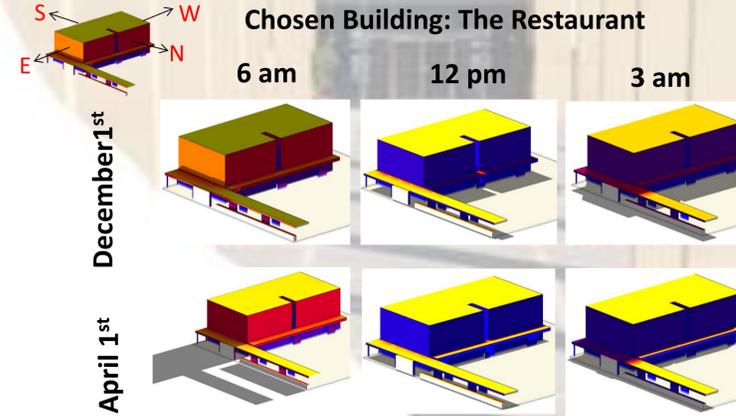
Hot Months



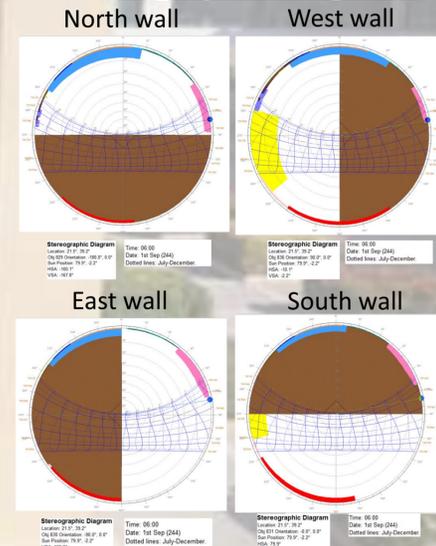
In the hot months, the analysis shows that the walking areas are the most areas that receive sun.

(4) Evaluation and Recommendation

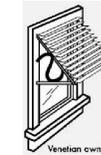
Chosen Building: The Restaurant



Stereographic Diagram



From the analysis of the chosen building (the restaurant). The analyses of these different months shows that the most area that receive hot solar radiation is the west side. So, we recommend to provide horizontal louvers to shade the interior from the direct sun.



From the Stereographic Diagram it shows that the masses that cast most shading is the mass of the student affairs building, then it is the engineering building, then followed by the Effat hall then the Residence building. After that it looks like rest of the buildings of the campus are ones casting minimum amount of shading.

Evaluation and Recommendation:

1) Shading devices and Canopies:
As shown in the solar studies the courtyards are the most area which receive a lot of sun, and has minimal shading. One of the ideas is to use innovative, and eco friendly shading devices like, Blossomings. It is a shading devise which have a minimal impact on the natural environment. By taking maximum sun intensity and exposure durations during the day, and harvesting dominant wind direction and intensity during the night only. It's structure have the same concept of a flower blossoming as it's open in the day time acting like a shading device, and store the sun energy, so when it closes in the night it will use this solar energy to create electricity that will light up the campus at night. The material used for this shading device will be recycled material like recycled steel, aluminum, and fiber glass. Another idea is to Create a type of a canopy around the courtyard for shading with openings to insert daylight with the view of the sky. The ideas of creating masses that act like a shading devices, store energy, eco-friendly, while allowing daylight, and still maintain an aesthetic value is the answer.

3) Louvers:
Horizontal mesh shading devices to be placed in front of a curtain wall. This could be implemented on the glass window in the engineering building. Specially in the south area of this building. Those horizontal louvers could be in different shapes, and colors to go with the building design.

2) Sunshades, Raised floors, operable windows, air intake, and light shelves: It can all be included in the buildings envelope. If a window is opened, the building automation system shuts off the flow of conditioned air through the raised floor in the adjacent zone.

4) Revolving sun shade with integrated PV: cell can also be a great solution for protecting glass windows from the sun, and at the same time save energy.

In the cold months: October 1st, we see that the two building which cast shading are student affair, and Effat hall. The student affair is mostly shading the mosque and the restaurant area. In January 1st, is the month when building cast the maximum amount of shading on other buildings, the rest of the building are casting little amount of shadow. The student affair building cast the biggest shade shading all the buildings next to it as well as a part of the big courtyard. The engineering and the restaurant also cast shade on the courtyards, moreover, all the buildings in general do cast shadow on the near areas next to them. Hot months: April 1st the student affair and the Effat hall do cast shows but in a vertical direction and the connecting bridges, covered walkways, library, admin building, all are casting a bit of show on the areas next to them. July 1st the only two buildings casting shadow are the student affair and the effat hall.