Phipps Conservatory Preliminary Daylight Analysis

September 11,2008

7group

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Summary

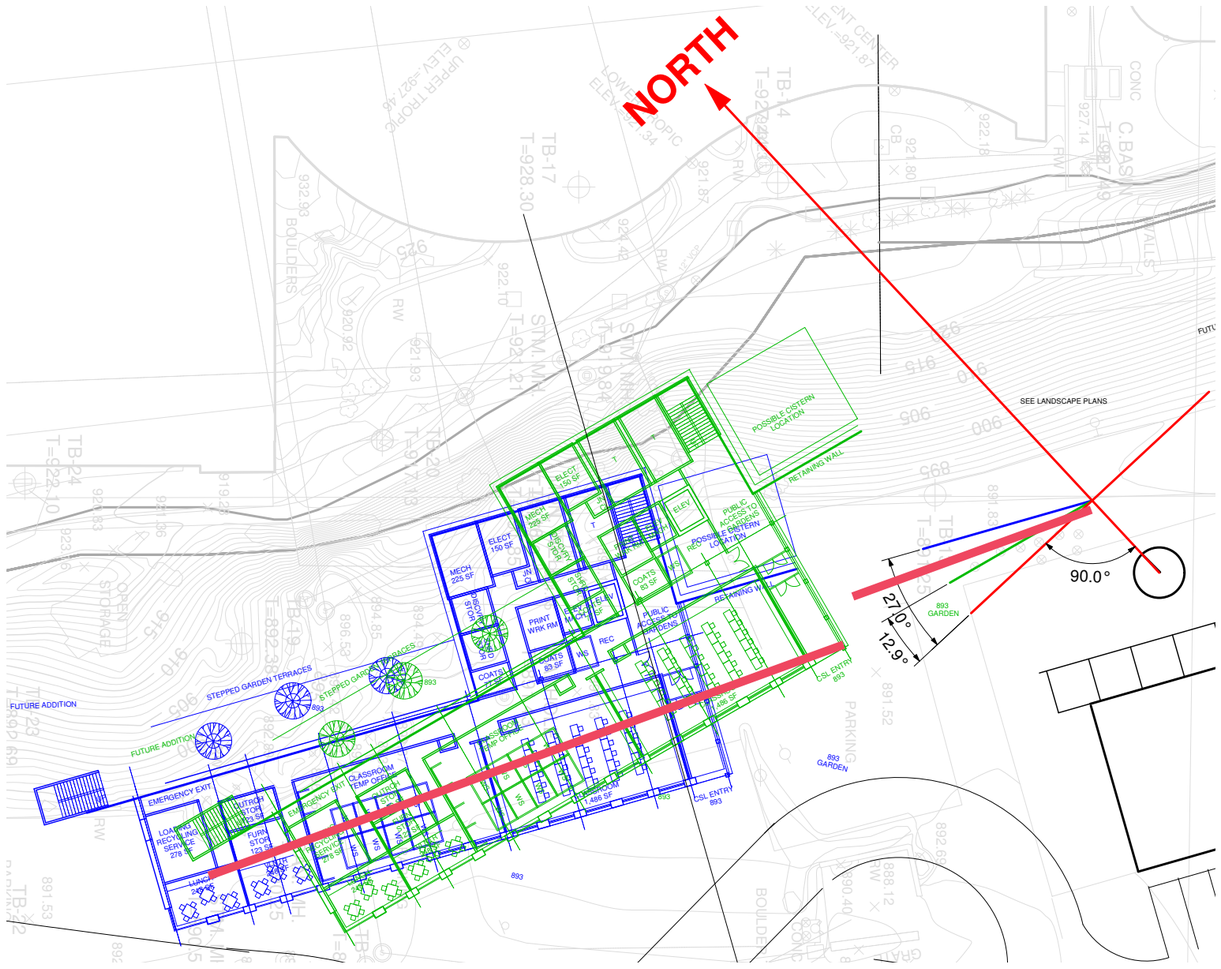
This analysis is based upon the project design as of August 20, 2008. The two primary areas of focus are the first floor classrooms and the second floor offices. The feasibility of the clerestories was also analyzed along with the seign of exterior shading devices and interior light shelves

The goals of the anlaysis is to determine the performance of the design, glazing selections, and alternate scenarios. Quantity and qulaity of daylight were examined as well. The goal is trying to have an average of at least 25fc througout any of the spaces in overcast sky conditions. Reduction of glare and contrast is another goal.

This information should be used to effect the design to meet the parameter goals established for the project. The information should be shared with all memebers of the design team and be used to compliment the electrical lighting layout.

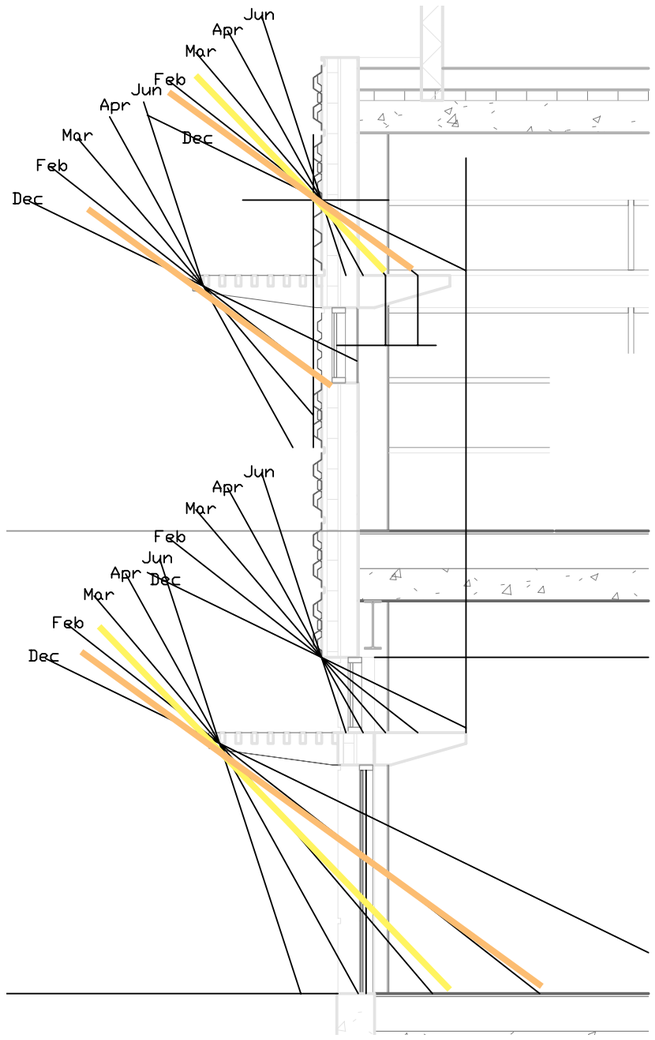
The base scenario uses 63% VLT for both the view and daylight windows on the south side and 70% VLT for all windows on the north. Internal refelctances used were 40% floor, 70% walls, 80% ceiling, 70% exterior shading device, 75% light shelf.

Direct Solar & Orientation



Having the east/west axis of the building is optimal for day lighting performance. As the orientation faces more to the south west, the issue of direct solar penetration is more relevant. The lower sun angles of the primary heating periods of the day are more perpendicular to the south facade. This allows greater penetration of sun and radiation into the building. It is more optimal to decrease the angle of the sun on the facade so that the reflective properties of the glazing decrease both the direct solar and radiation issues. Exterior shading devices will have to become longer to decrease the solar heat gain and the direct solar penetration.

The daylight scenarios for this analysis were run with the east/west axis 20 degrees north of west.



The section above shows the sun angles for March 21st at 12pm for the noted months. Based upon the 20 degree orientation, it is suggested that the exterior shading device is angled at 22 degrees on the first floor. This not only decreases the direct solar penetration, but also decreases the length to only 2'-11". This is an eight inch reduction from the proposed design.

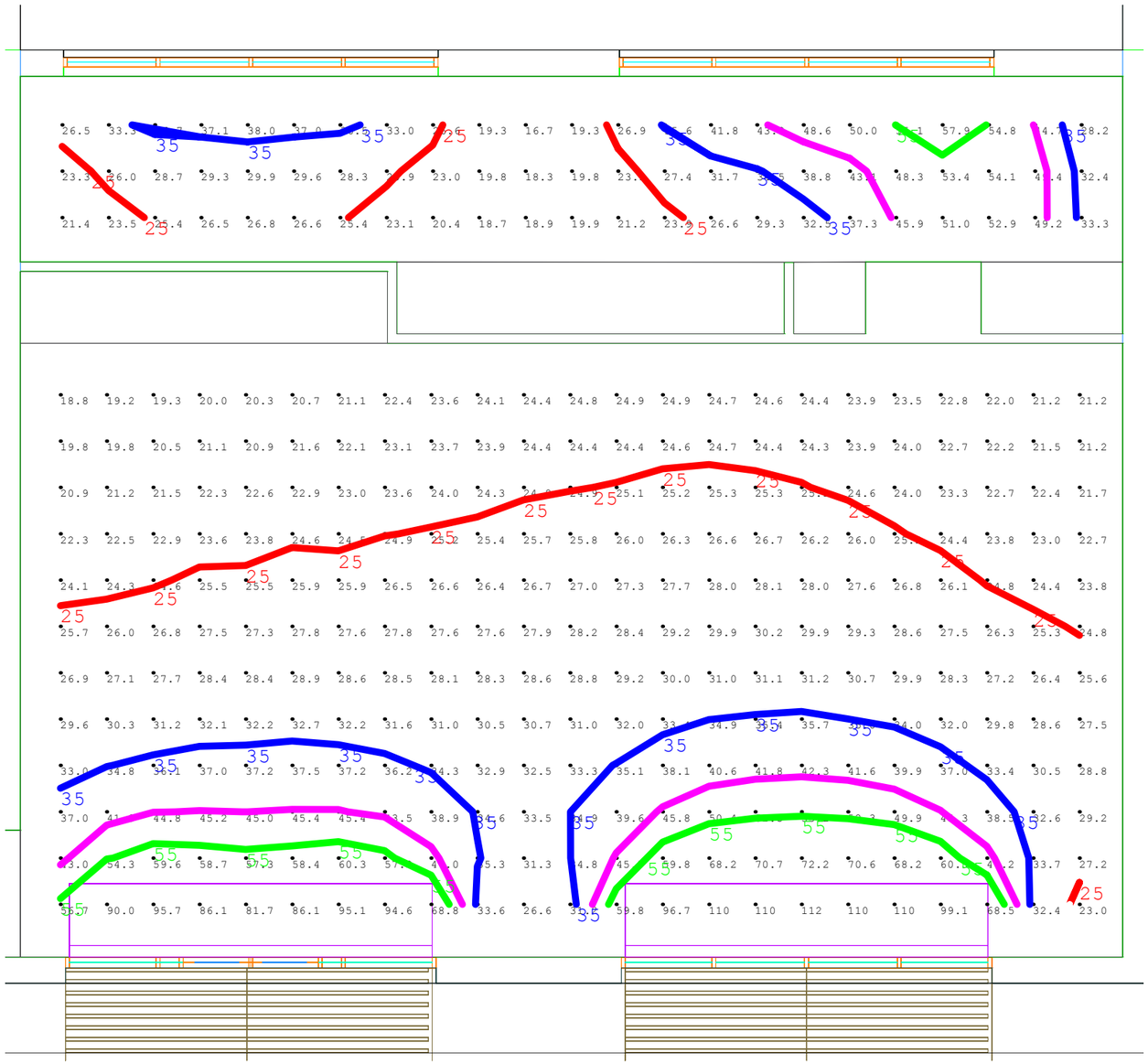
The interior light shelf can also be reduced to 20" from the glazing on all floors. Interior shades will be needed on both the view and daylight windows. These shades should be at least 10% transparency and roll from the bottom up.

The section above shows 2 & 3 pm on March 21st. These are times were the south facade is closest to being perpendicular to the sun. These are also the prime heating periods of the day. Penetration and heat gain are more prevalent with the current exterior shading device design.

Base Scenario Analysis

Classrooms March 21st, Overcast

Avg: 35fc
Contrast Ratio: 1:6
Window/Floor Ratio: 22%



The space is performing well in overcast sky conditions in March. This analysis simulation would cover the months of February to April, and from late August to October. The daylight zone is about 18 feet and contrast is optimal. Glare will be an issue due to the floor to ceiling glazing, but solar shade will help reduce the effects of this condition.

The luxor plan also shows the north hallway. This space is very well lit, yet this space is not regularly occupied, and the amount of glazing for this space will increase heat loss. A scenario is run later in the report for a recommended bilateral lighting scenario and glazing configuration for the hallway.

Base Scenario Analysis

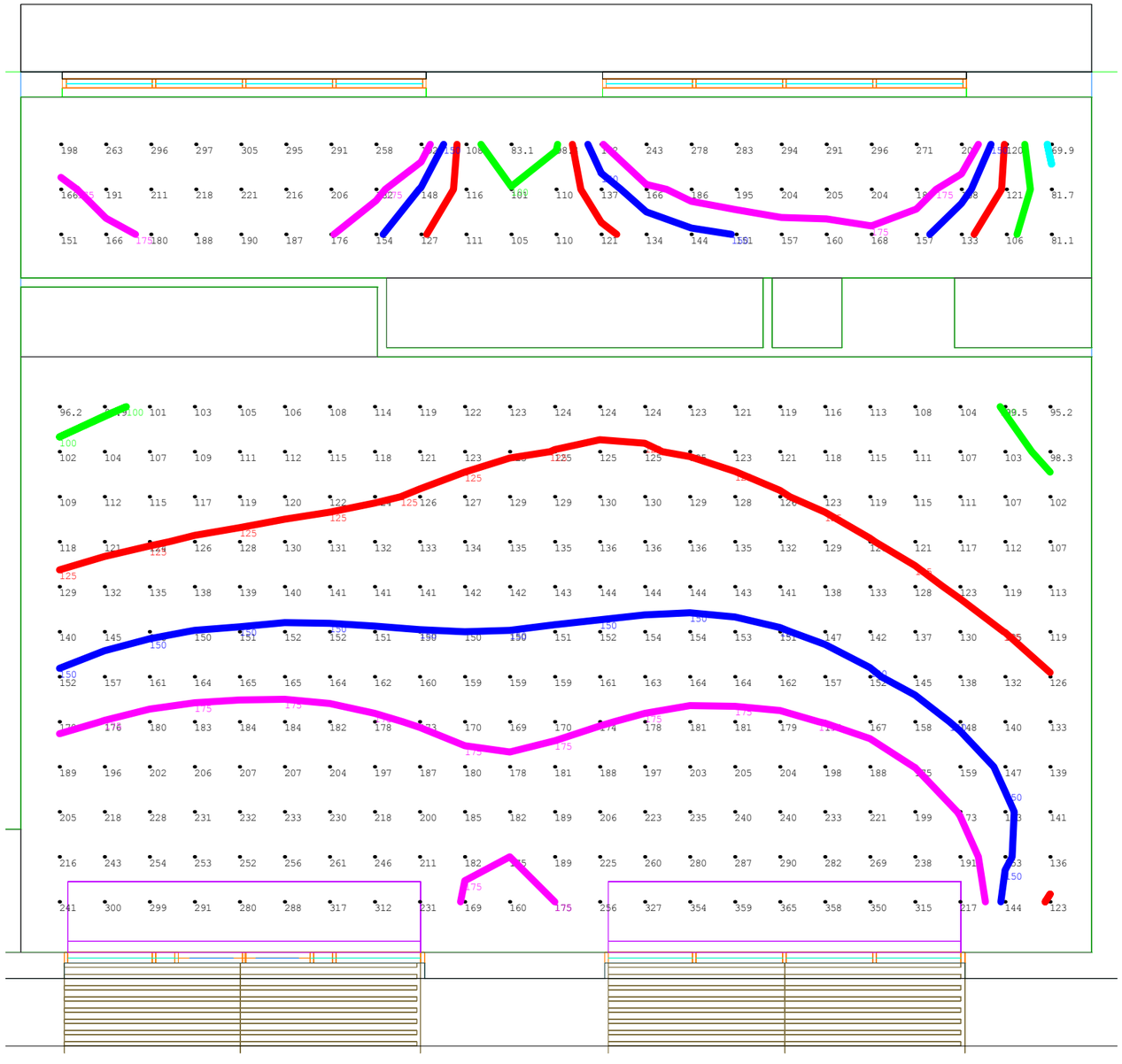
Classrooms March 21st, Clear

Avg: 165fc
Contrast Ratio: 1:4
Window/Floor Ratio: 22%

12pm

3pm

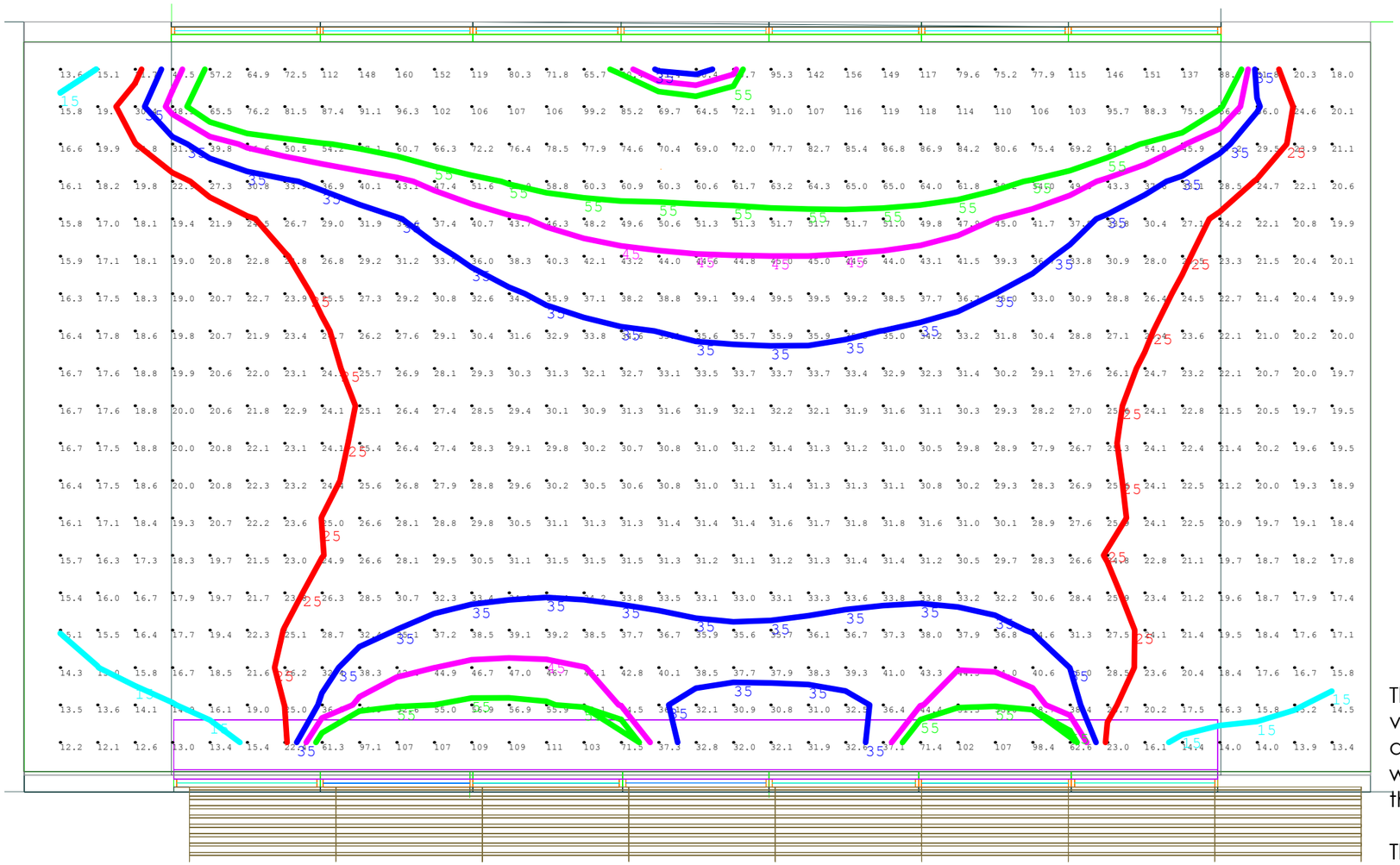
There is plenty of illuminance in the classroom under clear sky conditions throughout the year. The issue is glare and direct solar penetration into the space. Where direct solar is not an issue at noon, 2pm till sunset is. As noted prior, angling of the shading device and the use of solar shades is recommended to control these issues.



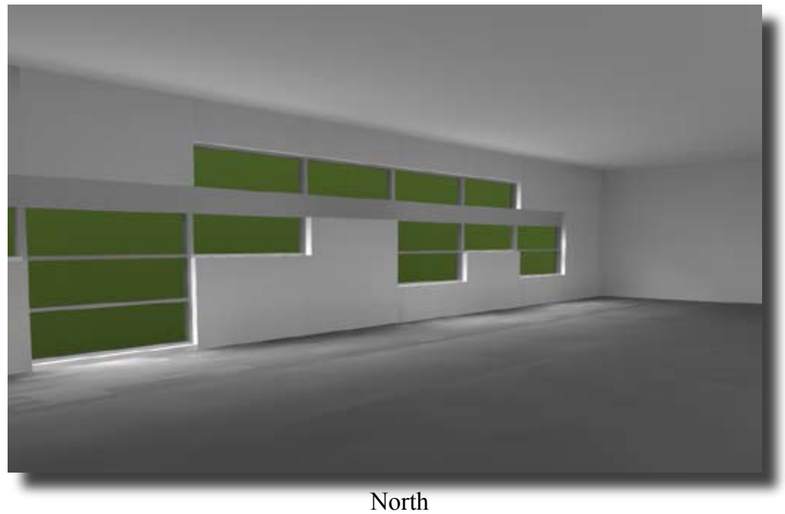
Base Scenario Analysis

2nd Floor Office March 21st, Overcast

Avg: 41 fc
Contrast Ratio: 1:8
Window/Floor Ratio: 20%



South



North

The second floor office performs well with the average illuminance values being with in the performance range and general contrast and glare acceptable. The average illuminance levels will drop with 5-10 fc on average with the office furniture. It is critical that the cubicles are low in height and light in color.

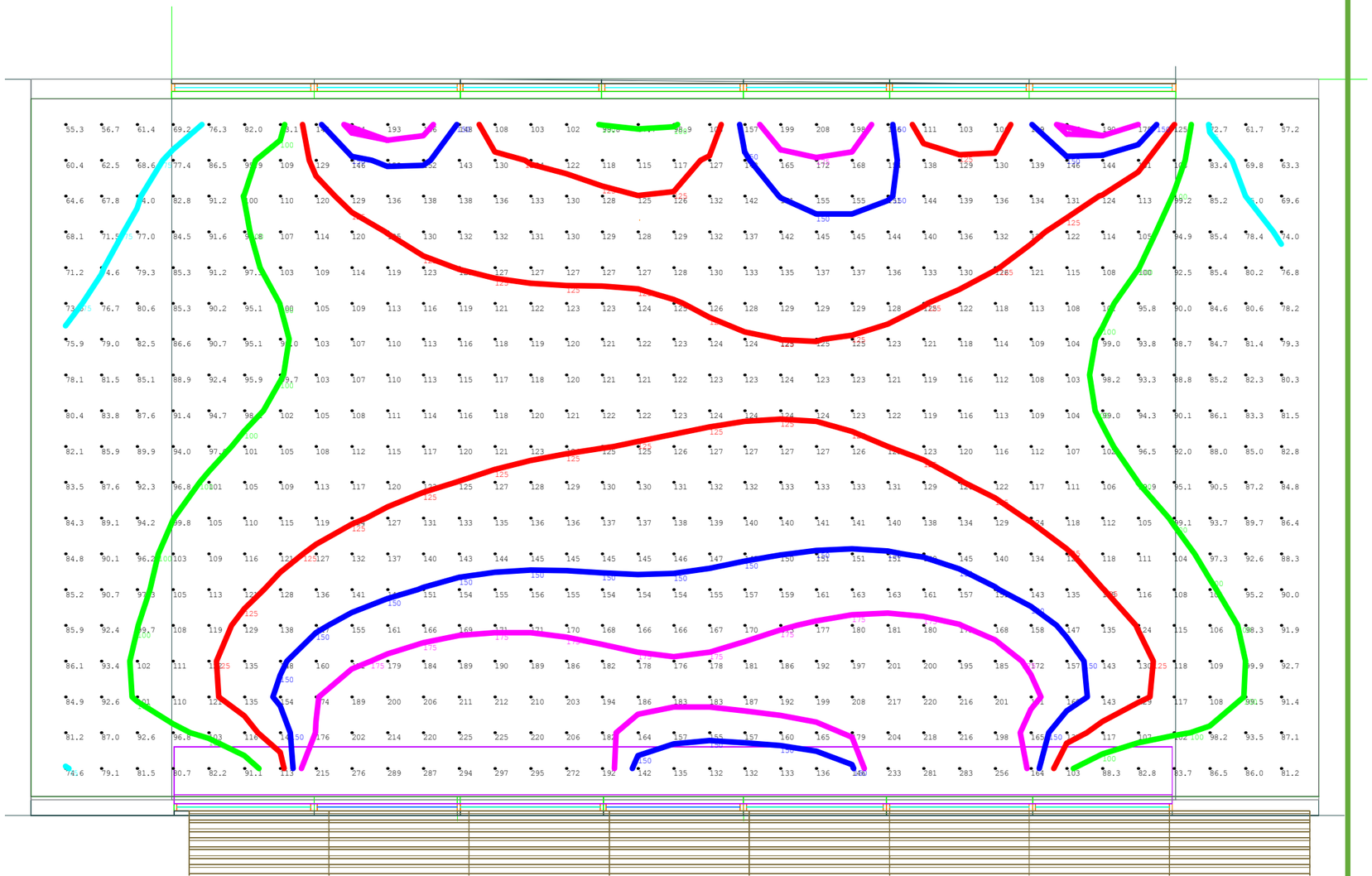
The pattern of the glazing is also causing areas of contrast and glare. This will be very prevalent on the south side with the light shelf and worse under clear sky conditions. Solar shades should be used on the south and west side of the space.

Suggestions and alternate scenarios are provided later in the report.

Base Scenario Analysis

2nd Floor Office March 21st, Clear

Avg: 127 fc
Contrast Ratio: 1:6
Window/Floor Ratio: 20%



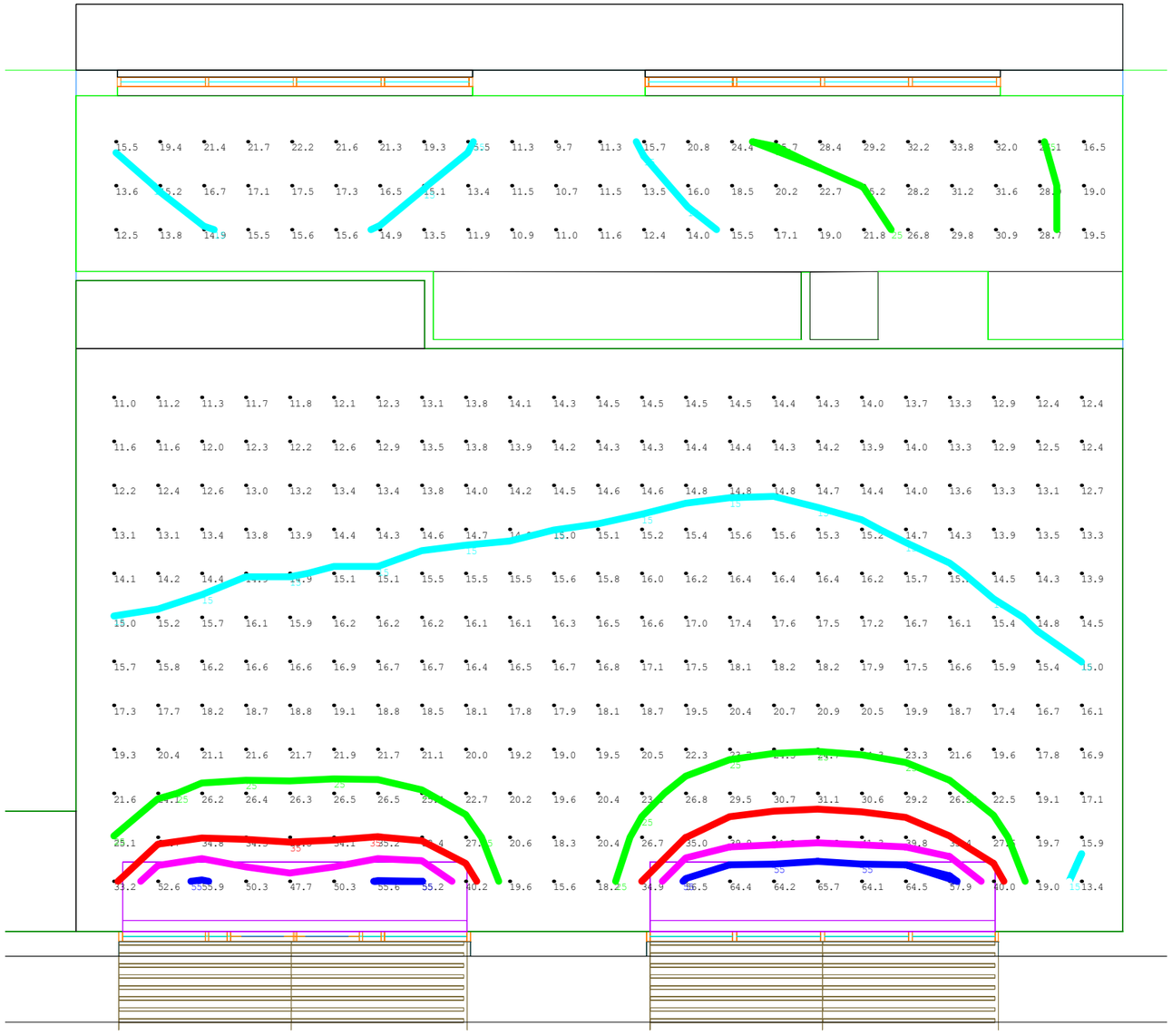
The space is well lit under clear sky conditions. As noted previously, the issue of glare and contrast are more prevalent because of the pattern of the glazing. Contrast and glare will be an issue on the south side where there is no daylight window. Glare will be an issue along the facade where the windows are close to the floor. These issues can be improved by using daylight windows across the entire south facade and using solar shades in both windows.

These are not as relevant on the north, but shades should be used for any unwanted reflections or glare from the cliff and existing structures.

Base Scenario Analysis

Classrooms December 21st, Overcast

Avg: 20 fc
Contrast Ratio: 1:6
Window/Floor Ratio: 22%

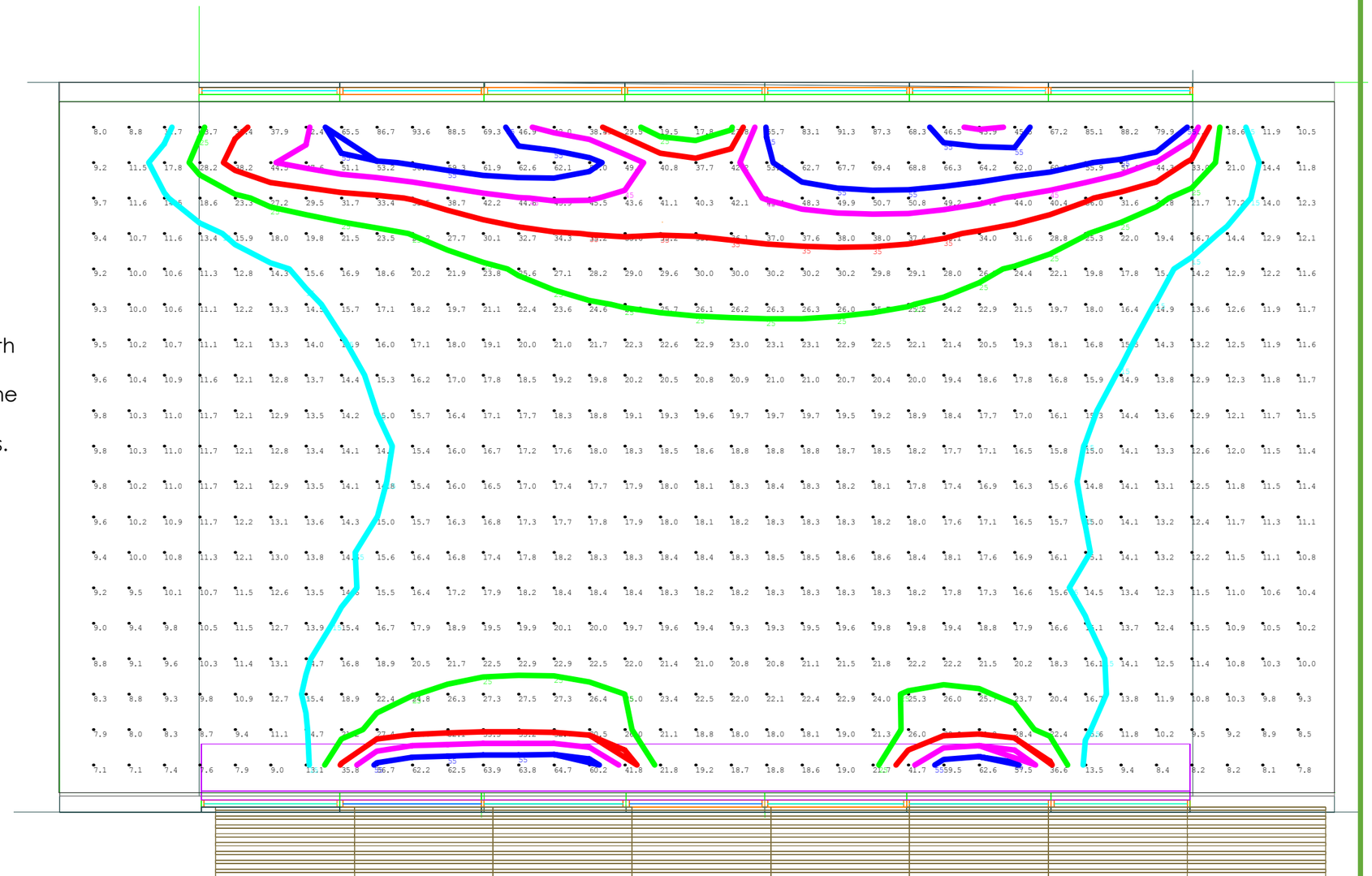


This simulation would be representative of the time from late October to mid February. As shown on the luxor plan the daylit zone is just barely 10' with an increase in contrast. These condition would suggest that a bilateral day lighting scenario should be used for the classroom. An analysis of that scenario is provided later in the report.

Base Scenario Analysis

2nd Floor Office December 21st, Overcast

Avg: 22 fc
Contrast Ratio: 1:13
Window/Floor Ratio: 20%



As previously sated, the daylit zone is very minimal. However, with a bilateral lighting condition, the contrast is not as great as the classrooms. With the use of daylight windows continuously on the south side, the levels will increase. Electrical lighting, preferably task lighting will be needed in the winter months on cloudy days.

63-63-70 Scenario Analysis

Classrooms September 21st, Overcast

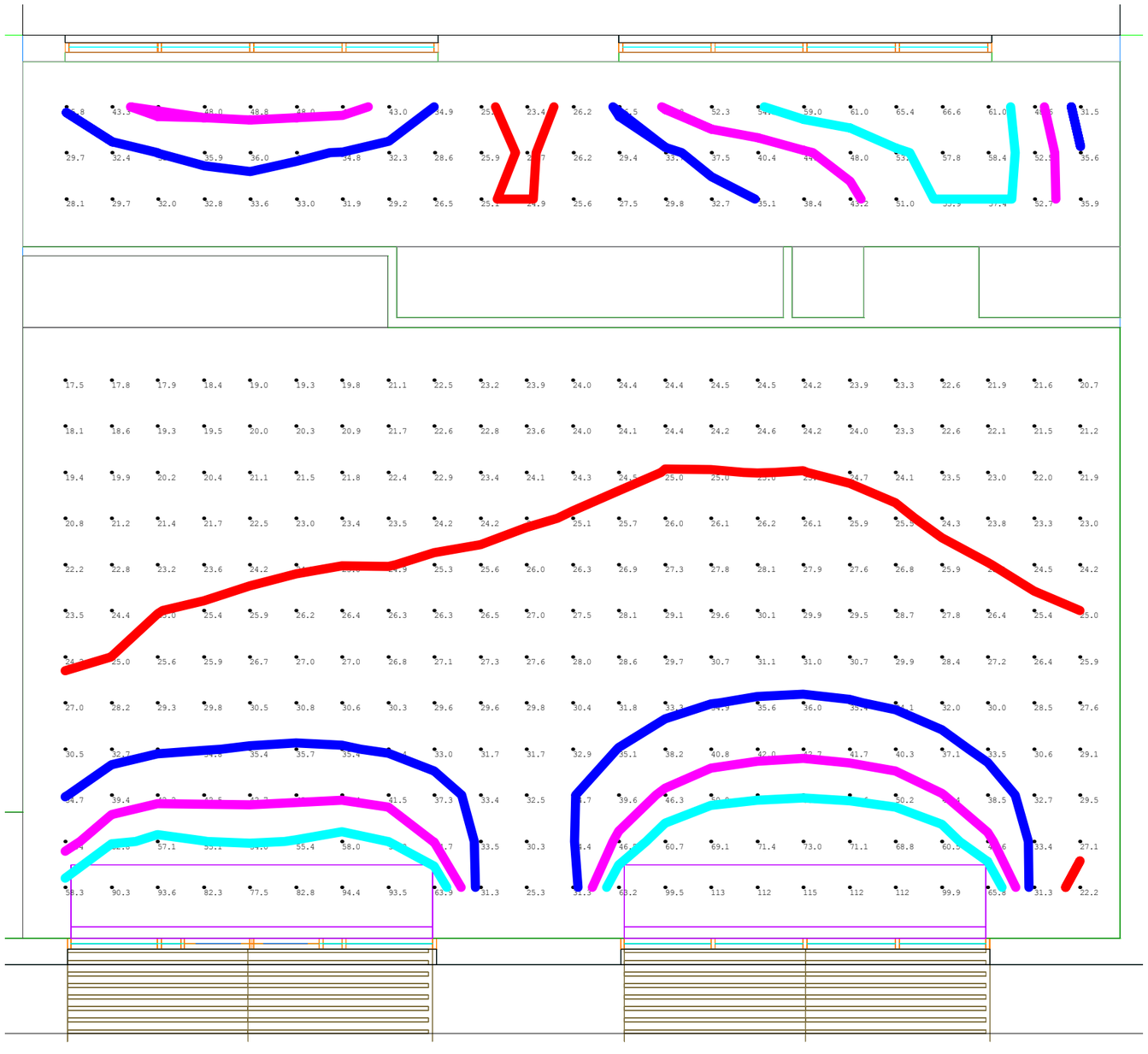
Avg: 34 fc
Contrast Ratio: 1:7
Window/Floor Ratio: 22%

September 21st, Clear

Avg: 176 fc
Contrast Ratio: 1:40
Window/Floor Ratio: 22%

December 21st, Overcast

Avg: 20 fc
Contrast Ratio: 1:7
Window/Floor Ratio: 22%



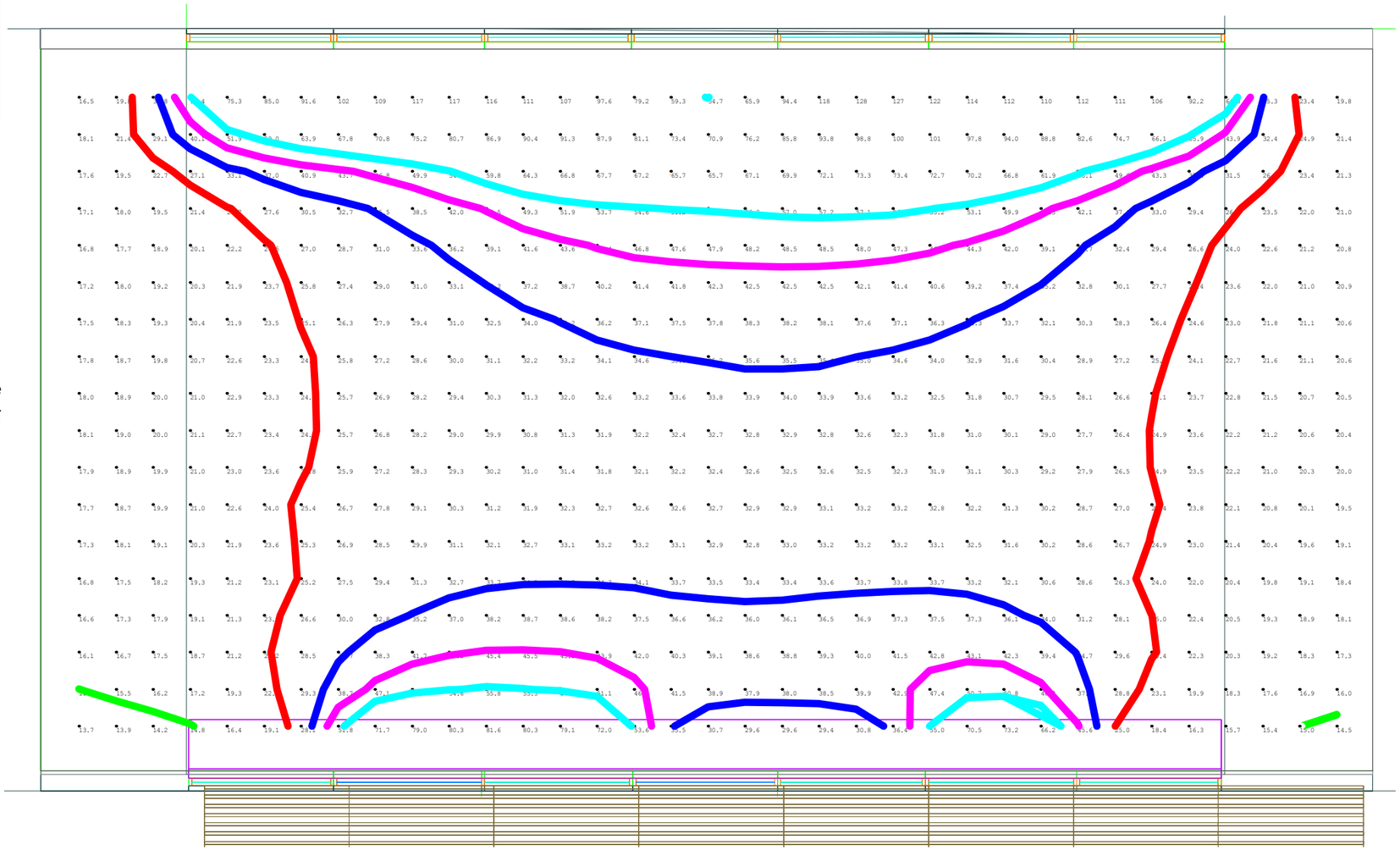
This scenario looked at the implementation of 63% VLT for the view windows and 70% VLT for the daylight windows. As noted, there is little difference between this scenario and the use of 63% VLT for all south facing windows. But the daylight zone is increased by 2'. The reason for the higher VLT in the daylight windows is for when the shades are used to control any direct solar issues. The higher VLT will allow a greater illuminance value of indirect light into the space.

63-63-70 Scenario Analysis

December 21st, Overcast
Avg: 22 fc
Contrast Ratio: 1:9
Window/Floor Ratio: 22%

September 21st, Clear
Avg: 142 fc
Contrast Ratio: 1:65
Window/Floor Ratio: 22%

2nd Floor Office September 21st, Overcast
Avg: 37 fc
Contrast Ratio: 1:8
Window/Floor Ratio: 20%



As noted, there is little difference in the average as the base scenario. But there is an increase in the day lighting zone. If daylight windows are continuously used on the south facade, the average illuminance value will be greater along with the daylight zone.

This scenario works well in office environments where cubicles covered in cloth become light sponges.

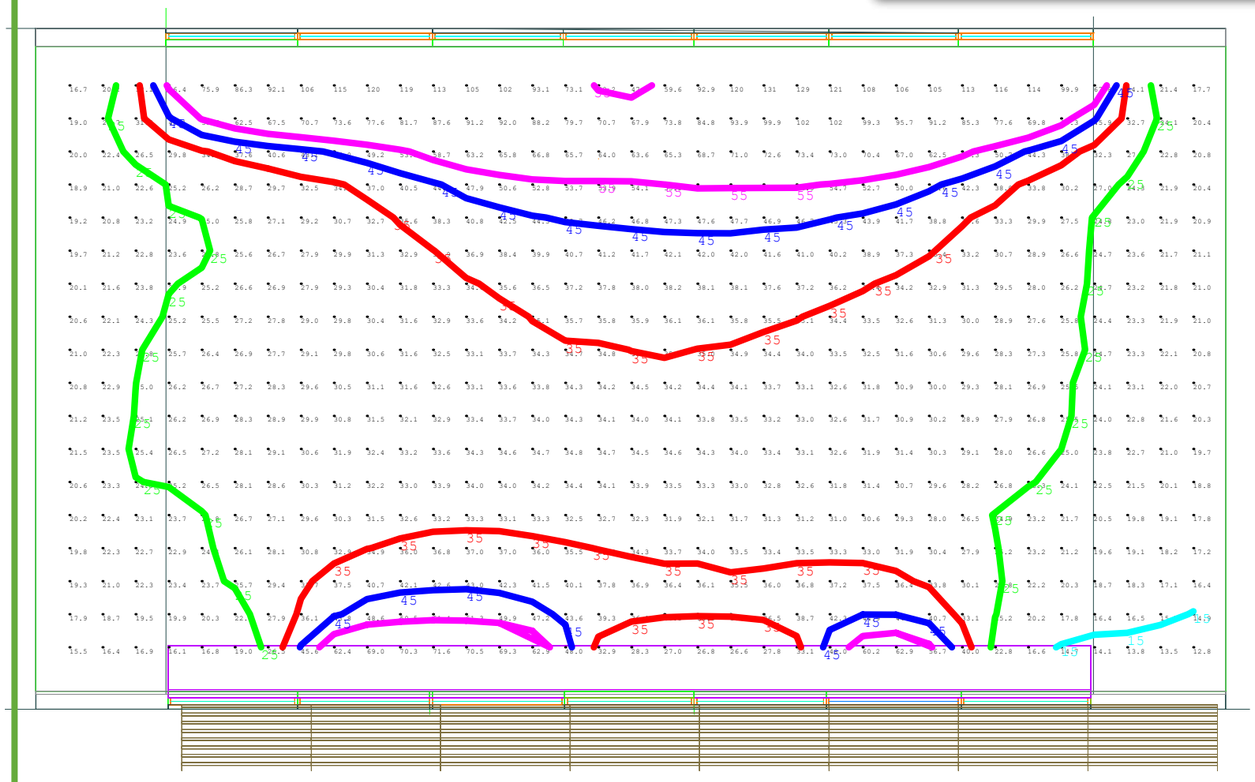
All Daylight Windows Scenario Analysis

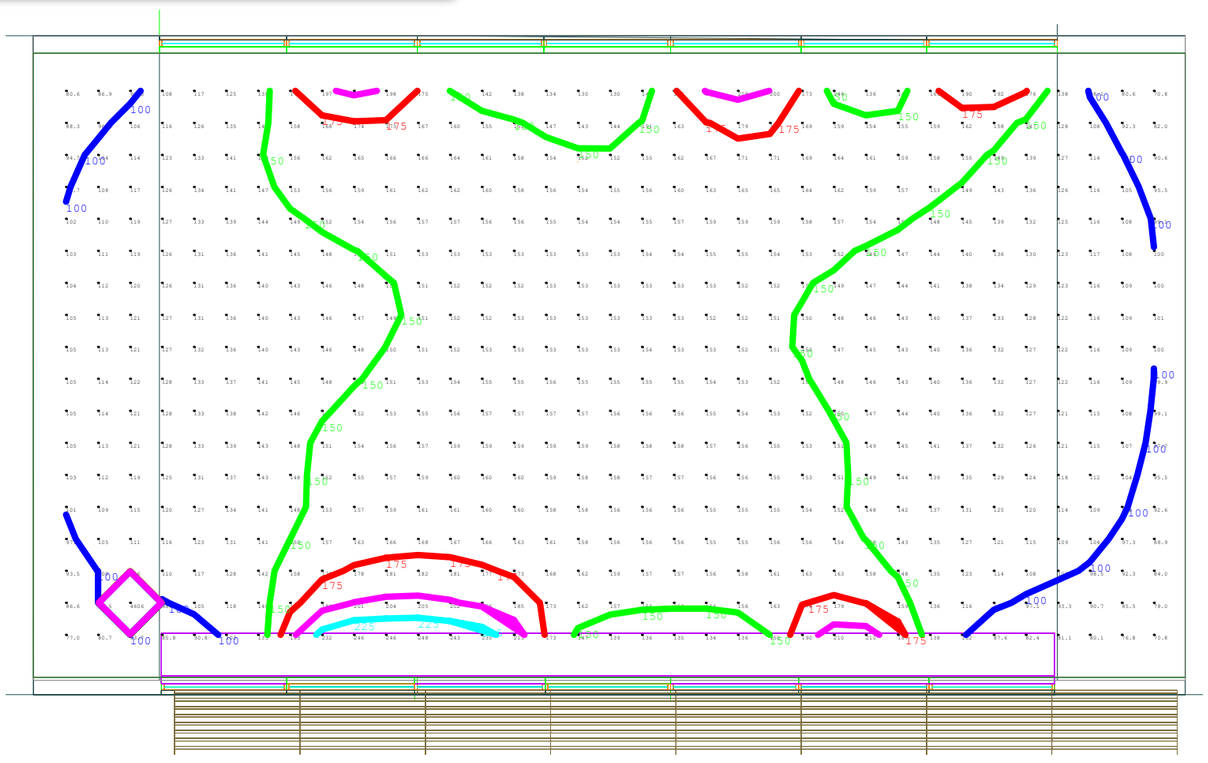
Office September 21st, Overcast

Avg: 38 fc
Contrast Ratio: 1:10
Window/Floor Ratio: 22%

Office September 21st, Clear

Avg: 149 fc
Contrast Ratio: 1:31
Window/Floor Ratio: 22%





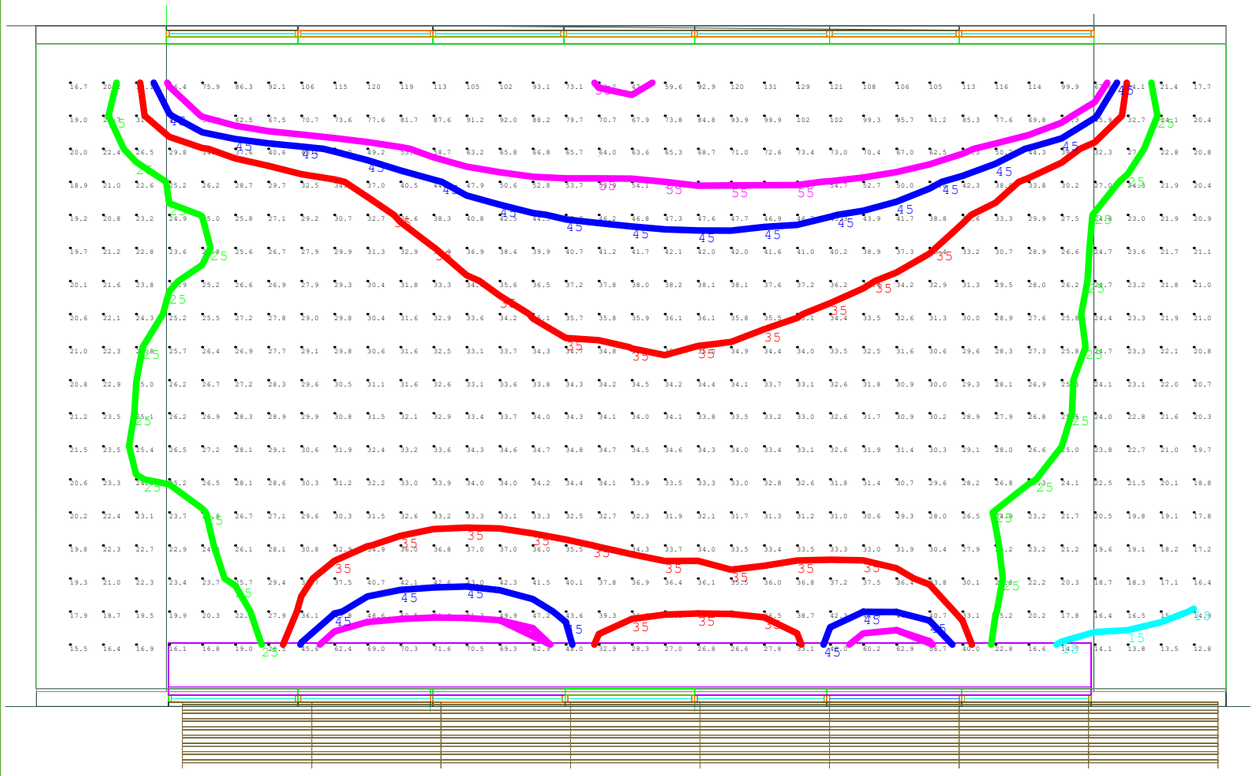
These scenarios looked at using daylight windows along the entire south wall. This produced a more evenly distributed daylight zone and a reduction in glare. The contrast ratio is higher, but this is not taken on the wall. Visually it is more balanced. If the shades are used in the view windows, the only effective illuminance is from the daylight windows.

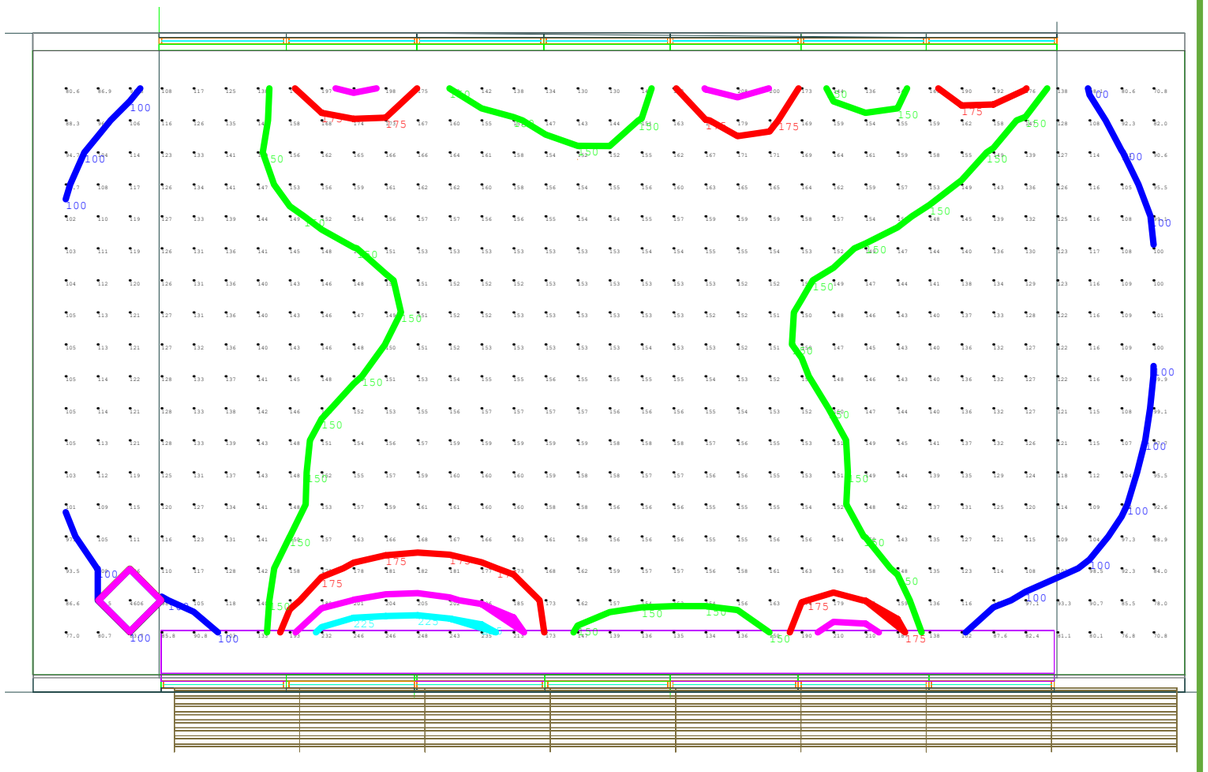
Office December 21st, Overcast

Avg: 22 fc
Contrast Ratio: 1:10
Window/Floor Ratio: 22%

Office December 21st, Clear

Avg: 246 fc
Contrast Ratio: 1:32
Window/Floor Ratio: 22%

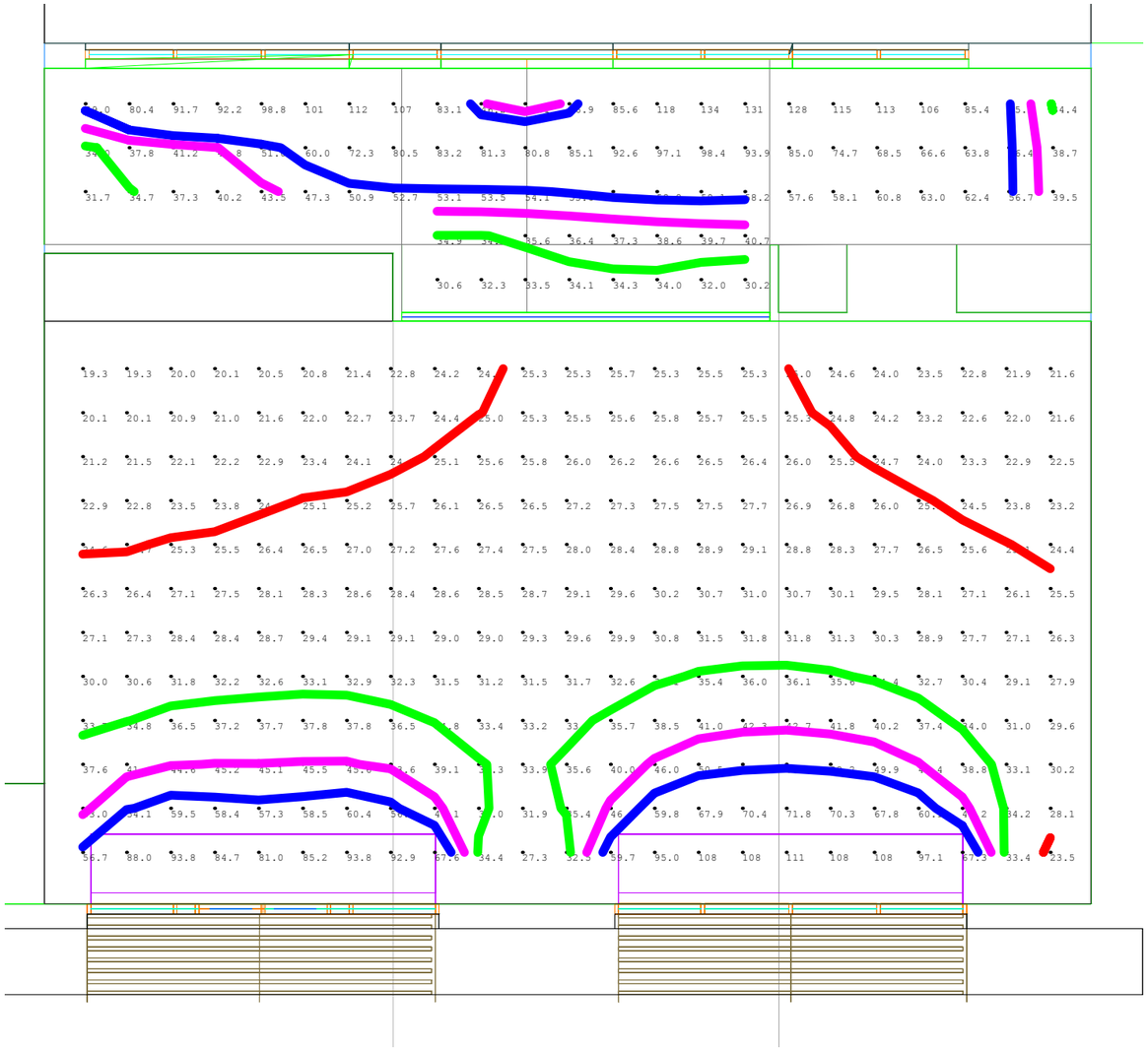




Bilateral Scenario Analysis

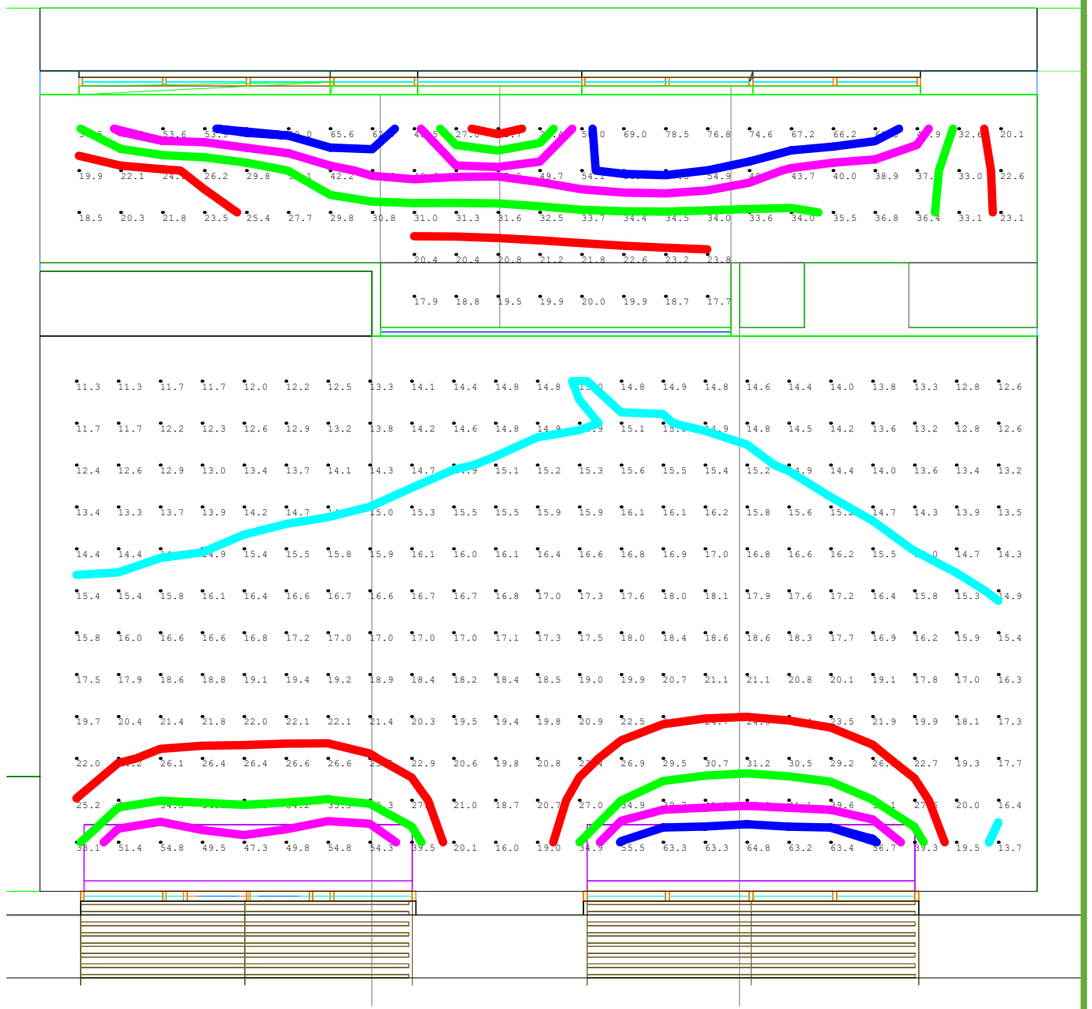
Office September 21st, Overcast

Avg: 45 fc
Contrast Ratio: 1:4
Window/Floor Ratio: 22%



Office December 21st, Overcast

Avg: 21 fc
Contrast Ratio: 1:5
Window/Floor Ratio: 22%



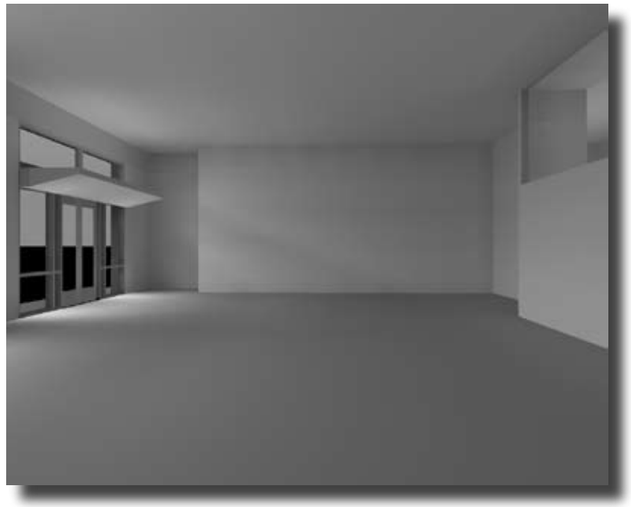
This scenario looks at bilateral lighting scenario in the classrooms. Since the previous analysis still shows that the daylight zone covers about 2/3s of the space, and that there is a lot glazing being used in the north facing hallway, a bilateral scenario was tried.

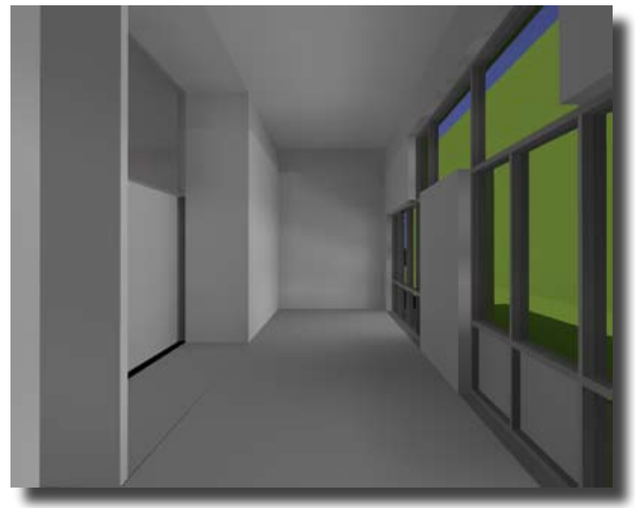
The elevations and section show the configuration of the windows of the north facade and the height of both the interior and exterior windows. The interior glazing has a VLT of 89%.

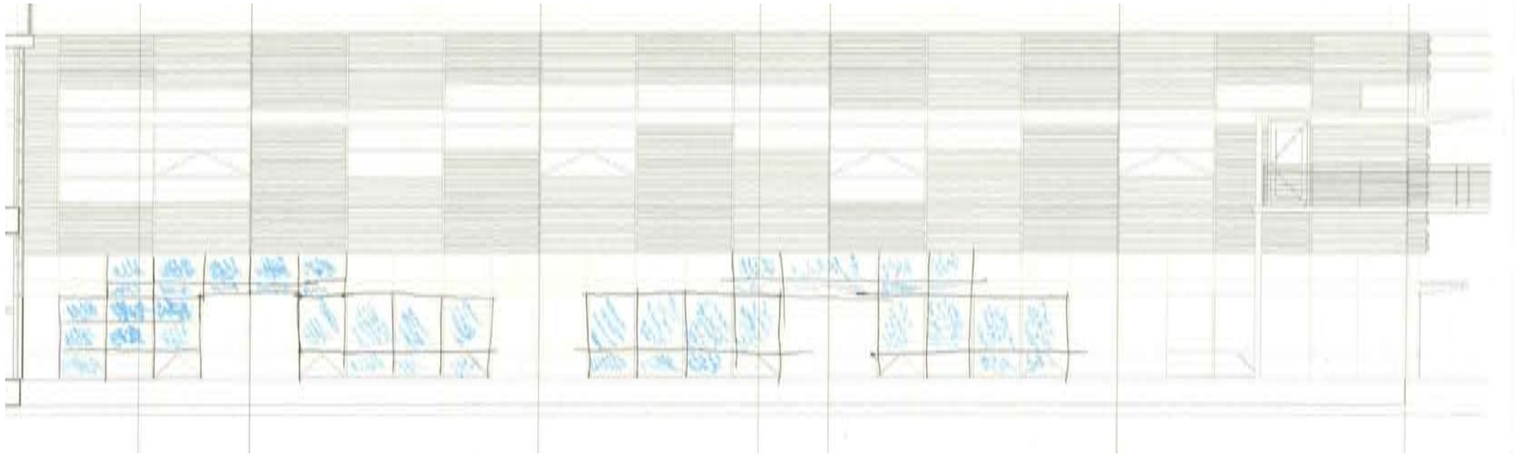
As shown by the luxor plans for both September and December, the daylight zone and average illuminance has increased and the contrast ratio has been reduced.

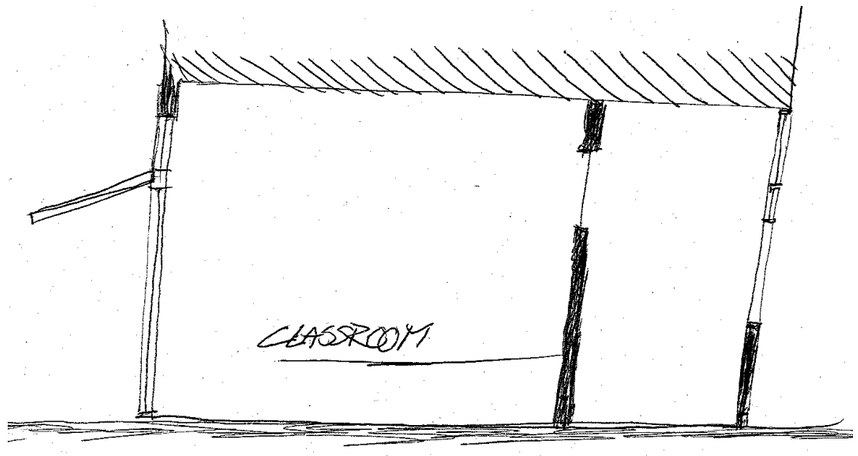
By moving the windows from the ground to the ceiling along the hallway allows more access to the skydome and increases the illuminance in the classroom.

If the bilateral scenario is not implemented, then it is suggested that the amount of glazing be reduced. At minimum, the glazing along the ground can be removed.

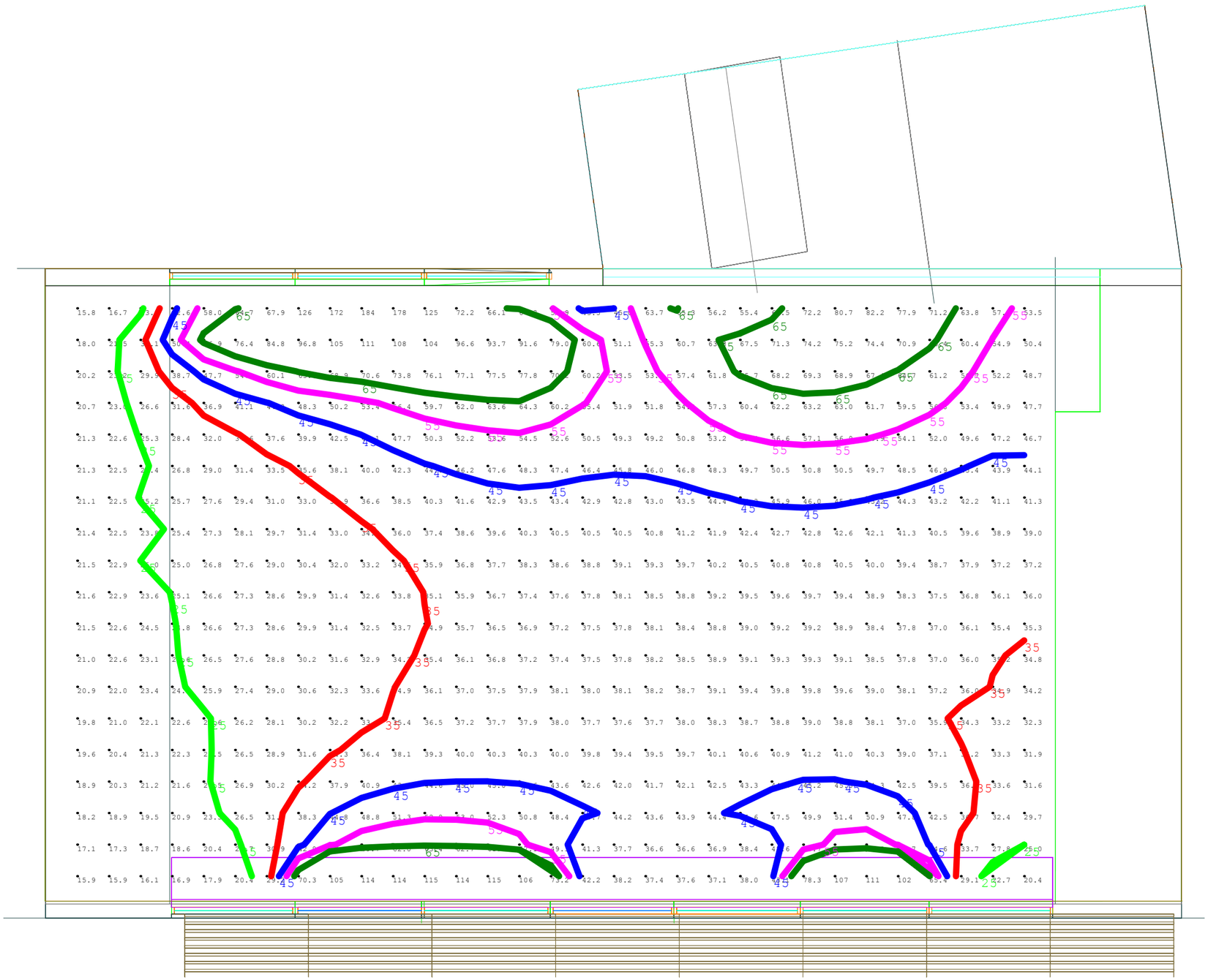








Clerestory Feasibility Analysis



A scenario was analyzed that tested the feasibility of the proposed south facing clerestories. Based upon the typical eternal reflectances, interior glazing with 89% VLT and the light atrium with a 50% VLT, the clerestories are not needed. The luxor plan shows that the area proposed to have clerestories receives sufficient illuminance in overcast sky conditions.

This may change if there is a reduction of glazing in the light atrium or reduction in interior glazing to the atrium.

General Comments

- In the volunteer/education work room; have transom windows or walls that do not extend floor to ceiling.

-East Facade glazing, Heat Shield 53% VLT.

-South Facade Glazing, 63% view, 70% daylight window.

-West Facade, 63% VLT

-North Facade, 70% VLT

-Light Atrium, 50% VLT

- If no bilateral condition is used in the classrooms, reduce the amount of glazing in the north corridor.

-Use a transom window from the donor room to the conference room.

-Reduce the amount of glazing in the vestibule, 6'11 height would work. 53% VLT. Reduce the amount of curtain wall where not needed.

-Lobby, same as the vestibule.

-Distribute the glazing more evenly in the break room.

-Transom windows in the conference rooms.

-Distribute the glazing more evenly in conference room 234.

-Use two small view windows and two larger daylight windows in conference room 235.

-Keep orientation as close to true south as possible.

-Use angled exterior shading devices.