



# Loyola/Notre Dame Library Expansion & Renovation

Baltimore, MD



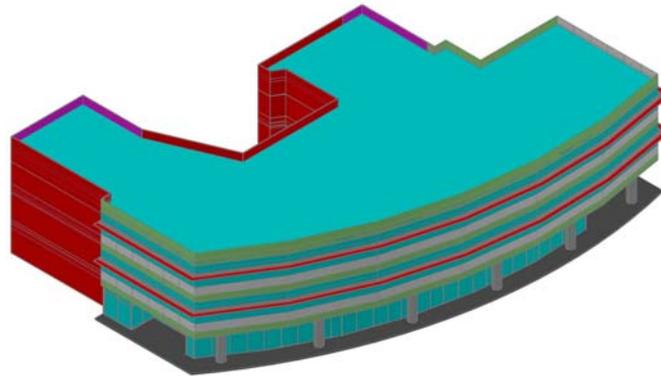
## Thesis Lighting Breadth

*Daylight Analysis*



### *Lighting Breadth*

## Daylighting Analysis



As mentioned in previous sections of the report, an effort to conserve energy is the main focus for the re-design aspects of this thesis. In different universities across the U.S., retrofitting light fixtures is one way that building renovations can achieve this goal. At the Loyola/Notre Dame Library, this was already done for the existing portion of the library, so no lighting re-design was necessary. Another big energy conservation strategy is the use of renewable resources. One of the greatest renewable resources used in sustainable design is clever use of the sun's energy.

Since the solar shades were re-designed in the previous section, it made sense to analyze the natural sunlight's penetration to the three floors of gallery space in the new addition. For the most part, the space is already well lit during the day (without the use of light fixtures), so only a few minor adjustments were necessary for this analysis.

The objective of this analysis will be to configure a way to

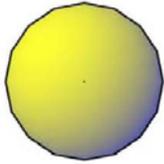
- Maintain sufficiently illuminated spaces without sacrificing daylight circulation
- Allow for indirect light to enter space with the right balance of
  - Solar shading
  - Use of light shelves
- Change architectural appearance of solar shade, while decreasing solar heat gain energy, as seen in the previous section of this report.

Notice that some of the objectives for this analysis are also objectives for the solar shading analysis in the previous section (Mechanical Breadth). These two analyses are dependent of one another. They must be correlated in order to meet their common goal.

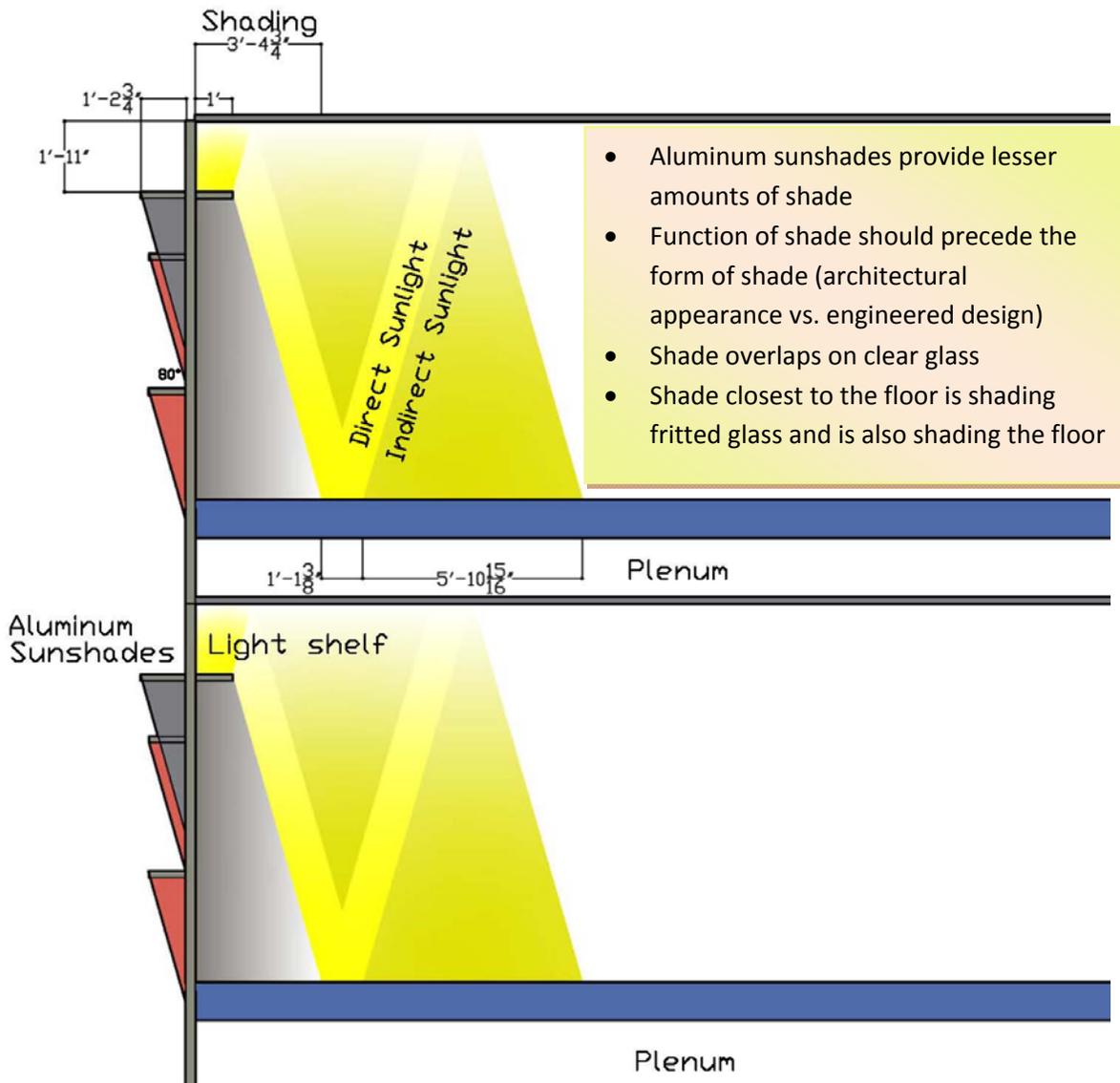
**Below are some schematics for the existing and proposed solar shades to better explain what is going on in terms of items that were re-designed. The months of June and December were chosen since they display worst case**

Lighting Breadth

Schematic of Existing Design in Summer



Sun angle at 12:00 PM on June 21st  
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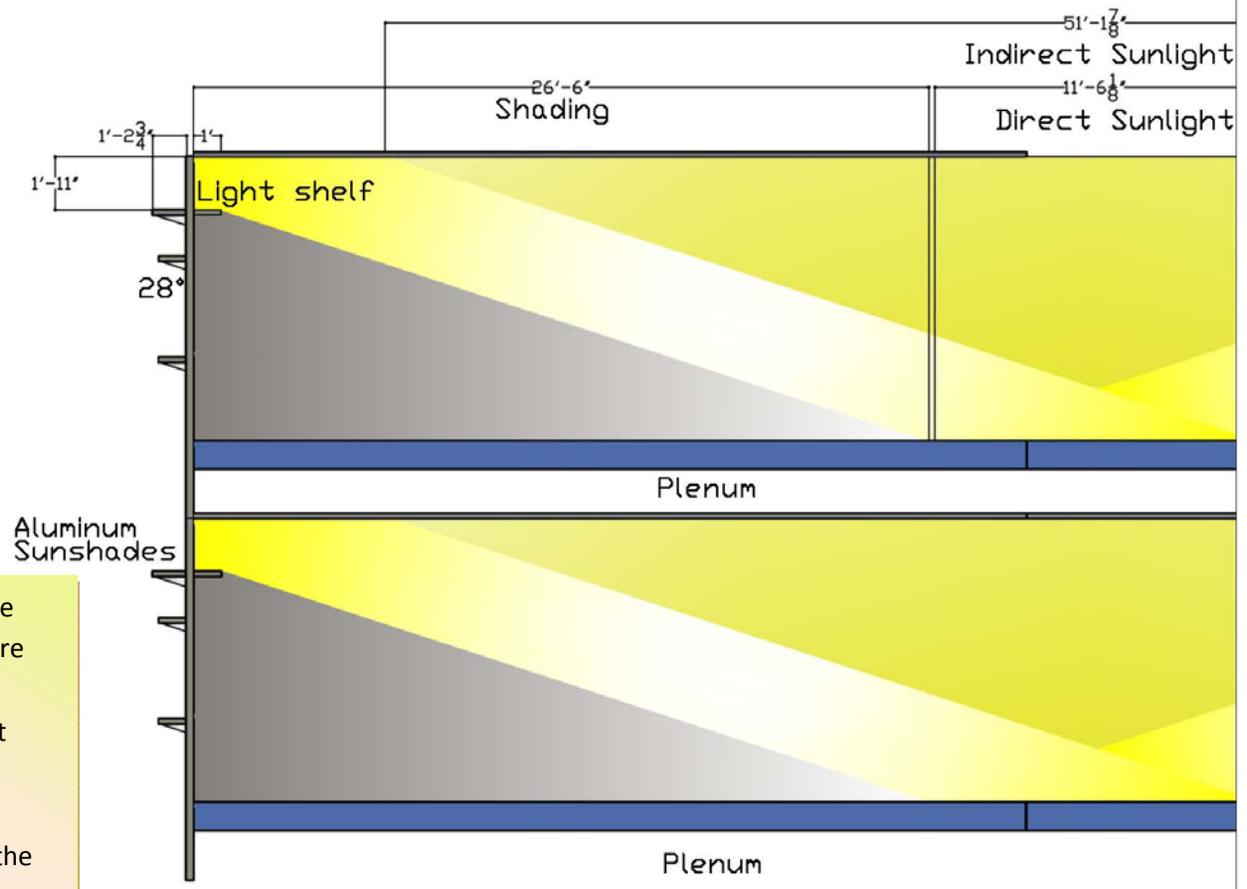
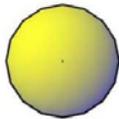
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## Lighting Breadth

### Schematic of Existing Design in Winter

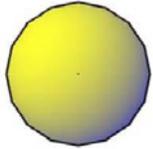
Sun angle at 12:00 PM on Dec 21st  
Baltimore, MD



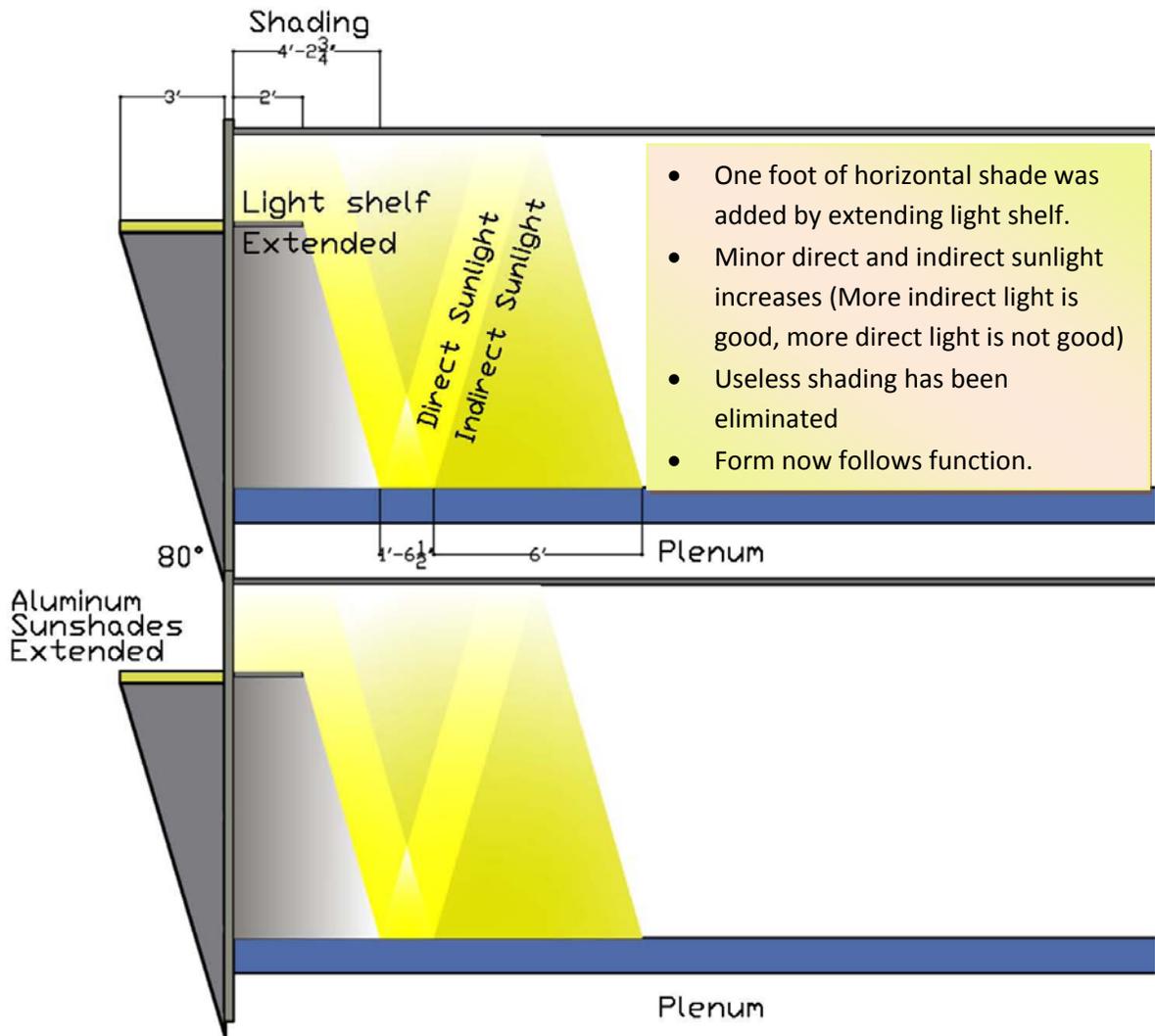
- In the winter, the existing shades are not doing much, which is good. More sunlight is desired this time of year.
- There is plenty of direct and indirect light entering the room at the sun's lower angle.
- The new design should not change the results much for winter months.

Lighting Breadth

Schematic of Proposed Design in Summer



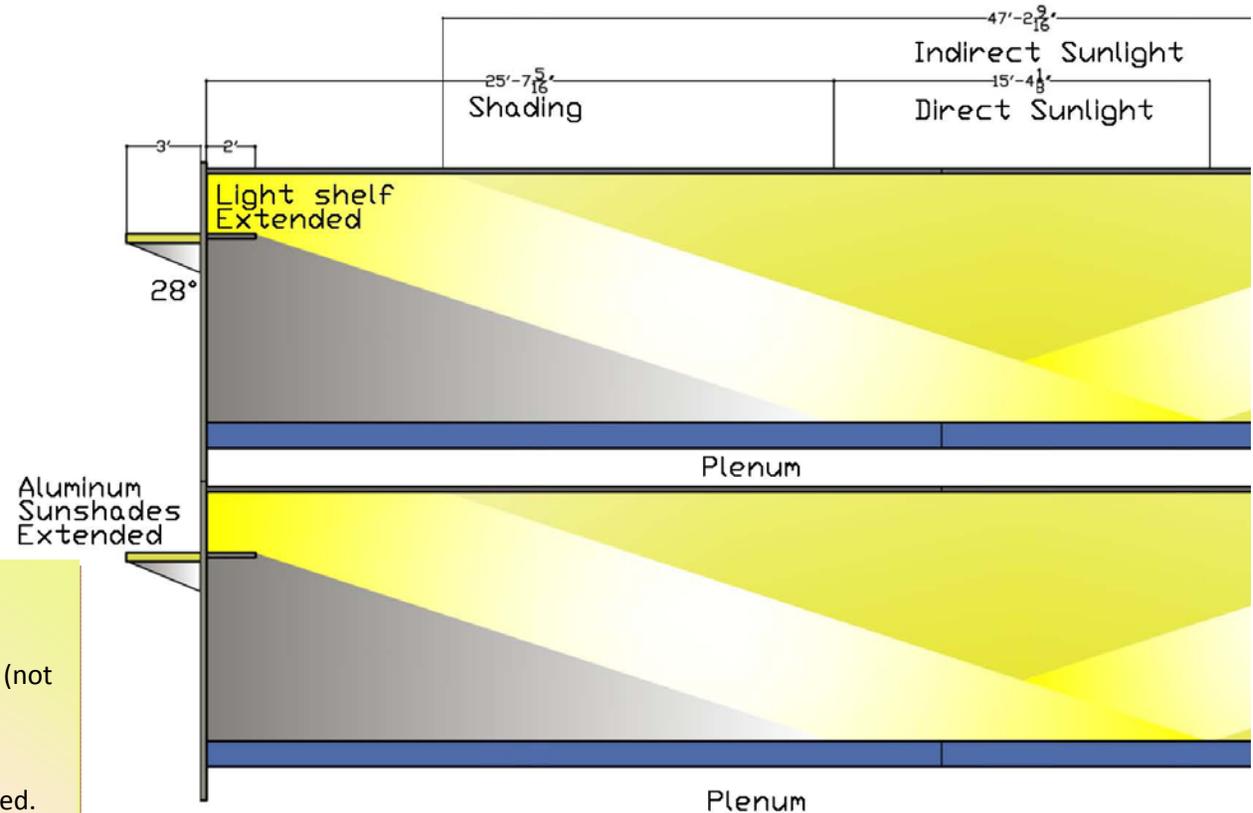
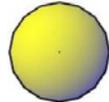
Sun angle at 12:00 PM on June 21st  
Baltimore, MD



*Lighting Breadth*

Schematic of Proposed Design in Winter

Sun angle at 12:00 PM on Dec 21st  
Baltimore, MD



- Only one foot of shade was added horizontally.
- Four feet direct sunlight was added (not great, but still sunlight during cold winter months)
- Four feet of indirect sunlight removed.
- Plenty of sunlight hitting the space.
- Daylight is not sacrificed in this new solar shade design

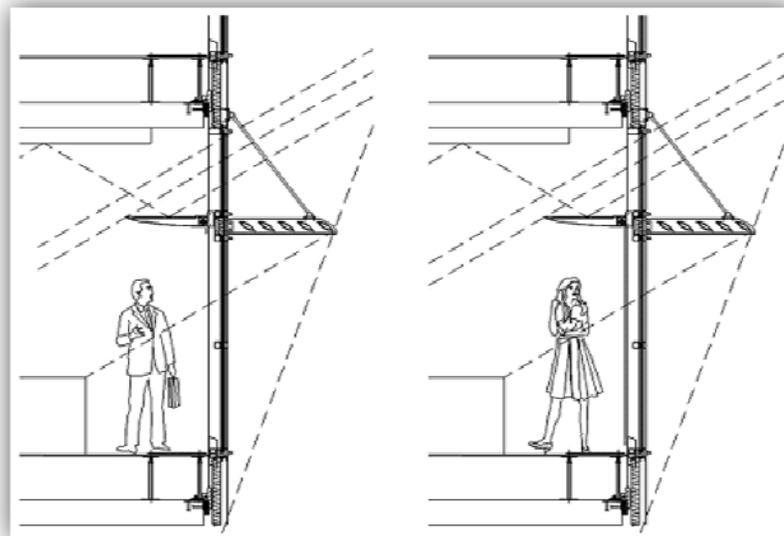
### *Lighting Breadth*

Although the affect of changing the solar shades geometrically did not have a huge affect on the daylight distribution in the three floors of the gallery space, it was still interesting to analyze how the sunlight penetrated the spaces during different hours of the day in the two extreme months (June and December).

To analyze the daylight distribution, a three dimensional model was constructed in AutoCAD 2008. Renderings were then conducted in AGI lighting software for floors one, two, and three before and after the light shelves were added in. (Lower level not included since it is below ground) The analysis runs in increments of three hours. (Increments: (1) 9:00 AM, (2) 12:00 PM, and (3) 3:00 PM)

Since the daylight distribution has not changed much, as seen from the schematics above, the rendering comparisons will show the sunshade design with and without lightshades. This is important because a lot of daylight will inevitably be entering the spaces, so directing some of the sun's direct light toward the ceiling through the use of light shelves will more cleverly distribute the use of sun's light, which was the main goal of this analysis.

Below is an image of this concept that will be shown in the following AGI plan view renderings.



*[See next ten pages for daylight analysis results]*

**Right Images:** Room rendering with true materials and proper reflectance from AGI Library  
**Left Images:** Pseudo color images refer to the foot-candle distribution in a given area.

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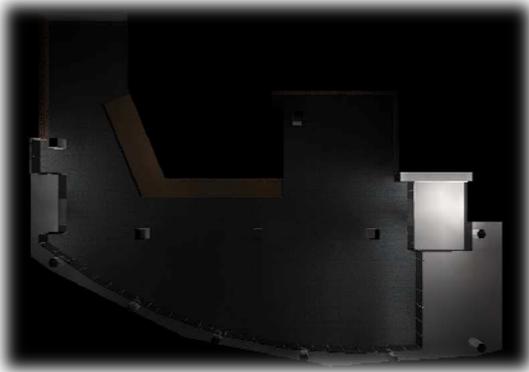
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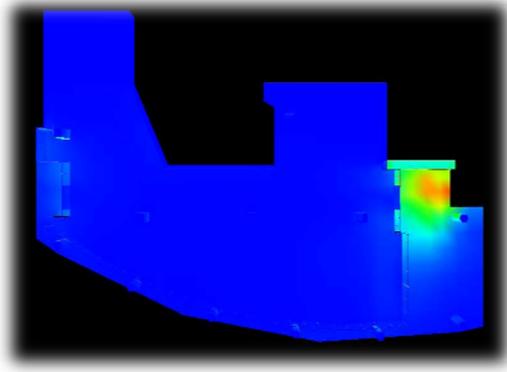
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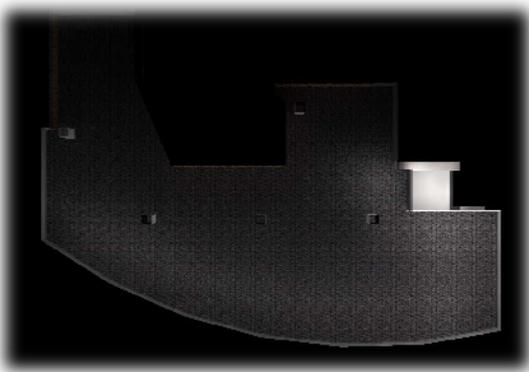
### Existing Daylight Distribution in Summer without Light Shelves



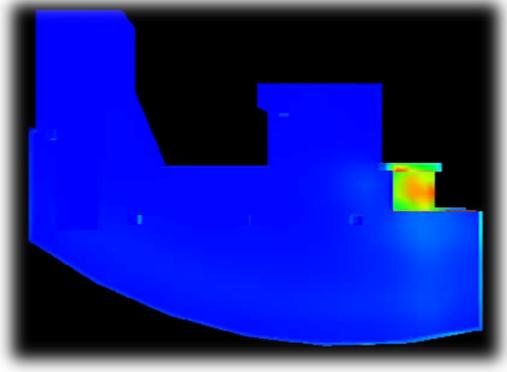
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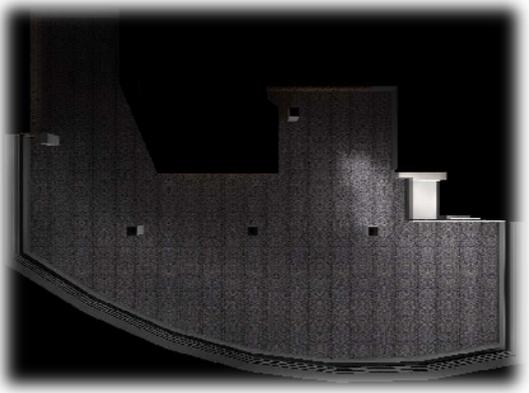
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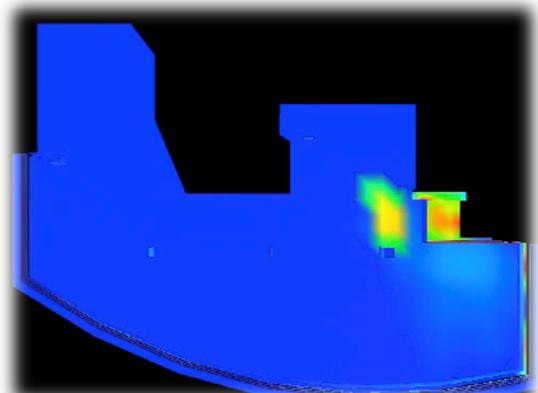
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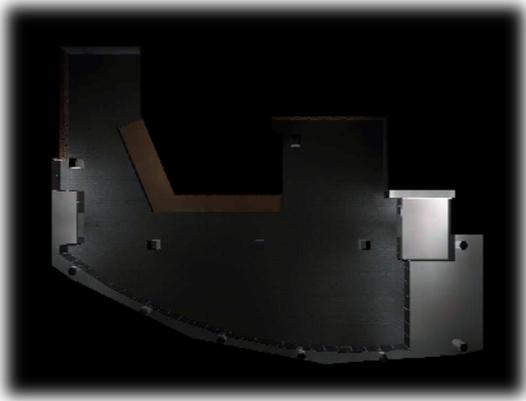
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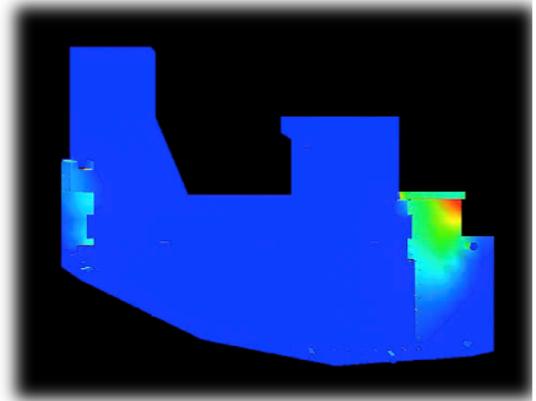
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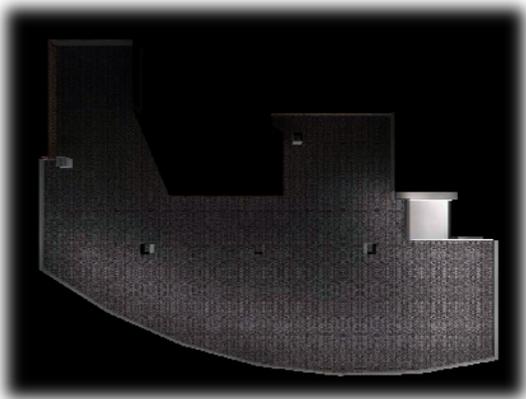
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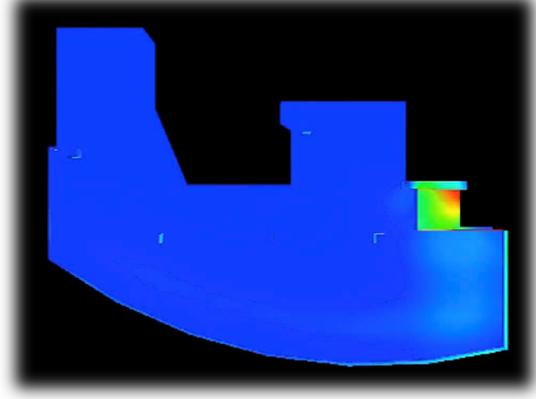
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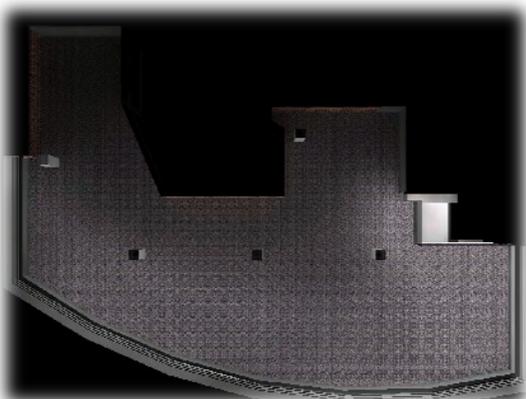
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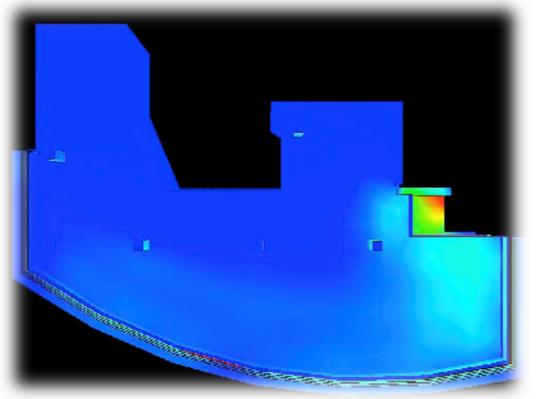
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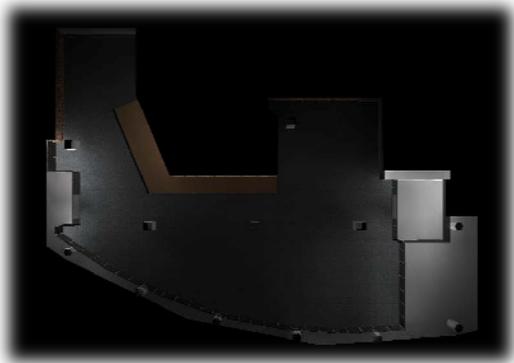
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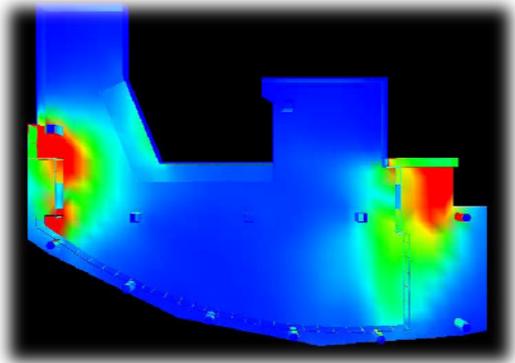
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## *Lighting Breadth*



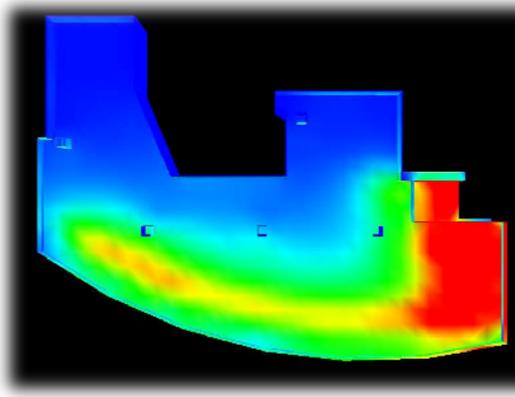
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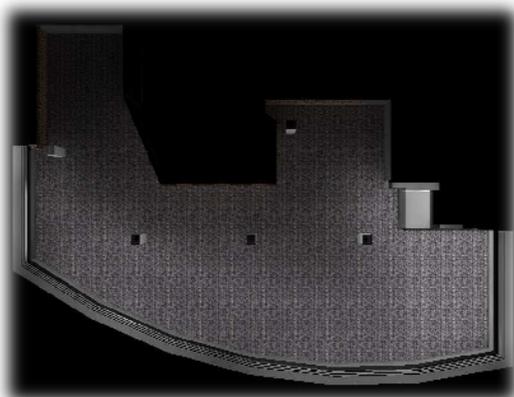
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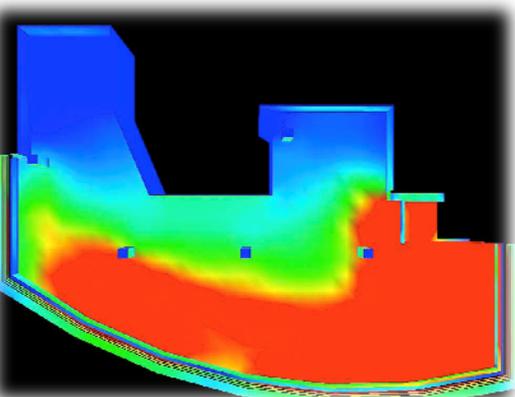
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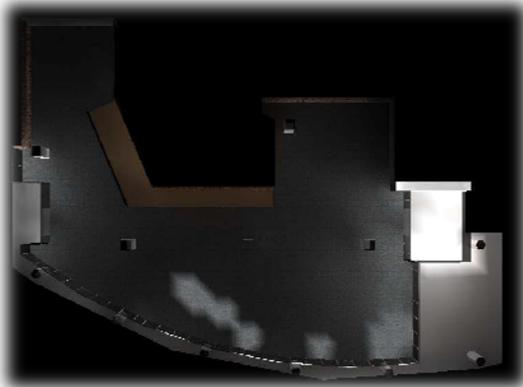
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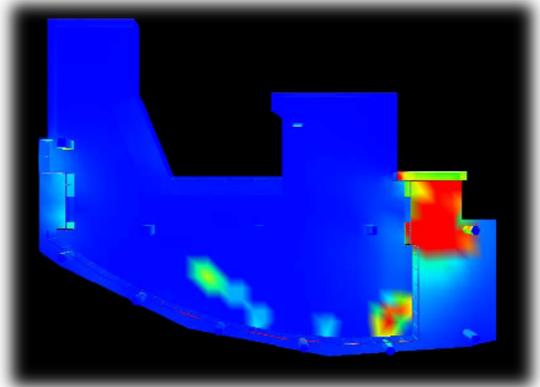
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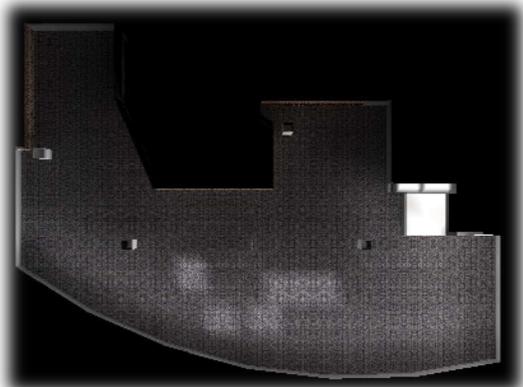
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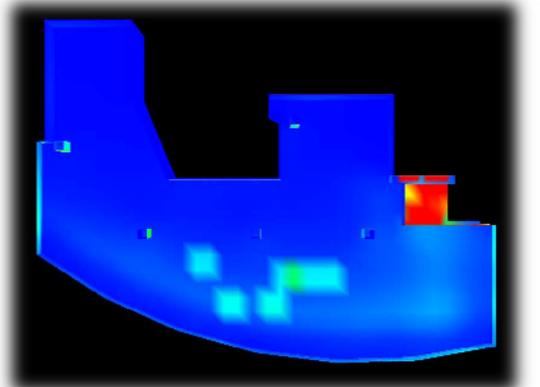
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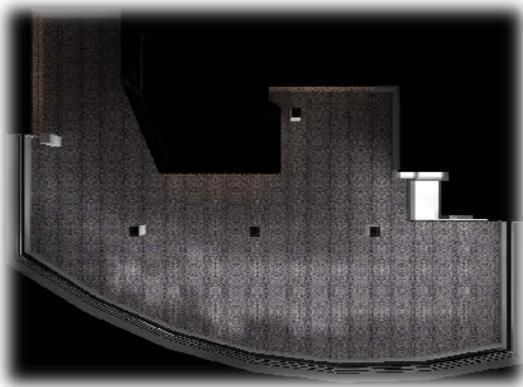
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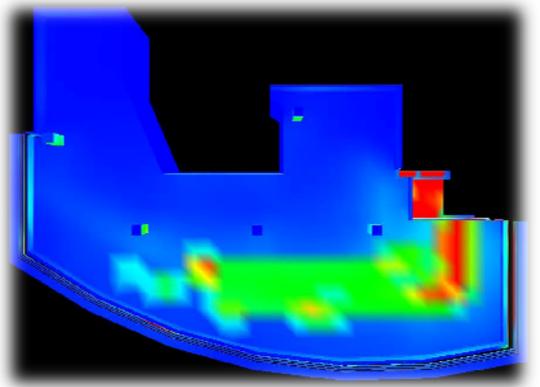
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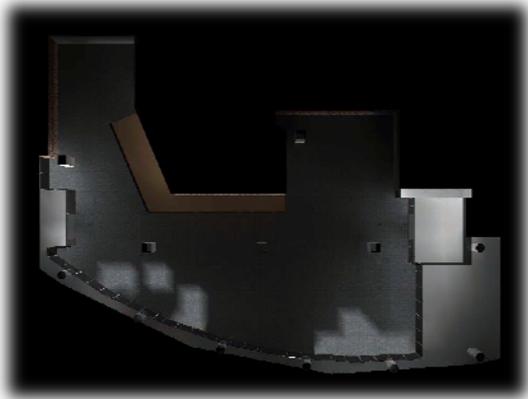
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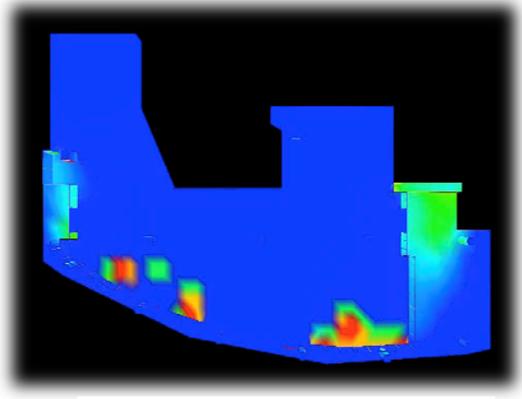
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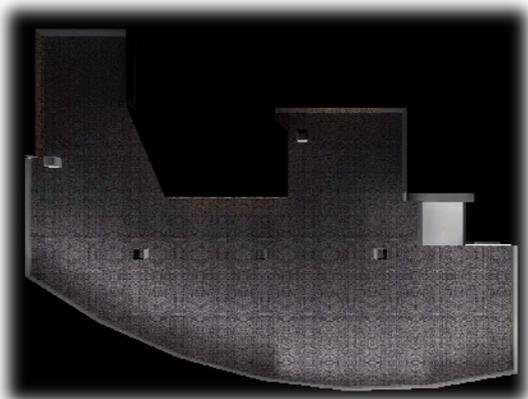
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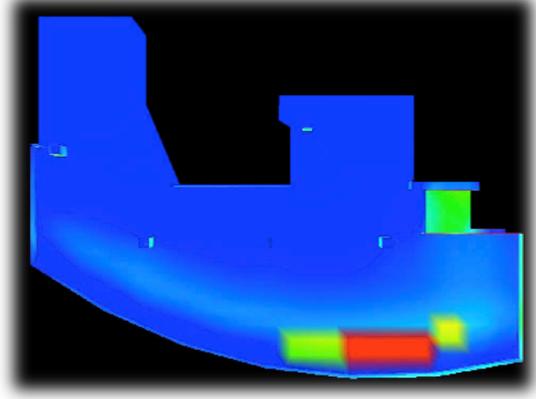
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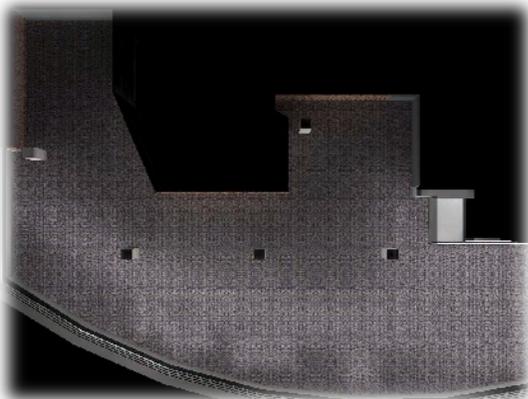
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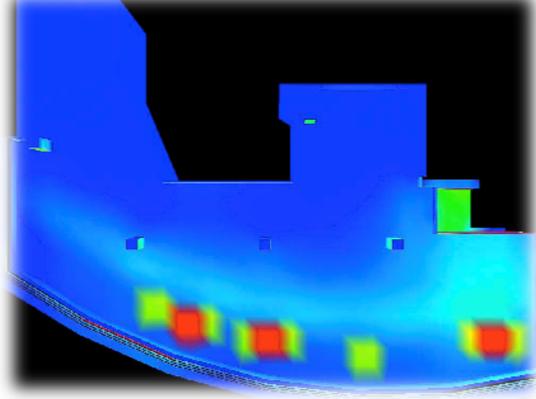
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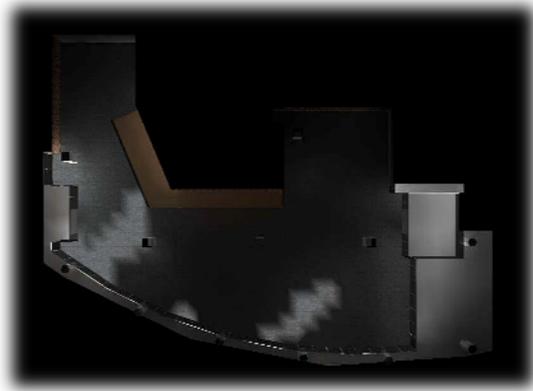
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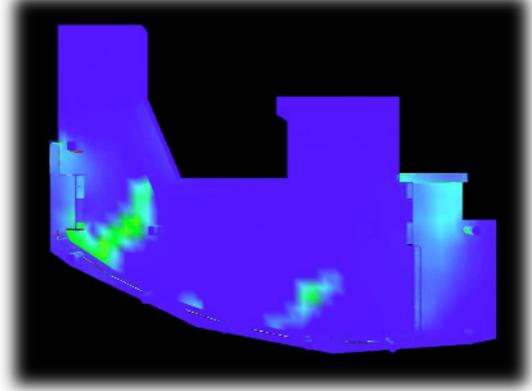
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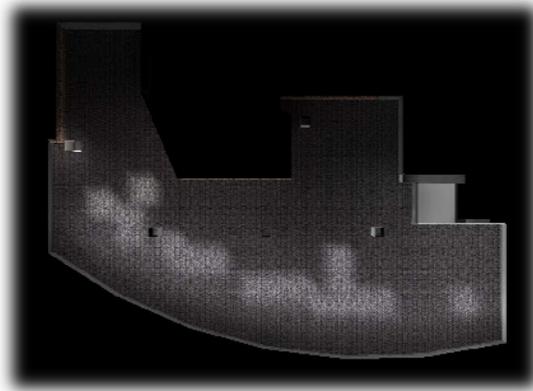
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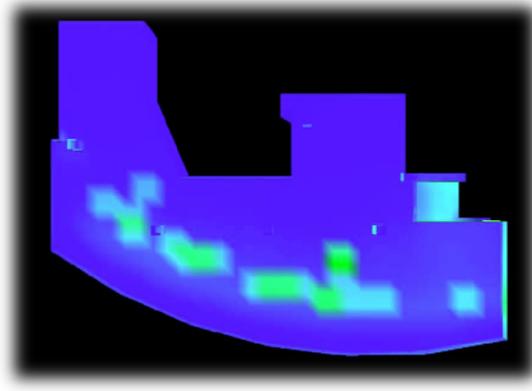
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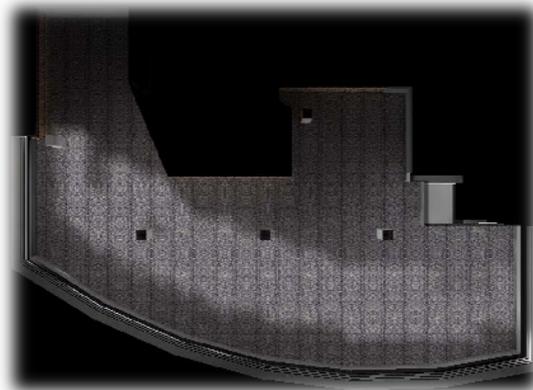
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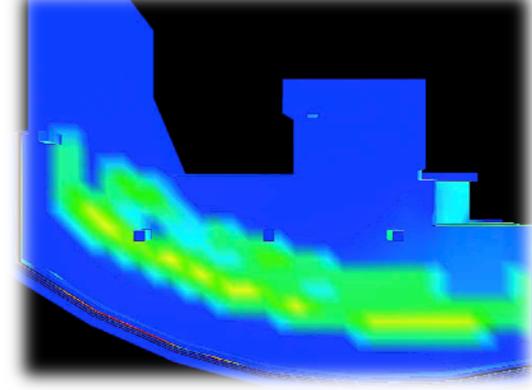
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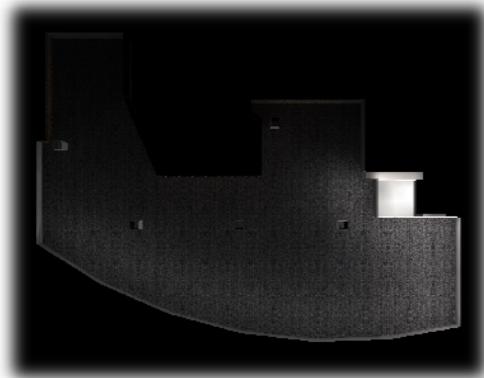
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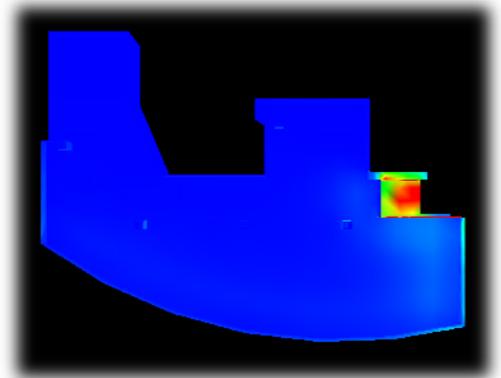
### Proposed Daylight Distribution in Summer with Light Shelves

*\*[First floor not affected because there are no light shelves on the first floor]*

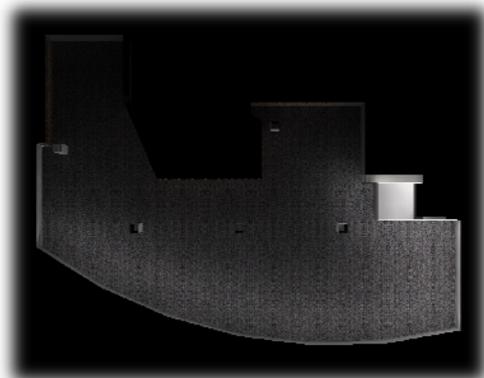
*\*\*[Second and Third Floor essentially display the same concept. The renderings shown are on Floor 2]*



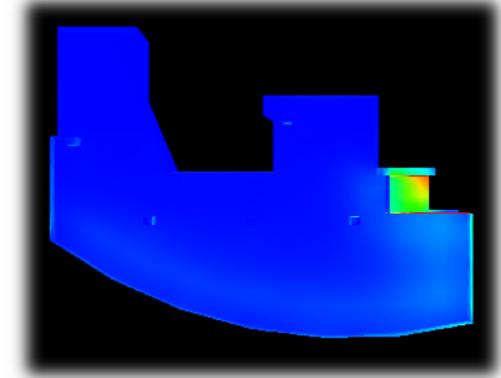
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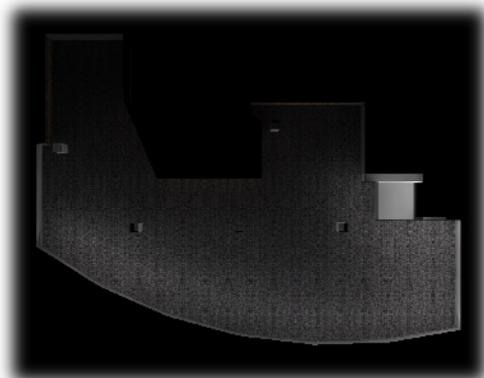
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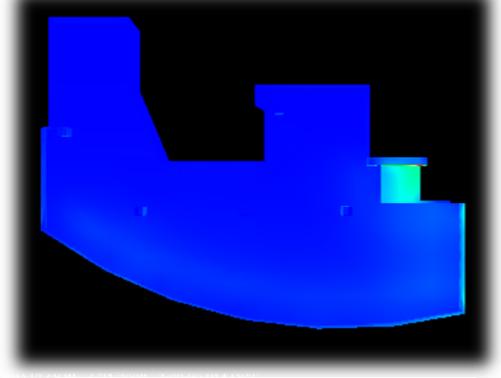
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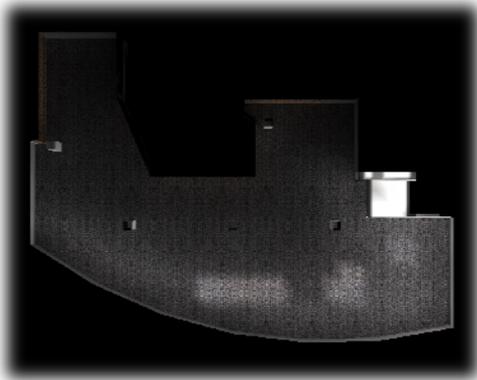
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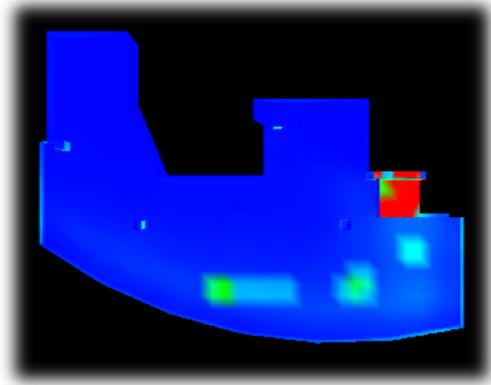
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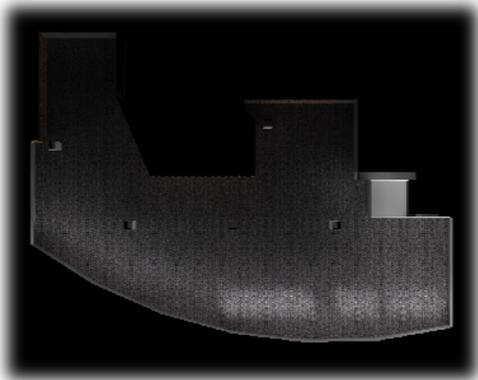
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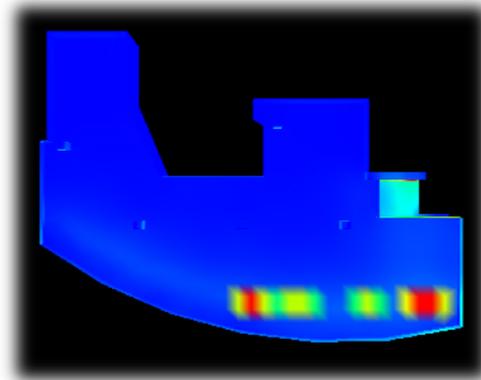
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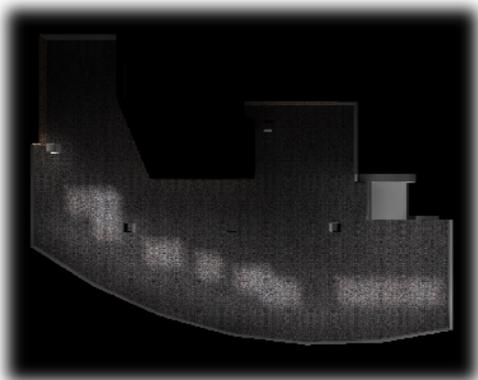
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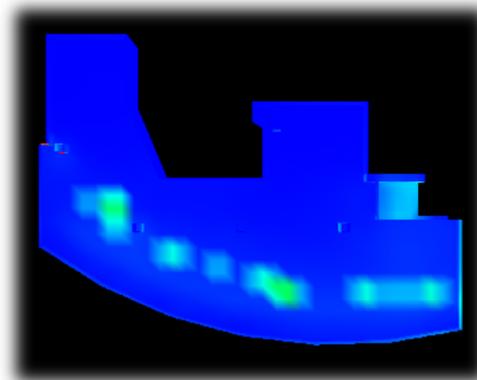
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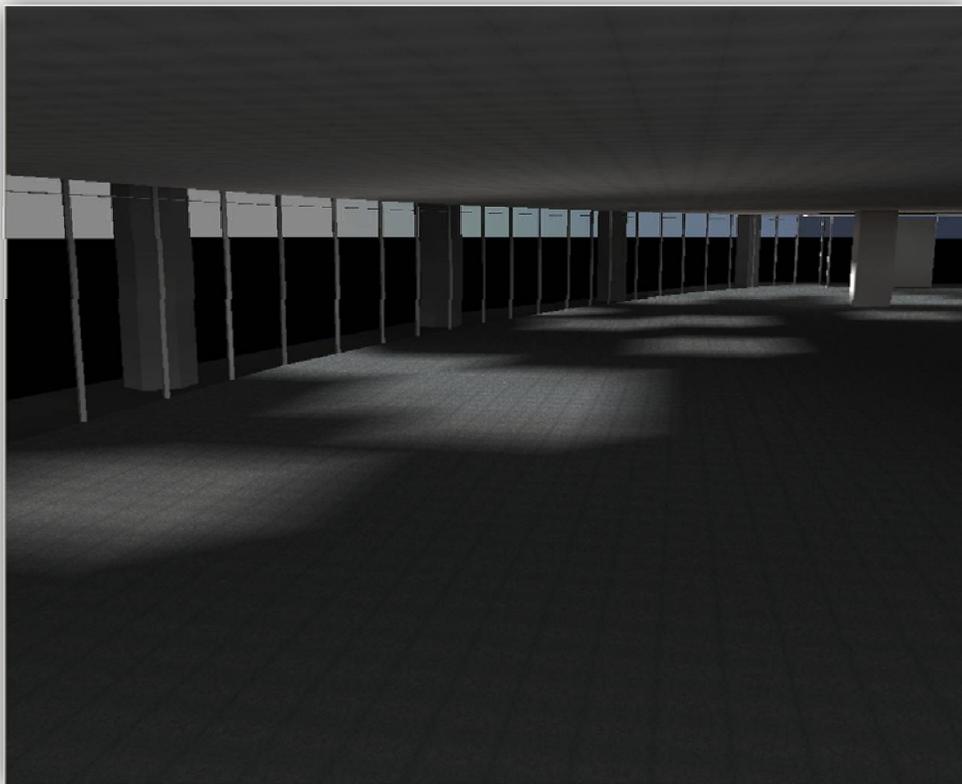
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## *Lighting Breadth*

It is difficult to see some of the differences. Below are some perspective drawings to better display the effect of the light shelves on floors two and three as well as daylight distribution on floor one without light shelves. What is going on is light that was originally clustered together in various regions now seems to be minimized. Keep in mind that some of that light is now reflected on the ceiling, which makes the plan view drawings seem to be lacking sufficient daylight.

*[Mass model can drawn in AutoCAD can be found in Appendix E.1]*

December 21<sup>st</sup>



*Fig 1: First Floor at south facing storefront wall*

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Apr. 9, 2008

## *Lighting Breadth*



*Fig 2: First Floor at west entrance*



*Fig 3: Second floor at east curtain wall*

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Final Thesis Report

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## *Lighting Breadth*



*Fig 4: Third floor at west curtain wall*



*Fig 5: Third Floor at east curtain wall*

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## *Lighting Breadth*

June 21<sup>st</sup>



*Fig 6: First floor at east curtain wall*



*Fig 7: Second Floor indirect light distribution from light shelf*

*Lighting Breadth*



*Fig 8: Third floor indirect light distribution from light shelf*



*Fig 9: Third floor indirect light distribution from light shelf at north east wall*

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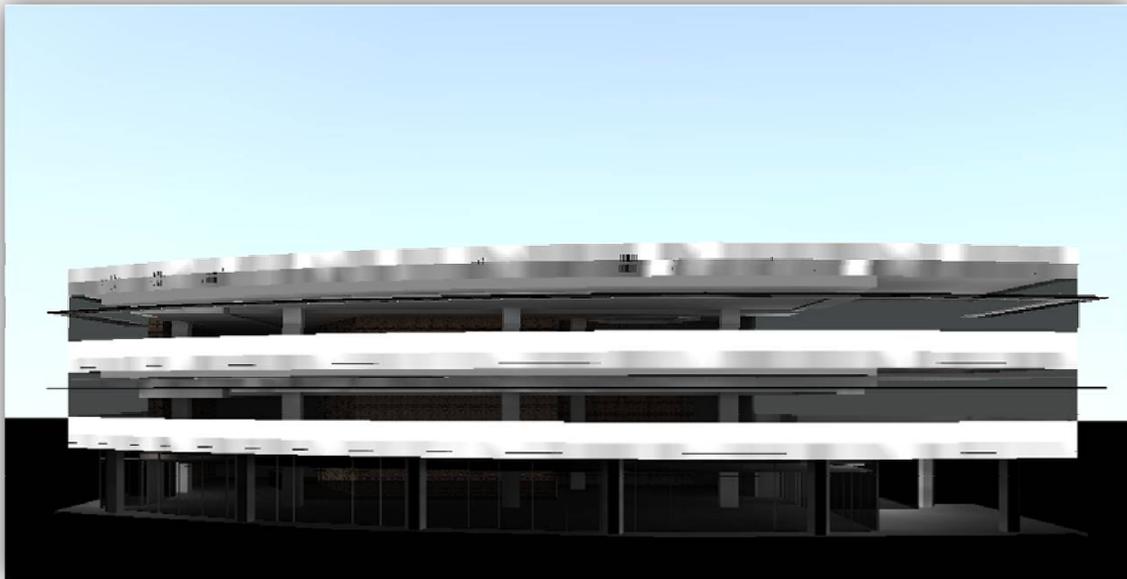
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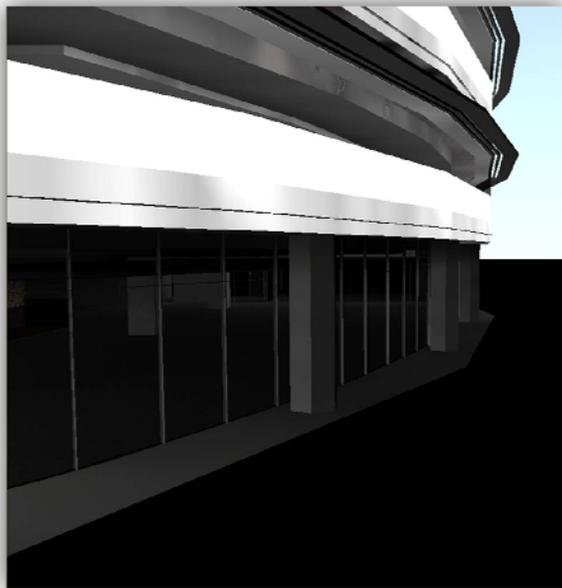
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## *Lighting Breadth*

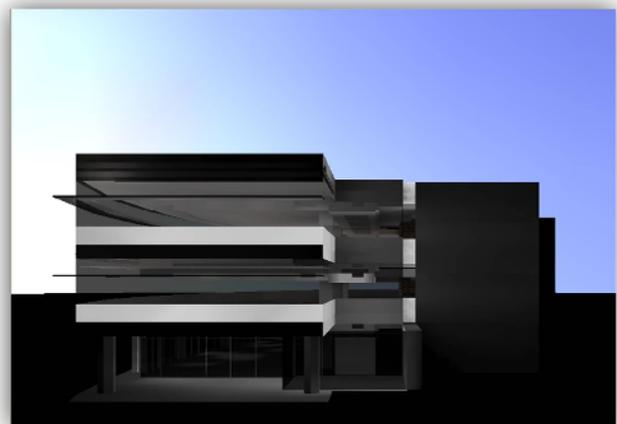
### Loyola/Notre Dame Library Exterior Views



*Fig 9: South Elevation showing new sunshades*



*Fig 11: Close-up Sun shades on south*



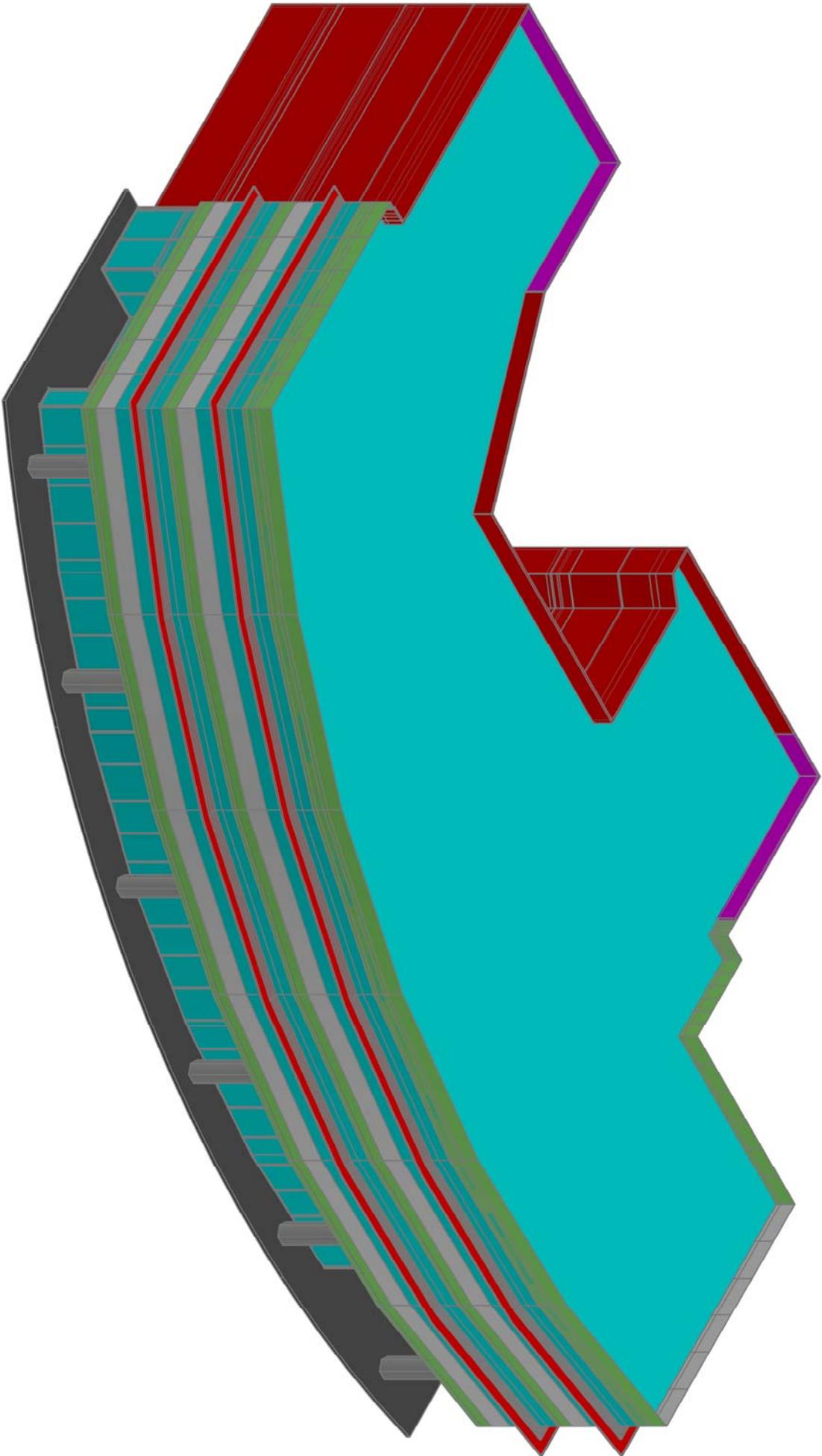
*Fig 12: East Entrance with new sun shades*

## *Lighting Breadth*

### Conclusion

As seen throughout this analysis, natural daylight design is a vital attribute in the construction of new buildings and renovations. Some of the key goals of this analysis were met without much re-design at all. The series of pictures above is a reminder that all building designs should utilize renewable resources, such as the sun, to light interior spaces whenever necessary. Light fixtures that consume less energy are also helpful, but why not try to eliminate the need to turn the lights on at all. Through the minor changes in the schematics explained earlier, the library is still able to:

- ✓ Maintain sufficiently illuminated spaces without sacrificing daylight circulation
- ✓ Allow for indirect light to enter space with the right balance of
  - Solar shading
  - Use of light shelves
- Change architectural appearance of solar shade, while decreasing solar heat gain energy, as seen in the previous section of this report.



Appendix E.1