

UCI NATURAL SCIENCE UNIT II

Final Presentation
April 15, 2009



GRANT W KIGHTLINGER
ARCHITECTURAL ENGINEERING SENIOR THESIS
LIGHTING / ELECTRICAL OPTION
ADVISORS: DR. HOUSER + PROF. DANNERTH

PRESENTATION OUTLINE

PROJECT INTRODUCTION

SUMMARY OF SPACES

DESIGN GOALS

LIGHTING – LOBBY

LIGHTING – CONFERENCE ROOM

PHOTOVOLTAIC ARRAY ANALYSIS

CURTAIN WALL ANALYSIS

OFFICE DAYLIGHTING STUDY

CONCLUSIONS

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NAME: UCI Natural Science Unit II

LOCATION: Irvine, California

OWNER: The University of California Irvine

SIZE: 146,075 ft²

Five Stories

COST: \$45 Million

FUNCTIONS: Science Laboratories

Faculty Offices

Graduate Student Offices



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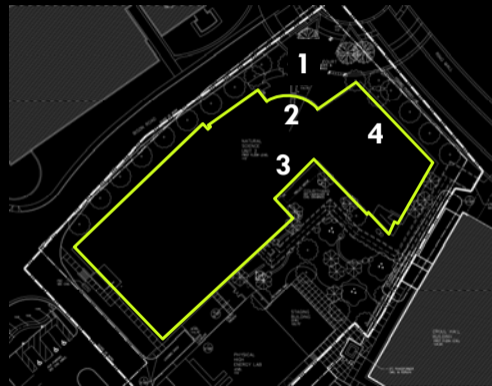
1. NORTH FAÇADE
AND PLAZA

2. LOBBY

3. CONFERENCE
ROOM

4. OPEN OFFICE
(3F)

SUMMARY OF SPACES



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SLEEK, MODERN AESTHETIC

BUILDING IDENTITY

VERTICAL + RADIAL MOTION

TRANSPARENCY

WARM EXTERIOR vs. COOL INTERIOR



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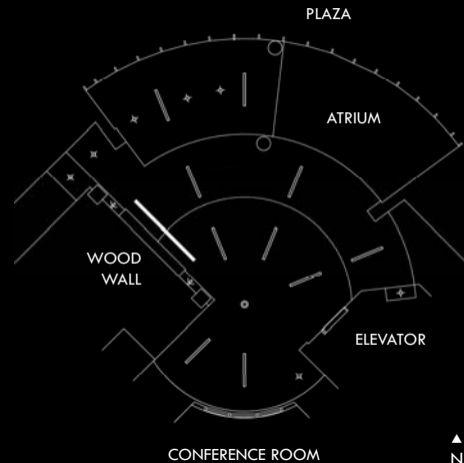
CURTAIN WALL ANALYSIS

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LIGHTING – LOBBY 1F

FOCAL POINTS



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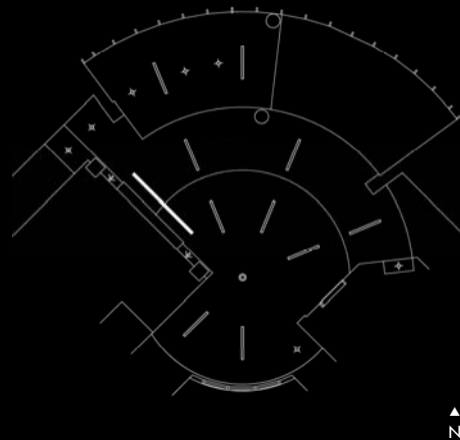
CURTAIN WALL ANALYSIS

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1. Transparency to Plaza
2. Signature View
3. Highlight Center
4. Facial Rendering
5. Radial + Vertical Motion



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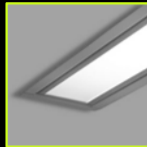
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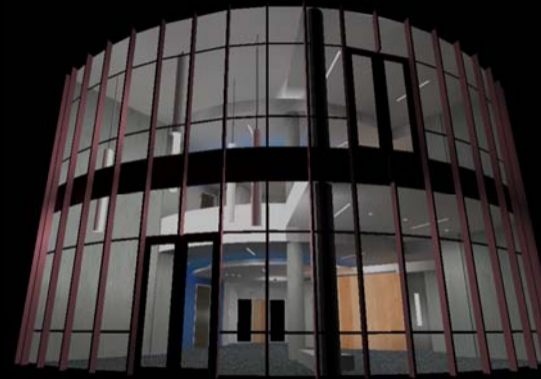
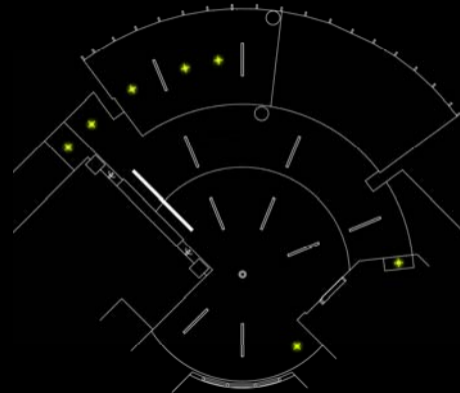
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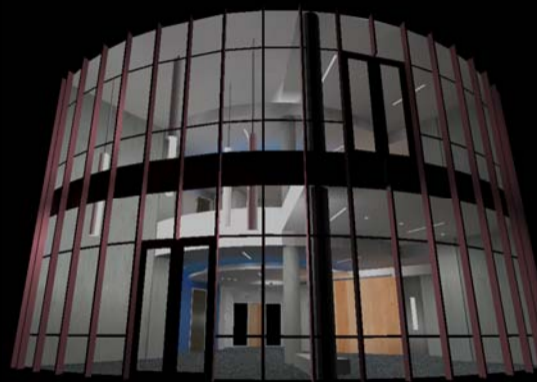
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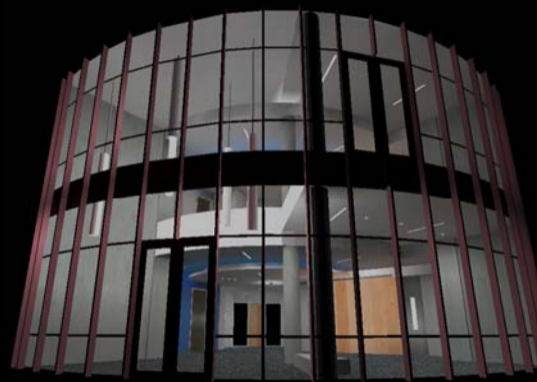
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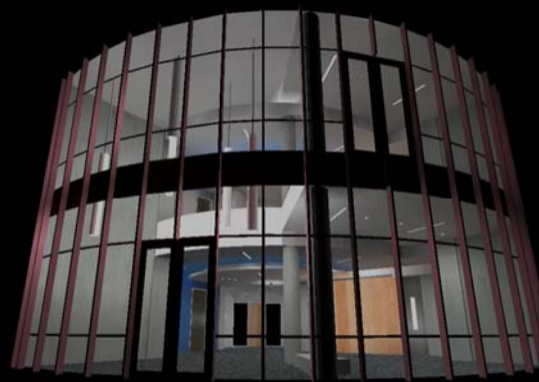
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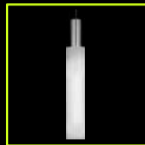
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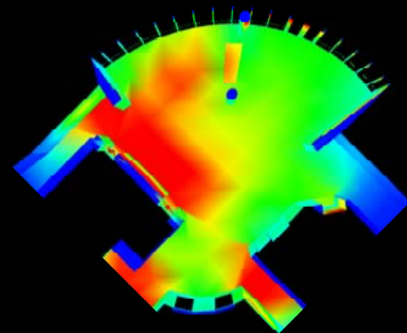
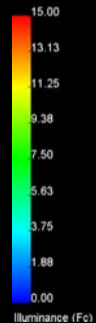
LIGHTING – LOBBY

HORIZONTAL ILLUMINANCE

Goal: 10.0 fc
Result: 10.1fc (1F) **OK**
9.8fc (2F) **OK**

POWER DENSITY

ASHRAE 90.1: 1.30 W/ft²
Result: 0.79 W/ft² **OK**



FIRST FLOOR



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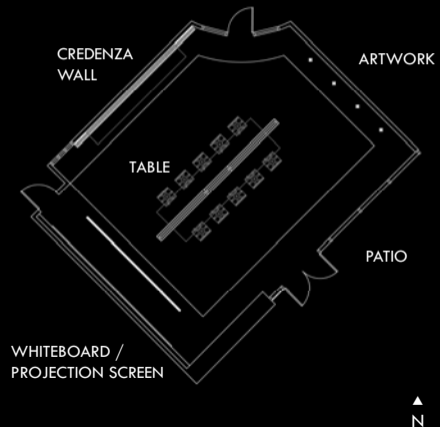
CURTAIN WALL ANALYSIS

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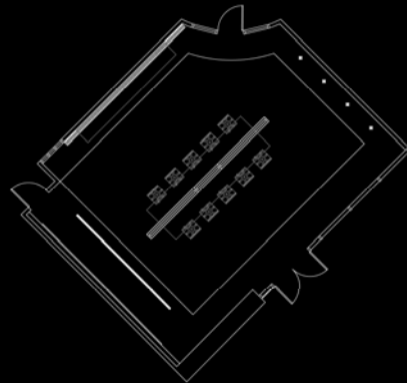
CURTAIN WALL ANALYSIS

OFFICE DAYLIGHTING STUDY

CONCLUSIONS

DESIGN OBJECTIVES

1. Transparency to Patio
2. Scene Flexibility
3. Peripheral Emphasis
4. Facial Rendering



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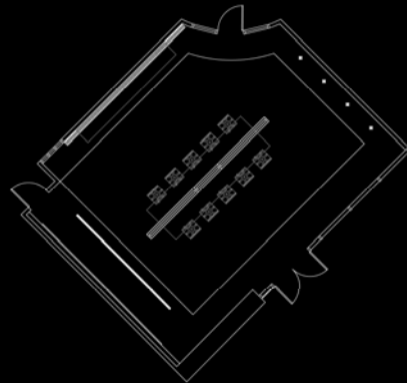
CURTAIN WALL ANALYSIS

OFFICE DAYLIGHTING STUDY

CONCLUSIONS

CONTROL SCENES

1. Meeting / Classroom
2. AV Presentation
3. Social



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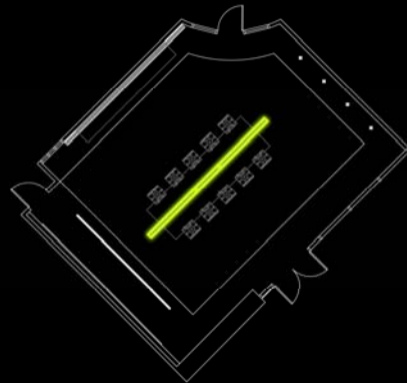
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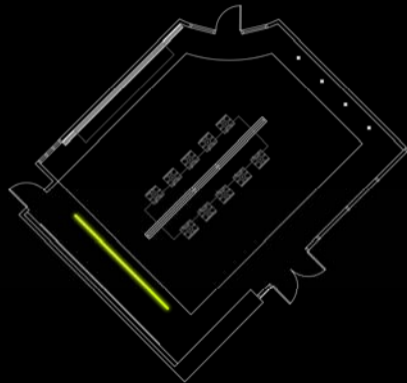
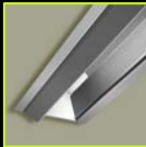
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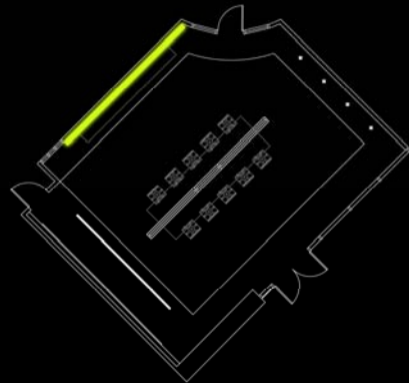
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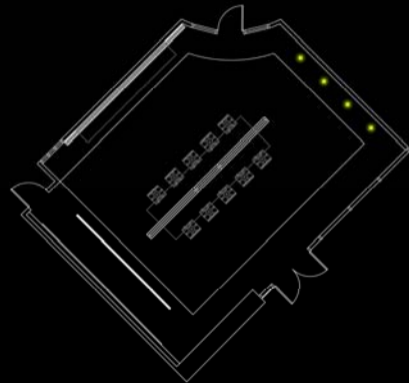
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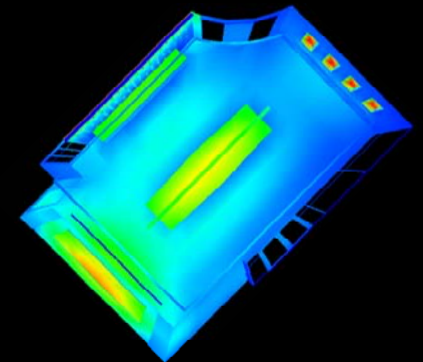
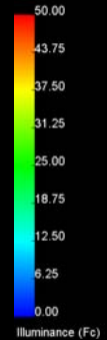
CURTAIN WALL ANALYSIS

OFFICE DAYLIGHTING STUDY

CONCLUSIONS

TECHNICAL OBJECTIVE SUMMARY

| DESCRIPTION | GOAL | RESULT | MET? |
|-----------------------------|-------------------------------|-----------|------|
| Meeting / Classroom Mode | Table: 30 fc Avg. | 33.7 fc | YES |
| | Credenza: 15 fc Avg. | 25.0 fc | YES |
| | Whiteboard: 30 fc Avg. | 35.6 fc | YES |
| | Faces: 15 fc Avg. | 25.6 fc | YES |
| A/V Presentation Mode | Projection Screen: < 5 fc Max | 2.6 fc | YES |
| | Table: 15-30 fc Avg. | 16.3 fc | YES |
| Social Mode | Faces: 15 fc Avg. | 16.1 fc | YES |
| | Credenza: 15 fc Avg. | 28.3 fc | YES |
| Power Density (ASHRAE 90.1) | 1.3 W/SF (Space Method) | 0.56 W/SF | YES |



MEETING / CLASSROOM



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CONCLUSIONS

Unoccupied Roof Area: 21,302 ft²
Usable Roof Area (75%): **15,976 ft²**



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CONCLUSIONS

SELECTED PV PANEL BP SOLAR - BP 3165

Rated Power: 165 Watts
Nominal Voltage: 24V
Module Efficiency: 13.1%
Frame Size: 13.6 ft²

Usable Roof Area: 15,976 ft²
Total Installable Units: **1,174** Panels



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TOTAL SYSTEM COST (RS MEANS 2009)

\$2,211,033

AVAILABLE INCENTIVES

Calif. Solar Initiative: \$293,169

Federal Tax Credit: \$456,000

TOTAL Incentives: **\$749,169**

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RETScreen ENERGY ANALYSIS

Utility Cost: \$0.09033 / kWh

Weather Data: Long Beach, Ca

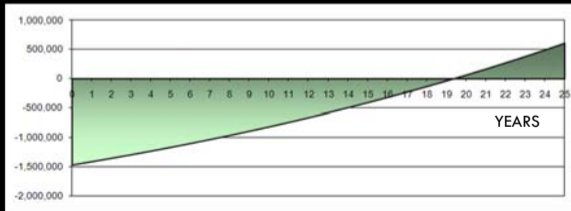
Annual Production: 270.5 MWh

Annual Utility Savings: \$24,434

Payback Period: **19.4** Years

Recommended

CASHFLOW (USD)



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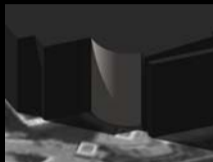
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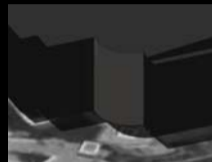
CONCLUSIONS

MECHANICAL – CURTAIN WALL ANALYSIS

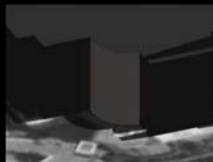
DIRECT SOLAR PENETRATION
Summer Solstice – Worst Case



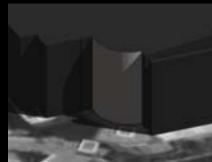
9 AM



11 AM



1 PM



3 PM



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EXISTING GLAZING

Heat Mirror 66

U-Value: 0.29

SHGC: 0.37

Annual Heat Gain: 99,599 kBTU

PROPOSED GLAZING

PPG SolarBan 70XL

U-Value: 0.26

SHGC: 0.27

Annual Heat Gain: 72,539 kBTU

27% Improvement

Recommended



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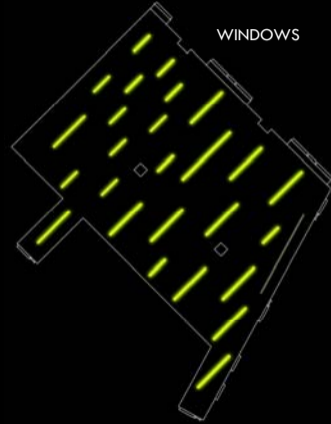
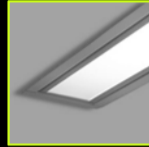
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DAYLIGHTING – OPEN OFFICE



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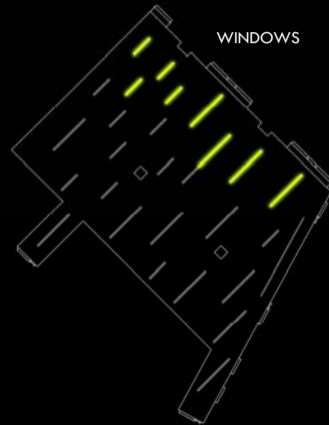
LIGHTING – CONFERENCE ROOM

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ONE-ROW DIMMING

| | | | | | | | | | | | | | | | | | | | | | |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 5.1 | 5.2 | 5.2 | 5.1 | 5.5 | 6.3 | 6.7 | 6.4 | 5.3 | 6.5 | 6.6 | 6.2 | 5.1 | 5.3 | 5.9 | 6.9 | 6.8 | 6.8 | 6.6 | 6.3 | 6.2 | 5.6 |
| 4.7 | 5.2 | 5.5 | 5.3 | 5 | 6.2 | 6.8 | 6.7 | 5.1 | 5.9 | 6.5 | 6.6 | 5 | 5.8 | 6.5 | 7 | 6.8 | 6.7 | 6.4 | 5.7 | 5.6 | 5.4 |
| 4 | 5.2 | 6.1 | 5.5 | 4.7 | 5.5 | 7.7 | 7.4 | 4.7 | 5.2 | 6.5 | 6.6 | 5 | 6.2 | 6.7 | 6.7 | 6.7 | 6.9 | 6.1 | 5.2 | 5.2 | 5.2 |
| 2.5 | 3.3 | 6.1 | 6.4 | 2.9 | 3.5 | 8.1 | 8 | 3 | 3.6 | 7.5 | 7 | 6.1 | 6.4 | 6.8 | 7.1 | 7.2 | 7.2 | 3.4 | 3.7 | 3.6 | 3.6 |
| 7.1 | 6.7 | 5.8 | 6.5 | 8 | 8.4 | 8 | 8.2 | 8.4 | 8.2 | 7.3 | 6.6 | 5.7 | 6 | 7.2 | 8.1 | 8.1 | 7.8 | 5.5 | 7.7 | 7.4 | 7.4 |
| 8.2 | 7.7 | 4 | 6.5 | 9 | 9.1 | 7.6 | 7.7 | 9.1 | 9.8 | 7.7 | 6.1 | 4.1 | 5.7 | 8.7 | 9.3 | 8.6 | 8.4 | 7.9 | 7.5 | 7.2 | 7.1 |
| 9.6 | 9.7 | 10.9 | 3.9 | 10.2 | 11.6 | 4.7 | 4.7 | 10.1 | 11.5 | 4.7 | 4.2 | 10.9 | 3.4 | 10.7 | 10.1 | 8.3 | 9.4 | 9 | 7.1 | 6.9 | 6.8 |
| 10.9 | 11.7 | 12.3 | 11.9 | 11.7 | 13.4 | 13.3 | 11.4 | 11.5 | 13.3 | 14.1 | 13.3 | 12.9 | 13.5 | 13 | 11.8 | 9.5 | 11.2 | 3.8 | 3.9 | 4 | 4.5 |
| 12.1 | 13.1 | 13.5 | 12.8 | 13 | 14.6 | 14.7 | 12.7 | 12.5 | 14.7 | 15.1 | 14.4 | 13.9 | 14.5 | 14.5 | 13.1 | 11.1 | 13.8 | 10.1 | 13.8 | 13.5 | 12.9 |
| 11.2 | 12.2 | 13.1 | 12.4 | 12.5 | 13.6 | 13.6 | 12.6 | 12.4 | 13.9 | 14 | 13.7 | 13.2 | 13.9 | 13.7 | 12.6 | 13.2 | 16.1 | 15.7 | 15.7 | 14.7 | 13.9 |
| 7.2 | 7.9 | 8.4 | 8 | 8.2 | 8.9 | 8.9 | 8.5 | 8.4 | 9.1 | 9.2 | 9 | 8.6 | 9 | 8.8 | 8.2 | 15.6 | 18.4 | 17.3 | 14.1 | 13.7 | 13.2 |
| 28.5 | 32.4 | 33.4 | 32.2 | 27.4 | 30.9 | 29.4 | 25.2 | 25.1 | 29.2 | 31.3 | 29.9 | 31 | 32.6 | 32 | 29.5 | 18.4 | 21.5 | 6.9 | 6.9 | 6.9 | 7.1 |
| 34.7 | 39 | 41.4 | 40.2 | 31.6 | 35.6 | 33 | 27 | 27.3 | 32.3 | 35.2 | 34.5 | 36.1 | 38 | 37.5 | 34.8 | 21.3 | 25.3 | 21.9 | 28.2 | 29.9 | 29 |
| 44.5 | 50.8 | 54.3 | 53.6 | 39.5 | 43.9 | 37.5 | 26.9 | 30 | 35.5 | 37.8 | 38.3 | 40.5 | 41.8 | 45.6 | 44.1 | 23.2 | 31.5 | 31.7 | 33.5 | 35.4 | 34.6 |
| 56.6 | 66.8 | 72.4 | 71.6 | 62.9 | 53.3 | 19.2 | 16.4 | 34.8 | 44.9 | 22.4 | 22 | 21.9 | 21.2 | 64.2 | 54.5 | 38.7 | 33.5 | 31.6 | 34.7 | 39 | 40.3 |
| 70.6 | 88.8 | 98.5 | 97.7 | 85.6 | 64.2 | 41.1 | 29.4 | 29.8 | 44.8 | 72.5 | 92 | 103 | 102 | 87.2 | 64.9 | 40.1 | 29 | 15.3 | 16.1 | 17.5 | 19.7 |

WINDOWS

Illuminance Data
Clear Sky – Winter Solstice 12PM



PRESENTATION
OUTLINE

DAYLIGHTING – OPEN OFFICE

PROJECT INTRODUCTION

SUMMARY OF SPACES

DESIGN GOALS

LIGHTING – LOBBY

LIGHTING – CONFERENCE ROOM

PHOTOVOLTAIC ARRAY ANALYSIS

CURTAIN WALL ANALYSIS

OFFICE DAYLIGHTING STUDY

CONCLUSIONS

DAYSIM ENERGY ANALYSIS

Desired Workplane Illuminance: 30 fc (without personal task)
Lighting Power Density: 0.86 W/ft²

Non-Dimming Power Use: **2914.7** kWh Annually

Dimming System Power Use: **477.0** kWh Annually

\$220 Annual Energy Savings
Not Recommended

PRESENTATION
OUTLINE

CONCLUSIONS

PROJECT INTRODUCTION

LIGHTING

Technical and Design Objectives **Achieved**

SUMMARY OF SPACES

ELECTRICAL

Photovoltaic Array:

Recommended – 19.4 Year Payback

DESIGN GOALS

LIGHTING – LOBBY

MECHANICAL

Curtain Wall Glazing:

Recommended - 29% Improvement with SolarBan Glazing

LIGHTING – CONFERENCE ROOM

PHOTOVOLTAIC ARRAY ANALYSIS

DAYLIGHTING

Office Dimming System:

\$220 Annual Savings – **Not Recommended**

CURTAIN WALL ANALYSIS

OFFICE DAYLIGHTING STUDY

CONCLUSIONS

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