ENERGY.DAYLIGHT.GLARE.COMFORT

Bringing it all together
“The Board of Regents is committed to providing sustainability leadership through responsible stewardship of the state’s natural and physical resources.”
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Learning Objectives

1) Understand the methodology parametric building design.

2) Showcase the use of rapid feedback method in design process to save time.

3) List the key metrics of success for a high performance buildings

4) Learn how to compare building options for performance.
CONTEXT
CURRENT ENERGY CODES
Georgia Currently using ASHRAE 90.1 – 2007. Will adopt 2010 version this Year.
ASHRAE 90.1 STANDARD EVOLUTION

Energy codes are changing in the United States.

Effectiveness Improvement in ASHRAE Std. 90.1 and IECC (1975 to 2015)

- 2004 to 2007: 5% reduction
- 2004 to 2010: 30% reduction
- 2004 to 2013: 50% reduction
CURRENT STANDARDS REQUIRE A NEW DESIGN METHOD
Overlaps Between High Performance Building Standards

**Requirements**
- 1.1 – Commissioning
- 1.2 – Water-Use Reduction
- 1.3 – Georgia-based Materials & Products

**Incentives**
- 5.1 – Commissioning
- 5.2 – Water-Use Reduction
- 5.3 – Georgia-based Materials & Resources
- 5.4 – Energy Modeling and Life Cycle Cost Analysis
  (Note: Section 4.1 Recommendation = 30 Points)

**Place**
- Water
- Energy
- Health and Happiness
- Materials
- Equity
- Beauty

5 Site Sustainability
6 Water Use Efficiency
7 Energy Efficiency
8 Indoor Environmental Quality (IEQ)
9 The Building’s Impact on the Atmosphere, Materials, and Resources
10 Construction and Plans for Operation

ASHRAE 189.1/LEED
KEY OBJECTIVES TO CREATE VALUE

Value is created by architects balancing 5 competing objectives

- MAXIMIZE DESIGN QUALITY
- MINIMIZE FIRST COST INCREASE TO CLIENTS
- MINIMIZE LIFECYCLE COST TO CLIENTS
- MAXIMIZE BUILDING HEALTH
- MAXIMIZE OCCUPANT COMFORT
KEY METRICS FOR MEASURING VALUE

To evaluate the success of a strategy, there are five major metrics every team should use.

- Total Energy
- Daylight
- Glare
- Thermal Comfort
- Cost
KEY STRATEGIES

Teams should use the 4 main strategies in the design process and measure success using the 5 metrics:

- Shading
- Glazing
- Orientation
- Schedules
CASE STUDIES

Project: Public Safety Facility
School: Georgia Institute of Technology
Architect: Pond/Houser Walker Architects

Project: Student Services and Success Center
School: Atlanta Metropolitan State College
Architect: GSSTJ

Project: Lecture Hall and Art Science Building Renovation
School: Clayton State University
Architect: Flynn Finderup Architects / JW Robinson & Associates
Project: Public Safety Facility
School: Georgia Institute of Technology
Architect: Pond/Houser Walker Architects
BENCHMARKS
WHERE DO WE NEED TO BE

National Average: 91 KBTU/sf/yr
Georgia Average: 115 KBTU/sf/yr
Net Zero Ready: 40 KBTU/sf/yr

National EUI Average for Public Safety Facilities: 91 KBTU/sf/yr

Measured EUI of Public Safety Facilities Data from Building Performance Database by LBL
TESTING ALTERNATIVES
WHICH MASSING TO CHOOSE
sDA
39.4 %

Spatial Daylight Autonomy describes the percentage of floor area that receives at least 300 lux for at least 50% of the annual occupied hours. As per the WELL requirements, a 55% sDA is the minimum to achieve the optimization.
DAYLIGHT MAP
SECOND FLOOR PLAN

Adding solar tubes would increase this to 80% day lit

sDA
72.5 %

Spaces Not Regularly Occupied
Not Included in calculation
PHOTOVOLTAIC PANELS
CREATING A NET ZERO ENERGY DESIGN

- EUI Offset: 16
- Building EUI: 27
- EUI Offset: 27

- 11000 sqft
- 6500 sqft
FAÇADE STUDY
SHADING STRATEGY

Baseline
No Shading

Alternative 1
6” Vertical Fins

Alternative 2
12” Vertical Fins

Alternative 3
18” Vertical Fins

Alternative 4
6” Horizontal Fins

Alternative 5
12” Horizontal Fins

Alternative 6
18” Horizontal Fins

Alternative 7
5’ Overhang
UNDERSTANDING THE RESULTS
SHADING STRATEGY

<table>
<thead>
<tr>
<th>ALTERNATIVE</th>
<th>ORIENTATION</th>
<th>ENERGY [Kbtu/sf/yr]</th>
<th>DAYLIGHT [sDA%]</th>
<th>GLARE [ASE %]</th>
<th>RADIATION</th>
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<td>6in OH</td>
<td>West</td>
<td>29</td>
<td>20</td>
<td>15</td>
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<tr>
<td>5' OH</td>
<td>South</td>
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<td>15</td>
<td>10</td>
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<tr>
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UNDERSTANDING THE RESULTS
PROCESS TO SELECT OPTIMAL RESULT

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<th>GLARE (ASE %)</th>
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<td>6in Fin</td>
<td>East</td>
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<tr>
<td>Baseline</td>
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For South Orientation

Low Glare
High Daylight
Low Energy
GLARE-FREE FACADE
SOUTH EAST CONFERENCE ROOM

SD

Recommended Option

DD

Intolerable Glare  Disturbing Glare  Perceptible Glare  Imperceptible Glare

>45  40-45  35-40  <35

18" Projection
40% Frit
18" Projection
Vision Glass
40% Frit

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GLARE-FREE FACADE
WEST CONFERENCE ROOM

SD

Recommended Option

DD

Intolerable Glare  Disturbing Glare  Perceptible Glare  Imperceptible Glare

>45  40-45  35-40  <35
DESIGN EVOLUTION
ENERGY AND DAYLIGHT

53 Kbtu/sf/yr Energy  56 % Daylight
The diagrams on the left show yearly glare studies for West and South without any shading strategy on the façade. This helps us understand that if no strategy is used, there will be high amounts of glare in the space. Using this, we pick two points in time to test for various façade options.
GLARE
1ST FLOOR LOOKING WEST

The Glare looking out to the West is **Intolerable** and needs to be mitigated using appropriate shading strategies. Of the 3 tested strategies, **option 3** is most effective in reducing the daylight glare probability.

<table>
<thead>
<tr>
<th>Imperceptible Glare</th>
<th>Perceptible Glare</th>
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<tr>
<td>&lt;35</td>
<td>35-40</td>
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<table>
<thead>
<tr>
<th>Disturbing Glare</th>
<th>Intolerable Glare</th>
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<tr>
<td>40-45</td>
<td>&gt;45</td>
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**Option 1**
- Horizontal shades,
- Mecho shades,
- Dark tint glass,
- Dbl. pane glazing

**Option 2**
- Horizontal Shades,
- Fritted glass
- Dbl. pane glazing

**Option 3**
- Spandrel glass
- Fritted glass
- Dbl. pane glazing

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The Glare looking out to the South is **Perceptible** and needs to be mitigated using appropriate shading strategies. Of the 3 tested strategies, **option 3** is most effective in reducing the daylight glare probability.
USEFUL DAYLIGHT ILLUMINANCE
THREE FAÇADE OPTIONS

Useful Daylight Illuminance

Orange is good, blue is bad. The diagrams on the left show daylight maps. Option 2 and 3 perform well from a daylight standpoint, allowing the daylight the penetrate deep into the floor plan to help reduce the use of electrical lights.
For Atlanta, lower radiation is better. The radiation maps on the left help us understand the three different options. Option 1 with Mecho shades allows is very little radiation. Option 2 is the worst performing from a radiation standpoint, creating the highest amounts of hot spots.
Project: Lecture Hall and Art Science Building Renovation
School: Clayton State University
Architect: Flynn Finderup Architects / JW Robinson & Associates
GLARE POTENTIAL – SOUTH WEST FACADE
TIME OF YEAR WITH INTOLERABLE GLARE

Jan – Apr

Sep – Dec

9am – 5pm

Imperceptible Glare  Perceptible Glare

<35  35–40

Disturbing Glare  Intolerable Glare

40–45  >45

Glare View
GLARE POTENTIAL – TESTING ALL FAÇADE OPTIONS

LECTURE HALL - USING PPG SOLARBAN 60 GLASS

Baseline – No Shading
3’ Spandrel Glass at the Bottom
4’ Spandrel Glass at the Bottom
4’ Spandrel Glass at the Top
4’ Spandrel Glass at the Bottom with 12” Fin
4’ 60% Frit Glass at the Bottom
60% Frit Glass Throughout
4’ 60% Frit Glass at the Bottom and 2’ at top
60% Shaded Glass Spec
3’ Spandrel Glass at the Bottom and 3’ at the Top
GLARE POTENTIAL – SHORT-LISTED OPTIONS
LECTURE HALL - USING PPG SOLARBAN 60 GLASS

Preferred Options

3’ Spandrel Glass at the Bottom
Perceptible Glare

4’ Spandrel Glass at the Bottom
Imperceptible Glare

4’ Spandrel Glass at the Bottom with 12” Fin
Perceptible Glare

60% Frit Glass Throughout
Imperceptible Glare

60% Shaded Glass Spec
Imperceptible Glare

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GLARE POTENTIAL – PREFERRED OPTIONS

LECTURE HALL- USING PPG SOLARBAN 60 GLASS

3’ Spandrel Glass at the Bottom and 3’ at the Top

60% Frit Glass Throughout

60% Shaded Glass Spec

Spandrel Glass Panel

Screen 5023 1/8” Holes
Screen 5961 7/16” Dots
Screen 6019

Glass with 60% Silk-screening ceramic frit
Viracon
Oldcastle
*There are other manufacturers that provide similar glass

Glass with Visible Transmittance (VT) below 40%
Solarban® 90 Tint+ Clear
Solarban® 70XL [2] Solargray® + Clear
*There are products by other manufacturers that qualify similar spec.