WHRC — Team D
We are all about illuminating the questions!
Hypotheses

#1a - The light levels in the office spaces in which people are working are 20% below the light levels in common IES standards.

#1b - The people working in these spaces are satisfied with these light levels.

Reference: - MEEB – 8th Edition (Stein & Reynolds) - 1992

p. 941, Table 18.5 – Illuminance Categories & Illuminance Values for Generic Types of Activities in Interiors

Type of Activity = Performance of Visual Tasks of medium contrast or small size – Category E

Range of Illuminances – 50-75-100 foot candles
Methods

• Calibrate Sylvania Light Meters to Minolta X-10

• Establish outdoor baseline (measurement)

• Establish typical office baseline (measurement)

• Collect data –
  • Measurement #1 at work plane
  • Measurement #2 at secondary work plane
  • Measurement #3 center of room at 1 meter elevation
  • Log room light (overhead, task) & control (shades) conditions
  • Conduct questionnaire

• Compare findings to IES Standard for Light Levels

• Go beyond…
Daylight Only
WHRC – Team D – Daylighting Influence

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Daylight Room-Light
Daylight
Task-Light
Room-Light
Methods

Typical Unoccupied Office Measurement

Outdoor Measurement

AGENTS OF CHANGE

WHRC – Team D – Daylighting Influence

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Primary Work Surface
Secondary Work Surface
Survey Questions

1. How satisfied are you with the light level under these conditions (scale of 1-7)?

2. Would you prefer less light, light as it is now, or more light for what you are doing?

3. How satisfied are you with the available lighting options over the course of the year (scale of 1-7)?

4. What do you like the best about the lighting in your office?
Data Collection

The Data Set

Base Plan 1

Base Plan 2

Agents of Change

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### Data Collection

#### The Data Set

**Task Lighting**

<table>
<thead>
<tr>
<th>Orientation</th>
<th># of rooms</th>
<th>Task Lights On</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>South</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>East</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>West</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>North &amp; East</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>South &amp; East</td>
<td>1</td>
<td>0</td>
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<tr>
<td>South &amp; West</td>
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<td>0</td>
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</table>
**Data Collection**

**The Data Set**

**Task Lighting**

**Overhead Lighting**

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<table>
<thead>
<tr>
<th>OVERHEAD LIGHTS</th>
<th>Base Plan 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orientation</td>
<td># of rooms</td>
</tr>
<tr>
<td>North</td>
<td>3</td>
</tr>
<tr>
<td>South</td>
<td>1</td>
</tr>
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</table>

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WHRC – Team D – Daylighting Influence

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The Data Set

Task Lighting
Overhead Lighting
Shading

<table>
<thead>
<tr>
<th>Orientation of Window</th>
<th># of windows</th>
<th>% use of Shades</th>
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</thead>
<tbody>
<tr>
<td>North</td>
<td>4</td>
<td>none available</td>
</tr>
<tr>
<td>South</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>East</td>
<td>3</td>
<td>25</td>
</tr>
<tr>
<td>West</td>
<td>3</td>
<td>25</td>
</tr>
</tbody>
</table>

Data Collection

Base Plan 1

Base Plan 2
Conclusions

• **Hypothesis #1a**
  - We found that the average illuminance level of the offices observed was:
    - **31 fc** – primary work surface
    - **42 fc** – secondary work surface
  - As you recall – IESNA Standard = **50 fc** (generic work tasks)
  - Therefore the average of the two work surface areas was between 16-38% < IESNA Standard.

• **Hypothesis #1b**
  - Interviews with occupants indicated
  - **100% Satisfaction Level** with these lighting levels
  - Additional info — **17.5 fc** – center of the room at 3'-0"
Additional Findings

• 25% used task lighting
• 25% used overhead lighting
• (1) occupant used both

• Correlation between use of overhead lighting & window orientation
  • Offices were oriented on N & E (east facing window under porch)
• Correlation between interior shading device use & window orientation
  • E,W offices 20-25% window coverage
  • S offices 50% window coverage
  • N offices – no shading devices

• No correlation between use of task lighting and window orientation
What do you like about the lighting in your office?

- natural daylight
- west orientation of the office windows in the winter
- afternoon light
- triple glazing makes light the same year-round and constant all day long
- light is non-glaring
- multiple light sources that can be adjusted
- natural light
- natural light
- light on cloudy days
- light level is working great
- natural daylight
What do you dislike about the lighting in your office?

- motion detectors inside the office and throughout the building (because they do not work or are inadequate)
- west orientation troublesome in the summer
- gets dark early in Nov, Dec, and Jan
- north side requires overhead light on cloudy days
- southern orientation must use a screen (uses a transparent screen so as to maintain the view)
- start-up noise of the overhead light
- quality of the overhead light (described as like the light in a dentist’s office)
What do you dislike about the lighting in your office?

- overhead light start-up flickering and operation noise
- overhead light in the winter is behind user and less effective
- task light is too harsh
- necessity of using shades on sunny days
Glare, a form of visual discomfort, can occur when the eye is challenged with adjacent surfaces of widely varying brightness?

Old building
Lower floor
Facing south, side main entry

Spot luminance measurements using the Minolta LS-100 Luminance Meter yield a luminance ratio of $1:85$.

Sky reflected in specular floor finish.
Windows in the older part of the building can challenge visual comfort.

Old building
Upper floor
East side

Spot luminance measurements using the Minolta LS-100 Luminance Meter yield a luminance ratio of 1:185.

Unobstructed view of the clear sky.
North-facing windows in the addition are visually comfortable.

New building
Upper floor
East side

Spot luminance measurements using the Minolta LS-100 Luminance Meter yield a luminance ratio of 1:131. However, if we consider the foveal plane the value ratio is constrained to 1:8.

Green, leafy foreground and blocked view of the clear sky.
Design Lessons Learned

• Daylighting is preferred by occupants, and results in a lower use of electric lighting

• People may tolerate lower light levels than IESNA standards suggest

• Shades might be required even on a cloudy day

• When designing a daylighting scheme involving nominally clear glass it is incumbent to deal with visual comfort and solar control — OR users may modify.