A Case Study on the Use of Temporary Construction Lighting System

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The Context

Natural Lighting

Temporary Lighting

Task Lighting

Egress Lighting

Electrical Sub

Bid Package

G.C.

General Req.

Project Owner
Traditional Temp. Lighting Setup

Incandescent lamps (100W or 150W) suspended from the slab deck at a 10’ x 10’ grid. (Smith, 2007)

Suspended compact fluorescent lamps, (Clear-Vu Lighting, www.clearvulighting.com)
Traditional Temp. Lighting Setup

Wobble lights with cords on the ground on site (www.probuiltpighting.com)
Traditional Temp. Lighting Setup

Suspended metal halides (Smith 2007)
Low Voltage LED Lighting Setup

## Comparison

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Traditional</th>
<th>LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illumination</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td>Glare and Glow</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td><strong>Maintenance</strong></td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td>Productivity</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td>Safety</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td>Health</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td>Energy</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td>Sustainability</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td><strong>Initial Material Cost</strong></td>
<td>↑</td>
<td>↓</td>
</tr>
<tr>
<td>Installation</td>
<td>↑</td>
<td>↓</td>
</tr>
</tbody>
</table>
Case Study Project

- UW Bothell Phase 3 (UWB P3)
  - **Location:** Bothell, WA
  - **Facility Size:** 75,000 ft$^2$ (= 7000 m$^2$)
  - **Type of Project:**
    - Academic Building
    - New Construction
  - **Construction Duration:** 17 Months
  - **Total Project Cost:** $68 Million USD

http://pm.uw.edu/cpo/cpoutlook/uwb-celebration-and-tour

http://pm.uw.edu/cpo/cpoutlook/uw-bothell-discovery-hall
LED Lighting Setup @ UWB P3

• Meeting the 5 foot candle OSHA requirement

Temporary lighting power cables installed within concrete slab

Temporary lighting whips and light fixtures dropped and exposed below ceiling deck
### Pre-construction Estimate

Preliminary estimate of number of LED modules needed using Clear-Vu calculator

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of project</td>
<td>Sq ft</td>
<td>74,000</td>
</tr>
<tr>
<td>Ceiling height</td>
<td>ft</td>
<td>15</td>
</tr>
<tr>
<td>Desired illumination per floor</td>
<td>fc</td>
<td>5</td>
</tr>
<tr>
<td>LED module spacing</td>
<td>ft</td>
<td>17</td>
</tr>
<tr>
<td>LED module coverage</td>
<td>17ft x 17 ft</td>
<td>Sq ft</td>
</tr>
<tr>
<td>LED modules needed</td>
<td>74,000 / 289</td>
<td>nos</td>
</tr>
</tbody>
</table>

LED modules needed: $\frac{74,000}{289} = 256$
Planning
Installation
Data Collection

Interview with lighting manufacturer

Site interviews with project staff

Survey questionnaires distributed to workers on site

Cost information derived from the electrical sub and others
Interview Findings

• Immediate use of temp. lighting
• Reflection of light off drywall
• Drilling into embedded cable
• Upward lighting requirement
• Duration of use of temp. lighting
• Temp. lighting contractual requirements
Survey Findings

- 21 response (of which 19 were analyzed)
- Agreement level (1~5 Liker scale)

<table>
<thead>
<tr>
<th>Description</th>
<th>Average rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LED lighting</td>
</tr>
<tr>
<td>Amount of light provided</td>
<td>3.70</td>
</tr>
<tr>
<td>Consistent and well distributed</td>
<td>3.50</td>
</tr>
<tr>
<td>Productive</td>
<td>3.75</td>
</tr>
<tr>
<td>Visually comfortable</td>
<td>3.84</td>
</tr>
<tr>
<td>Safe operation of work</td>
<td>4.00</td>
</tr>
<tr>
<td>Distracted from work</td>
<td>2.43</td>
</tr>
<tr>
<td>More disruption</td>
<td>2.10</td>
</tr>
<tr>
<td>More coordination efforts</td>
<td>2.10</td>
</tr>
</tbody>
</table>
Survey Findings (cont.)

- LED Provides More Lighting Than TRAD
- LED Lighting Made My Work More Operationally Safer
- LED Provides More Consistent And Well-Distributed Lighting Than TRAD
- LED Distracted Me From Working Properly More Than TRAD
- LED Required More Coordination Efforts Than TRAD
- LED Lighting Is More Visually Comfortable Than TRAD Lighting
## Cost Analysis

<table>
<thead>
<tr>
<th>Items</th>
<th>LED ($)</th>
<th>Metal Halides ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials</td>
<td>53,952.80</td>
<td>40,990.00</td>
</tr>
<tr>
<td>Installation</td>
<td>30,914.70</td>
<td>26,757.22</td>
</tr>
<tr>
<td>Maintenance</td>
<td>3,324.36</td>
<td>26,984.88</td>
</tr>
<tr>
<td>Removal</td>
<td>3,835.80</td>
<td>10,228.00</td>
</tr>
<tr>
<td>Energy</td>
<td>3,442.21</td>
<td>24,527.12</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>95,469.87</strong></td>
<td><strong>129,488.02</strong></td>
</tr>
</tbody>
</table>

> $28,750
> $22,375
$29,343 to $45,906
> $7,360

=$109,997
Conclusion

- 5 FC OSHA requirement is not met
- Some issues were caused by how the traditional lighting systems were deployed
- Ascertained known LED temp. lighting benefits
- Allowed immediate use of temp. lighting
- LED required additional pre-construction planning and higher installation cost
- If 5 FC were to be met, the cost of LED is comparable if not less
- However, cost saving might belong to different parties
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