A Review of Safety on four LEED Projects

Nicholas Tymvios

PtD – Prevention through Design
Washington DC, August 23, 2011

Study sponsored by,
Outline

• Goals
• Projects
• Methodology
• Results
• Conclusions
Goals of Study

• Investigate construction projects with “Green” features
• Evaluate how the features impact construction worker safety
OSU LEED certified (or equivalent) projects investigated

• OSU Energy Center (Platinum)
  • Completed 2009
  • 21,500 ft²
  • Steel framed
  • Electricity & Steam generation
  • LEED 2.2

• Linus Pauling Science Center
  • To be completed Sept. 2011
  • 105,000 ft²
  • Steel framed
  • Labs, classrooms, offices
  • LEED 2.2
OSU LEED certified (or equivalent) projects investigated

- **Hallie Ford Center**
  - Completed June 2011
  - 18,000 ft²
  - Masonry
  - Offices, meeting rooms
  - LEED 2.2

- **INTO Living Learning Center**
  - To be completed Sept. 2011
  - 148,000 ft²
  - Reinforced concrete
  - Offices, Classrooms, Dorm, Retail
  - LEED 3.0
Methodology

• Specifications
  • Identify credits sought, and specified work.

• Meetings with contractor LEED AP
  • Identify tasks performed for credits and actions taken by contractor
  • Identify effects on OSH and compare with non-LEED buildings
  • Identify any accidents that occurred
  • Investigate specific mention of additional risk in contractor and subcontractor Job Hazard Analyses (JHA)
# Results – Risk from LEED Credits

## LEED 2.0, 2.1, 2.2

### Sustainable Sites (SS)

<table>
<thead>
<tr>
<th>Pre 1</th>
<th>SS 1</th>
<th>SS 2</th>
<th>SS 3</th>
<th>SS 4.1</th>
<th>SS 4.2</th>
<th>SS 4.3</th>
<th>SS 4.4</th>
<th>SS 5.1</th>
<th>SS 5.2</th>
<th>SS 6.1</th>
<th>SS 6.2</th>
<th>SS 7.1</th>
<th>SS 7.2</th>
<th>SS 8</th>
</tr>
</thead>
</table>

### Water Efficiency (WE)

<table>
<thead>
<tr>
<th>WE 1.1</th>
<th>WE 1.2</th>
<th>WE 2</th>
<th>WE 3.1</th>
<th>WE 3.2</th>
</tr>
</thead>
</table>

### Energy & Atmosphere (EA)

<table>
<thead>
<tr>
<th>Pre 1</th>
<th>Pre 2</th>
<th>PRE 3</th>
<th>EA 1</th>
<th>EA 2</th>
<th>EA 3</th>
<th>EA 4</th>
<th>EA 5</th>
<th>EA 6</th>
</tr>
</thead>
</table>

### Materials & Resources (MR)

<table>
<thead>
<tr>
<th>Pre 1</th>
<th>MR 1.1</th>
<th>MR 1.2</th>
<th>MR 1.3</th>
<th>MR 2.1</th>
<th>MR 2.2</th>
<th>MR 3.1</th>
<th>MR 3.2</th>
<th>MR 4.1</th>
<th>MR 4.2</th>
<th>MR 5.1</th>
<th>MR 5.2</th>
<th>MR 6</th>
<th>MR 7</th>
</tr>
</thead>
</table>

### Indoor Environmental Quality (IEQ)

| Pre 1 | Pre 2 | IEQ 1 | IEQ 2 | IEQ 3.1 | IEQ 3.2 | IEQ 4.1 | IEQ 4.2 | IEQ 4.3 | IEQ 4.4 | IEQ 5 | IEQ 6.1 | IEQ 6.2 | IEQ 7.1 | IEQ 7.2 | IEQ 8.1 | IEQ 8.2 |
|-------|-------|-------|-------|---------|---------|---------|---------|---------|---------|-------|---------|---------|---------|---------|---------|---------|---------|

- **No OSH risk**
- **Less OSH risk**
- **Equal OSH risk**
- **More OSH risk**
### Results – Risk from LEED Credits

**LEED 3.0**

| Sustainable Sites (SS) | Pre 1 | SS 1 | SS 2 | SS 3 | SS 4.1 | SS 4.2 | SS 4.3 | SS 4.4 | SS 5.1 | SS 5.2 | SS 6.1 | SS 6.2 | SS 7.1 | SS 7.2 | SS 8 |
|------------------------|-------|------|------|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| Water Efficiency (WE)  | WE 1.1 | WE 1.2 | WE 2 | WE 3.1 | WE 3.2 | WE 3.2 |
| Energy & Atmosphere (EA) | Pre 1 | Pre 2 | Pre 3 | EA 1 | EA 2 | EA 3 | EA 4 | EA 5 | EA 6 |
| Materials & Resources (MR) | Pre 1 | MR 1.1 | MR 1.2 | MR 2 | MR 3 | MR 4 | MR 5 | MR 6 | MR 7 |
| Indoor Environmental Quality (IEQ) | Pre 1 | Pre 2 | IEQ 1 | IEQ 2 | IEQ 3.1 | IEQ 3.2 | IEQ 4.1 | IEQ 4.2 | IEQ 4.3 | IEQ 4.4 | IEQ 5 | IEQ 6.1 | IEQ 6.2 | IEQ 7.1 | IEQ 7.2 | IEQ 8.1 | IEQ 8.2 |

**Legend:**
- Blue: No OSH risk
- Green: Less OSH risk
- Beige: Equal OSH risk
- Orange: More OSH risk
## How are the credits used in practice?

### LEED 2.0, 2.1, 2.2

### Sustainable Sites (SS)

<table>
<thead>
<tr>
<th>Pre 1</th>
<th>SS 1</th>
<th>SS 2</th>
<th>SS 3</th>
<th>SS 4.1</th>
<th>SS 4.2</th>
<th>SS 4.3</th>
<th>SS 4.4</th>
<th>SS 5.1</th>
<th>SS 5.2</th>
<th>SS 6.1</th>
<th>SS 6.2</th>
<th>SS 7.1</th>
<th>SS 7.2</th>
<th>SS 8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>88%</td>
<td>34%</td>
<td>22%</td>
<td>63%</td>
<td>78%</td>
<td>56%</td>
<td>66%</td>
<td>24%</td>
<td>67%</td>
<td>43%</td>
<td>50%</td>
<td>52%</td>
<td>60%</td>
<td>37%</td>
</tr>
</tbody>
</table>

### Water Efficiency (WE)

<table>
<thead>
<tr>
<th>WE 1.1</th>
<th>WE 1.2</th>
<th>WE 2</th>
<th>WE 3.1</th>
<th>WE 3.2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>61%</td>
<td>19%</td>
<td>80%</td>
<td>69%</td>
</tr>
</tbody>
</table>

### Energy & Atmosphere (EA)

<table>
<thead>
<tr>
<th>Pre 1</th>
<th>Pre 2</th>
<th>Pre 3</th>
<th>EA 1</th>
<th>EA 2</th>
<th>EA 3</th>
<th>EA 4</th>
<th>EA 5</th>
<th>EA 6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8-80%</td>
<td>13%</td>
<td>59%</td>
<td>58%</td>
<td>31%</td>
</tr>
</tbody>
</table>

### Materials & Resources (MR)

<table>
<thead>
<tr>
<th>Pre 1</th>
<th>MR 1.1</th>
<th>MR 1.2</th>
<th>MR 1.3</th>
<th>MR 2.1</th>
<th>MR 2.2</th>
<th>MR 3.1</th>
<th>MR 3.2</th>
<th>MR 4.1</th>
<th>MR 4.2</th>
<th>MR 5.1</th>
<th>MR 5.2</th>
<th>MR 6</th>
<th>MR 7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>11%</td>
<td>4%</td>
<td>0%</td>
<td>90%</td>
<td>68%</td>
<td>6%</td>
<td>5%</td>
<td>89%</td>
<td>66%</td>
<td>88%</td>
<td>67%</td>
<td>7%</td>
<td>45%</td>
</tr>
</tbody>
</table>

### Indoor Environmental Quality (IEQ)

| Pre 1 | Pre 2 | IEQ 1 | IEQ 2 | IEQ 3.1 | IEQ 3.2 | IEQ 4.1 | IEQ 4.2 | IEQ 4.3 | IEQ 4.4 | IEQ 5 | IEQ 5.1 | IEQ 6.1 | IEQ 6.2 | IEQ 7.1 | IEQ 7.2 | IEQ 8.1 | IEQ 8.2 |
|-------|-------|-------|-------|---------|---------|---------|---------|---------|---------|-------|---------|---------|---------|---------|---------|---------|---------|---------|
|       |       | 46%   | 32%   | 80%     | 52%     | 93%     | 94%     | 92%     | 51%     | 58%   | 60%     | 40%     | 80%     | 74%     | 32%     | 54%     |
Results - Accidents

• OSU Energy Center – NA
• Linus Pauling Science Center
  • Plumber – bicep muscle tear during lifting
  • Worker – Trip and fall on steel deck/exposed rebar, scrapes
  • Near Miss – Worker drills through live power cables
• Hallie Ford Center – No Accidents
• INTO Living Learning Center
  • Worker - Fall from height of 8’ while tying rebar
Results – Job Hazard Analysis

• Linus Pauling Science Center
  • “Green Features” not treated differently
  • No additional or different risk mentioned due to features
  • Example for roof, risks mentioned:
    • Falling objects during loading, falls while working at roof edge, falls from slipping on debris, falls from ladders, cuts & scrapes, soft tissue injuries

• Energy Center - NA

• Hallie Ford Center and INTO Building
  • Information was restricted
Conclusions

• “Green” features not introducing new risks that are foreign to workers
  • Project Engineers
  • Job Hazard Analysis reports
• Amount of risk varies on “Green” features selected
  • Skylights, windows, solar panels, etc.

• Safety measures similar to non-LEED buildings
Conclusions

- Features that reduce risk
  - Use of low VOC (IEQ 4.1 – 4.4)
  - Earned by projects extremely often (up to 94%)
- Features that have no change on risk to workers
  - Low-flow fixtures, efficient lighting, use of environmentally friendly materials
- Features that do not affect workers
  - Community connectivity (SS1, SS2, SS4.1)
  - Inspections
  - Innovation credits
Conclusions

- Credits that increase risk to workers
  - SS 5.1 – Protect & restore habitat (restrictions to site)
  - MR 2.1 & 2.2 – Recycling – increases material handling
  - IEQ 8.1 & 8.2 – Daylight & Views – Increase in openings on wall and ceilings

- Credits earned in a variety of ways
  - Further research needs to take place to determine typical methods of earning each particular credit

- Accidents observed not related to “Green” features
Questions?

Contact info:
Nicholas Tymvios
tymviosn@onid.orst.edu

John Gambatese
John.Gambatese@oregonstate.edu