Using Building Automation Systems in Attaining LEED Certification

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ASHRAE Member
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LEED AP
LEED Certification Process for Commercial Buildings

• Credits are broken down by categories
  – Sustainable sites
  – Water Efficiency
  – Energy & Atmosphere
  – Materials & Resources
  – Indoor Environmental Quality
  – Innovation in Design
BAS and the LEED Certification Process

• Of these categories, building automation systems can typically help to enable LEED points:
  – Water efficiency
  – Energy & Atmosphere
  – Indoor Environmental Quality
  – Innovation in Design
LEED-NC® Point Distribution

- Indoor Environmental Quality: 23%
- Sustainable Sites: 22%
- Water Efficiency: 8%
- Energy & Atmosphere: 27%
- Materials & Resources: 20%

Five LEED credit categories
# Sustainable Sites

<table>
<thead>
<tr>
<th>Credit</th>
<th>Description</th>
<th>Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prereq</td>
<td><strong>Erosion &amp; Sedimentation Control</strong></td>
<td></td>
</tr>
<tr>
<td>Credit 1</td>
<td><strong>Site Selection</strong></td>
<td>1</td>
</tr>
<tr>
<td>Credit 2</td>
<td><strong>Development Density</strong></td>
<td>1</td>
</tr>
<tr>
<td>Credit 3</td>
<td><strong>Brownfield Redevelopment</strong></td>
<td>1</td>
</tr>
<tr>
<td>Credit 4.1</td>
<td><strong>Alternative Transportation</strong>, Public Transportation Access</td>
<td>1</td>
</tr>
<tr>
<td>Credit 4.2</td>
<td><strong>Alternative Transportation</strong>, Bicycle Storage &amp; Changing Rooms</td>
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</tr>
<tr>
<td>Credit 4.3</td>
<td><strong>Alternative Transportation</strong>, Alternative Fuel Vehicles</td>
<td>1</td>
</tr>
<tr>
<td>Credit 4.4</td>
<td><strong>Alternative Transportation</strong>, Parking Capacity and Carpooling</td>
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</tr>
<tr>
<td>Credit 5.1</td>
<td><strong>Reduced Site Disturbance</strong>, Protect or Restore Open Space</td>
<td>1</td>
</tr>
<tr>
<td>Credit 5.2</td>
<td><strong>Reduced Site Disturbance</strong>, Development Footprint</td>
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</tr>
<tr>
<td>Credit 6.1</td>
<td><strong>Stormwater Management</strong>, Rate and Quantity</td>
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<tr>
<td>Credit 6.2</td>
<td><strong>Stormwater Management</strong>, Treatment</td>
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<tr>
<td>Credit 7.1</td>
<td><strong>Landscape &amp; Exterior Design to Reduce Heat Islands</strong>, Non-Roof</td>
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</tr>
<tr>
<td>Credit 7.2</td>
<td><strong>Landscape &amp; Exterior Design to Reduce Heat Islands</strong>, Roof</td>
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</tr>
<tr>
<td>Credit 8</td>
<td><strong>Light Pollution Reduction</strong></td>
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</table>
### Water Efficiency

<table>
<thead>
<tr>
<th>Credit</th>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td><strong>Water Efficient Landscaping</strong>, Reduce by 50%</td>
<td>1</td>
</tr>
<tr>
<td>1.2</td>
<td><strong>Water Efficient Landscaping</strong>, No Potable Use or No Irrigation</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td><strong>Innovative Wastewater Technologies</strong></td>
<td>1</td>
</tr>
<tr>
<td>3.1</td>
<td><strong>Water Use Reduction</strong>, 20% Reduction</td>
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</tr>
<tr>
<td>3.2</td>
<td><strong>Water Use Reduction</strong>, 30% Reduction</td>
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### Energy & Atmosphere

<table>
<thead>
<tr>
<th>Prereq</th>
<th>Description</th>
<th>Required</th>
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<tbody>
<tr>
<td>1</td>
<td><strong>Fundamental Building Systems Commissioning</strong></td>
<td>Required</td>
</tr>
<tr>
<td>2</td>
<td><strong>Minimum Energy Performance</strong></td>
<td>Required</td>
</tr>
<tr>
<td>3</td>
<td><strong>CFC Reduction in HVAC&amp;R Equipment</strong></td>
<td>Required</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Credit</th>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Optimize Energy Performance</strong></td>
<td>1-10</td>
</tr>
<tr>
<td>2.1</td>
<td><strong>Renewable Energy</strong>, 5%</td>
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</tr>
<tr>
<td>2.2</td>
<td><strong>Renewable Energy</strong>, 10%</td>
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</tr>
<tr>
<td>2.3</td>
<td><strong>Renewable Energy</strong>, 20%</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td><strong>Additional Commissioning</strong></td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td><strong>Ozone Depletion</strong></td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td><strong>Measurement &amp; Verification</strong></td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td><strong>Green Power</strong></td>
<td>1</td>
</tr>
<tr>
<td>Credit</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td><strong>Building Reuse</strong>, Maintain 75% of Existing Shell</td>
<td></td>
</tr>
<tr>
<td>1.2</td>
<td><strong>Building Reuse</strong>, Maintain 100% of Shell</td>
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</tr>
<tr>
<td>1.3</td>
<td><strong>Building Reuse</strong>, Maintain 100% Shell &amp; 50% Non-Shell</td>
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</tr>
<tr>
<td>2.1</td>
<td><strong>Construction Waste Management</strong>, Divert 50%</td>
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</tr>
<tr>
<td>2.2</td>
<td><strong>Construction Waste Management</strong>, Divert 75%</td>
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<tr>
<td>3.1</td>
<td><strong>Resource Reuse</strong>, Specify 5%</td>
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</tr>
<tr>
<td>3.2</td>
<td><strong>Resource Reuse</strong>, Specify 10%</td>
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<tr>
<td>4.1</td>
<td><strong>Recycled Content</strong>, Specify 5% (post-consumer + ½ post-industrial)</td>
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<tr>
<td>4.2</td>
<td><strong>Recycled Content</strong>, Specify 10% (post-consumer + ½ post-industrial)</td>
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<tr>
<td>5.1</td>
<td><strong>Local/Regional Materials</strong>, 20% Manufactured Locally</td>
<td></td>
</tr>
<tr>
<td>5.2</td>
<td><strong>Local/Regional Materials</strong>, of 20% Above, 50% Harvested Locally</td>
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</tr>
<tr>
<td>6</td>
<td><strong>Rapidly Renewable Materials</strong></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td><strong>Certified Wood</strong></td>
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**Prereq 1**: **Storage & Collection of Recyclables**

**Required**: 13 Points
<table>
<thead>
<tr>
<th>Credit</th>
<th>Description</th>
<th>Points</th>
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<tbody>
<tr>
<td>3.1</td>
<td><strong>Construction IAQ Management Plan</strong>, During Construction</td>
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<tr>
<td>3.2</td>
<td><strong>Construction IAQ Management Plan</strong>, Before Occupancy</td>
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<tr>
<td>4.1</td>
<td><strong>Low-Emitting Materials</strong>, Adhesives &amp; Sealants</td>
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</tr>
<tr>
<td>4.2</td>
<td><strong>Low-Emitting Materials</strong>, Paints</td>
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<tr>
<td>4.3</td>
<td><strong>Low-Emitting Materials</strong>, Carpet</td>
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<tr>
<td>4.4</td>
<td><strong>Low-Emitting Materials</strong>, Composite Wood &amp; Agrifiber</td>
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<tr>
<td>5</td>
<td><strong>Indoor Chemical &amp; Pollutant Source Control</strong></td>
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<tr>
<td>6.1</td>
<td><strong>Controllability of Systems</strong>, Perimeter</td>
<td>1</td>
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<tr>
<td>6.2</td>
<td><strong>Controllability of Systems</strong>, Non-Perimeter</td>
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<tr>
<td>7.1</td>
<td><strong>Thermal Comfort</strong>, Comply with ASHRAE 55-1992</td>
<td>1</td>
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<tr>
<td>7.2</td>
<td><strong>Thermal Comfort</strong>, Permanent Monitoring System</td>
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<tr>
<td>8.1</td>
<td><strong>Daylight &amp; Views</strong>, Daylight 75% of Spaces</td>
<td>1</td>
</tr>
<tr>
<td>8.2</td>
<td><strong>Daylight &amp; Views</strong>, Views for 90% of Spaces</td>
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## Innovation & Design Process

<table>
<thead>
<tr>
<th>Credit</th>
<th>Description</th>
<th>Points</th>
</tr>
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<tbody>
<tr>
<td>1.1</td>
<td>Innovation in Design: Provide Specific Title</td>
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</tr>
<tr>
<td>1.2</td>
<td>Innovation in Design: Provide Specific Title</td>
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</tr>
<tr>
<td>1.3</td>
<td>Innovation in Design: Provide Specific Title</td>
<td>1</td>
</tr>
<tr>
<td>1.4</td>
<td>Innovation in Design: Provide Specific Title</td>
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</tr>
<tr>
<td>2</td>
<td>LEED™ Accredited Professional</td>
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**Yes? No**

## Project Totals (pre-certification estimates)

<table>
<thead>
<tr>
<th>Level</th>
<th>Points Range</th>
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<tbody>
<tr>
<td>Certified</td>
<td>26-32 points</td>
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<tr>
<td>Silver</td>
<td>33-38 points</td>
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<tr>
<td>Gold</td>
<td>39-51 points</td>
</tr>
<tr>
<td>Platinum</td>
<td>52-69 points</td>
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</table>
BAS and LEED-NC Credits

• Great impact on amount of LEED points:
  – Water Efficient Landscaping – 1pt
  – Energy and Atmosphere points – Up to 12 pts
    • Optimize Energy Performance (1-10 pts)
    • Best Practice Commissioning (1 pt)
    • Measurement & Verification (1 pt)

Building Automation System – Can impact up to 40% of LEED points
BAS and LEED -NC Credits

– Indoor Environmental Quality – 6 pts
  • Carbon Dioxide Monitoring (1 pt)
  • Increase Ventilation Effectiveness (1 pt)
  • Controllability of Systems (2 pts)
  • Thermal Comfort (2 pts)

– Innovation and Design Credits – Up to 5 pts

Building Automation System – Can impact up to 40% of LEED points
Water Efficiency

Water Efficient Landscaping 1-2 Points

Intent
Limit or eliminate the use of potable water for landscape irrigation.

Requirements & Submittals

Credit 1.1 (1 point) Use high efficiency irrigation technology, OR, use captured rain or recycled site water, to reduce potable water consumption for irrigation by 50% over conventional means.

- Provide cut sheets for high efficiency irrigation equipment. Include calculations demonstrating that potable water consumption for irrigation is reduced by 50%.

- OR,

- Provide drawings and a narrative describing the captured rain system or recycled site water system of the system highlighted. Include calculations demonstrating potable water consumption reduced by 50%.

Credit 1.2 (1 point) Use only captured rain or recycled site water to demonstrate a 50% reduction (100% total reduction of potable site irrigation needs, OR, do much better than irrigation systems.

- Provide drawings and a narrative describing the captured rain system or recycled site water system of the system highlighted. Include calculations demonstrating that potable water used for irrigation is reduced by 100%.

- OR,
Energy & Atmosphere

Prerequisite 1  Fundamental Building Systems
Commissioning

Required

Intent
Verify and ensure that fundamental building elements and systems are designed, installed and calibrated to operate as intended.

Requirement
Prerequisite 1.0  Implement the following fundamental best practice commissioning procedures:
- Engage a commissioning authority
- Review design intent and basis of design document
- Include commissioning requirements in documents
- Develop and utilize a commissioning plan
- Verify installation, functionality and operation
- Complete a commissioning report

Technologies & Strategies
Engage a commissioning authority and adopt a commissioning plan. Include commissioning requirements in bid documents and task the commissioning agent to produce a commissioning report once commissioning activities are completed.

Use BAS here-Trends, reports
Energy and Atmosphere

Prerequisite 2  Minimum Energy Performance

Intent
Establish the minimum level of energy efficiency for the base building and systems.

Requirement
Design to meet building energy efficiency and performance as established by ASHRAE/IESNA 90.1-1999 or the local energy code is the more stringent.

Use BAS here-Monitor minimum energy efficiency requirements
Energy and Atmosphere

Credit 1  Optimize Energy Performance

Intent
Achieve increasing levels of energy performance above the prerequisite standard to reduce environmental impacts associated with excessive energy use.

Requirements
Reduce design energy cost compared to the energy cost budget for regulated energy components described in the requirements of ASHRAE/IESNA Standard 90.1-1999, as demonstrated by a whole building simulation using the Energy Cost Budget Method described in Section 11:

<table>
<thead>
<tr>
<th>New Buildings</th>
<th>Existing Buildings</th>
<th>Points</th>
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<tbody>
<tr>
<td>20%</td>
<td>10%</td>
<td>2</td>
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<tr>
<td>40%</td>
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<td>60%</td>
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<td>6</td>
</tr>
<tr>
<td>80%</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>100%</td>
<td></td>
<td>10</td>
</tr>
</tbody>
</table>

Use BAS here-Use system to integrate more energy efficient sequences. Integrate systems to gain efficiencies.
What are Intelligent, Integrated Buildings?

**FIRE**
- Functionality checks
- Detector service
- Fire, Life, Safety

**SECURITY**
- Doors
- PIR
- Integration
- Asset Location

**ACCESS**
- Doors
- Buildings
- Occupancy
- Feed Forward

**ENERGY**
- Utility Monitoring (Elect/Water/Gas/Oil)
- Tenant Billing
- Air/Water
- Heat
- Lighting
- Back-up Generation

**24/7 Monitoring**
- Breakdown Monitoring
- Plant Tuning
- Conditioned Monitoring
- Car Park Utilization

**LIGHTING**
- Schedules
- Occupancy Sensing

**LIFTS**
- Breakdown
- Maintenance
- Traffic Performance

**COMMUNICATIONS**
- Voice/Video/Data

**HVAC**
- Air-Handling Unit
- Boilers
- Pumps
- Fans
- Energy Control
- Variable Air Volume
- Air Quality
Enterprise Load Management: Bringing the data together

- Control
- Energy Monitoring
- Data Integrity
- Decision Support
- Enterprise Load Mgmt
- Weather forecast - hourly avg temperature 31 days ahead
- Monitoring of outdoor avg temperature once in 60’
- Energy monitoring sampled once in 15’
- Cost optimization
- Accurate forecasting is the key to maximizing cost savings
- Real time prices one day ahead
- Consumption profile for next year

- UTILITIES
- CONSUMER
- LOADS, GENERATORS
- SCHEDULE
Automation Sequences enabling LEED-NC Credits

• Integration has increased value when “knowledge” is built-in
  – A cardholder automatically turns on lights and triggers temperature control upon entering area of the building
    • Integrates Security and HVAC to reduce energy costs
  – Window contacts shut off/minimize mechanical cooling to a zone when a window is open.

Building Automation System – Can impact up to 40% of LEED points
Automation Sequences enabling LEED-NC Credits

– Motorized blinds sequenced with lighting and HVAC controls to optimize indoor environment conditions
  • Integrates HVAC, lighting, occupancy and window status sensing to optimize energy use and provide ultimate working conditions

– System analyzes landscaping moisture conditions and weather data from web-based provider to determine need for watering landscape
  • Takes advantage of Internet link set up to optimize building performance for improving water usage efficiency also

Building Automation System – Can impact up to 40% of LEED points
Energy and Atmosphere

Credit 3

1 Point

Credit 3 Additional Commissioning

Intent
Verify and ensure that the entire building is designed, constructed, and calibrated to operate as intended.

Requirement
Credit 3.0 (1 point) In addition to the Fundamental Building Commissioning prerequisite, implement the following additional commissioning tasks:
1. Conduct a focused review of the design prior to the construction documents phase.
2. Conduct a focused review of the construction documents phase.
4. (The above three reviews must be performed by the designer.)

Project design phases. Task the commissioning agent to complete the following tasks before and after construction documents are released to the construction contractor. The commissioning agent must also create a recommissioning manual that reviews the project at near-warranty end.

Use BAS here- comprehensive trending and reporting to determine systems current state and compare to recommissioning for future
Energy and Atmosphere

Credit 5 Measurement & Verification

Intent
Provide for the ongoing accountability and optimization of building energy and water consumption performance over time.

Requirement
Credit 5.0 (1 point) Comply with the long term continuous measurement of performance as stated in Option B: Methods by Technology of the US DOE’s International Performance Measurement and Verification Protocol (IPMVP) for the following:
- Lighting systems and controls
- Condensing and variable motor loads
- Frequency drive (VFD) operation
- Condenser water temperatures (°F)
- Heat recovery cycles
- Static pressures and ventilation air volumes
- HVAC system efficiencies
- Building specific process energy efficiency systems and equipment
- Indoor water risers and outdoor irrigation systems

Technologies & Strategies
Model the energy and water systems to predict savings. Design the building with equipment to measure energy and water performance. Draft a Measurement & Verification Plan to apply during building operation that compares predicted savings to those actually achieved in the field.

Use BAS here-Use system to integrate systems for metering and sub metering purposes. Verification is automated
Use BAS here-Use system to determine that proper minimum outdoor air control is implemented according to ASHRAE standards.
Credit 1 Carbon Dioxide (CO₂) Monitoring

Intent
Provide capacity for indoor air quality (IAQ) monitoring to sustain long-term occupant health and comfort.

Requirement
Credit 1.0 (1 point) Install a permanent carbon dioxide (CO₂) monitoring system that provides feedback on space ventilation performance in a form that affords operational adjustments, AND specify initial operational set point parameters that maintain indoor carbon dioxide levels no higher than outdoor levels by more than 500 ppm at any time.

Use BAS here-Use system to monitor and control (as required per code) the CO2 levels in densely occupied spaces and outdoor air flows
Credit 2  

Increase Ventilation Effectiveness  

1 Point

Intent

Provide for the effective delivery and mixing of fresh air to support the health, safety, and comfort of building occupants.

Requirement

Credit 2.0 (1 point)  For mechanically ventilated buildings, design ventilation systems that result in an air change effectiveness (E) greater than or equal to 0.9 as determined by ASHRAE 129-1997. For naturally ventilated spaces demonstrate a distribution and laminar flow pattern that involves not less than 90% of the room or zone area in the direction of air flow for at least 95% of the time. 

Use BAS here-Use system to determine that proper minimum outdoor air control is implemented according to ASHRAE standards.
Credit 6  Controllability of Systems

Intent

Provide a high level of individual occupant control of thermal, ventilation, and lighting systems to support optimum health, productivity, and comfort conditions.

Requirements

Credit 6.1 (1 point) Provide a minimum of one operable window and one lighting control zone per 200 SF for all occupied areas within 15 feet of the perimeter wall.

Credit 6.2 (1 point) Provide controls for each individual for airflow, temperature, and lighting for 50% of the non-perimeter, regularly occupied spaces.

Use BAS here-Use system to determine that proper temperature and humidity control is provided to occupants
Green Credit Example: Controllability

HVAC, Lighting, Motorized shades, Window Status/Control

Router IP

Fan Coils

VAV Boxes
Indoor Environmental Quality

Credit 7

1-2 Points

Credit 7  Thermal Comfort

Intent
Provide for a thermally comfortable environment that supports the productive and healthy performance of the building occupants.

Requirements

Credit 7.1 (1 point) Comply with ASHRAE Standard 55-1992, Addenda 1995 for thermal comfort standards including humidity control within established ranges per climate zone.

Credit 7.2 (1 point) Install a permanent temperature and humidity monitoring system configured to provide operators control over thermal comfort performance and effectiveness of humidification and dehumidification systems in the building.

Use BAS here—Use system to determine that parameters are met and allow control of comfort by operators.
Innovation & Design Process

Credit 1  Innovation in Design

Intent
To provide design teams and projects the opportunity to be awarded points for exceptional performance above requirements set by the LEED Green Building Rating System™ and/or innovative performance in Green Building categories not specifically addressed by the LEED Green Building Rating System™.

Requirements
Credit 1.1 (1 point)  In writing, using the LEED™ Credit Equivalence process, identify the intent of the proposed innovation credit, the proposed requirement for compliance, the proposed submittals to demonstrate compliance, and the design approach used to meet the required elements.

Credit 1.2 (1 point)  Same as Credit 1.1.
Credit 1.3 (1 point)  Same as Credit 1.1.
Credit 1.4 (1 point)  Same as Credit 1.1.

Technologies & Strategies
Substantially exceed a LEED™ performance credit such as energy performance or water efficiency. Apply strategies or measures that are not covered by LEED™ such as acoustic performance, education of occupants, community development, or lifecycle analysis of material choices.
As stated in the LEED Rating Systems, the intent of Innovation in Design Credit 1 is to provide design teams and projects the opportunity to be awarded points for *exceptional* performance above the requirements set by the LEED Green Building Rating System and/or *innovative* performance in green building categories not specifically addressed by LEED.

As a general rule of thumb, ID credits for *exceptional* performance are awarded for doubling the credit requirements and/or achieving the next incremental percentage threshold. For instance, an ID credit for exemplary performance in water use reduction (WE Credit 3) would require a minimum of 40% savings (20%=WE Credit 3.1; 30%=WE Credit 3.2, etc.).

ID credits for *innovative* performance are awarded for comprehensive strategies which demonstrate quantifiable environmental benefits. A representative list of innovative performance ID credits awarded to LEED certified projects is outlined below.

- Educational Outreach Program (IDc1.1 inquiry 9-24-01)
- Green Housekeeping (IDc1.1 inquiry 4-8-04)
- High Volume Fly Ash (IDc1.1 inquiry 12-6-02)
- Low-Emitting Furniture & Furnishings (AD inquiry 1-6-03; IDc1.1 inquiry 10-21-03)
- Organic Landscaping / Integrated Pest Management Program (via certification submittal)
On-going Benefits of BAS for Green Buildings

• Building Automation Systems can help maintain LEED intent through a building’s life cycle
  – Weather-factored energy usage data and graphs pinpoint building performance difference over time
    – Recommissioning capabilities
    – Remote diagnostics, etc.

• BAS will help set the stage for LEED-EB Certification
  – Trending and reporting capabilities to tie into maintenance and operation of a building
Summary

• Commissioning
  – Use BAS
• Water Efficiency
  – Use BAS
• Energy system performance
  – Use BAS
• Enhance Energy strategies
  – Use BAS
• Measurement and verification
  – Use BAS
• Innovation
  – Use BAS
Use the BRAIN-BAS

CABA's Intelligent & Integrated Buildings Conference

FIRE
Functionality checks
Detector service
Fire, Life, Safety

SECURITY
Doors
PIR
Integration
Asset Location

ACCESS
Doors
Buildings
Occupancy
Feed Forward

ENERGY
Utility Monitoring
(Elec/Water/Gas/Oil)
Tenant Billing
Air/Water
Heat
Lighting
Back-up Generation

LIGHTING
Schedules
Occupancy Sensing

LIFTS
Breakdown
Maintenance
Traffic Performance

COMMUNICATIONS
Voice/Video/Data

24/7 Monitoring
Breakdown
Plant Tuning
Conditioned Monitoring
Car Park Utilization

HVAC
Air-Handling Unit
Boilers
Pumps
Fans
Energy Control
Variable Air Volume
Air Quality