University of Illinois
Business Instructional Facility
LEED ® Gold Design
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Keys to success:

- Sustainable design strategies included early.
- Clear and early benchmarking choice.
- Integrated design process.
- Consensus building.
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Keys to success:

- Sustainable design strategies considered early:

  Feasibility Study included:
  - Sustainability listed as one of six main Project Goals
  - Sustainability Statement / Executive Summary
  - Preliminary LEED checklist review identified point/LEED certification level options
  - Design Strategies considered and described.
Keys to success:

- Clear and early benchmarking choice:
  - LEED for New Construction v. 2.1. Project Registered.
  - Early strategy: set target at “high Silver”
  - Regular checklist reviews identified new opportunities for integrated design decisions leading to additional points.
  - All options for sustainable design were considered – decisions were NOT based on achievability of LEED points.
  - Regular review of life cycle cost analysis and energy model helped identify additional strategies / points.
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Keys to success:
◆ Integrated design process followed from the outset.
  • Design Team / Design Strategy integrated from outset.
  • Environmental Consultant was key to successful integration.
  • All sub-consultants present for virtually all design meetings.
  • Regular review of life cycle cost analysis and energy model.
  • Owner / occupant participation.
  • Specialized consultants included:
    • Environmental Design
    • Sustainable Lighting Design
    • Sustainable Landscape Design
    • Acoustical Design
Integrated design - Who / What are you integrating?

- University of Illinois
  - University Facilities Planning Office
  - Board of Trustees
- Urbana-Champaign Campus
  - College of Business
    - Dean
    - Director of College Facilities
    - Director of College Finance
    - Department / Unit heads
    - Teaching Faculty
    - Students
    - Support Staff
- Campus Design Review Committee
- Committee for a Sustainable Campus Environment
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Urbana-Champaign Campus (cont.)
CITES
Classroom Technology
Facilities and Services
  Executive Director
  Planning
    Project Planner
    Campus Architect
    Landscape Architect
    Financial Director
  Construction
  Design / Technical Reviewers
    Architectural
    HVAC
    Plumbing
    Fire Protection
  Code compliance / Life Safety reviews
  Environmental Compliance reviews
  Trades / Specializations
    Grounds
    Security
    Lighting
    HVAC Controls
    Furniture shops
Outside Consultants / Contractors

Design Team

Design Architect
Architectural / Structural / Civil
Mechanical / Electrical Engineer
Environmental Engineers
Landscape Architect
Acoustical Engineer
Lighting Designer

Manufacturer’s representatives

Lighting Controls
Green Roof Design
Displacement Air Systems
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Construction Management
  Pre-bid team
    LEED specialist
    Feasibility / Cost reviewers
    Bid package development

Construction team
  Project Manager
  Site Superintendent
  Assistants

Prime Contractors (15)
  General Work
  Plumbing
  Heating A/C
  Ventilation
  Electrical
  Sprinkler
  Temperature Control
  Test and Balance
  Concrete
  Drywall
  Masonry
  Roofing
  Site Work
  Structural Steel
  Windows
  Subcontractors…too many to list
Keys to success:

- Consensus building: throughout the entire design process:
  - Environmental Consultant key to educating an inexperienced client.
  - Continuous checks and balance review
    - Variance Process
    - Commissioning and Inspection
    - Energy Model / Life cycle cost analysis
    - Technical rigor – critical.
  - Leveraging existing beliefs - sustainable building is simply good building practice taken to the next level.
  - Understanding that it is a good idea to different people for different reasons – and that is OK!
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Site Location Plan
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Project Site Plan
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Section: North Wing at Commons
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Commons: View from 3rd Floor west side.
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Section: East Wing
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Early Daylighting Model: Typical Classroom
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Energy Model: Daylight Sensor Study

Regulated Energy Comparison
Daylight Sensors in Offices

- Area Lights
- Hot Water
- Pumps & Aux.
- Vent Fans
- Space Heat
- Space Cool

ASHRAE 90.1-1999
DESIGN CASE- NO DAYLIGHT SENSORS
DESIGN CASE- ONLY CLASSROOM DAYLIGHT SENSORS
DESIGN CASE- CLASSROOM AND OFFICES DAYLIGHT SENSORS

43%
44%
45%
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Daylighting Study: Tiered Classroom
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Wall / Window Section Study
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Operable Casement Windows

Triple Glazed with Interstitial Blinds

5/8" Blind/Triple Glazed
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Perimeter Heat - Eliminated at Casement Window Locations

Mean Radiant Temperature Model

Figure 1: Mean Radiant Temperature Distribution in a typical classroom
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Schematic Design – Primary Air Handling Unit (AHU)
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Energy Model: Outdoor Air Economizer

Diagram showing total regulated energy for different cases:
- ASHRAE CASE
- DESIGN CASE NO DOA, NO HEAT RECOVERY, FULL OUTDOOR AIR ECONOMIZER
- DESIGN CASE WITH DOA, WITH HEAT RECOVERY, LIMITED OUTDOOR AIR ECONOMIZER

Peak energy savings:
- 42%
- 44%
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Concept Sketch: Displacement Ventilation in tiered classroom

Fig. 1: Classroom displacement ventilation arrangement
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Energy Model: Displacement Ventilation

Monthly Energy Consumption

Mixed Ventilation Option

Displacement Ventilation Option
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Energy Model: Displacement Ventilation

Annual Space Cooling Energy Consumption

![Bar chart showing energy consumption comparison between mixed ventilation and displacement ventilation. The chart indicates a 25.7% reduction in energy consumption with displacement ventilation.]
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Green Roofs
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We now understand that this…

Is not this….
# LEED Checklist

## Achievability

<table>
<thead>
<tr>
<th>Achievability</th>
<th>hi</th>
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<th>low</th>
<th>NP</th>
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<tr>
<td>52</td>
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</table>

### 52 Attempted Points

- **24 Points earned**
- **28 Points in review/to be submitted**

## Prerequisites

<table>
<thead>
<tr>
<th>Y</th>
<th>Prereq 1</th>
<th>Erosion &amp; Sedimentation Control</th>
</tr>
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<tbody>
<tr>
<td>Y</td>
<td>Prereq 2</td>
<td>Fundamental Building Systems Commissioning</td>
</tr>
<tr>
<td>Y</td>
<td>Prereq 3</td>
<td>Minimum Energy Performance</td>
</tr>
<tr>
<td>Y</td>
<td>Prereq 4</td>
<td>CFC Reduction in HVAC&amp;R Equipment</td>
</tr>
</tbody>
</table>

- **Standard**
  - EPA 640-B-92-002 1/93, Management Measures for Sources of Non-Point Pollution.
  - Engage commissioning agent, include Commissioning Plan in specifications.
  - Follow best practice design standards.

<table>
<thead>
<tr>
<th>Y</th>
<th>Prereq 5</th>
<th>Storage &amp; Collection of Recyclables</th>
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<tbody>
<tr>
<td>Y</td>
<td>Prereq 6</td>
<td>Minimum IAQ Performance</td>
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<tr>
<td>Y</td>
<td>Prereq 7</td>
<td>Environmental Tobacco Smoke (ETS) Control</td>
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</table>

- **Standard**
  - 250 square feet of dedicated materials handling space.
  - Ban smoking throughout building.

## Sustainable Sites

<table>
<thead>
<tr>
<th>10</th>
<th>SS Credit 1</th>
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<th>Site Selection</th>
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<tbody>
<tr>
<td>1</td>
<td>SS Credit 2</td>
<td>Urban Redevelopment</td>
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<td>SS Credit 3</td>
<td>Brownfield Redevelopment</td>
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<tr>
<td>1</td>
<td>SS Credit 4.1</td>
<td>Alternative Transportation, Public Transportation Access</td>
<td></td>
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<tr>
<td>1</td>
<td>SS Credit 4.2</td>
<td>Alternative Transportation, Bicycle Storage &amp; Changing Rooms</td>
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<tr>
<td>1</td>
<td>SS Credit 4.3</td>
<td>Alternative Transportation, Alternative Fuel Vehicles</td>
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<tr>
<td>1</td>
<td>SS Credit 4.4</td>
<td>Alternative Transportation, Parking Capacity</td>
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<tr>
<td>1</td>
<td>SS Credit 5.1</td>
<td>Reduced Site Disturbance, Protect or Restore Open Space</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SS Credit 5.2</td>
<td>Reduced Site Disturbance, Development Footprint</td>
<td></td>
</tr>
</tbody>
</table>

- **Standard**
  - Site is not farmland, wetland, endangered spp. habitat, near water, or former parkland.
  - Locate project in area with average density of 60,000 sf per acre.
  - Build on EPA certified Brownfield site.
  - Locate project within 1/2 mile of rail station or 1/4 mile of 2 lines.
  - Provide showers and bicycle storage for 5% of building occupants.
  - Alternative fuel stations for 5% of site parking.
  - Do not exceed zoning requirements; reserved carpool parking for 5% of occupants.
  - Restore 50% remaining open area to indigenous vegetation and animal habitat.
  - Exceed zoning open space requirements by 25%.
# LEED Checklist

<table>
<thead>
<tr>
<th>Prereq</th>
<th>Description</th>
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<tbody>
<tr>
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<tr>
<td>Prereq 4</td>
<td>CFC Reduction in HVAC&amp;R Equipment</td>
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LEED Checklist
## LEED Checklist

<table>
<thead>
<tr>
<th>4</th>
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<th>Water Efficiency</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>WE Credit 1.1 Water Efficient Landscaping, 50% Reduction</td>
<td>Reduce potable water used for irrigation by 50%.</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>WE Credit 1.2 Water Efficient Landscaping, No Potable Use or No Irrigation</td>
<td>No potable water use, or no permanent irrigation system.</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>WE Credit 2 Innovative Wastewater Technologies</td>
<td>Reduce water used for sewage conveyance by 50%.</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>WE Credit 3.2 Water Use Reduction, 30% Reduction</td>
<td>Energy Policy Act of 1982.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>13</th>
<th>4</th>
<th>Energy &amp; Atmosphere</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td></td>
<td>EA Credit 1.3-4 Optimize Energy Performance, 25% / 30%</td>
<td>ASHRAE 90.1-1999 Energy Standard for Buildings, calculated by cost.</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>EA Credit 1.5-6 Optimize Energy Performance, 35% / 40%</td>
<td>ASHRAE 90.1-1999 Energy Standard for Buildings, calculated by cost.</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>EA Credit 1.7-8 Optimize Energy Performance, 45% / 50%</td>
<td>ASHRAE 90.1-1999 Energy Standard for Buildings, calculated by cost.</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>EA Credit 1.9-10 Optimize Energy Performance, 55% / 60%</td>
<td>ASHRAE 90.1-1999 Energy Standard for Buildings, calculated by cost.</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>EA Credit 2.1 Renewable Energy, 5%</td>
<td>On-site renewable production, calculated by cost.</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>EA Credit 2.2 Renewable Energy, 10%</td>
<td>On-site renewable production, calculated by cost.</td>
</tr>
</tbody>
</table>
### LEED Checklist

#### Water Efficiency

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</table>

**WE Credit 1.1**  
Water Efficient Landscaping, 50% Reduction

**WE Credit 1.2**  
Water Efficient Landscaping, No Potable Use or No Irrigation

**WE Credit 2**  
Innovative Wastewater Technologies

**WE Credit 3.1**  
Water Use Reduction, 20% Reduction

**WE Credit 3.2**  
Water Use Reduction, 30% Reduction

#### Energy & Atmosphere

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</tbody>
</table>

**EA Credit 1.1-2**  
Optimize Energy Performance, 15% / 20%

**EA Credit 1.3-4**  
Optimize Energy Performance, 25% / 30%

**EA Credit 1.5-6**  
Optimize Energy Performance, 35% / 40%

**EA Credit 1.7-8**  
Optimize Energy Performance, 45% / 50%

**EA Credit 1.9-10**  
Optimize Energy Performance, 55% / 60%

**EA Credit 2.1**  
Renewable Energy, 5%
# LEED Checklist

<table>
<thead>
<tr>
<th>Materials &amp; Resources</th>
<th>Standard</th>
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<tbody>
<tr>
<td>MR Credit 1.1 Building Reuse, Maintain 75% of Existing Shell</td>
<td>Applies to renovation projects only.</td>
</tr>
<tr>
<td>MR Credit 1.2 Building Reuse, Maintain 100% of Shell</td>
<td>Applies to renovation projects only.</td>
</tr>
<tr>
<td>MR Credit 1.3 Building Reuse, Maintain 100% Shell &amp; 50% Non-Shell</td>
<td>Applies to renovation projects only.</td>
</tr>
<tr>
<td>MR Credit 2.1 Construction Waste Management, Divert 50%</td>
<td>Specify reused/salvaged materials or products, calculated by cost.</td>
</tr>
<tr>
<td>MR Credit 2.2 Construction Waste Management, Divert 75%</td>
<td>Specify reused/salvaged materials or products, calculated by cost.</td>
</tr>
<tr>
<td>MR Credit 3.1 Resource Reuse, Specify 5%</td>
<td>Specify materials or products with recycled content, calculated by cost.</td>
</tr>
<tr>
<td>MR Credit 3.2 Resource Reuse, Specify 10%</td>
<td>Specify materials or products with recycled content, calculated by cost.</td>
</tr>
<tr>
<td>MR Credit 4.1 Recycled Content, Specify 5% (post-consumer + 1/2 post-industrial)</td>
<td>Specify materials or products with recycled content, calculated by cost.</td>
</tr>
<tr>
<td>MR Credit 4.2 Recycled Content, Specify 10% (post-consumer + 1/2 post-industrial)</td>
<td>Specify materials or products with recycled content, calculated by cost.</td>
</tr>
<tr>
<td>MR Credit 5.1 Local/Regional Materials, 20% Manufactured Locally</td>
<td>Specify materials or products manufactured within 500 miles, calculated by cost.</td>
</tr>
<tr>
<td>MR Credit 5.2 Local/Regional Materials, of 20% in MRc5.1, 50% Harvested Locally</td>
<td>Specify materials from raw materials harvested within 500 miles, calculated by cost.</td>
</tr>
<tr>
<td>MR Credit 6 Rapidly Renewable Materials</td>
<td>Specify 50% of hardwood material with FSC certified wood, calculated by cost.</td>
</tr>
<tr>
<td>MR Credit 7 Certified Wood</td>
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<tr>
<td>7</td>
<td>6</td>
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## LEED Checklist

### Indoor Environmental Quality

<table>
<thead>
<tr>
<th>IEQ Credit</th>
<th>Description</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Carbon Dioxide (CO₂) Monitoring</td>
<td>ASHRAE 129-1997, air-change effectiveness of 0.9 OR ASHRAE Fundamentals CO₂ 6.4.1.2.2</td>
</tr>
<tr>
<td>1</td>
<td>Ventilation Effectiveness</td>
<td>SMACNA IAQ Guidelines for Occupied Buildings Under Construction.</td>
</tr>
<tr>
<td>1</td>
<td>Construction IAQ Management Plan, During Construction</td>
<td>Air quality test OR two week pre-occupancy fresh air flush-out (phasing allowed).</td>
</tr>
<tr>
<td>1</td>
<td>Construction IAQ Management Plan, Before Occupancy</td>
<td>SCAQMD Rule #1168, adhesives; BAAQMD Reg 8 Rule 51, sealants.</td>
</tr>
<tr>
<td>1</td>
<td>Low-Emitting Materials, Adhesives &amp; Sealants</td>
<td>Green Seal GS-11 requirements.</td>
</tr>
<tr>
<td>1</td>
<td>Low-Emitting Materials, Paints &amp; Coatings</td>
<td>CRI Green Label Test Program requirements.</td>
</tr>
<tr>
<td>1</td>
<td>Low-Emitting Materials, Carpet</td>
<td>No added urea-formaldehyde resins or binders.</td>
</tr>
<tr>
<td>1</td>
<td>Low-Emitting Materials, Composite Wood</td>
<td>Provide floor grates at doors, exhaust ventilation points for chemical use areas.</td>
</tr>
<tr>
<td>1</td>
<td>Indoor Chemical &amp; Pollutant Source Control</td>
<td>Operable windows and lighting controls along building perimeter.</td>
</tr>
<tr>
<td>1</td>
<td>Controllability of Systems, Perimeter</td>
<td>Requires individual control of ventilation and lighting for interior spaces.</td>
</tr>
<tr>
<td>1</td>
<td>Thermal Comfort, Comply with ASHRAE 55-1992</td>
<td>Humidistatic controls for HVAC. Must be installed in conjunction with credit 7.1.</td>
</tr>
<tr>
<td>1</td>
<td>Thermal Comfort, Permanent Monitoring System</td>
<td>Achieve 2% daylight factor in spaces with critical visual tasks.</td>
</tr>
<tr>
<td>1</td>
<td>Daylight &amp; Views, Daylight 75% of Spaces</td>
<td>Direct views outside from 90% of regularly occupied areas.</td>
</tr>
<tr>
<td>1</td>
<td>Daylight &amp; Views, Views for 90% of Spaces</td>
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</table>

### Innovation & Design Process

<table>
<thead>
<tr>
<th>Standard</th>
<th>5</th>
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## LEED Checklist

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<th>Indoor Environmental Quality</th>
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<tr>
<td>1</td>
<td>IEQ Credit 2</td>
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<td>IEQ Credit 8.1</td>
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<tr>
<td>1</td>
<td>IEQ Credit 8.2</td>
</tr>
</tbody>
</table>
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- The final energy savings is 51% over ASHRAE 90.1-1999 in terms of energy cost. (In terms of energy use, the savings is 47% over ASHRAE).
- The PVs provide 4.7% of the building's annual energy use which earns 1 credit.
- 83% construction waste diversion (this number probably dropped in the last months of the project - this is from April of this year).
- 15-23% recycled content
- 50-75% local manufacture
- 40-70% local harvest
- 2% rapidly renewable (doesn't earn the LEED credit)
- 60% FSC wood
- Met all low-emitting materials credits
- Innovation credits sought are:
  - Greatly exceed SSc7.1, heat island effect non-roof
  - Greatly exceed EAc6, Green power (100% green power for 2 years)
  - Greatly exceed MRc5, local materials
  - Green building education

Other innovations were revisions to the University standards (based on our variances), future raw water use, and green furniture.
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Construction Manager’s comments:

- Huge learning curve for contractors (no prior LEED experience)
- First project for Construction Management site team
- Learned a lot about forms and how to use them
- Learning curve to find recycling facilities for construction waste (drywall, brick, CMU)
- Confusion about VOC’s and where they are allowed (outside vapor barrier – but this is ill-defined on docs.)

LOTS OF PAPER!!!!

- Communication is key to end use success (space heaters)
- Lighting control issues (ballasts)
- Imported items from overseas (diffusers, some stone)
- Comments on landscaping
- Comments on heat gain in Commons
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Sustainable design items from design that didn’t happen…
  Light shelves eliminated
  Dual flush toilets
  Intensive green roof area became extensive
    (wrong roof deck specified)
  Window set-back
  Green cleaning?
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Design Team comment:

Durability of materials a key element in sustainable building design that is not always understood by contractors (example: veneer used where solid wood was called for)
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Not ready for prime time…yet:
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