IPRO 335

Renovation of Alumni Memorial Hall
Background

**Alumni Memorial Hall** (1945-46) is Mies van der Rohe’s first classroom building on the IIT campus. This historical building is in need for a major renovation due to its age and maintenance requirements. This renovation must be completed by preserving the original look and feel of the building and at the same time achieving a green title for the building and meeting the requirements of the Chicago Building Code and being ADA compliant.
Work to be Completed from Last Semester

• Final LEED (Leadership in Energy and Environmental Design) documentation and identification of individuals that might be part of a LEED team should the school desire to pursue that route.

• Final design of Americans with Disabilities Act (A.D.A.) elements including a re-design of the elevator, and approval by the client.

• Using the Code of Ethics written last semester as a base line, the code will be rewritten to strengthen its objective to provide guidance for the I-Pro.
Main Project Goals

I. Green roof design that includes storm water retention and grey water recycling systems and additional plumbing systems.

II. Elevator design for disabled.

III. Heating, Ventilation, and Air Conditioning (HVAC) design. This includes Air conditioning load calculation, Lab hoods and Hydronic Heating design.

IV. Electrical system design – Illumination calculations, Alarm systems, and ‘Off-heating’ load calculations from equipment to be housed in AM Hall.

V. Cost estimate.
Architectural Redesign
Redesign of first floor:

- New office layouts
- Bathroom expansion
- Elevator addition
- Access hallway
- Entrance ramp addition
Redesign of second floor:

- New office layouts
- Classroom addition
- Bathroom expansion
- Elevator addition
- Student work area expansions
Green Roof Design

Benefits
• Storm water management
• Improves energy efficiency of building
• Absorbs external noise pollution
• Processing of airborne toxins

Primary Considerations
• Architectural
• Structural
Checking Available Strength

• Loads
  – Dead: decking and green roof
  – Live: Rain

• Member Capacity
  – Ultimate Load vs. Design Strength
  – Beams: bending strength
  – Columns: axial strength
Typical Cross-Section
Roof Plan
Stormwater Management

Objective

• Obtain LEED credit for stormwater management
• Reduce water runoff on property site by 15%
  – For an average weather year
  – For the two-year, 24-hour design storm
Methods For Reducing Stormwater Runoff

**Rain Barrels** – An effective way of capturing water, but unusable because it would change the exterior look of the building.

**Permeable Paving** – Allows water to flow through sidewalks and driveways. There was not enough paving on the site to make a noticeable difference.

**Bioinfiltration** – Shallow swales that collect water during storms. These were impractical due to the lack of space around the property.

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**Green Roof** – Layers of vegetation covering a conventional roof. This method was chosen due to the size of the roof in comparison to the lot size, and the effectiveness of a green roof to collect and delay stormwater runoff. Green roofs also reduce urban heat island effect, as well as lower building heating and cooling costs.
Design

• Using Chicago Stormwater Ordinance Manual

• Propose to cover 50% of roof with green roof
  – Calculate existing runoff from storm events
  – Calculate runoff with proposed green roof to show reduction of at least 15%
Results

• Impervious area on site will be reduced to 43% from 64 %

• Total volume of water leaving site will be reduced from 3252 cubic feet to 2686 cubic feet

• Stormwater runoff reduced 17%; LEED point available
**Elevator Design**

**Project Goal:**

i) Design a 2-story glass elevator that satisfies American Disability Act (ADA)

ii) Research on elevator technologies that can minimize energy consumption

iii) Find a suitable location for elevator

iv) Design the curtain wall surrounding the elevator
Why Gen2 Machine Room-less Elevator System?

I. Lubrication-free
-the polyurethane-coated, galvanized-steel belts prevent the rust and lubrication problems.

II. Space Saving
-it does not require a machine room and it permits flexible control-space placement.
III. Environmental friendly
-50% more energy efficient than conventional elevators

IV. Smoothest and quietest
-reduces vibration and car noise significantly
Column and Beam Design

- Proposed Roof Beam W10x22
- Proposed Roof Girder W10x22
- Proposed Column W6x15
- Ground Floor
- Buffer
- Foundation
- Controller System

See Detail 1

Detail 1

A-A section

Detail 2

A-A section
Elevator Cover on the Roof

- 72”x 72”x20” Polycarbonate Skylight as elevator cover on the roof

Foundation Design

- We recommended single square footing (2’x2’x1’) as foundation for each column
Proposed Location of Elevator

Top View of Elevator
3D Gen2 Elevator Model
HVAC Redesign

• Currently
  – Heated hydronically by steam
  – Entire building is not air conditioned

• Needed
  – Updated heating and air conditioning system to improve comfort and balance temperature throughout the building

• Process
  – Room loads were calculated
  – Duct sizes were determined
HVAC Load Calculations

- The building was divided into zones
  - Labs
  - Classrooms
  - Offices
- Loads for each room were calculated using computer software
IPRO 335 – Alumni Hall Renovation

Second Floor

ROOM LOAD KEY:
- 3550 - 2840 CFM
- 2839 - 2130 CFM
- 2129 - 1420 CFM
- 1419 - 710 CFM
- 709 - 0 CFM

First Floor

ROOM LOAD KEY:
- 3550 - 2840 CFM
- 2839 - 2130 CFM
- 2129 - 1420 CFM
- 1419 - 710 CFM
- 709 - 0 CFM
Duct Sizing

• A layout was conceived that properly ventilated each room adequately
• Another computer program was used to determine the size of ducting
Equipment

• The air handler must be able to push 100 tons of air through the building
• Recommended Air Handler: Trane M-Series 100 ton capacity
LEED Credit

Qualify for the following LEED credits

• Additional Ozone Protection
• Building Systems Monitoring
Electrical System Design

The Electrical Design Procedure

1. Analyze building needs
2. Determine electrical loads
3. Select electrical systems
4. Coordinate with other design decisions
5. Prepare electrical plans and specifications

We followed this procedure in our design for Alumni. The results on the next few slides will give an appreciation for electrical systems.
One of the considerations in our design is the placement and count of our Outlets (receptacles).

After we had a finalized floor plan we place and count our improved outlet locations. In the current building offices for instance are restricted to only 2 outlets, where as ideally they would have approximately 6.

The total count comes to 649, example rooms are listed on the right.

<table>
<thead>
<tr>
<th>Room</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>124</td>
<td>8</td>
</tr>
<tr>
<td>129</td>
<td>11</td>
</tr>
<tr>
<td>122</td>
<td>7</td>
</tr>
<tr>
<td>128</td>
<td>6</td>
</tr>
<tr>
<td>120</td>
<td>11</td>
</tr>
<tr>
<td>120B</td>
<td>6</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

First Floor Alumni Outlets

<table>
<thead>
<tr>
<th>Room</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>211-216</td>
<td>6</td>
</tr>
<tr>
<td>210</td>
<td>30</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

Second Floor Alumni Outlets
Another factor considered is the Extra Loads that would be put on the system such as the buildings High Powered 3 and 5 ton Cranes, and other large equipment such as Table Saws, Grinders, Welders, and very large Compression/Tension testing equipment.

The number of extra loads was well over 100. (short example below)

### First Floor Alumni Room 114

<table>
<thead>
<tr>
<th>Object</th>
<th>Volts</th>
<th>Amps</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table Saw</td>
<td>208</td>
<td>6.2</td>
<td>3</td>
</tr>
<tr>
<td>Resistance Welder</td>
<td>208</td>
<td>34.5</td>
<td>3</td>
</tr>
<tr>
<td>Vertical Milling Machine</td>
<td>240</td>
<td>12.7</td>
<td>1</td>
</tr>
<tr>
<td>Precision Drill Press</td>
<td>120</td>
<td>4.4</td>
<td>1</td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Below is a Demand Load table that is necessary for estimating our buildings power supply and used for several further application in our design procedure.

Here we take into account even more equipment in addition to our outlets and extra load objects. Important examples are the Lighting, HVAC, Elevator.

With these calculations, and more detailed sub category calculations, we size our wires, breakers, circuit panels, etc.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>VA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air-conditioning equip.</td>
<td>20,800</td>
</tr>
<tr>
<td>Fastened-in-Place appliances</td>
<td>116,820</td>
</tr>
<tr>
<td>General illumination</td>
<td>54,000</td>
</tr>
<tr>
<td>25% of Largest Motor</td>
<td>5,200</td>
</tr>
<tr>
<td>Total Demand Load</td>
<td>255,420</td>
</tr>
</tbody>
</table>

Electrical System Design
The last calculations we will mention with respect to our electrical system are the Riser and One-Line Diagrams that start to give physical presence to our system. Below is a simplified version of our systems Riser Diagram. It is showing the equipments general location, types of equipment, and number of panels. Our One-Line Diagram adds information such as how many branch circuits there are, and what our separate lines are rated at.
Safety and Accessibility

Layouts, Signage, and Equipment for Fire and ADA
Fire Alarm Systems

First Floor

D: Heat and Smoke Detector
EX: Fire Hose and Extinguisher
AV: Horn/Visual Strobe Alarm
RA: Remote Annunciator
S: Manual Pull
FAA: Fire Alarm Annunciator
Fire Alarm Systems
Second Floor

D  Heat and Smoke Detector
EX  Fire Hose and Extinguisher
AV  Horn/Visual Strobe Alarm
RA  Remote Annunciator
S   Manual Pull
FAA Fire Alarm Annunciator
ADA Signage

First Floor

- **Enter**
- **Intl. Symbol of Accessibility**
- **Incase of Fire Use Stairs**
- **Stairs**
- **Exit**
- **Elevator**
ADA Signage

Second Floor

1. Enter
2. Intl. Symbol of Accessibility
3. Incase of Fire Use Stairs
4. Stairs
5. Exit
6. Elevator
These are examples of the Siemens equipment chosen for the fire alarm system. They are both compliant with standards with special focus on ADA compliance:

- FP-11 FirePrint Detector (fire detector)
- Siemens HS-HMC R & HS-HMC W (horn strobe – high intensity multi candela fire alarm)

The fire detectors are programable for optimization depending on location such as hallways versus office space.

One of the improvements in this system will be the use of fire detectors capable of both heat and smoke detection rather than the present case of only heat detectors.

Of note, our plan has also added a fire detector in every Alumni Office space.
This is our current model chosen to act as the Brain of our fire detection system.

This Siemens Addressable Fire Alarm Control Panel: FireSeeker FS-250, has the input of all manual pull stations and fire detectors.

In addition to the screen shown, there will be a remote LCD display screen at the opposite end of the building to enable the viewing and updating of fire status from both ends of the building.
The addition of an elevator allows for Alumni Memorial Hall to be compliant with the Americans with Disabilities Act with the usage of suitable signage.

All ADA signage must meet specific requirements such as:
- Suitable Color Scheme
- Height and Distances with respect to placement
- Raised Letter and Pictogram
- Braille Lettering

The signs you see here are an example suitable ADA compliant signage.
Lighting

• Lamps and ballasts were updated 2006/2007 for higher efficiency
• Goals
  – Redesign light layout for even more efficiency
  – Add Lighting Controls
  – Meet LEED requirements for Existing Buildings
  – Still Provide Adequate Lighting Levels
Ledalite Edapt System

- Fewer Fixtures = Lower Energy
- Optimal Lighting using Direct/Indirect Lighting
- Occupancy & Daylight Sensors
- Personal dimming control from user’s desktop
AHM Redesign

- Use of 2 Types of Lights
- Reuse Retrofit-ref, 2 T-8s (58W) from 2006/2007 redesign (Hallways)
- Edapt Luminaires (106W) replaced in offices, classrooms and labs
- Average of 40-50 Footcandles (fc)
## Redesign Results

<table>
<thead>
<tr>
<th>Fixture Quantity</th>
<th>kW 2007</th>
<th>kWh 2007</th>
<th>Cost 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Various Fixtures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.51</td>
<td>2,040</td>
<td>$153.00</td>
<td></td>
</tr>
<tr>
<td>0.116</td>
<td>464</td>
<td>$34.80</td>
<td></td>
</tr>
<tr>
<td>0.058</td>
<td>232</td>
<td>$17.40</td>
<td></td>
</tr>
<tr>
<td>1.044</td>
<td>4,176</td>
<td>$313.20</td>
<td></td>
</tr>
<tr>
<td>0.44</td>
<td>1,760</td>
<td>$132.00</td>
<td></td>
</tr>
<tr>
<td>19.03</td>
<td>76,120</td>
<td>$5,709.00</td>
<td></td>
</tr>
<tr>
<td>6.27</td>
<td>25,080</td>
<td>$1,881.00</td>
<td></td>
</tr>
<tr>
<td>0.928</td>
<td>3,712</td>
<td>$278.40</td>
<td></td>
</tr>
<tr>
<td>4.07</td>
<td>16,280</td>
<td>$1,221.00</td>
<td></td>
</tr>
<tr>
<td>2.146</td>
<td>8,584</td>
<td>$643.80</td>
<td></td>
</tr>
<tr>
<td>0.18</td>
<td>720</td>
<td>$54.00</td>
<td></td>
</tr>
</tbody>
</table>

**Total**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Edapt</td>
<td>245</td>
<td>106</td>
<td>25.97</td>
<td>3,000</td>
<td>77,910</td>
<td>$5,843.25</td>
</tr>
<tr>
<td>Retrofit-ref, 2 T-8s</td>
<td>54</td>
<td>58</td>
<td>3.132</td>
<td>4,000</td>
<td>12528</td>
<td>$939.60</td>
</tr>
</tbody>
</table>

**Total**

|                | 299      |          | 29.1    | 90,438      | $6,782.85|

### 2007 Redesign

- Savings does not include reduced costs from daylight sensors
Redesign Results

Number of Fixtures

kWh Expended

Annual Cost
LEED Credit

Qualify for the following LEED credits

– Sustainable Sights
  • Light Pollution Reduction

– Energy & Atmosphere
  • Minimum Energy Performance
  • Optimize Energy Performance
  • Measurement and Verification

– Indoor Environmental Quality
  • Controllability of Systems-Perimeter

– Innovation & Design Process
Cost Estimating


<table>
<thead>
<tr>
<th>501700</th>
<th>UNIT COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>S.F. COSTS</td>
<td>1/4</td>
</tr>
<tr>
<td>0010 COLLEGES Classrooms and Administration</td>
<td>$109</td>
</tr>
<tr>
<td>0090 COLLEGES Science, Engineering, Laboratories</td>
<td>$185</td>
</tr>
</tbody>
</table>

Using $\frac{3}{4}$ Cost Data (most likely), Size Modifier=1.1, and Chicago (60616) Location Factor=1.133

\[
\left[(15,552 \text{ SF})\times(196/\text{SF})\times(1.1) + (15,552\text{SF})\times(263/\text{SF})\times(1.1)\right]\times1.133 = \$8,896,548.04
\]

Demolition Costs (RS Means Building Construction Cost Data 2007 024116130012)

\[
0.19/\text{CF} \times 438,048 \text{ CF} \times 1.133 = \$94,298.59
\]

Total Cost of Building a New Alumni Memorial Hall = \$8,990,800.00
## Line Item Estimate


- There is a 20% contingency for the line item estimate because the project and design drawings are still in the schematic phase. There are not complete plumbing, HVAC, or Electrical drawings for this estimate. A typical engineer's estimate will have a 10% contingency using a line item estimate.

<table>
<thead>
<tr>
<th>Div.</th>
<th>Description</th>
<th>Items Included</th>
<th>Total Cost (including O&amp;P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>General Requirements</td>
<td>Exterior Scaffolding</td>
<td>$32,776.20</td>
</tr>
<tr>
<td>02</td>
<td>Existing Conditions</td>
<td>Interior building demolition, disposal, and removal</td>
<td>$74,560.20</td>
</tr>
<tr>
<td>04</td>
<td>Masonry</td>
<td>Exterior masonry cleaning, Interior CMU Partition walls</td>
<td>$54,410.94</td>
</tr>
<tr>
<td>05</td>
<td>Metals</td>
<td>Exterior steel resurfacing and cleaning</td>
<td>$4,351.16</td>
</tr>
<tr>
<td>06</td>
<td>Woods, Plastics, and Composites</td>
<td>Interior wood door frames</td>
<td>$5,628.70</td>
</tr>
<tr>
<td>07</td>
<td>Thermal and Moisture Protection</td>
<td>Roofing selective demolition and extensive green roof</td>
<td>$204,576.00</td>
</tr>
<tr>
<td>08</td>
<td>Openings</td>
<td>Window glazing removal, re-glazing windows, doors</td>
<td>$260,309.13</td>
</tr>
<tr>
<td>09</td>
<td>Finishes</td>
<td>Ceilings, ACT, carpet, terrazzo, VCT, interior painting and exterior steel painting</td>
<td>$313,383.04</td>
</tr>
<tr>
<td>13</td>
<td>Special Construction</td>
<td>Darkroom shell</td>
<td>$10,822.50</td>
</tr>
<tr>
<td>14</td>
<td>Conveying Equipment</td>
<td>Magnetic Elevator system (price provided by elevator subgroup)</td>
<td>$130,000.00</td>
</tr>
<tr>
<td>22,23, 26</td>
<td>Plumbing, HVAC, and Electrical</td>
<td>A parametric estimate was used for schematic line item estimate.</td>
<td>$2,472,768.00</td>
</tr>
</tbody>
</table>

**Total Cost of Alumni Memorial Renovation = $4,037,542.79**
Questions?