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.

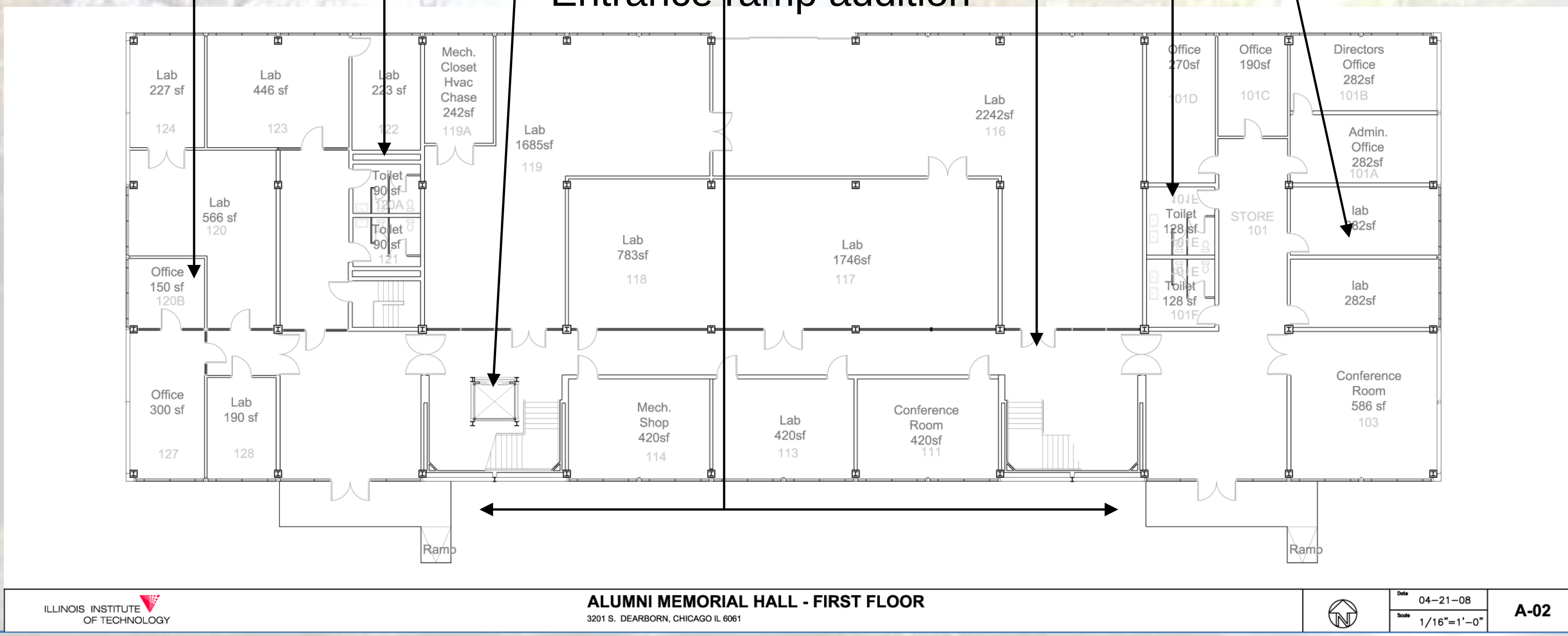
IV. Electrical system design –Illumination calculations, Alarm systems, and ‘Off-heating’ load calculations from equipment to be housed in AM Hall.

V. Cost estimate.

Architectural Redesign

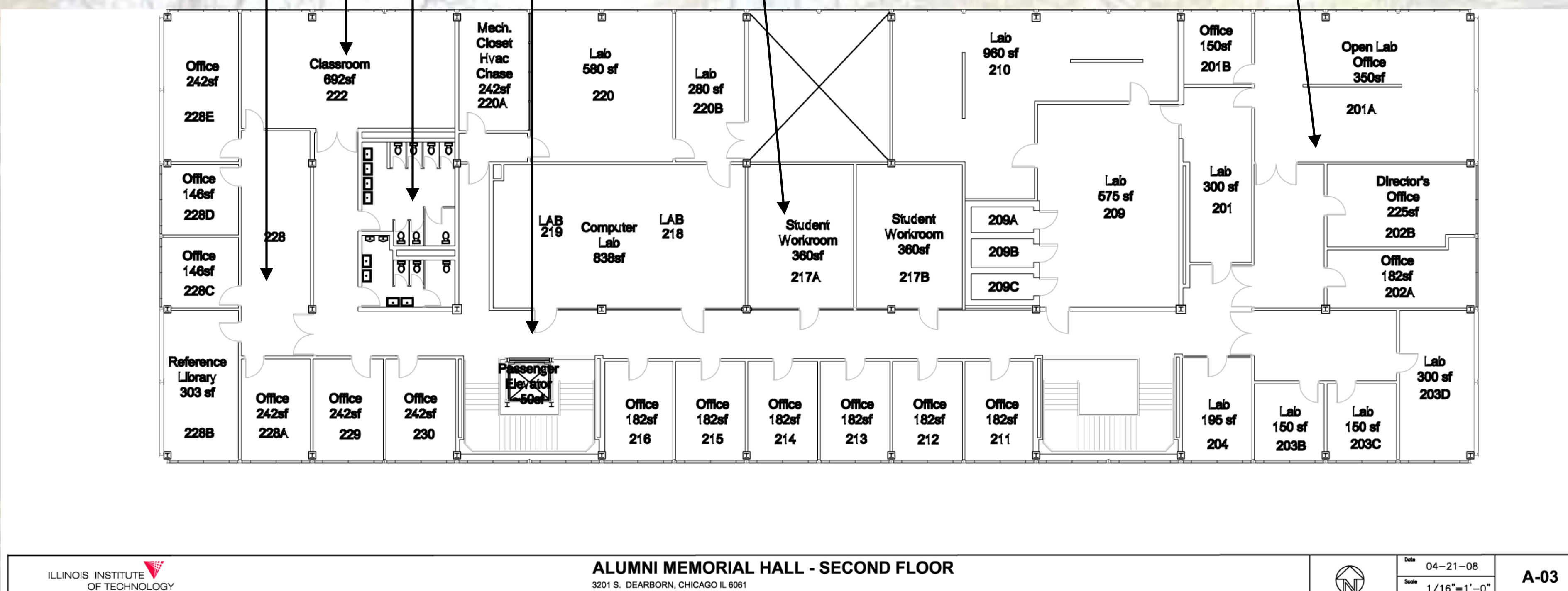
Redesign of first floor:

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

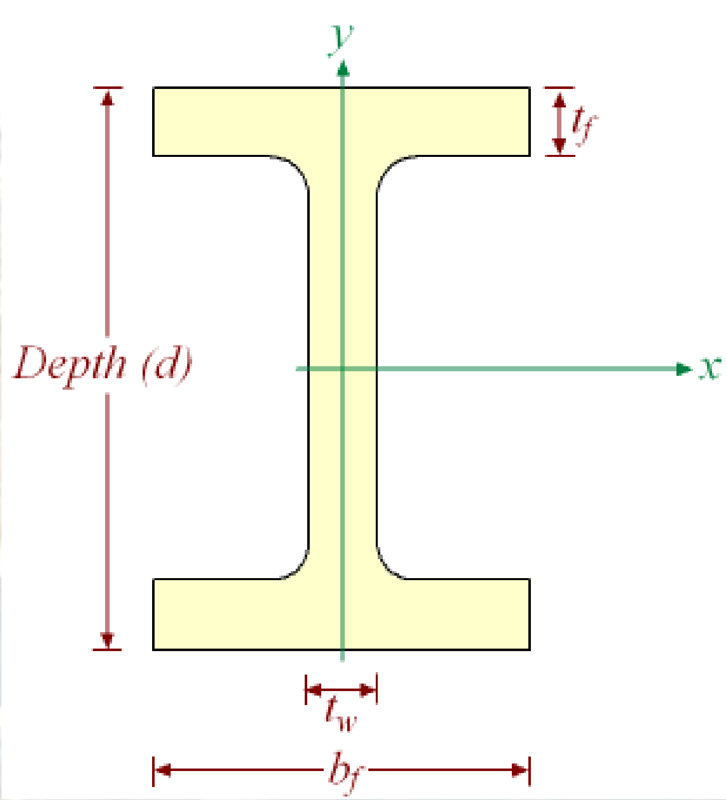
Primary Considerations

- Architectural
- Structural

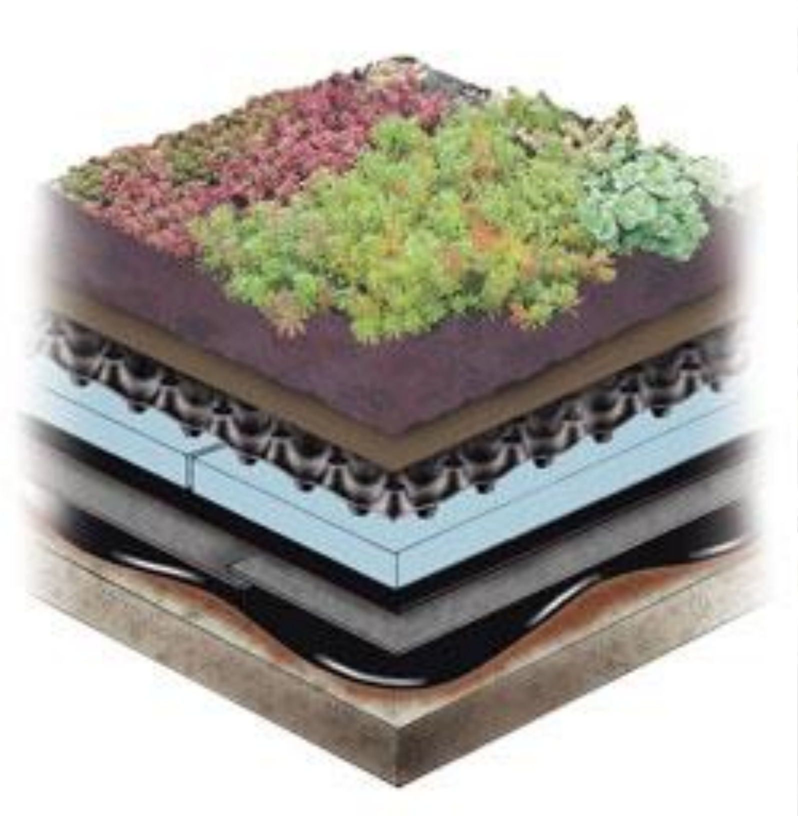
Checking Available Strength

- Loads
  - Dead: decking and green roof
  - Live: Rain

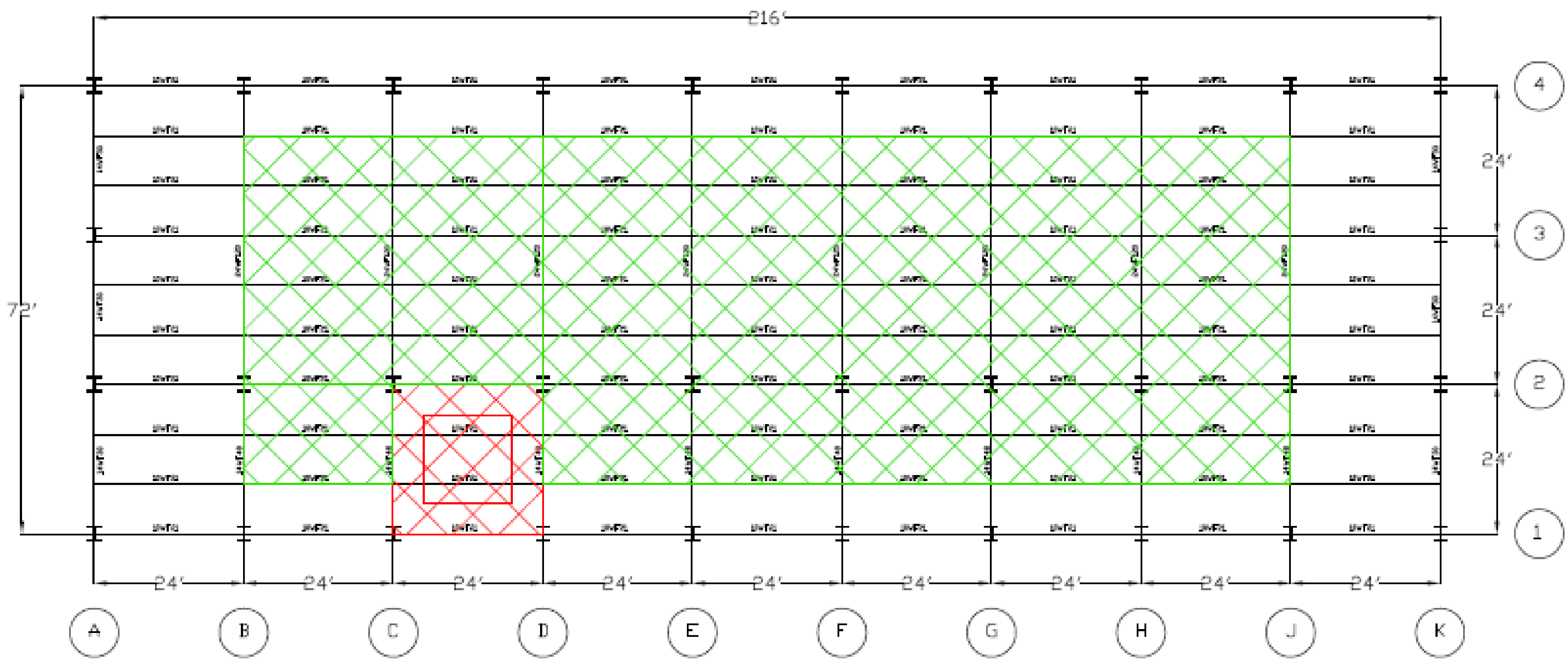
- Member Capacity
  - Ultimate Load vs. Design Strength
  - Beams: bending strength
  - Columns: axial strength



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.

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

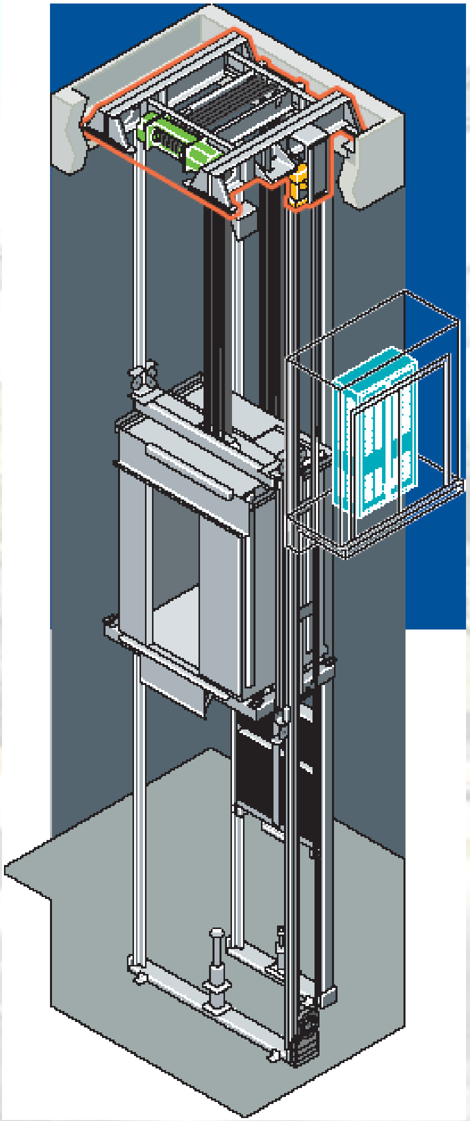
Project Goal:

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

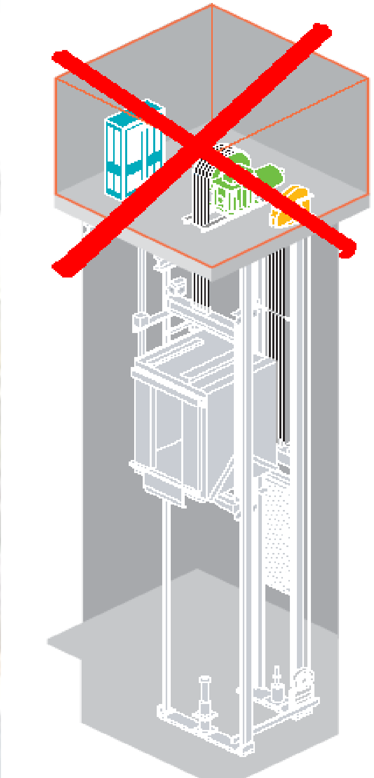
ii) Research on elevator technologies that can minimize energy consumption

iii) Find a suitable location for elevator

iv) Design the curtain wall surrounding the elevator



Why Gen2 Machine Room-less Elevator System?

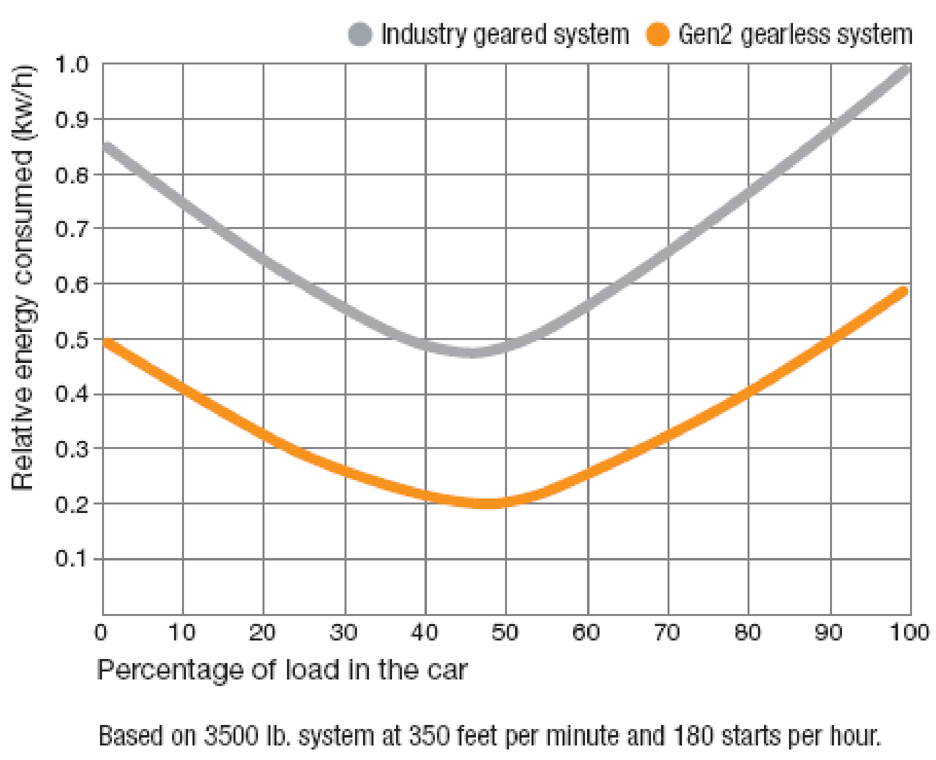


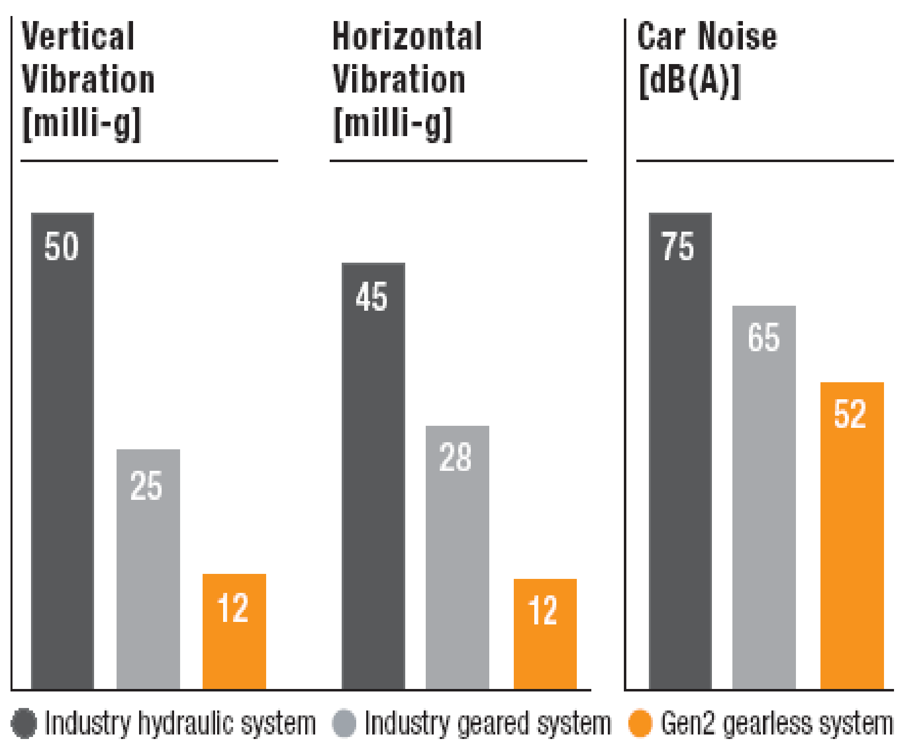
I. Lubrication-free

-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





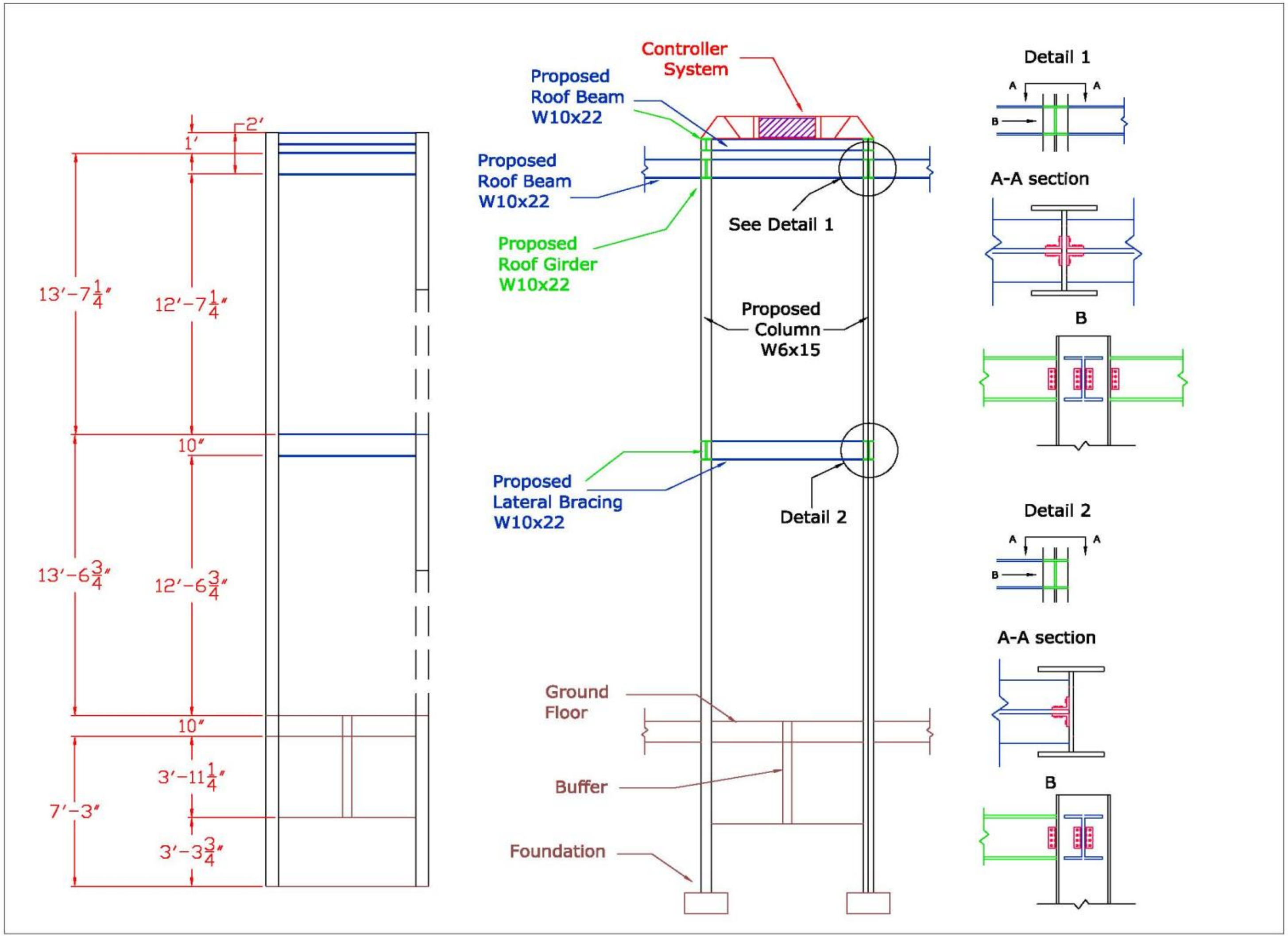
III. Environmental friendly

-50% more energy efficient than conventional elevators

IV. Smoothest and quietest

-reduces vibration and car noise significantly

Column and Beam Design

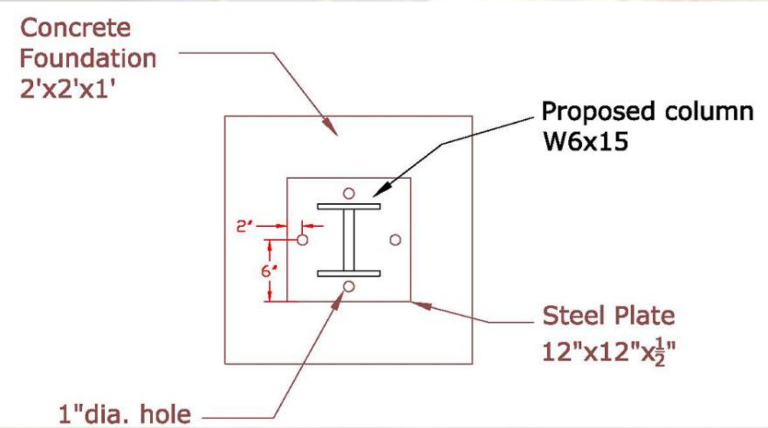


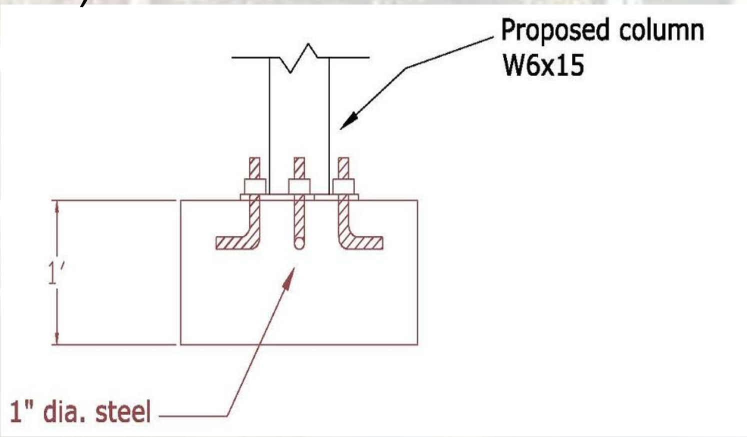
Elevator Cover on the Roof

72”x 72”X20” Polycarbonate Skylight as elevator cover on the roof

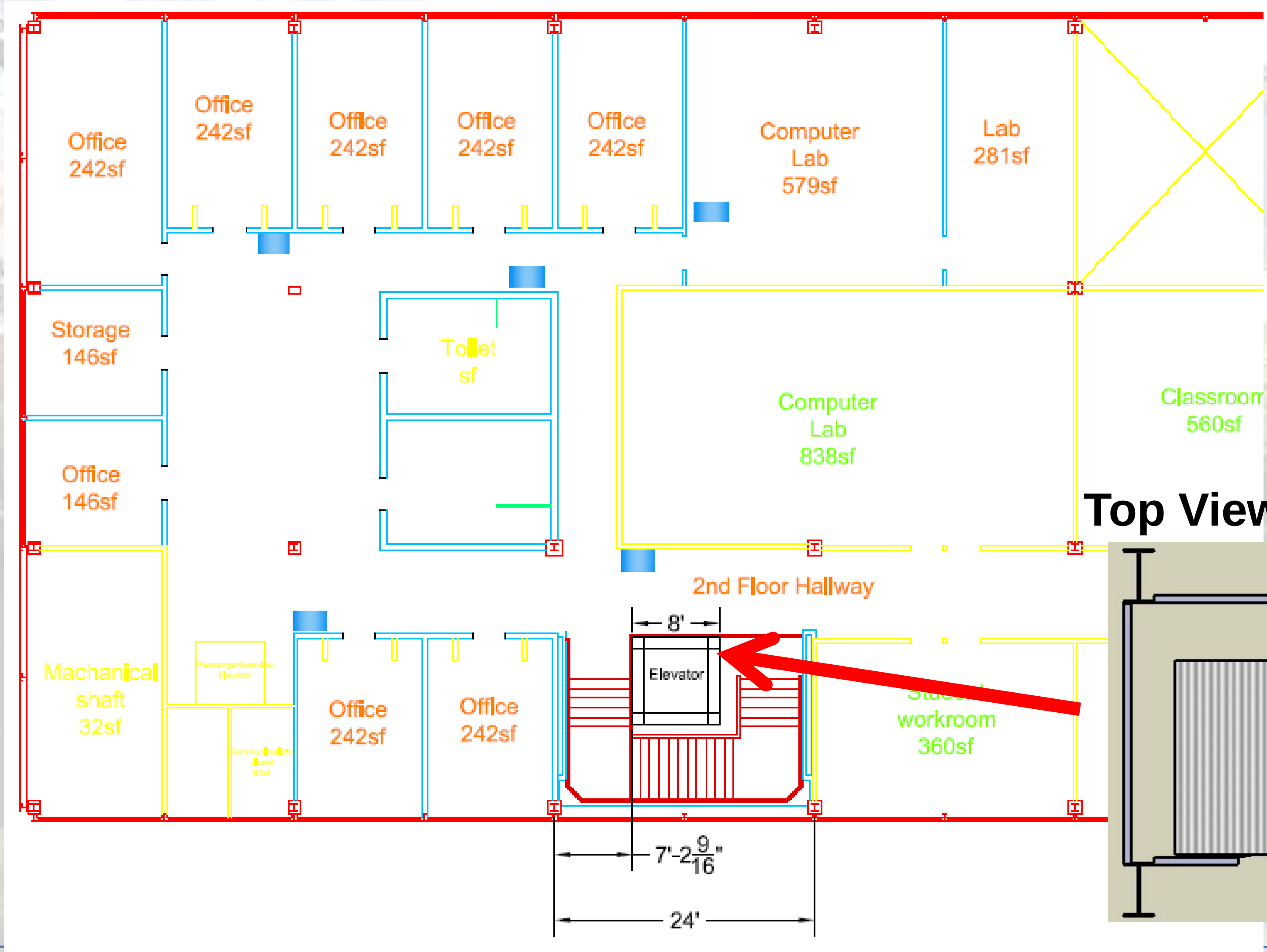
Foundation Design

We recommended single square footing (2’x2’x1’) as foundation for each column

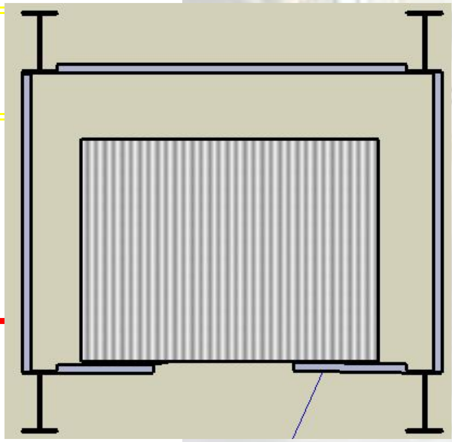




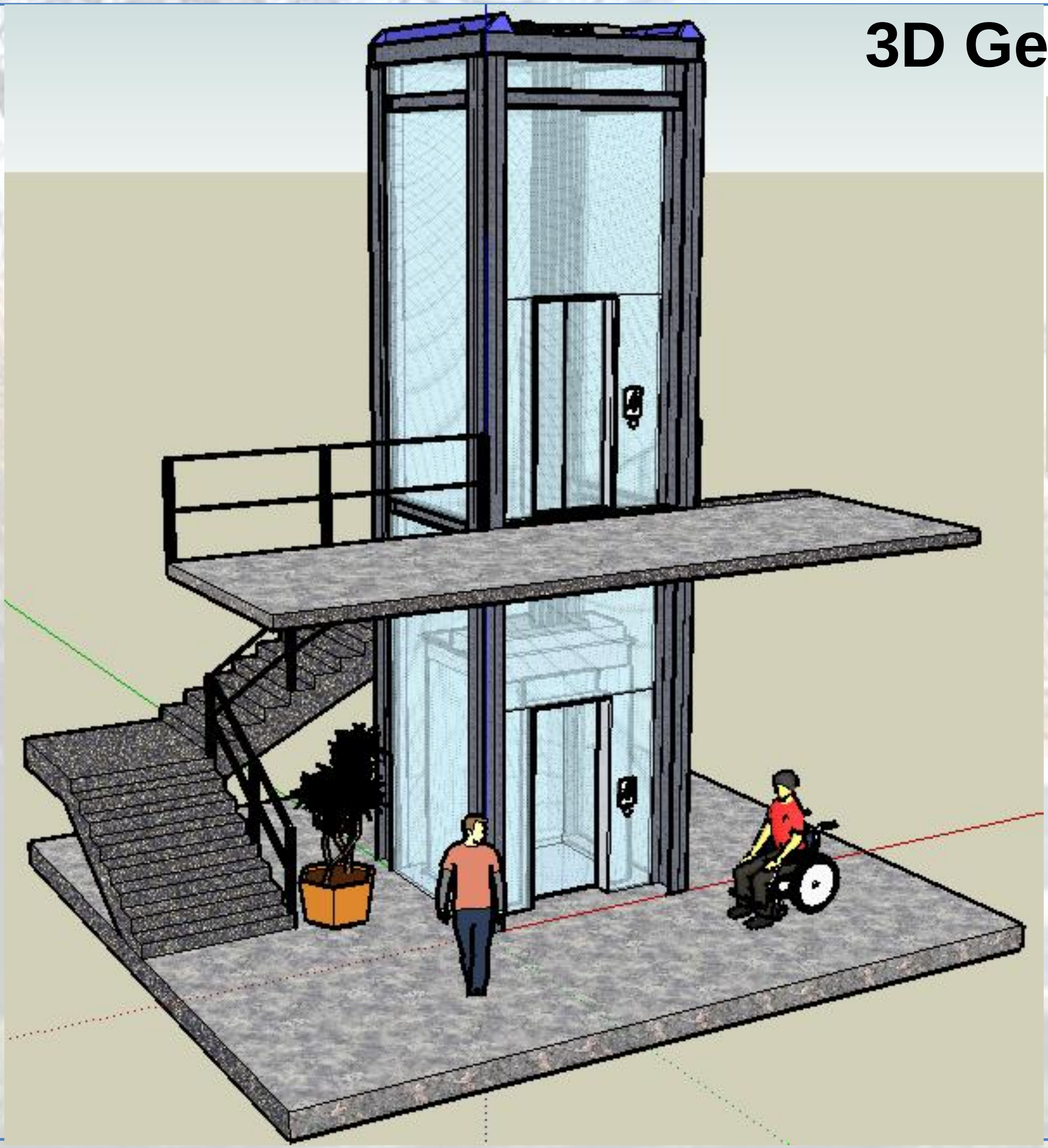
Proposed Location of Elevator

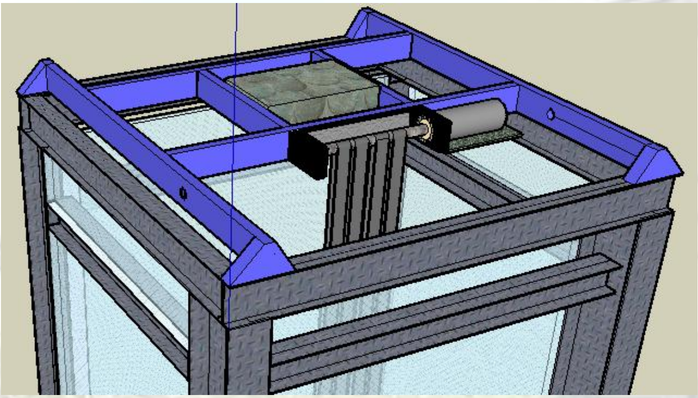


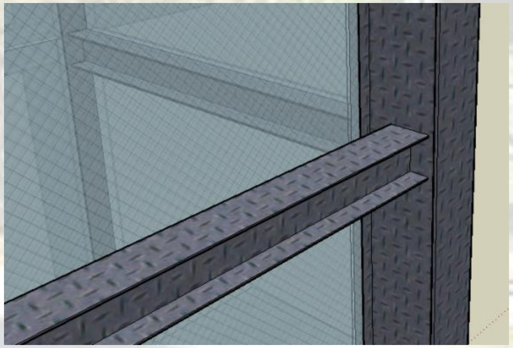
Top View of Elevator

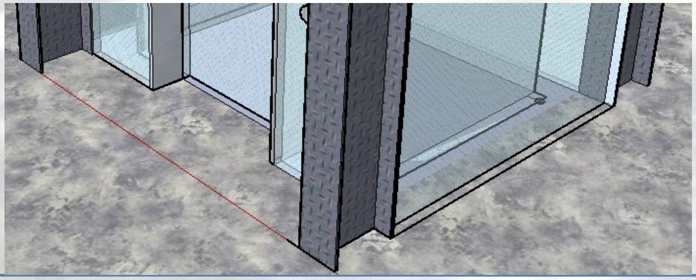


3D Gen2 Elevator Model









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

Second Floor

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

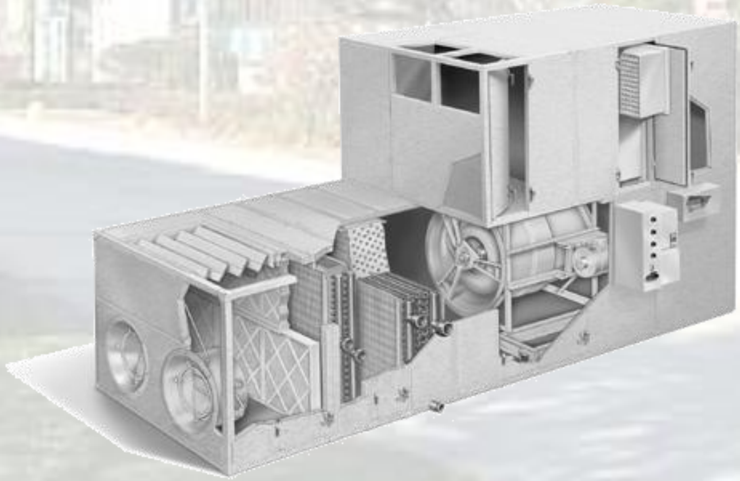
First Floor

Duct Sizing

- A layout was concieved 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.

First Floor Alumni Outlets

Room	#
124	8
129	11
122	7
128	6
120	11
120B	6
...	

Second Floor Alumni Outlets

Room	#
211-216	6
210	30
...	

Electrical System Design

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

Object	Volts	Amps	Phase
Table Saw	208	6.2	3
Resistance Welder	208	34.5	3
Vertical Milling Machine	240	12.7	1
Precision Drill Press	120	4.4	1
...			

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.

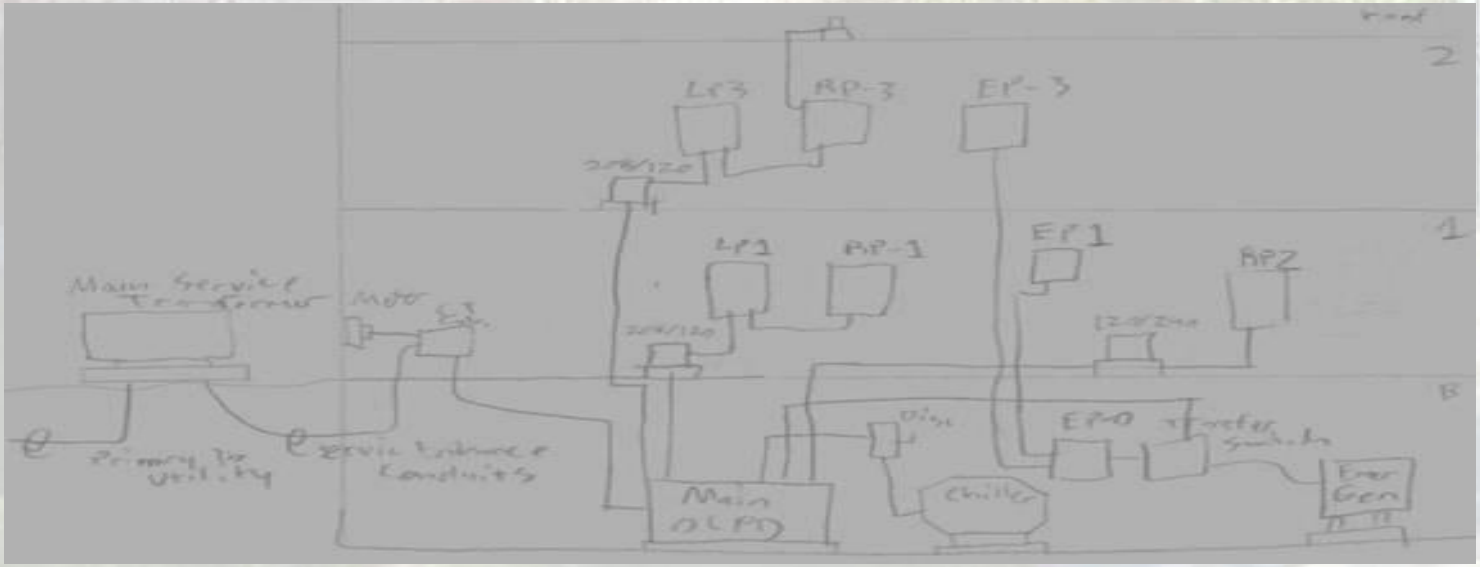
Here we take into account even more equipment in addition to our outlets and extra load objects. Important examples are the Lighting, HVAC, Elevator.

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

• • •		• • •
Air-conditioning equip.	=	20800 VA
Fastened-in-Place appliances	=	116820 VA
General illumination	=	54000 VA
25% of Largest Motor	=	5200 VA
Total Demand Load	=	255,420 VA

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.



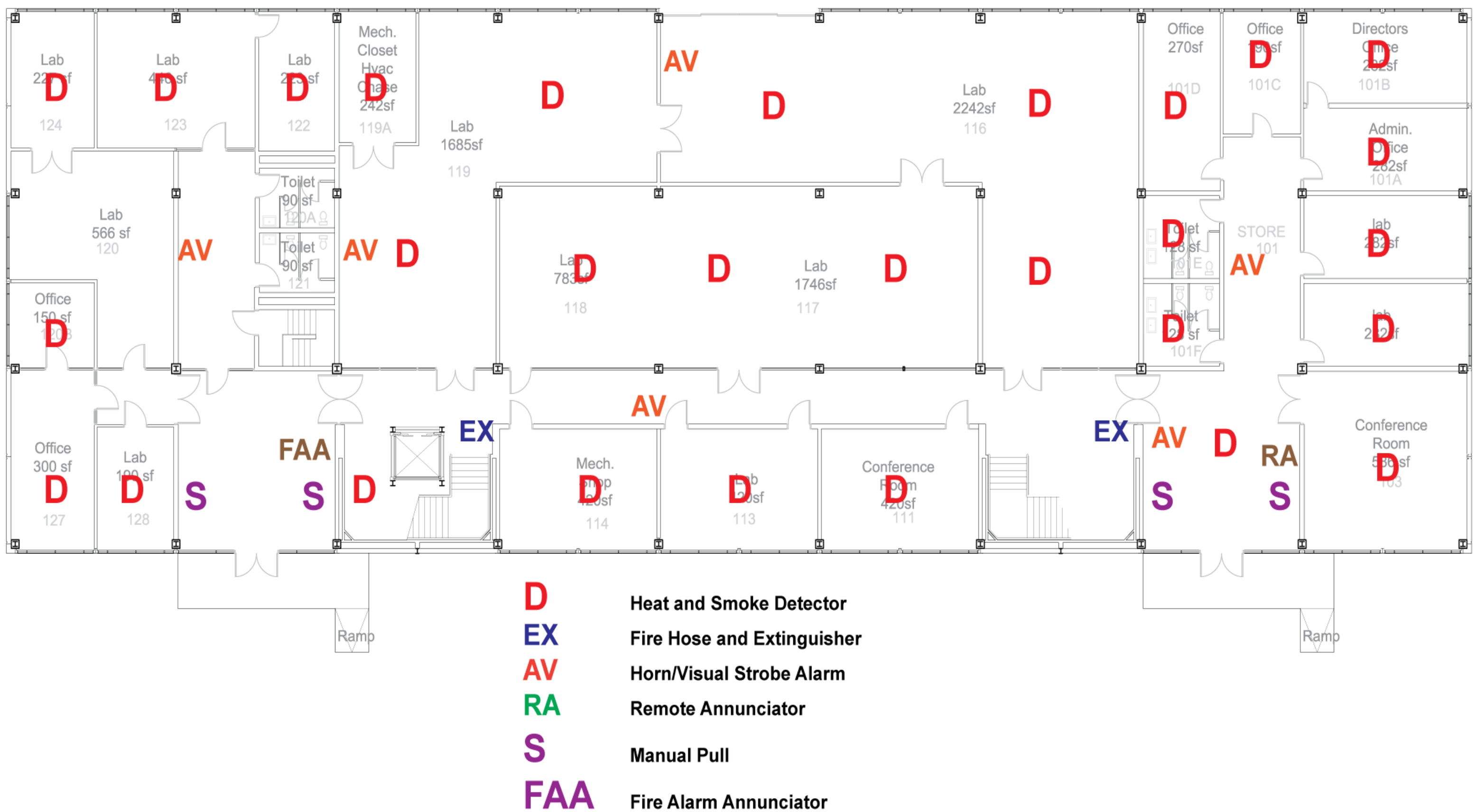
Electrical System Design

Safety and Accessibility

Layouts, Signage, and Equipment for Fire and ADA

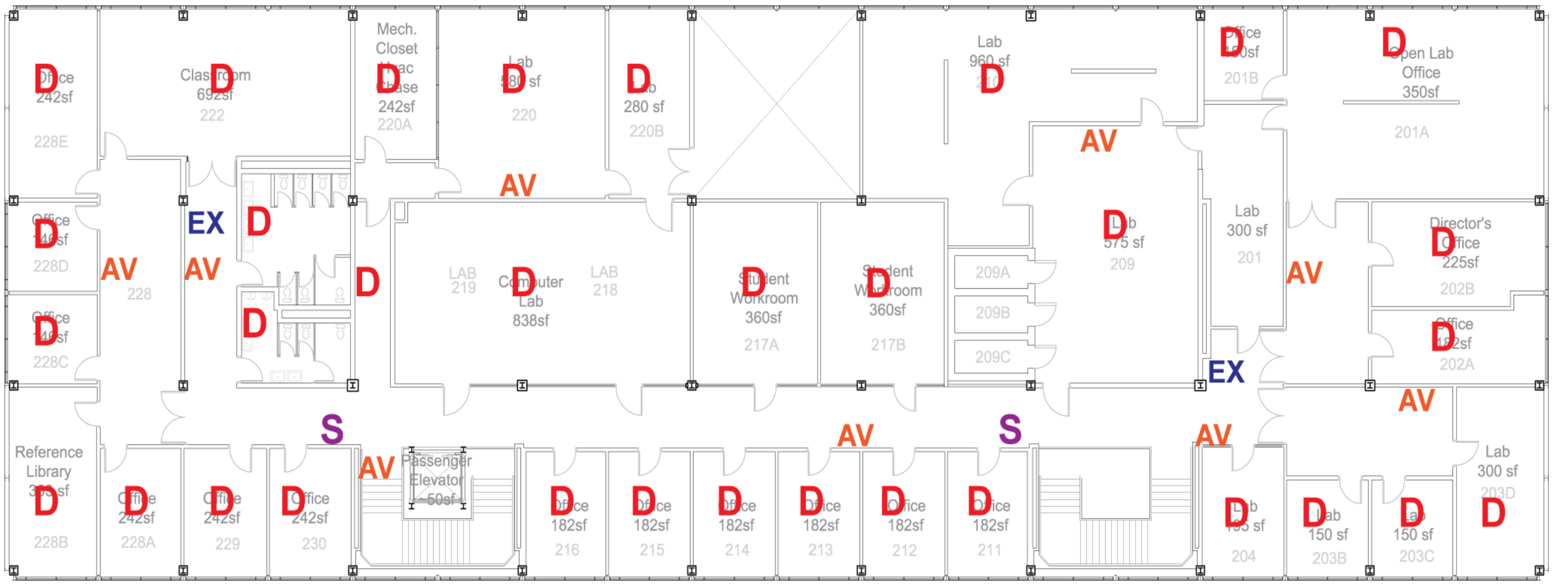
Fire Alarm Systems

First Floor



Fire Alarm Systems

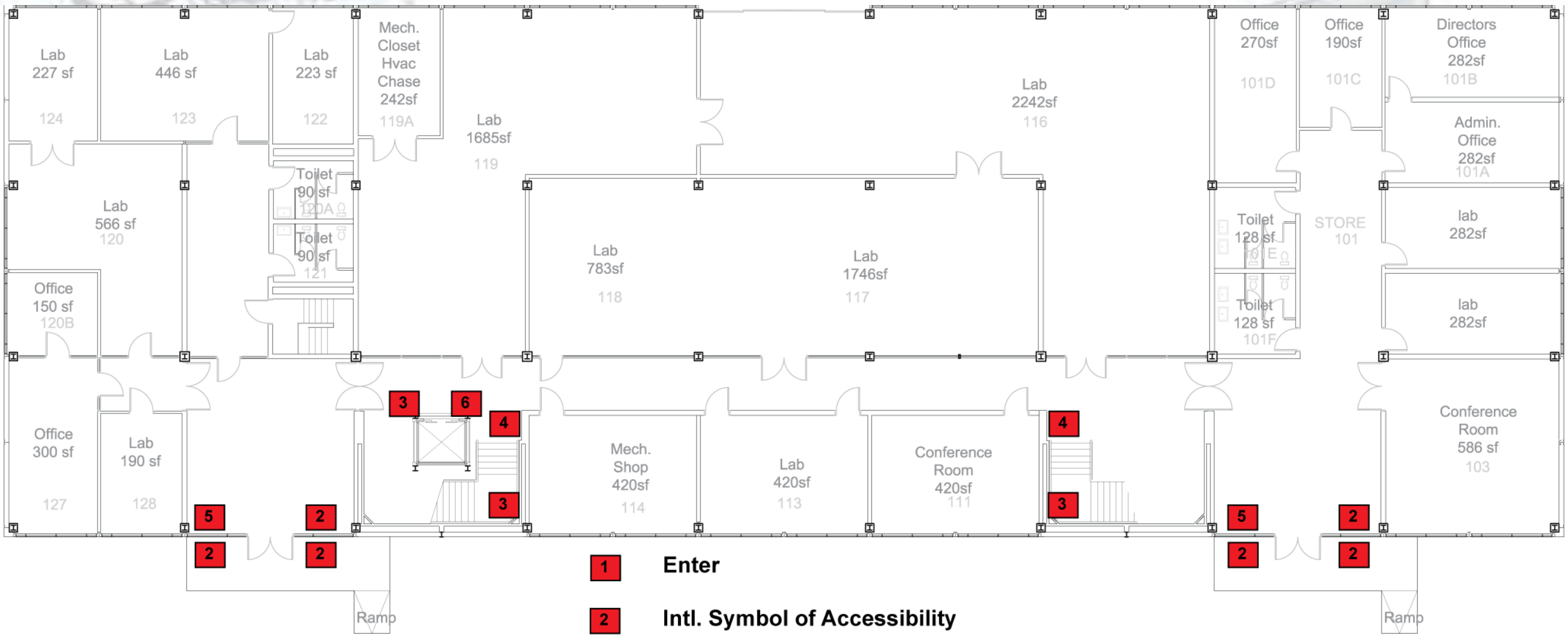
Second Floor



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



1 **Enter**

2 **Intl. Symbol of Accessibility**

3 **Incase of Fire Use Stairs**

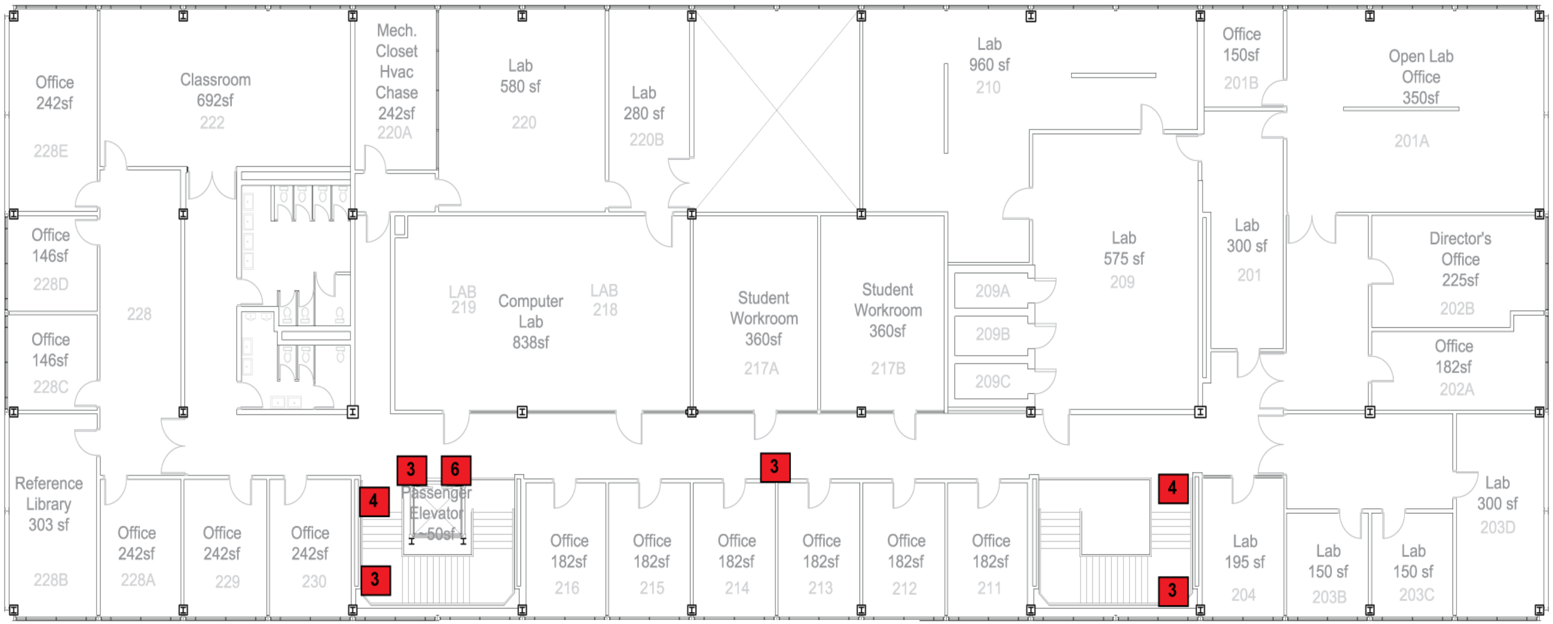
4 **Stairs**

5 **Exit**

6 **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:

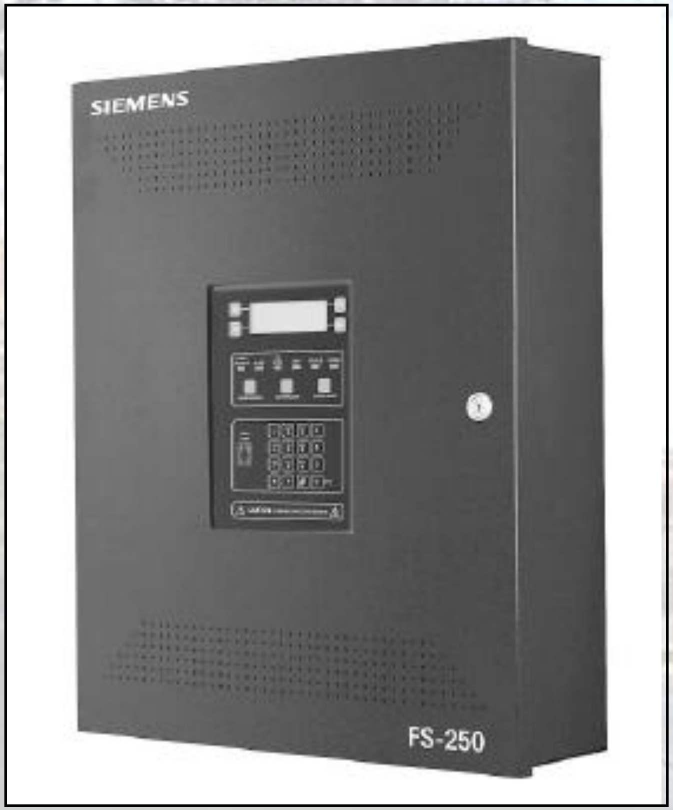
FP-11 FirePrint Detector (fire detector)

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 placment
Raised Letter and Pictogram
Brail 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

Fixture Quantity	kW 2007	kWh 2007	Cost 2007
Various Fixtures	0.51	2,040	$153.00
	0.116	464	$34.80
	0.058	232	$17.40
	1.044	4,176	$313.20
	0.44	1,760	$132.00
	19.03	76,120	$5,709.00
	6.27	25,080	$1,881.00
	0.928	3,712	$278.40
	4.07	16,280	$1,221.00
	2.146	8,584	$643.80
	0.18	720	$54.00
Total			
368	34.792	139,168	$10,437.60

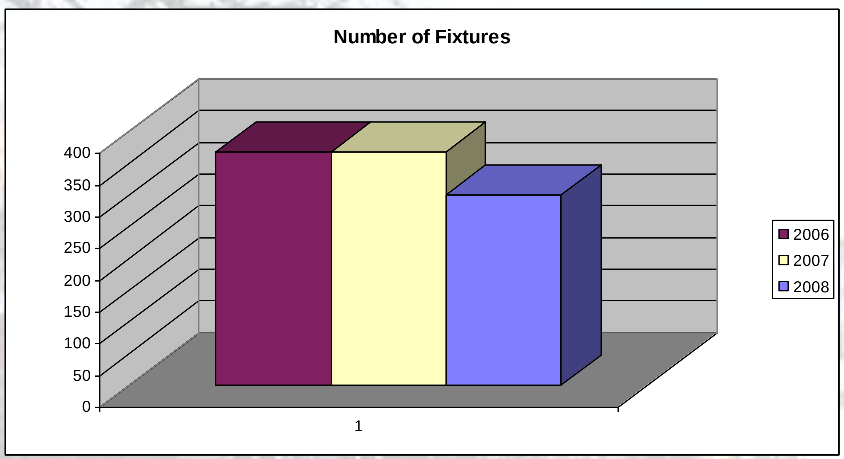
2007 Redesign

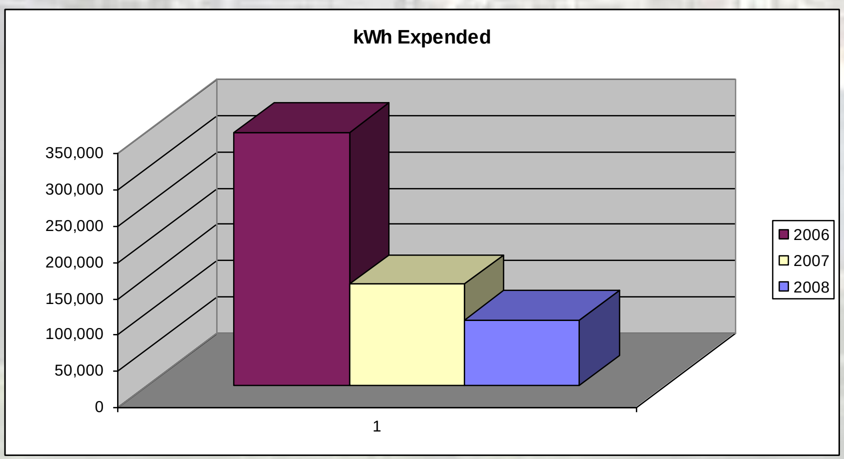
Fixture Quantity	Fixture Type	W/h 2008	kW 2008	Hrs/Yr 2008	kWh 2008	Cost 2008
245	Edapt	106	25.97	3,000	77,910	$5,843.25
54	Retrofit-ref, 2 T-8s	58	3.132	4,000	12528	$939.60
Total						
299			29.1		90,438	$6,782.85

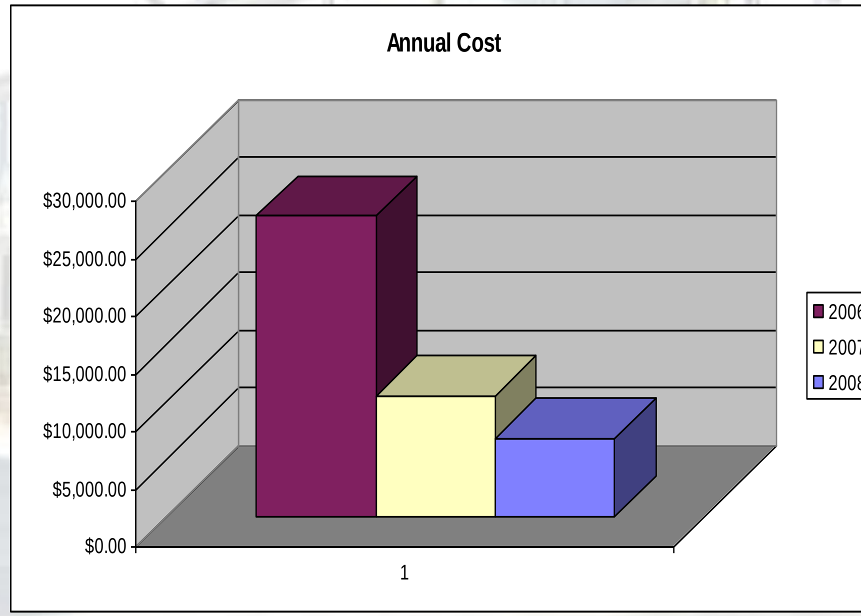
IPRO 335 Redesign

- Savings does not include reduced costs from daylight sensors

Redesign Results







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

- **Parametric Cost Estimate** for Building a New Alumni Memorial Hall using RS Means Building Construction Cost Data 2007

501700	UNIT COSTS			
S.F. COSTS	1/4	MEDIAN	3/4	
0010 COLLEGES Classrooms and Administration	$109	$144	$196	- First Floor
0090 COLLEGES Science, Engineering, Laboratories	$185	$216	$263	- Second Floor

Using ¾ Cost Data (most likely), Size Modifier=1.1, and Chicago (60616) Location Factor=1.133

[(15,552 SF)*($196/SF)*(1.1)+(15,552SF)*($263/SF)*(1.1)]*1.133 = **$8,896,548.04**

Demolition Costs (RS Means Building Construction Cost Data 2007 024116130012

$0.19/CF * 438,048 CF * 1.133 = **$94,298.59**

Total Cost of Building a New Alumni Memorial Hall = **$8,990,800.00**

- **Line Item Estimate** for renovating Alumni Memorial Hall using RS Means Building Construction Cost Data 2007.
- 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 engineers estimate will have a 10% contingency using a line item estimate.

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

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

Questions?