

IPRO 314

Spring 2009

Greening & Adaptive Reuse
of Queen of Peace High School's Facilities



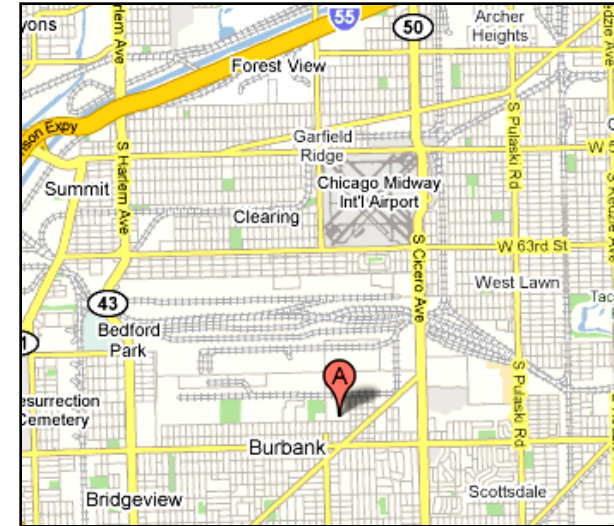
Introduction



- Problems:



- Declining Enrollment
- Under-Utilized Library Area
- Turning Peace 'Green'
- Under-Utilized Courtyard



Queen of Peace is located at Burbank, which is in the vicinity of Midway Airport.

- Mission Statement:

“To work with Queen of Peace High School to **attract more students** by *re-designing* and *developing alternative uses* for the library space and to create a solution that would **reduce** heating and cooling **costs.**”

History of IPRO 314



Client:

- Queen of Peace High School
- Alumnus & IIT Trustee: Ellen Jordan Reidy

IPRO 314: Fall 2008

- First time IPRO
- Too broad
- Lacked detail



Convent at Queen of Peace

Team Organization



I PRO 314

Advisors : Nancy Hamill-Governale and Jim Braband

Leaders : David Horabik and Kyle Dralle

Wall System	Information Commons	Courtyard Development
Matthew Alvarez	Kyle Dralle	Gina Grande
Svetlana Semenova	Kyle Duke	David Horabik
Randall Weyhe	Brian Lipski	Leonel Hernandez
	Michael Muyco	
	Naima Zakir	

Information Commons

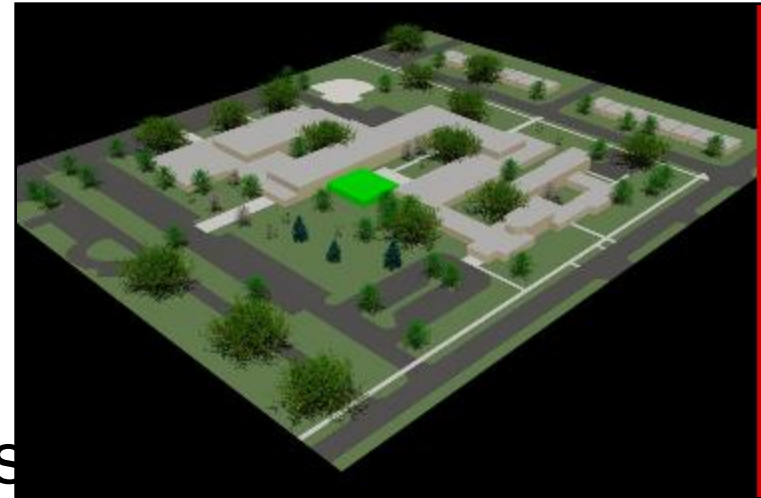


Re-design the area allowing it to incorporate:

- Individual/ Group Study spaces
- Tele-conferencing rooms
- Movable walls
- Public entrance

The area can also be used to host

- Community outreach programs
- Parent-Teacher meetings
- Large staff gatherings

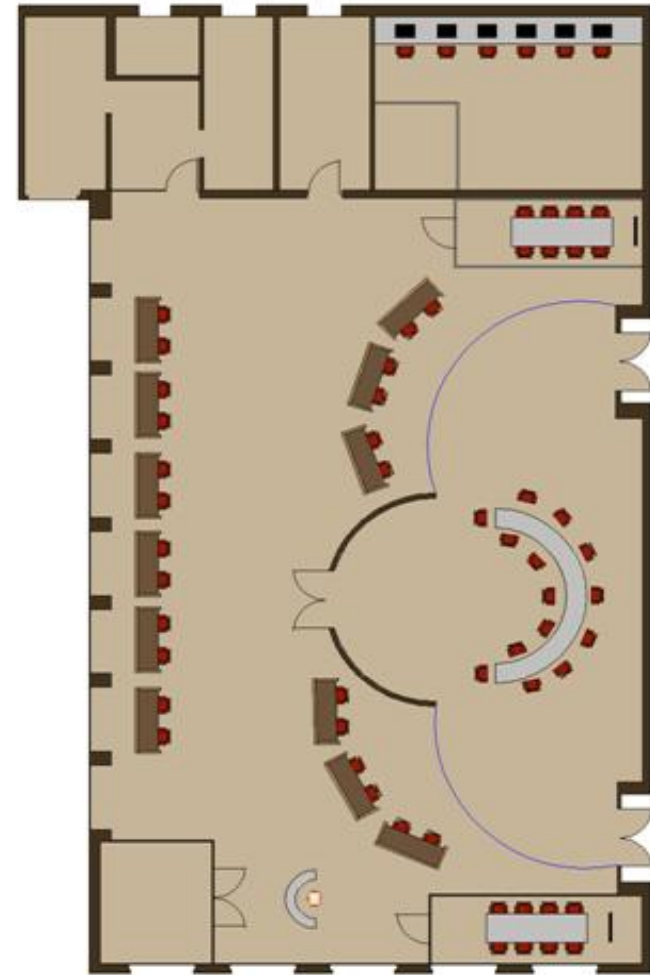


Green area represents the location of the Library on the campus.

Proposed Layouts



Proposed Layout



Alternative Layout

Information Commons



Information Commons



Information Commons



Information Commons

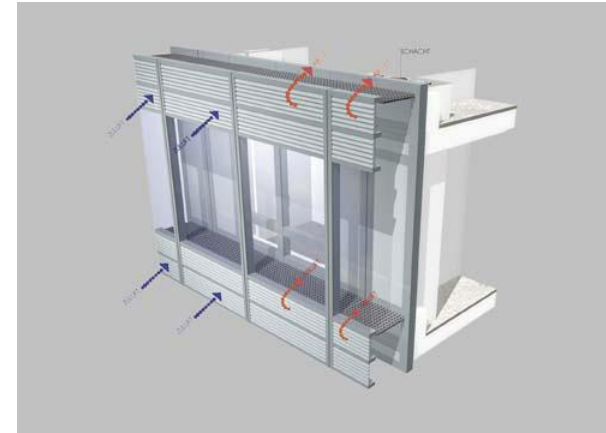
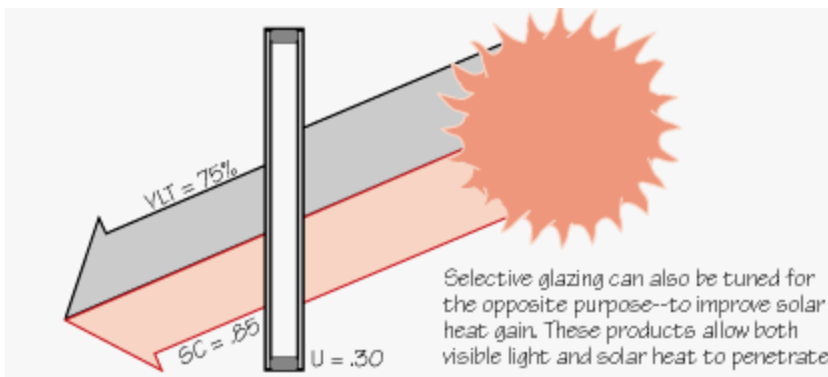




Cost

- Video conferencing package: \$14,000
- Furniture : \$30,000
- Wall partitions : \$5,000
- Movable glass partition : \$12,000
- New entrance cost : \$20,000
- Contingency : \$ 20,000
- Grand Total : \$101,000**

Cooling Options



Options	Cost including Construction	Approximate Temperature Decrease
1) Replacing the Current Window Walls with a Ventilated Double Façade Wall	\$28,000 for West wall \$15,000 for South wall	20-22°F Decrease in Temperature during Summer months
2) Replacing the Glazing on Current Windows with Double Glazing	\$15,000 for Both walls	10-15°F Decrease in Temperature during Summer months
3) Planting Tall Shrubbery in front of the West Wall to block direct sunlight	\$3,000 for plants and labor	2-3°F Decrease in Temperature during Summer months



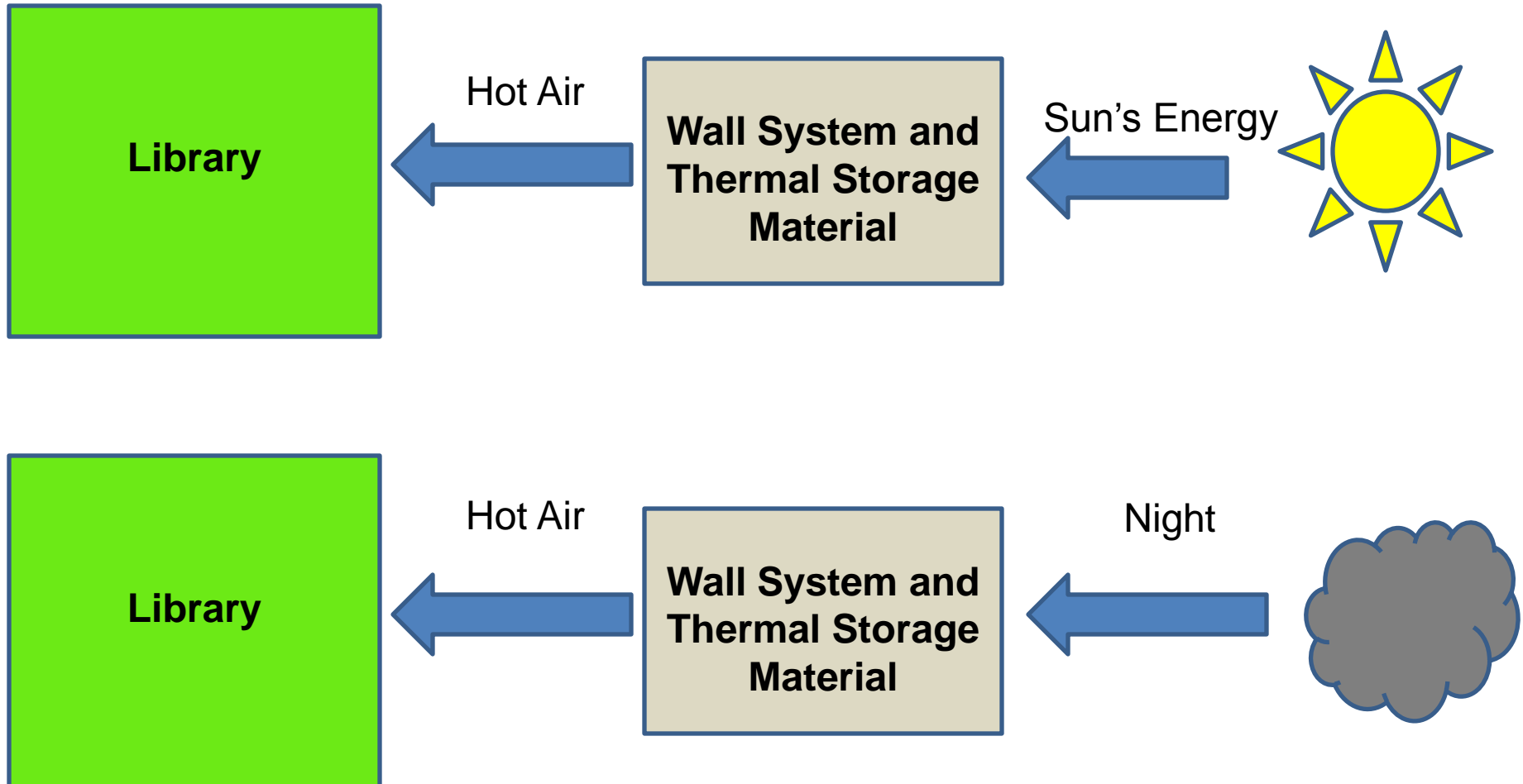
Benefits of Thermal Storage Wall

- Market science and technology to potential students and the community
- Decrease Heating Cost for Library Space
- Reduce Green House gasses
- Use Wall Structure to Teach Students about Sustainability

Wall System



Basic Operation



Wall System



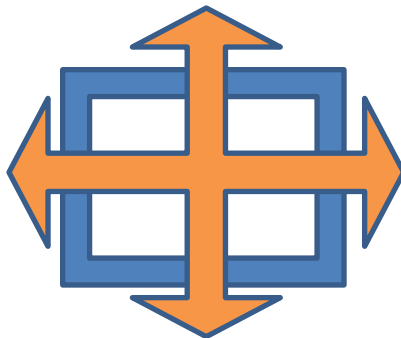
Calculating the Heating Requirement

Governing Equation: $Q = UA\Delta T$

ΔT (70°F - (-20°F))

Heat Loss Through :

- Walls R-2.20
- Windows- .90
- Roof-15

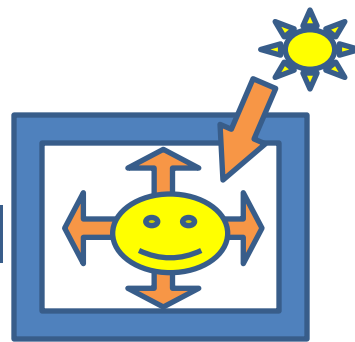


$$Q_{Loss} = -Q$$

$$Q_{Loss} = 91,000 \text{ Btu/hr}$$

Heat Gain By:

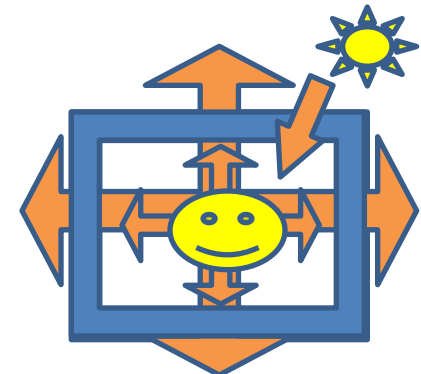
- Sun 126.84 Btu/hr/ft²
- People 410 Btu/hr



$$Q_{Gain} = +Q$$

$$Q_{Gain} = 34,000 \text{ Btu/hr}$$

=



$$Q_{required} = Q_{Loss} + Q_{Gain}$$

$$Q_{required} = 57,000 \text{ Btu/hr}$$

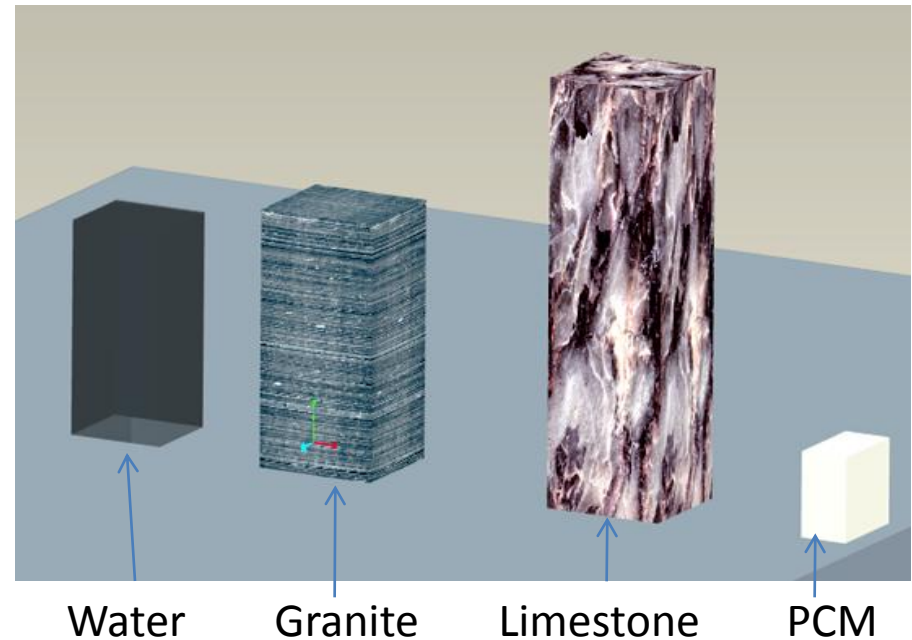
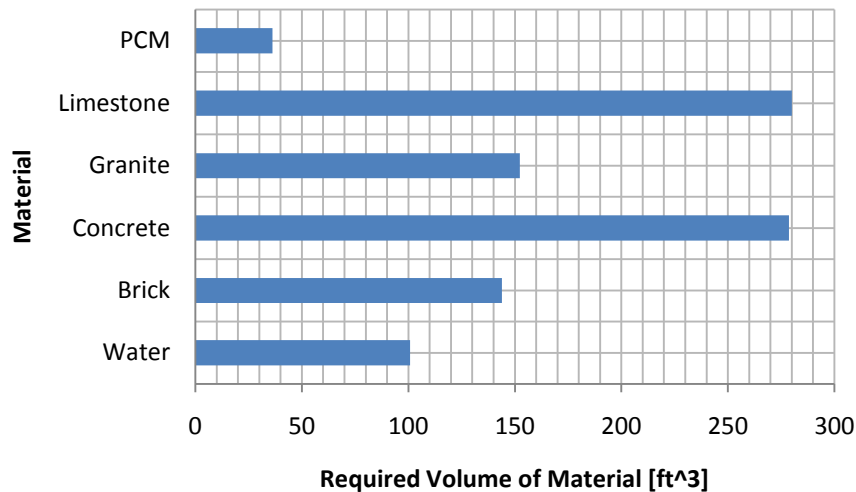
To Maintain Steady Temperature: $Q_{Loss} + Q_{Gain} - Q_{required} = 0$

Wall System



How to Choose Thermal Storage Material?

Required Volume of Material To Heat Library Space (54,054 ft³)



Material Properties of Trimethylolethane (63%) + Water (37%) $C_5H_{12}O_3 + H_2O$

Phase Change Temperature: 86 °F

Density = 68 lb/ft³

Latent Heat= 93 Btu/lb

Specific Heat (solid)= .65 Btu/(lb °F)

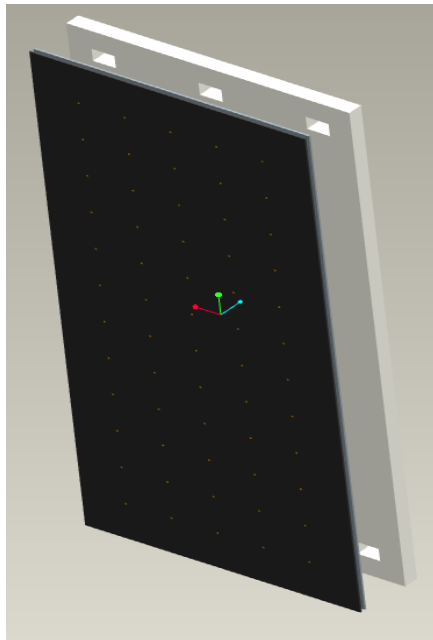
Specific Heat (liquid)= .85 Btu/(lb °F)

Wall System

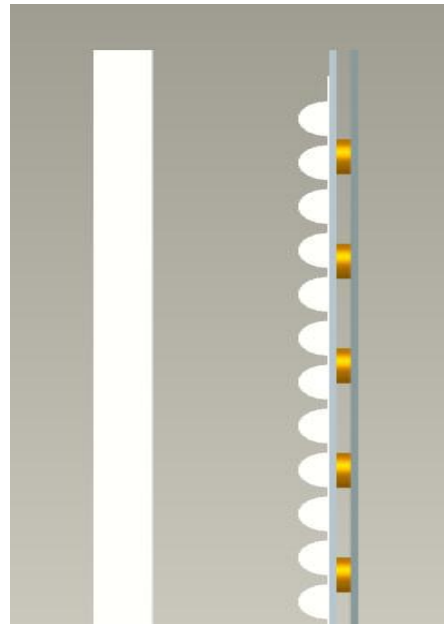


Components of Wall System

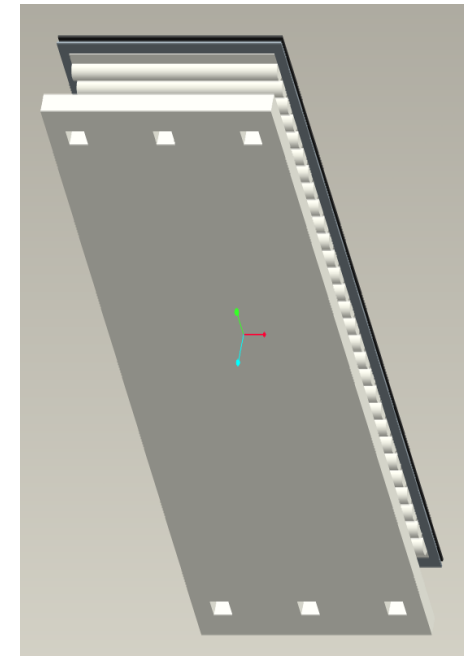
Outside View



Side View

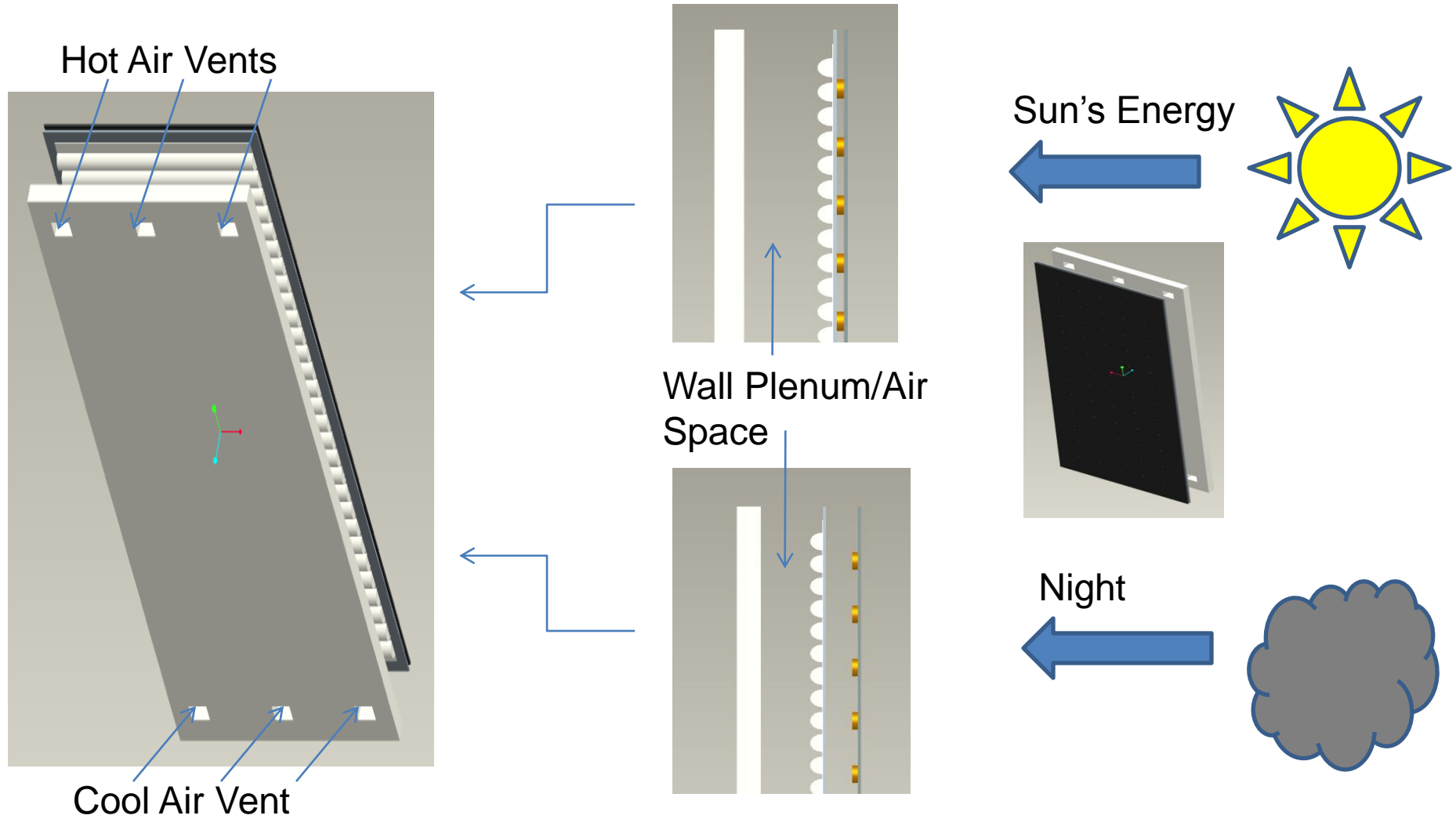


Interior View



- Aluminum Sheets (2x: 6ft x 13ft & $\frac{1}{4}$ inch thick)
- Copper Cylinders (1900: $d=3/4$ in, $L=1$ in, $t(\text{wall})= 1/16$ in)
- Phase Change Material: Trimethylolethane (240lbs)
- Interior Wall with Supply and Return Vents

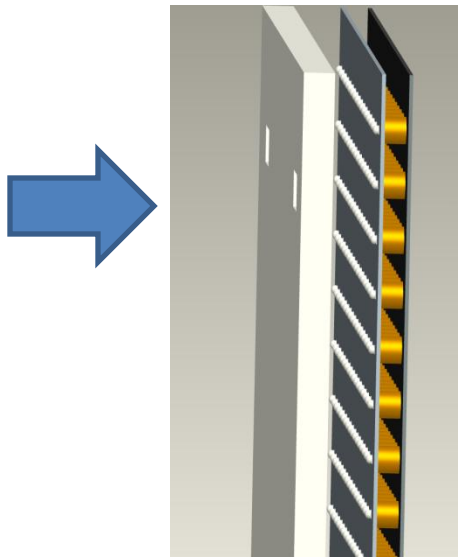
Wall System



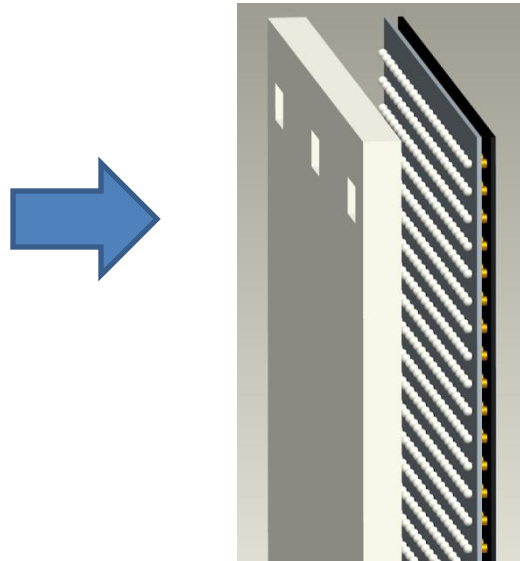
Wall System



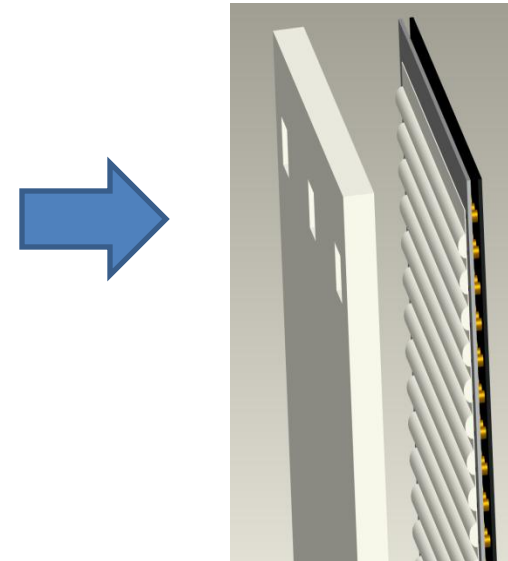
Revisions



- PCM:** N/A encapsulated in $d=1/2$ in Spheres (8lbs)
- Wall Plenum:** 8in Wide
- Solid Copper Cylinders:** $d=3$ in, $L=4$ in
- Problems:**
 - Need more PCM to satisfy heating requirement



- PCM:** N/A encapsulated in $d=1$ in Spheres (60 lbs)
- Wall Plenum:** 12in Wide
- Solid Copper Cylinders:** $d=1$ in, $L=1$ in
- Problems:**
 - Poor Heat Transfer to PCM
 - Copper Cost



- PCM:** Trimethylolethane enclosed in Packets (240lbs)
- Wall Plenum:** 12in Wide
- Hollow Copper Cylinders:** $d=3/4$ in, $L=1$ in, $t(\text{wall})=1/16$ in
- Future Improvements:**
 - Heat Transfer from PCM to Air
 - Design a “thermal switch”



Cost of Materials for the South Wall (54ft x 13ft)

• Phase Change Material	: \$150
• Aluminum plates	: \$28,000
• Copper Cylinders	: \$700
• Insulation	: \$300
Grand Total	: \$29,150



Purpose

- Incorporate activities that would allow outdoor education experiences.
- Creates desirable atmosphere for students to spend free time/study hall, weather permitting.
- Orient spaces so that area for studying and areas to spend free time intertwine.
- Create an outdoor space that appeals to teachers and students alike.



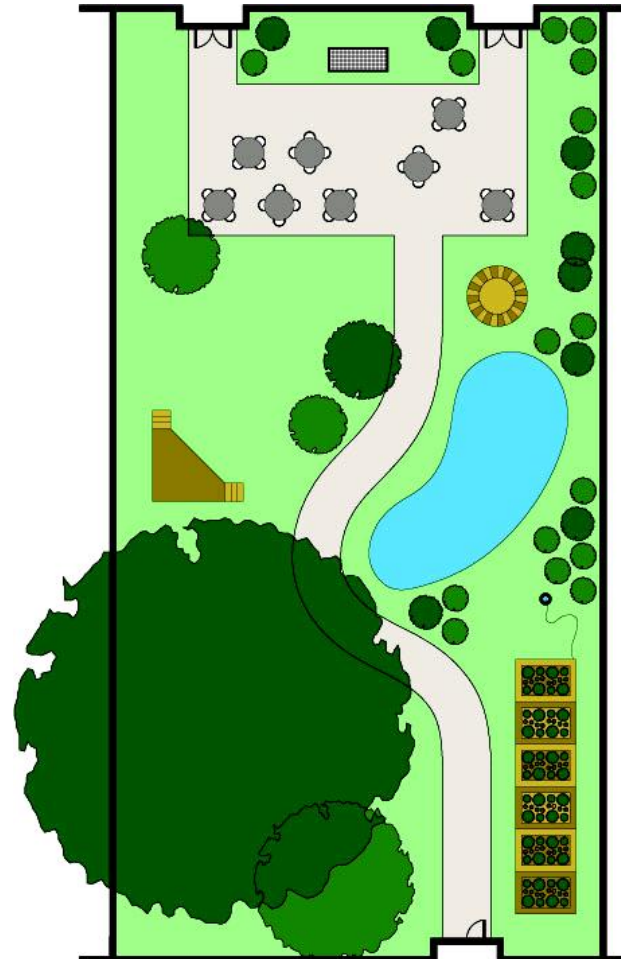
Existing Courtyard

Courtyard Features



- Amphitheatre / Stage
- Open Seating Area

- Bird Feeders
- Wildlife Sanctuary
- Insect Traps



Proposed Layout

- BBQ Pit
- Fire pit
- Tables and Seating

- Pond
- Marsh
- Water Wildlife
- Drainage Swale
- Erosion Control
- Soil Study Area
- Groundwater Well

- Herb and Nursery Garden
- Irrigation System
- Native Grasses and Wildflowers
- Berry Producing Shrubs
- Compost Pile

Courtyard



Cost

• BBQ Pit	: \$3500
• Fire Pit	: \$2500
• Tables & Chairs (x8)	: \$5500
• Pond Excavation (\$85-\$125 per hour)	: \$1000
• Performance Stage (\$20-\$30 per sq ft)	: \$2500
• Herb Garden	: \$3000
• Irrigation System	: \$1000
• Misc. Vegetation	: \$3000
• Concrete Sidewalk	: \$3500
Total	: \$31500

Ethical Dilemmas



- Queen of Peace's needs vs. our wants
- Finding the equilibrium between meeting our deadlines and delivering the best options to our client
- Difficult to tap 100% productivity of all team members

Conclusion



Suggestions for our Successors

- Determine your interests and aptitude and form sub-teams as soon as possible.
- Research alternate materials for movable wall in the Information Commons.
- Work towards applying for a grant to implement the Wall System.
- Learn the strengths of your team members and assign them a task that they enjoy.

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Questions?

