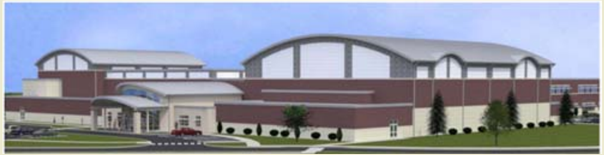
The New Upper Dublin High School

Upper Dublin High School Construction Project



Senior Thesis Final Presentation
Stephen Kelchaw
Construction Management

Presentation Overview

Upper Dublin High School Construction Project

- Building Overview
- Thesis Theme/Goals
- MAE Requirements
- Analysis I – LEED on Projects
- *Analysis II – Geothermal Well System*
  - *Mechanical Breadth*
- Analysis III – Rainwater Collection
- Analysis IV – Lighting System Analysis
  - Lighting/Electrical Breadth
- Summary/Conclusions
- Questions

Building Overview

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- Size: 368,000sf
- Location: Fort Washington, PA
- Project Budget: $119.2 Million
- Pursuing minimum LEED Silver rating
- Located on the same site as the existing high school

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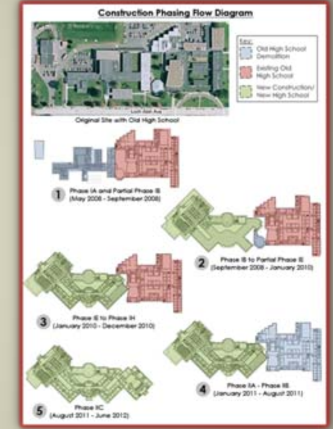
- 4-year construction timeline (Aug. ‘08 – Aug.’12)
- 2 Phases with multiple sub-phases
- Major Milestones:
  - December 2009 – Gym/Pool Completion
  - December 2010 – Classroom Wing/Phase I Completion
  - January 2011 – Final demolition of existing high school
  - August 2012 – Phase II/Final Building Completion



Thesis Theme/Goals

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- <u>Overall Theme:</u>
    - Impact of implementing sustainable practices and technologies on construction projects
- <u>Main Goals:</u>
    - Look at sustainability from a CM's point of view
    - Study the impact of implementing new/additional technologies with a cost and schedule focus
    - Keep in mind the public, school district, and students
    - Take advantage of this opportunity to look at the impact of sustainability on an actual project

MAE Requirements

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- Graduate Class Incorporation:
  - AE 597D – “Sustainable Building Methods”
  - AE 572 – “Project Development and Delivery Planning”

Analysis I – LEED on Projects

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- Goals:
  - Study the benefits of pursuing LEED on projects
  - Determine the impact of LEED on schedule and overall costs
  - Take a look at how LEED changes the project structure
- Why did the UDSD Pursue LEED?
  - Project approved by public referendum
  - Held several town meetings
  - Public pushed for energy efficiency, a healthier facility, and a building that serves as an educational tool

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- Main Points of Contact:
  - Owner
  - Construction Manager
  - LEED Consultant
- LEED Checklist and Responsibilities:
  - LEED for Schools, released in 2007
  - Integrative Design Process
  - Increased amount of paperwork
  - Responsibilities Matrix

LEED® for Schools Documentation Responsibility Matrix
Upper Dublin High School
Fort Washington, PA

Yes	?				LEED Consultant	Owner	Cx Authority	Architect	Civil Engineer	Landscape Architect	Mechanical Engineer	Plumbing Engineer	Construction Manager	General Contractor	Mechanical Contractor	Electrical Contractor	Plumbing Contractor	Acoustical Consultant	Documentation Complete
				Provide specifications and cut sheets highlighting the installed carbon dioxide monitoring system, including both the exterior and interior sensors.							x								
Y		EQc3.1	C	**Construction IAQ Management Plan**, During Construction															
				Complete the LEED Submittal Template									x						
				Provide a copy of the project's Construction Indoor Air Quality (IAQ) Management Plan.									x						
				Provide photographs highlighting the implemented construction IAQ practices.									x		x				
				Provide filter manufacturer, model #, MERV rating, and location of installation for all filtration media utilized during construction									x		x				
				Provide cut sheets indicating MERV value for all filtration media used during construction and installed immediately before occupancy.									x		x				
				Optional: Prepare a narrative describing any special circumstances or considerations regarding the approach to the credit											x				

Analysis I – LEED on Projects

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- Project Structure Changes:
  - Third-party commissioning agent
  - LEED Consultant
  - Energy Modeler
  - No difference in labor crews
- Additional Costs and Benefits:
  - There aren't necessarily additional costs
  - LEED provides proof that a building meets initial expectations

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•Conclusion/Recommendations:

- Can be implemented without additional costs
  - Integrative Design Approach
- The only major timeline difference is increased paperwork
  - Divided in Responsibility Matrix
- Some additional entities may be necessary
- LEED provides proof that the building was constructed as expected.
- Beneficial to all construction projects

Analysis III – Rainwater Collection

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- Goals:
  - Look into the addition of a rainwater collection system for this school
  - Implement a system that is cost friendly, and will not impact the schedule
- Initial Observations:
  - This area receives approximately 48” of rain annually
  - Large amount of roof area
  - Large potential for rainwater collection

Analysis III – Rainwater Collection

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•Discussion with Owner and CM:

- •Rainwater collection was not considered during design
- •This was mainly due to cost and space
- •There was also a lot done with storm water management and water efficiency
- •This would have been valuable as a learning tool for students

Analysis III – Rainwater Collection

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- Rainwater Collection System Attributes:
  - Low space requirements
  - Minimal Cost
  - Visible
  - Educational

- Solution:
  - RainXchange Rain Barrel by Aquascape, Inc.
  - 75 gallon capacity
  - Can be combined in series
  - $250 per barrel

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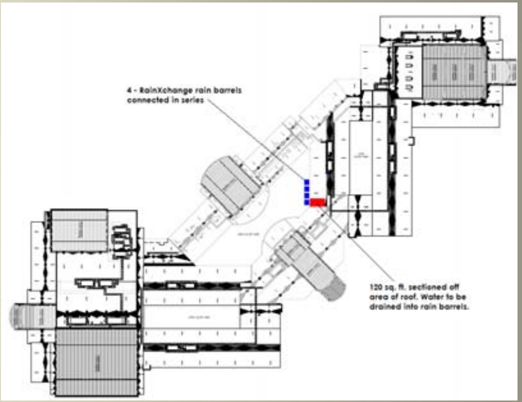
- Implementation:
  - 4 barrels can be combined for a 300 gallon capacity
  - Based on an average 4in. rain per month, this requires 120ft^2 of roof space
  - Roof can be sectioned off to funnel water into rain barrel through guttering
  - Can be installed after building completion
  - Located in a visible area



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- Conclusions/Recommendations:
  - Large-scale rainwater collection is not a feasible idea
  - RainXchange rain barrels are very inexpensive
  - They can be installed post-construction
  - They are relatable for the students and is something they can implement in their own homes

Analysis IV – Lighting System Analysis

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- Goals:
  - Research the components of the main classroom lighting system
  - Compare these technologies to other industry lighting systems
  - Compare efficiency between this lighting system and typical lighting systems

Analysis IV – Lighting System Analysis

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- Lighting System Components:
  - Occupancy and Daylight Sensors
  - High-output T5 Fluorescent lighting
  - Combination will decrease lighting loads by up to 80% compared to standard switching controls
- T8 versus T5 Fluorescent:
  - HOT5 cost 3-4 times the price of a T8 fluorescent bulb
  - HOT5 is only slightly more efficient than a T8
  - Both have a 20,000 hour lifecycle

Lamp Type	Color Rendering Index (CRI)	Efficacy (lumens/watt)	Co-efficiency of Utilization (CU)
T12	62	78	0.46
T8	85	92	0.76
T5	85	103	0.90

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- Added Benefit to HOT5 Fluorescent:
  - Produces much more light than a T8
  - This will reduce the quantity of lights needed per room
  - The value will increase with the size of the project
- Conclusions/Recommendations:
  - HOT5 costs much more than T8, but makes it up in performance and quantity of light
  - The combination of elements create a very efficient lighting system

Lighting/Electrical Breadth

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•Goal:
- •To find a comparable replacement for the HOT5 fluorescent in terms of cost, energy efficiency, and performance

•LED Fluorescent Tube:
- •50,000 hour lifecycle
- •Can be used in the same fixture as the fluorescent lamp
- •Does not require a ballast
- •Consumes much less energy at 12W (compared to 54W)

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- Easy Installation:
  - Requires bypass of the ballast
  - Simple wiring can be performed by building maintenance
- Disadvantages:
  - 8-10 times more expensive than HOT5 ($75 each)
  - Much less light output (900 lumens compared to 5,000 for HOT5)

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- Load Reduction, Cost, Payback
  - Approx. 117 classrooms
  - 6 fixtures per classroom with 4 lamps per fixture
  - $260 per 4-pack of LED Tubes
  - $182,500 total initial cost
  - 3.5 year payback
  - Estimated 17 years total service life

Energy and Cost Savings Comparison

	Lamp Type	HO T5 Fluorescent	T5 LED Replacement
1 lamp	Power Consumption (W)	54	12
	KWH/Year[1]	157.86	35.04
	$/Year[2]	23.65	5.26
Classroom (4 lamps per fixture, ≈6 fixtures per room)	KWH/Year	3789	841
	$/Year	568	126
Building (≈117 classroom spaces)	KWH/Year	443,271	98,392
	$/Year	66,409	14,770
Total Savings	KWH/Year	-	344,879
	$/Year	-	51,639

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- Conclusions/Recommendations:
  - Pros far exceed cons of LED Fluorescent Tubes to HOT5
  - Initial cost is reasonable, and payback is very quick
  - Large reduction in energy consumption
  - Significantly lower light output than a HOT5
  - This is not suitable as a direct replacement for the existing fixtures

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- Main thesis goals were met
- Sustainability was looked at from the standpoint of a construction manager
- LEED can be a valuable addition to any project
- Many sustainable technologies exist, but some still need development

Questions

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Questions??

Acknowledgements

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