PERSHING HILL ELEMENTARY SCHOOL

MITCHELL REINERS
AE SENIOR THESIS 2010
CONSTRUCTION MANAGEMENT

Presentation Outline

- Introduction
- Analysis 1: Green Roof (Breath Topic)
  - Green Roof Properties
  - Structural Impact/Analysis
  - Constructability Analysis
  - Schedule Impact/Analysis
  - Analysis Conclusion
- Analysis 2: Geothermal (Breath Topic)
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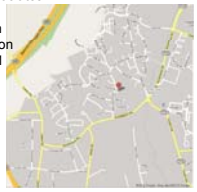
PERSHING HILL ELEMENTARY SCHOOL

Project Team and Building Information

Owner: Anne Arundel County Public Schools
Tenant: Pershing Hill Elementary School
Architect: Grimm and Parker Associates
Construction Manager: Jacobs
Construction Costs: $13.3 million
Total Costs to Owner: $15.1 million
Estimated Completion: Feb. 2011
Total size: 87,160 sqft
Delivery Method: Multiple prime with 15 prime contractors

•Project site lies entirely within a US Army Base



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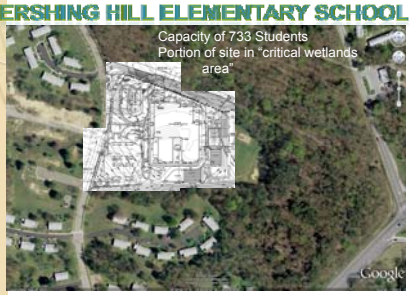

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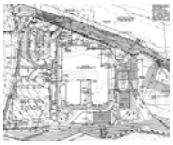
ANALYSIS 1: GREEN ROOF

Introduction to Analysis

Increase in impervious area → increased rainwater runoff

20,245 sqft building footprint
38,400 sqft paved area



42,595 sqft building footprint
104,700 sqft paved area

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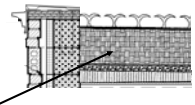
ANALYSIS 1: GREEN ROOF

Green Roof Properties

Rainwater runoff primarily dependent on depth of growing media



11.5" Growing media to equalize rain water runoff between old and new school

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ANALYSIS 1: GREEN ROOF

Green Roof Properties

Talinum calycinum, Delosperma nubigenum, or similar due to soil depth and hardiness zone

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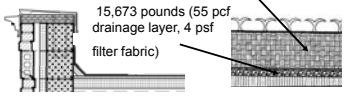
ANALYSIS 1: GREEN ROOF

Structural Impact

Additional weight for typical bay:

101,545 pounds (120 pcf)

15,673 pounds (55 pcf drainage layer, 4 psf filter fabric)



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ANALYSIS 1: GREEN ROOF

Structural Impact

For Typical Bay:

Before:	After:
•20 gauge roof deck	•19 gauge roof deck
•18KCS2 joists at 5' o.c.	•18KCS2 joists at 3' o.c.
•W18 x 46 girders	•W 18 x 143 girders
•HSS 9 x 5 x 3/8 exterior columns	•HSS 9 x 5 x 1/2 exterior columns
•HSS 9 x 5 x 1/2 interior columns	•HSS 18 x 6 x 1/2 interior columns

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ANALYSIS 1: GREEN ROOF

Constructability

- Coordination with structural steel contractor
- Coordination with mechanical contractor

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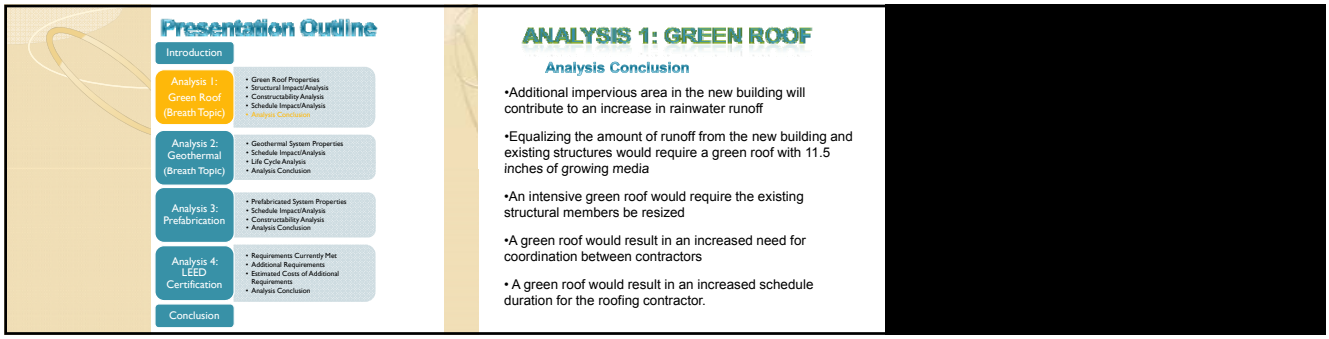
ANALYSIS 1: GREEN ROOF

Schedule Impacts

- No increase to final project completion date
- 9 additional work days to roofing contractor's schedule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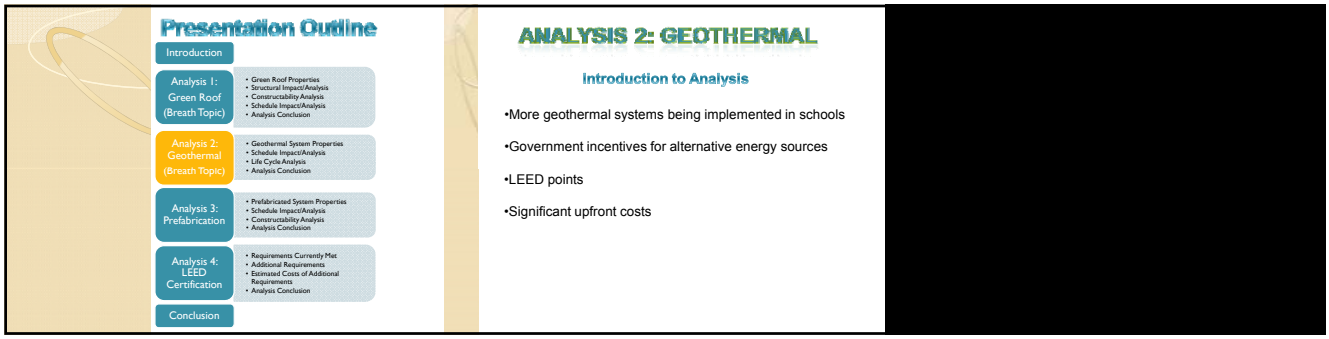
ANALYSIS 1: GREEN ROOF
Analysis Conclusion
•Additional impervious area in the new building will contribute to an increase in rainwater runoff
•Equalizing the amount of runoff from the new building and existing structures would require a green roof with 11.5 inches of growing media
•An intensive green roof would require the existing structural members be resized
•A green roof would result in an increased need for coordination between contractors
• A green roof would result in an increased schedule duration for the roofing contractor.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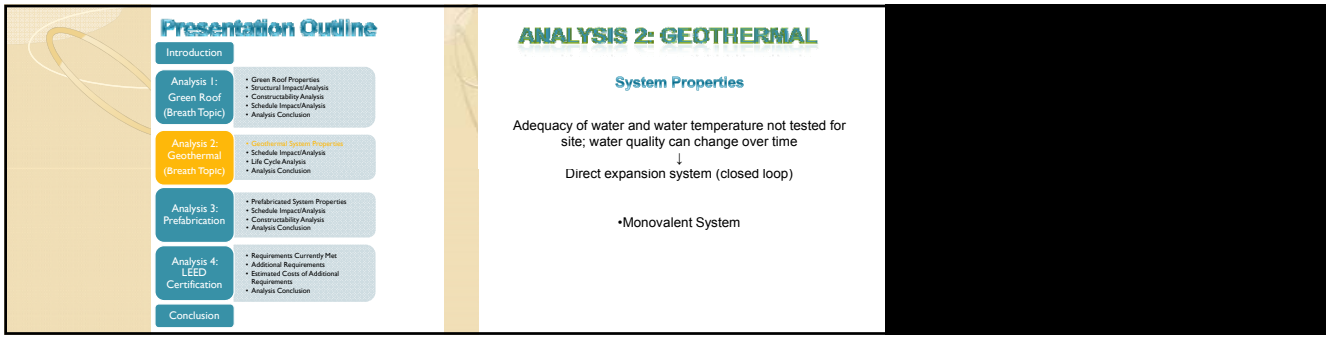
ANALYSIS 2: GEOTHERMAL
Introduction to Analysis
•More geothermal systems being implemented in schools
•Government incentives for alternative energy sources
•LEED points
•Significant upfront costs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ANALYSIS 2: GEOTHERMAL
System Properties
Adequacy of water and water temperature not tested for site; water quality can change over time
↓
Direct expansion system (closed loop)
•Monovalent System

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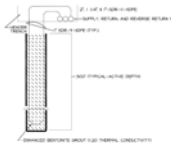
ANALYSIS 2: GEOTHERMAL

System Properties

•237,481 BTU/Hr needed to heat the building during the winter



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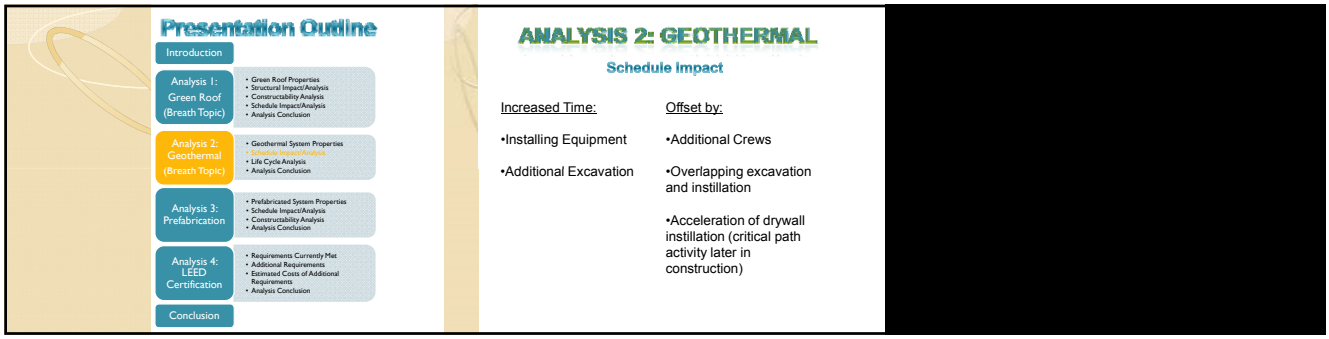
TYPICAL 305' BOREHOLE-(ACTIVE DEPTH)

Image courtesy of Foreman University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ANALYSIS 2: GEOTHERMAL
Schedule Impact
Increased Time:
•Installing Equipment
•Additional Excavation
Offset by:
•Additional Crews
•Overlapping excavation and instillation
•Acceleration of drywall instillation (critical path activity later in construction)

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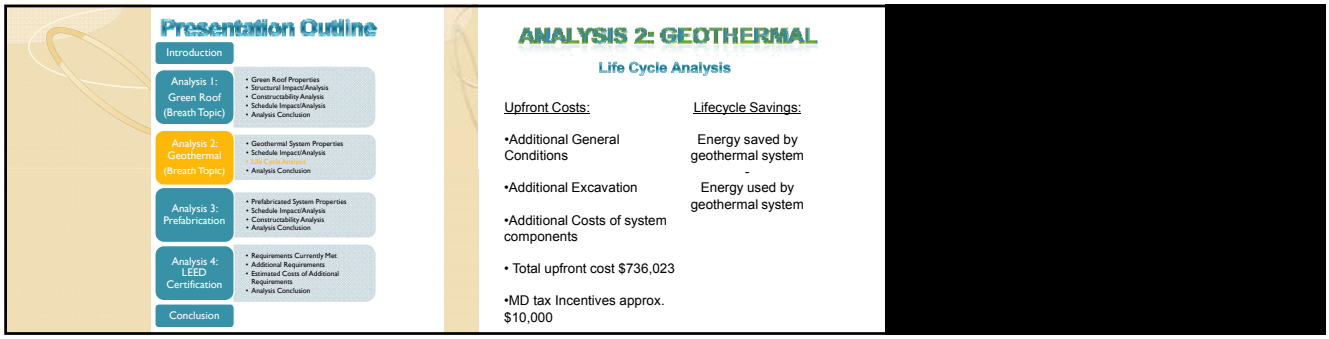
ANALYSIS 2: GEOTHERMAL

Schedule Impact / Life Cycle Analysis

Additional Construction Time → Additional General Conditions

		Cost	Quantity	Unit	Total
Staffing	Project Manager	2975	2	week	$5,950
	Superintendent	2750	2	week	$5,500
	Assistant Super.	2475	2	week	$4,950
	Project Engineer	1800	2	week	$3,600
	Clerk	590	2	week	$1,180
CM Fee		4.6		% of Project	$31,683
Temporary Utilities	Trailer Rental	310	0.5	month	$155
Field Office Expenses	Office Equipment	171	0.5	month	$86
	Office Supplies	94	0.5	month	$47
	Telephone bill	88	0.5	month	$44
	Lights and HVAC	165	0.5	month	$83
Estimated Cost	$53,277	Location Factor	0.93	**Total Cost**	**$49,548**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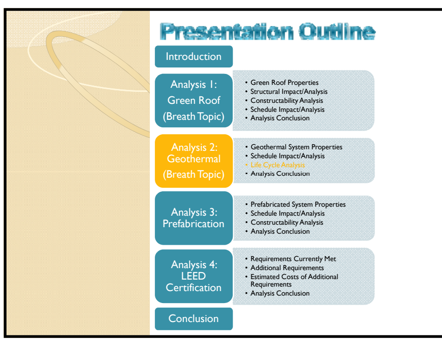
Life Cycle Analysis
Upfront Costs:
•Additional General Conditions
•Additional Excavation
•Additional Costs of system components
• Total upfront cost $736,023
•MD tax Incentives approx. $10,000
Lifecycle Savings:
Energy saved by geothermal system
-
Energy used by geothermal system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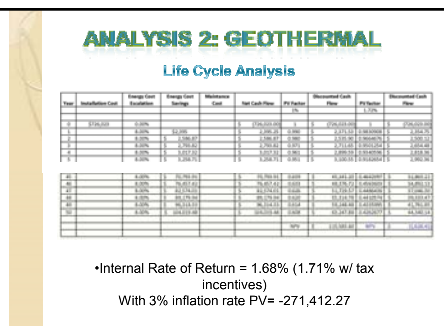
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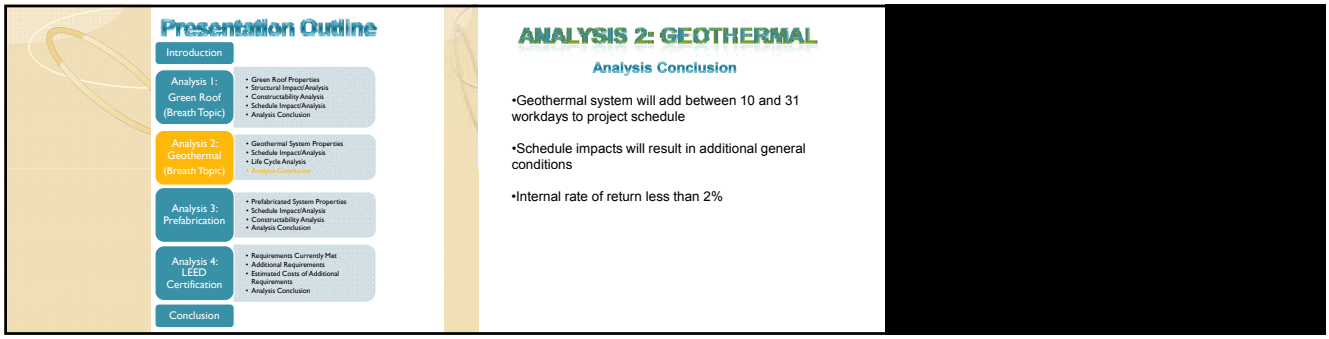
Life Cycle Analysis
•Internal Rate of Return = 1.68% (1.71% w/ tax incentives)
With 3% inflation rate PV= -271,412.27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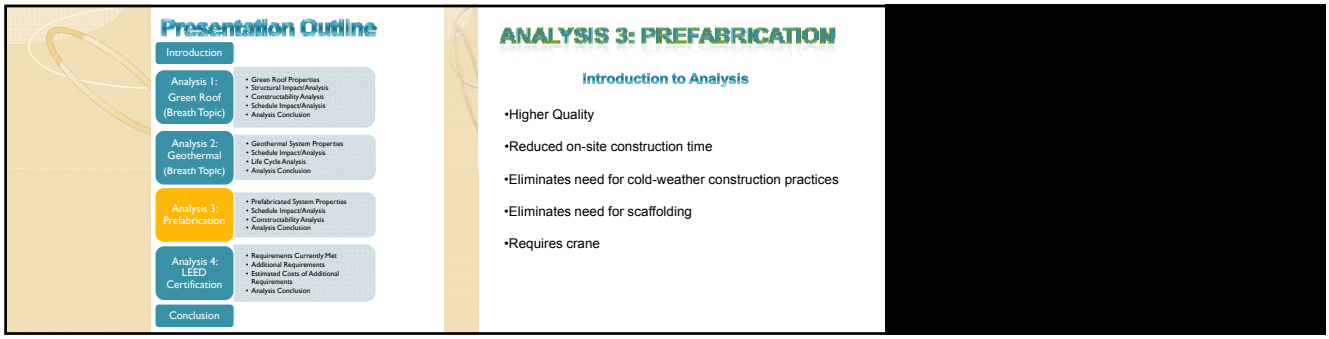
Analysis Conclusion
•Geothermal system will add between 10 and 31 workdays to project schedule
•Schedule impacts will result in additional general conditions
•Internal rate of return less than 2%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ANALYSIS 3: PREFABRICATION
Introduction to Analysis
•Higher Quality
•Reduced on-site construction time
•Eliminates need for cold-weather construction practices
•Eliminates need for scaffolding
•Requires crane

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ANALYSIS 3: PREFABRICATION

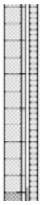
System Properties

Panels constructed using hand-laying method

↓

Masonry contractor's regular workforce can serve as off-site prefabricator

•Casting method not appropriate for this project



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ANALYSIS 3: PREFABRICATION

Schedule Impacts

Increased daily output from 240 sqft/day to 500 sqft/day

↓

•Moves end date for masonry activities from July 21 to July 2

•Reduces schedule for entire project by 2 days

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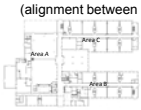
ANALYSIS 3: PREFABRICATION

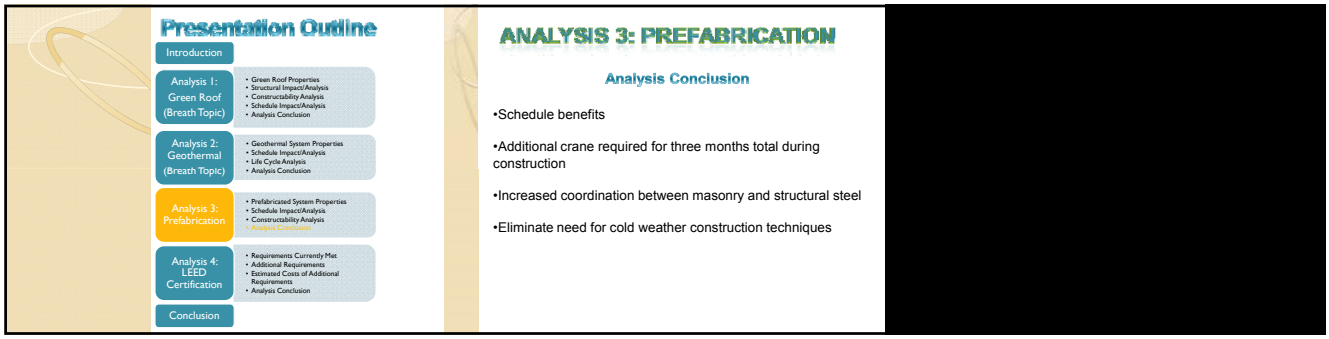
Constructability Analysis

Need for crane → ◦Coordination with steel erection
◦Additional crane needed for three months (alignment between trade schedules)



Masonry done over winter → ◦Elimination of cold weather construction techniques

Storage of Panels → ◦Timed delivery of panels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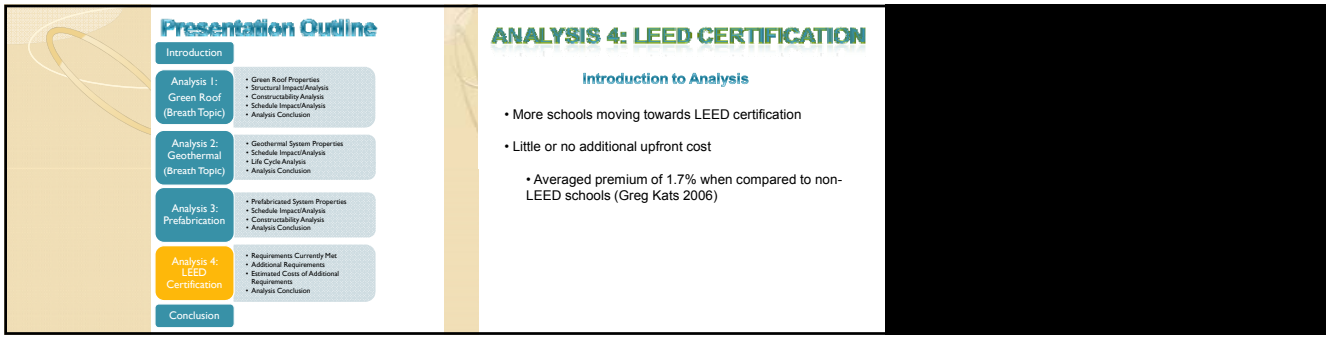
ANALYSIS 3: PREFABRICATION
Analysis Conclusion
•Schedule benefits
•Additional crane required for three months total during construction
•Increased coordination between masonry and structural steel
•Eliminate need for cold weather construction techniques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ANALYSIS 4: LEED CERTIFICATION
Introduction to Analysis
• More schools moving towards LEED certification
• Little or no additional upfront cost
• Averaged premium of 1.7% when compared to non-LEED schools (Greg Kats 2006)

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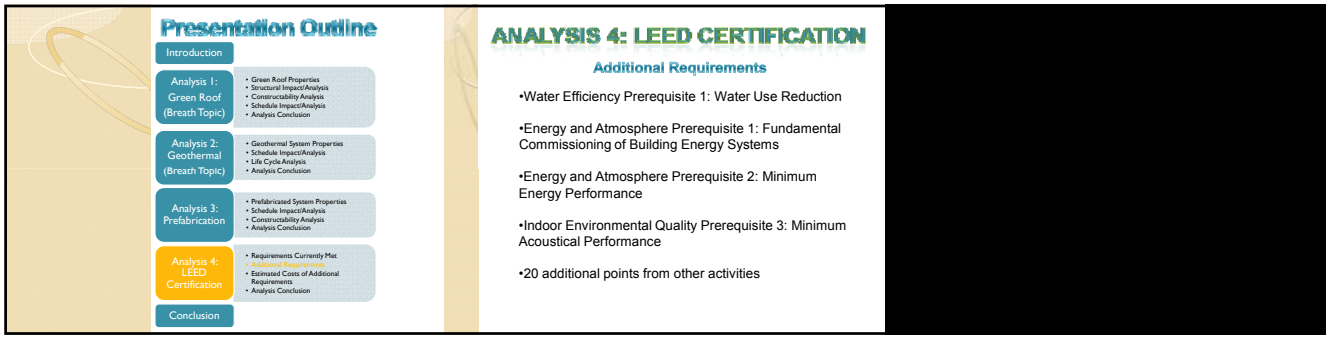
ANALYSIS 4: LEED CERTIFICATION

Requirements Currently Met

- 6 of 10 prerequisites
- 20 points (40 required)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ANALYSIS 4: LEED CERTIFICATION
Additional Requirements
•Water Efficiency Prerequisite 1: Water Use Reduction
•Energy and Atmosphere Prerequisite 1: Fundamental Commissioning of Building Energy Systems
•Energy and Atmosphere Prerequisite 2: Minimum Energy Performance
•Indoor Environmental Quality Prerequisite 3: Minimum Acoustical Performance
•20 additional points from other activities

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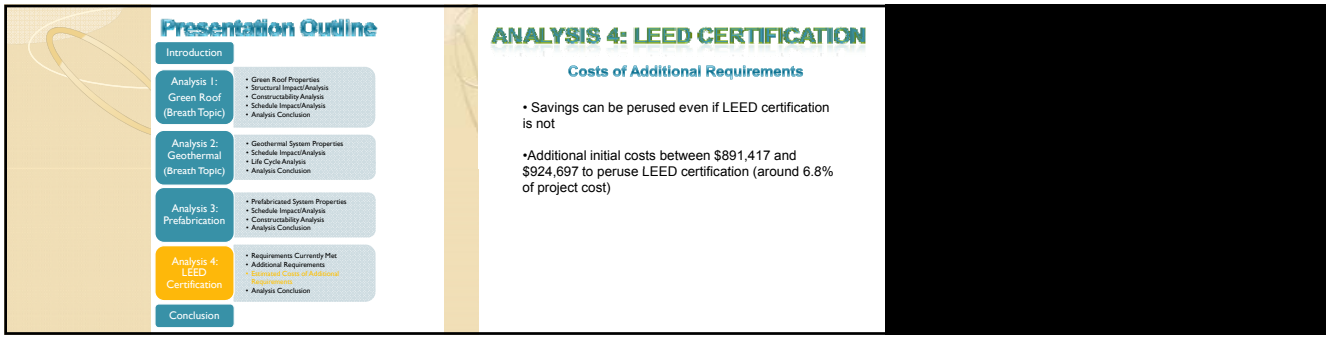
ANALYSIS 4: LEED CERTIFICATION

Costs of Additional Requirements

LEED Requirement	Activity	Associated Cost
Water Use Reduction	Use WaterSense-Certified fixtures, high-efficiency fixtures, dry fixtures	No additional cost
Fundamental Commissioning of Building Energy Systems	Commissioning of Building Energy Systems	0.5% to 0.75% of project costs ($66,558 to $99,838)
Minimum Energy Performance	Compliance with prescriptive guidelines during design phase	No additional cost
Minimum Acoustical Performance	Cirrus Tile and Lay-In by Armstrong in classrooms	$30,636 (additional cost of 92 cents per sqft)
20 additional points	Geothermal System	$726,023
	Construction Waste Management; separate dumpster for recyclables	$68,200 ($775/week)
	Reduction of parking area	Savings due to reduced area of paving
	Preferred parking to energy efficient vehicles	No additional cost
	Green Power for first 2 years	Savings when price of green electricity per kWh for 2 year contract in area compared to average cost for electric in MD
	Use of Salvaged Material	Savings due to use of salvaged material from existing building
	Use of school as a teaching tool	No additional cost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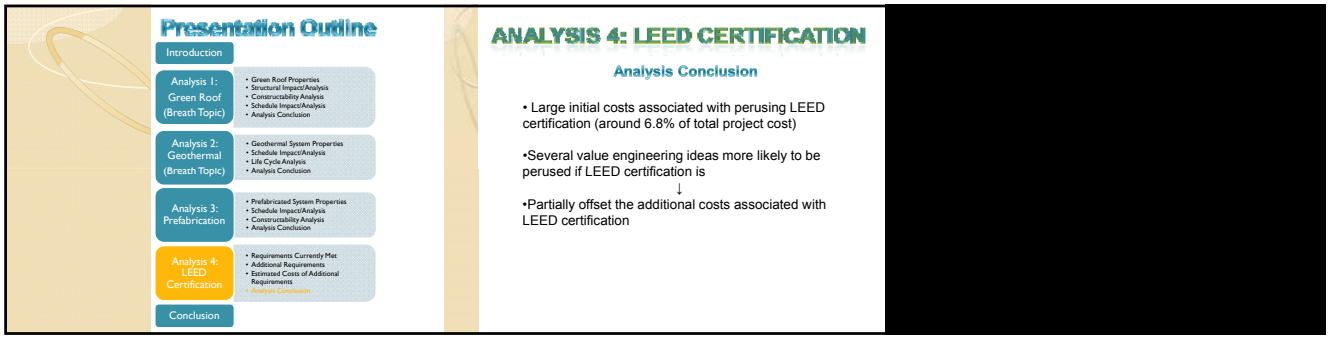
ANALYSIS 4: LEED CERTIFICATION
Costs of Additional Requirements
• Savings can be perused even if LEED certification is not
•Additional initial costs between $891,417 and $924,697 to peruse LEED certification (around 6.8% of project cost)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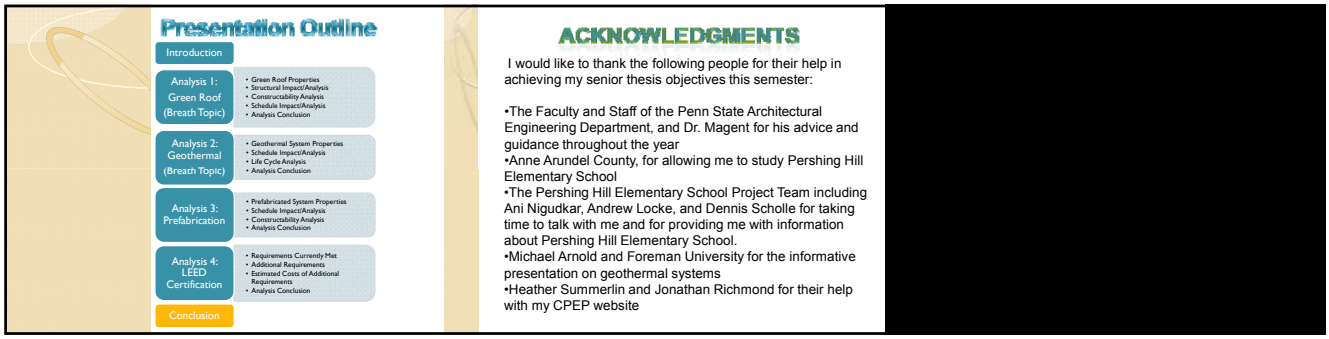
ANALYSIS 4: LEED CERTIFICATION
Analysis Conclusion
• Large initial costs associated with perusing LEED certification (around 6.8% of total project cost)
•Several value engineering ideas more likely to be perused if LEED certification is
↓
•Partially offset the additional costs associated with LEED certification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QUESTION AND ANSWER