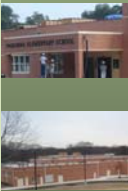
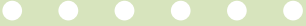


Pasadena  
Elementary  
School

**Catherine Neiderer**

Architectural Engineering  
Construction Management Thesis  
Dr. Riley  
Spring 2008

introduction | leed certification | greenroof design | solar lights | building reuse | conclusions

- introduction
- LEED certification
- greenroof design
- solar parking lights
- building reuse
- conclusions



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## Pasadena Elementary School

- Pasadena, Maryland
- Anne Arundel County School District




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## Existing Building

- Built in 1954
- 45,296 square feet
- 20 Classrooms
- One interior renovation in 1961



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## New Building

- 68,000 square feet
- 20 classrooms
- Gymnasium
- Cafeteria including stage
- Media Room



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## Construction Phases




Phase I

- Construction of new building

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## Construction Phases



Phase I

- Construction of new building

Phase 2

- Asbestos abatement
- Demolition of existing building
- Construction of multi-use sports fields

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## Project Delivery

<b>Construction Manager</b>	Jacobs Facilities, Inc.
<b>Site Work</b>	Pessoa Construction
<b>Abatement &amp; Demolition</b>	GeoStructures, Inc.
<b>Concrete</b>	Canyon Contracting
<b>Masonry</b>	Moehrie Masonry
<b>Steel</b>	Jarvis Steel & Lumber
<b>General Works</b>	Hancock & Albanese
<b>Roofing</b>	Heidler Roofing
<b>Windows</b>	College Park Glass Company
<b>Kitchen Equipment</b>	Clark Food Service
<b>Casework</b>	Glover Equipment, Inc.
<b>Technical Wiring</b>	HP Electronics
<b>Mechanical &amp; Plumbing</b>	G.E. Tignall
<b>Fire Sprinkler</b>	Fire-Mak, Inc.
<b>Electrical</b>	Action Electrical Contractors, Inc.

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## Project Schedule

Phase I

- September 2006 through November 2007

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## Project Schedule

Phase I

- September 2006 through November 2007

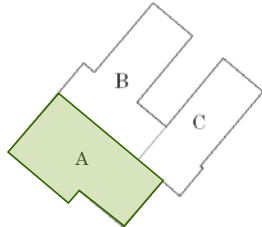
Phase 2

- Demolition complete May 2008
- Sports fields complete July 2008

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## Construction Sequencing



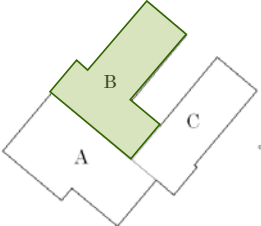
**Area A**  
Gymnasium  
Kitchen  
Music Room

Building Footprint

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## Construction Sequencing



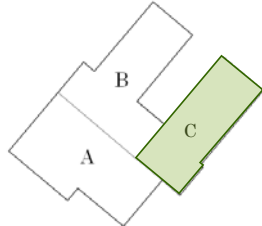
**Area B**  
Multi-purpose Room  
Corridor  
One-Story  
Classrooms

Building Footprint

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## Construction Sequencing



**Area C**  
Two-Story  
Classrooms

Building Footprint

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## Project Cost Information

Site Work	\$ 3,319,746
Abatement	\$ 244,780
Demolition	\$ 457,572
Concrete	\$ 692,129
Masonry	\$ 1,057,000
Steel	\$ 907,921
General Works	\$ 1,727,333
Roofing	\$ 440,500
Windows	\$ 215,166
Kitchen Equipment	\$ 99,500
Casework	\$ 215,110
Technical Wiring	\$ 76,419
Mechanical & Plumbing	\$ 2,427,947
Fire Sprinkler	\$ 171,045
Electrical	\$ 1,539,838
<b>Project Total</b>	<b>\$ 14,042,006</b>

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## LEED Certification

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## Conclusions

- Decision made earlier in the project the better
- Not much extra effort is needed
- Each part of the team can incorporate green strategies

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## Greenroof Design

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## Greenroof Design

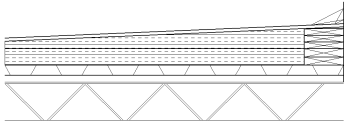
- SS Credit 5.1: Site Development: Protect or Restore Habitat
- SS Credit 5.2: Site Development: Maximize Open Space
- SS Credit 7.2: Heat Island Effect: Roof
- WE Credit 1.1: Water Efficient Landscaping: Reduce by 50%
- WE Credit 3.1: Water Use Reduction: 20% Reduction
- EA Credit 1: Optimize Energy Performance

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## Original Roof Design

- Built-up Bituminous Roofing
- Galvanized Steel Decking
- Tapered Polyisocyanurate Insulation with Perlite Cap



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### Proposed Roof System

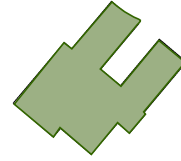


Photo Taken from <http://www.greenroofproducts.com/>

- Green Roof Blocks
- 2' x 2' portable blocks
- 4 inches growing medium
- 100 year lifetime

### Cost Analysis

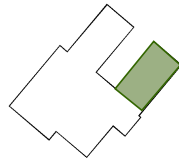
Price per square foot = \$12.50  
 Roof square footage = x 49,280  
 Total Estimated Price = \$616,000



Footprint of Building

### Cost Analysis

Price per square foot = \$12.50  
 Roof square footage = x 49,280  
 Total Estimated Price = \$616,000



Footprint of Building

Price per square foot = \$12.50  
 Roof square footage = x 8,890  
 Total Estimated Price = \$111,125

### Schedule Impact

- 500 installed per day
- Provided by manufacturer

### Schedule Impact

- 500 installed per day
- Provided by manufacturer

**Total 18 work days**

### Structural Analysis

	Weight (psf)	Weight (plf)
Galvanized Roof Deck	3	15
Concrete	24	120
Insulation with Perlite Cap	2	12
Tapered Insulation with Perlite Cap	7	34
Bituminous Membrane, with gravel	6	28
Green Roof Blocks	17	85

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## Structural Analysis

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Galvanized Roof Deck	3	15
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Green Roof Blocks	17	85
<b>Total</b>	<b>59</b>	<b>293</b>

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## Structural Analysis

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<b>Total</b>	<b>59</b>	<b>293</b>

**Truss Dead Load Tolerance = 215 plf**

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- ## Conclusions
- Provides energy savings
  - Increased cost
  - Other options could be explored
  - I would not recommend the system
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## Solar Parking Lot Lights

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- ## Original Lights
- Gardco
  - Gullwing G18
  - 400 Watts
  - Metal Halide
- 
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- ## Proposed Lights
- Solar Illuminations
  - 140 Watts
  - 744 LED
  - 100,000 hour lifetime
- 
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## Metal Halide vs. Light-Emitting Diode Lamps

### Metal Halide

- Requires start-up time
- Lifespan 20,000 hours
- Causes light pollution
- Contains gases at high pressures

### Light-Emitting Diode

- Does not require start up time
- Lifespan 100,000 hours
- Reduces light pollution
- Contains no mercury or halogen gases

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## Lifetime Cost Savings Analysis

12 hours x 0.14 kilowatts = 1.68 kW hour  
 11.39 ¢/kW hour x 1.68 kW hour = 19.135 ¢/lamp/day  
 19.135 ¢ x 14 lamps x 30 days /month = \$80.37 per month

## Lifetime Cost Savings Analysis

12 hours x 0.14 kilowatts = 1.68 kW hour  
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12 hours x 0.40 kilowatts = 4.80 kW hour  
 11.39 ¢/kW hour x 4.80 kW hour = 54.67 ¢/lamp/day  
 54.67 ¢ x 14 lamps x 30 days /month = \$229.61 per month

## Lifetime Cost Savings Analysis

12 hours x 0.14 kilowatts = 1.68 kW hour  
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**Monthly savings = 229.61 – 80.37 = \$149.24**

## Lifetime Cost Savings Analysis

**Original Lights**  
**\$800 x 14 = \$11,200 Initial Cost**  
**\$229.61 / month x 12 months x 20 years = \$ 66,306**

## Lifetime Cost Savings Analysis

### Original Lights

\$800 x 14 = \$11,200 Initial Cost

\$229.61 / month x 12 months x 20 years = \$ 66,306

### Solar Lights

\$ 3,325 x 14 = \$46,550 Initial Cost

\$80.37 / month x 12 months x 20 years = \$65,839

## Conclusions

- Solar LED lights provide greater benefits than Metal Halide
- Solar lights are better for the environment
- 20 year payback period
- I would propose the solar lights

## Building Reuse

## Original Construction Plan

- Demolish original building
- Outdated and did not meet today's standards and local codes
- Decision was made in 2001

## Building Reuse

- Save material and construction waste
- Possibly save time, money and materials



## Building Reuse

- Save material and construction waste
- Possibly save time, money and materials



## Scope of Renovation

- Most systems need replacement
- New roof and new boilers recently installed



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### Cost Analysis

	Area	Unit Price	Total
Arch/Engineering Fees	23,722		\$ 810,000
Const. Management Fees			\$ 375,000
Site Development			\$ 978,655
Selective Demolition	23,722	\$ 4.00	\$ 94,888
Renovation	21,137	\$ 60.00	\$ 1,268,220
Modernization	6,937	\$100.00	\$ 693,700
New Construction	35,841	\$150.00	\$ 5,376,150
Contingency			\$ 680,000
Inspection Fees			\$ 42,000
Building Technology			\$ 200,000
Abatement	46,259	\$ 3.00	\$ 138,777

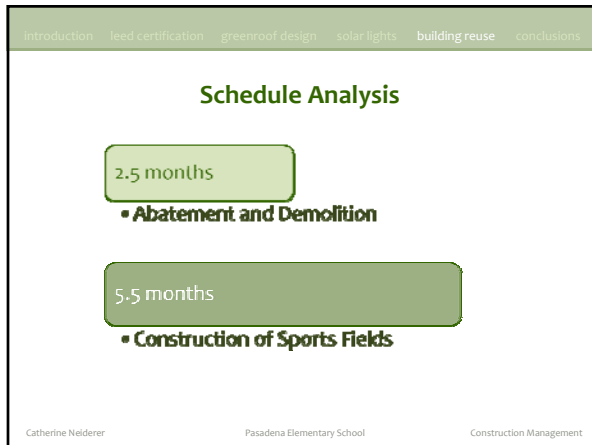
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### Cost Analysis

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Contingency			\$ 680,000
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Building Technology			\$ 200,000
Abatement	46,259	\$ 3.00	\$ 138,777
<b>Estimated Total</b>			<b>\$ 10,657,890</b>

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- ### Conclusions
- Could have been great savings in waste and materials
  - No extra cost
  - No increase in schedule
  - I would recommend a building renovation
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- ### Conclusions
- LEED Certification should have been sought
  - Greenroof Design could have been explored, but another option than Green Roof Blocks
  - Solar lights should have been pursued
  - Building renovation should have taken place
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## Acknowledgements



Dr. Riley  
Professor Parfitt  
All other AE Faculty



Andrew Locke  
Alvaro Zumaran  
Susan Haff

## Acknowledgements



# Questions?



Dr. Riley  
Professor Parfitt  
All other AE Faculty



Andrew Locke  
Alvaro Zumaran  
Susan Haff