Bellefonte Area High School

Mark Demianovich

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Agenda

- Project Background
- Analysis Areas
  - Additional Window Structural System
  - New Lighting Design
  - Green Roof Design
- Green Construction
- Conclusions and Recommendations

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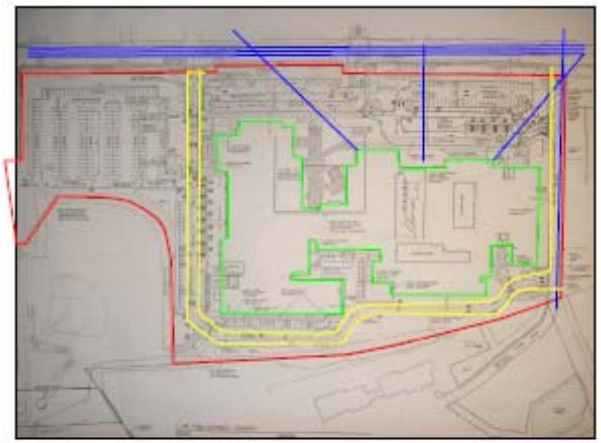
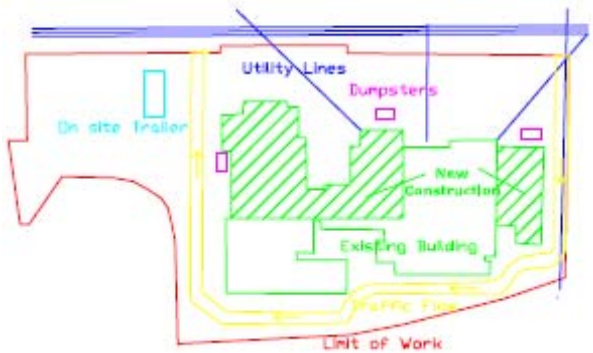
Project Background

- Project Name: Bellefonte Area High School
- Location: Bellefonte, PA
- Delivery Method: CM Agent Multiple Prime
- CM: Reynolds Construction
- Cost: $35 million
- Duration: 24 months

Project Background

- Project Size:
  100,000 sqft.
- Building Use:
  Education, 9-12th grades
- Contains:
  Classrooms, media center, gyms, theatre, auditorium





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Structural System

Objective: Install additional windows in classroom space.

Problems: Increased loading?
Increased cost?
Schedule Interference?
Site changes?

Options: Steel structure
CMU structure

Structural System

Why change?

- Increased day-lighting
  - ***Improved Life-Cycle Cost***: Day-lighting has been shown to save from $0.05 to $0.20 per square foot annually.
  - ***Increased User Productivity***: Daylight enlivens spaces and has been shown to increase user satisfaction and visual comfort leading to improved performance.
  - ***Reduced Emissions***: By reducing the need for electric consumption for lighting and cooling, the use of daylight reduces greenhouse gases and slows fossil fuel depletion.
  - ***Reduced Operating Costs***: The energy savings from reduced electric lighting through the use of day-lighting strategies can directly reduce building cooling energy usage an additional 10 to 20 percent.
- Loading from green roof

Structural System

Test performance from day-lighting:

- 15% better in day-lit classroom in the same school
- 10% better in schools that were day-lit

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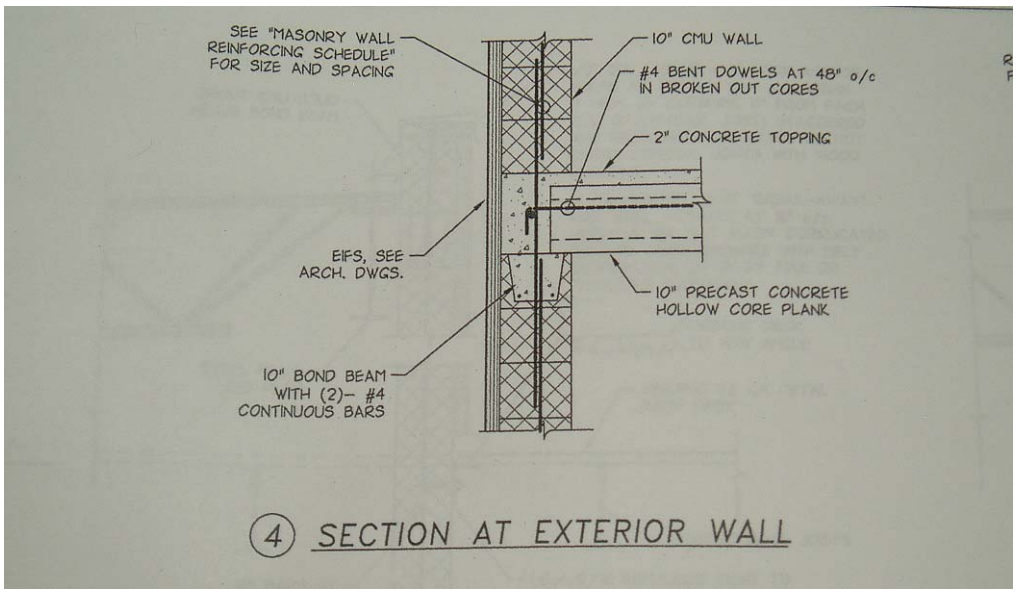
Structural System

Existing Structure:

- 10” grouted reinforced CMUs
- 10” Pre-cast hollow core planks



Structural System

Loading situation:

- Decreased bearing wall size
  - 14 of 25 feet linear feet is window
  - Steel lentils used over windows
- Additional loading from green roof
  - Additional 65psf

Structural System

Loading calculations completed:

- First Floor:
  - School live load: 80psf
  - Floor dead/self load: 120psf
- Second Floor:
  - Dead/self/green roof 150psf
  - Snow load 20psf

1.2D+1.6L+.5S

Structural System

- Loading existing structure:
  - 50psi
  - Well within ACI 530 Sec.6.3
  - No steel structure needed

Structural System

Implications:

- Steel Staging Area
- Crane locations
- Schedule impacts

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Lighting Design

Objective:	Reconfigure lighting layout to more appropriate levels
Problems:	Increased cost?
	Schedule Interference?
Benefits:	Cheaper energy bills
	More efficient lighting
	Ineffective current system

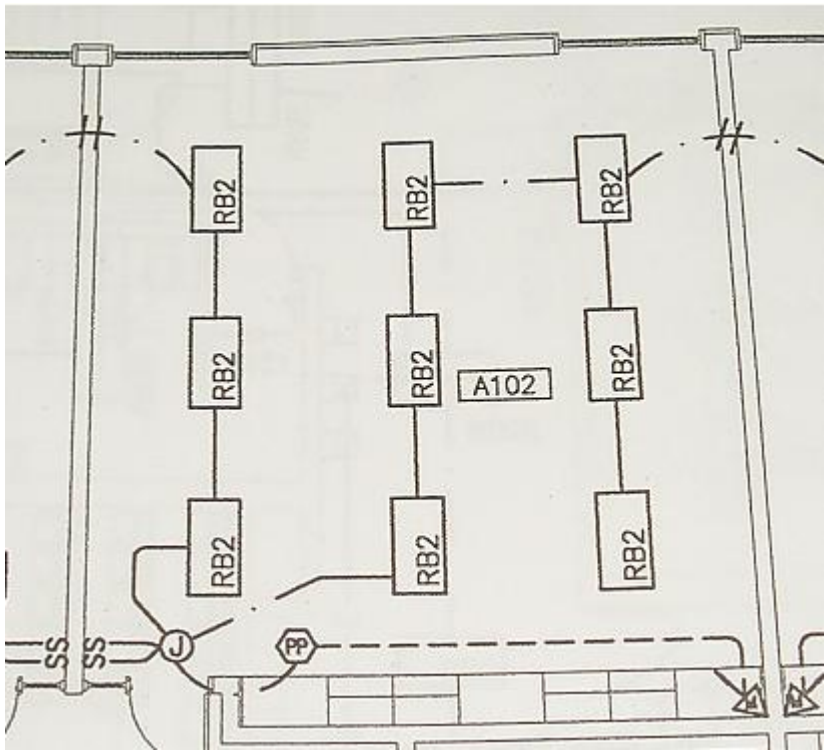
Lighting Design

Current system:

Cooper Metalux 9 GR8s housing (2) 32W fluorescent bulbs

2 series circuit with 4 different lighting layout situations

2 windows provide day-lighting



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Lighting Design

New Lighting Design

- 6 Cooper Metalux GR8s housing (3) 32W bulbs
- Wired so that either:
  - Middle 1 of 3 bulbs can be turned on by themselves
  - The end 2 bulbs can be turned on by themselves
  - All bulbs can be turned on at the same time

Lighting Design

Classrooms need to be lit to 500 lux.

Current Design Lighting:		New Design Lighting:	
Windows:	160lux	Windows:	250lux
All Lights:	1350lux	1 Bulb:	300lux
	1500lux		550lux
	5400WHrs/day		1728WHrs/day

Lighting Design

Cost Implications

Product	Installation	Product Cost	Total
9 2GR8 232W	$207.90	9@112.98	$1224.72
6 3GR8 332W	$158.40	6@109.98	$818.28

Cost Savings for 100 classrooms:

Product and Installation: $40,500

Energy Savings: $2,855

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Green Roof

Objective: Install green roof over classroom space to reduce HVAC energy usage.

Problems: Increased loading?

Increased cost?

Benefits: Decreased energy bills?

Green Roof

Green roof cost:
$15/sf

Classroom Area:
15,000sqft

Green roof total:
$225,000

#	*Component*	*Costs*
1	**Design & Specifications**	5 - 10 % (of total roofing cost)
2	**Project Administration & Site Review**	2.5 - 5 % of total roofing cost
3	**Re-roofing with root-repelling membrane**	$ 10.00 - $15.00 / ft 2
4	**Green Roof System (drainage, filtering, paving, growing medium)**	$ 5.00 - $10.00 / ft 2
5	**Plants**	$ 1.00 - $3.00 / ft 2
6	**Installation and Labor**	$ 3.00 - $8.00 / ft 2
7	**Maintenance**	$ 1.25 - $2.00 / ft 2 (only for the first two years)
8	**Irrigation System**	$ 2.00 - $4.00 / ft 2

Green Roof

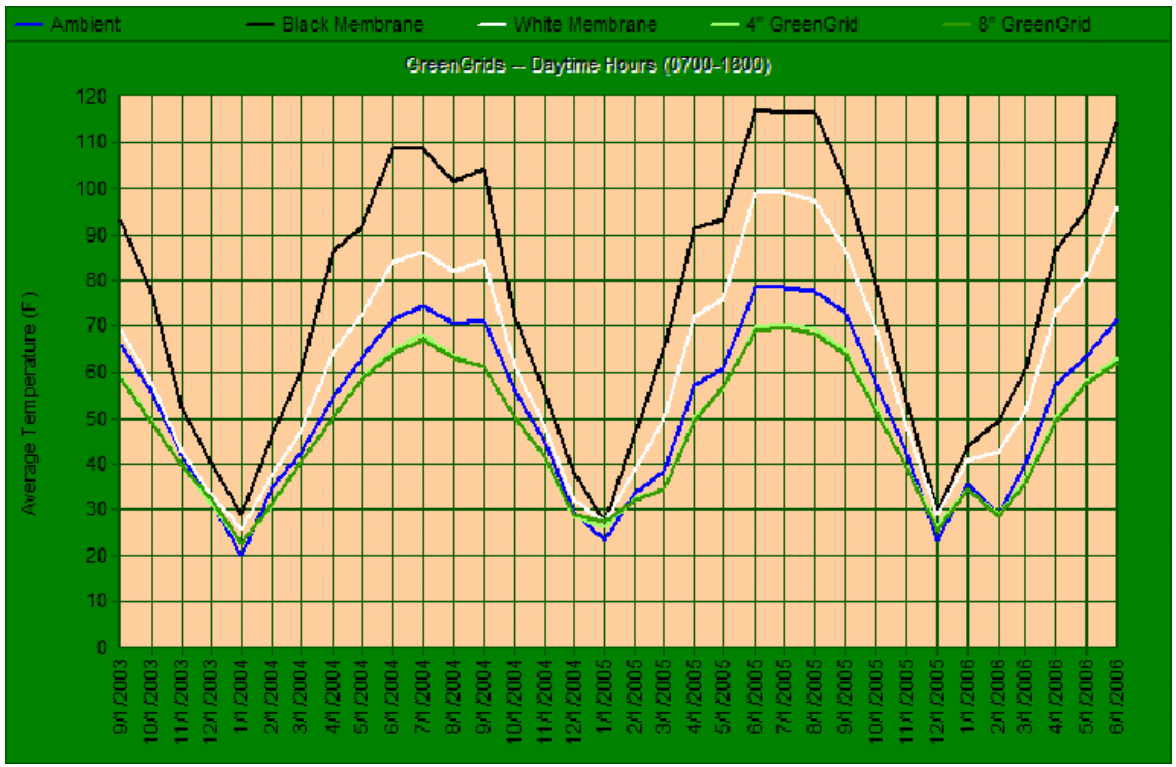
Cost Savings Factors:

- 65% of energy consumption goes to HVAC
- Energy cost is $200 per student/year
- 1500 students

HVAC costs for the Bellefonte High School per year:

0.65 x (200 x 1500) = $200,000

Green Roof



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Green Roof

Cost Savings Factors:

- 15% reduced energy consumption
- 70% of energy bill for classroom/lab space

Total cost savings for classroom area by adding 4” green roof at current energy prices:

(0.70 x $200,000) x 0.15 = $15,000/year

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Green Construction

Popular and known in industry, what about outside of industry?

Survey of the non-industry populous:

- Knowledge
- Experience
- Opinion
- Actions

Green Construction

Do you know what a green building is? (Hint: it is not a building that is the color green)	
Yes	(270; 62%)
No	(167; 38%)

Do you know what it means to be LEED rated?	
Yes	(72; 16%)
No	(365; 84%)

Green Construction

Do you think if it is possible that all buildings should be green buildings?	
Yes	(317; 73%)
No	(120; 27%)

Do you think the government should put requirements on new building construction to make them green?	
Yes	(328; 75%)
No	(109; 25%)

Green Construction

Do you think that the government shoud inform the public more about the green building industry?	
Yes	(369; 84%)
No	(68; 16%)

Do you think some institution other than the government should inform the public about the green building industry?	
Yes	(413; 95%)
No	(24; 5%)

Conclusions

- Delivery Method
  - Green roof
  - Day-lighting
  - Economical lighting system

Questions?

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