Susquehanna Health Patient Tower Expansion

Williamsport, PA

PENN STATE AE SENIOR CAPSTONE PROJECT

Adam Lasher | Construction Management

Dr. Robert Leicht

PRESENTATION OUTLINE:

I. Project Background
II. Analysis 1: Shift from Mobile Crane to Tower Crane
    I. Site Logistic Impacts
    II. Productivity and Schedule Impacts
    III. Cost Impacts
III. Analysis 2: Use of Prefabrication in Patient Rooms
    I. Project Comparisons
    II. Background of Prefabricated Items
    III. Cost Impacts of Prefabrication
    IV. Schedule Impacts of Prefabrication
    V. Assumptions and Considerations
IV. Analysis 3: Value Engineering of Roofing Systems and Alternatives
    I. Analysis Background
    II. Current Green Roof System
        I. Design
        II. Cost Impacts
    III. EPDM Roof System
        I. Design
        II. Structural Impacts/Steel Reduction
        III. Cost Impacts
    IV. Photovoltaic Roof System
        I. Design
        II. Cost Impacts/Payback Period
V. Lessons Learned and Recommendations
VI. Acknowledgements

Susquehanna Health Patient Tower Expansion

Williamsport, PA

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PRESENTATION OUTLINE:

Project Background

Location:

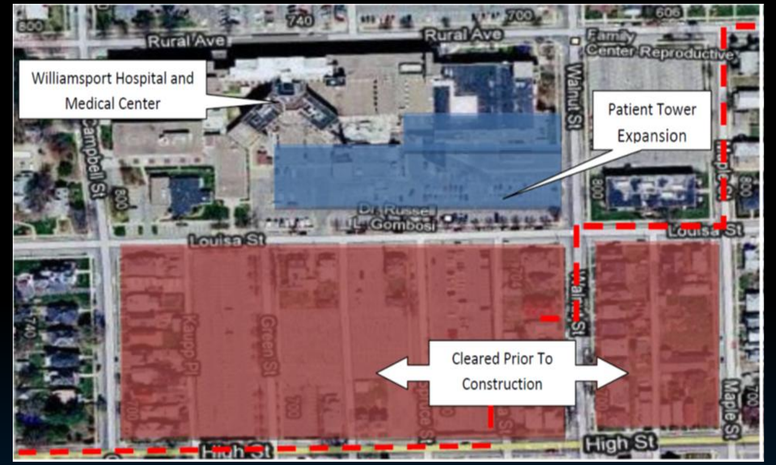
777 Rural Avenue, Williamsport, PA
Williamsport Hospital and Medical Center

Design:

Gross Building Area- 243,000 SF
Construction Type- Hospital Addition

Construction:

Delivery Method- Design-Bid-Build
GMP Amount- $82,297,101
Construction Dates- 10/22/2009 – 9/19/2012



PRESENTATION OUTLINE:

Project Background

Structural System

Continuous Spread Footings
Rigid Steel Moment Frame

Building Enclosure

Architectural Precast Panels
Curtain Wall
Metal Panels

PRESENTATION OUTLINE:

Problem Identification

Problem Identification

Due to weather and other delays the watertight milestone was in jeopardy of being hit.

Mobile cranes forced Walnut Street to be closed down for entire project

Research Goal

Use a tower crane to reduce schedule and reduce overall costs through schedule savings

Keep Walnut Street open

Validate tower crane initial costs with income evaluation

Tower Crane Analysis

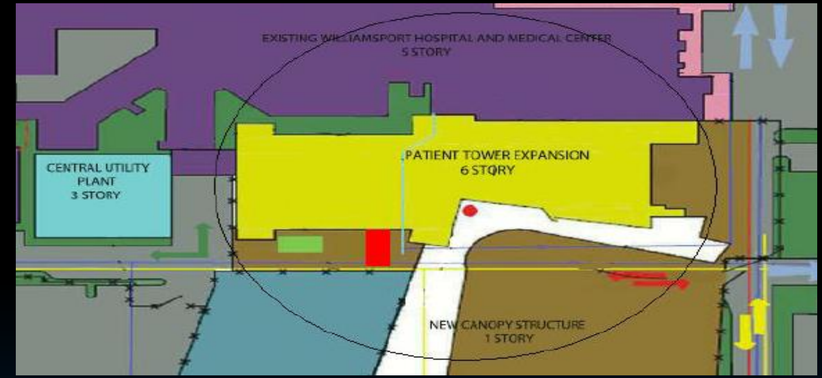
VS

PRESENTATION OUTLINE:

Site Logistics Impacts

- Walnut Street can be open
- Waste Container will need to be moved to allow for material/man hoist
- Tower Crane will allow more organized steel shakedown areas

Tower Crane Analysis



PRESENTATION OUTLINE:

Schedule Savings

Methodology

RS Means is an inaccurate way of estimating productivity

Use Milton Hershey Children's Hospital project to analyze tower crane productivity

- Both projects are being constructed by L.F. Driscoll
- Both projects have same size steel crew
- Both are healthcare projects similar in size
- Both projects have similar structures

Tower crane was used due to site restrictions

Tower Crane Analysis

PRESENTATION OUTLINE:

Schedule Savings

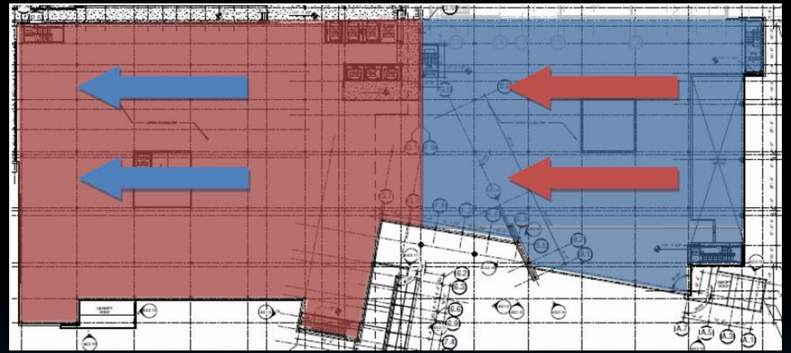
Productivity Comparison

Project	Total LF of Steel	Total Steel Schedule (Calendar days)	LF of Steel Erection Per Day	Using Tower Crane Erection Rate
Patient Tower Expansion	39,901	103 Days	387.40	95 Days
Hershey Children's Hospital	65,344	155 Days	421.57	

Tower Crane increased productivity 34 LF/Day

Total Schedule Savings: 8 Days

Tower Crane Analysis



PRESENTATION OUTLINE:

Cost Impacts

Tower Crane vs. Mobile Crane

Crane Type	Duration Used	Crane Cost	Mobile vs. Tower
165 ton Demag AC120	6.5 months	$335,500	$978,500
240 Ton Liebherr LTM 1200	10 months	$750,000	
Potain Model HDT 180 Ton	16 months	$1,038,500	$1,033,500

Material/Man Hoist

Concrete Pad and Removal	$1,5000
Erection and Dismantle	$25,000
Rental	$120,000
Labor	$224,000
Electrical and Carpentry	$20,000
Total	$404,000

Total Additional Costs $464,000

Tower Crane Analysis

PRESENTATION OUTLINE:

Conclusions and Recommendations

Tower Crane only reduced schedule by 6 work days

Walnut Street was able to be opened

Additional cost of tower crane $464,000

Keep mobile cranes because Susquehanna Health can't justify additional costs

Tower Crane Analysis

PRESENTATION OUTLINE:

Critical Industry Issue

Problem Identification

Commissioning and testing/balancing on this project is a long and drawn out process that eats up schedule time. (215 days, 43 days/fl)

Project cannot be turned over until all commissioning and testing/balancing is complete

Research Goal

Reduce schedule allowing for commissioning to take place sooner

Use prefabrication to reduce total cost of project

Perform income evaluation to see income generated from schedule savings

Prefabrication Analysis

PRESENTATION OUTLINE:

Project Comparisons

Project Summary Comparisons		
Project Name:	Miami Valley Hospital Southeast Addition	Susquehanna Health Patient Tower Expansion
Location:	Dayton, Ohio	Williamsport, Pennsylvania
Construction Type	Healthcare Addition	Healthcare Addition
Size:	484,000 SF	243,000SF
Cost:	$152,000,000	$78,800,000
Site Layout	Small/Congested/Limited Lay-down Area	Non-Congested, Lay-down Area Available
Structure	Steel Moment Frame	Steel Moment Frame
Number of Stories	12	6
Typical Patient Rooms	178	104
Crane Type	Tower Crane	Mobile Crane
Façade	Unitized Curtain Wall	Precast Panels
		Metal Panels
		Unitized Curtain Wall
Prefabricated Elements	Headwalls, Footwalls, Bathroom Units, Overhead Corridor Racks	-

Prefabrication Analysis

PRESENTATION OUTLINE:

Lessons Learned From Skanska

Never underestimate rate of productivity and always have a back-up plan

Delays in the field happen. Learn how to fix the problem without just throwing money at it

All aspects of the project team must buy into prefabrication

Utilize strengths to their absolute

Prefabrication Analysis

PRESENTATION OUTLINE:

Fabrication

		Fabrication Time			
		(Figures Based on 15 Man Crew Size and 5 Day Week)			
Prefabricated Unit	Number of Units	Time to Fabricate Each Unit (Per 8 Hour Day)	Total Time to Fabricate	Total Time to Fabricate at (20% Increased Efficiency)	Total Time to Fabricate at (50% Increased Efficiency)
Headwall	52	2.1	25 Days	21 Days	16.5 Days
Footwall	56	2.5	23 Days	19.5 Days	14.5 Days
Patient Bathrooms	104	2	52 Days	41.5 Days	29 Days
		Total	100 Days	82 Days	60 Days
			Savings	18 Days	40 Days

100 Days cut from 6th floor schedule
40 Day reduction in manpower

Prefabrication Analysis

		Installation Time			
		(Figures Include Delivery Time)			
Prefabricated Unit	Number of Units	MVH Installation Time (Per 8 Hour Day)	Total Patinet Tower Expansion Installation Time (Using MVH Installation Time)	Projeted Patient Tower Expansion Installation Time (Per 8 Hour Day)	Total Patinet Tower Expansion Installation Time (Using New Installation Time)
Headwall	52	–	–	32 Units	1.63≈2days≈13 Hours
Footwall	56	–	–	32 Units	1.75≈2days≈14 Hours
Patient Bathrooms	104	33 Units	3.5 Days/ 25.5 Hours	36 Units	2.88≈3 Days≈23.11 Hours
				Total	6.5 Days

20 Deliveries Total
3 Days

PRESENTATION OUTLINE:

Schedule Savings

6^{th} Floor Schedule Savings

93 days (100 days- 6.4 installation days)

Commissioning Schedule Savings

New limiting factor for commissioning is the 1^{st} floor lobby

Translates to 43 days of commissioning accelerated

Total Schedule Saving of 40 days

Prefabrication Analysis

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Cost Impacts

Added Cost		Cost Reductions	
Trucking	$296	General Conditions Savings	$197,564
Warehouse Rental (3 Months)	$15,267	Man Power Reduction (229 Hours)	$6,870
Dumpster	$1,200		
Extra Insurance	$13,520		
Additional Supervision	-		
Total	$30,283	Total	$204,434
Total Net Savings: $174,151			

Total Net Savings $174,151

Prefabrication Analysis

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Income Evaluation

Projected Monthly Income
$198,469

Total Schedule Savings
40 Days

Income Generated
$258,010

Total Savings with Income Generated: $432,161

Prefabrication Analysis

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Assumptions and Considerations

Union Contractors will work in warehouse with Open-Shop Contractors

Design team can coordinate with owner's staff to produce mock-ups 3 weeks ahead of time

Prefabrication Analysis

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Conclusions and Recommendations

- Prefabrication can be used to reduce the schedule by over a month
- Combined with income evaluation total savings can be upwards of $432,161 for a mere $30, 283

Prefabrication Analysis

PRESENTATION OUTLINE:

Problem Identification

Problem Identification

Very little value engineering was done on this project which is a problem for Non-Profit organizations such as Susquehanna Health

Last minute design changes lead a inefficient green roof, loss of concept in the design, and overdesigned steel

Green roofs are expensive and offer little payback especially in this design

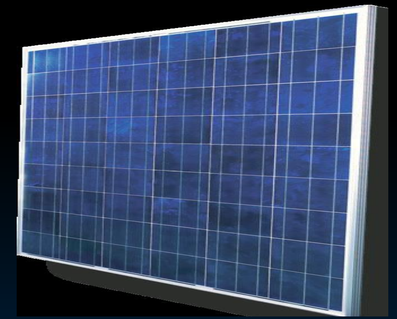
Research Goals

Reduce the overall cost of the project by value engineering green roofs and provide alternatives the align more with owner's goals

Roofing Analysis

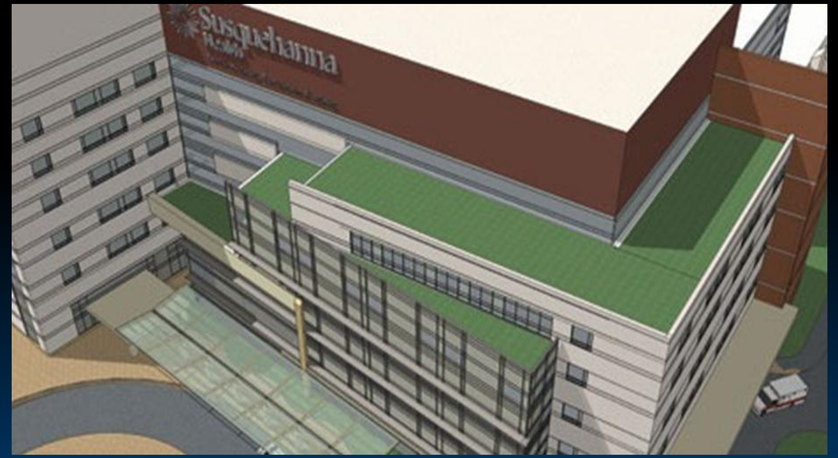
Vegetative Mat with Nylon Entanglement

Poly-Crystalline Solar Panel



PRESENTATION OUTLINE:

Problem Background



Roofing Analysis

Design Features

Multi-tiered green roof system gives patients a one-on-one relationship with a green environment

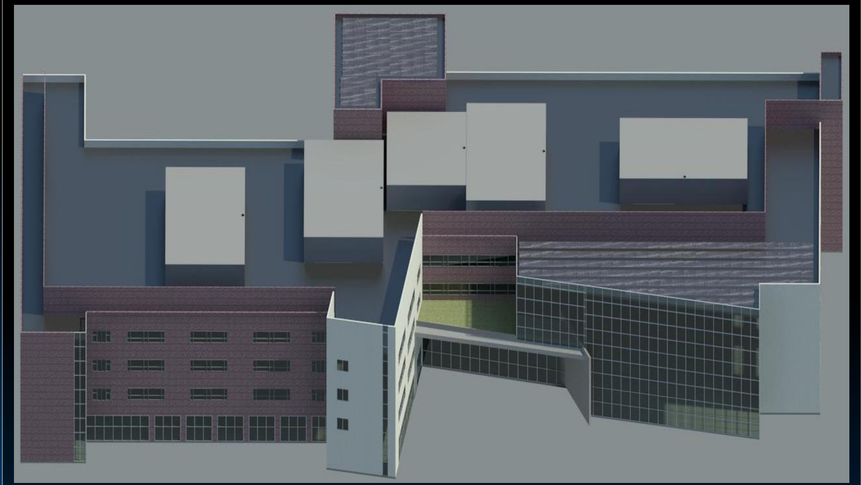
Green roof is a completely aesthetic feature and provides no substantial drainage or thermal benefits

Green roof used is very minimal vegetative mat with nylon entanglement

Simple EPDM Roofing

Current Design

Photovoltaic Desin



PRESENTATION OUTLINE:

Cost of Current Design

Roof Designation	Area (SF)	Unit Cost /SF	Material Cost	Labor Cost	Total Labor Cost	Total
Roof 1 East	8,002	$7.50	$60,015	$3.00/SF	$24,006	$84,021
Roof 2 Center	1,070	$7.50	$8,025	$3.00/SF	$3,210	$11,235
Roof 3 West	2,235	$7.50	$16,763	$3.00/SF	$6,705	$23,468
Total			$84,803			$118,724

Current design costs a total of $118,724

This system provides no payback and is a completely aesthetic feature

Roofing Analysis

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    I. Project Comparisons
    II. Background of Prefabricated Items
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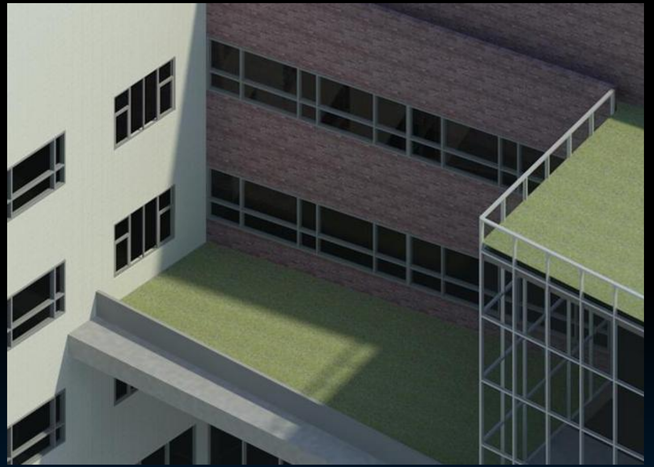
VI. Acknowledgements

Potential Candidates for VE

Roofing Analysis



PRESENTATION OUTLINE:

Structural Breadth

Steel Beam Redesign

Original Design Called For W16X31

After taking out the 7psf dead load for green roof it was determined that steel could not be reduced

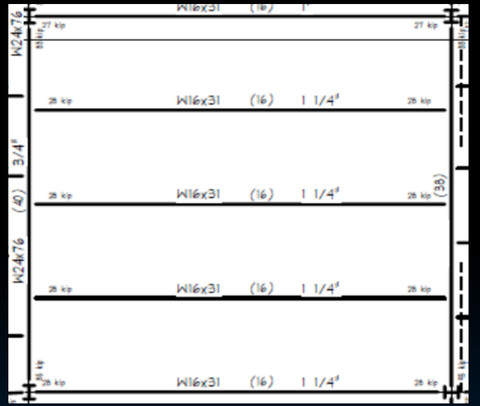
Girder Redesign

Original Design Called For W24x76

After taking out green roof dead load girders could be reduced to W24X68

Roofing Analysis

Roof Typical Bay



PRESENTATION OUTLINE:

Value Engineering Selected Roofs

Steel Reduction Savings

Designation	Shape/Size	LF	Cost/LF	Total Cost
Original Design	W24X76	967	$92.00	$88,964.00
New Design	W24X68	967	$82.50	$79,777.50
			Total Savings	$9,186.50

Total Savings

Value Engineered System	VE Y/N	System Cost	Savings	Total Savings
Roof Steel	Yes	$79,777.50	$9186.50	$9,187
Roof 1 East	Yes	$84,021	$84,021	$84,021
Roof 2 Center	No	$11,235	-	-
Roof 3 West	Yes	$23,468	$23,468	$23,468
			Total Savings	$116,676

Total Savings: $116,676

Roofing Analysis

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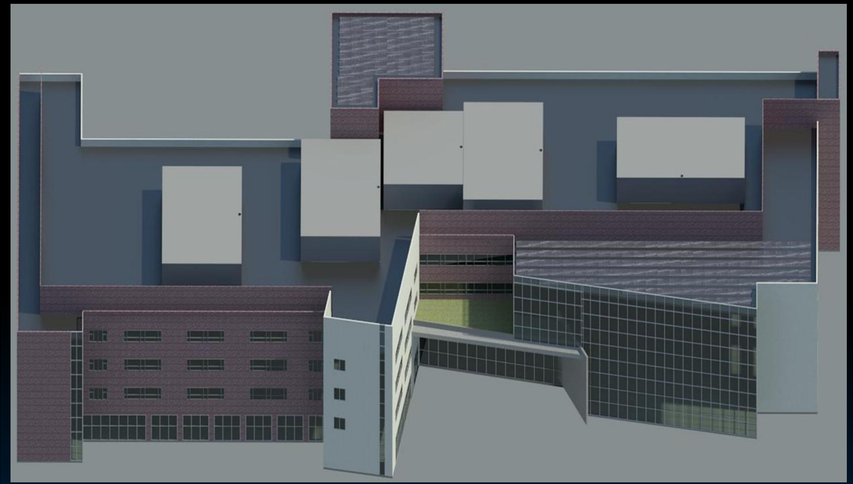
Photovoltaic Roof

Basic Photovoltaic Information

- Roof Orientation-Directly South
- Membrane Mounted System
- 258 Poly-Crystalline Solar Panels
- 54.2 kW System
- Inverter located on roof behind parapet wall

Roofing Analysis



PRESENTATION OUTLINE:

Photovoltaic Costs

Photovoltaic Material Costs						
Material	Quantity	Cost Per Unit	Total Cost	Installation Cost/Unit	Total Installation Cost	Total
STP210-18/Ud	258	$610.00	$157,380	$7.00	$1,806	$159,186
Sunny Tower with 6 Sunny Boy 8000US	1	$20,816.80	$20,816.8	$500.00	$500	$21,317
4/0 Wire	160	$35	$5,600	-	-	$5,600
Mounting	258	$50	$12,900	-	-	$12,900
					Total	$199,003

After Rebates and Incentives $165,661

Payback Period of 25 years

Roofing Analysis

Year	Energy Cost ($/kW)	Energy Savings (kWH)	Yearly Savings	Total Savings
1	$0.09	59884	$5,569.21	$5,389.65
2	$0.09	59884	$5,569.21	$10,958.86
3	$0.09	59884	$5,569.21	$16,528.07
4	$0.10	59884	$5,988.40	$22,516.47
5	$0.10	59884	$5,988.40	$28,504.87
6	$0.10	59884	$5,988.40	$34,493.27
7	$0.10	59884	$5,988.40	$40,481.67
8	$0.10	59884	$5,988.40	$46,470.07
9	$0.10	59884	$5,988.40	$52,458.47
10	$0.11	59884	$6,587.24	$59,045.71
11	$0.11	59884	$6,587.24	$65,632.95
12	$0.11	59884	$6,587.24	$72,220.19
13	$0.11	59884	$6,587.24	$78,807.43
14	$0.11	59884	$6,587.24	$85,394.67
15	$0.11	59884	$6,587.24	$91,981.91
16	$0.12	59884	$7,186.08	$99,167.99
17	$0.12	59884	$7,186.08	$106,354.07
18	$0.12	59884	$7,186.08	$113,540.15
19	$0.12	59884	$7,186.08	$120,726.23
20	$0.12	59884	$7,186.08	$127,912.31
21	$0.12	59884	$7,186.08	$135,098.39
22	$0.13	59884	$7,784.92	$142,883.31
23	$0.13	59884	$7,784.92	$150,668.23
24	$0.13	59884	$7,784.92	$158,453.15
25	$0.13	59884	$7,784.92	$166,238.07

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Conclusions and Recommendations

- Value Engineer East and West Green Roofs
- Leave steel overdesigned
- Use money saved to put towards PV arrays and have a new payback period of 11 years

Roofing Analysis

PRESENTATION OUTLINE:

Acknowledgements

Penn State AE Faculty
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My Brother John Lasher
AE Friends and Family