

Bayhealth Medical Center Expansion Dover, Delaware

Introduction



PRESENTATION OUTLINE

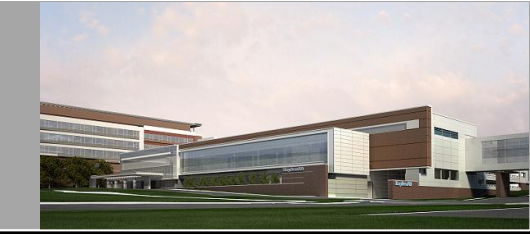
- **Project Introduction**
- Analysis 1: Curtain Wall Timeline
- Analysis 2: Green Roof Addition
 - Structural Breadth
 - Mechanical Breadth
- Analysis 3: Prefabrication
- Summary of Analyses
- Acknowledgements

Penn State AE Senior Capstone
Project
Christopher Barron Construction
Management
CM Advisor – Dr. Anumba



Bayhealth Medical Center Expansion Dover, Delaware

Project Background

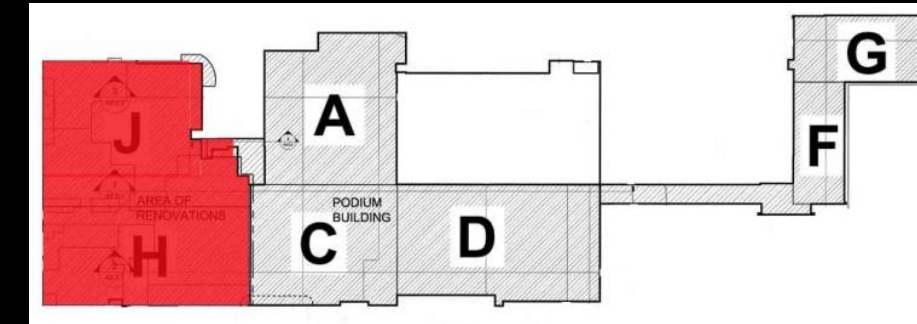


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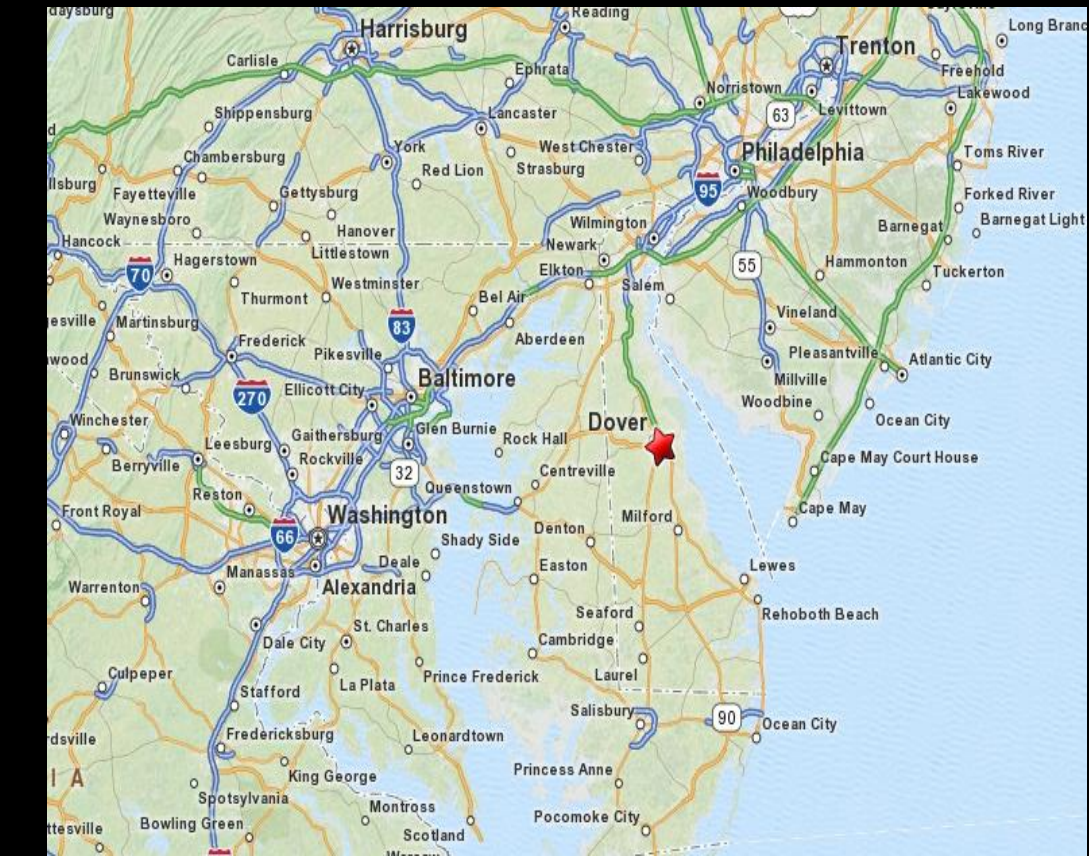
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Phase two expansion

- **Existing Facility**
- Podium Building
 - Welcome Center
 - Emergency Department
 - Integrated Cancer Center
- Parking Garage
- Bridge
- Central Service Building



Location: Dover Delaware



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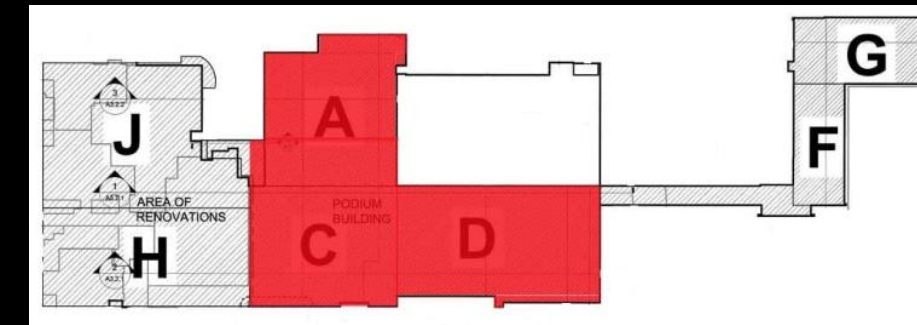


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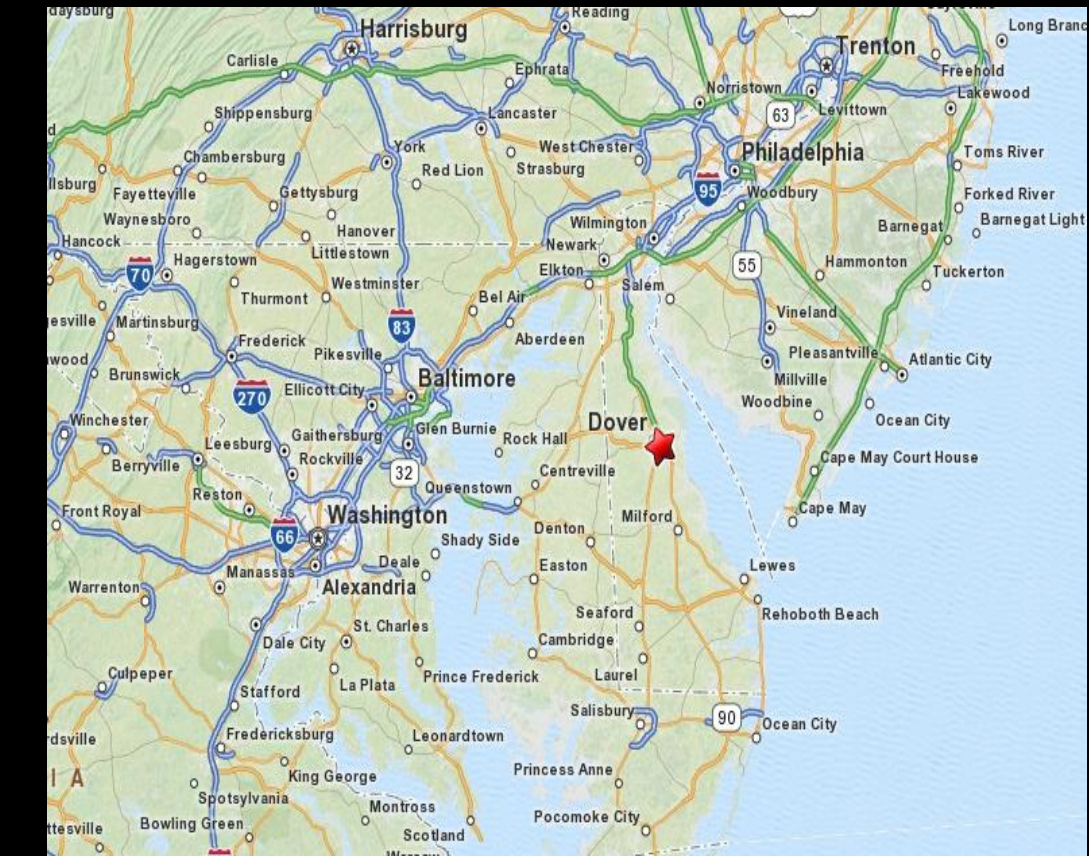
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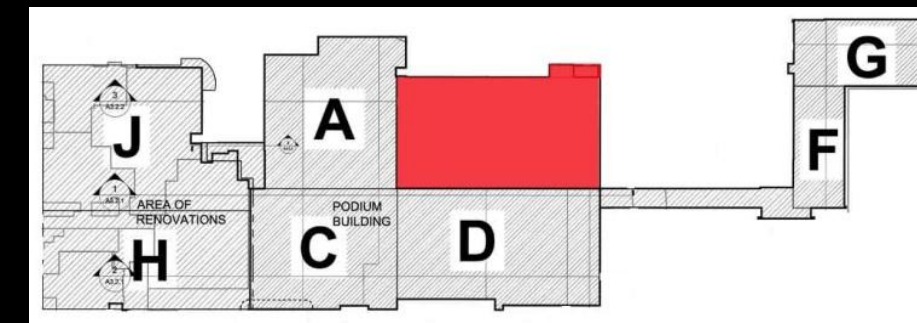


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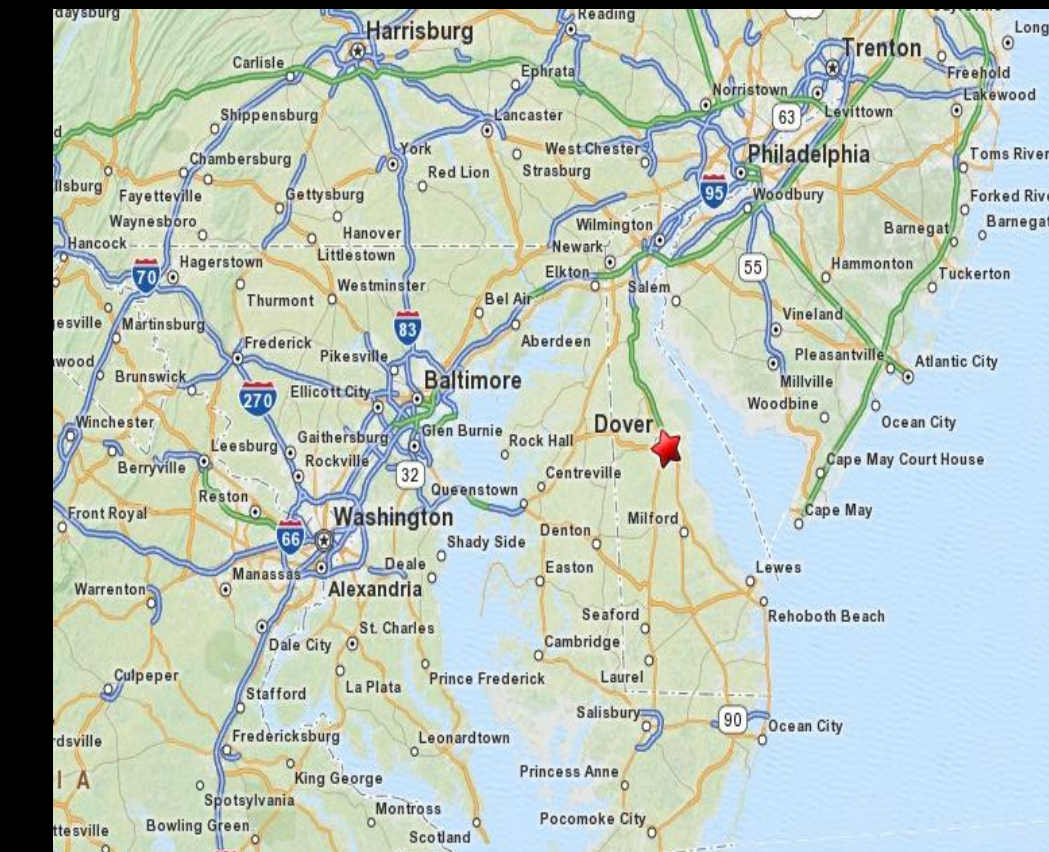
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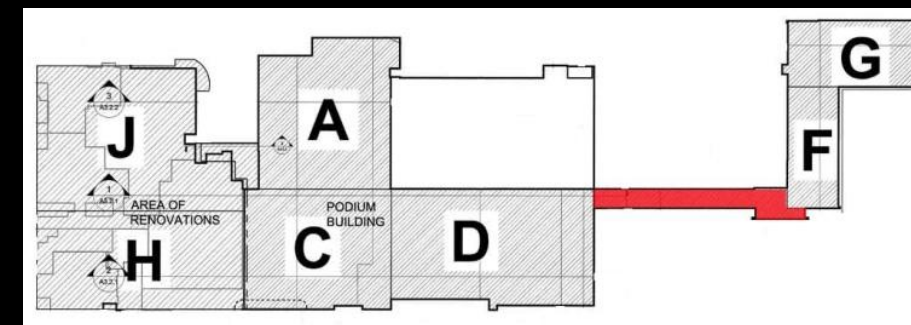


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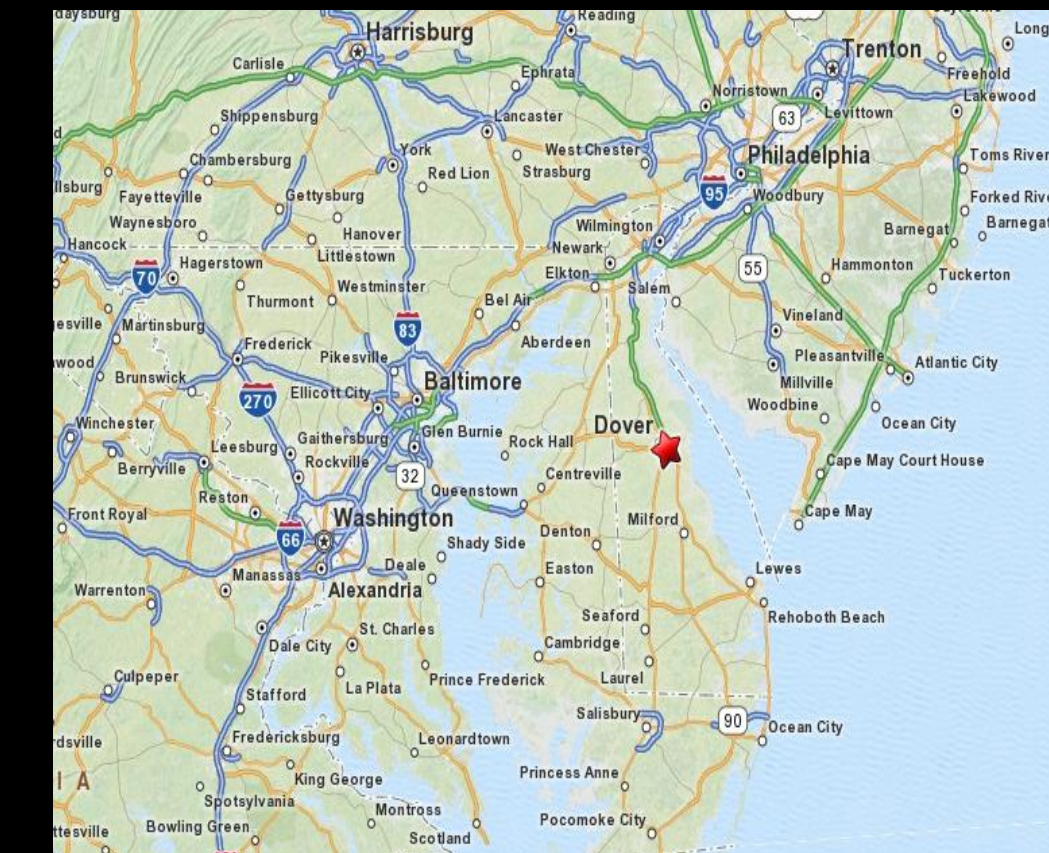
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Phase two expansion

- Existing Facility
- Pavilion Building
 - Welcome Center
 - Emergency Department
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- **Bridge**
- Central Service Building



Location: Dover Delaware



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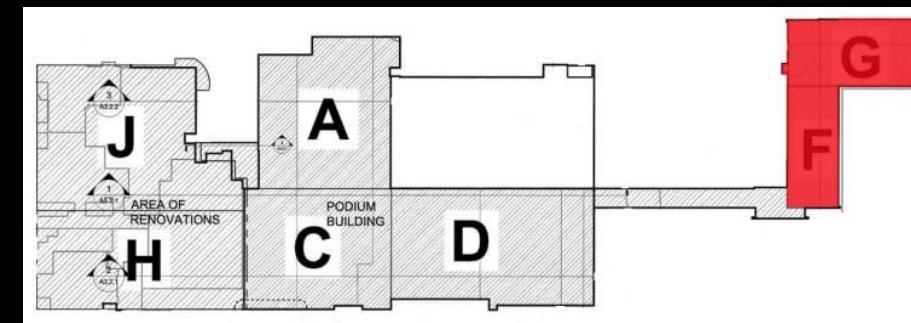


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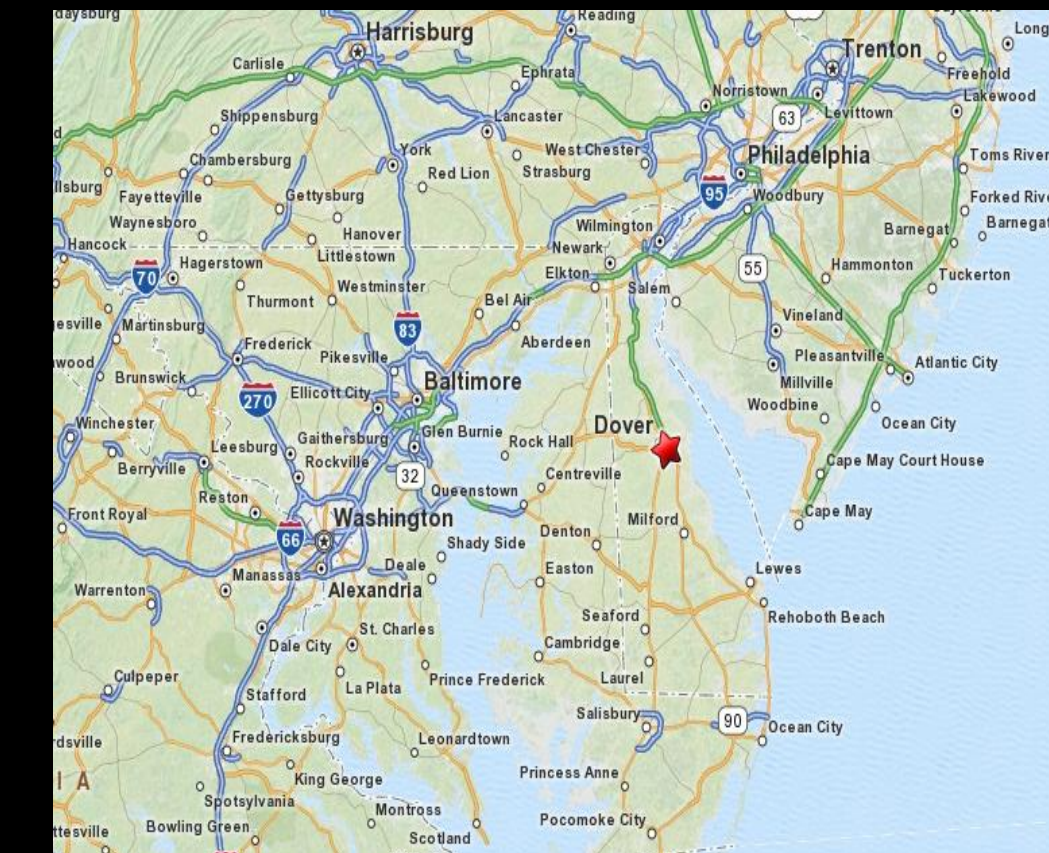
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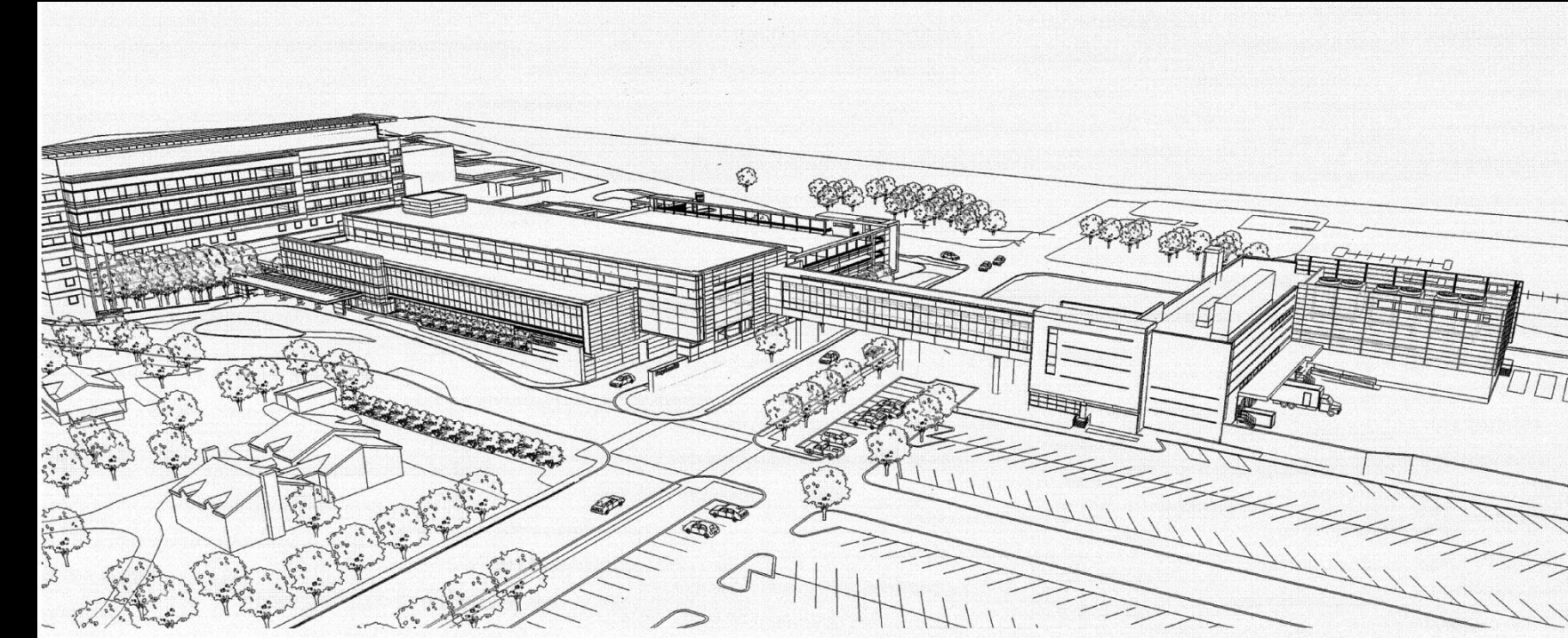


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Podium Building

- Function: Hospital
- Size: 215,000 sq ft
- Building Cost: GMP 65 million
- Construction Dates: Oct 7, 2008 – AUG 19, 2011
- Delivery Method: Design-Bid-Build CM Agency



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Project Background

Structural System

- Braced frame
- Bay size 30' X 30'
- Oversized system

Building Facade

- Schuco FW 60 Mullion-Transom System
- Masonry brick
- Preformed metal siding





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Problem Statement

- Conflicting waterproofing systems of the three façade systems made it difficult to get the podium building's enclosure watertight

Goal

- Study the current façade system used
- Investigate the reason why making it water tight became so problematic
- Construct timeline to portray events
- Summarize events



FW 60 Mullion-Transom
System



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Lack of design

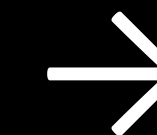
- 70% designed when project was bid

Sequencing

- In order for waterproof system to work, the metal panels needed to be installed before curtain wall
- Designed for curtain wall to be installed before metal panels

Space constraints

- In order to build to specifications, the brick waterproofing would have needed to be installed in a 5/8" caulking joint



Issue Discovered

Reactions

How Issued Was Solved

Recommendations



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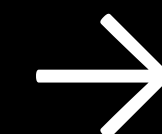
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Owner/ Architect

- Did not want to change curtain walls appearance
- Brought skin consultant on

Whiting-Turner

- Wanted to change to a similar curtain wall system
 - Would have eliminated tying ABV into brick
 - Less fabrication time



Issue Discovered

Reactions

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Watertight Wall was Erected

- Built behind curtain wall
- Kept project's schedule critical path on track

Additional Waterproofing Measures Taken

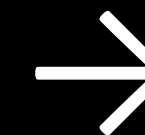
- AVB wrapped into all sides of the building
- Stainless steel flashing
- Any further gaps were caulked shut

Issue Discovered

Reactions

How Issued Was Solved

Recommendations





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Summary

- Over \$400,000 in design changes added
- Additional 6 Weeks Added to the Project Schedule

Recommendations

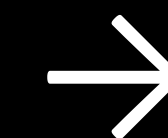
- Better collaboration between all parties
- Switch to alternative system
- Bring CM onto project earlier

Issue Discovered

Reactions

How Issued Was Solved

Recommendations



Bayhealth Medical Center Expansion Dover, Delaware

Analysis: 2 Green Roof Addition



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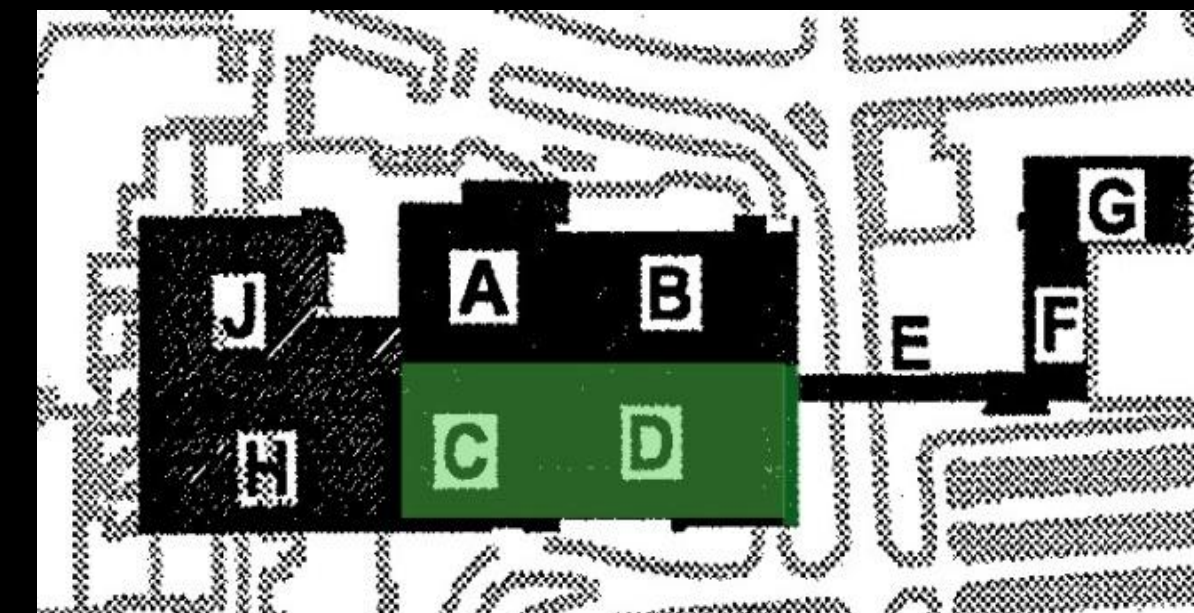
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Problem Statement

- Few sustainable ideas implemented on the Bayhealth Medical Center Expansion

Goal

- Study green roof technology, and then determine its cost effectiveness on this project



- Located on the Third Floor

- Total 28,000 SQ FT

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Analysis: 2 Green Roof Addition



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System Chosen

Manufacturer

- GreenGrid roofing systems

Module

- 2'X2'X4" 100% Pre-consumer recycled polyethylene trays

Weight

- 18 to 22 lbs/ft² (Wet)

Growth Media

- Blend of organic and inorganic components

Vegetation

- Perennials, grasses, shrubs, etc



Modular Green Roof System

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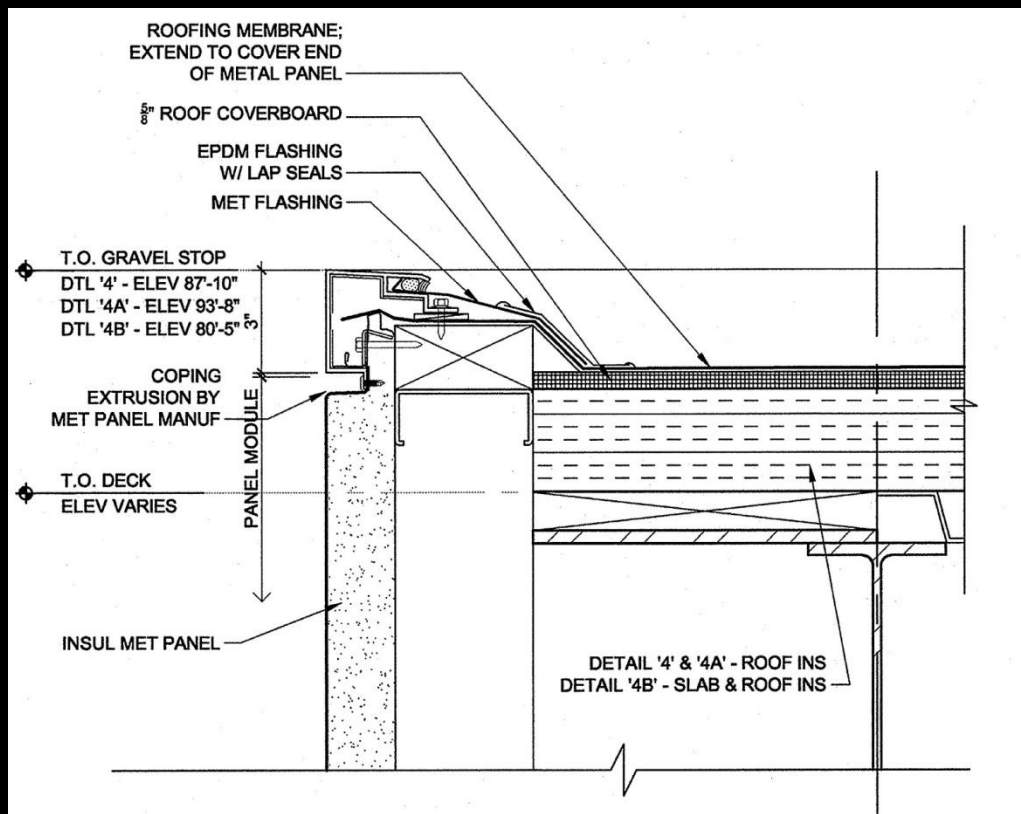
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Existing Roof Detail



Current Roof Slab

- Composite deck 3-1/4" LW concrete
- 18 gauge galvanized metal decking
- 3" to 1.5" tapered insulation
- 5/8" cover board
- Single ply EPDM membrane

Roof Loads

- Live = 25 PSF
- Dead = 15 PSF
- Snow = 24 PSF
- Green Roof = 20 PSF
- Conc. Slab = 24 PSF

- The dead load is less than the snow load therefore the snow load is used

Total = 94 PSF

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	Bay One	Bay Two	Bay Three
Demension	30'X32'	30'X26'	30'X32'
Beam Size	W18X35	W14X22	W30X108
Beam Spacing	10'	7.5'	10'
Shear	15.04 kip	9.17 kip	15.04 kip
Shear Capacity	159 kip	96 kip	488 kip
Moment	120.32 kip-ft	58.96 kip-ft	120.32 kip-ft
Moment Capacity	249 kip-ft	125 kip-ft	1300 kip-ft

- Girders were also determined to be sufficiently sized

$$\text{Shear} = WL/2$$

$$\text{Moment} = WL^2/8$$

- All beams were considered simply supported
- Bare beam capacity was used despite a composite beam system

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Column K12 (Interior) W14 X 145
Live Load = 40.34 PSF
Dead Load = 57 PSF

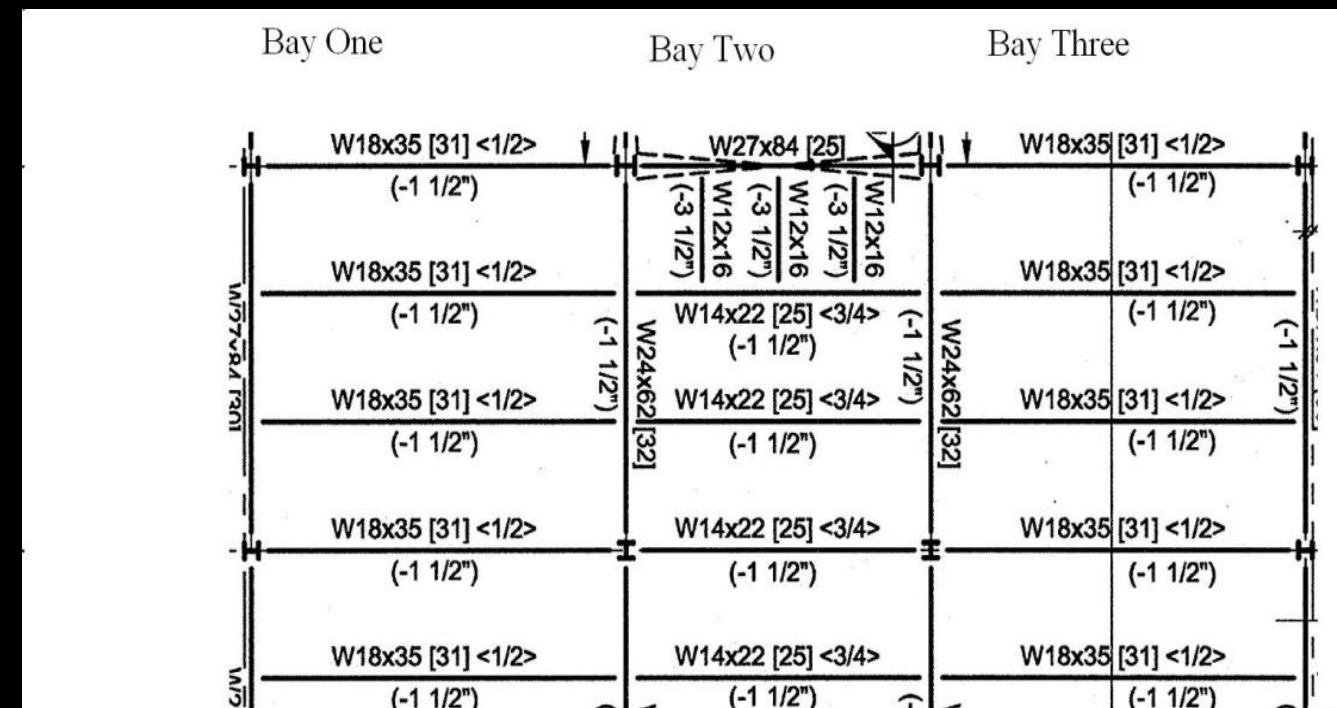
Column L12 (exterior) W14 X 120
Live Load = 23.69 PSF
Dead Load = 57 PSF

- Roof Load = 98.48 kip

- Roof Load = 54.34 kip

- Floor load = 115.66 kip/floor

- Floor load = 51.03 kip/floor



Typical Bay Used (Column Line 10-11 / H-L)

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Roof	98.48 kip	$P_U = 11393.4$
10th	115.66 kip	$P_U < 1650$
9th	115.66 kip	
8th	115.66 kip	
7th	115.66 kip	
6th	115.66 kip	
5th	115.66 kip	
4th	115.66 kip	
3th	115.66 kip	
2th	115.66 kip	
1th	115.66 kip	

Roof	54.34 kip	$P_U = 513.61$
10th	51.03 kip	$P_U < 1340$
9th	51.03 kip	
8th	51.03 kip	
7th	51.03 kip	
6th	51.03 kip	
5th	51.03 kip	
4th	51.03 kip	
3th	51.03 kip	
2th	51.03 kip	
1th	51.03 kip	

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Analysis: 2 Green Roof Addition



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- The change in mechanical loading was determined using Trace software
- Limited change was observed
- Therefore, no reduction of the mechanical system can be preformed

R Values Original Roof

- 3 ¼" LW Conc.(80psf) = 5
- 18 gauge decking = 0
- 3" rigid insulation = 30
- 5/8 roof board = .85

U value (1/ΣR = .030166)

With Green Roof

- 3 ¼" LW Conc.(80psf) = 5
- 18 gauge decking = 0
- 3" rigid insulation = 30
- 5/8 roof board = .85
- Green roof = 5

U value (1/ΣR = .026123)

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System Checksums
By ACADEMIC

COOLING COIL PEAK		CLG SPACE PEAK		HEATING COIL PEAK		TEMPERATURES	
Peak at Time	Capacity	Peak at Time	Capacity	Peak at Time	Capacity	Room	Capacity
Capacity	MBh	Capacity	MBh	Capacity	MBh	Room	Capacity
4/23/21	43.23	4/23/21	43.23	4/23/21	43.23	Room	43.23
Total Capacity		ton		MBh			
Main Clg		35.4		425.0			
Aux Clg		0.0		0.0			
Opt Vent		0.0		0.0			
Total		35.4		425.0			

System Checksums
By ACADEMIC

COOLING COIL PEAK		CLG SPACE PEAK		HEATING COIL PEAK		TEMPERATURES	
Peak at Time	Capacity	Peak at Time	Capacity	Peak at Time	Capacity	Room	Capacity
Capacity	MBh	Capacity	MBh	Capacity	MBh	Room	Capacity
4/23/21	36.08	4/23/21	171.43	4/23/21	36.08	Room	36.08
Total Capacity		ton		MBh			
Main Clg		35.0		420.5			
Aux Clg		0.0		0.0			
Opt Vent		0.0		0.0			
Total		35.0		420.5			

Other Possible Benefits

- Roof shading
- Plant transpiration
- Aesthetically pleasing

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Cost Impacts

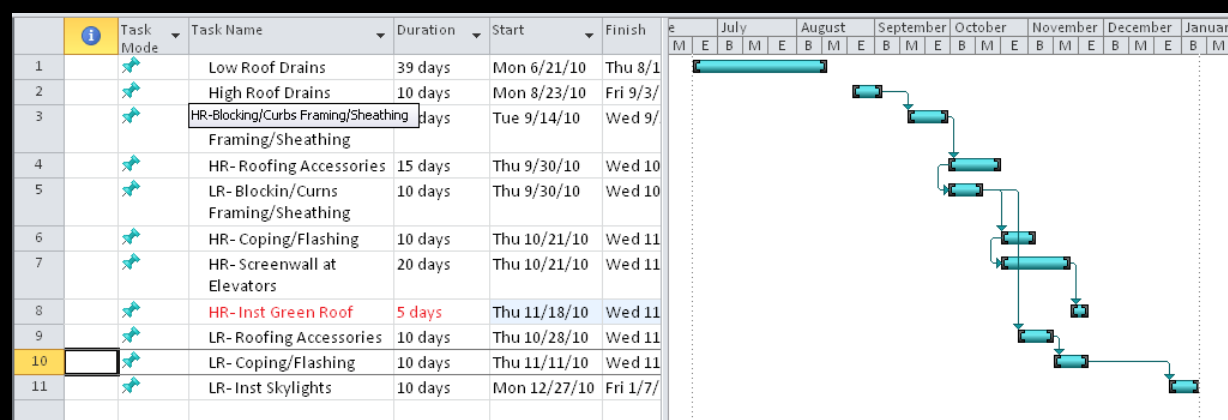
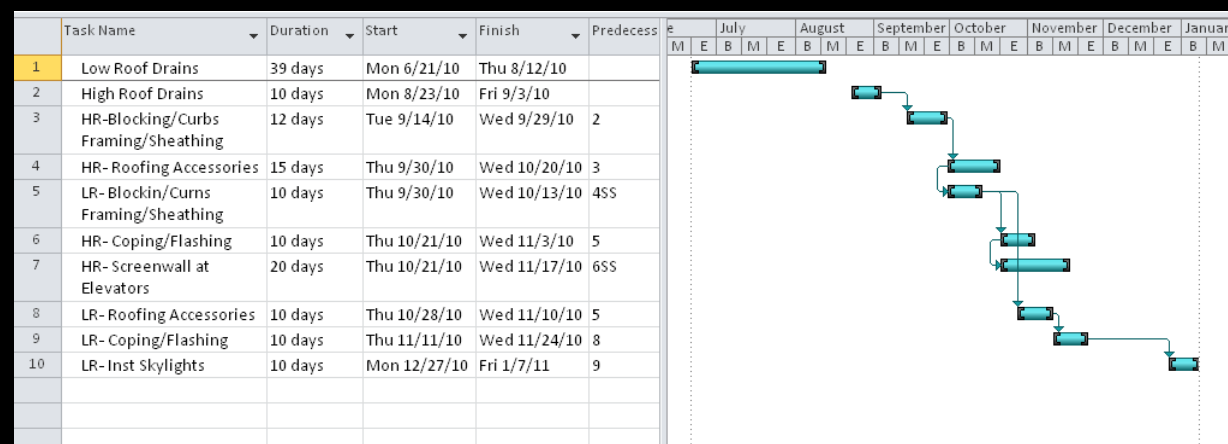
- Material / Delivery: \$10-\$15 per SQ/FT
- Installation: \$3-\$6 per SQ/FT

Total Cost \$462,000

Schedule Impacts

- Installation Time:
Five Days

- Will have no impact
on project's overall
schedule





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Summary

- Building's structural system is more than adequate
- Mechanical system cannot be reduced
- Total cost of green roof addition: \$462,000

Recommendations

- Because one of the owner's concerns is cost, this is not a worthwhile addition at this time



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Problem Statement

- Because of the extensive amount of MEP systems needed in a hospital, a lot of time and money is spent installing these systems

Goal

- Determine potential areas to implement prefabrication
- Determine advantages of prefabrication
- Evaluate possible cost and time savings

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Analysis: 3 Prefabrication

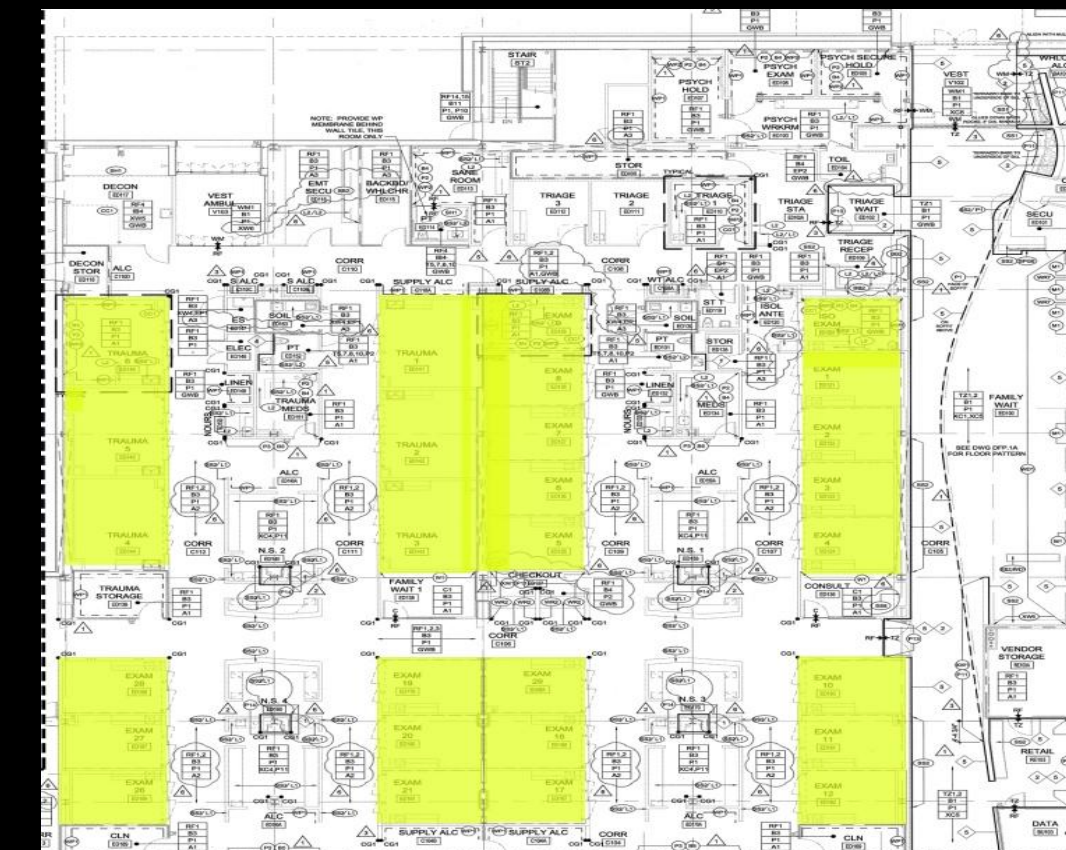


Miami Valley Hospital

- Similar to Bayhealth Medical Center
- Patient rooms and overhead corridor racks prefabricated

Where to perform prefabrication

- Area with high level of MEP
- Patient exam rooms, trauma rooms
- Concluded 41 appropriate rooms



Sector A of First Floor

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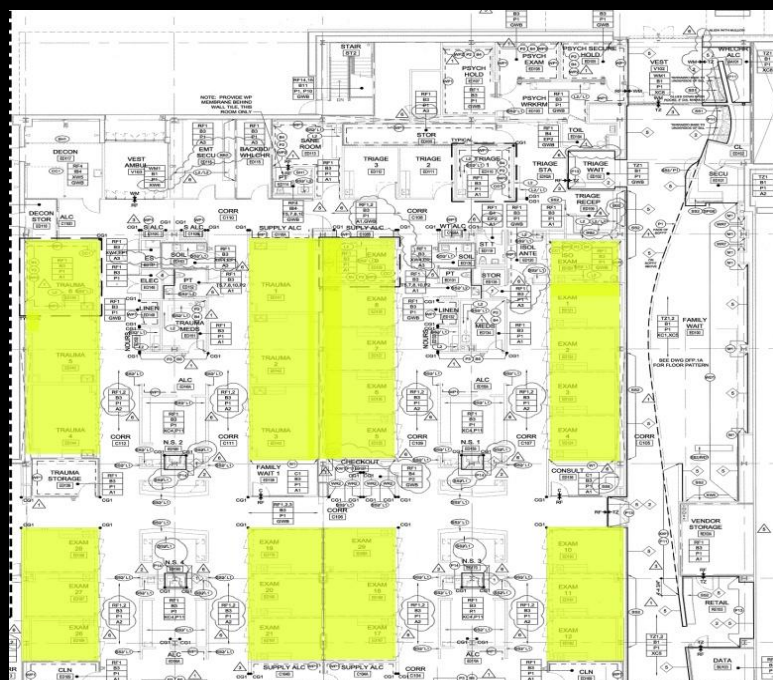
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Time and Cost Savings



- Estimated 1,352 LF of partition wall in Sector A
- 30% inside the highlighted area
- 90 working days to install the partition walls highlighted

Activity Description	Duration
FA IN WALL	20
IN WALL BLOCKING	15
HEADWALL UNIT ROUGH-IN BOXES	15
BAS IN WALL	15
DW IN WALL INSTALL, TEST+INSUL	20
MED GAS IN WALL INSTALL+TEST	15
ELECT POWER, LIGHTING+LV RACEWAYS IN WALL	50
DUCTWORK IN WALL, INSTL+TEST	10
WALL-ELECTRICAL DEVICES	50
WALL-LV DEVICES	50
WALL-FA DEVICES	20
WALL-PLBG+MED GAS DEVICES	20
Total Days	300



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Time and Cost Savings

- Conservatively applying the Miami Valley Hospital's production rates, the installation rates were Increased to 125% and 150%
- At 125% production rates, an average of .64 days can be saved per prefabricated room
- It was determined that 1% to 2% of the total project cost was saved

	Original Production Rates	125% Production Rates	150% production Rates
Schedule Days	90	72	60
Savings	0	18	40

- **At 125% 44.16 working days are saved on the entire project**
- **1% is Equal to \$650,000**

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Analysis: 3 Prefabrication



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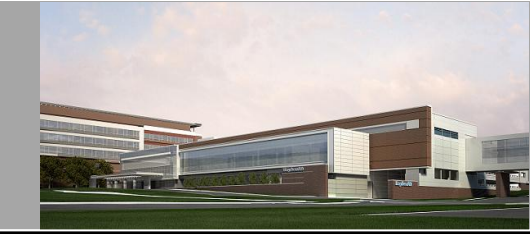
- Reduction of man hours
- Less waste
- Time savings
- Cost savings

Recommendations

- Cost and schedule are two aspects the owner is concerned with, so prefabrication would be an effective tool because of its possible cost and schedule savings



Prefabrication Warehouse



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Analysis 1: Curtain Wall Timeline

- Better collaboration among all parties
- Switch to alternative system
- Bring CM onto project earlier

Analysis 2: Green Roof Addition

- Because one of the owner's concerns is cost, this is not a worthwhile addition at this time

Analysis 3: Prefabrication

- Cost and schedule are two aspects the owner is concerned with, so prefabrication would be an effective tool due to its possible cost and schedule savings

Acknowledgements



Questions

Academic Acknowledgements:

Penn State AE Faculty Dr. Anumba (CM Advisor)

Special Thanks To:

The Bayhealth Medical Center Project team
Mr. Craig Dubler
My AE Friends

Industry Acknowledgements:

