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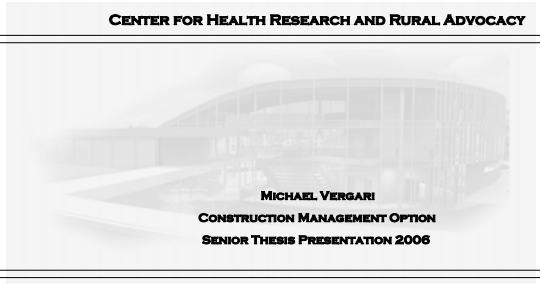

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Senior Thesis Presentation 2006

Presentation Outline:

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Project Background Information

Occupant: Geisinger Health System

Size: 67,000 sq*ft

Cost: $18,400,000

Schedule: July 2005 – February 2007

Delivery: Design-Bid-Build

Function: Facility to promote research efforts for Geisinger Health System locally and nationally with numerous conference spaces, research employee offices, and 300 seat auditorium

LEED Rating: Basic certification (26 points)

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Project Background Information

Architectural Features

- 13,750 sq*ft aluminum curtain wall
- 4' x 9' architectural pre-cast panels
- open office spaces
- garden roof above auditorium
- connection to existing Weis Research Center

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Thesis & Presentation Goals

Industry Research → LEED Credit Guide for Envelope Design and Construction

Alternate Construction Methods & Procedures → Prefabrication of Aluminum Curtain Wall System **vs.** Stick-Built Aluminum System

Site & Sequencing Issues →

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Research Analysis

Envelope Design & Construction Challenges

- Interface of all design systems
- Sustainable aspects
- Identifiable feature of project
- Increasing complexity
- Lead times
- Imported or specialty finishes

Resources

LEED Accredited Professionals

LEED-NC Version 2.2

GSA: LEED Cost Study

Version 2.0: Pilot

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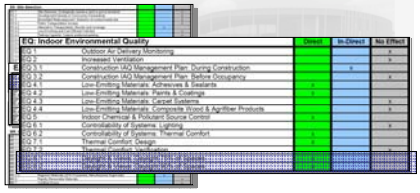
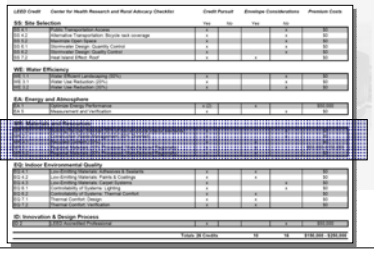
LEED Credits Affect On Envelope Design & Construction



EQ: Indoor Environmental Quality	Direct	In-Direct	No Effect
EQ 1	Outdoor Air Delivery Monitoring			x
EQ 2	Increased Ventilation			x
EQ 3.1	Construction IAQ Management Plan: During Construction		x	
EQ 3.2	Construction IAQ Management Plan: Before Occupancy			x
EQ 4.1	Low-Emitting Materials: Adhesives & Sealants	x		
EQ 4.2	Low-Emitting Materials: Paints & Coatings	x		
EQ 4.3	Low-Emitting Materials: Carpet Systems			x
EQ 4.4	Low-Emitting Materials: Composite Wood & Agrifiber Products			x
EQ 5	Indoor Chemical & Pollutant Source Control	x		
EQ 6.1	Controllability of Systems: Lighting			x
EQ 6.2	Controllability of Systems: Thermal Comfort	x		
EQ 7.1	Thermal Comfort: Design	x		
EQ 7.2	Thermal Comfort: Verification			x
IDC 1.1	Daylight & Views: Daylight 75% of Spaces	Direct Glare		
IDC 1.2	Daylight & Views: Daylight 90% of Spaces	Direct Glare		



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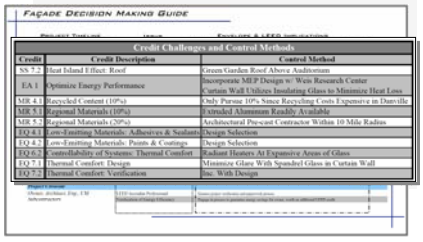
Façade Decision Making Guide Goals

- Decision timeline
- Key façade design issues
- Constructability considerations
- Participants
- Potential LEED credits
- Budget and cost escalation considerations



Façade Decision Making Guide

Credit Challenges and Control Methods

Credit	Credit Description	Control Method
SS 7.2	Heat Island Effect: Roof	Green/Garden Roof Above Auditorium
EA 1	Optimize Energy Performance	Incorporate MEP Design w/ Weis Research Center Curtain Wall Utilizes Insulating Glass to Minimize Heat Loss
MR 4.1	Recycled Content (10%)	Only Pursue 10% Since Recycling Costs Expensive in Danville
MR 5.1	Regional Materials (10%)	Extruded Aluminum Readily Available
MR 5.2	Regional Materials (20%)	Architectural Pre-cast Contractor Within 10 Mile Radius
EQ 4.1	Low-Emitting Materials: Adhesives & Sealants	Design Selection
EQ 4.2	Low-Emitting Materials: Paints & Coatings	Design Selection
EQ 6.2	Controllability of Systems: Thermal Comfort	Radiant Heaters At Expansive Areas of Glass
EQ 7.1	Thermal Comfort: Design	Minimize Glare With Spandrel Glass in Curtain Wall
EQ 7.2	Thermal Comfort: Verification	Inc. With Design

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Prefabrication of Aluminum Curtain Wall System

Advantages

- Complexity of façade components
- On-site construction schedule
- Quality

Disadvantages

- Double handling of material
- Facility & equipment costs
- Safety

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Need for Prefabrication on Center for Health Research and Rural Advocacy

Duration

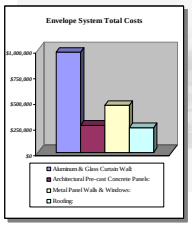
- On critical path
- Longest scheduled activity

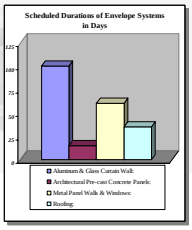
Budget

- Most expensive envelope component

Quality Standards

Site Logistics





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Typical Prefabricated Units

13' x 8' Panels

- Includes triple pane glazing & aluminum frame
- Watertight connections with silicone
- Represents 80 of the 118 panels

Revised Durations

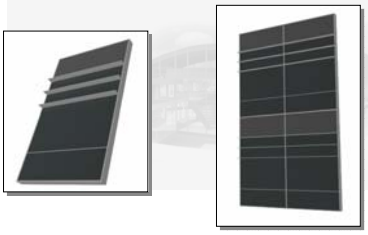
- On-site

Install 10-11 Panels per day (1,040 sq. ft)

vs.

Stick-built (150 sq. ft)

- Warehouse – 3 panels per day



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Schedule Impacts

On-Site Labor Force

- Original: 10 Skilled Laborers
- Proposed: 6 Skilled Laborers

Durations

- Original: 150 SF / Day
- Proposed: 1,040 SF / Day

Overall Curtain Wall Construction

- Original: 100 Days
- Proposed: 13 Days

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Cost Impacts

Labor Rates

- Original: Pay all laborers equivalent of skilled wages
- Proposed: On-site workers paid more than fabrication

Fabrication Plant & Equipment

- Additional facility and equipment rental

General Condition Savings

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Mechanical Impacts

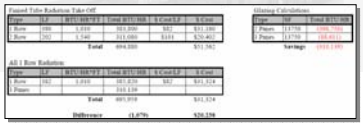
Additional Resistance to Heat Transfer

- Deletion of Radiant Heaters
- Create comfortable environment

Double Pane Glass:
Heating: Q = (10 – 68) * 13,750 SF / 2 = (398,750) BTU/hr
Cooling: Q = (68 – 72) * 13,750 SF / 2 = 110,000 BTU/hr

Triple Pane Glass:
Heating: Q = (10 - 68) * 13,750 SF / 8 = (99,611) BTU/hr
Cooling: Q = (68 – 72) * 13,750 SF / 8 = 24,450 BTU/hr

- R – Values
  - Insulating Glass r=1 - 4
  - Triple Pane R= 3 - 8



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Structural Impacts

Additional load of triple pane glass

- dead load
- Connections
  - Shear, bearing, & Tear - out
- Structural Columns
  - Compression, buckling, flexure

Analysis Conclusion

Prefabricated Approach vs. Stick-built Construction

Prefabricate Aluminum Curtain Wall	Impact	Stick-Build Aluminum Curtain Wall
Not on critical path	Schedule	On-critical path
Accelerate schedule 40 days		
Save $74,652	Cost	Already budgeted
Requires only single row radiant heaters	Mechanical	Requires double and single row radiant heaters
Additional $24,000 for triple pane		
System sound	Structural	System sound
Requires staging areas	Site	No crane or staging areas
Minimal waste		Large material lay down and work spaces
Requires crane		Material waste

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4D Visualization Model of Façade Construction

Building Façade Construction Sequence & Site Analysis

- Three separate systems
- Safety issues
- Controls building enclosure date

Proposed Use of 4D Model

- Coordinate work flow
- Address hazardous work environments
- Predict which activities which may delay critical path

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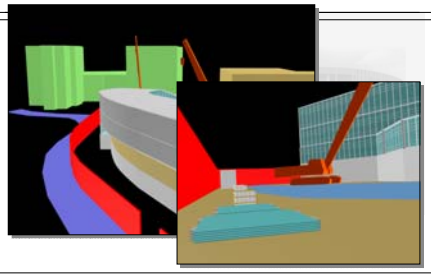
3D Model Development

- Use CAD systems to create virtual model of CHHRA
- Adequate level of detail to display construction

Included Items

- Site boundaries
- Material staging areas
- Crane locations
- Temporary facilities
- Existing Geisinger facilities



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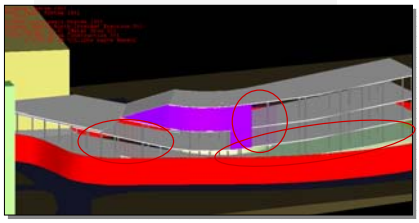
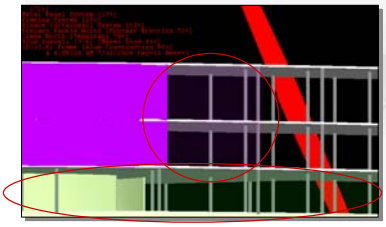


July 7, 2006



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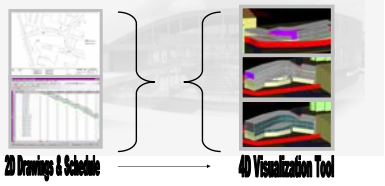
Advantages of Using 4D Visualization Model

- Communicate sequence to all contractors
- Create schedule iterations
- Conflicts
- Hazardous work environments



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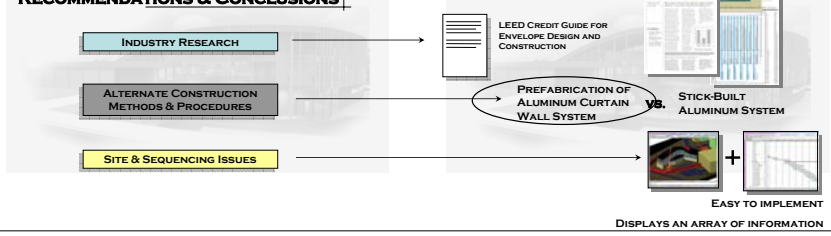

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Special Thanks

Geisinger Health System
Harmon Inc.
AE Faculty
Fellow Students
Family & Friends