Plaza East

Chantilly , Virginia

Steven M. Miller
Senior Thesis 2008
Construction Management

Project Overview
Analysis 1: Building Envelope
Analysis 2: Green Roof Implementation
Analysis 3: Checking Green Roof Loads
Research: Implementation of Software for Steel Buildings
Q & A

Presentation Topics

Building Envelope Investigation

Green Roof Implementation

New Roof Loads Analysis

Research Topic: Steel Erection Software

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Goals

1. **Save time and money with new building façade material**
2. **Use money saved to install a green roof**
3. **Save energy and money with new building façade material and green roof**
4. **Inform others of the perks in the paperless process of steel buildings**

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Project Overview

Basic Project Information:
- 5 stories above grade
- 123,000 sqf per building
- Design-Bid-Build
- Function - General Office Building
- Duration - March 2006 to August 2007
- Cost - $28 to $29.5 million
- Total Project Cost $ 54 million

Project Team:
- Owner - Tishman Speyer Properties
- Architect - Hellmuth, Obata + Kassabaum, P.C.
- Mechanical Contractor - GHT Limited
- Structural Contractor - Smislova, Kehnemui & Associates, P.C.
- General Contractor: James G. DAVIS Construction
- Civil Engineer - VIKA, Inc.

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Building Envelope

CENTRIA Formawall Dimension Series with Duracast Coating
And CENTRIA Versawall with Duracst Coating
vs
Architectural Precast Concrete

CENTRIA

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Building Envelope

Architectural Precast

Pros
- Highly Durable
- Good Acoustics
- Molds can be easily replicated
- Usually Cheap

Cons
- Degradation from acid rain and alkali runoff etches glass and deteriorates metals
- Surface Finishes inconsistent
- Accidents usually fatal

CENTRIA Formawall and Versawall

Pros
- Reduces structural requirements
- Reduces installation costs
- Shortens material lead time
- Faster Installation
- Higher R-Value
- LEED Points

Cons
- Plain looking compared to the architectural precast

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Building Envelope

LEED Points

- **Up to 10 for optimizing energy performance**
- **2 for recycling content**
- **2 for low-emitting materials**
  - **Adhesives and Sealants**
  - **Paints and Coatings**

U.S. GREEN BUILDING COUNCIL

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Building Envelope

Area and cost Calculations

Estimated Façade Costs				
	Quantity	Unit	Total Unit Cost	Total Cost
Precast (original)	23,663	sf	--	$2,600,000.00
Versawall	23,663	sf	30	$709,890.00
Formawall Dim. Series	23,663	sf	60	$1,419,780.00

Savings: 4" Versawall with Duracast Finishing
Actual precast cost (not including change orders):
$2,600,000.00 - $709,890.00 = **$1,890,110.00**

Formawall Dimension Series with Duracast Finishing
Actual precast cost (not including change orders):
$2,600,000.00 - $1,419,780.00 = **$1,180,220.00**

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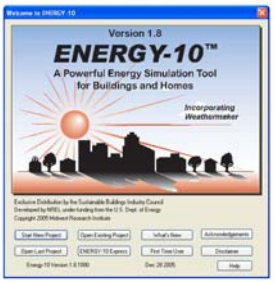
Building Envelope



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Building Envelope

Top Floor Only

Existing
R-Value of 10 for Walls
R-Value of 18 to 19 for Roof

Formawall and Versawall
R-Value of 20 and 30 for Walls
R-Value of 18 to 19 for Roof

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Building Envelope

Energy Savings

Formawall
1.90 kBtu/ft² Heating
-0.1 kBtu/ft² Cooling
1.8 kBtu/ft² Total

Annual Energy Costs Savings were $0.021/ft²

Versawall
1.6 kBtu/ft² Heating
-0.3 kBtu/ft² Cooling
-0.1 kBtu/ft² Other
1.2 kBtu/ft² Total

Annual Energy Costs savings were $0.012/ft²

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Green Roof Implementation

Proposal: Use money saved from different façade to add a Green Roof to help with Energy Savings

Some Green Advantages

- Helps manage storm water – almost 1000 parking spots
- Reduce noise pollution
- Long life span from ultraviolent protection
- Creates habitat for birds and other animals
- Helps with the urban heat island effect

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Green Roof Implementation

Top Floor Only

Existing
R-Value of 10 for Walls
R-Value of 18 to 19 for Roof
Solar Absorption 0.6

Green Roof
R-Value of 10 for Walls
R-Value of 30 for Roof
Solar Absorption 0.2

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Green Roof Implementation

Energy Savings

Green Roof
4.5 kBtu/ft² Heating
0.1 kBtu/ft² Cooling
0.2 kBtu/ft² Other
4.8 kBtu/ft² Total

Annual Energy Costs Savings were $0.003/ft²

Cost of Existing Roof
$9 per ft² at 20 years life span

Cost of Green Roof
$8 to $12 per ft² additional to existing price at 40 to 50 years life span

$17/ft² x 26000 = $442,000
$ 208,000 additional original cost

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Green Roof Implementation

Years needed to make money back?

$442,000 - $234,000 = $208,000

Annual Energy Cost Savings does not apply

After 20 years build up roof needs replaced:

($9/ft²)(26,000ft²)(2nd roof) = $468,000 > $442,000

Green roof pays for itself after 20 years…

…and lasts up to the next 20 to 30 years

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Green Roof Implementation

Individually

-Building façade — Not much energy or cost savings

-Green Roof — Not much energy or cost savings

Decided to combine green roof and new building envelope

Versawall and Green Roof

Formawall and Green Roof

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Green Roof Implementation

The energy saving conclusion with combined new façade and roof still not great.

Energy Savings from Façade and Green Roof vs Existing (kBtu/sqf)					
	Heating	Cooling	Other	Total Energy Savings	Total Cost Savings ($/sqf)
Versawall and Green Roof	5.9	-0.2	0.3	6.0	$0.015
Formawall and Green Roof	6.2	-0.1	0.3	6.4	$0.028

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Checking Green Roof Loads (Structural Breadth)

Additional Load of Green Roof = 37 psf
Extensive not intensive (less of a change)
Sedum and herbs (3" think)
Sedum, herbs, and perennials (5"thick)

Live Load : **35 psf**
Dead Loads: (150 lb/ft3)(5 ½")/(12"/ft) = **68.75 psf**
Green Roof **37 psf**
Snow Load: **27 psf**

Total Load:
1.2(68.75+37) + 1.6(35) + 27 = 209.9 => **210 psf**

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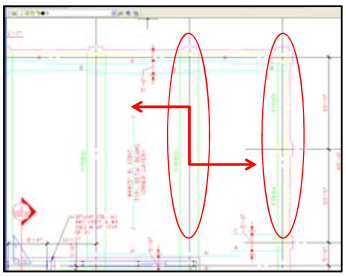
Checking Green Roof Loads

Checking Load Across Roof Slab



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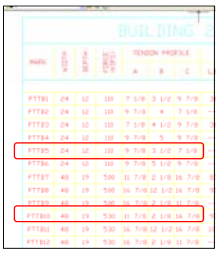
Checking Green Roof Loads

Post Tensioning Girders

PT Girders 5 and 10
- Force is post tension force
  - Divided by 26.5 kips for #
- Tendon Profile Measured from top or bottom of girder
  - A – end of member
  - B – Low or High point
  - C – Low or High point
- If Increase Strength is needed
  - Increase depth or width
  - Add tendons
    - Each tendon is already stretched to maximum



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Checking Green Roof Loads

Slab Calculations

Biggest Moment was at Exterior Support:

$-M = 1/12\ (210\ psf)(20')^2 = 7{,}000$ ft-lb

Worst case calls for :

$[(7\ kips)(12)] / [.9(60)(4.75 - 0.615/2)] = 0.35\ in^2$

Existing Reinforcement

#4 @ 15" = 0.16 in^2 < 0.35 in^2 No Good

Use #5 @ 10" = 0.37 in^2

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Checking Green Roof Loads

Rough Estimate of new steel cost from RS Means

($0.88/lb)(1.03% inflation)(2 years) = $0.93/lb

Existing #4 @ 15"

(215.5')(12"/15") = 97.2 bars, (97 bars)(214 ft)(0.668lb/ft) = 13,866.344 lb

#5 @ 10"

(215.5')(12"/10") = 145.8 bars, (146 bars)(214 ft)(1.043 lb/ft) = 32,587.492 lb

Additional Cost

32,587.492 lb - 13,866.344 lb = 18,721.148 lb($0.93/lb) = **$17,410.67**

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Conclusions

Using the new façade and green roof can save time, money, and will be better for the environment

End up making more money with new façade using the calculations below
(precast cost – façade cost – green roof – new steel cost = money saved)

Dimension Series:
$2,600,000 - $1,419,780 - $441220 - $17,410.67 = **$721,589.33**
Versawall:
$2,600,000 - $709,890 - $441220 - $17,410.67 = **$1,431,479.33**

These money saved along with the minor energy savings proves that this new façade and green roof are a good idea, despite the fact of a different look to the building.

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Implementation of Software for Steel Buildings

CIMsteel Integration Standards is not a program, function, or language

CIS/2 is a translator or a bridge to help software programs to communicate

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Implementation of Software for Steel Buildings

In 2002 the National Institute of Standards and Technology did a test to show inefficient interoperability increased new construction by $6.18 per ft²

Totaling $15.8 billion wasted per year back in 2002

Stakeholder Group	Planning, Engineering, Design Phase	Construction Phase	O&M Phase	Total
Architects and Engineers	$1,007.2	$147.0	$15.7	$1,169.8
General Contractors	$485.9	$1,265.3	$50.4	$1,801.6
Specialty Contractors/Suppliers	$442.4	$1,762.2	---	$2,204.6
Owners and Operators	$722.8	$898.0	$9,027.2	$10,648.0
All Stakeholders (Total)	$2,658.3	$4,072.4	$9,093.3	$15,824.0

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Implementation of Software for Steel Buildings

Some Advantages of implementing CIMSteel Integration Standards/Version 2 (CIS/2)

- Single model is carried through entire project
- Allows steel to arrive faster
- No 2D drawings or paper involved
- No snail mail involved
- Updates instantly with timestamp
- Links electronic versions of shop drawings to pdf
  - make viewable through web browsers
- Multiple method – to count steel more efficiently
- Can move model into SDS/2 software saving hundreds of hours

SDS/2 Software can detail a steel connection for you

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Implementation of Software for Steel Buildings

Case Studies

Glenn Oaks Campus, New York (2 Middle Schools, 1 High School)
- 3 schools simultaneously built in 18 months
- saved 2 to 3 weeks on steel delivery

Soldier Field, Illinois
- gutted and reconstructed 4 to 6 months less than a normal NFL stadium
- steel erection finished 2 weeks ahead of schedule

Presbyterian Hospital, New Mexico
- hospital was kept operational during addition
- fabricator quoted saying, "We saved a t least a couple of months as a result"

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Conclusions

Software saves time and money for every project it was used on.

Therefore this software should be incorporated in every project

If technology like this was used on Plaza East the Building Façade Mockup would not have been 4 ½ months past its due date

Weekly meetings could have flowed more smoothly

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Questions?