Columbia Heights Community Center

Washington, DC

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Construction Management

Presentation Outline

- Project Overview
- Analysis 1 – LEED® Point Research
- Analysis 2 – Precast Brick Façade
- Analysis 3 – Gymnasium Structure Redesign
- Analysis 4 – Foundation Placement Method
- Conclusions
- Q&A

Project Overview

Total Cost:
$ 9.8 Million

Size:
47,395 Sq. Ft.
4 Stories

Duration:
16 Months
Original: May 2005 – July 2006
Revised: July 2005 – September 2006

Building Function:
Public Recreational Activity Center
Satellite offices for DPR

Facilities:
Classrooms, Computer Lab, Gymnasium, Stage and Dressing Rooms, Dance Studio, Weight and Aerobics Rooms, Arts / Crafts, Music Room

North Elevation

Project Overview

- Extremely Congested Site
- Adjacent Structures
  - Apartments
  - Embassies
  - Park & Playground
- One Way Streets

Project Overview

Relevant Systems Background

Façade:
- Brick and Cast Stone with CMU backup
- Curtain Wall Assembly

Foundation:
- Step Footings, Strap Beams, and Tie Beams for cantilever adjacent to existing apartment

Framing:
- Structural Steel

Mechanical:
- Three rooftop Air-Handling Units
  - 31,200 cfm capacity
- VAV's at the local level
- Constant Volume used in the Gymnasium

Foundation – South

Project Overview

Traditional Delivery Method

Project Team

Owner:
DC Department of Parks and Recreations

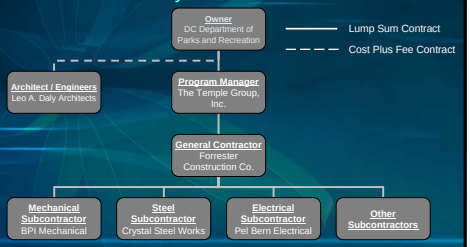
Program Manager:
The Temple Group, Inc.

General Contractor:
Forrester Construction Company

Architects/ Engineers:
Leo A. Daly Architects

Project Overview

Traditional Delivery Method



Project Overview

Silver LEED® Rated

- Leadership in Energy and Environmental Design ®
- Rating System
  - Sustainable Sites
  - Water Efficiency
  - Energy and Atmosphere
  - Materials and Resources
  - Indoor Environmental Quality
  - Innovation and Design Process

Certified 26-32 points Silver 33-38 points Gold 39-51 points Platinum 52-69 points

Analysis 1
LEED® Point Alignment

LEED® Point Alignment

Problem

- Owners going Green for many reasons
  - *Owners tend to pursue points based on cost*
- Initial LEED® targets are difficult to maintain
- Some points at risk

Existing Research

- Setting early "green" goals is critical
- No tools that connect owner values with LEED® points

Goal

- Identify LEED® points that are aligned with owners' goals
- Produce an interactive tool can be used to identify the most achievable and functional points

LEED® Point Alignment

Interviews of owners of 10 projects

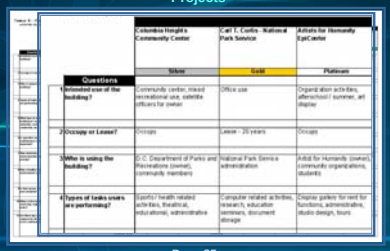
- Selected from the U.S. Green Building Council (USGBC) database
- Focus: New Construction and Major Renovations (LEED®-NC) Version 2.1 projects
- Variable certification levels
  - 4 LEED® Certified
  - 3 LEED® Silver
  - 2 LEED® Gold
  - 1 LEED® Platinum

LEED® Point Alignment

Goal Summary

Projects

Questions



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LEED® Point Alignment

Common Goals

- Healthy indoor environment
  - Priority for office / administrative environments (7 out of 10 projects)
- Lowering operation and maintenance costs
  - Common among owners who plan to occupy (7 out of 10 projects)
- Accessible to the Community
  - Mentioned by owners in urban setting (4 out of 10 projects)
  - Accessible to multiple forms of transportation

LEED® Point Alignment

Common Goals (cont.)

- "Setting an example" or "being the measuring stick" for future Green facilities
  - Noted by organization with future projects or mandated level of LEED® certification
    - As economical and efficient as possible
    - Cost an underlying factor
    - "Low Cost" LEED® Points research

LEED® Point Alignment

LEED® Point Matrix

- Compares 10 projects
  - Common / Uncommon points
- "Low Cost" LEED® Points
  - Hernando Miranda (Soltierra LLC), "Achieving 'Low Cost' LEED® Projects", *HPAC Engineering Magazine*, April 2005.

LEED® Point Alignment

LEED® Point Matrix

Projects

LEED® Points

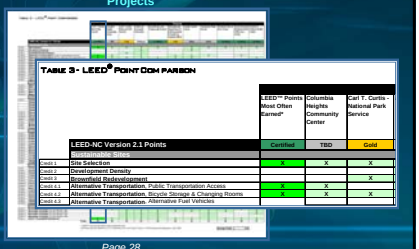

TABLE 3 - LEED® POINT COMPARISON

	LEED-NC Version 2.1 Points	LEED™ Points Most Often Earned*	Columbia Heights Community Center	Carl T. Curtis - National Park Service
		Certified	TBD	Gold
	Sustainable Sites			
Credit 1	Site Selection	X	X	X
Credit 2	Development Density			
Credit 3	Brownfield Redevelopment			X
Credit 4.1	Alternative Transportation, Public Transportation Access	X	X	
Credit 4.2	Alternative Transportation, Bicycle Storage & Changing Rooms	X	X	X
Credit 4.3	Alternative Transportation, Alternative Fuel Vehicles			

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LEED® Point Alignment

Deviations from the "Low Cost" 26

- Patrick H. Dollard Health Center (17 out of the 26)
- Baca/Dlo'ay azhi Community School (18 out of the 26)

Shared Attributes

- Not projects where the organization mandated they go Green
- Goal of obtaining points that were functional to their building

"Low Cost" LEED® Point List – a great start for projects that *must* obtain Green!

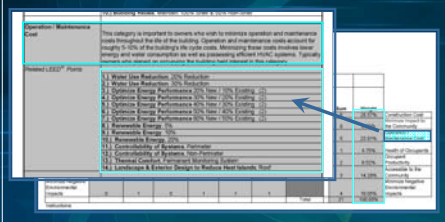
LEED® Point Alignment

Point Alignment Tool

- Microsoft Excel® Tool
  - Use of owner responses / points achieved
  - Modified version of that created by Mike Pulaski (Ph.D. dissertation 2005)
  - Rate Goals on Importance
  - Weight Factor
  - Refer to "Definitions" for possible LEED® Points

LEED® Point Alignment

Point Alignment Tool



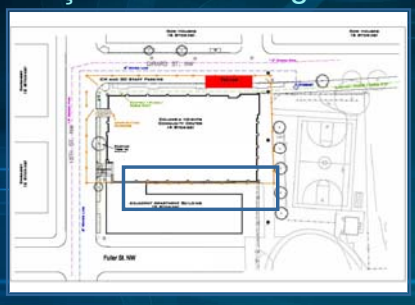
LEED® Point Alignment

Conclusions & Recommendations

- Mandated projects should consult the "Low Cost" LEED® Point List as a foundation
- Point Alignment Tool can be an aid during design and planning
  - Helps to set goals and determine priorities
  - Reorganizes LEED® Points according to goals
- Next: Test the "Point Alignment Tool" on new projects

Analysis 2
Façade Redesign

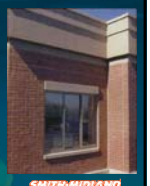
Façade Redesign



Façade Redesign

Outcome

- Slenderwall® System (Smith Midland™)
- Initially $57,400 more expensive
- Reduces schedule by almost 14 days
- Weighs significantly less
- Slightly reduces heat-loss and heat-gain



Façade Redesign

Precast System

- Slenderwall® System (Smith Midland™)
  - Architectural precast concrete
  - Reinforced with hot-dipped galvanized welded wire
  - Insulated Nelson® anchors (THERMAGUARD™)
  - Stainless steel framing backup (fill with R13 batt)
- Cost: $22/s.f. - $33/s.f.
- Productivity: 15-20 panels/day
  - Depends on complexity

Slenderwall®

Façade Redesign

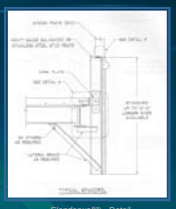
Cost Impacts

- Replacing 5,720 s.f. of façade (110' x 52')
- Two types of panels
  - Panel A: 10'-0" x 39'-8"
  - Panel B: 10'-0" x 12'-4"
- No crane impacts: max lift is 5 tons / panel
  - Crane Manufacturer specifications show a 5.5 ton lift with 115'-0" boom and 90'-0" radius (Grove® TMS900E Crane)
- $57,400 more expensive

Façade Redesign

Structural Impacts

- Brick: 4" thick ➔ 40lbs/sf
  - ASCE7 2005 Minimum Design Loads for Buildings
- Slenderwall® ➔ 28lbs/sf per manufacturer
- Slenderwall® weighs 34 tons less
- Since connection at 16" O.C. (typical), assume no negative structural impacts
  - Evenly distributed



Slenderwall® - Detail

Façade Redesign

Mechanical Analysis

Heatloss Winter

Item	U-Value	Area (sf)	Delta T (F)	Heatloss (BTU/hr)
Brick Assembly	0.144	2970	55	23522.40
Slenderwall®	0.057	2970	55	9310.95
			Difference:	14211.45
			Existing AHU	218700
			% Difference of Total AHU Load:	6.50%

Heatgain Summer

Item	U-Value	Area (sf)	Delta T (F)	Heatgain (tons)
Brick Assembly	0.144	2970	25	0.89
Slenderwall®	0.057	2970	25	0.35
			Difference:	0.54
			Existing AHU	20.04
			% Difference of Total AHU Load:	2.69%

1 Ton = 12000 BTU/hr

Façade Redesign

Schedule Impacts

- Total of 22 Slenderwall® panels
- Assume 16 panels / day
  - 15-20 panels/day from manufacturer
- Reduces schedule by nearly 14 days
  - Saves $21,500 in General Conditions
- Building Enclosed two weeks early

Façade Redesign

Conclusions & Recommendations

- No mechanical and structural impact
- Reduces waste associated with brick
- Reduces site congestion
- Reduces schedule by almost 14 days
  - Saves $21,500 in General Conditions
  - Encloses building
- Ultimately $35,900 more expensive
  - Only 0.37% of entire project

Slenderwall® worth the investment

Slenderwall®

Analysis 3
Gymnasium Steel Redesign

Gymnasium Steel Redesign

Problem

- Gymnasium steel very large
  - Span 60'-0", W40x215
  - Support open office on fourth floor
  - Some members take loads from the roof through transfer columns (15 kips)
- Costly in terms of material
- Large crane needed

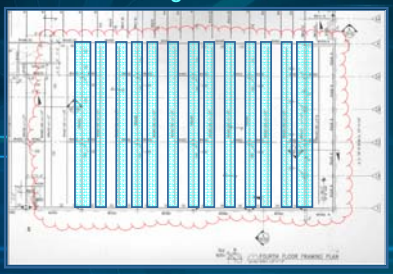
Steel Joists

Goal

- Verify existing member sizes
- Change to open-web steel joist

Gymnasium Steel Redesign

Fourth Floor Framing Plan



Gymnasium Steel Redesign

Outcome

- RAM Steel v10.0 modeling software output:
  - Reduced Steel System (I-beams)
  - Open-web Steel Joists
- Extensive review of output showed an error in the results
- Only some members could be changed

Gymnasium Steel Redesign

Building Loads

- ASCE7 2005 Minimum Design Loads for Buildings
- Structural Specifications
- Roof Loads (including Green Roof):
  - Snow: 30 psf
  - Dead: 118 psf
- 4th Floor Loads:
  - Dead: 57 psf
  - Live: 80 psf

➔ Loads were then entered into RAM modeling software

Gymnasium Steel Redesign

RAM Steel v10.0 Output

- Reduced Steel Design
  - W40x215x60' reduced to W30x90x60' at 6'-6" O.C.
- Open-web Steel Joists (Long-Span)
  - 44LH09 and 44LH15 (transfer column) at 4'-0" O.C.

Significant reduction – how is this possible?

Gymnasium Steel Redesign

Output Error and Recalculations

- Distributed Loads identified by RAM were incorrect
- Worked with structural consultant to verify loads
  - 327plf (RAM) vs. 785plf (hand) – transfer beams
    RAM output can not be used
    Can not reduce beams supporting transfer columns
  - Looked to replace filler beams

Gymnasium Steel Redesign

Recalculations

- Filler beams could be replaced by open-web joists
  - (16) 36LH13 @ 4'-0" O.C. - replace existing (8) W24x62
- Reduces costs and material:
  - ½ ton of steel
  - $23,000
- No impact on erection speed

Gymnasium Steel Redesign

Conclusions & Recommendations

- Change filler beams to open-web joists
  - Cost and material quantities decreased without impacting speed
- Next: could the metal deck size be reduced due to closer beam spacing?

Analysis 4
Foundation Placement

Foundation Placement

Analysis Overview

- Cast the footings in excavated trenches
- Bulk excavation of site and use of forms
- Reduce labor costs, schedule, and the amount of material used

Site Photo - Foundation

Foundation Placement

Outcome

- Increased safety measures must be taken
- More concrete needed (10%)
- Trench Method Saves
  - $92,400
    - Reduced spoils
    - Removal of formwork labor and materials
  - 4 days off schedule
  - 1653 BCY reduction in spoils
    - Reduced by roughly 77%
    - Reduced site disturbance – supports LEED® ideals

Site Photo - Foundation

Conclusions

Conclusions

Conclusions

- LEED® Point Alignment
  - Rearranged LEED® Points according to goals
  - Effective tool for planning future LEED® projects
- Façade Redesign
  - Slenderwall® System used
    - Costs slightly more but relieves congestion, reduces waste quantities, and saves time
- Gymnasium Steel Redesign
  - Filler beams could be changed to open-web joists
    - Saves material quantities as well as costs
- Foundation Placement Method
  - "Trench" foundation placement method is a feasible alternative
    - Reduces quantities of spoils and associated costs

Conclusions

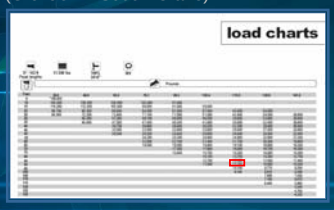
Acknowledgements

- Penn State Department of Architectural Engineering
- Forrester Construction Company
- DC Department of Parks and Recreations
- Smith-Midland Precast Manufacturer
- All of the LEED® Rated project personnel
- Family, AE students and friends
- Most importantly: Mom, Dad, Seth

Questions?

Façade Redesign

- No crane impacts: max lift is 5 tons / panel
  - Crane Manufacturer specifications show a 5.5 ton lift with 115'-0" boom and 90'-0" radius (Grove® TMS900E Crane)



Façade Redesign

Mechanical Impacts

- Temperatures taken for Washington, DC
  - Summer
  - Winter

Temperature Assumptions

Areas:		
Gymnasium Wall:	110'-0" x 27'-0"	2970 SF

Winter Temperature	
To	15 F
Ti	70 F
Delta T	55 F

Summer Temperature	
To	95 F
Ti	70 F
Delta T	25 F

* Temperatures taken from 1997 ASHRAE Handbook Fundamentals

Gymnasium Steel Redesign

Building Loads

Snow (roof slope 1/4" / 12")

C_e	C_t	I	p_g (psf)	p_s (psf)
0.7	0.9	1.0	1.1	25.0	17.33

*Quantities and calculation method taken from ASCE7-05(Ch.7)

Dead Loads

Assignment	Load (psf)
Roof	
PVC Roofing Membrane (single ply)	0.7
Polyisocyanurate Board Insulation (glass-fiber)	1.1
Purlin Metal Frame	8.0
Steel Deck (20 gage)	2.5
Concrete slab on deck (lightweight 3" thick)	50.0
Green Roof*	50.0
Misc.	0.7

* Per drawing A 2.00

Floor System (4th Floor)	
Carpet Tile	2.0
Steel Deck (18 gage)	2.5
Concrete slab on deck (lightweight 3" thick)	50.0

Ceiling System (Gymnasium)	
Mechanical Allowance	4.0
Total:	57.0

*Quantities and calculation method taken from ASCE7-05(Ch.3)

Ceiling System (4th Floor)	
Acoustical Fiberboard	1.0
Mechanical Allowance	4.0
Total:	118.0

Live Loads

Assigned	Load (psf)
Fourth Floor	
Open Office / corridor	80.0

*Quantities and calculation method taken from ASCE7-05(Ch.4)

Gymnasium Steel Redesign

Recalculations

- Filler Beams
  - W_u = 548plf
  - M_u = 353 k*ft
  - 36LH13 @ 4'-0" O.C.
    - *Canam Steel Corp. Joist Calalog*

Columbia Heights
Community Center

Gymnasium Steel Redesign

Recalculations

Item	Number	Total Length (ft.)	Tons	Total Material $	Total Labor $	Total Equipment $	Total Cost
W 24x62	8	480.00	14.88	$37,944	$5,357	$2,515	$45,816
36LH13	16	960.00	14.40	$20,808	$1,306	$653	$22,766

Item	Material $ / Ton	Labor $ / Ton	Equipment $ / Ton
W 24x62	2550	360	169
36LH13	1445	90	45

Columbia Heights
Community Center

Foundation Placement

Method Comparison

Difference Summary Table

Item	Trench Excavation	Bulk Excavation	Difference
Material (BCY)	967.09	2620.93	1653.84
Material (LCY)	1063.80	2883.02	1819.22
Total Costs	$27,893.91	$120,317.59	$92,423.68
Excavator Demand (Days)	4.8	8.8	4

** Total costs include excavation costs and forming costs*

Assume average swell factor to be 10%