THAMES ST. WHARF OFFICE BUILDING
BALTIMORE, MD

C. CHRISTOPHER BELL
THE PENNSYLVANIA STATE UNIVERSITY
CONSTRUCTION MANAGEMENT

Presentation Outline

I. Project Background
II. Integrated Project Delivery
III. Façade Redesign
IV. Mechanical System Redesign
V. MAE Requirements
VI. Conclusions & Recommendations
VII. Acknowledgements
VIII. Q & A

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Project Overview

- Location: Baltimore, MD
- 7 Story Office Building 8th Floor Mechanical PH
- Ground Floor Restaurant and Retail Space
- 277,000 SF: 34,000 SF – 36,000 SF/Floor
- $55 Million GMP Contract
- DBB w/ CM @ Risk
- Schedule: October 2007 – March 2010

Project Overview

- Owner: Harbor Point Development, LLC.
  - Subsidiary of H&S Properties Development Corp.
- Construction Manager
  - Struever Bros. Eccles & Rouse (Oct. 2007 – April 30, 2009)
  - Armada Hoffler Construction Company (May 1, 2009 – March 15, 2010)
- Architect of Record: Ayers/Saint/Gross + Planners
- Structural Engineer: Morris & Ritchie Associates
- MEP Engineer: Vanderweil Engineers

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Building Systems

- Structure:
  - Deep pile foundation
  - PT Concrete Slabs and Beams
  - Mild steel reinforced columns and shear walls
  - Steel Penthouse
- Façade
  - Glass curtain wall on south face and southern portions of east & west face
  - Brick with curtain wall windows on remainder of east & west and north face

Building Systems

- Mechanical System
  - (16) SCU's – two per floor
    - (2) 36 ton units
    - (14) 50 ton units
  - 24,000 CFM per unit
  - Under floor ductwork distribution system
  - (2) energy recovery units
  - (3) cooling towers

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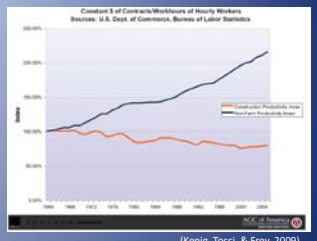
Architectural Engineering

Integrated Project Delivery

- Background
  - Construction industry only one that is becoming less efficient
  - 30% of projects do not make schedule or budget
  - 92% of owners say drawings not sufficient for construction
  - Estimated 37% of materials are wasted
  - Estimated 37% of project cost is non-value added

"Imagine, getting the building you wanted, at the price you were promised, on the day you were promised it."
  - John Tocci Sr., CEO of Tocci Building Companies

- Goals
  - Introduce IPD as solution for issues plaguing industry
  - Show benefits of IPD on Thames St. Wharf



(Kenig, Tocci, & Frey, 2009)

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Architectural Engineering

Drawbacks of Design-Bid-Build

- Project team members work against each other
  - Play the "blame game" instead of solving problems
- Concern over own profits rather than success of project
- Non-collaborative design process doesn't allow for best product
  - Some of the best ideas are left out because they are introduced to late
- Design takes longer than needed due to re-work
- Money is made on change orders
- Idea of best product for lowest price does not lead to success

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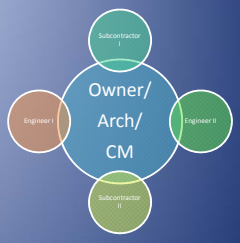
Integrated Project Delivery

- Contracting
  - All project team members sign one contract
    - Aligns the goals of all team members – project success is biggest priority
    - Signed at the very beginning of design
    - Engineers and subcontractors sign adjoining agreements
  - Target cost contract not GMP
  - Shared risk: if one party loses, all lose
  - Shared reward: any savings from target cost are split among team members by their risk allocation
  - No litigation clause



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Cost

- Continuous estimates refine the cost of the project
- Savings are realized early on and can be put back into project
- Decisions are made earlier where they have more influence on cost
- Contingency is able to be reduced because actual costs are known earlier
- Not the “cheaper” option but a more value added option
- Autodesk HQ was able to add 7.5% of base budget in improvements without raising cost of the project

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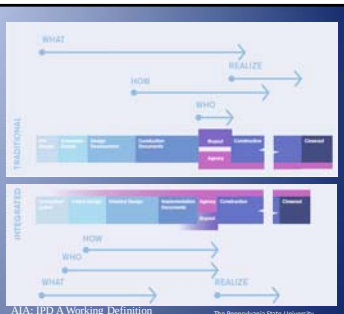
Schedule

- Design schedule able to be reduced
  - Elimination of rework
  - Entire design done at the same time instead of in stages
  - CD phase shortened because project already fully designed and coordinated
    - CD phase is to show how project will be built, not to refine design
- Construction
  - Subcontractor familiarity allows them to work faster
  - Building already coordinated so don't have to stop work to make decisions
  - When issues come up emphasis on fixing it rather than who is going to pay for it
  - Better able to prefab systems
  - Long lead items are able to be ordered sooner



AIA: IPD A Working Definition

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DBB for Thames St. Wharf

- Three redesigns
  - New ideas were proposed by different designers as they were brought on throughout design
- Estimated $6 million added to original scope
  - Caused non-value added work to be done
- 400+ RFI's
- Coordination was taking place during construction
  - Issues with concrete shop drawings
    - Concrete curbs and beams 2" too large
- Tenant fit-out was included as separate design package
- Constant blaming occurred during project meetings

IPD Solutions

- Design team would have been assembled sooner and new ideas could have been incorporated in original design
- Early cost estimates could have let owner know how much money was available to add systems
- "RFI's" are asked during detailed design phase
- Coordination would have taken place during design phase eliminated delays while waiting for RFI responses
- Tenant fit-out could have been included in original scope
- Issues would have been resolved without wasted time on legal documentation

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Conclusions

Pros
- IPD increases project value
- IPD decreases project schedule
- IPD increase work experience
- IPD makes the project itself the most important thing, not personal profits

Cons
- Heavy design cooperation
- Sophisticated owner

Owner needs to have a large amount of trust in the team that was chosen

Recommendations

- IPD has the ability to benefit almost any project and should be considered as a viable delivery method for all projects in the future

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Façade Redesign

- Background
  - Building façade is 68% glazing
  - Enclosure cooling load accounts for 42% of total load
- Goals
  - Reduce the building cooling load without drastically increasing price
  - Reduce the amount of glare in the building spaces

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Current Façade

- Stick built curtain wall & windows
  - Curtain wall is outside glazed
  - Windows are inside glazed
- Brick only used to cover column lines and concrete curbs
- Interior daylight views from floor to ceiling

Current Façade

Performance				
W/SF	Area [SF]	Btu/hr	tons	tons/unit
3	48,000	491,040	40.92	20.46

Cost			
	Area (SF)	Cost/SF	Cost
Curtain Wall	31,914	$ 70	$ 2,233,980
Windows	18,445	$ 30	$ 553,350
Total	50,359		$ 2,787,330
Glazing			
Glazing	47,923	$ 8.50	$ 407,346

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Proposed Façade

- Keep the same base curtain wall
- Change all of the buildings glazing
  - Pick a glazing with a higher R-Value and lower SHGC
  - Switch from PPG Solarban® 70XL to Serious Materials SeriousGlass SG 8

Proposed Façade

Solarban® 70XL (2) Starphire®													
Product	U-Value		R-Value	SHGC	Glass Surface Temp. (F)		Reflectance (%)		Transmittance (%)			Shading Coefficient	Relative Heat Gain	LSG
	Wint.	Sum.			Wint.	Sum.	Vis.	Solar	Vis.	Solar	UV			
Solarban® 70XL (2) Starphire®	0.28	0.26	3.7	0.27	UNK	UNK	12	52	64	25	6	0.32	UNK	2.37

PPG Industries

SeriousGlass SG 8 51/24-150														
Product	U-Value		R-Value	SHGC	Glass Surface Temp. (F)		Reflectance (%)			Transmittance (%)			Shading Coefficient	Relative Heat Gain	LSG
	Wint.	Sum.			Wint.	Sum.	Vis-Out	Vis-In	Solar	Vis.	Solar	UV			
SG 8 51/24-150	0.13	0.13	7.7	0.24	62	82.3	13	16	37	57	22	<1	0.28	57.4	2.36

SeriousMaterials, SeriousGlass

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Performance Comparison

Façade Cooling Load Comparision						
	Original Enclosure Load - Actual	Original Envelope Load - Calculated	Proposed Enclosure Load - Calculated	% Reduction	Load Difference Original-Actual vs. % Difference	Adjusted Proposed Façade Load
Btu/hr	491,520	31,622	23,268	26%	127,795	363,725
Tons	40.96	2.64	1.94	26%	10.65	30.31

Cost Comparison

Cost			
	Area (SF)	Cost/SF	Cost
Curtain Wall	31,914	$ 71.43	$ 2,279,536
Windows	18,445	$ 31.43	$ 579,679
Total	50,359		$ 2,859,215
Glazing			
Glazing	47,923	$ 10.00	$ 479,230

Cost Comparison				
	Original Total	Proposed Total	Difference	% Addition
Glazing	$ 407,346	$ 479,230	$ 71,885	15.0%
Curtain Wall	$ 2,233,980	$ 2,279,536	$ 45,556	2.0%
Windows	$ 553,341	$ 579,670	$ 26,329	4.5%
Subtotal	$ 2,787,330	$ 2,859,215	**$ 71,885**	**2.5%**
Total System Cost Including O&P	$ 4,315,917	**$ 4,427,223**	**$ 111,306**	**2.5%**
Total Construction Contract Value	$ 54,321,902	**$ 54,441,133**	**$ 119,231**	**0.22%**

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Conclusions

- Switching from PPG Solarban® 70XL to SeriousGlass SG 8 reduces cooling load by 26% while only increasing cost by 2.5%

Recommendations

- The added first cost for the new system is justified by the improved performance, switching the glazing type is recommended

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HVAC System Evaluation & Redesign

- Background
  - HVAC system cost is 18.5% of the total building cost
  - High energy performance system
- Goals
  - Use energy savings from façade redesign to reduce mechanical system cost

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Current Mechanical System

- Building Loads
  - 3.5 W/ft^2 for equipment
  - 1 W/ft^2 for occupants
  - 2 W/ft^2 for lighting
- Total cost = $10.2 Million
  - SCU cost = $1,779 per ton

Current Mechanical System

Cooling Load Summary							
	Occupants	Lighting	Equipment	Total Non-Envelope	Envelope	Total	Total per SCU
Btu/hr	103,187	199,417	365,211	667,815	491,040	1,158,855	579,428
Tons Cooling	8.60	16.62	30.43	55.65	40.92	96.57	48.3
% of Total	9%	17%	32%	58%	42%		

Mechanical System Cost Breakdown		
Total Cost	$	10,194,691
Mechanical Sub O&P (30%)	$	2,352,621
Subtotal (Unit Cost)	$	7,842,070
SCU Cost	$	1,372,069
Unit Cost w/o SCU's	$	6,470,001

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Proposed System

- Existing system fits all of the extensive requirements of the owner
  - Keep current system just reduce size due to lower load

Performance

Proposed Cooling Load Summary per Floor

	Occupants	Lighting	Equipment	Total Non-Envelope	Envelope	Total	Total per SCU
Btu/hr	103,187	199,417	365,211	667,815	361,669	1,029,484	514,742
Tons Cooling	8.60	16.62	30.43	55.65	30.14	85.79	42.90
% of Total	10%	19%	35%	65%	35%	100%	50%

Performance Comparison

Cooling Load Comparison Original vs. Proposed

	Original Cooling Load	Proposed Cooling Load	Total Savings per Floor	Savings per SCU	% Reduction
Btu/hr	1,158,855	1,029,484	129,371	64,686	11%
Tons Cooling	96.57	85.79	10.78	5.39	11%

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Performance Comparison

System Cost Comparison

Original Size (Tons)	Proposed Size (Tons)	Quantity	Cost/Ton	Original Cost	Proposed Cost	Difference	% Difference
36	32	2	$ 1,777.29	$ 127,965	$ 113,747	$ 14,218	11%
50	43	14	$ 1,777.29	$ 1,244,103	$ 1,069,929	$ 174,174	14%
				$ 1,372,068	$ 1,183,675	$ 188,393	13.7%

Cost Comparison

Proposed Mechanical System Cost	
System Unit Cost w/o SCU's	$ 6,470,001
Proposed SCU Cost	$ 1,183,675
Subtotal	$ 7,653,676
Mechanical Sub O&P	$ 2,296,103
Total Proposed Cost	$ 9,949,779
Original Cost	$ 10,194,691
Savings	$ 244,912
Percent Savings	2.4%
Proposed Total Building Cost* (Including CM O&P)	$ 54,178,783
Original Building Total (Including CM O&P)	$ 54,321,902
Total Savings	$ 143,119

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Conclusions

- System reduction saves $143,119 on building first cost
- does not add to construction schedule

Recommendations

- Reduction in HVAC system cost pays for the increased cost in the building façade

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MAE Requirements

- AE 542: Building Enclosure Science & Design
  - Building load calculations, curtain wall design ideas
- AE 597D: Sustainable Building Methods
  - Building orientation, integrated design approach

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Conclusions

- IPD delivers a higher quality project, in less time, with less hassle
- Switching glazing reduces energy performance by 26% while only increasing cost by $119,231
- Reducing mechanical system saves $143,119 on total contract

Recommendations

- Use IPD as delivery method when possible
- Use SeriousGlass SG 8 for TSW
- Reduce mechanical system to reflect reduction in building load

Acknowledgments

- Marco Greenburg: Harbor Point Development LLC
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- Dr. James Freihaut: Architectural Engineering Faculty
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- My Family & Friends

Questions?