The Moore Building Addition

University Park, PA 16802

Mohammad Alhusaini

Construction Management

Presentation Outline

Building Systems

Steel structure
Laterally braced frames
Basement houses mechanical equipment
Brick veneer façade + aluminum panels & glazing
Ground level glass curtain wall
Underpinning required for existing structure

Project Background

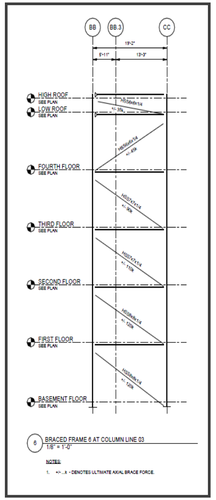
Building Summary

Department	Department of Psychology at PSU
Budget	~$26.1 Million State Funds Included
Size	57,000 SF addition + 16,000 SF North Wing
Time	June 2010 to January 2012
Project Delivery Method	Design Bid Build
Classification	B (Business)

Photo: Bing Maps

Photo: Bing Maps

Building Site & Bracing



Presentation Outline

The Theme

Department of Psychology

Research intensive – 45% of liberal arts research funds
Focus on new and innovative research and techniques
Currently located in existing Moore Building
"Displaced" researchers

Goal: Explore methods that will [theoretically] allow the dept. of psychology to be able to occupy the Moore Building Addition at a date sooner than anticipated.

Top Priorities (construction)

1. Expand & enhance labs
2. Lab technologies
3. Soundproofing

Presentation Outline

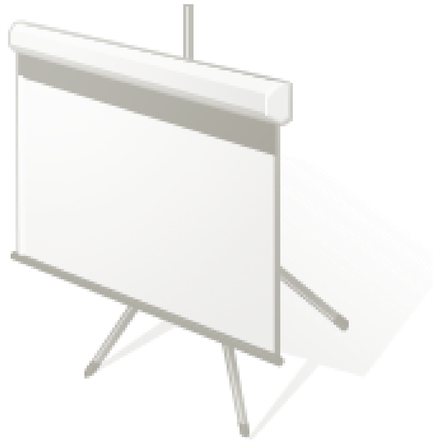
Presentation Overview

Analysis I: Demolition

Analysis II: Façade
Mechanical Breadth *presented*
Structural Breadth *not presented*

Analysis III: Structural Steel

Analysis IV: BIM through AE



Presentation Outline

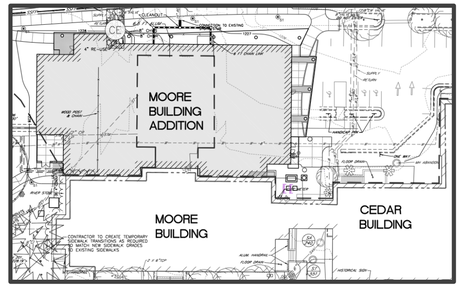
Asbestos

Cost of removing asbestos from North Wing: ~$350K

Analysis I: Demolition

North Wing
16,000SF
Selective Deconstruction
Structurally independent of addition
Contains asbestos

Calendar days required for Asbestos Abatement and Selective Demolition: **103 Days**



Selective Demolition
Will occur on North Wing
Cannot begin before Asbestos Abatement

Cost of selective demolition on North Wing: ~$280K

Presentation Outline

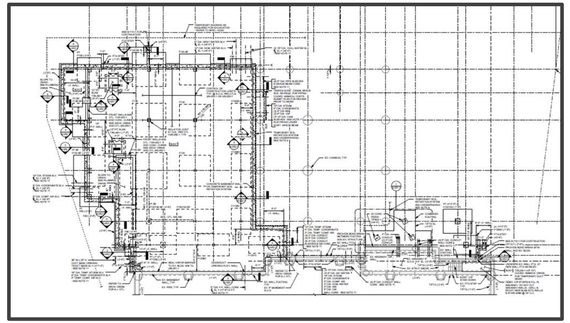
Demolition/Deconstruction
16,000SF
Proposed schedule accelerator
Must occur after asbestos abatement
Deconstruction; less debris, low cost

9 workdays to deconstruct
$81K to deconstruct

Analysis I: Demolition

Superstructure Reconstruction
16,000SF
This needs to occur after demolition
Considered as part of entire structure
Cost/SF of steel w/o HSS Bracing

~~26 workdays to erect superstructure (schedule-derived)~~
10 workdays to erect superstructure (comparative)
$426K cost of reconstruction



Added Benefits
Possible increase in basement size by 5,400SF &
Underpinning will be eliminated for North Wing

Cost would be $24K less than underpinning alone

Presentation Outline

Risks
If >17,000SF asbestos; losses
Demolition pollution dangerous; 9x increase

General Conditions
Savings: $34.4K
Based on $17K/wk

Analysis I: Demolition

Final Comparison (no asbestos)
Selective Demolition

Cost: $237K

Duration: 29 workdays

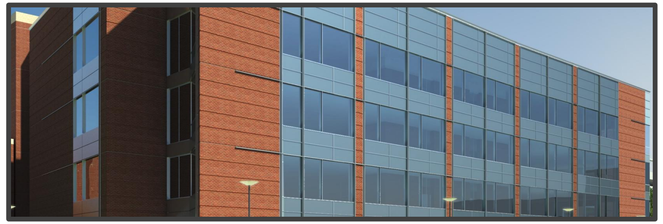
Final Comparison (no asbestos)
Demolition/Deconstruction

Cost: $390K

Duration: 19 workdays

Presentation Outline

Analysis II: Façade



Façade System Composition

Brick veneer

Metal panels

Glazing

Façade System Importance

Face of psychology at PSU

Architectural significance

Presentation Outline

Analysis II: Façade

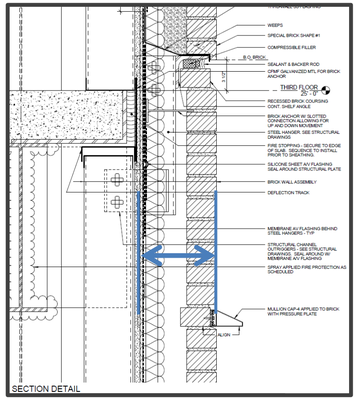
Brick Veneer
13,300SF Brick Façade (+waste)
CFMF Backing
46psf – 307.5 tons

98 days to construct (Framing separate contract)
$300K to construct

Precast Panels (Oldcastle Precast)
12,100SF Brick Façade (+waste)
CFMF Backing
44.5psf – 270.5 tons

7-20 days to construct (after superstructure)
$304-363K to construct

Schedule impact: 67 days reduction



Presentation Outline

Structural Breadth

Performed hand calculation

Performed STAAD analysis

Realized load implications

Bending moments and deflections in report

Precast panels have no ill effect on structure

Analysis II: Façade

Mechanical Breadth

Energy Savings

Energy Through Façade Systems

	q = U * A * ΔT				
Brick Façade	q = 0.1059 * 12100SF * 25 F	32,044	BTU/h	279,900,000	BTU/year
Precast Façade	q = 0.0769 * 12100SF * 25 F	23,251	BTU/h	203,100,000	BTU/year
			Difference	76,800,00	BTU/year
				22,500	kWh/year
$0.1026/kWh Commercial 2010 Data	**Cost Saving = 22,500*0.1026 = 2,310 $/year**				

R Values (coloradoENERGY)

R & U Values for Different Systems

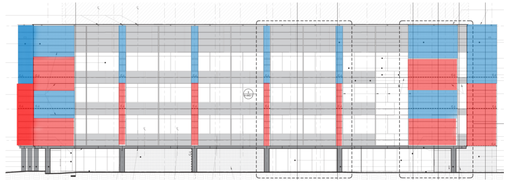
Material	R Value/Inch	Brick Façade	Precast Façade	
Concrete	0.08	0.00 (0")	0.40 (5")	
Brick	0.11	0.44 (4")	0.11 (1")	
Air Film	1.00 (0.5" – 4")	1.00 (2")	0.00 (0")	
Rigid Insulation	4.00	8.00 (2")	0.00 (0")	
Polyurethane Insulation	6.25	0.00 (0")	12.50 (2")	
	Sum of R Values	9.44	13.01	
	U Value (1/R)	0.1059	0.0769	BTU/(ft² * °F * h)

Presentation Outline

Panels

66 panels

Range of sizes: 3’ x 24’ to 12’ x 30’



Analysis II: Façade

Logistics

Transport by Semi-trailer

Max load 55,000lbs

8.5’ x 53’ (W x L)

10 trips required

Slot = row on bed of truck

Ample turning room form park avenue to site

Trailer					
Slot	1 (x2)	2 (x2)	3 (x3)	4 (x1)	5 (x2)
1	12x30	6x24	12x19	9x24	12x24
	12x20	12x17	3x24	9x24	12x24
2	12x30	6x24	12x19	4x24	12x24
	12x20	12x17	3x24	4x24	12x24
3	3x24	12x17	3x24	4x24	12x24
	12x20	12x17	3x24	4x24	12x24
		12x15			
4	3x24	12x17	12x19	3x24	12x24
	12x20	12x17	12x19	3x24	12x24
		12x15			
5	3x24	12x15	12x19	6x24	
	3x24	12x17	12x19	6x24	
		12x19			
6	3x24	12x15	12x19	12x16	
	3x24	12x17	12x19	7x16	
		12x19			
7	3x24	8x24	12x19		
	3x24	8x24	12x19		

Photo: Google

Presentation Outline

Architectural Implications

May not be appropriate

Higher cost to better mimic masonry

Analysis II: Façade

Conclusions

Costs more

Saves at least 2 months

Structurally sound

Performs better in energy savings: $2.3K/year

Reduces on-site clutter and waste

May be hard to coordinate

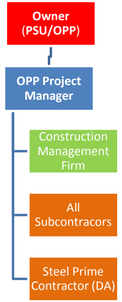
Photo: Google

Presentation Outline

Design Assist (DA) Contract

Similar to design-build, but for one subcontract (e.g. steel prime)

Moore Goal: accelerate steel fabrication & erection



Analysis III: Structural Steel

Significance of Structural Steel

Most important critical path item

2 unsuccessful attempts at accelerating

1ST attempt: Accelerate foundations

2ND attempt: Accelerate steel fabrication

Shortcomings: No money involved

Design Assist Process

Phase I: Owner must have clearly defined scope, schedule and budget

Phase II: Collaboration between DA professional/contractor and owner to create design goals and specifications

Phase III: Contract adapted for DA introduction, and DA professional formally selected.

Presentation Outline

Case Studies

Based on Don Proffer studies on Haven Steel
Direct DA correlation
Performed in 2000's

Analysis III: Structural Steel

Case 1: Dakota Dome

Scope: tear down air supported fabric roof off dome; create structural steel roof
Schedule: 4.5 Months
Successful through DA contract

Case 2: Convention Center

Success story as well!

Photo: Proffer

Presentation Outline

Survey

Performed to quantify benefits/drawbacks of DA

50+ participants

Majority CM, owners and PMs replied

Most performed >1 DA projects

Analysis III: Structural Steel

Survey Results

Results Averaged	
Question	Average
3. How much more (or less) effective is a design-assist contract (generally) in terms of schedule reduction than a typical contract?	15.385%
4. How much more (or less) effective is a design-assist contract for structural steel in terms of schedule reduction than a typical contract?	15.769%
5. How much more (or less) effective is a design-assist contract (generally) in terms of cost reduction than a typical contract?	10.388%
6. How much more (or less) effective is a design-assist contract for structural steel in terms of cost reduction than a typical contract?	8.462%
7. How would you quantify the risk involved with taking on a design-assist contract as opposed to holding a typical contract with a steel subcontractor, as a percentage of the contract value?	13.88%

Survey Results

Final Analysis			
Item	% Average increase/decrease	Original Quantity	Increase/(Savings)
Schedule Impact	15.769%	71 Days (from design to delivery of structural steel)	(12 work days)
Cost Impact	8.462%	$1.28M (structural steel only)	($108K)
Risk Involved	13.88%	$26.1M	($3.62M)

Presentation Outline

Analysis III: Structural Steel

Conclusions

Owner buy-in

Action must be taken early

Most cost savings in terms of less changes

Early purchase of steel

Trustworthy contractors

Barrier

The only barrier to this approach is money

Presentation Outline

Photo: Google

Analysis IV: BIM Through AE

Outline

Collaboration effort between OPP and AE dept.

Medium: AE222

Main participants: Dr. Ed Gannon, Colleen Kasprzak, Craig Dubler, Paul Bowers, Dr. David Riley

Important to note

Previous trial: good and bad!

AE222 consists of inexperienced students, many have little/no experience with Revit

Lack of definitive standard

OPP considered as client in this analysis

Presentation Outline

Photo: Google

Analysis IV: BIM Through AE

OPP: What do they want?

Useable models

Modeling un-modeled buildings and renovations

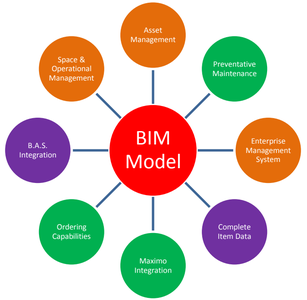
425 projects available

M.E.P. modeled accurately

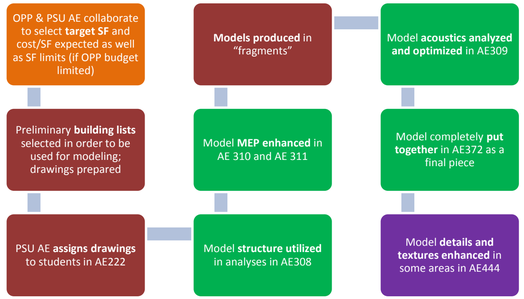
Exterior modeled to close resemblance (differing opinion available!)

Spaces need to be representative

OPP: Why do they want it?



Presentation Outline



Analysis IV: BIM Through AE

PSU AE

Education is number 1; no intrusions
No tedious modeling; no benefit
Equal learning opportunity
Must be related to classwork

Dual-benefit Approach

Fully integrated approach – 2nd to 3rd year
Exterior and interior spaces modeled in 2nd year

3rd year:

Structural class: model structure and use in STAAD
Mechanical class: model mechanical equipment and use if necessary
Electrical Class: model electrical equipment and light fixtures
CM class: perform BIM integration to put models together
Acoustics can also be integrated

4th year: if also integrated, could be used for data

Presentation Outline

Challenges

Value 3D model vs. BIM model
Trial and error suffered unusual fate
Very optimistic
Too many constraints
Lost investments
Off-limits buildings

Analysis IV: BIM Through AE

Internship

OPP in full control
Students benefit form pay and experience
No restrictions to program
LACCD currently do this

Architecture Studio

Photo: Google

Presentation Outline

Conclusions

Analysis 1: Asbestos must be considered on demo projects
Full demolition will reduce schedule marginally

Analysis 2: Façade change must be incorporated early in project – Design issues

Analysis 3: DA contract must be a planning phase thought
Communication is key

Analysis 4: The answer may be simpler than you think!
Internship may be the best method

Acknowledgements & Thanks

ED GANNON, PH.D.

JAMES FAUST, P.E.

JOHN BECHTEL, P.E.

DR. MOSES LING, P.E., R.A.

OFFICE OF PHYSICAL PLANT

ANDY SCHRENK

CHAD SPACKMAN

COLLEEN KASPRZAK

CRAIG DUBLER, (PH.D.)

DAVID RILEY, PH.D.

DEPARTMENT OF PSYCHOLOGY AT PENN

STATE

Presentation Outline

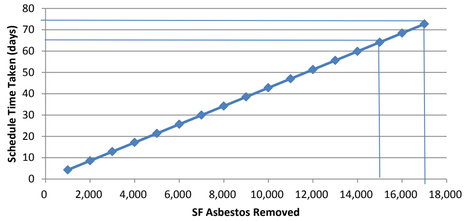
?

Q & A

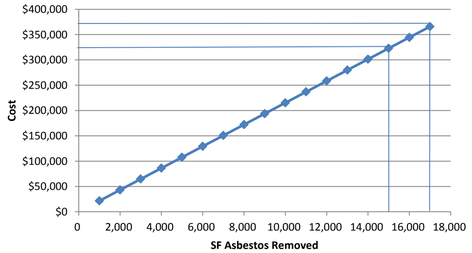
?

Presentation Outline

Schedule Time Taken V. SF Asbestos Removed



Cost V. SF Asbestos Removed

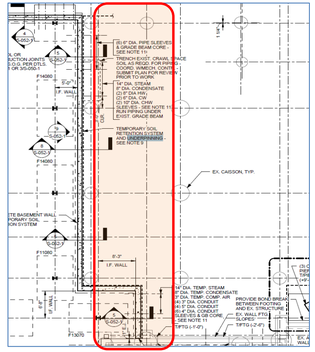


Appendix

Asbestos Abatement Cost Analysis - North Wing				
Item		Unit	Cost / Unit	
1	Asbestos Abatement & Removal	16,375 SF	$20/SF	$327,500
2	Selective Demolition for Asbestos Preparation	3,986 SF	$10/SF	$39,860
3	Temporary Equipment for Abatement	1 EA	$25,000	$25,000
4	Selective Demolition for North Wing	16,375 SF	$12.10/SF	$198,080
5	Demolition of Concrete, Casework etc.	16,375 SF	$2.4/SF	$39,303
			Total	$629,750

Asbestos Abatement Schedule Impact Analysis – North Wing + Selective Demolition			
	W/O Basement Abatement	W/ Basement Abatement	Total Area (SF)
Total Days	93 days	207 days	16,375 SF
Only Workdays	80 days	177 days	
Schedule Day/CSF	0.4885 days/CSF	1.0809 days/CSF	
Schedule Hrs./CSF	11.7252 hrs./CSF	25.9420 hrs./CSF	

Underpinning



Underpinning Elimination and Basement Expansion Analysis					
Condition	Item	Quantity		Unitcost	Totalcost
Existing	SOG Basement	5,788	SF	9.26	$53,596.88
Deduct	Underpin North Wing	1,620	SF	50	$81,000.00
Add	SOG New Basement	5,461	SF	9.26	$50,568.86
Add	Concrete Deck Fill New	5,461	SF	6.41	$35,005.01
Deduct	Strip Footings 18X12	136	LF	130	$17,680.00
Add	Strip Footings 24X12	500	LF	140	$70,000.00
Total Cost					$57,000

Presentation Outline

Appendix

Masonry Construction Costs				
Item	Quantity		Unitcost	Totalcost
Metal Panels	2,020	SF	40	$80,800
Window Sills	585	LF	35	$20,475
				$101,275
Masonry Veneer	13,360	SF	20	$267,200
Stone Base - Granite	168	SF	100	$16,800
Caulking & Sealants	13,360	SF	0.75	$10,020
Rigid Insulation 3"	13,260	SF	2.5	$33,150
				$327,170
			TOTAL	$428,500