

#### Mission Statement:

HPR Integrated Design combines innovative, cutting edge concepts with a collaborative multi-disciplinary approach through the utilization of state-of-theart BIM technologies to exceed owner expectations both in system efficiencies and the enrichment of the human experience within its aesthetic.

#### Presentation #4: Proposal

#### Penn State Ice Hockey Arena

The Pennsylvania State University









### Agenda



## **BIM Uses**

X	DESIGN	x	CONSTRUCT	x	OPERATE
Х	DESIGN AUTHORING		SITE UTILIZATION PLANNING		BUILDING MAINTENANCE SCHEDULING
Х	DESIGN REVIEWS		CONSTRUCTION SYSTEM DESIGN		BUILDING SYSTEM ANALYSIS
Х	3D COORDINATION		3D COORDINATION		ASSET MANAGEMENT
х	STRUCTURAL ANALYSIS		DIGITAL FABRICATION		SPACE MANAGEMENT / TRACKING
x	LIGHTING ANALYSIS		3D CONTROL AND PLANNING		DISASTER PLANNING
Х	ENERGY ANALYSIS		RECORD MODELING		RECORD MODELING
Х	MECHANICAL ANALYSIS	•	OUT OF SCOPE O	F	THESIS PROJECT
	OTHER ENG. ANALYSIS				
х	SUSTAINABLITY (LEED) EVALUATION				
	CODE VALIDATION				
x	PHASE PLANNING (4D MODELING)		PHASE PLANNING (4D MODELING)		PHASE PLANNING (4D MODELING)
Х	COST ESTIMATION		COST ESTIMATION		COST ESTIMATION
х	EXISTING CONDITIONS MODELING		EXISTING CONDITIONS MODELING		EXISTING CONDITIONS MODELING

#### Required by Contract

Used for this Stage of design

#### HPR Integrated Design's Project Touchstones for the Penn State Ice Arena

Improve the Game Day experience for both the fans and players
Create an environment that fosters hockey excellence
Minimize the amount of energy the facility consumes
Create an architecturally recognizable facility
Maximize value with minimizing cost
Earn a LEED Gold rating

































## UESIGN Air Handler Relocation and Event Level Redesign

**REASON:** -Reduce duct size and length -Reduce fan energy and use smaller air handling units -Limit the number of shafts and there sizes.





Club Level









## Air Handler Relocation and Event Level Redesign









# Air Handler Relocation



## Roof Profile Redesign

**REASON:** -Maximize the efficiency of the structural system to reduce cost -Integrate the mechanical, lighting, and catwalk systems to optimize the performance of each

-Create a clean and attractive ceiling area

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N-S Section – Lighting **Incident Angle Reflection** 



#### DESIGN CONSTRAINTS









#### Holuba Hall

## Roof Profile Redesign

**REASON:** -Maximize the efficiency of the structural system to reduce cost -Integrate the mechanical, lighting, and catwalk systems to optimize the performance of each

-Create a clean and attractive ceiling area

60' Clear (To Bottom Of Steel)

## N-S Section – New Roof Profile

N-S Section – Lighting **Incident Angle Reflection** 















APPROACH









### 

## Façade Redesign

**REASON:** We believe we can maintain the original intent of the east façade (to create an impressive view from University Drive as well as a view out to Mt. Nittany and the Bryce Jordan Center) while enhancing the prominence of the entrances as well as reducing thermal loads and cost.















### Team & Individual Focus Schedules



#### **KEY MILESTONES:**



January 27<sup>th</sup>, 2012: Initial Architectural Modeling Completed

#### February 13<sup>th</sup>, 2012:

Air Handler Relocation & Event Level Design Completed



DISCIPLINE	TASK	ACTIVITY
	Air Handeler Relocation &	Relocate Air Handlers
A such is a such i	Event Level Redesign	Site Considerations
Architectural	Main Arena Roof System	Finalize Main Arena Roof Design
	Façade Redesign	Redesign Façade - address East façade views
	Air Handeler Relocation &	Design Two Way Flat Plate System w/ & w/o Pos
	Event Level Redesign	Column Design/Redesign; Column Foundations
Structural		Long Span Truss Alt. Research & Opt.
	Main Arena Root System	Long Span Truss Design; Misc Steel Members fo
	Façade Redesign	Exterior Columns, Exterior Glazing Panels
	Air Line deles Deles sties (	Event Level Load Calcs, Concept Design ERV for
	Air Handeler Relocation &	Select AHU & Determine Structural Load, Locate
Manhaniant	Event Level Redesign	Finalize Design, Size/Locate Low Press duct/diff,
Mechanical		Volumn Calcs, Size Ducts, Locate Diffusers
	Main Arena Roof System	Life Safety Systems (Sprinkler & Smoke Exhaust)
	Façade Redesign	Trace-Load & Energy Analysis
	Air Liondalar Dalaastir - A	Plug Load Research, Load Calcs, Early Coord Iss
	Air Handeler Relocation &	Locate Panels, Load Calcs, Conduit & Wire Sizing
	Event Level Redesign	Finalize Design
<b>F</b>		Rigging Load Research, Load Calcs, Size Condui
Electrical	Main Arena Roof System	Finalize Design
		Plug Load Research, Load Calcs
	Façade Redesign	Locate Panels, Size Conduit & Wiring, Conduit Ro
		Finalize Design
	Air Handalar Delegation 8	Daylight Analysis
	Air Handeler Relocation &	Light study Ev LvI Rms, Calcs, Intigrate Daylight, I
	Event Level Redesign	Finalize Design, Lighting Layout, Reflect Ceil
	Mala Areas Deef Sustan	Arena Lighting Research
Liebtine /	Main Arena Root System	Calculations, Controls, Aiming Diagrams, Lighting
Deudialation		Atrium, Concourse, Mt. Nittany Rm, Club Dining L
Daylighting		3DS Modeling for best shading analysis
	Escado Redecion	Space Daylight Utilization Analysis, Daylight Harv
	Paçade Redesign	Integrate Daylight Controls with Lighting
		Luminaire Select, Calcs, Energy Analysis, Code C
		Aiming Diagram, Lighting Layout, Finalize Cut Sh
	Receiling for Eviction	Existing Condition Estimate
	Conditions	Schedule Analysis, Create Schedule
	Conditions	Analysis of LEED Score Card
	Air Handeler Relocation &	Update Estimate, Schedule, & LEED Score Card
CM	Event Level Redesign	Perform 3D Coordination, Clash Detection, 4D M
	Main Arma Deaf Oratara	Perform Crane Analysis
	Main Arena Roor System	Site Utilization Analysis
	Main Arena Roof System	Update Cost, Schedule, & LEED Score Card
	& Façade Redesign	Perform 3D Coordination, Clash Detection, 4D M
-	Architectural	Complete Architectural Report
	Event Level Relocation	Complete Air Handler Relocation & Event Level R
	Main Arena Roof System	Complete Main Arena Roof System Redesign Re
Team	Facade Redesign	Complete Facade Redesign Report

#### Team Schedule

			Miles	tone 1 (2012	Milest	one 2		Milest	one 3		Milesto	one 4 Pi	roj Due	Preser	nt.	
	1/9/2012	1/16/2012	1/23/2012	1/30/2012	2/6/2012	2/13/2012	2/20/2012	2/27/2012	3/5/2012	3/12/2012	3/19/2012	3/26/2012	4/2011	12 4	1/9/2012	
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#### 2012: cuses Completed.

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#### **Redesign Focus Schedules**

					Miles	tone 1	Milestone	2	Milestone 3	Τ	Γ	Milestone	4 Proj Due	e Present.	T					
SYSTEM DESIGN	DISCIPLINE	TASK	ACTIVITY	1/9/2012 1/16/2012	1/23/2012	1/30/2012	2/6/2012 2/	13/2012 2/20/2012	2/27/2012 3/5/	2012 3	3/12/2012 3/1	9/2012 3/	2 4/4/201	2/2012 4/9	2/2012	E E	SYSTEM DESIGN	DISCIPLINE	TASK	ACTIVITY
		Air Handeler Relocation &	Relocate Air Handlers															Architectural	Roof Design	Modeling
	Architectural	Event Level Redesign	Site Considerations																Concep & Schem Design	Long Span Truss Alternatives Research & Optimization
		Schematic Design	Design Two Way Flat Plate System w/o Post-Tensioning			1							- 1						ouncep a ochem ochign	Long Shen Truss Design
			Design Two Way Flat Plate System w Post-Tensioning									- I		1				Chrysterral	Design Documentation	Misc. Steel Members Design to Accommodate Pont
	Charles and		Redesign Concrete Gravity Columns				- 1											structural	Ma dalla a	Pault, Opendiantian will other disabilities
	Succura	Design Development	Design Concrete Gravity Columns for Mech. Loft									- I							Modeling	Revit - Coordination w/ other disciplines
			Design New Foundations for Columns									1	- 1						Value Engineering	Redesign if necessary based on CM's Estimate
			Re-Evaluate Existing Columns																	New Volume/Load Calculations
		Schematic Design	Re-calculate Loads on the Event Level			1	- 1												Design Development	Size Ducts
		ventimine oranger	Concept Design for ERV system serving training facility																Design Development	Locate Diffusers & Coordinate w/ other Disciplines
_		Design Development	Select Air Handlers & Determine Structural Load			<u> </u>												Mechanical		Life Safety Systems (Sprinkler & Smoke Exhaust)
Б	Mechanical		Locate/Size high & medium pressure duct																Modeling	Revit - Coordination w/ other disciplines
<u></u>		Modeling	Revit - Coordination w/ other disciplines									<u> </u>							Value Engineering	Redesign if necessary based on CM's Estimate
e e		Dealer Dealer in	Finalize Design									-+							Design Documentation	Finalize Design
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e e e e e e e e e e e e e e e e e e e		Schematic Design &	Load Calculation							- H							Ð		Distribution Custom	Cizing of Coodwit & Wiring
Le Le		System Analysis	Early Foreseeable Coord, Issues			I				- H							st		Distribution system	Sizing of Conduit & Winnig
Ħ			Location of Panels throughout Level														Š	Electrical	Design Development	Conduit Routing throughout Building
e	Electrical	Distribution System	Sizing of Conduit & Wiring							. ⊢		_					5		Modeling	Revit - Coordination w/ other disciplines
Ш		Design Development	Conduit Routing throughout Building			1			1	-							ò		Value Engineering	Redesign if necessary based on CM's Estimate
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ů.	Daylighting	Design Development	Integration with Lighting System							~							e le		Schematic Design	Life Safety Lighting
<u>0</u>		Design Documentation	Finalize Design		-												$\triangleleft$		-	Versatility of Space
e a			Office Spaces														.=			Luminaire Selection
s,		Conceptual &	Locker Rooms														١a		Design Development	Calculations
ē		Schematic Design	Training Facilities			-											2	Lighting		Control Design
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Air		Modeling	Revit - Coordination w/ other disciplines							- H										Finalize Design
			Finalize Design																Design Documentation	Aiming Diagram
		Design Documentation	Lighting Layout			I						1								Lighting Layout
			Reflected Ceiling Plan			1														Reflected Ceiling Plan
		fi ati an ata	Existing Conditions Baseline Estimate									1		1					Crane Selection	Perform Crane Analysis
		Esumate	Update Cost Based on Event Level Relocation																Site Logistics	Site Utilization Analysis
		Scheduling	Perform Schedule Analysis & Create Baseline Schedule									1		1					Estimate	Update Cost Based on Roof/Light/Elect/Mech Design
	см		Update Schedule Based on Event Level Relocation			1												СМ	Scheduling	Update Schedule Based on Roof/Light/Elect/Mech Design
		LEED	Baseline LEED Score Card																LEED	Update LEED Score Card Based on Roof/Light/Elect/Mech
		60 G	Update LEED Score Card Based on Event Level Relocation			1													3D Coordination	Perform Clash Detection
		3D Coordination	Perform Clash Detection			I				- H				l					4D Modeling	Perform 4D Modeling
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#### AIR HANDLER RELOCATION & EVENT LEVEL REDESIGN

#### MAIN ARENA ROOF SYSTEMS

1/9/2012 1/16/2012

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															Value Engineering	Redesign if necessary based on CM's Estimate		
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_																Daysim Model for verification		
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									i		· · · ·				Schematic Design &	Design additional Steel Members		
_											<u> </u>				System Analysis	Analyze & Design Exterior Glazing Panels		
														structural	Modeline	Revit - Coordination w/ other disciplines		
											1				Modeling	Model members in Revit		
					•						1				Value Engineering	Redesign if necessary based on CM's Estimate		
											1				Estimate	Update Cost Based on Facade/Light/Elect/Mech Design		
											1				Scheduling	Update Schedule Based on Facade/Light/Elect/Mech Design		
											1			СМ	LEED	Update LEED Score Card Based on Facade/Light/Elect/Mech Design		
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#### FAÇADE REDESIGN



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### MILESTONE: Architectural Modeling Completed



Milestone Date:

							Team	Schedule	3								L PD
		Milestone 1	: 1/27/2012		Milestone 2: 2/13/2012		Milestone :	3: 3/2/2012			Milestone 4: 3/26/2012	Project Due: 4/4/2012	Presentations : 4/9/2012			Centre	GRATED DESIGN
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	,,				3D & 4D reviev	w & design aut	horing										

Two Way Flooring Redesign & Arena Roof Modeling

Event Level Daylighting & Electrical Load Calculations

Event Level Load Calcs, AHU & Ductwork Sizing

Existing Conditions Estimate & Scheduling Analysis



Design Authoring, Structural Analysis

Design Authoring, Lighting Analysis

Design Authoring, Mechanical Analysis

Cost Estimation, 4D Modeling

### MILESTONE: Air Handler Relocation Completed



Milestone Date:

							Team	Schedule	5								PD
		Milestone 1	l: 1/27/2012		Milestone 2: 2/13/2012		Milestone 3	3: 3/2/2012			Milestone 4: 3/26/2012	Project Due: 4/4/2012	Presentations : 4/9/2012			C	GRATED DESIGN
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Gravity Column Redesign & Long Span Truss Design

Façade Daylighting Controls & Finalize Event Lvl. Design

Finalize Event Level Designs & AHU Relocations

LEED Analysis & Crane Placement Study



#### Structural Analysis

Design Authoring, Lighting Analysis

Design Authoring, Mechanical Analysis

Site Utilization, LEED Analysis

### **MILESTONE:** Initial Clash Detection & Value Eng.



Milestone Date:

							Team	Schedule	;								PD
		Milestone 1	1: 1/27/2012		Milestone 2: 2/13/2012		Milestone 3	3: 3/2/2012			Milestone 4: 3/26/2012	Project Due: 4/4/2012	Presentations : 4/9/2012			Cart	ORATHED DESIGN
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					3D & 4D revie	w & design aut	noring										

Long Span Truss Design & Façade Glazing Analysis

Arena Lighting Layout & Finalize Electrical Redesign

Main Arena Mechanical Design & Coordination

Update Cost, Schedule & Perform Clash Detection



Design Authoring, Structural Analysis, 3D Coordination

Design Authoring, Lighting Analysis

Design Authoring, Mechanical Analysis, 3D Coordination

3D Coordination, Cost Estimation, 4D Modeling

### MILESTONE: Redesign Focuses Completed



Milestone Date:

							Team	Schedule	2							TI	PD
		Milestone 1	: 1/27/2012		Milestone 2: 2/13/2012		Milestone 3	: 3/2/2012			Milestone 4: 3/26/2012	Project Due: 4/4/2012	Presentations : 4/9/2012				GRATED DY SIGN
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2	1/16/2012	1/23/2012	1/30/2012	2/6/2012	2/13/2012	2/20/2012	2/27/2012	3/5/2012	3/12/2012	3/19/2012	3/26/2012	4/2/2012	4/9/2012	4/16/2012	4/23/2012	4/30/2012	5/7/2012
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Column Analysis & Façade Analysis/Redesign

Finalize Arena Lighting Design & Façade Redesign

Main Arena Mechanical & Life Safety Designs

Finalize Cost Estimates, Schedule & LEED Analysis



Structural Analysis, 3D Coordination

Design Authoring, Lighting Analysis

Design Authoring, Mechanical Analysis, 3D Coordination

3D Coordination, Cost Estimation, 4D Modeling

### MILESTONE: Final Report Submission



							Team	Schedule	9								PD
		Milestone 1	: 1/27/2012		Milestone 2: 2/13/2012		Milestone 3	3: 3/2/2012			Milestone 4: 3/26/2012	Project Due: 4/4/2012	Presentations : 4/9/2012				GRAIND DESIGN
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Finalize Final Report

Finalize Final Report

**Finalize Final Report** 

Finalize Final Report

SOFTWARE

None.

None.

None.

None.

None.





							Team	Schedule	9								PD
		Milestone 1	: 1/27/2012		Milestone 2: 2/13/2012		Milestone 3	3: 3/2/2012			Milestone 4: 3/26/2012	Project Due: 4/4/2012	Presentations : 4/9/2012				GRAIND DYSIGN
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Finalize & Practice Final Presentation

Milestone Date:

Finalize & Practice Final Presentation

Finalize & Practice Final Presentation

Finalize & Practice Final Presentation



None.

None.

None.

None.



### **Questions & Comments** Penn State Ice Hockey Arena



### Presentation #4: Thank You Juestions & Comments

The Pennsylvania State University

SYSTEM DESIGN	DISCIPLINE	TASK	ACTIVITY	1/9/2012	1/16
Main Arena Roof System	Architectural	Roof Design	Modeling		
	Structural	Concep & Schem Design	Long Span Truss Alternatives Research & Optimization		
		Design Documentation	Long Span Truss Design		
			Misc. Steel Members Design to Accommodate Roof		
		Modeling	Revit - Coordination w/ other disciplines		
		Value Engineering	Redesign if necessary based on CM's Estimate		
	Mechanical	Design Development	New Volume/Load Calculations		
			Size Ducts		
			Locate Diffusers & Coordinate w/ other Disciplines		
			Life Safety Systems (Sprinkler & Smoke Exhaust)		
		Modeling	Revit - Coordination w/ other disciplines		
		Value Engineering	Redesign if necessary based on CM's Estimate		
		Design Documentation	Finalize Design		
	Electrical	Schematic Design &	Rigging Load Research		
		System Analysis	Load Calculation (lighting & rigging)		-
		Distribution System	Sizing of Conduit & Wiring		
		Design Development	Conduit Routing throughout Building		
		Modeling	Revit - Coordination w/ other disciplines		
		Value Engineering	Redesign if necessary based on CM's Estimate		
		Design Documentation	Finalize System		
	Lighting	Conceptual & Schematic Design	Ice Lighting		
			Seating Lighting		
			Life Safety Lighting		
			Versatility of Space		
		Design Development	Luminaire Selection		
			Calculations		_
			Control Design		
		Modeling	Revit - Coordination w/ other disciplines		
		Value Engineering	Redesign if necessary based on CM's Estimate		
		Design Documentation	Finalize Design		
			Aiming Diagram		_
			Lighting Layout		
			Reflected Ceiling Plan		
	СМ	Crane Selection	Perform Crane Analysis		
		Site Logistics	Site Utilization Analysis		
		Estimate	Update Cost Based on Roof/Light/Elect/Mech Design		
		Scheduling	Update Schedule Based on Roof/Light/Elect/Mech Design		
		LEED	Update LEED Score Card Based on Roof/Light/Elect/Mech Design		-
		3D Coordination	Perform Clash Detection		
		4D Modeling	Perform 4D Modeling		



