TOWSON TIGER ARENA

TOWSON, MD

Derek Stoecklein | Construction Management Option

Advisor: Ray Sowers

Project Background

- Overview
- Location
- Site Planning

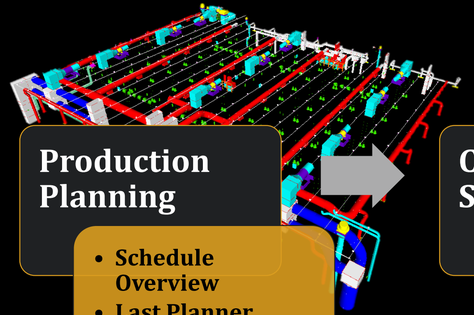
Fabric Duct System

- Existing System
- Load Calculations
- DuctSox Design
- Comparison

Prefabricated Terra Cotta

- Existing System
- Designed Panels
- Delivery and Connection Details
- Comparison

Production Planning



- Schedule Overview
- Last Planner
- Implementation

Cisco StadiumVision

- Technology at Home
- StadiumVision Overview
- Application at Towson
- Case Studies

Presentation Outline

Project Overview

Building: Towson Tiger Arena

Building Location: Towson University; Towson, MD

Building Size: 120,000 SF

Number of Stories: 4 Stories

Occupancy Type: Sports, Entertainment

Project Cost: $56 Million

Construction Duration: 18 Months

Project Delivery Method: Design-Bid-Build

Contract Type: Guaranteed Maximum Price (GMP)

Sustainable Design: LEED Gold

Owner: Towson University

Construction Manager: Gilbane Building Company

Architect: Hord | Coplan | Macht

Associated Architect: Sasaki Associates

MEP Engineer: James Posey Associates

Structural Engineer: Faisant Associates

Civil Engineer: Site Resources, Inc.

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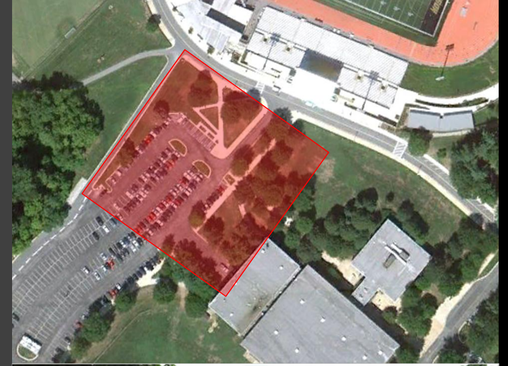
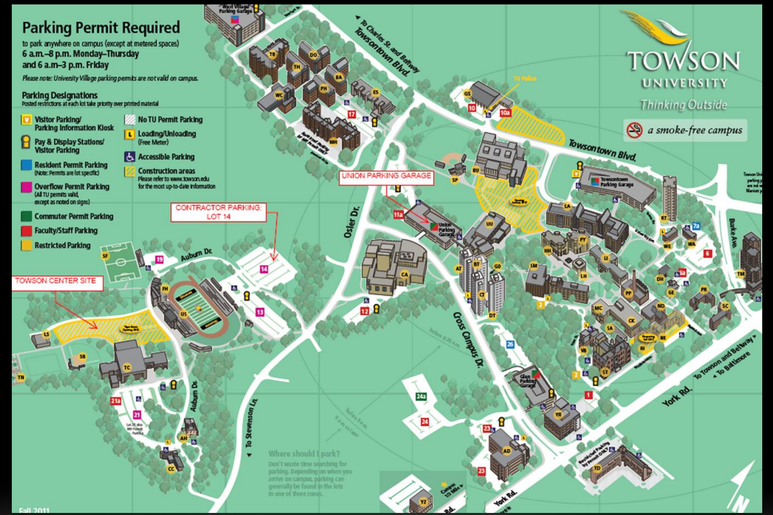
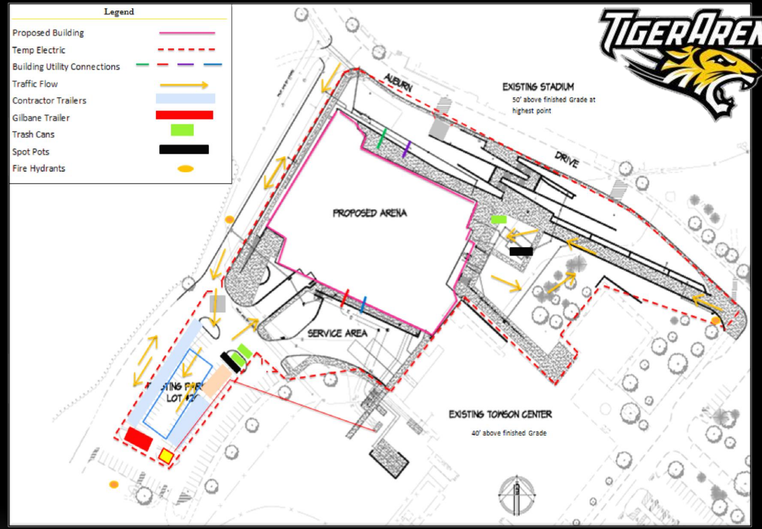
Presentation Outline







Location and Site Planning

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ANALYSIS I: DUCTSOX SYSTEM

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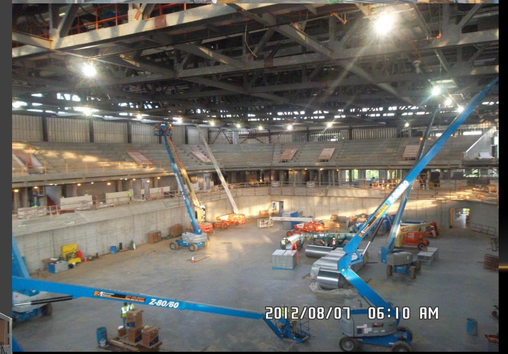
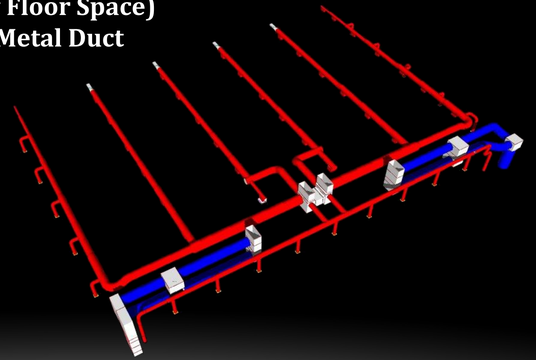
Presentation Outline



System Overview

- (2) 47,000 CFM Rooftop Units = 94,000 CFM
- Single Zone Variable Air Volume (VAV) with a CO2 reset
- 2,635,720 CF (Volume of Space)
- 43,340 SF (Area of Floor Space)
- Traditional Sheet Metal Duct
    - 14” to 62” Dia.



TIGER ARENA

Existing System

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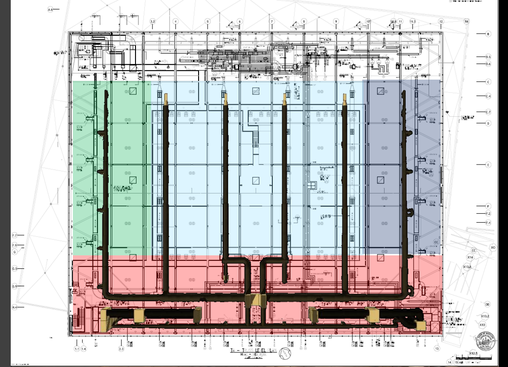
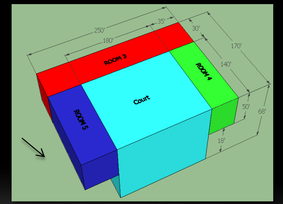
Presentation Outline



Load Calculation (Mechanical Breadth)

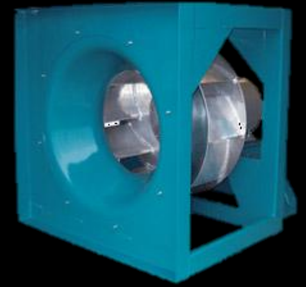
1. **Ventilation Loads (ASHRAE Standard 62.1)**
   45,312 CFM
1. **Heating and Cooling Loads (Trace)**
   87,041 CFM Cooling
   26,830 CFM Heating

Zone Identification
Zone Parameters
Internal Loads
System Creation
Run Report

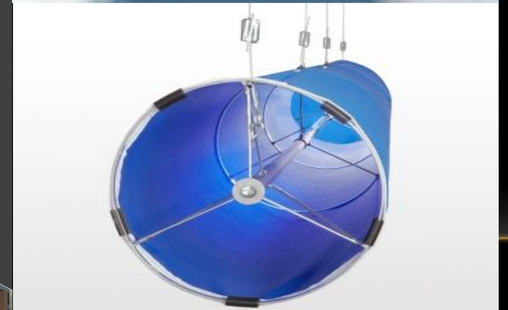


Original Output of AHU 8 – 9	94,000 CFM
Total Calculated Demand	87,041 CFM
Difference	6,956 CFM

EPFN-490 → EPFN-445



Presentation Outline



DuctSox System Selection Process

Series	Round
Model	High-Throw
Fabric	TurTex
Suspension System	SkeleCore IHS Cable
Personalized Options	White

Design Layout

(2) 46” Dia. x 101’ L = (2) Duct Sections Ea.
(4) 32” Dia. x 144’ L = (4) Duct Sections Ea.
(2) 32” Dia. x 118’ L = (3) Duct Sections Ea.
(2) 32” Dia. x 24’ L = (1) Duct Section Ea.
(1) 32” Dia. x 17’ L = (1) Duct Section Ea.
(29) Total Fabric Duct Sections

32	5,585	6,702	7,819	8,936
34	6,305	7,566	8,827	10,088
36	7,069	8,482	9,896	11,310
38	7,876	9,451	11,026	12,601
40	8,727	10,472	12,217	13,963
42	9,621	11,545	13,470	15,394
44	10,559	12,671	14,783	16,895
46	11,541	13,849	16,157	18,466

Presentation Outline

I. Project Background
II. Fabric Duct System
  I. Existing System
  II. Load Calculations
  III. DuctSox Design
  IV. Comparison
III. Prefabricated Terra Cotta
IV. Production Planning
V. Cisco StadiumVision
VI. Conclusion/Recommendation
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Schedule Comparision		
Standard Fabrication & Deliver		
DuctSox	4 Weeks	**Savings**
Sheet Metal Duct	8 Weeks	**4 Weeks**
Complete Ductwork Installation		
DuctSox	14 Days	**Savings**
Sheet Metal Duct	70 Days	**56 Days**
Painting		
DuctSox	0 Days	**Savings**
Sheet Metal Duct	30 Days	**30 Days**

Total Time Savings		
Description		**Days**
Fabrication		20
Installation		56
Others		30
	Days	**106**
TOTAL	**Weeks**	**21.2**
	Months	**5.3**

**86 Days on-site labor*

Price Comparision		
Material Cost		
DuctSox	$37,310.00	**Savings**
Metal Duct Total	$455,000.00	**$ 417,690.00**
Sheet Metal Duct	$375,000.00	
Sheet Metal Insulation	$50,000.00	
Paint Metal Duct	$30,000.00	
Labor Cost		
DuctSox Total	$ 28,568.00	**Savings**
Metal Duct Total	$375,000.00	**$ 346,432.00**
Sheet Metal Duct	$265,000.00	
Sheet Metal Insulation	$50,000.00	
Paint Metal Duct	$60,000.00	

Total Cost Savings to Towson	
Description	**Savings**
Material	$417,690.00
Labor	$346,432.00
CM Fee (2%)	$15,282.44
Subtotal	**$779,404.44**

Comparison

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ANALYSIS II: PREFABRICATED TERRA COTTA PANELS

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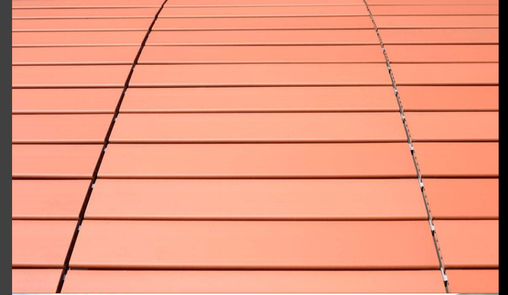
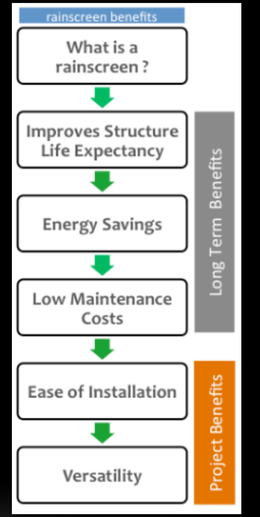
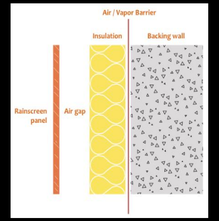
Presentation Outline

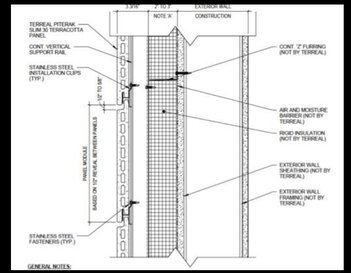


What is a Terra Cotta Rainscreen?

- Wall panel made from clay
- Hung on structural sub-framing system
- Sub-framing mounts to primary structural wall system
- Clay panels and sub-framing components create cavity in facade
- Pressure equalized







Terra Cotta Rainscreen

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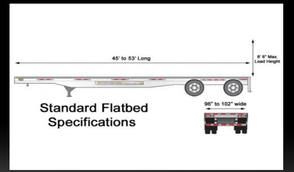
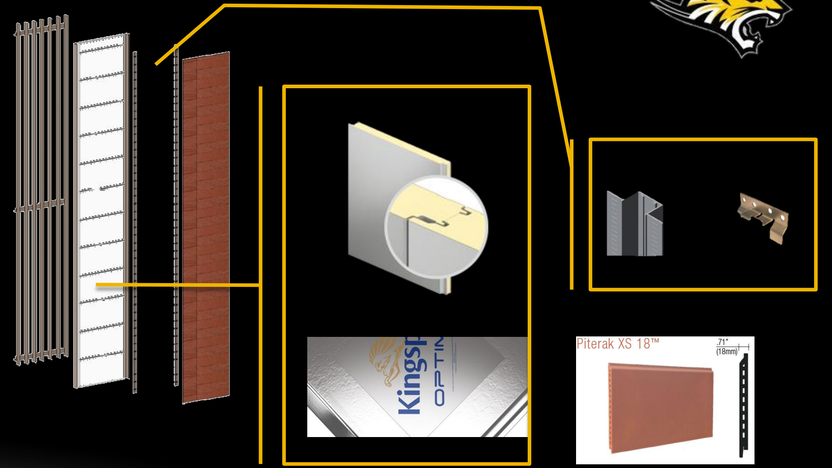
Presentation Outline

Panel Sizes
Width: 5’ -4”
Height: 20’ to 37’





Prefabricated Panel Design

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Presentation Outline

I. Project Background
II. Fabric Duct System
III. Prefabricated Terra Cotta
  I. Terra Cotta Overview
  II. Prefabricated Panel Design
  III. Comparison
IV. Production Planning
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6015 SF of Terra Cotta

Stick-Built System
$65.60 SF
171 Days On-Site Labor

Prefabricated System
$70.00 SF
24 Days On-Site Labor

Overall
$46,113 Increase
4 Months On-Site Labor Decrease

Cost & Schedule Comparison

Description	Duration (Days)	Cost
Prefabricated		
TOTAL	119	$674,510
Stick-Built		
TOTAL	211	$628,397
Delta		
TOTAL	92	$46,113

TIGER ARENA

R-Value Comparison $ft^2 \cdot °F \cdot h/Btu$

Description	R-Value	Thickness	Subtotals
Existing System			
FOAMULAR 250 Rigid Foam Insulation	5 per inch	3"	15
GlassRoc Exterior Sheating	.51 per SF	5/8"	0.51
		Total	**15.51**
Prefabricated System			
Optimo Smooth Insulated Metal Panel	7.5 per inch	3 5/8"	27.19
		Total	**27.19**

Comparision

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ANALYSIS III: PRODUCTION PLANNING OF THE TRUSS PHASE MEPFP

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Presentation Outline

I. Project Background
II. Fabric Duct System
III. Prefabricated Terra Cotta
IV. Production Planning
  I. Schedule Analysis
  II. Last Planner
V. Cisco StadiumVision
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VII. Acknowledgments

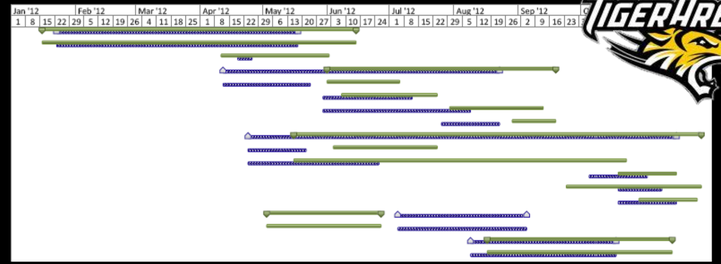
Baseline Schedule vs. Actual Schedule

Actual Starts vs. Baseline Analysis

Actual Start Dates Task	Actual Duration	Baseline Start	Actual Start	Delta
Sprinkler RI @ Trusses	39	7/5/2012	5/3/2012	45
Storm Rough In Truss Lvl	25	4/12/2012	6/1/2012	36
HVAC Pipe RI @ Trusses	32	5/30/2012	6/8/2012	7
Comm Conduit/Cable tray	36	4/24/2012	6/4/2012	29
Conduit/Wire Truss Lvl	114	4/24/2012	5/16/2012	16
Duct Rough In	33	5/30/2012	7/30/2012	43
Duct Insulation @ Trusses	15	7/26/2012	8/29/2012	35
Paint @ Trusses/Deck	63	8/9/2012	8/17/2012	6
Lighting @ Truss Level	20	10/5/2012	10/19/2012	10
Fire Alarm Devices and Test Truss Level	21	10/19/2012	10/29/2012	6
Electrical Devices @ Truss Level	47	10/19/2012	9/24/2012	19

Actual Starts vs. Baseline Analysis

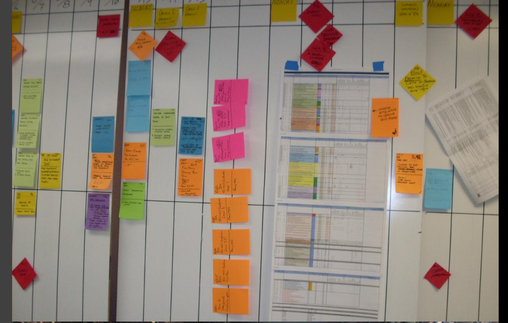
Actual Finish Dates Task	Actual Duration	Baseline Finish	Early Finish July	Delta
Sprinkler RI @ Trusses	39	9/4/2012	6/26/2012	50
Storm Rough In Truss Lvl	25	5/23/2012	7/5/2012	31
HVAC Pipe RI @ Trusses	32	7/11/2012	7/23/2012	8
Comm Conduit/Cable tray	36	5/21/2012	7/23/2012	45
Conduit/Wire Truss Lvl	114	6/25/2012	10/22/2012	85
Duct Rough In	33	8/8/2012	9/12/2012	25
Duct Insulation @ Trusses	15	8/22/2012	9/18/2012	19
Paint @ Trusses/Deck	63	10/17/2012	11/13/2012	19
Lighting @ Truss Level	20	11/1/2012	11/15/2012	10
Fire Alarm Devices and Test Truss Level	21	11/15/2012	11/25/2012	6
Electrical Devices @ Truss Level	47	11/8/2012	11/27/2012	13



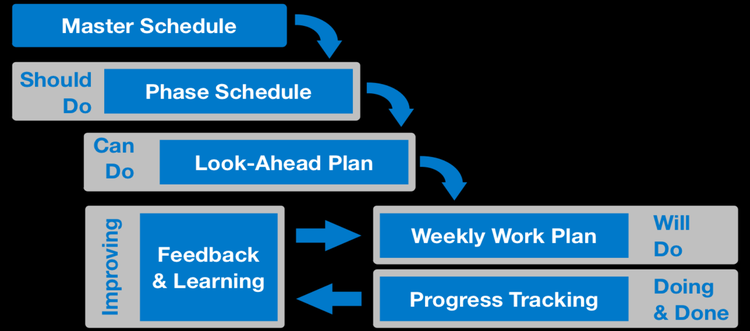
Common Construction Productivity Challenges

- Poor or incomplete design and documentation
- Client scope change during construction
- Mistakes during construction
- Delays in decision making or instructions
- Poor planning and communication
- Weather
- Labor skills, availability or disputes
- Incorrect material types or quantity

Presentation Outline



The Last Planner System



4 Levels of Planning

1. **Master CPM Schedule**
   - Feasibility
   - Long Lead Items
   - Milestones
2. **Phase Schedule**
   - Pull planning
3. **Look-Ahead Plan**
   - Detail Tasks
   - Screen Tasks
   - Workflow Plan
4. **Weekly Work Planning**

Last Planner System Overview

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    I. Overview
    II. Implementation
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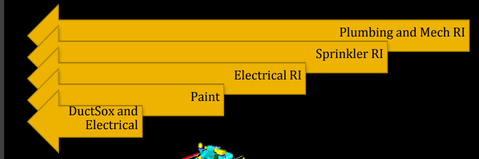
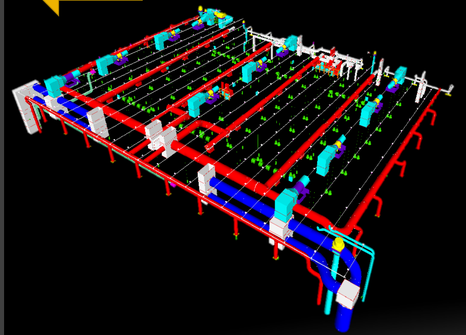
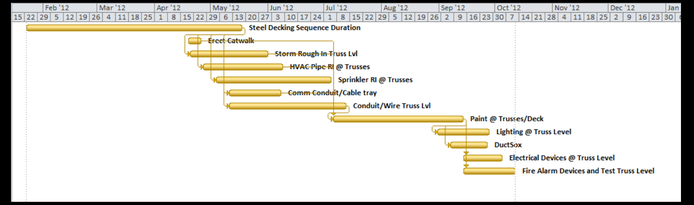






Name	Duration: Re-Seq	Duration: Actual	Duration: Diff	Start: Re-Seq	Start: Actual	Start: Diff	Finish: Re-Seq	Finish: Actual	Finish: Diff
Kinsley - Steel	**84 days**	**109 days**	**-25d**	**Mon 1/23/12**	**Mon 1/16/12**	**5d**	**Thu 5/17/12**	**Thu 6/14/12**	**-20d**
Steel Decking Sequence Duration	84 days	109 days	-25d	Mon 1/23/12	Mon 1/16/12	5d	Thu 5/17/12	Thu 6/14/12	-20d
Erect Catwalk	15 days	38 days	-23d	Thu 4/19/12	Wed 4/11/12	6d	Wed 5/9/12	Fri 6/1/12	-17d
DenverElek - Mechanical	**114 days**	**78 days**	**36d**	**Fri 4/20/12**	**Fri 6/1/12**	**-30d**	**Wed 9/26/12**	**Tue 9/18/12**	**6d**
Storm Rough In Truss Lvl	30 days	25 days	5d	Fri 4/20/12	Fri 6/1/12	-30d	Thu 5/31/12	Thu 7/5/12	-25d
HVAC Pipe RI @ Trusses	31 days	32 days	-1d	Fri 4/27/12	Fri 6/8/12	-30d	Fri 6/8/12	Mon 7/23/12	-31d
Duct Rough In		33 days			Mon 7/30/12			Wed 9/12/12	
Duct Insulation @ Trusses		15 days			Wed 8/29/12			Tue 9/18/12	
DuctSox	14 days			Fri 9/7/12			Wed 9/26/12		
BK Truland - Electrical	**110 days**	**140 days**	**-30d**	**Fri 5/11/12**	**Wed 5/16/12**	**-3d**	**Thu 10/11/12**	**Tue 11/27/12**	**-33d**
Comm Conduit/Cable tray	20 days	36 days	-16d	Fri 5/11/12	Mon 6/4/12	-16d	Thu 6/7/12	Mon 7/23/12	-32d
Conduit/Wire Truss Lvl	45 days	114 days	-69d	Fri 5/11/12	Wed 5/16/12	-3d	Thu 7/12/12	Mon	-72d
Lighting @ Truss Level	20 days	20 days	0d	Fri 8/31/12	Fri 10/19/12	-35d	Thu 9/27/12	Thu 11/15/12	-35d
Electrical Devices @ Truss Level	15 days	47 days	-32d	Fri 9/14/12	Mon 9/24/12	-6d	Thu 10/4/12	Tue 11/27/12	-38d
Fire Alarm Devices and Test Truss Level	20 days	21 days	-1d	Fri 9/14/12	Mon	-31d	Thu 10/11/12	Sun 11/25/12	-31d
NFP - Sprinkler	**44 days**	**39 days**	**5d**	**Fri 5/4/12**	**Thu 5/3/12**	**1d**	**Wed 7/4/12**	**Tue 6/26/12**	**6d**
Sprinkler RI @ Trusses	44 days	39 days	5d	Fri 5/4/12	Thu 5/3/12	1d	Wed 7/4/12	Tue 6/26/12	6d
NLP - Painting	**50 days**	**63 days**	**-13d**	**Fri 7/6/12**	**Fri 8/17/12**	**-30d**	**Thu 9/13/12**	**Tue 11/13/12**	**-43d**
Paint @ Trusses/Deck	50 days	63 days	-13d	Fri 7/6/12	Fri 8/17/12	-30d	Thu 9/13/12	Tue 11/13/12	-43d

Truss MEPF - Baseline Duration
4/12/2012 – 11/15/12
156 Days

Truss MEPF - Actual Duration
5/3/2012 – 11/27/12
149 Days
Not including overtime

Truss MEPF– Re-Sequenced "Phased Schedule" Duration
4/12/2012 – 10/11/12
126 Days
Difference of 33 Days from Actual Completion
= $354,629 GC Savings

ANALYSIS IV: CISCO STADIUMVISION

Derek Stoecklein | Construction Management Option

Presentation Outline

The Comfort of Home

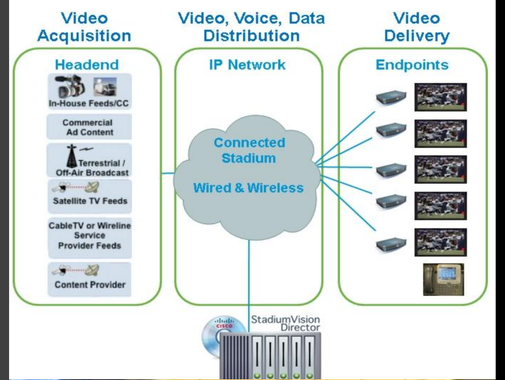
- Lazyboy
- Technology
- Cost Effective

TigerArena

Technology at Home

Derek Stoecklein | Construction Management Option

Presentation Outline



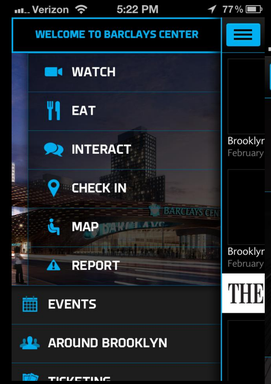
The Ultimate Experience

- Video Feeds Options
- Sales
- Player Stats
- Directions
- Wi-Fi
- Big Board Interaction
- Suite Features

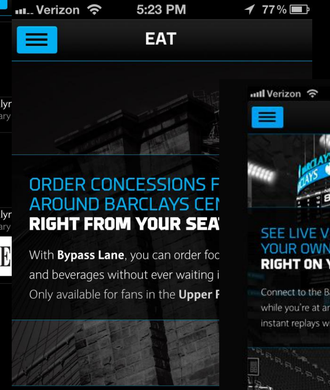
StadiumVision Director

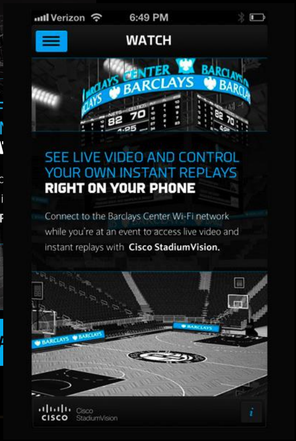
StadiumVision Mobile

Connected Stadium



"Meeting the demands of a new generation of fans"





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    I. Electrical Breadth
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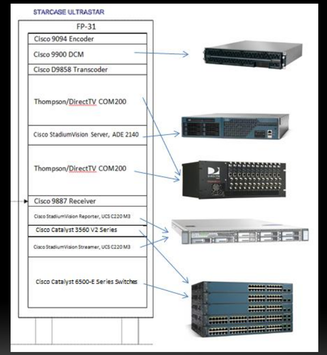
Revenue Generation for Towson

- Advertisements
- Point of Sale
- Merchandise
- Promotions
- Purchasing

Tiger Arena StadiumVision Components



DMP

Required Rack Equipment v. 3.0	Rack Slot	Amount	Max Power (W)	Power Req. (W)
Cisco 9094 Encoders	1	1	60	60
Cisco D9858 Transcoder	1	1	110	110
Cisco 9887 Receiver	1	1	200	200
Cisco 9900 DCM (Digital Content Manager)	2	1	350	350
Catalyst 3560/3750 Ethernet Switches	1	1	130	130
Catalyst 6504 Switch (Video Distribution System)	5	1	113	113
Thomson/DirecTV COM200	5	2	320	640
Cisco StadiumVision Server, ADE 2140	2	1	600	600
Cisco StadiumVision Reporter	1	1	650	650
Cisco StadiumVision Streamer	1	1	650	650
Rack Total	**20**	**11**	**-**	**3503**
			Adjusted Power (.95 PF)	**3687**

RP1C

Rack Details

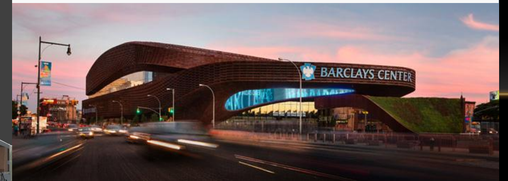
11 Components
3,687 VA Output
3,840 VA Capacity
120 V, Single-Phase 20A

WIRING SCHEDULE: PANEL RP1C

120/208 VOLTS					3PHASE 4 WIRE				100 AMP MAINS				SURFACE MOUNTED					
CIRC	POLE	DESCRIPTION	WIRE/	BREAKER	KVA/Ø							CIRC	POLE	DESCRIPTION	WIRE/	BREAKER		
NO			CONDUIT	POLE/ AMP	AØ		BØ		CØ			NO			CONDUIT	POLE	AMP	
1	1	CUH-TA-1 (VESTIBULE 124)	#12-3/4"C	1	20	0.5	1.4					2	2	HAND DRYER MEN'S 131	#8-3/4"C	1	20	
3	3	REC FAN ASSIST 134, 135,137	#8-3/4"C	1	20			1.0	1.4			4	4	HAND DRYER MEN'S 131	#8-3/4"C	1	20	
5	5	REC EVENT MGMT 133, 134	#8-3/4"C	1	20					0.8	0.8	6	6	REC MEN'S 131	#8-3/4"C	1	20	
7	7	REC WOMEN'S 132	#8-3/4"C	1	20	0.8	0.8					8	8	REC RECEPTION 125, CORR	#12-3/4"C	1	20	
9	9	HAND DRYER WOMEN'S 132	#8-3/4"C	1	20			1.4	0.4			10	10	REC PRESS RM 127	#12-3/4"C	1	20	
11	11	HAND DRYER WOMEN'S 132	#8-3/4"C	1	20					1.4	0.4	12	12	REC PRESS RM 127	#12-3/4"C	1	20	
13	13	REC PRESS ROOM 127	#12-3/4"C	1	20	0.8	1.0					14	14	REC AIR PRESS RM 127	#12-3/4"C	1	20	
15	15	REC PRESS ROOM 127	#12-3/4"C	1	20			0.8	0.5			16	16	REC METAL DETECTOR 125	#12-3/4"C	1	20	
17	17	REC EVENT STAFF 121	#12-3/4"C	1	20					0.8	0.5	18	18	REC METAL DETECTOR 125	#12-3/4"C	1	20	
19	19	REC EVENT STAFF 121, CORR 114	#12-3/4"C	1	20	0.8	0.5					20	20	REC EWC 125	#12-3/4"C	1	20	
21	21	REC SECURITY 122, CORR	#12-3/4"C	1	20			0.8	0.8			22	22	REC AIR SECURITY 122	#12-3/4"C	1	20	
23	23	REC PRODUCTION 129	#10-3/4"C	1	20					0.8	0.8	24	24	REC PRODUCTION 129	#10-3/4"C	1	20	
25	25	REC PRODUCTION 129	#10-3/4"C	1	20	0.8	0.8					26	26	REC PRODUCTION 129	#10-3/4"C	1	20	
27	27	REC PRODUCTION 129	#10-3/4"C	1	20			0.8	1.0			28	28	REC PRODUCTION 129	2#10+#10	2	20	
29	29	REC PRODUCTION 129	#10-3/4"C	1	20					0.8	1.0	-	30		G-3/4"C			
31	31	REC PRODUCTION 129	2#10+10	2	20	1.0	1.0					32	32	REC PRODUCTION 129	2#10+#10	2	20	
33	33		3/4"C					1.0	1.0			-	34		G-3/4"C			
35	35	REC PRODUCTION 129	2#10+10	2	20					1.0	0.8	36	36	REC PRODUCTION 129	#10-3/4"C	1	20	
-	37		3/4"C			1.0	0.4					38	38	REC TV PRESS ROOM 127	#12-3/4"C	1	20	
39	39	CISCO STADIUM VISION RACK	3#10+10G	2	20			3.8				-	40	SPARE				
-	41		3/4"C				1.3					42	SPARE			1	20	
						5.5	5.9	7.7	5.5	7.0	4.7							
		CONNECTED LOAD =	56.6	KVA		11.4		13.2		12.0				MAIN BREAKER	100	AMPS		
		DEMAND LOAD =	27.1	KVA										NOTE: PROVIDE SEPARATE NEUTRAL FOR EACH CIRCUIT				
		MIN A/C RATING =	10,000	AMPS SYMMETRICAL										LOCATION	SECURITY 122			

Presentation Outline

CISCO™



"The value that we are receiving from Cisco Stadium Vision far outweighs just a financial investment. We can easily justify it financially, but the value to our brand is immeasurable. We can demonstrate to sponsors and fans that they gain a far better experience, and there is not a more effective way to do it."
– David Peart, Senior Vice President of Sales and Service, CONSOL Energy Center

CONSOL Energy Center, PA

200% increase in advertisers

300% increase in advertisement and sponsorship revenues

80% of fans retaining the digital content they viewed

Staples Center, LA

9% increase in concession revenue

400% increase in pilot promotions revenue

"Cisco solutions are helping us use our new home to deliver the biggest and best experience in the world of sports and entertainment."
– Jerry Jones, Owner and General Manager, Dallas Cowboys

Case Studies

Derek Stoecklein | Construction Management Option

Presentation Outline

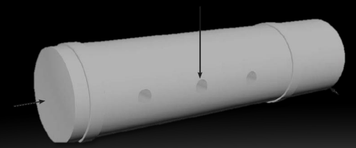
DuctSox

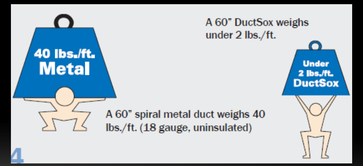
On-Site Schedule Savings: 86 Days

Towson Savings: $779,404

25% More Efficient than Sheet Metal

Reduction in AHU Fan Size





Prefabricated Terra Cotta

On-Site Schedule Decrease: 4 Months

Towson Cost: ($46,113)

Improved R-Value: 27.19 > 15.15 $ft^2 \cdot °F \cdot h/Btu$

Improved Safety, Quality, and Logistics

Conclusion & Recommendations

Derek Stoecklein | Construction Management Option

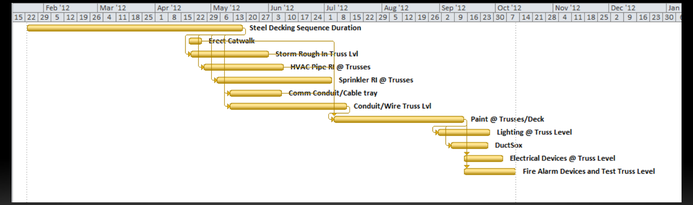
Presentation Outline

Last Planner System

Schedule Decrease: 33 Days

GC Savings: $354,629

Improved Safety and Logistics



Cisco StadiumVision

Revenue Generation Potential

Creating the Ultimate Experience

Cost and Schedule Increase

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hord | coplan | macht

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DUCTSOX Fabric Air Dispersion Products

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Family and Friends

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TIGER ARENA

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Questions?

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