7700 ARLINGTON BOULEVARD
FALLS CHURCH, VA


Photo Courtesy of Gensler

Penn State AE Senior Thesis Project
Christie Smith | Construction Management
Advisor: James Faust

PRESENTATION OUTLINE


Photo Courtesy of Gensler

I. PROJECT BACKGROUND

II. ANALYSIS #1 | IPD PROCESS MAP

III. ANALYSIS #2 | NW MECH SYSTEM

  I. STRUCTURAL BREADTH

IV. ANALYSIS #3 | SIP SCHEDULE

V. ANALYSIS #4 | BIM IN THE FIELD

VI. SUMMARY

VII. ACKNOWLEDGEMENTS


Photo Courtesy of Davis Construction

PROJECT BACKGROUND

PROJECT LOCATION

| 7700 Arlington Blvd., Falls Church, VA
| New Defense Health Headquarters (DHHQ)
| BRAC BP 198

SQUARE FOOT BREAKDOWN

| 267,000 SF Northwest Gross Building Area
| 258,000 SF Main Gross Building Area
| 159,000 SF Southwest Gross Building Area
| 684,000 Total Gross Building Area

BUILDING PARAMETERS

| $52,691,347 Negotiated GMP
| CM at Risk Project Delivery Method
| 1/20/10 – 5/1/12 Construction Schedule
  | Phase I 11/1/10 – 7/29/11
  | Phase II 1/3/11 – 5/1/12


Photo Courtesy of Davis Construction

SCOPE OF WORK

| Demolition
| Anti-terrorism/force protection
| Renovation of mechanical and electrical systems in NW
| New mechanical and electrical systems in Main & SW


Photo Courtesy of Davis Construction

Photo Courtesy of Davis Construction

SIMPLIFYING THE IPD APPROACH

7700 ARLINGTON BOULEVARD
FALLS CHURCH, VA

CHRISTIE SMITH | CONSTRUCTION MANAGEMENT

PRESENTATION OUTLINE

PROBLEM IDENTIFICATION

| Material procurement was a challenge
| Expressed interest in finding a way to simplify the IPD approach

RESEARCH GOAL

| Research AIA contracts
| Design a process map based on gathered information

DOCUMENTS USED

| AIA Contract Document A295
"General Conditions of the Contract for Integrated Project Delivery"
| 2007 Version of the AIA Guide for Integrated Project Delivery

Goolier.com

SIMPLIFYING THE IPD APPROACH

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FALLS CHURCH, VA

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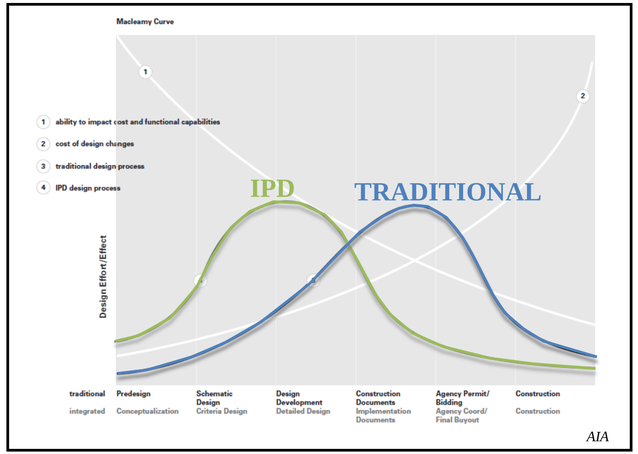
PRESENTATION OUTLINE

WHY IPD
- Macleamy Curve
  - Decreased cost of design changes
  - Higher ability to impact cost and functional capabilities

CASE STUDY
- Autodesk Headquarters in Waltham, Massachusetts
  - “true” IPD agreement
  - Engaged Owner



SIMPLIFYING THE IPD APPROACH

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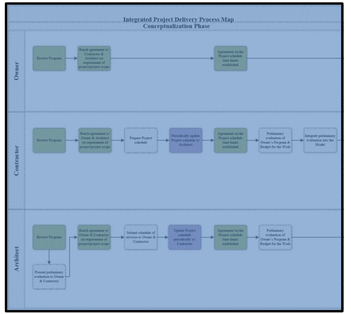
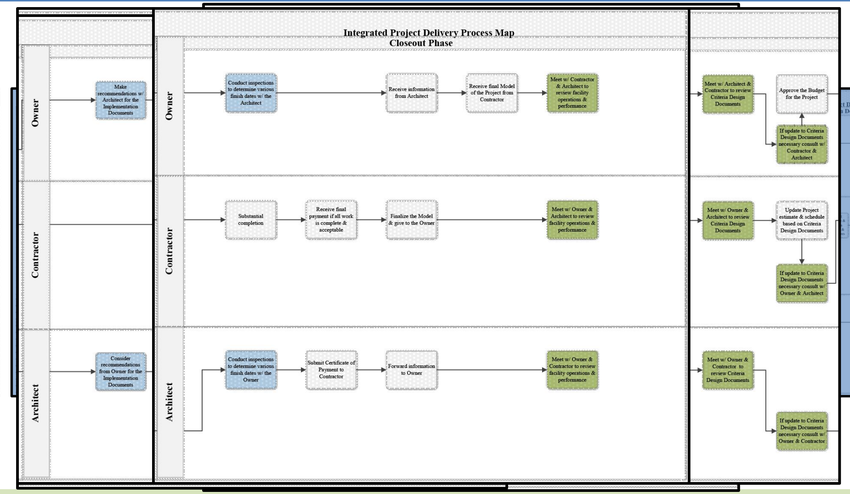
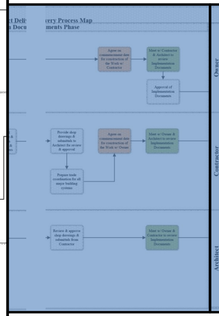
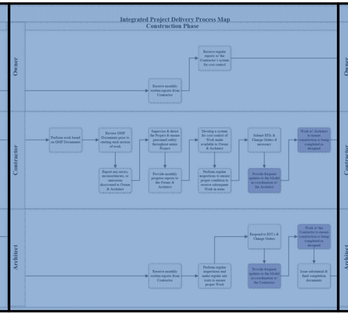
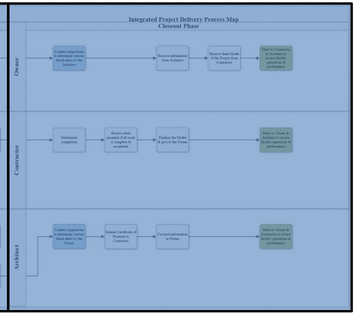
PRESENTATION OUTLINE











SIMPLIFYING THE IPD APPROACH

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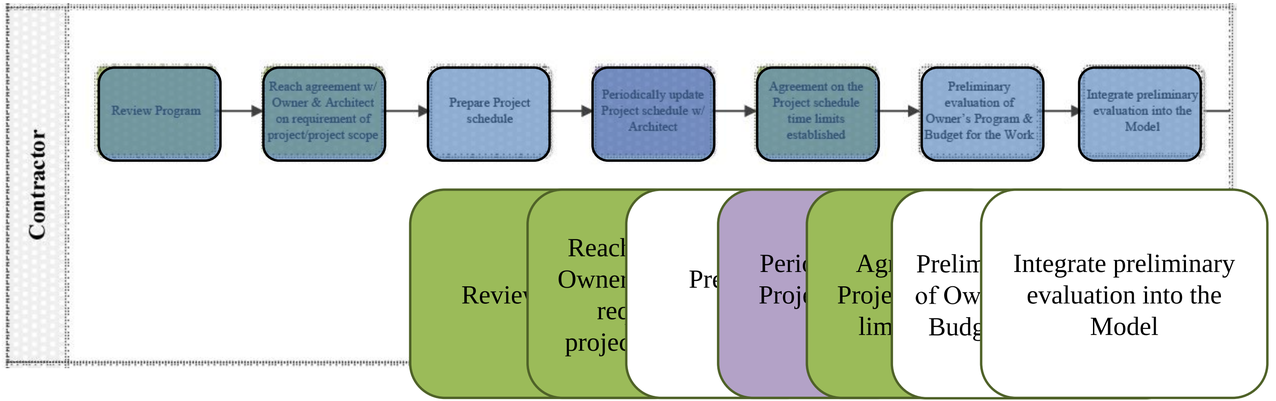
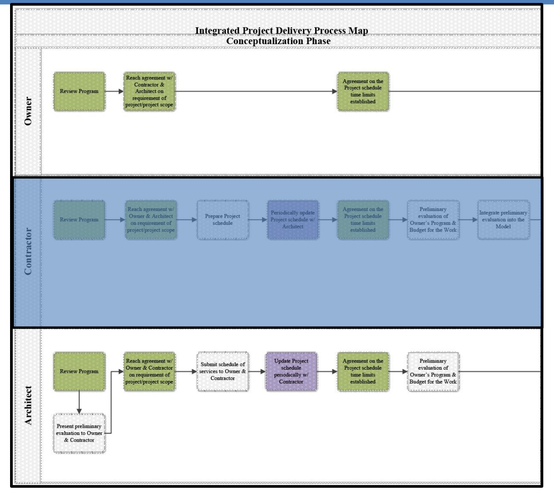
PRESENTATION OUTLINE



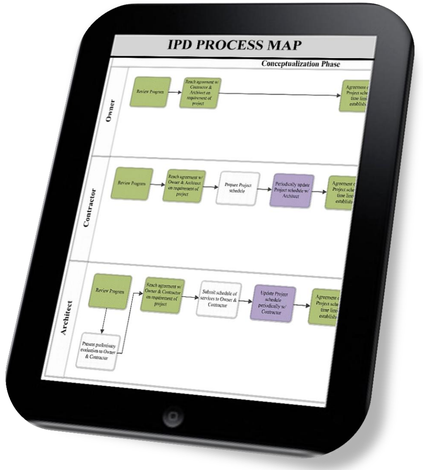


SIMPLIFYING THE IPD APPROACH

Gamblock.com

TABLET CAPABILITIES

| Simplified use during team meetings
| Shared document
| Optimize team collaboration by tailoring map to specific job



PRESENTATION OUTLINE

NEW MECHANICAL SYSTEM IN THE NORTHWEST BUILDING

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FALLS CHURCH, VA
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Photo Courtesy of Davis Construction

Photo Courtesy of Davis Construction

PROBLEM IDENTIFICATION
| Existing conditions
| Constructability challenge

RESEARCH GOAL
| Compare and contrast a water source heat pump & VAV mechanical system

RESULTS
| Based on the Owner's goals a VAV system would be recommended

WATER SOURCE HEAT PUMP
| $28.00 / ft^2 + Location Factor = **$6.89 million**
| Construction: 10 – 12 months
| System Life: 20 – 25 years

VAV SYSTEM
| $26.00 / ft^2 + Location Factor = **$6.39 million**
| Construction: 8 – 10 months
| System Life: 25 years

NEW MECHANICAL SYSTEM IN THE NORTHWEST BUILDING

7700 ARLINGTON BOULEVARD

FALLS CHURCH, VA

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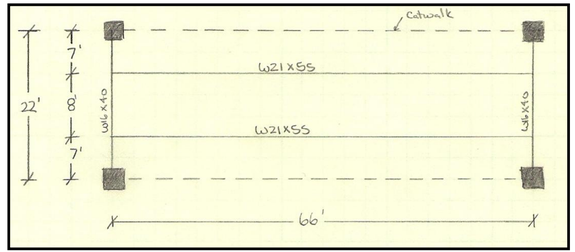
Photo Courtesy of Davis Construction

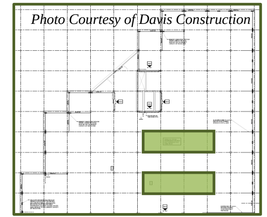
GUIDELINES

| 36000lb unit
| 66’ x 22’ raised platform

DESIGN

| (2) W16x40 laterally braced to (6) W21x55
| $14,000
| Must consider other loads on concrete columns





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CREATING A SHORT INTERVAL PRODUCTION SCHEDULE

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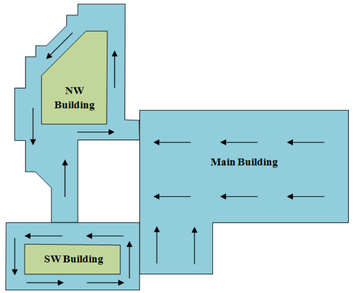

PROBLEM IDENTIFICATION

| Coordination
| Construction delays
| Double shifts to finish demolition
| Demoed perimeter first

RESEARCH GOAL

| SIPS for Demolition & Structural aspect
| Reduce construction schedule
| Reduce general condition costs

ASSUMPTIONS

| Demolition is one activity
| Double the time for demolition
| Double crew for seismic bracing


Photo Courtesy of Davis Construction

CREATING A SHORT INTERVAL PRODUCTION SCHEDULE

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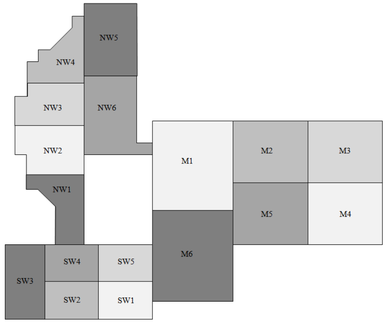

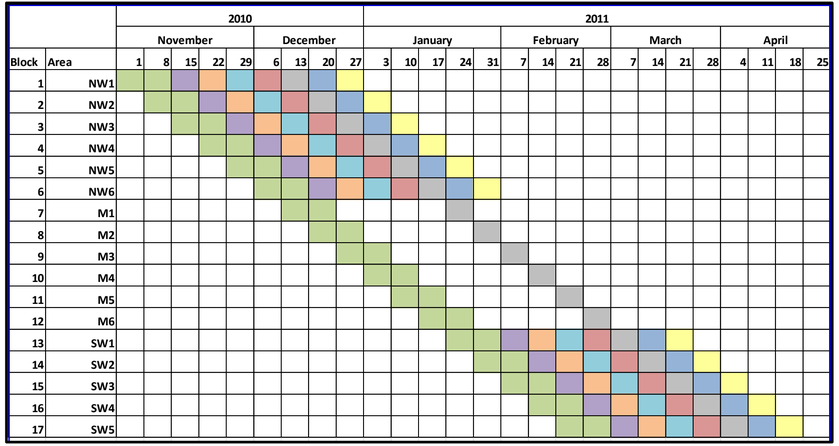

LEGEND
Demolition
Core Drill
FRP Footings for Progressive Collapse
FRP Cols & Beams for Progressive Collapse
Strengthening/Hardening
Seismic Bracing
Erect Steel for Progressive Collapse
Detail Steel for Progressive Collapse

TIME SAVINGS: 9 WEEKS

GC SAVINGS: $359,000.00

CREATING A SHORT INTERVAL PRODUCTION SCHEDULE

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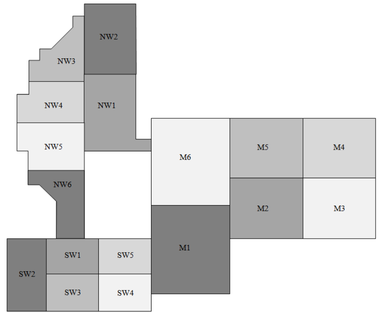

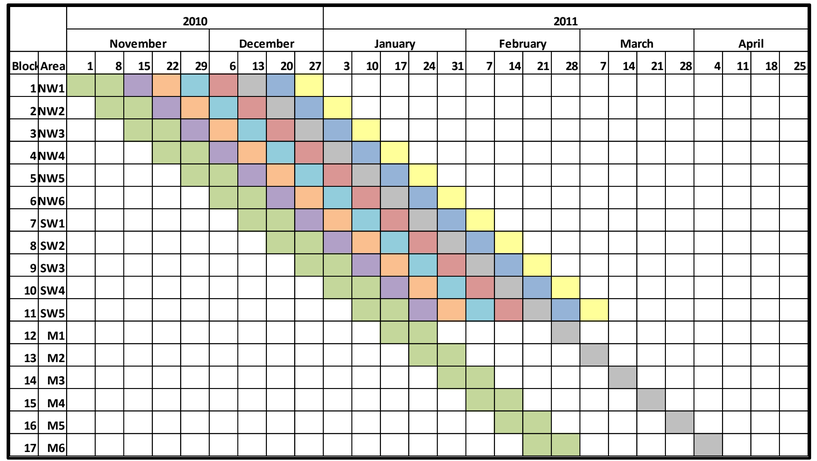

LEGEND
Demolition
Core Drill
FRP Footings for Progressive Collapse
FRP Cols & Beams for Progressive Collapse
Strengthening/Hardening
Seismic Bracing
Erect Steel for Progressive Collapse
Detail Steel for Progressive Collapse

TIME SAVINGS: 11 WEEKS

GC SAVINGS: $439,000.00

BIM IMPLEMENTATION INTO THE FIELD

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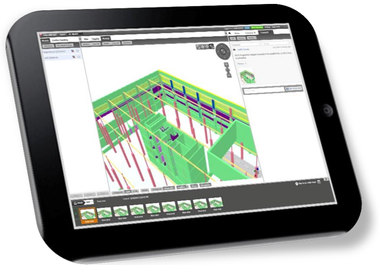
PRESENTATION OUTLINE

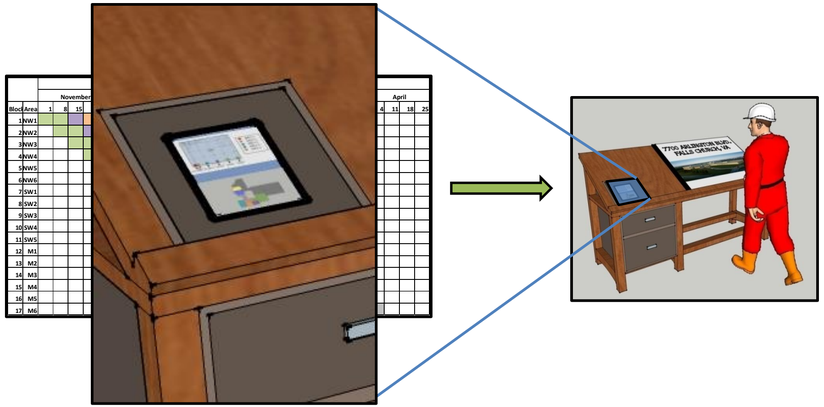


PROBLEM IDENTIFICATION

| Trade coordination

RESEARCH GOAL

| Simplify SIP schedule into flow diagrams & process charts
| Worker access to vital information at Hi-Tech Work Stations
| BIMsight technology



BIM IMPLEMENTATION INTO THE FIELD

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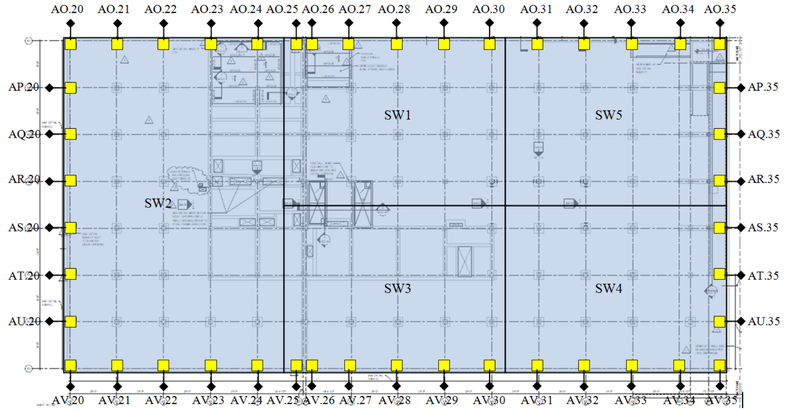
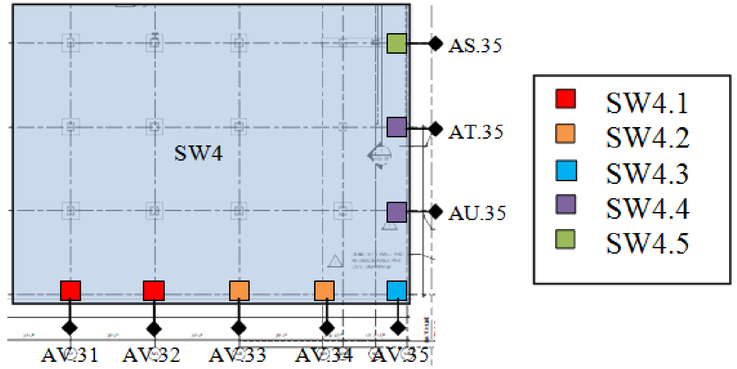
PRESENTATION OUTLINE





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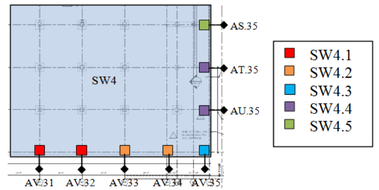
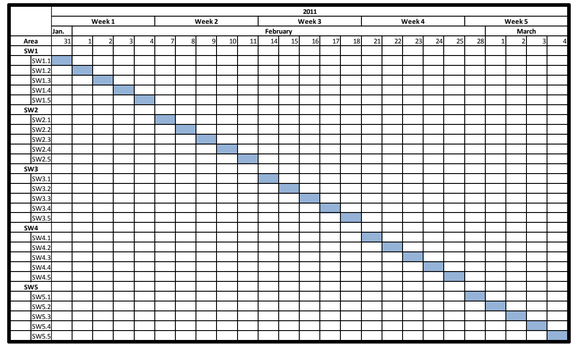


SW4		Feb. 21	Feb. 22	Feb. 23	Feb. 24	Feb. 25
		Time (hrs)				
SW4.1	AV.31	4				
	AV.32	4				
SW4.2	AV.33		4			
	AV.34		4			
SW4.3	AV.35			8		
SW4.4	AU.35				4	
	AT.35				4	
SW4.5	AS.35					8



BIM IMPLEMENTATION INTO THE FIELD

BENEFITS

| Coordination between trades on the jobsite
| Tablet simple to use
| Worker involvement
| Easy to move station around jobsite
| Damage and theft free
| Relatively cheap to build

BIM IMPLEMENTATION INTO THE FIELD

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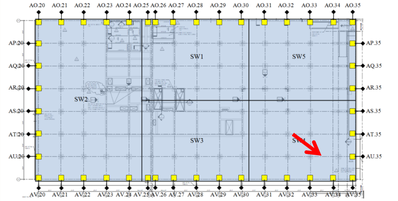
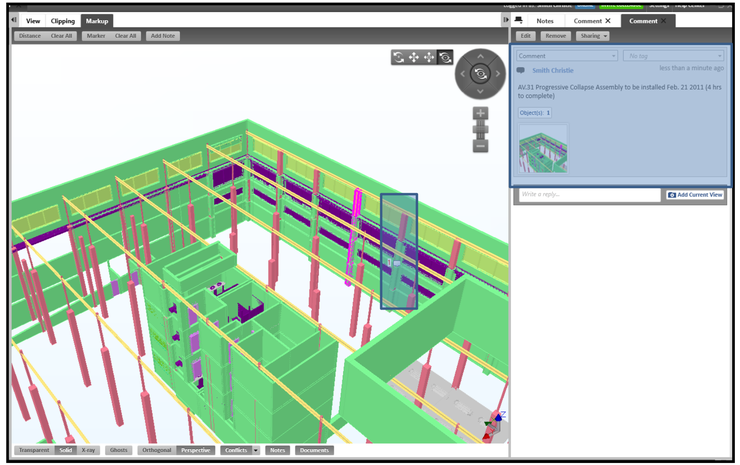
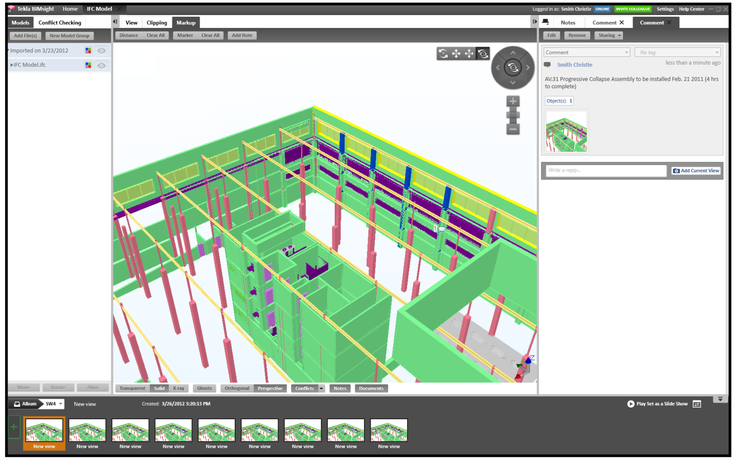
PRESENTATION OUTLINE

BENEFITS

| 3D sequencing
| Fast learning curve
| Collaboration features







SUMMARY

ANALYSIS #1 | IPD PROCESS MAP

ANALYSIS #2 | NW MECH SYSTEM

ANALYSIS #3 | SIP SCHEDULE

ANALYSIS #4 | BIM IN THE FIELD

ACKNOWLEDGEMENTS

Personal Acknowledgements

My family and friends

Industry Acknowledgements

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| Mr. Bill Moyer
| Mrs. Julie Kirkwood
| Mr. Tyler Moyer
| Mr. Jonathan Dougherty
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GBA Associates LP
GHT Limited
| James Cummings
WE Bowers
| Dave O'Donnell
PACE Industry Members

Academic Acknowledgements

Penn State AE Faculty

Table 9 | Water Source Heat Pump System Calculations

	Floor (ft^2)	ft^2/ton	Primary Heating (kBtu/yr)	Primary Cooling (kBtu/yr	Auxiliary (kBtu/yr)	Total Source Energy (kBtu/yr)	Building Energy Consumption (kBtu/ft^2)
WSHP System	267,289	545.50	48,331	4,283,341	5,010,683	9,342,355	34.95

Table 11 | VAV System Calculations

	Floor (ft^2)	ft^2/ton	Primary Heating (kBtu/yr)	Primary Cooling (kBtu/yr)	Auxiliary (kBtu/yr)	Total Source Energy (kBtu/yr)	Building Energy Consumption (kBtu/ft^2)
VAV System	267,289	455.63	95,138	4,958,626	4,654,482	9,708,246	36.32

APPENDICES

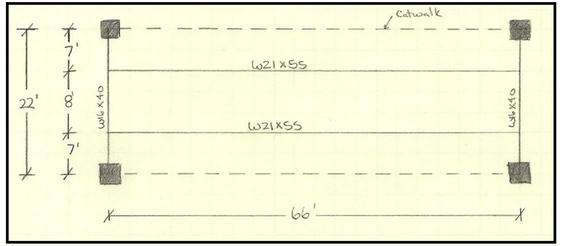

Table 12 | Raised Platform Design #1

Beams									
Description	**Quantity**	**Unit**	**Bare Material**	**Bare Labor**	**Bare Equipment**	**Bare Total**	**Total Incl O&P**	**Total Bare Cost**	**Total Cost Incl O & P**
W21x55	132	LF	$75.88	$3.71	$1.54	$81.12	$91.21	**$10,707.84**	**$12,039.72**
W16x40	44	LF	$55.00	$3.38	$1.87	$60.25	$68.50	**$2,651.00**	**$3,014.00**
							Total	**$13,358.84**	**$15,053.72**

TOTAL: $13,849.42

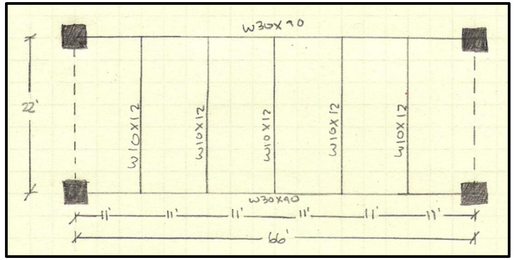

Table 13 | Raised Platform Design #2

Beams									
Description	**Quantity**	**Unit**	**Bare Material**	**Bare Labor**	**Bare Equipment**	**Bare Total**	**Total Incl O&P**	**Total Bare Cost**	**Total Cost Incl O & P**
W10x12	110	LF	$66.00	$4.91	$2.72	$73.63	$84.00	**$8,099.3**	**$9,240.00**
W30x90	132	LF	$136.00	$3.25	$1.35	$140.60	$157.00	**$18,559.20**	**$20,724.00**
							Total	**$26,658.50**	**$29,964.00**

TOTAL: $27,566.88

Table 15 | Schedule Analysis

	Original Schedule		SIP Schedule		SIP Schedule New	
Task Name	**Start**	**Finish**	**Start**	**Finish**	**Start**	**Finish**
Phase I – 500,000 SF						
NW Building						
- Demolition	11/1/10	1/24/11	11/1/10	12/17/10	11/1/10	12/17/10
- Structure	11/4/10	2/8/11	11/15/10	2/4/11	11/15/10	2/4/11
Main Building						
- Demolition	1/3/11	3/29/11	12/13/10	1/28/11	12/13/10	1/21/11
- Structure	1/24/11	3/28/11	1/24/11	3/4/11	12/27/11	3/11/11
Phase II – 147,000 SF						
SW Building						
- Demolition	2/28/11	5/26/11	1/24/11	3/4/11	1/17/11	3/4/11
- Structure	4/19/11	**6/27/11**	2/7/11	**4/22/11**	2/28/11	**4/8/11**
Total Schedule Reduction			**9 Weeks**		**11 Weeks**	

Table 16 | General Conditions Summary

	Total	$ / Day	$ / Week
General Conditions	**$3,293,004.80**	**$7,973.38**	**$39,866.9**

APPENDICES

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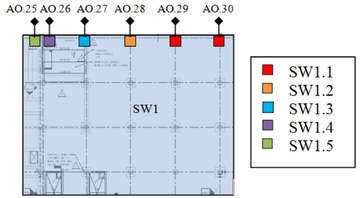
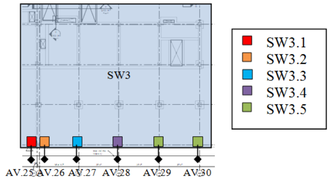
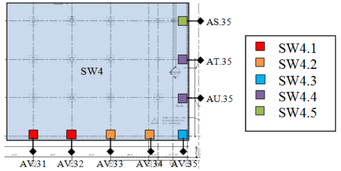
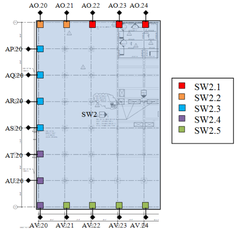
FALLS CHURCH, VA
CHRISTIE SMITH | CONSTRUCTION MANAGEMENT

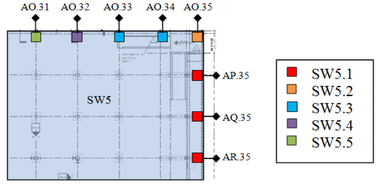
PRESENTATION OUTLINE











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		Time (hrs)				
SW1.1	AO.30	4				
	AO.29	4				
SW1.2	AO.28		8			
SW1.3	AO.27			8		
SW1.4	AO.26				8	
SW1.5	AO.25					8

SW2		Feb. 7	Feb. 8	Feb. 9	Feb. 10	Feb. 11
		Time (hrs)				
SW2.1	AO.24	2.67				
	AO.23	2.67				
	AO.22	2.67				
SW2.2	AO.21		4			
	AO.20		4			
SW2.3	AP.20			2		
	AQ.20			2		
	AR.20			2		
	AS.20			2		
SW2.4	AT.20				2.67	
	AU20				2.67	
	AV.20				2.67	
SW2.5	AV.21					2
	AV.22					2
	AV.23					2
	AV.24					2

SW3		Feb. 14	Feb. 15	Feb. 16	Feb. 17	Feb. 18
		Time (hrs)				
SW3.1	AV.25	8				
SW3.2	AV.26		8			
SW3.3	AV.27			8		
SW3.4	AV.28				8	
SW3.5	AV.29					4
	AV.30					4

SW4		Feb. 21	Feb. 22	Feb. 23	Feb. 24	Feb. 25
		Time (hrs)				
SW4.1	AV.31	4				
	AV.32	4				
SW4.2	AV.33		4			
	AV.34		4			
SW4.3	AV.35			8		
SW4.4	AU.35				4	
	AT.35				4	
SW4.5	AS.35					8

SW5		Feb. 28	Mar. 1	Mar. 2	Mar. 3	Mar. 4
		Time (hrs)				
SW5.1	AR.35	2.67				
	AQ.35	2.67				
	AP.35	2.67				
SW5.2	AQ.35		8			
SW5.3	AQ.34			4		
	AQ.33			4		
SW5.4	AQ.32				8	
SW5.5	AQ.31					8