Jeremy Feath
Construction Option

(Courtesy of Owner)

University Engineering Building
Mid-Atlantic University, United States

Jeremy Feath
Construction Option

Project Overview

University Engineering Building
Mid-Atlantic University, United States

Location: *Mid-Atlantic, United States*

Size: *95,000 SF*

Project Cost: *$43 million*

Delivery Method: *Design-Bid-Build*

Project Duration: *Jan. 2013 – Jan. 2015*

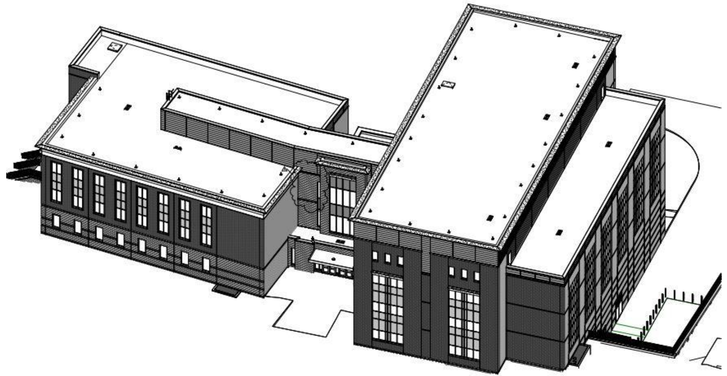
Massaro

Stantec

Owner: *Mid-Atlantic University*

Design Architect: *Stantec Arch. Inc.*

General Contractor: *Massaro Const.*



(Courtesy of Stantec)

(Courtesy of Google Maps)

Jeremy Feath
Construction Option

Project Overview

University Engineering Building
Mid-Atlantic University, United States

Analysis 1: Clean Room Coordination

- *Reorganize project organization chart, along with creating and analyzing Clean Room coordination schedule & process*

Analysis 2: Roof System Redesign

- *Propose a feasible alternative to the Fully-Adhered TPO roof system*

(Courtesy of Jeremy Feath)

Analysis 3: Underground Spring

- *Propose an alternative to the permanent sump pump to manage the underground spring located underneath the UEB's foundation*

Analysis 4: FM Information Delivery

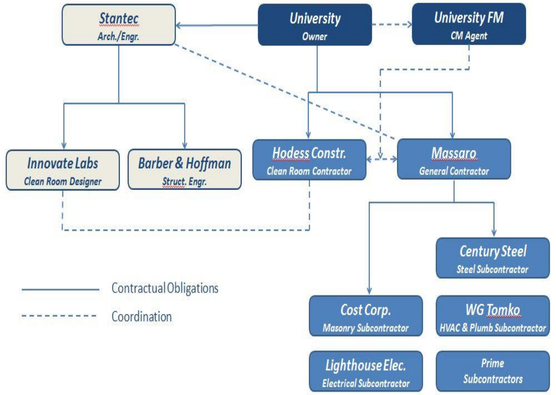
- *Research and study the methods of information delivery from CM to FM and utilizing that information to manage facilities*

Analysis 1:
Clean Room Coordination

Analysis 1
Clean Room Coordination

Background

University Engineering Building
Mid-Atlantic University, United States



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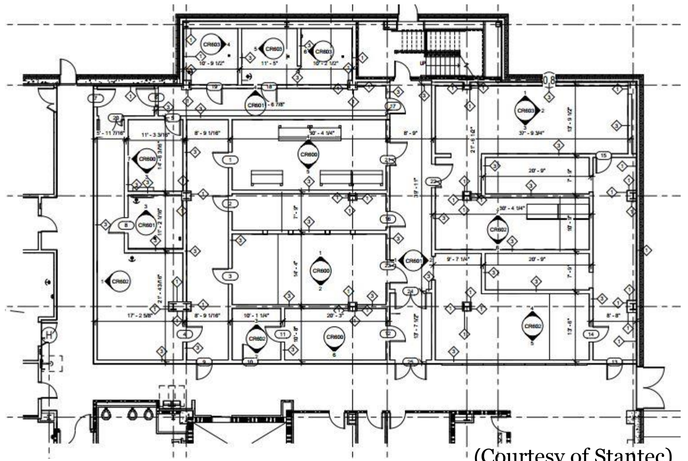

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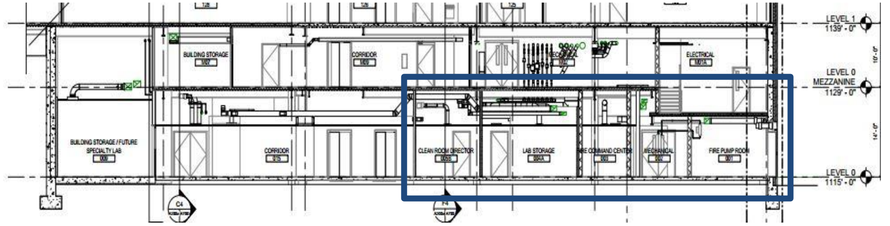
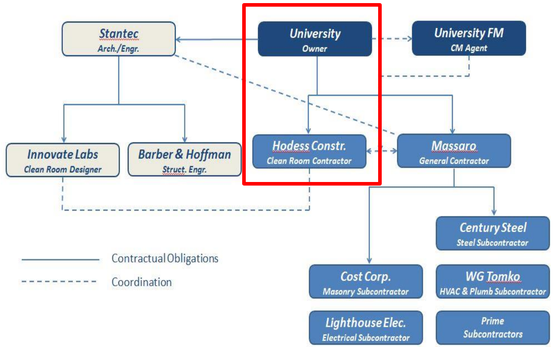


(Courtesy of Stantec)

Problem Identification:

- *Both Massaro and Hodess have separate contracts w/ the Owner*
- *Coordination for the Clean Room is extremely intensive*
  - *Scopes of Work*
  - *Constructability*

Project Organization



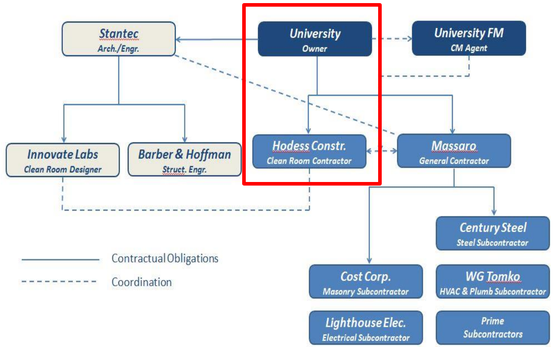
Original Design-Bid-Build
Hodess contract w/ Owner

(Courtesy of Jeremy Feath)

Original Contractual Obligations:

- *Hodess used for Design Coordination, contracted to Owner at time*
- *Massaro chosen as General Contractor, contracted to Owner*
- *Owner unsuccessfully attempted to transfer Hodess' contract to Massaro*

Project Organization



Original Design-Bid-Build
Hodess contract w/ Owner

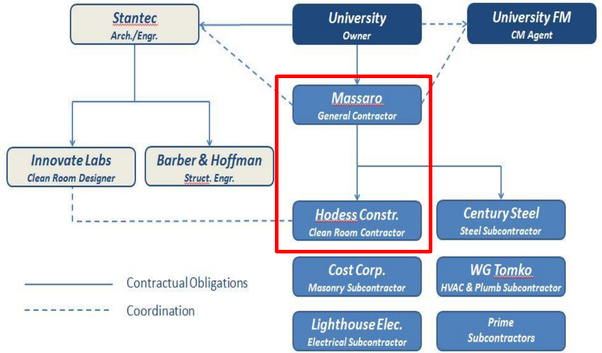
Original Contractual Obligations:

- *Hodess used for Design Coordination, contracted to Owner at time*
- *Massaro chosen as General Contractor, contracted to Owner*
- *Owner unsuccessfully attempted to transfer Hodess' contract to Massaro*

New Contractual Obligations:

- *Hodess has preconstruction contract with Owner*
- *Massaro awarded bid, contract with the Owner*
- *Hodess now acts as a subcontractor, construction contract with Massaro*

(Courtesy of Jeremy Feath)



New Design-Bid-Build
Hodess contract w/ Massaro

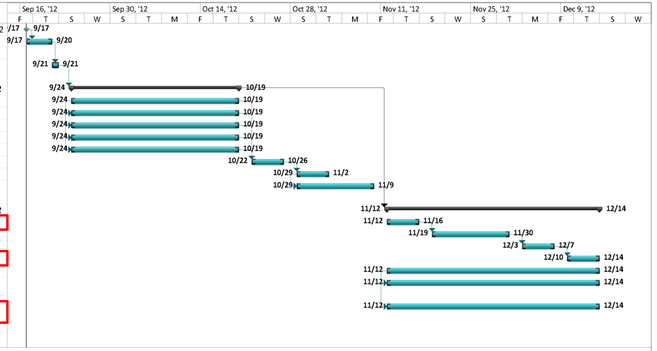
(Courtesy of Jeremy Feath)

Analysis 1
Clean Room Coordination

Clean Room Coordination

University Engineering Building
Mid-Atlantic University, United States

ID	Task Name	Duration	Start	Finish
1	Awarded UEB Project	0 days	Mon 9/17/12	Mon 9/17/12
2	Finalize Subcontractor Contracts	4 days	Mon 9/17/12	Thu 9/20/12
3	Preliminary Coordination Meeting	1 day	Fri 9/21/12	Fri 9/21/12
4	**3D Coordination Model**	**20 days**	**Mon 9/24/12**	**Fri 10/19/12**
5	Mechanical Model	4 wks	Mon 9/24/12	Fri 10/19/12
6	Electrical Model	4 wks	Mon 9/24/12	Fri 10/19/12
7	Plumbing Model	4 wks	Mon 9/24/12	Fri 10/19/12
8	Structural Model	4 wks	Mon 9/24/12	Fri 10/19/12
9	Clean Room Model	4 wks	Mon 9/24/12	Fri 10/19/12
10	Combine Models	5 days	Mon 10/22/12	Fri 10/26/12
11	Run Clash Detection	5 days	Mon 10/29/12	Fri 11/2/12
12	Clash Detection Meeting(s)	10 days	Mon 10/29/12	Fri 11/9/12
13	**Clean Room Coordination**	**25 days?**	**Mon 11/12/12**	**Fri 12/14/12**
14	CR Ceiling Grid Hangars	5 days	Mon 11/12/12	Fri 11/16/12
15	MEP Transitions	10 days	Mon 11/19/12	Fri 11/30/12
16	Mechanical Fittings	5 days	Mon 12/3/12	Fri 12/7/12
17	Electrical Equipment	5 days	Mon 12/10/12	Fri 12/14/12
18	Clash Fixes	25 days	Mon 11/12/12	Fri 12/14/12
19	Designer Coordination on Potential RFIs	25 days	Mon 11/12/12	Fri 12/14/12
20	Determine Long Lead items	25 days	Mon 11/12/12	Fri 12/14/12
21				



(Courtesy of Jeremy Feath)

Problem Areas:
- *Clean Room Light Fixtures*
- *Mezzanine AHUs*
- *Clean Room Ceiling Grid*

(Courtesy of Stantec)

(Courtesy of Jeremy Feath)

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Analysis 1
Clean Room Coordination

Clean Room Coordination

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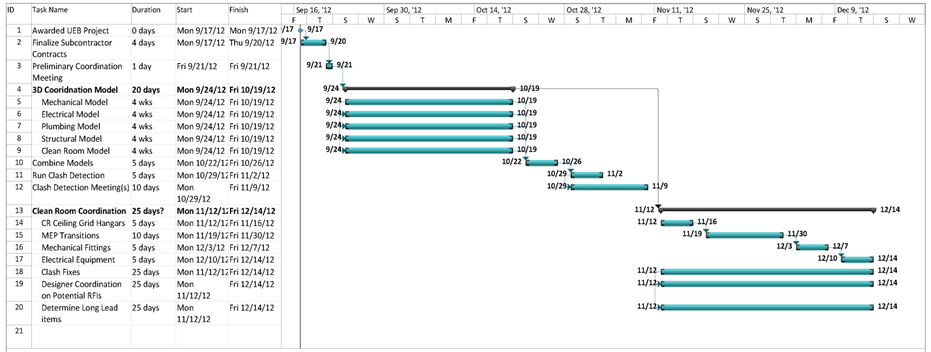


(Courtesy of Jeremy Feath)

Problem Areas:
- *Clean Room Light Fixtures*
- *Mezzanine AHUs*
- *Clean Room Ceiling Grid*

(Courtesy of Stantec)

Tools:
- *3D Model Coordination*
- *Hodess Precon experience*
- *Early Problem Identification*

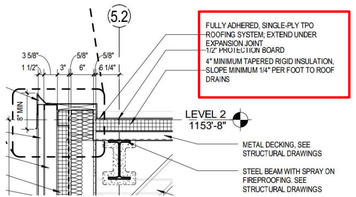
(Courtesy of Jeremy Feath)

Savings:
- *Less RFIs, COs*
- *Fewer Constructability Problems*
- *Potential Schedule Savings*

(Courtesy of Jeremy Feath)

Analysis 2: Roof System Redesign

Background



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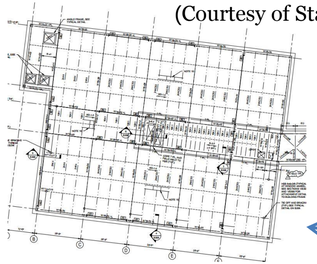
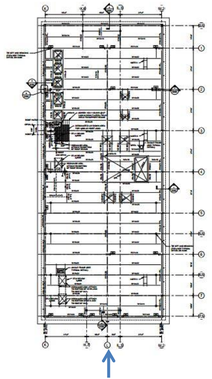
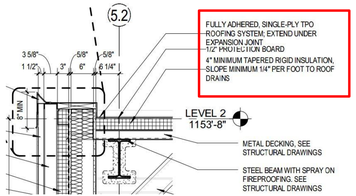




Lab Roof: 14,000 SF

Office Roof: 10,000 SF

Background



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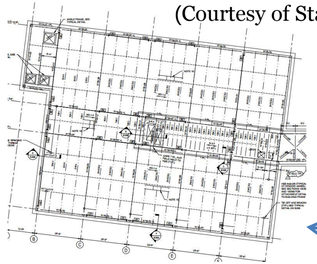

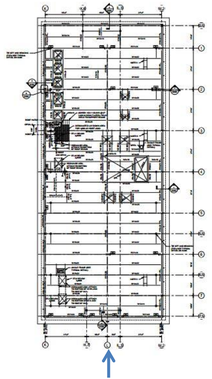

Lab Roof: 14,000 SF

Office Roof: 10,000 SF

Original Project Schedule

Building Roof & Exterior Enclosure		133	133		11-Nov-13	19-May-14
Lab		133	133		11-Nov-13	19-May-14
Lab - Roof		61	61		12-Dec-13	10-Mar-14
Lab-30000	Roof Blocking - Lab Roof	5	5	0%	12-Dec-13	18-Dec-13
Lab-30010	Roof Drains - Lab Roof	4	4	0%	13-Dec-13	18-Dec-13
Lab-30020	Roofing System - Lab Roof	15	15	0%	11-Feb-14	03-Mar-14
Lab-30030	Lightning Protection - Lab Roof	5	5	0%	04-Mar-14	10-Mar-14
Lab-30035	Install Roof Crane	5	5	0%	04-Mar-14	10-Mar-14

Lab Roof Activities – Total Duration: 61 days

Office		101	101		25-Nov-13	17-Apr-14
Office - Roof		30	30		07-Jan-14	17-Feb-14
Off-30000	Roof Blocking - Office Roof	5	5	0%	07-Jan-14	13-Jan-14
Off-30010	Roof Drains - Office Roof	4	4	0%	08-Jan-14	13-Jan-14
Off-30020	Roofing System - Office Roof	20	20	0%	14-Jan-14	10-Feb-14
Off-30030	Lightning Protection - Office Roof	5	5	0%	11-Feb-14	17-Feb-14

Office Roof Activities – Total Duration: 30 days

(Courtesy of Massaro)

Analysis 2
Roof System Redesign

Background

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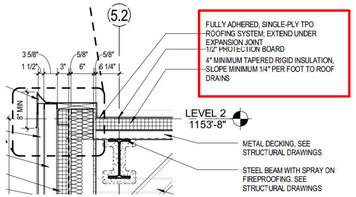
Mid-Atlantic University, United States



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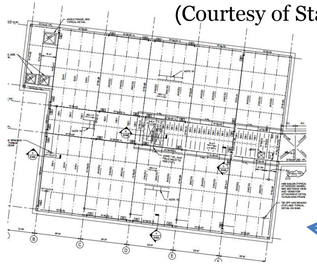

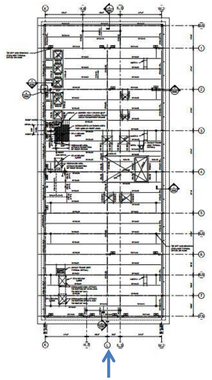

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Off-30020	Roofing System - Office Roof	20	20	0%	14-Jan-14	10-Feb-14
Off-30030	Lightning Protection - Office Roof	5	5	0%	11-Feb-14	17-Feb-14

Office Roof Activities – Total Duration: 30 days

(Courtesy of Massaro)

Roof System Problems:

- *Cold-Weather Constructability Difficult*
- *Increased General Conditions Costs*
- *Delayed Interior Work (Fireproofing, MEP Rough-Ins)*

(Courtesy of Jeremy Feath)

(Courtesy of Jeremy Feath)

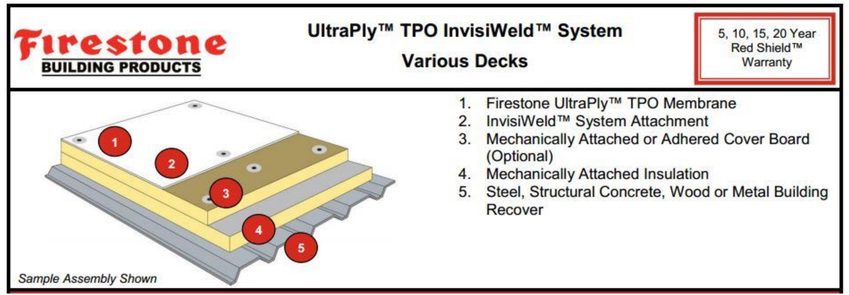
Background

Proposed Solution:

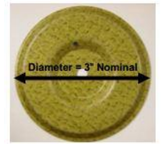
Firestone TPO InvisiWeld System

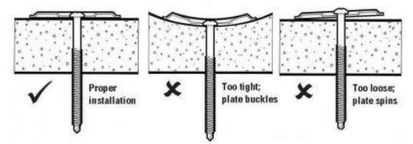
Improved Cold-Weather Constructability

Meets Owner Approval & Contractor Experience



(Courtesy of Firestone Building Products)





(Courtesy of Firestone Building Products)

Schedule Results

InvisiWeld Plate Weld Durations

Location	Area (SF)	4'x8' Board (SF)	# Boards	Avg. # of Plates	Total Plates	# Plates/Hr.	Total Hrs.	Total Days
Lab	14000	32	437.5	14	6125	300	20.42	2.55
Office	10000	32	312.5	14	4375	300	14.58	1.82

Note: 300 plates/hr. based on Firestone literature

Roof System Duration Comparison

Roof System	Lab Duration	Office Duration	Total Duration
Fully-Adhered TPO	61	30	61
InvisiWeld	35	25	40
Built-Up Roof	51	47	65

(All Courtesy of Jeremy Feath)

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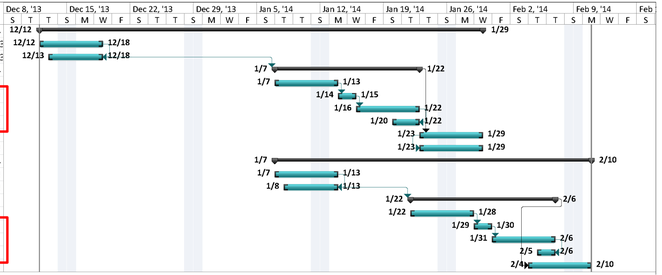
Built-Up Roof	51	47	65

InvisiWeld Construction Schedule

ID	Task Name	Duration	Start	Finish
1	**Lab - InvisiWeld Roof**	**35 days**	**Thu 12/12/13**	**Wed 1/29/14**
2	Roof Blocking - Lab	5 days	Thu 12/12/13	Wed 12/18/13
3	Roof Drains - Lab	4 days	Fri 12/13/13	Wed 12/18/13
4	**Roof System**	**12 days**	**Tue 1/7/14**	**Wed 1/22/14**
5	Insulation & Cover Board Install	5 days	Tue 1/7/14	Mon 1/13/14
6	InvisiWeld Plates Install	2 days	Tue 1/14/14	Wed 1/15/14
7	Membrane Install	5 days	Thu 1/16/14	Wed 1/22/14
8	Plate Welds	3 days	Mon 1/20/14	Wed 1/22/14
9	Lightning Protection	5 days	Thu 1/23/14	Wed 1/29/14
10	Install Roof Crane	5 days	Thu 1/23/14	Wed 1/29/14
11	**Office - InvisiWeld Roof**	**25 days**	**Tue 1/7/14**	**Mon 2/10/14**
12	Roof Blocking - Lab	5 days	Tue 1/7/14	Mon 1/13/14
13	Roof Drains - Lab	4 days	Wed 1/8/14	Mon 1/13/14
14	**Roof System**	**12 days**	**Wed 1/22/14**	**Thu 2/6/14**
15	Insulation & Cover Board Install	5 days	Wed 1/22/14	Tue 1/28/14
16	InvisiWeld Plates Install	2 days	Wed 1/29/14	Thu 1/30/14
17	Membrane Install	5 days	Fri 1/31/14	Thu 2/6/14
18	Plate Welds	2 days	Wed 2/5/14	Thu 2/6/14
19	Lightning Protection	5 days	Tue 2/4/14	Mon 2/10/14



(All Courtesy of Jeremy Feath)

Cost Comparison

Fully Adhered TPO Membrane Roof Estimate

Material	Quantity	Unit	Cost/Unit	Total Cost
TPO Membrane (80 mil)	24000	SF	$1.03	$24,720.00
Multipurpose Adhesives	40	600 SF	$145.00	$5,800.00
Expansion Joint	800	LF	$2.00	$1,600.00
1/2" Protection Board	24000	SF	$0.53	$12,720.00
(2) 2" Rigid Insulation	24000	SF	$0.65	$15,600.00
Single-Ply Memb. Sealants	100	1 gal. Pail	$75.00	$7,500.00
Sealant Primers	100	1 gal. Pail	$67.00	$6,700.00
Sheet Flashing	24	100 SF	$251.00	$6,024.00
Bonding Adhesive	54	450 SF Pail	$145.00	$7,830.00
Fasteners	25	5" HD 1000/Pail	$190.00	$4,750.00
Metal Termination Bar	80	10 LF	$7.00	$560.00
Total				**$93,804.00**

Original General Conditions Estimate

TOTAL			$1,610,845.00
TOTAL CONSTRUCTION COSTS * 6%			$1,962,000.00
COST DIFFERENCE			$351,155.00
% DIFFERENCE			17.90

Revised General Conditions Estimate

TOTAL			$1,618,545.00
TOTAL CONSTRUCTION COSTS * 6%			$1,962,000.00
COST DIFFERENCE			$343,455.00
% DIFFERENCE			17.51

Fully-Adhered TPO System
General Conditions Increase - $7,700

Increase in Temporary Heating & Enclosure:

- ***Protect Penthouse Equipment & Stored Materials***
- ***Enable interior rough-in work to continue***

Note: The increase in GC does not occur for BUR or InvisiWeld

(All Courtesy of Jeremy Feath)

Cost Comparison

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Single-Ply Memb. Sealants	100	1 gal. Pail	$75.00	$7,500.00
Sealant Primers	100	1 gal. Pail	$67.00	$6,700.00
Sheet Flashing	24	100 SF	$251.00	$6,024.00
Bonding Adhesive	54	450 SF Pail	$145.00	$7,830.00
Fasteners	25	5" HD 1000/Pail	$190.00	$4,750.00
Metal Termination Bar	80	10 LF	$7.00	$560.00
Total				**$93,804.00**

Traditional Built-Up Roof				
Material	Quantity	Unit	Cost/Unit	Total Cost
Ply VI Membrane (4 Layers)	96000	SF (1 - Layer)	$0.85	$81,600.00
Asphalt	30	ton	$820.00	$24,600.00
(2) 2" Rigid Insulation	24000	SF	$0.65	$15,600.00
Cover Board	24000	SF	$0.53	$12,720.00
Total				**$134,520.00**

Labor Cost Estimate				
Roof Type	Duration (days)	Hourly Rate	Daily Rate	Total Cost
Fully-Adhered TPO	61	$100.00	$800.00	$48,800.00
Built-Up Roof	65	$100.00	$800.00	$52,000.00
InvisiWeld TPO	40	$100.00	$800.00	$32,000.00

(All Courtesy of Jeremy Feath)

Cost Comparison

Fully Adhered TPO Membrane Roof Estimate

Material	Quantity	Unit	Cost/Unit	Total Cost
TPO Membrane (80 mil)	24000	SF	$1.03	$24,720.00
Multipurpose Adhesives	40	600 SF	$145.00	$5,800.00
Expansion Joint	800	LF	$2.00	$1,600.00
1/2" Protection Board	24000	SF	$0.53	$12,720.00
(2) 2" Rigid Insulation	24000	SF	$0.65	$15,600.00
Single-Ply Memb. Sealants	100	1 gal. Pail	$75.00	$7,500.00
Sealant Primers	100	1 gal. Pail	$67.00	$6,700.00
Sheet Flashing	24	100 SF	$251.00	$6,024.00
Bonding Adhesive	54	450 SF Pail	$145.00	$7,830.00
Fasteners	25	5" HD 1000/Pail	$190.00	$4,750.00
Metal Termination Bar	80	10 LF	$7.00	$560.00
Total				**$93,804.00**

Traditional Built-Up Roof

Material	Quantity	Unit	Cost/Unit	Total Cost
Ply VI Membrane (4 Layers)	96000	SF (1 - Layer)	$0.85	$81,600.00
Asphalt	30	ton	$820.00	$24,600.00
(2) 2" Rigid Insulation	24000	SF	$0.65	$15,600.00
Cover Board	24000	SF	$0.53	$12,720.00
Total				**$134,520.00**

Labor Cost Estimate

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Fully-Adhered TPO	61	$100.00	$800.00	$48,800.00
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InvisiWeld TPO Membrane Roof

Material	Quantity	Unit	Cost/Unit	Total Cost
TPO Membrane (80 mil)	24000	SF	$1.03	$24,720.00
Expansion Joint	800	LF	$2.00	$1,600.00
1/2" Protection Board	24000	SF	$0.53	$12,720.00
(2) 2" Rigid Insulation	24000	SF	$0.65	$15,600.00
Single-Ply Memb. Sealants	100	1 gal. Pail	$75.00	$7,500.00
Sealant Primers	100	1 gal. Pail	$67.00	$6,700.00
Sheet Flashing	24	100 SF	$251.00	$6,024.00
Fasteners	25	5" HD 1000/Pail	$190.00	$4,750.00
InvisiWeld Plates	21	500 Pail	$90.00	$1,890.00
InvisiWeld Machine	1	EA	$7,500.00	$7,500.00
T-Patches	5250	EA	$0.44	$2,310.00
Pipe Boots	10	EA	$23.00	$230.00
Total				**$91,544.00**

Total Cost Savings:

$26,760.00

(All Courtesy of Jeremy Feath)

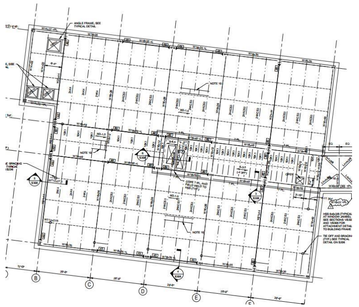
Analysis 2
Roof System Redesign

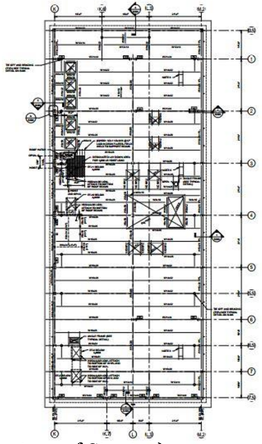
Roof Deck Study

University Engineering Building
Mid-Atlantic University, United States

Purpose:
- *To study the affect increased roof load has on metal decking*

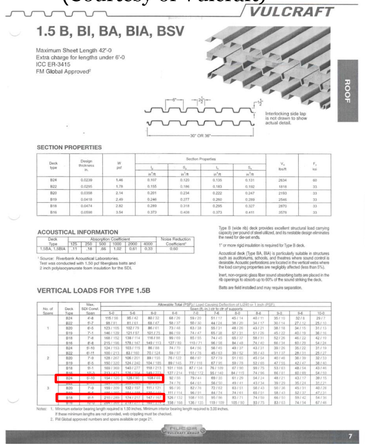
Original Deck: 1-1/2", 20 gauge



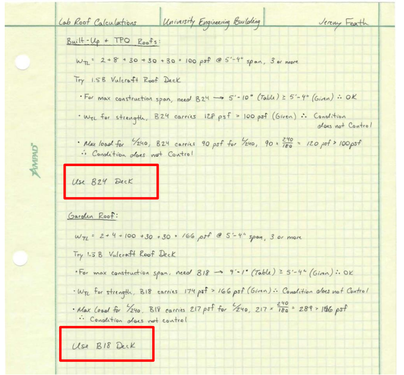


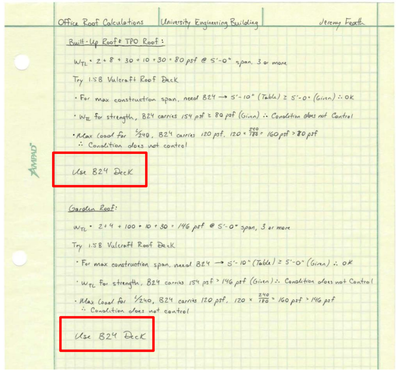
(Courtesy of Stantec)

(Courtesy of Vulcraft)



TPO vs. Garden Roof





(Courtesy of Jeremy Feath)

Analysis 3: Underground Spring

Background

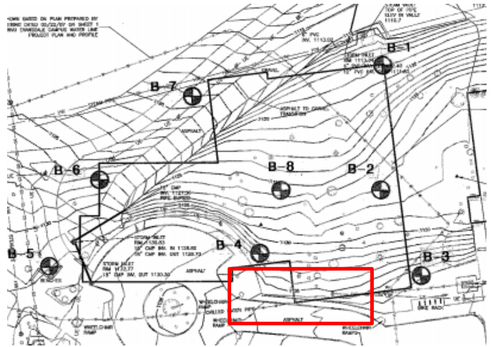
Problems:

- *Spring & Rain delayed construction during Excavation & Foundations*
- *Spring was NOT discovered during GeoTech Investigation*

(Courtesy of Jeremy Feath)

Proposed Solution:

- *Addition of Waterproofing Membrane to Lab Foundation Wall w/ Sump Pump backup*



(Courtesy of Stantec)

Analysis 3
Underground Spring

Background

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Mid-Atlantic University, United States

Problems:

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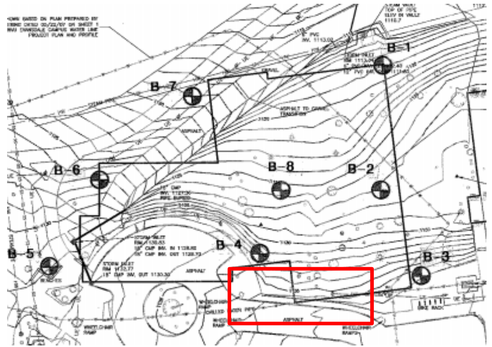
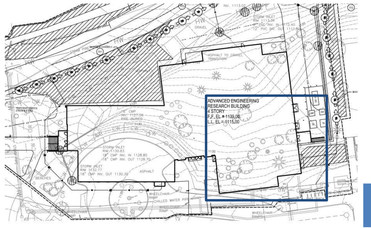
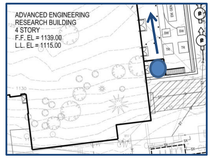


(Const. DWGs Courtesy of Stantec)
(Photos & Table Courtesy of Jeremy Feath)

Project Team Solution – Permanent Sump Pump





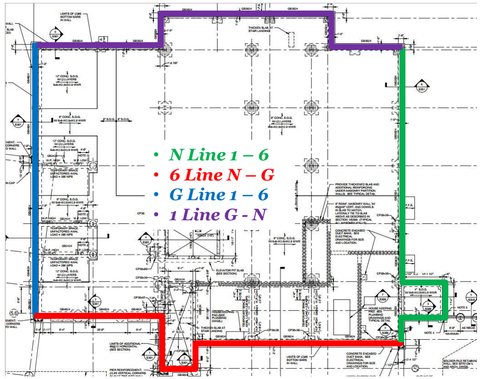
Sump Pump System Estimate

Material	Quantity	Unit	Cost per Unit	Total Cost
Sump Pump (Temporary)	1	EA	$120.00	$120.00
Sump Pump (Permanent)	1	EA	$215.00	$215.00
2" PVC	160	LF	$12.09	$1,934.40
Check Valve	1	EA	$37.25	$37.25
90° Elbow	1	EA	$46.86	$46.86
45° Elbow	3	EA	$36.48	$109.44
Total				$2,462.95

Underground Spring Solution:

Tamko TW-60 Waterproofing Membrane

(Courtesy of Tamko)



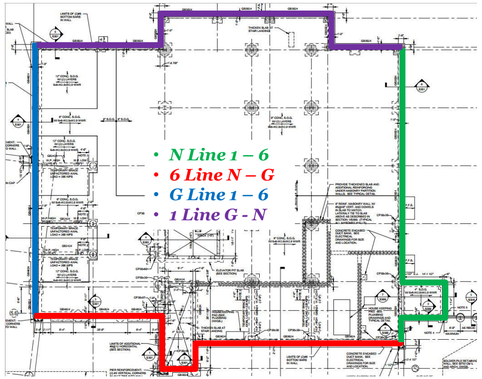
(Const. DWGs Courtesy of Stantec)
(Photos & Table Courtesy of Jeremy Feath)

Results

Underground Spring Solution:

Tamko TW-60 Waterproofing Membrane

(Courtesy of Tamko)



Cost Estimate Impact

Tamko TW-60 Material Foundation Wall Costs

Level 0 & Mezzanine (Lab)	Roll Width (in.)	Roll Size	Area Coverage	Wall Area	# Rolls Needed	Cost per Roll	Total Cost
N Line 1 - 6	39.375	39.375" x 61'	200	3404.88	18	$292.00	$5,256.00
6 Line N - G	39.375	39.375" x 61'	200	4173.36	21	$292.00	$6,132.00
G Line 1 - 6	39.375	39.375" x 61'	200	2496.96	13	$292.00	$3,796.00
1 Line G - N	39.375	39.375" x 61'	200	2210.18	12	$292.00	$3,504.00
Total							**$18,688.00**

Note: Labor Costs do NOT change

Total System Cost - $21,151.00

Sump Pump System Estimate

Material	Quantity	Unit	Cost per Unit	Total Cost
Sump Pump (Temporary)	1	EA	$120.00	$120.00
Sump Pump (Permanent)	1	EA	$215.00	$215.00
2" PVC	160	LF	$12.09	$1,934.40
Check Valve	1	EA	$37.25	$37.25
90° Elbow	1	EA	$46.86	$46.86
45° Elbow	3	EA	$36.48	$109.44
Total				**$2,462.95**

- *Cost difference made up from Roof System change*
- *System is necessary to combat the Spring in combination with heavy rainfall*

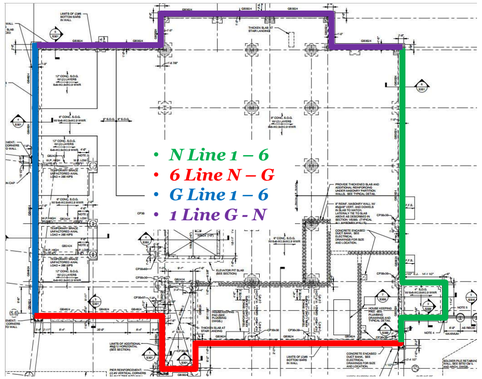
(Const. DWGs Courtesy of Stantec)
(Table s Courtesy of Jeremy Feath)

Results

Underground Spring Solution:

Tamko TW-60 Waterproofing Membrane

(Courtesy of Tamko)



Schedule Impact

Foundation Waterproofing Membrane Durations

Level 0 & Mezzanine (Lab)	LF Coverage	Wall Height	Daily Output (LF)	Daily Output (SF)	Coverage Area	Duration
N Line 1 - 6	141.87	24	80	1920	3404.88	**1.77**
6 Line N - G	173.89	24	80	1920	4173.36	2.17
G Line 1 - 6	104.04	24	80	1920	2496.96	1.30
1 Line G - N	157.87	14	80	1120	2210.18	1.97
Total						7.22

Total Schedule Change = +4 days

Roughly 1 extra day per Wall section

(Const. DWGs Courtesy of Stantec)
(Table & Schedule Courtesy of Jeremy Feath)

9	N Line 1 - 6	27 days	Tue 4/2/13	Wed 5/8/13
10	Bituminus Seal	1 day	Tue 4/2/13	Tue 4/2/13
11	Excavate Grade Beam	2 days	Tue 4/2/13	Wed 4/3/13
12	Place Geo-Foam	1 day	Wed 4/3/13	Wed 4/3/13
13	FRP Grade Beams	4 days	Thu 4/4/13	Tue 4/9/13
14	FRP Walls N Line 1 - 3	2 days	Fri 5/3/13	Mon 5/6/13
15	Install Sheet Waterproofing N Line 1 - 3	1 day	Tue 5/7/13	Tue 5/7/13
16	FRP Walls N Line 3 - 6	2 days	Mon 5/6/13	Tue 5/7/13
17	Install Sheet Waterproofing N Line 3 - 6	1 day	Wed 5/8/13	Wed 5/8/13

- *Each Wall section follows same pattern*
- *Duration from Table, broken down based on # of pours for the Wall section*
- *Schedule increase acceptable, work can be completed around steel erection*

Sizing of a Sump Pump

Technical Data:

- *System Capacity = 30 GPM*
- *Total Dynamic Head = 14'*
  - *Static Head = 10'*
  - *Friction Head = 3.27'*

$$\frac{(Actual + Equivalent)(Friction\ Loss)}{100}$$

$$\frac{(150 + 30.8)(1.81)}{100} = 3.27$$

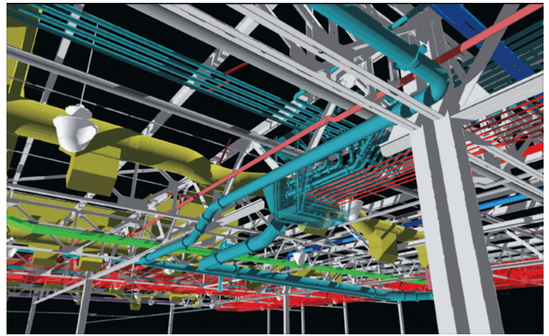
(Const. DWGs Courtesy of Stantec)
(Equation Courtesy of Jeremy Feath)
(Literature Courtesy of Hydromatic)

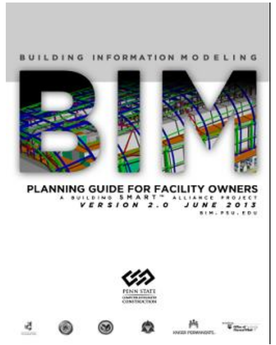
PANEL NAME	VOLTAGE INFORMATION					PANEL INFORMATION						FEEDER INFORMATION	
PLN-GB7	VOLTAGE		208/120V			BUSS		200A				FROM	DPLN-GB
RECESSED	PHASE		3			MAIN/M.O		MAIN BREAKER - 150A				TYPE	NORMAL
GROUND FLOOR	WIRE		4			AIC RATING		10,000				SIZE	SEE RISER ON E601
LOCATION/ITEM	LOAD WATTS	NOTES	WIRE	COND	BREAKER	CKT	PHS	CKT	BREAKER	COND	WIRE	NOTES	LOAD WATTS	LOCATION/ITEM
RCPT LAB 009	540		#12	3/4"	20A-1P	1	A----	2	20A-1P	3/4"	#12		540	RCPT LAB 011
RCPT LAB 009	540		#12	3/4"	20A-1P	3	--B--	4	20A-1P	3/4"	#12		540	RCPT LAB 011
RCPT LAB 009	540		#12	3/4"	20A-1P	5	----C	6	20A-1P	3/4"	#12		540	RCPT LAB 011
RCPT LAB 009	540		#12	3/4"	20A-1P	7	A----	8	20A-1P	3/4"	#12		540	RCPT LAB 011
RCPT LAB 009	540		#12	3/4"	20A-1P	9	--B--	10	20A-1P	3/4"	#12		540	RCPT LAB 011
RCPT LAB 009	1000		#10	3/4"	30A-2P	11	----C	12	30A-1P	3/4"	#10		1000	RCPT LAB 011
RCPT LAB 009	1000		#10	3/4"	30A-1P	13	A----	14	30A-1P	3/4"	#10		1000	RCPT LAB 011
SPC RCPT LAB 009	1200		#10	3/4"	30A-2P	15	--B--	16	30A-2P	3/4"	#10		1200	SPC RCPT LAB 011
	1200					17	----C	18					1200	
SPC RCPT LAB 009	1200		#10	3/4"	30A-2P	19	A----	20	30A-2P	3/4"	#10		1200	SPC RCPT LAB 011
	1200					21	--B--	22					1200	
FUME HOOD 000H	400		#12	3/4"	20A-1P	23	----C	24	20A-1P	3/4"	#12		400	EM SWBR
FUME HOOD 000H	400		#12	3/4"	20A-1P	25	A----	26	20A-1P					SPARE
RCPT LAB 000H	540		#12	3/4"	20A-1P	27	--B--	28	20A-1P					SPARE
RCPT LAB 000H	540		#12	3/4"	20A-1P	29	----C	30	20A-1P					SPARE
RCPT LAB 000H	540		#12	3/4"	20A-1P	31	A----	32	20A-1P					SPARE
SPARE					20A-1P	33	--B--	34	20A-1P					SPARE
SPARE					20A-1P	35	----C	36	20A-1P					SPARE
SPARE					20A-1P	37	A----	38	20A-1P					SPARE
SPARE					20A-1P	39	--B--	40	20A-1P					SPARE
SPARE					20A-1P	41	----C	42	20A-1P					SPARE

NOTES:

- *Level 0 Panelboards have the capacity to handle the additional load of a sump pump*

Summary





(Images Courtesy of Google, Penn State & IBM)

Key Takeaways:

- *Necessary to weed out critical information from excess*
- *It's not always the information itself, but the means of using that information for O&M*

Jeremy Feath
Construction Option

Final Recommendations

University Engineering Building
Mid-Atlantic University, United States

Analysis 1: Clean Room Coordination:

- *Reorganize project team chart to reflect new contractual obligations for Hodess*
- *Creation of Coordination Schedule to maximize early coordination for the Clean Room*
- ***Recommendation: PROCEED***

Analysis 2: Roof System Redesign:

- *Replace Fully-Adhered TPO with InvisiWeld TPO system.*
- *Saves 20+ working days on schedule*
- *Saves $27,000 in costs*
- ***Recommendation: PROCEED***

(Courtesy of Owner)

Analysis 3: Underground Spring:

- *Add Waterproofing Membrane in addition to the sump pump solution of the project team.*
- *Schedule Impact is negligible*
- *Cost Impact, while substantial, can be offset by Roof savings*
- ***Recommendation: PROCEED***

Analysis 4: CM – FM Information Delivery:

- *Outline created to help Owners/FM incorporate technologies*
- *Means of using information more important than information at times*
- ***Recommendation: PROCEED***

Acknowledgements

A Special Thanks to ...

Massaro

Stantec

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Dr. Craig Dubler

Dr. Ed Gannon

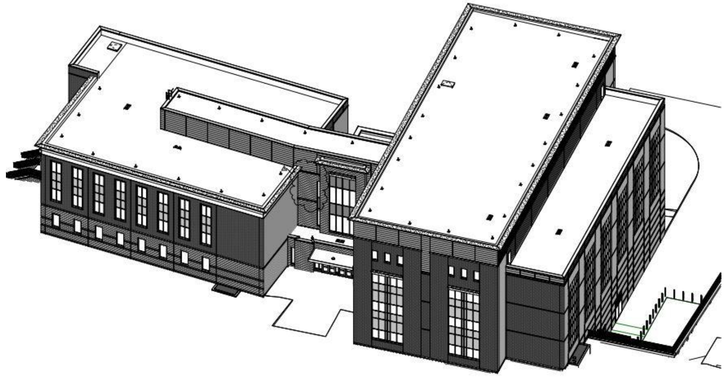
Todd Bookwalter

Bud Curry

The University Project Team

Massaro Project Team

Friends & Family



(Courtesy of Stantec)

Jeremy Feath
Construction Option

Questions

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