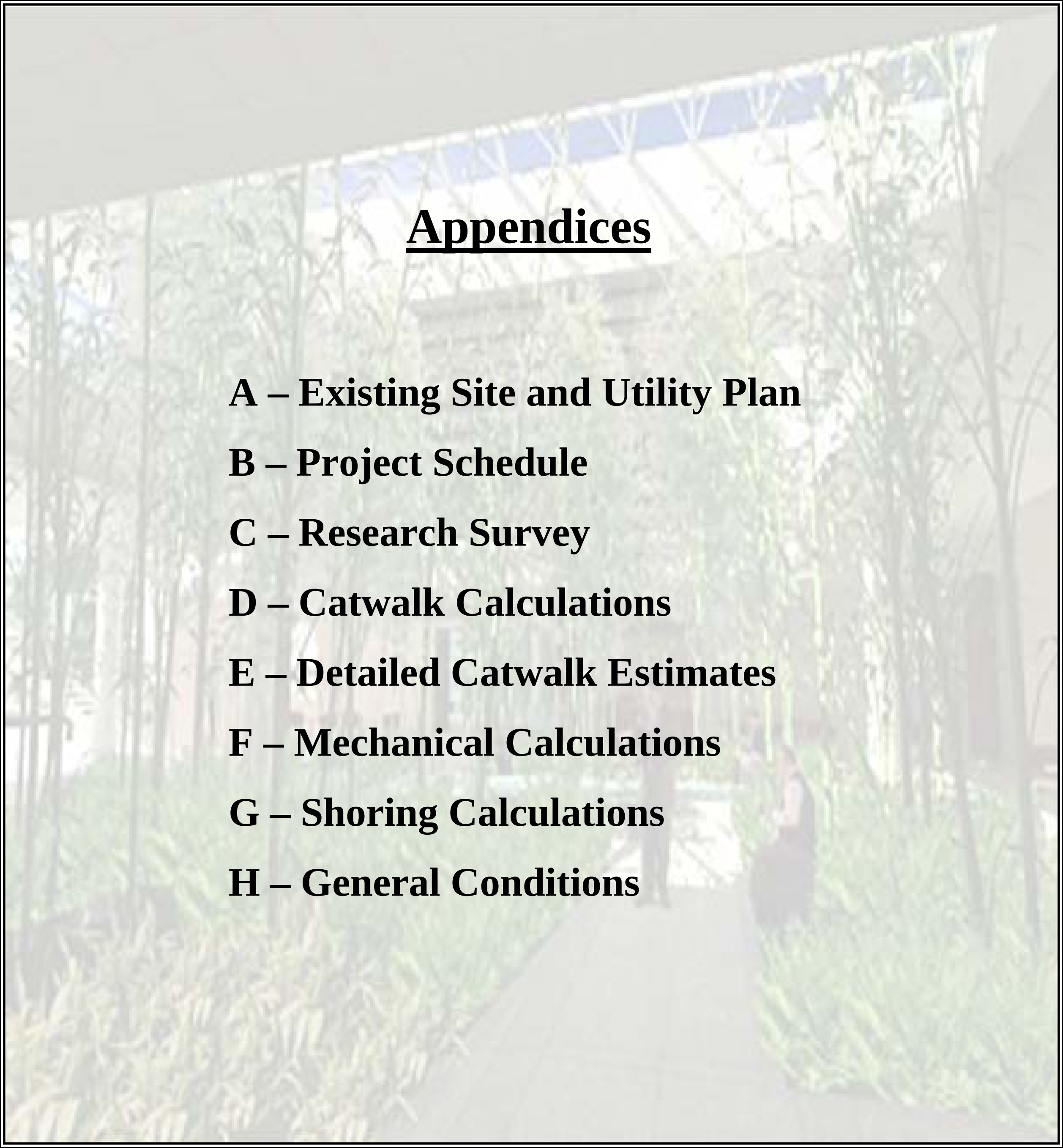


Appendices

A – Existing Site and Utility Plan

B – Project Schedule

C – Research Survey

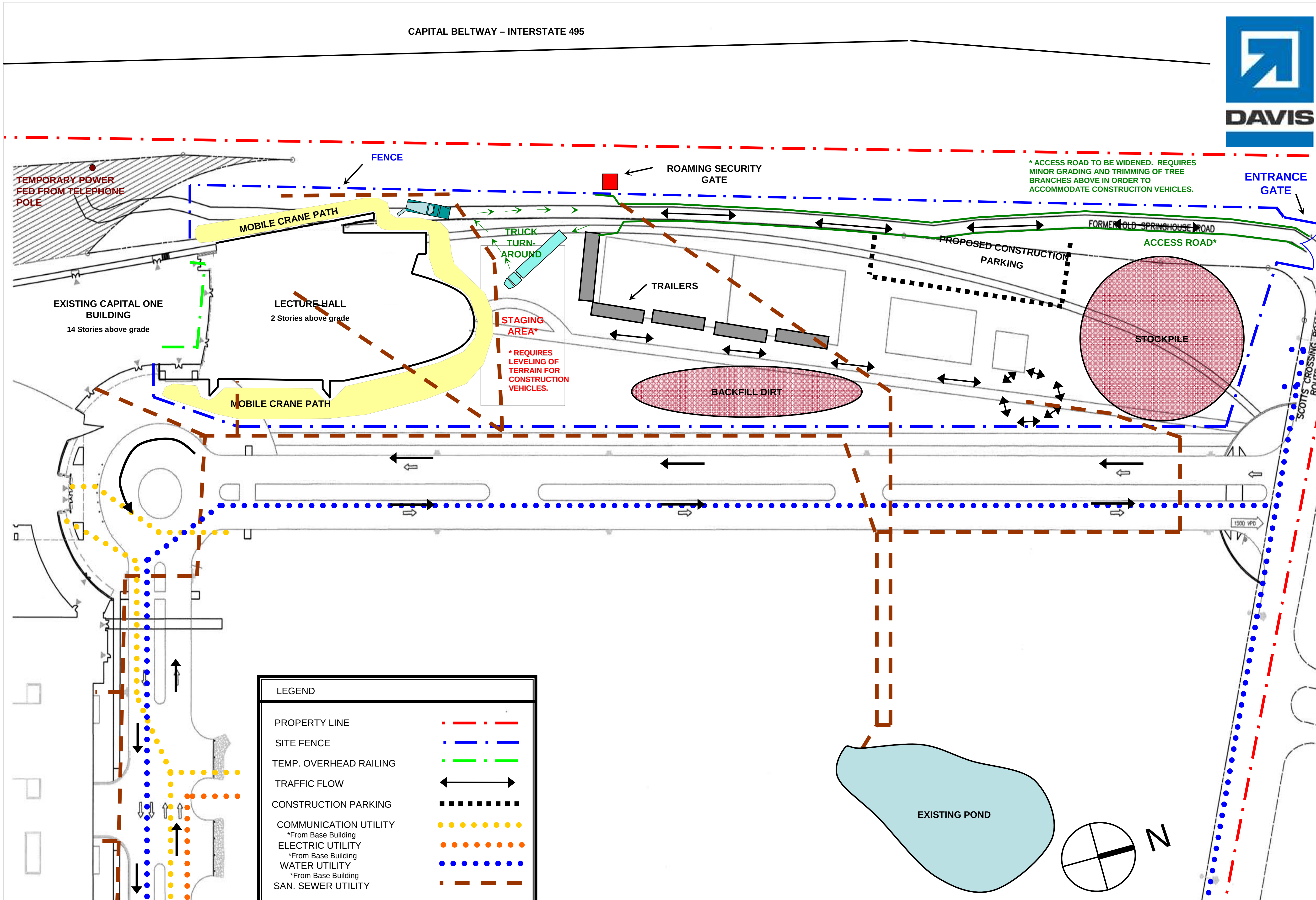
D – Catwalk Calculations

E – Detailed Catwalk Estimates

F – Mechanical Calculations

G – Shoring Calculations

H – General Conditions



Capital One

LECTURE HALL ADDITION

1680 CAPITAL ONE DRIVE, McLEAN, VA 22102

APPENDIX A

EXISTING SITE & UTILITY PLAN

Scale: NTS

Prepared by	Date	Sheet
Sean C. Ehlers Construction Management	April 3, 2006	1 of 1

Appendix C – Research Survey

Partnering for Value Engineering

Company: ______________________________ ***Years in Industry:*** ______________________
Name (optional): ________________________ ***Current Project Type:*** ___________________
Position: _______________________________ ***Delivery Method:*** _______________________

The first section of the questionnaire consists of 6 questions related to Value Engineering and similar activities. Please respond to each question regarding your current project. Additional comments to increase understanding of the answers may be added at the conclusion of this survey.

1. Please verify the approximate release dates of Design Documents listed on the timeline below.

   50% (__________) 75% (__________) 100% (__________)

2. On the timeline above, please indicate when value engineering was first performed.

3. Do you feel that the timing of the VE process was appropriate for your given project? If not, why and how could it be improved?

4. In the table below, please indicate the percentage of value engineering time which was directed to *reducing costs versus adding value*. (ie: 90% Reduce cost/10% Add Value)

Reduce cost to meet budget	**Add value** to better meet goals

5. In the table below, indicate which entities were the sources of VE suggestions.

______%	Owner
______%	Architect
______%	Engineer
______%	GC/CM

100% Total

6. What steps were taken to identify the Owner's needs and priorities *prior to the Value Engineering process*?

The second section of the questionnaire consists of 9 positive statements to which you are requested to indicate how much you strongly agree (5) or strongly disagree (1). Please rate the accompanying statements to indicate how you feel in relation to the other project teams on your current job.

1. I feel I am working in a trusting environment: ____
2. I feel I am working in a positive atmosphere and being respected: ____
3. I feel that good communication is being maintained: ____
4. I feel that working relationships are honest and upheld with integrity: ____
5. I feel that I am working in a team, with no exclusions: ____
6. When disputes arise, I feel that they are being resolved in a timely manner: ____
7. I feel that disputes are being resolved considering the needs of everyone: ____
8. I feel that every party is contributing to the overall goal of the Contract: ____
9. I feel that every party is working to minimize waste from design and construction: ____

The final section of the questionnaire consists of 2 short answer questions related to Value Engineering. Please respond to each question that may apply to your current project.

1. What are the attributes of successful VE processes?

2. How would you define success for your current project?

Thank you for participating in this survey. For your convenience, please email this attachment to sce120@psu.edu or print the survey out and fax your response to (814) 863-4789 Attention: Sean Ehlers.

Appendix D – Catwalk Calculations

Steel Catwalk Load Calculations:

Assumptions:

- Considering HSS 5x5x5/16 hangers and W8x28 girders are the critical members
- The catwalk is 1' wide, with largest spans of 25'
- Load requirements are 40 PSF LL and 20 PSF DL

HSS 5x5x5/16 hanger –

Tributary Area = 25' x 1' = 25 ft^2

1.2(20 PSF) + 1.6(40 PSF) = 88 PSF

25 ft^2 x 88 PSF = 2,000 lb

Stress = P/A = 2.2 kips / 8.42 in^2 = 0.27 ksi < 50 ksi

W8x28 girder –

W = 88 PSF x 1' = 88 PLF

V_u = (wl)/2 = (88 PLF x 25 ft)/2 = 1,100 lbs

M_u = $(wl^2)/8$ = [8 PLF x $(25ft)^2$]/8 = 6,875 ft-lbs

*DL & LL: $\Delta = (5wl^4)/384EI$

= [5 x 88 PLF x $(25ft)^4$ x 1728 in^3] / (384 x 29e3 ksi x 98 in^4 x 1,000 lbs) = 0.272 in

0.272 in < 0.625 = (25 ft x 12 in/ft) / 480

*LL: $\Delta = (5wl^4)/384EI$

= 5 x 64 PLF x $(25ft)^4$ x 1728 in^3] / (384 x 29e3 ksi x 98 in^4 x 1,000 lbs) = 0.198 in

0.198 in < 0.833 = (25 ft x 12 in/ft) / 360

$Z_{required} = M_u / \Phi_b F_y$ = (6,875 ft-lbs x 12 in) / (0.9 x 50 ksi x 1,000lbs) = 1.83 in^3

Aluminum Catwalk Load Calculations:

Assumptions:

- Considering HSS 4x4x3/16 hangers and W10x210 girders are the critical members
- The catwalk is 1' wide, with largest spans of 25'
- Load requirements are 40 PSF LL and 20 PSF DL
- F_y = 35 ksi and E = 10e3 ksi for alloy 6061-T6
- Additional material characteristics are to be that of steel, allowing for the same equations

HSS 4x4x3/16 hanger –

Stress = P/A = 2.2 kips / 2.87 in2 = 0.77 ksi < 35 ksi

W8x28 girder –

W = 88 PSF x 1' = 88 PLF

$V_u = (wl)/2$ = (88 PLF x 25 ft)/2 = 1,100 lbs

$M_u = (wl^2)/8 = [8 \text{ PLF} \times (25\text{ft})^2]/8$ = 6,875 ft-lbs

*DL & LL: $\Delta = (5wl^4)/384EI$

$= [5 \times 88 \text{ PLF} \times (25 \text{ ft})^4 \times 1728 \text{ in}^3] / (384 \times 10e3 \text{ ksi} \times 155.8 \text{ in}^4 \times 1{,}000 \text{ lbs}) = 0.496 \text{ in}$

0.496 in < 0.625 = (25 ft x 12 in/ft) / 480

*LL: $\Delta = (5wl^4)/384EI$

$= [5 \times 64 \text{ PLF} \times (25 \text{ ft})^4 \times 1728 \text{ in}^3] / (384 \times 10e3 \text{ ksi} \times 155.8\text{in}^4 \times 1{,}000 \text{ lbs}) = 0.198 \text{ in}$

0.37 in < 0.833 = (25 ft x 12 in/ft) / 360

FRP Catwalk Load Calculations:

No calculations were evaluated for this section. E.T. Techtonics estimator considered the 40 PSF live load and 20 PSF deal load.

Wood Catwalk Load Calculations:

No calculations were evaluated for this section. The steel hangers remained in this design and have already been checked. Manufactured I-beams were recommended by a Georgia-Pacific Product Guide.

Appendix E – Detailed Catwalk Estimations

Table 12. Detailed Steel Catwalk Estimate

Main Strip (2)

Quantity	Type	Lb/ft	Length (ft)	Weight (lbs)	Total Weight	Labor ($/LF)	Labor ($)	Total Labor
4	W8x28	28	12	336	1344.0	3.96	47.52	190.08
4	W8x28	28	25	700	2800.0	3.96	99.00	396.00
4	W8x28	28	25	700	2800.0	3.96	99.00	396.00
4	W8x28	28	9	252	1008.0	3.96	35.64	142.56
8	L 5x31/2x5/16	8.72	12	104.64	837.1	7.10	85.20	681.60
8	L 5x31/2x5/16	8.72	25	218	1744.0	7.10	177.50	1420.00
8	L 5x31/2x5/16	8.72	25	218	1744.0	7.10	177.50	1420.00
8	L 5x31/2x5/16	8.72	9	78.48	627.8	7.10	63.90	511.20
26	W6x12	12	2	24	624.0	3.63	7.26	188.76
24	L 4x4x3/8	9.72	6	58.32	1399.7	7.00	42.00	1008.00
32	HSS 4x4x5/16	14.8	3.5	51.8	1657.6	9.00	31.50	1008.00
20	HSS 5x5x5/16	19	10	190	3800.0	30.00	300.00	6000.00
80	L 3x3x1/4	4.89	4	19.56	1564.8	6.85	27.40	2192.00
				Cum Weight	21951.0		Labor Cost	$ 15,554.20
				Cum Tonnage	10.98		Material Cost	$ 21,951.04
							Total Cost	$ 37,505.24

Middle Wing (2)

Quantity	Type	Lb/ft	Length (ft)	Weight (lbs)	Total Weight	Labor ($/LF)	Labor ($)	Total Labor
4	W8x28	28	14	392	1568.0	3.96	55.44	221.76
6	W6x12	12	2	24	144.0	3.63	7.26	43.56
6	L 4x4x3/8	9.72	6	58.32	349.9	7.00	42.00	252.00
8	HSS 4x4x5/16	14.8	3.5	51.8	414.4	9.00	31.50	252.00
4	HSS 5x5x5/16	19	10	190	760.0	30.00	300.00	1200.00
24	L 3x3x1/4	4.89	4	19.56	469.4	6.85	27.40	657.60
				Cum Weight	3705.8		Labor Cost	$2,626.92
				Cum Tonnage	1.85		Material Cost	$3,705.76
							Total Cost	$6,332.68

Middle Strip

Quantity	Type	Lb/ft	Length (ft)	Weight (lbs)	Total Weight	Labor ($/LF)	Labor ($)	Total Labor
4	W8x28	28	20	560	2240.0	3.96	79.20	316.80
2	W8x28	28	18	504	1008.0	3.96	71.28	142.56
8	L 5x31/2x5/16	8.72	20	174.4	1395.2	7.10	142.00	1136.00
4	L 5x31/2x5/16	8.72	18	156.96	627.8	7.10	127.80	511.20
8	W6x12	12	2	24	192.0	3.63	7.26	58.08
9	L 4x4x3/8	9.72	6	58.32	524.9	7.00	42.00	378.00
12	HSS 4x4x5/16	14.8	3.5	51.8	621.6	9.00	31.50	378.00
9	HSS 5x5x5/16	19	10	190	1710.0	30.00	300.00	2700.00
40	L 3x3x1/4	4.89	4	19.56	782.4	6.85	27.40	1096.00
5	W8x28	28	4	112	560.0	3.96	15.84	79.20
3	W8x28	28	9	252	756.0	3.96	35.64	106.92
				Cum Weight	10417.9		Labor Cost	$6,902.76
				Cum Tonnage	5.21		Material Cost	$10,417.92
							Total Cost	$17,320.68

Top Tail

Quantity	Type	Lb/ft	Length (ft)	Weight (lbs)	Total Weight	Labor ($/LF)	Labor ($)	Total Labor
1	W8x28	28	5	140	140.0	3.96	19.80	19.80
1	W10x30	30	5	150	150.0	2.48	12.40	12.40
4	L 5x31/2x5/16	8.72	5	43.6	174.4	7.10	35.50	142.00
4	L 3x3x1/4	4.89	4	19.56	78.2	6.85	27.40	109.60
2	HSS 5x5x5/16	19	10	190	380.0	30.00	300.00	600.00
2	HSS 4x4x5/16	14.8	3.5	51.8	103.6	9.00	31.50	63.00
2	W6x12	12	2	24	48.0	3.63	7.26	14.52
				Cum Weight	1074.2		Labor Cost	$961.32
				Cum Tonnage	0.54		Material Cost	$1,074.24
							Total Cost	$2,035.56

Metal Grating

Width (ft)	Length (ft)	Ft^2	Material ($/ft^2)	Material ($)	Labor ($/ft^2)	Labor ($)	Total Cost
2	240	480	10.00	4800.00	2.00	960.00	5760.00
						Total Cost	$5,760.00

Cum Total	$ 68,954.16
Sub Profit	+10%
Final Total	$ 75,849.58

Table 13. Detailed Aluminum Catwalk Estimate

	Quantity	Type	Lb/ft	Length (ft)	Weight (lbs)	Total Weight	Material ($/lb)	Material ($)	Labor ($/lb)	Labor ($)	Total Cost
Main Strip (2)	4	W10x10	10.286	12	123.432	493.7	2.19	1081.26	1.64	809.71	1890.98
	4	W10x10	10.286	25	257.15	1028.6	2.19	2252.63	1.64	1686.90	3939.54
	4	W10x10	10.286	25	257.15	1028.6	2.19	2252.63	1.64	1686.90	3939.54
	4	W10x10	10.286	9	92.574	370.3	2.19	810.95	1.64	607.29	1418.23
	8	L 5x5x3/8	4.28	12	51.36	410.9	2.19	899.83	1.64	673.84	1573.67
	8	L 5x5x3/8	4.28	25	107	856.0	2.19	1874.64	1.64	1403.84	3278.48
	8	L 5x5x3/8	4.28	25	107	856.0	2.19	1874.64	1.64	1403.84	3278.48
	8	L 5x5x3/8	4.28	9	38.52	308.2	2.19	674.87	1.64	505.38	1180.25
	26	W8x7	7.023	2	14.046	365.2	2.19	799.78	1.64	598.92	1398.70
	24	L 4x4x1/2	4.41	6	26.46	635.0	2.19	1390.74	1.64	1041.47	2432.20
	32	HSS 4x4x3/16	3.44	3.5	12.04	385.3	2.19	843.76	1.64	631.86	1475.62
	20	HSS 4x4x3/16	3.44	10	34.4	688.0	2.19	1506.72	1.64	1128.32	2635.04
	80	L 3x3x1/4	1.68	4	6.72	537.6	2.19	1177.34	1.64	881.66	2059.01
										Total Cost	$ 30,499.75
Middle Wing (2)	4	W10x10	10.286	14	144.004	576.0	2.19	1261.5	1.64	944.67	2206.14
	6	W8x7	7.023	2	14.046	84.3	2.19	184.6	1.64	138.21	322.78
	6	L 4x4x1/2	4.41	6	26.46	158.8	2.19	347.7	1.64	260.37	608.05
	8	HSS 4x4x3/16	3.44	3.5	12.04	96.3	2.19	210.9	1.64	157.96	368.91
	4	HSS 4x4x3/16	3.44	10	34.4	137.6	2.19	301.3	1.64	225.66	527.01
	24	L 3x3x1/4	1.68	4	6.72	161.3	2.19	353.2	1.64	264.50	617.70
										Total Cost	$4,650.59
Middle Strip	4	W10x10	10.286	20	205.72	822.9	2.19	1802.1	1.64	1349.52	3151.63
	2	W10x10	10.286	18	185.148	370.3	2.19	810.9	1.64	607.29	1418.23
	8	L 5x5x3/8	4.28	20	85.6	684.8	2.19	1499.7	1.64	1123.07	2622.78
	4	L 5x5x3/8	4.28	18	77.04	308.2	2.19	674.9	1.64	505.38	1180.25
	8	W8x7	7.023	2	14.046	112.4	2.19	246.1	1.64	184.28	430.37
	9	L 4x4x1/2	4.41	6	26.46	238.1	2.19	521.5	1.64	390.55	912.08
	12	HSS 4x4x3/16	3.44	3.5	12.04	144.5	2.19	316.4	1.64	236.95	553.36
	9	HSS 4x4x3/16	3.44	10	34.4	309.6	2.19	678.0	1.64	507.74	1185.77
	40	L 3x3x1/4	1.68	4	6.72	268.8	2.19	588.7	1.64	440.83	1029.50
	5	W10x10	10.286	4	41.144	205.7	2.19	450.5	1.64	337.38	787.91
	3	W10x10	10.286	9	92.574	277.7	2.19	608.2	1.64	455.46	1063.68
										Total Cost	$14,335.56
Top Tail	1	W10x10	10.286	5	51.43	51.4	2.19	112.6	1.64	84.35	196.98
	1	W10x8	8.76	5	43.8	43.8	2.19	95.9	1.64	71.83	167.75
	4	L 5x5x3/8	4.28	5	21.4	85.6	2.19	187.5	1.64	140.38	327.85
	4	L 3x3x1/4	1.68	4	6.72	26.9	2.19	58.9	1.64	44.08	102.95
	2	HSS 4x4x3/16	3.44	10	34.4	68.8	2.19	150.7	1.64	112.83	263.50
	2	HSS 4x4x3/16	3.44	3.5	12.04	24.1	2.19	52.7	1.64	39.49	92.23
	2	W8x7	7.023	2	14.046	28.1	2.19	61.5	1.64	46.07	107.59
										Total Cost	$1,258.85

	Width (ft)	Length (ft)	Ft^2	Material ($/ft^2)	Material ($)	Labor ($/ft^2)	Labor ($)	Total Cost
Metal Grating	2	240	480	10.00	4800.00	2.00	960.00	5760.00
							Total Cost	$5,760.00

Cum Total	$ 56,504.74
Sub Profit	+10%
Final Total	$ 62,155.22

Table 14. Detailed Wood Catwalk Estimate

Main Strip (2)

Quantity	Type	Length (ft)	Total Length	Material ($/LF)	Material ($)	Labor ($/LF)	Labor ($)	Total Cost
4	GPI 40	12	48.0	2.23	107.0	0.51	24.48	131.52
8	GPI 40	13	104.0	2.23	231.9	0.51	53.04	284.96
8	GPI 40	13	104.0	2.23	231.9	0.51	53.04	284.96
4	GPI 40	9	36.0	2.23	80.3	0.51	18.36	98.64
8	2x6	12	96.0	0.59	56.6	0.57	54.72	111.36
8	2x6	25	200.0	0.59	118.0	0.57	114.00	232.00
8	2x6	25	200.0	0.59	118.0	0.57	114.00	232.00
8	2x6	9	72.0	0.59	42.5	0.57	41.04	83.52
26	2x10	2	52.0	1.29	67.1	0.66	34.32	101.40
24	2x10	6	144.0	1.29	185.8	0.66	95.04	280.80
24	4x4 Columns	3.5	84.0	2.34	196.6	0.89	74.76	271.32
80	2x4	4	320.0	0.37	118.4	0.32	102.40	220.80
							Total Cost	$ 2,333.28

Middle Wing (2)

Quantity	Type	Length (ft)	Total Length	Material ($/LF)	Material ($)	Labor ($/LF)	Labor ($)	Total Cost
4	GPI 40	14	56.0	2.23	124.9	0.51	28.56	153.44
6	2x10	2	12.0	1.29	15.5	0.66	7.92	23.40
6	2x10	6	36.0	1.29	46.4	0.66	23.76	70.20
8	4x4 Columns	3.5	28.0	2.34	65.5	0.89	24.92	90.44
24	2x4	4	96.0	0.37	35.5	0.32	30.72	66.24
							Total Cost	$403.72

Middle Strip

Quantity	Type	Length (ft)	Total Length	Material ($/LF)	Material ($)	Labor ($/LF)	Labor ($)	Total Cost
4	GPI 65	20	80.0	2.23	178.4	0.51	40.80	219.20
2	GPI 65	18	36.0	2.23	80.3	0.51	18.36	98.64
8	2x6	20	160.0	0.59	94.4	0.57	91.20	185.60
4	2x6	18	72.0	0.59	42.5	0.57	41.04	83.52
8	2x10	2	16.0	1.29	20.6	0.66	10.56	31.20
9	2x10	6	54.0	1.29	69.7	0.66	35.64	105.30
12	4x4 Columns	3.5	42.0	2.34	98.3	0.89	37.38	135.66
40	2x4	4	160.0	0.37	59.2	0.32	51.20	110.40
5	GPI 25	4	20.0	2.23	44.6	0.51	10.20	54.80
3	GPI 25	9	27.0	2.23	60.2	0.51	13.77	73.98
							Total Cost	$1,098.30

Top Tail

Quantity	Type	Length (ft)	Total Length	Material ($/LF)	Material ($)	Labor ($/LF)	Labor ($)	Total Cost
2	GPI 40	5	10.0	2.23	22.3	0.51	5.10	27.40
4	2x6	5	20.0	0.59	11.8	0.57	11.40	23.20
4	2x4	4	16.0	0.37	5.9	0.32	5.12	11.04
2	4x4 Columns	3.5	7.0	2.34	16.4	0.89	6.23	22.61
2	2x10	2	4.0	1.29	5.2	0.66	2.64	7.80
							Total Cost	$92.05

Hangers

Quantity	Type	Lb/ft	Length (ft)	Weight (lbs)	Total Weight	Labor ($/LF)	Labor ($)	Total Labor
4	W10x30	30	9	270	1080	2.48	22.32	89.28
43	HSS 5x5x5/16	19	10	190	8170.0	30.00	300.00	12900.00
				Cum Weight	9250.0		Labor Cost	$12,989.28
				Cum Tonnage	4.63		Material Cost	$9,250.00
							Total Cost	$22,239.28

Metal Grating

Width (ft)	Length (ft)	Ft^2	Material ($/ft^2)	Material ($)	Labor ($/ft^2)	Labor ($)	Total Cost
2	240	480	10.00	4800.00	2.00	960.00	5760.00
						Total Cost	$5,760.00

Cum Total	$ 31,926.63
Sub Profit	+10%
Final Total	$ 35,119.29

Appendix F – Mechanical Calculations

Geothermal Heat Pump:

In order to estimate the size of units needed for this system, the boiler MBtu/hr (1,000 British thermal units per hour) must be calculated. As an aside, Btu's are a unit of energy used in the United States and is defined as the amount of heat required to raise the temperature of one of water by one degree Fahrenheit.

Provided in the mechanical schedule, the two boilers have an entering water temperature of 140°F and a leaving water temperature of 180°F. Moreover, they are designed to provide the Lecture hall space with 67 gallons of water per minute (gpm). The sensible cooling load equation to follow can be utilized to help convert the 40°F change and 67 gpm into MBtu/hr.

$Q = C_p \times \cdot m \times \Delta T$, where

Q = total heat

C_p = specific heat of water at 80°F and 1atm

$\cdot m$ = mass flow rate of water

ΔT = change in temperature

This equation will change to $Q = C_p \times \cdot V \times \rho \times \Delta T$ since we have a volumetric flow per minute, where:

$\cdot V$ = volume flow rate

ρ = density of water at 80°F and 1 atm

a = conversion from gpm to cfm

$\cdot V$ = a x gpm = (0.133681 ft2/min / gal/min) x 67 gpm = 8.957 cfm

C_p = 0.9991 Btu/lbm-R

ΔT = 40°F

$\rho = 62.22\ lb_m/ft^3$

Substituting these numbers gives us Q = 22271Btu/min. Multiplying this by 60 min/hr and dividing by 1,000 Btu/MBtu = 1,336 MBtu/hr. In order to satisfy the existing boiler system, heat pumps will have to supply the Lecture Hall with around 1,336 MBtu/hr.

Electric Heating Coils:

As calculated above, the estimated heating load at the air handling units is 1,336 MBtu/hr. Looking at the three different air handling units and the spaces they serve, it is important to get an idea of mixed air temperatures within each system and calculate their sensible heating capacity. Depending on the amount of MBtu/hr, one can get an idea of the required heat coil demands for sizing. Speaking with Capital One's MEP engineer, supply and mixed air temperatures were obtained. The following numbers are at full load, design conditions in the worst case scenario.

- AHU-1 services the offices with 4,800 cfm, needing 77.5°F supply air from 48.9°F mixed air
- AHU-2 services the atrium with 19,200 cfm, needing 75.8°F supply air from 43.9°F mixed air
- AHU-3 services the auditorium with 10,725 cfm, needing 72.4°F supply air from 33°F mixed air

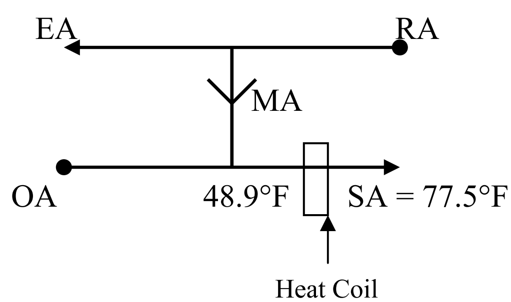
Using the same $Q = C_p \times \cdot m \times \Delta T$ equation as before, but adjusting it for air because the heating no longer deals with water, gives us $Q = 1.08 \times cfm \times \Delta T$. The 1.08 includes the density of air, C_p and conversion factors for air only. The sum of all these quantities should be approximately the same value as the 1,336 MBtu/hr calculated before for the geothermal heat pump system.

For AHU-1: $Q_1 = 1.08 \times cfm \times \Delta T$

$Q_1 = 1.08 \times 4800cfm \times (77.5°F - 48.9°F)$

$Q_1 = 148.1$ MBtu/hr

Figure 14. Heat Coil Schematic for AHU-1



For AHU-2: $Q_2 = 1.08 \times cfm \times \Delta T$

$Q_2 = 1.08 \times 19{,}200cfm \times (75.8°F – 43.9°F)$

$Q_2 = 456.3$ MBtu/hr

For AHU-2: $Q_3 = 1.08 \times cfm \times \Delta T$

$Q_3 = 1.08 \times 19{,}200cfm \times (72.4°F - 33°F)$

$Q_3 = 659.7$ MBtu/hr

Lastly, in order to calculate the required amount of energy for the electric heat coils, divide each coil's MBtu/hr by 3.412 to obtain kilowatts (kW). This will give us 44 kW for coil #1, 194 kW for #2, and 134 kW for #3.

Appendix G – Shoring Calculations

*** Earth Pressure for Common Conditions of Loading:**

Assumptions:

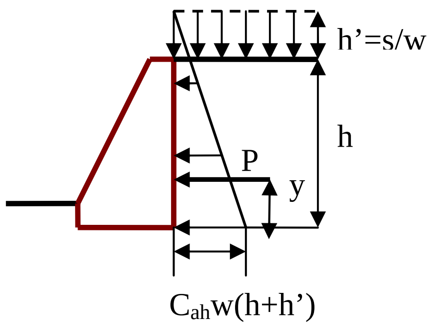
- Backfill material is considered "silty sands, poorly graded sand-silt mixes"
- As stated in the Subsurface Exploration and Geotechnical Engineering Analysis, the active soil pressure is 45 lbs/sf of depth and the at-rest soil pressure is 60 lbs/sf of depth
- Backfill height will be for the worst case scenario of 9'
- Soil surcharge (s) from the backhoe and roller drum will be 115 lb/ft^2
- Unit weight (w) of the soil is 115 pcf
- PAmax for Ulma posts = 8,500 lbs

Figure 15. Earth Pressure
(horizontal surface with surcharge)

$h' = s/w$

$y = \frac{h^2 + 3hh'}{3(h + 2h')}$

$P = 1/2 C_{ah} wh(h+2h')$



Finding the soil force per horizontal foot –

$C_{ah}wh$ = 60 x height

y = h/3 = 9 ft / 3 = 3 ft

P = ½ x 60 x $(9ft)^2$ = 2,430 lb/horizontal foot

h' = 1.05 ft

y = [$(9ft)^2$ + 3 x 9ft x 1.05ft] / [3 x (9ft x 2 x 1.05ft)] = 3.28 ft

P = ½ x 60 x 9ft (9 ft x 2 x 1.05 ft) = 2,997 lbs/horizontal foot

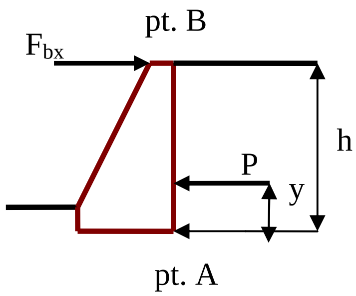
Finding the axial load in the shoring –

h = 9'

y = 3.28 '

P = 2,997 lbs

Figure 16. Free Body Diagram



Sum of Moments about pt. A =

2,997 lbs (3.28') – F_{bx} (9') = 0

F_{bx} = 1093 lbs

To find the axial load in the Ulma post –

$(1093^2 + 1093^2)$ ^ ½ = 1546 lbs

Assuming each post has a max PA of 8,500 lbs, shores have to be spaced between 5 and 6 feet on-center along the face of the walls.

***Nilson 2004**

Appendix H – General Conditions

For the two following tables, only the major management and labor costs have been included. The first table represents the DAVIS' exact estimates provided to Capital One within their GMP contract. Within the **Foundation Shoring and Sequencing** analysis, approximately 4 weeks of construction time could have been removed, had DAVIS implemented a revised schedule. In order to evaluate a cost difference between the two timetables, four weeks have been removed from appropriate employee's unit quantities in the second table.

Table 10. Actual General Conditions

			Material		Labor		Material	Labor
SUPERVISION & PROJECT MANAGEMENT	Quantity	Unit	Rate	Cost	Rate	Cost	Total Cost	Total Cost
Vice President	N/A		In Fee					
Project Executive	N/A		In Fee					
Project Manager	52	Wks	N/A		$1,395	$72,540	$0	$72,540
Assistant Project Manager	52	Wks	N/A		$1,005	$52,260	$0	$52,260
Senior Superintendent	52	Wks	N/A		$2,117	$110,084	$0	$110,084
Superintendent	44	Wks	N/A		$1,313	$57,772	$0	$57,772
MEP Coordinator	5	Wks	N/A		$1,000	$5,000	$0	$5,000
Senior Layout Engineer	26	Wks	N/A		$791	$20,566	$0	$20,566
Layout Engineer	26	Wks	N/A		$450	$11,700	$0	$11,700
Total Supervision & Management						**$329,922**	**$0**	**$329,922**

			Material		Labor		Material	Labor
MISCELLANEOUS LABOR	Quantity	Unit	Rate	Cost	Rate	Cost	Total Cost	Total Cost
Misc. Labor	52	Wks	N/A		$697.85	$36,288	$0	$36,288
Courier	52	Wks	N/A		$110.90	$5,767	$0	$5,767
Dump Truck - Driver	40	Hrs	N/A		$114.14	$4,566	$0	$4,566
Total Miscellaneous Labor						**$46,621**	**$0**	**$46,621**

			Material		Labor		Material	Labor
CATEGORY TOTALS	Quantity	Unit	Rate	Cost	Rate	Cost	Total Cost	Total Cost
Supervision & Project Management							$0	$329,922
Miscellaneous Labor							$0	$46,621
Subtotal							**$0**	**$376,543**
Insurance & Employee Benefits	46	%					$0	$173,210
Total General Conditions							**$0**	**$549,752**
GRAND TOTAL								**$549,752**

Table 11. Revised General Conditions

SUPERVISION & PROJECT MANAGEMENT	Quantity	Unit	Material Rate	Material Cost	Labor Rate	Labor Cost	Material Total Cost	Labor Total Cost
Vice President	N/A		In Fee					
Project Executive	N/A		In Fee					
Project Manager	48	Wks	N/A		$1,395	$66,960	$0	$66,960
Assistant Project Manager	48	Wks	N/A		$1,005	$48,240	$0	$48,240
Senior Superintendent	48	Wks	N/A		$2,117	$101,616	$0	$101,616
Superintendent	40	Wks	N/A		$1,313	$52,520	$0	$52,520
MEP Coordinator	5	Wks	N/A		$1,000	$5,000	$0	$5,000
Senior Layout Engineer	26	Wks	N/A		$791	$20,566	$0	$20,566
Layout Engineer	26	Wks	N/A		$450	$11,700	$0	$11,700
Total Supervision & Management						**$306,602**	**$0**	**$306,602**

MISCELLANEOUS LABOR	Quantity	Unit	Material Rate	Material Cost	Labor Rate	Labor Cost	Material Total Cost	Labor Total Cost
Misc. Labor	48	Wks	N/A		$697.85	$33,497	$0	$33,497
Courier	48	Wks	N/A		$110.90	$5,323	$0	$5,323
Total Miscellaneous Labor						**$38,820**	**$0**	**$38,820**

CATEGORY TOTALS	Quantity	Unit	Material Rate	Material Cost	Labor Rate	Labor Cost	Material Total Cost	Labor Total Cost
Supervision & Project Management							$0	$306,602
Miscellaneous Labor							$0	$38,820
Subtotal							**$0**	**$345,422**
Insurance & Employee Benefits	46	%					$0	$158,894
Total General Conditions							**$0**	**$504,316**
GRAND TOTAL								**$504,316**