AIRPORT TERMINAL EXPANSION - EASTERN UNITED STATES

PAUL YINGLING AE SENIOR THESIS 2009

Executive Summary

This portion of the thesis submission is to analyze the key features of the project that affect project execution. These concepts will be explored through important schedule attributes and the cost of key building systems with respect to the construction management aspect of architectural engineering. Particular attention will be given to the site layout, as well as, start up estimates of the general conditions and main structural system.

The detailed schedule will reflect how the project was built and the two distinct phases. The building was erected in phases as not to disturb the airport customers. To accommodate the customers of the facility, any and all disturbances of normal operation were conducted at night when there is very limited traffic in the airport (12am-5am).

Included in this report are two detailed estimates. The structural steel estimate came out to be $7,105,937. And the general conditions estimate came out to be $2,586,169. Also, included will be a justification of why the estimates may seem high or low.

To conclude the paper there will be an evaluation of the SPACE (The Student Chapter of Achieving Construction Excellence) that was recently held at the Penn Stater in State College Pennsylvania. The theme for this year's meeting was *Investing in People*. Topics discussed ranged from Energy & Economy, Sustainability, and Building Information Modeling.

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Detailed Project Schedule

Scheduling was a concern for the project team. The owner requested that customers would not have to exit the terminals while the new connector building was being constructed. This not only affected the schedule but also the design. The previous connector building was constructed from cast in place concrete columns. To accommodate customer travel was a temporary enclosure was built on the existing columns. The schedule was affected, due to the fact that there were limited night shutdowns of the bridge to erect steel.

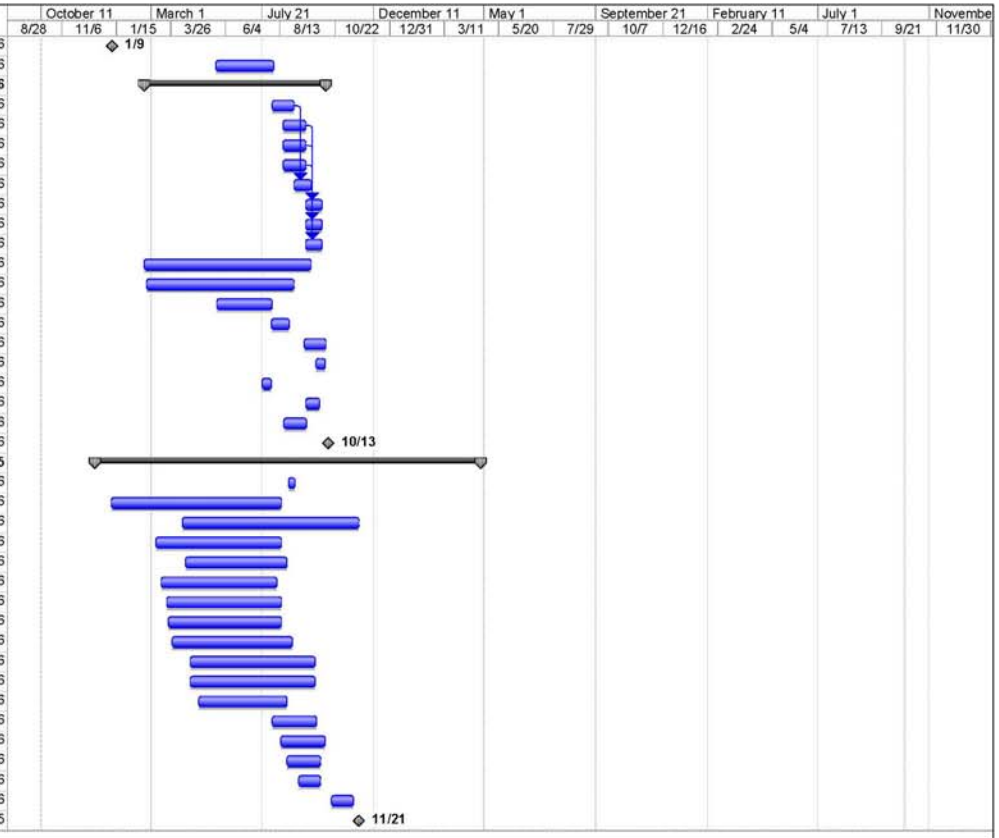
Also, the building was to be occupied in phases. One milestone was to transfer part of the second floor over to a separate contractor to construct retail space. After the transfer over of the second floor the third floor was to be partially completed for the Department of Aviation occupation. The grand opening is slated for Thanksgiving of 2009 and the first floor baggage handling system will still be under construction until early 2010.

A detailed schedule is illustrated in the following pages.

AIRPORT TERMINAL EXPANSION - EASTERN UNITED STATES

PAUL YINGLING AE SENIOR THESIS 2009

ID	Task Name	Duration	Start
1	NTP 1A	1 day	Mon 1/9/06
2	Approve Security Dwgs	54 days	Tue 5/23/06
3	**Electrical Work**	**167 days**	**Mon 2/20/06**
4	Submit O&M Manuals - Switch Gear/ Panel Boards	20 days	Thu 8/3/06
5	Submit O&M Manuals - CCTV	21 days	Thu 8/17/06
6	Submit O&M Manuals - Access Control	21 days	Thu 8/17/06
7	Submit O&M Manuals - Fire Alarm	21 days	Thu 8/17/06
8	Approve O&M Manuals - Switch Gear/ Panel Board	16 days	Thu 8/31/06
9	Approve O&M Manuals - CCTV	15 days	Fri 9/15/06
10	Approve O&M Manuals - Access Control	15 days	Fri 9/15/06
11	Approve O&M Manuals - Fire Alarm	15 days	Fri 9/15/06
12	Electrical Procument Phase 1A	154 days	Mon 2/20/06
13	Electrical Demolition Phase 1A	135 days	Thu 2/23/06
14	Install New Electrical Panels	51 days	Wed 5/24/06
15	Pull Cable Install New Temporary Power	17 days	Wed 8/2/06
16	Inatall Temp Lights on Fence Roof Top	20 days	Wed 9/13/06
17	New Fire Alarm System in Existing Stair Towers	8 days	Thu 9/28/06
18	Install New CCTV	8 days	Fri 7/21/06
19	Install New Light Poles in Light Poles in Parking Lot	12 days	Fri 9/15/06
20	Demo and Relocate light/power in Ext. Bridge	21 days	Fri 8/18/06
21	Electrical Construction Phase 1A Complete	1 day	Fri 10/13/06
22	**Stuctural Work**	**355 days**	**Mon 12/19/05**
23	Install Loop Detection in Parking Lot	6 days	Thu 8/24/06
24	Submit Structural Dwgs. And Submittals	156 days	Mon 1/9/06
25	Approve Structural Dwgs. And Submittals	163 days	Mon 4/10/06
26	Fab/ Del Misc. Metals	115 days	Tue 3/7/06
27	Fab/ Del Steel Pile	92 days	Fri 4/14/06
28	Fab/ Del Timber Piles	106 days	Tue 3/14/06
29	Fab/ Del GWB	105 days	Tue 3/21/06
30	Fab/ Del EDPM Water Proofing & Roofing	103 days	Thu 3/23/06
31	Fab/ Del Precast Concrete	110 days	Tue 3/28/06
32	Fab/ Del Structural Steel - Phase 3	114 days	Thu 4/20/06
33	Fab/ Del Structural Steel - Phase 4	114 days	Thu 4/20/06
34	Fab/ Del D & E Stairs	81 days	Mon 5/1/06
35	Fab/Del Metal Decking	41 days	Thu 8/3/06
36	Fab/ Del Structural Steel - Phase 1	41 days	Mon 8/14/06
37	Fab/ Del Rebar for Pile Caps and Grade Beams	31 days	Tue 8/22/06
38	Fab/ Del Structural Steel - Phase 2	20 days	Wed 9/6/06
39	Fab/ Del Steel Trusses	20 days	Wed 10/18/06
40	Steel Procurment Completed Phase 1A	243 days	Mon 12/19/05



Project: Schedule BETTER WORK
Date: Mon 10/20/08

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

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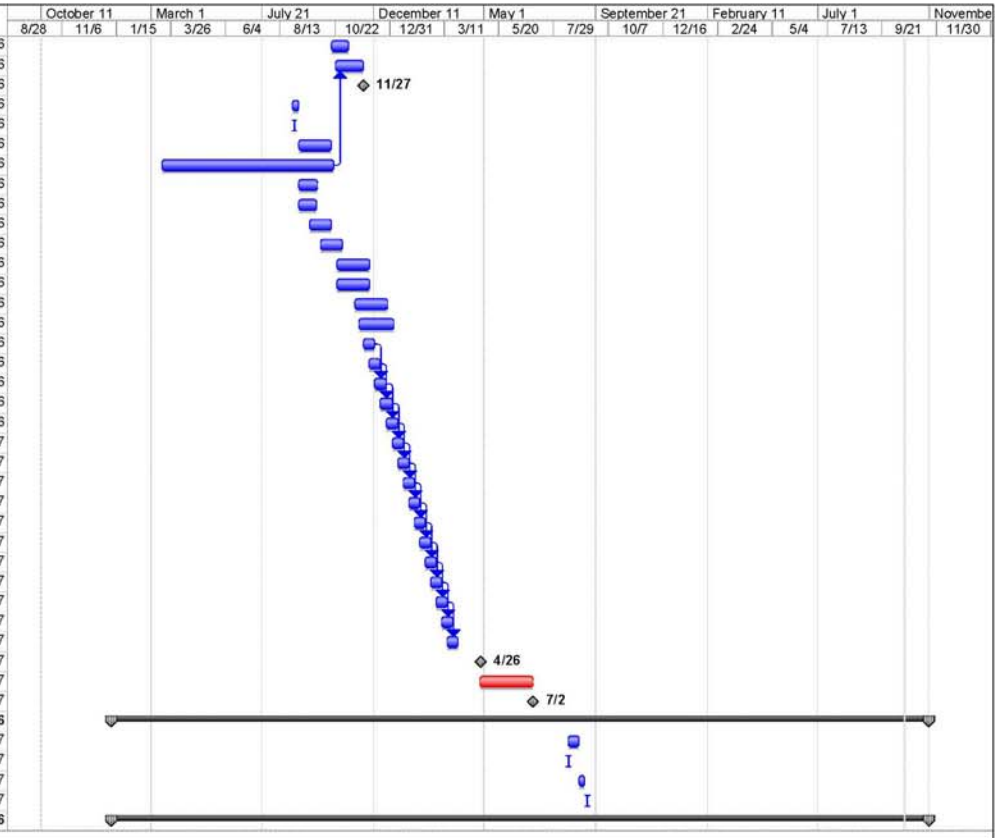
ID	Task Name	Duration	Start
41	Decommission and Remove Existing Stairs	16 days	Wed 10/18/06
42	Demolition Link Bridge	27 days	Mon 10/23/06
43	Demolition Phase 1A Complete	1 day	Mon 11/27/06
44	Install Construction Fencing & Jersey Barriers	6 days	Tue 8/29/06
45	Grade Site	1 day	Thu 8/31/06
46	Install New Stair Towers	30 days	Wed 9/6/06
47	Temporary Pedestrian Bridge Construction	158 days	Wed 3/15/06
48	Steel Piles Col A thru D	18 days	Wed 9/6/06
49	Timber Piles Col A thru D	17 days	Wed 9/6/06
50	Foundations & Pile Caps Col A thru D	20 days	Wed 9/20/06
51	Grade Beams & Piers Col A thru D	20 days	Wed 10/4/06
52	Steel Piles Col D thru J	31 days	Wed 10/25/06
53	Timber Piles Col D thru J	31 days	Wed 10/25/06
54	Foundations & Pile Caps Col D thru J	31 days	Fri 11/17/06
55	Grade Beams & Piers Col D thru J	33 days	Wed 11/22/06
56	Erect Structural Steel - Col A-D, Row 5-10	10 days	Tue 11/28/06
57	Framing and Decking Col A-D, Rows 5-10	10 days	Tue 12/5/06
58	Erect Structural Steel - Col A-D, Row 1-5	11 days	Tue 12/12/06
59	Framing and Decking Col A-D, Rows 1-5	12 days	Tue 12/19/06
60	Erect Structural Steel - Col D-H, Row 10.4-9	11 days	Wed 12/27/06
61	Framing and Decking Col D-H, Rows 10.4-9	10 days	Thu 1/4/07
62	Erect Structural Steel - Col D-H, Row 9-7	10 days	Thu 1/11/07
63	Framing and Decking Col D-H, Rows 9-7	10 days	Thu 1/18/07
64	Erect Structural Steel - Col D-H, Row 7-5	10 days	Thu 1/25/07
65	Framing and Decking Col D-H, Rows 7-5	10 days	Thu 2/1/07
66	Erect Structural Steel - Col D-H, Row 5-3	10 days	Thu 2/8/07
67	Framing and Decking Col D-H, Rows 5-3	10 days	Thu 2/15/07
68	Erect Structural Steel - Col D-H, Row 3-1	10 days	Thu 2/22/07
69	Framing and Decking Col D-H, Rows 3-1	10 days	Thu 3/1/07
70	Erect Structural Steel - Col D-H, Row 1-0.4	10 days	Thu 3/8/07
71	Framing and Decking Col D-H, Rows 1-0.4	10 days	Thu 3/15/07
72	Construction Complete Package 1A	1 day	Thu 4/26/07
73	Availible Float	48 days?	Thu 4/26/07
74	NTP 1B	1 day	Mon 7/2/07
75	**1B Aiport Terminal Connector Building**	**753 days?**	**Mon 1/9/06**
76	Engineering Review Submittal	10 days	Fri 8/17/07
77	Submittal Issued by Subcontractor	1 day	Fri 8/17/07
78	Gilbane Review & Approve Submittal	5 days	Fri 8/31/07
79	Subcontractor Procure & Deliver Material	1 day	Mon 9/10/07
80	**Pkg 1B: General Contractor**	**753 days?**	**Mon 1/9/06**



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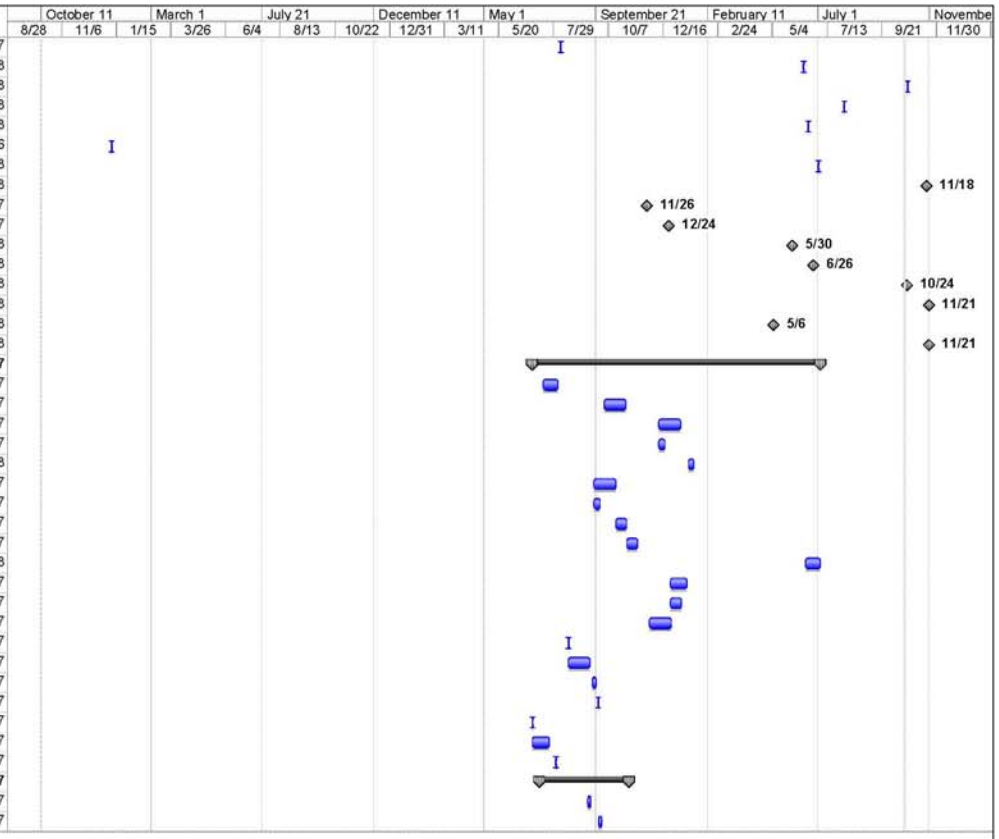
ID	Task Name	Duration	Start
81	Area Brought to Sub Grade (Pkg. 1A)	1 day	Tue 8/7/07
82	1st Floor Substantial Completion	1 day	Fri 6/13/08
83	Cert. of Occupancy - Concession Offices	1 day	Fri 10/24/08
84	2nd Floor Substantial Completion	1 day	Mon 8/4/08
85	Substantial Completion Level 3 Office Area	1 day	Thu 6/19/08
86	Temporary Certificate of Occupancy Office Spa	1 day?	Mon 1/9/06
87	4th Floor Substantial Completion	1 day	Wed 7/2/08
88	Milestone 1a: Complete Sec. Chkpt. / Opening	0 days	Tue 11/18/08
89	Milestone 1b : Complete Under-Slab Utilities	0 days	Mon 11/26/07
90	Milestone 1c: Complete Level 2 Slab on Deck	0 days	Mon 12/24/07
91	Milestone 1g: Cmplt Concession Area Shell Sp	0 days	Fri 5/30/08
92	Milestone 1h: Complete Level 3 Office Area	0 days	Thu 6/26/08
93	Milestone 1i: Complete Concession Offices	0 days	Fri 10/24/08
94	Milestone 1j: Relocate Project Mgmt Office	0 days	Fri 11/21/08
95	Milestone 2c: CWS Available from STP	0 days	Tue 5/6/08
96	Opening Day - Pkg 1B	0 days	Fri 11/21/08
97	**Pkg 1B: Div 1- General Requirements**	**265 days**	**Mon 7/2/07**
98	Mobilization	15 days	Mon 7/16/07
99	Demo CMU Block Walls Existing Building	20 days	Tue 10/2/07
100	Construct Permanent Egress Corridors D & E	20 days	Tue 12/11/07
101	Remove Temporary Egress Corridors D & E	6 days	Tue 12/11/07
102	Concrete Infill of 1st Temporary Bridge Area	5 days	Fri 1/18/08
103	Studs for Temporary Bridge	20 days	Wed 9/19/07
104	Insulation for Temporary Bridge	6 days	Wed 9/19/07
105	Drywall for Temporary Bridge	10 days	Wed 10/17/07
106	Drywall Ceilings for Temporary Bridge	10 days	Wed 10/31/07
107	Demo 2nd Temporary Bridge	15 days	Mon 6/16/08
108	Demo Current Temporary Bridge	15 days	Wed 12/26/07
109	Remove Precast Planking and Columns	10 days	Wed 12/26/07
110	Demo Walls Existing Building	20 days	Thu 11/29/07
111	Submittal Issued by Subcontractor	1 day	Fri 8/17/07
112	Engineering Review Submittal	20 days	Fri 8/17/07
113	Gilbane Review & Approve Submittal	5 days	Mon 9/17/07
114	Subcontractor Procure & Deliver Material	1 day	Mon 9/24/07
115	Submittal Issued by Subcontractor	1 day	Mon 7/2/07
116	Engineering Review Submittal	16 days	Mon 7/2/07
117	Subcontractor Procure & Deliver Material	1 day	Wed 8/1/07
118	**Pkg 1B: Div 2- Site Construction**	**83 days**	**Wed 7/11/07**
119	Fill Stone Subbase Quad 1	4 days	Tue 9/11/07
120	Fill Stone Subbase Quad 2	4 days	Tue 9/25/07



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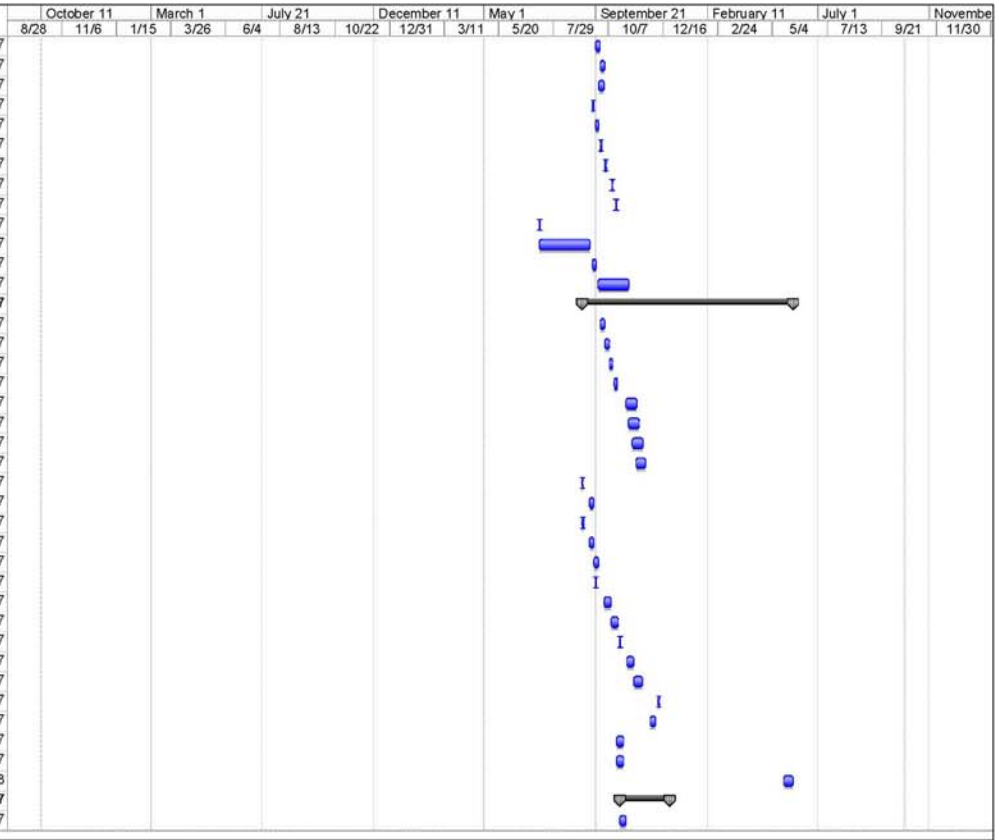
ID	Task Name	Duration	Start
121	Fill Stone Subbase Quad 3	4 days	Fri 9/21/07
122	Fill Stone Subbase Quad 4	4 days	Thu 9/27/07
123	Remove Grade Beam Existing Building	5 days	Tue 9/25/07
124	Concrete Pile Caps Quad 1	2 days	Mon 9/17/07
125	Concrete Pile Caps Quad 2	2 days	Fri 9/21/07
126	Concrete Pile Caps Quad 3	2 days	Thu 9/27/07
127	Concrete Pile Caps Quad 4	2 days	Wed 10/3/07
128	Drive Timber Piles at DT1072	1 day	Fri 10/12/07
129	Drive Timber Piles at ET1072	1 day	Wed 10/17/07
130	Submittal Issued by Subcontractor	1 day	Wed 7/11/07
131	Engineering Review Submittal	47 days	Wed 7/11/07
132	Gilbane Review & Approve Submittal	5 days	Mon 9/17/07
133	Subcontractor Procure & Deliver Material	30 days	Mon 9/24/07
134	**Pkg 1B: Div 3 - Concrete**	**194 days**	**Tue 9/4/07**
135	Rebar for SOG Quad 1	4 days	Thu 9/27/07
136	Rebar for SOG Quad 2	4 days	Wed 10/3/07
137	Rebar for SOG Quad 3	4 days	Tue 10/9/07
138	Rebar for SOG Quad 4	4 days	Mon 10/15/07
139	Pour SOG Quad 1	10 days	Tue 10/30/07
140	Pour SOG Quad 2	10 days	Fri 11/2/07
141	Pour SOG Quad 3	10 days	Wed 11/7/07
142	Pour SOG Quad 4	10 days	Mon 11/12/07
143	Wire Mesh for SOD North Side of Bridge	1 day	Tue 9/4/07
144	Form and Pour SOD North Side of Bridge	4 days	Thu 9/13/07
145	Rebar for SOD South Side of Bridge	2 days	Tue 9/4/07
146	Form and Pour SOD South Side of Bridge-1st Pour	4 days	Thu 9/13/07
147	Form and Pour SOD South Side of Bridge-2nd Pour	4 days	Wed 9/19/07
148	Wire Mesh for SOD	1 day	Fri 9/21/07
149	Form and Pour SOD (1st Pour)	7 days	Tue 10/2/07
150	Form and Pour SOD (2nd Pour)	7 days	Thu 10/11/07
151	Wire Mesh for SOD	1 day	Mon 10/22/07
152	Form and Pour SOD (1st Pour)	7 days	Wed 10/31/07
153	Form and Pour SOD (2nd Pour)	7 days	Fri 11/9/07
154	Pour Concrete Slab Mezzanines	2 days	Mon 12/10/07
155	Pour Concrete Floor for Walkable Ceilings	5 days	Fri 11/30/07
156	Form and Pour Foundations/Slab at DT1072	7 days	Thu 10/18/07
157	Form and Pour Foundations/Slab at ET1072	7 days	Thu 10/18/07
158	Install Site Masonry Walls	10 days	Mon 5/19/08
159	**Pkg 1B: Div 4- Masonry**	**46 days**	**Mon 10/22/07**
160	Block Walls to Grade Quad 1	6 days	Mon 10/22/07



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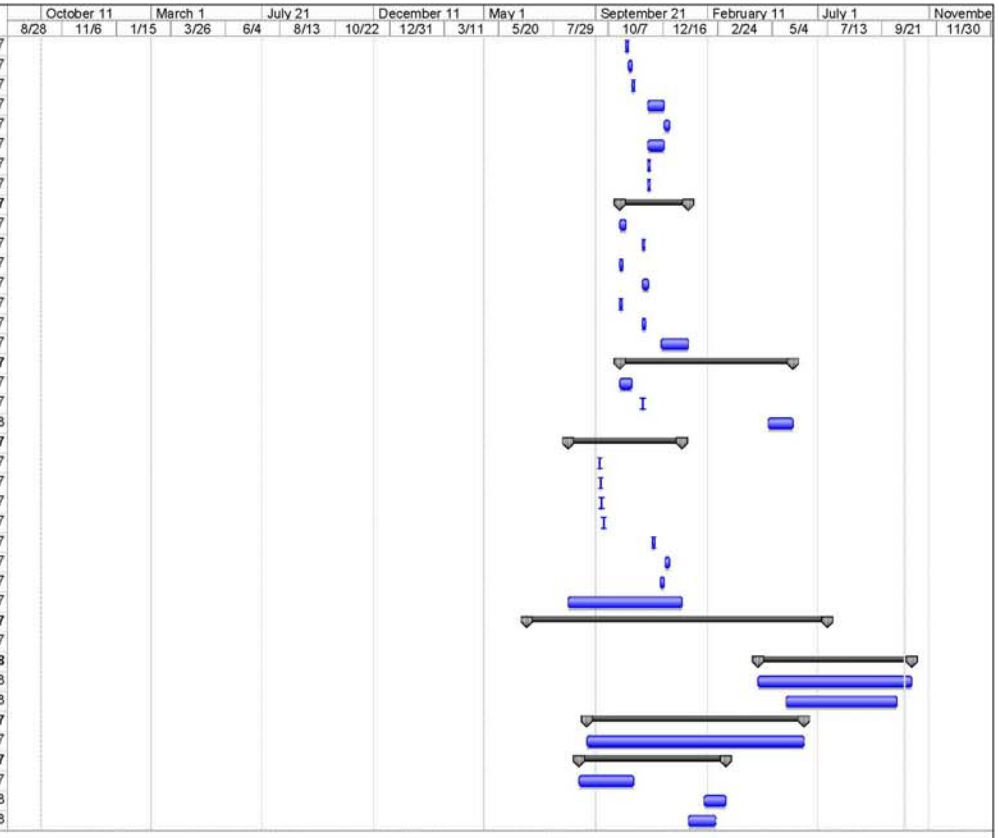
ID	Task Name	Duration	Start
161	Block Walls to Grade Quad 2	3 days	Tue 10/30/07
162	Block Walls to Grade Quad 3	3 days	Fri 11/2/07
163	Block Walls to Grade Quad 4	3 days	Wed 11/7/07
164	Interior Masonry Walls	15 days	Tue 11/27/07
165	Interior Masonry Walls	5 days	Tue 12/18/07
166	Interior Masonry Walls	15 days	Tue 11/27/07
167	Masonry Shaft Walls	3 days	Tue 11/27/07
168	Masonry Shaft Walls	3 days	Tue 11/27/07
169	**Pkg 1B: Div 5- Metals**	**64 days**	**Mon 10/22/07**
170	Exterior Walls - 3rd Floor	6 days	Mon 10/22/07
171	Exterior Walls - 4th Floor	3 days	Tue 11/20/07
172	Exterior Walls - 3rd Floor	4 days	Mon 10/22/07
173	Exterior Walls - 4th Floor	6 days	Tue 11/20/07
174	Exterior Walls - 3rd Floor	3 days	Mon 10/22/07
175	Exterior Walls - 4th Floor	4 days	Tue 11/20/07
176	Roof Misc. Metals	25 days	Fri 12/14/07
177	**Pkg 1B: Div 6- Wood & Plastics**	**160 days?**	**Mon 10/22/07**
178	Roof Blocking 3rd Floor	12 days	Mon 10/22/07
179	Roof Blocking 4th Floor	1 day?	Tue 11/20/07
180	Build Concession Walls	24 days	Tue 4/29/08
181	**Pkg 1B: Div 7- Thermal and Moisture Protection**	**104 days**	**Fri 8/17/07**
182	SOG Vapor Barrier Quad 1	1 day	Wed 9/26/07
183	SOG Vapor Barrier Quad 2	1 day	Thu 9/27/07
184	SOG Vapor Barrier Quad 3	1 day	Fri 9/28/07
185	SOG Vapor Barrier Quad 4	1 day	Mon 10/1/07
186	Air Membrane for Block Walls	3 days	Mon 12/3/07
187	Air Membrane for Block Walls	4 days	Wed 12/19/07
188	Air Membrane for Block Walls	3 days	Thu 12/13/07
189	Fireproofing	104 days	Fri 8/17/07
190	**Pkg 1B: Div 8- Doors and Windows**	**276 days**	**Mon 6/25/07**
191	Doors/Hardware Submittals, Rough In, Install	276 days	Mon 6/25/07
192	**Pkg 1B: Div 9- Finishes**	**144 days**	**Wed 4/16/08**
193	Install Accoustical Ceiling	144 days	Wed 4/16/08
194	Install Terrazo	105 days	Thu 5/22/08
195	**Pkg 1B: Div 10- Specialties**	**200 days**	**Mon 9/10/07**
196	Procurement/ Delivery	200 days	Mon 9/10/07
197	**Pkg 1B: Div 14- Conveying Systems**	**134 days**	**Fri 8/31/07**
198	Procurement/ Delevery	50 days	Fri 8/31/07
199	Install Elevators	20 days	Thu 2/7/08
200	Install Escalators	25 days	Fri 1/18/08



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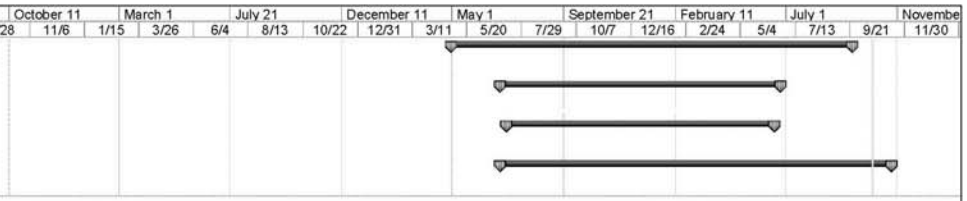
ID	Task Name	Duration	Start
201	**Pkg 1B: Div 16- Electrical**	**371 days**	**Mon 4/30/07**
202	Submittals, Rough In, Install	371 days	Mon 4/30/07
203	**Pkg 1B: Div 15- Mechanical**	**257 days**	**Mon 7/2/07**
204	Submittals, Rough In, Install	257 days	Mon 7/2/07
205	**Pkg 1B: Div- Plumbing and Fire Protection**	**245 days**	**Tue 7/10/07**
206	Submittals, Rough In, Install	245 days	Tue 7/10/07
207	**Pkg 1B: Special Systems**	**362 days**	**Mon 7/2/07**
208	Submittals, Rough In, Install	362 days	Mon 7/2/07



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Site Layout Planning

With the foundation system of slab on grade there was little excavation. Also, the building incorporated existing piles and grade beams from the previous structure. An additional 650 piles were driven to support the new building. New grade beams and elevator pits were the only other subsurface components of the building (shown on *Excavation Site Plan* in Appendix A).

Due to the fact that the construction site is in a high traffic area the building was constructed similarly to buildings in a downtown setting. Steel deliveries were closely monitored and coordinated by the General Inspector. There was limited to no lay down areas for steel onsite; however there was a satellite staging area for short haul if schedule delays occurred. General flow of steel erection was from the landside of the temporary bridge north toward the main road. The crane was a mobile hydraulic crane considering the congestion of the site. A second hydraulic crane was later brought to pick from the airside and work from the temporary bridge outward. With a main thoroughfare on one side and a federally secured airside there was no opportunity or space for a stationary crane.

Structural Steel Sequencing drawing is located in Appendix B.

Detailed Structural Systems Estimate

The main system is steel with a composite slab on deck floor system. The building is symmetrical and the takeoff was done for only half the building and then duplicated. Possible errors occurred in the rounding of values, as well as, the inconsistencies with RSMeans. For example, the slab on grade was calculated originally by a square foot estimate which is presented in Appendix C. Then another estimate for the same system was determined from a cubic yard method, which is presented in the following slab on grade chart. The two values differ by $36,369. Below is a summary of the structural costs, a more detailed takeoff can be found in Appendix C.

Piles

	QTY.	VLF	MATERIAL	LABOR	EQUIPMENT	UNIT COST	COST
Steel	210	75	$215,618	$67,725	$47,250	$21	$330,593
Wood	440	45	$228,096	$84,546	$59,202	$18	$371,844
Totals:			**$443,714**	**$152,271**	**$595,985**		**$702,437**

Concrete and Rebar

	CY	MATERIAL	LABOR	EQUIPMENT	UNIT COST	COST
Concrete For Piers (4000psi)	11	$1,310	$289	$5	$146	$1,606
Concrete For Pile Caps (4000 psi)	172	$20,417	$4,508	$81	$146	$25,152
Concrete For Grade Beams (4000 psi)	390	$46,376	$6,379	$2,405	$142	$55,159
SOG (Includes Forming & WWM)*	1801	$214,341	$19,363	$7,313	$129	$267,861
Slab on Deck	3104	$353,871	$57,426	$21,729	$137	$433,027
Reinforcing Rebar (Tons)	24	$27,924	$12,948	N/A	$1,700	$40,872
Totals:		**$664,239**	**$100,913**	**$31,532**		**$823,676**

*Forming and WWM added to final number

Metal Decking

	Square Feet	Material	Labor	Equipment	UNIT COST	COST
2nd Floor 6 1/4" LW 3" Deck	48632	$126,443	$21,884	$1,945	$3	$150,273
3rd Floor 6 1/4" LW 3" Deck	46426	$120,708	$20,892	$1,857	$3	$143,456
4th Floor 6 1/4" LW 3" Deck	31221	$81,175	$14,050	$1,249	$3	$96,474
Roof 6 1/2" LW 1 1/2" Deck	48632	$91,914	$17,994	$1,945	$2	$111,854
Totals:		**$420,240**	**$74,819**	**$6,996**		**$502,056**

Structural Steel

	LBS	TONS	MATERIAL	LABOR	EQUIPMENT	UNIT COST	TOTAL COST
Mezzanine & 2nd Floor Framing	1,218,717	609	$1,498,047	$169,779	$175,483	$3,025	$1,843,310
Third Floor Framing	387,089	194	$475,810	$53,925	$55,737	$3,025	$585,473
Fourth Floor Framing	638,754	319	$785,156	$88,985	$91,974	$3,025	$966,115
Roof Framing	673,742	337	$828,164	$93,859	$97,012	$3,025	$1,019,035
Columns	438,900	219	$539,496	$61,143	$63,197	$3,025	$663,836
Totals:	**3,357,202**	**1,679**	**$4,126,673**	**$467,691**	**$483,403**	**$15,125**	**$5,077,768**

Total Structural Cost: $7,105,937

General Conditions Estimate

A general conditions was performed using RSMeans. Unfortunately, some components are left out of the cost index. For example Means excludes corporate involvement, and only seems to include onsite personnel. Therefore the estimate that has been generated will be lower than the actual estimate, as well as, Gilbane was working as a CM Agency and did not have as much risk involved as when they perform work as a GC.

CODE	NAME	UNIT	COST	DURATION	TOTAL
01 11 31.20 (0010)	Construction Management Fees	1%			$185,000.00
01 31 13.20 (0020)	Clerk	Week	$590.00	58	$34,220.00
01 31 13.20 (0180)	Project Manager	Week	$2,975.00	58	$172,550.00
01 31 13.20 (0100)	Project Engineer 1A	Week	$2,100.00	40	$84,000.00
01 31 13.20 (0100)	Project Engineer 1A	Week	$1,375.00	40	$55,000.00
01 31 13.20 (0100)	Project Engineer 1B	Week	$2,100.00	16	$33,600.00
01 31 13.20 (0100)	Project Engineer 1B	Week	$1,375.00	16	$22,000.00
01 31 13.20 (0240)	General Superintendent	Week	$3,125.00	58	$181,250.00
01 31 13.20 (0240)	Superintendent 1A	Week	$2,750.00	40	$110,000.00
01 31 13.20 (0240)	Superintendent 1B	Week	$2,750.00	8	$22,000.00
01 31 13.20 (0240)	Superintendent 1B	Week	$2,750.00	8	$22,000.00
01 31 13.20 (0240)	Superintendent 1B	Week	$2,750.00	18	$49,500.00
01 31 13.20 (0240)	Superintendent 1B	Week	$2,750.00	18	$49,500.00
01 31 13.20 (0240)	Superintendent 1B	Week	$2,750.00	18	$49,500.00
01 31 13.20 (0240)	Superintendent 1B	Week	$2,750.00	18	$49,500.00
01 31 13.20 (0240)	Superintendent 1B	Week	$2,750.00	18	$49,500.00
01 31 13.20 (0240)	Superintendent 1B	Week	$2,750.00	18	$49,500.00
01 31 13.20 (0240)	Superintendent 1B	Week	$2,750.00	18	$49,500.00
01 31 13.20 (0290)	Scheduler	Week	$1,600.00	80	$128,000.00
01 32 13.50 (0650)	Scheduling Large Job	0.03%			$55,000.00
01 52 13.40 (0100)	Office Equipment	Month	$171.00	14.5	$2,479.50
01 52 13.40 (0120)	Office Supplies	Month	$93.50	14.5	$1,355.75
01 52 13.40 (0140)	Telephone Bill	Month	$88.00	14.5	$1,276.00

	SUBTOTAL	$	1,456,231.25
Allowances (16.15%)		$	1,691,412.60
Labor Burden (39%)		$	2,351,063.51
Fee:		$	2,586,169.86
	TOTAL	**$**	**2,586,169.86**

Critical Industry Issues

The information session that I attended at the SPACE Roundtable Meeting dealt with the topic of Energy and the Economy. I felt that this is of particular concern due to recent market fluctuations and the current unpredictable oil prices. Below is a summary of topics discussed by both students and industry professionals.

Energy

Material price was the first topic of discussion with regard to energy. A possible solution was to decrease transportation cost by utilizing materials that are locally manufactured. This solution is also recognized as credit in the LEED Certification process (Leadership in Energy Efficient Design). Also, the general public will take notice of the GC's commitment to the community, hence, free advertising and potential long term construction in the area.

With the main thermal losses occurring at the glazing of a building, dual facades have become increasingly popular. This concept has been standard in residential construction for a number of years and I found it intriguing that commercial owners are being educated to the potential benefits. A common theme trough the discussion was the idea that the contractors have the ability to convince the owner to have higher upfront costs in exchange for long term savings. This however is compromised by the inability or unwillingness of the owner to seek out the needed financing.

Power Systems

A main concern, with respect to power systems, is the competitive advantage of saving the owner money. To accomplish this, contractors need to be aware and have personal evaluate the federal, state, and local government rebates offered. Lighting loads need to be properly calculated and not over engineered for the designed use of occupied space. Also, wire sizing calculations can be improved to minimize cost if the owner does not anticipate future expansion.

Economy

With the economy slowing and new construction declining an emerging market is retro fitting existing buildings. This can be sold to the owner as a long term savings in an uncertain world. Also, old or partially completed building can turn a profit; however, much lower return and a greater need for budget focus. Lastly, industrial professionals informed the students that with the current market new construction will focus on data centers, federal work, PPP, healthcare, and education.

Industry Interaction

The first activity to encourage communication between the students and professional was an exercise to evaluate a potential mentoring program suggested by the Department Head, Dr. Anumba. We split into groups of three students and one professional. The discussion was productive and thought provoking. After the session we came back as a whole to express our views and opinions of how to have the mentoring program come to fruition. The meeting was relaxed and less intimidating since the students were not competing for a job, but colaborating as a whole to better the entire architectural engineering program at Penn State.

APPENDIX A

Excavation Site Plan

APPENDIX B

Structural Steel Sequencing Plan

APPENDIX C

Detailed Takeoff

Mezzanine and Second Floor Framing				
Beams and Girders				
Mezzanine				
W	x ###	L	LBS	LBS
14	82	10	820	
14	82	10	820	
14	82	10	820	
14	82	10	820	
14	82	10	820	
14	82	10	820	
14	82	10	820	
14	82	10	820	
14	82	10	820	
14	82	10	820	
14	82	10	820	
14	82	10	820	
14	109	29.41667	3206.417	
14	109	29.41667	3206.417	
14	109	29.41667	3206.417	
14	109	29.41667	3206.417	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	30.41667	2494.167	
14	82	30.41667	2494.167	
14	82	30.41667	2494.167	
14	109	30.41667	3315.417	
14	109	30.41667	3315.417	
14	82	13.33333	1093.333	
14	82	13.33333	1093.333	
14	82	13.33333	1093.333	
14	82	13.33333	1093.333	

14	82	13.33333	1093.333	
14	82	13.33333	1093.333	
14	22	9.416667	207.1667	
14	22	9.416667	207.1667	
14	22	9.416667	207.1667	
			58433.5	116867
Second Floor Beams				
5.5 to6				
12	68	15.16667	1031.333	
16	26	15.16667	394.3333	
21	44	15.16667	667.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
8	67	15.16667	1016.167	
8	67	15.16667	1016.167	
8	67	15.16667	1016.167	
8	67	15.16667	1016.167	
8	67	15.16667	1016.167	
8	67	15.16667	1016.167	
8	67	15.16667	1016.167	
8	67	15.16667	1016.167	
8	67	15.16667	1016.167	
8	67	15.16667	1016.167	
8	67	15.16667	1016.167	
8	67	15.16667	1016.167	
8	67	15.16667	1016.167	
8	67	15.16667	1016.167	
8	67	15.16667	1016.167	
8	67	15.16667	1016.167	
8	67	15.16667	1016.167	
8	67	15.16667	1016.167	
18	40	15.16667	606.6667	
30	116	15.16667	1759.333	
30	116	15.16667	1759.333	

16	31	15.16667	470.1667	
16	45	15.16667	682.5	
10	22	10.16667	223.6667	
36	359	42	15078	
36	359	42	15078	
36	359	42	15078	
36	359	42	15078	
			86137	172274
6 to 7				
12	68	30.41667	2068.333	
16	26	30.41667	790.8333	
21	44	30.41667	1338.333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
8	67	30.41667	2037.917	
8	67	30.41667	2037.917	
8	67	30.41667	2037.917	
8	67	30.41667	2037.917	
8	67	30.41667	2037.917	
8	67	30.41667	2037.917	
8	67	30.41667	2037.917	
8	67	30.41667	2037.917	
8	67	30.41667	2037.917	
8	67	30.41667	2037.917	
8	67	30.41667	2037.917	
8	67	30.41667	2037.917	
8	67	30.41667	2037.917	
8	67	30.41667	2037.917	
8	67	30.41667	2037.917	
18	40	30.41667	1216.667	
21	44	30.41667	1338.333	
16	45	30.41667	1368.75	
16	45	30.41667	1368.75	
16	45	30.41667	1368.75	

16	45	30.41667	1368.75	
			44712.5	89425
7 to 8				
12	68	29.41667	2000.333	
16	26	29.41667	764.8333	
21	44	29.41667	1294.333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
8	67	29.41667	1970.917	
8	67	29.41667	1970.917	
8	67	29.41667	1970.917	
8	67	29.41667	1970.917	
8	67	29.41667	1970.917	
8	67	29.41667	1970.917	
8	67	29.41667	1970.917	
8	67	29.41667	1970.917	
8	67	29.41667	1970.917	
8	67	29.41667	1970.917	
8	67	29.41667	1970.917	
8	67	29.41667	1970.917	
8	67	29.41667	1970.917	
8	67	29.41667	1970.917	
8	67	29.41667	1970.917	
18	40	29.41667	1176.667	
21	44	29.41667	1294.333	
16	45	29.41667	1323.75	
16	45	29.41667	1323.75	
16	45	29.41667	1323.75	
16	45	29.41667	1323.75	
			43242.5	86485
8 to 9				
12	68	29.41667	2000.333	
16	26	29.41667	764.8333	

21	44	29.41667	1294.333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
8	67	16.41667	1099.917	
8	67	16.41667	1099.917	
8	67	16.41667	1099.917	
8	67	16.41667	1099.917	
8	67	16.41667	1099.917	
8	67	29.41667	1970.917	
8	67	29.41667	1970.917	
8	67	29.41667	1970.917	
8	67	29.41667	1970.917	
8	67	29.41667	1970.917	
8	67	29.41667	1970.917	
8	67	29.41667	1970.917	
8	67	29.41667	1970.917	
8	67	29.41667	1970.917	
8	67	29.41667	1970.917	
21	44	29.41667	1294.333	
16	45	29.41667	1323.75	
16	45	29.41667	1323.75	
16	45	29.41667	1323.75	
16	45	29.41667	1323.75	
			37710.83	75421
9 Line Over				
16	40	38	1520	
21	44	34	1496	
16	26	32	832	
14	22	5	110	
14	22	5	110	
14	22	5	110	
10	22	5	110	
14	68	11	748	
10	22	5	110	

14	68	26	1768	
14	68	16	1088	
14	22	9	198	
14	22	9	198	
36	359	27	9693	
21	44	27	1188	
18	35	27	945	
36	359	29	10411	
21	44	30	1320	
18	35	30	1050	
16	45	29.25	1316.25	
16	45	29.25	1316.25	
16	45	29.25	1316.25	
16	45	29.25	1316.25	
16	45	29.25	1316.25	
16	45	29.25	1316.25	
16	45	29.25	1316.25	
16	45	29.25	1316.25	
16	45	29.25	1316.25	
21	44	29.25	1287	
16	45	20	900	
16	45	29.25	1316.25	
14	22	6	132	
14	22	6	132	
14	22	6	132	
14	22	6	132	
14	22	6	132	
14	22	6	132	
14	22	6	132	
14	22	6	132	
16	31	24	744	
16	31	26	806	
16	31	27	837	
16	31	29	899	
18	40	30	1200	
18	40	32	1280	
27	94	34	3196	
16	31	17	527	
16	31	19	589	

21	44	21	924	
21	44	23	1012	
16	26	24	624	
12	14	19.25	269.5	
16	26	19.25	500.5	
16	26	19.25	500.5	
16	26	19.25	500.5	
18	40	19.25	770	
			63141.25	126282
Girders				
5 Line (Count Once)				
27	94	11	1034	
27	94	17	1598	
33	118	29	3422	
16	31	15	465	
			6519	6519
6 Line				
27	94	11	1034	
27	94	29	2726	
24	68	16	1088	
16	31	15	465	
			5313	10626
7 Line				
27	94	11	1034	
27	94	29	2726	
24	68	16	1088	
16	31	12	372	
			5220	10440
8 Line				
27	94	11	1034	
27	94	29	2726	
24	68	16	1088	

16	31	11	341	
			5189	10378
9 Line				
27	94	15	1410	
27	94	17	1598	
33	118	30	3540	
16	31	10	310	
12	65	38	2470	
			9328	18656
10 Line over				
24	55	31	1705	
24	55	23	1265	
30	141	40	5640	
14	22	10	220	
14	22	10	220	
10	12	11	132	
16	31	17	527	
14	68	15	1020	
14	22	15	330	
21	44	25	1100	
18	40	33	1320	
6	15	32	480	
6	15	27	405	
10	12	11	132	
6	15	30	450	
6	15	14	210	
21	44	32	1408	
21	44	14	616	
24	55	5	275	
24	68	34	2312	
21	44	29	1276	
			21043	42086
Truss T1 (Eight Total)				

14	283	90	25470	
14	283	70	19810	
14	120	16	1920	
14	120	16	1920	
12	72	17	1224	
12	72	17	1224	
12	72	17	1224	
12	72	17	1224	
12	96	18	1728	
12	96	18	1728	
			57472	459776
			Pounds (lb)	1218717
			Ton	609.3585833
		Cost ($3,025 per ton)		$1,843,309

Third Floor Framing				
Beams				
5.5 to 6				
W	x ###	L	LBS	LBS
12	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	89	15.16667	1349.833	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
21	44	15.16667	667.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
21	44	15.16667	667.3333	
8	10	2.5	25	
8	10	2.5	25	
12	30	20	600	
16	26	15.16667	394.3333	
			10826.83	21653
6 to 7				
12	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	89	30.41667	2707.083	
16	26	30.41667	790.8333	

16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
21	44	30.41667	1338.333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	89	30.41667	2707.083	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
18	40	30.41667	1216.667	
16	26	30.41667	790.8333	
			24576.67	49153
7 to 8				
12	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	89	29.41667	2618.083	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
21	44	29.41667	1294.333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	

16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
21	44	29.41667	1294.333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
			21268.25	42536
8 to 9				
12	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	89	29.41667	2618.083	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
21	44	29.41667	1294.333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
21	44	29.41667	1294.333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	

16	26	29.41667	764.8333	
			21268.25	42536
9 to 10				
16	26	29.25	760.5	
16	26	29.25	760.5	
16	26	29.25	760.5	
16	26	29.25	760.5	
16	26	29.25	760.5	
16	26	29.25	760.5	
16	26	29.25	760.5	
16	26	29.25	760.5	
16	26	29.25	760.5	
16	26	29.25	760.5	
16	26	29.25	760.5	
16	26	29.25	760.5	
21	44	29.25	1287	
16	26	24	624	
16	26	31	806	
16	40	37	1480	
24	55	39	2145	
16	40	30	1200	
12	14	10	140	
27	94	31	2914	
27	94	10	940	
16	26	24	624	
16	26	33	858	
14	22	10	220	
16	26	34	884	
24	94	36	3384	
24	94	10	940	
16	31	10	310	
24	94	32	3008	
24	94	8	752	
14	22	11	242	
14	22	12	264	
16	26	30	780	
14	22	8	176	

16	26	27	702	
21	44	16	704	
21	44	8	352	
16	40	23	920	
14	22	11	242	
18	40	24	960	
18	40	7	280	
16	31	19	589	
16	31	19	589	
14	22	5	110	
14	22	5	110	
14	22	5	110	
14	22	5	110	
14	22	5	110	
24	62	5	310	
16	31	28	868	
21	44	30	1320	
18	40	32	1280	
27	94	34	3196	
10	12	7	84	
10	12	7	84	
10	12	7	84	
14	22	5	110	
16	26	19	494	
16	26	21	546	
21	44	23	1012	
16	26	24	624	
24	55	5	275	
21	44	5	220	
			48738.5	97477
Girders				
Column Line 5				
Column Line 6				
16	31	2	62	
16	31	15	465	

24	62	26.79167	1661.083	
24	55	26.79167	1473.542	
24	55	26.79167	1473.542	
24	55	26.79167	1473.542	
16	26	13.79167	358.5833	
27	94	33.79167	3176.417	
27	94	11	1034	
			11177.71	22355
Column Line 7				
16	31	2	62	
16	31	14	434	
24	55	26.79167	1473.542	
24	55	26.79167	1473.542	
24	55	26.79167	1473.542	
24	55	26.79167	1473.542	
16	26	13.79167	358.5833	
27	94	33.79167	3176.417	
27	94	11	1034	
			10959.17	21918
Column Line 8				
16	31	2	62	
16	31	11	341	
24	55	26.79167	1473.542	
24	55	26.79167	1473.542	
24	55	26.79167	1473.542	
24	55	26.79167	1473.542	
16	26	13.79167	358.5833	
27	94	33.79167	3176.417	
27	94	13	1222	
			11054.17	22108
Column Line 9				
16	31	2	62	
16	31	8	248	
24	55	26.79167	1473.542	

24	55	26.79167	1473.542	
24	55	26.79167	1473.542	
24	55	26.79167	1473.542	
16	26	13.79167	358.5833	
24	68	33.79167	2297.833	
24	68	15	1020	
			9880.583	19761
Column Line 10 and over				
24	55	26.79167	1473.542	
24	62	33	2046	
24	55	28	1540	
24	55	19	1045	
16	31	24	744	
24	55	34	1870	
18	40	20	800	
30	108	43	4644	
16	26	19	494	
14	22	9	198	
14	22	9	198	
14	22	19	418	
14	68	19	1292	
24	55	16	880	
21	44	45	1980	
16	26	27	702	
16	26	15	390	
18	40	17	680	
18	65	8	520	
30	90	18	1620	
16	26	10	260	
			23794.54	47589
			Pounds (lb)	387089
			Ton	194
		Cost ($3,025 per ton)		$ 585,472

Fourth Floor Framing				
Beams				
5.5 to 6				
W	x ###	L	LBS	LBS
14	82	15.16667	1243.667	
14	82	15.16667	1243.667	
14	82	15.16667	1243.667	
14	82	15.16667	1243.667	
14	82	15.16667	1243.667	
14	82	15.16667	1243.667	
14	82	15.16667	1243.667	
14	82	15.16667	1243.667	
14	82	15.16667	1243.667	
14	82	15.16667	1243.667	
14	82	15.16667	1243.667	
14	82	15.16667	1243.667	
14	82	15.16667	1243.667	
14	82	15.16667	1243.667	
14	82	15.16667	1243.667	
14	82	15.16667	1243.667	
14	82	15.16667	1243.667	
14	82	15.16667	1243.667	
14	82	15.16667	1243.667	
14	82	15.16667	1243.667	
14	82	15.16667	1243.667	
14	82	15.16667	1243.667	
14	82	15.16667	1243.667	
14	82	15.16667	1243.667	
14	82	15.16667	1243.667	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	

16	26	15.16667	394.3333	
18	40	15.16667	606.6667	
			29362.67	58725
6 to 7				
14	82	30.41667	2494.167	
14	82	30.41667	2494.167	
14	82	30.41667	2494.167	
14	82	30.41667	2494.167	
14	82	30.41667	2494.167	
14	82	30.41667	2494.167	
14	82	30.41667	2494.167	
14	82	30.41667	2494.167	
14	82	30.41667	2494.167	
14	82	30.41667	2494.167	
14	82	30.41667	2494.167	
14	82	30.41667	2494.167	
14	82	30.41667	2494.167	
14	82	30.41667	2494.167	
14	82	30.41667	2494.167	
14	82	30.41667	2494.167	
14	82	30.41667	2494.167	
14	82	30.41667	2494.167	
14	82	30.41667	2494.167	
14	82	30.41667	2494.167	
14	82	30.41667	2494.167	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	

18	40	30.41667	1216.667	
			58886.67	117773
7 to 8				
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	40	29.41667	1176.667	
			56185.83	112371

8 to 9				
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
14	82	29.41667	2412.167	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	40	29.41667	1176.667	
			56185.83	112371
9 to 10				

8	18	9	162	
8	18	9	162	
12	14	4	56	
12	14	4	56	
12	14	4	56	
12	14	4	56	
12	14	4	56	
12	14	4	56	
12	19	7	133	
12	19	7	133	
12	19	7	133	
12	19	7	133	
12	19	7	133	
12	19	7	133	
12	19	7	133	
12	19	7	133	
12	44	31	1364	
14	22	15	330	
14	22	15	330	
14	22	15	330	
14	22	23	506	
14	22	23	506	
14	22	23	506	
14	22	23	506	
14	22	23	506	
14	22	23	506	
14	22	23	506	
14	22	23	506	
14	22	9	198	
14	22	10	220	
14	22	11	242	
14	22	12	264	
14	22	13	286	
14	22	14	308	
14	22	15	330	
14	22	5	110	
14	22	13	286	
14	22	17	374	
14	58	11	638	

14	58	19	1102	
14	58	20	1160	
14	58	22	1276	
14	58	23	1334	
14	82	29.25	2398.5	
14	82	29.25	2398.5	
14	82	29.25	2398.5	
14	82	29.25	2398.5	
14	82	29.25	2398.5	
14	82	29.25	2398.5	
14	82	29.25	2398.5	
14	82	29.25	2398.5	
14	82	29.25	2398.5	
14	82	29.25	2398.5	
14	82	29.25	2398.5	
14	82	29.25	2398.5	
14	82	29.25	2398.5	
14	82	29.25	2398.5	
14	82	29.25	2398.5	
14	82	29.25	2398.5	
14	82	29.25	2398.5	
14	82	29.25	2398.5	
14	82	29.25	2398.5	
14	82	29.25	2398.5	
14	82	27	2214	
14	82	27	2214	
16	26	29	754	
16	26	29.75	773.5	
16	26	29.75	773.5	
16	26	22	572	
16	26	33	858	
16	26	23	598	
16	31	35	1085	
16	45	27	1215	
16	45	16	720	
16	45	7	315	
18	40	37	1480	
18	40	38	1520	
18	40	16	640	

18	40	7	280	
18	40	23	920	
18	40	23	920	
18	40	23	920	
18	40	4	160	
18	40	4	160	
18	40	4	160	
21	44	29.25	1287	
21	44	10	440	
21	44	39	1716	
21	44	40	1760	
21	44	7	308	
21	44	41	1804	
24	55	25	1375	
			86730	173460
Girders				
5 count only once				
16	26	22.5	585	
24	55	42.5	2337.5	
			2922.5	2922
Column Line 6				
16	26	22.5	585	
24	55	42.5	2337.5	
			2922.5	5845
Column Line 7				
16	26	22.5	585	
24	55	42.5	2337.5	
			2922.5	5845
Column Line 8				
16	26	22.5	585	
24	55	42.5	2337.5	
			2922.5	5845
Column Line 9				

16	26	22.5	585	
24	55	42.5	2337.5	
			2922.5	5845
Column Line 10 and over				
12	19	5	95	
12	44	28	1232	
14	22	9	198	
14	22	9	198	
16	26	16	416	
18	40	22	880	
18	40	27	1080	
18	40	16	640	
18	40	26	1040	
18	40	27.83333	1113.333	
18	40	4	160	
21	44	22.41667	986.3333	
21	44	34	1496	
21	44	28	1232	
21	44	36	1584	
21	44	19	836	
24	55	30	1650	
24	55	14	770	
24	76	43	3268	
			18874.67	37749
			Pounds (lb)	638753
			Ton	319
		Cost ($3,025 per ton)		$ 966,115

Roof Framing				
Beams				
5.5 to 6				
W	x ###	L	LBS	LBS
18	40	15.16667	606.6667	
18	40	15.16667	606.6667	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
16	26	15.16667	394.3333	
			9494.333	18988
6 to 7				
18	40	30.41667	1216.667	
18	40	30.41667	1216.667	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	

16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
16	26	30.41667	790.8333	
			19040.83	38081
7 to 8				
16	40	29.41667	1176.667	
18	40	29.41667	1176.667	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
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16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	

16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
			17650	35300
9 to 10				
16	40	29.41667	1176.667	
18	40	29.41667	1176.667	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
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16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
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16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
16	26	29.41667	764.8333	
			17650	35300
10 over				
16	26	20		
16	26	10.25	266.5	
16	26	10.25	266.5	
16	26	10.25	266.5	

16	26	10.25	266.5	
16	26	10.25	266.5	
16	26	4	104	
16	26	5	130	
16	26	6	156	
16	26	8	208	
16	26	9	234	
16	26	10	260	
16	26	12	312	
16	26	13	338	
16	26	14	364	
16	26	15	390	
16	26	17	442	
16	26	18	468	
16	26	20	520	
16	26	21	546	
16	26	22	572	
16	57	2	114	
			6490.5	12981
Girders				
21	44	22.41667	986.3333	
21	44	34	1496	
21	44	28	1232	
18	40	18	720	
18	40	27	1080	
27	84	36	3024	
21	44	20	880	
16	45	23	1035	
			10453.33	20906
Truss T1 (Eight Total)				
14	193	107	20651	
14	193	108	20844	
14	120	19	2280	
12	96	19	1824	

12	72	19	1368	
12	72	19	1368	
12	72	19	1368	
12	72	19	1368	
12	96	19	1824	
14	120	19	2280	
14	176	14	2464	
14	176	14	2464	
12	40	14	560	
12	40	14	560	
12	40	14	560	
12	40	14	560	
12	40	14	560	
12	40	14	560	
			64023	512184
			Pounds (lb)	673742
			Ton	336
		Cost ($3,025 per ton)		**$1,019,034**

AIRPORT TERMINAL EXPANSION - EASTERN UNITED STATES

PAUL YINGLING AE SENIOR THESIS 2009

W	x###	L	LBS	LBS	QTY	TOTAL LBS	TONS	COST ($3025 PER TON)
C1								
14	193	42.5	8202.5					
14	193	36	6948					
				15150.5	8	121204	60.602	$183,321
C2								
12	72	42.5	3060					
12	72	24	1728					
				4788	8	38304	19.152	$57,934
C3								
12	96	42.5	4080					
12	96	24	2304					
				6384	12	76608	38.304	$115,869
C4								
10	45	14	630					
				630	2	1260	0.63	$1,905
C5								
10	54	38.5	2079					
10	54	10	540					
				2619	12	31428	15.714	$47,534
C6								
12	96	38.5	3696					
				3696	10	36960	18.48	$55,902
C7								
12	96	20	1920					
12	96	26	2496					
				4416	2	8832	4.416	$13,358
PU1								
14	193	40	7720					

				7720	8	61760	30.88	$93,412
PU2								
12	72	28	2016					
				2016	12	24192	12.096	$3,6590
PU4								
12	96	40	3840					
				3840	6	23040	11.52	$34,848
PU6								
10	33	12	396					
				396	6	2376	1.188	$3,593
HANGERS								
10	33	14	462					
10	33	14	462					
10	33	14	462					
10	33	14	462					
10	33	14	462					
10	33	14	462					
10	33	14	462					
10	33	14	462					
10	33	14	462					
10	33	14	462					
10	33	14	462					
10	33	14	462					
10	33	14	462					
10	33	14	462					
10	33	14	462					
				6468	2	12936	6.468	$19,565
						438900	219.45	**$663,836**

AIRPORT TERMINAL EXPANSION - EASTERN UNITED STATES

PAUL YINGLING AE SENIOR THESIS 2009

P1 - (12) #8 VERT w/ #4 TIES @ 16"								
P2 - (8) #8 VERT w/ #4 TIES @ 16"								
P3 - (8) #7 VERT w/ #4 TIES @ 16"								
Concrete and Rebar for Piers 4000psi								
	DIM	CY	COST	LBS OF REBAR	TONS	COST	QTY	TOTAL
P1	32x32x24	0.526749	$56.89	67.64	0.03382	$57.49	8	$915
P2	26x26x24	0.173868	$18.78	46.28	0.02314	$39.34	22	$1,278
P3	22x22x24	0.24897	$26.89	36.27	0.018135	$30.83	12	$692
								$2,886

Concrete and Rebar for Pile Caps 4000psi								
	DIM	CY	COST	LBS OF REBAR	TONS	COST	QTY	TOTAL
PC2	4.5'x7.75'x2.5'	3.229167	377.8125	19.774	0.009887	16.8079	36	$14,206
PC4	7.75'x7.75'x2.5'	5.561343	650.6771	19.526	0.009763	16.5971	10	$6,672
								$20,879

SOG (12")							
SQFT		UNIT COST (SF)	COST	FORMING (FT)	UNIT COST	COST(3 POURS)	TOTAL COST
48632		5.65	$274,770.80	311.872	4.21	$3,938.94	**$278,709**

Mesh for Slab on Grade 6x6-W2.9 x W2.9 (4x4) 58 lb. per CSF			
AREA	UNIT	UNIT COST	COST
48632	CSF	52.5	**$25,531**

AIRPORT TERMINAL EXPANSION - EASTERN UNITED STATES

PAUL YINGLING AE SENIOR THESIS 2009

	Square Feet	Material	Labor	Equipment	UNIT COST (SF)	Cost
2nd Floor 6 1/4" LW 3" Deck						
	48632	126443.2	21884.4	1945.28	3.09	$150,272
3rd Floor 6 1/4" LW 3" Deck						
	46426	120707.6	20891.7	1857.04	3.09	$143,456
4th Floor 6 1/4" LW 3" Deck						
	31221.2	81175.12	14049.54	1248.848	3.09	$96,473
Roof 6 1/2" LW 1 1/2" Deck						
	48632	126443.2	21884.4	1945.28	2.29	$111,367
						$501,570.01

Material and Pour for Slab on Deck 3000psi				
	Area	CY	Unit Cost	Total
5.75"	126279.2	2241.06605	114	**$255,481**
6"	48632	863.067901	114	**$98,389**

AIRPORT TERMINAL EXPANSION - EASTERN UNITED STATES

PAUL YINGLING AE SENIOR THESIS 2009

Grade Beams						
	LNF	CY	UNIT COST	POUR COST	TOTAL UNIT COST	COST
GB1						
	314.3333	77.6053	117	22.5	139.5	$10,825
GB2						
	30	8.14815	117	22.5	139.5	$1,136
GB3						
	68	11.75	117	22.5	139.5	$1,639
GB4						
	270	50	117	22.5	139.5	$6,975
GB5						
	263.1667	35.33	117	22.5	139.5	$4,928
GB6						
	59.4	12.35	117	22.5	139.5	$1,722
					Total:	**$54,456**

Rebar For Grade Beams			
		LNF	LBS
GB1 - (4) #8 (4)#8 (4)#5 [25.532 lb/ft			
		314.333333	8025
GB2 - (4) #8 (6) #9 (2) #5 [33.166 lb/ft]			
		30	994
GB3 - (5) #8 (5) #8 [26.7 lb/ft]			
		68	1815
GB4 - (4) #6 (4) #6 (2) #5 [14.102]			
		270	3807
GB5 - (6) #6 (6) #6 (2) #5 [20.11]			
		263.166667	5292
GB6 - (4) #8 (4) #8 (2) #5 [23.446 lb/ft]			
		59.4	1392
		Total LBS	21328
		Tons	10
		Cost($1,700 per ton)	**$18,129**