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Option: Construction management  
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# Thesis Technical Assignment #2

## Cost and Schedule Analysis

George Mason University PE Building  
Renovation & Expansion  
Fairfax, Virginia



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## Executive Summary

The following report contains: a detailed project schedule, analysis of site planning, a detailed estimate for the structural system, a general conditions estimate, and a summary of current critical industry issues for the George Mason PE Building Renovation and Expansion. A detailed construction schedule was produced by taking the schedule from the previous technical assignment and adding to it. This schedule contains 172 activities and is broken down by trades. By breaking down the schedule in this manner, the sequencing and work order become apparent.

Site layout planning for the superstructure phase of the project was analyzed as well. Since this phase is broken up into two separate sequences, several site plans were developed showing the site layout for each sequence. In developing these site plans, it seemed interesting that only one crane was used to erect the steel. The structural system for the new addition seems large enough that using two cranes may have been a better option. The schedule and monetary impact of using two cranes instead of one could be an interesting aspect to research at a later time.

The detailed structural system estimate was calculated using *MC<sup>2</sup> Estimating Software*. An easy to read estimate summary broken down by CSI Division shows how the final cost was obtained. Through this estimate, a more in depth analysis of the structural system was performed than in the previous technical assignment and specifics about the structure were learned. The general conditions estimate was calculated using *RS Means Building Cost Data 2009*. Included in this estimate are the CM's staffing fees, general project item costs, and temporary utilities.

Lastly, critical industry issues discussed at the PACE Roundtable Meeting were analyzed. The PACE Roundtable is an event for students and industry members to come together and share current information and issues going on in the industry. The issues discussed at this meeting included LEED, BIM, and Energy and the Economy. The current issues of the economy crisis and how it affects the construction industry is the specific topic analyzed in this paper.

## Detailed Project Schedule Summary

As previously mentioned in technical assignment one, the construction schedule for this project spans a time period of approximately two years. The preconstruction phase started in May 2007 following with the construction starting in October 2007. The completion date for the PE Building is set for April 2009. The detailed schedule was produced simply by revamping the previously made schedule. This was done by breaking out each general activity into the activities of the different trades. In doing this, 172 activities were scheduled. Some of the different trades the schedule is broken into are as follows:

- Demolition
- Site work
- Concrete
- Steel
- Mechanical & HVAC
- Electrical

By looking at the detailed schedule, the sequencing, work flow, and in what order the building was constructed can be recognized with ease. The PE Building has been strategically phased by the different building sectors. These phases include:

- Cage Gym
- Linn Gym
- Existing Core
- Mechanical Room
- New Venue Gym
- New Venue Gym Public Space
- New East Wing

On the schedule, the Mechanical Room and New Venue Gym Areas are part of sequence 1A and 1B. The New East Wing is Sequence 2 and the renovation of the existing core is Sequence 3. A couple activities found that do not follow the traditional start on the bottom floor and build up are in Sequence 3. In this sequence, the MEP rough-in and hanging and finishing the walls of the upper level are done before the lower level. It has yet to be determined why this was done, since the rest of the work flows in the traditional manner. The detailed schedule can be seen in Appendix A.

## Site Layout Planning

Following up the site plan made in technical assignment one for GMU's PE Building, site layout planning needed to be done for a critical construction phase of the project. In this case, the erection of the superstructure phase was chosen. The PE Building's new superstructure includes steel erection for the new Mechanical Plant, new Venue Gym, and new East Wing. These areas are broken down into two sequences with the Mechanical Plant and Venue Gym being sequence one and the East Wing being sequence two. Figure 1 (below) shows the site layout with the respected sequences. Note that prior to this time the existing East Wing has been demolished.



Figure 1.



Figure 2.

Figure 2 (above) shows the site layout for sequence one steel erection. Note only one 70 ton hydraulic truck crane was used to erect the steel. The site plan shows two cranes only for the purpose of showing the work flow from West to East, which is represented by the (red) arrow. The material hoist follows the crane and is used to hoist men and tools to connect the steel members. The (orange) arrows are the entrance and exit to the site. Material staging on the PE Building's site is rather limited to the South and East sides of the site due to congestion. As Figure 2 shows, the staging area for this sequence is South of the new Venue Gym. Note the trailers shown do not include the CM's (Gilbane) trailers. These are trades trailers only. At this point in the project, Gilbane had their office set up inside the existing core of the building. Also note that the parking shown is only for Gilbane personnel. As mentioned in technical assignment one, the subs had other designated parking areas on GMU's campus.

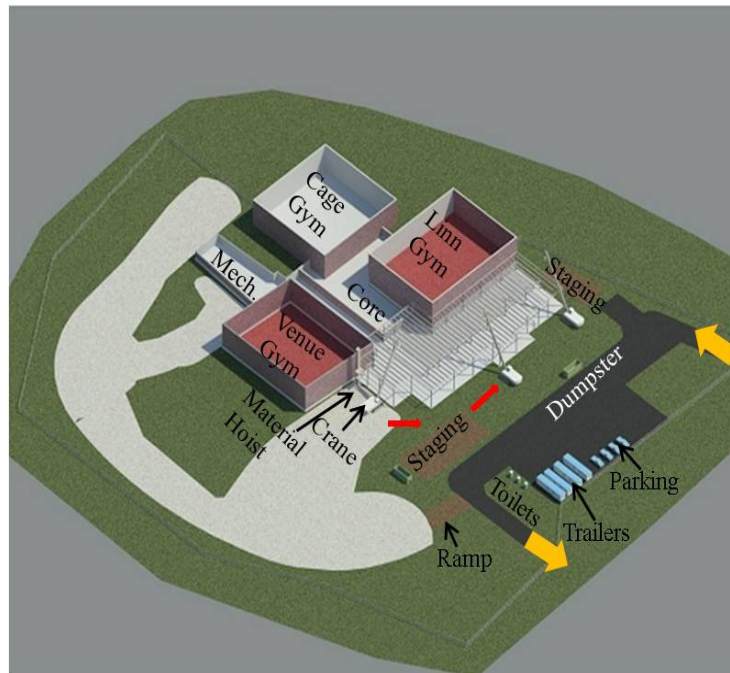


Figure 3.

Figure 3 (above) shows the site layout for sequence two steel erection. Again, note the multiple cranes are only shown to portray the work flow from South to North represented by the (red) arrows. The material hoist again follows the crane with the purpose of hoisting men and tools to connect the steel members. For this sequence there are two staging areas, one at each end of the East Wing. This may not be the most ideal staging setup, but again options are limited due to site congestion. Note in this sequence, Gilbane's office is now outside in the trailers since this steel erection hinders their ability to enter from the East side until the steel sequence is complete. No site plans were able to be obtained from the CM to compare and critique to these. Larger, scale versions of the sequence one and two site plans can be seen in Appendix B.

## Detailed Structural Systems Estimate

The detailed structural systems estimate was calculated using *MC<sup>2</sup> Estimating Software*. This estimate encompasses the structural system for the new construction on the GMU PE Building. The new construction includes the Mechanical Plant, Venue Gym and public spaces, and East Wing. The structural system for these new areas is a combination of the following:

- Concrete Strip Footings
- Concrete Slab on Grade
- Concrete Column Footings
- Steel Columns
- Steel Beams
- Elevated Composite Metal Deck Floor Slabs
- Metal Roof Deck

Figure 4 (right) shows quantities of the concrete and steel components of the structural system.

<b><u>Concrete &amp; Steel Quantities</u></b>		
<b>Item</b>	<b>Quantity</b>	<b>Unit</b>
Concrete	1316.69	CY
Steel	332.61	Tons
Steel	744	Pieces

Figure 4.

Figure 5 (right) shows the labor, material, and equipment costs for the entire structural system.

<b><u>Manpower Costs</u></b>	
<b>Description</b>	<b>Total Cost</b>
Labor	\$2,150,917.80
Materials	\$419,347.59
Equipment	\$37,022.37

Figure 5.

The total cost of the structural system obtained using the MC<sup>2</sup> Software was approximately 2.6 million dollars. For more quantity and cost related data, see quantity takeoff sheets and the estimate summary broken down into CSI Divisions in Appendix C.



## General Conditions Estimate

The general conditions estimate was calculated using *RS Means Building Cost Data 2009*. It is a representative of what Gilbane's general conditions estimate would include. Some items included in this estimate are as follows:

- Staffing costs
- Jobsite Office costs
- Vehicle/Travel costs
- Temporary Utilities

For a more in-depth breakdown, see Appendix D for the full general conditions estimate as well as supporting RS Means data sheets.

## Critical Industry Issues

During the PACE Roundtable Meeting, there were three different breakout sessions that discussed various topics and how they affect the construction industry. The topics included LEED, BIM, and Energy and the Economy. Given the current economic crisis, the topic of choice was Energy and the Economy. During this session, industry members explained how the crisis was affecting their projects and ways of doing business. The first affect brought up was material escalation. This is a major issue due to gas prices skyrocketing, which leads to higher freight charges and delivery costs. To manage this, contractors are buying out work early and including price guarantees into their contracts for projects that span several years. Owners are starting to demand more emphasis on the design of control systems for their buildings, as well as caring more about the life cycle costs. As a result of this, energy retrofits are becoming popular. There has also been an increase in European and Japanese products being used, specifically mechanical systems and building facades. These products are more energy efficient than American products, hence the increase.

On the economy side of things, current good and bad markets were discussed. The good markets being:

- Data Centers
- Federal Work
- Healthcare
- Education
- PPP

The bad markets being:

- Gaming
- Condos
- Spec Offices

Some industry members viewed the current crisis as a good thing instead of bad, pointing out that there are a lot of opportunities to pick up work were maybe another contractor left the job. Lastly, they pointed out that renovation projects were on the rise as the result of our current economy. George Mason's PE Building fits right in being that it is in the Education market and is part renovation.

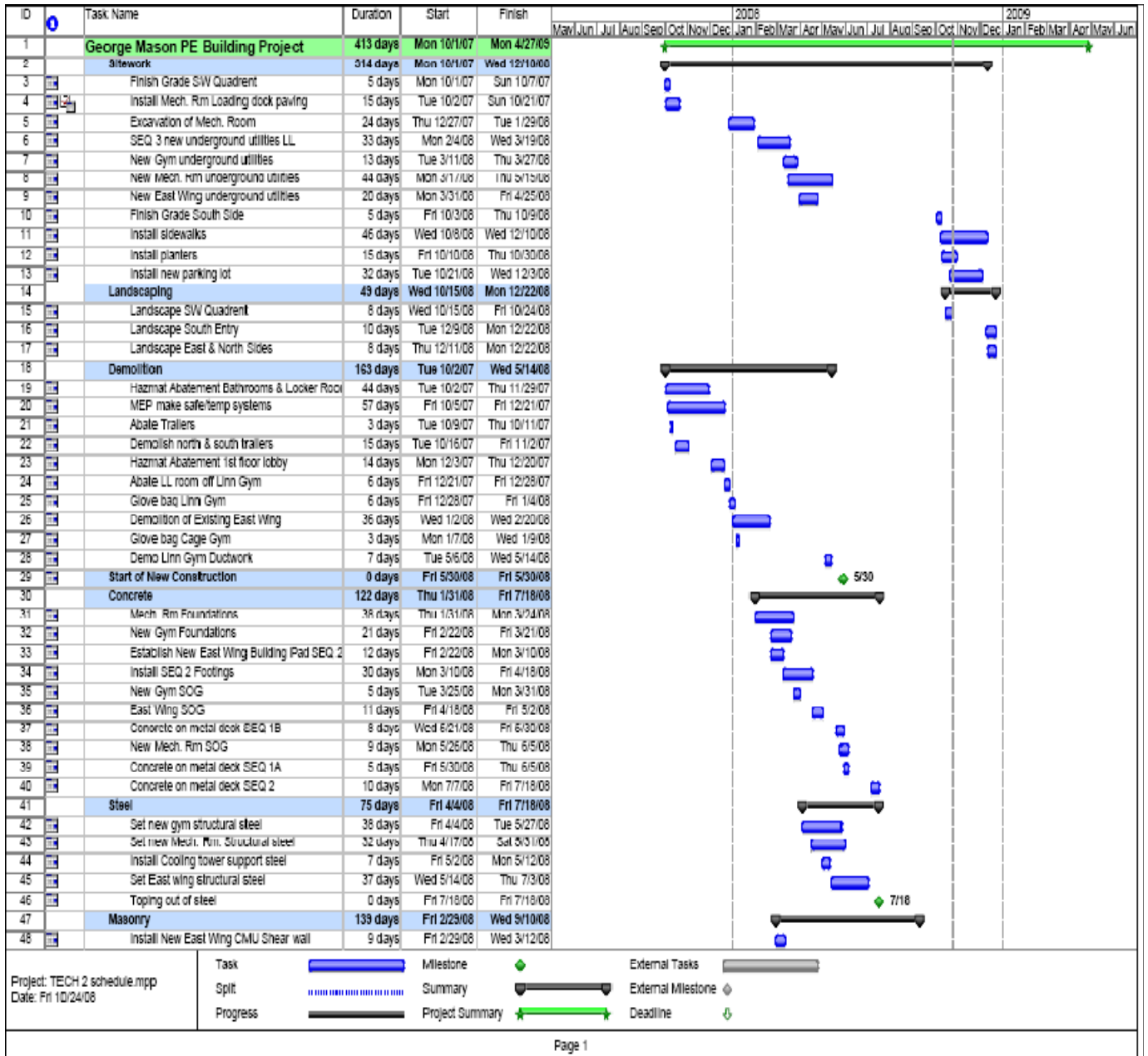
Another important topic discussed, while not being an industry issue, was the idea of a mentoring program for the students. This is a great idea if implemented properly. It would not only help students in deciding what option to pursue within the major, but keep them aware of what is really going on in the industry. It would also help develop the people skills needed to succeed in this business. This program would initiate the first contact with an industry member, which can be quite intimidating to a young student who is not used to that type of situation. These mentors would also be people students could go to for help on projects as well as thesis as they advance through their college careers. Overall, it will help develop a better all around engineer, and it is a program that should have been thought of and put into action years ago.

#### Key Contacts Met

- Seth Glinski – Forrester Construction Co.
- Coleman Walker – Hassel Construction Co.

## Appendix A- Detailed Project Schedule Summary

## Appendix A



ID	Task Name	Duration	Start	Finish	2008												2009											
					May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
49	Install CMU at Linn Gym East openings	3 days	Tue 6/3/08	Thu 6/5/08																								
50	Install CMU SEQ 1B	36 days	Wed 6/11/08	Wed 7/30/08																								
51	Install exterior CMU lower level Mech. Rm	21 days	Thu 6/12/08	Thu 7/10/08																								
52	Install Brick SEQ 1B	47 days	Wed 7/2/08	Thu 9/4/08																								
53	Install Interior CMU Lower Level Mech. Rm	10 days	Mon 7/14/08	Fri 7/25/08																								
54	Install East wing brick façade	25 days	Mon 7/28/08	Fri 8/29/08																								
55	Install Brick Façade Mech. Rm	21 days	Wed 8/13/08	Wed 9/10/08																								
56	<b>Spray Fireproofing</b>	<b>88 days</b>	<b>Thu 5/22/08</b>	<b>Mon 9/22/08</b>																								
57	Spray fireproof SEQ 1B	14 days	Thu 5/22/08	Tue 6/10/08																								
58	Spray fireproof SEQ 1A roof	77 days	Fri 6/6/08	Mon 9/22/08																								
59	Spray fireproof Mech. Rm beams	2 days	Fri 6/20/08	Mon 6/23/08																								
60	Spray fireproof SEQ 2 beams & columns	10 days	Mon 7/14/08	Fri 7/25/08																								
61	Spray fireproof New East wing SEQ 2 roof de	15 days	Tue 9/2/08	Mon 9/22/08																								
62	Spray fireproof SEQ 1B roof deck	2 days	Wed 9/10/08	Thu 9/11/08																								
63	<b>Building Enclosures</b>	<b>186 days</b>	<b>Thu 2/14/08</b>	<b>Thu 10/30/08</b>																								
64	Infill roof openings @ existing core	3 days	Thu 2/14/08	Mon 2/18/08																								
65	Install new parapet roofing	5 days	Fri 6/6/08	Thu 6/12/08																								
66	Frame & hang walls SEQ 1B	75 days	Fri 6/13/08	Thu 9/25/08																								
67	Frame North wall of Raquet ball courts	3 days	Mon 6/16/08	Wed 6/18/08																								
68	Install East wing skylights	8 days	Fri 7/11/08	Tue 7/22/08																								
69	East wing perimeter framing & sheathing	10 days	Mon 7/21/08	Fri 8/1/08																								
70	Frame upper level exterior wall Mech. Rm	20 days	Wed 7/30/08	Tue 8/26/08																								
71	East wing roofing	20 days	Mon 8/4/08	Fri 8/29/08																								
72	Install East wing entry metal panels	8 days	Tue 8/19/08	Thu 8/29/08																								
73	SEQ 1B low roofing	11 days	Tue 8/26/08	Tue 9/9/08																								
74	Penthouse roofing	8 days	Tue 8/26/08	Thu 9/4/08																								
75	Install Metal panels @ North wall Raquetball c	5 days	Wed 8/27/08	Tue 9/2/08																								
76	Install high roof SEQ 1 @ courts	16 days	Wed 8/27/08	Wed 9/17/08																								
77	Install metal panels North façade	11 days	Fri 8/29/08	Fri 9/12/08																								
78	Install windows East façade	8 days	Tue 9/2/08	Thu 9/11/08																								
79	Install Metal panels SEQ 1 courts	20 days	Wed 9/3/08	Tue 9/30/08																								
80	Install low roof @ raquetball court lobby	4 days	Wed 9/3/08	Mon 9/8/08																								
81	Install Metal panels SEQ 1B	30 days	Fri 9/12/08	Thu 10/23/08																								
82	Install East Wing entry curtain wall	25 days	Tue 9/16/08	Mon 10/20/08																								
83	Install curtain wall at North façade	10 days	Wed 9/24/08	Tue 10/7/08																								
84	New Gym roofing	20 days	Fri 9/26/08	Thu 10/23/08																								
85	Install windows SEQ 1B	16 days	Thu 10/9/08	Thu 10/30/08																								
86	<b>Building Water Tight</b>	<b>0 days</b>	<b>Thu 10/30/08</b>	<b>Thu 10/30/08</b>																								
87	<b>Mechanical &amp; Plumbing</b>	<b>185 days</b>	<b>Tue 3/25/08</b>	<b>Mon 12/8/08</b>																								
88	MEP roughn SEQ 3 upper level	75 days	Tue 3/25/08	Mon 7/7/08																								
89	Install new ductwork @ Cage Gym	25 days	Mon 4/7/08	Fri 5/9/08																								
90	MEP roughn SEQ 3 lower level	36 days	Mon 4/21/08	Mon 6/9/08																								
91	MEP roughn SEQ 1B	114 days	Tue 5/20/08	Fri 10/24/08																								
92	Install hangers in Mech. Rm	10 days	Fri 6/6/08	Thu 6/19/08																								
93	Install new ductwork @ Linn Gym	16 days	Mon 6/9/08	Mon 6/30/08																								
94	Set Mech. Tower	3 days	Fri 6/20/08	Tue 6/24/08																								
95	MEP roughn Mech. Rm	77 days	Fri 6/27/08	Mon 10/13/08																								
96	MEP roughn SEQ 2 Lower Level	41 days	Mon 7/21/08	Mon 9/15/08																								

Project: TECH 2 schedule.mpp  
Date: Fri 10/24/08

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

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## Appendix B – Superstructure Sequencing Site Plans



## Appendix C – Detailed Structural System Estimate

Appendix C – MC<sup>2</sup> Estimate Summary

# GMU PE Building Structural System Estimate Summary - Standard Construction Project

Detail - Without Taxes and Insurance indirect Costs are Spread

Group 1: Divisions

Estimator :  
Project Size : soft

ItemCode	Description	Quantity	UM	Lab.Unit	Lab.Total	Mat.Unit	Temp.Mat.Unit	Mat.Total	Eqp.Unit	Eqp.Rent.Unit	Eqp.Total	Sub Unit	Other Unit	Tot.UnitCost	TotalCost
<b>Sitework</b>															
02316.00	MACH EXCAV CONTINUOUS FTG	101.19	CUYD	6.6649	703.73				0.850		96.13			7.905	799.86
02316.02	FINE GRADE CONTINUOUS FTG	2,732.00	SQFT	0.4761	1,300.71									0.476	1,300.71
02316.10	MACH EXCAV COLUMN FTG	394.19	CUYD	6.6649	2,741.54				0.850		374.48			7.905	3,116.02
02316.12	FINE GRADE @ COLUMN FTG	3,063.60	SQFT	0.4761	1,487.07									0.476	1,487.07
	* Total Sitework				6,633.05						470.61				7,103.65
<b>Concrete</b>															
03110.620	COLJMN FOOTING EDGE FORMS	3,447.64	SQFT	4.4257	15,258.22	1.039		3,581.06						5.464	18,839.28
03110.701	FLOOR EDGE FORMS	2,181.20	LNFT	3.0729	6,702.61	0.851		1,357.07						3.924	8,559.68
03111.800		2,184.80	EACH												
03150.650	SCREEDS FOR SLAB	4,166.98	LNFT	0.9219	3,840.62	0.320		1,333.11						1.242	5,173.73
03150.650	SCREEDS FOR SLAB	4,791.72	LNFT	0.9219	4,417.49	0.320		1,533.35						1.242	5,950.84
03210.210	COLJMN FOOTING REBAR	7.41	CWT	31.7857	236.69	26.750		198.35						58.536	434.04
03220.010	6x6 W1.4W1.4 MESH	439.24	SQS	18.8940	8,285.84	8.200		3,301.78						27.064	11,887.62
03220.012	6x6 W2.9W2.9 MESH	381.88	SQS	23.1963	8,846.73	15.000		5,728.22						38.166	14,575.00
03310.150	**CCNC IN CONTINUOUS FOOTING**														
03310.151	3000 PSI DIRECT	101.19	CUYD	11.0090	1,113.95	55.000		5,585.19						68.009	6,679.13
03310.200	**CCNC IN COLUMN FOOTING**														
03310.201	3000 PSI DIRECT	248.40	CUYD	11.0090	2,734.61	55.000		13,361.86						68.009	16,366.46
03310.360	**CCNC IN SLAB ON GRADE**														
03310.361	3000 PSI DIRECT	536.75	CUYD	11.0090	5,898.05	55.000		29,486.17						68.009	35,384.22
03311.700	**CCNC IN SLAB OVER MTL DECK**														
03311.713	3500 PSI DIRECT	431.35	CUYD	14.6787	6,331.71	54.500		23,508.76						69.179	29,840.47
03315.971	* CONTINUOUS FOOTING LENGTH *	1,366.00	LNFT												
03315.972	* NO. OF COLUMN FOOTINGS *	78.00	EACH												
03315.978	* SOG AREA *	34,716.50	SQFT												
03315.981	* SLAB OVER METAL DECK AREA *	39,931.00	SQFT												
03350.30	MACHINE TROWEL FINISH	34,716.50	SQFT	0.3304	11,470.33									0.330	11,470.33
03350.30	MACHINE TROWEL FINISH	39,931.00	SQFT	0.3304	13,193.20									0.330	13,193.20
03390.010	PROTECT & CURE	34,716.50	SQFT	0.1102	3,825.73	0.019		396.66						0.129	4,492.32
03390.010	PROTECT & CURE	39,931.00	SQFT	0.1102	4,400.40	0.019		798.68						0.129	5,197.07
	* Total Concrete				96,555.25			91,468.15							188,023.40
<b>Metals</b>															
06129.101	STEEL BEAMS		****												
06129.101	STEEL BEAMS		****												
06129.102	I BEAMS	4,029.49	CWT	28.7300	116,767.33	35.000		141,332.25	5.000		20,147.46			68.730	276,947.05
06129.102	I BEAMS	1,108.34	CWT	28.7300	31,765.05	35.000		38,721.78	5.000		5,531.88			68.730	78,038.51
06129.103	CHANNELS	15.91	CWT	28.7300	457.13	35.000		556.96	8.000		127.30			71.730	1,141.44
06129.121	STEEL COLUMNS		****												
06129.122	I SHAPES	1,248.50	CWT	28.7300	35,812.00	35.000		43,327.57	5.000		6,232.51			68.730	85,672.08
06129.181	BRACING		****												
06129.182	I BEAMS	253.82	CWT	38.3067	9,722.82	35.000		8,383.63	5.000		1,269.08			78.307	19,675.42
06129.990	* STRUCTURAL STEEL WEIGHT *	284.80	TONS												
06129.990	* STRUCTURAL STEEL WEIGHT *	68.01	TONS												
06310.018	2" METAL DECK	39,931.00	SQFT	0.4445	17,749.33	0.870		34,755.94						1.315	82,503.27
06310.052	1-1/2X20 GA MTL DECK GALV	32,086.00	SQFT	0.4134	13,264.35	0.806		25,374.15						1.220	39,138.50
06310.056	3X20 GAMTL DECK GALV	14,437.50	SQFT	0.4445	6,417.47	1.126		16,262.40						1.571	22,679.87
	* Total Metals				230,975.53			309,714.57			33,308.04				573,996.14
<b>Thermal and moisture protection</b>															
07310.031	CEMENTIOUS FIREPROOFING	33,283.25	BDFT	44.8086	1,490,413.23	0.448		14,301.94	0.080		2,861.06			45.335	1,507,678.23
07310.031	CEMENTIOUS FIREPROOFING	7,283.32	BDFT	44.8086	328,340.74	0.448		3,282.93	0.080		582.67			45.335	330,186.33
	* Total Thermal and moisture protection				1,816,753.97			18,164.86			3,243.73				1,838,162.56
	Total Estimate				2,150,917.80			419,347.59			37,022.37				2,607,287.76

Appendix C – Quantity Takeoffs

<b>Column Takeoff</b>					
Size	Weight (plf)	Height (ft)	Quantity	lbs of Steel	Tons
W10X33	33	26	20	17160	8.58
W10X33	33	12	4	1584	0.792
W10X39	39	26	6	6084	3.042
W10X39	39	12	1	468	0.234
W10X45	45	26	12	14040	7.02
W10X49	49	26	4	5096	2.548
W12X45	45	35	2	3150	1.575
W12X53	53	12	2	1272	0.636
W12X53	53	14	4	2968	1.484
W12X53	53	26	2	2756	1.378
W12X65	65	35	4	9100	4.55
W12X65	65	26	6	10140	5.07
W14X90	90	35	12	37800	18.9
W8X48	48	14	5	3360	1.68
HSS6X6X3/8	27.48	35	9	8656.2	4.3281
HSS6X6X3/8	27.48	26	1	714.48	0.35724
HSS6X6X3/8	27.48	12	1	329.76	0.16488
<b>TOTAL</b>				<b>124678.44</b>	<b>62.33922</b>

<b>Slab on Grade Takeoff</b>				
Concrete thickness (in)	Concrete (SF)	Concrete (CF)	Concrete (CY)	Reinforcing (WWF)
5	34716.5	14465.2	535.7	6x6 W2.9xW2.9
6	4140	2070	76.7	6x6 W4xW4

<b>Elevated Slabs on Metal Decking Takeoff</b>				
Concrete Thickness (in)	Concrete (SF)	Concrete (CF)	Concrete (CY)	Reinforcing (WWF)
4.5	39,931	14,974	554.6	6x6 W1.4xW1.4

### Concrete Column Footings Takeoff

Size	Thickness	Quantity	Concrete (SF)	Concrete (CF)	Concrete (CY)	Rebar Qty.	Rebar size	Rebar Dia. (in.)	Rebar Wt. (plf)
10'X10'	24"	1	100	200	7.4	44	#7	0.875	2.044
10'X11'	24"	1	110	220	8.1	46	#7	0.875	2.044
10'X12'	24"	1	120	240	8.9	24	#7	0.875	2.044
10'X20.66'	24"	1	206.6	413.2	15.3	70	#7	0.875	2.044
15'X13'	24"	1	195	390	14.4	60	#8	1	2.67
16'X15'	24"	1	240	480	17.8	66	#8	1	2.67
2'X4'	12"	1	8	8	0.3	8	#5	0.625	1.043
3'X7'	12"	1	21	21	0.8	12	#5	0.625	1.043
4'X4'	12"	4	16	64	2.4	48	#5	0.625	1.043
5'X5'	14"	1	25	29.2	1.1	16	#5	0.625	1.043
5'X5'	18"	17	25	637.5	23.6	272	#5	0.625	1.043
5'X5'	12"	4	25	100	3.7	64	#5	0.625	1.043
6'X11'	12"	1	66	66	2.4	20	#5	0.625	1.043
6'X6'	14"	1	36	42	1.6	16	#5	0.625	1.043
6'X6'	18"	3	36	162	6.0	48	#5	0.625	1.043
6'X6'	24"	2	36	144	5.3	48	#5	0.625	1.043
6'X6'	30"	2	36	180	6.7	64	#5	0.625	1.043
7'X7'	32"	2	49	261.3	9.7	32	#6	0.75	1.502
7'X7'	18"	18	49	1323	49.0	288	#6	0.75	1.502
7'X7'	24"	2	49	196	7.3	64	#6	0.75	1.502
8'X8'	18"	4	64	384	14.2	72	#6	0.75	1.502
8'X8'	24"	1	64	128	4.7	36	#6	0.75	1.502
8'X8'	18"	3	64	96	3.6	36	#5	0.625	1.043
9'X9'	24"	3	81	486	18.0	120	#6	0.75	1.502
9'X9'	18"	2	81	243	9.0	40	#6	0.75	1.502

### Roof Decking Takeoff

Deck Depth (in)	Gauge	Area (SF)
1.5	20	32,086
3	18	14,437.5

### Floor Decking Takeoff

Deck Depth (in)	Gauge	Area (SF)
2	18	39,931

<b>Steel Beam Takeoff</b>		
Size	Length (ft)	Quantity
C12x20.7	8	3
C12x20.7	10	4
C6x8.2	6	4
C6x8.2	8.5	1
HSS 12x12x1/2	26.25	8
HSS 12x12x1/2	27.5	5
HSS 12x12x1/2	24	13
HSS 12x12x1/2	32.17	1
HSS5x5x3/8	17.5	6
HSS6x6x3/8	8.5	1
W12x14	26.75	2
W12x16	6	16
W12x16	15	4
W12x16	8	8
W12x16	13	3
W12x16	7.5	30
W12x16	10	23
W12x16	16	2
W12x16	22	16
W12x16	5	16
W12x16	9	7
W12x16	14	1
W12x16	2	3
W12x16	18.5	1
W12x16	21	8
W12x16	23	11
W12x16	24	2
W12x16	12	3
W12x16	17	2
W12x16	25	1
W12x16	20	2
W12x16	11	7
W12x19	18	8
W12x19	22	8
W12x19	21	4
W12x19	20	3
W12x19	19	5
W12x19	17	4
W12x22	9	1
W12x22	21	1
W12x26	7.5	5
W12x26	16	4
W12x26	17	5

W12x26	32.83	1
W12x26	8.5	10
W12x26	18.5	3
W12x26	20	2
W12x26	30	1
W12x26	25.66	5
W12x26	4	23
W12x26	5	3
W12x26	10	3
W12x26	21	1
W12x26	22.5	2
W12x26	12	2
W12x26	28.33	1
W12x26	14.33	1
W12x26	11	1
W12x40	27.5	1
W12x40	26.25	2
W14x22	21	5
W14x22	19	3
W14x22	20	5
W14x22	22	5
W14x22	18	3
W14x22	23	11
W14x22	8	1
W14x22	25	2
W14x22	26.33	4
W14x22	24	3
W14x22	13.5	1
W14x22	17	1
W14x43	6	1
W16x26	22	6
W16x26	20	7
W16x26	16	1
W16x26	7	2
W16x26	4	10
W16x26	10	1
W16x26	25.6	1
W16x31	20	9
W16x31	10	2
W16x31	16	3
W16x31	24	4
W16x31	25.25	2
W16x31	22.83	6
W16x31	22	9
W16x31	21	2
W16x31	32	3
W16x31	6	2

W16x31	28	3
W16x31	18	3
W16x31	26	8
W16x31	23	3
W16x31	15	2
W16x36	24	2
W16x36	22.25	2
W16x36	26.75	1
W16x36	21	1
W16x36	20	1
W16x40	26.75	1
W16x45	22.83	1
W18x35	30	3
W18x35	28.58	5
W18x35	25.75	8
W18x35	32.83	104
W18x35	6	5
W18x35	23	2
W18x35	35.33	13
W18x35	17.5	3
W18x35	10	2
W18x35	21	1
W18x35	20	1
W18x35	16.33	1
W18x35	27.17	1
W18x35	12.75	1
W18x35	20.25	1
W18x40	21	1
W18x40	32	1
W18x40	32.83	2
W18x40	25.66	1
W18x40	5.5	1
W18x40	22	2
W18x40	23	1
W18x50	32.83	4
W18x77	24	1
W21x44	27.5	7
W21x44	30	5
W21x44	25.75	1
W21x44	16	1
W21x44	28.58	4
W21x44	34.25	1
W21x44	29.83	2
W21x44	32.83	8
W21x44	35	1
W21x44	6	2
W21x44	20	1

W21x50	27.5	3
W21x50	25.75	2
W21x50	32.83	1
W21x57	32.83	1
W21x62	24	1
W21x68	24	1
W21x73	26	1
W24x55	30.66	7
W24x55	28.58	1
W24x55	26.83	1
W24x55	8.5	1
W24x55	32.17	2
W24x55	32.83	1
W24x55	29.83	1
W24x55	35	1
W24x55	38.75	1
W24x62	25.25	2
W24x62	34.25	1
W24x62	29.83	1
W24x62	30.66	2
W24x62	27.5	10
W24x68	30.66	1
W24x68	35	1
W24x68	38.75	2
W24x68	32.17	1
W24x76	36	1
W24x84	36	1
W24x84	40	1
W8x10	10	1
W8x24	10	1
W8x31	6	2
W8x58	12	1
HSS8x8x3/8	25.25	3
HSS8x8x3/8	27.5	6
HSS6x6x3/8	30	4
HSS6x6x3/8	35	4
HSS6x6x3/8	24.33	4
HSS6x6x3/8	32.83	4
HSS6x6x3/8	26.83	4

## Appendix D – General Conditions Estimate

Appendix D – General Conditions Estimate

<b>General Conditions Estimate</b>					
<b>Description</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Cost</b>	<b>Subtotal</b>	<b>Total</b>
<b>Jobsite Management</b>					
Project Director	104	Weeks	5114.58	\$531,916.32	
<b>Field Personnel</b>					
Project Manager	104	Weeks	2175	\$226,200.00	
Field Engineer	104	Weeks	1350	\$140,400.00	
Cost Engineer	104	Weeks	1350	\$140,400.00	
Superintendent	83	Weeks	2025	\$168,075.00	
<b>Project Controls</b>					
Document Control	100	Weeks	1882.17	\$188,217.00	
Safety	83	Weeks	2452.17	\$203,530.11	
QA/QC	75	Weeks	3075.86	\$230,689.50	
<b>SUBTOTAL Management</b>					<b>\$1,829,427.93</b>
<b>SITE REQUIREMENTS</b>					
<b>Jobsite Office</b>					
Office Trailers (50'x12')	8	Months	416	\$3,328.00	
Office Equipment	18	Months	155	\$2,790.00	
Office Supplies	18	Months	85	\$1,530.00	
Telephone Bill	18	Months	80	\$1,440.00	
High Speed Data Setup	1	LS	2600	\$2,600.00	
High Speed Data Monthly	18	Months	200	\$3,600.00	
Lights & HVAC	18	Months	150	\$2,700.00	
<b>Site</b>					
Port-a-Johns	3	Ea.	171	\$513.00	
Toilets, Trailer	2	Ea.	355	\$710.00	
Dumpsters (2) 40 C.Y. capacity	83	Weeks	1300	\$215,800.00	
<b>Vehicles/Travel</b>					
Pickup Trucks 4x4 (4)	24	Months	645	\$61,920.00	
Fuel, Trucks	104	Weeks	800	\$83,200.00	
<b>Temporary Services</b>					
Temporary Lighting	66926	CSF	27.7	\$1,853,850.20	
Temporary Power (18 months)	66926	CSF	0.75	\$903,501.00	
<b>SUBTOTAL Site Requirements</b>					<b>\$3,137,482.20</b>
<b>TOTAL ESTIMATE</b>					<b>\$4,966,910.13</b>



Appendix D – RS Means Data Sheets

## 01 21 Allowances

### 01 21 61 – Cost Indexes

01 21 61.50 Material Index		Daily Labor-Crew	Output	Hours	Unit	Material	2009 Bare Costs Labor	Equipment	Total	Total Incl O&P
0010	<b>MATERIAL INDEX</b> (Reference) For over 930 zip code locations in									
0020	the U.S. and Canada, minimum (Elizabethtown, KY)				%	90.10%				
0040	Average				↓	100%				
0060	Maximum (Ketchikan, AK)				↓	139.60%				

### 01 21 63 – Taxes

#### 01 21 63.10 Taxes

01 21 63.10 Taxes										
0010	<b>TAXES</b>	R012909-80								
0020	Sales tax, State, average				%	4.91%				
0050	Maximum	R012909-85				7.25%				
0200	Social Security, on first \$102,000 of wages						7.65%			
0300	Unemployment, combined Federal and State, minimum						.80%			
0350	Average						6.20%			
0400	Maximum				↓		11.74%			

## 01 31 Project Management and Coordination

### 01 31 13 – Project Coordination

#### 01 31 13.20 Field Personnel

01 31 13.20 Field Personnel										
0010	<b>FIELD PERSONNEL</b>									
0020	Clerk, average				Week	360			380	590
0100	Field engineer, minimum					895			895	1,375
0120	Average					1,165			1,165	1,800
0140	Maximum					1,350			1,350	2,100
0160	General purpose laborer, average					1,250			1,250	1,925
0180	Project manager, minimum					1,650			1,650	2,550
0200	Average					1,925			1,925	2,975
0220	Maximum					2,175			2,175	3,375
0240	Superintendent, minimum					1,600			1,600	2,475
0260	Average					1,775			1,775	2,750
0280	Maximum					2,025			2,025	3,125
0290	Timekeeper, average					1,040			1,040	1,600

#### 01 31 13.30 Insurance

01 31 13.30 Insurance										
0010	<b>INSURANCE</b>	R013113-40								
0020	Buildings risk, standard, minimum				Job					.24%
0050	Maximum	R013113-50								.64%
0200	All-risk type, minimum									.25%
0250	Maximum	R013113-60								.62%
0400	Contractor's equipment floater, minimum				Value					.50%
0450	Maximum				"					1.50%
0600	Public liability, average				Job					2.02%
0800	Workers' compensation & employer's liability, average									
0850	by trade, carpentry, general				Payroll	17.80%				
0900	Clerical					.58%				
0950	Concrete					14.58%				
1000	Electrical					6.46%				
1050	Excavation					10.01%				
1100	Glazing					13.89%				
1150	Insulation					14.44%				
1200	Lathing					10.63%				

# 01 52 Construction Facilities

## 01 52 13 – Field Offices and Sheds

01 52 13.20 Office and Storage Space		Daily Crew	Labor- Output	Hours	Unit	Material	2009 Labor	Bare Costs Equipment	Total	Total Incl O&P
0010	<b>OFFICE AND STORAGE SPACE</b>									
0020	Trailer, furnished, no hookups, 20' x 8', buy	2 Skwk	1	16	Ea.	8,200	655		8,855	10,000
0250	Rent per month					163			163	179
0300	32' x 8', buy	2 Skwk	.70	22.857		12,200	935		13,135	15,000
0350	Rent per month					200			200	220
0400	50' x 10', buy	2 Skwk	.60	26.667		23,200	1,100		24,300	27,300
0450	Rent per month	2 Skwk	.50	32		27,900	1,300		29,200	32,700
0550	Rent per month					375			375	410
0700	For air conditioning, rent per month, add					41			41	45
0800	For delivery, add per mile				Mile	4.50			4.50	4.95
1000	Portable buildings, prefab, on skids, economy, 8' x 8'	2 Corp	265	.060	S.F.	85	2.41		87.41	97
1100	Deluxe, 8' x 12'	"	150	.107	"	95	4.26		99.26	112
1200	Storage boxes, 20' x 8', buy	2 Skwk	1.80	8.889	Ea.	4,675	365		5,040	5,700
1250	Rent per month					72			72	79
1300	40' x 8', buy	2 Skwk	1.40	11.429		6,400	465		6,865	7,775
1350	Rent per month					99			99	109
5000	Air supported structures, see Div. 13 31 13.13									

## 01 52 13.40 Field Office Expense

01 52 13.40 FIELD OFFICE EXPENSE										
0010	<b>FIELD OFFICE EXPENSE</b>									
0100	Office equipment rental average				Month	155			155	171
0120	Office supplies, average				"	85			85	93.50
0125	Office trailer rental, see Div. 01 52 13.20									
0140	Telephone bill, avg. bill/month incl. long dist.				Month	80			80	88
0160	Lights & HVAC				"	150			150	165

# 01 54 Construction Aids

## 01 54 09 – Protection Equipment

### 01 54 09.50 Personnel Protective Equipment

01 54 09.50 PERSONNEL PROTECTIVE EQUIPMENT										
0010	<b>PERSONNEL PROTECTIVE EQUIPMENT</b>									
0015	Hazardous waste protection									
0020	Respirator mask only, full face, silicone				Ea.	223			223	245
0030	Half face, silicone					33			33	36.50
0040	Respirator cartridges, 2 req'd/mask, dust or asbestos					5.30			5.30	5.85
0050	Chemical vapor					4.69			4.69	5.15
0060	Combination vapor and dust					9.70			9.70	10.65
0100	Emergency escape breathing apparatus, 5 min					465			465	510
0110	10 min					500			500	550
0150	Self contained breathing apparatus with full face piece, 30 min					1,750			1,750	1,925
0160	60 min					2,925			2,925	3,225
0200	Encapsulating suits, limited use, level A					905			905	995
0210	Level B					270			270	297
0300	Over boots, latex				Pt.	6.35			6.35	7
0310	PVC					21.50			21.50	24
0320	Neoprene					41.50			41.50	46
0400	Gloves, nitrile/PVC					21			21	23.50
0410	Neoprene coated					24			24	26.50

### 01 54 09.60 Safety Nets

01 54 09.60 SAFETY NETS										
0010	<b>SAFETY NETS</b>									
0020	No supports, stock sizes, nylon, 4" mesh				S.F.	1.10			1.10	1.21

# 01 54 | Construction Aids

01 54 33   Equipment Rental		UNIT	HOURLY OPER. COST	RENT PER DAY	RENT PER WEEK	RENT PER MONTH	EQUIPMENT COST/DAY
40	5700 Salamanders, L.P. gas fired, 100,000 BTU	Ea.	4.56	15.35	46	138	45.70
	5705 50,000 BTU		3.40	8.65	26	78	32.40
	5720 Sandblaster, portable, open top, 3 C.F. capacity		.55	27	81	243	20.60
	5730 6 C.F. capacity		.85	40	120	360	30.80
	5740 Accessories for above		.12	19.65	59	177	12.75
	5750 Sander, floor		.81	18.65	56	168	17.70
	5760 Edger		.75	25.50	77	231	21.40
	5800 Saw, chain, gas engine, 18" long		1.90	17.65	53	159	25.80
	5900 Hydraulic powered, 36" long		.60	55	165	495	37.80
	5950 60" long		.65	56.50	170	510	39.20
	6000 Masonry, table mounted, 14" diameter, 5 H.P.		1.25	53	159	475	41.80
	6050 Portable cut-off, 8 H.P.		2.05	28	84	252	33.20
	6100 Circular, hand held, electric, 7-1/4" diameter		.19	4	12	36	3.90
	6200 12" diameter		.26	7.35	22	66	6.50
	6250 Wall saw, w/hydraulic power, 10 H.P.		7.50	60	180	540	96
	6275 Shot blaster, walk behind, 20" wide		4.60	300	905	2,725	217.80
	6280 Sidewalk broom, walk-behind		2.31	57	171	515	52.70
	6300 Steam cleaner, 100 gallons per hour		2.90	46.50	140	420	51.20
	6310 200 gallons per hour		4.15	55	165	495	66.20
	6340 Tar Kettle/Pot, 400 gallon		6.15	80	240	720	97.20
	6350 Torch, cutting, acetylene-oxygen, 150' hose		.50	21.50	65	195	17
	6360 Hourly operating cost includes tips and gas		9.45				75.60
	6410 Toilet, portable chemical		.11	19	57	171	12.30
	6420 Recycle flush type		.14	23	69	207	14.90
	6430 Toilet, fresh water flush, garden hose,		.16	26.50	79	237	17.10
	6440 Hoisted, non-flush, for high rise		.14	22.50	68	204	14.70
	6450 Toilet, trailers, minimum		.24	39.50	118	355	25.50
	6460 Maximum		.72	119	358	1,075	77.35
	6465 Tractor, farm with attachment		14.40	262	785	2,350	272.20
	6500 Trailers, platform, flush deck, 2 axle, 25 ton capacity		4.75	107	320	960	102
	6600 40 ton capacity		6.20	150	450	1,350	139.60
	6700 3 axle, 50 ton capacity		6.70	165	495	1,475	152.60
	6800 75 ton capacity		8.35	218	655	1,975	197.80
	6810 Trailer mounted cable reel for H.V. line work		4.84	231	692	2,075	177.10
	6820 Trailer mounted cable tensioning rig		9.59	455	1,370	4,100	350.70
	6830 Cable pulling rig		69.62	2,575	7,710	23,100	2,099
	6900 Water tank, engine driven discharge, 5000 gallons		6.25	143	430	1,300	136
	6925 10,000 gallons		8.50	202	605	1,825	189
	6950 Water truck, off highway, 6000 gallons		66.95	775	2,320	6,950	999.60
	7010 Tram car for H.V. line work, powered, 2 conductor		6.48	125	375	1,125	126.85
	7020 Transt (builder's level) with tripod		.08	14	42	126	9.06
	7030 Trench box, 3000 lbs. 6'x8'		.56	93	279	835	60.30
	7040 7200 lbs. 6'x20'		1.05	175	525	1,575	113.40
	7050 8000 lbs., 8' x 16'		.95	158	475	1,425	102.60
	7060 9500 lbs., 8'x20'		1.16	194	581	1,750	125.50
	7065 11,000 lbs., 8'x24'		1.27	212	637	1,900	137.55
	7070 12,000 lbs., 10' x 20'		1.71	285	855	2,575	184.70
	7100 Truck, pickup, 3/4 ton, 2 wheel drive		10.35	56.50	170	510	116.80
	7200 4 wheel drive		10.65	71.50	215	645	128.20
	7250 Crew carrier, 9 passenger		14.70	86.50	260	780	169.60
	7290 Flat bed truck, 20,000 G.V.W.		15.55	122	365	1,100	197.40
	7300 Tractor, 4 x 2, 220 H.P.		21.80	190	570	1,700	288.40
	7410 330 H.P.		32.15	262	785	2,350	414.28
	7500 6 x 4, 380 H.P.		36.85	305	920	2,750	478.80
	7600 450 H.P.		44.90	370	1,110	3,325	585.20
	7620 Vacuum truck, hazardous material, 2500 gallon		10.80	310	925	2,775	371.40
	7625 5,000 gallon		16.90	435	1,300	3,900	555.20
	7640 Tractor, with A frame, boom and winch, 225 H.P.		24.35	267	800	2,400	364.80

# 02 41 Demolition

## 02 41 19 - Selective Structure Demolition

02 41 19.19 Selective Demolition, Dump Charges		Daily Crew	Output	Labor-hours	Unit	Material	2009 Bare Costs Labor	Equipment	Total	Total Incl C&P
0010	<b>SELECTIVE DEMOLITION, DUMP CHARGES</b>									
0020	Dump charges, typical urban city, tipping fees only									
0100	Building construction materials				Ton	100			100	110
0200	Trees, brush, lumber					75			75	82.50
0300	Rubbish only					90			90	99
0500	Reclamation station, usual charge					100			100	110

## 02 41 19.21 Selective Demolition, Gutting

02 41 19.21 Selective Demolition, Gutting		Daily Crew	Output	Labor-hours	Unit	Material	2009 Bare Costs Labor	Equipment	Total	Total Incl C&P
0010	<b>SELECTIVE DEMOLITION, GUTTING</b>									
0020	Building interior, including disposal, dumpster fees not included									
0500	Residential building									
0560	Minimum	B-16	400	.080	SF Fl.		2.58	1.33	3.91	5.45
0580	Maximum	"	360	.089	"		2.86	1.48	4.34	6.05
0900	Commercial building									
1000	Minimum	B-16	350	.091	SF Fl.		2.94	1.52	4.46	6.25
1020	Maximum	"	250	.128	"		4.12	2.13	6.25	8.75

## 02 41 19.23 Selective Demolition, Rubbish Handling

02 41 19.23 Selective Demolition, Rubbish Handling		Daily Crew	Output	Labor-hours	Unit	Material	2009 Bare Costs Labor	Equipment	Total	Total Incl C&P
0010	<b>SELECTIVE DEMOLITION, RUBBISH HANDLING</b>									
0020	The following are to be added to the demolition prices									
0400	Chute, circular, prefabricated steel, 18" diameter	B-1	40	.600	L.F.	47	19.35		66.35	82
0440	30" diameter	"	30	.800	"	48.50	26		74.50	96.50
0775	Dumpster, weekly rental, 1 dump/week, 20 C.Y. capacity (8 Tons)				Week	775			775	852.50
0800	30 C.Y. capacity (10 Tons)					1,000			1,000	1,100
0840	40 C.Y. capacity (13 Tons)					1,300			1,300	1,430
1000	Dust partition, 6 mil polyethylene, 1" x 3" frame	2 Cap	2000	.008	S.F.	.44	.32		.76	.99
1080	2" x 4" frame	"	2000	.008	"	.27	.32		.59	.80
2000	Load, haul, and dump 50' haul	2 Clab	24	.667	C.Y.		21		21	32.50
2040	100' haul		16.50	.970			30.50		30.50	47.50
2080	Over 100' haul, add per 100 L.F.		35.50	.451			14.25		14.25	22
2120	In elevators, per 10 floors, add		140	.114			3.61		3.61	5.60
3000	Loading & trucking, including 2 mile haul, chute loaded	B-16	45	.711			23	11.85	34.85	48.50
3040	Hand loading truck, 50' haul	"	48	.667			21.50	11.10	32.60	45
3080	Machine loading truck	B-17	120	.267			8.95	5.15	14.10	19.40
5000	Haul, per mile, up to 8 C.Y. truck	B-343	1165	.007			.22	.46	.68	.84
5100	Over 8 C.Y. truck	"	1550	.005			.16	.34	.50	.63

## 02 41 19.25 Selective Demolition, Saw Cutting

02 41 19.25 Selective Demolition, Saw Cutting		Daily Crew	Output	Labor-hours	Unit	Material	2009 Bare Costs Labor	Equipment	Total	Total Incl C&P
0010	<b>SELECTIVE DEMOLITION, SAW CUTTING</b>									
0015	Asphalt, up to 3" deep	B-85	1050	.015	L.F.	.40	.53	.38	1.31	1.67
0020	Each additional inch of depth	"	1800	.009		.08	.31	.22	.61	.81
1200	Masonry walls, hydraulic saw, brick, per inch of depth	B-898	300	.053		.42	1.87	2.28	4.57	5.80
1220	Block walls, solid, per inch of depth	"	250	.064		.42	2.24	2.74	5.40	6.85
2000	Brick or masonry w/hand held saw, per inch of depth	A-1	175	.064		.34	2.02	.51	2.87	4.07
5000	Wood sheathing to 1" thick, on walls	1 Carp	200	.040			1.60		1.50	2.48
5020	On roof	"	250	.032			1.28		1.28	1.98

## 02 41 19.27 Selective Demolition, Torch Cutting

02 41 19.27 Selective Demolition, Torch Cutting		Daily Crew	Output	Labor-hours	Unit	Material	2009 Bare Costs Labor	Equipment	Total	Total Incl C&P
0010	<b>SELECTIVE DEMOLITION, TORCH CUTTING</b>									
0020	Steel, 1" thick plate	1 Clab	360	.022	L.F.	.22	.70		.92	1.33
0040	1" diameter bar	"	210	.038	Eq.		1.20		1.20	1.87
1000	Oxygen lance cutting, reinforced concrete walls									
1040	12" to 16" thick walls	1 Clab	10	.600	L.F.		25.50		25.50	39
1080	24" thick walls	"	6	1.333	"		42		42	65.50

