2010

WESTINGHOUSE BUILDING 4

TECHNICAL ASSIGNMENT 2

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Technical Assignment Two

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Executive Summary

Technical Assignment Two is intended to expand upon some of the logistic and project planning aspects of the Westinghouse Building 4 project. A detailed project schedule for the site will look into and explain this projects individual phases and processes. A site plan laying out the logistics of the excavation phase of the project will be explored in detail along with a thorough investigation into the costs of the structural system of the building. Finally, a general conditions estimate that is unique to this particular project will be produced and explained.

A key finding in the project schedule is that it is laid out in such a way that the subcontractors can start working on new sections of the building while another part of their team finishes the last part. This schedule feature allows the project to progress faster and keeps work going in different parts of the building simultaneously. This method of scheduling also leaves room subcontractor delays. If a portion of the building is delayed the full subcontractor team can continue working on the current part of the building and then move on all together when the next portion is ready. The site layout plan for Building 4 is very simple and generic. The building is being building built in a very rural part of Pennsylvania so it has few site logistics abnormalities. One key feature of this site plan is its openness. Having a large parking lot at their disposal at all times makes it very easy for Turner Construction to run a well-organized site during all phases. The detailed structural estimate revealed that there are 2,772 cubic yards of concrete and 443 tons of structural steel supporting the new building. A cost analysis revealed very similar findings between the structural costs found while conducting the RS Means square footage estimate and conducting and RS Means Costs works analysis. The general conditions estimate was just a little lower than most building coming in at 7.3% of the overall cost of the project. This is due to the low cost of the personal needed on site at any one time because of the small project size. It was also found in this section that the insurance and bonds portion of the project was abnormally high in terms of its overall percentage of the estimate.

Detailed Project Schedule

**See Appendix A for the detailed project schedule*

Turner Construction employed a unique construction schedule technique when constructing the Westinghouse Building 4 project. The building schedule is broken down into several sections that break out the schedule by both floor and discipline. This method of breaking down the schedule made it very easy to identify where in the building contractors would be spending their time considering the unique method of phasing that was employed. Since the building is only three floors, the construction team was able to use a method of phasing that allowed them to be working on multiple floors simultaneously. For example, while the electrical work is being finished up on the 2nd floor the electrical contractor is scheduled to begin the 3rd floor wiring. This was an effective method of phasing on this project because it allowed work to move forward at a quicker pace.

Sequencing the structure of the building was a simple and straightforward process. The steel and metal decking were constructed at the same time and less than a month later the interior metal framing began. Again, the building height and simplicity made this possible because the whole steel erection process only lasted 3 weeks. During these three weeks while the steel was still being erected, the first concrete of the slab on grade was poured. The pouring of the slabs on deck started the same day that the last of the steel decking was placed. The rush on the slab on grade was necessary so that the workers would have a solid ground floor to walk around on and a place to store equipment and materials.

The electrical system of the building is an excellent example of how the MEP systems were broken down into the rough-in, distribution, and finishing stages. The electrical rough-in process started just 3 days before the first wiring was placed in the building. Once the wiring was completed, a three month electrical break occurred before the lighting was connected. This 3 month period is meant to give the other mechanical contractors time to finish their above ceiling work before the suspended ceiling tile was installed and the ceilings were ready for the lights. Balancing the system is the final step of the MEP process. There is a grace period of several months left before this stage to ensure that all building construction is completed and ready for a fair evaluation. Looking at the other mechanical systems reveals a similar timing and delivery method as was used for the electrical system.

There were no real timing constraints on the project that added difficulty to the schedule. The building does not block the flow of traffic on any major roads nor did it have any specific events that it had to be ready for. However, keeping top this schedule was very important to the customer who is renting office space in other buildings until this one is completed. Westinghouse building 4 was completed on time and actually received its certificate of occupancy 3 months ahead of schedule.

Site Layout Planning

See Appendix B for site layout plan

When analyzing the site layout planning for this project there are several key elements that should be pointed out. Westinghouse Building 4 has a unique and valuable site for this project. Being a smaller project in a non-congested area, the building's workers were able to utilize the surrounding parking lots and space directly adjacent to the building. Shown on the site plan as the only major building sharing the site, Westinghouse Building 3 is owned by the same company and is thus more than happy to help out the project team and be accommodating in any way they can. Contractors on the job are allowed to park and store extra building materials outside the actual project property line which allows for less on site congestion.

The site plan shown was developed for the excavation and early steel erection phases of the project. A sloped cutback at the west side of the site allows for excavators and large equipment to enter the building footprint during excavation. Being the this excavation is only extending an average of 6 feet down this sloped cutback is all that is required and no additional equipment ramps are required. The 200 ton crawler crane that will be on site has an entire side of the building to itself to move back and forth along the building throughout construction. Any deliveries to the site will utilize the back entrance on the west side of the site and circle around the south of the building to drop their loads. This feature allows the north road of the site to be used only for dump trucks and concrete trucks to minimize traffic congestion around the site. Also, the site dumpsters and wood chipping area sit right next to the road to minimize the amount of site dump trucks have to traverse during trash removal.

All of the trailers and temporary toilet facilities sit onside the construction fence in the neighboring Westinghouse parking lot. This site features allows for enough space so that workers do not have to yell over the sounds of construction during meetings and close enough that walking to and from the bathroom is not a problem.

The temporary site power is a unique feature to the Westinghouse Building 4 project. Having just completed the first 3 buildings, Westinghouse was already planning for the fourth building to begin construction. The power supply shed on the site that feeds the main 3 buildings was constructed with the power hook ups for the fourth building. This made it very easy for the construction team to tap into the grid power to quickly set up the temporary power supply. This feature was also handy in the later stages of construction when the temporary power lines on the site were just simply converted to permanent ones.

Detailed Structural Systems Estimate

See Appendix C for detailed structural systems take off and cost

Westinghouse Building 4 utilizes a simple concrete spread footing substructure with a steel frame superstructure. Sixty footings total distribute the load from the floors above to the ground below. Table 1 below shows the total amount of material with the building. These quantities along with, which entity they came from allowed for the detailed structural systems cost to be done using RS Means Cost Works. To obtain these numbers a waste factor of 5% was used for the concrete and a waste factor of 10% was used for the formwork. All of the structural steel pieces would be cut via the shop drawings and no waste factor was applied.

Material Totals		
System	Units	Total
CIP	CY	2772
Structural Steel	tons	442.812
Rebar	tons	30
Formwork	LF	9209

Table 1: shows the total amount of the various structural materials required for Westinghouse Building 4

Table 2 shows the comparison between the estimated structure costs using the RS Means square footage estimate conducted in tech report 1 and the system costs using the RS Means Cost Works program. When looking at the results it is easy to see that the CIP estimate differs greatly. This anomaly occurs because the RS Means Square Footage Estimate only accounts for the concrete in the slab on grade. This leaves out a significant amount of concrete that lies in the building's footing, piers, and foundation walls. Had this extra concrete been accounted for it would be expected that the estimates would be much closer. The Structural Steel estimate however, is extremely similar in the two cases, only differing by 3 cents per square foot.

Structural System Cost				
	RS Means SF Estimate (Tech 1) Values		Cost Works Estimate	
System	Total	$/SF	Total	$/SF
CIP	$755,540.00	$6.24	$1,345,477.00	$11.12
Structural Steel	$1,686,787.00	$13.94	$1,682,598.00	$13.91

Table 2: shows a comparison between the structural system estimate conducted for tech report 1 and the estimate using RS Means Cost Works.

The structural steel in Building 4 is laid out in 7 different patterns. The system is very simple in general because this system is the same in is the same in all floor systems. Figure 1 shows the layout of the bays in a single floors and shows how the bays repeat themselves quite frequently. This repetition of bay and floor structural systems is a common feature of office buildings and buildings with congruent space uses on each floor. The building itself is symmetrical about its axis so it only make sense that its structural system would follow suite. It should be noted that the number 7 bays house the elevators and the number 5 bays house the vertical stairwells and mechanical runs.

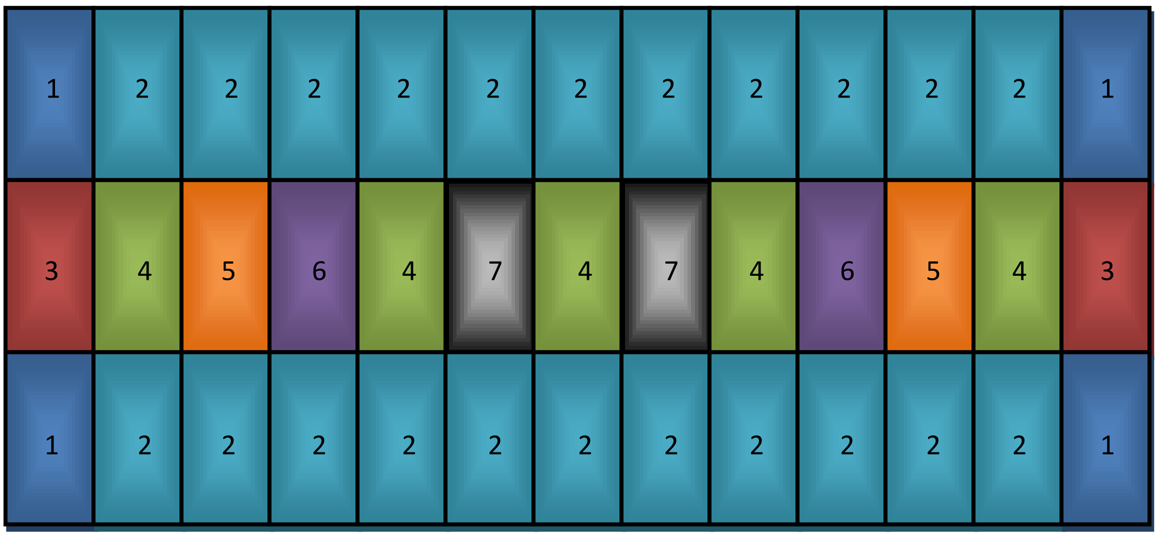


Figure 1: Shows the labeling of the bays within Westinghouse Building 4. Repeating numbers represent identical bays.

When conducting the structural systems estimate using RS Means Cost Works the program assumes a value for equipment and Labor. This program also automatically assigns an appropriate value for the amount and size of rebar in each concrete quantity depending on its thickness and strength. Time and location factors are also automatically applied by selecting a start time of the project and project location. One assumption that was made during the concrete square footage was that the vertical shafts that run through the building were not subtracted from the square footage of the floors. This would only really come into play in the second and third floor because the roof and the slab on grade have fewer penetrations.

General Conditions Estimate

See Appendix D for General Conditions Estimate

The general conditions estimate for Westinghouse Building 4 was conducted using two different resources. By using a combination of RS Means and knowledge provided by the project manager on site a fairly accurate estimate was compiled without releasing any proprietary information. Table 3 below shows a breakdown of the total results from the four areas of the general conditions estimate. The total general conditions costs of this project is about 7.3% of the total building cost. The general conditions costs on an average construction project is between 8% and 10% of the project value with a larger difference between the personal costs and the insurance and bonds costs. Westinghouse Building 4 is a unique project because it has a smaller on site project team and thus less personal costs throughout the project. This feature brings down the total personal cost of the project which in turn yields a lower overall cost estimate for the general conditions.

General Conditions Summary	
Personal	$530,400.00
Temporary Facilities, Utilites, and Equipment	$250,450.00
Miscellaneous	$59,400.00
Insurance and Bonds	$448,052.98
Total GC Cost	**$1,288,302.98**

Table 3: shows a comparison between the 4 categories of the general conditions estimate.

Figure 2 shows how the $1.2 million is distributed on the project. The personal cost accounts for 41% of the total and includes all people directly involved in this project. It should be noted that this personal cost does include the cost of the estimator's time to come up with a detailed project estimate. The amount of time each person on the project team actually spends on this project is estimated. Complications and unexpected change orders may require more time from certain people and thus change this amount. The second largest cost is the insurance and bonds cost. This category encompasses all of the expenses associated with insuring the site and its occupants along with all the costs of permits and bonds on the project. The temporary facilities, utilities, and project equipment total accounts for 10% of the overall project. This category includes costs such as: trailer costs, crane costs, dumpster costs, and temporary power, water, and electric costs. Each one of these entities must be accounted for to ensure that all necessary subjects arrive to the site when they are supposed to and removed on time to avoid pointless spending. The last category is the miscellaneous costs, which are relatively small individually, but can add up to large sums of money in the end.

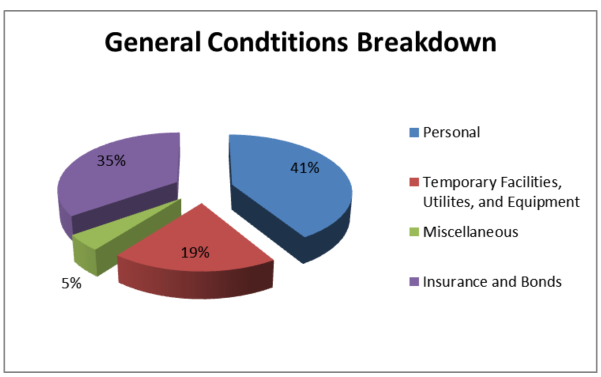


Figure 2: shows the breakdown of the general conditions estimate.

Critical Industry Issues

This year the 19th annual PACE Roundtable was held at The Pennsylvania State University. The purpose of the meeting is to create opportunity for industry leaders, professors, and students to interact and discuss pertinent industry issues that are currently plaguing the construction industry. In addition to a large meeting environment there were also several smaller breakout session that gave an opportunity for more face to face interaction between individuals. One of these breakout sessions discussed Integrated Project Delivery, or IPD. Another was a very informative session that discussed the future of electricity monitoring and metering called Smart Grid. These sessions were very informative and valuable to take part in because they discuss some of the issues that are currently plaguing our industry because of either lack of participation amongst industry members or lack of knowledge of the technology.

IPD, or Integrated Project Delivery, was hosted by Robert Leicht and discussed some of the issues that cause the construction industry to be less productive than it could be. Integrated Project Delivery is a delivery method that is meant to ease the delivery of a project and speed up the procurement time, but there are major barriers that industry members must first overcome before this method can work. This system of delivery is always a Design-Build delivery method because all subcontractors must be brought on board early in the design phase of the project. Also, in this new type of delivery there is no individual entity to blame for hold ups or bad estimates. However, IPD also has some real advantages over traditional delivery methods. IPD encourages collaboration and shares responsibility on a jobsite, which leads to more innovative projects and can lead to a speedier construction time.

Industry barriers that discourage IPD from becoming common place in construction are vast and complicated. Working together and sharing information is not traditionally held as a high priority on a job site amongst the different trades and managers, but it is of the utmost importance on an IPD site. Subcontractors are usually chosen on a lowest bid basis and only want to accomplish the minimum amount they have to then move on to their next job. In IPD however, the mechanical contractor for example has just as much at stake in the project as say the bricklayer. All trades must work together and help each other in order for the job to get done correctly and on budget. Also, deciding who is at fault for certain schedule delays or extra cost on a project is of utmost importance to all entities on the jobsite because people's lively hoods and wages are at risk when expensive mistakes or miscalculations occur.

Another barrier that IPD must overcome is minimizing the initial job target cost. Because there is no GMP initial contract agreements and pricing must be agreed upon by all entities up front. Usually if a project goes over budget the owner is stuck footing the bill so it is very important to get them on board and understanding their responsibilities before the project gets under way. Traditional design-bid-build construction is also usually cheaper because the lowest bid of all of the subcontracts is chosen so that the overall building cost is minimized. In IPD however this minimizing cost technique cannot be utilized because all parts of the project team are brought on so early so other cost cutting techniques must be investigated. With high collaboration and cooperation on site value engineering is an easy way to cut costs on an IPD job. Another barrier for IPD to overcome, especially in today's economy, is that it cannot be used on state or federal projects because they require that competitive bidding take place on the projects.

IPD, along with its challenges, also carries with it many positive aspects. Since there is more collaboration and cooperation on IPD sites the jobs usually turn out to be more innovative than traditional jobs. Trades are encouraged to share ideas and find solutions instead of determine blame and create excuses. Another positive is that subcontractors are often given more authority on IPD projects and are allowed to make their own educated decisions on the spot in the field to solve a problem. This decreases the amount of time that is wasted while subs wait to hear back for the architect or other authoritative figure on design changes. The positives of IPD definitely outweigh the negatives, but the culture of the construction industry is very difficult to change because it has been the same way for so long. Hopefully with the integration of BIM and 4D modeling closer collaboration will take place on sites and one day Integrated Project Delivery construction will be a viable option for owners to pursue on their projects.

The breakout session pertaining to Smart Grad technology was more of an information session than a discussion. The session was very valuable and informative and brought to light some concepts that could help address the energy crisis going on around the world right now. Dr. Riley headed this session and used a very interesting example to describe Smart Grid technology. He described how the electricity company offered Penn State a large sum of money to show that they could drop their electricity consumption suddenly my several megawatts. Being that my building is being built for a power company I can relate closely to this concept. When power companies have to buy electricity from other companies the costs are very high and the company does not make any profit. For this reason Smart Grid could be used to reduce consumption while, say a power plant is being serviced.

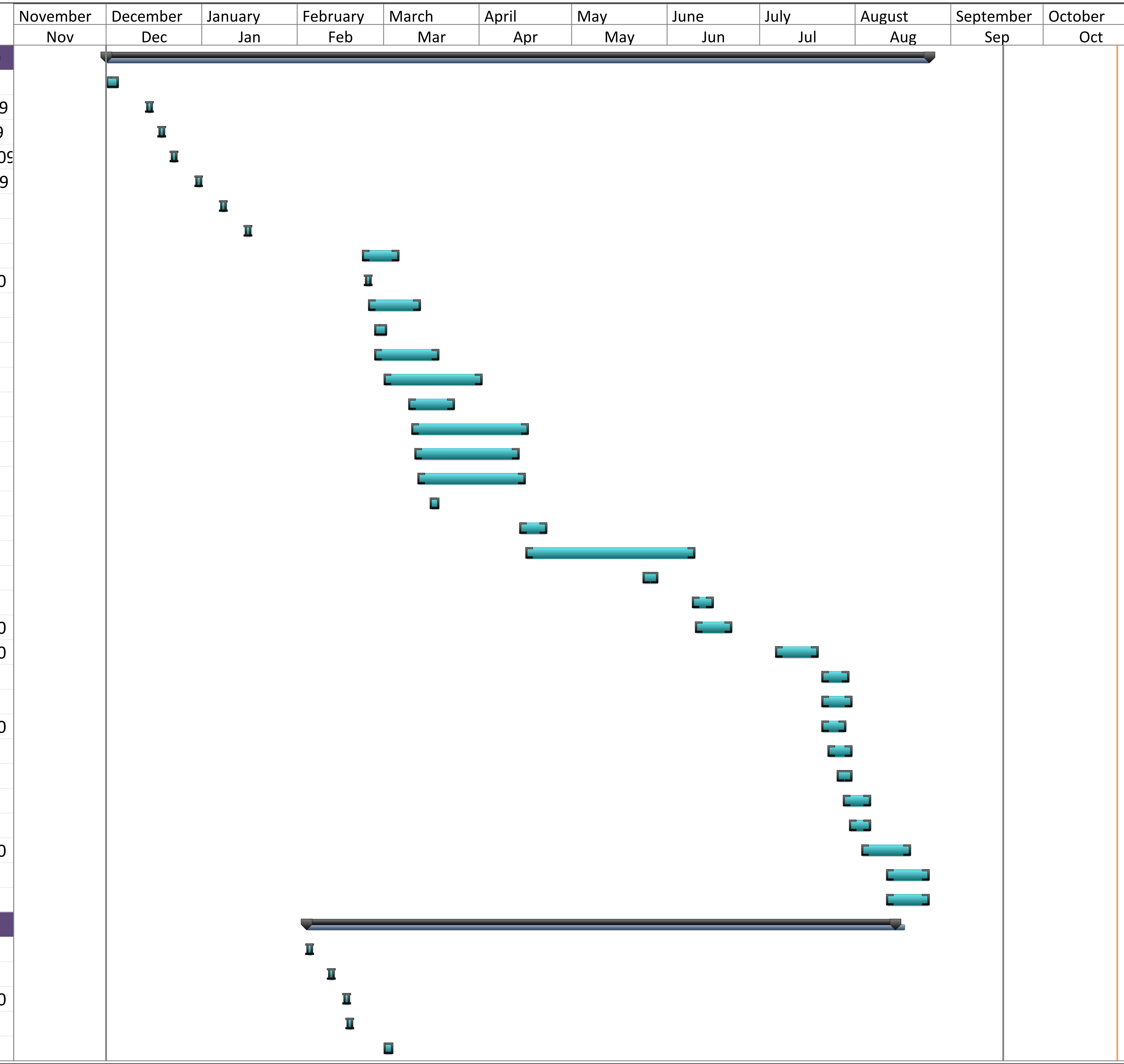
Other aspects of Smart Grid Technology include advanced metering, small quantity power generation, and cyber security over the system. The concept of advanced metering involves installing meters on buildings and even homes that measure not only the quantity of electricity being used but the time of day that energy is being used. This technology may encourage building owners to install battery banks in their buildings that charge at night when power is cheaper and then discharge them during the day. Small quantity power generation involves the generation of small amounts in large amounts of locations to balance grids. This idea could include anything from smaller power plants to putting solar panels on the roofs of buildings. These ideas should be at the forefront of the industry because indications are already apparent that power companies will not be able to keep up with demand in the future. A risk of using Smart Technology is that computer hackers could break into your meter online and determine when you are home during the day. If burglars knew when you were not home it would be an excellent opportunity for them to break in and rob your house.

Both of these breakout sessions presented ideas that could be directly applied to my project. It would be interesting to investigate how IPD could have been used on the Westinghouse Building 4 project to create a more innovative project. Being that the project is a privately owned project IPD could have been a valuable delivery method that showed how it successfully delivers projects both on time and on budget. Westinghouse advertises them self as a green company because they design nuclear power plants that do not generate green house gasses. Smart Grid Technology could be installed in their new building to show another way that they are trying to help the global energy crisis. In every new technology there must be genie pigs and I plan to investigate both of these industry ideas for my thesis building.

Both during the main meeting and the breakout sessions the industry leaders were excited to share their knowledge and experience from the field. Some of this information could not be learned in a classroom, which made this event very valuable to both students and industry members of other trades. Later down the road in this project I think it would be valuable to contact Robert Grottenthaler from Barton Malow about IPD. In the breakout session Bob shared multiple experiences working with this delivery method and seemed like he could definitely share more knowledge on the subject. Shawn Cingle from Southland Industries attended both of the breakout sessions that I attended. He would be another person I would contact on both subjects, but especially the Smart Grid Technology. Being that he works for an electrical subcontractor I think he would be an excellent contact from the industry.

Appendix A – Detailed Project Schedule

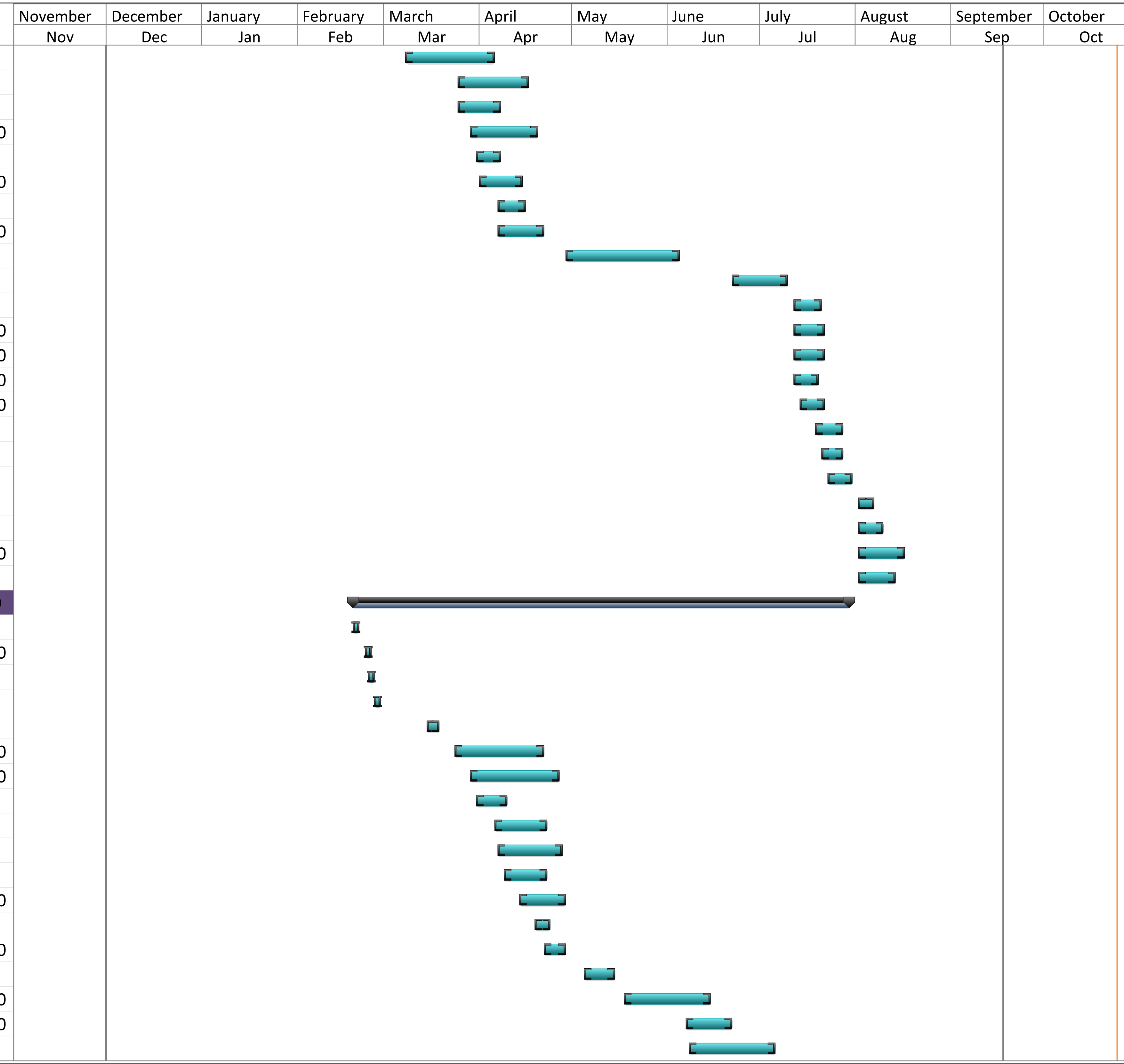
ID		Task Mode	Task Name	Duration	Start	Finish
1			**First Level Schedule**	**191 days**	**Tue 12/1/09**	**Tue 8/24/10**
2			2336 Poke-Thru RI	4 days	Tue 12/1/09	Fri 12/4/09
3			1001 Slab on Grade 1	2 days	Mon 12/14/09	Tue 12/15/09
4			1002 Slab on Grade 2	2 days	Fri 12/18/09	Sat 12/19/09
5			1003 Slab on Grade 3	2 days	Tue 12/22/09	Wed 12/23/09
6			1004 Slab on Grade 4	2 days	Wed 12/30/09	Thu 12/31/09
7			1005 Slab on Grade 5	2 days	Thu 1/7/10	Fri 1/8/10
8			1006 Slab on Grade 6	2 days	Fri 1/15/10	Sat 1/16/10
9			2251 Electrical OH RI	10 days	Mon 2/22/10	Fri 3/5/10
10			1061 SOFP 1st Floor	2 days	Tue 2/23/10	Wed 2/24/10
11			2101 Mechanical OH RI	13 days	Wed 2/24/10	Fri 3/12/10
12			1062 SOFP 1st FLoor	2 days	Fri 2/26/10	Mon 3/1/10
13			2102 Mechanical OH RI	15 days	Fri 2/26/10	Thu 3/18/10
14			1181 Sprinkler Mains and Branches	24 days	Mon 3/1/10	Thu 4/1/10
15			1740 Interior Framing	11 days	Tue 3/9/10	Tue 3/23/10
16			2325 Electrical In-Wall RI	28 days	Wed 3/10/10	Fri 4/16/10
17			1741 Interior Framing	24 days	Thu 3/11/10	Tue 4/13/10
18			1142 Plumbing OH RI	25 days	Fri 3/12/10	Thu 4/15/10
19			1750 Interior Framing	3 days	Tue 3/16/10	Thu 3/18/10
20			2127 Duct Insulation	7 days	Wed 4/14/10	Thu 4/22/10
21			2432 Drywall T & F	39 days	Fri 4/16/10	Wed 6/9/10
22			1200 Switchgear Installation	5 days	Mon 5/24/10	Fri 5/28/10
23			2342 Finish Walker-Duct- 1	5 days	Wed 6/9/10	Tue 6/15/10
24			2730 Tile Floors and Walls 1st Fl	8 days	Thu 6/10/10	Mon 6/21/10
25			2431 Drywall T & F (exterior wall)	10 days	Tue 7/6/10	Mon 7/19/10
26			2530 Painting 1st Fl	7 days	Wed 7/21/10	Thu 7/29/10
27			2630 Ceilings 1st Fl	8 days	Wed 7/21/10	Fri 7/30/10
28			2930 Sprinkler Heads 1st Fl	6 days	Wed 7/21/10	Wed 7/28/10
29			3030 Diffuser Installation 1st Fl	6 days	Fri 7/23/10	Fri 7/30/10
30			2830 Finish Power 1st Fl	5 days	Mon 7/26/10	Fri 7/30/10
31			3130 Lighting 1st Fl	7 days	Wed 7/28/10	Thu 8/5/10
32			3560 Set Doors and Hardware 1st Fl	5 days	Fri 7/30/10	Thu 8/5/10
33			3330 Flooring 1	12 days	Tue 8/3/10	Wed 8/18/10
34			4060 Casework	10 days	Wed 8/11/10	Tue 8/24/10
35			11430 Punchlist 1st Fl	10 days	Wed 8/11/10	Tue 8/24/10
36			**Second Floor Schedule**	**137 days**	**Thu 2/4/10**	**Fri 8/13/10**
37			1011 Slab on Deck 2	2 days	Thu 2/4/10	Fri 2/5/10
38			1012 Slab on Deck 2	2 days	Thu 2/11/10	Fri 2/12/10
39			1013 Slab on Deck 2	2 days	Tue 2/16/10	Wed 2/17/10
40			1014 Slab on Deck 2	2 days	Wed 2/17/10	Thu 2/18/10
41			1063 SOFP 2nd Floor	3 days	Mon 3/1/10	Wed 3/3/10



Project: Full Schedule
Date: Mon 10/25/10

Task	Project Summary	Inactive Milestone	Manual Summary Rollup
Split	External Tasks	Inactive Summary	Manual Summary
Milestone	External Milestone	Manual Task	Start-only
Summary	Inactive Task	Duration-only	Finish-only
Deadline	Progress		

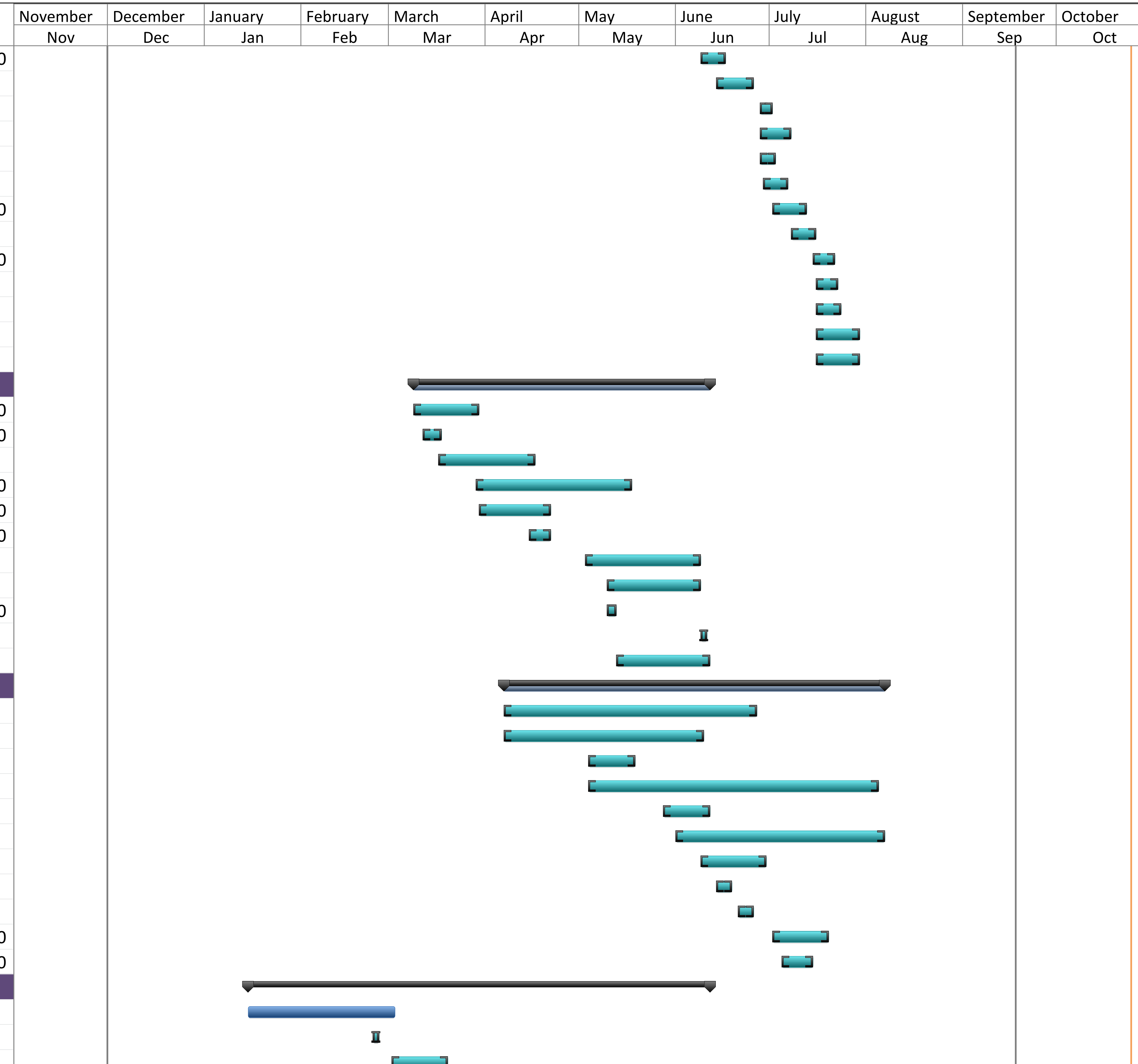
ID	Task Mode	Task Name	Duration	Start	Finish
42		2103 Mechanical OH RI	21 days	Mon 3/8/10	Mon 4/5/10
43		1183 Sprinkler Mains and Branches	17 days	Thu 3/25/10	Fri 4/16/10
44		2254 Electrical OH RI	10 days	Thu 3/25/10	Wed 4/7/10
45		1143 Plumbing OH RI	16 days	Mon 3/29/10	Mon 4/19/10
46		2334 Poke-Thru RI	6 days	Wed 3/31/10	Wed 4/7/10
47		2328 Electrical In-Wall RI	10 days	Thu 4/1/10	Wed 4/14/10
48		1760 Interior Framing	7 days	Wed 4/7/10	Thu 4/15/10
49		2135 Duct Insulation	11 days	Wed 4/7/10	Wed 4/21/10
50		2428 Drywall T & F - Duct Shafts	27 days	Thu 4/29/10	Fri 6/4/10
51		2434 Drywall T & F (exterior wall)	14 days	Tue 6/22/10	Fri 7/9/10
52		2520 Painting 2nd Fl	7 days	Mon 7/12/10	Tue 7/20/10
53		2620 Ceilings 2nd Fl	8 days	Mon 7/12/10	Wed 7/21/10
54		2720 Tile Floors and Walls 2nd Fl	8 days	Mon 7/12/10	Wed 7/21/10
55		2920 Sprinkler Heads 2nd Fl	6 days	Mon 7/12/10	Mon 7/19/10
56		3020 Diffuser Installation 2nd Fl	6 days	Wed 7/14/10	Wed 7/21/10
57		3120 Lighting 2nd Fl	7 days	Mon 7/19/10	Tue 7/27/10
58		3550 Set Doors and Hardware 2nd Fl	5 days	Wed 7/21/10	Tue 7/27/10
59		3320 Flooring 2	6 days	Fri 7/23/10	Fri 7/30/10
60		2340 Poke-Thru Install	5 days	Mon 8/2/10	Fri 8/6/10
61		3321 Flooring 2	6 days	Mon 8/2/10	Mon 8/9/10
62		4040 Casework	11 days	Mon 8/2/10	Mon 8/16/10
63		11420 Punchlist 2nd Fl	10 days	Mon 8/2/10	Fri 8/13/10
64		**Third Floor Schedule**	**115 days**	**Fri 2/19/10**	**Thu 7/29/10**
65		1015 Slab on Deck 3	2 days	Fri 2/19/10	Sat 2/20/10
66		016 Slab on Deck 3	2 days	Tue 2/23/10	Wed 2/24/10
67		1017 Slab on Deck 3	2 days	Wed 2/24/10	Thu 2/25/10
68		1018 Slab on Deck 3	2 days	Fri 2/26/10	Sat 2/27/10
69		1065 SOFP 3rd Floor	4 days	Mon 3/15/10	Thu 3/18/10
70		2105 Mechanical OH RI	21 days	Wed 3/24/10	Wed 4/21/10
71		1145 Plumbing OH RI	21 days	Mon 3/29/10	Mon 4/26/10
72		2332 Poke-Thru RI	8 days	Wed 3/31/10	Fri 4/9/10
73		2255 Electrical OH RI	13 days	Tue 4/6/10	Thu 4/22/10
74		1146 Plumbing OH RI	15 days	Wed 4/7/10	Tue 4/27/10
75		1790 Interior Framing	10 days	Fri 4/9/10	Thu 4/22/10
76		1186 Sprinkler Mains and Branches	11 days	Wed 4/14/10	Wed 4/28/10
77		2330 Electrical In-Wall RI	5 days	Mon 4/19/10	Fri 4/23/10
78		2136 Duct Insulation	5 days	Thu 4/22/10	Wed 4/28/10
79		2429 Drywall T & F - Duct Shafts	8 days	Wed 5/5/10	Fri 5/14/10
80		2452 Drywall T & F - Interior	20 days	Tue 5/18/10	Mon 6/14/10
81		2436 Drywall T & F Exterior Wall	11 days	Mon 6/7/10	Mon 6/21/10
82		2610 Ceilings 3rd Fl	20 days	Tue 6/8/10	Mon 7/5/10



Project: Full Schedule
Date: Mon 10/25/10

Task
Split
Milestone
Summary
Project Summary
External Tasks
External Milestone
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
Deadline
Progress

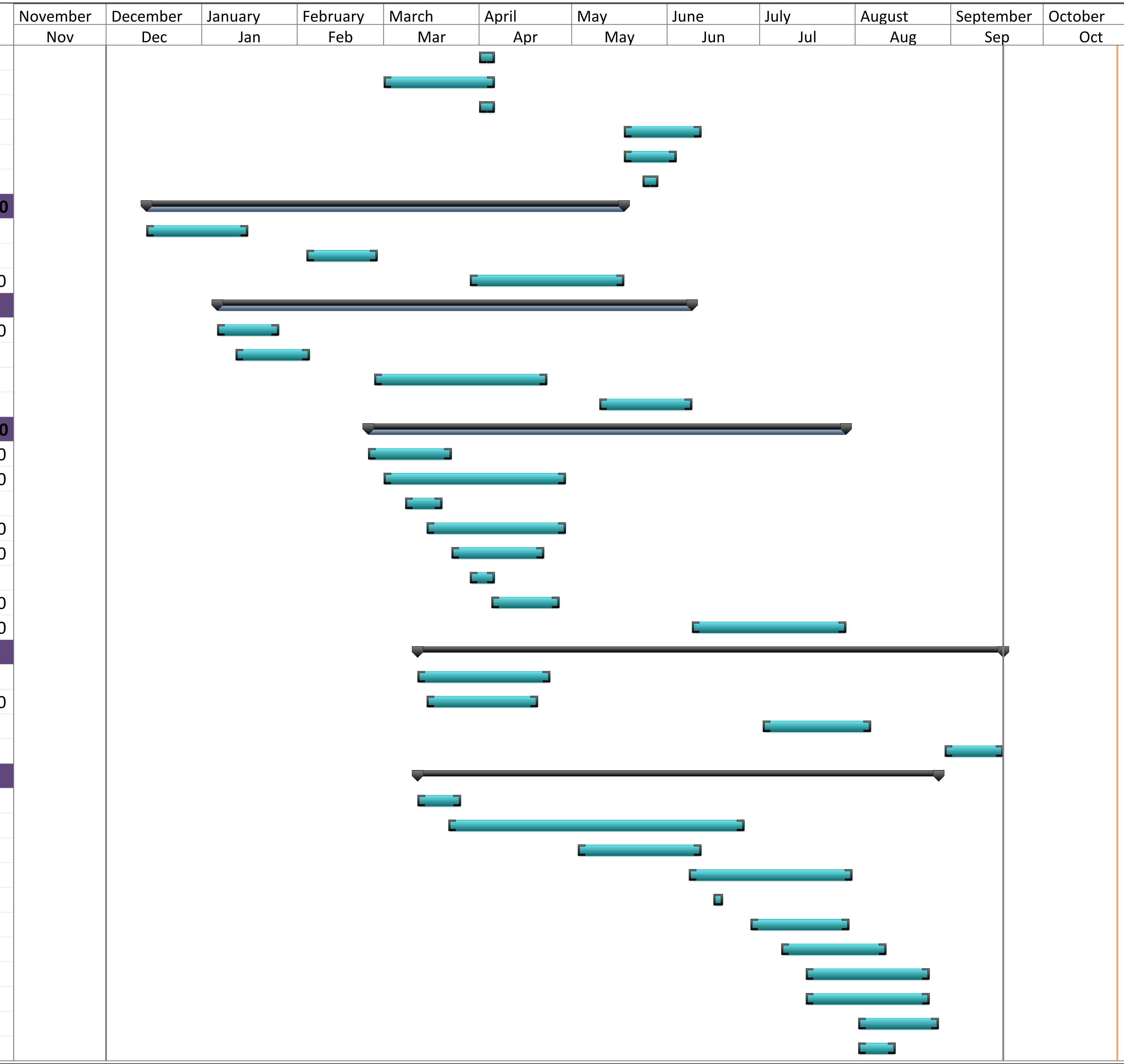
ID	Task Mode	Task Name	Duration	Start	Finish
83		2910 Sprinkler Heads 3rd Fl	6 days	Wed 6/9/10	Wed 6/16/10
84		2437 Drywall T & F Exterior Wall	10 days	Mon 6/14/10	Fri 6/25/10
85		2510 Painting 3rd Floor	4 days	Mon 6/28/10	Thu 7/1/10
86		2710 Tile Floors and Walls 3rd Fl	8 days	Mon 6/28/10	Wed 7/7/10
87		2810 Finish Power 3rd Fl	5 days	Mon 6/28/10	Fri 7/2/10
88		3010 Diffuser Installation 3rd Fl	6 days	Tue 6/29/10	Tue 7/6/10
89		3110 Lighting 3rd Fl	7 days	Fri 7/2/10	Mon 7/12/10
90		3310 Flooring 3	6 days	Thu 7/8/10	Thu 7/15/10
91		2820 Finish Power 2nd Fl	5 days	Thu 7/15/10	Wed 7/21/10
92		2338 Poke-Thru Install	5 days	Fri 7/16/10	Thu 7/22/10
93		3311 Flooring	6 days	Fri 7/16/10	Fri 7/23/10
94		4020 Casework	10 days	Fri 7/16/10	Thu 7/29/10
95		11410 Punchlist 3rd Fl	10 days	Fri 7/16/10	Thu 7/29/10
96		**Exterior Activities**	**69 days**	**Tue 3/9/10**	**Fri 6/11/10**
97		1030 Lintels	15 days	Tue 3/9/10	Mon 3/29/10
98		1101 Knee Wall	4 days	Fri 3/12/10	Wed 3/17/10
99		1820 Exterior Framing w/ Parapet	23 days	Wed 3/17/10	Fri 4/16/10
100		1102 Brick/ Backup & Washdown	36 days	Mon 3/29/10	Mon 5/17/10
101		1071 Roofing at Parapet	17 days	Tue 3/30/10	Wed 4/21/10
102		1850 Exterior Framing w/ Parapet	5 days	Thu 4/15/10	Wed 4/21/10
103		1112 Glass & Glazing	27 days	Mon 5/3/10	Tue 6/8/10
104		1121 Parapet Metal Panels	22 days	Mon 5/10/10	Tue 6/8/10
105		1126 Metal Panels 3rd Floor	3 days	Mon 5/10/10	Wed 5/12/10
106		1135 Metal Panels - 3rd Floor	2 days	Wed 6/9/10	Thu 6/10/10
107		1114 Glass & Glazing	22 days	Thu 5/13/10	Fri 6/11/10
108		**Site Activities**	**88 days**	**Wed 4/7/10**	**Fri 8/6/10**
109		6000 Curbing	59 days	Wed 4/7/10	Sat 6/26/10
110		8000 Site Lighting	46 days	Wed 4/7/10	Wed 6/9/10
111		6020 Curbing - Phase 3	11 days	Tue 5/4/10	Tue 5/18/10
112		7000 Landscaping	67 days	Tue 5/4/10	Wed 8/4/10
113		9010 Exterior Sidewalks - Phase 1	11 days	Fri 5/28/10	Fri 6/11/10
114		10000 Sub-Base & Pavement	49 days	Tue 6/1/10	Fri 8/6/10
115		2270 Generator	15 days	Wed 6/9/10	Tue 6/29/10
116		9030 Exterior Sidewalks - Phase 2	5 days	Mon 6/14/10	Fri 6/18/10
117		9040 Exterior Sidewalks - Phase 3	5 days	Mon 6/21/10	Fri 6/25/10
118		7040 Landscaping- Phase 5	12 days	Fri 7/2/10	Mon 7/19/10
119		6030 Curbing - Phase 4	8 days	Mon 7/5/10	Wed 7/14/10
120		**Roof**	**106 days**	**Fri 1/15/10**	**Fri 6/11/10**
121		1080 Roof Curbs (RTUs and Mechanical)	33 days	Fri 1/15/10	Tue 3/2/10
122		1020 Roof Penetrations	2 days	Wed 2/24/10	Thu 2/25/10
123		1070 Roofing	14 days	Tue 3/2/10	Fri 3/19/10



Project: Full Schedule
Date: Mon 10/25/10

Task | Project Summary | Inactive Milestone | Manual Summary Rollup | Deadline
Split | External Tasks | Inactive Summary | Manual Summary | Progress
Milestone | External Milestone | Manual Task | Start-only
Summary | Inactive Task | Duration-only | Finish-only

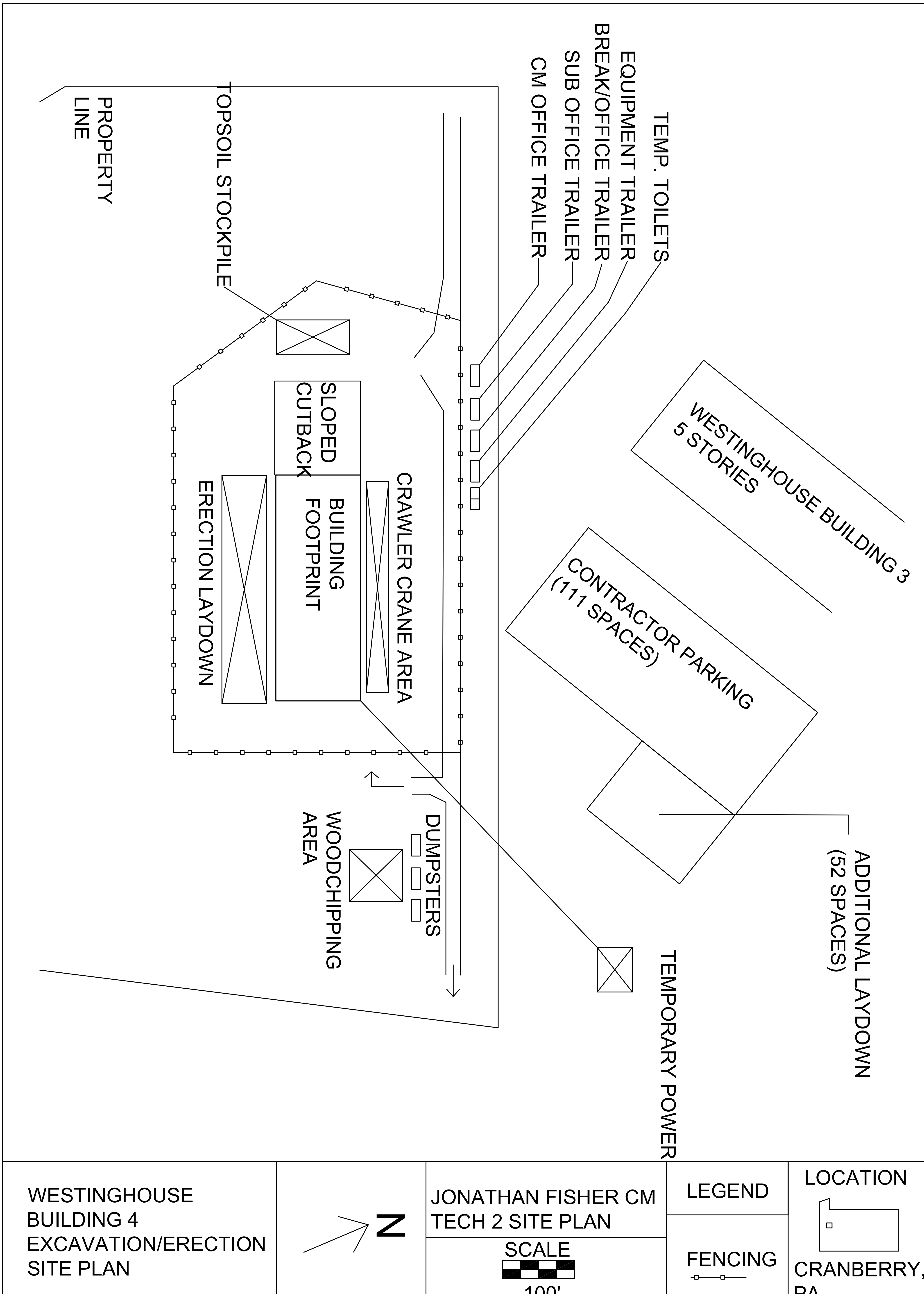
ID		Task Mode	Task Name	Duration	Start	Finish
124			1179 RTU Installation	3 days	Thu 4/1/10	Mon 4/5/10
125			2118 Set Condensing Units 1, 2, 3,	26 days	Mon 3/1/10	Mon 4/5/10
126			2122 Set Condensing Units 4, 5	3 days	Thu 4/1/10	Mon 4/5/10
127			1125 Screen Wall	19 days	Tue 5/18/10	Fri 6/11/10
128			2110 Kitchen Exhaust	13 days	Tue 5/18/10	Thu 6/3/10
129			1147 Plumbing RTU Hook-Up	5 days	Mon 5/24/10	Fri 5/28/10
130			**Concrete Work**	**111 days**	**Mon 12/14/09**	**Mon 5/17/10**
131			1000 Slab on Grade	25 days	Mon 12/14/09	Fri 1/15/10
132			1009 Slab on Deck	17 days	Thu 2/4/10	Fri 2/26/10
133			1100 Masonry	36 days	Mon 3/29/10	Mon 5/17/10
134			**Steel**	**110 days**	**Wed 1/6/10**	**Tue 6/8/10**
135			1007 Steel Erection	14 days	Wed 1/6/10	Mon 1/25/10
136			1008 Metal Deck	18 days	Tue 1/12/10	Thu 2/4/10
137			1450 Interior Metal Framing	40 days	Fri 2/26/10	Thu 4/22/10
138			1120 Metal Panels	22 days	Mon 5/10/10	Tue 6/8/10
139			**HVAC, Fire Protection, Plumbing**	**111 days**	**Wed 2/24/10**	**Wed 7/28/10**
140			2100 Ductwork	19 days	Wed 2/24/10	Mon 3/22/10
141			1180 Sprinkler Mains and Branches	43 days	Mon 3/1/10	Wed 4/28/10
142			1130 Sprinkler Standpipes	10 days	Mon 3/8/10	Fri 3/19/10
143			1140 Plumbing Rough-In	33 days	Mon 3/15/10	Wed 4/28/10
144			1178 Plumbing Risers	22 days	Tue 3/23/10	Wed 4/21/10
145			2117 Mechanical Piping	6 days	Mon 3/29/10	Mon 4/5/10
146			2107 Duct Risers	16 days	Mon 4/5/10	Mon 4/26/10
147			2900 Sprinkler Heads	36 days	Wed 6/9/10	Wed 7/28/10
148			**Electrical**	**136 days**	**Fri 3/12/10**	**Fri 9/17/10**
149			2300 Electrical Building Rough-In	31 days	Fri 3/12/10	Fri 4/23/10
150			2200 Electrical Service Distribution	26 days	Mon 3/15/10	Mon 4/19/10
151			3100 Lighting	25 days	Fri 7/2/10	Thu 8/5/10
152			3500 Balancing	15 days	Mon 8/30/10	Fri 9/17/10
153			**General**	**121 days**	**Fri 3/12/10**	**Fri 8/27/10**
154			1021 Remove Weather Protection	10 days	Fri 3/12/10	Thu 3/25/10
155			2400 Drywall Tape & Finish	70 days	Mon 3/22/10	Fri 6/25/10
156			1110 Glass & Glazing	30 days	Mon 5/3/10	Fri 6/11/10
157			2600 Ceilings	39 days	Tue 6/8/10	Fri 7/30/10
158			3200 Toilet Fixture Installation	3 days	Wed 6/16/10	Fri 6/18/10
159			2500 Painting	24 days	Mon 6/28/10	Thu 7/29/10
160			3300 Flooring	24 days	Thu 7/8/10	Tue 8/10/10
161			4010 Casework	28 days	Fri 7/16/10	Tue 8/24/10
162			11400 Punchlist	28 days	Fri 7/16/10	Tue 8/24/10
163			4000 Startup and Testing	20 days	Mon 8/2/10	Fri 8/27/10
164			11440 Owner Training	10 days	Mon 8/2/10	Fri 8/13/10



Project: Full Schedule
Date: Mon 10/25/10

Task		Project Summary		Inactive Milestone		Manual Summary Rollup		Deadline	
Split		External Tasks		Inactive Summary		Manual Summary		Progress	
Milestone		External Milestone		Manual Task		Start-only			
Summary		Inactive Task		Duration-only		Finish-only			

Appendix B – Site Layout Plan


PROPERTY LINE
TOPSOIL STOCKPILE
CM OFFICE TRAILER
SUB OFFICE TRAILER
BREAK/OFFICE TRAILER
EQUIPMENT TRAILER
TEMP. TOILETS
SLOPED CUTBACK
BUILDING FOOTPRINT
ERECTION LAYDOWN
CRAWLER CRANE AREA
WESTINGHOUSE BUILDING 3
5 STORIES
CONTRACTOR PARKING
(111 SPACES)
ADDITIONAL LAYDOWN
(52 SPACES)
DUMPSTERS
WOODCHIPPING AREA
TEMPORARY POWER
WESTINGHOUSE BUILDING 4 EXCAVATION/ERECTION SITE PLAN
N
JONATHAN FISHER CM TECH 2 SITE PLAN
SCALE
100'
LEGEND
FENCING
LOCATION
CRANBERRY, PA

Appendix C – Detailed Structural System Estimate

Cast in Place Concrete

Footings (3000psi)									
Length (ft.)	Width (ft.)	Depth (ft.)	Rebar Type	Rebar Qty.	LF of Rebar	Weight (lb/LF)	No. of Columns	Total Concrete (CY)	Total Rebar (tons)
4.5	4.5	1.5	6	7	63	1.502	4	4.50	0.19
6	6	2	6	11	132	1.502	16	42.67	1.59
6.5	6.5	2	6	14	182	1.502	8	25.04	1.09
4	4	1.33	6	5	40	1.502	4	3.15	0.12
7.5	7.5	2.33	8	11	165	2.67	24	116.50	5.29
5.5	5.5	1.75	6	9	99	1.502	4	7.84	0.30
						Total		200	9
						5% waste for Concrete		10	
						Grand Total		210	9

Piers (3000 psi)									
Length (ft.)	Width (ft.)	Depth (ft.)	Rebar Type	Rebar Qty.	LF of Rebar	Weight (lb/LF)	No. of Piers	Total Concrete (CY)	Total Rebar (tons)
2	2	2	8	8	24	2.67	38	11	1
						Total		11	1
						5% waste for Concrete		1	
						Grand Total		12	1

Slab On Grade (4000 psi)								
Length (ft.)	Width (ft.)	Depth (in.)	WW Fabric Type	W-Number	Fabric Qty. (sqft)	Weight (lb/100 sqft)	Total Concrete (CY)	Total Rebar (tons)
312	132	5	6 x 6	W2.1 x W2.1	41184	30	636	6
					Total		636	6
					5% waste for Concrete		32	
					Grand Total		668	6

Slabs On Deck (4000 psi)									
Length (ft.)	Width (ft.)	Depth (in.)	WW Fabric Type	W-Number	Fabric Qty. (sqft)	Weight (lb/100 sqft)	No. of Slabs	Total Concrete (CY)	Total Rebar (tons)
312	132	4.5	6 x 6	W2.1 x W2.1	82368	30	3	1716	12
						Total		1716	12
						5% waste for Concrete		86	
						Grand Total		1802	12

Foundation Walls (3000 psi)									
Length (ft.)	Width (ft.)	Depth (ft.)	Slope	Rebar Type	Rebar Qty.	LF of Rebar	Weight (lb/LF)	Total Concrete (CY)	Total Rebar (tons)
888	1.5	2.33	2	4	3	2664	0.668	77	1
Foundation Wall Dowels									
Length (ft.)	DWL Spacing (in.)	Bent Dowel Size	No. of Dowels	LF of Rebar	Weight (lb/LF)	Total Rebar (tons)			
5.5	16	4	667	3668.5	0.668	1			
						Total		77	2
						5% waste for Concrete		4	
						Grand Total		80	2

Formwork	
Name	Formwork Req. (sq ft)
Footings	2880
Piers	608
Foundation Walls	4440
Slab on Grade	444
Total	8372
10% waste	837
Grand Total	9209

Steel Quantities

Beams

Bay	Size	lb/lft	Length	Qty./Bay	No. of Bays/Floor	No. of Vert. Bays	Total Linear Feet	Total Tons
1	W18x35	35	24	1	4	2	192	3.36
1	W24x55	55	24	2	4	2	384	10.56
1	W24x62	62	24	1	4	2	192	5.952
1	W21x44	44	48	2	4	2	768	16.896
2	W24x55	55	48	1	22	2	2112	58.08
2	W24x55	55	24	1	22	2	1056	29.04
2	W24x62	62	24	1	22	2	1056	32.736
2	W21x44	44	48	2	22	2	4224	92.928
3	W21x44	44	30	1	2	2	120	2.64
3	W18x35	35	30	2	2	2	240	4.2
4	W24x55	55	30	1	5	2	300	8.25
4	W18x35	35	30	2	5	2	600	10.5
5	W24x62	62	30	1	2	2	120	3.72
5	W10x19	19	8	2	2	2	64	0.608
5	W10x17	17	11	1	2	2	44	0.374
5	W18x35	35	24	2	2	2	192	3.36
5	W10x15	15	8	10	2	2	320	2.4
5	W12x19	19	11	1	2	2	44	0.418
6	W24x62	62	30	1	2	2	120	3.72
6	W18x35	35	30	2	2	2	240	4.2
7	W24x55	55	30	1	2	2	120	3.3
7	W21x44	44	16.5	1	2	2	66	1.452
7	W10x19	19	16.5	1	2	2	66	0.627
7	W10x15	15	2	2	2	2	16	0.12
7	W12x22	22	11.5	2	2	2	92	1.012
7	W10x15	15	10	2	2	2	80	0.6
							Total	301.053

Metal Decking (type B-Deck)

	Type	Total (sq ft)
Roof Decking	1.5" Type B	41184
Floor Decking	1.5" Type B	82368

Columns					
Size	lb/lft	Length	Qt.	Total Length	Total Tons
W14x90	90	22	12	264	11.88
W14x109	109	20	24	480	26.16
W14x120	120	22	24	528	31.68
W14x68	68	28	8	224	7.616
W14x90	90	28	48	1344	60.48
W14x61	61	28	4	112	3.416
				Total	141.232

Westinghouse Electric Company

Cranberry,
PA, 16066
Year 2009 Quarter 4
Date: 26-Oct-10

Unit Detail Report

Cost Estimate Report CostWorks RSMeans

Structural System Estimate

Prepared By:
Jonathan Fisher
Penn State

LineNumber			Description	Quantity	Unit	Total Incl. O&P	Ext. Total Incl. O&P
Division 03 Concrete							
031113053950			C.I.P. concrete forms, wood, exterior plyform, buy, 3/4", includes material only	9,209.00	S.F.	$0.98	$9,024.82
033053400920			Structural concrete, in place, column, square, avg reinforcing, 24" x 24", includes forms(4 uses), reinforcing steel, and finishing	12.00	C.Y.	$1,286.56	$15,438.72
033053401900			Structural concrete, in place, elevated slab, flat slab with drop panels, 125 psf superimposed load, 20' span, includes forms(4 uses), reinforcing steel, and finishing	1,802.00	C.Y.	$638.42	$1,150,432.84
033053404700			Structural concrete, in place, slab on grade, 6" thick, includes forms(4 uses) and reinforcing steel	668.00	C.Y.	$171.92	$114,842.56
033105701950			Structural concrete, placing, continuous footing, shallow, pumped, includes vibrating, excludes material	80.00	C.Y.	$28.47	$2,277.60
033105702450			Structural concrete, placing, spread footing, pumped, under 1 C.Y., includes vibrating, excludes material	210.00	C.Y.	$65.89	$13,836.90
033529300100			Concrete finishing, floors, manual screed, bull float	123,552.00	S.F.	$0.32	$39,536.64
033913500400			Curing, curing blankets, buy, minimum, 1" to 2" thick	300.00	S.F.	$0.29	$87.00
Division 03 Subtotal							**$1,345,477.08**
Division 05 Metals							
051223750620			Structural steel member, 100-ton project, 1 to 2 story building, W10x15, A992 steel, shop fabricated, incl shop primer, bolted connections	416.00	L.F.	$31.45	$13,083.20
051223750700			Structural steel member, 100-ton project, 1 to 2 story building, W10x22, A992 steel, shop fabricated, incl shop primer, bolted connections	174.00	L.F.	$40.99	$7,132.26
051223751300			Structural steel member, 100-ton project, 1 to 2 story building, W12x22, A992 steel, shop fabricated, incl shop primer, bolted connections	136.00	L.F.	$37.30	$5,072.80
051223753300			Structural steel member, 100-ton project, 1 to 2 story building, W18x35, A992 steel, shop fabricated, incl shop primer, bolted connections	1,464.00	L.F.	$56.40	$82,569.60
051223754100			Structural steel member, 100-ton project, 1 to 2 story building, W21x44, A992 steel, shop fabricated, incl shop primer, bolted connections	5,178.00	L.F.	$67.58	$349,929.24
051223754900			Structural steel member, 100-ton project, 1 to 2 story building, W24x55, A992 steel, shop fabricated, incl shop primer, bolted connections	3,972.00	L.F.	$81.88	$325,227.36

LineNumber			Description	Quantity	Unit	Total Incl. O&P	Ext. Total Incl. O&P
051223755100			Structural steel member, 100-ton project, 1 to 2 story building, W24x62, A992 steel, shop fabricated, incl shop primer, bolted connections	1,488.00	L.F.	$91.42	$136,032.96
053113503900			Metal decking, steel, open type, long span, galvanized, over 50 Sq, 4-1/2" D, 16 ga	123,552.00	S.F.	$6.18	$763,551.36
Division 05 Subtotal							**$1,682,598.78**

Appendix D – General Conditions Estimate

Personal

	Qty.	Cost per Week	Weeks	Total
Vice President	1	2200	12	$26,400.00
Project Executive	1	$2,150.00	30	$64,500.00
Project Manager	1	$2,800.00	45	$126,000.00
Project Engineer	1	$1,800.00	45	$81,000.00
Project Superintendent	1	$2,400.00	45	$108,000.00
Assistant Superintendent	1	$2,200.00	45	$99,000.00
Project Safety Manager	1	$300.00	45	$13,500.00
Estimating Cost	1	$4,000.00	3	$12,000.00
		Total Cost		**$530,400.00**

Temporary Facilities, Utilities and Equipment

	Qty.	Units	Cost per Unit	Months	Total
Office Trailer Start Up	1	each	$1,800.00	once	$1,800.00
Office Trailer Rent	1	months	$1,000.00	11	$11,000.00
Office Trailer Removal	1	each	$2,000.00	once	$2,000.00
Office Supplies/Equipment	1	months	$200.00	11	$2,200.00
Storage Trailers	3	months	$150.00	11	$4,950.00
Crawler Crane	1	months	$24,000.00	6	$144,000.00
Portable Toilets	2	months	$175.00	11	$3,850.00
Hand Tools/Small Equipment	1	months	$500.00	11	$5,500.00
Fire Extinguishers	10	each	$75.00	once	$750.00
Office Computer Equipment	3	months	$400.00	11	$13,200.00
Dumpsters	3	months	$175.00	12	$6,300.00
Personal Mobile Phones	3	months	$100.00	11	$3,300.00
Temporary Power Hook Up	1	each	$2,000.00	once	$2,000.00
Temporary Power	1	months	$5,000.00	7	$35,000.00
Temporary Water Hook Up	1	each	$1,000.00	once	$1,000.00
Temporary Water	1	months	$1,200.00	7	$8,400.00
Temporary Lighting	1	months	$1,000.00	7	$7,000.00
				Total Cost	**$250,450.00**

Miscellaneous Costs

	Qty.	Units	Cost per Unit	Months	Total
Signage	50	each	$10.00	once	$500.00
Site Clean Up	1	months	$1,200.00	12	$14,400.00
Field Expenses	1	months	$1,000.00	12	$12,000.00
Fencing	2500	LF	$0.75	12	$22,500.00
Temporary Road Ways	1	each	$10,000.00	once	$10,000.00
				Total Cost	**$59,400.00**

Insurance and Bonds

	% of Contract	RS Means Building Cost Estimate	Cost
Bonds	1.00%	$17,570,705.00	$175,707.05
Permits	1.00%	$17,570,705.00	$175,707.05
Insurance	0.55%	$17,570,705.00	$96,638.88
		Total Cost	**$448,052.98**