TECHNICAL REPORT 2

National Intrepid Center of Excellence
Bethesda, MD

10/28/2009
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EXECUTIVE SUMMARY

The following technical report is an in-depth schedule and cost analysis of the National Intrepid Center of Excellence. Topics discussed include: project schedule, site logistic plans, structural estimate, and general conditions estimate. At the conclusion of the report is an outline of the PACE Roundtable event, which summarizes current and critical industry issues discussed by industry members and students.

The project schedule has been refined to provide a more accurate picture of the project's trade sequencing. Two activities important to project success are trade coordination and sequencing between different systems. Therefore, the two façade systems, MEP system and clinical equipment installation, are critical path elements that drive the trade coordination and sequencing activities.

The site logistics at NICoE are very favorable for a flexible work environment. Due to the large workspace available, there is plenty of room to maneuver within the site during the construction phases. As a result, site logistics plans were consistent throughout the critical construction phases: excavation, substructure and interior work.

The 72,000 sq.ft concrete structural system cost for NICoE was estimated to be $1.7 Million. This estimate was derived by doing a hand take-off for the formwork, concrete, and reinforcement. Then, using RS Means 2009, all costs involving labor, materials and equipment were calculated for footings, columns, beams, and the elevated flat slabs.

General Conditions estimate arrived at $1.6Million dollars, approximately 4% of the project's total cost. A list of general conditions items were provided by Turner Construction for analysis. Then RS Means 2009 was run to develop a unit cost value for each of the items. The majority of the general conditions cost is comprised of personnel salaries.

Finally, this report concludes with an analysis of the technical session presented at the PACE Roundtable. The main topic was BIM, particularly how to plan and execute BIM within construction industry projects. Other critical issues included: how to promote the usage of BIM, and the cost/time benefits.

DETAILED PROJECT SCHEDULE

In order to create a schedule for the National Intrepid Center of Excellence, it is critical to understand the sequencing of the construction activities and how each activity affects the schedule on a daily basis. The purpose of the detailed schedule is to refine the activity requirements of the summary schedule. The information generated in the detailed schedule will be used in cost estimation analysis.

NICoE began construction in early March 2009 and is scheduled to be completed in mid-July 2010, just over 16 month of construction. Considering the limited time frame, and the 30 subcontractors needed, the construction activities in the schedule must be subdivided by trade. Some of the major activities on this project include: Mobilization/Demolition/Excavation, Cast-In-Place Concrete, Precast Concrete façade, Curtain Wall system, MEP rough-ins and distribution, interior finishes, and the medical equipment installation.

Please see Appendix A for the detailed Gantt chart for NICoE.

Schedule Narrative:

The detailed schedule was first broken down into major activities by trades, and then further broken down into sub-activities. Corresponding durations to each activity were also included in the schedule. This section will go through the major activities in order with the detailed schedule.

The schedule kicks off with The Notice to Proceed, which was delivered on March 2, 2009. Next follows the contractor Mobilization activities.

Site Utilities

Site utility activities began by running existing utility lines from the naval medical center campus central utility plant to the project site. The owner (NAFAC) is responsible for making sure campus utility lines are available for contractor use. It is very important to have temporary utilities available, as they are required for the all construction activities occurring on site. The site is scheduled to be run on temporary power for a 3 month period, and then switched to a permanent power using a 3000 amp transformer.

Excavation

The NICoE project has a shallow foundation design; therefore, minimum excavation is required. Excavation is accomplished using a combination of laid back and shield/trench boxes as necessary depending on the space available around the perimeter of the building. Site restoration and asphalt paving activities are completed later in the project.

Substructure and Superstructure

Following the excavation phase, the structural phase of the project is begun by substructure and superstructure activities. On May 14, 2009, spread footings and foundation walls were formed, poured and stripped in 42 days. Tower crane erection took place on May 19, 2009. The crane was used to lift chute concrete buckets to make way for the placement of the cast-in-place concrete slabs. Next, the slab-on-grade pouring began on June 17, 2009, and was poured in 7 sections.. Finally, the Level 2, low and high roofs were formed, poured, and stripped over a 2 month period.

Building Envelope

The building envelope is comprised of precast concrete panels and a curved curtain wall system. Therefore, it is essential that the subcontractors for the precast concrete, curtain wall, and elevated concrete slabs coordinate to ensure that critical connections are available to fuse all three systems successfully.

On September 11, 2009 the precast concrete panels were placed using the on site crane, beginning at the northeast edge and continuing around the building in a clockwise-direction. During this time, the curtain wall subcontractor has been placing the curtain wall system with punched-in windows from the northeast edge, however, working in a counter clockwise direction. The curtain wall is being installed from the interior of the building.

After the façade has been installed, the crane will be removed from the site and the 30'x30' section of the floor structure will be formed, poured and finished. Roofing, fire protection and waterproofing activities will also be taking place at the same time in order to meet the watertight milestone date (December 25, 2009) and launch the interior activities of the project.

Interior Work

Miscellaneous metals and the elevator installations begin with the building's interior phase. Metal strips for the concrete stairs are installed with metal railings required for the loading dock and the interior staircase. Meanwhile, elevator layout installation took place on August 4, 2009. It is important for the elevators to be up and running for the interior finishing phase, because they will be used to transfer the clinical equipment and materials. Therefore, testing and commissioning of the elevators is a major responsibility of the elevator subcontractor.

Next, drywall activities begin with metal stud framing of the 1st floor after all of the floors have been stripped and finished. Hanging, taping and finishing the drywall occurs concurrently with the interior finishing activities of the project (November 20, 2009- January 11, 2009).

The MEP is a critical path activity in this project. The MEP rough-ins have a total of 12 major activities; starting with installation of the least-flexible to most-flexible items. Rough-in duration will take about 4 months. A 30 day duration time is used to field-erect the air handling unit, which is placed on the second floor mechanical room. Then HVAC testing and balancing is required to ensure the system's performance. The electrical subcontractor, along with the mechanical and plumbing subcontractor, is in constant communication and coordination to ensure the required fit-outs are completed.

Meanwhile, interior finishing and medical equipment installation is taking place. The sequencing of finishes will begin on November 20, 2009, with a majority of the work done by trade-stacking each of the major clinical rooms. The interior finishes will continue in the same sequence as the building façade: beginning at the northeast and continuing in a clockwise direction in 4 quadrants. Along with interior finishes are the clinical equipment installations, provided by the owner. It is important to make sure that all required electrical hookups are installed and ready to be joined with the medical equipment for a secure installation. The interiors of the building are scheduled to be completed on April 7, 2010 which puts the National Intrepid Center of Excellence substantial completion date on May 10, 2010.

SITE LAYOUT PLANNING

The National Intrepid Center of Excellence will be constructed within the Naval Medical Center site, located on the corner of Rockville Pike and Jones Bridge Road, in Bethesda, Maryland. The campus site is composed of 12 facilities. Even though there are a total of six projects under construction concurrently at the Naval Medical site, NICoE has plenty of room to maneuver within the site (Figure1). As a result, the site logistics were pretty consistent throughout the main construction phases: excavation, substructure and interior work. Material storage, trailers, contractors parking, dumpsters, project fencing/gates, traffic and pedestrian flows remain in consistent locations throughout the duration of the project. The site logistics plan has been put in place by Turner Construction.

Figure 1-National Intrepid Center of Excellence located in Bethesda, MD

Security is a major issue faced by Turner Construction site access. Every laborer on site is required to have a background check, which grants him/ her a name tag. The name tag permits them site access and to work on the project. The security process can affect adversely affect the project schedule since it requires almost an hour per person to obtain security clearance. Also, all visitors are required to be escorted by a team member of Turner Construction if entering the site.

See Appendix B for detailed site layout plans.

As seen in Figure 2, all construction traffic enters and exits the site via South Palmer road. This entrance will also be used as the permanent entrance for the NICoE once the construction is complete. All delivery trucks are brought into the site and travel around the required loop, where they unload their shipments in the proper location.

Turner Construction job trailers are located on the far southwest side of the site. This location was selected since the large empty grassed lot is not used by any other buildings or projects on campus. Limited staff parking is located

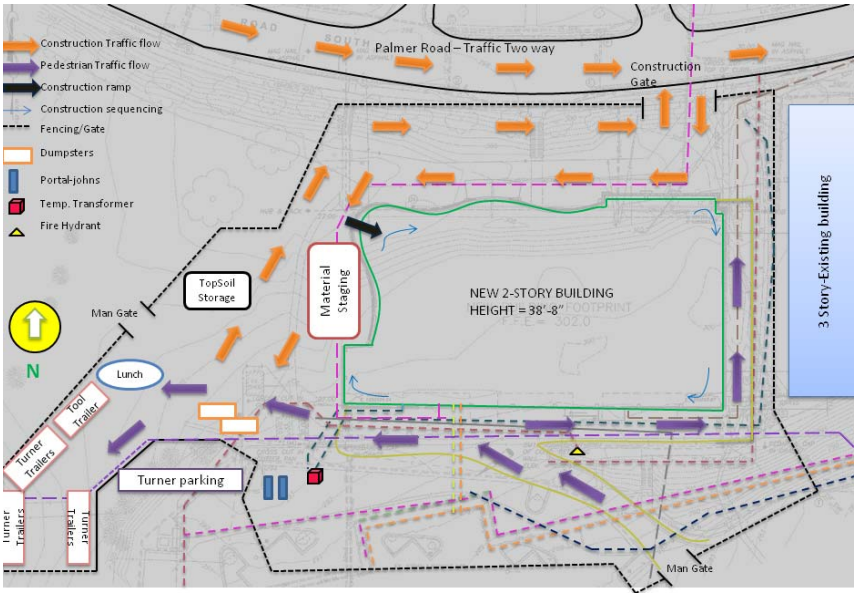


Figure 2-SiteLayout

close to the trailers for convenience. The lunch area, designated for all field laborers, is located adjacent to the job trailers.

Two 30 Yard dumpsters, which hold up to 6 tons of debris total, are located on the southwest side of the site, for easy access to both project laborers and truck routes for weekly dumpster pickups. Material storage is placed on the west side, adjacent to the building footprint and in the range of the crane radius. In addition, a fire hydrant has been installed on the south side of the site for safety.

Finally, a temporary road has been constructed around the west and south sides of the building perimeter to allow for easy workflow around the building. Convenient dumpster locations and pathways ensure that a clean and organized construction site will be maintained at all times.

Excavation Site Layout

The excavation phase for this project is very minimal since most of the spread footings only have a depth of 2.5'. The duration period for this phase is approximately 42 days. The soils that will be removed from this site will be hauled offsite or if found suitable, will be stock piled on the west side of the site for backfill. In order to run temporary power on site, a temporary transformer has been placed on the southwest edge of the building, which ties into existing electrical supply. -

Structure Site Layout

The structural phase of this project consists of a slab-on-grade; the concrete elevated slabs and the building envelope. The crane location and the introduction of a concrete pump are the crucial factors between the excavation and structural site plans of the project. The concrete pump will be utilized to deliver concrete for the 2nd floor and both roof levels. However, the crane was unable to be placed outside of the building due to existing utilities. Instead, it is located on the south side of the building, one column line into the building. This location was chosen based upon allowable reaching distance without swinging over the adjacent 3-story building. The foundation for the crane is 30' square and is placed on the 45 to the column grid so it does not interfere with the building foundation.

Finishing Site Layout

The crane and the concrete pump will be taken off of the site at final phase of the project. A key feature for the site layout is the location of loading docks and material hoists within the building perimeter. The material hoists will be located on the northeast side based upon the finishing sequencing of the construction phase. Loading docks, along with the two main elevators, are used throughout the finishing phase of the project for material transportation and owner equipment installation.

DETAILED STRUCTURAL SYSTEMS ESTIMATE

All take-off calculations for the structural estimate were performed by hand based off of the construction documents and specifications provided by Turner Construction. RS Means 2009, along with MC^2 Estimating Software, were utilized to calculate the cost associated with the structural take-off for the NICoE. The structural system for the NICoE includes:

- Reinforced Concrete Spread Footings
- Concrete Slab-on-Grade
- Reinforced Concrete Round and Square Columns
- Reinforced Concrete Beams
- Reinforced Elevated Concrete Slabs.

Footings and Columns:

The structure of the NICoE is not a uniform structure. It includes 17 different types of footings ranging from 4'-6"x4'-6" x12" to 15'x15'x33". The columns are also composed of 17 different sizes, which vary from exterior 28" diameter round columns with a height of 36'-6", to interior square columns which are 24"x24"x15' (floor height). Given the size variability, a detailed take off for each of the footing and column types was included within the structural estimate.

Concrete Beams:

The structural system used is a flat slab with 8" drop panels. The drop panels are designed to transfer the loads uniformly to the reinforced column strips. Utilizing the drop panels between the columns and the floor slabs minimized the amount of concrete beams needed within the structure of the building. Five types of beams are included to support the structure around the high traffic areas, such as: the central open staircase and two elevators. A detailed take off for each of the beam types were included within the structural estimate.

SOG and Elevated Slabs:

The slab-on-grade is mostly composed of a 5" thick concrete slab. Transitions to a 6" and a 12" thick slab in some spaces were also calculated. As for the 9" thick elevated slabs, the concrete and formwork estimate was done for each floor and roof level.

Concrete Strengths:

The concrete strength for the footing is given as 3000psi. Slab on grade strength is 3500psi. The strength for the concrete columns, reinforced slabs and beams is 4000psi.

Please see Appendix C for detailed structural take-offs.

In order to make the detailed estimate process more efficient the following assumptions were made:

- The reinforcement required for the elevated slabs, beams and columns were estimated by an average area per floor and roof.
- Finishing floor methods is with a manual screed, manual float and broom finish.
- Silver Spring, MD location factor was used since Bethesda's location factor does not exist in RS Means

- Overhead and profit are omitted from the cost estimate
- Formwork, reinforcement and concrete waste factors are omitted from the cost estimate.

See Figure 3 for a summary of the concrete, formwork and reinforcement quantities of the structural system, along with the labor, material and equipment cost associated with the work performed.

Cast In Place Concrete Estimate

CSI Code	Description	Qty	Units	Material Cost	labor Cost	Equipment Cost	Price/Unit	Totalt Cost
03 11 13.20	Form in place, Beams, 12"x 18" beams, 4use	240.00	SFCA	$ 1.40	$ 4.95		$ 6.35	$ 1,524.00
	Form in place, Beams, 24"x 17" beams, 4use	741.00	SFCA	$ 2.80	$ 5.85		$ 8.65	$ 6,409.65
03 11 13.25	Form in place, Columns, 24" diamter, 4use	4115.00	SFCA	$ 18.65	$ 14.25		$ 32.90	$ 135,383.50
	Form in place, Columns, 24" x 24", 4use	11160.00	SFCA	$ 0.81	$ 5.10		$ 5.91	$ 65,955.60
	Form in place, Columns, 16" x 24", 4use	1364.00	SFCA	$ 0.73	$ 5.15		$ 5.88	$ 8,020.32
	Form in place, Columns, 12" x 24", 4use	678.00	SFCA	$ 0.74	$ 6.14		$ 6.88	$ 4,664.64
03 11 13.35	Form In Place Flat Slab,drop panels,job-built plywood, to 15' high,4use	86915.00	S.F	$ 1.55	$ 3.43		$ 4.98	$ 432,836.70
03 11 13.40	Form in place Equipment Foundation	1860.00	SFCA	$ 1.17	$ 9.10		$ 10.27	$ 19,102.20
03 11 13.45	Forms for spread Footing, Job Built Lumber, 4use	4273.00	SFCA	$ 0.70	$ 2.93		$ 3.63	$ 15,510.99
03 11 13.65	Form in place slab on grade, Edge Forms,wood,4use,ongrade, to 6" high	646.00	L.F	$ 0.38	$ 2.02		$ 2.40	$ 1,550.40
	Form in place slab on grade, Edge Forms,wood,4use,ongrade, 7"to12" high	824.00	SFCA	$ 0.74	$ 2.79		$ 3.53	$ 2,908.72
	Form in place slab on grade,For depressed slabs, 4use, to 12" high	204.00	L.F	$ 0.56	$ 4.04		$ 4.60	$ 938.40
03 31 05.35	Normal Wight Concrete, Ready Mix, 3000PSI	486.00	C.Y	$ 101.00			$ 101.00	$ 49,086.00
	Normal Wight Concrete, Ready Mix, 3500PSI	750.00	C.Y	$ 104.00			$ 104.00	$ 78,000.00
	Normal Wight Concrete, Ready Mix, 4000PSI	2772.00	C.Y	$ 106.00			$ 106.00	$ 293,832.00
03 31 05.70	Beams, elevated, small beams, pumped	15.00	C.Y		$ 36.00	$ 13.15	$ 49.15	$ 737.25
	Columns,Square or round, 12" thick,with crane and bucket	10.00	C.Y		$ 61.50	$ 30.00	$ 91.50	$ 915.00
	Columns,Square or round, 18" thick,with crane and bucket	36.00	C.Y		$ 45.00	$ 22.00	$ 67.00	$ 2,412.00
	Columns,Square or round, 24" thick,with crane and bucket	294.00	C.Y		$ 35.00	$ 17.10	$ 52.10	$ 15,317.40
	Elevated slabs, 6" to 10"thick,pumpec	2342.00	C.Y		$ 13.55	$ 4.94	$ 18.49	$ 43,303.58
	Elevated slabs over 10"thick,pumped	63.00	C.Y		$ 12.05	$ 4.39	$ 16.44	$ 1,035.72
	Footings,spread,under 1C.Y, with crane and bucket	5.00	C.Y		$ 55.00	$ 26.50	$ 81.50	$ 407.50
	Footings,spread,over 5C.Y, with crane and bucket	481.00	C.Y		$ 24.50	$ 11.95	$ 36.45	$ 17,532.45
	Slab on grade, up to 6" thick, with crane and bucket	750.00	C.Y		$ 22.50	$ 10.90	$ 33.40	$ 25,050.00
03 35 29.30	Finishing Floors, Manual screed,bull float, manual float & broom finish	114595.00	S.F		$ 0.47		$ 0.47	$ 53,859.65
						Total Cost of Cast in Place Concrete		$ 1,276,293.67

Concrete Reinforcement Estimate

CSI Code	Description	Qty	Units	Material Cost	labor Cost	Equipment Cost	Price/Unit	Totalt Cost
03 21 10.60	Rinforcing in place, Beams and Girders, #8 to #18	1.25	Ton	$ 1,550.00	$ 530.00		$ 2,080.00	$ 2,600.00
	Rinforcing in place, Columns, #8 to #18	119.5	Ton	$ 1,550.00	$ 620.00		$ 2,170.00	$ 259,315.00
	Elevated Slabs, #4 to#7	72.59	Ton	$ 1,650.00	$ 490.00		$ 2,140.00	$ 155,342.60
	6X6 W2.1 x W2.1 WWF 42 lbs per CSF	540	CSF	$ 28.25	$ 21.50		$ 49.75	$ 26,865.00
	Footings, #4 to #7	5.68	Ton	$ 1,475.00	$ 680.00		$ 2,155.00	$ 12,240.40
	Footings, #8 to #18	4.62	Ton	$ 1,400.00	$ 395.00		$ 1,795.00	$ 8,292.90
						Total Cost of Reinforcement in Concrete:		$ 464,655.90

Figure 3 – Cast-In-Place Concrete and Reinforcement Estimates

The total estimate of the structural system for the NICoE is $1,559,960 ($1,733,289 *0.9(location factor)).

This project is a 100% donated project from both private and public sectors. Subcontractors are heavily involved in donating both materials and labor for this project. Therefore, the actual cost for the structural system is not provided. As a result, the detailed structural estimate is compared to the RS Means CostWorks breakdown estimate of $1,672,950, calculated in Technical Assignment 1. This number is very close, only with a difference of 7.2%. Also, comparing the hand takeoff from the 2009 RS Means estimate to the MC^2 Estimating Software report included in Appendix B, the numbers are again close with a percent difference of 6.8%.

GENERAL CONDITIONS ESTIMATE

Turner Construction's typical list of items included within their General Conditions estimate is represented by this GC estimate for the NICoE. This list is broken into 5 categories: Project management / coordination, temporary services, construction facilities, general conditions, and insurance/bonds/testing and inspections. On the list of the GC items, RS Means Building Cost data 2009 was used to calculate the unit cost per item. Each calculated cost of was based on a 9 month design phase (40weeks) and a 16 month construction period (73weeks). The total general condition estimate is about $1.7Million (4% of the building cost). Like most general conditions estimate, the salaries for the project management and site supervision team makes up a large portion of the cost. In addition, an examination of the project and construction site location aided in determining the necessary items to include in the estimate.

The following assumptions were made throughout the estimate:

- RS Means 2009 was used to derive individual staffing salaries for the job.
- When staff salaries were not avaliable in RS Means, a 10% increase was used for each of the respective levels.
- Staffing durations are based off of the start dates on the job (Information received from Turner Construction)

Project Staff	%on PreCon	%on Construction phase	Results weeks
Project Manager	75	100	103.00
BIM Coordinator	100	20	54.60
Safety Manager	0	100	73.00
Superintendent	25	100	83.00
Superintendent2	0	100	73.00
Project Engineer	50	100	93.00
Ass. Superintendent	0	100	73.00
Ass. Engineer	35	100	87.00
Ass. Engineer2	0	100	73.00

A summary of the General Conditions cost estimate includes:

- Project management and coordination: $1,509,995.00
- Temporary services: $61,911.00
- Construction Facilities: $28,170.00
- General conditions: $72,964.00
- Insurance/Bonds/Testing & Inspections: $135,250.00

A detailed breakdown of the General conditons is seen in Figure 4.

General Condition Estimate						
	Description	Qty.	Units	Unit price		Total Cost
Project Management and Coordination						
Project Staff						
	Project Manager	103.00	Wks	$2,975	$ 306,425.00	$306,425.00
	BIM Coordinator	54.60	Wks	$1,950	$ 106,470.00	$106,470.00
	Safety Manager	73.00	Wks	$2,100	$ 153,300.00	$153,300.00
	Superintendent	83.00	Wks	$2,750	$ 228,250.00	$228,250.00
	Superintendent2	73.00	Wks	$2,750	$ 200,750.00	$200,750.00
	Project Engineer	93.00	Wks	$1,800	$ 167,400.00	$167,400.00
	Ass. Superintendent	73.00	Wks	$1,800	$ 131,400.00	$131,400.00
	Ass. Engineer	87.00	Wks	$1,350	$ 117,450.00	$117,450.00
	Ass. Engineer2	73.00	Wks	$1,350	$ 98,550.00	$98,550.00
						$1,509,995.00
Temporary Services						
Project Utilities						
	Temp. Lighting	720	Csf flr	$19.35	$13,932.00	$41,796.00
	Temp. Electricity	12	Wks	$51.70	$620.40	$620.40
Protection						
	Chain Link fence	1560 LF	Month	$11.15	$17,394.00	$17,394.00
	safety Signs	120	SF	$17.50	$2,100.00	$2,100.00
						$61,910.40
Construction Facilities						
Facilities						
	3Job office Trailers	16	month	$455.00	$21,840.00	$21,840.00
	Office Equipment	16	month	$171.00	$2,736.00	$2,736.00
	Office Supplies	16	month	$93.50	$1,496.00	$1,496.00
	Telephones/Fax	16	month	$88.00	$1,408.00	$1,408.00
	Site Signage	30	SF	$23.00	$690.00	$690.00
						$28,170.00
General Conditions						
	Dumpsters	1	Wks	$500.00	$36,500.00	$36,500.00
	Continuous Cleanup	72	MSF	$40.50	$2,916.00	$2,916.00
	Final Cleanup	72	MSF	$84.00	$6,048.00	$6,048.00
	Punchlist,Etc.	1	Each	$5,500.00	$5,500.00	$5,500.00
	Temp. Roads		Lump Sum			$22,000.00
						$72,964.00
Insurance/Bonds/Testing & Inspections						
	Performance Bond		Job	1%	65000	$65,000.00
	Liability Insurance		Job	1%	65000	$65,000.00
	Inspectors	15	days	$350.00	$5,250.00	$5,250.00
						$135,250.00
	General Conditions Subtotalt					$1,673,039.40

Figure 4- General Conditions Estimate

CRITICAL INDUSTRY ISSUES

On October 26, 2009, the Penn State AE depatment launched the 18th Annual PACE Roundtable event at the Penn stater in State College, PA. Undergraduate and graduate students, as well as professors and industry members attended the event. The day consisted of an industry panel discussion, three breakout sessions, and ending with a student panel group discussion. The main topics discussed included: affects of the economic downturns in the construction industry, Energy and the Construction Industy, Business and Networking, BIM Executive Planning, and the communication landscape of this generation.

Industry Panel: State of Construction

The purpose for this discussion was to provide leaders in the building industry an opportunity to share their observations of the economic downturn impact on the construction industry. They also shared some working strategies currently in use that are helping to make projects more successful.

This panel included 5 industry members from different companies. Each began with sharing their thoughts and views on the economic impacts to their company and how it is changing the way they receive and do work on a daily basis. The economy has had an obvious impact on the construction industry.

One of the most noticable outcomes has been an increase in competition between companies on bid days. This results from an increasing number of smaller companies bidding on projects in markets that they have little to no experience in. For those companies, their risky strategy is to bid more often to be able to keep cashflow on a consistent level.

Another outcome is the decrease in construction fees. Profits are depending more on how good a team is able to deliver projects under budget and on-time. Many panels members have noted that new technology is an effective way to differentiate companies from their competitors. After the industry panel leaders provided their input, the audience was given the oppotunity to question about insights on what to expect from a future economic turnaround.

Technical Sessions :

Three critical technical industry issues were discussed at the PACE Roundtable event. These isses were: Energy and the Construction Industy, Business and Networking, and BIM Executive Planning. At this event, I choose to attend the BIM Executive Planning break-out session, which included industry memebers from Barton Malow Company, Gilbane Building Company, Clark Construction, Balfour Beatty Construction, and Truland Systems Corporation.

BIM Summary

Most of the companies currently using BIM use the software for: design coordination, document control, 3D MEP coordination, and cost estiamting. Successfully implementing BIM can speed up coordination of the contruction process, which in turn results in a cost savings up to millions of dollars. Despite the increased knowledge of BIM benefits, there are several issues faced by the industry concerning the BIM process. The following questions were raised during the session:

- Who all should be involved in the BIM process? What subcontractors do we include or not include?

- How to utilize young educated students, who are considered to have a strong technical background but no construction field experience. Will they be considered adaquate project BIM modelers?
- In what stage of the BIM process does the model get turned over to the contractor?
- How are time and cost benfits calculated for the BIM coordination meetings being held on the project?
- How do we engage subcontractors and manufacturers to implement BIM technology?
- How detailed should the models be?

Some of these questions can be answered using the Project Execution Planning Guide, which has been released to the public by Dr. Mesner and his fellow reseachers. The Guide breaks down the procedures of implementing BIM into 4 procedures on a construction proejct. The 4 procedures include: Identifiying the BIM goals and uses, designing BIM project execution process, developing information exchange requirements , and defining support infrastructure for BIM implementations. This guide serves as a promising start for the industry to begin comfortably using BIM on a fundamental and wide-scale basis. In addition, IFC-industry Foundation Classes, which are apart of "BuildingSMART" is currently working on BIM standerization plans. This will help ease some industry issues conserning the usage of BIM.

Suprising Facts

The lack of familiarity with the BIM technology among the industry memebers in this discussion surprised me the most. The students seemed to have a better grasp on this technology than some of the industry leaders in the room. Also, there were smaller subcontractor companies in the room who outright opposed the usage of BIM due to lack of funding, knowledge or incentive for them to implement the new technology. Finally, there was a brief discussion on design repetition in the construction industry. Design drawings are being redesigned by the subcontractors, which have a better grasp on the construction side of the project.

Overall, the Industry memebers were eager to hear from students about the current research with BIM and ways to further incorporate BIM into their company.

Thesis Relevance

The project team for National Intrepid Center of Excellence uses BIM modeling for 3D coordinations with MEP and structural designs. A dedicated BIM coordinator is assigned to hold weekly meetings with the MEP and structural subcontractors on the job. During these meetings, clash detections are run between the designs and corrective action for these clashes are assigned to each of the subcontractors. After speaking with project team, it appears that BIM successfully continues to save money and time on this project.

One very helpful topic that may be applied to my thesis project is the implementation of BIM as a facility management and document control tool. RFI's and submittals could be tracked within the model as opposed to relying on a shared filing system. This can be very helpful in many aspects of the project. For instance, the material status can be immediately tracked with a click of a button. The model can also be used as a facility management tool when transferring the model to the owner. It can simply be used as a maintenance and operation tool. The equipment used in this building is essential to the operation of the building itself. Using the model as a facility mangement tool will can expedite the mantaince process as whole.

Key Contacts

One of the main industry memebers within the BIM Execution Planning session that I hope to gain additional information from is Tyler Swartzwelder, Gilbane Building Company. Tyler is a Penn State AE graduate, 2007. He is on a project that is implementing BIM and is curently discussing the usage of the model for a document control purposes.

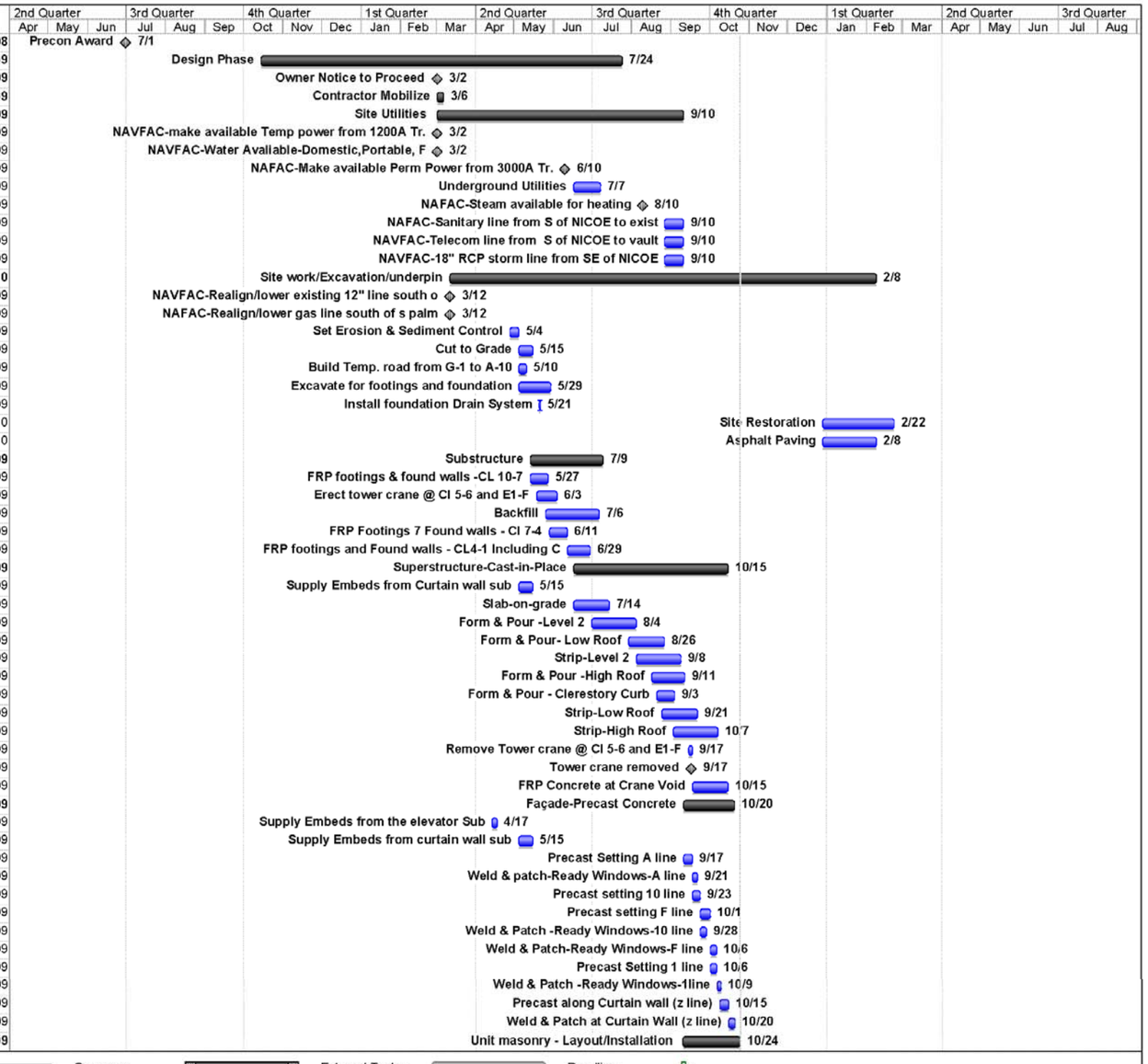
Another company I hope to gather information from is Turner Construction and their BIM department. After speaking to Keith Knarr (Turner's PACE attendee) and David Wysong(NICoE's Project Manager), they strongly recommended me to their BIM department since they are currently discussing the usage of the model as a facility management tool.

Student Panel Discuisson :

The event came to a close with a small student panel discussion concerning the communication landscape of this generation. Five students shared their thoughts on social networking sites such as Twitter and facebook, and how they are being increasingly used as a way of communication. Blackberries, Gmail, and other new technologies allow for faster and more efficient means of exchanging information. Finally, the industry memebers had a chance to provide insight on the roles these communication patterns have in the professional workplace.

APPENDIX A

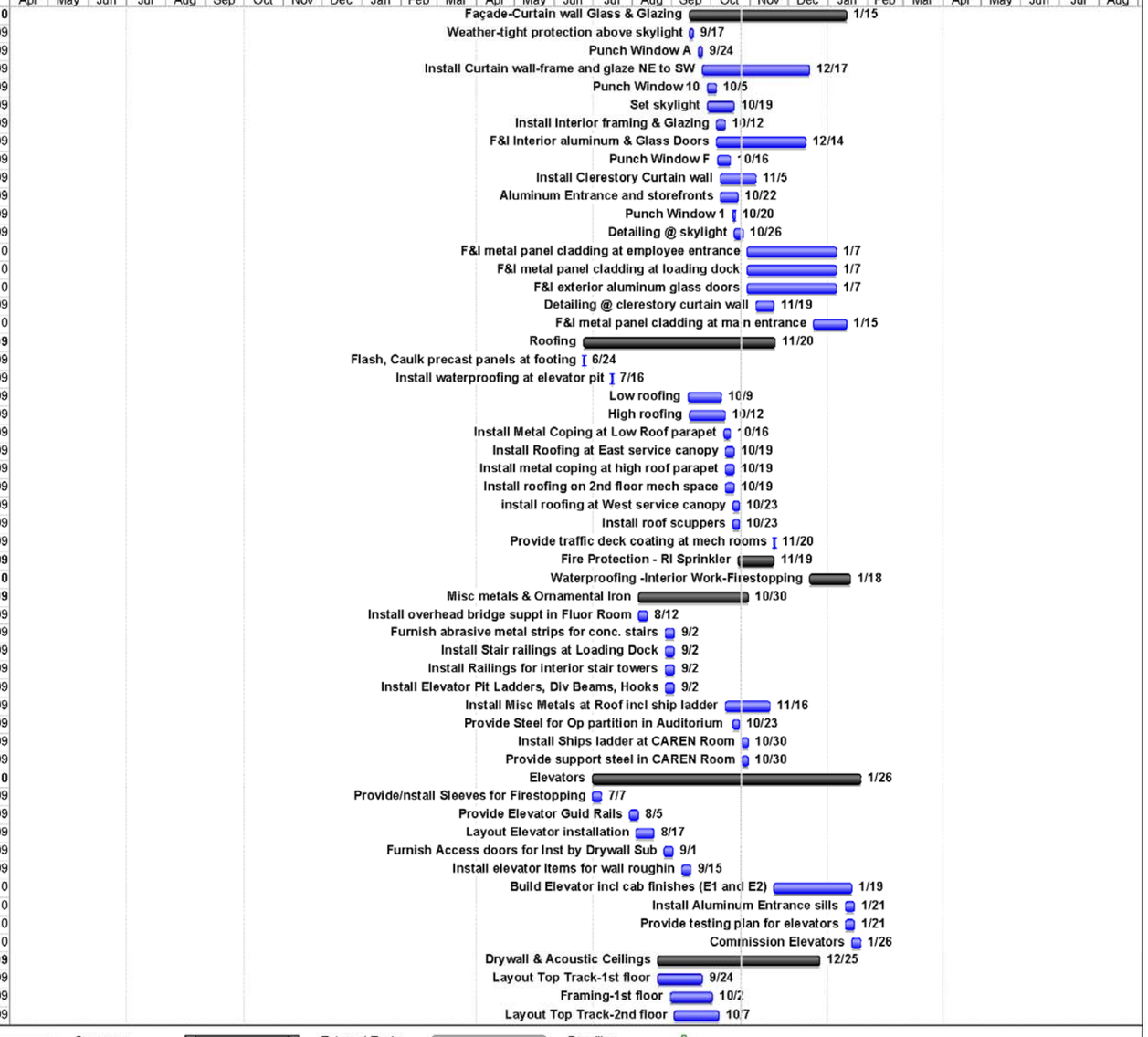
ID	Task Name	Duration	Start	Finish
1	**Precon Award**	**0 days**	**Tue 7/1/08**	**Tue 7/1/08**
2	**Design Phase**	**204 days**	**Wed 10/15/08**	**Fri 7/24/09**
3	**Owner Notice to Proceed**	**0 days**	**Mon 3/2/09**	**Mon 3/2/09**
4	**Contractor Mobilize**	**5 days**	**Mon 3/2/09**	**Fri 3/6/09**
5	**Site Utilities**	**140 days**	**Mon 3/2/09**	**Thu 9/10/09**
8	NAVFAC-make available Temp power from 1200A Tr.	0 days	Mon 3/2/09	Mon 3/2/09
9	NAVFAC-Water Avaliable-Domestic,Portable, F	0 days	Mon 3/2/09	Mon 3/2/09
10	NAFAC-Make available Perm Power from 3000A Tr.	0 days	Wed 6/10/09	Wed 6/10/09
11	Underground Utilities	15 days	Wed 6/17/09	Tue 7/7/09
12	NAFAC-Steam available for heating	0 days	Mon 8/10/09	Mon 8/10/09
13	NAFAC-Sanitary line from S of NICOE to exist	11 days?	Thu 8/27/09	Thu 9/10/09
14	NAVFAC-Telecom line from S of NICOE to vault	11 days?	Thu 8/27/09	Thu 9/10/09
15	NAVFAC-18" RCP storm line from SE of NICOE	11 days?	Thu 8/27/09	Thu 9/10/09
16	**Site work/Excavation/underpin**	**239 days**	**Thu 3/12/09**	**Mon 2/8/10**
17	NAVFAC-Realign/lower existing 12" line south o	0 days	Thu 3/12/09	Thu 3/12/09
18	NAFAC-Realign/lower gas line south of s palm	0 days	Thu 3/12/09	Thu 3/12/09
19	Set Erosion & Sediment Control	5 days	Tue 4/28/09	Mon 5/4/09
20	Cut to Grade	10 days	Tue 5/5/09	Fri 5/15/09
21	Build Temp. road from G-1 to A-10	5 days	Tue 5/5/09	Sun 5/10/09
22	Excavate for footings and foundation	20 days	Tue 5/5/09	Fri 5/29/09
23	Install foundation Drain System	1 day	Thu 5/21/09	Thu 5/21/09
24	Site Restoration	40 days	Tue 12/29/09	Mon 2/22/10
25	Asphalt Paving	30 days	Tue 12/29/09	Mon 2/8/10
26	**Substructure**	**41 days**	**Thu 5/14/09**	**Thu 7/9/09**
27	FRP footings & found walls -CL 10-7	10 days	Thu 5/14/09	Wed 5/27/09
28	Erect tower crane @ Cl 5-6 and E1-F	12 days	Tue 5/19/09	Wed 6/3/09
29	Backfill	30 days	Tue 5/26/09	Mon 7/6/09
30	FRP Footings 7 Found walls - Cl 7-4	10 days	Fri 5/29/09	Thu 6/11/09
31	FRP footings and Found walls - CL4-1 Including C	12 days	Fri 6/12/09	Mon 6/29/09
32	**Superstructure-Cast-in-Place**	**87 days**	**Wed 6/17/09**	**Thu 10/15/09**
33	Supply Embeds from Curtain wall sub	10 days	Tue 5/5/09	Fri 5/15/09
34	Slab-on-grade	20 days	Wed 6/17/09	Tue 7/14/09
35	Form & Pour -Level 2	25 days	Wed 7/1/09	Tue 8/4/09
36	Form & Pour- Low Roof	20 days	Thu 7/30/09	Wed 8/26/09
37	Strip-Level 2	25 days	Wed 8/5/09	Tue 9/8/09
38	Form & Pour -High Roof	20 days	Mon 8/17/09	Fri 9/11/09
39	Form & Pour - Clerestory Curb	10 days	Fri 8/21/09	Thu 9/3/09
40	Strip-Low Roof	20 days	Tue 8/25/09	Mon 9/21/09
41	Strip-High Roof	25 days	Thu 9/3/09	Wed 10/7/09
42	Remove Tower crane @ Cl 5-6 and E1-F	3 days	Tue 9/15/09	Thu 9/17/09
43	Tower crane removed	0 days	Thu 9/17/09	Thu 9/17/09
44	FRP Concrete at Crane Void	20 days	Fri 9/18/09	Thu 10/15/09
45	**Façade-Precast Concrete**	**28 days**	**Fri 9/11/09**	**Tue 10/20/09**
46	Supply Embeds from the elevator Sub	4 days	Tue 4/14/09	Fri 4/17/09
47	Supply Embeds from curtain wall sub	10 days	Tue 5/5/09	Fri 5/15/09
48	Precast Setting A line	5 days	Fri 9/11/09	Thu 9/17/09
49	Weld & patch-Ready Windows-A line	2 days	Fri 9/18/09	Mon 9/21/09
50	Precast setting 10 line	4 days	Fri 9/18/09	Wed 9/23/09
51	Precast setting F line	6 days	Thu 9/24/09	Thu 10/1/09
52	Weld & Patch -Ready Windows-10 line	3 days	Thu 9/24/09	Mon 9/28/09
53	Weld & Patch-Ready Windows-F line	3 days	Fri 10/2/09	Tue 10/6/09
54	Precast Setting 1 line	3 days	Fri 10/2/09	Tue 10/6/09
55	Weld & Patch -Ready Windows-1line	3 days	Wed 10/7/09	Fri 10/9/09
56	Precast along Curtain wall (z line)	5 days	Fri 10/9/09	Thu 10/15/09
57	Weld & Patch at Curtain Wall (z line)	3 days	Fri 10/16/09	Tue 10/20/09
58	**Unit masonry - Layout/Installation**	**32 days**	**Thu 9/10/09**	**Sat 10/24/09**



Project: DetailedprojectSchedule.mpp
Date: Sun 10/25/09

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

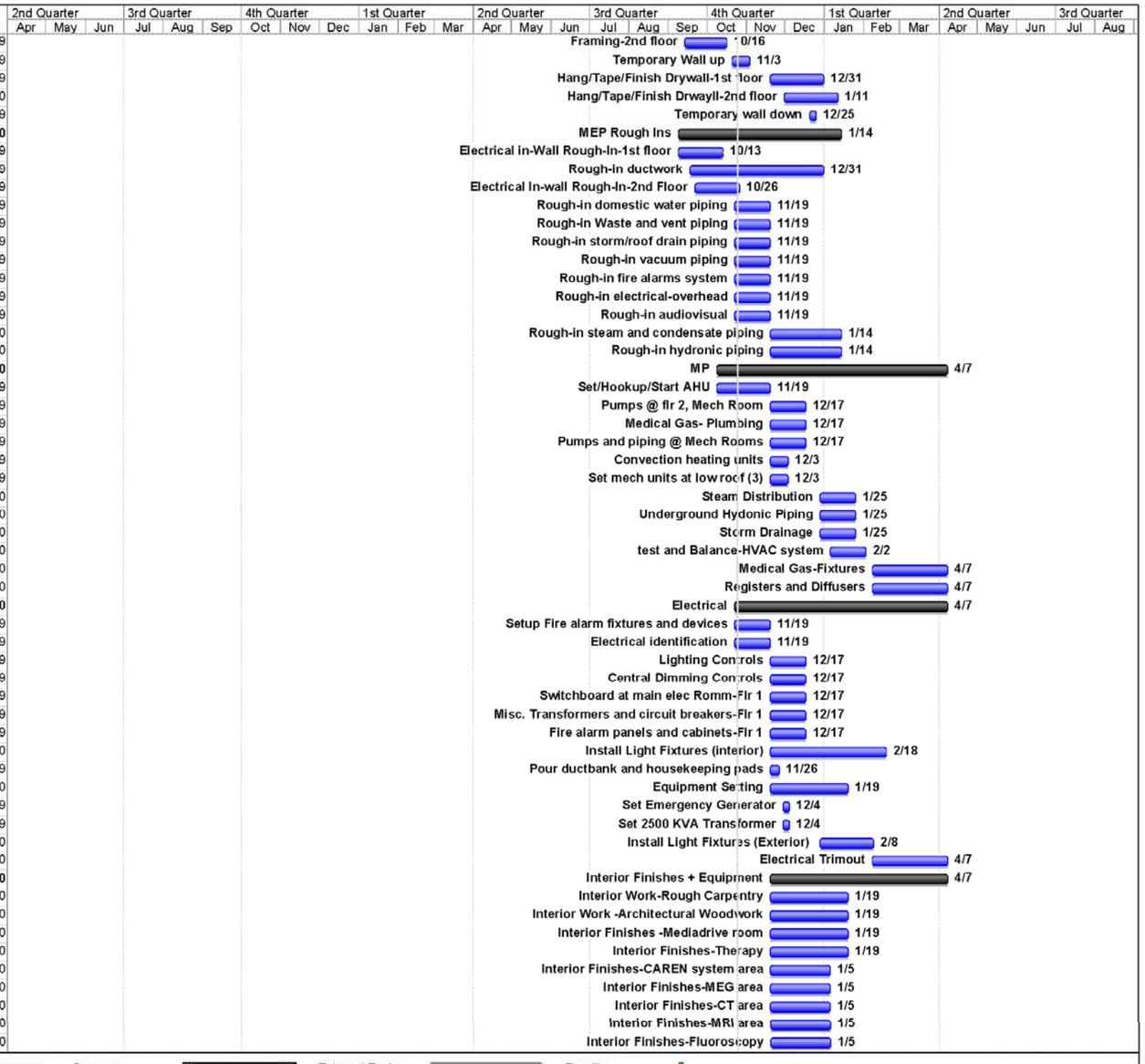
ID	Task Name	Duration	Start	Finish
59	**Façade-Curtain wall Glass & Glazing**	**89 days?**	**Tue 9/15/09**	**Fri 1/15/10**
60	Weather-tight protection above skylight	3 days	Tue 9/15/09	Thu 9/17/09
61	Punch Window A	3 days	Tue 9/22/09	Thu 9/24/09
62	Install Curtain wall-frame and glaze NE to SW	60 days	Fri 9/25/09	Thu 12/17/09
63	Punch Window 10	5 days	Tue 9/29/09	Mon 10/5/09
64	Set skylight	15 days	Tue 9/29/09	Mon 10/19/09
65	Install Interior framing & Glazing	5 days	Tue 10/6/09	Mon 10/12/09
66	F&I Interior aluminum & Glass Doors	50 days	Tue 10/6/09	Mon 12/14/09
67	Punch Window F	8 days	Wed 10/7/09	Fri 10/16/09
68	Install Clerestory Curtain wall	20 days	Fri 10/9/09	Thu 11/5/09
69	Aluminum Entrance and storefronts	10 days	Fri 10/9/09	Thu 10/22/09
70	Punch Window 1	2 days	Mon 10/19/09	Tue 10/20/09
71	Detailing @ skylight	5 days	Tue 10/20/09	Mon 10/26/09
72	F&I metal panel cladding at employee entrance	50 days	Fri 10/30/09	Thu 1/7/10
73	F&I metal panel cladding at loading dock	50 days	Fri 10/30/09	Thu 1/7/10
74	F&I exterior aluminum glass doors	50 days	Fri 10/30/09	Thu 1/7/10
75	Detailing @ clerestory curtain wall	10 days	Fri 11/6/09	Thu 11/19/09
76	F&I metal panel cladding at main entrance	20 days	Mon 12/21/09	Fri 1/15/10
77	**Roofing**	**108 days?**	**Wed 6/24/09**	**Fri 11/20/09**
78	Flash, Caulk precast panels at footing	1 day	Wed 6/24/09	Wed 6/24/09
79	Install waterproofing at elevator pit	1 day	Thu 7/16/09	Thu 7/16/09
80	Low roofing	20 days	Mon 9/14/09	Fri 10/9/09
81	High roofing	20 days	Tue 9/15/09	Mon 10/12/09
82	Install Metal Coping at Low Roof parapet	5 days	Mon 10/12/09	Fri 10/16/09
83	Install Roofing at East service canopy	5 days	Tue 10/13/09	Mon 10/19/09
84	Install metal coping at high roof parapet	5 days	Tue 10/13/09	Mon 10/19/09
85	Install roofing on 2nd floor mech space	5 days	Tue 10/13/09	Mon 10/19/09
86	install roofing at West service canopy	5 days	Mon 10/19/09	Fri 10/23/09
87	Install roof scuppers	5 days	Mon 10/19/09	Fri 10/23/09
88	Provide traffic deck coating at mech rooms	1 day	Fri 11/20/09	Fri 11/20/09
89	**Fire Protection - RI Sprinkler**	**20 days**	**Fri 10/23/09**	**Thu 11/19/09**
90	**Waterproofing -Interior Work-Firestopping**	**22 days**	**Fri 12/18/09**	**Mon 1/18/10**
91	**Misc metals & Ornamental Iron**	**62 days?**	**Thu 8/6/09**	**Fri 10/30/09**
92	Install overhead bridge suppt in Fluor Room	5 days	Thu 8/6/09	Wed 8/12/09
93	Furnish abrasive metal strips for conc. stairs	5 days	Thu 8/27/09	Wed 9/2/09
94	Install Stair railings at Loading Dock	5 days	Thu 8/27/09	Wed 9/2/09
95	Install Railings for interior stair towers	5 days	Thu 8/27/09	Wed 9/2/09
96	Install Elevator Pit Ladders, Div Beams, Hooks	5 days	Thu 8/27/09	Wed 9/2/09
97	Install Misc Metals at Roof incl ship ladder	25 days	Tue 10/13/09	Mon 11/16/09
98	Provide Steel for Op partition in Auditorium	5 days	Mon 10/19/09	Fri 10/23/09
99	Install Ships ladder at CAREN Room	5 days	Mon 10/26/09	Fri 10/30/09
100	Provide support steel in CAREN Room	5 days	Mon 10/26/09	Fri 10/30/09
101	**Elevators**	**150 days?**	**Wed 7/1/09**	**Tue 1/26/10**
102	Provide/nstall Sleeves for Firestopping	5 days	Wed 7/1/09	Tue 7/7/09
103	Provide Elevator Guid Rails	5 days	Thu 7/30/09	Wed 8/5/09
104	Layout Elevator installation	10 days	Tue 8/4/09	Mon 8/17/09
105	Furnish Access doors for Inst by Drywall Sub	5 days	Wed 8/26/09	Tue 9/1/09
106	Install elevator Items for wall roughin	5 days	Wed 9/9/09	Tue 9/15/09
107	Build Elevator incl cab finishes (E1 and E2)	43 days	Fri 11/20/09	Tue 1/19/10
108	Install Aluminum Entrance sills	5 days	Fri 1/15/10	Thu 1/21/10
109	Provide testing plan for elevators	5 days	Fri 1/15/10	Thu 1/21/10
110	Commission Elevators	5 days	Wed 1/20/10	Tue 1/26/10
111	**Drywall & Acoustic Ceilings**	**91 days?**	**Fri 8/21/09**	**Fri 12/25/09**
112	Layout Top Track-1st floor	25 days	Fri 8/21/09	Thu 9/24/09
113	Framing-1st floor	25 days	Mon 8/31/09	Fri 10/2/09
114	Layout Top Track-2nd floor	25 days	Thu 9/3/09	Wed 10/7/09



Project: DetailedprojectSchedule.mpp
Date: Sun 10/25/09

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

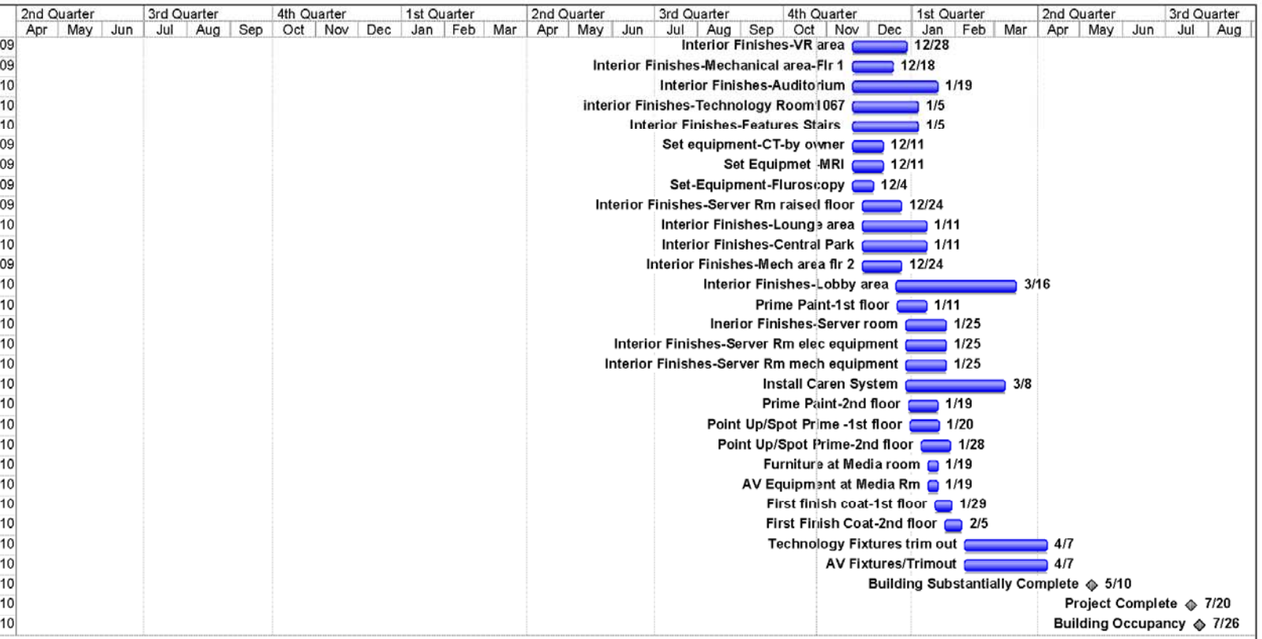
ID	Task Name	Duration	Start	Finish
115	Framing-2nd floor	25 days	Mon 9/14/09	Fri 10/16/09
116	Temporary Wall up	10 days	Wed 10/21/09	Tue 11/3/09
117	Hang/Tape/Finish Drywall-1st floor	30 days	Fri 11/20/09	Thu 12/31/09
118	Hang/Tape/Finish Drwayll-2nd floor	30 days	Tue 12/1/09	Mon 1/11/10
119	Temporary wall down	5 days	Mon 12/21/09	Fri 12/25/09
120	**MEP Rough Ins**	**92 days?**	**Wed 9/9/09**	**Thu 1/14/10**
158	Electrical in-Wall Rough-In-1st floor	25 days	Wed 9/9/09	Tue 10/13/09
157	Rough-in ductwork	75 days	Fri 9/18/09	Thu 12/31/09
159	Electrical In-wall Rough-In-2nd Floor	25 days	Tue 9/22/09	Mon 10/26/09
153	Rough-in domestic water piping	20 days	Fri 10/23/09	Thu 11/19/09
154	Rough-in Waste and vent piping	20 days	Fri 10/23/09	Thu 11/19/09
155	Rough-in storm/roof drain piping	20 days	Fri 10/23/09	Thu 11/19/09
156	Rough-in vacuum piping	20 days	Fri 10/23/09	Thu 11/19/09
160	Rough-in fire alarms system	20 days	Fri 10/23/09	Thu 11/19/09
161	Rough-in electrical-overhead	20 days	Fri 10/23/09	Thu 11/19/09
162	Rough-in audiovisual	20 days	Fri 10/23/09	Thu 11/19/09
163	Rough-in steam and condensate piping	40 days	Fri 11/20/09	Thu 1/14/10
164	Rough-in hydronic piping	40 days	Fri 11/20/09	Thu 1/14/10
165	**MP**	**129 days**	**Fri 10/9/09**	**Wed 4/7/10**
166	Set/Hookup/Start AHU	30 days	Fri 10/9/09	Thu 11/19/09
167	Pumps @ flr 2, Mech Room	20 days	Fri 11/20/09	Thu 12/17/09
168	Medical Gas- Plumbing	20 days	Fri 11/20/09	Thu 12/17/09
169	Pumps and piping @ Mech Rooms	20 days	Fri 11/20/09	Thu 12/17/09
170	Convection heating units	10 days	Fri 11/20/09	Thu 12/3/09
171	Set mech units at low roof (3)	10 days	Fri 11/20/09	Thu 12/3/09
172	Steam Distribution	20 days	Tue 12/29/09	Mon 1/25/10
173	Underground Hydonic Piping	20 days	Tue 12/29/09	Mon 1/25/10
174	Storm Drainage	20 days	Tue 12/29/09	Mon 1/25/10
175	test and Balance-HVAC system	20 days	Wed 1/6/10	Tue 2/2/10
176	Medical Gas-Fixtures	43 days	Mon 2/8/10	Wed 4/7/10
177	Registers and Diffusers	43 days	Mon 2/8/10	Wed 4/7/10
178	**Electrical**	**119 days**	**Fri 10/23/09**	**Wed 4/7/10**
179	Setup Fire alarm fixtures and devices	20 days	Fri 10/23/09	Thu 11/19/09
180	Electrical identification	20 days	Fri 10/23/09	Thu 11/19/09
181	Lighting Controls	20 days	Fri 11/20/09	Thu 12/17/09
182	Central Dimming Controls	20 days	Fri 11/20/09	Thu 12/17/09
183	Switchboard at main elec Romm-Flr 1	20 days	Fri 11/20/09	Thu 12/17/09
184	Misc. Transformers and circuit breakers-Flr 1	20 days	Fri 11/20/09	Thu 12/17/09
185	Fire alarm panels and cabinets-Flr 1	20 days	Fri 11/20/09	Thu 12/17/09
186	Install Light Fixtures (interior)	65 days	Fri 11/20/09	Thu 2/18/10
187	Pour ductbank and housekeeping pads	5 days	Fri 11/20/09	Thu 11/26/09
188	Equipment Setting	43 days	Fri 11/20/09	Tue 1/19/10
189	Set Emergency Generator	5 days	Mon 11/30/09	Fri 12/4/09
190	Set 2500 KVA Transformer	5 days	Mon 11/30/09	Fri 12/4/09
191	Install Light Fixtures (Exterior)	30 days	Tue 12/29/09	Mon 2/8/10
192	Electrical Trimout	43 days	Mon 2/8/10	Wed 4/7/10
193	**Interior Finishes + Equipment**	**99 days?**	**Fri 11/20/09**	**Wed 4/7/10**
194	Interior Work-Rough Carpentry	43 days	Fri 11/20/09	Tue 1/19/10
195	Interior Work -Architectural Woodwork	43 days	Fri 11/20/09	Tue 1/19/10
126	Interior Finishes -Mediadrive room	43 days	Fri 11/20/09	Tue 1/19/10
127	Interior Finishes-Therapy	43 days	Fri 11/20/09	Tue 1/19/10
128	Interior Finishes-CAREN system area	33 days	Fri 11/20/09	Tue 1/5/10
129	Interior Finishes-MEG area	33 days	Fri 11/20/09	Tue 1/5/10
130	Interior Finishes-CT area	33 days	Fri 11/20/09	Tue 1/5/10
131	Interior Finishes-MRI area	33 days	Fri 11/20/09	Tue 1/5/10
132	Interior Finishes-Fluoroscopy	33 days	Fri 11/20/09	Tue 1/5/10



Project: DetailedprojectSchedule.mpp
Date: Sun 10/25/09

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

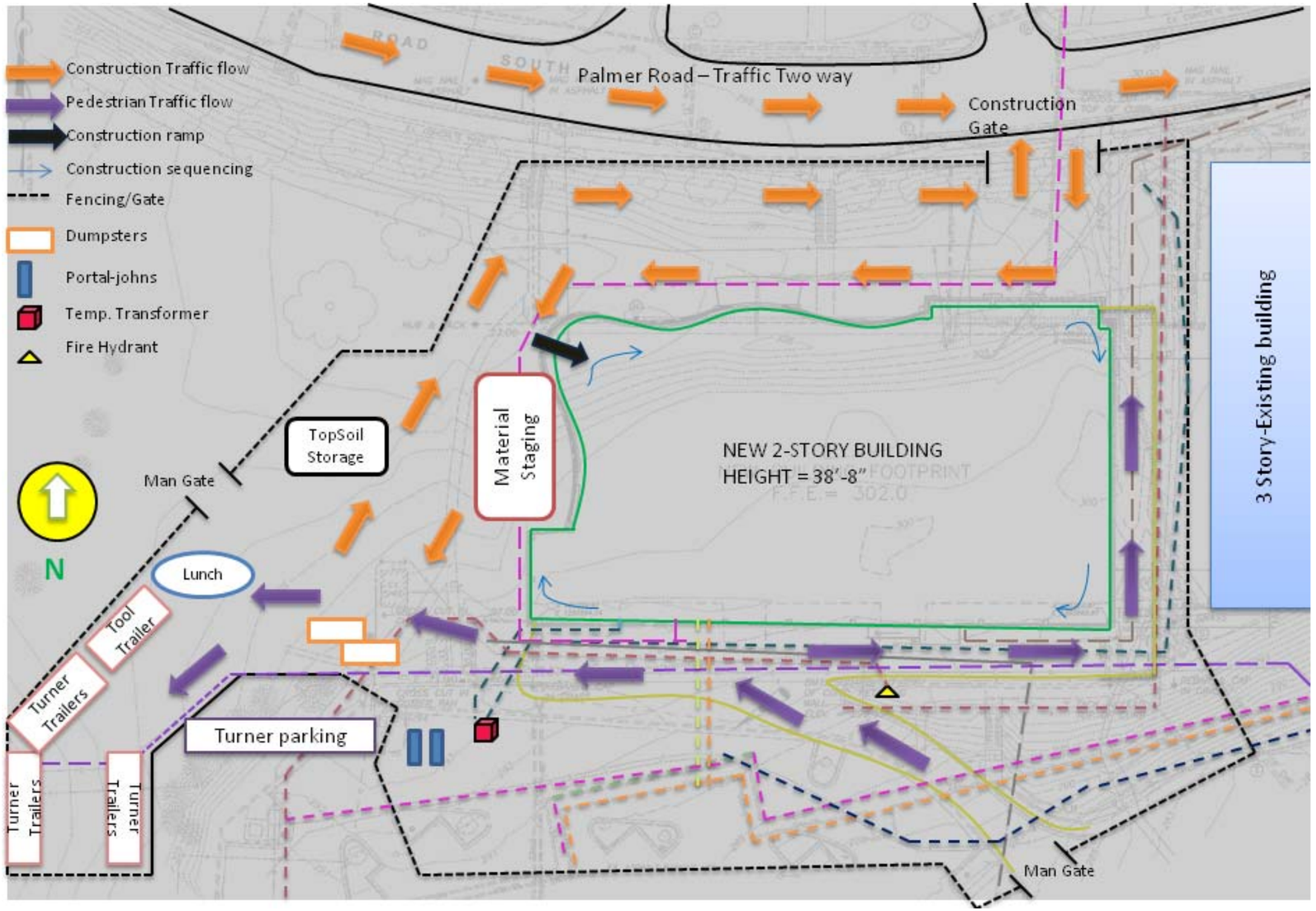
ID	Task Name	Duration	Start	Finish
133	Interior Finishes-VR area	27 days	Fri 11/20/09	Mon 12/28/09
134	Interior Finishes-Mechanical area-Flr 1	21 days	Fri 11/20/09	Fri 12/18/09
135	Interior Finishes-Auditorium	43 days	Fri 11/20/09	Tue 1/19/10
136	interior Finishes-Technology Room1067	33 days	Fri 11/20/09	Tue 1/5/10
137	Interior Finishes-Features Stairs	33 days	Fri 11/20/09	Tue 1/5/10
138	Set equipment-CT-by owner	16 days?	Fri 11/20/09	Fri 12/11/09
139	Set Equipmet -MRI	16 days?	Fri 11/20/09	Fri 12/11/09
140	Set-Equipment-Fluroscopy	11 days	Fri 11/20/09	Fri 12/4/09
141	Interior Finishes-Server Rm raised floor	20 days?	Fri 11/27/09	Thu 12/24/09
142	Interior Finishes-Lounge area	32 days	Fri 11/27/09	Mon 1/11/10
143	Interior Finishes-Central Park	32 days	Fri 11/27/09	Mon 1/11/10
144	Interior Finishes-Mech area flr 2	20 days	Fri 11/27/09	Thu 12/24/09
145	Interior Finishes-Lobby area	62 days	Mon 12/21/09	Tue 3/16/10
146	Prime Paint-1st floor	15 days	Tue 12/22/09	Mon 1/11/10
147	Inerior Finishes-Server room	21 days	Mon 12/28/09	Mon 1/25/10
148	Interior Finishes-Server Rm elec equipment	21 days	Mon 12/28/09	Mon 1/25/10
149	Interior Finishes-Server Rm mech equipment	21 days	Mon 12/28/09	Mon 1/25/10
150	Install Caren System	51 days?	Mon 12/28/09	Mon 3/8/10
121	Prime Paint-2nd floor	15 days	Wed 12/30/09	Tue 1/19/10
122	Point Up/Spot Prime -1st floor	15 days	Thu 12/31/09	Wed 1/20/10
123	Point Up/Spot Prime-2nd floor	15 days	Fri 1/8/10	Thu 1/28/10
6	Furniture at Media room	5 days?	Wed 1/13/10	Tue 1/19/10
151	AV Equipment at Media Rm	5 days	Wed 1/13/10	Tue 1/19/10
124	First finish coat-1st floor	10 days	Mon 1/18/10	Fri 1/29/10
125	First Finish Coat-2nd floor	10 days	Mon 1/25/10	Fri 2/5/10
7	Technology Fixtures trim out	43 days?	Mon 2/8/10	Wed 4/7/10
152	AV Fixtures/Trimout	43 days	Mon 2/8/10	Wed 4/7/10
196	**Building Substantially Complete**	0 days	Mon 5/10/10	Mon 5/10/10
197	**Project Complete**	0 days	Tue 7/20/10	Tue 7/20/10
198	**Building Occupancy**	0 days	Mon 7/26/10	Mon 7/26/10



Project: DetailedprojectSchedule.mpp
Date: Sun 10/25/09

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

APPENDIX B



Turner

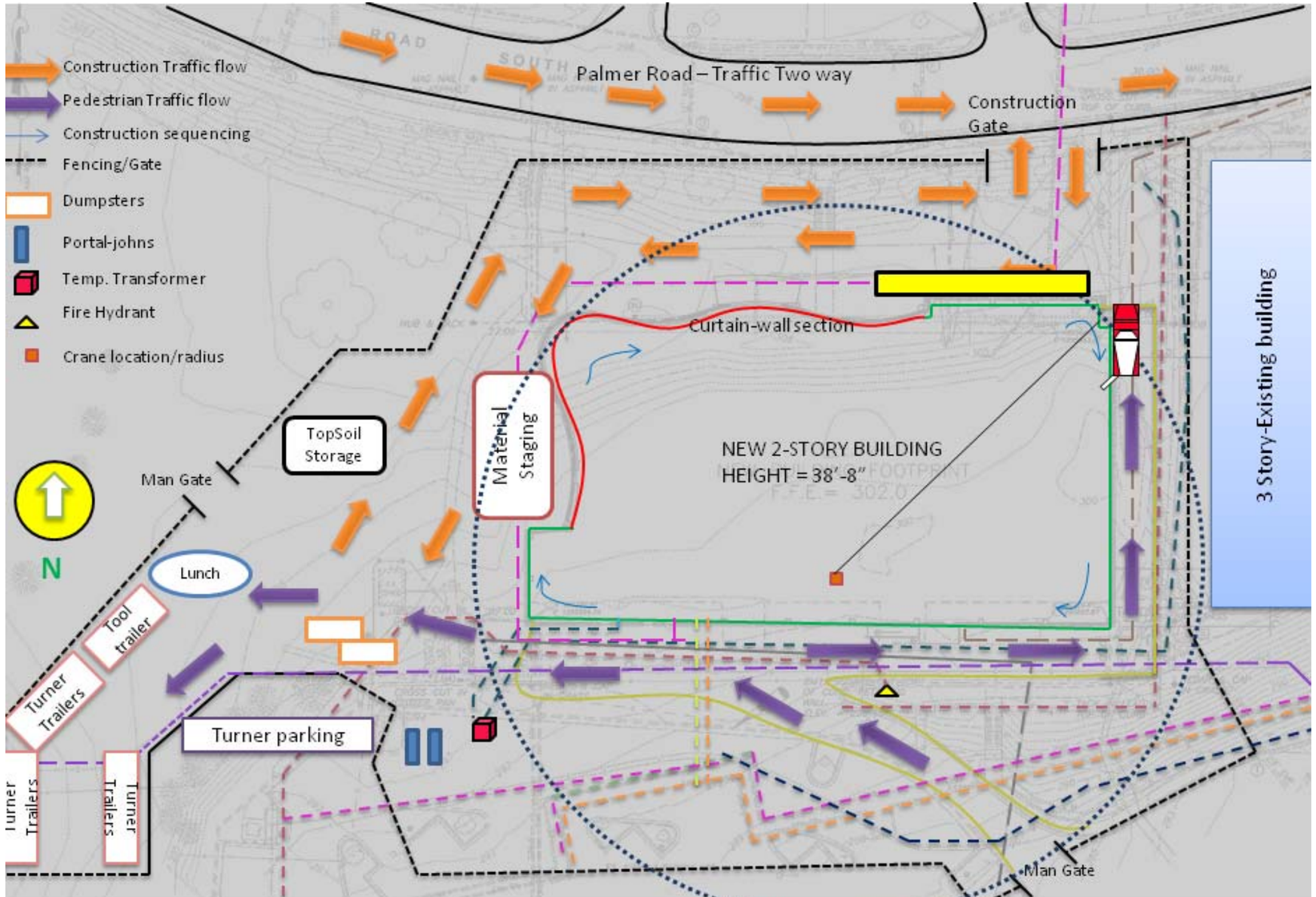
Rose Abousaid
Tech. Assignment 1
October 28, 2009

Site Layout-Excavation

National Intrepid Center of Excellence
Bethesda, MD

Note To scale

Sheet 1 of 1



Turner

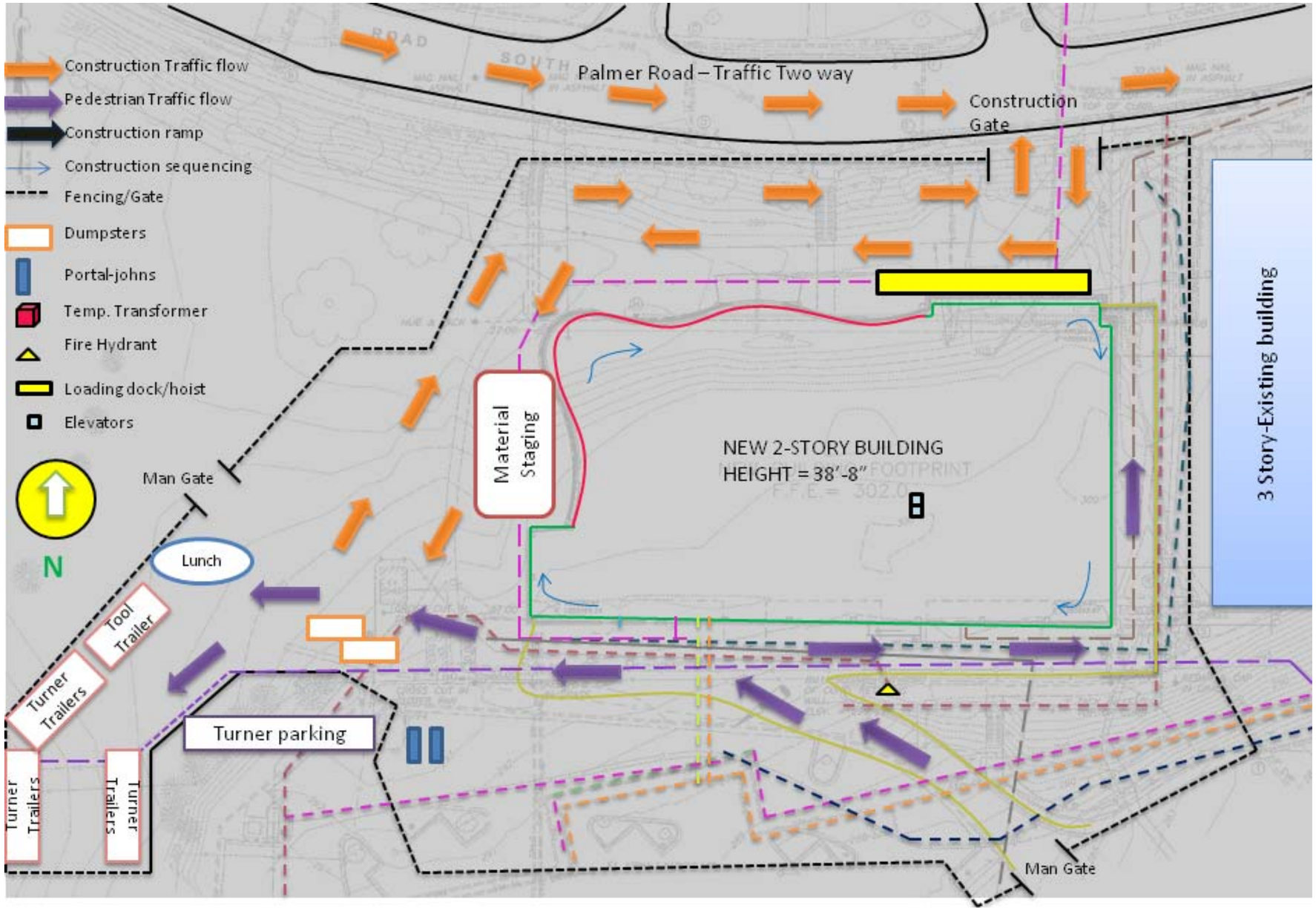
Rose Abousaid
Tech. Assignment 1
October 28, 2009

Site Layout-Superstructure

National Intrepid Center of Excellence
Bethesda, MD

Note To scale

Sheet 1 of 1



Turner

Rose Abousaid
Tech. Assignment 1
October 28, 2009

Site Layout-Finishings

National Intrepid Center of Excellence
Bethesda, MD

Note To scale

Sheet 1 of 1

APPENDIX C

Concrete (3000PSI) Column Footing take-offs											
Size (WxlxD)	Description	Qty	Concrete(LF)	Concrete (CF)/per Ftg	Concrete (CY)	Rebar size	Rebar Qty.	Rebar Dim.(in)	Rebar Wt. (Plf)	Rebar(Tones)	Formwork (SFCA)
4'-6"x4'-6"x12"	Square Spread Ftg.	2	4.5	20.5	1.52	#4	12	0.5	0.668	0.072	36.0
5"x5"x12"	Square Spread Ftg.	1	5	25	0.93	#4	14	0.5	0.668	0.042	20.0
5'-6"x5'-6"x13"	Square Spread Ftg.	2	6.1	32.8	2.43	#5	12	0.625	1.043	0.113	48.5
6"x6"x14"	Square Spread Ftg.	5	7	42	7.78	#5	14	0.625	1.043	0.329	140.0
6'-6"x6'-6"x16"	Square Spread Ftg.	4	8.8	56.3	8.34	#6	12	0.75	1.502	0.324	138.7
7"x7"x17"	Square Spread Ftg.	3	9.9	69.4	7.71	#6	12	0.75	1.502	0.243	119.0
7'-6"x7'-6"x18"	Square Spread Ftg.	3	11.4	84.4	9.38	#6	14	0.75	1.502	0.284	45.0
8"x8"x19"	Square Spread Ftg.	6	12.7	101.3	22.51	#7	12	0.875	2.044	0.662	304.0
8'-6"x8'-6"x20"	Square Spread Ftg.	10	14.2	120.4	44.59	#7	14	0.875	2.044	0.129	566.7
9"x9"x21"	Square Spread Ftg.	2	15.8	141.8	10.50	#6	20	0.75	1.502	1.352	126.0
9'-6"x9-6"x22"	Square Spread Ftg.	4	17.4	165.5	24.52	#7	18	0.875	2.044	0.662	278.7
10'-6"x10'-6"x25"	Square Spread Ftg.	8	21.9	229.7	68.06	#7	20	0.875	2.044	1.472	87.5
11"x11"x26"	Square Spread Ftg.	4	23.8	262.2	38.84	#8	16	1	2.67	0.192	381.3
11'-6"x11'-6"x27"	Square Spread Ftg.	1	25.88	297.6	11.02	#8	18	1	2.67	0.216	108.5
12"x12"x27"	Square Spread Ftg.	7	27	324	84.00	#8	20	1	2.67	1.682	756.0
12'-6"x12'-6"x28"	Square Spread Ftg.	1	29.2	364.6	13.50	#8	22	1	2.67	0.264	116.7
13'-6"x13'-6"x30"	Square Spread Ftg.	5	33.8	455.6	84.37	#9	20	1.128	3.40	1.530	675.0
15"x15"x33"	Square Spread Ftg.	2	42.3	618.8	45.84	#9	24	1.128	3.40	0.734	330.0
		70			485.84					10.303	4273

Concrete (4000PSI) Column Take-off									
Size	Description	Height	Qty	Concrete (LF)/Per Ftg	Concrete (CF)/Per Ftg	Concrete(CY)	Vert. Reinf. Size	Vert. Reinf. Qty	Formwork(SFCA)
28" Diameter	Round Column 1st Flr.	36'-6"	5	267.55	156.1	28.91	#11	10	1337.75
24" Diameter	Round Column 1st Flr.	15'	7	94.2	47.1	12.21	#8	6	659.4
16"x24"	Rectangular Column 1st Flr.	15'	4	20	40	5.93	#8	6	320
16"x24"	Rectangular Column 1st Flr.	36'-6"	1	48.7	97.3	3.60	#11	6	194.8
16"x30"	Rectangular Column 1st Flr.	15'	2	20	50	3.70	#9	6	160
24" Diameter	Round Column 1st Flr.	15'	2	6.3	47.1	3.49	#9	8	12.6
12"x24"	Rectangular Column 1st Flr.	15'	5	15	30	5.56	#8	4	300
24"x24"	Square Column 1st Flr.	15'	49	30	60	108.89	#11	4	5880
24" Diameter	Round Column 2nd Flr.	21'-6"	10	135.1	67.5	25.00	#8	6	1351
16"x24"	Rectangular Column 2nd Flr.	21'-6"	4	28.7	57.3	8.49	#8	6	459.2
16"x30"	Rectangular Column 2nd Flr.	21'-6"	2	28.7	71.7	5.31	#9	6	229.6
24"x24"	Square Column 2nd Flr.	21'-6"	1	43	86	3.19	#11	4	172
12"x24"	Rectangular Column 2nd Flr.	21'-6"	1	21.5	43	1.59	#8	4	86
12"x24"	Rectangular Column 2nd Flr.	15'	1	15	30	1.11	#8	4	60
24"x24"	Square Column 2nd Flr.	15'	44	30	60	97.78	#11	4	5280
12"x24"	Rectangular Column low Roof	15'	1	15	30	1.11	#8	6	60
24" Diameter	Round Column low Roof.	15'	8	94.2	47.1	13.96	#8	6	753.6
						329.82			17315.95

Concrete (4000PSI)Beams Take-off											
Size (WxH)	Length	Qty	Concret (Sf)	Concret (CF)	Concrete(CY)	Formwork(SFCA)	Bottom Rebar Size	Qty	Top Rebar Size	Qty.	Stirrups
12"x18"	12'	4	12	18	2.67	240	#9	2	#9	2	#3
12"x24"	38'	1	38	76	2.81	228	#9	2	#9	2	#3
24"x17"	18'	1	36	51	1.89	123	#9	3	#8	3	#3
48"x17"	18'	2	72	102	7.56	390	#9	5	#7	4	#3
					14.93	981.00					

Slab On Grade+elevated slab Take-off							
Descirpition	Concrete (sf)	Concrete (CF)	Concrete(CY)	Concrete(LF)	Edge Formwork (SFCA)	Bottom Formwork (SFCA)	Total Formwork(SFCA)
5" SOG entry level	28430	11845.8	438.7	166	350		350
6"SOG	4500	2250.0	83.3	480	480		480
4" Depressed Slab	630	210.0	7.8		68		68
12"SOG	5520	5520.0	204.4	704	704		704
2(12"SOG floor Mech Pads)	400	400	14.8	120	120		120
9"Elevated slab (2nd Floor)	35150	26362.5	976.4	720	540	35150	35690
8" Drop Panels (2nd Floor)	5300	3533.3	130.9	2120	1413.3	5300	6713.3
4"housekeeping pad	1800	600.0	22.2	180	60	1800	1860
9" Elevated low roof slab	22770	17077.5	632.5	1110	832.5	22770	23602.5
8" Drop Panels (lowroof)	4000	2666.7	98.8	1600	1066.7	4000	5066.7
9" Elevated high roof slab	16245	12183.8	451.3	560	420.0	18000	18420.0
8" Drop Panels (high Floor)	2100	1400.0	51.9	840	560.0	2100	2660.0
15" Drop	1350	1687.5	62.5	530	662.5	1250	1912.5
			3175.4				97647.0

Cast In Place Concrete Estimate								
CSI Code	Descrption	Qty	Units	Material Cost	labor Cost	Equipment Cost	Price/Unit	Totalt Cost
03 11 13.20	Form in place, Beams, 12"x 18" beams, 4use	240.00	SFCA	$ 1.40	$ 4.95		$ 6.35	$ 1,524.00
	Form in place, Beams, 24"x 17" beams, 4use	741.00	SFCA	$ 2.80	$ 5.85		$ 8.65	$ 6,409.65
03 11 13.25	Form in place, Columns, 24" diamter, 4use	4115.00	SFCA	$ 18.65	$ 14.25		$ 32.90	$ 135,383.50
	Form in place, Columns, 24" x 24", 4use	11160.00	SFCA	$ 0.81	$ 5.10		$ 5.91	$ 65,955.60
	Form in place, Columns, 16" x 24", 4use	1364.00	SFCA	$ 0.73	$ 5.15		$ 5.88	$ 8,020.32
	Form in place, Columns, 12" x 24", 4use	678.00	SFCA	$ 0.74	$ 6.14		$ 6.88	$ 4,664.64
03 11 13.35	Form In Place Flat Slab,drop panels,job-built plywood, to 15' high,4use	86915.00	S.F	$ 1.55	$ 3.43		$ 4.98	$ 432,836.70
03 11 13.40	Form in place Equipment Foundation	1860.00	SFCA	$ 1.17	$ 9.10		$ 10.27	$ 19,102.20
03 11 13.45	Forms for spread Footing, Job Built Lumber, 4use	4273.00	SFCA	$ 0.70	$ 2.93		$ 3.63	$ 15,510.99
03 11 13.65	Form in place slab on grade, Edge Forms,wood,4use,ongrade, to 6" high	646.00	L.F	$ 0.38	$ 2.02		$ 2.40	$ 1,550.40
	Form in place slab on grade, Edge Forms,wood,4use,ongrade, 7"to12" high	824.00	SFCA	$ 0.74	$ 2.79		$ 3.53	$ 2,908.72
	Form in place slab on grade,For depressed slabs, 4use, to 12" high	204.00	L.F	$ 0.56	$ 4.04		$ 4.60	$ 938.40
03 31 05.35	Normal Wight Concrete, Ready Mix, 3000PSI	486.00	C.Y	$ 101.00			$ 101.00	$ 49,086.00
	Normal Wight Concrete, Ready Mix, 3500PSI	750.00	C.Y	$ 104.00			$ 104.00	$ 78,000.00
	Normal Wight Concrete, Ready Mix, 4000PSI	2772.00	C.Y	$ 106.00			$ 106.00	$ 293,832.00
03 31 05.70	Beams, elevated, small beams, pumped	15.00	C.Y		$ 36.00	$ 13.15	$ 49.15	$ 737.25
	Columns,Square or round, 12" thick,with crane and bucket	10.00	C.Y		$ 61.50	$ 30.00	$ 91.50	$ 915.00
	Columns,Square or round, 18" thick,with crane and bucket	36.00	C.Y		$ 45.00	$ 22.00	$ 67.00	$ 2,412.00
	Columns,Square or round, 24" thick,with crane and bucket	294.00	C.Y		$ 35.00	$ 17.10	$ 52.10	$ 15,317.40
	Elevated slabs, 6" to 10"thick,pumpec	2342.00	C.Y		$ 13.55	$ 4.94	$ 18.49	$ 43,303.58
	Elevated slabs over 10"thick,pumped	63.00	C.Y		$ 12.05	$ 4.39	$ 16.44	$ 1,035.72
	Footings,spread,under 1C.Y, with crane and bucket	5.00	C.Y		$ 55.00	$ 26.50	$ 81.50	$ 407.50
	Footings,spread,over 5C.Y, with crane and bucket	481.00	C.Y		$ 24.50	$ 11.95	$ 36.45	$ 17,532.45
	Slab on grade, up to 6" thick, with crane and bucket	750.00	C.Y		$ 22.50	$ 10.90	$ 33.40	$ 25,050.00
03 35 29.30	Finishing Floors, Manual screed,bull float, manual float & broom finish	114595.00	S.F		$ 0.47		$ 0.47	$ 53,859.65
						Total Cost of Cast in Place Concrete		$ 1,276,293.67

Concrete Reinforcement Estimate								
CSI Code	Descrption	Qty	Units	Material Cost	labor Cost	Equipment Cost	Price/Unit	Totalt Cost
03 21 10.60	Rinforcing in place, Beams and Girders, #8 to #18	1.25	Ton	$ 1,550.00	$ 530.00		$ 2,080.00	$ 2,600.00
	Rinforcing in place, Columns, #8 to #18	119.5	Ton	$ 1,550.00	$ 620.00		$ 2,170.00	$ 259,315.00
	Elevated Slabs, #4 to#7	72.59	Ton	$ 1,650.00	$ 490.00		$ 2,140.00	$ 155,342.60
	6X6 W2.1 x W2.1 WWF 42 ilbs per CSF	540	CSF	$ 28.25	$ 21.50		$ 49.75	$ 26,865.00
	Footings, #4 to #7	5.68	Ton	$ 1,475.00	$ 680.00		$ 2,155.00	$ 12,240.40
	Footings, #8 to #18	4.62	Ton	$ 1,400.00	$ 395.00		$ 1,795.00	$ 8,292.90
						Total Cost of Reinforcement in Concrete:		$ 464,655.90

Estimate Detail - Standard Construction Project

Detail - Without Taxes and Insurance

Estimator :
Project Size : sqft

ItemCode	Description	Quantity	UM	Lab.Unit	Mat.Unit	Eqp.Unit	Sub.Unit	Eqp.Rent.Unit	Temp.Mat.Unit	Other Unit	Tot.UnitCost	TotalCost
02316.001	FINE GRADE FLOOR BY HAND	3,600.00	SQFT	0.4046							0.405	1,456.56
02316.001	FINE GRADE FLOOR BY HAND	28,440.00	SQFT	0.4046							0.405	11,506.82
02316.001	FINE GRADE FLOOR BY HAND	900.00	SQFT	0.4046							0.405	364.14
02316.001	FINE GRADE FLOOR BY HAND	5,520.00	SQFT	0.4046							0.405	2,233.39
02316.100	MACH EXCAV CONTINUOUS FTG	285.83	CUYD	6.9549		0.950					7.905	2,259.48
02316.102	FINE GRADE CONTINUOUS FTG	5,057.50	SQFT	0.4761							0.476	2,407.88
02316.130	MACH BACKFILL CONTINUOUS FTG	98.52	CUYD	8.5005		0.500					9.001	886.72
02316.134	EXCESS CONTINUOUS FOOTING SOIL	187.31	CUYD									
03110.510	CONTINUOUS FOOTING EDGE FORMS	2,380.00	SQFT	4.4257	1.039						5.464	13,005.27
03110.701	FLOOR EDGE FORMS	360.00	LNFT	3.0729	0.851						3.924	1,412.75
03110.701	FLOOR EDGE FORMS	120.00	LNFT	3.0729	0.851						3.924	470.92
03110.701	FLOOR EDGE FORMS	60.00	LNFT	3.0729	0.851						3.924	235.46
03110.701	FLOOR EDGE FORMS	184.00	LNFT	3.0729	0.851						3.924	722.07
03111.203	WOOD COLUMN FORMS, 12'-16'	13,440.00	SQFT	1.1524	1.227						2.379	31,976.45
03111.244	ROUND MTL FORMS, 24" COLUMN	480.00	LNFT	19.2060	2.829						22.035	10,576.70
03111.420	BEAM SIDE FORMS	7,680.00	SQFT	2.8709	1.028						3.899	29,941.25
03111.614	SLAB FORM W/2.7 BM/SF	74,165.00	SQFT	2.6205	1.301						3.921	290,815.80
03111.624	SLAB EDGE FORM	113,937.00	SQFT	2.1511	0.853						3.004	342,243.96
03111.630	DROP PANEL EDGE FORMS	36,480.00	SQFT	2.8453	0.851						3.697	134,855.62
03150.650	SCREEDS FOR SLAB	8,899.80	LNFT	0.9219	0.320						1.242	11,052.66
03150.900	FORM RELEASING AGENT	13,440.00	SQFT	0.2095	0.023						0.233	3,124.80
03150.900	FORM RELEASING AGENT	3,015.94	SQFT	0.2095	0.023						0.233	701.21
03150.900	FORM RELEASING AGENT	7,680.00	SQFT	0.2095	0.023						0.233	1,785.60
03150.900	FORM RELEASING AGENT	188,102.00	SQFT	0.2095	0.023						0.233	43,733.72
03150.900	FORM RELEASING AGENT	36,480.00	SQFT	0.2095	0.023						0.233	8,481.60
03210.200	CONTINUOUS FOOTING REBAR	51.48	CWT	31.7857	26.750						58.536	3,013.71
03220.011	6x6 W2.1/W2.1 MESH	39.60	SQS	22.0080	10.650						32.658	1,293.26
03220.011	6x6 W2.1/W2.1 MESH	9.90	SQS	22.0080	10.650						32.658	323.31
03220.011	6x6 W2.1/W2.1 MESH	312.84	SQS	22.0080	10.650						32.658	10,216.73
03220.011	6x6 W2.1/W2.1 MESH	60.72	SQS	22.0080	10.650						32.658	1,982.99
03310.150	**CONC IN CONTINUOUS FOOTING**		****									
03310.153	3000 PSI W/CART	187.31	CUYD	13.1475	55.000						68.148	12,765.04
03310.350	**CONC IN SLAB ON GRADE**		****									
03310.350	**CONC IN SLAB ON GRADE**		****									
03310.350	**CONC IN SLAB ON GRADE**		****									
03310.350	**CONC IN SLAB ON GRADE**		****									
03310.365	3500 PSI W/CARTS	66.67	CUYD	14.3996	54.500						68.900	4,593.31
03310.365	3500 PSI W/CARTS	16.67	CUYD	14.3996	54.500						68.900	1,148.33
03310.365	3500 PSI W/CARTS	438.89	CUYD	14.3996	54.500						68.900	30,239.27
03310.365	3500 PSI W/CARTS	204.44	CUYD	14.3996	54.500						68.900	14,086.14
03310.650	**CONCRETE IN COLUMNS**		****									
03310.650	**CONCRETE IN COLUMNS**		****									
03310.677	4000 PSI W/CARTS	248.89	CUYD	30.2392	56.000						86.239	21,463.98
03310.677	4000 PSI W/CARTS	55.85	CUYD	30.2392	56.000						86.239	4,816.52
03311.100	**CONC IN BEAMS W/SLAB**		****									
03311.130	4000 PSI W/PUMP	1,706.67	CUYD	15.1196	56.000	5.280					76.400	130,388.65
03311.500	**CONC IN SUPPORTED SLAB**		****									
03311.500	**CONC IN SUPPORTED SLAB**		****									
03311.530	4000 PSI W/PUMP	2,060.14	CUYD	12.5997	56.000	5.280					73.880	152,202.44
03311.530	4000 PSI W/PUMP	3,377.78	CUYD	12.5997	56.000	5.280					73.880	249,549.21
03315.971	* CONTINUOUS FOOTING LENGTH *	595.00	LNFT									
03315.976	* SOG AREA *	3,600.00	SQFT									
03315.976	* SOG AREA *	900.00	SQFT									
03315.976	* SOG AREA *	28,440.00	SQFT									
03315.976	* SOG AREA *	5,520.00	SQFT									
03315.984	* NO. OF COLUMNS *	112.00	EACH									
03315.984	* NO. OF COLUMNS *	32.00	EACH									
03315.985	* LENGTH OF BEAMS *	160.00	LNFT									
03315.986	* SUPPORTED SLAB AREA *	74,165.00	SQFT									
03315.987	* NO. OF DROP PANELS *	114.00	EACH									
03350.130	MACHINE TROWEL FINISH	3,600.00	SQFT	0.3304							0.330	1,189.44
03350.130	MACHINE TROWEL FINISH	900.00	SQFT	0.3304							0.330	297.36
03350.130	MACHINE TROWEL FINISH	28,440.00	SQFT	0.3304							0.330	9,396.58
03350.130	MACHINE TROWEL FINISH	5,520.00	SQFT	0.3304							0.330	1,823.81
03350.130	MACHINE TROWEL FINISH	74,165.00	SQFT	0.3304							0.330	24,504.12
03350.131	POINT & PATCH	13,440.00	SQFT	0.1102	0.013						0.123	1,653.12
03350.131	POINT & PATCH	7,680.00	SQFT	0.1102	0.013						0.123	944.64
03350.131	POINT & PATCH	3,015.94	SQFT	0.1102	0.013						0.123	370.96
03350.131	POINT & PATCH	188,102.00	SQFT	0.1102	0.013						0.123	23,136.55
03350.131	POINT & PATCH	36,480.00	SQFT	0.1102	0.013						0.123	4,487.04
03390.010	PROTECT & CURE	3,600.00	SQFT	0.1102	0.019						0.129	465.84
03390.010	PROTECT & CURE	900.00	SQFT	0.1102	0.019						0.129	116.46
03390.010	PROTECT & CURE	28,440.00	SQFT	0.1102	0.019						0.129	3,680.14
03390.010	PROTECT & CURE	5,520.00	SQFT	0.1102	0.019						0.129	714.29
03390.010	PROTECT & CURE	74,165.00	SQFT	0.1102	0.019						0.129	9,596.95
Total Estimate												**1,666,710.97**