



## *Executive Summary*

The main focus of this technical assignment is to become more familiar with the structural and exterior façade systems for the Center for Health Research and Rural Advocacy. General conditions estimate, site planning, and project schedule also are analyzed in detail.

The project schedule for the project is typical for large construction projects but has a few interesting aspects. Two crews will be used to pour cast-in-place concrete foundation walls, one of which is subcontractor and the other is self-performed by Geisinger Facilities. The interior finishes schedule is phased to start from the second floor and work towards the lower level to minimize re-work and damaged to already finished areas.

An assembly's estimate is prepared for the exterior façade of the Center for Health Research and will be used for future design and construction considerations using prefabrication of components. The value of this estimate came out a little low, which is possibly due to the differing system interfaces as well as high quality architectural precast concrete. The detailed structural estimate showed that the steel prices accounted for about 60% of the structure costs, and should be monitored to make sure prices do not escalate.

The general conditions estimate for the project was derived for the Geisinger Health System to ensure that Geisinger Facilities is spending money discretionally. One project manager and superintendent are assigned to the project and will be utilized for the entire 21 months of preconstruction and construction. It is difficult for the Geisinger Facilities to garner additional funds for general conditions once the project is underway, so it is extremely important for the general conditions to be accurate and reflect the needs for the project.

Site planning is also of importance due to the restricted site conditions along Centre Street and the adjacent Weis Research Center. Steel will be commenced in three separate locations for the crane with two distinct staging areas. Concrete truck movement will flow through to the bottom of the site ensure adequate movement and location of temporary roadways. The dumpsters and loading docks are placed on the lower level next to the material hoists. The reason for this location is on the lower level and will be a simple area to finish once everything else is complete.



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## ***Detailed Project Schedule***

Appendix A shows the detailed project schedule for the Center for Health Research and Rural Advocacy project.

Some interesting aspects of the project schedule include the phasing of the structural cast-in-place concrete. The reason for this is due to that Geisinger Facilities is self performing half the work and subcontracting the rest. The first pour will be used by the Geisinger Facilities to manage the quality control and schedule of the subcontracted group. Once Geisinger Facilities feels the output is acceptable, two separate teams will begin pouring on separate portions and working towards the auditorium.

Structural erection will occur during two phases, with the second phase incorporating two different crane locations. The east wing of the center will be constructed first with the crane stationed outside the sheeting and shoring system. Once complete, the crane will move inside Centre Street and erect half the west wing and then move one more time to finish the structural steel.

The rest of the schedule is fairly standard. The interior spaces will start on the ground floor since there is a minimal amount of finish work on that floor. Once this is completed, finishes will start on the second floor and work down towards the lower level dumpsters and loading dock. This will keep crews and trash moving away from already finished areas and will minimize punch-list items and damage to finished work.



## ***Assemblies Estimate***

The assemblies estimate was created for the exterior skin of the Center for Health Research and Rural Advocacy to allow future research into the prefabrication of some of the components. The estimate includes all the exterior façade and necessary pieces for construction including the roof and windows.

The assembly estimate shown in Appendix B outlines the R.S. Means values for material and labor. The total construction cost per square foot of the building was about 75% of the Geisinger Facilities estimate. Some areas which would have affected this deviation are from the interface areas between skin systems which were not taken into account through the R.S. means analysis. The precast architectural concrete panels are to be of high quality and not standard 4' x 8' panels used in the assembly estimate. This is potentially a large added expense because the panels are of differing sizes as well, which would make the material cost be much greater than the value in the R.S. means catalogue.

The aluminum frame curtain wall system estimate is about 60% of the value estimated by the Geisinger Facilities team. This could possibly be due to the high engineering and development costs for the extensive three story tall and curved layout. It is not a typical square system as was taken from the estimating manual.

The total cost also does not take into account all the subcontractors required to install the assemblies and their respective general conditions and fees. Since different contractors will be utilized for the precast fabrication and erection, the aluminum curtain wall, and the metal panel systems, overlapping of general conditions fees could occur.



## ***General Conditions Estimate***

The Center for Health Research and Rural Advocacy is constructed under the supervision of the Geisinger Facilities Division. The project team develops a general conditions cost estimate for the main reason of tracking expenses throughout the course of the project. Once an accurate estimate has been established by the team, it is submitted to the Geisinger Health System Board of Directors for approval. If approved, the general conditions costs are added to the job cost system and are monitored closely during construction. Often times the initial general conditions are a bit inflated, as to guarantee money is given back to the Health System at the completion of the job. It is difficult to garner more general conditions funding once the project has commenced.

Another interesting aspect of the general conditions for the CHRRA is that Geisinger Facilities does not charge a fee on top of the base costs. This clearly shows the contractual connection between Geisinger Facilities and the Geisinger Health System.

Project management travel and facilities are already provided to the Facilities team by the Health system. The operation headquarters is located within walking distance of the project site which minimizes actual on-site facilities. A small office trailer housing drawings, small tools, safety equipment, etc. is all that is located on site. The three portable toilets are spread across the site for easy access for all.

Please refer to Appendix C for the general conditions breakout for the Center for Health Research and Rural Advocacy project.



## ***Site Plan – Superstructure***

Site planning for this project is extremely important due to the fully operational Centre Street and the proximity of the Weis Research Center. The expansive footprint of the Center for Health Research and Rural Advocacy requires three separate lift points for the crane. Careful consideration must be made by the geo-technical engineers to ensure that the sheeting and shoring system can maintain the added load of a close proximity pick point. The restriction of the site also requires two separate staging areas for the structural steel which will increase costs and management headaches to manage traffic patterns.

The three crane locations are necessary due to the site restrictions. Even though the project is schedule for structural steel erection in two phases, the relocation of the crane from position two to three will not be difficult, since both locations can use the same staging area.

The material hoists, loading dock, and dumpsters are all located on the lower level at the open recreational room. The dumpsters may be extensive depending on the LEED certification desired for the project. Not only do costs increase with trying to achieve the recycling points, but site logistics needs to be reworked to include all the necessary dumpsters. The recreational room is designated as the last room because it does not require extensive finishes.

The concrete trucks park adjacent to the material auditorium and will have piping to the east portion of the building as well as the west. Trucks will follow this scheme throughout the elevated slab pours and a temporary roadway will be put in place to maintain the constant traffic flow.

The site plan for the superstructure is shown in Appendix D.



## ***Detailed Structural Estimate***

The structural estimate is an interesting one because the Center for Health Research and Rural Advocacy employs numerous types of systems into the structure. There are load bearing cast-in-place concrete walls around the skin of the structure, as well as square and strip concrete footings.

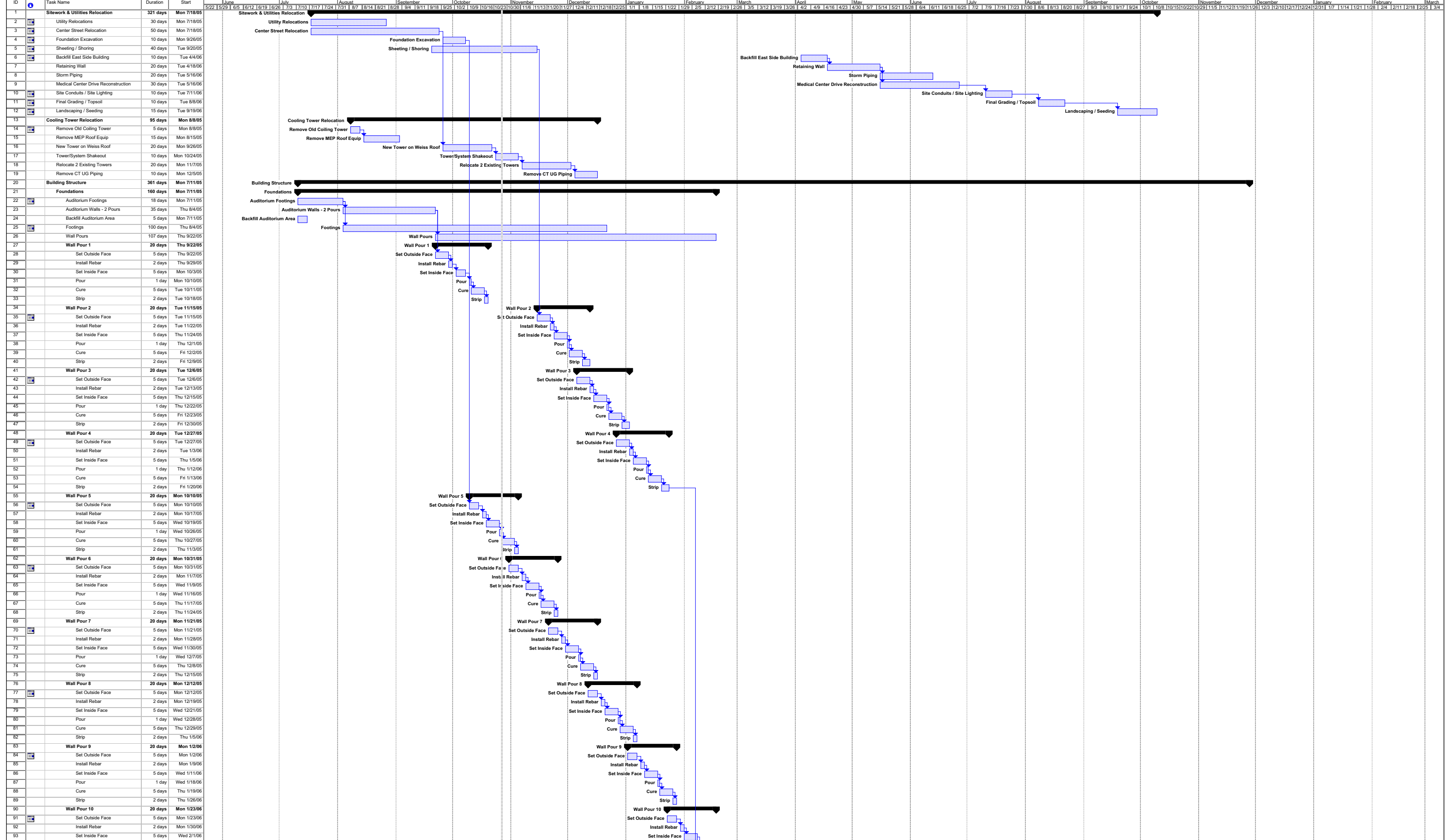
The typical bay chosen to analyze was from columns 5 to 6 and A – D. The bay incorporated concrete footings, slab on grade, four-story structural steel columns, steel beams and girders, metal deck, elevated slabs, roof deck, and miscellaneous connections. The construction cost total was then extrapolated by the percentage of square feet.

Steel beams and columns accounted for almost 60% of the structural costs and should be closely monitored to ensure prices do not skyrocket during the rapid changes in material costs. Elevated slab construction is also very costly and accounts for about half of the remaining forty percent.

The analysis performed was approximately 80% of the estimate calculated by Ewing Cole for the project. The main reason for this is that the typical bay does not take into account the structure for the auditorium, with steel joists and a sloped concrete floor. This area would typically be more expensive to construct with heavier materials and related equipment costs.

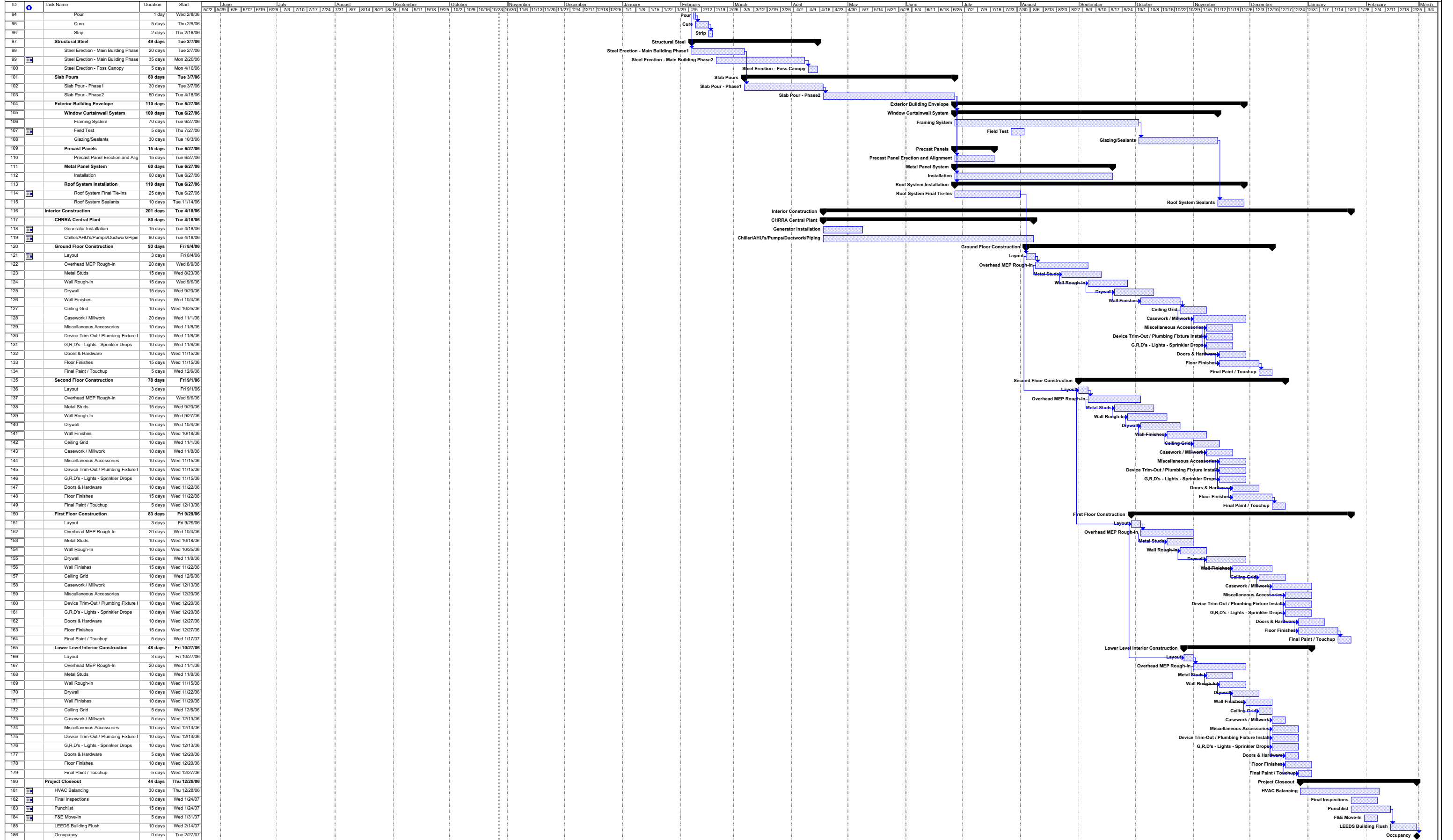
The detailed structural estimate is outlined in Appendix E with the relevant labor and material costs for the project.

# Appendix A - Project Schedule





# Appendix A - Project Schedule



## Appendix B : Exterior Skin Assembly Estimate

### B. Shell

#### B2010 Exterior Walls

Architectural Precast					Cost Per SF			
Assem #	Description	Panel Size	Total Units	Finishes	Material	Labor	Total	Total Cost
102 4000	Precast Concrete	4'x8'	680	White	\$6.25	\$5.95	\$12.20	<b>\$265,472</b>

Metal Panel System					Cost Per S.F.			
Assem #	Description	Units	Total Units	Colored	Material	Labor	Total	Total Cost
146 3300	Flat Panels	S.F.	4510	Yes	\$2.67	\$2.85	\$5.52	<b>\$24,895</b>
146 3400	Profiled Panels	S.F.	2482	Yes	\$2.83	\$3.01	\$5.84	<b>\$14,495</b>

Aluminum Framing					Cost Per S.F.			
Assem #	Description	Units	Total Units	Horizontal	Material	Labor	Total	Total Cost
210 1100	Alum Frame for 1/4" Glass	S.F.	13060	None	\$9.85	\$9.85	\$19.70	<b>\$257,282</b>

#### B2020 Exterior Windows

Glazing					Cost Per S.F.			
Assem #	Description	Units	Total Units	Color	Material	Labor	Total	Total Cost
220 2050	Plate glass tempered	S.F.	16180	Clear	\$6.80	\$6.65	\$13.45	<b>\$217,621</b>

#### B2030 Exterior Doors

Glazed Aluminum Doors					Cost Per Opng.			
Assem #	Description	Units	Total Units	Opening S	Material	Labor	Total	Total Cost
110 6450	Dbl. Door Wide Stile	Ea	8	6'-0" x 7'-0"	\$2,850	\$1,550	\$4,400	<b>\$35,200</b>

#### B3010 Roof Coverings

Roofing					Cost Per S.F.			
Assem #	Description	Units	Total Units	Thickness	Material	Labor	Total	Total Cost
120 6300	Reinforced PVC 60 mils	S.F.	15200	-	\$0.97	\$0.39	\$1.36	<b>\$20,672</b>
320 1600	Polyisocyanurate Panels	S.F.	15200	2"	\$0.50	\$0.37	\$0.87	<b>\$13,224</b>
410 2700	Rubber Flashing	L.F.	560	1/16"	\$7.10	\$11.45	\$18.55	<b>\$10,388</b>

<b>Exterior Skin Total Cost</b>	<b>\$859,249</b>
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<b>Sales Tax</b>	<b>\$51,555</b>
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<b>Location Factor</b>	<b>Inc.</b>
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<b>Time Factor</b>	<b>Inc.</b>
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<b>Exterior Skin Total Costs</b>	<b>\$910,804</b>
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<b>Exterior Skin Costs / SF</b>	<b>\$13.55</b>
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## Appendix C : General Conditions Summary

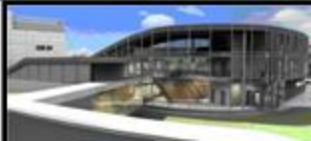
Code	Description	Quantity	Labor	Material	LS	Total	Comments
<b>Project Management</b>							
PM001	Director of Construction (1)	4 months	\$8,200	\$0	\$0	\$32,800	
PM002	Project Manager (1)	21 months	\$6,400	\$0	\$0	\$134,400	
PM003	Superintendent (1)	21 months	\$4,960	\$0	\$0	\$104,160	
PM004	Project Engineer (1)	Hourly (500)	\$36 / hr	\$0	\$0	\$18,000	
PM005	CPM Schedule	LS	\$0	\$0	\$4,852	\$4,852	
<b>Temporary Utilities</b>							
T001	Job Telephone	21 months	\$0	\$75 / mo	\$0	\$1,575	
T002	Trailer Electric	21 months	\$0	\$210 / mo	\$0	\$4,410	Inc. Jobsite trailer
T003	Temporary Heat	4 months	\$0	\$1,045 / mo	\$0	\$4,180	November thru February 06'
T004	Fire Protection	12 months	\$0	\$280 / mo	\$0	\$3,360	During Interior Work
T005	Air Compressor (2)	21 months	\$0	\$325 / mo	\$0	\$13,650	
T006	Temp Generators (2)	21 months	\$0	\$1,216 / mo	\$0	\$51,072	
<b>Equipment</b>							
E001	Mobile Crane	11 months	\$0	\$12,200 / mo	\$0	\$134,200	Inc. Steel, Precast, & Curtainwall Erection
E002	Jobsite Forklift (2)	21 months	\$0	\$700 / mo	\$0	\$29,400	
E003	Jobsite Trailer	21 months	\$0	\$380 / mo	\$0	\$7,980	
E004	Equipment Hoist	4 months	\$0	\$2600 / mo	\$0	\$10,400	Used until Elevator is Operational
E005	Scissor Lifts (3)	12 months	\$0	\$900 / mo	\$0	\$32,400	For Interior Work
<b>Site Safety &amp; Prep</b>							
SS001	Temporary Fence	LF (900 FT)	\$2 / LF	\$12 / LF	\$0	\$12,600	
SS002	Temporary Road	SQYD (60)	\$1.20 / SQYD	\$4 / SQYD	\$0	\$312	
SS003	Job Signs	EA (6)	\$275 / EA	\$115 / EA	\$0	\$2,310	
SS004	Clean Up	SF (67,200)	\$0.5 / SF	\$0	\$0	\$33,600	
SS005	Trash Removal	CY (200)	\$32 / CY	\$4 / CY	\$0	\$7,200	Include Recycling Costs
SS006	Trash Chutes	Floors (3)	\$0	\$0	\$642	\$642	Lump Sum per Floor
<b>Miscellaneous Materials &amp; Supplies</b>							
MM001	Management Phones (2)	21 months	\$0	\$65 / mo	\$0	\$2,730	
MM002	Trailer Supplies	21 months	\$0	\$220 / mo	\$0	\$4,620	Fax Machine, Paper, Furniture, etc.
MM003	Portable Toilet (3)	21 months	\$0	\$80 / mo	\$0	\$5,040	
MM004	First Aid Supplies (2)	LS	\$0	\$0	\$460	\$460	
MM005	Safety Supplies	LS	\$0	\$0	\$820	\$820	Inc. Hard Hats, Safety Glass, Vests, etc.
MM006	Drawing Reproduction	LS	\$0	\$0	\$4,500	\$4,500	
<b>Permits, Bonds, Insurance, &amp; Testing</b>							
PT001	Occupancy Permits	LS	\$0	\$0	\$950	\$950	
PT002	Land Permits	LS	\$0	\$0	\$1,350	\$1,350	
PT003	Bonds	N/A	\$0	\$0	\$0	\$0	Not Required, Through GHS
PT004	Insurance	N/A	\$0	\$0	\$0	\$0	Covered by GHS Insurance Policies
PT005	System Testing & Certification	LS	\$0	\$0	\$122,600	\$122,600	Inc. Elec, HVAC, Fire, etc.

<b>Labor Subtotal</b>	<b>\$332,861</b>
<b>Material Subtotal</b>	<b>\$317,538</b>
<b>Miscellaneous Subtotal</b>	<b>\$136,174</b>
<b>Fee (0%)</b>	<b>\$0</b>

Geisinger Facilities Does Not Charge GHS

General Conditions Grand Total **\$786,573**

Monthly Billing (21 months) **\$37,456**



## Appendix E : Detailed Structural Estimate

Typical Bay: Columns 5-6 & A-D    4,800 SF    7.14% of Project

Slab On Grade							
Description	Unit	Total Units	Labor \$ / Unit	Material \$ / Unit	Equipment	Total Unit Cost	Total Cost
Concrete	CY	21	\$12.60	\$58.00	\$5.28	\$75.88	\$1,593.48
WWF (6x6 - W2.9 x W2.9)	C.S.F	12	\$15.35	\$12.50		\$27.85	\$334.20
Edge Forms	LF	160	\$3.07	\$0.85		\$3.92	\$627.20
Vapor Barrier	SF	1320	\$0.01	\$0.03		\$0.04	\$52.80
Finishing	SF	1200	\$0.44	\$0.02		\$0.46	\$552.00
<b>Totals</b>			<b>\$1,481.20</b>	<b>\$1,567.60</b>	<b>\$110.88</b>		<b>\$3,159.68</b>

Cast-In Place Walls							
Description	Unit	Total Units	Labor \$ / Unit	Material \$ / Unit	Equipment	Total Unit Cost	Total Cost
Concrete (Footings)	CY	4	\$12.60	\$58.00	\$5.28	\$75.88	\$303.52
Reinforcing Steel (Footings)	EA	44	\$7.80	\$16.20	\$7.80	\$31.80	\$1,399.20
Concrete (Walls)	CY	30	\$12.60	\$58.00	\$5.28	\$75.88	\$2,276.40
Reinforcing Steel (Walls)	EA	126	\$7.80	\$16.20	\$7.80	\$31.80	\$4,006.80
Wall Forms	LF	88	\$3.07	\$0.85		\$3.92	\$344.96
<b>Total</b>			<b>\$2,024.56</b>	<b>\$4,800.80</b>	<b>\$1,505.52</b>		<b>\$8,330.88</b>

Column Footings							
Description	Unit	Total Units	Labor \$ / Unit	Material \$ / Unit	Equipment	Total Unit Cost	Total Cost
Concrete	CY	18	\$12.60	\$58.00	\$5.28	\$75.88	\$1,365.84
Reinforcing Steel	EA	84	\$7.80	\$16.20	\$7.80	\$31.80	\$2,671.20
<b>Total</b>			<b>\$882.00</b>	<b>\$2,404.80</b>	<b>\$750.24</b>		<b>\$4,037.04</b>

Steel Columns							
Description	Unit	Total Units	Labor \$ / Unit	Material \$ / Unit	Equipment	Total Unit Cost	Total Cost
W Shape Columns	Tons	6.96	\$575.00	\$1,000.00	\$100.00	\$1,675.00	\$11,658.00
<b>Total</b>			<b>\$4,002.00</b>	<b>\$6,960.00</b>	<b>\$696.00</b>		<b>\$11,658.00</b>

Steel Beams							
Description	Unit	Total Units	Labor \$ / Unit	Material \$ / Unit	Equipment	Total Unit Cost	Total Cost
<b>Ground Floor</b>							
Steel Beams	Tons	2.745	\$575.00	\$1,000.00	\$100.00	\$1,675.00	\$4,597.88
Shear Studs	EA	60	\$0.54	\$0.72	\$0.30	\$1.56	\$93.60
<b>Sub-total</b>			<b>\$1,610.78</b>	<b>\$2,788.20</b>	<b>\$292.50</b>	<b>\$1,676.56</b>	<b>\$4,691.48</b>
<b>First Floor</b>							
Steel Beams	Tons	3.015	\$575.00	\$1,000.00	\$100.00	\$1,675.00	\$5,050.13
Shear Studs	EA	48	\$0.54	\$0.72	\$0.30	\$1.56	\$74.88
<b>Sub-total</b>			<b>\$1,759.55</b>	<b>\$3,049.56</b>	<b>\$315.90</b>	<b>\$1,676.56</b>	<b>\$5,125.01</b>
<b>Second Floor</b>							
Steel Beams	Tons	3.835	\$575.00	\$1,000.00	\$100.00	\$1,675.00	\$6,423.63
Shear Studs	EA	64	\$0.54	\$0.72	\$0.30	\$1.56	\$99.84
<b>Sub-total</b>			<b>\$2,239.69</b>	<b>\$3,881.08</b>	<b>\$402.70</b>	<b>\$1,676.56</b>	<b>\$6,523.47</b>
<b>Roof Framing</b>							
Steel Beams	Tons	3.66	\$575.00	\$1,000.00	\$100.00	\$1,675.00	\$6,130.50
Shear Studs	EA	56	\$0.54	\$0.72	\$0.30	\$1.56	\$87.36
<b>Sub-total</b>			<b>\$2,134.74</b>	<b>\$3,700.32</b>	<b>\$382.80</b>	<b>\$1,676.56</b>	<b>\$6,217.86</b>

Totals							
			Labor	Material	Equipment	Cost	
Steel Beams	Tons	13.255	\$7,621.63	\$13,255.00	\$1,325.50	\$22,202.13	
Shear Studs	Each	228	\$123.12	\$164.16	\$68.40	\$355.68	
<b>Totals</b>			<b>\$7,744.75</b>	<b>\$13,419.16</b>	<b>\$1,393.90</b>	<b>\$22,557.81</b>	

## Appendix E : Detailed Structural Estimate

Elevated Slabs							
Description	Unit	Total Units	Labor \$ / Unit	Material \$ / Unit	Equipment	Total Unit Cost	Total Cost
<b>Ground Floor</b>							
Edge Forms	LF	160	\$3.07	\$0.85		\$3.92	\$627.20
WWF (6x6 - W2.9 x W2.9)	C.S.F	12	\$15.35	\$12.50		\$27.85	\$334.20
2" 18 Ga. Metal Deck	SF	1320	\$0.21	\$0.92	\$0.05	\$1.18	\$1,557.60
Concrete	CY	15	\$12.60	\$58.00	\$5.28	\$75.88	\$1,138.20
Finishing	SF	1200	\$0.44	\$0.02		\$0.46	\$552.00
Sub-total			<b>\$1,669.60</b>	<b>\$925.49</b>	<b>\$306.29</b>		<b>\$4,209.20</b>
<b>First Floor</b>							
Edge Forms	LF	160	\$3.07	\$0.85		\$3.92	\$627.20
WWF (6x6 - W2.9 x W2.9)	C.S.F	12	\$15.35	\$12.50		\$27.85	\$334.20
2" 18 Ga. Metal Deck	SF	1320	\$0.21	\$0.92	\$0.05	\$1.18	\$1,557.60
Concrete	CY	15	\$12.60	\$58.00	\$5.28	\$75.88	\$1,138.20
Finishing	SF	1200	\$0.44	\$0.02		\$0.46	\$552.00
Sub-total			<b>\$1,669.60</b>	<b>\$925.49</b>	<b>\$306.29</b>		<b>\$4,209.20</b>
<b>Second Floor</b>							
Edge Forms	LF	160	\$3.07	\$0.85		\$3.92	\$627.20
WWF (6x6 - W2.9 x W2.9)	C.S.F	12	\$15.35	\$12.50		\$27.85	\$334.20
2" 18 Ga. Metal Deck	SF	1320	\$0.21	\$0.92	\$0.05	\$1.18	\$1,557.60
Concrete	CY	15	\$12.60	\$58.00	\$5.28	\$75.88	\$1,138.20
Finishing	SF	1200	\$0.44	\$0.02		\$0.46	\$552.00
Sub-total			<b>\$1,669.60</b>	<b>\$925.49</b>	<b>\$306.29</b>		<b>\$4,209.20</b>
<b>Second Floor</b>							
2" 18 Ga. Metal Deck	SF	1320	\$0.21	\$0.92	\$0.05	\$1.18	\$1,557.60
Sub-total			<b>\$277.20</b>	<b>\$0.19</b>	<b>\$0.05</b>		<b>\$1,557.60</b>
<b>Totals</b>							
			Labor	Material	Equipment	Cost	
Edge Forms	LF	480	\$1,473.60	\$408.00	\$0.00	\$1,881.60	
WWF (6x6 - W2.9 x W2.9)	C.S.F	36	\$552.60	\$450.00	\$0.00	\$1,002.60	
2" 18 Ga. Metal Deck	SF	5280	\$1,108.80	\$4,857.60	\$264.00	\$6,230.40	
Concrete	CY	45	\$567.00	\$2,610.00	\$237.60	\$3,414.60	
Finishing	SF	3600	\$1,584.00	\$72.00	\$0.00	\$1,656.00	
			<b>\$5,286.00</b>	<b>\$8,397.60</b>	<b>\$501.60</b>	<b>\$14,185.20</b>	
<b>Estimate Totals</b>							
Tons of Structural Steel		20.215					
Cubic Yards of Concrete		118					
Total Cost per Typical Bay		\$63,929					
Cost / SF		\$13					
<b>Total Structural System Cost</b>		<b>\$895,000</b>					