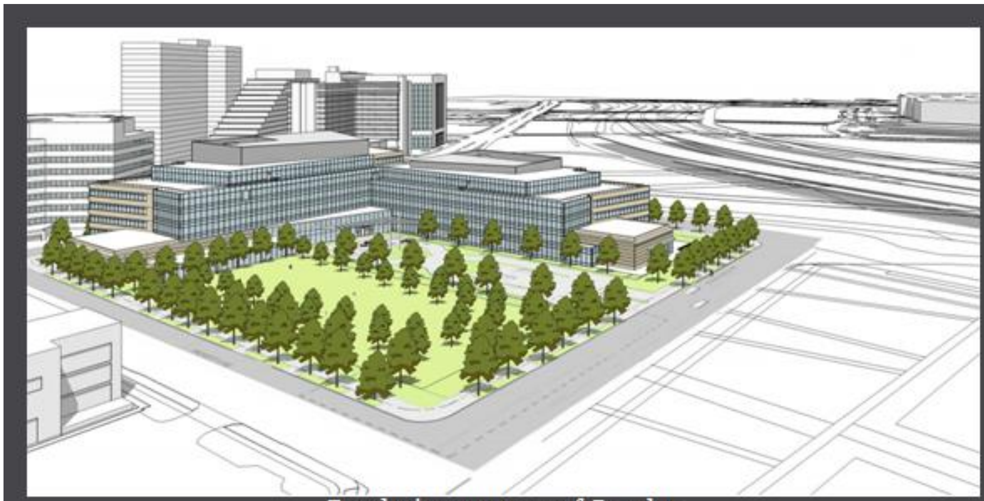

Rendering courtesy of Gensler

Memorial Vista

A North Virginia Office Building

Technical Assignment II

William J. Gamble | 5th Year – Construction Option | October 16th, 2013

Executive Summary

The following technical report it written about Memorial Vista, an office building for an undisclosed aviation tenant in northern Virginia. This report analyzes the detailed project schedule, structural and MEP estimates, site layout planes for various phases, a general conditions estimate, constructability challenges, and the uses of building information modeling (BIM) on the project.

The detailed project schedule breaks down the Memorial Vista Project into the sequence of work being done by each trade to easily show the flow of work on the project. The project start date was set to be April of 2011, and is scheduled to finish in January of 2014. This translates to total project duration of approximately 26 months or 540 working days. It is important to remember, like stated in Technical Assignment I, the building is split up into a North and South Wing to allow for an easier flow of work up the building. The schedule also has very few interior fit-out activities included within it. This is because the building is a core and shell structure being performed by James G. Davis Construction (Davis). The interior fit-out will be bid out after the completion of the base building.

A detailed structural systems estimate was calculated from modules within the P2 level, the first level, and the second level of the structure and interpolated throughout the building to come up with a detailed structural estimate. Since Memorial Vista is a structure made primarily of concrete, the estimate is made up of cast in place concrete, the formwork included, reinforcing, and the labor involved. The total detailed estimate for the building came out to be $16.4 Million, which is 3.20% off of the actual cost of the building, which is $16.9 Million. This difference in price could be from lack of detail in the estimate, the use of R.S. Means instead of actual cost data for the region, and the fact that the estimate performed does not include the post tensioning that takes place above the Lobby Space or Multipurpose Space.

This report also includes the four individual phases of the site layout throughout the project. The first phase plan shows the layout of the site during the demolition phase, where the structures that originally accompanied the site are shown to be removed. The next site layout plan shoed the excavation of the North and South Wing. The third plan shows both the initial phases of the foundation of the structure and also the excavation of the rest of the site. This full excavation of the site was being completed based on the owners request to ensure there was no contaminated soil on the site. The final site layout plan shows the building during the erection of the superstructure. This includes both the concrete structure, and the façade of the building.

The general conditions estimate for Memorial Vista came out to be $2.6 Million, which translates to around $101,000 per month. For this project, Davis was brought in when the design phase was 90% completed. This means the GMP had not been fully negotiated, so Davis had a fairly low general conditions estimate, where a majority of the line items that would normally show up as a line item are actually charged to the job. The break down for the general conditions estimate preformed is that 73% of the cost goes towards personnel costs, whereas the remaining 27% goes to miscellaneous costs. These miscellaneous costs include things such as temporary power, field and office equipment, signage, and various other items.

The main constructability issues the Memorial Vista faced in the phases that it has completed so far are the lack of knowledge of the contents below the earth at the project site and the unknown time frames for certain long lead items. One of the first constructability issues the team faced was the fact that the utilities below grade were extremely cluttered, unmarked, and even and some instances – mismarked. This led to a longer utility relocation process than anticipated, and caused early scheduling problems that would need to be fixed quickly and efficiently. One of the second constructability issues that arose was in the excavation phase. In the initial phase of the project, only twenty-four bore holes had been completed for the geotechnical report. If more were done, the team would have found suitable soil for their foundation and the loads created by the buildings loads. If the foundation had been studied more, it would have been noted that the piles would have been redundant and could have been value engineered out of the project. Since the team found this information out in the excavation process, the piles were already ordered and set to be delivered for use. The third issue was the fact that the bus duct that was used to run a current from the switchboard to the panel board had a longer than anticipated delivery date. This then resulted in the delayed start of equipment and in turn pushed the schedule back.

Finally, the team on Memorial Vista completed a model for the project in order to aid in the 3-D coordination and clash detection, and also to aid in the phase planning on the project. The architectural, mechanical, electrical, plumbing, fire protection and structural systems were looked at when running the clash detections to find potential problems in the initial design and construction phases. Although using 3-D coordination provided a great deal of value to the Memorial Vista project team, there are many more BIM options that are outlined in the report that could have provided even more value to the project.

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Detailed Project Schedule

Overview

The detailed project schedule for Memorial Vista was done using Primavera P6, where the actual full schedule can be found in Appendix A in the back of this report. This schedule breaks down the office building into the scope of work performed throughout the phases of the project. The schedule is a little over 200 line items that range from the original design of the drawings in the earliest phase of the project, all the way to the final completion of the base building. The next step to this project, which is not included, would be the interior fit out. This building contracted as of no to be only a base built core and shell structure, where only a few minor finishes have been put into the building due to the fact that the owner has not expressed their needs and wants for the building's interior until the base structure was completed. The interior contract will be bid out upon the completion of the base building structure.

The original design of the building started in late December of 2010 and takes place until mid-October. Demolition is then scheduled to take place November 23rd. Excavation then takes place the following month and is followed by the actual construction of the building. Substantial completion is reached on October 30th, 2013. The next step is to complete the punch list, and then the final base building will be completed on the 6th of January in 2014. The actual project, where the team is on site, then translates to around 26 months to complete the project, with a total of around 540 work days. Within this schedule, the detail of the project is broken up into sections where major trades can be seen. These major divisions include excavation for the subcontractor performing that task and substructure and super structure for the concrete subcontractor involved in the pouring of the structure.

A detailed schedule overview can be seen below, in table 1, where the main phases of Memorial Vista can be seen.

Table 1 – Detailed Project Schedule Overview

Detailed Schedule Overview			
Phase	**Start Date**	**Finish Date**	**Duration (Days)**
Design / Procurement	20-Dec-10	11-Feb-13	547
Demolition / Site Preparation	23-Nov-11	16-May-12	123
Excavation	3-Jan-12	27-Jul-12	147
Concrete Substructure	30-Aug-12	29-Jan-13	105
Concrete Superstructure	6-Dec-12	1-May-13	103
MEP / Finishes	15-Feb-13	7-Oct-13	164
Façade	25-Mar-13	14-Jun-13	59
Roof	17-Apr-13	10-Jun-13	38
Elevators	8-May-13	16-Oct-13	113
Final Completion & Occupancy	30-Oct-13	6-Jan-14	46

Design & Procurement Phase

The design process for this project was started in late December 2010. James G. Davis Construction (Davis) was then brought in when the drawings reached 90% completion in order to perform a design assist role on the project. After the completion of the drawings, the guaranteed maximum price for the project was finalized and agreed upon, and the project began. As the project began to be underway, it was important for Davis to look ahead in the project at the long lead items for the project. In other words, if a piece of mechanical equipment needed to be on the site on a specific day, the team would have to work backwards and keep to a schedule for the submittal, fabrication, and delivery process.

Demolition & Site Preparation

The next step was to clear the site of the structures that were accompanying the land. These structures include numerous industrial warehouses, and a motel. These structures can be seen in figure 1 below, where the building in the top left of the figure is the hotel and the other six structures are industrial warehouses.

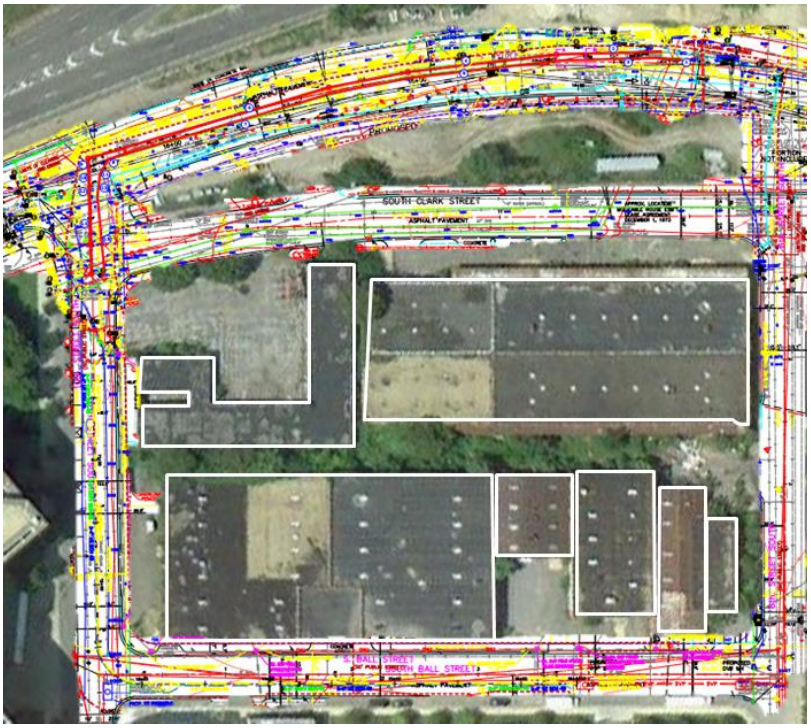


Figure 1 – Existing Structures and Utilities (Courtesy of Davis drawings & Google Maps)

It is important to note the extreme amount of existing utilities at the site of Memorial Vista. Being that the building is located near government locations in northern Virginia, there are utilities weaved below the roads surrounding this location. This information was taken into account and reflected in the schedule.

Excavation

As the site was cleared, excavation for the foundation of Memorial Vista began to take place. It is again crucial to note in figure 1 (previous Page), the vast amount of utilities surrounding the site of this location. All of these utilities had to be taken in to account, along with the fact that there are numerous mismarked or even unmarked utilities that would surely be discovered.

An aspect that also must be kept in mind is that the majority of the buildings that originally accompanied the site at one time had an industrial use to them. This being said, each location and surrounding location would need to be checked for contaminated soil. The owner requested that the entire site be excavated for this purpose to eliminate the possibility of contaminated soil in the chance that further renovations or additions take place. Figure 2, below, shows the excavation of the future foundation for an addition on to the building. This was to be filled in after the excavation takes place and any contaminated soils are removed. To complete the entire excavation of the site, Davis decided the best tactic would be to excavate each wing of the building (North and South) and then the remaining land. This can be seen in the site layout plane, during the excavation phases later in the report.

Figure 2 – Excavation for Future Addition (Courtesy of Davis)

Substructure & Superstructure

Following the excavation was the cast in place concrete substructure. This, like the excavation, was split into wings. Splitting the project into North and South wings allowed for linear scheduling, where the concrete subcontractor was able to work their way across the building and up the structure. This similarity between floors allowed the subcontractor to be more efficient and cut down the duration of the pour on the project, rather than sequencing the pours with gaps between them.

The majority of the structure was first formed using Peri SKYDECK reusable panel formwork. The next steps were to reinforce the slabs and pour. There were two locations where post tensioning was used, those being the Lobby and the Multipurpose Space, which allowed for wider spans for the spaces.

Core MEP & Finishes

To allow for quick and easy installation, the MEP equipment was delivered as close to the installation time as possible. This allowed the site to remain uncongested, and be as safe as possible. Once the materials were delivered to the site, they were moved and store on their respected floors that they were to be installed on. This allowed the crews to have what the needed close by and allowed for quick installation. This can be seen in figure 3 to the right. Since this building is simply a core and shell building, the finishes with in at this time are not extensive. The finishes time frame that is expressed in the schedule includes things like paint, acoustic ceiling tiling, miscellaneous metals, and flooring. All of these are fairly generic, where the future aviation tenant will further emphasize their needs and want during the interior fit out of the building.

Figure 3 – Duct Storage on Floor
(Courtesy of Davis)

Facade

The concrete superstructure sequenced their work bottom up, so as the concrete work began at the top of the structure, the façade began to be attached to the structure. This was quick and easy due to the fact that curtain wall, windows, precast panels, and metal paneling were all attached directly to the structure though the use of embeds and anchors. The two tower cranes on site are used to hoist the façade pieces into place and then are directly welded to these embeds or are bolted, as per the specs.

Roof

On the top of the building is the penthouse, this space contains two cooling towers, 2 chillers, and a single heat exchanger. Surrounding this space is various types of roofing, ranging from roof pavers to a fluid applied protective membrane with gravel on top. The pavers were used where balconies are located to allow for the safety of the occupant and prevent them from tripping. There are also raised planters on the roof where the balconies are located to allow small gardens to be a part of the roof and to cut down on the heat island effect. The most important aspect when scheduling the construction sequence of the roof is not necessarily the roof materials, but rather the mechanical equipment that will be housed in the penthouse space. These items have long lead times, and drive the schedule for when the roof can be completed. Figure 4, below, shows the framing of the mechanical room penthouse. It can be seen that the completion of this penthouse is holding up the roofing phase of the project.

Figure 4 – View of Penthouse from Roof (Courtesy of Davis)

Elevators

A critical part to this project is the elevators. It was the owner's requests to have the building contain 14 elevators throughout. These elevators take a long time to install and need to be completed on schedule to ensure the building would be completed on time. This puts the elevators on the critical path of the project.

Final Completion & Occupancy

The final phases of the project were to complete the punch-list and ensure the base building structure is exactly what the owner needs and meets all their desires. This is a crucial part to this project, because once the base building is completed, the interior fit out will be bid out. If Davis did everything that the owner desired and the owner is happy with the final project, the probability of acquiring the interiors project is very likely.

Detailed Estimate & Assemblies Estimate

Detailed Structural System Estimate

This detailed structural estimate will provide an accurate breakdown of the cost of Memorial Vista. In order to perform this estimate, modules were taken off and then interpolated to the entire size of the building. These modules can be seen in Appendix B1, where the areas and other dimensions were found using Autodesk Quantity Takeoff.

The total detailed estimate of the structure led to a value of $16.4 Million. This is not far off from the actual cost of the structural cast in place concrete for the building that is actually valued at $16.9 Million. Table 2, seen below, shows the breakdown of the project and how the total was reached.

Table 2 – Detailed Structural Cost Break Down

	Cost of Foundation	Cost of Level P2	Cost of Level 1	Cost of Level 2
Estimated cost after Interpolation	$2,621,339.10	$2,739,015.91	$2,514,366.34	$1,543,462.92
Number of Similar Floors	1	1	1	5.5
Estimate of Building	$2,621,339.10	$2,739,015.91	$2,514,366.34	$8,489,046.07

Estimate Total =	$16,363,767.43
Actual Total =	$16,896,800.00

Percent Difference =	3.20%

The table above shows the estimate taken off for each floor, where the Foundation cost after interpolation is found by adding the total for the column footings, column piers, foundation wall, and wall footings seen in the detailed structural estimate spreadsheet in Appendix B1. Since there is only one foundation, the multiplier for similar floors is only one, leading to an estimate for the foundation being around $2.6 Million.

Next was the cost for the P2 level of the underground parking garage. This is found by adding the total for the slab on grade, and the columns to P1. These values can be seen in the spread sheet provided in Appendix B1. Since level P2 was a slab on grade and the floor to floor height was only 9 feet, it was completely different than Level P1. Therefore, this level is only multiplied by one, leading to a cost of around $2.6 Million. Level P1 would be taken care of as a multiple similar to Level 2, due to the fact it has elevated slabs and similar floor to floor heights.

Level 1 was the next level to be estimated, due to its different layout and slab thickness compared to the rest of the building. This level ranged in floor thicknesses, but had an average of around eleven inches. For the purpose of this estimate, eleven inches was used, due to the fact the concrete slab would over compensate in some areas and under compensate in others, but resulting in a fairly reasonable estimate. The value in Table 2 for Level 1 can be seen in Appendix B1, where the total cost of the elevated slab and columns add to the cost estimate for this floor.

The final floor take off was the second floor. Floors two through six and Level P2 in the garage needed to be taken off, where floor two was the perfect average of both floor thickness and floor to floor height. The values for the elevated slab and columns to Level 3 in Appendix B1 can be seen to add up to around $1.5 Million. This value was then multiplied by 5.5 to account for Levels 2through 6, and then also Level P2 in the underground garage. Since level 6 only takes place in the South half of the building and not the North, it is the 0.5 seen in the multiplier in the table above. Level P2 was also accounted for in this section due to the fact that the floor to floor height was similar and the slab thickness was the same.

Level P2 & Foundation

Level P2 can be seen below, where it is broken down into table 3 through 6. These tables represent the detailed estimate of the P2 Level in the 6,500 SF space seen in figure 5.

Table 3 – Column Footings in Module Area

Column Footings in Module Area 0f 6,500 SF (Various Sizes)							
Call Out	Length x Width x Depth	Volume of Concrete (ft^3)	C.Y.	Rebar	Lbs. / Linear Foot (Rebar)	Weight of Rebar (lbs.)	Weight of Rebar (Tons)
E -4	10' x 6'6" x 30"	162.5	6.02	15#8L & 12#7S	#8 = 2.670, #7 = 2.044	#8 = 400, #7 = 159	#8 = 0.2, #7 = 0.08
F - 4	23' x 23' x 74"	3262.2	120.82	28#11	5.313	6843	3.4215
G - 4	13'2" x 8'8" x 72"	684.7	25.36	15#10L & 21#9S	#10 = 4.303, #9 = 3.4	#10 = 849, #9 = 642	#10 = 0.4, #9 = 0.3
E - 5	16' x 15' x 52"	1040	38.52	18#10	4.303	2401	1.20
F - 5	16' x 14' x 52"	970	35.93	18#10	4.303	2323	1.16
G - 5	9' x 9' x 56"	378	14.00	10#10	4.303	775	0.39
G - 5.5	9' x 9' x 56"	378	14.00	10#10	4.303	775	0.39
H - 5.5	7'6" x 7'6" x 48"	225	8.33	8#10	4.303	537	0.27
E - 6	15' x 15' x 48"	900	33.33	16#10	4.303	2065	1.03
F - 6	12' x 12' x 36"	432	16.00	12#9	3.4	979	0.49
G - 6	9' x 9' x 56"	378	14.00	10#10	4.303	775	0.39
H - 6	6' x 6' x 48"	144	5.33	4#10	4.303	516	0.26
N/A	Total	8954.4	331.64	N/A	N/A	#7 = 159	#7 = 0.08
						#8 = 400	#8 = 0.2
						#9 = 1621	#9 = 0.81
						#10 = 11016	#10 = 5.5
						#11 = 6843	#11 = 3.4

Table 4– Foundation Walls & Foundation Wall Footings in Module Area

Foundation Walls in Module Area 0f 6,500 SF (Various Sizes)						
Length x Width x Depth	Volume of Concrete (ft^3)	C.Y.	Rebar	Lbs. / Linear Foot (Rebar)	Weight of Rebar (lbs.)	Weight of Rebar (Tons)
100' x 1' x 3'	300	11.11	#6@12" O.C.	1.502	976.3	0.49
Foundation Wall Footings in Module Area 0f 6,500 SF (Various Sizes)						
Length x Width x Depth	Volume of Concrete (ft^3)	C.Y.	Rebar	Lbs. / Linear Foot (Rebar)	Weight of Rebar (lbs.)	Weight of Rebar (Tons)
70' x 2'6" x 2'	350	12.96	4#5	1.043	413.7	0.21

Table 5 – Column Piers in Module Area

Column Piers in Module Area 0f 6,500 SF (Various Sizes)								
Call Out	Length x Width x Depth	Volume of Concrete (ft^3)	C.Y.	Rebar	Lbs. / Linear Foot (Rebar)	Weight of Rebar (lbs.)	Weight of Rebar (Tons)	S.F.C.A.
E -4	2' x 2' x 5.17'	20.68	0.77	#10 @ 12" O.C.	4.303	295	0.15	41.36
F - 4	4' x 2.5' x 5'	50	1.85	#10 @ 12" O.C.	4.303	365	0.18	65
G - 4	1' x 2' x 3'	6	0.22	#10 @ 12" O.C.	4.303	129	0.06	18
E - 5	2' x 2' x 1.5'	6	0.22	#10 @ 12" O.C.	4.303	77	0.04	12
F - 5	2' x 2' x 1.67'	6.68	0.25	#10 @ 12" O.C.	4.303	86	0.04	13.36
G - 5	1' x 2' x 3'	6	0.22	#10 @ 12" O.C.	4.303	129	0.06	18
G - 5.5	2' x 2' x 3'	12	0.44	#10 @ 12" O.C.	4.303	155	0.08	24
H - 5.5	2' x 1' x 3'	6	0.22	#10 @ 12" O.C.	4.303	129	0.06	18
E - 6	2' x 2' x 2.5'	10	0.37	#10 @ 12" O.C.	4.303	129	0.06	20
F - 6	2' x 2' x 2.5'	10	0.37	#10 @ 12" O.C.	4.303	129	0.06	20
G - 6	2' x 2' x 3'	12	0.44	#10 @ 12" O.C.	4.303	154	0.08	24
H - 6	2' x 2' x 3'	12	0.44	#10 @ 12" O.C.	4.303	154	0.08	24
N/A	Total	157.36	5.83	N/A	N/A	#10 = 1931	#10 = 0.97	297.72

Table 6 – P2 Columns in Module Area

P2 Columns in Module Area 0f 6,500 SF (Various Sizes)								
Call Out	Length x Width x Depth	Volume of Concrete (ft^3)	C.Y.	Rebar	Lbs. / Linear Foot (Rebar)	Weight of Rebar (lbs.)	Weight of Rebar (Tons)	S.F.C.A.
E -4	24" x 24" x 12'	48	1.78	8 #9	3.4	380.8	0.1904	96
F - 4	30' x 48' x 12'	120	4.44	24 #11	5.313	1912	0.956	156
G - 4	24' x 24' x 12'	48	1.78	12 #11	5.313	765.1	0.38255	96
E - 5	24' x 24' x 12'	48	1.78	12 #11	5.313	765.1	0.38255	96
F - 5	24' x 24' x 12'	48	1.78	12 #10	4.303	619.6	0.3098	96
G - 5	24' x 24' x 12'	48	1.78	12 #11	5.313	765.1	0.38255	96
G - 5.5	24' x 24' x 12'	48	1.78	8 #10	4.303	481.9	0.24095	96
H - 5.5	24' x 24' x 12'	48	1.78	8 #9	3.4	380.8	0.1904	96
E - 6	24' x 24' x 12'	48	1.78	12 #11	5.313	765.1	0.38255	96
F - 6	24' x 24' x 12'	48	1.78	8 #10	4.303	481.9	0.24095	96
G - 6	24' x 24' x 12'	48	1.78	8 #10	4.303	481.9	0.24095	96
H - 6	24' x 24' x 12'	48	1.78	8 #10	4.303	481.9	0.24095	96
N/A	Total	648	24.00	N/A	N/A	#9 = 761.6	#9 = 0.381	1212
						#10 = 2547.2	#10 = 1.27	
						#11 = 4972.4	#11 = 2.49	
						Total =	4.1406	

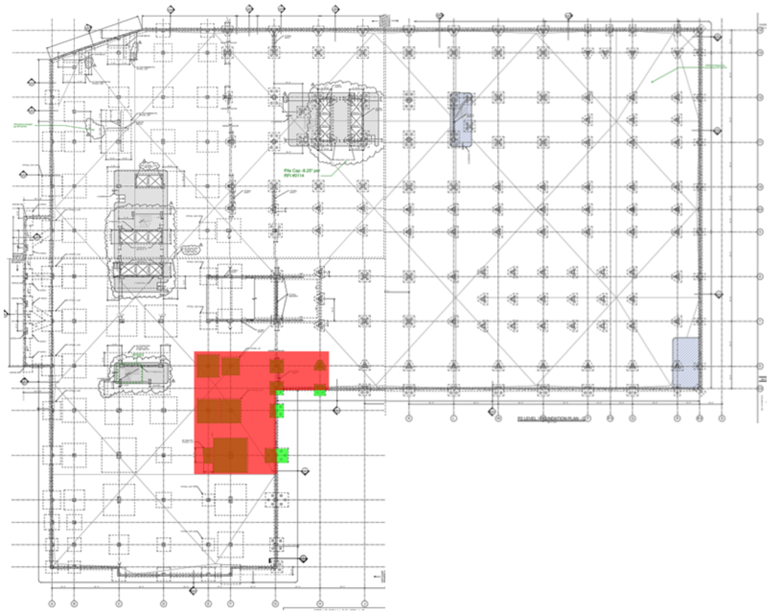


Figure 5 – Level P2 Module Area Location (Original Drawing Courtesy of Gensler)

Once the values for each one of the tables above were found for the module space, the total area of the space was interpolated from the module area. In other words, 6,500 square feet of Level P2 were taken off out of the total 123,765 square feet for Level P2. This means there is a multiplier of around 19 that needs to be multiplied by the values on the tables above to reach the values shown in the detailed estimate cost sheet shown in Appendix B1.

Level 1

The first level can be seen below, where it is broken down into table 7 and 8. These tables represent the detailed estimate of the Level 1 in the 2,400 SF space seen in figure 6.

Table 7 – Level 1 Elevated Slab in Module Area

Level 1 Elevated Slab								
Total S.F.	Slab Thickness (ft.)	Ft^3	C.Y.	Rebar	Lbs. / Linear Foot (Rebar)	Weight of Rebar (lbs.)	Weight of Rebar (Tons)	S.F.C.A.
2400	0.92	2200	81.48148	#5 @ 12" O.C.	1.043	20654	10.327	73.6

Table 8 – Level 1 Columns in Module Area

Level 1 Columns in Module Area 0f 2,400 SF (Various Sizes)								
Call Out	Length x Width x Depth	Volume of Concrete (ft^3)	C.Y.	Rebar	Lbs. / Linear Foot (Rebar)	Weight of Rebar (lbs.)	Weight of Rebar (Tons)	S.F.C.A.
L - 13	2' x 2' x 13'	52	1.93	12 #10	4.303	638	0.319	104
L - 14	2' x 2' x 13'	52	1.93	8 #10	4.303	500	0.25	104
M - 13	2' x 2' x 13'	52	1.93	12 #10	4.303	638	0.319	104
M - 14	2' x 2' x 13'	52	1.93	8 #10	4.303	500	0.25	104
N - 13	2' x 2' x 13'	52	1.93	12 #10	4.303	638	0.319	104
N - 14	2' x 2' x 13'	52	1.93	8 #10	4.303	500	0.25	104
N/A	Total	312	11.56	N/A	N/A	#10 = 4158	#10 = 1.707	624

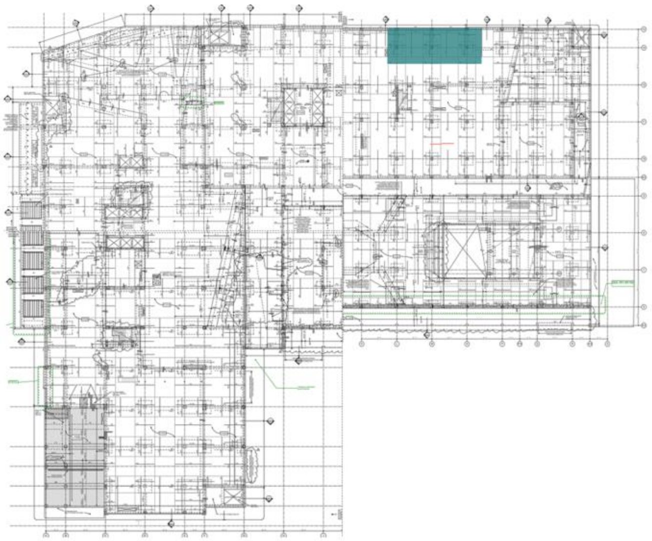


Figure 6 – Level 1 Module Area Location (Original Drawing Courtesy of Gensler)

Once the values for each one of the tables above for Level 1 were found for the module space, the total area of the space was interpolated from the module area. In other words, 2,400 square feet of Level 1 were taken off out of the total 72,243 square feet for Level 1. This means there is a multiplier of around 30 that needs to be multiplied by the values on the tables above to reach the values shown in the detailed estimate cost sheet shown in Appendix B1.

Level 2

The first level can be seen below, where it is broken down into table 9 and 10. These tables represent the detailed estimate of the Level 1 in the 2,400 SF space seen in figure 7.

Table 9– Level 2 Elevated Slab in Module Area

Level 2 Elevated Slab								
Total S.F.	Slab Thickness (ft.)	Ft^3	C.Y.	Rebar	Lbs. / Linear Foot (Rebar)	Weight of Rebar (lbs.)	Weight of Rebar (Tons)	S.F.C.A.
2400	0.67	1600	59.25925926	#5 @ 12" O.C.	1.043	20654	10.327	53.6

Table 10– Level 2 Columns in Module Area

Level 2 Columns in Module Area 0f 2,400 SF (Various Sizes)								
Call Out	Length x Width x Depth	Volume of Concrete (ft^3)	C.Y.	Rebar	Lbs. / Linear Foot (Rebar)	Weight of Rebar (lbs.)	Weight of Rebar (Tons)	S.F.C.A.
L - 13	2' x 2' x 11.5'	46	1.70	12 #10	4.303	792	0.396	92
L - 14	2' x 2' x 11.5'	46	1.70	8 #10	4.303	594	0.297	92
M - 13	2' x 2' x 11.5'	46	1.70	12 #10	4.303	792	0.396	92
M - 14	2' x 2' x 11.5'	46	1.70	8 #10	4.303	594	0.297	92
N - 13	2' x 2' x 11.5'	46	1.70	12 #10	4.303	792	0.396	92
N - 14	2' x 2' x 11.5'	46	1.70	8 #10	4.303	594	0.297	92
N/A	Total	276	10.22	N/A	N/A	#10 = 4158	#10 = 2.079	552

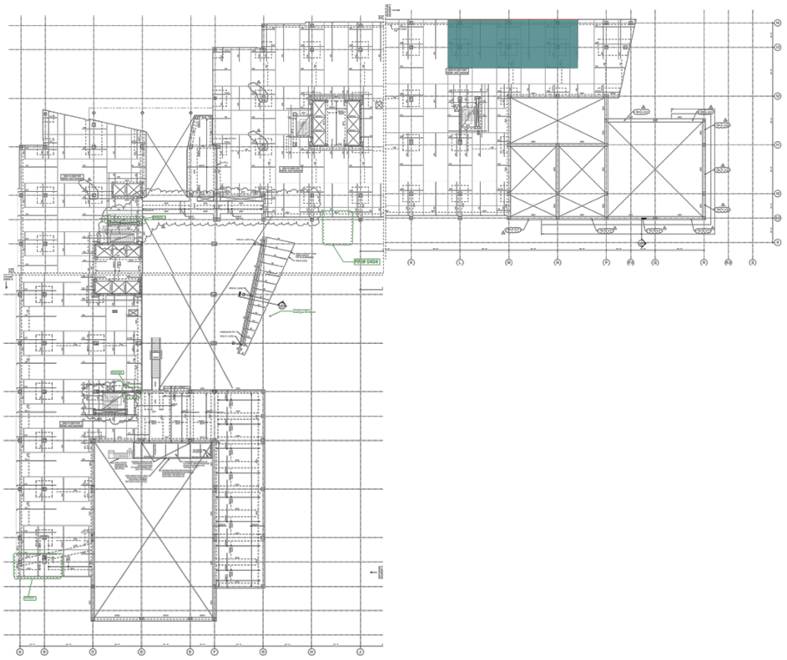


Figure 7 – Level 2 Module Area Location (Original Drawing Courtesy of Gensler)

Once the values for each one of the tables above for Level 2 were found for the module space, the total area of the space was interpolated from the module area. In other words, 2,200 square feet of Level 2 were taken off out of the total 48,001 square feet for Level 2. This means there is a multiplier of around 22 that needs to be multiplied by the values on the tables above to reach the values shown in the detailed estimate cost sheet shown in Appendix B1.

The detailed estimate preformed ended up being just less than 3% of the actual cost of the cast in place concrete (Referencing Table 2). It is important to note that this value does not include the piles that are located on half of the building's foundation due to the fact that they are precast and in a separate cost break down that includes the precast panels that make up the façade of the building. A reason for being off by a small fraction would be the fact that level 2 was multiplied by 5.5 floors. If more accuracy was required, level P2 could have been taken off individually. This would have helped due to the fact that Level 2 has foundation walls that were not taken into account when multiplied by level 2, which does not take into account any amount of concrete walls. The reason that the estimate was able to work was due to the fact that Level 2 through 6 all have drop panels located at the column, where they are not in the garage level. This area of concrete that makes up the drop panels was assumed to take the place of the foundation wall in the P2 level, and may have resulted in less concrete and rebar than actually needed and would result in the price being both higher and closer to the actual cost of the past in place concrete for Memorial Vista. One other aspect that may have resulted in a lower cost is the fact that RS Means was used to calculate the values for the material and labor. A location factor was applied for the north Virginia location, but this is not a perfect modifier and varies significantly on an actual project. A third reason for the cost being off from the actual estimated price was due to the fact that the post tensioning above the Lobby Space and Multipurpose Space was not taken into account. These cables would have also added some value to the final cost of the structure. All in all, if every square foot of the building was taken off in detail, an extremely accurate estimate could have taken place in a relatively short period of time and would have led to an estimate that would be extremely close to the actual cost of the buildings structure.

MEP Assemblies Estimate

Referencing Appendix B.2, one will see the assemblies estimate of the mechanical, electrical, plumbing, and fire protection for the building. The plumbing and mechanical estimate was combined for the actual estimate provided by Davis Construction, and came out to be $11.2 million. After performing the mechanical and plumbing estimate, it was found that the cost would be $10.6 million, which is just under 6% of the actual cost. The electrical equipment was projected to cost $7.1 million, whereas it was estimated for the purpose of this thesis report to be $6.7 million, which is just under 7% of the cost. The last division that was taken off in the assemblies estimate was the fire protection within the building. This was projected by Davis to be $650,000 and was calculated to be around 633,325, which is just under 2% of the original projected cost. A breakdown of all this information can be seen in table 11 below.

Table 11 – Assemblies Estimate Breakdown & Comparison

Devision	Estimate Cost	Actual Cost	% Difference
Mechanical & Plumbing	$10,566,648.52	$11,200,000.00	5.65%
Electrical	$6,656,995.23	$7,100,000.00	6.24%
Fire Protection	$633,325.60	$650,000.00	2.57%

When looking at the mechanical and electrical breakdown, one will see that included in the mechanical estimate is a water cooler unit, this is a single package water cooled unit that includes a water tower, pump, and piping allowances. Along with this information, this line item also includes the duct and diffusers used to distribute the conditioned air to the required spaces. The cooling tower is then also included because this includes the rest of the mechanical system that is not a part of the water cooling unit stated above. This means, that the chilled water cooling tower system has two closed loops for condenser water, pumps associated with this system, and expansion tanks. The only thing left out of the bulk of the mechanical system is the heat exchanger. This is a plate type, floor mounted heat exchanger, described in the table in the appendix. The plumbing systems are a numeric count of the fixtures to be placed in the office building, including toilets, sinks and drinking fountains. Along with these components, the estimate also takes into account the water heaters and the sewage ejectors in the building. These are essential for the flow within the building, but one must not forget the pipework for the drainage of a building's roof, which is also included in the report. This estimate in total comes fairly close to the actual cost once completed

The electrical equipment within the estimate can be seen, were the majority of the cost is the panel boards, receptacles, switchboards, light fixtures, switches, and transformers. These are the main components of a building, but there is also emergency backup equipment in the building that includes an automatic transfer switch, and a diesel generator. Since the building is an office building, there must also be data and voice system run throughout the building.

The final component of this assemblies estimate was the fire protection for Memorial Vista. This building has two types of fire suppression systems in the building, shown in the estimate. One is a dry system, where the pipes are filled with compressed air to prevent them from freezing. These pipes are located in the garage area, due to the fluctuation in temperature. The other type is wet pipe, where they are filled with water, and at the point of a fire, the glass filament in a sprinkler breaks and water comes rushing out to put out the fire. This specific building has an automated system, where in the case of a fire; there is a fire alarm panel to shut off dampers in the ventilation system to prevent smoke from spreading throughout the building. This was assumed to be included in the price of the wet and dry fire suppression systems.

Site Layout Planning

Demolition Phase

Below is four site plans in the sequence that the construction process would take place. For a better look at the components of each phase, there are larger plans in the appendix under Appendix C. Figure 8 (below) is the demolition phase of the project. The purple objects represent the structures that are to be demolished. It is important to note that a majority of them are industrial structures, where the possibility of the structures containing some form of asbestos was high. Davis Construction, the general contractor for the project, took this information into account and it was reflected in their actual schedule and budget. It is also important to note that the parking and one lane of traffic on the northeast side of the site is closed and the space is used as a location for the job trailers. The actual road through the site will be used to discard the material that has been demolished and will have to be removed after the demolition phase. When this road is removed for the future office building, there will have to be extensive reworking of the underground utilities below the road due to the large amount of underground utilities in this area.

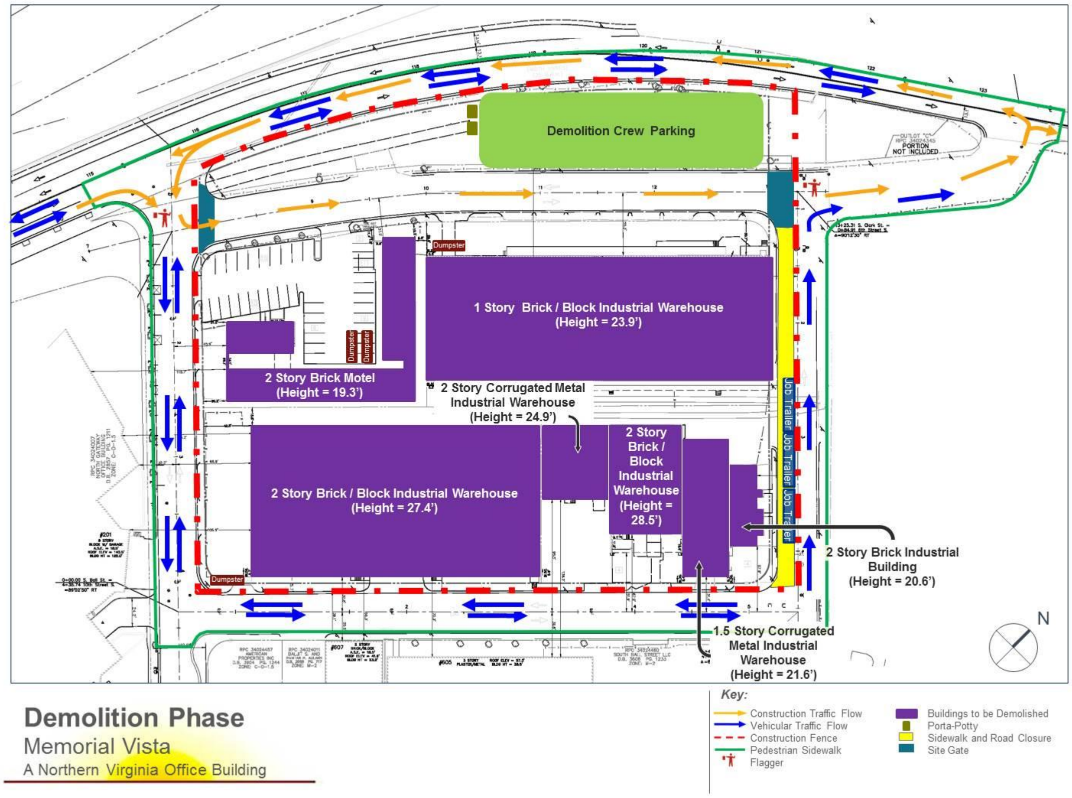


Figure 8 – Demolition Phase Site Plan (Original Drawing Underlay Courtesy of Gensler)

Building Excavation – Phase 1

The next phase can be seen in figure 9. This is a site layout while in the excavation phase. The excavating crew will start in the south wing, move to the north wing, and then follow up with the plaza area where the ramp to the parking garage is located. This will ensure continuous work across the entire site. There are three ramps in and out of the site, allowing for quick and efficient access to the site. All ramps lead to the gates of the site, where there will be a positioned flagger to allow the safety of the vehicles going in and out of the site, along with other vehicular traffic around the site. One thing that was added to the perimeter of this site plane that did not exist in the previous figure is the fact that there is now jersey barriers in the plan along the perimeter of the site to minimize the probability of a vehicle going off the road into the pit created during the excavation process. The parking for the excavation crew is also now across the street, where soccer fields will be located in the future.

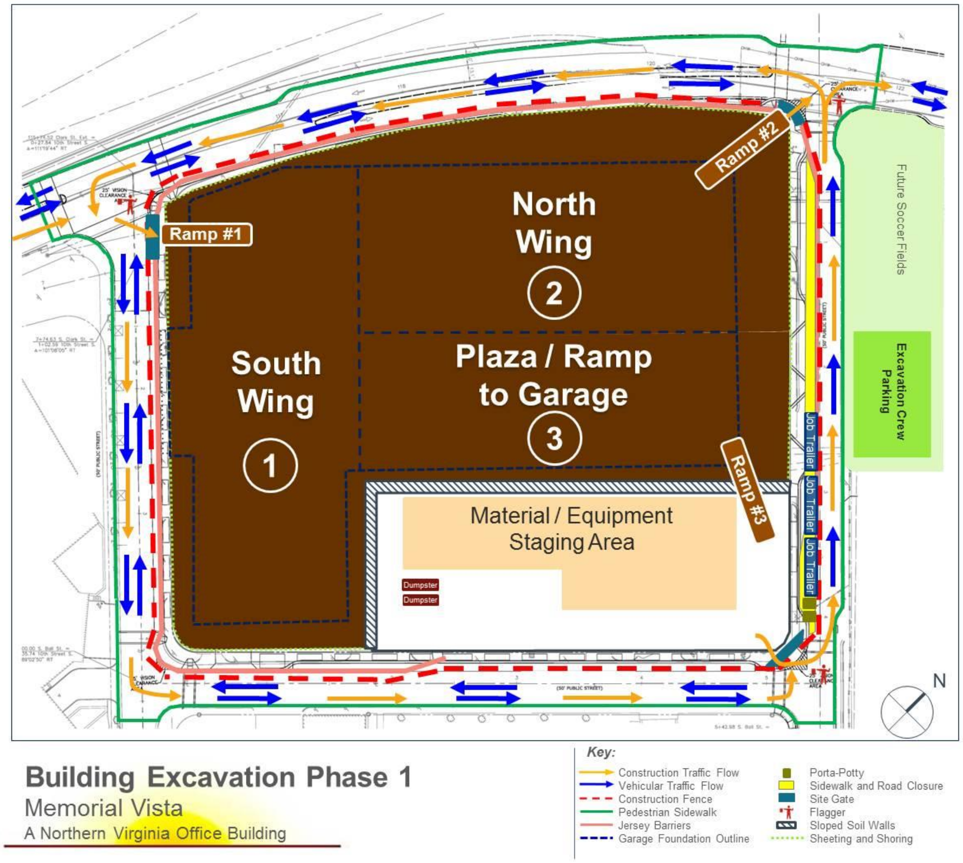


Figure 9 – Building Excavation Phase Site Plan (Original Drawing Underlay Courtesy of Gensler)

Excavation & Foundation Phase

The next phase would be the excavation of location 4 (see figure 10 below). The reason that this is being excavated is due to the owners desire to ensure that there will be no contaminated soils on the site from the industrial buildings that once occupied the land. The excavation of this location will go to the lowest point of the actual foundation. In the future, another phase of the building will be constructed and be put here, but that is not until the tenant to occupy the building expands to a larger size. For the time being, the location of this future wing will be excavated and then filled in after the soil has been ensured to not be contaminated. As this process is taking place, the piles will be laid from the south wing to the north wing, followed by the concrete foundation in this same fashion. A tower crane will be put in on the southwest side of the project with a 224’ swing radius. This crane will begin to place concrete for the foundation of the structure and the movement of material on the south side of the project. Parking is still offsite where the soccer fields will be located in the future. There are also still flaggers to keep the vehicles flowing in and out of the site as quickly as possible

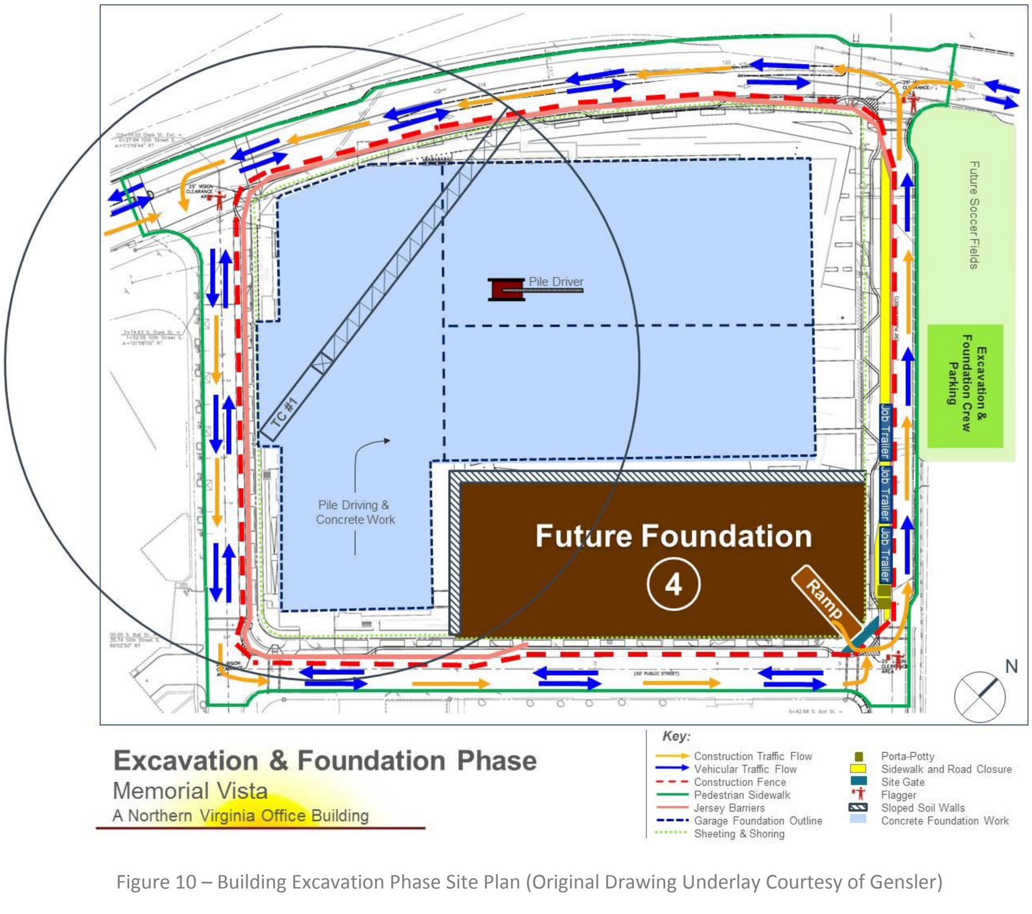


Figure 10 – Building Excavation Phase Site Plan (Original Drawing Underlay Courtesy of Gensler)

Substructure & Superstructure Phase

The final figure below is figure 11, which shows how the logistics of the site will be from the substructure to the superstructure phase. A second tower crane is brought on site to finish the foundation and stays throughout the project until the façade is assembled to the structure. This tower crane has a swing radius of 219’ and will we located out of the garage entrance. This second tower crane requires shoring at the garage levels and after the tower crane is disassembled, the garage will be completed. Dumpsters with trash chutes will be located on each wing, along with a material hoist that is fairly centrally located on the southwest façade of the building. Material staging will take place in the southwest portion of the project, after the excavation of this location has been completed and filled back in (see previous phase). An important aspect to note is that the trailers are still in their original location with the one lane of traffic closed. As the building is fully sealed, there is the possibility to remove the trailers and make the office inside a room in the building, thus saving money on general conditions costs. It is also important to note the location of the electrical vault in the northern part of the project. This is out of the reach of the tower cranes, allowing for the safety of this equipment to not be in harm’s way of something falling or bumping into it.

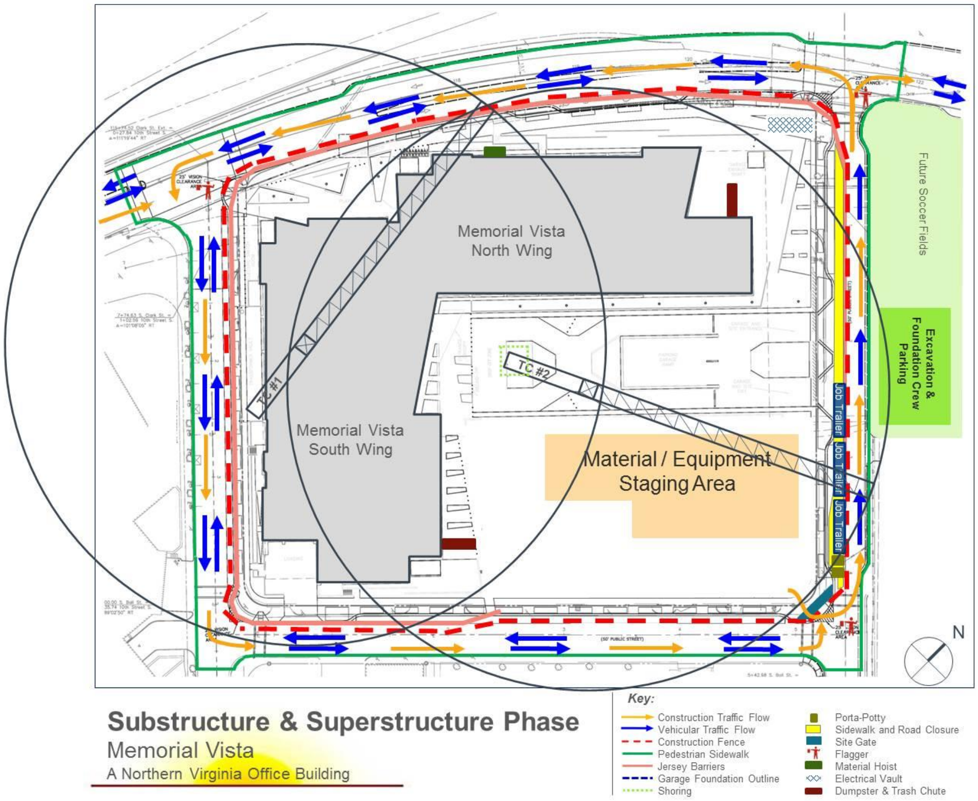


Figure 11 – Building Excavation Phase Site Plan (Original Drawing Underlay Courtesy of Gensler)

General Conditions Estimate

The general conditions cost for this project is unique in the fact that it is fairly low for the overall project cost. This is due to the fact that Davis Construction was initially brought on to the project after agreeing to a fixed-fee contract for preconstruction and general condition costs. This low cost is then made up for when the guaranteed maximum price is established, due to the fact that the items excluded in the general conditions are rolled into the project cost.

The actual general conditions cost that was submitted to the owner was $2.89 Million. The conditions that were excluded in the actual general conditions cost were costs for construction site fences, material hoists, temporary heat, temporary lighting, temporary water, trash chutes, guard rails, permits, insurance, bonds, and the cost of work during closeout. Due to the fact that a vast majority of what is normally provided in a general conditions estimate that tends to severely increase the initial price has been omitted, the cost is reflected as fairly low. It is important to remember that since these line items are not being executed in the general conditions phase of the project, the costs excluded will show up in the actual guaranteed maximum price and will result in a slightly increased project cost.

After performing the estimate using both R.S. Means and information provided by Davis construction, it was found that the general conditions cost was estimates to be $2.63 Million. This is a little lower than the actual general conditions cost, but is within ten percent. The break down for the estimate can be seen to be split into two divisions, where one is personnel subtotal costs, and the second is miscellaneous subtotal costs. Personnel subtotal costs are the culmination of all employees on the job and their corresponding salaries for the amount of time that they will bill the project. The second component, the miscellaneous costs are made up of the costs to get the job done. This includes the cost of cellular phones, signage, and office supplies. It is clear, that for this project, the primary constituent that forms a large chunk of the general conditions cost is the personnel costs. This can be seen in figure 12, to the right. The entire general conditions estimate can be seen on the following page in table 12.

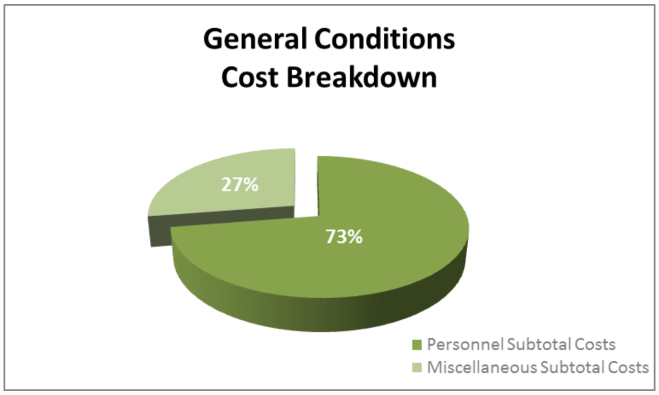


Figure 12 – General Conditions Cost Breakdown

Table 12 – General Conditions Estimate

Description	EA	Quantity	Units	Rate	Total Cost
Personnel Cost					
Senior Superintendent	1	102	Weeks	$4,036/Week	$ 411,672
Superintendent	1	65.3	Weeks	$2,329/Week	$ 156,198
Project Engineer - Field Supervision	1	35	Weeks	$1,860/Week	$ 65,100
Safety Manager	1	102	Weeks	$404/Week	$ 41,208
Project Executive	1	102	Weeks	$1,071/Week	$ 109,242
Senior Project Manager	1	106.3	Weeks	$3,260/Week	$ 346,538
Project Manager	1	108.6	Weeks	$2,329/Week	$ 252,929
Project Engineer - I.C.E.	1	21.4	Weeks	$1,863/Week	$ 39,868
Project Engineer	2	106.3	Weeks	$1,708/Week	$ 363,121
LEED Coordinator	1	10.9	Weeks	$629/Week	$ 6,856
Project Scheduler	1	78	Weeks	$629/Week	$ 49,062
Project Administrator	1	106.3	Weeks	$189/Week	$ 20,091
Project Accounting	1	106.3	Weeks	$233/Week	$ 24,768
Courier / Yard Delivery	1	102	Weeks	$217/Week	$ 22,134
Dump Truck Delivery	1	2.1	Weeks	$217/Week	$ 456
Miscellaneous Costs					
Time Lapse Equipment, Camera and Projector	1	24	Months	$2650/Camera	$ 2,650
Small Tools and Equipment	1	0.50%	Job	$78500000 Total	$ 392,500
Signage	1	0.01%	Job	$78500000 Total	$ 7,850
Trash Carts	1	3.5	Months	$300/Month	$ 1,050
Field Telephone	1	23.6	Months	$350/Month	$ 8,260
Temporary Power	1	23.6	Months	$8,177/Month	$ 192,977
IT	1	23.6	Months	$150/Month	$ 3,540
Office Supplies	1	23.6	Months	$75/Month	$ 1,770
General Health & Safety	7	23.6	Months	$300/Month	$ 7,080
Fire Extinguishers	1	23.6	Months	$350/Month	$ 8,260
Potable Water	1	23.6	Months	$150/Month	$ 3,540
Temporary Toilets	1	23.6	Months	$1,800/Month	$ 42,480
Miscellaneous Clean Up - Labor	2	20	Weeks	$1240/Week	$ 49,600
Miscellaneous Clean Up - Material	1	15.3	Weeks	$150/Week	$ 2,295
				Personnel Costs Subtotal	$ 1,909,242
				Miscellaneous Costs Subtotal	$ 723,852
				GENERAL CONDITIONS TOTAL	**$ 2,633,095**

Constructability Challenges

Memorial Vista was an extremely difficult project in the fact that its location in northern Virginia leads to a large amount of underground utilities, which can be seen in figure 1 (earlier in the report). This is crucial because the owner required that Davis excavate the entire site, even where the foundation was not to be. This was done to search for contaminated soils, but caused numerous problems. A majority of the constructability concerns are revolved around these phases of the construction process. The other issue was with the equipment going into the building and the long lead items that came with the equipment. The concerns that were a main focus for the team out on the Memorial Vista project are the site utility relocations, an inconclusive geotechnical report, and the long lead items that were longer than those that were originally projected.

The first major constructability concern is the existing utilities below grade on and around the project site. A majority of the utilities were either mismarked or completely unmarked on the actual drawings, and then the utilities that were marked, did not correspond to what was being found in the field through the utility company. This resulted in the team having to create a design for the relocation of the utilities without even completely knowing what was below the earth. Several test pits, where an excavator was used to dig a hole and mark what was found were completed, but not enough to fully map the utilities below grade. The biggest problem was the relocation of the sanitary sewer that ran through the site under a road that went through the plot of land that would eventually be the site for construction. The sequence for removing the gravity and forced main on the site and swapping into the new lines installed in the street on a bordering road were not entirely flushed out. Upon excavation of the pipes, it was found that there was no redundancy in the system and that these were significant pipes for the County and the pumping. As a result, the team had to perform a complicated tie-in and swap process that cost a lot of money and time. To perform this tie in to a new system of pipes that would bring the sanitary sewer line around the property of the building instead of through it, a line stop was needed. This caused some delays due to the fact that a line stop has an extremely long lead time and there are only a handful of crews in the country that perform the task. This problem could have easily been avoided if more accurate preconstruction surveys had been completed with information that could have cleared up potential problems that would have arisen in the future. On the following page is figure 13 that shows the initial break down of utilities. These are the main utilities that need to be relocated or removed. Davis provided these issues in phases, giving deadlines for each utility line's relocation. By doing this, Davis was able to form a schedule, and get the project back on track and make it possible to complete the project on the projected completion date. (Note that the street names referenced have been renamed as fictitious names due to the request of the owner to keep the building classified.)

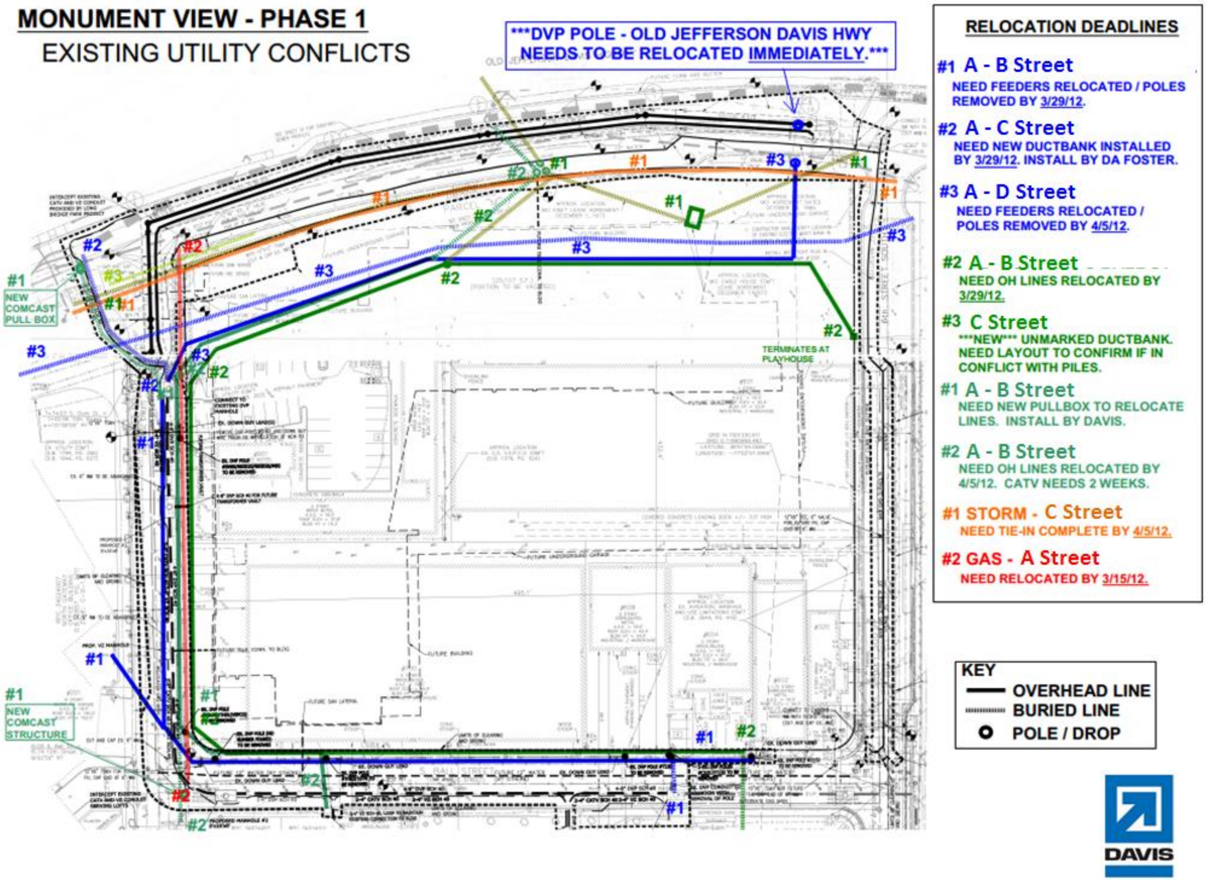


Figure 13 – Davis Relocation Deadlines (Courtesy of Davis Construction)

The next constructability issue, like the previous one, can be traced back to inconclusive information in the initial stages of the project. The geotechnical report was preformed, where twenty-four boring holes were drilled around numerous places throughout the future site. The location of these boring holes can be seen below in figure 14. After the excavation process took place, it was found that the soil contained suitable bearing capacity for the column piers and footings to be place directly, without the use of precast concrete piles. By the time the excavation had taken place, the precast piles had already been ordered, due to the fact that they have a fairly long lead time. The original design was to have one half of the building on the precast piles and the other on spread footings. As the excavation got down to the necessary level, the team realized that a good portion of the piles could have been eliminated, which would have saved a tremendous amount of money and time in the schedule. By this time it was to late, due to the fact they had already been ordered and were in the fabrication stage. If a more thorough geotechnical report was performed, it not only could have found that fewer piles were needed in the foundation of the building, but also the fact that the report said that there were contaminated soils. This report was extremely vague in the amount of contamination throughout the site, but rather shared the amount of contamination that was found in each test bore. This resulted in the team having a more difficult time quantifying the exact amount of contaminated soil on the site. For bidding purposes, Davis ended up put the risk on the excavation contractors to essentially guess at how much contaminated soil they thought they would encounter. After the bidding process was completed, it was apparent that each subcontractor had their own qualifications but in the end the bids varied substantially. Adding to the high cost, high risk excavation was the fact that the subcontractor would have to excavate the entire site, and not just where the foundation of the building was to be going. This was a result due to the request of the owner. After the entire site is excavated, the portion of the site where the foundation is not located is then filled in. The fact that there was so little information on precisely how much contaminated soil was in the earth below the site boundary, the pricing for this work was higher than average. The figure below visually shows the large amount of land that was open for question as to what was below the earth. If a simple more thorough boring array was completed, Davis would have been able to have a better chance at quantifying how much risk should have been assumed, which again would have saved time and money in the long term of the project.

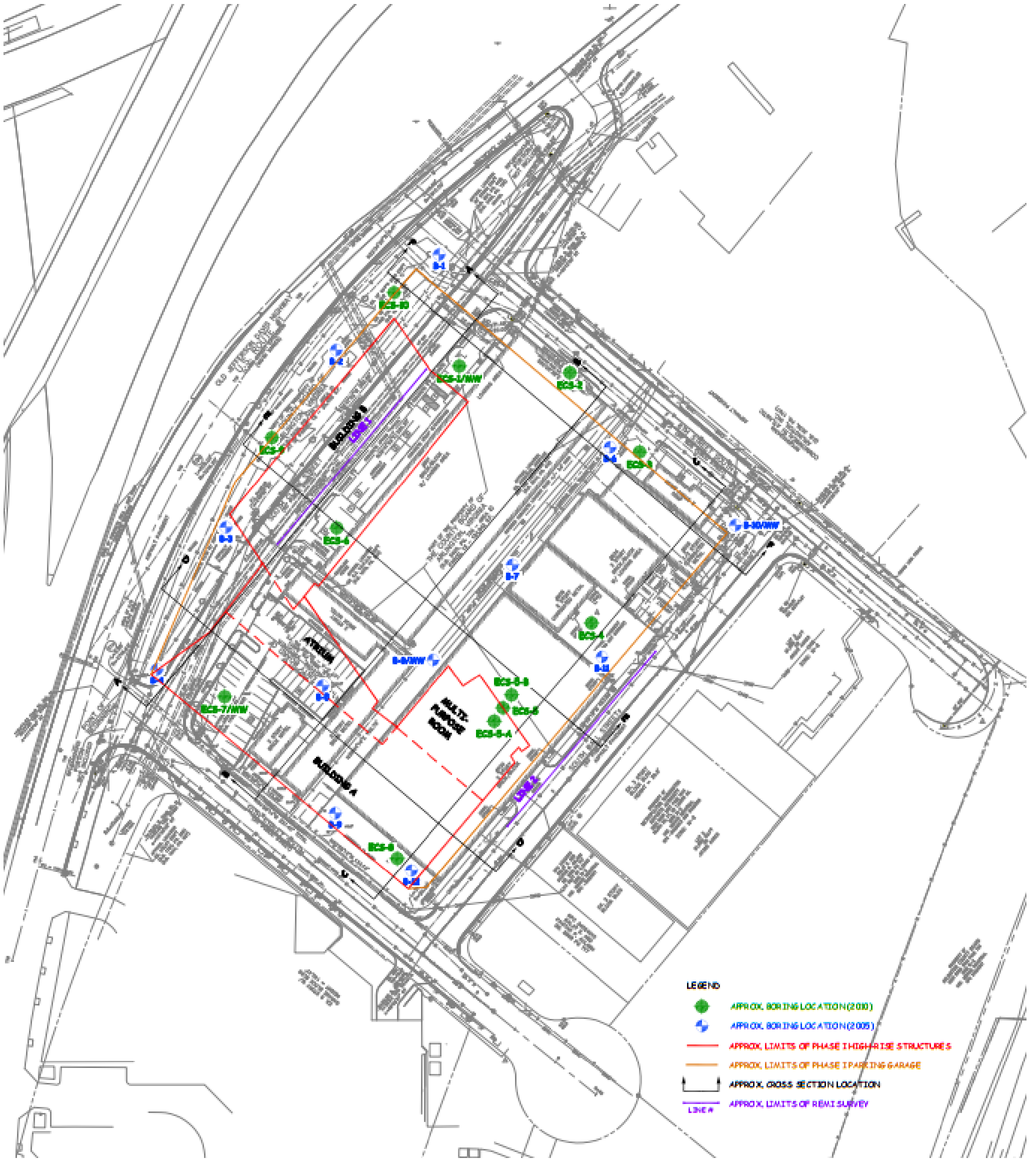


Figure 14 – Geotechnical Boring Hole Locations (Drawing Underlay Courtesy of Gensler)

The final constructability challenge was the fact that the bus bar within the building had and extremely long lead time. This bus bar was used for the main electrical distribution from the switchgear to the typical floors throughout the building. It is used to run the current from the switchboard from the P1 level to the panel boards on each level (seen below represented in green in figure 15). This being said, it's a critical part of running electricity throughout the building. The item originally was scheduled for installation based off of assumed lead times from previous projects and product information from the manufacturer. It was later found that the items were taking longer than anticipated and became an issue as the construction team waited on the last few pieces of the bus duct to arrive on site. This resulted in the impact of equipment start-ups being delayed from their original start-up dates. This problem could have been totally avoided if the Davis team presented alternatives to the bus duct, such as electrical conduit distribution, when Davis was originally brought on board to preform and share value engineering items early in the construction phase. This value engineering would have resulted in known lead times of the material, and moderate cost decreases compared to the bus duct. This would have just been a proposal, because although the lead time on the project was longer than anticipated, the bus duct does allow for more flexibility and serviceability, but since this building is simply an office building, rigid conduit could have fulfilled the same job for cheaper and would have been more reliable for delivery dates.

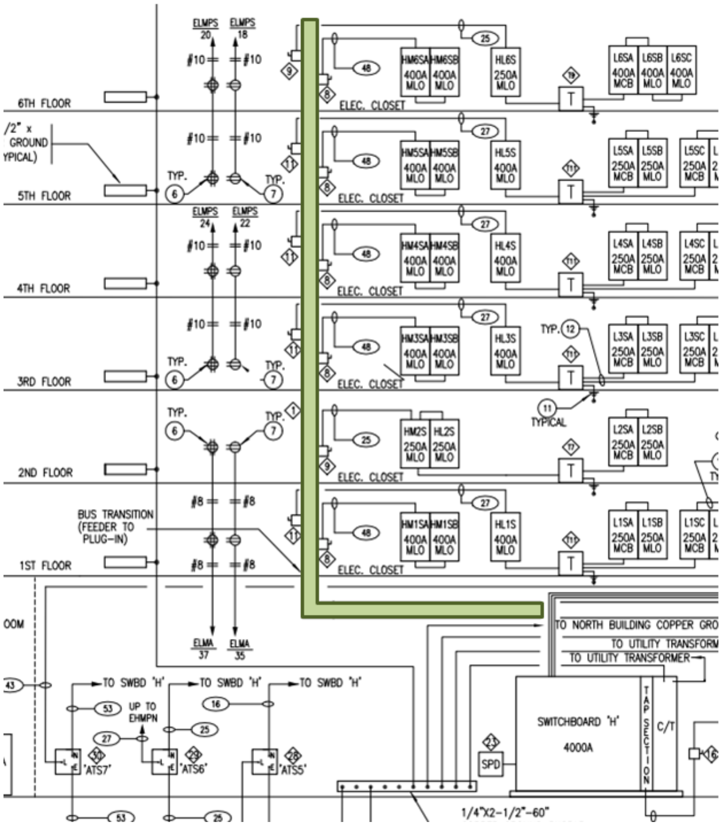


Figure 15 – Bus bar running from vertically through building (Drawing Underlay Courtesy of Gensler)

Building Information Modeling Use Evaluation

Building Information Modeling (BIM) is an extremely useful tool to not only the construction team, but also the owner. Although the object produced is referred to as a model, it is much more than that. The model formed is a resource that can provide input varying from clash detection to telling an owner when a piece of equipment needs replacing. BIM can be used for a wide variety of uses including cost estimation, systems analysis, 3-D coordination, 4-D phase planning, facility maintenance and many other uses. These systems are all implemented to provide cost and time saving to the owner. Since the cost and schedule can be affected through the use of BIM, it is obvious that this is a crucial factor in the industry. The important thing to keep in mind is the end use of the building and what steps can be aided through the use of BIM to get the project complete not only on time and under budget, but also meet all of the owners need that they originally desired.

The first step, when BIM has been decided to be implemented on a project, is to form a plan of what the owner wants upon the completion of the project and how modeling can help reach those goals. This is done through the use of completing the BIM use list and the level one process map. The BIM use list is a graphical chart that defines all uses of BIM throughout the project's phases. These phases include the planning, design, construction, and operation phases. The level one process map is then a flow chart that describes the phasing of each BIM use and defines who is responsible for performing the tasks to complete the BIM activities on the project. This is important, because the BIM team members need to be sure who is responsible for each deliverable and when it is needed by. After the completion of the BIM use list and level one process map, the project team will clearly understand what BIM uses will be implemented on the project and who is responsible for the completion of each task.

Below, in figure 16, is a model of Memorial Vista in Navisworks Manage 2014.

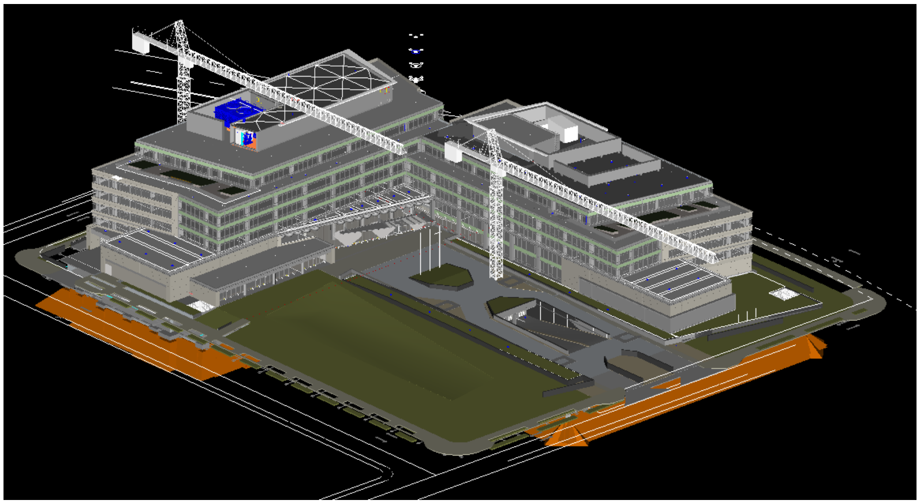


Figure 16 – Navisworks Model of Memorial Vista (Courtesy of Davis)

BIM Use List

The first step for implementing BIM for this project is to for a BIM use list. This list can be found below in figure 17, where the items circled in orange are the items that have been looked at for this project and plan to be completed.

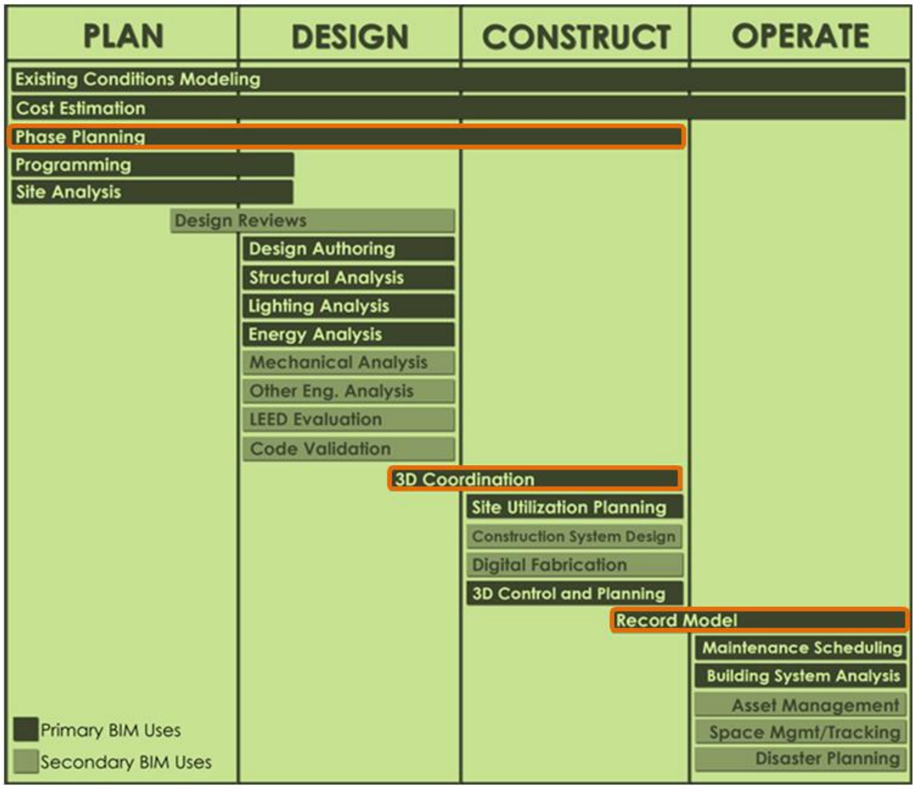


Figure 17 – BIM Use List (Courtesy of Penn State's BIM Execution Planning Guide)

For this project, you can see that Davis focused on using BIM for 3-D coordination and planning. They produced a coordinated model with participation from the concrete, mechanical and plumbing, duct, sprinkler, and electrical / lighting contractors. The architect's Revit model was used and then each subcontractor formed their models, as per the drawings and specifications and these were then imported into the model. The original models made by each subcontractor are formed in Autocad and then brought into Navisworks to run clash detections. These clash detections were run not only against each trade, but also against the architecture and the structure of the building. These clashes showed where problems were in the original design and preliminary stages, where the cost to fix them is extremely lower than the cost to fix in the field. These clashes were done on each level of the building and worked their way upward until the building had minimal clashes and all major problems had been found and sorted out. Other than clash detection, the only other thing the model was used for, was to show some phasing for the excavation process, due to its complexity. A model is then completed at the end of the project, not necessarily for the owner, but more for the use of Davis. They can use this model to help win the bid for the interior fit out, by showing phasing or other potentially useful diagrams.

Level 1 BIM Execution Plan

Within Appendix D is an example of a possible level one BIM execution plan that could have been implemented by Davis construction as a result to their BIM use list. This level one process map was created to not only show the BIM uses, but to also show who is responsible for what. The project is from start to finish and how building information modeling will be used throughout that time frame.

Prospective BIM Uses

Cost Estimation

For this project, the owner of the building asked that Davis create a schedule that not only showed the activities for the entire duration of the project, but also to cost load it. This means that each activity had a specific cost assigned to it so that any time, the owner could see what amount of money they owe for the work done and compare it to the payment applications that Davis would submit monthly. To go along with this, the Davis team also formed a model with the help of the subcontractors to run clash detection. Together, a cost loaded schedule and three dimensional model were formed but were never linked together. This would have taken some time to do, but would have resulted in a useful tool for the employees on the project to physically see where they are supposed to be and what work should be completed on a specific day, along with the cost of that work completed. This would also be helpful for the owner to see what work has been done without even leaving their desk. They could then compare it to what Davis is billing for to see if the project will be completed on time or if there would be duration of time that the project comes in past the original targeted completion date.

Virtual Mock-Ups

Virtual mock-ups are taking a specific location and modeling them for the use of quality control, or trying to smooth out potential problems that could take place in the field. These mock-ups would not necessarily be useful for the facade since it was so simple and was all being fastened directly to the structure through the use of either welding or bolting. On the other hand, the mock-up could have been advantageous when modeling gathering spaces like the lobby that had custom features. If the Lobby would have been quickly modeled in the already existing architectural model, to the point where materials were designed and imported, it would have been found that a few of the dimensions would have been off from what the drawings were showing and caused problems in the layout. This is a problem that was found in the field, where dimensions did not quite add up, and led to alignment problems.

Site Analysis

A critical portion of this project, as reflected in the constructability concerns of this report, was the existing utilities that were packed around the sites, and originally doing through part of the site. If a more extensive study of these utilities was completed and looked at. The complexity of the systems below grade would have been noticed immediately in the modeling process. After the systems would have been modeled, the schedule could have been adjusted early and cost impact could have been weighed. This would have allowed the relocation and removal of any utilities in a timely fashion while staying on track for the completion date and staying under budget.

Façade Sequencing

Since a model was already complete, it would have been easy to link the model to the schedule to for a 4-D model. This would then help the subcontractors assembling the façade, because they would be able to see in what sequence the façade went up and what their next phase of work would be. This information could then be used to ensure materials were arriving on time and crews were working at the proper pace to get the project completed on schedule. Figure 18 and 19 below sow the different materials the structure is accompanied with. If the model had been linked with the schedule, the crews assembling the facade could have seen the sequencing and the management staff could have seen how the crews are doing according to the schedule

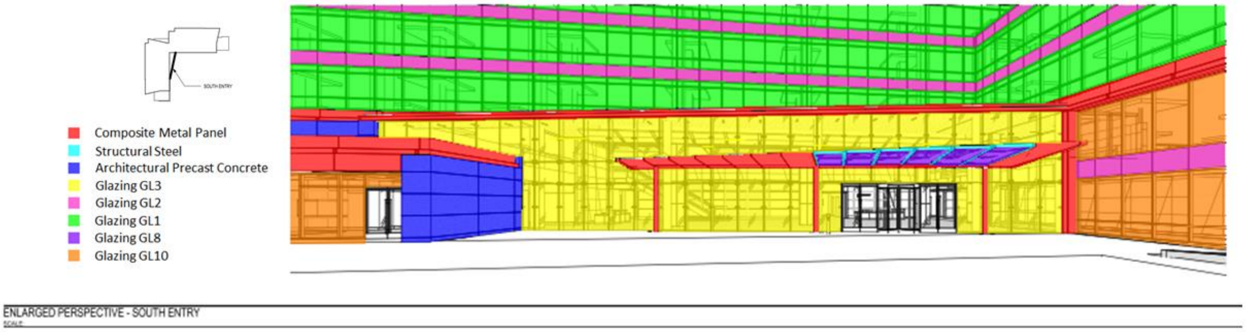


Figure 18 – Façade Materials on South Entrance (Original Drawing Underlay Courtesy of Gensler)

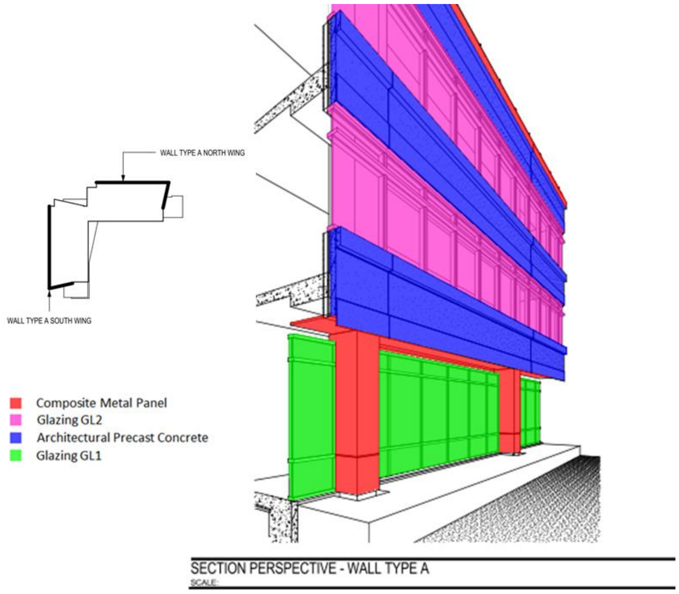


Figure 17 – Façade Materials on North & South Wing (Original Drawing Underlay Courtesy of Gensler)

Appendix

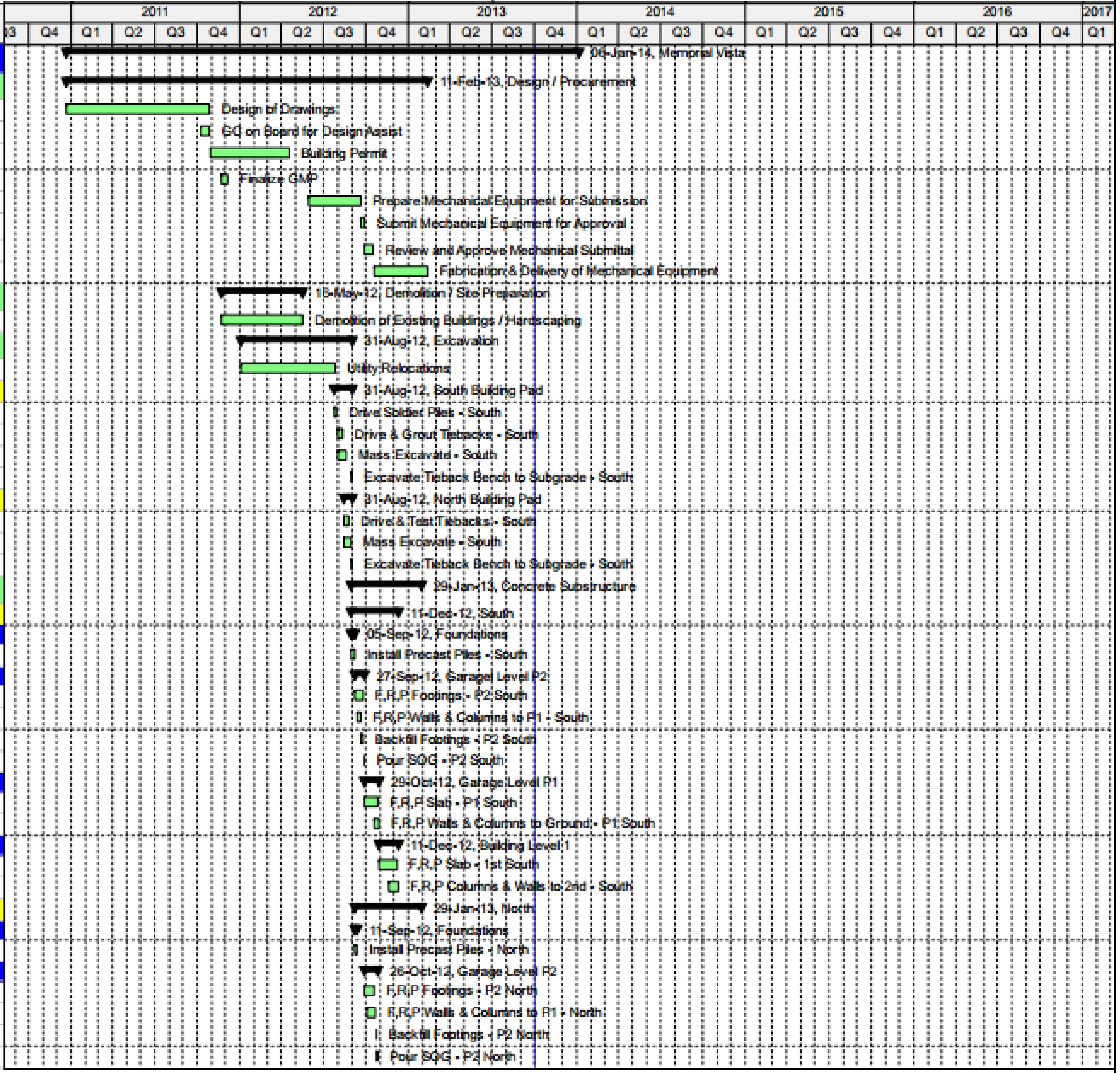
Appendix A

Memorial Vista

Classic Schedule Layout

04-Oct-13 15:39

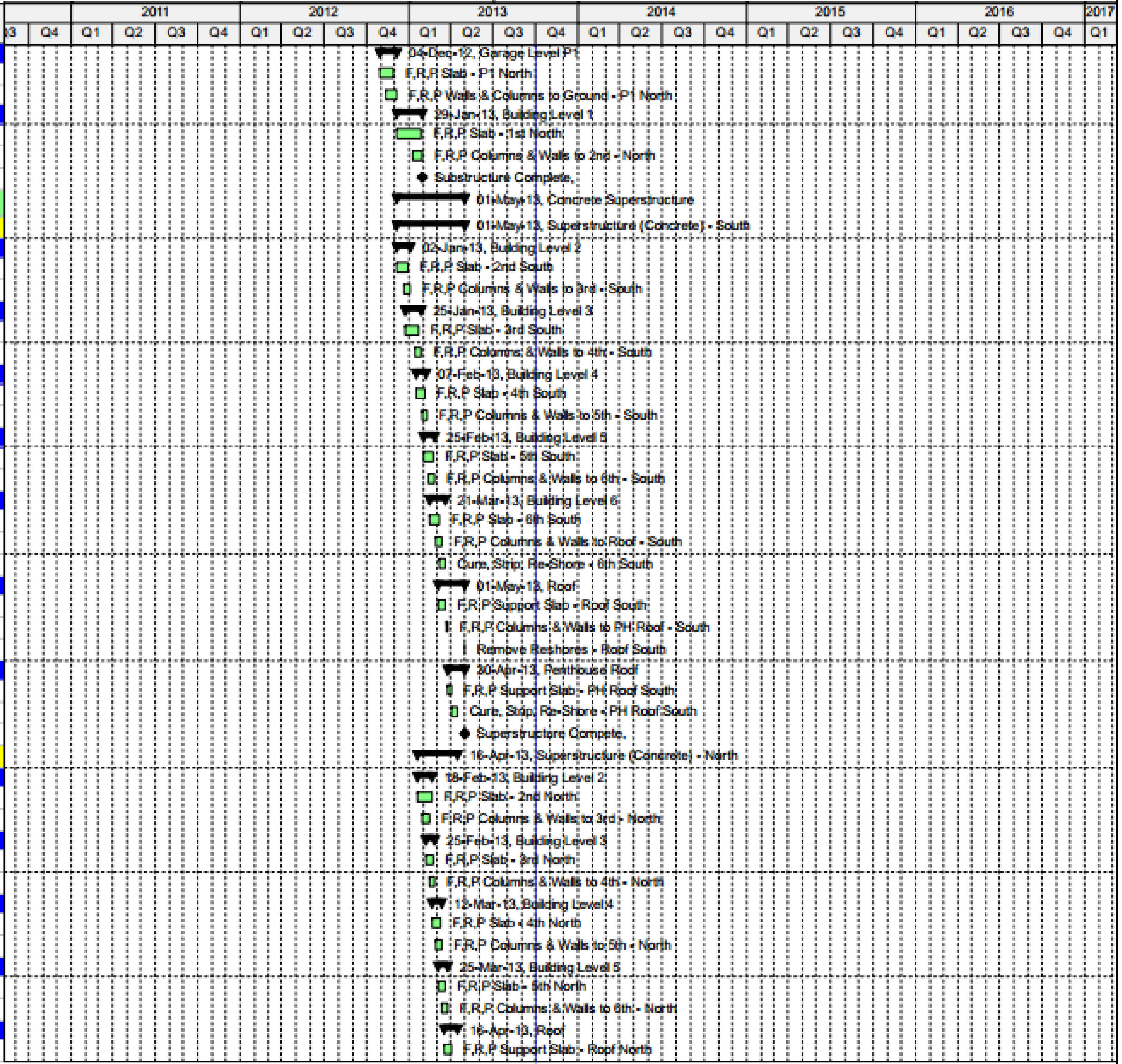
#	Activity ID	Activity Name	Original Duration	Start	Finish
1		**Memorial Vista**	777	20-Dec-10	06-Jan-14
2		**Design / Procurement**	547	20-Dec-10	11-Feb-13
3	A1000	Design of Drawings	220	20-Dec-10	28-Oct-11
4	A3220	GC on Board for Design Assist	15	10-Oct-11	28-Oct-11
5	A3260	Building Permit	119	31-Oct-11	17-Apr-12
6	A3300	Finalize GMP	9	22-Nov-11	05-Dec-11
7	A3310	Prepare Mechanical Equipment for Submission	80	29-May-12	19-Sep-12
8	A3320	Submit Mechanical Equipment for Approval	5	20-Sep-12	26-Sep-12
9	A3330	Review and Approve Mechanical Submittal	15	27-Sep-12	17-Oct-12
10	A3340	Fabrication & Delivery of Mechanical Equipment	80	18-Oct-12	11-Feb-13
11		**Demolition / Site Preparation**	123	23-Nov-11	16-May-12
12	A3290	Demolition of Existing Buildings / Hardscaping	123	23-Nov-11	16-May-12
13		**Excavation**	172	03-Jan-12	31-Aug-12
14	A3250	Utility Relocations	147	03-Jan-12	27-Jul-12
15		**South Building Pad**	29	24-Jul-12	31-Aug-12
16	A1030	Drive Soldier Piles - South	5	24-Jul-12	30-Jul-12
17	A1050	Drive & Grout Tiebacks - South	7	02-Aug-12	10-Aug-12
18	A1060	Mass Excavate - South	13	02-Aug-12	20-Aug-12
19	A1070	Excavate Tieback Bench to Subgrade - South	2	30-Aug-12	31-Aug-12
20		**North Building Pad**	14	14-Aug-12	31-Aug-12
21	A1010	Drive & Test Tiebacks - South	8	14-Aug-12	23-Aug-12
22	A1020	Mass Excavate - South	13	14-Aug-12	30-Aug-12
23	A1040	Excavate Tieback Bench to Subgrade - South	2	30-Aug-12	31-Aug-12
24		**Concrete Substructure**	105	30-Aug-12	29-Jan-13
25		**South**	72	30-Aug-12	11-Dec-12
26		**Foundations**	4	30-Aug-12	05-Sep-12
27	A1080	Install Precast Piles - South	4	30-Aug-12	05-Sep-12
28		**Garagel Level P2**	16	06-Sep-12	27-Sep-12
29	A1090	F,R,P Footings - P2 South	13	06-Sep-12	24-Sep-12
30	A1100	F,R,P Walls & Columns to P1 - South	7	11-Sep-12	19-Sep-12
31	A1110	Backfill Footings - P2 South	3	20-Sep-12	24-Sep-12
32	A1120	Pour SOG - P2 South	1	27-Sep-12	27-Sep-12
33		**Garage Level P1**	22	28-Sep-12	29-Oct-12
34	A1130	F,R,P Slab - P1 South	20	28-Sep-12	25-Oct-12
35	A1140	F,R,P Walls & Columns to Ground - P1 South	7	19-Oct-12	29-Oct-12
36		**Building Level 1**	30	30-Oct-12	11-Dec-12
37	A1150	F,R,P Slab - 1st South	28	30-Oct-12	07-Dec-12
38	A1160	F,R,P Columns & Walls to 2nd - South	15	20-Nov-12	11-Dec-12
39		**North**	101	06-Sep-12	29-Jan-13
40		**Foundations**	4	06-Sep-12	11-Sep-12
41	A1170	Install Precast Piles - North	4	06-Sep-12	11-Sep-12
42		**Garage Level P2**	22	27-Sep-12	26-Oct-12
43	A1180	F,R,P Footings - P2 North	16	27-Sep-12	18-Oct-12
44	A1190	F,R,P Walls & Columns to P1 - North	15	02-Oct-12	22-Oct-12
45	A1200	Backfill Footings - P2 North	2	23-Oct-12	24-Oct-12
46	A1210	Pour SOG - P2 North	4	23-Oct-12	26-Oct-12



▬ Actual Level of Effort	🟩 Remaining Work	◆	◆ Milestone
▬ Actual Work	🟥 Critical Remaining Work	▬ summary	

TASK filter: All Activities

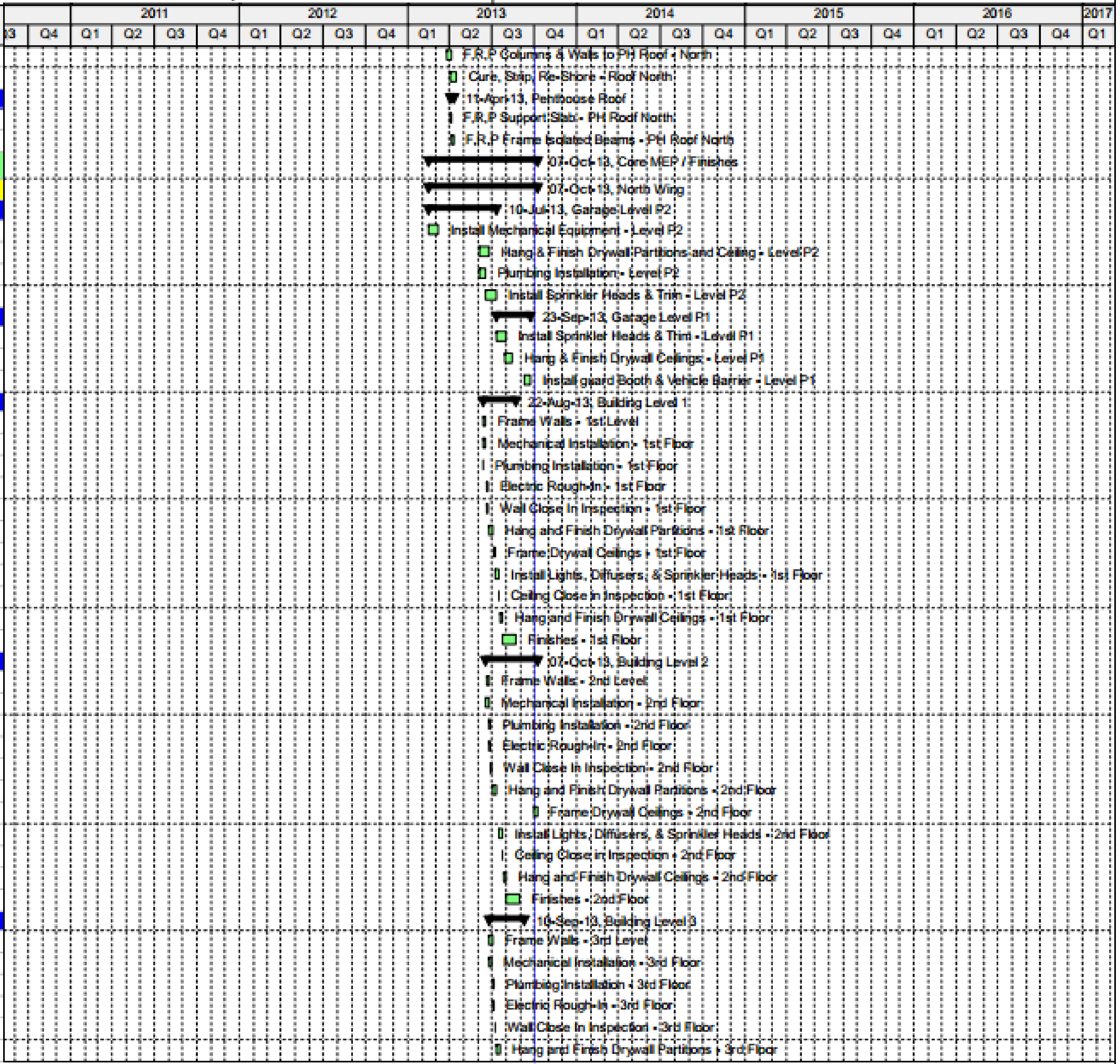
#	Activity ID	Activity Name	Original Duration	Start	Finish
47		**Garage Level P1**	25	30-Oct-12	04-Dec-12
48	A1220	F,R,P Slab - P1 North	19	30-Oct-12	26-Nov-12
49	A1230	F,R,P Walls & Columns to Ground - P1 North	16	12-Nov-12	04-Dec-12
50		**Building Level 1**	37	06-Dec-12	29-Jan-13
51	A1240	F,R,P Slab - 1st North	35	06-Dec-12	25-Jan-13
52	A1250	F,R,P Columns & Walls to 2nd - North	17	07-Jan-13	29-Jan-13
53	A3270	Substructure Complete	0		29-Jan-13
54		**Concrete Superstructure**	103	06-Dec-12	01-May-13
55		**Superstructure (Concrete) - South**	103	06-Dec-12	01-May-13
56		**Building Level 2**	18	06-Dec-12	02-Jan-13
57	A1260	F,R,P Slab - 2nd South	15	06-Dec-12	27-Dec-12
58	A1270	F,R,P Columns & Walls to 3rd - South	7	21-Dec-12	02-Jan-13
59		**Building Level 3**	23	24-Dec-12	25-Jan-13
60	A1280	F,R,P Slab - 3rd South	20	24-Dec-12	22-Jan-13
61	A1290	F,R,P Columns & Walls to 4th - South	10	14-Jan-13	25-Jan-13
62		**Building Level 4**	17	16-Jan-13	07-Feb-13
63	A1300	F,R,P Slab - 4th South	14	16-Jan-13	04-Feb-13
64	A1310	F,R,P Columns & Walls to 5th - South	9	28-Jan-13	07-Feb-13
65		**Building Level 5**	18	31-Jan-13	25-Feb-13
66	A1320	F,R,P Slab - 5th South	16	31-Jan-13	21-Feb-13
67	A1330	F,R,P Columns & Walls to 6th - South	11	11-Feb-13	25-Feb-13
68		**Building Level 6**	25	15-Feb-13	21-Mar-13
69	A1340	F,R,P Slab - 6th South	15	15-Feb-13	07-Mar-13
70	A1350	F,R,P Columns & Walls to Roof - South	10	26-Feb-13	11-Mar-13
71	A1360	Cure, Strip, Re-Shore - 6th South	10	08-Mar-13	21-Mar-13
72		**Roof**	42	05-Mar-13	01-May-13
73	A1370	F,R,P Support Slab - Roof South	13	05-Mar-13	21-Mar-13
74	A1380	F,R,P Columns & Walls to PH Roof - South	3	22-Mar-13	26-Mar-13
75	A1390	Remove Reshores - Roof South	2	30-Apr-13	01-May-13
76		**Penthouse Roof**	27	25-Mar-13	30-Apr-13
77	A1400	F,R,P Support Slab - PH Roof South	6	25-Mar-13	01-Apr-13
78	A1410	Cure, Strip, Re-Shore - PH Roof South	10	02-Apr-13	15-Apr-13
79	A3280	Superstructure Compete	0		30-Apr-13
80		**Superstructure (Concrete) - North**	63	18-Jan-13	16-Apr-13
81		**Building Level 2**	22	18-Jan-13	18-Feb-13
82	A1420	F,R,P Slab - 2nd North	22	18-Jan-13	18-Feb-13
83	A1430	F,R,P Columns & Walls to 3rd - North	12	30-Jan-13	14-Feb-13
84		**Building Level 3**	15	05-Feb-13	25-Feb-13
85	A1440	F,R,P Slab - 3rd North	14	05-Feb-13	22-Feb-13
86	A1450	F,R,P Columns & Walls to 4th - North	7	15-Feb-13	25-Feb-13
87		**Building Level 4**	16	19-Feb-13	12-Mar-13
88	A1460	F,R,P Slab - 4th North	14	19-Feb-13	08-Mar-13
89	A1470	F,R,P Columns & Walls to 5th - North	9	28-Feb-13	12-Mar-13
90		**Building Level 5**	15	05-Mar-13	25-Mar-13
91	A1480	F,R,P Slab - 5th North	13	05-Mar-13	21-Mar-13
92	A1490	F,R,P Columns & Walls to 6th - North	9	13-Mar-13	25-Mar-13
93		**Roof**	22	18-Mar-13	16-Apr-13
94	A1500	F,R,P Support Slab - Roof North	12	18-Mar-13	02-Apr-13



▬ Actual Level of Effort
▬ Actual Work
🟩 Remaining Work
🟥 Critical Remaining Work
◆ ◆ Milestone
▬ summary

TASK filter: All Activities

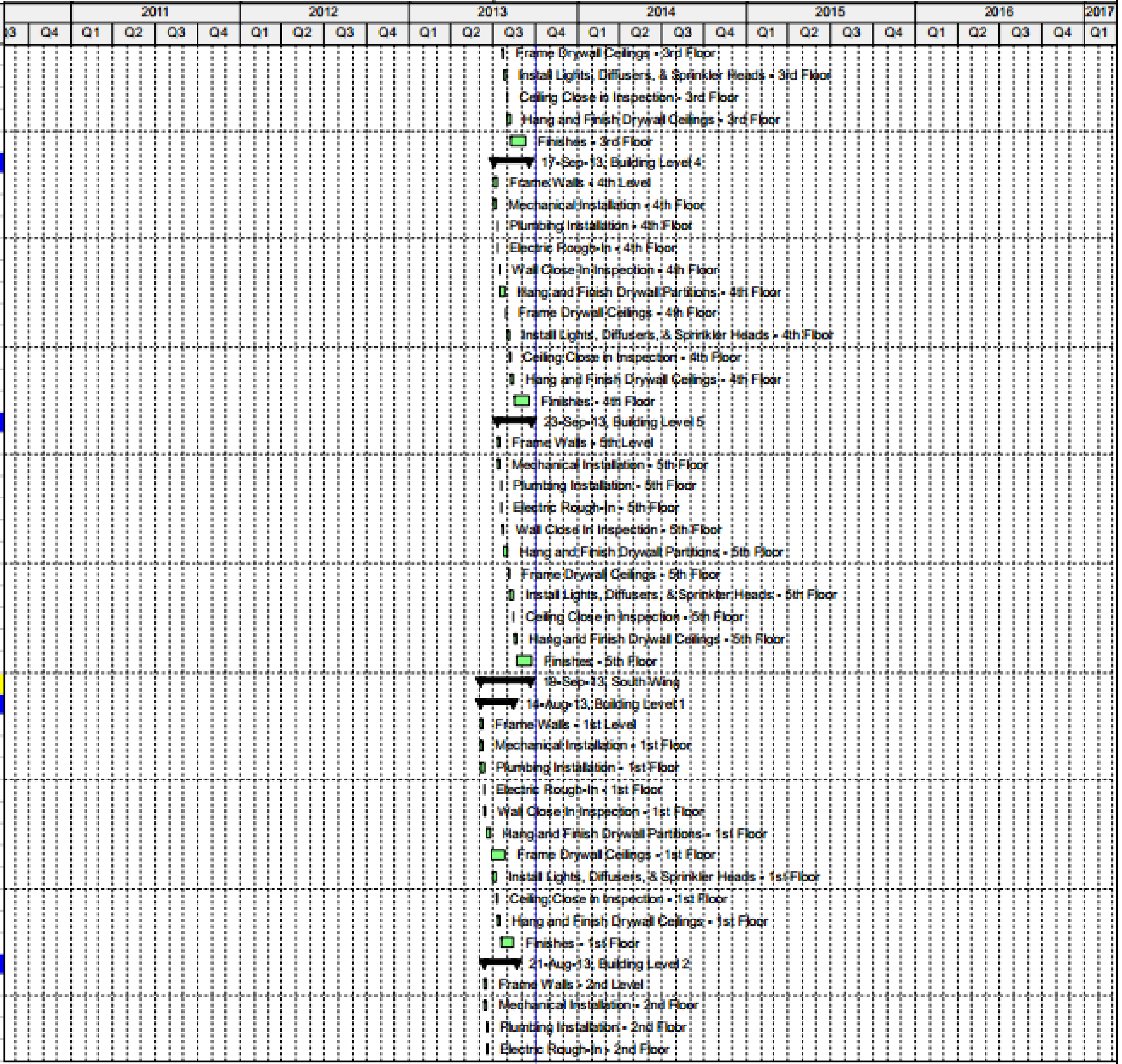
#	Activity ID	Activity Name	Original Duration	Start	Finish
95	A1510	F,R,P Columns & Walls to PH Roof - North	8	26-Mar-13	04-Apr-13
96	A1520	Cure, Strip, Re-Shore - Roof North	10	03-Apr-13	16-Apr-13
97	**Penthouse Roof**		8	02-Apr-13	11-Apr-13
98	A1530	F,R,P Support Slab - PH Roof North	4	02-Apr-13	05-Apr-13
99	A1540	F,R,P Frame Isolated Beams - PH Roof North	5	05-Apr-13	11-Apr-13
100	**Core MEP / Finishes**		164	15-Feb-13	07-Oct-13
101	**North Wing**		164	15-Feb-13	07-Oct-13
102	**Garage Level P2**		102	15-Feb-13	10-Jul-13
103	A1550	Install Mechanical Equipment - Level P2	15	15-Feb-13	07-Mar-13
104	A1560	Hang & Finish Drywall Partitions and Ceiling - Level I	15	04-Jun-13	24-Jun-13
105	A1570	Plumbing Installation - Level P2	10	04-Jun-13	17-Jun-13
106	A1580	Install Sprinkler Heads & Trim - Level P2	16	18-Jun-13	10-Jul-13
107	**Garage Level P1**		52	11-Jul-13	23-Sep-13
108	A1590	Install Sprinkler Heads & Trim - Level P1	16	11-Jul-13	01-Aug-13
109	A1600	Hang & Finish Drywall Ceilings - Level P1	13	29-Jul-13	14-Aug-13
110	A1610	Install guard Booth & Vehicle Barrier - Level P1	10	10-Sep-13	23-Sep-13
111	**Building Level 1**		52	11-Jun-13	22-Aug-13
112	A1620	Frame Walls - 1st Level	5	12-Jun-13	18-Jun-13
113	A1630	Mechanical Installation - 1st Floor	5	11-Jun-13	17-Jun-13
114	A1640	Plumbing Installation - 1st Floor	2	11-Jun-13	12-Jun-13
115	A1650	Electric Rough-In - 1st Floor	3	19-Jun-13	21-Jun-13
116	A1660	Wall Close In Inspection - 1st Floor	1	21-Jun-13	21-Jun-13
117	A1670	Hang and Finish Drywall Partitions - 1st Floor	8	24-Jun-13	03-Jul-13
118	A1680	Frame Drywall Ceilings - 1st Floor	2	05-Jul-13	08-Jul-13
119	A1690	Install Lights, Diffusers, & Sprinkler Heads - 1st Floor	5	09-Jul-13	15-Jul-13
120	A1700	Ceiling Close in Inspection - 1st Floor	2	16-Jul-13	17-Jul-13
121	A1710	Hang and Finish Drywall Ceilings - 1st Floor	5	18-Jul-13	24-Jul-13
122	A1720	Finishes - 1st Floor	21	25-Jul-13	22-Aug-13
123	**Building Level 2**		78	18-Jun-13	07-Oct-13
124	A1730	Frame Walls - 2nd Level	5	19-Jun-13	25-Jun-13
125	A1740	Mechanical Installation - 2nd Floor	5	18-Jun-13	24-Jun-13
126	A1750	Plumbing Installation - 2nd Floor	2	26-Jun-13	27-Jun-13
127	A1760	Electric Rough-In - 2nd Floor	2	26-Jun-13	27-Jun-13
128	A1770	Wall Close In Inspection - 2nd Floor	2	28-Jun-13	01-Jul-13
129	A1780	Hang and Finish Drywall Partitions - 2nd Floor	8	02-Jul-13	12-Jul-13
130	A1790	Frame Drywall Ceilings - 2nd Floor	5	01-Oct-13	07-Oct-13
131	A1800	Install Lights, Diffusers, & Sprinkler Heads - 2nd Flo	5	17-Jul-13	23-Jul-13
132	A1810	Ceiling Close in Inspection - 2nd Floor	2	24-Jul-13	25-Jul-13
133	A1820	Hang and Finish Drywall Ceilings - 2nd Floor	5	26-Jul-13	01-Aug-13
134	A1830	Finishes - 2nd Floor	21	02-Aug-13	30-Aug-13
135	**Building Level 3**		54	25-Jun-13	10-Sep-13
136	A1840	Frame Walls - 3rd Level	5	26-Jun-13	02-Jul-13
137	A1850	Mechanical Installation - 3rd Floor	5	25-Jun-13	01-Jul-13
138	A1860	Plumbing Installation - 3rd Floor	2	03-Jul-13	05-Jul-13
139	A1870	Electric Rough-In - 3rd Floor	2	03-Jul-13	05-Jul-13
140	A1880	Wall Close In Inspection - 3rd Floor	2	08-Jul-13	09-Jul-13
141	A1890	Hang and Finish Drywall Partitions - 3rd Floor	8	10-Jul-13	19-Jul-13



▬ Actual Level of Effort	🟩 Remaining Work	◆ ◆ Milestone
▬ Actual Work	🟥 Critical Remaining Work	▬ summary

TASK filter: All Activities

#	Activity ID	Activity Name	Original Duration	Start	Finish
142	A1900	Frame Drywall Ceilings - 3rd Floor	2	22-Jul-13	23-Jul-13
143	A1910	Install Lights, Diffusers, & Sprinkler Heads - 3rd Floor	5	24-Jul-13	30-Jul-13
144	A1920	Ceiling Close in Inspection - 3rd Floor	2	31-Jul-13	01-Aug-13
145	A1930	Hang and Finish Drywall Ceilings - 3rd Floor	5	02-Aug-13	08-Aug-13
146	A1940	Finishes - 3rd Floor	22	09-Aug-13	10-Sep-13
147	**Building Level 4**		54	02-Jul-13	17-Sep-13
148	A1950	Frame Walls - 4th Level	5	03-Jul-13	10-Jul-13
149	A1960	Mechanical Installation - 4th Floor	5	02-Jul-13	09-Jul-13
150	A1970	Plumbing Installation - 4th Floor	2	11-Jul-13	12-Jul-13
151	A1980	Electric Rough-In - 4th Floor	2	11-Jul-13	12-Jul-13
152	A1990	Wall Close In Inspection - 4th Floor	2	15-Jul-13	16-Jul-13
153	A2000	Hang and Finish Drywall Partitions - 4th Floor	8	17-Jul-13	26-Jul-13
154	A2010	Frame Drywall Ceilings - 4th Floor	2	29-Jul-13	30-Jul-13
155	A2020	Install Lights, Diffusers, & Sprinkler Heads - 4th Floor	5	31-Jul-13	06-Aug-13
156	A2030	Ceiling Close in Inspection - 4th Floor	2	07-Aug-13	08-Aug-13
157	A2040	Hang and Finish Drywall Ceilings - 4th Floor	5	09-Aug-13	15-Aug-13
158	A2050	Finishes - 4th Floor	22	16-Aug-13	17-Sep-13
159	**Building Level 5**		53	10-Jul-13	23-Sep-13
160	A2060	Frame Walls - 5th Level	5	11-Jul-13	17-Jul-13
161	A2070	Mechanical Installation - 5th Floor	5	10-Jul-13	16-Jul-13
162	A2080	Plumbing Installation - 5th Floor	2	18-Jul-13	19-Jul-13
163	A2090	Electric Rough-In - 5th Floor	2	18-Jul-13	19-Jul-13
164	A2100	Wall Close In Inspection - 5th Floor	2	22-Jul-13	23-Jul-13
165	A2110	Hang and Finish Drywall Partitions - 5th Floor	8	24-Jul-13	02-Aug-13
166	A2120	Frame Drywall Ceilings - 5th Floor	2	05-Aug-13	06-Aug-13
167	A2130	Install Lights, Diffusers, & Sprinkler Heads - 5th Floor	5	07-Aug-13	13-Aug-13
168	A2140	Ceiling Close in Inspection - 5th Floor	2	14-Aug-13	15-Aug-13
169	A2150	Hang and Finish Drywall Ceilings - 5th Floor	5	16-Aug-13	22-Aug-13
170	A2160	Finishes - 5th Floor	21	23-Aug-13	23-Sep-13
171	**South Wing**		76	04-Jun-13	19-Sep-13
172	**Building Level 1**		51	04-Jun-13	14-Aug-13
173	A2170	Frame Walls - 1st Level	5	04-Jun-13	10-Jun-13
174	A2180	Mechanical Installation - 1st Floor	5	04-Jun-13	10-Jun-13
175	A2190	Plumbing Installation - 1st Floor	7	04-Jun-13	12-Jun-13
176	A2200	Electric Rough-In - 1st Floor	2	11-Jun-13	12-Jun-13
177	A2210	Wall Close In Inspection - 1st Floor	2	13-Jun-13	14-Jun-13
178	A2220	Hang and Finish Drywall Partitions - 1st Floor	8	17-Jun-13	26-Jun-13
179	A2230	Frame Drywall Ceilings - 1st Floor	21	27-Jun-13	26-Jul-13
180	A2240	Install Lights, Diffusers, & Sprinkler Heads - 1st Floor	5	01-Jul-13	08-Jul-13
181	A2250	Ceiling Close in Inspection - 1st Floor	2	09-Jul-13	10-Jul-13
182	A2260	Hang and Finish Drywall Ceilings - 1st Floor	5	11-Jul-13	17-Jul-13
183	A2270	Finishes - 1st Floor	20	18-Jul-13	14-Aug-13
184	**Building Level 2**		51	11-Jun-13	21-Aug-13
185	A2280	Frame Walls - 2nd Level	5	11-Jun-13	17-Jun-13
186	A2290	Mechanical Installation - 2nd Floor	5	11-Jun-13	17-Jun-13
187	A2300	Plumbing Installation - 2nd Floor	2	18-Jun-13	19-Jun-13
188	A2310	Electric Rough-In - 2nd Floor	2	18-Jun-13	19-Jun-13



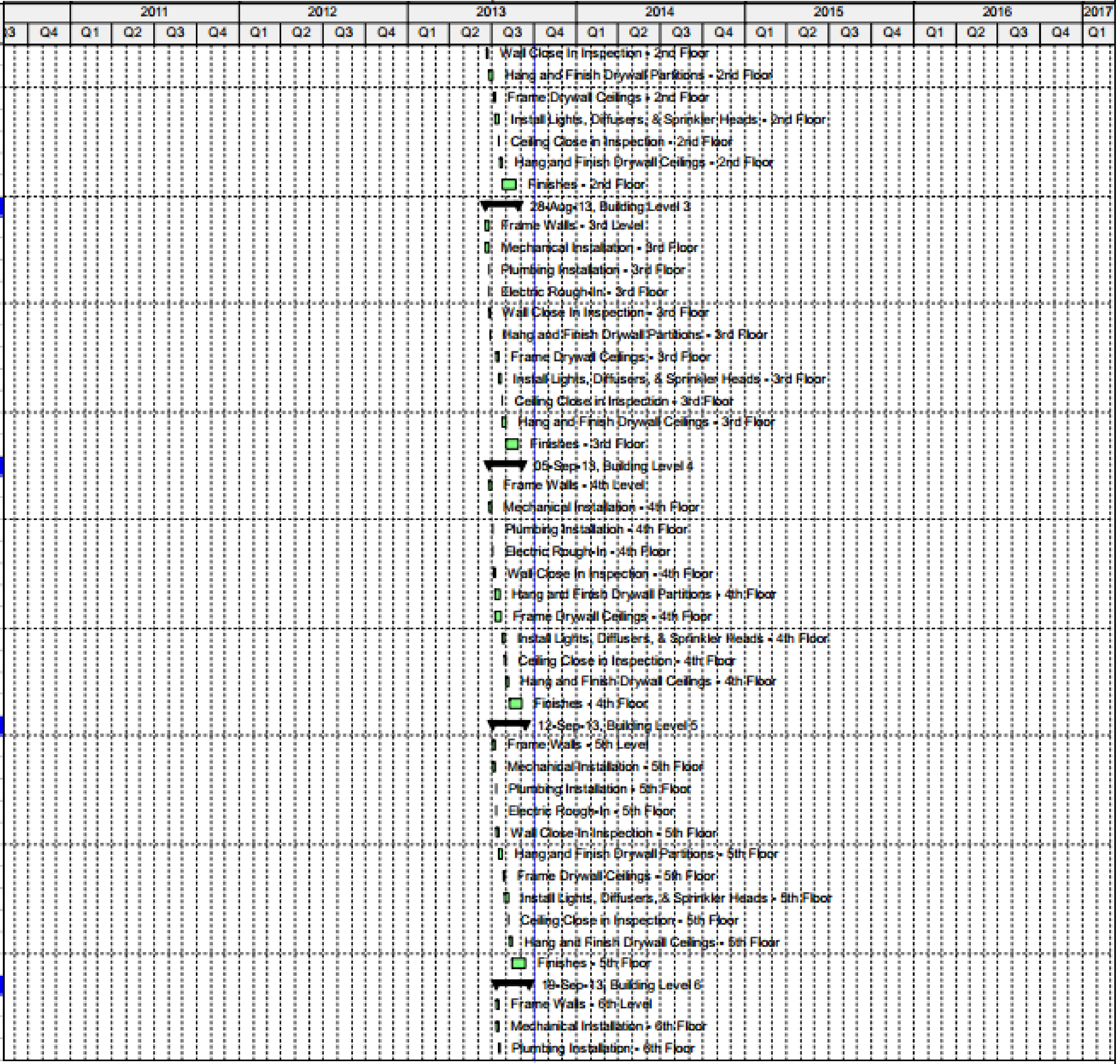
▬ Actual Level of Effort	🟩 Remaining Work
▬ Actual Work	🟥 Critical Remaining Work

◆ ◆ Milestone

▬ summary

TASK filter: All Activities

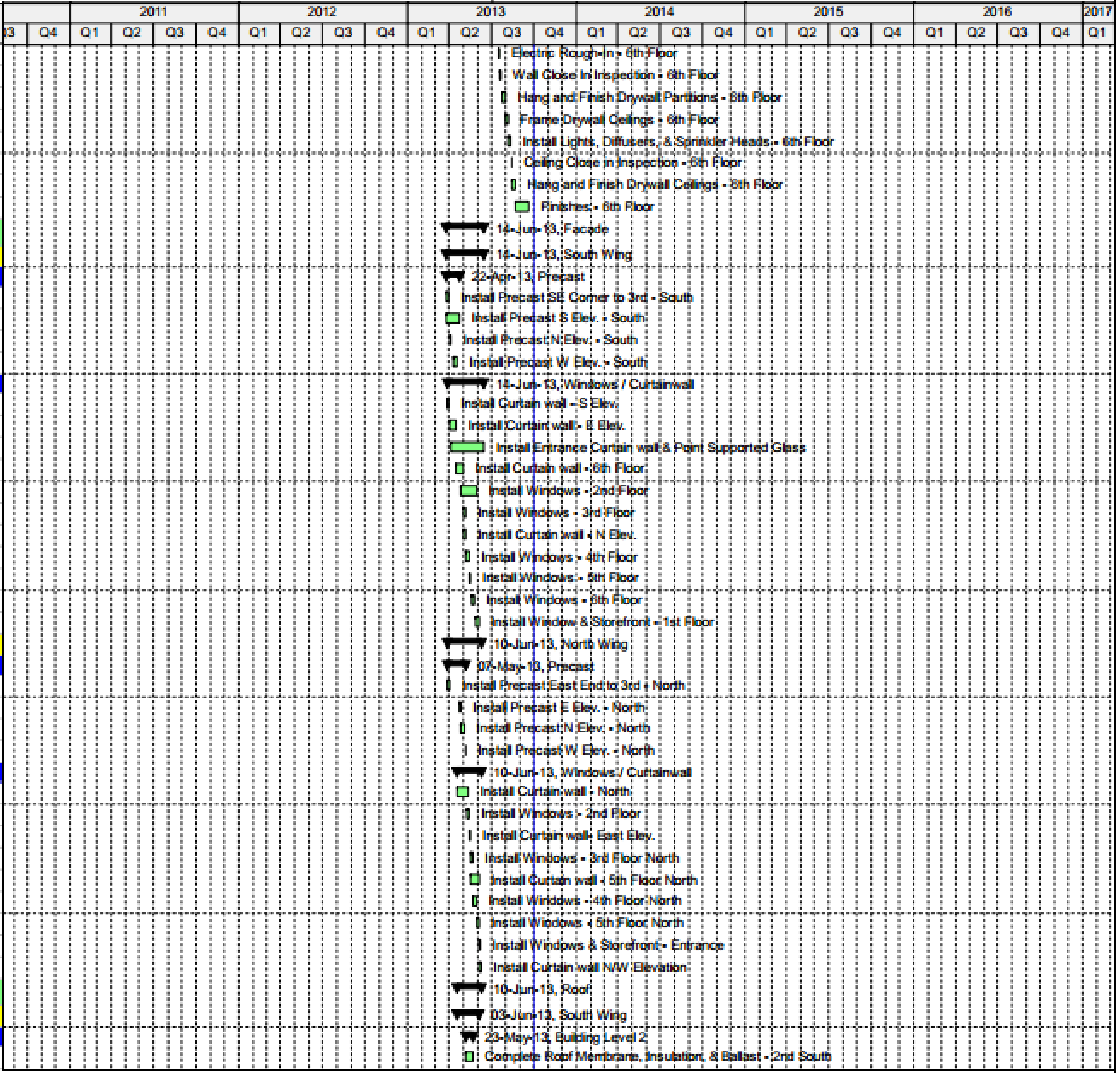
#	Activity ID	Activity Name	Original Duration	Start	Finish
189	A2320	Wall Close In Inspection - 2nd Floor	2	20-Jun-13	21-Jun-13
190	A2330	Hang and Finish Drywall Partitions - 2nd Floor	8	24-Jun-13	03-Jul-13
191	A2340	Frame Drywall Ceilings - 2nd Floor	2	05-Jul-13	08-Jul-13
192	A2350	Install Lights, Diffusers, & Sprinkler Heads - 2nd Flo	5	09-Jul-13	15-Jul-13
193	A2360	Ceiling Close in Inspection - 2nd Floor	2	16-Jul-13	17-Jul-13
194	A2370	Hang and Finish Drywall Ceilings - 2nd Floor	5	18-Jul-13	24-Jul-13
195	A2380	Finishes - 2nd Floor	20	25-Jul-13	21-Aug-13
196	**Building Level 3**		51	18-Jun-13	28-Aug-13
197	A2390	Frame Walls - 3rd Level	5	18-Jun-13	24-Jun-13
198	A2400	Mechanical Installation - 3rd Floor	5	18-Jun-13	24-Jun-13
199	A2410	Plumbing Installation - 3rd Floor	2	25-Jun-13	26-Jun-13
200	A2420	Electric Rough-In - 3rd Floor	2	25-Jun-13	26-Jun-13
201	A2430	Wall Close In Inspection - 3rd Floor	2	26-Jun-13	27-Jun-13
202	A2440	Hang and Finish Drywall Partitions - 3rd Floor	2	27-Jun-13	28-Jun-13
203	A2450	Frame Drywall Ceilings - 3rd Floor	2	12-Jul-13	15-Jul-13
204	A2460	Install Lights, Diffusers, & Sprinkler Heads - 3rd Floor	5	16-Jul-13	22-Jul-13
205	A2470	Ceiling Close in Inspection - 3rd Floor	2	23-Jul-13	24-Jul-13
206	A2480	Hang and Finish Drywall Ceilings - 3rd Floor	5	25-Jul-13	31-Jul-13
207	A2490	Finishes - 3rd Floor	20	01-Aug-13	28-Aug-13
208	**Building Level 4**		51	25-Jun-13	05-Sep-13
209	A2500	Frame Walls - 4th Level	5	25-Jun-13	01-Jul-13
210	A2510	Mechanical Installation - 4th Floor	5	25-Jun-13	01-Jul-13
211	A2520	Plumbing Installation - 4th Floor	2	02-Jul-13	03-Jul-13
212	A2530	Electric Rough-In - 4th Floor	2	02-Jul-13	03-Jul-13
213	A2540	Wall Close In Inspection - 4th Floor	2	05-Jul-13	08-Jul-13
214	A2550	Hang and Finish Drywall Partitions - 4th Floor	8	09-Jul-13	18-Jul-13
215	A2560	Frame Drywall Ceilings - 4th Floor	10	09-Jul-13	22-Jul-13
216	A2570	Install Lights, Diffusers, & Sprinkler Heads - 4th Floor	5	23-Jul-13	29-Jul-13
217	A2580	Ceiling Close in Inspection - 4th Floor	2	30-Jul-13	31-Jul-13
218	A2590	Hang and Finish Drywall Ceilings - 4th Floor	5	01-Aug-13	07-Aug-13
219	A2600	Finishes - 4th Floor	20	08-Aug-13	05-Sep-13
220	**Building Level 5**		51	02-Jul-13	12-Sep-13
221	A2610	Frame Walls - 5th Level	5	02-Jul-13	09-Jul-13
222	A2620	Mechanical Installation - 5th Floor	5	02-Jul-13	09-Jul-13
223	A2630	Plumbing Installation - 5th Floor	2	10-Jul-13	11-Jul-13
224	A2640	Electric Rough-In - 5th Floor	2	10-Jul-13	11-Jul-13
225	A2650	Wall Close In Inspection - 5th Floor	2	12-Jul-13	15-Jul-13
226	A2660	Hang and Finish Drywall Partitions - 5th Floor	8	16-Jul-13	25-Jul-13
227	A2670	Frame Drywall Ceilings - 5th Floor	2	26-Jul-13	29-Jul-13
228	A2680	Install Lights, Diffusers, & Sprinkler Heads - 5th Floor	5	30-Jul-13	05-Aug-13
229	A2690	Ceiling Close in Inspection - 5th Floor	2	06-Aug-13	07-Aug-13
230	A2700	Hang and Finish Drywall Ceilings - 5th Floor	5	08-Aug-13	14-Aug-13
231	A2710	Finishes - 5th Floor	20	15-Aug-13	12-Sep-13
232	**Building Level 6**		51	10-Jul-13	19-Sep-13
233	A2720	Frame Walls - 6th Level	5	10-Jul-13	16-Jul-13
234	A2730	Mechanical Installation - 6th Floor	5	10-Jul-13	16-Jul-13
235	A2740	Plumbing Installation - 6th Floor	2	17-Jul-13	18-Jul-13



▬ Actual Level of Effort
▬ Actual Work
🟩 Remaining Work
🟥 Critical Remaining Work
◆ ◆ Milestone
▬ summary

TASK filter: All Activities

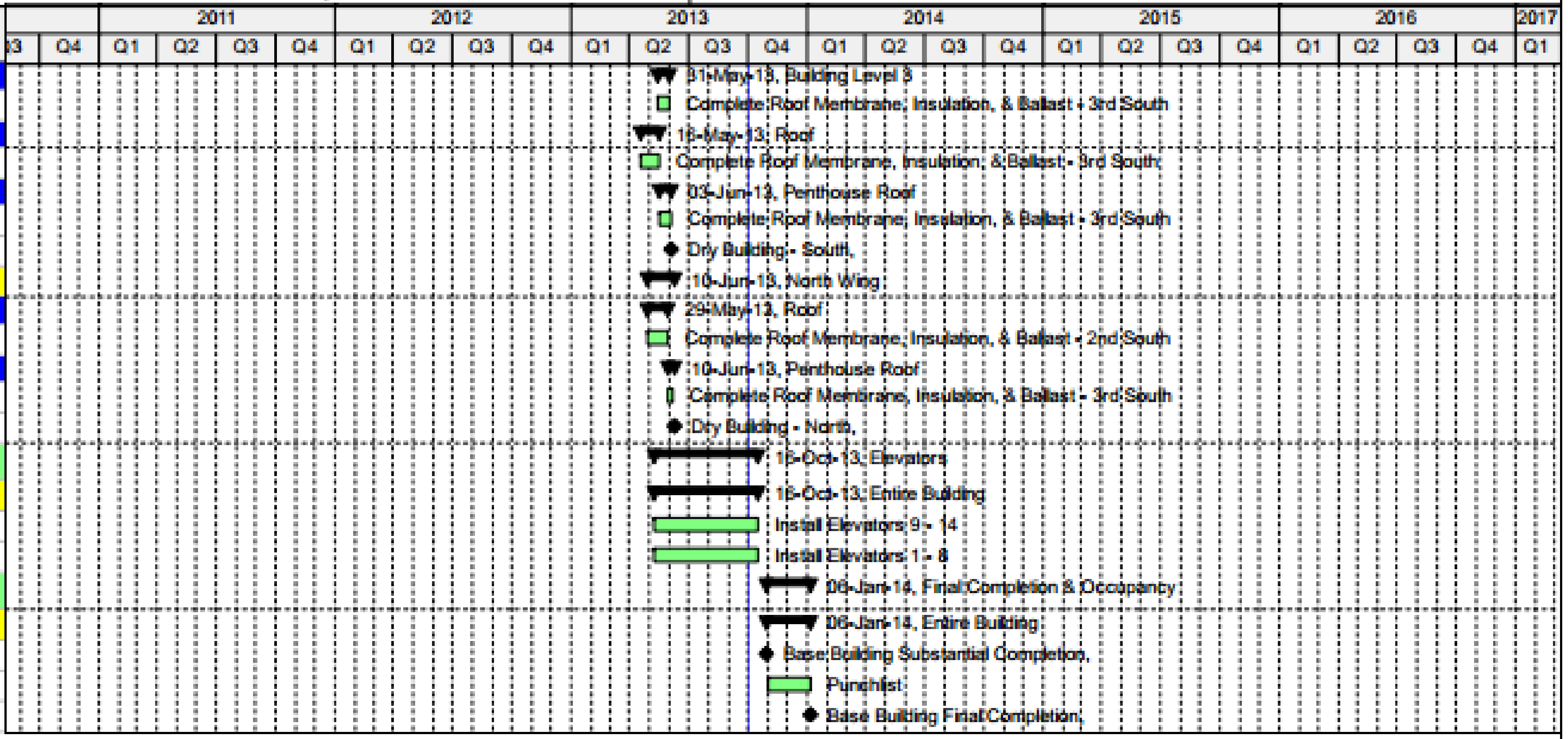
#	Activity ID	Activity Name	Original Duration	Start	Finish
236	A2750	Electric Rough-In - 6th Floor	2	17-Jul-13	18-Jul-13
237	A2760	Wall Close In Inspection - 6th Floor	2	19-Jul-13	22-Jul-13
238	A2770	Hang and Finish Drywall Partitions - 6th Floor	8	23-Jul-13	01-Aug-13
239	A2780	Frame Drywall Ceilings - 6th Floor	2	02-Aug-13	05-Aug-13
240	A2790	Install Lights, Diffusers, & Sprinkler Heads - 6th Floor	5	06-Aug-13	12-Aug-13
241	A2800	Ceiling Close in Inspection - 6th Floor	2	13-Aug-13	14-Aug-13
242	A2810	Hang and Finish Drywall Ceilings - 6th Floor	5	15-Aug-13	21-Aug-13
243	A2820	Finishes - 6th Floor	20	22-Aug-13	19-Sep-13
244		**Facade**	59	25-Mar-13	14-Jun-13
245		**South Wing**	59	25-Mar-13	14-Jun-13
246		**Precast**	21	25-Mar-13	22-Apr-13
247	A2830	Install Precast SE Corner to 3rd - South	5	25-Mar-13	29-Mar-13
248	A2840	Install Precast S Elev. - South	20	26-Mar-13	22-Apr-13
249	A2850	Install Precast N Elev. - South	2	03-Apr-13	04-Apr-13
250	A2860	Install Precast W Elev. - South	8	09-Apr-13	18-Apr-13
251		**Windows / Curtainwall**	57	27-Mar-13	14-Jun-13
252	A2870	Install Curtain wall - S Elev.	3	27-Mar-13	29-Mar-13
253	A2880	Install Curtain wall - E Elev.	11	01-Apr-13	15-Apr-13
254	A2890	Install Entrance Curtain wall & Point Supported Glass	50	05-Apr-13	14-Jun-13
255	A2900	Install Curtain wall - 6th Floor	11	16-Apr-13	30-Apr-13
256	A2910	Install Windows - 2nd Floor	25	25-Apr-13	30-May-13
257	A2920	Install Windows - 3rd Floor	4	01-May-13	06-May-13
258	A2930	Install Curtain wall - N Elev.	4	01-May-13	06-May-13
259	A2940	Install Windows - 4th Floor	5	07-May-13	13-May-13
260	A2950	Install Windows - 5th Floor	4	14-May-13	17-May-13
261	A2960	Install Windows - 6th Floor	5	20-May-13	24-May-13
262	A2970	Install Window & Storefront - 1st Floor	5	28-May-13	03-Jun-13
263		**North Wing**	53	27-Mar-13	10-Jun-13
264		**Precast**	30	27-Mar-13	07-May-13
265	A2980	Install Precast East End to 3rd - North	5	27-Mar-13	02-Apr-13
266	A2990	Install Precast E Elev. - North	3	23-Apr-13	25-Apr-13
267	A3000	Install Precast N Elev. - North	6	26-Apr-13	03-May-13
268	A3010	Install Precast W Elev. - North	2	06-May-13	07-May-13
269		**Windows / Curtainwall**	38	17-Apr-13	10-Jun-13
270	A3020	Install Curtain wall - North	18	17-Apr-13	10-May-13
271	A3030	Install Windows - 2nd Floor	4	10-May-13	15-May-13
272	A3040	Install Curtain wall- East Elev.	4	13-May-13	16-May-13
273	A3050	Install Windows - 3rd Floor North	4	16-May-13	21-May-13
274	A3060	Install Curtain wall - 5th Floor North	11	17-May-13	03-Jun-13
275	A3070	Install Windows - 4th Floor North	4	23-May-13	29-May-13
276	A3080	Install Windows - 5th Floor North	3	30-May-13	03-Jun-13
277	A3090	Install Windows & Storefront - Entrance	4	04-Jun-13	07-Jun-13
278	A3100	Install Curtain wall N/W Elevation	5	04-Jun-13	10-Jun-13
279		**Roof**	38	17-Apr-13	10-Jun-13
280		**South Wing**	33	17-Apr-13	03-Jun-13
281		**Building Level 2**	13	07-May-13	23-May-13
282	A3110	Complete Roof Membrane, Insulation, & Ballast - 2n	13	07-May-13	23-May-13



▬ Actual Level of Effort	🟩 Remaining Work	◆ ◆ Milestone
🟦 Actual Work	🟥 Critical Remaining Work	▬ summary

TASK filter: All Activities

#	Activity ID	Activity Name	Original Duration	Start	Finish
283	Building Level 3		12	15-May-13	31-May-13
284	A3120	Complete Roof Membrane, Insulation, & Ballast - 3rd	12	15-May-13	31-May-13
285	Roof		22	17-Apr-13	16-May-13
286	A3130	Complete Roof Membrane, Insulation, & Ballast - 3rd	22	17-Apr-13	16-May-13
287	Penthouse Roof		11	17-May-13	03-Jun-13
288	A3140	Complete Roof Membrane, Insulation, & Ballast - 3rd	11	17-May-13	03-Jun-13
289	A3230	Dry Building - South	0		03-Jun-13
290	North Wing		30	29-Apr-13	10-Jun-13
291	Roof		22	29-Apr-13	29-May-13
292	A3200	Complete Roof Membrane, Insulation, & Ballast - 2nd	22	29-Apr-13	29-May-13
293	Penthouse Roof		8	30-May-13	10-Jun-13
294	A3210	Complete Roof Membrane, Insulation, & Ballast - 3rd	6	30-May-13	06-Jun-13
295	A3240	Dry Building - North	0		10-Jun-13
296	**Elevators**		113	08-May-13	16-Oct-13
297	Entire Building		113	08-May-13	16-Oct-13
298	A3150	Install Elevators 9 - 14	112	08-May-13	15-Oct-13
299	A3160	Install Elevators 1 - 8	111	10-May-13	16-Oct-13
300	**Final Completion & Occupancy**		46	30-Oct-13	06-Jan-14
301	Entire Building		46	30-Oct-13	06-Jan-14
302	A3170	Base Building Substantial Completion	0		30-Oct-13
303	A3180	Punchlist	46	31-Oct-13	06-Jan-14
304	A3190	Base Building Final Completion	0		06-Jan-14



▬	Actual Level of Effort	🟩	Remaining Work	◆ ◆	Milestone
▬	Actual Work	🟥	Critical Remaining Work	▬	summary

TASK filter: All Activities

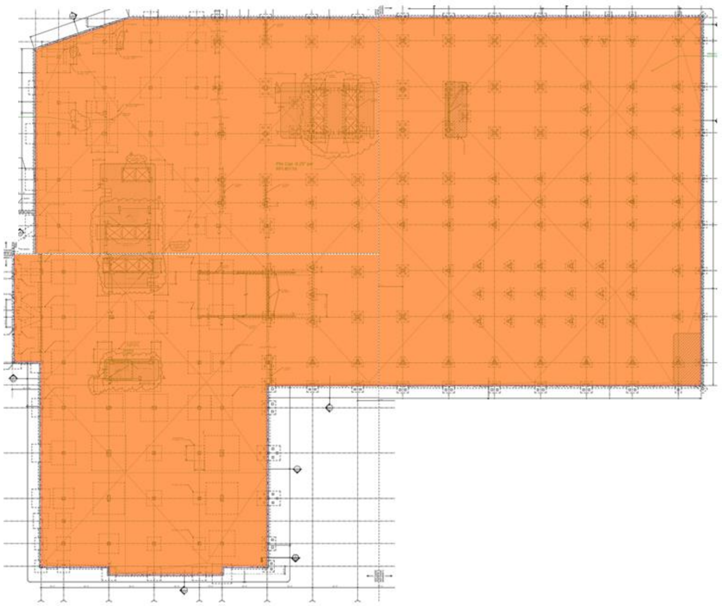
Appendix B.1

Detailed Structural Estimate

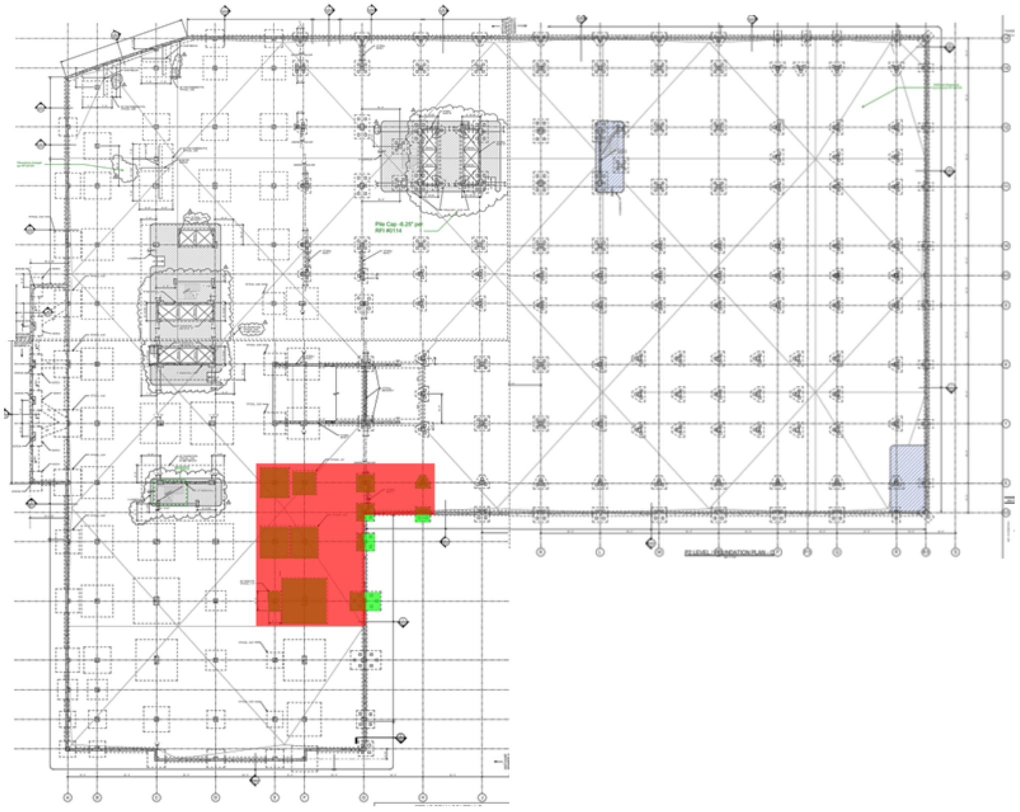
Line Item	Material	Quantity	Waste Factor (%)	Adjusted Quantity	Unit	Material $/Unit	Labor $/Unit	Total Material	Total Labor	Total Cost
Foundation - Column Footings										
330533850	Cast In Place Concrete - Footings, Over 5 C.Y.	6618	5	6948.9	C.Y.	$179.00	$64.00	$1,243,853.10	$444,729.60	$1,688,582.70
321100500	Reinforce in Place - Footings, #4 to #7	1.52	5	1.596	Tons	$1,000.00	$760.00	$1,596.00	$1,212.96	$2,808.96
321100550	Reinforce in Place - Footings, #8 to #18	188	5	197.4	Tons	$1,000.00	$445.00	$197,400.00	$87,843.00	$285,243.00
									Subtotal =	$1,976,634.66
									Overhead & Profit (15%) =	$296,495.20
									Total for Column Footings =	$2,273,129.86
Foundation - Column Piers										
330530900	Concrete in Place - Columns - 24" x 24", 2 -3% Reinforce	111	10	122.1	C.Y.	$238.00	$380.00	$29,059.80	$46,398.00	$75,457.80
311136650	Forms in Place - Columns, 24" x 24", 4 Uses	297.7	5	312.585	S.F.C.A.	$0.96	$5.70	$300.08	$1,781.73	$2,081.82
321100250	Reinforcing in Place - Columns, #8 to #18	18.5	5	19.425	Tons	$1,000.00	$695.00	$19,425.00	$13,500.38	$32,925.38
									Subtotal =	$110,464.99
									Overhead & Profit (15%) =	$16,569.75
									Total for Column Piers =	$127,034.74
Foundation - Wall & Wall Footings										
330536200	Cast in Place Concrete- Retaining Walls, 4' High	211	10	232.1	C.Y.	$134.00	$135.00	$31,101.40	$31,333.50	$62,434.90
330533850	Concrete in Place - Footings - Spread over 5 C.Y.	246	10	270.6	C.Y.	$179.00	$64.00	$48,437.40	$17,318.40	$65,755.80
321100700	Reinforce in Place - Walls, #3 to #7	9.2	5	9.66	Tons	$1,000.00	$530.00	$9,660.00	$5,119.80	$14,779.80
321100500	Reinforce in Place - Footings, #4 to #7	3.9	5	9.8	Tons	$1,000.00	$760.00	$9,800.00	$7,448.00	$17,248.00
311132150	Forms in Place - Wall Below Grade, Job Built, 4 Use	5712	10	6283.2	S.F.C.A.	$0.96	$4.15	$6,031.87	$26,075.28	$32,107.15
									Subtotal =	$192,325.65
									Overhead & Profit (15%) =	$28,848.85
									Total for Foundation Walls and Footings =	$221,174.50
Level P2 - SOG										
33053404760	Slab on Grade - 5" Thick	123765	5	129953.25	S.F.	$1.68	$0.57	$218,321.46	$74,073.35	$292,394.81
32205500300	Welded Wire Fabric (6" x 6" - W2.9 x W2.9)	1237.65	10	1361.4	C.S.F.	$21.85	$18.14	$29,746.59	$24,695.80	$54,442.39
305130050	Integral Waterproofing	123765	5	129953.25	S.F.	$12.10	$0.00	$1,572,434.33	$0.00	$1,572,434.33
31113653000	Edge Forms, Wood - 4 Use, On Grade	1598	10	1757.8	L.F.	$0.30	$1.23	$527.34	$2,162.09	$2,689.43
									Subtotal =	$1,921,960.96
									Overhead & Profit (15%) =	$288,294.14
									Total for SOG =	$2,210,255.10
Level P2 - Columns to P1										
330530900	Concrete in Place - Columns - 24" x 24", 2 -3% Reinforce	457	10	502.7	C.Y.	$238.00	$380.00	$119,642.60	$191,026.00	$310,668.60
311136650	Forms in Place - Columns, 24" x 24", 4 Uses	1212	10	1333.2	S.F.C.A.	$0.96	$5.70	$1,279.87	$7,599.24	$8,879.11
321100250	Reinforcing in Place - Columns, #8 to #18	78.8	5	82.74	Tons	$1,000.00	$695.00	$82,740.00	$57,504.30	$140,244.30
									Subtotal =	$459,792.01
									Overhead & Profit (15%) =	$68,968.80
									Total for Columns on P2 =	$528,760.81
Level 1 - Elevated Flat Slab (11" Thick)										
330531950	Cast in Place Concrete - Elevated Slab, flat slab w/ Drops	2438	10	2681.8	C.Y.	$268.00	$183.00	$718,722.40	$490,769.40	$1,209,491.80
311132150	Forms in Place - Flat Slab, Drop Panels, 4 Use	2215	10	2436.5	S.F.C.A.	$1.32	$3.85	$3,216.18	$9,380.53	$12,596.71
321100400	Reinforce In Place - Elevated Slabs, #4 to #7	310	5	325.5	Tons	$1,000.00	$550.00	$325,500.00	$179,025.00	$504,525.00
									Subtotal =	$1,726,613.51
									Overhead & Profit (15%) =	$258,992.03
									Total for Elevated Slab, Level 2 =	$1,985,605.53
Level 1 - Columns to Level 2										
330530900	Concrete in Place - Columns - 24" x 24", 2 -3% Reinforce	348	10	382.8	C.Y.	$238.00	$380.00	$91,106.40	$145,464.00	$236,570.40
311136650	Forms in Place - Columns, 24" x 24", 4 Uses	18782	10	20660.2	S.F.C.A.	$0.96	$5.70	$19,833.79	$117,763.14	$137,596.93
321100250	Reinforcing in Place - Columns, #8 to #18	51	5	53.55	Tons	$1,000.00	$695.00	$53,550.00	$37,217.25	$90,767.25
									Subtotal =	$464,934.58
									Overhead & Profit (15%) =	$69,740.19
									Total for Columns on Level 2 =	$534,674.77
Level 2 - Elevated Flat Slab (8" Thick)										
330531950	Cast in Place Concrete - Elevated Slab, flat slab w/ Drops	1309	10	1439.9	C.Y.	$268.00	$183.00	$385,893.20	$263,501.70	$649,394.90
311132150	Forms in Place - Flat Slab, Drop Panels, 4 Use	1169	10	1285.9	S.F.C.A.	$1.32	$3.85	$1,697.39	$4,950.72	$6,648.10
321100400	Reinforce In Place - Elevated Slabs, #4 to #7	225	5	236.25	Tons	$1,000.00	$550.00	$236,250.00	$129,937.50	$366,187.50
									Subtotal =	$1,022,230.50
									Overhead & Profit (15%) =	$153,334.58
									Total for Elevated Slab, Level 2 =	$1,175,565.08
Level 2 - Columns to Level 3										
330530900	Concrete in Place - Columns - 24" x 24", 2 -3% Reinforce	223	10	245.3	C.Y.	$238.00	$380.00	$58,381.40	$93,214.00	$151,595.40
311136650	Forms in Place - Columns, 24" x 24", 4 Uses	12043	10	13247.3	S.F.C.A.	$0.96	$5.70	$12,717.41	$75,509.61	$88,227.02
321100250	Reinforcing in Place - Columns, #8 to #18	45	5	47.25	Tons	$1,000.00	$695.00	$47,250.00	$32,838.75	$80,088.75
									Subtotal =	$319,911.17
									Overhead & Profit (15%) =	$47,986.68
									Total for Columns on Level 2 =	$367,897.84

Breakdowns of Detailed Modules for Structural Estimate

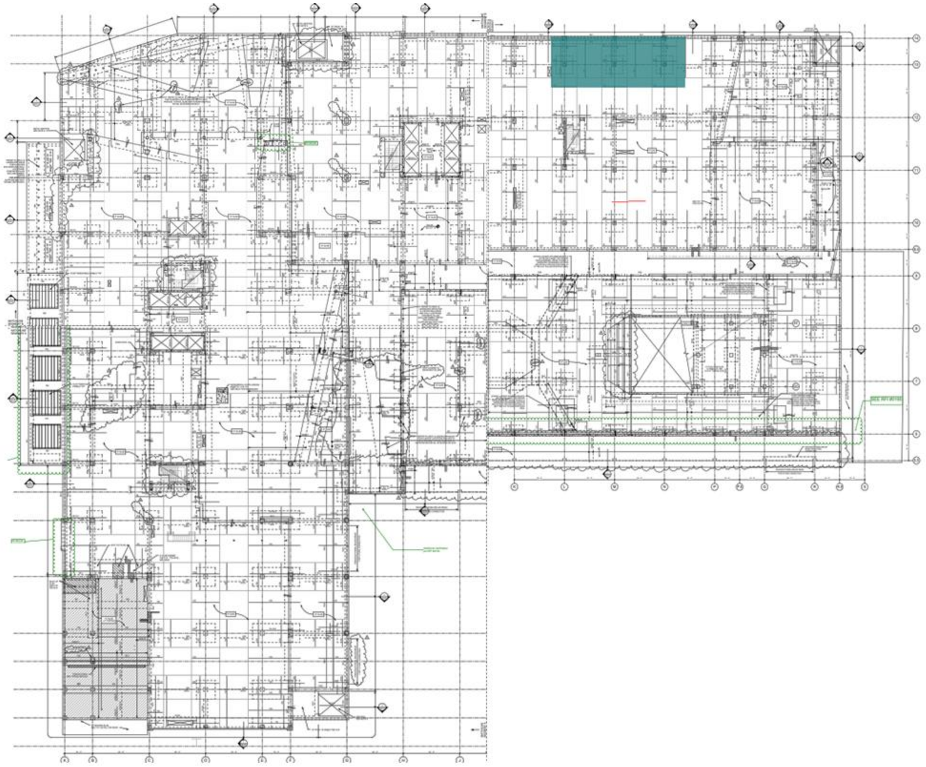
Quantity Take-Off of SOG



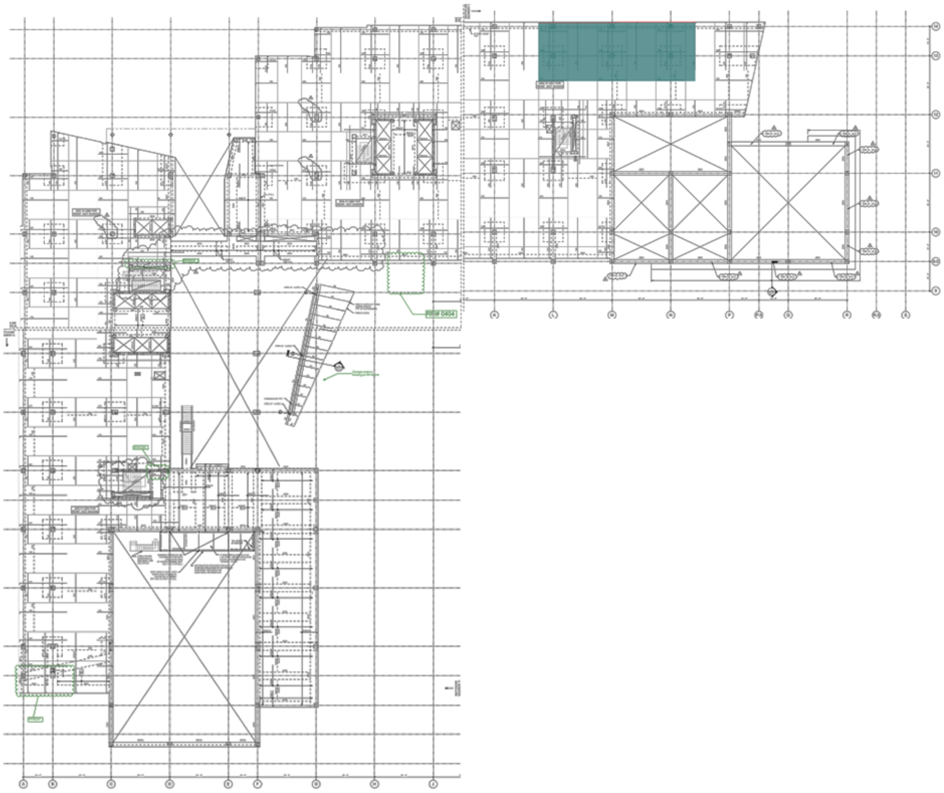
Quantity Take-Off of Foundation Module



Quantity Take-Off of Level 1 (Ground Floor)



Quantity Take-Off of Level 2

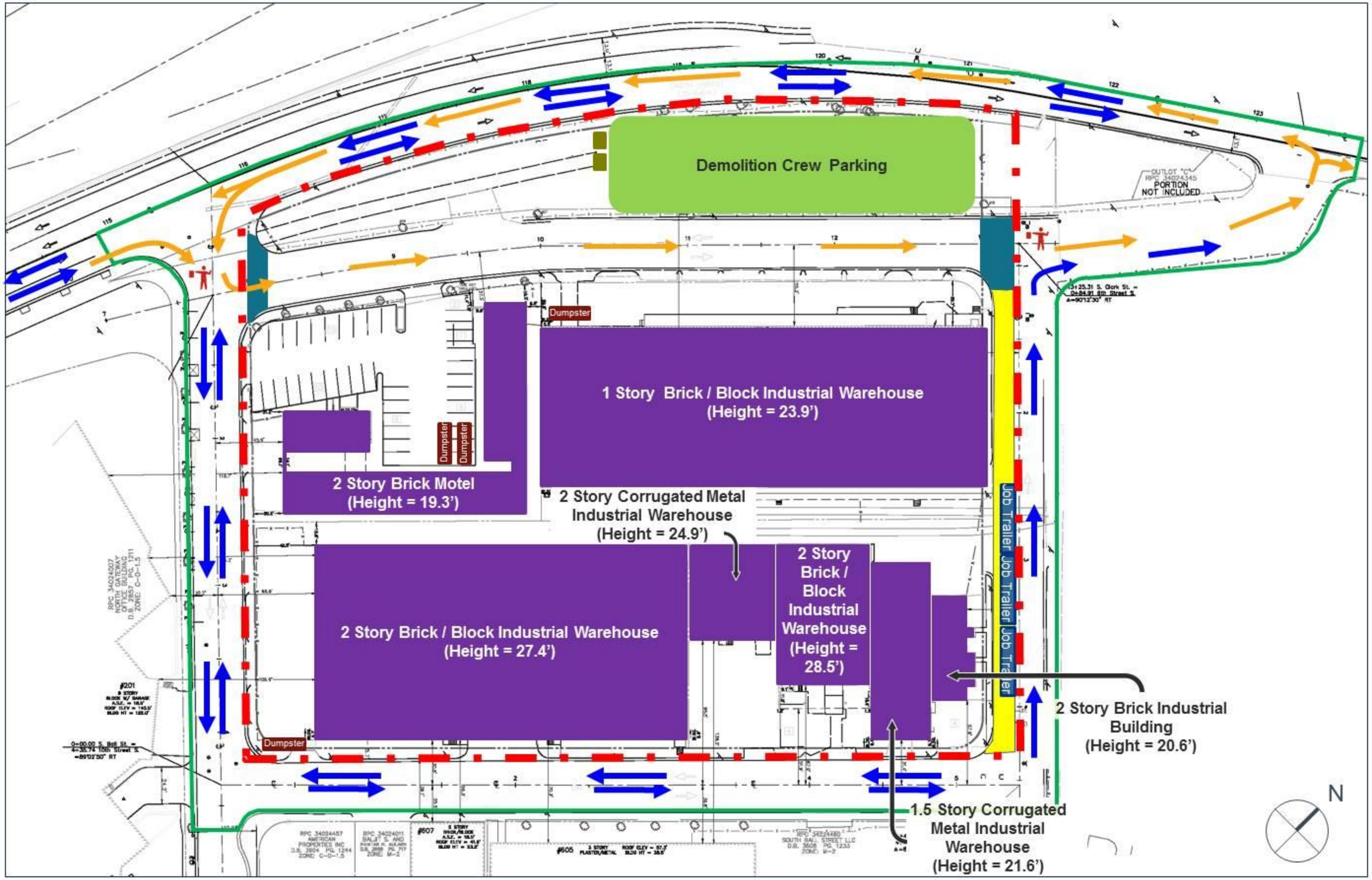


Appendix B.2

Assemblies Estimate of MEP & Fire Protection

Cost Code	Equipment	Quantity	Unit	Material $/Unit	Labor $/Unit	Total Material	Total Labor	Total Cost
Mechanical Equipment								
D3030 214 1500	Heating / Cooling System, Heat pump 5 Ton, SEER 14, 2000 SF Building	5	EA	$ 8,725.00	$ 5,625.00	$ 43,625.00	$ 28,125.00	$ 71,750.00
D3050 160 3320	Self Contains, water cooled unit. Offices, 10,000 SF, 23.33 Tons	322725	S.F.	$ 4.88	$ 2.76	$ 1,574,898.00	$ 890,721.00	$ 2,465,619.00
D3030 115 4040	Chilled Water, Cooling Tower System. Offices, 60,000 SF, 300 Ton	322725	S.F.	$ 7.75	$ 6.80	$ 2,501,118.75	$ 2,194,530.00	$ 4,695,648.75
D3050 170 3440	Split System with Air Condensing Unit. Offices, 20,000 SF, 63.32 Ton	322725	S.F.	$ 3.71	$ 4.44	$ 1,197,309.75	$ 1,432,899.00	$ 2,630,208.75
D2357 191 33160	Heat Exchanger, Plate Type, 1800 GPM	1	EA	$ 108,810.00	$ 4,442.10	$ 108,810.00	$ 4,442.10	$ 113,252.10
Plumbing Equipment								
D2010 110 2080	Water Closet Systems - Bowl, Flush Valve, Wall Hung	102	EA	$ 1,900.00	$ 810.00	$ 193,800.00	$ 82,620.00	$ 276,420.00
D2010 210 2000	Urinal Systems, Vitreous China, Wall Hung	25	EA	$ 625.00	$ 800.00	$ 15,625.00	$ 20,000.00	$ 35,625.00
D2010 310 1920	Lavatory W/ Trim, Vanity, Vitreous china, 20" x 16"	74	EA	$ 730.00	$ 750.00	$ 54,020.00	$ 55,500.00	$ 109,520.00
D2010 810 1920	Drinking Fountain, Wall Mounted, Stainless Steel, No Back	32	EA	$ 1,525.00	$ 470.00	$ 48,800.00	$ 15,040.00	$ 63,840.00
D2020 260 1820	Oil Fired Water Heaters - 140 Gal, 134 GPH	3	EA	$ 21,700.00	$ 1,525.00	$ 65,100.00	$ 4,575.00	$ 69,675.00
D2040 210 2240	Roof Drain, PVC, 6" Diameter, 12' High	12	EA	$ 1,388.80	$ 1,187.00	$ 16,665.60	$ 14,244.00	$ 30,909.60
D22132 914 0630	Sewage Ejector , Simplex System, 87 GPM, 45 Gallons	3	EA	$ 1,218.80	$ 174.64	$ 3,656.40	$ 523.92	$ 4,180.32
Electrical Equipment								
D 5010 250 1000	Panelboards, 4 Wire, 120/208 V, 100A	14	EA	$ 2,525.00	$ 3,025.00	$ 35,350.00	$ 42,350.00	$ 77,700.00
D 5010 250 2020	Panelboards, 4 Wire, 120/208 V, 250A	5	EA	$ 6,175.00	$ 4,800.00	$ 30,875.00	$ 24,000.00	$ 54,875.00
D 5010 250 3000	Panelboards, 4 Wire, 120/208 V, 400A	34	EA	$ 8,500.00	$ 7,600.00	$ 289,000.00	$ 258,400.00	$ 547,400.00
D 5020 110 0560	Receptacle - 16.5 per 1000 S.F. W/ Transformer	322725	S.F.	$ 1.14	$ 3.35	$ 367,906.50	$ 1,081,128.75	$ 1,449,035.25
D 5020 130 0320	Wall switch - 2.5 per 1000 S.F.	322725	S.F.	$ 0.13	$ 0.45	$ 41,954.25	$ 145,226.25	$ 187,180.50
D5050 165 0920	Switchboards, Aluminum Bus Bars, 400 A	18	EA	$ 9,447.75	$ 1,313.00	$ 170,059.50	$ 23,634.00	$ 193,693.50
D5020 208 0600	Fluorescent Strip Fixtures, 17 fixtures per 1000 ft.	322725	S.F.	$ 2.95	$ 6.00	$ 952,038.75	$ 1,936,350.00	$ 2,888,388.75
D5030 920 0110	Data & Voice System, 8 data/ voice outlets/ 1000 SF	322.725	M.S.F.	$ 615.00	$ 1,775.00	$ 198,475.88	$ 572,836.88	$ 771,312.75
D5090 210 1400	1000 kW Diesel Engine Generator w/ Fuel Tank	1500	kW	$ 224.00	$ 12.55	$ 336,000.00	$ 18,825.00	$ 354,825.00
D2636 231 00600	Automatic Transfer Switches, Enclosed, 3 Pole, 480V, 260 A	7	EA	$ 4,554.30	$ 338.35	$ 31,880.10	$ 2,368.45	$ 34,248.55
D2622 131 04865	Transformer, Dry Type, 3 Phase 480V Primary, 120/208V Secondary, 75 kVA	11	EA	$ 7,970.03	$ 969.60	$ 87,670.33	$ 10,665.60	$ 98,335.93
Fire Protection								
D4010 310 1100	Dry Pipe Sprinkler System, 6" Diameter, Black Steel	2	Floor	$ 5,450.00	$ 4,625.00	$ 10,900.00	$ 9,250.00	$ 20,150.00
D4010 410 0760	Wet Pipe Sprinkler System, Light Hazard, 50,000 SF, Black Steel	322724	S.F.	$ 0.75	$ 1.15	$ 242,043.00	$ 371,132.60	$ 613,175.60

Appendix C



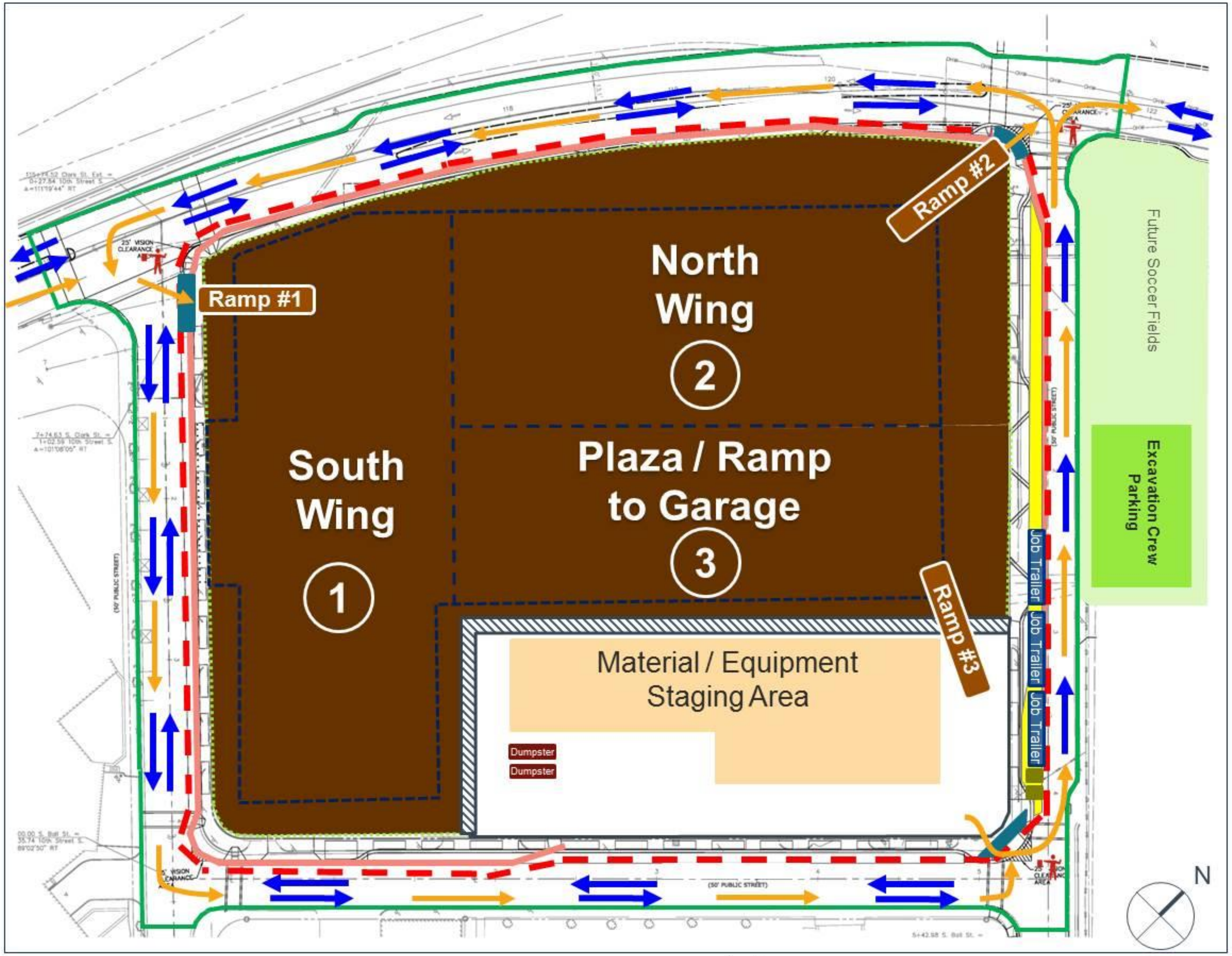
Demolition Phase

Memorial Vista

A Northern Virginia Office Building

Key:

- → Construction Traffic Flow
- → Vehicular Traffic Flow
- - - Construction Fence
- — Pedestrian Sidewalk
- Flagger
- 🟪 Buildings to be Demolished
- ▮ Porta-Potty
- 🟨 Sidewalk and Road Closure
- 🟦 Site Gate



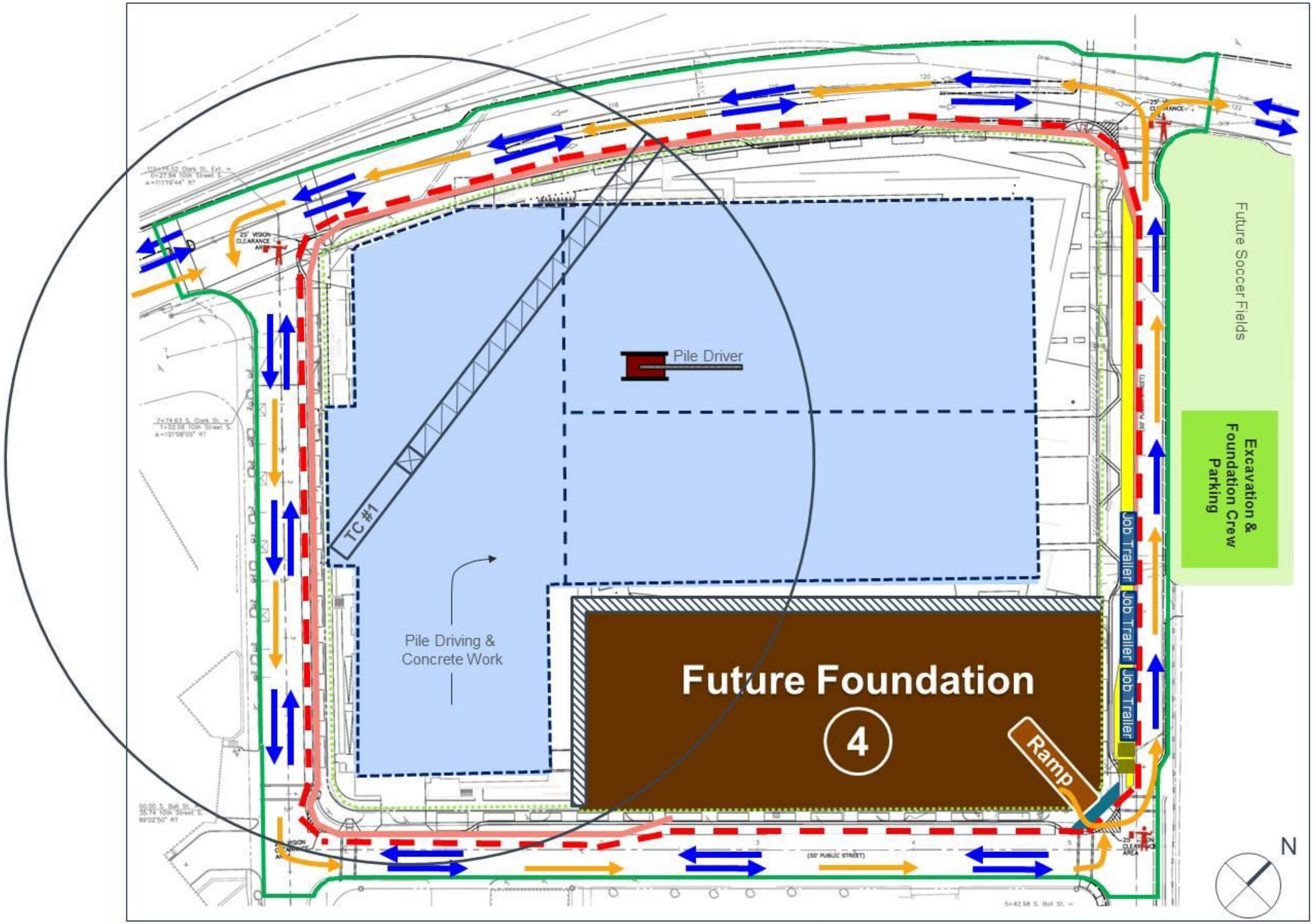
Building Excavation Phase 1

Memorial Vista

A Northern Virginia Office Building

Key:

- → Construction Traffic Flow
- → Vehicular Traffic Flow
- - - Construction Fence
- — Pedestrian Sidewalk
- — Jersey Barriers
- - - Garage Foundation Outline
- ■ Porta-Potty
- ■ Sidewalk and Road Closure
- ■ Site Gate
- 🚩 Flagger
- ▨ Sloped Soil Walls
- ····· Sheeting and Shoring



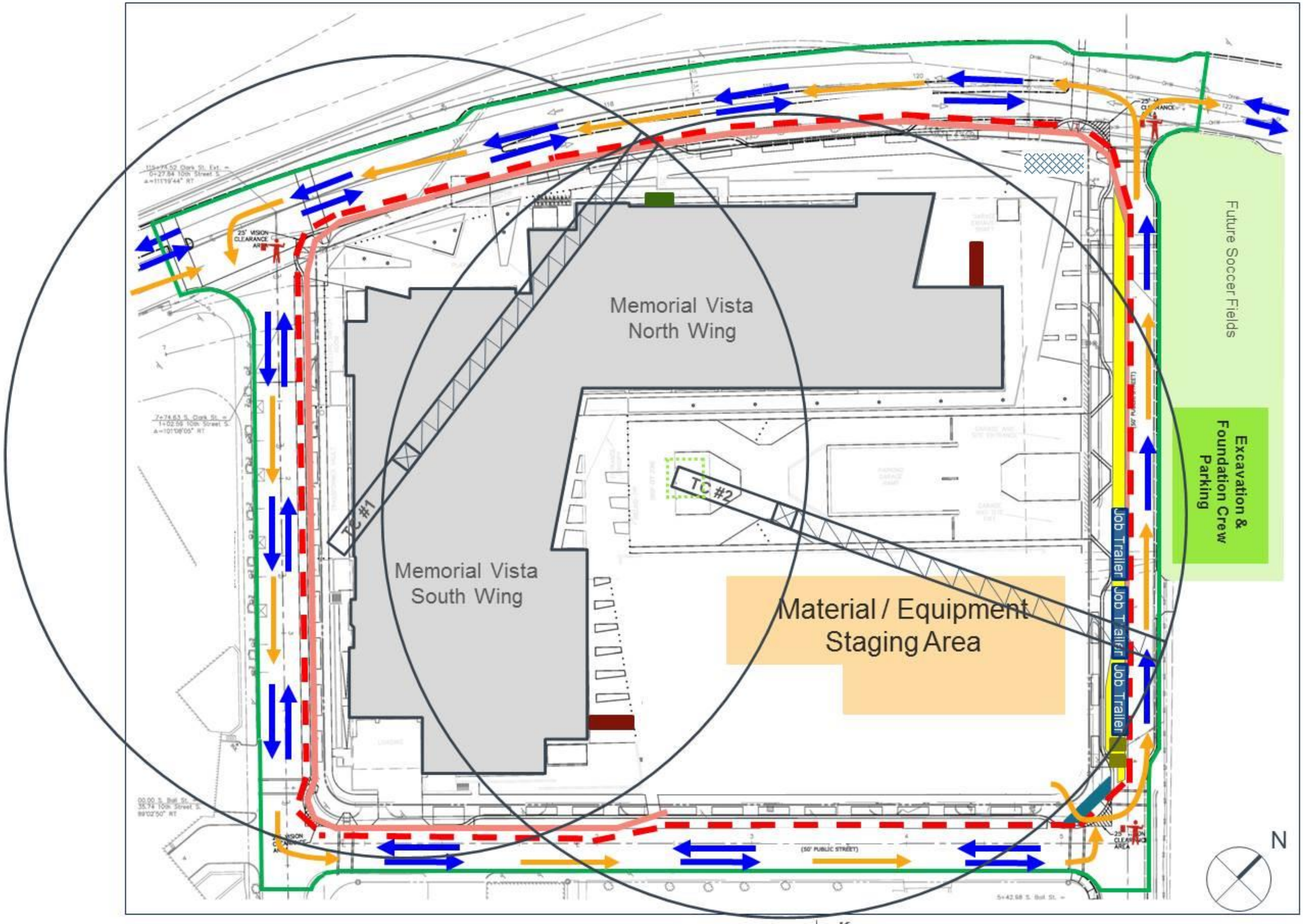
Excavation & Foundation Phase

Memorial Vista

A Northern Virginia Office Building

Key:

- → Construction Traffic Flow
- → Vehicular Traffic Flow
- - - Construction Fence
- — Pedestrian Sidewalk
- — Jersey Barriers
- - - Garage Foundation Outline
- ····· Sheeting & Shoring
- ■ Porta-Potty
- 🟨 Sidewalk and Road Closure
- ■ Site Gate
- 🚩 Flagger
- ▨ Sloped Soil Walls
- ■ Concrete Foundation Work



Substructure & Superstructure Phase

Memorial Vista

A Northern Virginia Office Building

Key:

- → Construction Traffic Flow
- → Vehicular Traffic Flow
- - - Construction Fence
- — Pedestrian Sidewalk
- — Jersey Barriers
- - - Garage Foundation Outline
- ⋯ Shoring
- ■ Porta-Potty
- 🟨 Sidewalk and Road Closure
- ■ Site Gate
- 🚶 Flagger
- 🟩 Material Hoist
- ▨ Electrical Vault
- 🟥 Dumpster & Trash Chute

Appendix D

LEVEL 1: BIM EXECUTION PLANNING PROCESS
Project Title

Developed with the BIM Project Execution Planning Procedure by the Penn State CIC Research Team
http://www.engr/psu.edu/ae/cic/bimex