

Images Courtesy of The Preston Partnership

SOLAIRE WHEATON

Image Courtesy of Clark Builders Group

Kevin Martyn

Technical Report 2

Construction Management

Adviser : Dr. Rob Leicht

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EXECUTIVE SUMMARY

The following technical report analyzes the key features and controls that affect the final outcome of the Solaire Wheaton design and construction project. The analyses include a detailed project schedule, detailed structural estimates and MEP assemblies estimates, an estimate of the construction manager's general conditions, site layout plans during several phases of construction, constructability challenges encountered on the project, as well as an evaluation and suggestion of building information modeling uses.

With the residential market booming in the Wheaton Maryland region and an owners goal of project completion before neighboring competitors, an aggressive schedule with multiple turnovers was formed. With competitors building out of concrete and steel, the project team has a clear advantage in the use of wood construction, which is erected at a faster pace. The two turnovers in November of 2014, and March of 2014 help the marketing team show units and sign tenants prior to building occupancy.

The combination of concrete and wood makes for an interesting, yet economic structure. Comparing the detailed concrete estimate of $3.3 million and wood framing estimate of $1.9 million; the advantages of wood construction are apparent. To put everything in perspective, the wood framing cost is 2/3 the cost of concrete while the wood structure is two stories higher. These estimates came in lower than the guaranteed maximum price budgeted cost, which is expected to have built-in contingencies.

Assemblies MEP estimates proved to be difficult to accurately quantify using commercial cost data on a residential project. The cost data did not provide the ability to encounter cost savings by use of MEP materials common to the residential sector.

Using the CM @ Risk delivery method, the construction manager carries a low amount of general conditions costs on the project aside from the staff. This is apparent with 78% of general conditions being a product of the project team. The total general conditions cost and employee benefit expense for the project totals 6% of the guaranteed maximum price contract.

The combination of a tight site and access from one of the four sides of the building made for a difficult formation of site utilization plans. Different phases of the project called for different layout plans and flow of workers and materials.

In addition to the site constraints the combination of parking garage and residential apartment building provided a number of constructability challenges including safety hazards and mold growth. These structures are making their way into the D.C. market and have a specialized set of contractors that are working through the constructability and coordination issues.

With BIM on the leading edge of the industry at the start of the project, the advantages and opportunities were not recognized by the project team. Looking back, the technology could have improved the project success if implemented in the design and construction phases in a collaborative manner.

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DETAILED PROJECT SCHEDULE

The Solaire Wheaton project has a projected schedule of 21 months. The major phases of design and construction can be seen in Table 1. The planning and design phase took over two years, and included having the land rezoned formulating a sufficient design. Appendix A containt the detailed critical path schedule. Notice that the critical path goes through the demolition, structure, and MEP rough-in stages of the project. A major finish milestone is temporary dry which allows the MEP overhead rough-in to begin. This is important recieve close-in inspections on time and allow finishes to follow closely behind. The critical path for finishes flows through the 3rd floor which is the final floor prior to total building turnover in January 2014.

Table 1. Schedule Summary Activities

Schedule Summary Activities			
Phase	**Duration (Days)**	**Start Date**	**End Date**
Design & Preconstruction	577	3/22/2010	6/22/2012
Procurement	198	6/25/2012	4/3/2013
Sitework- Demolition & Excavation	89	7/10/2012	11/12/2013
Structure	148	9/11/2012	4/9/2013
MEP	238	9/13/2012	8/19/2013
Building Enclosure	145	3/18/2013	10/9/2013
Interior Finishes	145	6/17/2013	1/1/2004
Landscape/ Hardscape	77	8/12/2013	11/27/2013
Project Closeout	80	11/27/2013	3/21/2014

STRUCTURE SEQUENCING

Figure 1 (right) shows the flow of structural wood framing which follows a clockwise sequence starting in the southwest corner. This plan allows for the third floor post tensioned concrete deck, which sits on the northeast corner, to finish as the second floor wood framing arrives. Site access is also minimal on the south and west sides of the building. This plan allows the carpentry contractor to work their way out of the constrained area. Walls are framed on the ground and tilted into place. The walls are then temporarily braced until the above floor trusses have been set in place by the crane. This phase requires diligent safety planning and management as workers are constantly exposed to falls, which are the number one cause of accidents on construction sites.

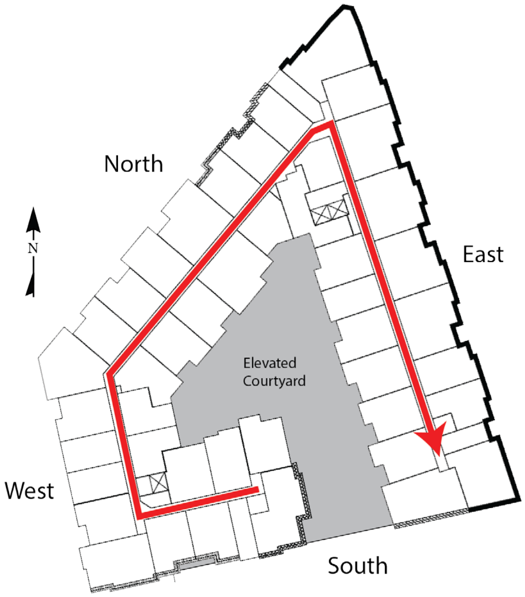


Figure 1. Structural Wood Framing Sequencing Plan

BUILDING ENCLOSURE SEQUENCING

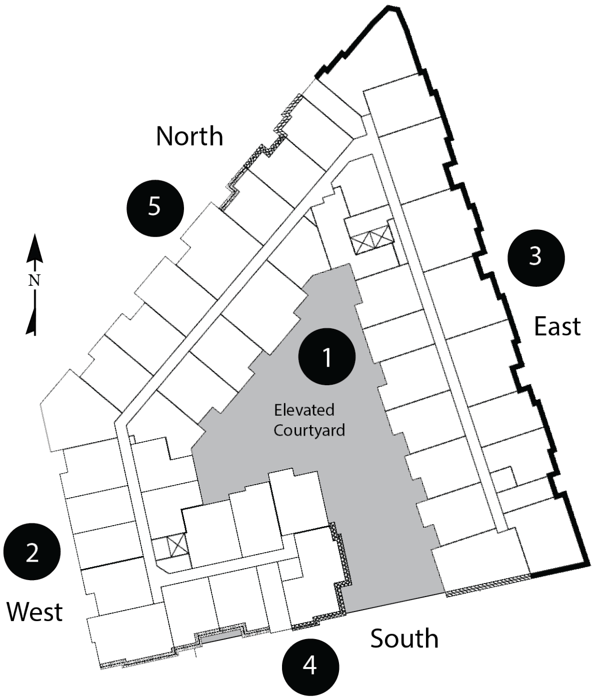


Figure 2. Building Enclosure Sequencing

Seen in Figure 2 (left), the original plan for building enclosure followed an unconventional sequence due to the atypical building footprint and site constraints. Exterior work started in the elevated courtyard due to the disassembling of the tower crane at the end of May, 2013. Large equipment, such as basket lifts, needed to be removed from the courtyard and material stockpiled prior to the tower crane being disassembled. As can be seen by the numbers in Figure 2, the flow starts to jump around starting on the west elevation. The mason will jump to the east elevation next to get out of the way of the bio-retention vaults which will be located on the east. Once the siding in installed on the west, the contractor then moves to the south facade and completes his scope of work on the north elevation. The plan evolved during construction to take a clockwise sequence of courtyard, south, west, north, and finishing on the east. This plan was more conducive to the tight site constraints in the southwest corner.

INTERIOR SEQUENCING

As previosuly noted, the project team is faced with a phased occupancy with a first turnover in November of 2013. The elements of the building included in the first turnover can be seen shaded in purple in Figure 3 at the right. Because of this turnover, the sequencing of the interior trades is extremely important and follows a rather unconventional plan. The sequence involves finishing the first and second floors first, followed by a jump to the top floor to work down and out of the building. The MEP trades will be following the erection of the structure closely with their riser rough-in, as seen in the schedule. This allows them to meet the finish trades at the 6th floor and work down to the third floor together, with interior finishes following the close-in inspection of MEP distribution rough-in. This sequence was chosen due to the material loading constraints. This plan also reduces damage and rework as the upper floors are signed off when completed. As seen by the red arrow in figure 3, the flow of finishes goes from the southwest corner, clockwise to the more accessible east side.

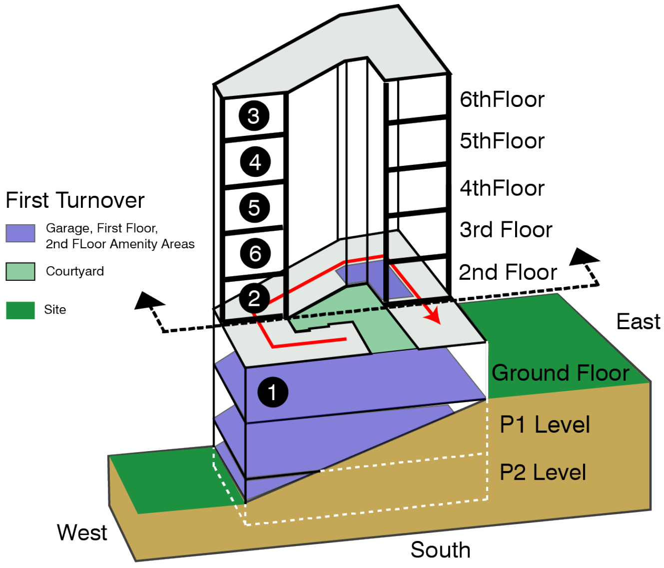


Figure 3. Interior Sequencing Plan

DETAILED STRUCTURAL ESTIMATE AND MEP ASSEMBLIES ESTIMATE

Detailed estimates were performed for both types of structural systems using RSMeans Online cost data. Reference Appendix B for the estimate spreadsheets.

The foundation of the structure consists of column spread footings as well as foundation wall strip footings. The foundation walls are located on the East elevation along Georgia Avenue wih the site sloping gradually to grade on the West elevation P2, the lowest level, on the West elevation.

The P2 and P1 garage levels, as well as the ground floor, are constructed of cast in place concrete. P2, the lowest level, consists of a 5" slab on grade placed with 3500 psi concrete. P1 and the groud floor are constructed of an 8" thick typical elevated slab with column drop panels. The 2nd floor slab involves the courtyard in the middle, where the swimming pool is placed. The typical concrete column size for the building is 14" x 24", and each level of the garage is accessed by a 10" thick garage ramp.

The third level of this structure utilizes a 10 ½" thick post tensioned concrete deck in the northeast corner. The PT tendons are laid out with a maximum spacing of 60", and the assumed effective strength of the tendons after all losses is 27 kips.

The remaining structure from the 2nd floor to the 6th is constructed of wood framing. The walls are framed at 12" on center typically. The floors are designed as 18" pre-engineered open web wood trusses typically spaced at 24" on center topped by tongue and groove subfloor sheathing.

DETAILED STRUCTURAL CONCRETE ESTIMATE

The concrete estimate was done in three parts; a foundation and slab on grade module for the P2 level, an elevated deck module for the P1 and ground floor, and a detailed estimate of the post tensioned deck section of the third floor slab.

The module chosen for the P2 level can be seen in Figure 4. This section was chosen because of all of the elements incorporated. Included are the continuous wall footings, spread footings, slab on grade, typical columns, and elevated deck above. Concrete is placed with a combination of crane & bucket and concrete pump trucks.
As you will see on the following page, the P2 level and foundations were estimated at a cost of $1 million.

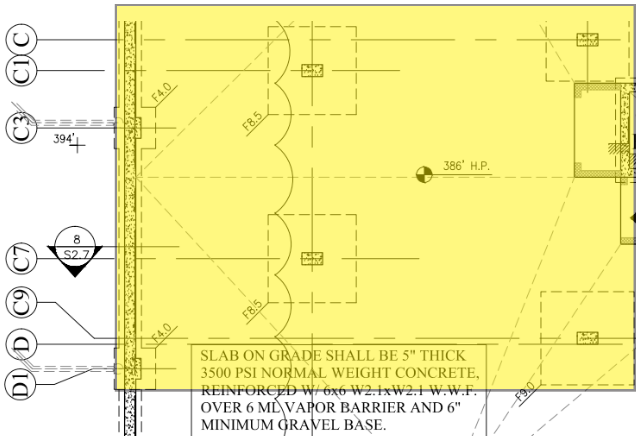


Figure 4. P2 - Foundations & Slab on Grade Module

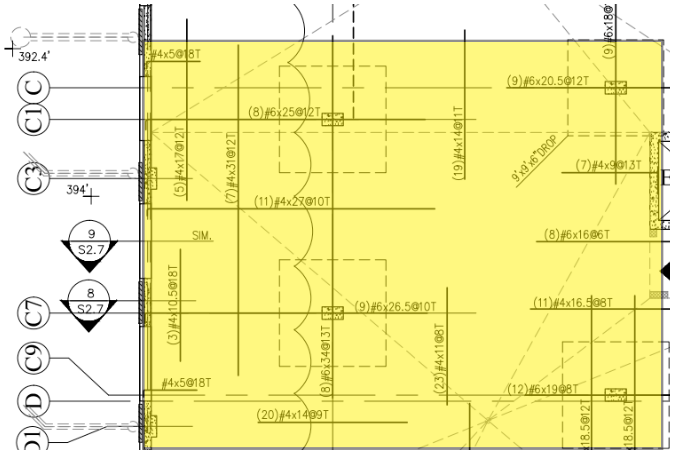


Figure 5. P1 & 1st Floor - Elevated Slab Module

This same module, as seen in Figure 5, was used for the floors with elevated slabs. This system pertains to the P1 level and 1st floor. These floors include the typical columns with drop panels, and 8" elevated slabs. This proved to be the majority of the cost for structural concrete at $2 million. The elevated deck pours utilized re-usable formwork with a typical size of 2' x 4'. The P1 level has a tall height of 17' for access by delivery trucks while the 1st floor has a typical heigt of 10' 7".

As seen in Figure 6 at the right, the post tensioned (PT) deck, which is shaded in gray, sits at the Northeast corner of the building. This concrete system is required by code to provide a fire barrier between the amenity space, and the units above. The deck is a 10 1/2" thick slab with tendons laid out with a maximum spacing of 60". Because this was a small area of the building, the post tensioned concrete was estimated in full detail. This 1570 square foot slab yielded a total price for post tensioned concrete of $177,000. This number is assumed to be fairly low due to the amount of rebar and tendon work necessary with PT slabs.

Figure 6. Post Tensioned Deck Section

As seen in Table 2, the concrete contract was estimated at nearly $3.3 million. This comes in $500,000 lower than the actual contract value of 3.8 million. This can be expected with a guaranteed maximum price contract and incomplete design documents at the start of construction. The contractor, presumably, built in contingencies to account for these uncertainties. The conducted detailed concrete estimate also does not account for the complexities with two garage ramps and the additional structural concrete concerns associated with an elevated swimming pool located on the courtyard level.

Table 2. Structural Concrete Detailed Estimate

Structural Concrete Estimate	
Description	**Cost**
P2- Foundations & Slab on Grade	$1,072,522.65
P1 & 1st Floor - Elevated CIP Concrete Deck	$2,032,862.23
3rd Floor Post Tensioned Deck	$177,095.11
Total	**$3,282,479.98**

DETAILED STRUCTURAL WOOD FRAMING ESTIMATE

The structural wood framing estimate was broken into several different parts, similar to the concrete estimate. The residential units were broken into single and double bedroom units and taken off separately. Typical layouts were used for both unit types, as seen in Figures 7A and 7B. In addition, the roof sheathing, parapets and stairwell construction were estimated. All wood framing was moved throughout the site by the tower crane and installed with pneumatic nail guns. As you will see in the detailed spreadsheet in Appendix B, the wood structure consisted of 2" x 4" framed wall with pre-engineered floor trusses, which were sheathed on one side with oriented strand board to resist shear along with the exterior sheathed walls.

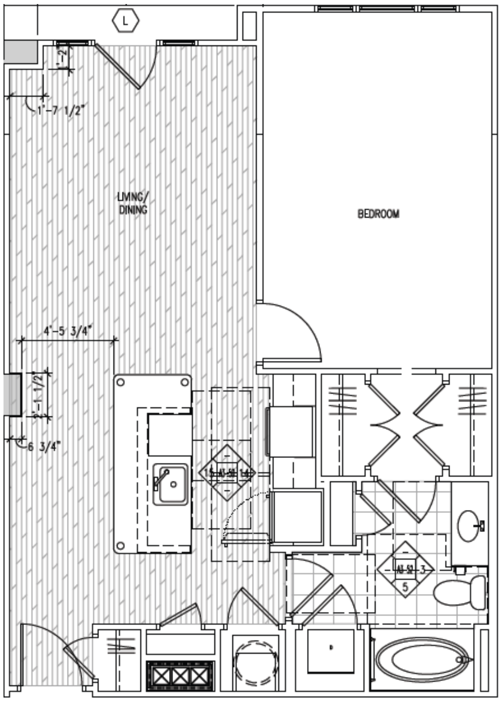


Figure 7A. Typical Single Bedroom Layout

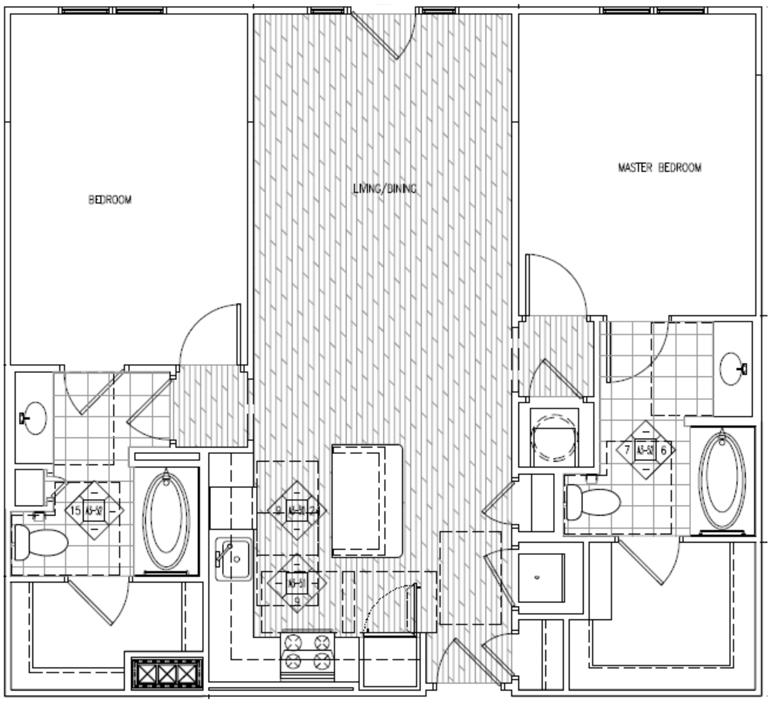


Figure 7B. Typical Double Bedroom Layout

As seen in Table 3 on the following page, the estimate provided a total cost of $1.9 million, coming in about $500,000 lower than the actual cost of $2.4 million. This can be partly attributed to the missing dens glass stairwell enclosure, which was not included in the estimate. The roof sheathing takeoff is also assumed to be conservative. The intricate parapet canopy walls, located along the east elevation as seen in Figure 8, required significant wind load bracing in addition to the large crew size required to construct. Finally the carpentry contractor supplied a full time crane directing and rigging crew, which was not included in the detailed estimate.

Figure 8. Image Courtesy of the Preston Partnership

Table 3. Structural Wood Framing Detailed Estimate

Structural Wood Framing Estimate			
Description	**Qty.**	**Unit Price**	**Total Price**
2nd Floor	**38**		
Single Bedroom Units	29	$7,873.84	$228,341.36
Double Bedroom Units	9	$10,509.57	$94,586.13
3rd Floor	44		
Single Bedroom Units	32	$7,873.84	$251,962.88
Double Bedroom Units	12	$10,509.57	$126,114.84
4th Floor	44		
Single Bedroom Units	32	$7,873.84	$251,962.88
Double Bedroom Units	12	$10,509.57	$126,114.84
5th Floor	44		
Single Bedroom Units	32	$7,873.84	$251,962.88
Double Bedroom Units	12	$10,509.57	$126,114.84
6th Floor	44		
Single Bedroom Units	32	$7,873.84	$251,962.88
Double Bedroom Units	12	$10,509.57	$126,114.84
Stairwell Framing (5 Floors)			
Stairwell A	5	$2,875.74	$14,378.70
Stairwell B	5	$2,875.74	$14,378.70
Stairwell C	5	$2,875.74	$14,378.70
Roofing			
Sheathing & Parapets			$81,005.52
Total Wood Framing			**$1,959,379.99**

STRUCTURAL ESTIMATE COMPARISON

Overall the structural estimate was closer than the SF estimate calculated in Technical Report 1. The foundations and structure in the square foot cost model totaled $3,478,000 which is closer to the total contract cost of $3.8 million than the detailed estimate of $3.3 million. This is likely due to the excluded garage ramp in the detailed estimate. The square foot cost model could more accurately estimate the cost of a garage ramp in a three story parking garage. The wood structure was more accurate at $1.9 million than the square foot cost model, which estimated the carpentry at $1.5 million.

MEP ASSEMBLIES ESTIMATE

To develop MEP assemblies estimates, RSMeans Online cost data was used. Table 4 shows the comparisons between the square foot cost model conducted in technical assignment 1, the recently conducted assemblies estimates, and the actual guaranteed maximum price budgeted costs. Reference Appendix B. for the cost breakdowns of the MEP assemblies estimates.

Table 4. MEP Estimate Comparison

MEP Estimates			
Description	SF Cost Model Estimate	Assemblies Estimates	Actual GMP Cost
Mechanical	$3,548,500.00	$1,745,216.37	$1,810,000.00
Electrical	$1,932,500.00	$2,672,373.01	$2,347,000.00
Plumbing	$3,972,000.00	$2,325,742.11	$1,635,910.00
Fire Protection	$1,143,500.00	$1,625,492.74	$675,000.00

Looking at the mechanical cost, the assemblies estimate narrowed the margin significantly to merely 4%. As will be discussed in the following paragraphs, the cost data used for the estimates was for commercial construction due to the fact that residential assemblies cost data is not available. This is a major reason for the extreme difference in prices for the other systems. The reason for a close mechanical number, however, is that HVAC materials and equipment do not vary much from commercial to residential. The cost data aligned very closely with the mechanical systems and equipment in the Solaire project's design.

The electrical cost increased greatly from the low square foot cost model to being approximately 13% over the actual cost. This difference is assumed to be due to the fact that the RSMeans cost data does not separate commercial and residential construction assemblies costs. The assemblies data assumes the use of MC cable instead of the romex cable used for the branch wiring on the project. This would decrease the cost significantly. On the other hand, the lighting fixture package was excluded in the assemblies estimate, as it is not part of the scope of the electrical contractor. For that reason lighting branch wiring could not be included. The combination of cost decrease of romex branch wiring, and the addition of lighting branch wiring are leading reasons for the more accurate estimate for the electrical system.

The plumbing assemblies seemed to split the large gap between the square foot cost model and the actual GMP cost. This large gap is again presumed to be due to the commercial cost data used. The cost data may have assumed cast iron materials while the project used PVC. Another major cost saver on the project was the vertically stacked units which aligned unit types and layouts on top of each other. This allowed the plumbing distribution to be mostly vertical, eliminating additional labor intensive overhead distribution commonly seen in commercial construction.

The fire protection rose through the assemblies estimate to more than double the actual cost. This can be explained once again in the difference between the commercial and residential cost data assumptions. The fire protection system for the Solaire Wheaton project utilized steel in the garage and CPVC throughout the residential units. CPVC tends to be less expensive when compared to steel. There is also a consideration for weight of materials. Steel is much heavier than CPVC adding to the labor and equipment necessary to move material and install pipe. Finally the connections are more difficult to install on steel pipe.

GENERAL CONDITIONS

The general conditions estimate for the project was completed with data from the RSMeans Online database. The detailed breakdown can be referenced in Appendix D. The estimate includes administrative, quality, temporary facility, and execution and closeout costs in addition to the staffing of the project.

The general conditions were estimated for 21 months of construction and totaled 1.8 million. The staffing costs are directly related to the staffing plan developed in Technical report 1. Project time commitments were assumed for the different members of the project team. Most of the team was full time with the exception of the vice president and the safety manager. The Vice president is in charge of several projects at any given time. His time commitment to the project included being on site once a week for in-house meetings, with additional visits as required. Similarly the safety manager directed several project, visiting the jobsite up to twice a week and as required, adding an estimated $20,000.

The administrative requirements include any job costs that keep the job office operating. In order to assure quality and compliance, the team needed to allocate GC costs to consultants and third party inspectors. One of the major concerns of the owner was Americans with Disabilities Act (ADA), and Fair Housing Act (FHA) compliance. In order to ensure compliance, Clark Builders Group hired a consultant to help ensure compliance with the previously noted acts. Many of the temporary facilities costs were absorbed into the specialty contractor scoped. Because Clark Builders Group is a local contractor, the project exectution costs were low by eliminating excessive travel and living expenses.

The chart shown in Figure 9 shows the breakdown of the general conditions costs. As you can see the staff of the project team accounts for 78% of the general conditions. This type of breakdown can be typical of the CM @ Risk delivery method. Unlike a project with a general contractor, the CM does not carry much of the cost and liability for tools and equipment. As mentioned, many of the temporary faciliy costs such as the tower crane were placed under the guaraneed maximum price or picked up by specialty contractor scopes. For example, temporary fencing was bought by the balcony railing contractor. In comparison with the actual general conditions cost, the estimate was about $200,000 high. This is because the original GC estimate excluded an assistant superintendent who was added to the project team. Had this member of the team been present at the beginning of the project, the GC estimates would have been similar. The $1.8 million estimate is 6% of the overall GMP which can be expected.

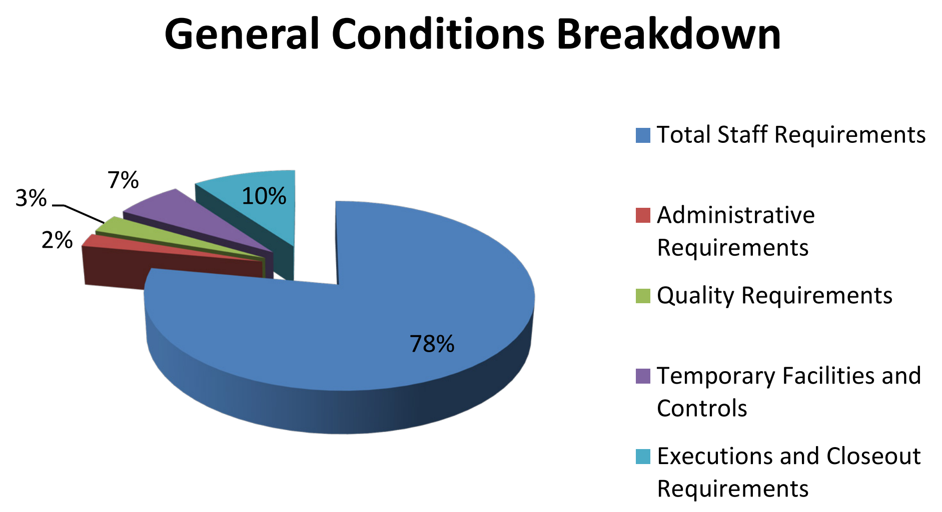


Figure 9. General Conditions Cost Breakdown

SITE LAYOUT PLANNING

DEMOLITION LAYOUT PLAN

Figure 10. Image Courtesy of Clark Builders Group

Prior to the start of excavation and construction, the existing structure, seen in Figure 10, needed to be abated of hazardous material and demolished. The recycling of the existing structure greatly contributed to attaining the LEED MR2 credits for greater than 75% waste diversion. As seen in the demolition layout plan in appendix C, the parking lot west of the existing structure was used for the trailers, and abatement/ recycling dumpsters. Once the demolition phase was completed, the excavation and foundations phase began.

Reference Appendix C for the detailed layout plan

EXCAVATION LAYOUT PLAN

To accommodate for the two stories of semi-below grade garage, the site required a fair amount of excavation. As noted in the geotechnical report, the soils were classified as clayey sand with varying amounts of gravel, silt, asphalt, and organics. These were favorable conditions with ground water table below the depth of excavation. The geotechnical report suggested an earth retention system in the Northeast corner of the site. As seen in Figure 11, the excavation was trenched back towards Georgia Avenue eliminating the need for the an extensive earth retention system. Entrance to the site is available by means of the southern gate with the soil stockpile in the Southwest corner of the site.

Reference Appendix C for the detailed layout plan

Figure 11. Image Courtesy of Clark Builders Group

STRUCTURAL CONCRETE LAYOUT PLAN

Figure 12. Image Courtesy of Clark Builders Group

As the excavation wrapped up, the tower crane pad can be placed and crane erected. In order to erect the crane, a designated area of the mall parking lot will be used, as seen in the layout plan in Appendix C. This requires great coordination with the mall security and parking authorities to limit disruption of the flow of mall traffic. The concrete phase will begin to utilize both entrances along Georgia Avenue. Site access is restricted by the steep grade change from east to west and the single adjacent road. In addition to laydown areas along Georgia Avenue, there is also space on the north of the site in the mall parking lot. As shown in Figure 12, the sequence of work flows outward from the tower crane in a counterclockwise manner from the southeast corner. This allows the east foundation walls to be placed early, waterproofed and backfilled.

Reference Appendix C for the detailed layout plan

STRUCTURAL WOOD FRAMING LAYOUT PLAN

Figure 13. Image Courtesy of CBG

Figure 13 faces the west, again showing the flow of work out of the southwest corner. During the structural wood framing phase of the project, the east side of the building started to get more congested as there was constant material deliveries and dumpster pulls. Workers began to establish the east elevation building entrance as the construction entrance. This is where the porta-johns were located, and all foot traffic went through the busiest area of the site. Some consideration could have been made for placement of the porta johns and construction entrance on the north side eliminating the safety risk with constant equipment movement and material deliveries on the east side.

Reference Appendix C for the detailed layout plan

PHASED OCCUPANCY

The phased occupancy plan includes an initial turnover of the site, ground floor, courtyard, and 2nd floor amenity areas on November 27th, 2013. CBG will then be tasked with completing the remaining floors (3 through 6). Prior to the 1st turnover, the building was loaded with material on the east elevation via forklifts. During the phased occupancy the construction team will need to utilize elevator B, located in the southwest corner of the building. The project team moved the job office into two units on the first floor where they will remain until full building turnover. The schedule is being pushed to finish as much of the remaining floors as possible to create the least disruption to the occupants.

Reference Appendix C for the detailed layout plan

CONSTRUCTABILITY CHALLENGES

BALCONY RETURN WALL ASSEMBLY

One of the major construction challenges included meeting the fire rating of the wall assembly at certain sections of the building. Figure 14 (right) depicts the wall assembly, which consists of 2 layers of gypsum wall board continuously along the exterior of the building, while all interior partitions and demising walls are enclosed with one layer.

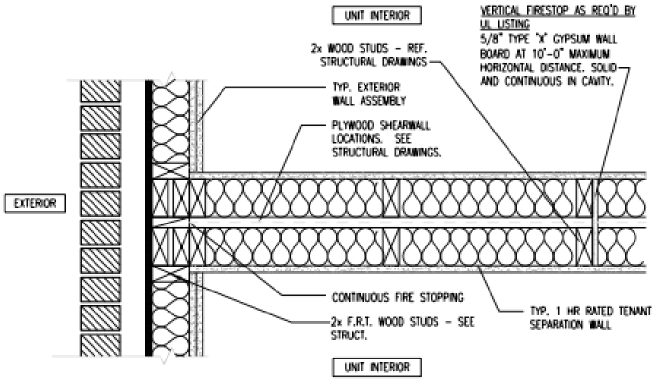


Figure 14. Wall Assemblies

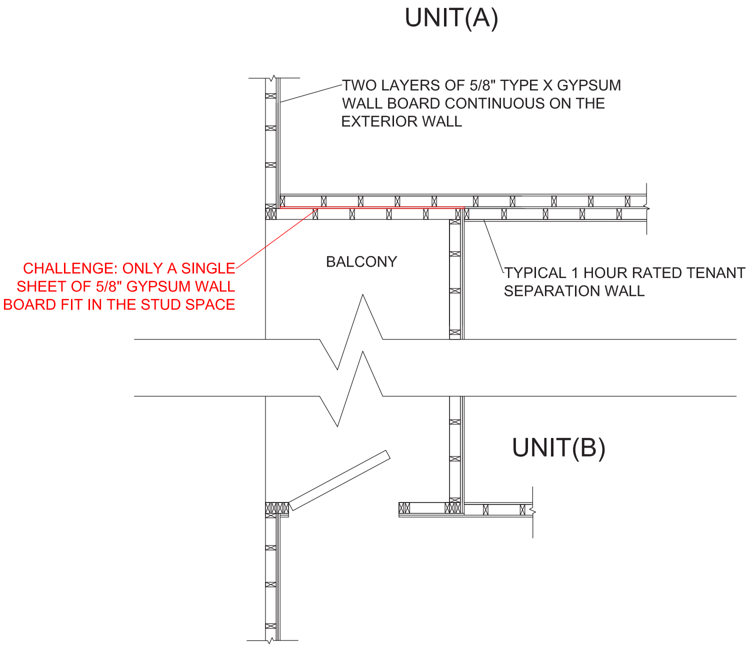


Figure 15. Image Courtesy of KAM

As seen in the plan view sketch of the issue in Figure 15, the area highlighted in red was one of the major problem areas. The area that creates the problem is where a demising wall meets the balcony return of the adjacent unit. By the specified wall type, the balcony return is part of the exterior wall and is required to receive two layers of gypsum wall board where the framing only allows space for one. This issue occurred approximately a dozen times on floors two through six. As shown in the sketch, there are a significant number of other areas that required the wood framing to stop in order for the two layers of 5/8" drywall totaling 1 1/4" to pass. Unfortunately this issue slipped through the pre-construction coordination meetings and was not discovered until the drywall was being installed.

The photograph at the right, Figure 16, shows the solution to the constructability issue. The drywall contractor was required to install small pieces of drywall in the stud cavity and tape the joints. This only solved the accessibility issue. To meet the wall assembly requirements, a fire engineer was required to analyze and sign off on the assembly. This issue created significant labor time and consultant fees to resolve. This was an issue that easily could have been solved in a coordination meeting with the designer and CM, had they existed. Although the contract language rids the architect of construction means and methods liability, they could have (along with their third party inspector) suggested a solution for this apparent issue. The framing contractor could have left out a few studs in order to slip the drywall through. These types of issues require creative solutions from collaborative teams.

Figure 16. Image by KAM

TIGHT SITE WITH MINIMAL ACCESS

Figure 17. Image Courtesy of CBG

One of the reoccurring constructability issues on the Solaire Wheaton project was the extremely tight jobsite with limited access. As noted in the site layout plans, the site can only be accessed by Georgia Avenue, which runs along the east side of the building. This can be seen at the left side of Figure 17. This is the location for material laydown, jobsite toilets, material deliveries, building entrances, and current facade work. This poses a significant safety risk, especially with the ongoing stone and brick work on the scaffolding. The site drops off significantly from east to west with narrow access around the entire building. The other elevations are only accessible by track equipment and basket lifts, which are still subject to getting stuck in the mud. This was a major issue during construction in terms of movement of material to the work stations, and equipment access. For this reason the team needed to install a temporary road, which was not included in the general conditions for the project.

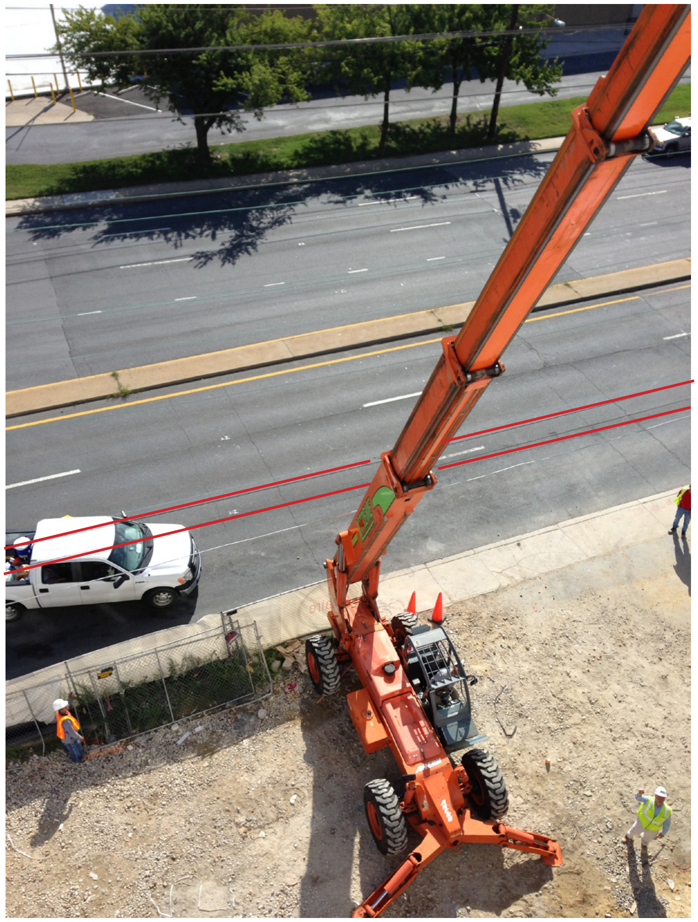


Figure 18. Image Courtesy of KAM

These types of constructability concerns pose great safety risks. For example, in Figure 18 the forklift is in the process of lifting material to the 6th floor. At this point the elevators were not in service yet and the 6th floor needed to be loaded to keep the interior finishes on schedule while not affecting the critical path. The forklift happens to be only a few feet away from the overhead electrical lines, which are highlighted in red in Figure 18. The boom of the forklift is approximately 3 feet away from the lines. These types of safety issues are items that need to be discussed prior to construction. There should be contingency plans formed to deal with situations like this. One solution to deal with the site constraints could have been to use a material hoist. The project team could have also put the elevator installation on the critical path to be sure it was in service for material deliveries.

DRYWALL/GYPCRETE SEQUENCING

With the interior finishes on the critical path and the last stage of the project before turnover, there is a big push during this stage. One of the major battles in residential wood construction is between the drywall and the gypcrete regarding sequencing.

In industry there are two theories on how to sequence this stage. If the drywall is installed first, then there is potential for mold growth as the gypcrete cures. The hydration process causes water to evaporate and climb up the wall. For this reason gypcrete contractors recommend having air conditioning running in the spaces should the drywall already be installed. The other theory is to pour the gypcrete prior to installing the drywall. The issue with this is that gypcrete is typically 1 1/4” thick, so there needs to be a second bottom plate for the drywall to nail into. This is not an issue if this scope is included in the carpentry contract. The absence of drywall allows air to circulate better and helps the building to dry out more quickly. The drawback to this option is that the gypcrete floor is subject to damages during drywall installation.

On the Solaire Wheaton project, the gypcrete was scheduled to be poured after drywall, so the second bottom plate was not included and therefore not installed. Gypcrete started on the 6th floor after the drywall had been installed, and resulted in issues with mold growth as seen in figure 19. As this problem arose, the team decided to go ahead and gypcrete the remaining floors prior to drywall installation due to delays with the drywall contractor. This eliminated the mold issue, however, it added significant material and labor cost of adding bottom plate nailers between the studs.

Both theories for drywall & gypcrete sequencing have their pros and cons. The key to eliminating this constructability challenge is to make a plan, which aligns to the overall project plan and stick to it. This is an issue that needs to be communicated in meetings with specialty contractors early on and preferably before construction begins.

Figure 19. Image Courtesy of KAM

LEADING INDUSTRY PRACTICE - BUILDING INFORMATION MODELING

ACTUAL BUILDING INFORMATION MODELING USES

As seen in the schedule summary (Table 1) on page 1, the planning and design phase for the project started in 2010. At this point, BIM was not a mainstream practiced process in residential construction market. For these reasons, the use of building information modeling on the Solaire Wheaton project was only observed to be used during design. The design team claims to use 3D visualization to produce renderings to enable the clients to visualize their projects, share them with their equity partners, and seek approvals from design review boards. They also advertise the multidisciplinary factor in their design which include: landscape architects, structural engineers, interior designers, and MEP engineers.

Below, in Table 6, are the observed actual BIM uses based on personal jobsite experience and design team research. As you can see, building information modeling was solely used in the design stage to author and review design and create 3D visualization renderings for the owner and marketing teams. Although the architect advertises collaborative design process and coordination, it was apparent that these were not implemented in any extensive means of BIM use on this project.

Table 6. Courtesy of PSU BIM PEP

X	PLAN	X	DESIGN	X	CONSTRUCT	X	OPERATE
	PROGRAMMING	X	DESIGN AUTHORING		SITE UTILIZATION PLANNING		BUILDING MAINTENANCE SCHEDULING
	SITE ANALYSIS	X	DESIGN REVIEWS		CONSTRUCTION SYSTEM DESIGN		BUILDING SYSTEM ANALYSIS
			3D COORDINATION		3D COORDINATION		ASSET MANAGEMENT
			STRUCTURAL ANALYSIS		DIGITAL FABRICATION		SPACE MANAGEMENT / TRACKING
			LIGHTING ANALYSIS		3D CONTROL AND PLANNING		DISASTER PLANNING
			ENERGY ANALYSIS		RECORD MODELING		RECORD MODELING
			MECHANICAL ANALYSIS				
			OTHER ENG. ANALYSIS				
			SUSTAINABLITY (LEED) EVALUATION				
			CODE VALIDATION				
	PHASE PLANNING (4D MODELING)		PHASE PLANNING (4D MODELING)		PHASE PLANNING (4D MODELING)		PHASE PLANNING (4D MODELING)
	COST ESTIMATION		COST ESTIMATION		COST ESTIMATION		COST ESTIMATION
	EXISTING CONDITIONS MODELING		EXISTING CONDITIONS MODELING		EXISTING CONDITIONS MODELING		EXISTING CONDITIONS MODELING

SUGGESTED BUILDING INFORMATION MODELING USES

The suggested BIM uses can be seen below in Table 7. These pertain solely to the design and construction phases of the project. BIM use for the operation and maintenance phase of the project, although advantageous, is not suggested. The owner is assumed to not be aware of the abilities and advantages of BIM facility management techniques and therefore will not make the investment.

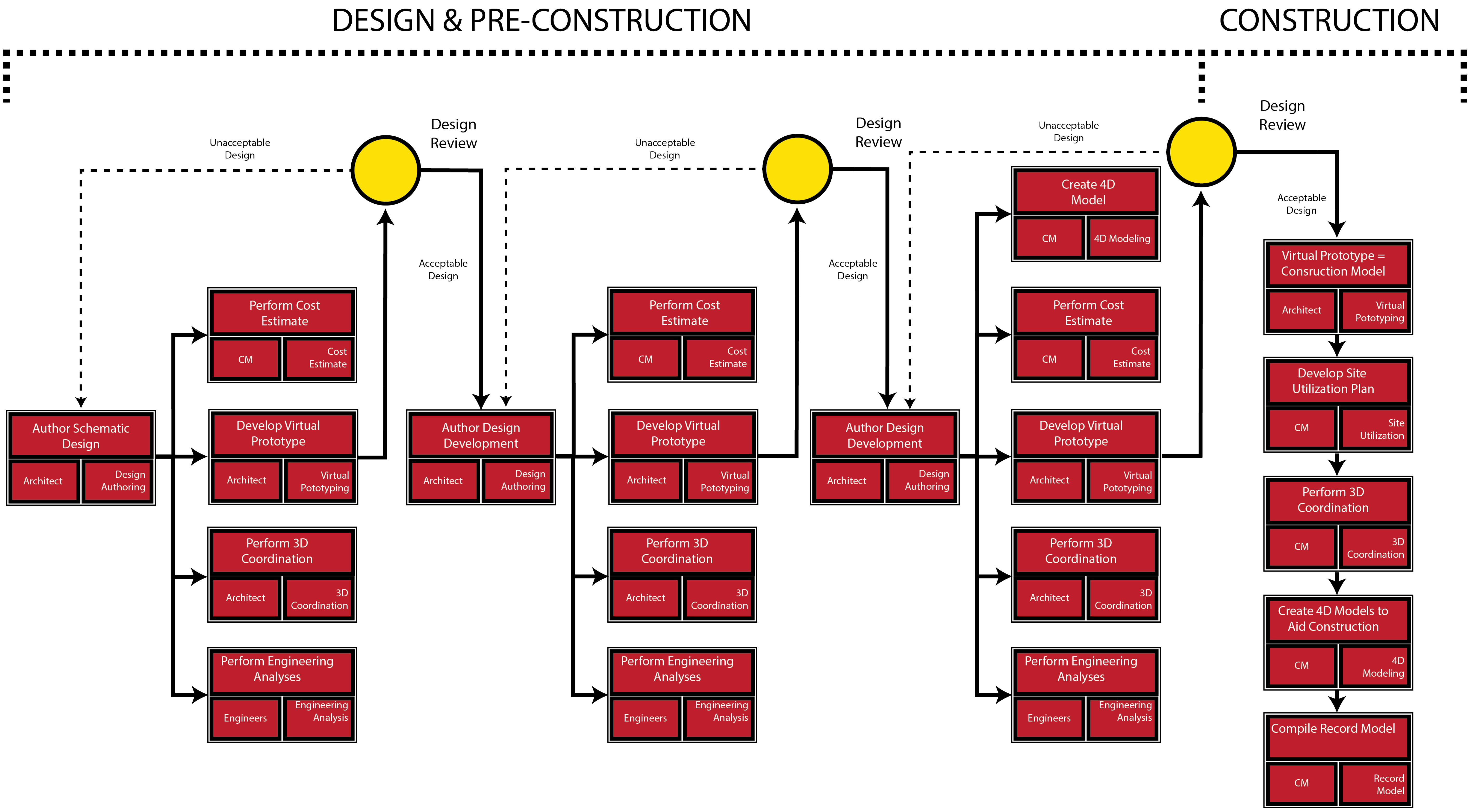
The use of building information modeling during the design stage could have been expanded immensely. The design utilizes a combination of many different materials and equipment within the different systems. One example is the integration of the wood and concrete systems. More accurate and in depth engineering analysis could have been performed with the different software available during the collaborative BIM process. With the construction manager, Clark Builders Group, being brought on early in pre-construction, the models could have been used to provide quick and accurate cost estimates. One of the major issues during construction was coordination between the MEP systems. There were instances where rework had to be done to avoid lower ceiling heights. 3D Coordination not only should have been done during construction but also during design.

During the construction phase, BIM could have been used to more accurately assemble a site utilization plan and to analyze work sequences with 4D modeling. As noted in the site layout section, the east side of the site was constantly congested. The schedule also jumps around in a non-continuous work flow, particularly in the building enclosure stage. These tools could have aided in avoiding safety risks and coordinating sitework activities and flow of work. Lastly record modeling could have been used on the project. An incomplete design at the start of construction and aggressive schedule result in inaccurate and incomplete record drawings. The BIM record model could have been made a requirement by the owner and aided in obtaining an accurate representation of the actual constructed building. The level one process map of the suggested BIM uses can be seen on the following page.

Table 7. Courtesy of PSU BIM PEP

X	PLAN	X	DESIGN	X	CONSTRUCT	X	OPERATE
	PROGRAMMING	X	DESIGN AUTHORING	X	SITE UTILIZATION PLANNING		BUILDING MAINTENANCE SCHEDULING
	SITE ANALYSIS	X	DESIGN REVIEWS		CONSTRUCTION SYSTEM DESIGN		BUILDING SYSTEM ANALYSIS
		X	3D COORDINATION	X	3D COORDINATION		ASSET MANAGEMENT
		X	STRUCTURAL ANALYSIS		DIGITAL FABRICATION		SPACE MANAGEMENT / TRACKING
		X	LIGHTING ANALYSIS		3D CONTROL AND PLANNING		DISASTER PLANNING
		X	ENERGY ANALYSIS	X	RECORD MODELING		RECORD MODELING
		X	MECHANICAL ANALYSIS				
		X	OTHER ENG. ANALYSIS				
		X	SUSTAINABLITY (LEED) EVALUATION				
			CODE VALIDATION				
	PHASE PLANNING (4D MODELING)		PHASE PLANNING (4D MODELING)	X	PHASE PLANNING (4D MODELING)		PHASE PLANNING (4D MODELING)
	COST ESTIMATION	X	COST ESTIMATION		COST ESTIMATION		COST ESTIMATION
	EXISTING CONDITIONS MODELING		EXISTING CONDITIONS MODELING		EXISTING CONDITIONS MODELING		EXISTING CONDITIONS MODELING

BIM LEVEL 1 PROCESS MAP



APPENDIX A. DETAILED PROJECT SCHEDULE

10914 Georgia Avenue

Classic Schedule Layout

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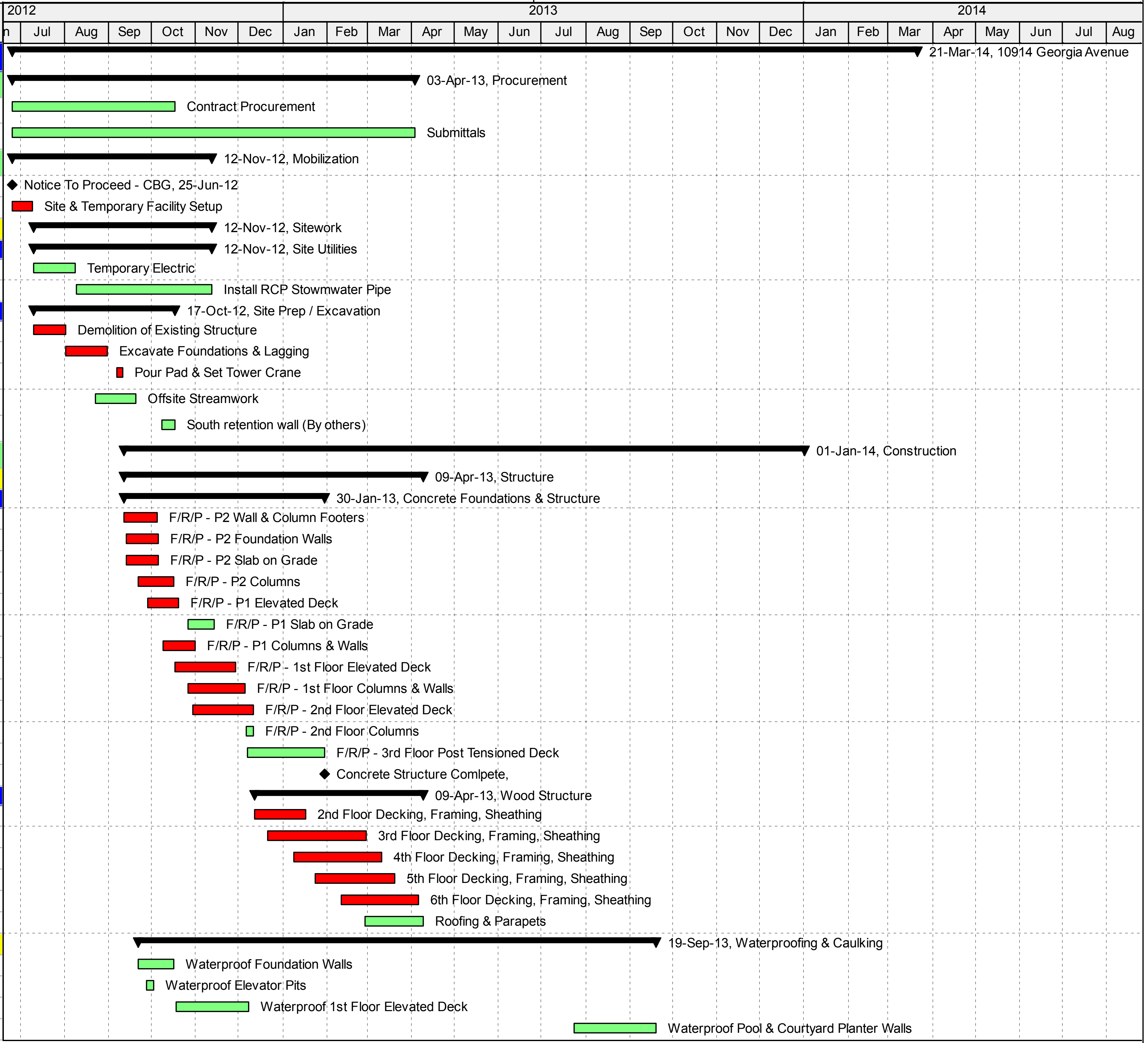
Activity ID	Activity Name	Original Duration	Start	Finish
10914 Georgia Avenue		445	25-Jun-12	21-Mar-14
Procurement		198	25-Jun-12	03-Apr-13
A1081	Contract Procurement	81	25-Jun-12	17-Oct-12
A3180	Submittals	198	25-Jun-12	03-Apr-13
Mobilization		99	25-Jun-12	12-Nov-12
A1080	Notice To Proceed - CBG	0	25-Jun-12	
A1090	Site & Temporary Facility Setup	10	25-Jun-12	09-Jul-12
Sitework		89	10-Jul-12	12-Nov-12
Site Utilities		89	10-Jul-12	12-Nov-12
A1110	Temporary Electric	22	10-Jul-12	08-Aug-12
A1260	Install RCP Stowmwater Pipe	67	09-Aug-12	12-Nov-12
Site Prep / Excavation		71	10-Jul-12	17-Oct-12
A1250	Demolition of Existing Structure	17	10-Jul-12	01-Aug-12
A1430	Excavate Foundations & Lagging	21	02-Aug-12	30-Aug-12
A1435	Pour Pad & Set Tower Crane	3	06-Sep-12	10-Sep-12
A1440	Offsite Streamwork	20	22-Aug-12	19-Sep-12
A1450	South retention wall (By others)	8	08-Oct-12	17-Oct-12
Construction		334	11-Sep-12	01-Jan-14
Structure		148	11-Sep-12	09-Apr-13
Concrete Foundations & Structure		99	11-Sep-12	30-Jan-13
A1130	F/R/P - P2 Wall & Column Footers	18	11-Sep-12	04-Oct-12
A1280	F/R/P - P2 Foundation Walls	17	13-Sep-12	05-Oct-12
A1500	F/R/P - P2 Slab on Grade	17	13-Sep-12	05-Oct-12
A1510	F/R/P - P2 Columns	18	21-Sep-12*	16-Oct-12
A1520	F/R/P - P1 Elevated Deck	16	28-Sep-12	19-Oct-12
A1530	F/R/P - P1 Slab on Grade	13	26-Oct-12	13-Nov-12
A1540	F/R/P - P1 Columns & Walls	17	09-Oct-12	31-Oct-12
A1550	F/R/P - 1st Floor Elevated Deck	30	17-Oct-12	28-Nov-12
A2110	F/R/P - 1st Floor Columns & Walls	28	26-Oct-12	05-Dec-12
A2120	F/R/P - 2nd Floor Elevated Deck	30	30-Oct-12	11-Dec-12
A2130	F/R/P - 2nd Floor Columns	4	06-Dec-12	11-Dec-12
A2140	F/R/P - 3rd Floor Post Tensioned Deck	37	07-Dec-12	30-Jan-13
A3210	Concrete Structure Comlpete	0		30-Jan-13
Wood Structure		83	12-Dec-12	09-Apr-13
A1150	2nd Floor Decking, Framing, Sheathing	24	12-Dec-12	16-Jan-13
A1300	3rd Floor Decking, Framing, Sheathing	48	21-Dec-12	28-Feb-13
A2070	4th Floor Decking, Framing, Sheathing	45	08-Jan-13	11-Mar-13
A2080	5th Floor Decking, Framing, Sheathing	41	23-Jan-13	20-Mar-13
A2090	6th Floor Decking, Framing, Sheathing	40	11-Feb-13	05-Apr-13
A2100	Roofing & Parapets	30	27-Feb-13	09-Apr-13
Waterproofing & Caulking		254	21-Sep-12	19-Sep-13
A1490	Waterproof Foundation Walls	18	21-Sep-12	16-Oct-12
A2150	Waterproof Elevator Pits	4	27-Sep-12	02-Oct-12
A2160	Waterproof 1st Floor Elevated Deck	36	18-Oct-12	07-Dec-12
A2170	Waterproof Pool & Courtyard Planter Walls	41	24-Jul-13	19-Sep-13



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

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10914 Georgia Avenue

Classic Schedule Layout

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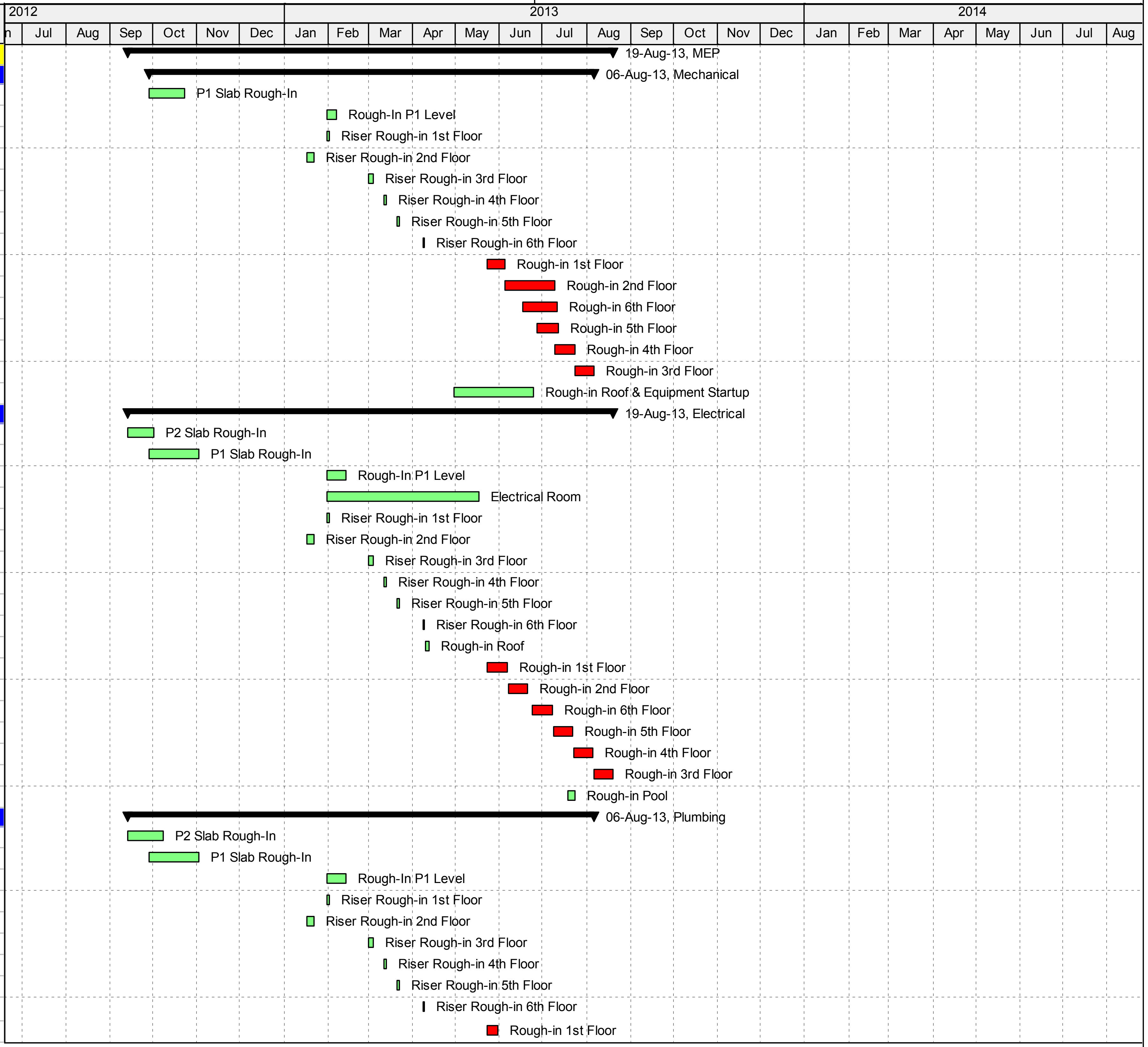
Activity ID	Activity Name	Original Duration	Start	Finish
MEP		238	13-Sep-12	19-Aug-13
Mechanical		218	28-Sep-12	06-Aug-13
A1160	P1 Slab Rough-In	18	28-Sep-12	23-Oct-12
A1320	Rough-In P1 Level	5	31-Jan-13	06-Feb-13
A1650	Riser Rough-in 1st Floor	2	31-Jan-13	01-Feb-13
A1660	Riser Rough-in 2nd Floor	3	17-Jan-13	21-Jan-13
A1670	Riser Rough-in 3rd Floor	2	01-Mar-13	04-Mar-13
A1680	Riser Rough-in 4th Floor	2	12-Mar-13	13-Mar-13
A1690	Riser Rough-in 5th Floor	2	21-Mar-13	22-Mar-13
A1700	Riser Rough-in 6th Floor	2	08-Apr-13	09-Apr-13
A1780	Rough-in 1st Floor	8	23-May-13	04-Jun-13
A1790	Rough-in 2nd Floor	24	05-Jun-13	09-Jul-13
A1800	Rough-in 6th Floor	18	17-Jun-13	11-Jul-13
A1810	Rough-in 5th Floor	11	27-Jun-13	12-Jul-13
A1820	Rough-in 4th Floor	10	10-Jul-13	23-Jul-13
A1830	Rough-in 3rd Floor	10	24-Jul-13	06-Aug-13
A1840	Rough-in Roof & Equipment Startup	39	30-Apr-13	24-Jun-13
Electrical		238	13-Sep-12	19-Aug-13
A1180	P2 Slab Rough-In	13	13-Sep-12	01-Oct-12
A1340	P1 Slab Rough-In	26	28-Sep-12	02-Nov-12
A1560	Rough-In P1 Level	10	31-Jan-13	13-Feb-13
A1580	Electrical Room	77	31-Jan-13	17-May-13
A1590	Riser Rough-in 1st Floor	2	31-Jan-13	01-Feb-13
A1600	Riser Rough-in 2nd Floor	3	17-Jan-13	21-Jan-13
A1610	Riser Rough-in 3rd Floor	2	01-Mar-13	04-Mar-13
A1620	Riser Rough-in 4th Floor	2	12-Mar-13	13-Mar-13
A1630	Riser Rough-in 5th Floor	2	21-Mar-13	22-Mar-13
A1640	Riser Rough-in 6th Floor	2	08-Apr-13	09-Apr-13
A1900	Rough-in Roof	3	10-Apr-13	12-Apr-13
A1910	Rough-in 1st Floor	10	23-May-13	06-Jun-13
A1920	Rough-in 2nd Floor	10	07-Jun-13	20-Jun-13
A1930	Rough-in 6th Floor	10	24-Jun-13	08-Jul-13
A1940	Rough-in 5th Floor	10	09-Jul-13	22-Jul-13
A1950	Rough-in 4th Floor	10	23-Jul-13	05-Aug-13
A1960	Rough-in 3rd Floor	10	06-Aug-13	19-Aug-13
A2190	Rough-in Pool	3	19-Jul-13*	23-Jul-13
Plumbing		229	13-Sep-12	06-Aug-13
A1170	P2 Slab Rough-In	18	13-Sep-12	08-Oct-12
A1330	P1 Slab Rough-In	26	28-Sep-12	02-Nov-12
A1570	Rough-In P1 Level	10	31-Jan-13	13-Feb-13
A1710	Riser Rough-in 1st Floor	2	31-Jan-13	01-Feb-13
A1720	Riser Rough-in 2nd Floor	3	17-Jan-13	21-Jan-13
A1730	Riser Rough-in 3rd Floor	2	01-Mar-13	04-Mar-13
A1740	Riser Rough-in 4th Floor	2	12-Mar-13	13-Mar-13
A1750	Riser Rough-in 5th Floor	2	21-Mar-13	22-Mar-13
A1760	Riser Rough-in 6th Floor	2	08-Apr-13	09-Apr-13
A1770	Rough-in 1st Floor	5	23-May-13	30-May-13



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

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Classic Schedule Layout

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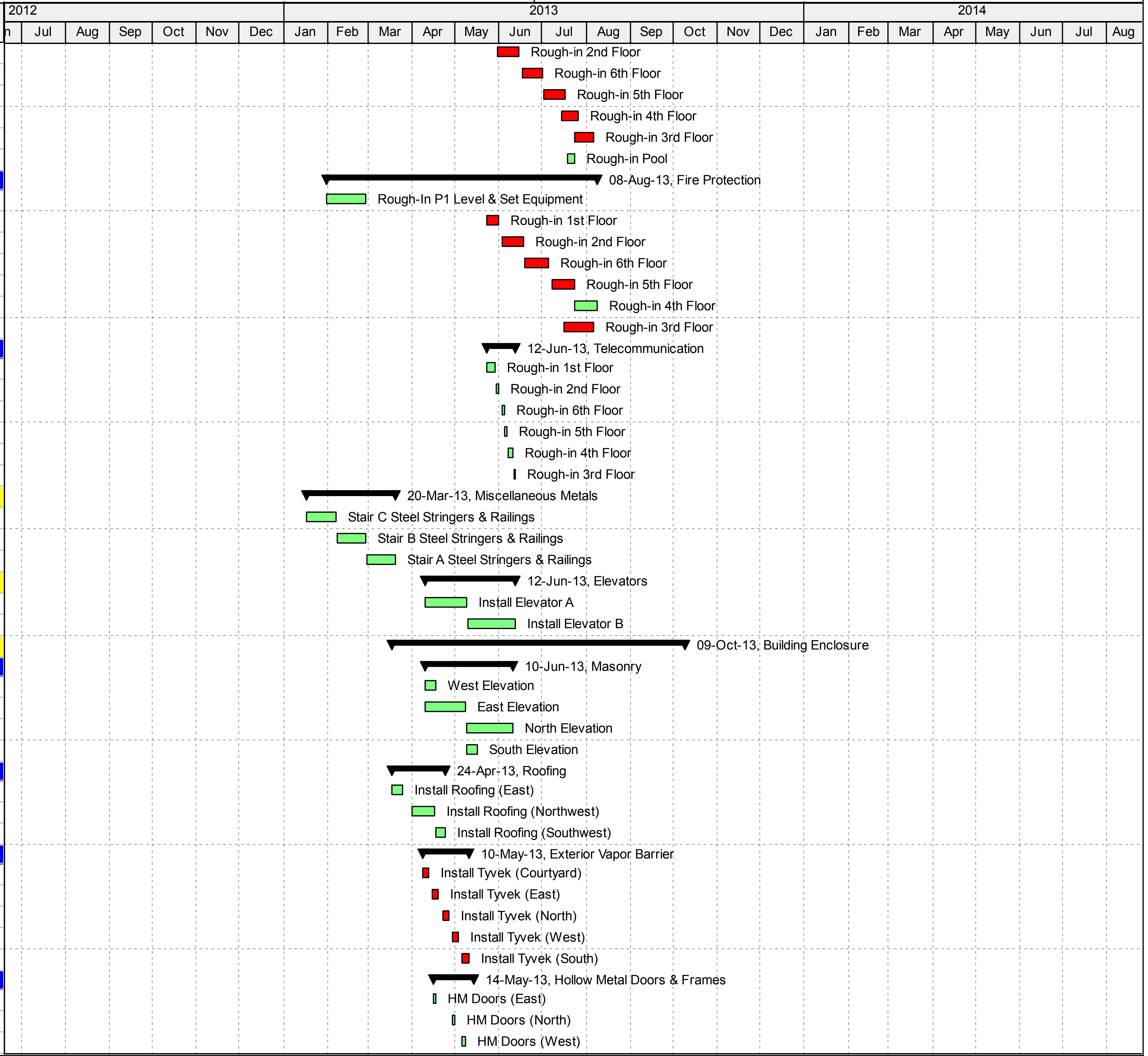
Activity ID	Activity Name	Original Duration	Start	Finish
A1850	Rough-in 2nd Floor	11	31-May-13	14-Jun-13
A1860	Rough-in 6th Floor	11	17-Jun-13	01-Jul-13
A1870	Rough-in 5th Floor	11	02-Jul-13	17-Jul-13
A1880	Rough-in 4th Floor	10	15-Jul-13	26-Jul-13
A1890	Rough-in 3rd Floor	10	24-Jul-13	06-Aug-13
A2180	Rough-in Pool	3	19-Jul-13*	23-Jul-13
Fire Protection		134	31-Jan-13	08-Aug-13
A1200	Rough-In P1 Level & Set Equipment	20	31-Jan-13	27-Feb-13
A1360	Rough-in 1st Floor	6	23-May-13	31-May-13
A1970	Rough-in 2nd Floor	12	03-Jun-13	18-Jun-13
A1980	Rough-in 6th Floor	12	19-Jun-13	05-Jul-13
A1990	Rough-in 5th Floor	12	08-Jul-13	23-Jul-13
A2000	Rough-in 4th Floor	12	24-Jul-13	08-Aug-13
A2010	Rough-in 3rd Floor	16	16-Jul-13	06-Aug-13
Telecommunication		14	23-May-13	12-Jun-13
A1210	Rough-in 1st Floor	4	23-May-13	29-May-13
A1370	Rough-in 2nd Floor	2	30-May-13	31-May-13
A2020	Rough-in 6th Floor	2	03-Jun-13	04-Jun-13
A2030	Rough-in 5th Floor	2	05-Jun-13	06-Jun-13
A2040	Rough-in 4th Floor	2	07-Jun-13	10-Jun-13
A2050	Rough-in 3rd Floor	2	11-Jun-13	12-Jun-13
Miscellaneous Metals		45	17-Jan-13	20-Mar-13
A1190	Stair C Steel Stringers & Railings	15	17-Jan-13	06-Feb-13
A1350	Stair B Steel Stringers & Railings	15	07-Feb-13	27-Feb-13
A2060	Stair A Steel Stringers & Railings	15	28-Feb-13	20-Mar-13
Elevators		45	10-Apr-13	12-Jun-13
A1230	Install Elevator A	22	10-Apr-13	09-May-13
A1390	Install Elevator B	23	10-May-13	12-Jun-13
Building Enclosure		145	18-Mar-13	09-Oct-13
Masonry		43	10-Apr-13	10-Jun-13
A2620	West Elevation	6	10-Apr-13	17-Apr-13
A2680	East Elevation	21	10-Apr-13	08-May-13
A2690	North Elevation	22	09-May-13	10-Jun-13
A2700	South Elevation	6	09-May-13	16-May-13
Roofing		28	18-Mar-13	24-Apr-13
A2630	Install Roofing (East)	6	18-Mar-13	25-Mar-13
A2710	Install Roofing (Northwest)	12	01-Apr-13	16-Apr-13
A2720	Install Roofing (Southwest)	6	17-Apr-13	24-Apr-13
Exterior Vapor Barrier		25	08-Apr-13	10-May-13
A2730	Install Tyvek (Courtyard)	5	08-Apr-13	12-Apr-13
A2740	Install Tyvek (East)	5	15-Apr-13	19-Apr-13
A2750	Install Tyvek (North)	5	22-Apr-13	26-Apr-13
A2760	Install Tyvek (West)	5	29-Apr-13	03-May-13
A2770	Install Tyvek (South)	5	06-May-13	10-May-13
Hollow Metal Doors & Frames		21	16-Apr-13	14-May-13
A2640	HM Doors (East)	2	16-Apr-13	17-Apr-13
A2780	HM Doors (North)	2	29-Apr-13	30-Apr-13
A2790	HM Doors (West)	3	06-May-13	08-May-13



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

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Classic Schedule Layout

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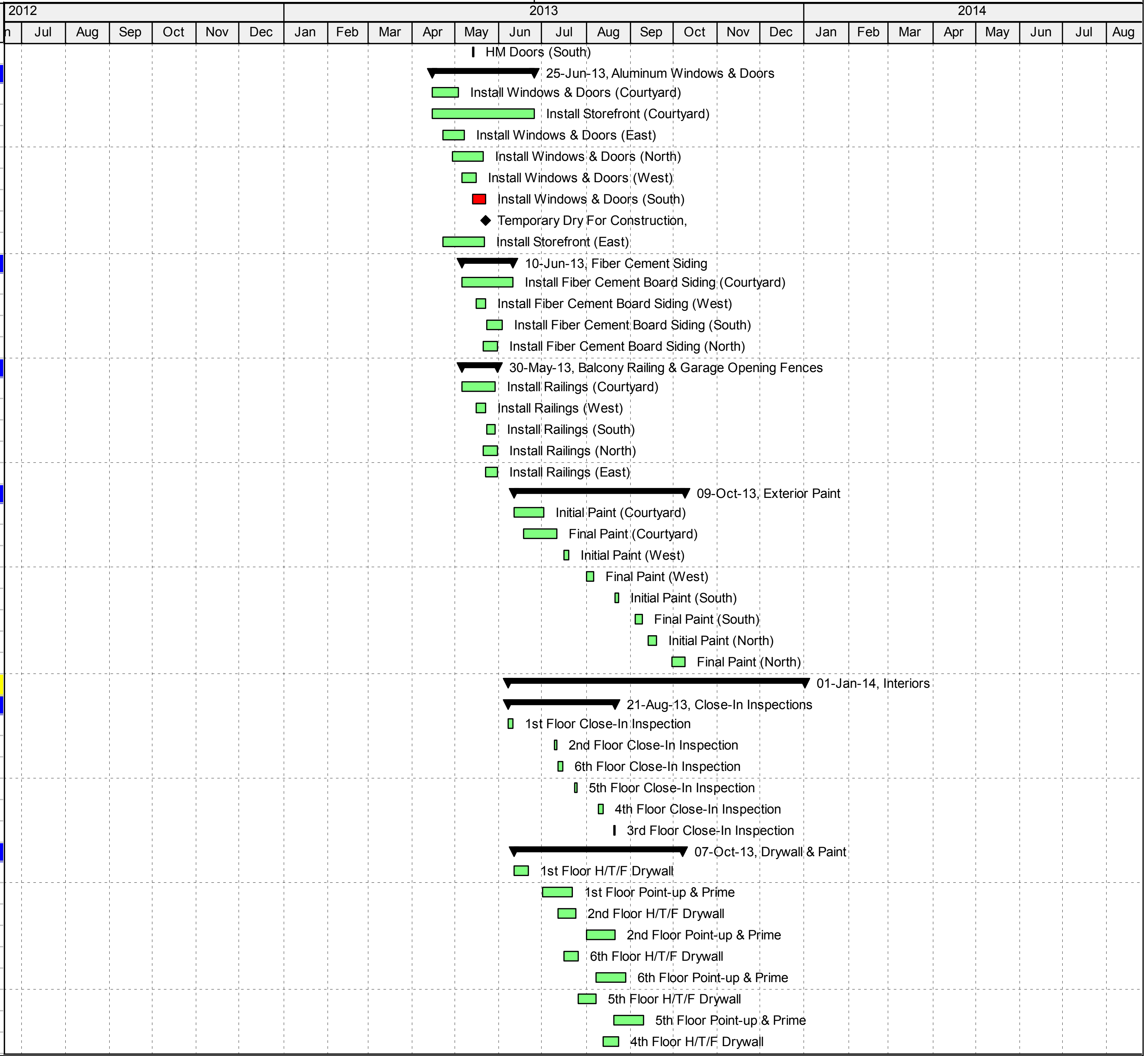
Activity ID	Activity Name	Original Duration	Start	Finish
A2800	HM Doors (South)	2	13-May-13	14-May-13
Aluminum Windows & Doors		51	15-Apr-13	25-Jun-13
A2670	Install Windows & Doors (Courtyard)	15	15-Apr-13	03-May-13
A2671	Install Storefront (Courtyard)	51	15-Apr-13	25-Jun-13
A2673	Install Windows & Doors (East)	12	22-Apr-13	07-May-13
A2900	Install Windows & Doors (North)	16	29-Apr-13	20-May-13
A2910	Install Windows & Doors (West)	8	06-May-13	15-May-13
A2920	Install Windows & Doors (South)	8	13-May-13	22-May-13
A2921	Temporary Dry For Construction	0		22-May-13
A2940	Install Storefront (East)	22	22-Apr-13	21-May-13
Fiber Cement Siding		25	06-May-13	10-Jun-13
A2650	Install Fiber Cement Board Siding (Courtyard)	25	06-May-13	10-Jun-13
A2810	Install Fiber Cement Board Siding (West)	5	16-May-13	22-May-13
A2830	Install Fiber Cement Board Siding (South)	7	23-May-13	03-Jun-13
A2840	Install Fiber Cement Board Siding (North)	7	21-May-13	30-May-13
Balcony Railing & Garage Opening Fences		18	06-May-13	30-May-13
A2660	Install Railings (Courtyard)	17	06-May-13	29-May-13
A2850	Install Railings (West)	5	16-May-13	22-May-13
A2860	Install Railings (South)	4	23-May-13	29-May-13
A2870	Install Railings (North)	7	21-May-13	30-May-13
A2880	Install Railings (East)	6	22-May-13	30-May-13
Exterior Paint		85	11-Jun-13	09-Oct-13
A2950	Initial Paint (Courtyard)	16	11-Jun-13	02-Jul-13
A2960	Final Paint (Courtyard)	17	18-Jun-13	11-Jul-13
A2970	Initial Paint (West)	4	16-Jul-13	19-Jul-13
A2980	Final Paint (West)	4	01-Aug-13	06-Aug-13
A2990	Initial Paint (South)	3	21-Aug-13	23-Aug-13
A3000	Final Paint (South)	4	04-Sep-13	09-Sep-13
A3010	Initial Paint (North)	5	13-Sep-13	19-Sep-13
A3020	Final Paint (North)	8	30-Sep-13	09-Oct-13
Interiors		145	07-Jun-13	01-Jan-14
Close-In Inspections		53	07-Jun-13	21-Aug-13
A3220	1st Floor Close-In Inspection	2	07-Jun-13	10-Jun-13
A3230	2nd Floor Close-In Inspection	2	10-Jul-13	11-Jul-13
A3240	6th Floor Close-In Inspection	2	12-Jul-13	15-Jul-13
A3250	5th Floor Close-In Inspection	2	24-Jul-13	25-Jul-13
A3260	4th Floor Close-In Inspection	2	09-Aug-13	12-Aug-13
A3270	3rd Floor Close-In Inspection	2	20-Aug-13	21-Aug-13
Drywall & Paint		83	11-Jun-13	07-Oct-13
A2240	1st Floor H/T/F Drywall	9	11-Jun-13	21-Jun-13
A2241	1st Floor Point-up & Prime	15	01-Jul-13	22-Jul-13
A2250	2nd Floor H/T/F Drywall	9	12-Jul-13	24-Jul-13
A2251	2nd Floor Point-up & Prime	15	01-Aug-13	21-Aug-13
A2260	6th Floor H/T/F Drywall	9	16-Jul-13	26-Jul-13
A2261	6th Floor Point-up & Prime	15	08-Aug-13	28-Aug-13
A2270	5th Floor H/T/F Drywall	9	26-Jul-13	07-Aug-13
A2271	5th Floor Point-up & Prime	15	20-Aug-13	10-Sep-13
A2280	4th Floor H/T/F Drywall	9	13-Aug-13	23-Aug-13



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

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10914 Georgia Avenue

Classic Schedule Layout

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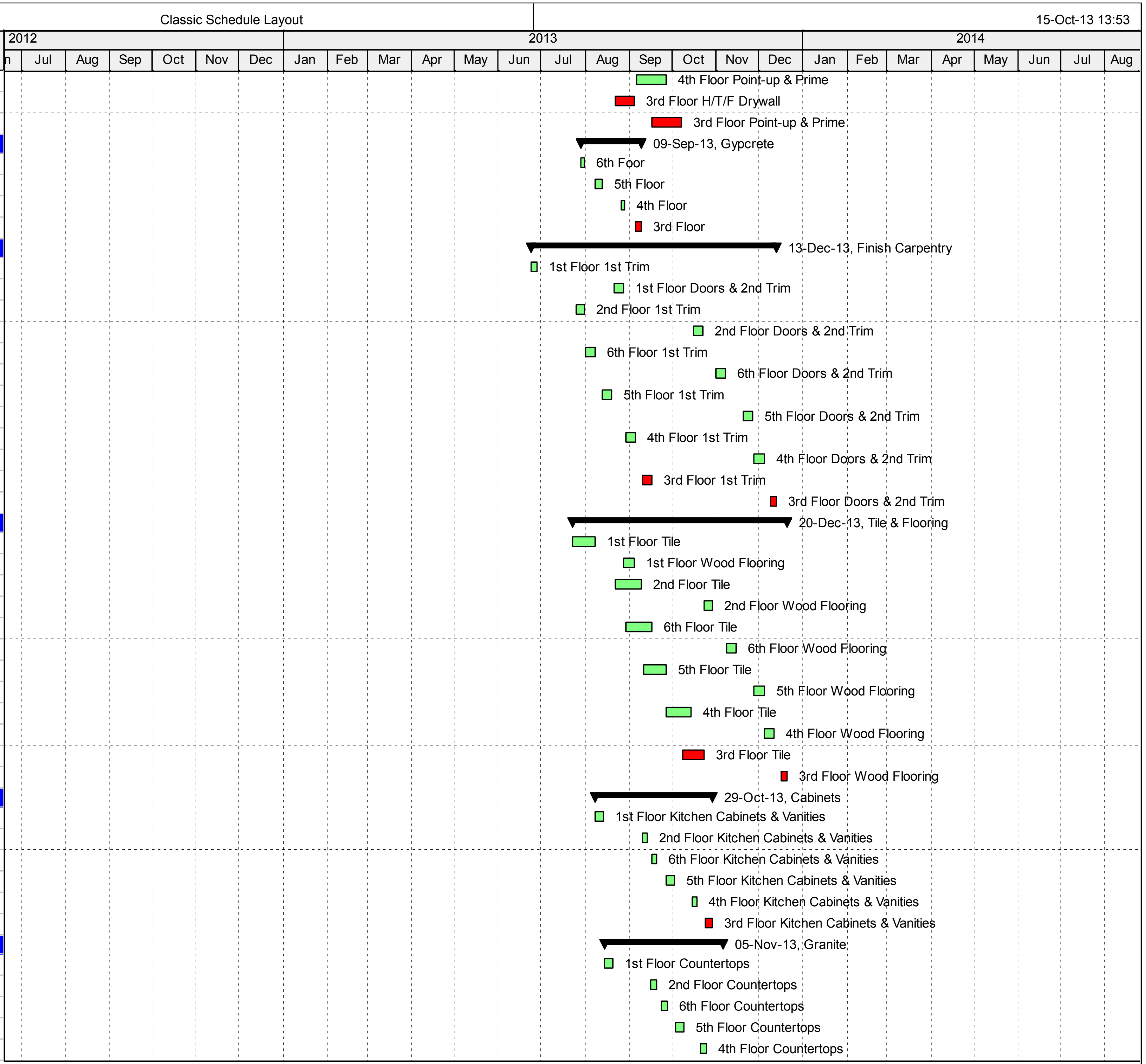
Activity ID	Activity Name	Original Duration	Start	Finish
A2281	4th Floor Point-up & Prime	15	06-Sep-13	26-Sep-13
A2290	3rd Floor H/T/F Drywall	9	22-Aug-13	04-Sep-13
A2291	3rd Floor Point-up & Prime	15	17-Sep-13	07-Oct-13
Gypcrete		**30**	**29-Jul-13**	**09-Sep-13**
A2200	6th Foor	3	29-Jul-13	31-Jul-13
A2210	5th Floor	3	08-Aug-13	12-Aug-13
A2220	4th Floor	3	26-Aug-13	28-Aug-13
A2230	3rd Floor	3	05-Sep-13	09-Sep-13
Finish Carpentry		**122**	**24-Jun-13**	**13-Dec-13**
A2440	1st Floor 1st Trim	5	24-Jun-13	28-Jun-13
A2450	1st Floor Doors & 2nd Trim	5	21-Aug-13	27-Aug-13
A2460	2nd Floor 1st Trim	5	25-Jul-13	31-Jul-13
A2470	2nd Floor Doors & 2nd Trim	5	16-Oct-13*	22-Oct-13
A2480	6th Floor 1st Trim	5	01-Aug-13	07-Aug-13
A2490	6th Floor Doors & 2nd Trim	5	01-Nov-13*	07-Nov-13
A3050	5th Floor 1st Trim	5	13-Aug-13	19-Aug-13
A3060	5th Floor Doors & 2nd Trim	5	20-Nov-13*	26-Nov-13
A3070	4th Floor 1st Trim	5	29-Aug-13	05-Sep-13
A3080	4th Floor Doors & 2nd Trim	5	27-Nov-13*	04-Dec-13
A3090	3rd Floor 1st Trim	5	10-Sep-13	16-Sep-13
A3100	3rd Floor Doors & 2nd Trim	5	09-Dec-13*	13-Dec-13
Tile & Flooring		**107**	**23-Jul-13**	**20-Dec-13**
A2500	1st Floor Tile	12	23-Jul-13	07-Aug-13
A2510	1st Floor Wood Flooring	5	28-Aug-13	04-Sep-13
A2520	2nd Floor Tile	12	22-Aug-13	09-Sep-13
A2530	2nd Floor Wood Flooring	5	23-Oct-13*	29-Oct-13
A2540	6th Floor Tile	12	29-Aug-13	16-Sep-13
A2550	6th Floor Wood Flooring	5	08-Nov-13*	14-Nov-13
A3110	5th Floor Tile	12	11-Sep-13	26-Sep-13
A3120	5th Floor Wood Flooring	5	27-Nov-13*	04-Dec-13
A3130	4th Floor Tile	12	27-Sep-13	14-Oct-13
A3140	4th Floor Wood Flooring	5	05-Dec-13*	11-Dec-13
A3150	3rd Floor Tile	12	08-Oct-13*	23-Oct-13
A3160	3rd Floor Wood Flooring	5	16-Dec-13*	20-Dec-13
Cabinets		**58**	**08-Aug-13**	**29-Oct-13**
A2320	1st Floor Kitchen Cabinets & Vanities	4	08-Aug-13	13-Aug-13
A2330	2nd Floor Kitchen Cabinets & Vanities	4	10-Sep-13	13-Sep-13
A2340	6th Floor Kitchen Cabinets & Vanities	4	17-Sep-13	20-Sep-13
A2350	5th Floor Kitchen Cabinets & Vanities	4	27-Sep-13*	02-Oct-13
A2360	4th Floor Kitchen Cabinets & Vanities	4	15-Oct-13*	18-Oct-13
A2370	3rd Floor Kitchen Cabinets & Vanities	4	24-Oct-13*	29-Oct-13
Granite		**59**	**14-Aug-13**	**05-Nov-13**
A2380	1st Floor Countertops	5	14-Aug-13	20-Aug-13
A2390	2nd Floor Countertops	5	16-Sep-13	20-Sep-13
A2400	6th Floor Countertops	5	23-Sep-13*	27-Sep-13
A2410	5th Floor Countertops	5	03-Oct-13*	09-Oct-13
A2420	4th Floor Countertops	5	21-Oct-13*	25-Oct-13



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

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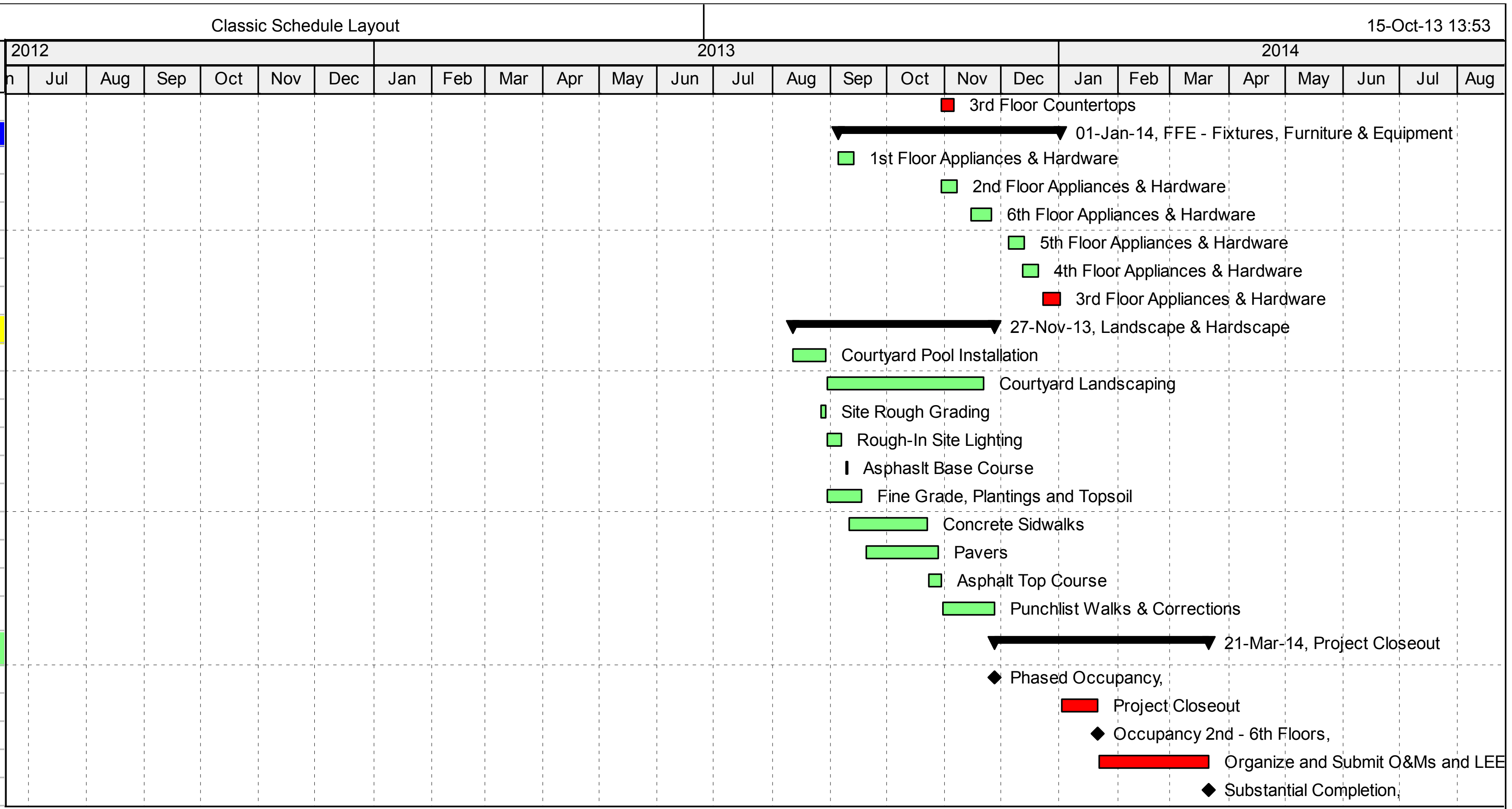
TASK filter: All Activities

10914 Georgia Avenue

Classic Schedule Layout

15-Oct-13 13:53

Activity ID	Activity Name	Original Duration	Start	Finish
A2430	3rd Floor Countertops	5	30-Oct-13*	05-Nov-13
FFE - Fixtures, Furniture & Equipment		83	05-Sep-13	01-Jan-14
A2560	1st Floor Appliances & Hardware	7	05-Sep-13	13-Sep-13
A2570	2nd Floor Appliances & Hardware	7	30-Oct-13*	07-Nov-13
A2580	6th Floor Appliances & Hardware	7	15-Nov-13*	25-Nov-13
A2590	5th Floor Appliances & Hardware	7	05-Dec-13*	13-Dec-13
A2600	4th Floor Appliances & Hardware	7	12-Dec-13*	20-Dec-13
A2610	3rd Floor Appliances & Hardware	7	23-Dec-13*	01-Jan-14
Landscape & Hardscape		77	12-Aug-13	27-Nov-13
A1116	Courtyard Pool Installation	14	12-Aug-13*	29-Aug-13
A1117	Courtyard Landscaping	59	30-Aug-13	21-Nov-13
A1118	Site Rough Grading	3	27-Aug-13*	29-Aug-13
A1119	Rough-In Site Lighting	5	30-Aug-13	06-Sep-13
A1120	Asphaslt Base Course	2	09-Sep-13	10-Sep-13
A1271	Fine Grade, Plantings and Topsoil	12	30-Aug-13	17-Sep-13
A1460	Concrete Sidwalks	30	11-Sep-13	22-Oct-13
A1470	Pavers	27	20-Sep-13*	28-Oct-13
A1471	Asphalt Top Course	6	23-Oct-13*	30-Oct-13
A1480	Punchlist Walks & Corrections	20	31-Oct-13*	27-Nov-13
Project Closeout		80	27-Nov-13	21-Mar-14
A1240	Phased Occupancy	0		27-Nov-13
A1241	Project Closeout	14	02-Jan-14*	21-Jan-14
A1242	Occupancy 2nd - 6th Floors	0		21-Jan-14
A1243	Organize and Submit O&Ms and LEED Documentat	43	22-Jan-14*	21-Mar-14
A3170	Substantial Completion	0		21-Mar-14



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

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TASK filter: All Activities

APPENDIX B. DETAILED STRUCTURAL & MEP ASSEMBLY ESTIMATES

DETAILED STRUCTURAL CONCRETE ESTIMATE

P2 - Slab on Grade Concrete Estimate (Module = 1860 SF)

Description	Unit	Qty.	Material	Material Total	Labor	Labor Total	Equipment	Equipment Total	Total
Footings									
F4.0 (4' x 4' x 12")	**Ea.**	**2**							
3500 psi Concrete	CY	0.59	$125.43	$74.00	$17.59	$10.38	$1.17	$0.69	$85.07
Rebar (5 #4 Bottom E.W.)	Lbs	35.5	$0.54	$19.17	$0.20	$7.10	$0.00	$0.00	$26.27
Total				**$186.35**					**$222.68**
F8.0 (8' x 8' x 26")	**Ea.**	**1**							
3500 psi Concrete	CY	5.13	$125.43	$643.46	$8.06	$41.35	$0.54	$2.77	**$687.57**
Rebar (6 #8 Bottom E.W.)	Tons	0.12	$1,089.00	$130.68	$241.83	$29.02	$0.00	$0.00	**$159.70**
F8.5 (8.5' x 8.5' x 27")	**Ea.**	**2**							
3500 psi Concrete	CY	6.02	$125.43	$755.09	$8.06	$48.52	$0.54	$3.25	$806.86
Rebar (7 #8 Bottom E.W.)	Tons	0.15	$1,089.00	$163.35	$241.83	$36.27	$0.00	$0.00	$199.62
Total				**$1,836.88**					**$2,012.97**
F9.0 (9' x 9' x 28")	**Ea.**	**1**							
3500 psi Concrete	CY	7	$125.43	$878.01	$8.06	$56.42	$0.54	$3.78	**$938.21**
Rebar (8 #8 Bottom E.W.)	Tons	0.18	$1,089.00	$196.02	$241.83	$43.53	$0.00	$0.00	**$239.55**
Continuous Wall Footing									
3500 psi Concrete	CY	2.96	$167.24	$495.03	$56.03	$165.85	$0.66	$1.95	**$662.83**
Rebar (#4)	Lbs	53.4	$0.54	$28.84	$0.20	$10.68	$0.00	$0.00	**$39.52**
Keyway Formwork	LF	40	$0.20	$8.00	$0.34	$13.60	$0.00	$0.00	**$21.60**
Columns (14" x 24" x 9')	**Ea.**	**4**							
5000 psi Concrete	CY	0.78	$136.84	$106.74	$16.77	$13.08	$13.08	$10.20	$130.02
Rebar (10 #8 Bars)	Tons	0.12	$1,089.00	$130.68	$241.83	$29.02	$0.00	$0.00	$159.70
Formwork	SFCA	57	$2.70	$153.90	$3.55	$202.35	$0.00	$0.00	$356.25
Rebar Ties (#3)	Lbs	27	$0.54	$14.58	$0.15	$4.05	$0.00	$0.00	$18.63
Column Drop Panels	CY	1.85	$339.56	$628.19	$149.69	$276.93	$14.35	$26.55	$931.66
Total				**$4,136.32**					**$6,385.03**
SOG (5")									
3500 psi Concrete	CY	28.7	$125.43	$3,599.84	$8.75	$251.13	$0.59	$16.93	**$3,867.90**
Vapor Barrier (6 ML)	SF	1860	$0.04	$74.40	$0.06	$111.60	$0.00	$0.00	**$186.00**
WWF	SF	1860	$0.25	$465.00	$0.15	$279.00	$0.00	$0.00	**$744.00**
Edge Forms	LF	40	$0.31	$12.40	$10.70	$428.00	$0.00	$0.00	**$440.40**
Concrete Finishing	SF	1860	$0.00	$0.00	$0.32	$595.20	$0.03	$55.80	**$651.00**

P2 - SLAB ON GRADE ESTIMATE CONTINUED ON THE FOLLOWING PAGE

Elevated Deck (8" Slab)									
Concrete Including Formwork	CY	46	$339.56	$15,619.76	$149.69	$6,885.74	$14.35	$660.10	**$23,165.60**
Rebar (#4 @ 12" O.C. Bottom)	Lbs	2484.96	$0.54	$1,341.88	$0.20	$496.99	$0.00	$0.00	**$1,838.87**
Concrete Finishing	SF	1860	$0.00	$0.00	$0.32	$595.20	$0.03	$55.80	**$651.00**
Foundation Walls									
5000 psi Concrete	CY	11.1	$136.84	$1,518.92	$16.77	$186.15	$13.08	$145.19	**$1,850.26**
Vertical Rebar (#5 @ 12")	Lbs	281.6	$0.54	$152.06	$0.15	$42.24	$0.00	$0.00	**$194.30**
Vertical Rebar (#4 @ 16")	Lbs	180.36	$0.54	$97.39	$0.15	$27.05	$0.00	$0.00	**$124.45**
Horizontal Rebar (#4 @16")	Lbs	180.36	$0.54	$97.39	$0.15	$27.05	$0.00	$0.00	**$124.45**
Formwork	LF	80	$2.05	$164.00	$3.46	$276.80	$0.00	$0.00	**$440.80**
Concrete Finishing	SF	720	$0.92	$662.40	$0.22	$158.40	$0.00	$0.00	**$820.80**
Waste Factor (5%)									$1,617.25
Material Tax (8%)									$2,587.60
Module Total									**$50,674.35**
Module Multiplier	**37,141.71 SF / 1,860 SF = 20**								$1,013,487.03
O & P (15%)									$7,601.15
Bonds (1.5%)									$760.12
Total (Including O & P)									**$1,072,522.65**

Post Tensioned Deck Concrete Estimate (1570 SF)

Description	Unit	Qty.	Material	Material Total	Labor	Labor Total	Equipment	Equipment Total	Total
Columns (14" x 24" x 10' 7 7/16")									
Concrete Including Formwork	CY	17.44	$339.56	$5,921.93	$149.69	$2,610.59	$14.35	$250.26	**$8,782.78**
Rebar (10 #8 Bars)	Tons	2.54	$1,089.00	$2,766.06	$241.83	$614.25	$0.00	$0.00	**$3,380.31**
Rebar Ties (#3)	Lbs	428.64	$0.54	$231.47	$0.15	$64.30	$0.00	$0.00	**$295.76**
Column Drop Panels	CY	46.9	$339.56	$15,925.36	$149.69	$7,020.46	$14.35	$673.02	**$23,618.84**
Slab									
Concrete Including Formwork	CY	48.5	$304.08	$14,747.88	$319.02	$15,472.47	$30.26	$1,467.61	**$31,687.96**
Tendon Support Rebar	Lbs	1603.2	$0.54	$865.73	$0.20	$320.64	$0.00	$0.00	**$1,186.37**
Studrails									**$1,500.00**
Concrete Finishing	SF	1570	$0.00	$0.00	$0.32	$502.40	$0.03	$47.10	**$549.50**
Beams (24" x 30")									
Concrete Including Formwork	CY	68.5	$399.11	$27,339.04	$470.35	$32,218.98	$46.85	$3,209.23	**$62,767.24**
Rebar	Tons	5.9	$1,089.00	$6,425.10	$241.83	$1,426.80	$0.00	$0.00	**$7,851.90**
Stirrups	Lbs	2669.32	$0.54	$1,441.43	$0.20	$533.86	$0.00	$0.00	**$1,975.30**
Tendons									
Placing Tendons	SF	1570	$0.64	$1,004.80	$0.22	$345.40	$0.03	$47.10	**$1,397.30**
Stressing Tendons	SF	1570	$0.00	$0.00	$0.17	$266.90	$0.01	$15.70	**$282.60**
Waste Factor (5%)									$2,591.20
Material Tax (8%)									$4,145.92

DETAILED STRUCTURAL WOOD FRAMING ESTIMATE

Post Tensioned Deck Concrete Estimate (1570 SF)									
Description	**Unit**	**Qty.**	**Material**	**Material Total**	**Labor**	**Labor Total**	**Equipment**	**Equipment Total**	**Total**
Columns (14" x 24" x 10' 7 7/16")									
Concrete Including Formwork	CY	17.44	$339.56	$5,921.93	$149.69	$2,610.59	$14.35	$250.26	**$8,782.78**
Rebar (10 #8 Bars)	Tons	2.54	$1,089.00	$2,766.06	$241.83	$614.25	$0.00	$0.00	**$3,380.31**
Rebar Ties (#3)	Lbs	428.64	$0.54	$231.47	$0.15	$64.30	$0.00	$0.00	**$295.76**
Column Drop Panels	CY	46.9	$339.56	$15,925.36	$149.69	$7,020.46	$14.35	$673.02	**$23,618.84**
Slab									
Concrete Including Formwork	CY	48.5	$304.08	$14,747.88	$319.02	$15,472.47	$30.26	$1,467.61	**$31,687.96**
Tendon Support Rebar	Lbs	1603.2	$0.54	$865.73	$0.20	$320.64	$0.00	$0.00	**$1,186.37**
Studrails									**$1,500.00**
Concrete Finishing	SF	1570	$0.00	$0.00	$0.32	$502.40	$0.03	$47.10	**$549.50**
Beams (24" x 30")									
Concrete Including Formwork	CY	68.5	$399.11	$27,339.04	$470.35	$32,218.98	$46.85	$3,209.23	**$62,767.24**
Rebar	Tons	5.9	$1,089.00	$6,425.10	$241.83	$1,426.80	$0.00	$0.00	**$7,851.90**
Stirrups	Lbs	2669.32	$0.54	$1,441.43	$0.20	$533.86	$0.00	$0.00	**$1,975.30**
Tendons									
Placing Tendons	SF	1570	$0.64	$1,004.80	$0.22	$345.40	$0.03	$47.10	**$1,397.30**
Stressing Tendons	SF	1570	$0.00	$0.00	$0.17	$266.90	$0.01	$15.70	**$282.60**
Waste Factor (5%)									$2,591.20
Material Tax (8%)									$4,145.92
Total									**$152,012.97**
O & P (15%)									$22,801.95
Bonds (1.5%)									$2,280.19
Total (Including O & P)									**$177,095.11**

Single Bedroom Unit

Description	Unit	Qty.	Material	Material Total	Labor	Labor Total	Equipment	Equipment Total	Total
Framing (Pneumatic Nailed)									
2 X 4 Bottom Plate	LF	191	$0.33	$63.03	$0.59	$112.69	$0.00	$0.00	**$175.72**
2 X 4 Top Plate	LF	191	$0.33	$63.03	$0.59	$112.69	$0.00	$0.00	**$175.72**
2 X 10 Demising Wall Top Plate	LF	191	$0.99	$189.09	$0.83	$158.53	$0.00	$0.00	**$347.62**
2 X 4 Studs (12" O.C.)	LF	1695	$0.33	$559.35	$0.59	$1,000.05	$0.00	$0.00	**$1,559.40**
2 X 4 Stud Blocking (3 Rows)	LF	504	$0.33	$166.32	$0.59	$297.36	$0.00	$0.00	**$463.68**
Sheathing									
Subfloor Sheating (23/32" APA Rated T & G Floor Sheathing)	SF Flr	780	$0.62	$483.60	$0.29	$226.20	$0.00	$0.00	**$709.80**
Exterior Wall Sheathing (7/16" FRT OSB Sheathing)	SF	276	$0.34	$93.84	$0.21	$57.96	$0.00	$0.00	**$151.80**
Trusses									
Pre-Engineered (24' Span)	Ea	17	$88.95	$1,512.15	$15.04	$255.68	$11.47	$194.99	**$1,962.82**
2 X 6 Strongbacks (10' Max Spacing)	LF	100	$0.51	$51.00	$0.67	$67.00	$0.00	$0.00	**$118.00**
Shear Panel (42 LF) (7/16" OSB Sheathing - One Side)	SF	63	$0.34	$21.42	$0.25	$15.75	$0.00	$0.00	**$37.17**
Waste Factor (20%)									$640.57
Stud Pack Factor (5%)									$160.14
Material Tax (8%)									$256.23
Total									**$6,758.66**
O & P (15%)									$1,013.80
Bonds (1.5%)									$101.38
Total (Including O & P)									**$7,873.84**

Double Bedroom Unit									
Description	**Unit**	**Qty.**	**Material**	**Material Total**	**Labor**	**Labor Total**	**Equipment**	**Equipment Total**	**Total**
Framing (Pneumatic Nailed)									
2 X 4 Bottom Plate	LF	258	$0.33	$85.14	$0.59	$152.22	$0.00	$0.00	**$237.36**
2 X 4 Top Plate	LF	258	$0.33	$85.14	$0.59	$152.22	$0.00	$0.00	**$237.36**
2 X 10 Demising Wall Top Plate	LF	258	$0.99	$255.42	$0.83	$214.14	$0.00	$0.00	**$469.56**
2 X 4 Studs (12" O.C.)	LF	2289	$0.33	$755.37	$0.59	$1,350.51	$0.00	$0.00	**$2,105.88**
2 X 4 Stud Blocking (3 Rows)	LF	678	$0.33	$223.74	$0.59	$400.02	$0.00	$0.00	**$623.76**
Sheathing									
Subfloor Sheating (23/32" APA Rated T & G Floor Sheathing)	SF Flr	1072	$0.46	$493.12	$0.27	$289.44	$0.00	$0.00	**$782.56**
Exterior Wall Sheathing (7/16" FRT OSB Sheathing)	SF	446	$0.34	$151.64	$0.21	$93.66	$0.00	$0.00	**$245.30**
Trusses									
Pre-Engineered (30' Span)	Ea	17	$122.88	$2,088.96	$18.26	$310.42	$14.01	$238.17	**$2,637.55**
2 X 6 Strongbacks (10' Max Spacing)	LF	160	$0.51	$81.60	$0.67	$107.20	$0.00	$0.00	**$188.80**
Shear Panel (42 LF) (7/16" OSB Sheathing - One Side)	SF	90	$0.62	$55.80	$0.29	$26.10	$0.00	$0.00	**$81.90**
Waste Factor (20%)									$855.19
Stud Pack Factor (5%)									$213.80
Material Tax (8%)									$342.07
Total									**$9,021.09**
O & P (15%)									$1,353.16
Bonds (1.5%)									$135.32
Total (Including O & P)									**$10,509.57**

Roofing									
Description	**Unit**	**Qty.**	**Material**	**Material Total**	**Labor**	**Labor Total**	**Equipment**	**Equipment Total**	**Total**
Sheathing									
Roof Sheating (19/32" APA Rated OSB)	SF	42000	$0.50	$21,000.00	$0.19	$7,980.00	$0.00	$0.00	**$28,980.00**
Parapet Wall Sheathing (7/16" FRT OSB Sheathing)	SF	5552	$0.34	$1,887.68	$0.21	$1,165.92	$0.00	$0.00	**$3,053.60**
Parapet Walls									
Pre-engineered Parapet Trusses (2' O.C.)	Ea.	694	$32.00	$22,208.00	$0.59	$409.46	$0.00	$0.00	**$22,617.46**
Waste Factor (20%)									$9,019.14
Stud Pack Factor (5%)									$2,254.78
Material Tax (8%)									$3,607.65
Total									**$69,532.63**
O & P (15%)									$10,429.90
Bonds (1.5%)									$1,042.99
Total (Including O & P)									**$81,005.52**

Stairwell Framing (2nd -6th Floors)									
Description	**Unit**	**Qty.**	**Material**	**Material Total**	**Labor**	**Labor Total**	**Equipment**	**Equipment Total**	**Total**
Framing									
2 X 4 Bottom Plate	LF	76	$0.33	$25.08	$0.59	$44.84	$0.00	$0.00	**$69.92**
2 X 4 Top Plate	LF	76	$0.33	$25.08	$0.59	$44.84	$0.00	$0.00	**$69.92**
2 X 4 Studs	LF	808	$0.33	$266.64	$0.59	$476.72	$0.00	$0.00	**$743.36**
2 X 12 Wood Joists	LF	107	$1.21	$129.47	$0.97	$103.79	$0.00	$0.00	**$233.26**
2 X 4 Stud Blocking	LF	808	$0.33	$266.64	$0.59	$476.72	$0.00	$0.00	**$743.36**
Sheathing									
Subfloor Sheating (23/32" APA Rated T & G Floor Sheathing)	SF Flr	552	$0.46	$253.92	$0.27	$149.04	$0.00	$0.00	**$402.96**
Waste Factor (20%)									$193.37
Stud Pack Factor (5%)									$48.34
Material Tax (8%)									$77.35
Total									**$2,581.83**
O & P (15%)									$387.28
Bonds (1.5%)									$38.73
Total (Including O & P)									**$3,007.84**

MEP ASSEMBLIES ESTIMATES

Mechanical Assemblies Estimate							
Description	**Unit**	**Qty.**	**Material**	**Material Total**	**Installation**	**Installation Total**	**Total**
Split System with Air Cooled Condensing Units							
Single Bedroom Units	SF	780	$2.83	$2,207.40	$2.23	$1,739.40	$3,946.80
Double Bedroom Units	SF	1072	$2.83	$3,033.76	$2.23	$2,390.56	$5,424.32
Total Unit Mechanical Price							
Single Bedroom Units	Ea.	162	$2,207.40	$357,598.80	$1,739.40	$281,782.80	**$639,381.60**
Double Bedroom Units	Ea.	70	$3,033.76	$212,363.20	$2,390.56	$167,339.20	**$379,702.40**
Rooftop Multizone AHU's							
East Side Corridor (50 ton)	SF	18050	$7.18	$129,599.00	$4.25	$76,712.50	**$206,311.50**
West Side Corridoe (50 ton)	SF	18050	$7.18	$129,599.00	$4.25	$76,712.50	**$206,311.50**
Material Tax (8%)							$66,332.80
Total							**$1,498,039.80**
O & P (15%)							$224,705.97
Bonds (1.5%)							$22,470.60
Total (Including O & P)							**$1,745,216.37**

Plumbing Assemblies Estimate							
Description	**Unit**	**Qty.**	**Material**	**Material Total**	**Installation**	**Installation Total**	**Total**
Residential Units							
Three Fixture Bathroom (Share Common Plumbing Wall)	Ea.	302	$2,697.70	$814,705.40	$1,492.43	$450,713.86	**$1,265,419.26**
Kitchen Sink System	Ea.	232	$814.40	$188,940.80	$699.44	$162,270.08	**$351,210.88**
Domestic Water Distrubution	Ea.	232	$870.67	$201,995.44	$128.63	$29,842.16	**$231,837.60**
Material Tax (8%)							$147,877.42
Total							**$1,996,345.16**
O & P (15%)							$299,451.77
Bonds (1.5%)							$29,945.18
Total (Including O & P)							**$2,325,742.11**

Electrical Assemblies Estimate

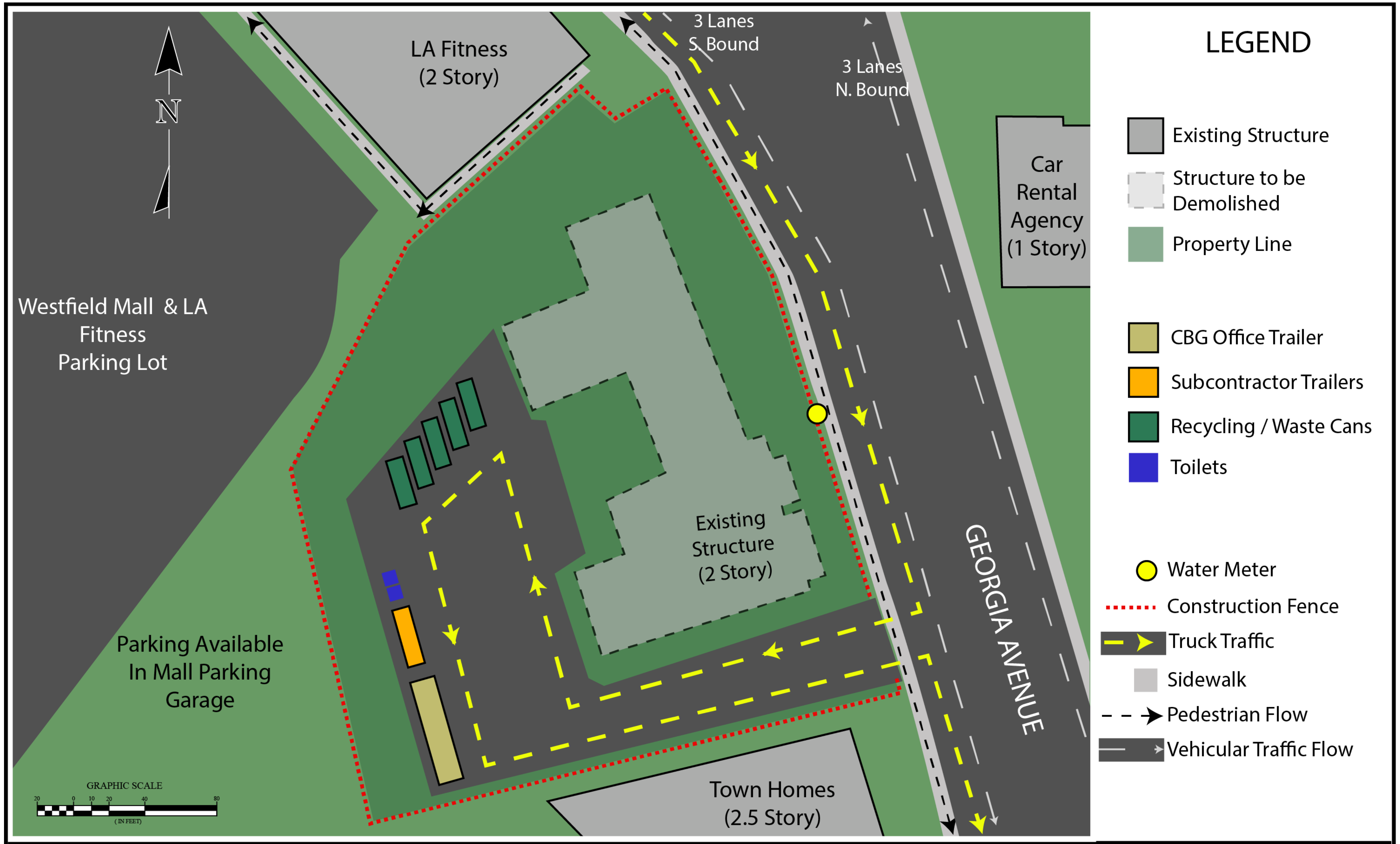
Description	Unit	Qty.	Material	Material Total	Installation	Installation Total	Total
Equipment & Distribution							
Switchgear	Ea.	2	$62,887.68	$125,775.36	$7,826.76	$15,653.52	**$141,428.88**
250 KW Diesel Emergency Generator	KW	250	$238.96	$59,740.00	$30.05	$7,512.50	**$67,252.50**
Electrical Service Distribution (1 phase, 120/240V)	Ea.	232	$1,261.75	$292,726.00	$1,600.20	$371,246.40	**$663,972.40**
Condensing Unit Disonnects	Ea.	232	$155.53	$36,082.96	$207.23	$48,077.36	**$84,160.32**
Branch Wiring							
Single Bedroom Units				$0.00		$0.00	$0.00
Receptacles (16.5 Per 1000 SF)	SF	780	$0.71	$553.80	$2.94	$2,293.20	$2,847.00
Wall Switches (10 per 1000 SF)	SF	780	$0.56	$436.80	$2.01	$1,567.80	$2,004.60
Total				$990.60		$3,861.00	$2,847.00
Double Bedroom Units							
Receptacles (20 Per 1000 SF)	SF	1072	$0.75	$804.00	$3.20	$3,430.40	$4,234.40
Wall Switches (10 Per 1000 SF)	SF	1072	$0.56	$600.32	$2.01	$2,154.72	$2,755.04
Total				$1,404.32		$5,585.12	$6,989.44
Single Bedroom	Ea.	162	$990.60	$160,477.20	$3,861.00	$625,482.00	**$785,959.20**
Double Bedroom	Ea.	70	$1,404.32	$98,302.40	$5,585.12	$390,958.40	**$489,260.80**
Material Tax (8%)							$61,848.31
Total							**$2,293,882.41**
O & P (15%)							$344,082.36
Bonds (1.5%)							$34,408.24
Total (Including O & P)							**$2,672,373.01**

Fire Protection Assemblies Estimate

Description	Unit	Qty.	Material	Material Total	Installation	Installation Total	Total
Wet Pipe Sprinkler System - Schedule 40 Pipe							
Ordinary Hazard P2 Level	SF	37142	$1.25	$46,427.14	$1.85	$68,712.16	**$115,139.30**
Ordinary Hazard P1 Level	SF	51480	$1.25	$64,350.50	$1.85	$95,238.74	**$159,589.24**
Ordinary Hazard 1st Floor	SF	51647	$1.25	$64,558.88	$1.85	$95,547.14	**$160,106.01**
Extra Hazard 2nd Floor	SF	41859	$1.91	$79,950.42	$2.40	$100,461.26	**$180,411.69**
Extra Hazard Floors 2 through 6	SF	170208	$1.91	$325,096.97	$2.40	$408,498.82	**$733,595.79**
Material Tax (8%)							$46,430.71
Total							**$1,395,272.74**
O & P (15%)							$209,290.91
Bonds (1.5%)							$20,929.09
Total (Including O & P)							**$1,625,492.74**

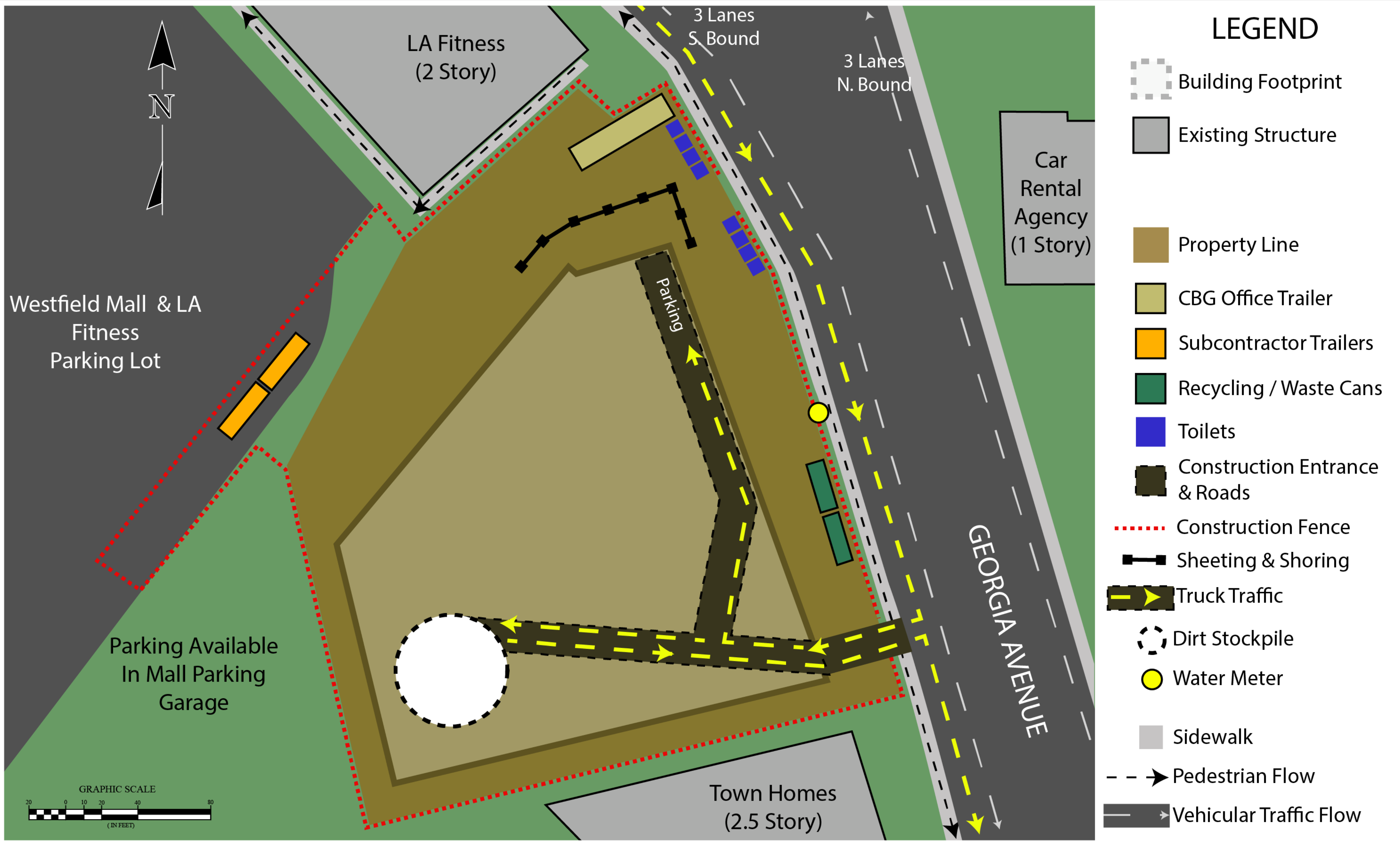
APPENDIX C. SITE LAYOUT PLANNING

DEMOLITION PHASE



Solaire Wheaton	Logistics Plan - Demolition	October 16, 2013
Wheaton, MD		Kevin Martyn

EXCAVATION PHASE



Solaire Wheaton

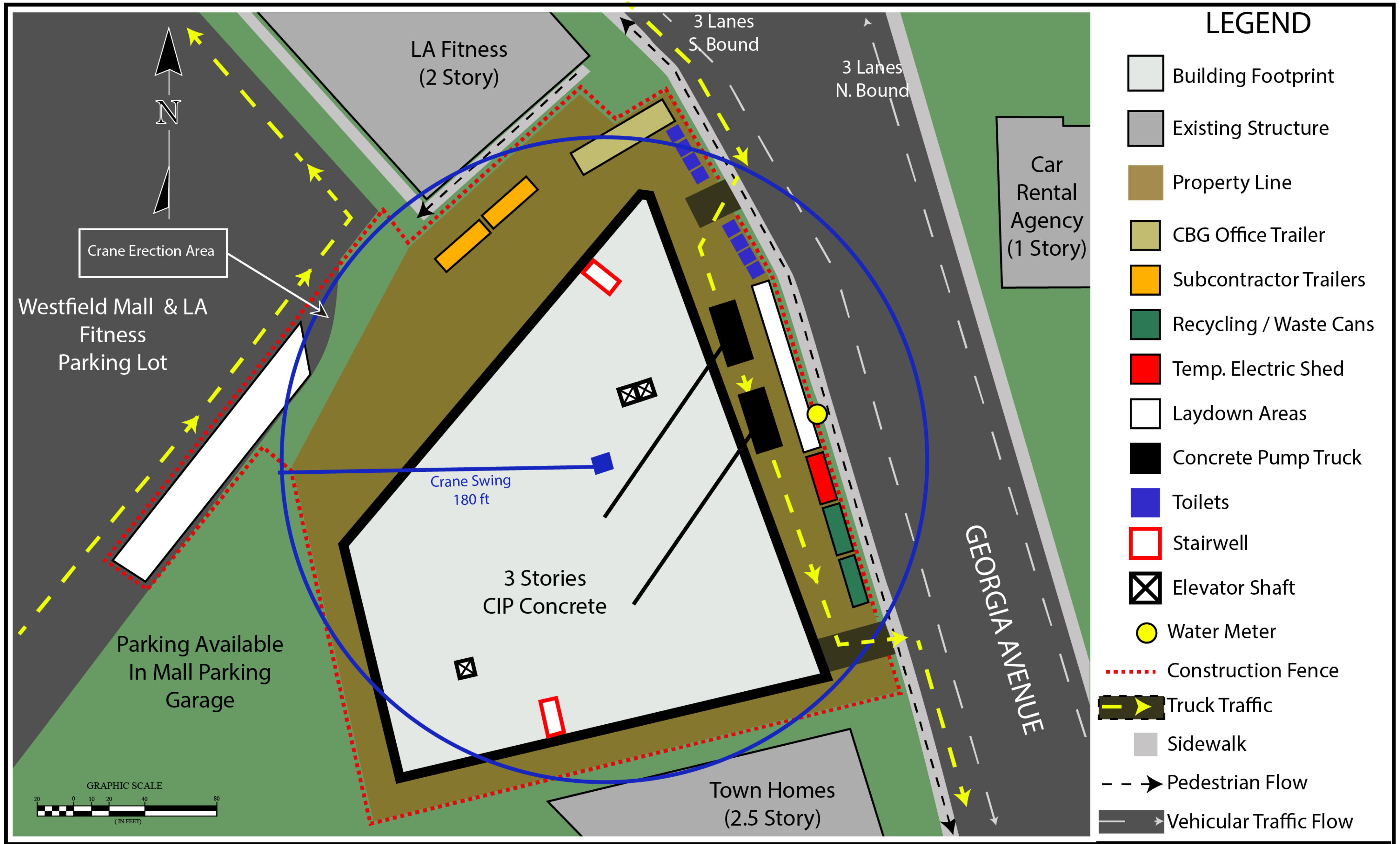
Wheaton, MD

Logistics Plan - Excavation

October 16, 2013

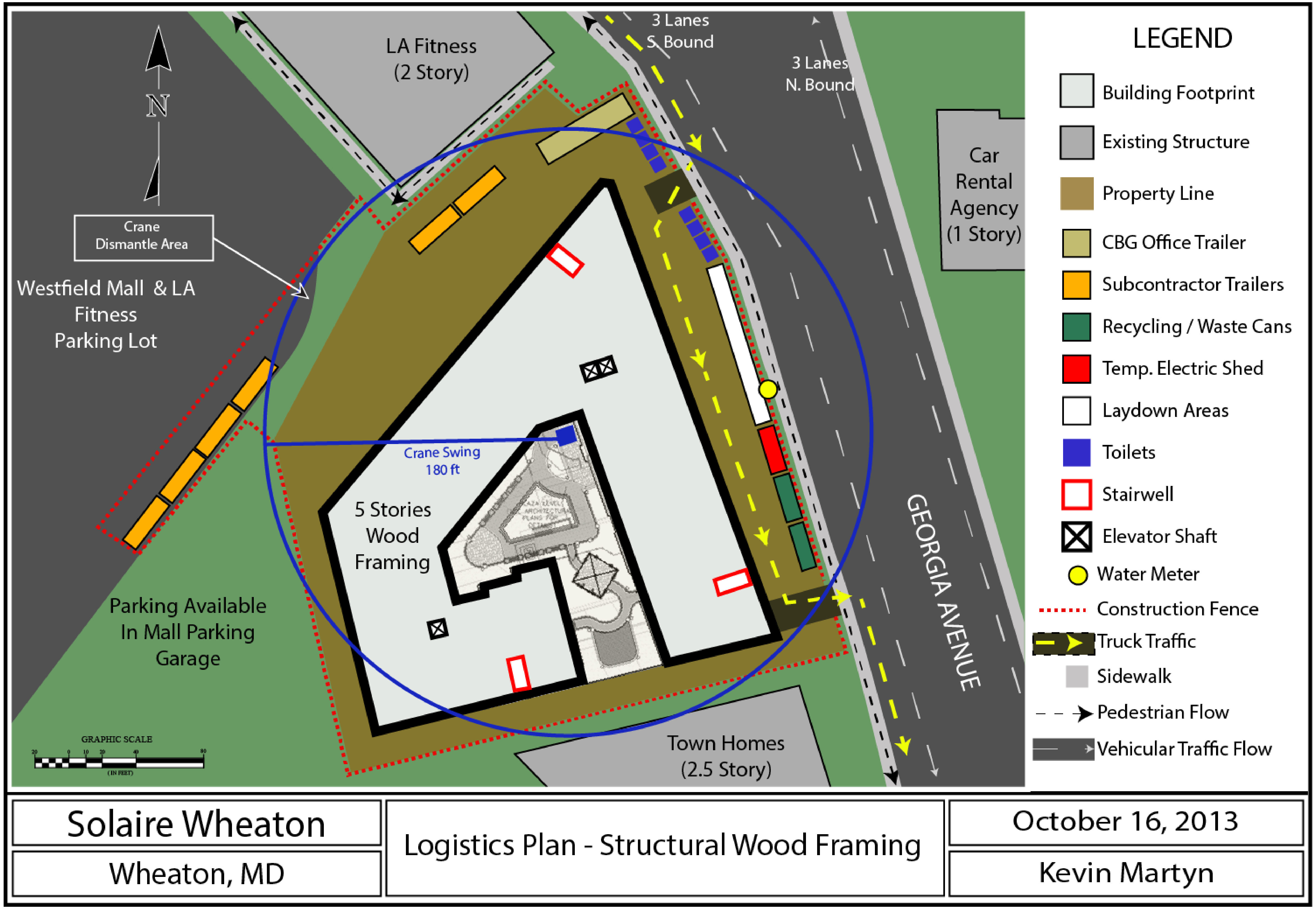
Kevin Martyn

STRUCTURAL CONCRETE PHASE

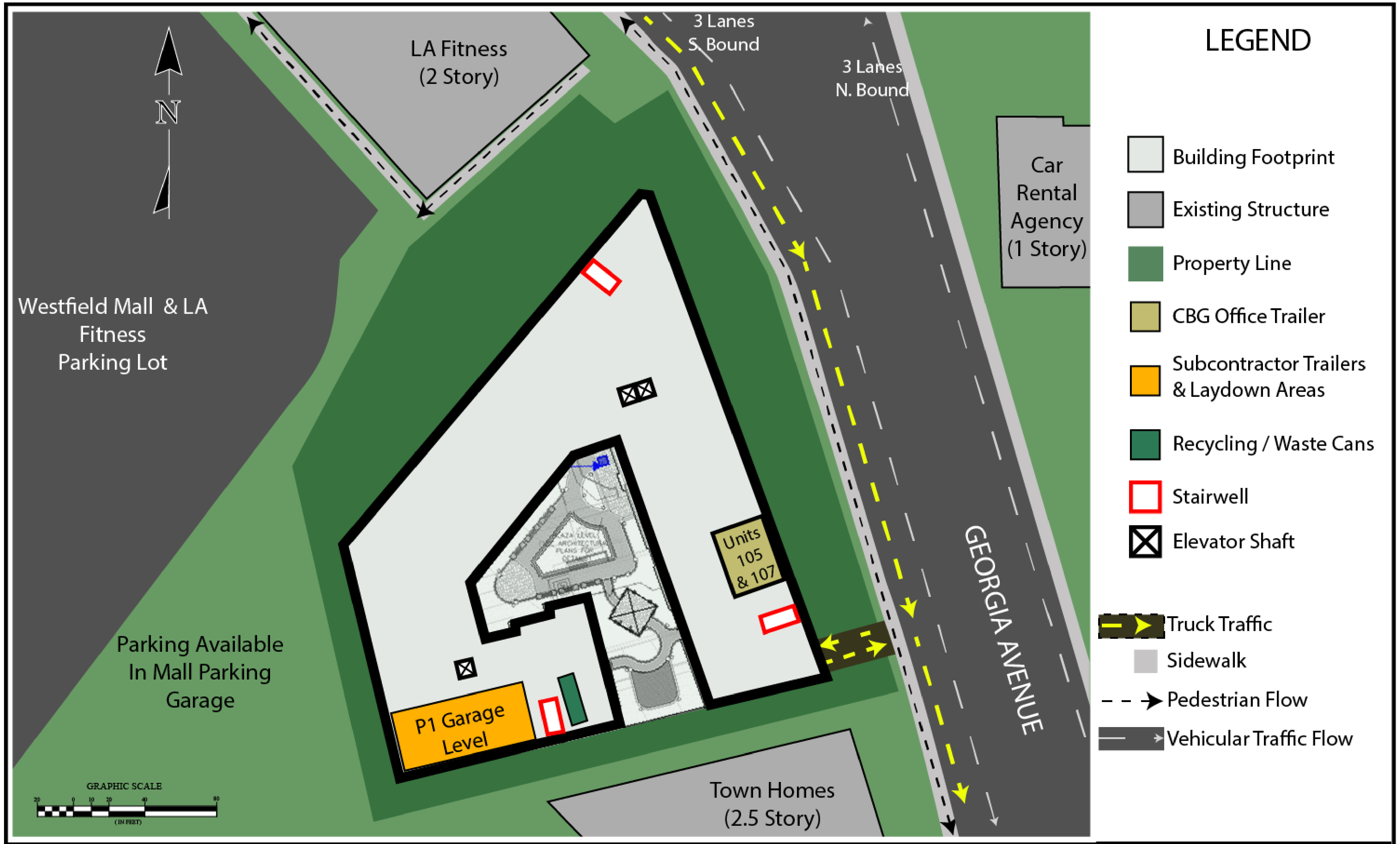


Solaire Wheaton	Logistics Plan - Structural Concrete	October 16, 2013
Wheaton, MD		Kevin Martyn

STRUCTURAL WOOD FRAMING PHASE



PHASED OCCUPANCY PLAN



Solaire Wheaton
Wheaton, MD

Logistics Plan - Phased Occupancy

October 16, 2013
Kevin Martyn

APPENDIX D. GENERAL CONDITIONS ESTIMATE

GENERAL CONDITIONS

					Material		
Cost Code		**Description**	**Qty.**	**Units**	**Per Unit**	**Total**	**Total**
01 30 00	**ADMINISTRATIVE REQUIREMENTS**						
	01 31 00	PROJECT MANAGEMENT AND COORDINATION					
		OFFICE SUPPLIES & EQUIPMENT	21	Months	$500.00	$10,500.00	$10,500.00
		OFFICE FURNITURE	21	Months	$400.00	$8,400.00	$8,400.00
		PRINTING DRAWING/SPECIFICATIONS	21	Months	$300.00	$6,300.00	$6,300.00
		FAX MACHINE	21	Months	$200.00	$4,000.00	$4,000.00
		POSTAGE/PACKAGING	21	Months	$400.00	$8,400.00	$8,400.00
		COMPUTER EQUIPMENT/SOFTWARE	21	Months	$100.00	$2,100.00	$2,100.00
		OX BLUE WEBCAM	21	Months	$200.00	$4,200.00	$4,200.00
		TOTAL					**$43,900.00**
01 40 00	**QUALITY REQUIREMENTS**						
	01 45 00	QUALITY CONTROL					
		TESTING AND INSPECTION	1	LS	$20,000.00	$20,000.00	$20,000.00
		CONSULTANTS	1	LS	$40,000.00	$40,000.00	$40,000.00
		TOTAL					**$60,000.00**
01 50 00	**TEMPORARY FACILITIES AND CONTROLS**						
	01 51 00	TEMPORARY UTILITIES CONSUMPTION	17	Months	$4,000.00	$68,000.00	$68,000.00
	01 52 00	CONSTRUCTION FACILITIES					
		JOB OFFICE/TRAILER	14	Months	$900.00	$12,600.00	$12,600.00
		STORAGE TRAILER	21	Months	$300.00	$6,300.00	$6,300.00
		TOILETS	21	Months	$500.00	$10,500.00	$10,500.00
		DRINKING WATER/ICE	21	Months	$100.00	$2,100.00	$2,100.00
		RADIOS/PHONES	21	Months	$300.00	$6,300.00	$6,300.00
	01 54 00	CONSTRUCITON AIDS					
		PERSONAL PROTECTIVE EQUIPMENT	21	Months	$100.00	$2,100.00	$2,100.00
		TEMPORARY HOISTS / FORKLIFT	17	Months	$1,000.00	$17,000.00	$17,000.00
		TEMPORARY CRANES	**INCLUDED UNDER GMP**				
	01 55 00	VEHICULAR ACCESS AND PARKING					
		TEMPORARY STONE SITE ROADS	**INCLUDED IN THE SITEWORK SCOPE**				
	01 56 00	TEMPORARY BARRIERS AND ENCLOSURES					
		TEMPORARY FENCING	**INCLUDED UNDER GMP**				
	01 57 00	TEMPORARY CONTROLS					
		TEMPORARY EROSION AND SEDIMENT CONTROL	**INCLUDED IN THE SITEWORK SCOPE**				
		TOTAL					**$124,900.00**
01 70 00	**EXECUTION AND CLOSEOUT REQUIREMENTS**						
	01 73 00	EXECUTION					
		SIGNAGE	21	Month	$50.00	$1,050.00	$1,050.00
		AUTO ALLOWANCES	21	Month	$4,000.00	$84,000.00	$84,000.00
	01 74 00	CLEANING AND WASTE MANAGEMENT					
		DUMPSTERS	21	Months	$5,000.00	$105,000.00	$105,000.00
		AS NECESSARY & FINAL CLEANING	**INCLUDED IN THE CLEANERS SCOPE**				
		Total					**$190,050.00**

GENERAL CONDITIONS & STAFF TOTAL

Description	Quantity	Units	Labor $/Unit	Labor Total	Grand Total
Personnel/Staffing					
Dave Tapparo, Vice President	5	Months	$120.00	$96,000.00	$96,000.00
Tommy Rumley, Project Executive	21	Months	$98.00	$329,280.00	$329,280.00
Mark Metzler, Project Manager	21	Months	$75.00	$252,000.00	$252,000.00
John Aldridge, Superintendent	21	Months	$98.00	$329,280.00	$329,280.00
Charlie Liesfeld, Assistant Superintendent	21	Months	$65.00	$218,400.00	$218,400.00
Will Thomas, Assistant Superintendent	10	Months	$65.00	$104,000.00	$104,000.00
Mike Ogrady, Assistant Superintendent	10	Months	$65.00	$104,000.00	$104,000.00
Brian LeTard, Safety Manager	2	Months	$65.00	$20,800.00	$20,800.00
Clerical	2	Months	$45.00	$14,400.00	$14,400.00
Kevin Martyn, Field Engineer Intern	3	Months	$18.00	$8,640.00	$8,640.00
Total Staff Requirements					$1,476,800.00
Administrative Requirements					$43,900.00
Quality Requirements					$60,000.00
Temporary Facilities and Controls					$124,900.00
Executions and Closeout Requirements					$190,050.00
BASELINE TOTAL GENERAL CONDITIONS AND FEE					**$1,895,650.00**