Fort Pickett Regional Training Institute Phase II
Blackstone, VA

Technical Assignment 2

Figure 1: Site Aerial - Courtesy of Barton Malow

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Executive Summary

The Fort Pickett Military Base located in Blackstone, VA is currently underway with Phase II of the Regional Training Institute project with the design and construction contracted to Barton Malow. The $28M contract consists of the design and construction of three billeting buildings totaling 116,400 SF in order to replace the dilapidated barracks currently being occupied by members of the Virginia Army National Guard. In order to obtain a better understanding of the circumstances encountered and tactics employed by the involved parties, the project was analyzed in regards to the project's schedule, estimates, sustainability, and BIM coordination. After conducting a thorough investigation, it was found that Barton Malow lacked depth in the use of BIM on the project, but excelled in every other area under review.

After compiling and reviewing the detailed project schedule, it was found that the project team enacted the most logical and efficient schedule possible. Upon notice to proceed with Phase II, the project team was able to finalize a design while simultaneously begin the sitework required. The construction was then sequenced incorporating a one week lag between buildings to maintain crew sizes and remove a learning curve. The detailed structural systems estimate fell on par with the actual systems cost, but did show an unexplainable cost elevation in the precast hollow-core planks. The total structural systems were estimated to be $2,188,042.11 or around 7.5% of the total project cost, a reasonable value. The general conditions estimate followed a similar trend by resulting in similar numbers to the cost of the actual general conditions. The general conditions estimate resulted in a price of $3,199,054.58 or 11.3% of the project's contract value. Where Barton Malow significantly surpassed expectations given the project's circumstances was in the sustainability area by pursing a LEED Silver rating. Barton Malow was limited by cost, location, and resource constraints, but still found a way to manufacture a plan to achieve a highly respected LEED Silver certification. Where Barton Malow could have made the largest improvement in the strategies utilized was in their use of BIM. The project primarily focused on clash detection and coordination, but refrained from incorporating a number of other value adding BIM uses, particularly Design Reviews, Cost Estimation, and LEED Evaluations.

Phase II of the Regional Training Institute utilized premiere design and construction techniques that have contributed to the overall success of the project up to this point. The combination of efficient scheduling, accurate estimating, and sustainability planning have put the project team in a favorable position. Although there exists significant room for improvement through further BIM uses, the project excelled in nearly every aspect of the areas analyzed and have made the Regional Training Institute a superior example of proper planning, design, and construction within the construction industry.

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Detailed Project Schedule

The Fort Pickett Regional Training Institute project utilized a very unique schedule in comparison to traditional schedules, due to the Design-Build delivery system employed. The project was bid as a two phase approach with an option to award Phase II upon successful completion of Phase I. As seen in Appendix A, the contract was awarded to Barton Malow on September 9, 2009 based on 30% design documents for both Phases I and Phase II. Phase I consisted of office, educational, and administration construction, while Phase II was composed of three billeting buildings followed by demolition of a later to be determined number of buildings located on another area of the Military Base. In order to present a clearer understanding of the dates associated with the project, Table 1 shows an overview of the dates and durations associated with each phase of the project.

Project Schedule Overview			
	Duration	Start Date	Finish Date
Phase I	485	9/29/08	8/6/10
Design	214	9/29/08	7/24/09
Construction	351	4/2/09	8/6/10
Closeout	11	7/23/10	8/6/10
Phase II	661	2/27/10	9/10/12
Design	186	2/27/10	3/1/10
Submittals	438	3/1/10	11/2/11
Initial Sitework	315	3/1/10	5/13/11
Construction - 700	352	8/25/10	12/29/11
Construction – 500	347	9/1/10	12/29/11
Construction – 600	349	9/13/10	1/12/12
Closeout	1	1/13/12	1/13/12
Demolition	169	1/16/12	9/7/12
Project Closeout	1	9/10/12	9/10/12
Total	**1146**	**9/29/08**	**9/10/12**

Table 1: Project Schedule Overview – Developed by Kendall Mahan

Upon recommendation from the Army Corps of Engineers near the end of the Phase I construction, Barton Malow was given notice to proceed with Phase II on February 27, 2010. With preliminary design work performed during the bidding process, the 30% design documents needed to be finalized within the Design Phase. As the design work was carried out, the construction management team was given the task of completing construction and closeout on Phase I, while planning to begin work on Phase II. The construction of Phase II finally broke ground on June 8, 2010, a period of time where finish trades were just wrapping up work in the newly constructed buildings. Sitework at this stage of the schedule was comprised of relocating temporary fences, establishing construction limits, creating temporary roads, establishing a truck wash, and begin underground utilities, which were completed by the Sitework Subcontractor. The phasing between buildings extended well into Phase II, but was viewed as advantageous to both parties; Barton Malow was able to learn acceptable standards and apply methods to Phase II, while the Army Corps of Engineers had the luxury of working with familiar personnel. On June 8, 2010, Phase I reached contract completion allowing the project team to divert its efforts solely on Phase II.

As observed in the project schedule, the buildings in Phase II were sequenced with an approximate one week lag in progress between the three buildings and their respected two floors. In addition, Fig. 2 to the right depicts a sequencing of the work utilized throughout the project with Building 700 constructed first, followed by Building 500, since it was an identical design. Building 600 was the last billet in the sequence and although the floor plan was not identical, the construction type was exactly the same. By phasing the construction work by buildings and floors it allowed the work force to maintain steady crews and minimize a potentially hindering learning curve.

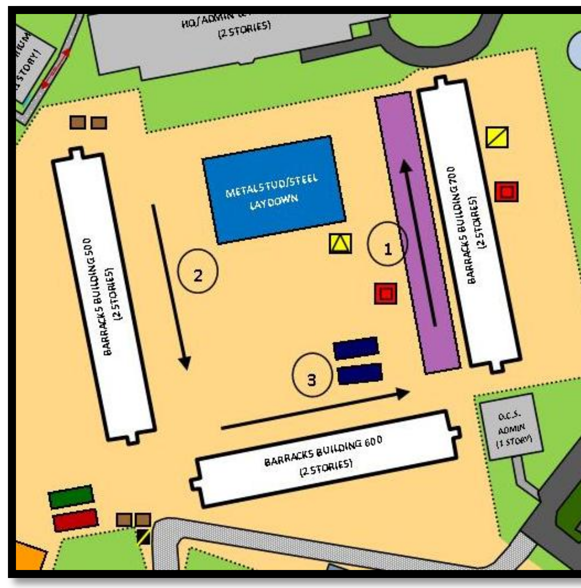


Figure 2: Work Sequencing - Developed by Kendall Mahan

The Construction Phase was organized by building on the project schedule with a further breakdown in work by separating activities by core and shell or fit-out. The core and shell activities included foundations, slab-on-grade, cold formed metal stud load bearing walls, hollow-core planks, roof trusses, and building enclosure. The fit-out items included mechanical, electrical, plumbing, fire protection, and finish trades. This separation of work on the schedule furthered the organization of the project schedule and made the schedule a much more efficient construction aid.

Punch list items will be addressed near the end of the Construction Phase and are to be conducted by Barton Malow prior to the Army Corps of Engineers inspections. Upon correction of the noted items, the COE will have the opportunity to compile their own punch list, which will be addressed, corrected, and reviewed by Barton Malow. The Closeout Phase also consists of testing and commissioning, which stretches well into the Construction Phase. On January 13, 2012, the billeting buildings are set to reach final completion, where the project team can then turn their attention to the final part of Phase II, demolition.

The Demolition Phase consists of the deconstruction and abatement of a number of dilapidated barracks constructed during the World War II era. The buildings contain hazardous materials, notably asbestos and lead paints, which will require special attention. With the construction of the new buildings at the Regional Training Institute, the Virginia Army National Guard is required by law to demolish a specified amount of occupiable square feet equivalent to the new construction. In order to best meet the needs of the client, negotiations are set to take place in the near future to determine what buildings are to be removed. The contract is expected to reach completion on September 10, 2012, ending a four year endeavor with the Virginia Army National Guard.

Detailed Structural Systems Estimate

In order to conduct a detailed structural systems estimate of the Fort Pickett Regional Training Institute's three billeting buildings, a structural systems takeoff was performed for Building 700, which is identical to Building 500 and uses a similar, but larger design footprint than Building 600. The buildings were constructed using a number of different foundations, slab-on-grade, precast hollow-core planks, topping slabs, cold formed metal stud bearing walls, and cold formed metal roof trusses. The buildings utilized no structural masonry components with the only masonry on the exterior of the building, which was non load bearing.

Foundations

The foundations consisted of a number of grade beams, stepped wall footers, continuous footers and piers that wrapped around the buildings' perimeter, as well as along the length of the buildings in two locations. The foundations were designed to be located beneath every load bearing wall in the building. Every component used 4000 psi normal weight cast-in-place concrete, which was reinforced with a number of different rebar types. Since the foundations only reached 2' into the earth, only the piers required the use of formwork. All of the concrete was pumped using a pump, in order to maximize placement time and expedite the schedule.

Slab on Grade

The slab-on-grade consisted of 4000 psi concrete that was placed using a concrete pump. Along with the piers, the slab-on-grade was the only other component of the building that required the use of formwork. The slab was reinforced using sheets of 6'x6' W1.4x1.4 welded wire fabric, which was much more efficient than using rebar. In order to reach the Army Corps of Engineer's standards, the slab was finished using manual and power techniques. Once the slab was placed, a ride-on machine float and trowel was utilized to reach the higher standards.

Precast Hollow-Core Planks

The second floor of the buildings used 8" thick precast hollow-core planks. The planks were placed using the aid of a 75 ton and 100 ton crane. Once the planks were set on top of the load bearing walls, the planks were adjusted to meet the plates located at the joints. Each joint was filled with one #5 rebar, as well as grout to make the joints flush with the top of the planks. Grout and rebar also extended 1' into the hollow cores of each plank to ensure further stability.

Topping Slab

Once the hollow-core planks were set, a 2" topping slab was placed using a concrete pump. The topping slab was reinforced using 6'x6 ' sheets of W2.9x2.9 welded wire fabric and required no formwork, since the top of the hollow core planks was located 2" from the top of steel angles located around the building perimeter. The concrete was then able to cover the top of the planks, as well as the outside edge of the planks.

Load Bearing Walls

The load bearing walls were composed of cold formed 16 gauge. metal studs placed 16” on center. Although the building consists of a number of framed metal stud walls, only the exterior walls, as well as the corridor walls were load bearing walls. The top and bottom floors shared exactly the same floor layouts, making construction and design very efficient. Each building contained only four structural members, which were located in the living commons and used as headers to cover the extended spans. A number of steel angles were also used throughout the buildings to serve as sills and lintels.

Roof Trusses

The roof trusses were cold formed metal framed and were manufactured at three different spans. The most common truss on the project was 56’ and spanned the entire length of the building. The 34’ trusses were used at the step–out locations at the ends of the buildings. Finally, the 11’ truss was used for the vestibule at the end of the buildings. The trusses were erected using the 75 ton and 100 ton cranes that were used for the hollow-core planks. The roof slope was at 2/12, a fairly flat incline.

Analysis

In order to conduct a detailed structural estimate, Building 500/700 was selected for quantity takeoff purposes, where the takeoffs can be seen in Appendix B-1. The takeoffs were organized by CSI Masterformat and consist of Division 3 – Concrete and Division 5 – Metal. Using the takeoffs and a number of assumptions found in Appendix B-2, a detailed structural systems estimate was able to be compiled, which can be observed in Appendix B-3. This estimate was manufactured using RSMeans 2011 and reflects the national construction average costs. In order to capture a better understanding of the actual cost of construction in Blackstone, VA, as well as when the construction took place, the numbers were adjusted for location and time using values from RSMeans 2011 found in Appendix B-4. The values of the cast-in place concrete, precast concrete, and structural steel framing can be observed below in Table 2.

Structural Systems Estimate (Building 500/700)		
	National Average Cost	**Adjusted Cost**
Cast-in-Place Concrete	$279,546.20	$237,538.35
Precast Concrete	$420,451.20	$357,269.34
Structural Steel Framing	$194,390.55	$165,179.18
	$894,387.95	**$760,006.90**

Table 2: Detailed Structural Systems Estimate – Developed by Kendall Mahan

Once the values for each system were adjusted, the total project's structural system estimate was derived, which can be seen in Table 3 below. The detailed estimate was conducted for Building 500/700, so in order to account for Building 600 an adjustment factor was applied using the ratio of square footage between the two different building sizes. The total cost of the buildings was then found to be $2,188,042.11 with a square foot cost of $18.80.

Total Project Structural Systems Estimate			
Building #	500	600	700
Area (SF)	40,428	35,544	40,428
Adjustment Factor	1.000	0.879	1.000
Location Factor	0.849	0.849	0.849
Time Factor	1.0009	1.0009	1.0009
Cast-in-Place	$237,538.35	$208,796.06	$237,538.35
Precast Concrete	$357,269.34	$314,039.76	$357,269.34
Structural Steel Framing	$165,179.18	$145,192.50	$165,179.18
Total Building Cost	$760,006.90	$668,028.32	$760,006.90
Total Buildings Cost	**$2,188,042.11**		
SF Cost	**$18.80**		

Table 3: Total Project Detailed Structural Systems Estimate – Developed by Kendall Mahan

After manufacturing system estimates, it was then possible to observe the impact of the systems on the project budget. The precast hollow-core planks made-up the greatest portion of the overall project's structural cost with an estimated value of just over $1M. Although these were incredibly expensive, it was incredibly advantageous to the project schedule. Cast-in-place concrete was the second biggest component with an estimated total of nearly $700,000, followed by structural steel framing around $500,000. These values can be viewed more clearly in Fig. 3 .

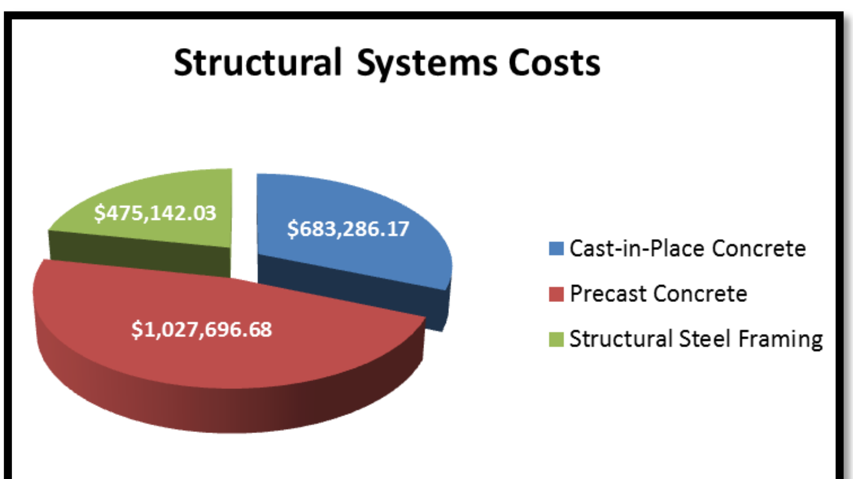


Figure 3: Systems Breakdown - Developed by Kendall Mahan

Finally, it was important to evaluate the cost differences between the actual cost of the systems and the estimated values. From Table 4 below, the cast-in-place concrete differed significantly from the actual cost. This was mostly contributed to the neglect of the cast-in-place concrete used throughout the site for sitework. The actual cost reflects both the concrete used for the structural system and sitework, where a significant amount of sitework was performed. Sidewalks run along the perimeter of the campus quadrangles, as well as from building to building and in the parking lots. Taking into account these items, it is reasonable to have such a discrepancy. The precast hollow-core planks posed a different scenario with elevated costs in the estimated value. The planks selected within RSMeans 2011 accounted for 8” thick hollow core planks, grouting, erection, and the square footage covered. The only rational to explain the elevated cost is that the budget may have included items not associated with just the precast, but rather they may have included reinforcing or connections. The last item analyzed was the structural steel framing. The estimated cost falls well below the actual cost, which is completely reasonable, since a significant portion of the structural steel framing was not accounted for, because it was not load bearing. Only load bearing walls were estimated, leaving out partition walls from the estimation. In addition, the 56’ trusses were estimated as 40’ trusses, since a value was not incorporated within RSMeans. This resulted in a lower estimation of the truss system for the project.

Structural Systems Comparison (Actual vs. Estimated)				
	Actual Cost	**Actual Cost/SF**	**Estimated Cost**	**Estimated Cost/SF**
Cast-in-Place Concrete	$1,243,212.00	$10.68	$683,286.17	$5.87
Precast Concrete	$657,224.00	$5.65	$1,027,696.68	$8.83
Structural Steel Framing	$944,350.00	$8.11	$475,142.03	$4.08
Total	**$2,844,786.00**	**$24.44**	**$2,188,042.11**	**$18.80**

Table 4: Structural Systems Comparison – Developed by Kendall Mahan

General Conditions Estimate

In order to gain a further understanding of the expenses occurred by Barton Malow while working on the Fort Pickett Regional Training Institute, a General Conditions estimate was conducted using the aid of RSMeans 2011 and RSMeans CostWorks. An estimate of the General Conditions can be observed in Appendix C-1, where the estimate is organized by CSI Masterformat. Using the values calculated from the estimate, it was then possible to group the items into their respected categories, including project staff, bonding/insurance, general services, general expenses, and temporary facilities/utilities. The categories were then adjusted using a combination of location, time, and burden factors, which can be seen in Table 5. The time factor was calculated by taking a national inflation value and adjusting it to reflect the time at the midpoint of construction. Burden was another factor that was incorporated and was used for the project staff to cover costs related to business meals, traveling, and employee relocation. After compiling the results, the general conditions for the Fort Pickett Regional Training Institute were an estimated $3,199,054.58 or 11.3% of the total project cost.

General Conditions					
	Location (Petersburg, VA)	Time	Burden	Unadjusted GC Costs	Adjust GC Costs
Project Staff	0.849	1.085	1.300	$1,622,250.00	$1,944,159.962
Bonding & Insurance	0.849	1.085		$411,386.00	$379,245.1266
General Services	0.849	1.085		$708,440.00	$653,090.985
General Expenses	0.849	1.085		$155,572.00	$143,417.1337
Temporary Facilities & Utilities	0.849	1.085		$85,848.50	$79,141.37132
			Total	**$2,983,495.00**	**$3,199,054.58**

Table 5: General Conditions – Developed by Kendall Mahan

The project staff category consisted of the field personnel present on site and did not include office overhead, such as estimating, accounting, and the upper management. This category composed 61% of the total General Conditions, which can be seen in Table 6. This category is probably the most likely to deviate, since there is no way of knowing which members of the management team will be present the entire way through construction. It is common practice for Superintendents to leave earlier than the Project Managers and Engineers, since there presence is not required for most closeout activities. There are also unforeseen conditions relating to turnover within the company, relocations, or overstaffing to keep personnel employed that were not initially intended to be a part of that project team. The general conditions estimate conducted reflects all of the employees' presence the entire way through the construction project, except for the intern, in order to ensure that the project is properly funded.

Within the bonding and insurance category, Barton Malow bonded the project at its full contract value as specified by the U.S. Army Corps of Engineers. By bonding the project for its contract value, it ensured that the VAARNG would have their buildings delivered to them as intended with or without Barton Malow serving as the CM. Barton Malow also picked up General and Liability Insurance, as well as Builder's Risk Insurance. Together these items composed 12% of the General Conditions and ensured the company against any potential incidents that could occur throughout the course of construction.

General services include a number of different services provided by outside companies, such as material testing, equipment testing, inspections, borings, commissioning, surveying, scheduling, periodic cleaning, and final cleaning. These services made-up 20% of the total cost of the project or around $650K. Many of these estimates were calculated from a percentage of the total cost of the job, but others such as cleaning were determined using a reasonable duration for their services.

General expenses was composed of items utilized during the course of construction, such as dumpsters, safety equipment, weather protection, temporary fencing, temporary roads, and other necessary items. This category was responsible for only 5% of the construction costs and served as one of the safest and cheapest categories required for construction. These items could all be priced successfully through a book or vendor, which leaves little uncertainty for budgeting purposes.

The last and one of the most difficult items to estimate was the temporary facilities and utilities, since it was tough to estimate utility prices and the duration of necessary items on a job site. These items included the construction management trailer, equipment, furniture, storage units, portable toilets, and temporary utilities. Like the project staffing category, the actual cost of these items is directly related to the duration of construction. If the project is delayed then the use of these items will need to be extended, resulting in heightened costs in comparison to what was budgeted. For this reason, it is highly beneficial to the project team to complete the work as soon as possible.

Percentage of General Conditions by Category		
	Project Cost	Percentage of GC Cost
Project Staff	$1,944,159.962	61%
Bonding & Insurance	$379,245.1266	12%
General Services	$653,090.985	20%
General Expenses	$143,417.1337	5%
Temporary Facilities & Utilities	$79,141.37132	2%

Table 6: Percentage of General Conditions by Category – Developed by Kendall Mahan

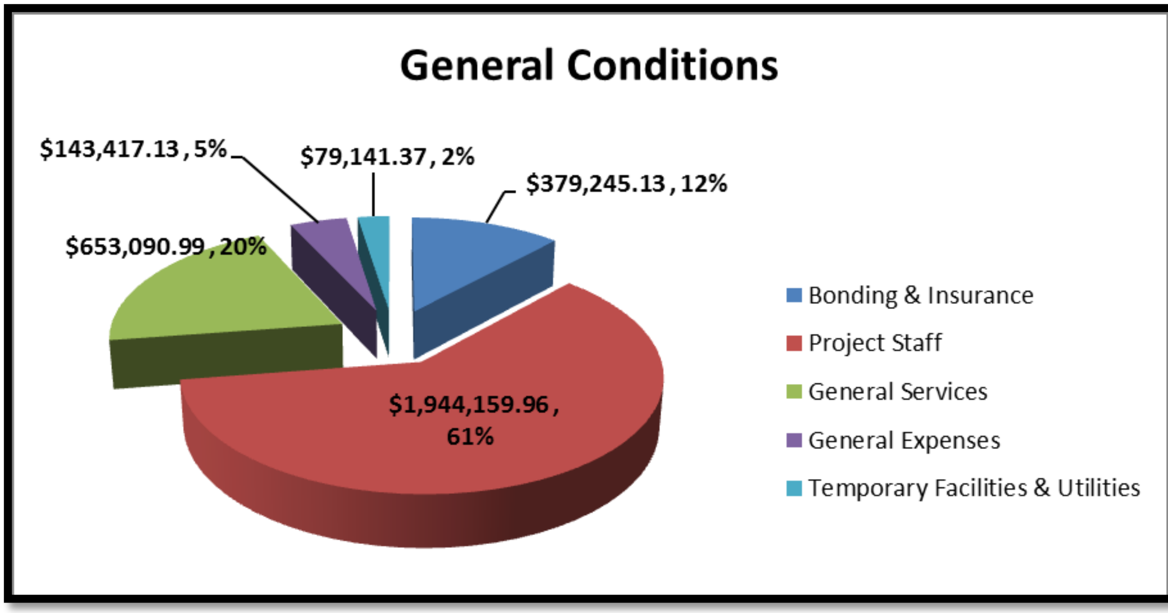


Figure 4: General Conditions by Percentage – Developed by Kendall Mahan

To convey a better depiction of the cost breakdown within the General Conditions, Fig. 4 above shows each category and its respected percentage and costs. Altogether, the General Conditions values estimated represent a reasonable estimate for a typical project at 11.3% of the total contract value. The driving factor is most notably the project staff and for that reason in order for Barton Malow to gain as much fee as possible for the project, it is dire that the team completes its work on schedule, if not faster. Although Barton Malow is utilizing a GMP contract, an accelerated schedule still results in the early removal of temporary facilities, temporary utilities, and project personnel, which in turn results in higher profits for the company. Although General Condition’s estimates are composed of a level of variability, it is believed that the values estimates are very accurate for the Fort Pickett Regional Training Institute.

LEED Evaluation

Introduction

Figure 5: U.S. Green Building Council - Courtesy of USGBC

The Fort Pickett Regional Training Institute (RTI) is currently pursing LEED Silver under the Version 2.2 rating system, a system that significantly differs from the most up to date LEED 2009 rating system. Although the systems share a number of the same categories and credits, the weighting for each credit has been drastically altered, particularly within the Energy and Atmosphere category. Under the v2.2 rating system, the RTI obtained a score of 38 out of 69 as seen in Appendix C-1, which earned LEED Silver and one credit from LEED Gold, but after evaluating the RTI using the LEED 2009 system, the RTI only reached a score of 53 out of 110 as seen in Appendix C-2, just qualifying for a LEED Silver rating. Although evaluating the buildings under both systems resulted in a LEED Silver rating, the RTI performed drastically better in the former version, since the energy credits were much less emphasized and weighted lighter under the older system. Regardless of the system utilized, the RTI was designed and constructed under stringent guidelines provided by the Army Corps of Engineers, which were very specific for energy purposes, but did not require or intend to obtain LEED certification. The decision to pursue LEED certification was made by Barton Malow, in order to gain further experience in green construction, as well as to provide the client with a better product. For this reason, the RTI was designed and constructed in the most efficient method to earn credits, while remaining within the Virginia Army National Guard's tight regulations. After conducting a thorough investigation of the LEED 2009 scoring system, which can be seen below in Fig. 6, it is believed that the RTI was constructed within the appropriate LEED Silver rating.

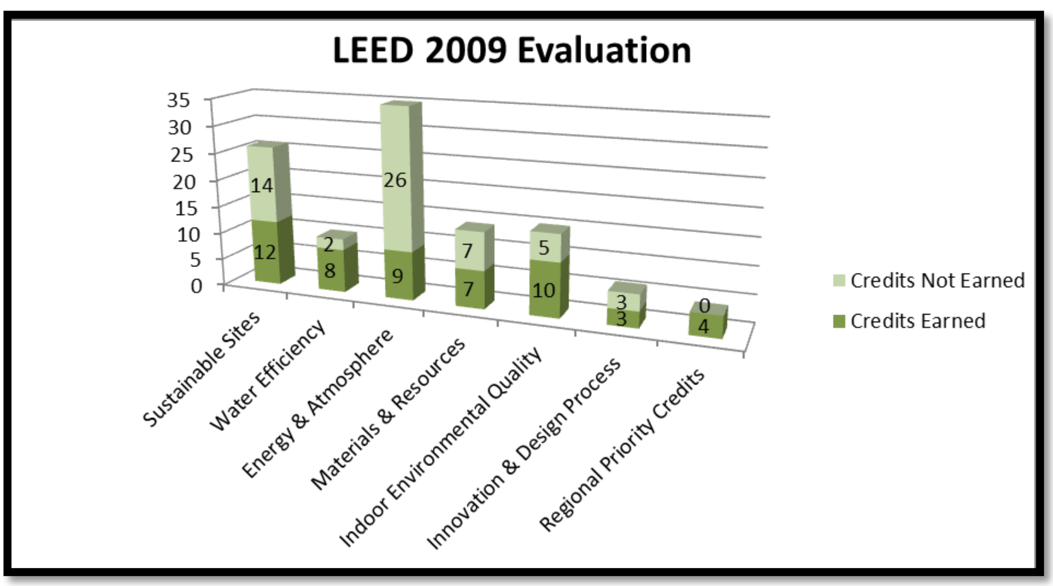


Figure 6: LEED 2009 Evaluation - Developed by Kendall Mahan

Sustainable Sites

Within the LEED 2009 scoring system, the RTI obtained a possible 12 out of 26 points, a score that is more than satisfactory considering the location of the site selected by the Virginia Army National Guard. The Sustainable Sites category is intended to reduce pollution and minimize its impact on the environment by selecting an environmentally site and materials. Although many of these credits can be controlled, a number of them are captured by simply choosing a favorable site. Since Fort Pickett Military Base is isolated from any nearby urban environments or public transportation, the RTI is at a disadvantage of not gaining eleven possible credits from the Development Density and Community Connectivity category and Public Transportation Access category. Where Barton Malow excelled was in the design of the actual buildings constructed, credits that are controllable under any circumstance. Barton Malow Design utilized a strategy that allowed the project to create a green environment without sacrificing the requirements set forth by the Army Corps of Engineers, as well as not costing Barton Malow a considerable amount of money to earn these credits. The design consisted of providing bicycle storage and changing rooms within the specified distance from the entrances, provided preferred parking to fuel-efficient vehicles, controlled the amount of parking allotted to the full time equivalent occupants, and reduced the amount of exterior and interior lighting utilized by the buildings. Barton Malow was also conscious of the site that the buildings occupied by restoring the natural habitat that was impacted during construction. All site disturbances were limited to the required specifications, a vegetated open space was designed within the campus quadrangle and around the buildings, and stormwater was controlled both quantitatively and qualitatively. The only potential credits that could have been obtained were for reducing the Heat Island Effect, which were not possible, due to the strict restrictions required by the Army Corps of Engineers within the RFP and the additional costs accrued to these types of materials. Altering colors and materials would have drastically altered the image of the buildings, something that was not intended to be sacrificed to gain LEED points. All in all, Barton Malow excelled in the Sustainable Sites category by obtaining every credit that could have been possibly earned.

Water Efficiency

The strongest score achieved by Barton Malow was in the Water Efficiency category with a score of 8 out of 10 under the LEED 2009 system. The Water Efficiency topic exists to reduce the burden on municipal water supply and wastewater systems, which is exactly what was performed using smart building design and construction. The first item addressed was a complete use of non-potable water from a nearby retention pond for landscaping, which removed potential negative effects generated from treating water on the environment. Low flow fixtures were also used throughout the buildings to minimize the amount of water used, resulting in a 40% reduction in water use. Where there was room for improvement was in the Innovative Wastewater Technologies credits, but without investing a significant amount of money, this option was not feasible or in the best interest of either party for only two credits.

Energy and Atmosphere

As other topics excelled, Energy and Atmosphere struggled towards reaching LEED credits with only 9 out of a possible 35 credits collected. The Energy and Atmosphere credits strive to reduce the amount of energy utilized during construction and the use of the buildings, while minimizing the impact on the atmosphere and environment. As mentioned earlier, where the Energy and Atmosphere scores struggled in the v2.2 system, it was further exposed in the 2009 system. The buildings were designed to optimize the energy performance by over 24%, resulting in 7 out of a potential 19 credits. Although this was a significant savings in comparison to baseline buildings, there remains an enormous gap for improvement. A central glycol loop system, heat pumps supplying multiple rooms, and fluorescent luminaries with T-5 lamps contributed to the energy reduction, but there still exists drastic room for greater energy efficiency. Unaware of the costs associated with upgrading some of the systems, it is certainly recommended that other energy utilizing systems are investigated and potentially put into place, as long as the prices of these changes do not negatively impact the responsible parties' wallets. Another recommendation, although expensive, would be to invest in renewable on-site energy. This would be an investment not only for the RTI, but rather it could be used on future endeavors. Solar powered temporary lighting is growing in popularity throughout the construction industry and is something of value to not only this one particular project, but for other projects trying to achieve LEED certification. This would have to be a significant investment to the company, but by achieving only 13% renewable energy on-site, every Barton Malow project would begin construction with seven points. Although the Virginia Army National Guard is not concerned with obtaining LEED certification, an easily obtainable 2 points can be found in the Green Power credits. If Owner chose to engage in a contract to supply at least 35% of the buildings' energy with renewable energy, the project could be enhanced with a lessened carbon footprint on the environment and a higher LEED rating. Other potential gains in scoring regard the testing and commissioning of the buildings. Although these items can be easily achieved, they do typically result in elevated costs, an item that is not in the best interest of Barton Malow or the VAARNG. Under the current set of circumstances, the project obtained an acceptable amount of credits within the Energy and Atmosphere category, but there certainly exists gains to be found through more efficient building systems, purchasing a Green

Energy contract from the local utilities, and investing in on-site green technology, which is a less likely option for this particular project.

Materials and Resources

Within the Materials and Resources area, the RTI performed exceptionally well considering its lack of existing materials and resources on-site with a score of 7 of a possible 14. The intent of this category is to select materials and resources that minimize waste through the act and use of choosing recycled and environmentally friendly products. As previously mentioned, the RTI started construction at the disadvantage of not selecting an existing site with existing materials present, resulting in a loss of four potential points. Although these items put the project team at a disadvantage, they excelled in the other items. The team was able to successfully divert over 75% of construction waste from landfills to a nearby facility to be sorted and recycled. The buildings were also designed to utilize over 30% recycled materials and over 40% regional materials. These credits extended well past the minimum requirements for points in their respected topics, as well as served as Innovations and Design Process credits. Items that did not meet LEED standards were the Materials Reuse and Rapidly Renewable Materials topics. Although these items were considered to be incredibly environmentally friendly, the increased investment in time and cost was not found to be in the best interest of the project team. Without dedicating a significant amount of time into obtaining favorable materials, it was believed that the RTI utilized methods well above acceptable standards.

Indoor Environmental Quality

Another category that succeeded towards delivering a green-building was Indoor Environmental Quality, where the RTI scored a 10 out of 15 points. With the new construction being billeting buildings for occupants to sleep in, it was critical for this category to meet heightened expectations. For this reason, the project team enacted Indoor Air Quality (IAQ) plans for construction and occupancy, which earned two points total. The selection and installation of low-emitting materials earned the RTI an additional four points, items that required no additional costs, just careful selection in design. Another two credits were earned in the proper design of the mechanical system to meet thermal comfort standards according to ASHRAE. Where the project team lost points was in cost and energy involving design features. The RTI failed to utilize a monitoring system for outdoor air, which could negatively impact the IAQ of the building, but would have elevated the cost of the mechanical system. In addition to this point gap regarding the mechanical system, it was also believed to be in the best interest of the operating cost of the building to limit the outside air delivered to the building. By introducing more fresh air, the energy efficiency of the building is dampened, which creates a lower score in the Energy and Atmosphere category and increases the operating cost of the building. For these reasons, the credits can easily be disregarded. To further the energy discussion, the RTI did not meet the requirements for daylighting, since it was believed to be more beneficial to institute a more energy efficient building than occupant appealing building. The design utilized acceptable lighting standards, but simply failed to meet the high LEED standards, a sacrifice that was necessary in order to meet energy goals. Without exacerbating construction and operating costs, the methods selected and carried out on the RTI are more than sufficient and had no room for improvement.

Innovation and Design Process

The Innovation and Design Process was introduced to allow projects to exceed the standards through innovative practices or exceptional techniques. Within this category, the RTI was able to acquire three additional points by incorporating over 30% recycled materials and 40% regional materials into the buildings' design, far beyond the standards proposed in LEED 2009. In addition, the Project Engineer served as the LEED Accredited Professional on-site, which earned the project an additional point.

Regional Priority Credits

The Regional Priority Credits were enacted in LEED 2009 to place an emphasis on reaching credits that are of high concern to specific regions of the country. In regards to the RTI, the team was able to reach four of the possible six bonus credits, which happens to be the capacity in the category. By reducing parking capacity, reducing the quantity of stormwater, reducing light pollution, and diverting over 50% of the construction waste from landfills into recycling facilities, the RTI was able to take full advantage of the new category.

Recommendation

Currently, the Fort Pickett Regional Training Institute is on course to reach a LEED Silver rating, a grade that is highly regarded within the building industry and well above the expectations of the Owner. The Virginia Army National Guard set forth guidelines to follow, but Barton Malow took on the responsibility of lessening the environmental impact of its construction through innovative design, appropriate planning, and the use of favorable materials in an attempt to transform the once simple construction into a LEED certified structure. After looking into a number of the categories, it is clear that Barton Malow has done a commendable effort to acquire the most obtainable credits while minimizing the costs in doing so.

Within the Sustainable Site, Water Efficiency, and Materials and Resources categories, Barton Malow was able to reach nearly every credit that was not limited by deep cost endeavors, the desired building site location, and the Army Corps of Engineer's restrictions. Every credit that did not hinder the energy efficiency of the building within the Indoor Environmental Quality category was put place on the project. Within the Innovation and Design Process category, Barton Malow was to surpass the high standards proposed by the USGBC and earn an additional three credits. They even were able to capitalize on the Regional Priority Credits category by reaching the full maximum of credits that can be earned. Where I do believe that there was room to make a significant leap forward and potentially earn LEED Gold was in the Energy and Atmosphere category. The project struggled with a dismal 9 out of 35 score. Although the energy performance performed adequately there was room for improvement with the current system only reaching around one third of the credits available. A quick two credits that could have been easily obtained would have been through the VAARNG's methods by signing a Green Energy contract with the local utilities, credits that take minimal effort to acquire. Another recommendation would be for Barton Malow to pursue on-site renewable energy generation. This equipment would be looked at as an investment for both the RTI, as well as future work in the region and could provide the needed seven credits to reach a LEED Gold rating.

LEED certification is a process that is believed to be in the best interest of all parties associated with the building project, but without the full cooperation of one of those parties, the full potential of the building rating is confined. Since the VAARNG was restricted by the funds they were granted by Congress, it limited their desire to invest in costly green friendly endeavors over more functional spending practices. Steps such as signing a contract to acquire green power, the willingness to use more environmentally materials, and a higher contract value to reflect the installation of more green friendly equipment, such as an on-site waste water treatment facility would have drastically changed this project's fate. Barton Malow not only met, but exceeded the expectations that many would expect given their circumstances. With an additional seven credits to obtain in order to reach LEED Gold and a minimal credits remaining that will not burden both parties' financial investments into the project, it appears that their work has met its limit. After conducting a detailed analysis of the Fort Pickett Regional Training Institute for Phase II, it is believed to be in the best interest of Barton Malow and the Virginia Army National Guard to maintain their current path and pursue a LEED Silver rating.

Building Information Modeling Use Evaluation

The Fort Pickett Regional Training Institute project was delivered as a Design-Build delivery method making the use of a Building Information Modeling (BIM) Execution Plan an optimal opportunity to enhance coordination, estimation, and designs. Within the various uses of BIM, the project team at Barton Malow primarily used 3D Coordination and 3D Control and Planning, which was believed to aid in coordination considerably, where their BIM model can be observed below in Fig. 7. Although Barton Malow successfully utilized BIM for these particular values, BIM was used sparingly and could have been greatly expanded upon to create additional opportunities for savings, shortened durations, and higher Owner satisfaction. After reviewing The Pennsylvania State University's BIM Execution Plan, it was found that it would have been in the best interest of all of the involved parties to include Cost Estimations, Design Authoring, Design Reviews, LEED Evaluations, 3D Coordination, 3D Control and Planning, Record Modeling, and Asset Management in their BIM Execution Plan.

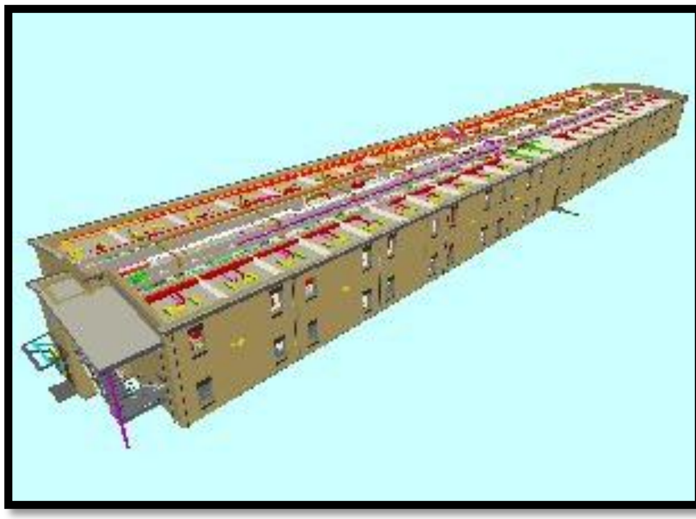


Figure 7: BIM Model - Courtesy of Barton Malow

For the Regional Training Institute, it was important to establish a number of goals to achieve for the BIM Execution Plan, which can be seen in Appendix E-1. Using the goals, BIM uses were selected that correlated with reaching the goals successfully. Once these goals and uses were established, the uses were evaluated to aid in the decision whether or not to pursue that particular goal, which can be seen in Appendix E-2. After conducting an evaluation, a formal decision was made to proceed with the uses that were expected to be beneficial to the project. The results to this analysis can be observed in Appendix E-3, as well as the phase in which these uses are to be enacted. This selection process was based upon the complexity of the building systems, the site, and experience of the involved parties. Finally, a Level 1 BIM Execution Planning Process was manufactured to aid in the enactment of the plan, which can be seen in Appendix E-4. This process map shows a more detailed structure of the process proposed for the RTI, including the BIM uses, design phases, and information exchanges.

The first BIM use selected was Cost Estimation, the idea of using the BIM model to produce take-off and cost estimates of the buildings. Cost Estimation was chosen for a number of key reasons, specifically for the ability to change design options and generate a quick cost impact report. The use of Cost Estimation for the project was believed to be most beneficial during the planning, design, and construction phases, but not for the occupancy phase due to the lack of experience and personnel to operate the model. Value engineering techniques have been an activity that has taken place in the building industry for years, but with the use of Cost Estimation throughout the project's life, it is possible to explore various options efficiently. The use of Cost Estimation has the capability of reducing the time required to conduct quantity take-offs, since the model can provide an accurate take-off of all desired building systems and components. This reduction in estimating time can be incredibly beneficial in reducing overhead in the office within the estimating department. In addition, change orders in the field can be easily conducted using the BIM model if the material pricing is correctly attached to the model.

The next BIM use selected was Design Authoring, a step that was believed to be crucial in the development of other BIM uses. Design Authoring is the process of combining all of the building documents and files into one 3D model, which can later be used for linking databases of quantities, properties, and costs. This use acts a step between other uses by updating information between each design phase until an accurate final product is reached. Design Authoring is the most fundamental and key BIM use found on the process map and BIM Execution Plan.

Design Reviews was the next use chosen, a use that was believed to be incredibly valuable towards developing good working relationships and resolve potentially costly future changes. Design Reviews have the ability to eliminate costly traditional mock-ups and give the Virginia Army National Guard the opportunity to examine the desired design prior to construction. This creates higher Owner satisfaction, as well as reduces the chance of experiencing a change order. In addition to selecting proper building components, the time and cost of producing a physical, traditional mock-up can be eliminated and replaced with cheaper and less timely computer renderings, something of great significance to Barton Malow. This process takes place throughout the design phase, but is particularly important when finalizing a design.

In coordination with the Design Authoring BIM use, LEED Evaluations can be incredibly beneficial to the project team through the use of the proposed BIM Execution Plan. The greatest benefit of using the LEED Evaluation use was that it could be used to track materials through a database. Specifically in the Materials and Resources LEED 2009 category, a BIM model could provide accurate quantities of the materials used on the building, which aids in tracking LEED credits. The BIM model could also be used to reduce wasted materials through clash detection, which in turn could lead to reduced materials to be recycled or disposed of. This step was found to be most beneficial during the design and construction phases, and a tremendous aid in the project team's initiative to obtain a LEED Silver rating. Within the process map, LEED Evaluations require the involvement of all parties, an idea that differs from all other BIM uses. In order to maximize the potential to deliver the greenest building possible, it is critical to involve all project parties within the initial design phases.

The next and largest advantage to enacting a BIM Execution Plan on the RTI was the use of 3D Coordination. This use involves the ability to conduct clash detection in order to determine field conflicts between the building systems prior to construction. 3D Coordination has the opportunity to save an enormous amount of money and time by eliminating burdensome Requests for Interpretations. With a strict construction schedule and budget, the RTI serves as the perfect example for the use of 3D coordination. Not only does this use benefit the construction team, but it also saves the designer, Barton Malow Design, an enormous amount of effort in producing as-built drawings, since there should be minimal changes to the construction drawings.

Building upon the use of 3D Coordination, 3D Control and Planning has the opportunity to make the same impact on the job-site. 3D Control and Planning involves the process of creating lift drawings from the model. The lift drawings provide the Subcontractors clearer and more detailed drawings for construction of the buildings. The RTI could greatly benefit from this use, due to tight project schedule being followed by Barton Malow. The use of this step has the potential of reducing layout errors in the field and shortening the overall project schedule. Both 3D Coordination and 3D Control and Planning are to be utilized throughout the design process with significant rewards to be found during the construction phase.

The next BIM use selected was Record Modeling, the idea of attaching all relative design and construction information to the model as a final product for both Barton Malow and the Virginia Army National Guard. Barton Malow serves to benefit from this step by having the model as a historical document for future endeavors with the client and for legal disputes. The model has the ability to act as proper documentation for proper equipment and facility operations and maintenance, which can be used to minimize risk and serve as legal evidence of the final product. The Record Modeling steps are to be enacted during construction and completed as the as-built drawings are finalized, where they can then be turned over to the Virginia Army National Guard for use during occupancy. The Record Model is introduced towards the end of the process map and stems from the 3D Coordination work with the building model.

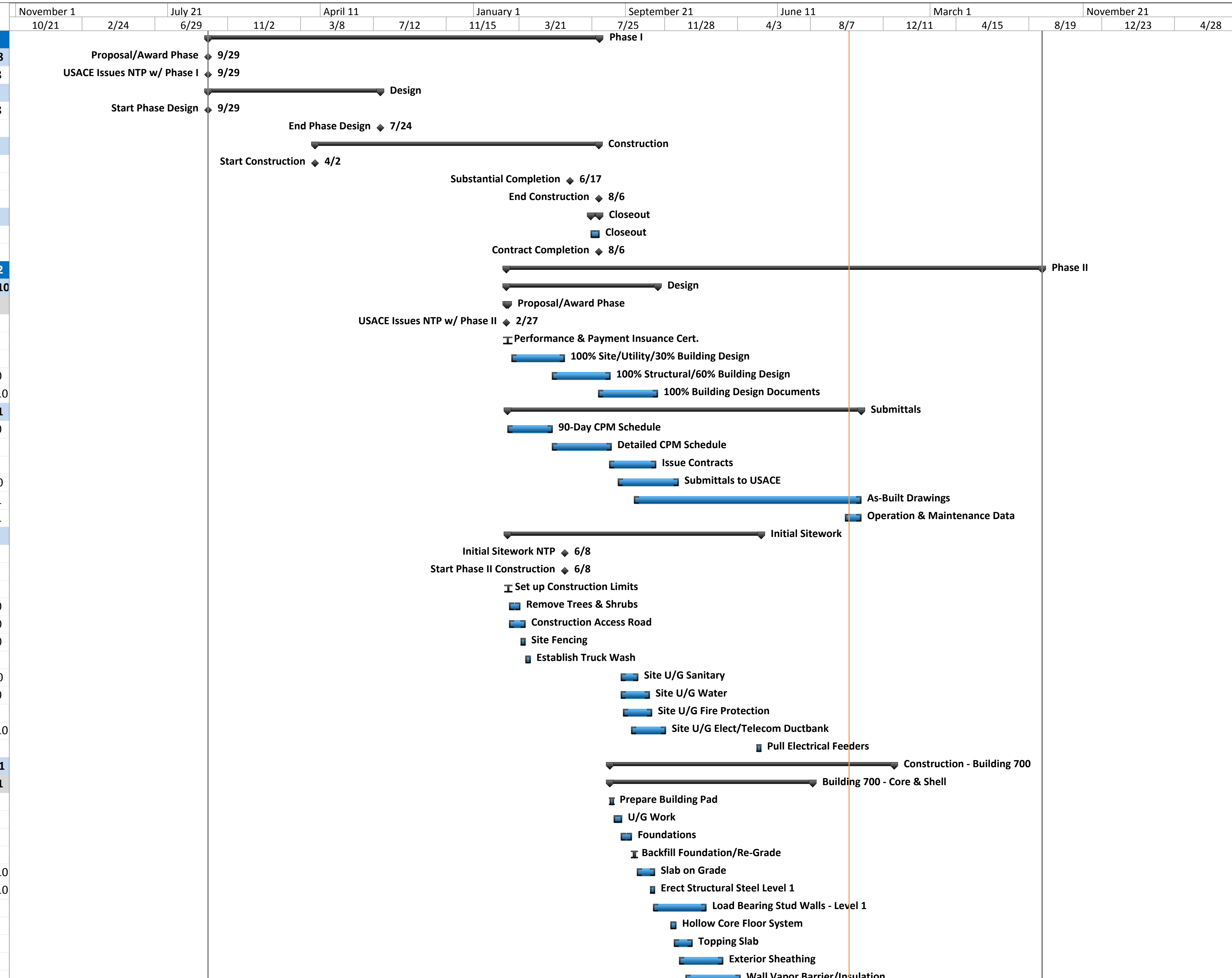
Last but not least, the use of Asset Management can be incredibly beneficial to the Virginia Army National Guard in determining future financial decisions. The Virginia Army National Guard can use the model to serve as a database of the building. All information regarding costs, properties, operations, and maintenance can be attached to the model for future references. This provides an accurate database of information for the facility manager, which ensures improved building maintenance and operations. It also allows the opportunity to conduct expedited renovations and expansions to the building, since all relative information can be drawn from the model. This BIM use expands on the Record Model, which is developed and finalized following the issuing of the construction documents.

BIM continues to develop into a tool of great benefit to both building industry professionals and owners alike. The BIM Execution Plan and its components provide a structured approach in determining the appropriate BIM uses to pursue, and although the BIM Execution Plan is composed of a number of BIM uses, the uses mentioned earlier were believed to hold the greatest relevance to the goals that are intended to be achieved at the Fort Pickett Regional Training. It is therefore in the best interest of the Fort Pickett Regional Training Institute project to enact the BIM uses outlined in order to expedite the project schedule, reduce the project cost, and reach higher working relationships.

Appendix A

Detailed Project Schedule

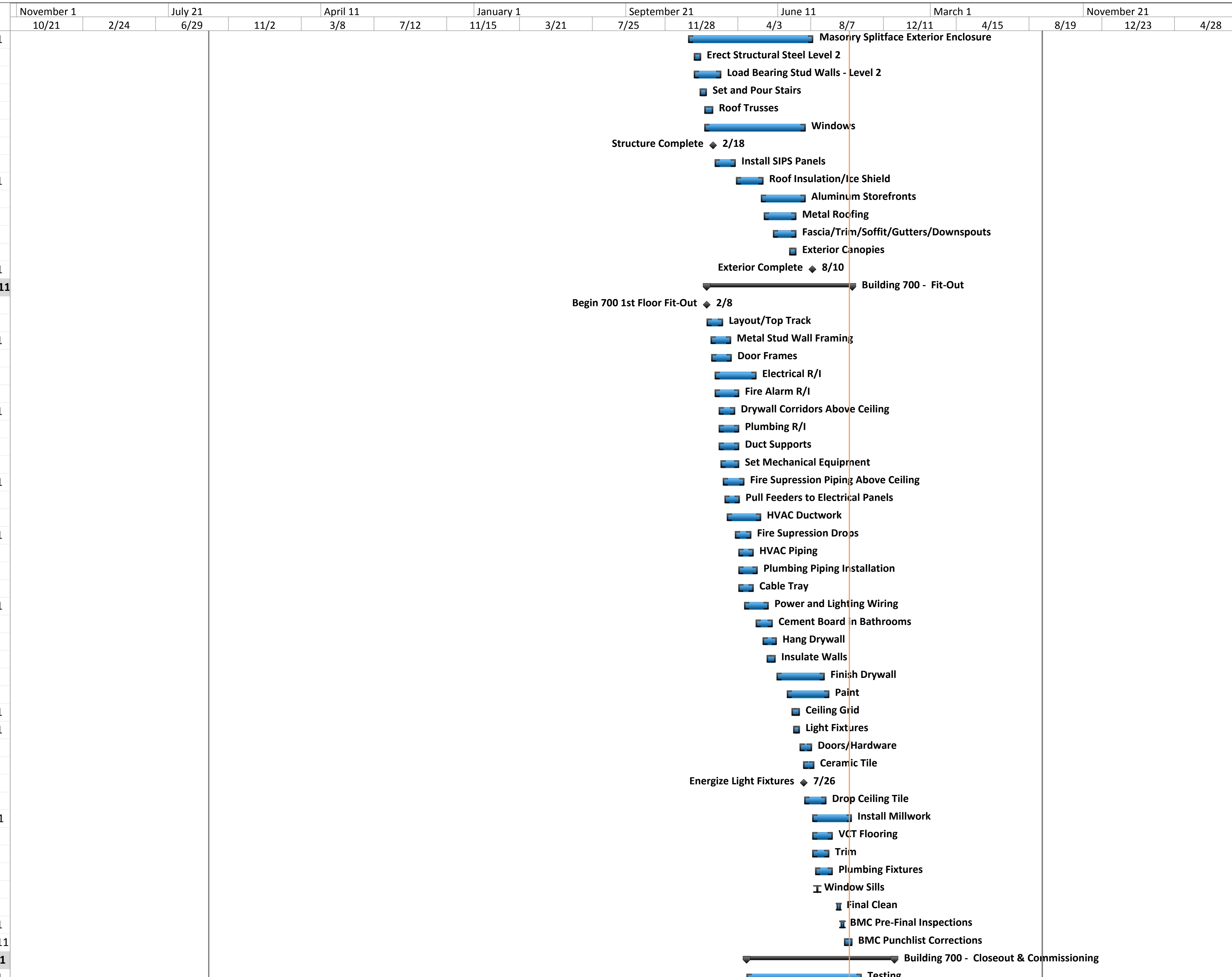
ID	Task Name	Duration	Start	Finish
1	**Phase I**	**485 days**	**Mon 9/29/08**	**Fri 8/6/10**
2	**Proposal/Award Phase**	**0 days**	**Mon 9/29/08**	**Mon 9/29/08**
3	USACE Issues NTP w/ Phase I	0 days	Mon 9/29/08	Mon 9/29/08
4	**Design**	**214 days**	**Mon 9/29/08**	**Fri 7/24/09**
5	Start Phase Design	0 days	Mon 9/29/08	Mon 9/29/08
6	End Phase Design	0 days	Fri 7/24/09	Fri 7/24/09
7	**Construction**	**351 days**	**Thu 4/2/09**	**Fri 8/6/10**
8	Start Construction	0 days	Thu 4/2/09	Thu 4/2/09
9	Substantial Completion	0 days	Thu 6/17/10	Thu 6/17/10
10	End Construction	0 days	Fri 8/6/10	Fri 8/6/10
11	**Closeout**	**11 days**	**Fri 7/23/10**	**Fri 8/6/10**
12	Closeout	11 days	Fri 7/23/10	Fri 8/6/10
13	Contract Completion	0 days	Fri 8/6/10	Fri 8/6/10
14	**Phase II**	**661 days**	**Sat 2/27/10**	**Mon 9/10/12**
15	**Design**	**186 days**	**Sat 2/27/10**	**Mon 11/15/10**
16	**Proposal/Award Phase**	**1 day**	**Sat 2/27/10**	**Mon 3/1/10**
17	USACE Issues NTP w/ Phase II	0 days	Sat 2/27/10	Sat 2/27/10
18	Performance & Payment Insuance Cert.	1 day	Mon 3/1/10	Mon 3/1/10
19	100% Site/Utility/30% Building Design	66 days	Mon 3/8/10	Mon 6/7/10
20	100% Structural/60% Building Design	73 days	Mon 5/17/10	Wed 8/25/10
21	100% Building Design Documents	73 days	Thu 8/5/10	Mon 11/15/10
22	**Submittals**	**438 days**	**Mon 3/1/10**	**Wed 11/2/11**
23	90-Day CPM Schedule	56 days	Mon 3/1/10	Mon 5/17/10
24	Detailed CPM Schedule	75 days	Mon 5/17/10	Fri 8/27/10
25	Issue Contracts	59 days	Tue 8/24/10	Fri 11/12/10
26	Submittals to USACE	75 days	Wed 9/8/10	Tue 12/21/10
27	As-Built Drawings	281 days	Wed 10/6/10	Wed 11/2/11
28	Operation & Maintenance Data	20 days	Thu 10/6/11	Wed 11/2/11
29	**Initial Sitework**	**315 days**	**Mon 3/1/10**	**Fri 5/13/11**
30	Initial Sitework NTP	0 days	Tue 6/8/10	Tue 6/8/10
31	Start Phase II Construction	0 days	Tue 6/8/10	Tue 6/8/10
32	Set up Construction Limits	3 days	Mon 3/1/10	Wed 3/3/10
33	Remove Trees & Shrubs	13 days	Thu 3/4/10	Mon 3/22/10
34	Construction Access Road	20 days	Thu 3/4/10	Wed 3/31/10
35	Site Fencing	6 days	Wed 3/24/10	Wed 3/31/10
36	Establish Truck Wash	7 days	Thu 4/1/10	Fri 4/9/10
37	Site U/G Sanitary	22 days	Mon 9/13/10	Tue 10/12/10
38	Site U/G Water	36 days	Mon 9/13/10	Mon 11/1/10
39	Site U/G Fire Protection	36 days	Fri 9/17/10	Fri 11/5/10
40	Site U/G Elect/Telecom Ductbank	42 days	Fri 10/1/10	Mon 11/29/10
41	Pull Electrical Feeders	6 days	Fri 5/6/11	Fri 5/13/11
42	**Construction - Building 700**	**352 days**	**Wed 8/25/10**	**Thu 12/29/11**
43	**Building 700 - Core & Shell**	**251 days**	**Wed 8/25/10**	**Wed 8/10/11**
44	Prepare Building Pad	5 days	Wed 8/25/10	Tue 8/31/10
45	U/G Work	10 days	Wed 9/1/10	Tue 9/14/10
46	Foundations	15 days	Mon 9/13/10	Fri 10/1/10
47	Backfill Foundation/Re-Grade	5 days	Mon 10/4/10	Fri 10/8/10
48	Slab on Grade	23 days	Mon 10/11/10	Wed 11/10/10
49	Erect Structural Steel Level 1	6 days	Wed 11/3/10	Wed 11/10/10
50	Load Bearing Stud Walls - Level 1	66 days	Mon 11/8/10	Mon 2/7/11
51	Hollow Core Floor System	8 days	Wed 12/8/10	Fri 12/17/10
52	Topping Slab	24 days	Tue 12/14/10	Fri 1/14/11
53	Exterior Sheathing	54 days	Thu 12/23/10	Tue 3/8/11
54	Wall Vapor Barrier/Insulation	69 days	Mon 1/3/11	Thu 4/7/11



Project: Detailed Project Schedule
Date: Thu 10/13/11

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

ID	Task Name	Duration	Start	Finish
55	Masonry Splitface Exterior Enclosure	154 days	Fri 1/7/11	Wed 8/10/11
56	Erect Structural Steel Level 2	10 days	Mon 1/17/11	Fri 1/28/11
57	Load Bearing Stud Walls - Level 2	35 days	Mon 1/17/11	Fri 3/4/11
58	Set and Pour Stairs	8 days	Thu 1/27/11	Mon 2/7/11
59	Roof Trusses	11 days	Fri 2/4/11	Fri 2/18/11
60	Windows	125 days	Fri 2/4/11	Thu 7/28/11
61	Structure Complete	0 days	Fri 2/18/11	Fri 2/18/11
62	Install SIPS Panels	26 days	Tue 2/22/11	Tue 3/29/11
63	Roof Insulation/Ice Shield	33 days	Thu 3/31/11	Mon 5/16/11
64	Aluminum Storefronts	55 days	Fri 5/13/11	Thu 7/28/11
65	Metal Roofing	40 days	Wed 5/18/11	Tue 7/12/11
66	Fascia/Trim/Soffit/Gutters/Downspouts	28 days	Fri 6/3/11	Tue 7/12/11
67	Exterior Canopies	8 days	Fri 7/1/11	Tue 7/12/11
68	Exterior Complete	0 days	Wed 8/10/11	Wed 8/10/11
69	**Building 700 - Fit-Out**	**180 days**	**Tue 2/8/11**	**Mon 10/17/11**
70	Begin 700 1st Floor Fit-Out	0 days	Tue 2/8/11	Tue 2/8/11
71	Layout/Top Track	20 days	Tue 2/8/11	Mon 3/7/11
72	Metal Stud Wall Framing	25 days	Tue 2/15/11	Mon 3/21/11
73	Door Frames	25 days	Wed 2/16/11	Tue 3/22/11
74	Electrical R/I	52 days	Tue 2/22/11	Wed 5/4/11
75	Fire Alarm R/I	30 days	Tue 2/22/11	Mon 4/4/11
76	Drywall Corridors Above Ceiling	20 days	Tue 3/1/11	Mon 3/28/11
77	Plumbing R/I	25 days	Tue 3/1/11	Mon 4/4/11
78	Duct Supports	25 days	Tue 3/1/11	Mon 4/4/11
79	Set Mechanical Equipment	22 days	Fri 3/4/11	Mon 4/4/11
80	Fire Supression Piping Above Ceiling	27 days	Tue 3/8/11	Wed 4/13/11
81	Pull Feeders to Electrical Panels	18 days	Fri 3/11/11	Tue 4/5/11
82	HVAC Ductwork	43 days	Tue 3/15/11	Thu 5/12/11
83	Fire Supression Drops	20 days	Tue 3/29/11	Mon 4/25/11
84	HVAC Piping	20 days	Mon 4/4/11	Fri 4/29/11
85	Plumbing Piping Installation	25 days	Mon 4/4/11	Fri 5/6/11
86	Cable Tray	20 days	Mon 4/4/11	Fri 4/29/11
87	Power and Lighting Wiring	30 days	Thu 4/14/11	Wed 5/25/11
88	Cement Board in Bathrooms	21 days	Wed 5/4/11	Wed 6/1/11
89	Hang Drywall	18 days	Mon 5/16/11	Wed 6/8/11
90	Insulate Walls	11 days	Mon 5/23/11	Mon 6/6/11
91	Finish Drywall	59 days	Thu 6/9/11	Tue 8/30/11
92	Paint	53 days	Mon 6/27/11	Wed 9/7/11
93	Ceiling Grid	10 days	Tue 7/5/11	Mon 7/18/11
94	Light Fixtures	7 days	Fri 7/8/11	Mon 7/18/11
95	Doors/Hardware	15 days	Tue 7/19/11	Mon 8/8/11
96	Ceramic Tile	15 days	Mon 7/25/11	Fri 8/12/11
97	Energize Light Fixtures	0 days	Tue 7/26/11	Tue 7/26/11
98	Drop Ceiling Tile	28 days	Wed 7/27/11	Fri 9/2/11
99	Install Millwork	49 days	Wed 8/10/11	Sun 10/16/11
100	VCT Flooring	25 days	Wed 8/10/11	Tue 9/13/11
101	Trim	21 days	Wed 8/10/11	Wed 9/7/11
102	Plumbing Fixtures	22 days	Mon 8/15/11	Tue 9/13/11
103	Window Sills	3 days	Wed 8/17/11	Fri 8/19/11
104	Final Clean	5 days	Wed 9/21/11	Tue 9/27/11
105	BMC Pre-Final Inspections	4 days	Wed 9/28/11	Mon 10/3/11
106	BMC Punchlist Corrections	10 days	Tue 10/4/11	Mon 10/17/11
107	**Building 700 - Closeout & Commissioning**	**184 days**	**Mon 4/18/11**	**Thu 12/29/11**
108	Testing	143 days	Mon 4/18/11	Wed 11/2/11

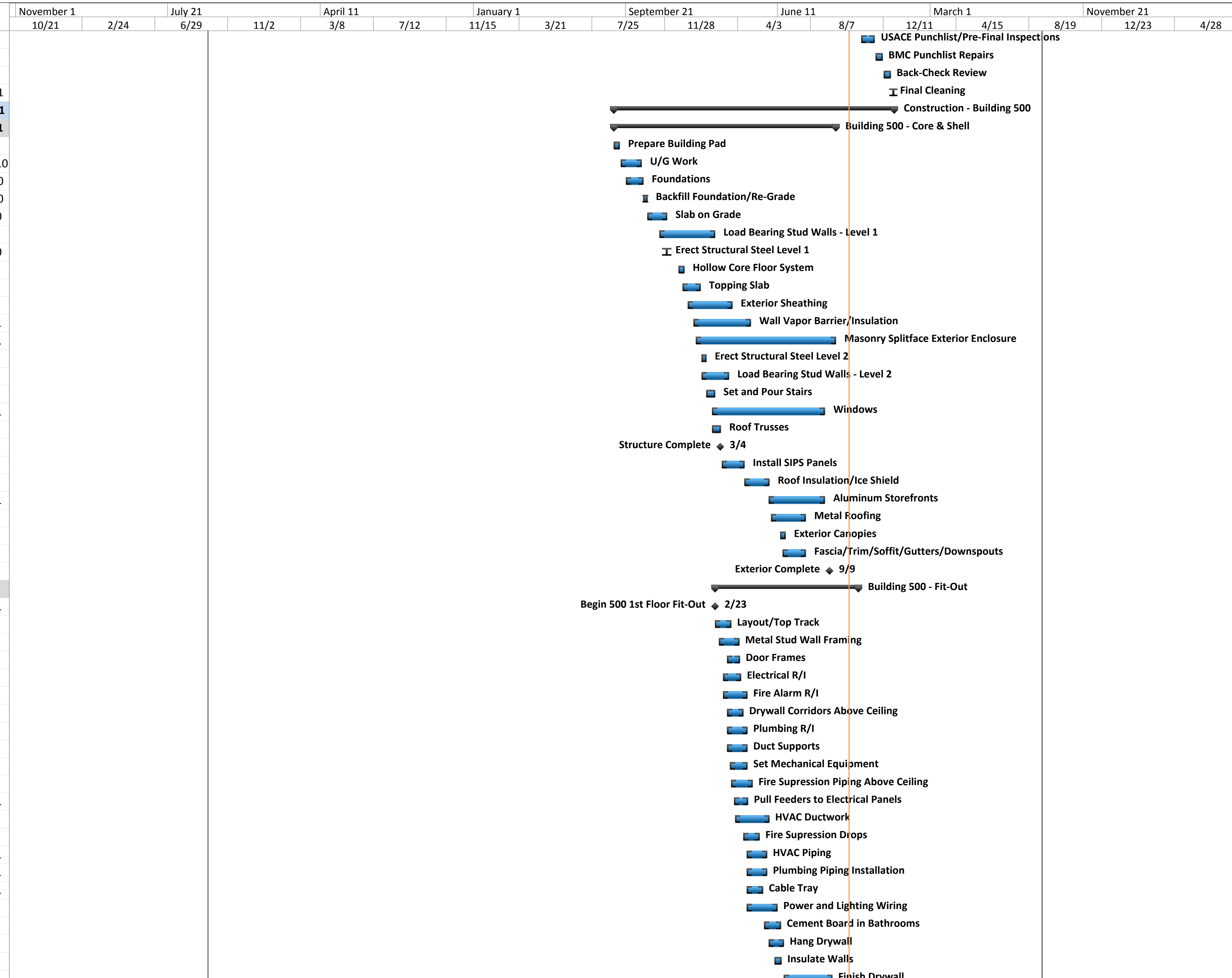


Project: Detailed Project Schedule
Date: Thu 10/13/11

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

Finish-only
Deadline
Progress

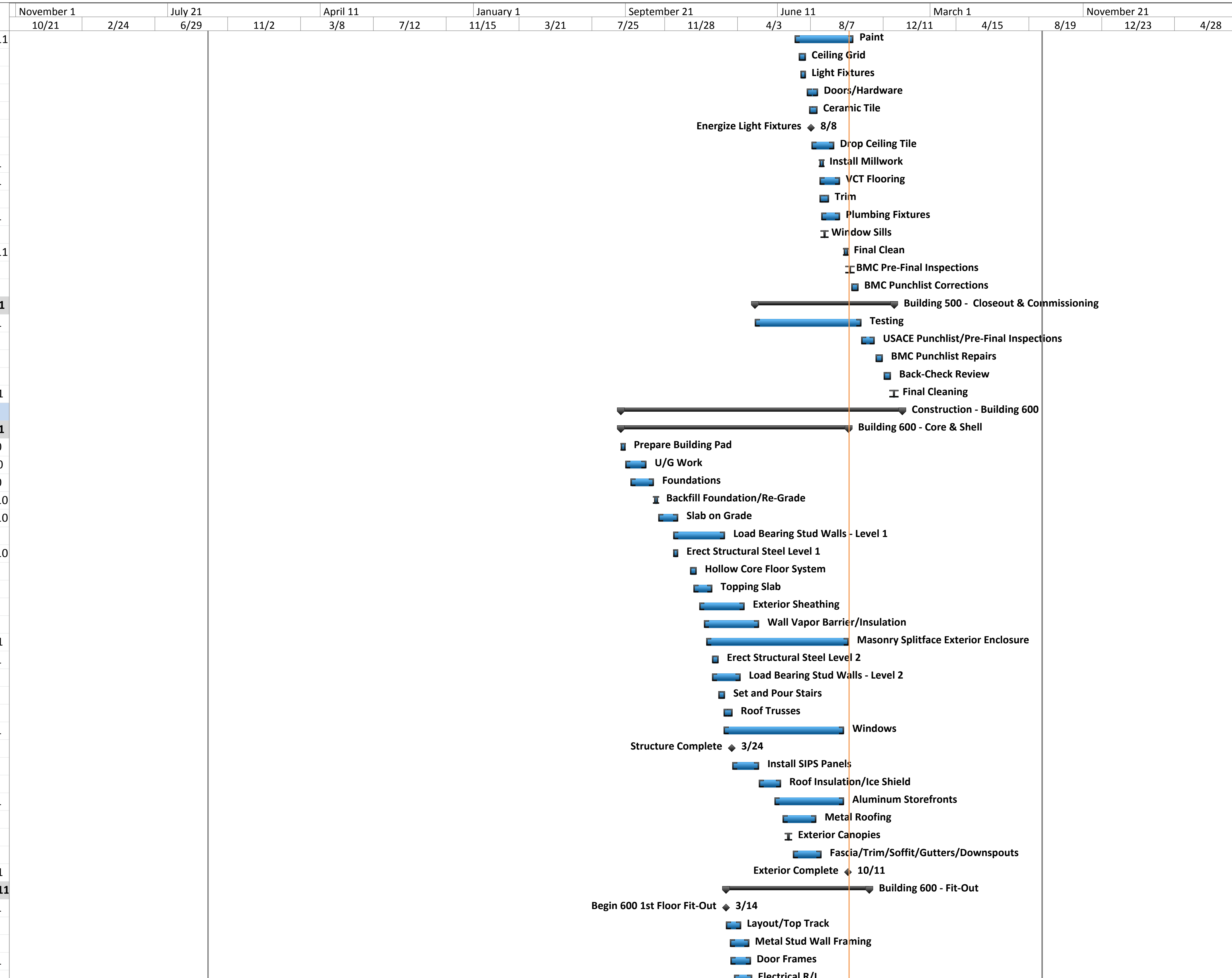
ID	Task Name	Duration	Start	Finish
109	USACE Punchlist/Pre-Final Inspections	17 days	Thu 11/3/11	Fri 11/25/11
110	BMC Punchlist Repairs	10 days	Mon 11/28/11	Fri 12/9/11
111	Back-Check Review	10 days	Mon 12/12/11	Fri 12/23/11
112	Final Cleaning	3 days	Tue 12/27/11	Thu 12/29/11
113	**Construction - Building 500**	**347 days**	**Wed 9/1/10**	**Thu 12/29/11**
114	**Building 500 - Core & Shell**	**274 days**	**Wed 9/1/10**	**Mon 9/19/11**
115	Prepare Building Pad	8 days	Wed 9/1/10	Fri 9/10/10
116	U/G Work	26 days	Mon 9/13/10	Mon 10/18/10
117	Foundations	22 days	Wed 9/22/10	Thu 10/21/10
118	Backfill Foundation/Re-Grade	5 days	Fri 10/22/10	Thu 10/28/10
119	Slab on Grade	24 days	Fri 10/29/10	Wed 12/1/10
120	Load Bearing Stud Walls - Level 1	68 days	Fri 11/19/10	Tue 2/22/11
121	Erect Structural Steel Level 1	1 day	Wed 12/1/10	Wed 12/1/10
122	Hollow Core Floor System	8 days	Wed 12/22/10	Fri 12/31/10
123	Topping Slab	23 days	Wed 12/29/10	Fri 1/28/11
124	Exterior Sheathing	55 days	Fri 1/7/11	Thu 3/24/11
125	Wall Vapor Barrier/Insulation	71 days	Mon 1/17/11	Mon 4/25/11
126	Masonry Splitface Exterior Enclosure	172 days	Fri 1/21/11	Mon 9/19/11
127	Erect Structural Steel Level 2	6 days	Mon 1/31/11	Mon 2/7/11
128	Load Bearing Stud Walls - Level 2	35 days	Mon 1/31/11	Fri 3/18/11
129	Set and Pour Stairs	11 days	Tue 2/8/11	Tue 2/22/11
130	Windows	139 days	Fri 2/18/11	Wed 8/31/11
131	Roof Trusses	11 days	Fri 2/18/11	Fri 3/4/11
132	Structure Complete	0 days	Fri 3/4/11	Fri 3/4/11
133	Install SIPS Panels	29 days	Mon 3/7/11	Thu 4/14/11
134	Roof Insulation/Ice Shield	31 days	Fri 4/15/11	Fri 5/27/11
135	Aluminum Storefronts	69 days	Fri 5/27/11	Wed 8/31/11
136	Metal Roofing	44 days	Tue 5/31/11	Fri 7/29/11
137	Exterior Canopies	7 days	Thu 6/16/11	Fri 6/24/11
138	Fascia/Trim/Soffit/Gutters/Downspouts	30 days	Mon 6/20/11	Fri 7/29/11
139	Exterior Complete	0 days	Fri 9/9/11	Fri 9/9/11
140	**Building 500 - Fit-Out**	**178 days**	**Wed 2/23/11**	**Fri 10/28/11**
141	Begin 500 1st Floor Fit-Out	0 days	Wed 2/23/11	Wed 2/23/11
142	Layout/Top Track	20 days	Wed 2/23/11	Tue 3/22/11
143	Metal Stud Wall Framing	25 days	Wed 3/2/11	Tue 4/5/11
144	Door Frames	16 days	Wed 3/16/11	Wed 4/6/11
145	Electrical R/I	23 days	Wed 3/9/11	Fri 4/8/11
146	Fire Alarm R/I	30 days	Wed 3/9/11	Tue 4/19/11
147	Drywall Corridors Above Ceiling	20 days	Wed 3/16/11	Tue 4/12/11
148	Plumbing R/I	25 days	Wed 3/16/11	Tue 4/19/11
149	Duct Supports	25 days	Wed 3/16/11	Tue 4/19/11
150	Set Mechanical Equipment	22 days	Mon 3/21/11	Tue 4/19/11
151	Fire Supression Piping Above Ceiling	27 days	Wed 3/23/11	Thu 4/28/11
152	Pull Feeders to Electrical Panels	18 days	Mon 3/28/11	Wed 4/20/11
153	HVAC Ductwork	43 days	Wed 3/30/11	Fri 5/27/11
154	Fire Supression Drops	20 days	Wed 4/13/11	Tue 5/10/11
155	HVAC Piping	25 days	Tue 4/19/11	Mon 5/23/11
156	Plumbing Piping Installation	25 days	Tue 4/19/11	Mon 5/23/11
157	Cable Tray	20 days	Tue 4/19/11	Mon 5/16/11
158	Power and Lighting Wiring	39 days	Tue 4/19/11	Fri 6/10/11
159	Cement Board in Bathrooms	21 days	Thu 5/19/11	Thu 6/16/11
160	Hang Drywall	18 days	Fri 5/27/11	Tue 6/21/11
161	Insulate Walls	10 days	Mon 6/6/11	Fri 6/17/11
162	Finish Drywall	60 days	Wed 6/22/11	Tue 9/13/11



Project: Detailed Project Schedule
Date: Thu 10/13/11

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

ID	Task Name	Duration	Start	Finish
163	Paint	73 days	Mon 7/11/11	Wed 10/19/11
164	Ceiling Grid	10 days	Mon 7/18/11	Fri 7/29/11
165	Light Fixtures	7 days	Thu 7/21/11	Fri 7/29/11
166	Doors/Hardware	15 days	Mon 8/1/11	Fri 8/19/11
167	Ceramic Tile	10 days	Fri 8/5/11	Thu 8/18/11
168	Energize Light Fixtures	0 days	Mon 8/8/11	Mon 8/8/11
169	Drop Ceiling Tile	29 days	Tue 8/9/11	Fri 9/16/11
170	Install Millwork	5 days	Tue 8/23/11	Mon 8/29/11
171	VCT Flooring	25 days	Tue 8/23/11	Mon 9/26/11
172	Trim	12 days	Tue 8/23/11	Wed 9/7/11
173	Plumbing Fixtures	22 days	Fri 8/26/11	Mon 9/26/11
174	Window Sills	3 days	Tue 8/30/11	Thu 9/1/11
175	Final Clean	5 days	Tue 10/4/11	Mon 10/10/11
176	BMC Pre-Final Inspections	1 day	Fri 10/14/11	Fri 10/14/11
177	BMC Punchlist Corrections	10 days	Mon 10/17/11	Fri 10/28/11
178	**Building 500 - Closeout & Commissioning**	**173 days**	**Tue 5/3/11**	**Thu 12/29/11**
179	Testing	132 days	Tue 5/3/11	Wed 11/2/11
180	USACE Punchlist/Pre-Final Inspections	17 days	Thu 11/3/11	Fri 11/25/11
181	BMC Punchlist Repairs	10 days	Mon 11/28/11	Fri 12/9/11
182	Back-Check Review	10 days	Mon 12/12/11	Fri 12/23/11
183	Final Cleaning	1 day	Thu 12/29/11	Thu 12/29/11
184	**Construction - Building 600**	**349 days**	**Mon 9/13/10**	**Thu 1/12/12**
185	**Building 600 - Core & Shell**	**282 days**	**Mon 9/13/10**	**Tue 10/11/11**
186	Prepare Building Pad	6 days	Mon 9/13/10	Mon 9/20/10
187	U/G Work	26 days	Tue 9/21/10	Tue 10/26/10
188	Foundations	28 days	Thu 9/30/10	Mon 11/8/10
189	Backfill Foundation/Re-Grade	4 days	Wed 11/10/10	Mon 11/15/10
190	Slab on Grade	24 days	Wed 11/17/10	Mon 12/20/10
191	Load Bearing Stud Walls - Level 1	65 days	Mon 12/13/10	Fri 3/11/11
192	Erect Structural Steel Level 1	6 days	Mon 12/13/10	Mon 12/20/10
193	Hollow Core Floor System	9 days	Tue 1/11/11	Fri 1/21/11
194	Topping Slab	24 days	Mon 1/17/11	Thu 2/17/11
195	Exterior Sheathing	56 days	Thu 1/27/11	Thu 4/14/11
196	Wall Vapor Barrier/Insulation	67 days	Fri 2/4/11	Mon 5/9/11
197	Masonry Splitface Exterior Enclosure	176 days	Tue 2/8/11	Tue 10/11/11
198	Erect Structural Steel Level 2	7 days	Fri 2/18/11	Mon 2/28/11
199	Load Bearing Stud Walls - Level 2	35 days	Fri 2/18/11	Thu 4/7/11
200	Set and Pour Stairs	9 days	Tue 3/1/11	Fri 3/11/11
201	Roof Trusses	11 days	Thu 3/10/11	Thu 3/24/11
202	Windows	148 days	Thu 3/10/11	Mon 10/3/11
203	Structure Complete	0 days	Thu 3/24/11	Thu 3/24/11
204	Install SIPS Panels	32 days	Fri 3/25/11	Mon 5/9/11
205	Roof Insulation/Ice Shield	28 days	Tue 5/10/11	Thu 6/16/11
206	Aluminum Storefronts	86 days	Mon 6/6/11	Mon 10/3/11
207	Metal Roofing	42 days	Mon 6/20/11	Tue 8/16/11
208	Exterior Canopies	4 days	Tue 6/28/11	Fri 7/1/11
209	Fascia/Trim/Soffit/Gutters/Downspouts	35 days	Fri 7/8/11	Thu 8/25/11
210	Exterior Complete	0 days	Tue 10/11/11	Tue 10/11/11
211	**Building 600 - Fit-Out**	**178 days**	**Mon 3/14/11**	**Wed 11/16/11**
212	Begin 600 1st Floor Fit-Out	0 days	Mon 3/14/11	Mon 3/14/11
213	Layout/Top Track	20 days	Mon 3/14/11	Fri 4/8/11
214	Metal Stud Wall Framing	25 days	Mon 3/21/11	Fri 4/22/11
215	Door Frames	25 days	Tue 3/22/11	Mon 4/25/11
216	Electrical R/I	23 days	Mon 3/28/11	Wed 4/27/11



Project: Detailed Project Schedule
Date: Thu 10/13/11

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

ID	Task Name	Duration	Start	Finish
217	Fire Alarm R/I	30 days	Mon 3/28/11	Fri 5/6/11
218	Drywall Corridors Above Ceiling	20 days	Mon 4/4/11	Fri 4/29/11
219	Plumbing R/I	25 days	Mon 4/4/11	Fri 5/6/11
220	Duct Supports	25 days	Mon 4/4/11	Fri 5/6/11
221	Set Mechanical Equipment	22 days	Thu 4/7/11	Fri 5/6/11
222	Fire Supression Piping Above Ceiling	27 days	Mon 4/11/11	Tue 5/17/11
223	Pull Feeders to Electrical Panels	18 days	Thu 4/14/11	Mon 5/9/11
224	HVAC Ductwork	44 days	Mon 4/18/11	Thu 6/16/11
225	Fire Supression Drops	20 days	Mon 5/2/11	Fri 5/27/11
226	HVAC Piping	18 days	Wed 5/11/11	Fri 6/3/11
227	Plumbing Piping Installation	23 days	Wed 5/11/11	Fri 6/10/11
228	Cable Tray	18 days	Wed 5/11/11	Fri 6/3/11
229	Power and Lighting Wiring	28 days	Mon 5/23/11	Wed 6/29/11
230	Cement Board in Bathrooms	18 days	Mon 6/13/11	Wed 7/6/11
231	Hang Drywall	18 days	Wed 6/15/11	Fri 7/8/11
232	Insulate Walls	11 days	Wed 6/22/11	Wed 7/6/11
233	Finish Drywall	59 days	Mon 7/11/11	Thu 9/29/11
234	Paint	52 days	Wed 7/27/11	Thu 10/6/11
235	Ceiling Grid	10 days	Wed 8/3/11	Tue 8/16/11
236	Light Fixtures	7 days	Mon 8/8/11	Tue 8/16/11
237	Doors/Hardware	10 days	Wed 8/17/11	Tue 8/30/11
238	Ceramic Tile	16 days	Tue 8/23/11	Tue 9/13/11
239	Energize Light Fixtures	0 days	Wed 8/24/11	Wed 8/24/11
240	Drop Ceiling Tile	29 days	Thu 8/25/11	Tue 10/4/11
241	Install Millwork	5 days	Fri 9/9/11	Thu 9/15/11
242	VCT Flooring	24 days	Fri 9/9/11	Wed 10/12/11
243	Trim	5 days	Fri 9/9/11	Thu 9/15/11
244	Plumbing Fixtures	21 days	Wed 9/14/11	Wed 10/12/11
245	Window Sills	3 days	Fri 9/16/11	Tue 9/20/11
246	Final Clean	5 days	Thu 10/20/11	Wed 10/26/11
247	BMC Pre-Final Inspections	4 days	Thu 10/27/11	Tue 11/1/11
248	BMC Punchlist Corrections	11 days	Wed 11/2/11	Wed 11/16/11
249	**Building 600 - Closeout & Commissioning**	**167 days**	**Wed 5/25/11**	**Thu 1/12/12**
250	Testing	127 days	Wed 5/25/11	Thu 11/17/11
251	USACE Punchlist/Pre-Final Inspections	16 days	Fri 11/18/11	Fri 12/9/11
252	BMC Punchlist Repairs	10 days	Mon 12/12/11	Fri 12/23/11
253	Back-Check Review	10 days	Tue 12/27/11	Mon 1/9/12
254	Final Cleaning	3 days	Tue 1/10/12	Thu 1/12/12
255	**Closeout**	**1 day**	**Fri 1/13/12**	**Fri 1/13/12**
256	Final Inspection	1 day	Fri 1/13/12	Fri 1/13/12
257	Final Completion	0 days	Fri 1/13/12	Fri 1/13/12
258	**Demoliton**	**169 days**	**Mon 1/16/12**	**Fri 9/7/12**
259	Begin Abatement/Demolition	0 days	Mon 1/16/12	Mon 1/16/12
260	Demoliton Complete	0 days	Fri 9/7/12	Fri 9/7/12
261	**Project Closeout**	**1 day**	**Mon 9/10/12**	**Mon 9/10/12**
262	Project Final Inspection	1 day	Mon 9/10/12	Mon 9/10/12
263	Contract Completion	0 days	Mon 9/10/12	Mon 9/10/12

Project: Detailed Project Schedule
Date: Thu 10/13/11

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

Appendix B-1

Structural Quantity Takeoffs (Building 500/700)

Formwork (03 11 13)				
	Quantity (Ea.)	Perimeter (LF)	Height (LF)	(SFCA)
4" - Slab on Grade	1.00	858.00	0.33	286.00
	Total	858.00		
Shear Wall Piers - P1	36.00	6.00	1.66	358.56
Canopy Piers - P2	2.00	8.00	1.66	26.56
			Total	385.12

Rebar (03 21 10)			
	Length (LF)	Lbs./LF	Total Weight (Tons)
#3 - Piers	456	0.376	0.09
#5 - Foundations	2068.88	1.043	1.08
#5 - Hollow Core Plank Joints	2216.72	1.043	1.16
#6 - Piers	504.64	1.502	0.38
#6 - Foundations	4421.75	1.502	3.32
#7 - Foundations	1453.96	2.044	1.49
#8 - Foundations	950.80	2.67	1.27
		Total	8.78

Welded Wire Fabric (03 22 05)	
	Area (CSF)
Slab on Grade (6x6 -W1.4xW1.4)	404.28
2nd Floor Topping Slab (6x6 - W2.9xW2.9)	404.28
Total	808.56

Concrete - Foundations (03 31 05)				
	Width (FT)	Length (FT)	Depth (FT)	Volume (CY)
Spread Footer	3.00	3.00	1.50	0.50
Continuous Footer -1	2.50	689.63	1.50	95.78
			Total	96.28
Grade Beam -1	1.50	462.69	2.00	51.41
Grade Beam - 2	1.83	157.38	2.00	21.33
			Total	72.74
Stepped Wall Footer - 1	4.00	207.71	2.00	61.54
Stepped Wall Footer - 2	5.00	47.54	2.00	17.61
Stepped Wall Footer - 3	6.00	47.54	2.00	21.13
			Total	100.28

Concrete -Piers (03 31 05)					
	Quantity (Ea.)	Width (FT)	Length (FT)	Depth (FT)	Volume (CY)
Shear Wall - P1	36.00	1.50	1.50	1.66	4.98
Canopy Pier - P2	2.00	2.00	2.00	1.66	0.49
				Total	5.47

Concrete - Slabs (03 31 05)			
	Area (SF)	Height (LF)	Volume (CY)
4000 psi Normal Weight 4" - Slab on Grade	40428.00	0.33	499.11
4000 psi Light Weight 2" - Topping Slab	40428.00	0.17	249.56
		Total	748.67

Precast Concrete (03 41 13)	
	Area (SF)
8" Thick Precast Hollow Core Planks	40428.00
Total	40428.00

Structural Steel Members (05 12 23)			
	Quantity (Ea.)	Length (LF)	Total Length (LF)
W8x10	2.00	11.10	22.20
W10x22	1.00	13.17	13.17
W12x26	1.00	13.17	13.17
Sill Angles - 4"x3-1/2", 1/4" Thick, 5'-0" Long	76.00		
Leveling Plates - 2'x2'x1/4"	4.00		
Lintels	162.00		
Total	246.00		48.54

Load Bearing Stud Walls (05 41 13)	
	Length (LF)
Exterior Walls - 1st Floor	852.00
Interior Walls - 1st Floor	734.96
Exterior Walls - 2nd Floor	852.00
Interior Walls - 2nd Floor	734.96
Total	3173.92

Cold Formed Roof Trusses (05 44 13)	
	Quantity (Ea.)
58.65' Span	87.00
34.88' Span	2.00
11.10' Span	2.00
Total	91.00

Appendix B-2

Quantity Takeoff Assumptions and Criteria

Building 500/700 Takeoff

- Foundations required no formwork.
- Pile cap formwork was used for the pier formwork.
- All cast-in-place concrete was placed with a pump.
- Manual and power finishing was selected for the slab-on-grade, but only the manual finishing was selected for the topping slab on the second floor.
- #5 rebar was placed in the joints of the hollow-core planks.
- Only four W-Beams were used throughout the building, which were utilized for headers at longs spans for the commons rooms.
- Sill angles varied in size around 5’, so this used as the common member for estimation purposes.
- Leveling plates were used for the building canopies at both ends of the buildings, but were not used throughout the rest of the building.
- Only the load bearing walls were estimated and not the partition walls.
- Three types of trusses were used on the buildings, but since the trusses were custom designed, the first span found in RSMeans was utilized.
- A 40’ truss was selected for the 58.65’ trusses, since this was the largest cold formed steel roof truss listed.
- The roof trusses utilize a 2/12 slope, but the smallest slope in RSMeans was chosen at 4/12.
- 4’ pan stairs were used for the building, although the width was actually 4’-6”.

Appendix B-3

Detailed Structural Systems Estimate

Detailed Structural System Estimate													
Code	Item	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P	Quantity	Project Total	Project Total Incl O&P
Divison 03 - Concrete													
03 11 13.45 3100	Forms in Place, Footings - Pile Cap, Square or Rectangular, Job-built Plywood, 3 Use	C-1	371	0.086	SFCA	0.93	3.53		4.46	6.4	385	$ 1,717.10	$ 2,464.00
03 11 13.65 3000	Forms in Place, Slab on Grade - Edge Forms, Wood, 4 Use, On Grade, 6" High	C-1	600	0.053	LF	0.27	2.18		2.45	3.64	858	$ 2,102.10	$ 3,123.12
03 21 10.60 0400	Reinforcing in Place - Elevated Slabs #4 to #7	4 Rodm	2.9	11.034	Ton	955	535		1490	1900	1.16	$ 1,728.40	$ 2,204.00
03 21 10.60 0500	Reinforcing in Place - Footings, #4 to #7	4 Rodm	2.1	15.238	Ton	855	740		1595	2125	6.36	$ 10,144.20	$ 13,515.00
03 21 10.60 0550	Reinforcing in Place - Footings, #8 to #18	4 Rodm	3.6	8.889	Ton	810	430		1240	1575	1.27	$ 1,574.80	$ 2,000.25
03 22 05.50 0100	Welded Wire Fabric - 6 x 6 - W1.4 x 1.4 (10 x 10) 21 lb. per C.S.F.	2 Rodm	35	0.457	CSF	12.5	22		34.5	49.5	404.28	$ 13,947.66	$ 20,011.86
03 22 05.50 0300	Welded Wire Fabric - 6 x 6 - W2.9 x 2.9 (6 x 6) 42 lb. per C.S.F.	2 Rodm	29	0.552	CSF	21.5	26.5		48	66	404.28	$ 19,405.44	$ 26,682.48
03 31 05.35 0300	Normal Weight Structural Concrete - 4000 psi Concrete				CY	103			103	113	499.11	$ 51,408.33	$ 56,399.43
03 31 05.35 0300	Normal Weight Structural Concrete - Structural Lightweight				CY	25%			128.8	141.25	249.56	$ 32,130.21	$ 35,249.64
03 31 05.70 1400	Placing Concrete - Elevated Slabs, Less than 6", Pumped	C-20	140	0.457	CY		16.8	5.6	22.4	31.5	249.56	$ 5,590.14	$ 7,861.14
03 31 05.70 1950	Placing Concrete - Footings, Continuous, Shallow, Pumped	C-20	150	0.427	CY		15.7	5.25	20.95	30	96.28	$ 2,017.07	$ 2,888.40
03 31 05.70 3250	Placing Concrete - Grade Beams, Pumped	C-6	180	0.356	CY		13.1	4.37	17.47	24.5	72.74	$ 1,270.77	$ 1,782.13
03 31 05.70 4350	Placing Concrete - Slab on Grade, Up to 6", Pumped	C-20	130	0.492	CY		18.1	6.05	24.15	34	499.11	$ 12,053.51	$ 16,969.74
03 31 05.70 4350	Placing Concrete - Pile Caps, Under 5 CY, Pumped	C-20	110	0.582	CY		21.5	7.15	28.65	40.5	5.47	$ 156.72	$ 221.54
03 35 29.30 0150	Finishing - Bull Float, Manual Float, & Broom Finish, w/ Edging & Joints	C-10	1850	0.013	SF		0.5		0.5	0.74	80856	$ 40,428.00	$ 59,833.44
03 35 29.30 0350	Finishing - Power Screed, Bull Float, Machine Float & Trowel (Ride-On)	C-10E	4000	0.006	SF		0.23	0.06	0.29	0.4	40428	$ 11,724.12	$ 16,171.20
03 39 23.13 0300	Concrete Curing - Sprayed Membrane Curing Compound	2 Clab	95	0.168	CSF	5.6	5.8		11.4	15.05	808.56	$ 9,217.58	$ 12,168.83
03 41 13.50 0100	Precast Slab Planks -Prestressed Floor Members, Grouted, Hollow, 8" Thick	C-11	3200	0.023	SF	7.2	1.07	0.6	8.87	10.4	40428	$ 358,596.36	$ 420,451.20
											Total	**$ 575,212.50**	**$ 699,997.40**
Division 05 - Metals													
05 05 23.05 1150	Anchor Bolts - 4-Bolt Pattern, Per Set J-Type, Incl. Hex Nut Washer, 3/4" Diameter, 18" Long	1 Carp	17	0.471	Set	26	20.5		46.5	59.5	4	$ 186.00	$ 238.00
05 12 23.45 2100	Sill Angles - Steel Angles 3-1/2" x 3", 1/4" Thick, 4'-6" Long	1 Bric	26	0.308	Ea.	22	13.3		33.3	44	76	$ 2,530.80	$ 3,344.00
05 12 23.45 2100	Lintels - Steel Angles 4" x 3-1/2", 1/4" Thick, 5'-0" Long	1 Bric	21	0.381	Ea.	28	16.45		44.45	55	162	$ 7,200.90	$ 8,910.00
05 12 23.65 0100	Leveling Plates - 1/4" Thick (10.2 lb./SF)				SF	11.5			11.5	12.6	16	$ 184.00	$ 201.60
05 12 23.75 0300	Structural Steel Members - 1-2 Story Project, Bolted Connection, W8x10	E-2	600	0.093	LF	12.4	4.42	2.7	19.52	24	22.2	$ 433.34	$ 532.80
05 12 23.75 0700	Structural Steel Members - 1-2 Story Project, Bolted Connection, W10x22	E-2	600	0.093	LF	27	4.42	2.7	34.12	40.5	13.17	$ 449.36	$ 533.39
05 12 23.75 1500	Structural Steel Members - 1-2 Story Project, Bolted Connection, W12x26	E-2	880	0.064	LF	32	3.01	1.84	36.85	42.5	13.17	$ 485.31	$ 559.73
05 41 13.30 6400	Load Bearing Metal Stud Framing - 12' High Walls, 16 ga x 6" Wide, Studs 16" O.C.	2 Carp	51	0.314	LF	14.9	13.5		28.4	37	3173.92	$ 90,139.33	$ 117,435.04
05 44 13.60 0120	Cold Formed Metal Roof Trusses - Fabrication on Ground 4:12 Pitch, 18 ga x 4" Chords, 16' Span	2 Carp	12	1.333	Ea.	50.5	57.5		108	144	2	$ 216.00	$ 288.00
05 44 13.60 0270	Cold Formed Metal Roof Trusses - Fabrication on Ground 4:12 Pitch, 18 ga x 6" Chords, 36' Span	2 Carp	8	2	Ea.	142	86		228	289	2	$ 456.00	$ 578.00
05 44 13.60 0280	Cold Formed Metal Roof Trusses - Fabrication on Ground 4:12 Pitch, 18 ga x 6" Chords, 40' Span	2 Carp	8	2	Ea.	158	86		244	305	87	$ 21,228.00	$ 26,535.00
05 44 13.60 5120	Cold Formed Metal Roof Trusses - Erection Only of Trusses, 4:12 Pitch, 16' Span	F-6	48	0.833	Ea.		33.5	13.65	47.15	66	2	$ 94.30	$ 132.00
05 44 13.60 5170	Cold Formed Metal Roof Trusses - Erection Only of Trusses, 4:12 Pitch, 36' Span	F-6	38	1.053	Ea.		42.5	17.25	59.75	83.5	2	$ 119.50	$ 167.00
05 44 13.60 5180	Cold Formed Metal Roof Trusses - Erection Only of Trusses, 4:12 Pitch, 40' Span	F-6	36	1.111	Ea.		44.5	18.2	62.7	88	87	$ 5,454.90	$ 7,656.00
05 51 13.50 0300	Pan Stairs - Shop Fabricated, Steel Stringers, Cement Fill Metal Pan, Picket Rail, 4' Wide	E-4	30	1.067	Riser	475	52.5	3.64	531.1	620	44	$ 23,370.16	$ 27,280.00
											Total	**$ 152,547.91**	**$ 194,390.55**
											Structural System Estimate Total	**$ 727,760.41**	**$ 894,387.95**

Appendix B-4

RSMeans - Crews, Workers, & Adjustment Factors

Crews						
	Bare Costs		Incl. Subs O&P		Cost per Labor-Hour	
Crew No.	Hr.	Daily	Hr.	Daily	Bare Costs	Incl. O&P
C-1						
3 Carpenters	43.05	1033.2	66.05	1585.20	40.88	62.71
1 Laborer	34.35	274.80	52.70	421.60		
32 L.H., Daily Totals		**$1308.00**		**$2006.80**		**$62.71**
C-6						
1 Labor Foreman	36.35	290.80	55.75	446.00	35.77	53.34
4 Laborers	34.35	1099.20	52.70	1686.40		
1 Cement Finisher	40.85	326.80	59.50	476.00		
2 Gas Engine Vibrators		46.40		51.04	0.97	1.06
48 L.H., Daily Totals		**$1763.20**		**$2659.44**	**$36.73**	**$55.41**
C-11						
1 Struc. Steel Foreman	50.55	404.40	89.25	714.00	47.63	81.49
6 Struc. Steel Workers	48.55	2330.40	85.75	4116.00		
1 Equip. Oper. (Crane)	46.50	372.00	69.45	555.60		
1 Equip. Oper. Oiler	40.30	322.40	60.20	481.60		
1 Lattice Boom Crane, 150 Ton		1906.00		2096.60	26.47	29.12
72 L.H., Daily Totals		**$5335.20**		**$7963.80**	**$74.10**	**$110.61**
C-20						
1 Labor Foreman	36.35	290.80	55.75	446.00	36.79	55.81
5 Laborers	34.35	1374.00	52.70	2108.00		
1 Cement Finisher	40.85	326.80	59.50	476.00		
1 Equip. Oper.	45.35	362.80	67.75	542.00		
2 Gas Engine Vibrators		46.40		51.04		
1 Concrete Pump		741.00		815.10	12.30	13.53
64 L.H., Daily Totals		**$3141.80**		**$4438.14**	**$49.09**	**$69.35**
E-2						
1 Struc. Steel Foreman	50.55	404.40	89.25	714.00	47.36	80.27
4 Struc. Steel Workers	48.55	1553.60	85.75	2744.00		
1 Equip. Oper. (Crane)	46.50	372.00	69.45	555.60		
1 Equip. Oper. Oiler	40.30	322.40	60.20	481.60		
1 Lattice Boom Crane, 90 Ton		1622.00		1784.20	28.96	31.86
56 L.H., Daily Totals		**$4274.40**		**$6279.40**	**$76.33**	**$112.3**
E-4						
1 Struc. Steel Foreman	50.55	404.40	89.25	714.00	49.05	86.63
3 Struc. Steel Workers	48.55	1165.20	85.75	2058.00		
1 Welder, Gas Engine, 300 Amp		109.00		119.90	3.41	3.75
32 L.H., Daily Totals		**$1678.60**		**$2891.90**	**$52.46**	**$90.37**
F-6						
2 Carpenters	43.05	688.80	66.05	1056.80	40.26	61.39
2 Building Laborers	34.35	549.60	52.70	843.20		
1 Equip. Oper. (Crane)	46.50	372.00	69.45	555.60		
1 Hyd. Crane, 12 Ton		655.60		721.16	16.39	18.03
40 L.H., Daily Totals		**$2266.00**		**$3176.76**	**$56.65**	**$79.42**

Installing Contractor's Overhead & Profit											
	Trade	Base Rate Incl. Fringes		Workers' Comp. Ins.	Avg. Fixed Over head	Over head	Profit	Total Overhead & Profit		Rate with O&P	
Abbr.		Hourly	Daily					%	Amount	Hourly	Daily
Clab	Common Building Laborer	34.35	274.80	16.1%	16.3%	11.0%	10%	53.4	18.35	52.70	421.60
Bric	Bricklayer	43.15	345.20	12.7%	16.3%	11.0%	10%	50.0	21.60	64.75	518.00
Carp	Carpenter	43.05	344.40	16.1%	16.3%	11.0%	10%	53.4	23.00	66.05	528.40
Rodm	Rodmen	48.40	387.20	19.5	16.3%	14.0%	10%	59.8	28.95	77.35	618.80

Location Factors				
	City	Mat.	Inst.	Total
Virginia	Petersburg	99.6	66.8	84.9

Appendix C

General Conditions Estimate

General Conditions Estimate													
Code	Item	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Total Incl O&P	Quantity	Project Total	Project Total Incl O&P
Divison 01- General Requirements													
01 31 13.30 0020	Insurance - Builders Risk, Standard, Minimum				Job					0.24%	28177099.98	$ -	$ 67,625.04
01 31 13.30 0250	Insurance - General Liability, Maximum				Job					0.62%	28177099.98	$ -	$ 174,698.02
01 31 13.90 0020	Performance Bond - For Buildings, Minimum				Job					0.60%	28177099.98	$ -	$ 169,062.60
01 32 13.50 0650	Scheduling - Rule of Thumb, CPM Scheduling, Large Job ($50M)				Job					0.05%	28177099.98	$ -	$ 14,088.55
01 32 33.50 0500	Photographs - Aerial Phots, Initial Fly-over, 6 Shots, 1 Print Ea., 8" x 10"				Set	845			845	925	11	$ 9,295.00	$ 10,175.00
01 41 26.50 0020	Permits - Most Cities, Minimum				Job					0.05%	28177099.98	$ -	$ 14,088.55
01 45 23.50 0050	Testing and Inspecting Services - For Steel Building Maximum				Job				4725	5200	1	$ 4,725.00	$ 5,200.00
01 31 13.20 0100	Field Personnel - Field Engineer				Week		975		975	1500	90	$ 87,750.00	$ 135,000.00
01 31 13.20 0120	Field Personnel - Project Engineer				Week		1265		1265	1950	90	$ 113,850.00	$ 175,500.00
01 31 13.20 0200	Field Personnel - Project Manager				Week		2075		2075	3175	90	$ 186,750.00	$ 285,750.00
01 31 13.20 0220	Field Personnel - Project Administrator				Week		2375		2375	3650	90	$ 213,750.00	$ 328,500.00
01 31 13.20 0100	Field Personnel - Quality Control Manager				Week		975		975	1500	90	$ 87,750.00	$ 135,000.00
01 31 13.20 0240	Field Personnel - Assistant Superintendent				Week		1750		1750	2675	90	$ 157,500.00	$ 240,750.00
01 31 13.20 0280	Field Personnel - Senior Superintendent				Week		2200		2200	3375	90	$ 198,000.00	$ 303,750.00
01 31 13.20 0100	Field Personnel - Intern				Week		975		975	1500	12	$ 11,700.00	$ 18,000.00
01 51 13.80 0600	Temporary Utilities - Power for Job Duration Incl. Elevator, Etc., Minimum				CSF Flr				47	51.5	164	$ 7,708.00	$ 8,446.00
01 51 13.80 0700	Temporary Utilities - Temporary Construction Water Bill per Month				Month	62			62	68	11	$ 682.00	$ 748.00
01 51 33.40 6410	Temporary Utilities - Rent Toilet Portable Chemical				Ea.	0.11	18.65	56	168	180.1	360	$ 60,480.00	$ 64,836.00
01 52 13.20 0550	Office and Storage Space - Trailer, Furnished, No Hookups, 50' x 12' Rent per Month				Ea.	360			360	395	10.5	$ 3,780.00	$ 4,147.50
01 52 13.20 0700	Office and Storage Space - Add Air Conditioning, Rent per Month, Add				Ea.	41.5			41.5	45.5	10.5	$ 435.75	$ 477.75
01 52 13.20 0800	Office and Storage Space - Add Delivery, Add per Mile				Mile	4.6			4.6	5.05	75	$ 345.00	$ 378.75
01 52 13.20 1350	Office and Storage Space - Storage Boxes, 20' x 8', Rent per Month				Ea.	71.5			71.5	78.5	10.5	$ 750.75	$ 824.25
01 52 13.40 0120	Field Office Equipment Rental Average				Month	200			200	220	10.5	$ 2,100.00	$ 2,310.00
01 52 13.40 0120	Field Office Expense - Office Supplies, Average				Month	86			86	94.5	10.5	$ 903.00	$ 992.25
01 52 13.40 0140	Field Office Expense - Telephone Bill, Incl. Long Distance				Month	81			81	89	10.5	$ 850.50	$ 934.50
01 52 13.40 0160	Field Office Expense - Lights & HVAC				Month	152			152	167	10.5	$ 1,596.00	$ 1,753.50
01 54 09.60 6220	Protective Equipment - Safety Supplies and First Aid Kits				Month	24.5			24.5	27	90	$ 2,205.00	$ 2,430.00
01 56 13.90 0250	Winter Protection - Tarpaulin Polyester Reinf. w/ Integral Fastening System 11 Mils Thick	2 Clab	1600	0.01	SF	0.8	0.34		1.14	1.41	25000	$ 28,500.00	$ 35,250.00
01 55 23.50 0050	Roads and Sidewalks - Roads, Gravel Fill, No Surfacing, 4" Gravel Depth	B-14	715	0.067	SY	4	2.43	0.45	6.88	8.6	1700	$ 11,696.00	$ 14,620.00
01 56 23.10 1300	Barricades - Stock Units, 6' High, 8' Wide, Plain, Buy				Ea.	435			435	480	10	$ 4,350.00	$ 4,800.00
01 56 23.10 1300	Barricades - Barricade Tape, Polyethylene, 7 mil, 3" Wide x 500' Long Roll				Ea.	25			25	27.5	20	$ 500.00	$ 550.00
01 56 26.50 0250	Temporary Fencing - Rented Chain Link, 6' High, Over 1000' (Up to 12 mo.)	2 Clab	300	0.053	LF	3.29	1.83		5.12	6.45	2440	$ 12,492.80	$ 15,738.00
01 58 13.50 0020	Signs - High Intensity Reflectorized, No Posts, Buy				SF	26.5			26.5	29.5	200	$ 5,300.00	$ 5,900.00
01 71 23.13 1400	Construction Layout - Crew for Roadway Layout, 4 Person Crew	A-8	1	32	Day		1475	70	1545	2300	20	$ 30,900.00	$ 46,000.00
01 74 13.20 0020	Cleaning Up - After Job Completion, Allow, Minimum				Job					0.30%	28177099.98	$ -	$ 84,531.30
01 74 13.20 0050	Cleaning Up - Cleanup of Floor Area, Continuous, Per Day, During Construction	A-5	24	0.75	MSF	1.7	25.5	1.87	26.07	38.93	11640	$ 303,454.80	$ 453,145.20
01 91 13.50 0100	Building Commissioning - Basic Building Commissioning, Minimum				%					0.25%	28177099.98	$ -	$ 70,442.75
											Total	**$ 1,550,099.60**	**$ 2,896,443.51**
Divison 02- Existing Conditions													
02 21 13.09 0020	Topographical Surveying - Convential, Minimum	A-7	3.3	7.273	Acre	18.2	340	21	379.2	565.00	10	$ 3,792.00	$ 5,650.00
02 21 13.30 0320	Boundary and Survey Markers - Lot Location and Lines, Large Quantities, Average	A-7	1.25	19.2	Acre	51.5	900	55.5	1007	1500.00	10	$ 10,070.00	$ 15,000.00
02 21 13.13 0600	Boundary and Survey Markers - Monuments	A-7	10	2.4	Ea.	30.5	113	6.95	150.45	212.00	3	$ 451.35	$ 636.00
02 21 13.13 0800	Boundary and Survey Markers - Property Lines, Perimeter, Cleared Land	A-7	1000	0.024	LF	0.03	1.13	0.07	1.23	1.82	2440	$ 3,001.20	$ 4,440.80
02 32 13.10 0020	Borings and Exploratory Drilling - Borings, Initial Field Stake Out & Determination of Elevations	A-6	1	16	Day		690	69.5	759.5	1125.00	1	$ 759.50	$ 1,125.00
02 32 13.10 0100	Borings and Exploratory Drilling - Drawings Shoing Boring Details				Total		300		300	375.00	2	$ 600.00	$ 750.00
02 32 13.10 0200	Borings and Exploratory Drilling - Report and Recommendations for P.E.				Total		700		700	875.00	2	$ 1,400.00	$ 1,750.00
02 32 13.10 0300	Borings and Exploratory Drilling - Mobilization and Demobilization, Minimum	B-55	4	6	Total		204	231	435	565.00	2	$ 870.00	$ 1,130.00
02 32 13.10 1400	Borings and Exploratory Drilling - Borings, Earth, Drill Rig and Crew with Truck Mounted Auger	B-55	1	24	Day		815	925	1740	2275.00	2	$ 3,480.00	$ 4,550.00
02 41 19.23 0700	Rubbish Handling - Dumpster, Weekly Rental, 1 Dump/Week, 40 C.Y. Capacity (13 Tons)				Week	525			525	578.00	90	$ 47,250.00	$ 52,020.00
											Total	**$ 71,674.05**	**$ 87,051.80**
											Project Total	**$ 1,621,773.65**	**$ 2,983,495.31**

Appendix D-1

LEED v2.2 Checklist

LEED for New Construction v2.2
Registered Project Checklist

Project Name: Regional Training Institute Fort Pickett Military Reservation
Project Address: Blackstone, Virginia - Fed PN No.: 510302 2009-2010

Yes	?	No			
9		5		**Sustainable Sites**	**14** Points
Y			Prereq 1	**Construction Activity Pollution Prevention**	Required
1			Credit 1	**Site Selection**	1
		1	Credit 2	**Development Density & Community Connectivity**	1
		1	Credit 3	**Brownfield Redevelopment**	1
		1	Credit 4.1	**Alternative Transportation**, Public Transportation Access	1
1			Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
1			Credit 4.3	**Alternative Transportation**, Low-Emitting & Fuel-Efficient Vehicles	1
1			Credit 4.4	**Alternative Transportation**, Parking Capacity	1
1			Credit 5.1	**Site Development,** Protect or Restore Habitat	1
1			Credit 5.2	**Site Development,** Maximize Open Space	1
1			Credit 6.1	**Stormwater Design,** Quantity Control	1
1			Credit 6.2	**Stormwater Design,** Quality Control	1
		1	Credit 7.1	**Heat Island Effect,** Non-Roof	1
		1	Credit 7.2	**Heat Island Effect,** Roof	1
1			Credit 8	**Light Pollution Reduction**	1

Yes	?	No			
3		2		**Water Efficiency**	**5** Points
1			Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1
		1	Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1
		1	Credit 2	**Innovative Wastewater Technologies**	1
1			Credit 3.1	**Water Use Reduction**, 20% Reduction	1
1			Credit 3.2	**Water Use Reduction**, 30% Reduction	1

Yes	?	No				
6		11			**Energy & Atmosphere**	**17** Points
Y			Prereq 1		**Fundamental Commissioning of the Building Energy Systems**	Required
Y			Prereq 2		**Minimum Energy Performance**	Required
Y			Prereq 3		**Fundamental Refrigerant Management**	Required

*Note for EAc1: All LEED for New Construction projects registered after June 26th, 2007 are required to achieve at least two (2) points under EAc1.

Yes	?	No				
5		5	Credit 1		**Optimize Energy Performance**	1 to 10
					10.5% New Buildings or 3.5% Existing Building Renovations	1
					14% New Buildings or 7% Existing Building Renovations	2
					17.5% New Buildings or 10.5% Existing Building Renovations	3
					21% New Buildings or 14% Existing Building Renovations	4
				5	24.5% New Buildings or 17.5% Existing Building Renovations	5
					28% New Buildings or 21% Existing Building Renovations	6
					31.5% New Buildings or 24.5% Existing Building Renovations	7
					35% New Buildings or 28% Existing Building Renovations	8
					38.5% New Buildings or 31.5% Existing Building Renovations	9
					42% New Buildings or 35% Existing Building Renovations	10
		3	Credit 2		**On-Site Renewable Energy**	1 to 3
					2.5% Renewable Energy	1
					7.5% Renewable Energy	2
					12.5% Renewable Energy	3
		1	Credit 3		**Enhanced Commissioning**	1
1			Credit 4		**Enhanced Refrigerant Management**	1
		1	Credit 5		**Measurement & Verification**	1
		1	Credit 6		**Green Power**	1

continued…

Yes	?	No			
7		6	**Materials & Resources**		13 Points
Y			Prereq 1	**Storage & Collection of Recyclables**	Required
		1	Credit 1.1	**Building Reuse**, Maintain 75% of Existing Walls, Floors & Roof	1
		1	Credit 1.2	**Building Reuse**, Maintain 100% of Existing Walls, Floors & Roof	1
		1	Credit 1.3	**Building Reuse**, Maintain 50% of Interior Non-Structural Elements	1
1			Credit 2.1	**Construction Waste Management**, Divert 50% from Disposal	1
1			Credit 2.2	**Construction Waste Management**, Divert 75% from Disposal	1
		1	Credit 3.1	**Materials Reuse**, 5%	1
		1	Credit 3.2	**Materials Reuse**,10%	1
1			Credit 4.1	**Recycled Content**, 10% (post-consumer + ½ pre-consumer)	1
1			Credit 4.2	**Recycled Content**, 20% (post-consumer + ½ pre-consumer)	1
1			Credit 5.1	**Regional Materials**, 10% Extracted, Processed & Manufactured Regio	1
1			Credit 5.2	**Regional Materials**, 20% Extracted, Processed & Manufactured Regio	1
		1	Credit 6	**Rapidly Renewable Materials**	1
1			Credit 7	**Certified Wood**	1

Yes	?	No			
10		5	**Indoor Environmental Quality**		15 Points
Y			Prereq 1	**Minimum IAQ Performance**	Required
Y			Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**	Required
		1	Credit 1	**Outdoor Air Delivery Monitoring**	1
		1	Credit 2	**Increased Ventilation**	1
1			Credit 3.1	**Construction IAQ Management Plan**, During Construction	1
1			Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1
1			Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1
1			Credit 4.2	**Low-Emitting Materials**, Paints & Coatings	1
1			Credit 4.3	**Low-Emitting Materials**, Carpet Systems	1
1			Credit 4.4	**Low-Emitting Materials**, Composite Wood & Agrifiber Products	1
1			Credit 5	**Indoor Chemical & Pollutant Source Control**	1
1			Credit 6.1	**Controllability of Systems**, Lighting	1
		1	Credit 6.2	**Controllability of Systems**, Thermal Comfort	1
1			Credit 7.1	**Thermal Comfort**, Design	1
1			Credit 7.2	**Thermal Comfort**, Verification	1
		1	Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces	1
		1	Credit 8.2	**Daylight & Views**, Views for 90% of Spaces	1

Yes	?	No			
3		2	**Innovation & Design Process**		5 Points
1			Credit 1.1	**Innovation in Design**: Provide Specific Title - Regional Material 40%	1
1			Credit 1.2	**Innovation in Design**: Provide Specific Title - Recycled Material 30%	1
		1	Credit 1.3	**Innovation in Design**: Provide Specific Title	1
		1	Credit 1.4	**Innovation in Design**: Provide Specific Title	1
1			Credit 2	**LEED® Accredited Professional**	1

Yes	?	No		
38		31	**Project Totals** (pre-certification estimates)	69 Points

Certified: 26-32 points, **Silver:** 33-38 points, **Gold:** 39-51 points, **Platinum:** 52-69 pc

Appendix D-2

LEED 2009 Checklist

LEED 2009 for New Construction and Major Renovations

Project Checklist

Y	?	N			
12		14	**Sustainable Sites**	Possible Points:	**26**
Y			Prereq 1	Construction Activity Pollution Prevention	
1			Credit 1	Site Selection	1
		5	Credit 2	Development Density and Community Connectivity	5
		1	Credit 3	Brownfield Redevelopment	1
		6	Credit 4.1	Alternative Transportation—Public Transportation Access	6
1			Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms	1
3			Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	3
2			Credit 4.4	Alternative Transportation—Parking Capacity	2
1			Credit 5.1	Site Development—Protect or Restore Habitat	1
1			Credit 5.2	Site Development—Maximize Open Space	1
1			Credit 6.1	Stormwater Design—Quantity Control	1
1			Credit 6.2	Stormwater Design—Quality Control	1
		1	Credit 7.1	Heat Island Effect—Non-roof	1
		1	Credit 7.2	Heat Island Effect—Roof	1
1			Credit 8	Light Pollution Reduction	1
8		2	**Water Efficiency**	Possible Points:	**10**
Y			Prereq 1	Water Use Reduction—20% Reduction	
4			Credit 1	Water Efficient Landscaping	2 to 4
		2	Credit 2	Innovative Wastewater Technologies	2
4			Credit 3	Water Use Reduction	2 to 4
9		26	**Energy and Atmosphere**	Possible Points:	**35**
Y			Prereq 1	Fundamental Commissioning of Building Energy Systems	
Y			Prereq 2	Minimum Energy Performance	
Y			Prereq 3	Fundamental Refrigerant Management	
7		12	Credit 1	Optimize Energy Performance	1 to 19
		7	Credit 2	On-Site Renewable Energy	1 to 7
		2	Credit 3	Enhanced Commissioning	2
2			Credit 4	Enhanced Refrigerant Management	2
		3	Credit 5	Measurement and Verification	3
		2	Credit 6	Green Power	2
7		7	**Materials and Resources**	Possible Points:	**14**
Y			Prereq 1	Storage and Collection of Recyclables	
		3	Credit 1.1	Building Reuse—Maintain Existing Walls, Floors, and Roof	1 to 3
		1	Credit 1.2	Building Reuse—Maintain 50% of Interior Non-Structural Elements	1
2			Credit 2	Construction Waste Management	1 to 2
		2	Credit 3	Materials Reuse	1 to 2

Fort Pickett Regional Training Institute

Y	?	N			
			Materials and Resources, Continued		
2			Credit 4	Recycled Content	1 to 2
2			Credit 5	Regional Materials	1 to 2
		1	Credit 6	Rapidly Renewable Materials	1
1			Credit 7	Certified Wood	1
10		5	**Indoor Environmental Quality**	**Possible Points:**	**15**
Y			Prereq 1	Minimum Indoor Air Quality Performance	
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	
		1	Credit 1	Outdoor Air Delivery Monitoring	1
		1	Credit 2	Increased Ventilation	1
1			Credit 3.1	Construction IAQ Management Plan—During Construction	1
1			Credit 3.2	Construction IAQ Management Plan—Before Occupancy	1
1			Credit 4.1	Low-Emitting Materials—Adhesives and Sealants	1
1			Credit 4.2	Low-Emitting Materials—Paints and Coatings	1
1			Credit 4.3	Low-Emitting Materials—Flooring Systems	1
1			Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Products	1
1			Credit 5	Indoor Chemical and Pollutant Source Control	1
1			Credit 6.1	Controllability of Systems—Lighting	1
		1	Credit 6.2	Controllability of Systems—Thermal Comfort	1
1			Credit 7.1	Thermal Comfort—Design	1
1			Credit 7.2	Thermal Comfort—Verification	1
		1	Credit 8.1	Daylight and Views—Daylight	1
		1	Credit 8.2	Daylight and Views—Views	1
3		3	**Innovation and Design Process**	**Possible Points:**	**6**
1			Credit 1.1	Innovation in Design: Recycled Material 30%	1
1			Credit 1.2	Innovation in Design: Regional Material 40%	1
		1	Credit 1.3	Innovation in Design: Specific Title	1
		1	Credit 1.4	Innovation in Design: Specific Title	1
		1	Credit 1.5	Innovation in Design: Specific Title	1
1			Credit 2	LEED Accredited Professional	1
4			**Regional Priority Credits**	**Possible Points:**	**4**
1			Credit 1.1	Regional Priority: Recycle/Salvaged 50%	1
1			Credit 1.2	Regional Priority: Alternative Transportation-Parking Capacity	1
1			Credit 1.3	Regional Priority: Stormwater Design-Quantity Control	1
1			Credit 1.4	Regional Priority: Light Pollution Reduction	1
53		57	**Total**	**Possible Points:**	**110**

Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110

Appendix E-1

BIM Execution Plan – Major BIM Goals/Objectives

Major BIM Goals/Objectives

PRIORITY (HIGH/ MED/ LOW)	GOAL DESCRIPTION	POTENTIAL BIM USES
High	Increase Productivity in the Field	• 3D Coordination • Construction Systems Design • 3D Control and Planning
High	Eliminate Conflicts in the Field	• 3D Coordination • Construction Systems Design
High	Increase the Effectiveness of the Design	• 3D Coordination • Construction System Design • Design Authoring • Programming • Cost Estimation
Med	Review Design Progress	• Design Review • Programming
Med	Identify Potential Conflicts Regarding Phasing Between the Buildings	• 4D Modeling, • Site Utilization Planning
Med	Improve Site Planning and Logistics	• 4D Modeling • Site Utilization Planning
Low	Improve Efforts to Reach Sustainable Goals	• LEED Evaluation • Engineering Analysis
Low	Provide the Owner with a Functional Maintenance Program	• Building Maintenance Scheduling • Asset Management • Record Modeling

Appendix E-2

BIM Execution Plan – BIM Use Analysis Worksheet

BIM Use Analysis Worksheet

BIM Use	Value to Project	Responsible Party	Value to Resp Party	Capability Rating			Additional Resources / Competencies Required to Implement	Notes	Proceed with Use
	High / Med / Low		High / Med / Low	Scale 1-3 (1 = Low)					YES / NO / MAYBE
				Resources	Competency	Experience			
LEED Evaluation	MED	Contractor	HIGH	2	3	2	Requires a LEED Certified	Would Aid in Tracking LEED Credits,	MAYBE
		Owner	HIGH	2	2	2	Individual on the Project Team.	Especially Materials.	
		Designers	MED	3	2	2			
Site Utilization Planning	LOW	Contractor	MED	2	1	1	Requires 4D Software	The Project Utilizes a Large Site and	NO
							Requires Training for 4D Software	Simple Construction Process.	
4D Modeling	HIGH	Contractor	HIGH	3	2	2	Requires Training for 4D Software	Valuable for Planning Phasing	MAYBE
							Requires Software	Between the 3 Buildings and Floors.	
3D Coordination	HIGH	Contractor	HIGH	3	3	2	Requires Training for 4D Software	Learning Curve for Contractor and	YES
		Subcontractors	HIGH	3	3	2		Subcontractors.	
		Architect	HIGH	3	3	3		Requires Coordination Between All	
		Structural Engineer	MED	3	3	3		Responsible Parties in Design and	
		MEP Engineers	HIGH	3	3	3		Construction.	
Engineering Analysis	HIGH	MEP Engineer	HIGH	3	3	2			NO
		Structural Engineer	HIGH	3	3	2			
		Architect	MED	3	2	2			
Design Reviews	HIGH	Architect	MED	3	2	2		Reviews to be Based From 3D Model.	YES
		Owner	MED	1	2	2			
Design Authoring	HIGH	Architect	HIGH	3	3	2			YES
		MEP Engineer	HIGH	3	3	2			
		Structural Engineer	HIGH	3	3	2			
Record Modeling	LOW	Architect	LOW	3	2	2		Beneficial for Future Changes and as	YES
		Owner	HIGH	1	2	1	Requires Software Training	a Form of Documentation.	
		Contractor	LOW	3	2	2			
Programming	HIGH	Architect	HIGH	3	3	3			NO
		Owner	HIGH	3	3	3			
Cost Estimation	HIGH	Architect	MED	3	2	3		Valuable for Conducting Quick and	YES
		Contractor	MED	3	3	2		Accurate Estimates.	
Construction Systems Design	LOW	Architect	HIGH	3	3	3		The Project Consists of Simple	NO
		MEP Engineers	HIGH	3	3	3		Construction and Would Probably Not	
		Structural Engineer	HIGH	3	3	3		Benefit From This Item.	
3D Control and Planning	HIGH	Architect	MED	3	3	3		Increase Efficiency in the Field and	YES
		MEP Engineers	MED	3	3	3		Reduce Possilbe Layout Errors for	
		Contractor	MED	3	3	2		Multiple Systems.	
		Subcontractors	HIGH	3	2	2			
Building Mainteance Scheduling	MED	Architect	LOW	3	2	2		Could be Difficult to Teach a	NO
		Owner	HIGH	1	2	1	Requires Software Training	Representative of the Owner the	
		Contractor	LOW	3	2	2		Software.	
Asset Management	MED	Architect	MED	3	2	2		Could be Difficult to Teach a	MAYBE
		Owner	MED	1	2	1	Requires Software Training	Representative of the Owner the	
		Contractor	MED	3	2	2		Software.	

Appendix E-3

BIM Execution Plan – BIM Uses

BIM Uses

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
		X	3D COORDINATION	X	3D COORDINATION	X	ASSET MANAGEMENT
			STRUCTURAL ANALYSIS		DIGITAL FABRICATION		SPACE MANAGEMENT / TRACKING
			LIGHTING ANALYSIS	X	3D CONTROL AND PLANNING		DISASTER PLANNING
			ENERGY ANALYSIS	X	RECORD MODELING	X	RECORD MODELING
			MECHANICAL ANALYSIS				
			OTHER ENG. ANALYSIS				
		X	SUSTAINABLITY (LEED) EVALUATION				
			CODE VALIDATION				
	PHASE PLANNING (4D MODELING)		PHASE PLANNING (4D MODELING)		PHASE PLANNING (4D MODELING)		PHASE PLANNING (4D MODELING)
X	COST ESTIMATION	X	COST ESTIMATION	X	COST ESTIMATION		COST ESTIMATION
	EXISTING CONDITIONS MODELING		EXISTING CONDITIONS MODELING		EXISTING CONDITIONS MODELING		EXISTING CONDITIONS MODELING

Appendix E-4

BIM Execution Plan – Process Map

Level 1: BIM Execution Planning Process

Fort Pickett Regional Training Institute Phase II