West Village Commons
Towson University
Towson, Maryland

Technical Assignment #1
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-EXECUTIVE SUMMARY-

Towson University's West Village Commons will be the mar key highlight of the new student living area, West Village. It will be the home to of dining facilities, meeting rooms, take-out restaurants, and an accessible green roof. The project will strive for a LEED silver rating with the possibility of reaching gold. Technical assignment 1 required an in-depth analysis into the project, including project schedule, building systems, project cost, existing site conditions , local conditions, client information, project delivery, and construction staffing.

Construction will take approximately 19 months and has been broken up into two separate bid packages. Bid package A includes all initial site work and foundations and bid package B will include the remaining trades. This was done so construction could start early, while Bid Package B is still in design. Bid Package A will cost approximately $7.1 million dollars and B will cost $22.7 million.

The highlight of the substructure is the unique foundation system called Ram Aggregate Piers® (trademark name of Geopier Foundation Company, Inc.) which is basically stone that is hydraulically rammed into core drilled holes to create enough bearing pressure to support the building. The superstructure is split into two sections, a north end and a south end. The north end rises out of the ground to a height of four stories and is made up of structural concrete. The south end spans over an existing road (Emerson Drive) and rests in a hillside, creating a bridge-like architectural feature. The south end is two stories, beginning on floor three, and is comprised of structural steel. The unique two part structural system makes for an interesting engineering and construction feat, as the road it spans must stay open during construction.

The project site is within a college campus, leading to logistic issues for delivery and site safety. There is almost no lay down area for construction and all deliveries must be made the day they are installed. Structural steel sequencing will have to be planned out meticulously so as not to delay the schedule. The university has also placed an emphasis on pedestrian and site safety. Barton Malow has partnered with the Maryland Occupational Safety and Health Association to create job specific safety plans and training.

This Technical Assignment explores the basic engineering systems and construction techniques of Towson West Village Commons. From it, I have found some areas of exploration in which to study for my thesis, including the delivery method using two separate packages, the bridging of two different structural systems, and the complexities of a tight construction site.

-Project Schedule Summary-

The Barton Malow Company was awarded the West Village Commons project on a best value basis while still in the design phase. To help accelerate the start of the project, it was broken down into two separate packages, bid package A and bid package B. Bid package A includes initial site work, excavation, site utilities, deep foundations, under slab penetrations, and cast-in-place concrete. Bid package B consists of structural steel, masonry, curtain wall/exterior glazing, fireproofing, mechanical, electrical, and plumbing trades, interior finishes, and final site work/landscaping. I have highlighted the separate packages in my summary schedule; "BPA" is bid package A and "BPB" is bid package B. The summary schedule may be found in Appendix A.

Foundation

The basement level of the north side of the building, shown in figure 1 (northwest section of the site), rests on spread and strip footers. They are poured along with foundation perimeter walls after the excavation of the basement. The Ram Aggregate Piers® are dug and pounded in the northeast section of the site (figure 2) while the basement foundation concrete is being poured. They are than capped with footings and connected with grade beams. After both areas have their respective foundations, slabs on grade are poured first in the west and than in the east. Level 1 has a slab on grade in the east area and an elevated slab on the west above the basement. When both level 1 slabs are poured, the spread footers supporting the south end of the building are excavated, formed, and poured

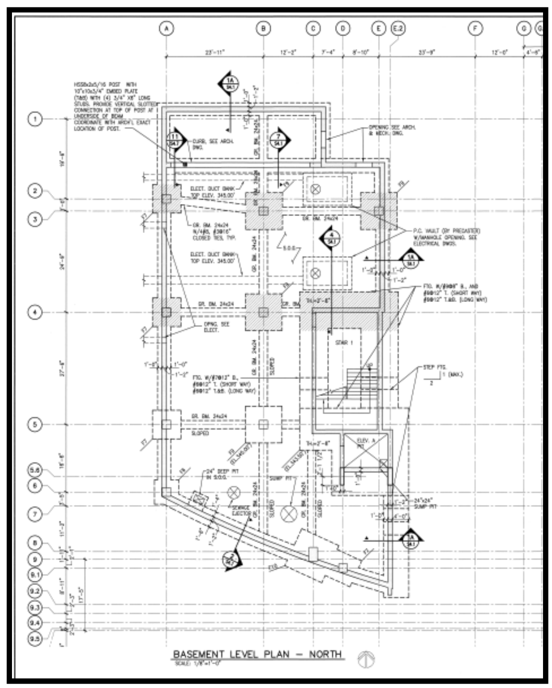


Figure 1: Basement Level Structural Plan

Structural

The structural phase begins when concrete has been poured up to level 1. The concrete contractor will move in an east to west pattern forming and reinforcing columns and elevated slabs. A second crew will follow closely behind to pour the concrete. This flow continues the entire north end and off at the roof level on February 24th, 2010. Around the same time the roof tops off, structural walls and columns are poured on the south side of Emerson Drive. The south side of the building and the two floor bridge that spans across Emerson Drive consists of structural steel beams and columns. Metal embeds will be placed in the concrete columns and structural steel columns will be connected. The steel will be set in a north to south direction and is followed by the metal decking and detailing. Figure 5 in the "Building Systems" section shows where the concrete system ends and the steel system begins.

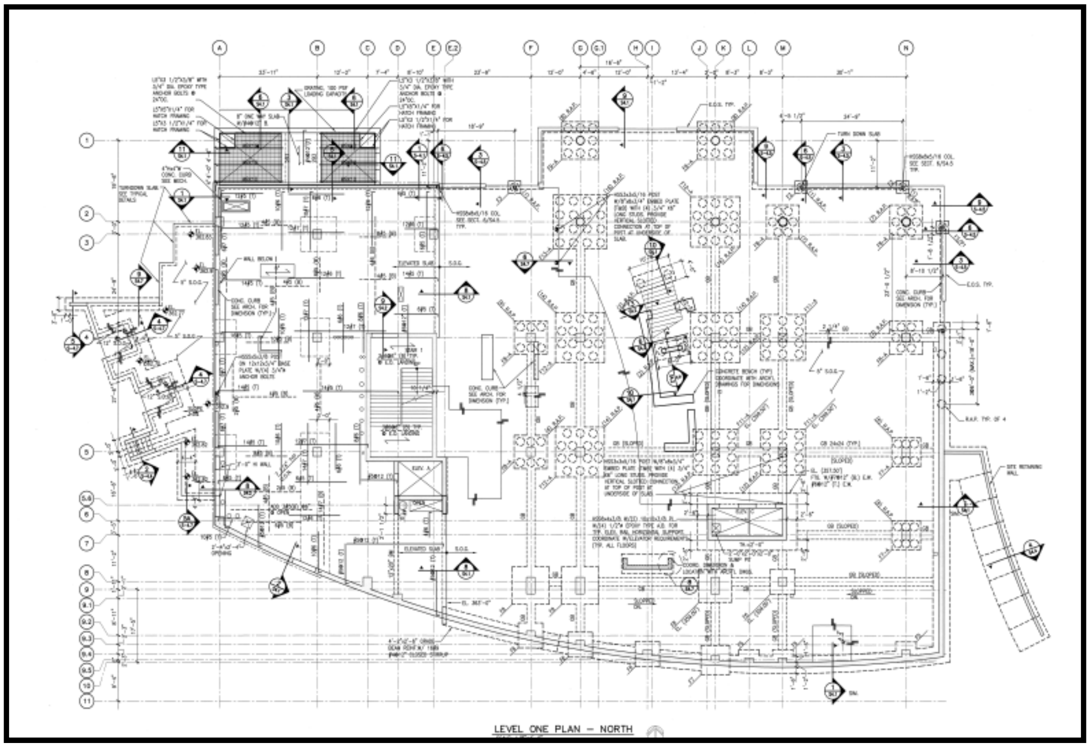


Figure 2: Level One Structural Plan

Finish Sequence

The finish sequence will be coordinated so that levels 1 and 2 are being worked on simultaneously, followed by levels 3 and 4. For instance, the metal stud contractor will have two crews. The first crew will work on level 1 first, and when work is completed will move to floor 3. At the same time the second crew will work on level 2 and then move to level 4. The sequence of trades will first begin with layout of the top and bottom tracks for the interior metal stud partitions. This gives overhead trades with rough-ins a guideline on where to run lines. All overhead duct work, mechanical piping, and fire sprinkler mains are roughed in before the metal studs are installed. After interior studs are constructed, over head electrical conduits are run throughout the ceiling; in-wall plumbing and electrical conduits are placed; and knockout boxes are installed. Before ceiling grid is hung, overhead HVAC equipment is installed and insulation is wrapped around supply ducts.

Once each floor has passed in-wall inspections, drywall can be hung, finished, and primed for painting, branch wiring can be pulled and terminated, and casework can be fitted out. Kitchen equipment may also begin initial placement and installation. Some larger pieces such as the walk-in refrigerators will need to be delivered before some of the interior partitions are built. The ceiling grid can then be placed and sprinkler heads adjusted to final locations. After the above ceiling inspection, all of the diffusers, lights, and ceiling equipment can be trimmed out. The ceramic tile, VCT, and carpeting are then laid down. Before the final owner and architect inspection, a final coat of paint will be applied to the walls.

-Building Systems Summary-

The following is a description of Towson University's West Village Commons building systems. Descriptions will be given on the foundations, cast in place concrete, the structural steel framing, the mechanical systems, electrical systems, the exterior masonry veneer, the curtain wall system, and the system used for supporting the site excavation. There is no demolition or precast concrete on this project.

Foundations

The building's foundation system consists of spread footers on natural soil to support the basement level, and Ram Aggregate Piers® (R.A.P. ® or Geo Piers®) supporting the levels above the northeast. The piers have a minimum bearing capacity of 6,000 ksf and a compacted fill with an allowable bearing capacity of 4,000 psf. To place the R.A.P.'s®, first an auger is drilled to the specified geotechnical depth. Stone is placed in 12" lifts and pounded by an excavator equipped with a hydraulic break hammer. When properly placed, these piers not only allow direct structural support, but also strengthen the surrounding soil. With a foundation load greater than 3,000 kips, the system will limit foundation settlement to 1 inch or less (www.geostructures.com). The piers will only take about a week to place and they are far cheaper than traditional foundations. See Figure 3 for a cross-sectional view of the foundation.

The smallest footers have 6 piers and the largest have 16. All footers and grade beams shall have a compressive strength of 4000 psi and have dimensions ranging from 3' x 3' x 16" to 13' x 13' x 44". The south side of the building, where the bridge portion of the structure meets the hill, has a crawl space consisting of a 4" slab on grade and 12" thick concrete walls. Figure 4 shows the different compressive strength requirements for concrete.

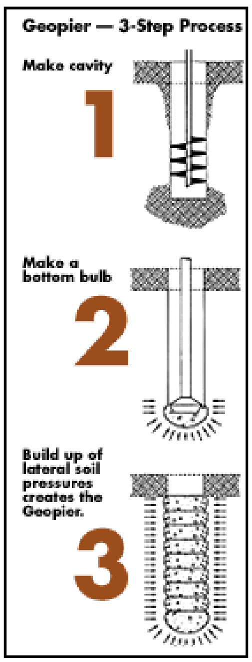


Figure 3: www.Geostructures.com

The construction team is experiencing more rock than was expected in the northeast quadrant of the building. They will not be able to drill as far as they are specified to do and the earth may require some blasting. In the northwest quadrant, where there is no deep foundation system, just footers and grade beams, there is more sand than expected. The construction team may have to cut some of the sand and fill with more compact soil to gain the required bearing capacity.

Cast In Place Concrete

The north half of the building consists of cast-in-place concrete for all retaining walls, columns, beams, suspended slabs, and slabs on grade. This half of the building will have all of the dining commons and take-out restaurants. The abundance of mechanical piping and ductwork to support the kitchen equipment requires a larger plenum height, which cast in place concrete allows. Figure 5 shows where the building's structural systems split. Floor slab to floor slab height on level 2 (location of the largest kitchen) is 17' – 4" with a plenum height of 7' – 4", ample room to coordinate overhead systems.

The suspended slabs are 9" thick normal weight concrete with 7 1/4" drop panels. Most of the concrete columns are 24" x 24" with 12 #8 reinforcing bars. The elevator and stairwell walls act as 12" thick shear walls reinforced with #5 reinforcing bars at 12" o.c. The slab on grade is 5" thick reinforced with 6"x6" - W2.9 x W2.9 welded wire fabric (WWF). The roof structure for the third floor partial roof and on the fourth floor of the north end of the building is 9" thick normal weight concrete. Figure 4 gives the typical concrete strengths.

Type	Strength (psi)
Footings, Grade Beams	4,000
Slab on Grade	3,500
Retaining Walls	4,000
Columns, Slabs, and Shear Walls	5,000
Curbs and Equipment Pads	4,000

Figure 4: Typical Concrete Strengths

All formwork on the job will be reusable so as to expedite the process. They will also be made with Forest Stewardship Council certified wood to count for LEED credit MRc7: Certified Wood. Concrete will be placed with two different methods; either by a concrete pump placing concrete directly in the formwork or by a crane and bucket. The concrete pump will mainly be used for foundations, slabs on grade, and initial columns. When the tower crane is erected, concrete will pumped into a bucket and swung to locations.

Structural Steel Framing

The south end of the building where the structure spans over Emerson Drive, is supported by structural steel. This system was chosen because overhead head mechanical support systems are less dense (no kitchen areas, just meeting rooms) and requires less plenum space. The steel also has the tensile strength to span across Emerson Drive without supports; at some points spanning between 40 and 50 feet. On the third floor (the first floor of the bridge) the beams are larger to support the load over the road. Some of the typical beams are W18x35, W21x24, W24x55, and W24x76.

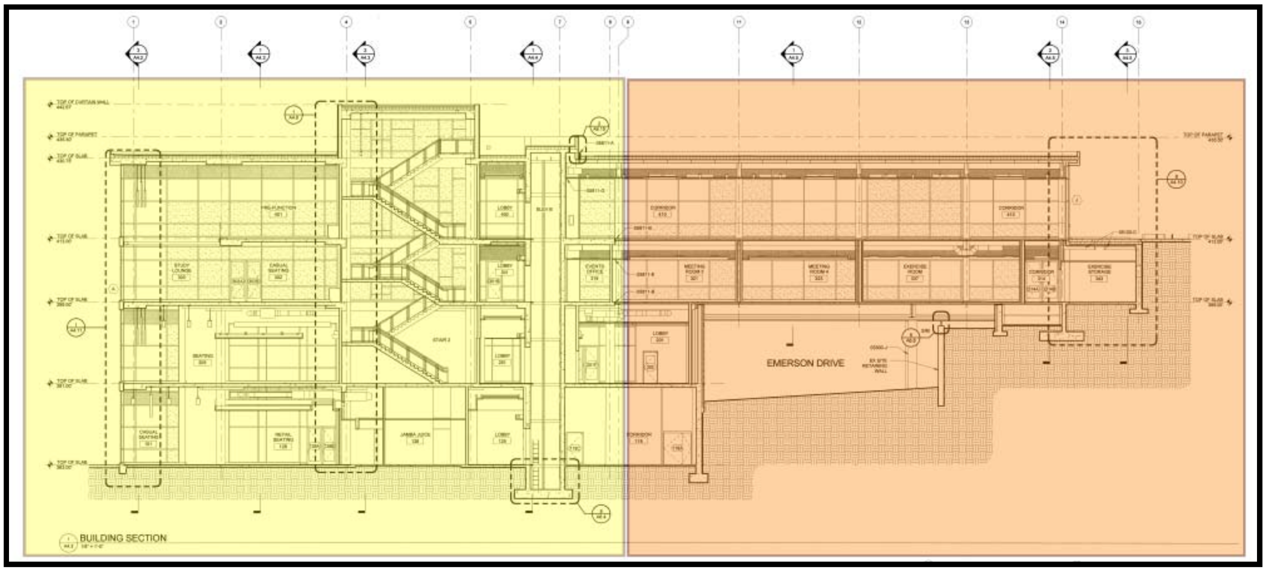


Figure 5: Building Section showing different structural components. The yellow section is the north end made of structural concrete and the red section is the south end made up of structural steel.

The fourth floor beams are more consistent in type, only varying between bays. The four main beams are W10x12, W12x14, W12x19, and W14x22. The steel columns are mostly W12x40's with the occasional W12x45 or 50.The floors are a composite slab structure made up of 3-1/4" light weight concrete reinforced with 6"x6" - W2.1xW2.1 WWF, over a 2", 20 gauge composite steel deck. The roof structure for the south end utilizes 52DLH16 sloped joists with 1-1/2", 20 gauge steel decking. Structural bracing runs east to west along the north and south side of the bridge on the third and fourth floor. There is also two 17' sections of cross bracing on east and west wall at the very south end of the bridged. This building was designed for Seismic Site Class C.

All structural steel and metal decking will be set using a tower crane approximately 120' tall with a boom radius of 164', located near elevators B & C. It will rest on a cast in place concrete foundation. Figure 6 illustrates the location and figure 7 is a photo of the reinforcement for the crane pad.

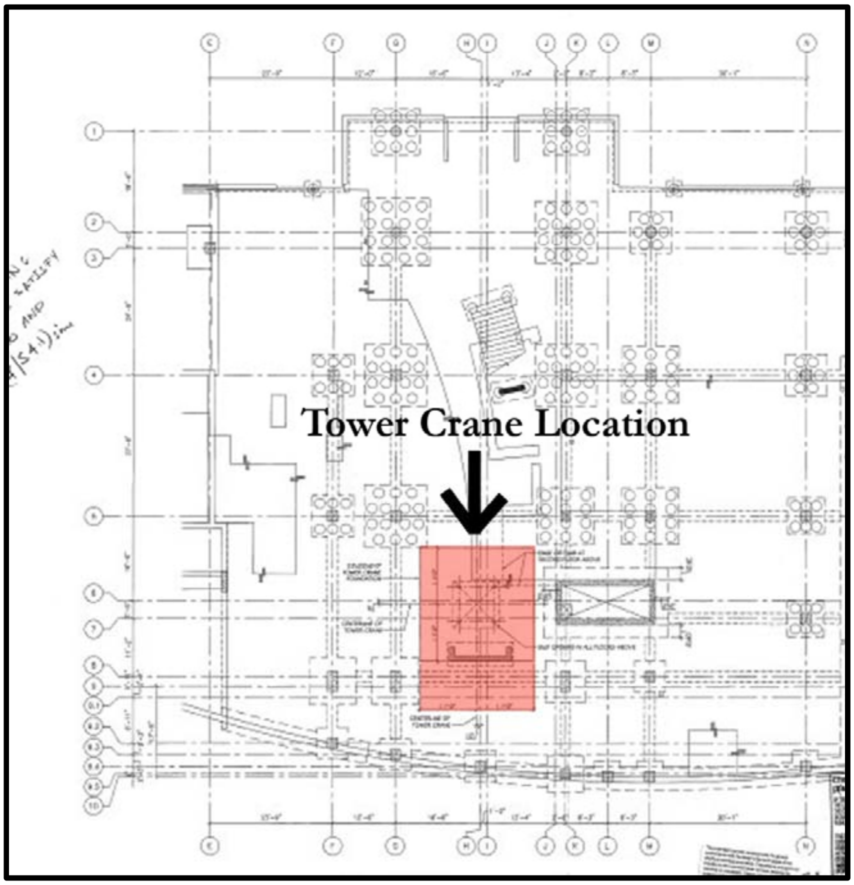


Figure 6: Crane Tower Location in North End, Carson Crane, Inc. crane submittal

Figure 7: Crane Foundation Reinforcing, Barton Malow Site Photo

Mechanical Systems

Heating Water System:

The hot water system for West Village Commons consists of two packaged cast iron sectional pressurized, wet-base, water boiler-burners. They run off natural gas and are rated for 3000 MBH. Each weighs approximately 10,000 lbs. The hot water is distributed throughout the building by two 465 gallon per minute pumps located in the basement.

Chilled Water System:

The cold water source is from a chiller located in the basement. The evaporator for the chiller is 3535 MBH with a 565 gpm max flow, and will require 193 kilowatts to power it. The cold water is distributed by two 565 gpm pumps located in the basement. It works together with a closed loop condenser water system which consists of a cooling tower located on the roof. The tower is rated as a 300 ton, induced draft counter flow, upblast system, with a 20 horsepower motor and a maximum flow rate of 900 gpm. The condensed water system is distributed by two 900 gpm pumps located in the basement.

HVAC:

The new commons building has an interesting heating, ventilating, and air conditioning system in that it has 7 separate air handling units (AHU) spread throughout the building. They provide hot or cold air to variable air terminal units, allowing greater control in each of the zones. The dining commons kitchen has its own dedicated AHU, and the 3rd and 4th floor are the largest areas supplied by one unit. Greater control means a greater expense in not only material, but also labor and coordination. AHUs 1, 2, 3, 4, and 6 are custom designed air handling units. Figure 8 is a table describing each of the AHU's.

Unit Designation	Type	Area Served	Unit Location	Unit Weight (lbs)	CFM
AHU - 1	Custom Variable Air Volume	Meeting Room	Roof	20,500	7,500
AHU - 2	Custom Variable Air Volume	Meeting Room	Roof	20,500	5,000
AHU - 3	Custom Variable Air Volume	Meeting Room	Roof	20,500	7,500
AHU - 4	Custom Variable Air Volume	3rd and 4th Floors	Roof	49,000	25,000
AHU - 5	Trane "M" Series Constant Air Volume	Kitchen	Basement	not specified	6,550
AHU - 6	Custom Variable Air Volume	2nd Floor	Roof	31,000	17,000
AHU - 7	Trane "M" Series Variable Air Volume	1st Floor	1st Floor Mech. Room	not specified	16,000

Figure 8: Air Handling Unit Breakdown

Exhaust System

The large kitchen and individual restaurants require multiple ventilation systems and exhaust hoods. There are 11 of these hoods throughout the building that are exhausted with 6 separate exhaust fans. They range from 800 cfm to 8300 cfm and are located on either Level 3 or Level 4 roof. In addition to the exhaust fans, a 2,000 gallon grease interceptor will be installed below grade and connected to all pieces of equipment with grease waste products.

Fire Suppression

West Village Commons has a water-based, wet automatic fire suppression system. It will connect with the domestic water piping to achieve a minimum static pressure of 99 psi. The two stair towers will house the sprinkler risers, where at each landing a sprinkler zone valve is installed. In areas of elevated temperatures, such as the kitchen, high temperature sprinkler heads will be used.

Electrical/Lighting System

West Village Commons will tie into existing campus utilities and provide an outlet to future buildings on the west side of campus. Currently there are three main outdoor switch gears providing 15 kilovolts and 1200 amps each. A new switch gear with the same attributes will feed into a 1500KVA, medium voltage transformer and then into the main switchboard in the basement level. The switchboard is a 277/480 volts, 3-phase, 4-wire with a 2000 amp main breaker. A 150 kilowatt natural gas generator with 277/480 volts, 3-phase, 4-wire, will provide backup energy within 10 seconds to the commons during a power loss.

The vast amount of kitchen equipment requires a lot of energy and many electrical connections. The complicated electrical system needs to be closely coordinated with the kitchen equipment vendors. Equipment is constantly changing and the owner will want the most up to date appliances. Changes in locations of connections will have to be carefully tracked.

The majority of the lighting is of generic standard and there is not much architectural value to highlight. The ornamental stair case has some architectural lighting, but will probably be cut from the project due to the high cost. There is mostly down lighting to provide adequate visual comfort for cafeteria dining. The large multipurpose room on the fourth level (Room #411) will have special dimming capabilities depending on what the room is being used for. Dimming switches will be installed capable of dimming standard and low-voltage incandescent and halogen fixtures, and fluorescent fixtures with dimming ballasts. The room has movable partitions to divide it into three sections, and will be equipped with partition lighting sensors. These will dim to the appropriate lumen level for smaller rooms. All audio-visual equipment will have lighting controls as well.

Exterior Masonry Veneer

The east and west side of the north end of the building has an exterior face brick veneer that encloses the 1st and 2nd floor. The exterior wall has a load bearing metal stud back up, followed by exterior gypsum board, rigid insulation, and an air cavity. Adjustable metal anchors tie the brick into the exterior wall studs and gypsum board. The metal brick relief angles supporting the brick at each floor are connected to concreted slabs by vertical channel brackets. As part of the LEED requirements, all brick needs to have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of the project site. Due to site restrictions brick veneer installation must utilize hydraulic mast-climbing work platforms on all facades. All work platforms will have catch nets installed under them to protect workers and pedestrians.

The basement level, mechanical rooms, and all 2 hour fire-rated risers use a concrete masonry unit wall. They have a minimum compressive strength of 2,800 psi and are classified as lightweight. The walls are strengthened vertically with reinforcing bars and laterally with hot-tip galvanized ladders. Again, the material must be brought from within 500 miles of the project site.

Curtain Wall

The north end of the West Village Commons has a glass curtain wall on the north elevation for floors 1 through 4, and on the east and west elevations from floors 2 through 4. A variation of clear tempered glazing, low-e tempered spandrel panels, and spandrel panels make up the main composition. Thermally broken aluminum framing connects the glazing, and in between floors a continuous aluminum panel matching the curtain wall is placed to hide the floor slabs. The south end has a similar curtain wall on the east and west elevations of the bridge span over Emerson Drive. The curtain wall was architecturally designed by GWWO, Inc./Architects and is a unified system: it will be fabricated in sections and installed on site.

Support of Excavation

Figure 9: Sheathing and Shoring, Barton Malow Site Photo

The excavation for West Village Commons will be supported with sheathing and shoring (soldier beams and lagging boards). They will remain permanent on site after excavation concludes. Figure 9 is a photo of the support system on site. The water table varies with times and location but there is a reliable indication of hydrostatic water at levels ranging from 18-33 feet below existing grade. A dewatering system will need to be used during construction activities.

-Project Cost Evaluation-

The following is a cost breakdown of the building construction costs (figure 10), total project costs (figure 11), and the building system costs (figure 12). There was though a limit to the budget information permitted to be published for the building systems, and I was unable to obtain design fees from the architect or engineers. Please note that I have broken the costs into the different packages as there will be two separate GMP's. All of this information was collected and permitted to be published by the Barton Malow Company. There is a minimum percentage of the contract value that must be awarded to minority run businesses. The State of Maryland has designated companies that have a net worth of less than $1.5 million as Minority Business Enterprises (MBE). There is a requirement that all state funded contracts have at least 25% of that contract value dedicate to MBE companies. Towson University and its programs are state funded and fall under this requirement. Under the "Total Project Cost" (figure 11), the percentage of MBE per GMP A or GMP B is broken down.

Figure 13 represents a Parametric D4Cost Estimate, compared to a 2 story 16,000 SF commons building, built in Rhode Island. It is named the Hope Dining Commons and is the only project found in the database closely related to the purpose and size of the West Village Commons. The full report can be found in the appendix B. Figure 14 is a breakdown of an RSMeans square foot estimate. As you can see, there is a major discrepancy between this estimate and the actual cost budgets. RSMeans does not have an accurate model number for a project like West Village Commons. This will be addressed in "Project Cost Discussion." Note that no time multiplier is being used as it is a 2009 manual and the building is currently under construction. Note that for the RSMeans and D4Cost estimate, only one structural component can be selected. Concrete was chosen as it is utilized more throughout the building than steel.

Building Construction Cost		
Package	**Construction Cost (CC)**	**CC/SF**
Bid Package A	$5,222,789.04	$61.44
Bid Package B	$21,924,265.00	$257.93
Total	$27,147,054.04	319.38*
*Does not include earth retention, landscape, site utilities, design and preconstruction fees		

Figure 10: Building Construction Data

Total Project Cost			
Package	**Total Project Cost (TC)**	**TC/SF**	**MBE Participation****
CM Preconstruction	$300,000.00	$3.53	$0.00
Bid Package A	$7,120,965.00	$83.78	$1,432,510.00
Bid Package B	$22,961,029.00	$270.13	$5,885,843.00
Total	$30,381,994.00	357.44†	$7,318,353.00
**Contract values of companies qualified as a Minority Business Enterprise, must be 25% of project †Design fee information is unavailable			

Figure 11: Total Project Cost

Building Systems Cost				
Building System	**Cost**	**Cost/SF**	**% of Total Project**	**Notes**
Bid Package A				
Under slab MEP	$771,155.93	$9.07	3%	
Structure (Cast in Place Concrete and Geopiers)	$4,451,633.11	$52.37	15%	Includes CIP Concrete for Entire Building
Site Work	$1,898,175.96	$22.33	6%	
Bid Package B				
Structure (Steel)	$1,160,628.00	$13.65	4%	
MEP††	$12,126,343.00	$142.66	40%	
Enclosures	$3,396,882.00	$39.96	11%	
Interiors	$5,057,443.00	$59.50	17%	
Finish Site Work	$766,764.00	$9.02	3%	
††This is the extent of the break down I was allowed to use from Barton Malow				

Figure 12: Building Systems Cost

Parametric D4Cost Estimate				
Code	**Divison**	**Percent**	**Sq. Ft. Cost**	**Amount**
00	Procurement	5.79%	$22.14	$1,882,143.00
01	General Requirements	7.15%	$27.34	$2,324,143.00
03	Concrete	7.32%	$27.97	$2,377,571.00
04	Masonry	3.79%	$14.47	$1,230,071.00
05	Metals	5.98%	$22.86	$1,942,857.00
06	Woods , plastics, and Composites	4.64%	$17.72	$1,506,321.00
07	Thermal and Moisture Protection	4.17%	$15.93	$1,353,726.00
08	Openings	3.89%	$14.88	$1,264,881.00
09	Finishes	7.34%	$28.04	$2,383,036.00
10	Specialties	1.01%	$3.85	$327,048.00
11	Equipment	11.30%	$43.17	$3,669,167.00
12	Furnishings	0.81%	$3.10	$263,095.00
14	Conveying Systems	1.20%	$4.57	$388,571.00
21	Fire Suppression	0.87%	$3.33	$283,333.00
22	Plumbing	7.68%	$29.34	$2,494,222.00
23	HVAC	18.61%	$71.13	$6,046,360.00
26	Electrical	8.46%	$32.33	$2,748,131.00
	Total Project Cost:		$382.17	$32,484,676.00

Figure 13: Parametric D4Cost Estimate

RSMeans Square Foot Estimate					
RS Means Source	2009	Model #: M.140	College Dormitory, 4-8 stories		
Page(s):	106 - 17	Exterior Wall Type:	Face Brick With Concrete Back-up		
Building Area:	85,000	Frame:	Reinforced Concrete Frame		
Basement Area:	6,766	Story Height:	17'		
Perimeter	596.4				
	Area Falls Between:	Nothing	And		85,000
				Base Cost per Square Foot:	**$170.70**
Adjustment Type:	Perimeter Adjustment			Per Squre Foot Adjusted:	$4.05
	Story Height Adjustment			Per Squre Foot Adjusted:	$1.60
				Adjusted Base Cost per Square Foot:	**$182.59**
Base Building Cost:	$182.59	x	85000.00	=	$15,520,150.00
Basement Cost	$32.65	x	6766.00	=	$220,909.90
				Total Cost:	**$15,741,059.90**
Addition			Cost Per	Quantity	Total Amount
4,500 lb Capacity Elevator (used 3,500 lb value)			$163,700.00	3	$491,100.00
Kitchen Equipment - Broiler			$4,025.00	10	$40,250.00
Kitchen Equipment - Coffee Urn, Twin, 6 Gallon			$3,075.00	9	$27,675.00
Kitchen Equipment - Cooler, 6ft long			$4,925.00	25	$123,125.00
Kitchen Equipment - Dishwasher			$4,950.00	10	$49,500.00
Kitchen Equipment - Food Warmer			$735.00	12	$8,820.00
Kitchen Equipment - Freezer			$3,725.00	20	$74,500.00
Kitchen Equipment - Ice Cube Maker			$1,750.00	10	$17,500.00
Kitchen Equipment - Range			$2,700.00	35	$94,500.00
				Subtotal:	$926,970.00
Multiplier Type:	Location (Baltimore, MD)			Value:	$0.93
				Total Square Foot Estimate:	**$15,501,267.81**

Figure 14: RSMeans Square Foot Estimate

Project Cost Evaluation Discussion

D4Cost Estimate

The discrepancy between the D4Cost Estimate and the actual building cost is around $2 million, which is about a 7% difference. The project selected in D4 was similar in type, but not statistics. There was a major divergence between the two in square footage and number of floors. I thought the difference in projects was going to have a major effect on the result, but D4Cost lacked any other similar projects that would be appropriate to use. The Hope Commons historical data was the only logical choice.

After evaluating the D4Cost estimate, it can be seen that the major sq. ft. costs that drive the majority of the overall estimate, are similar to the building systems costs. For instance, the difference between the MEP systems square foot costs is only 4.6% lower in D4Cost. The large differences between West Commons Village and The Hope Commons are sustainable and LEED Requirements, the enclosures division (D4Cost is 24% lower), and the finishes divisions (D4Cost is 18% lower).

A complete breakdown of all the building divisions was not available, making it hard to see where exactly the D4Cost estimate is higher than the actual budgeted costs. The D4Cost estimate predicts that $43.17 per sq. ft will be allocated toward equipment (about 11.30%). While I was not able to receive the actual budget for equipment, one can assume that with all of the kitchen equipment, it would be a major component to the price. While there is a large amount of kitchen equipment for West Village Commons, I do not believe that $43.17 per sq. ft is accurate. The majority of floor space is given to meeting rooms, multipurpose rooms, and cafeteria seating.

RSMeans Square Foot Estimate

The RSMeans square foot cost estimate manual proved difficult to use for West Village Commons. While there was a model for “student union” projects, the building square footage was far too small, and the perimeter was far too large. The “student union” model was for buildings up to two stories. The base square foot costs were extremely low, and when the proper cost adjustments were made, the square foot cost would be unreasonable. I decided to use a complete analysis on the model for “college, dormitory, 4 – 8 stories.” This worked out to be a little closer, but still far off. The major difference in price may be contributed to the lack of large kitchen equipment and mechanical systems. While I made an attempt to use RSMeans additions for the kitchen equipment, the manual lacked large industrial size appliances. Even when escalating the number of appliances to make up the difference in “price per,” the square foot estimate still had a 50% discrepancy.

The RSMeans method of a square foot estimate cannot be performed for the West Village Commons for several reasons. First, it has a large, expensive curtain wall that is not an option for either the dormitory model or the student union. While the student union may take into account some kitchen equipment, it is not comparable to West Village Commons. There is also a large amount of sustainable features and LEED requirements that RSMeans does not take into account. If RSMeans square foot estimate was used to obtain a quick price in the beginning of the project for the Owner to reference, he would be receiving a completely inaccurate number. Using a historical database such as D4Cost estimate may provide more favorable results.

-SITE PLAN OF EXISTING CONDITIONS-

Towson University West Village Campus is an extremely tight site. Please reference Appendix D for a site plan of the existing conditions, utility lines, and project constraints that was recreated using civil drawings by Site Resources, Inc. All construction parking is located down Emerson Drive, approximately 1.5 miles away. Emerson Drive will be the only entrance to the construction area with trucks entering from the west and exiting to the east. This road must also remain functional during construction as it serves as the main avenue to the Towson Run Apartments and the Millennium Hall. The University has also emphasized the importance of not damaging the Great Elm located within the construction perimeter.

Pedestrian safety is a chief concern of any college campus project and West Village Commons is no exception. The University has made it clear to the students and faculty what pathways they should be using to travel around campus. The concrete sidewalks shown in the site plan (Appendix D) provide pedestrian traffic in both directions. Because safety is a major concern, the site fence will be tight to construction providing very little lay down are (represented by the light blue shading). The highlighted utility lines are ones that will directly impact construction. The electrical lines running through the proposed building will be demoed and relocated; the other utilities will be used to connect to the new building and extensions will be made for future projects. There will be some lay down area in the parking lot, but because of the distance from the site, day-of deliveries for large item will be employed.

Most of the utilities in West Village Campus have already been put in place during previous projects in preparation for West Village Commons. These will serve as temporary utilities during construction as well as final utility sources. Some of the existing utilities that run through the site will be cut, capped, and relocated, but there are minimal instances due to advance site planning for the William Paca and Harriet Tubman houses. While effort was made to locate fire hydrants, they were not indicated on any contract drawings.

In addition to the Site Plan Appendix, figure 15 is a map of the surrounding roadways near the site, and figure 16 is a campus map. The clouded area is West Village and the yellow hatching areas are proposed buildings. The yellow hatching in the bottom left area of West Village is West Village Commons.

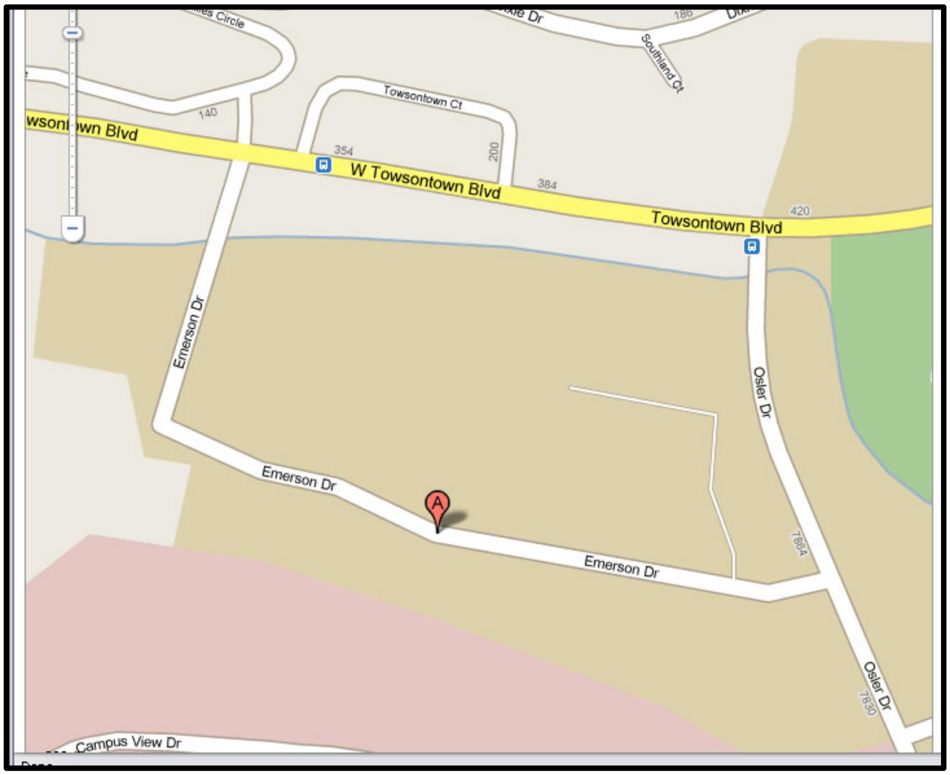


Figure 15: Road Map, www.googlemaps.com

Figure 16 – Campus Map, www.towson.edu

-LOCAL CONDITIONS-

Towson, Maryland medium size city located right outside of the larger metropolis, Baltimore City. The major contractors in the area usually work in and around Baltimore, middle Maryland, and the eastern shore of Maryland. With the economic crash as of late, some have begun to branch out into new regions to search for more work. Even major construction managers are stretching the arms out a little further to keep their employees working. Barton Malow has begun bidding on projects on the eastern shore and is making a strong push to enter the Washington, DC market. The Baltimore area has developed some construction trends over the year. First off, Baltimore utilizes a lot of steel and brick masonry, as opposed to DC's projects which are almost exclusively concrete. Baltimore is also heavily weighted toward union workers. While non union members are not scrutinized as much as areas like New York City, there is a distinct loyalty to one's chapter, even during economic hardships. Baltimore's major construction projects are usually split between three contractors: Whiting-Turner, Barton Malow, and Gilbane. Occasionally Clark Construction, which holds a major share of the DC construction market, makes its way up to Baltimore for a project or two. Whiting-Turner is constructing the new Liberal Arts Building for Towson only a few hundred yards away from West Village Commons.

The Baltimore area's weather is much like typical mid-Atlantic patterns. At its coldest average in January, the temperature dips down to 23.5°F at night and its highest in July is 87.2°F during the day. The driest month is usually April with only 3" of precipitation and the wettest is September with 3.98", though the amount of precipitation throughout the year stays pretty even (see figure 17). Weather may play a factor during concrete construction; the schedule has concrete beginning in November and ending in March - the coldest time of the year.

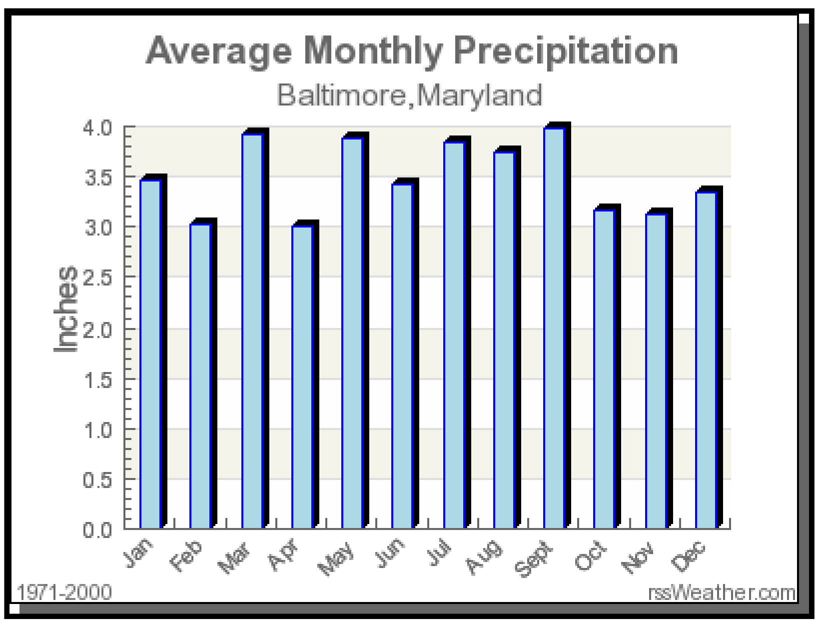


Figure: 17: Average Precipitation of Baltimore, www.rsseather.com

As part of the LEED requirements, Barton Malow and its subsequent contractors must follow a recycling program. Barton Malow hired A2Z Environment Group to haul all trash dumpsters away, sort through the trash and separate recyclable debris, and measure the contents for

LEED documentation. This is part of a contracted amount, but figure 18 is a section from the "Maryland Association of Counties – Budget, Tax Rates, and Selected Statistic" showing tipping and recycling fees in Baltimore County. According to their statistics, Baltimore City has one of the highest tipping rates, and Baltimore County (where Towson is located) has the highest tipping rate for commercial construction at $80/ton.

	Trash Collection Fee	$275/year	48,271,177	47,909,900
BALTIMORE CITY	Commercial Tipping Fee	$60/ton		
	Solid Waste Surcharge	$7.50/ton	10,044,485	9,650,000
BALTIMORE COUNTY	Commercial Tipping Fee	$80/ton	909,146	1,110,000

Figure 18: Tipping Rates for Baltimore County and City, www.mdcounties.org

According to the geotechnical report produced by, the soil in and around the site ranges from rock to sand, and as Barton Malow began excavation they found the difference to be more extreme. There is more bedrock in the northeast region of the site where the Geopiers are being placed, and more sand in the northwest region where spread footers are utilized. This is causing some concern for there may be more cut and fill than was originally planned. The water table moves anywhere from 15.5' to 27' below current grade, requiring a dewatering system during construction and permanent below slab drainage system.

-Client Information-

In September of 2003, Towson University released an updated Master Plan to address planning issues the university was facing. First of all Towson University had just made a commitment of increasing enrollment by 2,500 students over the next 10 years (2013). The campus is already "grappling with significant space needs" and increasing enrollment would only enhance the issue. The conditions of the current facilities has deteriorated from age and in 2003 had $52 million in deferred maintenance. Also at that time 90% of the academic buildings had not had a comprehensive renovation in over 30 years. The Towson area is home to several prestigious universities, including Johns Hopkins University and Loyola College of Baltimore, creating stiff competition for potential new students. Needless to say, when the Master Plan was released, Towson was embarking on a campus wide building revitalization and expansion, to help reflect its mission statement of teaching and learning.

With the additional students, Towson's Master Plan called for a new focus on student life and social engagement. The area of campus previously known as Towson Run Precinct (would soon be renamed West Village) would serve as the building ground for this vision. Figure 19 is an original site layout, with West Village Commons labeled as number "23". The Master Plan also addressed the need for additional student parking for safe transportation at night. West Village Commons was originally going to be much smaller and contain a parking garage connected on its south side (labeled 25). At the time, all orange buildings on the image had yet to be constructed; currently the two buildings directly north of the proposed commons have been built.

Figure 19: Original West Village Master Plan, www.Towson.edu

A little more recent than the Master Plan, Towson University President Robert L. Claret committed that all future building projects would embrace green technologies. The University devoted itself to not only green buildings, but also green initiatives such as campus-wide recycling programs, energy savings, and student programs such as "adopt-a-campus" and "trayless Tuesdays."

As highlighted earlier, the project has strict safety and pedestrian access conditions and safety requirements.Towson University has a commitment to campus safety and that is highlighted in all of their building projects. Barton Malow has a safety director for the region and a safety manager for the surrounding projects. A comprehensive safety plan has been created, and is contractually required to be followed by all subcontractors. Barton Malow has also partnered with the Maryland Occupation Safety and Health Association to help keep the job site safe.

All of these initiatives can be seen in the West Village Commons; Towson is addressing student social engagement, student learning environments, and green initiatives. Figure 20 is a final design rendering view from Emerson Drive. The West Village Commons is the final piece that will make West Village a complete living environment for Towson Students. Towson's green initiatives can be seen in the expansive green space and landscaping, accessible green roof, and environmentally friendly construction techniques. This building will be the center piece for all of West Village and a highlight for Towson University.

Figure 20: Final Design Rendering, GWWO, Inc./Architects

-Project Delivery System-

West Village Commons was bid out to a private list of contractors on a best value basis. Contractors bid on fee, reputation, construction techniques, reputation, and job history. The Barton Malow Company won the project when bid package A was 100% Design Development and bid package B was around 25% Design Development. Barton Malow signed a contract with the owner as a Construction Manager at Risk and quickly began to send bid package A to potential subcontractors. The concrete contract in bid package A was not just for foundations but for the entire structure; it is planned so that concrete work would not stop and have to be picked up by a separate contractor. Key highlights of this arrangement are in the mechanical and electrical packages. The initial under MEP under slab work (bid package A) was completed by Joseph M. Zimmer (mechanical) and Enterprise Electric. All MEP work in bid package B, though, was awarded to M. Nelson Barnes (mechanical) and BK Truland (electrical). It will be interesting to see how this effects coordination, and whether or not issues will arise from this arrangement.

All subcontractors are required to submit performance and payment bonds, as well as show evidence that their stored materials will be properly insured. At the sole discretion of Barton Malow, subcontractors may be allowed to participate in a controlled insurance and bond program, specifically SubGuard. This allows for a lower bid on all subcontractors because they will no longer mark up their performance and payment bonds. Instead the contractor has the ability to apply their own fee to the cost of SubGuard. The following is the contract language from the project manual contract:

2.01 PERFORMANCE BONDS AND PAYMENT BONDS

> *A. Barton Malow Company may, at it's sole determination, elect to enroll the Subcontractor into a Controlled Insurance Program – specifically Subguard. If so engaged, the costs of the Subcontractors' Performance and Payment Bonds shall be directed to the Subguard insurance program (the Subcontractor will not be required to submit P&P Bonds) and the initial value of the evaluated base contract price shall be adjusted accordingly.*

The project delivery and contract methods are appropriate for this project because of the project constraints. There was a push to make sure the commons were open for the 2011-2012 school year; by breaking the design into two packages, there should be no problem meeting that deadline a few months ahead of time. This eliminated the costs of a condensed schedule that a completely design-bid-build job (where the job is not put out to bid until 100% design development) would require. Construction manager at risk arrangement allows ample time for preconstruction analysis, MEP coordination, sufficient contractor LEED preparation, and an effective building information modeling strategy. Figure 21 is an organizational chart breaking down the architect's consultants and the construction manager's subcontractors. Note that mechanical and electrical trades are either BPA or BPB which relates to either bid package A or bid package B, respectively. Also note that the blue encirclement highlights those trades required to submit a BIM model and participate in BIM coordination in accordance with their contract.

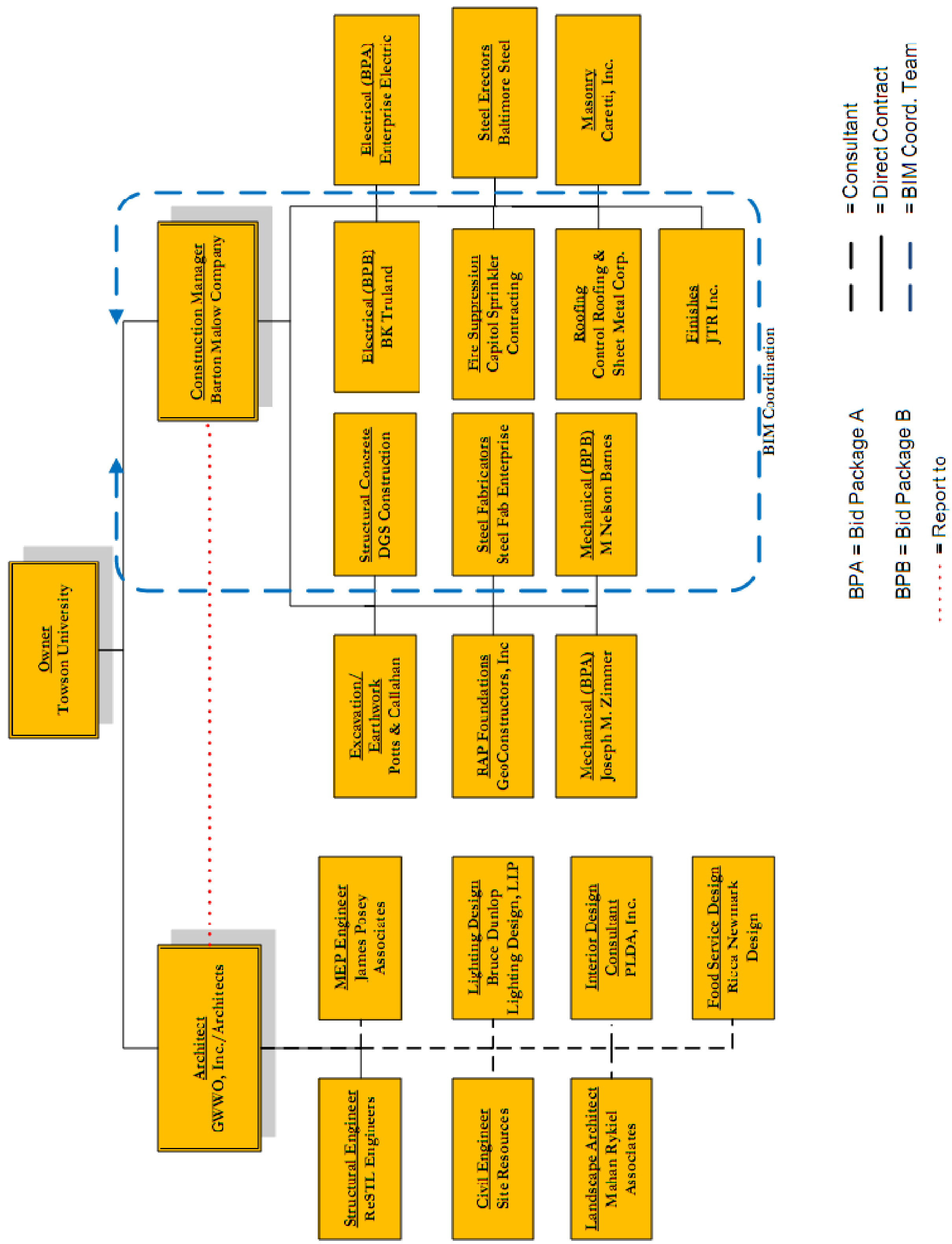


Figure 21: Project Team Organization Chart

-Staffing Plan-

The Barton Malow Company has a presence in several regions throughout the country. Currently they are broken into three separate regions: The central region, where the main headquarters is located (Southfield, Michigan), the southern region, and the eastern region. The eastern region has shown a huge advancement in the past 10 to 15 years, and has become a major focus for Barton Malow. The Senior Vice President of the eastern region is Phil Kirby, and within that region are several office. The Mid-Atlantic area (Virginia, DC, and Maryland) is run from their office outside of Baltimore in Linthicum, Maryland. West Village Commons was bid from the Baltimore, Office, whose Vice President is Robert Grottenthaler. The staff is made up of a project director, who is responsible for this project and a few others, a project manager, a general superintendent, and two project engineers. Figure 22 is an organizational chart of the Barton Malow team.

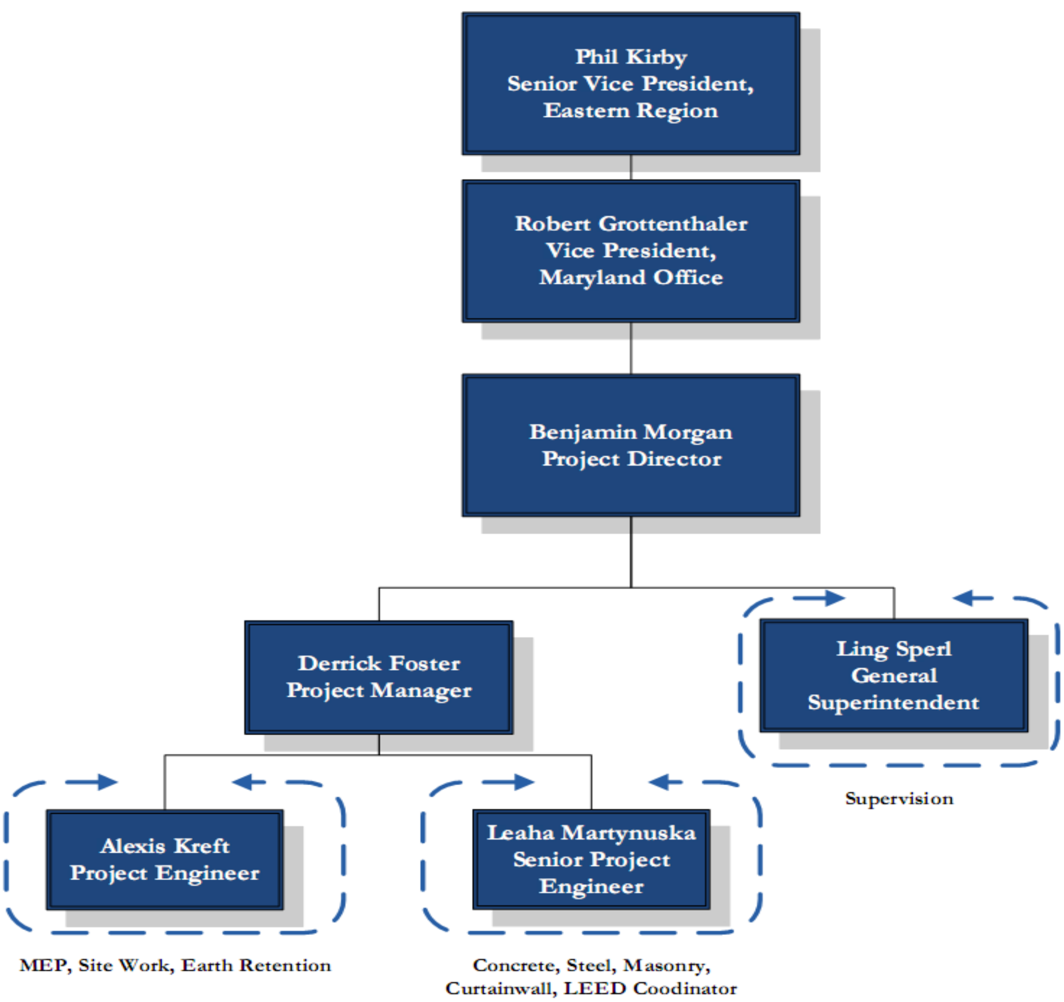


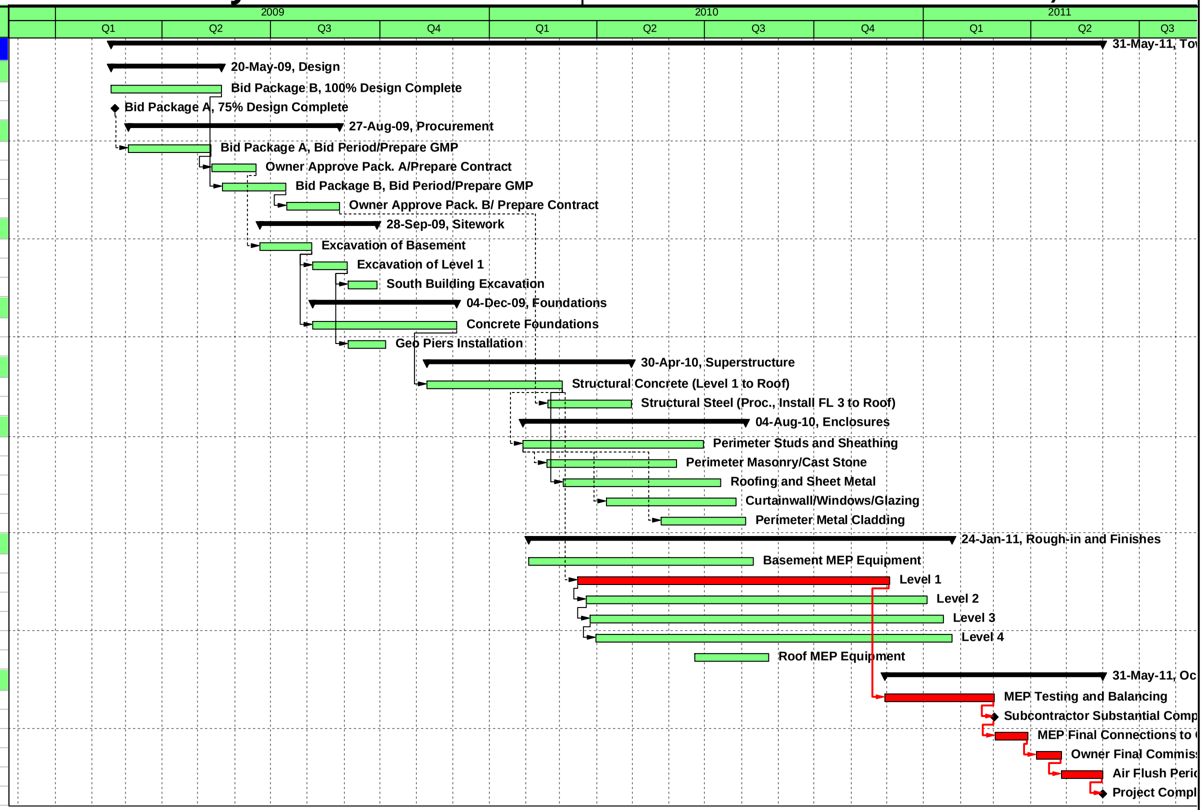
Figure 22: Barton Malow Project Team

-Appendix A-

Milestone Schedule

Towson West Village Commons | Summary Schedule | October 5th, 2009

Activity Name	Packa...	Remaining Duration	Start	Finish
Towson University West Village Commons Mile...		596	17-Feb-09	31-May-11
Design		67	17-Feb-09	20-May-09
Bid Package B, 100% Design Complete	BPB	67	17-Feb-09*	20-May-09
Bid Package A, 75% Design Complete	BPA	0	20-Feb-09*	
Procurement		128	03-Mar-09	27-Aug-09
Bid Package A, Bid Period/Prepare GMP	BPA	50	03-Mar-09*	11-May-09
Owner Approve Pack. A/Prepare Contract	BPA	28	12-May-09*	18-Jun-09
Bid Package B, Bid Period/Prepare GMP	BPB	38	21-May-09*	13-Jul-09
Owner Approve Pack. B/ Prepare Contract	BPB	33	14-Jul-09	27-Aug-09
Sitework		71	22-Jun-09	28-Sep-09
Excavation of Basement	BPA	32	22-Jun-09*	04-Aug-09
Excavation of Level 1	BPA	22	05-Aug-09*	03-Sep-09
South Building Excavation	BPA	17	04-Sep-09	28-Sep-09
Foundations		88	05-Aug-09	04-Dec-09
Concrete Foundations	BPA	88	05-Aug-09*	04-Dec-09
Geo Piers Installation	BPA	22	04-Sep-09*	05-Oct-09
Superstructure		125	09-Nov-09	30-Apr-10
Structural Concrete (Level 1 to Roof)	BPA	83	09-Nov-09*	03-Mar-10
Structural Steel (Proc., Install FL 3 to Roof)	BPB	51	19-Feb-10*	30-Apr-10
Enclosures		134	29-Jan-10	04-Aug-10
Perimeter Studs and Sheathing	BPB	108	29-Jan-10*	29-Jun-10
Perimeter Masonry/Cast Stone	BPB	78	18-Feb-10*	07-Jun-10
Roofing and Sheet Metal	BPB	95	04-Mar-10*	14-Jul-10
Curtainwall/Windows/Glazing	BPB	78	09-Apr-10*	27-Jul-10
Perimeter Metal Cladding	BPB	52	25-May-10*	04-Aug-10
Rough-in and Finishes		254	03-Feb-10	24-Jan-11
Basement MEP Equipment	BPB	135	03-Feb-10*	10-Aug-10
Level 1	BPB	189	16-Mar-10*	03-Dec-10
Level 2	BPB	205	23-Mar-10*	03-Jan-11
Level 3	BPB	212	26-Mar-10*	17-Jan-11
Level 4	BPB	214	31-Mar-10*	24-Jan-11
Roof MEP Equipment	BPB	45	22-Jun-10*	23-Aug-10
Occupancy		132	29-Nov-10	31-May-11
MEP Testing and Balancing	BPB	67	29-Nov-10*	01-Mar-11
Subcontractor Substantial Completion	BPB	0		01-Mar-11
MEP Final Connections to Owner Equipment	BPB	20	02-Mar-11*	29-Mar-11
Owner Final Commissioning	BPB	15	06-Apr-11*	26-Apr-11
Air Flush Period	BPB	25	27-Apr-11*	31-May-11
Project Completion	BPB	0		31-May-11



Actual Work | Critical Remaining Work | Summary
Remaining Work | Milestone

Nicholas Umosella
Construction Management
Advisor: Dr. Magent

-Appendix B-

D4Cost Estimate Report

Statement of Probable Cost

West Village Commons - Aug 2009 - MD - Baltimore

Prepared By: **Nicholas Umosella**

,
Fax:

Prepared For: **AE 5th Year Thesis**
Technical Assignment 1

,
Fax:

Building Sq. Size:	**85000**	Site Sq. Size:	**130680**
Bid Date:		Building use:	**Educational**
No. of floors:	**4**	Foundation:	**CON**
No. of buildings:	**1**	Exterior Walls:	**CUR**
Project Height:	**80**	Interior Walls:	**MSD**
1st Floor Height:	**17**	Roof Type:	**BIT**
1st Floor Size:		Floor Type:	**CON**
		Project Type:	**NEW**

Division		Percent	Sq. Cost	Amount
00	**Procurement and Contracting Req.**	**5.79**	**22.14**	**1,882,143**
	Procurement and Contracting Req.	5.79	22.14	1,882,143
01	**General Requirements**	**7.15**	**27.34**	**2,324,143**
	General Requirements	7.15	27.34	2,324,143
03	**Concrete**	**7.32**	**27.97**	**2,377,571**
	Concrete	7.32	27.97	2,377,571
04	**Masonry**	**3.79**	**14.47**	**1,230,071**
	Masonry	3.79	14.47	1,230,071
05	**Metals**	**5.98**	**22.86**	**1,942,857**
	Metals	5.98	22.86	1,942,857
06	**Wood, Plastics, and Composites**	**4.64**	**17.72**	**1,506,321**
	Wood, Plastics, and Composites	4.64	17.72	1,506,321
07	**Thermal and Moisture Protection**	**4.17**	**15.93**	**1,353,726**
	Thermal & Moisture Protection	4.17	15.93	1,353,726
08	**Openings**	**3.89**	**14.88**	**1,264,881**
	Openings	3.89	14.88	1,264,881
09	**Finishes**	**7.34**	**28.04**	**2,383,036**
	Finishes	7.34	28.04	2,383,036
10	**Specialties**	**1.01**	**3.85**	**327,048**
	Specialties	1.01	3.85	327,048
11	**Equipment**	**11.30**	**43.17**	**3,669,167**
	Equipment	11.30	43.17	3,669,167
12	**Furnishings**	**0.81**	**3.10**	**263,095**
	Furniture	0.81	3.10	263,095
14	**Conveying Systems**	**1.20**	**4.57**	**388,571**
	Elevators	1.20	4.57	388,571
21	**Fire Suppression**	**0.87**	**3.33**	**283,333**
	Water Based Fire Suppression	0.87	3.33	283,333
22	**Plumbing**	**7.68**	**29.34**	**2,494,222**
	Plumbing	7.68	29.34	2,494,222
23	**HVAC**	**18.61**	**71.13**	**6,046,360**
	HVAC	18.61	71.13	6,046,360
26	**Electrical**	**8.46**	**32.33**	**2,748,131**
	Electrical	8.46	32.33	2,748,131
Total Building Costs		**100.00**	**382.17**	**32,484,677**

-Appendix C-

RSMeans Square Foot Estimate Resource

Costs per square foot of floor area

Exterior Wall	S.F. Area	20000	35000	45000	65000	85000	110000	135000	160000	2000
	L.F. Perimeter	260	340	400	440	500	540	560	590	640
Face Brick with Concrete Block Back-up	R/Conc. Frame	206.20	188.70	184.05	174.75	170.70	166.50	163.30	161.45	159.35
	Steel Frame	223.15	205.65	201.05	191.75	187.70	183.50	180.30	178.45	176.35
Decorative Concrete Block	R/Conc. Frame	192.05	178.10	174.40	167.40	164.30	161.15	158.80	157.40	155.90
	Steel Frame	209.00	195.10	191.35	184.35	181.25	178.10	175.80	174.40	172.90
Precast Concrete Panels With Exposed Aggregate	R/Conc. Frame	205.30	188.05	183.45	174.25	170.25	166.15	163.05	161.20	159.20
	Steel Frame	222.15	204.90	200.35	191.20	187.20	183.10	179.95	178.10	176.10
Perimeter Adj., Add or Deduct	Per 100 L.F.	17.40	9.95	7.75	5.35	4.05	3.15	2.65	2.15	1.80
Story Hgt. Adj., Add or Deduct	Per 1 Ft.	3.50	2.60	2.40	1.80	1.60	1.35	1.15	1.00	0.85
***For Basement**, add $32.65 per square foot of basement area*										

The above costs were calculated using the basic specifications shown on the facing page. These costs should be adjusted where necessary for design alternatives and owner's requirements. Reported completed project costs, for this type of structure, range from $104.85 to $252.85 per S.F.

Common additives

Description	Unit	$ Cost
Carrels Hardwood	Each	660 - 990
Closed Circuit Surveillance, One station		
Camera and monitor	Each	1850
For additional camera stations, add	Each	1000
Elevators, Electric passenger, 5 stops		
2000# capacity	Each	158,700
2500# capacity	Each	162,700
3500# capacity	Each	163,700
Additional stop, add	Each	13,600
Emergency Lighting, 25 watt, battery operated		
Lead battery	Each	282
Nickel cadmium	Each	805
Furniture	Student	1900 - 3600
Intercom System, 25 station capacity		
Master station	Each	2650
Intercom outlets	Each	169
Handset	Each	470

Description	Unit	$ Cost
Kitchen Equipment		
Broiler	Each	4025
Coffee urn, twin, 6 gallon	Each	3075
Cooler, 6 ft. long	Each	4925
Dishwasher, 10-12 racks per hr.	Each	4950
Food warmer	Each	735
Freezer, 44 C.F., reach-in	Each	3725
Ice cube maker, 50 lb. per day	Each	1750
Range with 1 oven	Each	2700
Laundry Equipment		
Dryer, gas, 16 lb. capacity	Each	885
30 lb. capacity	Each	3600
Washer, 4 cycle	Each	1075
Commercial	Each	1450
Smoke Detectors		
Ceiling type	Each	187
Duct type	Each	480
TV Antenna, Master system, 12 outlet	Outlet	315
30 outlet	Outlet	203
100 outlet	Outlet	194

Important: See the Reference Section for Location Factors

Model costs calculated for a 6 story building with 12' story height and 85,000 square feet of floor area

College, Dormitory, 4-8 Story

			Unit	Unit Cost	Cost Per S.F.	% Of Sub-Total
A. SUBSTRUCTURE						
1010	Standard Foundations	Poured concrete; strip and spread footings	S.F. Ground	9.06	1.51	2.2%
1020	Special Foundations	N/A	—	—	—	
1030	Slab on Grade	4" reinforced concrete with vapor barrier and granular base	S.F. Slab	4.74	.79	
2010	Basement Excavation	Site preparation for slab and trench for foundation wall and footing	S.F. Ground	.25	.04	
2020	Basement Walls	4' foundation wall	L.F. Wall	74	.64	
B. SHELL						
B10 Superstructure						
1010	Floor Construction	Concrete slab with metal deck and beams	S.F. Floor	31.60	26.33	22.3%
1020	Roof Construction	Concrete slab with metal deck and beams	S.F. Roof	23.40	3.90	
B20 Exterior Enclosure						
2010	Exterior Walls	Decorative concrete block *80% of wall*	S.F. Wall	16.70	5.66	6.4%
2020	Exterior Windows	Aluminum horizontal sliding *20% of wall*	Each	492	2.78	
2030	Exterior Doors	Double glass & aluminum doors	Each	3214	.30	
B30 Roofing						
3010	Roof Coverings	Single ply membrane, loose laid and ballasted; perlite/EPS composite insulation	S.F. Roof	4.74	.79	0.6%
3020	Roof Openings	N/A	—	—	—	
C. INTERIORS						
1010	Partitions	Concrete block *9 S.F. Floor/L.F. Partition*	S.F. Partition	9.38	10.42	27.5%
1020	Interior Doors	Single leaf wood *90 S.F. Floor/Door*	Each	565	6.28	
1030	Fittings	Closet shelving, mirrors, bathroom accessories	S.F. Floor	1.87	1.87	
2010	Stair Construction	Concrete filled metal pan	Flight	18,950	4.02	
3010	Wall Finishes	95% paint, 5% ceramic tile	S.F. Surface	2.25	5	
3020	Floor Finishes	80% carpet, 10% vinyl composition tile, 10% ceramic tile	S.F. Floor	8.77	8.77	
3030	Ceiling Finishes	Mineral fiber tile on concealed zee bars, paint	S.F. Ceiling	.92	.92	
D. SERVICES						
D10 Conveying						
1010	Elevators & Lifts	Four geared passenger elevators	Each	234,388	11.03	8.1%
1020	Escalators & Moving Walks	N/A	—	—	—	
D20 Plumbing						
2010	Plumbing Fixtures	Toilet and service fixtures, supply and drainage *1 Fixture/390 S.F. Floor*	Each	3338	8.56	7.2%
2020	Domestic Water Distribution	Oil fired water heater	S.F. Floor	.89	.89	
2040	Rain Water Drainage	Roof drains	S.F. Roof	1.80	.30	
D30 HVAC						
3010	Energy Supply	Oil fired hot water, wall fin radiation	S.F. Floor	3.77	3.77	8.6%
3020	Heat Generating Systems	N/A	—	—	—	
3030	Cooling Generating Systems	Chilled water, air cooled condenser system	S.F. Floor	7.93	7.93	
3050	Terminal & Package Units	N/A	—	—	—	
3090	Other HVAC Sys. & Equipment	N/A	—	—	—	
D40 Fire Protection						
4010	Sprinklers	Sprinklers, light hazard	S.F. Floor	2.25	2.25	1.7%
4020	Standpipes	N/A	—	—	—	
D50 Electrical						
5010	Electrical Service/Distribution	1200 ampere service, panel board and feeders	S.F. Floor	1.21	1.21	13.1%
5020	Lighting & Branch Wiring	Fluorescent fixtures, receptacles, switches, A.C. and misc. power	S.F. Floor	8.88	8.88	
5030	Communications & Security	Alarm systems, internet and phone wiring, communications systems and emergency lighting	S.F. Floor	7.49	7.49	
5090	Other Electrical Systems	Emergency generator, 30 kW	S.F. Floor	.20	.20	
E. EQUIPMENT & FURNISHINGS						
1010	Commercial Equipment	N/A	—	—	—	2.2 %
1020	Institutional Equipment	N/A	—	—	—	
1030	Vehicular Equipment	N/A	—	—	—	
2020	Other Equipment	Built-in dormitory furnishings	S.F. Floor	2.99	2.99	
F. SPECIAL CONSTRUCTION						
1020	Integrated Construction	N/A	—	—	—	0.0 %
1040	Special Facilities	N/A	—	—	—	
G. BUILDING SITEWORK		N/A				
				Sub-Total	135.52	**100%**
	CONTRACTOR FEES (General Requirements: 10%, Overhead: 5%, Profit: 10%)			*25%*	33.87	
	ARCHITECT FEES			*7%*	11.86	
				Total Building Cost	**181.25**	

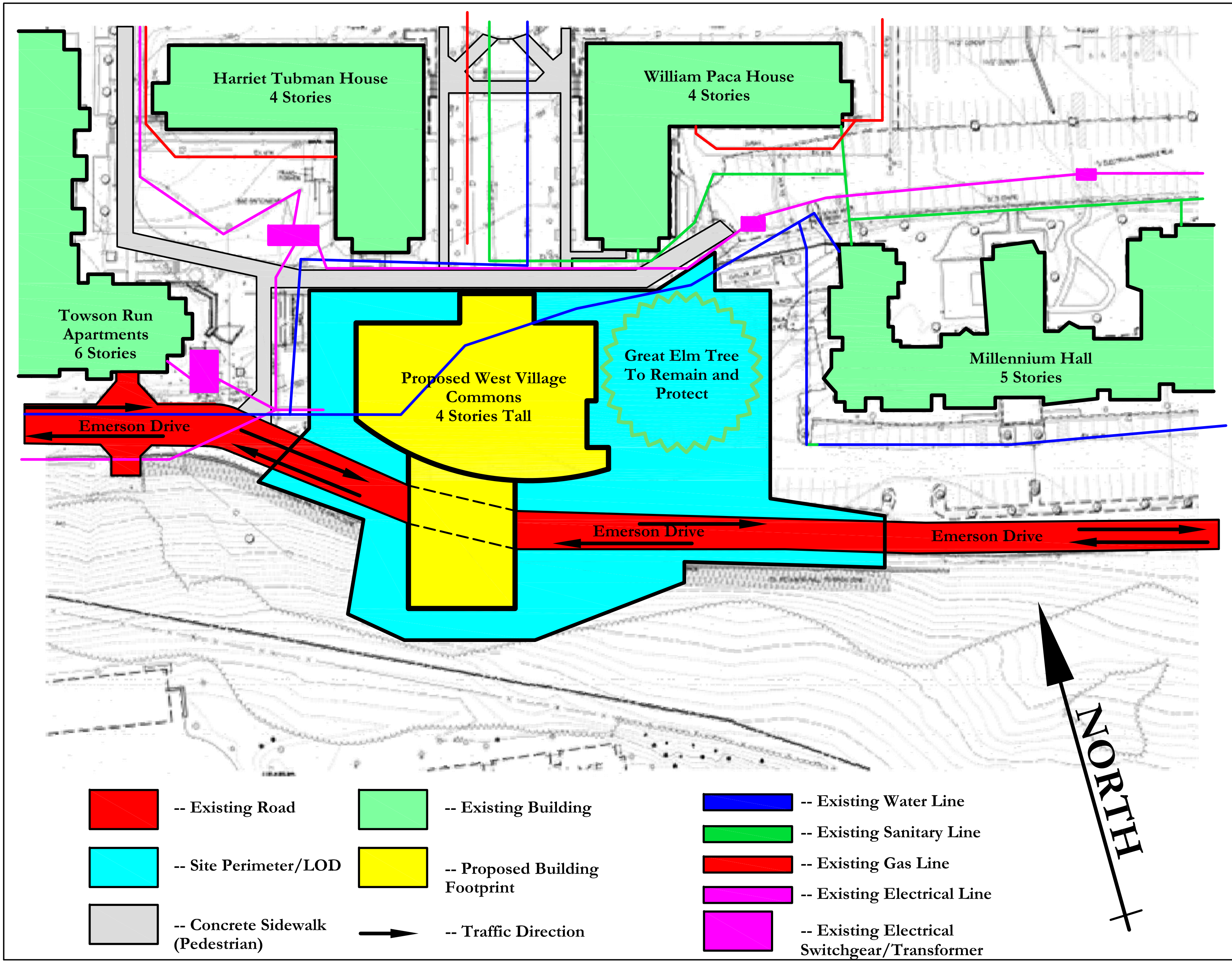
-Appendix D-

Existing Conditions Site Plan

West Village Commons

Towson University

Nicholas Umosella



Existing Conditions Site Plan

Scale: NOT TO SCALE