

West Village Commons Towson University Towson, Maryland

TECHNICAL ASSIGNMENT #1 October 5th, 2009

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OCTOBER 5 th , 2009		

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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.

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-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

<u>STRUCTURAL</u>

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,

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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

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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.

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-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.

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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.

Туре	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.

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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.

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



Figure 7: Crane Foundation Reinforcing, Barton Malow Site Photo

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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	<u>Type</u>	Area Served	Unit Location	Unit Weight (lbs)	<u>CFM</u>
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	1st Floor	1st Floor Mask Bases	not specified	16,000
	Air Volume		Mech. Room		

Figure 8: Air Handling Unit Breakdown

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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.

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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

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.

Figure 9: Sheathing and Shoring, Barton Malow Site Photo

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-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

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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	В				
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	†This is the extent of the break down I was allowed to use from Barton Malow						

Figure 12: Building Systems Cost

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	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		
	Tot	al Project Cost:	\$382.17	\$32,484,676.00		

Figure 13: Parametric D4Cost Estimate

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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	I	Frame:		Reinforced Concrete Frame	
Basement Area:	6,766	Story H	leight:		17'	
Perimeter	596.4					
	Area Falls Between:	Nothing			And	85,000
		<u>_</u>		Base	e Cost per Square Foot:	\$170.70
Adjustment Type:	Perimeter A	djustment			er Squre Foot Adjusted:	\$4.05
	Story Height	Adjustment		Pe	er Squre Foot Adjusted:	\$1.60
			Adjust	ed Base	e Cost per Square Foot:	\$182.59
Base Building Cost:	\$182.59	x	8500		=	\$15,520,150.00
Basement Cost	\$32.65	x	676	6.00	=	\$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) 0				3	\$491,100.00	
Kitchen	Equipment - Broile	er	\$4,02	25.00	10	\$40,250.00
Kitchen Equipmen	it - Coffee Urn, Tw	in, 6 Gallon	\$3,07	75.00	9	\$27,675.00
Kitchen Equi	pment - Cooler, 61	ft long	\$4,92	25.00	25	\$123,125.00
Kitchen Eq	uipment - Dishwa	sher	\$4,95	50.00	10	\$49,500.00
Kitchen Equ	ipment - Food Wa	irmer	\$73	5.00	12	\$8,820.00
Kitchen I	Equipment - Freez	er	\$3,72	25.00	20	\$74,500.00
Kitchen Equi	pment - Ice Cube I	Maker	\$1,75	50.00	10	\$17,500.00
Kitchen	Equipment - Rang	je	\$2,70	00.00	35	\$94 <i>,</i> 500.00
					Subtotal:	\$926,970.00
Multiplie	Multiplier Type: Location (Baltimore, MD) Value:				\$0.93	
Figure 14: RSMeans Sou				Tota	Square Foot Estimate:	\$15,501,267.81

Figure 14: RSMeans Square Foot Estimate

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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

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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.

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-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.

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Figure 15: Road Map, www.googlemaps.com



Figure 16 – Campus Map, www.towson.edu

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-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

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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
Commercial Tipping Fee	\$60/ton		
Solid Waste Surcharge	\$7.50/ton	10,044,485	9,650,000
Commercial Tipping Fee	\$80/ton	909,146	1,110,000
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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.

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-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.



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."

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

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

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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

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-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

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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

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-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

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-APPENDIX A-Milestone Schedule

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BFB 212 CeMan-10* 17.Jam-11 Lawel Equipment BFB 214 24.Jam-11 Lawel Equipment BFB 214 Lawel Lawel Lawel Galancing BFB 12 23-Mus-11 Lawel	BPB 312 Main(r) Alment) Alment i Alment i <t< td=""><td>Bits 713 Metric 713 Metri 713 Metric 713 Metric</td><td></td><td>BPB</td><td>205 23-Mar-10*</td><td>03-Jan-11</td><td></td><td>Level 2</td></t<>	Bits 713 Metric 713 Metri 713 Metric 713 Metric		BPB	205 23-Mar-10*	03-Jan-11		Level 2
Guidment BPB 214 Jan-10 24-Jan-11 Iguidment BPB 214 Jan-10 24-Jan-11 Ig and Balancing BPB 214 Jan-10 23-Jan-11 Ig and Balancing BPB 27 Jan-11 23-Jan-11 Ig and Balancing BPB 27 Jan-11 Root MEP Equipment Ig and Balancing BPB 27 29-Nor-10 21-Mar-11 Ig and Balancing BPB 27 29-Nor-10 21-Mar-11 Ig and Balancing BPB 20 20-Mar-11 20 4-Mar-11 Ic constistion to Ware Equipment BPB 10 2-Mar-11 20 4-Mar-11 Ic connection to Ware Equipment BPB 15 06-Mar-11 29-Mar-11	Bit 37.2 23.446-10 23.446-10 23.446-10 24.466-10 24.446-10	Ruthomst BPI R 2 Allowing Statement (and statement (and statement) R 2 Allowing (and statement) R 2 Allowing (and statement) R 2 Allowing (and statement) Ruthomstore (and statement) BPI R 2 Allowing (and statement) P Allowing (and statement) P Allowing (and statement) P Allowing (and statement) P Allowing (and statement) Ruthomstore (and statement) P Allowing (and statement) P Allowing (and statement) P Allowing (and statement) P Allowing (and statement) Ruthomstore (and statement) P Allowing (and statement) P Allowing (and statement) P Allowing (and statement) P Allowing (and statement) Ruthomstore (and statement) P Allowing (and statement) P Allowing (and statement) P Allowing (and statement) P Allowing (and statement) Actual Work Allowing (and statement) P Allowing (and statement) P Allowing (and statement) P Allowing (and statement) P Allowing (and statement)		BPB	212 26-Mar-10*	17-Jan-11		Level 3
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rg and Balancing BPB 67 23-Nov-10* 01-Mar-11 et of Substantial Competition BPB 0 Connections Owner Equipment BPB 12 02-Mar-11* 28-Mar-14 al Commissions Owner Equipment BPB 12 06-24Mar-11* 28-Mar-14 al Commissions Owner Equipment BPB 12 06-24Mar-14* 28-Mar-14* 28* 28* 28* 28* 28* 28* 28* 28* 28* 28	Interfactor	are area harming of a contract	c dupment.		132 29-Nov-10	31-Mav-11		
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BPB 15 06-Apr-11*	BPB 1 0 0 BPB 2 27494711 2843671 1 14139411 1 10 1 14139411 1 10 1 14139411 1 10 1 14139411 1 10 1 14139111 1 10 1 141311 1 10 1 141311 1 10 1 141311 1 10 1 141311 1 10 1 141311 1 10 1 1413111 1 10 1 1413111 1 10 1 1413111 1 10 1 1413111 1 10 1 1413111 1 10 1 1413111 1 10 1 1413111 1 10 1 14131111 1 10	PEB 16 (Advertity 2 Advertity 1 (Advective)) 10 (Advective) 20 (Advective) <t< td=""><td></td><td>BPB</td><td>20 02-Mar-11*</td><td>29-Mar-11</td><td></td><td>MEP: Final Connections to</td></t<>		BPB	20 02-Mar-11*	29-Mar-11		MEP: Final Connections to
		I Work ■ Critical Remaining Work ■ Advisor: 1 Micholas Umos		BPB	15 06-Apr-11*	26-Apr-11		Owner Final Commis
BPB 25 27-Apr-11*		I Work Critical Remaining Work Mitcholas Umos Advisor: Dr. Mag		BPB	25 27-Apr-11*	31-May-11		
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		◆ ◆ Milestone				. 141	Cumman	Nicholas Umosella
Critical Remaining Work	Critical Remaining Work			5	itical Kemainin			Construction Manadament

NICHOLAS UMOSELLA	СМ	Advisor: Dr. Magent
WEST VILLAGE COMMO	NS	Towson, Maryland
OCTOBER 5th, 2009		

-APPENDIX B-D4Cost Estimate Report

TECHNICAL ASSIGNMENT #1 PAGE 31

Statement of Probable Cost

	Prepared By: Nicholas Umosella		Prepared For:	AE 5th Year Thesis Technical Assignment 1	
	, Fax: Building Sq. Size: 85000		Site Sq. Size:	, Fax: 130680	
	Bid Date:		Building use:	Educational	
	No. of floors: 4		Foundation:	CON	
	No. of buildings: 1		Exterior Walls:	CUR	
	Project Height: 80 1st Floor Height: 17		Interior Walls: Roof Type:	MSD BIT	
	1st Floor Size:		Floor Type: Project Type:	CON 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 Furniture	0.81 0.81		3.10 3.10	263,095 263,095
		0.01		5.10	203,090
14	Conveying Systems Elevators	1.20 1.20		4.57 4.57	388,57 1 388,571
		1.20		4.57	300,37
21	Fire Suppression Water Based Fire Suppression	0.87 0.87		3.33 3.33	283,333 283,333
22	Plumbing Plumbing	7.68 7.68		29.34 29.34	2,494,222 2,494,222
	-				
23	HVAC HVAC	18.61 18.61		71.13 71.13	6,046,360 6,046,360
26	Electrical Electrical	8.46 8.46		32.33 32.33	2,748,13 2,748,13
	Licenca	0.40		02.00	2,170,131
Total Dec	Iding Costs	400.00		202.47	22 404 07-
I OTAL BUI	Iding Costs	100.00		382.17	32,484,677

NICHOLAS UMOSELLA	СМ	Advisor: Dr. Magent
WEST VILLAGE COMMO	NS	Towson, Maryland
October 5 th , 2009		

-APPENDIX C-RSMeans Square Foot Estimate Resource

TECHNICAL ASSIGNMENT #1 PAGE 32



Costs per square foot of floor area

Exterior Wall	S.F. Area	20000	35000	45000	65000	85000	110000	135000	160000	2000
and the second	L.F. Perimeter	260	340	400	440	500	540	560	590	640
Face Brick with	R/Conc. Frame	206.20	188.70	184.05	174.75	170.70	166.50	163.30	161.45	
Concrete Block Back-up	Steel Frame	223.15	205.65	201.05	191.75	187.70	183.50	180.30	178.45	159.3
Decorative	R/Conc. Frame	192.05	178.10	174.40	167.40	164.30	161.15	158.80	1/ 8.45	176.3
Concrete Block	Steel Frame	209.00	195.10	191.35	184.35	181.25	178.10	175.80	137.40	155.90
Precast Concrete Panels	R/Conc. Frame	205.30	188.05	183.45	174.25	170.25	166.15	163.05	1/4.40	172.90
With Exposed Aggregate	Steel Frame	222.15	204.90	200.35	191.20	187.20	183.10	179.95	178.10	159.20
erimeter Adj., Add or Deduct	Per 100 L.F.	17.40	9.95	7.75			100.10	17 7.75	170.10	176.10
tory Hgt. Adj., Add or Deduct			9.93	7.75	5.35	4.05	3.15	2.65	2.15	1.80
wy rigit Auj., Add of Deduct	Per 1 Ft.	3.50	2.60	2.40	1.80	1.60	1.35	1.15	1.00	0.85

r basement, and \$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

common adamves				÷ '	
Description Carrels Hardwood Closed Circuit Surveillance, One station Camera and monitor For additional camera stations, add	Unit Each Each Each	\$ Cost 660 - 990 1850 1000	Description Kitchen Equipment Broiler Coffee urn, twin, 6 gallon Cooler, 6 ft. long	Unit Each Each	\$ Cost 4025 3075
Elevators, Electric passenger, 5 stops 2000# capacity 2500# capacity 3500# capacity Additional stop, add Emergency Lighting, 25 watt, battery operated Lead battery	Each Each Each Each	158,700 162,700 163,700 13,600	Dishwasher, 10-12 racks per hr. Food warmer Freezer, 44 C.F., reach-in Ice cube maker, 50 lb. per day Range with 1 oven Laundry Equipment	Each Each Each Each Each	4925 4950 735 3725 1750 2700
Nickel cadmium Furniture Intercom System, 25 station capacity Master station Intercom outlets Handset	Each Each Student Each Each Each	282 805 1900 - 3600 2650 169 470	Dryer, gas, 16 lb. capacity 30 lb. capacity Washer, 4 cycle Commercial Smoke Detectors Ceiling type Duct type TV Antenna, Master system, 12 outlet	Each Each Each Each Each	885 3600 1075 1450 187 480
			30 outlet 100 outlet	Outlet Outlet Outlet	315 203 194

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

Bandcolf Foundation Proceed contents, at ip and speed feating: S.F. Geored 900 1.51 2.57 <th2.57< th=""> 2.57 2.57<th>No. Second foundation Proved concent; stip and speed footing S.F. Genuel 9.06 1.51 10 Second foundation No. S.F. Schull S.F. Schull Z.Z. 10 Beacher Execution of Biol and preved foot set and barries S.F. Schull Z.Z. Z.Z. 10 Beacher Execution of Biol and preved foot set and barries S.F. Schull Z.Z. Z.Z. 11 Beacher Execution of Biol and set and barries S.F. Schull Z.Z. Z.Z. 12 Beacher Execution of Biol and barries and b</th><th>ith 12' story heig floor area</th><th>ht and 85,000 square feet</th><th></th><th></th><th>Cast</th><th>%0</th></th2.57<>	No. Second foundation Proved concent; stip and speed footing S.F. Genuel 9.06 1.51 10 Second foundation No. S.F. Schull S.F. Schull Z.Z. 10 Beacher Execution of Biol and preved foot set and barries S.F. Schull Z.Z. Z.Z. 10 Beacher Execution of Biol and preved foot set and barries S.F. Schull Z.Z. Z.Z. 11 Beacher Execution of Biol and set and barries S.F. Schull Z.Z. Z.Z. 12 Beacher Execution of Biol and barries and b	ith 12' story heig floor area	ht and 85,000 square feet			Cast	%0
Display String of Constraints Proved constraints thip and speed fasting: S.F. Geord 9.00 1.31 Display A miniscred constraints with and period formations will and footing: S.F. Stable 4.74 79 2.2 Display A miniscred constraints will and others for foundations will and footing: S.F. Geord 2.5 A.4 Display A miniscred constraints will and others for foundations will and footing: S.F. Floor 2.5 A.4 Display Constraints Constraints S.F. Floor 3.16 2.8.3 2.3.3 Display Constraints Constraints Constraints S.F. Floor 3.16 2.8.3 2.8.3 Display Constraints Constraints Constraints S.F. Floor 3.16 2.8.3 2.8.3 Display Constraints Constraints S.F. Floor 3.7.4 2.8 2.8.3 2.8.4 2.8.5 2.8.5 2.8.5 2.8.5 2.8.5 2.8.5 2.8.5 2.8.5 2.8.5 2.8.5 2.8.5 2.8.5 2.8.5 2.8.5	Stand Transference Power and concepts any and general learing: S.F. Ground 9.00 1.31 Stand Transference S.F. Ground 9.00 1.31 2.2 Stand Transference S.F. Ground 9.00 1.31 2.2 Stand Transference S.F. Ground 9.00 1.31 2.2 Beamerit Excension S.F. Freed 1.2 4.4 7.7 7.7 2.2 ID Decommentation Concerne side with metal deck and beams S.F. Freed 1.6 2.4.3 2.4.4 2.5.6 2.4.4 2.5.6 2.4.4 2.5.6 2.4.4 2.5.6 2.4.2 2.5.6 2.5.6 2.5.6 2.5.6 2.5.6 2.5.6 2.5.6 2.5.6<	Tioor area		Unit	Cet	Ren S.F.	Sub-To
100 Status NA Status Status <t< th=""><th>Bit State Constraint V/A T</th><th>SUBSTRUCTURE</th><th></th><th></th><th></th><th>l I</th><th></th></t<>	Bit State Constraint V/A T	SUBSTRUCTURE				l I	
30 Sin Crade 4" methode accrease with upper barrier and granular base 5.5 Sin Count 2.5 Sin Count	Si Si Alia Gradue # methoded concerts with opportants and grouted base S. F. Boil 2.5 Adv Description Signed part of the diameter is foundations will and footing S. F. Boil 2.5 Adv Dispersiment Concerts allo with meth deck and bases S. F. Boil 3.0 2.5 Adv Dispersiment Concerts allo with meth deck and bases S. F. Boil 3.0 2.0 2.2 3.0 2.2 Dispersiment Concerts allo with meth deck and bases S. F. Boil 3.0 4.0 3.0 2.2 2.0			S.F. Ground	9.06	1.51	
300 Site Overlag S.F. Convert S.F. Co	Bit of Vetex Star presentation for add methods for fundation well and boding S.F. Chorn II S.S. F. Common III S.S. F. Common IIII S.S. F. Common IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII			S F Slab	4.74	.79	2.29
Bits 4' foundation well L.F. Well 74 64 M 10 Superstructure (Concrete dob with medi dock and boom (Scorette dob with medi (Scorette dob with medi dock and boom (Scorette dob with medi (Scorette dob with medi (Scorette dob (Scorette dob (S	Displayer Mit Concrete data with med dack and beams S.F. Foor J. 4. Displayer Concrete data with med dack and beams S.F. Foor J. 4.0 23.30 22.33 Dead Construction Concrete data with med dack and beams S.F. Foor J. 4.0 23.80 22.0 3.90 22.73 6.4 Dead Construction Concrete data with med dack and beams S.F. Moor J. 4.00 2.73 6.4 Dead Construction Concrete block 80% or endl S.F. Moor J. 4.74 .79 0.4 Dead Construction Concrete block 9.5.f. Floor/L.F. perition S.F. Port Mon S.F. Moor S.F. Moor 1.0 2.0 2.0 2.27 2.4 2.0 2.27 2.4 2.0 2.27 2.4 2.0 2.75 2.75 2.75 2.75 2.75 2.75 2.75 2.75 2.75 5.7 2.75 5.7 2.75 5.7 5.7 5.7 5.7 7.7 7.77 7.77 5.7 7.77 7.77 7.77 <t< td=""><td></td><td></td><td></td><td>1</td><td>1</td><td></td></t<>				1	1	
ML BU Superint active St. Floor	44 B1 Superstructure S5. Floor 21.60 24.00 28.00			L.F. Wall	74	.64	
Dip Roc Consuscition Concerve lab with media data of beams S.F. Boot 31.40 22.33 22.33 Dip Roc Consuscition Concerve lab with media data of beams S.F. Moot 23.40 23.30 22.33 Dip Roc Consuscition Decorring concerve labot. 80% of well S.F. Mool 4.5. Vell 6.5. 4.5. Vell 5.5. 6.5. 4.7. 2.5. 7.5.	10 Fibor Consuscian Concrease slids with media dack and beams S.F. Boor 31.60 22.33 22.3 300 Straticat Industration Concrease slids with media dack and beams S.F. Moor 22.40 3.00 <t< td=""><td>SHELL</td><td></td><td></td><td></td><td></td><td></td></t<>	SHELL					
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Dip Star Construction Cancerse laborith meeth dack and beams S.F. Root 23.40 33.00 Dip Star Construction Decording concrete block 80% of well 5.F. Well 16.70 5.6.6 47.2 7.0 6.4.6 Dip Decording Construction Double glass & durnnium doors 20% of well 5.F. Root 47.4 79 0.6 Dip Decording Single ply membrane, locse laid and bolicated; perfax/EFS composite mudation 5.F. Floori 5.F. Root 8.7.8 10.42 27.3 0.6 Dip Decording N/A Single ply membrane, locse laid and bolicated; perfax/EFS composite mudation 5.F. Floori 5.F. Root 8.7.8 10.42 27.4 Dip Decording Concrete block 9.5.F. Floor/LF. Perfation 5.F. Root 1.8.7<	20 Reof Construction Carcete side with medi deck and beams S.F. Medi 23.40 3.40 10 Extension Mindman Decoder in concerte block. 80% of well S.F. Medi 47.2 27.8 6.4 10 Extension Mindman Instructed Isaling 20% of well S.F. Medi 47.2 27.8 6.4 10 Roof Coverings N/A Concerted Isaling 5.F. Floor / S.F. Floor /	Party statements and stat	Concrete slab with metal deck and beams		1.		22.3
1010 Enterior Wells Descentive concrete block 80% of well 5% fill 16.7.00 3.5.00 6.4.00 2010 Enterior Vendows Double glass & dumminm chorman dialing 20% of well 5.7. Roof 4.7.4 7.9 0.6.0 2010 Roof Coverings Single ply membrane, loose loid and ballated; perfay/EFS composite insulation 5.7. Roof 4.7.4 7.9 0.6.6 1010 Roof Coverings N/A - - - 0.6.6 1010 Roof Coverings N/A 9.5.7. Roov/LF. Perfilion 9.3.8 10.0.2 5.6.6 6.23 2.7.5 6.4.6 2.8.7 6.7.6 6.5.6 6.23 2.7.5 6.6.6 10.0.2 10.0.2 6.5.7 6.0.7 7.8.7 6.7.6 7.0.7 7.0.2 7.	10 Exterior Works Boccardine concrete black. 80 % of work S.F. Meil 40 / 2 5.8 / 60 / 4 27.8 / 60 / 60 / 60 / 60 / 60 / 60 / 60 / 6		Concrete slab with metal deck and beams	S.F. Roof	23.40	3.90	
Dial Dial Dial Adminish forward damp 20% of well Each 492 2.78 6.44 00 Decking Doors Docking glass & duminum doors 20% of well Each 472 4.74 77 0.04 10 Roof Covering N/A - - - - - 0.04 10 Roof Covering N/A - - - 0.04 10 Roof Covering N/A - - - 0.04 10 Roof Covering Information S.F. Floor/LF. Portlion S.F. Floor/LF. Portlion 9.35 Floor 9.35 Floor 5.5 Floor 5.5 Floor 5.7 5.5 Floor 5.7 Floor 5.7<	0 Example VMBa 20% of woll Each 422 2.7.8 4.4 00 Each 20% of woll Each 324	B20 Exterior Enclosure			1/ 70	544	
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NICHOLAS UMOSELLA	СМ	Advisor: Dr. Magent
WEST VILLAGE COMMO	NS	Towson, Maryland
OCTOBER 5th, 2009		

-Appendix D-

EXISTING CONDITIONS SITE PLAN

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