BACKGROUND

Local Conditions

In State College there are two distinct types of buildings. One is a steel frame building with a curtain wall. These are primarily on Penn State's campus. Downtown state college tends to be a different type of building. They are for the most part made of precast concrete elements and cast in place concrete, which is what The Palmerton is. This building is built just like many buildings have been built before it in this area. One major difference is the underground parking garage. Not too many projects have gone two to three stories below grade for a parking garage.

The site is somewhat congested, leaving little room for laydown. The crane pulls items right off the delivery truck which requires shutting down one lane of traffic. The parking space for workers is also limited, maybe enough to park 15 cars, however many of the workers drive large trucks. Many of the workers squeeze their cars and trucks on W Highland Alley on the south side of the site.

Construction waste management was not a concern on this project. Despite recycling programs for on campus construction projects, there was not an opportunity to recycle on this job. Luckily for this job most of the structure is precast so there is smaller amount of waste. There are a lot of metal studs used in the project, whose waste could easily be recycled. The main waste will come about during finishes, with drywall, carpet, and tile.

Subsurface conditions were one of the more interesting aspects of this project due to a contaminant known as PCE, which seeped into the soil of the site. This chemical originates from an outdated dry cleaning process, which Balfurd Cleaners, located next door, used in the past. Before Balfurd Cleaners moved in, in the 1960's, there was another cleaning business that most likely used the same toxic chemical in their cleaning process. The chemical was required to be completely removed before the site could be used.

Client Information

Blue Mountain Harmony, LLC, wishes not to reveal any information.

Purely speculating, Blue Mountain Harmony is making a multi-use facility in order to delve into two different markets, student apartments as well as the commercial sector for some small shops or maybe a café. Due to the area this project should do well.

Project Delivery System

The Palmerton is a design-bid-build project, which was selected by the owner. The owner would prefer that most of the contracts be kept confidential. What can be said is that some of the contracts were GMP contracts and others were Cost plus a fee. As seen in the diagram below all the subcontractors work directly below Poole Anderson Construction, except for R&R Steel who is working under Altoona Pipe & Steel who is was contracted by Poole Anderson Construction.

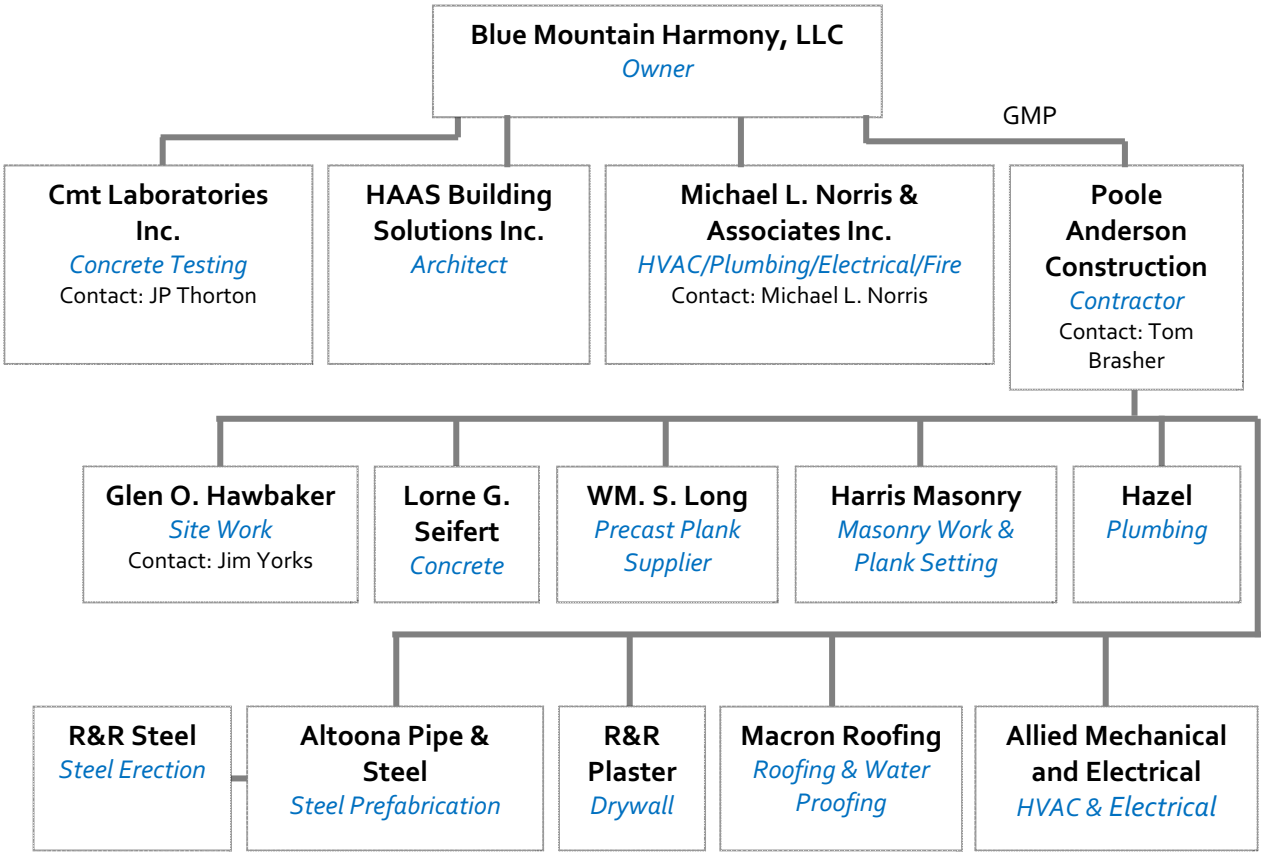

Figure 1: Project Delivery System

Staffing Plan

The Palmerton has 3 staff from Poole Anderson assigned to the project. Ben Shuff is the Project Manager and Tom Brasher, the Project Engineer both work underneath Dan Long, the Vice President of Operations, at Poole Anderson Construction. Ben Shuff and Tom Brasher coordinate the project mostly from the onsite office, located in the basement of the church next door and communicate the project with the outside world, through deliveries, other engineers, the architect, and the owner. Terry Getz, the Superintendent, organizes the construction on the site and works directly with the subcontractors on the site. He is the main communication between the subcontractors and Ben and Tom. This is all shown in Figure 2

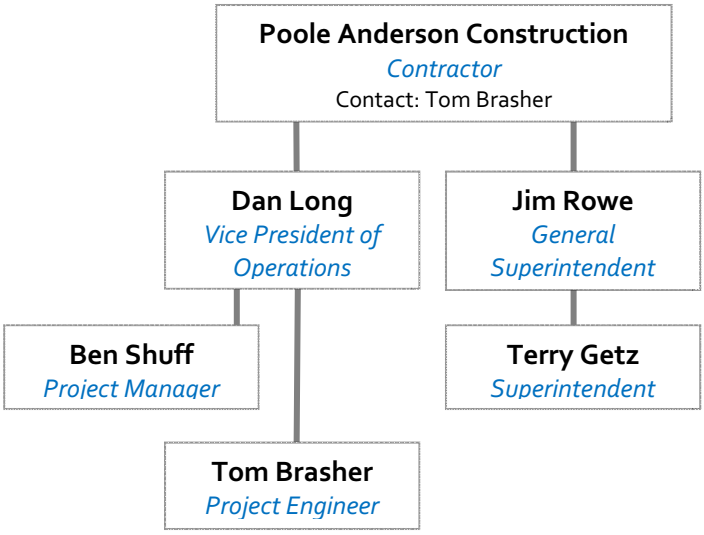

Figure 2: Staffing Plan

Building Systems Summary

Demolition

There were two existing buildings on the property. One, the old 320 W. West Beaver Ave., was located on the west end of the site and 310 -314 W. Beaver Ave., which was located at the east end of the site. Both of these buildings were demolished. There was also a small structure taken down behind the church to the north east of the building. All three building are shown clearly on the site plan In Appendix C.

Excavation

320 W. Beaver Ave. was excavated mostly two levels below grade, except for the northeastern part which went 3 levels below, due to the sloping of the parking garage and the slight slope of site. There were two major issues on this project dealing with the excavation; the first was the amount of rock. A great deal of drilling and blasting were required. The second, was contaminated soil, see Local Conditions on page 4 for more information.

In the process of excavation, shoring pipes were placed 8' o.c., down one level below grade. Next, pre split holes are drilled every 6" o.c., between the shoring pipes, to allow for the soil and rock to split along those holes when excavated. After these were drilled, explosives were used to blast the rock and soil to the inside of the site, for it to be removed. Once the excavation was down one story below grade, lagging was used to hold back the soil and rock. This process was repeated until the required depth was met, which was typically 19'. Dewatering was not needed during the entire process of excavation and construction. This is because of a natural sink hole located to the west of the site under South Atherton Street. This also made for some interesting foundations.

Structure

The foundation varied going from east to west. On the east side of the building, the footers were incased in rock. As you travel west along the site the bedrock drops off dramatically due to the sink hole under South Atherton Street. On the west side the footers had 70' long mini piles underneath them to transfer the loads to bedrock.

The parking garage contains cast in place concrete walls for the exterior walls, structural interior walls and columns. The formwork used was made by Ulma. There were two types used, one was Mega Forms, which are large metal wall forms put in place with a crane, the other is called Mega Light, which are much smaller that can be put in place by hand. The floors for the parking garage are slopped as ramps for the cars to get up and down the different levels. The bottom floor level is a slab on grade, at least 5" thick with welded wire mesh. The parking floors above consist of solid precast panels that are tied together with welding plates.

All precast panels for the building were poured and manufactured by Wm S Long Inc, in Callery, PA.

The first floor, at grade level, is mostly cast in place concrete walls; however, it contains a structural steel front for the commercial space. The commercial store front had a glass curtain wall system supported by a steel frame. The rest of the façade at the first floor is non load bearing brick requiring minimal scaffolding. At Floor 2, the structure is a combination of cast in place concrete and CMU walls. In floors 2-7, the structure consisted of CMU walls. All of the floors were hollow core planks with a 2" topping. These are attached with welded plates up to the 3rd Floor, and then switch to bent rebar, which is grouted into the CMU walls. Exterior and interior non load bearing walls consisted of metal stud framing.

The tower crane used on this project was a Peiner SK 315, which is located in the elevator shaft on the western side of the building that has an 8-16 ton capacity and an HUH of 237'.

Mechanical

The sprinkler system utilizes a dry pipe system for the parking garage, while for the rest of the building a wet pipe system was implemented. The fire pump is located in the basement.

The mechanical system is split into 4 areas, the parking garage, the commercial space, the corridors and the apartments. There is a main mechanical room in the basement that contains two combustion water heaters connected to a hot water storage tank, which will be used for the domestic hot water. The commercial floor does not have a mechanical system implemented at the moment, but the system will be electric and decided upon tenant fit out. The parking garage has continuously running fans that pull in fresh air. The corridors of the building are heated through two gas fired 3000 CFM air handling units that are housed on the roof. The roof also contains a 27.9 kW condensing unit that cools the corridors. The 2 bedroom apartments have individual 2 ½ ton heat pumps with an addition 5.4 kW of heating capacity. The one bedroom apartment has a 2 ton heat pump with the same addition electric resistance heat as the 2 bedroom apartment. Each heat pump is located in the exterior porch closet of its apartment. They are controlled from a thermostat. Each apartment's bathroom has an individual 0.75 kW wall heater and is directly vented to the outside.

Electrical

The power enters into the building into the main switchboard with a 2000 A main breaker, located in the basement and is then distributed up through the building via a 1600 A copper busway. There is a 125 kW backup diesel generator located in the basement. Each floor has a 400 A panel coming off of the busway that distributes the power to a 125 A panel for each apartment. There are 3 other panels that run off of the busway. The first Panel E1 is 400 A and distributes the power for the fire suppression system and safety systems, such as exit signs.

Panel MSB is another 400 A panel that distributes power for the heating systems for the corridors and the basement. Panel LSB is a 225 A panel for the lighting and receptacles in the parking garage as well as the first floor, containing the mail room and the commercial spaces.

CATV cable and phone lines are distributed throughout the building. Each apartment has a cable jack and telephone jack located in the living room and each bedroom, there is also an additional telephone jack in the kitchen.

Project Schedule

There are two main items in this schedule that caused delays. The first occurred during the design process. This plot of land was originally designed for another building, Nicholas Tower, which was moved to another site; therefore the design had to essentially start over. Many of the same aspects of Nicholas Tower carried over to 320 W. Beaver Ave, which allowed HAAS Building Solutions to base the design off of something. During this period the lead Architect on the project left HAAS Building Solutions, which extended the design process even further. The other main item that delayed the project was the excavation phase. This was due to the amount of drilling and blasting to create a large hole, two floors below grade. During this process contaminated soils were found, which required special removal, delaying the project further. For further information about the soil conditions refer to local conditions on page 8. Besides these two main factors, the schedule flows smoothly. After the foundation and parking garage are constructed, the rest of the building is a flow of trades one after another. The hollow core planks are placed, the block walls are erected, and then the different trades can move up through the building following one floor behind the structural erection.

The schedule for The Palmerton is made of several major sections throughout construction. The first is the design phase which a great deal of time. The second major part was excavation, which was one of the most intensive parts of the project, due to an average depth of 19' below grade and soil conditions being mostly rock. The third section we get to construction of the parking garage, which consists of cast in place footers, an exterior wall, interior walls and columns and a slab on grade for the lowest level. The levels above that have a floor structure of prefabricated floor planks. After the completion of the parking garage below grade the commercial space is constructed at the same time as the on grade part of the parking garage. After these areas are complete, the apartment floors get built. These floors use a flow of trades that go through the building on a weekly schedule. This sequence is shown in Appendix B: SIPS Schedule.

Refer to Appendix A: Detailed Project Schedule for the overall schedule.

Project Cost Evaluation

Square Foot Cost Analysis

Table 1

Exterior wall construction		Concrete Block and Precast Panels						
Ground Floor Area	13,427 SF							
Gross Floor Area	80,102 SF							
Number of Stories	7					RS Means 2002		
Story Height	9'							
Perimeter	640 LF							
Basement Area	56,533 SF							
Specify Source	Page	104	Model #	140	Area	85,000 SF		
	Frame	Steel Frame With Concrete Block						
Size Adjustment	65000	80102	85000					$111.97
	$114.05	$111.97	$111.30					
Height Adjustment	65000	80102	85000		$0.99	per foot		$2.96
	$1.25	$0.99	$0.90		3	foot difference		
Perimeter	65000	80102	85000		$2.97	per 100 LF		$4.48
	$3.65	$2.97	$2.75		150.69	LF Difference		
Total Adjustment				Cost per SF				**$113.49**
Building Cost	$113.49		80102	SF				**$9,090,972**
Basement Cost	$21.40		56533	SF				**$1,209,806**

Additives

Type	#	Cost					
Elevator	1	$105,400.00	Adjustment	5	$5,675.00	$28,375.00	$133,775
Cook top	65	$400.00	Assumed 400 because of range of 340-1475				$26,000
Fridge	65	$600.00	Assumed 600 because of range of 555-950				$39,000
Total							**$198,775**

Total Building Cost						**$10,499,553**
Location Modifier	City	State College PA	Date	May-07	0.96	**$10,079,571**
Final Cost	Time Factor	2002	2007	1.32		**$13,267,500**

D4 Cost Estimate					
Table 2					
Code	Division Name		%	SF Cost	Projected
1	General Requirements		4.53	$7.90	$632,805
3	Concrete		10.82	$18.88	$1,512,325
4	Masonry		17.31	$30.21	$2,419,881
5	Metal		2.49	$4.35	$348,443
6	Wood & Plastics		1.82	$3.18	$254,724
7	Thermal & Moisture Protection		3.06	$5.35	$428,545
8	Doors & Windows		7.06	$12.31	$986,055
9	Finishes		10.22	$17.84	$1,429,019
10	Specialties		0.8	$1.40	$112,142
11	Equipment	Appliances	0.05	$0.08	$6,408
12	Furnishings	Window Treatments	0.08	$0.13	$10,413
14	Conveying Systems	Elevators	2.6	$4.53	$362,862
15	Mechanical		24.8	$43.28	$3,466,814
16	Electrical		14.36	$25.05	$2,006,555
	Total		100	$174.49	**$13,977,000**

Actual Cost			
Table 3			
	Type of Cost	SF Cost	Projected
	Construction Cost	$83.00	$11,000,000
	Excavation Cost	$30.00	$4,000,000
	Mechanical Cost	$8.00	$1,000,000
	Electrical Cost	$6.00	$800,000
	Structural Cost	$34.00	$4,500,000
	Total Cost	$113.00	**$15,000,000**

The actual costs were not allowed to be disclosed but rough numbers were given.

There is some variation in the costs due to several factors. The RS Means estimate shown in Table 1 and the D4 estimate shown in Table 2, are low because there were not any multiuse facilities to compare to 320 W. Beaver in the references used. These estimates assume that there is a three story basement not a parking garage and does not have a commercial space on the front of the first floor. When looking at two estimates using a parking garage and a building then combining them, the cost was extremely high giving a false representation of the project. The actual cost was given by Pole Anderson Construction. One reason the actual cost is higher is due to the excavation costs.

Structural Estimate

The structural Estimate was split into floors. The two levels below grade were lumped together. The commercial section was done separately from the parking behind it. Then the 2nd floor was calculated, the 3rd – 6th floors were lumped together, then last the 7th floor.

Table 4: Structural Estimate	
Parking Garage	$1,165,469.26
Commercial	$151,962.43
2nd Floor	$287,756.23
3rd - 6th Floors	$713,187.78
7th Floor	$217,006.19
Total	**$2,535,381.89**

This number is almost 2 million less than a ballpark number received from the project engineer. The exact estimate was confidential. This could be due to the estimate assumptions and not as much of a clarification between all the beams above the cast in place concrete. The complexity of the below grade parking could have a major impact on this number. The last large difference is that every piece needs to be pulled off of the delivery truck which can slow production, increasing the labor costs.

For further breakdown of each section of the building, refer to Appendix E: Detailed Structural Estimate.

Listed below are assumptions made during the estimate.

Parking Garage, assumed all walls at angles were 11'-4" which would be the same volume, but would definitely cost more to construct at an angle which could increase the cost of labor. Assumed both underground parking levels were identical except the floor structure and the mechanical room. For the exterior walls, a 14' high grade wall was assumed, which is incorrect, but the cost should be relatively similar. For the cast in place estimates, numbers were used that included rebar, concrete, and formwork. The formwork had an estimated use of 4 times, which is not the case on the project. Strip Footings that were 5' X 1'8" were assumed to be 5' X 1'4" which is a big difference, however the calculation is done is cubic yards, so the only effect this would have is on the

Mechanical Estimate

This estimate focuses on the heating and cooling systems only. The major part that was looked into in detail was the systems for each apartment. This estimate is split into sections depending on the different spaces and type of equipment. The one and two bedroom apartments were the two spaces chosen to be done as a system. This helped simplify the process due to the apartments being identical when looking at the mechanical systems. The rest of the mechanical estimate was arranged by type of material, due to the fact that they were scattered all around the building.

Listed below are assumptions made during the estimate.

> Interpolation was used for the following, bathroom exhaust fan, 14" flex ductwork, the one bedroom heat pump, rooftop air conditioning unit, condensing unit, make up air handling unit. Wall heating were estimated off of the smaller unit and an oil based wall heater from RSMeans. The cost was adjusted, by comparing the difference between other oil and oil units that preformed the same function.

General Conditions Estimate

The numbers used for the general conditions estimate, were drawn from numbers used in previous classes were general estimates were used. Some of the numbers were given by the Project Engineer, from Poole Anderson Construction.

Table 5: General Conditions Estimate	
Staff	$314,850.00
General Site Work	$19,515.00
Temporary Utilities	$55,820.00
Temporary Facilities	$5,154.00
Total	**$395,339.00**

The numbers used for the general conditions estimate, were drawn from numbers used in previous classes were general estimates were used. Some of the numbers were given by the Project Engineer, from Poole Anderson Construction.

One major cost that was not needed for The Palmerton was the cost of a job trailer. This was not, thanks to the church next door letting Poole Anderson Construction using their basement. The major cost was then the staff wages, which shows how important time and productivity are in the workforce of today.

Refer to Appendix F: General Conditions Estimate, for a more detailed cost break down.

Site Layout Planning

Throughout the construction process there are three phases that require site plan19ning. Due to the limited amount of space on site, planning becomes extremely important. Most of this needs to be done through deliveries, since there is not much storage space, especially in the beginning of the project. Later into construction items can be stored in the parking garage and on site. The items that are stored on site are crammed into the south side of the site.

Throughout the entire construction process the temporary offices are located in the basement of the church next door. It is accessed on the south west corner of the building. The parking for the workers and managers is right at the back of the church which can hold approximately 15 cars when they are squeezed together, however many of the workers drive trucks, so less than 15 vehicles can fit. The bathroom facilities are located right next to the parking, along with the dumpster.

Excavation

During this phase the most notable things to consider is the depth of the excavation. The excavation started at the ramp area and then worked its way down. Trucks drove through the back of the site at this point in the project.

Superstructure

The major issues to be considered during this phase of construction are the deliveries and the crane. The deliveries will shut down one lane of traffic, using cones and road signs. These signs and cones are moved after construction hours and on the weekends. The area shut down can hold about two large trucks, which means that the crane has to pick the materials directly from the truck into place, this process must flow smoothly or things can be delayed significantly.

The crane seems to be very large when first seeing it on site, due to the amount it sticks out into the street and over the neighboring buildings. The operator has to be extremely careful of pedestrians and traffic around the site.

Finishes

During this stage, there will be many workers on site and a great deal of coordination will need to take place. Due to the flow of trades throughout the building material storage for each trade can be stored in the parking garage until the materials are needed. At this point they can be taken to the floor where they are needed. At this stage parking should not be an issue; workers could potentially park in a section of the parking garage saving outdoor storage space.