Project Schedule Summary:

See attached Figure 1, a general construction schedule for the project. The project is being delivered as a design-build project that began with a design competition. This creates some interesting challenges for everybody. The first is that the general shape of the building is set by the competition and can not be influenced during the typical design phase of the project. The next is that as a design-build project, the building will not be completely designed when construction begins. As shown on the schedule, all the geothermal wells are finished and the foundations are at 50% completion when the design is finalized. This is fine as long as the critical parts have been completed. These include the mechanical system because that is what the wells are for, and the structural system, which should be designed first in order to have the pre-cast concrete and steel ordered. After this early part of the project is completed, the schedule becomes repetitious as the building is built from the first floor to the roof. At the end of the schedule, when the building is under roof, the interior trades are able to move in and things become more complicated again due to the increase in trades on the project. For simplification all of the interior trades have been lumped together for this summary schedule.

The keys to making this a successful project will be to keep the crane busy at all times during the structural part of the project and avoiding conflicts among the interior trades. The reason these are the most important activities is that there is really no way to have problems in other areas. The foundation is a very simple shallow foundation system. The structural system is equally simple, using masonry walls and pre-cast floor planks. However, if the planks are not delivered as they are needed this process could easily fall behind. It will be critical that the project management staff keeps a close eye on this process. The last part of the project will also be important. There will be more people on the project, creating more opportunities for congestion, conflicts, and unsafe conditions than at other points in the project. Also, if an activity falls behind at this point in the project there is no time to recover. Any delays will directly influence the final completion of the project.

Building Systems Summary:

See Figure 2 for an overview of items to be covered in this section. The first item is Demolition. This site began as an open field so there is no demolition on this project.

Structural Steel Frame:

There is structural steel framing used in two places on this project. First is in the bridge section at the corner of the L-shaped building. The diagonal bracing used in this section is HSS 4x4x3/8" diagonal braces. These are not used to resist lateral loads, but to support a cantilevered section of the building. The lateral load is held by the CMU shear walls in the main part of the building. The steel for this building will require a crane with the capacity to lift approximately 1300 pounds at a range of 40 feet. This should be well within the limits of the crane that will need to be on site for placing the pre-cast hollow floor planks. The other place structural steel is used is in the clubhouse building around the atrium. The largest piece in this section will way about 550 pounds. This will not be a problem for the crane used for the rest of the building.

Cast in Place Concrete:

The only concrete that will be cast in place is the foundations and the topping for the floors. The foundations will not be formed. The walls of the excavation will be made the correct size for the footers and no forming is necessary unless there is over excavation in an area. The openness of the site lends itself to placing the concrete in the forms directly out of the chute from the truck. This is the most economical way to place concrete in shallow foundations.

Yes	No	Work Scope	If yes, address these questions/issues
	X	Demolition required?	Types of materials, lead paint, or asbestos?
X		Structural Steel Frame	Type of bracing, composite slab?, crane size/type/location
X		Cast in Place Concrete	Horiz. And Vert. Formwork types, concrete placement methods
X		Precast Concrete	Casting location, connection methods, crane size/type/location
X		Mechanical System	Mech. Room locations, system type, types of distribution systems, types of fire suppression
X		Electrical System	Size/ capacity, redundancy
X		Masonry	Load bearing or veneer, connection details, scaffolding
X		Curtain Wall	Materials included, construction methods, design responsibility
	X	Support of Excavation	Type of excavation support system, dewatering system, permanent vs. Temporary

Figure 2. List of general topics to be covered in this section.

Precast Concrete:

Precast concrete is being used on this building as the structural floor system. Hollow core planks are being used for all elevated floor systems as well as the roof. The precast members are 8” hollow core concrete planks between 23’ and 30’ long. The crane required for the placement of the planks will need to be able to carry the weight of the planks at a maximum distance of 70’. The planks will be cast at the Morrisville, PA plant of Old Castle Precast and trucked to site as needed to be placed directly off of the trailer.

Mechanical:

The air intake and discharge for the building is on the roof in the form of 4 Greenheck ERV-521H heat recovery units. The units send the air to geothermal heat pumps located in the mechanical closet of each apartment unit. The heat pumps are part of a loop that receives water from 72 – 500 foot deep wells located in the rear of the building. From the heat pumps the air is ducted into the bedrooms and hallway of the building. Then the air travels through the living areas and is returned through the bathroom exhaust system into a vertical chase that takes it back to the rooftop heat recovery units and out of the building. There is also a large mechanical room on the ground floor of the building on the South end. This houses systems such as water heaters, fire protection pumps, electrical switchgear, and electrical and plumbing feeds into the building.

Electrical:

Power will come from a feed connected at an existing transformer at nearby Moll Hall. The feeder will run underground in a 4” conduit at 13.2 kV. This will be carried by 3 #2/0, Type 133% EPR conductors with the capability of handling 15 kV. It will be reduced to a 208/120V, 3 phase, 4 wire power supply by a transformer at the entrance to the building; inside the mechanical room. This power will then be distributed by a switchboard to a fire pump, jockey pump, TVSS, and other distribution switchboards that will send power to the individual panelboards. The emergency system will be a generator capable of producing 1000kW at 125kVA. This power will be distributed in the form of 3 phase, 60 Hz, 208/120V power to the life safety systems panel and the elevator.

Masonry:

The masonry system in Widener University's new residence is the primary vertical structure. This building uses load bearing CMU walls to support nearly all loads. The exterior walls and one of the hallway walls in the middle of the building support the precast plank floors. These walls are solid grouted on the first level, but are only reinforced at the corners on the second through fourth floors. There are also CMU shear walls between each apartment to support lateral loadings due to wind. The building also makes use of brick veneer exterior which is attached to the masonry walls by the standard masonry anchors.

Curtain Wall:

The last system to be covered for this building is the curtain wall and storefront systems. These use insulated metal panels to break up the massive brick walls. These 2 inch thick panels are locked into place and secured to the wall using screws that become hidden by the panel above them. The storefront system uses aluminum mullions between sections of glazing. This system is used at the entrances to the building.

Excavation Support:

Because this system uses a shallow foundation system, the excavation is very simple. The foundations are small enough to dig out with an excavator at surface level. There will be no support needed for the foundations except in the deepest area where the side walls of the excavation will be stepped to provide protection and access for the concreters placing the footers. The shallow depth also means that there will be no problem with the water table and dewatering will not be necessary.

Project Cost Evaluation:

Actual building construction cost is $14.5 million. The total building size is 87340 s.f. This gives a building cost of $166.02 per square foot. The total project cost is $18 million giving a total cost per square foot of $206.09.

For the square foot estimate of the building, I used R.S. Means 2005. For a typical college dormitory with 85,000 s.f. of space with exterior walls of face brick on concrete block back-up and a reinforced concrete frame the building should cost $125.75 per square foot. Because this building is in the Philadelphia area and the area code for the building is 19013 there is an adjustment increasing the price by 13.6%. This increases the price to $142.85 per s.f. The next thing to consider is the linear feet of exterior wall. Because this building is made up of two long narrow wings there is 1115 l.f. of perimeter wall, compared to the 500 l.f. of wall included in Means. To adjust for this 3.15 must be added for each additional 100 l.f. of exterior wall. This brings the square foot cost to $162.24 per square foot. After multiplying by 87,340 s.f. the Means estimated price for this building is $14.17 million. This price should include all structure, shell, and services for the building. It also includes built in dormitory furnishings but not kitchen equipment or furniture that is not built in to the building. The price also excludes building site work and commercial, institutional, and vehicular equipment.

The final price of nearly 14.2 million is $300,000 lower than the building cost for this project. This is most likely due to having a kitchen in each apartment. Another thing that may have increased the cost of the building is the layout. The building layout is more like an apartment building than the standard rows of rooms found in a dormitory.

I also used Means to find the expected Electrical and Mechanical costs for the building. I have been unable to locate the actual costs on the project, but because the square foot estimate for the building was very close to the actual cost, I feel that it is a valid assumption to believe that the estimated costs will fall very near the actual cost for the various systems as well. The mechanical costs for a building in the upper quarter of expenses is $27.80 per square foot. Adjusted for the area of this building this becomes $31.58 per square foot, or $2.76 million for this project. The electrical cost for a building in the upper quarter of expenses is $14.20 per s.f. Adjusted for the area this results in a cost of $16.13 per s.f. or $1.41 million. If the quality of the building were to be reduced to median quality the costs would be brought down to $1.93 million for the mechanical system and $1.25 million for the electrical system.

Another way to check the estimate was to use D4 Cost. I tried 3 different cases within D4. The first came out very low with a price of just under $12 million. Because this was well below both the actual cost and the Means cost, I tried another case. The second case gave an estimate of $15.8 million with a total project cost of $17 million. This is very close to the price range of Means and the actual project costs. Next I ran D4 a third time to see which result it would be closest to and received an estimate of $15.3 million with a total project cost of $15.8 million. This falls near the upper end of the estimates, but is very close to the second D4 case. It appears that D4 will generally give a conservative result for the building cost but this building has extra site work that can not be taken into account through D4. This results in the project cost given by D4 to be lower than the actual project cost for this building.