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Thesis Proposal

Construction

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Executive Summary

The following four analyses describe problematic features of the Charlottesville Community Hospital, as well as potential improvements to its design and function. The first involves the implementation of an on-site storage facility for construction materials. This would present a solution to the concerns such as limited site laydown space and delivery congestion. The temporary loading docks and material hoist would see less daily traffic, which leave more room for car traffic throughout the parking garage, and tradesmen traveling from floor to floor. Material delays would be minimal with the new minor delivery restrictions because of the added staging space. Special site deliveries from the facility would include materials from multiple trades, depending on what is needed for that day.

A second analysis consists of the installation of either photovoltaic panels or wind turbines on the penthouse roof. The most sustainable option based on research will be chosen. If Photovoltaic panels are used, they will be installed on the roof at an angle facing south. If wind turbines are used, they will be mounted near the edge of the roof where they are designed to capture the updraft wind that travels up along the building's façade. Both strategies would contribute to an electrical cost reimbursement to the owner.

Prefabricated brick panels on the East and South façade represent another analysis topic. This façade system is composed of either hollow or solid bricks that are assembled in an offsite facility, and then delivered to the site in the appropriate dimensions. The brick panels would be installed via crane, which eliminates the need for scaffolding. Without the stationary scaffolding wrapping the East and South facades, all egress points would be accessible and the risk of an injury from falling objects would be decreased.

Lastly, a safety protocol for the distribution of materials such as ductwork, drywall, and metal stud will specifically be researched as to the best way to transport and store them inside. A plan for specific locations of materials like these to be stored will also be designed. A floor plan will be devised to show exactly where to put materials as they enter the building. The goal is to provide tradesmen with an organized way of moving materials around without wasting time or getting injured.

For an electrical breadth, a study of the power generated from a renewable energy source will be analyzed. Either a photovoltaic panel system or a rooftop wind turbine apparatus will be used to create this alternate energy. The cost savings will be calculated over a period to determine a reasonable payback time scale.

An energy analysis of the building will also be performed with the addition of the new brick panels for a mechanical breadth. With better insulation principles, this façade assembly may reduce the energy demand of the building. The results of the increased R-value and weather proofing materials will be analyzed. Additionally, the means of erection and installation methods will be discussed to further discover schedule and costs adjustments.

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[Analysis 1] Material Storage/Delivery Hub

Problem Identification

The first of four technical analysis topics to be discussed is the creation of material storage units and a potential delivery hub for all contractors. The idea stems from the main problematic theme of limited site space for material staging. Also encouraging these new units are the congested loading docks and parking garage driving lanes that suffer from large deliveries. Another concern for management is the tight material ordering windows that contractors have. Since contractors can only bring their material into the building when it is ready to be installed, they must either have their own warehouse for staging or have the material delivered at the perfect time. With such demands, the project team is at a greater risk for construction delays due to material not being delivered on time. Additionally, owners are now paying warehouse storage fees for materials that contractors need to have released. These off-site storage facilities are also an inconvenience for the contractors who have to spend time traveling from them back to the job-site.

Background Research

To determine if this analysis was possible, a physical site for the storage facility would have to be proposed. Even though the job-site boundary does not have room, there is a vacant lot located across the street to the East. It is an undeveloped space with part of it used for contractor parking. Another idea considered was the possibility of trades using the facility to pre-assemble or produce buildings parts, instead of doing so in the field. The size, construction type, and materials used for the units will also be considered.

Potential Solutions

The implementation of these on-site storage units would present a solution to the concerns listed above. The temporary loading docks and material hoist would see less daily traffic, which leave more room for car traffic throughout the parking garage, and tradesmen traveling from floor to floor. Material delays would be minimal with the new minor delivery restrictions because of the added staging space. A certain area of space would need to be allotted for each contractor, with preference to those with large building materials like ductwork, and drywall. A member from the project team would be in charge of overseeing the operations of this facility. Their duties would include managing the storage space, accepting deliveries, and creating specific deliveries to go on-site. These special site deliveries would include materials from multiple trades, depending on what is needed for that day.

Requirements for Achieving Analysis

To achieve this technical analysis, the most important area of research is to communicate with other organizations as to their methods of facility coordination. Construction agencies such as Southland Industries or cargo transporters like FedEx, use storage facilities like this for their business. I would investigate the complications and logistics that are associated with this idea. Another area to look into is the site selection. The proposed site described above would be ideal as long as zoning requirements and the owner of the land permitted the temporary structure. After this is investigated, it will be determined if the storage unit can be constructed here, of if another location near the job-site will need to be used. Lastly, a cost and schedule analysis will need to be conducted to determine the financial and duration impacts. Although additional costs will be needed to build the structure, contractor fees for off-site staging will be avoided. The unit's construction will need to be implemented into the overall project schedule. The exact chronological placement of its construction into the schedule will need to be considered.

Expected Outcome

The results of the analysis should prove that the addition of a nearby storage facility will make for a smoother material delivery and laydown transition. It will also show the costs comparisons of this new facility, versus the estimated costs of paying for offsite storage. Lastly, it is expected that this research will show how material delays and site congestion will be reduced. The picture below shows the new hospital construction in red and the proposed site of the storage facility in green. The yellow line connecting them is the path in which material would eventually be delivered to the project. This path requires traveling through an existing parking garage entrance, which is the current method for deliveries today.

Figure 1

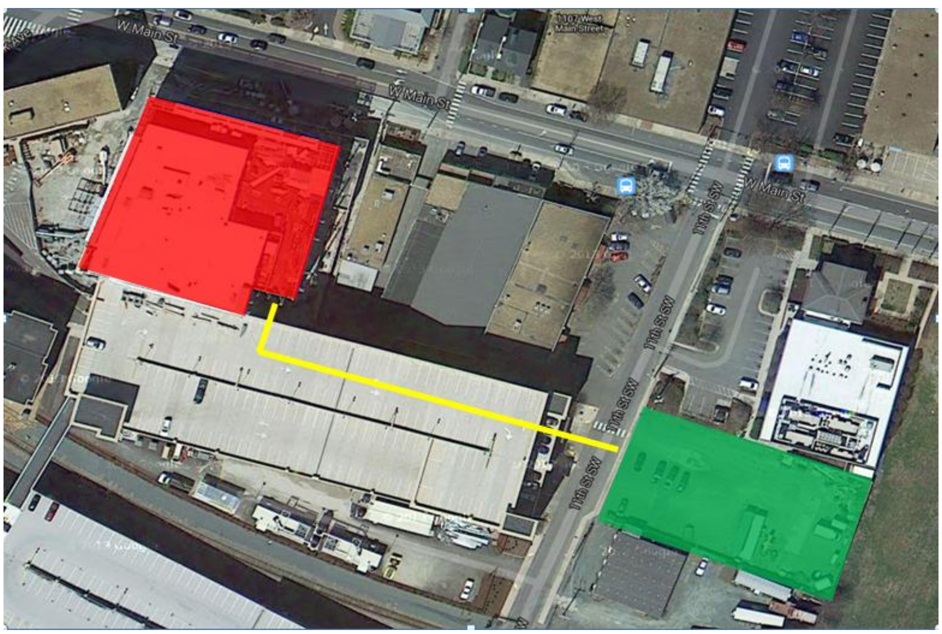


Photo from Google Maps

*This analysis will be the basis of my research topic for my construction thesis.

[Analysis 2] Photovoltaic/Wind Turbine

Problem Identification

To power the new hospital takes a great deal of electrical demand. The goal of this analysis is to lower the energy costs of the building by means of renewable energy. This type of renewable power is not common on this project, and the facility could greatly benefit from the modification. Although a LEED Silver certification is required, the project team has a goal of Gold. Additional LEED points will be needed to attain this goal.

Background Research

To begin the search for renewable energy potential, the exterior of the structure was investigated. It was first determined that the penthouse roof is a well suited site for renewable energy. Its surface spans approximately 5000 square feet and is flat with minimal rooftop obstructions. Additionally, research into local wind reports and building orientation needed to be performed to determine if wind and solar generated power would be viable. It was determined that the town of Charlottesville has an average wind speed rate that is well above the average for the rest of Virginia as well as the average for the United States. Also, the hospital will not be shaded from other buildings after it is completed and will have good exposure to sun.

Potential Solutions

The installation of either photovoltaic panels or wind turbines will be implemented on the penthouse roof. The most sustainable option based on research will be chosen. If PV's are used, they will be installed at an angle facing south. If wind turbines are used, they will be mounted near the edge of the roof where they are designed to capture the updraft wind that travels up along the building's façade. Both strategies would contribute to electrical cost savings.

Requirements for Achieving Analysis

A successful analysis of both the photovoltaic and wind turbine ideas will require the research of local atmospheric conditions such as average wind speeds and solar studies. It will have to be determined if Charlottesville lies in a region with substantial wind speeds to warrant wind turbines. The constructability methods will also need to be analyzed to determine how the equipment will be installed and what other building assemblies might be affected. A schedule and costs analysis will also be conducted to determine the time and financial effects. Lastly, the amount of power the devises can potential produce will be determined to see its effects of energy savings.

Expected Outcome

The best option for research, either photovoltaic or wind turbines, will be chosen based on practicality. The energy output of the devises is expected to prove that they are a positive addition to the building, with reasonable upfront installation costs. This includes sizing the exact system for the roof and determining how much energy it can produce over a given time. The contribution to LEED will also be investigated. The pictures below show examples of both the angled photovoltaic panels and a wind turbine system.

Figure 2

Image from Google Images

Figure 3

Image from Google Images

[Analysis 3] Prefabricated Brick Panels

Problem Identification

The East and South Façade of the hospital are predominantly composed of red brick masonry. The installation of the brick requires the masons to use scaffolding which is erected along both the East and South sides of the building. The scaffold creates both a safety hazard and an inconvenience for workers traveling alongside the building. There is always the threat of falling objects from construction occurring above ground floor workers. Also, brick material and mortar mixing stations occupy much of the already limited site space. Often times, building entrances would need to be closed off due to the progress of the masons, resulting in tradesmen needing to find alternate egress points. Since the space for material staging was limited, brick was delivered to the job site often and with short notice.

Background Research

Two of the building's five main construction entrances are located near the brick construction. They provide access to the rear of the building when most deliveries are conducted. When they are closed off, the most direct route for traffic to reach the back of the building is to exit from the North side of the building and walk along the East wall, past the scaffolding. Additionally, the installation of the brick facades takes about five combined months to complete. The smaller South Façade takes about one and a half months to complete and is begun after the completion of the East façade, which takes about 3 and a half months. The idea for improving upon the buildings brick façade is driven by unsafe site conditions, congested pathways, and a lengthy schedule.

Potential Solutions

The proposed solution to these issues is to introduce prefabricated brick panels. This façade system is composed of either hollow or solid bricks that are assembled in an offsite facility, and then delivered to the site in the appropriate dimensions. Because they are prefabricated offsite, the risk of a construction related injury is decreased. Also, this solution eliminates the need for brick pallets and mortar supplies on the jobsite which are the main causes of congestion. The brick panels would be installed via crane, which eliminates the need for scaffolding. Without the stationary scaffolding wrapping the East and South facades, all egress points would be accessible and the risk of an injury from falling objects would be decreased.

Requirements for Achieving Analysis

To achieve the analysis of the proposed prefabricated brick panels, specific research of the type, weight, and insulation properties of the material will need to be performed. These factors will help contribute to a future breadth analysis, as well as provide an idea of how many men will be needed to install a panel. The application process will need to be analyzed to determine where a crane will be set up, and at what stage of construction the panels will be able to be installed. A cost comparison will be made between the prefabricated panels and traditional bricks. Lastly, the rate of installation will be analyzed to determine if there is a schedule savings.

Expected Outcome

This modification is expected to reduce the installation time of the Hospital's East and South brick façade. It will also eliminate the need for long term scaffolding on the site which has been a distraction for all workers. The panels are also expected to increase the insulation properties of the building, with the goal of reducing the building's total energy load. A cost and schedule savings will also results from the panels, due to their fast installation time and fabrication methods. Most importantly it is expected that the site conditions near the current scaffolding will be clearer without necessary material staging. Below is a picture of an example of how the installation process may begin.

Figure 4

Photo by All Brick & Stone Ltd

[Analysis 4] Safety Protocol for Material Distribution

Problem Identification

The premise for this analysis is to make efforts to eliminate construction related risks inside the building. To do so, items such as material staging and organization will be implemented. Currently, the interior spaces such as the corridors and foyer areas are being used to store materials, which are areas often traveled by workers. An issue arises when work needs to be done in these particular areas. Efforts are then made to move materials to other locations, which involves time and safety concerns if the correct moving equipment is not available. Also, trades often do not know where exactly their material is located on a particular floor. This is due to the rapid rate at which material is imported from the material hoist and quickly staged.

Background Research

One critical construction industry topic discussed at the 22nd annual PACE Roundtable event was the idea of preventing safety related issues though design. This involves the preplanning of safety procedures that are appropriate for a specific jobsite. It was noticed that there are a few rooms on each floor of the hospital that are not completed during the same time frame as others. These rooms may need special equipment that is scheduled to arrive at a later date, or they are simply not of high priority to complete. Another applicable feature of the hospital to this research is that floors three to six have very similar floor plans, so a similar safety protocol for material distribution can be used throughout most of the building. Furthermore, workers would recognize and understand these methods as the progressed to different areas of work.

Potential Solutions

Construction materials such as ductwork, drywall, and metal stud will specifically be researched as to the best way to transport and store them inside. A plan for specific locations of materials like these to be stored will also be designed. These areas will be a combination of unfinished rooms and general spaces throughout each floor. A floor plan will be devised to show exactly where to put materials as they enter the building. These locations may need to be changed as construction progresses, but they will be planned for.

Requirements for Achieving Analysis

The first step to achieving this analysis is to indicate which rooms will be used to stage materials. Theses rooms will be the location for contractors to find what they need for their daily work. They will need to be appropriately sized fit large materials like drywall, ductwork, and studs, with enough room to enter and exit easily. Requirements will need to be made for how material is stored, as far as stackable heights and laydown procedures. The rate at which specific trades are able to install their material will also need to be determined. This will help designate how much material should be in one room at a time.

Expected Outcome

The goal of the analysis is to create a cleaner an organized approach to interior construction through preparation. This will ultimately reduce risk of injury from congested work areas and improper material handling. It will provide a clear direction of where materials will be staged as they enter the building and how they should be stored. The goal is to provide tradesmen with an organized way of moving materials around without wasting time or getting injured.

Conclusions

The following breakdown depicts how each analysis will be weighed as far as its research efforts and relevance to many construction topics.

Detailed weighed Grade Breakdown					
Description	Critical Industry Research	Value Engineering Analysis	Constructability Review	Schedule Reduction	**Total**
Material Storage/ Delivery Hub	**0%**	**10%**	**10%**	**10%**	**30%**
Photovoltaic/ Wind Turbine	**10%**	**0%**	**5%**	**5%**	**20%**
Prefabricated Brick Panels	**10%**	**10%**	**5%**	**10%**	**35%**
Safety Protocol for Material Distribution	**15%**	**0%**	**0%**	**0%**	**15%**
Total	**35%**	**20%**	**20%**	**25%**	**100%**

Appendix 1

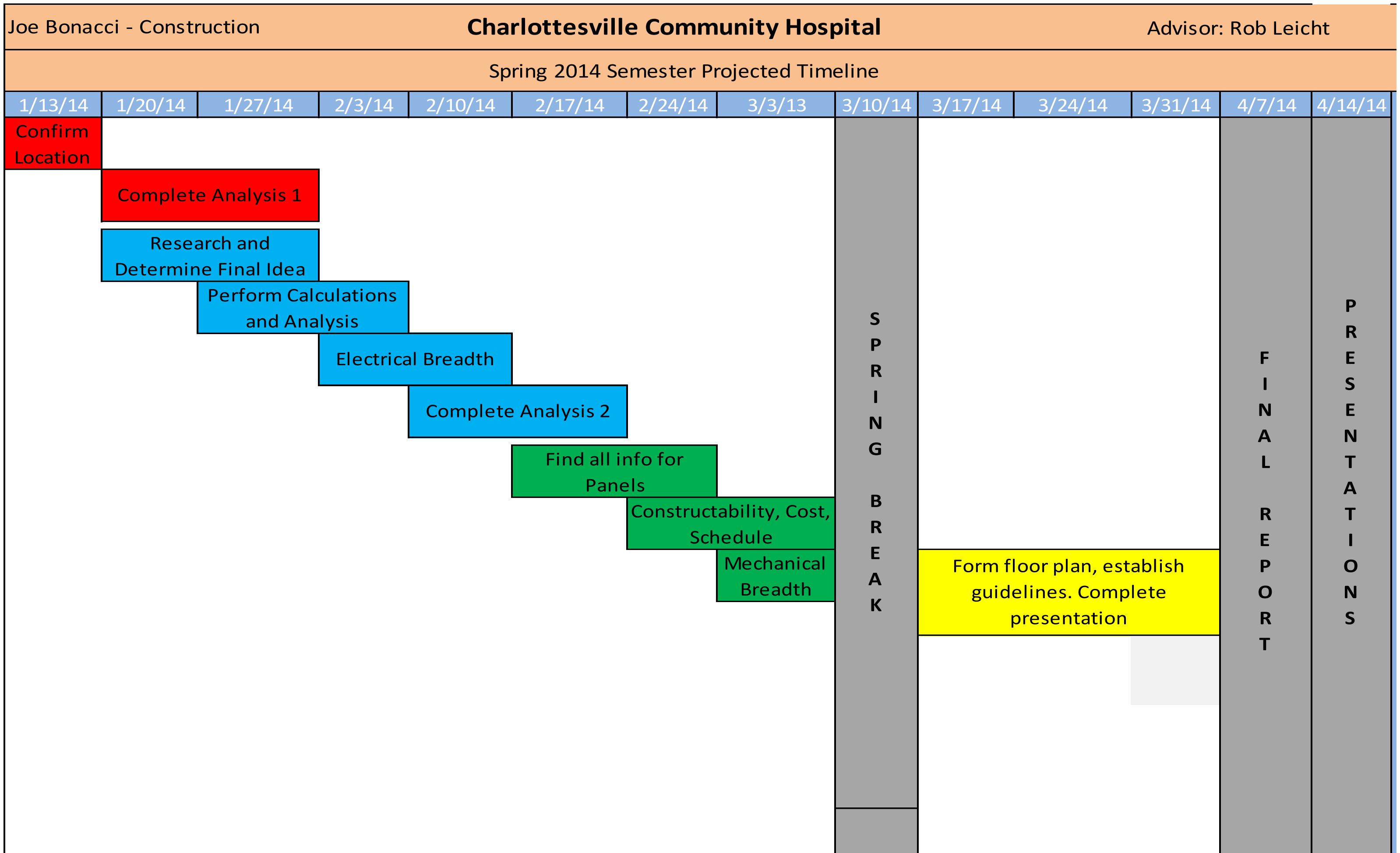
[Electrical Breadth] **Photovoltaic/Wind Turbines**

The study of the power generated from a renewable energy source will be analyzed. Either a photovoltaic panel system or a rooftop wind turbine apparatus will be used to create this alternate energy. The electrical power generated will be dispensed back into the grid for compensation to the owner for electrical costs. This savings will be calculated over a period of time to determine a reasonable payback time scale. The most applicable option for renewable power will be chosen after further analysis. Once determined, the constructability measures for installation and maintenance will be analyzed. Lastly, a schedule modification will be conducted to justify the new rooftop addition.

[Mechanical Breadth] **Prefabricated Brick Panels**

An energy analysis of the building will be performed with the addition of the new brick panels to the East and South facade. These panels will be assembled off site and delivered to the project when they are needed. With better insulation principles, this façade assembly may reduce the energy demand of the building. The results of the increased R-value and weather proofing materials will be analyzed. Additionally, the means of erection and installation methods will be discussed to further discover schedule and costs adjustments.

Appendix 2



	Analysis	Breadths
1	Material Storage/Delivery Hub	
2	Photovoltaic/Wind Turbine	Electrical
3	Prefabricated Brick Panels	Mechanical
4	Safety Protocol for Material Distribution	