ST. JOSEPH'S WOMEN'S HOSPITAL

Neonatal Intensive Care Unit (NICU)

3030 W. Dr. Martin Luther King, Jr. Blvd.

Tampa, FL 33607

Final Thesis Proposal

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BayCare Health System

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Construction Management

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Executive Summary

After a full semester of analyzing the current construction means and methods, costs, scheduling, contracts, and issues, this document has been drafted to propose potential opportunities to improve upon these current procedures. Unexplored areas that may pose potential benefits for the construction processes are going to be explored, covering various topics such as constructability, value engineering, critical industry issues and trends, and schedule acceleration scenarios. These analyses have been organized into four construction depth analyses, which will be supplemented with a structural redesign breadth analysis and a mechanical redesign breadth analysis.

The first analysis entails redesigning the façade to include more prefabrication, which is a currently increasing industry trend. The idea will be to include the glazing in a manufacturing environment so as to reduce cost, increase quality, and save time in the field. This will be the primary analysis, covering all four points mentioned above, and constituting the majority of the report.

Currently the structural slab system is 12" thick with double matted rebar. In a hospital where above ceiling MEP space is at a premium, and in an economy where material costs have succumbed to inflation, it would be beneficial to explore other floor system options. A comparative matrix will be created to help the owner, engineers, and contractors visually and numerically assess their decision on which floor system would best benefit them. From there the chosen slab type will be designed at a basic level to manifest a general working knowledge of structural design methods.

The current schedule is aggressive and entails some phased turnover along with a difficult demolition phase. Different opportunities for phased turnover and sequencing will be explored in hopes to accelerate the overall project schedule, or better distribute float to tasks with ambiguous durations.

Finally an energy study will be conducted on the current design and then suggestions for engineered improvement will be made. The building is set to achieve LEED Certified. Possibly with more energy reduction provisions, Silver will be possible. Once an energy reduction system is chosen, it will be schematically designed and analyzed for return on investment in addition to initial costs. This analysis will also comprise the mechanical breadth.

These topics may be subject to change pending a site visit over the winter break, and feedback early next semester from industry professionals and faculty advisors.

Contents

Project Information

In April 2010, BayCare Health System began construction on its newest addition, the St. Joseph's Women's Hospital NICU Tower in downtown Tampa, FL. The new structure is designed to accommodate twice as many patients as the existing facilities, and do so with fully exclusive rooms for increased privacy. In addition to standard patient rooms, a new breast health center, medical imaging suites, and operating rooms will also be constructed within the new five story structural concrete building. The new facility will achieve LEED Certification, upon completion in July 2012.

Construction has been broken into three phases, which will require the Barton Malow team to meet tight deadlines for phased turnover. The first phase will include the construction of the new tower, a five story structural concrete structure outlined in blue in Figure 1 below. The second phase will involve the demolition of the existing NICU in red, and the construction of the five story connector wing in orange. Finally, a renovation of existing hospital facilities will comprise the phase three work, as seen outlined in green. Maintaining full operational status is the primary concern of the owner, and with sensitive customers such as premature babies, the task will require strict attention to detail, efficient processes, and intense planning in order to be successful.

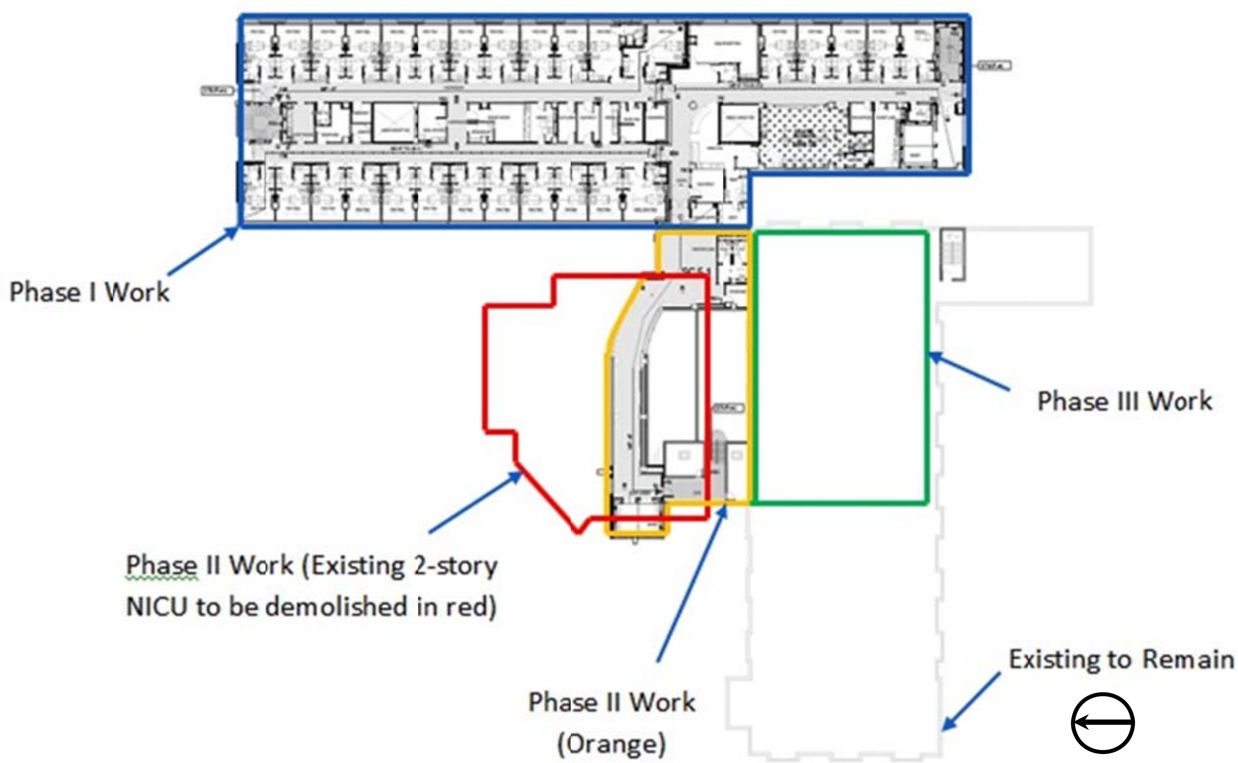

Figure 1. St. Joseph's NICU Phasing Plan. ALS-51A from 100% CD's, Compliments of HKS, Inc.

Prior to the start of construction, BayCare Health system had renovated all major mechanical systems to accommodate the possibility of an addition such as this. Therefore, the majority of electrical and mechanical feeds will come from the main chiller plant and electrical room in the existing hospital. There are still provisions for new air handlers and pumps to be installed in the sixth floor mechanical penthouse of the new facility, but the MEP effort has been greatly aided by the owner's pre-planning. Also, a cool roof is scheduled to be installed in an effort to reduce the cooling loads needed in the tropical climate. The façade itself consists of precast concrete panels and large windows, but phase two will manifest a large glass curtain wall on the North side, facing Martin Luther King, Jr. Blvd. and St. Joseph's Hospital across the street. When completed, St. Joseph's Women's Hospital will house the premier Neonatal Intensive Care Facility in Central Florida.

In addition to challenges presented by the intense nature of constructing a healthcare facility, the St. Joseph's project team must compete with a tight urban site, height restrictions imposed by local FAA laws, and the surgical demolition of a partially operational building. These and many other factors evoke the opportunity to study several construction process oriented topics to improve the overall efficiency of building this project.

Construction Analysis Topics

Analysis #1: Façade Redesign and Prefabrication

The FAA height restriction placed a limit on the size of the crane that could be used for the construction of the superstructure. This last minute issue forced the project team to resort to two smaller cranes, which approach the limits of their capabilities in this particular application. In an attempt to get the precast panel façade installed on the East side of the building, where the crane will be making the most difficult picks, the precast manufacturer was able to construct the panels out of lightweight concrete. This created the need for a different connection method of window frames, as the anchors to those frames were originally designed to be placed directly into the concrete panels. A Notice of Acceptance (NOA) rating number, which certifies the window for multiple tests including fire and blast resistance, as well as wind and rain leakage, had never been issued for the system that had to be designed. In a geographic region that is predisposed to hurricanes, there was little room for this detail to go overlooked. NOA testing takes time, so the possibility of schedule impact was very much a concern, although to date this issue has not affected the critical path.

Research Focus and Goal: Since the project team did not have time to redesign the façade for the field condition, it presents the opportunity to do so now. The real focus will not just be on the connection detail of the window frames to the precast panel, which is typically an architectural issue, but rather on the possibility of enhancing the prefabrication scope to include frames and glazing into the precast panels at the factory. Prefabrication has been a developing market in the construction industry in recent years, and will be a good way to reduce the time that will be needed for the glazing contractor to perform installations onsite. Additionally, the panel layout should be redesigned so that the crane can comfortably make the long picks needed to complete the East façade construction.

Means and Methods: The research for this task will include feasibility studies with the project team, precast concrete manufacturer, and glazing contractor. A basic understanding of the NOA rating points can be obtained from local building code literature, as well as interviews with the glazing manufacturer.

A basic understanding of the structural requirements for the façade connections can also be obtained from an interview with the structural engineer. Once feasibility is established, the layout of the façade itself can be altered to allow window panes to be totally enclosed and sealed to the precast at the factory. Then the façade will be cut into sections that can be easily managed by the crane. Productivity analyses and cost analyses should be carried out to forecast the magnitude of cost savings and schedule savings, if any.

Expected Outcomes: The analysis is intended to achieve the following:

- Decide if the idea as a whole is conceptually feasible
- Identify if there is a net schedule savings by eliminating the glazing contractor's time onsite
- Assure that the crane is able to safely and efficiently set the façade pieces
- Identify if there is a cost savings by prefabricating the pieces in a manufacturing environment
- Determine the quality control and safety advantages from prefabrication in a manufacturing environment
- Understand the NOA rating system

Analysis #2: Change of Structural Slab Design

Currently the two-way flat plate structural floor slabs are 12" thick with double matted rebar. Approximately 4,500 cubic yards of f'c=5,000 psi concrete is estimated to be needed for the construction of only these slabs. At nearly $100 per yard, there exists an opportunity for savings if the amount of concrete can be reduced. Based on personal experience with structural concrete installations, post-tensioned slab systems can offer a decent amount of thickness reduction, thus saving money on concrete costs. There are many other systems which may reduce this number as well, including precast solutions such as duct plank.

Research Focus and Goals: The main focus of this analysis will be to value engineer the structural slab system in an effort to reduce cost. This can be done by reducing material costs, or accelerating the schedule, thus reducing the general conditions costs, and field labor.

Means and Methods: The first step will involve creating a comparison matrix between multiple floor systems to see the benefits and disadvantages of each type of system. This matrix should be designed with cost in mind as the main driver. An example of this Weight Matrix can be found in Appendix C. From here, the selected system(s) will be designed at a basic level to create the basis for a detailed estimate. The detailed estimate will then be carried out and compared to the original design to evaluate savings.

Expected Outcomes: The analysis is intended to achieve the following:

- Determine if another construction type is found to be financially beneficial
- Identify if the construction type chosen can accelerate the schedule

- Correctly design the selected system at a basic level
- Create a professional matrix that can be used as a template to weigh the decision between structural floor systems
- Above ceiling space is maximized to accommodate MEP equipment

Analysis #3: Phased Turnover & Resequencing of Construction

The three phase project has very critical milestone dates for turnover. The deadline for phase one completion marks the beginning of the owner's move from the existing NICU facility into the new NICU tower. From here, the focus shifts to surgically severing and demolishing the existing NICU structure which is tied into the existing operational part of the hospital. There have only been twenty work days allotted for this work. That is extremely tight considering the extensive MEP equipment in the facility, and all of the connections running back into the existing hospital that will need to be cut, capped, and safed off prior to the demolition of the structure. Also ICRA protection and temporary facilities must be adjusted accordingly. Temporary sound attenuation must be installed in the new NICU tower to protect delicate premature babies from the intense sound that may occur during demolition. The existing NICU also has a few areas that will require abatement. The first area applies to the insulation around mechanical piping fittings. These fittings must be removed separately from the rest of the system, but can be cut on either side of every fitting so as to not have to penetrate the asbestos itself. While this is a safe method of abatement, it still must follow proper procedures and takes a significant amount of time. The second type is found under the old VCT flooring and in the form of mastic. Abatement of these areas require keeping the floor submerged in water so as to not allow the asbestos to become airborne. This is a safer abatement, but again requires time consuming procedures, as the concrete below will need to be recycled for the LEED credits.

Research Focus and Goals: The current schedule can be analyzed for possible alternative sequencing scenarios. With the new NICU tower being roughly twice as large as the current facility, there would not be a need for total completion of the new tower before the owner can begin partially occupancy. It would be feasible to finish three floors early to accommodate the existing patients, while leaving the remaining floors to be completed under less pressure. This will allow a little more time for the prep work and demolition of the existing facility. The demolition seems to be the current hot spot in the schedule so anything to create float for this activity would be well received. There may be additional areas for resequencing that can aid both the schedule, and constructability.

Means and Methods: Keith Munson from Barton Malow would be a good source to consult for this analysis as he is in charge of the schedule. While a scheduling consultant is currently used for this project, Barton Malow has the onsite knowledge needed regarding possible phasing opportunities. Additionally the GSA provides an online resource for 4D BIM which has provisions for phased occupancy. This would be a good place to begin drafting potential issues and requirements for carrying out phased turnover. Once some suggestions for resequencing are drafted, they should be presented to the owner for an operations review. Maintaining hospital operations is the primary concern of the project team, so facilitating this will hold precedence over overall schedule savings. Based on feedback from the BayCare representatives, the project schedule should be revised then compared with the original baseline to evaluate where float had been shifted, and if the critical path had been accelerated.

Expected Outcomes: This analysis is intended to achieve the following:

- Determine if partial phasing for the new NICU tower is acceptable to the owner
- Add days to the demolition activity without affecting the critical path
- Draft a new detailed project schedule that yields a savings in overall project duration
- There is a cost savings as a result of either general conditions or early profitable turnover of certain parts of the building

Analysis #4: Energy Assessment and Reduction

The current LEED projection is for Certified; however, it seems that there is certainly more room for improvement. The majority of the points are coming from sustainable sites, and there are not too many LEED points engineered into the building systems. In an extreme climate such as Florida, it would seem that there would be a tremendous benefit from energy efficient mechanical systems since so much energy is expended on pacifying the cooling load. Currently, the system is largely providing cooling with constant air volume (CAV) reheat systems. This is possibly the most inefficient system that could be used. It was most likely chosen because the prescriptive requirements for 100% outside air in a hospital. The issue lies within the logistics of the system. Supply air is brought in from the outside and then cooled to below the desired room temperature. Next, the air is delivered to the spaces at this temperature, and reheated to accommodate the room loads. Finally, this air is totally exhausted outside of the building. In short, energy is expended to cool the air to below desired temperature, then more energy is used to reheat it to the temperature needed in the space. This overlap in cooling is where the inefficiency comes in, not to mention that the air is then totally exhausted. They have introduced some air to air energy recovery units, but there is still more room for improvement.

Research Focus and Goals: This issue provides the opportunity to explore the more difficult LEED credits and see what is involved with the decision making process. The focus should be on engineered LEED credits, and not circumstantial credits. In particular, energy saving mechanical design ideas will be focused on.

Means and Methods: The first step in deciding which direction to go with this analysis will be to consult with a LEED accredited professional on which points are most commonly pursued. Once a few points are identified for further analysis, a consultation with a mechanical design engineer will distinguish both hard and soft costs of designing and implementing the additional credits chosen. Additionally, if there is specialty mechanical equipment that is to be installed, the additional lead times of procurement, costs of equipment, more extensive testing and balancing, and automation systems should all be analyzed from a constructability standpoint, then compared with the owners budgetary and operational needs.

Expected Outcomes: This analysis is intended to achieve the following:

- Identify certain LEED points for further design analysis
- Design and integrate an energy reduction system into the building
- Identify soft costs for design as well as hard costs for equipment and installation
- Successfully integrate the procurement of specialty equipment into the project schedule
- Compare costs to the owner's budget and lifetime operational costs.

Analysis Weight Matrix

Below sit he proposed weighting matrix for the focus of each individual analysis. This matrix is subject to change as project developments occur, and after initial feasibility studies are conducted for each analysis.

Description	Critical Industry Issues	Value Engineering	Constructibility Review	Schedule Reduction	Total
Façade Prefabrication	10	10	10	10	40
Change of Structural Slab Design	0	15	10	0	25
Phased Turnover/Resequencing	0	0	10	10	20
Energy Assessment and Reduction	10	5	0	0	15
Total	20	30	30	20	100

Table 2. Grading Weight Matrix of Analysis Focus.

Conclusion

Based on the feedback provided from the Barton Malow project team, the above analysis topics will be likely to yield the most beneficial results for the project. It is likely that some of these topics will need to be revised or even completely changed, in particular the LEED analysis section. There may be a greater depth of mechanical design knowledge needed that could be outside of my capabilities. Expect that this analysis will not change, but will likely be very deeply explored. Pending a site visit to the project over the winter break, more analysis ideas will likely be drafted. The strongest depth analysis will be the façade redesign to incorporate more prefabrication. Overall, these topics will provide the most inclusive view of challenging issues in the construction industry, as well as providing value engineering, time savings, and constructability through in depth research and comparison.

Appendix A – Breadth Analysis Topics

Breadth Requirements

In addition to the thorough analyses pertaining to the construction of the project, two breadths have been selected for further analysis which will tie back into the original analyses. They will consist of a structural design breadth, and a mechanical design breadth focused on energy reduction.

Structural Breadth

Based on the results of the structural slab constructability and cost comparison matrix, the most beneficial slab choice from Depth Analysis #2 will be chosen for further structural design analysis. A basic floor layout will be designed to incorporate this new system. There will be a need to consult with structural engineering faculty members and advisors at Penn State to review basic design procedures learned in 300 level Architectural Engineering structural courses, and likely expand more on that and into some 400 level knowledge of concrete systems. Once a design is correctly calculated, some sample construction documents can be drafted , including plans, sections, and details of the system.

Mechanical Design Breadth

Using the LEED analysis information from Depth Analysis #4, and consulting with a mechanical design engineer, some type of additional energy recovery systems will be designed. More importantly energy modeling may be utilized to express energy usage and potential cost savings to the owner. A matrix may be created to assess the feasibility, cost, and benefits of several different options. Taking it a step further, some type of energy production system can possibly be designed if Depth Analysis #4 proves to be insufficient.

Appendix B – Schedule for Development of Analyses, Spring 2011

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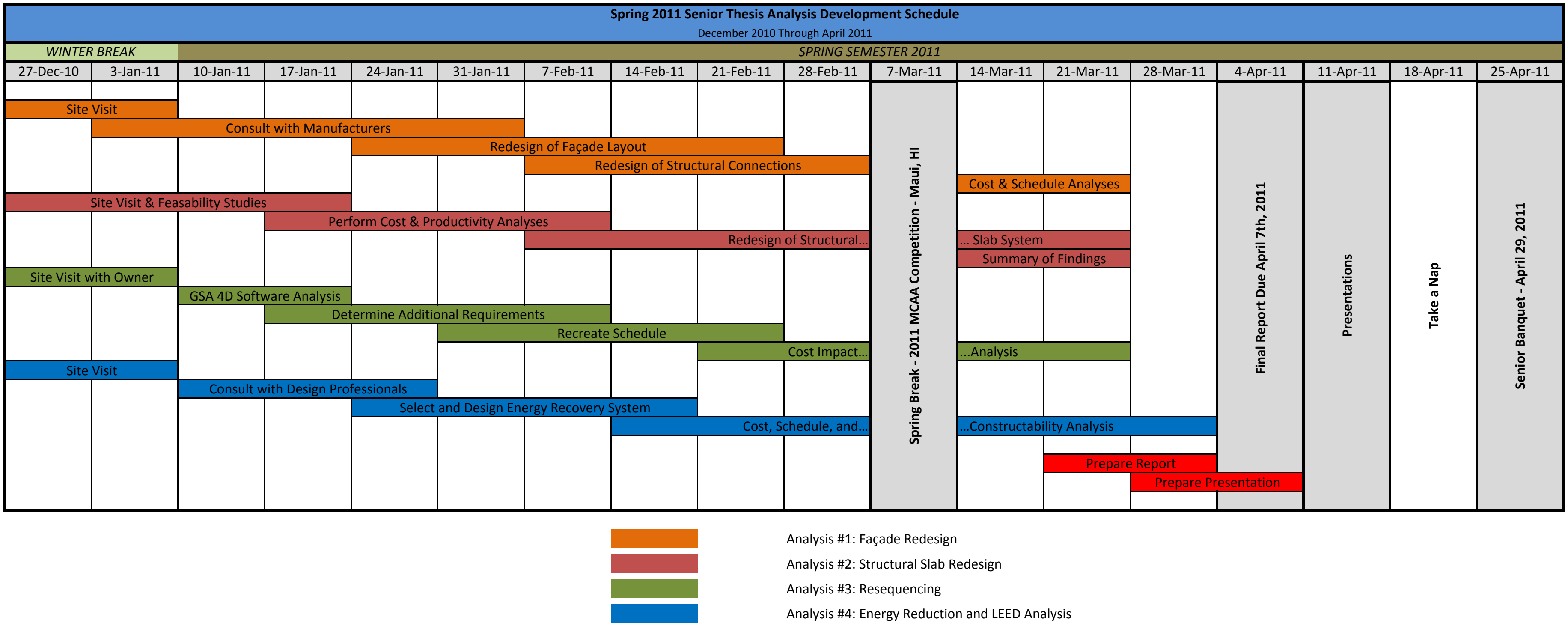
AE 481W

St. Joseph's Women's Hospital NICU Expansion
Tampa, FL



Appendix C – Slab Comparison Analysis Matrix

Slab Type Comparison Matrix

Slab Type	Average Cost/SF	Material Costs	Labor Costs	Average Productivity	Design Fees	GC Impacts	Constructability Challenges	Schedule Impacts	Miscellaneous Benefits
Two-Way Flat Plate									
Post Tensioned									
Waffle Slab									
Precast Duct Plank									
One-Way Slab and Beam									
Category Totals									
Importance Factor									
Revised Total									

- Each item will be ranked 1 to 5 under each category, with 5 being the most beneficial rating
- An importance factor will be designated for each numerical column based on owner desires
- The GC Impacts, Constructability Challenges, Schedule Impacts, and Miscellaneous Benefits Category will be assessed individually as either positive or negative points based on importance
- Slab system resulting in the highest numerical total is the most beneficial