St. Joseph's Women's Hospital

Neonatal Intensive Care Unit (NICU)

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

Tampa, FL 33607

Spring Thesis Proposal Revision

February 22, 2011

BayCare Health System

Dennis Gibson

Construction Management

Dr. Robert Leicht

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 three construction depth analyses, which will be supplemented with a structural redesign breadth analysis and an architectural façade design 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. In addition to the construction depth analysis, an adjacent narrative will be formed which will comprise the architectural design breadth analysis. This section will resound the challenges of maintaining the architects original vision while at the same time redesigning the system.

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. This design will constitute the structural design breadth topic.

The third analysis has been revised from an energy reduction and LEED study, which would promote a LEED Silver and platinum feasibility analysis, to a BIM implementation study, particularly for the integration of concrete reinforcement into the model. This study has a twofold purpose; the first being to reduce the time necessary for shop drawing approval, the second to provide digital as-builts for future renovation work. Although radar testing slabs gives you a pretty good idea of where the reinforcement is located, having a digital as-built allows for better coordination should additional slab penetrations need to be installed. An assessment of various software platforms and a general reaction to the modeling process and its benefits will serve as the deliverable for this analysis.

At this time, these analyses are to be considered the final proposal items. A site visit on January 3, 2011 confirmed that these will likely be the most beneficial topics from both the project perspective, as well as facilitating interesting material for research and presentation purposes.

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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 nearly 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.

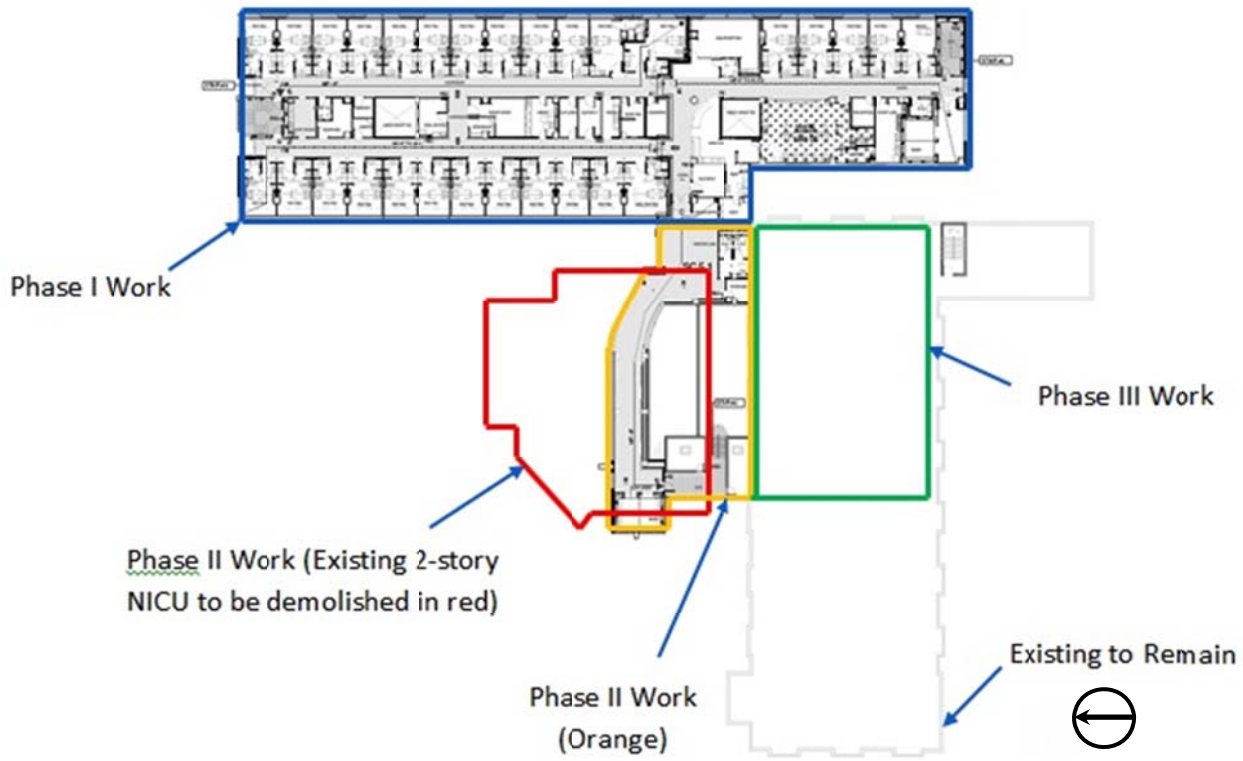


Figure 1. St. Joseph's NICU Phasing Plan. ALS-51A from 100% CD's, Compliments of HKS, Inc.

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, mainly 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, or cast-in-place systems such as a pan slab.

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 (structural breadth analysis)
- 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: BIM Modeling and Shop Drawing Integration

The previous analysis was intended to analyze Green Design and the efficiency of the mechanical systems. From there, the intent was to create energy models and compare the initial design with a new design which would include more energy reducing methods. This proved to be a bit difficult for me to apply with the St. Joseph's project for several reasons. Frist, both the existing hospital and new addition will be serviced from a central mechanical plant, requiring the modeling of existing facilities which would require an unnecessary amount of time. Second, the level of detail required to run the model to any type of accuracy would require a deeper knowledge base than I have.

In place of this analysis, I have chosen to study the integration of BIM models and shop drawings. There are several contractors that already use BIM, however, it is rare that the model is used to produce shop drawings even though it will eventually produce spool drawings for the manufacturer. For example, steel contractors often use a model for coordination with other trades, but when it is time to fabricate beams, the model is dissected into sheet drawings which are reviewed piece by piece "the old fashioned way." Once the review is complete, the model is then converted to a different file format which allows the automated detailing of the material at the yard. Another example, which will be the primary focus of this analysis, will be the use of BIM for rebar shop drawings. In my brief time in the field working for a concrete contractor, and more notably this past summer in reviewing structural concrete rebar shop drawings on behalf of a construction manager at risk, I have found that the ambiguity and time involved with a manual review of paper rebar shop drawings is a difficult task, and if not done properly, will result in serious mistakes. Figure 2 Below shows a snapshot of Tekla Structures reflecting a reinforcing and embed model in a concrete wall.

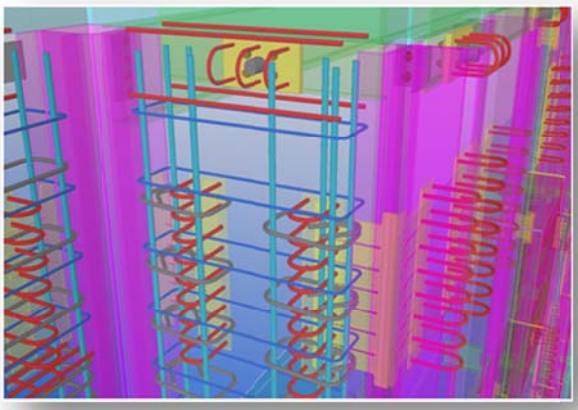


Figure 2. Snapshot from Tekla Structures. Courtesy AECBytes.com

The site was walked on January 3rd, and the topic was brought up about the possibility of future renovation work, which is frequent for BayCare Health facilities. This was in reference to analysis two, when talking about the reasons for a two-way flat plate slab. Since they were partial to using this slab type, which involves an extensive amount of reinforcing steel, this analysis will prove to be beneficial, especially if a post tension system is chosen, so that penetrations can be made with greater confidence.

Research Focus and Goals: This issue provides an opportunity to explore into a relatively new and underused sector of BIM modeling capabilities. The idea will be to produce a sample model for the St. Joseph's Project, and show the benefits of having a model for shop drawing review, as well as an archived model which will allow future penetration and or expansion work to be better planned, resulting in a safer product for the user.

Means and Methods: First a polling of various construction companies will be necessary to determine if the issue of inefficient shop drawing review is a shared concern. Once this is determined, a software selection should be made to model the reinforcing. Next, a model will be created, efficiency and feasibility of coordination and review will be assessed, and the system will be critiqued based on my experience using the software, and feedback received from industry professionals.

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

- Identify if there is a general issue with the common paper shop drawing review and coordination methods.
- Select a software that promotes a balance of detail and efficient drafting.
- Identify soft costs and productivity for using reinforcement modeling as a substitute to paper shop drawings.
- Provide an overall assessment of the effectiveness of using reinforcement modeling for both construction and as-built purposes.

Analysis Weight Matrix

Below is the proposed weighting matrix for the focus of each individual analysis. At this time, the weight matrix has been finalized.

Description	Critical Industry Issues	Value Engineering	Constructibility Review	Schedule Reduction	Total
Façade Prefabrication	10	5	15	15	45
Change of Structural Slab Design	0	20	10	0	30
Reinforcement Modeling	15	0	10	0	25
Total	25	25	35	15	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. 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 an architectural breadth focused on the façade layout.

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.

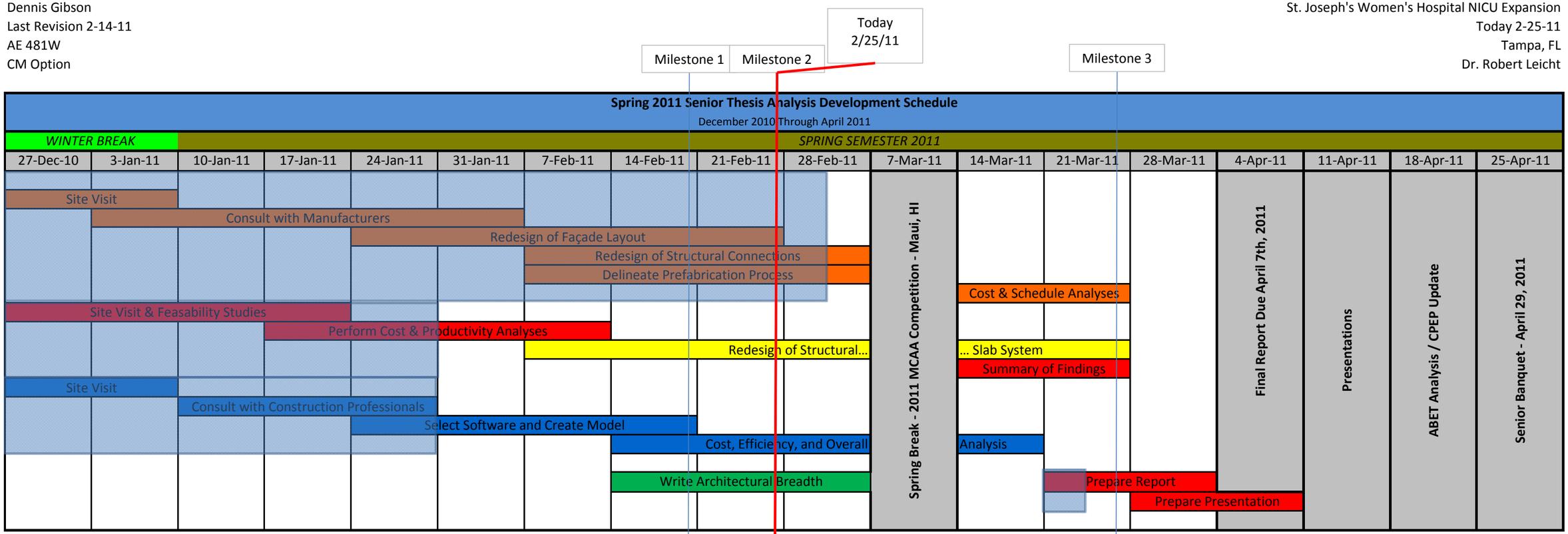
Architectural Breadth

The façade redesign will require both architectural and structural provisions to be successful. While this analysis is intended to provide an exploration of my constructability knowledge, the architectural features must be maintained throughout the alteration of design. The challenge will be maintaining similar joints to the original design, and not changing the aesthetic qualities, while at the same time creating detailed connection methods to facilitate the NOA rating issues of the design, factory installation of glazing, delivery of materials, and overall constructability.

Appendix B – Schedule for Development of Analyses, Spring 2011

Dennis Gibson
Last Revision 2-14-11
AE 481W
CM Option

St. Joseph's Women's Hospital NICU Expansion
Today 2-25-11
Tampa, FL
Dr. Robert Leicht



Milestone 1: Go / No Go Checks 2/18
Milestone 2: Go / No Go Confirmation 2/25
Milestone 3: Presentation Checklist 3/25
Progress

Analysis #1: Façade Redesign (Architectural Breadth)
Analysis #2: Structural Slab Redesign (Structural Breadth)
Analysis #3: Reinforcing Steel Modeling
Breadth #1: Structural Slab Redesign
Breadth #2: Architectural Redesign Narrative

Notes: Structural Slab Redesign must be performed prior to finalization of cost and productivity analysis for Analysis #2. A meeting with Professor Boothby is pending.
Analysis #3 progress is now predicated upon receiving the Tekla software. I am curretnly working with a representative from Mortenson who is assisting me with this.

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