SAINT VINCENT HEALTH CENTER

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CM Option

Final Thesis Proposal

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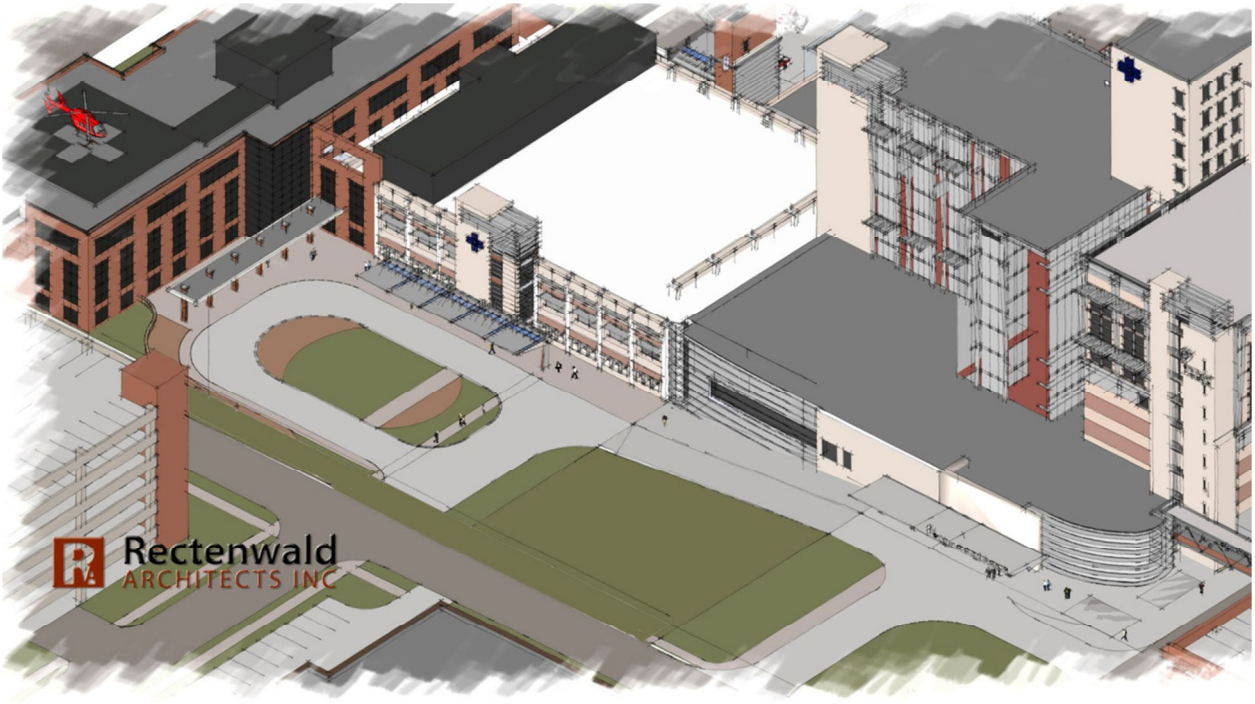
SAINT VINCENT
INFILL BUILDING



Executive Summary

Senior Thesis Final Proposal is intended to discuss the five analyses that will be performed for the final thesis report on the Saint Vincent Health Center Addition. Each topic is centered on the central theme of improving efficiency in the construction industry: efficiency, prefabrication efficiency

ANALYSIS #1: Schedule Reduction from Re-sequencing Construction Phases

The proposed sequence has multiple phases with demolition work overlapping new construction activities throughout the entire project schedule. Phased occupancies are planned for the Emergency entrance, connecting corridor and In-Fill Addition and the Existing Hospital to accommodate Saint Vincent's requirements. This scenario creates potential problems with trade coordination, contractor delays. There will be several contractors switching between renovation, demolishing and new construction work which will make coordination and schedule understanding extremely difficult. The goal of this analysis is to perform an in-depth re-structuring of the project schedule to reduce schedule length by working on phase 1 and 2 unrelated tasks simultaneously. Creating a 4D model to show sequencing and phasing will be useful for this analysis.

ANALYSIS #2: Improving Site Coordination and Safety

Safety is one of the biggest concerns on any job. Since this project is located on an active hospital complex, several problems exist with ensuring the safety of the patients/employees while maintaining a productive site. Several measures must be in place to separate hospital and construction activities without sacrificing hospital operations. The fact that the two adjacent structures that the addition will be attached to will be occupied during construction presents a challenge to public safety. The goal of this analysis is to create a 4D site model to limit and reduce site congestion and improve safety for workers and pedestrians. The site model will show work flow, material laydown areas, delivery entrance and pedestrian entrances and how they will change throughout the project.

ANALYSIS #3: Critical Industry Issue: Elimination of Inefficiency through use of BIM and Prefabrication

Hospitals typically have a lot of coordination that is need between the MEP trades. BIM could improve the coordination and reduce the delay time with the MEP work that will be done on this project. I will look at the costs, schedule, potential results, and the ability of the project team to decide how the MEP coordination process could be conducted more efficiently with the use of BIM. The use of prefabrication should reduce the schedule by decreasing the MEP placement work time.

ANALYSIS #4: Improving Efficiency by using on common Façade System

The proposed façade is currently a combination of many different materials including brick, stone, a curtain wall, and metal panels: white and stainless steel. The details for all of these connections are very time consuming and difficult to comprehends. Simplifying the façade to just one system would allow for less details and more consistency allowing the construction to run more smoothly. The materials would need to be researched to see if there are alternatives that have easier connections. The materials also need to have similar properties to perform the same. Precast masonry is also a possibility to decrease construction time and site congestion. This analysis will be including a portion of the structural breadth by analyzing and designing additional supports and connections.

ANALYSIS #5: Develop an Infection Control Risk Assessment (ICRA) Plan

There are many considerations in the design and construction or renovation of the health care facility. The environment must cultivate a safe, caring, healing environment for patients and their loved ones, while also being efficient, functional and safe for staff. Improperly designed and maintained environments pose numerous risks for patients, including hazards from fires, chemical exposures, or contaminated air, water or environmental surfaces.

The goal of this analysis is to develop an ICRA plan for the hospital to keep a safe and clean condition for the patients. This analysis will include a mechanical breadth by check the mechanical capabilities to make sure the hospital could pressurize the building to prevent dust and health hazards.

ANALYSIS #1: REDUCTION OF SCHEDULE THROUGH RE-SEQUENCING CONST. PHASES

PROBLEM IDENTIFICATION: CONSTRUCTION PHASING

This is a three phase project: Phase 1 is new Ambulance Entrance Addition, which is currently under construction. Phase II is Temporary connector corridor along the west side of the site so the existing connector can be removed to allow for access to the new building. Phase III is the new inlet building itself. With three phases, a lot of coordination must be done to not fall behind schedule. A critical sequencing issue is not to interrupt flow of hospital operations at ED and movement between the existing hospital and the MOB (Medical Office Building / Hardner Building) to the North.

The new emergency ambulance entrance (Phase I) is being constructed now so until it is complete, ambulances and patients will continue to use the existing emergency department entrance off of 24th Street. During Phase II, when Phase I is all complete, all ED traffic (patients and ambulances) will use the new Ambulance Entrance for access to the Emergency Department (ED), down the connector corridor. During Phase III, after the temporary connector on the west side is complete at the end of Phase II, pedestrian ED traffic will use the entrance at the southwest corner of that new temporary connector. Ambulance traffic will continue using the new Ambulance Entrance.

The proposed sequence has multiple phases with demolition work overlapping new construction activities throughout the entire project schedule. Phased occupancies are planned for the Emergency entrance, connecting corridor and In-Fill Addition and the Existing Hospital to accommodate Saint Vincent's requirements. This scenario creates potential problems with trade coordination, contractor delays. There will be several contractors switching between renovation, demolishing and new construction work which will make coordination and schedule understanding extremely difficult. Ultimately, the overall project schedule starts with work on the new entrance for the emergency department and ends with the construction of the In-Fill Building, along with temporary construction and demolition in between.

RESEARCH GOAL

The goal of this analysis is to perform an in-depth re-structuring of the project schedule to reduce schedule length by working on phase 1 and 2 unrelated tasks simultaneously. Creating a 4D model to show sequencing and phasing will be useful for this analysis.

METHODOLOGY

- Interview Construction project team for sequencing and trade coordination issues
- Research material availability and resource leveling to determine production capabilities
- Contact subcontractors to discuss activity durations and man-power requirements
- Re-sequence schedule to reduce schedule length but doing unrelated work simultaneously
- Evaluate trade coordination and develop sequencing diagrams for work flow
- Construct 4D sequencing model for phase planning and visualization
- Analyze schedule, cost and constructability

- Analyze site congestion and trade coordination improvements
- Calculate savings in general conditions and Saint Vincent's revenue produced due to reduced schedule

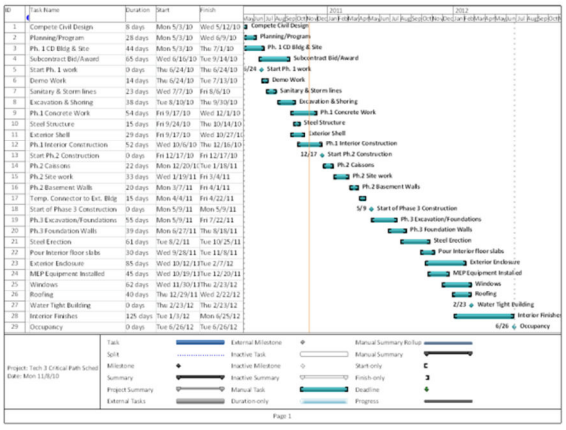
RESOURCES AND TOOLS TO BE USED

- Industry Professionals
- AE Faculty – Structural
- SVHC Project Team
- Applicable literature

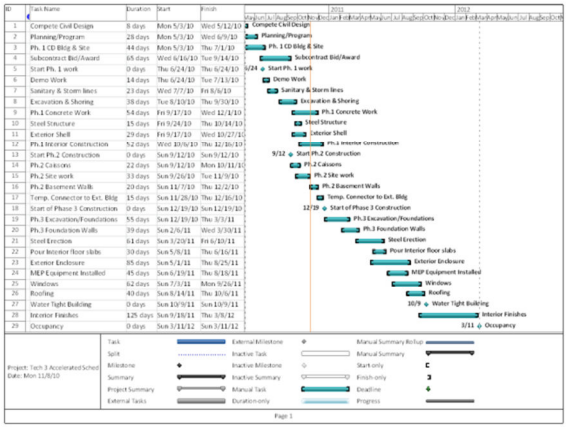
EXPECTED OUTCOME

After completing extensive research and an in-depth study, the schedule should be able to be reduced by a few weeks which will save general conditions cost along with revenue that could be made by Saint Vincent using the new patient and operation rooms.

Critical Path Project Schedule



Potential Accelerated Schedule



ANALYSIS #2: IMPROVING SITE COORDINATION AND SAFETY

PROBLEM IDENTIFICATION: PUBLIC SAFETY/ SITE CONGESTION

Site congestion is a major concern identified on this project. This issue has impacted several trades and caused delays in excavation, geo-pier installation and masonry work. The lack of material storage and lay-down space has caused contractors to work inefficiently and unsafely. More than once, a trade had to demobilize until the site cleared up to allow for productive work.

As shown in the figures below, the site is surrounded by two existing and running hospital buildings. Material layout, crane placement, and equipment paths makes the site very congested. With many workers and equipment moving around safety and coordinating is a construction challenge. The project team has limited the amount of congestion by having field trailers inside the Hardner Building; this saves more space on site for material storage as well as space for equipment mobility.

FIG. 1: PHASE 1

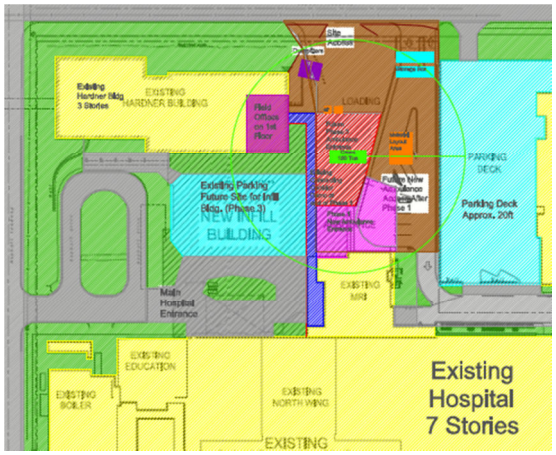


FIG. 2: PHASE 2

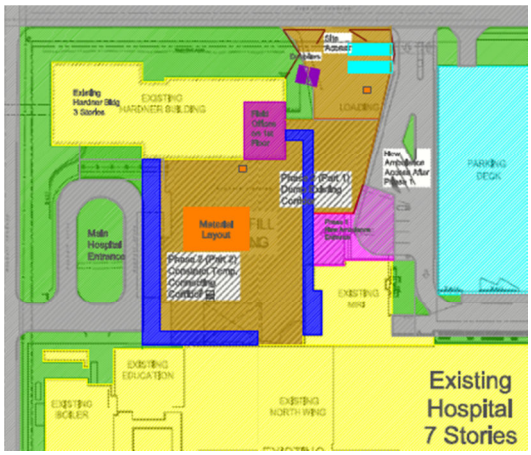
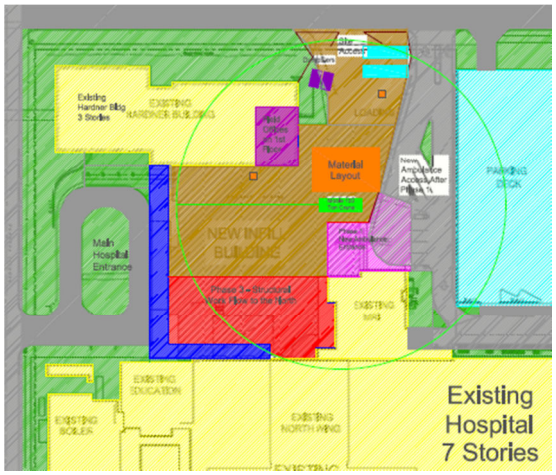


FIG. 3: PHASE 3



Safety is one of the biggest concerns on any job. Since this project is located on an active hospital complex, several problems exist with ensuring the safety of the patients/employees while maintaining a productive site. Several measures must be in place to separate hospital and construction activities without sacrificing hospital operations. The fact that the two adjacent structures that the addition will be attached to will be occupied during construction presents a challenge to public safety. Items such as crane swing, emergency egress, vehicular traffic and ED entrance must be considered for all phases of the project schedule. No one wants any of the workers or the public getting hurt or possibly losing their lives. Material delivery and unloading can be one of the most dangerous activities on a job site since it includes trucks and material which are outside the construction site perimeter, and cranes which are moving over the heads of many lives carrying tons of material. Fencing and safety awareness is the primary ways the project team is handling this safety challenge. They have weekly safety meetings to inform workers. They also have a safety director that often visits the site and supervises/informs workers on safe work practices, such as correct scaffolding layouts and proper tie-off systems.

RESEARCH GOAL

The goal of this analysis is to create a 4D site model to limit and reduce site congestion and improve safety for workers and pedestrians. The site model will show work flow, material laydown areas, delivery entrance and pedestrian entrances and how they will change throughout the project.

METHODOLOGY

- Interview Construction project team for sequencing and trade coordination issues
- Contact subcontractors to discuss activity durations and man-power requirements
- Evaluate trade coordination and develop sequencing diagrams for work flow
- Construct 4D sequencing model for phase planning and visualization
- Analyze site congestion and trade coordination improvements

RESOURCES AND TOOLS TO BE USED

- Industry Professionals
- AE Faculty – Construction
- SVHC Project Team
- Applicable literature

EXPECTED OUTCOME

After completing extensive research and an in-depth study, the 4D model should help coordinate a detailed site plan that would reduce site congestion and improve safety for workers and pedestrians. The site model will show work flow, material laydown areas, delivery entrance and pedestrian entrances and how they will change throughout the project.

ANALYSIS #3: ELIMINATION OF INEFFICIENCY THROUGH USE OF BIM & PREFABRICATION

PROBLEM IDENTIFICATION: BIM MEP COORDINATION & PREFABRICATION

Hospitals typically have a lot of coordination that is need between the MEP trades. BIM could improve the coordination and reduce the delay time with the MEP work that will be done on this project. The use of the 3D model is an analysis that would be good to pursue further. Since the only model was used solely for design purposes it would be interesting to learn what results can be obtained by using a model for clash detection and also using it to create a 4D sequencing model. This has the potential to yield results that would help the project team with future installations.

This analysis would require research into best practices for creating a set of models that can be easily utilized for coordination and scheduling purposes. I also want to look into the possibilities of using the model for prefabrication purposes. I heard of projects using prefabbed MEP ceiling plans in hallways, and prefabbed restrooms. This may also work in prefabbing some of the patient and operating rooms. A possible source of information will be the recently developed BIM Execution plan that was created by the CIC research group here at Penn State. My research could be focused on developing a project specific BIM Execution plan for use on the Saint Vincent Health Center new addition.

The interior wall system can take a very long time to construct and could delay the project. One way to prevent that would be to prefabricate the walls to shorten the duration of the task to speed up the schedule. The walls are typically metal studs with drywall and some conduit for the electrical and controls systems. Because the walls are similar throughout the entire building it would be easy to prefabricate due to the repetitiveness and simplicity of the walls.

RESEARCH GOAL

There will be two parts to my research. First, how could the process used been improved to return better results. Second, are there any new types of MEP coordination processes that might have worked for this project. Using Building Information Modeling (BIM) for MEP coordination and clash detection could be a possible tool to improve the results of coordination. I will look at the costs, schedule, potential results, and the ability of the project team to decide how the MEP coordination process could have been conducted more efficiently. The use of prefabrication should reduce the schedule by decreasing the MEP placement work time.

METHODOLOGY

- Research into best practices for creating a set of models that can be easily utilized for coordination and scheduling purposes
- Look into the possibilities of using the model for prefabrication purposes
- The process of the prefabrication would need to be studied and analyzed
- Research transportation cost for shipping prefabricated units
- Research constructability concerns such as prefab panel's weight, how will they move them and get them around the building

- Compare original cost, schedule and constructability compared to new proposed reduced schedule, new cost and constructability

RESOURCES AND TOOLS TO BE USED

- Industry Professionals
- Case Studies
- AE Faculty – BIM
- SVHC Project Team
- Applicable literature

EXPECTED OUTCOME

After completing extensive research and an in-depth design, using Building Information Modeling (BIM) for MEP coordination and clash detection could be a possible tool to improve the results of coordination. Prefabrication should reduce the construction schedule which would cause a quicker turnover date to Saint Vincent, which will allow them to get their patient and operating rooms up and running before the original scheduled date.

ANALYSIS #4: IMPROVING EFFICIENCY BY USING ONE COMMON FAÇADE

PROBLEM IDENTIFICATION

The proposed façade is currently a combination of many different materials including brick, stone, a curtain wall, and metal panels: white and stainless steel. The details for all of these connections are very time consuming and difficult to comprehends. Simplifying the façade to just one system would allow for less details and more consistency allowing the construction to run more smoothly. The materials would need to be researched to see if there are alternatives that have easier connections. The materials also need to have similar properties to perform the same. Precast masonry is also a possibility to decrease construction time and site congestion. I would need to contact manufacturers to understand the properties and connections of the different materials. After that is understood, I would analyze the pros and cons along with the cost of each and make a decision as to whether it would be a viable option. It would also be possible to use BIM technology to assist in a number of ways including the visual aspects using a virtual mockup, the cost of the changes using quantity takeoff and the schedule implications using 4D modeling.

RESEARCH GOAL

The goal of this analysis is to choose the most efficient façade system for the Saint Vincent Health Center. A structural check will be constructed to make sure the new façade system will not change the structural integrity. If not, changing of the structural elements may happen, either increasing or reducing the member size.

METHODOLOGY

- Research current precast masonry panel systems and select applicable manufacturer
- Contact manufacturer for design consultation
- contact manufacturers to understand the properties and connections of the different materials
- Analyze how the precast system impacts existing structure and design necessary connections
- Assess impact on window and curtain wall interfaces
- Analyze the pros and cons of each façade
- Analyze schedule, cost and constructability
- Analyze site congestion and trade coordination improvements
- Structural check

RESOURCES AND TOOLS TO BE USED

- Industry Professionals
- Precast Panel Manufacturer
- AE Faculty – Structural
- Saint Vincent – Project Architect/Structural Engineer
- EE Austin – Site coordination

- Applicable literature
- RAM Structural System Software

EXPECTED OUTCOME

After completing extensive research and an in-depth design, it is believed that a new effective façade system will reduce the masonry schedule and improve the trade coordination to eliminate inefficiencies due to site congestion. If precast or prefabricated façade used instead of the hand-laid masonry, the savings in schedule should cover the added costs.

ANALYSIS #5: DEVELOP AN INFECTION CONTROL RISK ASSESMENT (ICRA) PLAN

PROBLEM IDENTIFICATION

There are many considerations in the design and construction or renovation of the health care facility. The environment must cultivate a safe, caring, healing environment for patients and their loved ones, while also being efficient, functional and safe for staff. Improperly designed and maintained environments pose numerous risks for patients, including hazards from fires, chemical exposures, or contaminated air, water or environmental surfaces.

An essential first step in a comprehensive Construction and Renovation Plan is an "infection control risk assessment" (ICRA). This assessment provides the foundation for long range planning, as well as for each phase of the project from concept to completion

RESEARCH GOAL

The goal of this analysis is to develop an ICRA plan for the hospital to keep a safe and clean conditions for the patients.

METHODOLOGY

- Research current ICRA typical plans
- Contact Infection control professionals
- Identify areas with highest risk
- Create diagram showing the areas with the most risk
- Developing plan to reduce and eliminate risks
- Check air handling system to see if it is large enough to pressurize building
- Analyze schedule, cost and constructability
- Analyze ICRA matrix

RESOURCES AND TOOLS TO BE USED

- Industry Professionals
- AE Faculty –Mechanical
- Saint Vincent – Project Architect/Structural Engineer
- Applicable literature

EXPECTED OUTCOME

After completing extensive research and an in-depth study of the ICRA plans and risk matrix, I will construct a ICRA plan for Saint Vincent to reduce and eliminate health risks. This analysis will include a mechanical breadth by check the mechanical capabilities to make sure the hospital could pressurize the building to prevent dust and health hazards.

ANALYSIS WEIGHT MATRIX

The weight matrix, shown below in Table 1, depicts how each analysis for the four main core areas on investigation. The percentages represent expected time and effort that will be allocated for the core areas in each respective analysis.

ANALYSIS DESCRIPTION	RESEARCH	VALUE ENGINEERING	CONSTRUCTABILTY REVIEW	SCHEDULE REDUCTION	TOTAL
SCHEDULE RE-SEQUENCE		5%	10%	20%	**35%**
SITE COORDINATION			5%	5%	**10%**
BIM & PREFABRICATION	5%	5%	5%	5%	**20%**
COMMON FAÇADE	10%	5%	5%		**20%**
ICRA PLAN	10%		5%		**15%**
TOTAL	**25%**	**15%**	**30%**	**30%**	**100%**

TABLE 1: Weight Matrix for Distribution of Core Areas of Investigation

TIMETABLE

In order to stay on task and meet project goals, a preliminary semester timetable has been developed to schedule work progression for each technical analysis. See **APPENDIX A** for the spring semester preliminary timetable.

CONCLUSION

Through in-depth research and thorough investigation, the proposed technical analyses will provide a comprehensive review of improving efficiency in the construction industry. The prefabricated brick panel system will reduce site congestion and increase productivity for all trades involved. The new schedule from re-sequencing should be able to be reduced by a few weeks which will save general conditions cost along with revenue that could be made by Saint Vincent using the new patient and operation rooms. A 4D Site model should help coordinate a detailed site plan that would reduce site congestion and improve safety for workers and pedestrians. It will show work flow, material laydown areas, delivery entrance and pedestrian entrances and how they will change throughout the project. BIM for MEP coordination and clash detection could be a possible tool to improve the results of coordination. Prefabrication should reduce the construction schedule which would cause a quicker turnover date to Saint Vincent. A new effective façade system will reduce the masonry schedule and improve the trade coordination to eliminate inefficiencies due to site congestion. If precast or prefabricated façade used instead of the hand-laid masonry, the savings in schedule should cover the added costs. The ICRA plans and risk matrix constructed for Saint Vincent to reduce and eliminate health risks.

This proposal is intended to be a working submission with revisions expected based on feedback from the thesis consultants.

BREADTH TOPICS

The following topics involve a more detailed analysis in distinct technical disciplines within the major. Each topic contributes to one of the previously mentioned analyses, which are identified accordingly.

STRUCTURAL BREADTH: Contributes to Technical Analysis #4

The proposed façade is currently a combination of many different materials including brick, stone, a curtain wall, and metal panels: white and stainless steel. The details for all of these connections are very time consuming and difficult to comprehends. Simplifying the façade to just one system would allow for less details and more consistency allowing the construction to run more smoothly. The materials would need to be researched to see if there are alternatives that have easier connections. The materials also need to have similar properties to perform the same. Precast masonry is also a possibility to decrease construction time and site congestion.

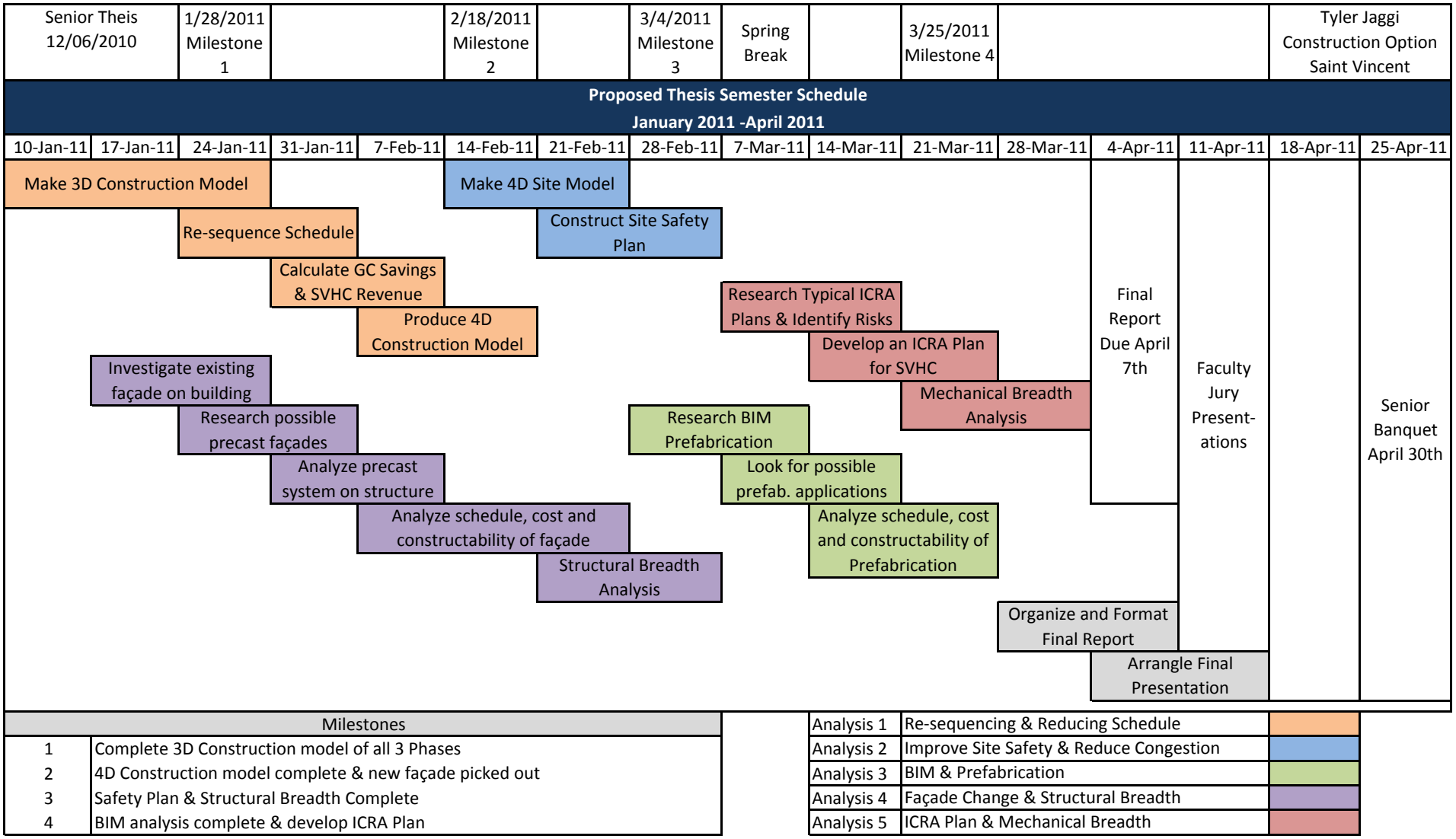
This analysis will be including a portion of the structural breadth by analyzing and designing additional supports and connections. The current façade is hand-laid masonry, but since the structural is Steel beams and columns and there are problems with site congestion already, precast masonry might be a viable option. A structural analysis will be constructed to size the beam sizes to hold the precast panels.

MECHANICAL BREADTH: Contributes to Technical Analysis #5

There are many considerations in the design and construction or renovation of the health care facility. The environment must cultivate a safe, caring, healing environment for patients and their loved ones, while also being efficient, functional and safe for staff. Improperly designed and maintained environments pose numerous risks for patients, including hazards from fires, chemical exposures, or contaminated air, water or environmental surfaces. The goal of this analysis is to develop an ICRA plan for the hospital to keep a safe and clean condition for the patients.

In the ICRA plan, it calls for the hospital to be positively pressured. My mechanical breadth analysis will be checking the mechanical capabilities of the air handing system to make sure the hospital's system could be positively pressurize to prevent dust infiltration and health hazards.

APPENDIX B: SPRING SEMESTER PRELIMINARY TIMETABLE



Milestones	
1	Complete 3D Construction model of all 3 Phases
2	4D Construction model complete & new façade picked out
3	Safety Plan & Structural Breadth Complete
4	BIM analysis complete & develop ICRA Plan

Analysis 1	Re-sequencing & Reducing Schedule
Analysis 2	Improve Site Safety & Reduce Congestion
Analysis 3	BIM & Prefabrication
Analysis 4	Façade Change & Structural Breadth
Analysis 5	ICRA Plan & Mechanical Breadth