



# THESIS PROPOSAL

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*Thesis Proposal*

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## Executive Summary

The Mansoura Development is a residential building located in the Mansoura area of Doha, Qatar. Since the owner's priority is the completion of the project on time, or ahead of schedule, this gives an opportunity to explore alternative construction methods and scheduling techniques for schedule acceleration. This proposal outlines the construction analyses and breadths that will be pursued throughout my thesis.

The first analysis suggests the use precast concrete, instead of the intended cast-in place concrete. Since cast-in place concrete can take time for the concrete to set and place, precast could be a faster and cheaper alternative. This will show if this alternative method of construction has any potential to accelerate the schedule. A structural and mechanical breadth will encompass this analysis due to the change in structural and mechanical loads, therefore further research must be made to see if there any impacts in structural and mechanical performances of the building.

The second analysis will explore the use of Short Interval Production Schedule (SIPS) to both of the concrete placing methods; the suggested precast and the originally intended cast in place. Due to the repetitive nature of the structure, this created a great opportunity to implement SIPS. This analysis will help investigate the impact of crews and the tasks to increase the efficiency, productivity and quality of work.

The third analysis focuses on the comparison of construction practices between the US and Qatar. This will help gain some knowledge as to where the project is losing time and money in comparison if it were built in the US. Research on Labor and Material will be critical to understand the main differences that impact construction in both countries. This could help provide other construction techniques into the Mansoura Development that could save money and time from the overall schedule.

The fourth and final analysis will explore schedule and labor re-adjustment in order to by-pass the halt of construction during the hot summer months. This will be regarded as the main topic of research as it is seen as the major potential negative impact to the project by creating a delay in the overall schedule. This research will help find a solution to overcome this problem.

These analyses are meant to provide possible solutions to the current problems and opportunities that the project faces. The intent is to offer potential schedule acceleration/reduction scenarios.

## Project Background

2B + G + M + 7 is a 9 story residential building that is around 106, 000 square feet. The building is located in the Mansoura region in Doha, Qatar. It is comprised of mainly residential apartments with retail stores on the ground floor. The Mansoura area is an up and coming renovated region, targeting high end retail stores in order to bring in more attraction and business to the area. The \$7M Lump Sum contract was granted to Commitment Construction, who is the sole contractor on the project, with no sub-contractors. The start of construction began on April 15, 2013, with an estimated time for completion of 24 months.

The development of the project is located between Al Mansoura Street and Al Salhiya Street in Doha, Qatar. There was a prior office building on the site, however demolition was not included in the contractual agreement. The area around the site is very congested due to it being a residential and office region.

The project delivery method is Design-Bid-Build and the schedule of construction is broken down into a floor-by-floor sequence rather than by trades. The structure is comprised of cast in place concrete, which is the structural support of the building. A curtain wall system is used partly on all facades of the building, and is comprised of powder coated finish aluminum frame and double pane glazing.

The 24-month construction schedule seemed a little long for this building type, since floors 1-7 are all typical. Therefore there was an opportunity for schedule acceleration scenarios to be analyzed and implemented on the project. This could provide the prospect of saving money and help generate profit to the owner if the project can be completed at an earlier date by allowing for tenants to move in earlier.

## Analysis Descriptions

### Analysis 1 – Construction of Precast Vs. Cast in Place Concrete

#### **Opportunity Identification**

It is seen that the schedule and construction techniques are the main issues holding back the completion date for the Mansoura Project. The owner is very particular in having the completion date for the project to be accomplished as soon as possible in order for her tenants to move in and she can start generating some profit. Since cast-in place concrete can take time for the concrete to set and place, another option could be researched, which can be seen as a faster installation alternative. This in turn could help with schedule saving and allow for a faster completion of the overall project.

#### **Background Research Performed**

After some preliminary research, a faster and cheaper alternative to cast in place could be using precast concrete. This alternative method can be analyzed to further understand how it would affect the structure of the building with the addition of schedule and cost reduction. The areas that are of concern with precast concrete are how it will be transported and installed on site. However since precast is manufactured in a controlled casting environment, quality can be controlled and monitored easily. Weather does not come into a factor since it is done in a closed environment. Less labor will be required to install and it does not require skilled labor, which in turn can decrease the overall project cost. The greatest advantage to precast is that it can be installed immediately with no need for waiting for it to gain strength and modularity unlike cast in place. Furthermore it's easy to make copies of the same precast by maximizing the repetition of using the same mold. This will allow for a faster construction process and substantial completion date. In addition modularization was a key topic during the 22<sup>nd</sup> Annual PACE Roundtable, which noted that several projects found significant reduction in the construction schedule with the use of this method.

#### **Potential Solutions**

When analyzing the schedule, a lot of time is wasted waiting for the concrete to set and cure in place; therefore, a potential solution can include using precast concrete. This will help create a much easier system to construct and procure while reducing the overall cost and schedule duration of the project. Since the precast modules would be ready made before coming to the site, installation would be the only step for this process. In addition to using precast, the matt foundation used for this project can be re-evaluated due to the decrease in weight of the

structure from using the precast panels instead of cast in place. This can generate costs and schedule reductions.

### Solution Method

- The study will initially be performed on a typical bay that can be expanded to the entire area of the building.
- Analyze the cost of switching from cast in place to precast concrete. This will include:
  - Immediate actual cost of both systems
  - Long term cost of both systems
  - Construction cost of each system
    - Equipment used
    - Material used
    - Machinery needed
    - Storage area cost
    - Labor cost
    - Laydown area
    - Transportation cost of both systems
- Analyze Structural Load.
- Analyze Mechanical Load.
- Compare duration impacts of both systems on the project schedule. The factors included:
  - Labor differences
  - Placing time (installation)
  - Efficiency of workers
- Analyze other factors such as safety concerns, logistics and sequencing of both systems.

### Resources

- ~ Relative Project Documents
- ~ Commitment Construction Project Team Members
- ~ Industry Professionals and AE Faculty Members

### Expected Outcome

The initial schedule of casting concrete seemed extensive, therefore it allowed for a different construction method to be analyzed. Through the use of precast concrete modules, the schedule is expected to be reduced significantly through the increase in productivity. Additionally it can reduce site traffic however increase cost of transportation and erection.

\*See Appendix A – Mechanical & Structural Breadth

## **Analysis 2 – SIPS Implementation for Precast Vs. SIPS Implementation for Cast in Place Concrete**

### **Opportunity Identification**

Since the entire building is constructed of the same material, whether it is the original method of cast in place concrete, or the proposed method of precast concrete modules, this creates an opportunity to improve schedule areas. Subsequently the structure is considered a critical task in the project schedule. Therefore proper coordination and management for the process must be taken into account to complete the project on or ahead of time.

### **Background Research**

The repetitive construction of the Mansoura Development creates the opportunity to explore the effects of utilizing a Short Interval Production Schedule (SIPS). The analysis will focus on the most critical activity of the schedule, which is the construction of the core (exterior) of the building. With looking at these production principles, the schedule can be evaluated to find areas of improvement. Lessons learned from previous projects can be improved in order to find the best method for the schedule sequence.

### **Potential Solutions**

Since cast in place concrete can take time, it can be seen as one of the longer activities on the schedule. Reducing this activity may impact the project significantly. Specific scheduling methods can be implemented to achieve a shorter duration. By using SIPS, the tasks and crews can be broken down and can be more detailed. Coordination of the crews can be used to help optimize and increase efficiency of work. By having better coordination, it will help eliminate any deficiencies with wasting crew members in any specific area. The process of construction will be much smoother and with higher quality, as each crew will be designated a specific area, while repeating the tasks multiple times.

### **Solution Method**

- Gather all information regarding structure of building outlines in the schedule.
- Develop a sequence of work and balance crews with consideration to the project schedule individually for both concrete-placing methods.
  - Identify respective durations, tasks and designate crews.
- Evaluate feasibility of using SIPS.
- Analyze both concrete placement methods to quantify the best possible outcome.
- Establish any cost concerns

- Evaluate quality of work
- Evaluate potential risks
- Critique potential outcome

### Resources

- ~ Relative Project Documents
- ~ Scheduling Software
- ~ AE 473 Course – SIPS Project
- ~ Commitment Construction Project Team Members
- ~ Industry Professionals and AE Faculty Members

### Expected Outcome

The original schedule duration allows for implementing a different production method to the project schedule. Due to the length of construction and repetitive nature of the building, SIPS allows for many opportunities for improvement. Since the owner's main priority is schedule acceleration, coordinating the tasks and crews by implementing new production sequencing can substantially reduce the project schedule.



## Analysis 3 – Comparison of Construction Practices between US & Qatar

### **Opportunity Identification**

Since construction practices are different in each country, material, labor and construction techniques must be evaluated to understand the differences between costs and procedure between both Qatar and the USA. These differences can help identify what can be improved with the current construction process for the Mansoura Development. This can create an opportunity to improve the schedule, the cost of the project and general quality of the final product.

### **Background Research**

There is an exponential difference between the construction industries in Qatar in comparison to the USA. Labor wages and labor hours are different, which could affect the duration of when projects are completed. Labor hours and practices could yield to different results, and either help or hinder the project completion date. Along with the difference in workforce, material availability can also affect when a product can be completed and either increase or decrease the project by a substantial amount. The usual method of construction in Qatar is cast in place concrete, which is a very lengthy process; therefore reasons for this use must be researched and understood.

### **Potential Solutions**

Since cast in place concrete is the usual method of construction in Qatar, further research must be completed in order to understand the reasons for using this method over others. Labor rates and hours will be researched and compared to the USA, in order to understand how it affects construction practices, and how it lengthens or shortens the time in contrast to one another. Material availability will also be researched in this analysis, to further understand how it affects the duration of construction. Information such as where material is shipped from, and how it is used will be taken into account.

### **Solution Method**

- Research information regarding Qatar & USA labor wages.
- Research information regarding common construction practices in Qatar.
  - Why is cast in place method most popular?
- Material availability in Qatar
  - What material is readily available?
  - Where is material shipped from?
- Compare information retrieved about Qatar with the USA statistics.

- What construction methods can be used in Qatar to improve their construction practice?
- Establish cost differences.
- Conclusion and Recommendation based on Findings.

### Resources

- ~ Commitment Construction Project Team Members
- ~ Industry Professionals and AE Faculty Members
- ~ Individual research performed online

### Expected Outcome

There is potential to cut down on the schedule of duration for the project, if some construction practices were performed similar to the USA. Cost of construction will be exponentially cheaper in Qatar than in the USA, largely due to the difference in labor wages and material availability.

## **Analysis 4 – Field Labor Management & Alteration**

### **Problem identification**

Due to the intense heat of the summer months in Qatar, weather can reach over 122 °F. This can cause a delay in the project schedule, due to a halt of construction during the day, which is primarily done for safety issues regarding the laborers. As mentioned in technical report 3, this pause in construction comes with direct enforcement from the Ministry of Labor and has to be abided by. This can create some delays in the schedule, which in turn could affect the project completion date.

### **Background Research**

With the project under construction, there is a need to understand the situation that will be encountered during the warm months in Qatar. As a result, this analysis will focus on the critical activities of the schedule and possible scenarios to by-pass this construction delay and have it not affect the project schedule in a negative way. The project schedule can be analyzed and evaluated to find any critical areas that can be improved. This will help improve the lessons learned from past situations in previous projects, or previous delays, and institute the best possible sequencing for the schedule.

### **Potential Solutions**

When analyzing this possible project delay, some potential solutions come to play and can include re-evaluating/re-considering certain schedule of events. Certain critical milestones in the schedule, like exterior finishes, or construction of exterior structure can be rescheduled to prior months before summer, so to not delay critical events in the schedule and still have the project completion date on time. Increasing labor force during the non-summer months can also be evaluated to see if it could affect countering the delay of construction during summer. Therefore, halting construction during the summer would not have any negative effects in the overall project hand in date. Another option that can also be evaluated is working the laborers after hours in the summer months. Construction times for a regular day can be re-evaluated and pushed back during the late afternoons and night time in order to complete the project in time. This might affect labor cost, but will by-pass the construction stop during the day. Lastly a Manpower Loaded schedule can be established to systematically assign the appropriate personnel to specific tasks in an efficient and effective manner. This can help improve efficiency and decrease any delays with errors and weather delays.

## Solution Method

- Gather all information regarding the outlined schedule and relevant durations.
- Re-evaluate/re-schedule critical events in schedule
  - Determine different possibilities of changing certain events and how it could affect schedule delays.
- Utilize background research to increase workforce prior to summer months.
  - Determine cost analysis of increasing labor.
  - Evaluate possibility of schedule of reduction.
- Analyze process of working after hours.
  - Determine cost analysis of increasing labor.
  - Evaluate possibility of schedule of reduction.
- Develop a Man Power Loaded Schedule
- Analyze each method to quantify the best potential outcomes.
- Establish cost concerns with the owner.
- Develop process for implementation.
- Critique potential outcome.

## Resources

- ~ Commitment Construction Project Team Members
- ~ Industry Professionals and AE Faculty Members
- ~ Scheduling Software

## Expected Outcome

The schedule delays that this can bring to the project can be detrimental to the contractor and owner; therefore different methods must be taken to overcome this projected schedule delay. Through the re-scheduling of events, increasing labor force and working after hours, the schedule should not be negatively affected by the halt of construction during the summer months. Additionally, a schedule reduction can be expected if summer months turn out to be more workable than what is suggested.

## Thesis Investigation Objectives

### Analysis Weight Matrix

As seen in Table 1 below, the weight matrix was created to visually display how much time was distributed to each analysis. The four core thesis investigation areas include: Critical Industry research, Value Engineering Analysis, Constructability Review and Schedule Reduction/Acceleration. As portrayed below, the most time will be distributed to the Field Labor Management and finding a solution to the projected delay of the summer months where construction can be halted due to the intense heat. This relates to the highest core thesis investigation area of Schedule Reduction/Acceleration. Due to the completion date being of most importance to the owner of the Mansoura Development, this area of Schedule Reduction/Acceleration will be the focus of this thesis proposal.

**Table 1 – Weight Matrix**

Description	Critical Industry Research	Value Engineering Analysis	Constructability Review	Schedule Reduction/Acceleration	Total
Precast Vs. Cast in Place		5%	10%	10%	25%
SIPS Implementation	5%	5%		15%	25%
Construction Practices Comparison	5%	5%	5%	5%	20%
Field Labor Management	10%	10%	5%	5%	30%
<b>Total</b>	20%	25%	20%	35%	<b>100%</b>

\*See Appendix B – Spring Semester Projected Timetable

## Conclusion

The owner and project team for the Mansoura Development have stressed the importance of a timely completion of the residential building. The goal of these analyses is to research areas for potential schedule acceleration and reduction in order for the owner to be able to lease out the apartments and commercial areas to the tenants as soon as possible to start receiving revenue. Schedule savings are expected through the detailed research of the four core thesis investigation areas. These analyses will be targeted to benefit the owner and contractor, which can then be used on future projects to eliminate and cut down on any delay.

## Appendix A – Breadth Topics

## Breadth Topics

### **Structural Breadth – Incorporated into Analysis 1**

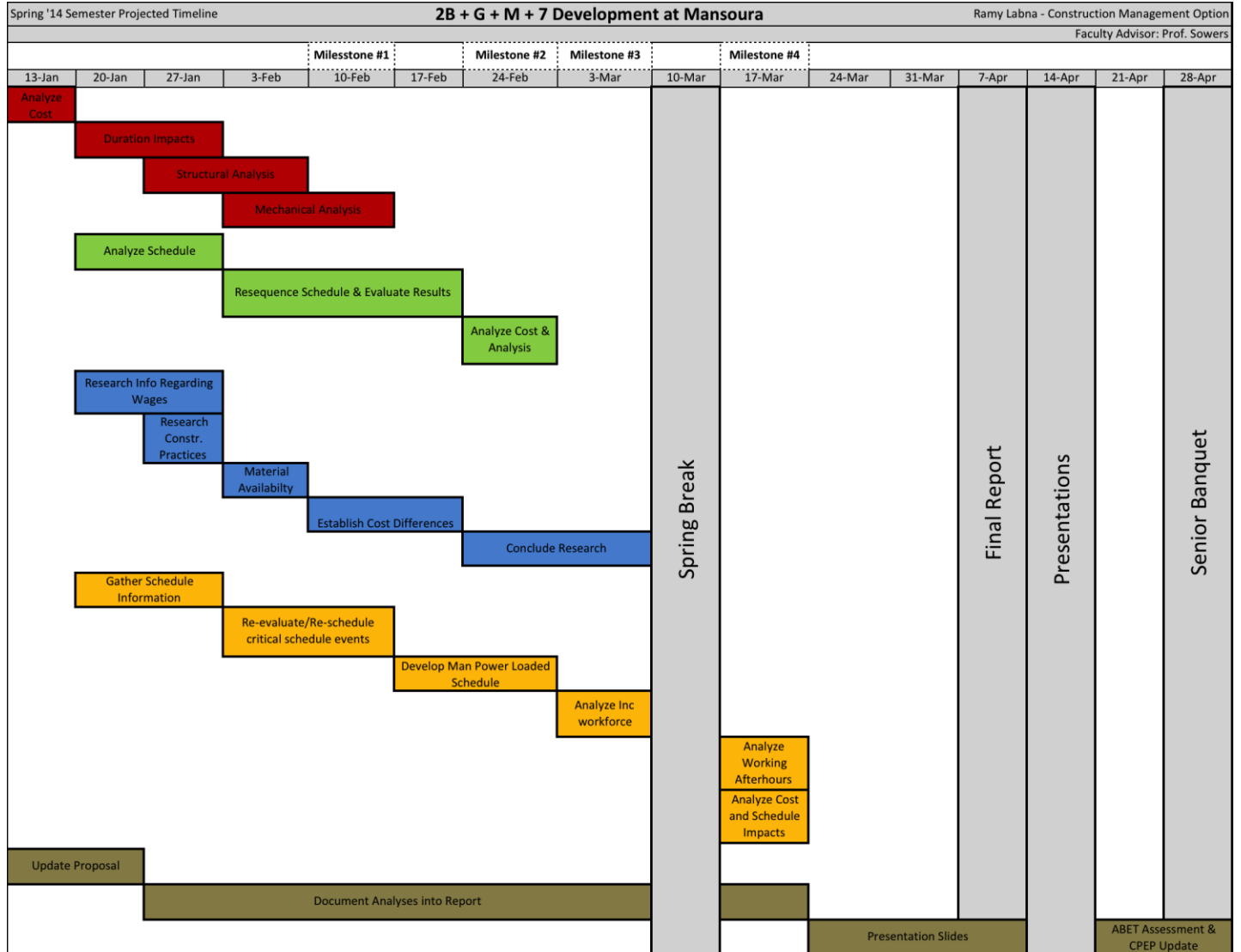
As mentioned in Analysis 1, experimenting with precast concrete rather than cast-in place concrete creates an opportunity to research and analyze outside of the construction management option. This breadth will analyze the structural load difference of having precast concrete over cast-in place concrete. As mentioned in the analyses, the current structure is made entirely of cast-in place concrete, therefore I will experiment with substituting the entire cast-in place structure with precast and note the structural load differences. Since the thickness of the concrete would decrease, this should impact the loading of the entire structure on the foundations. This in turn could change the specifications of the foundations, which could help experiment with a cheaper form or alternate foundation system that would help save money, and be quicker to produce. Proper bearing capacity and building loads will need to be considered with the new system. However there is a structural concern with tying the precast concrete to the structure, which should be analyzed and further reviewed.

### **Mechanical Breadth – Incorporated into Analysis 1**

As mentioned with the structural breadth, experimenting with precast over cast in place concrete also creates an opportunity to analyze the mechanical option. This breadth will target the mechanical installation and calculation of the difference in heating and cooling loads and note the disparity of energy efficiency between both concrete-placing methods. This will help in comparing both methods and determine if precast is an acceptable alternative. I will do a basic resizing of equipment if required and will include the costs in my analysis. In addition, if any significant changes in the building's mechanical performance are found, this analysis could help determine whether the mechanical system in use is appropriate for this change.



## **Appendix B – Spring Semester Projected Timetable**



Milestones Activity	
#1	Analysis #1 Complete
#2	Analysis #2 Complete
#3	Analysis #3 Complete
#4	Analysis #4 Complete

Analysis Description	
#1	Construction of Precast Vs. Cast in Place Concrete
#2	SIPS Implementation for Precast Vs. Cast in Place Concrete
#3	Comparison of Construction Practices between US & Qatar
#4	Field Labor Management & Alteration
	General Course Maintenance