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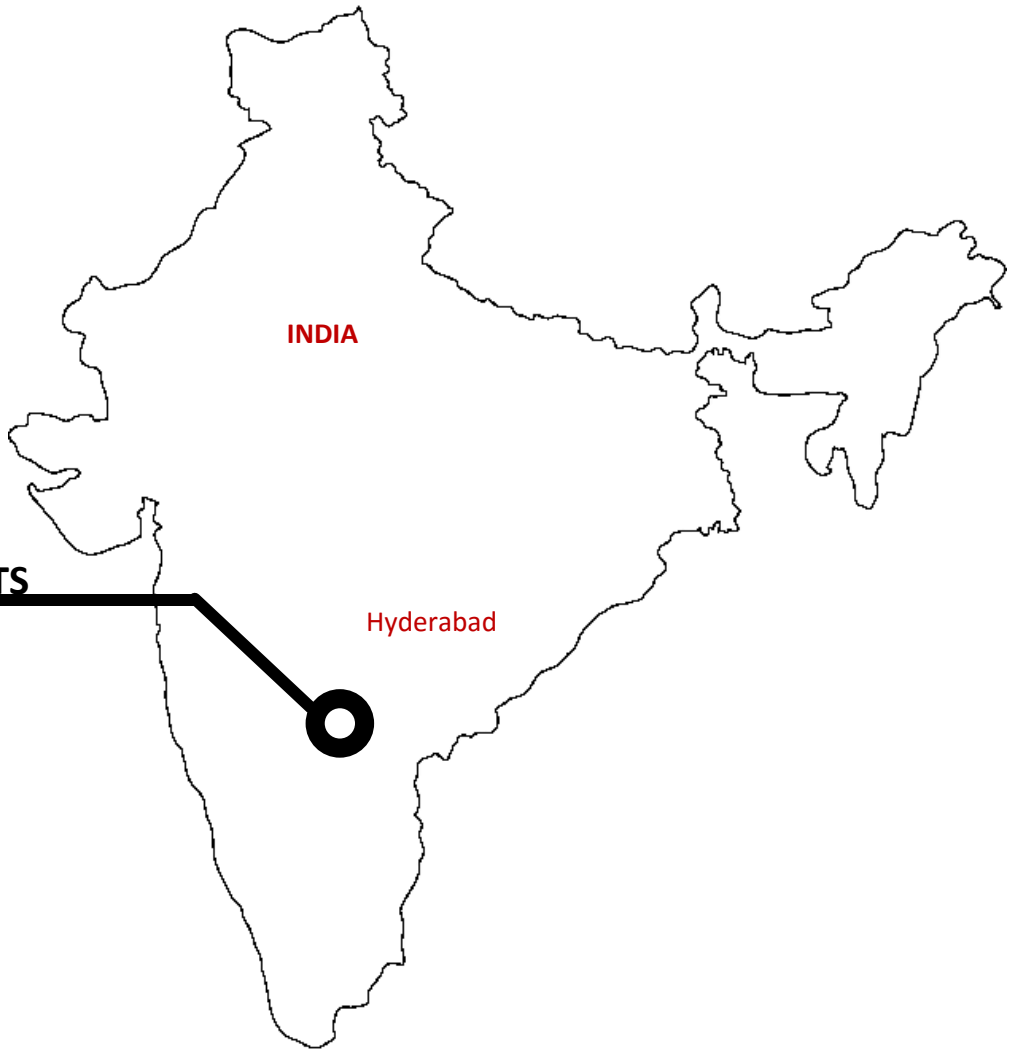
THESIS PROPOSAL



HANZA CREST APARTMENTS

Bhavana Reddy

Advisor: Dr. Robert Leicht

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EXECUTIVE SUMMARY

Ambience Construction firm was appetent about introducing their firm into residential construction market through Hanza Crest apartments project and extend the firm's reputation. The apartments are designed for the high-income demographic. The building contains eight stories of residential floors which consists of two basements, five floors with two apartments each floor and a club house. The project is budgeted for $1.05M and handed-over in 32 months. The following report consists of four analysis, focusing mainly on schedule driven and workforce challenges.

The first analysis focusses on prefabrication analysis of a typical bay for the Hanza Crest apartments. The prefabrication analysis is proposed due to the project possessing repetitive layout. This analysis has a scope of schedule acceleration/reduction scenario for this project. The cost performance and schedule for off-site fabrication of the units will be performed. There is a scope for structural breadth to analyze the hook system for the units and ensure the load of the unit is appropriate for the superstructure.

The second analysis will look at the safety concerns during construction in India. This analysis follows critical industry research. The scope of the analysis is the implementation of BIM for safety and transfer verbal communication to visual communication. A 3-D model will be developed to help the workers understand better about the safety measures to be followed on site and the potential risks involved during construction.

The third analysis focusses on schedule reduction/acceleration by implementing Short Interval Production Schedule (SIPS). SIPS would be utilized for superstructure or finishes phase of the project. This would be analyzed based on the most important phase and tasks involved in critical path. A detailed short interval schedule of the production of the phase for a single floor, basic analysis of matrix scheduling to other trades will be developed and comparison with the current schedule to analyze the effectiveness of SIPS on schedule reduction/acceleration for this project.

The fourth analysis will look at the façade change for this project. The existing façade is brick with concrete plastering and possess poor thermal properties. This analysis targets on an alternative façade that consists of better thermal properties and absorbs less heat which will lead to reduction in usage of air conditioning units to cool the apartment and saving energy. A mechanical breadth is developed to analyze the thermal properties, thermal conductivity, cooling load and change of the mechanical load based on the alternative facade and the overall system capacity.

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PREFABRICATION

Problem Identification

As mentioned earlier, The Hanza Crest Apartments has 8 floors, comprising of 5 residential floors. The building consists of 10 apartments with a mirror image layout. These identical apartments are made out of steel and cast-in-place concrete structure. This leads to consuming more cost and time. There were errors that took place due to the unskilled workforce leading to re-doing tasks. All the situations mentioned above lead to a compromise in quality of the outcome as there is not enough consistency in quality thus increasing the cost and time to re-do the task.

Based on the project's schedule, each floor takes 18-22 days during the superstructure phase in which 10 days is specifically meant for column erection & column concrete for each floor. This duration is very stagnant and the project's schedule might have further delays due to transportation of materials to the site and efficiency of workforce. To make an effective impact in schedule acceleration/reduction, the bathroom units are considered to be the ideal units for prefabrication due to repetitive layout of all the apartments.

Background Research

Prefabrication is a practice in the construction industry to reduce labor on site and save time for schedule acceleration/reduction. The units are assembled together in a manufacturing site and transported to the site. Prefabrication makes an effective impact on the consistency of the quality, safety which leads to lower injury rates, reduction in "lost" materials/tools helping in reduction of cost and cleaner site with less debris lying around.

Modularizing any part of the building that consists of repetitive layout throughout the building in an effective manner, can have all the potential benefits of prefabrication such as quality control, fast track construction and safety.

Potential Solution

The prefabrication analysis will identify a typical bay and determine to implement the proposed prefabrication. This would proceed to investigate if the proposed method is making a positive impact and creates an advantage to the project. This analysis would target the client's goal to maintain the consistency in quality and schedule acceleration/reduction of the project.

Analysis Steps

1. Identify a typical bay with repetitive layout and divine 3 options to design the module to analyze the scope of what can be prefabricated along with considering the site restrictions and constraints for transportation of the prefabricated unit.
2. Develop a production schedule for the bay for offsite fabrication and analyze the difference with the current schedule.
3. Analyze the manpower required to assemble the components on off-site location.
4. Analyze the procedure for the components of the unit to be assembled and create a site logistics for warehouse by developing process diagram how an assembly can put together by sequence analysis.
5. Develop the cost & schedule analysis for prefabrication to analyze the difference in the cost if pre-fabrication is implemented.

Resources

1. Dr.Rob leicht- – Penn State AE faculty member
2. Dr.Linda Hannigan- Penn State AE faculty member
3. Mr.Jillela Goverdhan Reddy- Managing director of the project
4. Mr.prashanth- Site engineer
5. Prefabricated case studies

Expected Outcome

As mentioned above, schedule reduction/acceleration and consistency in quality are the targeted outcomes. Since prefabrication allows to do work simultaneously, the bathroom units can be constructed simultaneously while on site construction is going on and can be transported to site for installation hence saving considerable amount of duration of time and enhanced quality is possessed.

BIM APPLICATTION FOR SAFETY

Problem Identification

One of the biggest issue in the construction industry is safety. It is a problem faced worldwide. The issue of safety has been a major problem in India. Workers do not do not follow the rules and ethics for safety purposes. One of major reasons is due to being untrained and not enough exposure of safe work zones. There has not been enough and very effective steps taken to train and educate the workers about the importance of safety and the consequences for not understanding the potential risks involved. This projects has a site superintendent but he can manage the safety of the site and workers to a bare minimum. This is due to the time involving to make the untrained and uneducated workforce understand safety importance. There are violations occurred by multiple workers at the same time and such circumstances is difficult to handle on site.

Some of the instances occurred in site are workers without shoes while nails, debris and sharp equipment lying on the site. The hard hats are not worn and high chance of free fall while erecting columns at 22 feet high due to not being tied back. This kind of practice of not following safety rules needs to be discouraged. Everyone on site is responsible for their own safety and make a safe-working site. A better approach should be considered for enhancing the safety and to educate the workers.

Background Research

Based on the PACE conference, there were different approaches to enhance safety and most of them were applicable to Indian workers. Since most of the Indian workers are untrained and uneducated, it would be effective to communicate virtually rather verbally. The workers are unaware of safety. The effective resource for this type of communication would be implementation of BIM during construction to improvise safety and safer working environment.

Virtual communication through videos would not require to understand any verbal communication and visual demonstration would be more effective than the superintendent instructing the workers about safety. Such visual communication is possible through Building information modeling (BIM) which a procedure of creating digital representations of project before, during and after construction.

Potential Solution

Implementation of BIM would be an ideal software for safety training through visual communication. It will enhance the safety on site and train the workers by showing the safety measures to be taken and potential risks involved on site. BIM has the potential to give knowledge about safety in replacement of verbal communication and this is very critical for the workers in India since a lot of workers are uneducated and find it difficult to understand verbally.

Analysis Steps

1. Interview the owner, superintendent, PM about safety concerns for structures and other project work force to investigate about common problems with safety knowledge and communication with workers. Analyze the steps taken for safety currently
2. Look for literature case studies or examples of similar purposes of the 3D model to create a similar approach for this project.
3. Simultaneously , develop a 3D model to give a description of the safety concerns and risks involved on site for the most a s
4. Create a document about the tasks being performed, the way they should be tied off , required clearance or other required safety measure by obtaining information from OSHA and other related safety resources about the right procedure.
5. Visit the site and experts and get their feedback after the usage of this document. Possibly through a survey.
6. Interview the workers to get the feedback on the visual safety training after using the 3D model.

Resources

1. Dr.Somayeh Asadi- Penn State AE faculty member
2. John Messener- Penn State AE faculty member
3. 3. Mr.Jillela Goverdhan Reddy- Managing director of the project

4 Mr.prashanth- Site engineer

5. Safety concerns case studies
6. BIM applied for projects in India for safety
7. Interview the owner and PM about the safety concerns and steps taken so far

Expected Outcome

The target of this research topic is to enhance the safety for this project through visual communication. The goal is to analyze the current precautions taken for safety, analyze its success rate with interview and take a visual communication approach to improvise safety and make a safer working environment for the project team. This is a critical industry research topic and leads to an effective scope to improvise the safety during construction in India.

Interview Questions

1. What are the most common accidents?
2. What is percentage of workers following the rules?
3. What are the steps taken for safety currently?
4. How effective has verbal communication to demonstrate has been?
5. Have you ever tried to demonstrate safety videos to the workers?
6. How is it to handle/ have an eye on each and every worker?
7. Any rules implemented for not following the rules?

IMPLEMENTATION OF SIPS

Problem Identification

The Hanza Crest apartments had faced a schedule problem. Being located in a residential zone there are a lot of restrictions for demolition, this caused a delay in demolition & excavation phase by almost 150 days. The total duration for this activity took 360 days. Even with the maximal effort to keep the schedule on track after the demolition & excavation delay, there are obstacles faced due to unskilled work force, site congestion & transportation of materials as per schedule.

The superstructure and finishes phase are consuming 157 days for each phase. This would lead to a further delay. This delay can be reduced with an alternative approach for the project's schedule and increase the productivity.

Background Research

Short Interval Production Schedule (SIPS) is the proposed alternative approach for the current schedule. SIPS is specifically used for projects that consists of repetitive layout like hotels, apartments, schools and offices. This schedule is developed to portray day-to-day production for repetitive layout. It consists of higher level of details for the schedule. SIPS schedule requires personal commitment and involvement, so the workforce has to be dedicated and ensure the schedule is executed as planned for the reduction/acceleration of schedule.

Based on the information from AE 473 class and some basic research, SIPS has been effective for the projects that used it. In many projects delay is occurred and goes over budget due to poor scheduling, workforce and ineffective coordination. In this kind of situation, SIPS would be effective provided the project has repetitive layout and implemented on the tasks involved in the critical path. The Hanza crest apartments consisting of repetitive floor plans for all the 10 apartments, there is a high scope for implementing SIPS for schedule reduction/acceleration.

Potential Outcome

This analysis would focus on schedule reduction/acceleration for this project by the implementation SIPS**.** It will be implemented for superstructure or finishes phase after further analysis. SIPS would develop a detailed day-to-day production that would give a clear idea about the task and time period to finish the task to the workforce. This would lead to better co-ordination and completion of task on time. SIPS would also help to prepare for the task ahead by the specific workforce leading to save time.

Analysis Steps

1. Pick a trade/phase that is the most important phase of the construction, the tasks that are on the critical path and highly repetitive.
2. Break the phase into specific tasks by each floors or subsections.
3. Develop a detailed, short interval schedule of the production of the phase for a single floor, basic analysis of matrix scheduling to other trades to show the schedule they will follow up and update overall project schedule.
4. Analyze the amount of workforce and production rate required based on the impacts or changes in workforce for the other trades.
5. Develop a basic logistics to show the flow of other trades.
6. Analyze the difference between current schedule and after implementation of SIPS.

Resources

1. Dr.Somayeh Asadi– Penn State AE faculty member
2. Mr.Jillela Goverdhan Reddy- Managing director of the project
3. Mr.prashanth- Site engineer
4. Dr.Rob leicht – Penn State AE faculty member
5. Case studies related to projects that have implemented SIPS

Expected Outcome

This analysis would target on schedule reduction/acceleration as mentioned above. The analysis would also be effective in comparing the current schedule and SIPS leading analyze the difference in both the schedules and gain knowledge by understanding the advantages and disadvantages for implementing SIPS to analyze if this would be appropriate to implement in this project's schedule.

FAÇADE CHANGE

Problem Identification

The Hanza Crest apartments have brick with concrete plastering façade. Putty as filler for minor cracks and Waterproof paint is added to the concrete plastering. This type of façade is common in residential buildings constructed in India.

The issue with this type of façade is there is no reduction is absorption of heat through the wall. This façade requires a lot of workforce and consumes more time to get erected leading to slow workflow. Hyderabad is typically has warm weather, so the thermal properties are not very effective to keep the building cool without much usage of air conditioner units.

Background Research

Bricks absorb water very easily causing fluorescence when it is not exposed to air. It also had very less tensile strength though there are highly fire resistant and low maintenance. The concrete plastering has an issue with the alkali-silica reaction (ASR) known as “concrete cancer” creating cracks and poor aesthetics. Both bricks and concrete are poor at blocking moisture and due to the moisture movement between bricks and concrete plastering, there is a chance for a weak bond to form between them.

The thermal conductivity of material is the rate at which heat passes through that specified material. The thermal conductivity of brick is between 0.6-1.0 W/ (m k) and concrete 1.0-1.8 W/ (m k) at 25C. The R-value is the capacity of a material to lose heat at a certain amount of time. The R value of brick is 0.2 ft2 .F.h/(BTU.in)and 0.08 ft2 .F.h/(BTU.in) for concrete. Both the materials are poor at controlling heat passing through them. These factors would direct to analyze an alternative façade with better thermal properties.

Potential Solution

Replacing bricks with concrete plastering façade with a façade that possess better thermal properties, more insulating and absorb less moisture. The new façade should consume less time to get constructed and require less work force. It should be more insulating and absorb less moisture. With the usage of this new façade, it should consumes less heat leading to increase in thermal comfort. This would help in reducing work for the air conditioner units to cool the room and save energy.

Analysis Steps

1. Develop a list of 3-5 facades that could be used for residential construction in India and analyze their respective cost/SF, structural bare value, R-value, aesthetics, thermal conductivity and other thermal properties like insulation and its effectiveness on thermal comfort.
2. Pick the best-fit façade for this project after discussing with the resources.
3. Analyze the new façade's cost performance and develop a production schedule.
4. Analyze the procedure of installing the new facade and the manpower required for installation along with developing a logistics to show the workflow of the facade.
5. Evaluate the facades schedule impact, cost estimate and overall quality.
6. Compare the cost and schedule outcomes.

Resources

1. Dr.Moses Ling- Penn State AE faculty member
2. Mr.Jillela Goverdhan Reddy- Managing director of the project
3. Mr.prashanth- Site engineer
4. Dr.Rob leicht- – Penn State AE faculty member
5. Case studies, books and articles about façades.

Expected Outcome

Select a façade that can replace the current façade used for this project with better thermal properties, enhancing the thermal comfort and reducing the usage the of air conditioner units to cool the room. The new façade should also lead to schedule reduction/acceleration scenario by reducing the time to construct and reduction in the requirement of workforce leading to cost savings.

CONCLUSION

The analyzation of these four proposals will lead to progressive understanding in the overall process of construction and identifying the problems faced during construction and target the potential solution for it. The four analysis are proposed focusing mainly targeting on schedule driven and workforce challenges. Another aspect focused is the scope to improvise quality of the project.

The analysis are leading to a scope of research critical industry issue and focus on the potential solution or alternate ways to rectify the problem. The prefabrication allows to understand the shortening of schedule and workforce on site. This would also enhance safety and quality control. The implementation of BIM will enhance the safety measures taken and improvise the methods to train the workforce with easy communication. The scope of replacing visual communication with verbal communication would lead to the workers grasping the knowledge of safety more effectively since, a lot of the workforce in India are uneducated. SIPS will focus on the schedule acceleration/reduction scenario along with better co-ordination between the trades and enhanced workflow.

Concluding, all the four analysis would not be deviated from owner's goals and see the scope to maintain or implement the goals in an effective way by enhancing the quality of the project, safety reducing the cost and schedule. By research and information from case studies, Penn state architectural engineering department, industry professionals and the project's work team will lead to an effective understating on overall thesis.

APPENDIX-1

BREADTH STUDIES

Structural Breadth

For the prefabrication analysis, a structural breadth has been identified. The unit will be fabricated offsite and transported to the site. The unit will be attached to the superstructure made of steel and RCC by an anchor/hook. It would take 25-30% more constructed load and manpower for these units. After the bay has been decided, the weight of the unit, its impact on the schedule and production, the field that needs to be augmented and **v**erify if there is a requirement for redesigning the superstructure or reshore the load. Another main criteria to be analyzed is to ensure the unit fits into the structure without any modification in the superstructure and ensure the superstructure can handle the unit load. Another aspect to be analyzed is the re shore capacity to support the logistics

Mechanical Breadth

For the facade change, a mechanical breadth has been identified. The current facade has relatively poor thermal properties, low R-value and consumes a lot of time to get erected. An alternative facade will be analyzed with better thermal properties and faster with construction. The R- value, U-value, thermal conductivity, materials that can ensure better insulation and less intake of moisture content will be analyzed based on the requirements of Indian Standard Code (ISC).The important analyzation from this breadth is the change of the mechanical load based on the facade change and the overall system capacity including the cooling load impact based on sources provided by AE 202 and AE 310 classes.