

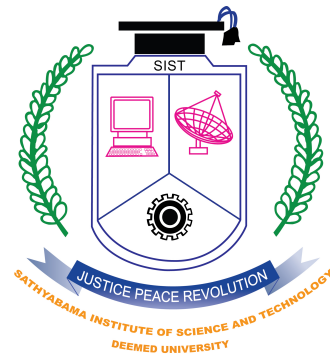
# **REDUCING TIME OVERRUN IN RESIDENTIAL PROJECTS USING AGILE PROJECT MANAGEMENT**

A Thesis

Submitted in partial fulfillment of the requirements for the award of  
Master of Architecture degree in Building Management

By

**GURU SOUNDER K (40840006)**



**DEPARTMENT OF ARCHITECTURE  
SCHOOL OF BUILDING AND ENVIRONMENT**

## **SATHYABAMA**

**INSTITUTE OF SCIENCE AND TECHNOLOGY  
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade "A" by NAAC**

**JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119**

**MAY 2022**



# SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY  
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## DEPARTMENT OF ARCHITECTURE

### BONAFIDE CERTIFICATE

This is to certify that this Report is the bonafide work of **GURU SOUNDER K (40840006)** who carried out the Thesis entitled "**REDUCING TIME OVERRUN IN RESIDENTIAL PROJECTS USING AGILE PROJECT MANAGEMENT**" under our supervision from Jan 2022 to May 2022.

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## DECLARATION

I **GURU SOUNDER K** hereby declare that the Thesis Report entitled “**REDUCING TIME OVERRUN IN RESIDENTIAL PROJECTS USING AGILE PROJECT MANAGEMENT**” done by me under the guidance of **Ar. RAMESH KUMAR** (Internal) and **Mr. S. KAVIN KUMAR** (External) at Sathyabama Institute of Science and Technology is submitted in partial fulfillment of the requirements for the award of Master of Architecture degree in Building Management.

**DATE: May 6<sup>th</sup> 2022**

**PLACE:**



**SIGNATURE OF THE CANDIDATE**

## ACKNOWLEDGEMENT

I am pleased to acknowledge my sincere thanks to Board of Management of **SATHYABAMA** for their kind encouragement in doing this Pre-Thesis project and for completing it successfully. I am grateful to them.

I convey my thanks to **Dr. Devyani Gangopadhyay, Dean and Head of the department, Dept. of Architecture, School of Building and Environment**, for providing me necessary support and details at the right time during the progressive reviews.

My special thanks to **Dr. Suresh Kuppusamy**, our Design chair and **Mr. S. Kavın Kumar** (External guide) and **Ar. Sukirtha Suresh** (Pre-Thesis Coordinator) for their valuable comments and guidance during the project work.

I would like to express my sincere and deep sense of gratitude to my Project Guide **Ar. Ramesh Kumar** for his valuable guidance, suggestions and constant encouragement which paved way for the successful completion of my project work.

I wish to express my thanks to all Teaching and Non-teaching staff members of the Department of Architecture who were helpful in many ways for the completion of this Pre-Thesis.



## **ABSTRACT**

Time is a major factor in construction and on time completion will bring about many benefits to the client, contractor and the society. Agile Project Management (APM) is an interactive and incremental method of management that is applicable for highly flexible environments. Agile methodology has been found to improve the reliability of project delivery by decomposing the project into smaller manageable parts and completing these parts with greater delivery value.

On-time completion of construction projects is an indicator of efficiency but many variables influence the construction which hinder timely completion. These variables include performance of parties, resources availability, environmental conditions, involvement of other parties, and contractual relations etc. The traditional project management approach seems to be generic and does not hold much to reduce the time overrun. Modern management approaches are being researched and one such approach is Agile Project Management, which is primarily used in information technology

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## LIST OF SYMBOLS AND ABBREVIATIONS

|            |   |                           |
|------------|---|---------------------------|
| $L_r$      | - | Resonant Inductor         |
| $L_s$      | - | Series Resonant Inductor  |
| $C_r$      | - | Resonant Capacitor        |
| $C_s$      | - | Series Resonant Capacitor |
| $\cos\phi$ | - | Power Factor              |
| $R$        | - | Resistance                |
| $Z$        | - | Impedance                 |
| $X_L$      | - | Inductance Reactance      |
| $X_c$      | - | Capacitive Reactance      |
| $V_c$      | - | Voltage across capacitor  |
| $V_{in}$   | - | Input voltage             |



# **CHAPTER 1**

## **INTRODUCTION**

### **1.1 INTRODUCTION**

On time completion of construction projects is an indicator of efficiency but many variables influence the construction which hinder timely completion. These variables include performance of parties, resources availability, environmental conditions, involvement of other parties, and contractual relations etc. Traditional project management approach seems to be generic and does not hold much to reduce the time overrun. Modern management approaches are being researched and one such approach is Agile Project Management, which is primarily used in information technology.

### **1.2 AIM**

To study and reduce the Time Overrun in the Construction of Residential Projects using Application of Agile Project Management

### **1.3 OBJECTIVE**

The objective of this research thesis is to develop a framework to reduce time overrun in the construction of residential project by applying Agile Project Management (APM) methodology.

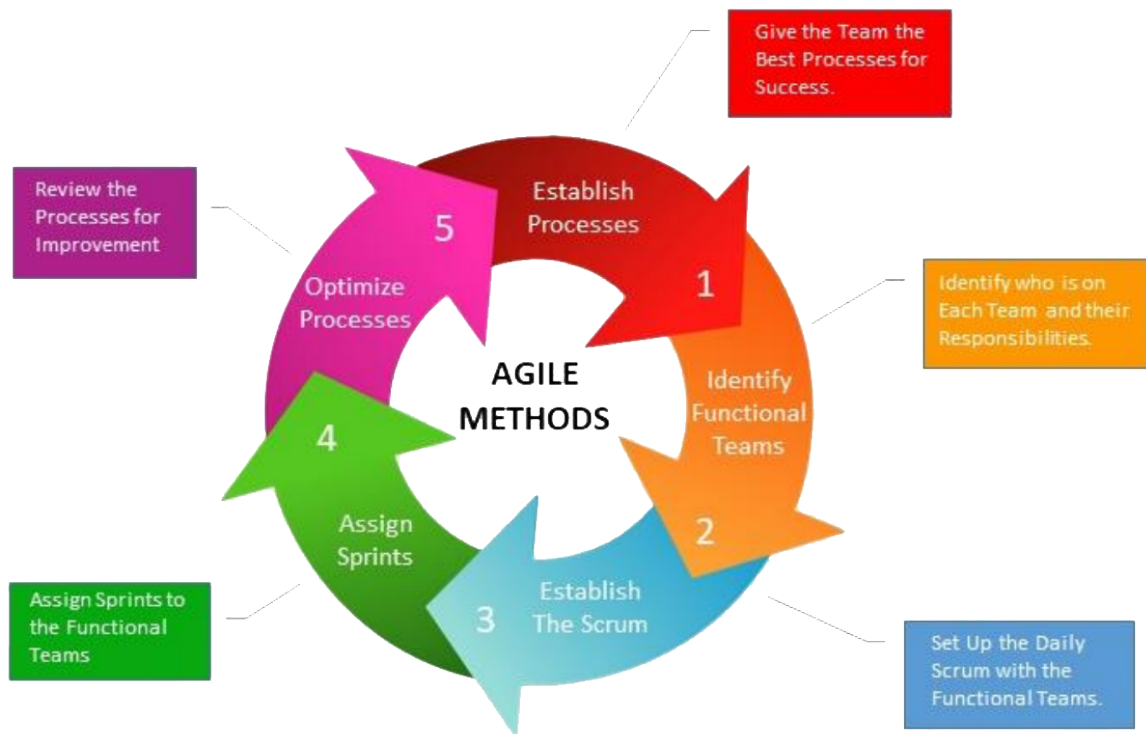
### **1.4 SCOPE AND LIMITATIONS FOR THE STUDY**

- To study the Traditional Project Management and Agile Project Management principles related to construction industry
- To study the delay factors in the construction of residential projects
- To identify the delay factors in the residential project where agility can be applied
- To develop a management framework based on the study results.

## CHAPTER 2 LITERATURE REVIEW

### 2.1 INTRODUCTION

Application of agile project management is mainly seen in software industry which follows an iterative and incremental method which assures efficiency in the project by reducing the delay. Many researches have been done on the application of APM during the pre-design and design phases of construction projects. It seems application of APM is laborious in the construction phase. The concept of agility is applied by dividing the entire project into smaller manageable parts and completing each part.



**Fig 1.1 Agile Methodology**

## **2.2 Some basic concepts of agility include:**

- Avoiding inflexible processes that can't be changed.
- Using short iterative processes allowing for improvements to be quickly implemented or failures to be identified before the end product.
- Emphasizing learning and continuous improvement.
- Identifying issues and weaknesses as soon as they occur.
- Implementing root cause analysis to determine the cause of problems.
- Changing processes to suit specific projects, goals.
- Focusing on continuous training and mentoring.

## **2.3 RESEARCH PAPERS:**

### **2.3.1 Defining an Agile Construction Management System:**

*Author - Fei Han, Susan M. Bogus*

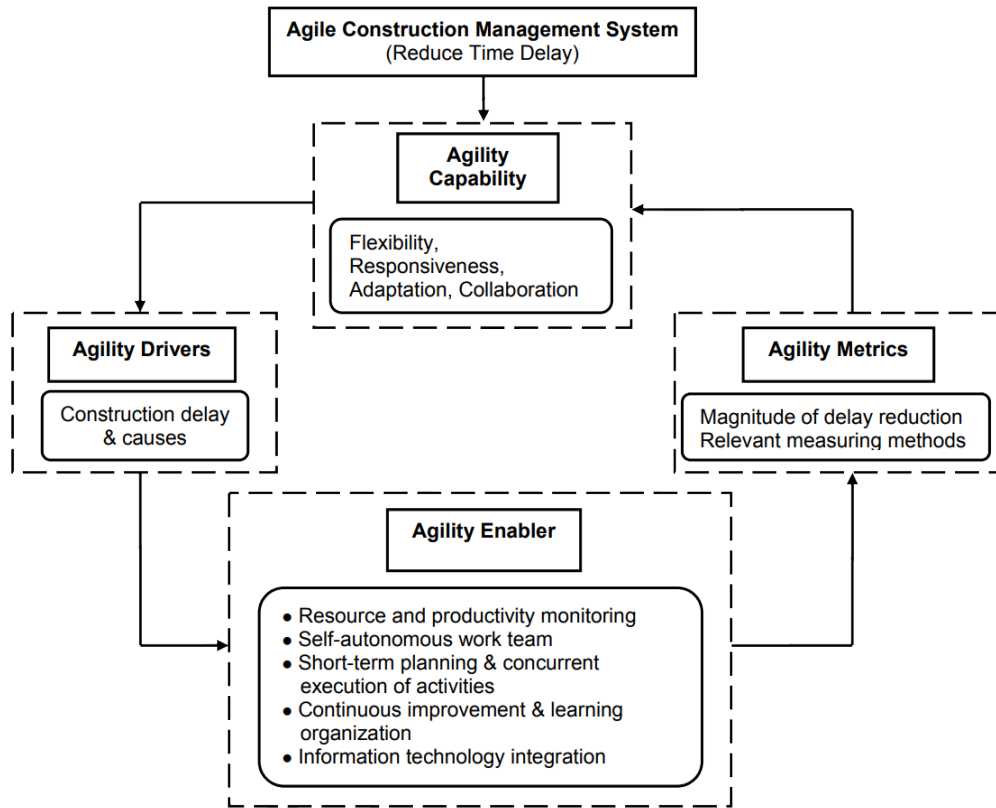
*Date - May 2013*

#### **2.3.1.1 Purpose:**

Schedule delays are common and recurring in construction, inevitably resulting in rework, cost overruns and legal claims. Construction delays can cause problems to more than the schedule, such as cost, quality and safety issues. Handling delays requires solutions that are adaptive and flexible. The first element of the agile construction management system is a framework. The framework consists of agility drivers,

agility enablers, and agility metrics. Agility drivers are the types of delays and their causes. The enablers target various delay causes, and are grouped into five categories including strategy, generic practice, people, technology, and theoretical model.

### 2.3.1.2 Methodology:



**Fig 1.2 Agile Construction Management Framework**

In order to create a framework for agile construction management, a comprehensive review of existing literature was employed as the primary approach. Conceptual framework is considered appropriate as a type of intermediate theory that attempts to connect all aspects of research interest. Thus, reducing delays can be viewed more like a “problem solving process” which starts from “problem identification” (delay causes), “solution development” (theoretical/empirical data and practice) to “result evaluation” and “lessons learned” (validation of delay reducing methods).

### **2.3.1.2 Conclusion:**

Construction is usually challenged to complete projects on schedule. In order to deal with increasingly complex delays, this study shifts the original idea of getting rid of delays to reducing or neutralizing delays by adding “agility” to the entire project management. Agility, a concept originating from agile manufacturing and other engineering areas, is found to be well-suited to construction management because of its potential to break barriers of “over control” and facilitate a flexible, responsive, collaborative and solutions-oriented construction delivery process.

### **2.3.2 A Systematic Literature Review of the Agile Methodology Applied During Construction Project Design:**

*Author - Mr Sixolile Mnqonywa, Dr Sune von Solms,*

*Prof Annlize Marnewick*

*Date - Nov 2018*

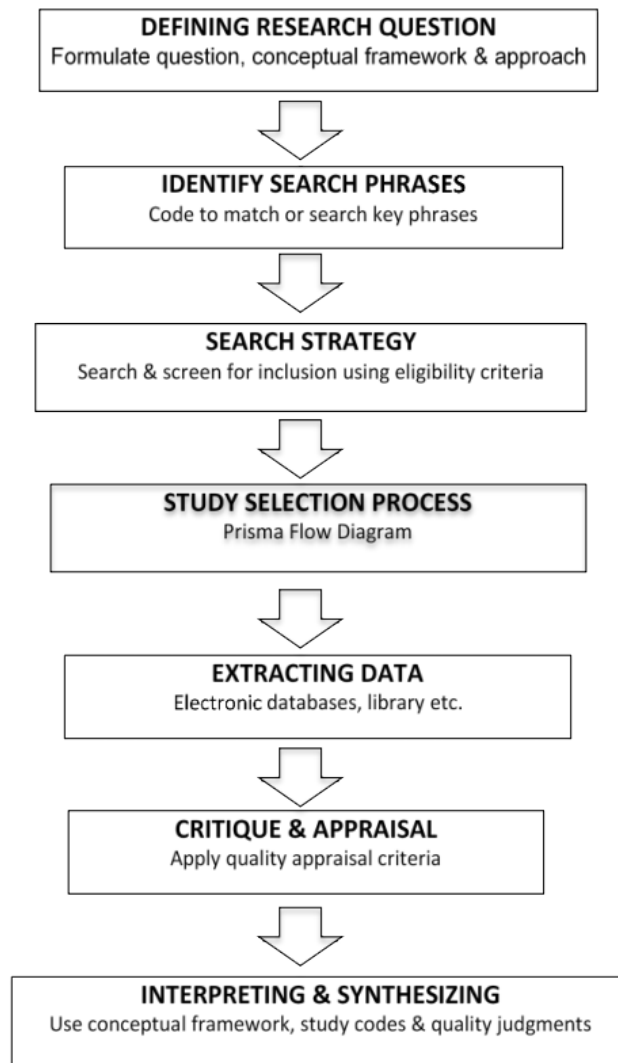
#### **2.3.2.1 Purpose:**

The purpose of the study aims to determine if agile methodologies can improve the delivery of the design phase of a civil construction project. This paper investigates the challenges generally faced in the design phase of a civil construction project and to determine how agile methodologies can address these challenges. The possibilities of using agile methodologies in the design phase of a civil engineering project to mitigate cost and schedule overrun and to improve the delivery of the design phase.

#### **2.3.2.2 Agile Methodology :**

- “Individuals and interactions” “over “processes and tools”: Responding to the bureaucracy of current management that is more concerned about the figures and organizational processes than the people.

- “Working software” over “comprehensive documentation”: Reacting to the amount of documentation required at each stage of the project, which sometimes gets in the way of the final product developed.



***Fig 1.3 Methodology***

- “Customer collaboration” over “contract negotiation”: Emphasizing client interaction to better produce the client requirement, and to get more client satisfactory

- “Responding to change” over “following a plan”: Responding to the rigid and linear, conventional method that makes it difficult to make changes even if they are warranted

| CHALLENGES                       | MAIN CAUSES                     | RESPONSES FROM LITERATURE                                                                                                                                                                                                                                                              | AGILE STATEMENTS                                                                                                                                       |
|----------------------------------|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Cost and Schedule Overrun</b> | Design Change                   | Responding to change over after a plan, the ability to be more adaptable to any circumstances is what helps the client to be more in control of shaping the final product instead of allowing circumstances to dictate the final product.                                              | “Responding to change over after a plan” One of agile’s four core values.                                                                              |
|                                  | Complex projects                | Agile ability to take any complex situation and break it down into manageable increments. Including its iterative nature when using the Scrum method is very suitable for unpacking complexity.                                                                                        |                                                                                                                                                        |
|                                  | Client Scope Change             |                                                                                                                                                                                                                                                                                        |                                                                                                                                                        |
| <b>Waste Management</b>          | Quality control                 | In agile methodology, because of its iterative cycles of continuous learning and development, mistakes are easily picked up and all the errors rectified.                                                                                                                              | “At regular intervals, the team reflects on how to become more effective then tunes and adjusts its behaviour accordingly.” One of agile’s Principles. |
|                                  | Unclear goals                   | Agile methodologies can operate under unclear goals and strategies and can help the client reach towards making clearer goals by means of alliteration and innovation                                                                                                                  |                                                                                                                                                        |
|                                  | Project coordination            | It is a cross-functional group of people who constantly interact. The Agile methodology works in cycles of delivering a product every week to the client and during the week by conducting stand up meetings which are generally a fast useful and efficient way of checking progress. |                                                                                                                                                        |
| <b>Design Performance</b>        | Problem Solving                 | Agile methodologies are structured in solving problems by removing bureaucracy as stated in the Manifesto.                                                                                                                                                                             | “Continuous attention to technical excellence and good design enhances agility.” One of the agile’s Principles.                                        |
|                                  | Lack of skills                  | Agile teams are a cross-functional group of individuals and everyone is important in producing the final product, the team is motivated and skilled and there is no redundancy within the team it is fully functional.                                                                 |                                                                                                                                                        |
| <b>Project management</b>        | Rigid                           | Agile methodologies, in particular, the Scrum method does not refer to project managers, but rather, Scrum Master, the two roles can be significantly different in some cases, the scrum master is a motivator and a mentor and not viewed as the boss of the team.                    | “Working programming over exhaustive documentation” One of Agile’s four core values.                                                                   |
|                                  | Lack of effective communication | Feedback is done more regularly daily stand-up meetings and after weekly sprints, Agile methodologies can offer constant feedback between the teams                                                                                                                                    |                                                                                                                                                        |
|                                  | Documentation intensive         | An agile methodology allows for project managers and design team to adapt to changing circumstances, instead of forcing rigid and linear control as in the traditional method                                                                                                          |                                                                                                                                                        |

**Table 1.1 Challenges, Causes and Agile Statement**

### 2.3.2.3 Conclusion:

The design stage was distinguished as the stage at which the greater part of the cost and schedule overrun begins, it was along these lines with reason that it is the

stage at which mitigation measures can be connected. To conclude the execution of agile methodology in the design period of construction projects can enhance this stage by limiting the weakness or vulnerability and help in managing the unanticipated risks and having the capacity to adjust to evolving conditions.

### **2.3.3 Agile Project Management Feasible Methodology in Construction Industry:**

*Author - Aakanksha Ingle*

*Date - Oct 2019*

#### **2.3.3.1 Purpose:**

This paper research on AM is actually centered on improving the systematic methodologies to study. The Scrum method designed for software development sector has to be defined to comply with construction business first. Artifacts, events, and the roles of scrum framework shall be connected to the stakeholders, group meetings, and documents applying in the construction business. The objective of the research is to establish the applicability of scrum meeting in construction project management. And to establish the applicability of scrum roles in construction project management.

#### **2.3.3.2 Research methodology:**

- Application of agile management is actually unusual or perhaps no in the construction business.
- The stakeholders aren't been in a position to share the point of theirs of view on scrum and agile.

- Therefore the direct information sourcing is not sensible from construction industry regarding scrum method.
- The Scrum method designed for software development sector has to be defined to comply with construction business first.
- Artifacts, events, or the roles of scrum framework shall be connected to the stakeholders, group meetings, and documents applying in the construction business.

#### **2.3.3.3 Conclusion:**

For the construction project management, the APM is actually an unusual word to nearly all stakeholders. Just about all construction projects practice the TPM (waterfall management). Therefore the iterative approach as scrum methods in APM is actually a difficult task to integrate in constructions projects. The literature states that the cost overruns and time overruns are actually the key issues with TPM.

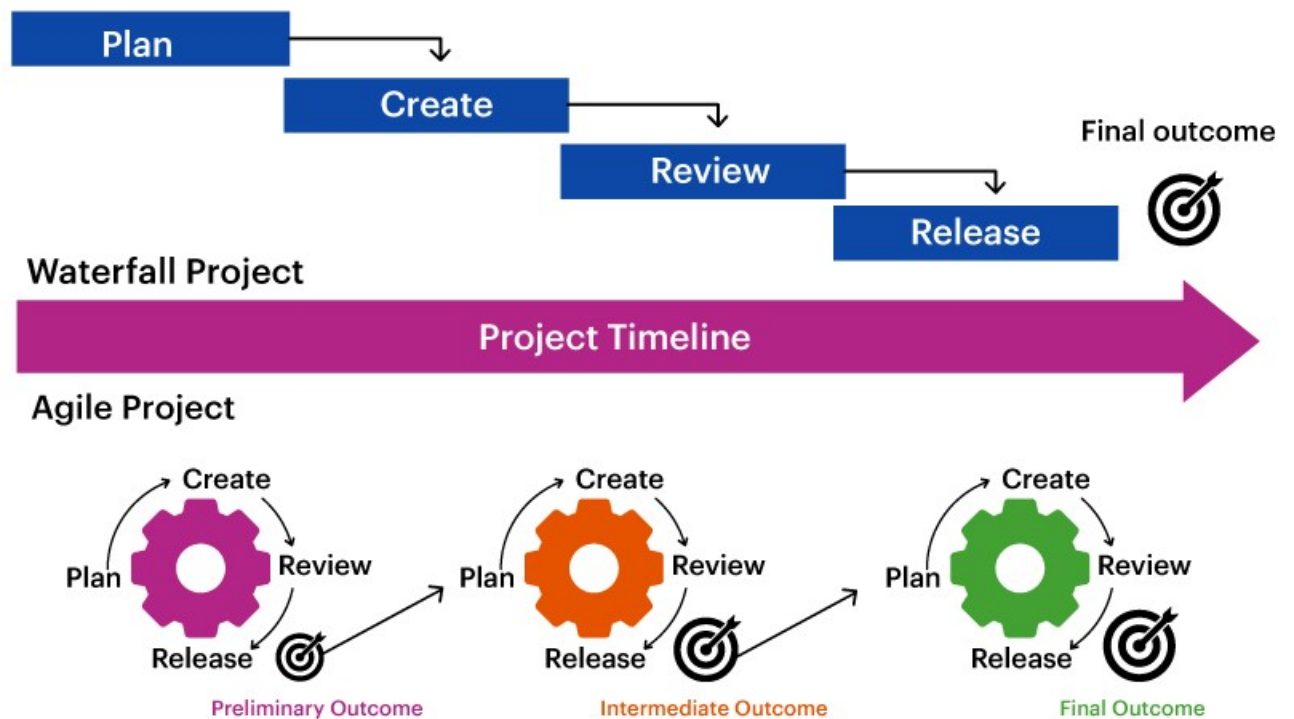
#### **2.4 Benefits of Agile Methodology :**

With Agile project management, primary constraints, such as time and cost, can be continuously evaluated. Rapid feedback, continuous adaptation and Q&A best practices are built into teams' schedules, which ensures quality output and a streamlined process. The following represents some of the other benefits of Agile project management:

- Increased focus on the specific needs of customers
- Reduced waste through minimizing resources
- Increased flexibility enabling teams to easily adapt to change
- Better control of projects
- Faster project turnaround times
- Faster detection of product issues or defects

- Increased frequency of collaboration and feedback
- Improved development process
- Increased success because efforts are more focused
- Rapid deployment of solutions

## 2.5 Difference between Traditional and Agile project methodology



***Fig 1.4 Difference between Traditional and Agile project methodology***

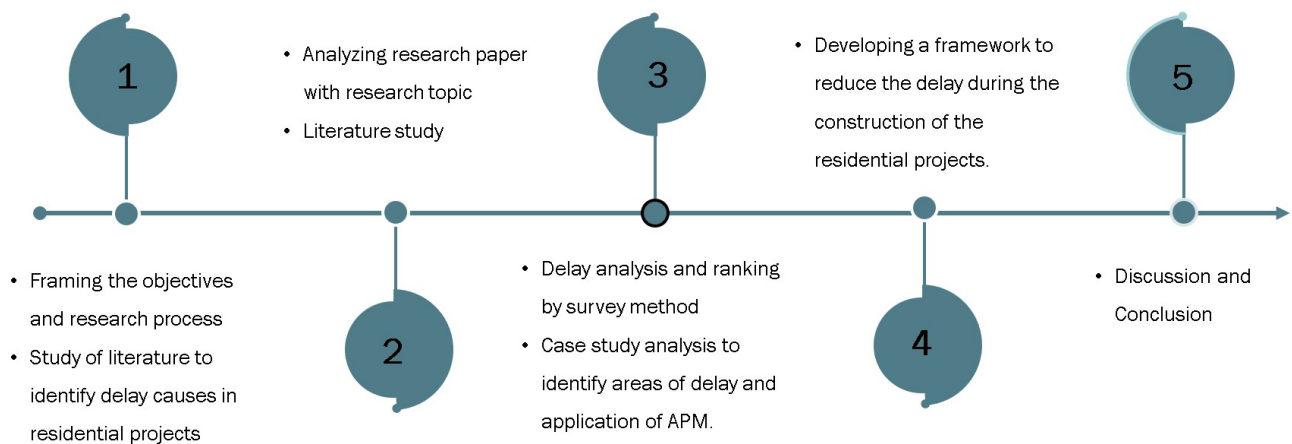
| <b>Characteristics</b>   | <b>Agile approach</b>                                             | <b>Traditional approach</b>                                                         |
|--------------------------|-------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Organizational structure | Iterative                                                         | Linear                                                                              |
| Scale of projects        | Small and medium scale                                            | Large-scale                                                                         |
| User requirements        | Interactive input                                                 | Clearly defined before implementation                                               |
| Involvement of clients   | High                                                              | Low                                                                                 |
| Development model        | Evolutionary delivery                                             | Life cycle                                                                          |
| Customer involvement     | Customers are involved from the time work is being performed      | Customers get involved early in the project but not once the execution has started  |
| Escalation management    | When problems occur, the entire team works together to resolve it | Escalation to managers when problem arise                                           |
| Model preference         | Agile model favors adaption                                       | Traditional model favors anticipation                                               |
| Product or process       | Less focus on formal and directive processes                      | More serious about processes than the product                                       |
| Test documentation       | Tests are planned one sprint at a time                            | Comprehensive test planning                                                         |
| Effort estimation        | Scrum master facilitates and the team does the estimation         | Project manager provides estimates and gets approval from PO for the entire project |
| Reviews and approvals    | Reviews are done after each iteration                             | Excessive reviews and approvals by leaders                                          |

***Table 1.2 Difference between Traditional and Agile project methodology***

## CHAPTER 3 METHODOLOGY

### 3.1 RESEARCH METHODOLOGY:

Questionnaire survey is to identify the delay reasons in residential projects and find its contributor at each phase of project development and construction, thereby enabling easy identification of various areas for the application of APM.



***Fig 1.5 Research Methodology***

## CHAPTER 4 ANALYSIS AND RESULTS

### 4.1 LITERATURE CASESTUDY:

#### 4.1.1 INTRODUCTION:

- The selection of case studies was done in two major cities of Gujarat, Ahmedabad and Gandhinagar.
- From the above table, One42 and IBIS Brigade hotel were managing their project using SCRUM in their construction project
- Number of labors and area of construction differs as the scale of all project were different.

| SR.NO.                 | DETAILS                    | ONE 42 AMAYA PROPERTIES     | IBIS BRIGADE HOTEL      |
|------------------------|----------------------------|-----------------------------|-------------------------|
| <b>PROJECT DETAILS</b> |                            |                             |                         |
| 1                      | Location                   | Ahmedabad                   | GIFT city, Gandhinagar  |
| 2                      | Client                     | Farpoint Properties LLP     | Brigade Group           |
| 3                      | Contractor                 | PSP Projects Ltd.           | PSP Projects Ltd.       |
| 4                      | Type of Project            | 12 storey Commercial towers | 9 storey Hotel Building |
| 5                      | Current Status             | Under Construction          | Under Construction      |
| 6                      | No. of Labours             | 325                         | 210                     |
| 7                      | Area Considered (in Sq.m.) | 41510                       | 32600                   |
| 8                      | PM methodology using       | SCRUM                       | SCRUM                   |
| 9                      | Project Start Date         | 28th April, 2017            | 30th April, 2017        |

**Table 1.3 Project Details**

These data gives basic idea about scrum team and what was the scale of the project. By observing all two sites, in which Scrum is implemented, planning engineers are acting as scrum masters. Depend on the size of the project and development team, number of scrum master is being finalize. The ideal size of development team is 5-10 per scrum master.

Daily scrum is the most important part to properly follow Scrum. Sincerity and regularity is must in terms of daily scrum. we can see the difference between two projects in terms of documentation, reporting and for proper follow up. Both the projects had their individual daily scrum formats and sprint review methods.

| SR.NO.               | DETAILS                         | ONE 42 AMAYA PROPERTIES                                  | IBIS BRIGADE HOTEL                                         |
|----------------------|---------------------------------|----------------------------------------------------------|------------------------------------------------------------|
| <b>SCRUM DETAILS</b> |                                 |                                                          |                                                            |
| 1                    | Scrum Master                    | Planning Engineer                                        | Planning Engineer                                          |
| 2                    | No. of Scrum Master             | 1                                                        | 2                                                          |
| 3                    | Development Team Size           | 10 Engineers                                             | 12 Engineers                                               |
| 4                    | Daily Scrum meeting time        | 9:30 AM                                                  | 9:30 AM                                                    |
| 5                    | Duration of Daily Scrum Meeting | 15 to 30 Minutes                                         | 15 to 30 Minutes                                           |
| 6                    | Date of Implementation Scrum    | 1st September,2017                                       | 12th September, 2017                                       |
| 7                    | Daily Scrum Report method       | None                                                     | Manual form                                                |
| 8                    | Sprint Duration                 | Floor to Floor Cycle                                     | Weekly cycle                                               |
| 9                    | Sprint Meeting time             | Once in a Week                                           | Once in a Week                                             |
| 10                   | Sprint Meeting Duration         | 1 to 2 hours                                             | 1 to 2 hours                                               |
| 11                   | Sprint Review method            | In format of word file with all the details and comments | In format of excel sheet comparing with planned quantities |

**Table 1.4 Scrum Details**

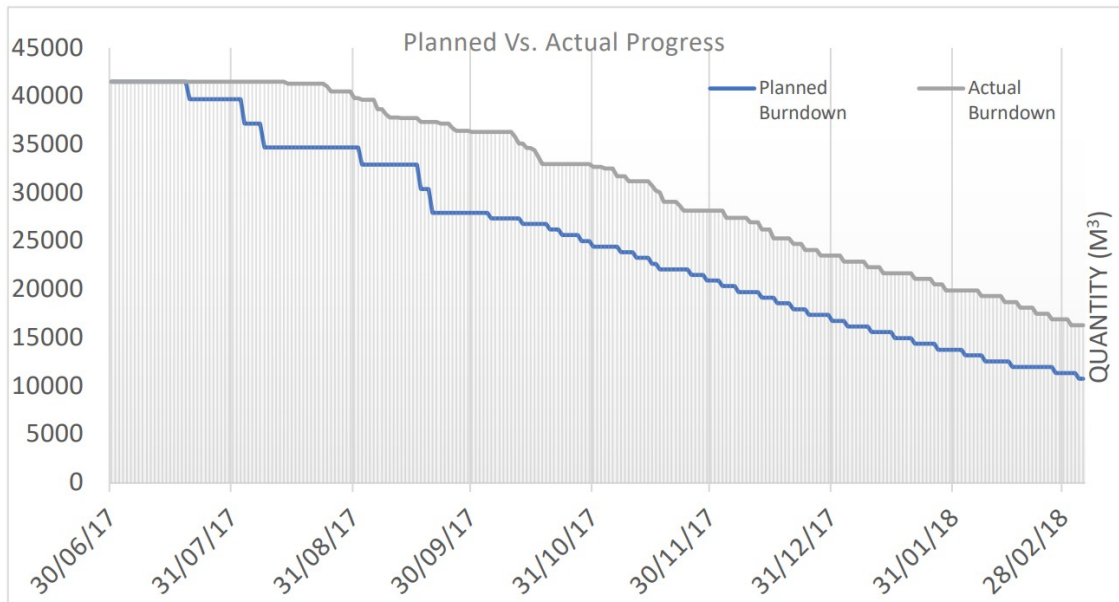
#### **4.1.2 BURN-DOWN CHART:**

The main function of burndown charts are as similar to S curve. Burn down chart are also prepared to keep track of planned versus actual work done on site. However, burndown chart shows the amount of work remaining over the particular time. The burndown graph is an excellent way to visualize the correlation between the work remaining at a given time and the progress of project teams in reducing that work. The intersection of a trend line for the remaining work and the horizontal axis indicates the most likely completion of the work on planned period of time. The burndown chart helps planning and execution teams with "what if" project by adding functionality and removing it from the version to get a more acceptable date or to extend the date with more functionality. The burndown graph is the collision of reality (the amount of work done and how quickly it is done) with what is planned or hoped for

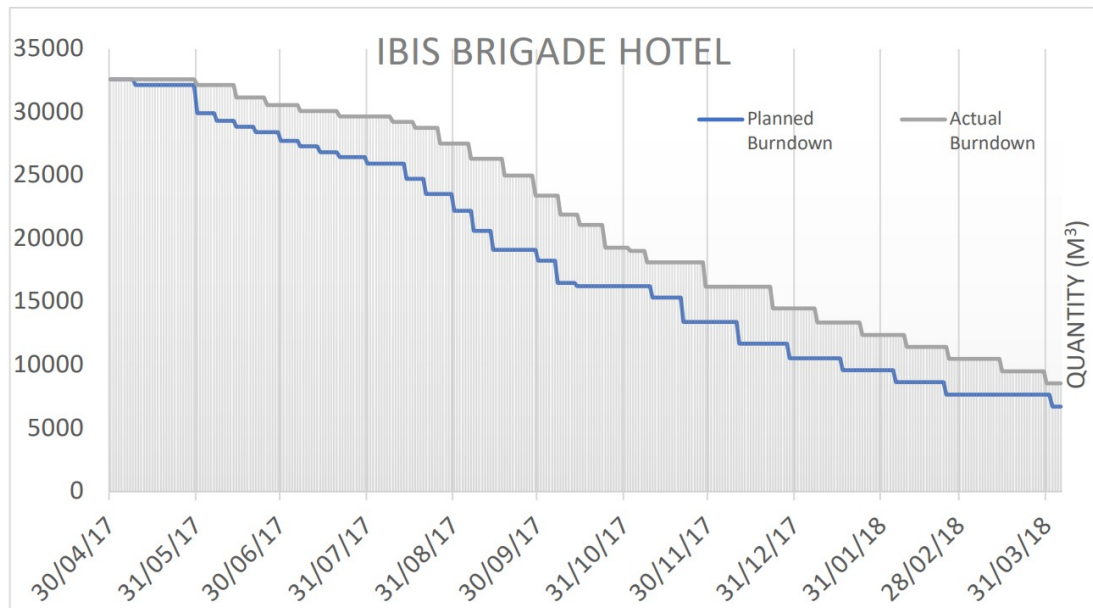
sprint is prepared from wthe Microsoft Project file. Planned data was taken from the Microsoft Project file and Actual data was taken from daily progress reports. By using given data, two lines are generated in the graph. Which are, planned burndown and actual burndown lines indicating work remaining in the project. If planned line is below actual line than the project is delayed or behind planned dates and if planned line is above actual line than the project is ahead of time or planned dates. Formulas for calculating planned and actual burndown lines are as follows:

$$\text{Planned Burndown} = (\text{Total Quantity} - \text{Cumulative Planned Quantity})$$

$$\text{Actual Burndown} = (\text{Total Quantity} - \text{Cumulative Actual Quantity})$$



**Fig 1.6 One42 Amaya properties Burn-down Chart**



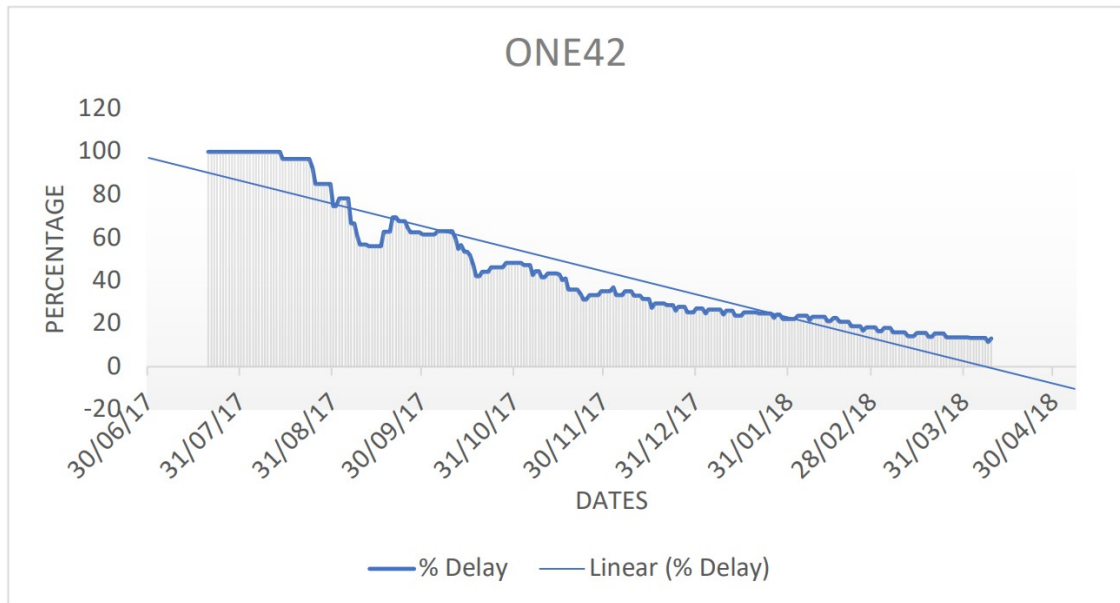
**Fig 1.7 IBIS Brigade Hotel Burn-down Chart**

One42 Amaya properties. Located in Ahmedabad, Gujarat and IBIS Brigade Hotel located in GIFT City, Gandhinagar, Gujarat. Scrum was introduced to the planning team in mid-august of 2017. At that time, both the projects were delayed by one and half month as per the planned schedule. In above figure, the gap between planned burndown and actual burndown is comparatively high. It was mainly due to the heavy rain conditions during the monsoon in Ahmedabad and Gandhinagar. On 1st of September, both the project teams formed a dedicated development team and started following Scrum artifacts. Sooner, they started preparing burndown chart for their projects. Regarding that, they were using the planned schedule from the Microsoft Project file comparing it to the actual progress of the site. The graphs were generated, based on the planned data and actual data entered in the excel sheet. The development teams have adopted and understood scrum very well that it was became a part of their daily routine. Fortunately, They were able to solve so many problems from the initial stage of the project. Somehow, they were about to cover up the delayed work after 6 months from starting of the project. we can assume that the gap between planned and actual progress is narrowing down over the time. The reason behind that was, proper follow up of scrum on both the projects. The development team have adopted scrum completely by doing daily scrum meetings and sprint retrospective meetings. They were able to solve the major problems just by conducting daily scrum meetings on the regular basis.

#### **4.1.3 Percent Delay:**

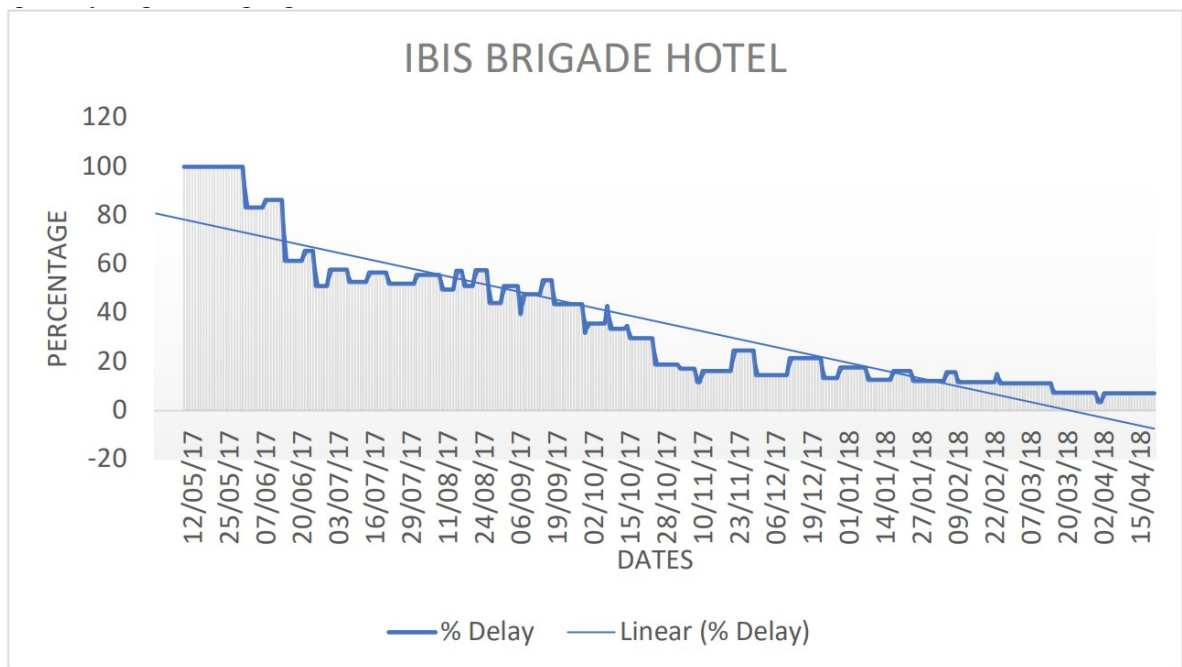
Percentage delay graph was generated for a precise analysis about project progress. Percent delay is also prepared in term of reducing delay, The inclined line denotes constant reduce of percentage delay over the time to cover up the delayed work as per project completion date. Below formula is used to prepare percentage delay graph,

$$\text{Percent delay(\%)} = 100 - (\text{Actual Cumulative/Planned Cumulative}) * 100$$



**Fig 1.8 One42 Amaya properties Percentage Delay**

Percentage delay graph for ONE42 Amaya Properties is reducing over the time as per the estimated reduce percentage. In February end, project was facing some problems due to material unavailability and tower crane breakage. So the percentage delay line is again above the approximate reduce line.



**Fig 1.9 IBIS Brigade Hotel Percentage Delay**

Percentage delay graph for IBIS Brigade Hotel is reducing over the time nearly the estimated linear reduce. It is decreasing constantly. In the march end, the project was on the verge of reaching the same quantity as planned progress. Percentage delay graph is generated to know, the remaining amount of delay in the project and how one can reduce this delayed work over the remaining time for on time completion of the project. By generating these graphs, any member of development team or client can see the performance of a development team and current status of projects.

## 4.2 LIVE CASE STUDY:

### 4.2.1 INTRODUCTION:

- The selection of case studies was stilt + 5 Storey residential apartment building located in Chennai.
- Total buildup area – 25,000sqft
- The current status of the project – Yet to start
- Khosla associates are the architect of the project and ESVE Design solution pvt.ltd are the MEP consultant of the project

| S.No | DETAILS         |                                       |
|------|-----------------|---------------------------------------|
| 1    | Location        | Chennai                               |
| 2    | Type of Project | Stilt + 5 Storey Residential Building |
| 3    | Current Status  | Yet to start                          |
| 4    | Area            | 25,000sqft                            |
| 5    | Architect       | Khosla Associates                     |
| 6    | MEP Consultant  | ESVE Design solution pvt.Ltd          |

**Table 1.5 Case-study Details**

## 4.2.2 SCHEDULING IN TPM :

No of days - 186

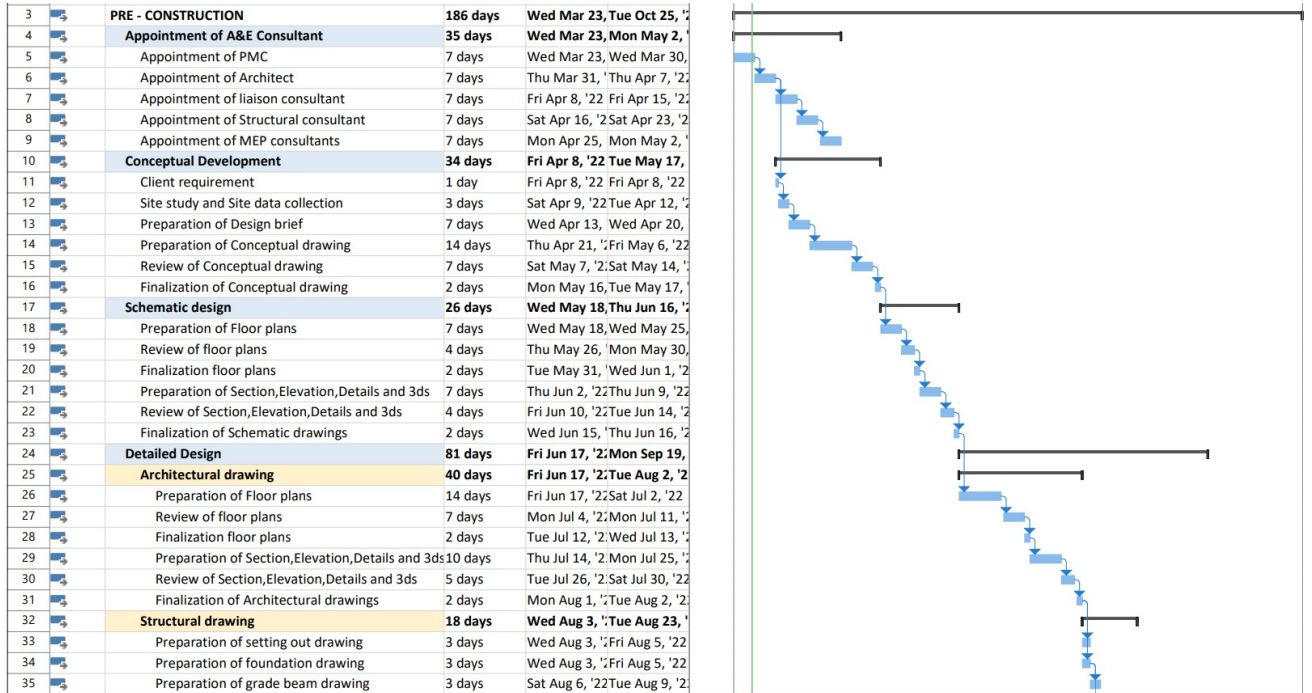


Fig 1.10 Scheduling in TPM

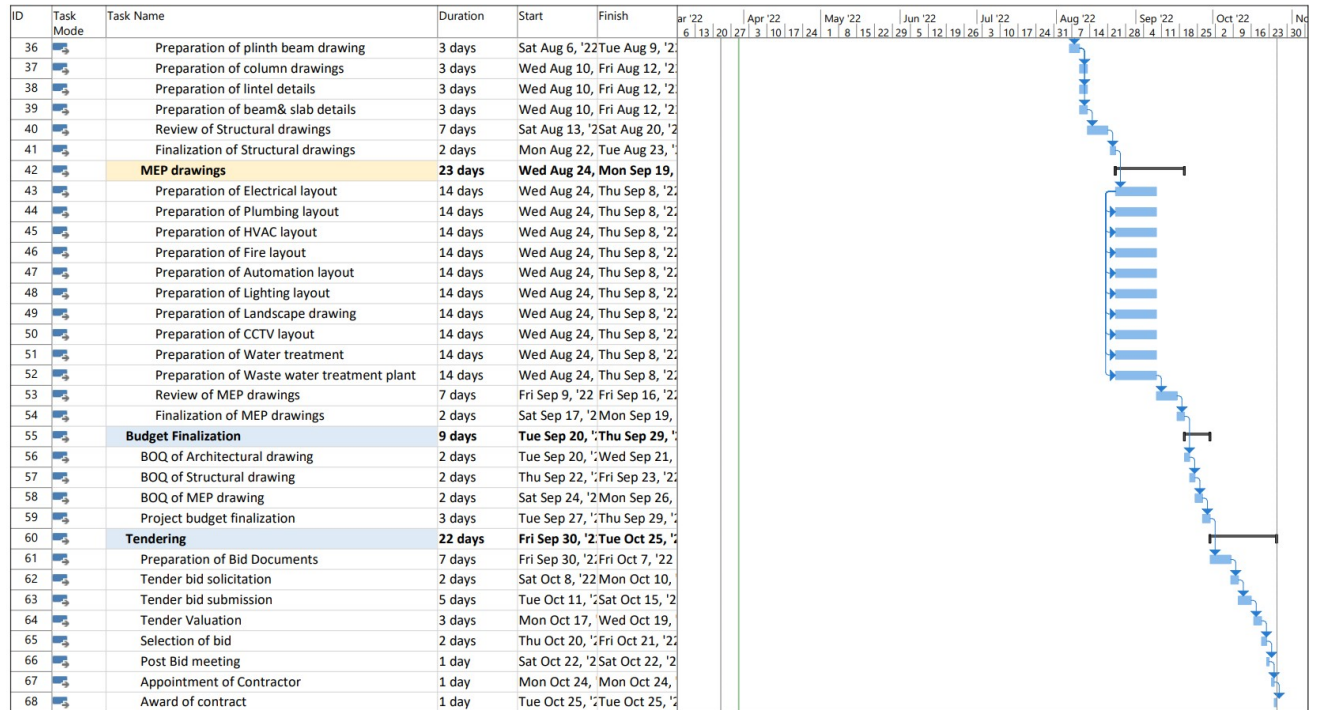


Fig 1.11 Scheduling in TPM

#### 4.2.3 ISSUE IDENTIFICATION:

- PMC and liaison consultant was appointed after one year
- The design stage happened for one year with many iteration and they finalized the design but they didn't check structural feasibility of the design
- The height of building is calculated from road mean level according to old Tamilnadu combined regulation but in the revised regulation Tamilnadu combined regulation form the formed ground one meter height of the building is allowed - The Architect is not aware of the revised regulation
- After one year when PMC was appointed they reviewed the drawings are according to CMD guidelines they found that the height of the building was exceeding . The height of the building is 75ft(22.8m) but according to the CMD guidelines it should be only 60ft(18.3m)



**Fig 1.12 Sections**

- Area also exceed the built-up area and they also calculated stilt area driver room area in the built-up area according to CMD guidelines it should not be added
- Due to the cantilever beam depth the clear height of driveway is not obtained

#### **4.2.4 AGILE PRINCIPLES:**

- SHORT TERM PLANNING
- CLIENT INVOLVEMENT
- RECONCILIATIONS
- REQUIRED REFLECTION AND ADAPTATION
- BUSINESS PEOPLE AND DEVELOPERS WORK TOGETHER

#### **4.2.5 AGILE FRAMEWORK:**

Agile recommended having a project kick-off meeting with qualified consultants and client to envision the required to start the project's design phase. Discussed with stakeholders and updated drawings are given for tendering. After tendering, site kick-off meeting is held on site with consultants where preparation of product backlog is done which shows the main works to be held like excavation, column, and ground floor roof etc. status can be updated like open/closed, on process and planning with color code of green, orange and red respectively.

#### **4.2.6 SPRINT PLANNING :**

Sprint planning can be for 14 to 21 days (two to three weeks) duration which incorporate top five chosen principles like short term planning. Client involvement, reconciliation, and

required reflection and adaptation also business people and developers work together. Timing for sprint meeting with consultants will be 45 to 60 minutes and daily scrum meetings will be 10 to 15 minutes

Schedule is prepared to follow sprints for the project. First meeting should be conducted three weeks before the commencement of work on site. On the first meeting of sprint, Approval for sprint 1 activities, procedures in handling changes from beginning and arrangement to freeze the design after certain period is discussed.

#### **4.2.7 SPRINT AFD:**

Proposal do AFD - Approval of upcoming sprint,  
Finalization of the next sprint,  
Discussion of later one

is done on every single meeting. Changes are allowed only for the sprint discussion. If changes are needed, the justification of the change is to be done along with the consultants and negotiated. "Exchange request " is given in place of change request and revised in the contract. Changes without written approval are not allowed in this method.

On every sprint meeting, evaluation of previous completed sprint is reviewed and quality is tested. Unapproved work is added to next sprint and visual management is updated. No overloaded documentation is allowed and report is submitted for the completed sprint for further reference.

Sprint Meeting :

Date –

**Approval** of Sprint – 1

**Finalization** of Sprint – 2

**Discussion** of Sprint - 3

#### 4.2.8 PREPARATION OF PRODUCT BACKLOG:

- In the simplest definition the Scrum Product Backlog is simply a list of all things that needs to be done within the project.
- The most important items are shown at the top of the product backlog so the team knows what to deliver first.

| S.No | PRODUCT BACKLOG                                    | Sprint | Status |
|------|----------------------------------------------------|--------|--------|
| 1    | Appointment of PMC                                 | 1      |        |
| 2    | Appointment of Architect                           | 1      |        |
| 3    | Appointment of liaison consultant                  | 1      |        |
| 4    | Appointment of Structural consultant               | 1      |        |
| 5    | Appointment of MEP consultants                     | 1      |        |
| 6    | Client requirement                                 | 2      |        |
| 7    | Site study and Site data collection                | 2      |        |
| 8    | Preparation of Design brief                        | 2      |        |
| 9    | Preparation of Conceptual drawing                  | 2      |        |
| 10   | Review of Conceptual drawing                       | 2      |        |
| 11   | Finalization of Conceptual drawing                 | 2      |        |
| 12   | Preparation of Floor plans                         | 3,4    |        |
| 13   | Review of floor plans                              | 3,4    |        |
| 14   | Finalization floor plans                           | 3,4    |        |
| 15   | Preparation of Section, Elevation, Details and 3ds | 3,4    |        |
| 16   | Review of Section, Elevation, Details and 3ds      | 3,4    |        |
| 17   | Finalization of Architectural drawings             | 3,4    |        |
| 18   | Preparation of setting out drawing                 | 4      |        |

**Table 1.6 Product Backlog**

| S.No | PRODUCT BACKLOG                            | Sprint | Status |
|------|--------------------------------------------|--------|--------|
| 19   | Preparation of foundation drawing          | 4      |        |
| 20   | Preparation of grade beam drawing          | 4      |        |
| 21   | Preparation of plinth beam drawing         | 4      |        |
| 22   | Preparation of column drawings             | 4      |        |
| 23   | Preparation of lintel details              | 4      |        |
| 24   | Preparation of beam&slab details           | 4      |        |
| 25   | Review of Structural drawings              | 4      |        |
| 26   | Finalization of Structural drawings        | 4      |        |
| 27   | Preparation of Electrical layout           | 4      |        |
| 28   | Preparation of Plumbing layout             | 4      |        |
| 29   | Preparation of HVAC layout                 | 4      |        |
| 30   | Preparation of Fire layout                 | 4      |        |
| 31   | Preparation of Automation layout           | 4      |        |
| 32   | Preparation of Lighting layout             | 4      |        |
| 33   | Preparation of Landscape drawing           | 4      |        |
| 34   | Preparation of CCTV layout                 | 4      |        |
| 35   | Preparation of Water treatment             | 4      |        |
| 36   | Preparation of Waste water treatment plant | 4      |        |

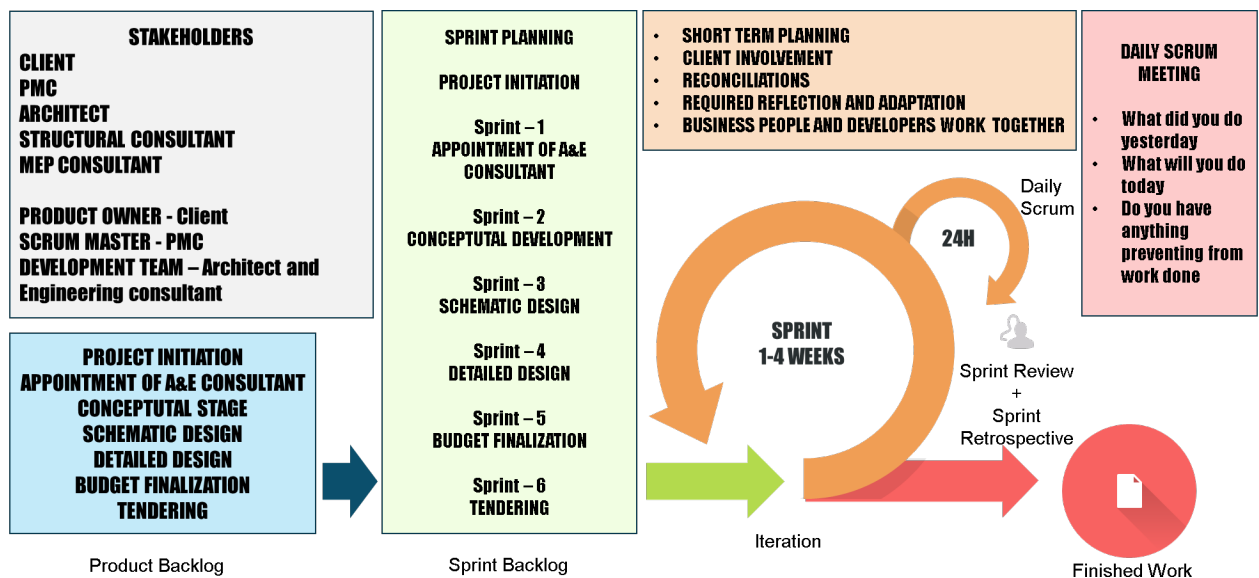
**Table 1.7 Product Backlog**

- In the simplest definition the Scrum Product Backlog is simply a list of all things that needs to be done within the project.
- The most important items are shown at the top of the product backlog so the team knows what to deliver first.

| S.No | PRODUCT BACKLOG                        | Sprint | Status |
|------|----------------------------------------|--------|--------|
| 37   | Review of MEP drawings                 | 4      |        |
| 38   | Finalization of MEP drawings           | 4      |        |
| 39   | BOQ of Architectural drawing           | 5      |        |
| 40   | BOQ of Structural drawing              | 5      |        |
| 41   | BOQ of MEP drawing                     | 5      |        |
| 42   | Project budget finalization            | 5      |        |
| 43   | Preparation of Bid Documents           | 6      |        |
| 44   | Architectural drawing for tender       | 6      |        |
| 45   | MEP drawing for tender                 | 6      |        |
| 46   | Appointment of contractors and vendors | 6      |        |
| 47   | Tender bid solicitation                | 6      |        |
| 48   | Tender bid submission                  | 6      |        |
| 49   | Selection of bid                       | 6      |        |
| 50   | Award of Contract                      | 6      |        |

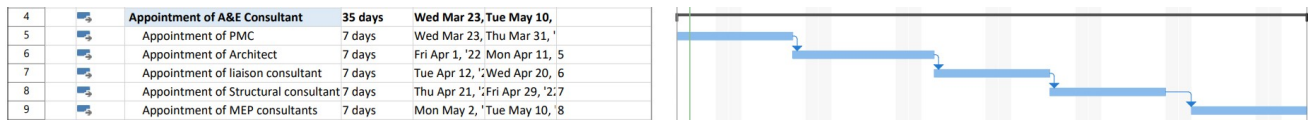
**Table 1.8 Product Backlog**

## 4.2.9 SCRUM PROCESS:

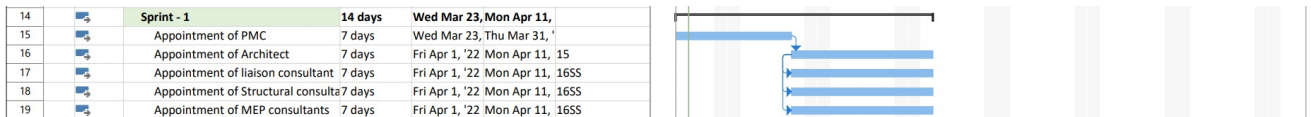


**Fig 1.13 Scrum Process**

#### 4.2.9.1 SPRINT - 1:



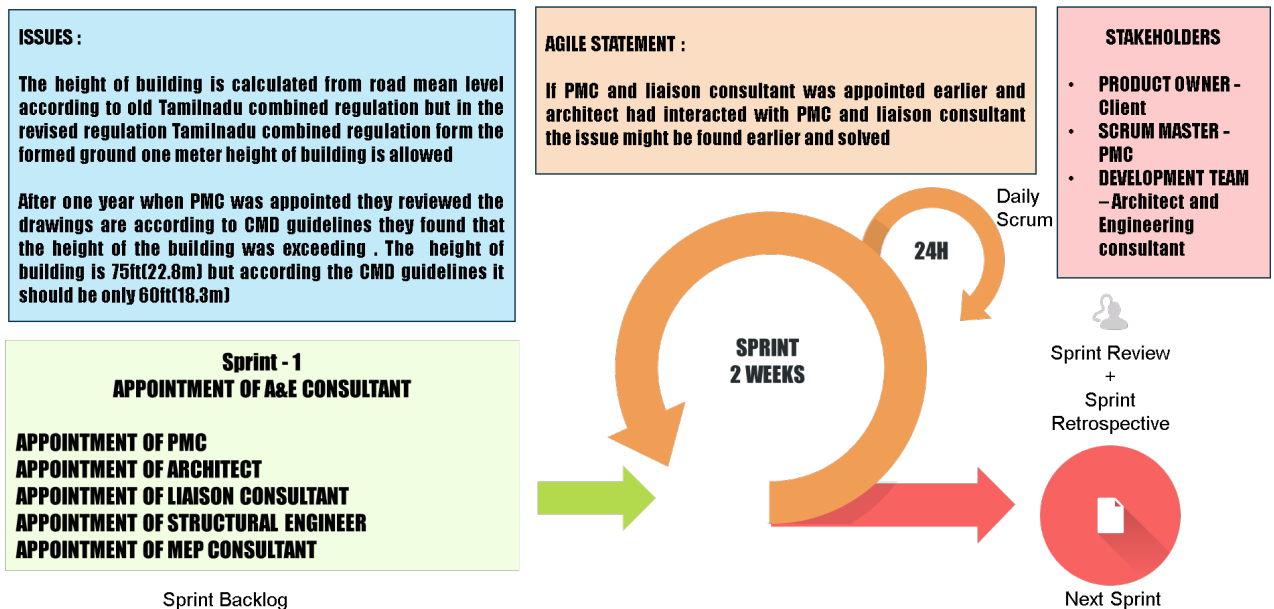
**Fig 1.14 Scheduling in TPM – SPRINT - 1**



**Fig 1.15 Scheduling in APM – SPRINT - 1**

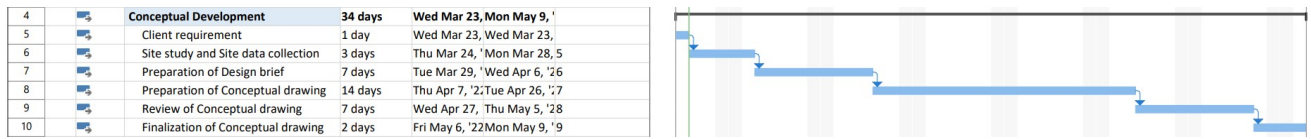
#### SPRINT – 1:

In sprint - 1 the appointment of A & E consultants activities is been done by the product owner - client. Where the client appoint the PMC and PMC will appoint the Architectural and Engineering consultants. In TPM the total no of days for appointment of A & E Consultant is 35 days while implementing agile methodology it can be done in 14 days.

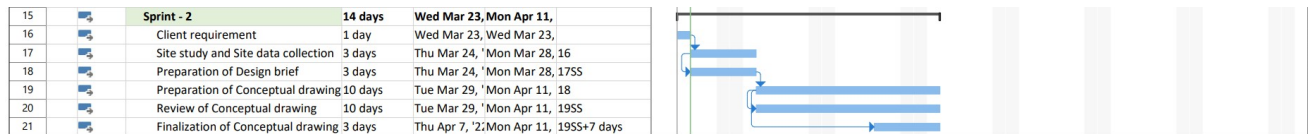


**Fig 1.16 SPRINT – 1 - Framework**

#### 4.2.9.2 SPRINT - 2:



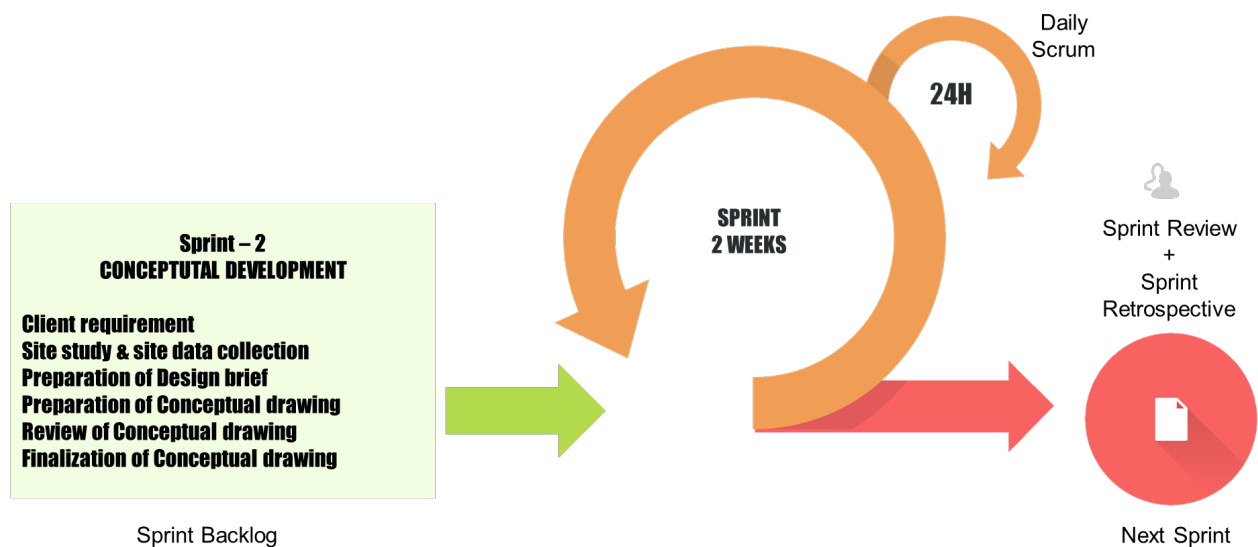
**Fig 1.17 Scheduling in TPM – SPRINT - 2**



**Fig 1.18 Scheduling in APM – SPRINT - 2**

#### SPRINT – 2:

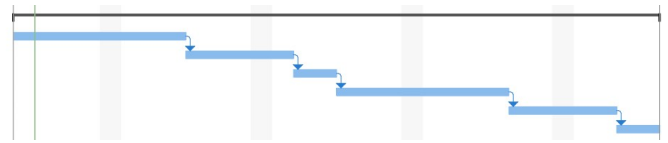
In sprint - 2 the conceptual development is been done by the development team - architect and engineering consultants. The site study site, site data collection, preparation of design brief and conceptual drawings are done in sprint - 2. In TPM the total no of days for Conceptual development is 34 days while implementing agile methodology it can be done in 14 days.



**Fig 1.19 SPRINT – 2 - Framework**

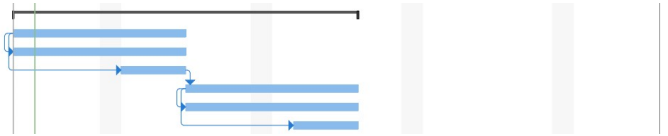
### 4.2.9.3 SPRINT - 3:

|    |                                                    |         |                                  |
|----|----------------------------------------------------|---------|----------------------------------|
| 4  | Schematic design                                   | 26 days | Wed Mar 23, Thu Apr 21, '17      |
| 5  | Preparation of Floor plans                         | 7 days  | Wed Mar 23, Wed Mar 30, '17      |
| 6  | Review of floor plans                              | 4 days  | Thu Mar 31, '17; Mon Apr 4, '17  |
| 7  | Finalization floor plans                           | 2 days  | Tue Apr 5, '17; Wed Apr 6, '17   |
| 8  | Preparation of Section, Elevation, Details and 3Ds | 7 days  | Thu Apr 7, '17; Thu Apr 14, '17  |
| 9  | Review of Section, Elevation, Details and 3Ds      | 4 days  | Fri Apr 15, '17; Tue Apr 19, '17 |
| 10 | Finalization of Schematic drawings                 | 2 days  | Wed Apr 20, Thu Apr 21, '17      |



**Fig 1.20 Scheduling in TPM – SPRINT - 3**

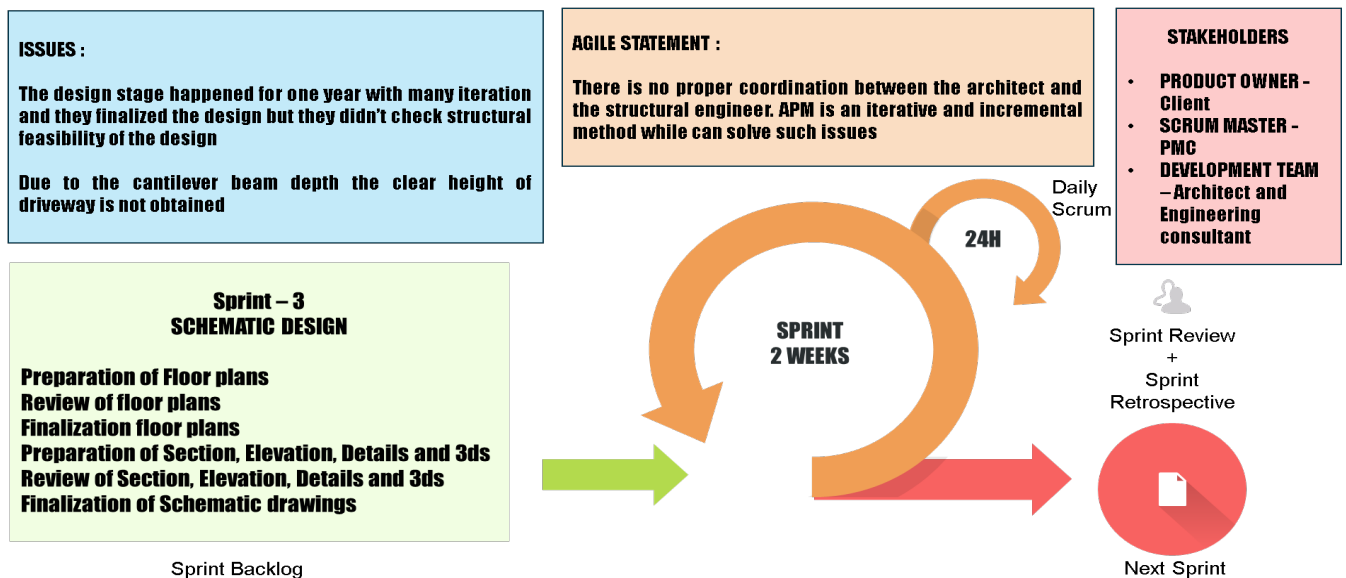
|    |                                                    |                |                                   |
|----|----------------------------------------------------|----------------|-----------------------------------|
| 14 | <b>Sprint - 3</b>                                  | <b>14 days</b> | <b>Wed Mar 23, Thu Apr 7, '17</b> |
| 15 | Preparation of Floor plans                         | 7 days         | Wed Mar 23, Wed Mar 30, '17       |
| 16 | Review of floor plans                              | 7 days         | Wed Mar 23, Wed Mar 30, '17       |
| 17 | Finalization floor plans                           | 3 days         | Mon Mar 28, Wed Mar 30, '17       |
| 18 | Preparation of Section, Elevation, Details and 3Ds | 7 days         | Thu Mar 31, '17; Thu Apr 7, '17   |
| 19 | Review of Section, Elevation, Details and 3Ds      | 7 days         | Thu Mar 31, '17; Thu Apr 7, '17   |
| 20 | Finalization of Schematic drawings                 | 3 days         | Tue Apr 5, '17; Thu Apr 7, '17    |



**Fig 1.21 Scheduling in APM – SPRINT - 3**

### SPRINT – 3:

The schematic design drawings is done in sprint - 3 by the development team - architect and engineering consultants. Preparation of floor plans, preparation of section, elevation, details and 3Ds are done in sprint – 3. In TPM the total no of days for Schematic design is 26 days while implementing agile methodology it can be done in 14 days.



**Fig 1.22 SPRINT – 3 - Framework**

#### 4.2.9.4 SPRINT - 4:

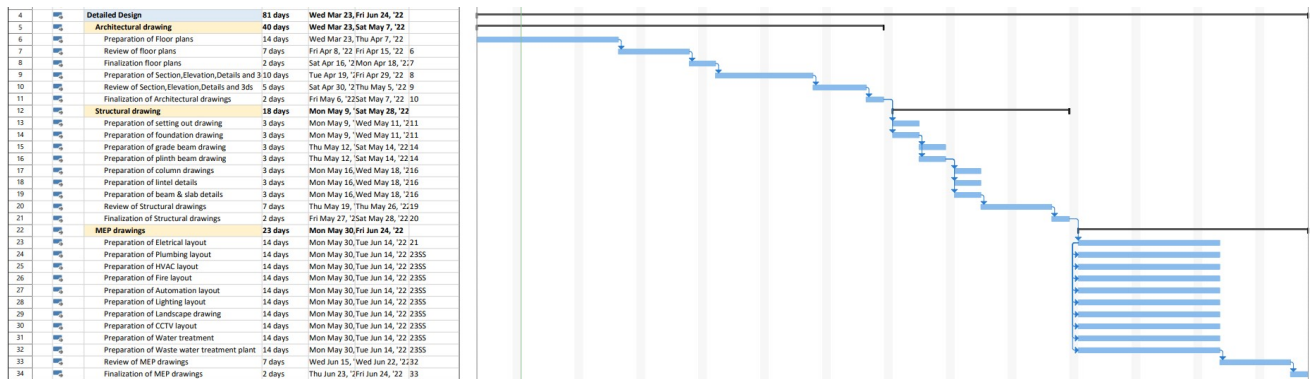


Fig 1.23 Scheduling in TPM – SPRINT – 4

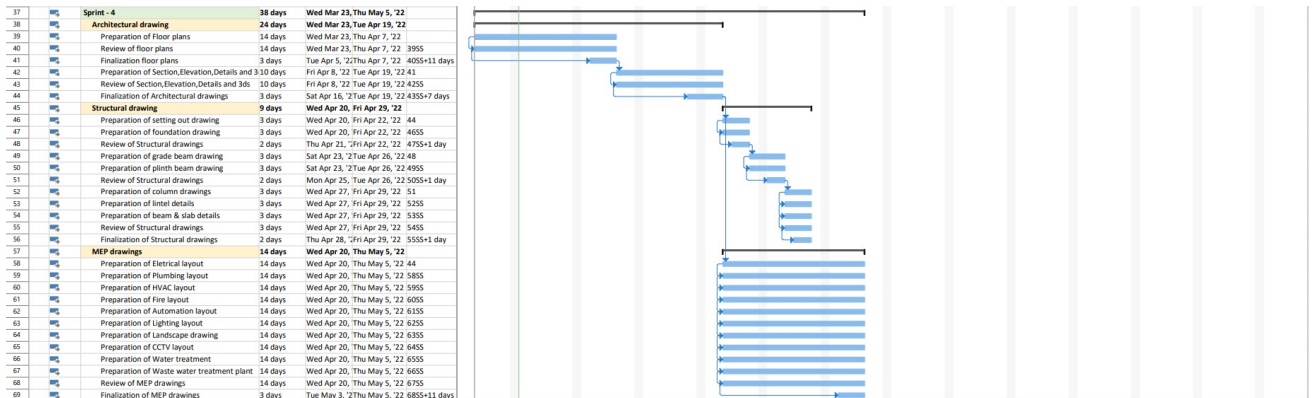
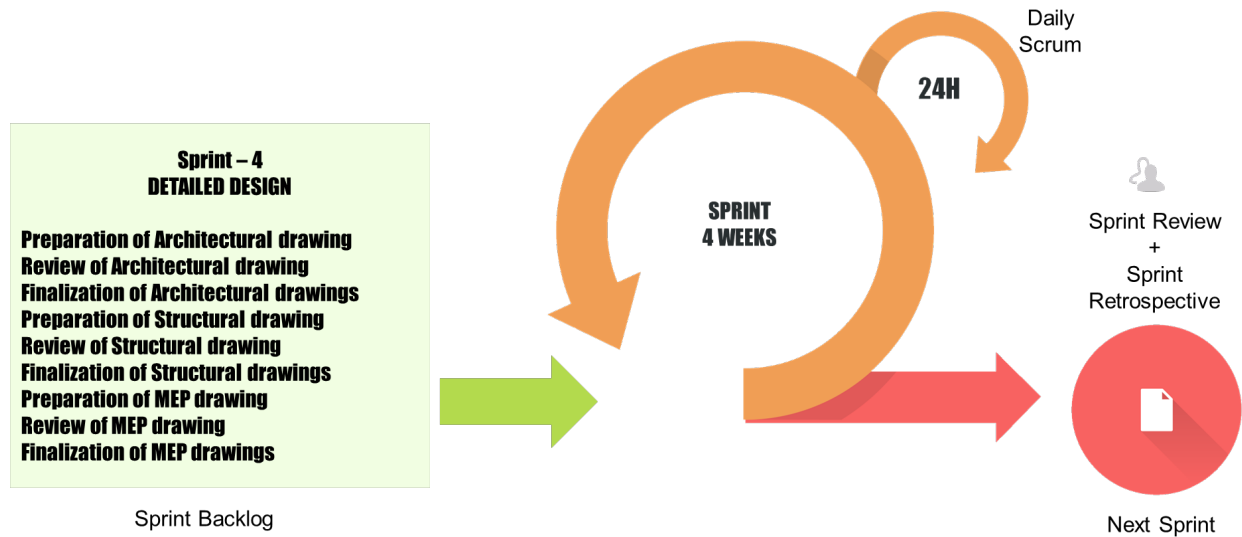


Fig 1.24 Scheduling in APM – SPRINT – 4

#### SPRINT – 4:

The detail design drawings is done in sprint - 4 by the development team - architect and engineering consultants. Preparation and finalisation of Architectural drawings, Structural drawings and MEP drawings are done in sprint – 4. In TPM the total no of days for Detailed design is 81 days while implementing agile methodology it can be done in 38 days.



**Fig 1.25 SPRINT – 4 - Framework**

#### 4.2.9.5 SPRINT - 5:



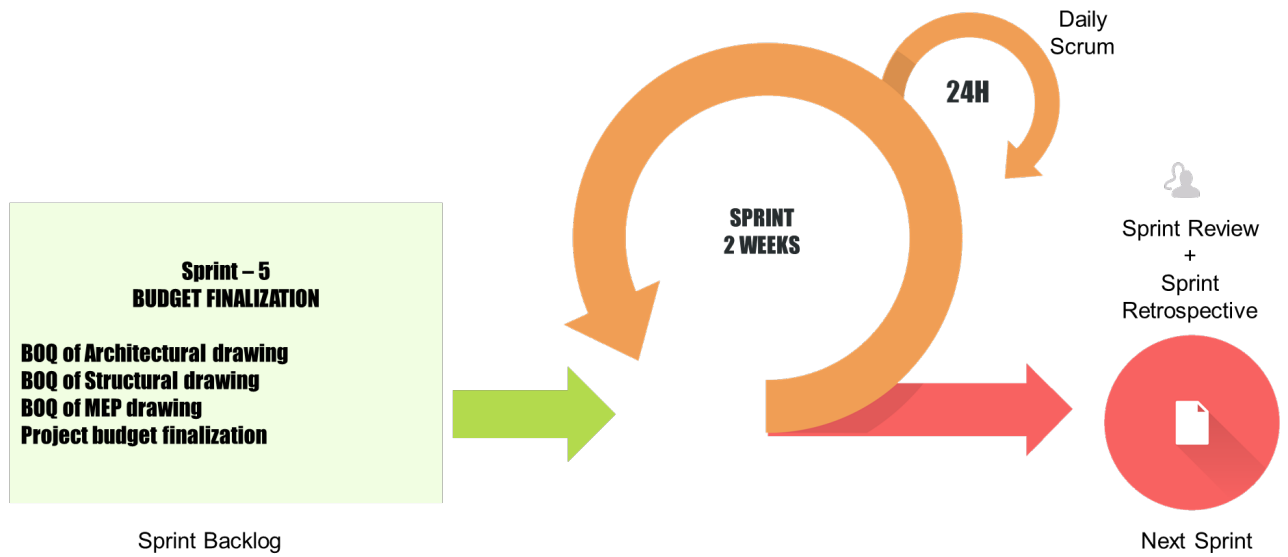
**Fig 1.26 Scheduling in TPM – SPRINT – 5**



**Fig 1.27 Scheduling in APM – SPRINT – 5**

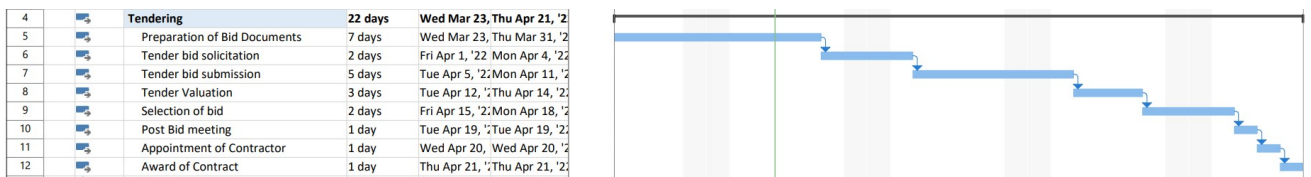
#### SPRINT – 5:

The project budget finalisation is done in sprint - 5. The BOQ of architectural drawings, structural drawings and MEP drawings are done and project budget is finalised in sprint – 5. In TPM the total no of days for Budget finalization is 9 days while implementing agile methodology it can be done in 3 days.

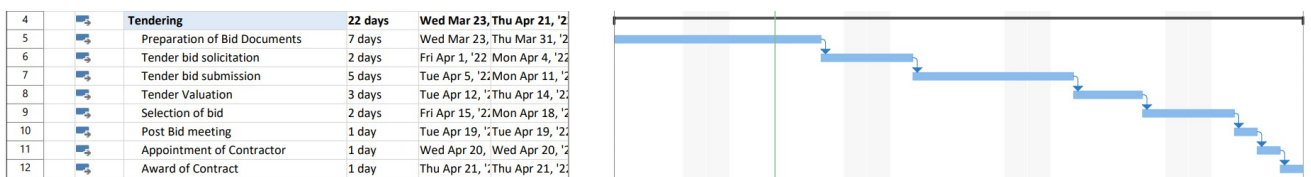


**Fig 1.28 SPRINT – 5 – Framework**

#### 4.2.9.6 SPRINT - 6:



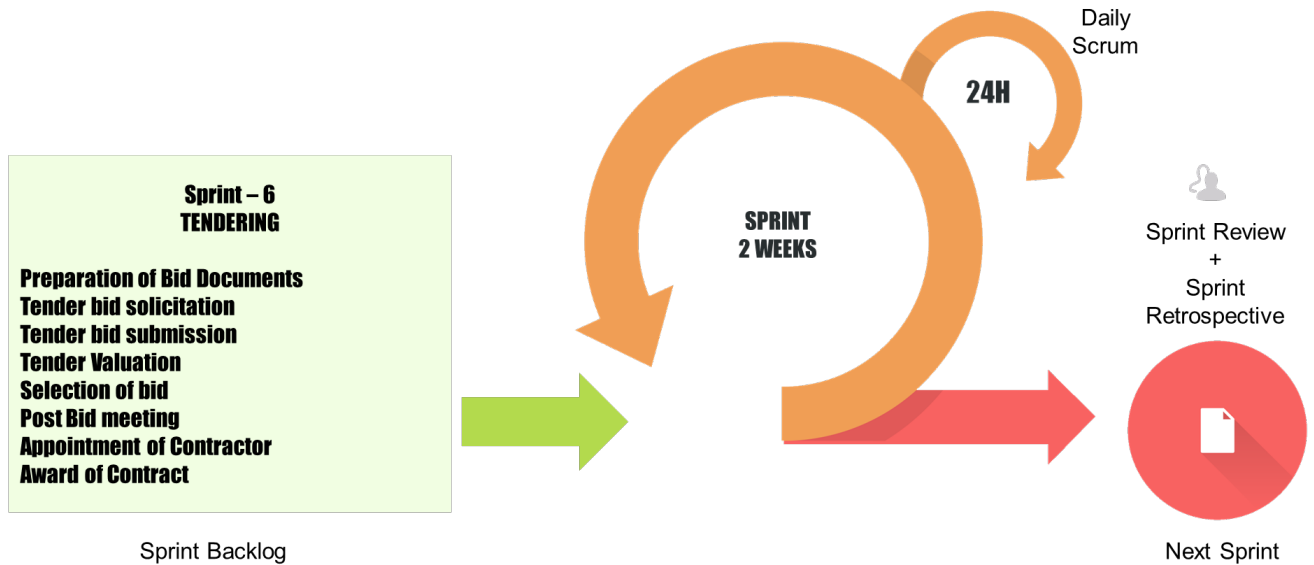
**Fig 1.29 Scheduling in TPM – SPRINT – 6**



**Fig 1.30 Scheduling in APM – SPRINT – 6**

#### SPRINT – 6:

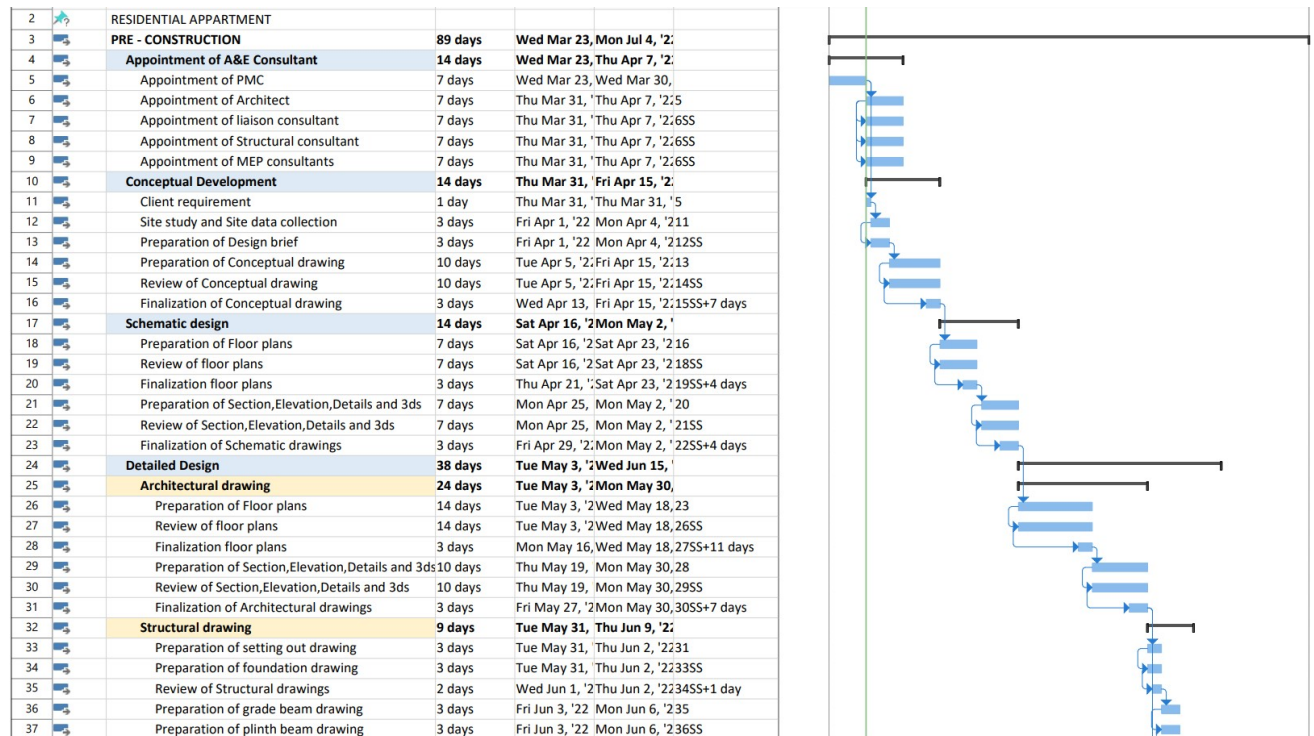
Tendering and contracting is done in sprint - 6. Preparation for bid documents, bid solicitation, valuation, selection of bid, appointment of contractors and award of contract is done in sprint – 6. In TPM the total no of days for Tender and contracting is 22 days while implementing agile methodology it can be done in 13 days.



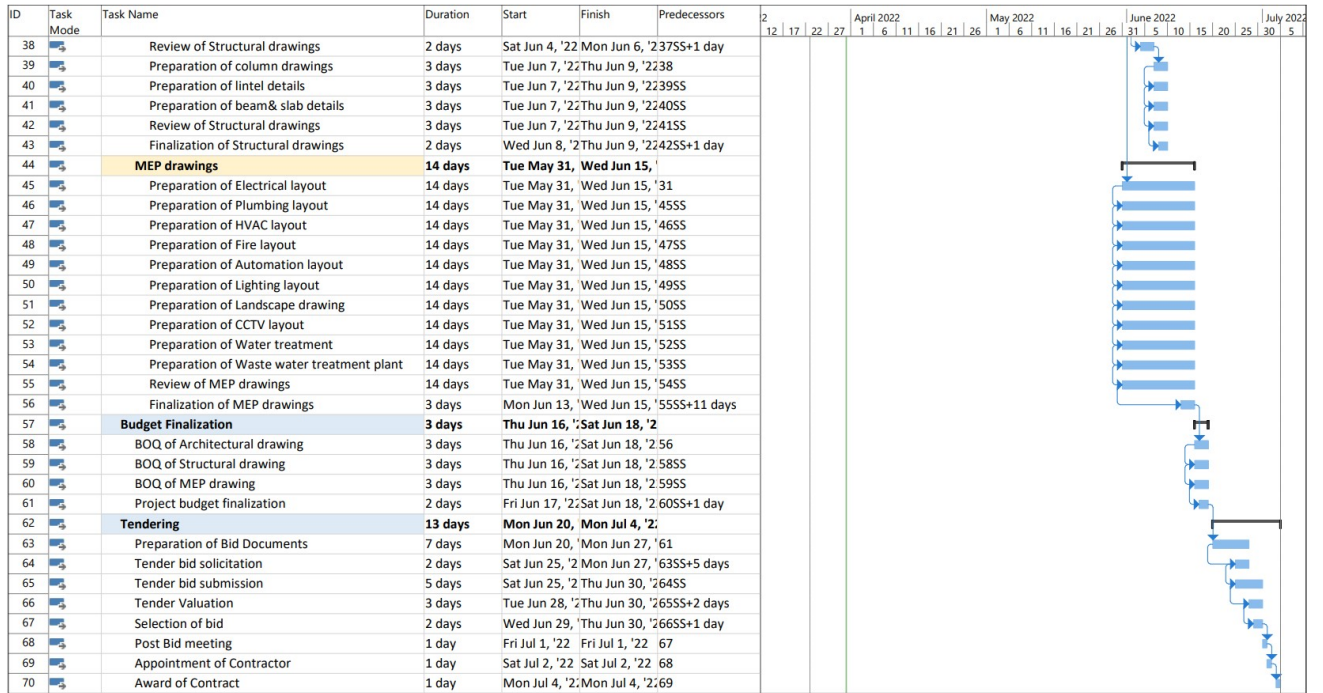
**Fig 1.31 SPRINT – 6 – Framework**

#### 4.2.9.7 SCHEDULING IN APM:

**No of days - 89**

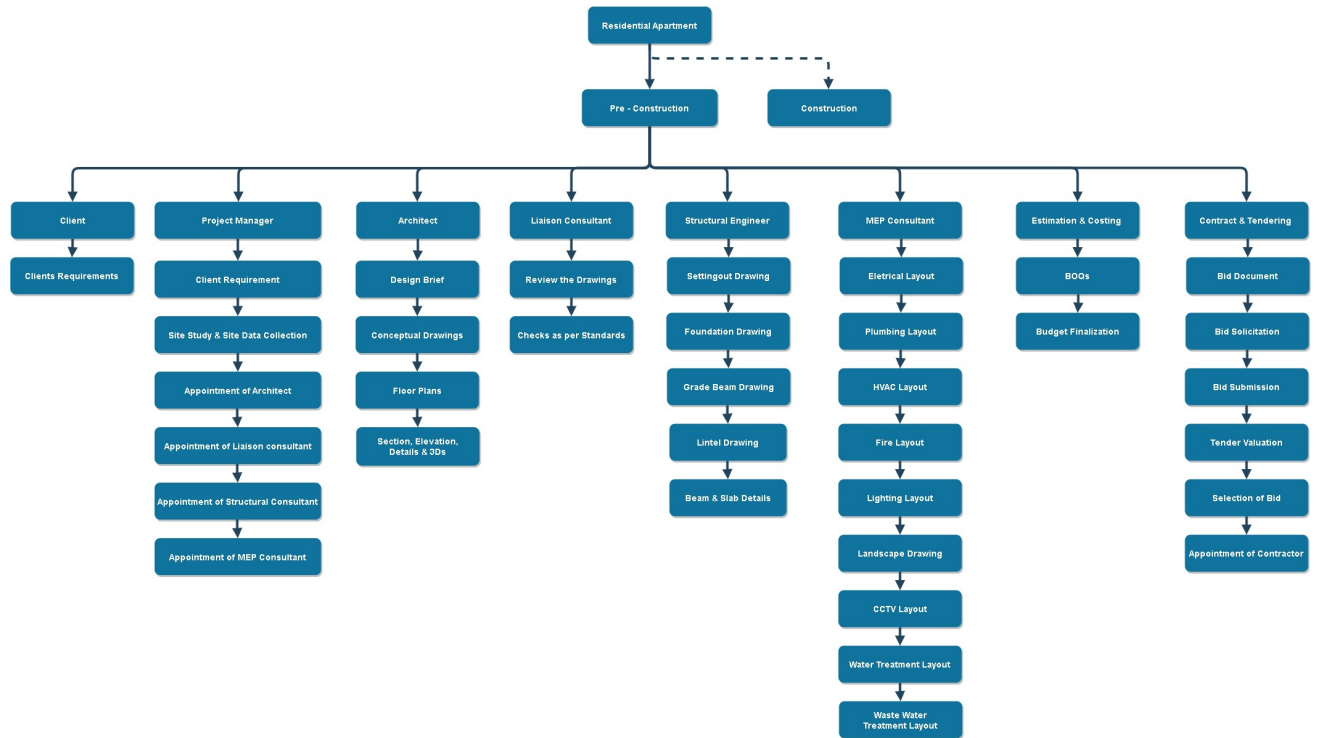


**Fig 1.32 Scheduling in APM**



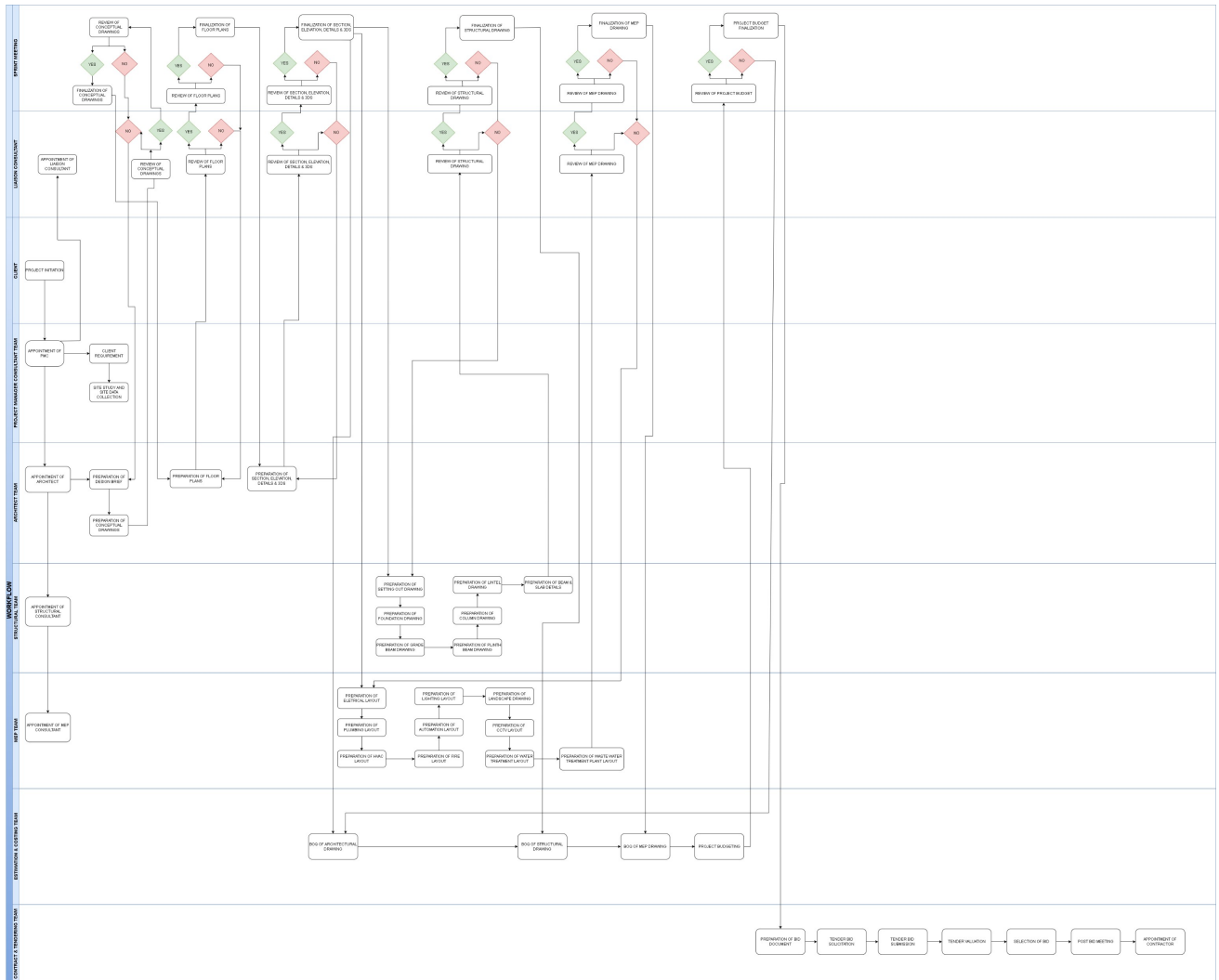
**Fig 1.33 Scheduling in APM**

#### 4.2.9.8 WORKFLOW:



**Fig 1.34 Work Flow**

#### 4.2.9.8.1 DETAILED WORKFLOW:



**Fig 1.35 Detailed Work Flow**

#### 4.2.9.9 DAILY SCRUM MEETING REPORT:

|                       |       |             |                  |         |         |
|-----------------------|-------|-------------|------------------|---------|---------|
|                       |       |             |                  | Date :  |         |
| RESIDENTIAL APARTMENT |       |             |                  | Time :  |         |
| Daily Scrum Meeting   |       |             |                  |         |         |
|                       |       |             |                  |         |         |
| Scrum Master          |       |             | Scrum Master     |         |         |
|                       |       |             |                  |         |         |
|                       |       |             |                  |         |         |
| Development Team      |       |             | Development Team |         |         |
| Development Team      |       |             | Development Team |         |         |
| Development Team      |       |             | Development Team |         |         |
| Development Team      |       |             | Development Team |         |         |
| Development Team      |       |             | Development Team |         |         |
|                       |       |             |                  |         |         |
| Comments :            |       |             |                  |         |         |
| Stakeholder - 1 :     |       |             |                  |         |         |
| Stakeholder - 2 :     |       |             |                  |         |         |
| Stakeholder - 3 :     |       |             |                  |         |         |
| Stakeholder - 4 :     |       |             |                  |         |         |
| Stakeholder - 5 :     |       |             |                  |         |         |
| Stakeholder - 6 :     |       |             |                  |         |         |
|                       |       |             |                  |         |         |
|                       |       |             |                  |         |         |
| Daily Progress        |       |             |                  |         |         |
| S.No                  | To Do | In Progress | Done             | Backlog | Remarks |
|                       |       |             |                  |         |         |
|                       |       |             |                  |         |         |
|                       |       |             |                  |         |         |
|                       |       |             |                  |         |         |
|                       |       |             |                  |         |         |

**Fig 1.36 Daily Scrum Meeting Report**

## CHAPTER 5 SUMMARY AND CONCLUSION

### 5.1 CONCLUSION:

| Issue Identified                                                                                                                                                                                                                                                 | Sprint     | Recommendation                                                                                                                                                                                                                                                                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The height of building is calculated from road mean level according to old Tamilnadu combined regulation but in the revised regulation Tamilnadu combined regulation form the formed ground one meter height of building is allowed                              | Sprint - 1 | <ul style="list-style-type: none"> <li>The architect was not aware of the revised Tamilnadu combined regulation If PMC and liaison consultant was appointed earlier and architect had interacted with PMC and liaison consultant the issue might be found earlier and solved</li> </ul> |
| After one year when PMC was appointed they reviewed the drawings are according to CMD guidelines they found that the height of the building was exceeding . The height of building is 75ft(22.8m) but according the CMD guidelines it should be only 60ft(18.3m) | Sprint - 1 | <ul style="list-style-type: none"> <li>The architect was aware of the CMD guidelines If PMC and liaison consultant was appointed earlier and architect had interacted with PMC and liaison consultant the issue might be found earlier and solved</li> </ul>                            |

**Table 1.9 Conclusion and Recommendation**

| Issue Identified                                                                                                                                                | Sprint     | Recommendation                                                                                                                                                                                                                                                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The design stage happened for one year with many iteration and they finalized the design but they didn't check structural feasibility of the design             | Sprint - 3 | <ul style="list-style-type: none"> <li>There is no proper coordination between the architect and the structural engineer. APM is an iterative and incremental method while can solve such issues</li> </ul>                                                            |
| Area also exceed the built-up area and they also calculated stilt area driver room area in the built-up area according to CMD guidelines it should not be added | Sprint - 4 | <ul style="list-style-type: none"> <li>The architect is not aware of the CMD guidelines, If architect and liaison consultant had interacted the issue might be found earlier and solved</li> </ul>                                                                     |
| Due to the cantilever beam depth the clear height of driveway is not obtained                                                                                   | Sprint - 3 | <ul style="list-style-type: none"> <li>Client and Architect was not aware of the clear height in driveway and they did not discuss the design with structural engineer and finalized the design they did not check the structural feasibility of the design</li> </ul> |

**Table 1.10 Conclusion and Recommendation**

- Agile project management is the advanced type of method used for construction project management instead of the traditional waterfall method. It can reduce the construction delay and uncertainty in the construction projects and also give better customer satisfaction. It also reduces the time overrun in construction work.
- By implementing sprint planning the barriers are resolved and it helps to have a clear understanding of all doubts. Easy to manage, easy to communicate, Risk involved in a particular sprint is discussed suggestions and corrections are made by all stakeholders involved in the project and weekly meetings (40-45min) with consultants and daily meetings (10-15min) with site people
- Kick – off-meeting – Face-to-face conversation with architect, engineer, consultants, and client. Drawings are made and discussed with all stakeholders involved in the project.
- In the conventional method, the total number of days for pre-construction phase is 186 days while implementing agile project management scrum method the total number of days is reduced to 89 days. This is because simultaneous work is carried out in agile project management
- In agile project management, the client will be forced to increase their participation, more or less for better delivery of work. Implementing agile project management will also result in client satisfaction at the end of the project. This is because this approach manages the product backlog, including the customer's requirements for the project.
- The major advantage of implementing agile project management in the pre-construction phase of the project is to increase communication between the architect, engineer, consultant, and client.

- The proposal of AFD Approval, Finalisation, and Discussion of sprint activities for the upcoming three sprints could manage the changes and freeze the design by a certain period.
- Agile project management follows an iterative approach using a scrum team wherever possible to check the defects and apply corrections in order to avoid reworks
- Backlogs - Frame backlogs shows the milestone to achieve, which act as a base for sprint meeting. The status of each milestone will be updated in the meeting like open, closed, and processed.
- Agile project management develops a proper communication flow between the architect, engineer, client, contractor, and consultant. Workers involved in planning, executing, controlling, monitoring, and reporting to scrum master
- Conventional method is not applicable for the design stage because the design stage has many changes. The timeline is fixed in the conventional method if there is any change in the design the entire process should be repeated from the first step but in Agile project management the project is been divided into various phases and it is an iterative process where the changes can be adopted easily
- The complex stage in the pre-construction is even if the architect design the building he has to get clarification and approval from all other consultants.
- Breaking down the design stage into various phases and setting target timelines and review the timelines with a sprint review and complete the task
- In Agile project management scrum, all stakeholders are involved in the sprint meetings so all stakeholders will know what's going in the project and if there are any issues they can be identified and solved quickly

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