

STRATEGIES TO OVERCOME CONSTRUCTION DELAY OF A MID-RISE OFFICE BUILDING

A Thesis

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

by

KARTHICK.P (39840009)



**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

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BONAFIDE CERTIFICATE

This is to certify that this Report is the bonafide work of **KARTHICK.P (39840009)** who carried out the Thesis entitled "**STRATEGIES TO OVERCOME CONSTRUCTION DELAY OF A MID-RISE OFFICE BUILDING** " under our supervision from January 2021 to May 2021.

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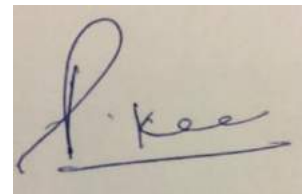
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DECLARATION

I **KARTHICK.P** hereby declare that the Thesis Report entitled “**STRATEGIES TO OVERCOME CONSTRUCTION DELAY OF A MID-RISE OFFICE BUILDING**” done by me under the guidance of **Ar. M.PRIYADHARSHINI** (Internal) and **Ar SARATH C. KANTH**, Principal Architect, Designtech (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:

PLACE:

A handwritten signature in blue ink, appearing to read 'K. P.' with a stylized flourish underneath.

SIGNATURE OF THE CANDIDATE

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ABSTRACT

In India, construction is the second largest economic industry next to agriculture. The construction industry's delay crisis is a global phenomenon. Many construction projects experience delays, which can be simple or complex. Different factors that cause project delays should be evaluated and handled correctly to prevent project delays. Hence the research contains various factors which are responsible for delay in mid-rise office building projects. A questionnaire was prepared by considering the various factors that causes delay in the construction industry. The collected list contained 16 causes for delay were categorized. This questionnaire was sent to different owners, consultants and contractors for the ranking of the various factors. This data was used to analyze "Importance index" of different delay factors. The study aimed to provide the compilation of different views of researchers and results clearly showed that every group of researchers gave different ratings for various factors causing delay. To Prove that evidentially have taken up a live case study of Mid-Rise Office Building which has several concurrent delays and listed out the delay factors occurred in that, and to know the what are all the delay factors occurs in the same typology of building picked up an another case study and stated out the delay factors occurred in that and compared all the delay factors occurred as a whole and picked out the major repeating delay factors from all and suggested a suitable solution for that, Thus, we have like to conclude from this analysis that concentrating on major delay variables obtained from the study would almost eliminate the likelihood of staying on board with the construction project's actual schedule and budget.

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CHAPTER 1

1.1 INTRODUCTION

Construction delays are a global issue that affects not just the construction industry but the entire economy. The construction industry's delay crisis is a global phenomenon. Many construction projects experience delays, which can be simple or complex. The term "delay" refers to the length of time it takes to complete a project. Construction delays are a common issue in the civil engineering industry. A construction delay is described as a period of time that extends beyond the contract deadline or the date agreed upon by the parties for the project's completion. Excusable (outside of control) and non-excusable delays may be distinguished (with in control of the contractor).

Delay can occurred due to many reasons:

1. Owner related delay
2. Consultant related delay
3. Contractor related delay
4. Material related delay
5. Labour and consultant related delay
6. Project related delay
7. External related delay

Delays are insidious often resulting in time overrun, cost overrun, disputes and litigation. The most common delay analysis include the CPM (critical path method), as planned expanded technique, collapsed but for technique, windows technique, bar chart etc.

DELAYS AND COST OVERRUNS:

A construction project may be considered a successful investment until it meets the cost, time, and quality constraints that have been applied to it. It is not uncommon, however, for a construction project to fail to meet its objectives within the budgeted cost, time, and quality constraints.

TIME DELAYS:

Construction project delays damage clients, vendors, and consultants in terms of the development of adversarial relationships, mistrust, lawsuits, arbitration, and cash-flow issues. "Project management" is used to anticipate and mitigate unnecessary delays. Expertise, qualifications, tools, and processes are all used in project management. project

activities to fulfil the requirements of the project and involves effective management of the processes of project management.

1.2 AIM:

To analyze and articulate the strategies to overcome various delay factors during construction stage of a mid-rise office building

1.3 SCOPE:

This research is needed to determine the degree to which these delay principles are understood and applied in emerging with, and field operation. The project's scope involves an inquiry into the various causes of construction project delays in the Indian context.

1.4 NEED FOR STUDY

In a construction project, delay analysis is critical since it affects the project's length and expense. To prevent project delays, various factors that cause delays should be identified and properly handled. For the construction project to run smoothly, different recommendations or delay management strategies would be beneficial. As a result, further research is required in Indian construction projects, for recommendation of some guidelines to minimize project delay.

1.5 OBJECTIVES

The primary aim of construction is to complete the project according to the specifications, on time, and on budget, while making efficient use of all available resources such as manpower, materials, capital, and equipment.

The main objectives of this study are:

- To identify different causes of delay in construction project.
- To analyse delay factors.
- To quantify delay duration in choosen case study

1.6 METHODOLOGY

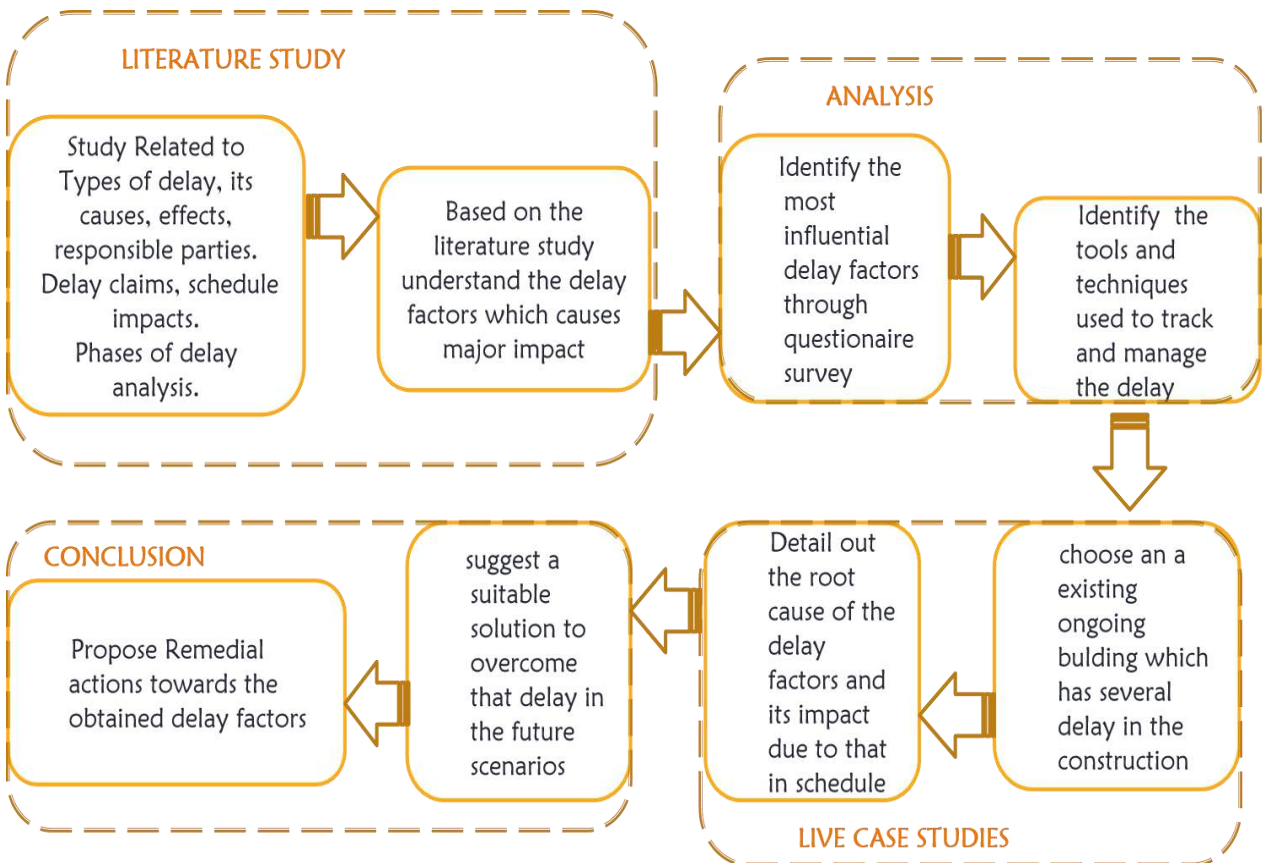


Figure 1.1 Methodology

CHAPTER-2 LITERATURE REVIEW

2.1 Processes in Construction Project Management:

Project management processes have been sorted into five categories known as Project Management Process Groups.

1. Project Initiating
2. Project Planning
3. Project Execution
4. Project Monitoring & Control.
5. Project Closing

Plan Tracking & Control comes under the detection and analysis of delays. If handled correctly, it is possible to reduce delays by:

- Coordination
- Thorough inquiries
- Monitoring and meetings carefully & regularly.
- Successful leadership.
- Working and coordinating collaboratively & efficiently.
- Careful preparation.

2.2 Types of Delays in Construction Projects:

Before evaluating construction delays, however, it is important to recognize the types or categories that a delay falls into. A clear understanding of the types of delays is important in order to undertake further mitigation efforts and turn them into merit.

The delays are categorized into four basic ways:

- A) Critical or non-critical delays
- B) Excusable or non-excusable delays
- C) Concurrent delays
- D) Compensable or non-compensable delays

Before determining the impact of delays on the project, there is also a need to understand the assimilation between the categories.

- If the delay is critical or non-critical, one must determine.
- All delays are often either excusable or non-excusable.
- It is possible to describe both excusable and non-excusable delays as either concurrent or non-concurrent.
- Delays may be broken down further into delays that are compensable or non-compensable.

2.2.1 Critical or non-critical Delays:

delay that is responsible for extending project duration is critical. Few results are mentioned below:

- Extended Field Overhead.
- Unabsorbed home office overhead.
- Liquidated Damage.
- Idle labour& equipment cost.
- Labour& Material Cost increase and many more.

A delay that is not the cause of extended project duration is non-critical; however, it will affect terms of activities getting completed late than scheduled completion. These activities tend to impact the project cost estimates as repeated below;

- a) Idle labour& equipment cost
- b) Labour& Material Cost Escalation and many more.



Figure 2.1 delay classificaions

2.2.2 Excusable & non-excusable Delay:

A delay where the contractor is entitled to an extension of time or compensation or both, under the terms & conditions of the contract is an excusable delay. In this case, the contractor does not have any control over the activity getting delayed. Client delays (approvals, decisions, etc.), etc. The causes may be;

1. Force Measure Clause
2. Natural Calamities
3. Political/Social Unrest
4. Terrorist Attacks

Non-excusable delays are a delay where the contractor is entirely responsible for the activities being postponed and resulting in an extension of project length (responsible for critical delays). In this scenario, the contractor must bear the burden of cost effects, including the responsibility to pay costs for itself, but likely even for the other party.

The causes may be:

- Delayed Mobilization
- Delayed Procurement
- Delayed submission of important documents
- Planning & Scheduling
- Critical events that were not highlighted to the client at the right time, etc.

2.2.3 Concurrent Delays in Construction Projects

A simultaneous delay is a condition where there is more than one delay occurrence at the same time involving several activities simultaneously/independently affecting the completion. Not all these incidents, however, cause the contractor to be entitled to an extension of the claim for time & expense. Importantly, it is the causes of delay that must overlap, rather than the delay itself.

2.2.4 Compensable or non-compensable Delays in Construction Projects

The case is compensable delays where the contractor is responsible for Time Extension & Cost compensation. Both compensable delays are subject to excusable delays, whereas if the contractor is solely responsible for the occurrence of a delay, the delay is considered non-compensable. However, depending on the situation it has created and the terms of the contract, the non-compensable can fall under critical, non-critical, excusable, or non-excusable conditions.

2.3 COST OVERRUNS

Any construction project consists of direct and indirect costs, which constitute the cumulative costs and expenditures arising from the usage of the key components of the construction project implementation.

Different classifications of construction project costs and their features are as explained.

Types of Construction Project Costs:

Some of the unique costs found in building projects are explained below before heading into the key project cost classification.

Fixed Cost:

This is defined as the cost spent once for a particular point in time. The acquisition of equipment, machinery, and so on comes under fixed cost resources.

Time-Related :

Time-related cost is the expense spent for a specific activity for a given time. The cost spent on wages, equipment, and shelter rents, and so on goes under this class.

Quantity -Proportional Cost :

This quantity – proportional cost will vary depending on the quantities. Materials costs are examples of quantity-proportional costs.

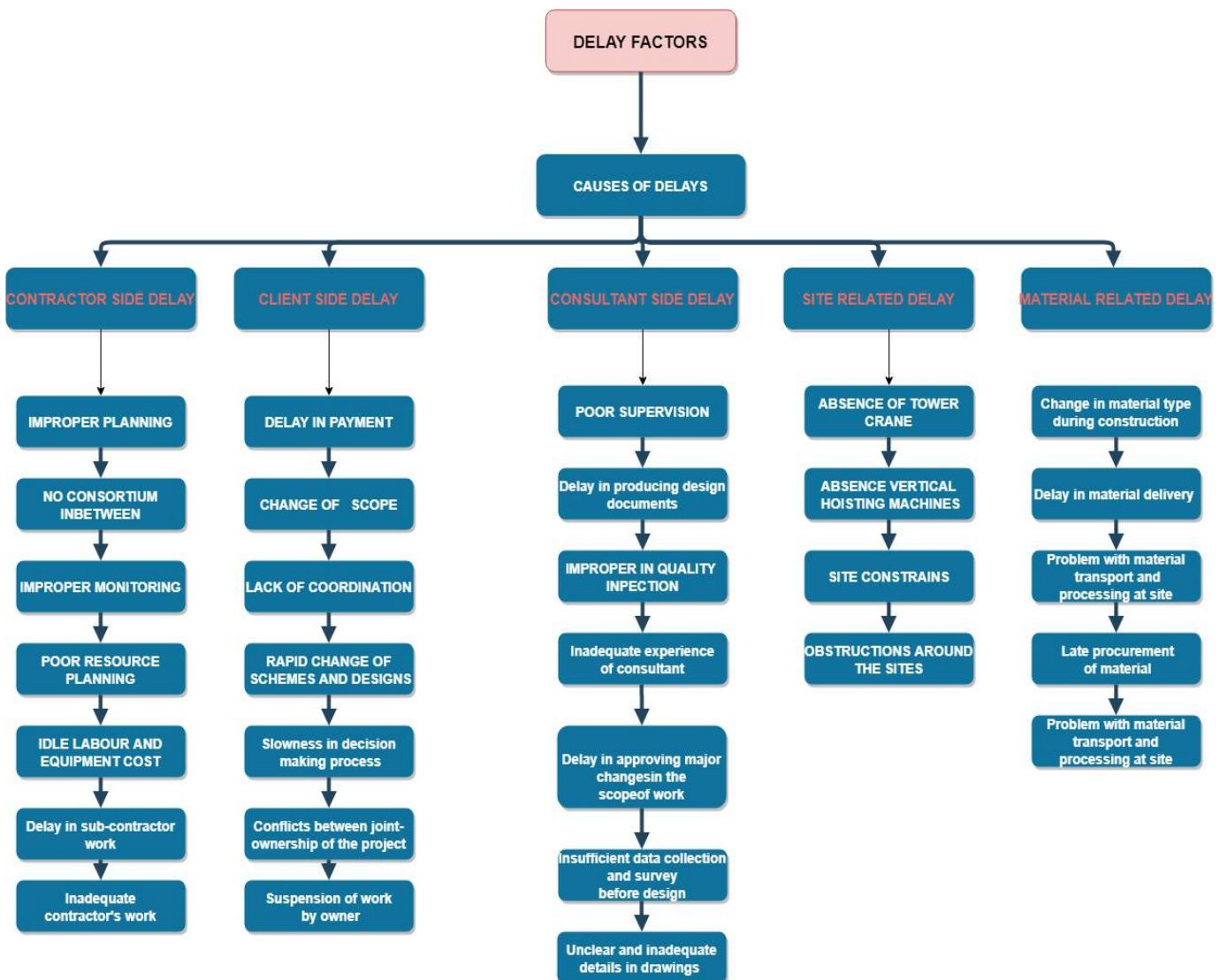


Figure 2.2 delay factors types

CHAPTER -3 JOURNAL REVIEW

3.1 JOURNAL PAPER-1

System Dynamics Approach for Investigating the Risk Effects on Schedule Delay in Infrastructure Projects

This paper focuses a lot on the effective risk management for the success of the infrastructure projects in common. A hybrid research strategy has been used in this study. First, a thorough review of various kinds of literature has been done and the risk cited were connected with various stakeholders of the project like Client, Contractor, Designers, Subcontractors, local authority, and external environment. Depending on the risks, a questionnaire survey has been developed and the consequence of each risk on the project schedule has been collected as a response and was ranked and analyzed using the risk importance index method. Then the System Dynamics model was introduced and dynamic interaction was developed.

INFERENCE:

This paper has implicated 6 major risks that cause a delay in the schedule in infrastructure projects. Of course, the most important implication to the industry is that project risk managers should envisage the dynamic interactions between diverse risks and therefore, take them into full consideration when performing a risk assessment.

3.2 JOURNAL PAPER-2

Delays in Building construction projects in Ghana

The study sought the relative importance of the factors that cause delays in building construction projects in Ghana, from that study showed that all three groups of respondents generally agreed that out of an aggregate of 32 elements the main ten affecting factors in causing delay being arranged in descending order of significance are:

- 1) Delay in regarding declarations.
- 2) Underestimation of the expenses of projects.
- 3) Underestimation of the multifaceted nature of the project.
- 4) Difficulty in getting to bank credit.
- 5) Poor supervision.
- 6) Underestimation of time for finishing of activities by contractors.
- 7) Shortage of materials
- 8) Poor professional management.
- 9) Fluctuations of prices/rising cost of materials.
- 10) Poor site management.

INFERENCE

In this study, 32 factors were categorized into nine major groups and were ranked. The outcome shows that client, consultants, and contractual workers all concurred that the financing group of delay factors was the most persuasive factor. Material factors were viewed as the second most significant factor causing a delay in construction projects followed by scheduling and controlling factors and recommended a few solutions for the delay.

3.3 JOURNAL PAPER-3

Method of Calculating Schedule Delay Considering Lost Productivity

This paper focuses a practical method for converting lost productivity in to schedule delay. Among the various factors that causes delay thus study focus on the factors that cause loss of productivity. Few kind of productivity are:

- Labour productivity
- Equipment productivity

INFERENCE:

This study focuses on labour productivity because labour productivity representatively shows all kind of productivity. Productivity may be defined as the quantity of work produced per man hour, per equipment hour. This paper presents a method of calculating schedule delay considering lost productivity is an attempt to settle claims without litigation.

CHAPTER-4 Questionnaire Survey

4.1 Identification of factors that causes delay through literature review:

Journals and research papers related to delays and cost overruns are referred. After a detailed study of papers, different factors causing time and cost overruns are listed.

Preparation of questionnaire based on factors identified:

Referred in many journals and identified the main factors influencing the cost and time overrun in projects and formed a questionnaire survey on cost-related factors and time-related factors individually.

4.1.1 Questionnaire Survey:

The formed questionnaire survey was circulated to many major players in construction industries to know the exact factors influencing the cost and time overrun from their perspective.

4.1.2 Data Collection

The responses were recorded from the circulated questionnaires and were used for further analysis.

4.1.3 Analysis

To analyze the recorded responses, we used RII method to obtain the frequency of factors influencing the cost and time overrun.

4.1.4 FACTORS OF SCHEDULE DELAY

There is no consensus in the literature on the identification of factors that affect the time and cost of a construction project, as each independent research views the subject from different perspectives. This might be the project type, size, area, sort of agreement, and so on.

Factors that affect the schedule delay are both related to cost and time overruns, the main factors are taken into the survey for better results.

- 1.Approval delays
- 2.Land acquisition and other procurement delays
- 3.Arranging finances from the owner or contractor side
- 4.Improper planning and scheduling
- 5.Inaccurate estimation of Resources
- 6.Poor contract management
- 7.Poor resource management
- 8.Design changes and changes in the scope of work
- 9.Poor weather and Unforeseen site conditions
- 10.Inflation in the prices of resources
- 11.Inexperienced employees or skilled labors
- 12.Poor site management
- 13.Rise in transportation cost from planned cost
- 14.Rework or Defective workmanship
- 15.Poor documentation
- 16.Political issues

4.1.5 QUESTIONNAIRE SURVEY

Few factors from the above literature survey which are frequently repeating and are majorly affecting the time and cost overruns in construction projects are considered. The questionnaire contained the following three major sections

Section 1: Reasons for delay in the Initial stage of a project

Most of the delay impacting factors happen all over the construction phase but the initial stages of the project have a fair share of factors that will be vital in these time and cost overruns. Section one has the factors of delay in the initial stages of the project.

Section 2: Reasons for delay in the construction stage of the project

In this section the factors of delays that pops up in the construction phase of a project. These play an important role because not resolving these can lead the project to go in vain.

Section 3: Reasons for delay in the Finishing stage of the project

The factors under this section happen in the final and construction phases of the project. These are main factors that can lag the project and result in the schedule delay of the project which in turn results in cost and time overruns

Likert Scale for Rating of Responses

1.- No Impact 2.- Very Low Impact 3.- Low Impact 4.- High Impact 5.- Very High Impact

FACTORS	1	2	3	4	5
APPROVAL DELAYS					
LAND ACQUISITION AND OTHER RESOURCE PROCUREMENT DELAYS					
ARRANGING FINANCES FROM OWNER OR CONTRACTOR SIDE					
IMPROPER PLANNING AND SCHEDULING					
INACCURATE ESTIMATION OF MATERIALS					
POOR CONTRACT MANAGEMENT					
POOR RESOURCE MANAGEMENT					
DESIGN CHANGES AND CHANGES IN SCOPE OF WORK					
POOR WEATHER AND UNFORESEEN SITE CONDITIONS					
INFLATION IN PRICE OF RESOURCES					
INEXPERIENCED EMPLOYEES OR SKILLED LABOURS					
POOR SITE MANAGEMENT					
RISE IN TRANSPORTATION COST FROM PLANNED COST					
REWORK OR DEFECTIVE WORKMANSHIP					
POOR DOCUMENTATION					
POLITICAL ISSUES					

Table 4.1 Delay factors

CHAPTER 5

5.1 LIVE CASE STUDY-1

TIL CORPORATE OFFICE , MOUNT ROAD, CHENNAI

TYPOLOGY : OFFICE (TIL CORPORATE OFFICE)

Location: Taj Club House Road

Plot size: 50,000 sft

Area of the project: 60,000 sft (incl. basements)

Status: Under construction

Storey : G + 6



Figure 5.1 Til corporate office

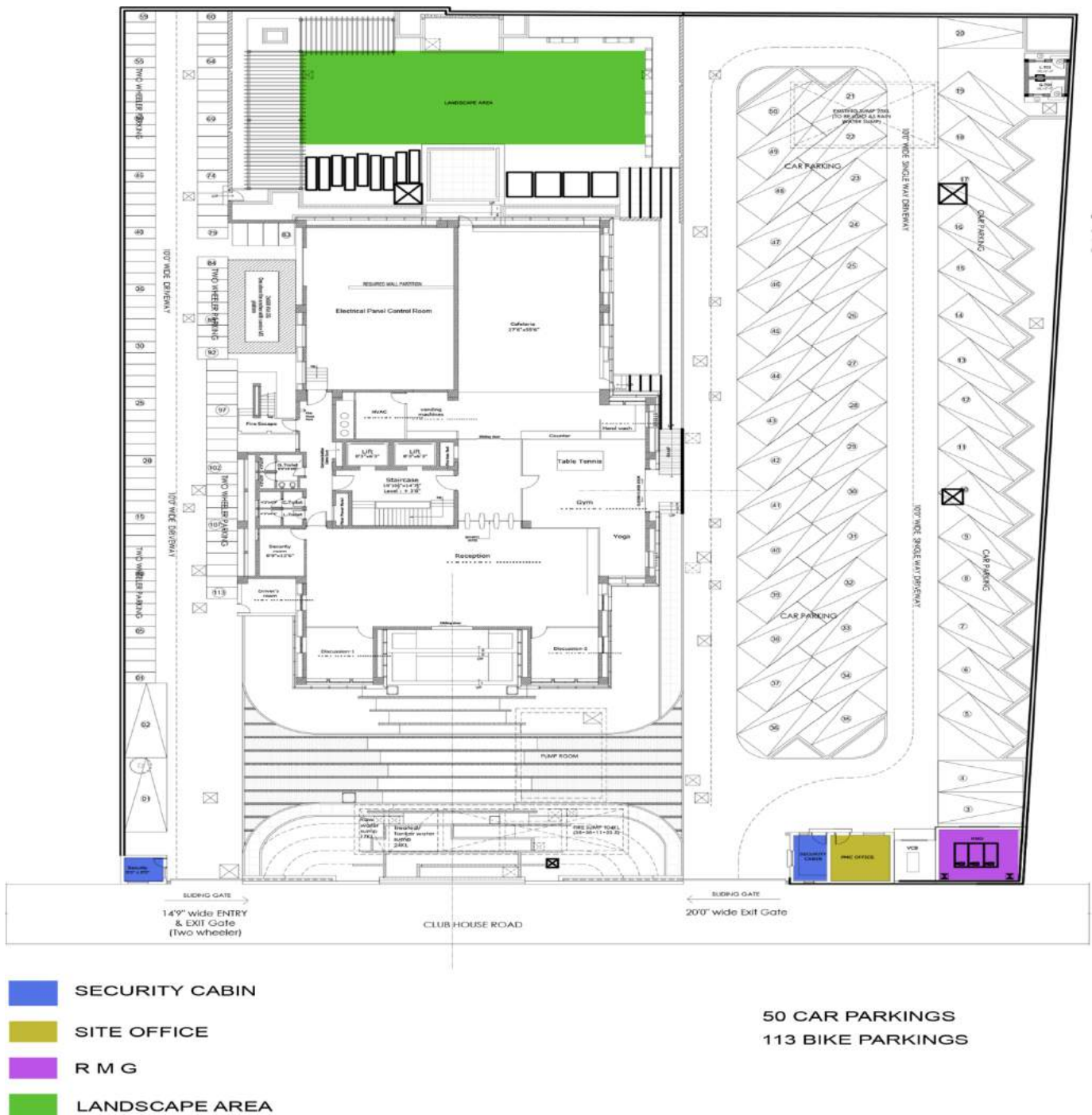


Figure 5.2 Site plan

5.1.1 CONSULTANTS:

PROJECT NAME	TIL CORPORATE OFFICE
LOCATION	CLUB HOSUE ROAD
CLIENT	TAGROS
ARCHITECTURAL CONSULTANTS	KHARCHE & ASSOCIATES
INTERIOR DESIGNERS	TALATI & PANTHAKY ASSOCIATES
PROJECT MANAGEMENT CONSULTANCY(PMC)	KHARCHE & ASSOCIATES
MEP CONSULTANT	SUMANAM ENGINEERING Ltd
STRUCTURAL CONSULTANT	Jays Civil Tech Pvt Ltd
IGBC CONSULTANTS	M/s En3 Sustainability Solutions Ltd
KITCHEN CONSULTANT	Chef Arora
LANDSCAPE CONSULTANT	GENUIS LOCI

5.1.2 CONTRACTORS:

	DISIPLINE	NAME
1	Civil Contractor , External Glazing, ACP UPVC , Steel works	Power Builders
2	Interior Contractor , Electrical (Low- Side) Contractor	Cherry Hill Interiors
3	HVAC Contractor	M/s . Cold Points Pvt. Ltd
4	HVAC (ODU) Supplier	M/s . Daikin Airconditoning
5	Fire Fighting & Fire Alarm System	KHARCHE & ASSOCIATES
6	IT Passive Networking Work	M/s VJ Network Pvt . Ltd
7	Electrical (High- side) Contractor	Shri Vaari Electricals

5.1.3 DELAY FACTORS WHICH OCCURED IN THE BUILDING:



5.1.4 Consequences of delay factors :

1. (Due to delay in the construction these are all the works that have been getting affected as stated by PM)
2. Each contractors works are more depended on the other contractors works
3. Work Task checklist is not been followed while doing a particular work
4. They are not following any quality checklist and quality audit procedure after a completion of work
5. Rectification of works are not done using Snag list
6. There is no Third party inspection or commissioning (quality inspector)
7. Due to Material scarcity un approved materials which is not been listed in the list of approved makes are being used
8. Material Procurement manegement are not Properly followed
9. Quality of work is been affected due to poor supervision which leads to Reworks
10. Due to poor communication between PM and contractors several works are been delayed
11. As planned Schedule is not followed
12. Alteration and Reworks are getting delayed beacause that should be done only after the approval from the Architectural consultancy
13. Minutes of meetings and weekly contractors meetings are not been followed due to unavailability for other contractors

Out of several delay factors obtained from the case study we are highlighting the most prominence delay factors in that and elaborating with particular impact happen due to that

Delay Factors	out - turn
POOR DOCUMENTATION	Building scope was changed after civil core construction was finished
DESIGN CHANGES AND CHANGES IN SCOPE OF WORK	Due to Scope change Many additional scope of work was added to the project which was not mentioned in the earlier stage
POOR COMMUNICATION	There is no consortium between the contractors
IMPROPER PLANNING AND SCHEDULING	Due to work dependencies as planned schedule is not feasible in this case

5.1.5 POOR DOCUMENTATION:

If you do not organize and file your documents correctly that could lead to put your organization's security at risk , If you do not have a centralized hub for handling of documents, you risk losing track of revisions. There is nothing worse than sending out an old version of a document to contractors just before an important activity. Even an outdated agenda may cause you to miss an important issue for a timely vote.

MEETINGS	STAKEHOLDERS INVOLVED	Duration
Progress Review meetings	Project Review meeting chaired by Project Manager, attended by Client, Architect and all consultants / contractor / vendors.	*It will be held on weekly basis,monthly basis *Venue of this meeting will be at Project site office.
MINUTES OF MEETINGS	CLIENT ,PMC, ARCHITECT , CONSULTANTS,	Site Office



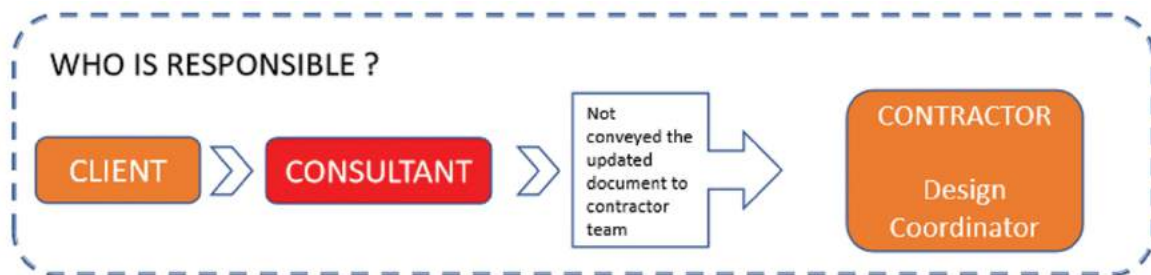
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HINDRANCE DUE TO POOR DOCUMENTATION:

S.N O	Description	Responsibility	Due
1	conference room TV size has been changed from 55 inch to 65 inch from the client side after seeing the capacity of the room	interior consultant, contractor	

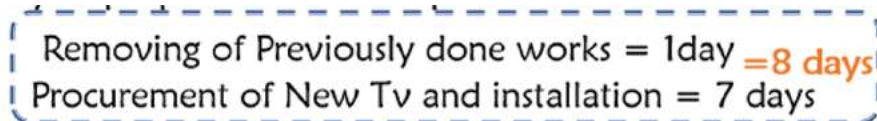
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since its a wall mounting TV unit has to be designed in a concealed manner with in the plyboard partitons . Due to negligence of interior consultantancy they actually designed , Procured 55” Tv Which was Previously Designed.



S

Due to Poor Documentation maintainance consultant side failed to convey to proper revised description of work



5.1.6 DESIGN CHANGES AND CHANGE IN SCOPE OF WORK

Sixth floor entire scope was changed after following up the typical floor plan , so due to that Demolition and Re- construction happend and it extended the project completion date Most of the Reworks comes under Interior Contractor Scope Client side contribution to delay is a major impact that affects towards the project completion due to that several concurrent delays occurred between the contractors This is mainly due to lack of expertise, re-designing, and unnecessary scope change in between construction sequence

Activity : Interior works	As Planned Schedule	Delay Duration	Delay Reason	As Built Schedule	Delay Type
6 th Floor	30days 18oct 2020- 20Nov 2020	39 days	Change of scope of work	20 dec2020 -29 jan2020	Caused by Owner (Compemsable Delays)

Concurrent Delays Ocuured Due to Design Changes :

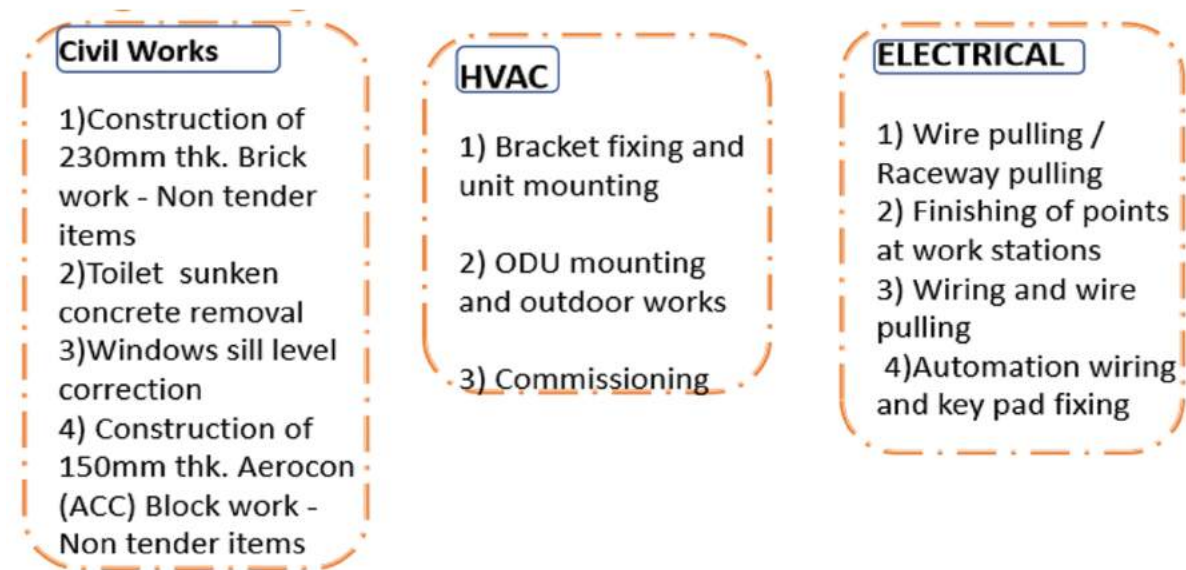


Figure 5.3 site pictures

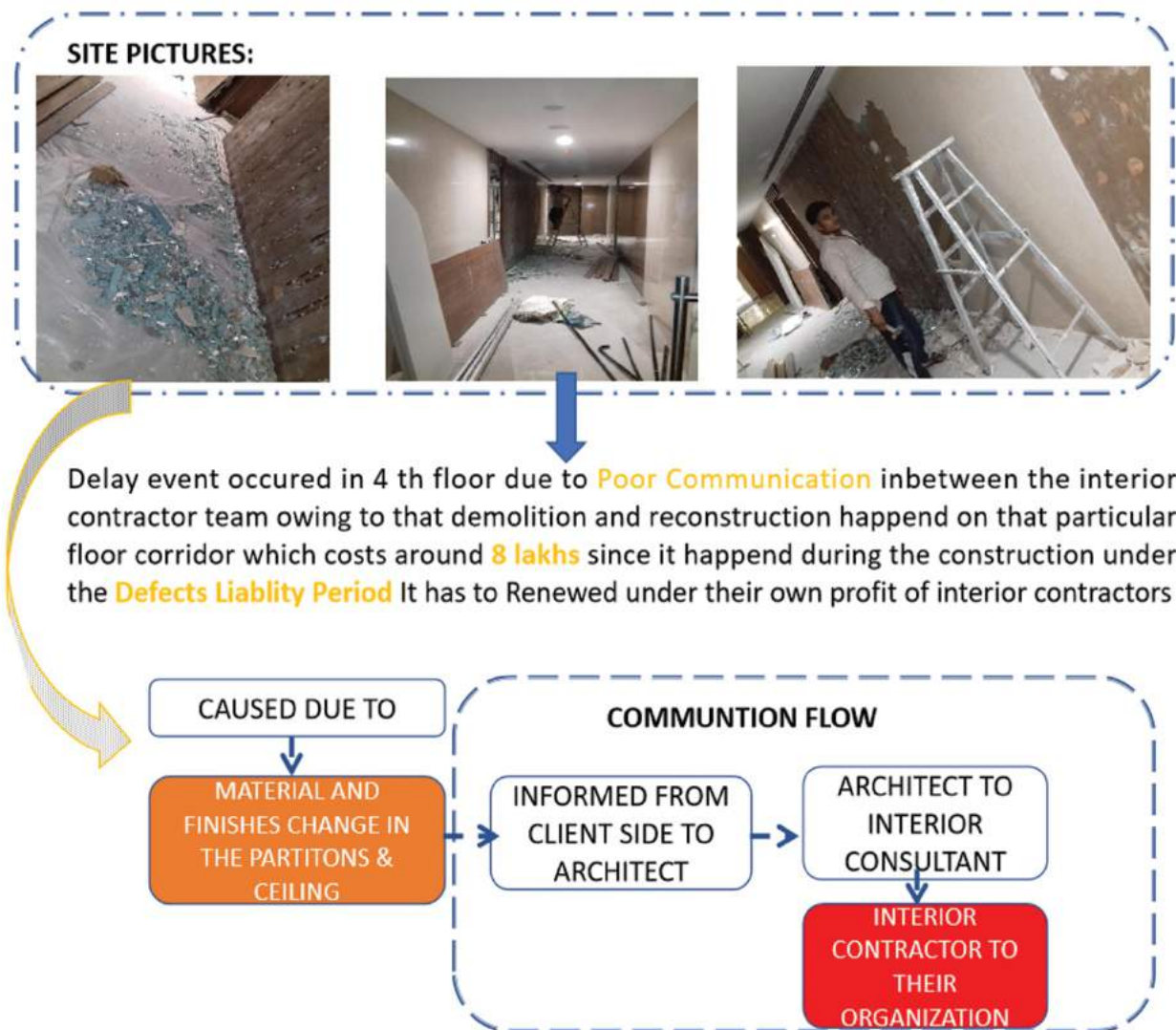
INTERIOR CONTRACTOR WORK BREAK DOWN ON SIXTH FLOOR

ACTIVITY	ACTUAL START DATE	END DATE
Partition marking	20-dec-20	20-dec-20
Partition frame work	21-dec-20	25-dec-20
Partition one side boarding	26-dec-20	28-dec-20
PopPunning	26-dec-20	28-dec-20
Services work on partition	29-dec-20	31-dec-20
Insulation	2-jan-21	2-jan-21
Other side boarding	3-jan-21	5-jan-21
False ceiling framework	6-jan-21	10-jan-21
Laminate on partition	6-jan-21	9-jan-21
Sevices area tile work	25-dec-20	28-Dec-20
Above ceiling other vender work	28-dec-20	31-dec-20
False ceiling boarding	8-Aug-20	15-Aug-20
Glass partition	11-jan-21	14-jan-21
Glass partition profile fixing	16-jan-21	18-jan-21
Wooden flooring	19-jan-21	21-jan-21
Ceiling painting	22-jan-21	23-jan-21
Partition painting	24-jan-21	26-jan-21
Glass door	27-jan-21	27-jan-21
Flush door	27-jan-21	28-jan-21
Wall paper	26-jan-21	28-jan-21
Blinds	29-jan-21	29-jan-21
Sliding partition	28-jan-21	29-jan-21
		39 DAYS

Table 5.1 Work break down

5.1.7 POOR COMMUNICATION:

Communications management is the systematic planning, implementing, monitoring, and revision of all the channels of communication within an organization and between organizations; it also includes the organization and dissemination of new communication directives connected with an organization, network, or communications technology.



HIERARCHICAL OF COMMUNICATION IN THE SITE

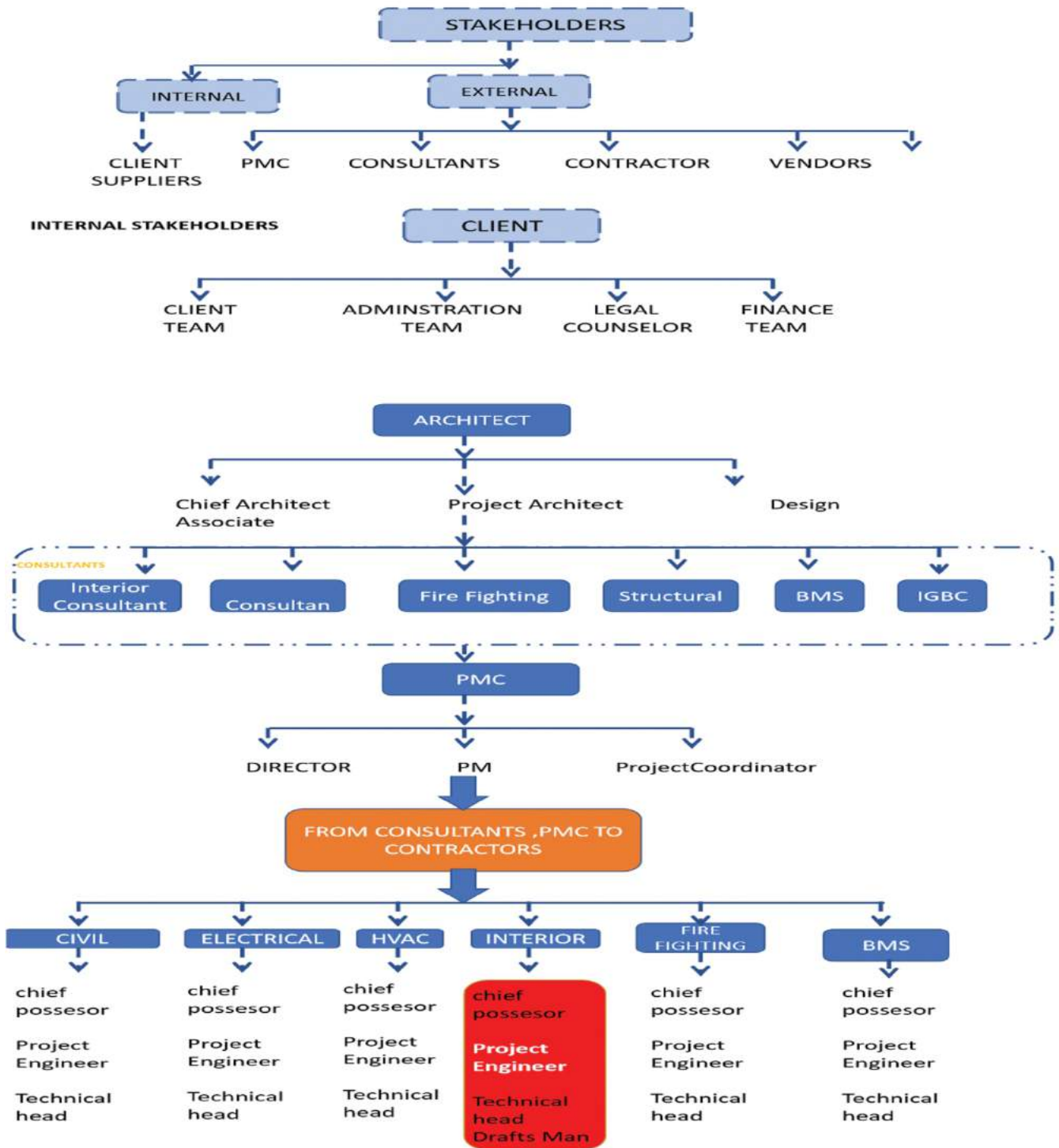
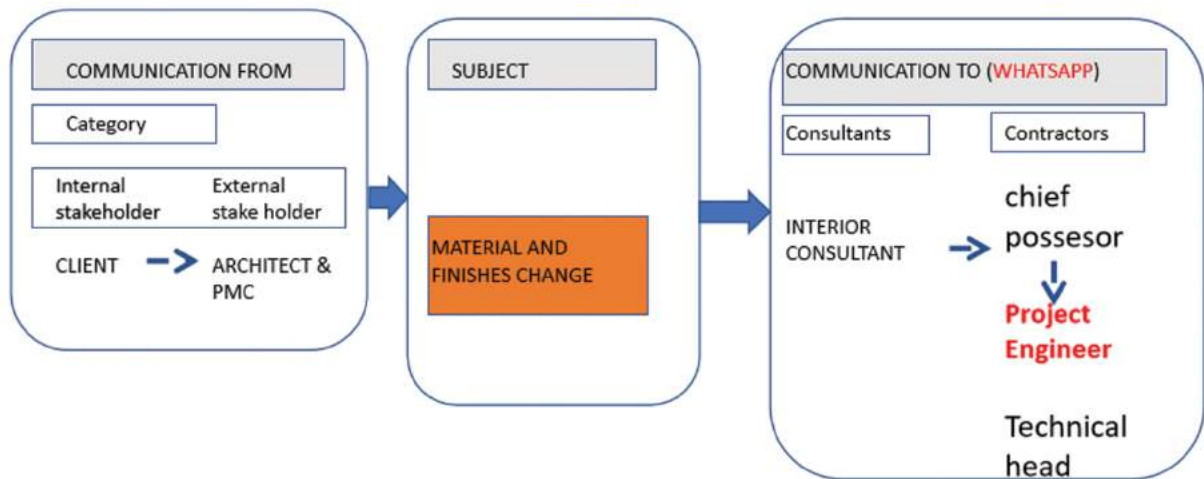


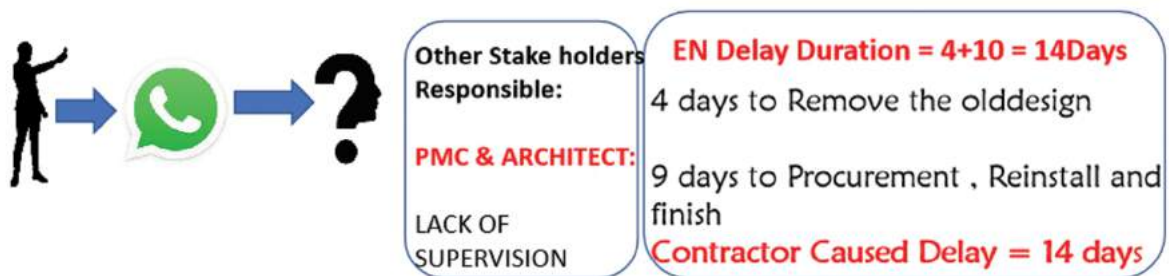
Table 5.2 Hierarchical communication flow

WHERE DID THE COMMUNICATION LAG HAPPEND ?



Due to Negligence of Project Engineer , Revised activity has been ignored and implemented the earlier design stage due to poor communication , The main reason for this delay is the communication method Interior Contractor Director has informed through Whatsapp

Most of the defects in the workmanships and pending work are being transmitted through whatsapp , due to several messages on one day , important messages are being unnoticed and the pending works remains the same for a long period till they notice next time on the field

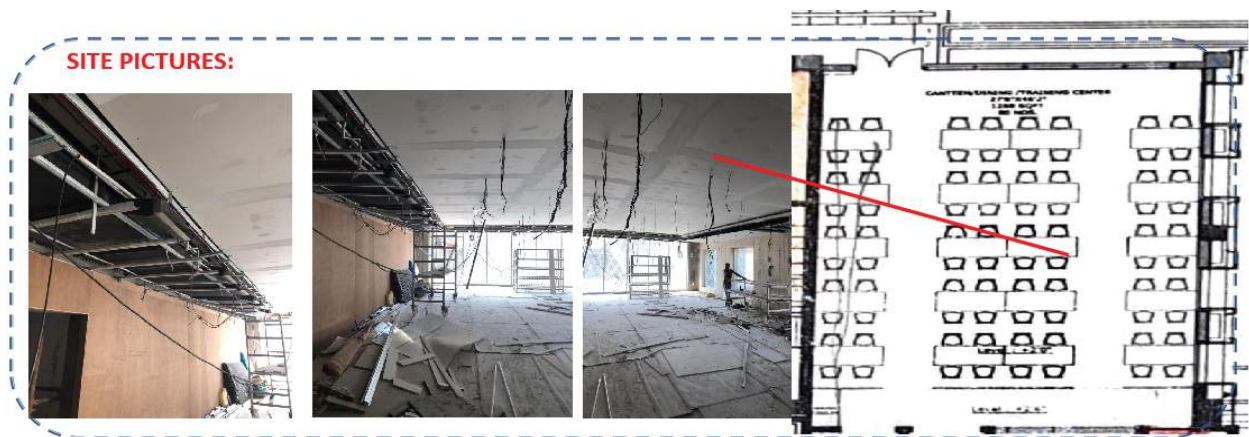


5.1.8 IMPROPER PLANNING AND SCHEDULING:

Failing to plan exposes the project to unpredicted high risks and problems

Time is money hence the funds of the project will be used in solving the issues that arise from the project due to poor planning. Subsequently, the project will be destined for failure. The people assigned to do various tasks on the project may not be the ones suitable for that because the planning was poorly done. This limits the members from fully exploiting their full potential hence the project fails.

HVAC Duct installation works where Reworked due to Improper Planning and Scheduling in the ground floor Canteen area



IMPROPER PLANNING AND SCHEDULING:



Reason For Rework :

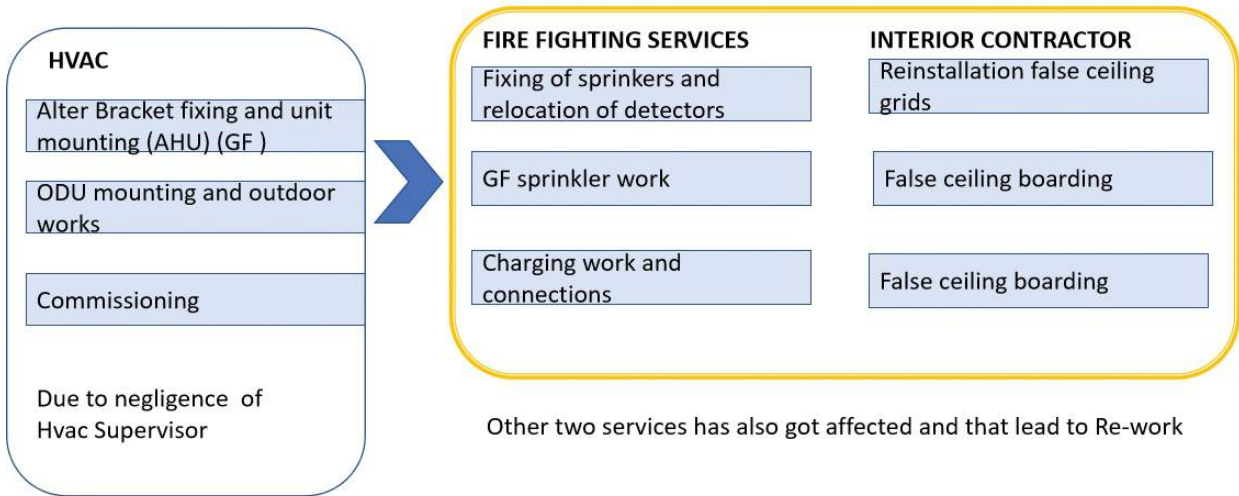
Supply air duct vent and below false ceiling gypsum board overlap one among the other there is no sufficient amount of gap inbetween the two layers

Why This Error Occured:

Due to unskilled labours from HVAC Contractor :

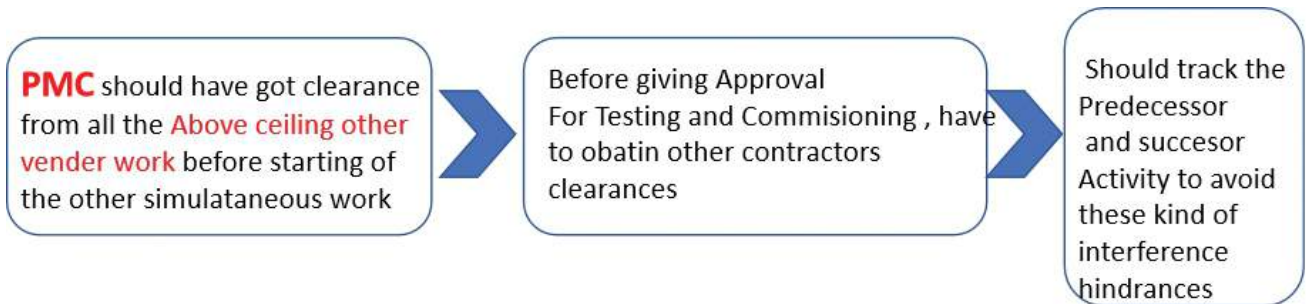
Without knowing the Actual height of the FF height and other activites requirments they have installed the ducts below

CONCURRENT DELAY OCCURED :



WHO IS RESPONSIBLE ?

(HVAC ORGANISATION) Due to Improper instruction from the Project Engineer side to the Lay man



CONTRACTORS	Reminder	Responsible	Work Completion	Testing & Completion	Remarks & Clearance	Remarks byArchitect
HVAC,FIREFIGHTING INTERIOR					●	●

(NN) Non- Excusable Delay Duration = 2days + 4days = 6Days

2 days to Remove the olddesign

4days to alter other above ceiling works

Contractor Caused Delay = 6 days

5.1.9 HOW TO MANAGE THESE DELAYS IN A ONGOING CONSTRUCTION AND FINDOUT PROJECTION COMPLETION:

IMPACTED AS PLANNED

This method measures the impact of the delays on the Contractors as - planned CPM schedule . The various delays are formulated as activities and added to the as-planned network in a chronological order showing the effect of each delay at a time and demonstrating how the project is being delayed

STRATEGY

We should insert all Delaying events into the as planned schedule in a proper order Impact of Delay events shown one at a time to demonstrate how project completion is extended Project delay amount is the difference in completion dates between the schedule before and after insertion

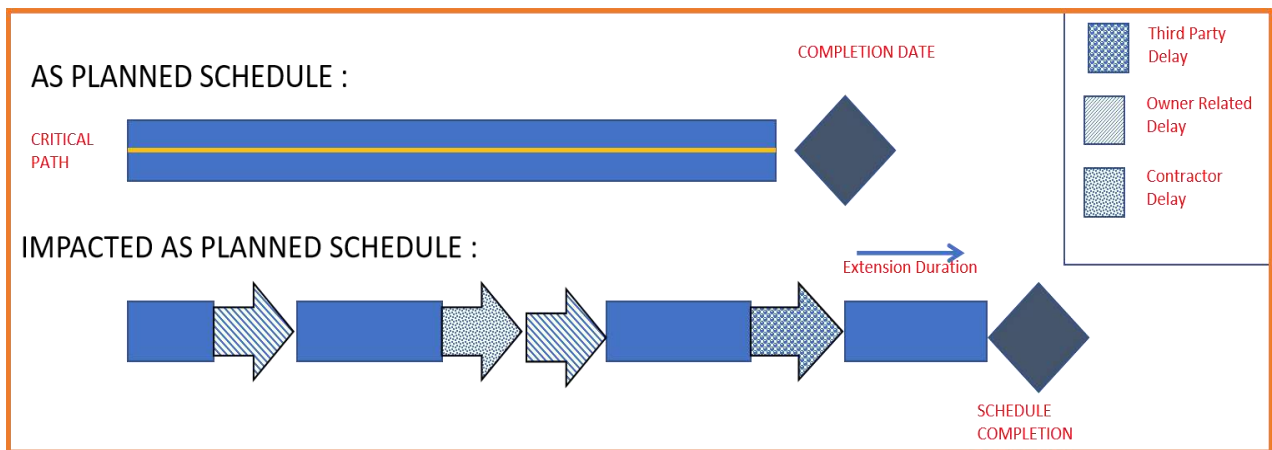


Figure 5.4 Impact as planned

5.2 As-Planned vs As-Built:

Under this method , all delaying events encountered on the project are depicted on the as-built schedule . The difference between the as- planned and as - built completion dates is the amount of time for which the claimant will request for compensation . The critical path is determined once in

the as-planned and again in the as-built schedule . This technique and the net impact technique utilizing bar chart are similar in that they all show the net effect of all claimed delays

DESCRIPTION OF WORK	COMPLETION AS PER SCHEDULE	COMPLETION AS IN SITE
Civil Contractor		
Terrace Tiling works	Sep 20, 2020	Sep 22, 2020
Internal and external civil works	Dec 20 , 2020	Dec 27 , 2020
Road works and paving	Dec 29 2020	Jan 5 , 2021
Kitchen civil works	Dec 16 , 2020	Dec 20 , 2020
External Glazing & ACP,UPVC Windows, Structural Works	Jan 28, 2020	Feb 5, 2020
UPVC Windows	Nov 30 ,2020	Dec 4 ,2020
Canteen glazing	Nov 15 , 2020	Nov 21, 2020
DESCRIPTION OF WORK	COMPLETION AS PER SCHEDULE	COMPLETION AS IN SITE
Plumbing Contractor		
water lines	Nov 20, 2020	Nov 26, 2020
Connection of external waterlines and Sewage lines	Dec 30 , 2020	Jan 9 , 2020
Kitchen works	Dec 23 , 2020	Dec 26 , 2020
Interior Contractor		
Cabin False ceiling	Sep 18 , 2020	Sep 22, 2020
Cabin finishing	Oct 16 , 2020	Oct 20, 2020
Partition glass fixing	Oct 30 , 2020	Nov 6, 2020
Open office false ceiling	Nov 25 , 2020	Dec 4, 2020
Open office finishing	Dec 12, 2020	Dec 20, 2020
BOH and Service area finishing	Aug 10 , 2020	Aug 10, 2020
Toilet finishing	Nov 20 , 2020	Nov 26,2020
DESCRIPTION OF WORK	COMPLETION AS PER SCHEDULE	COMPLETION AS IN SITE
Electrical (Low Side) Contractor		
Wire pulling / Raceway pulling (Floors 2 to 5)	15 Aug , 2020	17 Aug, 2020
Finishing of points at work stations	Nov 30 , 2020	Dec 15, 2020
Wiring and wire pulling	20 July , 2020	24 July,2020
Automation wiring and key pad fixing	Nov 29 , 2020	Dec 5, 2020
Electrical (High Side) Contractor		
DG, UPS testing works	Feb 20 ,2020	Feb 20, 2020
Internal power connection	March 14, 2020	March 18, 2020
External lighting and electrical work	Nov 27, 2020	Dec 16, 2020
HVAC Contractor		
Bracket fixing and unit mounting	Jan 30, 2020	Feb 6, 2020
Bracket fixing and unit mounting (AHU) (Flr 2-5)	Feb 8 , 2020	Feb 15, 2020

Table 5.3 As planned vs As built

DESCRIPTION OF WORK	COMPLETION AS PER SCHEDULE	COMPLETION AS IN SITE
ODU mounting and outdoor works	April 21, 2020	June 14, 2020
Grill fixing and commissioning	May 13, 2020	Nov 16, 2020
Fire Fighting and Fire Alarm System		
Fixing of sprinklers and relocation of detectors	May 15 , 2020	May 18, 2020
GF sprinkler work	June 2020	June 2020
External Hydrant work and Ring Main Work	July 2020	Sep 2020
UG Pump room works	Oct 2020	Nov 2020
BMS		
Pulling cables, boxing and interconnecting (Flr. 2-5)	July 2020	Aug 2020
Pulling cables and interconnecting (GF,6th)	Aug 2020	Aug 2020
Fixing terminal elements	Sep 2020	Sep 2020
DESCRIPTION OF WORK	COMPLETION AS PER SCHEDULE	COMPLETION AS IN SITE
ODU mounting and outdoor works	April 21, 2020	June 14, 2020
Grill fixing and commissioning	May 13, 2020	Nov 16, 2020
Fire Fighting and Fire Alarm System		
Fixing of sprinklers and relocation of detectors	May 15 , 2020	May 18, 2020
GF sprinkler work	June 2020	June 2020
External Hydrant work and Ring Main Work	July 2020	Sep 2020
UG Pump room works	Oct 2020	Nov 2020
BMS		
Pulling cables, boxing and interconnecting (Flr. 2-5)	July 2020	Aug 2020
Pulling cables and interconnecting (GF,6th)	Aug 2020	Aug 2020
Fixing terminal elements	Sep 2020	Sep 2020

An as-planned Schedule is a schedule by which the contractor intends to work. The as-built schedule is a schedule actually performed on the site

Actual Project Start and Finish date = 12 oct, 2019 - Jan 10, 2021 = 396 Days

Delay Due to Force Majeure = **51 Days**

Owner Side Delay = 28 Days

Total Contractor Side delay duration = 56 Days

$$= 51 + 21 + 56 = \mathbf{135 \text{ days}}$$

Therefore Net Effective delay duration = 135 days

Revised Project Finish date = **524 Days**

INFERENCE:

So from Calculating the Net effective delay , Project Estimated completion date Will be Around May 15 , 2021

5.3 LIVE CASESTUDY - 2 (HCL TECHNOLOGY CENTRE)

LOCATION: ELCOT (The Electronics Corporation of Tamil Nadu Limited) MADURAI, TN

TOTAL SITE AREA: 6.75 ACRES

TOTAL BUID UP AREA: 6,00,000 SQFT (approx.)/ 55,750 SQM approx

TOTAL NOS. OF SEATS: 4,865 SEATS (11.5 sqm/ person)

NO. OF TOWERS: 3

NO. OF FLOORS: B+G+4 FLOORS (TOWER 2 & 3), G+2 (TOWER 1)

FSI: 1.43

GROUND COVERAGE : 39 %

CONSTRUCTION START DATE: MARCH, 2016

PHASE 1 (TOWER 1) COMPLETION: SEPTEMBER, 2016

PHASE 2 (TOWER 2 & 3) COMPLETEION: JULY, 2018

MAJOR CLIENTS: MERK, DEUTSCHE BANK, JOHNSON & JOHNSON, BAXTER ETC



Figure 5.5 Site picture

5.3.1 SITE PLAN



Figure 5.6 Site plan

DELAY FACTORS WHICH OCCURED IN THE BUILDING

To know what are all the delay factors ocuring in the same typology we have taken up a finished mid-rise office building and listed out that delays which occured during the construction phase

Delay in
progress
payments

Poor
communication
and
coordination

Conflicts
between joint-
ownership of
the project

Delay in
subcontractor
work

Design
changes&scope
of work

Improper
planning &
scheduling

Low operator
equipment skill

Shortage of
labours



- Preventable
Delays



- UnPreventable
Delays

5.3.2 DESIGN CHANGES AND CHANGE IN SCOPE OF WORK

Floor Space Index or FSI

Its known as Tamilnadu Combined Development and Building Rules, 2019. These Rules categorise buildings as High Rise and Non High Rise buildings. Buildings with height upto 18.30 Meters are Non High Rise Buildings. For these Non High Rise Buildings, the maximum Floor Space Index allowed is 2.

TOWER -1 Has initally planned has an a G+1 Structure

by priorly knowing the FSI revision gonna be happend in 2019so to obtain the feature client insisted Architect side to rise an a extra floor in any of the towers , since they have used only1.43 FSI .

TO make that practical Architectural consultant had an a discussion with all other consultants to rise the typical floor

Structural Side approval = 10 days

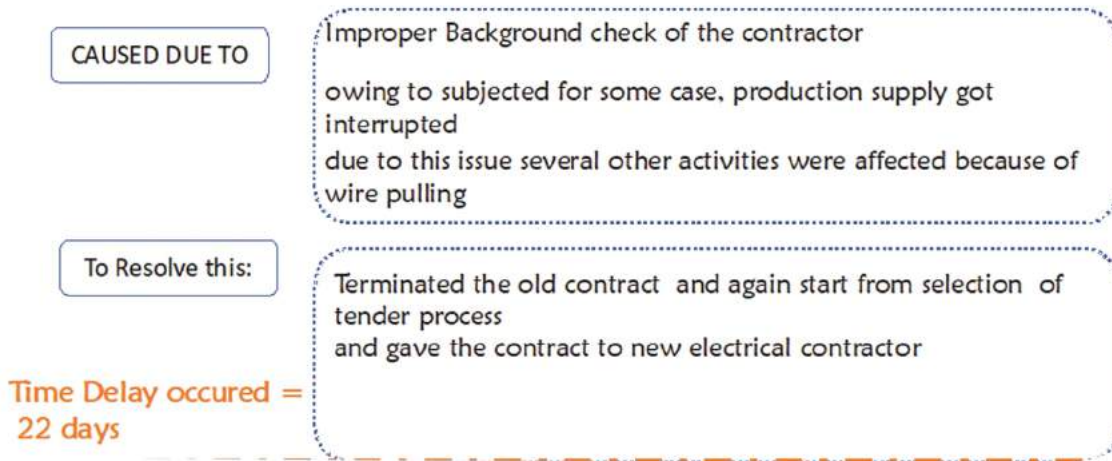
And rised up extra floor during Tower 2 & 3 construction

floor rise time = 30days

Total = 40days

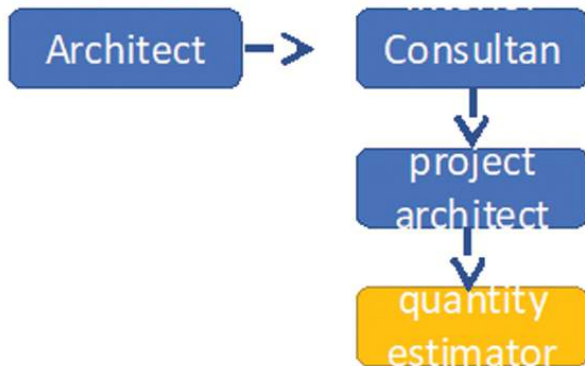
5.3.3 Improper planning and scheduling

Due to electrical contractor breach in middle of the project planning and scheduling got affected



5.3.4 POOR COMMUNICATION

Due to poor communication happened between the organization it led shortage of materials and furniture since it is an office all the furniture used in this are modular furniture it can't be sorted out easily



Sr. no.	Description	Image	Material	Size	Qty
Ground Floor					
A	2 Seater Sofa		Leather Make: Stanley Avintino Protecto (Sahar Dune #0110)	1600x825 mm	4
B	Single Seater Sofa		Leather Make: Rasulbhat Rico (Cognac #1011)	900 X 825mm	2
C	Centre Table		Top = French Brown Marble, with Sides to be in High Gloss ebony Veneer and Base to be Hairline Bronze Finished S.S material (refer to naman steel catalogue)	900mm Dia X 400 Ht.	2
D	Side Table		Top = French Brown Marble, with Hairline Bronze Finished S.S material (refer to naman steel catalogue)	400mm Dia X 450mm Ht.	4
Total - G Floor					

Terms & Conditions:

1. Payment Terms : 75% Advance with confirmation of PO & 25% Balance Before Delivery
2. Taxes Extra : GST 18% applicable
3. Packaging Costs: 5% On Net Value
4. Freight Costs : Ex-works , Bengaluru
5. Installation Costs: Are included in the above pricing
6. Delivery: 60-90 days from date of receipt of PO & Advances.

Due to inadequate estimator furniture shortage has happened time taken to deliver the product is 60-90 days Packing cost would be 5% extra due to negligence of estimator it led unwanted delays

5.3.5 As-Planned vs As-Built:

DESCRIPTION OF WORK	COMPLETION AS PER SCHEDULE	COMPLETION AS IN SITE
CIVIL WORK	JUNE , 2017	JUNE , 2017
ELECTRICAL HIGH SIDE WORK	JULY, 2017	AUG, 2017
FIRE FIGHTING & FIRE ALARM SYSTEM	NOV ,2017	DEC 2017
HVAC WORS	JAN 2018	FEB 2018
INTERIOR WORKS	FEB 2018	APRIL 2018
Landscape WORKS	MARCH 2018	APRIL 2018
Waterbody civil works	MARCH 2018	APRIL 2018
BMS SYSTEM WORKS	Oct 2020	Nov 2020
INFRASTRUCTURE WORKS	MARCH 2018	JUNE 2020
STP WORKS	Nov 2017	Dec 2020

Figure 5.7 As built

PROJECT START : MARCH, 2016

PROJECT ESTIMATED COMPLETION : MARCH, 2018

PROJECT COMPLETION : JULY, 2018

AS PLANNED PROJECT DURATION : 740 DAYS

AS BUILT PROJECT DURATION : 821 DAYS

EFFECTIVE DELAY : 81

CHAPTER-6 ANALYSIS AND DISCUSSIONS

Responses are collected from the people working in infrastructure projects and the responses are analyzed.

A total of 83 responses are obtained from the questionnaire survey, by floating to people working in the infrastructure projects.

RANKING THE FACTORS USING RELATIVE IMPORTANCE INDEX (RII)

Higher RII represents the most significant contributor for the delay and the lesser value indicates the least contributor factor. An RII value varies only from 1 to 5.

$$RII = W/(A*N)$$

Where: W – The weight given to each factor by the respondents which range from 1 to 5

A – The highest weightage (i.e. 5 in this case)

N – total number of respondents

The analysis is made and rank is given to the factors.

The responses that are collected are put into an excel sheet and the responses are transformed as

1. - No Impact
2. - Very Low Impact
3. - Low Impact
4. - High Impact
5. - Very High Impact

FACTORS	1	2	3	4	5	TOTAL	RII	RANK
POOR DOCUMENTATION	1	12	29	35	20	351	0.71485	1
DESIGN CHANGES AND CHANGES IN SCOPE OF WORK	3	18	17	42	15	347	0.7069	2
POOR CONTRACT MANAGEMENT	6	10	27	38	14	340	0.6970	3
IMPROPER PLANNING AND SCHEDULING	7	12	26	35	13	330	0.6910	4
INEXPERIENCED EMPLOYEES OR SKILLED LABOURS	8	21	26	24	22	325	0.6752	5
POOR SITE MANAGEMENT	7	16	22	35	12	318	0.67524	6
LAND ACQUISITION AND OTHER RESOURCE PROCUREMENT DELAYS	3	20	28	30	12	310	0.6633	7
REWORK OR DEFECTIVE WORKMANSHIP	8	15	24	40	9	301	0.6594	8
INACCURATE ESTIMATION OF MATERIALS	6	24	26	27	15	298	0.6455	9
POOR RESOURCE MANAGEMENT	7	20	22	30	13	290	0.6455	10
POOR WEATHER AND UNFORESEEN SITE CONDITIONS	7	15	35	20	17	281	0.6415	11
APPROVAL DELAYS	8	27	11	39	10	275	0.6396	12
RISE IN TRANSPORTATION COST FROM PLANNED COST	5	24	25	30	10	270	0.63564	13
INFLATION IN PRICE OF RESOURCES	7	21	25	32	9	265	0.6336	14
POLITICAL ISSUES	8	21	25	30	10	260	0.63168	15
ARRANGING FINANCES FROM OWNER OR CONTRACTOR SIDE	17	22	30	10	13	253	0.5524	16

Table 6.1 Delay factors result

TOTAL NUMBER OF RESPONDENTS:					
ARCHITECTS	PROJECT MANAGERS	CONTRACTORS	OWNERS	ENGINEERS	
38	8	19	5	13	= 83

POOR DOCUMENTATION :

ARCHITECTS	PROJECT MANAGERS	CONTRACTORS	OWNERS	ENGINEERS
17	4	9	-	6

DESIGN CHANGE AND CHANGE IN SCOPE :

ARCHITECTS	PROJECT MANAGERS	CONTRACTORS	OWNERS	ENGINEERS
8	3	7	-	4

POOR CONTRACT MANAGEMENT:

ARCHITECTS	PROJECT MANAGERS	CONTRACTORS	OWNERS	ENGINEERS
9	1	-	3	1

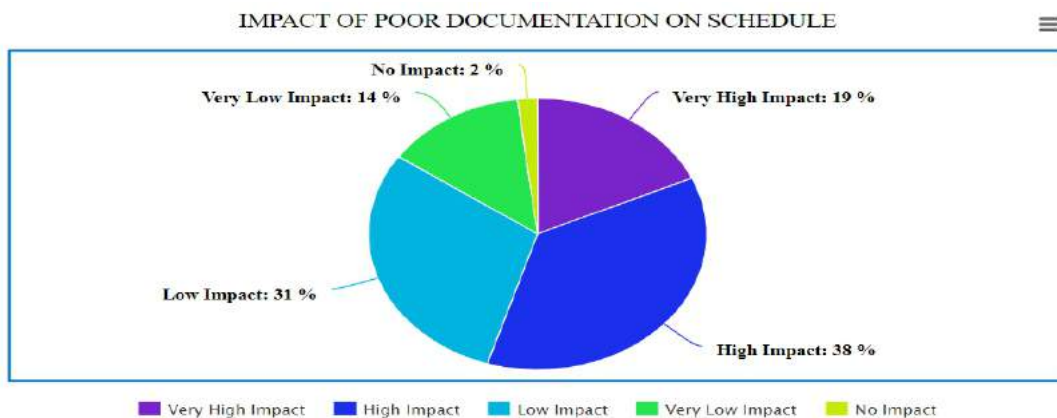
IMPROPER PLANNING SCHEDULE:

ARCHITECTS	PROJECT MANAGERS	CONTRACTORS	OWNERS	ENGINEERS
4	-	3	2	2

From the analysis of the responses based on the factors divided into 3 basic categories we easily arrive at a conclusion with 1 factor predominantly impacting the entire schedule of the construction project. All the 4 factors are represented in a graphical format for making the conclusion much easier and understandable.

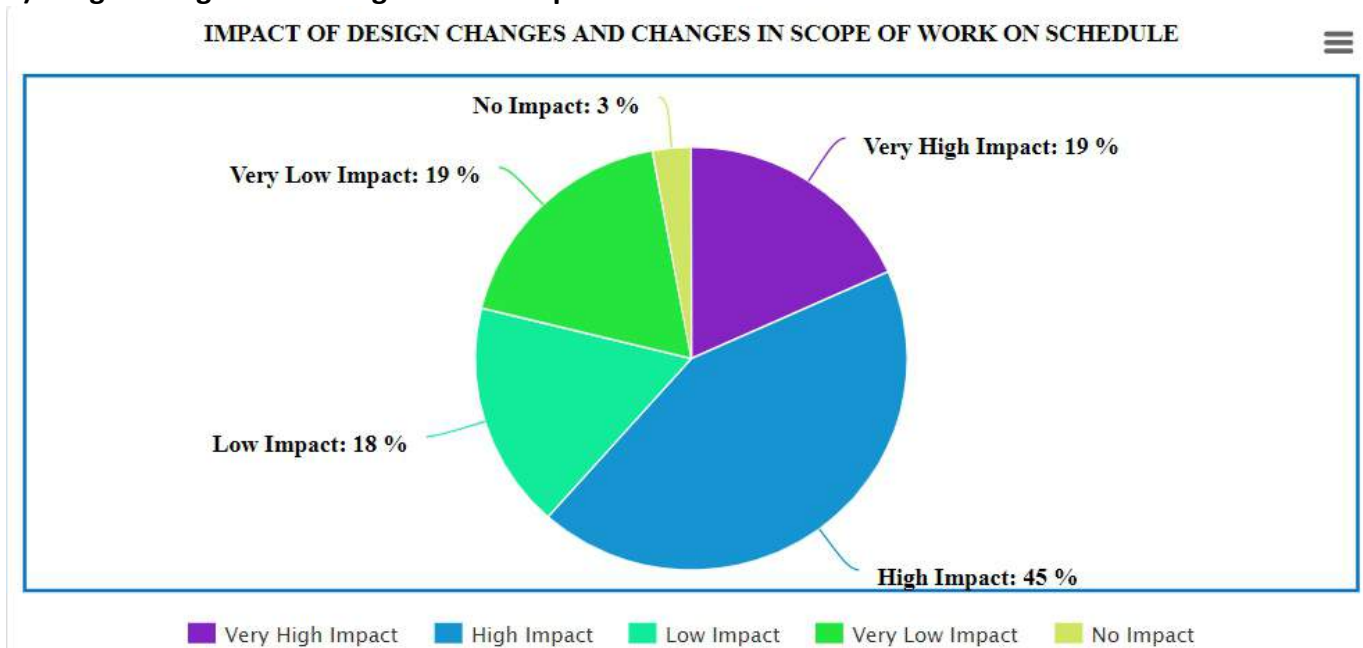
The 4 factors apart from the categorization based on its time of occurrence in the project, it affects the schedule much more prominently are as follows

1) POOR DOCUMENTATION:



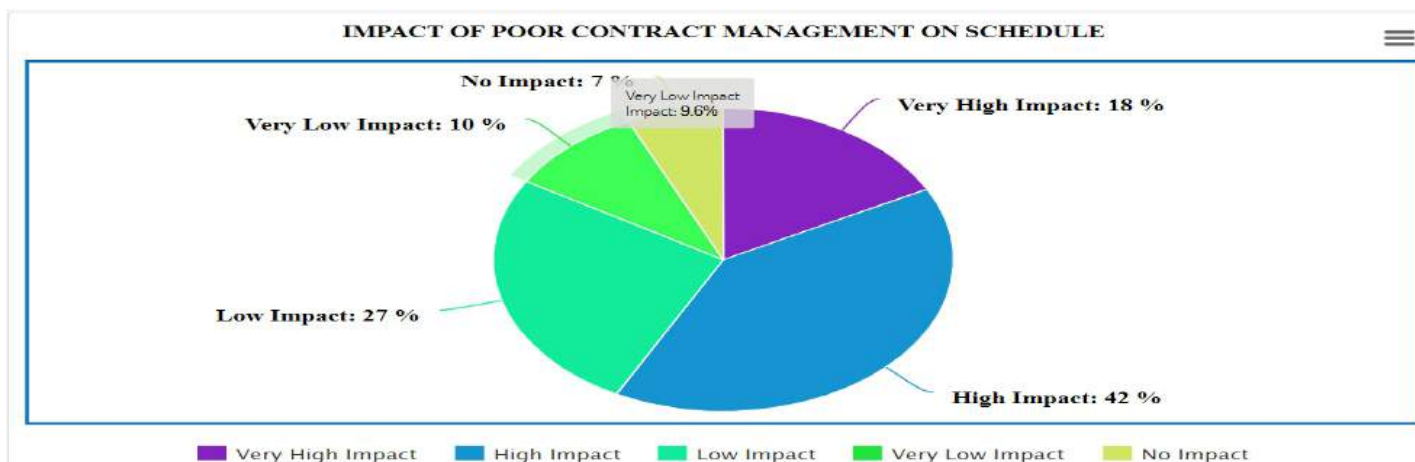
From the Pie Chart, we get to see that almost 57% of the respondents have voted for Poor Documentation as a factor that affects the schedule in a very high manner.

2) Design Changes and Changes in the Scope of Work



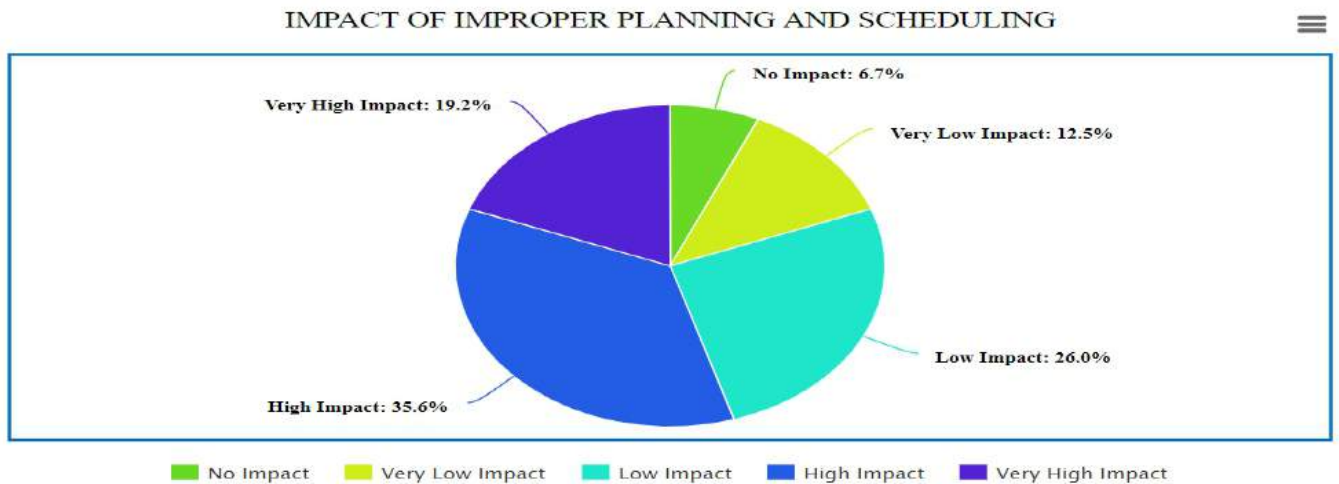
From the Pie Chart, we get to see that almost 64% of the respondents have voted for Design changes as a factor that affects the schedule in a very high manner.

3) Poor Contract Management:



From the Pie Chart, we get to see that almost 60% of the respondents have voted for Poor Contract Management as a factor that affects the schedule in a very high manner.

4) Improper Planning and Scheduling



From the Pie Chart, we get to see that almost 55 % of the respondents have voted for Improper planning as a factor that affects the schedule in a very high manner.

6.1 COMPARITIVE ANALYSIS:

PROFESSIONALS OPINION	CASE STUDY -1		CASE STUDY -2	
	UnPreventable Delays	Preventable Delays	UnPreventable Delays	Preventable Delays
3 POOR DOCUMENTATION	3 POOR DOCUMENTATION	POOR SUPERVISION	Delay in progress payments	4 Poor communication and coordination
2 DESIGN CHANGES AND CHANGES IN SCOPE OF WORK	2 DESIGN CHANGES IN SCOPE OF WORK	MATERIAL SHORTAGE	Conflicts between joint-ownership of the project	Delay in subcontractor work
POOR CONTRACT MANAGEMENT	POOR CONTRACT MANAGEMENT	POOR RESOURCE MANAGEMENT	2 Delay in approving major changes in the scope of work	1 Improper planning & scheduling
1 IMPROPER PLANNING AND SCHEDULING	APPROVAL DELAYS	1 IMPROPER PLANING AND SCHEDULING		Low operator equipment skill
		REWORK OR DEFECTIVE WORKMANSHIP		
		4 Poor communication and coordination		Shortage of labours

Table 6.2 Comparative analysis

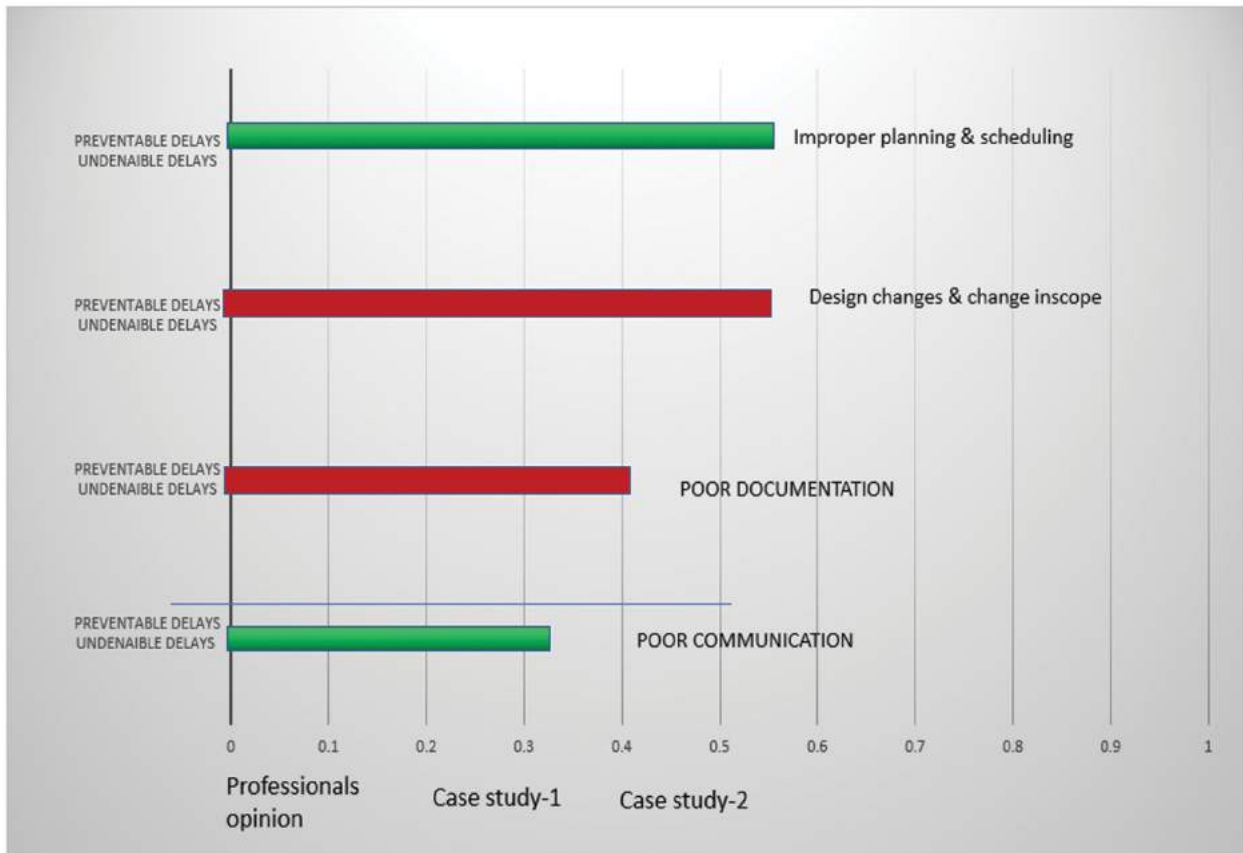


Table 6.3 Bar chart analysis

From the Professionals opinion and the live case study comparative analysis we derived the most common delay factors which causes concurrent delays in the current construction industry



6.2 Design changes and change in scope of work

The most common effects of projects that change of design took place during construction stage were delay of the projects, increasing of cost of the project (cost overrun), abandoning of the project, wastage of materials and conflicts between the parties

This type of delays could be minimized by use of advanced engineering design software like BIM(Building information Model) based softwares like Navis works

Navisworks project review software to improve BIM (Building Information Modelling) co-ordination.

- Combine design and construction data into a single model.
- Identify and resolve clash and interference problems before construction.
- Aggregate data from multiple trades to better control outcomes.
- Control schedules and costs using 4D and 5D simulation
- Easily capture material quantities from 2D or 3D designs
- Create synchronised project views that combine Revit and
- AutoCAD files, including geometry, images and data.



Figure 6.1 BIM model

6.3 POOR COMMUNICATION

WEB COMMUNICATION PORTAL:

For an effective communication management between all the parties can be enhanced by creating an a seprate portal so that it would be a great tool for communicating since it wont contain any spam or add mails , all contractors queries , claims , delays , pending works , dependencies work can be shared through the portal which will be useful for an transperent communication .



Communications management is the systematic planning, implementing, monitoring, and revision of all the channels of communication within an organization and between organizations; it also includes the organization and dissemination of new communication directives connected with an organization, network, or communications technology.



6.4 IMPROPER PLANNING AND SCHEDULING

SELECTION OF DELAY ANALYSIS TECHNIQUE:

Through various literature studies factors for the selection of DAT are the time of analysis and capabilities of the method to mitigate the delay activity in further more occurrences, the nature of causative events, the programme information available and the users familiarity in the project characteristics

In that case window analysis method, since it's the most suitable DAT which gives high accuracy and low error margin. This method uses similar documents in their analytical process as planned schedule and as built schedule and revised schedule and project documents

Delay analysis technique should have the following characteristics:

- 1) It should have a systematic approach
- 2) Scrutinize different types of delays before analyzing the schedule
- 3) Consider all types of concurrent delay scenarios

Windows Analysis is a forensic technique that involves interim assessment of delays on updated schedules at specific intervals or "windows". In applying this methodology, the overall performance period being analyzed is partitioned using available contemporaneous progress updates.

Identify major activities which is held on the total duration of the project and divide that into several smaller windows and set as a milestone. That would be an easier way to track the progress and it reduces the major delay activities in the project duration

A milestone is a specific point within a project's life cycle used to measure the progress toward the ultimate goal. Milestones in project management are used as signal posts for a project's start or end date. A milestone is a reference point that marks a significant event or a branching decision point within a project.

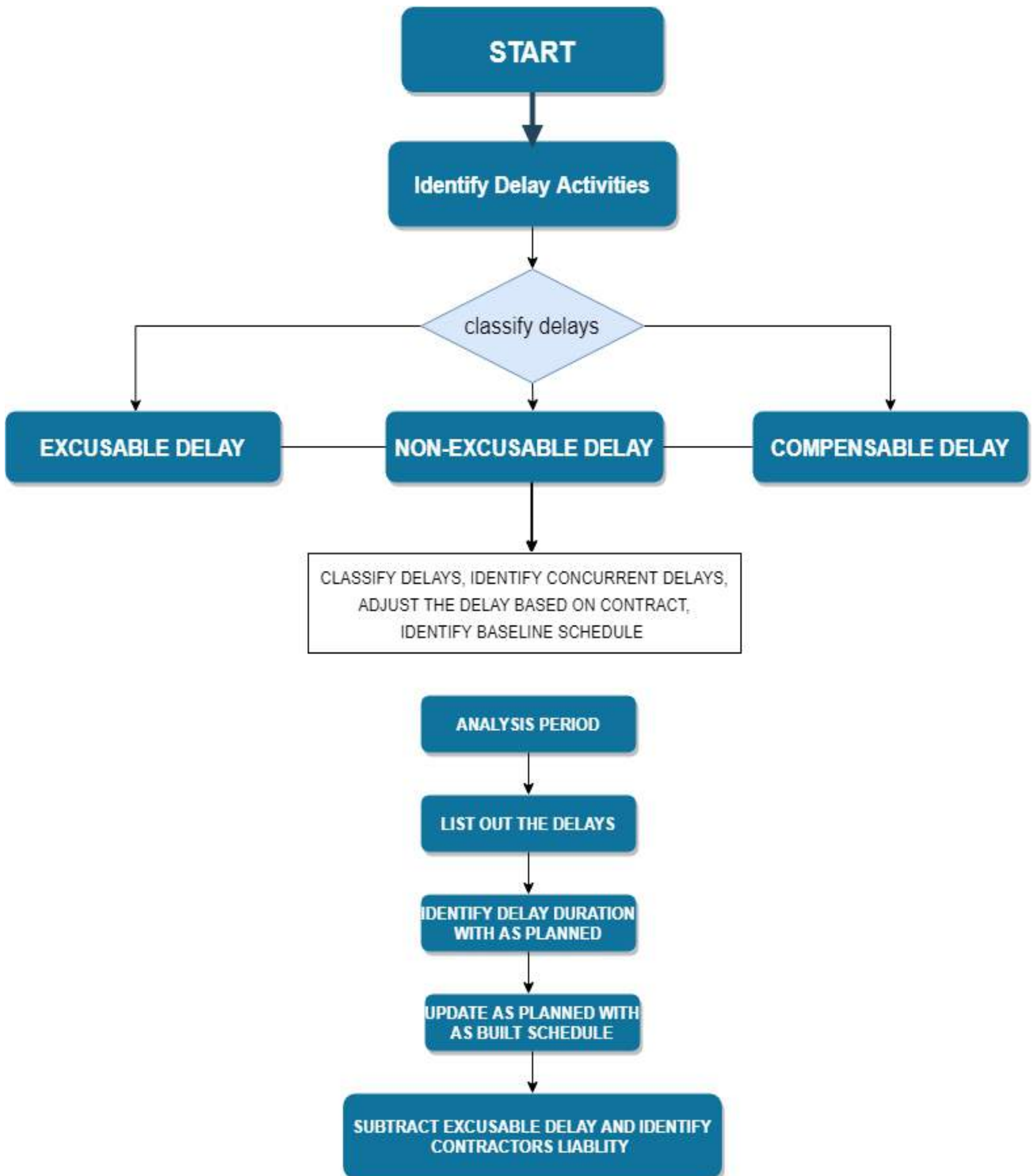


Figure 6.2 Window analysis technique

WEEK-1 (MONTH)	
Activity ID	
Task Name	
Floor	
Person in charge	
Contact no	
completion Percentage	
Materials & Resources Required	
Predecessor & Successor	
Remaining works	

Figure 6.3 Activity Tracker

6.5 POOR FEASIBILITY:

Poor document management is detrimental to a project and can lead to delays, budget overruns, and rework. For most of us, construction document management is an unavoidable and necessary part of the job. From architectural plans to markups to one mistake in a single document can lead to costly mistakes in execution.

Misinterpretation of study stages and also having incorrect idea of the goal of the feasibility studies. Other factors that affect directly such as delay, cost, and other issues that affect quality of the construction projects

MITIGATION ACTIVITIES:

One of the reasons software projects fail is the lack of understanding of the business' needs. The business must clearly articulate the requirements in detail.

So hereafter if a client is taking up a new project without knowing the end user. They can start up the project in a Multi tenant usage basis so that the building could adapt to any type of users

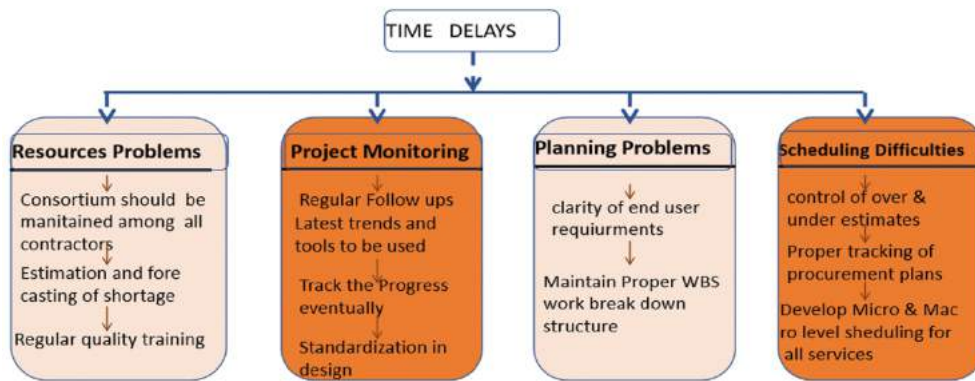
CHAPTER-7 RECOMMENDATIONS & CONCLUSION

7.1 DELAY OVER COMES IN SCHEDULE

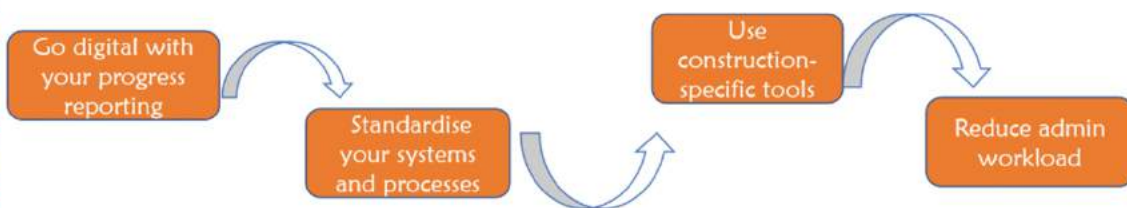
Resource Loading and Levelling Requirements	CONCURRENT DELAYS	CRITICAL PATH CONSIDERATIONS	RATIONAL SEQUENCE
It is thus quite important for baseline programmes to be resource-loaded so as to ensure both reliable task duration and network logic, especially when many tasks require the same resources at the same time. It is noteworthy that the need for analysts to take resource allocations into account in their delay analyses is becoming an increasingly vital requirement.	A reliable approach for analysing concurrent delays should involve using dynamic multiple time periods or windows, as this is capable of tracing changes in the critical path. Therefore analysts should use different time intervals are bound to interpret a given concurrent delay situation differently.	Critical path activities are the project tasks that must start and finish on time to ensure that the project ends on schedule. changes in critical path should be traceable and we should make it conjoin with the actual critical path.	Sequence Activities is the process of identifying and documenting relationships among the project activities. should consider logical sequence so that it doesn't affect with other activities.

7.2 REMEDIES TO CONTROL TIME DELAYS

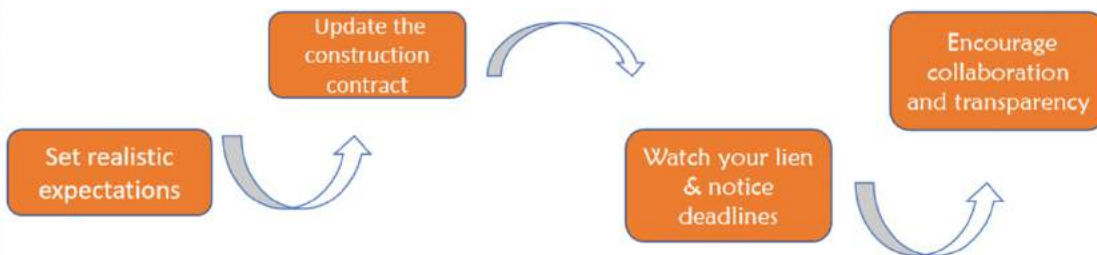
The elements that contribute to time delays were identified through the analysis, and mitigation activities to reduce time delays were advised. There are various aspects that influence a project's success or failure, and each project will be assessed on the basis of several key dimensions such as time, cost, and quality. If the factors are in place, all of the concerns should be adequately controlled, planned and managed properly the project delay will be minimized.

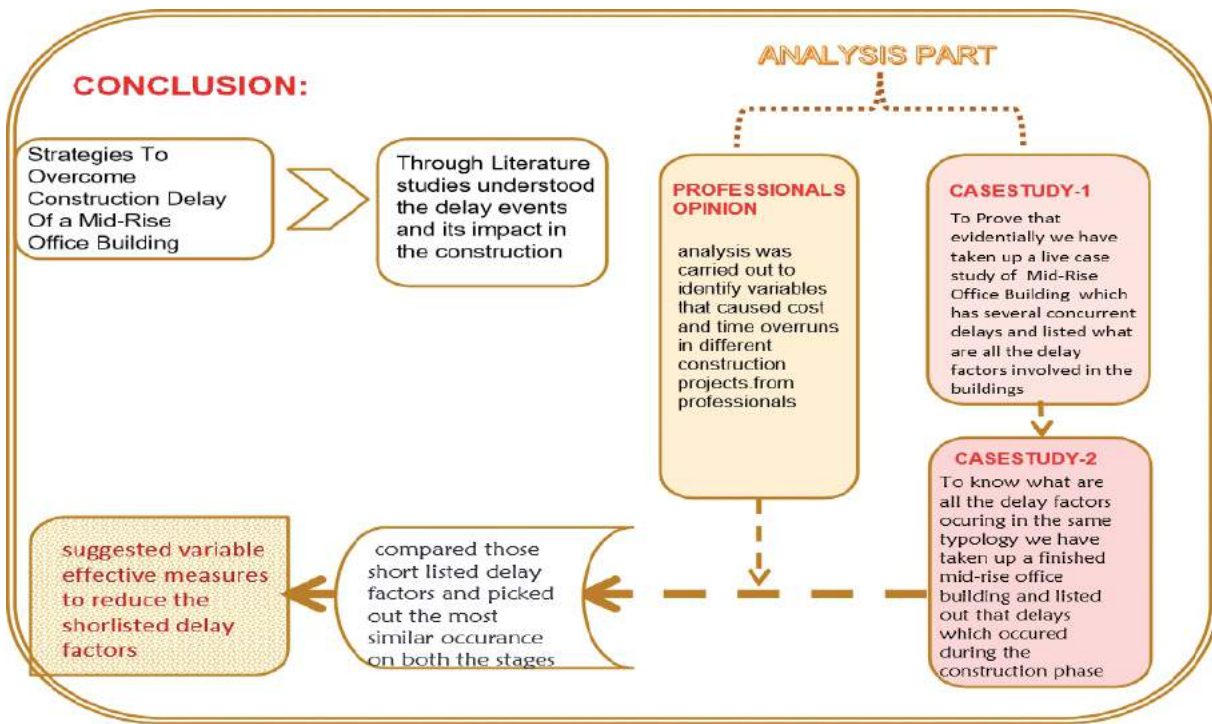


GENERAL PARAMETERS TO REDUCE CONSTRUCTION DELAYS:



Schedule Related Delay can be minimized by the following :





7.3 CONCLUSION:

Delay lawsuits have been a significant point of contention in the building industry, as well as one of the most difficult to settle. Time and money are the lifeblood of every building project. The successful completion of construction projects within the prescribed time and budget has become the most valuable and challenging task for managers, architects, engineers, and contractors. In India, there are several projects facing these problems. Construction project time and cost overruns are caused by a variety of causes, some of which are interconnected. This study details the most important factors influenced by time and cost overruns. Using a survey questionnaire, this analysis was carried out to identify variables that caused cost and time overruns in different construction projects. This gives all the combination of factors and categories responsible for construction delays. Ratings given by respondents are not same as the response from different organization have different point of view on factor causing delay. The data from the questionnaire survey were analyzed. As an important tool for rating time & cost overruns, the Relative Importance Index (RII) is used. As a result from this questionnaire survey that inadequate documentation, design changes, and changes in the scope of work and poor contract management have shown a greater effect on the delays that arise in different construction projects. To Prove that evidentially we have taken up a live case study of Mid-Rise Office Building which has several concurrent delays and listed what are all the delay factors involved in the buildings and stated out the consequences caused by the delay factors and from the delay duration

we have calculated the Net effective delay and suggested some tools to mitigate for timely completion. And to know what are all the delay factors occurring in the same typology we have taken up a finished mid-rise office building and listed out that delays which occurred during the construction phase

And by knowing the Delay factors from the Professionals opinions and live case studies we have compared those delay factors and picked out the most similar occurrence on both the stages that are Improper planning & scheduling, Design changes and change in scope of work, poor documentation, poor communication have shown a greater effect on the delays that arise in different construction projects, which in turn has become a greater cause for the delay in schedule and cost runs. Analysis gives the significance of those variables. The findings of this study indicate that certain factors greatly influence the timeline and expense of the construction project. The project would be completed within the estimated timetable and cost by considering those variables and implementing effective measures. Thus, we would like to conclude from this analysis that concentrating on these top 4 variables would almost eliminate the likelihood of staying on board with the construction project's actual schedule and budget.

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