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A Methodology for Ranking of Causes of Delay for Residential Projects

Mr Ashish Chandu Pawar[1]. Mrs. Sheetal .D. Marawar[2], Mr. Nikhil .V. Bhalerao[3]

Department. of Civil Engineering, TSSM"s, PVPIT College, Bavdhan, Maharashtra, India.

Abstract - *One of the most common problems in the construction project is delay. Delay of a construction project can be defined as the late completion of works as compared to the planned schedule or contract schedule. Projects can be delayed due to number of reasons that may be due to the client, the contractor, acts of God, or a third party. They may occur early or later in the project development, alone, or with other delays. Delays can be minimized only when their cause are identified. The objective of this study was to identify the major causes of delays, the effects of delays, and methods of minimizing delays in construction project. This study was carried out based on literature review and questionnaire survey*

The paper presents the Result of a questionnaire survey conducted to identify and evaluate the relative importance of the significant factors contributing to delay and Importance Index. Effective project planning, Controlling and monitoring should be established to enhance project performance in order to minimize or avoid delay.

Key Words: **Construction delay, Delay Causes, Ranking, Schedule and Causes, Recommendations of delays.**

1 INTRODUCTION

Construction industry in India is growing with very fast speed. There are many project s in India currently with major clients out of which 1 to 5 % complete on time and remaining part project got delayed or some even not completed till date.

These projects are mainly caused by improper planning or different scenario while planning and actual execution of the project. This is because of various obstructions or uncertainties or risk involved in current activity which may not be known by novice planner or engineer this may be because scenario at working site is different than as anticipated by designer or planner.

Delays and cost overruns have significant implications from economic as well as political point of view. Due to delays in project implementation, the people and the economy have to wait for the provisions of public goods and services longer than is necessary. Thus, delays limit the growth potential of the economy.

The absence of comprehensive India centric studies apart, there exists a large body of theoretical and empirical literature on the subject. It suggests that delays and cost overruns are generic to infrastructure projects and a global phenomenon; India in not an exception. However, the literature also reveals that the underlying causes and, therefore, the remedies differ from country to country. Case studies are very helpful in explaining particular instances but have limited capacity to educate us about the intrinsic problems besetting the infrastructure delivery system. In sum, the main causes behind time and cost overruns in India and their statistical significance have remained unsubstantiated.

2 AIM AND OBJECTIVES

To identify the delay factor in Construction Projects.

The main objectives of this study include the following:

1. To identify the factors causing the delays in Indian construction scenario.
2. To identify delays caused by the various segments of the industry.
3. To test the importance of the causes of delay by RII and Importance Index methods.
4. To suggest possible majors to minimize or curb these factors causing delay.

3 LITERATURE REVIEW

A number of studies have been carried out to determine the causes of delay in construction projects.

Alwi and keith (2003)[1] did survey for identifying the important causes of delays in building Construction projects in Indonesia. A questionnaire survey was carried out targeting 89 respondents from large contractors and 23 respondents from small contractors.

The delay factors were grouped into six major groups. The results showed that the large and small contractors generally agree on the importance ranking of the individual delay variables. In relation to the groups of the delay variable, however, the result showed that there is no agreement

between the two groups of contractors. The professional management group was ranked the highest and the external groups were ranked the lowest by large contractors. Whereas, small contractors ranked the design and documentation group as the highest and the execution group as the lowest.

A survey on time performance of different types of construction projects in Saudi Arabia was conducted by Assaf and Hejji (2005)[3] to determine the causes of delay and their importance according to each of the project participants, i.e., the developer, consultant and the contractor. The field survey conducted included 23 contractors, 19 consultants, and 15 developers. Seventy-three causes of delay were identified during the research. 76% of the contractors and 56% of the consultants indicated that average of time overrun is between 10% and 30% of the original duration. The most common cause of delay identified by all the three parties is ''change order''. Surveys concluded that 70% of projects experienced time overrun and found that 45 out of 76 projects considered were delayed.

Baldwin and Manthei (1971) studied the causes of delay in building projects in the United States. They surveyed engineers, architects, and contractors, and found that there was substantial agreement among the three groups concerning the causes of delay. They also noticed that weather, labor supply, and subcontractors were the major causes of delay.

Chalabi and Camp (1984) discussed causes of building project delays in developing countries during the pre-planning and the construction stages. Their study dealt With developing countries where workers are relatively skilled. They found that adequate planning at the very early stages of the project is important for minimizing delay and cost overruns in most projects in developing countries.

Al-Momani[2] investigated causes of delay in 130 public projects in Jordan. The main causes of delay were related to design, user changes, weather, site conditions, and late deliveries, economic conditions and increase in quantity. The study suggested that special attention to factors will help industry practitioners in minimizing contract disputes. Delays have strong relationship with failure and in effective performance of contractors.

Chan and Kumaraswamy[10] conducted a survey to evaluate the relative importance of 83 potential delay factors in Hong Kong construction projects and found five principal factors: poor risk management and supervision, unforeseen site conditions, slow decision making, client-initiated variations, and work variations. They suggested that biases of different industry groups might direct blame for delays to other groups.

Ogunlana et al., [11] studied the delays in building projects in Thailand, as an example of developing economies. They concluded that the problems of the construction industry in developing economies could be nested in three layers: (1) problem of shortages or inadequacies in industry infrastructure, mainly supply of resources; (2) problems caused by clients and consultants; and (3) problems caused by incompetence of contractors.

Doloi H. et al.(2012) [4] did research to analyze factors affecting delays in Indian construction projects. They selected set of 45 attributes. Their research first identified the key factors impacting delay in Indian construction industry and then established the relationship between the critical attributes for developing prediction models for assessing the impacts of these factors on delay. A questionnaire and personal interviews have formed the basis of their research. Factor analysis and regression modeling were used to examine the significance of the delay factors. From the factor analysis, most critical factors of construction delay were identified as lack of commitment followed by inefficient site management and poor site coordination ranked third.

From all above analysis the most critical factors causing delays in construction projects are miscommunication between contractors, subcontractors, and property owners, bad weather, site condition, slow decision making, improper planning, shortage of Material, Lack of Funds, etc.

4 PROBLEM STATEMENTS

Many Residential construction projects have faced various problems and delay of time is one of the major problems. The delay in dispute settlement has manifold effects such as it will give detrimental to the relationship between owner and contractor. Moreover, it will also contribute to the cost and time overruns. It is generally said that the contract language is considered difficult to comprehend and they are therefore a major source of disputes.

5 CONSTRUCTION DELAYS

In construction, delay could be defined as the time overrun either beyond completion date specified in a contract, or beyond the date that the parties agreed upon for delivery of a project. It is a project slipping over its planned schedule and is considered as common problem in construction projects. To the owner, delay means loss of revenue through lack of production facilities and rent-able space or a dependence on present facilities. In some cases, to the contractor, delay means higher overhead costs because of longer work period, higher material costs through inflation, and due to labour cost increases. Completing projects on

time is an indicator of efficiency, but the construction process is subject to many variables and unpredictable factors, which result from many sources.

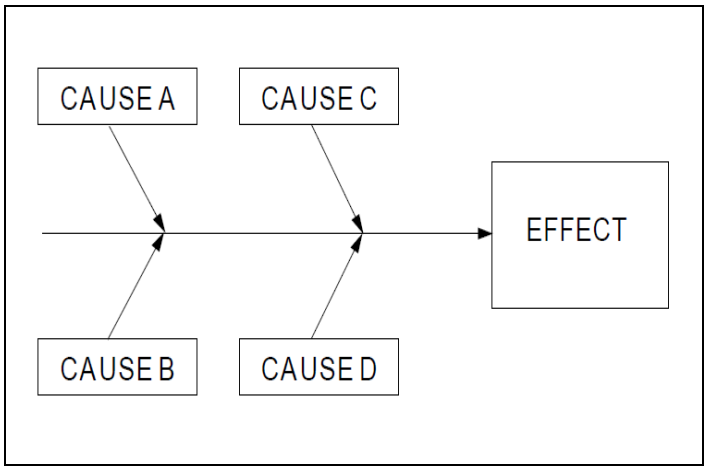


Figure: 1 Ishikawa Diagram Example

Construction Delays are mainly due to:

1. Material related delay.
2. Labour related delay.
3. Equipment related delay.
4. Design related delay.
5. Consultant related delay.
6. Contractor related delay.
7. Owner Related delay.
8. Project Related delay
9. External Related delay.

Types Of Delay: There are four basic ways to categorize type of delays:

1. Critical or noncritical
2. Excusable or non-excusable
3. Compensable or non-compensable
4. Concurrent or non-concurrent

6 RESEARCH METHODOLOGY

The study required both primary and secondary data. The Primary data has been collected by interviewing the officials of the construction industry. The study has been broadly undertaken as follows:

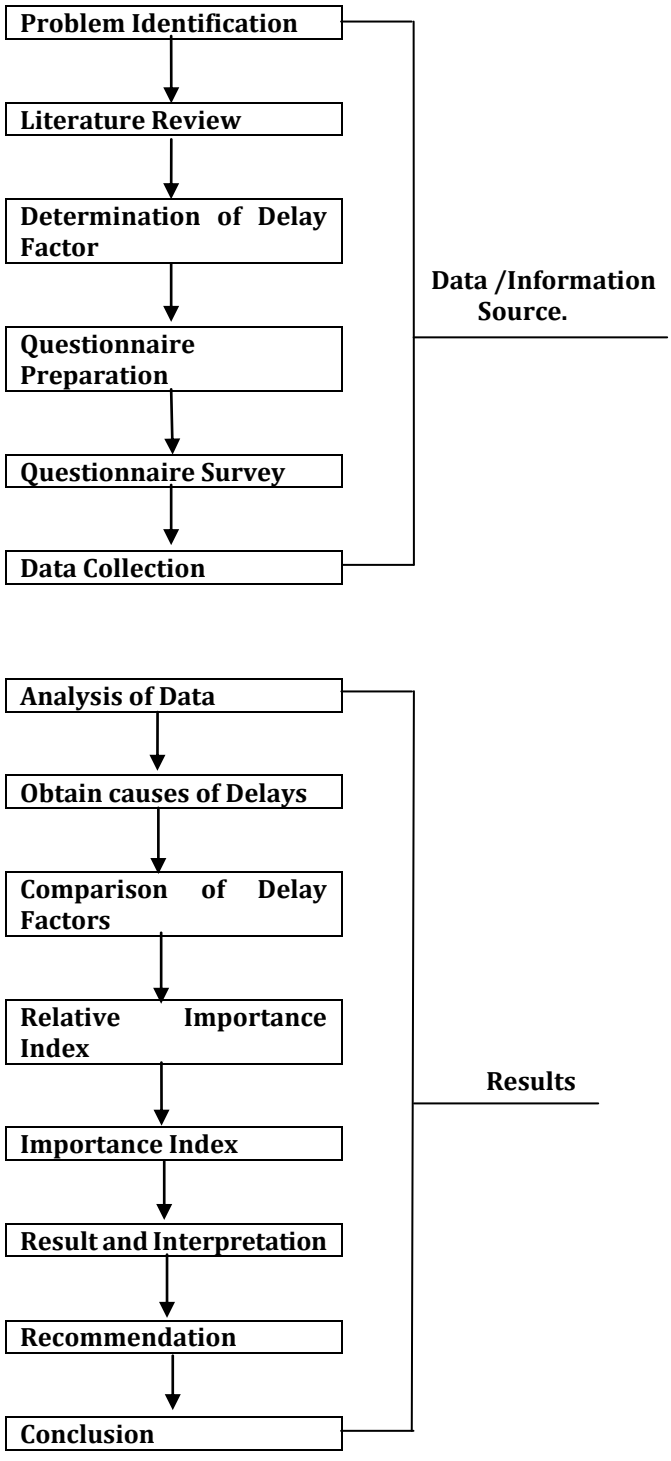


Figure: 2 Methodology Diagram

Questionnaire Preparation

The questionnaire is mainly based on Likert's scale of 5 ordinal measures from 1 to 5 according to level of contributing.

(5) = Extremely Significant

(4) = Very Significant

(3) = Moderate Significant

(2) = Slightly Significant

(1) = Not Significant

Cronbach's Alpha for Reliability Statistics

There liability of an instrument is the degree of consistency which measures the attribute; it is supposed to be measuring (Politand Hunger, 1985). The less variation an instrument produces in repeated measurements of an attribute, the higher its reliability. Reliability can be quoted with the stability, Consistency, or dependability of a measuring tool. The test is repeated to the same sample of people two occasions and then compares the scores obtained by computing a reliability coefficient (Polit and Hunger, 1985). It is difficult to return the scouting sample of the questionnaire-that is used to measure the questionnaire validity to the same respondents due to the different work conditions to this sample. Therefore Cronbach's Coefficient Alphatest can be applied to the scouting sample in order to measure the consistency of the questionnaire. This method is used to measure their liability of the questionnaire between each group and the mean of the whole groups of the questionnaire. Cronbach's alpha (George and Mallery 2003) is designed a same as sure of internal consistency, that is, do all items with in the instrument measure the something? Alpha typically varies between 0 and 1. The closer the Alphaisto1, the greater the internal consistency of items in the instrument being assumed. Cronbach's Alpha can be written as a function of the number of test items and the average inter-correlation among the items.

Cronbach's Alpha for Reliability Statistics is given by:

$$\alpha = \frac{K*C}{v+(K-1)*C}$$

Where,
K = Highest rank to each number of item
C = average inter-item covariance among the items
V = average variance ib items

Data Analysis

To analyze data various researchers used the research instrument which was developed using a variety of measures that were adopted from extant literature and a number of new measures developed for this research project .The instruments used in the field survey questionnaires were five Point Likert-scales. The questionnaire was carefully designed to allow the respondents to provide the significant and occurrence of the delay in construction projects based on their experience. The sample consisted of engineering professionals working in three major construction stakeholders: owner, consultant and contractor. No any logical or mathematical process for sampling was employed in this study.

Relative Importance Index (RII)

The Relative Importance Index (RII) ranking method had been applied to determine the ranks of the different delay causes. From the ranking assigned to each cause of delays, it is able to identify the most critical delay factors in the construction industry. The RII has been used in many domains to evaluate the comparative importance of a single item to others.

The five-point Likert scale ranging from l (very low Significant) to 5 (Extremely Significant) was adopted and transformed to relative importance indices (RII) for each factor as follows:

$$\mathbf{RII} = \frac{\sum W}{A*N}$$

Where,

W = Weightage given to each factor (ranging from 1 to 5)
A is 5 (the highest weight) and
N is the Total number of Respondents

The RII value had a range from 0 to 1 (0 not inclusive), the higher the value of RII indicates that the more important was the delay factor to the Construction industry.

Importance Index (*I*)

The collected data was analyzed using an importance index. The importance index was computed by the following formula:

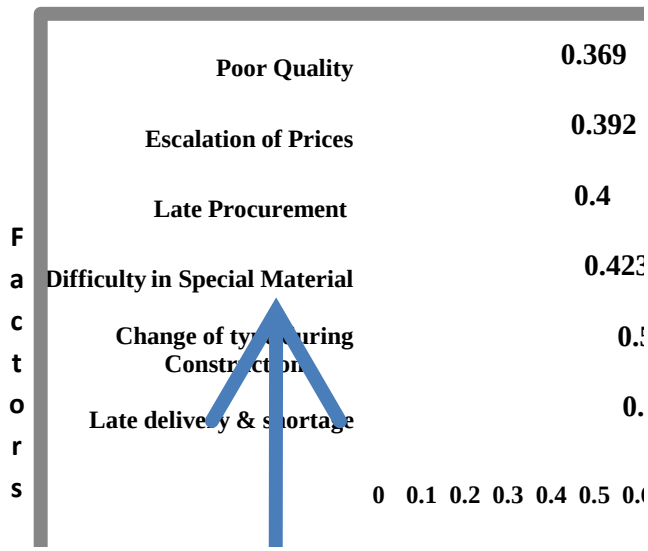
$$(I) = \sum_{i=1}^{5} \frac{ai\ xi}{4}$$

Where,

I = importance index
ai= constant expressing the weight of the 228th response,
Xi = frequency of the 228t h response given as a percentage of the total responses for each cause
The importance index for all the delay factors and the groups of delays were calculated. The indexes were ranked for owners, contractors, and consultants.

Table: 1 Top Delay Factors of Related to Material.

Rank	Description of Delay Factor	Mean Score	Relative Importance Index(RII)	RII %
1.	Shortage of Material in Site or Market causes late delivery on site.	2.88	0.577	21.68
2.	Change of Material type and Specifications during construction.	2.5	0.5	18.79
3.	Difficulties in Special Manufacturing Materials.	2.12	0.423	15.9
4.	Late Procurement of materials.	2	0.4	15.03
5.	Escalation of Material Prices.	1.96	0.392	14.73
6.	Poor Quality of Construction Material.	1.85	0.369	13.87



Graph: 1 shows Top Material Related Delay Factor. (Delay Factor versus RII).

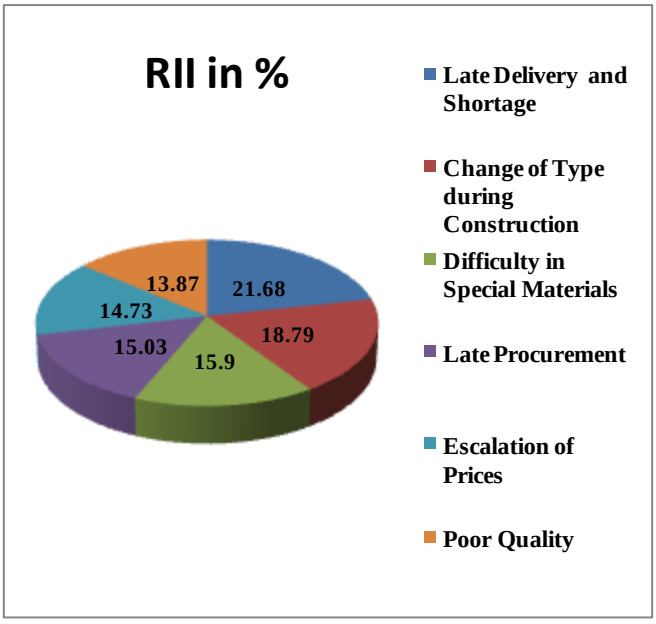


Figure: 2 Pie Diagram to show Relative Importance Index in Percentage(%).

7 RECCOMENDATION TO MINIMIZING DELAYS

7.1 Effects of Construction Delays

Some of the factors which effects construction delays are as follows:

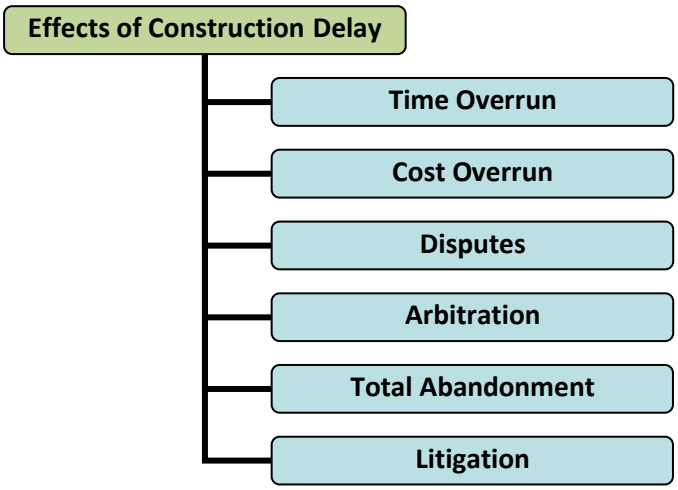


Figure 3: Effects of Delays diagram

7.2 Methods to reduce down construction delays.

Following are the various majors to control the delays, which can be easily applied to construction project:

- Sound Implementation Planning
- Better Formulation and Appraisal of Projects.
- Advance Action
- Clearances
- Assurance of Funds Resources
- Better Contract Management, Penalties and Incentives
- Monitoring
- Management Techniques, Systems, Incentives
- Consultant's perspective management
- Contractor's perspective management
- Aspects related to management of contracts between the owner, contractor, and subcontractors
- Failure to document changes to the project.

7.3 Minimizing Techniques of Construction Delays

The tools here each have their strengths and particular purposes, summarized as a basic guide in the matrix below:

- Brainstorming
- Project financial planning and reporting
- Project contingency planning
- Communicate the project plan to your team
- Agree and delegate project actions
- Manage, motivate, inform, encourage, enable the project team
- Project critical path analysis

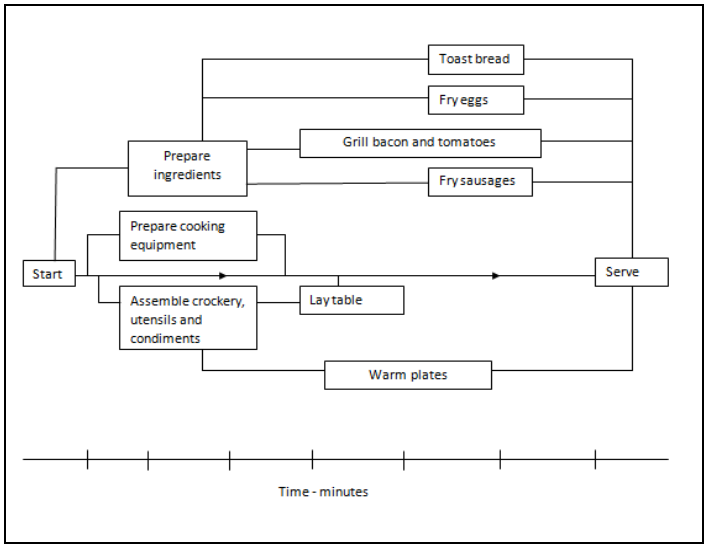


Figure 4: Example of flow diagram or chart

- Gantt charts

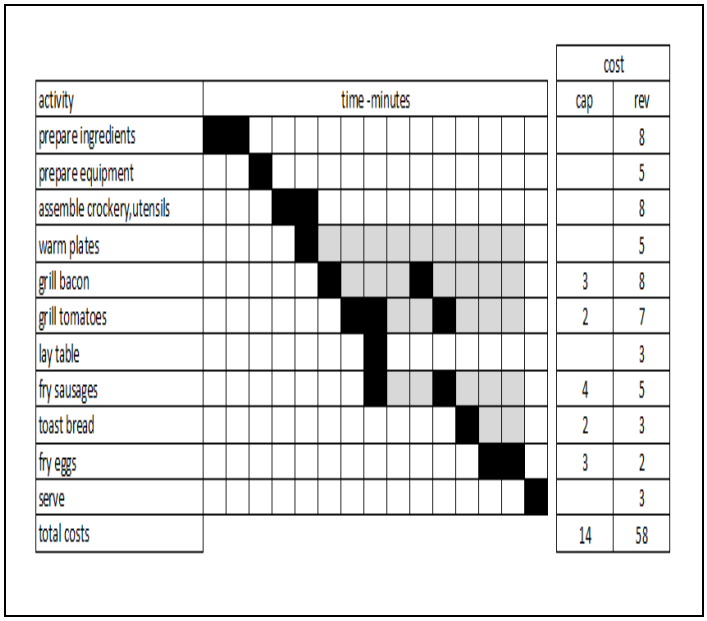


Figure 5: Example of Gantt chart

8 CONCLUSION

India is developing country, and population of the country is tremendously increasing. This intern increases pressure on the infrastructure and residential construction field. So there are large number of projects currently are in progress. Government sector is working hard for such development; as

well there are large numbers of private organizations running behind same goal. The field of civil engineering, construction is a process that consists of the building or assembling of infrastructure. Far from being a single activity, large scale construction is a feat of multitasking. Normally the job is managed by the project manager and supervised by the construction manager, design engineer, construction engineer or project architect. The successful execution of a project, effective planning is essential. Besides the successful planning it has been reported that 86 % construction projects get delayed. Reasons for such delay which cause cost and time overruns are enormous.

Construction delays are disruptive and expensive. Delays on construction projects, and the claims which emanate from such delays, are an integral part of the modern construction process. The overwhelming amount of time, energy, and cost devoted to delay claims does not begin when a claim is initially submitted at or near the completion of a job, rather, the construction delay claim process commences at project inception.

Even though there are plenty of management techniques to control delays in construction projects, most of the projects are facing the problem. Many projects are suffering because of delay from the part of the client to supply of some of the material which as part of the contractual agreement they have to supply to the contractor or delay in settling Running Account bills. These problems together with other problems such as delay in getting clearances and other problems listed above makes it more difficult to complete the project on time and within planned budget. Another difficulty faced by the construction industry is the low productivity of resources, especially equipment productivity. Even then, the use and implementation of better project management and management techniques can improve the situation and can lead to achievement of more growth and development to the economy as a whole.

The study is limited to sample interviews of 26 Sites.
The main factors which cause delay in present study are as follows:

- Delays to obtain permits from authority /municipality and Strict Checking
- Delays due to weather conditions
- Delay due to excessive extra works to be carried out due to design change or mistakes to include in beginning.
- Delay due to wrong incomplete drawing/specification and poor instructions of supervising engineers, results into rework.
- Manufacturing difficulties of special materials and shortage of Skilled labor.
- Delay due to excessive slow in decision making and lack of experience.
- Delay due to changed site conditions – design need to be revised.
- Delay due to Multiple owners of projects and several projects at a time..
- Delay by Subcontractor to finish work in time due to lack of fund or taking several projects which affects further work.

9 RECOMMENDATIONS FOR FUTURE WORK

More research to be done on various construction project sites to identify complex factors causing delays and find solutions to it. It is necessary to understand and find the importance of delays in projects and sort them out for accurate results.

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