

Analysis of Delay Causes in Residential Construction Projects

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Abstract— Delays on construction projects are a universal phenomenon. For owner, delay means the loss of income and unavailability of facilities. For contractor, delay means the loss of money for extra spending on equipment and materials and hiring the labour and loss of time. They are almost always accompanied by cost and time overruns. Construction project delays have a debilitating effect on parties such as owner, contractor, and consultant in terms of a growth in adversarial relationships, distrust, litigation, arbitration, cash-flow problems etc. Construction delay has become endemic in Indian construction industry. Delay of a project is a main factor and the major cause of construction claims. Therefore there is acute necessity for a detailed analysis of the delay factors and chooses correct actions to minimize the adverse effect of delay on time, within cost and for high quality. This research paper present list of construction delays causes retrieved from literature. The feedback of construction experts was obtained through interviews. Subsequently a questionnaire survey was prepared .The questionnaire survey was distributed to owner, contractor, engineer, architect and consultant. Frequency index, importance index and severity index are calculated. The number of recommendations ends the paper. The findings of this research paper can be used as a reference by project owners, managers, and in various organizations in developing their project management strategies and minimizing construction delays.

Keywords— *Construction delay; causes of delays; effects of delays; delay analysis; recommendations.*

I. INTRODUCTION

Construction industry has complexity in its nature because it contains large number of parties as clients, contractors, consultants, stakeholders, shareholders, regulators and others. 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 labor 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 .These sources, include the performance of parties, resources availability, environmental conditions, involvement of other parties, and contractual relations. However, it is rarely happen that a project is completed within the specified time. The survey revealed differences in perceptions of the relative significance of factors between the three groups, indicative of their experiences, possible prejudices and lack of effective communication. It was found that owners had more concerns with regard to financial issues; contractors regarded contractual relationships the most important, while consultants considered project management issues to be the most important causes of delays. The results indicate that delays are very extensive in nature. Therefore, it is essential to identify the actual causes of delay in order to minimize and avoid the delays and their corresponding expenses. to analyse, because of the non-linear behaviour of the material. Explosions result in large dynamic loads, greater than the original design loads, for which the structures are analysed and designed. Analyses and design of blast loading requires detailed knowledge of blast and its phenomena.

II. LITERATURE REVIEW

A number of studies have been carried out to determine the causes of delay, effects of delays in construction projects. Sweis et al. studied the causes of delay in residential projects and concluded that financial difficulties faced by the contractor and too many change orders by the owner are the leading causes of construction delay.

Abd El-Razek et al. In a similar study found that the most important causes of delay are financing by contractor during construction, delays in contractor's payment by owner, design changes by owner or his agent during construction, partial payments during construction utilization of professional construction/contractual management.

Assaf and AlHejji conducted a time performance survey of different types of construction projects to determine the causes of delay and their importance according to each project participant (owner, consultant, and contractor). They identified seventy three (73) causes of delay during the research. The most common cause of delay identified by all three parties was "change order."

Assaf, Al-Khalil, and A-Hazmi summarized main causes of delay in large building construction projects in Saudi

Arabia. They identified approval of shop drawings, delays in payment to contractors and the resulting cash problems during construction, design changes, conflicts in work schedules of subcontractors, slow decision making and executive bureaucracy in owner's organizations, design errors, labour shortage and inadequate labour skills as the most important causes of delay.

III. TYPES OF CONSTRUCTION DELAYS

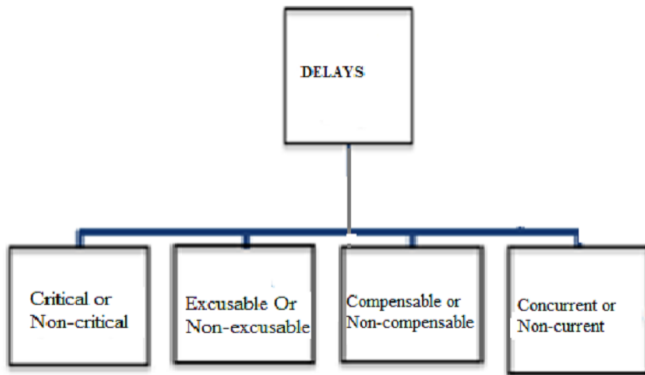


Figure 3.1 Types of delays

3.1 Critical or non-critical delays:

Delays that affect the project completion or in some cases a milestone date are considered as critical delays, and delays that do not affect the project completion, or a milestone date, are noncritical delays. If these activities are delayed, the project completion date or a milestone date will be delayed.

3.2 Excusable or non-excusable delays:

All delays are either excusable or non-excusable. An excusable delay is a delay that is due to an unforeseeable event beyond the contractor's or the subcontractor's control. For example general labour strikes, fires and acts of God. Non-excusable delays are events that are within the contractor's control or that are foreseeable. Inexcusable delays (Non-Excusable delay) are caused solely by the contractor or its suppliers.

3.3 Compensable or non-compensable delays:

A compensable delay is a delay where the contractor is entitled to a time extension and to additional compensation. Compensable delays are caused by the owner or the owner's agents. An example of this would be the late release of drawings from the owner's architect.

Non-compensable delays mean that although an excusable delay may have occurred, the contractor is not entitled to any added compensation resulting from the excusable delay. Non compensable delays are caused by third parties or incidents beyond the control of both the owner and the contractor. Examples typically include unusual weather, strikes, acts of government etc.

3.3 Concurrent or non-concurrent delays:

The concept of concurrent delay has become a very common presentation as part of some analysis of construction delays. The concurrency argument is not just from the standpoint of determining the project's critical delays but from the standpoint of assigning responsibility for damages associated with delays to the critical path. Unfortunately, few contract specifications include a definition of concurrent delay and how concurrent delays affect a contractor's entitlement to additional compensation for time extension or responsibility for liquidated damages. In analysed concurrent delays, each delay is assessed separately and its impact on other activities and the project duration is calculated.

IV. CAUSES OF DELAYS IN RESIDENTIAL CONSTRUCTION PROJECTS

Delays in construction can have multiple effects such as late completion, loss of productivity, acceleration cost and in some cases contract termination. Though delay in a noncritical activity may not affect the project duration significantly, a delay may occur concurrently with other delays and all of them may impact the project completion date.

Cause of delays in construction projects are mainly as:

4.1 Client related factors:

Finance and untimely payment making and unrealistic contract duration imposed by owners.

4.2. Contractor related factors:

Delays caused by subcontractor, poor site management, improper construction methods, improper planning, inability to adhere strictly to the project schedule, errors during construction, and inadequate contractor experience, lack of construction equipment and facilities.

4.3. Consultant related factors:

Contract management, preparation and approval of full working drawings, quality assurance and waiting time for approval of test and inspection.

4.4. Material related factors:

Quality of material and shortage in material, lack of construction equipment and facilities/substandard machineries.

4.5. Labour and equipment related factors:

Labour supply, poor labour management, labour productivity and equipment availability and failure.

4.6. Contract related factors:

Change orders and mistakes or discrepancies in contract document, lack of due process in the award of the contract an

4.7. Contract relationship related factors:

Major disputes and negotiations, inappropriate organizational structure and lack of communication between the parties.

4.8. External factors:

Weather condition regulatory changes, problem with neighbour’s and unforeseen site condition, political and security instability all are the external factors.

V. EFFECTS OF CONSTRUCTION DELAYS

Several factors cause the overall delay in the construction project such as some within contractor’s liability and some are within owner’s liability. It is mostly seen that delay problems are cause of dispute, negotiation, lawsuit, total desertion, litigation and abandonment. The consequences of delay are different for different parties. The general consequences are the loss of wealth, time and capacity.

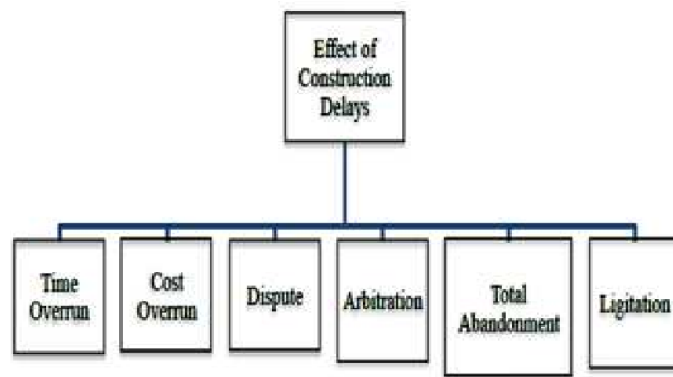


Figure 4.1 Effects of delays on construction projects

VI. DELAY ANALYSIS APPROACH

Data were gathered through a questionnaire. The questionnaire is divided into two main parts. Part 1 is related to general information for both the company and respondent. Both contractors and consultants were further requested to answer questions pertaining to their experience in the construction industry and their opinions about the percentage average time delay in projects they experienced. Part 2 includes the list of the identified causes of delay in construction project. These causes are classified into nine groups according to the sources of delay.

5.1 Frequency Index:

A formula is used to rank causes of delay based on frequency of occurrence as identified by the participants.

$$\text{Frequency Index (FI)} = (\sum (a n) \div N) \times (100 \div 4)$$

Where a is the constant expressing weighting given to each response (ranges from 1 for rarely up to 4for always), n is the frequency of the responses, and N is the total number of responses

5.2 Severity Index (SI):

A formula is used to rank causes of delay based on severity of occurrence as identified by the participants.

$$\text{Severity Index} = (\sum (a n) \div N) \times (100 \div 4)$$

Where a is the constant expressing weighting given to each response (ranges from 1 for little up to 4for severe), n is the frequency of the responses, and N is the total number of responses.

5.3 Importance Index (II):

It is a function of both frequency and severity indices, as follows:

$$\text{Importance Index (I.I \%)} = (\text{F.I \%} \times \text{S.I \%}) \div 100$$

VII. RESULT AND FINDINGS

Following are the most critical causes of delays concluded from the result and analysis:

Table I: Causes of delays concluded from the result and analysis

Sr.no	Group	Delay Causes	F.I (%)	S.I (%)	I.I (%)
1	Project group	Contract duration is too short	70	55	46
2		Types of construction contract	62.5	47.7	30
3		Type of project building awarded	53.4	39.8	22
4	Contractor group	Rework	47.3	57.5	27
5		Difficulties in financing	60	58	34
6		Subcontractors conflicts	53.2	53	28
7	Owner group	Delay in payment by owner	70.4	59	41.6
8		Change order by owner	59	54.5	38.9
9	Consultant group	Poor communication	60.2	50	30
10		Delay in performing inspection	42	42	17
11		Inflexibility of consultant	61.3	48.7	30
12	Design group	Mistakes and discrepancies	57	60	34
13		Inadequate details in documents	52.2	52.1	28
14		Complexity of project design	51.2	55	28
15	Material group	Shortage of construction material	59	66	38
16		Delay in material delivery	66	63.6	41.9
17		Damage of sorted material	45.5	50	22.7
18	Equipment group	Equipment breakdown	62.5	59	36.9
19		Shortage of equipment	61.3	52.3	32
20		Low level of operators skill	50	59	30
21	Labour group	Shortage of labour	71.6	67	48
22		Unqualified workforce	60	67	40.3
23		Personal conflict among labours	50	47.7	24
24	External group	Delay in obtaining permits from municipality	64.8	64.8	42
25		Rain effect on construction activities	50	56.8	28.4
26		Hot weather effect on construction	54.6	48.7	26.7

VIII. RECOMMENDATIONS

Delays can be avoided or minimized when their cause are clearly identified. It is the responsibility of various team members involved on construction projects forming a team for construction projects to avoid delays as far as possible. The various parties involved in the construction team to formulate their responsibility about delays in construction are Owner, Engineer, Contractor, Consultant, Architect, Material supplier.

7.1 Owner:

The owner is the final holder of major decision making regarding managerial, financial and administrative. He controls the project resources such as manpower, funds and property. In case not to happen delays in construction there are various responsibilities of owner are as in case of shortage of labour-owner or contractor should take care of that they should have sufficient labours with them to complete the work well before .in case of shortage of labors, for small works they can use the small equipments to replace some manpower so that instead of doing work manually machine can do the work faster

7.2 Contractor:

The contractor may be an individual undertaking small or large contract for construction projects. The contractor submit running bill for payment based on the progress of work and material brought at site. Responsibility of contractor in case of delay should be as: Contractor should take care that they should provide comfortable environment to the workers to do their work effectively and efficiently with maximum outcome. Also give the proper wages to the workers with monitory and non monitory benefits.

7.3 Engineer:

For unclear and inadequate details in drawings-at the time of submission of drawings architect, engineer should give all the necessary details without any omissions. Drawings should be very much clear and easy to understand so that at the time of actual execution of work one will not face any difficulty and wastage of time and project will complete in time as per originally planned.

7.4 Architect:

The role of architect is to assess the client functional requirements, design for pleasing and aesthetic appearance and to assist the engineer for proper design to avoid delays.

7.5 Consultant:

For Delay in approving major changes in the scope of work by consultant- Change in Scope of work is alteration of the original work if there are major changes according to consultant, he should take prior approval from owner.

7.6 Material supplier:

He should supply the material on time at site as per requirement and specific terms and condition to avoid possible delay due to late delivery of material at site.

IX. CONCLUSIONS

Construction delay is a critical function in construction projects. In practice, this phenomenon is expected to continue unless management takes action to control these causes right from design stages. And adequate planning; coordination; and proper monitoring of the construction projects by an experience and qualify professionals will reduce the impact of delay. In general, the amount of time-delay and cost-increase (overrun), increased with an increase in the total cost of a residential project. However, private residence owners who spent more time on the pre-planning phase –spent more money on the design phase; issued less change orders; selected more experienced contracting companies; and hired a supervising engineer to independently supervise the progress of work and ensure the delivery of materials –experienced less time-delays and cost-increases during the implementation phase of their residential projects. Cost overrun and time overrun (elongation of project duration) were the two most frequent effects of delays which significantly affects the construction projects.

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