

Computations of Consequence Factors Causing Delays in Construction Project

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ABSTRACT

Construction delays can be defined as the delay in completion of work compared to the planned schedule or contract schedule. Construction delays can be minimized only when their causes are identified. The objective of this study was to identify the major causes of construction delays, the effects of delays, and methods of minimizing construction delays. This study was carried out based on literature review and a questionnaire survey. A number of groups were contributed to the cause of construction delays, factors that effects delays and methods of minimizing construction delays were identified based on literature review. The questionnaire survey was distributed to the target respondent in and around Coimbatore. The objectives of the study were successfully achieved. The top most important factors that contributed to the causes of delays were late in revising and approving design documents, delays in sub-contractors work, and poor communication and coordination change orders by owner during construction. Contractor-related delays was ranked the most significant groups that cause delays, followed by client-related delays, and consultant-related delays. Time and cost overrun were the common effects of delays in construction projects .To minimize delays in construction projects it has been identified that the top effective methods of minimizing construction delays includes: site management and supervision, effective strategic planning, and clear information and communication channel.

Keyword: Construction Project, Construction Delays, Schedule Analysis, Relative importance index, Gantt chart.

I. INTRODUCTION

1.1 GENERAL

Construction delays can be defined as the late completion of work compared to the planned schedule or contract schedule. Construction delays can be minimized only when their causes are identified. The objective of this study was to identify the major causes of construction delays, the effects of delays, and methods of minimizing construction delays. This study was carried out based on literature review and a questionnaire survey. 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. The problem of project delay is a fact that occurs mostly in Indian construction industry. The main objective of this study is to identify the factors of delays in the Major Construction Projects in Indian Industry. The most common factors of delays are financial problems, improper planning, poor site management, insufficient experience, shortage of materials and equipment, weather conditions etc.

The questionnaire survey was distributed to the target respondents in Coimbatore construction project sites. The objectives of the study were successfully achieved. The top three most important factors that contributed to the causes of delays were late in revising and approving design documents, problems due to change in law and order, delays in sub-contractors work, and poor communication and coordination between the different agencies involved in the construction process.

Time and cost overrun were the common effects of delays in construction projects. To minimize delays in construction projects it has been identified that the top three effective methods of minimizing construction delays includes: site management and supervision, effective strategic planning, and clear information and communication channels.

Delays caused by the client such as late submission of drawings and specifications, frequent change orders, and inadequate site information generates claims from both the main contractors and subcontractors which many times entail lengthy court battles with huge financial repercussions. Delays caused by contractors can generally be attributes to poor managerial skills. Lack of planning and a poor understanding of accounting and financial principles have led to many contractor's downfall.

1.2 OBJECTIVES

The objectives of present thesis are,

1. The main objective of this study is to identify the major causes of delays in construction projects in Coimbatore Construction Industry through a survey.
2. The primary aim is to identify the perceptions of the different parties regarding causes of delays, the allocation of responsibilities and the types of delays.
3. To monitor the schedule assigned for the project and identify the delay factors affecting the total work schedule.

II. LITERATURE REVIEW

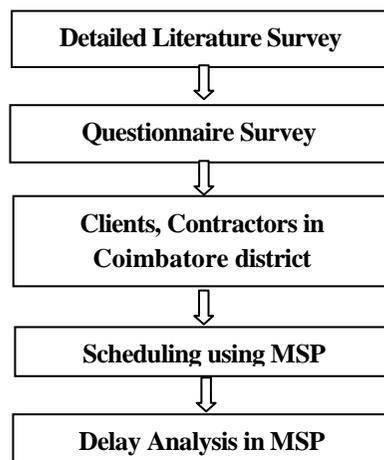
Adnan et al (2016) assess the factors leading to time overruns and cost overruns in construction projects in the Gaza Strip. The survey included 110 delay factors, 42 cost overrun factors. The main four causes of time delays included strikes and border closures, material-related factors, lack of materials in markets, and delays in materials delivery to the site. Additionally, the main three causes for cost over runs included price fluctuations of construction materials, contractor delays in material and equipment delivery and inflation. This study concluded that the major causes could be removed by better management practices.

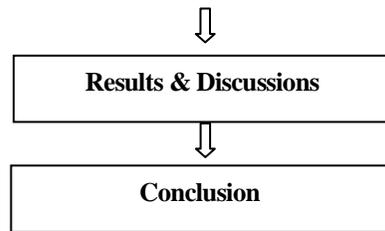
Remon et al (2015) lists the construction delay causes. The questionnaire survey was distributed to 500 construction from the identified 293delay causes. Relative Importance Index (RII) is calculated and according to the highest values the top twenty and the least twenty delay causes of construction projects in Egypt are determined. From the analysis of case study, the most contributing causes and groups to delays were identified, and some future suggestions were proposed in order to control and minimize delays in road construction project.

Charles et al (2014) assess the causes and effects of delays in public sector housing projects in Ghana. A purposive sampling approach was used in finding the respondents for the study. Results focussed that the critical factors that contribute to project delays in Ghana are delay in payment to contractor/supplier, inflation/price. Fluctuation, price increases in materials, inadequate funds from sponsors/clients, variation orders and poor financial/capital market. The critical effects of delays are cost overrun, time overrun, litigation, lack of continuity by client and arbitration.

Greeshma et al (2013) had done a study on quantification of delay factors in construction industry in Kerala region. Top 10 major causes of construction delays in construction industry are shortage of construction materials, effect of sub surface conditions and natural disaster, delay in material delivery, low productivity of labors, rework due to errors, late procurement of materials ,unqualified workforce, low productivity and efficiency of equipment, delay in quality control, poor site management and supervision, poor communication between parties & lack of high technology were analyzed.

III. METHODOLOGY





3.1 RESERACH METHODOLOGY

In the present study Microsoft Project has been used for planning and scheduling and for delay analysis As Planned vs. As Built technique has been used. Various data has been collected in the form of bar charts and drawings from site. The bar charts are converted into network by MSP and critical path is found out.

3.2 PREPARATION OF SCHEDULE USING MSP SOFTWARE

With the help of MSP schedule that will be prepare for the project according to the information collected from the organization. Before preparing the schedule initially different activities are identified with the help of data given by the organization and resources required for the project by rate analysis.

3.3 QUESTIONNAIRE DESIGN

A questionnaire is an analyzing instrument consisting of a set of questions for the purpose of collecting information from the respondents. They are designed for statistical analysis of the responses. The questionnaire is mainly based on Likert's scale of 5 ordinal measures from I to 5 ranking according to level of contributing.

- (5) = Very high effective
- (4) = High effective
- (3) = Effective
- (2) = Low effective
- (1) =Very low effective

IV. CONSTRUCTION DELAYS

There are three basic ways to categorize type of delays:

1. Critical and noncritical
2. Excusable and Non-excusable
3. Compensable and non-compensable

4.1 CRITICAL AND NON-CRITICAL DELAYS

Delays that influence the project completion or at times a point of reference date are considered as basic delays and delays that don't influence the project completion or a breakthrough date are considered as noncritical delays. On the off chance that these exercises are delayed, project completion date or a point of reference later will be delayed. The figuring out which exercises really control the undertaking project completion date upon the accompanying: The project itself

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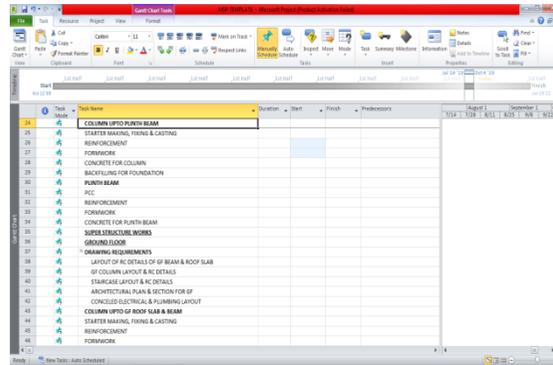


fig 5.1 PROJECT RESOURCE

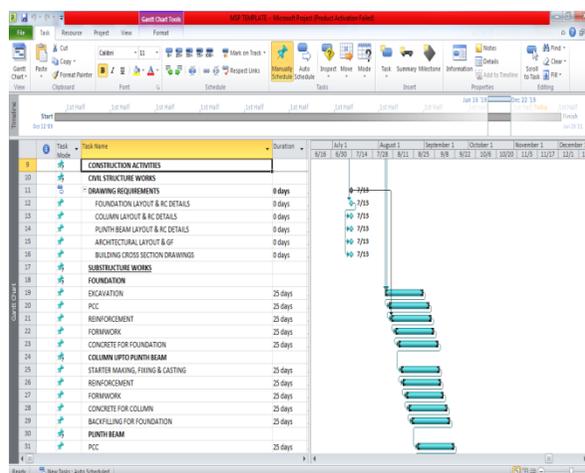
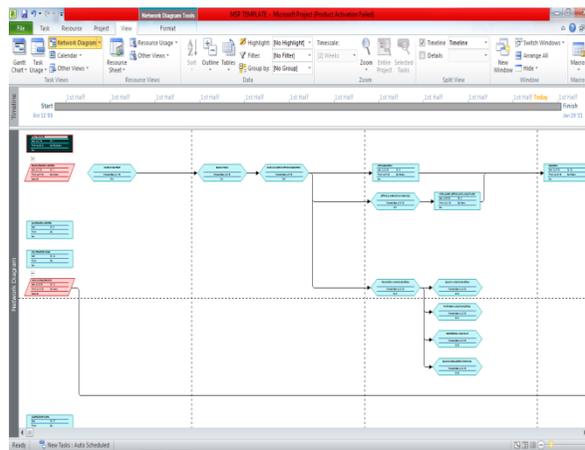


fig 5.1 PROJECT SCHEDULE

VI. RESULTS AND DISCUSSION

All the questionnaire survey was done from project manager of the project or project engineer at the site. In some cases, consultant gave the answers on behalf of their clients, both from the owner and the contractor side.

6.1 IDENTIFICATION OF THE KEY DELAYS

6.1.1 Acts of God

From the below analysis it is clear that these delays does not affect the construction in the Coimbatore region. The below given delay factors were given the least importance according to the survey responses. Because of the same reason these factors wouldn't affect the construction work progress. Figure 6.1.1 gives the graphical representation of the data given below.

Table 6.1.1 Result analysis for Acts of God related delays

Sl. No.	Acts of God	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Relative index
1	Flood	15	3	2	0	0	1.35
2	Hurricane	5	10	3	1	0	1.52
3	Fire	8	8	4	0	0	1.8
4	Wind damage	6	9	5	0	0	1.95

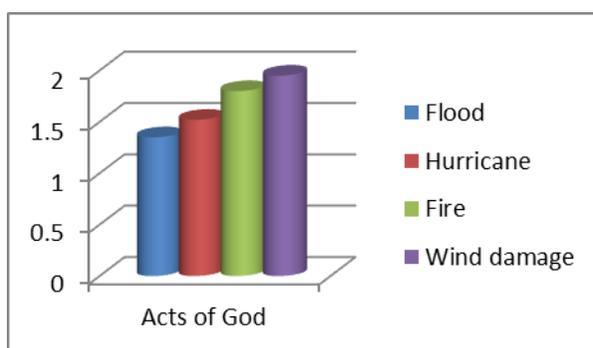


Fig 6.1.1 Histogram of delays (acts of god)

6.1.2 Design Related Delays

Design related factors play a crucial role in the construction project development. It is seen that the different issues like change in drawings and specifications, delay in decision making, delay in approval of drawings and other details were given high priority by the

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contractors. Also these factors are found to be the major causes of delay as per the contractor side. Figure 6.1.2 gives the graphical representation of the data given below.

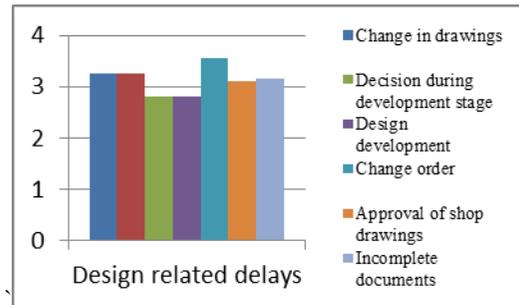


Fig 6.1.2 Histogram of design related delays

6.1.3 Financial / Economical delays

According to the below survey responses it is evident that the delay in payments to the contractor from the owner side acts as an important factor for the construction delay. Therefore the owner has to make sufficient arrangements in order to release required amount of payment to the contractor so as to carry out the various construction activities as per the approved schedule leading to the timely completion of the project. Figure 6.1.3 gives the graphical representation of the data given below.

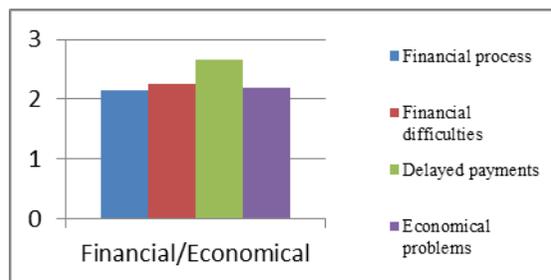


Fig 6.1.3 Histogram of financial / economical delays

6.1.4 Management and Administration delays

The result analysis of the factors of management and administration delays. From the analysis it is observed that lack of proper planning and management in the execution of works is a major construction delay factor. Poor site management and deployment of poor skilled supervisors for the different activities also added to the delay factor. So in order to ensure the timely and successful completion of the project, it is the duty and responsibility of the contractor to strictly monitor and control above aspects. Figure 6.1.4 gives the graphical representation of the data given below.

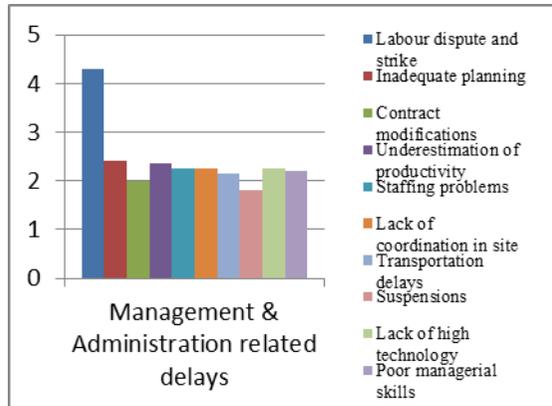


Fig 6.1.4 Histogram of management & administration related delays

6.1.5 Code Related Delays

Code related delays also play a major role when it comes to smooth functioning of a construction project. The changes in laws and regulations from the part of the government, delay in the building approval are identified as the important factors causing delays. Figure 6.1.5 gives the graphical representation of the data given below.

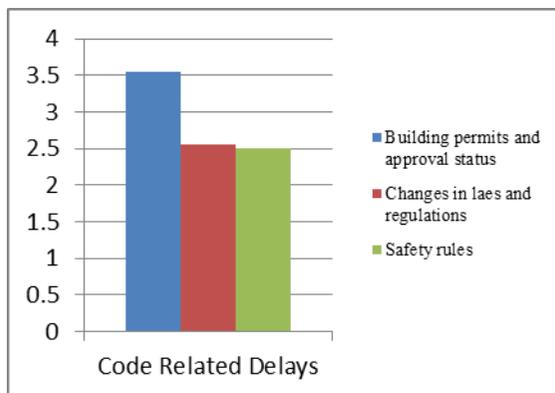


Fig 6.1.5 Histogram of code related delays

6.2 IDENTIFICATION OF RESPONSIBILITY AND TYPE OF DELAYS

The identification of responsibility as well as types of delays are shown in tables 6.2.1 to 6.2.5. The responsibility was rated among the parties that may be involved on a construction project starting from the owner, contractor, consultant and government to shared (Owner-Contractor, Owner-Consultant, etc.). On the other hand, the types of delays, which were already explained in chapter 4 are classified as:

Table 6.2.1 Types of delays and responsibilities (Acts of God)

Acts of God	Responsibility	Type of delay
Flood	Owner	Excusable Compensable
Fire	Shared	Excusable Compensable
Wind damage	Owner	Excusable Compensable

Table 6.2.2 Types of delays and responsibilities (design related delays)

Design Related	Responsibility	Type of Delay
Changes in drawings	Owner	Excusable Compensable
Changes in specification	Owner	Excusable Compensable
Decision during development stage	Owner	Excusable Compensable
Design development	Consultant	Excusable Compensable
Change order	Owner	Excusable Compensable
Shop drawings approval	Consultant	Excusable Compensable
Incomplete documents	Consultant	Excusable Compensable

Table 6.2.3 Types of delays and responsibilities (Financial/Economical)

Financial/ Economical	Responsibility	Type of Delay
Financial process	Owner	Excusable Compensable
Financial difficulties	Owner	Excusable Compensable
Delayed payments	Owner	Excusable Compensable
Economic problems	Owner	Excusable Compensable

Table 6.2.4 Types of delays and responsibilities (Management & Administration)

Management & Administration	Responsibility	Type of Delay
Labour dispute and strike	Contractor	Excusable Non-compensable
Inadequate planning	Contractor	Non-Excusable
Inadequate scheduling	Contractor	Non-Excusable
Contract modifications	Owner	Excusable Compensable

Table 6.2.5 Types of delays and responsibilities (Construction related delays)

Construction Related	Responsibility	Type of Delay
Inspections	Contractor	Non-Excusable
Material procurement	Contractor	Non-Excusable
Lack of qualified craftsmen	Contractor	Non-Excusable
Poor sub-contractors performance	Contractor	Non-Excusable

6.3 Observations and Results

It was observed that certain delays were occurred in the schedule of work and the executions of some activities were far behind the schedule. After tracking it was found that only 68% of the work was completed during the scheduling period. The delay occurred due to the shortage of construction materials like sand, laterite blocks etc. Because of the shortage of these materials, a hike in price was witnessed for the same materials. The fluctuations in the prices of construction materials had a significant effect on the implementation of these works as well as the total cost incurred for the construction.

The major reasons for the delays in Coimbatore site and responsibility of the agency behind it and the delay types are given in the table 6.3.1.

Table 6.3.1 Types of delays and responsibilities (schedule monitoring at site)

Reason for Delays	Responsibility	Type of Delay
Change in drawings	Client	Excusable compensable
Change in specifications	Client	Excusable Compensable
Decision during development stage	Client	Excusable Compensable
Delayed payments	Client	Excusable Compensable
Financial difficulties	Client	Excusable Compensable
Material procurement	Contractor	Non-Excusable
Lack of qualified craftsmen	Contractor	Non-Excusable
Poor sub-contractor performance	Contractor	Non-Excusable
Labour injuries	Contractor	Non-Excusable
Damage to structure	Contractor	Non-Excusable
Poor supervision	Contractor	Non-Excusable
Equipment availability	Contractor	Non-Excusable
Labour disputes and strikes	Contractor	Non-Excusable
Inadequate planning	Contractor	Non-Excusable

Inadequate scheduling	Contractor	Non-Excusable
Lack of coordination on-site	Contractor	Non-Excusable
Transportation delays	Contractor	Non-Excusable
Poor managerial skills	Contractor	Non-Excusable
Staffing problems	Contractor	Non-Excusable

6.4 Main reasons for delays in Coimbatore site

6.4.1 Contractor's improper planning

Local contractors often fail to come out with a practical and workable “work program” at the initial planning stage. This failure is interrelated with lack of systematic site management and inadequate contractor's experience towards the projects. The consultant only checks and reviews the work program submitted by the contractors based on experience and intuitive judgment. Improper planning at the initial stages of a project manifests throughout the project and causes delays at various stages. Only a project that is well planned can be well executed.

6.4.2 Contractor's poor site management

Contractor's poor site management is one of the most significant causes for construction delays. The result of this research for the schedule for the 2 months period indicates that local contractors face deficiency in site planning, implementation and controls. A poor site management causes negative impact on the overall work progress. Lack of communication between parties, the delays in the material shifting for the upper floors for the tiling works, kitchen pre-cast slab works granite laying and sand shifting for the plastering and masonry works etc. are the major delays which affected the smooth functioning of the project in the above mentioned period

6.4.3 Payments for completed work

Construction works involve huge amounts of money and most of the contractors find it very difficult to bear the heavy daily construction expenses when the payments are delayed. Work progress can be delayed due to the late payments from the clients.

6.4.4 Problems with sub- contractors

Typically in huge projects, there are many sub-contractors working under main contractors. If the sub-contractor is capable, the project can be completed on time as planned. In the Coimbatore site there was shortage of skilled labours for few sub-contractors which delayed the shuttering works in the floor slab. Due to this the schedule for the same floor

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revised and this delayed the total slab casting schedule resulting the delay in the following works. The project can be delayed if the sub-contractor under performs because of inadequate experience or capability.

6.4.5 Shortage in material

Shortages in basic materials like sand, cement, stones, bricks and steel can cause major delays in projects. In this period there was sudden shortage of laterite stone supply to the site due to hike in price of the material. This led to the delay in the wall masonry in turn resulting the delay in electrical conduit chipping and wall plastering works. The sudden hike in the rate of sand due to the shortage affected the overall work schedule which led to increase in the cost of the works. Also low quality of sand and laterite were also supplied, because of which the works were not commenced.

6.4.6 Equipment availability and failure

Many of the contractors do not own the equipments that are required for the construction works. They rent the equipment when required. During the season when there are many construction projects, the equipments are in short supply and are poorly maintained. Blocks were damaged and stopped functioning for 3 days which hindered the smooth functioning of the material shifting works. Because of this progress of the works were running well behind the schedule. Also the delay in procuring the excavators delayed the external boundary wall works.

6.4.7 Lack of communication between parties

Since there are many parties involved in a project, the communication between the parties is very crucial for the success of the project. Proper communication channels between the various parties must be established during the planning stage. Any problem with the communication can lead to severe misunderstanding and therefore, delays in the execution of the project. Lack of communication between the Client, Project management consultancy, contractor and sub-contractors had considerable effect on the total project schedule in Coimbatore project.

VII.CONCLUSIONS

Project delays have been a topic of concern in the construction industry. Delays have become a universal phenomenon and are almost always accompanied by cost and time overruns. Construction project delays have a debilitating effect on parties (owner, contractor, and consultant) to a contract in terms of a growth in adversarial relationships, distrust, litigation, arbitration, cash-flow problems, and a general feeling of apprehension each other.

Delays can be minimized only when their causes are identified. Knowing the cause of any particular delay in a construction project would help avoiding the same. This project was therefore, aimed at identifying the major causes of delays in construction projects in few construction projects in Coimbatore through a survey, and quantifies the perceptions of different parties relating to cause, responsible party and types of delay. Also a detailed work schedule is prepared and monitored in a site in Coimbatore and the reasons causing delays are identified.

Among all the six delay factors discussed in the survey, the top ranked reasons for the delay are given below.

1. Change order and building permits approval
2. Changes in drawings
3. Changes in specifications
4. Incomplete documents
5. Site inspections
6. Design development
7. Changes in law and order

The main delays occurred at Coimbatore site are as follows.

- 1) Improper planning, management and arrangement of works: It was seen that there wasn't any proper method for implementing works and also pre-planned procurement of materials delayed the slab casting works at site. The slab casting works were delayed for more than a month which affected the overall schedule of the project.
- 2) The delay in carrying out the external works and also the wrong methods used for the back filling etc. lead to waste of time and money affecting the other works at site.
- 3) Also the delay in completing the critical activities like external plastering again led to the slow progress of the works.
- 4) After the schedule monitoring process in Coimbatore site it was seen that the majority of the delays and other issues happened from the contractor side.
- 5) The changes in drawings, missing details, late in issue of drawings also played a major part.
- 6) The sudden hike in material rates, machinery breakdowns etc. increased the total construction cost which could have easily avoided with a proper managing system in the contractor side.

On basis of the results obtained, this study suggests the following measures to minimize the construction delays:

- 1) A construction delay occurs mostly during the construction phase. This is mostly caused by the poor labour skill, lack of proper supervision, use of low quality materials and machineries for construction. Therefore, contractor need to give awareness on these 3 factors stated above in order to minimize the construction delay problems.
- 2) A lot of problems occur due to improper planning and site management. So it is the responsibility of a contractor to implement a proper system to manage the different activities at site.
- 3) Contractors should organize some training programs for their workers in order to update their knowledge and improve their management skills.
- 4) The critical activities at site must be given preference because delays in this works can affect the overall project schedule.
- 5) The material procurement issues happen in the entire site. Therefore, the contractor must foresee the shortage of materials, hike in prices if any and must arrange the materials required for the different works in such a manner that it won't affect the smooth functioning of works.

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