Investigating Rework Causes in the Construction Industry

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***Abstract*—Rework, are activities in the field, which have been completed, but were required to be repeated or undertaken again as a result of some impeding correction that was necessary to be carried out during the project. This is regardless of source, or effecting a change, not due to change of scope by the owner. Fundamentally, rework becomes necessary either when an element of building works fails to meet customer requirements, or when the completed work does not conform to the contract documents. In either scenario, the product is altered so as to ensure conformity. At ascertain moment during construction, for example due to an error, rework is necessary. But the rework might not be discovered until some form of quality control check is done, after which it can be concluded as to what kind of rework needs to be done. Rework can also have internal or external origins. Changes in clients' expectations are an example of an external factor that might lead to rework. Rework can cause many costs to be higher than calculated at the start of the project. Rework can result from various sources such as errors, omissions and changes. While it is widely recognized that additional costs due to rework can have an adverse effect on project performance, limited empirical research has been done to investigate the influencing factors.**

***Index Terms*—Rework, Construction Projects, Rework Analysis, Importance Index.**

1. INTRODUCTION

The Researchers has indicated that rework is worsen by errors made during the design process, errors which then appear downstream in the procurement process. The Researchers has argued that the longer an error goes undetected, the greater the possibility of rework occurring that significantly impacts cost and schedule. The Construction Industry Institute (CII)(1989) study of nine large industrial construction projects found that rework due to design error contributed an average of 79% of total rework cost. In relation to Busby and Hughes (2004) and Cooper (1993), errors are ten not readily identifiable and often only become manifest after a period of incubation in the system. The extent of rework required, then, depends on how long the error has remained unnoticed. For instance, a dimensional error or spatial conflict contained within design credentials may not arise until the project is being physically constructed onsite. According to the researchers, errors occur as a result of a complex range of interactions, and hence attempting to segregate a singular causative variable is an unseemly strategy to undertake. Once an understanding of the typical nature and underlying dynamics of errors is acquired, only then can error reduction and error restraint strategies be implemented in projects.

2. PROBLEM STATEMENT

Rework is a recurring issue in the construction industry, leading to significant cost overruns, project delays, and resource wastage. Despite advancements in construction technology and project management practices, many projects continue to experience high levels of rework due to a variety of underlying causes. These causes are often multifaceted, ranging from poor workmanship and inadequate planning to communication breakdowns and design errors.

A. Lists of Factors Causes Rework in Construction Projects.

- Design-Related Factors
- Construction & Execution Factors
- Project Management & Coordination Factors
- Environmental & External Factors
- Human Factors
- Contractor field management
- Client related factors

3. REWORK CASE ON ACTUAL SITE

The bituminous concrete (BC) layer was damaged from chainage 8+000 to 9+000 and needs to be relaid. This has resulted in additional time and cost due to rework.

THE TIMES OF INDIA

Mumbai coastal road patchwork sparks outrage among motorists

TNN | Feb 20, 2025, 07.36 PM IST

MUMBAI: A video went viral on social media X (formerly Twitter) showing patchwork on the Mumbai coastal road's northbound stretch near Haji Ali on the bridge towards Worli.

The post by the handle @drifteternal read, "This is beyond disappointing. Mumbai's Rs 14000 crore Coastal Road already looks like patchwork. I feel betrayed—this was supposed to be world-class infrastructure. L&T and BMC must be held accountable. Is this what we paid for?"

The post got reposted over a 1,000 times and had close to four lakh views.

The stretch of the road which was constructed by Larsen & Turbo was opened to motorists on July 10 last year.

Fig 1 News about patchwork

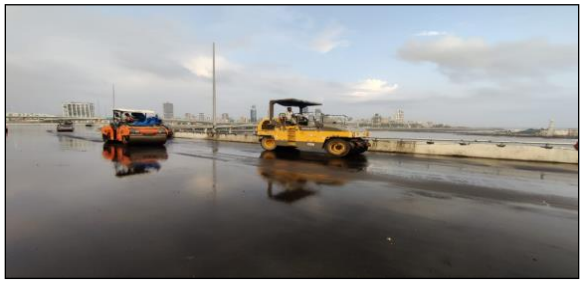


Fig 2 BC laid during rain

Fig 3 Pot holes created due to bad work

Fig 4 BC layer milling

At a Mumbai Coastal Road Project 10 km stretch of road was constructed, but due to Bituminous concrete (BC) layer laid during rain need to rework about 1 km length. The rework amount is calculated in following charts.

Table 1 Overview of the work

Overview of the work	
Description	Cost
Total Road Length	4 km
Affected Road Length (Rework)	1 km
Original Cost per km	₹10 crore/km
Cause of Rework	Laid during rain
Delay Due to Rework	1 week

Table 4.3 Direct Rework Costs

Direct Rework Costs			
Activity	Unit Cost (₹/km)	Qty (km)	Total Cost (₹ crore)
Milling & Removal	0.2	1	0.2
Clearing and Tack coat application	0.2	1	0.2
BC material cost	1.0	1	1
BC laying and compaction	0.3	1	0.3
Re-mobilization of Equipment	—	—	0.30 (lump sum)
Subtotal (Direct Costs)			₹2.0 crore

Table 4.4 Indirect Rework Costs

Indirect Rework Costs	
Cost Head	Amount (₹ crore)
Consultant Re-engagement Fee	0.15
Traffic Management / Diversion	0.25
Delay Penalty	0.3
Additional Supervision (1 week)	0.1
Subtotal (Indirect Costs)	₹0.80 crore

Total Rework Cost = Direct Costs + Indirect Cost

= 2.0 + 0.80

= ₹2.8 crore

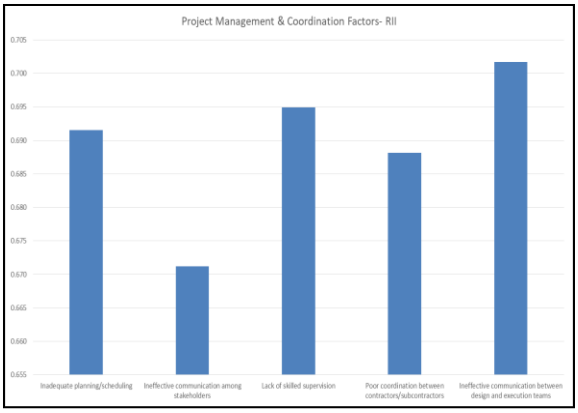
4. ANALYSIS OF QUESTIONNAIRE

A structured questionnaire survey was conducted using google form platform. Creating a questionnaire for a survey on the factors affecting study for rework causes in the construction industry requires clear, targeted questions. The purpose of the questionnaire should be to gather data on the root causes of rework, its impact, and the factors that contribute to its occurrence in construction projects. The questionnaire has been prepared by the author for the working staff of the Mumbai coastal road project to evaluate the factors affecting study for rework causes. The spreadsheet was sent to the respective employees of the coastal project, and total - 59 responses were collected

A. Possible Causes of Rework- Project Management & Coordination Factors (Rate from 1 to 5)

Table 1 RII of Project Management & Coordination Factors

Material Wastage – Influencing Factors							(RII)
Sr No	Answer	1	2	3	4	5	RII
1	Inadequate planning/scheduling	0	9	20	24	6	0.692
2	Ineffective communication among stakeholders	3	6	26	15	9	0.671
3	Lack of skilled supervision	3	9	12	27	8	0.695
4	Poor coordination between contractors/subcontractors	0	11	18	23	7	0.688
5	Ineffective communication between design and execution teams	2	6	19	24	8	0.702



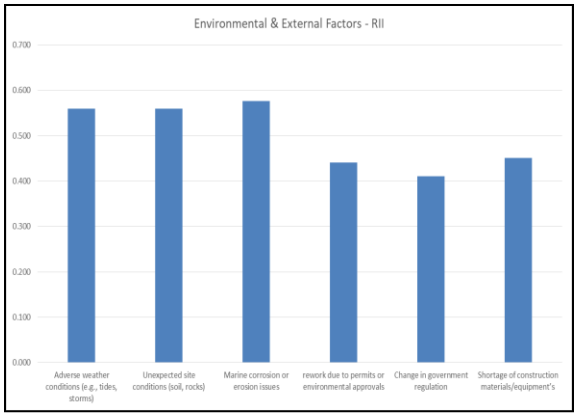
Graph 2 Project Management & Coordination Factors RII

The graph above illustrates the factors contributing to rework. Among the Project Management & Coordination related factors, the highes RII have Ineffective communication between design and execution teams RII 0.702 and Lack of skilled supervision RII- 0.695.

B. Possible Causes of Rework- Environmental & External Factors (Rate from 1 to 5)

Table 2 RII of Environmental & External Factors

Quality Management – Influencing Factors							(RII)
Sr No	Answer	1	2	3	4	5	RII
1	Adverse weather conditions (e.g., tides, storms)	3	25	16	11	4	0.559
2	Unexpected site conditions (soil, rocks)	10	18	11	14	6	0.559
3	Marine corrosion or erosion issues	5	21	14	14	5	0.576
4	rework due to permits or environmental approvals	21	19	9	6	4	0.441
5	Change in government regulation	25	15	12	5	2	0.410
6	Shortage of construction materials/equipment's	16	24	9	8	2	0.451



Graph 4 Environmental & External Factors RII

The graph above illustrates the factors contributing to rework. Among the Environmental & External related factors, the highes RII have Marine corrosion or erosion issues RII 0.576 and adverse weather conditions, unexpected site conditions with RII- 0.559

5. CONCLUSION

This study aimed to identify and evaluate the key factors contributing to rework in the Mumbai Coastal Road Project by gathering insights directly from the working staff through a structured questionnaire. A total of 59 responses were collected and analyzed using the Relative Importance Index (RII) method to rank the severity and frequency of rework causes across multiple categories. The analysis revealed that Construction & Execution related factors emerged as the most significant contributors to rework, with a group RII of 0.742. Specifically, improper sequencing of works (RII = 0.769) and poor workmanship (RII = 0.739) stood out as critical issues that need immediate attention. These findings highlight the need for better planning, execution strategies, and skilled labor at the site level.

Overall, the study concludes that rework in large-scale infrastructure projects like the Mumbai Coastal Road is a multi-faceted problem driven largely by execution inefficiencies, poor communication, and design discrepancies. By addressing these key factors—especially those with higher RII values—project stakeholders can significantly reduce the frequency and cost of rework, leading to more efficient and timely project delivery.

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