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Causes of Delay in Construction of Bridge Girders

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Abstract: *The construction industry is the tool through which a society achieves its goal of urban and rural development. Delays inconstruction are the most serious problems which even slow down the national development. It is one of the sectors that provides important ingredient for the development of an economy.It is widely accepted that a project is successful when it is finished on time. Unfortunately, due to many reasons, largenumber of construction projects fails to follow the planned schedule and hence delayed. Construction delay is considered to be one of the recurring problems in the construction industry and it has an adverse effect on project success in terms of time, cost and quality. So, careful study and planning of each and every activity of a construction project becomes important in order to minimise delays. This paper presents the causes of delayoccurring on anongoing bridge construction project with respect to constructionof bridge girders of three spansof a Major bridge across river Sabarmati, Gandhinagar, Gujaratas a case study.*

Keywords:*Project delay, Types of delay, Time overrun, Cost overrun*

I. Introduction

Issue of delay in the construction sector is a worldwideproblem. Delays occur in most construction projects, either simple or complex. In construction, delay can be defined as the extension of time in the completion of project. In short delay means failure to complete project in targeted time and budgeted cost as agreed in contract. Construction site activities are only the second part of the whole construction process. The first part comprises of all kinds of office work like planning, designing, estimating, negotiating, purchasing, scheduling, controlling, accounting, etc. are required to be done carefully in the office before the work starts on the site to accomplish the objective of a project within budget and on schedule. Construction delays are widespread in most projects around the world. Some delays may happen in the preconstruction phase which is defined as the period beginning from the initial conception of the project to the signing of the contract between the owner and the contractor; however some of them may happen in the construction phase that is the period when actual construction is underway. Project schedules are dynamic and uncertain. Several factors, controllable and uncontrollable, affect the project schedule and cause delays. These delays definitely create negative impacts on project performance. Delay in schedule in the completion of a construction project is a majorproblem for contractors leading to disputes and spoiled relationships between project participants.

The challenge is to measure the net impact of construction delays accurately. In absence of which delay claims between all parties involved in the construction process would become serious and lead to litigation.Time for performance of a project is particularly an important consideration for the owner and the contractor. Often, the most troublesome construction disputes involve delays and failure to complete the work in a timely manner. In fact, delays can be caused by several parties therefore the effects and remedies vary from case to case. Concurrent delays are two or more delays occurring at the same time and are always difficult to resolve.

So, in this paper delay occurrences on a bridge project is given with respect to the construction ofgirders as a case study.

II. Objective Of Study

The objectives of this study are:

1. Determine the major construction delays of the project.
2. To analyse different causes of delay of the project
3. To measure the net impact of construction delays accurately.

III. Construction Delays

There are a number of definitions for delay. In the construction management context, the simplest definition of a delay is "an event or a condition that results in finishing the project later than stipulated in the contract."

There are four main groups of construction delays:

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

The diagram displayedin figure presents a general overview of how the construction delays can be categorized and some of the frequently occurring delays on any infrastructure project and the responsible stack holder are as follows.

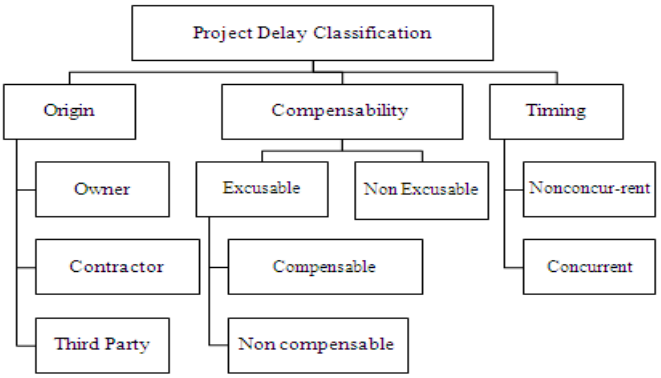


Chart 1: Delay classification

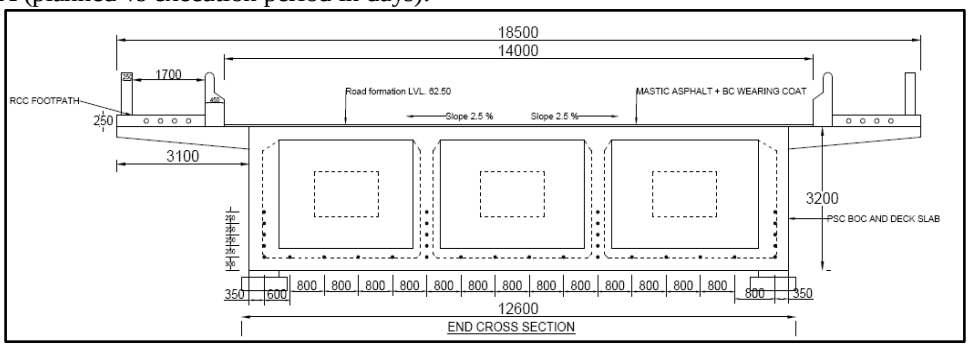
SR.	REASONS FOR DELAY	RESPONSIBILITY
1.	Delay in handing over of site	Client
2.	Unforeseen ground conditions	Consultant
3.	Conflicts between owner and other parties	Other
4.	Improper planning of contractor during bidding stage	Contractor
5.	Poor means of contracting	Contractor
6.	Inaccurate specification of site condition	Client
7.	Unrealistic time schedule given in contract	Consultant
8.	Faulty soil investigation report	Client
9.	Slow decision from owner	Client
10.	Bureaucracy in client's organisation.	Client
11.	Ambiguity in specifications and conflicting interpretation by parties.	Client
12.	Unrealistic inspection and testing methods proposed in contract.	Client
13.	Delay in approval of completed work (i.e. stage passing)	Client
14.	Delay in approval of shop drawings and samples	Client
15.	Non availability of drawing/ design on time	Client
16.	Consultant or Architect's reluctance for change	Consultant
17.	Obtaining permissions from local authorities	Client
18.	Poor organizational structure for client or consultant	Client/Consultant
19.	Financial Constraints of contractor	Contactor
20.	Delay in running bill payments to the contractor	Client
21.	Inadequate experience of contractor	Contractor
22.	Poor labour productivity	Contractor
23.	Lack of control over subcontractor	Contractor
24.	Frequent change of subcontractor	Contractor
25.	Poor site management and supervision	Contractor
26.	Use of improper or obsolete construction methods	Contractor
27.	Increase in scope of work	Client
28.	Rework due to errors in execution	Contractor
29.	Rework due to change of design or deviation order	Client
30.	Delay in finalization of rates for extra items	Client
31.	Poor coordination among parties	Client
32.	Delay in material delivery by vendors	Other
33.	Delay in material to be supplied by the owner	client
34.	Delay in material procurement (action by the contractor)	Contractor
35.	Change in material prices/ price escalation	Other
36.	Improper storage of materials leading to damaged material when necessary	Contractor
37.	Inefficient use of equipment	Contractor
38.	Lack of skilled operators for specialized equipment	Contractor
39.	Extreme weather conditions	Other
40.	Local political conditions	Other
41.	Restricted access at site	Client
42.	Site accidents due to lack of safety measures	Contractor
43.	Site accidents due to Negligence	Contractor
44.	Lack of motivation for contractor(viz. Incentive for early finish etc.)	Client

IV. Research Methodology

Research methodology is designed after assessing the extent of the objectives to be fulfilled. For data collection a cable stayed Major Bridge across river Sabarmati, Gandhinagar, Gujaratis taken as a case study. There was a huge difference in rate of progress and time required in completion between planned schedule and actual execution in girders of three spans constructed on site. Frequent site visits were carried out to find the key factors that control time performance as well as the factors which govern the rate of progress in order to find out major as well as general causes of delay in construction of girders.

V. Data Collection

The data collected from site regarding the progress of construction of bridge girders is given in Appendix-A (planned vs execution period in days).



End cross section of girder

VI. Data Analysis

For data analysis each activity of construction of bridge girders has been compared with its planned duration andactual duration. Delays occurred in each activity and the cumulative delay are calculated in days as shown in Appendix B (delay and cumulative delay in days). Also graphs for planned schedule vs as executed and cumulative delay occurred on each girder are plotted for better understanding of the delay phenomenon. Total delay caused on the project in completion of girders for 3 spans is 75 days (Appendix B (Delay and Cumulative delay in days)). Activity wise total delay is shown in following table.

Sr.	Activity	Delay on Span 1 (Days)	Delay on Span 2 (Days)	Delay on Span 3 (Days)	TotalDelay (Days)
1	Staging work	3	3	2	8
2	Shuttering Work	7	7	2	16
3	Reinforcement fixing	22	6	6	39
4	Cable arrangement	8	4	0	12
5	Concreting	0	0	0	0
				Total	75

There upon reasons of delay and interpretation are discussed in next section.

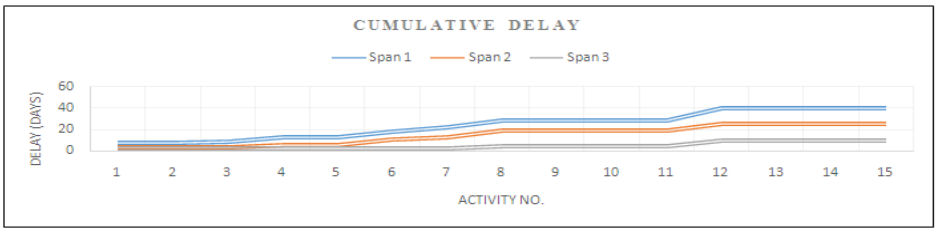


Chart 1: Cumulative delay

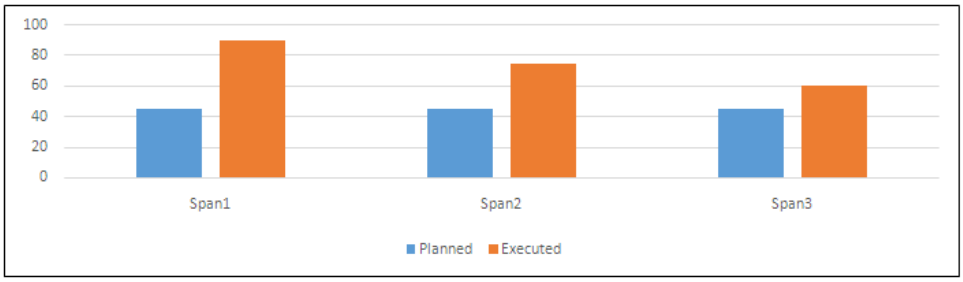


Chart 2: Planned vs Execution.

After careful study of delay occurred on each activity and the reason of delay are worked out and the stake holders responsible for the delay are as follows.

SR.	REASONS FOR DELAY	RESPONSIBE PARTY
1	Insufficient crane capacity	Contractor
2	Non availability of bar binder	Contractor
3	Non availability of skilled labour	Contractor
4	Delay in design	Client /Consultant
5	Labour issues	Contractor
6	Conventional method of bar cutting and bending	Contractor
7	Over labour employment on a single work other than important one.	Contractor
8	Poor site layout resulting in poor labour productivity	Contractor
9	Shortage of Concrete due to insufficient capacity of RMC	Contractor
10	Delay in procurement of bearing plate	Contractor

Table: Summary of Delay reasons

Above mentioned causes of delay have direct effecton time overrun and cost overrun for the whole project. Careful identification and mitigation of causes of delay is required to save time and cost. The comparisonof cumulative delay is shown in Chart 1. It is observed from Chart 1 thatthe construction of girder of span 1 delayed more than the other two girders. Major cause of delay of construction offirst girder on span 1 is delay in getting working drawings.Other two girders will not be affected by this reason because all girders are symmetrical on the bridge. There are also some reasons which affect performance of girder on span 1 such as labour issues, more number of labours employed on an unimportant work and lack of skilled labours etc. Another important reason is poor site layout planning. Because of poor site layout planning workers have to walk more and this resulted in wastage of time and poor labour productivity. Same girder on span 2 gets delayed by less number of days compared tothat on span 1. Major reason is labour issues. Contractor is responsible for this delay. Third girder is delayed by 15 days only and major reason for delay is again labour issues.

VII. Conclusion

This study aims to investigate the important causes of delay in construction of bridge girder. Activities on site with respect to construction of girder are thoroughly observed and comparison done between planned and as executed schedule. The results revealed that the problem ofdelays in construction of bridge girder is frequent and notable. Contractor plays vital role in completion of project as scheduled. Most of reasons for delays are related with contractor performance such as site management, labour productivity, and lack of expert proficiency in supervision etc. Same as delay in drawing and delay in design come under client responsibility.It is evident that consultant has a less responsibility. Some of the causes are to be addressed are beyond the control of all the project parties such as differing site conditions, unforeseen weather etc. Talking about the overall responsibility of delay, contractor possesses near about more responsibility.

APPENDIX A
TABLE SHOWING PLANNED AND EXECTION PERIOD IN DAYS

Sr. No.	Activity	Span 1			Span 2			Span 3		
		Planned (Days)	Executed (Days)	Major Delay Reasons	Planned (Days)	Executed (Days)	Major Delay Reasons	Planned (Days)	Executed (Days)	Major Delay Reasons
1	Staging work	7	10	Insufficient crane capacity	7	10	Insufficient crane capacity	7	10	Insufficient crane capacity
2	Shuttering for bottom slab	6	6	NIL	6	6	NIL	6	6	NIL
3	Fixing of reinforcement for bottom slab	5	6	Non availability of bar binder	5	5	NIL	5	5	NIL
4	Arrangement of cables	1	5	Non availability of skilled labour	1	3	Non availability of skilled labour	1	1	Nonavailability of skilled labour
5	Concreting in bottom slab	1	1	NIL	1	1	NIL	1	1	NIL
6	Reinforcement for web girder	5	15	Delay in design	5	10	Non availability of bar binder	5	5	NIL
7	Cable arrangement	1	5	Non availability of skilled labour	1	3	Non availability of skilled labour	1	1	NIL
8	Shuttering for web girder (4 girder in a span)	8	15	Labour issues	8	15	Labour issues	8	10	Labour issues
9	Concreting (4 girder in a span)	4	4	NIL	4	4	NIL	4	4	NIL
10	Deshuttering of web	1	1	NIL	1	1	NIL	1	1	NIL
11	Shuttering for top slab	5	5	NIL	5	5	NIL	5	5	NIL
12	Fixing of reinforcement for top slab	4	15		4	10		4	10	
13	Concerting in top slab	1	1	NIL	1	1	NIL	1	1	NIL
14	Curring Period (not affect the schedule) (Dummy)	21	21	NIL	21	21	NIL	21	21	NIL
15	Deshuttering of bottom	1	1	NIL	1	1	NIL	1	1	NIL
	Total	50	90		50	75		50	60	

Total time required as per planned scheduleon Span 1 + Span 2 + Span 3 = 150 days but actual time of execution taken for the same 225 days. Therefore total delay is 75 days.

APPENDIX B
TABLE SHOWING DELAY AND CUMULATIVE DELAY IN DAYS

Sr. No.	Activity	Span 1				Span 2				Span 3			
		Planned (Days)	Executed (Days)	Delay (Days)	Cum. (Days).	Planned (Days)	Executed (Days)	Delay (Days)	Cum. (Days)	Planned (Days)	Executed (Days)	Delay (Days)	Cum. (Days)
1	Staging work	7	10	3	3	7	10	3	3	7	9	2	2
2	Shuttering for bottom slab	6	6	0	3	6	6	0	3	6	6	0	2
3	Fixing of reinforcement for bottom slab	5	6	1	4	5	5	0	3	5	5	0	2
4	Arrangement of cables in btm. slab	1	5	4	8	1	3	2	5	1	1	0	2
5	Concreting in bottom slab	1	1	0	8	1	1	0	5	1	1	0	2
6	Fixing of Reinforcement for web girder	5	15	10	18	5	10	5	10	5	5	0	2
7	Arrangement of cable in girders	1	5	4	22	1	3	2	12	1	1	0	2
8	Shuttering for web girder	8	15	7	29	8	15	7	19	8	10	2	4
9	Concreting	4	4	0	29	4	4	0	19	4	4	0	4
10	Deshuttering of web	1	1	0	29	1	1	0	19	1	1	0	4
11	Shuttering for top slab	5	5	0	29	5	5	0	19	5	5	0	4
12	Fixing of reinforcement for top slab	4	15	11	40	4	10	6	25	4	10	6	10
13	Concerting in top slab	1	1	0	40	1	1	0	25	1	1	0	10
14	Curring Period (not affect the schedule) (Dummy)	21	21	0	40	21	21	0	25	21	21	0	10
15	Deshuttering of bottom	1	1	0	40	1	1	0	25	1	1	0	10
	Total	50	90		40	50	75		25	50	60		10

References

[1] Assaf, S. A., And Al-Hejji S. (2006). "Causes of Delay in Large Construction Projects". International J. Project Mgmt.,Science Direct, 24, 349-357. 4
[2] Enasfathitaher, R.K.Pandey "Study Of Delay In Project Planning And Design Stage Of Civil Engineering Projects" (2013)
[3] S.K.Patil, A.K.Gupta, D.B.Desai, A.S.Sajane "Causes Of Delay In Indian Transportation Infrastructure Project" (2013)
[4] Jyh-Bin Yang And Chih-Kuei Kao "Review Of Delay Analysis Methods: A Process-Based Comparison" (2008)
[5] Tarek Hegazy And Wail Menesi "Delay Analysis Under Multiple Baseline Updates" (2007)
[6] Muralisambasivan , Yau Wen Soon "Causes And Effects Of Delays In Malaysian Construction Industry"
[7] Ashwiniarunsalunkhe, Rahul S. Patil"Effect Of Construction Delays On Project Time Overrun Indian Scenario (2014)
[8] Ram Singh, "Delays And Cost Overruns In Infrastructure Projects: Extent, Causes And Remedies", Economic And Political Weekly, Vol.21. May 22, 2010, Pp 43-54.