# **RISK ANALYSIS IN FLYOVER CONSTRUCTION**

### Gauri L. Patil<sup>1</sup>, Prof. Kiran Ghorpade<sup>2</sup>

<sup>1</sup>M.E. Students (Construction & Management), <sup>2</sup>Faculty Department of Civil Engineering Trinity Academy of Engineering, Pune-48,India

*Abstract*: Managing risks in Flyover construction projects has been recognized as a very important management process in order to achieve the project objectives in terms of time, cost, quality and scope. Construction of flyover projects were initiated in complex and dynamic problems resulting in circumstances of high uncertainty and risk, which were compounded by demanding many constrains. The general methodology to study relies largely on the survey questionnaire which will be collected from flyover project construction contractors and project managers of different sizes by mail or personnel meeting. The questionnaire prepared for the survey was formulated by seeing the relevant literatures in the area of construction management. This paper seeks to identify the risks factors that affect the performance of flyover projects as a whole and analyzed by using appropriate tools and technique and to develop a risk management. The questionnaire was divided into various categories. The responses were analyzed using the software of SPSS. Statistical analysis of responses on the factors was segregated into distinct sets of critical factor. This study aims to identify factors that affected flyover construction project and incorporating critical factors to improve the risk analysis. The extent of their contribution has, however, been observed to vary for a given level of project performance. The analysis results were expected to help project professionals to focus on a few factors and get the optimum results rather than giving attention to all the factors and not getting the proportionate results.

Keywords: Construction Management, Risk Analysis and SPSS, Flyover projects.

# 1. INTRODUCTION: RISK ANALYSIS AND MITIGATION IN FLYOVER PROJECT

Risk is the potential of gaining or losing something of value. Values such as physical health, social status or financial wealth can be gained or lost when taking risk resulting from a given action or inaction. Consequences of uncertainty and its exposure in a project is risk. In a project context, it is the chance of something happening that will have an impact upon objectives. It includes the possibility of loss or gain, or variation from a desired of planned outcome, because of the uncertainty associated with following a particular course of action. Risk hence has two elements likelihood or probability of something happening, and the consequence or impact if it does. Managing risk is an important part of good management and fundamental to achieving good business and project outcomes and the effective procurement of goods and services. Risk management provides a structured way of assessing and delaying with future uncertainty. A case study was done at flyover to get well versed with topic. For the purpose to understand the actual working and various issues in construction of flyover a current ongoing Flyover construction is choose for the project work.

## **1.1 OBJECTIVE**

This research deals with analysis and mitigation of various risk in flyover construction and aims to identify the key problems in critical areas of construction project, which have the potential to become major roadblocks in the progress of the project. The study identify, classify of various risks in a given set of contract documents of construction project, and on basis of qualitative risk analysis, suggests methods to mitigate risks in construction projects.

Various objectives are as follow:

- 1) To Identify and examine key risk factors associated with a project.
- 2) To investigate severity and allocation of each risk factor.
- 3) Providing practical suggestions.

# **1.2 LITERATURE REVIEW**

1) Agnieszka, Dziadoszaand Mariusz Rejmentb in paper "Risk analysis in construction project - chosen methods" stated that The risk management in the construction industry requires a complementary, interdisciplinary, flexible approach allowing to capture the changing character of risk factors (qualitative, quantitative) as well as it requires a precise description and explanation of the mechanisms involved in the organization of construction production.

2) B.Vidivelli, E. Vidhyasagar and K.Jayasudha in paper "Risk Analysis in Bridge Construction Projects" described the first category of risk often referred to as 'pure and particular risk'. It includes damage to persons and property. The second category is 'fundamental risk'. This includes external factor such as damage due to war, nuclear pollution and supersonic bangs, government policy on taxes, labour, safety or other laws malicious damage and industrial disputes.

3) Dr. Rafiq Muhammad Choudhryin paper "Risk Analysis of Bridge Construction Projects in Pakistan" analyzed risk based on questionnaires and interview. Risk factors of previous year were compared with result. A case study was conducted on bridge project constructed to facilitate an expressway connecting a highway with a housing society.

4) Jie Li and Patrick X.W. Zou in paper "Risk identification and assessment in PPP infrastructure projects using fuzzy analytical hierarchy process and life-cycle methodology" The paper put a glance on the point that due to the long concession period and large amount of investment, the risks associated with PPP projects should not be underestimated.

5) K. Jayasudha Dr. B.Vidivelli and E.R. GokulSurjith in paper "Risk Assessment and Management in Construction Projects" defined risk as "a situation where there exists no knowledge of its outcomes". He focused on several factors of risk exposure like team size, history, staff expertise and experience, Complexity, Management stability, Time compression, Resource availability.

6) Lemos et al (2004, Portugal) studied 2 bridges cases in Lusoponte Portugal, which includes an overview of the project's background and an analysis of the main risk categories stating both the actual risks encountered and the mitigation measures. The risk factors were classified into 6 categories: Social, Legal, Economic, Environmental, Political and Regulatory and Technological, which included not only the technical factors but also a realistic assessment of environmental and social risks.

7) NagallaVasishta, D. Satish Chandra and SS. Asad in paper "Analysis of risk assessment in construction of highway projects using relative importance index method" suggested that inadequate construction quality, Selection of inappropriate equipment, Lack of communication, Lack of coordination and Insufficient technology/skills/techniques are the top five major risks.

8) Pejman Rezakhani in paper "classifying key risk factors in construction projects" The paper focused on generally risk factors in a project can be categorized based on their source and effect on project objectives and can be categorized in external, internal and legal categories. Case studies have shown that by utilizing proposed hierarchical risk breakdown, most of the risks in regular and complex projects are covered and as a result an effective risk management plan can be conducted.

9) PrakashMutgi , Udayashankar D. Hakari in paper "Project Management Practice And Risk Perception In Construction Companies" highlighted A survey by way of direct interaction / interviews has been carried out to evaluate the percentage usage of different risk management practices by some of the leading construction companies of Hubli city so as to find out the most commonly employed method of risk management while making major decisions on the different types of risks normally encountered in their construction projects.

10) Wang et al (2000, China) identified about 50 risks in 6 categories, Political risks, Construction risks, Operating risks, Market and revenue risks, Financial risks and Legal risks, and mitigating measures associated with BOT/PPP power projects based on literature review.

# 2. MATERIAL AND METHODOLOGY

## 2.1 METHODOLOGY

This research focused on the intrinsic area of risk analysis, was carried out in a systematic manner. The literature review included academic journals, books and other published materials. The research methodology of the study included the process to classify the awareness on implementation of risk analysis in flyover construction projects. To provide a foundation several structured questionnaire was developed, which was followed throughout the project. Extensive literature was reviewed in the form of academic journals, books and published content. The following sequence was then decided by the researchers. The various steps in analyzing risk are a) Develop questionnaire to identify critical risk factors b) Identify survey participants c) Questionnaire survey & Interviews of selected participants d) Data analysis of survey by SPSS Statistics e) Quantify impact of risk on project f) Formulate the risk analysis guidelines for Flyover construction projects g) Enumerate risk mitigation techniques. The questionnaire was developed keeping in view the current situation to extract risk factors.



### Figure No 1: Flow Chart for Research Methodology

#### 2.2 DATA COLLECTION TECHNIQUE

The site work was observed for few hours during the peak period and various features and issues were identified. Data collection is carried out by using following technique:

a) **BY OBSERVATION:** Information is gathered through observation to know what is happening currently. It do not take in consideration past or future happening. Actual plans, design and work was observed at flyover construction to understand various uncertainty and flaws.

b) **THROUGH PERSONAL INTERVIEW:** This method is a complimentary method of data collection and is applied to get in-depth information about the work. Through personal interview, various obstacles were noted down. This method was very useful in collection of various key points and put a light on un notified factors. This method has helped in deep analysis of various factors. For personal interview, depending upon degree of freedom of interviewer and interviewee three techniques was used:

- a) Fully structured interview
- b) Semi structured interview
- c) Unstructured interview

c) THROUGH QUESTIONNAIRES: To get into root cause and to collect huge amount of data associated a set of various questions are prepared and circulated to collect various factors, difficulties and problems associated. This method was useful as various factors came forward. For the purpose of this study, a set of contract documents of the infrastructure project has been referred. To alleviate the congestion at junctions, government has planned project which includes this flyovers. Table I shows the referred contract documents between client and contractor.

Sr. No. Content		
1	Tenderer notice	
2	Detailed tender notice	
3	Instructions to tenderers	
4	Declaration of the contractor	
5	General condition of the contract	
6	Special condition of the contract	
7	Technical specification	
8	Tender of works	
9	Letter of acceptance	
10	Material brought by contractor	
11	Schedule A schedule B	
12	Suggestive format for cement steel	
13	Price variation clause	
14	Bill of quantity	

## **Table No 1 - Referred Contract Documents**

Based on the extensive literature reviews and expert's advice, the questionnaires were framed. Responses on the extent of effect of those attributes on flyover construction were sought on a five-point linkert scale: "1" referred to "very low," "2" to "low," "3" to "medium," "4" to "high," and "5" to "very high". The extent of their contribution has, however, been observed to vary for a given level of project performance. The analysis result expected to help project professionals to focus on a few factors and get the optimum results rather than giving attention to all the factors and not getting the proportionate results. The questionnaire was prepared which included various types of risk factors. Though there were many types of risks which affected the bridge construction projects, those 7 risk factors were considered the most easy to collect all the sub risk factors. The questionnaire aimed to explore seventy risk factors related to bridge construction projects, which is time consuming and may retard respondents from participation. Secondly, the questionnaire content is broad and may not be within the knowledge context of some industries practitioners. The large sample may weaken the effectiveness of the questionnaire survey. The risk factors were further integrated in 50 sub risk factors, these sub factors were included in respective risk factor category based on the type of risk associated with the bridge construction project. The risk factors considered are Financial Risk, Insurance, Risk, Contractual, Risk, Management, Risk, Design Risk, External Risk, and Time Management Risk.

# 2.3 CONDUCT OF SURVEY

Questionnaires survey was distributed to different persons worked in the flyover construction projects. The survey consisted of companies which had worked in a flyover construction projects. In these companies the questionnaire were distributed to Project Managers, planning Engineers, Architect and Site Engineers. Total questionnaires gathered in two methods, firstly through personal interview, which was face-to-face process with the respondents and another method was through online survey with the aid of Google forms. The respondents allowed to asked questions with a brief explanation for the ideas and contents of questionnaire, conducted. The data was given as an input into the statistical package for Statistical analysis. Result would show the present scenario of risk in bridge construction projects.

#### **3. RESULT AND ANALYSIS**

The risk was ranked according to the mean value of each risk factor. The highest ranked factors were the most influencing factors the cause problems during the construction process. From the table, though there are many risks that affect the quality of the structure top fifteen risks were taken as most important risks for further analysis. Ranking the risks help in identifying impact during construction process in a site. The overall ranking of the factors in Table 2 shows that each factor with their factor Id is ordered according to the highest mean value to the lowest mean value. The table also consists of standard deviation of each factor and rank of every factor is given in the table, top ranks would be considered as critical risk in the flyover construction projects.

CD	FACTOD				
SK NO	FACIOR	FACTORS	MEAN	SD	RANK
1		Design character	2.25	0.946	1
1	AM4	Design changes	2.35	0.840	1
2	AMI	Improper Site investigation	2.28	0.605	2
3	AM2	Inappropriate Specification and design	2.23	0.606	3
4	IU2	Shifting various utilities	2.21	0.664	4
5	IU1	Construction delay	2.2	0.637	5
6	HT1	Insufficient Planning	2.2	0.545	6
7	HT2	Resource management and productivity	2.19	0.456	7
8	HT4	Poor site management and supervision	2.19	0.692	8
9	FR1	Delay in approval from regulatory bodies	2.17	0.601	9
10	FR2	Land acquisition	2.17	0.724	10
11	DP3	Price fluctuation	2.17	0.742	11
12	DP5	Improper estimation	2.16	0.546	12
13	DP7	Unavaibility of fund	2.13	0.644	13
14	GS3	Disputes and claims	2.13	0.528	14
15	GS4	Unrealistic cost estimates	2.12	0.614	15
16	AM5	Additional site requirement	2.08	0.427	16
17	AM3	Incomplete design	2.07	0.704	17
18	IU7	Unexpected site condition	2.05	0.490	18
19	IU9	Work interruption	2.04	0.417	19
20	HT9	Industrial related problem	2.04	0.448	20
21	HT12	Attitude of participants	1.95	0.59	21
22	DP2	Delay in payment	1.93	0.644	22
23	CO1	Weather and seasonal implication	1.88	0.492	23
24	MY3	Accidents and Injuries	1.83	0.476	24
25	MY1	Damage to structures	1.76	0.898	25
26	KW7	Reputational risk	1.73	0.92	26

**Table No 2: Ranking of Risks** 

27	KW1	Regulatory risk	1.71	0.835	27
28	RD1	Technological risk	1.71	0.818	28
29	GS8	Improper verification of contract	1.69	0.87	29
30	EQ1	Resettlement of cultural property	1.64	0.799	30
31	JV2	Unpredictable government behavior	1.64	0.864	31
32	CO5	Cutting of trees	1.59	0.807	32
33	NZ7	Undocumented change orders	1.57	0.661	33
34	EQ3	Difficulty in disposal of plant and equipment	1.56	0.826	34
35	GS5	Law and order	1.4	0.52	35

#### **3.1 RANKING OF RISK FACTORS**

Flyover were one of the most critical components in the transportation infrastructure for safety, security and mobility. The risk in a bridge construction site was studied by adopting survey method. The data collection was conducted through questionnaire survey and Google forms and was well analyzed with statistical analysis software (SPSS). In this study the questionnaire survey's respondents were project managers, planning engineers and site engineers who had rich experience in construction and strong academic background. Out of various factors, the questionnaires were grouped into subgroups as financial risks, insurance risks, contractual risks, management risks, design risks, external risks and time management risk etc. From the statistical results, the top 15 critical factors were taken as the main factors. The ranks were formed in hierarchical order from lowest mean value to highest mean value. The Table 3 and Figure 2. Showed critical risk factors were ranked hierarchical manner.

#### Table No 3: Critical Risk Factors

SR NO	FACTOR ID	FACTORS	MEAN	SD	RANK
1	AM4	Design changes	2.35	0.846	1
2	AM1	Improper Site investigation	2.28	0.605	2
3	AM2	Inappropriate Specification	2.23	0.606	3
4	IU2	Shifting various utilities	2.21	0.664	4
5	IU1	Construction delay	2.2	0.637	5
6	HT1	Insufficient Planning	2.2	0.545	6
7	HT2	Resource management and productivity	2.19	0.456	7
8	HT4	Poor site management and supervision	2.19	0.692	8
9	FR1	Delay in approval from regulatory bodies	2.17	0.601	9
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13	DP7	Unavaibility of fund	2.13	0.644	13
14	GS3	Disputes and claims	2.13	0.528	14
15	GS4	Unrealistic cost estimates	2.12	0.614	15

Mean



Figure No 2: Critical Risk Factors

## **4. CONCLUSION**

The overall ranking of risk factors for the categories were analyzed, the mean value ranging from 4 to 5 as considered as the most critical factors in the bridge projects. The top ten ranking of risk factors were as follows: Delay during construction process, Lack of coordination, Safety equipment for workers, many modifications on design are made during execution, Unavailability of land and right of way that restricts access to the site, Casting and curing time is more, Inexperience when pricing tenders, Unrealistic cost estimate and schedules, the owner lags behind in paying the contractors and Low level of capability of contractor. Out of 24 risks incorporated, top six risks have been highlighted and discussed in details for further effective measures to ensure the right direction of future development to construction professionals.

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