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Analyzing and Managing Bridge cum Bandhara Construction Project

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ABSTRACT

Risk exists in all construction projects. Risk is one of the uncertain events that occur during a construction project and have an impact on project objectives such as cost, time, and quality. To achieve project objectives, risk in the construction project must be minimized. Risk in construction projects cannot be eliminated, but it can be mitigated. The project's poor performance can be attributed to a lack of proper risk management processes. This paper discusses the risks that arise in bridge construction projects in India. The major risk factors for bridge construction in India were identified and classified into seven major attributes and twenty-seven sub-attributes. A questionnaire survey was conducted with the project managers, contractors, engineers, and supervisors. Through a direct survey. Before to the questionnaire survey, a pilot survey was conducted. The experts' responses were analyzed to determine the risk and their contribution to bridge construction projects. The results of the analysis assist engineers and project managers in minimizing risk during the pre-construction, construction, and post-construction stages of bridge projects. This reduces cost overruns while also improving construction quality.

Keywords: Risk, cost, time, quality, bridge, survey

INTRODUCTION

A bridge is a structure designed to cross a physical barrier, such as a river, road, or valley. Bridges are intended to facilitate the movement of people, vehicles, and goods. Bridges are classified into several types, including beam bridges, arch bridges, suspension bridges, and cable-stayed bridges, each with its own set of design and construction requirements. Bandhara is a term that can refer to water management systems. In some contexts, it refers to a dam or embankment built to impound water and form a reservoir. These structures are commonly used for irrigation, water supply, and flood control. A bridge cum bandhara (BCB) is a bridge structure that serves two functions: crossing and water retention. In India, many rivers run dry after the monsoon season. So, to drink and irrigate, the post-monsoon flow must be blocked. The BCB system is popular in Maharashtra. It can store water on the upstream side to a height of 3.50 meters or less. The height of the tap water is fixed in such a way that additional land acquisition is unnecessary. The BCB system originated in the state of Kolhapur and is also known as the K.T. (Kolhapur-Type) weir. A new model for constructing an elliptical concrete arch abutting the bridge has been developed. This type of arch Bandhara is an almost permanent structure with a height of up to 2.4m in the shape of an ellipse to create water storage at U/S. The bridges are primarily constructed to cross rivers during the monsoon season. They are thus designed with enough openings to allow water to flow freely while minimizing obstruction from piers and other structures. However, the Bridge structure needs to be redesigned so that it can also serve as a water storage structure. It is possible to design these bridges for a dual purpose, i.e. "Bridge-cum-Bandhara," with a storage capacity of 4.5 to 5.00 meters.

The post-monsoon flow, particularly the flow in the river after September, is proposed to be used for storage. Such a structure would also be useful in areas where there is heavy irrigation and percolated water returns to the mainstream. The percolated water can be stored. One or two showers typically happen in September through February following the main monsoon, and the water from these showers can be kept in all of these buildings. To plan the bridge as a storage structure, i.e., Bridge-cum-Bandhara, appropriate gates, and auxiliary piers are required. Gates and needles should be removable; they can be automated or manually replaced after the monsoon. For a variety of circumstances, including exposed rock, rock at a shallow depth, and silty, clayey soil in the bed, standard - type plans have been developed.

The standard type blueprints have also been modified to create Bridge-cum-Bandhara from the current bridge construction.

This stored water can be used for both irrigation and boosting the amount of potable water provided to villages. Additionally, it replenishes nearby wells and the ground, greatly enhancing the water supply and addressing the severe summertime scarcity of potable water.

METHODOLOGY

1. Data Collection

Data collection and archiving include meteorological data consisting of recorded meteorological observations. Before analyzing any amount of forecast or model data, need to ensure we have an accurate picture of what is occurring now. The website used to find out datais https://maharain.maharashtra.gov.in/. Mahavedh project is operationalized by the Government of Maharashtra (GoM) through Public Private Partnership with M/S Skymet Weather Services pvt. ltd. on Build, Own & Operate (BOO) mode. At present 2127 Automatic Weather Stations (AWS) have been installed at circle level. Weather data fetched from these Automatic Weather Stations (AWS) is useful for the implementation of Public Welfare and Development schemes, Research and Development, Disaster Management, and Allied services.

1.1 Maharashtra State

Around 67% of the districts in Maharashtra are rain deficient due to the below-normal showers so far this monsoon. The highest rainfall deficiency is being seen in Hingoli, Akola, Sangli, and Jalna, followed by Chandrapur, Amravati, Satara, Pune, Ahmednagar, Solapur and Jalgaon, among others.

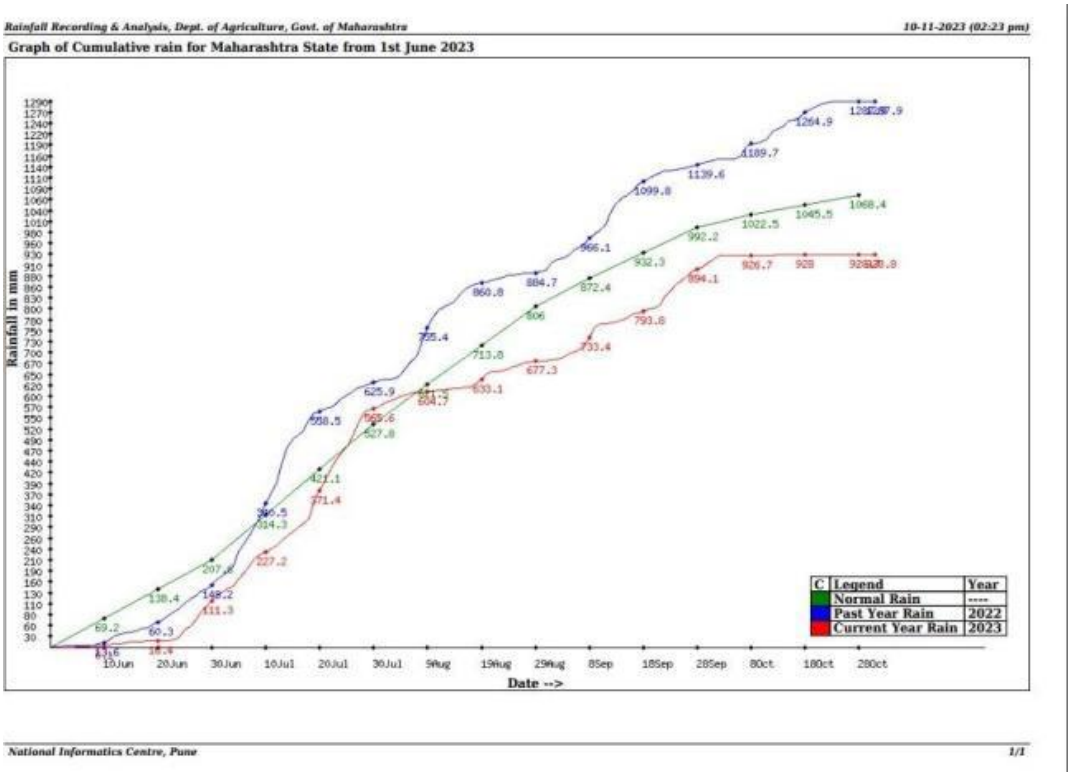

Fig. No. 1 Maharashtra State

1.2 Jalgaon District

Jalgaon is very famous for the production of bananas. But nowadays farmers of Jalgaon district are facing various problems in agriculture. In some places of this district heavy rainfall occurs and in some places, the rainfall is very sporadic. The area of shallow medium black soil in Jalgaon district is 638. 1 thousand hectares and it is very suitable for cotton and banana crops. and the area of deep black soil is 213. 5 thousand hectares are suitable for sugarcane, banana, and other cash crops. Due to decreasing rainfall in this region, nears are using high-power water pumps for irrigation.

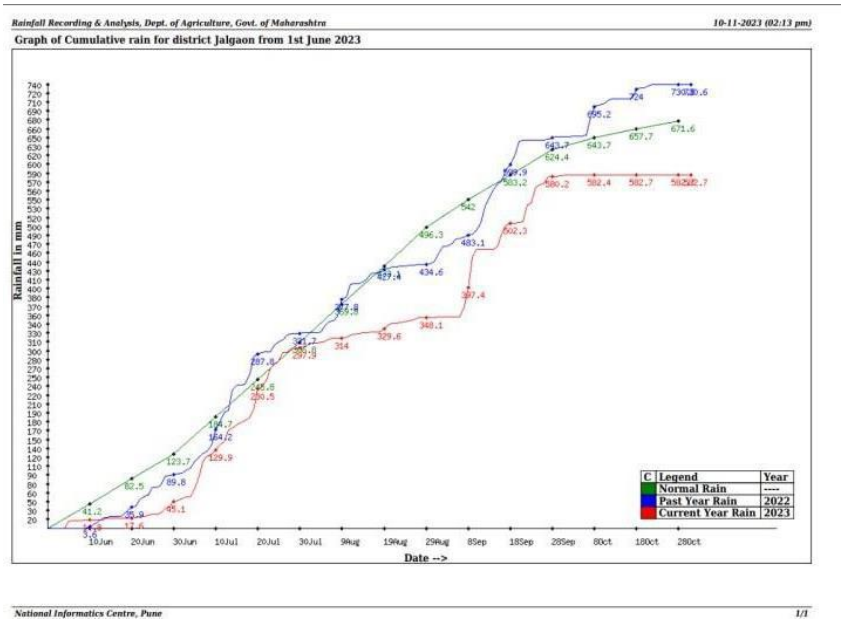

Fig. No 2 Jalgaon District

1.3 Jalgaon Tehsil

Based on the long-term rainfall analysis from 2001 to 2021 it is observed that Bhadgay, Bodliwad.Erandol, Edlabad, and Jalgaon blocks experienced declining rainfall trends. Severe droughts have been experienced in Amalner, 2 times and once in Jalgaon, Jamner, and Dharangaon blocks from 2001 to 2021 with the exception of Bodhwad block which has never experienced drought conditionsduring these years.

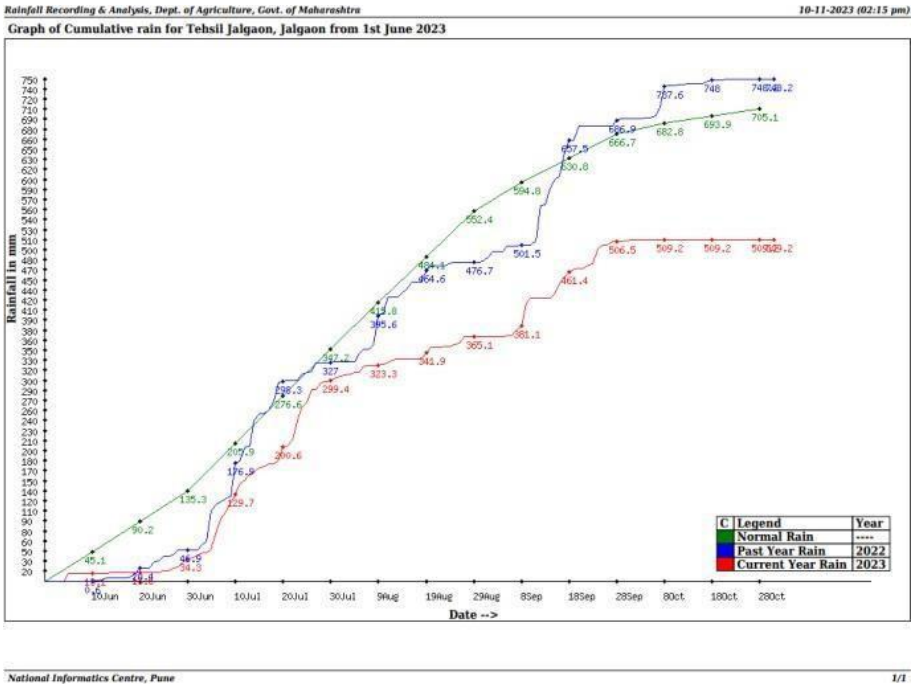

Fig. No. 3 Jalgaon Tehsil

2. Field Survey

We have done three field surveys in different parts of Maharashtra state. Which is described below.

2.1 Rojgaon (Dhule District)

Date: 22 September 2023
Location: Burai Dam
Limitation: Two different structures are there (Bridge & Dam)so they should beconverted into BCB.

Fig No. 4 Burai Dam

2.2 Varangaon (Jalgaon District)

Date: 26 September 2023
Location: Varangaon
Limitation: Existing bridge converted into Bandhara but transportation facilityis prohibited.

Fig No. 5 Varangaon Site Visit

2.3 Sangoba (Solapur District)
Date: 1 October 2023
Location: Sina River
Limitation: Manual Gate and Unsatisfactory width of the road.

Fig No. 6 Sangoba Site Visit

3. Site visit

Mr. Ajit Anantrao Pawar, the deputy chief minister of Maharashtra, and Mr. Sunil Tatkare, the minister of irrigation, officially opened the Kantai weir. The capacity of this weir is 179.2 crore liters. The 8 crores in internal accruals from Jain Irrigation provided funding for this project. According to guidelines from the Maharashtra state government, we are only allowed to utilize 50% of the water, with the remaining 50% being used by society.

As 50% of the water will be used for food processing (fruit and onion dehydration), this weir will guarantee a sustainable and guaranteed supply of water for Jain irrigation. This is because we need water during the peak summer months when there is a water deficit due to drought. Seasons with little rainfall saw an increase in the condition. As soon as the mango season begins in the height of summer, the water supply becomes a problem once more. Drinking water is given precedence, and for good reason—this region is prone to drought region.

As a result, this large storage facility meets both our demands and the needs of the surrounding community. One of the main motivations was to support the ecology. In addition, this weir will lessen the amount of water available during off-season periods and, to some extent, lessen the likelihood of flash or unexpected floods in the downstream region. This 9000 square kilometer catchment region is located in the Girna River basin. The backwaters will sustain fishing because the water spreads out 5.6 kilometers from the weir. This area experiences high temperatures, a moderate 700 mm of annual precipitation, and, as previously indicated, periodic droughts. Therefore, the nearby 7–8 villages, home to a population of 15–16 thousand, will benefit from this storage building. We are an agriculture-based company with our headquarters located in Jalgoan, around 10 km away from the weir, thus it fits our objectives. The fact that they obtain their water supply from MIDC industrial belts in Pune, Nasik, Aurangabad, and other places could be the cause.

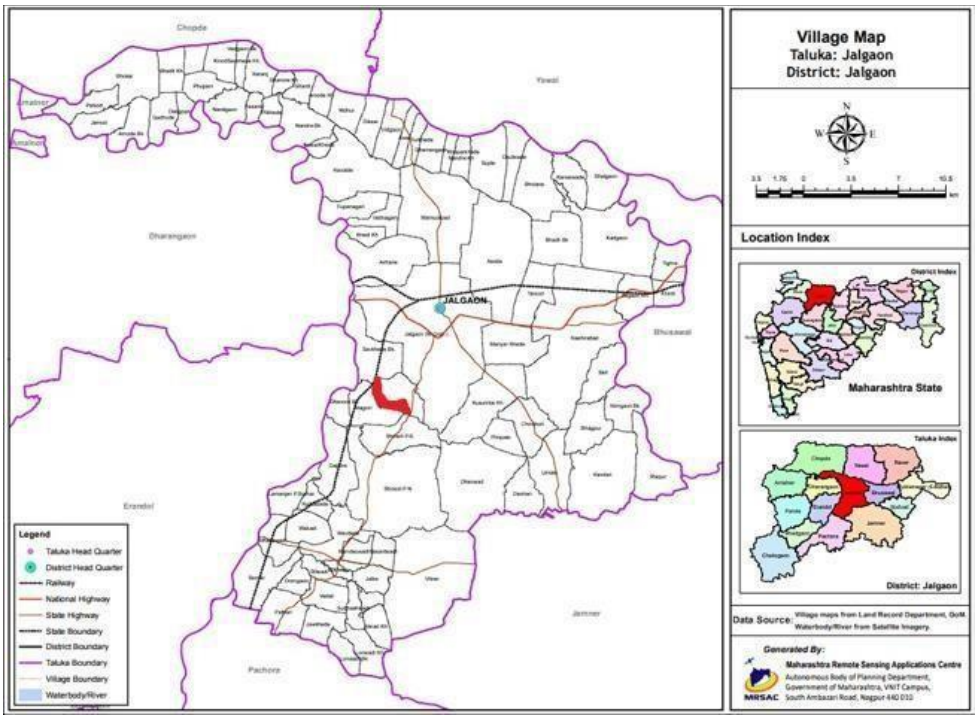

Fig No: 7 Village Map

With just nine months to finish the weir's construction before the monsoon arrived, it was a significant challenge. Should we miss this opportunity, we would have to wait an additional four months, which would equate to a year without water. Similarly, despite lacking significant experience in building a large weir, the company threw itself into it, seeing it as a step towards realizing the lofty goals we had set for the business. Despite being an irrigation systems company and being in a completely uncharted territory incorporating structural engineering elements, the team rose to the challenge and developed the necessary integrated solutions.

Fig No. 8 Kantai BCB

Fig No. 9 Interaction with Er. Raotole at Project Kantai

4. SPSS (Statistical Package for Social Science)

The program SPSS is used to estimate risks. This allows for the determination of each risk type's chance of occurring as well as the relationships among them. The main risk that affects the building of bridges is identified, along with the contribution of each risk category. a popular tool for statistical analysis in social science is SPSS. In addition, data miners, government agencies, market research firms, health research centers, government agencies, education researchers, and others use it. One of "sociology's most influential books" is the original SPSS manual (Nie, Bent & Hull, 1970), which made it possible for regular researchers to conduct their statistical analysis. You can program the numerous capabilities of SPSS Statistics using a proprietary 4GL command syntax language, or you can access them via pull-down menus. The advantages of command syntax programming include handling complicated data manipulations and analysis, handling recurring operations, and reproducible output. Furthermore, some sophisticated programs cannot be accessed through the menu layout and can only be created in syntax. Additionally, the pull-down menu interface creates command syntax, which may be seen in the output. However, the user must adjust the default settings in order for the syntax to be seen. The "paste" button found in each menu can also be used to put them into a syntax file. Programs can be executed using the provided Production Job Facility interactively or without supervision.

5. Comparison

Bridge Cum Bandhara (BCB) construction is a custom in Maharashtra. In BCB, a bridge serves both a river crossing and a limited amount of water storage. They are well-liked because they may act as a structure for storing water in addition to being a crossing. Utilizing such structures, storage no more than 3.50 meters has been created by tapping into post-monsoon flow. Time is of the essence in order to preserve and make use of the post-monsoon water that would have otherwise run off. The steams in the majority of the state only run dry for a brief while after the monsoon ends. Immediately following the monsoon, tankers supply artificial water to numerous locations. The Bridge cum Bandhara (BCB) is a structure that stores water and can be utilized for agriculture, drinking, and industrial purposes as well as groundwater recharge. Water percolates to the ground below, forming what resembles a reservoir with little evaporation loss. The Public Works Department (PWD) of Maharashtra has prepared an easy-to-use standard type plan for BCB and other simple structures to raise awareness and facilitate their construction.

Here are the differences between existing bridges, bandharas, and new bridge-cum-bandhara structures:

5.1 Purpose:

- Existing bridges: Designed primarily for facilitating transportation across rivers, streams, or valleys.
- Bandharas: Traditional Indian water-harvesting structures used for storing rainwater and recharging groundwater.
- New bridge-cum-bandhara structures: Designed to serve both transportation needs and water conservation purposes,integrating elements of both bridges and bandharas.

5.2 Functionality:

- Existing bridges: Provide passage for vehicles, pedestrians, and livestock over water bodies or low-lying areas.
- Bandharas: Store rainwater during monsoons, which can then be used for irrigation, drinking water, or

replenishingaquifers.
- New bridge-cum-bandhara structures: Combine the functions of a bridge for transportation and a bandhara for waterstorage, effectively utilizing the infrastructure for dual purposes.

5.3 Construction:

- Existing bridges: Typically constructed with materials like concrete, steel, or stone, designed to bear heavy loads andwithstand environmental factors.
- Bandharas: Traditionally built using local materials such as stone, mud, and sometimes cement, focusing on waterretention and seepage reduction.
- New bridge-cum-bandhara structures: Constructed with considerations for both structural integrity (for vehicular andpedestrian traffic) and water storage capacity, often incorporating modern engineering techniques.

5.4 Impact on Water Resources:

- Existing bridges: Generally, have no direct impact on water resources except for potential obstruction of water flow duringconstruction or due to maintenance issues.
- Bandharas: Positively impact water resources by storing rainwater, preventing runoff, and allowing groundwater recharge.
- New bridge-cum-bandhara structures: Aim to contribute positively to water resources by incorporating water storagefeatures while fulfilling transportation needs.

5.5 Maintenance:

- Existing bridges: Require regular maintenance to ensure safety and structural integrity, focusing on aspects like surfacecondition, supports, and corrosion prevention.
- Bandharas: Need periodic maintenance such as desilting, repair of walls or embankments, and ensuring proper outletstructures for water management.
- New bridge-cum-bandhara structures: Demand maintenance practices that address both transportation infrastructure requirements and water storage functionality, involving inspections, repairs, and water management measures.

5.6 Environmental Impact:

- Existing bridges: Can have environmental impacts such as habitat fragmentation, altered water flow patterns, and potentialerosion issues.
- Bandharas: Generally, have a positive environmental impact by conserving water, promoting biodiversity around waterbodies, and supporting sustainable agriculture.
- New bridge-cum-bandhara structures: Aim to minimize negative environmental impacts while maximizing water conservation benefits, often incorporating eco-friendly design elements and mitigation measures. These variations highlight the various functions, architectural styles, effects, and upkeep requirements connected to the more recent bridge-cum-bandhara construction and the current bridges and bandharas.

RESULT & DISCUSSION

Table no.1: Analysis from SPSS software

Statistics														
Que. No.		1	2	3	4	5	6	7	8	9	10	11	12	13	14
N	Valid	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Mean		3.80	3.20	3.20	3.00	3.40	4.00	3.00	3.60	4.00	3.00	3.60	4.00	3.00	4.40
Median		4.00	3.00	3.00	3.00	4.00	4.00	3.00	3.00	4.00	3.00	3.00	4.00	3.00	4.00

Mode		4a	3	3	1a	4	4	3	3	4	3	3	2a	3	4
Std. Deviation		1.643	1.483	1.483	2.000	1.517	.000	.000	.894	.000	.000	.894	1.581	.000	1.140
Variance		2.700	2.200	2.200	4.000	2.300	.000	.000	.800	.000	.000	.800	2.500	.000	1.300
Skewness		- 1.736	-.552	-.552	.000	- 1.118			1.258			1.258	.000		.405
Std. Errorof Skewness		.913	.913	.913	.913	.913	.913	.913	.913	.913	.913	.913	.913	.913	.913
Kurtosis		3.251	.868	.868	- 3.000	1.456			.312			.312	- 1.200		-.178
Std. Errorof Kurtosis		2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
Minimum		1	1	1	1	1	4	3	3	4	3	3	2	3	3
Maximum		5	5	5	5	5	4	3	5	4	3	5	6	3	6
Per cen tiles	25	2.50	2.00	2.00	1.00	2.00	4.00	3.00	3.00	4.00	3.00	3.00	2.50	3.00	3.50
	50	4.00	3.00	3.00	3.00	4.00	4.00	3.00	3.00	4.00	3.00	3.00	4.00	3.00	4.00
	75	5.00	4.50	4.50	5.00	4.50	4.00	3.00	4.50	4.00	3.00	4.50	5.50	3.00	5.50

a. Multiple modes exist. The smallest value is shown

Table no.2 : The contribution of each (sub-attributes) type of risk is found.

Main Attributes	Probability	Rank	Risk Factor	Cause Of Risk
Financial Risk	52.5	1	Construction Delays	Financial Problems
Contractual Risk	50.7	2	Contractual deviation	Error in the omission Of bill of Quantities
External Risk	48.6	3	Design changes and inadequate scope	Inadequate planning
Design Risk	26.1	4	Defective Design	Communication Gap between client/ contractors / architect
Construction Risk	24.5	5	Inadequate Project planning	Lack of Expertise/ training
Health and Safety	23.6	6	Accidents	Lack of safety Precautions
Management Risk	0.00	7	Inadequate Site Investigation	Lack of Client/ contractor awareness

CONCLUSION

Twenty-seven sub-aspects and seven primary attributes were used to categorize the risks. It is evident from the probability and ranking approach that the primary factor contributing to risk in the bridge construction project is financial risk. The risk factors need to be taken into account both during and before construction febto minimize this. This paper assists architects, project managers, contractors, and engineers in reducing risk. Financial risk, political risk, design risk, management risk, contractual risk, environmentalism health and safety, and construction risk should be prioritized in descending order for bridge

construction projects. Therefore, by considering every risk factor, less time and money will be needed, and the construction quality could be raised.

Explores the risk that arises during Indian bridge construction projects. Seven major attributes and twenty-seven sub-attributes were identified as the main risk factors in bridge construction in India. In addition to conducting a direct survey, a questionnaire survey was given to project managers, contractors, engineers, and supervisors. The risk and the experts' input in bridge building projects were determined by analyzing their responses. The analysis's findings assist engineers and project managers in reducing risk throughout the pre-, during-, and post-construction phases of bridge projects.

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