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RISK ASSESMENT AND MITIGATION OF RESIDENTIAL STRUCTURE

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Abstract: Risk assessment and mitigation are most essential process to ensuring safety durability and performance of any structure, Residential structure are exposed to various types of risk including structural failures, construction defects, environmental issues and operational issues. This study focuses on identifying types of risk associated with residential building and evaluating their impact on safety, cost, time, environment and overall project performance. The process of risk assessment including identification of risk and analyzing and prioritization of risk based on their severity. This study also highlights practical mitigation measures such as proper design, use of good quality material, adherence to building codes, regular maintenance, and good site, supervision. Environmental consideration such as floods, earthquakes and soil conditions are also addressed to enhance resilience. A greater knowledge is anticipated to lead to more effective risk management and as result is a better project outcome and value for both contactors and clients. This study focused on importance of proactive planning and monitoring or supervision to reduce risks and ensure safe, economical and sustainable residential construction.

Keywords: Risk management, mitigation, environmental consideration, prioritization of risk, performance of residential structure, safety, building codes

1. Introduction:

Residential construction projects are fundamental to economic growth, social development, and urban expansion. Housing is a basic human necessity, and the demand for residential structures continues to rise due to population growth, migration to urban areas, and improved living standards. However, residential construction projects are inherently complex and involve numerous uncertainties.

Risk in residential construction refers to the probability of occurrence of events that may negatively impact

project objectives such as cost, time, quality, safety, and sustainability. These risks may arise from internal factors (design errors, poor planning, inadequate supervision, financial instability) or external factors (market fluctuations, regulatory changes, environmental conditions, political instability).

Risk assessment is the systematic process of identifying, analyzing, and evaluating risks associated with a project. Risk mitigation involves developing strategies to reduce, transfer, avoid, or accept these

risks in a controlled manner. In residential structures, effective risk assessment and mitigation are critical because even minor issues can lead to significant consequences such as structural failure, financial loss, legal disputes, and safety hazards.

The residential construction sector has a significant impact on the global economy, society, and environment. It contributes substantially to national GDPs, generates large-scale employment, and supports urban development worldwide. However, risks associated with residential projects have far-reaching global consequences.

Across both developed and developing countries, residential construction projects frequently experience cost overruns, schedule delays, quality deficiencies, and safety incidents. These risks affect not only individual homeowners and developers but also financial institutions, insurance companies, and national economies. When large housing projects fail or are delayed, it can slow economic growth and reduce investor confidence.

Rapid urbanization in countries across Asia, Africa, and Latin America has increased pressure on housing infrastructure. In such regions, inadequate risk assessment often leads to poor construction quality, structural failures, and unsafe living conditions. Natural disasters such as earthquakes, floods, hurricanes, and cyclones have exposed the vulnerability of residential buildings worldwide. Poorly assessed structural risks have resulted in significant loss of life and property in many countries. These events highlight the global importance of disaster-resistant design, strong building codes, and effective risk mitigation strategies.

1.1 Engineering risk

1.1.1 Construction Risk

Construction risks are problems or on expected event that can happen during construction project. construction risk affects cost of the project, time, quality, scope and safety of the project. Construction projects involve many activities, workers, materials, equipment and external factors, they are naturally exposed to different types of risks. These risks may arise due to design errors, changes in project scope, increase in material prices, shortage of labor, equipment failure, poor site conditions, accidents, natural disasters or legal disputes. If these risks are not identified and managed, they can lead to project delays, cost overruns, poor quality work, safety incidents or even complete project failure

1.1.2 Design Risk

Design risk means the chance of mistakes or problems in the project design that can create difficulties during construction. It happens when drawings, plans, or specifications are incorrect, incomplete, or not clearly prepared. Because of this worker may face confusion on site, which can cause delay, increase costs, or require rework.

For example, If the structural drawing does not match the architectural drawing, or if the measurements are wrong,

construction work may stop until the issue is corrected. Frequent changes in design during construction can also create

problems. Therefore, checking the design carefully, proper planning, and clear communication among team members are very important to reduce design risk and complete the project successfully.

1.1.3 Safety Risk

Safety risk is the possibility of accidents or injuries occurring at a construction site due to unsafe conditions or unsafe actions. Safety risks may happen because of lack of safety training, not using personal protective equipment (PPE) like helmets, gloves, faulty equipment, poor supervision, or unsafe working environments. Construction sites involve heavy machinery, heights, electricity, sharp tools, and moving vehicles, which can be dangerous if proper precaution are not taken. For example, a worker may fall from

height if safety harness is not used, or injuries can occur due to improper handling of machinery. Safety risks can lead to serious injuries, loss of life, work delays, and financial losses.

1.1.4 Operating Risk

In construction projects, operating risk can happen due to machine breakdown, worker mistakes, poor supervision, lack of materials, delay in equipment supply, poor communication between team members, or system failure. These problems can increase project cost, cause delays, reduce quality, and sometimes create safety issues. For example, if construction equipment stops working during work, the project will be delayed and extra repair cost will occur. This is operating risk. So operating risk mainly affect the time, cost, quality, and performance of a project during its execution stage.

1.1.5 Environment risk

In construction projects, environment laws and regulations. The risk can occur because of heavy rainfall, floods, earthquakes, strong winds, extreme temperature, pollution issues, or environmental laws and regulations. These factors can cause project delay, damage to materials, increased cost, and safety problems. For example, if heavy rains, floods the construction site, work will stop and materials may get damaged. This is environmental risk. These conditions may damage materials, weaken soil stability, and reduce the quality of work. Environmental risk mainly affects the time, cost, safety and sustainability of a project.

1.2 Non engineering risk

1.2.1 Financial Risk

In construction project, financial risk can occur due to increase in material prices, inflation, delay in payment from the client, poor budgeting, cost overruns, shortage of funds, or changes in interest rates. Financial risk refers to the possibility of losing money or facing financial difficulties during the execution of a project, It affects the project's budget, cash flow, profitability, and overall financial stability. For example, if the price of steel suddenly increases the project cost will increase, if the client delays payment for completed work, the contractor may face cash flow problems and may not be able to pay workers or suppliers on time.

1.2.2 Legal Risks

Legal risk in construction is the possibility of facing legal action, penalties or disputes due to non-compliance with contracts, laws, or government regulations during a project. Legal risk is especially important in business because companies operate within complex legal frameworks that govern areas such as employment, taxation, consumer protection, data privacy, and corporate governance. A major source of legal risk is non-compliance with laws and regulations. For example, if a company fails to follow labour laws, environmental regulations, or tax rules, it may face heavy fines, sanctions, or even shutdowns.

1.2.3 Political risk

Political risk is the risk that governmental and socio-political action, inaction, or instability will adversely affect the legal position, economic value, or operational continuity of an enterprise or investment. It arises where sovereign power, public policy, or political behavior can change the rules of the game through legislation, administrative practice, or through shifts in ideology, coalitions, or social movements. Political decisions can create new rules in governance, risk management, property rights, contract enforcement, and market access. For example, a sudden increase in import duties can make it expensive for companies to trade goods across borders.

1.2.5 Social risk

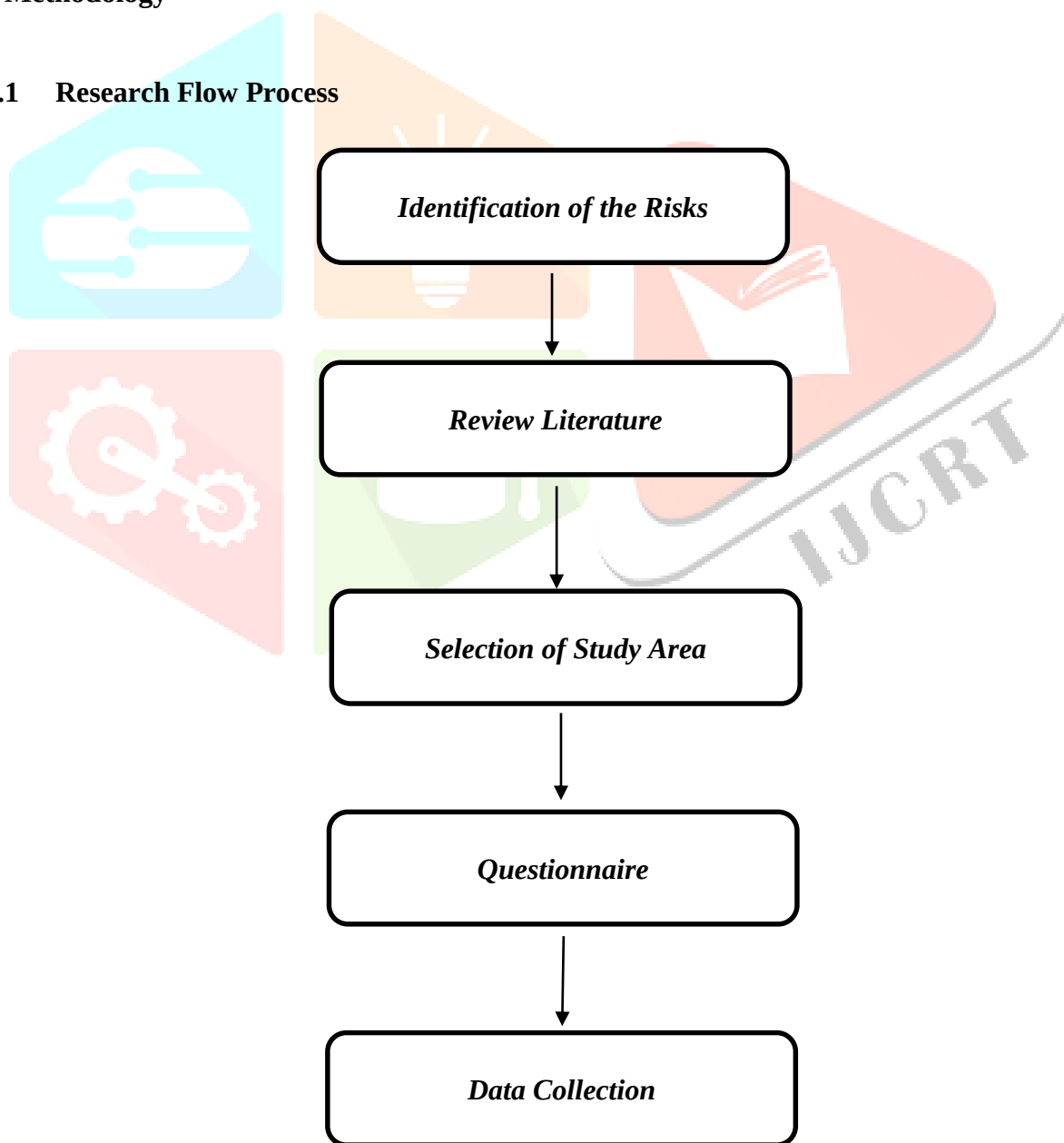
Social risk refers to the potential for adverse effects on individuals, communities, or societies due to the actions, policies, or behaviors of organizations, governments, or other entities. These risks can arise from various factors, including economic changes, environmental issues, cultural shifts, and political dynamics. Understanding social risk is crucial for businesses, policymakers, and communities to mitigate negative impacts and promote positive social outcomes.

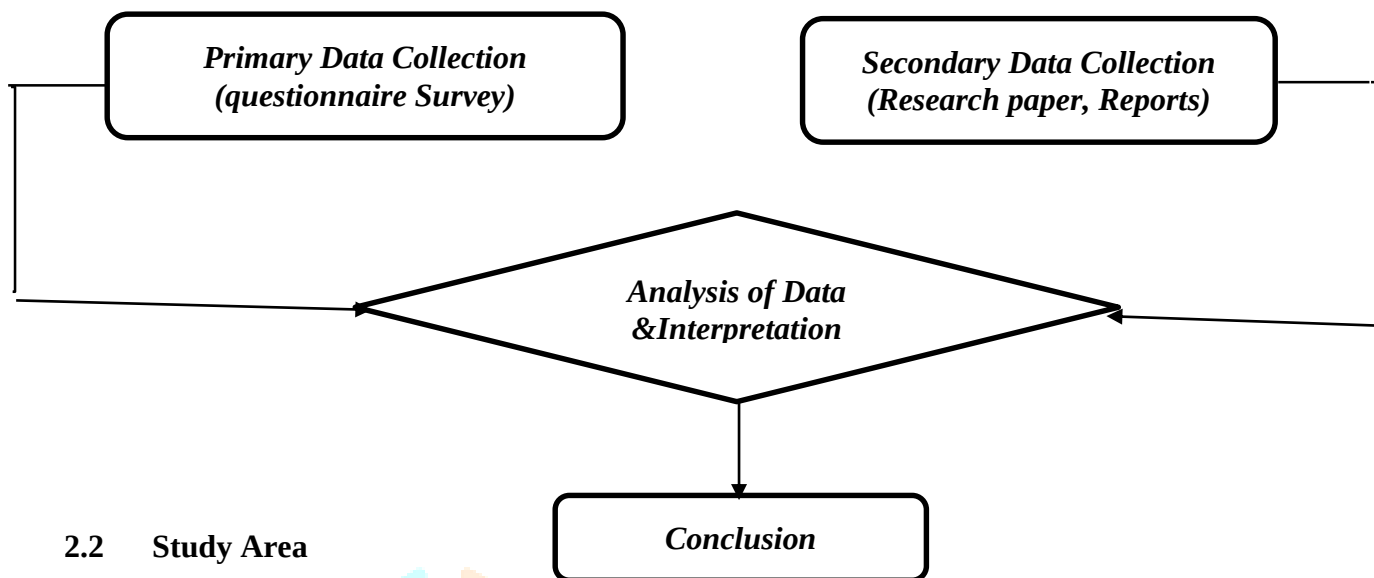
1.2.6 Management risk

In construction projects, management risk can arise because of poor project planning, lack of coordination among team members, weak communication, improper scheduling, inexperienced managers, or failure to monitor progress. If management does not control time, cost, and quality properly, the project may face delays, cost overruns, low quality work, and conflicts among stakeholders. For example, Poor planning, risk assessment, management etc.

2. Methodology

2.1 Research Flow Process





2.2 Study Area

The **first site** was conducted at the project named **Dosti greater Thane**, which is being developed by Dosti Reality. The project is located in **KALHER, Bhiwandi**, a rapidly developing area with growing residential demand. The construction work at the site is being carried out by the contractor **DHANLAXMI Enterprises**. It is residential project consisting of a **G+29 floors** structure, indicating a high rise building designed to accommodate a large number of residents. The project aims to facilities with proper provide modern housing facilities with proper planning, safety measures, .and efficient use of space.

The **Second site** visit was conducted at the project named **JP INFRA STARLIFE** developed by **JP Infra**. This project is located in **Mira Bhayandar**, a well develop and rapidly growing suburban area with strong connectivity and infrastructure. The construction work is being handled by the contractor **Dev construction**, who is responsible for executing the project with proper quality control and safety standards. The structure is planned as a **G+45 floors** high rise building, indicating a modern and large-scale development. This is a mixed-use development, consisting of both residential and commercial spaces, making it a versatile project designed to meet multiple needs such as living, shopping and business activity within the same area.

2.3 Identification of various risks in building construction project

After conducting the site visit several risks related to construction activities, safety, materials, and execution were identified. From the first site named Dosti greater thane, initially we observe proper site preparation is done through soil **testing, piling, and building outline assessment**. Despite this, there exists a **foundation risk** if soil investigation is inadequate or pilling is not properly executed. Additionally, the presence of water at the site requires dewatering can lead to ground instability and delay risks During structural execution, maintaining proper **column alignment and levelling** is crucial. Any deviation may introduce structural risk, affecting load distribution and long-term stability. The use of **Acrow jacks** and various shuttering system (**Mivan, Wooden conventional** also present execution risks, where improper installation or failure of supports can lead to partial collapse or deformation during concreting. Material-related risks are also evident from the use of different concrete grades (**M15 to M60**) And steel reinforcement (**Fe 415 with varying diameters**). In cases of material shortage, substitution with higher-grade steel may introduced design inconsistency risks. In Foundation protection, the use of pre bond membranes, vertical coating and dimple boards indicates waterproofing measures. Improper installation of these systems can cause durability risk such as leakage and dampness over time. During the site visit, environmental risk was identified due to changing weather conditions, In case of rainfall **Tarpaulin sheets** are required to prevent material damage and work delays. It was observed that workers using personal protective and lifelines indicating awareness of safety measures. From the second site we observed that activities from the field notes include **column strengthening** and **capping work** involve structural risks,

where improper techniques or use of low-quality materials can weaken the load bearing capacity of the structure and may lead to failure. **Deep excavation up to around 23 meters** was being done. Creating geotechnical risk such as soil collapse and ground instability. **Dewatering** failure leads to **waterlogging and soil weakening**. Additionally, inadequate or improperly designed retaining systems such as **pile walls** and **tie beams** may fail to resist lateral pressure increasing the chances of structural failure. Near the access tower, it was observed that several **electrical cables** and **temporary wiring are draped directly over the scaffolding**. These cables are currently disorganized and lack of proper hanging systems. Another critical hazard is the presence of **underground gases** which can pose serious health risks to workers and may lead to fire or explosion if not properly detected and ventilated. Environmental consideration such as dust control (**fogging machines**), ventilation systems and weather monitoring is also addressed and maintain factor of safety (**FOS=3.5**). Use of personal Protective equipment such as **helmets, safety belts, jackets** and, **gloves** and provisions of **first aid** and **CPR** facilities on site.

2.4 Questionnaire Structure

The first section of the questionnaire Survey contains general corporate information such as the company name, project name and details, and interviewer information (name, designation and mobile number). In the second part of the questionnaire survey the risk variables that are involved in building construction projects were input and arranged according to the type of risk involved. The survey was conducted across three categories, namely Engineers, architects, Laborers. Based on this, we asked them relevant questions. Which are follows:

QUESTIONS FOR ARCHITECT
Design changes during construction affect project time and cost.
Building plans meet safety and fire protection requirements.
Approval delays from authorities affect the start of construction.
Poor coordination between design teams creates site problems.
Environmental rules influence design planning and material selection

QUESTIONS FOR LABOURERS
Workers experience unsafe working conditions on site.
Fire extinguishers and emergency exits are not easily accessible at the work site.
Work is affected by shortage of tools or materials.
Waste and debris create problems at the work area.
Payment delays or labor issues affect work performance.

QUESTIONS FOR PROJECT ENGINEER
Poor planning leads to delays in construction activities.
Workers follow safety rules during daily work.
Quality problems occur due to improper construction methods.
Weather conditions affect construction progress.
Legal inspections or government checks slow down site work.

2.5. Data Collection:

After the questionnaire Structure is done, the data collection process is started. The questionnaire was prepared in the form of a five-point Likert scale, i.e., 1-very low, 2-low, 3-moderate, 4-high, and 5-very high importance.

2.6 Data Analysis using RII Method-

The required information from the questionnaire survey is retrieved and graded using the quantitative method of the relative importance index. The RII approach is used to analyze the data. Following the analysis, the various hazards were graded according to the severity of their influence on the construction project. The relative importance index (RII) was determined as follows:

FORMULA

$$RII = \frac{(n1 * a1 + n2 * a2 + n3 * a3 \dots \dots)}{A * N}$$

Where,

RII = Relative Importance Index

N = Total respondents

A = Highest response (i.e. =5)

n = Respondents selecting options

a = Individual responses (i.e. = 1, 2, 3, 4, 5)

Where: n1, n2, n3, n4 and n5, = the number of respondents who selected:

Scale	Meaning	Ranges	Rank
1	Very Low	0.80 – 1.0	1
2	Low	0.60 – 0.79	2
3	Moderate	0.40 – 0.59	3
4	High	0.20 – 0.39	4
5	Very High	0.1 – 0.19	5

N is the weightage given to each factor by the respondents (ranging from 1 to 5)

2.7 Calculation: The data for this study was collected using a structured questionnaire. The responses obtained from participants were compiled and analysed. Based on the collected responses, calculations were performed:

For 1st Site named DOSTI GREATER THANE

- Number of Architect: 2
- Number of Engineer: 7
- Number of Labor: 30

For Architect = N=2

Sr no.	Question	1	2	3	4	5	Total Score(ΣW)	RII	Rank
1	Q.1	0	0	2	1	5	26	0.74	2
2	Q.2	0	0	4	1	2	25	0.71	2
3	Q.3	0	0	0	0	5	30	0.85	1
4	Q.4	0	2	2	0	1	19	0.54	3
5	Q.5	0	1	5	1	1	18	0.51	3

Observation: From above calculation it is observed that,

Q.4) Poor coordination between design teams creates site problems. It's the most ranked question from the risk range which should be prioritized first among the other questions. This question is a type of 'operating risk' & 'design risk' which is highly faced by architects.

Sr no.	Question	1	2	3	4	5	Total Score(ΣW)	RII	Rank
1	Q.1	0	0	18	9	3	105	0.70	2
2	Q.2	0	2	8	15	5	113	0.75	2
3	Q.3	0	0	11	10	9	118	0.78	2
4	Q.4	0	2	17	9	2	101	0.67	2
5	Q.5	0	0	5	7	18	133	0.88	1

For Engineers =N=7

Observation: From above calculation it is observed that,

Q.3) Quality problems occur due to improper construction methods. It's the most ranked question from the risk range which should be prioritized first among the other questions. This question is a type of 'construction risk' which is highly faced by engineers

For Labors =N=30

Sr no.	Question	1	2	3	4	5	Total Score(ΣW)	RII	Rank
1	Q.1	0	0	1	1	0	7	0.70	2
2	Q.2	0	0	1	1	0	7	0.70	2
3	Q.3	0	2	0	0	0	4	0.40	3
4	Q.4	0	0	0	0	2	10	1.0	1
5	Q.5	0	0	1	1	0	7	0.70	2

Observation:

From above calculation it is observed that,

Q.5) Payment delays or labor issues affect work performance. It is the most ranked question from the risk range which should be prioritized first among the other questions. The question is a type of 'financial risk' which is highly faced by labor.

For 2nd Site named JP INFRA STARLIFE MIRA BHAYNDER

- Number of Architect: 2
- Number of Engineers: 15
- Number of Labors: 70

For Architect = N=2

Sr no.	Question	1	2	3	4	5	Total Score(ΣW)	RII	Rank
1	Q.1	0	0	3	7	5	62	0.82	1
2	Q.2	0	0	6	6	3	57	0.76	2
3	Q.3	0	1	3	7	2	59	0.65	2
4	Q.4	0	6	6	2	1	43	0.57	3
5	Q.5	0	1	4	6	4	58	0.77	2

Observation:

From above calculation it is observed that,

Q.1) Design changes during construction affect project time and cost. Q.4) Poor coordination between design teams creates site problems. These are the most ranked question from the risk range which should be prioritized first among the other questions.

For Engineers =N=15

Sr no.	Question	1	2	3	4	5	Total Score(ΣW)	RII	Rank
1	Q.1	0	8	48	10	4	220	0.62	2
2	Q.2	0	19	20	20	11	233	0.66	2
3	Q.3	5	16	14	28	17	276	0.78	2
4	Q.4	2	18	23	20	7	222	0.63	2
5	Q.5	0	4	13	15	38	297	0.84	1

Observation

calculation it is observed that,

Q.1) Poor planning leads to delays in construction activities.

It is the most ranked question from the risk range which should be prioritized first among the other questions. This question is a type of 'construction risk' which is highly faced by engineers.

For Labors=N=70

Sr no.	Question	1	2	3	4	5	Total Score(ΣW)	RII	Rank
1	Q.1	0	0	0	1	1	9	0.90	1
2	Q.2	0	0	1	1	0	7	0.70	2
3	Q.3	0	1	0	1	0	6	0.60	2
4	Q.4	0	0	0	2	0	8	0.80	1
5	Q.5	0	0	1	1	0	7	0.70	2

Observation

From above calculation it is observed that,

Q.5) Payment delays or labor issues affect work performance.

It is the most ranked question from the risk range which should be prioritized first among the other

questions. The question is a type of 'financial risk' which is highly faced by labours.

3. Result and Discussion:

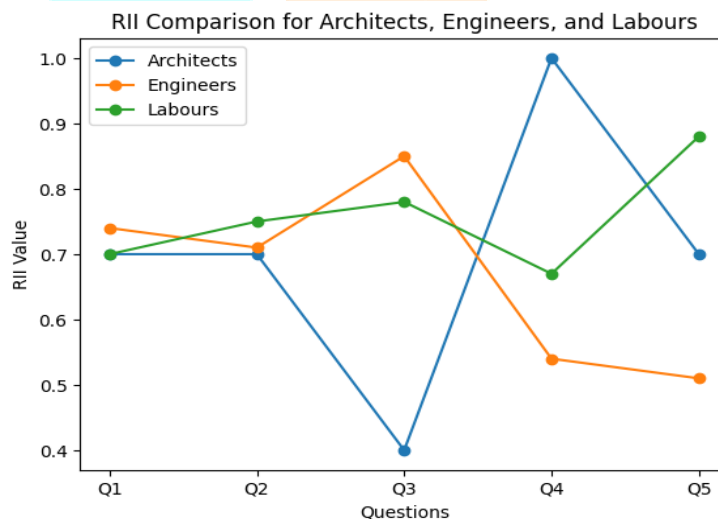
The data collected through structured questionnaires from Architects (N = 2,2), Engineers (N = 7,15), and Labours (N = 30,70) were analyzed using the **Relative Importance Index (RII)** method. The purpose of this analysis was to identify and rank the most significant risk factors affecting construction projects at the selected site.

1st site: The graphical representation of RII values provides a clear visualization of the variation in risk perception among different groups. The bar chart shows distinct peaks for different questions:

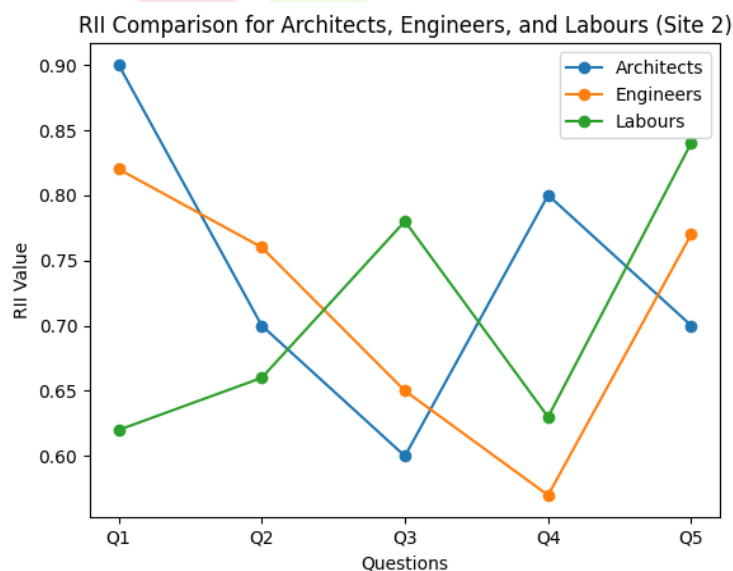
- Q4 exhibits the highest value for Architects
- Q3 shows the highest value for Engineers
- Q5 records the highest value for Labours

2nd site:

- Q1 exhibits the highest value for Architects
- Q1 shows the highest value for Engineers
- Q5 records the highest value for Labours



(Site 1)



3.1 Overall Comparison

Stakeholder	Site 1 Major Risk	Site 2 Major Risk	Common Insight
Architects	Coordination (Q4)	Design change + Coordination (Q1, Q4)	Design risks dominate
Engineers	Construction quality(Q3)	Planning delays (Q1)	Execution & planning risks
Labors	Payment issues (Q5)	Payment issues (Q5)	Financial risk common

4. Conclusion

Construction risks differ by stakeholder but share common themes. Architects mainly face design-related issues like poor coordination and frequent changes, causing delays and extra costs. Engineers deal with construction and management risks, which vary by site (e.g., poor methods or planning issues). Laborers are most affected by financial problems, especially payment delays. Overall, construction risks involve design, execution, and finance, so effective management needs a combined approach covering all areas.

References:

- [1] Momand, A., Adil, F., Shah, S.Z.A., Khan, K., Elahi, M., Sameem, S. and Zaib, S. (2025) *Enhancing risk management strategies in highway and road construction projects using the Relative Importance Index (RII)*. Spectrum of Engineering Sciences, 3(9), pp. 709–721. Available at: <https://sesjournal.org>
- [2] Deshmukh, A. and Bhirud, S. (2016) 'Risk analysis in construction project using RII method', *International Journal of Engineering Research*.
- [3] Fadlansyah, H., Sandhyavitri, A. and Iriana, R.T. (2024) *Road construction delay risk identification based on Relative Importance Index method*. Journal of Civil Engineering.
- [4] Kassem, M.A., Khoiry, M.A. and Hamzah, N. (2020) *Using Relative Importance Index method for developing risk map in oil and gas construction projects*. Jurnal Kejuruteraan, 32(3), pp. 85–97.
- [5] Ranjith, S., Kumar, P. and Singh, A. (2020) *Review on construction risk and development of risk management procedural index*. Available at: <https://www.sciencedirect.com> (Accessed: 11 April 2026).
- [6] Sharma, S. and Gupta, A. (2019) *Risk identification and management in construction projects*. Available at: <https://www.researchgate.net> (Accessed: 11 April 2026).
- [7] Patel, R. (2018) *Risk management in construction*. International Journal of Engineering Research & Technology (IJERT). Available at: <https://www.ijert.org> (Accessed: 11 April 2026).
- [8] Tanaya, R. (2025) *Innovative approaches for risk management in construction projects*. Available at: <https://www.researchgate.net> (Accessed: 11 April 2026).
- [9] Dixit, S., Mandal, S.N., Thanikal, J.V. and Saurabh, K. (2019) *Study of significant factors affecting construction productivity using Relative Importance Index in Indian construction industry*. E3S Web of Conferences, 140, 09010.

Assessment of Risk Management Practice in Construction Projects Using RII Method: A Case Study of Gondar City, Ethiopia