ASSESSING QUALITY PERFORMANCE IN HIGH-RISE BUILDINGS PROJECTS USING RII METHOD: A CASE STUDY OF PUNE CITY

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Abstract

High-rise building projects have gained prominence in the urban development of Pune, India, contributing significantly to the city's skyline. However, ensuring quality in such construction endeavors remains a critical challenge. This research paper presents a comprehensive case study focused on assessing the quality problems encountered in high-rise building projects within the Pune region. The study employs a mixed-methods approach, combining data collected through interviews, document analysis, and on-site observations.

The research reveals a range of quality problems, including structural deficiencies, workmanship issues, materials procurement challenges, and project management shortcomings. By exploring the causes and consequences of these problems, this paper sheds light on the complex nature of quality assurance in high-rise construction. The findings suggest that factors such as inadequate supervision, lack of skilled labor, and poor communication among project stakeholders contribute to the prevalence of quality issues.

The case study serves as a valuable resource for both academia and industry professionals, offering insights into the unique challenges faced by high-rise building projects in Pune. The paper concludes with recommendations aimed at enhancing quality control and project management practices in the context of high-rise construction. Addressing these issues will not only improve the quality of the buildings but also enhance safety and sustainability in the urban landscape of Pune.

Keywords- Quality Management, High-rise buildings, Pareto analysis, RII Assessment

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1 Introduction

1.1 Background and Context of the Research

The construction industry, especially in rapidly growing urban areas like Pune, has witnessed a surge in high-rise building projects in recent years. This growth can be attributed to several factors, including urbanization, population expansion, and the need for efficient land use. High-rise buildings are an integral part of modern urban landscapes, offering vertical solutions to urban density and providing space for residential, commercial, and other uses. Understanding the background and context of this research involves recognizing the importance of high-rise buildings in Pune's urban development.

1.2 Significance of the Study

The significance of this study lies in its potential to address critical issues associated with high-rise building projects in Pune. Quality problems in construction can have far-reaching implications, affecting not only the safety and functionality of the buildings but also the economic and environmental sustainability of the city. Recognizing the significance of this research involves acknowledging the importance of improving quality assurance and management in high-rise construction in Pune.

1.3 The purposes of the research

The objectives of this investigation are as follows:

1. To grasp the concept of quality control in the development of tall structures
2. To identify the factors that influence the high-rise buildings' construction quality.
3. To assess, via a variety of case studies, the challenges related to high-rise building construction quality.
4. To offer recommendations for high-rise building construction quality control.

2 Literature Review

2.1 Quality Performance Measurement in Construction

2.1.1 Key Concepts and Definitions

Quality performance measurement in construction involves evaluating and ensuring the quality of construction projects. This section delves into key concepts and definitions related to quality in construction, including terms such as quality control, quality assurance, and quality management. It explores how these concepts are applied in the construction industry, with a specific focus on high-rise building projects in Pune City.

2.1.2 Importance of Quality in Construction

This subsection highlights the critical importance of quality in construction projects, emphasizing its impact on safety, durability, sustainability, and overall project success. It draws attention to the significant implications of poor quality in high-rise construction in Pune City and its broader consequences for urban development.

2.2 High-Rise Building Projects in Pune City

2.2.1 Overview of the Construction Industry in Pune

This section provides an in-depth overview of the construction industry in Pune City, with a focus on its growth, key players, and trends. It also discusses the role of high-rise building projects in Pune's urban development and the associated challenges.

2.2.2 Characteristics of High-Rise Buildings

In this subsection, you should detail the specific characteristics of high-rise buildings, including architectural, structural, and functional aspects. Understanding these characteristics is crucial for formulating a tailored quality performance measurement framework.

2.3 Existing Quality Performance Measurement Frameworks

2.3.1 Review of Established Frameworks and Models

This section should provide a comprehensive review of existing quality performance measurement frameworks used in construction and assess their applicability to high-rise building projects. Analyze their strengths and weaknesses.

2.3.2 Gaps and Limitations in Current Measurement Methods

Discuss the limitations and gaps in the existing quality performance measurement frameworks. Identify areas where these frameworks fall short in adequately addressing the unique challenges of high-rise construction in Pune City.

2.4 Factors Influencing Quality in High-Rise Building Projects

2.4.1 Environmental Factors

Examine how environmental factors, such as climate, geology, and natural disasters, impact the quality of high-rise construction in Pune City.

2.4.2 Regulatory and Safety Considerations

Discuss the role of local regulations and safety standards in shaping quality performance in high-rise building projects.

2.4.3 Stakeholder Expectations

Examine the expectations of various stakeholders, including investors, developers, residents, and local communities, and their impact on the quality of high-rise projects in Pune City.

3 Methodology Case Study for Pune City

In-Depth Interviews with Stakeholders

Interviews with construction professionals, including architects, contractors, engineers, and other key stakeholders, form a cornerstone of the data collection process. These interviews are conducted to gain comprehensive insights into quality performance in high-rise projects. Here's a detailed explanation:

Figure 1: Location of Pune

Methodology: Semi-structured interviews are employed to facilitate open-ended discussions. These interviews provide the opportunity to delve deep into the experiences, perceptions, and challenges faced by construction professionals in relation to quality performance.

Sample Selection: A diverse sample of professionals involved in high-rise projects is selected to capture a wide range of perspectives. This may include individuals from different phases of the project, such as design, construction, and inspection.

Data Collection: Interviews are designed to elicit responses related to quality metrics, challenges, best practices, and potential areas for improvement. The qualitative nature of these interviews allows for rich and context-specific data.

Data Analysis: Transcripts from interviews are analyzed using qualitative data analysis RII techniques. Themes and patterns related to quality performance are identified and synthesized.

Data of all these tables were analyzed by a RII Index was calculated for each type of claims as follows;

RII Index = $\sum W / (A \times N)$

Where,

W = weight given to each factor by the respondents, ranges from 1 to 5,

A = highest weight

N = total number of respondents.

Analysis Case Study for Pune City

The following table calculation based on the survey data.

Table 1 Analysis of the response

Main Factor	Factor Name	Relative Importance Index	Cumulative Index	Cumulative Percentage
PLANNING	don't learn how to work	1	1	0.30%
	Construction Process	4.37	5.37	1.61%
	Incomplete information	3.37	8.74	2.63%
	Improper project planning	2.97	11.71	3.52%
	Inadequate planning of quality	2.6	14.31	4.30%

	Other Paper work	2.4	16.71	5.02%
	Improper supply of Labours	2.53	19.24	5.78%
	Improper supply of Material	3.23	22.47	6.75%
	Improper supply of fund	2	24.47	7.35%
DESIGN	Compliance with Codes and Standards	5	29.47	8.86%
	Design Requirements	4.03	33.5	10.07%
	Compliance with specifications	3.6	37.1	11.15%
	Design Changes	2.07	39.17	11.77%
	Coordination and contact with the design office	2.97	42.14	12.66%
	Quality-related specifications	4.53	46.67	14.02%
	Misunderstanding of drawings and specifications	2.03	48.7	14.63%
	Lighweightstrucurest	3.03	51.73	15.55%
	Wind load & Earthquake Resistant Design	4.4	56.13	16.87%
	Soil interactions	4	60.13	18.07%
	Construction & Fire safety	3	63.13	18.97%
RULES AND REGULATION	Difficulties in work approval	3.47	66.6	20.01%
	Changes in government policies	4.33	70.93	21.32%
	Bidding/bidding misconduct	1.83	72.76	21.86%
	Application of Building Bylaws	4.93	77.69	23.35%
	Refugee area demarcation	3	80.69	24.25%
	Fire safety Norms	4.43	85.12	25.58%
MATERIALS	Rising building material costs	4.1	89.22	26.81%
	Availability of quality building materials	4.13	93.35	28.05%
	Materials management system	3.43	96.78	29.08%
	Cooperation between contractors and material suppliers	2.97	99.75	29.98%
	Inspection and control of incoming materials	3.57	103.32	31.05%
	new building materials	4.33	107.65	32.35%
	Use of modern forwork	3.2	110.85	33.31%
	Material Requirment Planning	3.9	114.75	34.48%
	Inventory control	2.57	117.32	35.26%
	Material Purchasing	3.37	120.69	36.27%
EQUIPMENTS	Equipment availability	4	124.69	37.47%
	Equipment/ machinary management system	2.77	127.46	38.30%
	Optimum use of equipment	4	131.46	39.50%
	Maintenance of equipmets	2.77	134.23	40.34%
	Breakdown related problems	2.7	136.93	41.15%
	Site characteristics	3.47	140.4	42.19%
	Safety of equipment	4.47	144.87	43.53%
LABOUR	Untrained labour	3.87	148.74	44.70%
	Income level and wages for work	2.8	151.54	45.54%
	training courses for workers	3.3	154.84	46.53%
	Recession related downsizing	2.8	157.64	47.37%
	Blame Game	1.37	159.01	47.78%
	higher Insurance costs	2.4	161.41	48.50%
EXECUTION	Appropriate sampling and testing	4	165.41	49.71%
	Curing and demoulding plan	2.97	168.38	50.60%
	Onsite lab	2.2	170.58	51.26%
	Keep an eye on your regular schedule	4.2	174.78	52.52%
	Not maintaining a good design mix	2.77	177.55	53.36%
	Vibrator in concrete	2.2	179.75	54.02%
	Improper construction techniques	2.57	182.32	54.79%

	On-site quality manual	4.23	186.55	56.06%
	NDT overall performance	2.8	189.35	56.90%
	Advanced method of construction	4.2	193.55	58.16%
	Design Supervision	3.2	196.75	59.12%
	Appointment of Project Management Consultatnt	4	200.75	60.33%
	Continuous supervision of construction works	2.77	203.52	61.16%
	Commissioning supervision on quality and schedule	4	207.52	62.36%
	Testing materials, systems and installations	2.8	210.32	63.20%
	Technical and legal advice	2.2	212.52	63.86%
MANAGEMENT	Implementing a quality control and quality assurance system	4.43	216.95	65.20%
	Implementing a security program	3.43	220.38	66.23%
	Cost monitored system	3.97	224.35	67.42%
	Scheduling time	3.47	227.82	68.46%
	Inadequate support from management	2.47	230.29	69.20%
	External organisation for first-class checking out	4.23	234.52	70.48%
	Suggestions from structural designers during construction	2.53	237.05	71.24%
	Implementation of proposals from various institutions	4.23	241.28	72.51%
	Implementation of materials used according to specifications	2.53	243.81	73.27%
	Third party Audit work	4.23	248.04	74.54%
	Salary Issues	2.47	250.51	75.28%
	Improper documentation of site layout	3.23	253.74	76.25%
	Compensation issues	2.47	256.21	76.99%
	Bonus/ Incentive	2.77	258.98	77.83%
SITE STAFF MANAGEMENT	Field Staff Experience	4.43	263.41	79.16%
	Lack of timely monitoring and inspection	3.4	266.81	80.18%
	Coordination between contractors and supervisors	4.07	270.88	81.40%
	inadequate technical expertise	3.4	274.28	82.42%
	Reflection meeting with employees	2.23	276.51	83.09%
	Undefined Goals	2.6	279.11	83.87%
	Changing Scope	2.13	281.24	84.51%
	Lack of Risk Management	2.6	283.84	85.30%
	No Accountability	2.67	286.51	86.10%
	Unrealistic Conditions	2.87	289.38	86.96%
FINANCIAL ISSUE	cash flow	3.87	293.25	88.12%
	Political interference	3.07	296.32	89.05%
	No delinquency of interim payment	2.57	298.89	89.82%
	Insufficient Fianancial issues	2.73	301.62	90.64%
	financial market instability	3.87	305.49	91.80%
	Contractors' instable financial background	2.77	308.26	92.63%
	Client's poor financial Management	1.93	310.19	93.21%
	Difficulties in obtaining loan from financiers	2.77	312.96	94.05%
	Inflation	2.9	315.86	94.92%
CORRUPTION	Buildings without approved drawings	3.4	319.26	95.94%
	Approval of drawings with	2.57	321.83	96.71%

	technical defects			
	undocumented construction	2.07	323.9	97.33%
	Inefficient administrative structures.	2	325.9	97.94%
	Political monopolization.	3.1	329	98.87%
	Political Stability	3.77	332.77	100%

1. Planning
This factor encompasses issues related to project planning, including the construction process, availability of information, project planning quality, planning for quality, paperwork, labor supply, material supply, and fund supply.

2. Design
The design factor covers aspects related to design compliance with codes and standards, design requirements, specification compliance, design changes, coordination with the design office, quality-related specifications, misunderstanding of drawings and specifications, lightweight structures, wind load and earthquake-resistant design, and soil interactions.

3. Rules and Regulation
This factor deals with challenges related to regulatory and compliance issues, including difficulties in work approval, changes in government policies, bidding misconduct, application of building bylaws, refugee area demarcation, and fire safety norms.

4. Materials
The materials factor focuses on issues related to building material costs, availability of quality materials, materials management, cooperation between contractors and suppliers, inspection and control of incoming materials, new building materials, use of modern formwork, material requirement planning, inventory control, and material purchasing.

5. Equipment
Equipment-related factors include equipment availability, equipment/machinery management systems, optimum equipment use, maintenance of equipment, breakdown-related problems, site characteristics, safety of equipment, and more.

6. Execution
This factor encompasses aspects of construction execution, including sampling and testing, curing and demoulding plans, onsite labs, design mix, vibrator usage, construction techniques, quality manuals, NDT performance, construction methods, design supervision, project management, and more.

7. Labour
The labor factor relates to the workforce, addressing untrained labor, income levels, training courses, recession-related downsizing, insurance costs, and more.

8. Management
Management-related issues involve implementing quality control and assurance systems, security programs, cost monitoring, time scheduling, support from management, external quality checks, structural designer input, material specifications, third-party audits, salary issues, site layout documentation, and compensation.

9. Financial Issues
This factor includes aspects of project finance, such as cash flow, political interference, delinquency of interim payments, financial instability, contractor financial backgrounds, client financial management, difficulties in obtaining loans, and inflation.

10. Corruption
Corruption-related factors cover issues like buildings without approved drawings, approval of drawings with technical defects, undocumented construction, inefficient administrative structures, political monopolization, and political stability.

11. Site Staff Management
This factor is related to the management and coordination of site staff, including staff experience, monitoring, technical expertise, coordination, and risk management.

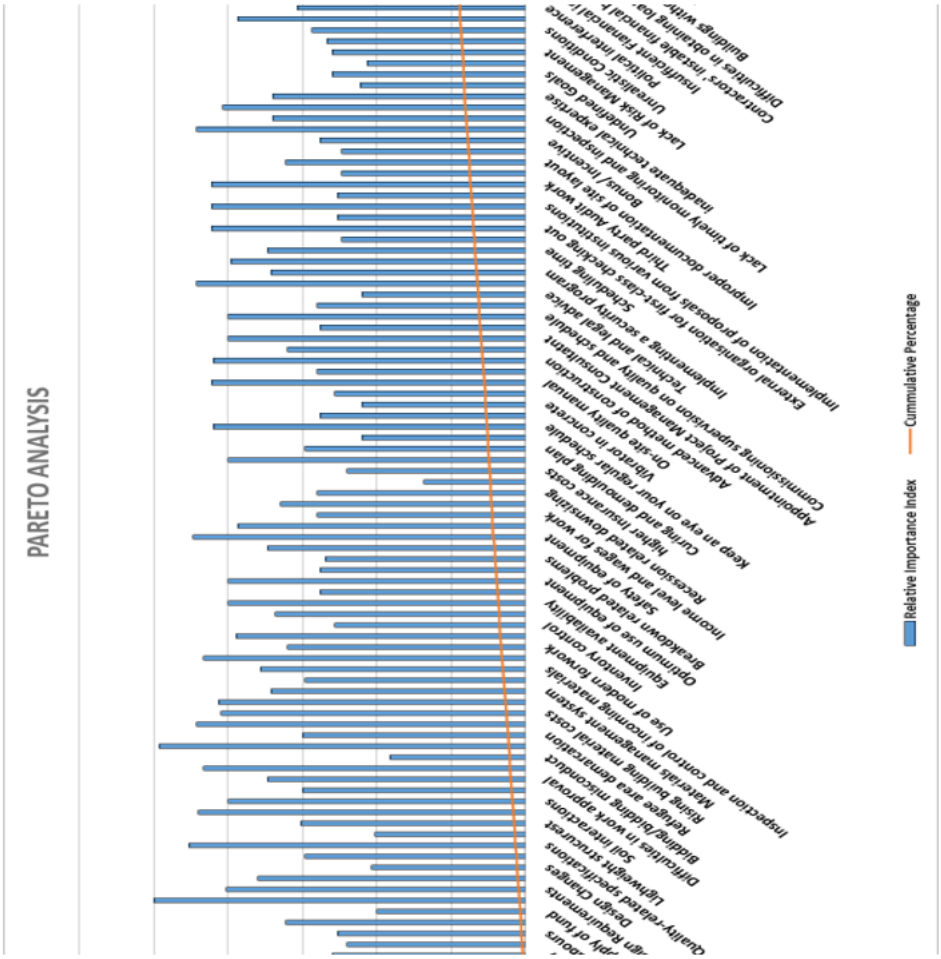

Figure 2 Pareto Analysis

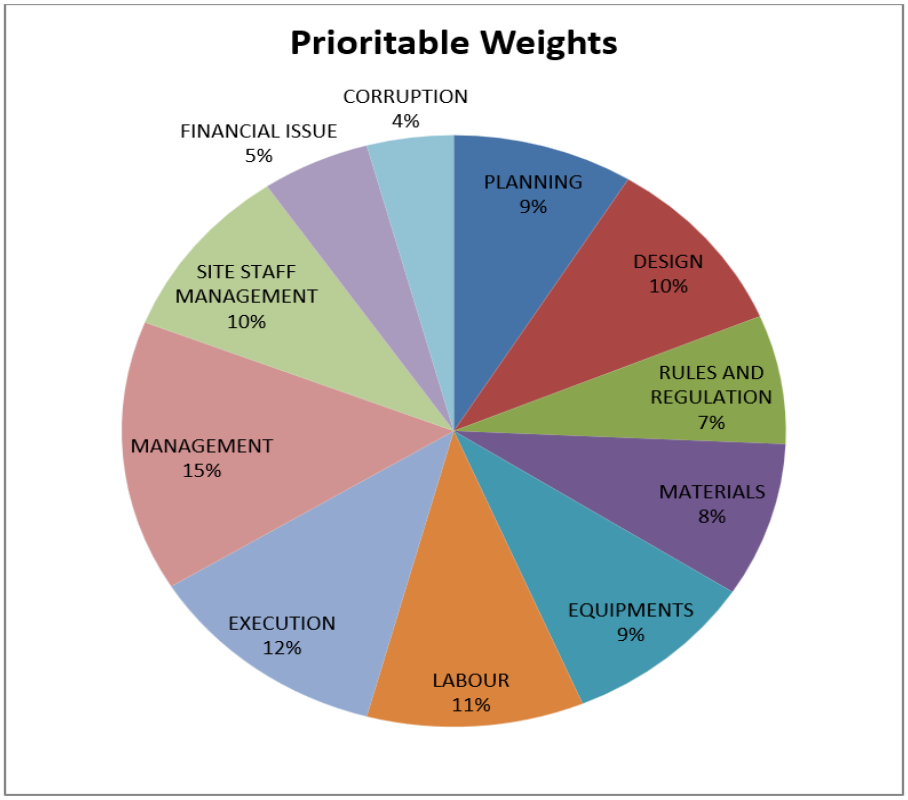

Figure 3 Prioritable Weights

Conclusion:

In the ever-expanding urban landscape of Pune City, the construction of high-rise buildings has become a common phenomenon. Ensuring the quality and performance of these structures is of paramount importance, as they directly impact the safety and well-being of the city's inhabitants. This research has developed a theoretical framework for performance measurement, utilizing the RII method, to better understand the factors influencing quality management in high-rise building construction within Pune City.

The findings of this study suggest that several critical factors, such as design standards, material quality, construction techniques, and project management practices, significantly influence the quality of high-rise buildings. The RII method has been instrumental in assessing and prioritizing these factors, allowing stakeholders in the construction industry to focus their efforts on areas with the greatest impact.

By implementing the RII-based theoretical framework, construction professionals, regulators, and policymakers can better allocate resources and make informed decisions to enhance the quality management of high-rise buildings in Pune City. This, in turn, can lead to safer and more resilient structures, ensuring the city's continued growth and development is sustainable and conducive to a high quality of life for its residents.

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