

# Challenges in High-Rise Building Projects for Parameters of Project Management: A Review

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**Abstract** - India is having the 2<sup>nd</sup> highest population in the world. With the increase in population need for good infrastructure is also arising for a better life. People are moving from rural areas to urban areas. This causes population density problems in urban areas. To solve the population density problem, the need for high-rise building structures is arising as land for development in an urban area is limited. High-Rise building projects are complex. There are many challenges related to various parameters of project management. Various factors affect the parameters of project management. This review study identifies which factors affect the parameters of project management for high-rise building projects most.

**Key Words:** High-Rise Building, Parameters, Project Management, Quality, Safety, Scope, Time & Cost

## 1. Introduction

India is having about 138 crores population as of 2020. Which is 2<sup>nd</sup> highest in the world. The majority of the Indian population lives in villages around 65% and about 35% population lives in an urban area as of 2020 as per World Data Bank. India is quickly urbanizing, with projections that by 2030, half of the country's population will be living in cities. In the majority of Indian cities, 20–30% of buildings are unlicensed and built-in complete disregard of the by-laws. India's urbanization policy, aimed at delivering quicker and more inclusive growth, has put additional strain on current services and infrastructure, while new townships have been built with limited capacity building. [1]

High-rise buildings are often noteworthy architectural projects that represent the status of the science and technology process, as well as novel construction methods, and are being built in response to increased populations of cities and a scarcity of land. Tall buildings have characteristics that distinguish them from other structures. These are well-known architectural designs that represent scientific and technical development while also reducing technology. [2]

Shadow limitations are intended to limit the overall height of buildings to ensure that the city gets enough sunshine. Buildings that reach new heights present a slew of engineering and technological challenges, such as foundation stabilization, ventilation, heating, cooling, lighting, public transit (elevators, stairs, parking), interaction, electricity, plumbing, air resistance, structural integrity, fire protection, and security. There is also a slew of societal issues associated with the increased job density brought on by tall buildings, such as traffic congestion and environmental concerns. [3]

### 1.1 Need of High-Rise Buildings

Because there are no other possibilities for attaining high-density growth, tall skyscrapers are built. They give a possibility to curb urban development due to their modest footprint. This same requirement for a modern design form-the density of the action closeness to options for large number of individuals could be depicted in trying to identify the distinctive traits which a tall structure brings, which is much more than "picture" and is a more self-sustaining type of growth.

### 1.2 Objective of Study

Below are the study's objectives:

1. To study various factors affecting to parameters of project management.
2. To study which factor affects the most project management parameters.
3. To understand the effect of various factors on high-rise building construction.

## 2. Literature Review

By studying literature review from various authors some were concluded which are follows:

### 2.1 Scope

Chirayu Thapa et al. (2013) stated In heavily populous places or urban areas, high-rise buildings are common. The

construction method and requirements for high-rise buildings are critical for proper management and structural strength. If there isn't a good structure, there isn't a good building. The materials used in the building conform to the structure. The utilization of resources required for high-rise building construction, as well as the management of waste products as well as the treatment of wastewater for reuse, are critical. The development of high-rise buildings has a distinct history. [4]

**Pooya Lotfabadi et al. (2014)** structured questions collect data, which was then analyzed using Microsoft Excel 2007. The findings suggest that the majority of skyscraper occupants (about 83 percent) are unaware of new renewable energy sources in high-rise structures. Simultaneously, they are virtually completely satisfied (73%) with the natural energy sources that are employed in their apartments. Furthermore, about a third of the residents say they pay less, and at minimum a lesser amount than people who live in regular buildings. [5]

**Peng Cheng et al. (2014)** stated high-rise structures have become a major emblem of urbanization in recent years as socialist modernization has progressed. The building of a tall building, and the construction phases of a tall place, is an important part of construction that has a massive effect on people's manufacturing and work, and as a result, the tall tower technology construction method has become increasingly important. [6]

**Mainak Ghosal et al. (2018)** stated in 2017, the functional proportion of tall buildings reversed, with the CTUBH data showing a move from all-office and mixed-use towers to all-residential towers. Structures within all residential functions accounted for 49 project completion, or 34% of a total, up from 19 last year, which accounted for 15% of the total. At the same time, total office building completions declined at 56, or 39% of a total, from 67, or 52% in 2016. In terms of construction materials, 74 (51%) of such 144 buildings with a height of 200 meters or more completed in 2017 used concrete as the major structural material, while 64 (44%) used a steel-concrete composite. [7]

**Yanhui Sun et al. (2020)** did comprehensive literature research and a focus group study with seasoned professionals found a total of 27 restrictions over the whole modular building life cycle. In a questionnaire survey, a significant number of research researchers and modular construction participants with adequate expertise and knowledge were given the final list of obstacles inhibiting the advancement of high-rise modular buildings. The main problems were identified as "lack of communication and coordination among stakeholders," "higher costs," "lack of government assistance," "lack of knowledge and competence," "lack of construction norms and standards," "poor supply chain integration," and "complexity of connectivity." [8]

**Table-1:** Factors Affecting to Scope

Factors/Authors	Chirayu Thapa(2013)	Pooya Lotfabadi (2014)	Peng Cheng(2014)	Mainak Ghosal(2018)	Yanhui Sun(2020)
Lack of experience and expertise	*	*			*
Lack of government support		*		*	*
Poor market and society acceptance	*		*		*
Higher capital cost		*			*
Higher construction cost				*	*
Additional transportation cost		*	*		*
Additional crane cost	*				*
Lack of R&D and resource support		*	*		
Lack of coordination and communication among stakeholders	*			*	
Lack of building codes and standards			*		*
Unable to freeze design early		*	*		*
Poor design flexibility	*		*	*	
Complexity of design on seismic performance					*
Complexity of design on fire-resistant performance		*			
Incompetence of suppliers and manufacturers			*		*
Unable to achieve economies of scale				*	*
Lack of skilled labour		*	*		
Limitation of weight and dimensions	*				*
Damage to modules during transportation			*		*

## 2.2 Quality

**Yi Fang et al. (2015)** discussed controlling the quality of high-rise construction projects is crucial. Because our high-rise structure was constructed in such a short period, there are still several challenges and concerns that need to be addressed. Engineers believe as long as maintain every quality control system and conduct management work, will be able to effectively regulate the quality of high-rise building projects. [9]

**P Siva Sankar et al. (2016)** discussed in India; current construction techniques still use the methodology of "as-needed" resource management. Lack of professionalism leads to a lack of detail when it comes to careful planning and decision-making in site management, resulting in a significant underutilization of resources. Project resource planning is still confined to planning with time, while resource mobilization and consumption planning based on capacity and availability before the planning stage is still a non-issue. To analyze resource utilization capacities and measure productivity, the very first stage seems to be to maintain their real-time records from existing projects. Since

this is an already completed project, its four planning and scheduling would be similar to Total Quality Management. [10]

**K.Loganathan et al. (2016)** collected information from a variety of sources in order to assess the cost, duration, and quality of different forms of formwork. Aluminum formwork has a high starting cost when compared to other forms of formwork, according to the investigation. An aluminum frame is an effective approach for large construction projects when compared to length, productivity, quality, and repeatability. Aluminum formwork is cost-effective for normal floors since the number of repetitions is great and labor costs are low when compared to other varieties. Aluminum formwork, on the other hand, is ineffective for smaller projects. Formwork can be selected as part of the project type and floor heights. [11]

**Table-2: Factors Affecting to Quality**

Factors\Authors	Vernon Ireland(1985)	Yi Fang(2015)	K.Loganathan(2016)	Prof.Reshma.Fegade(2016)	Artem Davidyuk(2018)
Time overlap of design and construction	*		*	*	*
Complexity of form of construction	*	*			*
Variations to the contract		*	*		
Number of site managerial personnel		*	*		
Use of more-competent-than-average designers	*		*		*
Use of more-competent-than-average construction management personnel		*	*		
Number of days lost through industrial disputes		*	*		
Fluctuation in labours, materials availability	*		*		*
Low skilled manpower			*		*
Inappropriate methods fo constructions	*		*		
Poor site management & supervision		*	*	*	*
Change in Design	*		*		
Quality of equipment & raw materials			*		*
Rework due to errors during construction		*	*	*	*

### 2.3 Time & Cost

**Shambalid Ahady et al.'s (2017)** stated cost overruns in building projects are caused by a range of variables, according to the findings. The most major element leading to construction overruns in developing nations has been identified as fluctuating and rising material costs. It was also

demonstrated that not all project features are the same, even though many of them are common to programs in developing countries, such as poor management, inaccurate material estimations, and the company's financial status. [12]

**Leonid Kolchedantsev et al. (2018)** discussed the entire effect of existing technological solutions combined with a preliminary concrete mixes warming-up application for steel and concrete element manufacturing and grouting of joints between them during rigging up, as well as the «thermos» method application in moderate and high structures The following is the construction: About 65-70 percent of high-rise building structures must be constructed using the prefabricated and cast-in-place method, which allows for a 1,5-2 day reduction in typical floor construction time. [13]

**Aaditya Sanyal et al. (2018)** discussed the most significant variables generating delays in estate high-rise projects in just a few key cities across India were investigated using a questionnaire containing 67 delay causes divided into ten groups. Various professions working with property developers, contractors, consultants, and project management consultants were asked to respond on a 5-point scale. Each of the areas received approximately 100 answers. The relative relevance of different delay causes and delay types was determined. Overall, it can be seen that, while the most significant delays appear to be comparable, the individual rankings of the delay reasons varied. There are a few reasons for delays that are peculiar to certain areas. [14]

**Eric Asa et al. (2019)** discussed construction delays are crucial because they result in losses for owners and builders, as well as affect the construction industry's economy. Prior understanding of potential construction delays saves money, time, and energy, and was vital for high-rise structure construction. Because of the intricacy of these projects, there was a substantial risk of delays. The purpose of this research was to find out the sources of potential delays in the high-rise building construction sector, as well as the severity of those delays. In addition, through structured questionnaires distributed across the United States and India, this study evaluates all conceivable delays and their severity. [15]

**Saurav Dixit et al. (2019)** reviewed all of the project management and project managers that participated in the survey, it was discovered implies there was an excess of time is highly common in most projects and that it is often accompanied by the budget shortfall the vast majority of high-rise building projects in Noida and Pune. Design variations or scope modification, lack of effective planning, resource shortages, and faulty productivity calculation are all key reasons that contribute to time overruns or delays. [16]



**Table-3:** Factors Affecting to Time & Cost

Factors\Authors	U. Sindhu Vaardini(2015)	Sakshi Gupta(2017)	Aaditya Pratap Sanyal(2018)	Saurav Dixit(2019)	Eric Asa(2019)
Insufficient contractor experience	*		*		*
Difficulties in obtaining permits	*	*	*	*	
Fluctuation in labours, materials availability	*		*		*
Delay in approving drawings		*	*		*
Lack of training and experience of PM		*		*	*
Low skilled manpower	*		*		
Inappropriate methods for constructions		*		*	*
Restricted access		*	*		
Poor site management & supervision			*		
Increases in scope of work	*	*	*	*	
Cash flow problems		*		*	*
Speed of owner decision making progress			*		*
Unforeseen condition on ground		*		*	
Strike	*		*		
Non-performance of subcontractors		*		*	*
Lowest bid win		*			*
Delay in progress payment	*		*		

### 2.4 Safety

**Panchal Varsha et al. (2013)** discussed the construction sector is one of the biggest industries in the globe. It delivers a significant boost to the national economy. It has registered a tremendous degree of increase in recent years. In India, the construction industry hires the second most successful after agriculture. Thus the incidence of fatal accidents is very high as unorganized workers are exposed to major Oxygen Deficiency Hazard (OHS). The goal of this paper was to examine our construction companies' attitudes on worker protection on building sites and see whether there was any correlation between worker safety and site productivity. [17]

**Elena Voskresenskaya et a. (2018)** discussed a group of guidelines for high-rise buildings that have been prepared by the Federal Autonomous Institution "Federal Center for Standardization, Technical Standardization, and Compliance in Construction." It becomes effective on February 2, 2017. The revised set of guidelines "Architecting High-rise building systems " includes the design of civil engineering systems and Public buildings having a height of much more than 55 meters are being renovated and residential structures

having a maximum height of 75 meters. The paper establishes guidance for the design of high-rise engineering systems. structures that will offer complete building security and boost their energy efficiency and decrease non-renewable resource usage in building and operation. Before the passage of new laws, it was difficult to construct a facility larger than 100 m. It was required to create and amend special rules (SR) that stifled progress. High-rise construction is a kind of high-rise building. [18]

**Chen Chen et al. (2021)** discussed the dynamic characteristic preternatural frequency is included in the curtain wall vibrating detection based on the current laboratory experimental model. The regularity of these distinct orders has been proven to have a variable association with concrete wall safety. The natural frequency of the first order, in particular, rapidly drops as the curtain wall's safety lowers, as well as the point that detects vibrations has minimal impact on the end outcome. The finite element model is a method of calculating the quantifies the link between both the restraint for forces on the enclosure as well as the natural frequency of a curtain wall, It's also determined that the curtain wall's failing, instability, and stability are the three phases of safety status. When compared to other high-order frequencies, the very first natural frequency (the main foundation) is more appropriate for judging curtain wall safety.[19]

**Table-4:** Factors Affecting to Safety

Factors\Authors	Panchal Varsha Govindbhai(2013)	Hanish Verma(2017)	Yadi LI(2018)	Elena Voskresenskaya(2018)	Chen Chen(2021)
Daily safety records	*		*		*
Regular safety meetings	*	*		*	
Safety education and training of workers		*		*	*
Safety and technology disclosure	*	*	*		
Emergency response plan	*			*	*
Accident/incident reports and investigation		*	*		*
Worker cooperation on safety	*	*			*
Low worker mobility		*	*		
Workers obey management			*	*	
Electrical safety		*		*	
Equipment safety	*		*		
Safety investment		*	*		*
Worker compensation insurance	*			*	*

## 2.5 Risk

V.Sakthiniveditha et al. (2015) examined literature from numerous publications and papers covering risk assessment in the construction industry, according to the approach. Arbitration knowledge lacking has the highest hazard assessment among engineers, with additional dangers including shortages of supplies, electrical shortages, poor quality of bought materials, lost due to interest rate rises, on-site subcontractor problems, inaccuracy in drawings, faulty verification of the initial contract, and rivalry from other firms Environmental risk, government relations, local protectionism, and labor issues get the lowest risk ratings from project engineers. [20]

Leenu Paul et al. (2018) discussed risk management as an important aspect of the building process. The process of correctly identifying and assessing risk factors is important to the project's success. Through pilot research and expert guidance, a series of 24 dangers influencing elements divided into three sections have been discovered. Each factor's influence is investigated. In Ernakulam's building sector, formal risk assessment methodologies are hardly applied. Mixing qualitative and quantitative approaches to analyze hazards may improve risk management and assessment. [21]

S. Janani et al. (2020) assessed the risk factors using the preceding literature research, and then they were categorized into several categories, and the risk factors' probability was computed using the Risky project Pro. The risk factors' dependability has been determined using the Risky project Pro. Then, for each of the risk variables, safety measures have been identified, and the findings and discussions have been decided as part of the aforementioned process. The preceding literature review identifies the hazards that arise in the construction business, and how these risks affect project completion. The literature has been gathered and the full research has been performed. [22]

Table-5: Factors Affecting to Risk

Factors\Authors	Pradeep.T(2015)	Boris Titarenko(2018)	Leenu Paul(2018)	Ms. S. JANANI(2020)	Guines Bardakci(2020)
Type of contract	*			*	*
Delay in license and permits		*	*	*	
Cost overruns	*				*
Environmental regulations procedure		*	*		
Differing site conditions	*			*	
Late changes in design	*		*	*	*
Schedule delays	*				
Supply of defective materials	*	*		*	
Obsolete technology & Tools	*				
Knowledge on equipment			*		*
Designing errors		*		*	
Non availability of resources			*	*	*
Labor accidents	*			*	
Defective work/Rework					
Acceptance of unrealistic deadlines in contract	*	*		*	*
Unrealistic planning	*	*			*
Union issues			*		
Bribery & Corruption		*		*	
Fluctuation of raw material prices			*		*

## 3 High-Rise Buildings

The urban area of a town is a record of the things that happened there, including expansion, transition, and change, with buildings conveying signals about how they were put together architecturally. One of the most important design policy considerations is that development should adapt correctly to its context, which should be characterized in terms of visual, social, functional, and environmental characteristics. Culture, society, and economy, as well as the surrounding environment, are all aspects of architecture. The combination of all of these factors is critical in determining a location's features. A city's constructed environment is therefore a result of its socio-cultural and political setting, which influences architectural and planning disciplines. Tall structures (Fig-1) may be clustered or stand-alone, depending on the situation. The appropriateness of a location for tall building development, on the other hand, will be determined by the site's individual conditions as well as the plan in the issue.



**Fig-1:** High-Rise Building Structures

The approach to tall building design has evolved swiftly, and nowadays, building design is an important element of a complicated process. The location and design of towering buildings in many American and Canadian cities has resulted in virtually arctic temperatures. Apart from pointing out the unfavorable shadow impact, Peter Bosselmann's book *Sun, Wind, and Comfort* includes instances of climatic degradation caused by wind around gratis high-rise structures, such as the analysis. this analysis, the corner effect, and the gap effect. "It is now well established that very tall freestanding towers can generate tremendous draughts down their sides," William H. Whyte, writing on the state of affairs in New York, notes the ramifications, saying, "It is now well established that very tall freestanding towers can generate tremendous draughts down their sides."

Every application for a new high-rise structure in many major cities must include a "Sunlight Access and Shadow Impact Study." New structures should not project considerable shadow on city parks, plazas, rivers, beaches, or playgrounds, according to the study guidelines. By improving interactions and harmony between structures and their urban environmental environments, each building is assessed on its design, height, and orientation, with an emphasis on environmental aspects.

Three fundamental methods for ecological sustainability may be identified. The first technique is what we refer to as "design for low operating expenses." This entails efficient energy, materials, and design configuration using passive ways with little environmental effect. The second step is to plan for low-cost fire protection. This refers to the energy gear and assembly that results in cheap initial costs and a minimal environmental effect. Finally, if we have enough data, we should design for the most economical end cost and end usage. You have to cope with the hot and cold seasons, as well as the two mid-seasons, if you operate in various climatic zones. As a result, the enclosure, or skin, must be designed as a sensitive environmental filter for energy efficiency.

### 3.1 Advantages of High-Rise Buildings:

The following are some of the benefits of high-rise buildings:

1. One of the benefits of having a large number of skyscrapers in your town is the variety of vistas it provides. These vistas may be so beautiful that they attract tourists, bringing money to the company or city in which they are located.
2. Another apparent benefit is the amount of room available. These buildings contain so much interior room that they could accommodate more than one corporation. The presence of more than one enterprise in the same building reduces the amount of space required in the city.
3. Another benefit of skyscrapers is their symbolic value. The meaning of the tower might be that a catastrophe occurred in that location, and they are erecting a memorial to it and naming the structure after it. This might represent a significant benefit to the city since it could serve as a big draw for visitors, resulting in increased revenue.
4. When they supply high-value floorspace at crowded wealthy population choke spots, they become cost-effective.
5. There would be nothing to bother guests, so they can rest and enjoy the city's skyline while enjoying a great panoramic view.

### 3.2 Disadvantages of High-Rise Buildings:

High-rise structures have a number of drawbacks, including the following:

1. The building's safety is one of the skyscraper's key concerns. Because of their size, these massive buildings are much more likely to be damaged by a natural catastrophe.
2. The larger the structure, the more foundation is required, therefore if there is indeed a natural catastrophe and the foundation fails, there might be serious consequences.
3. Another significant expense in the construction of buildings is the price of the structures themselves. These structures are so large and expensive that many people believe they really aren't worth the cost.



4. The high environmental cost of its construction, as well as the lift / elevators power consumption, has been a negative. New technology may be able to mitigate this disadvantage.
5. Buildings that are very tall People will lose touch with the roads and the earth, causing them to become disconnected from nature and their surroundings.

### 3.3 High-Rise Building Construction Characteristics:

The following are the features of high-rise structures in terms of construction:

1. The construction duration for high-rise structures is lengthy, due to the large number of buildings and the amount of labour required. The construction complexity is significant, due to the large workload and sophisticated technology. As a consequence, vertical transportation, high ratings, firefighting, communications, water, and construction waste processing issues have all become features of high-rise building development.
2. To maintain the general stability of tall tower construction to increase the foundation's dependability, a layer of two major building construction must be dug deep into the soil 5 m, with auxiliary equipment level and garage, among other things.
3. The development of high-rise structures takes a long time because of the large number of people required, the high cost of materials used, and the seasonal nature of the work. As a result, higher criteria must be met in terms of personnel and technical quality.
4. Land conflicts in high-rise building construction, complicated ambient conditions, in order to make sure normal behaviour of engineering hardware, proper material use, and site temporary facility technology, reduce storage in high-rise building material, equipment, and make proper more use products and pre-packaged elements and semi-finished materials as much as possible.

### 4 Conclusion

Following are the conclusions from the review study:

1. Skyscrapers have evolved from their inception to the present day, and governments are building them as a source of pride for their country. However, there are some challenges and restrictions that must be considered.

2. High-rise building projects face many challenges in the pre-construction stage as well as while construction is going on.
3. Many factors affect the parameters of project management, which should be eliminated for the achievement of desired building standards.
4. Proper control mechanism is required to overcome challenges faced by the construction industry for high-rise building construction.

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