

# SUSTAINABILITY OF HIGH-RISE BUILDINGS: NEED OF MODERN SOCIETY

\*Pranav Srivastava

\*\*Dr. Rajesh Prakash Dubey

**Paper Received:** 14.12.2021 / **Paper Accepted:** 12.01.2022 / **Paper Published:** 15.01.2022

**Corresponding Author:** Pranav Srivastava; doi:10.46360/cosmos.et.620212020

## Abstract

Urban space is limited and majority of the world's population is currently residing in urban areas, which has led to an increase in population density. Because of this, there is a tremendous amount of pressure placed on the land that is already available, and it is imperative that limited urban space be utilized effectively. The construction of high-rise structures enables communities to make the most efficient use of land while yet being able to accommodate an increasing number of citizens as well as companies. As concerns about climate change and the degradation of the environment grow more intense, modern society seeks more sustainable solutions. When designed with environmentally friendly elements such as green roofs, energy-efficient systems, and rainwater harvesting, high-rise structures have the potential to drastically lessen their impact on the surrounding environment. Because urban land is so expensive, building horizontally is sometimes impractical because of the high construction costs involved. High-rises provide an economically viable option for developers, enabling them to optimize returns on investment by housing more units or companies in a smaller area. This allows high-rises to have a smaller overall footprint. As the population of cities grows, the amount of congestion in their transportation networks increases. When they are positioned in such a way as to be in close proximity to major transportation hubs, high-rise buildings facilitate effective urban mobility and cut down on the amount of time spent traveling. Sustainability is a major consideration in the design of contemporary apartment complexes and office towers. In order to lessen their impact on the environment, they are designed with eco-friendly elements such as energy-saving systems, green roofs, and cutting-edge materials. It is now normal practice to work toward earning certifications in green building practices such as LEED (Leadership in Energy and Environmental Design) and others.

**Keywords:** Building, Sustainability, Construction, High-rise.

## Introduction

Skyscrapers are commonly used to refer to high-rise buildings, which are widely considered to be the pinnacle of architectural and engineering success. These towering skyscrapers have come to represent urbanization, progress, and innovative human endeavors, and they are now virtually indistinguishable from modern cityscapes. High-rise structures are not just architectural marvels, but also critical solutions to the difficulties of limited urban space, economic efficiency, and sustainable development. This is because metropolitan populations are expected to continue growing in the next decades.

Ancient civilizations such as the Indus, Egyptians and Babylonians erected enormous structures, thus the idea of tall buildings is not new. However, it wasn't until the late 19th and early 20th centuries that high-rise buildings began to take their contemporary form. Buildings that could reach heights never before imagined became possible after the invention of steel-frame construction techniques, elevators, as well as breakthroughs in materials and engineering.

Over the course of several decades, there has been a substantial amount of progress made in both the design and construction of high-rise buildings. In the beginning, skyscrapers could be recognized by their vertical emphasis, intricate detailing, and different architectural styles. This can be seen in well-known buildings such as the Empire State Building in New York City, Burj Khalifa in Dubai & so on. On the other hand, modern high-rise design has embraced a strategy that is more diversified and environmentally friendly.

High-rise buildings are now used for a variety of functions and purposes in addition to their original use as office towers. Today, they are put to use in a wide variety of settings, including residential, hospitality, and healthcare settings, as well as mixed-use areas. Because of this diversity, the ways in which we live, work, and interact within urban areas have all undergone significant shifts.

## Literature Review

Pershakov (2020) This article is devoted to current problems encountered when researching structural designs to be a component of high-rise buildings' structural systems. These systems constitute an architectural image as well as a volumetric three-

\*Research Scholar, CMJ University, Shillong, India.

\*\*Supervisor, CMJ University, Shillong, India.

dimensional structure, which consists of a set of interconnected structural elements that, when working together, offer the durability of the volumetric structure, spatial rigidity, and overall stability of the object. These issues are discussed in detail in the article. Vertical elements, such as columns, walls, nuclei, and diaphragms, are used in the construction of high-rise buildings, whereas horizontal elements, such as floors, beams, and slanting belts, are used in the construction of low-rise buildings. Horizontal loadbearing structures of high-rise buildings are typically of the same type and constitute a rigid reinforced concrete disk (monolithic, precast-monolithic, precast). This is because these types of constructions are the most cost-effective and efficient. Loads of both a vertical and horizontal nature are carried by horizontal structures, which then transfer those loads to load-bearing structures including foundations. In order to lessen the impact of the wind on the building, an aerodynamically advantageous design such as a cylinder, pyramid, or prism may be selected. The designs of high-rise structures each have their own particularity, which has a significant impact on the decisions about three-dimensional planning as well as architectural and design matters. The following characteristics are included: significant loads on load-bearing structures; unequal loads on structural elements; high wind load as a horizontal component; problems of joint work of load-bearing structures made of steel and concrete; impact of natural factors (seismic, atmospheric, aerodynamic); impact of technogenic factors (vibrations, noise, accidents, fires, sabotage acts, local destruction); heightened requirements for fire safety and environment control system.

Line (2018) The main topic of discussion in this study is the influence that the vertical component of earthquake ground acceleration has on the structural integrity of reinforced concrete buildings. The evaluation of the effect of the vertical component of earthquake ground acceleration across zone V of India forms the foundation of this thesis. In order to accomplish these goals, a medium soil profile was analyzed with ETABs 2015 software to perform linear response spectrum assessments on a selection of buildings. As comparison parameters, structural reactions such as shear force, axial force, & bending moment, as well as column caused by horizontal and vertical vs horizontal earthquake ground accelerations, were utilized. If the designed structure is going to be situated close to faults, then the vertical component of earthquake ground acceleration needs to be taken into consideration. First, a model of the building that included both X and Y components of an earthquake was created so that the effects of the vertical portion of the earthquake acceleration on the ground in zone V could be evaluated on a chosen building structure.

The next thing that was done was modeling the earthquake that had previously occurred on the same building, but this time taking into account the effect of the vertical earthquake component as well as to the gravity loads. The following reactions of structures, such as axial force, shear force, and bending moment, were employed in the model to analyze the influence that the vertical component of the earthquake ground acceleration had on the building element. Below is given the floor plan of the building, which is able to reflect the building type as well as the structural system. When planning the layout of a structure, it is important to pay attention to both the plan and the elevation regularity.

### Importance of High-Rise Buildings

Vertical urbanization is achieved through the construction of high-rise buildings, which makes it possible for cities to contain a greater number of people and activities on a given amount of land. Because of this vertical rise, there is less of a demand for outlying suburbs, which helps to preserve natural areas and agricultural land.

**Mixed-Use Development:** Many modern high-rise buildings feature mixed-use spaces, which combine residential, business, and recreational activities all inside the same building. This integration helps to cultivate lively communities, which decreases the amount of congestion that inhabitants experience, and promotes a sense of convenience for the residents.

**Innovation in Architecture:** The design of high-rise buildings has progressed beyond the stage of only being practical constructions, and has instead become a canvas on which artists can express themselves. Designs that have become instantly recognizable, such as the Guggenheim Museum in Bilbao or the Shard in London, are excellent examples of how architectural creativity and urban functionality may be successfully combined.

In order to foster a sense of community, well-designed high-rises frequently give priority to the creation of social spaces. These spaces may include rooftop gardens, common lounges, and fitness centers. The inhabitants' quality of life is improved, and the building as a whole gains a stronger feeling of community as a result of these amenities.

The design of modern society absolutely requires the construction of skyscrapers and other types of tall buildings. High-rise buildings offer a workable solution to the pressing concerns of limited space, environmental sustainability, and economic efficiency as our cities continue to develop and grow. In addition to this, they present possibilities for creative design, the development of

communities, and the revitalization of metropolitan areas. It is indisputable that high-rise buildings will play a significant part in determining the nature of urban life in the decades to come, despite the fact that the construction of such structures requires careful consideration of a variety of elements and obstacles. As long as urbanization continues, high-rise design will continue to play a critical role in the development of cities that are more hospitable, sustainable, and lively for future generations.

### Concerns and Things to Take into Account

High-rise buildings, despite the many advantages they offer, also come with a number of disadvantages. Concerns have been raised concerning things like the building's ability to withstand earthquakes and fires, the fire suppression systems, the vertical transportation systems, and the residents' right to an equal amount of sunlight and views. In order to find solutions to these problems, it will be necessary for architects, engineers, urban planners, and policymakers to work together. The construction of towering buildings presents their own unique set of difficulties and issues to consider:

**Integrity of the Structure:** The stability and safety of high-rise structures under varied loads, such as wind and seismic pressures, is a significant issue for architects and engineers. This is accomplished by ensuring that high-rise buildings maintain their structural integrity.

**Vertical Mobility:** For high-rise structures, the provision of effective vertical transportation systems, such as elevators, is absolutely necessary in order to facilitate the movement of both people and products.

**Safety and Security:** It is absolutely essential for high-rise buildings to have fire safety systems, emergency evacuation plans, and security measures in place to protect the people who live there.

**Sustainability and Energy Efficiency:** Striking a balance between the impact that high-rise buildings have on the surrounding environment and the amount of energy they require is a continuing problem.

### Conclusion

According to this study, "sustainability" should be seen as an umbrella concept that connects the concepts of "ecological," "green," "resilient," and "smart," where each contributes to the concept's three pillars: social, economic, and environmental sustainability. That is to say, "sustainability" can be seen as a central concept due to its comprehensive framework, which is represented in its three pillars (social, economic, and environmental) or the 3Ps (people, profit, and planet). In this context, "people"

refers to the health and equity of a community, "profit" refers to the vitality of an economy, and "planet" refers to the preservation of natural resources and the environment. These pillars or dimensions are also symbolized by what is known as the triple bottom line, usually abbreviated as TBL or 3BL. The 3Es stand for equality, economic, and ecological sustainability. The purpose of sustainability is to strike a healthy equilibrium between these three dimensions in accordance with both near-term and long-term objectives and at various scales of geography, ranging from individual habitats through neighborhoods, communities, cities, regions, countries, continents, and the entire planet.

The ideas of tenacity and continued existence across time have been highlighted by the sustainability movement. As a result, it contributed to the development of the concept of resilience. As a result, global warming and climate change have resulted in abnormally high rates at flooding, droughts, storms, tidal surges, soil erosion, and sea-level rise, all of which have collectively prompted the notion that resilience is of the utmost importance. As a result, sustainable as well as resilient designs have merged with emergency preparedness to lessen the detrimental impacts upon people, infrastructure, including institutions caused by unanticipated future natural catastrophes. This is done in order to reduce the number of people who are killed, injured, or made homeless as a result of these disasters.

Construction of high-rise buildings currently makes use of cutting-edge materials and technologies, including reinforced concrete, steel, glass, and even carbon-fiber composites. Building Information Modeling (BIM) and modular construction are only two examples of the advanced building technologies that have completely changed the manner that these types of structures are constructed.

High-rise structures continue to push the boundaries of architectural design, despite the fact that utility and sustainability are vital aspects of building design. The Lokhandwala Minerva in Mumbai, India and the Shanghai Tower in China are two examples of iconic buildings that have pushed the envelope in terms of what is feasible in terms of shape and aesthetics.

The vitality and aspirations of urban life in the 21st century is reflected in the high-rise skyscrapers that stand as testaments to human ingenuity. They were once seen as symbols of corporate dominance, but today they are important parts of environmentally responsible urban development. As the population of our cities continues to increase, high-rise structures will play an increasingly important part in

meeting the difficulties of urbanization and environmental sustainability while at the same time providing us with living and working places that are both functional and visually beautiful. The design of high-rise buildings in the future contains the potential for even more radical innovation, not to mention seamless incorporation into our existing cityscapes.

### Conflict of Interest

There is no conflict of interest by the authors in this manuscript.

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