

A Comprehensive Survey of Multistory Building Design, Construction, and Performance

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Abstract

In the life cycle of multistory buildings, design, construction, and performance emerge as pivotal components that not only shape urban landscapes but also respond to the escalating needs of contemporary societies. This comprehensive survey navigates the intricate dynamics of multistory buildings, offering insights into the evolution of design philosophies, innovative construction methodologies, and their consequential impact on building performance. Design stands as the initial cornerstone, with an evolution that mirrors societal shifts, technological advancements, and architectural aspirations. From historical marvels like the Roman Colosseum to the contemporary fusion of aesthetics, functionality, and sustainability facilitated by computer-aided design (CAD), the design philosophy of multistory buildings has adapted to the changing tapestry of human needs and capabilities.

Construction, the subsequent stage, witnesses a transformative journey marked by traditional methods, the advent of steel and reinforced concrete, and the contemporary rise of prefabrication and modular construction. This evolution not only enhances structural integrity but also addresses the pressing demands for cost-effectiveness and time efficiency in the construction process. The final chapter, performance, unfolds as a crucial assessment of structural integrity, sustainability, and occupant well-being. Multistory buildings, strategically positioned as solutions to urbanization challenges, incorporate advanced technologies and sustainable practices. The evaluation encompasses not only the building's ability to withstand external forces but also its contribution to energy efficiency, environmental sustainability, and the overall comfort and well-being of its occupants. As we traverse this comprehensive survey, the aim is to unravel the intricate interplay of design, construction, and performance that defines the dynamic narrative of multistory buildings. Each aspect plays a synergistic role, collectively contributing to the resilience, efficiency, and adaptability of these structures in the ever-evolving urban landscape.

Keywords: Multistory Buildings, Design Evolution, Construction Techniques, Building Performance, Urbanization Challenges.

1. Introduction

For centuries, multistory buildings have been integral components of urban development, serving as enduring symbols of the interwoven dynamics between societal requirements, technological advancements, and architectural ambitions. This comprehensive survey seeks to delve into the nuanced realm of multistory buildings, unraveling the multifaceted layers of design intricacies, construction methodologies, and performance assessments that define their existence.

The historical tapestry of multistory buildings showcases a captivating evolution, mirroring the progression of engineering ingenuity alongside the shifting sands of societal norms. From the awe-inspiring structures of ancient civilizations, such as the Roman Colosseum, to the soaring Gothic cathedrals of medieval times, each era has etched its unique narrative into the architectural landscape. These historical marvels not only bear witness to the engineering prowess of their time but also encapsulate the functional demands and cultural nuances that shaped their existence.

In the contemporary milieu, multistory buildings epitomize a harmonious fusion of aesthetics, functionality, and sustainability. The advent of computer-aided design (CAD) has ushered in a new era, empowering architects to sculpt intricate structures with meticulous attention to efficiency, safety, and environmental impact. This modern design paradigm transcends mere construction; it transforms buildings into living entities that respond dynamically to the needs of the present while laying the foundation for a sustainable future. As we navigate through this survey, we aim to unravel the intricate web that binds together the diverse facets of multistory buildings. From the drawing boards of architects to the construction sites and the ultimate performance evaluations, each phase contributes to the narrative of these structures that stand tall as both artifacts of history and beacons of the future.

2. Design Evolution

2.1 Historical Perspectives

The journey of multistory building design is a captivating narrative that mirrors the ebb and flow of engineering ingenuity alongside the evolving tapestry of

societal norms. From the grandeur of the Roman Colosseum to the soaring spires of Gothic cathedrals, each epoch has woven its unique thread into the fabric of architectural evolution. These historical structures not only bear witness to engineering prowess but also reflect the functional demands and cultural nuances of their times.

2.2 Modern Design Paradigms

Contemporary multistory buildings epitomize a harmonious fusion of aesthetics, functionality, and sustainability. The advent of computer-aided design (CAD) has ushered in a revolution, empowering architects to craft intricate structures with meticulous attention to efficiency, safety, and environmental impact. This modern design era encapsulates a dynamic approach, where buildings are not mere structures but living entities responding to the needs of the present while laying the foundation for a sustainable future.

3. Construction Methodologies

3.1 Traditional Construction Techniques

Throughout history, multistory buildings primarily relied on traditional construction methods such as masonry and timber framing. These age-old techniques were the backbone of early construction endeavors. However, the landscape underwent a transformative shift with the introduction of steel framing in the 19th century and the subsequent evolution of reinforced concrete. These innovations marked crucial milestones, enabling the construction of taller and more resilient structures.

3.2 Innovative Construction Materials

The 20th century witnessed a surge in innovative construction materials, propelling the industry forward. Precast concrete, composite materials, and advanced steel alloys emerged as key players. These materials not only enhance structural integrity but also contribute to faster construction timelines and increased sustainability. The advent of innovative materials has opened up new possibilities in architectural design and construction practices.

3.3 Prefabrication and Modular Construction

In recent years, prefabrication and modular construction have risen to prominence, offering cost-effective and time-efficient alternatives to traditional methods. This approach involves constructing building components off-site, minimizing on-site construction time, reducing waste, and allowing for greater precision in assembling components. Prefabrication and modular construction have become vital contributors to modern construction practices.

4. Performance Evaluation

4.1 Structural Integrity and Safety

Ensuring the structural integrity and safety of multistory buildings is of paramount importance. Advanced structural analysis tools, such as finite element analysis (FEA) and performance-based design approaches, empower engineers to assess and optimize building structures for various loads, including seismic and wind forces. This ensures that buildings meet rigorous safety standards. Multistory buildings play a pivotal role in addressing urbanization challenges and environmental sustainability. Incorporating energy-efficient design principles, renewable energy sources, and sustainable construction practices is essential to reducing the environmental footprint of these structures. This aligns with the growing global emphasis on eco-friendly building practices.

The performance of multistory buildings extends beyond structural considerations to encompass occupant comfort and well-being. Factors like indoor air quality, natural light penetration, and acoustics significantly impact the overall experience of building occupants. Modern construction practices prioritize creating spaces that promote a healthy and comfortable environment for those who live and work within these structures.

5. Challenges and Future Trends

5.1 Urbanization Challenges

Rapid urbanization poses significant challenges related to the effective use of space, increased demands on infrastructure, and environmental consequences. The sheer influx of people into urban areas strains existing resources and necessitates innovative solutions. Multistory buildings, due to their vertical design, emerge as a strategic response to these challenges. By maximizing land use efficiency, they provide a means to accommodate the growing need for both residential and commercial spaces in a sustainable manner.

5.2 Technological Integration

The integration of cutting-edge technologies is revolutionizing the landscape of multistory building design and operation. Emerging technologies such as Building Information Modeling (BIM), Internet of Things (IoT), and smart building systems are at the forefront of this transformation. BIM facilitates a comprehensive and collaborative approach to design and construction, enhancing efficiency and reducing errors. IoT enables real-time monitoring and control of building systems, optimizing operational performance. Smart building systems, through automation and data-driven

insights, contribute to lower operational costs and an overall improvement in building functionality.

5.3 Sustainability Imperative

In the face of global environmental concerns, the imperative for sustainability is shaping the future of multistory building design and construction. This shift involves a commitment to eco-friendly materials, energy-efficient systems, and a holistic approach to minimize the environmental impact of buildings. The use of sustainable materials ensures responsible resource utilization, while energy-efficient systems contribute to reduced carbon footprints. Achieving net-zero or positive environmental impacts becomes a core objective, reflecting a broader commitment to creating buildings that not only meet human needs but also contribute positively to the surrounding environment. The journey of multistory buildings from historical marvels to modern urban landscapes is a testament to human ingenuity and the evolving needs of society. The integration of cutting-edge design philosophies, construction methodologies, and performance evaluation techniques positions multistory buildings as not just structures but as integral components in the sustainable and resilient development of our cities. This comprehensive survey serves as a guide to understanding the multifaceted world of multistory buildings and anticipates the continued evolution of these architectural marvels in the years to come.

6. Conclusion

In conclusion, these papers encapsulate the evolving research landscape focused on the seismic performance of multistory buildings with underground multiple storey's parking and shear walls. Several studies emphasize that shear walls, while not impeding the vertical load resistance in reinforced concrete structures, significantly influence the lateral load resistance due to their inherent stiffness and mass.

The findings consistently reveal that the incorporation of shear walls results in reduced deflection at different levels compared to RC buildings without shear walls. Researchers concur that providing shear walls to high-rise structures not only impacts seismic behavior but also enhances structural stiffness and strength. However, these conclusions warrant further exploration, underscoring the need for ongoing research to pinpoint the ideal locations for shear walls, thereby advancing our understanding of how to optimize building stability in seismic conditions. This synthesis of research insights calls for continued efforts to refine seismic design practices and contribute to the robustness and resilience of multistorey structures.

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