

Seismic Response Mitigation in High-Rise Structures Through Tuned Mass Dampers and Base Isolation: A State-of-the-Art Review

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Abstract: *The construction of high-rise buildings (HRBs) has surged in recent years due to population growth, limited residential space, and the scarcity of suitable land for development. Simultaneously, industrial activities such as excavation, mining, and blasting have contributed to increased seismic activity, making HRBs more vulnerable to earthquakes. The rising frequency of seismic events has underscored the urgent need for efficient strategies to enhance the seismic performance of tall structures. This review presents a comprehensive analysis of recent advancements in seismic control techniques, with a focus on Tuned Mass Dampers (TMDs) and Base Isolation (BI) systems. It explores their fundamental principles, design considerations, and comparative effectiveness in mitigating seismic responses such as displacement, inter-story drift, and base shear. Special emphasis is placed on the emerging hybrid approach that integrates TMDs with BI systems to achieve enhanced energy dissipation and structural flexibility. Various configurations of these systems are evaluated using the Response Spectrum method, demonstrating their potential to significantly improve structural safety and occupant comfort while minimizing repair costs and downtime. The review also highlights existing challenges, research gaps, and future directions, aiming to guide the development of more resilient and adaptable high-rise buildings in seismically active regions.*

Keywords: *Tuned mass damper, Base Isolation system, ETABs, Vibration control System*

