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Improved Seismic Response of Buildings with Enhanced ADAS Damper Configurations

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Introduction

In the face of frequent seismic activity worldwide, the resilience of structural systems has become a focal point in earthquake engineering. Among the many passive energy dissipation devices used to enhance structural performance during seismic events, Added Damping and Stiffness (ADAS) dampers have gained significant attention. These devices are strategically placed within a building's frame to dissipate energy through controlled plastic deformation, effectively reducing inter-story drift and base shear. However, conventional ADAS dampers often introduce unintended axial forces that compromise their effectiveness and increase demand on connected structural members. Recent advancements have proposed modifications to the classic ADAS configuration, aiming to improve energy dissipation while eliminating the drawbacks of axial loading. This paper explores how these enhanced ADAS damper designs significantly contribute to improved seismic response in buildings [1].

Description

Modified ADAS dampers are designed to maintain the characteristic stable hysteretic behavior of their conventional counterparts while addressing limitations such as induced axial forces and lack of design flexibility. One innovative approach involves decoupling the axial force components by reshaping the damper geometry and optimizing its load path. This ensures that the energy dissipation occurs primarily through flexural yielding, reducing the chances of axial compression or tension that can adversely affect beam-column joints and brace connections. Enhanced configurations also include symmetric arrangements of the X-shaped yielding plates, which provide more uniform deformation and better energy dissipation under cyclic lateral loads. These configurations have been validated through extensive experimental testing and numerical simulations, showing greater ductility, enhanced hysteretic energy dissipation capacity and improved post-yield stiffness compared to traditional ADAS systems.

Furthermore, when integrated into building frames, the enhanced dampers contribute to superior seismic performance metrics. Simulation results from nonlinear time-history analyses indicate that structures equipped with these improved devices exhibit lower peak story drifts, reduced residual displacements and more controlled deformation patterns. This translates into not only safer buildings during earthquakes but also lower repair costs and quicker post-event functionality. The improved dampers also demonstrate greater reusability potential, as their plastic deformation is better confined and distributed, allowing for predictable damage localization. Their application is particularly beneficial in retrofitting older buildings or in new constructions situated in high-seismic-risk zones where performance-based design is emphasized [2].

Conclusion

The development and integration of enhanced ADAS damper configurations mark a pivotal advancement in passive seismic control systems. By mitigating the issue of axial force transmission and optimizing energy dissipation mechanisms, these modified devices offer an effective solution for improving the seismic resilience of buildings. Their performance benefits are clearly evident in reduced structural demands, improved deformation control and enhanced safety outcomes. As seismic design continues to evolve toward more efficient and damage-tolerant strategies, the role of such optimized damping systems will become increasingly critical in shaping the next generation of earthquake-resistant infrastructure.

Acknowledgement

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Conflict of Interest

None.

References

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