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Tesis

Analysis and Optimization of Tuned Mass Dampers for Seismic Resilience in 5- to 20-Story Buildings

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Abstract Seismic movement in various regions of the world, especially in those located in areas of high tectonic activity such as the Pacific Ring of Fire, has resulted in considerable damage to infrastructure and significant human losses. In South America, particularly in Peru, this high seismic vulnerability has been a constant concern. In response to this global issue, the present study focused on investigating the effectiveness of Tuned Mass Dampers (TMD) to mitigate seismic effects in buildings of various heights. A comprehensive analysis of building models spanning heights from 5 to 20 stories was carried out, evaluating variations in key parameters such as drifts and accelerations under different percentages of mass in the TMD, ranging from 1% to 10% of the total building weight, supported by advanced computational analysis using specialized software such as ETABS. The results obtained revealed that the optimum mass percentages for TMD varied significantly depending on the height of the building. In taller buildings, specifically 15 and 20 stories, an improved structural response was observed when using 10% mass in the TMD, achieving considerable reductions in drifts and accelerations. In contrast, for buildings of lower height (5 and 10 stories), 5% mass in the TMD proved to be adequate to improve structural behavior without compromising its effectiveness. In conclusion, this study emphasizes the need to tailor the design and implementation of TMD according to the specific characteristics of each building to optimize their effectiveness in seismic risk mitigation. These findings provide a solid foundation for future research and practical applications in the field of earthquake engineering, underscoring the importance of meticulously considering the particular conditions of each structure when implementing vibration control devices such as TMD.

Keywords Tuned Mass, Damping, Stiffness, Floor Drifts, Accelerations

1. Introduction

The global seismic movement was attributed to the location of several regions in areas of high tectonic activity, such as the Pacific Ring of Fire. These areas are known for intense tectonic activity resulting from the interaction between different tectonic plates. This seismic vulnerability resulted in significant damage to the built heritage in multiple countries, causing considerable economic losses [1], [2]. In 2007, Peru was shaken by a 7.9 Mw magnitude earthquake, which resulted in the death of 600 people and left 2000 people injured. This event also caused severe damage to infrastructure, including water facilities, sewage systems and schools. According to the report of the Geophysical Institute of Peru (IGP) in 2008, 52,154 houses were destroyed, 23,632 were severely damaged and 116,706 suffered minor damage [3], [4]. These data underscore the urgent need to analyze and improve housing structures in Peru, where it is estimated that 80% of buildings are self-constructed, which makes