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EXPERIMENTAL INVESTIGATION OF PASSIVE TUNED MASS DAMPER AND FLUID VISCOUS DAMPER ON A SLENDER TWO DIMENSION STEEL FRAME

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To my beloved mother and father

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ABSTRACT

Vibration is a serious concern for tall buildings added to a natural disaster such as earthquake, wind storms, sea waves and hurricanes. The risk of occurrence of structural damage can be decreased by using a controlled vibration system to increase the damping characteristics of a structure. Damping is defined as the ability of the structure to dissipate a portion of the energy released during a dynamic loading event. The aims of this study are (1) to investigate a 4-storey 2D steel frame retrofit with tuned mass damper to reduce its vibration as well as compare the results with response displacement of the structure using viscous damper. In this project, the focus is limited to present an experimental model with semi-rigid connections and to show its validity by comparing the experimental results (achieved from shaking table test) with the analytical results obtained from theoretical model (SAP2000 software), (2) to demonstrate the performance of such a damper when fitted to a structure by analysis and tests the models and (3) comparison the dynamic responses of the structure in three verify of: a) using passive tuned mass damper, b) using viscous damper and c) using the combination of these two damping devices. Therefore, a series of shaking table tests of the 4-storey 2D steel frame $(scale{:}\frac{1}{4})$ with and without passive tuned mass damper (PTMD) and viscous damper (VD) was carried out to evaluate the performance of the buildings. The results of the experimental tests illustrate that damping devices decrease the structural responses of slender frame on shaking table. In addition, effectiveness of passive tuned mass damper is greater than viscous damper.

ABSTRAK

Getaran adalah satu kebimbangan yang serius untuk bangunan tinggi ditambah kepada bencana alam seperti gempa bumi , ribut angin, ombak laut dan ribut taufan. Risiko berlakunya kerosakan struktur boleh dikurangkan dengan menggunakan sistem kawalan getaran untuk meningkatkan ciri-ciri redaman struktur. Redaman ditakrifkan sebagai keupayaan struktur untuk menghilangkan sebahagian daripada tenaga yang dibebaskan semasa acara muatan dinamik. Tujuan kajian ini ialah (1) untuk menyiasat bingkai keluli (4 tingkat) 2D yang diselaras dengan peredam untuk mengurangkan getaran. Ia membandingkan keputusan anjakan bebas struktur dengan struktur diperkuat degan menggunakan redaman likat. Dalam projek ini , sambungan separa tegar diguna pada ujian dengan keputusan analisis yang diperolehi daripada model teori (perisian SAP2000) , (2) untuk menunjukkan prestasi peredam yang dipasang pada struktur dengan analisis dan (3) perbandingan respons dinamik struktur dalam tiga keadaan : a) peredam massa pasif ditala, b) yang menggunakan peredam likat dan c) menggunakan gabungan kedua-dua peranti peredam. Oleh itu , satu siri ujian kerangka 4 tingkat kerangka keluli 2D (skala : 1/ 4) tanpa peredam massa pasif (PTMD) dan peredam likat (VD) telah dijalankan untuk menilai prestasi kerangka. Keputusan ujian uji kaji menunjukkan bahawa peranti redaman mengurangkan tindak balas struktur di atas meja getaran. Di samping itu, keberkesanan peredam massa pasif ditala adalah lebih besar daripada peredam likat.