The Effects of Tuned Mass Dampers on a Structure's Earthquake Resistance

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The purpose of this experiment was to determine the effect of tuned mass dampers (TMDs) on a structure’s earthquake resistance, while also working to optimize the position and weight of the damper in reducing the displacement range. The hypothesis was if the damper had a ratio of 10% of weight to total building weight and was placed closer towards the top, then the displacement range would be most reduced. The project involved using a shaking simulator to optimize the effectiveness of TMDs. Structures were then made of wooden craft sticks with cross-braces and connected with hot glue. These wood structures were too rigid to observe any data; thus, five new structures were built of metal bars aligned in the same direction to observe change in displacement percentages with dampers. One structure was the control while the other four were weighed for 10%, 20%, 30%, and 40% of their respective structure weights to create dampers hung from the structure. each were then shaken for two trials of about 150 RPM and two for 100 RPM, one minute per trial. The control had the most displacement and permanent damage to the structure. The 10% damper was then tested and had a sufficiently reduced displacement range. The 20% damper followed proving the displacement could be reduced further. There was a negative effect of lowering the damper to the middle, greatly increasing the displacement range. 30% and 40% damper weights were then tested and both significantly improved stability; however, the 40% damper weight broke off from the wire because its weight could not be supported. The advantage of tuned mass dampers for this research diminishes past 30%. Statistical Analysis showed the data to be significant in improving stability. The hypothesis was not supported by the data.