

2012/13 Undergraduate Research Grant Scheme – Executive Summary

Project title:

Seismic rocking of flexible structures provided with a Sloshing Liquid Damper (SLD)

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Project summary:

It has been identified that there is a lack in current research that explains the effects of combining a Sloshing Liquid Damper (SLD) with a structure permitted to uplift when exposed to seismic excitations. Therefore an experimental study was conducted on a small-scale model to assess the singular and coupled effects of the two systems.

The experimental setup was designed to allow the assessment of the model in a fixed configuration (no uplift) or in a rocking configuration (uplift is permitted); with or without the SLD. The structures stiffness was varied to assess how flexibility of the system altered the response, in conjunction with the SLD. The outcomes of the experiments for the singular systems showed good correlation with previous literature, validating the setup.

Due to the complexity of rocking dynamics, the stability of the combined system was assessed using pulse-type ground motions, creating overturning spectra with the experimental results. Further testing was conducted using a recorded accelerogram, but it should be noted that the results obtained from such tests should be treated with caution as they strongly depend on the frequency content and amplitude of the input.

The results obtained for the rocking base with the application of the SLD suggest that combination of the two provides advantages in increasing the overturning stability of the structure when exposed to near source earthquakes, and also presents the possibility of reducing the number of impacts experienced during rocking. These results imply that structures could be designed to resist multiple seismic events requiring fewer repairs when compared to conventionally designed systems, limiting excessive deformation and rotation of the structure if a tuned SLD is installed. However, due to the complex nonlinearity of rocking dynamics, further research should be undertaken to confirm and build upon these findings.