Comparison of passive and active mitigation devices for vibrations control in slender structures.

Álvaro Magdaleno*, José M. Soria†, Emiliano Pereira‡, Iván M. Díaz† and Antolín Lorenzana†

*ITAP, Universidad de Valladolid.
Paseo del Cauce 59, 47011 Valladolid, Spain
E-mail: alvaro.magdaleno@uva.es, ali@eii.uva.es, web page: https://www.stopgroup.uva.es/

† ETS Ingenieros de Caminos, Canales y Puertos.
Universidad Politécnica de Madrid. 28040, Madrid, Spain.
E-mail: jm.soria@upm.es, ivan.munoz@upm.es

‡ Escuela Politécnica Superior.
Universidad de Alcalá de Henares. 28805, Alcalá de Henares, Spain.
E-mail: emiliano.pereira@uah.es

ABSTRACT

Several engineering structures can exhibit vibration problems that need to be mitigated. For vibrations under 10 Hz (typical in slender structures) the problem can be addressed using passive or active approaches. Assuming that the structure cannot be stiffened (nor additional supports neither bracings) the only solution is to act on it inertially. Among the possible inertial systems, TMDs (tuned mass dampers) or AMDs (active mass dampers) are well known. The TMDs are passive systems consisting of a moving mass linked to a mounting frame by guides, springs and dampers, the frame being rigidly attached to a point of the structure. The AMDs are actuators capable of accelerating a heavy slider according to the corresponding signals from a microcontroller, which depend on some input records (usually via accelerometers). This active system, in addition to the moving mass, is composed of the corresponding power equipment and mounting frame.

An experimental comparison is presented, and its corresponding computational simulation applied to a specific lab-scale structure. The structure consists of a cantilever model whose first mode is at 2 Hz, having a modal mass of 1.8 Kg and with 0.2% structural damping. Both TMD and AMD devices will be installed on it. Both will have a moving mass of 10% of the modal mass.

In the TMD, the moving mass is attached to the free end of a slender plate acting as a bending spring. The other end is attached to its rigid frame, which is directly bolted to the model. Damping is induced through permanent magnets that move in front of an aluminium plate. The relative movement between them induces magnetic fields that oppose to the movement of the mass, resulting in a simple system that can be modelled just like a viscous damping device.

The AMD consists on the stator and the slider of a linear motor. The corresponding driver and power supply are installed in the lower part of the model.

Both systems will undergo two types of loads. First, the structure is moved from its equilibrium position and then released. The performance of each device is evaluated in terms of the time free oscillations take to return to rest (with acceleration within a thin band). Secondly, the maximum displacements in both systems will be measured when they are installed on a shaking table.

Conclusions about the efficiency of the proposed mitigation devices will be analysed from the engineering and economic point of view.

REFERENCES

[1] C. Casado, I.M. Munoz, J. Sebastian, A. Poncela and A. Lorenzana, “Implementation of passive and active vibration control on an in-service footbridge”, *Struct. Control Health Monit.*, Vol. **20**, pp. 70–87, (2013). 10.1002/stc.47