# Vibration Absorber for Stay-Cables

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## Summary

The new device works like an impact damper, embedded inside the stay-cable in order to decrease the dynamic “hazards” in various cable eigenmodes. Vienna University of Technology has developed a method to increase the structural damping of stay cables. Advantages in regard to conventional dampers are the simple and robust technology and the fact that all components required for the new method are located inside the structural components (cables). In full scale field tests on stay cables with a length of 31,2 m the damping ratio of a conventional stay cable and a stay cable equipped with the damping system could be compared.

**Keywords:** stay-cable, impact damper, mechanical model, non-linear dynamics, field test, wind-rain induced vibration

## 1. Introduction

From the middle ages on, many researchers have studied the behavior of stay-cables, from Leonardo da Vinci to Stevin to Galileo. The principle of the theory of a swinging catenary or string can be applied in many fields e.g. in the worlds of music, physics and engineering. Irvine studied the sageffects of stay cables for static and dynamic behaviors where he introduced a parameter which considers the geometric and elastic relation [1]. Due to the slenderness of cables, which makes them prone to vibrate, many solutions were formulated to mitigate these vibrations. Often during the construction process, or for permanent conditions, the cables have been interconnected to reduce the sags and to stiffen the cables in order to change the eigenfrequencies of each rope. The so called structural control of vibration is an effective system, but from a designing point of view it is not always desirable and sufficiently sustainable considering the lifespan of a bridge. Nowadays, the most common system used is to place a transverse damper with viscoelastic or friction properties near the anchorage between the stay cables and the bridge deck. Active or semi-active dampers can be used which deliver good mitigation results as well [2]. The disadvantages are that they are expensive, maintenance intensive and do not meet aesthetic requirements.

## 2. Description of the damping system

The new method works like a vibration absorber attached along the whole stay cable in order to decrease the dynamic hazards in various eigenfrequencies. It is a kind of a tuned mass damper which was studied by Den Hartog and, in its simplest form; it can be modeled as a secondary mass-spring dashpot attached to the cable [3]. The stay cable can be modeled as single degree of freedom. Kovacs mentions in his paper that a punctual tuned mass damper attached to a stay cable could increase the damping ratio user-defined, but the technical realization seems tricky [4]. A more precise approach could be to have a taut cable with a multipendulum attached along the cable. The impulses of the impact damper lead to a momentum transfer on one side and due to friction, energy

https://doi.org/10.2749/222137912805110835
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