Vibration Control of Stay Cables

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Abstract

During the recent past years several analyses have been conducted dealing with the vibration characteristics of stay cables. The fundamental theories as well as the fundamental behaviour of various types of cables have been developed. At the same time, various remedies and vibration control devices were proposed by contractors and suppliers.

This paper reviews the previously used systems and presents the up-to-date technology which is available today. It covers the streamline sheath coping with the rain and wind vibration phenomena, the internal or external hydraulic dampers, the visco-elastic dampers and the damping cross ropes. Calculations of the damping system characteristics, prediction and measurement of the damping ratio are presented.

1. Introduction

Cable vibrations can be excited by dynamic wind forces acting directly on the cable itself or by the movements of the cable attachments on the pylon or on the deck due to the action of traffic loads or of the wind itself. Four different sources of vibrations are considered in the analysis :

- parametric excitation by the movements of the pylons and the deck ;
- rain and wind vibration ;
- low wind dry vortex ;
- galloping.

2. Damping technologies

2.1 Damping ropes

The natural frequency of the stays can be modified by means of transversal cables connected to them. This solution which is effective although expensive and delicate to install has been used for some large bridges. It is recommended when the vibration frequencies of the deck or pylon are close to the frequencies of the stay cables.

2.2 External hydraulic damper

This damper is specifically designed to each project. The damping capacity can be tuned to obtain the required logarithmic decrement. However it requires a regular maintenance and it is not always meeting the aesthetics objective of the designer.

2.3 Internal visco-elastic damper (IED) and Internal hydraulic damper (IHD)

This damper is completely invisible from the deck since it is located inside the steel guide pipe of the stay cable.

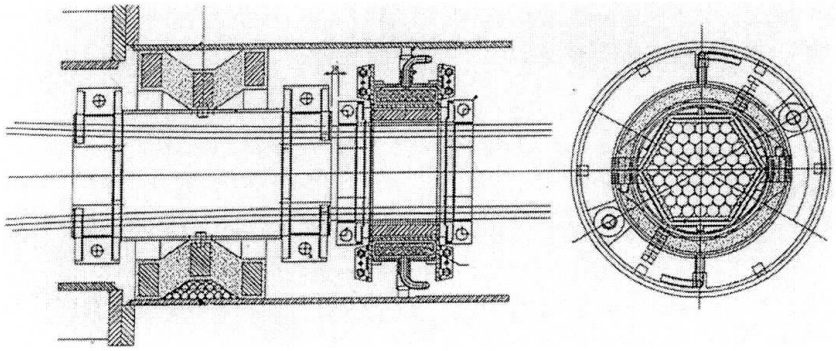
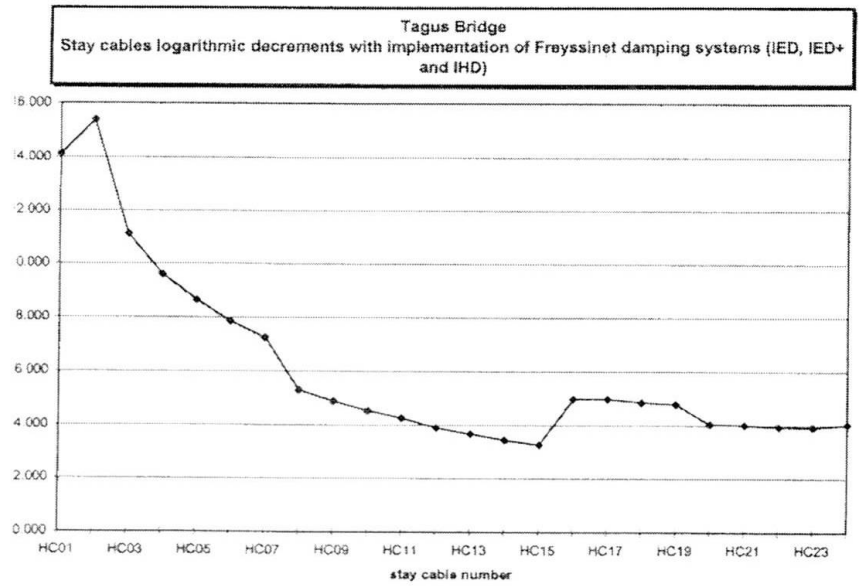


Figure 1

3. Vibration control

Calculation models have been developed to evaluate the logarithmic decrement δ provided by the various types of damping systems. A universal damping surface has been established allowing an accurate tuning of the damper.



Tagus bridge Lisbon (Portugal)