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Parameter analysis of a Hungarian developed „Stockbridge damper”

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Nowadays, in line with technological advances and societal demands, slender, lightweight steel structures are becoming increasingly common in all areas of building industry, including bridges too. One of the key issues in the design of this type of structure is the analysis of the dynamic behaviour, with a particular focus on the vibrations generated by pedestrians. In many cases, to achieve the level of pedestrian comfort required by the client, it is necessary to install damping devices afterwards. These can be very diverse, but it is common practice in Hungary to use products available on the international market, and there have been no developments in Hungary in this area in the past.

It was also necessary to install cable damping elements in the case of the Osztósziget cable-stayed bridge of the Budapest Athletics Stadium project, but these were entirely of the „Stockbridge damper” type, developed and manufactured in Hungary, in cooperation with Acélhidak Kft, the Department of Structural Engineering of BME, Hídépítő Zrt. and Speciálterv Építőmérnöki Kft.

Already at an early stage of the design it was shown that the effectiveness of the damper is influenced by a number of parameters (type, length and nominal diameter of the messenger cable; mass of the damper, positioning of the device on the cables, etc.), the extent and exact nature of which were not available in the literature for the present geometry. The main objective of my research is the parameter analysis of the developed „Stockbridge damper”, i.e. to analyse which free input data and in which way they influence the efficiency and applicability of the element, thus facilitating the adaptation of the product to other bridge structures and supporting further domestic developments in this field.

To this end, in the first part of my thesis, I briefly described the principle of operation of the „Stockbridge damper” family of damping devices and reviewed the most important results of the international literature on the design and efficiency of this type of devices. On this basis, I developed two types of finite element models for parameter analysis. One is an exact body element local model, which I used to determine the natural frequency of the damper. The other one is a global model (based on the example of the Osztósziget cable-stayed bridge) to study the combined behaviour of the damper and the cable system. The selected parameter set was investigated using numerical simulations on these two models, supported by additional laboratory measurements.