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A SIMPLIFIED DYNAMIC ANALYSIS OF EXISTING PEDESTRIAN BRIDGES, A POSSIBILITY TO GET NEW EXPERIENCE FOR DESIGNING

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Summary

Technology gives us new instruments that can help us in our daily work. There is a rapid development of different kinds of sensors used in buildings, bridges, towers and other structures. These sensors can help us gather much information from our existing structures, which gives us the possibility to use a large amount of data obtained from real structures to evaluate our theoretical models used in the design and refine them.

In the topic of pedestrian bridges, it is interesting to evaluate their dynamic properties since they are sensible to the dynamic vertical and horizontal loads from people. The fundamental data for the dynamic behaviour of a pedestrian bridge are the eigenfrequencies, which can be obtained easily using an accelerometer. Today there is almost always one available since the mobile phones are equipped with them. With an application, it is easy to obtain the fundamental vibration frequency for a bridge and it is also possible to analyse the higher vibration modes in a frequency spectrum. Furthermore, it is easy to obtain a measurement of acceleration in the time domain from walking or running. Also the damping has a very important effect on the vibration level, and it can also be evaluated with measurements.

This tool can be used for evaluating a similar structure as the one to be designed and it could provide us with valuable insight in the dynamic behaviour of the structure. This paper presents some examples, where the theoretical results from models are compared with measurements of the finished bridges. The results from measurements are validated with a simple, well known structure.

Keywords: Pedestrian bridge; dynamics; vertical vibration; measurements; response; comfort; sensors; damping; eigenfrequency; experimental validation.

1. Introduction

The aim of this paper is to analyse results from measurements of some different kinds of pedestrian bridges and make a comparison with the theoretical design parameters.

One of the driving parameters in the design phase is the comfort criteria regarding vertical and horizontal vibrations. The focus in this paper is regarding vertical vibrations which normally can be controlled to a level where they are hardly appreciable. In some cases the vibrations become clearly noticeable leading sometimes to necessary arrangements with dampers.

Since there are uncertainties in the parameters affecting the dynamic behaviour of the bridge, it is not always clear when it is necessary to provide a solution mitigating the vibrations. The most important parameters affecting the vibration level are the damping, the eigenfrequencies and the mass. The two first parameters are difficult to predict with sufficient precision in the design phase, and a damping solution is prepared when it is considered to be necessary. In some cases the dampers are not installed, when measurements of the finished structure show that they are not needed since the damping and the eigenfrequencies differ from the theoretical design model.

More information from measurements of finished structures give valuable experience and insight that can be used in the design work of new structures.

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