DYNAMIC CHARACTERISTICS OF MEDIUM SPAN TRUSS, CABLE-STAYED AND SUSPENSION STEEL FOOTBRIDGES UNDER HUMAN-INDUCED EXCITATION

Marek PAŃTAK
PhD
Cracow University of Technology
Cracow, Poland
mpantak@pk.edu.pl

Summary

In the paper results of dynamic in-situ tests of six medium span steel footbridges are presented. The dynamic response of tested footbridges under human excitation (running and jumping) as well as dynamic characteristics of the footbridges are given and discussed. Furthermore, the case of the influence of slow running users (jogging users) on comfort of use of medium span steel footbridges and evaluation of vibration comfort criteria of the footbridges are presented.

Keywords: footbridge; dynamics; vibrations; comfort criteria; response; damping; running.

1. Introduction

As a result of using of new high strength structural materials contemporary footbridges are characterized by small cross sectional dimensions and long spans. Mass and stiffness of the structures are decreased. In many cases the vibration damping capacity is strongly reduced. The structures become susceptible to various dynamic actions. Fundamental vibration frequency of the lightweight and slender footbridges often appear in frequency range of human actions. It can be already observed in case of small and medium span steel footbridges. In some cases, fulfilment of the serviceability limit state (i.e. vibration comfort criteria) of these footbridges can be problematic. Special attention should be paid to slow running users in frequency range 2.10 - 2.70 Hz.

2. Characteristics of Analysed Footbridges

General views and cross-sections of six steel lightweight footbridges analysed in the paper are presented in Figs 1 and 2. Footbridges are grouped in pairs with similar structural solutions.

All analysed footbridges are characterized by simply structural solutions and lightweight. Its cross-sections are composed of steel pipes, hot-rolled profiles and steel sheet covered by thin epoxy resin coating (3-6 mm) or asphalt pavement (3-6 cm).

a) Osjaków footbridge, spatial truss beam, (2x50.0 m)

b) Sławięcice footbridge, spatial truss beam, (44.7 m)

Fig. 1 General views of analysed footbridges