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DLMs FOR PEDESTRIAN VIBRATION CONTROL ON BRIDGES

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SUMMARY

The development of new materials and construction techniques enables engineers to build innovative structures, which become more and more slender and lighter. Light and slender footbridges are prone to vibrate when subjected to dynamic loads, especially to pedestrian dynamic loads. To build the structural model for checking the vibration serviceability of a footbridge, beside the footbridge properties, the designer need to know the loading models (dynamic load models - DLMs). This paper presents the review of DLMs for assessment of acceleration due pedestrian loading that designers can use to their advantage in bridge design.

Keywords: *Pedestrian bridge, vibration serviceability, dynamic load model.*

1. INTRODUCTION

Although there is a lot of dynamic load models (DLMs) for the serviceability state verification in relation with vibration defined through the past few decades none of them were implemented in the European code EN 1991-2 for traffic loads on bridges [1]. The dynamic models of pedestrian loads, according to EN 1991-2, may be defined in the National Annex or for the individual project. Unfortunately, many European countries did not define DLMs in their National Annexes (e.g. Croatia [2], Romania [3], Germany [4], Austria [5], Bulgaria [6] and Italy [7]). Besides, parts of Eurocodes relating to the design of bridges [8-10] do not define DLMs although EN 1995-2 [10] defines simplified procedures for acceleration determination on simple bridge structures.

Shortcomings listed above puts the designer to challenge the selection of appropriate dynamic load model(s) to evaluate the maximum acceleration of the bridge structure due to pedestrian traffic.

2. DYNAMIC LOAD MODELS

In general, a bridge may be loaded by single pedestrian, different groups of pedestrians and continuous pedestrian streams in his service life.

Dynamic load models (DLMs) are deterministically obtained models that attempt to describe, as accurately as possible, the effects of human walking over the footbridges. Time domain models are the most common models used and they are based on the assumption that both human feet produce exactly the same force. DLMs for group or stream of pedestrians are based on single pedestrian DLM.

The dynamic forces induced by one pedestrian are generated by the movement of the body mass and the put-down, rolling and push-off of the feet. This forces are called human ground reaction forces and can be expressed as three-dimensional force. The magnitudes of the vertical and longitudinal forces mainly depend on the person's step frequency and body weight. Their periodicity is related to the step frequency. The lateral component is caused by the movement of the centre of gravity from one foot to the other. The oscillating motion of the centre of gravity introduces a dynamic force with half the walking frequency. The resulting force is periodic and can be represented by Fourier series [11]:

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