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INVESTIGATION OF THE DYNAMIC BEHAVIOUR OF STRESS-RIBBON FOOTBRIDGES UNDER PEDESTRIAN ACTIONS

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Stress-ribbon footbridges are slender structures consisting of cables with a catenary layout embedded in a relatively thin concrete deck made of permanent formwork and in-situ concrete or fully precast segments (see Fig. 1 and Fig. 2). Stress-ribbon footbridges promote the axial behaviour and allow designers to take advantage of the entire sectional areas reducing the required construction materials. In addition to their high structural efficiency and sustainability, they also possess a number of other advantages such as lightness, relatively easy construction possibilities, strong aesthetic characteristics with small impact to the landscape and minimum maintenance requirements. As a result, they present an attractive proposal for covering medium to large spans in urban and remote places. Whilst currently the structural behaviour of stress-ribbon footbridges has been investigated, more attention has been paid on their static response. Nevertheless, their dynamic response under pedestrian actions is more critical for their design, as significant vibrations can be generated during service compromising users' comfort.

This paper presents a detailed investigation of a benchmark stress-ribbon footbridge under dynamic pedestrian actions. A modal analysis has been performed first, followed by a full time-history dynamic analysis under the action of a stochastic pedestrian load model. The influence of geometric and material non-linearity in the dynamic response has been examined. Results show that inclusion of geometric non-linearity affects significantly the stiffness of the bridge and consequently it is important for predicting its dynamic behaviour. On the other hand, material non-linearity, to account for the effects of concrete cracking at the supports, has minor influence on the dynamic response. Finally, based on a parametric study it was found that, increasing the concrete slab's depth is an effective way of reducing vibrations and increase comfort for the bridge users.

Fig. 1. Lignon Loex footbridge, Switzerland [1]

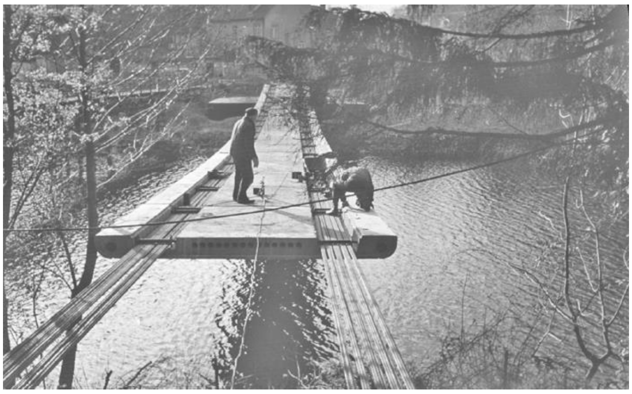

Fig. 2. DS-L footbridge, Czech Republic [1]

References

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