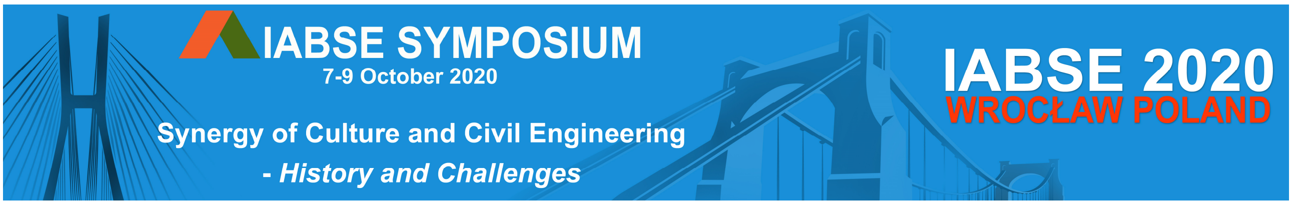

COMPARISON OF THE STRUCTURAL BEHAVIOUR BETWEEN UNDER-DECK CABLE-STAYED AND UNDER-DECK SUSPENSION FOOTBRIDGES UNDER PEDESTRIAN ACTION

K. Georgiadis[1], A. M. Ruiz-Teran[1], P. J. Stafford[1]

[1]Imperial College, Faculty of Civil and Environmental Engineering, London, UK.

e-mail: kg112@imperial.ac.uk, a.ruiz-teran@imperial.ac.uk, p.stafford@imperial.ac.uk

---

SUMMARY

Under-deck cable-stayed (UDCS) and under-deck suspension (UDS) footbridges are slender structures supported by cables located below the deck and, despite the similarities in their appearance, they represent two different engineering concepts. In the present work, their structural behaviour has been investigated in detail and their response under static and dynamic pedestrian loading has been compared. A static analysis has been conducted first. Then a modal analysis has been performed, followed by a full time-history dynamic analysis under the action of a stochastic pedestrian load model. The influence of geometric non-linearity in both static and dynamic analyses has been examined. Results show that although the bending moments and deflections in UDS footbridges are smaller compared to UDCS footbridges, the level of accelerations, which is the governing design criterion for the bridge deck in order to satisfy comfort, is similar.

Keywords: *Dynamic Response, Footbridges, Non-linear, Pedestrian Loading, Static Response.*

1. INTRODUCTION

Under-deck cable-stayed (UDCS) and under-deck suspension (UDS) footbridges are slender structures that promote the axial behaviour and possess a number of advantages such as high efficiency, multiple construction possibilities and strong aesthetic characteristics. They consist of cables which are located underneath the deck and are deviated with the aid of struts. In the former the cables are pre-stressed and self-anchored on the deck, whereas in the later the cables are not pre-stressed and anchored at the abutments (see Fig. 1).

Fig. 1. *Amanenomori footbridge, Japan [1] on the left and Zourhaven footbridge, Netherlands [2] on the right.*

Although the similarities in their appearance, they represent two separate engineering concepts with different structural behaviours. In UDCS bridges the loads are transferred from the deck through the struts to the cables and ultimately to the supports. As the cables are self-anchored to the deck, only vertical reactions are transferred to the ground. The struts work mainly under compression, the cables under tension, whereas the

https://doi.org/10.2749/wroclaw.2020.0765
Distributed by structurae