Experimental and numerical analysis on dynamic responses of UHPC cable-stayed pedestrian bridge

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Summary

The first cable-stayed pedestrian bridge using ultra-high performance concrete (UHPC) has been designed and constructed in Korea, and this bridge was equipped with TMD(Tuned mass damper) to reduce excessive vibration and increase serviceability. To validate the performance of the TMD, a number of experimental human loading tests and corresponding numerical simulations were performed. Explicit dynamic code, LS-DYNA was utilized to simulate the experimental tests, using a wheel with 6-shoes designed to mimic a pedestrian's walk or run. Through the experimental and numerical investigation, reduction of peak acceleration and increase of damping ratio is confirmed as expected. In this paper, procedures and results of numerical simulation is presented and compared with experimental results.

Keywords: ultra high performance concrete, cable stayed bridge, vibration control, TMD, numerical simulation

1. Introduction

UHPC has been developed to overcome shortcomings of ordinary concrete using steel fiber and composite materials resulting in ultra-high compressive strength and ductility, together with improved tensile strength, flexural strength, shear strength, resistance against fracture and impact loading. UHPC was first commercialized by Ductal of France and KICT developed its own product, K-UHPC recently, which has the minimum compressive strength of 150MPa and bisecting tensile strength of 5Mpa. The water-cement ratio is below 0.24 and more than 2% (volume) of reinforcing fibers are included.

The bride in KICT is a cable stayed pedestrian bridge and the upper part of the main girder is made of K-UHPC [1]. An excessive vibration of the main structure was previously investigated [2], thus, a TMD was installed as a passive vibration control system [3]. This study verifies the reduction of vibration magnitude by numerical analyses.

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