Seismic performance of robotic bridge using scissors system

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ABSTRACT

In recent years, the world has seen several types of natural disasters that have caused many critical situations in the lives of people by damage of an infrastructure. It is important to rebuild the damaged traffic routes immediately in such serious situations in order to facilitate quick relief and restoration activities.

This paper presents a dynamic analysis of robotic emergency bridge, called Mobile Bridge, which can be quickly constructed in case of damage after a natural disaster. The concept of the bridge is based on the application of a scissor mechanism, which enables its rapid deployment. During the deployment phase, the bridge is supported only at one end resulting in cantilever boundary conditions. Once deployed, the bridge has two supports hence the deployed, second condition is the simply supported beam case, where the supports have horizontal and vertical displacement constraint. After finishing construction, the pedestrian bridge is set on the upper decks aligned at the line of top hinges.

In the case of deployable structures as well as the static analysis of different configurations of expansion, it is important to investigate dynamic behaviour of the system. The high compliance and flexibility of the scissors type bridge may influence the comfort and safety of users in case of heavy dynamic loads such as human induced impacts, wind gusts, or earthquakes.

The presented research deals with fundamental numerical and experimental results to clear dynamics of the Mobile Bridge based on the experimental pedestrian bridge. From the point of using the Mobile Bridge in disaster area, it is needed to clear dynamic behaviour. Therefore, numerical simulation included both eigenvalue and seismic response analysis and experimental testing by acceleration measurements in free and forced loading conditions was performed. From these results, it was possible to estimate basic mechanical characteristics of dynamic properties of the bridge. The conducted research allows for better and safer design of the structure of the Mobile Bridge.

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