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Numerical Study of Train-Bridge Interaction System for Shinkansen Viaducts

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High-speed railway system response under strong earthquakes

【Background】

As we knows, Japan is a country prone to frequent earthquakes. High-speed railway systems are also facing potential risks of suffering from strong earthquakes, which may cause derailment or bridge collapse accidents. Till now, quite few researches have been made considering both strong earthquake sand large-mass trains' combined effect on bridges. In order to ensure the safety of viaducts, it is necessary to investigate the train-bridge interaction system response under strong earthquakes.

【Objective】

The most significant characteristic for viaducts under strong earthquakes is the material nonlinearity. And the research can be divided into elastic phase and elastoplastic phase. The first step in this research is to develop an available method and validate the elastic phase analysis result.

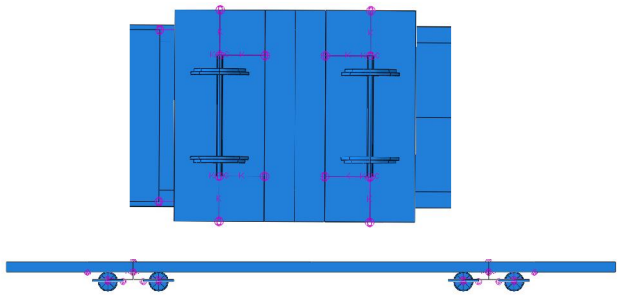
【Approach】

Finite element method is applied to make the investigation. It includes two main parts: model simulation and solving dynamic equations. The commercial software ABAQUS is utilized to do these work. A finite element train-bridge interaction model has been built. HHT-α method and Newton-Raphson method are used to solve dynamic equations. In this way, we can get the time-history response of this system.

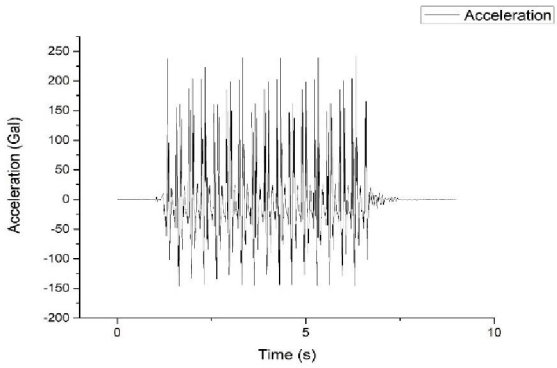
【Publication 】

【Result】

One typical Shinkansen train (16 vehicles) passes a 3-block bridge with the speed 270km/h within 7 seconds. The simulation has been completed. The result matches well with the test data. This approach has been validated.



Vehicle model in ABAQUS



Acceleration time history of one test point