July 10, 2020

RTRI Develops On-Board Measurement Method to Identify Resonant Bridges

Railway Technical Research Institute developed a method to identify resonant bridges that vibrate intensely due to resonance using the data measured by running trains. This method has enabled to save the labor required for ground measurement and made possible more efficient inspections.

[Overview]

Usually, while a Shinkansen train passes on a bridge, downward displacement occurs due to the moving train load. In the meantime, due to the aging of bridges and increased train speeds, some of the bridges resonate with the vibrations of the running train and the bridge vibrations increase with train passing. [Fig. 1(b)] Since large amplitude resonance affects ride comfort and durability of facilities, preventive measures may be needed. Therefore, it has been necessary to identify bridges that resonate with passing trains (resonant bridges) among a vast number of bridges.

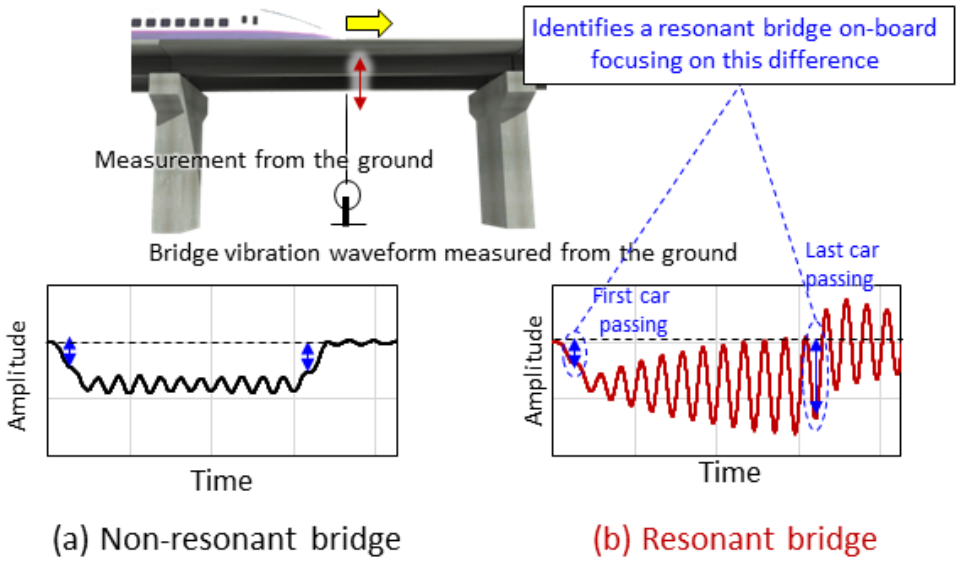

Fig.1 Vibration waveforms of ordinary (non-resonant) bridges and resonant bridges

In order to solve this problem, RTRI developed a new method marked by the following two points:

- The vibration data measured on the passing train includes vibrational components specific to the resonant bridges. We have been able to identify resonant bridges by focusing the differences between these vibrational components measured by the first car and the last one. (Fig.2) Prior to the development of this method, it has been necessary to mount one sensor to each bridge and to measure the vibration amplitude of each bridge from the

ground. The newly-developed method has made it possible to measure the entire area that a train runs through and therefore the workload can be greatly reduced.

- This method can be easily introduced to bridge inspections by using the data of the existing track maintenance database system (LABOCS).

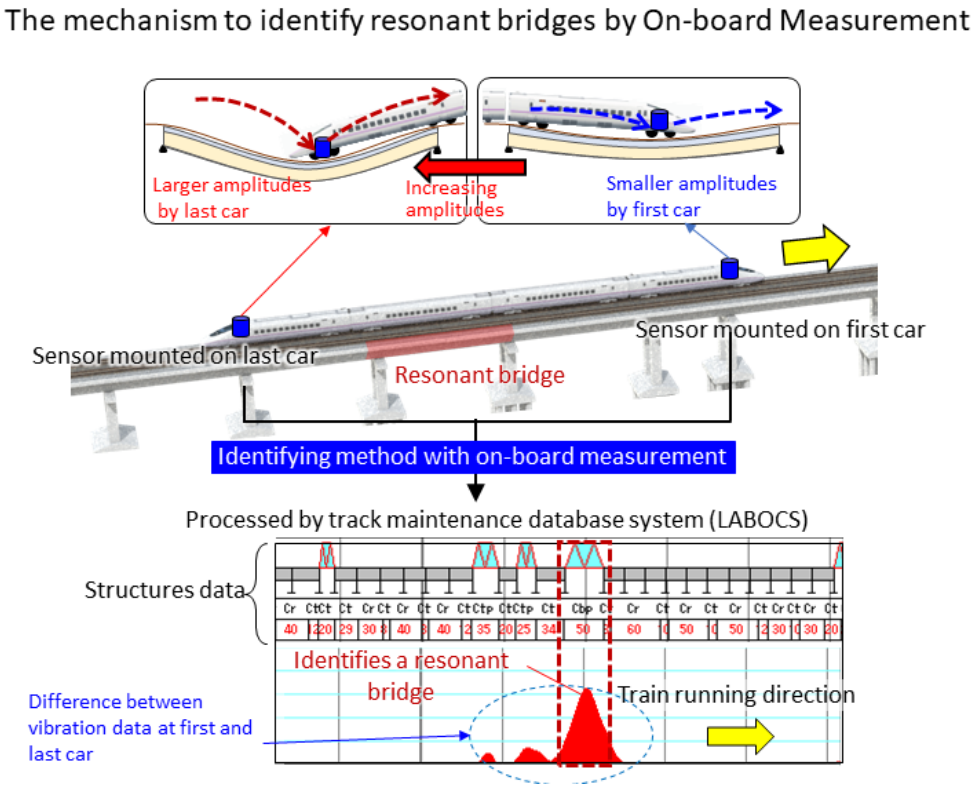

Fig. 2 The method to identify bridges that vibrates intensely using on-board measurement

[Using the method for effective maintenance]

This method has already been used on the Shinkansen track and 10 resonant bridges have been identified. The results help determine the priority in inspecting bridge facilities and enhance the efficiency of maintenance.

Going forward, it is expected as well that this method will be used to evaluate impacts of train speed increase on bridges and their facilities and to determine the necessity of introducing any measures.

***1 Resonance**

Resonance occurs when difference between the frequencies of bridge vibrations cause by a passing train and the natural frequency of the bridge gets smaller.

***2 LABOCS**

A software that analyzes and processes a wide variety of data including the track irregularity and vehicle vibrations. This software was developed by RTRI and used by 6 JR passenger rail companies and other railway operators for the track condition monitoring and maintenance.