

Impact absorbing damper to suppress bridge vibration at joints

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Summary

Noise and vibration emit when a large lorry passes the expansion joints on road bridges, causing serious environmental problems. Field measurements were conducted on the road bridge, showing that the dominant frequency was 13.3Hz when vehicles ran over the joints. A new type of damper, the impact absorbing damper based on momentum exchanging mechanism, has been proposed to suppress the vibration occurred at the expansion joints. This damper system consists of the contact device between the RC slab and the additional mass with springs and oil dampers. When the vehicle wheel hits the expansion joints, the impact force is directly transferred to the attached mass through the contact device due to the momentum exchanging property, and then the energy produced by impact forces are dissipated by the oil dampers. Parametric experimental studies were conducted using a model consisting of the damper system and the RC slab which was impacted by a free-fall weight. The tests show optimum values of consisting elements of this damping system, such as materials of the contact device, mass ratio of the additional mass, damping ratio, spring constants and impact forces. Then, the impact absorbing dampers were installed in an actual bridge, and its suppression effect was measured. The model and field tests show that the new damper system is feasible and effective in reducing the vibration and noise levels.

Keywords: road bridge; expansion joints; vibration; noise; impact absorbing dampers; momentum exchanging damper; field measurements.

1. Introduction

Noise and vibration emit when large vehicles pass the expansion joints on road bridges. They may cause serious environmental problems to nearby habitants such as vibrations of houses or low-frequency noise [1]. This vibration caused at the joints has an impact kind of property and the dominant frequency is between 10 Hz and 40 Hz.

It is not easy to suppress this kind of impact force and no effective counter measure has been established yet. In this paper a new type of damper, the impact absorbing damper based on momentum exchanging mechanism [2], has been proposed to suppress the vibration occurred when vehicles run over the expansion joints. This damper system consists of the contact device between the RC slab and the additional mass with springs and oil dampers. When the vehicle wheel hits the expansion joints, the impact force is directly transferred to the attached mass through the contact device due to momentum exchanging property, and then the energy produced by impact forces are dissipated by the oil dampers.

Parametric experimental studies are conducted using a model consisting of the damper system and the RC slab which is impacted by a free-fall weight. The tests are expected to provide optimum values of the elements of this damping system, such as materials of the contact device, mass ratio of the added mass, damping values, spring constants and impact forces. Then, the impact absorbing dampers are installed in an actual bridge, and its suppression effect is measured.