ABSTRACT

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Title: Analytical Study on Suppression of Vortex Induced Vibration of Bridges by Separated Flow Control

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Abstract

Vortex-induced vibration (VIV) is one of the aerodynamic vibration phenomena of bridges. VIV is restricted vibration that occurs with peak amplitude in a restricted range of wind velocity. VIV is important for the fatigue strength and serviceability of bridges.

There are a lot of constraints to take measures against VIV without impairing the function of bridges. Installation of the aerodynamic appendage is most applicable for both existing bridges and newly constructed bridges. However, the effective position and the adequate size are difficult to determine. This requires trial and error approach by the wind tunnel tests, as the mechanism on suppression of VIV with the appendage is not elucidated sufficiently.

The author focused on an experimental fact that the VIV occurred in the box girder bridge section was suppressed with a vertical plate attached only to the bottom plate. This thesis discusses the suppression mechanism of VIV through the two-dimensional computational fluid dynamics (CFD).

This thesis revealed that the main mechanisms on suppression of VIV were disappearance of periodicity of lift component in the space below the girder, and decreasing separation angle and reattachment on the wake side promoted by secondary vortices. These secondary vortices were formed on the rear side or both the front and rear sides of the vertical plate by the vibration of the section.

Heaving response on VIV had a tendency depending on the height of the plate regardless of the horizontal location. The preferable height of the plate was equal to the average height of the shear layer of a fixed section without an appendage. The results indicated that the CFD on the fixed section was applicable to examine the measures against dynamic phenomenon of VIV. This thesis showed the way to examine wind-resistance measures numerically before the wind tunnel tests.