Control of Vortex Induced Oscillation of Bridge Girders by Separated Flow Control

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Vortex excited oscillations appearing at bridge sections and other bluff bodies are mainly caused by unsteady separated flow from the leading edges. If the separated flow from the leading edge is controlled, vortex oscillation may be suppressed. This study investigates the possibility of suppressing flow-induced vibration for rectangular cylinder and bridge girder by using acoustic excitation, aerodynamic appendages and periodic suction-blowing at the leading edges.

The sound excitation is applied at the leading edges of a cylinder by speakers placed outside wind tunnel. The sound emits from inside of cylinder excites at the leading edges. The shear flow around the cylinder is improved by using sound excitation to control the boundary layer. A free spring mounted model and a forced oscillatory model were used for experimental study. For investigating the effect of sound excitation, the measurement of surface pressures was carried out in addition to flow visualization. The experimental results show that when there is a sound excitation with a specific frequency, the vibration amplitude of the cylinder was suppressed completely.

The main idea of second method is the improvement of shear flow around the girder by using special devices to control the separated shear layer. These devices are attached to the girder near the leading edge and have influences on the separated shear flow. The stabilizing appendages such as semi-circular rod, circular rod, thin plate and vortex generator sheet were used in this study. The flow visualization experiment was also conducted to investigate the influence of these devices to the shear layer of a bridge girder.

With third method, energy from approach flow is transmitted to the leading edges of a box girder for producing a blowing excitation at low frequencies. This blowing excitation at different frequencies is produced by a system using motor. In addition, a cylinder piston is also used to produce a periodic suction and blowing at the leading edges. The frequency of this exciting method can be adjusted in this study. Response and pressure measurements are also used to examine the effect of this suction and blowing excitation. The results show that periodic excitation by using piston has good effect on suppressing the oscillation.