Effects on Vortex Shedding of Bridges with Rotatable Wind Fence

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Summary

Vortex shedding related with strouhal number cause to make inconvenience and fatigue problem. To improve these problems, rotatable wind fence is adopted. Rotatable wind fence breaks repeating of vortices caused by the unsteady separation of flow of a fluid around bridge girders. Rotatable wind fence works for reducing amplitude of vortex shedding.

Keywords: rotatable wind fence; vortex shedding; strouhal number; dynamic instability.

1. Introduction

Steel-Composite Cable Stayed Bridges with edge girders which have rectangular section have disadvantage on vortex shedding. Vortex shedding related with strouhal number cause to make inconvenience and fatigue problem. To improve these problems, systematic and geometrical approaches are used. Specifically, it can enhance dynamic stability to change frequency ratio of vertical and torsional first mode and to convert I girder into box girder. However, those trials have limitation because of space constraints. That is, if girder has specific width and height, position of cable anchor of girders can almost not be movable. In addition to this, dramatic change of girder's shape can cause economical problems. Wind fences are fixed member which prevents direct damage from wind but cause bridges to be heavily loaded by wind. In this study, rotatable wind fence is adopted for separating fluid. Rotatable wind fence works for breaking vortex shedding without any change of shape of girder and whole system. Rotational frequency of wind fence has influences on fluid separation tendency. Several types of spring are used to make fences which have various frequencies. Dynamic test are conducted in Wind Tunnel of Korea University. In this test, IFSS (Independent frictionless spring-support system) of 2DOF which has vertical and torsional direction is used to find change of vortex shedding effects. Dynamic test about vertical displacement and rotation angle are conducted from -5 to 5 degrees in test section.

2. Instability of Aerodynamics

2.1 Strouhal Number

Strouhal number (S_t) is a dimensionless number describing oscillation flow mechanisms.

$$S_t = \frac{fB}{U} \quad (1)$$

where, f is the frequency of vortex shedding, B is the characteristic length (width of cross section) and U is the upstream of x component velocity.

As showing Eq. (1), Strouhal number is related with velocity to induce instability of aerodynamics and frequency of repeating of fluids. In other words, if periodic action can be broken, dynamic stability is to be enhanced.

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