

A Fundamental Study on Wind Resistant Design for Bridges using Computational Fluid Dynamics

Hidesaku Uejima

In this study, a numerical analytical approach for evaluating aerodynamic responses of bridges is presented. Computational fluid dynamics (CFD) based on unsteady RANS is introduced to predict unsteady aerodynamic force properties of bridge decks. The primary findings in this study are as follows;

- (1) In order to estimate the flutter resistant performance of long-span bridge employing the box-girder, flutter derivatives under heaving and pitching motion are predicted by two-dimensional CFD. The present method can estimate the flutter velocity with satisfactory accuracy of the model bridge which has simplified mono-boxed girder and twin-boxed girder if angle of attack of incoming flow is small.
- (2) The present method will be effective to evaluate the dependence of Reynolds Number on unsteady aerodynamic force properties of bridge decks. Reynolds Number problem is one of difficult tasks for wind tunnel test to solve. Therefore, the present method will be a useful tool which complements the weakness of wind tunnel test.
- (3) An estimation method of aerodynamic admittances of bridge decks using the two-dimensional CFD is introduced. The calculated gust response amplitude using the aerodynamic admittance obtained by CFD is 50% above the experimental result.
- (4) The separation bubble formed on the upper and lower sides due to vertical fluctuation of incoming flow tends to be more intensive in two-dimensional turbulent flow than in three-dimensional one. Then the aerodynamic admittance obtained by the presented method tends to be larger than that in natural wind flow. It is important to take account the fact that the difference leads to the overestimate of the response amplitude as mentioned in (4).