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Study on flow structures affecting vehicle running stability on bridge deck under strong cross wind

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ABSTRACT

Vehicle overturning accidents on a bridge often happen during strong crosswinds. In order to prevent such accidents, a bridge operator imposes some traffic regulations such as speed limit or bridge closure. Besides, safety measures such as a windshield are installed in some cases. In case of long-span bridges, a windshield is difficult to install for the entire span because it decreases aerodynamic stability. However, some recent bridges installed a windshield with keeping enough aerodynamic stability. In order to enhance vehicle running stability against strong crosswinds, in any case understanding of the flow structures on a bridge deck is necessary. Then, an optimum windshield having high aerodynamic performance can be developed. In this study, targeting typical bridge decks of truss and closed box, flow structures on the bridge decks are investigated by wind-tunnel experiment first. Then, optimum shape and dimensions of a windshield are investigated with respect to the reduction of crosswind on the bridge deck and wind-induced vibration. In addition, PIV tests are conducted to understand flow fields around the bridge deck.

Keywords: Crosswind, bridge deck, vehicle running stability, windshield

1 INTRODUCTION

Vehicle overturning accidents on a bridge often happen during strong crosswinds (see Fig. 1. In order to prevent such accidents, a bridge operator imposes some traffic regulations such as speed limit or bridge closure. For example, a speed limit regulation is issued when a 10-minute mean wind speed exceeds 15m/s and the bridge is closed when the mean wind speed exceeds 25m/s in the case of Honshu-shikoku Bridges in Japan. However, it is very difficult to evaluate accurate crosswind speed at different traffic lanes and bridge spanwise locations. Therefore, in order to enhance traffic safety on a bridge deck and issue effective traffic regulations, understanding of wind fields on the bridge deck due to strong crosswinds is necessary. Besides, in order to enhance the traffic safety further, installing safety measures such as a windshield to protect traffic from the crosswind is another option.