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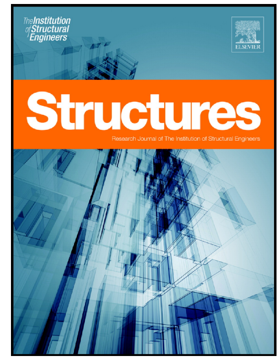

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Influence of Separation Interference Method on aerodynamic responses of a pentagonal shaped bridge deck

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Abstract: Long-span bridges often exhibit vibration under wind action. Various aerodynamic countermeasures have been developed over the years to enhance the aeroelastic responses of the long-span bridge deck and Separation Interference Method (SIM) is one of these. Engineers should have sound knowledge about the flow mechanism of the aerodynamic countermeasures of the bridge deck for further improvement of the aerodynamic responses and better design of the bridge deck. In the present study, a numerical investigation was carried out to disclose the flow mechanism of SIM on a pentagonal bridge deck. Simulation was conducted by using unsteady RANS for a pentagonal bridge deck with and without SIM techniques and their aerodynamic responses were compared. In the first part performance of unsteady RANS was evaluated to predict the dynamic responses for a pentagonal bridge deck. Then, the steady state responses and flow fields were explored for a bridge deck with and without SIM. Later, the dynamic responses such as flutter derivatives and unsteady pressure characteristics were evaluated and compared. It was found that SIM can improve the aerodynamic responses of the bridge deck. The addition of the curb affected the flow field around the bridge deck and the important flow features noticeably. The leading-edge top and bottom surface separations and the trailing-edge bottom surface separation are the most significant flow features to control both the steady state and dynamics responses of the bridge deck.

Keywords: Pentagonal bridge deck; Separation Interface Method; Unsteady RANS; Force coefficients; Flutter derivatives; aerodynamic damping

1. INTRODUCTION

Cable-stayed and suspension bridges are two common forms for long-span bridges. The deck of these bridges often exhibit instability against wind such as vortex-shedding vibration and flutter instability. Engineers adopt both aerodynamic and structural measures to improve the aerodynamic behavior and suppress the vibration. Aerodynamic countermeasures are more attractive to the engineers as it is less expensive and requires less maintenance compared to the structural countermeasures. Common aerodynamic countermeasures are fairing, flap and skirt etc. However, for each of these counter