# Flutter Behavior and Stability Evaluation of Suspended Footbridge through Wind Tunnel Experiments and Aeroelastic Flutter Analysis

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## Abstract

Suspended footbridges are set apart by being much more lightweight and slender compared to conventional highway bridges. For this reason, the stiffness and damping of the bridge system are significantly lower, causing an outsized influence of wind load. Therefore, a precise evaluation must be performed to secure the wind stability of the suspended footbridge. However, design specifications are not documented, and reported studies are insufficient. In this study, a conventional 2-DOF section model test was conducted to estimate the flutter wind velocity of the suspended footbridge and observe the flutter behavior. Frequency domain step-by-step flutter analysis was performed to identify the flutter generation mechanism of examined suspended footbridge. It was deduced that the decrease of torsional damping due to the torsional-driven vertical vibration and coupled aeroelastic force induced the torsional flutter.

**Keywords:** suspended footbridge; flutter stability; section model test; aeroelastic flutter analysis; flutter behavior.

## 1 Introduction

Suspended footbridges are gaining interest worldwide with rising demand for their construction. In particular, the title for the longest suspended footbridge is in fierce competition to promote local tourism. The suspended footbridge is a highly flexible structure because the deck contributes little to the rigidity of the structural system, and the main cable supports the entire bridge. As an indicator of flexibility, the aspect ratio, the main span length/width ratio, can be used [1]. The 516 Arouca Bridge of Portugal, the world's longest suspended footbridge built in 2020, is 516.5 m long and 2.1 m wide, with an aspect ratio of 246 [2]. It is significantly higher than the aspect ratio of 45 of the world's longest suspension bridge span of the 1915 Çanakkale Bridge. It can be seen that the suspended footbridge is a much more flexible structure than the conventional highway bridge. The slenderness and lightweight characteristics of suspended footbridges cause the vibration response induced by dynamic loads to occur relatively larger than highway bridges [3-5]. In particular, flutter instability is an important structural problem that must be resolved at the design stage due to suspended footbridges being mainly installed in mountainous or coastal terrain

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