# Wind-Resistant Measures of the Busan~Geoje Fixed Link Bridges during Construction

**Young-Min KIM**
Senior Researcher
Daewoo E&C, Co., Ltd.
Suwon, Korea
*ymkim@daewooenc.com*

**Sang-Kyoon JEONG**
Manager
Daewoo E&C, Co., Ltd.
Seoul, Korea
*sangkyoon.jeong@daewooenc.com*

**Seok-Jun JOO**
Director
TE Solution Co., Ltd.
Anseong, Korea
*sjjoo@tesolution.com*

## Summary

In general, temporary tied-down cables are used on cable stayed bridges during construction for stabilization when subjected to wind loads. However, the system requires temporary concrete blocks or pile foundation. Thus, tied-down cable systems are an expensive temporary method and have the potential of causing environment pollution problems; furthermore, the system may interrupt the route of ships or induce collisions.

Tuned mass damper (TMD) system is proposed to cable stayed bridges or similar structures to supress wind-induced vibrations and ensure aerodynamic stability. TMD systems are more economical and workable in comparison with the temporary tied-down cables. TMD is shown to be the most efficient solution to bridge stabilization during construction when subjected to wind loads.

**Keywords:** vibration control; temporary tied-down cables; tuned mass damper (TMD); cable-stayed bridge; wind tunnel test.

## 1. Introduction

Structures experience deformations caused by self-weight or external excitation, and these deformations can be classified into two categories: static deformation independent of time, dynamic deformation including time-variant vibration induced by dynamic wind or earthquake loads. Small vibration of the structure can deteriorate the serviceability or workability rather than stability; however, large vibration could damage the structure causing serious stability problems. The ISO criterion of the design criteria of each country limits the vibration of the structure to a reasonable level to guarantee stability and serviceability of the structure.

The Busan-Geoje fixed link bridges were found to be vulnerable to dynamic wind loads from the wind tunnel test results and dynamic analyses. Especially during the 96% construction stage (prior to key segment connection), the dynamic properties of the bridge could be most vulnerable to dynamic wind loads. When a structure is subjected to a typhoon during construction, the bridge could experience overload above the design criteria. Remedial measures must be provided to reduce dynamic wind loads or wind-induced vibrations.

Wind tunnel tests and dynamic analyses showed that temporary tied-down cables (wind-resistant cables) are an effective temporary stabilizing measure for bridges. However, difficulty arises when installing the temporary tied-down cable system. Therefore, a TMD was considered and proposed as an alternative measure to the wind-resistant cables.

## 2. Busan~Geoje Fixed Link Case Study

The Busan~Geoje fixed link is a major infrastructure developed in the south-eastern part of Korea. The link provides easy access between Busan metropolitan and Geoje Island. The 8.2km long Busan~Geoje fixed link consists of three main elements: two cable stayed bridges (Lot 1 and Lot 2) and a 3.7km long immersed tunnel (Lot 3). In addition, roads and bored tunnels are provided on the two intermediate islands to connect the main elements as well as a toll station and buildings for operation and maintenance.

Computational Fluid Dynamics (CFD) analysis was carried out to determine structural performance when subjected to wind load in the design phase. A wind analysis program was used to obtain aerodynamic properties (drag, lift, moment) for application, and the calculated wind load was used

https://doi.org/10.2749/222137912805110970