

Stabilizing Measures of the BGFL Bridge during Construction by TMD

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Summary

In general, the stabilizing measures by temporary tied-down cables during typhoon are used to the free cantilever construction for a cable stayed bridge. However, it needs temporary concrete blocks or pile foundations to rest on 30m deep sea in the Busan~Goeje fixed link (BGFL) site. Thus it is a very expensive temporary method and could cause an environmental pollution problem to dredge the ground in the sea. Moreover, it could disturb the route of the ships or induce ship collisions.

A TMD (Tuned Mass Damper) is proposed to the three-pylon cable stayed bridge during construction to suppress the wind-induced vibrations and ensure the aerodynamic stability. The stabilizing measures by TMD do not need any foundations. Thus it could solve the environmental problem and avoid the risk of the ship collisions induced by the temporary cables. In addition, it is more economical in comparison with the temporary tied-down cables.

Keywords: stabilizing measures; temporary tied-down cables; free cantilever construction; cable stayed bridge; TMD (Tuned Mass Damper); wind-induced vibrations; typhoon.

1. Introduction

Any structure could experience the deformations caused by self-weight or external excitation. These deformations can be classified into two categories. One is the static deformation independent of time, and the other is the dynamic deformation including the time-variant vibration induced by dynamic wind or earthquake loads. The dynamic deformation, that is vibration, is directly related to the dynamic loads and therefore could be controlled to reduce the dynamic loads.

The small vibration of the structure can deteriorate the habitability or workability rather than stability. However, the large vibration could damage the structure causing the serious stability problem. The ISO criterion or the design criteria of each country limits the vibration of the structure below a reasonable level to guarantee the stability and the serviceability of the structure.

The Busan-Geoje fixed link bridges were found to be susceptible to dynamic wind loads from the results of the wind tunnel test and the dynamic analyses. Especially during the 96% construction stage just before the connection of the key segment, the dynamic characteristics of the bridge could be the most vulnerable to the dynamic wind loads. When typhoon comes during construction, the bridge could experience the overload above the design criteria specified for the completed bridge. It is necessary to provide the remedial measures to reduce the dynamic wind loads or the wind induced vibrations.

Temporary tied-down cables (wind-resistant cables) were investigated to be an effective temporary stabilizing measure for the bridges through the wind tunnel test and the dynamic analyses. However, it also has the difficulties in construction of anchor blocks, cable tensioning, and ensuring clearance of ships. Thus a tuned mass damper (TMD) is considered and proposed as an alternative measure to the wind-resistant cables. So far TMD has been successfully applied to lots of skyscrapers and long span bridges in the world.