Design Assisted By Wind Tunnel Testing

Massimo MAJOWIECKI
Professor
IUAV University
Venice, Italy
massimo.majowiecki@majowiecki.com

Nicola COSENTINO
Civil Engineer
Bologna, Italy
cosentino@astens.com

Summary

According to principle of the “design assisted by testing”, contemplated by the Eurocode, the combination of tests and calculations is increasingly used. The motivation of this increasing interest-demand are various: from the sophisticated architectural shapes to the absence of corresponding reliable fluid-dynamics models, from the increasing flexibility of structures to the necessity of checking complex aeroelastic phenomena.

The purpose of the paper is to outline the potentiality of wind tunnel testing and the main problems encountered in their use. These aspects have to be accurately evaluated in defining the tests specifications. The use of some data analysis techniques (such as the proper orthogonal decomposition, the sensibility analysis, etc.), in keeping the essential design parameters, is presented too.

Keywords: design assisted by testing, wind tunnel testing, test specification, aerodynamic behaviour, aeroelastic behaviour.

1. Introduction

The paper presents some of the recent experiences in wind tunnel testing, made by the Authors within the design stage of steel structures. According to principle of the “design assisted by testing”, contemplated by the Eurocode, the combination of tests and calculations is increasingly used. Multiples are the motivation of this increasing interest/demand. The sophisticated architectural shapes (culminating in the “free form design”), the absence of corresponding reliable fluid-dynamics models and the increasing flexibility of structures are probably the main ones. Not less important is the opportunity/necessity to confirm by control checks the assumptions made in the design, specially with respect to complex aeroelastic phenomena, such as the lock-in, the flutter, the rain-wind induced vibration, etc..

The main purpose of the paper is to outline the potentiality of the presented tests and the main problems encountered in their use. These aspects have to be accurately evaluated in defining the tests specifications. The use of some data analysis techniques (such as the proper orthogonal decomposition, the sensibility analysis, etc.), in keeping the essential design parameters, is presented too.

The presented experiences are relative to the tests performed during the design of: a cable stayed bridge on the Adige river (on the A31 motorway - Italy); the New Braga Stadium (Braga - Portugal); the new Unipol headquarter Tower (Bologna - Italy); the new Bologna town-hall (Bologna - Italy).

2. The Adige River Bridge

The design of the Adige river cable stayed bridge was assisted by wind tunnel tests aimed to check the aerodynamic and the aeroelastic behaviour of the deck and of the tower. The tests were carried out at the “Politecnico di Milano” boundary layer wind tunnel (Fig. 1).

https://doi.org/10.2749/222137810796025627