



Effect of Terrain Conditions on the Along-wind Response of Tall Buildings

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Abstract

Rapid population growth leads to tall buildings construction, so it is necessary to study effective parameters on tall structures behavior against wind pressure. Wind speed changes, structures' damping and terrain conditions are effective on structure's aerodynamic behavior. In this paper, using Computational Fluid Dynamics (CFD), Computational Structural Dynamics (CSD) and Commonwealth Advisory Aeronautical Council (CAARC) tall building model, impact of mentioned factors on wind- structure interaction is investigated. Several 3D standard models are generated using ABAQUS finite element software. Next, wind profile is modeled using power law. Flow turbulence is simulated by Implicit Large Eddy Simulation (ILES) method and co- simulation method is used to transfer non- uniform loads from fluid to structural domain. Structural damping is determined by Rayleigh method. Results show that denser terrain around the structure change wind velocity profile at height and decreases maximum displacements and stresses in upper and lower parts of structure.

Key words: CAARC, implicit large eddy simulation, aerodynamic, aero- elastic

1.Introduction

In current societies, due to rapid growth of large cities' population, space limitation, as well as socioeconomic factors, tall buildings construction has grown considerably, which has caused important consequences for different aspects of human life, such as weather conditions, the environment, health conditions and safety of structures [1, 2]. According to the mentioned issues, the study of tall structures under the wind influence is necessary to ensure the safety and well-being of residents [3]. The pressure and suction resulted from the wind is kind of random loading that depends on various parameters such as structural shape, structural dimensions, terrain conditions, and architectural and structural characteristics of the building [4]. If structure is surrounded by other high-rise buildings, the wind speed will increase in horizontal and vertical directions, thus increasing the pressure on the building [5]. Also, characteristics of the wind imposed on the structure, such as wind speed, wind direction, wind duration and wind turbulence, are also parameters that strengthen the wind pressure on the building [6].