World Academy of Science, Engineering and Technology
International Journal of Civil and Architectural Engineering
Vol:11, No:04, 2017

Investigation of Aerodynamic and Design Features of Twisting Tall Buildings

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Abstract : After decades of conventional shapes, irregular forms with complex geometries are getting more popular for form generation of tall buildings all over the world. This trend has recently brought out diverse building forms such as twisting tall buildings. This study investigates both the aerodynamic and design features of twisting tall buildings through comparative analyses. Since twisting a tall building give rise to additional complexities related with the form and structural system, lateral load effects become of greater importance on these buildings. The aim of this study is to analyze the inherent characteristics of these iconic forms by comparing the wind loads on twisting tall buildings with those on their prismatic twins. Through a case study research, aerodynamic analyses of an existing twisting tall building and its prismatic counterpart were performed and the results have been compared. The prismatic twin of the original building were generated by removing the progressive rotation of its floors with the same plan area and story height. Performance-based measures under investigation have been evaluated in conjunction with the architectural design. Aerodynamic effects have been analyzed by both wind tunnel tests and computational methods. High frequency base balance tests and pressure measurements on 3D models were performed to evaluate wind load effects on a global and local scale. Comparisons of flat and real surface models were conducted to further evaluate the effects of the twisting form without façade texture contribution. Comparisons highlighted that, the twisting form under investigation shows better aerodynamic behavior both for along wind but particularly for across wind direction. Compared to the prismatic counterpart; twisting model is superior on reducing vortex-shedding dynamic response by disorganizing the wind vortices. Consequently, despite the difficulties arisen from inherent complexity of twisted forms, they could still be feasible and viable with their attractive images in the realm of tall buildings.

Keywords : aerodynamic tests, motivation for twisting, tall buildings, twisted forms, wind excitation
Conference Title : ICTBBS 2017 : International Conference on Tall Buildings and Building Services
Conference Location : Zurich, Switzerland
Conference Dates : April 20-21, 2017