

Numerical Investigation of Wind Interference Effects on Tall Buildings

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As structures grow taller, their response to wind becomes significantly more pronounced. A particularly noteworthy aspect to consider is the phenomenon of the "interfering effect." This effect, integral to wind engineering, materializes when an upstream structure alters the wind loading on a downstream building. The Computational Fluid Dynamics (CFD) simulation proves to be an effective tool in comprehending this phenomenon. Consequently, the principal objective of this study is to use CFD to qualitatively and quantitatively determine how an upstream building's configuration impacts a downstream building. First, the chosen building structure from the literature was modeled using CFD software. The accuracy of the findings was verified by comparing them with wind tunnel test results published for the same building. Within CFD simulations for wind analysis, three primary approaches are commonly employed: RANS, LES, and DNS. While DNS is acknowledged for its higher accuracy, it demands more computational power. On the other hand, RANS yields reasonably accurate results while utilizing fewer computational resources. Given the constraints of available computing facilities, this study employs the RANS approach to simulate turbulent flow. The validated CFD model was then employed to examine the interference effect on a principal square-shaped building resulting from an upstream building with varying shapes, orientations, and heights. This investigation predominantly focuses on assessing the impact of interfering effects by analyzing the base moment, base shear, and pressure fluctuation of the principal building. The CFD numerical simulations were conducted using the Midas NFX software. Noteworthy outcomes from the investigation's analysis of base moment and base shear underscore the imperative of accounting for a safety factor when designing building structures within urban environments to counter the effects of interference, specifically recommending a factor of 1.3 for worst-case scenarios. Furthermore, the study emphasizes the significance of meticulously designing the cladding system's connection to accommodate both compression and tension forces, as elucidated by the pressure fluctuation results. The discoveries presented in this paper will play a pivotal role in ensuring the stability and safety of building structures for wind load, particularly when these structures are developing within densely populated urban environments.

Keywords: CFD simulations, Interfering effect, Turbulence model, Wind response, Wind tunnel test