Postprint: Calibration and Uncertainty Quantification for Wind Tunnel Pressure Measurement Tests on High-Rise Buildings

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Abstract

The reliability of wind tunnel tests for high-rise buildings is often validated through comparative assessments of CAARC standard high-rise building wind tunnel test results from multiple institutions; however, the uncertainty inherent in such wind tunnel test results is difficult to quantify. This study conducted rigid-model pressure measurement wind tunnel tests on a CAARC standard high-rise building at a scale ratio of 1:400 under Category D terrain conditions. Firstly, the influence of reference position selection in wind tunnel tests on the experimental results was investigated, revealing that the reference position for pressure measurement tests should be located at the wind tunnel ceiling above the model where turbulence effects are minimal. Secondly, the impact of sampling frequency on both mean and extreme wind pressure coefficients was examined; to obtain relatively stable extreme wind pressure coefficients, a minimum of 15 sampling repetitions is recommended. Finally, through comparative analysis of the experimental results with those from multiple domestic and international research institutions, the reliability of the wind tunnel tests in this study was verified and the uncertainty in the test results was quantified. The results demonstrate that the modeling uncertainty bias for wind pressure coefficients in this high-rise building wind tunnel study is 0.98, with a coefficient of variation of 0.14.

Full Text

Preamble

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