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COMPARATIVE STUDY OF WIND LOADING COMBINATIONS FOR TALL BUILDINGS INCLUDING TORSION: A CFD APPROACH

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Abstract: In the wind analysis of tall buildings considering the appropriate proportion of rectilinear loadings from both orthogonal principal axes along with the torsional moment is an important factor as it will highly influence the internal forces developed in the lateral load resistance system. Although different recommendations were introduced in wind design standards in the recent past for the combination of along wind, across wind and torsional wind loads for the analysis of tall buildings significant inconsistences were found. Further, only a limited number of research works were carried out regarding the combination of these wind loading components. This study employed a finite volume based numerical analysis using Large Eddy Simulation (LES) to determine the suitable wind loading combinations for a standard tall building (CAARC) of which wind tunnel test results are available for the validation of numerical predictions. In this study, the wind loading in both principal axis of the building and torsional moments were obtained from a validated Computational Fluid Dynamics (CFD) simulation for wind directions varying from 0 to 90 degrees. Based on the numerical results suitable critical wind loading combinations were identified. The combination factors obtained from this study were compared with three wind design standards namely AIJ: 2015, AS/NZS: 2021 and CNS: 2012. The comparison shows that the combination factors derived for the selected building reasonably match with the recently introduced load combination provisions of AIJ: 2015 and AS/NZS: 2021. However, the combination factors proposed by CNS: 2012 are found to be underestimating the wind loading effect.

Keywords: Computational Fluid Dynamics (CFD); Large Eddy Simulation (LES); Tall buildings; Torsion; Wind load combinations