Sensitivity of Peak Pressure Estimated by LES on a Tall Building in City

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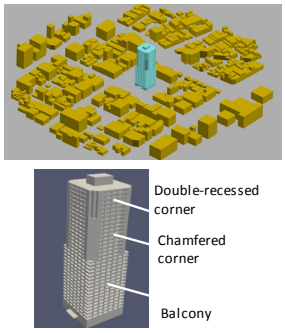
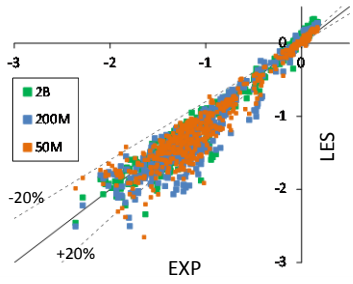
ABSTRACT

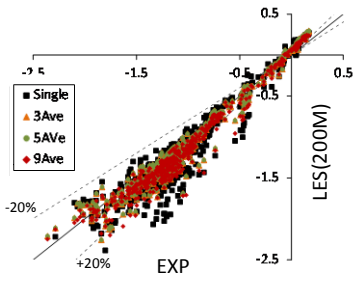
For the strong-wind resistant design of a tall building located in city centre, peak pressures acting on various positions on the surface of side walls and top roof of a building should be accurately estimated. Especially almost wind disasters occur at the cladding covering a building and very rare at building frame. Then, local features of extremely large peak pressures, which are generated by special flow patterns or the vortex formation near a building, have to be understood from a physical point of view. Recently Large Eddy simulation (LES) of turbulent flows around buildings and structures is often used in order to predict the aerodynamic characteristics including pressure fluctuations for a bluff body. LES is currently expected for the feasible tool for the wind resistant design of a building because accurate estimation of peak pressure must be guaranteed under the appropriate numerical conditions [1]. However peak values of pressures are very sensitively changed by selected condition. This paper discusses the sensitivity of peak pressures under various conditions such as the grid size and the ensemble-averaging number of peak values acting on the actual tall building with complicated shape in city. The present LES employs the Smagorinsky model for SGS model and SMAC method for numerical algorithm. Fig. 1(a) is numerical model for wind around residential tall building with various corner shapes surrounded by other buildings. Here this study investigates the effect of resolution of mesh system on negative minimum pressure at all measurement points in wind tunnel experiment. 3 cases for grid number are set to be 2 billion (B) for finest case, 200 million (M) and 50M. According to Fig. 1(b), in the case of 50M, lowest peak pressures are crucial for the wind resistant design but are unstably scattered in comparison with the experimental data. The cases of 200M and 2B show almost good agreement with each other and it can be said that the computed data by 200M produce reasonably accurate data. Peak pressure tends to be unstable value because the value is instantaneously estimated for the given duration time (usually 10 mins used at real scale). This study also discusses the effect of ensemble number for the peak pressure estimation in Fig. 1(c). As increasing the number of ensemble averaging, the LES results are convergent and come close to the experimental data. From these results, it can be said that 5 cases of ensemble averaging are required as an appropriate estimation.



(a)Target building(Residential building)



(b)Dependency of Cp min on spatial resolution (Residential building, 1 ensemble inflow)



(c)Dependency of Cp min on ensemble number of inflow (Residential building,200M grid number)

Fig. 1 LES results of Min. peak of *Cp* on tall building and their dependency on numerical conditions

REFERENCES

[1] H. Kawai, T. Tamura et al., appropriate numerical conditions for practical LES of actual high rise building –Requirement of grid number and wind direction, 9th Asia-Pacific Conference on Wind Engineering Auckland, New Zealand (2017)