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論 文 要 約

THESIS OUTLINE

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要約（様式自由）
Thesis Outline（free format ）

Large-eddy Simulation for Convective Heat Transfer around Buildings within Unstable Boundary Layer

With the development of urbanization, the urban heat island (UHI) phenomenon became a crucial issue for human living in the past decades. The convective heat transfer coefficient (CHTC) is an important parameter to evaluate the building energy simulation, which is a crucial part in the UHI. This thesis focused on convective heat transfer for buildings within different stratified thermal boundary layers studied by large-eddy simulation (LES). In the present study, two difficulties caused by LES were solved including the turbulent inflow and the vast computational cost. An isolated building case and two different building array cases were modeled.

In Chapter 2, the influence of different calculation parameters on the generation of turbulence inflow with velocity and temperature fluctuations under unstable condition was investigated to find out the best numerical setting for the precursor method using LES. Based on the optimal numerical setting, the inflows under different thermal stratifications were generated and compared for flow characteristics. The generated inflow was applied to an isolate building case to validate the quality of transferred inflow and its applicability for engineering.

In Chapter 3, six different inflow profiles generated in Chapter 2 were applied to a 1:1:2 isolated building model. The grid sensitivity test for hexahedral meshes was conducted and the accuracy of the method were validated by comparing with the data of the WTE. CHTC distributions on the building surfaces with different thermal stratifications were compared with that in neutral condition to figure out the effect of temperature difference and velocity on the CHTC results. The surface-averaged CHTCs on different building surfaces were compared and different correlations of CHTC and velocity combined with temperature difference were provided, respectively.

In Chapter 4, the performance of polyhedral meshes on wind and temperature fields around an isolated building within unstable boundary conditions were evaluated using LES. The grid sensitivity test of polyhedral meshes was conducted. The mean velocities, turbulent kinetic energy, mean temperature, standard deviation of temperature and CHTC distributions on building surfaces were evaluated. The computational cost of hexahedral and polyhedral meshes were also compared.

In Chapter 5, the performance of polyhedral meshes on wind and temperature fields around building arrays within neutral and unstable boundary conditions were evaluated using LES, respectively. The effect of local mesh refinement was discussed based on the cases within the unstable boundary layer. Then, the

numerical accuracies of statistical characteristics and computational costs of cases with local mesh refinement within neutral and unstable boundary layers were investigated, respectively.

The structure of the thesis is summarized below.