Study of flow structure and prediction accuracy of RANS model for urban flow using PIV and LES

Study of turbulent flux modelling using LES (Neutral)

Objective of numerical analysis (Urban canyon)

Mean velocity within urban canyon (upper : LES, lower : k-ε model)
The prediction accuracy of the k-ε model decreased compared to the LES.
The k-ε model failed to reproduce the production of the turbulent kinetic energy at the urban canyon top compared to the LES.
Study of flow structure and prediction accuracy of RANS model for urban flow using PIV and LES

Study of turbulent flux modelling using LES (Thermal stratification)

- Mean velocity and temperature

Mean velocity and temperature at urban canyon center

The prediction accuracy of the k-ε model decreased compared to the LES as the thermal stratification became unstable.

- Reynolds stress and turbulent heat flux

Reynolds stress, turbulent heat flux, and production of them at urban canyon.

Within the urban canyon, the $P_{3T(2)}$ and $G_{3T}$, which are neglected in the k-ε model, increased compared to the $P_{3T(1)}$.

<table>
<thead>
<tr>
<th>Thermal stratification</th>
<th>Case SU</th>
<th>Case WU</th>
<th>Case WS</th>
<th>Case SS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground temperature</td>
<td>78.9°C</td>
<td>39.7°C</td>
<td>20.6°C</td>
<td>20.5°C</td>
</tr>
<tr>
<td>Air flow temperature</td>
<td>19.8°C</td>
<td>19.0°C</td>
<td>38.4°C</td>
<td>77.6°C</td>
</tr>
<tr>
<td>Bulk Richardson number</td>
<td>-0.3</td>
<td>-0.1</td>
<td>0.1</td>
<td>0.3</td>
</tr>
</tbody>
</table>

※ $P_{3T}$ : Production of $<u_3' u_3'>$ by mean velocity gradient, $G_{3T}$ : Production of $<u_3' T'>$ by buoyancy
※ $P_{1T}$ : Production of $<u_1' T'>$ by mean temperature gradient, $P_{3T}$ : Production of $<u_3' T'>$ by mean velocity gradient, $G_{3T}$ : Production of $<u_3' T'>$ by buoyancy