1. Research Aim
In order to build an energy-saving structure aiming to minimize energy consumption, we'll analyze the thermal buffering phenomena between the ventilation flow inside and the unsteady wind flow outside the building, and suggest an optimized design criteria. Therefore, this proposal aims to (i) obtain comprehensive mean and fluctuating thermo-fluid properties in order to delineate more clearly the link between unsteady motions of the wind flow and the shape of the obstacles, (ii) analyze the mechanism of natural/forced ventilation similarity (e.g. Grashof & Rayleigh number) in the modelling of turbulent flows inside generic three-dimensional obstacles of a wide variety of heights and aspect ratios, (iii) make a flow modelling between the unsteady flow outside of the obstacles and the natural/forced ventilation inside and herein analyze the thermal buffering, and (iv) thus secure the core technologies of the structural design criteria.

2. Research Method
First, the wind tunnel tests were conducted in the turbulent boundary layer wind tunnel (Fig. 1) of the Wind Engineering Research Center at Tokyo Polytechnic University (TPU) in Japan. This wind tunnel is an open-circuit, low-speed wind tunnel designed for wind environmental assessment and ventilation studies. Most of the experiments were conducted in the end-part test section of the tunnel, where the sectional dimensions were 1.2 m width, 1.0 m height, and 14 m length, with a maximum wind speed of approximately 30 m/s. Table 1 gives the dimensions of the group of surface roughness blocks used in the wind tunnel to generate the simulated turbulent boundary layer. The details of the generated turbulent boundary layer are illustrated in the Fig. 2.

Represents the content from the image.
The work involved covers a combination of microclimate measurements, numerical microclimate simulations and studies of the urban planning process. If possible, field measurements would be conducted in areas with significantly differing characteristics, including variations in urban geometry and distance to the sea, to map variations in microclimate and outdoor thermal comfort within each city. To cover a wider range of urban design, to test the impact of different design parameters on outdoor thermal comfort and to achieve optimum design solutions, microclimate simulations using Computational Fluid Dynamics (CFD) software will be conducted in the near future. The results obtained will be studied and examined as well as analyzed carefully for preparing • Criteria of urban ventilation and • Thermal comfort criteria for outdoor environment

3. Research Result

One of the priorities of this study was the validation of the surface pressure around square models with different height. To achieve this, we carried out pressure measurements and precise analysis based on the non-dimensional parameter Cp. Fig. 3 depicts the variation of the averaged surface pressure Cp along the axial centreline of the cube obtained in the wind tunnel. It also graphically compares our results to those obtained by others in previous studies. As shown in the figure, the current surface-pressure profile is reasonably well located in the middle of the others, which means that the turbulent intensity and other inflow conditions are slightly different, but not identical, so that it can be easily conjectured that the surface-pressure distribution around the cube could be different based on the inflow boundary condition. For example, CR’s result was obtained under a specific inlet flow condition of high turbulent intensity, whereas LCH’s was obtained under relatively lower turbulent intensity (Castro and Robins, 1977; Lim et al., 2006; Lim, 2009).

<table>
<thead>
<tr>
<th>Size [WxH] [mm²]</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. Elements</td>
<td>60</td>
<td>60</td>
<td>128</td>
<td>108</td>
<td>36</td>
<td>3</td>
</tr>
<tr>
<td>Length [mm]</td>
<td>240</td>
<td>525</td>
<td>1,780</td>
<td>1,435</td>
<td>2,450</td>
<td>450</td>
</tr>
</tbody>
</table>

Table 1 Group of surface roughness blocks used in the tunnel

In order to observe the effect of different height on the surface pressure around the building, we performed three different buildings.
These surface profiles are the fundamental pressure to estimate the impact of wind load inside the building, which can be used to estimate the thermal comfort for the indoor environment. The current results were not fully described, but the relationship between the wind load and thermal comfort inside the room will be parametrically estimated for the future work.

4. Published Paper etc.
[Published papers]

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