The simulation of the indoor air current which installed the WindWill

Tohoku University School of Engineering
Chemical-related fields

Using computer simulation in theoretical experiments to boost industrial efficiency Energy Process Engineering (Miura Laboratory)
Purpose

- The effect of a WindWill is verified.
- An indoor flow place and a temperature place are calculated using a heat fluid analysis code.
- It calculates by the existence of WindWill installation and considers the influence which WindWill has on an indoor air style and a temperature place.
Analysis method

- Heat fluid analysis is carried out using Finite-volume method.
- A convergence solution is calculated by repeating and solving the in-and-out type of mass, movement, and energy.

\[
\frac{\partial}{\partial x_j} \left( \rho u_j \phi - \Gamma_\phi \frac{\partial \phi}{\partial x_j} \right) = S_\phi
\]

\[\phi = 1(\text{mass}), u_j, h...\]
Computational grid

Air-conditioning equipment

WindWill
Indoor air flow place

(a) WindWill installation  (b) WindWill un-installing

Downdraft speed distribution
Heating is an object of analysis

- Room facilities to be 2 air-conditioning equipment and 6 aircraft WindWill
- Simulation conditions, 0 °C ambient temperature, 30 °C air conditioner flow temperature of heating
Three-dimensional temperature distribution of heating

Temperature distribution to the height, 0.1 m, 1m, 2m, and a room center

(a) WindWill installation  (b) WindWill un-installing
Two-dimensional temperature distribution of heating

Comparison of the temperature distribution in height 2m

(a) WindWill installation  (b) WindWill un-installing
Two-dimensional temperature distribution of heating

(a) WindWill installation

(b) WindWill un-installing

Comparison of the temperature distribution in height 1m
Two-dimensional temperature distribution of heating

(a) WindWill installation
(b) WindWill un-installing

Comparison of the temperature distribution in height 0.1m
Cooling is an object of analysis.

Room facilities to be 2 air-conditioning equipment and 6 aircraft WindWill.

Simulation conditions, 30 °C ambient temperature, 10 °C air conditioner flow temperature of cooling.
Three-dimensional temperature distribution of heating

(a) WindWill installation
(b) WindWill un-installing

Temperature distribution to the height, 0.1 m, 1m, 2m, and a room center
Two-dimensional temperature distribution of cooling

(a) WindWill installation  (b) WindWill un-installing

Comparison of the temperature distribution in height 2m
Two-dimensional temperature distribution of cooling

(a) WindWill installation  (b) WindWill un-installing

Comparison of the temperature distribution in height 1m
Two-dimensional temperature distribution of cooling

(a) WindWill installation  (b) WindWill un-installing

Comparison of the temperature distribution in height 0.1m
Conclusion

- When WindWill is installed, and when not carrying out, heat fluid analysis was carried out.
- WindWill considered the influence which it has on an indoor temperature place.
- By installing WindWill, the difference in temperature at 2 m in height falls. (cooling and heating)
- It checks that warm air descends by installing WindWill at the x-y plane in height 1 m (heating).
- By installing WindWill, a low-temperature belt appears in the WindWill lower part in height 0.1 m (cooling).