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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

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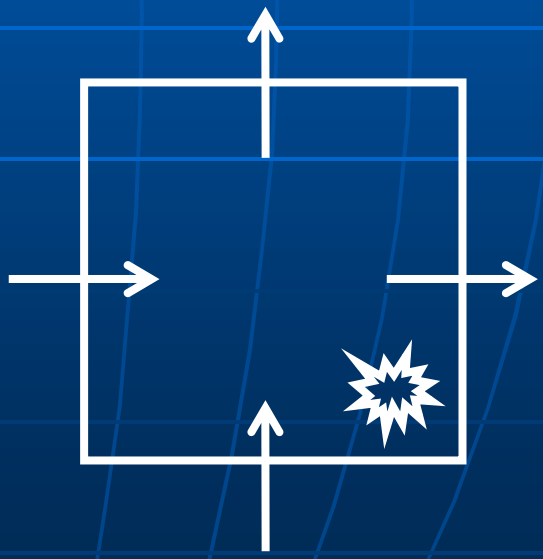
- The effect of a WindWill is verified.
- An indoor flow place and a temperature place are calculated using a heat fluid analysis code.
- It calculates by the existence of WindWill installation and considers the influence which WindWill has on an indoor air style and a temperature place.

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.

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

$$\phi = 1(\text{mass}), u_j, h \ldots$$



Grid finite-volume

Computational grid

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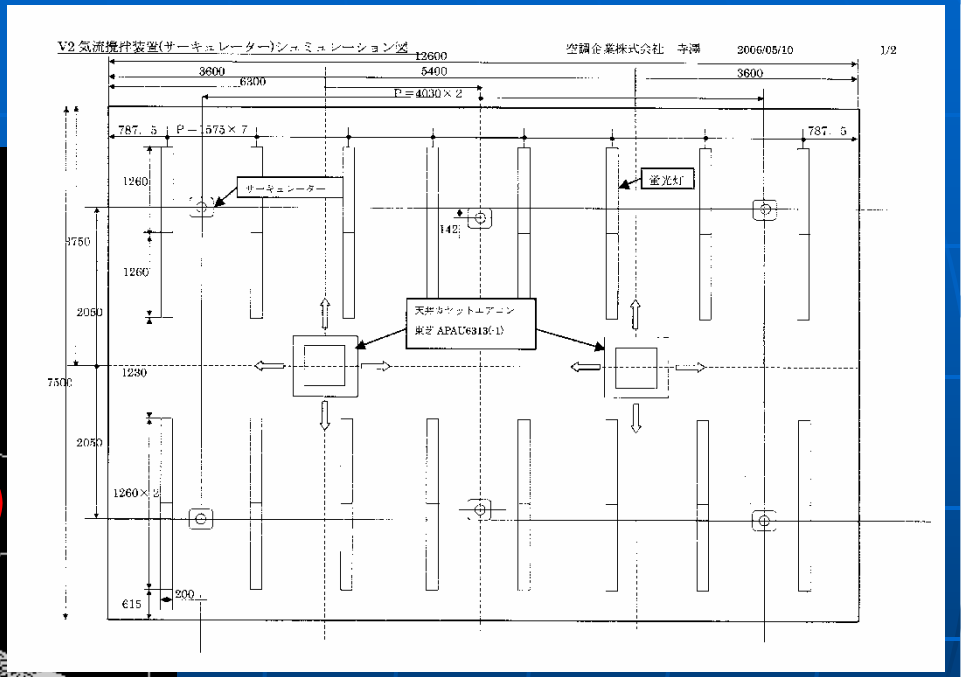
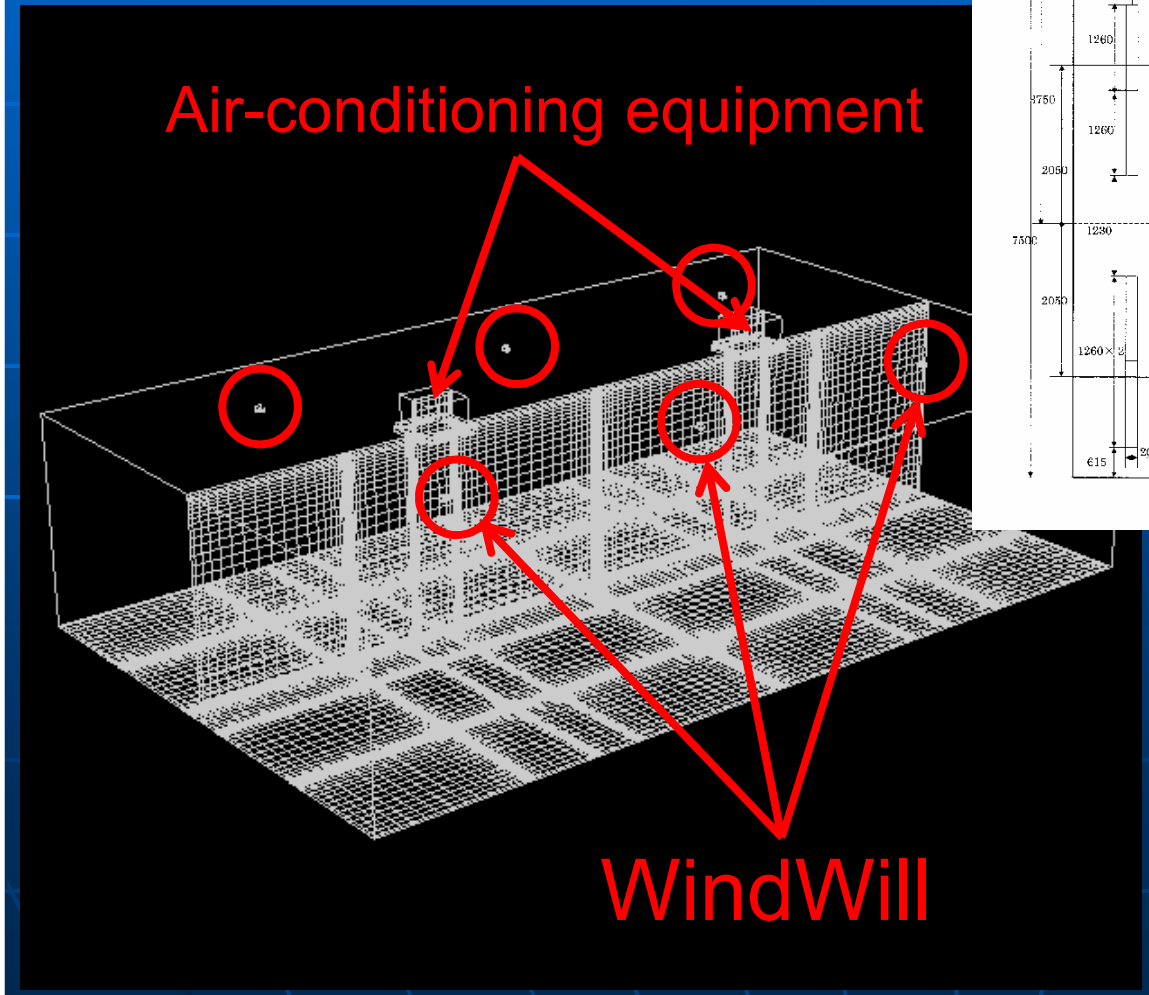
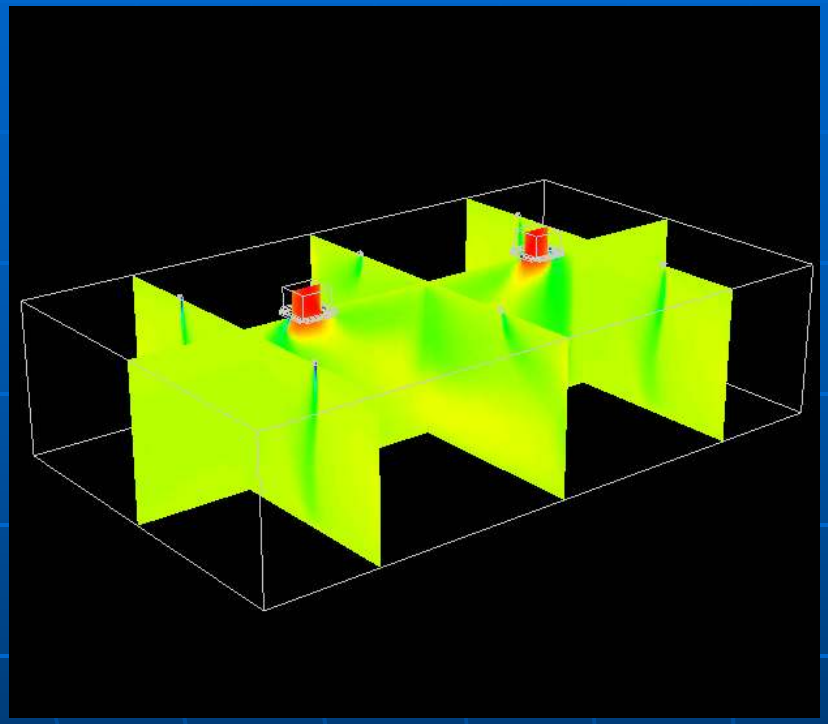
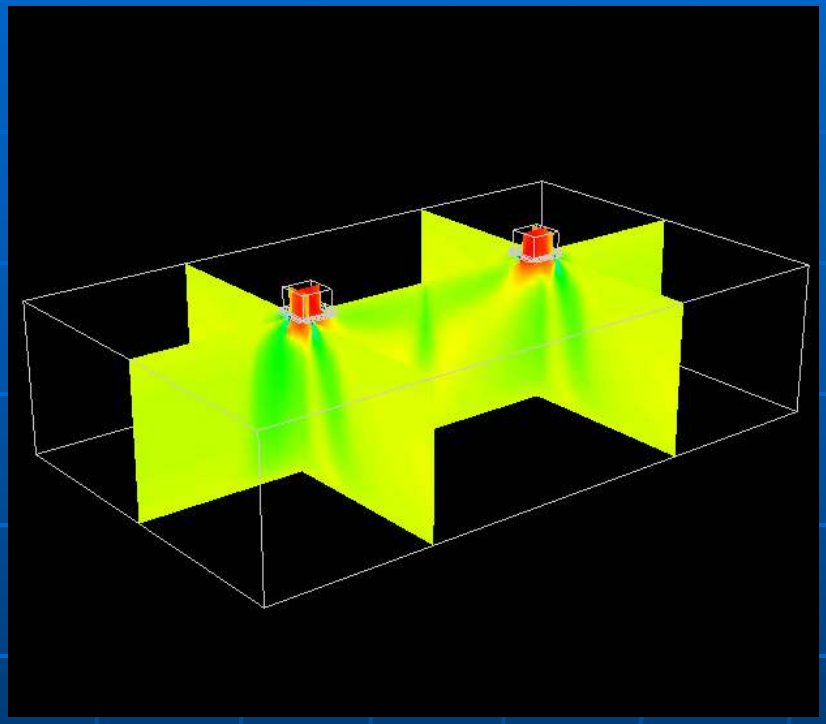




Indoor air flow place



(a) WindWill installation

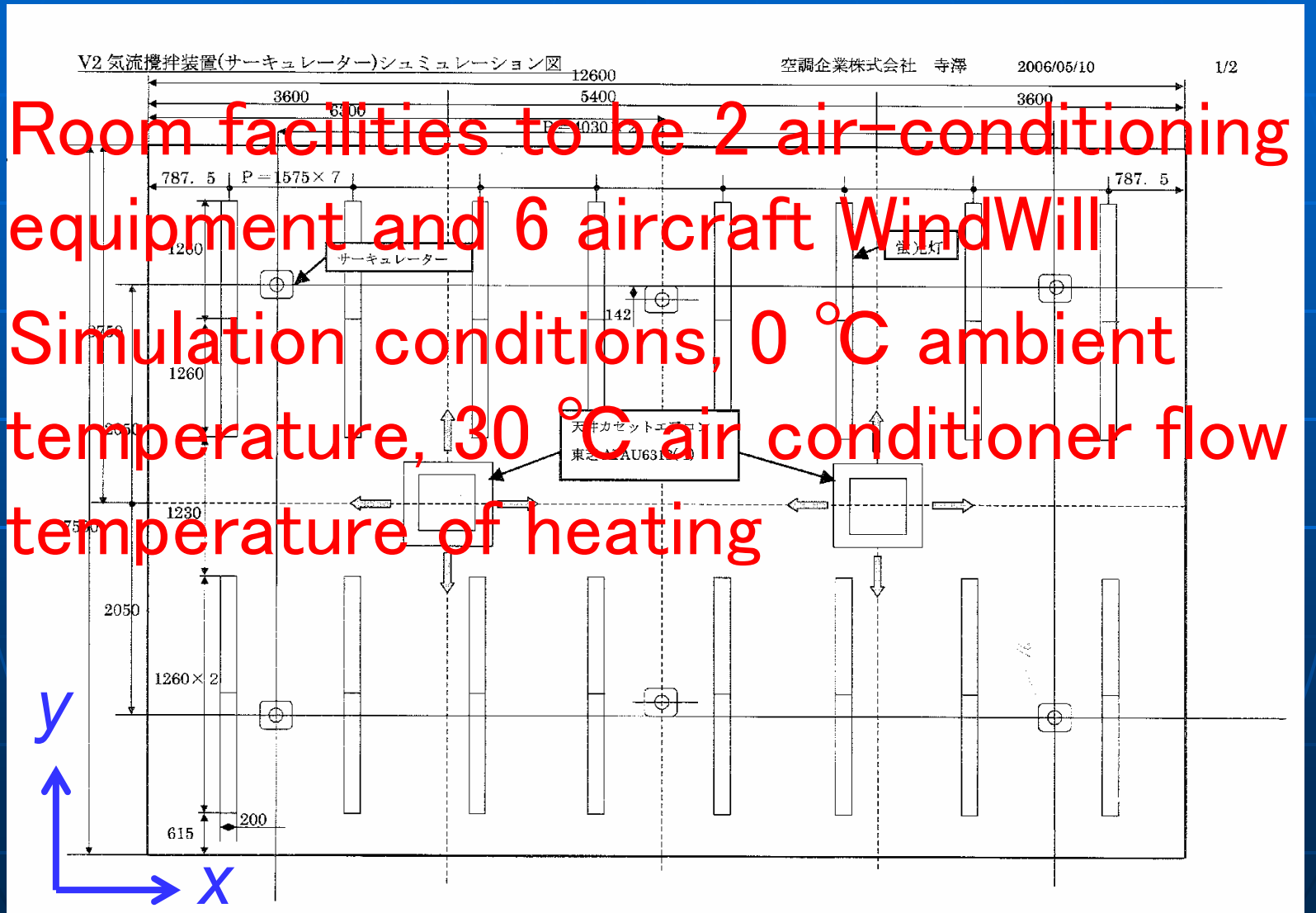


(b) WindWill un-installing

Downdraft speed distribution

Heating is an object of analysis

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



Three-dimensional temperature distribution of heating

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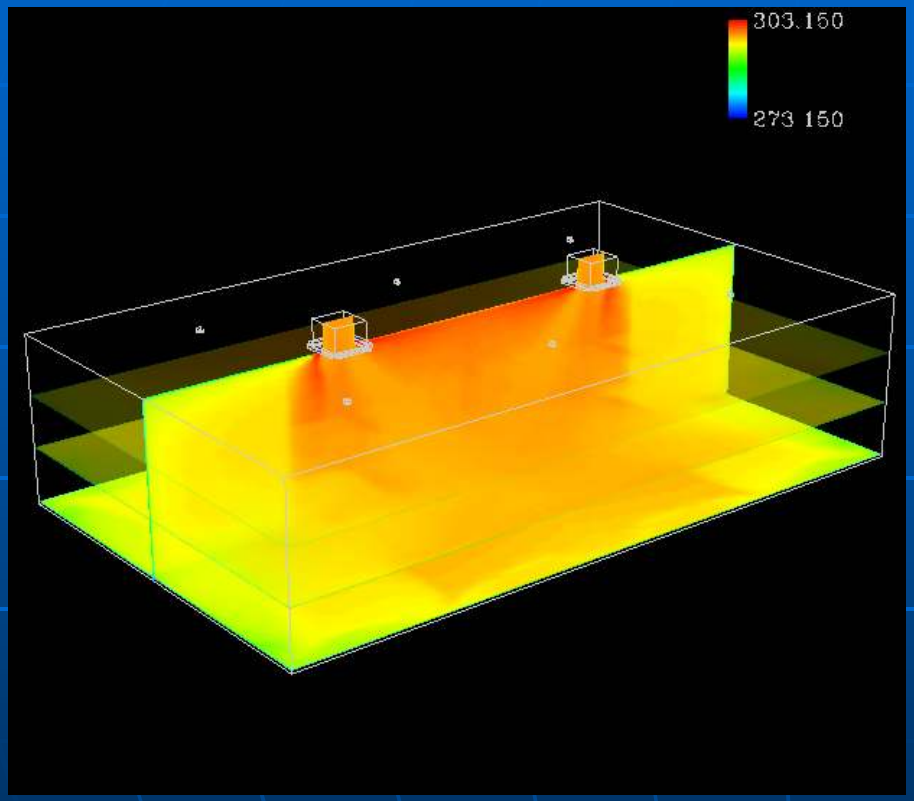

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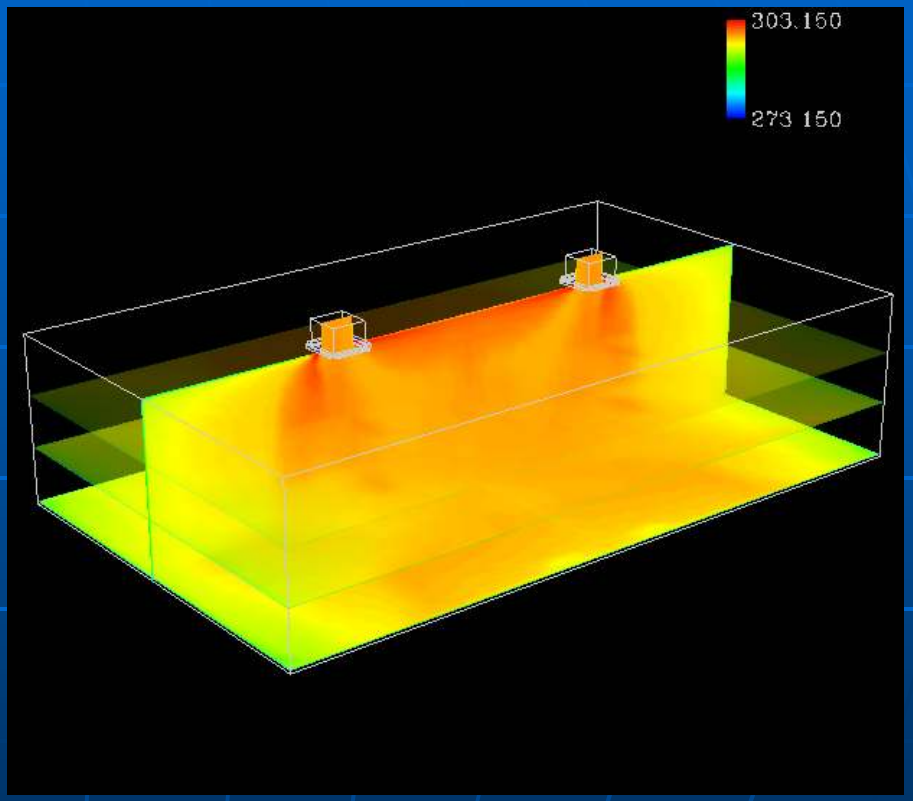
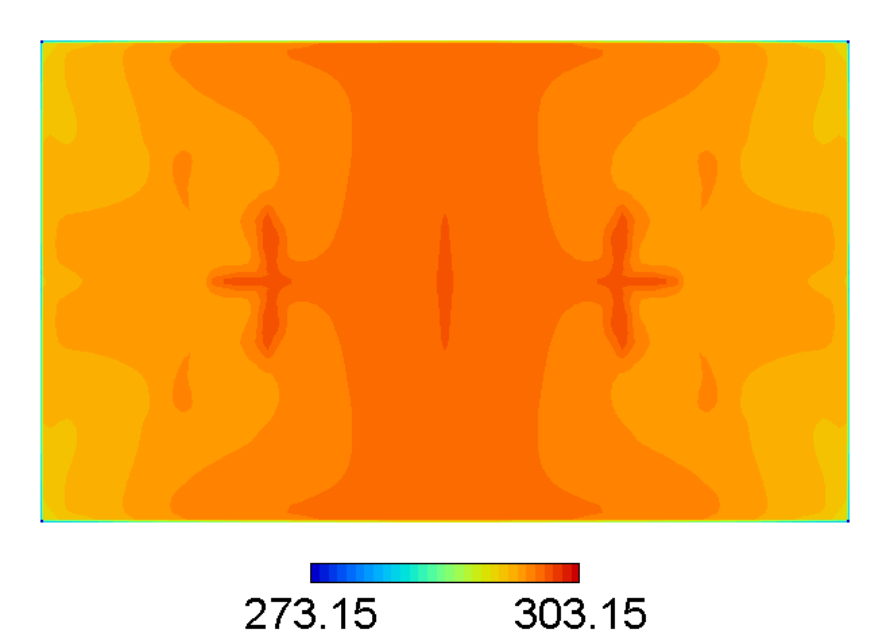


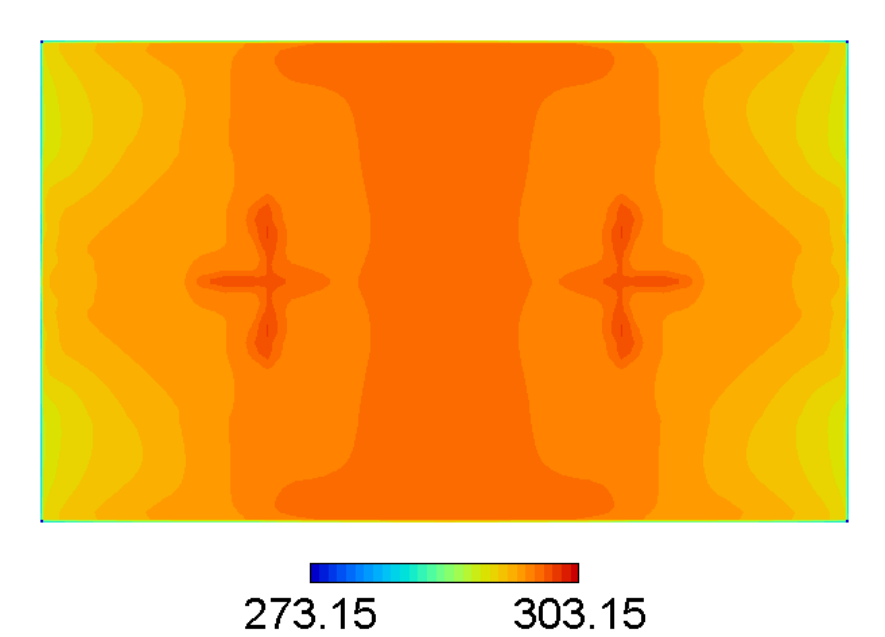
(b) WindWill un-installing

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

Two-dimensional temperature distribution of heating



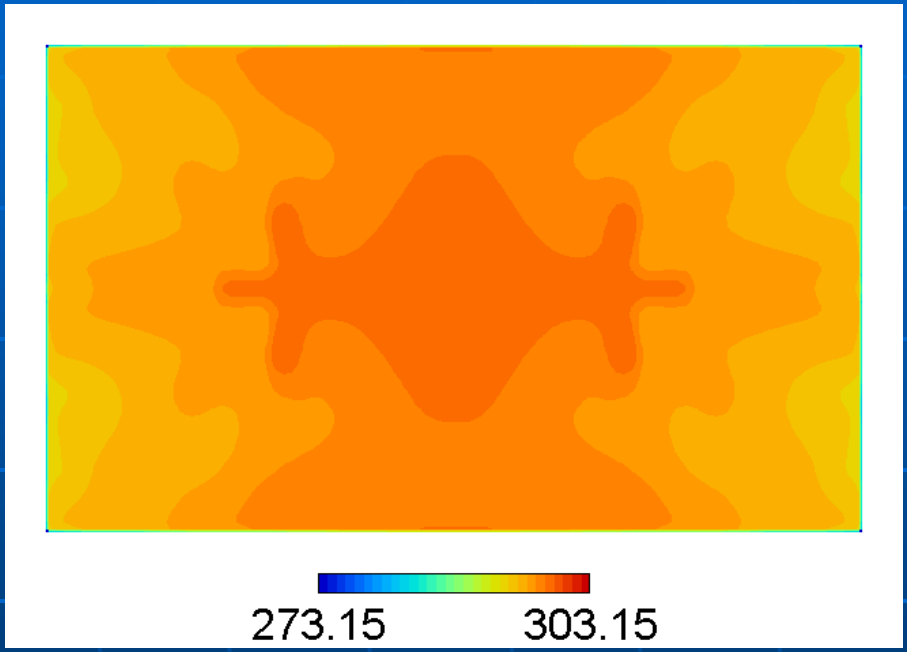
(a) WindWill installation



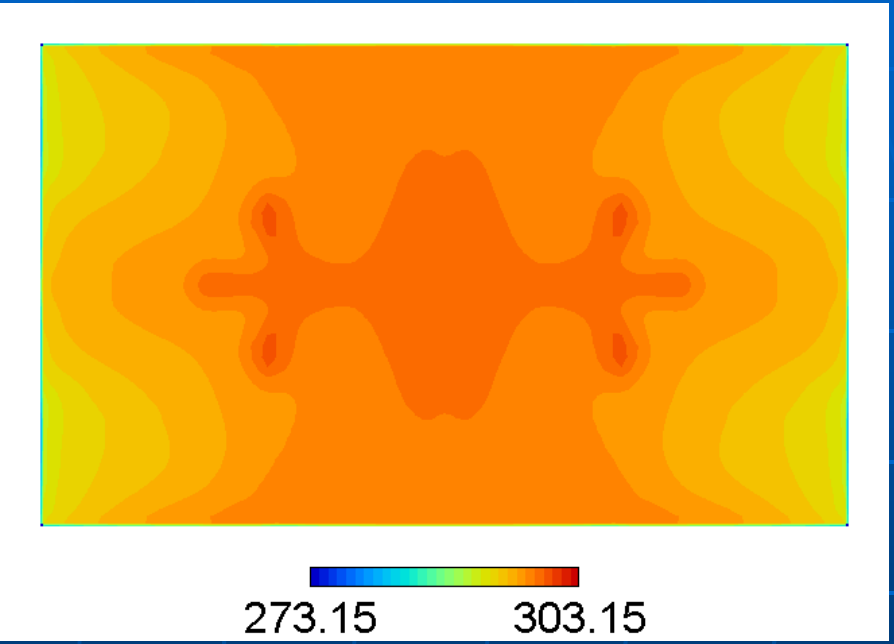
(b) WindWill un-installing

Comparison of the temperature distribution in height 2m

Two-dimensional temperature distribution of heating



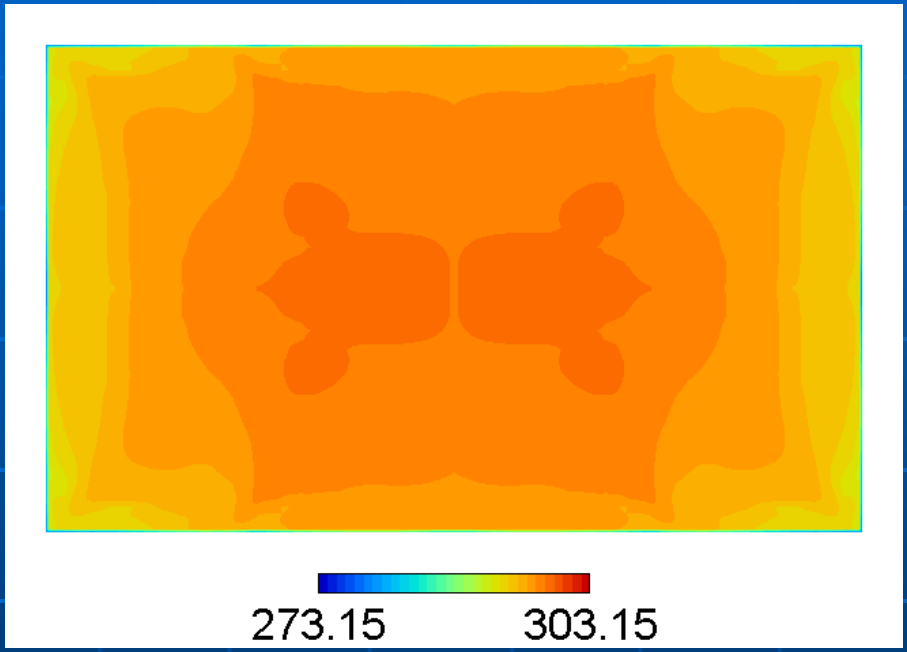
(a) WindWill installation



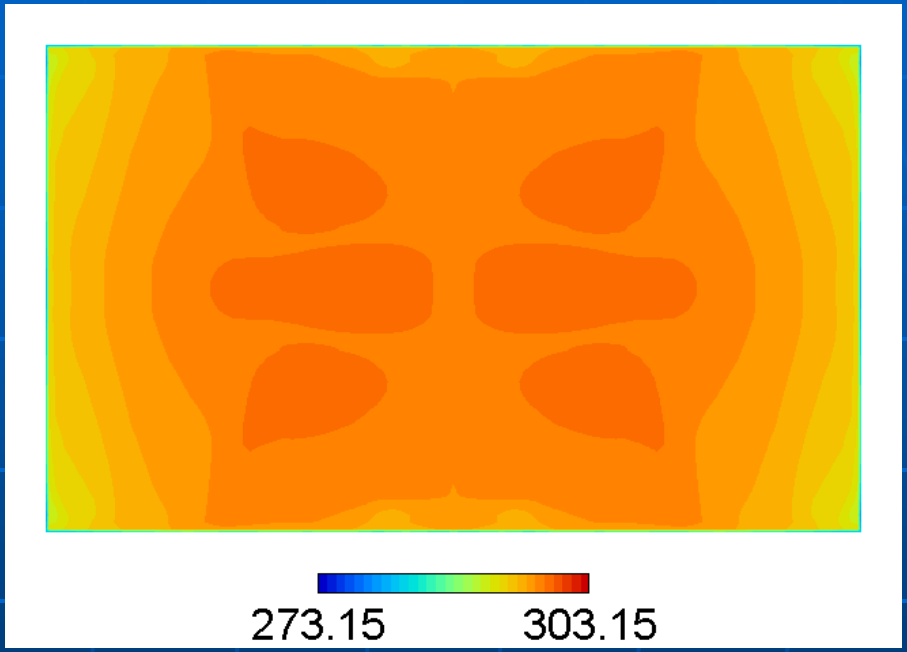
(b) WindWill un-installing

Comparison of the temperature distribution in height 1m

Two-dimensional temperature distribution of heating



(a) WindWill installation

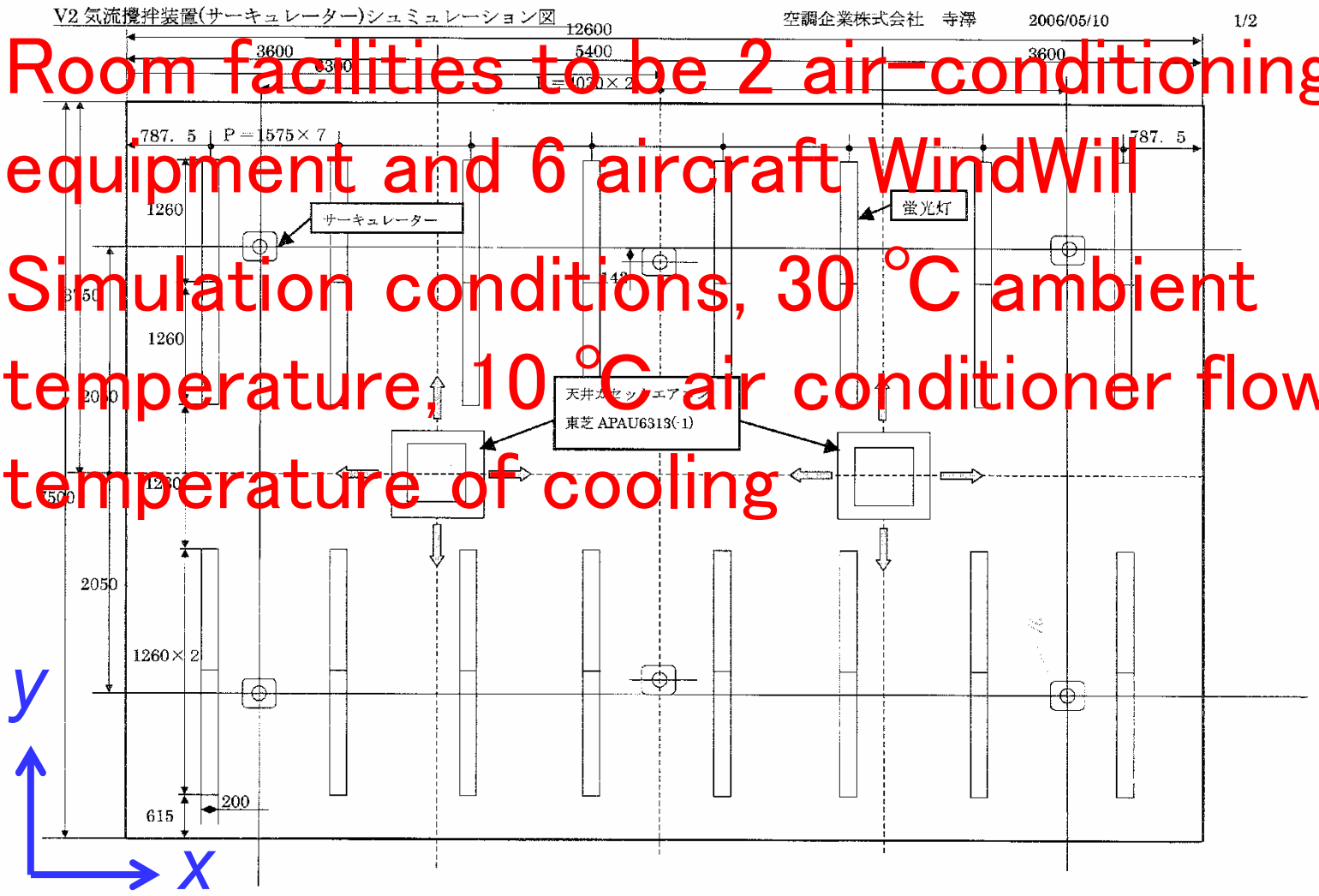


(b) WindWill un-installing

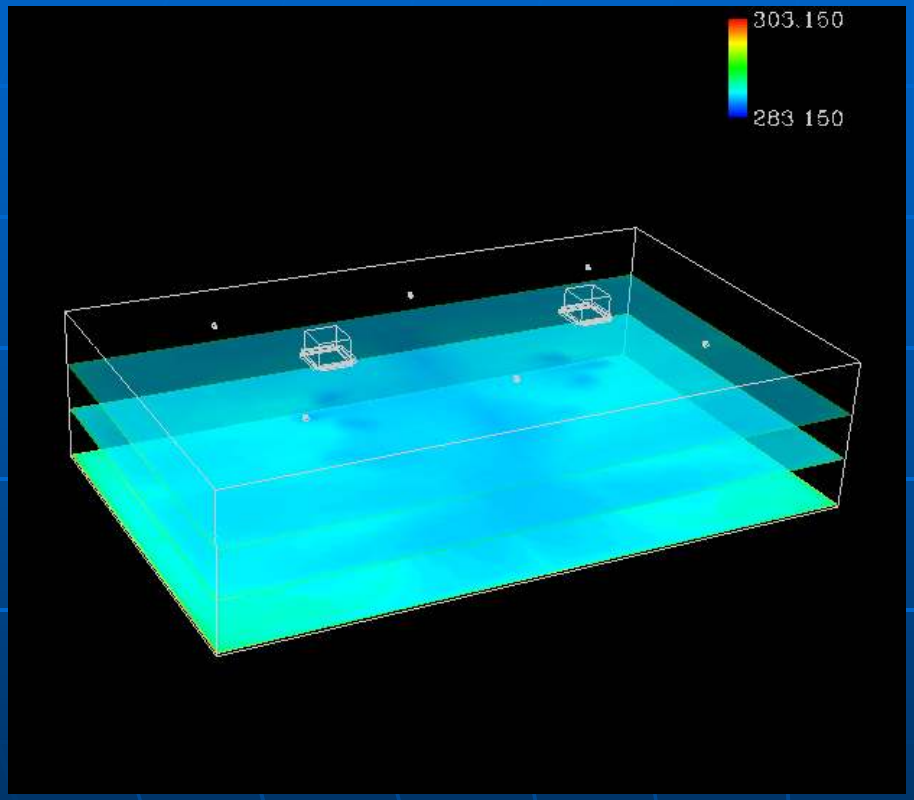
Comparison of the temperature distribution in height 0.1m

Cooling is an object of analysis

- Room facilities to be 2 air-conditioning equipment and 6 aircraft WindWill
- Simulation conditions, 30 ℃ ambient temperature, 10 ℃ air conditioner flow temperature of cooling



Three-dimensional temperature distribution of heating



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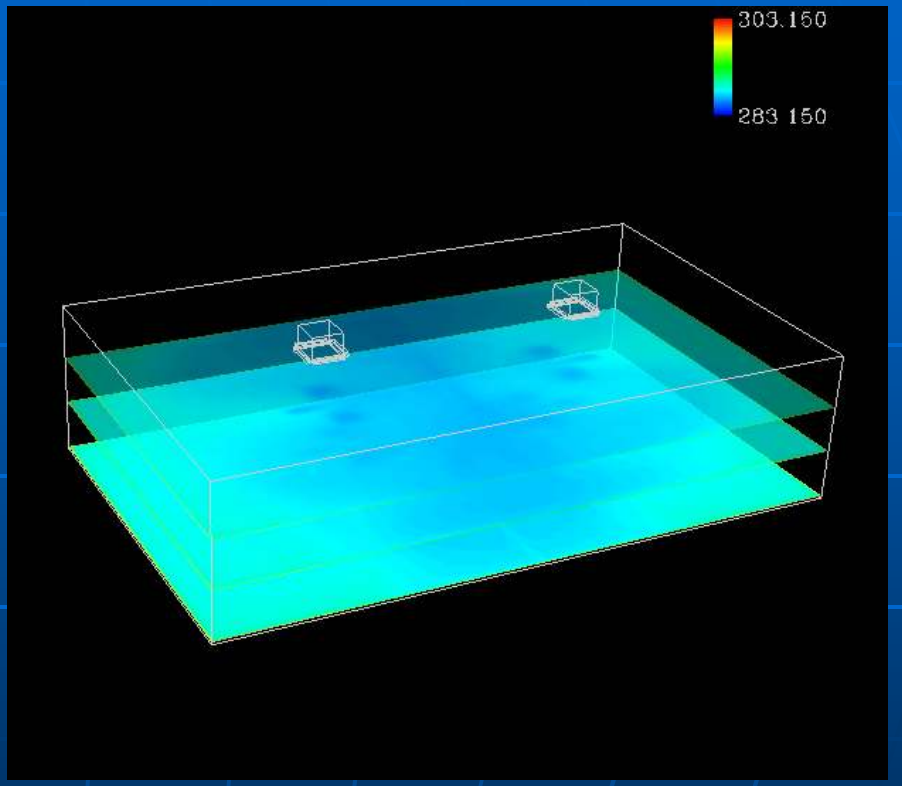
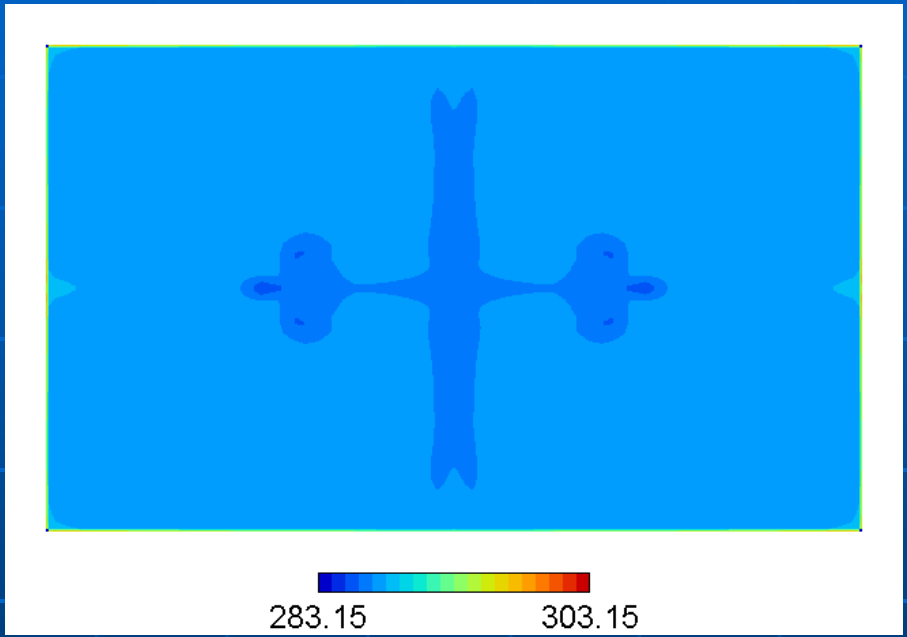


(b) WindWill un-installing

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

Two-dimensional temperature distribution of cooling



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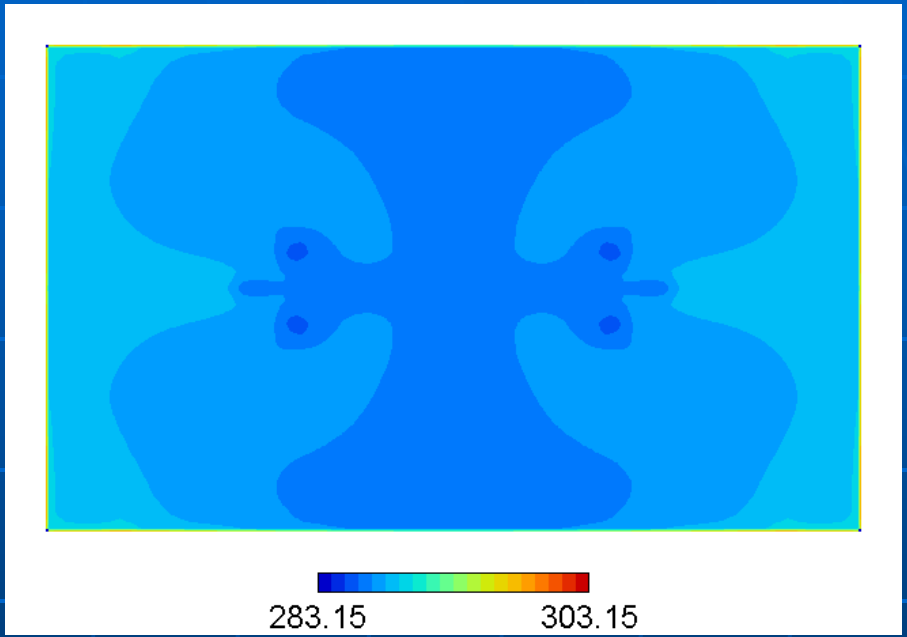
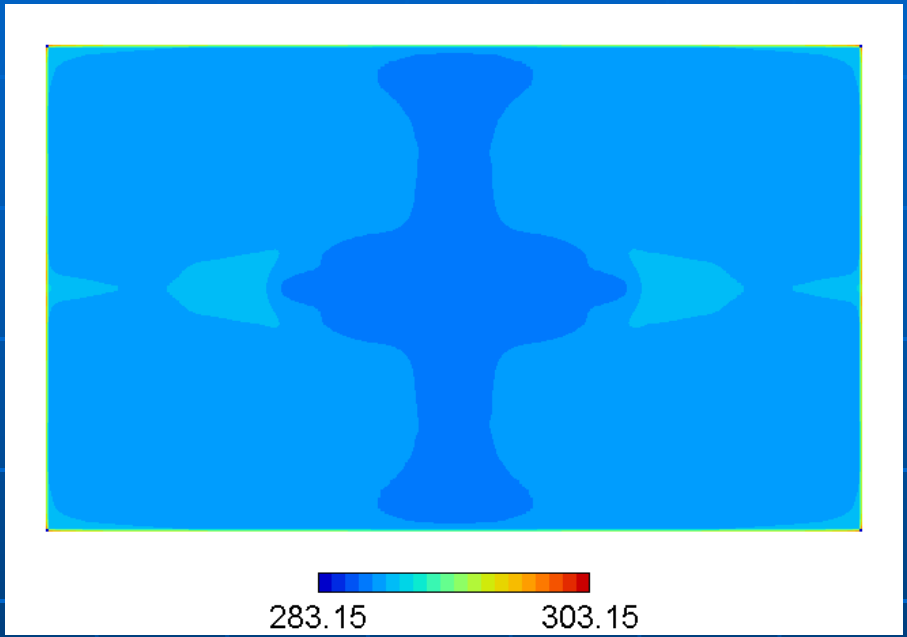


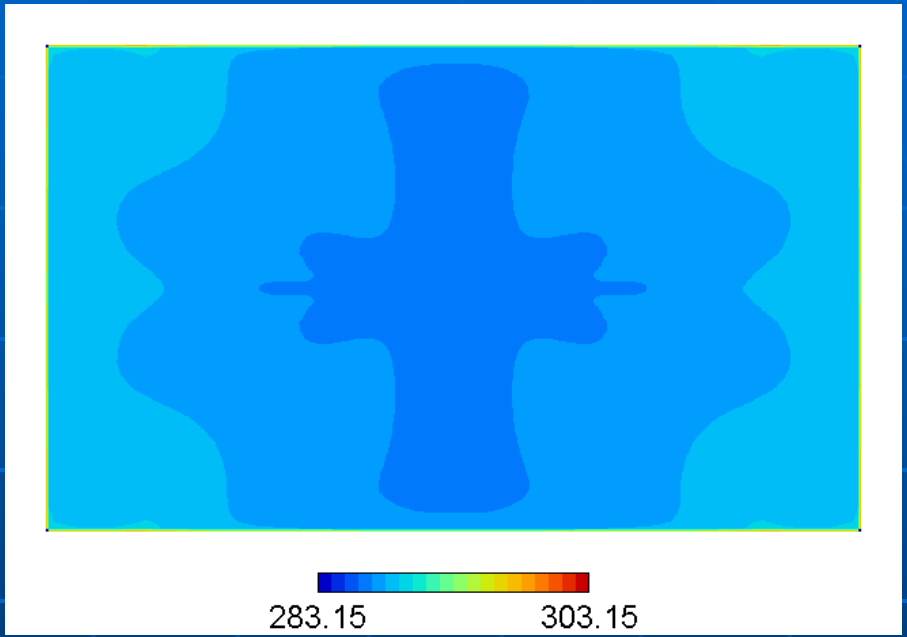
(b) WindWill un-installing

Comparison of the temperature distribution in height 2m

Two-dimensional temperature distribution of cooling



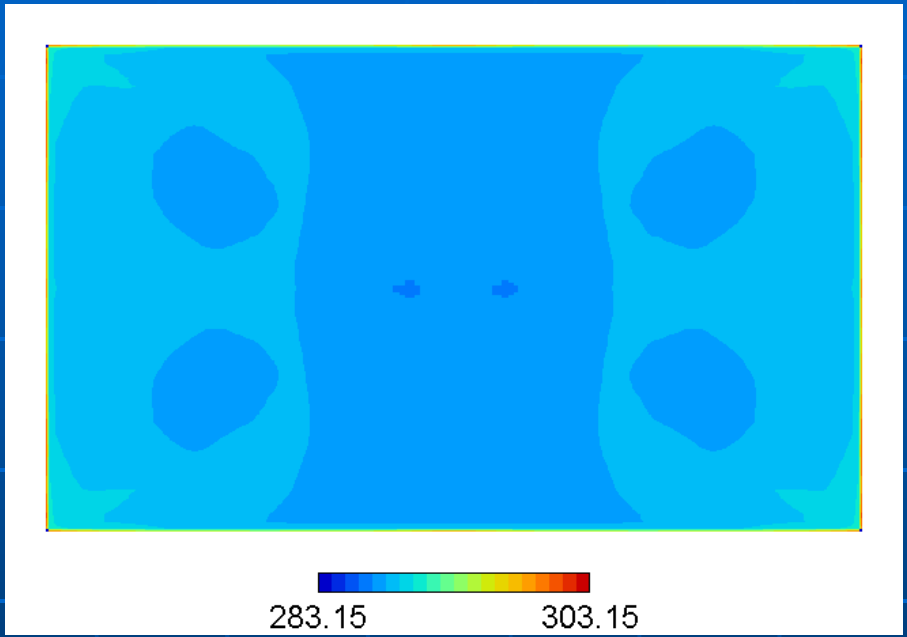
(a) WindWill installation



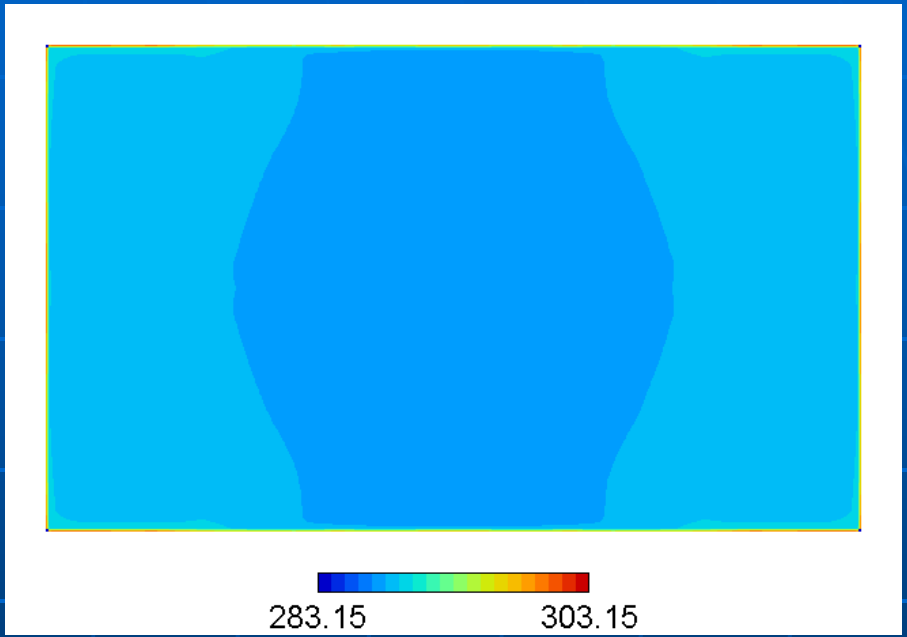
(b) WindWill un-installing

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

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- 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).