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Commissioning test for existing large scale building using simulation modeling

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Introduction

Before an upcoming renovation of the existing building, various energy-saving effect items were examined and assessed on the 24th of the building office.

Since the result of the assessment was greater than expected, the analysis of the assessment result was conducted by using simulation to clarify the mechanism of the energy saving.

This presentation presents the energy-saving method and evaluation by BEMS data, and analytical method by using simulation and the calculation result.

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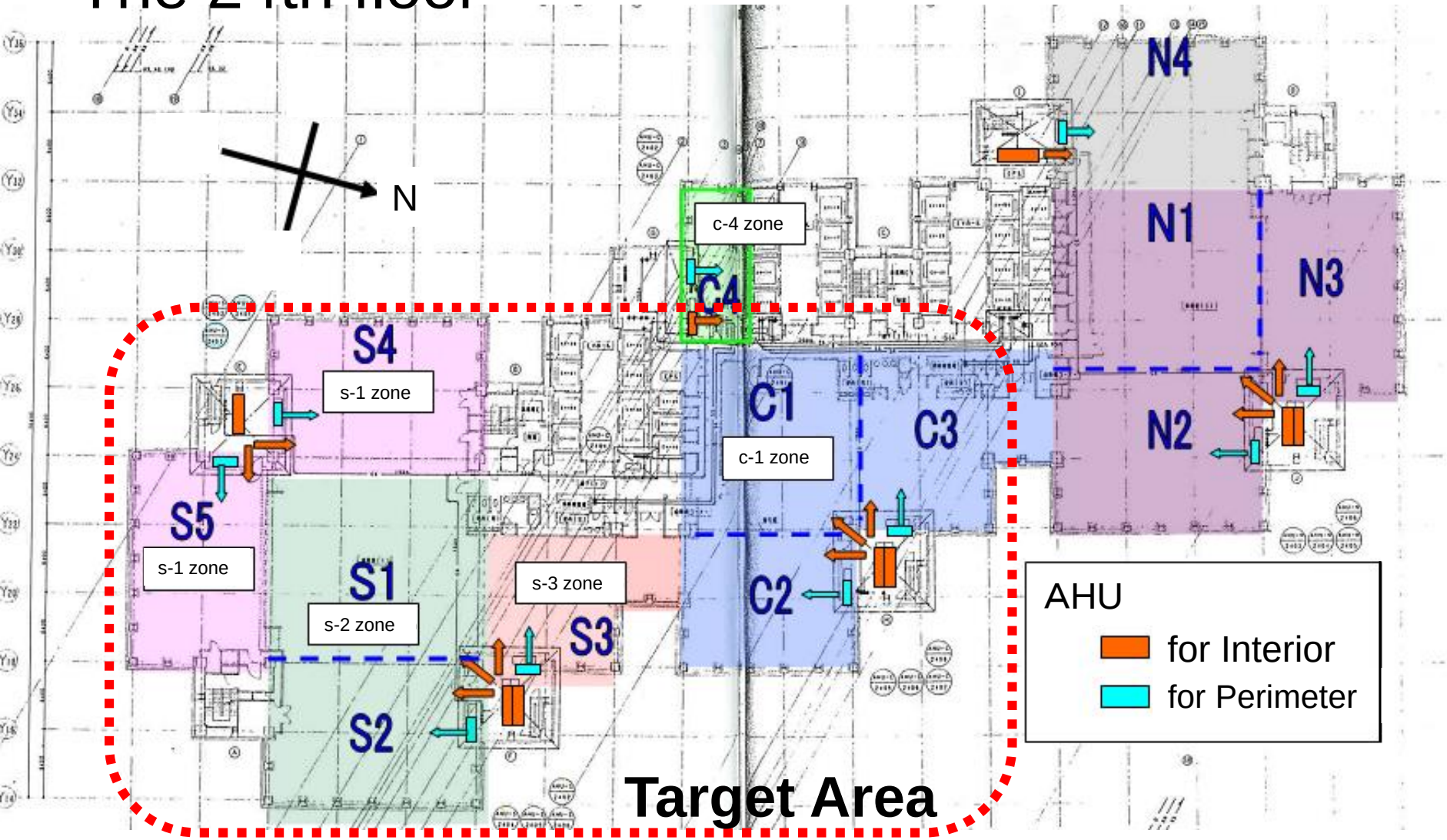
Profile of the Building

Location	**Shinjuku-ku, Tokyo**
Scale	**The fifth floor under the ground The 52nd floor above the ground 235m in height**
Total floor area	**About 264,000m^2**
Completion	**Constructed in 1994**
Use	**Office : from 8th to 37th floor Hotel : from 39th to 52th floor Shop : from B1th to 7th floor**

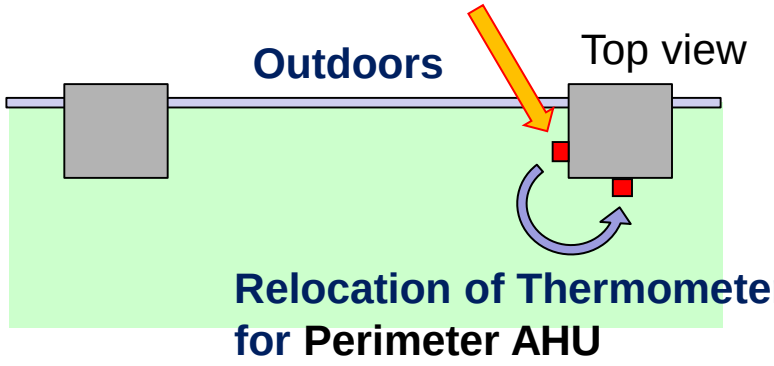
The Target Area

The 24th floor



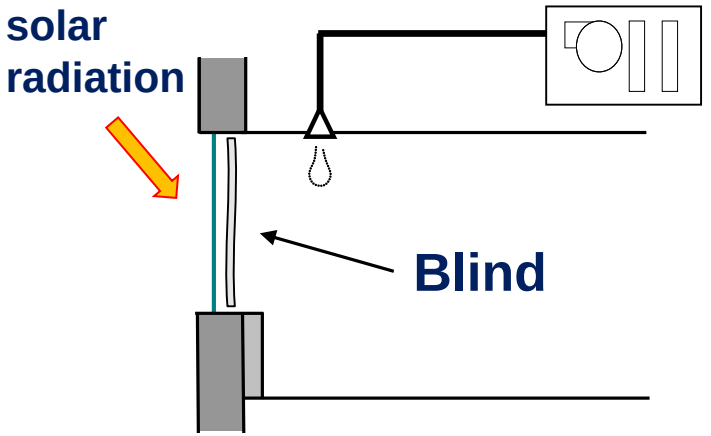
Improvement Item for Energy Saving -1

(1)Relocation of the Thermometer



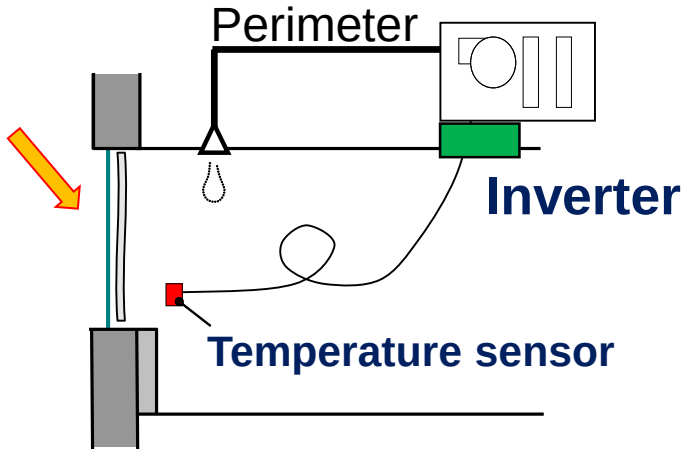
Remove Effect of the Solar Radiation

(2) High-performance Blind



Reduction of the Air Conditioning Load

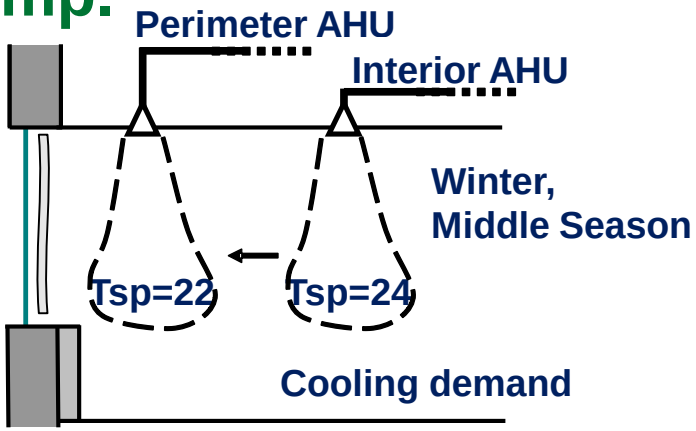
(3) Inverter Control of the Fan



Reduction of the Fan Electricity

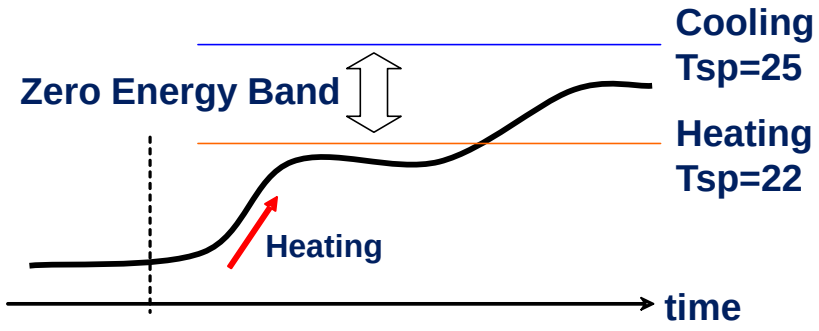
Improvement Item for Energy Saving -2

(4) Adjustment of the Setting Temp.



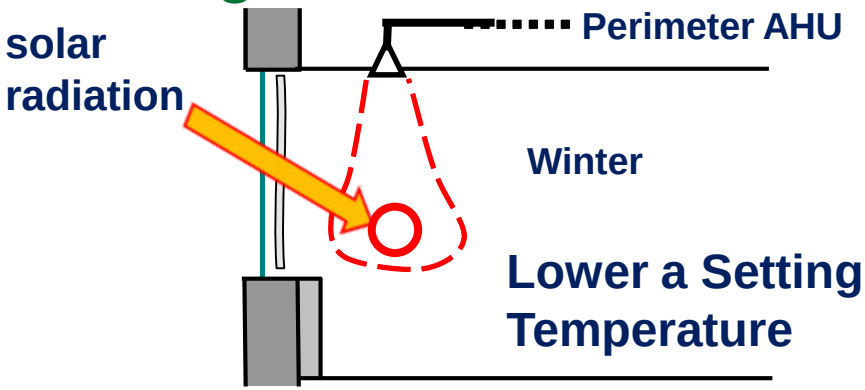
Reduction of the Mixing Loss

(5) Zero Energy Band for Perimeter AHU



Prevention of the Excessive Operation

(6) Temperature setting Using of Radiation heat



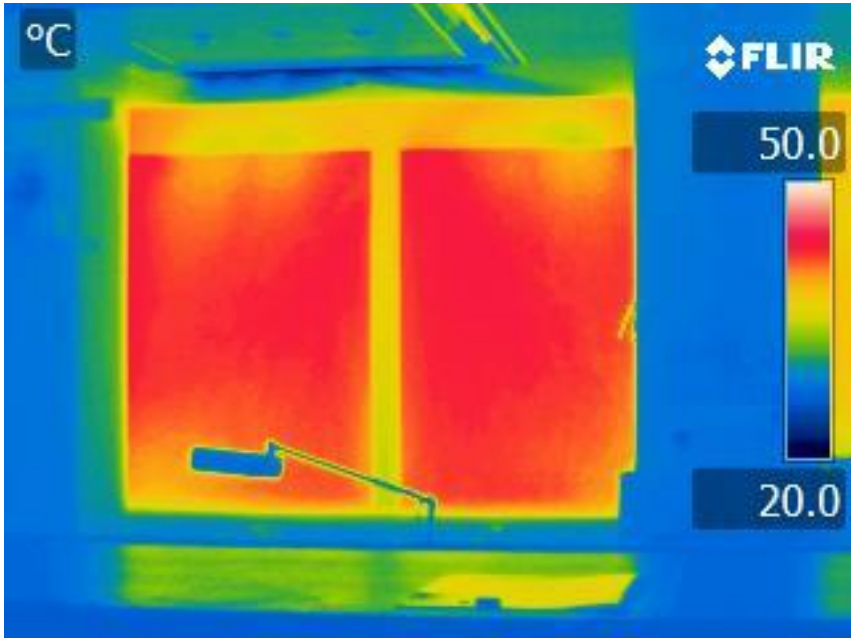
Reduction of the Air Conditioning Load

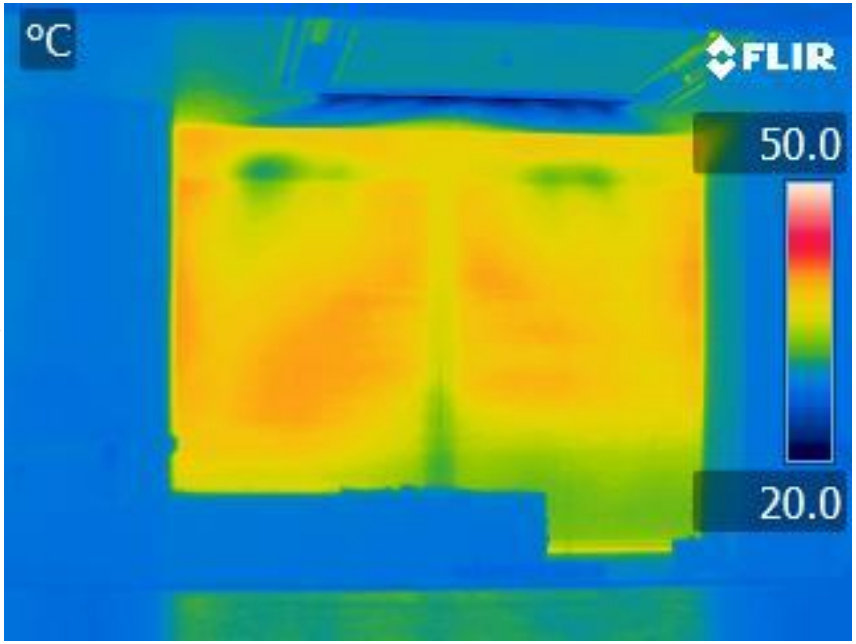
Verification of the Improvement - 1

The effect of each improvement item were verified

Thermal Performance of the Blind

2013 August





Existing Rolling Screen

High-Performance Blind

Confirm the heat load reduction of the window

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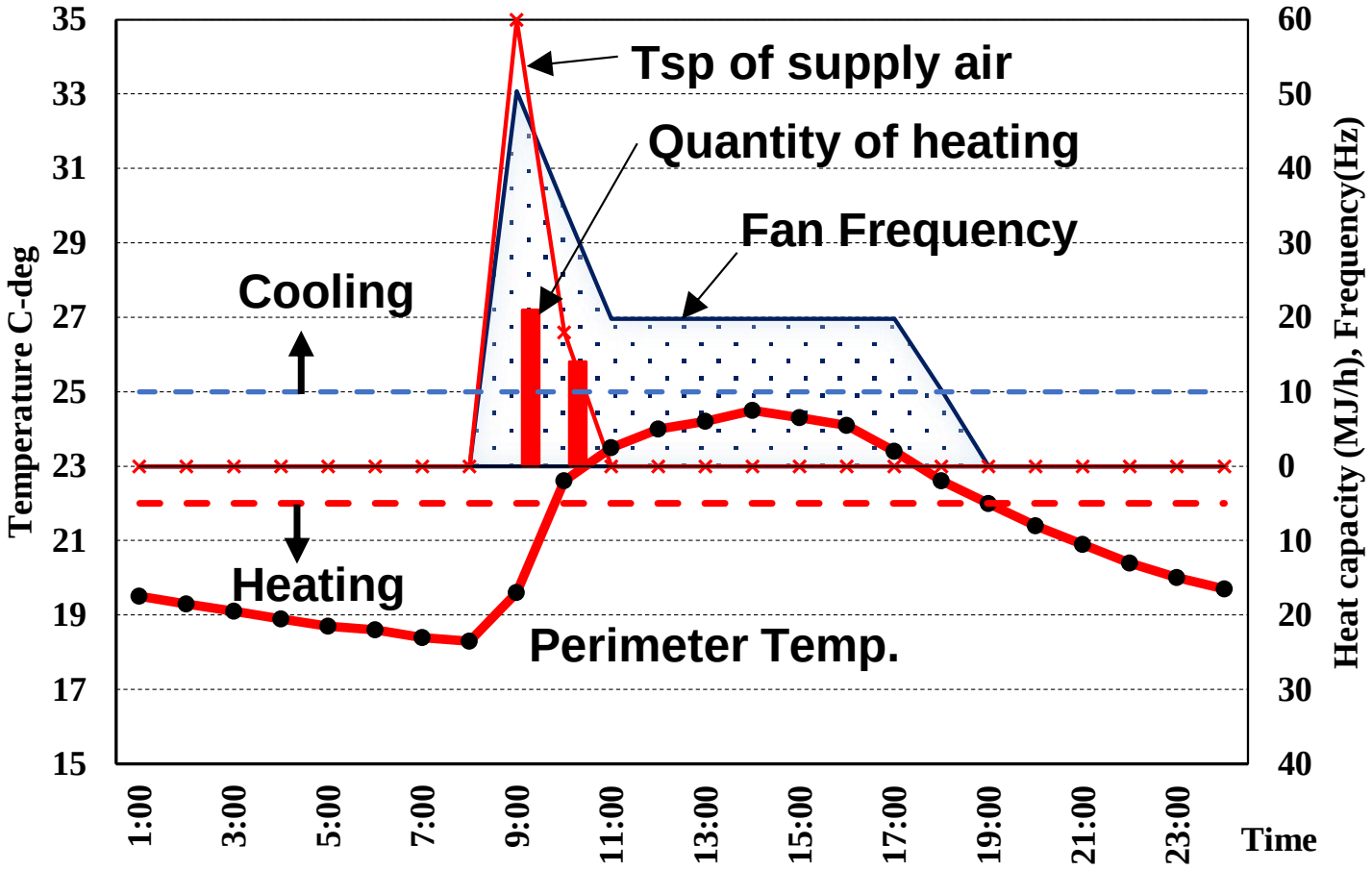
Verification of the Improvement - 2

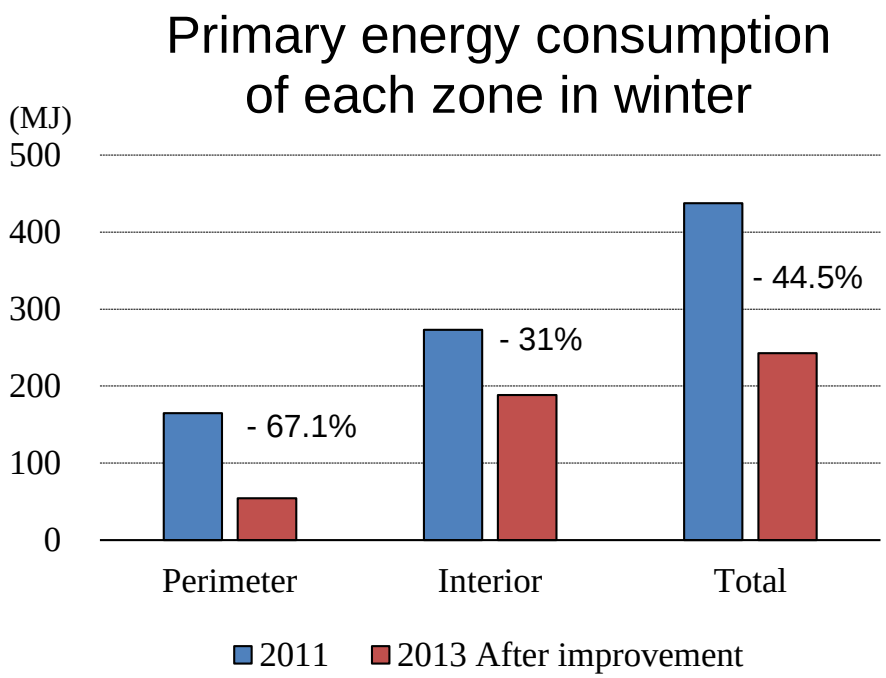
Inverter Control of the Fan

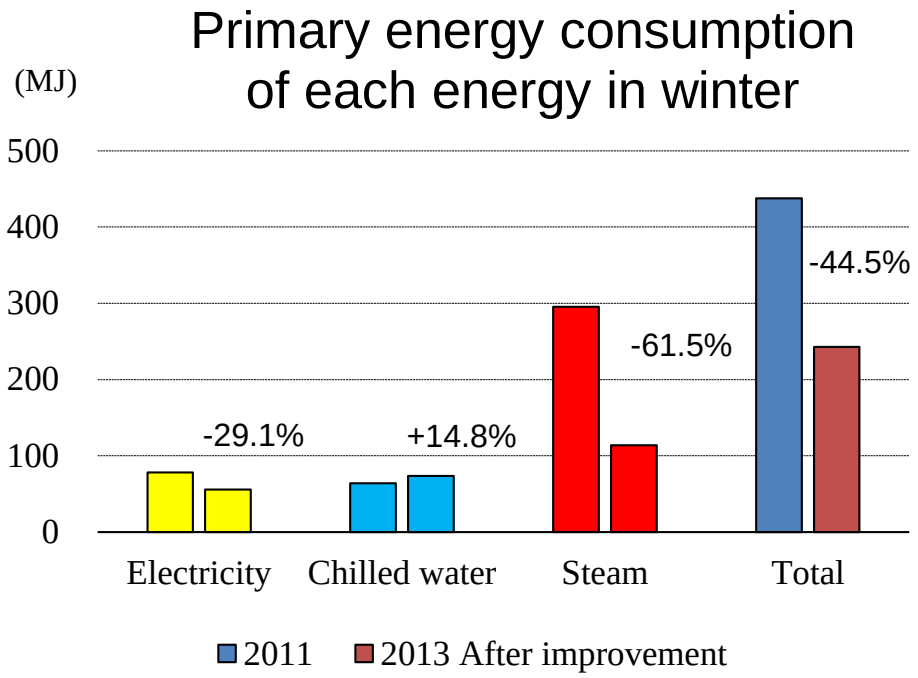


Operation check of fan control, zero energy band

Verification of the Improvement Effect by the BEMS data

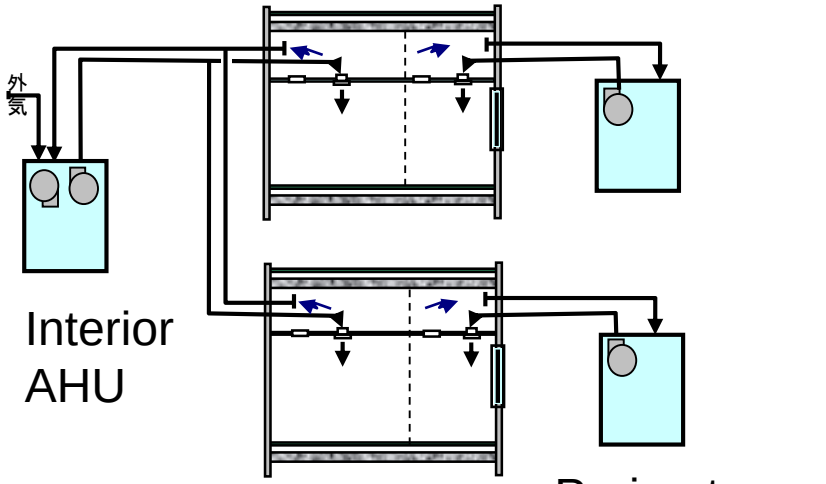
2011 : Before improvement
2013 : After improvement
Operational state is about the same

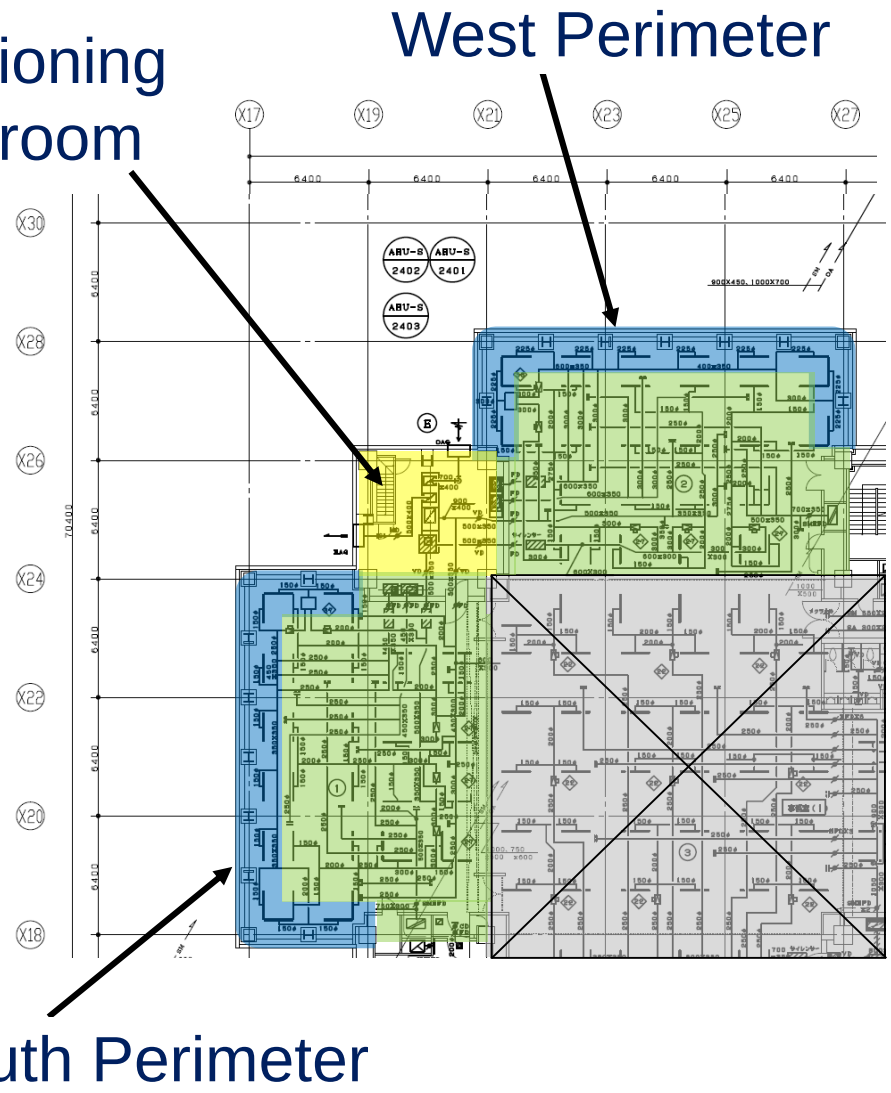




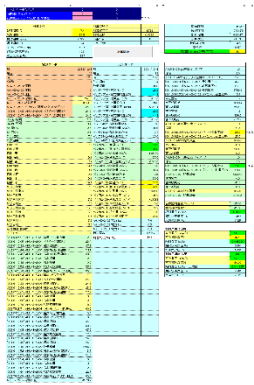
Explanation is impossible by big effect more than expected >>> Analyze it by simulation

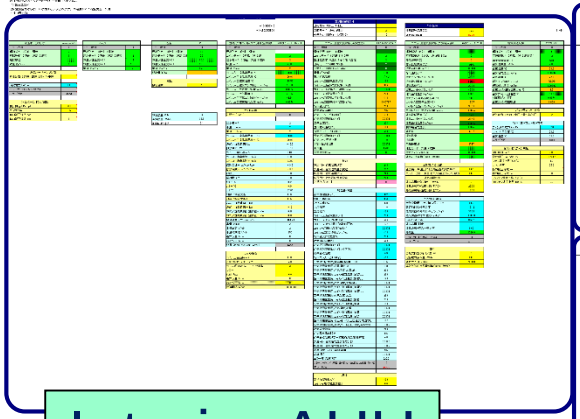
Analytic Target by the Simulation



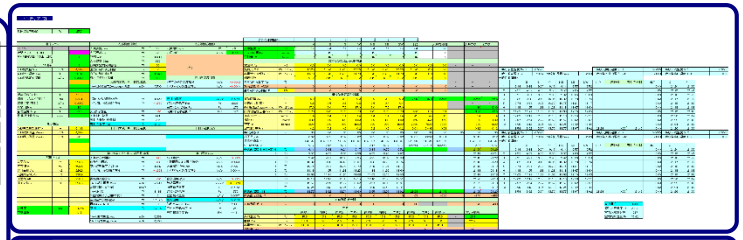


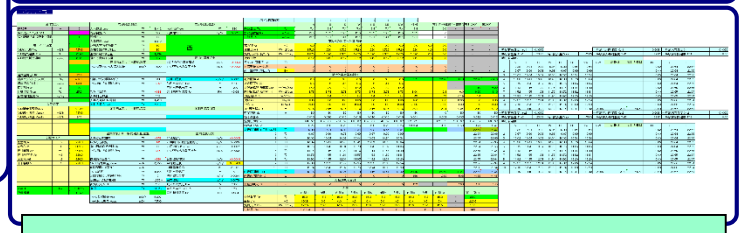
Simulation Tool of LCEM and Indoor Thermal Load



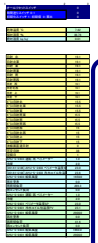


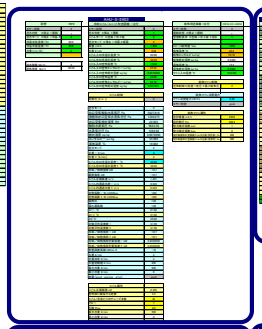
Interior AHU

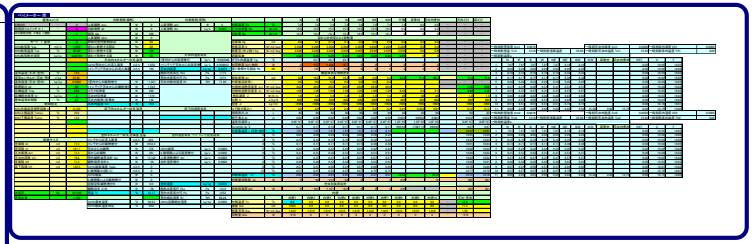




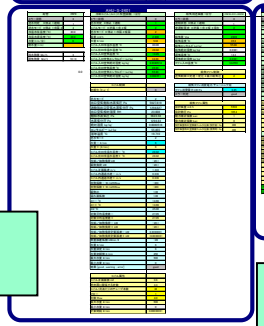
Interior Thermal Load



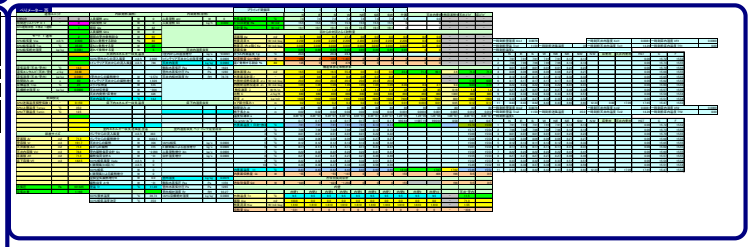




AHU : Based on LCEM
Thermal Load : Original

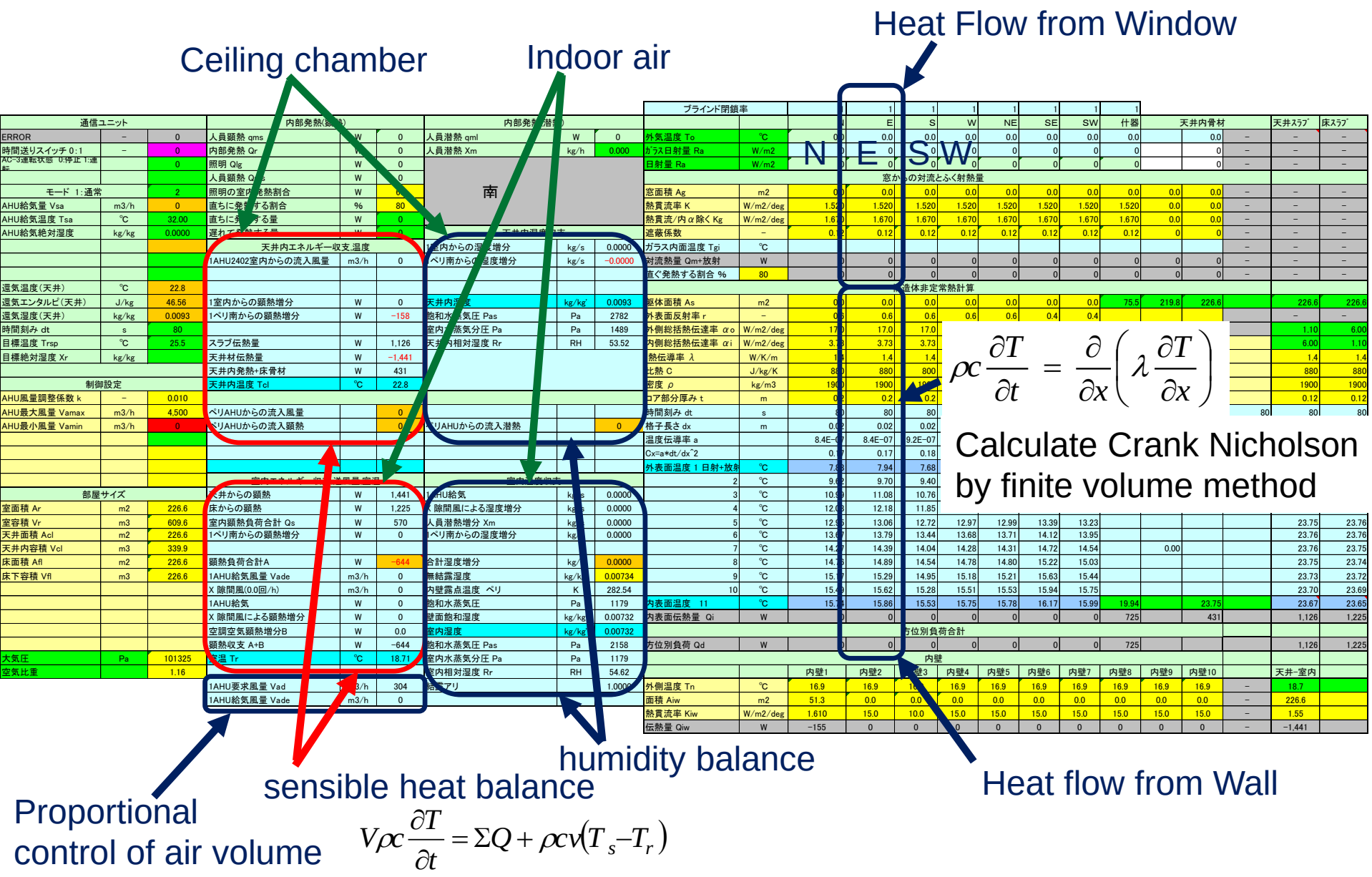


Perimeter AHU



Perimeter Thermal Load

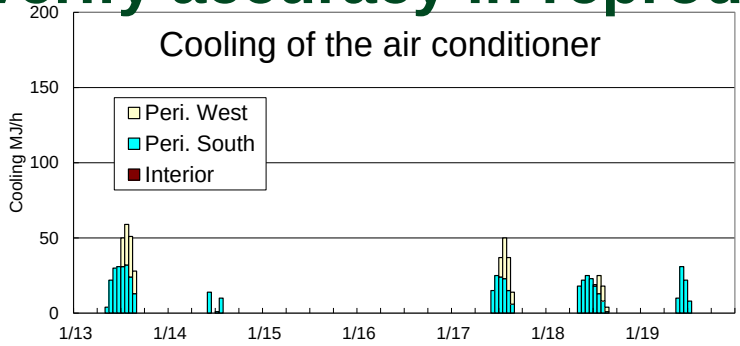
Thermal Load Program on the Spreadsheet

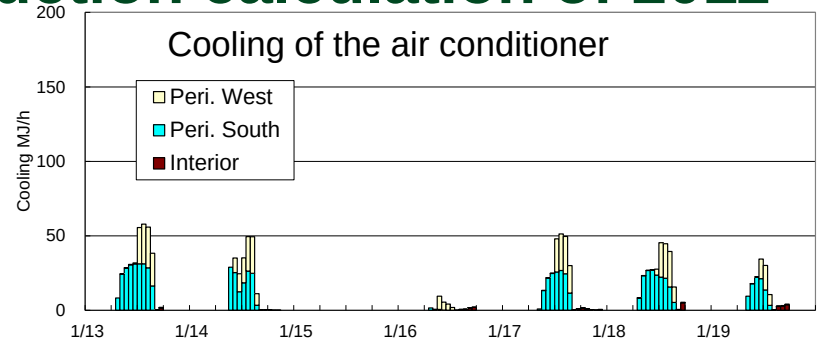


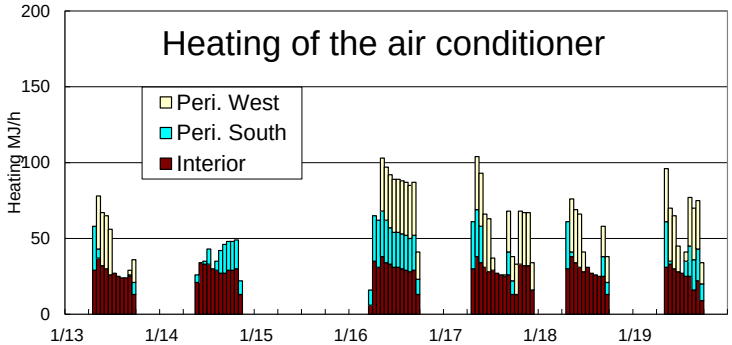
Time step = 80 seconds

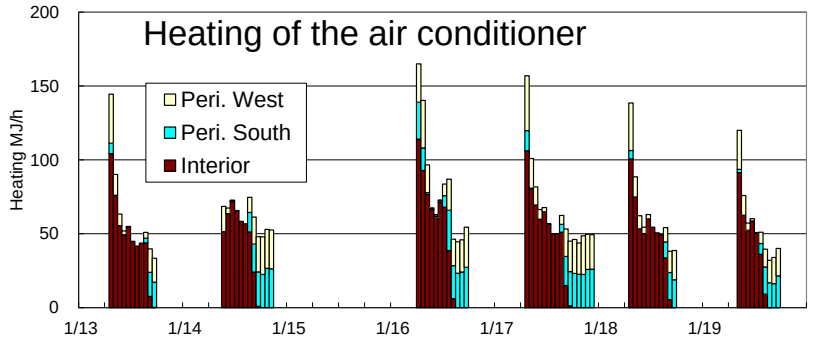
Verification of the calculation accuracy

Verify accuracy in reproduction calculation of 2011

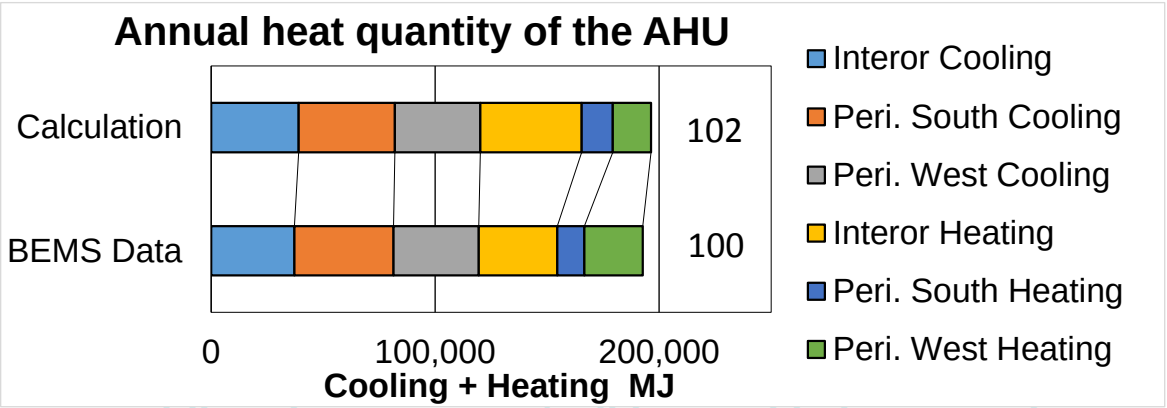






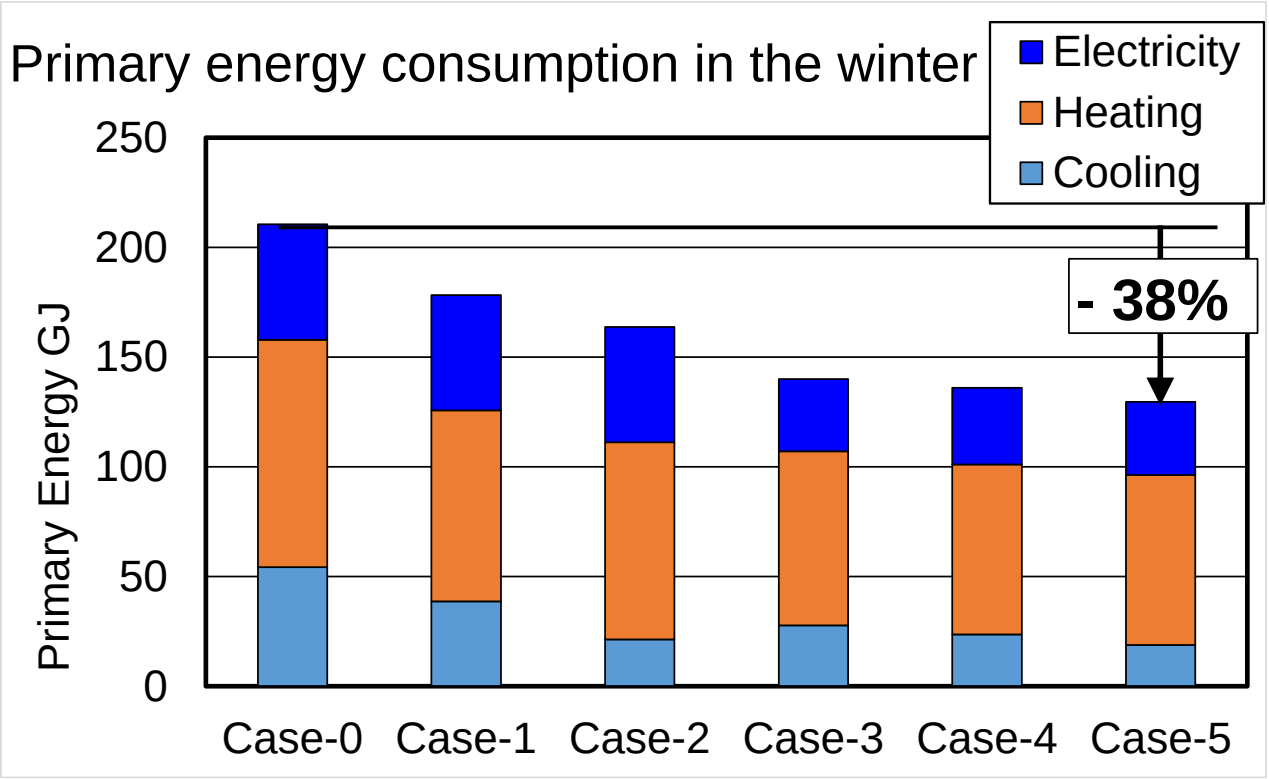


BEMS Data **Calculated Value**



The annual consumption accorded,
but further improvement is necessary

Analysis of the improvement effect by the simulation



No.	Item	%
C-0	Before improvement	100
C-1	Relocation of the Thermometer	85
C-2	High-performance Blind	78
C-3	Inverter Control of the Fan	67
C-4	Adjustment of the Setting Temp.	65
C-5	Zero Energy Band for Perimeter AHU	62
C-6	Temp. setting Using of Radiation	Not ready

Mixing loss disappeared by C-1

The thermostat of perimeter is heated in solar radiation, and cool too much it.
To disappear cool too much, the interior is heated too much.

Comparison between of 2011 and 2013 BEMS data

>>>> 43.5% Reduction

Calculation by case study ⇕

>>>> 38% Reduction

Conclusion

- The mechanism of the energy saving effect was clarified through simulation; a major contributing factor to energy saving was relocation of the temperature sensor which was conducted at lower cost.
- In the process of the analysis and the evaluation of the operation phase, this simulation method was shown to be valid.
- This assessment is continuing this summer to confirm the last year's results and conduct the energy saving effect evaluation in the summer.
- Furthermore, the thermal load calculation including the spatial distribution is under development to improve accuracy of the simulation.

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