Development of technologies to evaluate the energy consumption performance of advanced buildings

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1. Expansion of energy consumption performance calculation programs

In April 2017, non-residential buildings with 2000 m^2 or more of floor area became required to comply with energy conservation standards. To support the evaluation to see the compliance status relative to the standard, the National Institute for Land and Infrastructure Management released the energy consumption performance calculation program (for non-residential buildings).[1] In addition to the evaluation to see compliance with the energy conservation standards, people started to use the program as an evaluation tool for the labeling system (BELS), which is linked to the application for subsidies. The program was mainly used to see whether a building satisfied the minimum level of energy conservation standards. Yet, the program is now in demand to properly evaluate advanced buildings equipped with advanced technologies. Therefore, the authors developed evaluation methods based on the analysis of on-site investigations and simulations of advanced technologies (especially automatic control technology and the technology to use unused energies), which are not sufficiently evaluated with the current program due to the shortage of technical examinations. The function of the program was thus expanded.

2. Brightness detection and control in lighting devices (automatic control technology)

Brightness detection and control in energy conservation standards is defined as the function to detect the brightness inside a room using a sensor (sensors) installed on the ceilings or other areas and to control the output of lighting devices depending on the detected values. The analysis using a simulation (radiance) was conducted to determine the energy reduction rate per opening ratio (area of window per floor area) (table 1). The requirements of lighting devices to ensure control to function effectively are also organized along with the requirements for the function of automatically controlled blinds that are used along with lighting control. References are thereby prepared to allow inspection organizations to properly evaluate energy conservation performance.

Table 1. Options of brightness detection control in lighting control

Option	Condition of application	Reduction rate
Dimming type W15	Opening ratio: 15% or more	0.85
Dimming type W15BL	Opening ratio: 15% or more with automatically controlled blinds	0.78
Dimming type W20	Opening ratio: 20% or more	0.80
Dimming type W20BL	Opening ratio: 20% or more with automatically controlled blinds	0.70
Dimming type W25	Opening ratio: 25% or more	0.75
Dimming type W25BL	Opening ratio: 25% or more with automatically controlled blinds	0.63

3. Air-conditioning systems using geothermal heat (unused energy)

The authors analyzed geothermal heat pump air-conditioning systems with large piles that could not be evaluated with the current program based on four on-site investigations at four sites and simulations (Ground Club). Geothermal heat exchangers were then categorized, and the conditions of their applications were organized (figure 1). The formula for estimating the heat exchange rate with the ground was then developed.

4. Reflection in the program

The evaluation methods for the brightness detection control of lighting devices and geothermal air-conditioning systems developed in this research were reflected in the program, which was released to the public in October 2017.

☞ For detailed information

1) NILIM reference No. 973: 2016 Energy Conservation Standards (issued in January 2016) Description of Relevant Technical Reference, Energy Consumption Performance Calculation Program (for non-residential buildings)
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn973.htm

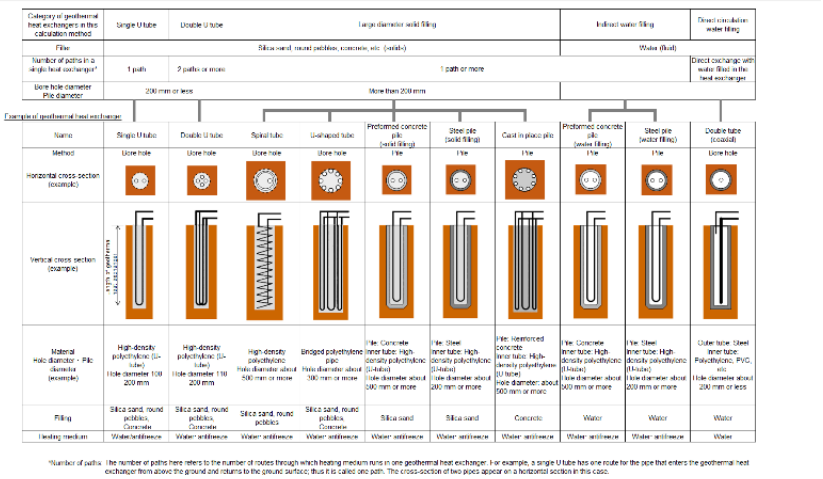

Figure 1. Category of geothermal heat exchanger and conditions of application in the energy conservation standard evaluation method