Research on the facade design method to improve energy conservation performance in buildings

(Study period: FY 2017–2019)

MIKI Yasuhiro (Ph.D. in Engineering), Head; HABARA Hiromi (Ph.D. in Engineering), Senior Researcher; MIYATA Masato (Ph.D. in Engineering), Senior Researcher, Housing Department, Building Environment Division; KUWASAWA Yasuo (Ph.D. in Engineering), Research Coordinator for the Housing Information System, Housing Department

(Keywords) Energy conservation, facade, thermal environment, optical environment

1. Facade design to improve energy conservation in buildings

To realize advanced energy conservation in buildings, it is important to use the design of the facade (the exterior section of a building, such as the outer walls, windows, and roofs), which is the upstream step in the building design process, to reduce the loads on building facilities, such as the loads on air conditioners. Thus, this research examines how various types of facades affect the reduction of energy consumption in air conditioning and lighting facilities. The objective of this research is to develop design methods to improve energy conservation performance using the facade.

2. Examination of technical material to design energy conservation type facade

This research is conducted based on the flow shown in the table. This year, which is the final year of this study, technical material is examined to prepare the proposal for the guidelines for designing the energy conservation type facade. The technical material is the result of an annual simulation that measured the differences among major types of façades using software known for the evaluation of energy conservation and the indoor environment. The software used to measure the air conditioning load is EnergyPlus, and the lighting load is Radiance. Using the result, energy conservation performance, which can be used as a reference when designing a common office building, precautions in the actual design, and the concept of maintaining the thermal and optical environment are organized. Figure 1 and Figure 2 are part of the technical material based on an office in a large building. In the case of a large room that is long in the direction of depth, the load for cooling dominates the annual air-conditioning load, which is the most emphasized aspect of the design, and the effect of different types of façades is extremely small. Yet, the effect of using daylight with different types of façades, depending on the direction, becomes large in reducing the lighting load. Meanwhile, the façade design becomes more effective in mid-size buildings. This is because the depth of a room becomes shorter, and the effect of the façade in reducing the lighting load becomes relatively large compared to the air-conditioning load. This is also described in the drawings in the material.

Table: Research flow of the entire research period

FY 2017	Reconstruction of the method to evaluate the performances of individual facade types and preparation of indexes and standards for the indoor environment
FY 2018	Development of the method to evaluate the energy conservation performance based on the combined effects of the facade on air conditioning and lighting
FY 2019	Preparation of the facade design method to improve both the energy conservation performance and the indoor environment

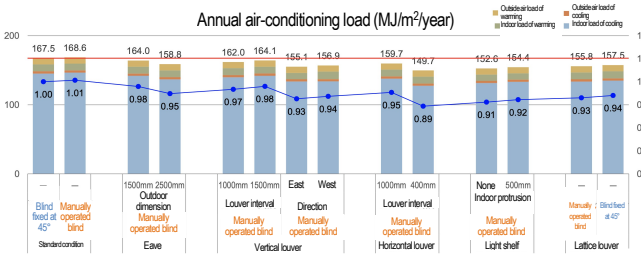

Figure 1: Annual load on air conditioning based on differences in facades

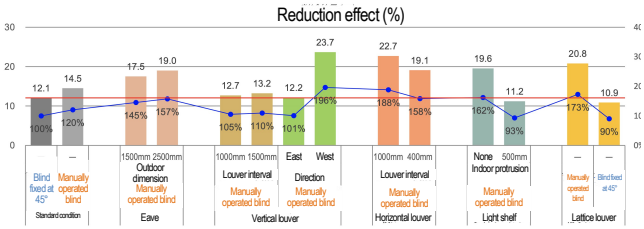

Figure 2: Effect of reducing the annual lighting load based on differences in facades

3. Future prospects

Technical materials will be organized and issued as an energy conservation design guideline using more graphical figures for better understanding among designers.