Research on the Method of Designing Façades to Improve the Energy Consumption Performance of Buildings (Period of research: fiscal 2017 to 2019)

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1. Background and Purpose

It is required that CO_2 emissions from buildings are reduced by 40% by 2030 from the level in 2013. (Japan's Intended Nationally Determined Contributions were adopted at a Cabinet meeting in July 2015 and submitted to the Secretariat of the United Nations as a new objective for greenhouse gas emission reduction after 2020.) Therefore, further energy conservation in buildings is essential. On the other hand, because there is a limit to the improvement of efficiency in facilities and equipment naturally, it is important to reduce the load placed on the equipment, including the air-conditioning and lighting load, by the design of a façade (design of the thermal performance of outer wall, windows, and roof), which is the upstream process of building design (Figure 1). The indoor environment (thermal and lighting/visual environment) is influenced by outdoor weather, and façade design plays an important role in it. In the current evaluation process, however, the indoor environment is not sufficiently considered. For example, heating energy is currently evaluated on the assumption that all room temperatures have already reached the set temperatures when the room heating starts. In actuality, however, you may feel colder in the peripheral areas of a room because they are cooled by cold walls and windows (Figure 2). On the other side of the window in a room, you may feel it is relatively dark during the daytime because the window is brighter than the surface of a desk (Figure 3).

Based on the above, in order to further promote energy conservation in buildings, we will start the research in the title from fiscal 2017 with the aim of establishing evaluation and design methods for façades that can reduce the load on facilities and equipment.

2. Procedure of the Research

We will rearrange the parameters of façade performance (thermal insulation, sun shading, daylighting and light guiding) based on the previous studies and domestic/international standards, grasp the relationship between performance and the indoor environment through experiments using a simulated office (Figure 4) and numerical simulations and develop an evaluation method. Based on the method and case studies, we will improve the method of designing a façade.

3. Use of the Result

The evaluation method developed will be reflected in the evaluation according to the energy efficiency standards. We are going to prepare NILIM reports or specific design guidelines and submit information on the façade design method to a wide variety of audiences.

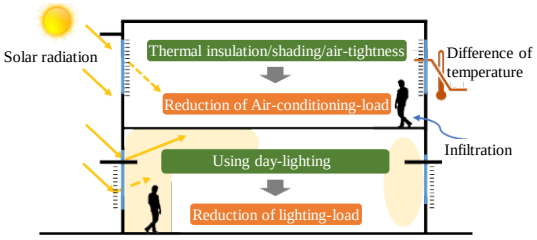

Figure 1: Example of the reduction of load by façade design

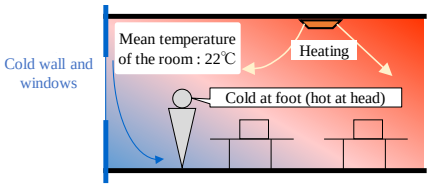

Figure 2: Example of thermal environment when heated

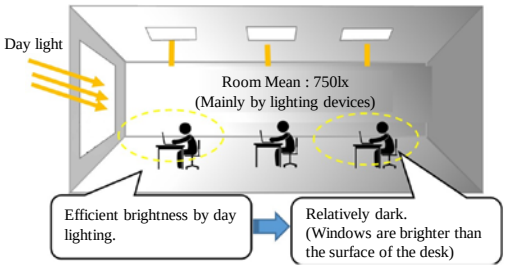

Figure 3: Example of light/visual environment in daylight

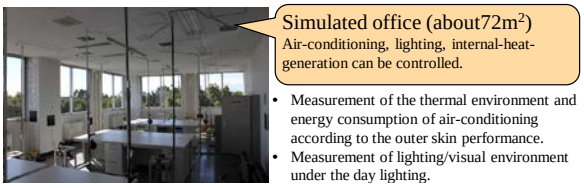

Figure 4: Simulated office for experiment (Building Research Institute)