Study on facade design to improve the energy efficiency of building (Research period: FY 2017-2019)

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1. Background and objectives

To realize advanced energy conservation in buildings, it is important to use the design of the facade (exterior section of a building, such as outer walls, windows, and roofs), the upstream step in the building design process, to reduce loads on facilities, such as loads on air conditioners and lighting facilities. Facade design affects the energy consumption of air conditioners and lighting facilities, but its effects have not been properly evaluated. In addition, unlike the annual consumption of primary energy, no proper evaluation has been done on the indoor environment, such as thermal and optical environments that are affected by the facade and installed facilities in regard to their balance with energy conservation, which is evaluated throughout the year. Thus, this study aims to develop methods to evaluate and design the energy conservation performance of buildings and the indoor environment using the facade to increase energy efficient buildings in which both energy conservation and the proper indoor environment are realized.

2. Contents of research

This research is conducted based on the structure shown in Table 1. In FY 2018, the energy consumption performance evaluation method was developed by taking into account the combined effect of the facade on air conditioners and lighting facilities. To conduct annual examinations, a simulation was conducted to measure the load on air conditioners using the software EnergyPlus and the load on lighting facilities using the software Radiance. These software programs are known to provide good evaluations of energy conservation and the indoor environment. This section describes a case as shown in Figure 1 that mainly examined the effect of a facade designed to effectively take in daylight while cutting solar radiation heat on the annual load on lighting facilities. Figure 2 shows the annual lighting reduction effect achieved when different types of building facades were combined with blinds fixed to 45 degrees. When the building facade is combined with blinds fixed to 45 degrees, which is the most common use of blinds, the load on lighting was reduced with the building façade, such as horizontal louvers, and a light shelf, which would take the light in using the reflection of daylight. These facades also have a good effect on the indoor environment (effect of preventing glare) because the blinds additionally block the light. Also, the building facade has the high effect of blocking solar radiation heat, and it is expected to reduce the load on air conditioners. As discussed above, various ideas with the facade design are effective in improving energy conservation effects and maintenance of the indoor environment.

Table 1 Research contents of the entire research period

H29年度	ファサードが持つ個別性能の評価法の再構築と室内環境の指標・水準の整備
H30年度	ファサードの空調・照明への複合的影響を考慮したエネルギー消費性能評価法開発
H31年度	エネルギー消費性能の向上と室内環境の両立を目指したファサード設計法の整備

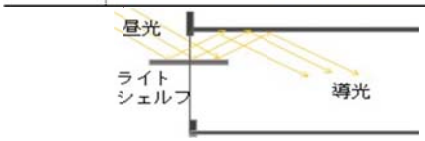

Figure 1 Example of facade which effectively take in daylight

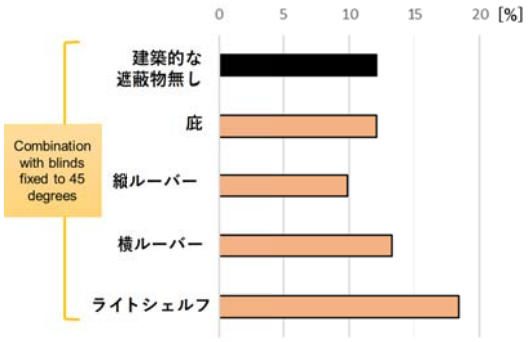

Figure 2 Annual energy conservation effect in lighting achieved by the combination of building facade and fixed blind