Air-conditioning Load Retrenching Effects for Buildings

ASHIE Yasunobu (Dr. Eng.), Head
Environmental and Equipment Standards Division, Building Department

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1. What is water-retentive material?

Water-retentive building materials are made of ceramics with fine pores of about 1 – 100 μm. When water accumulated by watering and precipitation vaporizes, it is deprived of vaporization heat, and an increase in the temperature of water retentive building material is curbed, which is expected to contribute to decreasing the cooling load.

2. Heat/moisture simultaneous analysis

The spread parameter of heat/moisture in high porosity materials widely varies according to the impact of temperature and the water content ratio. For this reason, we preliminarily investigated the characteristics of the parameters of water retentive building materials in an experimental laboratory and have developed a calculation method to predict the moment-to-moment surface temperatures and evaporation volumes by heat/moisture simultaneous analysis.

We also applied water to test samples in summer and observed the surface temperature (Figure 1). In order to corroborate the validity of analysis, the comparison between forecast calculations and observation results is illustrated in Figure 2. The surface temperature decreased to 40℃ from 70℃ by watering at noon on August 17, although it had been fine since the following day, showing the temperature increase being curbed.

3. Air-conditioning load reduction effects

In air-conditioning load calculations, water retentive building materials usually have not been dealt with. In this regard, we newly incorporated a heat/moisture simultaneous transfer model into air-conditioning load calculations for buildings and examined installation effects of water retentive building materials.

The annual air-conditioning load calculation result of a factory (floor area: 1,000m^2, roof insulation: 50mm) is indicated in Figure 3. This illustrates the fact that the cooling load and heating load have been reduced in each area of Tokyo, Osaka, and Naha owing to the construction of water retentive roofs. Since the water retentive building material decreases its surface temperature, it is effective for countermeasures against the heat island effect in the summer season and reduction in the cooling load. In addition, due to the function of the effect of heat resistance, it also is considered effective for reducing the heating load.

[Reference]

1) Ashie, et. al.: Japan Architectural Environmental Group Collection of Papers
2) Asie, et. al.: Collection of Academic Papers of the Convention of Society of Air-conditioning and Sanitary Engineers of Japan

Figure 1: Watering to experimental sample of water retentive building material

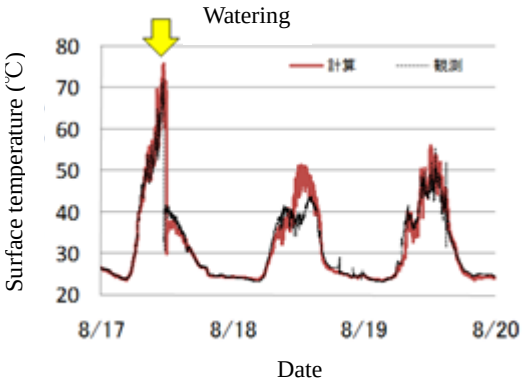

Chart 2: Comparison between calculation and

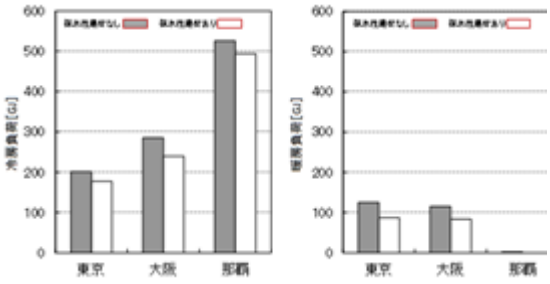

Chart 3: Air-conditioning load calculation results of factory

Watering