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EXPERIMENTAL STUDY ON THE MEASUREMENT OF SENSIBLE HEAT FLUX AT THE ROOF SURFACE COATED BY HIGH REFLECTIVITY PAINTS

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1. INTRODUCTION

Various roof finishes, such as high reflectivity paints, green roofs, are proposed as a countermeasure of urban thermal environment for the mitigation of heat island effects and the reduction of cooling load in summer[1),2),3)]. The roof surfaces coated by high reflective paints are able to reduce the sensible heat flux from roof surfaces and to prevent the heat storage caused by solar radiation. In this study, the sensible heat flux estimated from the result of surface heat budget was described with comparison between normal concrete surface and white paint surface. The albedo of white paint used here was 0.64 and the reference surface of concrete was 0.37.

2. METHOD OF MEASUREMENT

The roof experimental installation, constructed on the roof floor of the university building, was used for the measurements of heat budget. The university building was 8 stories, the floor area of about 17,500 m^2 and completed in July, 2002. Fig. 1 shows the experimental site, each size is basically 0.94m×1m. Unit 9 is the reference site of concrete surface, unit 11 is white in the Fig. 1.

Fig. 2 shows the section of the concrete slab. The surface temperature, the temperature of two points in the slab and the surface temperature of backside under the slab were measured using thermo couple with one minute interval. The experimental slab is located 3m high from the roof floor. However, when this experiment was conducted, the space under the experimental slab was not yet covered with walls, and has no temperature control. The analysis periods are fine three days of September, 2003.

3. RESULTS OF TEMPERATURE MEASUREMENT

Fig. 3 shows radiation budget measured by net radiation meter. The solar radiation was about 800 W/m^2 at the maximum in daytime. Fig. 4 shows the temperature of inside slab and air temperature. The surface temperature of white surface was about 8 degree lower than concrete. Nevertheless the surface temperature, measured by thermo couple, careful setting to the solar radiation, it may influenced by it.

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4. RESULTS OF SURFACE HEAT BUDGET

The conductive heat flux was estimated using the method of differential equation based on one dimensional unsteady heat conductive equation. The influence of evaporative heat flux was not considered because of no rain during and near before the analysis period. Finally the sensible heat flux was estimated by the residue method.

Figs. 5 show the heat budget at the each surface. The results show that the concrete surface was 120-150 W/m^2 at the maximum, while the white surface was 75-100. The white surface was about 50 W/m^2 smaller.

5. CONCLUDING REMARKS

The sensible heat flux on the roof surface was estimated from the results of surface heat budget. The comparison between white paint surface and normal concrete surface was presented. White paint surface was able to reduce the larger sensible heat flux comparing to the concrete surface. The comparisons with some kinds of paints, plants and the various conditions such as the temperature control at the underside of slab, are experimented in this summer.

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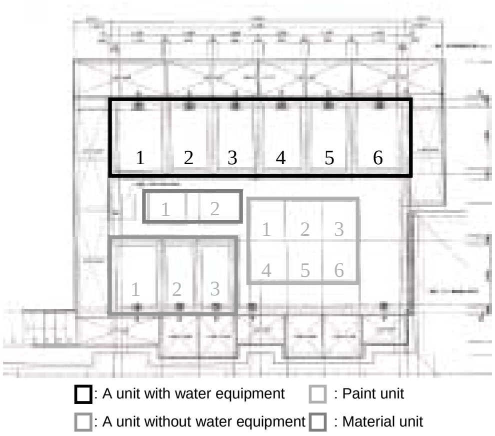

Figure 1 The roof experimental installation, constructed on the roof of the university building

Picture 1 Experimental roof of Kobe University

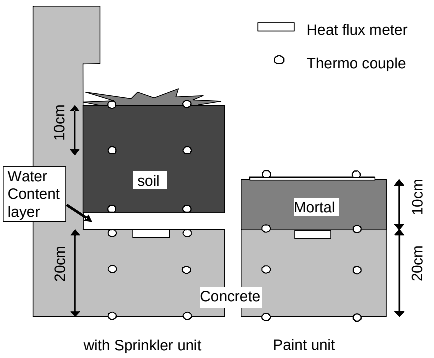

Figure 2 Section of Slab and Measuring Points

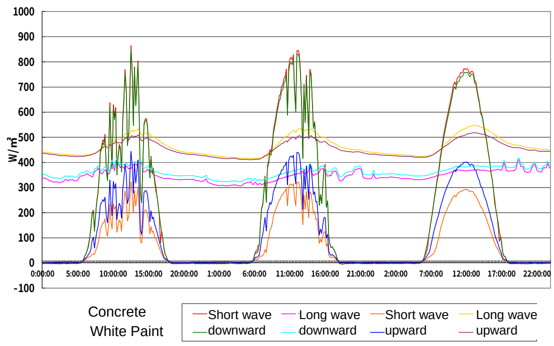

Figure 3 Radiation Budget

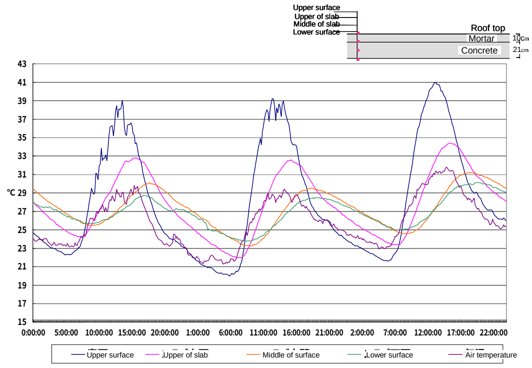

Figure 4a Inside Temperature of Concrete Slab and air temperature (measured by thermo couple)

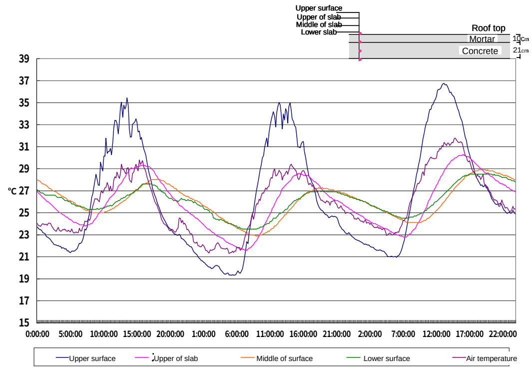

Figure 4b Inside Temperature of White Paint Slab and air temperature (measured by thermo couple)

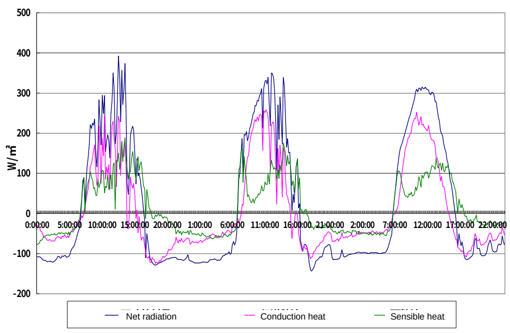

Figure 5a Heat Budget at Concrete Surface

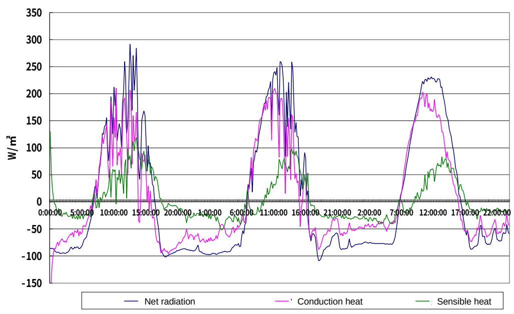

Figure 5b Heat Budget at White Paint Surface