Effect of Wall Greenery on improving the Thermal Environment

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Abstract

The aim of this study was to examine mitigating effects on the wall greenery heat environment. A control area of the experiment was the cement wall of a penthouse on the roof floor of a university building located in Aoba Ward of the city of Yokohama. Hedera helix was planted onto about half the area of the wall (height 3500 × wide 3600mm). Then thermal sensors were installed in mesh pattern in order to measure surface temperatures of the planted (length 4 points × side 4 points) and non-planted surfaces (length 4 points × side 4 points) and temperature distribution 10-cm in front of those surfaces of the planted (length 4 points × side 4 points) and non-planted (length 4 points × side 1 point). Temperature distribution in a summer and winter day was recorded and analyzed for 24 hour period.

No difference in temperatures of the planted and non-planted surface of the wall could be observed before dawn, and no significant difference was observed from morning till early afternoon. Both surface temperatures gradually decreased from evening till night, with those of the planted surface continuously being kept lower than those of the non-planted. The wall greenery is effective for the air temperature moderation caused by the plant transpiration, in addition to suppression of heat accumulation.

Keywords : Wall Greenery, Hedera helix, Thermal Environment, heat environment

1. Purpose of research

In late years the urban region becomes the problem that heat environmental degradation such as the heat island effect is serious. It is assumed to be an intention to decrease such a load, receives the inducement measure of the various place municipality in recent years, and a special greening by rooftop gardening and the wall greenery. (Photo.1,2)

There is a research on an insulating effect to the built structure brought by greening and a peripheral effect of the temperature easing for the effect of the heat environment improvement according to a special greening. Recently, the industrial method with the

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panel type unit is widespread though the plant hung on the built structure has been often verified about greening on the wall so far by the invitation, adsorption, and hanging downwards. [1][2]

The aim of this study was to examine mitigating for the surface temperature by the presence of the panel type greenery and the difference of the neighborhood temperature transition effects on the wall greenery heat environment.

2. Research material and method

The measurement targeted the penthouse south of the Toin university of Yokohama student Hall. The wall becomes height 3500mm × width 3600mm, and the white wall material is the plastic operation cement board (CBt1500 : C), it things except becoming the object .This right side was planted. The wall greenery set the standard of the greening unit height 1920mm × width 2550mm. The greenery unit box is filled to height 1200mm × width480mm × thickness100mm as a medium for the plant side. The experimented plant was assumed to be *Hedera helix* greenery used by greening on the wall. The temperature sensor (RSW-10 and made by the ESPEC MIC CORP.) (photo3,4) was used for the measurement. Then thermal sensors were installed in a mesh pattern in order to measure surface temperatures of the planted (length 4 points × side 4 points) and non-

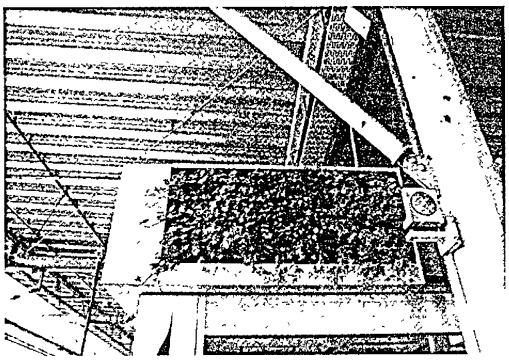

Photo.1 Case of wall greenery (1)
(Hutakotamagawa Sta.)

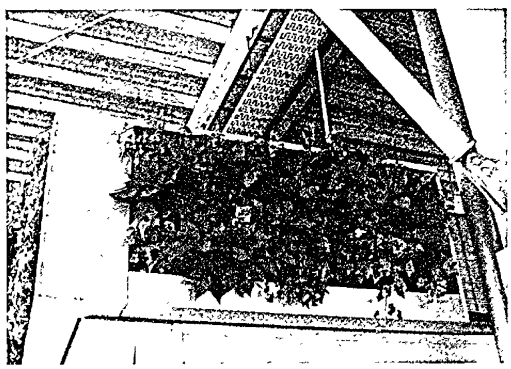

Photo.2 Case of wall greenery (2)
(Hutakotamagawa Sta.)

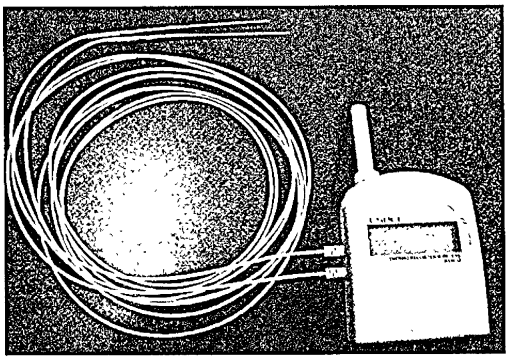

Photo.3 Temperature sensor for measurement

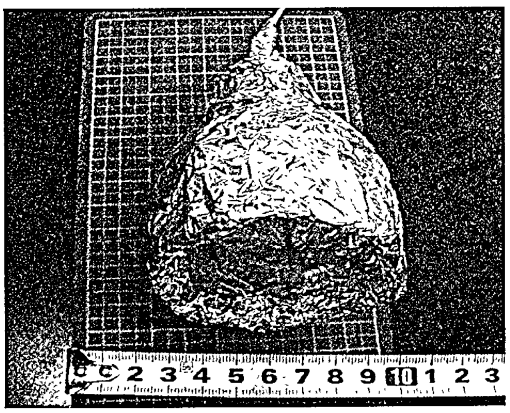

Photo.4 Aluminum cover for temperature sensor

planted surfaces (length 4 points × side 4 points) and temperature distribution 10-cm in front of those surfaces of the planted (length 4 points × side 4 points) and non-planted (length 4 points × side 1 point). Temperature distribution in a summer and winter day was recorded and analyzed for 24 hour period. (Photo.5,6)

Water is supplied by the automatic drip type at 1 hour from 6:00AM every day. Data measured the measurement from Jul. 27, 2008 to Jan.15, 2009 every 20 minutes of 24 hours.

3. Results

The day of a steady weather condition was selected based on the weather data of Kanagawa Prefecture Yokohama City at each season and the investigation object was assumed Jan. 15 (average wind speed 4.3 m/s hours of sunshine 9.5h) in winter and Aug.6 (average wind speed 2.4 m/s hours of sunshine 11.3h) in summer. In addition, it is 22 days when summer was precipitation amount 0.0 at the highest temperature 30 °C or more for six durations of sunshine hours or more as for the amplitude at the temperature day. It analyzed it for 22 days that were precipitation amount 0.0 from 6 durations of sunshine hours to the normal temperature 10 °C in winter.

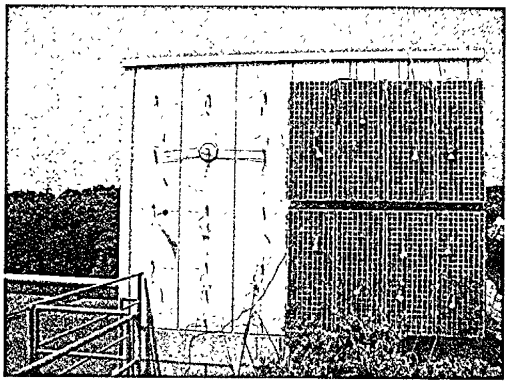

Photo.5 Wall greenery panels used to experiment

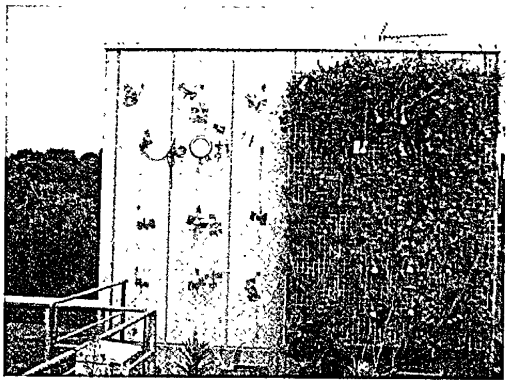

Photo.6 Planted Hedera

(1) Change on day of temperature in summer

Time when the cement wall had recorded the maximum temperature was 15:00. The wall greening side stayed in 30.5 °C, and there was a cooling effect of 12.6 °C though reached 43.0 °C by the cement wall. The temperature of the wall greenery neighborhood had decreased from 15:00 to 20:00 before the cement wall neighborhood though the temperature rose in the greening side neighborhood in 15:00 when the maximum temperature was recorded at 6:00 before the cement wall neighborhood (Fig.1).

(2) Change on day of temperature in winter

Time when the cement wall had recorded the maximum temperature was 13:00. The wall greenery had the cooling effect of stayed 15.8 °C~19.1 °C though the cement wall reached 34.3 °C.

The temperature of the wall greenery neighborhood had decreased from 13:00 to 17:00 before the cement wall neighborhood though the temperature rose in the wall greening neighborhood in 13:00 when the highest temperature was recorded at 8:00 before the cement wall neighborhood (Fig.2).

Durations of sunshine showed a similar

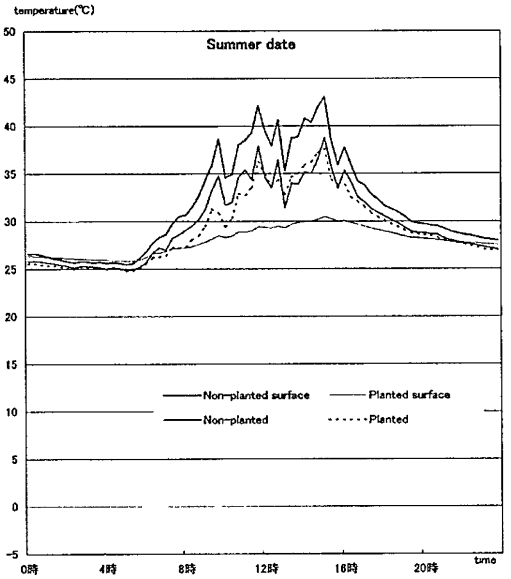

Fig.1 Change on day of temperature in summer

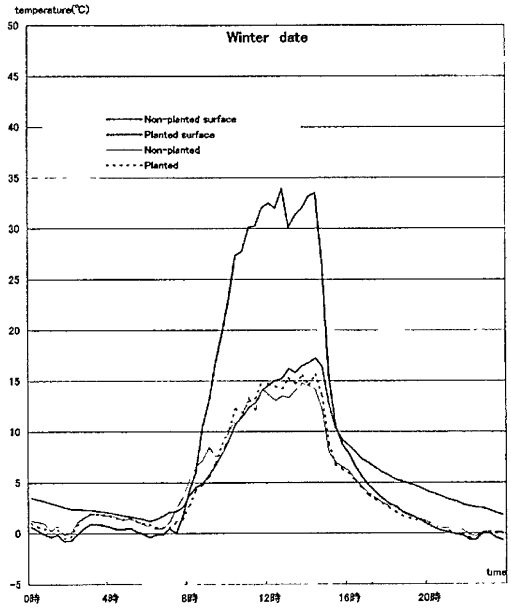

Fig.2 Change on day of temperature in winter

transition on the day of a steady weather condition on about 10h/day or more at any season.

(3) Difference between maximum temperature and lowest temperature

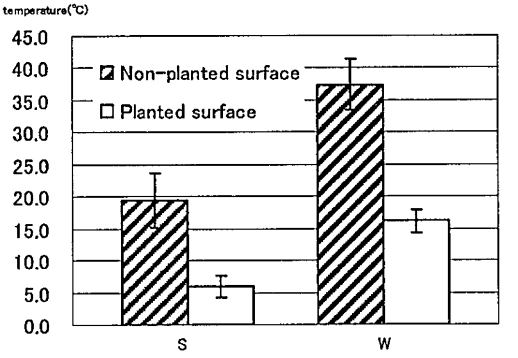

Fig.3 Difference between maximum temperature and lowest temperature
S = summer days (Aug.2008 - Sept.2008)
W = winter days (Dec.2008 - Jan.2009)

The effect of controlling about 5 ~15 ℃ and the day change was admitted on the surface of the wall greenery while the amplitude reached about 20 ~ 40 ℃ from summer to winter on the day of the outside wall surface temperature. The effect of a remarkable difference greenery was not able to be admitted on the other hand about the cement wall and the wall greenery neighborhood diurnal temperature range (Fig.3).

References

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