

# Some Examples of Roof or Wall Planting Works and Temperature Measurement of Planted Vegetation

by

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In this paper the authors presented some examples of roof or wall planting works in Nagasaki Prefecture and other places including Fukuoka City, and described the result of temperature measurement of vegetation used for roof or wall planting. As a result it was made clear that the temperature of vegetation was relatively low in comparison with those of other materials on roof and bare wall surface. This made us confirm that roof or wall planting may contribute to the reduction of heat radiated from the earth surface.

## 1 . Introduction

Nowadays we have intensification of the heat island problem as well as the global warming problem in Japan. For these problems the effect of vegetation is taken notice of in such a way that vegetation reduces the heat radiated from the earth surface.

In this paper the authors present some examples of roof or wall planting works using heat reduction effect of vegetation, and describe the result of temperature measurement of vegetation used for roof or wall planting.

## 2 . Examples of Roof Planting Works in Nagasaki Prefecture

Table 1 is a list showing examples of roof planting works performed in Nagasaki Prefecture and other places by a planting company at Nagasaki City since 1998. As seen from this table the number of roof planting works was a few for 1998 to 2000, but increases rapidly in 2001 in spite of it that the data of 2001 are until this August.

The background of rapid increase in roof planting works is supposed to be that in Nagasaki City they introduced the system of aiding roof planting works in 1993, in Tokyo Metropolitan they enforced the regulations concerning the duty of roof planting this April, and in the Ministry of Land, Infrastructure and Trans-

port they began to aid roof planting works this August.

Table 1 Example of roof planting works in Nagasaki Prefecture and other places

Bldg. Name	Location	Area (m <sup>2</sup> )	Perform. Period
A. Bldg.	Nagayo T.	45	May 1998
K. Medical Bldg.	Nagasaki C.	25	Aug. 1998
Priv. House		50	Nov. 1998
I. Bldg.	Nagasaki C.	50	Mar. 1999
MD Bldg.	Nagasaki C.	20	Mar. 1999
MR Hospital	Fukue C.	100	Dec. 1999
Mansion	Nagasaki C.	40	Mar. 2000
Priv. House	Nagayo T.	135	Mar. 2000
Eco-House	Fukuoka C.	4	May 2001
Care House	Kobe C.	1650	June 2001
Ward Office	Tokyo Met.	100	June 2001
Eco-Town C.	Kitakyushu C.	120	June 2001
Municipal Res.	Fukuoka C.	400	June 2001
Priv. House	Nagasaki C.	60	July 2001
Exhibit. House	Sasebo C.	35	July 2001
Exhibit. House	Oomura C.	25	July 2001
Dept. Store	Nagasaki C.	108	Aug. 2001

(after Masaki ENVEC Co., Ltd.)

## 3 . Detail of Roof or Wall Planting Work

### 3 . 1 Building with Stepping Garden

The “ACROS Fukuoka” is famous for a building with stepping garden which is located at the central part of Fukuoka City. This building was built in March, 1995, and recently gathers spot lights in respect of roof planting.

The “ACROS Fukuoka” has 14 floors on the ground, the roof of each floor which is planted a lot of trees as shown in Plate 1. Although having been of

76 kinds at the establishment of this institution, the trees are of over 110 kinds at present because new kinds of trees were added to plant and tree seeds were brought by birds and others.

Soils on which trees are planted are light-weight soil named "aqua soil", the depth of which is 40 cm for growing trees and 10 cm for draining, respectively. Under these soils a permeable mat and a pressure-bearing plate for permeating water and air are embedded as shown in Figure 1 .

According to The Mainichi dated on May 31, 2001, it was reported that the radiation temperature of the leaf surface was lower than that of the concrete surface of "ACROS Fukuoka" building, and that the maximum difference between both temperatures reached at 15°C . Moreover, the difference of temperature between the leaf surface and the atmosphere surrounding the building was informed to be 3°C in the maximum value. These reveal that the trees on the stepping garden of "ACROS Fukuoka" contribute to the reduction of heat island phenomenon.

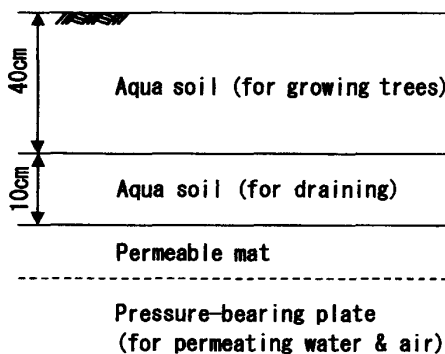


Figure 1 Construction of light-weight soil used for stepping garden of "ACROS Fukuoka"

**3 . 2 Parking Building with Planted Walls**

In Nagasaki City they have a parking building named "Nigiwaibashi Parking Center" with planted walls as shown in Plate 2.

This building has 7 floors, the structure of which is steel-framed and covered with the exterior walls of latticed bricks. Plate 3 shows the frame work of the interior floor and latticed bricks of the exterior wall. The planting work was performed with ivies having roots in the earth soil surrounding the building as shown in Plate 4.

**4 . Temperature Measurement of Planted Vegetation**

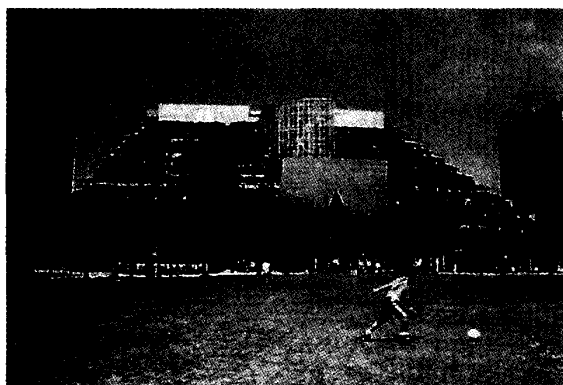
**4 . 1 Roof of Department Store**

A roof planting work was performed at a department store located at the central part of Nagasaki City this September as shown in Plate 5.

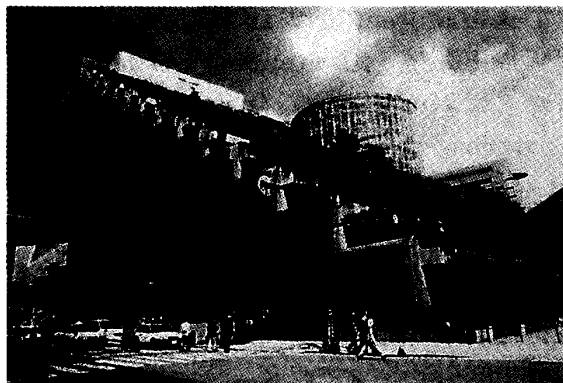
The authors measured the temperatures of turf used as vegetation for roof planting and concrete slab surface under the turf by using a thermal camera and a handy thermometer, respectively, this October.

Plate 6 shows a thermal imagery obtained from the temperature measurement for the roof including turf, by which the average values of temperature are given in Figure 2. It is clarified that the radiation temperature of turf is the lowest among those of a variety of things on the roof.

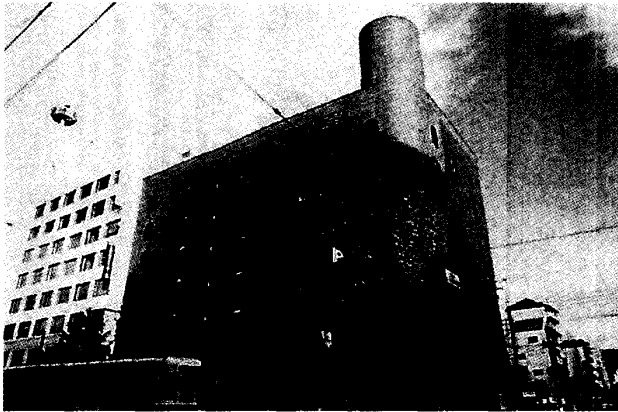
The temperature of concrete slab surface under the turf is made comparison with those of other materials on the roof and the atmosphere in Figure 3, from which the slab surface temperature under the turf is considerably low.



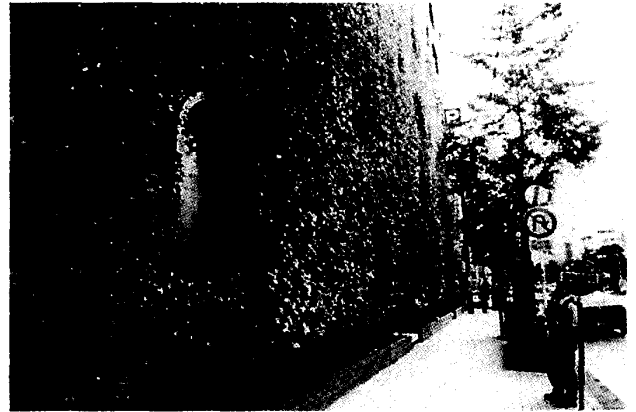
(a) View showing trees planted on roof of each floor



(b) View showing stepping garden of building  
Plate 1 "ACROS Fukuoka" building with stepping garden planted trees



(a) Panoramic view of building

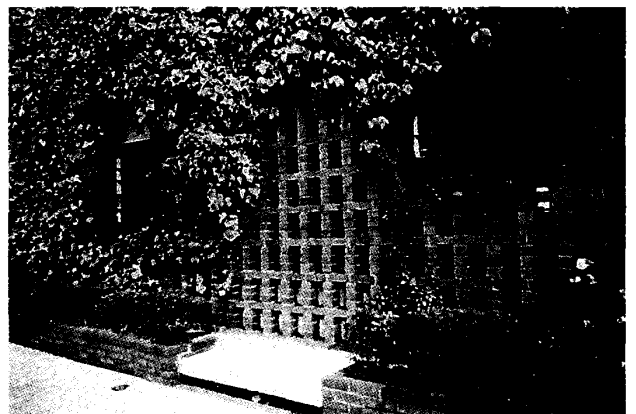


(b) Wall covered with ivies

Plate 2 Parking building with planted walls in Nagasaki City



(a) Frame work of interior floor

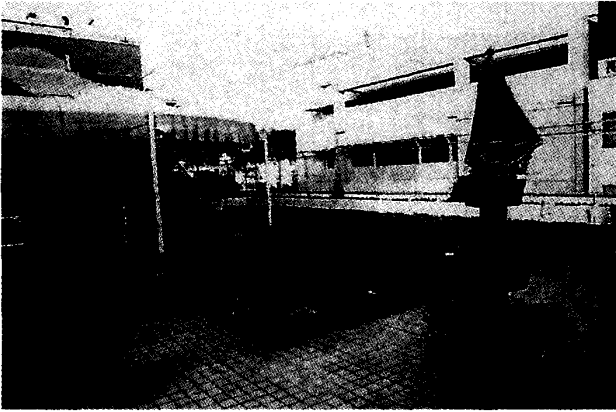


(b) Latticed bricks of exterior wall

Plate 3 Inside and outside views of parking building



Plate 4 Ivies having roots in the earth soil surrounding building



(a) Panoramic view of planted roof

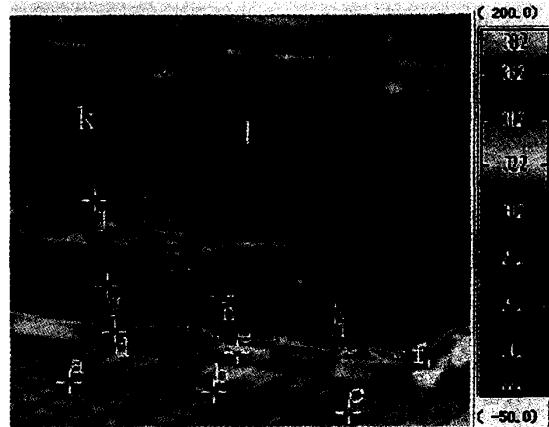


(b) Turf used for roof planting

Plate 5 Department store performed roof planting in Nagasaki City



(a) Objected area



(b) Thermal imagery

Plate 6 Thermal Imagery showing radiation temperature distribution on planted roof

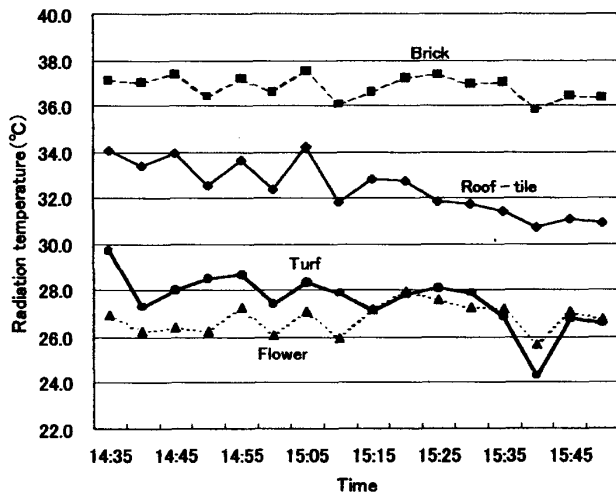


Figure 2 Average value of radiation temperature of some materials on roof

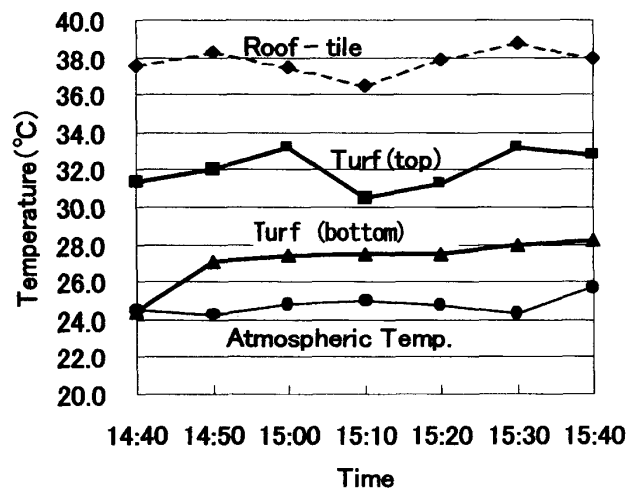


Figure 3 Comparison of temperature between concrete slab surface under turf and other materials



Plate 7 Exterior wall covered with ivies of private house in Fukuoka City

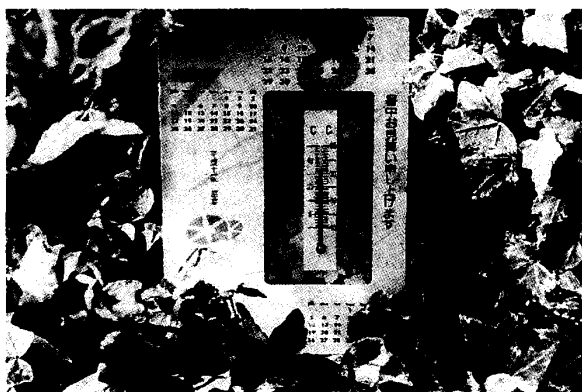
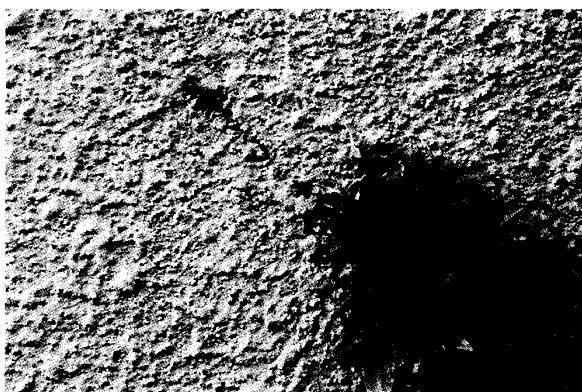


Plate 8 Handy thermometer used for temperature measurement



(a) View showing ivy crawl



(b) Trace of ivy taking roots on concrete wall

Plate 9 Ivies crawling on concrete wall



(a) Front side



(b) Reverse side with small roots at some places of branch

Plate 10 Leaves and branch of ivy

The results shown in Plate 6 and Figure 3 make us confirm that the heat reduction of the surrounding atmosphere and a building may be accomplished by planting vegetation on the roof of the building.

**4.2 Exterior Wall of Private House**

The authors carried out measurement of the temperature of exterior wall as well as ivy leaves on the walls of a private house in Fukuoka City this August. Exactly speaking, this wall is not one for wall planting, but was objected as a substitute for planted wall.

Plates 7 and 8 show the exterior wall covered with ivies and a handy thermometer used for the temperature measurement, respectively. This thermometer is attached with a styrol foam plate on the back so that is not problematic for the temperature measurement.

In addition the objected ivy may crawl on a concrete wall as shown in Plate 9 because its branch has small roots at some places as shown in Plate 10.

The result of temperature measurement is shown in Figure 4. As clearly seen from this figure the temperature of the wall covered with ivies is the lowest in comparison with those of the ivy leaf surface, the bare wall surface, and the atmosphere. This makes us confirm a wall covered with vegetation has such low temperature that may contribute to the reduction of heat radiated from the earth surface.

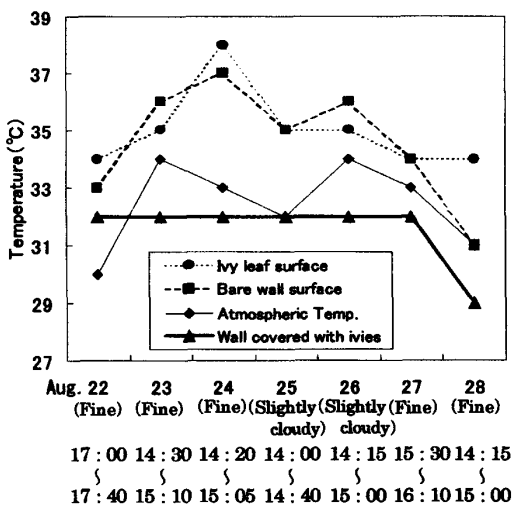


Figure 4 Comparison of temperature between wall covered with ivies and others

**5. Conclusions**

The results were obtained from the analysis on examples of roof planting works performed in Nagasaki Prefecture and other places including Fukuoka City and the temperature measurement for a department store with planted roof and a private house with planted wall as follows:

- (1) Although having been a few for 1998 to 2000, the number of roof planting works increases rapidly in Nagasaki Prefecture and other places in 2001.
- (2) It was reported that the radiation temperature of the leaf surface was relatively lower than that of the concrete surface of "ACROS Fukuoka" building with stepping garden planted trees (after The Mainichi).
- (3) A thermal imagery obtained for a department store with turf-planted roof clarified that the radiation temperature of turf was the lowest among those of a variety of materials on the roof. The temperature of concrete slab surface under the turf was also shown to be considerably low.
- (4) The temperature measurement carried out at a private house with ivy-planted exterior wall proved that the temperature of the wall covered with ivies was the lowest in comparison with those of the ivy leaf surface, the bare wall surface, and the atmosphere.
- (5) The results of (2) through (3) made us confirm a roof or a wall covered with vegetation has such low temperature that may contribute to the reduction of heat radiated from the earth surface.

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