B-16.2 Promotion of Solar Energy use to Control and Reduce Carbon Dioxide Emissions from Residential Sector.

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Total Budget for FY1991-FY1993 30,973,000 Yen (FY1993; 10,324,000 Yen)

Abstract To investigate the use of solar energy two types of low energy model house were designed and observed data was analyzed to clarify the heat performance and living conditions. Solar heat collecting system was designed to form part of the roof construction. As a result the durability of solar heat collector increased remarkably. Heating efficiency is also increased through a heat reservoir under the floor. Observed overall reduction rate of kerosene is approximately 50%.

The data observed from natural energy using house was analyzed. Observed living room temperature showed small daily variation and higher difference with outside temperature due to the super insulation and low infiltration of house and natural energy system such as passive solar material and cool tube.In day time electricity which generated by solar battery on the roof was used to drive the fan of this cool tube system. Conversion efficiency of this solar battery system was approximately 11%.

To clarify the usefulness of solar energy two types of passive solar houses were designed and thermal performance were discussed. It was found that the passive solar system is useful to reduce household energy consumption covering the wide area of Japan.

In considering Ech-house system human feeling in the room is another important aspects.To investigate this artificial wind flow system was applied for super insulated and low infiltrated model house. Observed result showed that even if room temperature goes up more than 27 degree C comfort zone is observed if wind speed is 0.4 to 0.6 m/s .Energy consumption of this artificial wind flow system is one tenth comparing with electric cooler in summer season.

Key Words Solar energy, Heat reservoir, Passive solar system, Eco-house

1. Introduction

Solar energy is the most important resource to counteract global warming especially to control and reduce carbon dioxide emission from residential sector. Average emission share by house heating and hot water supply are 27.1% and 36.3% respectively for the total household emission. This percentage is going to increase reflecting the change of living style.

Promotion of insulated and low infiltrated construction house is efficient in controlling house heating energy and solar panel system is efficient in controlling the energy for hot water supply. Solar battery system is also available for use as a countermeasure in residential sector to cope with global warming. To promote the use of these low energy house it is necessary to establish the concept of "Eco-house".

2. Research Objective

The major objectives of this study are, to clarify the present status of solar energy use in the residential sector, to investigate the promotion of solar energy use and to develop a basic construction manual for the low energy house.

During 1980 and 1982 roof top solar panel system for hot water supply had became very popular reflecting the increase of kerosene price due to the oil crisis. After this period demand of roof top solar panel system has decreased rapidly. The main reason of this decrease is the cost down of kerosene price but another reason might be exist, such as initial cost, maintenance cost

and design problem. In this study solar heat collecting system was designed to form part of the roof construction. Living condition in "Eco-house" was also investigated.

3. Results and Discussion

To investigate the use of solar energy two types of low energy model house were designed and observed data was analyzed to clarify the heat performance and living conditions. In the model house solar heat collecting system for air heating, cool tube system and solar battery system were used combined with super insulated and low infiltration construction method.

Solar heat collecting system was designed to form part of the roof construction in Date city of Hokkaido district. As a result the durability of solar heat collector increased remarkably. Heating efficiency is also increased through a heat reservoir under the floor. Observed overall reduction rate of kerosene is approximately 50% and quality of life is higher.

The data observed from natural energy using house which was constructed in Sendai city of Miyagi prefecture was analyzed. Example of observational results during November 1993 and February 1994 is shown in **Figure1**. Observed living room temperature showed small daily variation and higher difference with outside temperature due to the super insulation and low infiltration of house and natural energy system such as passive solar material and cool tube.

Using cool tube system warmer air than outside could introduce to the room. Maximum temperature difference was 12 degree. In day time electricity which generated by solar battery on the roof was used to drive the fan of this cool tube system. Conversion efficiency of this solar battery system was approximately 11%.

To clarify the usefulness of solar energy two types of passive solar houses were designed and thermal performance were discussed. From the calculation results for the passive solar house in Ibaraki prefecture house heating is only required at midnight and early morning in winter season. For the case in Okinawa prefecture average room temperature in January is 18.8 degree C and in August 27.7 degree C. The maximum temperature is 28.5 C due to the cooling effect during night time. It was found that the passive solar system is useful to reduce household energy consumption covering the wide area of Japan.

In considering Ech-house system human feeling in the room is another important aspects.To investigate this artificial wind flow system was applied for super insulated and low infiltrated model house. Relationship between window area and wind speed using this system is shown in **Figure2**. Effects of wind speed foe human beings were also analyzed combined with room temperature. Relationships between wind velocity, room temperature, heat loss from forehead and pleasantness observed in this investigation are shown in **Figure3**. In this figure +1 means slightly comfort and -1 means slightly discomfort zone respectively. It is important result that even if room temperature goes up more than 27 degree C comfort zone is observed if wind speed is 0.4 to 0.6 m/s .Energy consumption of this artificial wind flow system is one tenth comparing with electric cooler in summer season.

4. Summary

The emission share of carbon dioxide by hot water supply comparing with whole emission from residential sector is approximately 36% Hot water supply using solar panel is most efficient and popular way of solar energy use to control and reduce carbon dioxide emission from residential sector. To investigate this solar heat collecting system was designed to form part of the roof construction. As a result the durability of solar heat collector increased remarkably. Observed overall reduction rate of kerosene is approximately 50%. The data observed from natural energy using house was analyzed. Observed living room temperature showed small daily variation and higher difference with outside temperature due to the super insulation and low infiltration of house and natural energy system such as passive solar material and cool tube.In considering Ech-house system human feeling in the room is another important aspects.To investigate this artificial wind flow system was applied for model house. Observed result showed that even if room temperature goes up more than 27 degree C comfort zone is observed if wind speed is 0.4 to 0.6 m/s .Energy consumption of this artificial wind flow system is one tenth comparing with electric cooler in summer season. Improve the information exchange between house user, house maker, house equipment maker, constructor, architect and researcher.

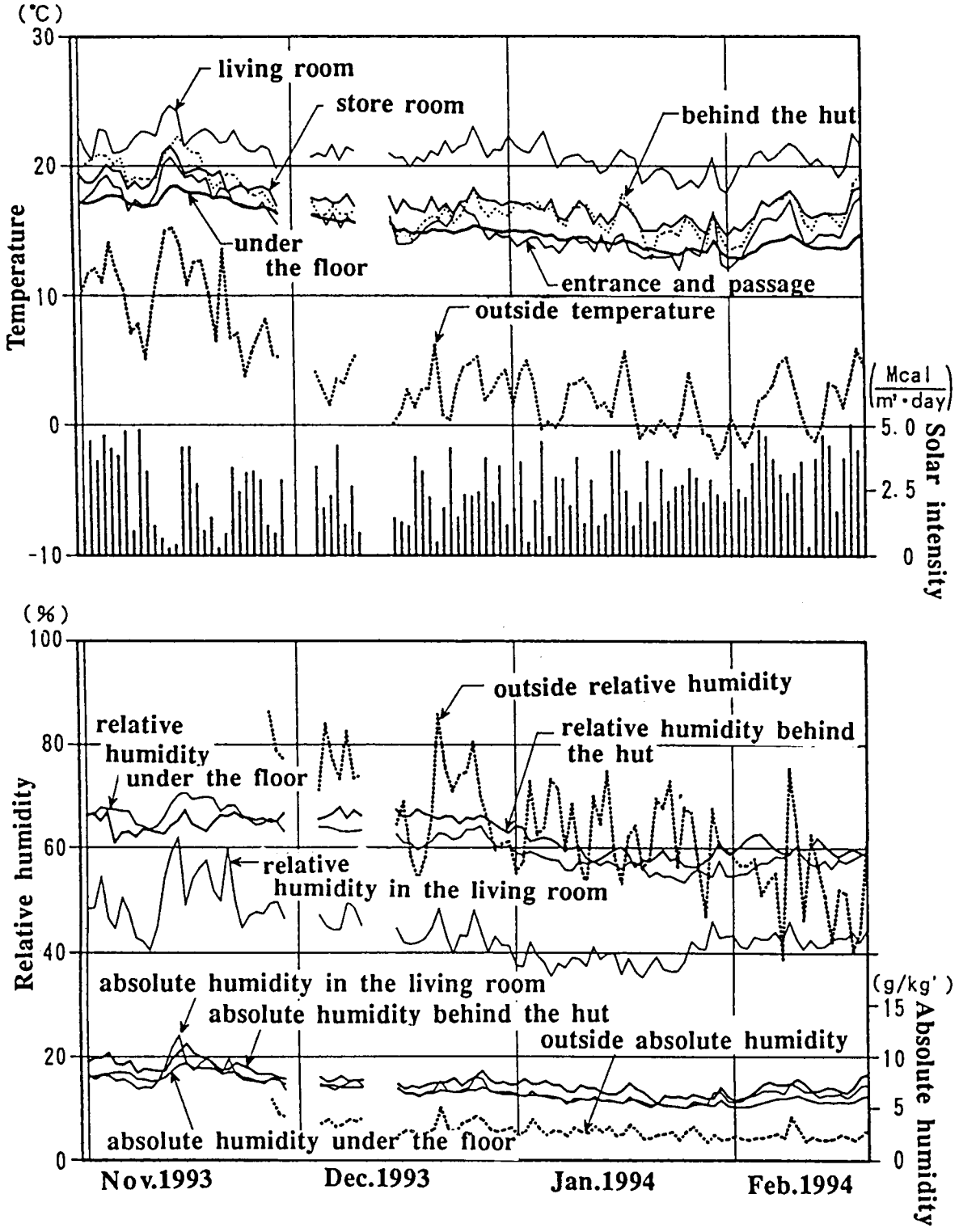

Figure 1. Daily average temperature and humidity observed at the various room in the model house during November 1993 -February 1994 in Sendai.

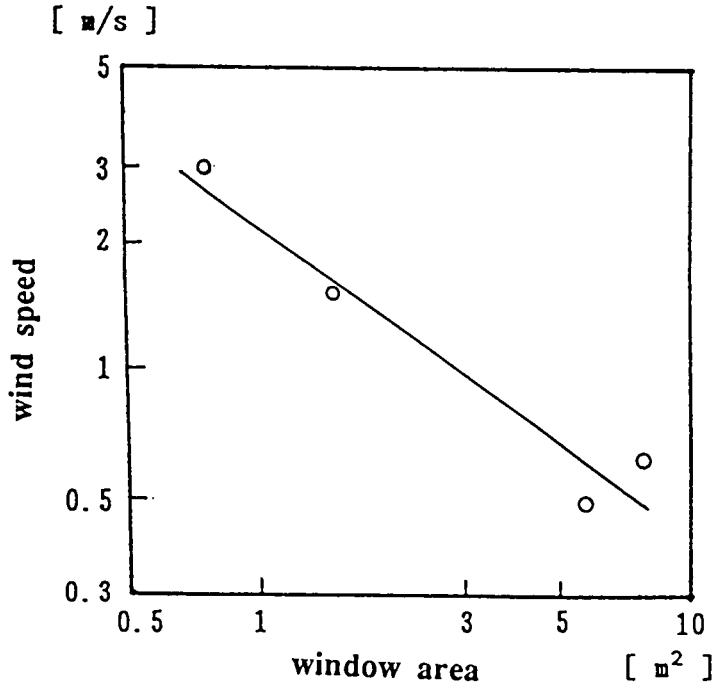

Figure 2. Relationship between wind speed and window area

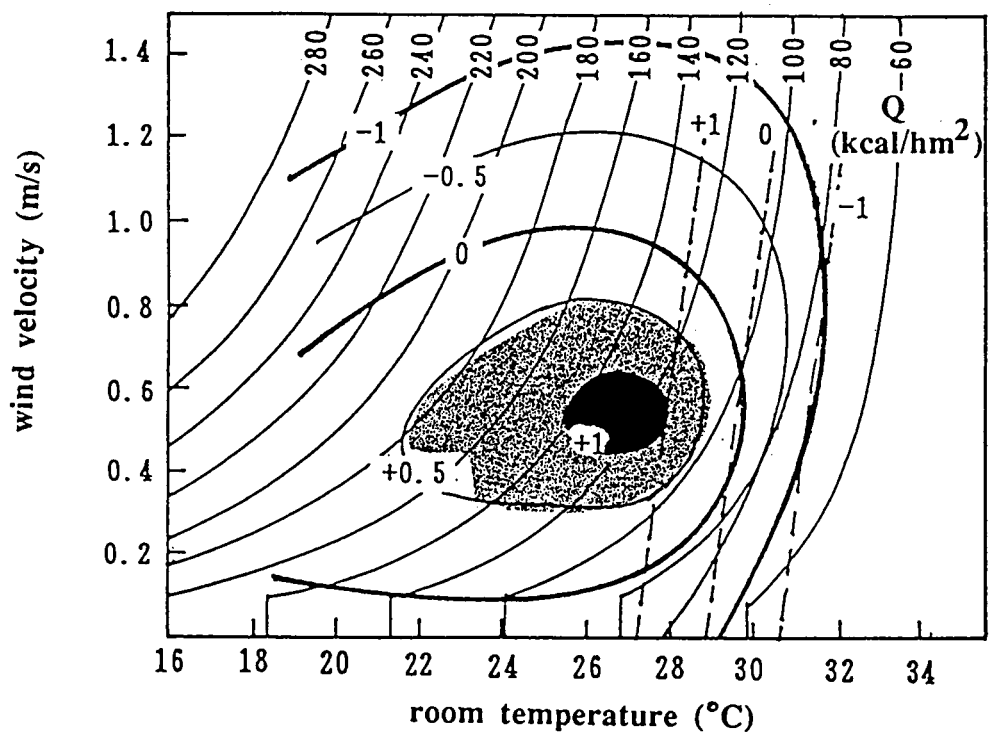

Figure 3. Relationship between wind velocity (m/s), room temperature (°C) and pleasantness,
Q (kcal/hm^2) is measured heat loss from forehead.
+1 means slightly comfort and -1 means slightly discomfort zone respectively.