A Research of Detached Houses with Air-Based Solar System Intended to Full Solar Energy Use
Part.2 Thermal Characteristics in Underfloor

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SUMMARY: This paper describes outline of the specifications of the two experimental huts that the air-based solar heat system is installed in. It also shows the changes of the heat flow on underground surface by installing the insulation under basis concrete, changing the area of solar heat collector, or applying the water-packs and PET bottles as the additional heat storage.

Keywords: air-based solar heating system, experiment, heat balance, heat storage

INTRODUCTION

In Japan, intermittent heating is very popular method in winter except for cold region such as Hokkaido and so on. In the case of using solar heating, the indoor temperature increase higher and become overheated if the heat is supplied into the rooms in the daytime. But the indoor temperature decrease in the nighttime and the heat load in the morning will not be decreased. Then we must prepare the heat storage for the solar collection in the daytime. If it works well, the heat emission will be caused in the nighttime and the heat load in the morning will be reduced.

THE PURPOSE OF EXPERIMENT

The purpose of these experiments is to analyze the efficiency of the improve methods. We judged the efficiency by the percentage of the amount of heat emission to the amount of heat absorption. The more the percentage (emission per absorption) is, it is consumed that the heating load will be reduced more.

EXPERIMENT OF HEATING IN WINTER

Settings and Conditions in the Experiment

We introduce the experiment huts in Part 1. In this report, we explain the four experiments in the huts as follows (shown in Figure 1. And Table 1.).

Experiment 1) Confirmation of the amount of absorption and emission through the basis concrete between hut no.1 and no.2 in case of small solar collector

Experiment 2) Confirmation of the amount of absorption and emission through the basis concrete between hut no.1 and no.2 in case of large solar collector

Experiment 3) Confirmation of the amount of absorption and emission through the basis concrete and the additional heat storage, which was consisted of water in 40 packs (25Litter per pack), between hut no.1 and no.2 in case of large solar collector

Experiment 4) Confirmation of the amount of absorption and emission through the additional heat storage. In hut no.1, there was water in 2000 PET bottles (0.5Litter per bottle). In hut no.2, there were water in 40 packs same as Experiment 3.

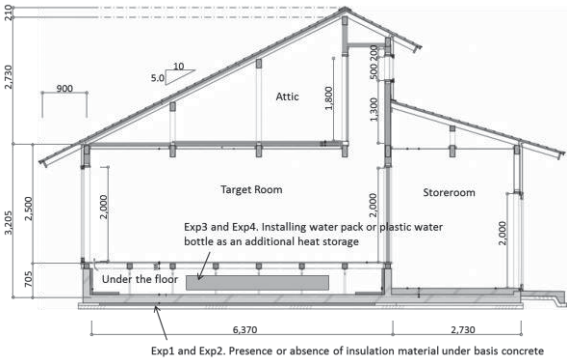

Figure 1. Four experiments in the huts

Table 1. Experiment conditions

	Heat collection area [m^2] (Preliminary, Glass)	Heat storage material	Experiment period
Experiment 1	7.0, 2.7	Basis concrete	29th Dec. 2012 ~6th Jan. 2013
Experiment 2	14.0, 5.3	Basis concrete	7th Jan. ~14th Jan. 2013
Experiment 3	14.0, 5.3	Basis concrete +water packs	21th Feb. ~26th Feb. 2013
Experiment 4	14.0, 5.3	Basis concrete +PET bottles	26th Dec. 2013 ~13th Jan. 2014

Insulation installation
Experiment1, 2, 3: Hut no.1-None, Hut no.2-possession under basis concrete
Experiment4: Hut no.1- possession on basis concrete
Hutno.2- possession under and on basis concrete

TEST RESULTS

Experiment 1

If the solar collector doesn't get enough solar heat energy, the amount of absorption into the basis concrete is not sufficient, so the difference of the emission of heat between hut no.1 and no.2 was not appeared.

Experiment 2

If the solar collector can get enough solar heat energy, the difference of the heat emission between hut no.1 and no.2 was appeared obviously. Although the amount of heat absorption into the basis concrete of no.2 was less than no.1, the amount of the heat emission of no.2 was bigger than no.1. The percentage (emission per absorption) was 17.6% in hut no.1 and 29.4% in hut no.2.

Experiment 3

In the case of setting water in packs in the underfloor space, the heat which water packs absorbed into wasn't extinguished as thermal loss into outdoor or soil. The amount of heat emission increased in nighttime. The percentage (emission per absorption) was 55.7% in hut no.2.

Experiment 4

In the case of setting water in PET bottles in the underfloor space, the heat which PET bottle absorbed wasn't extinguished same as Experiment 3. Because the surface area of PET bottle is much larger than one of the water pack, the heat transfer was accelerated and the amount of heat emission highly increased in nighttime (Shown in Figure 2.). The percentage (emission per absorption) was 47.01% in hut no.1 and 25.7% in hut no.2.

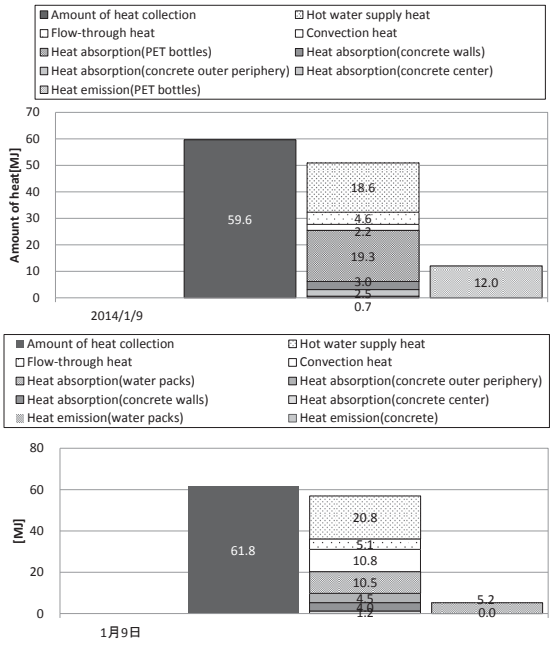

Figure 2. heat balance in the underfloor (Experiment 4)

CONCLUSION

We confirmed the improve method of heat storage of the air-based solar system. Especially, the additional heat storage material under floor is very efficient method, but the performance of the improvement system is not sure in the experiment. We'll show the amount of heating and hot-water load reduction by using simulation in the next paper.

References

[1] Youngjin Choi et al., "Evaluation of the characteristic of heat flow under the floor in the test buildings in winter". *Journal of environmental engineering (Transactions of AIJ)*, **79,** No.697, 2014, pp. 271-280.

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