Super energy conservation building in Tokyo (Japan)

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4. Super Energy Conservation Building in Tokyo (Japan)

Owner: *Ohbayashi Corporation*
Architect: *Ohbayashi Corporation*
Engineer: *Ohbayashi Corporation*
Contractor: *Ohbayashi Corporation*
Works duration: *12 months*
Service date: *April 1982*

Construction

Construction of the main building of Ohbayashi Corporation Technical Research Institute (Photo 1 and Fig. 1) was started in April 1981 and completed in April 1982 as an office building designed for super energy conservation within the limits of economical feasibility while maintaining proper living environment and office functions. As many as 98 energy conservation techniques have been adopted in this building. An outline of the building is shown in Table 1. Table 2 outlines the heating and air conditioning system. Fig. 2 is the heating and air conditioning heat source system diagram.

The building has fully been used and the energy consumption and indoor and outdoor environment have been continuouly measured since April 15, 1982.

Energy Consumption

The measured total energy consumption per unit area (m_2) for one year starting from April 1982 is shown in Fig. 3. Since the only energy source of this buildidng is electricity, the measured value has been converted to primary energy based on electricity consumption. For this conversion, 1 kw = 10.24 MJ is used. The predicted value shown in the figure was obtained from our E-Saver program and others, which were developed by Ohbayashi Corporation. The recorded energy consumption of the whole building is 362.4 MJ/m_2/year, which is 12% lower than the predicted value of 409.6 MJ/m^2/year, the initial target.

Considering that the energy consumption of a general building of the same scale in Japan is approximately 1580 MJ/m^2/year, the recorded value is only one fourth of the ordinary value, thus proving that this building is really a super energy saving building.

Fig. 4 shows the monthly variation in the energy consumption for the entire building. The peak consumption occured in August because of the air conditioning. The lowest consumption was November and was equivalent to 57% of the August consumption. In October and November, fresh air cooling can be frequently used, resulting in 5–8% of the energy consumption for the heat source compared to that in August.

Energy consumption other than that for air conditioning is generally constant throughout the year. The maximum consumption of theses has been occupied by lighting. Nine percent of the total energy consumption is for automatic control, which hinders promotion of energy conservation. The energy consumption for sanitary and ventilation use is low. The equipment included in the category "Others" are office automatic equipment, computers and copying machines.

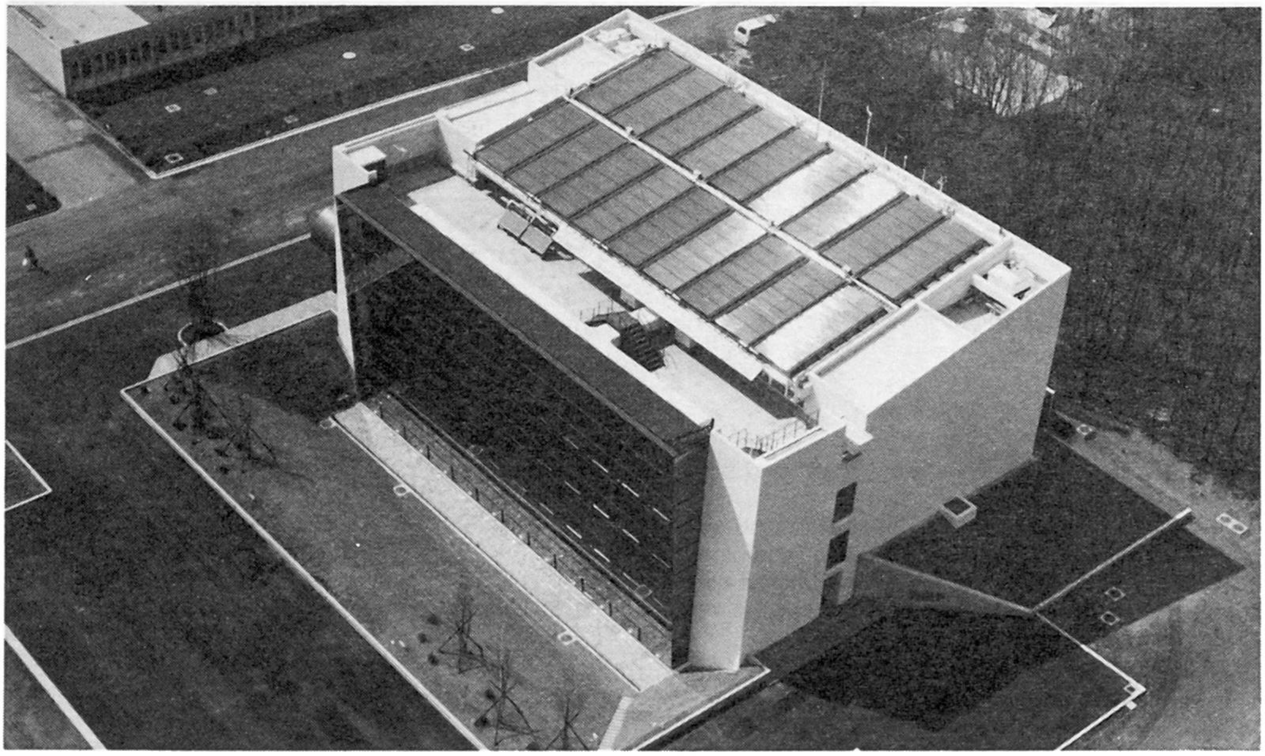

Photo 1. View of the main building of Ohbayashi Corporation Technical Research Institute

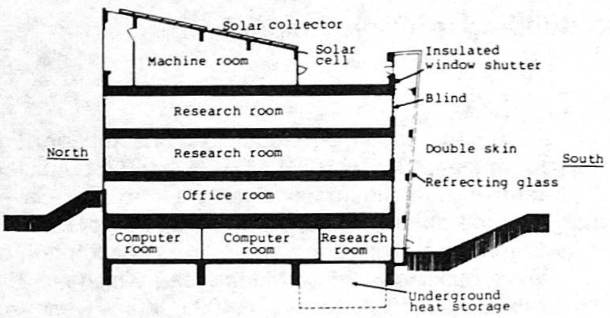

Fig. 1. Section

Table 1 An outline of the building

Location:	Kiyose, Tokyo
Building area:	886.85 m²
Gross floor area:	3.776 m²
Structure:	Reinforced concrete construction
Number of floors:	1 story below and 3 stories above ground
Typical floor height:	3.2 m

Table 2 Outline of heating and air conditioning system

Air conditioning heat source:	Absorption chiller 10RT Heat reclaim heat pump 10RT/15RT
Effective collector area:	220 m²
Heat storage tank:	70 m³ × 2
Air conditioning system:	Int.-VAV system Per.-4-pipe system F.C.U.

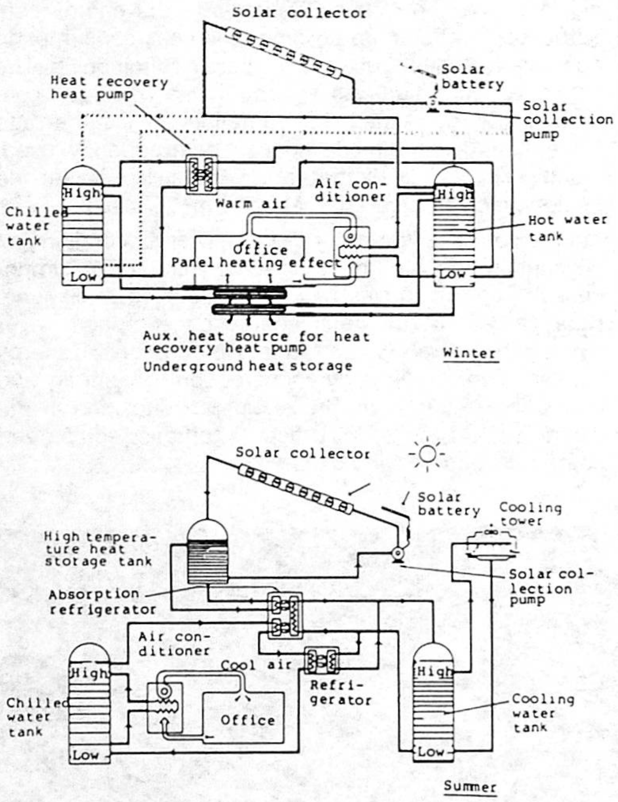

Fig. 2. Air conditioning system diagram

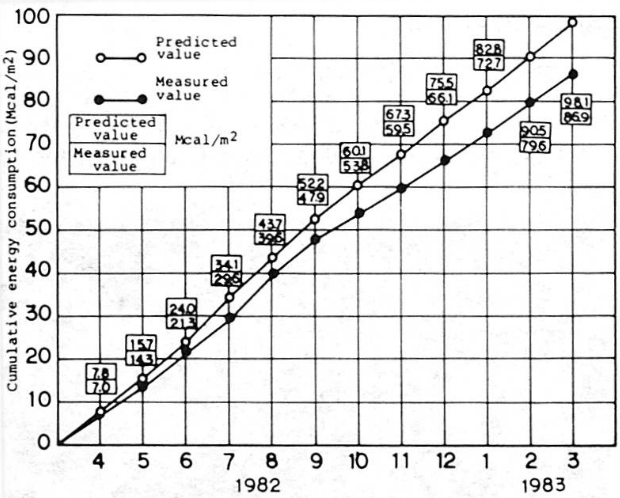

Fig. 3. Energy consumption of entire building

Underground Heat Storage

In this building, surplus solar energy in autumn is stored in the ground through buried coils at the bottom of the buildidng. This heat is utilized in winter. The energy stored in the ground will directly heat the rooms of the basement through the floor slab and will also be used as the low temperature heat source of heat reclaim heat pump.

Begining from November 1982, underground heat storage was performed until the middle of December. During this period, the heat amount are shown in Fig. 5. During the heating period, the surplus heat in the hot water storage tank was also stored. Partly assisted by the warm weather, considerable surplus solar heat generated in side the hot water storage tank in winter and the total heat stored in winter exceeded that in the intermediate season. The cumulative value of heat stored in the ground reached 29.4 GJ at the end of March. While the cumulative value of heat radiated to the rooms from the undergorund heat storage tank through the floor slab and the heat recovered from the ground through undergorund heat coil for the heat source of heat pump in winter were 8.4 GJ and 3.4 GJ respectively. This proves that 11.8 GJ, i.e. 40 % of the total heat stored, was utilized effectively for heating.

(T. Tanaka)

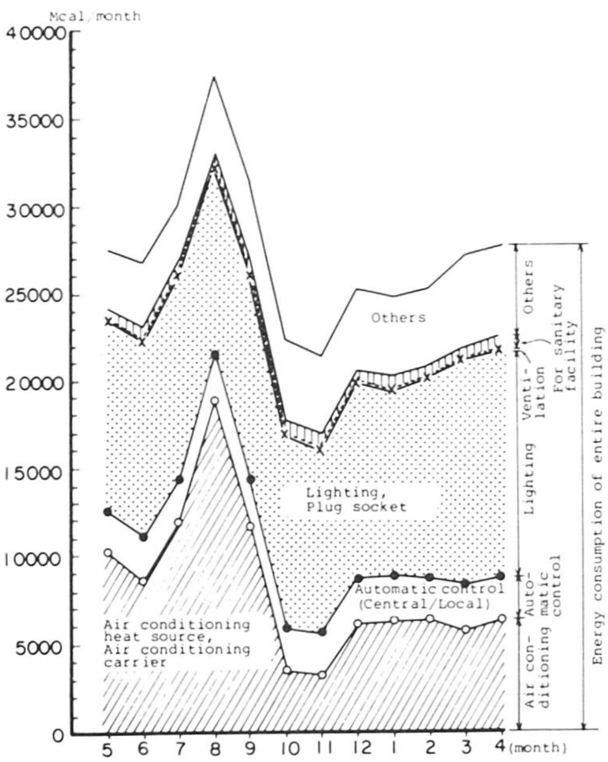

Fig. 4. *Monthly variation of energy consumption of entire building*

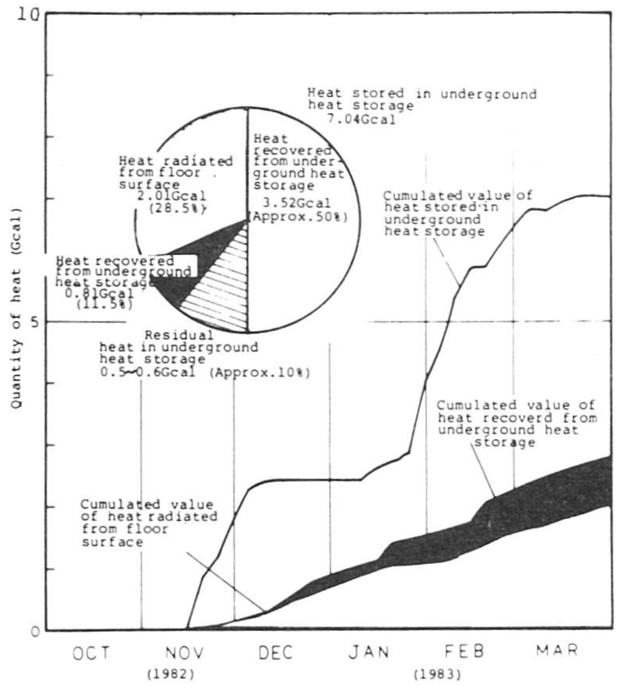

Fig. 5. *Heat stored or recovered by underground coil units*