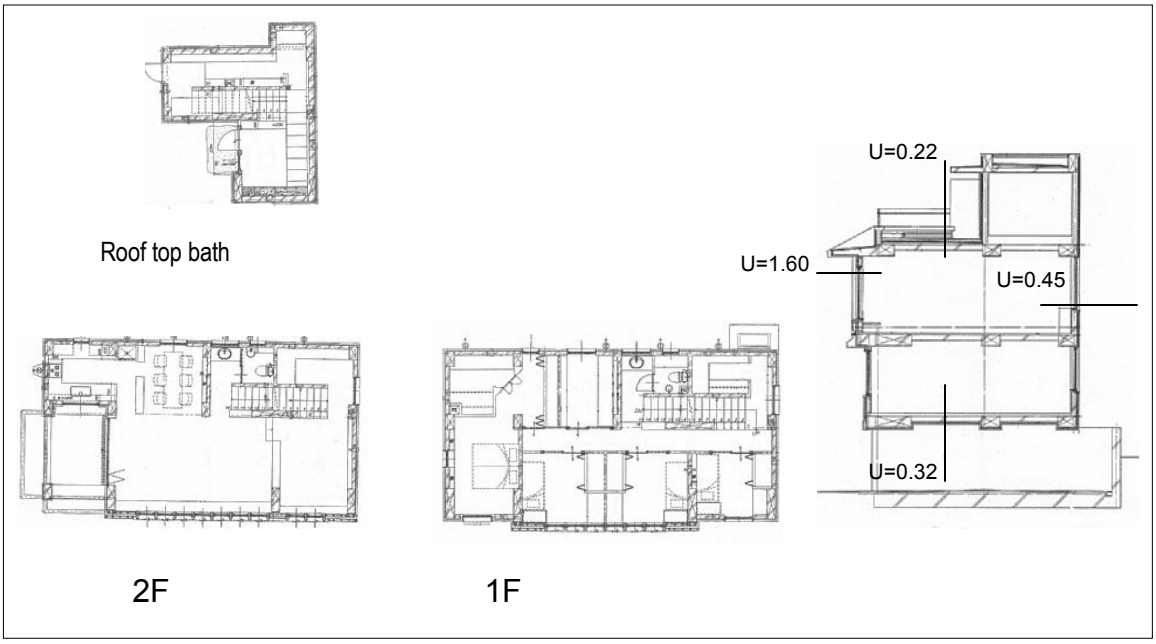
Okayama, Japan

International Energy Agency

IEA – SHC Task 28 / ECBCS Annex 38:

Sustainable Solar Housing



The project

This single-family house is in the suburb of Okayama, on the beautiful bank of Asahi River, overlooking clear water flow and reedy marsh. The project finished in February 2003.

Total floor area is 233m2.

Objectives

Low energy demand, with good and stabilized indoor climate, is the main target of this project.

A solar water heater is used for DHW demand including hot water for a roof-top bath to enjoy a Japanese dream to take bath under the starlight, looking over the river and city lights far beyond.

Marketing strategy

The owners often open their house for people interested in the new home, to educate and to highlight the importance of heating the whole house through the winter, of which most Japanese homes have not benefited from in the past.

Building construction

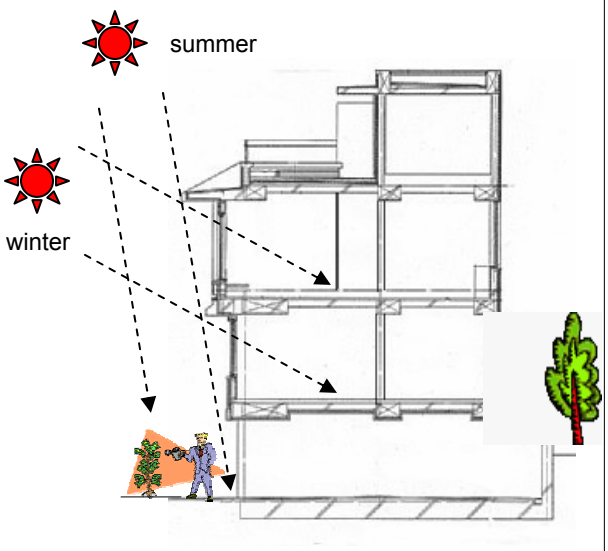
The building is constructed by reinforced concrete so as to benefit from thermal mass inside the insulation envelope.

Windows : Dual pane, low emission coated, argon gas filled, wood framed. Overall U-value is 1.64 w/m2K

Wall: Foamed polystyrene (50mm, R 1.79 m2K/w) over 150mm concrete. U-value 0.45.

Floor: Foamed polystyrene (75mm, R 2.68 m2K/w) over 200mm concrete. U-value 0.32.

Roof: Foamed polystyrene (115mm, R 4.11 m2K/w) over 200mm concrete. U-value 0.22.



Technical systems

South facing window area is optimized by calculation, to maximize winter solar gain and minimize heat loss.

Eaves are carefully designed considering solar position for each season, as illustrated above.

Concrete structure inside the insulation envelope is, coated with plaster, naked and exposed to the room temperature to maximize the heat absorption in the daytime.

8 m2 of solar collectors are installed on the roof for solar water heating with 370 liter storage tank.

Auxiliary heating is by radiant floor heating installed in the 2nd and 3rd floor and in the roof top bathroom as well.

Energy performance

The auxiliary heat demand is calculated for 3 cases.

A: This demonstration building.

B: Building with same plan but has insulation according to 1999 Japanese building code.

C: Building with same plan but has insulation according to 1992 Japanese building code.

The heating energy demand:
A: 27.4 kW/m2, while B 63.4 kW/m2

The DHW energy demand:
A: 6.4 kW/m2, while B 22.4 kW/m2

The cooling energy demand:
A: 17.5 kW/m2, while B 17.1 kW/m2

Pumps and fans
A: 2.2 kW/m2, while B 5.3 kW/m2

Lights and appliances
A: 36.8 kW/m2, while B 36.8 kW/m2

Total energy demand:
A: 90.3 kW/m2, while B 145.0 kW/m2

The heating energy demand and the total energy demand for C is calculated to be 134.6 kW/m2 and 203.2 kW/m2, but buildings according to 1992 building code is not heated whole house, so the comparison has no reality at all.

Degree Day(20-12) for heating : 1866
Degree Day(18-18) for heating: 1822
Degree Day(24-24) for cooling: -240

Planning tools

Energy performance calculation tool
SMASH

Costs and benefits

The extra costs for energy concept, taking into account reduced costs for heating and solar hot water system, is 13,000 EURO, compared to the same building with 1999 building code and without solar water heater.

Innovative products

Solar water heater: http://www.chiryuheater.jp/

Financing

The subsidy of the New Energy and Industrial Technology Development Organization(NEDO) partly assisted.

Project team

Architect: Uno Tdahide
Solar water heater: Chiryu Heater
Builder: Okayama Komuten co.,ltd.

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