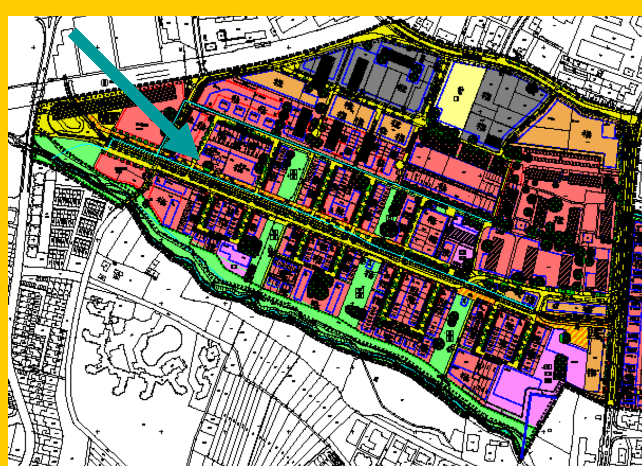
ISIS demonstration housing project in

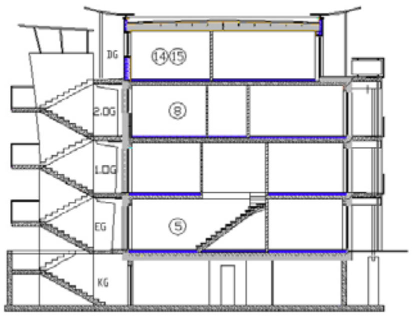
Freiburg, Germany



International Energy Agency

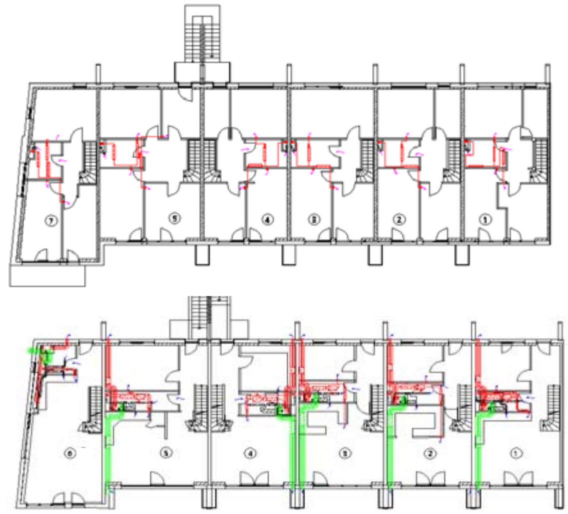
IEA – SCH Task 28 / ECBCS Annex 38:

Sustainable Solar Housing



Passive solar apartment block ISIS

- cross section -



Ground floor plan (top) and first floor plan (bottom) with pipelines of the ventilation system

The project

The ISIS solar passive apartment block is situated in the recently developed residential area, Vauban, a former military barracks area in Freiburg. The four-storey apartment building, which was built within one year, has been occupied since its final completion in June 02. The passive solar apartment block has nine maisonettes and four one-storey dwellings with heated floor areas from 77 to 145 m².

The construction of the owner-occupied flats was commissioned by the building group ISIS.

49 % of the southern facade area consists of windows. Each dwelling has access to spacious balconies or terraces on the ground floor, which are situated on the south side.

The entrances to the dwellings, situated on the north side, are accessible from the open staircase via access balconies, which are thermally separated from the building.
The ground floor has thermal insulation towards the cellar.

Most of the dwellings are connected to the wood fired district heating system. Each of the dwellings is equipped with a ventilation system with heat recovery. Therefore the rooms are heated mainly with the supply ventilation air.
One dwelling has a combined heating and ventilation unit, which includes the air-to-air heat recovery and an exhaust-air heat pump providing the back-up heating of the supply air and the heating of the domestic hot water.

Design data:
net heated floor area: 1370 m²
heated volume: 3564 m³
ratio of exterior surface to volume: 0.39

Objectives

The construction of the ISIS passive apartment building adapts the energy-efficient residential building design with passive house standard from the single-family house to the multi-storey residential building. Super-insulation of the envelope and the windows, a ventilation system with heat recovery and an airtight envelope ensure a low heating demand. The use of district heating, provided by renewable energy, for domestic hot water heating and auxiliary space heating results in a minimal primary-energy demand and demonstrates a sustainable energy supply concept.

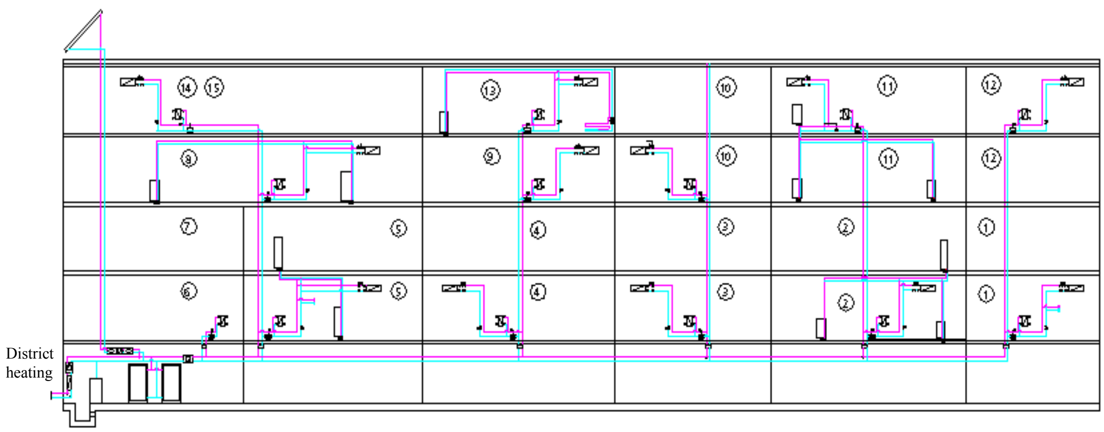
Building construction

Exterior walls: solid	
lime-sandstone brick	17.5 cm
thermal insulation	28.0 cm
Roof: lightweight construction	
thermal insulation	40.0 cm
Ceiling of cellar (cellar not heated)	
cement screed	6.0 cm
sound insulation	5.0 cm
concrete	22.0 cm
thermal insulation	20.0 cm

Windows: triple-glazed high-performance
wooden frame, externally insulated

U value:

Exterior wall	0.13 W/(m²K)
Roof	0.11 W/(m²K)
Window	0.90 W/(m²K)
Ceiling of cellar	0.18 W/(m²K)



ISIS passive solar apartment block - heating supply system with district heating and solar collector array

Technical systems

- District heating provided by a wood heating plant ensuring domestic hot water supply and space heating;
- Two-pipe system with individual heating of domestic hot water via a heat exchanger in every dwelling;
- Ventilation system with heat recovery and back-up heating of the supply air via hot water heat exchanger;
- Radiators (hot water and electric) in bath room and living room in some dwellings;
- Combined heating and ventilation units supplying fresh air, air heating and providing domestic hot water via a storage tank. ;
- 23 m² thermal solar collector array supporting the central heating system - space heating and DHW;
- 5 kW_P PV system, installed by 9 of the families of the apartment block.

Energy performance

- **Heat demand**
  Space heating: 13.2 kWh/(m²a) (PHPP)
  Domestic hot water: 12.5 kWh/(m²a) (EnEV2002)
- **Yield of solar collector system**: 300 kWh/(m²a) (expected value)
- **Electricity**
  Ventilation / fans: 5 kWh/(m²a) (expected value)
  controls / pumps: 1.7 kWh/(m²a) (expected value)
  lighting and appliances: 27 kWh/(m²a) (after VDI 3087)

Planning tools

The heating demand was calculated according to a planing tool for passive houses (PassivHaus-ProjektierungsPaket PHPP) taking the ventilation heat recovery gains into account.
A major aspect of the building planning was to avoid thermal bridges in accordance to DIN 4108 - Annex 2.

Costs and benefits

The positive experience made with a free-standing passive houses has been adapted to the apartment building.
Compact design, efficient thermal insulation, minimising of heat bridges and airtight envelopes are integral components for cost-optimised building of passive apartment blocks.
Central or individual systems can be used for ventilation and heat supply for space heating and domestic hot water, to allow for individual user requirements.
While comfortable living conditions are ensured, the operating costs for heating in passive apartment blocks are low, since the heating consumption is reduced to 10% of that for conventionally constructed, modern buildings.

The construction costs for the passive solar apartment block amounted 1241 Euro/m² (for construction and HVAC)t and costs for land and planning). That is 9% more compared to building constructed according to the standards of the German energy-saving ordinance (Energieeinsparverordnung EnEV).

Heat exchanger LOGOTERM for domestic hot water

Installation of the combined heating and ventilation unit

Innovative products

Building envelope

Window and door:Fa. Klaus Müller, Lautenbach; www.muellerlautenbach.de

Ventilation and cooling

Heat recovery unit: www.maico.de

Space heating and DHW:

District heating based on CHP(60% wood ship) and solar collector
Combined heat and ventilation unit : www.maico.de

Thermal solar collector : Fa.Solvis, Braunschweig www.solvis.de

Financing

The members of the building group were already informed about energy-efficient passive building and they deliberately decided on a passive house. Building in a building co-operative makes cost optimisation possible. A building co-ordinator and the estate agent's commission are avoided and building materials are less expensive. Coping together with conflict situations serves the common interest of the building group.

The building costs were financed by the owners, supported by the German governmental subsidy „Eigenheimzulage“ and to deal in favourable credit terms by the KfW (Kreditbank für Wiederaufbau - KFW40/60 CO_2-Reducing program).

The monitoring was funded by the DBU - Deutsche Bundesstiftung Umwelt

Project team

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Literature and links

www. ise.fraunhofer.de

www.phasea.de