

Krummbach, Geuensee, Switzerland

Renovation of an old schoolbuilding with a Prefab Retrofit approach aiming to be a net zero energy building for heating, ventilation, and hot water with a high level of self-consumption with a ground source heat pump and solar electricity installed on the roof.

Key facts

Building

| | |
|---------------------|---------------------|
| Location | Krummbach, Geuensee |
| Construction | 2011 retrofit |
| Heat distribution | |
| Heated area | 576 m ² |
| Level of insulation | MINERGIE |

Heat pump and source

| | |
|----------------------|-------------------------------------|
| Number of heat pumps | 1 |
| Installed capacity | 24 kW |
| Operation mode | monoenergetic |
| Heat source | Ground Source two 90 m boreholes |

Brand and type:

| | |
|-------------|----|
| Refrigerant | |
| Sound level | dB |

Heating system

| | |
|---------------------|----------------------------|
| Heat demand | 24 kWh/(m ² ·y) |
| Heating temperature | °C |

Domestic hot water

| | |
|-------------------------|-----------------------------|
| Type of system | |
| Max. Temperature | °C |
| Circulation system | Central collective |
| Legionella measures | |
| Storage size | 400 litres |
| Number of storage tanks | 2 |
| Electric energy use: | 2.2 kWh/(m ² ·y) |
| Temperature control | |

Other information

| | |
|-------------------|--|
| Electric energy | |
| Consumption year | 9.3 kWh/(m ² ·y) |
| Investments costs | 1.25 Mio. € |
| PV installation | 58.85 m ² amorphous PV modules (6.24 kWp). |

Experience

This project has been an example project for prefab retrofit under ECBCS Annex 50



The small school building belongs to the hamlet Krummbach near Geuensee, Switzerland. It was used to teach three primary school classes till 2004. Since then it was not used anymore due to demographic changes. Also the attached apartment of the caretaker was empty. As a school building dating back to 1969 it was built with bricks and hollow brick slab, but was basically not insulated. Only the roof was insulated with 80 mm mineral wool. The building had an oil fired heating with separate electric hot water system and was only naturally ventilated. The new owner intends to use the old school as training centre for continued education. The building renovation should not only modernize the building, it also should allow an energy efficient operation.

The goal of the renovation was not only the modernization of the old building. It was also aimed to improve the construction quality and the energy efficiency.

PV-modules were installed on the roof. The existing oil fired heating was replaced by a ground source heat pump. Radiators are used for heat distribution. A new ventilation system with heat recovery was installed in the attic space. It is expected that the rehabilitation reduces the heating and ventilation energy consumption by 92% for final energy or 83% for primary energy. Hot water energy (electricity) is reduced by 68%, for final energy as well as for primary energy. The total savings are expected to be 91% for final energy or 79% for primary energy. Due to the 60 m² PV installation, the energy needs for heating, ventilation, and hot water are more than compensated.

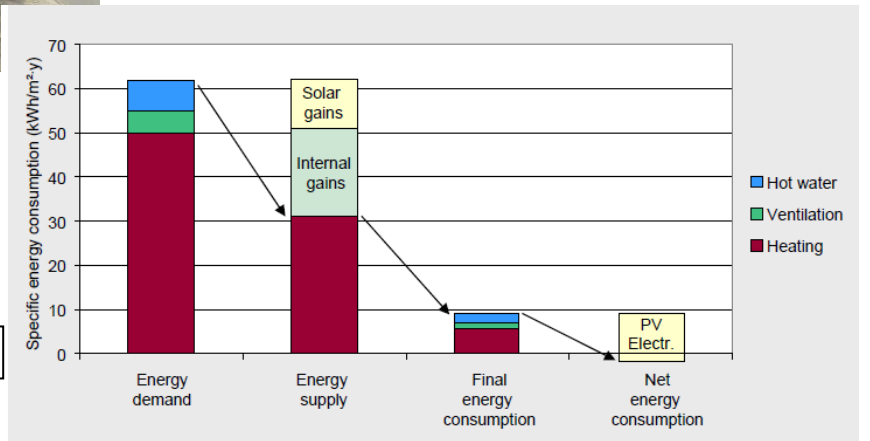
The renovation concept has proven to be efficient and trouble free. A good quality at a competitive price was possible due to the prefabrication technology. The expected primary energy savings are as high as 79%. The demonstrated solution could become a standard for the building renovation industry.

Krummbach, Geuensee, Switzerland, Technical details



- Key technologies**
- Prefabricated light-weight timber elements
 - Sheep wool insulation
 - Ground source geothermal bore hole heat-pump
 - Controlled ventilation
 - PV system on roof
 - Thermal bridges avoided

Monitored data



Description of the technical concept

Heat Pumps

The new heating system consists of a heat pump (expected COP: 4.35 for heating, 3.13 for hot water) that is using two 90 m boreholes as heat source. The heat pump is heating a 400 litre storage tank for space heating and a 400 litre storage tank for sanitary hot water.

PV system

Solar electricity is being produced on top of the roof with 58.85 m² amorphous PV modules (6.24 kWp). The yearly production of PV electricity is expected to be 6027 kWh.

Controlled ventilation

Two ventilation units with combined heat recovery (86%) and moisture recovery are providing fresh air for the classrooms and the caretakers apartment. They are installed in the attic space of the steep roof. The horizontal air distribution is also done in the attic space. It is connected with the module integrated vertical ventilation ducts.

In addition to the commonly known heat recovery system, a moisture recovery system was installed in the new apartments in order to prevent dry air during winter.

Energy consumption

- Transmission 50 kWh/(m²·y)
- Ventilation 5 kWh/(m²·y)
- Internal gains 11 kWh/(m²·y)
- Solar gains 20 kWh/(m²·y) (without PV)
- Heating demand 24 kWh/(m²·y)
- COP heat pump 4.35
- Heating energy 5.5 kWh/(m²·y)
- Ventilation energy 1.4 kWh/(m²·y)
- Hot water demand 7 kWh/(m²·y)
- COP heat pump 3.13
- DHW energy 2.2 kWh/(m²·y)
- Pumps 0.2 kWh/(m²·y)
- PV produced electricity 10.5 kWh/(m²·y)
- Total energy consumption -1.2 kWh/(m²·y)

Seen over a whole year, the building is expected to be a net zero energy building for heating, ventilation, and hot water.