Rapport annuel 2002

Project Low Energy Housing in Ticino

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RESUME

In the county of Tessin, very few low energy houses have been constructed in comparison to the German part of Switzerland, although the climate is rather temperate and sunny in winter. The "Vitali-Velti house", located in the village of Monte Carasso near Bellinzona, is designed to be a low energy house.

The main objectives of the project are to establish a monthly heat balance of the house, assess the thermal comfort, assess the house in the view of sustainable development and perform an economical analysis to compare the house with a conventional solution. This project is chosen to serve as an example for the IEA Solar Task 28 "Solar Sustainable Housing". The results will also contribute to both the promotion of low energy houses in Tessin and for Minergie information.

Measurement results and analysis showed that both house A and house B are conform to the new SIA 380/1 norm and they both satisfy the Minergie standard. House A could even meet the

Goal of projet

In the county of Tessin, very few low energy houses have been constructed in comparison to the German part of Switzerland, although the climate is rather temperate and sunny in winter. The "Vitali-Velti house" is one of the few examples of low energy housing. Its interesting yet simple energy concept, and the possibility to perform measurements, provided the motivation for the project.

The "Vitali-Velti house" is located in the village of Monte Carasso, near Bellinzona. The site is in a densely constructed area at the bottom of the south-facing valley. The project illustrates that low energy housing can and has to take into account the local limitations (shape, surface toward south, near and far shadows, etc.). Architecture, aesthetics, costs, reliability and simplicity are important!

The "Vitali-Velti house" is a massive construction, two-family house with a heated floor area of about twice 200 m^2. The exterior walls are insulated with 15 to 18 cm of insulation. Care has been taken to reduce thermal bridges as much as possible. An air controlled ventilation with heat recovery has been installed to save energy and provide good air quality. Large windows have been integrated in the south-east façade. The heating demand is very low (about 50 MJ/m^2y for one house and 70 MJ/m^2y for the other). It is covered by only a wood stove in each house, which heats the air and a murocaust. The saving from not installing a conventional heating system counterbalances the extra cost for the improved envelope of the building, the two ventilation units and the two solar hot water systems (system "Solkit"). The south-east and north-west façades of the house are shown in fig. 1.

Fig.1: South-east and north-west façades of the "Vitali-Velti house".

This project serves as an example for the IEA Solar Task 28 "Solar Sustainable Housing". The results also contributes to both the promotion of low energy houses in Tessin and for Minergie information.

The main objectives of the project are to establish a monthly heat balance of the house, assess the thermal comfort, assess the house in the view of sustainable development (analysis with the *OGIP* program), perform an economical analysis to compare the house with a conventional solution and to produce a documentation for the Solar Task 28 and Minergie information in Tessin.

The objectives for 2002 are **the completion of the measurement period (finished in July 2002), analysis of the measurements, coordination of the work with the IEA Solar Task 28 (the "Vitali-Velti house serves as a documented example for the task) and the completion of the final report.**

Works done and achieved results

The annual report for 2001 contains a description of the measurement devices and datalogger installed. In this report, a summary of the main results is given. The house A (on the west side) is measured with greater details than house B. The measuring period started in July 2001 and finished in July 2002.

Indoor air temperature and thermal comfort

In figure 2 classified temperatures are shown. Apart from a few hours, indoor air temperatures remain within thermal comfort limits, both during summer (<26.5°C) and winter (>19°C). In winter, the temperature may drop below 19°C due to absences or the decision of the occupant (no automatic heating control).

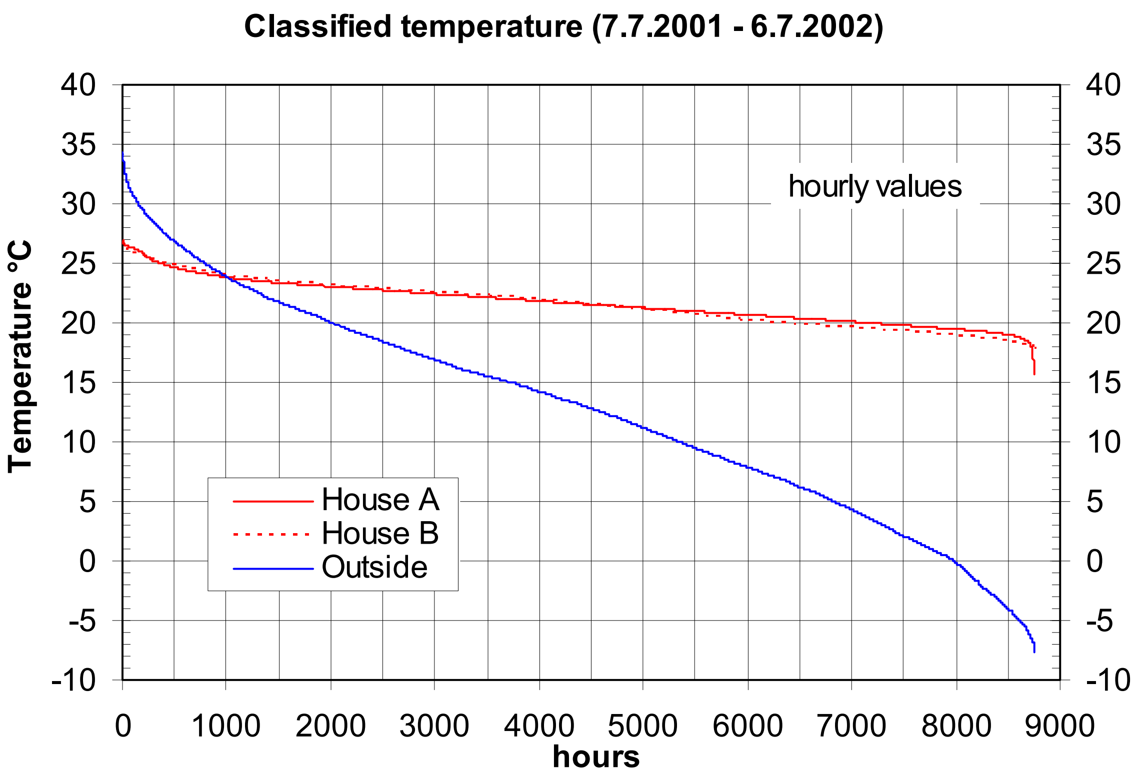

Fig. 2 Measured classified temperature: indoor air temperature of house A, house B and outdoor air temperature

Punctual thermal comfort measurement in winter, spring and summer confirm the satisfying thermal comfort climate.

House A ventilation system

Table 1 contains the main results of the house A ventilation system measurements.

Ventilation system	**Value**
Operation time	3 – 4 months per year
Electric energy for the fans	50 kWh/a
	0.19 kWh/m^{2}a [1] or 0.24 kWh/m^{2}a [2]
Air change rate with speed 1 (quasi always selected)	0.1 h^{-1} (net house volume 590 m^3)
	65 – 70 m^3/h or 16 – 17 m^3/h/person
Thermal energy recovered	200 kWh/a
	COP of 4
Electric energy used by the post-heating resistance	267 kWh/a
Efficiency of the ventilation system heat exchanger	50 – 60%

(1) with reference heated floor area of 260 m^2 (according to the SIA 380/1 norm)
(2) with reference heated floor area of 205 m^2 (according to the Passivhaus standard)

Table 1: Main results of the ventilation system measurements of house A.

The air change rate of the ventilation system, although insufficient regarding the net house volume, is sized for 4 non smoking persons. Indoor air quality measurement (CO_2 concentration) has shown that this low air change rate is enough to guaranty minimum hygienic air conditions for a normal house occupation (4 non smoking persons).

Thermal balance

With respect to the SIA 380/1 energy reference area (260 m^2 for house A and 234 m^2 for house B), the annual heat demand and energy indexes have been established. They are given in table 2.

Based on measurements from July 2001 to June 2002	**House A**	**House B**
Annual heating demand	50 MJ/m^{2}y	70 MJ/m^{2}y
Wood for heating	64 MJ/m^{2}y	100 MJ/m^{2}y
Electricity for heating	9 MJ/m^{2}y	negligi-ble
Energy index for heating (wood + electricity)	73 MJ/m^{2}y	100 MJ/m^{2}y
Energy index for hot water (electricity)	6 MJ/m^{2}y	8 MJ/m^{2}y
Energy index for household (electricity)	34 MJ/m^{2}y	53 MJ/m^{2}y

Table 2 Measured annual heat demand and main energy indexes.

The low energy index for hot water is due to the high solar fraction and a modest hot water consumption. The higher annual heating demand of house B is also due to lower passive solar gains. Unlike house B, house A has large windows in the south west façade. Calculation of the annual heat demand using the SIA 380/1 method from 2001 gives 56 MJ/m^{2}y for house A and 64 MJ/m^{2}y for house B.

The house A heat balance for heating, hot water and ventilation is performed for the measured year (see figure 3).

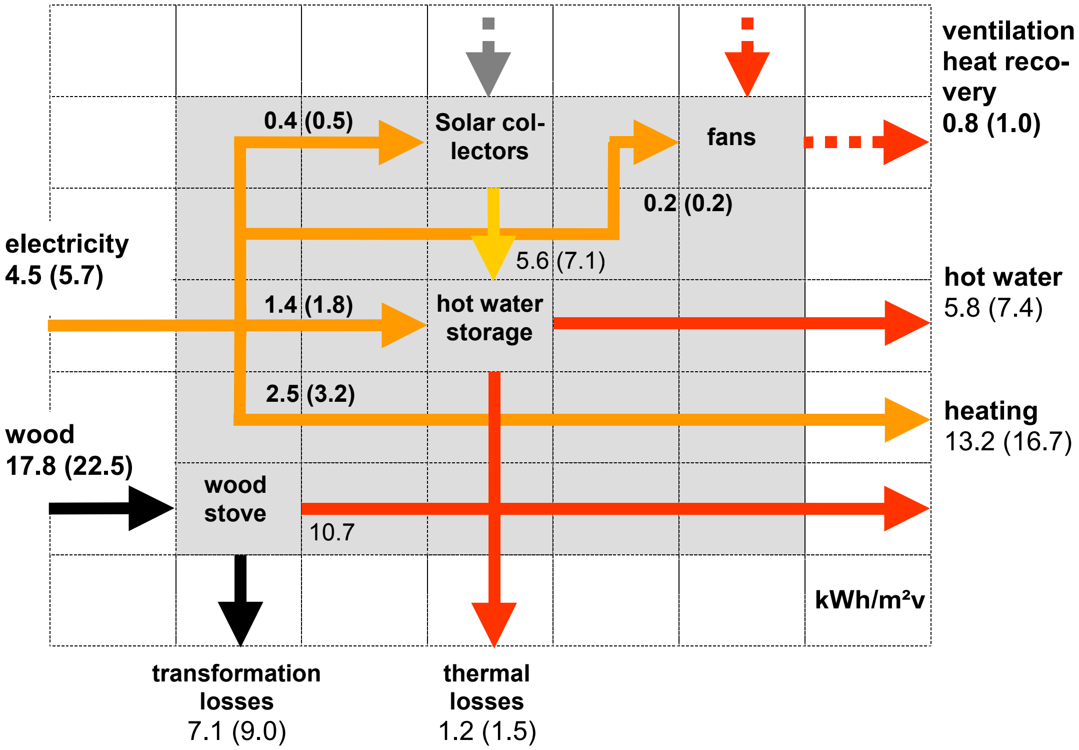

Fig. 3 House A heat balance for heating, hot water and ventilation, from July 2001 to June 2002. Energy quantities are given in kWh/m^{2}y. The reference heating area is determined with external area (SIA 380/1), except for values in brackets. For those values, the reference heating

area is determined with internal dimensions (Passivhaus). Bold values are determined from the measurements, whereas the others are based on estimations.

Conformity to the SIA 380/1 norm and the Minergie standard

The annual heat demand is recalculated in conformity to the conditions of the SIA 380/1 method of 2001 (meteo, air change rate specified by the norm, etc.). Values in table 3 show that the two houses are conform to the SIA 380/1 norm and the Minergie standard.

SIA 380/1 norm and Minergie standard proof	**House A**	**House B**
Aimed heat demand according to SIA 380/1	130 MJ/m^{2}y	160 MJ/m^{2}y
Calculated annual heat demand (SIA 380/1)	67 MJ/m^{2}y	84 MJ/m^{2}y
Required energy index for the Minergie standard	150 MJ/m^{2}y	150 MJ/m^{2}y
Calculated energy index according to Minergie [1)]	123 MJ/m^{2}y	121 MJ/m^{2}y

[1)] ventilation heat exchanger efficiency of 50% assumed
solar fraction for hot water of 50% assumed (pessimistic value; a higher solar fraction is attained in reality; based on estimations and measurements, should be comprised between 70 and 80%)
for house A, 20% of space heating with electricity, rest with wood. House B, 100% wood

Table 3 Conformity of the two houses to the SIA 380/1 norm and the Minergie standard.

The "Passivhaus" standard

The concept of house A does not need to be improved to make it conform with the *passive house standard*. It would be sufficient to have a ventilation system with an efficient heat exchanger which has an average efficiency of > 80%. The primary energy index is also respected (<120 kWh/m^{2}y).

House B does not meet the passive house standard due to fewer passive solar gains, It is not sufficient to improve the ventilation system. Additional insulation of the walls and the roof is necessary (insulation thickness increased at least by 8 cm, thus having a 23 – 26 cm thickness insulation layer). Another possibility is to change the double pane windows into triple pane windows (U value, glazing and frame included, of < 0.8 W/m^{2}K). However this measure has still to be combined with a thicker insulation layer in the walls and the roof (about 5 cm).

National Collaboration

The project is performed in collaboration with the architect office Aldo Velti, viale Stazione 1, CH-6500 Bellinzona.

Internationale Collaboration

Collaboration with the IEA Solar Task 28 “Solar Sustainable Housing”. This project provides a documented example of a low energy house that will be used in the Subtask D book “Measurement and Evaluation”.

Collaboration with the BEST of the Milano Polytechnic to provide a contribution in a book that will be published in Italy on low energy housing.

Evaluation of the year 2002 an perspectives for 2003

Coordination and contribution to the IEA Solar Task 28 “Sustainable solar housing”:

- Participation in the 6th expert meeting in Göteborg, Sweden, September 18 – 21 2002
- Presentation of monitoring results at the Fraunhofer Institute in Freiburg, Germany, October 10 – 12 2002

Information:

- Contribution to the Solar Task 28 brochure (deadline 15 December 2002)
- Promotion of the low energy concept of the Vitali-Velti house in the Edilespo exposition (Lugano, 19 -23 Novembre 2002). Poster and 1 A4 page presentation of the house.

Reporting:

- Submission of a paper to the Eurosun 2003 meeting in Göteborg (deadline for summary: 30 November 2002).
- Final report expected for the end of 2002.

Perspective:

- Ddocumentation of the project for the promotion of the Minergie standard in Tessin.