

RENOVATION OF A HISTORIC BARN INTO A PASSIVE RESIDENTIAL HOUSE

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Summary

An old barn with historic value was refurbished, and a new, highly insulated building made of glued laminated timber was created inside the building envelope.

Keywords: Renovation, historic building, Passivehouse technology, Active thermal solar collectors

1 Introduction

The wish of the client, to spend his pension in Palfau, is more than coherent. As one of seven municipalities in the Styrian nature park 'Eisenwurzen', Palfau offers unique scenic attractions: the beautiful river valley of 'Salza', thick forests, green alp meadows and an impressing mountain panorama – a pure landscape apart of mass tourism. A few years ago the client was able to acquire an attractive estate in Palfau from the property owner of the monastery Admont. On this estate existed, beside some auxiliary buildings, a barn, called 'Moarhofstadl', an agriculturally used barn, which has been renovated the last time 1940. At this typical type of construction, the walls are reduced to pillars of quarry stone, the interspaces are normally filled with simple wood walls. On condition, that the character of the barn is maintained, the public authorities accepted the adaption of the building for residential purposes. The builder owner confronted the author, Architect Reinberg, who already had renovated for this client an apartment house a few years ago, with this new topic. The successful implementation of the first renovation (a building close to Vienna) which has been expanded through a winter garden, leaded to this follow-up order.

2 Concept

After an accurate analysis of the existing building and in consideration of the presetting given by the client, to build thermal on a high grade, emerged the 'house-in house' solution, which has been realised nearly inevitable. The principle: In the barn has been integrated a residential building, which is in every respect separated from the barn. But who assumes a cramped compromise with tight rooms is at fault. With a usable living area of 200 m², the new domicile is planned quite generous. Part of the room concept is a small gallery with archive in the ground floor, which is indeed not heated. The background: One of the family members is a known painter and the comprehensive work is administrated here. Directly aside, the house technique room contains the central equipment of the heating. The actual residential area is extending over the first floor and the attic floor.

Load-bearing inner walls, ceilings and the roof are made of cross laminated plywood and transfer their load over a new fundament body. But this new building is not only statically disconnected from the old barn: thick layers of mineral wool between the wooden elements and the external stone walls isolate the living area. Loam rendering and the wooden plaster walls regulate the humidity and temperature – its positive effect on the room climate is appreciated by the inhabitants. The roof, which is in its substance completely renewed, accords in its outside dimensions to the specifications of the barn-roof. Adapted to the rural environment the façade is cased with larch wood. The quarry stone bricking of the barn has been repaired and coated with a specific organic colour, which also shows the original appearance.

The windows are executed as following: the glass layer of the extensive openings lies at the outer edge of the old brickwork. It is a gas-filled triple-glass ($U_w=0,85 \text{ kWm}^2/\text{K}$), which is located in a window-frame which has been developed specially for this building. With a high energetic claim these windows are an important part of the Passive House concept and allow an intensive utilization of passive solar energy. But also the living culture is benefiting from this solution: Through the wood boarding of the deep niche of the windows, delightful resting places occur, which are appreciated very much by the inhabitants and guests. Beyond that these windows accentuate through their appearance the rhythm of the façade. The garden is accessible through an already existing ramp from the living rooms in the first floor. In the garden a swimming pond brings additional living quality.

3 Energetic optimization

Generally this project is based on the Passive House standard. In this context longer periods are a problem, in which the building is not used (for instant on condition of holiday). A Passive House is fed from three heat sources: the inhabitants as interior heat source, the passive energy from the utilization of the sun and a small heating for the residual demand. Because this building is not inhabited continuously, in this case the first third of the energy balance is dispensed. In the quality of the component parts and in the airproofed accomplishment this building is according very well to the standard of a Passive House. This claim is successfully affirmed by the Blower Door Test. But the missing entry through the inhabitants and the big windows in the north influence the Passive House calculation negative. The house technique concept is directed to this utilization. As usual in the Passive House in this project a controlled ventilation system with heat recovery is used, which effects a steady going heating. Singular radiators are only used in the bathroom. The heating and water heating is done with a wood stove and a solar system. The wood stove with nominal heat capacity of 18 kW is integrated into a water-heating system and a hot air system. The furnace and 30 m² solar panels under the roof, provide the heat in a two-storey high storage tank with 3000L capacity. Through this storage the floor heating and hot water supplies, as well as the ventilation system (with heat recovery) is fed. The idea behind that: the puffer accumulator gives enough reserves, to assure – with help of the solar collectors – a minimum temperature level in the house, also in the uninhabited condition. However in winter, when there is just a little sunshine the temperature can fall, in longer phases of vacancy. To achieve after this period an agreeable temperature within a short time, a wood stove has been integrated. In this stove the inhabitants can use wood from the close-by forest, which is also part of the clients estate. Through the wood stove

the air volume can be heated very fast and efficient, surpluses are inserted to the water storage tank.

In the area of the existing ramp the wall of the barn was humid. To be able to effectively fight against this humidity, the ground was removed and a new ramp was filled in afterwards. The earthwork was also used for the house technique, to pass a water-tube system in the earth of the new ramp. In winter, when the ventilation appliance is in danger to freeze, over this loop a little warmth can be provided, to assure the operating safety. Otherwise through this system it is possible to cool the supply air. In Summer there is no danger of overheating, because in Palfau the nights also in summer are very fresh and the walls can cool in this hours.

4 Conclusion

Certainly the here described renovation is a particular case and the solution is very object-specific. However the example shows that an architect can develop buildings with a high living quality out of difficult problems.

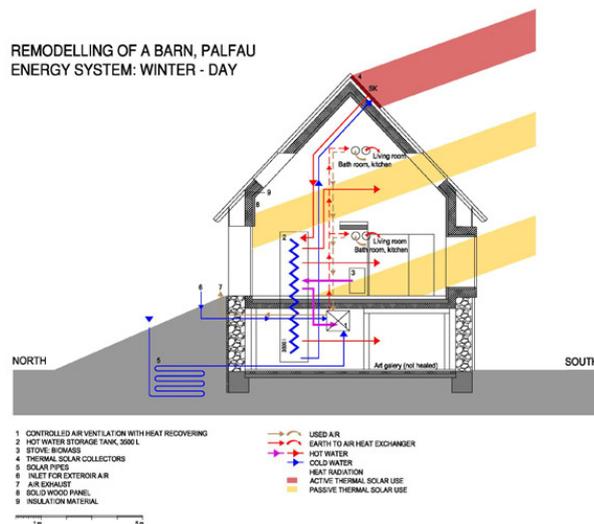


Fig. 1 Energy System / Winter

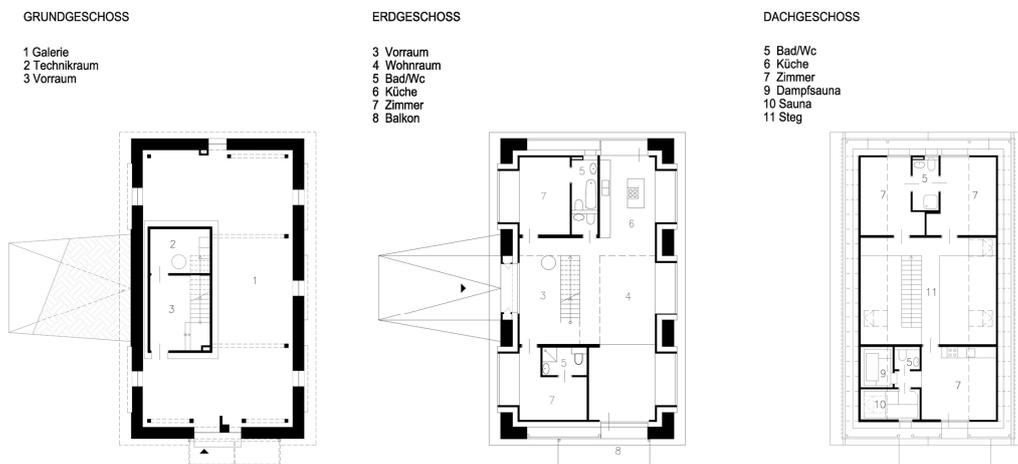


Fig. 2 Floor plan



Fig. 3 Before renovation



Fig. 4 After renovation



Fig. 5 South-East View

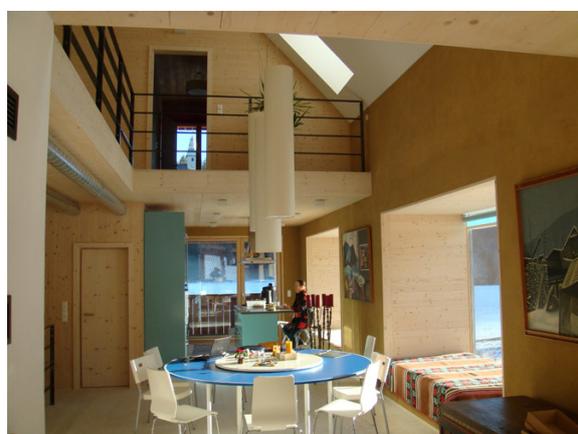


Fig. 6 First Floor



Fig. 7 Gallery (ground floor)