RENOVATION OF AN EXISTING TOWN HOUSE B14 INTO ENERGY AUTONOMOUS BUILDING, WELS (UPPER AUSTRIA)

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Summary

Professional discussions about energy passive constructions face more and more renovations and conversions of existing buildings. This is logical; the proportion of new buildings in the total energy requirements is only a fragment in comparison with existing objects. The same is true when we look at the proportion of the amount of new buildings to buildings already existing. Another aspect is the growing number of regenerative interventions into the structure of whole urban complexes and a shift of focus from expansion to improving the quality.

Due to the contemporary requirements of constructions and the technology development, the potential benefits of the renovations are enormous. Setting aside the protected monuments and buildings of historical or other exceptional value, which require individual approach, there is no reason to avoid the challenge of every renovation project to overcome the limitations of the original building structure and to achieve the best properties relevant to present technological knowledge.

Keywords: renovation, extension, architectural and technical quality, energy autonomy

Fig. 1 *Before renovation*

Fig. 2 *During renovation*

Fig. 3 *After renovation*

1 Town house B14

The project of renovation and extension of the building designed by PAUAT Architekten studio were based on the above thesis. An important emphasis was put on the architectural

concept which clearly and in every detail of interior and exterior reflects the artistic view of the architectural office specialized in technologically advanced projects in energy passive or active standard. Aspects of energy and technology are natural and necessary parts, but not an end in itself, and they are as important as the aesthetic aspects.

The original residential and office building, situated near the city centre, was erected in the 1960s in current building standard. It faced the common problems like draught, mold, poor indoor air quality, thermal discomfort and high operation costs.

The old building was extended to the neighbouring gap site, which in addition to the desired enlarging of usable area has led to a positive thickening of fragmented urban area. Volumetric solution of the building corresponds to the front of the street and the architectural structure of abstract horizontals and verticals in black and white comes out of an uncompromising contemporary architecture of technicism.

Fig. 4 *Court facade*

Fig. 5 *Wooden extension*

Fig. 6 *Street facade*

1.1 Technical solution

Project goal was to rehabilitate the common town house with high energy efficiency (reduction of all energy needs by 90 % = factor of 10), to extend the object, to create healthy environment for the users, to optimize the lighting, to use renewable power supplies (and save emissions) and to become independent on external energy sources.

The starting point for reaching the required qualities was using of passive house principles, including the elimination of thermal bridges. In the structure there were used various types of building materials with the intention to exploit their strengths and to suppress their weaknesses – everything was subordinate to the architectural concept and target technical parameters.

These included the construction materials of the building structure – reinforced concrete, timber (CLT panels) and steel, which enable new solutions of the static scheme with free layout without intermediate internal supports and with visually levitating elements with “empty” corners.

Using the full range of different types of thermal insulation and their combinations – phenolic foam, XPS, EPS graphite, EPS Dalmatian, vacuum insulation, PIR foam, foam glass gravel, purenit or blown cellulose ensure the integrity and the desired thermal properties of building envelope, even in the case of varied architectural treatment of the facades with changes in the thickness of insulation and of connection of particular elements.

Fig. 7 *Detail of insulated facade*

Fig. 8 *Extension*

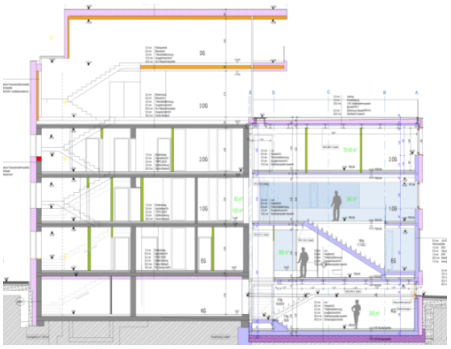

Fig. 9 *Longitudinal section*

1.2 Energy concept

The building, although it is located in a dense area, uses renewable energy sources available directly on site: for central air treatment (precooling, preheating) and activation of heavy structures (floor or ceiling) is used the groundwater potential. Central air-conditioning system with high efficient heat recovery is divided into several branches according to the operation. Amount of fresh air for the office complex depends on the concentration of CO_2 and moisture. The photovoltaic cells located on the adjacent garage and the roof provide energy for building operation and its surplus will be stored on site for later use. Waste heat will be used for water heating, which is also secured by photothermic panels. The sophisticated management of natural and artificial lighting focuses on perfect illumination and interior comfort. The concept of the building ensures its future energy independence. Despite enlarging the usable area energy consumption will be far below the original levels, so it will be a conversion with factor of 10.

Fig. 10–12 *Vertical installations are concentrated at the interface of the old and new parts*

1.3 Other innovative features

The project includes other innovative technologies: hydrogen fuel cell for storing the energy surplus from photovoltaic cells or windows with selective glazing. These windows with reduced frame were developed in cooperation with the producer especially for this object and glazing properties were tested in another building designed by PAUAT Architekten, where the glazing has been used as exterior shutters. The project of B14 already includes selective glass directly in window panels for eliminating unwanted heat gains and summer overheating, and so among other things, due to architectural concept the object passed without exterior shading elements. Experience from the first season of use is positive.

1.4 Expected results

- Increasing of the usable space: 325 m^2 originally
  900 m^2 after extension
- Improvement of user comfort compared to original conditions
- Reduction of energy demand for heating by 95 % (according to PHPP):
  150 $kWh/m^2 \cdot a$ originally
  7 $kWh/m^2 \cdot a$ after renovation
- Reduction of primary energy to max. 100 $kWh/m^2 \cdot a$
- Future energy independence
- Reduction of CO_2 emissions (heating and cooling) by 95 %
- Reduction of total energy need by 90 %

Fig. 13–15 *Precise design of illuminated interior*

Conclusions

Conversion and extension of the house B14 was implemented as a pilot project of renovation of current building situated in dense urban area to energy autonomous and without producing emissions from the building operation. In the house there is the seat of the architectural office PAUAT Architekten, who is the author of the project. Therefore, this realisation represents the studio's philosophy of work that combines both architectural and technical quality.

So it offers a real example for other similar buildings in the urban area suitable to follow and also shows the different possibilities of modern construction materials and technologies that enable dramatic reduction of energy demand without resignation on high architectural level.

References

[1] www.igpassivhaus.at

[2] www. klimaaktiv-gebaut.at

Photos and pictures

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