

Three residential buildings in Hofheim – a comparison of energy standards



In Hofheim am Taunus, three structurally identical double-family houses were refurbished according to different energy standards, allowing for a direct comparison. The pre-fabricated, storey-high insulating elements represent a new kind of facade heat insulation. They are thinner than the traditional insulation due to their integrated vacuum panels and do not stick so far out onto the public pavement. The refurbishment work on the building shell and services includes exterior insulation as a thermal insulation composite system which is set on the street side in large insulating elements, a new roof structure with between-rafter and over rafter insulation, basement ceiling insulation, new windows and a local heating system with wood pellet boiler. One of the three buildings complies with the new building standard according to EnEV, the second building meets KfW subsidy criteria “energy-saving house 60” and the third meets KfW criteria “energy saving house 40”. To check on the success of the project, a comprehensive measurement programme and socio-scientific studies are to be implemented.



The three detached double-family houses in Wilhelmstrasse, Hofheim (Taunus) shortly after the refurbishment work was completed – and in comparison...

© IWU, Institut Wohnen und Umwelt GmbH

Building summary

| | |
|---------------------------------------|--|
| Project status | |
| Location | Wilhelmstraße, 65719 Hofheim, Hessen |
| Year of construction | 1927 |
| Refurbished | 2006 |
| Building owner | Hofheimer Wohnungsbau GmbH |
| Gross floor area | 3.190 m ² |
| Gross volume | 853 m ³ |
| Usable floor area (according to EnEV) | 273 m ² |
| A/V ratio before refurbishment | 0,77 m ² /m ³ |
| A/V ratio after refurbishment | 0,64 m ² /m ³ |
| Key aspects | Heat insulation, Facade systems, Glazing + windows, Ventilation + heat recovery, Biomass utilisation |

Project description

The three detached double-family houses in Wilhelmstrasse, Hofheim (Taunus) were built structurally similar in 1927 using a massive construction method and all have basements. Despite initial insulation measures in the 1980s, their energy consumption continued to be very high at 226 kWh/m²a. Because they were all due for refurbishment, it was also decided to fundamentally modernise the buildings in terms of energy consumption at the same time. High quality heat insulation was hardly possible on the street side due to the location of the buildings directly on a public pavement, so an alternative vacuum insulation was considered. In the end, it was decided to use a new kind of pre-fabricated facade element with integrated vacuum insulation panels which were developed and tested especially for this refurbishment project. The large element insulation technology (*Großelemente-Dämmtechnik, GEDT*) allows for a thinner structure but with lower U-values and, as a result, high-quality, thin heat insulation could be installed on the street side.

Three of the six residential units were still occupied during the refurbishment work.

Refurbishing concept

It was decided to implement the refurbishment work to three different energy standards because the structural pre-requisites in the three buildings are almost identical. With scientifically founded monitoring, one gets a very interesting fundament of data for comparative studies with various refurbishing concepts. Furthermore, energy, construction technology and economic aspects will be studied.

Building 1: Refurbishment according to EnEV – new building standard

The refurbishment work includes adding a new heat insulation composite system to the current insulation (4 cm) so that an overall insulation thickness of 8 cm is achieved. One exception here is that insulation on the street side will be fitted with the new large-element insulation technology (GEDT) with vacuum insulation – all three buildings were insulated in the same way. The thickness of the roof insulation is 18 cm, the basement ceiling 4 cm. The new plastic windows have double glazing – again, the windows on the street side were an exception and were fitted with triple glazing.

Building 2: KfW energy-saving house 60

The structural heat insulation was fitted as with building 1.

Building 3: KfW energy-saving house 40

Compared to buildings 1 and 2, here there is a better heat insulation for the facades not on the street side (total: 24 cm), the roof (30 cm) and the basement ceiling (6 cm).

The ground plans and sectional views of the buildings including detailed construction solutions are available as a .pdf file [here](#).

Energy concept

The building services have been completely refurbished. All three buildings are now supplied with hot water by a central wood pellet boiler located in the basement of one of the buildings. The hot domestic water is stored in storage tanks in each house and is also supplied by the central boiler.

Depending on the respective energy standard, differing ventilation concepts were used:

Building 1: Refurbishment according to EnEV new building standard

Classic window ventilation. The refurbishment work will reduce the heat requirement by 55% and the primary energy characteristic value by 90%.

Building 2: KfW energy-saving house 60

Central building air exhaust system with decentralised inlet diffusers under the window sills. The refurbishment work will reduce the heat requirement by 70% and the primary energy characteristic value by 90.8%.

Building 3: KfW energy-saving house 40

For each individual flat: Air intake and exhaust system with heat recovery. The refurbishment work will reduce the heat requirement by 75% and the primary energy characteristic value by 94%.

Performance

The similarity of the building structures offers a good fundament of data for energy and economic analyses and comparisons. A technical and economic comparison of the three ambitious energy-saving standards can be drawn from the information gained during the conversion measures.

Detailed information on this subject will become available as the project continues.

Key energy data

| Energy indices according to German regulation EnEV (in kWh/m ² a) | before refurbishment | after refurbishment |
|--|----------------------|---------------------|
| Heating energy demand | 194,00 | 48,00 |
| Source energy for heating and domestic hot water (dhw) related to heated living space | 313,00 | 33,00 |

Implementation costs

| Implementation costs in €/m ² | |
|--|-----|
| Construction (KG 300) | 901 |
| Technical system (KG 400) | 210 |

These figures represent calculated costs

Net construction costs (according to German DIN 276) relating to gross floor area (BGF, according to German DIN 277)

 **Project description by the Institute for housing and environment (IWU)**

 **Projektinfo by BINE Information Service**