

Residential area Dieselweg, Graz

Owner: GIWOG

Gemeinnützige Industrie Wohnungs AG

Architect: Architekturbüro Hohensinn ZT GmbH

General Contractor: gap-solution GmbH

Energy concept: ESA-Energie Systeme Aschauer GmbH

Report: AEE INTEC

Location: A-8041 Graz

Date: 2010

Key technologies

- Passive solar-comb façade “climate wall concept”
- Heat supply with a high solar coverage + new kind of storage technology
- Heating-, Cooling- and hot water supply system between the new façade and existing wall
- Decentralized single room fans with heat recovery
- Control, measurements and remote maintenance via internet
- Pre-fabrication of all facade components



Picture 1: The residential area Dieselweg comprises five single buildings and one long building row. One single building – Dieselweg No.4 – was chosen here as representative for all others. [source: AEE INTEC]

Background

Building before renovation:

- 16 apartments
- Exterior walls, floor and roof without insulation
- Windows in need of revision
- Heat supply: 13% solid fuel, 33% oil, 54% current
- Power based hot water generation
- Low comfort
- High operating costs



Picture 2: View of “Dieselweg 4” before renovation [source: GIWOG]



Figure 1: Site plan showing the entire area and location of building “Dieselweg 4” [source: Hohensinn ZT GmbH]

Building “Dieselweg 4” before renovation

Location	Dieselweg 4, Graz
Altitude	345 m
Heating degree days	3.499 Kd
Year of construction	1959
Number of apartments	16
Treated floor area	1.091,6 m ²
Total energy demand for heating (incl. hot water)	200.855 kWh/a
Spec. energy demand for heating	184 kWh/m ² a
Installed heat load	71,83 kW
Spec. heat load	65,8 W/m ²



Figure 2: Floor plan of the building [source: Hohensinn ZT GmbH]

Renovation concept



Picture 3: View on the renovated building [source: GIWOG]

The objectives of the renovation were:

- 91% reduction of the energy demand for heating
- Reduction of the costs for the hot water generation from ca. 0,40 €/m² living area and month to ca. 0,10 €/m² living area and month
- 89% reduction of the CO₂-emissions
- Increase of property value
- Improvement of the indoor and outdoor environment quality

Design data for renovated building

Years of renovation 2008-2009
 Number of apartments 16
 Treated floor area 1.589,4 m²
 Total energy demand for heating (incl. hot water) 15.258 kWh/a
 Spec. energy demand for heating 9,6 kWh/m²a
 Energy savings for heating (174,4 kWh/m²a) 95 %
 Installed heat load 11,13 kW
 Spec. heat load 7,0 W/m²
 Current consumption (without heating) 34.031 kWh/a
 Spec. current consumption 21,4 kWh/m²a



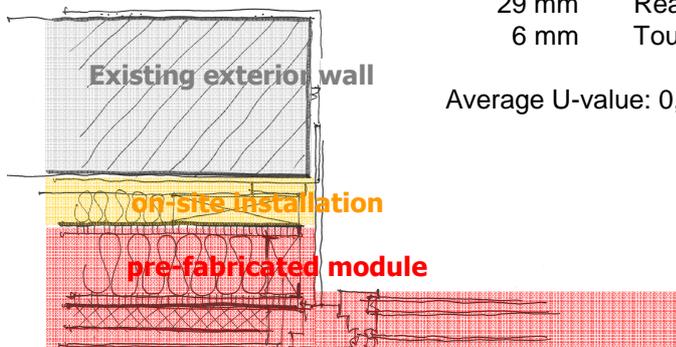
Picture 4: Façade integrated window at Dieselweg No.4 [source: AEE INTEC]



Figure 3: Floor plan changes of the renovated building [source: Hohensinn ZT GmbH]

Renovation design details

Façade Solution



Construction of the exterior walls:

- **Existing wall**
 - 300 mm External plaster
 - Existing exterior wall
 - Internal plaster
- **Compensation and equalization plane**
 - 100 mm Rock wool between post-mullion construction
- **Pre-fabricated façade module**
 - 18 mm OSB-board
 - 120 mm Rock wool between wooden construction
 - 15 mm MDF-board
 - 30 mm Solar comb
 - 29 mm Rear ventilation
 - 6 mm Toughened safety glass

Average U-value: 0,02 – 0,12 W/m²K

Figure 4: Structure of the new façade including the pre-fabricated module

Ventilation

- Decentralized, single room fans with heat recovery (efficiency = 73%)
- Air ducts are integrated into the modules and lead to open air
- Air ducts for supply / exhausted air are hidden behind the new façade

Heating and hot water system

Heat supply:

- 3m² solar thermal collector area per apartment
- 1 heat storage per house
- Groundwater to water heat pump



Heat storage:

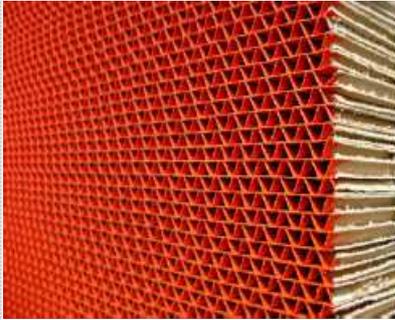
- Pressureless
- Construction of tanks: insulation brick + special foil
- Supply of the apartments exclusively through the façade

As far as possible the whole building services (hot water, climate wall,...) were delivered pre-fabricated.

Picture 5: Heat pump and storage tank [source: GIWOG]

Renovation design details

Façade Solutions



Picture 6: Solar-comb [source: gap-solution]

- „To insulate with sunlight“
 - Special solar-comb construction (cellulose) converts light into heat (warm during winter/ shading during summer)
 - Rear-ventilated glass panels protect the solar-comb construction from weather and mechanical damage
- Increase of the surface temperature → improvement of the indoor environment quality
- High acoustical absorption
- Solar-comb construction can be painted in every color



Picture 7: Mounting procedure of the modules [source: AEE INTEC]

Pre-fabricated modules:

- The joint formation is designed horizontally
- One joint at the level of the ceiling
- One joint on the upper line of the window
- Each module is matched on the lower one

Advantages of the renovation concept

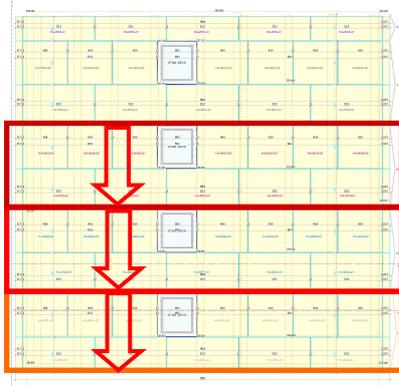


Figure 5: construction principle [source: AEE INTEC]

- Energy performance = passive house standard
- Project management based on QA system
- Improvement of indoor and outdoor environment
- Smart and quick construction procedure on-site
- Tenants are less disturbed during the construction works
- The existing static system keeps nearly unaffected
- Thermal bridges were eliminated determined by the system
- High quality because of construction works in the fabrication hall
- Weather-independent fabrication
- Best quality assurance of produced modules in the fabrication hall
- Smart and short-time construction sites
- Dry and mortar-less construction
- Separable and particularly reusable components

Construction process

Development of pre-fabricated modules :

- 3D – on-site measurement of the building façade
- Development of the pre-fabricated module by “gap-solution”
- Approval of the detailed composition of the modules by the building physician, consulted by AEE INTEC
- Design of each module and all detailed drawings (window-connections, plinth-weathering, angles,..)
- Approval of the detailed drawings, consulted by AEE INTEC



Pre-fabrication :

- “Solar-comb-system” pre-existing from “gap-solution”
- Fabrication hall of carpentry “KULMER BAU”
- Approval by building physician, architect, client
- The single modules are produced according to the real dimensions and plans



Preparation before mounting :

- Installation of the elevator's construction
- Installation of electricity cables
- Bore-holes for ventilation-pipes
- Installations of heating supply on the exterior walls
- Installation of the equalization plane
- Mounting of sheet steel angles <bearing at the splint-weathering>
- Mounting of rock wool between post and mullion construction
- Mounting of vapour-proof barriers
- Cutting-off roof-overhang



Mounting and fitting the single modules :

- The pre-fabricated modules are brought by a truck and trailer on-site.
- Afterwards they are lifted by a truck-mounted crane to the building's façade.
- Two additional mobile-cranes are positioned on each side
- Assembly operators on these cranes are helping during the fitting procedure.



Pictures 8 to 11: Mounting steps at Dieselweg 4 [source: AEE INTEC]

Summary

At this showcase project (GIWOG) for the high-quality renovation of a large-volume residential building to a passive house, the heating costs could be noticeably reduced (ca. 90%). With the use of alternative energy sources, e.g. solar thermal systems, the CO₂ emissions could also be reduced. Thereby highest possible pre-fabricated and large-scale façade modules with integrated components for the building services were used. In this way an essential increase of the comfort and an improvement of the indoor environment quality could be achieved.



*Pictures 12 and 13: View of the renovated building "Dieselweg 4"
[source: AEE INTEC]*

Practical Experience

Our reconstruction project in Graz, Dieselweg is remarkable for many reasons: All 204 flats were rented before and during the whole construction time. The room heating was based on electricity, oil and coal. There were no elevators and a majority of senior inhabitants. The buildings were in a very poor condition according to their age. Aiming a proofed technical solution – passive house standard, sustainable energy based heating, barrier free access, healthy indoor climate - we had to provide a perfect financial solution too, to convince the inhabitants to accept all the interference and disturbances. Supported by the Austrian system of public housing subsidies and additional help by research funds and a special support provided by the Governor of Environmental Affairs of Styria, Manfred Wegscheider, in connection with the non-profit status of GIWOG, we found a fit solution, in order to keep up the social low rental fees combined with a amortization of investments within reasonable time. We achieved affordable sustainability. The evaluation of the first results makes us confident, that we can keep our promises, given as well to our customers as to the supporting institutions and our shareholders.

**Georg Pilarz
(CEO) GIWOG AG**