A new quality of living
Passive house retrofitting of an apartment building

Makartstraße Linz

Johann Aschauer
gap-solar GmbH
PASSIVE HOUSE RETROFITTING – Linz, Makartstraße

porträt of gap-solar

- The company is situated in the technology centre Perg/Austria

- History of gap-solar
  - Foundation in Mai 2002
  - with the manufacturing of facade panels (since 2004)
    - concentration of market
    - gives the chance to greater outlet

- Organisation of market & production
  - market Germany, Luxembourg (with commercial agents)
  - market Switzerland by the company PAVATEX
  - market Scandinavia by the company barsmark (DK)
  - Home market Austria and the rest by gap-solar
  - production only in cooperation with partner companies

- Products
  - responsive building elements (solar panel, effect panel)
  - acoustic elements with honey-comb-design
PASSIVE HOUSE RETROFITTING – Linz, Makartstraße

Overview

• Introduction
  – Connection of the title of the workshop to gap-solar?
  – demo-projects: in Solar-City, Linz new building in Makartstraße, Linz retrofitting
  – Integrated building concepts, the way of the future?

• The project in detail
  – the situation of Makartstraße before and after renovation
  – aspects that should be reached by the renovation
  – renovation in detail

• The implemented responsive building elements in the project
  – gap-solar panel
  – controlled single room ventilation with heat recovery
  – Windows with internal shading

• Pictures from manufacturing and the building-site

• Summary
PASSIVE HOUSE RETROFITTING – Linz, Makartstraße

History in pictures

before retrofitting

in the phase of planning

after the retrofitting

Responsive building elements and integrated building concepts - A new quality of living - Workshop 11.09.2006

www.gap-solar.at
PASSIVE HOUSE RETROFITTING – Linz, Makartstraße

The situation before renovation

the apartments are built in 1957/58
50 apartments in 5 floors without a lift
2,981,92 m² living space (incl. balcony)
the walls are built general in scoria bricks (with bad static)
ceilings in concrete with steel
windows are changed individual (most of them in plastics)
the situation of the object next to busy Makart Street
did not allow a qualitative use of balconies due to enormous pollution and noise!

a good infrastructure
PASSIVE HOUSE RETROFITTING – Linz, Makartstraße

Renovation in detail

Integration of gap-facade panels and low energy windows into prefabricated wall-elements

controlled room ventilation with heat recovery (single room)

enlargement of balconies with integration in thermal wrap by increasing the living space (317.43 m²)

new entrance doors to the apartments (insulation, noise, air tightness)

warm water preparation:
  instead of heat exchanger by gas ➔ heat exchanger by „Fernwärme“

sun- and light shading integrated into the windows

reinforce insulation of top floor an cellar ceiling

electricity installation new in stair rooms

new roofing

additional installation of lifts

change of the parking situation in connection with the pavement
PASSIVE HOUSE RETROFITTING – Linz, Makartstraße

gap-solar facade – functional principle

• “insulation by light” defines the function
• the solar honeycomb acts as a solar absorber
• at low position of the sun (winter) the solar load penetrates into the solar honeycomb and heats up
• a warm zone is created on the outside of the wall
• The temperature difference between living space and outside climate is practically neutralized
• at high position of the sun (summer) the honeycomb shades itself
• an additional mechanical sun-shading isn’t needed
Panel construction from outside to inside:

• ESG-float glass pane, 6-8 mm
• air gap (slightly ventilated), 31 mm
• solar comb, fire classification ÖNORM B1, 50 mm
• rear wall made of wood, 4 mm
• insulation (rock wool), 40 mm

Maximum panel format: 1.250 x 3.050 mm
Manufacturing tolerance: +/- 2 mm
High and oblong format possible

Tone of the solar comb according to RAL
glass with or without structure

Characteristics of heat:
$U_b$ (without additional insulation, only for the panel): 0,59 W/m²K
$g_{n,b}$: 0,11 – 0,13 (for dark tones)

Soundproofing:
$R_w = 59$ dB for a wooden framework-construction (16 cm)
$R_w = 67$ dB for a vertically perforated brick-wall (38 cm), double sided plaster
PASSIVE HOUSE RETROFITTING – Linz, Makartstraße

Integration of gap solar panel in a wooden construction

The gap-facade panel will be integrated in the manufactory in the prefabricated wooden construction.

→ Finished prefabricated wooden wall complete with windows and air flue for ventilation.
The gap-facade panel II is a consequently continued development with a highly reduced frame construction and with identical function and performance than facade panel I.

Panel construction from outside to inside:
- ESG-float glass pane, 6-8 mm
- air gap (slightly ventilated), 27 mm
- solar comb, fire classification ÖNORM B1, 35 mm
- rear wall made of softwood fibreboard 4 mm
- total construction thickness 98 mm
- panel weight: 28 kg/m²

maximum panel format: 1.250 x 3.050 mm
manufacturing tolerance: +/- 2 mm
high and oblong format possible

tone of the solar comb according to RAL
glass with or without structure

characteristics of heat:
\( U_b \) (without additional insulation, only for the panel): 0.74 W/m²K
\( g_{n,b} \): 0.13 – 0.15 (for dark tones)
PASSIVE HOUSE RETROFITTING – Linz, Makartstraße

Integration into framework construction

gap facade panel I

gap facade panel II

Responsive building elements and integrated building concepts - A new quality of living - Workshop 11.09.2006
Effective U-values of the gap solar facade

- Dämmstandard 1
  - Ständerdämmung 100 mm
  - Solarwabe 50 mm
  - Luftspalt 20 mm
  - Glas 5 mm
  - U-Wert = 0,285 W/m²K

- Dämmstandard 2
  - Ständerdämmung 180 mm
  - Solarwabe 50 mm
  - Luftspalt 20 mm
  - Glas 5 mm
  - U-Wert = 0,183 W/m²K

- Dämmstandard 3
  - Ständerdämmung 260 mm
  - Solarwabe 50 mm
  - Luftspalt 20 mm
  - Glas 5 mm
  - Holzständer beplankt
  - U-Wert = 0,135 W/m²K
PASSIVE HOUSE RETROFITTING – Linz, Makartstraße

design with glass

floatglass blank
ornamente glass
textured glass
Form design with color

Practical every color is possible!
Determination of the heating capacity for the necessary hygienic air change:

- necessary air change per person: 30 m³/h
- interior air temperature: $T_I = 20^\circ C$
- outdoor air temperature: $T_o = -10^\circ C$

\[ \Delta \vartheta = 30 K; \quad (P = 30m^3/h \times 0.33Wh/K/m^3 \times 30 K) \]

\[ \Rightarrow \text{heating capacity} = 297 W \]

*ditto at use of a ventilation device with heat recovery*

- assumption heat recovery of 75%

\[ \Rightarrow \text{heating capacity} = 75 W \]

For ventilation devices with heat recovery the residual heat capacity for the necessary hygienic air change could be covered by the thermal discharge of one person.
in every living room and bed room there is situated one ventilation device

3 steps of ventilation - 15; 30 and 60 m³/h

changes of filter: 1-2/year

pollen filter alternative

heat recovery approx. 73 %

electrical power 4 - 12 Watt
(electricity consumption per heating period: 30 to 60 kWh)
PASSIVE HOUSE RETROFITTING – Linz, Makartstraße

Ventilation with heat recovery – localisation of devices

localisation 40 cm below the ceiling

2-3 devices per apartment
PASSIVE HOUSE RETROFITTING – Linz, Makartstraße

Ventilation with heat recovery – mounting & fixing-details.

bore holes for couple of single room ventilation
Window (in passive house-quality) with integrated jalousie.
balconies: pictures – existence before and after

balcony (existence)

entrance (existence)
Balconies: enlargement + integration into the thermal wrap.

Balcony (new)
• the new facade encloses the balconies
• and integrates them into the thermal wrapping
facade measuring

- facade measuring per laser scanning and
- visualisation in 3d
Summary of savings and reductions

The heat-energy-consumption reduction from 179 kWh/m² living space to 14,4 kWh/m² (by PHPP).
The summary of saving is about of 455,000 kWh/a.

This gives a reduction of heating costs from € 14,150,--/a (existence) to € 1,273,50/a and a reduction of the CO₂-emissions from 160 t/a to 14 t/a.

The saving- and reduction potential can be calculated – but the facts as … ????

…..optical seeing, the using of renewable energy, sustainability, the high degree of prefabrication and therefore the high quality and short building time and only slight bothering of tenants ….

have to be calculated in a other way.
Heating costs for a flat of 59 m² living space

Heating costs before retrofitting: ca. 0.69 Euro/m² month incl. VAT
= 40.80 Euro/month for 59.17 m²

Heating costs after retrofitting: ca. 0.08 Euro/m² month incl. VAT
= 4.73 Euro/month for 59.17 m²

Reduction of heating costs: ca. 0.61 Euro/m² month incl. VAT
= 36,--/month for 59.17 m² living space
approx. 15 – 20 % of the gross costs
Time table and financing

**termin**

begin of renovation: 24.08.2005  
finish of retrofitting: 1. quarter 2006

**financing**

building costs (all inclusive): 2.446.000,-- (787,--/m² WNFI)

reserves

loan from apartment building funds, 25 years, 40 %AZ, country OÖ

upkeep and providence amount (so called „EVB“)

actual € 1,39/m² living space/month

extra allowance from federal ministry „BMVIT“
PASSIVE HOUSE RETROFITTING – Linz, Makartstraße

. Pictures from manufactory.
Responsive building elements and integrated building concepts  -  A new quality of living  -  Workshop 11.09.2006

Pictures from manufactory
PASSIVE HOUSE RETROFITTING – Linz, Makartstraße

Pictures from the building-site

Responsive building elements and integrated building concepts - A new quality of living - Workshop 11.09.2006
PASSIVE HOUSE RETROFITTING – Linz, Makartstraße

Pictures from the building-site
Pictures from the building-site
PASSIVE HOUSE RETROFITTING – Linz, Makartstraße

Pictures from the building-site
PASSIVE HOUSE RETROFITTING – Linz, Makartstraße

. Pictures from the building-site
Pictures from the building-site - retrofitting is finished.
PASSIVE HOUSE RETROFITTING – Linz, Makartstraße


13.5 kWh/m²a

7.3 kWh/m²a

Responsive building elements and integrated building concepts   -   A new quality of living   -   Workshop 11.09.2006

www.gap-solar.at
summary

The building will meet the requirements of a passive house through prefabricated solar walls with gap solar facade-panels, reinforced insulation to the top floor and cellar ceiling, enlargement of existing balconies with integration into the thermal wrap as well as controlled room ventilation with single room ventilators with heat recovery.

It is an example for future oriented renovation of a building, i.e. partly high degree of prefabrication, therefore a short building time and high quality standards, makes only slight bothering of tenants possible.

The reduction of heat-energy from 179 kWh/m² living space to 14,4 kWh/m².a reduces the current heating costs for a flat of 59 m² living space from €40,80/month to € 4,73/month after modernization.

Improvement of living quality is made possible through an increase of sound protection and good ventilation by means of high quality single room ventilators without opening of windows.

It is one possibility to use responsive building elements in integrated building concepts by modern and future oriented overall shaping of „old objects“.

In the moment it is only a first step – many others should follow.