Part-financed by the European Union (European Regional Development Fund and European Neighbourhood and Partnership Instrument)

Pilot project ‘Elmschenhagen’, Kiel

GERMANY

1 Project description

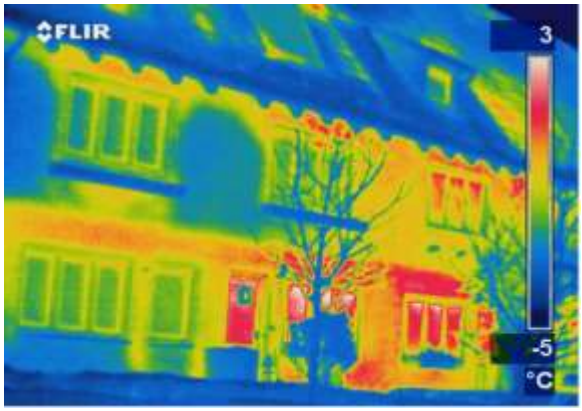
The garden-city was constructed from 1939-1945 with 1,800 apartments for app. 4,000 inhabitants. As these buildings are not listed and mostly privately owned, advice was given to optimise refurbishing and energy saving measures. Therefore a master refurbishing concept was developed and measures were evaluated. Communication between neighbours was initiated to achieve even better efficiency regarding energy consumption and cost-effectiveness by combining larger house sections.

Address: Gebiet Elmschenhagen-Nord, 24147 Kiel

Building type: residential building
Architect: Hermann and Paul Frank
Year of construction: 1939-1945
Owner: mostly privately owned terraced houses and rental flats
Used as: residential building

Number of floors: 2 -5
Façade: cavity wall, red brick façade
Floor space: 62 to 112 m² per unit

Cost of refurbishment: from 1,000 € to 30,000 € for an individual apartment



Refurbishment
Start: 2011
End: 2012, open for further owners, as they decide to start
Planer: Thomas Hahn, Stefan Saleh, Matthias Fiedler, Jasper Harten, Frank Andresen

Material
Façade: red brick cavity wall
Roof: concrete roof tiles
Windows: triple glazing, timber-frame with U-value 0,95 W/m²K, entrance door U-value 0,9 W/m²K
Shading system: none
Floor/Ceiling: concrete slab/timber
Inner walls: lime stone brick, external insulation U-value 0,2 W/m²K
Cellar: insulation regarding low headroom material
Foundation: lime stone bricks

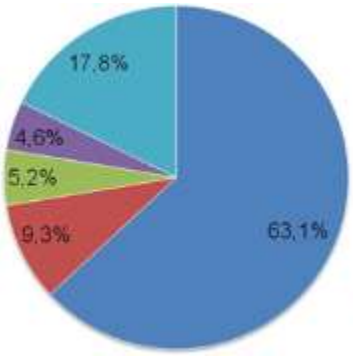
2 Strategy

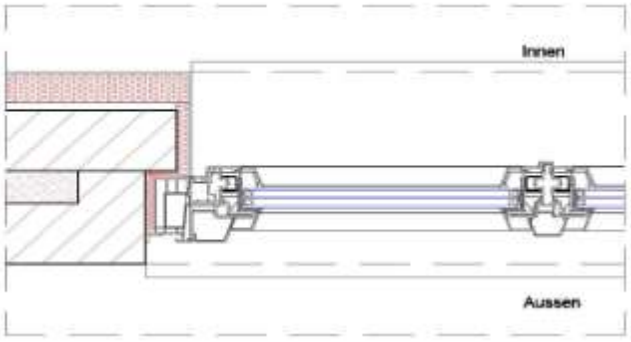
For long term quarter-preservation the city of Kiel set up a legally binding development plan regarding alterations e.g. of doors, windows and façades. Since 2010 a planning application and permission is mandatory for any alteration.

A master refurbishing concept was developed and measures were evaluated. An all-over insulation concept was aimed for and therefore the roof, walls, windows and cellar were examined to achieve best results on energy efficiency and design. The roof, an originally unfinished attic, acts nowadays as living space and needs improvement.

Design guidelines did not offer much assistance – a higher ridge line was not to be accepted. Therefor craftsmen installed insulation between the rafters and, when accessible, underneath towards the inside of the building, consisting of 12 cm mineral wool with a conductivity WLG 032. Technical difficulties arose from another layer of battens for the roof tiles which is mandatory because of German technical guidelines. The challenge of keeping the original ridge line was mastered by pure craftsmanship. Some cellars were excavated to install insulation from the outside. No measures were executed at the foundation and the inner walls. In the left photograph above the transmission heat loss is visualised: To the right the old existing façade and to the left a refurbished one. Four different measures were accomplished:

- Cavity wall insulation
- External insulation with brick-slip-finish
- Technical improvements
- Windows





Heating system / -production

Old: central gas heating

New: gas condensing boiler or wood-pellet burner

Building services

Electricity: Standard

Water / waste water: no measures

Energy consumption

Before:

202 kWh/m²/a

After, calculated:

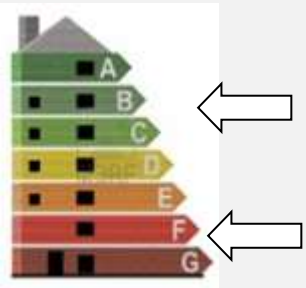
173 kWh/m²/a

After, measured:

no results so far

Energy saving:

15% to 35%



3 Wall insulations

The existing cavity of 6 -7 cm in some of the buildings is filled with highly insulating polystyrene material (heat conductivity 0.034 W/m²K). As the construction includes thermal bridges, e.g. bearings for flower boxes and especially a concrete floor joining the outer masonry wall, there are areas of lesser performance. The energy saving is app. 14%, including windows and doors. Other buildings (without a cavity between the brick layers) received a 14 cm insulation complemented with bricks slips and thus achieving a new U-value of 0.20 W/m²K. While technically easy to accomplish, highest efforts were needed to match the colour and size of the existing bricks. While the mortar colour is rather easy to match, it is extremely difficult to avoid joints which are too even. The visual impression differs. The energy saving is app. 35%, including windows and door.

4 Technical improvements

The existing central gas heating can be replaced by more efficient installations. For buildings containing rental flats with higher energy needs it is recommendable to replace the appliances with highly efficient wood-pellet burners. Further measures include the fine-adjustment of the heat valves and a complete hydraulic compensation.

5 Window connection / conjunction

Specially designed windows were acquired to allow the assemblin from the outside, as planned within this construction. Water tightness is achieved by compressed foam-tape.

6 Specials

The original elevations include flower boxes made of concrete and supported by concrete bearings which are built into the masonry wall. There is no binding plan concerning these elements. The recommendation is to dismount the bearings in order to avoid thermal bridges. Some owners developed their own boxes and new fittings.

7 Costs & financing

1. Costs	**total costs** (in €)
Cavity wall insulation	1,000
Windows, entrance door	7,500
Roof insulation: 4,000 € + roof cladding: 7,000 €	11,000
Basement ceiling insulation	2,000
Condensing gas boiler, incl. hydraulic compensation	7,000
sum 1	**28,500 €**

2. Financing	**funding sum** (in €)	**internal rate of return, interest rate** (in %)
Own money		
Bank credit		
Public funding: KfW	26,800	1%
Donations: Kieler Klimaschutzfonds	1,700	
sum 2	**28,500 €**	

3. Amortisation			
Heating cost <u>before</u> refurbishment	**energy use p.a.** (in kwh)	**cost per kwh** (in €)	**total cost p.a.** (in €)
Gas	18,000	0.08	1,440
Heating cost <u>after</u> refurbishment	**energy use p.a.** in kwh (estimated)	**cost per kwh** (estimated)	**total cost p.a.** (estimated)
Gas	9,200	0.08	736
Payback period for the refurbishment	**cost savings p.a.** (in €)	**amortisation period** (in years)	
	704	**28**	

Additional information:
- The amortisation period is calculated without the roof cladding

1. Costs	**total costs** (in €)
Cavity wall insulation	1,000
Windows, entrance door	7,500
Roof insulation: 4.000 € + roof cladding: 7.000 €	11,000
Basement ceiling insulation	2,000
Wood-pellet burner, incl. hydraulic compensation	14,000
sum 1	**35,500 €**

2. Financing	**funding sum** (in €)	**internal rate of return, interest rate** (in %)
Own money		
Public funding: KfW	31,765	1
Donations: KfW (Effizienzhaus 115)	635	
Donations: Kieler Klimaschutzfonds	1,700	
Donations: Bafa (biomass)	1,400	
sum 2	**35,500 €**	

Amortisation			
Heating cost <u>before</u> refurbishment	**energy use p.a.** (in kwh)	**cost per kwh** (in €)	**total cost p.a.** (in €)
Gas	18,000	0.08	1,440
Heating cost <u>after</u> refurbishment	**energy use p.a.** in kwh (estimated)	**cost per kwh** (estimated)	**total cost p.a.** (estimated)
Wood pellets	10,000	0.05	500
Payback period for the refurbishment	**cost savings p.a.** (in €)	**amortisation period** (in years)	
	940	**26**	

Additional information:
- The amortisation period is calculated without the roof cladding

8 History and historical value

The garden-city ‘Elmschenhagen-Nord’ was built between 1939 and 1945 by the architects Hermann and Paul Frank which created a garden-city pilot project for Kiel. Nowadays 1,800 apartments with ca. 4,000 inhabitants form a lively quarter showing specific qualities but also the limits to modern living in elderly quarters.

The row houses are unlisted historic, not heritage buildings. When the decision for listing was due authorities realised the many changes in the quarter. There was no convincing possibility for conserving every single feature of the façades any more. So, in order to ensure long-term preservation, a legally binding land-use plan including design guidelines was developed. Since 2010 a planning application and permission is mandatory for any alteration. In order to achieve the best possible results and to optimize refurbishing and energy saving measures consultations, refurbishment concepts and individual advices are provided. Also communication between neighbours is initiated to gather measure for quality, results and cost effectiveness. As a model project the development profits from consulting and funding programs for energy efficient refurbishment of historical and monumental buildings developed by different institutions, e.g. the City of Kiel. The goal of the model project is to motivate and to support the house owners to implement highest energy standards.

On the base of the master concept individual consultations for owners offer information about improving the roof and the façades but also about additional energy-saving measures as cellar insulation and heating systems. During the last two years about 103 owners were consulted and 66 owners implemented measures. Single units and complete rows of houses were refurbished. Three apartment buildings were completely refurbished by the housing association ‘FrankECOzwei-Group’. Savings add up to 360,000 kWh per year, equal to 72 tons CO2-reduction per year.

Aiming at keeping the brick facade for the quarter´s quality, the construction of the buildings offers a cavity wall for implementing insulation. Appropriate energy-efficient windows and doors were installed. The purlin roof, originally with unfinished attic, poses challenges: As the development plan demands a fixed ridge height, implementing highest energy standards collides with the limitation in the height of the rafters. While modern techniques as solar thermal or PV is allowed, their implementation shows the need for regulation due to visual aspects concerning different mounting heights and styles on one roof area. A conflict lies in the fact that the quarter´s buildings are highly interesting for first buyers rather neglecting the structures demand for maintenance and energy consumption. Low energy budgets is a result of earlier investment and here the support programs can assist to reach a higher level of energy efficient refurbishment, especially within the limited options a historical house has to offer.

The implemented measures reduce the energy consumption:

- Cavity wall insulation minus 12%
- Outer surface completely (wall, roof, windows) minus 54%

Concerning the cavity wall insulation, special attention must be paid to walls that are not in good condition and that are regularly exposed to wind-driven rain. Standards and guidelines for repairing joints, replacing bricks and applying water repellents correctly have to be developed in order to securely prevent rainwater from penetrating the outside wall and dampening the insulation. The façade should be in good state before cavity wall insulation is installed. Measures:

- New entrance doors, U-value: 0.90 W/m²K
- Cavity wall insulation:
  - Material polystyrene HK 35, hydrophobic
  - Water vapour diffusion resistance $\mu = 5$
  - Thermal conductivity: $\lambda = 0.034$ W/mK
  - Thickness of insulation = cavity 6 - 7 cm
  - Energy savings app. 14%
  - Investment app. 8,000 €
  - Repayment time app. 5 years