Etudes de cas

Bruno PEUPORTIER
Mines ParisTech – CEP

Soirée Réhabilitation, 11 mai 2009

En partenariat avec
Chaire ParisTech “Éco-Conception des ensembles bâtis et des infrastructures”

TREES
Training for Renovated Energy Efficient Social housing
Intelligent Energy Europe programme - Contract n° EIE/05/110/SI2.420021

Section 3 - Case study
3.1 Gårdsten, Sweden

Jan-Olof Dalenbäck
CIT Energy Management AB
High-rise

Low-rise

Before renovation

Foto: C. Nordström

Ongoing renovation – 255 apartments
After renovation

"Design study"

Heat supply - 255 apartm.

- Vent.
- Rad.
- DHW
- Distr.

Before: 270 kWh/a.m²

After: 160 kWh/a.m²
"TRADITIONAL" MEASURES

- **Ventilation** to be inspected - Improved systems
- **Roofs** to be renovated - Additional insulation
- **Balconies** to be renovated - Glazed balconies
- **Windows** to be renovated
  - Inner window panes replaced by low-e
- **Gables** to be renovated – Additional insulation
- **Drainage** to be improved
  - Additional insulation on floor slabs

"NEW" MEASURES

- **Roofs** to be renovated
  - Roof-integrated solar collectors (DHW)
- **Laundries** to be replaced - New washing machines and laundry dryers connected to the hot water system
- **White goods** to be replaced
  - Energy labelled white goods
- **Presence controlled lamps** in common spaces
- **PC-based supervision system**
- **Individual metering**
Roof module collectors that fit to the roof trusses
Heat recovery

Heat supply ~ 145 kWh/m² occupied area

Annual heat supply [kWh/OA]

Before 2001 2002 2003 2004

Solar DHW
District heat
Total electricity ~ 50 kWh/m² occupied area

Annual electricity use (kWh/OA)

65% occupied

99% occupied

Before 2001 2002 2003 2004

Household

Common

Total water use ~ 120 m³/apt

Annual water use [m³/OA]

65% occupied

99% occupied

Before 2001 2002 2003 2004

Household

Common
**ECONOMICS**

- **Total investment ~ 12 M€**
  incl. VAT and management cost
  (~ 47 000 € per apartment)
- **Energy measures ~ 2,1 M€**
  (~ 8 400 € per apartment)
- **Operational savings ~ 0,15 M€/a**
  (~ 600 € per year and apartment)
- **Feasible without subsidies !**

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**TREES**
Training for Renovated Energy Efficient Social housing

Intelligent Energy - Europe programme, contract n° EIE/05/110/SI2.420021

**Section 3 Case-Studies**
3.5 Nürnberg, Jean-Paul-Platz (Germany)

Developer: Uli Neumann (University of Kassel – CESR)
Reviewer: Arne Nesje (SINTEF)
Characteristic Data of the Building

<table>
<thead>
<tr>
<th>Type</th>
<th>30ies, 2-Flanner (carriage and pair), free-standing</th>
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</thead>
<tbody>
<tr>
<td>Characteristic</td>
<td>Compact building with plaster facade</td>
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<tr>
<td>Year of Construction</td>
<td>1930</td>
</tr>
<tr>
<td>Flats</td>
<td>6 (3 storeys)</td>
</tr>
<tr>
<td></td>
<td>30 dwellers</td>
</tr>
<tr>
<td>Area</td>
<td>897 m² (heated)</td>
</tr>
<tr>
<td></td>
<td>(6 * 149 m² / flat)</td>
</tr>
<tr>
<td>Volume</td>
<td>4028 m³</td>
</tr>
<tr>
<td>Surface / volume - ratio</td>
<td>0.45 resp. 0.42 m⁻¹</td>
</tr>
<tr>
<td></td>
<td>(before resp. after renovation)</td>
</tr>
</tbody>
</table>

Measures (I) : Constructional Thermal Protection

- **PassiveHouse - Windows**
  - 3 panes (thermal-protection glazing)
  - optimised glass spacer
  - Insulated Frames

  \[ U_{\text{window}} = 0.85 \text{ W/m}^2\text{K} \]

- **Insulation of External Walls**
  with 20 cm Neopor™ (\( \lambda \) 0.035)

  \[ U_{\text{ext. wall}} = 0.15 \text{ W/m}^2\text{K} \]
Measures (II) : Constructional Thermal Protection

- Insulation of Cellar Ceiling  
  with 14 cm EPS / Mineral Wool ($\lambda = 0.035$)  
  $U_{\text{cellar ceiling}} = 0.19 \text{ W/m²K}$  

- New roof covering of the step roof +  
  Insulation of the top-level ceiling  
  with 25 cm EPS ($\lambda = 0.035$)  
  $U_{\text{top level ceiling}} = 0.12 \text{ W/m²K}$

Measures (III) : Building Services

- Ventilation-System (decentral)  
  - supply / exhaust air  
  - heat recovery (efficiency > 85%)  
  - air flow 150 m³/h  
    (5 persons à 30 m³/pers*h)  

- Gas Heating System (30 kW)  
  - gross calorific value  

- Solarthermic System  
  - 17 m² flat collectors  
  - 1.000 l storage tank  
  - designed for DHW, only little heating support
Quality Assurance: Accompanying Checks

Thermography and Blower-Door

Balances of Space Heating Demand >>> Energy Saving Factor 10

before refurbishment: 200 kWh / (m²a)
refurbished: 27 kWh / (m²a)

source: Passivehouse Institute
Section 3 Case studies

3.2 Dunaújváros, Hungary

Tamas CSOKNYAI
BUTE
SOLANOVA - Demo Building

- Located in Dunaújváros, 80 km from Budapest
- 42 flats
- District heating
- During renovation flats are occupied

Thermal performance
Renovation measures

- External thermal insulation of walls (16 cm PS)
- Thermal insulation of roof (30-40 cm) and cellar ceiling (10 cm)
- Double glazed windows in the southern side flats (U=1.2 W/m²K) and shops, PVC frames
- Triple glazed windows with integrated shading in southern side dwellings
- Flatwise ventilation system with balanced heat recovery
- Solar collectors supporting hot water supply (72 m²)
- New low performance double pipe heating system
- Water saving taps and shower heads
- Green roof

Heating energy consumption

- **ORIGINAL**
  - 220 kWh/m².year

- **RENOVATED**
  - 39 kWh/m².year

*2005 - 2006: 85% saving*
Facades

**Original sandwich panels:**
- 15 cm reinforced concrete – 7 cm PS – 7 cm reinforced concrete
- Theoretic U-value: 0.44 W/m²K
- Real U-value in thermal bridge free zones: 0.8-1.1 W/m²K
- U-value incl. Thermal bridges: 1.8-2.0 W/m²K

**Insulation:**
- 16 cm polystyrene

**U = 1.8-2.0 W/m²K**

**U = 0.22 W/m²K**

Thermal bridges

**Temperature Distribution**

**Original**
- 14.4°C

**Renovated**
- 19.1°C
Insulation works

- U-value element: 2.3 W/m²K
- U-value installed: 3.2 W/m²K
- U-value staircase: 5.6 W/m²K
- U-value ground floor: 5.6 W/m²K

Windows

**ORIGINAL**
- U-value element: 2.3 W/m²K
- U-value installed: 3.2 W/m²K
- U-value staircase: 5.6 W/m²K
- U-value ground floor: 5.6 W/m²K

**RENOVATED**
- U-value South, West: 0.9 W/m²K
- U-value North: 1.4 W/m²K
- U-value ground floor: 1.4 W/m²K
Air tightness – blower-door

Measurement in 4 flats:

5/1 \( n_{50} = 7.1 \text{ h}^{-1} \)
5/2 \( n_{50} = 8.8 \text{ h}^{-1} \)
5/3 \( n_{50} = 9.1 \text{ h}^{-1} \)
7/3 \( n_{50} = 12.0 \text{ h}^{-1} \)

Flat roof

Original

\( U = 1.3 \text{ W/m}^2\text{K} \)

Renovated

\( U = 0.12 \text{ W/m}^2\text{K} \)

21 - 29 cm PS
Ground floor works

Heating system

**ORIGINAL**
- Vertical single pipe system
- Not controllable

**RENOVATED**
- Much smaller radiators
- One instead of two in each rooms
- Thermostatic valves
- Risk of overheating due to the uncontrolled heat flow of pipes
- Minimised total pipe length
- Unheated staircase
Ventilation system

Water saving units
Solar system

- Canopy integrated system on the Southern side: double function, shorter payback time
- 72 m²
- supports DHW production
- Solar+water saving: 50% DHW energy saving

Monthly energy consumption before and after renovation
Thermography before and after renovation

Satisfaction with flat
### Investment and Benefit of the Refurbishment Measures

<table>
<thead>
<tr>
<th>Period</th>
<th>Investment ct/kWh</th>
<th>Benefit ct/kWh 2006</th>
<th>Benefit ct/kWh forecast 2008</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Max. investment</td>
<td>Min. investment     + Increased comfort, productivity + CO₂ certificates</td>
<td></td>
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<tr>
<td></td>
<td>Avoided energy cost</td>
<td></td>
<td></td>
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</tbody>
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#### Section 3 Case Studies

**3.3 Kruitberg, Amsterdam**

Chiel BOONSTRA, Loes JOOSTEN

DHV
Kruitberg: high rise building in Bijlmermeer

Kruitberg is a typical large-scale high-rise building in the south-eastern part of Amsterdam built during the 1960-70’s. The demonstration project includes the second phase of a large renewal operation and consists of 363 apartments out of a total of 9000, which are in need of renovation.

Glazed Balconies at Kruitberg

New ventilation in upper windows, pressure controlled constant volume (left) and individual controllable (2 modes) pressure controlled outlet kitchen.
PV on end facades before and after renovation (artist impression)

Construction 720 m² collector (left) and framework (right)

Integration of a solar system

Getting solar storage into place and fixed
Conclusions

- Possibilité de réduire par 4 (voire 10) la consommation énergétique des logements existants
- Investissement compensé par les économies d’énergie dans les cas favorables

<table>
<thead>
<tr>
<th></th>
<th>Allemagne</th>
<th>France</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fonds environnement</td>
<td>11 Mds €</td>
<td>4,4 Mds €</td>
</tr>
<tr>
<td>dont bâtiment</td>
<td>7 Mds €</td>
<td>0,4 Mds €</td>
</tr>
</tbody>
</table>
- Efficacité énergétique et utilisation des énergies renouvelables à compléter par la sobriété (comportements)