Gårdsten
Solar Buildings

Gårdsten, location

location: Göteborg, Sweden
dates: originally built 1969-1972, renovated 1998-2004 in 2 phases
type: Sustainable renovation of existing 'million programme' prefabricated element and slab housing buildings
use: residential
size: 255 apartments (18 720 m^2 of living area) in phase 1 and about the same in phase 2

people:
actors: City of Göteborg, Gårdstenbostäder, Christer Nordström Arkitektkontor AB, SKANSKA Sweden AB, Rune Lindh Byggadministration AB, IO design, CIT Energy Management AB, Andersson & Hultmark AB, LTB Byggkonsult AB, Partille Elkonsult AB, Taggen Miljö och Landskap AB, EU Projects 'SHINE' and 'Regen-Link'

goals:
- to revitalize a run-down development
- to closely cooperate with tenants to create a strong and vibrant community with an interest in maintaining the properties
- to focus on energy efficiency and reduce energy costs for tenants and owners while improving quality of life, and to integrate renewable energy and sustainable design into the renovation project wherever possible

energy use	KWh/m^2
heating&electricity, goal	270
heating&electricity,achieved	146
household energy,original	55
household energy,achieved	53

construction
- prefabricated concrete slabs and frames
- increased insulation where necessary
- replacement of interior glazing w/ low- e glazing
- minimizing thermal bridges

amenities
- community greenhouses
- community rooms
- composting machines

systems	
district heating	x
combined heat & power	
solar panels	x
solar cells	
biomass and refuse	
wind power	
natural ventilation	x
forced vent.w/heat recovery	x
non-renewable energy	x
individual metering	x

special projects
- tenant participation in meetings and work groups

site ecology
- new planting areas

process and history

The housing area of Gårdsten, in Göteborg Sweden was built in the early 1970's. It soon fell into decline due to the poor initial building construction and a lack of services to the area. Since 1996, Gårdsten is undergoing a process of social and physical regeneration.In 1997, a public corporation called Gårdstenbostäder was formed, to purchase the buildings and refurbish them. Funding and the subsequent requirements from the EU's SHINE and Regen-Link projects, as well as Gårdstenbostäder's and resident's initiatives, defined the renovation project in terms of energy efficiency. An architect with experience in solar systems, Christer Nordström Arkitektkontor AB, was hired and worked with both the building company and resident's groups to create solutions that would both increase efficiency and raise the quality of living within the development. The task was to perform a design with high standards regarding social ambitions, sustainability, energy conservation and economy.

description of special project features

Two types of buildings make up the 4 -building block units that characterize the district of Gårdsten; 6 story balcony access buildings with external staircases, and conventional 3-story slab buildings with internal staircases. Buildings are connected to the district heating system.

Situation before renovation *(on picture to the right)*

Before the renovation the area suffered from severe social problems due to more than 60% unemployment causing poverty, lack of self confidence and increasing crime rate in the area. A large representation of different languages and cultures in combination with few Swedish dwellers lead to separation between groups of tenants and difficulties to integrate with the society.

Buildings – technical problems

- Most of the roofs had problems with leaking of rain and snow which had to be repaired almost every year.
- Facades and structural elements of concrete had damages cased by corroding concrete reinforcements
- Plaster falling down
- Corrosion of metal details such as doors, door frames, balconies, etc.

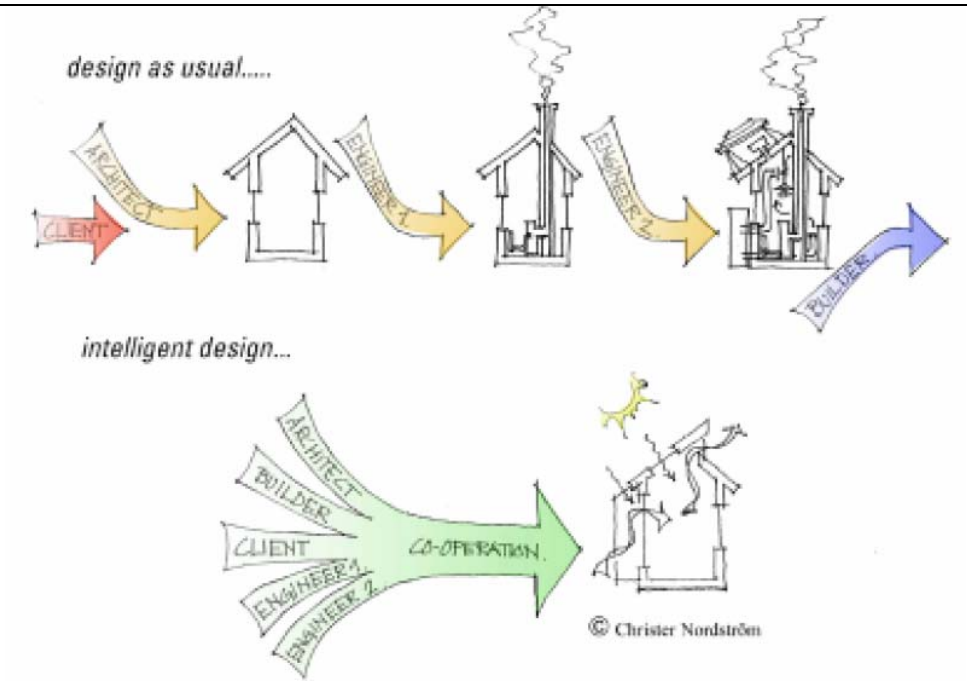
Health problems occurred due to poor ventilation systems. Open space under buildings caused very windy outdoor environment and the overall outdoor environment was unfriendly for children.

Energy problems

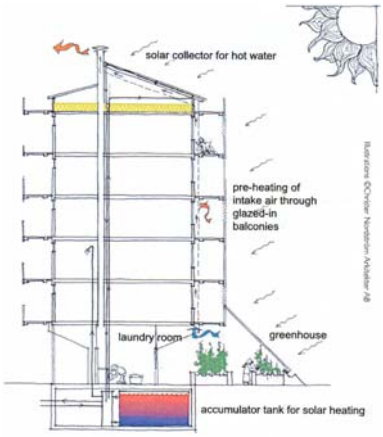
- Overall high energy consumption (heating 270 kWh/m2)
- Poor insulation of roofs and external walls
- Cold bridges in intersections between façade elements – especially important on facades exposed to prevailing winds.
- Windows did not match the standard.
- Very inefficient and energy consuming preheating ventilation systems
- Inefficient lighting and electrical appliances
- Energy wasting behaviour

Besides mentioned issues, the area had environmental problems with waste and PCB which was detected in some joints and sealants between concrete elements. Aesthetically the area was not appealing and gave a bad atmosphere to the place.

The success in the renovation is seen in the integrated design process shown on figure 1.



Figur 1 Design process



With the renovation being approached as an opportunity to save energy, the following solutions were applied:

1. In the balcony-access buildings, exhaust-air ventlation was introduced, and in the lower slab buildings, Heat Recovery Ventilation was provided.
2. Existing balconies were enclosed with operable glazed panels. This was done in conjunction with the repair of the balconies, which were in disrepair. This layer of glazing protects the original facades and reduces heat loss in the cold months, while pre-heating the ventilation air when the sun is shining in the spring and fall months. Residents can move the glazing out of the way during the warmer months.
3. Balcony-access buildings received solar panels, placed at an optimal solar aspect and integrated into the roof, to pre-heat water used within the 4 buildings that make up a block. This pre-heated solution is used to heat the water in large tanks in the basement level, which is then distributed to the 4 buildings that define a block. On the ground level of these buildings, a greenhouse was added along most of their length, similarly protecting the ground floor from the outdoor environment while providing indoor gardening and gathering space for the tenants. In the lower slab buildings, solar air collectors mounted vertically on the south facades provide warmed air that is circulated within the cavity created by the original building facades and the new insulated facades that were added on the north, east, and west sides. This reduces heat loss.

4. The inner pane of the existing double-paned windows was replaced with low-e glazing.
5. Roof insulation was added when the roofs were renovated.
6. Insulation was added in the gables of building roofs when the facades were re-built.
7. The base slabs were insulated when new drainage systems were installed.
8. Energy efficient washing and drying machines were connected to the solar hot water system.
9. Energy-labelled electrical appliances for the units were part of the renovation.
10. Efficient occupancy- sensor lighting was installed for common areas in the buildings.
11. A central control and supervisory system was installed to monitor energy and water use within the buildings. This system also involves individual meters for each unit, so residents can monitor their own use of energy and water. While a basic level of heat, 21C, is provided for in the rent of the units, residents can get a rebate for using less or must pay more for an increase in temperature. This also empowers residents to choose whether to spend their money on greater thermal comfort

or to save it by living with a slightly lower indoor air temperature. This system also applies to water usage.

Community Involvement

Tenants were seen as a key to the project's success. This was difficult initially, as most of the residents did not believe that their opinions would influence the outcome. To create interest in the project, an information apartment was created where tenants could meet with project representatives and discuss issues both more informally and in more depth than at the larger community meetings. A 'graffiti' wall was set aside in the living room of the information apartment where residents could write comments under the categories of "We Want" and We DO NOT Want". This wall became an important reference for Gårdestenbostäder and the design team.

Advisory working groups were seen as a real way for community participation to achieve some results. Out of a possible 150 households, 54 people actively became involved in the various workgroups. Workgroups were created to respond to security issues, create apartment renovation proposals, look at ways of making the utility spaces more useful, propose ways of improving the exterior environment, planning better car parking strategies, and developing a system for IT, satellite dishes, and aerials that would serve the apartments.

Focus: The Working Group for the New Ground Floor, Utility Rooms, and The Environment.

This working group "rejected the architect's first proposal and instead, in consultation with the architect, they formulated a further proposal for how the new ground floor should be designed." This led to the utility rooms being located on the ground floor with the other public rooms, with access and windows onto the new indoor greenhouses. This also led to a re-organization of the waste handling system, with composting that provides rich soil for the indoor greenhouse beds.

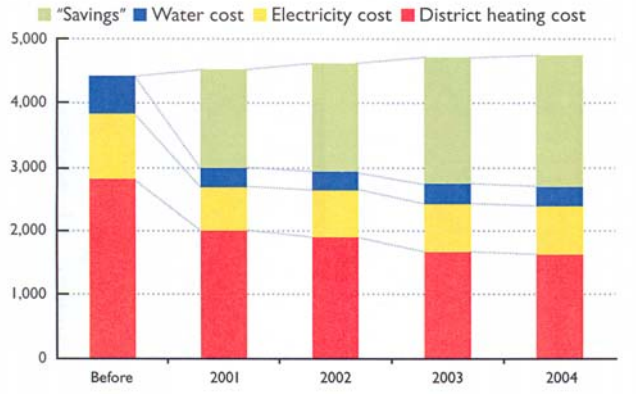
funding

The total cost of renovation was app 12 mil Euros. The additional cost for operating and energy saving measures amount to app 2 mil Euros of which less than 30% was covered by a contribution from the EU and the Swedish Energy Agency.

results

Performance:

After a large initial drop in consumption of water and energy which has lasted and is due to the increased energy efficiency of the construction and the integration of renewables, decreases in consumption continue every year. These decreases are attributed to a greater consciousness of the residents; the individual monitoring of each unit is allowing residents to reduce their household energy and water consumption, with the incentive of saving money on their utility bills.



The solar systems provide heating for hot water that translates to a reduction in the district heating needs of approximately 15 kWh/m2 per year of heated floor area.

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sources:

- Solar buildings at Gårdsten, a brochure downloadable from: http://www.gardstensbostader.se/data/content/DOCUMENTS/20065111939456 47SolarBuildings.pdf
- Solar buildings at Gårdsten, a brochure downloadable from: http://www.arch.chalmers.se/tema/byggd-miljo/grundutb/A4_2005-06/Solar_buildings_Gardsten.pdf
- Solar Buildings, official site of the Gårdstensbostäder http://www.gardstensbostader.se/default.asp?groupid=200592613179932&firstlevelid=20041112102939749
- http://www.gardstensbostader.se/data/content/DOCUMENTS/20065111939456 47SolarBuildings.pdf, TREES case study by Jan-Olof Dahlenbäck and V. Pavlovas
- Solar Housing Renoavtion in Gårdsten, Göteborg, Sweden, Entry for the World Habitat Awards, by Christer Nordström Arkitektkontor AB
- Pictures provided by Christer Nordström

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