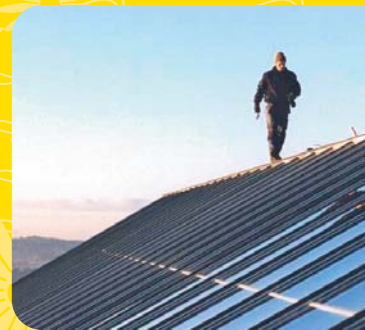




**GÅRDSTENS
BOSTÄDER**



Solar buildings in Gårdsten



The creation of Solar buildings in Gårdsten is a story with many dimensions

THIS IS A STORY ABOUT TECHNOLOGY AND HOUSING RENEWAL. Solar buildings, Solhusen, has become renowned as an example of property renovation with energy solutions based largely on solar heating.

THIS IS ALSO A STORY ABOUT COLLABORATION BETWEEN EXPERTS AND LAYMEN. It is about how a housing company succeeds in mobilising the tenants' inventiveness and how they can then act as a source of inspiration and ideas for both architects and building engineers.

AND IT IS ALSO A STORY OF PERSISTENCE. To in one and the same renewal project reduce future maintenance and energy use, cut living costs, apply modern recycling technology and achieve new aesthetic values requires a persistent initiator and a strong belief in the capacity of the individual.







Renewal and residential influence

This brochure is intended to highlight the creation of Solhusen from all these points of view. But first a brief description of Gårdsten and the background to the renewal process.

Gårdsten is a “million new homes programme” area dating from the early 1970s. It was in considerable need of renewal when Gårdstensbostäder, founded in 1997, purchased some 2,000 apartments in the area from Bostads AB Poseidon and Göteborgs Stads Bostadsaktiebolag and many of the apartments were vacant. Today, Gårdstensbostäder has also



acquired around 700 apartments in Norra Gårdsten (previously apartments owned on a co-operative basis and apartments under private management) and consequently it manages all the rented apartments in Gårdsten.

The management also included development – to contribute to the overall transformation of the area and ensure that it becomes a better area in which to live. The latter is possible only if the residents them-

selves are involved to a significant extent in the development process. Each change has been preceded by discussions and collaboration with the tenants and the results achieved – improved commercial services, a reduction in vandalism, a more pleasant environment, new jobs for the unemployed – have shown both the residents and others that local collaboration has been meaningful. The inception and care of Solhusen are the best proof of all.



From grey concrete



The first Solhus area, Solhus 1, comprised three blocks with 255 apartments and was renovated as a turnkey project with Skanska as the main contractor. Preparatory work commenced in spring 1998 and in March 2000 the first tenants could move in. The project's second phase, Solhus 2, was completed in autumn 2003. Solhus 2, which was completed as a number of sub-contracts, essentially comprised the same number of apartments, with in principle the same (exterior) measures taken as the original Solhus 1 with a five-year performance guarantee.

With advanced plans to combine renovation with solar heating, Gårdsten was included in the EU project

SHINE for Solhus 1 and Regen-Link for Solhus 2, which offered certain financial support from the EU to cover some of the additional costs. As an EU project, the Solhusen buildings were subject to particular technical and architectural stipulations. At the same time, it facilitated more extensive preliminary studies and enquiries than would normally have been the case.

The name Solhus ("Solar buildings") was chosen to emphasise the focus on the future, with the reconstruction of a "million new homes programme" area where use of solar energy was one of several technical measures employed. The focus also included Gårdstensbostäder's wish to keep rents low and make



blocks...



Photo ©Christer Nordström Arkitekt AB

it possible for the tenants to influence their costs (with the help, for example, of individual metering of space heating, electricity and water use). Gårdstensbostäder also had the ambition to trim costs by reducing the number of stages in the construction process. This ambition had cut costs by SEK 20 million by the time Solhus 2 was completed in the form of 31 smaller, “tailored” contracts.

The buildings were constructed using prefabricated concrete elements and have flat roofs. There are two types of buildings: buildings with access balcony walkways and three or five floors above ground, with an external staircase leading to entrances from the

walkway balconies, as well conventional slab buildings with entrances on the ground floor and internal staircase leading to three floors, including the ground floor. The balcony access buildings have balconies facing south along the whole building and the slab blocks have recessed balconies facing east and west.

The blocks were supplied with heat from district heating and they were fitted with mechanical supply and exhaust ventilation. The tenants paid rent that included heating and electricity and consequently there were few incentives to save energy.



...to open, bright “Solar buildings”

The balcony access buildings were fitted with roof-integrated solar collectors which, via accumulator tanks in the cellar, pre-heat hot water in the block. The balconies in the balcony access buildings were glazed to protect the facades, reduce heat loss and improve the balconies. During spring and autumn, the sun shining on the balconies pre-heats the ventilation air for the apartments. The open ground floors of the balcony access buildings at Solhus I have been replaced by greenhouses for the tenants and new, bright laundry rooms and rooms directly adjacent to the greenhouses, which can be used by the tenants. In addition, compost machines transform household waste into soil, which can then be used in the greenhouses.





New energy solutions combined with renovation

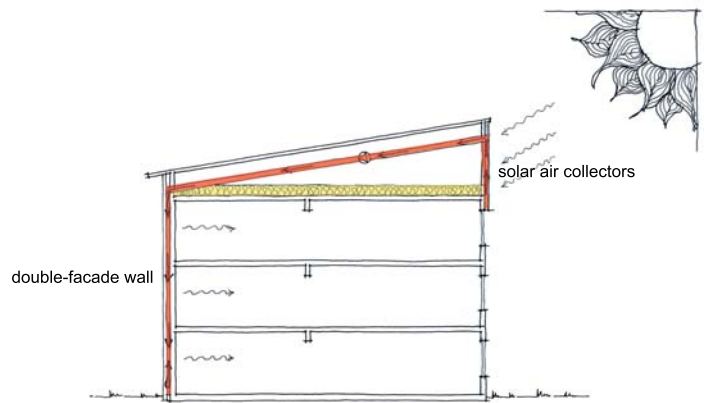
The proposed general measures, produced in collaboration with the tenants, were complemented and developed during the project's enquiry and system phase. To provide system documentation a basic alternative, in most cases covering mainly necessary measures, was compared with a more expensive alternative, which entailed energy savings within a budget for additional investments.

The project finally came to include carefully planned renovation where the majority of the additional costs for energy measures are covered by the reduction in operating costs. The energy-related measures can be summarised as follows:

- Conversion to exhaust air ventilation in the balcony access buildings and the installation of heat recovery on ventilation in the slab blocks
- The glazing-in of balconies in connection with renovation (damaged concrete elements)
- Replacement of the inner windowpane by low emission glass in the existing double-glazed windows
- Solar collectors integrated into the roof in connection with roof renovation
- Additional roof insulation in connection with roof renovation
- Additional insulation of the gables in connection with facade renovation
- Insulation of the bases in connection with renovation of the drainage system
- New washing machines and drying room equipment connected to the hot water system
- New energy-labelled white goods as part of the refurbishment of the apartments
- Installation of presence-controlled lighting in the common areas
- Installation of a central control and supervisory system
- Introduction of individual metering for electricity and heating as well as hot and cold water

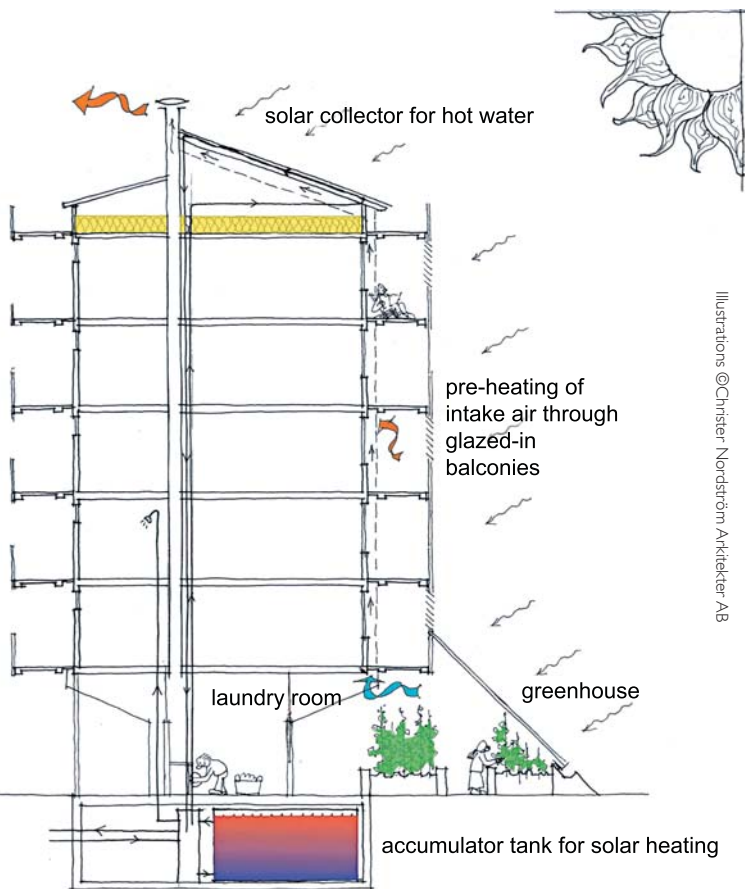


In addition, the buildings were given new laundry rooms and common areas, greenhouses on the ground floor in the balcony access buildings and new rooms for ventilation units on the roofs of all the buildings. The entrances and stairwells have been renovated and the whole area has been given a new colour scheme and external lighting. A new type of waste-handling system has also been introduced, with sorting at source (a new facility beside the car park) and composting (beside the greenhouses). Waste chutes and rubbish rooms are now being used for other purposes.



BUILDINGS WITH DOUBLE FACADES/ ENVELOPES

This building has solar air collectors on the southern facade. The walls to the north, east and west have been fitted with extra insulated facades outside the existing walls. In doing so, a cavity was created between the existing walls and the new facades where the heated air from the solar collectors is circulated by a fan.



BUILDING WITH SOLAR COLLECTORS ON THE ROOF

When the sun shines on the solar collectors the liquid (glycol mixed with water) inside the collectors is heated up. The liquid is transported down to the accumulator tank in the cellar with the aid of a small circulation pump. The warm liquid heats up the water in the tank, and the tank is used to heat the hot water used for washing dishes and clothes, baths etc.



Result:

Major savings

The follow-up through to 2004 has shown that operating costs have been cut by reducing the buildings' heating, ventilation and hot water requirements by 45%, from 5,000 to just over 2,700 MWh/year.

The graph on the next page shows the results from the follow-up of heat supply, use of electricity and water use:

- district heating requirements (corrected for temperature variation) have been reduced from just over 270 to approximately 145 kWh/year/m²
- electricity use is reduced from approximately 50 to 35 kWh/year/m²
- water use is reduced from 2.36 to 1.63 cubic metres/year/m²

The collective metering of electricity, water and heating has been changed to individual metering, which means that each tenant can influence the cost of electricity, water and heating, which has also contributed to reducing operating costs.

EACH APARTMENT HAS JUST OVER SEK 5,000 LOWER OPERATING COSTS PER YEAR

The additional cost for the operating and energy-saving measures that have been made amount to approximately SEK 20 million, of which just under 30% is covered by a contribution from the EU and the Swedish Energy Agency.

Since the tenants moved in savings have increased each year due to the tenants' actions, as it has proved advantageous to be thrifty. However, the cost of purchasing district heating, electricity and water increased during the same period.

In 2001, the saving was approximately SEK 1.0 million and in 2004 approximately SEK 1.6 million. During the period 2001–2004 the total saving was approximately SEK 5.3 million, which is just over SEK 5,000 per apartment per year.

MEASUREMENT OF HEATING, WATER AND ELECTRICITY

Space heating, or rather the thermal comfort, is metered by means of room temperature measured in the living room and bedroom. The temperature



measurements are transmitted from this sensor to a memory in the stairwell. The information from this memory is then passed on to a receiving station, where all the measurements are processed. The final result shows how warm it is in the apartment and what the tenant will pay. The tenant decides on the temperature in the apartment with the aid of thermostats on the radiators. The basic rent is based on a temperature of 21 degrees. If the tenant wants

it warmer it will cost extra and if the tenant wants it cooler there will be a rebate.

Similarly, the measurement of cold water and hot water takes place using flow meters and an electricity meter.

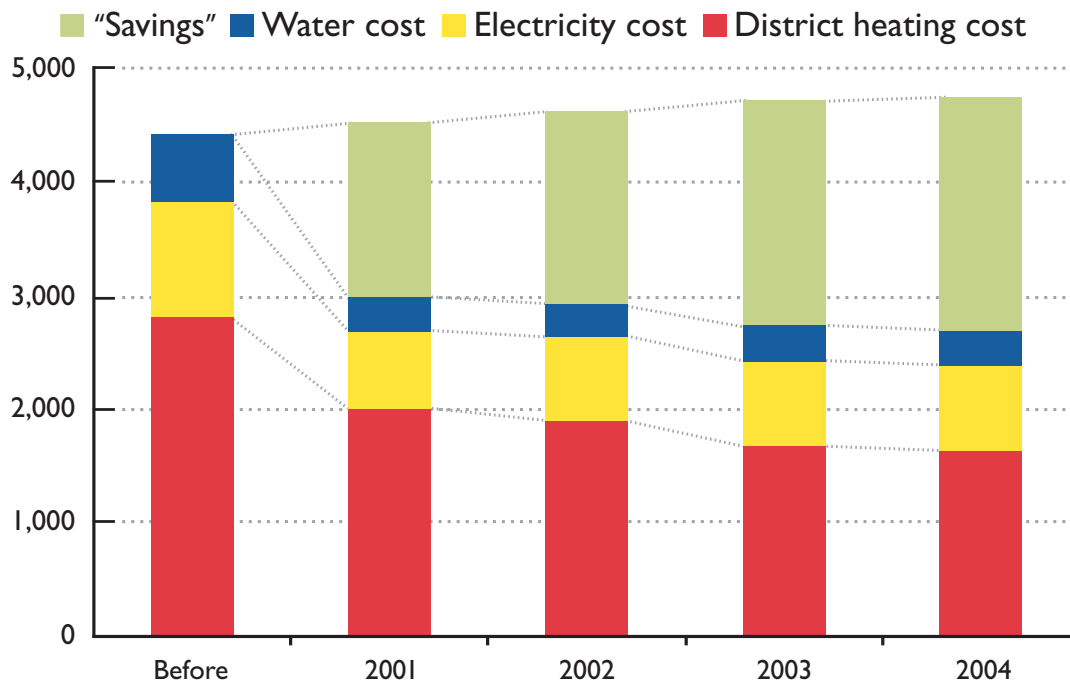
All information is transmitted automatically to a receiving station for compilation. The rent is adjusted depending on whether the tenant uses more or less than what is included in the basic rent.



Radiator thermostat



Temperature sensor





The tenants are very much involved in the changes

There are many factors to be taken into account – the EU project’s requirements, the assessments of building experts, Gårdstensbostäder’s own expertise and conditions – but first and foremost the tenants’ wishes and views. The aim was that these should be the controlling factor in the process.

Interest in being involved was initially lukewarm. Many tenants were sceptical about whether they could actually influence the work. They were reluctant to move into replacement apartments in the area that were offered during the reconstruction work. Methodical mobilisation was required to get the tenants involved.

INTEREST-AROUSING INFORMATION APARTMENT

An information apartment, strategically located in the heart of the area, was set up. The apartment was refurbished to the standard that was envisaged as a norm for the area and included models and information material.

In the information apartment it was possible to discuss with the tenants in more depth than at the more customary tenant meetings. In the “living room” there was a graffiti wall with the heading “We

want” and a heading “We do NOT want”. The writing on the graffiti wall increased steadily and gave Gårdstensbostäder a solid foundation for the project.

TENANT CONTACT IN SEVERAL STAGES

A meeting at which the reconstruction plans were first presented was attended by 80 tenants. Around 20 of them stated that they were willing to take part in the envisaged project working groups.

In the next stage, the inspection, each tenant was visited by a project manager responsible for tenant influence and an inspector. It emerged that the vast majority were positive about the reconstruction.

In a packed meeting hall there are many people who are reluctant to put up their hand and say what they think but the personal contact during the inspection stage led to 74 tenants indicating an interest in being involved in the eight working groups. Of these, 54 became permanently active in the ensuing work. This was in an area with 150 households.



WORKING GROUPS' PROPOSALS

The working groups were made up of interested tenants with the project manager responsible for tenant influence as a source of inspiration and conveyor. Experts from the project management and other specialists were invited to the groups as necessary.

The groups formulated proposals and a basis for what the tenants wanted the renovation to result in was created. This was based on the material that emerged at the information apartment, at the tenant meetings and during the inspections.

THE SECURITY GROUP submitted proposals for a new lock system and an entry system with cards, which would operate both the entrance door as well common areas. The group also wanted new entrance doors in the galleries as well as entryphones and better lighting.

THE APARTMENT GROUP produced a detailed proposal for how the apartments should be renovated.

THE WORKING GROUPS FOR THE NEW GROUND FLOOR, UTILITY ROOMS AND THE ENVIRONMENT 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. They wanted the utility rooms on the ground floor with a view over the outdoor areas, large windows, automatic lighting and a new booking system with cards. The utility rooms should be located directly adjacent to the greenhouse and the public rooms. The group also proposed a new waste-handling system with composting and a new system for residual waste. For the

ground floor, proposals were formulated for premises that could be used by all the tenants in the block.

THE WORKING GROUP FOR THE EXTERIOR ENVIRONMENT compiled the views from the information apartment and the inspection and reported that refurbishment was necessary. The group were agreed that refurbishment initially should make the areas outside the buildings into good play areas for small children. The tenants were even involved in the colour scheme – they wanted to do away with the feeling of grey concrete. The Building Committee approved a model with a new colour scheme facing inwards towards the outdoor areas where the tenants moved around and facing outwards the facades were painted in a light, uniform colour to retain the original facade image.

THE WORKING GROUP FOR CAR PARKS AND TRAFFIC put together basic documents that were centred on the fact that the residents wanted fresh-looking, secure garages and outdoor car parks within view of the apartments.

THE WORKING GROUP FOR AERIALS, SATELLITE DISHES AND IT wanted an IT-link to the apartments and a satellite dish or a common location for their own satellite dishes on the conventional slab buildings.

When the reconstruction and renovation work had been completed several of the old tenants moved back. Other apartments quickly acquired new tenants. The building managers sent out invitations to meetings dealing with the exterior environment and the tenants continued to show an interest in their area. Together with the building managers and a





Mobilisation following re-occupation

landscape architect they drafted a proposal for new play facilities and flowerbeds and a fence around their own outdoor areas facing the paths. At Ekgården an old football pitch was converted into an area for boules

MANY OF THE TENANTS' PROPOSALS have been implemented in conjunction with the reconstruction.

The involvement and interest from the rebuilding phase has continued. The tenant meetings have been well attended and the tenants have been involved in a range of different projects.

At Aspgården the tenants have on their own initiative taken over the cutting of the grass and clearing of weeds so that they have the flowerbeds they want and to save money for the rest of their outdoor area. The outdoor area committees have also created common areas. At Aspgården the tenants have painted and equipped a children's room for games, crafts and other things. The room can also be used by the tenants for children's parties and similar activities. Another room has become a table-tennis room. A table-tennis room has also been arranged at Syrengården.



Awards for Solar buildings

The project has attracted considerable attention both nationally and internationally, with a whole range of education visits and newspaper articles in the daily press and trade magazines.

Building of the Year

In 2000, the project was nominated in the construction industry competition “Building of the Year” in the class “Renovation Project of the Year 2000”.

Energy Prize

The method for individual metering of heating led to the Energy Prize for 2002.

Best Colour Scheme

In 2001, the project was one of the winners in the Master Painter’s competition for “Best Colour Scheme”.

World Habitat Award

Was received 2005 in Jakarta and presented by british BSHF (Building and Social Housing Foundation) in cooperation with UN Habitat.

FACTFILE:

NUMBER OF APARTMENTS: 255

LIVING AREA: 18,720 SQUARE METRES

PRODUCTION COST: SEK 105 MILLION

(equivalent to SEK 5,608 per square metre)

OF WHICH THE PRODUCTION COST FOR ENERGY-RELATED MEASURES: SEK 20 MILLION

(equivalent to SEK 1,068 per square metre)

REDUCED ENERGY COST 2004: SEK 1.6 MILLION

(equivalent to just over SEK 6,000 per apartment)

Facts about Gårdsten

Number of residents: approximately 7,000

Location: 13 km northeast of the centre of Göteborg

Height above sea level: 100 metres

Number of homes: 3,038

Of which municipal-owned rented apartments: 2,694

Construction period: 1969–1972

Currently under construction: 44 semi-detached dwellings

Planned: 150–200 single-family dwellings



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