The Inspektoren Residential Area

Work Package 4.1

Kalmarhem Ltd

Measurements and behavioural studies – Summary Report

Kalmar, Sweden 2002

Kalmarhem Ltd – Vatten och Samhällsteknik AB

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1. GENERAL

The Inspektoren area was built in 1956 and consists of five three-storey buildings containing a total of 159 flats. These are divided into 36 flats with one room and kitchen, 92 with two rooms, 19 three-room flats and 12 with four rooms. The total living area is 7000 m^2. One overall improvement was carried out in the days of the energy crisis, in which additional insulation was installed and a brick façade was added.

Faced with extensive renovation, Kalmarhem decided in consultation with Kalmar municipality and on the initiative of the tenants to focus on the ecological aspects of the refurbishment.

In connection with the refurbishment of the Inspektoren area, Kalmarhem arranged for an expert group to work with measurements and systematic evaluations both before and after completion of the project. Subsequent to completion of the refurbishment, follow-up measurements were concluded and have been compiled in a series of reports. These reports cover the following areas:

- Environmentally adapted rebuilding
- Water and waste water systems
- Surface water
- Refuse management
- Electricity and energy supplies
- Interior environments
- IT systems
- Behavioural issues

With the aim of continuously linking to the goal of the ecological focus, an illustration has been made describing the most important recycling loops with the Inspektoren area in the centre and relating to both the surrounding community as well as the relevant natural resources.

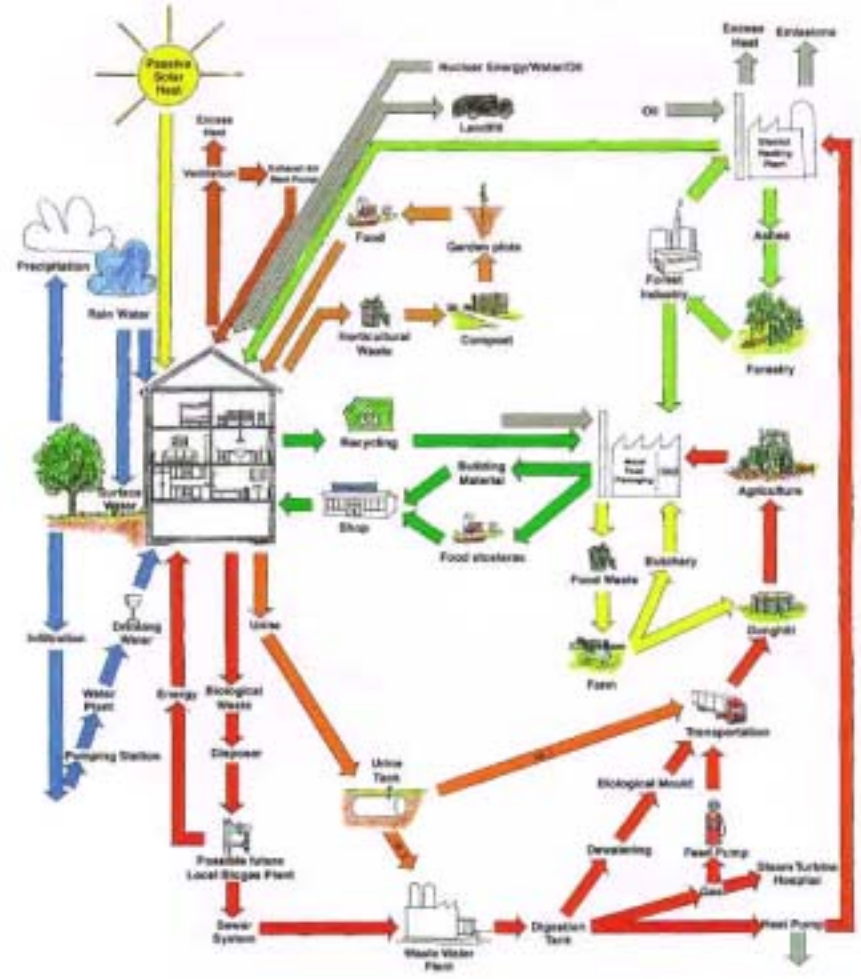

Figure 1 *Illustration of the Inspektoren area's role in an ecologically adapted city*

In this report a brief summary of the reports from the above areas is given together with comments on overall viewpoints based on the results obtained.

2. MEASUREMENTS AND BEHAVIOURAL STUDIES

In principle, all measurements and other studies have been carried out both prior to the refurbishment as well as after, and in certain cases during the rebuilding project. The results and experience from each area are summarised below.

2.1 Environmentally adapted refurbishment

Goals

Before the real planning work commenced, Kalmarhem's board shaped the overall goals.

Refurbishment of the Inspektoren area was to take place with as much consideration as possible given to economy of natural resources, at the same time as Kalmarhem's residential-political goals should be fulfilled. Planning and execution of the refurbishment was to take place in close consultation with the residents.

The challenge consisted in planning to achieve the overall goals through application of the following guidelines:

- The return rate of tenants after the refurbishment should be at least as high as in other refurbishment projects at Kalmarhem buildings.
- The option of individual choice in the level of involvement in environmental measures should be the aim, both when moving in and as the tenants' interest and involvement in the flats and environment increases.
- The tenants should not have to pay more rent than after normal refurbishment projects.
- Future refurbishments in line with the experience and knowledge gained in the Inspektoren area should bear their own costs.
- It must be accepted that certain measures that are important for economising on natural resources may not be able to be implemented, either wholly or partly, due to economic or other reasons.
- Strategies for continued adaptation to environmental thinking and recycling will be developed at Kalmarhem.
- The project will bring about a considerable increase in expertise for Kalmarhem

Inventories, environmental product declaration

A detailed investigation into the status of existing buildings was carried out using an inventory of environmental status, technical status, exterior form and gestalt, and size and structure of the flats.

A new system for the evaluation of all existing and new building materials was drawn up during the planning phase. The evaluation is based on the "natural steps" criteria and the results are shown categorized on a five-point colour scale.

Show flats
With the aim of providing tenants with an opportunity of actively participating in decisions regarding environmental standards, individual flat standards etc, three show flats were built with completely different levels of standards.

Exterior environment
An inventory was also made of the exterior environment using the same fundamental criteria as for the buildings. After consultation with the tenants, the area was provided with a number of allotments. The local system for surface water management was designed to make a valuable feature in the exterior environment.

Sorting at source
The proportions of clearance materials were studied in the three show flats with different standards and this was partly the basis of the stripping out plan drawn up. Detailed statistics were compiled of the quantities of waste material transported from the area during the contracting phase.

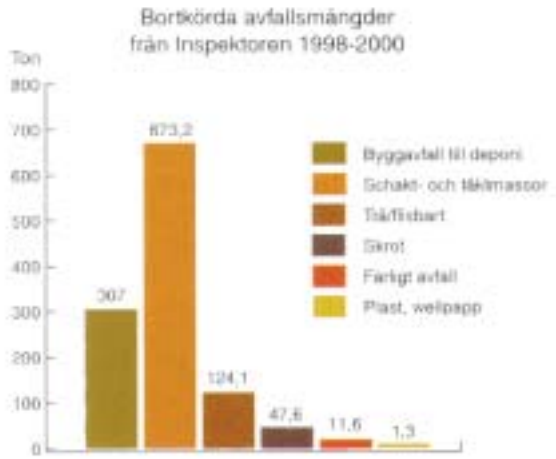

Figure 2 *Quantities of waste transported during refurbishment*

Comments
The most significant results of the planning and follow-up work are the insights obtained by our own staff, consultants, tenants, and contractors regarding ecological aspects and the opportunities through changes in working methods to live up to expectations and goals. It is of the utmost importance that the working environment is not marginalized and that the administration phase is paid sufficient attention in the planning process: see illustration of the total process.

Kalmarhem has introduced safety and security as instruments in the overall planning and administration process. Safety has also been specially treated during the planning and execution of the refurbishment of the Inspektoren area.

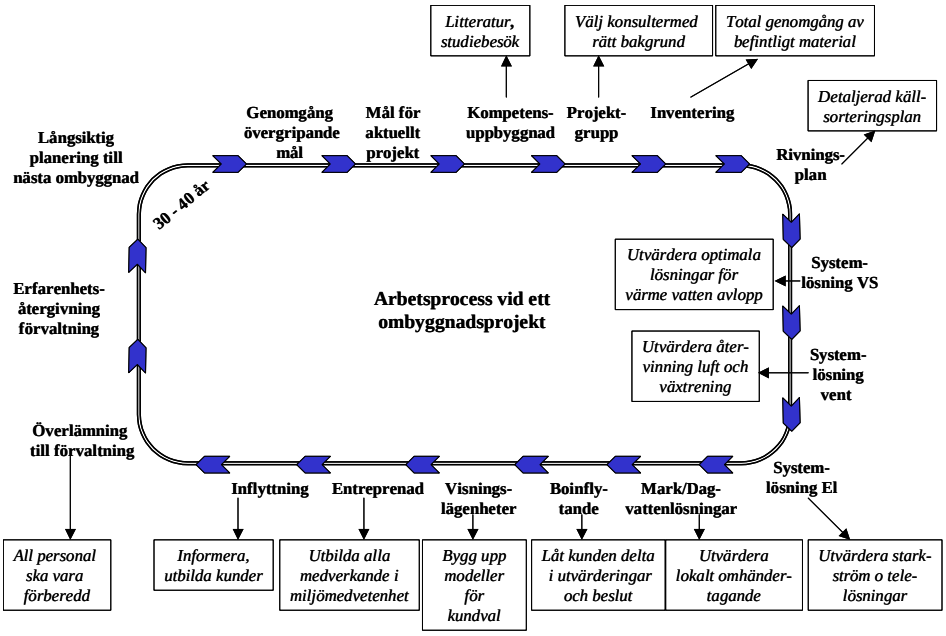

Figure 3 *Illustration of the total process from planning to administration*

2.2 Water and waste water system

Water supply and waste water disposal rely to a large extent on the municipal infrastructure of society. This can be illustrated through sub-studies of the general recycling loop illustration.

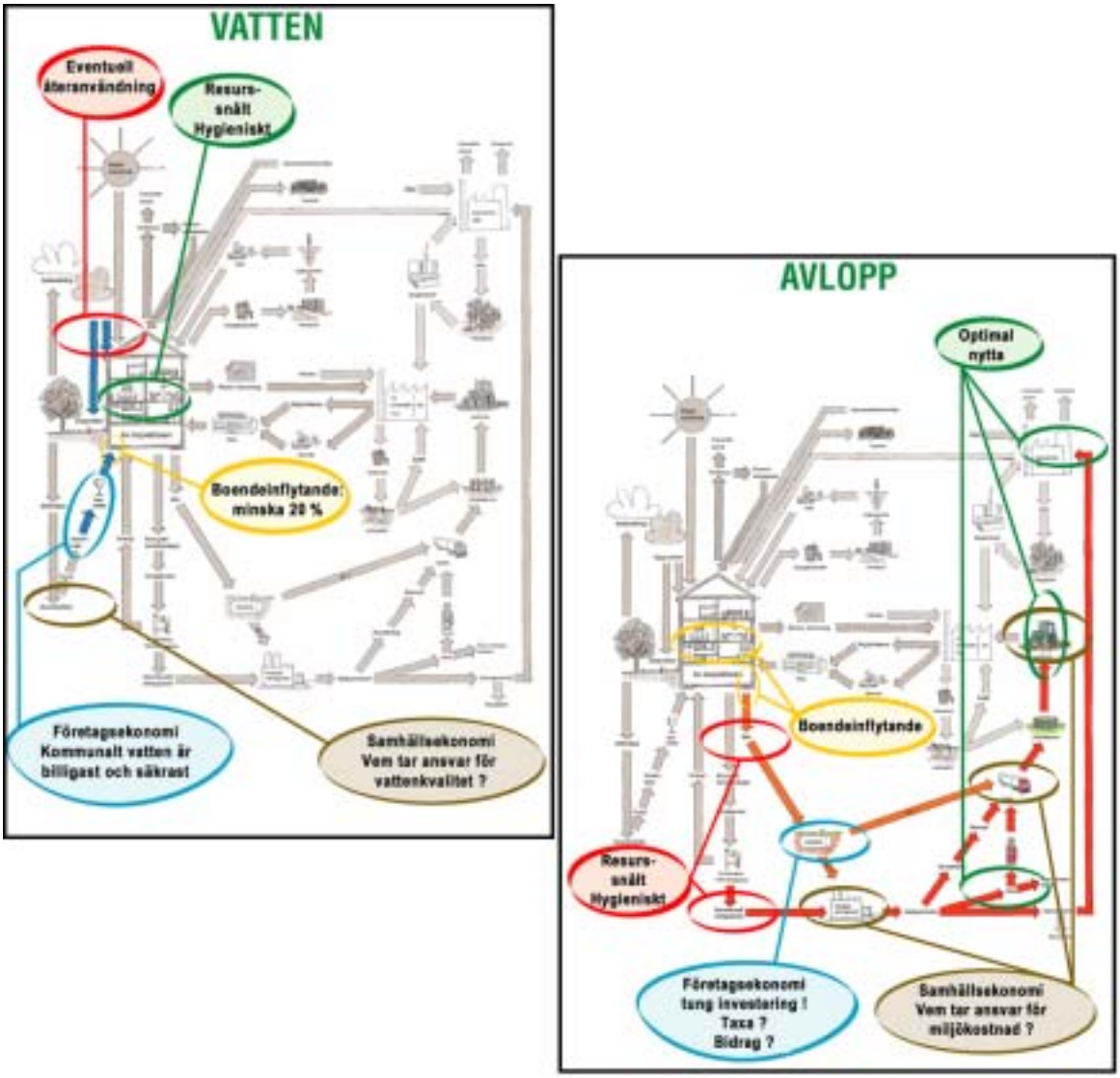

Figure 4 *Water and waste water systems' role in the total recycling loop*

Goal
The formulation of the goals for water supply were as follows:

- Water supply shall be provided in a hygienically acceptable fashion and the consumption shall be as low as possible.
- Consumption must be reduced by at least 20% from the earlier figure of around 240 l/day to 190 l/day.
- The possibilities of recycling waste water or surface water should be given close attention.

The corresponding goals for waste water and kitchen refuse were formulated as:

- The overall goal is to optimally utilize plant nutrition resources (phosphorus and nitrogen)
- Minimise risks of technical and hygienic problems
- Optimally utilize the plant nutrition substances and energy
- Consider the significance of tenants' involvement in organising possible events for the result of such solutions

Evaluation of system solutions
Before the choice was made of system solutions, extensive investigations were made especially regarding the possibility of a separate system for urine sorting and kitchen waste disposal units. The studies were conducted in the form of life cycle analyses at the system level.

The results of these evaluations were in accordance with a newly developed methodology, which is also a tool used within the frame of the SUREURO project. An example of how the methodology works is shown in the figure below.

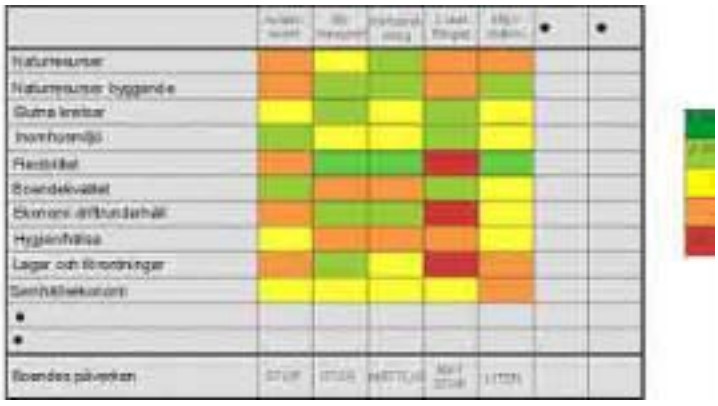

Figure 5 *Evaluation of alternative systems solutions for organic waste*

Measurement values
Comprehensive follow-up work on operational data obtained after the refurbishment has been carried out. This includes water consumption, water quality, waste water flow and analysis of waste water. The municipal sewage pipes were also photographed before and after refurbishment to clarify any possible problems caused by the installation of the kitchen waste disposal units.

Comments
The goal to use nutrients and energy from waste water as a resource has been partly achieved through the installation of kitchen waste disposal units. The goal can only be fully realised through combination with the municipal infrastructure and its modern purification plant with sludge handling/biogas production as well as further cooperation with the tenants. It was primarily hygienic aspects and environmental efficiency that lead to urine sorting not being introduced, but it is prepared for. All solutions clearly require active participation from the tenants.

2.3 Surface Water

The surface water system is also to a high degree dependent on the municipal infrastructure in the community. The structure of the municipal charges for connecting drainage of surface water to the municipal network also has special significance in this context.

Goals
A substantial part of the Inspektoren project has been to create a local solution for handling surface water taking into consideration the points below:

- Surface water contains a number of pollutants that must be “cleaned”. Nature is a good water purifier!
- Surface water is a water resource that is useful to exploit at a local level for plants
- Surface water is a resource for creating positive local environments from an aesthetic viewpoint
- Reduced surface water flow decreases the load on the municipal drainage system

Figure 6 *Example of solution for local rainwater management in a garden environment*

Systems solutions

Rainwater from roofs, garden areas and drained water is managed locally using a combination of solutions:

- It is lead directly to grass areas for filtration
- Surplus water is lead away on the surface via channels in the paths and
- Along valley drains to small ponds. Bushes have been planted alongside the valley drains and these contribute both to decreasing the water (though transpiration) and also prevent people from walking in wet areas.
- The water is then channelled from the ponds via small streams to manholes which are connected to…
- A new drainpipe along Klockhusgatan that has a very large diameter (800 mm). One of the functions of this drain is to even out water flow.
- The surface water is pumped from this drainpipe through a small pump station (located in the southeast corner of the area) to the green wooded area to the north of the buildings.

Measurement values

Extensive follow-up work on the operational data obtained from the new system has been carried out. This included quantities of surface water and an analysis of its composition. The analyses have resulted in further checks into the possibility of faulty connections in the system.

Comments
The goal to use water as a local resource has been achieved at the same time as the aesthetic opportunities have been exploited successfully in the garden environments. Both the municipal drainage network and the end recipient of surface water have been relieved of flows and pollutants.

2.4 Waste Disposal

The area of refuse management is where the technical system solution most clearly reflects economisation of resources and recycling. Irrespective of how the question is solved in practical terms, it requires meticulous cooperation from both the tenants and the municipality.

Goals
Before refurbishment commenced the following goals were set up regarding quantities of refuse:

- The total waste quantities unsorted to the deposit site shall be decreased from 325 kg/p per year to 29 kg/p per year with an interim goal of 150 kg/p per year.
- Optimal usage of the energy content of the waste as well as nutrients such as nitrogen and phosphorus.
- Minimise risks of technical and hygienic problems.
- Create conditions for complete sorting at source.
- Pay heed to the significance of tenants' involvement in organizing special events for the result of such solutions

Evaluation of systems solutions
Prior to making a choice of systems solutions extensive investigations were carried out, especially regarding the possible installation of kitchen waste disposal units. Studies were conducted in the form of life cycle analyses at the system level.

Evaluations of alternative solutions were made in accordance with a newly developed methodology, which is also a tool within the SUREURO project.

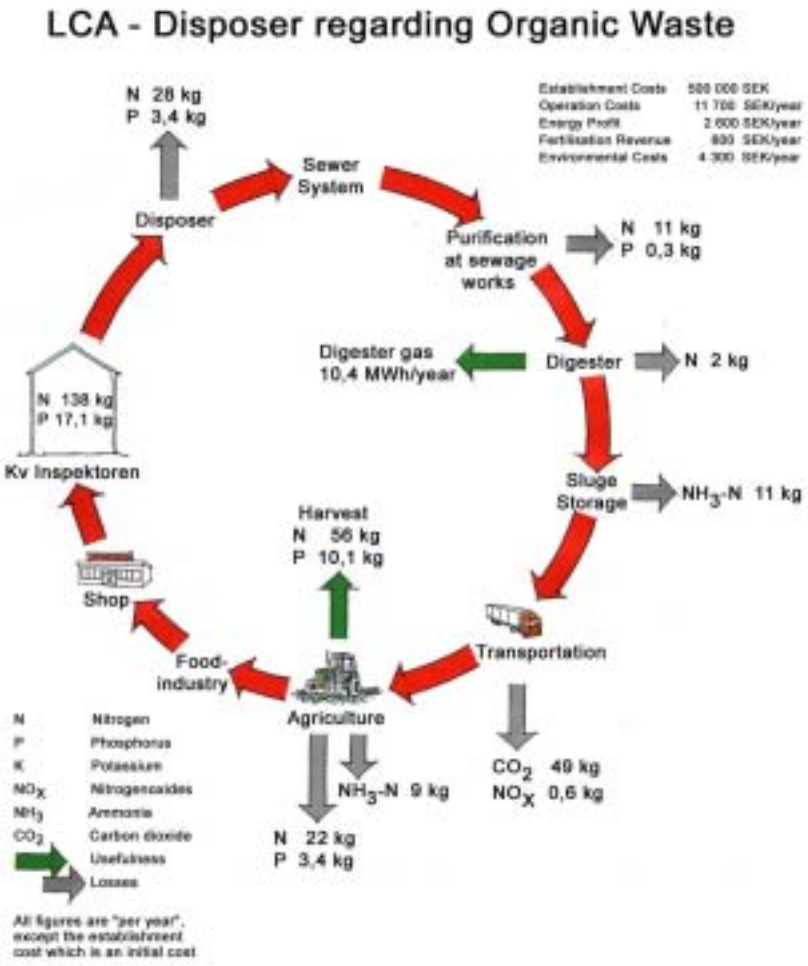

Figure 7 *Life cycle analysis for system solution using waste disposal units*

Measurement values

Registration of both the total quantities of refuse and various collected fractions of this refuse were made before and after refurbishment. This follow-up work has also included random checks in which unsorted refuse mass was analysed manually to check how much could have been sorted with better participation on the part of the tenants.

Comments

The goal of using the energy and nutrient contents of the refuse has been partially achieved through the installation of waste disposal units and the decomposition that takes place in the municipal biogas plant. In order to fully achieve the resource goal and at the same time reduce the amount of unsorted refuse in accordance with the long term goal, continuous information to and cooperation with tenants and the municipality is required. It rapidly became apparent that to increase the degree of sorting at source Kalmarhem would be forced to build a garden sorting station as a complement to the nearby council recycling station.

2.5 Electricity and Energy

Electricity and energy supplies are dependent on existing infrastructure. This is particularly relevant to the Inspektoren area as it is connected to the local district heating system. The way in which electricity or district heating energy is produced can be partially influenced even if one is a subscriber to the system in question.

Goals
The following goals were set up prior to the refurbishment work in the Inspektoren area regarding electricity and energy consumption:

- To decrease electricity consumption in flats and common installations in the property to 45 kWh/m^2 per year.
- To decrease energy consumption of purchased energy for transmission + ventilation + hot water to 145 kWh/m^2 per year.

Choice of system solution
Before making any choices of system solution, several alternative systems were discussed and evaluated, especially regarding the question of heat pumps and solar collectors. The district heating produced in Kalmar consists of 90% "green energy" at present. There was a small increase in energy used in the buildings through the installation of lifts, necessary for improved accessibility to the flats.

Measurement values
Measurements of electricity and energy consumption were made both as a total and for different purposes and different flats. On the issue of heating, a so-called comfort accounting system has been installed and is individualised for each flat. Consumption and charges relate to this system.

Installations since 1997 generally show energy consumption in houses from the 1960's of around 128 KWh/m^2 living area, including hot water, compared with a normal value of 160 KWh/m^2 – and that with satisfied tenants!

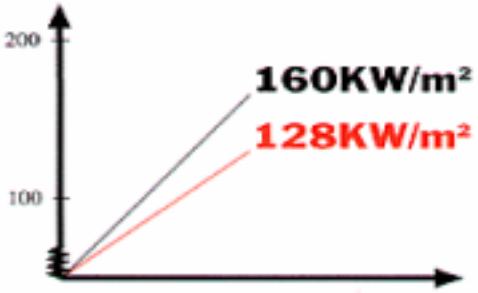

Figure 8 *Savings (general) though the comfort accounting system*

Comments
The goal of decreasing electricity and energy consumption has been achieved. It is however important to note that improvements in living standards, such as lifts installed, must be considered when making comparisons before and after refurbishment.

2.6 Interior Environment

Goals
The goals set before refurbishment covered a number of factors including the following:

- The objective of replacing the electricity installations was to reduce the electromagnetic fields in the flats.
- To reduce radon gas levels to less than 200 Bq/m3.
- Reduce allergy problems.
- Reduce draught problems.
- Reconstruction of the ventilation plant to achieve the best interior climate with the available technology plus to minimise energy losses.
- The goal for the construction process was to select low emission building materials and paint.
- To decrease the interior noise levels to below the limits stipulated

Systems solutions
Before the total refurbishment took place three show flats were built which were renovated to varying degrees and thus, of course, at different costs. In the so-called state-of-the-art flat, a futuristic solution was constructed according to sketches by a Danish architect bureau. This system included efficient energy use as well as air treatment through plant and root systems. The choice of technical systems and building materials, including paints, took place using the four systems conditions in the “natural steps”.

Measurement values
Measurement of environmental data took place before and after refurbishment. Here too, the comfort accounting system individual to each flat has significance for the results. With the aim of clarifying the conditions for a good interior environment, a number of different factors were discussed and in certain cases measurement data were registered. The more significant factors were:

- Electromagnetic fields
- Temperature
- Air quality, including radon levels and exchange rates
- Allergy problems
- Noise levels (noise measurements combined with calculations)

Comments
The more exact structuring of how measurements can and should be performed to monitor the interior environment is difficult to determine. It is clear that the real interior environment is to a large extent dependent on how tenants behave.

2.7 IT system

Selection and installation of a so-called IT system turned out to be largely a question of cable installation in the preparatory discussions. The more important point is however what the established system is used for, which may be collection of operational data, two-way information flow, TV broadcasts, computer connections, safety/security systems, various cultural arrangements, and so on.

Goals
The goal for the installation became rather concrete in nature, to create a system that was adapted to future connection to a broadband provider without being limited to one particular provider or technology.

Comments
Considering the rapid technological development, there is still considerable uncertainty as to whether any one choice of fixed equipment will be practicable for different future applications.

One important aspect of the system installed was that security for tenants was improved by the locking system on the entrance doors. Further safety/security functions such as fire alarms and burglar alarms should be appropriate in the future.

2.8 Behavioural studies

A significant initiative to the refurbishment of the Inspektoren area having an ecological focus was taken by representatives of the tenants in cooperation with the tenants' association. The municipality of Kalmar also strongly supported these initiatives. Naturally it was the management of Kalmarhem that subsequently developed these ideas and was responsible for executing them in a well-balanced fashion.

Behavioural studies
Three studies of the tenants' attitudes and behaviour in different situations have been carried out, two before and one after the refurbishment. The studies were aimed at throwing light on the tenants' behaviour in relation to the issues of energy and the environment and their values and attitudes towards these issues. A further aim was to influence the tenants' tendency to actively participate in the coming process of refurbishment.

The studies were performed primarily through the tenants filling in questionnaires handed out. The preparatory questionnaire had a 79% response rate, the follow-up questionnaire 57%.

Comments
In a choice situation it is clear that environmental engagement exists but becomes less significant the more it risks leading to increased rents. Put in other terms, tenants participate willingly in activities if there is an economic incentive involved. Many indicated that they would consider purchasing different types of service and equipment from Kalmarhem on an individual basis.

The studies show that it is more important to focus on presenting suggestions for solutions than discussing problems. It may also be noted that continuous information on the motives for and results of measures performed is necessary to obtain continued participation and engagement.

3. FURTHER RESEARCH

The measurements, investigations and studies described above were generally carried out both before and after the refurbishment. In several cases the need and opportunity for continued follow-up work have been identified. It is also possible to see the results and experiences obtained as the basis for further research of different types. Such research could be in the form of technical follow-up work and development or it could be studies of tenants' behaviour and the opportunities for Kalmarhem and the municipality to constructively influence the tenants' desire to participate in improving results. This improvement concerns environmental aspects and also costs for the tenants themselves and Kalmarhem.

Kalmar, Sweden 2002

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