



The Inspektoren Residential Area

Work Package 4.1

Kalmarhem Ltd

Environmentally adapted refurbishment

– Report –



Kalmar, Sweden 2002

Kalmarhem Ltd – Arkitektuset I Kalmar – NCC



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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 divided into the following categories: 36 one-room flats, 92 two-room flats, 19 three-room flats and 12 four-room flats. The total living area of all the flats is about 7000 m². A thorough improvement was made earlier, when exterior insulation and a brick façade was put in place in the days of the energy crisis.

The age groups vary from 18 – 29 year olds to the dominating single, 60 – 69 year old group. Single women make up close to 40% of the tenants and one third of the tenants have lived there for over 20 years.

Before any real planning work commenced, Kalmarhem's management set up the overall goals.

Refurbishment of the Inspektoren area was to be carried out with as much consideration as possible given to economy of natural resources in addition to the fulfilment of Kalmarhem's residential policy. Planning and execution of the refurbishment took place in close consultation with the residents.

The challenge consisted in planning to achieve the overall goals through the 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.

2. CONDITIONS

For both the planning and contract work, Kalmarhem's environmental policy and environment handbook for products shall be comprehensively employed. Work in general shall comply with the local Agenda 21 that is valid for municipal work. See *Appendix 1*.

3. THE CONSTRUCTION PROCESS

The process is illustrated by a time plan in the form of a “race track” which shows all the phases from the first pre-planning and goals to the transfer to the property administrator and experience feedback.

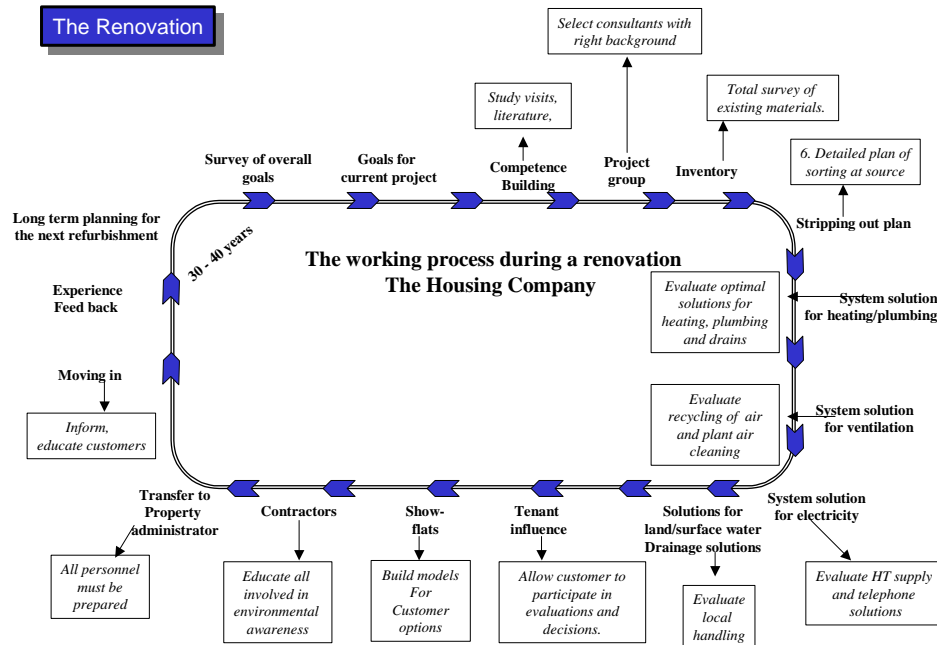


Figure 1. The construction process

3.1 Competence building

Since the method of tackling the environmental refurbishment was relatively new for both the ordering party, Kalmarhem, and the consultants engaged, an in-depth survey of existing literature was necessary together with investigations of any research projects and study visits to ongoing or completed eco-projects. Seminars were also arranged where specialists in specific areas were invited.

Professor Christer Wiberg, who initiated several eco-villages around Sweden, was amongst those visited. With his help a checklist of possible environmental measures was drawn up. This list was scrutinised point by point to determine whether the measures were transferable to the Inspektoren area.

One of the seminars carried out covered the area of wastewater management, ranging from traditional systems to local management in the buildings. A second seminar looked into questions relating to waste disposal units in the kitchens of the flats and problems associated with them; a third had documentation of the refurbishment process as its subject matter.

Representatives from the National Environmental Protection Agency, the Ministry of the Environment, the National Board of Housing, Building and Planning and other specialists from the whole country participated in the seminars.

3.2 Drawing up an inventory

An inventory of the existing buildings was carried out regarding the following aspects:

- Environmental status
- Technical status
- The exterior form and configuration of the buildings
- The division of flats within the buildings in terms of size, number of rooms, planning, connections between rooms and furnishing options.

The basis of the inventory work included:

- Original technical description
- Changes and maintenance performed on the flats
- Damage and fault reports
- Void rate
- Tenant turnover rate
- Age structure of tenants

Environmental status inventory

Environmental inspection of any environmentally hostile products, materials or substances existing in the buildings.

The targets of this inspection included the following:

- CFC's
- Asbestos
- Radon
- Heavy metals
- Toxic metals
- PCB
- PVC

At the time of the environmental inspection tenants were living in the flats and the buildings were in operation as usual.

This placed demands on knowledge to be gained about in-built products and materials, as well as discussions with installation consultants.

Known environmentally hostile products and materials were quantified and localised in the flats.

It may be mentioned that mercury (Hg) was discovered in lighting switches and certain types of fluorescent lamps. Asbestos occurred in large quantities in ventilation ducts, pipe insulation and

certain types of flooring materials. It was noted with some satisfaction that there were no traces of PCB in, for example, jointing compounds.

Homogeneous and compound materials of unknown origin and content were sent to a laboratory for analysis of possible environmental consequences or risks.

With the environmental inventory and laboratory analyses serving as a guide, a clearance plan was formed. This, together with the technical inventory of products and material exchange, was to form the basis of a comprehensive clearance plan with order of tasks and method descriptions.

Task order and method descriptions were drawn up with the aim of preventing environmentally hostile materials and substances spreading to other stripped out materials or parts of the structure of the buildings or surrounding areas.

Two of the criteria set up for the project were that the refurbishment should be carried out with great care and that the rent should not be significantly higher than after a normal renovation.

Certain environmentally hostile materials that do not in any way affect the tenants, service personnel or surroundings were marked and will remain in the buildings until such time as they are totally demolished.

3.3 Environmental product declaration

Since the overall goal was that all materials, both existing and new, should be declared environmentally and would form the basis of the buildings' total declaration and environmental loading, we strived find an environmental evaluation system for construction products that could be applied to all forms of evaluation.

Our search was successful at the Institute of Construction Ecology. A clearly understandable environmental evaluation system was being developed that was built around the "Natural Steps System Conditions". Products were not allowed which contained any of the substances on the lists of the National Chemicals Inspectorate (List of limitations, OBS list and classification list), nor were any potential emissions that could result in known health hazards. The handling procedures for waste products that could become hazardous were also laid down.

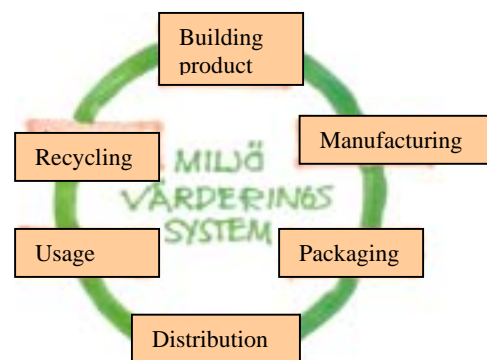


Figure: Environmental evaluation system

The evaluation gave rise to five classes of product:

	1. Recommended in first place
	2. Recommended in second place
	3. Acceptable
	4. To be avoided
	5. Unacceptable

Examples of environmental declaration for flats with normal refurbishment

Flooring and wall coverings

Environmental code	Product name	Manufacturer	Classification	Remarks
	Rag paper	Icopal AB	2. Recommended in second place	
	Laminated parquet 15mm Copenhagen	AB Gustav Kähr	2. Recommended in second place	Wet glue contains isotazolions and formaldehyde in manufacturing process
2360	Marmoleum Real	Forbo Forshaga	2. Recommended in second place	
2222	Bona Aqua Lino	Bona AB	3. Acceptable	Contains chloromethylisotazolion and cholophonium derivates
	Dempolag, acoustic damping layer	Icopal AB	3. Acceptable	Cork with asphalt on underside
2356, 2358	Floor tiles, "Höganäs 51"	CC Höganäs Byggkeramic AB	2. Recommended in second place	
2210	Sealing membrane FB 7	CC Höganäs Byggkeramic AB	3. Acceptable	Contains preservatives
2231	Damp protection FB 9	CC Höganäs Byggkeramic AB	3. Acceptable	Environmentally toxic waste
2213	RotFix FB 13	CC Höganäs Byggkeramic AB	3. Acceptable	Contains traces of chrome
2208	Tile jointing mass FB 20-23	CC Höganäs Byggkeramic AB	3. Acceptable	Contains traces of chrome
2363, 2366	Tile "Skärgård" white	CC Höganäs Byggkeramic AB	2. Recommended in second place	
2248	Jointing Compound FB 24 - 26	CC Höganäs Byggkeramic AB	3. Acceptable	Contains traces of chrome
2211	VitFix FB 11	CC Höganäs Byggkeramic AB	3. Acceptable	Contains traces of chrome
	Levelling mass ABS 147 Pronto	ABS Sweden	3. Acceptable	Chromate reduced plastic binding compound, flow additive, Melamine type

The institute for Construction Ecology has compiled a countless number of building materials in a database accessible through Svensk Byggtjänst (Swedish Construction Service). All building materials used in the Inspektoren area have been documented in accordance with a special template, “Basic data for administration plan”.

3.4 Show flats

Special show flats were built primarily to show tenants in the area the various possibilities involved in the environmental refurbishment, individualised standards of flats and solutions for each tenant. Three flats were constructed from the models described below:

Cautious refurbishment

The flat has been refurbished to a very limited degree. The guiding principle was to keep everything that was not worn

The refurbishment included:

- Lowering the floor in the bathroom
- Installing a wet area cassette
- Change to wider bathroom door
- Extractor hood in kitchen
- Replace fridge with fridge/freezer
- Re-paper one bedroom and hall
- Re-paint kitchen
- New floor and wall covering in bathroom
- Change electrical installation, put in special devices to reduce electromagnetic fields



Normal refurbishment

The refurbishment covers what is normally carried out when older blocks of flats are renovated....

The refurbishment included:

- One bedroom facing the street has changed place with the kitchen
- New kitchen fittings with waste disposal unit and special cupboard for sorting at source
- New wardrobe
- Enlargement of bathroom
- Lowering of floor in bathroom
- Installation of wet area cassette and urine separating toilet
- New floor and wall covering in bathroom
- Parquet floor in bedroom



- Re-papering and re-painting
- Enlargement and glazing of balcony
- Change electrical installation, install special devices to reduce electromagnetic fields
- Installation of central vacuum cleaner

State-of-the-art refurbishment

The flat was equipped with the latest, state-of-the-art technology for recycling-oriented refurbishment:

The refurbishment included:

- Completely new kitchen fittings including cooling pantry with natural cooling
- Enlarged bathroom, urine separating toilet and special installations for water and drains
- Light prism with glass brick walls
- Climate partitions outside kitchen, living room and bedroom
- Tiled floors in bathroom, hall and climate room
- Ash parquet floor in living room and bedroom
- Re-painting using emulsion, egg-tempera, tempera and linseed paints
- Special plumbing installations for handling waste water and urine
- Plant filter in climate room and temperature/humidity controlled ventilation damper
- Special electrical installation, install special devices to reduce electromagnetic fields



3.4.1 Stripped out material after refurbishment of show flats

To give a picture of the amount of stripped out material involved in the different refurbishment alternatives, the material was sorted at source into three fractions, namely filling material, combustible material and recyclable material.



Cautious refurbishment



Normal refurbishment



State-of-the-art refurbishment

3.5 Exterior environment

Changes in the exterior environment were made using the same guidelines as the refurbishment in general. Thus, only materials approved by the environmental declaration were used.

As requested by the tenants, the area was provided with a number of allotments located in the adjoining park area. The allotments were arranged at different levels to facilitate gardening activities for disabled tenants.

In order to make space for the allotments, a number of oak trees had to be felled in the park area. These were sawn into timber that was subsequently used to make climbing trees, fences around swings, swing frames, border frames for the allotments and so on.

The local management of surface water enabled it to be used for watering the allotment area.

All entrances were modified for easier access and 70% of the staircases were equipped with lifts in accordance with requirements from the town planning committee in the municipality. The location of the lifts was decided in consultation with the local contact committee active in the area.

3.6 The contracting phase

The environmental thinking in the Inspektoren area refurbishment formed the theme in the handling of materials in the contracting phase, from the planning stages to completion of the work.

An important instrument in the general contractor's (GC) environmental work was the environmental plan that was drawn up shortly after the tendering. It was stated in this plan that:

- Statutory environmental requirements and other authorities' requirements regarding the environment must be fulfilled
- GC's environmental policy and environmental goals must be complied with
- Environmental requirements from Kalmarhem must be fulfilled
- Kalmarhem, authorities, tenants and other interested parties must be kept informed to the extent necessary for each party

Significant environmental aspects were identified in the environmental plan with the aid of an environmental analysis. In order to ascertain whether environmental aspects were significant, due consideration was given to the following evaluation criteria:

- Probability
- Scope
- Environmental influence
- Opinions
- Laws
- Other requirements

From the analysis it became evident that significant environmental aspects in the Inspektoren area included residual products and chemicals. In the environmental guidance program, part of the environmental plan, GC's goals were laid down and explanations of how the goals were to be achieved. Among these goals may be noted:

- Residual products for disposal were to be minimised (20 kg/m² refurbished area)
- All toxic/dangerous waste would be registered
- Usage of chemicals would be documented
- Building provisions would be ordered from one supplier

To succeed in compliance with the established environmental plan and to achieve the project's environmental goals, scrupulous handling of materials and products was necessary. This handling, or material administration, can be seen in terms of three parts:

- Purchasing of materials
- Handling of materials
- Sorting at source

3.6.1 Purchasing of materials

The selection of a supplier was preceded by checking through factors such as work quality, environmental consideration and references. The basis for being able to make an environmental product declaration for the products and the materials included had to be reported, which proved to limit the choice of certain materials and product groups. Several suppliers observed that there were other competitive measures available apart from the price, namely the environmental product declaration. Kalmarhem's environmental requirements regarding materials and products were established in the technical description, which formed the basis for purchasing from sub-contractors and suppliers. These requirements forced suppliers to look in detail at what they sold and what the environmental effects of these products/materials were. GC's material goods database was used as an aid to the purchase of products and materials for the best choice with regard to environmental characteristics.

A large proportion of the materials were purchased ready-made for each flat and delivery of materials was planned so that the storage time before use was as short as possible and further transport inside the construction area avoided. This was done to reduce loss and thus decrease the overall amount of waste, one of the project's environmental goals.

The purchase of materials was from as few suppliers as possible to reduce the transport needs, among other reasons.

3.6.2 Handling of materials

In the Inspektoren area there were many materials and products that had to be declared environmentally in accordance with the above mentioned environmental evaluation system. Examples of material types that were closely examined under the environmental magnifying glass were white goods, kitchen fittings, flooring materials and paint. In addition, bathroom sanitary ware, electricity cables and water pipes were evaluated from an environmental perspective.

In most areas, environmental categories of “Acceptable” or better were achieved. This was something difficult to accomplish with regard to paints, where in certain cases it was impossible to find environmentally acceptable products.

A supplementary inventory of products and materials was made by GC prior to the start of refurbishment. This inventory resulted in changing the stipulated laundry room equipment and wet area cassettes for products with a better environmental declaration. Any changes in stipulated products and materials during the production phase required proof of environmental product declaration. Another example of changes made was in sealing compounds used.

In the above-mentioned inventory, health and environmentally hazardous materials such as asbestos, lead and CFC’s were defined and any handling, transport and recipients were documented. The occurrence of these materials was noted in the stripping out plan, in which was included the approximate quantities and how the materials would be disposed of.

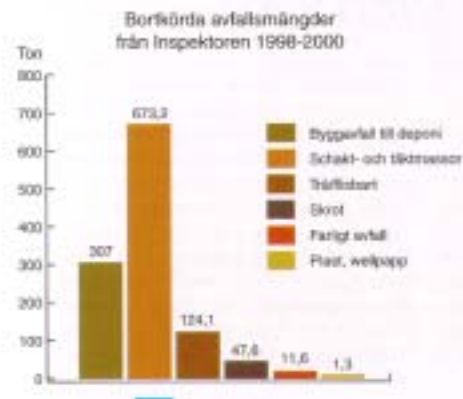
In the search for the best environmental choice of materials there were sometimes clashes with principles of good working environments. For example, halogen-free telephone cables turned out to be orange so that the surface installation stipulated was out of the question. Instead it was decided that the cables were to be concealed in the walls by chasing a groove for them. This resulted in an extremely dusty environment and a visit from the Labour Inspectorate. The choice of installation method was changed to skirting boards prepared for cables and so far less chasing in the walls was necessary.

Personnel training and instruction was carried out in accordance with GC’s quality plan to ensure that everybody involved at the contracting stage was well aware of the project’s goals and requirements for products and materials with regard to quality, environment and working environment.

3.6.3 Sorting at Source

The construction industry in Sweden gives rise to large quantities of building and stripping out waste, of which a large part goes unsorted for disposal. The total amount of waste in a general contract, as in the Inspektoren area, is decided in the planning phase. What can be influenced in the contract phase is the amount of loss and the degree to which the waste is sorted.

One of the significant environmental aspects of the Inspektoren area was residual products and one of the environmental goals was to minimise the amount of these residual products for disposal (20 kg/m² per refurbished area). The solution here is sorting at source. In consultation with the municipality and the receiving company, Stena metal, it was decided what fractions should be sorted in order to suit the existing transport and receiving system.



As shown in the diagram above, 307 tons of waste was transported for disposal. The project's goal was 20kg/m² total gross area, giving approximately 290 tons, so the goal was almost reached.

During the planning of the contract phase, a workplace disposition plan was drawn up in which sorting at source was an important part. Large skips and environmental stations were placed so that transport distances would be as short and uncomplicated as possible. There was an environmental station set up by the paint supplier in which paint cans were deposited and where paintbrushes were cleaned using a closed system.

A contingency plan was made by GC in the event of larger quantities of dangerous waste being discovered during the clearance work, or spillage of oil or chemicals. These had already been defined as significant environmental aspects for the Inspektoren area. Preventive measures as well as work information and a list of dangerous materials were listed.



One key to success for effective sorting at source is information. Everybody on site at the Inspektoren area was informed of the procedures for sorting at source through information meetings, establishing meetings, co-ordination meetings and planning meetings.

Sorting at source by skilled workers worked satisfactorily. However, it may be noted that the system of using different contractors for collecting different material groups meant unnecessary

transport. Cooperation between usual collections and the needs of the construction site could have worked better.

4. SAFETY

Safety and security are among the most important things for people, and our homes especially should provide a safe life. Kalmarhem feels that safety in this context means minimising the risks associated with being in the home in a structured way.

What, then, is a risk? Kalmarhem has chosen to use the National Rescue Services Agency definition of a risk:

$$\text{risk} = \text{probability} \times \text{consequence}$$

Those risks that Kalmarhem has focused on are risks for people's lives and well being in addition to the function and value of the buildings.

In the planning phase, safety was a concept that was present the whole time and may be described in the context of renovation work as the following:

Water risks:

- Stopcocks for hot and cold water must be easily accessible in every flat
- Operational surveillance sends alarms on leakage to an alarm computer and as text messages to caretaker personnel

Fire risks:

- Inspections of fire detectors in basements and communal areas with automatic fire-doors resulted in more, smaller fire detectors.
- Fire alarms were installed in all Kalmarhem flats in 2002, which should result in earlier detection of fires.
- Ventilation has smoke detector controlled shut-off and alarm connection to the alarm computer and text messages to caretaker personnel.

Burglary risks

- All entrance doors to communal areas are changed to steel doors installed further inside the building to obtain a negative refraction angle
- Doors to flats are equipped with a sheet steel security layer.
- Staircase doors are connected to a time-switch
- Parking areas were already only planted with trees to retain an unobstructed view of parked cars.
- Lighting was made stronger and improved in the area, including the parking areas
- Paths were built to avoid dark areas with obscuring bushes.

Electrical safety

-All flats had earth leakage circuit breakers installed

5. DISCUSSION

Environmental product declaration: When the guidelines for product declaration were sketched out in the initial stages they were based on the model using life-cycle analyses where the product was examined from raw materials through manufacture, packaging, distribution, use and recycling.

To enable classification to take place there were large demands placed on manufacturers and suppliers. This initially created large resistance. Some suppliers fell in with idea at once, whereas others were totally uninterested and thought that we at Kalmarhem should take care of our environmental issues and leave them to take care of theirs.

As the work proceeded and cooperation with the Institute for Construction Ecology started up, the materials industry became more and more willing to cooperate. Today there are probably no manufacturers that do not give a complete declaration of products. Certain materials could not be delivered at the commencement of refurbishing, meaning that it was necessary to replace some elements as soon as environmentally marked products came on the market. This included PVC-free electrical products.

Today there is a wide range of products analysed and accessible through Svensk Byggtjänst (which has taken over and enlarged the database from the Institute for Construction Ecology).

Working environment: In the contracting phase it was stated that in our striving to use environmentally friendly materials and working methods, the aspect of the working environment was on a few occasions neglected.

One of the parts of the contract was to install many electricity cables. Some of these were to be inset in existing partition walls and this gave rise to repetitive strain injuries due to their large number and the unsuitable working height. Another working environment issue concerned the removal of existing ventilation ducts from the attics, which constituted heavy work in conjunction with sawing through the asbestos ducts.

State-of-the-art flats: In the completed show flats new environmental technology was tested, some successful and some less so.

Plant filters which were constructed in special climate rooms for cleaning supply air and exhaust air, as well as temperature and humidity controlled ventilation dampers, have all functioned satisfactorily, with the exception of the humidity control which had some commissioning problems. The automatic watering of the plant filters had to be disconnected since the humidity supplement varied enormously depending on the season and the tenants' style of living. To prevent the plants becoming damaged by too much direct sunlight the plant filters that face south and west have had sunlight controlled blinds installed on the exterior of the glass.

The attempt at using BDT water to irrigate the plant filters has not functioned as well as planned since the BDT water was collected in special tanks in the bathroom, giving rise to odour problems.

In spite of these snags, it can be stated that the plant filters have worked in an excellent fashion regarding the cleaning of air in the flats and a few years' experience have given a lot of know-how about what species of plants provide the best cleaning effect.

Urine separation is another piece of new technology that tenants have found problematic. This is largely due to difficulties in operating the toilets and above all cleaning the urine section, where crystals form and are difficult to remove. Most of the separation toilets have now been replaced. Trials with special cooling cupboards that were planned to replace part of the fridges have also been carried out. The cooling cupboards' low temperature was to be maintained through a solar chimney that would draw in cool air from the ground through a cooling tower and subterranean supply air ducts. Unfortunately the temperature did not decrease to the level required for the storage of dairy products.

Painting has been carried out using emulsion, egg-tempera, tempera and linseed oil paints. Apart from the rather long drying times there have not been any negative aspects stated in this context.

6. SUMMARY

All the parties involved in this refurbishment process, from the specifier to the consultants, authorities, suppliers and contractors, have gone through a new phase in their everyday work due to the priority given to environmental thinking. This has meant that those who have had the privilege of working with the refurbishment of the Inspektoren area are probably far ahead of the other players in their areas of business.

Many of the measures that have been executed have by now been evaluated and will be used as a basis for continued work in the environmental area. As far as Kalmarhem is concerned, an environmental manual for construction and material handling has been compiled which every consultant and contractor engaged by Kalmarhem in the future will have to comply with.

Despite some of the trials, above all in the state-of-the-art flats, not being as completely successful as we had planned, this striving to find new approaches and our willingness to experiment must continue untiringly when it comes to issues involving environmental thinking, the working environment and refurbishment.

The administration phase has now been initiated and the follow-up work from the project will continue until the next renovation measures. The results will be analysed and utilised within the company for future projects.

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