A voluntary scheme for certification of indoor environment and energy use

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SUMMARY

Specialist researchers, property owners, builders and building managers have together developed a quality assurance (QA) management scheme that considers indoor environment and energy use. The primary objective of quality assurance is to work towards continuing improvements and to encourage those concerned to perform measures that otherwise would not have been considered, and to ensure that energy improvements are not introduced at the expense of indoor environment conditions. The QA scheme therefore aims to be flexible so that it can achieve the primary objective independently of the building's category or the management organisation. The new QA scheme's flexibility has successfully been tested in three different buildings; a school building, an office and an area of multi-family houses.

INTRODUCTION

To achieve the intended results of building, managing and using a property requires knowledge, continuity and communication, which can be assured by a dynamic and flexible quality assurance management scheme. Such a voluntary scheme focusing on high quality indoor environment has been developed during the 1990s and been successfully applied to schools, offices and multi-family houses [1]. Clients have been very satisfied with the scheme and its results in terms of an improved indoor environment, with fewer complaints from the building users [2, 3].

However, new emphasis on energy conservation (such as in the European Energy Performance in Buildings Directive [4], has added new demands for energy improvements as well. On the other hand, a reduction in energy use is appropriate only if it does not adversely affect the indoor environment. In order to avoid a one-sided focus on either good indoor environment or energy efficiency that might result in mutually adverse effects, the building sector requested that the QA scheme should be extended to consider energy use as well.

Specialist researchers, property owners, builders and building managers have therefore jointly developed the QA scheme with the objective of including energy efficiency assurance [5]. The scheme has been extended to a labelling scheme for the total building performance of both indoor environment and energy use. It includes methods and routines to control the indoor environment and energy use by using occupant questionnaires, the building monitoring systems or other methods during operation. A third party certifies the energy and indoor environment and makes annual inspections. To ensure that the scheme's rules are accepted, and that they are needed by the building sector, the scheme has been approved by a committee consisting of representatives of private and municipality property owners. However, the main target group of the end results is the occupants. It is important to occupants to know that their potential home or workplace building has a healthy indoor environment with minimum use of

energy. The new QA scheme for both indoor environment and energy use is now ready to be applied in practice.

The system covers the planning, design, construction, commissioning and operation phases, and it would be natural to perform a performance analysis of all phases of the extended scheme. However, to do so, considering both the indoor environment and energy use, would have required a very long trials period. In order to obtain a first relatively quick evaluation, the extended scheme was applied to buildings which formed a special case in that their indoor environments had already been certified with the QA scheme. They therefore needed only the additional element of QA of their energy schemes. The pilot buildings were chosen in order to represent a wide range of building categories and property manager organisations. The pilot projects are a school building, an office and an area of multifamily houses.

DESCRIPTION OF THE QUALITY ASSURANCE SCHEME

The primary objective of the scheme is to work towards continuing improvements and to encourage clients, builders, architects, administrators and occupants to perform measures that otherwise would not have been considered. This requires quantified and measurable goals, action plans for measures, and management systems during operation.

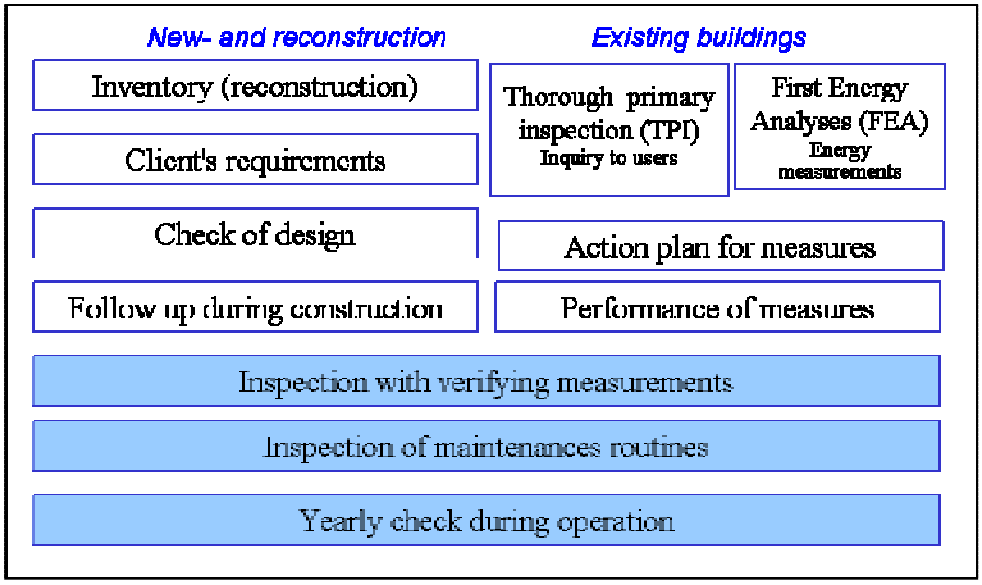

Figure 1. Illustration of procedures for quality assurance of indoor environment and energy use.

Cooperation between all parties, from scientists and public authorities to designers, contractors, managers and users, is important for the end results. All need to listen to, and to learn from, each other. Good indoor environment and efficient use of energy can be achieved by creativity, planning and layout design, choice of materials, general designs and detailed and overall designs of systems for heating, ventilation, electricity and water supply. This QA scheme makes sure that the requirements set out in legislation, standards or common codes of practice are fulfilled as intended. An independent third party supervises, evaluates and checks that the requirements are fulfilled. Measurements show that the performance requirements have been met. Occupants' perceptions of the indoor environment are evaluated with the help

of questionnaires, while energy use is evaluated with energy measurements or energy bills. The QA system includes new building and reconstruction work, as well as improvements of existing buildings, and covers the entire process, from planning and design, through the construction stage to final use and operation. The certification is based on ISO 9000 procedures, is illustrated in Figure 1 and described in SPCR 114E [6].

Additional elements for energy use

Certification work for existing buildings begins with a first energy analysis (FEA), which consists of an inventory of the actual property with its actual energy status, energy aspects and energy performance [7]. This can be done by examining construction drawings, operational follow-up programs, control systems or other documentation; inspections, interviews with staff and additional measurements. It is recommended that this should be carried out in conjunction with the TPI (Thorough Primary Inspection) of the indoor environment, particularly with respect to visual inspection and interviews with staff.

The results of the FEA are then used to set objectives to be achieved, including a performance measurement specification of how the comprehensive targets should be measured and checked. The QA scheme considers the fact that each building project is unique, and therefore the annual energy use target will be set on the basis of the building's current condition and its associated limitations, rather than on the basis of a specific predefined figure. For new construction, or major reconstruction, the primary limitations relate to building use and climate, while minor reconstruction and existing buildings also have limitations due to design.

The next step is to draw up an action plan for measures and carry them out in order to reach the set targets. Experience shows that successful energy efficiency in a building will be maintained only if the building is efficiently managed, operated and maintained, with all parties steadily improving their performance and with the results regularly monitored. This means that the energy target must be regularly monitored and reviewed, and the QA scheme is therefore based on a management system modelled on a Swedish standard (SS 62 77 50, [8]). The standard includes comprehensive routines for energy management for any organisation and has therefore been refined and customised to fit the building sector.

DESCRIPTION OF THE PILOT PROJECTS

The pilot projects are a school building, an office and an area of multifamily houses.

The Sjöbo School

The main classroom building of Sjöbo School (originally built in 1959) was rebuilt in 2001 and 2002, complemented by new building of the gymnasium, kindergarten, teachers' staff rooms etc. In total, the school consists of six buildings, with a floor area of 6673 m^2. The indoor environment element of the QA scheme was employed during the planning, design, construction and commissioning stages, and after some months of operation the school indoor environment was certified. As far as energy use is concerned, the school should perform quite well, since all buildings were rebuilt or newly built, with new building envelopes and HVAC systems. However, the focus of this project was to introduce the extended QA scheme in order to ensure retention of good building performance rather than (primarily) to improve energy use.

Figure 2. The Sjöbo school.

The Elektra Office

The Elektra building was built in 1894 for Borå's steam engine-driven power station. In 1970, it was converted to office premises. After the last refurbishment in 1990, the building presents a modern impression, while at the same time reminding us of older days with its large windows and small chimney towers. The 2100 m^2 interior was certified according to the indoor environment QA scheme in 2003. The owner and property manger is the town's district heating company, with good knowledge of energy efficiency measures and therefore already having clear ideas about how to improve the energy performance, with respect to the building's age, during the extension of the QA scheme to cover energy use.

Figure 3. The Elektra office.

The Högsbohöjd area with multifamily houses

The Högsbohöjd district consists of 14 multi-family houses with 940 apartments and a total area of 57 817 m^2. The district was built during 1959 to 1961 and was totally renovated in 1992. Part of the buildings were certified according to the indoor environment QA scheme in 2001, and the last building in 2006.


Figure 4. The Högsbohöjd district with multifamily houses.

TARGET DETERMINATION AND SPECIAL CONSIDERATION FOR EACH PILOT PROJECT

The three pilot projects are very different in their character regarding building categories and property manager organisations. They also had different additional aims with the introduction of the QA scheme and ways of working during the introduction.

The Sjöbo School

The property manager, based in the municipality and responsible for management of the Sjöbo school, worked very hard with getting all parties involved in the management process with several meetings between the principal, the operation staff at the school (caretaker, cleaner, etc.), teachers' and occupants' representatives and the municipality property manager. Besides this series of regular meetings with standing agendas, two consultants had been engaged to help with computerisation of the building management system, installation of new sensors and instrumentation equipment and commissioning the building control system. One of the main measures that was introduced was time-control and demand-control of the ventilation system in the kindergarten and the gymnasium. This required special consideration on how the ventilation should be controlled while the indoor environment was kept at a high level, which is described in Wahlström et al. [9].

The FEA showed that the annual energy use of district heating was 121 kWh/m^2, and that of electricity was 59 kWh/m^2. The target was a 10 % reduction during the first year, and 15 % after two years, while the use of electricity should not exceed the previous level. After one year, the first target was met for district heating, while electricity use had also been reduced by a few percentage points.

The Elektra Office

The property management structure for the Elektra office is a very flat organisation for management of the building, and it was simple to introduce a management system with rules and responsibilities since there was already an environmental management system. At the same time, it was very easy to monitor the energy performance, since the office consisted of only one building. The building owner had, however, an additional aim with the introduction of the management system, which was to analyse how energy use could be controlled using the company's own internet-based statistical monitoring tool. Monthly and yearly energy performance was evaluated with the internet tool, in the form of graphs and alarms for easy follow-up, during the introduction of the QA scheme.

The work involved in the Elektra building consisted of replacement of the building control system, modifications to the ventilation, heating and cooling control system, and calibration of sensors. The target for energy performance was set at a 15 % reduction in heating energy, a 7 % reduction in electricity use, and a 10 % reduction in cooling energy use during the first year.

The Högsbohöjd district with multifamily houses

The property manager for the Högsbohöjd district wanted to work in a different way with both organisational and target set-up. The main approach with their energy reduction work was to first consider and work with the buildings that had the highest energy use, and thus also the highest potential for energy improvements. This enabled the current year's investment costs to be used where they gave the most benefits. Targets were therefore set up for all 14 buildings together, instead of an individual target for each building, but with the limitation that the energy use was not allowed to increase in any building. An action plan for work was set up with the following main features; adjustment of heating, replacement of windows, insulation of windows, insulation of attics, hot water metering and improving the airtightness of the building envelope. However, what was not defined was in which building the various measures should be performed. Each year, a few buildings with the highest energy demand will be examined in order to decide which energy measures would be of most benefit to that particular building.

Today, the Högsbohöjd district has an average specific district heating demand of 169 kWh/m^2, and has set a target of 149 kWh/m^2 for the whole area by 2010. Electricity use is 21 kWh/m^2, and the target here is prevent any increase by 2010.

The organisation for management of the Högsbohöjd district consists of a chief property manager, based in the head office, and staff known as local landlords who deal directly with daily maintenance within the buildings. If anything acute happens that need to be dealt with immediately, the owner has a contract with a service company. The local landlords check the energy performance every month and report deviations directly to the chief property manager. At yearly evaluations by the chief property manager, buildings with high energy use are selected for further investigation by energy auditors. This can also be the case if a local landlord has recognised a large monthly deviation. The energy auditors examine the selected buildings and give suggestions for necessary improvement or remedial work.

RESULTS AND DISCUSSIONS

New demands for energy improvements must not be allowed to draw attention away from the indoor environment. The preliminary results from the pilot projects show that this can be done by using a practical and flexible quality assurance scheme, intended to design and maintain a good indoor environment and efficient energy use.

The primary objective with the QA scheme is to work towards continuing improvements and encourage property managers, administrators and occupants to perform measures that otherwise would not have been considered. The QA scheme aims to be flexible so that it can be used for different building categories, different organisational structures and different parts of the building process. This report describes application of the QA scheme to buildings that already employ the indoor environment management scheme, but in three different kinds of pilot projects.

The results show that the QA scheme is really flexible. For each pilot project it was possible to introduce quantified and measurable goals, action plans for measures and management systems during operation with authorities, responsibilities and awareness for all actors within the process. All pilot projects have already shown, with their new targets and action plans for work, that they are moving towards improved energy performance. The projects have also led to a significant improvement in the systematic work related to the controlling energy use, while at the same time maintaining a good indoor environment.

The main target group of the end results is the occupants. It is important to occupants to know that their potential home or workplace building has a healthy indoor environment with minimum use of energy.

The next step is to test the flexibility of the QA scheme during planning, design, construction and commissioning of different building categories.

ACKNOWLEDGEMENT

The authors would like to thank the building management department of Borås City Council, Bostads AB Poseidon and Borås Energi och Miljö. We gratefully acknowledge financial support from FORMAS (the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning) and BIC (the Swedish Construction Sector Innovation Centre).

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