Hedegaards School – Part F School Diary

Visits

3 Renovation works status, May 19, 2014
2 Renovation works status, October 30, 2013
1 Renovation works status, August 27, 2013

The school building before retrofit

The school building after retrofit
Visit 3 - Renovation works status, May 19, 2014
Memo by Ove Mørck, Cenergia & Kirsten Engelund Thomsen, SBi

The visit was a meeting with the involved technical people from Ballerup, SBi and Cenergia.

The meeting covered the following issues:
- New building energy management system
- Electrical lighting – in two classrooms and in the corridor area
- Solar cells
- New regulation of ventilation in the office area
- New painting in the corridor

Building Energy Management System (BEMS)

The installation of the BEMS system is finished. It has been delivered by the AEG-partner Schneider-Electric and a presentation of the system was given at the visit. The new control board is coupled to the overall BEMS system of the Municipality of Ballerup.

The system covers:
- Control of the ventilation system in the office area
- Program for the optimisation of the hot water system.
- The electricity and heat meters are connected to the new control board which gives access to the meters for the pupils on an info screen.
The system looks advanced and gives a clear overview of the different parts of the heating and ventilation systems.

The new info screen is located in the middle of the corridor so it is easy for the pupils and other to follow the energy consumption of their school.

**Electrical lighting**

In the two tests classes new white ceilings have been mounted and the electrical wiring changed to allow for the mounting of the new fixtures. Two different types LED fixtures are installed - square and round fixtures. They have daylight control and also the lights at the smart boards are regulated automatically.

The black board lighting has also been changed to LED light.

New LED lamps have been installed in the corridors. They are controlled by daylight sensors – divided in three separately controlled rows.

**New painting in the corridors**

The corridors in this part of the school which has been renovated have been painted white. This was one of the recommendations from the AEG, when they visited the school for the first time. Originally, the walls were wooden. Pictures and noticeboards will be placed on the walls afterwards to create a friendly and homely atmosphere.
Solar Cells

The solar cells have mounted on the roof. There is installed 152 m² (22.5 kW). The output from the solar cells can be followed on the control board and on the info screen in the corridor. See below:

New regulation of the ventilations system.

The new BEMS systems is used to control a mechanical ventilation systems which serves the office area of the building. Before this system was running 24/7.

The renovation of Hedegaards School is now completed.
The visit was introduced with a meeting with involved people from Ballerup, ISOVER, Schneider-Electric, SBi and Cenergia. The meeting covered the following issues:

• Facade renovation – including windows
• Solar cells
• Electrical lighting
• Ventilation
• Building energy management.

**Façade renovation**

When removing the existing windows lead (Pb) and PCB (polychlorinated biphenyl) were found. The windows had to be removed with special equipment and safety clothing of the workers and taken to a special incineration plant for destruction. This increased the cost and delayed the process somewhat. The insulation in the façade had to be installed taken into account the uneven external side of the inner brick wall. Therefore it was decided to split the insulation in two – an external mat of 95 mm mineral wool and an internal 230 mm granulated mineral wool. Granulated mineral wool usually comes with a lambda-value of 0.038 W/mK and the mat with a lambda-value of 0.034 W/mK. The member from ISOVER of the AEG (Advisory and Evaluation Group) helped to identity a wool product from Sweden with a lambda-value of 0.034 W/mK – allowing for a total lambda-value of 0.034
W/mK for the whole layer of 325 mm insulation. The U-value of the external wall then becomes as low as 0.1 W/m²K. See the new façade insulation on the photo.

**Solar Cells**

The solar cells have been delivered and are now lying on the roof ready for mounting. The mounting process has been a bit delayed because an additional layer of asphalt has to be installed on the sloping roof towards south before the cells could be mounted. The mounting will be carried out during November 2013.

**Electrical lighting**

In the three test class rooms new white ceilings have been mounted and the electrical wiring changed to allow for the mounting of the new fixtures. The first LED fixtures were delivered, but it turned out that they were only meant to be installed on a suspended ceiling, so they couldn’t be mounted. A new delivery has been ordered of the two types – square and round – LED fixtures that are to be mounted in two different class rooms. In the third – the one to be equipped with regular T5-tubes – an experiment had been carried out with mounting LED-tubes in the existing fixtures. The energy savings should be 70%. This, however, resulted in a 50% reduction in the light level in the class room. It will be investigated whether individual meters can be placed on the electrical lighting in the 3 test class rooms, mainly for educational purposes. All the 3 class rooms should be ready with new fixtures by the end of November.
A contractor has been found for the installation of LED lighting in the corridors. Two different lamps are in question and before the mounting starts both lamps will be trial-mounted to allow the proper choice. The installation will be carried out in November.

**Ventilation**

In the class rooms the existing ventilation system called Jaga will be kept. It is controlled by the CO₂ level in each room. The control system and hardware is not working ideally and often equipment has to be renewed. The municipality will look for a renovation possibility outside the scope of the School of the Future project.

Besides the class room ventilation the school (Part F) has two other ventilation systems. One cover an office section of the school and the other an auditorium and canteen area. The first one is to be controlled by the new BEMS system (see below) which will introduce some energy savings as it has been running continuously until now. Renovation possibilities for the other system is currently being investigated, but as it is not clear what will be the future use of the canteen area and the auditorium is not used very much it might turn out that it doesn’t make sense to change this system.

**Building Energy Management System (BEMS)**

The function and design of a BEMS has been discussed with AEG-partner Schneider-Electric. They had come up with a solution that included a complete renovation of the control part of the JAGA individual class room ventilation system. The U-value of the external wall then becomes as low as 0.1 W/m²K.
Municipality, however, does not have a budget for this part at the moment. Schneider-Electric will therefore present a revised system design covering only the School of the Future requirements within the next two weeks. This covers the following elements:

- Control of the office ventilation system
- Program for the optimisation of the heating and hot water systems.
- The electricity and heat meters to be connected to the new control board which will give access to the meters for the pupils for educational purposes.
- The new control board is coupled to the overall BEMS system of the Municipality of Ballerup.

It is expected that the system can be installed before Christmas 2013.
Visit 1 - Renovation works status, August 27, 2013
Memo by Ove Mørck, Cenergia & Kirsten Engelund Thomsen, SBi

Hedegaards School is located in Ballerup 15 kilometres to the west of Copenhagen. The school consists of a number of built spaces (parts) and it was built in the early seventies. Due to the age of the construction and the actual energy performances, the part F of the school has come to a state in need of a deep energy retrofit. As part of the School of the Future project a renovation plan has been worked out.

The energy renovation will greatly reduce the thermal losses of the building envelope. In 2012 an average 25 cm of insulation has been added on the roof, so the average thickness now is 45 cm.

All the exterior walls will be replaced by new highly insulated external cladding and all the windows will be replaced by new windows.

Electrical lighting and ventilation will be improved and solar cells (PV) and a building energy management system (BEMS) will be installed.

Visit on August 27, 2013
The visit was introduced with a meeting with involved people from Ballerup, ISOVER, SBi, Cenergia and Ove Heede (the engineer responsible for the energy renovation design). The meeting covered the following issues:
• Solar cells
• Electrical lighting
• Facade renovation – including windows – main focus of the meeting.
• Ventilation
• BEMS

Solar Cells
A PV-tender had been prepared and issued. Offers had been received and a contract was under preparation. The plan is to start the installation in September 2013. The tender had included two different areas for PV-installations: the south-facing sloped surface on roof-light build-up and a horizontal area on the flat roof. In the end it was decided only to install the PV-system on the sloped area. The decision was made out of economic reasons – to limit the overall cost of the renovation. The total installed effect will be 10 kW.

Electrical lighting
The electrical lighting systems in the classrooms are fluorescents tubes of a recent date and the effectiveness is so high that substituting them with new LED-lighting has a payback time of more than 50 years, because the yearly hours in use are as low as 1400. Nonetheless, it has been decided to make 3 test-rooms, two of which shall be equipped with new LED-lamps and one stay with the T5-tubes. This will allow a side-by-side comparison of lighting quality and electricity consumption, which will provide valuable experience to the municipality on the use of LED lamps that are considered the electrical lighting system of the future. One reason is the much
lower cost involved in maintenance, because of the many hours the LED-lamps can be lit compared to the T5-tubes.

The electric cabling for the lighting systems has to be rewired for the 2 classrooms in question and the lamps have to be ordered. This will be done in the next month.

The corridor lighting is to be upgraded to allow for a more flexible use of the building – the corridors can be used as extended classrooms when the lighting levels are 200 lux instead of the currently 50 lux. A tender for the exchange of the existing lighting system with a new LED-based system is to be worked out and issued in next month.

**Facade renovation**

The existing wall – see figure to the right - has an external brick layer and a hollow core insulation of 70 mm of mineral wool. The idea for the renovation is to remove the external brick layer and the insulation and replace it with 330 mm of mineral wool with a lambda value of 0.034 W/mK and a thin cover plate of fibre cement which makes room for the added insulation.

The renovation work has started with dismantling the outer part of the existing wall - see the next photos.

The façade renovation also includes the replacement of the existing windows with new low energy windows with 3 layers of glass and a frame system with very low thermal transmittance. The new windows can be mounted using the existing steel frames – which also were used for the old windows – see photo at the right.
Possible contamination with PCB and lead

The first tests have shown that the existing windows contain PCB and lead. Further tests is to be made immediately and if they show that the content is dangerous all the windows will have to be treated as dangerous waste, which will mean added costs for the municipality.

New windows

New windows have been ordered from the company Protec-Windows and have been delivered. The exchange of windows is planned in 6 steps. Each step comprising 4 classrooms which will have to be abandoned while the exchange is ongoing.

Ventilation

The existing classroom ventilation system called Jaga, allows in principle for individual classroom CO₂-controlled air exchange. However, the control system doesn’t work satisfactorily and the municipality is interested in the possibility of changing the control part of the system. It will be checked whether this can be done with the new BEMS system.

A separate ventilation system covers an old canteen area and an auditorium and it is to be investigated whether it makes sense to replace this system with a new system.

BEMS
Ove Morck from Cenergia will take contact to the industry partner Schneider-Electric for a contribution to the design and installation of a BEMS system that satisfies the School of the Future requirements. The monitoring results have to be visible for the students and for the teachers.

The new windows are triple glazed with an overall U-value around 0.7 W/m²K. The well-insulated frame and the three class layers are clearly seen.