

Property name: Norrtälje prison- Building 9
Property owner: Specialfastigheter
Consultants: CIT Energy Management AB

Total Concept method

Step 2. Carrying out the measures
 Step 3. Following up

Building and its use

Year built: 1958
Area: 8 030 m² heated area
Type of building: Prison

The Norrtälje prison is a high security institution for male prisoners. The building of interest - Building 9 - is with its 8 030 m² floor area by far the largest building within the Norrtälje prison area and holds several activities. The building is divided in four almost equally large sections separated from each other due to security reasons. The building is owned by Specialfastigheter AB but used by Kriminalvården. The greater part of the building is for stock-keeping, carpentry and mechanical work where wood furniture and all sorts of sheet-metal work is carried out. The rest of the building is for office and educational use. The activity is from 07.30 to 16.30 Monday - Thursday and 07.30 - 13.00 on Fridays. All together there are about 100 persons in the building during activity time.



Indoor climate

Indoor climate requirements in the premises are dependent on the function of the rooms and activity. The levels are controlled in the rental agreement between Specialfastigheter and Kriminalvården. According to these indoor climate requirements the room temperatures must be kept in between 16 - 22 °C, depending on the room and activity.

According to the energy audit, thermal comfort in premises is considered to be poor, which is a consequence of a malfunctioning heating system. In a number of rooms the room temperature setpoints are as low as 12 °C. The thermal comfort will however be improved soon, regardless if Specialfastigheter choose to carry out the entire action package in Step 2 of the Total Concept or not. The indoor air quality is considered to be rather good, due to high infiltration rates and the airflow rate measurements carried out previously.

The status of the building and its technical systems before measures

Building envelope

The building envelope is poor in general with almost no insulation in the light concrete walls, old original single or double pane windows and a bottom slab without insulation. The concrete roof is however in good shape

with new additional insulation. The air infiltration is probably huge, not the least due to several large and leaky doors for trucks etc.

Heating

The building has district heating distributed to a substation in a neighbor building. The heating system with mainly radiators is really poor in general, incapable of keeping the thermal comfort at required levels. The radiator system is probably never balanced and has old thermostats. In addition the radiators are often covered by slabs of wood etc. which of course reduce their performance and usefulness.

Ventilation

Building 9 has several ventilation systems providing the building with comfort ventilation and process ventilation. The comfort ventilation is provided with three separate air treatment units with heat recovery. Parts of the comfort air are provided with displacement ventilation but the ducts are often covered by slabs of wood etc.

The process ventilation systems (local exhaust ventilation systems) take care of dust particles from carpentry/mechanical work and chemical emissions from paint coating.

Comfort cooling

Building 9 has no comfort cooling.

Lighting

The lighting systems in the large production zones consist of 250 light fittings with 2x58 W fluorescent tubes. Almost all lighting in Building 9 is controlled manually.

Equipment

Even if there is some standard office equipment such as computers, refrigerators, kitchenettes etc., the vast majority of the 'equipment' consists of machines. There is also a large compressed air system.

Control and monitoring system(s)

The ventilation and heating systems are connected to the central building management system, TAC Vista, installed in 2002.

Other systems

Domestic hot water is produced by district heating.

Energy and resource use before renovation and baseline for energy savings

	<i>Measured before</i>	<i>Baseline</i>
Total specific energy use before measures	121 kWh/m ² ,yr	129 kWh/m ² ,yr
<i>Whereas,</i>		
Heat energy	53 kWh/m ² ,yr	60 kWh/m ² ,yr
Electricity for building operation	13 kWh/m ² ,yr	13 kWh/m ² ,yr
Electricity for tenants	56 kWh/m ² ,yr	56 kWh/m ² ,yr

Energy supplied to the Norrtäljeanstalten - Building 9 consists of electricity and district heating. There is no separate heat meter for Building 9. District heating use is measured with one meter for the whole property. Additionally, there is only one electricity meter in Building 9, which means that electricity for building operation and electricity for tenants is measured together. The energy use of Building 9 and different energy end users

are therefore calculated with the energy simulation tool IDA ICE. Based on the calculations, the specific annual energy use for the building before renovations was ca 121 kWh/m², including electricity for tenants.

According to the energy audit in Step 1, it can be difficult to meet the indoor climate requirements set for the premises. For improving thermal comfort the room temperature set points need to be increased in some areas of the building. Establishing of a new baseline was needed for assessing correctly the potential with the identified energy efficiency measures. A new baseline for the property's energy use was calculated by using the calibrated energy simulation model. With increased room temperatures the annual heat energy use will increase by 13 %, from 53 kWh/m² to 60 kWh/m² (excluding domestic hot water). The new baseline for the total specific annual energy use for Building 9 was set to be 128 kWh/m² including tenants.

Identified energy saving measures

Five energy saving measures were identified during the auditing in Step 1. All of them were included in the action package that meets the property owner's profitability requirements. Additionally two measures are proposed for improving indoor climate and for assuring that heat energy measurements can be carried out in the future.

It was proposed to: replace most of the existing HVAC-systems (two separate measures), replace most of the existing lighting system, replace five large doors and add extra insulation on the façade. Since the proposed measures will also be carried out as part of the property maintenance plan, therefore only part of the investment cost is included to the costs for energy efficiency improvement.

Summary of the action package and measures carried out in Step 2

Up till now (nov 2016) some of the measures have been partly carried out and some of the measures are ongoing and under planning. According to discussions with the property owner, the status of the proposed measures is as follows. Measure 3 (*Replacement of five large doors*) is mostly completed. Four big doors out of five are replaced. Measure 1 (*More energy efficient lighting*) is partly completed. Lighting system has been replaced in two smaller side areas. In the two main areas the lighting will be replaced shortly, planning is ongoing. Measure 4 (*Replacement of LB01 (comfort vent) and reduced airflows*) will be implemented in the future, no final decisions have been made. Measure 2 (*Extra insulation on facades*) will be implemented soon, planning is ongoing. Measure 5 (*Reconstruction of process ventilation*) will be implemented soon, investigation is ongoing.

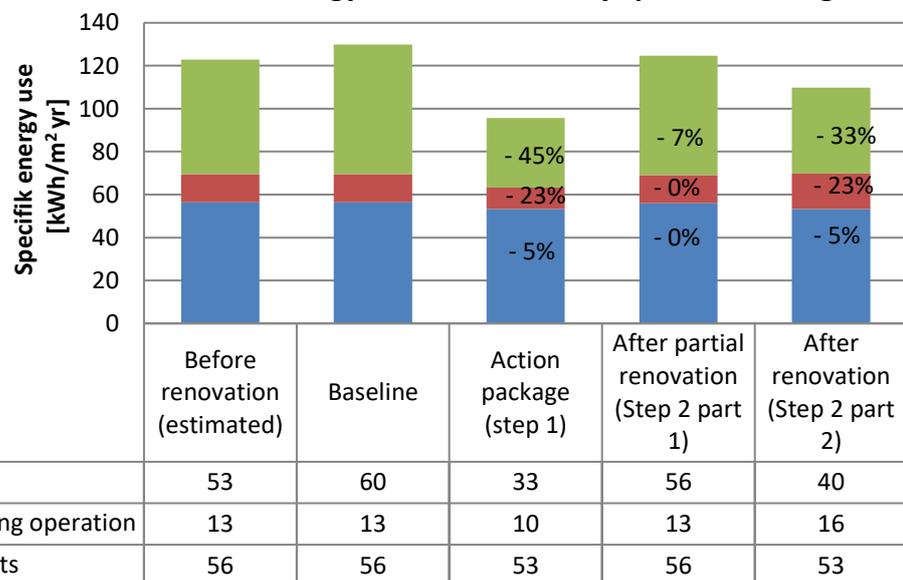
In addition to the proposed measures also two other measures have been carried out. The property owner has changed three regular doors in the façade and plans to go ahead with the replacement of the rest of the doors taking three at a time until all have been changed. In addition also 100 mm spray insulation has been sprayed onto the inside of the industry area roof (360 m²) and to another part close by (54 m²) to create better insulation and to improve the acoustics. Furthermore even small parts of the exterior facade has been insulated with the spray insulation.

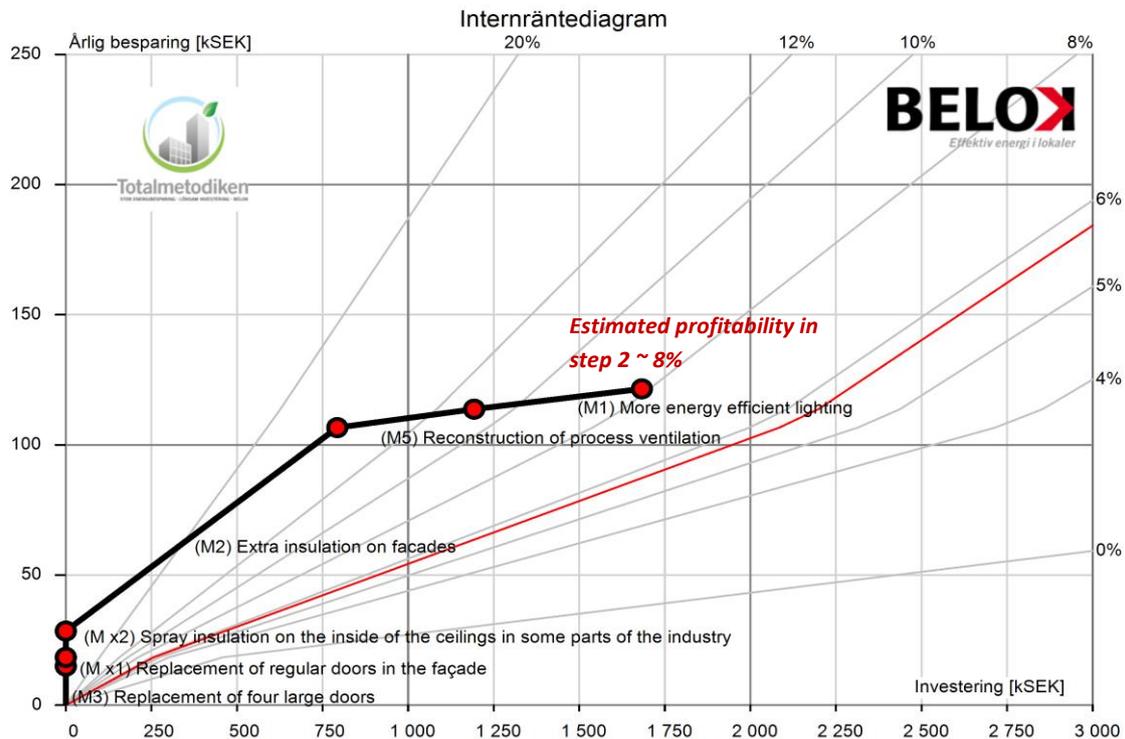
In order to follow-up the impact of energy efficiency measures that have already been carried out or planned to be carried out the action package from Step 1 has been adjusted according to the information available in Step 2. The estimated investments, cost and energy savings from Step 1 compared to real investments and with adjusted savings in Step 2 are shown in the table below.

According to the estimations the action package with planned measures in Step 2 will lead to total specific energy use of the building about 110 kWh/m² per year. The total heat energy use after renovations will be about 40 kWh/m² per year and total electricity use about 69 kWh/m² per year, where majority is used by the tenants. With the action package carried in Step 2 the total building energy use is estimated to decrease about 15 % compared to the new baseline and about 10 % compared to the energy use before renovation. The energy use for building operation (BBR) will decrease about 23 % compared to the baseline and about 15 % compared to measured energy use before renovation.

Measure		Step 1			Step 2		
		Investment cost kSEK	Cost saving kSEK/yr	Total energy saving MWh/yr	Investment cost kSEK	Cost saving kSEK/yr	Total energy saving MWh/yr
1	M3. Replacement of five large doors	0	19	24	0	15	20
2	M1. More energy efficient lighting in production zones	60	8	12	490	9	12
3	M4. Replacement of LB01 (comfort vent) and reduced airflows	740	90	125	-	-	-
4	M2. Extra insulation on facades	792	78	104	792	78	104
5	M5. Reconstruction of process ventilation	400	7	7	400	7	7
X1	Mx1. Replacement of regular doors in the façade	-	-	-	0	3	5
X2	Mx2. Spray insulation on the inside of the ceilings in some parts	-	-	-	0	10	14
Sum		1993	203	273	1683	121	161

Total energy use of the Norrtälje prison Building 9





The calculated profitability for the package in Step 2 is 8.1 %. Property owners profitability demand is 5,7 % and the estimated relative energy price increase is about 2%. Total annual costs savings will be about 121 kSEK/yr based on the estimated baseline. Energy investment cost for the updated action package is ca 1 683 kSEK.

Summary of the outcome of measurement and follow-up in Step 3

Step 2 is still ongoing and only few of the measures have been carried out resulting in estimated savings of 4 MWh/yr for electricity and 38 MWh/yr for heat energy. Due to lack of energy meters on the building level, it has not been possible to verify the savings at this stage of the renovation project. Estimated heat energy savings are very small compared to the entire facility's total heat energy use then it will not be possible to verify it with the measured energy use based on the energy statistics. Additionally, so far only part of *Measure 1* has been carried out, resulting in very modest savings in electricity, which is not noticeable from the measured electricity use of the building.

According to the recommendations from Step 1 separate energy meter should be installed in order to measure and follow up energy usage of the building in Step 3. Unfortunately, this has not been done at this stage of the project. Installation of additional energy meters is under discussion and will most possibly be done in the future. Then the building's energy performance can be monitored in more detail.