

Energy efficiency in listed buildings – Case study Forsåker, Mölndal

Renovation and retrofitting in buildings from 1880-1930

Background

Around 10% of the 3 100 000 Swedish buildings are considered to be of value for historical and esthetic reasons. Therefore they are listed which creates challenges when energy retrofitting these buildings. Although the total number of specified listed buildings in Sweden is uncertain, an investigation in 8 Swedish counties in 2010 showed that it can be roughly approximated to 67 000 buildings or about 2% of the Swedish building stock. In the near future, the task to increase the thermal performance while maintaining the esthetic qualities and historical areas of interest will increase in priority.

The focus on energy efficiency and reduced carbon emissions in society urges for the development of low-energy buildings and massive retrofitting measures in the built environment. Swedish buildings from before 1960 have an average U-value of the exterior walls of $0.58 \text{ W}/(\text{m}^2\cdot\text{K})$ while some buildings have U-values above $1 \text{ W}/(\text{m}^2\cdot\text{K})$ and the current building regulations recommends a U-value of $0.18 \text{ W}/(\text{m}^2\cdot\text{K})$. The high thermal transmittance of the exterior walls leads to a high energy use for heating and an insufficient thermal comfort for the occupants.

For existing buildings one of the possible measures to reduce the energy use is to retrofit the exterior walls. This could be done on either the exterior or interior side. Exterior insulation is preferred from a moisture perspective since the temperature in the wall is increased, leading to a lower relative humidity in the construction. Installing interior insulation leads to the contrary, an increased risk for moisture damages in the wall. This measure reduces the temperature in the outer part of the wall, leading to an increased relative humidity. However, for many listed buildings, retrofitting on the exterior side is not allowed.

Case study

Very close to Mölndal centrum, on the east side of the railway tracks, there was until 2006 a paper mill. The mill was founded in the Forsåker area in 1653 and had a working force of 700 employees at its height. When the paper mill was closed in 2006, the area was left into a rapid decay. In 2009, Mölndal municipality purchased the area and now plans to develop it into a new city district which will be transformed into a lively mixed use area with 3 000 dwellings. The aim is also to maintain the industrial identity of the area by preserving some of the buildings used by the mill. One of the buildings that will be renovated was built in 1896 and used for machinery. The building is a narrow concrete building with a red brick façade, see Figure 1.



Figure 1. The building from 1896. Left: South east facade in 1918. Middle: South west facade in 1932. Right: South west facade in 2009.

The present state of the building is quite good in regard of the structural load-bearing capacity. The building has a total floor area of 4 100 m² divided on two stories. The current plan is to keep the building and retrofit it to contain offices, shops and other commercial premises.

Aim

The aim of this project is to propose solutions on how the old industrial buildings in the Forsåker area can be preserved. The challenge is to preserve the aesthetics of the building while the energy performance is improved. It is also important to ensure a safe long-term hygrothermal performance in the construction.

Methods

The thesis project incorporates different research methods

- literature study of energy efficiency measures in listed buildings,
- site visits and meetings with the developer,
- modelling of the energy use, heat and moisture performance of specific building parts

Expected results

The thesis should propose retrofitting measures to preserve the building and reduce the energy use. Meanwhile the demands on thermal comfort for the new building usage should be met.

Required qualifications

Good knowledge of building technology and heat transfer in buildings. Good analytical and numerical modelling skills in Matlab, Comsol and WUFI.

Relation to the research

The thesis will contribute to ongoing research projects concerning listed buildings.

Potentials for expanding the thesis work

The project could be expanded to other buildings in the area.

Number of students in the project

This project is for two students

Time plan

School year 2014-2015

Supervisor

Pär Johansson, Chalmers
par.johansson@chalmers.se

Examiner

Angela Sasic Kalagasidis, Chalmers
angela.sasic@chalmers.se

Industry partners

MölnDala Fastighets AB