Adaptive reuse of an old industrial building by means of innovative thermal energy systems

Background

Former textile factories constitute an important industrial heritage of Sweden from architectural, constructional and technological perspectives. After a textile industry crisis in 1950's, many of the textile factory buildings were abandoned. Due to their close location to city centres and increased demands for habitat and business in expanding urban areas, these buildings have become attractive for adaptive reuse.

Unlike renovation, which refers to an improvement of the building's physical performances, the adaptive reuse means adaptation of the building to other purposes than the building was designed for. Preservation of the building character and memory are integrated part of the adaptive reuse, while renovation is optional.

Case study

The Sanden facility in Kinna neighbourhood in West Sweden is an example of adaptive reuse of a former textile weaving factory dating from 1837. In 2013 the factory has been turned into a commercial building to host business (offices), sports (fitness centre) and industry (wall paper factory and wool dye works) renters. The adaptive reuse of the Sanden facility stands out with its technical solutions, which provide each renter with desired (and largely different) working environment and thermal energy supply (heating, cooling and hot water). The fitness centre is the largest user of heating, cooling and hot water and its demands for the thermal energy are provided through a multipart energy system that combines district heating, desiccant cooling, an advanced thermal storage system and solar collectors.

Façade of the factory and a former weaving hall. Photo A. Sasic Kalagasidis, 2013.

The adaptation has been conducted with ambitions of creating high-quality rentable areas and being energy and cost-effective. The thermal storage system (under construction) is innovative by design and incorporates phase change materials. In order to evaluate the performance of the thermal energy system of the fitness centre, the entire system is equipped with measuring devices that record the flow of heat and indoor temperatures through this part of the facility.

Aim

The overall aim of the thesis project is to evaluate the performance of the thermal energy system of the fitness centre in the Sanden facility. This includes the follow up, by measurements, and complementary numerical analysis of the energy and heating power supply to fitness halls, as well as the indoor comfort in the halls (temperature, humidity and CO2. The specific aim is to characterize the performance of the thermal energy storage system with phase change materials, so it can be used as a reference case for the design of similar thermal storage systems.

Methods

The thesis project incorporates different research methods

- literature study of similar projects in Sweden and worldwide,
- measurements of heat flows in the facility and data processing,
- advanced simulation and analysis of the thermal energy storage system in Matlab/Simulink and Comsol, and
- prototyping of the thermal storage system in a laboratory environment.

Expected results

The thesis should serve as a knowledge-base and decision-support document for the adaptive reuse of textile factory buildings in Sweden, and for the design of thermal storage systems with phase change materials.

Required qualifications

Good knowledge of advanced heat transfer in buildings. Good analytical and numerical modelling skills in Matlab/Simulink and Comsol. Interest for practical work – the project includes measurements in the field and the prototyping in the lab. Interest for novel techniques and innovations.

Relation to the research

The thesis will contribute to the on-going research project on advanced materials and measuring techniques within the Climate-KIC financed flagship project Building technologies accelerator.

Potentials for expanding the thesis work

The project could be expanded to account for social aspects and cost-effective analyses of adaptive reuse.

Number of students in the project

This project is for two students

Time plan

School year 2014-2015

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