RUGGEDISED
Designing smart, resilient cities for all

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Executive Summary

Akademiska Hus AB, which owns the university college buildings for the Swedish State by working together with other local players in Umea develop neighborhoods of the University city area in the smart city project RUGGEDISED. The goal is also to reduce CO^2 emissions in the city of Umea by involving students, personal and other people in the university area.
In purpose to reduce energy consumption and CO^2 emissions several solutions have been tested and developed in the University area of Umea. This report describes the implementation of smart solution, intelligent building control-U4B, at the University area in Umea. Several equipments have been installed in 130 offices at a large lab house, Physiology House at the university area to enable control of air volumes, room climate and the lighting.
Region Västerbotten(formally VCC), the owner of the hospital in Umea, have also installed automatic smart control equipment in office and health care areas.
The concept is to adjust the indoor climate and lighting to exactly the degree of use. This solution will lead to energy savings, improved indoor climate and customer stisfactions. The idea is to create a system that learns the routines that exist in the premises and customize the energy usage.
The installation of the equipments in 130 offices are completed and the next step is to monitor and evaluate the system. To be able to evaluate the current system an energy analysis will be helding by measuring the energy consumption during a year.
The result from the measuring of the energy will be used to evaluate the opportunities for upscaling the solution to another building in the Umea. Once the project has been tested and evaluated successfully, the system will hopefully be able to use to another buildings. The solution will be used to any building which have different types of rooms with variable ventilation loading.

Contents

1. INTRODUCTION

1.1 Background

Akademiska Hus AB, which owns the university college buildings for the Swedish State by working together with other local players in Umea develop neighborhoods of the University city area in the smart city project RUGGEDISED. The purpose is to find and test the energy solutions of the future together.
Several solutions are performed in the cities of Umea and the focus is on developing smart solutions in the area called the University City. The goal is also to reduce CO^2 emissions in the city of Umea by involving students, personal and other people in the university area.
This report describes smart solution intelligent building control- U4B. The solution enables more efficient operation and the results should provide smarter buildings with optimized energy consumption. The solution is about an intelligent building control in one of the large lab houses, the Physiology House, with both offices and laboratories with a ventilation that operates 24 hours a day.
Akademiska Hus AB have comleted installing of cooling baffles, lighting fixtures, heating radiator with heating valves in 130 offices at the University area in Umea to be able to control air volumes, room climate and presence-activated lighting.
Region Västerbotten(formally VCC), the owner of the hospital in Umea, have also installed automatic smart control equipment in office and health care areas. In one place the system is built to be used for evaluation and as a testbed for the staff in order to optimize it further and learn how to connect it to other smart systems in the most optimal way.

1.2 What is demand controlled indoor climate?

A commercial property with a demand controlled indoor climate can become more energy efficient and cost-effective. Lindinvent is a complete system that create and maintain a sustainable indoor climate by adjusting the need of air flow, cooling, heating and lighting.
The concept is that to adjust the indoor climate to exactly the level required. The room ventilates only as much as needed. Naturally we want the rooms we use to be ventilated for the best comfort and health. However, in most rooms the level of activity varies over the day, which means we frequently ventilate empty rooms as if they were fully occupied. By using a smart ventilation system that adapts the ventilation and airconditioning to the demand the energy could be saved.

1.3 Installed components

Smart system components that have been installed at 130 offices at Physiology House, see figure 1 & 2:

- Cooling Baffle with presence sensor
- Lighting fixture
- Heating radiator
- Radiator valve

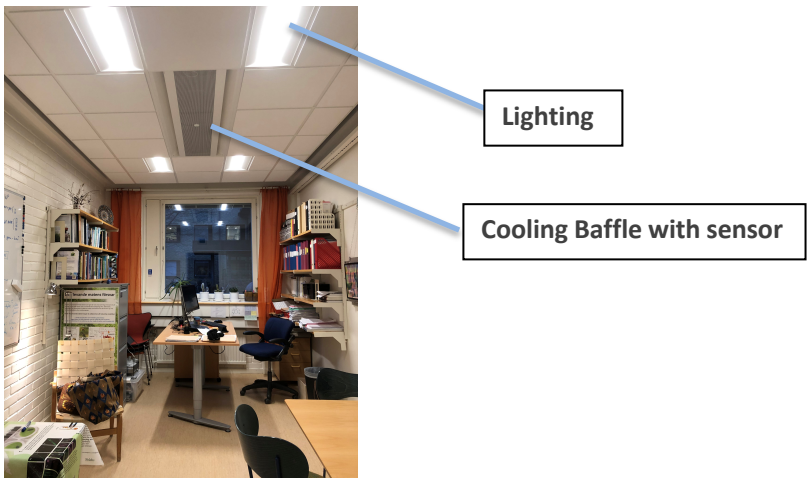

Figure 1.Smart system components, Physiology House: Including cooling baffle and lighting.

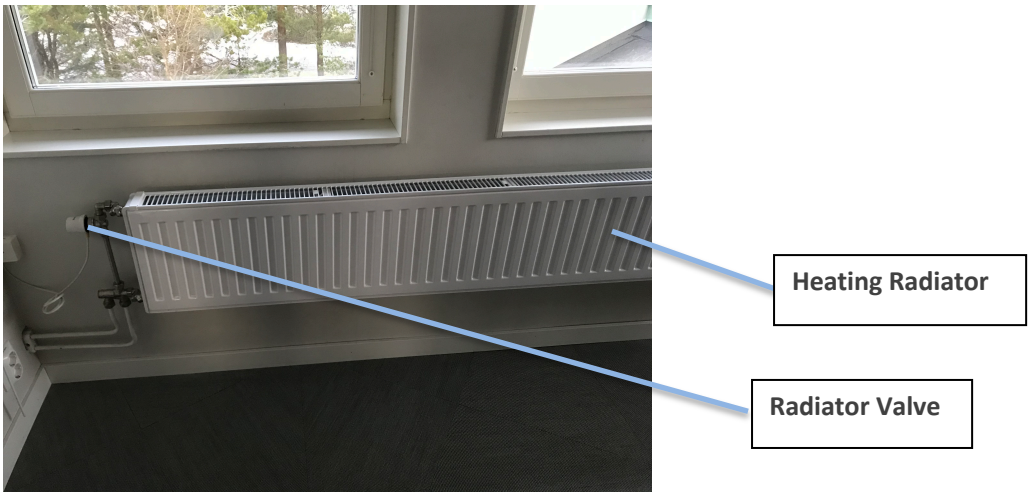

Figure 2. Heating radiator and heating valve for controll of temperature, Physiology house.

Smart system components installed at hospital of Umea, see figure 3 & 4:
A total of 265 rooms have been connected to the system. Of these 265 rooms 15 rooms are with visable integration to be used for maintanance personal to learn how to optimate and trouble shoot.

- Supply air diffuser with presence sensor
- CO^2 sensors (In meeting rooms)
- Heating radiator
- Radiator valve

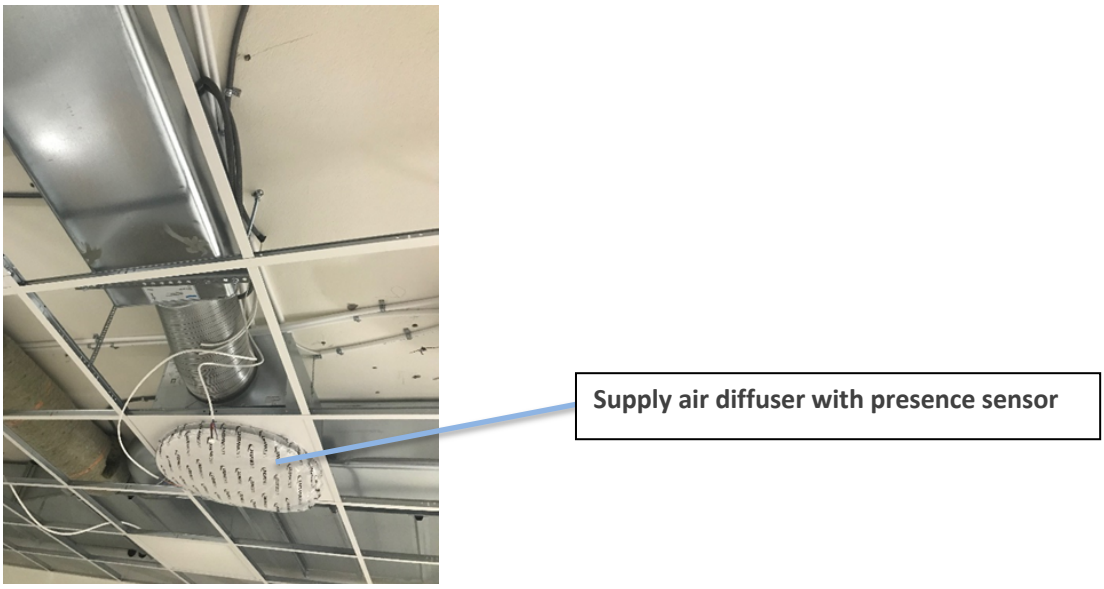

Figure 3. Smart system components, Hospital of Umea.

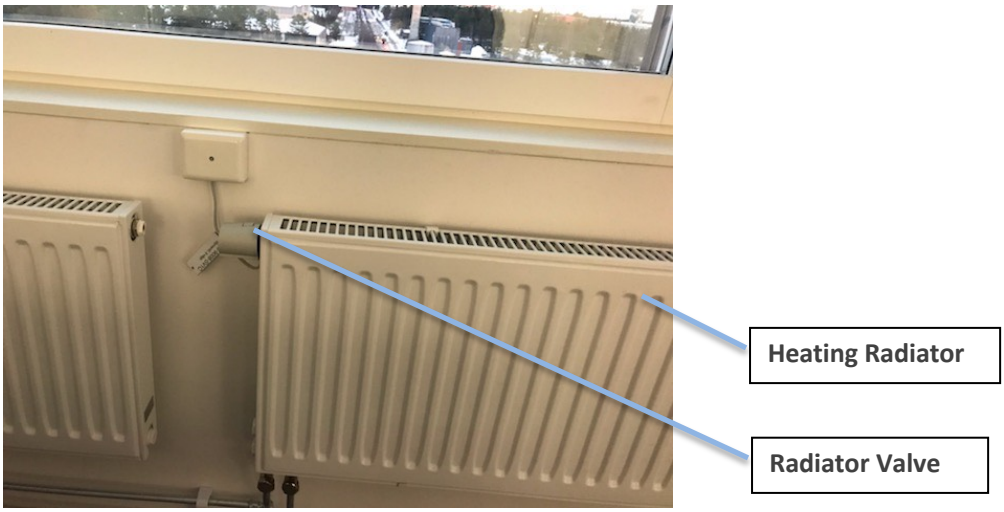

Figure 4. Heating radiator and heating valve for controll of temperature, Hospital of Umea.

2. How Does It work?

2.1 Indoor climate

The rooms are flexible and can be furnished for between 1-4 people. In each room, presence, temperature and carbon dioxide content is measured through a multi sensor located in the room. Air volumes and additional heating and cooling will be adjusted after the degree of occupacy. If there is no one in the current room, the ventilation can be radically lowered to reduce energy consumption. Similarly, high presence and activity require increased ventilation in the current room.

2.2 Lighting

The lighting will switch on with the help of switches on the wall. When the presence in the room is indicated, the lighting will continue to be lit. If no presence has been registered in a certain time he lighting will be dimmed down and swith off.

2.3 Energy use in the room

By measuring the energy consumption of heating, cooling and fans in the building, it is possible to calculate and report approximately how much energy each room and space uses.

3. Description of operation Physiology House

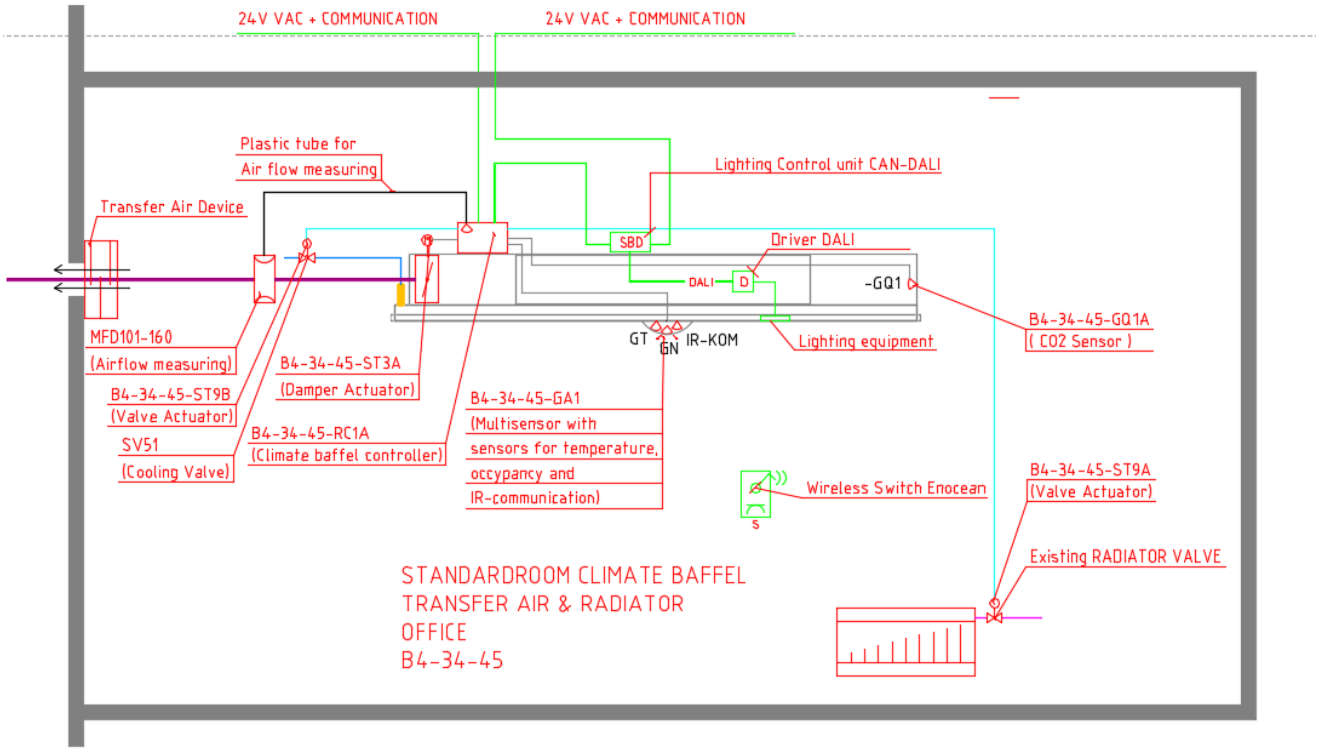

Figure 5. Operation Card in an office, physiology house.

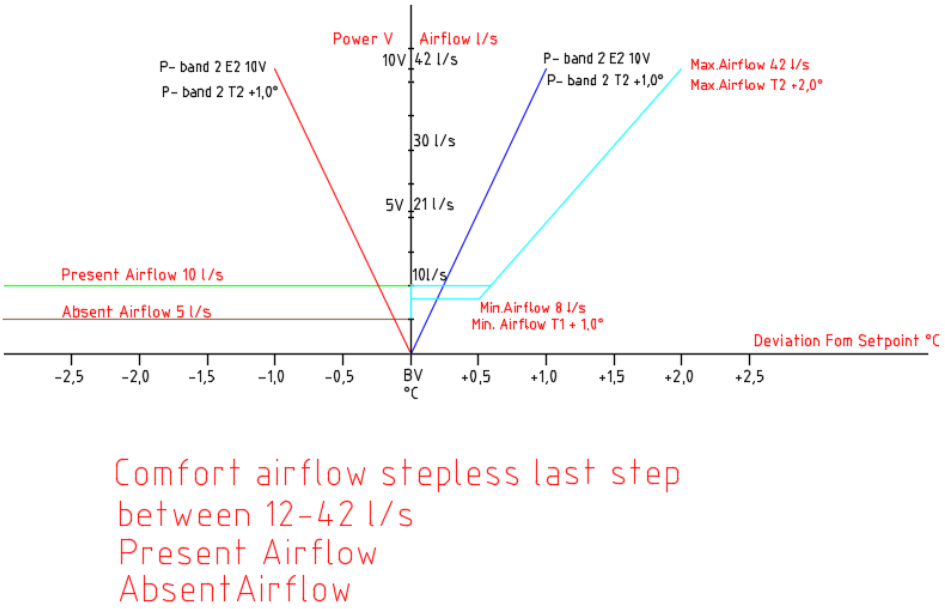

Figure 6. Temperature regulation according to the air flow.

3.1 Climate control with cooling baffle and radiator

Supply air in the room measures in climate baffel controller RC1A with an internal sensor connected to MFD101- in the connected duct. The controller RC1A is connected to an external multi sensor GA1 with a presens and temperature sennsor.
When the presence is detected the supply air increases from minimum flow to the projected attendance flow. At rising rooms temperature the cooling valve B4-54-43 regulates the air flow. When the roomstemperature drops the airflow will be lowered to the attendance flow.
The carbon dioxid content in the current room measures by GQ1A. The airflow will be regulated to avoid exceeding carbon dioxid content to 1000 ppm.
The temperature and caron dioxid content in the current room have higher priority than presence sensor. At rising rooms temparetaure the supplyair damper oppens to regulate the air quality even though there is no presence in the room.

3.2 Radiator control

When the temperature in the current room drops the radiator valve regulates the temperature in the room according to figure 6.

3.3 Economy mode

The economy mode could be used to reduce the energy consumption. The function is that the temperature in the room allowes to drop or rise a few degree when the room is not occupied.

3.4 Reading and settings

Reading of actual values, changing of setpoint and other settings are able to do in the user panel which could be wireless.

3.5 Lighting

The presence in the room indicates by a sensor GA1. If no presnce registers during a certain time the lighting will switch off.

4. Description of operation Hospital of Umea

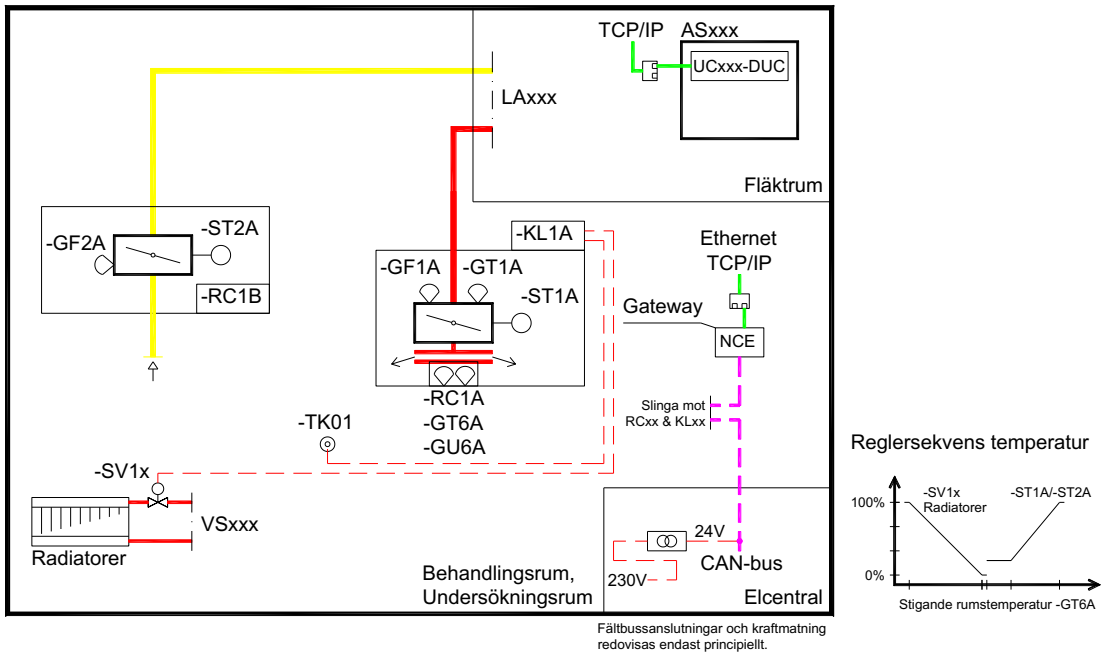

Figure 7. Operation card in a treatment room,Hospital of Umea.

4.1 Climate conrol

When there is no presence in the room the flow will be kept at a constant minimum flow rate that is controlled by the TTC, supply air diffuser.
When the button -TK01 is activated, the room is aired out according to Swedish health care recommendations.
The room communicates with the central air handling unit via a PLC through the NCE gateway.
The temperature sensor GT6A regulates the room temperature at the set value by RC1A and RC1B . The flow sensor GF1A regulates the air flow by RC1A and the flow damper ST1A so that the supply air flow is limited to the set values for minimum as well as maximum flow, depending on the operating mode.

4.2 Air out function

When the button -TK01 is activated, the room is aired out according to Swedish health care recommendations.
After the set interval for air out time is exceeded, the damper reverts to regular operating mode.

4.3 Economy mode

If no presence is detected in the room by GU6A, the room is set in economy mode. Set values for room cooling and heating are displaced according to the set boundaries of the economy mode.
The economy function is only activated in treatment rooms that are regularly used during daytime.

5 What will be achieved?

The main idea of this solution is reducing heating and cooling demand and optimize the electricity use of fans and lighting. Installing a smart system in existing buildings that regulates airflows, temperature and lighting based on the presence and number of occupacy in a given room will lead to create an attractive indoor climate and user satisfaction for sustainable energy use.
Furthermore, will Akademiska Hus and Region Vasterbotten(formally VCC) be able to optimize the system based on the need in the premises to achieve more efficient operation, which will save both energy and costs.

6 Energy Analysis

The installation of the system in 130 offices is completed and the next step is monitoring and evaluating the current system. To be able to evaluate the current system an energy analysis is required. The energy will be analyzed by measuring the energy consumption in the building during a year and the result will be compared with the reference case. The reference case of this work is the data for heating and cooling demand of the Physiology house under 2016.
Akademsika Hus will also evaluate the indoor environmental quality by using survey method. The questionnaire will be distributed to the main users of the rooms and will be used as a surface to evalute the opportunity to upscaling.

7 Replication

By using the result from the measuring, Akademiska Hus and VCC will be able to calculate an approximately energy saving after a year and evaluating the opportunities for upscaling. Potentially, the solution could be upscaled and easily spread to another building in Umea and could be upscaled at those buildings where the ventilation load is variable.

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