SIEMENS

Case Study

Industry Sector
Building Technologies Division

Zug (Switzerland), September 14, 2011

Saving energy with the help of weather forecasts

Located in the Swiss Alps at an altitude of almost 3,000 m, the New Monte Rosa Hut showcases the latest developments in the building technology field. The technologies deployed there, and additional research projects such as OptiControl, offer great potential for all types of buildings.

On July 14, 2011 a loud boom was heard in the Monte Rosa Massif south of Zermatt: Approximately 100 kg of explosives completed the demolition of the old Monte Rosa Hut located at an altitude of 2,795 m. Scores of mountaineers and hikers had grown fond of this rock structure, for many years one of the largest and most popular mountain huts of the Swiss Alpine Club. However, over time the comfort requirements of visitors had increased and it had become impossible to operate the hut according to modern standards. For this reason, a new structure was built approximately 100 m above the old hut.

After a planning and construction period of six years, the SAC's New Monte Rosa Hut was opened in September 2009. The idea for the design and implementation of this prestigious project was developed in conjunction with the 150th anniversary of the Swiss Federal Institute of Technology (ETH) Zurich. Because of the hut's remote location far away from any infrastructure, planning focused on making it as self-sufficient as possible. Achieving maximum autonomy and the desired sustainability required more than simply optimizing the individual building disciplines. The solution was to intelligently combine all the components. The most important aspects of the building envelope were the choice of materials and the physical layout. The active energy supply is based on solar thermal collectors, a photovoltaic system, as well as building technology and its control components. If needed, the system is backed up by a combined heat and power (CHP) plant operated with liquefied petroleum (LP) gas.

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Optimizing energy usage based on the weather

In what is called “F-E Phase II,” parameters such as “reservations/occupancy” and “weather forecasts” will be fed into the building automation system in addition to the conventional rule strategy implemented previously. The result will be predictive building automation, i.e. a system that responds proactively based on how the weather is likely to be. To this end, it uses regional weather forecasts instead of current environmental values such as outside temperature and solar radiation. At periodic intervals, the system will make automatic adjustments to fully utilize the current weather situation. Project partners for F-E Phase II are ETH Zurich, Lucerne University of Applied Sciences and Arts, and Siemens BT.

This predictive approach has many benefits, as illustrated by the wastewater cleaning process: If the hut’s battery and wastewater tank are half full and the immediate forecast calls for sunshine, the controller starts the power-consuming wastewater cleaning process, thus preventing the battery from charging too quickly, which would leave solar energy unused. If the forecast calls for bad weather, the cleaning process is stopped. Otherwise the battery’s power reserves might be used up, necessitating a switch to LP gas, a scarce resource at this remote location.

Desigo building automation software from the Siemens Building Technologies (BT) Division ensures that all system components work together seamlessly. The software continuously monitors all parameters, adapts the system to the changing requirements of the building’s users and, at a later stage, will also optimize energy consumption. The control software is optimized continuously via remote access, which boosts efficiency even further.

OptiControl research project

In Europe, buildings account for more than half of the primary energy demand. New building technologies (e.g. heat pumps, thermally activated building systems, solar systems, night-time cooling through ventilation, etc.) have great potential for reducing energy consumption. However, they result in complex total systems which depend on widely varying conditions such as weather, occupancy and dynamic electricity rates. Optimizing the operation of such systems partially requires new predictive control concepts which take weather and occupancy forecasts into account.

Such predictive control concepts are being developed as part of a research project called “Optimal Building Climate Control” (OptiControl), a joint effort by ETH Zurich, EMPA, Gruner AG, MeteoSchweiz, and Siemens BT. The predictive control strategies resulting from this project are aimed at minimizing the energy consumption of buildings while keeping investment and operating costs low, enhancing user comfort, and limiting peak electricity demand. While this innovative

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control concept is identical to the one used at the Monte Rosa Hut, the OptiControl project focuses on other applications, in particular the use of integrated room automation in office buildings, i.e. automatically achieving optimized control of blinds, lighting, heating, cooling, and ventilation in individual building zones. Experts have developed software, models and datasets for simulation-based evaluation of control strategies, new rule algorithms, new algorithms for improved weather forecasting at the building location, as well as analyses of savings potentials in conjunction with control technologies.

It has become clear that such intelligent systems require reliable weather information. New weather models already supply local weather forecasts for individual cells, with a precision of approximately two kilometers. These numerical weather forecasts can be corrected using readings from meteorological stations as well as from local sensors connected to the building automation system. This approach makes local forecasts specific to the building location much more accurate than before.

Predictive processing – and optimization – of all this information in the building automation system requires a great deal of computing power and high-performance electronics, which are available at ever more reasonable prices. Experts expect that the costs for the entire equipment needed to optimize building control will be recouped quickly through reduced energy costs as well as increased comfort in the building.

Great potential in all types of buildings

The pilot project covers the complex day-to-day operations of the Monte Rosa Hut in a very demanding high-altitude environment with extreme climatic conditions. However, the use of predictive control concepts also makes sense for other types of buildings, for example energy-efficient residential and office buildings or public facilities such as schools and hospitals.

For the first field trial of OptiControl, a five-year old office building in Allschwil near Basel was chosen because it is typical of Swiss building standards. The modifications made included adding several sensors to the existing Desigo control system by BT, making additions to the communications technology, and programming intelligent rule algorithms and the required monitoring processes. These adjustments are expected to yield energy savings of up to 20%. Better utilization of the thermal storage mass, such as the concrete ceilings, will result in a significant reduction of heating energy consumption. Starting this fall, OptiControl will be tested in the building for a period of 18 months. Siemens is planning to begin integrating components of this software into its products as early as 2013.

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