



ccem-retrofit

Advanced Energy Efficient Renovation of Buildings

In cooperation with the ccem-house2000 project.

Scope of project

The ccem-retrofit project is based on national and international research and development projects that are collaborating to promote and improve cost effective low energy renovation of existing buildings. The project focuses on typical apartment blocks representing approximately 40 % of the European dwelling stock. It concentrates on:

- Minimising the primary energy consumption (in the range of 30–50 kWh/(m²·year) for heating, cooling and hot water, per gross floor area),
- Optimising the integration of solar energy use,
- Improving electrical building components and control functions
- Increasing living comfort by better space use,
- Assuring good thermal and acoustical comfort, good indoor air quality and daylighting conditions, and
- Assuring a fast, high quality and cost-effective construction process.

Goals and activities of sub-projects

The project is structured in three parts:

A Technology development; B System integration; C Market analysis and tools.

A1: Advanced Geomatics

This subtask is responsible for efficient and accurate 3D measuring technologies that will allow a more efficient renovation process due to the availability of reliable data for renovation design, the industrial production process and the final construction on site.

For the as-built documentation of the targeted renovation buildings a toolbox of measurement technologies has been arranged. A terrestrial 3D laser scanning system has been evaluated and procured (Leica ScanStation2).

First tests on a pilot project were used to try out several techniques, processes and instruments. Possible workflows for the integration of 3D-geomatics and therefore for the extraction and management of the 3D-data have been introduced.

A2: High Performance Thermal Insulation

Space for extensive insulation is often not available or too expensive in existing buildings. New technologies such as vacuum insulation panels (VIP) offer the possibility to achieve highly insulating walls by slim overall wall thickness and/or better integration into buildings.

Specific goals are the development of components and envelope solutions that allow a reduction of 50 % of the construction thickness, optimization of the thermal performance and minimization of condensation risks of in-situ and pre-fabricated assemblies, and a service life of assembled VIP-constructions in the order of 50 years.

Specification data of existing products were collected, criteria and requirements as well as possible design solutions were discussed for a façade integrated ventilation module with VIP insulation. Regarding materials optimization, VIP specimens with a reduced fraction of fumed silica and with fiber-aerogel compound core were produced.

Collaborating Partners

The project is building up a strong collaboration between various ETH-Institutions, the National Buildings and Renewable Energies Network of Technology (brenet) and important Swiss industry partners.

Main Investigator

Mark Zimmermann, Empa

Project Partners

Empa
EPFL
ETHZ
PSI
FNHW
HSLU/HTAL

Monitoring data from VIP insulation layers integrated in two building sites are now running for more than 3 years (flat roof insulation) and 1 year (freezing room floor insulation). In short, the data show that VIPs perform as extrapolated from laboratory aging experiments, and a service life of several decades can be expected even with rather high humidity and temperature levels observed in the flat roof.

A3/4: New roof and façade constructions, solar integration

The aim is to develop in collaboration with industry partners a set of modular roof and façade solutions that are to a large extent suitable for industrial prefabrication. This set of building envelope solutions should ensure, besides energy efficiency, added values such as optimal space use, extensive integration of solar systems and daylighting. The envelope modules will also allow the integration of adapted and modernized technical installations.

A matrix of building products represented by the industry partners has been developed. The building products are systematically related to the renovation module typology developed in sub-project B1/2. The catalogue will be part of the final retrofit documentation for designers, that will facilitate the evaluation of appropriate building products.

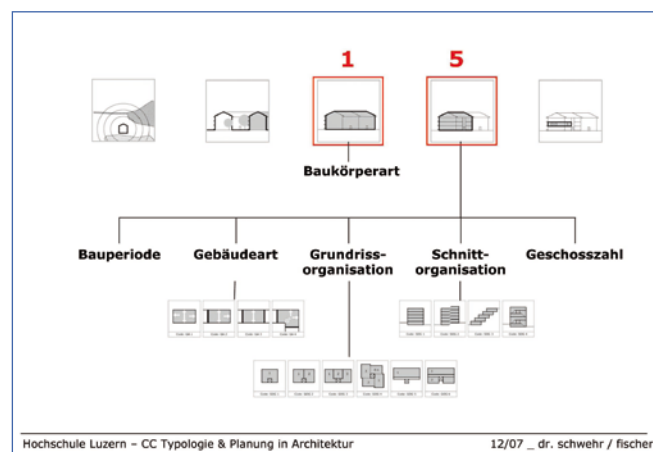
A creative design process focussing on the façade development for a potential demonstration building in Lucerne has been started.

A5: Integrated HVAC solutions

New modular heating, ventilating, and air conditioning (HVAC) systems, using the best technology available, have to be designed to cover the need for heating, cooling, hot water and ventilation. Solar thermal and photovoltaic systems have to be integrated where appropriate and the possibilities for minimizing electricity consumption and possible electricity production have to be investigated.

Two main strategies are investigated:

- The existing heating and hot water system has to a large extent to be replaced. Concepts for a new, optimised heating and a ventilation system will be developed.
- The existing heating and hot water system is partially reused (and improved) and only the ventilation system is newly installed.



A6: Advanced control systems

The research and development project BELControl, carried out by EPFL/LESO-PB (Lausanne) and Adhoco (Winterthur) is the base for a contribution to the ccem-retrofit and ccem-House2000 projects.

The development of control algorithm was finished successfully. Operational tests in an inhabited building in Winterthur and energy comparison tests have been performed.

B1/2: Building typology and renovation concept

The building typology provides basic data for the evaluation of the renovation potential of the existing building stock, for the definition of retrofit strategies and the envelope characteristics of specific building types. The typology is not limited to building structure, it considers also the needs of owners and tenants and processes such as retrofit design, building use and maintenance.

The parameters needed to define the structure and processes of the existing building stock have been identified and coordinated with existing data bases (Federal office of statistics BFS, Swiss engineers and architects association SIA). The focus is on apartment buildings with more than 3 apartments, constructed between 1919 and 1990, and less than 8 apartment floors. These buildings represent 52% of all existing multi-family homes in Switzerland.

The building stock evaluation considers 5 main levels (urban situation, situation of building in neighbourhood, building block, building struc-

The 6 main characteristics of the typology are considering building shape (1) and structure (5).

ture and apartment). The data base describes 36 building characteristics. Presently, a system model for a holistic renovation approach and the relevant parameters are being developed.

Strategies for sustainable building renovation and requirements for prefabrication will be based on the building stock analysis. Architectural guidelines will be coordinated with the technology development work packages A. The application potential will be evaluated in collaboration with the socio-economic work packages C.

C1: Markets and policies in Switzerland and Europe

The energy-efficiency potential of building renovations is considerable and to a large extent cost-effective, both from a private owner perspective and even more so from a long-term and societal perspective. However many barriers still prevail and hinder a more rapid diffusion of energy efficiency renovation, especially in the sector of rented multi-family house buildings. Typical barriers are, among others, high upfront investment costs and the lack of experience owners have with this kind of renovations. Moreover the costs of energy efficiency renovations vary considerably, depending on building types and contractor.

The aim of the project is to analyze the potential and effective markets for energy-efficient building renovations and to evaluate political measures to improve the diffusion of such technologies.

C3: Retrofit advisor

A multi-criteria decision tool is developed that will help to determine refurbishment/reconstruction strategies. It considers three different decision levels: financial, environmental and social/cultural aspects. An alpha-version was developed with financial support by the Swiss Federal Office of Energy. The alpha-version is available on Excel basis for use by interested experts.

C4: Modelling the diffusion of energy-efficient building refurbishment

The aim of this research project is to identify critical factors and processes that determine the change rate of the energy efficient code within the existing building stock of multi family houses. A policy framework will be developed that allows strategy and policy analysis towards a 2000 Watt vision.

Up to date, the project has developed the following dynamic working hypothesis:

Changing demand from stakeholders in the market, public opinion and politics lead to increasing pressures to adopt energy efficient renovation strategies. Hence, the number of energy-efficient renovation strategies increases and thus reduced the demand for energy resources by the building stock, while at the same time increasing the economic competitiveness of energy-efficient technology.

The key to a successful diffusion of energy-efficient renovation technologies is to keep the number of unsatisfactory implementations as low as possible and proactively develop a win-win image for energy-efficient renovation strategies.

Publications

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