THERMOMODERNISATION OF PUBLIC BUILDINGS CONDUCTED IN ACCORDANCE WITH CONDITIONS OF SUSTAINABLE DEVELOPMENT – STEP


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Summary

Thermomodernisation in Poland has already nine years of official record as in 1998 the Act of Thermomodernisation has been accepted by the Parliament. During these years many buildings have undergone investments lowering their energy use. The modernizations were related to energy savings and theirs economic efficiency, but not much attention have been put on sustainability issues, and the housing sector was a main beneficent. This situation guided to suggestion of the area of research to help fill the gap in existing scope of thermomodernisation, also taking into account the mandate provided by the Energy Performance on Buildings Directive 91/2002/EC. Thus, the proposal of STEP research project has been presented to Norwegian Financial Mechanism – NFM aiming at implementation of a better energy performance of public buildings in Poland. The proposal prepared by Warsaw University of Technology was awarded out of 130 proposals, and is included into 10 projects qualified for financing from scientific priority of NFM. Project started in December 2006 and will be completed by February 2011. The article describes objectives and work to be done within the scope of the project with special emphasis on Energy and Environment Work Packages.

Keywords: Public buildings, energy performance, environmental impact, educational programs and course materials about sustainability

1 Introduction

General objective of the STEP project is scientific and research support aiming at implementation of a better energy performance fulfilling at the same time the sustainability requirements of public buildings in Poland. The detailed aim – is to supply materials and tools helping to undertake decision as to the most efficient choice of technical solutions in new and already existing buildings, which at a later stage will form a database for the change from contemporary construction solutions to those optimised in accordance with

the chosen criteria. Public buildings are usually used by local governments and administration to perform the statutory duties such as: education, health and cultural facilities etc. Energy standard of those buildings is low and refitting or modernisations works are very limited. At the same time, these buildings act as a determinant for local construction practices and should be constructed in reference with standards displaying possible use of energy and environment efficient technologies. The energy technologies for residential buildings, being in a scope of thermomodernisation for nine years, are relatively well known, but the sustainability issues were not, so far, taken into considerations. In a case of non-residential even energy use is not deeply investigated. The only requirements related to these buildings are prescriptive and referring to energy losses.

Tab. 1 Level of coverage of scope of STEP project vs. buildings types
(no texture – covered, heavy texture – uncovered, light texture – partly covered)

Issue	Residential buildings	Non-residential buildings
Energy effects of thermomodernisation	Method exists	STEP
Sustainability related to thermomodernisation	STEP (partly)	STEP

The needs settled up by the Directive 91/2002/EC on the Energy Performance of Buildings; impose new demands in front of the owners and facility managers to upgrade the buildings in such a way that they will fulfil new energy performance requirements. Analysis of the Thermomodernisation Programme, which has been executed in Poland for the past 9 years, shows that traditional thermomodernisation techniques might be insufficient for the more demanding recent standards and for new issues that nowadays are taken into concern and should respond to the sustainability paradigm.

Higher dependence of Poland and other European Union countries on external supply of energy resources shows that actions dedicated to a more effective energy use are very important from the point of view of energy safety as well as due to the fulfilment of Kyoto Protocol. Additionally, contemporary modernisation should accept as the priority aims – the quality of the indoor environmental quality as well as influence of the building on existing natural environment. This increases the need to widen the scope of research to such issues as: electricity lighting and day lighting, emissions indoor and outdoor, productivity of users, management of water and resources, facility management of the building and surrounding site, waste management as well as new architectural solutions. Energy thermodernisation issues complemented with above mentioned have formed a scope of a scientific research realised in 2004-2006 by the Warsaw University of Technology and Norwegian University of Technology in Trondheim under the title SureBuild – Sustainable Rehabilitation of Polish Buildings, were the main concern was on school buildings. The STEP project plan is to continue the co-operation with NTNU, with special care taken on such tasks as: day lighting, hybrid ventilation system and Norwegian experiences concerning assessment of impact of buildings in line with conditions of the sustainable development. This interdisciplinary project requires evolvements of various experts from different WUT faculties; the integration process of individual results is conducted at the Faculty of Environmental Engineering WUT.

The work is divided in tasks identified as Work Packages:

- **WP0** Management, administration and coordination
- **WP1** Analysis of the state of art, existing scope of knowledge on the modelling of thermophysical processes and phenomena in public buildings
  - **WP1.1** Heating
  - **WP1.2** Ventilation
  - **WP1.3** Air-conditioning
  - **WP1.4** Hot Water Preparation
  - **WP1.5** Day- and artificial lighting
  - **WP1.6** Choice of external media
  - **WP1.7** Utilisation of renewable energies and passive solutions in public buildings
  - **WP1.8** Aquis Communautaire within the scope of new energy requirements in buildings
- **WP2** Environment – impact of public building
  - **WP2.1** Consumption of resources
  - **WP2.2** Quality of indoor environment
  - **WP2.3** External environmental loads
  - **WP2.4** Environmental impact assessment of public building
- **WP3** Education programme and methodology concerning sustainable development in construction
- **WP4** Building modernisation guidelines. Case study - Faculty of Environmental Engineering facility, Warsaw, Poland
- **WP5** Analysis of software required for the modelling of the processes discussed in WP 1, update of the software to Polish conditions, preparation of verification and attestation methods. Preparation of calculation algorithms
- **WP6** An experimental verification of the calculation methods in real conditions. Energy performance of an office building
- **WP7** Catalogues of the best technological and architectural solutions in public buildings
  - **WP7.1** Catalogue of the best architectural solutions in public buildings
  - **WP7.2** Catalogue of the best technological solutions in public buildings
- **WP8** Preparation of the education materials to be used In faculties and post diploma courses conducted at the Warsaw University of Technology and other didactic centres
- **WP9** Preparation of a website course concerning the tools supporting the decisions required for the final choice of low energy solutions
- **WP10** Monitoring of the investment Project within the scope of public building thermomodernisation, financed by the EOG and Norwegian Mechanism
- **WP11** Promotion and distribution of the Project's outcomes

2 Energy – the most important element of sustainability

The work package 1 consists of 6 parallel sub-tasks and two vertical – integrating the results of first 6. The scope of the tasks is in line with the objectives of the Directive 91/2002/EC that lays down requirements as regards:

- the general framework for a methodology of calculation of the integrated energy performance of buildings;
- the application of minimum requirements on the energy performance of new buildings;

- the application of minimum requirements on the energy performance of large existing buildings that are subject to major renovation;
- energy certification of buildings; and
- regular inspection of boilers and of air-conditioning systems in buildings and in addition an assessment of the heating installation in which the boilers are more than 15 years old.

The annex to the Directive defines obligatory elements of energy balance to be taken into account in calculation procedure. For support the implementation of Directive, Commission ordered set of new CEN standards. These standards, all together 43 new items (as reported April 2007 by CEN), are now already accepted or under the Formal Voting stage. However, due to the passed implementation date – 4th of January 2006 – most of the Member Sates decided to develop own methods of calculation declaring at the same time the use at the maximum possible extend of CEN standards once they will be accepted and adopted. Even standards as such should be easily adaptable, as they represent the engineering knowledge of the state of the art, they often require so called national data or other country specific parameters. Such data have to be provided as a result of research. Thus, the WP1 is dedicated to development of research to support implementation of the Directive in Poland with particular emphasis on public buildings. We plan to answer the question about the scope of the energy analysis of public buildings, the calculation method, data requirement, performance indicator, and at the integration stage – methodology of setting the requirements and potential use of renewable for every purpose of energy use in the building. Thus the WP1 is divided into 6 sub-tasks related to technical systems in buildings: heating, ventilation, air-conditioning, hot water preparation, day- and artificial lighting, choice of external energy media, and 2 horizontal one related to use of renewables in all six technologies of instalationa, the second that will help in definition of steps to achieve harmonisation with CEN in undertaken legal solutions, the example of this activity results can be [1].

3 Sustainability of public buildings

During the last 15 years considerable research has been focused on the development of systems to assess the environmental performance of buildings, based on different initial assumptions and prepared for different purposes. The best-known existing system is the Building Research Establishment Environmental Assessment Method (BREEAM), developed by BRE and private-sector researchers in the U.K. This system provides performance labels suitable for marketing purposes, and has captured increasing interest of the new office building market in the U.K. Many national systems have been developed by different countries world wide as HQE in France, Eco-profile in Norway, Ecoeffect in Sweden, LEED in US, CASBEE in Japan. There is no country in Europe which does not attempted to develop adaptation of existing or entirely new system. Several other systems (largely inspired by BREEAM and Green Building Challenge initiative) are in various stages of development in Europe and the World. There are also more specialized systems of interest that are more closely tied to Life Cycle Assessment (LCA), including ECO QUANTUM (Netherlands), ECO-PRO (Germany), EQUER (France) and ATHENA (Canada). Several of these systems have gone the next step, to result in a labeling system that indicates clearly the building's approximate performance to end users. In Poland,the environmental assessment sytem e-Audyt in 2004 was based on a concept of GBTool but adopted to local conditions and tailored to local data avilibility [2].

Taking ino accoun the situation in esearch activity, works of ISO TC 59/SC17 **Sustainability in building construction** composed of four working groups is working on series of standarisation document related to assessment of buildings:

- CD 21932 – Building Construction – Sustainability in Building Construction – **Terminology**, recommended for Committee Draft.
- WD 15392 – Building Construction – Sustainability in Building Construction – **General Principles**, recommended for Technical Report.
- CD 21929 – Building Construction – Sustainability in Building Construction – **Sustainability Indicators** – **Part 1** – **Framework for development of indicators for Buildings**, recommended for Technical Specification.
- CD 21930 – Building Construction – Sustainability in Building Construction – **Environmental Declarations of Building Products**, recommended for Draft International Standard.
- CD 21931 – Building Construction – Sustainability in Building Construction – **Framework for Methods for Assessment of Environmental Performance of Construction Works** – **Part 1** – **Buildings**, recommended for Technical Specification

European standarisation body in 2005 have got a mandate from CEN to prepare following documents:

CEN has got the EC mandate M/350 in 2004 for development of horizontal standardized methods for the assessment of the integrated environmental performance of buildings. The goal of the Commission is to provide a method for the voluntary delivery of environmental information that supports the construction of sustainable works including new and existing buildings (not all construction works will be included). These buildings should provide all of the necessary functions to the users whilst minimising their environmental impacts. Following documents are foreseen to be prepared up to 2009:

1. Framework standard for integrated environmental building performance. Framework standard is intended to provide the methodology for the assessment and the subsequent declaration of the integrated environmental performance of complete buildings and construction works.

2. Horizontal standard on the aggregation of LCA results of individual materials into the building, standard that will provide the methodology for the aggregation of materials data or data on components to provide the overall integrated environmental performance of a building.

3. Standard on the LCA methodology for building products/materials, standard will be based on the ISO TC 59 SC17 standard for the environmental declaration of building products, should provide an answer to the issues beyond the scope of ISO.

4. Standard on the communication format/EPD. This standard should be based on the results of the standard for the LCA methodology for construction products/materials. The outcome of the LCA is one of the communication items of an Environmental Product Declaration.

5. Technical report on the assessment of the environmental performance of the construction process of a building, which will provide LCA-based method for the assessment of the environmental impact of the construction process on relevant scenarios. It should identify which factors should be taken into account and which should not, what climate and what generalisations are acceptable regarding transport, etc. The results should be able to fit in the aggregation step for the integrated environmental performance of complete buildings and construction works.

6. Technical report on the assessment of the environmental performance of the end of life phase process (demolition, recycling, waste treatment processes) of a building and products. The deliverable will be a technical report that provides an LCA-based method for the assessment of the environmental impact of the end-of-life (demolition) process.

7. Technical report on the assessment of issues of building products related to the lifetime of the building (service life, durability, design, maintenance and replacement). The deliverable is a technical report that provides an LCA-based method for the assessment of the environmental impact of the maintenance and repair processes based on relevant scenarios.

The two above described standardisation activities formed a basis for the works covered by WP2 Environment. There are three main issues, which are considered in creation of assessment systems. These are environmental impact, indoor environment and impact related to production of building products – every issue is related to separate sub-task. Integration of all of them is a purpose of whole work in WP2.

4 Conclusions

The STEP project is a challenge for the whole WUT team. Within this article only a first two work packages have been presented in details. The rest altogether 8 packages will use results from WP 1&2 and will constitute educational framework, textbooks, guidelines and software that will be available for wide public for non-commercial use.

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