A DISTANT-LEARNING TRAINING MODULE ON ENERGY EFFICIENT INTEGRATED BUILDING DESIGN IN URBAN ENVIRONMENT

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ABSTRACT

The present paper aims to present a distant learning educational module that concerns the energy efficient integrated building design in the urban environment. The educational material of the module includes a handbook, computerized tools, examples of urban buildings, libraries on energy efficient products and materials and climatic documentation of climatic data measured in various European urban areas. Another product of this educational package is the development of an Integrated Building Design System (IBDS) which permits to the trainees to apply in practice the integrated building design methodology. The target group of this educational package is the building professionals, building designers, engineers and operators interesting on this field.

KEYWORDS

Distant learning, training, urban environment, building, energy efficiency

INTRODUCTION

The present work is a part of a project funded by EU, Directorate-General, in the frame of SAVE programme. The full title of the project is: "Development of a distant-learning training module on energy efficient integrated building design in urban environment and pilot action involving the production and promotion of modules for the initial training for building professionals and craftsmen/technicians". The present paper presents the work that has been performed for the distant-learning part of the project. For this work the following partners of the project have been involved:

- Group Building Environmental Studies, Department Applied Physics, University of Athens, Greece.
- Hellenic Open University, Greece.
- University of Ljubljana, Faculty of Mechanical Engineering, Slovenia.
- James & James Publishers, UK.
- Cambridge Architectural Research, UK.

OBJECTIVES

One of the main objectives of the present project concerns the production and promotion of a complete educational module using advanced media technology and facilitating distant learning techniques, addressing initial training of building professionals on the energy-efficient integrated design of new and refurbished buildings in urban environments.
The specific targets of the educational material to be developed in the frame of the present project are:

- To collect and evaluate the existing technical data, scientific knowledge, industrial developments, climatic information, regulatory standards, as well as, the more recent research developments on the characteristics of the urban environments and urban buildings into a distant-learning educational package.
- To provide building designer, engineers and operators with all the necessary technical, scientific, industrial, legal and marketing information and tools on the appropriate design, evaluation, selection and implementation of energy efficiency techniques in urban buildings. Also, to promote the use of energy conservation techniques, solar energy, high efficiency energy systems, improved and adapted thermal and visual comfort standards and appropriate indoor environment quality, through a flexible, interactive and on-going training process.
- To inform building professionals on the impact of the building, as an energy system, to the urban environment as well as on the impact of the urban environment to the quality and efficiency of the buildings.
- To offer the building professional all necessary technical and economic information to assess the real potential for energy conservation of the various existing conservation techniques as applied to urban environments as well as the associated limitations and restrictions and thus to assist designers and building professionals to define appropriately energy conservation priorities.
- To translate scientific achievements obtained through recent research projects on urban building climatology, energy engineering, ventilation and air quality to appropriate educational material.
- To establish a permanent educational infrastructure on the energy efficient integrated design of urban buildings which will continuously be updated and improved through self funding mechanisms and will enhance building professionals to learn across barriers of distance and time.

THE MATERIAL OF THE EDUCATIONAL PACKAGE

The distant learning training package includes printed and electronic media. This package is basically consisted of a distant learning course based on printed material (books, brochures, exercises, etc.) and electronic tools (didactic software, multimedia, evaluation tools) that can used by the trainees at their location (home or work) under a specific and well defined work program and timetable, combined with interactive communication between instructors and trainees. The package contains specific, compulsory and elective assignments for the trainees (exercises, dissertations, examinations) which should be undertaken periodically under a well defined plan and forwarded to the instructors for reviewing, so that the course is judged as successful for the participants and lead to the award of certification.
The material included in the training module, includes information structured as presented in the following paragraphs:

A Handbook

This handbook offers information on all aspects related to the energy efficient integrated design of buildings in urban environments. This handbook includes an introduction to integrated building design, as well as, considerations of the economic, social and technical issues underpinning effective decision making for the design, construction and management process. Also presents the design of building structure and use of intelligent materials, the architectural design, passive and active environmental and building engineering systems, as well as, the sustainable design, construction and operation. Furthermore, the handbook offers material that concerns the intelligent controls and advanced building management systems, the urban building climatology, the heat and mass transfer in urban buildings and the applied lighting technology including artificial lighting and daylighting. Additionally, the present text introduces the trainee to the energy conservation and passive solar technologies, presents guidelines to efficiently integrate specific energy conservation technologies to urban buildings, the indoor air quality, the applied energy and resources management in urban environment, as well as, includes economic information involving methods for cost-benefit analysis and other economic methodologies. Finally, the handbook presents a methodology regarding the setting of priorities and the process that should be followed in integrated building design. This methodology, named IBDS (Integrated Building Design System), will permit to the trained professionals to familiarize themselves with the philosophy of integrated building design and will instruct them through a step by step procedure on setting priorities and taking decisions during the design of the building and its related subsystems.
The structure of the developed handbook is the following:

- Chapter 1: Introduction to Integrated Building Design
- Chapter 2: Design of Building Structure and Use of Intelligent Materials
- Chapter 3: Architectural Design, passive and active environmental and building engineering systems
- Chapter 4: Sustainable Design, construction and operation
- Chapter 5: Intelligent Controls and advanced BMS
- Chapter 6: Urban Building Climatology
- Chapter 7: Heat and Mass Transfer phenomena in Urban Buildings
- Chapter 8: Applied Lighting Technology
- Chapter 9: Existing applications
- Chapter 10: Guidelines to integrate energy conservation
- Chapter 11: Indoor Air Quality
- Chapter 12: Applied Energy and Resources Management in the Urban Environment
- Chapter 13: Economic Methodologies
- Chapter 14: Design of the IBDS

At the present moment the handbook is in the final version. Additional material will be included in the handbook, until the end of the project, in order to improve the distant learning approach of the educational material.

Computerized Tools

These tools will be used to evaluate the heating, cooling, lighting, requirements and indoor air quality, as well as, the global performance of the buildings. In addition, the package of the software tools will include programs able to calculate the performance of specific energy conservation techniques that may be appropriate for urban environments. All programs will

be structured in such a way that can be used also as educational when necessary. Until the present moment of the project the following software tools are included in this section of the educational package:

- Summer-Building: A software tool that calculates the cooling and heating requirements of the buildings and it is able to simulate various passive cooling techniques (see Figure 1).
- Summer-Techniques: A software tool that simulate the performance of passive cooling systems, such as natural ventilation, evaporative cooling, radiative cooling, etc.
- Aiolos: A simulation tool for natural ventilation techniques.
- Canyon: A software tool that simulates the thermal behavior of urban canyons.
- Air-GR: A simulation tool that permits the calculation of the indoor air quality conditions in buildings (the latest version of the tool is in Greek language).
- DF^{CAD}: An Excel data base with graphical interface and report that calculates the daylight factor for a selected point in a rectangular room according to the standard DIN 5034-3 for different windows and overcast sky.
- SKY^{CAD}: An Excel data base with graphical interface and report which calculates the luminance of the clear, cloudy or overcast skies and illuminance of the tilted, not shaded surface for selected time during the year. Methodology according to the standard DIN 5034-2 is used.

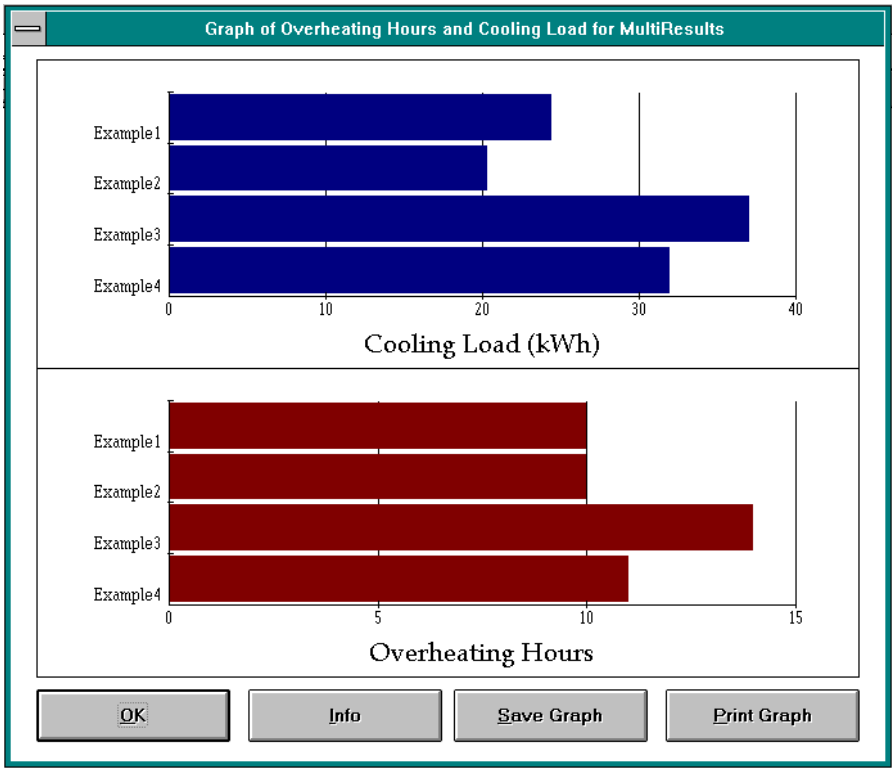

Figure 1: A screen capture from the Summer-Building tool

Examples of Urban Buildings

The building examples describe successful integration of energy efficient techniques in urban buildings. For each building, the basic design parameters including architectural and

engineering drawings are given. Data on the performance of the buildings are also given in order to illustrate the real efficiency of the measures. Until now 11 building examples have been collected (3 from Greece, 2 from Austria, 3 from Slovenia, 2 from Germany and 2 from UK).

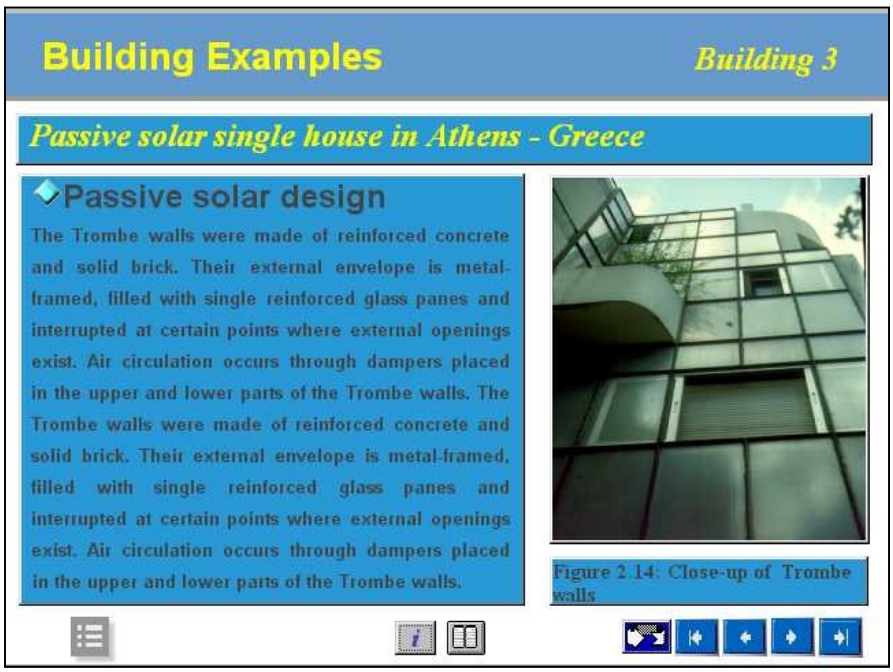

Figure 2: A building example from Greece

Industrial Libraries

The industrial libraries include data on energy efficient products and materials. The technical characteristics of the products will be given. The following main categories are included in the industrial libraries:

- Windows and glazing
- Mechanical ventilation
- Artificial lighting
- Daylighting
- Energy conservation and insulation
- Solar heating
- Solar cooling and natural ventilation
- Sustainable and recycled
- Photovoltaic systems
- Control systems
- Heating systems

Climatic Documentation

The climatic documentation includes urban climatic data appropriate to carry out realistic thermal simulations corresponding to urban characteristics. This documentation aims to

provide as much as possible data of ambient temperature, humidity, solar radiation, daylight, etc., measured in urban spaces and not in remote stations out of cities, like airports, etc. The use of appropriate data will permit to access the true potential of the various energy conservation techniques. Also, it will include data on urban heat islands, when possible, and will offer the possibility to access its impact on the cooling energy consumption of urban buildings. Until the present moment the following climatic data have been collected:

- Three urban locations in Greece
- One urban location in France
- Two urban locations in Germany

A Multimedia Tool

All the previous mentioned material is included in a multimedia tool (see Figure 2) that provides all the essential information about the energy efficient integrated building design in urban environment. This tool gives the possibility to the trainees to have a user-friendly approach to the developed educational material.

CONCLUSIONS

The purpose of the present educational module is to train and give a clear view on the energy efficient integrated building design in urban environment, through a distant-learning approach. By using various media technologies this educational package aims to facilitate the training procedure and to give a clear methodology on the aspects and technologies involved in the urban building design. The present module is already evaluating by the Hellenic Open University as a part of the postgraduate courses.

References

Geros, V., Santamouris, M. and Fechner, J. (2002). Interim Report of the SAVE project: "Development of a distant-learning training module on energy efficient integrated building design in urban environment and pilot action involving the production and promotion of modules for the initial training for building professionals and craftsmen/technicians", University of Athens, Greece.