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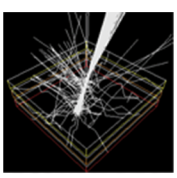
CISBAT

CLEANTECH FOR SUSTAINABLE BUILDINGS

From Nano to Urban Scale

PROCEEDINGS VOL. I

International Scientific Conference
Lausanne, 14-16 September 2011

LESO-PB
LABORATOIRE D'ENERGIE SOLAIRE
PHYSIQUE DU BÂTIMENT

Cambridge University
MIT
IBPSA - CH

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FROM NANO TO URBAN SCALE

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PREFACE

The vocation of the CISBAT international conference cycle is to present new perspectives offered by renewable energies in the built environment as well as the latest results of research and development in sustainable building technology in a setting that encourages interdisciplinary dialogue and networking at the international level. The 2011 edition gathered on the EPFL campus the largest number of scientists, engineers and architects of its 20 year long history. Travelled from all over the World in an effort to promote clean technologies for sustainable buildings and cities, the participants presented 171 scientific papers during three intense days of conference.

Major international events, such as the “Deepwater Horizon” oil spill in the Gulf of Mexico and the Fukushima-Daiichi nuclear accident, which occurred in the last few years, certainly account for the growing interest of the scientific community - as well as the interest of stakeholders - for energy efficient technologies and decentralized energy systems in the built environment, such as promoted by the conference.

CISBAT was organized for the fourth consecutive time in scientific partnership with the Massachusetts Institute of Technology (MIT) and Cambridge University. Furthermore, the organizing committee is proud to have been supported again by a renowned international team of scientists in order to ensure the scientific quality and rigor expected from the conference. CISBAT 2011 also teamed up with the Swiss Chapter of the International Building Performance Simulation Association (IBPSA-CH) to strengthen the subject of “Building and Urban Simulation”, one of the conference's leading topics.

Thanks to the financial support of a growing number of institutional and private partners, such as the Swiss federal Office of Energy (SFOE), Bank Julius Bär and the public utility Romande Energie, the CISBAT international conference cycle has undoubtedly gained maturity and recognition on the international scene for its 20th Birthday Anniversary, and deserves a promising sunny future.

Prof. Dr Jean-Louis Scartezzini
Conference Chairman
Solar Energy and Building Physics Laboratory
Swiss Federal Institute of Technology Lausanne

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TEENERGY SCHOOLS: HIGH ENERGY EFFICIENCY IN SCHOOL BUILDINGS IN THE MEDITERRANEAN AREA

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ABSTRACT

TEENERGY SCHOOLS is a EU project co-financed by the MED programme which gathers 8 international partners operating in 4 strategic Mediterranean countries: Italy, Greece, Spain and Cyprus. The project aims at solving 2 common problems of the Mediterranean area: the lack of energy saving benchmarks targeted to south Europe climatic conditions and the low energy efficiency of existing school buildings. The project works on the improvement of existing Secondary Schools' energy efficiency by developing a Common Strategy, based on the 3 typical climatic models that characterize the MED area: coast, mountain and plain. An internet based Platform is helping to implement a strategic approach in benchmarking of the comparable energy data of the selected Schools.

The main activities are:

- the realisation of Energy Audits, Surveys and Benchmarks;
- the redaction of a common Action Plan throughout the international partnership;
- the elaboration of a Concept Design for 12 innovative Pilot Projects, also through the organisation of 3 thematic Workshops and 1 international Campus involving experts, designers, students and decision makers;
- the creation of an in ICT Platform that works as an interactive operational tool gathering audit data and cataloguing laws, best practises and existing technologies; it contains the Guidelines of the Common Strategy for energy management; it is addressed to local authorities and decision makers, schools, technicians, public and private operators and all citizens interested in the construction sector and energy related issues;
- the diffusion and capitalisation actions directed also to raise awareness on the use of new energy techniques and standards and – in medium long term – to integrate and improve the energies policies and rules in the MED area and Europe;

The Specific objectives of the project are:

- to create a trans-national network amongst partners, other Public Authorities, Universities or technical bodies and schools, involving students in the educational dimension of Teenergy Schools;
- to experiment Benchmark activities for comparing buildings energy performances and defining a MED Action Plan, useful also for new construction;
- to implement a Concept Design action based on technological solutions for (passive) cooling, natural lighting and ventilation, renewable energies, also through the organisation of international events (3 Workshops and 1 Week international Campus);
- to diffuse and capitalize the results with the aim of increasing the awareness on energy saving practises and standards and –in medium long term – integrating and improving the policies at MED level.

INTRODUCTION

Teenergy Schools has developed a Decalogue to meet the needs for the providing a Common Method of decisional support involving stakeholders to fulfill the challenge of improving the school environment of education for the next generation of pupils, by starting today. The Teenergy Schools Decalogue aims at giving the basic indications for the implementation of existing schools retrofitting action a process. It is targeted to all the actors, but particularly to the public authorities—who must set themselves up as promoters of the process—and the scientific experts in charge with the coordination and the management of its application.

This Decalogue aims to illustrate the way towards an appropriate energy efficient retrofitting of school buildings in the specific Mediterranean context, going beyond the usual isolated interventions and taking into account new aspects such as bio-climatic technologies: solar architecture, passive cooling, intelligent windows for natural ventilation, energy efficient facades including sun shading, cool or green roofs and the use of materials from natural local resources with positive LCA evaluation.

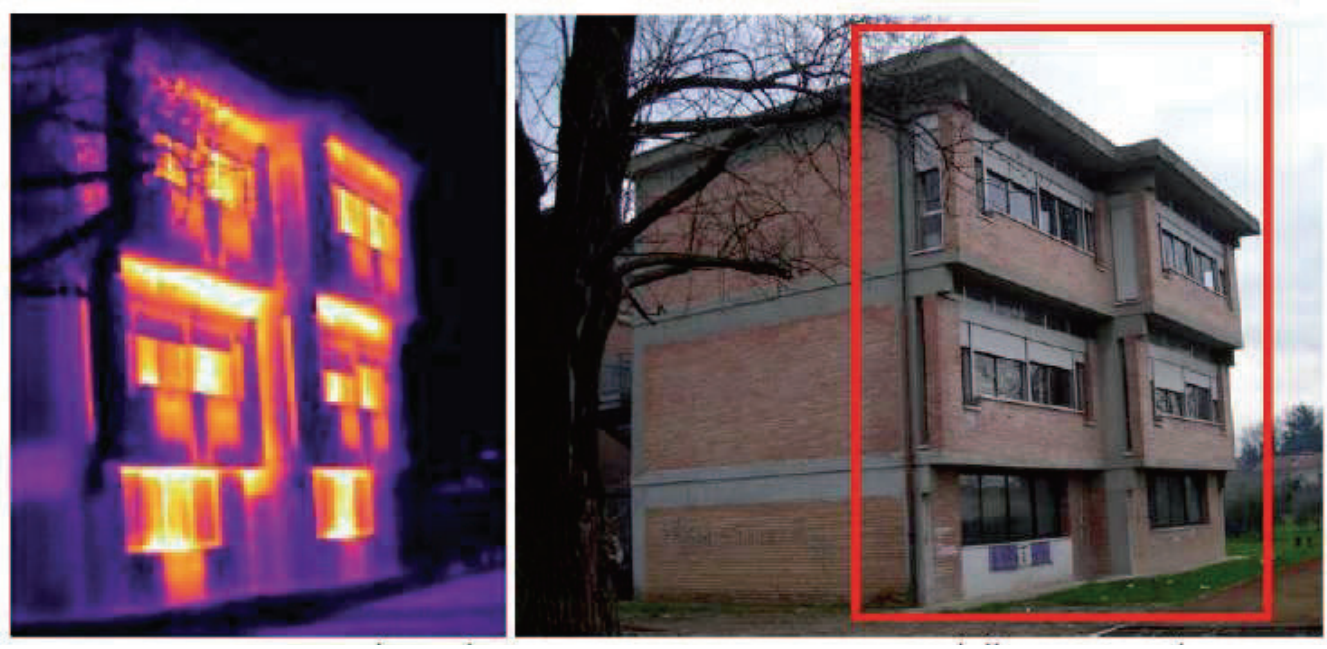

Figure1: Thermography has been a fundamental instrumenti in the diognosis fase: heat losses can be localized easily

METHOD

Teenergy Schools Decalogue for the Mediterranean Area

1. **Setting the targets:**
   definition of the Quality objectives to be reached in the retrofitting of existing schools and for the construction of new school buildings aiming at energetic efficiency and good indoor climate in all seasons
   - High Energy efficiency for heating and cooling
   - Efficient natural and artificial lighting
   - High standard of natural ventilation in classrooms guaranteeing low CO2 rate during the lessons ensuring good study conditions
   - Use of sustainable building material based on critical LCA analysis
   - Bioclimatic Strategies for energetic efficiency and good indoor climate in all seasons using Passive cooling (Ground Cooling/Night Cooling) Sun shading and Natural Ventilation systems against Summer overheating

- Correct Use and management of renewable resources: use of appropriate, cost- and energy-efficient technology
- Acoustic quality inside the building for good audio comfort in the classrooms
- High Outdoor Environmental Quality (outside microclimate)
- Good visibility and media communication to guarantee wide spreading of results
- Didactical aspect of the intervention as added value of retrofitting / new construction for the active involvement of pupils (change of mindset/behavior)

2. Energy Audit:

Checking the State of Art of the building and the energy performance of the envelope and energy consumption on HVAC (Heating, Ventilation and Air Conditioning) systems throughout data collection including bills, measurements and software simulations:

- energetic behavior of the building taking into account the real consumption, the simulations (expressed in kwh/a/m3)
- thermographic anaylis for the detection of heat losses for efficient problem solving
- Analysis of the functionality, occupancy (pupils/m2), use and costs for the running of the building (euro/pupil/year)
- Evaluation of the Security norms
- Evaluation of Level of maintenance
- Structural characteristics, anti-seismic aspects
- Sanitary equipment

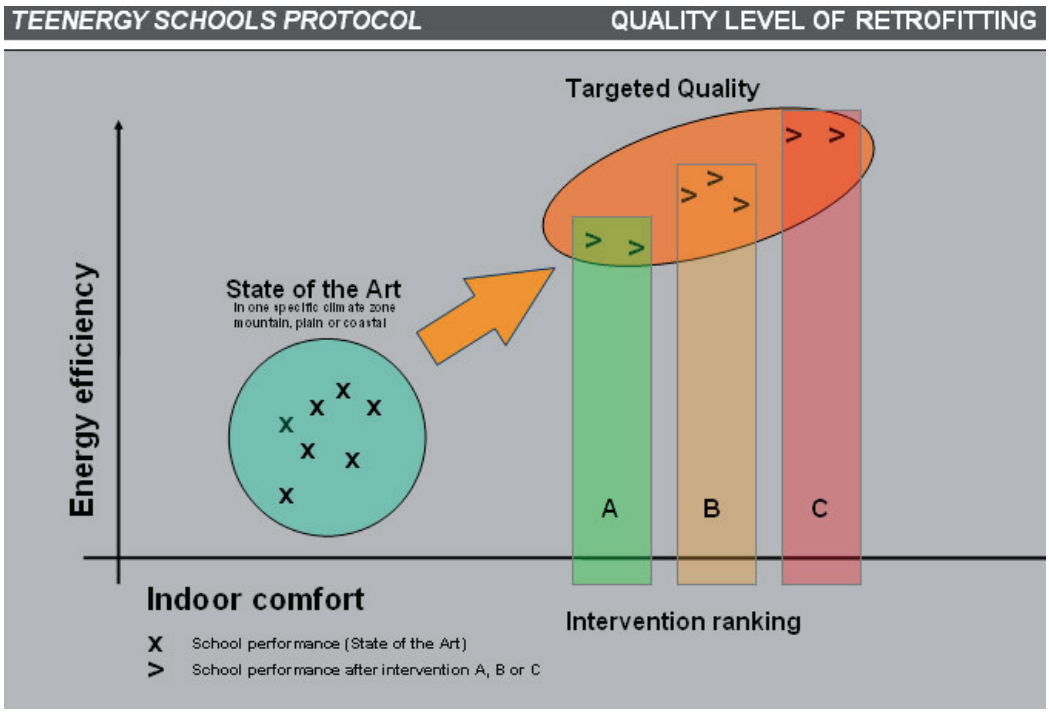

Figure 2: The definition of the Quality Objectives defined by energy efficiency AND indoor comfort in the school buildings within the Mediterranean climate context

3. End user feed-back questionnaire:

- Analysis of the feedback of pupils and teachers throughout a specific (anonymous) Questionnaire in order to define the psycho-physical aspects regarding the actual perception of indoor comfort by the end users
- Involvement of the students and end user to improve their awareness

- Evaluation of indoor quality
- Comparison between assessed performances of the e school building, the monitored use and occupancy and the satisfaction of the end users of the building in order to obtain a critical view of the actual situation.

4. Mapping and Evaluation

- Analysis and mapping the results with the support of adequate tool for the homogenization of the data at an appropriated decision scale (Municipality context, Provincial/Regional/National/ International) and Analysis and graphical visualization of the collected data from the Energy Audit, the End User Feedback Interpretation and graphical visualization of the collected data from the Energy Audit and the End User Feedback
- Evaluation of the gap between State of Art and Target,
- Analysis of the critical point where the data of energy performances of the school buildings are below the average (Mapping and Positioning of the results in a larger context (regional, national, European) taking into account specific 3 climatic sub areas: Coast, mountain and plain.

5. Benchmarking in the context :

- Comparison of the monitored school buildings to obtain a performance-ranking for the definition of preferences : which school building need to be refurbished first?
- Analysis throughout multi issue criteria: **what are the main criteria?**
- Definition of thresholds of energy performance, indoor quality level, available budget
- Definition of acceptable limits

6. BEST PATH Methodology

- The Best Path Methodology aims at defining the most adapted solution in terms of economical technical and human aspects following the elaborated quality criteria as indicated above. On administrative and political level a critical weighting of the importance of each of the following four main objective must be considered: energy efficiency B. indoor comfort C. quality of communication of the project, D. technical aspects (for instance obligatory issues such as anti-seismic norms, fire-security, sanitary aspects)
- Obviously each refurbishment or new construction of a school has an important mediatic value for the local administration, therefore the quality of the communication has to be considered an important issue. Building Sustainable Schools in the Mediterranean Area with bioclimatic principles in an energy efficient, socially and politically participated approach has a high value in terms of innovation.
- Each one of these aspects will have a weight expressed in % following the strategic decisions of each single administration.

7. Interdisciplinary involvement in the Participated Planning Process

- involving all the stakeholders of the school environment: pupils, parents and teachers, driven by the initiative of the administrational responsibles engaged in a transparent, participatory round table with the help of qualified technicians: the project bases for new schools or the refurbishment strategies for existing schools has to be elaborated in an interactive and interdisciplinary process involving all parts, taking into account the above mentioned ranking of priorities following the Best Path integrating previous analysis such as Energy Audit and the End User Satisfaction.

- The continuous illustration and monitoring of the proceedings of the process with is of great importance to guarantee satisfaction of all interests.

8. Concept Design Implementation of Architectural Solutions /Retrofitting strategies

- The Concept Design Solutions will be based on sustainable, energy efficient building technologies taking into account bio-climatical aspects in order to respond adequately in each single micro-climate area.
- High Indoor comfort is targeted by improving thermal, acoustic and visual comfort in the classrooms
- at least three scenarios with low medium and high outputs proportioned to the dedicated investment will be elaborated

9. Cost benefit evaluation

- Critical choice of the most suitable solution in terms of energy efficiency, satisfaction of the end users, economic context and communicational aspects for the local administrator's political targets

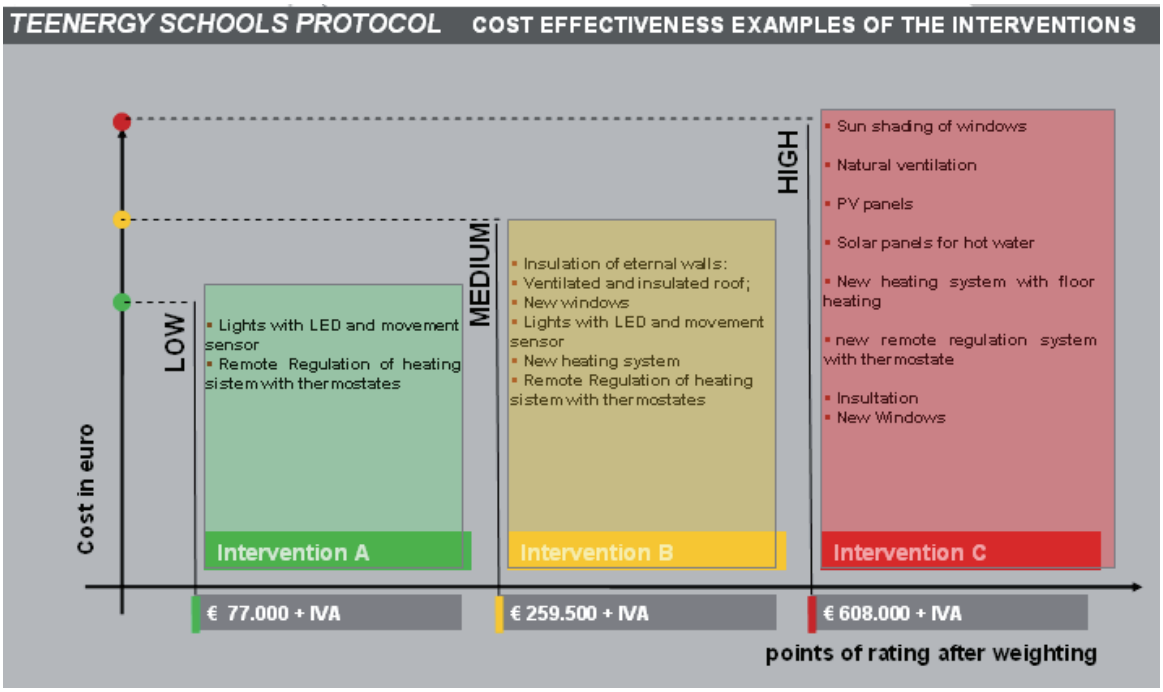

Figure 3: The three-scales scenario permits a ranking that takes into account energy performances of the proposed retrofitting solution, indoor comfort and economical aspects:

10. Diffusion and Communication of the results: towards Best Practice

- Constant monitoring of the feedback within the participated process
- Promotion of the results within the context of a Pilot Project that has a didactical vocation
- Networking of similar experiences in order to promote wide speading of the initiatives and guarantee efficient research results in collaboration with scientific institutions and exponents of the building industry.

RESULTS

A common Action Plan has been published gathering the obtained results of the project. It illustrates the partnership's methodology and shows tangible results by integrating the 12 Pilot Projects for retrofitting and new building of climate orientated, high energy performance

school building in the Mediterranean Area. The Projects have been developed in Mountain, Coast and Plain area in the 4 different partner countries: Italy, Spain , Greece and Cyprus.

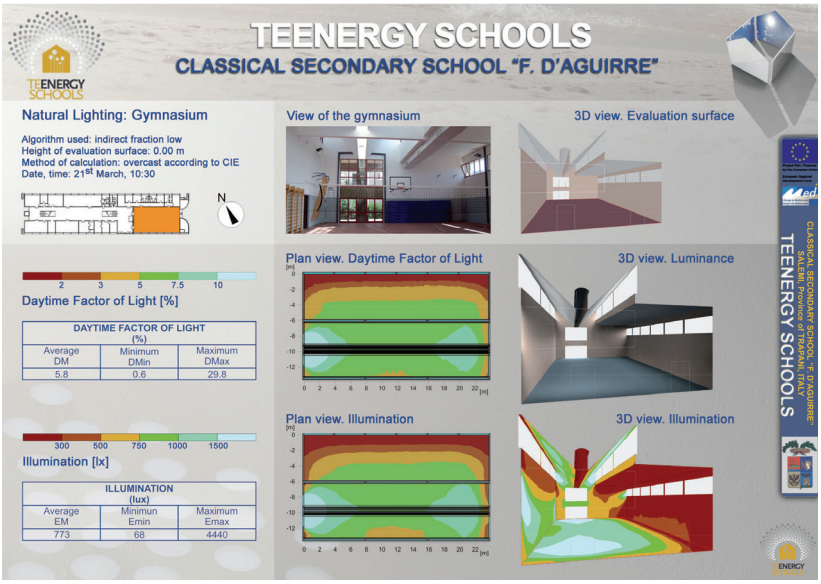

Figure 4: The 12 Pilot Projects have been elaborated by each territorial partner with the help of a scientific partner. The results take part in an international exhibitioni all partner countries.

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