

Spain Tries to Find the Formula to Save 80% Energy in Office Buildings

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ABSTRACT.- The Singular Strategic Project called Bioclimatic Architecture and Solar Cooling, ARFRISOL (ARquitectura bioclimática y FRío SOLar, in Spanish), has been promoted and supported by Spanish Ministry of Education and Science (MEC). This project plans to save up to 60% of the energy demand of an office building by means of construction passive techniques and reduce the conventional energy consumption to only the 10-20% of the usual consumption with active solar devices: solar thermal collectors and photovoltaic panels. Five office buildings are to be built or rehabilitated: four new buildings and a rehabilitated one, in different climatic zones of Spain. Thus the solutions for every building will be different, according to the different climates.

All materials of the bioclimatic buildings and the technology of active solar systems will be manufactured and optimised in Spain. Ventilated façades, absorption pumps, solar chimneys and wide roofs for solar collectors are some strategies to develop, depending on the climate. Almeria has the first building: CIESOL (Centre of Research about solar application technologies), The objective is to reduce the heat of summer and the cold of winter with solar cooling and heating systems. ARFRISOL has other building at the PSA (“Plataforma Solar de Almeria”). The architectural design is at the first stage, studying the energy strategies to improve thermal comfort for a semidesertic climate. ARFRISOL has other building at headquarters of CIEMAT in Madrid, with a continental climate, other one at northern Spain “Principado de Asturias” with an oceanic climate, the Barredo Foundation, and, finally, in Soria, where a building of the CEDER will be rehabilitated in a extreme continental climate. After four years of research, the project will provide useful quantitative information about saving energy and use of passive solar energy in buildings.

Finally, ARFRISOL will intend to influence the society to “change the mind” about energy consumption in the Spanish edifications and prove that it is possible to save 80% of conventional energy in office buildings. With this objective, the Ninth Subproject has been planned to spread this idea between Spanish users.

Keywords: PSE- ARFRISOL, Bioclimatic Architecture, Energetic efficiency.

1. INTRODUCTION

PSE-ARFRISOL aims to increase society’s awareness of Bioclimatic Architecture advantages. For this purpose, a journalist has been hired by the research group to be in charge of the diffusion plan, to publish and spread news about the project in mass media. This strategy intends to attract the attention and broaden the mind of society regarding energy efficiency in buildings. Spanish Ministry of Education and Science wants to introduce this formula in R&D national diffusion plan.

The advantage of Spain and the rest of Europe is that, nowadays, bioclimatic architecture is being promoted by their respective governments. Often, people

relate energy efficiency with solar collectors and photovoltaics panels. The objective of PSE-ARFRISOL Group is to prove how an architect can make Bioclimatics Buildings with equivalent costs. Ventilated façades, walls with high thermal inertia, cross ventilation and specials windows with shadowings are only some ways for the design of this kind of buildings, but the most effective way is to take into account the climate, the environment and the orientation of the building.

This ideas intend to change the current situation: the consumption of energy has increased by 5% since year 2000, approaching the energetic level of Northern European countries, in spite of the warmer climate in Spain. Nowadays more than 30% of the total consumed energy in Spain is used in buildings in order to achieve the thermal comfort. The newspapers are worried about it because they published these news. Also the 25% of the pollution is for the same reason. Besides according to the spanish energy efficiency plan elaborated by IDAE, (Spanish Institute for Saving and Diversification of the Energy), in the construction area the professionals implicated have to analyse the way of reducing the levels of energy consumption of HVAC systems.

These five buildings, (from now on, called Research and Demonstration and Building Prototypes-RDBP) will be used to obtain data about the saved energy and then, to show them to the Society. This Project is supported by the Spanish Government, the materials used and the companies involved must be Spanish and have certain guarantees of quality. Recently Spain has approved a Technical Code of Edification (CTE) about security and Efficiency Energy in buildings. A hard work that includes changing the ideas of the builders and architects.

		
F.1 CDI-CIESOL UAL (Almería)	F.2 CDI-70 – CIEMAT (Madrid)	F.3 CDI-PSA (Almería)
		
F.4 CDI-Fd. Barredo Asturias (Siero)	F.5 CDI-CEDER Cubo Solana (Soria)	

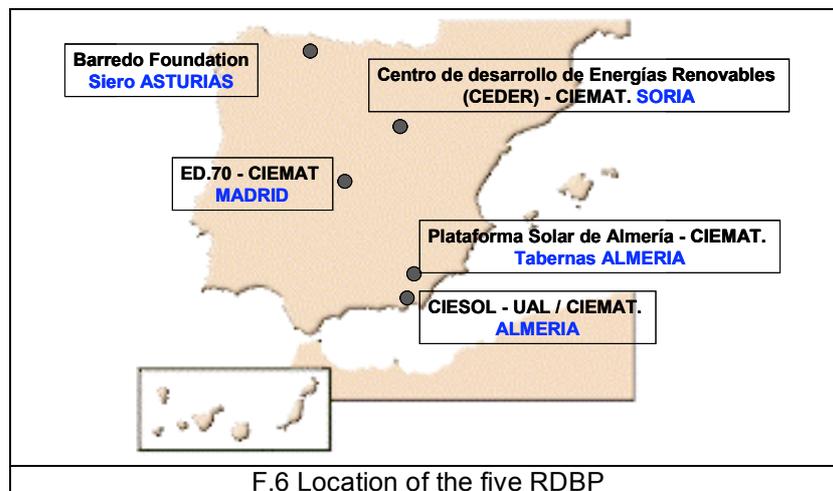
The PSE-ARFRISOL involves the most important building enterprises, (DRAGADOS, OHL, ACCIONA, FCC) and the best Spanish technology companies (UNISOL, ATERSA, GAMESA SOLAR, ISOFOTON) with some prestigious research centres, (CIEMAT, OVIEDO UNIVERSITY, ALMERIA

UNIVERSITY and BARREDO FOUNDATION). All them have signed an implementing agreement to carry out the project.

The tasks of this project are divided in 9 subprojects (SP's), 5 of which are the office buildings constructions. PSE-ARFRISOL will provide every RDBP with different strategies for each location of the Spanish geography and climate conditions. From SP2 to SP6 the subprojects are the construction of CIESOL-office RDBP at Almeria University, (Almería); ED-70 RDBP – office enlargement of an existing building at CIEMAT (Madrid), PSA – new technical office RDBP at the PSA (Tabernas Desert, Almería), a new office RDBP at Barredo Foundation (Siero, Oviedo) and the rehabilitation of an office RDBP at CEDER (Cubo de la Solana, Soria). SP 1 includes all the previous studies, SP 7 consists in the RDBP's monitoring for thermal analyse and air quality study, SP 8 is R&D in HVAC systems and, finally, SP9 will spread the results and transfer the information extracted from RDBP's to the society.

2. SPECIFIC OBJECTIVES

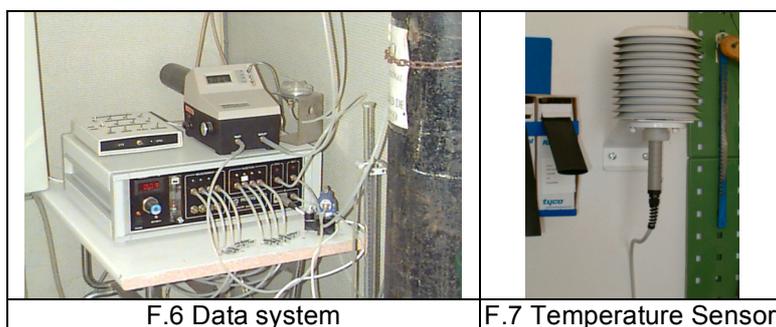
The research carried out by the PSE-ARFRISOL Group has as a principal objective to develop the passive solar techniques and the integration of active systems during four years (2005-2009). The PSE-ARFRISOL which is supported by the Spanish Government is currently the principal project in that group. It uses several effective techniques to reduce the total energy demand, such as cross ventilation, shadowings, greenhouses or special windows.



People knows that Spain is one of the European countries with more solar radiation. The Spanish researchers are looking for the way to take advantage of the Sun through solar energy use in buildings. PSE-ARFRISOL includes five zones in Spain. Asturias, Soria and Madrid are cooler climates than Almería, with a blazing sun. The scientists will equip every building with experimental systems based in solar passive and active technologies for heating and cooling. For example, in Soria, which is a cold area in Spain during winter, the scientists have thought in low consumption biomass boilers to provide the comfort to the future users. However, in the south of Spain (Almeria), the RDBP will contain an absorption pump, like the other building prototypes. It is a system which uses hot water from the solar collector field to produce cooling energy and offer the best conditions of comfort.

The strategy of this project is to save up to 60% of energy demand in offices buildings using passives techniques. Moreover, by means of active techniques (solar thermal collectors and photovoltaic panels) the conventional consumed energy will be reduced by 30%. In this kind of buildings, the users could save up to 90% by the combination of passive and active techniques. The Spanish government would like promoting the change of the society mind about these terms.

The PSE-ARFRISOL Group has a difficult labour based in monitoring all the data related to the energy demand (temperature, humidity, energy flux...). Besides, the data will be compared to energy demand of a reference building in order to demonstrate the energy saving.



After at least a year of experimentation by collecting data, the workgroup will be able to demonstrate how close reality is from simulation, and this will be useful to make more accurate each simulation model for future references. This is the most important part because the energy saving in office buildings based on real data could achieve a quota around 80%. The overcost of Bioclimatic office buildings would not be higher than 15%. According to IDAE, the overcost in office buildings due to the energetic requirements of the new Spanish Building Technical Code (CTE) will be around 5%. This higher initial cost will be compensated with an important reduction of the energy bill to pay during the building life period. These data will be proved by the end of the project and they will be spread into the society with real guarantees. They will help to change the people mind.

3. DIFFUSION PLAN

The diffusion plan of PSE-ARFRISOL is structured in three stages, as follows:

3.1. Development of Building Design guidelines. Using the final results of this project, two different guides will be developed:

3.1.1. New office buildings construction guidelines. The conditioning strategies tested during the project will lead to new office building design guidelines. This task will be done in collaboration with architects and other research groups.

3.1.2. Extend this study to other kind of buildings. The results of this project will be employed to develop new design guidelines in other areas: residential and non-residential (such as hospitals, shopping centers, etc.).

3.2. Development of systematic knowledge concerning energy efficiency in buildings. This task will be done regarding two complementary aspects:

3.2.1. Development of sets of educational resources, according to different knowledge levels. The know-how reached during the PSE-ARFRISOL project will be transposed directly to the different educational levels: Primary school, high school and university. The teachers of the Spanish Royal Society of Physics (RSEF) will lead this task, together with architects, engineers and scientists. Complete sets of courses and educational resources –“Didactic Units”- will be developed according to the current pedagogical view of education. These documents, then, will be adaptable enough to the different educational levels existing in the society.

3.2.2. Development of diffusion documents for the rest of the society. A complete marketing campaign will be launched to change the people’s state of mind. This change will be held in a joint collaboration with public institutions such Town Halls or Regional Governments. This effort will be useful to support further actuaciones in the energy efficiency area. This task involves showing the Bioclimatic strategies in science festivals and other similar public events. The PSE-ARFRISOL team has got a interactive scale model manufactured to explain to the public how every strategy works in this kind of buildings. In addition, PSE-ARFRISOL will be presented in round tables, scientific conferences and congresses to communicate the final results. The aim of these actuaciones is to influence the public opinion and specially the construction sector.



F.9 Interactive scale model at Madrid Science Festival.

4. EXPECTED RESULTS

After four years of investigation in the ARFRISOL project, the pursued results are:

- The five RDBP of this project will be singular buildings in the design and the solar heating and cooling systems.

- The constructions will have a high energy efficiency, with a saving of conventional energy between 80 and 90%. These data will be backed up by the monitoring of the building and the analyse of the energetic data collected.
- The solar devices and systems (like solar thermal collectors, absorption pumps and photovoltaic panels) used in the RDBP will be optimised for a reduced use of energy. In case that the system optimisation process produced any new development, it would be patented for marketing.
- The diffusion of the results will be carried out at different levels: from childhood (with educational guidelines) to adult age (news, science festivals...) and into society (newspaper, tv, radio, etc...). The guidelines will be developed in educational modules that will be checked and validated in several schools chosen by sampling.

The final result would be to achieve a reduction of the conventional energy used for heating and cooling because of having changed the society mind. This goal is not only applicable to offices buildings but also to any kind of construction.

5. ACKNOWLEDGEMENT

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