BIOCLIMATISM

KALAMATA (Greece)

Bioclimatism refers to the passive use of the sun's energy, i.e. its direct utilisation without transforming it into another form of energy, either electric, thermal or mechanical energy. Bioclimatic design is based on an analysis of the microclimate, building siting, window and roof orientation, the use of natural ventilation and air-conditioning and the optimisation of natural light. Although these aspects may sometimes be a source of conflict when it is not possible to address all of them at the same time, this concept has the advantage of not being limited by natural or seasonal considerations. It is a renewable source of energy in the sense that it is not finite and cheap. The Municipality of Kalamata in Greece applied this concept when rebuilding one of its district.

GENERAL ASPECTS

Kalamata is a city of 45,000 inhabitants with a long history. It is situated in the south of the Peloponnese. Its location at the foot of the Peloponnese Mountains and the presence of nice beaches makes it an attractive site for tourist activities. Its centuries' old and famous history – Homer mentioned it in the Iliad - has given the city an old district with many buildings of historical interest including forts, monasteries and churches.

Climatic data:
Degree days (Base 18 °C): 990
Average annual temperature: 17,9 ° C

CONTEXT

After the 1986 earthquake, the Municipality of Kalamata was faced with the task of rebuilding destroyed districts. The district concerned by the project is situated to the south-east of the old part of the town and is characterised by a high building density and a checkerboard layout. Destroyed buildings were of different local styles combining modern elements taken from the modern part of the town with more traditional ones from the oldest part. The surface area covered by these buildings is 13,316 m^2 and the ground has a 7% north-south gradient.

The dry climate and low wind speeds prompted the idea of building low energy houses with direct or indirect solar heating. The experiments carried out in other Mediterranean cities on direct and indirect solar use were also a source of inspiration and the Athenian architects' office selected for the operation had already an experience in this field. This retrofitting project is innovative in the sense that it integrates already tested techniques into a wide-scale commercial project. Assessments and measures therefore mainly focussed on cost-efficiency aspects.

EXPERIENCE OF KALAMATA

Technical aspects

The project concerns 120 new homes using direct or indirect solar heating. Buildings are 9 meter high up to the roof and include dwelling units of different sizes and types:

- Two-storey family houses,
- Family flats in blocks of flats,
- Student's flats in blocks of flats.

The techniques developed for the project have already been tested on previous occasions:

- Insulation of external walls,
- Building orientation and optimisation of the distances between them,
- Roof ventilation,
- Solar collectors,
- Optimised fenestration depending on solar radiation.

Building low energy houses in Greece implies accounting for climatic conditions that are quite different from those experienced in Northern Europe. As a general rule, the heating period extends from December to April, only. It is on the other hand necessary to provide efficient cooling systems from May to September. During this period indeed, temperatures rarely drop to below 18 °C and frequently exceed 24 °C. As a consequence of this, the unit of measure used during the summer is cooling degree-days instead of heating degree-days, i.e. the number of hours when temperature exceeds 24 °C. The Peloponnese region being characterised by a dry hot climate, indoor climate is quite pleasant as long as indoor temperatures do not exceed 30 °C and building cooling is only necessary when temperatures raise above this limit. As for protections against the cold such as double-glazing, they are only useful on north-facing windows.

The techniques used to build this low energy district in Kalamata are as follows:

- double casing external walls with 10 cm of air in between,
- south-facing buildings and aluminium window frames fitted with blinds to optimise both heat and light aspects,
- distance between the buildings calculated so as to provide a maximum of solar gains in winter and a minimum of solar heat in summer thanks to the broad-leaved trees planted between the houses, buildings laid out so as to facilitate space heating by avoiding cold northern winds,
- installation of solar collectors to cover around 60% of the requirements for domestic hot water,
- estimation of building annual needs for heating with a simulation software (SPIEL),
- all dwellings are fitted with electric heating appliances and optional cooling systems,
- adaptation of the glazing to the different room uses: double-glazing in living rooms, simple glazing and eight-hour solar heat storage in bedrooms etc.,
- roof ventilation systems consisting of a circulation of air between the tiles (see picture on next page).

A campaign was carried out from 96 to May 97 to assess the technical and economic viability of low energy buildings. The CRES investigated - in collaboration with the inhabitants - three typical dwelling units to assess the amount of energy savings achieved with the techniques used (data per m² of building) and payback periods. The CRES specifically looked at:

- double-casing walls,

- energy consumption in low energy houses compared to houses built according to prevailing standards in Greece,
- theoretical consumption taking no account of the energy savings generated by double-casing walls,
- energy savings resulting from solar collectors.

As the climate in Kalamata, especially in winter, does not impose high energy requirements highly sophisticated heating systems are not necessary. This means that insulation, ventilation and heating investments have much longer, if any, payback periods than in Northern Europe.

With the exception of double-casing walls, the innovative techniques used in this project appears however as interesting economic solutions for this part of Europe. In winter, they indeed allow to reduce energy consumption by 35 to 65% depending of the type of buildings. As regard pollutant emissions, 7.8 to 18.5 tonnes of CO_2 per dwelling house are also avoided. In summer, the techniques applied made it possible to strictly limit indoor temperature to 30 °C, a result which was confirmed by the inhabitants themselves in surveys.

Payback periods considering the techniques used vary from 12 to 22 years, depending on the surface area and utilisation of the premises. As already mentioned, only double-casing walls are not an appropriate solution, since the payback period calculated for this technique is 60 to 93 years. Leaving aside double-casing walls, additional costs could be paid back within 4 to 8 years. One of the conclusions that can be drawn from the Kalamata experience is that it is better to invest in any other energy-efficient techniques or in renewable energy.

Another remark would refer to the inhabitants' behaviour. The huge differences in the energy savings achieved (from 35 to 65% depending on the flats) are exclusively linked to the inhabitants' behaviour and their willingness to contribute to energy savings. This clearly demonstrates the need for providing the inhabitants with suitable information when launching this type of experience.

Building phase took place between 1992 and 1994. The Municipality of Kalamata sold the houses and flats once they were finished, which means that the occupiers (who for most of them are also the owners) could not have their say in the matter. They had been informed, however, of the experimental aspect of the buildings by reading the brochure presenting the project. This brochure was also used as materials for the information campaigns on the project as well as for publications in the local media.

Players involved

After the earthquake of September 1986, the Municipality of Kalamata founded DEAK, the municipal corporation for the rebuilding of Kalamata. This company of ten employees was responsible for co-ordination the different sub-contractors, mainly local or regional companies. Building operations gave work, at least on a temporary basis, to about 400 people. An Athenian company was entrusted with building design and erection drawings.

Assessment measures were carried out by the CRES, the centre for the development of renewable energy in Greece.

Financing

It was vital that such project be viable from an economic point of view and could deliver high quality buildings. Funding came from different sources:

- a loan from the European Investment Bank,
- grants from the European Commission through the THERMIE programme,
- The Municipality of Kalamata gave the land free of charge to DEAK.

EVALUATION AND PERSPECTIVES

Given the climate, innovative heating techniques were not necessary as insulation, ventilation and heating investments give much longer, if any, payback periods than in Northern Europe.

With the exception of double-casing walls, the innovative building techniques used for this project appear however as interesting economic solutions for this part of Europe (with payback periods from 12 to 22 years, depending on the surface area and utilisation of the premises).

Moreover, providing the inhabitants with suitable information greatly contributes to project success. The Kalamata experience in the field of low energy houses served also as an example for other projects in the region, including:

- improved insulation in private and public buildings,
- adaptation of a solar system for producing domestic hot water in the municipal slaughterhouse,
- projects aimed at integrating energy savings in municipal stadiums and sports facilities.

FOR FURTHER INFORMATION

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