

## Aspects and perspectives for the Zero Energy Buildings

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### ABSTRACT

The most important problem for a building nowadays is the energy and how someone can achieve to reserve it. There is a relation between environment, energy and economy and the research to solve the energy problem is continuously expanding through new design ideas, new and smart materials and cost effective energy systems. The bioclimatic design and passive energy systems, the solar thermal collectors and photovoltaics, the use of biomass and the small wind turbines are some of the ways to solve the "energy problem" of the buildings. The Zero Energy Building is a goal that scientists are trying to achieve and various concepts in this way have been made until now with different results, every time of course, but based on the same principles. The transformation of the building from a conventional design regarding energy use to a non-conventional building generally is always the first goal. Since the idea of using systems based on the Renewable Energy Sources (R.E.S.) has become the axis of the energy solution, a lot of buildings have been constructed using those systems. Several steps have been done for the understanding of RES and their use on the buildings and architects and other scientists have a very important role to this aim. The work that is presented in this paper includes a review of the studies and projects that are reported until now for the Zero Energy Buildings. The parameters that are involved in the energy efficient design of buildings as the sunlight, natural ventilation, etc and the available as well as the promising building integrated RES technologies are analyzed. The perspectives for the Zero Energy Buildings and the key issues that are related with financial and social

subjects for the understanding of how important is the use of such systems in the future is also included.

### 1. INTRODUCTION

The permanently increasing needs for energy in the building have the last years as result the most rapid consumption of sources of energy which is ensured main by mining fuels. However it appears to become henceforth perceptible that it is not possible to be ensured longly-lasting required energy with datum that the mining resources tend they finish. Taking into consideration this the scientists have turned their attention in methods of production of energy from other sources of energy. At the same time with this effort it appears exists an orientation to the restriction of consumption of energy in the buildings following new methods of manufacture, using new smart materials and of course various systems of control but also production of energy.

In the frames of this effort the last thirty years the engineers and the scientists that their work is connected with the energy and the building, have been focused in the concretisation of buildings which require less energy and the required minimal energy to emanate from Renewable Sources of Energy (R.E.S.). With given the difficulties that have this effort and taking into consideration the high percentage of residences, the first priority concerns the restriction of consumption of energy in the residence and in the groups. Thus it began an effort result residences with smaller energy needs and we reached today to speak for the Zero Energy Building. We are reported with this term in

buildings which in order to they ensure basic operations as the heating and cooling they limit the use of energy produced from conventional sources and exploit the R.E.S. as the solar radiation and the wind.

Thus new significances began to be used in the buildings such as the bioclimatic planning, the intelligent materials and the systems of saving energy, the passive and energetic systems, photovoltaic, the hybrid systems and other. Was increased the complexity in the planning and the management of buildings and became henceforth essential the study of their energy behaviour.

## 2. WHAT IS LOW ENERGY BUILDING?

Before we enter in the process we discuss the subject *low energy building* it is important we clarify the meaning but also the objectives of LEV. Often this term does not become explicit what precisely means. Many low-energy building concepts seem to have as a goal 'the exclusion of external purchased energy' when energy-efficient solutions strive towards 'the lowest possible energy requirements with reasonable utilization of resources'. However, in discussions about research a demonstration projects in this field and in reports published from these projects, this distinction is seldom, if ever, made. Especially when it is a question of low-energy buildings, technical solutions are often suggested and demonstration projects are carried out without a clear analysis of the applicability in practice (Abel, 1994).

It may mean achieving 'zero energy' requirements for a house or reduced energy consumption in an office building. A major goal of low energy building projects and studies usually is to minimise the amount of external purchased energy such as electricity and fuel gas. But sometimes the target may focus on the energy costs or a particular form of energy input to the building. As building design needs to consider other requirements and constraints as well (such as architectural functions, indoor environmental conditions, and economic effectiveness), a pragmatic goal of low energy building is to achieve the highest energy efficiency which requires the lowest possible need for energy within the economic limits of reason.

Since energy consumption in buildings is in-

fluenced by many complicated factors and phenomena, it is not easy to define 'low energy building' precisely and to measure and compare the level of building energy performance. The loose fit between form and performance in architectural design also make quantitative analysis of building energy use more difficult. Nevertheless, it is believed that 'super-efficient' buildings which have significantly lower energy consumption can be achieved through good design practices and effective use of energy efficient technologies (Todesco, 1996). In an ideal case, buildings can even act as producers rather than consumers of energy (Hui, 2001).

## 3. PROJECTS AND EXAMPLES

The last thirty years as already we have reported it has become a particular effort from the total of scientists for the concretisation of buildings that would have less energy demands and they develop the renewable sources of energy for their needs. In this direction they have been realised enough projects aiming mainly at the partial initially and then total emancipation by the conventional sources of energy as oil and natural gas.

Making a retrospection in past, in 1975 in the Aachen of Germany was materialised Philipshaus (Voss, 1997). In 1977 Tomas Herzog in Regensburg materialised a particularly original manufacture. In the substance it is a residence which is incorporated in an other nutshell. This as "onion" building functions exploiting one climatic buffer zone. In meets no one a physiologic residence that follows the basic design principals of bioclimatic architecture while from outside it is presented as a high - tech construction (Wines, 2000). Substantially from 1989 and afterwards it begins a big effort for the creation of manufactures that would be autonomous from little as very. This date the International Energy Agency (I.E.A.) it decided it creates one international project in order to they are drawn and manufactured a line from low energy houses with a total consumption for space heating, domestic hot water and electricity for only 25% compared with the typical consumption of new houses in the participating countries. The program forecasted attendance from enough countries of Europe and America with result the creation in total 16 different project from that

finally the 14 were only materialised and were placed under detailed monitoring and evaluation. The means of achieving the ambitious goal comprised a series of different low energy strategies and the extended use of sustainable energy resources. The scope of the project was further to demonstrate new technologies for improved energy efficiency. In order to minimise the risk of failure new technologies were tested in special facilities before being applied in the houses (Thomsen, 2005). At the same time with these project they were materialised certain still in Germany and Czech Republic from which the Sonnenhaus Jenni was been completely autonomous and it was realised in 1989 in the Oberburg of Czech Republic (Voss, 1997). In 1992 the architectural office of Kimberly Ackert and Robert Dawson –Brown they manufactured in Australia the “Australian House of the Future”. The building uses such passively as energetic systems of saving of energy. A wind generator helps in the production of electric current and solar collectors ensures the heating of water (Wines, 2000).

#### 4. THE GREEK REALITY

While these happen in the entire remainder world, in Greece hardly the last years have begun to become an effort to the direction of planning of buildings that would be costlier in the consumption of energy that would be produced by mining fuels. It deserves however it is marked that from very early a lot of Greek households they exploited the solar energy with the help of solar water – heaters installations. In Greece today exist roughly 180 applications of bioclimatic buildings, from which the 2 constitute built-up totals. From them, the bigger number of buildings finds in the region of Attica and in Macedonia. There are also recorded bioclimatic buildings in remainder Greece. The application of passive systems in the nutshell of buildings for increased profits from the exploitation of solar energy mainly concerns in the sector of residence of low height. The use of passive systems for heating and refrigeration, in other uses of buildings has not been applied particularly. In Greece, only the last decade it has begun the applying of the bioclimatic planning in buildings tertiary sector, in the frames of more general new confrontation of planning.

Thus, from the known buildings, the 74% of cases concern already in buildings of residence, while a in detail distribution in uses tertiary sector gives the bigger percentages in buildings of offices and education.

In 1997 were completed in Thessalonica a grandiose plan. His objective was to manufacture and study as for his energy behaviour a building which will have incorporated passive and energetic systems. Particularly important building with big dimensions functions as commercial centre of structural materials while simultaneously it functions also as flamboyant building bioclimatic architectural and low consumption of energy. It was manufactured with the support and the contribution of Centre of Renewable Energy Sources (C.R.E.S.). One of the main objectives of study of building it was his energy planning, aiming at the reduction of consumption of energy for the heating, the reject of overheat and the reduction of consumption for cooling the building. Particular importance at the planning was given in the sufficiency of natural lighting so that is decreased the need of artificial lighting hence also the consumption of “expensive” energy (Oikonomidis, 2002).

In 1995 were completed outside by Larissa a detached house which was drawn in order to it improves the conditions of existence and well-being for his householders. The master plan of the building concerned a two-storied residence that in the ground floor would have the communal spaces and a guestroom, while in floor they would be the spaces of bedrooms. Because of high temperatures at the summer months and low temperatures at the wintry months were used materially also techniques as the use of venetian blinds in order to is ensured the thermic balance. The building after it was drawn entered in program of simulation with the help of which was selected the most acceptable scenario concerning the use of energy (Valis, 2002).

In 1995 materialised in Kifisia a two-storied residence with incorporated passive systems of saving of energy. The greenhouse and the wall Trombe ensure a relative thermic comfort in the building while at the same time they do not influence considerably the temperature at the aestival months. The natural system for cooling uses little balconies and externally layers while exists also one wind chimney for the best cool-

ing because of the streams that are created (C.R.E.S., 2002).

## 5. CONCLUSIONS

From those we have reported up to now, it appears still exceptionally difficult is realised a completely autonomous residence. Even if in experimental stage in 1997 it was completed in the Freiburg of Germany a residence completely autonomous (Voss, 1997) is still very early we say that we are ready to advance in wide construction of such buildings. However it is realised that it is much easier to construct semi – autonomous buildings. There is the ability to be constructed buildings in which will have been limited the consumption of energy while part from the one that will be consumed to be produced from renewable sources of energy. In world level it appears that most manufactures are moved to this direction with the support of government owned and not government owned institutions and organisms. In the Greek reality the things however differ lightly. Even if exist institutions and organisms which make important efforts for the promotion of constructional solutions with smaller energy needs it appears an absence of the political will which will give the real impulse for the use of Renewable Energy Sources. Despite the fact that exist these difficulties in the Greek territory we can say that exist also the possibilities but also the prospect for restriction of consumption of mining resources and the concretisation of buildings of low consumption of energy.

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