Category: Energy efficient private house
Case Study: Private house in Asgourou

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Project cofinanced by
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SCORE
Sustainable Construction in Rural and Fragile Areas for Energy efficiency

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The village of Asgourou in the map of Rhodes

The private house in Asgourou

General Information

Standing on a low hill at the north-west side of Rhodes in Asgourou, this private house constitutes an example of the so called “passive house”.

Presentation

The house has southern orientation and big openings in order to exploit as much as possible sunlight during the months that this is required.

Moreover, the house’s shell is fully insulated with EPS 80 and more specifically the walls are constructed with a layer of bricks and in the exterior there is a layer of polyester. Gray dry foam rubber swabs are placed in the high parts of the house as well as plaster in the exterior of the building in order to protect from cold weather. In addition, it absorbs heat from the sun’s radiation and it is diffused into the house. Plasterboard is used for the aesthetics of the construction.

The special material that is placed at the foundations of the building in order to protect them from rain water.

White plaster and fiberglass is placed over the base of the house and as a result rain water cannot pass in the house's foundations and contributes to the reduction of moisture in the walls.

The front side of the house is oriented to the south. The ground floor has the central door and the two large windows that allow sunlight enter the living room and the kitchen. The upper floor has three smaller windows that contribute to the heating of the bedrooms. Over these windows special sensors are placed which rotate higher window blinds towards the sun.

Another remarkable characteristic of this building is the fact that the upper floor extends over the lower one and as a result there is no need for a shading for the ground floor. In summer that the heat is more intense and sun is higher, the ground floor is protected and cooler during the day and even more at night.

In addition, thanks to the constructional features of this passive house, no air condition unit is installed for the heating and cooling of the interior, as it is measured that even during winter the temperature of the house is 17oC. This fact is also supported by the large windows that block the sun's radiation and maintains the temperature at a satisfactory level.

The special material placed in the foundations of the house

The most important feature that has been applied to this private house is the system for heating and cooling of the air entering the house. It is called "Earth Tubing Heating" (ETHE) and it is based in geothermy. It functions with special tubes that are buried around the foundations of the house. Apart from the fact that the used hot air contributes to the heating of the passive house, it is also used for the production of hot water.

ETHE system has low operating cost and it leads to a reduction of annual costs by 200,00€. Moreover, it is environmentally friendly, highly resistant and we achieve an even contribution of the temperature inside the house between the floor and the roof due to the heat emitted from the wall. Through the optional combination of wall and under floor heating the total heated space of the building is increased. In this way, the temperature circulation is decreased and alternative energy sources are used more effectively, such as solar heating, heat pumps, geothermal collectors etc.

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The "blind" wall that does not allow the cold air to affect the temperature of the house

Sixty five meters of polyethylene pipes were used, which were located in the foundations of the house since the beginning. The use of these tubes offer a 5 degrees increase of the temperature during winter and a corresponding decrease in summer. This air circulation system is an air compressor that drives fresh air from the external space towards the interior through the piping system.

The mechanical equipment of the passive house mainly consists of:

- Heat exchangers: Air to air heat exchangers is the system that transfers heat from the exhaust air in the incoming fresh air.
- Heat pumps: They are devices that draw the residual heat of the exhaust air and transfer it into thermal storage, e.g. hot water. Heat pumps differ from common air condition because they can be used for heating and cooling with the same refrigeration cycle. In the passive house they operate right after the heat exchanger.
- ETHE system: This system consists of the pipes that are placed under the ground and the system of air circulation inside them. The tubes are made by the polymer polyethylene.

The layers used for the insulation of the walls

The owner of the house aims at getting a certificate for the house's energy efficiency which will be awarded after the audit implemented by the group of Passivhaus. The following process will be followed:

- Export the existing air from the house and ventilation of the interior space.
- Insulation of the air ducts.
- Measurement of the energy consumption for the transition of the temperature at the desired levels.
- If it is found that power consumption is lower than 0,15 W/(m2·K), the specialists will approve the certification after one year.

The construction of the houses shell

Evaluation

Nowadays, modern societies are characterized by an increasing awareness concerning the protection of the environment, because of strict regulations, financial and other influences, as well as the environmental consciousness expressed by consumers. In a highly competitive environment, everyone must be aware of the urgency of our compliance with the new conditions and the need to turn nature's protection into a part of our everyday life.

The advantages of the bioclimatic and energy efficient design are the following:

- Environmental protection through the reduced pollutants and greenhouse gas emmissions
- Energy saving, thermal andvisual comfort
- Money saving thanks to the reduced need for fuel and cost of heating, cooling, ventilation, lighting
- Improvement in the quality of life

Basic elements of bioclimatic design are passive solar systems that use environmental sources, such as sun, air, wind, vegetation, water, for cooling, heating, lighting the buildings.

The energy consumption of a building depends not only on the quality, the materials of the construction and the technical installations, but also on the rational behavior of its users.

The ETHE tube

The appropriate planning and design of a building leads to great energy savings, regarding the orientation, the size and the location of the windows and openings, the protection of the building's shell with the right type of insulation etc. Particularly important is adequate shading and natural ventilation during the period of summer and the oposite techniques in winter, in order to achive a stable temperature.

Energy savings through bioclimatic design vary depending on the type of the building, the region's climate and the technologies used. The application of energy efficient techniques does not increase the construction's cost if the systems are simple. The implementation of more complicated techniques can increase the total cost by 10-15%. As for interventions in existing buildings, there is always an additional cost, which can be considered as part of the overall cost of renovation or reconstruction of the building.

To sum up, the application of environmentally and energy friendly techniques in the island of Rhodes is rather encouraging and sets a very interesting example for other initiatives, too. More motivations from the state's side are required, especially during this period that the financial conditions are extremely difficult and prohibitory for rnovations or construction of new energy efficient buildings.

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The grey foam used for insulation

Potential for transferability

The presented good practice constitutes an undisputed proof that even islands have realised the importance of this shift towards building techniques. In a sector that is responsible for the 40% of total energy consumption in the European Union similar steps have to be made in order to achieve a significant limitation in the use of energy in everyday life.

It is a remarkable fact that in Greece an average household needs 340% more energy for heating than a household in Finland, if we take into consideration the average temperature of these two countries. From the above percentage it can be assumed that the buildings in Greece have inadequate thermal insulation and the use of energy cannot be characterized as rational. Therefore, apart from the reconstruction of more energy efficient buildings and the energy saving interventions that can be applied in the older ones, there is a significant lack of information and awareness from the part of the citizens.

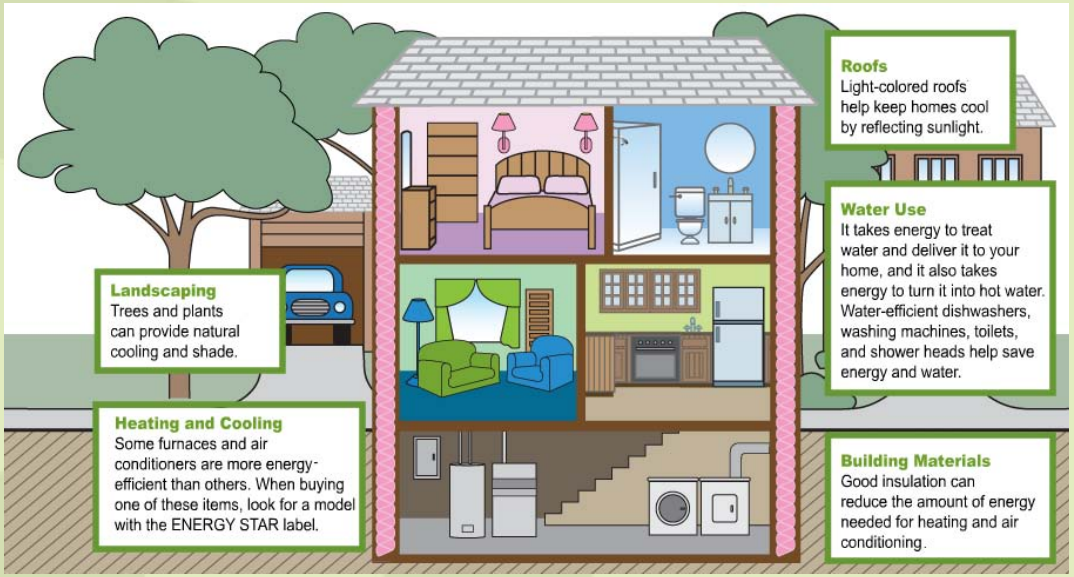
The energy efficient building that was presented in the embodies several methods that could be applied both in new and in older buildings, aiming at improving their energy footprint.

The large openings for natural lighting, ventilation and heating

The methods that were applied in the house in Asgourou for environmentally friendlier space and water heating, lighting, cooling, ventilation and shading could also be a part of the renovation of older buildings or the construction of new ones. Even if the installation of several energy saving systems is more expensive compared to the conventional methods, the actual profit is more important due to savings in energy and natural resources which is interpreted as reduced costs.

Even if it is not possible to spend large amounts in the establishment of new appliances and systems, there are also several no or low-cost techniques that are effective and result in the reduction of energy consumption.

One of the most important principles that has to be taken into consideration when constructing An energy efficient building, is its orientation that determines its behavior concerning weather conditions. Bioclimatic architecture pays attention to this feature as lighting, heating and ventilation depend on it.



Green Building applications

The improvement of the energy performance of a building is achieved thanks to the three categories of interventions:

- Extended reconstruction that can be done in case of total renovation, like the replacement of windows and frames, adding insulation materials, installation of exterior passive systems or conversion of conventional building materials in passive components (e.g. transforming a simple wall in solar wall), external shading systems (stable or mobile), etc.
- Small low-cost interventions such as limitation of cracks, indoor shading systems, ceiling fans, planting for shading, replacing incandescent light bulbs with low energy consumption bulbs, etc.
- Non-technique interventions, such as proper operation of building systems, including proper use of windows (natural heating in winter, shading and night ventilation in summer), rational use of electric devices in order to avoid thermal charge of the building (e.g. avoid cooking during the hours that the temperature is high).

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Project cofinanced by

European Regional Development Fund

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- Read S.A. (GREECE)
- Local Energy Agency Pomurje (SLOVENIE)
- Agência Regional de Energia do Centro e Baixo - Alentejo (PORTUGAL)
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