

# Sustainable Efficient Energy Concept for Passive Office Building

CRUȚESCU RUXANDRA

Dr.Arch. Assoc. Prof.

SpiruHaret University – Faculty of Architecture

13 IonGhica Street, sector 1, Bucharest

ROMANIA

[crutescuruxandra@gmail.com](mailto:crutescuruxandra@gmail.com)

*Abstract:* - This work presents an innovative building system used to build energy efficient buildings according to passive, nearly zero-energy, zero energy or plus energy standard. By introducing this concept in the first design phase, the result is an ecological building with low energy consumption. We want to show the advantages for the interior comfort, and also for the economic and environmental terms.

The building system consists indoor insulated concrete forms –ICF produced in Arcon Amvic Bragadiru. We want to highlight the advantages for the owner, consisting in having excellent interior comforted bills with insignificant amounts.

*Key-words* – energy efficient building, sustainable energy, passive concept, simple solution.

## 1 Introduction

Our goal is to demonstrate that it is possible to create an innovative, sustainable office building by respecting the passive house standard with a very easy to build efficient energy technology. That means neopor insulated concrete forms - ICF- produced in Romania, at Bragadiru, for the envelope and excellent work areas for headquarters of Amvic Group (Fig.1). This building is the first passive office building in Romania which was planned in year 2007 and built in 2008, in BRAGADIRU. We want to give an example for everyone, most of all for people and authorities, to show in reality the very big advantages of the passive house standard. We have the hope that this fact will increase the courage of the architects, engineers and especially of authorities to follow our example. In the paper we want to present how good the sustainable efficient energy concept was put in value in this first passive Romanian office building. What should be emphasized here is that we considered all conditions of the real estate for maximum benefit of its advantages. We wish to share our experience with all the specialists who are interested to get to know this concept. Further we want to point out that the passive house standard is an ongoing success story if you know how to take it into account in

an intelligent way. Starting from the planning of an energy efficient and sustainable solution and continuing with the building process which was very simple, we have obtained an environment-friendly result by using the ICF energy efficient building system. The PHPP was a real help for planning.



Fig.1 Amvic Group company.

## 2 Energy Efficient Solutions

We try to put in value and speculate the local conditions in our advantage, to make the most efficient possible the energy saving for all the processes in this building.

The insulated concrete forms –ICF- fabric offer partial protection for this building. We have a

heat- earth recovery in the garden who offer preheating or precooling of the fresh air for the entire building. The building is oriented with its main facade towards South (Fig.2). Within the space of the building with commercial and office purpose, the cold and hot water consumption being usually reduced. The lighting will be made by electric lamps with reduced consumption and sensitive system related to the illumination opportunity. Equipments like heating pumps, regenerative heat exchangers (between introduced air and evacuated air, fresh earth-air), solar panels and all equipments are with low energy consumption (fans, pumps).

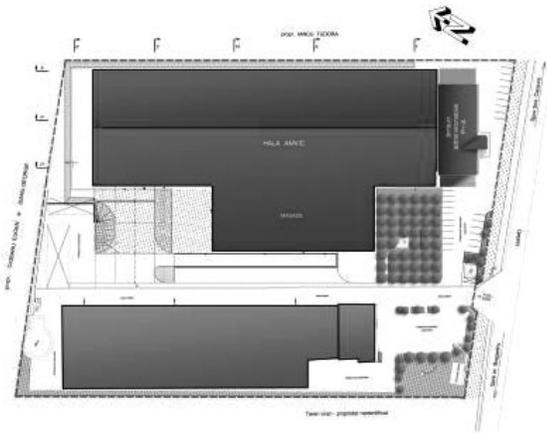


Fig.2 The orientation of building with his main façade.

The heating system of the building is made with hot air generally prepared with unconventional sources: soil heating taking over, pre-heating in a battery with heat carrier from a surface of solar receptor from an industrial process, heating recovery from the air exhausted, final heating being accomplished with heating pump water – water (Fig.3).

During summer, the interior air –conditioning is accomplished, that is its cooling by means of a reversible heating pump. The electric power necessary to generate the cooling task will be approximately three times lower than the heating effects.

For the air-conditioning dimensioning and the hot water preparation necessary for the functioning of the building, an assessment of the necessary heating and, respectively, of cold for the administrative house was accomplished under different challenging climatic conditions ,

summarized under the form of some equivalent temperatures.

In wintertime we use steam from the production process of insulated concrete forms as a source for the additional heating system. This offers gratis energy to be used in the building.



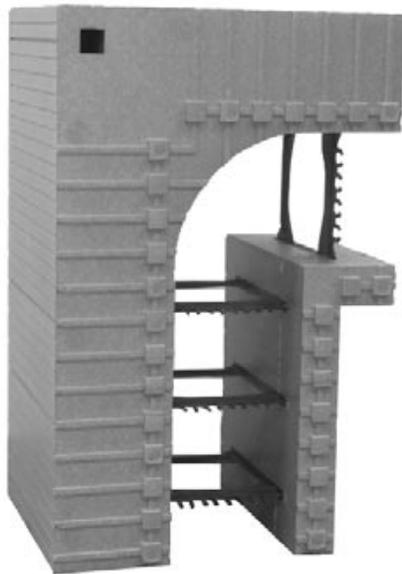
Fig.3 The heating system of the building.

For the design team, we have thus a very simple and easy to build system, with passive neopor insulated concrete forms, whoeliminates from the start thermal bridges, and have a very good solution for a continuous and sealed thermal envelope. The details were easy to design and construction time was very short also. Quality of the building is as aspect, very good and it was relative easy to obtain it. The building is in course to improve a monitoring system on-line for so that all the parameters to be observed in real time.

The two activities till now concerning interior temperatures during cold period have proved that what was designed very close also in reality. Other important aspects are:

- for envelope and structure of the building we have used Neopor ICF with an additional thermal insulation of Polystyrene (24kg/m<sup>3</sup>) to the exterior and Thermofloc to the interior;
- for the thermal insulation of the roof we used Thermofloc and Polystyrene.

Our researches have received from the building authorities the Certificate of Conformity (Fig.5).



a)



b)

Fig.4 a), b) Neopor ICF insulated concrete forms;

- the U-value of glazing is 0,5 W/ (m2 K), of the whole window (incl.aluframe) 0,8 W/ (m2 K);
- jalousie for solar protection;
- for preheating/ precooling of the fresh air we have a awaduct (Rehau) in the garden nearby (Fig.6a);



Fig.5 Certificate of conformity.

- the building has a good protection on the north side , consisting of the production hall;
- using renewable energy of sun (Fig.6b);
- heatpumps for floor heating system.

Due to the technological processes within the plant that is located close to the passive house the flow of hot technological water with an approximate temperature of 70 °C that totalize a maximal volume of 120 mc for a three hours interval, for the day period and for approximately 9 months each year.

During the very cold period of the year, this heating source is reduced as a consequence of the reduction of the technological process for producing expanded polystyrene. This source of energy is used in order to increase the temperature of the fresh air at the output of the switch with soil and before entering the filtration stage (Fig.6a).



a)



b)

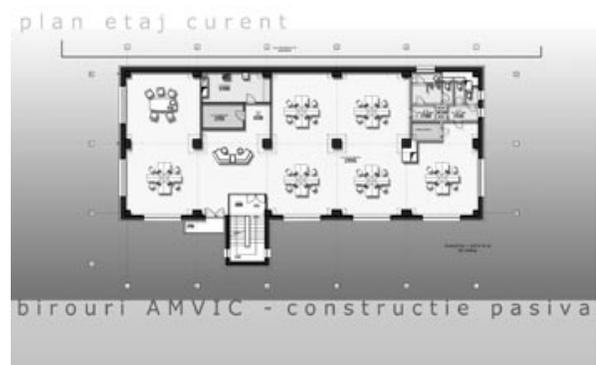
Fig.6 Preheating system (a) using renewable energy of sun (b).

The heating pump is the key equipment of this appliance and it functions in the cooling mode or in the heating mode, according to the season. Waste energies represent the energy sources of the heating pump; these types of energy can be renewable or with low heat potential and they are freely disposed in the nature (Fig.6b).

Moreover, in order to increase the energetic efficiency of the building, by means of reducing the power consumption in the warm period of the year, the cooling down the space with external air (free cooling) can be accomplished, according to the necessities; the flow of air can increase for a greater efficiency of the cooling process until a maximal value of 150% of the value of the nominal flow.



a)



b)

Fig.7 a) Increasing temperature of the fresh air; b) plan of Amvic offices.

Thus, heating accumulated over a day in the inertial elements of the building will be evacuated by means of free cooling phenomenon the next day the cooling unit being only used to eliminate the heating and humidity gains due to human activity as well as to the heating gains due to the equipment used. It is not recommended to accidentally open the windows for a natural ventilation because this action must be very well correlated with the external temperature as a random usage can lead to supplementary energetic consumptions.

### 3 Conclusion

Fig.7 presents the energy saving for each equipment as well as the global saving that is accomplished using the energetic loops developed in the functional scheme. Moreover,

an approximate value of 50% is represented by the energy recovered from the environment (soil, sun) and from the energy of the interior air, thus resulting only the necessary quantity for producing 50% of the total power. The isolation degree is highlighted once again by the energy need for the heat pump 3 that only covers the power losses to the exterior. At the present, the building described is finished and PassivhausProiect and Amvic Ltd are doing their activities as well inside of the very beautiful building; during cold period and also warm period ,the building is in process to monitoring of the energetic consumptions and to the analysis of their improvements.



a)



b)

Fig.8 Aerial (a) and façade (b) view of Amvic Ltd Group.

This monitoring as well as the entire building is part of the program “INOVARE”, in collaboration with Polytechnic University of Bucharest based on the European Union

Grand's Projects and the Research Department of Amvic Group Romania.

#### References:

- [1] Feist, Wolfgang, Protokollband Nr. 18 – *Qualitaetssicherung beim Bau von Passivhausern*, 2007.
- [2] Feist, Wolfgang, Protokollband Nr. 31 – *Energieeffiziente Raumkuhlung*, 2005.
- [3] Feist, Wolfgang, Protokollband Nr. 27 – *Waermeverlustedurch das Erdreich*, 2004.
- [4] Feist, Wolfgang, Protokollband Nr. 22 – *Lueftungsstrategien fuer den Sommer*, 2003.
- [5] Feist, Wolfgang, *Gestaltungsgrundlagen Passivhauser*, 2001.
- [6] Schnieders, Jurgen, *CEPHEUS-Wissenschaftliche Begleitung und Auswertung*, 2005.
- [7] Hera, Radu – *Usage of the heating pumps for dwelling heating, an ecological solution and power efficient*, rev. The plumber, no 9/2006, ISSN 1223-7418, p. 26-37, 2006.
- [8] Hera R., Mateescu, I., Ivan, G – *Optimization of power consumption within buildings by using heating pumps systems* (Conf. a XI-a a Installation Fac. With international participation „Efficiency, confort, power conservation and environmental protection”, Buc. 25-26 nov.2004), publ. CD.conf. p. 6, 2004.
- [9] Badescu V., - *Use of soil thermal energy for passive house heating*, 2nd International Symposium, „Renewable Energies And Sustainable Development“, 24-26 September, Tulcea, Romania, 2005.