BUILDING SYSTEM WITH INTEGRATED BIOCLIMATIC PILE

Arch. Nicolae Petrasincu

Romanian Solar Energy Society (SRES)
61 Blvd. Regina Elisabeta, 7062, Sector 5, Bucharest, Romania

ABSTRACT

The building system provides a solar energy passive contribution into a bio-climatic assembly. The heat carrier is the air. The solar radiation thermal conversion is made through the greenhouse effect. The air is diffused in the inner space naturally, due to pressure and temperature differences, without using mechanical means. There is a synergy, a cooperation of the assembly of building elements which, to this end, have multiple functions. The solar-building system operates optimally, according to the Sun's revolution, in the 45º parallel area, and provides conditioning both during the cold and the hot seasons, day and night.

The main advantages of implementing this solar-building system in the habitat are:
- an annual saving in conventional energy consumption of approx. 50%;
- increased comfort in the habitat and pollution reduction;
- depreciation of the costs of the elements specific to the solar energy thermal conversion in about 2 – 3 years, by reducing the conventional energy consumption.

The building cost, with average finishing, is not higher than that of a conventional building. From the town planning viewpoint, the system is suitable for individual plots for twinned and aligned homes. It is based on lightweight elements with dry manual mounting.

KEYWORDS

Passive solar heating and cooling.

DESCRIPTION OF THE BUILDING SYSTEM

The building system is designed as a wood or metal structure (cold bent sheet metal structures): poles of 3 m inter-axis with transverse beams at 60 cm inter-axis. The elements are assembled by using high resistance screws. The corrugated plate of steel or aluminum, which forms the covering, performs also the structural function of a tensional bar, ensuring the stability of the assembly. The outer walls are provided with light-weight thermo-insulating panels.

The entire building system has a strictly modular character, on the basis of the international planning module of 30 cm, with the basic module of the design network of 60 cm. The constructional elements are cold mounted manually. Both the form of the construction, its light weight and its mode of assembly ensure a good resistance against seismic stress and against high intensity of the wind (see Figure 1).

MODE OF OPERATION OF THE SOLAR BUILDING SYSTEM

The thermal conversion of the solar radiation is accomplished through the greenhouse effect. The heat carrier is the air, whose circulation is activated through the differences of temperature and pressure in the greenhouse and in the habitacle, without having to use mechanical means.

The covering, made of corrugated sheet metal, oriented towards South, with the glass panels mounted over the covering, forms the greenhouse. In the couple corrugated sheet metal - glass panels, the corrugated sheet metal constitutes the element of collection and conversion of the solar radiation.

In the functioning of the bioclimatic pile, fully integrated into the building, there are four types of conditions which can be distinguished: Cold season, sunny day (see Figure 1), Cold season, night or cloudy day (see Figure 2), Hot season, day, two situations - closed indoor space or ventilation through the current ascending from the glasshouse (see Figure 3); Hot season, night, situation in which the ventilation of the habitacle is ensured, from North to South, through the current ascending from the glasshouse (see Figure 4).

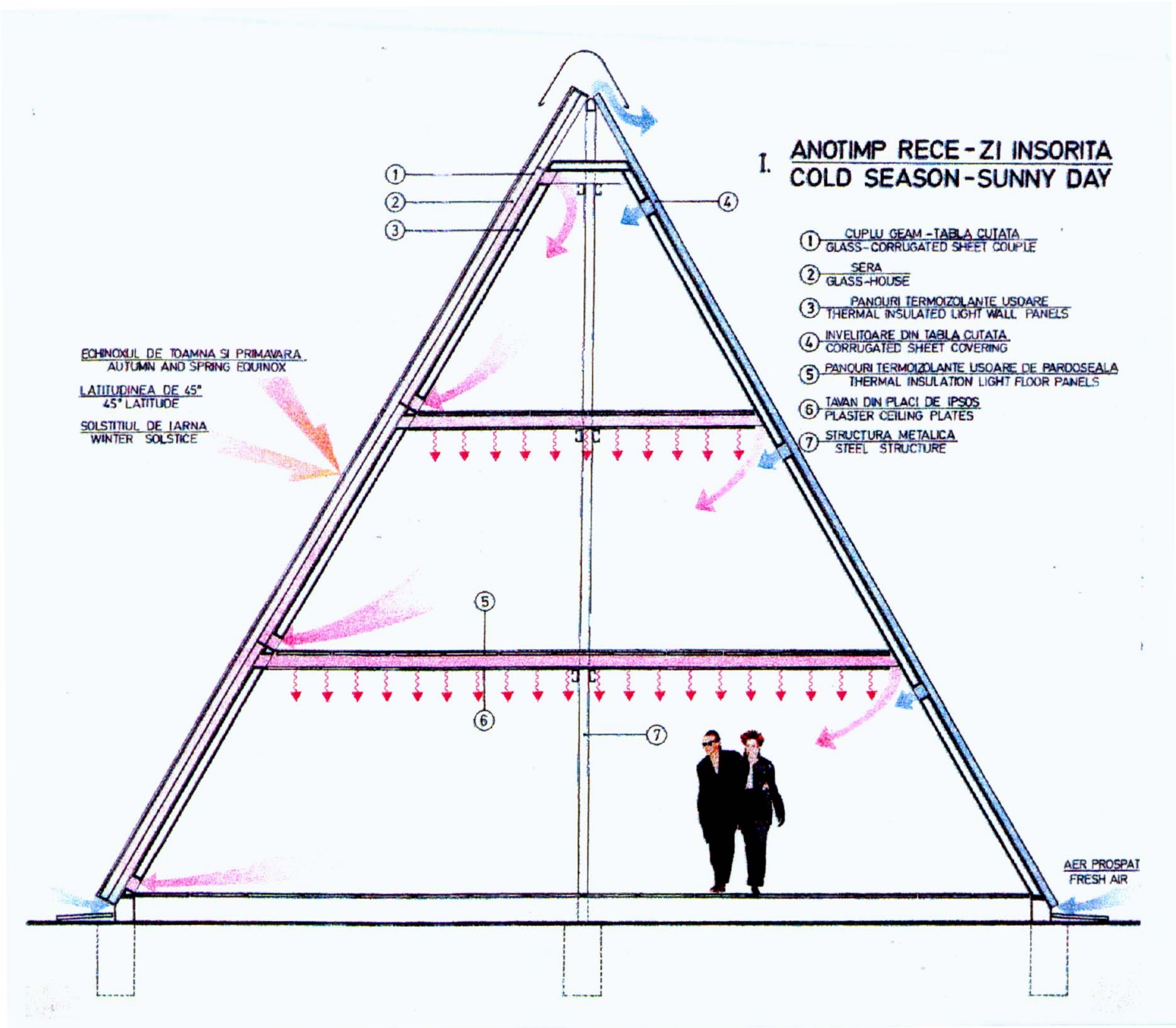

Figure 1. Cold season, sunny day

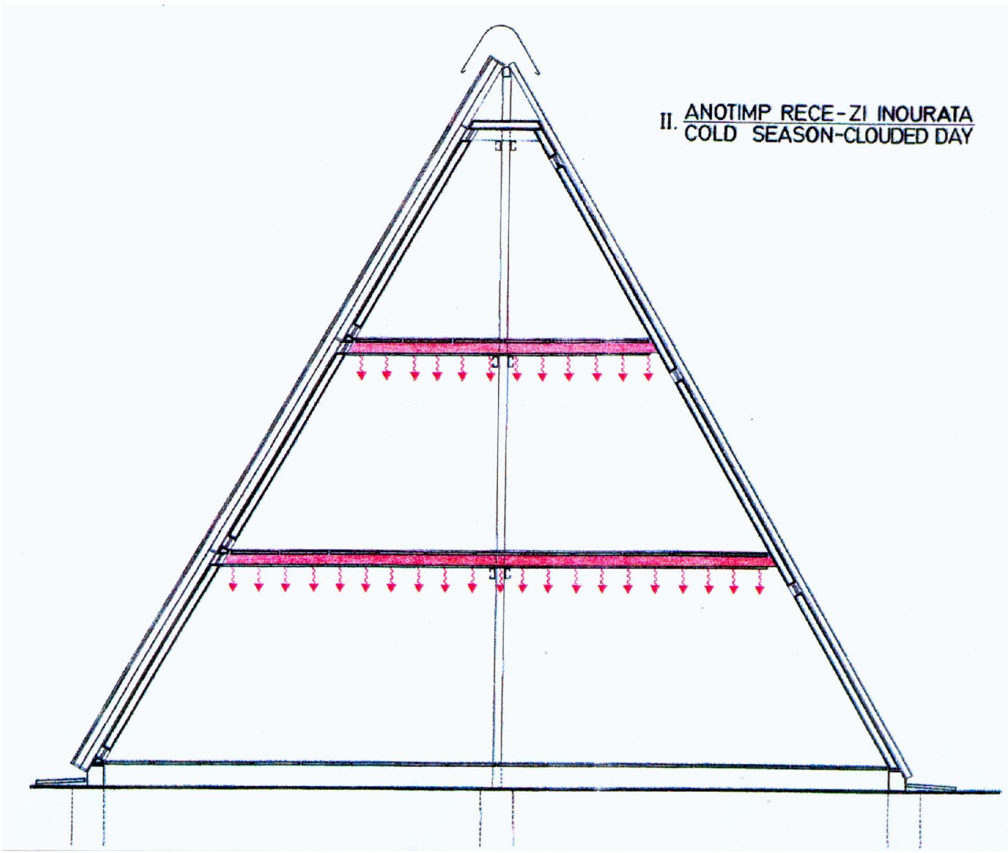

Figure 2. Cold season, clouded day

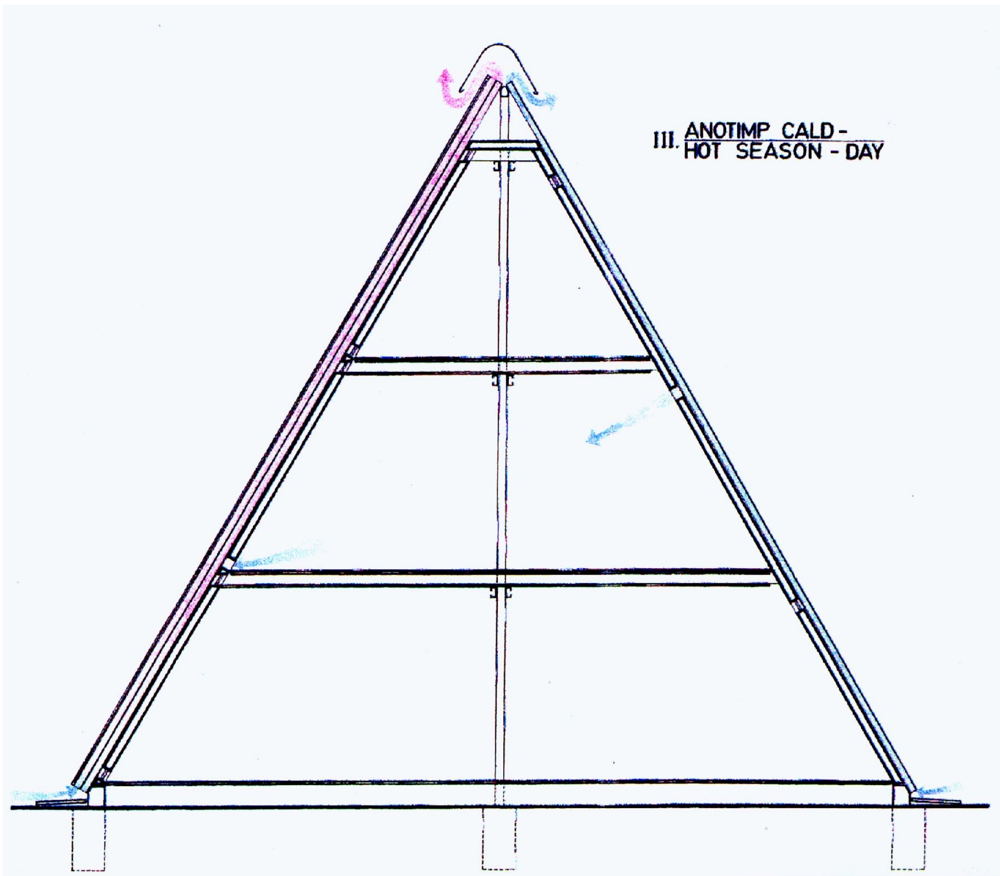

Figure 3. Hot season, day

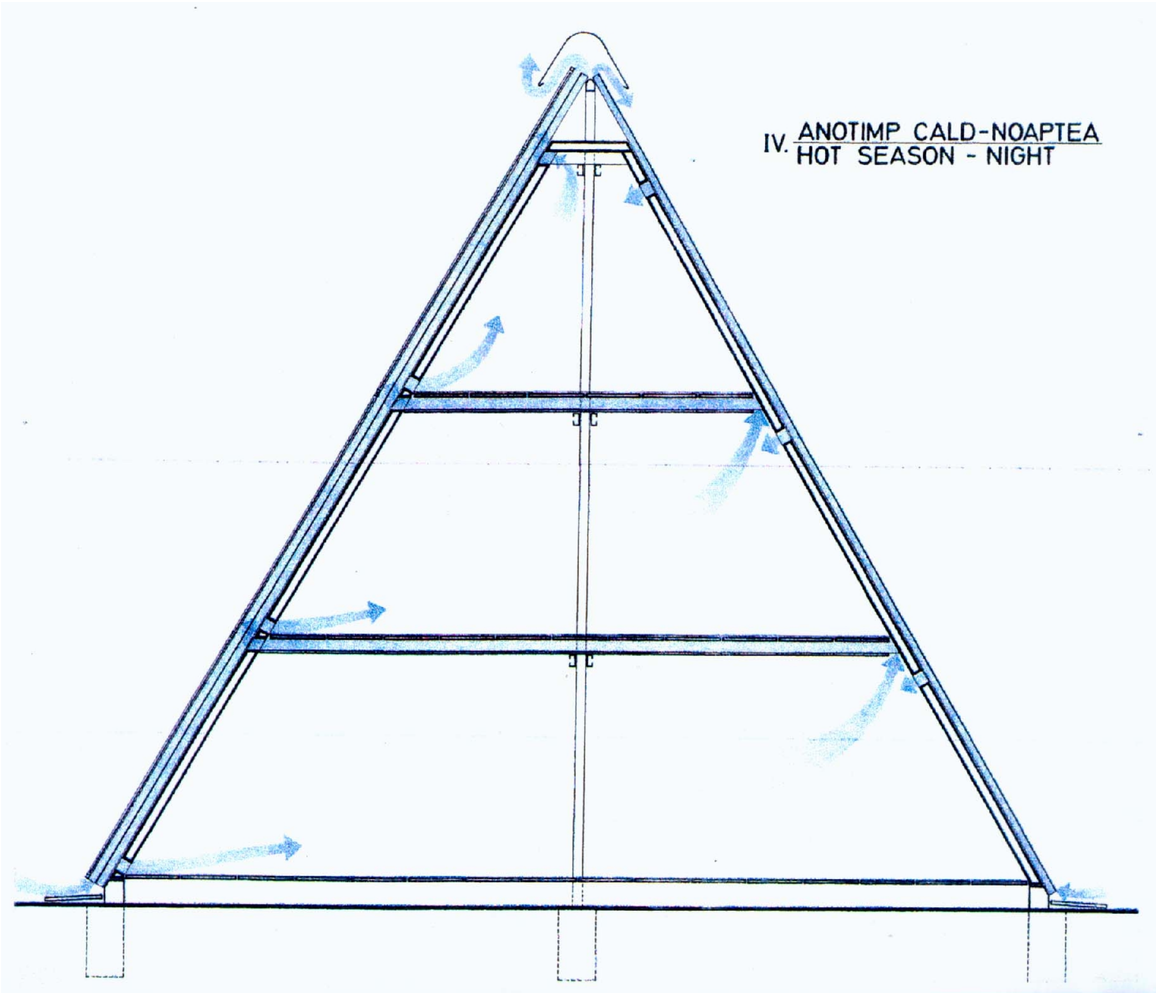

Figure 4. Hot season, night

The adaptation to the environmental conditions is achieved, in principle, through the tilting to 60° of the collecting surface, an optimum condition for the geographical area of 45° North latitude. This tilting of the collecting surface of the proposed building system with integrated bioclimatic pile permits, during the cold season (autumn equinox - spring equinox), a normal direction of the solar rays on the collecting surface, with a deviation of maximum 10° (see Figure 1). Also, this tilting offers the possibility to obtain a wide area for the collection of the solar radiation.

The opening and closing of the orifices for the access and directing of the air into the habitacle and into the glasshouse is achieved through simple means. During the cold season, no manual intervention is required. The changes which require an intervention are made only at the passage between cold and hot seasons.

In the TROMBE system, from which most of the passive solar heating systems are derived, the walls of the greenhouse are massive, with a high thermal inertia (ceramic blocks, autoclaved aerated concrete blocks, concrete, etc.), which accumulate heat slowly, their temperature not exceeding 25° - 30°C. The massive walls of the greenhouses have contradictory functions: the thermo-insulating elements in relation with the outdoor environment and heat generators for the indoor space.

Unlike the TROMBE system, in which it is necessary to have a long period of insolation in order for the system to start functioning, in the case of the above-described system the heating of the corrugated sheet metal occurs during an extremely short time interval. In this way, it is possible to benefit from any short time of insolation and even from the radiation of a diffuse sky. The thermo-insulating panels of the outer walls are separated from the corrugated metal plates, the collector element, which can reach a temperature of 60°C. The hot air obtained in the glasshouse is immediately introduced into the habitacle, where the heat is partially stored into the inner elements of the building, ensuring thus a constant average radiation.

CONCLUSIONS

The solar building system presented in this paper has been conceived on the basis of bibliographical data and of the author's own ideas. A constructional project was elaborated, however, due to some unfavourable circumstances, the experimental prototype could not be built until now.

Reality has shown that conventional energy will never again be cheap (bon marché), therefore the proposed system could represent a solution for the homes of an average social category as on the one hand its cost is acceptable, and on the other hand the system can be built by its own users, under the guidance of a constructor.

Another aspect worth highlighting is that the construction can be done in a short time. The fast execution of the construction work is also permitted by the fact that the building elements can be procured easily, due to their strict modular characteristics.

Conventional heating during peak hours can be carried out, depending on circumstances, locally or centrally. Also, hot water can be obtained in the hot season by installing solar collectors on the roof.

References

Barra, O. A. and Constantini, T. (1981). Sistema integrato barra - constantini per la climatizzazione di ambienti mediante energia solare.

Chauliaget, C. (1978). L'Energie Solaire dans le Bâtiment.

Colombo, R., Landabaso, A. and Sevilla, A. (1995). Manuel de Conception - Architecture Solaire pour la Région Méditerranéenne. *Centre Commun de Recherche - Commission Europée,* Bruxelles.

Cordier, J. P., Vion, P. and Duval J. P. (1984). Quattre Maisons Bioclimatiques à la recherche d'une nouvelle tradition. *Techniques et Architecture*, 78:85, 354.

Goulding, J., Levis, J. O. And Steemers, T. (1992). Energy in Architecture. *The European Passive Solar Handbook.* B. T. Batsford.

Jourda, F. and Perrandin, G. (1984). L'Architecture Climatique, élément d'une nouvelle culture. *Techniques et Architecture*, 50:53, 354.

Los, S. (1984). Processus de Conception et Système Solaires Passifs. *Techniques et Architecture*, 54:56, 354.

Menar, J. P. Maisons Solaires - Premiers Bilans. *Editions du "Moniteurs".*

Nibart, J. C. (1984). Le Fond de l'Air. *Techniques et Architecture*, 96, 354.

Phelouzat, P. and Foulanier, S. (1984). 33 Maisons Solaires HLM à Villepint, Seine-Saint-Denis. *Techniques et Architecture*, 68:69, 354.

Szokolay, S. V. Solar Energy and Building (1977). *The Architectural Press*, London.