Scientific Bulletin of the "Petru Maior" University of Tîrgu Mureş
Vol. 13 (XXX) no. 1, 2016
ISSN-L 1841-9267 (Print), ISSN 2285-438X (Online), ISSN 2286-3184 (CD-ROM)

THE ADVANTAGES OF THE PASSIVE CONSTRUCTION OF OFFICE BUILDINGS IN THE JIU VALLEY

Andreea Cristina TATARU[1], Dorin TATARU[2], Aurora STANCI[3]
[1,2,3]*University of Petrosani,*
Universităţii Street, no. 20, Petrosani, Romania
[1]andreeastanci@yahoo.com
[2]dorin.tataru@yahoo.com
[3]stanciaurora@yahoo.com

Abstract

The concept of a 'passive House' has been introduced for the first time in Germany, subsequently being extended and at higher latitudes and different features climatic from those of Germany, in the south, west and south-west of Europe. In this paper we strive to study at the concept of 'passive house' in the Jiu Valley (latitude 45.63, and longitude 25.41) Using the Passive House Planning Package (PHPP) software 2007 calculate the heating requirements for such a House, depending on the latitude and climate conditions in the locality. It will also analyze the constructive solutions for reduction of the amount of heat below the maximum allowed for a "passive house" (which is 15 kWh/m² per year). Also we will present you which are advantages of construction of this kind of building.

Key words: passiv hause, advantages, office buildings

1. Introduction

Passive house concept was first introduced in Germany. Passive building has been defined by Wolfgang Feist, Passivhaus Institut, as being the building that demand for heating must not be more than 15 kWh/m² year, and total consumption of primary energy should not be more than 120 kWh/m² year. Also, the number of changes of air per hour at a pressure of 50 Pascals should be less than 0.6 h^{-1} [1], [2], [4], [5].

The concept has been extended to other latitudes and climates in southern, western and southwestern Europe.

We ask ourselves if this passive building concept also applies to diferent latitudes than those of Germany (small latitude than those of Germany). In this paper we propose to study the concept for localities in Jiu Valley.

2. Presenting the concept of "passive house"

The passive house concept is a peak in energy efficient construction; Heating energy savings of 75-80% compared to a newly built house after current standards (European standards). The need for energy for heating is below 15 kW/h/m^2/year, we have cost € 10-25/month for heating which makes a passive house to be relatively indifferent to swings in energy prices. These houses reach enormous energy savings thanks to some particular components of an effective and intelligent ventilation. However, comfort is enhanced, not diminished, and considerably increased. Passive house is more than a home that saves energy, and passive building concept, is a global concept for building of quality homes, healthy and sustainable. This concept can be easily understood by everyone.

Currently new constructions and those in rehabilitation, is increasingly isolated even better and air tighter, generate true ventilation deficiencies by eliminating cracks and imperfect joints. Even "ventilation by opening windows" is not satisfactory in terms of energy. Fresh air is not just a matter of convenience, but a necessity for a healthy life. That is why the ventilation of a home is one of the essential techniques for future constructions.

Certainly a controlled mechanical ventilation system has a price, but if it is built in effective manner generates great savings. Ventilation systems labeled "passive house" are guaranteed profitable.

Determinant aspect of the concept of the passive house is the presence of fresh air in every room. It is used for heating - in reasonable quantity, without uncontrolled circulation, without noise and currents.

The idea of "fresh air heating" is only possible in a building very well insulated, tight as passive house. Energy demand for heating should be below 10 W / square meters (habitable sqm) if we want to use air ventilation and heating the building. Passive house

supposes performance in terms of: insulation, construction without thermal bridges, air tightness, ventilation with heat recovery, windows and innovative technique.

For all this to work harmoniously building's energy balance is achieved with specialized PHPP program, developed by the Passivhaus Institut in Darmstadt [1], [2], [4], [5].

3. Area description

Depression Jiu Valley, as the name suggests is crossed by two major rivers, the West Jiu and East Jiu the thread which is located localities of the micro-region and is surrounded by four mountain ranges: Retezat (nature reserve) located in the north-northwest, Sureanu in the east-northeast, Parang east-southeast and south Valcan (Figure 1). The average altitude in the Jiu Valley is 600 m above the Black Sea.

Access to depression Jiu Valley is:

- In the south part from Tirgu Jiu
- In the north part on the national road from Simeria 66,
- in perspective of the west side Cheile Butii from Herculane.
- from the eastern side through Jiet Valley to Petrosani from Obarsia Lotrului

Micro-region has a triangular shape and oriented WSW – ENE - a length of about 60 km, between the towns Cimpa east and west Campul lui Neag. Width decreases at 9 km, near Petrila and Livezeni, to 1.5 km to the Campul lui Neag.

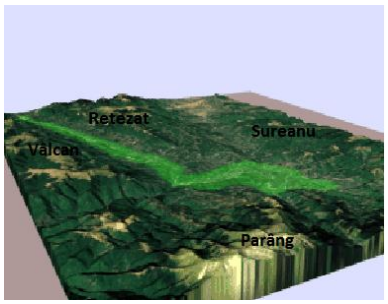


Fig. 1: Jiu Valley location

In the national territory, micro-region is located in the central-western Romania and intersected by parallel 46^{o} south latitude and the meridian 23^{o} east longitude. It borders the counties of Alba, Valcea, Gorj, Caras-Severin.

The climate is temperate continental, with slight influences of Mediterranean currents, the average annual temperature of 6-8^{o}C. The climate is harsh, but not excessive, the winters are not cold (there were never recorded -30°C), but the summers are generally cool.

For the study case we chose to place passive house building in the Jiu Valley, in the Vulcan city.

Vulcan town is located at the foothills Valcan and is crossed by the national road 66A, which connects the Valea de Brazi and Vulcan. The town lies at a distance of about 12 km from Petrosani.

Vulcan, currently covers an area of 8731 ha and has two localities: Dealu Babii (village located in the north on the DJ-66 Vulcan - Merisor) and Jiu-Paroseni (village located in the western part of the city, on Route 66APetrosani- Uricani) (Figure 2).

Fig. 2: Location of Vulcan

Vulcan is bordered by city Aninoasa east, to the west with Lupeni city, township and county Gorj Banita north to south. It is the second largest town of the Jiu Valley, after Petrosani, and is crossed from west to east of West Jiu river.

Settlement Vulcan has as geographic coordinates: latitude 45.63, longitude 25.41.

4. Advantages on the construction of passive buildings

The construction of passive houses presents a number of important advantages.

They offer an ideal interior temperature, optimum thermal insulation, reducing costs to a minimum energy consumption.

A passive house uses only building materials very good thermal insulation, thermal windows and woodwork insulated wood and a ventilation system integrated. The temperature remains pleasant both winter and summer.

Also, the passive house is very healthy for people, as it leaves no training dampness, moisture or air locked, providing daily comfort with minimal energy consumption.

The materials used to construct the buildings are 100% natural and is made from natural raw materials: quartz sand, lime, cement and water; They are environmentally friendly. (In production, for use in case of fire or harmful substances not apparent, the remainder being returned results in the manufacturing process;

In conclusion, homes energy-efficient are dedicated owners who think long term, who appreciate the reduced both costs: in the construction and energy bill, and who want an eco home, easy to maintain and comfortable.

Although passive investment for construction of buildings is higher than in a conventional construction with 5% to 25%, these long-term economic advantages due to low cost of maintenance.

Solar panels proved to be the most ecological and

economical heating method. Annual avoids release a quantity of CO_2 in nature, amount equivalent to the emission of gases of a motor vehicle has traveled more than 10,000 km.

Solar energy is inexhaustible and environmentally friendly. Light is pure, unaltered.

You benefit also such kind of pluses: 0 condensate, comfortable indoor climate in both summer and winter, heat loss 0, annual energy consumption up to 15 kwatts/sqm/hour. Heat loss through the roof, walls, floors or windows (common in a normal house) are non-existent here.

Environmental impact is negligible precisely because exploiting solar energy and fuel consumption is reduced. Like that toxic emissions are insignificant.

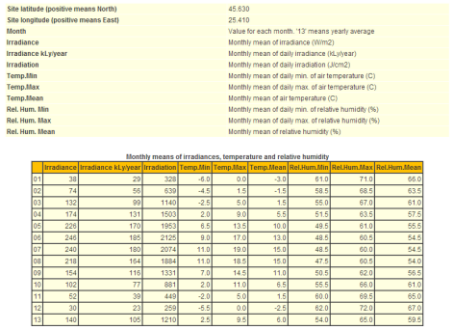
Once heated house, the windows no longer open and the heat stays indoors for days. Then use energy saving light bulbs and household appliances in energy class A+ to have reduced consume.

The advantage of such homes is energy saving, which translates into lower bills. Especially during winter, when heating costs more, but in the summer it saves electricity for air conditioning. Electric current equipment necessary home appliances will still be taken from the network, but it represents only a small part of the costs, we believe that an energy independent house can be cheaper in operation by 60-80% compared to a similar house, properly insulated and heated conventional.

Another advantage is that it is environmentally friendly by consuming less energy, produce less pollution [1], [2], [4], [5].

5. The possibility of implementing the concept of "passive house" in the Jiu ValleyChapters titles

For this study were processed climatic data (average monthly climatological database of solar radiation, temperature and relative humidity) were taken from the site www.soda-is.com (Figure 3).



Site latitude (positive means North)	45.630
Site longitude (positive means East)	25.410
Month	Value for each month. '13' means yearly average
Irradiance	Monthly mean of irradiance (W/m2)
Irradiance kLy/year	Monthly mean of daily irradiance (kLy/year)
Irradiation	Monthly mean of daily irradiation (J/cm2)
Temp.Min	Monthly mean of daily min. of air temperature (C)
Temp.Max	Monthly mean of daily max. of air temperature (C)
Temp.Mean	Monthly mean of air temperature (C)
Rel. Hum. Min	Monthly mean of daily min. of relative humidity (%)
Rel. Hum. Max	Monthly mean of daily max. of relative humidity (%)
Rel. Hum. Mean	Monthly mean of relative humidity (%)

Monthly means of irradiances, temperature and relative humidity

	Irradiance	Irradiance kLy/year	Irradiation	Temp.Min	Temp.Max	Temp.Mean	Rel.Hum.Min	Rel.Hum.Max	Rel.Hum.Mean
01	38	28	328	-6.0	0.0	-3.0	61.0	71.0	66.0
02	74	56	639	-4.5	1.5	-1.5	58.5	68.5	63.5
03	132	99	1140	-2.5	5.0	1.5	55.0	67.0	61.0
04	174	131	1503	2.0	9.0	5.5	51.5	63.5	57.5
05	226	170	1953	6.5	13.5	10.0	49.5	61.0	55.5
06	246	185	2125	9.0	17.0	13.0	48.5	60.5	54.5
07	240	180	2074	11.0	19.0	15.0	48.5	60.0	54.5
08	218	164	1884	11.0	18.5	15.0	47.5	60.5	54.0
09	154	116	1331	7.0	14.5	11.0	50.5	62.0	56.5
10	102	77	881	2.0	11.0	6.5	55.5	66.0	61.0
11	52	39	449	-2.0	5.0	1.5	60.0	69.5	65.0
12	39	29	259	-5.5	0.0	-2.5	62.0	72.0	67.0
13	140	105	1210	2.5	9.5	6.0	54.0	65.0	59.5

Fig. 3: Average monthly climatological database of solar radiation, temperature and relative humidity

Climatic data were processed using programs Fortran and introduced in Passive House Planning Package (PHPP) 2007 program.

Climatic data results after running the Fortran program (figure 4) are selected (figure 5) and introduced in the climatic data sheet in Passive House Planning Package (PHPP) 2007 program (figure 6).

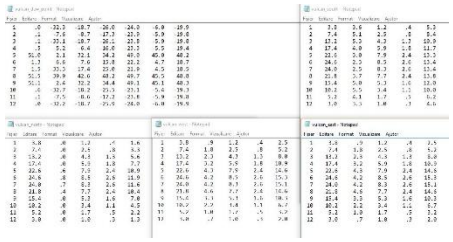


Fig. 4: Climatic data results after running the Fortran program

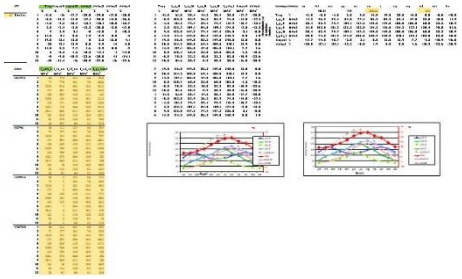


Fig. 5: Select climatic data for Passive House Planning Package

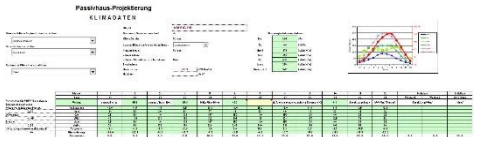


Fig. 6: Introduction of climate data in Passive House Planning Package (PHPP) 2007 program

The analysis was performed after the office building model Amvic (Figure 7).

Fig. 7: Passive office building AMVIC – Bragadiru

Amvic building is structured as follows: ground floor, three floors and attic. The structure and main functions of the office building Amvic are: on the ground floor there is a large open space, secretarial and department office. In a separate area is a technique room. The first, second and third floor have office space. In the attic there are five apartments Amvic (Figures 8, 9, 10).

Building envelope and interior divisions are separating elements with high thermal inertia. They are grouped into inner and outer walls respectively, roof, floor and plate. The outer walls are fitted with triple stratified low-e glazed.

Fig. 8: Ground floor plan for office building Amvic

Fig. 9: Floors plan for office building Amvic

Fig. 10: Attic plan for office building Amvic

After processing climate data and entering them into the computer program Passive House Planning Package (PHPP) 2007, we obtained results for Amvic house is a passive house office with an area of 2086 m^2. Windows from the southern area of 156 m^2, 56,08 m^2 northern, western and eastern 83,21m^2 of 42.35 m^2 (Table 1).

In this paper we propose to study the behavior Amvic house at different ways of construction of exterior walls. The calculations will be performed for a house with walls well insulated and a house with a simple insulation. Following this analysis, we can determine CO_2 pollution originating from obtaining the necessary energy to heat the home.

Table 1: The dimensions of the passive house Amvic

Zusammenstellung					
Gruppe Nr.	Flächengruppe	Temperaturzone	Fläche	Einheit	Bemerkung
1	Energiebezugsfläche		2085,93	m²	Wohnfläche nach WoFlV bzw. Nutzfläche nach DIN 277 innerhalb der thermischen Hülle
2	Fenster Nord	A	56,68	m²	
3	Fenster Ost	A	43,35	m²	
4	Fenster Süd	A	155,96	m²	Ergebnisse kommen aus dem Blatt "Fenster"
5	Fenster West	A	83,21	m²	
6	Fenster horizontal	A	0,00	m²	
7	Außentür	A	3,78	m²	Fläche der Außentür bitte selbst im entsprechenden Bauteil abziehen
8	Außenwand Außenluft	A	2212,39	m²	Fensterflächen werden bei den Einzelflächen abgezogen, die im Blatt "Fenster" angegeben sind
9	Außenwand Erdreich	B	0,00	m²	Temperaturzone "A" ist Außenluft
10	Dach/Decken Außenluft	A	0,00	m²	Temperaturzone "B" ist Erdreich
11	Bodenplatte	B	515,01	m²	
12			0,00	m²	Temperaturzone "A", "B", "S" und "X" dürfen verwendet werden. NICHT "I"
13			0,00	m²	Temperaturzone "A", "B", "S" und "X" dürfen verwendet werden. NICHT "I" Faktor zu X
14	porch / windfang etc	X	0,00	m²	Temperaturzone "X". Bitte Temperaturzeroliffaktor hier selbst eingeben (0 <f. < 1) 976
15	Wärmebrücken Außenluft	A	0,00	m	Einheit in lfm

It appears that for well-insulated house needs heating Amvic is 7 kWh/m² year (Table 2). The maximum limit for heating needs of a passive house is 15 kWh/m² year. Exterior wall thickness is 60 cm (Table 3).

Table 2: Required heating well insulated house Amvic

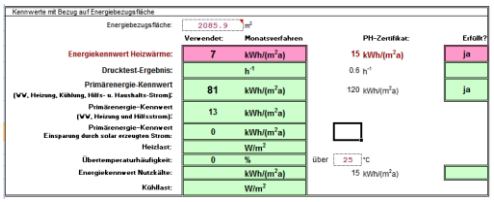
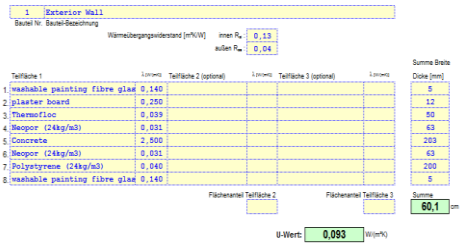


Table 3: Exterior size of walls for the house well insulated Amvic



Amvic, same house, but with normal insulation (100 mm polystyrene), heating demand is 22 kWh/m² year this we can be considered passive house (Table 4). Exterior wall thickness is 31 cm (Table 5).

Table 4: Heating necessary for normal insulated house Amvic

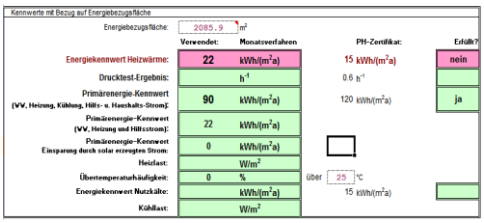
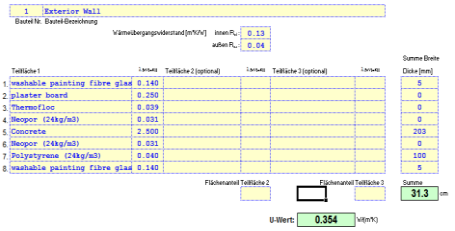


Table 5: Exterior size of walls insulated for normal home Amvic



Following this analysis can be seen as passive house concept is viable in this climate zone, falling into a necessary heating under 15 kWh / m² year.

Power consumption of the difference between the two models of the building can be seen significant energy savings. Yes, here we can determine the amount of CO_2 emitted into the atmosphere for heating of the both types of buildings. To obtain a kWh, 0.34 kg CO_2 is emitted into the atmosphere. Amvic heating a well insulated houses are emitting into the atmosphere 5022 kg CO_2/year, and for heating a Amvic house with normal insulation, in atmosphere is emanated 15941 kg CO_2/year.

6. Conclusions

Needs for heat depends on insulation and the thickness of exterior walls, and thermal conductivity of the insulation, the form and foundation and roof insulation and the distribution of windows.

From the performed analysis, we can see the difference necessary for heating a house with good insulation and a house with normal insulation, and both of these can be considered "passive house" for Jiu Valley.

Advantages on the ”Passive house” buildings are: ideal interior temperature, optimum thermal insulation, reducing costs to a minimum energy consumption.

Using the software Passive House Planning Package (PHPP), we found that the need for heating for the Amvic house in town Vulcan, Romania (latitude 45.63, longitude 25.41) with good insulation is 7 kWh/m² year and for the one with normal insulation is 22 kWh/m² year.

Amvic home with good insulation can be considered "passive house" because is not passing the maximum limit allowed for the necessary 15 kWh heating/m² year.

This high consumption of energy for normal insulated house cause greater air pollution from the process of energy production in power plants.

By achieving thermal insulation of Amvic houses, a good result in harm reduction of CO_2 emitted into the atmosphere from power plants 15941 kg CO_2/year to 5022 kg CO_2/year.

Reducing these pollutants emphasizing decreases greenhouse effect.

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