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DOMESTIC WATER SUPPLY SYSTEM OF AUTONOMOUS HOUSES

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Rezumat. *Conceptul de casă autonomă, în zilele noastre devine din ce în ce mai popular, datorită crizei energetice care este într-o continuă creştere şi a dorinţei oamenilor de a se asigura împotriva penelor de curent, de căldură şi de apă. Sistemul de electricitate, de apă menajeră, de canalizare şi cel de încălzire sunt cele mai importante când e vorba de autonomie. În schimb, trebuie să luăm în considerare şi poluarea mediului. Putem cosidera o autonomie 100% dacă avem suficient curent electric şi apă menajeră. [1]*

Abstract. *Autonomous house concept, in modern world become more and more popular, because of the crisis that increases every year, especially in energy sector, and people willingness of assure against electricity and heating breakdown as well. Electricity system, domestic water system, sewage system and heating system are the most important characteristics of autonomy. In exchange, we have to consider environment pollution too. The most delicate problem regarding house autonomy is power supply, then domestic water system; if it's enough, we can consider that we have a 100% autonomous house.[1]*

Keywords: water, energy, plumbing, autonomy, house.

1. Introduction

About autonomous house concept, there are not standards yet; we can tell a house autonomous any house which has got a fuel tank or few crates of firewood, but this is a big exaggeration. First we have to decide what is house autonomy and how it could be.

Electricity system, domestic water system, sewage system and heating system are the most important characteristics of autonomy. In exchange, we have to consider environment pollution as well. The most delicate problem regarding house autonomy is power supply; if it's enough, we can consider that we have a 100% autonomous house. Unfortunately geographical places where cheap and plenty of renewable electricity can be produced are very few. So, easiness or difficulty building of an autonomous house is determined by availability of renewable energy sources at construction site. [2]

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Putting in work this problem of autonomy, depends of energy quantity that house owners need. There is a lot of so called “green guys”, people that have a lifestyle environment friendly, even though their houses are equipped with computers, TV sets, fridges, light bulbs, and many other electric consumers. Electricity is produced by cheap wind turbines and photovoltaic solar panels that charge some batteries, heating and hot water are powered by solar panels and a small wood/ briquettes furnace. [4]

Regarding domestic water system, tap water is not necessary to be potable as in the case of ordinary water supply network, this water is used for washing, dishwashing and toilet use so, it can be obtained from natural source of fresh water, rain water. This can be acquired in a simple manner, using a captation area, as large as posible, and few water tanks. Before sending this water to tap, it must be filtered by all debris bigger than 0.05 mm, this operation can be carried out by a filtration battery.

The problem with drinking water can be solved fitting an additional tap in kitchen sink that is connected to a supplementary drinking water system who contains a drinking water tank filled by a small pump connected to a fresh water source (a water well or even a spring) situated nearby. [2]

Starting with 2019 we’ll have autonomous houses. European deputies at Strasbourg will vote a report that all the buildings built up after 2019 to produce locally, all the energy that it needs (*source:* “Amos News”).

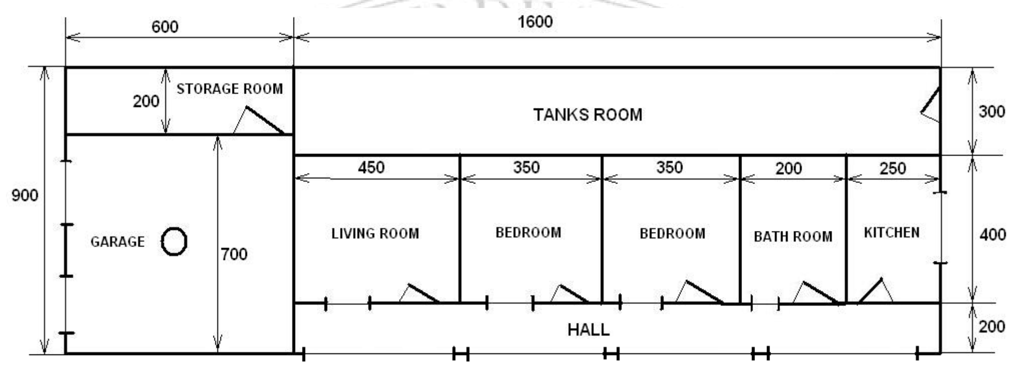
As report says, all the 160 millions buildings in Europe consumes 40% of total amount of energy consumed by Europe, hence they contributes substantially at greenhouse effect.

It’s estimated that new regulations will reduce energy consumption up to 5…6% and decreasing of CO_2 emissions up to 5% in EU untill 2020.

2. Domestic water system designing

The purpose of this study is designing of domestic water system, this system being one of the most important system because of the water consumption for washing and dishwashing machines, tap water and toilets, is considerable big.

A house with the following configuration can be considered, as in figure 1;



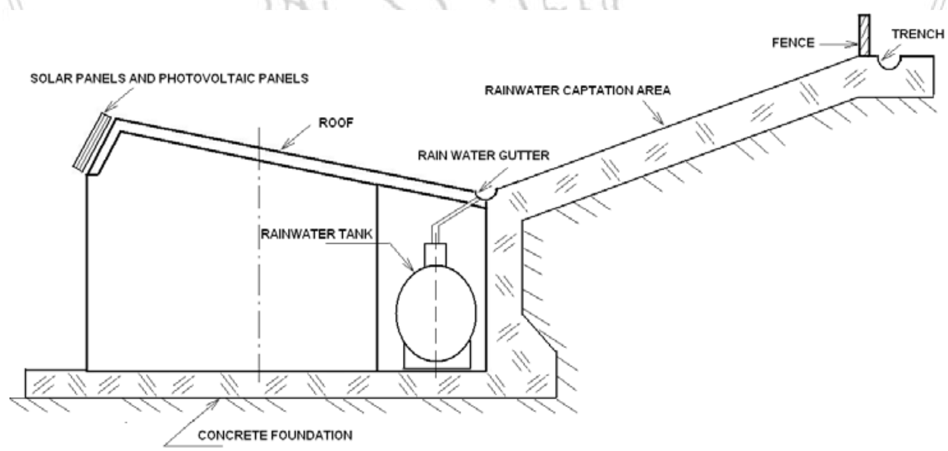


Figure 2. *House cross section plan*

2.1. Tanks volume calculation

First of all, total volumes of water tanks should be calculated, considering that a four members family need 25 cubic meters of water per month, as can be noticed below, in equation 1;

$$\langle 1 \rangle \quad Vtot = Vnec/month = 25m^3$$

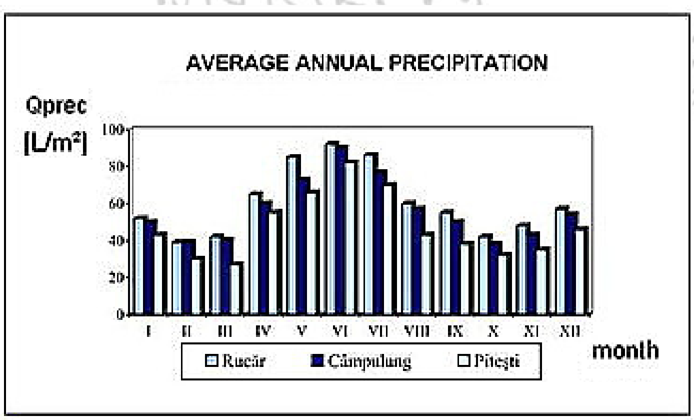
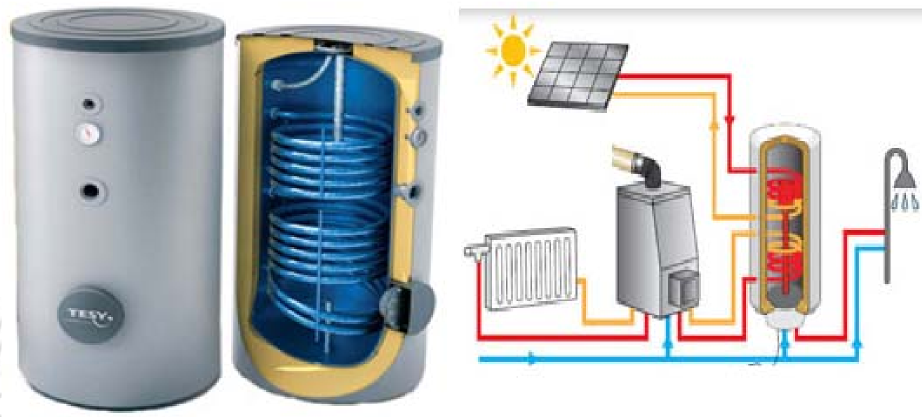


Figure 3.

2.3. Putting in work the water system

This house has the following water consumers: three sinks, one bathtub, one toilet and one bidet; excepting toilet, all consumers have cold and hot water as well.

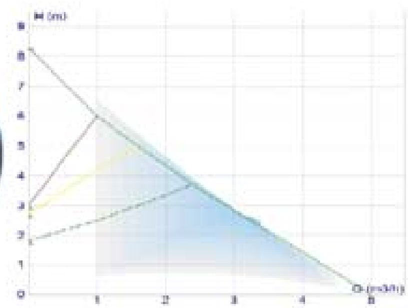
Hot water is prepared into an water heater with two heat exchangers (see fig. 4);



a reasonable value for flow. Problems appear when using washing machine, dishwashing machine or level in tanks decreases bellow sinks level, for example less than 1/6th of tanks capacity.

Solution is inserting a small pump in circuit, an energy class A 75W centrifugal pump that improves considerable the pressure and flow (as that one in figure no.6) and starts when a tap is used. [9]

The new value for pressure is <**13**> **p** = 0.7 bar , and flow <**14**> **Q** = 25 l/min



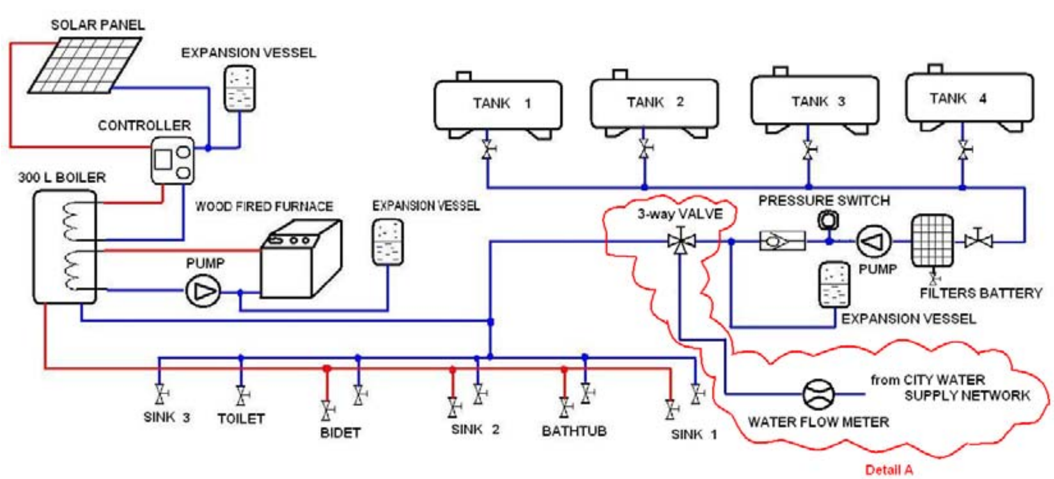


Figure 8. *DHW system diagram*

where the water heater has a capacity of 300 L (sufficient for use of four people), and solar panel is evacuated tube heating collector type with 30 tubes, as that in figure 7, which works even outside is cold and windy – this type of solar panel uses UV and infrared radiation of the sun. [7], [8]

In case of excessive draught, for ensuring house occupants against water shortage, connecting house water system to city water supply network solves this problem when house water tanks are empty for a determined period of time. Switching between ecological water system and city network is realized in a simple manner by a the 3-way valve, as can be observed in figure 7 , detail A; [9]

Another benefit of this independent water system is that it can be implemented into an ordinary house as well. An important amount of money can be saved.

3. Cost calculation and amortization

The total cost with DHW system is divided in two parts: cost with materials and cost with workmanship.

Mainly, the materials and equipments are needed for this kind of system can be observed in table 1.

Product name	**Price/unit <€>**	**Pieces**	**Price <€>**
6 000 L polyethylene water tank	950	4	3800
30 tubes evacuated tubes solar panel	550	1	550
Solar group controller	150	1	150
Double heat exchanger 300 L tank water heater	550	1	550
24 L expansion vessel	25	2	50
Filter battery	50	1	50
Centrifugal pump	150	1	150
PP-R aluminium composite pipe 25mm diam.	1.5	77	115
Fittings	1	125	125
Materials Total			**5540**

Table 1. *The cost with materials including equipments*

Workmanship cost:

Total amount of workmanship cost is calculated as per equation 15, rates are taken from [11]:

<**15**> $Cost_w$ = 4 x tank + 1 x filters + 1 x pump system + 1 x panel + 1 x group + 1 x boiler + 77m pipe = 4 x 22.5 + 1 x 30 + 1 x 70 + 1 x 70 + 1 x 35 + 1 x 35 + 77 x 1.04 = 410€ so, **Workmanship Total : 410€**

Considering that in one month, water consumption is 20m³, in one year total consumption is 240m³, with an average price of water in city network by 1€/ m³, this means annual cost with water is 240 € , then the amortization of the entire ecological water system, as can be seen in equation 7 is achieved in :

<**16**> **A** = (**C**ost_{mat} + **C**ost_{work})/$Water_{cons\ ann}$ = 5950/240 = **24.8 years** , aprox 25 years.

4. Conclusions

Investment in this kind of system is not made to be amortized, because of the maximum amortization period which is 25 years, considering that at this time the price per $1m^3$ of water is about 1€, in the future it will raise systematically.

The system is not designed to make a real economy even on long term, it can be used successfully in remote areas where a city supply network or a source of water is not available.

As novelty, this article brings an improvement of tap water characteristics in terms of flow/pressure, improvement developed by introducing of that small pump system (together with pressure switch and expansion vessel).

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