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WHAT MEAN "SUSTAINABLE HOUSE" IN HUNGARY

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Abstract*:*
In the paper I defined an idea called “sustainable house”. I draw up a working version of energetic criteria of “sustainable house” with regard to Hungarian natural resources. As a result of the idea I emphasize the growing importance of the regional energy consumption and the primer energy of building materials.

1. Problem statement

It is a fact that the natural resources are limited for the mankind with the way of present use. Reduction of environment load of building’s, especially it’s energy consumption, is a possible an important element how to solve the problem.

In the following I am looking for the answer, if it possible to define from the point of view of ecology the definition and criterion system of “sustainable house”.

2. Sustainable building

Before we would define the “sustainable house” we have to clarify its connection to the idea “sustainable building”. The most frequently used definition in Hungary for “sustainable building” is the following:

„Creation and responsible operation of a healthy built environment with the effective use of resources regarding the ideas of ecology.” (Kibert)

It is mainly evident what means the “creation and responsible operation of a healthy built environment”, but we have to write more about the “effective use of resources regarding the ideas of ecology”. During the planning of buildings regarding the ideas of ecology we have to consider the connections of the building and the four principle (fire, water, air, earth). We have to examine the connections of natural resources and consumer demand in the following fields (Fig. 1):

- the use earth of buildings and the surroundings of buildings,
- the energy management of buildings,

- the water management of buildings,
- the quality of building materials,
- the disposal of wastes during operation and housebreaking.

We have to examine the environment load of building during its whole life cycle.

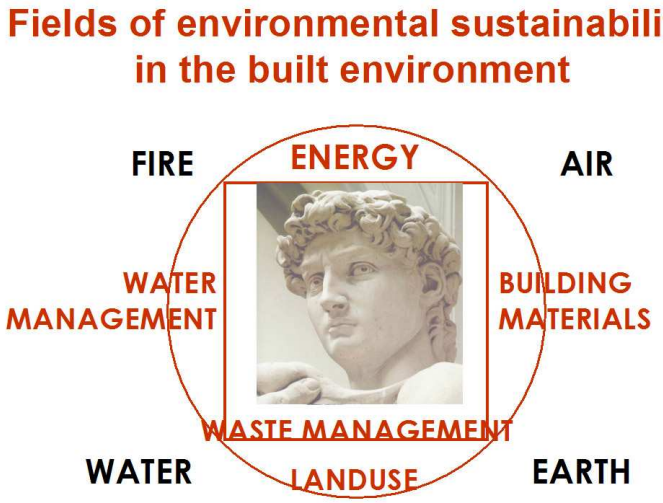

Fig. 1 The connections of built and natural environment from the point of view of ecology

In the following we examine the idea and criteria of “sustainable house” only from the point of view of energy. The reason why we restring our topic is, that the building energetic nowadays is the most important field of sustainable building, and we have several dates about energy consumption of buildings.

3. Definition of “sustainable house” and complementation to its energetic criteria system

It is clear, that on the phrasing of definition we have to take care on the natural resources and on the rate of resource consumption. We can define the “sustainable house” the following:

“Sustainable house” is a building the resource consumption of which throughout its life-cycle is not more than the resources available for that building in the examined area. [1]

By taking into account the broader aspects of sustainable building activity to define the energetic criteria system, at least two important complementary notes must be made:

- 1) Also the local environmental load must be studied in addition to the consumption of regional resources.
- 2) When erecting buildings, efforts must be made for cost-effective optimization – instead of minimization - of the environmental load (in this case energy use), subject to the regional conditions.

4. The energetic criteria system for “sustainable houses” in Hungary (version 2.1)

A “sustainable house” construed in the context of conditions prevailing in Hungary may only rely on the yield of the country’s natural energy capital (sustainable consumption of renewable energy resources). The energy demand of buildings can be covered by the following sources:

- Heating: biomass utilization, thermal water utilization, solar energy;
- Domestic hot water production: solar energy, biomass utilization;
- Cooling: electricity gained from renewable sources, as required;
- Cooking: biomass, electricity from renewable resources;
- Lighting: electricity gained from renewable sources.

4.1 What does “sustainable consumption” of renewable energy resources mean?

4.1.1 Heating, domestic hot water production, cooking (thermal energy demand)

The solar energy available within the territory of the country is 1800 PJ, but the realistically utilizable energy is more less because of the energy storage as well as the initial cost of equipment required for utilization does represent a problem.

The theoretical biomass potential of the country that can be utilized for energetic purposes is 203-328 PJ, of which 67-200 PJ energy can be utilized according to different calculations. We assume that at least 90 PJ biomass is recovered for heating of buildings and for domestic hot water production.

A further possibility is the recovery of thermal water energy, primarily for larger-scale usage. According to the Subcommittee of Technologies of Renewably Energetics in the Hungarian Academy of Science, 10 PJ energy of the theoretical 63 PJ potential is realistically utilizable. [2]

4.1.2 Electric energy

In Hungary, renewable energy resources such as solar energy, wind energy and biomass energy can be harvested and converted into electric energy. The theoretical potential is considerable; according to the calculations of the Hungarian Academy of Science the theoretical photoelectric utilization potential of solar energy is 1800 PJ/year and that of the wind energy is 530 PJ/year, however, without biomass utilization the realistically recoverable potential is low, only approx. 15-25 PJ/year. [2]

4.2 What energetic standards a “sustainable house” has to comply with?

The available primary energy can be divided differently from the method described below; it is subject to political decision which energy should be used for which purpose!

4.2.1 Thermal energy: domestic hot water demand

In Hungary the average hot water consumption runs up to 40-50 l/day/person in the residential and to approx. 0-10 l/day/person in the communal sector. Renewable energy resources (60 % solar energy, 40 % biomass or thermal water) can be used to satisfy the domestic hot water demand. Considering the total population of the country and 10,000.000 “unit consumers”, and assuming 85 % efficiency of building machinery at net 12.5 PJ, the gross energy demand of domestic hot water production amounts to 14.5 PJ.

Based on the above it can be established that in a “sustainable house” the energy demand of domestic hot water supply can be satisfied in Hungary by harvesting solar energy in the conventional way, and biomass or thermal energy use. Assuming 85 % efficiency of building machinery and considering the typical domestic hot water demand of households and communal buildings (4:1) and with regard to the area ratio of residential and communal buildings (2:1), gross 10 kWh/m^{2}a biomass or thermal energy is required in case of residential buildings and gross 5 kWh/m^{2}a in case of communal buildings.

4.2.2 Thermal energy: heating energy demand

The potentially 90 PJ biomass, 10 PJ geothermal energy and unlimited wind and solar energy can be harvested in Hungary. Since we have to use 14.5 PJ energy for domestic hot water production, only 86.5 PJ biomass and geothermal energy can be utilized for heating purposes. Therefore, we can calculate the heating energy demand:

- According to the energy demand per square meter: The building stock of Hungary represents about 480,000,000 m^2 (4,000,000 flats of average 80 m^2 area, and about half as much office and public buildings). With regard to the heating energy demand of this sector, the gross primary energy demand of the „sustainable house“ runs up to 50 kWh/m^{2}a biomass or thermal water energy. The benchmark value can be specified as net heating energy demand of 43 kWh/m^{2}a, with reference to the energetic quality of the building and assuming 85% efficiency of building machinery.

4.2.3 Electricity demand: cooling, household appliances

In case of family houses, adequate architectural and structural design can completely eliminate the energy demand for cooling under the present climatic conditions.

If we wish to provide electric power for the „sustainable house“ only from regionally harvested water, wind and solar energy, 25 PJ energy is available. Considering the typical electricity consumption of households and communal buildings (1:1) and the area ratio of households and communal buildings (2:1), gross 11 kWh/m^{2}a in case of dwelling houses and gross 22 kWh/m^{2}a in case of communal buildings must be provided by harvesting the water, wind and solar energy to meet the cooling, lighting and other electric energy demand of the buildings.

5. Evaluation of the „sustainable house” concept

The followings must be considered for evaluation of the concept:

- relation between the present status of energy consumption and the computed potential,

- regional characteristics of energy supply, and
- technical and economic possibilities of realization.

The total residential and communal thermal heat demand (heating, domestic hot water production) is approx. 427 PJ, while currently the total utilization of thermal biomass and geothermal energy amounts to about 43.5 PJ (approx. 40 PJ biomass and 3.6 PJ geothermal) according to the 2009' data published by the Hungarian Central Statistical Office. [3] Comparing the electric energy demand and potential reveals an even higher disproportionateness. Present consumption is 84 PJ, while we produce 6.8 PJ (5.7 PJ biomass and 1.1 PJ wind and water) by harvesting biomass, wind and water energy. Thus the utilization rate must be significantly increased to achieve the renewable energy utilization assumed for the criteria system!

It is important to emphasize that the „sustainable house“ criteria must be determined on regional level. While the present value of renewable electricity production is 183 PJ in Austria and average 38 PJ in the EU, the same value is only 7.2 PJ in Hungary, considering 10,000,000 inhabitant-equivalent. [4] Furthermore, with regard to the electric energy based heating systems in Hungary it must be taken into consideration that according the economically feasible potential of electric power generation using renewably energy sources runs up only to 25 PJ even over the medium term, without taking into account the power plants using biomass. This amount of energy fails to meet even the present typical household energy demand, so even application of state-of-the-art electric energy based heating and domestic hot water production systems would not facilitate sustainability, if we consider the present technical and natural conditions.

Decisions have to be made on regional professional political levels to specify which building operation systems should be supported by utilization of which natural resources. Based on these decisions the utilization of renewable energy sources must be increased up to the limits defined in the criteria system. Having achieved this level, we'll be able to establish that there are benchmark values, based on which it is technically feasible to realize operation of all Hungarian buildings using the country's own resources.

As for the heating energy demand, the 43 kWh/m^{2}a heating energy demand calculated as an example is higher than the 15 kWh/m^{2}a specified for passive houses in case of new buildings or the 30 kWh/m^{2}a proposed for restoration. Making the most of the lesson learned from the technical solutions applied in passive houses, it is possible to design buildings, which meet the criterion of sustainability both in case of new constructions and restoration projects. Hereby it must, however, be emphasized that building machinery systems must be applied in „sustainable houses“, which can be maintained using the country's own existing resources.

Although further research is required to investigate the possibilities of economic realization of „sustainable houses“, it is likely that because of lower energetic benchmark values, „sustainable houses“ can be constructed at a lower cost than passive houses.

6. Conclusion

The most important fundamental element of the „sustainable house“ concept is the use of construction and building operation technologies, which can be operated by using existing own inherent resources. The following assertions and tasks can be stated with a view to the application and further development of the concept:

- 1) Sustainability criteria must be defined for all areas of environmental sustainability as well as for energetics.
- 2) It is theoretically proven that – considering the regional conditions of Hungary – an energetic criteria system can be defined for the „sustainable house“, which is technically feasible and in case of realization the country’s own renewable energy resources can cover the energy supply demand of the country’s buildings.
- 3) To meet this criteria system it is essential to radically reduce the present energy consumption and significantly increase the utilizable renewable energy sources.
- 4) It is proposed to define the sustainability criteria system on regional or micro regional level, subject to local conditions.
- 5) In case of building sustainable houses, the task is cost-effective optimization not minimization of the energy demand of buildings, subject to local conditions. Applicable technologies must be studied and evaluated from time to time also with a view to their cost efficiency rate.
- 6) „Natural“ building materials of low environment load must be applied as far as possible.

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