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Directives and Possibilities of Enviromentally Friendly Construction

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Abstract: With this article we would like to represent how the existing eco-efficient technologies in construction industry could spread over the society and what are the constraints and difficulties of this process. The study focuses on some examples of buildings based on energy efficiency; above all the topic of passive and A+ houses is in the forefront of our enquiry. It was necessary to learn the opinion of several experts of this field, which was designed in a structured interview form. With their help we could get a complex picture why these developed, modern and environmental-friendly techniques have not yet spread in Hungary.

Keyword: innovation, environmental-friendly techniques, renewable energy techniques, passive houses

1 The relevance of construction in environmental pollution

Our health and quietude must be in harmony with our environment. Our ancestors, although they were a good deal fewer than us in the planet, lived a hunter-gatherer way of life, wandered in the wake of animals and followed the change of seasons living in

symbiosis with their surroundings. Admittedly, their fate was more uncertain, but their link to mother nature seemed much tighter than most of the societies' existing nowadays.

The unresponsible exploitation of fossil energy resources has implicated severe ecological consequences and resulted a significant loss in the Earth's set of resources. This fact has set such a task for mankind, which forces it to stop the process.

Due to the innovation, improved and effective technologies are available to us, with the help of which we can expect to solve our problems. By the innovations we can be just as innovative in the field of inventing new products as opening new markets and shaping a new form of organisation. The innovations could improve the quality of life socially and economically, our physical work and also our mental-work could become easier, also products, services and conditions of life and work could become more favourable. However, there are lot of innovations which are helpful in solving given problems, but at the same time they are creating other problems or harms – especially environmental ones. That is why this article concentrates on eco-innovations. The notion of eco-innovation appeared in 1996 (FUSSLER, (1996) p 364) which includes brand new products and services. Its main feature is the reduced harmful effect on the environment. As a matter of fact, it refers to all kinds of innovations, whose harmful effects on nature are minimized during the whole life-span of the process. The task of distributing and supporting renewable resources are mostly rely on governments and in Europe on the European Union. The main reasons of slow spread technologies are mostly the reasonable political and economical opposition against them, and the fact that their support is not sufficient.

About half of non-renewable resources are used up during construction works. That is why it is one of the least maintainable industry in the world, also it is in the first place of the emission of harmful substances. Producing different construction materials has a harmful effect on nature, which spoils our biosphere.

Constant studying of this field has led to innovative results, such as green construction, in other words, maintainable, environmental-friendly, ecological or energy-friendly construction. The essence of environmental-friendly construction is employing a method, which has low carbon-dioxide emission and spares mineral oil and natural gas sources for the sake of energy saving.

Food and drinking water requirements of mankind, also its demand for wood, cotton and fuel measured in the last 60 years as it was in the eighteenth and nineteenth century combined. According to statistics[1], 24% of the Earth's dry land surface is under usage, water tenure of lakes and rivers has been doubled during the last 40 years, since mankind uses between 40 and 50% of the whole water supply. The extent of global wood production showed a decreasing tendency in the past decade, however we destroy a forest area of over half the size of Hungary every year.

[1] http://www.alternativenergia.hu/ensz-csokkent-a-globalis-fakitermeles-merteke-az-elmult-evtizedben/16236

2 Innovation of renewable energy techniques

Dynamic utilizing of environmental resources and its rapid diminution urge society and economy to find out alternative prospects. As an effect of it, a rather new concept has emerged, the so-called eco-innovation, which was first published in *Driving Eco-Innovation: A Breakthrough Discipline for Innovation and Sustainability* (FUSSLER, (1996) p 364). How consumer society will receive these kinds of innovations, it cannot be given an accurate answer. In some fields it welcomes them, while in others nowadays rejection is dominant. This involves that feedback of the society is not adequate, either. In lack of support these technologies go with short investments, but returns only in the long run. Wüstenhagen et al. (2007) took social acceptance into three parts: socialpolitic, communal and market acceptance.

In Austria the AEE[2] (Arbeitsgemeinschaft Erneuerbare Energie – Work Community of Renewable Resources) organisation has been supporting unprompted communities for fifteen years, which produce solar collectors with the technical support of AEE Assembling-method. Those kinds of groups have been active in Austria since 1983 and have managed to built 50.000 solar collectors and over 500.000 m^2 of collector surface until 2000 from their own funds. With their activity, they could contribute to the change of the aspect of their participants, so they manifested a new kind of attitude towards innovations like those. The attitude and the desire towards the innovation of green energy resulted in Salzburg, that 50% of residental areas are equipped with solar collectors, with the contribution of operative regulations and rights and with the change of housing support.

Due to these movements, with the help of over 8 million people, 2,5 million m^2 collector surface were formed in Austria. Today, the sector of solar collectors is the main economic sector in the country and it is contributing the growth of its economy significantly. (Themessl-Weiss, 2007)

2.1 Utilization of materials in the building industry

About half of the non-renewable resources are used up during construction works. Thus, we can say it is one of the least maintainable industry in the world, which tops the chart of the emission of harmful substances. Since mankind really started to develop from the beginning of the industrial revolution, it began to use its natural environment, so that it could suit its requirements better and better. That is why we could live in brick houses and travel on concrete roads in our everyday life. Human civilisation depends on buildings and materials which utilized for their construction. We can ascertain our planet is not able to fulfill the need of present-day resources any more.

[2] http://www.aee-intec.at/

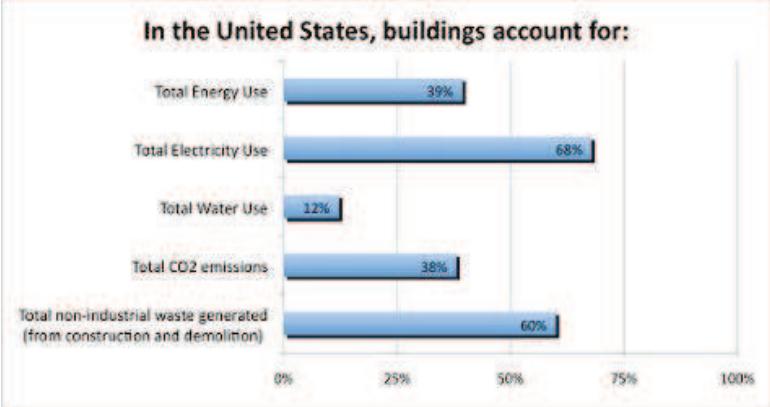

Figure 1
Use of energy resource of buildings in the USA
(Source: http://www.wbdg.org/design/sustainable.php)

3 Green construction, passive houses and energy efficient buildings

Green construction or sustainable-, environmental-friendly-, ecological- and energy conscious construction is a brand new approach. The definition, as it is accepted today, was drafted in Tampa, Florida in 1994 at the conference of C.I.B. (Conseil International du Bâtiment) by architect Charles Kibert:
„Procreation and responsible sustenance/actuation of a sound built environment with efficient utilization of resources based on ecological principles."
During energy conscious planning, we can control the energy necessity of a building with the elimination of heat loss in wintertime and minimizing the heat increment in summer. Architectually it means a thick heat insulation on the outer structure and an optimal tightness.
According to architects, building biologists and building material manufacturers, during construction, whether it is a construction of a brand new building or a modernization of an older one, main factors are providing the good way we feel and the savings on energy. Due to this concept, building methods of savings on energy spread faster. However some jump from this new technology, because they think it could involve discomfort and could mean a surplus of costs during construction. While if we reason on the long run, we can see, the sense of comfort improves and harmful effects on the environment reduces with methods of energy savings.

The main point of environmental friendly construction is applying a method with low carbon-dioxide emission and for the sake of energy savings it spares mineral oil and natural gas reserves. These materials travel thousands of kilometers from one side of the Earth to another, and their exploiters are situated in politically critical points of the world. Moreover these are dangerous substances, which can easily lead to natural disasters because of their flammability and the problems of their leaking.
Thus, if we want to have a fine time in a building with low energy use, it should be in accordance with the environment. This co-operation is based on really careful choosing of location and bearing. It is in the favour of profiting the rays of winter sun, protecting against dominant winds and minimizing the heat in summer. So, adequate bearing and good location are essential, since the house can use natural aptitudes and be energy efficient only with these factors.
For choosing the location, we have to consider such elements as the dominant direction of winds, average temperature, lie of the land and geobiological aspects (such as high voltage or electro-magnetic radiation). These items can be measured by experts, also, they can help obtaining knowledge of areas having energy surplus. Another essential factor is the quality and compound of air and water.
All in all, choosing a proper location is as important a criteria as the use of materials.
Before construction, it is worth considering the renovation of an existing building, so that the environment would be less polluted. Before the nineteen-fifties houses were often built from stone, brick or wood and in their interior there were not too many harmful materials, such as formaldehyde, PVC trim or plastic surfaces.
It is important to know what chemicals were used on the surfaces and avoid insulation containing formaldehyde. Also, we have to consider the features of building- and sheathing materials (it is favourable, if the walls are thick enough and the house has solid floors). (Pearson, 1998.)
Regarding energy efficient buildings we can meet definitions like solar houses, eco-solar houses, zero energy houses and energy efficient houses. However these expressions do not have an unambiguous meaning profesionally, thus a standard requirement scheme has been worked out for energetic classification of buildings. An important factor for defining the energetic quality of a building is its yearly need of heat energy calculated after the floorspace.

- Conductive energy need: utilized energy, which provides warm heaters, hot water and the emission of light from lamps. This heating energy need is defined considering annual utilization for the square meters of heated net living space in kilowatt an hour. Heating energy requirement is a number of energy served for distinguishing insulation standards and it is not identical to actual energy use.

- Definitive energy requirement: the energy, which is available directly in the building, namely residue, electric current, wood or natural gas. It is the measurable rate, after which we pay the prices.
- Prime energy-requirement: the original condition of resources as they are retrieved from nature (such as uranium, mineral oil or coal). (Königstein, 2006.)

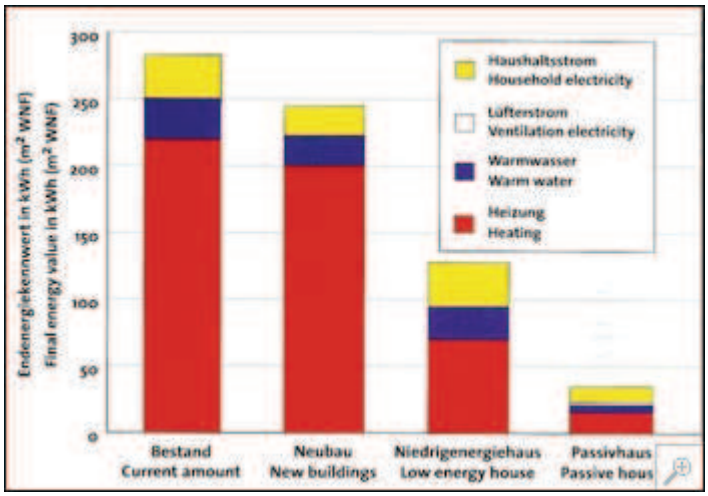

Figure 2
Standards of building insulation
(Source: http://www.cepheus.de/)

We can ascertain, that heat requirements of a building come from the difference between its heat increment and heat loss. (Debreczy, 2010.)

- Transmission heat loss: it influences the balance of heat losses negatively. These kinds of heat losses are from the heat loss of structural elements of space partitions.
- Heat losses from ventilation: as we can deduce from its name, it means the heat loss of inadequately insulated parts of the building and the heat loses during ventilation.
- Inner heat increment: transmitted heat of the inhabitants/users of the building, also the heat produced by electric devices (refrigerators, computers and lighting).
- Solar heat increment: heat gained from sunshine through glass pane surfaces.

It is expedient to work up methods, where fossil energy use can be reversed by renewable energy resources and heat requirements can be kept in the lowest possible

level. For this aim, parameters must be harmonized and it is not enough to focus onto one area only. During the formation of the building, we have to strive to need only a subsidiary heating during the whole heating period, while in summer, due to the proper performance of ventilation, the use of air conditioning can be minimized.

In all cases, standard of the building only refers to the aspect of the structure and not to the heating material of it.

Fulfilment of passive houses in Germany and Austria

Since the first passive house in Germany, built in 1991, we can experience a constant growth of their numbers. According to estimations, the number of buildings, which obtain a passive house certificate can be 25.000 for 2015. This value is slightly less in Austria, which is mostly because it is a much smaller country. While the number of passive houses were only 10 in 1995, it rose to 28.000 for 2014 and it can be an anticipated a number of 36.800 for 2015.[3]

4 The aim of our study and sample description

With this study we would like to understand how the existing eco-efficient technologies in construction industry could spread over the society and what are the constraints and difficulties of this process. The study focuses on some examples of buildings based on energy efficiency; above all the topic of passive and A+ houses is in the forefront of our enquiry. It was necessary to learn the opinion of several experts of this field, which was designed in a structured interview form. With their help we could get a complex picture why these developed, modern and environmental-friendly techniques have not yet spread in Hungary.

With the support of Passivhaus Planer we approached all the designers of passive houses, who have an official qualification in Hungary. Altogether it means 55 people in 2014. In addition we hunted up designers who do not have such a qualification, but plan buildings of A+ energy efficiency. We strove to approach experts from different parts of the country to observe the demand of passive houses and other buildings of energy efficiency. Without any doubt the most optimal method for it, in the framework of a qualitative survey, was the form of a structured interview, so that we could find out the opinion of architects, designers and executors proficient in the theory and practice of the issue. We aimed to find the factors which are shared among consumers thinking green through the topic of passive houses and buildings of energy efficiency. Moreover, we also wanted to understand to what extent designers can influence the decision of customers.

[3] http://derstandard.at/1288660121456/7-Tage-des-Passivhauses-Passivhaus-zwischen-Gegen-wart-und-Zukunft

5 Design of structured interviews

In the first point of our interview questions we enquired the interest of designers in A+ and possibly passive houses. The second point is tightly connected to the first, for we wanted to know the rate of inquirers here. In the next one we asked whether the involved designers suggest A+ and passive house solutions. With this point our aim was to learn whether they seclude themselves from those solutions and if so, the rate and reason of their seclusion. In the first part of the fifth question we wanted to know demographic and sociographic factors of the customers, while in the second part we came to environmental consciousness, whether it is an important issue for them or not. We touched upon the possibility that the dominance of social pressure could be an important factor for customers. In the sixth point we were curious about their motivations, what return interval is acceptable for them and how many years they plan afore. In the seventh question we wondered whether the designers make the calculation of costs before and after completing a house and what the reasons are when customers' expectations are not fulfilled concerning the financial return. For the question whether it happened when a customer had not been satisfied with the result and what it cause was almost everyone had the answer there has not been that kind of problem yet. With the 8th question of the structured interview, we wanted to learn the approximate percentage of extra costs of building passive houses or energy efficient houses compared with the expenses of "ordinary" constructions. Our next question referred to the regulation due 2020; in accordance with it a zero energy use level would be obligatory for public buildings from the year 2019 and for detached houses from 2021. We wanted to know what the designers' opinion of this regulation is and whether it could be fulfilled in Hungary.

So, as far as we concerned, it is rather difficult to execute the comparison, for a normal house falls into a lower cathegory in conveniences, it equipped more poorly and keeping the same level of quality it is almost more expensive. In another context, a normal house cannot be a concurrent neither in view of the invested amount of money nor in created value, also its marketability is much lower. These are considered as really important aspects, which at the present moment, cannot be expressed in money nor the differences in the standards of life or the independence from gas supplies.

6 The results of the research

21 out of 55 qualified passive house designers took part in our study and 5 more non-qualified experts were at our service. 20 of the designers co-operated with us have their seat in the country and only the remaining 6 are from Budapest. Some of the respondents design only passive or A+ houses, while a few of them do not deal with them at all, also there were, who design those kinds of houses in a 50% rate of their work.

The fourth question of the interview points to the attitude of customers and inquirers. We find it a significant point, because at the former questions we could see the ratio of developers of energy efficient buildings, passive houses and houses with ordinary insulation is a 50-50%, so there are ones, who seclude themselves from the former ones. With the 8th question of the interview, we wanted to learn the approximate percentage of extra costs of building passive houses or energy efficient houses compared with the expenses of "ordinary" constructions. The answers became pretty much varied. There were some who thought the surplus is between 5 and 8% or 5 and 10%, in special cases less than 5% while one believed the costs can be virtually the same. However the majority estimated in case of passive houses an extra cost of between 20 and 30%, but there were extreme cases who mentioned between 40 and 60%. Of A+ houses the solid majority answered 5-15%. However there was a general agreement that extra costs are affected strongly by personal demands and engineering system is also an important factor. These can raise prices very much. Moreover in this segment there are suppliers and systems represent another level of demands. Extra costs cannot be defined properly in case of passive houses, because there are extra items but missing items, as well. Insulation and built-in ventilation constitute higher costs, while the walls have only a function of a holding device; there is no need to have gas-fittings or to construct heating systems in them. Some respondents explained the higher costs by the Hungarian regulations which are lagging behind Europe with decades, so extra costs in Germany are between 7 and 17%, with an average of 8%. According to them, if energetic features of the countries for establishments are more severe, then the amount of extra costs will decrease. Moreover, besides the additional charges of structures and quality building materials, the expenses of professional workforce differ from the average. According to our research, we can conclude, that in Hungary we cannot make a difference between green and non-green developers. It is mostly because the main point for the developers is not the reduction of harmful substances, but the reduction of their own overhead. Currently, the economic situation of Hungary is not too advantageous for green thinking in construction. Nowadays it is only available for a very small strata of the society.

Current conditions of our homeland show, that due to the reduction of overhead by the government, the amount of money remained could be satisfactory for Hungarian people and so they do not necessarily think of modernization.

From the 1st of January 2013 domestic shop prices of gas, electric energy and district-heating are reduced by 20% in both the first and the second phases, moreover, in the second part of 2013 fees of water supply, sewerage, pb-gas, drag, refuse collection and chimney-sweeping were also reduced. As a result of it, inflation had showed a slowing tendency, thus the population paid lower overhead. This reduction continued in 2014 with the slackening of gas, electric energy and district-heating prices again. According to data, from the 1st of April 2014, natural gas prices are reduced by 6,5%, the price of electric current will be reduced by 5,7% from the 1st of September, while the price of district-heating will be less with 3,3% from the 1st of October this year.[4] To realize savings the population could pay a significantly higher amount as monthly loan

[4] http://www.fidesz.hu/hirek/2014-01-25/harom-lepesben-folytatodik-a-rezsicsokkentes/

repayments, since modernization of doors and windows of the flat can be made from an amount between 300.000 and one million forints, while cirko-modernization can be realized from approximately half a million forints. But this amount must be obtained somehow. Despite of that, for those considering the change or the insulation, it should not be a rejected alternative to modernize the energy efficiency of their home. Those who realize they also have to do something for their own good, all think that, in spite of the decisions by the government about reduce overhead, current conditions can be maintainable only temporarily. For them it is obvious, that an increasement of energy prices are anticipatory within a rather short time, so we have to do certain steps for the more efficient energy use of our homes. Most part of the households is usually lack of funds, and they are not able to or do not want to require more credits. It is strengthened by the fact, that the number of favourable bank loans, for instance an incidental green loan, is evanescent. (HVG, 2014\10.)

According to these facts, our conclusion is green or non-green consumer attitude is highly influenced by the decisions of the government, which is at the moment concentrating on the reduction of overhead. It distracts consumers' attention from the facts of modernization. Although a big part of the population realizes, that most of the Hungarian flats are obsolete, energetic modernization of them is really urgent and because of the expendable supplies a rise of prices can be expected in the future. However they are not able to do anything to reduce their own overhead expenses and the strain of their environment because of the lack of funds.

Both the reduction of overhead and environment protection are important factors for everyone. In the increasement of social or financial motivation, however, the government should play the most significant part.

According to a 2001 survey of the Department of Environmental Economics at the Budapesti Műszaki és Gazdaságtudományi Egyetem, which was taken with the participation of 1000 people throughout the country, 49,7% of the adult population of Hungary is interested permanently and 31,7% is interested at times in environmental problems. (Valkó 2003.) Accordingly, we came to think, that green developers are from the environmentally conscious stratum.

It is important to mention the so-called *Panelprogram*, which started in 2001 and continued in 2009. In the framework of it, 320.000 flats have been modernized with the help of notable support of the European Union. The program is to continue from 2014, but supports can be required only for changing of windows, insulation work and engineering modernization.[5]

As a result of our research we have come to the conclusion, that environmental consciousness can be influenced by factors like qualification, income or whether one lives in the green belt and having respect for the environment is essential to him or her. Accordingly, we think, that other factors play a significant part of whether someone ventures to build a passive house or another kind of energy efficient building.

[5] http://officina.hu/belfoeld/62-panel-program-2014-palyazatok-a-panel-felujitas-reszletes-tudnivaloi

Main conclusions of the study

- **Average age of developers of energy efficient buildings and passive houses:** 28-65
- **Education of developers:** mostly high- but at least medium-level qualification
- **Occupation of developers:** well-trained experts, who are leaders in their own fields or can be considered positively capable, they have their own company or enterprise by chance or at least they are in middle magagement at a multinational company
- **Marital status of developers:** they have families with 2 or 3 children
- **Motivation of developers:** mostly lower maintenance fees in the future, independence from utilities, safety and reduction of straining the environment
- **Accepted interval of return:** between 15 and 20 years
- **Possibility of building energy efficient or passive houses:** typically 60-90%
- **Reason of refusal of the energy efficient, passive house-conception:** customers are satisfied with less energy efficiency, which has mostly financial reasons or the fear of some of the new solutions

7 Conclusions

Hungary lags behind significantly in the point of energy efficiency, since we cannot keep the pace of development with the Western countries like Germany or Austria. In such a drastic situation our government should establish energy-independence and distribute renewable energy sources in the first place for current tendencies show, that quite the opposite is happening in our homeland. Energy production of Hungary is decreasing significantly just like the number of supports aiming to improving energy efficiency, which could also conduce the energetic modernization of immovables. The effect of these negatives produces a condition, in which energy-dependence is growing and the competitiveness of Hungary is declining.

Since there would be pretenses of significant number for investments of energy efficiency, the result of lack of resources and relapse of creditworthiness of families and companies, it needs more significant support for the interval of 2014 and 2020, unlike in the former period. After that period owners of immovable estates and companies could have the possibility to cover the investment costs from overhead savings becuase most part of the families considering investments would not resort to loans. In the background of it there is the fact, that they already have credit debts or they do not consider their workplaces safe enough.

However it is evident to everyone, that the topmost reason of missing investments growing energy efficiency is the lack of resources. The biggest help for that problem would be using up available sources from the European Union. And last but not least, it

is the duty of competent institutes and offices to inform the population about the instruments, methods and new technologies which can help making their homes more efficient so that they could be able to realize savings.

However, changes of attitudes are also important, because households interested only financially in the reduction of energy consumption will not certainly be partners in the strategy of the long run. Forming an attitude with emphasizing personal responsibility towards the condition of the environment is a necessity.

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