Criteria for classification of competitive housing projects in terms of their environmental friendliness

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Abstract. This article deals with social and economic essence of strategy of the housing industry development, both complex system of economic relations in field of production and consumption, which is regulated through the mechanism of prices and implemented through formation and realization of priority directions. Developed criteria for classification of housing construction projects as environmentally friendly and the quality criteria of variables for assessment of the environmental friendliness of residential buildings allowed to determine the ways of development of the industry on the basis of creation of competitive projects in interrelation with quality, environmental friendliness and price of consumption.

1. Introduction
Comprehensive assessment of environmental quality of housing construction projects (HCP) intends qualitative and quantitative certainty. As part of the research, qualitative analysis embodies the general direction of the development of ecological house-building and presupposes the study of specific features, parameters and standards of ecological houses and factors, which determine its development. This study is being performed through some unregulated procedures and approaches, and such an analytics has not any calculated character. That’s why qualitative analysis still has subjective character despite its merits (for example, it allows to consider opinions and points of view of many scientists and experts, different approaches and methods) and shortcomings (for example, the distortion of the real state of things) [1].

But for a subjective approach is often insufficient for decision-making in economic practice. So, necessity in performance of qualimetric procedures is often appears for the objective assessment. And, unfortunately, in reality, decision-makers often have problems with this: understanding of the essential content of the idea of proposed project is quite enough for some of them and someone requires mandatory concretization and digitization of characteristics, parameters and activities.

At formation of the new system of environmental criteria for HCP its necessary to consider the maturity of the environment and public demand for it. Unfortunately, we have to acknowledge that environmental housebuilding in our country is not a priority of social and economic development; this fully applies to both state and municipal government bodies and to majority of the population [2, 3].

As revealed the study of foreign experience, environment for development of ecological housing construction has matured adequately in the developed countries.

That's why issues of sustainable development and environmental security of housing construction are the focus of attention of governments of such states as the United States, Britain, Germany and France. Professional and expert community considers three main international certification systems for
"green" buildings the most visible and correct: BREEAM (Great Britain), LEED (USA) and DGNB (Germany).

2. Methods
However, in comparison with European countries with mild climate, housing construction in Russia has its own specifics and natural and climatic, geophysical and other differences. That is why the principles of design, classification of materials and environment, methods of calculation laid down in the Eurocodes and coefficients used there are fundamentally different from the Russian system of technical regulation in construction [3, 4].

Analysis of domestic economic and legal support for environmental certification of HCP allowed to establish the absence of clear and unambiguous interpretation of the order and criteria for the calculation of scores. Besides, degree of implementation of the criteria on section as a whole in percentagewise is not considered in the domestic practice. This allows to obtain low total score, which is formally sufficient for certification at absence of complete fulfillment of individual requirements at the expense of excellent performance of others.

Also, not all the criteria have indicators on the basis of which the degree of correspondence is determined [5, 6].

Understanding impossibility of assessment of the quality of ecological HCP from economic, social, ecological, technical and legal positions simultaneously, they built their own approach exclusively as a part of system "person-ecohouse-natural environment".

Methodology of modeling techniques for the factor systems was used with the purpose of construction of mathematical expression of environmental friendliness. Existence of the function $y = f(x_1, x_2, ..., x_n)$ which characterizes change in the effective indicator and factors $x_1, x_2, ..., x_n$, on which the function $f(x_i)$ depends, and definition of the functional deterministic relationship of the effective indicator with a set of factors (Table 1):

$$y = f(x_1, x_2, ..., x_n),$$

where $y$ is the outcome indicator; $x_1, x_2, ..., x_n$ is a set of functionally dependent factors.

Reference designation of environmental indicator is introduced with assume that dependence between the factors is linear. In this case, expression (1) takes the form:

$$ERB = \sum_{i=1}^{n} x_i = x_1 + x_2 + ... + x_n,$$

where $ERB$ (ecological residential building) is ecological compatibility of residential building; $\{x_1, x_2, ..., x_n\}$ is a finite set of factors.

As housing represents a combination of certain number of interacting subsystems (constructive, power supply, water supply, canalization, household waste collection, heating, ventilation, protection, etc.), then impact on the integral indicator of each of them is unequal.

Assessing the originality of approach stated above to the determination of environmental quality of HCP, the lack of systematic city in it can not but be noted.

This is reflected in the fact that assessment of the quality of all HCP is reduced to assessment of its environmental component only. At that, neither technical, nor economic and legal aspects was reflected. Distance from them and accepted assumptions reduced the accuracy of such an assessment.

Results of the research revealed that, in our country legislator does not have the ecological standards for housing construction up to the present time: corporate are present, and state (mandatory for execution by all participants of housing construction) are not present.
Table 1. Scale of qualitative variables criteria for assessment of ecological compatibility of residential building

| No. | Variable name                                | Conventional notation | Possible value | Qualitative value assignment concept                                                                 |
|-----|---------------------------------------------|-----------------------|----------------|------------------------------------------------------------------------------------------------------|
| 1   | environmental friendliness of the constructive elements | x1                    | 0.25           | 1) form of building does not correspond to the forms which harmonize with environment  
2) building material is not environmentally friendly  
3) indoor finish material is not environmentally friendly |
| 2   | environmental friendliness of the system of water supply | x2                    | 0.5            | 1) groundwater usage  
2) simple consumption cycle  
3) usage of natural precipitations with filtration system  
4) recycling (multiple use of water with filtration system) |
| 3   | Ecological friendliness of the energy supply system | x3                    | 1              | usage of the non-renewable sources or sources with long period of renewal  
2) usage of the renewable energy sources |
| 4   | environmental friendliness of the system channel. ecological compatibility of the solid waste collection system | x4                    | 0              | absence of waste purification process  
biological waste purification (composting) |
| 5   | ecological friendliness of the heating system | x5                    | 1              | absence of premises for primary processing, separate collection and safe storage of garbage before its delivery  
availability of premises for primary processing, separate collection and safe storage of garbage before its delivery |
| 6   | ecological friendliness of the ventilation system | x6                    | 0              | usage of the non-renewable sources or sources with long period of renewal  
usage of the renewable energy sources |
| 7   | ecological friendliness of the ventilation system | x7                    | 1              | without the possibility of heat recovery (plenum or exhaust ventilation)  
heat recovery |
Yes, the concept of environmentally safe products in domestic legislation exists. This is production which does not put the environment in jeopardy and meets the established standards and requirements of organizations which control environmental protection. But at that legislator did not prescribed what exactly should be understood as environmentally safe commodity-construction production (HCP, in our case) from the point of view of its impact on health of the people who lives there [7, 8, 9].

So, the states above allow to draw some conclusions:

1. Existing in the Russian Federation criteria for classification of HCP as environmentally friendly are not obligatory for developer and construction companies, as they are not codified. It allows to state the absence of the reference values of environmental friendliness of HCP in our country and shift the responsibility center from construction companies to design organizations and legislators. Perhaps law-abiding developers are ready to switch to environmental standards in housing construction, but legislator did not introduce them into the economic turnover. At that, developed corporate criteria and standards are not mandatory for execution.

2. There is still no cultural environment sufficient for the development of ecological construction in our country. There are no legislatively regulated criteria for ecological friendliness of HCP, as this segment of housing sector is not a priority of social and economic development of the Russian Federation to the present time.

In this regard new classification of criteria for classification of HCP as environmentally friendly on the basis of the environmental friendliness of the external and internal environment is proposed (Table 2)

| Environmental friendliness of the EXTERNAL (ambient) environment | Environmental friendliness of the INTERNAL environment |
|---------------------------------------------------------------|------------------------------------------------------|
| 1. Remoteness of HCP from large industrial and waste recycling enterprises, high-voltage power lines and transformer substations, and also motorways and boiler houses | 1. Radiation safety of building materials and structures of HCP |
| 2. Direction of prevailing winds, in zone of which HCP is placed | 2. Safety and quality of building structures and materials of HCP |
| 3. Landscaping of adjacent area, in the zone of which HCP is placed | 3. Thermal comfort of HCP. Directly related to energy efficiency and energy saving |
| 4. Remoteness of HCP from aquatic environment and visual comfort | 4. Comfort inside residential building |
| 5. Provision of the local area with parking lots, sports facilities and grounds | 5. Energy efficiency and energy saving of HCP |
| 6. Absence of geopathic zones, which have negative influence on human health | 6. Safety and quality of finishing materials of HCP |
| | 7. Air quality of the HCP living quarters and its required amount |
| | 8. Level of electromagnetic radiation in residential area of HCP |
| | 9. Acoustic comfort in HCP |
| | 10. Centralized water supply / wastewater disposal with autonomous drinking / waste water treatment system |

4. Conclusions
From our point of view, pointed criteria for classification of HCP as environmentally friendly must be determined by a group of experts; and a class of environmental safety can be assigned only on the basis of an official conclusion of the commission.

This system of elements can be a reference for consumers when making decisions on appropriateness of purchasing this or that HCP

Problem of sustainable development of living environment and quality of life of the population is very urgent for governments of the most of developed countries, including Russia. In recent years, growth of
anthropogenic impact of the aggressive external environment on the quality of human life (health) reduces operation capacity of citizens and, consequently, productivity of their labor. On the basis of the above, the author has developed new classification of criteria of reference of HCP to ecologically safe as the criteria existing in the Russian Federation aren't obligatory for construction companies.

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