Rating estimation of sustainability in the construction of high-rise building

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Abstract. The paper presents an assessment of a unique high-rise building according to the environmental certification system STO NOSTROY 2.35.4-2011 (Russia). Certification system of sustainable environment is described with the estimated criteria. An assessment of the existing European high-rise building adapted to the regional conditions of Rostov-on-Don in accordance with the specified standard was made. Result of preliminary assessment of building is shown. And the building parameters, work with which could increase the overall rating of certification, are emphasized.

1 Introduction

The problem of sustainable development of territories, cities and objects has been acute for several decades. The first discussion of the concept took place in 1972 at the UN conference in Stockholm [1]. Currently, the United Nations has developed a detailed program for achieving sustainable development of the planet [2], which includes 17 tasks: the fight against poverty, hunger, inequality, rational consumption and resource extraction, provision of clean ecological energy, construction of sustainable cities, and others.

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Fig. 1. Sustainable development achievement purposes of society and planet [3].
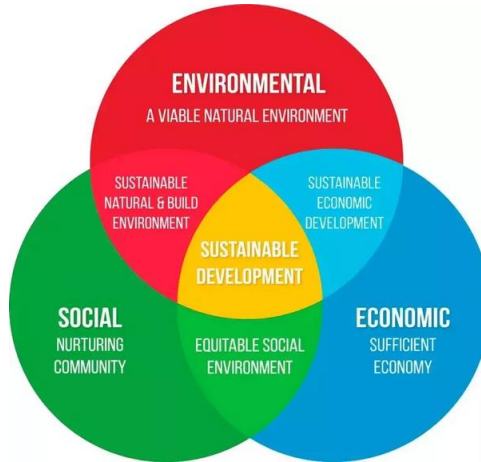

Fig. 2. Constituted elements of sustainable development [4].

2 Materials and methods

Sustainable urban development undoubtedly implies sustainable construction of urban facilities. In megacities great attention is paid to the construction of high-rise buildings, which are the center of large corporations and offices. In connection with the consumption of a large amount of resources and electricity, high-rise buildings should comply with existing environmental requirements and standards as much as possible. Studies have shown that the following factors have an influence on green high-rise construction [5,6] (Fig. 3.):

1) renewable energy resources use;
2) eco-friendly materials use;
3) innovative technologies implantation;
4) resource saving;
5) consumption control with Smart house system, and others.
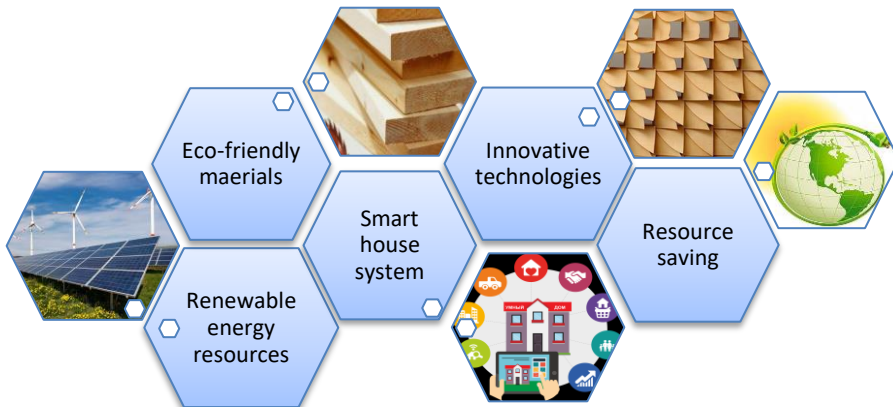
Fig. 3. Factors affecting energy efficient construction [7].

The need to take into account these factors to create a healthy human environment in an urban environment has led to the creation of various environmental certification systems, of which

the BREEAM (UK) [8] and LEED (USA) [9] assessment systems are the most common at present. Evaluation is carried out according to various criteria. For example, LEED takes into account the particularities of the region and the internal environment of the structure, while BREEAM emphasizes environmental preservation and waste disposal. The general criteria for assessing [10,11] (Fig. 4.) are highlighted:
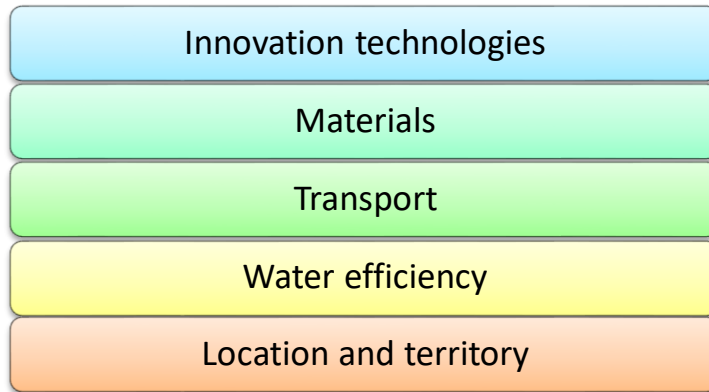
Fig. 4. Ecological assessment criteria accountable by BREEAM and LEED.

In Russia, there are several certification systems with green standards [12] that differ by assessment categories, normative bases and evaluation methods. One of them STO NOSTROY 2.35.4-2011, which estimates construction project on 46 parameters, united to 10 categories. This system matches with international standards ISO and takes into consideration key aspects of BREEAM, LEED, DGNB (Germany), and HQE (France) certification systems. Certification could be made both for finished and reconstructed residential and public buildings. Factor of construction object sustainability (S-factor) is a result of all parameters point summation. In accordance with S-factor sustainable environment assessment class has to be assigned. This paper has been developed foe regional characteristics of Moscow city and Moscow region. In the need of evaluation of the construction object in other regions, additional document has been input, that corrects number of categories the significance of which is a variable quantity, and taking into account the peculiarities of the territory in which the objects are certified [13]. The assessment of the building according to this document is implemented on the example of residential high-rise building Bosco Verticale ("Vertical Forest") Torre E [14] built in Milan in 2008, that is adapted for territorial conditions of Rostov region. Unique building with a height of 111 meters is designed by architect Stefano Boeri and has a worldwide fame due to bushes, scrubs and trees with the height up to 9 meters [15,16] located on balconies of the tower all around, creating peculiar forest across the height of the building. "Vertical Forest" has a Gold certificate by LEED.

For certification by STO NOSTROY 2.35.4-2011 it is necessary to calculate number of points by each category of evaluation. Several parameters of the certification could not be computed accurately on preinvestment stage because the construction is not finished. Concerning this fact, points of selected sustainability of environment level evaluation has been taken preliminarily. Data are summarized in Table 1.

Table 1. Number of points by categories of STO NOSTROY 2.35.4-2011.

Name of criterion	Maximal estimated score	Category proportion, %	Obtained score

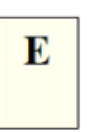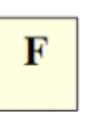|			
Maximal total score in rating system	650	100	536.768
Category 1 – Comfort and quality of external environment	70	10.8	45
Category 2 – Architectural and planning quality	60	9.2	56
Category 3 – Comfort and ecology of internal environment	86	13.3	81
Category 4 – Quality of sanitary protection and recycling	25	3.9	20
Category 5 – Efficient water use	40	6.1	36
Category 6 – Energy saving and energy efficiency	120	18.5	88,3
Category 7 – Alternative and renewable energy use	60	9.2	54
Category 8 – Ecology of design, use and disposal of construction object	64	9.8	38
Category 9 – Economic efficiency	65	10	63
Category 10 – Quality of preparation and management of the project	60	9.2	46

For resulting S-factor an additional calculation of regional coefficients by criteria27-29 (category 5), 30, 32 (category 6), 35 (category 7), 40, 41 (category 9), and also reduced S-factor is necessary [17], with the clause of object location is in Rostov region.

Table 2. Adjustable regional coefficients.

Parameter					27-29	30	32	35	40	41	K_{red}
Adjustable regional coefficient	0.9	0.9	1.3	0.8	0.9	1.0		1.06			

Fig. 5. Environmental sustainability classes of STO NOSTROY 2.35.4-2011 [17].

S-factor, score	520–650	420–519	340–419	260–339	170–259	100–169	0–99
Evaluation classes	A	B	C	D	E	F	G
Evaluation marks	A	B	C	D	E	F	G

3 Results and discussion

In accordance with calculated value of S-factor, this object has A-category (536,768), which is the highest estimated environmental sustainability class in mentioned certification system. However, with analysis of the table it is seen to be necessary to introduce additional systems and technologies by selected parameters for the highest score achievement. Thus, they should take action for increasing reclamation percentage up to 70 per cent, whereas in mentioned project process works just for 20 per cent. It is important to consider location of the building and environment. Inquired building does not have any artificial or natural water resources, and this fact reduces the visual comfort. Moreover, there were not envisaged to place any fitness grounds in the house area.

4 Conclusions

Thus, ecological standard certification of construction objects let to notice, what parameters effect on achievement of construction object sustainability, and what aspects are necessary to admit during design and construction process for the most energy efficient solution. Moreover, estimation process contributes the professional development and advance of competitiveness level among the design institution.

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