Environmental standardization of residential real estate according to "Green standards"

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Abstract. One of the difficult tasks for green developers in case of object certification is effective selection of the most suitable system from existing "green" standards. The goal of the work is to identify the most appropriate environmental certification system for our region. To solve this problem and choose the most optimal system, popular "green" standards were reviewed. For the detailed analysis of systems from the inside, an attempt to pre-certify the chosen object, a multi-apartment 16-storey residential building, was made. According to our work, the most suitable international system for category of buildings under study is the DGNB standard due to its adaptability and flexibility. Existing Russian standards, although created in Russia, basically trace over BREEAM and LEED and have a number of imperfections. Recommendation is given that the Russian "green" standard should not be just the adaptation of any foreign system. A number of criteria need to be worked out in more detailed way.

1 Introduction

21 Century became the century of global automation, which led to a large-scale development of production and construction all over the world. This affected the ecology of populated areas, which in turn significantly averaged the quality of life in many countries. Since the end of the 1970s, the theory of energy efficiency and the so-called sustainable development has become popular. In densely populated regions, as well as in regions with unstable environmental conditions, the issue of the importance of resource saving and energy efficiency at a country level became topical. It was then that the first non-commercial organizations began to be formed, whose purpose and task today correspond to the "Green standards".

"Green building" is a complex of knowledge related to the mechanism of processes and technologies based on regional standards for construction and design, as well as on the implementation and use of processes that are environmentally responsible, which determines the effective use of resources throughout the life cycle of the facility: from site selection for design, construction, repair and reconstruction, till demolition. The dynamics of its development directly depends on the technological progress of the country and the comprehension of the ecological situation by the society.

"Green Standard" is a set of direct principles and criteria for assessing the conformity of objects. In total for 2017 there are about 32 national standard systems around the world. Each

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of them is linked to a certain region, takes into account the climatic, natural and other factors that are key factors for certification.

The development of the "Green Standards" in Russia is primarily due to the Olympic Games in Sochi, in 2014. Until then, the certification of construction projects in the country was initiated by foreign developers only. Domestic developers did not show interest in this topic due to the lack of interest of potential consumers, as well as a significant increase in the cost of projects, which was due to the lack of necessary materials and technologies in the market.

However, today the things in Russia are changing qualitatively, and now the interest to the ecology and energy efficiency of the facilities and buildings under construction is growing: there are "advanced" developers, the demand for a “green construction” product gradually increases, and the most important is that the state at all levels shows its interest in developing energy efficient and environmentally friendly construction.

One of the most difficult tasks that Green - developers face is the choice of the most profitable and feasible project for a particular region. It is caused by climatic diversity, resource opportunities (both water and energy), and alternative energy potential in each particular region of the country. For example, in the southern regions of the country, priorities for the use of renewable energy sources are provided, for the areas with a lack of freshwater, the importance of indicators of rational water use will be of greater interest, for Chukotka, supplied with imported fuel, priority will be given to energy efficiency.

In addition, in the case of having an idea and making a decision to certify the object, the customer faces a difficult task of choosing from a variety of existing standards. A dilemma arises: Russian standards are more adapted, more accessible (in terms of the implementation process and low cost), but they are often not recognized by foreign investors and international commissions, foreign ones have a number of features, complicated and expensive to implement, not adapted to Russian conditions. And even if we narrow down the choice to three international standards DGNB, BREEAM, LEED and several Russian standards, the developer (including the state) needs to understand clearly the specifics of each standard in order to obtain the best result that is compilation of different criteria: the amount of paid funds, the time spent, the score received in the certificate, the quality of the facility etc.

The goal of the work is to identify the most optimal system of environmental certification for our region, by comprehensive analysis of systems and conducting preliminary certification by chosen international and domestic standards considering a multi-apartment 16-storey residential building as an example.

To achieve this goal, a number of tasks were implemented:

- to review the most popular and significant "green" standards - BREEAM (UK), LEED (USA), DGNB (Germany) and Green Standards (Russia): identify their main estimated criteria, the system criteria rating, analyze the advantages and disadvantages of each system, stages of certification.

-to study and compare how systems work from the inside: to conduct preliminary certification of the selected object, the multi-apartment 16-storey residential building of residential complex “Sovremennik”, located in Kazan, by four above-mentioned systems. All calculations are performed in accordance with the methods presented in the relevant codes.

2 Literature review

Despite the fact that compared to some foreign countries, the quantitative and qualitative level of introducing green standards and resource-saving technologies in the mass construction of our country is still quite low, “green standards” is very popular topic among both young scientists and experienced researchers, and it is widely discussed in the Russian scientific community. Over the past five years, we see a huge number of various scientific publications reviewed by the Higher Attestation Commission devoted to this topic. However, considering that the Russian “green building” market is in its infancy, and the positive dynamics of the development of green construction in Russia started in 2010, most of the studies, in particular [1-9], are of an overview nature: they generalize, systematize and clarify the definitions (meaning) of the basic concepts and terms in this area, describe the types of green standards existing in the world, the structure of their requirements and criteria, give them different characteristics, describe the history of the emergence of green standards and foreign experience in the implementation of standards, give examples of certification. These publications more often serve to develop the topic of "green" standards, as a field of scientific interests, and systematization of accumulated data, which, is although not unique and innovative, but crucially important for the trend that is at the initial stage of its development

All researchers mention successful foreign experience of introducing green standards in construction since the 1990s, their obvious advantages and prospects on the one hand, and low rate and level of their development in Russia on the other hand, which suggests number of problem factors that hamper it. A number of scientists in their works [10-14] pay attention to the analysis of existing problems suggest ways to solve them, predict the prospects for the development of "green standards" and ecological construction in Russia. Among the main problem and constraining factors are relatively low cost of natural resources, high cost of initial investments in environmental construction and the long payback period of projects, the lack of specialists in the field of environmental construction, the peculiarities of the mentality of the Russian consumer, and absence of a rigid regulatory framework regulating the use of energy-efficient solutions.

Improvement of regulatory framework in more detailed way is presented in [15, 16]. So approach to eco-rating and eco-certification in the EU, the USA and Russia is analyzed in the work of Bakaeva N.V., Natarova A.Yu., Igin A.Yu. [16]. The main disadvantages in the existing Russian system of ecological regulation are identified, among which the prevailing one is the low level of requirements aimed at ensuring the comfort of human stay in an artificial environment and the biocompatibility of buildings and the environment. The main technical vector of modern "green standards" is highlighted - prevalence of requirements for energy efficiency. In the work, scientists came to the conclusion that ecological standards in Russia should not become an analogue of foreign systems, but should be developed and improved taking into account natural, climatic, social, cultural and economic characteristics of our country.

Among the reviewed publications, it is possible to single out some analytical articles presenting results of the analysis of various certification systems advantages and disadvantages assessment, comparative analysis of Russian and foreign standards [17-23]. In particular, the work by Reteyum A.Yu. [18] is devoted to the analysis of "green standards" in terms of their balanced structure. The inadequacy of the basic assessment model is noted, in which the whole technological cycle of energy production is not taken into account. The standards focus on urgent actions to reduce carbon dioxide emissions, although the hypothesis of anthropogenic warming is not actually confirmed. The obvious weakness in introduction of BREEAM, LEED and planned Russian "green standard" is that they ignore geographic location of the certified building, which may impose serious restrictions on the introduction of alternative energy in most parts of our country. It is noted that for making domestic "green standard" popular, a number of measures should be taken to support the innovation. Work by Sheyina S.G., Minenko E.N. [19] presents a comparative analysis of existing rating systems for assessing the level of ecological compatibility of buildings and the urban environment in general. The authors proposed promising trends stimulating development of "green construction" in Russia. In the work of Mikhailova M.K., Semashkina D.O., Sovonnikova D.O.[20], leading international standards were compared: BREEAM, LEED, DGNB, Green Building Index and the Russian national standard "Green Building.

Residential and public buildings. Rating system for assessing the sustainability". Advantages and disadvantages of systems are identified. In work of Bakaeva N.V., Natarova, A.Yu. Igin A.Yu. [21] comparison of international and national "green standards" is carried out in terms of their structure and main criteria for real estate environmental assessment. As a result of the comparison, common basic categories are identified that are typical for all existing standards, as well as unique criteria appropriate for one or another assessment system. The authors also examined the areas of certain eco-standards application and concluded that the same standard cannot be applied simultaneously for residential, public and industrial buildings due to the fact that the priority requirements for environmental safety directly depend on the purpose of property. Proposals to improve the Russian national environmental assessment system have been formulated: the introduction of new criteria and detailed study of existing ones, the development of an effective assessing methodology, correction of the standard requirements depending on purpose of the property. In the work of Arkhangelskaya Ya.S., Arkhangelskaya E.A. [23] main indicators of sustainable development of municipalities are identified; recommendations for improving the sections of the national standard STO NOSTROY 2.35.68-2012 are developed.

Special interest is given to the research devoted to the study of the connection between life cycle cost (LCC) and the introduction of green standards [24.25]. In work of A.L. Naumova, D. Kapko, O. Cyudyina [24], it is shown how to minimize the cost of the object's life cycle by introducing green technologies, predicting the payback and efficiency of using "green standards". In the article by Sheina S.G., Mirgorodskaya E.O., Minenko E.N. [25] authors gave a brief description of modern calculations and design programs used in the system of "green standards" for integrating the evaluation of life cycle costs into the process of creating an information model of an ecological building. Among the foreign publications we can also find a lot of serious research on the topic of "green standards", and in view of a number of specific social, economic, political and environmental factors and much more successful experience of their application, a significant part of the publications is a description of "green" real estate building and reconstructing experience, the application of innovative technologies on them and the outstanding results of their certification.

3 Materials and methods

To solve the problem of choosing the most optimal certification system for the region, the most popular and significant "green" standards were reviewed - BREEAM (UK), LEED (USA), DGNB (Germany) and Green Standards (Russia); their main evaluated criteria and specifics of system ranking criteria are determined, advantages and disadvantages of each system and stages of certification are analyzed. In this part, general scientific methods of research were used: analysis and synthesis, comparison, generalization.

For the detailed analysis of systems from inside, an attempt to pre-certify the selected object-the multi-apartment 16-storey residential building of “Sovremennik” residential complex, located in Kazan, by four above-mentioned systems was made. All calculations were carried out experimentally in accordance with the methods presented in the corresponding codes.

Design documentation of the object, presented by the developer - a well-known Finnish company - was used as ground for certification. It included an explanatory note, land management, constructive, architectural and space planning decisions, electricity, gas, water, heating, ventilation and air conditioning systems, as well as detailed reports on environmental protection measures and ensuring fire safety, activities to ensure access for people with disabilities, a report on energy efficiency systems used in the project. In addition, a visual and instrumental inspection of the certification facility was carried out at various stages of construction. The study was conducted from January to June 2016.

4 Results

In many European countries and America, for more than two decades, standards for voluntary environmental certification have existed and are being actively applied, confined to the particularities of a region or category of construction.

We examined the most significant, in our opinion, of them.

LEED (LEADERSHIP IN ENERGY AND ENVIRMENTAL DESIGN) - American certification system, founded in 1988, is not only one of the main standards used in the US, but also a leader around the world.

Main assessment criteria:

– location and infrastructure;
– district, structure, project;
– implementation of innovations in the design process;
– regional advantages.

The rating system includes: platinum, gold, silver and bronze marks [26].

Advantages of the system:

– availability at the transnational level;
– availability of information in an understandable and structured form;
– high environmental requirements for facilities
– standard raises the issue of reducing operating costs;
– coherence with all available technologies, engineering innovations, materials on the market of the US and many other countries.
– universality of the assessment processes;
– coherence of the standard with international technical regulations, etc.

Disadvantages of the system:

– adaptation only to the social and economic conditions of the US;
– strict requirements for documentation, etc.

Stages of certification:

1. Planning
2. Registration
3. Motivation of design solutions
4. Assessment of design solutions
5. Motivation of structural solutions
6. Assessment of structural solutions
7. Calculation of points
8. Award

BREEAM (British Building Research Establishment Environmental Assessment Method) is a certification system founded in England in 1990. A distinctive feature of this system is its versatility, which made this system global.

The main categories are:

– climate and energy;
– resources;
– location;
– transport;
– society;
– ecology and biodiversity:
– business and economics;
– buildings and structures.

Marks can be: "outstanding", "excellent", "very good", "good" and "beyond evaluation" [27].

Strengths:
- possibility to certify various categories of buildings;
- availability of an independent assessment;
- strict requirements for materials used in construction;
- possibility of an individual approach to unique objects;
- adaptation to foreign standards, etc.

Weaknesses:
- rigidly structured requirements that do not allow deviations;
- complex hierarchical system;
- lack of training materials;
- high cost, etc.

The structure of certification:

1. Bring in the specialist (auditor) BRE Global
2. Registration of the project for the assessment according to BREAM requirements
3. Project verification
4. Preliminary assessment of building initial condition by the auditor
5. Awarding a preliminary certificate
6. Create a roadmap for certification
7. Carrying out a step-by-step analysis
8. Control over erection of the building and preparation of technical documentation
9. Creating a report on the completion of construction
10. Issue of a certificate with an appropriate assessment

DGNB (Deutsche Gesellschaft für Naschaligges Bauen) is a German society for sustainable development, established in 2007. The main goal is to combine basic concepts of sustainable development: economy, ecology and society with the construction process.

Assessed criteria:
- ecological quality;
- economy;
- social, cultural and functional qualities;
- technical quality;
- quality of performance.

The standard evaluation system assumes gold, silver and bronze marks [28].

Advantages of the system:
- high "flexibility" of the system. It allows you to improve and adapt to the latest developments easily;
- allows to trace building operation for a period of up to 50 years;
- social component is taken into account, etc.

Weak sides:
- poorly developed energy saving system, etc.
- Stages of certification:

1. Project Registration
2. Bringing in an auditor
3. Evaluation of design decisions
4. Evaluation of structural solutions
5. Calculation of points
6. Award

Thus, assessment by LEED system is presented in Table 1:

Table 1. Rating calculation of the object by the LEED certification system (Source: calculations performed by the authors).

Criterion under estimation	Evaluable points	Assigned points	Criterion weight,%	Reasons
Construction site, transportation	26	15	24	- Multi-storey parking is designed on the given site. Designed residential building is removed from parking at a distance of 29m. On the west side of the house, there are play grounds, recreation zones and landscaped areas. Sport ground is designed to the south from the house. Carpet cleaning areas are located to the south-west. - Entrance to the relief road is carried out at a distance of 50 m from the intersection. Internal passages along the territory of the complex are designed with a two-way traffic of 6 m wide, with 0.15 m high side stone. According to the complex as build drawing of the residential house, vehicles can reach all the facades.
Water use efficiency	10	8	9	1) application of modern high-efficiency pumping stations with frequency control, 2) complete water consumption records, 3) floor-by-floor water pressure regulation, 4) application of modern shut-off and control valves, 5) water pipeline zoning
Overall energy efficiency	35	15	32	-Use of heat recovery system -Heating: “Kermi” panel radiators are used as heating appliances. Appliances are installed either at a height of 2.2 m from the floor on the staircase, or under the stair flight on the 1st floor. In the corridors of office buildings, radiators and collectors are installed in niches. “Danfoss” automatic thermostats are installed on the piping to the radiator to control the temperature of the air in each room. Air bleeding from the heating system is carried out through the "Maevsky" cranes installed on the radiators, from the main risers and collectors via an automatic air vent. The main risers are heat-insulated with 19 mm thick K-Flex ST rubber insulation. Before the thermal insulation of the pipes, they should be covered with 2 coats of oil-bitumen mastic and 1 layer of GF-021 primer. Pipes laid in the basement are insulated with 32 mm thick K-Flex ST. Sections of steel pipelines without heat insulation are covered with oil paint two times on two layers of GF-021 primer. Along the whole heating system there are control valves, shut-off and air and water drain fittings. - Automation of supply air systems P1-P8, and exhaust systems B1-B20 is done by devices and means of automation, that go with equipment. Air-supply automation device provide: - filters loading control; - preheating the air heater; - control of circulation pumps; - automatic control of supply air temperature by changing the coolant flow; - protection from freezing of ventilating equipment;

				- control of the fan; - transfer to "standby" mode in case of fire; - display of parameters and settings on the check indicator. Automatic extraction systems device provide: - control of the fan; - transfer to "standby" mode in case of fire; The control circuits to control supply units are installed with cables of KSVEVng-LS, KVVGng-FRLS type, of different capacities and are laid along the construction structures and technological equipment openly: - group of cables on the trays; - single cables on the installation profile.
Materials, operational life	14	10	13	- Windows and balcony doors of the residential part are made of PVC profile with double-glazed windows with energy-efficient heat-reflecting coating with an index of reduced total thermal resistance R = 0.57m² ° C / W; windows and stained-glass windows of the office part are made by means of aluminum binders with 4 chamber profiles with an index of reduced total thermal resistance R = 0,49m² ° C / W; - sealing gaskets are applied in the stained-glass windows, windows and doors. The structure external walls, windows and stained-glass windows provide a standard sound insulation from external noise, the structure of internal walls - from air noise, the structure flooring - from air and impact noise. The project provides protection against noise of engineering equipment. The project provides waterproofing and vapor barrier in the structure of the building. Horizontal waterproofing on the basement slabs at level -2.700 – surface waterproofer Superflex 1; vertical waterproofing of walls in contact with ground – surface waterproofer bitumen mastic BKM 200. In the flooring structure in wet rooms (bathrooms, cleaning tools storeroom) waterproofing Superflex 1is provided. The equipment provided by the project for operation is certified. Electromagnetic and other radiation from the equipment - within the limits of admissible parameters.
Quality of indoor environment – acoustics, lighting	15	8	14	In communal spaces there is a working, evacuation lighting. The project requires lamps with fluorescent lamps, compact fluorescent lamps, LEDs produced in Russia. In technical rooms and storerooms, lighting control is done with switches installed either in rooms or at entrances, depending on the purpose. Evacuation lighting is provided in all rooms with equipment that ensures normal operation of the building (electrical room, lift motor room, pumping room, concierge room) and in the common-house corridors. To supply portable light for maintenance lighting in the premises of the electrical, pumping and engine rooms, reducing transformers 220 / 36V are provided. In office premises, the tenant himself builds lighting networks and installs lighting fixtures. - There is no information about the state of acoustics. - Insolation. Siting, number of floors and layout of apartments are based on the calculation of insolation, made according to SanPIN 2.2.1 / 2.1.1. 1076-01, confirming the continuous duration of insolation at least 2 hours in each apartment. The calculations take into account possible shading from own quarterly buildings and structures, as well

				as from the complex of point dwelling houses that are planned to be build on the south of the construction site. In rooms with permanent residence of people, the level of natural and artificial lighting is adopted in accordance with the requirements of SNiP 23-05-95 * "Natural and artificial lighting". In these rooms, building design requires installation of window and stained-glass blocks, providing sufficient daylight.
innovations	6	0	5	- There are no solutions in the draft that are subject to verification for patent purity
			100%	
Total score	**56**			
Assigned mark	**Silver**			

As a result of the preliminary certification according to the system of voluntary environmental certification, the object is awarded 56 points, which corresponds to the silver mark.

BREEAM

The next stage of the scientific research was the preliminary certification according to BREAM system. Conformity of the object to all the stated criteria is presented in Table 2.

Table 2. Rating calculation of the object by the BREAM certification system (Source: calculations performed by the authors).

BREEAM criteria	Assessed points	Available points	Percentage of assessed points, %	Criterion weight	Result of criterion ,%	Comments
Management	10	22	45%	0,12	5,45 %	Production quality control of construction is carried out by the contractor
Health and comfort	8	10	80.00%	0.15	12.00 %	Control of highlights (lighting) High-frequency lighting Levels of indoor and outdoor lighting Lighting zones and control Natural ventilation Quality of indoor air (recovery system) Thermal comfort Thermal zoning Microbiological contamination
Energy	16	30	53.33%	0.19	10.13 %	Heating: “Kermi” panel radiators are used as heating appliances. Appliances are installed either at a height of 2.2 m from the floor on the staircase, or under the stair flight on the 1st floor. In the corridors of office buildings, radiators and collectors are installed in niches. “Danfoss” automatic thermostats are installed on the piping to the radiator to control the temperature of the air in each room. Air bleeding from the heating system is carried out through the "Maevsky" cranes

						installed on the radiators, from the main risers and collectors via an automatic air vent. The main risers are heat-insulated with 19 mm thick K-Flex ST rubber insulation. Before the thermal insulation of the pipes, they should be covered with 2 coats of oil-bitumen mastic and 1 layer of GF-021 primer. Pipes laid in the basement are insulated with 32 mm thick K-Flex ST. Do not insulate the heat-insulated sections of steel pipelines with oil paint two times on two layers of GF-021 primer. Along the whole heating system control valves, shut-off and air and water drain fittings. - Automation of supply air systems P1-P8, and exhaust systems B1-B20 is done by devices and means of automation, that go with equipment. Air-supply automation device provide:
Transpor tation	6	9	33.3 3%	0.08	2.66 %	Entrance to the relief road is carried out at a distance of 50 m from the intersection. Internal passages along the territory of the complex are designed with a two-way traffic of 6 m wide, with 0.15 m high side stone. According to the complex as build drawing of the residential house, vehicles can reach all the facades. Radius of rounding of the roadway along the edge of sidewalk is not less than 5 m.
Water	5	9	55.5 6%	0.06	3.33 %	List of measures for the rational use of water: 1. application of modern high-efficiency pumping stations with frequency control, 2. complete water consumption records, 3. floor-by-floor water pressure regulation, 4. application of modern shut-off and control valves, 5. water pipeline zoning
Materials	6	12	50.0 0%	0.12 5	6.25 %	The interior decoration of premises uses modern and durable materials and technologies. The main condition necessary for finishing and for the use of certain materials is the fire hazard class of them, depending on the functional purpose of the room. The class of internal finishing materials' fire danger on evacuation routs meets the requirements.
Wastes	3	7	42.8 6%	0.07 5	3.21 %	For waste generated during the operation of the facility, the project considers the following activities: - preventing littering of the territory with construction and consumption wastes, - carrying out conditions of waste temporary on site, - accumulation of waste in accordance with their hazard class and species identity (separate waste-gathering is produced according to their types and classes in order to transfer to different

						waste treatment plants, recycling facilities and landfill); Cabins have small area, they are easily moved and transported. Overall dimensions of the cabin are 110 × 120 × 220 cm. The weight of cabin is 80 kg. When composting toilets are full, domestic wastewater is pumped out by specialized vehicles and then transported to existing treatment facilities of specialized enterprises on contractual terms. The hydrological conditions of this area meet the requirements for construction work, and do not need additional and complex engineering and preparatory measures for implementation.
Land development and ecology	7	10	70.0 %	0.10	7.00 %	Measures for the rational use and protection of water In order to protect surface and ground waters of the site during construction and installation works, and operation of the facility, the project considers activities such as: - Moving of construction machinery only by specially allocated ways
Contamination	10	13	76.9 %	0.10	7.69 %	In order to minimize the negative impact, following organizational and technical measures are considered: - fencing with solid material to ground level; - storing easily washable building materials under a shed; - timely removal of waste generated during construction. Temporary storage of construction waste is organized on special designated sites, which completely excludes the possibility of groundwater contamination in the area. There is a cleaning point of the wheels of motor vehicles with the circulating water supply system "Moidodir-K-2" on construction site.
Innovations		10	0%	0	0%	There are no solutions in the draft that are subject to verification for patent purity.
Final result by criteria	40.98					
Rate by BREEAM	Pass					

Based on the results of calculation we come to conclusion that the chosen object gains 40,98 points by BREAAM system, which is identical to the assigned rating "Pass"

DGNB

The final stage of detailed consideration of international standards for environmental certification systems was the preliminary certification of the facility by DGNB system (Table 3).

Table 3. Aggregate rating calculation of the object by the DGNB certification system (Source: calculations performed by the authors).

Main criterion	Group	Assessment criterion	Max. points	Weight	Assigned points	Total	Max. points for group	Total for group	Weight of group	Group rating
Quality of the environment	Impacts on the global and local ecology	Probability of global warming	10	3	4	12	195	67.5	22.5%	15.18
		Probability of depletion of the ozone layer	10	0,5	4	2				
		Probability of photochemical influence	10	0,5	4	2				
		Probability of oxidative processes	10	1	4	4				
		Probability of eutrophication	10	1	6	6				
		Risks for the local environment	10	3	4	12				
		Risks for the global environment	10	1	2	2				
		Microclimate	10	0,5	1	0,5				
	Utilization of resources and waste	Non-renewable energy resources	10	3	5	15				
		Renewable energy resources	10	2	2	4				
		Storage and collection of fresh water and waste water	10	2	4	8				
		Beneficial use of the territory	10	2	4	8				
Cost effectiveness	Expenses for house life	Costs for creation	10	3	6	18	50	28	22.5%	6.3
		Stability	10	2	5	10				
Socio-cultural qualities and functionality	Health, comfort and satisfaction of residents	Comfortable temperature in winter	10	2	6	12	280	130	22.5%	29.25
		Comfortable temperature in summer	10	3	6	18				
		indoor hygiene	10	3	6	18				
		Sound comfort	10	1	5	5				
		Visual comfort	10	3	4	12				
		Influence of residents	10	2	4	8				
		Roof structure	10	1	2	2				
		Safety and risk of failure \ collapse	10	1	6	6				
	Functionality	Barrier-free access	10	2	4	8				
		Quality of surrounding areas	10	1	4	4				
		Ability to vote for changes	10	2	2	4				
		Availability	10	2	6	12				
		Comfortable conditions for bike riding	10	1	4	4				
	Quality of structures	Ensuring the quality of structures	10	3	5	15				
		Visual comfort of structures	10	1	2	2				

Technical equipment	Quality of technical equipment	Fire safety	10	2	6	12	100	44	22.5%	9.9
		Noise protection	10	2	2	4				
		Protection against humidification of external walls	10	2	4	8				
		Easy to clean and replace parts of structures	10	2	5	10				
		Easy to redesign and demolish structural units	10	2	5	10				
Process quality	Quality of the project	Quality of project preparation	10	3	6	18	230	116	10.0%	11.6
		Integrated planning	10	3	4	12				
		Optimization and complexity of planning	10	3	5	15				
		Proving energy efficiency	10	2	4	8				
		Publication of requirements for technical operation	10	2	8	16				
		Publication of the stages of construction	10	2	5	10				
		Quality of management company	10	2	8	16				
	Quality of events	Quality of provided construction activities	10	3	4	12				
		Commissioning system	10	3	5	15				
Total	385,5									72.32%

Final index of the effectiveness of the object is 72.32%, which corresponds to the "Silver" mark.

Despite the fact that the selected certification systems are partially adapted to the realities of different countries, many criteria and principles of certification are not respected due to various climatic, social or economic factors. To take into account all the above mentioned aspects, we also studied Russian system of environmental certification, which is developed on the basis of popular international certification systems with some corrections in requirements for the facility. It should be mentioned that nowadays there are few similar systems in Russia, but this system, one of the first developed in Russia, served as a prototype of for developing a system used to certify Olympic facilities in Sochi in 2014, and it is most suitable for certification of multi-apartment housing (in turn, other existing systems in Russia are focused on certification of public buildings, sports facilities, football stadiums).

"GREEN STANDARDS"

Thus, the organizational chart of the "Green Standards" is following:

1. Preliminary analysis
2. Verification of project documentation
3. Confirmation of compliance of project documentation
4. Awarding a preliminary certificate [29];

An overview of the cost estimate is presented in Table 4.

Table 4. Rating calculation of the object by the "Green standards" certification system (Source: calculations performed by the authors).

№	Name of the group of criteria	Evaluation of the criteria group
1	Ecological management	11.47
2	Selection of site, infrastructure and landscaping	8.5
3	Rational water usage, stormwater management and pollution prevention	2.68
4	Architectural and structural solutions	9.38

5	Energy saving and energy efficiency	7.17
6	Materials and waste	5.22
7	Quality and comfort of habitat	5.58
8	Life safety	2.25
Total		52.25
Assigned rating		Silver

5 Discussion

In the work a detailed analysis of each declared systems was carried out, advantages and disadvantages were revealed, and preliminary certification for systems was analyzed on the basis of analysis of a residential 16 - storey multi - apartment building.

Based on the calculations performed, it can be concluded that the multifamily dwelling house satisfies the requirements of all selected certification systems.

The highest rating was earned by the preliminary certification by German system of environmental certification DGNB (Golden) - 72.32%. From the advantages of the system, should be mentioned high "flexibility" of the system and possibility to trace the functioning of the building for up to 50 years. The DGNB system can easily be adapted to any country, since the assessment uses the main criteria of the system, taking into account the national building codes of the country where certification is carried out. The disadvantage of the DGNB system is that the assessment is carried out only within the boundaries of the building and the environmental indicators of the surrounding area are practically not taken into account. To get a certificate, it is necessary to reach a certain set of minimum criteria for characteristics in each section (for "silver" rating - not less than 50%).

The results of the preliminary certification on the system of Russian "green standards" turned out to be equivalent to a silver mark. The given object was awarded 52.25 points. Here it is worth noting the greatest correlation of the assessed criteria to surroundings, i.e. it have advantage over foreign analogues. This standard has a large number of requirements for energy efficiency and engineering support of the building and insufficient criteria for aesthetic appeal, compliance with the surrounding buildings, as well as comfort and safety. In the section "Architectural, planning and constructive solutions" there are no requirements for that.

The result of preliminary certification according to the American standard LEED was a silver mark (56 points). However, this standard turned out to be the least applicable to the selected region and the object of certification due to the presence of strict requirements, focusing on US legislation, the lack of evaluation activities audit.

Based on the results of the preliminary certification according to the BREAAM standard, the object was assigned 40.98 points, which is equivalent to the rating "Pass". The disadvantage of the BREEAM system is that it is quite bulky, with a large number of criteria and a complicated evaluation procedure, while the system does not allow changes. In addition, the standard has a commercial focus and it is intended more for developers than for architects, designers and engineers. Also in this standard, insufficient attention is paid to the principles of sustainable development. In general, this standard is characterized by a wide range of evaluated criteria, including not only structural components, but it is also socially oriented.

It should be noted that before we started our research, the developer of the investigated object signed a contract for the actual certification with auditors of the system BREAAM earlier in 2016. This choice was not preceded by a detailed comparative analysis of the systems and calculation. In July 2016, after the completion of our calculations, as a result of the certification carried out by the developer, according to the conclusion of the BREAAM auditors, the facility was also awarded the "Pass" rating, which confirmed the results of our calculation for BREAM and that is the threshold for passing certification by this system.

There is a reason to believe that using DGNB system the customer could receive a higher rating and the mark of the object for approximately the same money, and therefore the best marketing component for future sales.

6 Conclusions

Analyzing the most popular international and national standards in Russia, we can conclude that, despite the similarity of the main categories, the criteria for each of the standards considered differ significantly. In each system there are unique criteria, which are due to the peculiarities of the country's development. According to our study, the most suitable international system for category of buildings under study, due to its adaptability and flexibility is the DGNB standard.

Existing Russian standards, although created in Russia, but as analysis and practice shows, copy BREEAM and LEED largely, and also have a number of imperfections and, moreover, they are not recognized abroad yet.

As a recommendation, it should be noted that the Russian "green" standard should not be just an adaptation of foreign system. It is necessary to work out in more detailed way such criteria as "transport", "building materials", "health and ecological well-being", "innovations", introduce more precise indicators for assessing the category "quality of the architectural appearance of the building and visual comfort", and expand the system of criteria of "safety" category. It is advisable to use the methodology of building life cycle assessing by the German standard DGNB for facility least-cost analysis and minimizing the environmental impact throughout the life of the facility. When developing quantitative criteria for the environmental characteristics of real estate objects, we should not limit ourselves to only existing standards (GOST, SNiP, SP), since they only provide minimum averaged values of indicators and they are often insufficient to assess compliance with the requirements of "green" standards. At the same time, the standards referred to current Russian "green" standards are scattered, there is no single methodological base that provides an integrated approach to "green" design and construction.

Nowadays it is necessary to create and develop national standards for "green" construction, containing state requirements for compulsory certification of residential and public buildings in Russia.

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