

DOI 10.15826/rjst.2024.1.007

УДК 69

Chen Yang Yang¹, Li Quan Peng², L. I. Mironova³

^{1,2,3} Ural Federal University, Ekaterinburg, Russia

e-mail: ¹ 837141139@qq.com, ² 1061011290@qq.com, ³ mirmila@mail.ru

ORCID: ² <https://orcid.org/0000-0002-3675-6008>

ANALYSIS OF ADVANTAGES AND DISADVANTAGES OF OPERATIONAL QUALITY OF OBJECTS "GREEN BUILDING"

Abstract: The purpose of the work is to identify the features at the modern concept "green building". To achieve the goal, it is necessary to solve the following tasks: to characterize the genesis for the concept "green building", to determine the possibilities of achieving the operational quality the construction products, to identify the advantages and disadvantages in the implementing the standards "green building". Hypothesis of the research: identification the direction in architectural and construction activities related to the concept under consideration can lead to the formation for a stable architectural space. Research methods include: a systematic approach and analysis at the factors affecting the possibilities they are achieving operational quality indicators at the construction products. Results: identification of advantages, as well as possible directions for development and problematic aspects the concept "green building".

Keywords: green building, ecology, energy efficiency, architectural space.

For citation: Chen Yang Yang, Li Quan Peng, Mironova L. I. (2024) Analysis of advantages and disadvantages of operational quality of objects "green building". *Russian Journal of Construction Science and Technology*. 10(1). 1001007. DOI 10.15826/rjst.2024.1.007.

Яньян Чэнь¹, Цюаньпэн Ли², Л. И. Миронова³

^{1,2,3} Уральский федеральный университет, Екатеринбург, Россия

e-mail: ¹ 837141139@qq.com, ² 1061011290@qq.com, ³ mirmila@mail.ru

ORCID: ² <https://orcid.org/0000-0002-3675-6008>

АНАЛИЗ ПРЕИМУЩЕСТВ И НЕДОСТАТКОВ ЭКСПЛУАТАЦИОННЫХ КАЧЕСТВ ОБЪЕКТОВ, ПОСТРОЕННЫХ В КОНЦЕПЦИИ "ЗЕЛЕНОЕ СТРОИТЕЛЬСТВО"

Аннотация: Целью статьи является выявление особенностей современной концепции "зеленого строительства". Для достижения поставленной цели необходимо решить следующие задачи: охарактеризовать основы концепции "зеленого строительства", определить возможности достижения эксплуатационных качеств строительной продукции, выявить преимущества и недостатки при внедрении стандартов "зеленого строительства". Гипотеза исследования: определение направления в архитектурной и строительной деятельности, связанного с рассматриваемой концепцией, может привести к формированию стабильного архитектурного пространства. Методы исследования включают в себя: системный подход и анализ факторов, влияющих на возможности достижения эксплуатационных показателей качества строительной продукции. Результаты: вы-

явление преимуществ, а также возможных направлений развития и проблемных аспектов концепции "зеленого строительства".

Ключевые слова: «зеленое строительство», экология, энергоэффективность, инновационные технологии, архитектурное пространство.

Для цитирования: Янян Чэнь, Цюаньпэн Ли, Миронова Л. И. Анализ преимуществ и недостатков эксплуатационных качеств объектов, построенных в концепции "зеленое строительство" // Russian Journal of Construction Science and Technology. – 2024. – Т. 10. № 1. –1001007. – DOI 10.15826/rjct.2024.1.007.

1. What is "Green Building"?

Sustainable development and green ecology have become two terms of social concern. The common theme of mankind in the 21st century is sustainable development. For urban construction, it is also necessary to shift from the traditional high-consumption development model to an efficient green development model. "Green buildings" are the only way to implement this transformation and are the development of architecture in the world today inevitable trend [1, 2].

A "green building" is a building that maximizes the conservation of resources (energy, land, water and materials), protects the environment and reduces pollution throughout the life cycle of the building, and provides people with a healthy, suitable and efficient use of space, living in harmony with nature.

The whole life cycle of a building refers to the whole process including material production, planning, design, construction, operation and maintenance, demolition, reuse and disposal of the building.

Due to geographical, conceptual, economic, technological and cultural differences, there is no consensus on the precise definition of "green building" at home and abroad. On the other hand, as "green building" practices ecological civilization and scientific development concept, its connotation and extension are extremely rich and are evolving along with the process of human civilization without any exhaustion, thus pursuing a so-called

world-recognized concept of "green building" is of little practical significance.

As a matter of fact, like many other concepts, people can understand the essential characteristics of "green building" from different time and space and from different perspectives. The reality is the same. There are, of course, some basic connotations that are recognized worldwide.

"Green buildings" are usually recognized by the world as having at least the following three basic connotations.

1) *Environmental conservation.*

Conservation and environmental protection is to require people in the whole process of constructing and using the building to maximize the conservation of resources (energy saving, land saving, water saving, material saving), protect the environment, care for the ecology and reduce pollution, and reduce the load and impact on the earth's resources and the environment caused by the construction and use of human activities on the building to the minimum and the ecological recycling capacity.

We usually call buildings that are designed and constructed in accordance with energy-efficient design standards to reduce energy consumption during use. This means that a "green building" requires that it is also an energy-efficient building. However, energy-efficient buildings cannot be simply equated with "green buildings".

2) *Healthy and Comfortable.*

Creating a healthy and comfortable living and working environment is one of the basic requirements for people to con-

struct and use buildings. It is to provide people with a healthy, suitable and efficient activity space.

3) *Natural Harmony.*

Natural harmony is to require people in the construction and use of buildings in the whole process, close to, care and care of people and buildings in the natural ecological environment, will know the world, adapt to the world, care for the world and transform the world of natural harmony and peace of mind in unity, so that people, buildings and nature coexist harmoniously. Only in this way can we consider and coordinate the economic benefits, social benefits and environmental benefits; in order to achieve the national economy, human society and the ecological environment in a good and fast sustainable development.

Because of the above connotation, some people call "green building" as environmental protection building, ecological building or sustainable building.

Therefore, what we understand by "green building" is a kind of multi-dimensional green physical carrier constructed by people to maximize resource conservation and environmental friendliness in the whole life cycle for people to live in peace and use. The key reason why "green building" is different from traditional building is that it stresses that the building is no longer isolated, static and purely the building itself, but a comprehensive, all-encompassing, all-encompassing, universally connected, moving, changing and constantly evolving multi-faceted greening physical carrier [3, 4].

We have developed evaluation criteria for "green buildings", which include general principles, terminology, basic regulations, safety, health and comfort, convenience of life, use of resources, environment and innovation. (Fig. 1)

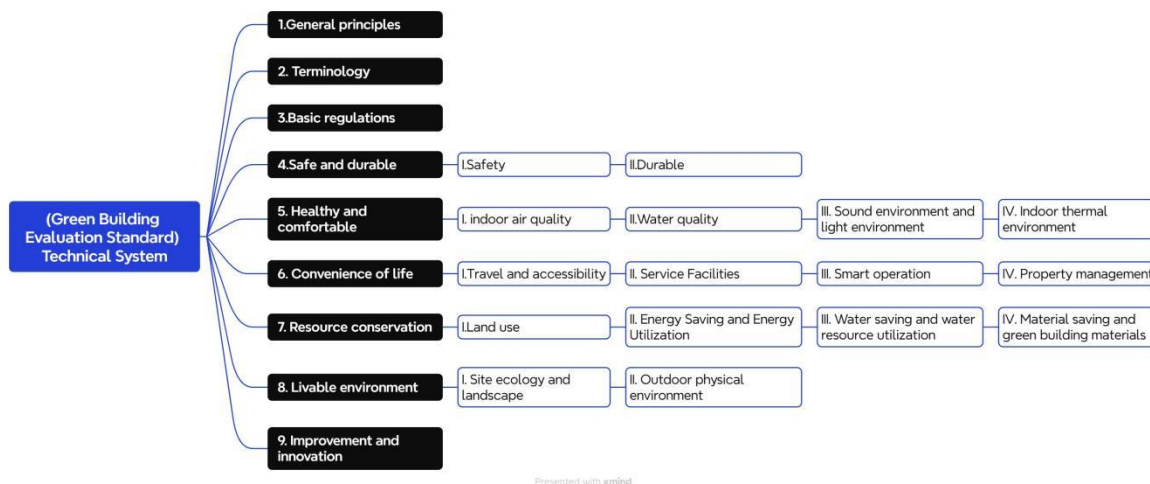


Fig. 1. Green building evaluation standards. (Picture author Chen Yangyang)

2. Advantages and disadvantages

The concept of "green building" cannot be attributed to a fundamentally new direction in architectural, construction, urban planning activities, as well as sustainable territorial development. Issues aimed at solving the harmonious interaction of the artificial environment with

the surrounding natural space were constantly considered in the past and found, to one degree or another, a practical reflection – depending on the social and technical-technological state of each specific historical era.

As a result of the completed industrial period of development and the process

of urbanization, problems associated with the following have sharply worsened:

- possible shortage of renewable resources;
- a significant reduction in areas of the planet's surface suitable for life;
- environmental pollution of the planet;
- revolutionary achievements in construction materials science, engineering and technology;
- social demands for the formation of a comfortable and safe space.

The listed circumstances determine the main prerequisites and scale of application of "green building".

The peculiarity of modern ideas about the organization of architectural space is expressed by the gradual but continuous involvement of the principles of "green building" in architectural and construction (investment and construction) activities [5, 6].

The genesis of the term "green building" can be characterized as the transformation of some initially exclusively economic category of assessment of a capital construction project into a system of indicators characterizing the features of the formation of the operational quality of construction products at all stages of the life cycle (Fig. 2)

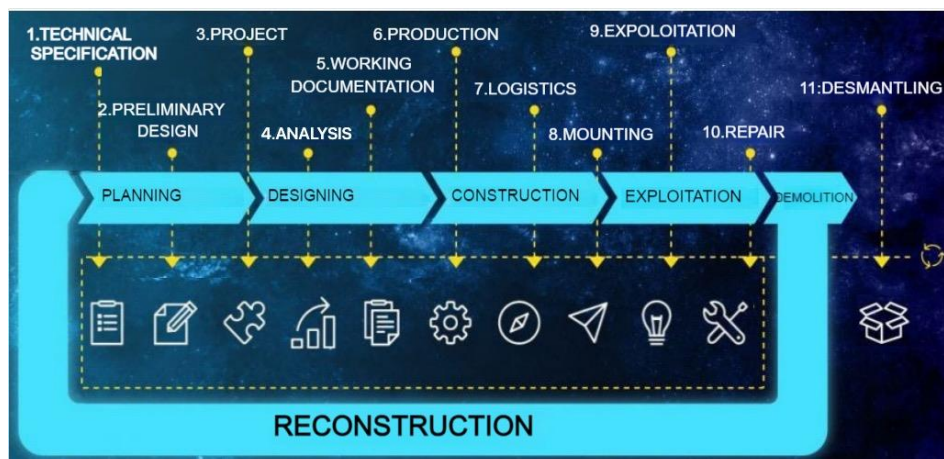


Fig. 2. The main stages of the life cycle of forming the quality of construction products [7] (Translator Chen Yangyang)

A key aspect contributing to the formation and development of ideas, goals and objectives of "green building" has become the concept of the feasibility of solving issues of ensuring the quality of the architectural environment by adapting the formed artificial formations (individual buildings, structures, urban planning formations, territories) to possible changes in the state of the natural environment – in conditions of continuous decrease in the availability of consumed resources.

The main task and target function of "green architecture" is to fully reduce the level of consumed resources: energy and material (energy efficiency property), as well as reduce the negative environmen-

tal impact on the environment (environmental friendliness property) [8, 9].

The criterion for creating or increasing the energy efficiency of a capital construction project is becoming one of the most significant indicators of operational efficiency or operational quality of construction products. Currently, the concept of energy-efficient and environmentally friendly technologies, materials and structures intended for the formation of "sustainable architecture" objects is being implemented in architectural and construction activities in the following main areas [10]:

- intelligent building;
- "passive building";

- “active” energy-efficient building (active building);
- building with zero energy consumption (net zero energy building);
- building of bioclimatic architecture.

“Ecological” and “energy efficient” innovations, which form the basis for the formation of the operational quality of the above types of “sustainable architecture” objects, are implemented at all stages of the life cycle (Fig. 2) and are taken into account even after the demolition of the building, as a subject basis for the reuse of building materials and structures [11, 12].

Thus, in the course of implementing the concept of “green building” in the modern sense, it is necessary to apply a systematic, interdisciplinary approach, which includes not only solving the problem of energy efficiency and minimizing environmental consequences, but also procedures related to the effective implementation of organizational and technological solutions, the formation and maintaining the established parameters of functional and technological processes and life processes.

Despite the fairly obvious advantages of the concept of “green building”, the constant and continuous (on a wide geographical scale) growth of practical examples of the formation of energy-efficient and environmentally friendly capital construction projects for various functional purposes, the process of development of sustainable architecture is accompanied by a number of conceptual problems [13, 14].

The first and most significant problem is the high capital costs of construction. The use of innovative materials, structures and construction technologies inevitably leads to significant financial and logistical costs. High operational quality and, accordingly, low maintenance costs and resource consumption can justify the initial costs over time, but it is the financial risks

that are the most important factor accompanying “green building”.

The next most important factor is the increased level of requirements for the knowledge and competencies of specialists involved in the development and implementation of design solutions. For example, a modern architect is required to have a much broader and deeper level of knowledge and skills, both in the purely architectural and construction field, and in specific areas of knowledge that go beyond the scope of this professional standard but are absolutely necessary to achieve the established quality indicators of construction products. Of particular importance is the effectiveness of the formation and conditions of interaction between specialists forming a temporary creative team of an investment and construction project.

Despite the development of a fairly large number of scientific and theoretical works and experimental studies, to date there is no verified methodology for architectural and construction design, which includes a rational algorithm for solving urban planning, functional planning, constructive, economic and aesthetic problems that will lead to the achievement of the required performance indicators “green building” projects.

3. Conclusion

This article presents the results of an analysis of the current characteristics of the “green building” concept.

The results show that “green building” have the following obvious advantages:

1. High-cost performance

Research confirms that “green buildings” can save more than ten times initial investment ten years after completion. The investment turnaround period ranges from 10 to 80 years.

An important key feature of “green buildings” is ensuring efficient use of resources, which allows users to save more

by reducing operating and maintenance costs such as energy, water, etc. While a “green building” may initially cost more than a regular building, the cost difference can usually be made up within 3–4 years.

Apart from this, it will also significantly increase the income of building owners who collect rent from their buildings as they will have to spend less on maintenance and earn more.

2. Improve health

One of the goals of “green building” is to improve the environment, including the air that the building’s residents breathe. Residents living in “green buildings” enjoy better health due to less exposure to air and water pollution.

For example, most indoor pollutants are due to the materials used in decorating and constructing buildings, i.e. carpets, paints. Breathing in these pollutants is harmful to health and, over time, accumulation of these pollutants can lead to serious health problems such as difficulty breathing.

On the other hand, people living in “green buildings” enjoy better health due to the safety of the building materials.

3. Improve energy efficiency

Water and energy efficiency are one of the biggest advantages of “green buildings” – energy efficiency can reduce the use of coal, an important source of electricity in the world. To preserve this natural resource, solar panels were installed to harness the power of the sun.

The design of the building also allows enough sunlight to enter through the windows, avoiding the use of artificial lighting, thus saving more energy. Efficient use doesn't stop at energy; water is also used efficiently to reduce waste. For example, water used in kitchens and bathrooms is filtered and treated with biofilters and then used to irrigate gardens.

People can also reduce water consumption by using new technologies, reusing water and collecting rainwater.

4. Better environment

According to the World Health Organization, air pollution kills about 7 million people each year. (Fig. 3) These statistics only show how bad our environment has become due to carbon dioxide emissions, trillions of gallons of untreated sewage being released into nature, and many other types of pollution. “Green buildings” effectively reduce pollution through the effective use of natural resources. That is, reducing carbon dioxide emissions to help slow the rate of climate change. Furthermore, “green buildings” create a better environment and a less polluted world. It also promotes a better indoor environment through healthier indoor conditions such as lighting, air quality, etc.

5. Higher market value

“Green buildings” have high return on investment, low maintenance costs and high market value. While rent is set as a high value in the real estate market, sale value is much higher.

6. Save water

In traditional buildings, one of the most serious wastes of natural resources is the waste of natural rainwater. In “green buildings”, structures are used to collect rainwater and sewage.

This device saves water for irrigation, gardening and toilet flushing. Rainwater is harvested to reduce localized flooding, thereby reducing waste entry into local water bodies and erosion. Driveways made of solid and porous materials can stop water damage and contamination.

7. Psychologically optimized environment

“Green buildings” are designed to maintain the existing environment and also improve the mental health of residents. An example will illustrate the problem. What sound would you like to wake up to – chirping birds, rustling leaves, car horns, or a loud noise?

“Green buildings” are also designed to provide optimal sound presence, including appropriate sound insulation and acoustics.

They are used to adapt and amplify natural sounds and eliminate harsh noises.

For these reasons, "green buildings" are recommended for educational, therapeutic, and residential purposes.

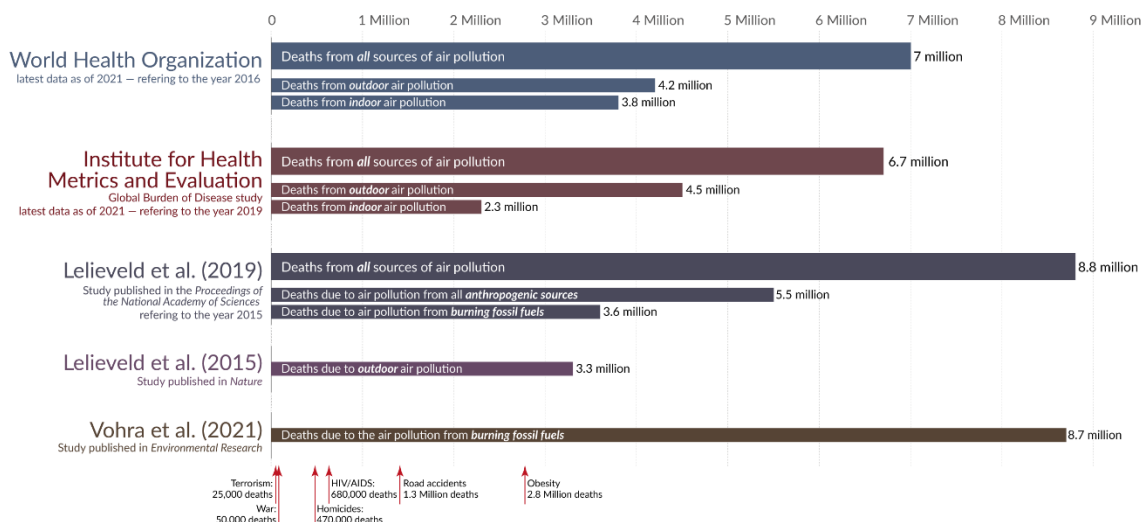
How many people die from air pollution each year?

Our World in Data

Estimates of the global death toll from air pollution published in major recent studies

'All sources' includes both anthropogenic and natural sources:

- The largest source of natural air pollution is airborne dust in the world's deserts. Other natural sources are fires, sea spray, pollen, and volcanoes.
- Anthropogenic sources include electricity production; the burning of solid fuels for cooking and heating in poor households; agriculture; industry; and road transport.



Data on annual death tolls from other causes is the latest data from the World Health Organization, UCDP, and Global Terrorism Database as of November 2021. Licensed under CC-BY by the author Max Roser

Fig. 3. World Health Organization statistics on annual deaths due to air pollution [15]

8. Protect the natural environment

"Green buildings" protect the natural habitats of living things through their operations. This event promotes healthy habits among residents such as walking, exercise and other physical activities. It also attracts birds and other animals, creating an integrated ecosystem throughout the area.

Despite all its advantages, its practical implementation requires solving complex interdisciplinary issues related to:

1. High capital cost

Despite the high returns over time, the initial investment remains a major issue for "green buildings". Some people want to live healthily but cannot afford the initial construction costs.

Depending on how much environmentally friendly technology you want to incorporate into your building, the cost can vary greatly.

However, the initial investment remains high due to the unavailability of

the resources required to construct "green buildings". Therefore, the high cost of "green buildings" will be an issue you have to face when making decisions.

It will be helpful to consider the initial cost of constructing a "green building" and the total savings over time.

2. Insufficient professional capabilities of experts involved in the development and implementation of design solutions in the field of "green building"

For "green buildings", finding professionals who understand both technical repairs and initial construction can be a challenge. This industry is relatively new; therefore, you may have difficulty finding experienced workers to help you solve common problems in your building.

3. Longer construction time

Building a "green building" takes "some" time. Before construction, a lot of work goes into planning and designing.

Building a green building can take upwards of 3 years because you must take into account the surrounding environment

and various variables. Factors that allow achieving the required performance quality of “green building” projects.

References

1. Zhou Qing (2013) Green Building and Sustainable Development DOI 10.19392/j.cnki.1671-7341.2013.15.135
2. Zhang Huihui, Wang Hairong, (2013) Green Building Development and Research. DOI 10.13719/j.cnki.cn14-1279/tu.2013.24.099
3. URL: <https://www.163.com/dy/article/IK843A850518VOHM.html> (date of access: 05/04/2024)
4. URL: <https://zhuanlan.zhihu.com/p/301089629> (date of access: 05/04/2024)
5. Girya M.A., Girya L.V. (2018) Perspektivy primeneniya zelenyh standartov i tehnologij v zhilishhnom stroitel'stve. Inzhenernyj vestnik Dona [Prospects for the use of green standards and technologies in housing construction] Engineering Bulletin of the Don. No. 3. pp. 21–29. (In Russian).
6. Jorgensen S., Pedersen L.J.T., Skard S. (2022) How going green builds trusting beliefs // Business strategy and the environment. V.31. Issue 1. pp. 297–311.
7. Vladimir Talapov (2017) The life cycle of a building and its relation to the introduction of BIM technology [Zhiznennyj cikel zdaniya i ego svyaz' s vnedreniem tekhnologii BIM] URL: <https://sapr.ru/article/25376/> (date of access: 21/05/2024) (In Russian).
8. Benuzh A. A., Kolchigin M. A. (2012) Analiz koncepcii zelenogo stroitel'stva kak mehanizma po obespecheniju jekologicheskoy bezopasnosti stroitel'noj dejatel'nosti [Analysis of the concept of green construction as a mechanism to ensure environmental safety of construction activities] Bulletin of MGSU. No. 3. pp. 161–165. (In Russian).
9. Nikonorov S. M., Sardarly A. (2023) Strategicheskie podhody k stroitel'stvu jenergojeffektivnogo zhil'ja v Rossii [Strategic approaches to the construction of energy-efficient housing in Russia] Strategy: theory and practice. V. 3. No. 3. pp. 336–347. (In Russian).
10. Tabunshchikov Yu. A., Shilkin N. V. (2012) Ocenki kachestva sredy obitaniya v «zelenom stroitel'stve» i ee vnedrenie v kompleksnoe arhitekturnoe proektirovanie [Assessment of the quality of the living environment in “green construction” and its implementation in integrated architectural design] Science, education and experimental design: collection of articles of the international scientific-practical conference April 9-13, 2012 Moscow Architectural Institute (state academy), - Moscow: MARKHI. pp. 161–164. (In Russian).
11. Zolotukhin S. N., Lobosok A. S. (2011) Povtornoje ispol'zovanie stroitel'nyh materialov i othodov proizvodstva v malozetazhnom stroitel'stve [Reuse of building materials and production waste in low-rise construction] Scientific Bulletin of the Voronezh State University of Architecture and Civil Engineering. Materials of the interregional scientific and practical conference "High technologies in ecology". No. 1. pp. 63–66. (In Russian).
12. W.Y. Ng, C.K. Chau (2015) New Life of the Building Materials - Recycle, Reuse and Recovery // Energy Procedia. V.7. pp. 2884–2891.
13. Zakharova M. Yu. (2017) "Zelenoe stroitel'stvo" za ili protiv? [Green building for or against?] Priority directions for the development of science and technology: XXI International Scientific and Technical Conference, Tula, March 30, 2017. Tula: Publishing House "Innovative Technologies", pp. 20–23. (In Russian).
14. Gaevskaya Z. A., Lazareva Yu. S., Lazarev A.N. (2015) Problemy vnedreniya sistemy "zelenyh" standartov [Problems of implementing a system of “green” standards] Young scientist. No. 16 (96). pp. 145–152. (In Russian).
15. Max Roser (2021) - “Data review: how many people die from air pollution?” Published online at OurWorldInData.org. URL: <https://ourworldindata.org/data-review-air-pollution-deaths> (date of access: 21/05/2024)

Получено: 18.03.24
 Прошла рецензирование: 21.05.24
 Принята к публикации: 30.05.24
 Доступно он-лайн: 15.07.24

Received: 18.03.24
 Revised: 21.05.24
 Accepted: 30.05.24
 Available on-line: 15.07.24