ISIS Journal No. 1 (51), 2023

LIFE CYCLE MANAGEMENT OF CONSTRUCTION FACILITIES

ENERGY OPTIMIZATION OF THE LIFE CYCLE OF A CAPITAL CONSTRUCTION FACILITY

E.P. GORBANEVA, S.G. SHEINA, I.A. KOSOVTSEVA

Gorbaneva Elena Petrovna, Ph.D. of Engineering Sciences, Associate Professor of the Department of Technology, Organization of Construction, Expertise and Real Estate Management, Voronezh State Technical University, Voronezh, Russia
Sheina Svetlana Georgievna, Grand PhD in Engineering, Professor, Head of the Department of Urban Construction and Economy of the Don State Technical University, Rostov-on-Don, Russia
Kosovtseva Ilona Andreevna, Senior Lecturer of the Department of Technology, Organization of Construction, Expertise and Real Estate Management, Voronezh State Technical University, Voronezh, Russia

The study of the aggravated energy and climate problems led to the conclusion that there is no alternative to energy-saving methods of economic and social development. Capital construction facilities (CCF) have a huge potential for energy saving, which determines the main demand of the economic and social spheres, which has predetermined a significant interest of researchers and practitioners in the task of improving the energy efficiency of the life cycle of CCF in the construction industry. The article presents methods of quantitative description of the influence of the thermophysical characteristics of the enclosing structures of the CCF on heat flows, and also formulated methods of energy optimization of the life cycle of the CCF.

Keywords: energy optimization, energy saving, energy efficiency, thermophysical characteristics, life cycle, capital construction object.

References

1. Abanda F.H. An investigation of the impact of building orientation on energy consumption in a domestic building using emerging BIM (Building Information Modeling) / Abanda F.H., Byers L. // Energy. – 2016. – No. 97. – pp. 517–527.
2. Mokrova N.V. Influence of space-planning solutions on the energy efficiency of the premises [Text] / Mokrova N.V., Biryukov A.N., Gribkova I.S., Chelyshkov P.D. // Collection of materials of the All-Russian scientific and practical conference. Construction systems engineering. Cyber-physical construction systems. – 2019. – P. 393-397.
3. Tabunshchikov Yu.A. Mathematical modeling and optimization of thermal efficiency of buildings / Tabunshchikov Yu.A., Brodach M.M. // Monograph. M.: AVOK-PRESS, 2002. – 194 p.
4. Caputo P. A supporting method for de-fining energy strategies in the building sector at urban scale / Caputo P., Costa G., Ferrari S. // Energy Policy. – No. 55. – pp. 261–270. DOI:10.1016/j.enpol.2012.12.006
5. Hamdy A. Taha Operations research an introduction / Hamdy A. Taha // University of Arkansas. Fayetteville Pearson Education. Inc. Upper Saddle River. New Jersey 07458. – 2019. – 897p.
6. Zou P.X.W. Review of 10 years of re-search on building energy performance gap: lifecycle and stakeholder perspectives, / Zou P.X.W., Xu X., Sanjayan J., Wang J. // Energy Build. – 2018. – No. 178. – pp. 165-181. DOI:10.1016/j.enbuild.2018.08.040
7. Gorbaneva E.P. Energy optimization of architectural and planning solutions for capital construction projects [Text] / Gorbaneva E.P., Kosovtseva I.A. // Scientific journal. News of higher educational institutions. Construction. – 2022. No. 5 (761). – P. 100-115.

ANALYSIS AND IDENTIFICATION OF THE PROBLEMS OF RESETTLEMENT OF CITIZENS FROM THE DAMAGED HOUSING FACILITY OF THE CITY OF KURSK

V.V. BREDIKHIN, K.I. LOS, P.S. TSYKALOVA, I.S. SIMEONOVA

Bredikhin Vladimir Viktorovich, Grand PhD in Economics, Associate Professor, Head of the Department of Expertise and Real Estate Management, Mining, Southwest State University, Russia, Kursk

Los Kirill Igorevich, Lecturer of the Department of Expertise and Real Estate Management, Mining, Southwest State University, Kursk, Russia
Tsykalova Polina Sergeevna, Bachelor of the Department of Expertise and Real Estate Management, Mining, Southwestern State University, Kursk, Russia
Simeonova Irina Sergeevna, Bachelor of the Department of Expertise and Real Estate Management, Mining, Southwest State University, Kursk, Russia

The article deals with the problems that arise in the process of forming an emergency housing stock and are subject to the resettlement of citizens on the territory of the city of Kursk. Often there are more and more emergencies in residential buildings. This is due to the fact that it is impossible to restore buildings to a standard or serviceable state using standard capital repairs. At the same time, residents should be resettled in protected and favorable conditions. An analysis of the city's housing stock for 2022 is given, as well as a study of the practice of implementing programs for the resettlement of citizens from emergency housing stock in Kursk.

Keywords: housing stock, emergency condition of the building, dilapidated state of the building, municipal resettlement program, emergency housing stock.

References

1. Elk K.I. Mechanisms of interaction of parties of the investment and construction process in simulated conditions [Text] / Elk KI, Tsykalova PS, Kabardina IO // Business Bulletin of the Entrepreneur. - 2022. - No 10(4). - WITH. 32–35.
2. Dmitrieva T.N. Approaches to the solution of problems of dilapidated and emergency housing [Text] / Dmitrieva T.N., Khanzhov I.S., Bolshakova S.M. //Economics and management of innovative technologies. - 2014. - No. 8. – P. 47-50.
3. Degtyareva K.M. Statistical analysis of old and emergency situations in the Russian Federation [Text] / Degtyareva K.M. // Scientific Journal. - 2017. - No 7(20). - WITH. 82–86.
4. Resolution of the Government of the Russian Federation of January 28, 2006. No 47 «On the approval of the Regulation on the recognition of residential disturbance, residential disturbance unsuitable for living, apartment house emergency and subject to demolition or reconstruction, garden house and residential house home".
5. Schneiderman I.M. Problems of dilapidated and emergency housing in Russia [Text] / Shneiderman I.M., Grishanov V.I., Guzanova A. K., [et al.] // Population. - 2019. - T. 22. - No 4. - S.18-35.
6. Korablikova Yu.K. Analysis of the problem of resettlement of citizens from dilapidated and emergency housing [Text] / Korablikova Yu.K., Grachev G.D. // Bulletin of Science and Education. - 2017. - No 11(35). - WITH. 61–65.
7. Housing Code of the Russian Federation of 29.12.2004 No 188-FZ.
8. Bredikhin V.V. Analysis of investment and construction projects in the formation and implementation of programs of territorial and spatial development of the city [Text] / Bredikhin VV // News of the South-Western State University. Series «Economy. Sociology. Management." - 2012. - No 2. - P. 70–76.
9. Order of the Ministry of Construction of Russia dated September 20, 2022 No 773/pr "On the indicators of the average market value of one square meter of the total area of residential premises in the subjects of the Russian Federation for the IV quarter of 2022".
10. Elk K.I. Improvement of the quality of production of forensic construction technical cost examination [Text] / Elk KI, Tsykalova PS // Architectonics of regional culture: collection of scientific papers of the V All-Russian scientific-practical conference with international participation, Kursk, October 27, 2022. – Kursk: Southwest State University, 2022. – P. 260-266.
11. Bredikhin V.V. Management of organizational and economic reliability of development and renewal of the urban territory in the conditions of established development [Text] / Bredikhin VV // Municipal Economy. - 2013. - No 4. - S. 66–81.
12. Organization of construction and development of real estate. Part II: Real estate development [Text] / Under general. ed. P. G. Grabovogo. – M.: Izdatel'skiy dom ASV, IIA «Prosvetitel», 2018. – 608 s.

TECHNOLOGY AND ORGANIZATION OF CONSTRUCTION

STATISTICAL EVALUATION OF PHYSICAL AND MECHANICAL PROPERTIES OF FINE-GRAINED

K.S. KOTOVA, G.S. SLAVCHEVA

Kotova Kristina Sergeevna, PhD in Engineering, Associate Professor of the Department of Design of Buildings and Structures, Voronezh State Technical University, Voronezh, Russia
Slavcheva Galina Stanislavovna, Grand PhD in Engineering, Associate Professor of the Department of Technology of Building Materials, Products and Structures of the Voronezh State Technical University, Russia, Voronezh

Test results made it possible to statistically reliably determine the grade by average density, strength class, as well as standard resistance and reliability factor of foam concrete. The values of the physico-mechanical and design characteristics of fine-grained foam concrete, which differ from the normative characteristics for light concrete of similar density classes, have been statistically reliably established.

Keywords: foam concrete, physical and mechanical properties of foam councrete.

References

1. Slavcheva G.S., Chernyshov E.M., Novikov M.V. Thermally efficient foam concretes of a new generation for low-rise construction // Construction materials. - 2017. - No. 7. - P. 20-24.
2. Slavcheva G.S. Design of structures of cement porous concretes based on a set of specified properties taking into account their implementation under operational moisture effects / G.S. Slavcheva // Bulletin of the central regional branch of the Russian Academy of Architecture and Construction Sciences. - 2009. - No. 8. - P. 128-135.
3. Chernyshov, E.M., Slavcheva G.S. Construction system "Monopor" / E.M. Chernyshov, G.S. Slavcheva // Construction materials, equipment, technologies of the XXI century. - 2000. - No. 9. - P.20-21.
4. Chernyshov, E.M. Porized concrete for low-rise building structures / E.M. Chernyshov, G.S. Slavcheva, N.D. Potamoshneva // Construction materials, equipment, technologies of the 21st century. - 2006. - No. 5. - P. 16-19.
5. Construction rules Concrete and reinforced concrete structures. Basic provisions [Text]: SP 63.13330.2012: approved. by order of the Ministry of Regional Development of Russia dated December 29, 2011 No. 635/8, put into effect on January 1, 2013 - Moscow, 2012. - 175 p.
6. GOST 31359-2007. Autoclaved cellular concrete. Specifications [Text]. - Introduced. Technical Committee for Standardization TC 465 "Construction" - St. Petersburg: Publishing House of Standards, 2008. - 9 p.

URBAN PLANNING, PLANNING OF RURAL SETTLEMENTS

THE MAIN STAGES OF THE FORMATION OF LANDSCAPE THINKING

E.A. ZHIDKO, A.B. ZAKATOV, I.A. ZAKHARENKOVA

Zhidko Elena Aleksandrovna, Grand PhD in Engineering, Professor of the Department of Technosphere and Fire Safety, Voronezh State Technical University, Voronezh, Russia
Zakatov Artem Borisovich, Master's Degree student of Design of Buildings and Structures, Voronezh State Technical University, Voronezh, Russia
Zakharenkova Irina Aleksandrovna, Specialist of the Department of Building Structures, Foundations and Foundations named after Professor Yu.M. Borisov, Voronezh State Technical University, Voronezh, Russia

The main concepts of landscape thinking and its main ideas. From the landscape art of the 19th century to landscape and recreational space in the structure of a modern city are considered

Keywods: landscape, natural environment, landscape architecture, urban planning, sustainable development, landscape urbanism.

References

1. Anisimov L.I.B. Urban landscape: Social and ecological aspects of design: textbook. Manual. Vologda: Voronezh State Technical University. -2002. -192 p.
2. Zhidko E.A. Management of technosphere safety. Voronezh. -2013. -.159 p.
3. Vasilenko N.A. Historical stages of development of the architectural landscape environment of Belgorod / N.A. Vasilenko, N.Ya. Krizhanovskaya // Actual problems of modern construction: collection of reports of the 57th Int. scientific and technical. conf. of young scientists (graduate students, doctoral students) and students. - St. Petersburg, St. Petersburg State University of Architecture and Civil Engineering, 2004. - P. 84-87.
4. Roper Laura Wood. FLO, Biography of Frederick Law Olmsted (1973) - 82c.
5. Tabachnikov P.A. Formation of a Unified System of Recreational Spaces and a System of Landscaping / Young Scientist. - 2021. - No. 30 (372). - P. 16-18.
6. Beveridge Charles E, Paul Rocheleau (October 1998): The Design of the American Landscape. New York, NY: Universe Publishing House -54c.
7. Rosenzweig Roy and Blackmar Elizabeth (1992). Park and People: A History of Central Park. Cornell University Press -75c.
8. Barkovskaya S.V., Zhidko E.A., Morozov V.P., Popova L.G. And integrated management of the 21st century: project management of sustainable development [Text] / Barkovskaya S.V., Zhidko E.A., Morozov V.P., Popova L.G. // Voronezh. -2011. -167 p.
9. Wilson A. Influential Gardeners / A. Wilson. - London: Mitchell Beazley, 2002– 192 p.

PRINCIPLES OF REVITALIZATION OF BUILT-UP AREAS FROM THE PERSPECTIVE OF SUSTAINABLE DEVELOPMENT OF THE URBAN ENVIRONMENT

O.A. SOTNIKOVA, A.A. TYUTEREV, E.E. PROKSHITS, YA.A. ZOLOTUKHINA

Sotnikova Olga Anatolyevna Grand PhD in Engineering, Professor, Head of the Department of Design of Buildings and Structures of the Voronezh State Technical University, Voronezh, Russia
Tyuterev Andrey Aleksandrovich, Senior Lecturer of the Department of Design of Buildings and Structures of the Voronezh State Technical University, Voronezh, Russia
Prokshits Ekaterina Evgenievna, Senior Lecturer of the Department of Design of Buildings and Structures of the Voronezh State Technical University, Voronezh, Russia
Zolotukhina Yana Alekseevn, Senior Lecturer of the Department of Design of Buildings and Structures of the Voronezh State Technical University, Voronezh, Russia

The article presents the results of the analysis and substantiation of the basic principles of revitalization of the urban living environment from the standpoint of sustainable development of territories. The experience of gentrification in the USA, France, Germany, as well as European countries is analyzed; the housing renovation program in Moscow, developed by the Government of Moscow, which is aimed at resettling and demolishing the old low-rise housing stock. The main shortcomings of such approaches to planning are revealed. A step-by-step scheme for the renovation of a residential microdistrict has been developed using the example of the city of Voronezh. Recommendations are proposed for changing the planning structure of the reconstructed quarter, taking into account the principles of sustainable development of the urban environment.

Keywords: revitalization, sustainable development, urban environment

References

1. Zolotukhina, Ya. A. Revitalization of old housing stock / Ya. A. Zolotukhina, D. N. Kazmina, K. S. Kotova [et al.] // Regional energy and energy saving. - 2017. - No. 1. - P. 79.
2. Marchenko, M. I. Trends in the development of peripheral zones of large cities / M. I. Marchenko, I. A. Voitenok, P. A. Grobovenko, D. S. Sviridov // Engineering systems and structures. - 2021. - No. 3-4 (45-46). - P. 75-81.

3. Pashchenko, Yu. O. Analysis and ways of development, renovation and revitalization of landscape and recreational spaces of the railway district of the city of Voronezh / Yu. O. Pashchenko, Ya. A. Zolotukhina, E. E. Prokshits, A. A. Matveeva // Engineering systems and structures. - 2021. - No. 3-4 (45-46). - P. 54-59.
4. Zolotukhina, Ya. A. Improvement and renovation of public spaces in areas of mass housing construction in the city of Voronezh / Ya. A. Zolotukhina, Yu. O. Pashchenko, M. I. Pashkov, E. E. Prokshits // Resource conservation and ecology of building materials, products and structures: collection of scientific papers of the 3rd International Scientific-Practical Conference, Kursk, October 01, 2020 / South-West State University. - Kursk: South-West State University, 2020. - P. 67-70.
5. Zolotukhina, Ya. A. Creation of a comfortable and safe urban environment as one of the concepts of sustainable development / Ya. A. Zolotukhina, D. A. Popov, K. S. Zotov, M. Ya. Troyanovskaya // Scientific journal. Engineering systems and structures. - 2019. - No. 3 (36). - P. 30-34.
6. Prokhorova, E. A. Foreign experience in implementing residential renovation projects // International Journal of Applied Sciences and Technologies "Integral". - 2019. - No. 3. - P. 45-56.
7. Mochalova, O. Renovation of residential areas. Example of France / O. Mochalova, J. Dechambre // High-tech buildings. – 2017. – No. 3. – P. 10-16.
8. Mogzoev, A.M. Renovation of the housing stock of the city of Moscow / A.M. Mogzoev, K.I. Kuzmicheva // Bulletin of Moscow University named after S. Yu. Witte. Series 1: Economy and Management. – 2017. – No. 4 (23). – P. 70-74.
9. Firsova, N.V. Public spaces in the urban environment: modern approaches to design and implementation / N.V. Firsova, M.R. Ryzhkova, E.A. Tselykh // Engineering systems and structures. – 2014. – No. 4-1 (17). – P. 65-70.
10. Prokshits, E.E. Analysis of mixed residential development of territories. Experience of mass housing construction / E.E. Prokshits, Ya.A. Zolotukhina, A.A. Matveeva // Engineering systems and structures. - 2021. - No. 1 (43). - P. 56-62.
11. Tsenkovskaya, A. A. Urban planning aspects of sustainable development of residential areas of Voronezh / A. A. Tsenkovskaya, E. A. Polyakova, E. E. Prokshits // The Future of Science -2022: Collection of scientific articles of the 10th International Youth Scientific Conference, Kursk, April 21-22, 2022. Volume 4. - Kursk: South-West State University. - 2022. - P. 199-203.

ENVIRONMENTAL SAFETY OF CONSTRUCTION AND URBAN ECONOMY

WASTE MANAGEMENT AS AN IMPORTANT COMPONENT ENVIRONMENTAL SUSTAINABILITY OF INFRASTRUCTURE URBAN ECONOMY

E.A. ZHIDKO, V.A. POPOVA, KIRYANOV, I.A. ZAKHARENKOVA

Zhidko Elena Aleksandrovna, Grand PhD in Engineering, Professor of the Department of Technosphere and Fire Safety, Voronezh State Technical University, Voronezh, Russia
Popova Victoria Alexandrovna, Bachelor of the Voronezh State Technical University, Voronezh, Russia
Kiryanov Konstantin Anatolyevich, Associate Professor of Military Training and Research Center of the Air Force "Air Force Academy named after Professor N. E. Zhukovsky and Yu. A. Gagarin" Russia, Voronezh
Zakharenkova Irina Aleksandrovna, Specialist of the Department of Building Structures, Foundations and Foundations named after Professor Yu.M. Borisov, Voronezh State Technical University, Voronezh, Russia

Waste management and sorting is one of the important environmental problems in the modern urban infrastructure of the city. The article is devoted to the problem of waste sorting. The analysis of waste management processes by regions of the Russian Federation is carried out

Keywords: production and consumption waste, environment, damage, disposal

References

1. Mezentsev I.Yu., Zhidko E.A., Kuprienko P.S. Waste incineration plants: positive and negative aspects. In the collection: Civil defense and natural engineering systems. Collection of articles based on the materials of the XVIII International scientific-practical conference. Editor-in-chief P.S.Kuprienko. Voronezh. - 2022. - P.250-254.
2. Azizov M.K., Zhidko E.A. Waste management system as the main element of environmental and economic sustainability of urban infrastructure [Text] / Azizov M.K., Zhidko E.A. // Engineering systems and structures. - 2021. - No. 1 (43). - P. 74 -79.
3. Zhidko E.A., Mushtenko V.S. Analysis of the state of the atmosphere in the region and the socio-ecological consequences of environmental pollution// In the collection: High technologies in ecology. proceedings of the 11th international scientific and practical conference. - 2008. - P.69-74.
4. Sotnikova O.A., Zhidko E.A. Problems of waste disposal from ecologically hazardous and economically important objects of the Central Black Earth Region and ways to solve them // Biosphere compatibility: man, region, technology. - 2017. - No. 3 (19). - P.11-20.
5. Waste recycling: waste sorting in Russia. [Electronic resource] - Access mode. - URL: https://rcycle.net/musor/razdelnyj-sbor/reforma-sortirovki-v-rossiinovovvedeniya-slozhnosti-perspektivy
6. Environmental protection in Russia. 2022: Stat. collection / Rosstat. – 0-92 M., 2022. – 115 p.
7. Gilmundinov V.M., Tagaeva T.O., Boksler A.I. Analysis and forecasting of waste management processes in the Russian Federation // Forecasting problems. -2020. -No. 1. - P. 126-134.
8. Lukanin A.V. Disposal of municipal solid waste // Ecological Bulletin of Russia. -2011. -No. 10. - P. 18-25.
9. Bespalov V.I. Economic aspects of solid waste management in the urban economy of the Russian Federation // Proc. VIII Int. scientific-practical. conf. "Science in the information space-2012". Ukraine, - 2012. - Vol. 9. -P. 29.
10. Zhidko E.A. Use of thermal power plant ash for the production of thermal insulation aerated concrete // Industrial and civil engineering. - 2004. - No. 4. - P. 16-17.

SYSTEM ANALYSIS, MANAGEMENT AND INFORMATION PROCESSING (IN CONSTRUCTION AND ARCHITECTURE)

SUBSTANTIATION OF THE URBAN PLANNING LOCATION AND FUNCTIONAL FEATURES OF A MODERN CAMPUS BASED ON A SYSTEM ANALYSIS

E.E. PROKSHITS, P.V. MOSKALEV, P.A. GROBOVENKO, D.V. POVARKOVA

Prokshits Ekaterina Evgenievna, Senior Lecturer of the Department of Design of Buildings and Structures of the Voronezh State Technical University, Voronezh, Russia
Moskalev Pavel Valentinovich, – Grand PhD in Physics and Mathematics, Associate Professor of the Department of Applied Mathematics and Mechanics, Voronezh State Technical University, Voronezh, Russia
Grobovenko Polina Alekseevna, Master of the Department of the Department of Design of Buildings and Structures of the Voronezh State Technical University, Voronezh, Russia
Povarkova Darya Vadimovna, Master of the Department of the Department of Design of Buildings and Structures of the Voronezh State Technical University, Voronezh, Russia

The article considers the spatial organization of a modern campus, made on the example of the Voronezh State Technical University (hereinafter VSTU). Based on the system-structural approach, the modern campus was considered as a complex dynamic system "Campus Territory" consisting of five subsystems. The plan of the territory research process and the development of the stages of campus transformation in the form of a flowchart is formulated. The transport relationship between academic buildings and dormitories of the university was analyzed. A survey of students and teachers of VSTU was conducted to assess the current state of the university's infrastructure today. The main directions for the development of the concept of innovative development of a modern campus are identified.

Keywords: campus, system analysis, dynamic system, assessment, questionnaire, functional zoning

References

1. Prokshits, E.E. Formation of a database for urban planning assessment of the placement of buildings and university infrastructure facilities / E.E. Prokshits, Ya.A. Zolotukhina // Engineering systems and structures. - 2022. - No. 4 (50). - P. 60-68.
2. Sladchenko, K.N. E-learning in European higher education institutions / K.N. Sladchenko, M.I. Marchenko // Engineering systems and structures. - 2020. - Vol. 2, No. 1 (39). - P. 32-35.
3. Danilova, D.V. Urban planning typology of cities in the Voronezh region as a vector of sustainable development of the region / D.V. Danilova, E.E. Prokshits, Ya.A. Zolotukhina // . - 2021. - No. 2 (44). – P. 42-48.
4. Golovinsky, P.A. Simulation modeling of energy consumption by a cluster of buildings on a university campus / P.A. Golovinsky, D.N. Vasenin, N.V. Savvin, E.E. Prokshits // Control systems and information technologies. – 2022. – No. 4(90). – P. 92-99. – DOI 10.36622/VSTU.2022.90.4.020.
5. Popov, A.V. Principles of formation of architecture of student housing of higher educational institutions: dis. cand. arch. sciences: 05.23.21. – M., 2014. – 274 p.
6. History of the university // Voronezh State Technical University URL: https://cchgeu.ru/ (date of access: 12/15/2022). 7. Grobovenko, P.A. University campus: types and functional zoning / P.A. Grobovenko, E.E. Prokshits, Ya.A. Zolotukhina // Engineering systems and structures. - 2022. - No. 3 (49). - P. 36-41.
8. Sedova Yu.A. Modern university campus // Symbol of science. - 2016. - No. 12-3. - P. 194-195.
9. Prokshits, E.E. Optimization of the structure of the Voronezh inter-university campus based on the systems analysis of the territorial dispersion of residential and educational facilities / E.E. Prokshits, P.V. Moskalov, O.A. Sotnikova, Ya.A. Zolotukhina // Control systems and information technologies. - 2023. - No. 1 (91). - P. 82-89.
10. Popov, V.M. Systems analysis in the management of socio-economic and political processes / V.M. Popov, G.P. Solodkov, V.M. Topilin // Rostov-on-Don: SKAGS Publishing House, 2002. - 501 p.
11. Order "On the criteria for selecting projects for the creation of modern world-class university campuses" dated 06.23.2021 No. 194-r // Rossiyskaya Gazeta.
12. Aleksandrovich, N.N. Systems approach to the territorial planning process / N.N. Aleksandrovich, G.I. Yurina // Inter Expo Geo-Siberia. - 2014. - No. 3 (2). - P. 208-214.
13. Tarasenko, F.P. Applied systems analysis // Study guide. – M.: KNORUS, 2010. – 224 p.