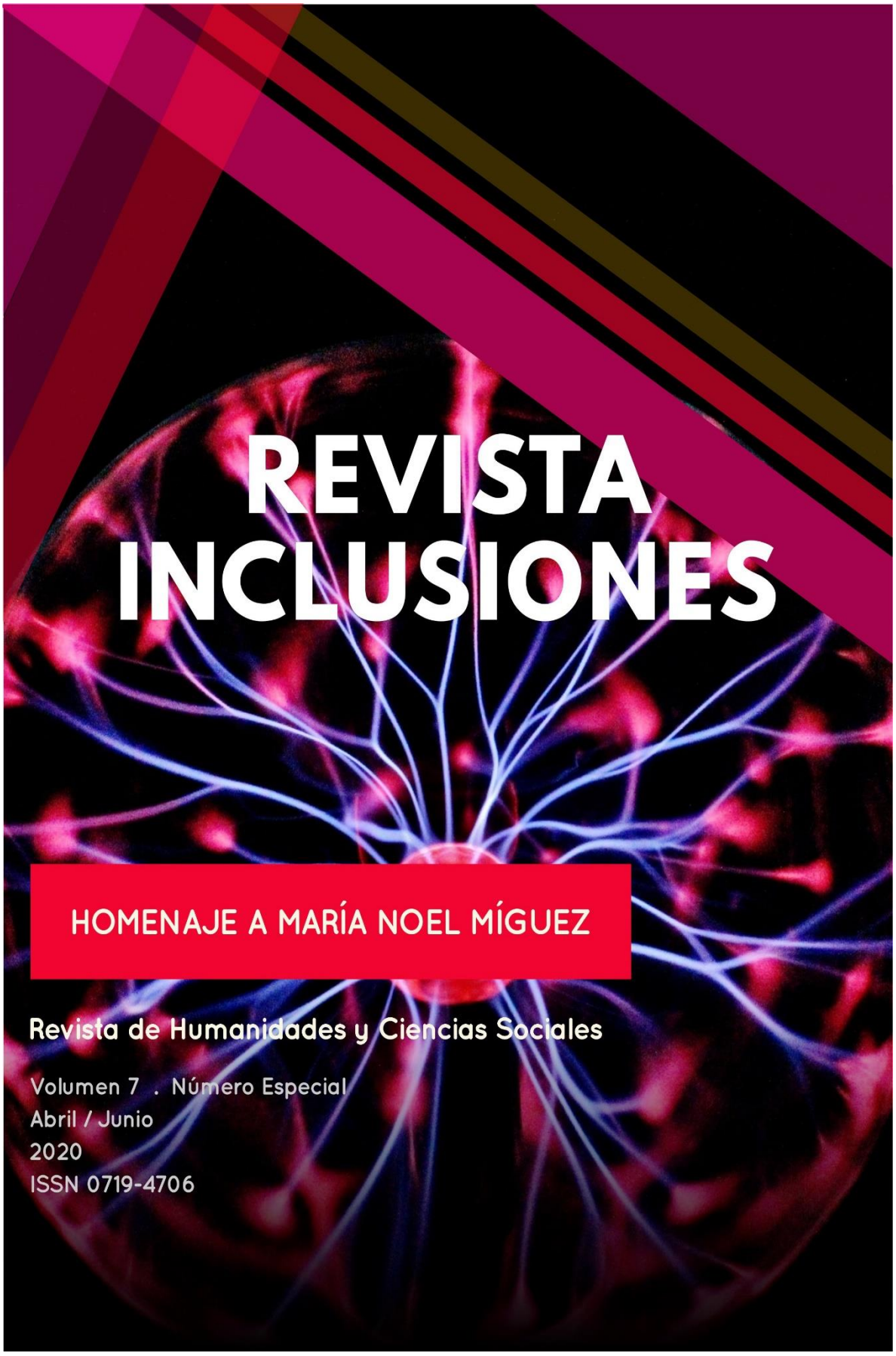

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HOMENAJE A MARÍA NOEL MÍGUEZ

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SUSTAINABLE DEVELOPMENT OF CONSTRUCTION IN THE CONTEXT OF MITIGATING ENVIRONMENTAL POLLUTION

Dr. (C) Arkadij Viktorovich Kramarenko
Togliatty State University0, Russia
ORCID ID: 0000-0001-7125-2318
kramarenkoav@mail.ru
Dr. Kirill Lvovitch Manaenkov
Kvartirabezriskov LLC, Russia
ORCID ID: 0000-0002-7242-8554
kirill.manaenkov@gmail.com
Dr. (C) Aleksandr V. Melnichuk
Russian State Social University, Russia
ORCID ID: 0000-0002-0210-3527
mav68@outlook.com
Dr. (C) Sergey A. Makushkin
Russian State Social University, Russia
ORCID ID: 0000-0002-8427-3991
S_makin2009@mail.ru
Dr. Mikhail V. Vinichenko
Russian State Social University, Russia
ORCID ID: 0000-0003-1973-3485
mih-vas2006@yandex.ru

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Abstract

Sustainable development is a general concept regarding the need to find a balance between meeting current human requirements and protecting the interests of future generations, including the need in a safe and healthy environment. The purpose of the research is to form a set of scholarly and methodological propositions in establishing the essence of the sustainable development concept with regard to the construction sector, analyse energy and environmental factors of balanced construction, and identify the methods of reducing carbon emissions. The paper outlines the theoretical definitions of sustainable development, discusses the elements of sustainable development in the construction industry, and shows the essence of environmentally friendly construction. An expert survey has lent insights for setting specific goals of green construction and outlining the types of green construction and the sustainable development potential of the construction industry.

Keywords

Sustainable development – Construction – Green construction – Energy efficiency

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Introduction

Urban expansion and infrastructure development have produced negative effects on the environment[1]. The excessive consumption of energy resources causes the degrading of the environment and raises carbon dioxide levels in the atmosphere, which causes climate change and threatens the future of humankind[2]. To manage energy resources in a balanced way, a concept is developed, proposing energy saving and waste prevention, as well as the adoption of renewable energy and efficient methods of energy utilisation. There is also the problem of waste management and bringing down the use of natural materials. Thus, the dominant ideology of civilisational operation in the 21st century is the sustainable development concept[3].

The principles of sustainable development in construction consisting in the minimisation of energy and resource consumption during the construction and operation of building structures combined with the mitigation of negative effects for the environment, alongside the provisions of the International Climate Agreement for mitigation and further neutralisation of carbon emissions, have become the priorities during new construction, reconstruction, and modernisation of the existing housing stock[4].

The urgent goal now is to implement the principles of sustainable development in construction, given the impact of buildings and structures and their components and processes over energy consumption and carbon emission. Today, the degree of sustainability relates to the innovative capacity in the energy sector, energy efficiency growth in the economy and increases in the share of renewable sources. The 20-20-20 concept adopted by the EU targets the share of energy generation from renewable sources at 20%, carbon emission reduction by 20%, and a cut in energy consumption of 20%. That said, the biggest potential of energy-saving and carbon dioxide emission reduction is associated with construction (the utility sector)[5].

That is why construction based on the rational use of energy resources in the utility sector and construction material production should become a key priority of public policies determining the need for wider adoption of energy-saving technologies in the construction sector taking into account environmental aspects. All that would provide an opportunity to simultaneously cut material and energy resource costs and mitigate environmental pollution.

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[1] S. O. Apsaliamova; B. O. Khashir; O. Z. Khuazh y A. V. Stygun, “Medical and Ecological Assessment of the Formation of the Carcinogenic Risk from Air Pollution in Megacities”, IJEAT, Vol: 9 num 1 (2019): 4978-4982.

[2] M. N. Dudin; E. E. Frolova; O. V. Protopopova; O. Mamedov y S. V. Odintsov, “Study of innovative technologies in the energy industry: nontraditional and renewable energy sources”, Entrepreneurship and Sustainability Issues Vol: 6 num 4 (2019): 1704-1713 y M. N. Dudin; N. P. Ivashchenko; A. G. Gurinovich; O. M. Tolmachev y L. A. Sonina, “Environmental entrepreneurship: characteristics of organization and development”, Entrepreneurship and Sustainability Issues, Vol: 6 num 4 (2019): 1861-1871.

[3] E. Kryukova; N. Bodneva; T. Sribnaya; N. Filimonova y O. Vershinina, “The Development of the Restaurant Business in Russia”, Journal of Environmental Management and Tourism, Vol: 10 num 2 (2019): 412-419.

[4] Ustoichivoe razvitie: Novye vyzovy. Textbook for college students, under the general editorship of V. I. Danilov-Danilian, N. A. Piskulova (Moscow: Aspekt Press Publishing house, 2015).

[5] U. Blohm-Hieber, “Europe's Strategic Vision”, IAEA Bulletin Vol: 49 num 2 (2008): 49-51.

Literature review

The theoretical and methodological base of the research primarily comprises scholarly papers on sustainable development. Thus, according to I. Maiburov[6], the essential criteria of sustainability of socioeconomic systems consist in ensuring sustainable development of complex territorial sociological, environmental, and economic systems through the efficient capitalisation of their natural, human, and productive components of the regional strategic resource potential.

By now, researchers and analysts have proposed more than 70 definitions of sustainable development, with new terms still emerging: balanced, steady, eco-development, etc. Consider some of the definitions below (Table 1).

No.	Source (author)	Definition
1	World Conservation Strategy[7]	development ensuring higher living standards for people and safeguarding natural diversity
2	Duran C.D., Gogan L.M., Artene A., Duran V.[8]	development ensuring natural, social and human capital management to improve the wealth and prosperity of people without jeopardizing their future
3	Holden E., Linnerud K., Banister D.[9]	a trajectory of long-term growth in common wealth for humankind including the following components: socioeconomic and technological and environmental security
4	Bobylev S. N., Girusov E. V., Perelet R. A.[10]	economic growth solving efficiently the issues of life sustenance for the society without degrading, depletion and pollution of the environment
5	Slepukhin V. G.[11]	implementation of the human strategy, the human path to the era of the noosphere, i.e., the state of co-evolution of the society and nature

Table 1
Definitions of sustainable development

The above definitions of sustainable development in Table 1 indicate a common feature, that is, the balancing and systematisation of requirements with the territorial resource and environmental capabilities and ensuring social development and such pattern of resource management as to satisfy the existing needs and open the way for maintaining the needs of future generations.

The construction industry, according to S. V. Zhukovsky et al.[12], can be characterised by the following elements of sustainable development:

[6] I. Maiburov, “Ustoichivoe razvitie kak koevolyutsionnyi protsess”, Obshchestvo i ekonomika num 4 (2004): 124-143.
[7] World Conservation Strategy. Living Resource Conservation for Sustainable Development. IUCN, UNEP, WWF. 1980.
[8] C. D. Duran; L. M. Gogan; A. Artene y V. Duran, “The components of sustainable development - a possible approach”, Procedia Economics and Finance, num 26 (2015): 806-811.
[9] E. Holden; K. Linnerud y D. Banister, “Sustainable development: Our Common Future revisited”, Global Environmental Change, num 26 (2014): 130-139.
[10] S. N. Bobylev; E. V. Girusov y R. A. Perelet, Ekonomika ustoichivogo razvitiya (Moscow: Stupeni, 2004).
[11] V. G. Slepukhin, “Ot strategii ustoichivogo razvitiya k strategii proryva”, Nauchnye trudy Moskovskogo gumanitarnogo universiteta num 5 (2018): 13-20.

- economics: life cycle costs, low operating costs for buildings, adjacent area improvement and planting;

- environment: limited use of raw materials and organic energy sources, ecosystem protection;

- society: ensuring well-being and healthcare, protection of social and cultural values.

According to P. G. Grabovoy and L. A. Manukhina[13], while traditional construction combines elements such as cost-saving, usability, durability, and comfort, sustainable construction adds the environmental and social aspects to this mix. Therefore, the primary objective of sustainable construction is mitigating the negative impact of buildings on the environment and health. Meanwhile, the researchers believe, that the principles of sustainable construction should be implemented even at the planning design stage and further to the reconstruction and demolition of buildings. While buildings are a complex product combining several materials and structures, each choice has direct influence on the environmental characteristics of the construction object.

According to S. G. Sheina and E. N. Minenko[14], environmental problems now fall in the same chapter with economic problems and have a common profile, requiring new instruments to address them. One of such approaches is the so-called "green construction", a prominent current trend in European countries applicable in the Russian context as well.

According to Z. S. Gelmanova[15], green construction refers to a combination of components of construction ecology, namely, urboecology, biopositive construction, environmental safety and reliability, active and energy-saving buildings, resources, zero-waste production and waste management, and environmental monitoring.

I. A. Nemtsev[16] believes that environmentally-friendly (green) construction also involves the use of environmentally responsible processes and materials in construction and cutting energy, water, and material consumption. Green construction should operate with organic materials, such as bamboo, thatch, wood materials, timber, stone, etc. Meanwhile, the construction plan should provide for bringing down man-caused waste generation.

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[12] S. V. Zhukovskii; A. A. Surkov y A. V. Kychkin, “Aspekty ustoichivogo razvitiya vysokotekhnologichnoi gorodskoi sredy”, Vestnik PNIPU. Prikladnaya ekologiya”, Urbanistika, num 1 (2017): 80-92.

[13] P. G. Grabovyi y L. A. Manukhina, “Natsionalnaya strategiya vnedreniya energoresursov i ekologicheski bezopasnykh (zelenykh) tekhnologii i proizvodstv v stroitelstvo i ZhKKh”, Nedvizhimost: ekonomika, upravlenie Vol: 1 num 2 (2014): 6-8.

[14] S. G. Sheina y E. N. Minenko, “Zelenoe stroitelstvo kak osnova ustoichivogo razvitiya gorodskikh territorio”, Nedvizhimost: ekonomika, upravlenie num 2 (2015): 55-60.

[15] Z. S. Gelmanova; M. A. Amirkhanova y I. V. Georgiadi, «Zelenoe» stroitelstvo kak effektivnyi instrument dlya obespecheniya ustoichivogo razvitiya territorio”, Nauchnoe obozrenie. Ekonomicheskie nauki num 1 (2016): 12-14.

[16] I. A. Nemtsev, “Zelenoe stroitelstvo: ekoposeleniya v kontseptsii ustoichivogo razvitiya”, Urbanistika num 3 (2014): 8-25.

Research hypothesis: sustainable construction development in the context of mitigating the environmental pollution aims to raise the energy-efficiency of buildings and constructions, improve livability through the application of environmentally friendly materials and processes in construction to meet social requirements.

Proposed Methodology

General description

The methods of research include general scientific and empirical methods, specifically:

- theoretical methods: comparative, functional, dialectic, and systems analysis;

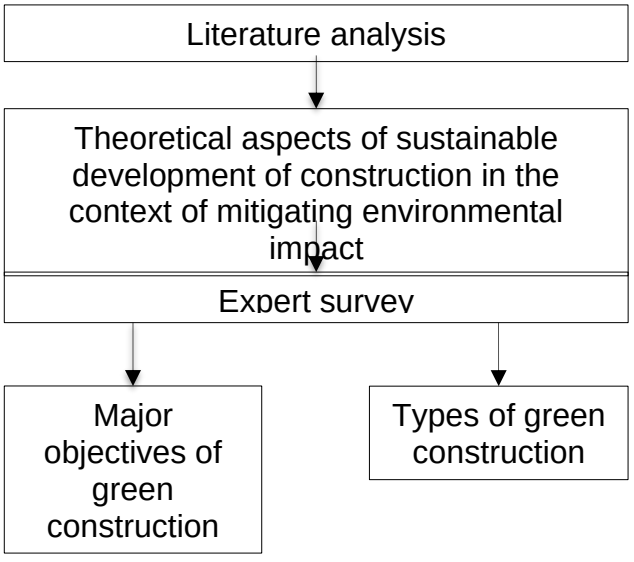
- empirical methods: online expert survey among professionals of the construction market (13 experts) and environmental specialists (14 experts) with regard to sustainable development in the construction industry in the context of environmental pollution mitigation.

Algorithm

The first stage of research involved a review of research literature on sustainable development of construction in the context of mitigating environmental impact.

The second stage was concerned with setting specific goals of green construction and outlining the types of green construction and the sustainable development potential of the construction sector.

Flow Chart



Results

The experts indicate the following most important goals of sustainable (environmentally friendly, green) development in construction (Table 2).

No.	Goals	%*
1	raising efficiency in natural and renewable (solar, wind, hydro) resource management	92.5%
2	reducing atmospheric emissions causing the greenhouse effect	89%
3	raising the share of renewable energy sources (solar, wind, hydro) through their adoption in the technological process and operation and management of residential green buildings	85%
4	mitigating the negative health impact (over the whole life cycle of buildings) through the application of the most advanced natural energy-saving and safe materials	77%
5	reducing power grid loads through the adoption and implementation of renewable energy sources	81,5%
6	reducing operational costs	78%

Note: based on the expert survey; * indicates the percentage of expert references.

Table 2

Major objectives of green constructionю

The findings of the expert survey helped to establish the main types of sustainable (green) construction. According to the experts, there are nine types of architectural planning solutions underlying the concept of green housing construction (Table 3).

No.	Types of green construction	Profile
1	Energy-efficient building with low or zero energy consumption (Zero-energy building)	scores high in energy efficiency, integrates capabilities of energy generation from renewable sources
2	Passive house	relies on energy-saving construction materials and renewable energy sources
3	Bioclimatic architecture	marked use of glass-covered spaces and natural lighting; climate is a factor in construction meant to provide necessary comfort with the lowest possible energy consumption levels and with the use of available clean energy, such as solar, wind, hydro energy, to heat, cool and illuminate buildings
4	Intelligent or smart home (smart home, digital house)	optimized circulation of light and heat in spaces and structures; residential houses or commercial estate with quality maintenance systems and operational multi-room system to connect all electronic devices in the building controlled via a display panel
5	Hi-tech building	buildings with ultra-advanced solutions in architecture in terms of structures and materials
6	Healthy building	the priorities are clean natural and construction materials
7	Sustainable building	zero waste and energy consumption levels
8	Eco-low-tech	local natural materials are used in construction, such as wood, clay, thatch, etc.
9	Eco futurism	the central idea is that new artificial substances will be non-poisonous and will be used as the components of zero-waste economic cycles. When a building suffers material and moral wear, some of its elements would be brought back to the soil and degraded, while other parts could be recycled into new production chains

Note: based on the expert survey.

Table 3

Types of green construction

An analysis of the above types of green construction suggests that its role in the residential sector is to improve energy efficiency and livability through the application of environmentally friendly materials in the process of construction. This means that green housing construction is primarily meant to satisfy social needs.

Discussion

The experts indicate that the energy-efficient home concept targets developing highly energy-efficient housing (energy requirements less than 75 kWh/m^2 per year), which is a recognised EU standard, since according to the EU directives, starting 2021, housing construction with low energy levels (nZEB) is a requirement. The experts cite the three main principles of design applying to such housing, namely, low energy requirements, the use of renewable energy sources, and the reduction of carbon emissions. With that, low energy consumption is ensured through high-performance insulation and the use of energy-efficient windows, high insulation capabilities and artificial ventilation with heat recuperation.

The experts believe that the aim to bring down primary energy consumption and the environmental footprint driven by the sustainable development principles encourages the search for new conceptual approaches in construction including, in particular, planning and gradual implementation, with a view to the potential outlook, of nearly zero energy buildings (nZEB), zero energy and zero heating buildings, active houses, and Smart-Grid-0-Energybuildings. According to the experts, this will significantly reduce the environmental footprint, as well as energy resource consumption, given the requirements set for nZEB also target bringing carbon dioxide emissions below 3 kg/m^2 per year.

The experts emphasise that the formation of a reference base for energy consumption, setting requirements for reconstruction and new construction and long-term planning of energy consumption in the EU rely on energy certification of buildings. Energy efficiency certification includes energy audits to analyse information on the actual and projected characteristics of screening structures and engineering systems, assess compliance of the estimated energy efficiency level with the minimum requirements of energy efficiency for buildings, and propose technically and economically viable recommendations on improving energy efficiency levels taking into account local climate. The introduction of a complex energy efficiency indicator for primary energy or carbon dioxide emissions characterising the amount of supplied and exported energy from each source type is supported by the assessment of rational use of energy resources[17].

According to the experts, environmental sustainability has become a priority in the EU construction sector, which appears a major resource consumer in the European economy. By the individual stages and across the whole life cycle of a building (from procurement and production of building materials to construction itself to operation and maintenance), the sector on the EU scale accounts for a half of procured material consumption, a half of energy, and a third of water consumption, as well as generates one-third of all waste and carbon dioxide emissions.

[17] A. P. F. Andaloro; R. Salomone; G. Ioppolo y L. Andaloro, “Energy certification of buildings: A comparative analysis of progress towards implementation in European countries”. Energy Policy, num 38 (2010): 5840-66.

Overall, 35% of buildings in the EU were built 50 years ago and now show moral and technical wear. Green buildings require five to six times less heating resource requirements and the introduction of steps to reconstruct the existing and promote new green buildings could bring down the total EU energy requirements by 6% and cut carbon dioxide emissions by 5% even in the mid-term[18].

The experts note a shift in focus in the European Commission agenda from the primary quest for the resource efficiency potential in the construction sector toward a more systemic view of the circular economic concept stating two groups of goals, specifically, the effects of a building's life cycle for the environment and the goals of resource efficiency on a quality level. These include six objectives: the life cycle of materials should be resource-efficient; water consumption should be brought to a minimum; the space of structured buildings should be comfortable and healthy; buildings should respond to climate change (the use of carbon dioxide at various stages of the life cycle of a building should be optimised by cost and price factors).

The experts claim green construction in the EU is a developed market.

Thus, according to the study[19], France, Germany, and the Netherlands are the green construction leaders among 25 countries globally as a result of the wide adoption of certification practices and the best progress in reducing carbon dioxide emissions and introduction of many market initiatives. These countries are also the first ones to implement the EU directives on sustainable economic development in their national legislation. On average, 28% of all construction projects in Europe are compliant with sustainability principles. Across Europe, the relevant structural change in construction will take place primarily in companies scoring less than 30% on the green profile currently, rather than through attracting new companies to the market of sustainable construction. Such trend reflects the improved motivation of companies with at least some awareness of the benefits and economic effects of sustainable development. Meanwhile, rising interest among companies that never came to adopt such projects is a prolonged and costly process. According to the experts, Germany is specifically expected to reach the highest concentration of experienced and fully green construction companies. One can hardly argue on specific dominant sectors in the green construction market of the EU amid the quite diverse trends nationally. In Germany, research suggests, 39% of companies are planning investment in green projects in the commercial and institutional sectors. Further 36% would opt for retrofitting (improvement and reconstruction of existing buildings). Generally, the German market of sustainable construction has been developing in line with global trends.

The experts emphasise that an equally important role for sustainable development of construction is reserved for the manufacturing of construction materials, which is a major consumer of energy and simultaneously the biggest generator of carbon dioxide emissions. Thus, the development of modern construction technologies in all developed countries is aimed at designing efficient materials to ensure economic viability and cut energy and raw material costs.

[18] S. Strohmer, “Green Buildings in Europe—Regulations, Programs, and Trends: An Interview with Robert Donkers”, Bridges, num 11 (2006): 1–5.

[19] M. Carpio; A. García-Maraver; D. P. Ruiz; A. Martínez y M. Zamorano, “Energy rating for green buildings in Europe”, WIT Transactions on Ecology and The Environment, num 190 (2014): 381-393.

According to the experts, one of the important indicators of eco-friendly production of building materials is the energy gauge. Notably, energy consumption in the production of Portland cement in Russia is considerably higher compared to the EU levels, because more than half of the total output is manufactured based on wet technology. Moreover, cement accounts for 50-70% of the energy-intensity of concrete. Therefore, the problem of reducing energy intensity in the production of cement is a major task for the cement industry, a key consumer of both natural resources and energy.

The experts provide an example that it takes 100 to 260 tonnes of reference fuel (depending on the production method) to produce 1 tonne of Portland cement clinker making on average 70% of cement, and it also requires 1.3 tonnes of limestone which degrades with emissions of 0.7 tonnes of carbon dioxide. Burning 1 kg of reference fuel, according to the experts, produces 2.75 kg of carbon dioxide. Thus, 1.04-1.34 tonnes of carbon dioxide get delivered to the environment per 1 tonne of Portland cement clinker output. The experts cite two potential ways to reduce the volume of carbon dioxide emissions in the production of Portland cement clinker: by replacing limestone with another component containing CaO (other than carbonates) and by cutting fuel consumption in clinker burning.

One of the principles of sustainable development, according to the experts, is the lowest possible use of non-renewable resources. Fossil fuels, groundwater, and minerals should be used with the highest efficiency and recycled and their consumption should be brought down with a voluntary shift to renewable sources. Under this principle, according to the experts, partial replacing of limestone in furnace feed with recycled materials (such as slag) would not only decrease material consumption but also bring down carbon dioxide emissions.

The experts note that a major number of cement plants in Russia operate based on wet technology, requiring 200-260 kg of reference fuel per 1 tonne of clinker. Fuel consumption in the dry technology (the main technology of the EU plants) equals 100-140 kg per tonne of clinker. A shift toward the dry production technology would open the way to bring down costs by 35-45% and considerably reduce carbon dioxide emissions.

Referring to the practice of cement factories in the EU countries, the experts point out that considerable improvements of the environmental outlook could be achieved through the use of waste fuel as an alternative fuel (household garbage, waste oil products, worn tyres, waste timber products, etc.) in the rotating furnaces of cement plants. Cement plants in some EU countries show a proportion of 30-40% and up to 70% in alternative fuels used in burning Portland cement clinker. In terms of environmental safety, the rotating cement furnace is the most suitable unit for burning fuel waste. The high temperature of 1,700-1,900ºC and the absorption of ashes in clinker minerals, among other factors, help to reduce the environmental impact of pollution in dioxines, furanes, and heavy metals. With that, the conditions of burning in cement furnaces provide for safe operation with great quantities of nearly all types of fuel waste without any by-products. Such solution to the problem of thermal waste disposal is much cheaper than the construction of new waste processing facilities, the experts believe. Burning recycled fuels saves non-renewable natural resources, helping simultaneously to bring down carbon emissions by 20-30%.

Conclusion

Sustainable development has become an ever-growing paradigm in construction. Construction specifics is more and more viewed as a motivation for quality improvement in materials and products, which, in turn, determines longer durability and reliability of building structures. The criteria of balanced development of construction serve as the basis for creating technological foundations, which opens the way for the formulation of potential tools and implementation of efficient steps 0to0 raise energy efficiency in line with the requirements of natural protection, the society and economy over the whole life cycle of products and objects. The findings support the hypothesis that sustainable construction development in the context of mitigating environmental pollution aims to raise the energy-efficiency of buildings and constructions and to improve livability through the application of environmentally friendly materials and processes in construction to meet social requirements.

References

Journal articles

Andaloro, A. P. F.; Salomone, R.; Ioppolo, G. y Andaloro, L. “Energy certification of buildings: A comparative analysis of progress towards implementation in European countries”. Energy Policy, num 38 (2010): 5840-66.

Blohm-Hieber, U. “Europe's Strategic Vision”. IAEA Bulletin Vol: 49 num 2 (2008): 49-51.

Bobylev, S. N.; Girusov, E. V. y Perelet, R. A. Ekonomika ustoichivogo razvitiya. Moscow: Stupeni. 2004.

Carpio, M.; García-Maraver, A.; Ruiz, D. P.; Martínez, A. y Zamorano, M. “Energy rating for green buildings in Europe”. WIT Transactions on Ecology and The Environment, num 190 (2014): 381-393.

Duran, C. D.; Gogan, L. M.; Artene, A. y Duran, V. “The components of sustainable development - a possible approach”. Procedia Economics and Finance, num 26 (2015): 806-811.

Gelmanova, Z. S.; Amirkhanova, M. A. y Georgiadi, I. V. «Zelenoe» stroitelstvo kak effektivnyi instrument dlya obespecheniya ustoichivogo razvitiya territorio”. Nauchnoe obozrenie. Ekonomicheskie nauki Vol: 1 num 1 (2016): 12-14.

Grabovyi, P. G. y Manukhina, L. A. “Natsionalnaya strategiya vnedreniya energoresursov i ekologicheski bezopasnykh (zelenykh) tekhnologii i proizvodstv v stroitelstvo i ZhKKh”. Nedvizhimost: ekonomika, upravlenie Vol: 1 num 2 (2014): 6-8.

Holden, E.; Linnerud, K. y Banister, D. “Sustainable development: Our Common Future revisited”. Global Environmental Change, num 26 (2014): 130-139.

Maiburov, I. “Ustoichivoe razvitie kak koevolyutsionnyi protsess”. Obshchestvo i ekonomika num 4 (2004): 124-143.

Nemtsev, I. A. “Zelenoe stroitelstvo: ekoposeleniya v kontseptsii ustoichivogo razvitiya”. Urbanistika num 3 (2014): 8-25.

Sheina, S. G. y Minenko, E. N. “Zelenoe stroitelstvo kak osnova ustoichivogo razvitiya gorodskikh territorio”. Nedvizhimost: ekonomika, upravlenie num 2 (2015): 55-60.

Slepukhin, V. G. “Ot strategii ustoichivogo razvitiya k strategii proryva”. Nauchnye trudy Moskovskogo gumanitarnogo universiteta num 5 (2018): 13-20.

Strohmer, S. “Green Buildings in Europe-Regulations, Programs, and Trends: An Interview with Robert Donkers”. Bridges, num 11 (2006): 1–5.

Ustoichivoe razvitie: Novye vyzovy. Textbook for college students, under the general editorship of V. I. Danilov-Danilian, N. A. Piskulova. Moscow: Aspekt Press Publishing house. 2015.

Zhukovskii, S. V.; Surkov, A. A. y Kychkin, A. V. “Aspekty ustoichivogo razvitiya vysokotekhnologichnoi gorodskoi sredy”. Vestnik PNIPU. Prikladnaya ekologiya. Urbanistika num 1(2017): 80-92.

Internet publications

Apsaliamova, S.O.; Khashir, B.O.; Khuazh, O.Z. y Stygun, A. V. “Medical and Ecological Assessment of the Formation of the Carcinogenic Risk from Air Pollution in Megacities”. IJEAT, Vol. 9 num 1 (2019): 4978-4982.

Dudin, M. N.; Frolova, E. E.; Protopopova, O. V.; Mamedov, O. y Odintsov, S. V. “Study of innovative technologies in the energy industry: nontraditional and renewable energy sources”. Entrepreneurship and Sustainability Issues 6 Vol: 4 (2019): 1704-1713.

Dudin, M. N.; Ivashchenko, N. P.; Gurinovich, A. G.; Tolmachev, O. M. y Sonina, L. A. “Environmental entrepreneurship: characteristics of organization and development”. Entrepreneurship and Sustainability Issues, Vol: 6 num 4 (2019): 1861-1871.

Kryukova, E.; Bodneva, N.; Sribnaya, T.; Filimonova, N. y Vershinina, O. “The Development of the Restaurant Business in Russia”. Journal of Environmental Management and Tourism, Vol: 10 num 2 (2019): 412-419.

World Conservation Strategy. Living Resource Conservation for Sustainable Development. IUCN, UNEP, WWF. 1980.

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