

STRUCTURE OF ENVIRONMENTAL REQUIREMENTS FOR INDUSTRIAL FACILITIES

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ABSTRACT

One of the key factors of rail transport's sustainable development is constituted by environmental requirements of «green construction». They are designed to comply with Russian and international law, the principles of industrial strategy and long-term programs and should be defined by a set of categories that reflect

Keywords: environmental engineering, building, construction, rail transport, sustainable development, «green construction», resource conservation, environmental protection, structure of requirements.

Background. The triune basis of sustainable development of railway transport contains economic efficiency, social justice and ecological safety [1]. An integral part of this process is design, reconstruction, operation of energy-efficient, environmentally friendly and resistant to environment buildings and structures.

For rail transport environmental requirements of «green construction» are permanent parts of innovation technologies and environmental legislation, as well as a means of improving the quality of engineering work.

In Russia there have been developed: own requirements of «green construction» for residential and public buildings [2], system of voluntary certification and rating of property units [3, 4], including the main provisions of systems BREEAM [5] and LEED [6].

Objective. The objective of the authors is to consider «green construction» issue in terms of railway operation.

Methods. The authors use general scientific methods, evaluation approach, comparative analysis, scientific description.

Results. On the one hand, the problem of identifying ecological characteristics of rail transport is associated with a wide nomenclature of buildings (industrial, administrative, passenger, auxiliary, subsidiary, warehouse) and structures (load test stations, oil stations, marshalling yards, locomotive holding sites, stations, tunnels).

On the other hand, the development of «green construction» requirements with respect to railways involves accounting specifics of processes inherent in transportation process.

Both together, that is conceptually important, should be based on compliance with a number of principles of sustainable development [7]:

1. Railway transport functioning is designed to be implemented in such a way as to equally ensure the ability to meet the needs of both present and future generations of the country, while maintaining a favorable human environment.

2. Economic efficiency, social justice and ecological safety of railway transport should be combined in a triune process on an equal footing, thereby ensuring sustainable development of the industry system.

3. During construction, reconstruction, maintenance of buildings and facilities it is necessary to fulfill the requirements of Russian legislation for safety of work sites, comply with sanitary regulations, construction rules and regulations.

4. Environmental management should be based on the maximum possible reduction of consumption of natural resources and reduction of harmful effects of

current view on environmental standards, which in turn can be «served» by a separate group of criteria designed for it. The article offers a structure of environmental requirements for construction and operation of buildings and facilities of railways, which involves effective implementation of environment-focused construction technology, and provision of environmental sustainability.

rail transport on the environment, increased use of secondary resources, maximum utilization, neutralization and safe disposal of waste, applying for this purpose the advanced resource-saving technologies.

5. Eliminating dangerous in (environmental sense) transportation process schemes, terms of technical maintenance and repair of rolling stock and transport infrastructure, environmentally sound placement of buildings and structures are essential elements of the industry's development strategy.

6. Greening of consciousness and outlook of railway workers, improvement of personal qualities of the person, rise of needs, promotion of intellectual and spiritual values to the priority in relation to tangible values determine the direction of formation of human resources.

7. The ideology of «green construction» must be accompanied by timely and flexible reorientation of vocational education system, corporate ethics, culture, sectoral science and technology to new civilizational values and goals.

The principles of sustainable development of rail transport reflect a set of categories that are associated with modern concepts of environmental requirements for industrial facilities. Each category of requirements, in turn, may be associated with a separate group of criteria defining it (see Table 1).

Each criterion of n-th category of environmental requirements for buildings and structures of railway transport is assigned a set of indicators that determine the content of the criteria (see example in Table 2).

Involvement of any of the indicators is predetermined by minimum environmental requirements of the current legislation, and is reflected in the recommended indicators.

Selection of recommended indices for indicators is made based on the nature of technological processes, functional purpose of buildings and structures, and regional characteristics of their operation, including [2]:

- Climatic parameters;
- Availability of water resources;
- Availability of energy resources;
- Availability of renewable energy sources;
- The cost of construction.

Conclusion. The effectiveness of implementation of environmental requirements of «green construction» for buildings and structures of railway transport should be evaluated in accordance with the system of voluntary certification of property units registered by the Federal Agency for Technical Regulation and Metrology [3, 4]. But determining the effect in any

Table 1

Categories and criteria of environmental requirements for buildings and structures of railway transport

Category	Criterion
1. Environmental management	1.1. Organization of environmental management 1.2. Pollution prevention 1.3. Environmental monitoring 1.4. Informing interested parties 1.5. Qualification requirements 1.6. Optimization of design solutions
2. Quality of environment, architectural and planning solutions	2.1. Selection of a site for construction 2.2. Optimal shape and orientation of the building 2.3. Quality of architectural aspect of the building 2.4. Planting of trees near the building 2.5. Optimality of mutual arrangement of buildings and forest-protection stands 2.6. Landscape design and arrangement of territory 2.7. Insolation of the territory 2.8. Noise, vibration and infrasound immunity of the territory 2.9. Illumination of the territory and light pollution immunity 2.10. Ionizing and electromagnetic radiation immunity 2.11. Availability of public transport 2.12. Accessibility of buildings for people with limited mobility 2.13. Car parking 2.14. Provision of usable area 2.15. Placement of social amenities in the building
3. Environmental protection	3.1. Minimizing the environmental impact by materials used in construction 3.2. Minimizing waste in the process of construction and reconstruction of buildings and structures 3.3. Measures to protect and restore the environment in the process of construction 3.4. Minimizing the environmental impact during operation of buildings and structures
4. Rational use of water and rainwater drainage regulation	4.1. Minimization of domestic water supply 4.2. Minimization of process water supply 4.3. Disposal of waste of domestic water supply 4.4. Disposal of waste of process water supply 4.5. Water-saving fixtures 4.6. Rainwater drainage systems regulation 4.7. Complex control system of rainwater drainage 4.8. Prevention of pollution of surface and groundwater 4.9. Prevention of underground water pollution 4.10. Prevention of violations of natural hydrological conditions
5. Energy saving and energy efficiency	5.1. Reduction of thermal energy consumption for heating and ventilation of buildings 5.2. Reduction of thermal energy consumption for hot water supply of buildings 5.3. Reduction of primary energy consumption 5.4. Reduction of electrical energy consumption 5.5. Use of secondary energy resources 5.6. Use of renewable energy 5.7. Increasing the efficiency of energy infrastructure
6. Protection against pollution of land of structures and land adjacent to the buildings	6.1. Prevention of land contamination 6.2. Cleaning and land recultivation

case is a stage of the process, when a stable system has been formed in response to the current requirements. That is, there are environment-focused principles, criteria, indicators, grounded in this article.

REFERENCES

1. Environmental strategy of JSC Russian Railways for the period up to 2015 and outlook up to 2030. The order of JSC Russian Railways № 293r dared 13.02.2009 [Ekologicheskaja strategija OAO «RZhD» na period do 2015 goda i perspektivu do 2030 goda. Rasporjazhenie OAO «RZhD» № 293r ot 13.02.2009]. [Electronic source]: http://www.rzd-expo.ru/innovation/regulatory_documents/07_293r.pdf. Last accessed 02.03.2016.

2. GOST R54964–2012. Compliance assessment. Environmental requirements for property units [GOST

R54964–2012. Ocenka sootvetstvija. Ekologicheskie trebovanija k ob'ektam nedvizhimosti]. [Electronic resource]: <http://docs.cntd.ru/document/gost-r-54964-2012>. Last accessed 02.03.2016.

3. ROSS RU.1630.04AAD0 system of voluntary certification of property units – «Green standards» [ROSS RU.1630.04AAD0 Sistema dobrovol'noj sertifikacii ob'ektov nedvizhimosti – «Zeljonye standarty»]. [Electronic source]: http://www.mnr2014.ru/data/application/1333527397_p_1.pdf. Last accessed 02.03.2016.

4. STO NOSTROY 2.35.4–2011. «Green construction». Residential and public buildings. The rating system for assessing sustainability of habitat [STO NOSTROY 2.35.4–2011. «Zeljonoje stroitel'stvo». Zdanija zhilye i obshhestvennye. Rejtingovaja sistema ocenki



A set of indicators of the criterion 6.1 «Prevention of land contamination»

Category	
6. Protection against pollution of land of structures and land adjacent to the buildings	
Criterion	Indicator
6.1. Prevention of land contamination	The use of processes, practices, materials allowing to avoid, reduce or control degradation, pollution, littering and disturbance of land
	Availability of organized places of temporary storage of waste
	The use of the best available technological processes, equipment and materials allowing to avoid, reduce or control the ingress of oil products into the soil (improvement of design, improvement of quality of control of serviceability of the drain and bulk devices, hermiticity of boilers of tanks for transportation of oil products, application of non-steaming methods for cleaning of tanks from oil residues, modernization of technologies for marshalling, equipment and testing locomotives)
	The use of the best available technological processes, equipment and materials allowing to avoid, reduce or control the ingress of heavy metals in the soil (improvement of quality of the rolling stock tribological systems and reduction of time of their operation, lubrication, use of composite materials, suppression of dusting sources of transported bulk cargo)
	Organization of activities for prevention and elimination of consequences of emergency situations, leading to penetration of oil products, heavy metals and other pollutants in soil

ustojchivosti sredy obitanija]. [Electronic source]: <http://docs.cntd.ru/document/1200087581>. Last accessed 02.03.2016.

5. BREEAM – (Building Research Establishment's Environmental Assessment Method). Environmental Assessment Method. Organizations on exploration of buildings. (United Kingdom). 1990 [BREEAM – (Building Research Establishment's Environmental Assessment Method). Metod ekologicheskoy ocenki. Organizacii po issledovaniju zdaniy. (Velikobritanija). 1990]. [Electronic source]: http://www.breeam.com/breeamGeneralPrint/breeam_non_dom_manual_3_0.pdf. Last accessed 02.03.2016.

6. LEED (Leadership in Energy and Environmental Design). Guide to Energy and Environmental Design. Developed by «American Council for green buildings» (USA). 1998 [LEED (Leadership in Energy and Environmental Design). Rukovodstvo po energeticheskoy i ekologicheskoy proektirovaniyu. Razrabotano «Amerikanskim sovetom po zel'nym zdaniyam» (SShA). 1998]. [Electronic source]: <http://www.cabrillo.edu/~msoik/3/LEED%20v4%20guide.pdf>. Last accessed 02.03.2016.

7. Popov, V. G. Safety, security and stable development. *World of Transport and Transportation*, Vol. 2, 2004, Iss. 3, pp. 18–28.

8. Decree of the Russian Ministry of Natural Resources dated 30.12.2009 № 75-r «On voluntary environmental certification of real estate, taking into account international experience in the application of «green «standards» [Rasporjazhenie Minprirody RF ot 30.12.2009 g. № 75-r «O dobrovol'noj ekologicheskoy sertifikacii ob'ektov nedvizhimosti s uchjotom mezhdunarodnogo opyta primeneniya «zel'nykh standartov»]. [Electronic source]: http://www.consultant.ru/document/cons_doc_LAShh_102174/. Last accessed 02.03.2016.

ru/document/cons_doc_LAShh_102174/. Last accessed 02.03.2016.

9. Federal Law «On Environmental Protection» dated January 10, 2002 № 7-FZ [Federal'nyj zakon «Ob ohrane okruzhajushhej sredy» ot 10 janvarja 2002 g. № 7-FZ]. [Electronic source]: http://shhshhshh.consultant.ru/document/cons_doc_LAShh_34823/. Last accessed 02.03.2016.

10. Kats, Greg. The Costs and Financial Benefits of Green Buildings// A Report to California's Sustainable Building Task Force, October 2003. [Electronic source]: <http://www.calrecycle.ca.gov/greenBuilding/Design/CostBenefit/Report.pdf>. Last accessed 02.03.2016.

11. Brodach, M., Eames, G. Green construction market in Russia [Rynok zel'nogo stroitel'stva v Rossii]. *Zdaniya vysokih tehnologij*, 2013, Winter, pp. 18–29. [Electronic source]: http://zvt.abok.ru/articles/42/Rinok_zelenogo_stroitelstva_v_Rossii. Last accessed 02.03.2016.

12. «Green» standards – now and in Russia! [«Zel'nyye standarty – teper' i v Rossii!]. *Energoberezhenie*, 2012, Iss. 7. [Electronic source]: http://shhshhshh.abok.ru/for_spec/articles.php?nid=5369. Last accessed 02.03.2016.

13. Tabunschikov, Yu. A., Granev, V. V., Naumov, A. L., Akiev, R. S. National rating system for assessing the quality of the building [Nacional'naja rejtingovaja sistema ocenki kachestva zdaniya]. *ABOK*, 2011, Iss. 3. [Electronic source]: http://www.abok.ru/for_spec/articles.php?nid=4876. Last accessed 02.03.2016.

14. Eddington, Ch. Who pays for green? the economics of sustainable buildings. *EMEA Research 2009*. [Electronic source]: <https://www.greenbiz.com/research/report/2009/09/24/who-pays-green>. Last accessed 02.03.2016.

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