The concept of increasing energy efficiency of low-rise construction in the context of technical regulation

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Abstract. Intensive development of low-rise construction and modern trends directed at enhancing energy efficient construction considering regulatory requirements determine the necessity to develop the concept based on variable control models managing the processes of low-rise construction. However effective process management cannot be performed without correlation of sectoral planning documents of federal and regional level also considering the technical regulations requirements. Development of concept to increase energy efficiency of low-rise construction on the basis of governmental housing policy should be built within integrated and system approach. This approach should take into account the factors and objectives of social and economic regional development and its peculiar features, as well as complex urban planning, transport and engineering conditions of low rise housing development. The program and goal-oriented approach used in the present study enables to provide integrity and interrelation with the technical requirements of energy efficiency.

1. Introduction
Efficient management of the processes in low-rise construction cannot be put into practice without harmonization of documents of federal and territorial sector planning with technical regulation requirements. As a result, the concept development of increasing energy efficiency of low-rise construction on the base of state housing policy should be realized within the framework of complex and system approach, including factors and purposes of social and economic regions development and a specific character of social and economic development, architectural, transport and engineering conditions developing territories of low-rise construction. Program-oriented approach with the realization of low-rise construction development provides complexity and interconnection with technical energy efficiency requirements [1].

It was established that low-rise construction has a range of substantial advantages over multi-storey buildings construction, being as follows: mobility, ease of transportation, quickness and easiness of installation, security and reliability, esthetics, comfort, identity, operating ability, cheaper autonomous housing and utility infrastructure and flexible use of energy-saving technologies. However models of interaction between subjects are still not worked out at the federal and regional levels. These models include effective mechanisms and instruments, providing stability of low-rise construction processes development. It is also necessary to improve all requirements to energy efficiency of low-rise construction.
The necessity and significance of developing the concept to increase energy efficiency and integrate energy saving technologies for low-rise construction is defined by high development rates of low-rise housing. It also depends on new tendencies which provide moving from point-like construction inside the settlement to long-distance structures of low-rise settlements around large settlements. They are forming both along engineering utilities and transport hubs and also in areas demanding establishment of stations of energy generation while executing the project of comprehensive development in towns and villages. Therefore arises a whole range of problems connected with development of new energy supply schemes that influences economic efficiency of construction.

2. Experimental

For the last 20 years input of new low-rise housing in the Russian Federation increased by 7 times. Since the period of 2008 to 2013 activation of processes in low-rise construction has been observed. In 2012 about 34.9 mln. m$^2$ of new low-rise housing has been put into commission (the interest of low-rise construction by total volume of housing equals 53.6 %), and in 2013 in Russia 37 mln. m$^2$ of low-rise housing has been commissioned which amounts 53.3 % by total volume. From the period of 2008 to 2013 more than 183 mln. m$^2$ of low-rise housing was commissioned (Table 1), which amounts more than 50 % by total volume on the territory of the Russian Federation. Increase in the level of new housing commissioning, including low-rise construction should make 60 % or around 54 mln. m$^2$ up to 2015 in accordance with Federal Target Program “Housing”[11]. However, the mentioned Program does not include requirements to energy efficiency of new housing and does not consider its necessity to comply with new technical regulations.

| Table 1. New housing commissioning from 2008-2013 thous. m$^2$. |
|---------------------------------------------------------------|
| **Low-rise housing (total square houses), mln m$^2$:**         |
| 2008   | 2009   | 2010   | 2011   | 2012   | 2013   |
| 27.2   | 28.5   | 25.5   | 30.3   | 34.9   | 37.0   |

The analysis [2] estimated that the process of low-rise construction development has a range of problems, on the one hand connected with absence of essential regional regulatory and legal framework along with the changes to active land and town-planning legislation and on the other hand connected with the absence of territories provided with access to utilities including the development of communal, transport and social infrastructure for the low-rise construction [3].

Another issue in low-rise construction that is more specific for developed social [4] and economic territories is a high cost of land. So, around 25 % of the housing cost is production cost, 15 % is finishing cost, around 30 % is cost of settling the utility lines of traditional technologies to towns and inside it and 30 % is land cost due to design expenses. In regard to the low income level of social groups (young professionals, public sector workers and other benefit-entitled citizens) needing low-cost comfortable housing, effective demand is essentially lower than volume of buildings planned for commissioning. In this case, financial and credit institutions, reluctantly give loans for low rise structures thus not allowing attracting of loan resources forming other loan programs. The situation deteriorates, because using of traditional low energy effective building technologies of low-rise housing makes high further operational expenses.

Finally, the problem of technical regulation and the development of national standards in the aspect of energy efficiency of low-rise construction must be emphasized. The standards, developed by National Association of Builders (NOSTROI) are established by assembly as private and become the ones to apply to by all the members. However, according to the first half of 2014 in the field of energy efficiency, one standard operated was developed “R NOSTROI 2.15.6-2013 “Guidelines for arranging energy efficient ventilation and air conditioning systems” (Resolution of the Board of National Association of Builders, protocol of 2003, 19 September, No.46) which underwent publisher’s editing.

It is worth noting, that the acceptance of technical regulations, according to section 6 of Federal Law “About technical regulation” [12] is providing energy efficiency and resource conservation.
Thus, processes of developing energy efficient low-rise construction are sufficiently restrained by the absence of the corresponding regulations. Consequently, the low-rise housing supply cannot be corresponded to modern regulations and requirements. For this reason, resolving the estimated problems, it requires the active transfer towards low-cost energy efficient technologies of fast erected buildings with necessary functional performance (sustainability, durability, comfort, heat stability), and, therefore, developing regional market of construction materials and structures.

Solving the estimated problems is based on developing of interaction models of management entities motivated to active integration of energy efficient technologies and increasing energy efficiency of low rise construction regarding the requirements of technical regulation.

It is defined by the governmental decision – Regulation No. 1 of 24.01.2014, which demands making energy performance certificate and assign energy efficiency class for every building and structure before its commissioning or after reconstruction. Energy performance certificate is a document necessary for commissioning as it proves correspondence of building parameters with the design documentation. There are also some tax advantages: tax free are newly built buildings with high energy efficiency class (B, B+, B++ and A) in accordance with section 21 Article 381 Tax Code of the Russian Federation, during 3 years from the date of personal property registration.

The model implementation should as well contribute to solving problems of old and failing housing stock.

In that way, a development concept of low-rise construction with account of energy efficiency requirements in the regions of Russia over a long period should follow:

– developing institutional environment, being formed under influence of regional operators of low-rise construction, coordinating interaction between subjects of low-rise construction and providing mutual guarantees and forming energy efficient environment;
– improving of the regulatory environment, stimulating development of energy efficient low-rise construction considering “Comprehensive program of regulatory documentation development in the field of energy-saving and increasing energy-efficiency of buildings and structures for the period until 2015”, that was considered and approved by the Ministry of Regional Development of the Russian Federation;
– developing interaction model between subjects of low-rise construction, taking into account energy efficiency requirements;
– forming the concept of integrated development of low-rise housing (including procedures for the provision of land plots for low-rise construction, developing social and energy efficient engineering and communal infrastructure [5];
– carrying out measures to analyze modern energy efficient technologies of low-rise construction according with the system of technical regulation (it is the system of NOSTROI standardization, which provides for those included in self-regulating organizations an opportunity to impose, on the base of NOSTROI, the uniform requirements in the sphere of construction);
– developing financial arrangements of low-rise construction, with the application of funds “Support Fund for the Low-Rise Construction Development”, “Housing and Utility Reform Foundation”, loan procedures, maternity capital and other mechanisms to provide land properties and construction materials, etc. [6,7];
– cataloging of the available low-rise construction, including defining standard design solutions of energy efficient construction, providing cost reduction at the design stage [8].

The above mentioned considers application of program- and goal-oriented approach which enables to perform the following:

– complex approach of resolving the problems including all aspects of low-rise construction development in the regions, in the context of energy efficiency and funding streams, defining priority ranking of measures and events;
– delegation of power and responsibility between the authority levels, builders, investors, etc. therefore increasing efficiency of programs and events performance;
efficient planning and monitoring of operational results, where it’s necessary to elaborate system of indicators, which allows annual estimation of results of program actions realization.

3. Results
To increase availability of the modern energy efficient low-rise housing, it should be emphasized that financial resources will be primarily directed at development and modernization in accordance with energy efficiency requirements, engineering and communal infrastructure of the low-rise towns. Land use planning and management will be based on the principles of governmental and private partnership and include supplying of accessible properties for the benefit-enabled citizens.

It should be considered, that the sufficient demand for the low-rise construction in suburban zones of big cities, deficit of free territories and environmental requirements restrict the average size of land by the low-rise construction. In addition, the main reserves of land properties are agriculture territories (not being used for designated purpose) of a municipal formation, where the subtraction is the reasonable decision.

The complex of events includes the measures of governmental and regional support of organizations dealing with construction complex, population, non-profit association of citizens, directed at demand and supply promotion at the housing market, in accordance with the energy efficiency requirements, market balance and development of low-rise construction and building industry in the region.

4. Conclusions
The developed concept realization should be carried out within the following directions:

- multipurpose projects of low-rise buildings (cottage settlements, including economy class), their construction is sometimes performed with the support of projects of integrated land use and development;
- low-rise construction for rural areas, in order to improve living conditions of young specialists and members of their families in the line of Ministry of Agriculture of the Russian Federation;
  - collective and individual low-rise construction (Housing Association).

The mentioned measures will enable to influence directly the final effectiveness of the projects of low-rise construction where effect should be built of the two components:

1. Economic effects occurring during the construction process starting from the new technology and building materials integration.
2. Economic effects occurring while long-term operation of low-rise construction objects.

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