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Architectural solution for energy efficient multi-storey residential buildings

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Abstract: *The energy efficiency of a building is the property of a building and its engineering systems to provide a given standardized level of consumption. In real design, the choice of the best option for an energy efficient building can be constrained by a number of restrictions that are fixed from the very beginning and cannot be violated.*

Keywords: energy efficiency, energy saving solutions, quality, residential, public, monolithic, frame, dry - hot climate, climate.

INTRODUCTION

Analysis of the development of energy-efficient buildings shows that the emergence and development of energy-efficient buildings is a reflection of the global problems of the development of society since the middle of the 20th century, with all its positive and negative directions of search.

Architectural and construction energy-saving solutions should take into account the positive impact of the outdoor climate in the best possible way and neutralize its negative impact as much as possible. This is the orientation and shape of the building, which is naturally associated with glazing, the heat of the sun protection of the enclosing structures. Engineering and construction energy-efficient solutions include not only the choice of the type of heating, cooling and ventilation system of the building, but also the form of their organization. It is also important to take into account the air distribution pattern in the room. In real design, the choice of the best option for an energy efficient building can be constrained by a number of restrictions that are fixed from the very beginning and cannot be violated, for example, the number of storeys or the length of a building [1]. In this case, an optimization problem is posed with given constraints, and the goal is achieved when an optimal solution is obtained taking into account the given constraints. And yet, making the final decision falls within the competence of the person in charge (or a group of persons) who has been given the right to make the final choice and who is responsible for this choice. When making a choice, he can take into account, along with the recommendations arising from the mathematical calculation, a number of considerations of a quantitative and qualitative nature, which were not taken into account in these calculations.

The operational energy consumption of existing residential buildings is approximately three times higher than those in technically developed countries with similar natural and climatic characteristics. In the work, the author noted the reasons for the irrational consumption of thermal energy, including:

- disadvantages of space-planning and engineering solutions;
- insufficient thermal insulation quality of external walls, coatings, basement ceilings and translucent fences;
- imperfection of unregulated natural ventilation systems;
- lack of metering, control and regulation devices on heating and hot water supply systems;
- an extremely developed network of external heating mains with insufficient or damaged thermal insulation;
- outdated and mostly unproductive types of boiler equipment;
- lack of an effective mechanism of material interest of energy consumers in its economy;
- extremely insufficient use of non-traditional and secondary energy sources.

According to expert estimates, the systematic implementation of energy-saving measures can reduce operating energy costs in the residential sector by 2.0-2.5 times. At the same time, the specific share of energy saving due to the improvement of urban planning solutions will be 8-10%, space-planning solutions - up to 25%, structural systems - up to 10%, engineering systems, including ventilation systems - up to 60%, due to the improvement of operation technology, including installation of metering devices, control and regulation of heat, water and power consumption - up to 20%.

A systematic approach and an economically justified sequence of performing a complex of interrelated and interdependent activities allowed the author to identify the main urban planning, functional and space-planning, constructive, engineering, environmental requirements and formulate principles for the formation of the architecture of EVZhZ [2].

RESEARCH

Urban planning requirements.

1) It is necessary to establish a moratorium on the expansion of city boundaries for 20-30 years. The development of cities during this period should be carried out through a more rational use of inner-city territories: the compaction of buildings to the normative level without the development of new suburban areas and without increasing the length of main heat pipelines, other energy networks and transport routes.

2) Develop feasibility studies for the integrated use of traditional, centralized and non-traditional heat supply systems. Including local ones with the use of container-type boiler houses located on the roof or near heated buildings.

3) Develop programs for the use of underground space (underground urbanization) for the placement of parking lots, storage and auxiliary premises using the heat of the earth or artificial sources of air heating to the required temperature.

4) Develop programs for the withdrawal of industrial enterprises from the city.

Functional and space-planning requirements.

1) Form the space-planning structure of the EVZhZ with the provision of the greatest compactness of the building in the plan.

2) Transition to the design and construction of wide-frame residential buildings with a 20-30% reduction in the specific area of enclosing structures per square meter of housing area.

3) Provide in the building areas of residence, recreation (recreation), sports and recreation areas and other premises of public and social services.

4) Provide for the possibility of redevelopment in all premises of the building.

5) Design open-plan apartments.

6) Use the underground space under the house for a parking garage with technical services and premises (ventilation chambers, sprinkler, transformer, boiler rooms); first floors - institutions of consumer services (hairdressing salons, shops, cafes, kindergartens, sports facilities, offices); technical floor - for engineering communications of the facility; roofs - under verandas, penthouses [3].

Design requirements.

Building structures must:

- performed using resource and energy saving materials;
- be easy to use;
- have sufficient 'strength, stability, rigidity, crack resistance and ensure the durability of buildings;
- be economical, depending on the consumption and cost of materials, the cost of manufacturing, transportation, installation and operating costs;
- have rational indicators in terms of weight, cost of operating costs;
- have fire resistance, durability, industry;
- provide the possibility of redevelopment of premises.

Environmental requirements:

- buildings should be located, if possible, near parks, recreation areas, picturesque landscapes, etc.;
- landscaping should be carried out, and aeration of the territories should be provided;
- architecture should improve the visual environment, avoid monotony and monotony of residential buildings, relieve tension, discomfort;
- the individual architectural appearance of buildings must be in harmony with the surrounding buildings (including, not to destroy the historical spirit and image);
- the height should not put pressure on a person, while the most rational and economically justified height of a modern building is up to 35 floors, with an ecologically justified floor height of at least 3.0 m;
- the building must be made of environmentally friendly materials;
- the norms for insolation of various functional and planning elements of the EVZhZ and the surrounding area should not be violated;
- the norms for noise protection of living quarters must be observed.

Conclusions:

1. The study of foreign experience in the design and construction of EVZHZ showed the similarity of the conditions for the formation and construction of this type of buildings with the processes taking place in modern domestic urban planning. The influence of modern socio-economic processes in Russia on the urban development complex and on the formation of the attitude of investors, large developers, persons responsible for the regulation of urban development, designers and potential residents to the construction and operation of EVZHZ is considered.

2. The basic requirements for the formation of the architecture of EHLZ have been identified, including: urban planning, functional and space-planning, constructive, engineering and technical and environmental.

3. The systematization of a number of scientific studies of the main solutions for the formation of the architecture of EHZH was carried out, which made it possible to consider EHLH as a promising type of buildings that allows solving many urban planning, architectural and construction and socio-economic problems in the existing development, in the areas of reconstruction and in the territories of new construction.

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