



## FEATURES OF THE CONSTRUCTION OF BUILDINGS FROM SEA CONTAINERS.

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### Abstract

The article is written on the basis of an analysis of a number of foreign and domestic scientific publications on the topic under study. The whole world, and in particular Uzbekistan, has been experiencing a shortage of living space for more than a century. During this time, countries seek to solve this problem in various ways, trying to increase the speed of construction and accessibility for the population. The possibility of using modular designs is being considered. It is noted that the use of transforming volumetric block modules significantly reduce transportation costs. Despite a number of drawbacks inherent in buildings from modular blocks, it is proposed to consider the use of volumetric block modules as one of the promising options for energy-efficient reconstruction.

*Key words: modular constructions, volume blocks, modular construction, modern construction, energy efficiency, sustainable architecture, block modules, reinforced concrete block modules, volume blocks, industrial construction, minimalism, functionalism, constructivism, renovation, residential buildings, public buildings, affordable housing, fast construction, profitability.*

Successful implementation of priority national projects, state programs and Decrees of the Government of the Republic of Uzbekistan, such as the Presidential Decree of 11.24.2018 “On additional measures to expand the construction of affordable houses in rural areas and for certain categories of citizens.” and others aimed at improving the quality of the living environment of citizens of Uzbekistan is directly related to the achievement of specified indicators for the development of the construction industry.

The development of industrial low-rise construction in modern conditions is due to the great need for housing construction in remote areas of the country, the need to build residential towns for military personnel and residents of districts in special and extreme conditions in a short time. The solution to this urgent problem can be successfully implemented through the use of prefabricated buildings of high factory readiness of a modular type with improved heat engineering and operational qualities. The development of this direction of construction is constrained by insufficient preparation of production and the absence of an appropriate technological support system.

In the middle of the 20th century, technological progress made it possible to gradually enlarge the building elements

of buildings as much as possible, which led to the creation of new industrial building systems and an increase in the pace of housing commissioning at times. However, the issue has not been fully resolved and remains relevant to this day. The current “modular construction” of lightweight block modules is not so massive, but it is seen by many foreign architects, builders and investors, along with other traditional ways of resolving the housing crisis, taking into account modern requirements for architecture and design, comfort and functionality, energy efficiency and environmental friendliness. The issues of reducing costs and environmental impact, as well as the timing of project implementation, are more than relevant for construction companies today and are reflected, among other things, in modern “modular construction”, in connection with which Uzbekistan should pay attention to this modern the construction system, as one of the ways to solve the problems of lack of new and resettlement of dilapidated living spaces {1}.

Today, a modular building does not necessarily have to look like a temporary structure (although this category remains in demand). Well-known architects and design companies develop modern, lightweight, practical buildings from sea containers or special frame blocks, which, in addi-

tion to all other advantages, are distinguished by an unusual and memorable design.

According to the manufacturing technology, the block modules are divided into container and frame-modular. Accordingly, the design of the first of them is developed on the basis of standard freight containers, to various degrees modernized. The second group includes modules manufactured according to the factory's own specifications. The sizes of such blocks, depending on the manufacturer, can vary within certain limits, but, as a rule, do not exceed the dimensions allowed for transportation by standard road and rail transport. The materials from which block-modular buildings are made can be different. First of all, as noted above, these are steel structures. Recently, wooden modules with a frame made of LVL timber and cladding from CLT panels are gaining popularity. Modular constructions include small transport houses made of logs or timber. Such buildings are assembled and fully equipped in the factory, after which they are transported to the installation site on a prepared foundation.

The use of modular designs is considered by many scientists [2-6] as one of the priority areas for the construction of buildings and structures, including high-rise and unique ones. Sustainable development of the construction industry, with the ensuing economic, social and environmental benefits, allows the active use of modules-blocks in construction.

Not only the profitability of modular construction, but also the reduction of negative environmental factors is achieved by reducing the duration of construction.

In the past five to seven years, these structures have gained particular popularity due to their energy efficiency, as individual structural modules and volumetric block modules are made of energy-efficient materials, and there are also modules (containers, blocks, boxes, etc.) with ready-for-use finishing.

At various stages of the development of construction science and production, the task of reducing the time for erecting buildings at the construction site was achieved through a rational combination of new constructive-technological and organizational-technological solutions. The problem of developing technologies to erect buildings in the shortest possible time was especially acute in our country during the period of intensive development of new geographical regions and the construction of workers' settlements in remote areas of the republic, moreover, at a fast pace and at minimal cost.

The technologies for erecting low-rise buildings for various purposes in modern mass construction are determined by

their structural, constructive-technological and space-planning decisions, functional purpose, construction conditions, and also the requirements for ensuring energy saving of buildings.

At present, construction technologies for low-rise buildings are developing in the direction of reducing construction time. The ratio between labor costs in the factory and on the construction site changes in the direction of reduction during the construction and installation works in the process of construction. With a significant reduction in labor costs in production compared to factory ones, it is customary to consider construction technology as pre-fabricated. Pre-fabricated technology is used to build houses for various functional purposes: suburban low-rise residential buildings, individual summer cottages, office and warehouse buildings, industrial and cultural and sports facilities.

For most prefabricated buildings, traditional machinery and equipment are used, including in the construction of foundations, and the use of industrial elements and structures with a high degree of assembly of nodal elements' connections can significantly reduce work on the construction site while ensuring all-weather season and quality of work.

However, the massive construction of prefabricated low-rise buildings of new structural and technological solutions in our country is hampered by the lack of a regulatory framework, organizational and technical difficulties in the conversion and re-profiling of existing enterprises for the production of non-demand building products.

One of the rational areas of application of this technology can be low-rise residential buildings of an economic class for various families. This is due to an increase in the volume of individual construction, which allows to use local resources, including: labor, construction materials, a fleet of construction vehicles and means of mechanization, as well as the demand for prefabricated resource-saving residential buildings using modern progressive environmentally friendly materials and advanced designs, as well as an increase investment attractiveness of the construction of prefabricated buildings.

### **Degree elaboration of the topic**

Currently, most of the research in the field of low-rise housing construction relates to solving problems in the field of improving existing structural and technological solutions and traditional technologies for their construction. Features of the construction and research of alternative solutions that

reduce the construction time for low-rise buildings are considered in the works of Russian and foreign scientists - Afanasyev A. A., Abramova I. L., Asaul A. N., Beryukova Yu. D., Berdnikova Y. D., Bykova V. L., Grabovoi P. G., Erofeeva N. Yu., Kazakova Y. N., Karaseva N. N., Kazantseva I. D., Kievsky L.V., Prince I. P., Myasnikova B. N., Nikolsky M. S., Oleinik P. P., Ostashko V. Y., Prykina B. V., Saprykina N. A., Slyusarenko Y. G., Stepanova I. V., Sycheva S. A., Temnova V. G., Tkachenko I. N., Adama F., Tange K., Fridman I., Doling J., Elsinga E., Nadim W., Goulding J. S., Fudge J., Brown S. et al.

At the same time, there is a limited number of experimental and theoretical studies in the field of improving the technology of construction of transformable low-rise buildings with a high degree of factory readiness, and at the same time meeting the rational conditions for their transportation and installation.

Sea (cargo) containers are one of the most popular and sought-after materials used for the construction of buildings for various purposes. Their advantages are as follows:

- The design of containers has long been determined, there is no need to select sections of load-bearing elements, connections, search for solutions for cladding, anti-corrosion treatment;

- There is an established production of containers at many enterprises manufacturing metal structures and shipyards;

- Containers have standard sizes respected throughout the world: 20-foot, 40-foot blocks and so on. The sizes are selected so as to ensure the maximum internal dimensions of the premises, if it is possible to transport the container by rail and road;

- Containers have basic parts for capture by lifting equipment;

- The number of container combinations in building construction is huge.

- The basic modernization of freight containers for the construction needs is carried out, as a rule, in the factories that produce them. In particular, reinforcement of the frame of the block, thermal insulation, replacement of the standard cladding from profiled steel sheet with other structures (sandwich panels, sip panels, wooden lining, siding and others), organization of window and door openings, panoramic walls with the installation of double-glazed windows can be performed.

Depending on the project in which the container-type block modules are used, the interior decoration may vary sig-

nificantly. One-story buildings of 1-2 blocks (cabins, checkpoints, trade pavilions) are usually sheathed from the inside with moisture-resistant OSB or chipboard panels. As flooring, linoleum is used. If there are wet processes in the rooms (showers, bathrooms), wood-cement slabs with a polyurethane coating are laid on the floor. Non-combustible stone wool is used as insulation.

Residential buildings, offices, hostels of a modular type can have any interior and exterior decoration, even the most sophisticated one. As a rule, such decoration is developed individually and is not performed at the container manufacturing plant. Container modernization according to this scheme is popular in the USA and Europe, where architects compete in the implementation of more and more daring projects. Naturally, at the cost of such buildings are approaching, or even surpassing traditional ones.

Depending on the design and decoration of the modules, they can be used for the construction of the following facilities:

- temporary shift camps consisting of modular buildings - a budgetary and practical method of resettlement of builders and the military. The required number of buildings with a height of up to 3 floors is mounted in the shortest possible time, which makes it possible to organize conditions suitable for the working life of the working collective;

- warehouse complexes. Actually the sea container is a ready warehouse. Picking up the required number of containers and placing them in the vertical and horizontal directions (depending on the characteristics of the designated area), warehouses of any size are obtained;

- office and logistics centers. Modular construction allows you to organize the full-fledged work of services in the territory where the rental of real estate is impossible or impractical. For example, a contractor's office at a construction site, operating enterprises, port territories;

- social housing. The direction of use of modular designs, which has gained popularity in recent years in China, India, Latin America. One of the modernisers of the idea is the famous Chilean architect Alejandro Aravena, who received the Pritzker in 2016 precisely for achievements in this area;

- trade facilities - a direction relevant for the post-Soviet space, where along with modern shopping centers, street markets do not lose their popularity. One-two-story heat-insulated container blocks equipped with heating and air conditioning systems are a worthy substitute for tent tents, both in terms of aesthetics and practice and convenience;

- private housing construction. These are buildings with a modern design, often equipped with the latest developments in the field of “active” and “passive” energy efficiency. Projects are strictly individual in nature and are the hallmark of well-known and gaining popularity architects, designers, studios and bureaus;

- multi-storey housing construction. A growing number of world-famous design and contracting companies are turning to multi-storey modular construction. This is facilitated by the low cost and excellent technical characteristics of the houses from the modules, earthquake resistance, energy-saving qualities. Most of the operations for the design and decoration of modules are carried out at the factory, therefore, in a building site, all work is carried out in a short time with the minimum number of workers and equipment. Overpopulated India and China are countries where modular skyscraper project competitions are held today.

### **Module Based Solutions**

Since the first time container houses and transport buildings began to be used, modular construction has gone forward. Today, it is far from always possible by the appearance of a structure to accurately determine that it consists of ready-made blocks. The solutions for the interior and exterior of buildings are innumerable. The design of the modules allows you to build both buildings with many small rooms of the same type, and to implement projects that have a free layout with two lights and atriums.

Blank walls can be replaced with spectacular panoramic glazing. On the roof of a modular building you can easily operate a summer area or a terrace under a canopy. The roof of the containers can be landscaped or used to house solar panels, water heaters and other attributes of sustainable construction. If necessary, the cover of a modular building can be converted into a pitched roof with an attic or attic.

Docking of various containers can be made on the long and short sides, with or without displacement. Modules can also be installed at some distance from each other, while the space between them is built up according to the frame-panel technology. There are projects in which containers are mounted at an angle to the horizon (for example, for a device inside a covered flight of stairs).

In private modular construction, extensions to the building are widely used in the form of canopies, peaks, verandas. To do this, the upper containers are mounted on the lower with a shift, forming the original composition. The top

block can be installed on the bottom, located at some distance from each other.

In conclusion, we note that the use of modular structures and especially volumetric block modules must be considered as one of the promising options for ensuring energy-efficient reconstruction. The main ways to increase organizational and technological solutions, as well as the energy efficiency of superstructure floors are to increase the size, while reducing the mass of assembly modular elements (ready for finish), which is possible with.

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