

## MOBILE HOUSING AS A FUNCTIONALLY-TYOLOGICAL DIFFERENCE OF THE INDUSTRY OF MODERN HOUSE BUILDING

Maslov F.B. Samuratova T.K.

*Eurasian National University after L.N. Gumilyov, Astana, e-mail: farxad.maslov@bk.ru,  
Samyratovatk@mail.ru*

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The article is devoted to the current socio-demographic conditions and the level of providing the population with housing of various types and quality, suggest the possibility of active development of mobile housing construction. The practical advantages of mobile homes in different regions of the world are reflected in the popularity of their use, especially as a temporary, recreational, holiday and tourist accommodation. The use of mobile housing currently has a limited functional and typological composition.

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The main purpose of the article is to identify the features of designing and erecting mobile housing on the basis of studying the world and domestic experience, taking into account a comprehensive assessment of the shaping factors (environmental and fire safety requirements, energy conservation, reliability and sustainability, etc.).

Throughout the course of historical development, the use of a mobile home was the optimal response of a person to harsh, unfavorable external living conditions or was related to the characteristics of life and economy. Two main types of mobile homes (land and water based) have received different vectors and the degree of their development, depending on the habitat habitual for a person. After a considerable pause in its development, the mobile home received a new round only after the first scientific and technological revolution, which is associated with the emergence of new zones of attraction of human resources and the availability of technical means for their movement. An analysis of the subsequent stages of development, both of the mobile home itself and of its position in the general structure of settlement, indicates that such dependence (the place of residence / zone of attention – the means of transportation – the mobile dwelling) is preserved, leading to the fact that the area of application of the mobile dwelling has constantly expanded in the direction of increasing extremes of the external environment. The range of factors (natural and climatic, technical, economic and ecological) that determine the use of a mobile dwelling depending on the conditions and the complex of problems solved with its help is widening. At the same time, the range of its potential consumers is widening, which can be conditionally divided into the following groups: public, social, private and special. It is worth noting that for each period of mobile

home development, the prevalence of certain groups of influence factors and groups of potential consumers over others is characteristic, taking place against the background of their increasing differentiation. The basic principles that predetermine the transition to the use of mobile homes remain unchanged: "the principle of limited resources" – the limited territory, living space, time, resources, labor, etc., and "the principle of changing conditions" – the variability of the place, external and internal conditions. The first principle is responsible for the conditions for the transition to the application and selection of typological varieties of the mobile home (scope, type, species and its varieties). The second relates to the characteristics of the mobile home itself, determining accordingly its transportability, adaptability and interactivity [1.12-13].

Modern socio-demographic conditions and the level of providing the population with housing of various types and qualities suggest the possibility of active development of mobile housing construction. The practical advantages of mobile homes in different regions of the world are reflected in the popularity of their use, especially as a temporary, recreational, holiday and tourist accommodation. The use of mobile housing currently has a limited functional and typological composition. The development of the mobile construction industry has a wide range of practical applications [2].

In studies on mobility and transformability of residential buildings, the following issues were considered: the experience of adapting housing to changes in the livelihoods of their inhabitants in the form of transforming the internal space and ensuring its multifunctionality; method and design of structures that differ in moving, collapsible or folding parts and the features of the formation of a mobile recreational dwelling; the evolution of the human

dwelling and the predicted futuristic view of the structure of the residential environment. In the scientific development of modern authors in the field of construction and architecture, the topics related to energy conservation are of great relevance: the study of the historical preconditions for the development of energy-efficient housing, the development of basic requirements and solutions for their formation, and the creation of an engineering-effective method for designing low-rise architecture; analysis of the use of non-traditional energy sources, identification of the main ways to save energy and the development of the architecture of energy-saving residential buildings of small and medium-level storeys; development of an integrated approach to the environmental and economic justification for the creation of energy-efficient residential houses using alternative energy sources; the urgency of energy saving in construction in the context of energy savings for future generations, the use of renewable energy sources (RES) and the creation of energy-efficient houses with the use of “smart” housing in the form of autonomous control systems; use of RES and secondary energy resources and construction of experimental houses; creation and formation of energy-active agro-life on low-productive areas degraded due to technogenic factors; creation of new standards for designing a home based on real experience in research, design, construction and operation of energy-efficient engineering systems [3]. It seems reasonable to study the problem of mobile modular housing in the context of energy conservation and energy efficiency requirements.

To start, I would like to stop on the historical foundations of the evolution of mobile housing. The history of the development of a residential house, the evolution of its formation in the environment is associated with the allocation of two basic forms – mobile housing (land and water) and a capital structure (real estate). The mobile form of habitation was characteristic of all ancient nomadic tribes inhabiting vast steppe open spaces from the Carpathians to East Asia (Cimmerians, Sarmatians, Huns, Turks, Tatars, Mongols, etc.). Among the peoples of the semi-settled way of life, portable houses were used along with the construction of permanent housing (Persians, Hittites, Scythians, Bulgarians, Magyars, Khazars, Pechenegs, etc.) [4].

The principle of the construction of a mobile home has not undergone significant changes since ancient times to the present day. The main types of portable dwellings: yurt, yaran-

ga, plague, tipi – are frame structures, round in plan with a center located in the center, differing in size and coverage. A feature of the device of the Central Asian yurt – the most complex of primitive nomadic dwellings – is the presence of lattice folding walls, poles making up the dome, holes at the top of the dome for daylighting and ventilation and felt cover [5].

At the same time, the yurts of different peoples have characteristic features in the details of the structures and organization of the internal space. The diameter of the average yurta is 5-7 m, the height is 3-3.5 m. So, instead of a felt canopy replacing the door, two-leaf wooden doors (in Kazakh and Turkmen yurts) can be arranged. Yurts have zoning on the male and female halves and mandatory allocation of places for honorary guests in the altar part, located opposite the entrance.

Traditional dwellings of the indigenous peoples of the North America, North and North-Eastern Europe and Siberia are the yaranga among the Chukchi, Eskimos, Koryaks and Yukagirs, and others; the plague of the Saami, Nenets, Evenks, Mansi, and others; and tipi (among the Indians of the Great Plains), consisting of poles covered with reindeer skins, birch bark, mats or bark [6,289].

The installation of the nomadic dwelling was usually carried out by women, the assembly took several hours, and the dwelling was also quickly disassembled and loaded onto camels, deer, lamas, and dog sleds. In modern conditions, traditional mobile, fast-gathering, seismic-proof housing is still in demand and is most common among residents of the North, Mongolia, Kazakhstan, Kyrgyzstan, Turkmenistan, etc., engaged in pasture-pasture livestock.

Since ancient times to the present day, various marquees and tents (simple frame structures, covered with cloth or leather, basically not providing the process of preparing food in the room with the help of the hearth and designed for moderate or hot climatic conditions) serve as a camp light lodging. To the prototype of campers – mobile housing, which has a wheel base, you can include indoor gypsy wagons, wagons and wagons of wandering artists and other residential “trailers”, the application of which is also associated with seasonal and climatic conditions.

Mobile form of housing in the modern view has been actively used in many countries since the early 1950s. In the beginning, these were inexpensive, often temporary houses; in some cases, the factory-made house was transported and installed on the prepared foundation in the chosen place. The first houses had a width of

2.5 m, then the sizes increased and as a result, the border separating camper-caravans (motorhomes), dimensions, weight and engineering capabilities of which were severely restricted, and mobile homes (full-fledged housing from 1 to 3 floors from bulk or flat elements) [7].

Currently, the field of application of mobile prefabricated low-rise housing construction (land and water) is extensive and diverse:

- temporary housing for shift work, including in construction conditions, as well as in underdeveloped and hard-to-reach areas remote from the industrial centers of the prirulous zone, in areas with unfavorable natural and climatic conditions;
- in the conditions of the increased migration of the population connected with problems of employment;
- for placement of internally displaced persons from regions with unstable military and political situation;
- in the context of emergencies caused by natural or man-made factors;
- temporary garrison housing for servicemen (soldiers' barracks and houses for officers);
- scientific-expeditionary activity;
- urban, suburban, suburban manor and dacha housing;
- housing for rural areas;
- recreational housing;
- tourist and hotel accommodation.

The development of the mobile housing market and the use of certain typological types of mobile housing have significant regional differences. Among the countries – the main producers of mobile housing, as well as in which the advantages of mobile homes in the form of suburbs, cottages, tourist campsites, hotels are used to the greatest extent are the USA, Great Britain, Germany, Spain, etc. A popular phenomenon was the adaptation of vehicles for residential needs: housing in buses, in the bodies of trucks, in freight containers.

In Central Asian countries, mobile homes have traditionally been used mainly as temporary working housing (wagons-trolley cars). Light mobile constructions of economic and commercial purpose (kiosks, booths, small hangars, etc.) and garages are quite in demand. An insignificant percentage is the use by citizens of automobile residential trailers.

In recent years, the use of prefabricated (mainly skeleton-panel and container) mobile homes for temporary, alternative living and recreation in the form of country and suburban housing (less often for the organization of tourism business) has increased noticeably. The production and erection of mobile residential

buildings meets the general building codes and requirements (town-planning, architectural and constructive, sanitary-hygienic, fire-fighting, socio-economic, ecological, energy-saving, etc.) imposed on residential buildings.

However, in some parameters there are specific features:

1) considering the urban factor, when placing mobile housing in the city system, the choice of the territory outside the historical development zone is of primary importance. Taking into account the principle of conceptuality, architectural formations from mobile homes are difficult to fit into the historical environment in which buildings of the period of construction until the middle of the 1910s are present. Preferable allocation of sites on the outskirts of residential areas; The most appropriate may be a neighborhood with a manor or multi-store building.

2) mobility: mobile homes belong to the so-called types of non-traditional housing and have the main difference – the types of mobile housing are different: a) by type of transportation:

- self-propelled – with a non-removable undercarriage and an engine similar to a car;
- with the possibility of towing;
- wheelless, transported by means of vehicles.

On structural and technological features: from bulk elements (container and superblock) and from flat and linear elements.

– container and super block houses consist of a house consisting of block-containers of increased factory readiness, often with a complete set of engineering equipment and furniture. The house is put into operation immediately after delivery to the destination. House-containers are transported by vehicles or towed on own undercarriage, which can be fixed or removable (automobile chassis, rolled-in cart, sled, etc.). Containers have a strict limitation of dimensions (super-block houses have considerably larger dimensions), planning capabilities and high cost.

Mobile houses of flat and linear elements are assembled from the structures of increased factory readiness (frames, racks, panels) into a single system directly at the site of operation. Compared with container houses, they have more diverse planning solutions, the possibility of creating cottages of various sizes and storeys. Installation and dismantling are carried out by cranes of small carrying capacity, the process of redeployment is more complex, primarily because of the need for on-site installation of engineering equipment and connection to centralized networks [8, 442-444].

3) turnover of a mobile home – the number of redeployments for a certain calendar period.

4) the structural and spatial system of an apartment house can be modular; Nowadays modern technologies allow creating a new type of housing – modular mobile homes.

Modular units can be module-containers, individual volume blocks, as a rule, full or maximum factory readiness. In this case, it is possible to use the transformation of modular structures and change the exploited area, construction volume and other technical and economic indicators of the house. There are such basic types of transformation:

a) with the change of external parameters – in the case of erecting the house in stages, by adding additional volumes to the main module by means of special docking elements;

b) with the change in the internal parameters of the house by re-planning the internal space with the help of transformable partitions. At the same time, the areas and proportions of the rooms, functional zoning and inter-room connections are changing;

c) combined, in which the principles of external and internal adaptation are applied.

Mobile mobile housing (including modular) is a kind of dynamic adaptable house and has already become widespread in economically developed countries (USA, Japan, Great Britain, etc.).

Depending on the method and nature of adaptation, the following main types of transforming houses are distinguished:

– folding – with the help of special folding structures;

– pneumatic – houses with flexible fabric inflatable fences, supported by excessive air pressure;

– sliding – with special sliding elements of walls and ceilings;

– cassette – characterized by a high-density interposition of structural elements.

5) Limitation of the number of storeys – up to three floors (with rare exceptions) and durability.

6) Certain difficulties of application in conditions of rough terrain and large slopes of the terrain. Preferably, the choice of flat sites with the purpose of reducing the preparation of the territory.

7) Certain specificity in the use of structural systems and methods of construction (or installation): as a rule, a frame or frame is used as a supporting system, and technologies of monolithic and finely assembled erection are not applied.

The main requirements for choosing a constructive solution should be reliability, stability and safety.

Before the installation of mobile housing (in most cases), earthworks of the zero cycle (excavations and trenches) are not carried out, foundations and basements are not being constructed (in some cases, collapsible lightweight foundations are used). The installation of a mobile home (not equipped with a wheelbase) can be made directly to a pre-prepared territory (the site is leveled, often with a bulk of rubble, sand or using special slabs).

Self-propelled mobile homes can be lifted by jacks before installation (lodges are put on special concrete or metal supports), while the wheelbase can be removed or covered, leaving the wheels in a hanging position.

8) In order to fulfill the requirements for energy saving and environmental friendliness, when creating energy-efficient mobile homes, it is necessary to take into account their design features. The construction of energy-efficient housing (including mobile), more technically more complex than the traditional one, requires an integrated approach based on close cooperation between architects and engineers.

In many countries that have adopted the Law on Renewable Energy Sources (REE), energy-efficient houses with the use of hybrid systems (using solar radiation, geothermal heat as an additional source of energy, etc.) become quite common. For example, in Germany, according to the Law on Renewable Energy, owners of houses using alternative renewable energy sources (solar, wind, geothermal energy) in the system of autonomous heating of housing receive state subsidies both in the arrangement of autonomous heating and in the operation of the heating system.

The use of energy-saving hybrid systems in mobile housing construction is also quite realistic. Taking into account the characteristic differences in the construction and operation of mobile housing (functional-typological and design features, the estimated time of use in one place, turnover, etc.), it is possible to work out various energy-efficient engineering and technological schemes that are acceptable for each specific case. When designing mobile homes for seasonal use (in the warm season) with low energy consumption, it is possible to provide energy only with autonomous installations operating on RES (recreational, dacha, tourist accommodation, etc.).

Experimental developments in the creation of a “smart house” (or a home-car) – an energy-efficient and equipped with an integrated automatic control system – are becoming increasingly popular. An example is an office green house with a roof used as a garden, built

in Israel. Inside the building, several thousand sensors continuously record data (temperature-humidity regime, air composition, etc.). The water from the sewer system is cleaned and used a second time for technical needs (watering plants on the roof, etc.). Thanks to the green plantations on the roof, the building receives additional thermal insulation. Thermal energy released by cooling plants is used to heat water. The control panel of the entire engineering system is located in the basement [9, 76-78].

The use of mobile housing construction of various typologies has real prospects for development. Along with the traditional capital housing, which constitutes the priority share of the construction industry, mobile homes can serve as a quick and good help (primarily for summer residents and tourists). A necessary condition for this is the general growth of the economic well-being of our country, the intensification of international cooperation in various sectors.

The design of mobile housing should be viewed from the standpoint of the processes of people's livelihood, carried out in this dwelling, and the processes of its creation. It is necessary to provide a comfortable living for a

person in a small area, to place in the internal space all necessary equipment. But, most importantly, it's the world in our common home and the confidence of people in the future – their own and their children.

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