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To cite this article: N N Alekseev *et al* 2018 *IOP Conf. Ser.: Mater. Sci. Eng.* **463** 032029

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Innovative Planning Solutions In Urban Areas With Permafrost Soils

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Abstract. The larger part of the territory of Russia is in cryolithic zone. The cities and settlements which are under construction on permafrost have special features – houses are built on the pile bases, at the same time the gap between soil and the basis is created and natural ventilation of a frozen surface is provided. It causes a number of problems at accommodation in such buildings, especially in big cities. In Yakutsk, thanks to implementation of different federal, regional state programs on construction of housing, there is a great demand for new housing and for improvement of living conditions, besides this, the population generally due to local migration intensively grows. At the same time, building is conducted generally due to renovation of wards with the decayed wooden housing fund. Demolition and resettlement of these houses are conducted at the expense of builders that causes increase in number of storeys and population density of residential areas. It leads to discontent of the population, because of lack of space of domestic territories with problems on sharp insufficiency of gardening, improvement of recreation development of children and other leisure areas, the yards are placed round by private vehicles. This article considers a number of innovative planning solutions which considerably improve accommodation conditions in the urban environment, at the expense of the organization of enough parking spaces both warm, and guest with preservation of the areas under recreation areas, children and sports courts.

1. Introduction

Economic value of area of permafrost, or cryolithic zone as it is called by permafrost researchers, it is difficult to overestimate, especially because it occupies 65% of the territory of modern Russia. This territory is the strategic back of economy of Russia, its fuel and energy base and the currency shop. Within a cryolithic zone of Russia there are concentrated: more than 30% of explored reserves of all oil of the country, about 60% of natural gas, incalculable deposits of coal and peat, the large part of hydroenergy resources, reserves of non-ferrous metals, gold and diamonds, huge reserves of wood and fresh water. A considerable part of this natural wealth has already been involved in economic circulation. Expensive and vulnerable infrastructure has been created: oil and gas objects, main oil and gas pipelines thousands kilometers long, mines and pits, hydroelectric power stations have been built, the cities and settlements, also the railroads, airfields and ports have been constructed. Magadan,



Anadyr, Yakutsk, Mirnyi, Norilsk, Igarka, Nadym, Vorkuta and other settlements are situated in the zone of permafrost. [1, 2, 3, 4]

2. Modern conditions of urban development

Now, in Yakutsk, thanks to implementation of different federal, regional state programs on construction of housing, there is a great demand for new housing and for improvement of living conditions. Besides, in Yakutsk, the population, generally due to local migration intensively grows. Yakutsk, being the cultural, educational and administrative center of the territorial subject of the Russian Federation of the Sakha (Yakutia) Republic, as well as Moscow, but in this scale, attracts the population of the republic. Demand for well-planned housing is available, therefore complex buildings of wards on the approved site plannings of territories and land surveying are conducted.

At the same time because there are no new territories in the city for construction of housing, building is conducted generally due to renovation of wards with the decayed two-storied wooden housing fund. Demolition and resettlement of these houses is conducted at the expense of builders. This condition together with expensive and technically difficult utilities, lay down a heavy burden on builders. Not to appear at a loss, builders forcedly move for increase in number of storeys and population density of residential areas, increasing the number of apartments with minimum admissible areas. At the same time it is necessary to build, following requirements "Rules of land use and building" without breaking maximum permissible parameters of "Rules" by the number of the area of gardening, building, parking spaces of cars, etc. Violation of admissible parameters of "Rules" leads to discontent of the population of these residential areas, because of the lack of domestic territories with problems on sharp insufficiency of gardening, recreation development, children and other leisure areas. The yards are actually placed round by private vehicles. The benefit, relative availability at its cost second-hand, but very strong still, the Japanese cars have very strongly raised the level of automobilization of the population in Yakutsk. Families have already two, three "foreign cars" of the Japanese origin.

Today in permafrost zone in the cities and settlements is applied the construction of buildings generally on the bases of piles when the gap between soil and the basis is created and natural ventilation of a frozen surface is provided.

Application of piles at construction of large-panel houses is the invention of the 60th years of the last century. The civil engineer Mikhail Kim, one of the former prisoners of Norilaga who studied properties of permafrost from 30th years was the author of this way of construction of the bases. [5]

Thanks to the ideas of Kim who suggested to put houses on piles, housing construction in Norilsk, Yakutsk, in the beginning of the 60th assumed a wide range. Mikhail Kim, was given in 1966 the Lenin award "for development and deployment of essentially new methods of industrial construction in the conditions of the Far North". [6]

To solve somehow the problems of development of urban areas, we make new architectural planning solutions and methods.

3. Problems of operation of buildings on the pile base

Introduction of the pile bases caused that the first floors of the houses built on piles "are torn off" from the earth, and space under the house, between piles is used only for ventilation of cold air for preservation of permafrost in a frozen state. The wider the building case, the higher the gleam under the house which is defined by calculation. In most cases under the house, practically the person stand without difficulty.

At the same time, as we see in of fig. 1 and 2, the mark of half of the first floor is on 2,5 - 3,5 meters from earth level. The residents living in such houses have to rise two - sometimes three - a mid-flight porch that causes difficulties in some groups of the population, especially during the periods when snow in isn't shoveled away in time or ice is formed.



Figure 1. General view of the residential building on the pile base.



Figure 2. General view of a porch of an apartment house on the pile base.

4. Innovative solutions of a problem

For an exception of the arisen problems, several innovative solutions are proposed.

4.1. InnovationNo. 1

Question: and why it is impossible to use this space between piles under the house for other purposes? For example for the guest parking. Having raised a mark of half of the first floor higher, we increase height of an underground gleam between a blind area and socle overlapping for use of this space under expansion of the domestic territory. It can be used under the guest parking, arrangements for leisure space etc.

4.2. InnovationNo. 2

Question: How one can now rise by such height of the first floor?

To solve this problem, we lower most low only entrance group of rooms (a lobby, the lift hall, elevators, a ladder). As building area under entrance group is minimum, it allows to lower a mark of a floor of entrance group to a minimum, actually to one meter from the earth (is defined by calculation), providing at the same time natural ventilation of the frozen Earth's surface. It will allow residents, crossing only through 6-7 steps, to appear in the lift hall, but not to climb porch stairs up to 2,5-3,5 meters. Besides, the possibility of the arrangement of a porch under the house appears, then on stairs snow, rain, icicles from a roof will not get.

These two innovative solutions are designed and realized at construction of an apartment house on Ordzhonikidze St. of Yakutsk (fig.3).



Figure 3. The solution of an entrance zone in a house (the author of the project Alekseev N.N.).

4.3. Innovation No. 3

Question: How to provide in the constrained city conditions with the necessary number of the guest and warmed parking spaces?

In residential wards warm parking spaces remain deficiency still. In the project of an apartment house with parking in a ward of 94 of Yakutsk (authors of the project architectures Alekseev N.N., Nesterov V.M., Nikiforov S. G.) (fig.4) has put the idea of double use of the land plot. Two 2-entrances of 16 floor houses are united at the level of the first floor by the general room under warm parking spaces for vehicles of owners of apartments, with the arrangement domestic territory with the play and sports ground on its roof. From the warm parking it is possible to get to the apartment, without going outside for each inhabitant through the entrance.

4.4. Innovation No. 4

In the project of a housing estate with warm parking places on Shevchenko St. in a ward of 94 of Yakutsk (authors of the project architectures Alekseev N.N., Nesterov V.M., Nikiforov S. G.) (fig.5), offers the idea of threefold use of the land plot that allows to create the urban environment, favorable for accommodation. So under the warm parking places raised on the level of the second floor it is possible to arrange open guest parking for cars. And the operated roof of warm parking places is given for additional domestic territories where it is possible to place zones for rest.



Figure4. The project of an apartment house with parking in a ward of 94 of Yakutsk.



Figure5. The project of a housing estate with warm parking places on Shevchenko St. in a ward of 94 of Yakutsk.

Summary

As a result of introduction of all proposed innovative planning solutions we can turn shortcomings of the pile bases into their advantages. At the same time accommodation conditions in the urban environment are improved at the expense of the organization of enough parking spaces of the areas, both warm, and guest with preservation of space for leisure zones.

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