

Assessment of Regional Factors Influencing Residential Quarters through The Intensity of the Aging of Buildings

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Abstract

Most of the apartment houses belonging to several “generations”, which exist in different regions of the Republic, today have a different level of technical condition. In the exploitation of multi-apartment houses in our republic, a lot of problems related to the maintenance of them have accumulated in the last 30 years.

The purpose of this study is to determine the process of wear and aging of building structures and buildings in multi – apartment buildings in General in order to clarify the durability of residential blocks for subsequent planning of their renovation.

To solve this problem, full-scale surveys of apartment buildings located in different regions of the Republic were conducted. For a full-scale survey, wooden, brick, reinforced concrete panel buildings and buildings made of natural stones with different storeys are accepted.

The results of the study show that the indicator of longevity of multi-family residential buildings in many cases depends on the quality of operation. The actual service life of certain parts of buildings, such as foundations, walls, and coverings, is also set, depending on the location in the region. Significant factors that negatively affect the durability of buildings, such as salinity of the soil, increase in the level of groundwater, are determined.

In conclusion, it is noted that the results of this study are adapted to the effective use of the housing stock for sustainable development from the point of view of safety in the development of a phased renovation program for the future development of cities.

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I. INTRODUCTION

Analyzing the composition by age of residential buildings in the city of Tashkent, you can qualify as follows:

- Residential buildings that are more than 100 years old. They are mostly preserved in the "old town" e, which consist of a wooden structure "frame". Some of these houses are about 200 years old.
- Residential buildings-built in the 30s of the last century, the condition of which is at the stage of "physically and morally obsolete".
- Residential buildings built before the Tashkent earthquake (1966), having a kind of architecture with ledges, columns, cornices on the facades, etc.

They do not meet the requirements of current design standards, in particular the requirements of seismic resistance of the structure.

- Residential buildings built during the period of mass industrial construction (after the Tashkent earthquake). They were built on the basis of the requirements of the design standards of the period, taking into account the requirements of seismic resistance of the structure. However, the monotony of design solutions and architectural appearance of buildings and structures, without taking into account the specific features of the region, requires their modernization. The state of buildings and structures of this generation varies. If we are talking about residential development, the age of residential

buildings of the industrial period already exceeds 50 years and the condition of a significant part requires a minimum of major repairs.

Research in the field of housing maintenance shows that untimely scheduled preventive repairs accelerate the physical deterioration of building structures. The experience of many years of research by the authors shows that permanent basic building structures get wear and tear of the basic nature (structural changes in strength, rigidity of building materials), which can not be restored or is not economically feasible. The change of environment, sanitary and hygienic environment, in particular, the increase in groundwater level due to the mismatch of irrigation systems of the city and also because of the destruction of the natural ravines in land improvement without drainage was the catalyst to the intensity of physical deterioration of structures below zero housing. This is clearly seen in the state of the city's underground engineering infrastructure. In addition, the daily increase in the concentration of salts, alkalis and acidity in the composition of groundwater has become an aggressive influence on the main Fund of the city economy. Widespread flooding of residential areas, streets and other functional areas with atmospheric and other surface water, lack of irrigation systems in the city, incorrect design decisions or errors in the construction and improvement of territories when performing vertical planning is the main source of groundwater increase.

Tashkent also found itself in the zone of influence of salt dust and rains of the Aral sea. The disruption of the global ecosystem, which is of a cross-border nature, has led to a huge damage to the main Fund of the city, which has led to an upward trend.

Today, proper operation of the main Fund of urban development is important. Research on the development of the theory of wear, aging, and operational reliability and safety of the urban construction Fund is relevant.

To reduce the negative impact of the above problems, ensuring and improving the durability and

safety of the urban construction Fund requires a comprehensive approach to the study of this problem, in particular, the study, analysis and assessment of the state, determining the remaining life, durability and reliable operation. And on the basis of the obtained results, it is important to forecast the residual resource of construction Fund city services for scientific substantiation of technical and economic indicators on the feasibility and operation of buildings and structures, sequence reconstruction, renovation subject to multivariate analysis.

This circumstance causes an urgent need to develop new, effective approaches to planning, organization and technologies for capital repairs and reconstruction of buildings and structures that contribute to more effective use of budget funds allocated for the restoration of fixed assets of the city economy.

II. MATERIALS AND METHODS.

Since 2008, in the history of mankind, more than half of the population of the Earth's sphere lives in cities, according to current estimates, this number will increase by 70% by 2050, which is largely due to the contribution of developing countries [2].

This situation is characteristic for our republic, which is also confirmed by the graph presented in Figure 1. The graph shows the relationship between the picture of population growth in the last 60 years in the Republic and the picture of the construction of multi-apartment residential buildings. As can be seen from the graph, the intensity of population growth in our republic is quite stable compared to the intensity of the construction of residential buildings, that is, it is growing almost at once.

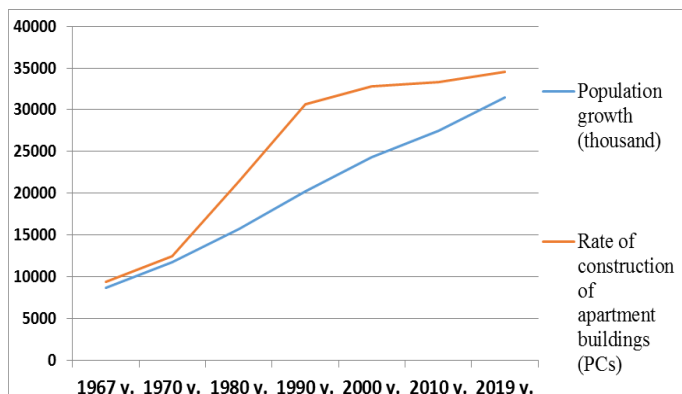


Figure 1. Ratio of the rate of construction of apartment buildings and population growth during 1960-2019 in Uzbekistan

It is known that the life expectancy of buildings depends on the timely performance of the work included in the system of inspections and repairs carried out in them.

In this regard, the results of observational studies conducted under the guidance of the author indicate that the current state of multi-apartment buildings, the existence of buildings that have become unusable-the system of examinations and repairs almost did not work, which occurred as a result of improper handling of the exploitation.

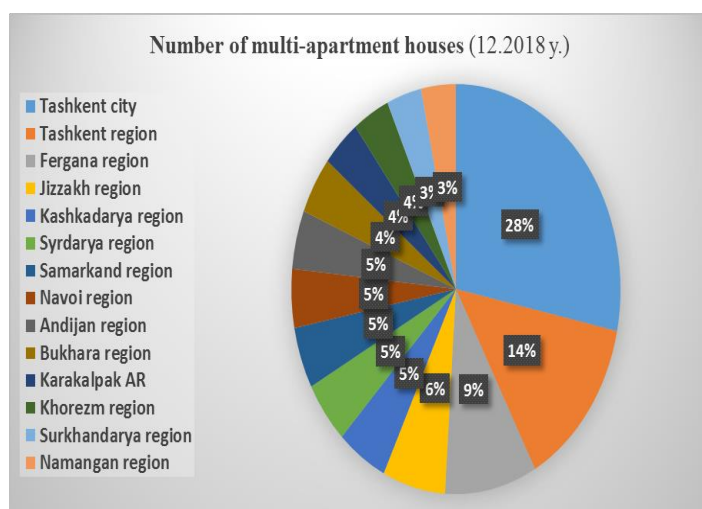


Figure 2. The current status of multi-apartment houses throughout the territory of the Republic.

In Figure 2, the current status of multi-apartment housing buildings throughout the regions of the Republic is presented. According to this information, 42% of the total available multi-

apartment residential buildings are located in the city of Tashkent and The Tashkent region. The 2nd place in this regard is occupied by Fergana Region (9%).

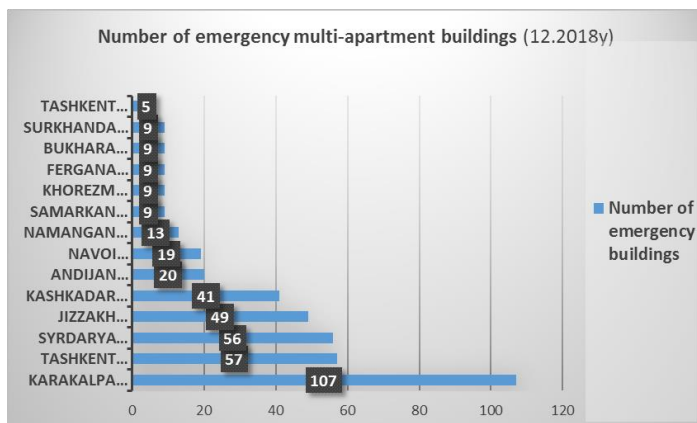


Figure 3. Number of apartment buildings recognized as emergency by territory

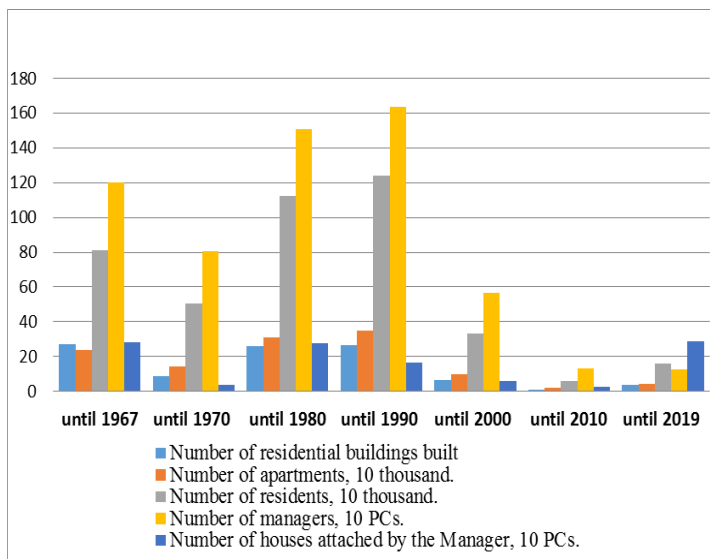


Figure 4. Dynamics of changes in the number of operated apartment buildings (%), the number of apartments and residents (10,000 PCs.), the number of houses attached to the Manager (10 PCs.), the number of houses not attached to the Manager (10 PCs.).

According to the data presented in Figure 4, according to the state of December 2018, there are a total of 1197318 apartments in 34584 multi-apartment houses, according to official data 4227358 residents. This accounts for about 13% of the population of our republic. This means that each

apartment in the existing multi-apartment houses in the Republic accounts for 3.53 people.

Based on the scientific point of view of the service life of residential buildings, the assessment of their current state by urban requirements is an important factor for the planning of a prospective economy on the housing fund.

In our work, we carried out the research work based on the findings obtained as a result of natural observations in order to ensure that the period of normative service established by the designer to residential buildings is consistent with their actual service period. Also, depending on the location of the residential buildings in the residential area, the location relative to the horizon, ventilation rhythm, housing construction in the study of amenities and the impact on their activities, fact their once again dictates the analysis due to the territorial characteristics of the Republic.

Factors assessing the settlement,

Convenience:

- Connection of the settlement with other regions of the city;
- Improvement of the territory;
- Level of transport availability;
- Indoor and outdoor parking lots and other farm areas;
- Provision of social and household conditions;
- Volume-planned structure of apartments;
- Composition of apartments by rooms, apartments;
- Historical and architectural value of buildings;
- Compatibility with the environment;
- Make-up of buildings;
- Availability and composition of engineering systems and equipment;
- Technical level of engineering systems and equipment...

Capital of buildings:

- Typology;

- Reliability of the building, including the possibility of failure to leave work, longevity (physical longevity, spiritual (functional) longevity), renovation, maintainability;
- The period of service of the building, including the period of normative service, the period of actual service, the period of residual service;
- Service life of landscaping elements;
- The degree of physical wear and tear of the building and its elements;
- The level of spiritual wear and tear of the building;
- Service periods of engineering systems and equipment;
- The level of physical wear and tear of engineering systems and equipment;
- Maintenance of engineering systems and equipment;

Purity of environment and sanitation:

- Insolation;
- Natural and artificial lighting;
- Noise level;
- Protection of buildings from sound conduction;
- Air pollution level, including: gas, dust amount;
- Level of suitability of drinking and technical water;
- The level of soil pollution, including: the amount of salt and other types of yachts;
- Aeration rhythm;
- Solar radiation level;
- Radioactive pollution;
- Danger of electromagnetic radiation;
- Vibration rate in buildings;
- The effects of underground water.
- Heat-humidity rhythm in buildings;
- Environmental purity of the domestic environment....

Security:

- Security of the dwelling;
- Durability and durability of the building;

- Earthquake;
- Explosion safety;
- Fire safety;
- Fire fighting;
- Maintaining the coloring atmosphere and grunt moisture;
- Flood, landslide, ravines, flooding, karst, strong wind, etc.;
- Engineering measures to protect against natural processes...

Economic efficiency:

- Investing in construction;
- Exploitation costs;
- Reconstruction costs;
- Costs of repair work;
- Costs for engineering systems and equipment;
- Energy management issues.

According to the factors listed above V. Kasyanov [4] is detailed in his works, in which some of the main factors are neglected, some of which are characteristic only for our republic. These are,

In the Group of Capital:

- Reliability of the building, including the possibility of failure to leave work, longevity (physical longevity, spiritual (functional) longevity), renovation, maintainability;
- The period of service of the building, including the period of normative service, the period of actual service, the period of residual service;

In the group of ecological and hygienic purity:

- Level of suitability of drinking and technical water;
- The level of soil pollution, including: the amount of salt and other types of yachts;
- Solar radiation level;
- The effects of underground water.

In the security group:

- Maintaining the coloring atmosphere and grunt moisture;

- Flood, landslide (shift), ravines, flooding, karst, strong wind, etc.;
- Degree of protection from natural processes, etc.

These factors are the necessary factors for the modern formation of settlements at the present time. Residential buildings built up to 1967 year can also be conditionally divided into the first low-and medium-rise residential buildings built in 1920-40 years, and residential buildings built in the period from 2-th World War to 1967 year.

The residential buildings, built until 1967 year, are a unique architectural solution, characterized by the presence of separate elements – ventilation windows-in the facade overlapping of cornices, quieter balcony constructions, columns and attic constructions on the front facade. Their actual service life (T_e) – if the machine guns approach 100 years, then most of them even exceed 50 years. In addition to physical erosion in these buildings, the levels of spiritual wear and tear are higher. In addition, many parameters of buildings built during this period do not correspond to the requirements of current normative documents, in particular, earthquake-proofing requirements.

On 2.01.01-94 [5], the regions of our republic consist of different regions, which differ sharply from each other in terms of climatic indicators, relief, geological conditions. This thing also has a different impact on the buildings of housing in the exploitation. The increase in salinity levels in the regions of Khorezm Oasis, Karakalpakstan Republic has a negative impact on the urbanization of these regions, while the increase in the level of underground waters in the regions of Sirdarya, Jizzakh, Fergana and Tashkent, is considered as a negative natural factor [7].

On our side, the analysis of the results of the monitoring and inspection works conducted on residential buildings of about 200 apartments across the Republic shows that the normative service periods of these buildings do not correspond to their

actual exploitation periods. The selected buildings are in different regions of the Republic, their typology, constructive solution, materials, year of construction, the Capital Group, the period of exploitation are different. Thus, they were studied as typological groups.

The intensity of physical wear is measured by the ratio of the absorption index to the period of ecluation:

$$\lambda = F^n / T_e,$$

where λ is the acceleration of absorption of the material (%/year);

F^M – normative physical wear (%);

T_e – is the projected expiration date (year).

Observation and inspection work was carried out in buildings located in different regions of the Republic with different climatic indicators. Their address, number, composition are presented in the table below [8]:

Table 1. Structure of buildings conducted a natural experiment

| № | Territory | Structure of multi-apartment houses by constructive structure | | | | | | | | | | Total |
|---|-------------------|---|---|----|---|-------|---|---|---------------|---|-----|-------|
| | | 2-storey wooden houses | Prefabricated reinforced concrete panel | | | Brick | | | Natural stone | | | |
| | | | *2 | 4 | 5 | *2 | 4 | 5 | 2 | 3 | | |
| 1 | Tashkent region | 16 | 1 | 10 | | 7 | 1 | 3 | | | 38 | |
| 2 | Karakalpak AR | 14 | | | 1 | 23 | | | | | 38 | |
| 3 | Khorezm region | 1 | | 2 | | 5 | | | | | 8 | |
| 4 | Bukhara region | 4 | | | | 6 | | | | | 10 | |
| 5 | Navoi region | | | | | 4 | 1 | | 13 | 2 | 20 | |
| 6 | Surkhandarya reg. | 2 | 1 | | | 5 | | | | | 8 | |
| 7 | Jizzakh region | 2 | 17 | | | 23 | | | 4 | | 46 | |
| 8 | Fergana region | | | | | 3 | | | | | 3 | |
| 9 | Namangan region | 2 | | 1 | | 9 | | | | | 12 | |
| | Жами | 41 | 19 | 13 | 1 | 85 | 2 | 3 | 17 | 2 | 183 | |

* Number of floors

As a result, the intensity of wear-absorption of their main constructive parts, foundation, walls, intermediate adhesion and roofing structures was investigated. The results obtained show that when an earthquake affects the normal operation of residential buildings, there are more dangerous

effects, which leads to the gradual failure of the buildings' in the period of time tattoo. These factors are of great importance in the urban development of our republic and it is necessary to pay special attention to each parameter of the territory by the designer.

III. THE RESULTS AND DISCUSSION.

To reduce the negative impact of the above problems, ensuring and improving the durability and safety of the urban construction Fund requires a comprehensive approach to the study of this problem, in particular, the study, analysis and assessment of the state, determining the remaining life, durability and reliable operation. And on the basis of the obtained results, it is important to forecast the residual resource of construction Fund city services for scientific substantiation of technical and economic indicators on the feasibility and operation of buildings and structures, sequence reconstruction, renovation subject to multivariate analysis.

This circumstance causes an urgent need to develop new, effective approaches to planning, organization and technologies for capital repairs and reconstruction of buildings and structures that contribute to more effective use of budget funds allocated for the restoration of fixed assets of the city economy.

The current methodology for determining the physical deterioration of residential buildings based on current regulatory frameworks does not allow you to determine the technical condition of the elements, the structure and the building as a whole.

The scientific novelty of this study is the development of a scientific and methodological basis for monitoring residential development, taking into account the deterioration of the housing stock of the urban economy in order to ensure their safety and durability, in particular:

1. Development of methods for mass assessment of physical deterioration of residential buildings for

certification and inventory of housing stock of urban economy;

2. Development of a methodology for assessing damage caused by natural and man-made emergencies, as well as the aging of the housing stock;

3. Development of a calculation method for determining the optimal option for the reconstruction of existing residential buildings.

The strategic significance and socio-economic efficiency of the proposed recommendations-the development of monitoring systems for residential development, the theory of wear and aging of the main Fund, the improvement of physical and mathematical models of wear processes allow further more accurately determine the residual resources of the construction Fund of the city

economy in order to ensure operational reliability and safety.

Complex in buildings the difficulty of carrying out capital repairs is that the structures that make up the premises, the elements, engineering equipment, the elements of external landscaping are very diverse, they are made up of different building materials, the service life of which is different. At the same time, the conduct of capital repairs in the building complex is therefore not economically feasible.

Therefore, in the process of designing buildings, it is desirable to use the standard types of structures, elements, engineering equipment, elements of external improvement, which make up them for the service life. Only then there will be an opportunity to predict even the intensity of their depreciation. This is an important factor in the monitoring of housing stock.

Table 2. Residential buildings with 2 floors of wood and concrete.

| No | Address of the object | Building number, units | T _e , year | F _{av} , % | *F _n , % | λ _{av} | T, year | Tr, year | Time spent on capital repairs | After capital repair F _{av} , % | Cost of capital repairs, % | Variability of wear to "T", % |
|--|------------------------|------------------------|-----------------------|---------------------|---------------------|-----------------|---------|----------|-------------------------------|--|----------------------------|-------------------------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| Residential buildings with wooden construction | | | | | | | | | | | | |
| 1 | In Namangan region | 2 | 60,0 | 44 | 80,0 | 0,00745 | 75 | 23 | 2019 й | 33,57 | 10,43 | -36 |
| 2 | In Karakalpak AR | 14 | 53,3 | 46,8 | 71,1 | 0,00850 | 75 | 11 | 2019 й | 35,70 | 11,09 | -24,3 |
| 3 | In Khorezm region | 1 | 86,0 | 44 | 100,0 | 0,00517 | 75 | 0 | 2019 й | 33,57 | 10,43 | -56 |
| 4 | In Jizzakh region | 2 | 69,0 | 52 | 92,0 | 0,00760 | 75 | 6 | 2019 й | 39,67 | 12,32 | -40 |
| 5 | In Bukhara region | 4 | 59,0 | 48,2 | 80,0 | 0,00817 | 75 | 16 | 2019 й | 36,77 | 11,42 | -31,8 |
| 6 | In Navoi region | 1 | 69,0 | 54,0 | 93,3 | 0,00782 | 75 | 6 | 2019 й | 41,20 | 12,8 | -39,3 |
| 7 | In Surkhandarya region | 2 | 59,0 | 54,0 | 80,0 | 0,00915 | 75 | 16 | 2019 й | 41,20 | 12,8 | -26 |
| 8 | In Tashkent region | 16 | 68,3 | 56,0 | 91,1 | 0,00818 | 75 | 6,7 | 2019 й | 42,77 | 13,23 | -35,1 |
| Residential buildings with 2 floors brick construction | | | | | | | | | | | | |
| 1 | In Namangan region | 7 | 45,7 | 48,3 | 36,6 | 0,01060 | 125 | 79 | 2019 | 37,29 | 11,01 | 11,7 |
| 2 | In Fergana region | 3 | 58,0 | 45,6 | 46,4 | 0,00803 | 125 | 67 | 2019 | 35,20 | 10,40 | -0,8 |
| 3 | In Karakalpak AR | 23 | 43,2 | 49,6 | 34,6 | 0,01158 | 125 | 81 | 2019 | 38,29 | 11,31 | 15 |
| 4 | In Khorezm region | 5 | 46,0 | 40,4 | 36,8 | 0,00902 | 125 | 79 | 2019 | 31,37 | 9,21 | 3,6 |
| 5 | In Jizzakh region | 23 | 39,9 | 37,6 | 31,9 | 0,00950 | 125 | 85 | 2019 | 29,03 | 8,57 | 5,7 |
| 6 | In Bukhara region | 6 | 47,5 | 40,0 | 38,0 | 0,00869 | 125 | 77,5 | 2019 | 30,88 | 9,12 | 2 |
| 7 | In Navoi region | 5 | 40,0 | 44,8 | 32,0 | 0,01120 | 125 | 85 | 2019 | 34,59 | 10,21 | 12,8 |
| 8 | In Tashkent region | 7 | 49,8 | 42,5 | 39,8 | 0,00881 | 125 | 75 | 2019 | 32,81 | 9,69 | 2,7 |

* F_n - normative wear;

**F_{rev} - residual wear and physical wear rate after capital repairs.

5 in the picture, the residual service life of multi-apartment residential buildings inspected throughout

the territory of the region, the intensity of wear and tear, and the relationship between their service life are described by graphs.

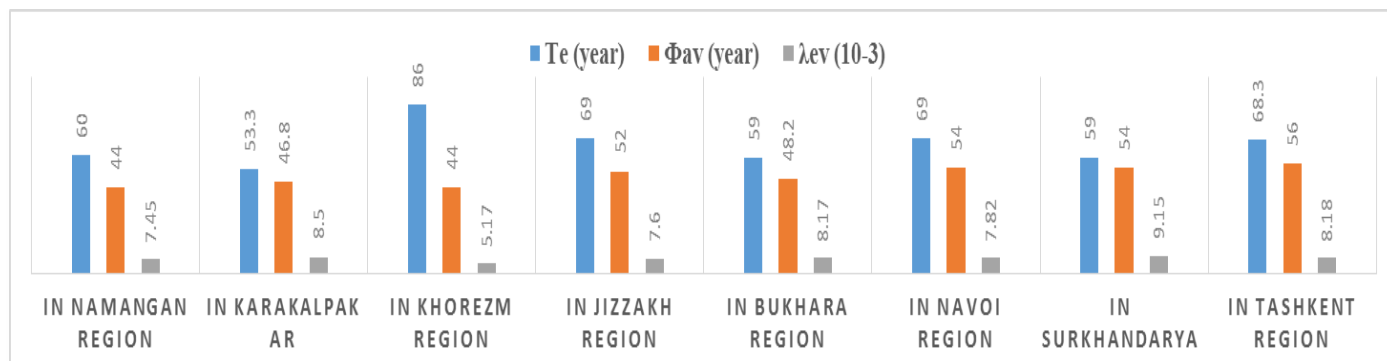


Fig.5. The period of actual exploitation, the average depreciation cost and the intensity of depreciation of multi-apartment buildings with 2-storey wooden construction located in the districts and cities of the Republic of Uzbekistan and the Republic of Karakalpakstan.

IV. CONCLUSION

The results of the conducted inspection confirm that the actual service periods of the building, structures and materials do not always correspond to the normative service periods established by the norms for them. As a result of the conducted natural observation-examination analysis, the following can be cited:

- The intensity of the construction of multi-apartment housing in Uzbekistan increased sharply from 2016 year, an average of 3.5 people in each apartment were determined to reside.
- Most of the exploited residential buildings do not meet the requirements of the current urban norms in terms of their technical condition, elements of improvement, sanitary and hygienic condition and the level of improvement in adjacent areas.
- In the design of multi-apartment houses by the designer, the lack of taking into account the specific conditions of the area and the negative effects of these factors during the operation leads to the early termination of the premises.
- Today, the service life of a large number of new materials (especially materials used in facade elements) is unknown due to the climatic indicators of our republic, which makes it difficult for designers and exploitation organizations to plan current and capital repairs;
- As a result of the observations, there is an accelerated depreciation of relatively new buildings, and over time, a decrease in the intensity, which in

this way provides an opportunity to create a graph of physical wear from the climatic conditions of the Republic and from the Capital Group of buildings;

- When using natural materials as a floor covering in buildings and structures, the need of the designer to know the intensity of the absorption of materials in terms of the full use of the reserves of these materials in order to plan the capital repair work in them is considered a prerequisite;
- The technical condition of residential buildings with 2-storey timber construction, although their resource over time was exhausted, the coefficient of physical wear rate relative to the normative wear was 1.3-1.56 (Table 2). Such a coefficient indicates that the Houses of this type of construction are more likely to be exploited in practice than the normative service life. Absorption intensity $\lambda_{av}=0.00517-0.00915$;
- In the technical situation of 2-storey residential buildings, this was observed. The coefficient of physical wear rate relative to normative wear by Regions was 0.85-1.02 (Table 2). This is evidenced by the fact that the premises of this type are out of work ahead of schedule. The intensity of absorption is $\lambda_{av}=0.00803-0.01158$, the maximum indicator belongs to KKR;
- The intensity of wear and tear of structures and materials indicates that according to BCR 1.04.03-98 [6], capital repairs in relation to the function of buildings and the operating environment are planned to be carried out every 8-20 years,

according to the 2-3 application of this document, some structures and materials do not fully fulfill their service life;

- With the help of the obtained results, there will be an opportunity to make corrections to BCR 1.04.03-98 [6] on the normative service life of materials, constructive parts and completely the building (lifetime), to forecast their residual service life;
- Once again, the factors known to us in the growth of the intensity of the general wear of the material, constructive parts and the building-the quality of the exploitation, in addition to the quality of the project, preparation and construction-have proved to be an autonomous factor.

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