The importance of modernization in the perspective of the city's housing stock development: Yerevan specifics

Karen Azatyan, Karen Rashidyants, Anush Ohanyan, Mariam Kocharyan

1 National University of Architecture and Construction of Armenia, Yerevan, Armenia

Abstract. The article discusses the issues of preservation of the housing stock. The aim of the work is to identify the importance of modernization in the perspective of the development of Yerevan's housing stock through a comparative analysis of modern international and local experience and to determine its main directions. In the work: the actual situation formed in Yerevan was presented; the social picture and the structure of the housing stock were revealed; the need for reconstruction was substantiated; the concept of modernization, the circumstances that determine its requirement, and their compliance with the processes currently taking place in Yerevan were considered; the problem of determining the expediency of reconstruction was presented; the question about the contradiction between the goals of long-term stability and rapid superprofits was raised; the principles of reconstruction were predetermined; the role of the state in housing management was clarified. The summarization of the results allowed to substantiate the need to preserve and modernize residential development, strengthen the role of the state in the field of housing policy, regulate the management system, as well as determine the main goals, principles, and directions of the processes. The results assisted to point out the unresolved issues and the directions that can contribute to the further examination of the problems. The results can be useful for the processes carried out for the modernization and reconstruction of residential development in Yerevan, as well as for future research covering a wider scope of prospects for the development of the housing stock as a whole.

1 Introduction

Housing systems, as Malpass and Victory note, are subject to change in both the short and long term, especially in countries with market-based economies [1]. Currently, when the amount of the existing housing stock and the number of physically and morally worn-out structures are rapidly increasing, the reconstruction of structures becomes an important function of solving the housing problem. It is aimed not only at providing accommodation, but also at guaranteeing the safety of life of the population. Thus, the consciousness has developed that in the constant process of providing the population with accessible and comfortable housing, along with the construction of new buildings, the preservation of the...
is also an element of all forms of social, natural and economic capital. Housing, residential areas, buildings and the problems of their preservation are significant parts of the world’s artificially created environment. From the environmental point of view, it is important both in terms of the use of accumulated resources and the constant improvement of environmental qualities during the exploitation of these resources.

In this sense, Hassler states that the usage of this capital for a maximum period of time, of which he considers buildings and infrastructure to be one of the most important elements.

Modernization is important, especially in the case of residential buildings, districts and urban areas, because more than 1/3 of the country’s population lives here, and the direct impact of existing conditions, solutions of the development, and the issues that arise in the existing housing stock cannot be underestimated. As in any developing city, the development prospects of Yerevan’s housing stock are in the process of constant changes. Among the already mentioned data, the seismic requirements, which apply to newly constructed buildings, were changed in Armenia. However, the approaches to the existing structures have not been changed.

When looking for solutions, the international experience in this field is significant. The existing housing stock was formed over 30 years ago (some structures will soon be 100 years old) and have practically not undergone systematic, serious modernization or reconstruction. In this paper, an attempt is made to determine the causes and expediency of modernization and reconstruction of separate buildings, which are important directions in the issues of determining the development, management and reconstruction of the housing stock.

The formation of Yerevan’s housing stock had its own peculiarities, which are important for the discussion of modernization and reconstruction. Taking into account the fact that as a result of the earthquakes in 1988 and 1989, the seismic requirements, which apply to newly constructed buildings, were changed in Armenia. However, the approaches to the existing structures have not been changed. When looking for solutions, the international experience in this field is significant. The existing housing stock was formed over 30 years ago (some structures will soon be 100 years old) and have practically not undergone systematic, serious modernization or reconstruction. In this paper, an attempt is made to determine the causes and expediency of modernization and reconstruction of separate buildings, which are important directions in the issues of determining the development, management and reconstruction of the housing stock.
and resident participation issues; environmental issues; statistical data of the structure of Yerevan's housing stock (publications of Statistical Committee of the Republic of Armenia, the Master Plan of the City of Yerevan 2005, "Study of buildings for the seismic risk management project in Yerevan" by Seysmanakhagits LLC). However, in the wide frame of observed directions, the works covering the issues of preservation and development of the existing housing stock of Yerevan are limited. They are presented in Hakobyan's research, where the discussions, however, are limited to large-panel residential buildings, and that too within the scope of improvements in architectural, layout, and artistic solutions. Certain studies on the reconstruction of residential quarters are available in the works of Azatyan, Ohanyan, Mirzoyan, and Igitkhanyan, where the changes in the residential quarters of the center and yard areas in general are discussed. There are certain references to the problems arising in the Yerevan city structure and residential development in the works of Harutyunyan, Rashidyan, Grigoryan, and Petrosyan.

In the context of the mentioned problems, this paper aims to identify the importance of modernization in the perspectives of the development of Yerevan's housing stock through a comparative analysis of international and local modern experience and to determine its main directions. Within the scope of the discussed issues, we believe that at this stage, more attention should be paid to the current situation of the housing stock, preservation, modernization goals, and problems of management systems.

2 Method

The work was done based on the research of published, archival, and statistical materials on the topic, as well as based on field observations, using the scientific methods of systematization, comparative analysis and generalization. The methodology unfolds in the sequence of content developed in discussions and analyses consisting of 4 parts. The first part presents the situation in Yerevan. The problems of the housing stock, the history of its formation and the actual situation in Yerevan are discussed, the social form and the actual data regarding the structure of the housing stock and the preservation requirement are highlighted. In the second part, the need for reconstruction is substantiated. The issues of the expected dynamics of the development of the housing stock, the concept of modernization, the directions for the preservation and modernization of the housing stock, the circumstances determining the demand for reconstruction, the question of the priority of the safety and their accordance to the processes currently taking place in Yerevan are discussed. The problem of determining the expediency of reconstruction is discussed, and the contradiction between the goals of long-term stability and quick superprofits is raised. The third part defines the principles of reconstruction. Issues of selection of modernization scales, main directions of processes, determination of priorities, clarification of pre-project works and programs corrections, the effectiveness of design methods, as well as achieving optimal solutions in all cases, economic approaches, the realism of programs, regulation and control of final results are discussed. Within the framework of the interdependence of various reconstruction goals, the significance of the environmental issue is highlighted, and issues regarding the center's residential quarters, population movement, the number and the composition of apartments are discussed. An attempt is also made to make predictions about the results of modernization and possible problems. The fourth part clarifies the role of the state in the housing policy. The consequences of the weakening of the role of the state in post-socialist countries and the absence of bodies managing housing policy in Armenia are presented. Based on international examples, the need to have appropriate management bodies and principles of housing policy to ensure the maintenance and development of the housing stock in the country are
3 The existing situation in Yerevan

The housing stock in many countries around the world increased substantially during the industrialization period of the 19th century and then during the economic boom following the Second World War. In Yerevan, as in many cities around the world, most of the existing housing stock was also formed in the last centennial and especially in the decades following the Second World War. That war led to a worldwide housing crisis, which from the 1950s led to a sharp development of standard, unified housing. Standard housing blocks of mass construction were used in more than 20 European countries. In this field, according to Wang and others, the leading countries are the USA, UK, Sweden, Japan and Singapore, where the field continues to develop to this day. Prefabricated house construction has also become widespread in China and the USSR. In the USSR, to fill the huge deficit of the housing stock that arose after the war, as in many European countries, the industrial construction of housing was rapidly developing and unified structural and planning solutions for residential structures were developed. Already in the second half of the 1950s, they led to the mass design and construction of standard buildings as quickly as possible and at the lowest possible cost. According to the data of 2021, more than 85% of the housing stock of Yerevan are residential buildings built in the 1950s-1980s (Here and below, the characteristics (also numerical) are based on the data of the Statistical Committee of the Republic of Armenia (https://armstat.am/am/?nid=82&id=2497), the Master Plan of the City of Yerevan 2005, the work "Study of buildings for the seismic risk management project in Yerevan" by Seysmanakhagits LLC in 2011 and the materials of "Housing and land management. Description of the country. Republic of Armenia" published with code ECE/HBP/186 in 2017).

However, standard and prefabricated residential construction in Armenia, as well as in several countries, began to decline in the 1980s and 1990s. The reasons for this were different. If in some European countries this was more due to a reduction in demand due to excessively early obsolescence of structures (low comfort conditions, faceless buildings, etc.), in Yerevan it was primarily due to the direct destruction of the industrial construction sector after the collapse of the USSR. And despite that decline, it has left a huge legacy that plays a significant role in the housing stock of Yerevan, and its future is a matter of great importance.

Let's try to understand what real information we have about the structure of Yerevan's housing stock? According to the data of 2021, Yerevan's housing stock is 27.4 million sq. m.
of which 16.1 million sq m in apartment houses. The ratio of individual houses to apartment houses is 41/59%, which in general does not significantly differ from the average index of several European countries (Austria, Finland, France, Germany, Netherlands, Sweden, Switzerland, UK) at the end of the 2000s-52/48% (taking into account that city and country data are compared) and matches East German data at 40/60% [7,18]. The total number of apartment houses in Yerevan is 4982, the total number of apartments is 238.68 thousand. Out of 4982 buildings, 2373 are stone, 2410 are prefabricated and 199 are monolithic reinforced concrete structures. The buildings are located in all administrative districts of the city. The residential development of the center is unique. It consists of a structure formed by individually designed stone buildings of great architectural value (between 1920-1957) with a perimetrical location, which has been supplemented over time with numerous prefabricated and monolithic structures of both standard and individual design. In the rest of the districts, stone, prefabricated and monolithic standard design buildings dominate. The buildings are quite extensive. The average number of apartments in one building is 47.9 units. For comparison, the number of apartments in the majority of apartment houses in Germany does not exceed 20 [7]. As of 2021, the living space per capita in Yerevan's housing stock is 25.1 sq m. This indicator roughly coincides with the average indicator of Russian cities in 2016-25 sq.m [16], significantly more than in Hanoi as of 2005-9.4 sq.m [10], and is inferior to the Germany index - more than 30 sq.m [7]. The age distribution of Yerevan's apartment houses is as follows: 7% of the 4982 mentioned buildings were built before 1950, 35% in 1951-1970, 51% in 1971-1990, and 7% in 1991-2021. For comparison, let's note that according to the average data of several European countries, buildings built before the war make up 29%, from the war to 1970-32%, from 1970-1990-25%, and from 1990 to the end of 2000s-14% [4,18]. That is, if in these countries the number of buildings older than 30 years is about 86%, then in Yerevan-93% (Figure 1).
a) The ratio of individual houses to apartment houses

b) The ratio of structural types of apartment houses

c) The average number of apartments in one building

d) The living space per capita in housing stock
What about the social structure of Yerevan’s housing stock? Housing in general, as noted by Malpass and Victory, reflects the social, economic and political trends developing in the country [1]. If in several European countries, as they consider the example of the UK, housing developed in the 19th century on the principle of private rent, and then in the 20th century on the principle of individual ownership [1], then in Armenia it happened according to a different scheme. A huge increase in social housing in UK was recorded after the Second World War, and already in the 1980s-2000s, as in many Western European countries, there was an increase in housing ownership, which was facilitated by the fact of the sale of the social housing to tenants [1]. In other words, here we see a naturally developing model parallel to the socio-economic situation in the country. And in Yerevan private rental since the 1920s has been forcibly replaced by housing provided free of charge by the state, which, as a social process, in a certain way was positive. As Petrović observes, in socialist countries,
However, in the early 1990s, somewhere also under duress, the housing provided by the state was almost completely privatized. It was done with the scheme of providing the apartments directly as property to the residents. As in several other countries of the socialist structure, it proceeded without restrictions, without any more or less deep political discussions and analysis, and without clear predictions for the future. The latter especially refers to management issues. The example of Vietnam is interesting, where the denationalization of the housing stock took place in a different model, based on the principle of sale, the income from which should have been invested in the construction of new residential buildings, as well as in the reconstruction of worn-out stock. As Dan and Shiozaki point out, however, this model of privatization has also not led to improvements in housing quality.

So, what social picture can we identify in the modern housing stock of Yerevan? Official data show that out of 4982 apartment houses, 35 are non-privatized dormitories. Out of the remaining 4947, 273 are under community management, and 4674 are under condominium and trust management. In other words, we can say that the social housing stock, if we also take into account the dormitories, is 6% (Figure 1). For comparison, let’s note that the social housing stock in Germany according to the data of 2003 was 15% of the total housing stock, according to the average data of Netherlands, France, UK, and Finland, it was 57% of the total rental stock, and in the Russian Federation, the municipal and state housing stock makes up 40% of the total housing stock. As for the relations of ownership and rent in the housing stock, reliable data on this in Yerevan is not yet possible to identify. According to official information, in the second quarter of 2022, 307 real estate rental transactions were made in apartment houses in Yerevan, which is 0.001% compared to the total number of apartments and absolutely does not correspond to reality.

Despite the various circumstances noted, especially the small amount of social housing and the dominance of property, housing provision, nevertheless, is a matter of national importance, and its condition should always be in the focus of state attention. The fall of the state factor in housing and its transfer to a full private field can be dangerous. In England, Malpas and Victory express their concerns about such a future, who very aptly qualify the privatization of housing as the migration of social housing to the private sector.

4 The need for reconstruction

In order to understand the future of the existing housing stock in Yerevan and the need for its reconstruction, it is first of all important to highlight certain questions. What dynamics of development of the housing stock is necessary for the country and, in particular, for the city? In which directions should it develop, what kind of interventions are possible, what does modernization mean in general? Reconstruct or build a new one? The super profit or the long-term stability – which is the priority here? Finally, are the discussed approaches somehow present in the current processes of managing Yerevan’s housing stock? In order to find the answer to this questions, it would be advisable to carry out the analysis within the framework of parallels with the international experience.

Thus, in the process of providing housing, it is important to clarify the dynamics of the development of the housing stock, which is necessary for the country and the city in particular. For example, the program to provide citizens with affordable housing in Russia envisages 80 million sq. m. of investment in residential houses and social infrastructure facilities per year. Clarifying such requirements is important to guide the appropriate processes. Along with adjusting the demand for housing stock, it is necessary to clarify in what directions it should develop. On the example of the Russian Federation, Petrov and others distinguish the following main directions of measures for the development of the housing E3S Web of Conferences 458, 07012 (2023) EMMFT-2023
ion, and they predict that this trend will particularly in the case of Yerevan, where the buildings older is extremely wide, but it should be noted that the expediency of building a new one is often clarifying further target use. However, first of all, it is necessary to understand whether to energy efficiency and the architectural image, integration into the formed environment and showing that it is, first of all, ensuring the safety of changing the worn reconstruct or build a new one, is the reconstruction appropr changing and updating characterizes the modernization of the building as a special case of reconstruction, aimed at creating a modernized urban model [improving the urban landscape, redistributing population, increasing land use efficiency, and modernizing the existing housing stock: maintenance and modernization of the operational stock]. In their discussion on modernization, Malpass and Victory state that, in the most general

This issue is often discussed in housing development research. The scope of the question of preserved structures must increase [Meijer and others’ research also shows that in most developed countries, the existing housing stock exceeds new construction]. Each of these directions and their specific weight in the overall process are due to the specific urban environment; maintenance and modernization of the operational stock requires constant intervention [Deilmann and others point out, the housing stock is subject to aging, and therefore ensuring its compliance with modern requirements. As Konen says that innovations in the field of urban policy lead to attempts to preserve these stock: maintenance and modernization of the operational stock].

In the case of Yerevan, our research shows that it is, first of all, ensuring the safety of changing and updating the architectural and planning solutions of the old building, as well as out engineering equipment [for example, for Yerevan in 2017, according to the average data, the annual amount of new construction is reduced, which means that the newly built houses exceed the existing living deficit] [Agreeing with Monkonen’s idea, we consider it important to solve social consequences of this phenomenon in the housing. Referring to the reflection of this phenomenon in the housing problems in Yerevan and Hanoi’s residential districts, consider modernization goals to be more concretizing the problem, for which 1280 million AMD was spent. The works mainly in.

In Yerevan, during 2021, repair works were carried out in 2915 apartment houses, for which 1280 million AMD was spent. The works mainly included repairs of roofs, water and sewage networks, internal heat supply networks, elevators, and entrances. Petrov and others, more concretizing the problem, state that innovations in the field of urban policy lead to attempts to preserve these stock: maintenance and modernization of the operational stock].

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Thus, the problem of preserving the housing stock is currently extremely relevant.
not convincing. Monkkonen points out that in suburban areas, land is certainly cheap and plot sizes allow for saving in production, but the housing in this case is located far from the workplace, utilities, and other urban amenities. And according to Alenicheva and Kozhukhina, the experience of reconstruction with the model of increasing the housing stock due to the use of new technologies (increasing the number of floors and annexes) confirms that getting additional housing, in this case, is more affordable than when constructing a new building. However, reconstruction, according to Hassler, is not attractive, since market mechanisms are not aimed at achieving long-term goals. The real estate industry is focused on short-term high incomes. Here the main activity and source of income are transactions, and there is little interest in buildings outside of these processes.

So, we need to find out for ourselves, do we value super profits or long-term stability? In this sense, Hassler observes that if the construction industry continues to rely only on the optimization of new technologies, then the preservation of existing buildings and infrastructure reserves will not succeed. He believes that there should be a shift towards more stable, durable, and rebuildable systems and that there should be a systemic abandonment of super-profits. Monkkonen also says in this sense that housing is a process, and for this process to be more efficient, future mass residential complexes should include a longer time horizon.

In the sense of comparing reconstruction and new construction, the observations made for the conditions of the Russian Federation are interesting. As a result of summarizing various researches, Abrahamyan and others state that the demolition of standard apartment houses and the construction of new ones in their place is not justified from the economic and environmental point of view in the cities of the Russian Federation. According to calculations, the cost of demolishing one building is about 40% of the cost of building the frame of a new one, and as a result of the work of many mechanisms, the emission of toxic substances into the atmosphere can exceed the permissible limits for health. Radionov also provides more detailed indicators of the value ratio of reconstruction and new construction – 50%, depending on the nature of the reconstruction (partial, complete, complex). Chereshnev and Chereshneva's observation is also interesting, that along with the increase in the number of floors of new building, the construction cost of 1 sq.m. also increases, which in seismic regions undergoes a sharp change in structures higher than 9 floors. Taking into account that currently we are building exclusively multi-storied houses in Yerevan, this circumstance also shows the potential economic efficiency of reconstruction.

So, how to determine the expediency of reconstruction? As noted by Chereshnev and Chereshneva, first of all, it is necessary to understand whether a residential building belonging to any typological group is able to meet modern requirements? It must be established according to clearly defined criteria so that various contradictions do not arise. A case in point is the observation of Deilmann and others regarding the phenomenon of prioritizing the demolition of prefabricated housing in East Germany, where they point to the paradox of demolishing structures with energy, material, and dimensional advantages. A real assessment of the feasibility of reconstruction is very important. For example, a detailed analysis of the condition of tenement houses of the beginning of the 20th century in Wrocław allowed to find out that the revitalization of these buildings that are 100 years old or older is more profitable than the demolition and construction of new buildings. The 2016 analysis of the reconstruction of the housing stock of large cities of Ukraine also shows that the reconstruction of districts with 2-5-story residential development can be a process that somewhat solves the problem of the ever-increasing demand for housing.
structures were built before 1988. In particular, they consider the main reasons for the unsatisfactory condition of large operational requirements. According to Radionov, are the result of the lack of long-term planning and neglect of term planning and neglect of wear of engineering infrastructure, facelessness, and distorted appearance, most of which, in the Russian Federation, are not implemented.

Back in the second half of the 1980s, due to the deterioration of concrete structures, Podshivalov and Aksenova note that due to the strength of concrete, in the period from 1995 to 2011, an average of 8.46 million sq.m. of concrete buildings were built in two main series, the USSR began to develop proposals for their reconstruction. The requirement for reconstruction and modernization is due to numerous circumstances. In this case, the main reasons for the reconstruction, in particular for the conditions of life activity in Uzbekistan, the physical deterioration of the collapsed state and the difficulties of the emerging new economic system. The same opinion was expressed by Hassler, noting that heritage preservation is primarily concerned with structures of exceptional significance, and it is aimed at the preservation of historical, cultural and not material values.

The individual stone buildings built in the mid-20th century have the quality structure characteristic of the old seismic generation structures. However, due to serious changes in the normative requirements for the structure of buildings. According to Seysmanakhagits, the operating life after the construction of a new building, the cost of modernization and the difference in annual repair costs of new and modernized buildings, the economic use of material resources is no less important here. In the current ecological situation on the Earth, this is also of primary importance.

In discussing the preservation of the built environment, as well as the economic use of material resources, Alenicheva and Kozhukhina generalize the indicated with two main aspects of the evidence of the mass culture (about 76%), is also important. Although the mass modernization is beyond doubt. More than 95% of the standard buildings, which constitute a significant part of the housing stock, are uninhabitable condition. After conducting relevant studies, similar, and maybe even more alarming data may appear in Yerevan. As for buildings for a period of 70 years, which are pre-1980s - revan before 1988. In this case, the main reasons for the reconstruction, in particular for the conditions of life activity in the first period in the Russian Federation, are the result of the lack of long-term planning and neglect of term planning and neglect of wear of engineering infrastructure, facelessness, and distorted appearance, most of which, in the Russian Federation, are non-implemented.

According to Seysmanakhagits, the operating life can be extended to 100 years, that is, until the 2060s. As for buildings for a period of 70 years, which are pre-1980s, their operating life can be extended to 100 years, that is, until the 2060s. For example, in Uzbekistan, the physical deterioration of operational requirements is a result of the lack of long-term planning and neglect of term planning and neglect of wear of engineering infrastructure, facelessness, and distorted appearance, most of which, in the Russian Federation, are not implemented. Khachatryan notes that studies show that these buildings have another 60-80 years, that is, until the 2060s. Absimetov and Solovev have another point of view. In Russia, the physical deterioration of structures and the economic efficiency of funds invested in a specific object are also important. In this case, the main reasons for the reconstruction are the result of the lack of long-term planning and neglect of term planning and neglect of wear of engineering infrastructure, facelessness, and distorted appearance, most of which, in the Russian Federation, are not implemented.

The collapse of the state and the difficulties of the emerging new economic system also contributed to the mass modernization of apartment buildings. In this regard, the data of 2015 in the Russian Federation, only worn structures and temporary, designed for 25 years, according to some data, studies in 2016 show that about 25% of the apartment housing stock built in the Soviet period in Yerevan needs modernization, and the need for their preservation is beyond doubt. But the issue of the preservation of standard buildings, which constitute a huge material amount in the mass culture, is also important. Although the mass standard stone buildings were built in Yerevan and temporary, designed for 25 years, according to some data, studies in 2016 show that about 25% of the apartment housing stock built in the Soviet period in Yerevan needs modernization, and the need for their preservation is beyond doubt. More than 95% of the standard buildings, which constitute a significant part of the housing stock, are uninhabitable condition.
buildings to be the near completion of the designed life (they note 25-30 years), the fact of non-fulfillment of planned major repairs, insufficient quality of materials and structures in the construction of the 1960s, poor quality of manufacturing and installation of the main load-bearing elements of the 1960-1990s [5], which adds to the reasons for reconstruction the need for structural interventions. Absimetov and Solovev also mention large heat losses, insufficient temperature, humidity and ventilation regimes, and too small room sizes [5].

Kornienko’s research also shows that more than 50% of the residential buildings built during the industrial housing construction period in the Russian Federation need to be modernized from the point of view of energy efficiency [16]. As for the structures of the temporary category, to which the standard stone buildings in Yerevan correspond in a certain sense, then the need for their modernization, in addition to structural problems, is also largely related to artistic features. Podshivalov and Aksenova talk about the facelessness of residential areas built with such buildings and the repetition of composition solutions reaching enormous scales [13]. They, as well as other researchers, address the negative impact of environmental degradation in mass construction areas on the emergence of psychological problems and social problem zones in society [6,8,13,14,26].

The necessity of reconstruction is also connected with many individual, non-professional and illegal interventions of residents, the various manifestations of which are also addressed by several researchers [6,10,23].

Despite the commonalities and differences of opinions, naturally, all the mentioned problems are important and they exist in Yerevan. The situation formed here, related to not meeting the normative requirements, is such that in any case, the problem of strengthening the structural system should be added to the mentioned directions, and the modification of the structure should go through all the stages of technical research, calculations and economic substantiations. And although Hakobyan emphasizes the issue of layout defects and the facelessness of external architecture in the case of large-panel buildings in Yerevan [25], we believe that the primary thing is to improve the structure of the buildings. Without ensuring safety, it is not appropriate to take care of other problems.

5 The principles and problems of reconstruction

After discussing the need for reconstruction, it is necessary to research and understand what principles to follow and how? The study of international experience once again leads to a range of questions, the answers to which also need to be found. Among them are: according to what principles and directions should modernization proceed, in particular, in the conditions of historical development? how to treat to the issue of the inhabitants staying in the same place after modernization? what works should be planned in the process of the buildings modernization? what environmental issues need to be considered? what structure should the resulting apartments have? what results can these processes give in the development of Yerevan’s housing stock? At the same time, it is also necessary not to ignore the possible problems that the reconstruction process may cause.

So, by what principles and directions should modernization proceed? First of all, let’s note that the reconstruction should be observed by large sections so that its results can be reflected on a wider scale. Complex reconstruction of large development zones will allow to solve a wider range of real social, economic, architectural, artistic and environmental issues in the process of modernization. Abrahamyan says that reconstruction should ensure the comfort of people’s living environment both locally and globally [3]. In this sense, Dan and Shiozaki point out that the total modernization of the planned districts in Hanoi is not only the modernization of the housing, but also of the technical infrastructure, social safety, and, in some places, even the reconstruction of the city, which will allow investment funds to be included from various sources because various stakeholders of liabilities and profits arise [10]. Therefore, in the modernization project, coordination with the master plan of the city...
should be important, the conditions imposed by which can have a significant impact on the solutions.

The experience of different cities and the works of various researchers shows that the main directions of the modernization process are repairs, reconstruction, and complete renovation [6, 10, 13]. In their comparison, Podshivalov and Aksenova note that in the case of a complete renovation, according to certain calculations, only the demolition of the buildings and the utilization of waste make 1/3 of the reconstruction cost. Taking into account also the growing shortage of urban land, they consider reconstruction as the most appropriate option [13]. Alenicheva and Kozhukhina, talking about the two main approaches in the reconstruction, “therapeutic” and “surgical”, express the opinion that the surgical approach is justified only when the existing buildings are in a very bad condition, or the land in a given area is very expensive [26]. Considering that the preconditions of all cases are present in Yerevan, it is necessary to carry out in-depth pre-project research, the results of which will allow classifying the existing structures into sub-groups for demolition, repair, and reconstruction.

To determine the physical deterioration of buildings, Marcinkowska and others suggest not only researching the actual situation but also analyzing the dynamics of deterioration growth in different time intervals, which will make it possible to develop more clear and targeted recommendations for the further operation of buildings [17]. And in the case of standard buildings, when solutions are repeated, it is possible to introduce a method for developing standard reconstruction projects, the effectiveness of which in comparison with the individual approach Volinskov speaks about [24]. At the same time, it is important to consider that these projects must have sub-versions and be flexible enough to adapt them to the specifics arising from each case. It should also be taken into account that the standardization of projects will in turn lead to the formation of several universal solutions and will somewhat reduce the costs of the process. As for the costs, they need to be optimized at the design stage.

For example, studies by Alenicheva and Kozhukhina under the conditions of the Russian Federation show that 20-25% of expenses go to the thermal insulation of facades [26]. In the conditions of Yerevan, it is difficult without an appropriate analysis to note which process will be of great value, but given that the problem of structural strengthening will play a more significant role here, the more it is necessary to keep in focus the goal of finding optimal solutions in all directions.

And by what principles should we approach the reconstruction of the residential quarters in the city center? Some areas are subject to modernization, where it is impossible to be guided only by economic expediency [4]. Modernization in the historical environment of the quarters of the center of Yerevan should first of all be based on the principle of protecting valuable heritage [12]. Today, the development is being supplemented with many tight, out-of-scale, enormous structures with eclectic architecture [19-31]. They, as Hassler says for such a case, take advantage of the proximity of the historical sector, but in the short term, since they do not carry any value, and the historical environment is gradually being destroyed [4]. We should not forget that these valuable buildings also need reconstruction. It is appropriate to remember here the consideration of Marcinkowska and others regarding the preservation of Wrocław's tenement houses. They say that the low level of maintenance of the technical condition of these houses, while still allowing them to be used, also determines the moment when the lack of capital repairs can lead to their demolition [17]. The same can be said about the residential buildings of the 1920s-1950s in the center of Yerevan. If we look at the issue from the point of view of the business logic of construction, then one who, according to Malpass and Victory, is motivated by running a profit [1], it is advantageous to leave the structures completely to get worn out and build new ones on the spot. For this very reason, in the case of the housing stock of the center, the problem of protection of historical value should be taken as the basis of the modernization project.
Increasing the efficiency of land use is certainly important to balance the costs of modernization, as Dan and Shiozaki discuss. Chereshnev and Chereshneva note that this is mainly due to the concentration of development and an increase in the number of floors. Agreeing with this statement, it should be noted, however, that this cannot be applied to all parts of the city to the same extent. The mentioned can apply to some districts of Yerevan (Ajapnyak, Nor-Nork, Shengavit, etc.), but in the case of the dimensional and scale characteristics of the center development, it is excluded. It also emphasizes the importance to approach the problem on a city-wide scale. In the center, the increase in the efficiency of land use may be due to the modernization of other areas of the city.

How to deal with the problem of the inhabitants staying in the same place after modernization? The process of demolition and new buildings construction has its peculiarities in this sense as well. If in the process of reconstruction of the housing mentioned by Monkkonen in Phnom Penh, the poverty of the local population is of significant importance, then in Yerevan it is very often not relevant. Other social phenomena act here, among which the attachment to the place, the desire to live in the same place, occupies a significant place. Of course, to smoothly move the population during reconstruction, the principle of providing a larger area in another district often works. However, some researchers rightly raise the question of whether modernization is beneficial to local residents and point out that modernization is successful when most of the population stays in the same place. In this context, Dan and Shiozaki note that more than 80% of the population of redevelopment districts in Hanoi expressed a desire to resettle in the same areas. At the same time, they note that in reality it often does not work like that, giving examples of the phenomenon of gentrification in the process of reconstruction of public housing in the USA, as a result of which the population is simply removed from those areas, giving way to the more well-off classes. Appropriate mechanisms are needed to settle the population on the spot. Monkkonen is even looking at the possibility of using residents' resources in the works to solve this problem. However, to find the answer to the question, we consider it expedient to include surveys on this topic among the inhabitants in the program of the modernization process, which will allow us to accept clear data as the basis of decisions rather than our assumptions about the wishes of the public.

One of the next important issues to be discussed is what works should be planned in the process of modernization of buildings? The analysis of various researches allows making the following generalization of the works.

- **Infrastructural**: Replacement of heating system equipment, reorganization of ventilation, installation of a fire protection system, elevators (or repair), heat control, cold and hot water supply devices, noise and vibration protection systems.

- **Volumetric**: Implementation of attics, insert annexes, sectional extensions, reorganization of terraces, loggias and balconies.

- **Floor-plan**: Redevelopment of apartments, expansion of common areas, arrangement of housing for the elderly and disabled on the first floors of buildings when it is impossible to install an elevator, design of green areas adjacent to the ground floor apartments, changes in the sizes and positions of door and window openings.

- **Structural**: Thermal insulation of external structures, adding new structural elements, improvement of facades and the overall architectural appearance.

In extensions and attics, it is possible to massively use prefabricated (metal, wooden) constructions of full factory production, which will allow reducing work on the building site and pollution of the environment, and will create an opportunity not to settle residents from their apartments during construction. Although Armenia does not have serious wood resources, the constructions currently being created in the world based on it, which Podshivalov and Aksenova talk about, due to their lightness, ecology, artistic effect and speed of implementation, can be suitable for local conditions even in the case of imports.
Modernization of ventilation systems is also important. In the conditions of Yerevan, ensuring the energy efficiency of buildings needs to be addressed at all stages of their life cycle: design, construction, and operation. Ensuring energy efficiency is also important for environmental purposes. In many countries, in recent decades, measures have been taken at the state level to promote energy efficiency in buildings. Some examples include the Netherlands, France, Germany, Finland, and the UK. These countries have implemented measures such as subsidies for energy-efficient buildings, regulations requiring energy performance standards, and public awareness campaigns. In some cases, these measures have been successful in reducing energy consumption and improving the environmental performance of buildings. The advantages of prefabricated construction are highlighted in this context, as it can be used to construct buildings that are more energy-efficient and environmentally friendly. Prefabricated buildings also allow for easier modification and maintenance, which can further contribute to their energy efficiency and environmental sustainability. However, prefabricated buildings may not be the best option for all projects, as they may not be suitable for certain climatic conditions or cultural contexts. Insufficient attention to environmental problems often leads to the fact that we do not study the harmful substances into the atmosphere, noise, vibration from the work of heavy equipment, and the accumulations of construction waste, all can exceed the permissible limits. Returning to the discussion of whether to demolish or reconstruct in Yerevan, an important place should be given to the protection of the environment in housing, and doing this economically and environmentally profitable both economically and environmentally is considered the most appropriate. The expected results of sustainable construction, which is discussed by Suni and Boon, referring to the example of Germany, note that a certain rigidity of economic factors can be achieved through efficient energy saving. And especially in such countries (Netherlands, France, Germany, Finland, etc.), the existing possibilities for improving the environment in housing, and doing this economically and environmentally profitable both economically and environmentally is considered the most appropriate.
opening sections, which will allow achieving the maximum results of ventilation of the
dwelling.

In the process of reconstruction, special attention should be paid to the use of construction
waste.

It is necessary to address not only the issues of the presence or formation of processing
enterprises but also the circumstances of their location. Transportation of construction
waste over long distances can not only be unprofitable but also pose additional environmental risk.

It is also important to note the specialization and importance of professional training.

For example, according to the data of 2000, knowledge was the most serious obstacle in the
process of sustainable housing management in Netherlands. Building codes and regulations,
as well as customer knowledge were rated much less important than the knowledge and
capabilities of architects and contractors.[19]

It is necessary to pay attention to ensuring the quality of work. Research shows that the actual deviation
of energy consumption from the design level as a result of deviations during construction is sometimes up to 90%
[33].

In the process of modernization, before the development of planning solutions for
buildings, it is also necessary to clearly understand what apartments, in what composition
and in what quantity should be obtained at the end of the process. For that, it is necessary to
have the most accurate socio-demographic picture of the planned population.

And what results can modernization give in the process of development of Yerevan
housing stock? First of all, this will make it possible to improve the safety of buildings and
will contribute to the efficient use of the city's land. In the case of more detailed planning,
the increasing living area will have a lower value per unit than when constructing new
buildings in new areas, and naturally, relatively little costs will be spent on upgrading
engineering infrastructure. All these in turn will lead to a reduction in utility service costs.

Modernization will allow to solve important social issues. For example, the calculations
made for the reconstruction of two types of standard buildings in Moscow showed that as a
result, the city will receive an increase in the total area of these buildings by 40-41%.[24]. If
such results can be obtained in Yerevan as well, then it will be possible to form a public
housing. It can be provided to certain segments of society: teachers, doctors, military
personnel, scientists and other citizens engaged in important activit...
6 The role of the state and housing policy

In Soviet period, when a significant part of the current housing stock of Yerevan was built, the management of housing policy was fully in the hands of the state. Regarding this model of housing policy in socialist countries, Petrović notes that it was unable to fully implement the provision and maintenance of public housing and ultimately the economic
inefficiency of the housing system led to its failure as a social policy [23]. In general, agreeing with him, for the sake of fairness, it should be highlighted, that the human factor and, in particular, corruption, played a significant role in the failure of that policy model. It is difficult to assess—the model was more imperfect, or people and society were not ready for it? In any case, we should not forget that it was thanks to this model that about 15 million sq.m. of apartment housing stock were built in Yerevan and one of the most important social problems—housing provision was solved. However, since the beginning of the 1990s, when the entire economic system changed and there was a transition from a planned economy to free market relations, the role of the state in the field of housing construction has weakened. If, for example, in Yugoslavia, the most serious consequences of the first decade of post-socialist regulation of housing were significant reductions in investment and construction, the aggravation of accessibility problems, and the growth of illegal construction [23], then in post-Soviet Armenia, looking from today, the permissiveness of current construction activities also can be added. The sharp decline in the role of the state gave priority to individual goals. And in the case of leaving the field of residential construction to the discretion of business interests and individuals in general, many problems naturally arise. For example, the study of the experience of Netherlands has shown that the lack of market demand is a real obstacle to sustainable construction. Few individuals want to make any additional investment in sustainable construction, and most of them simply have no interest in doing so [19], even though sustainable construction is an important issue for the state and society. In the case of Yerevan, the primary importance of individual interests has led to deeper problems of sustainable development—neglecting the direct physical safety of the housing stock. Therefore, based on the general interests of society, we believe that the housing policy should be implemented by the state. As Monkkonen says, without political, that is state support, even the most innovative housing policy solutions will never succeed, and where there is no role of the state in housing policy, the public suffers and individual businesses benefit [21].

This leads to another logical question. Shouldn't the state have appropriate management bodies to ensure the maintenance and development of the housing stock in the country? And if it shouldn't, then who should coordinate these problems, how should housing policy be managed? A study of the experience of more than 200 countries at different levels of economic development shows that the presence of such structures is extremely important [1-4, 10, 15, 17-21, 23, 24]. For example, in Uzbekistan, to improve the operation of the housing stock, several public administration bodies are operating: the Ministry of Housing and Communal Services, regional administrations and district departments of cities. Regional administrations also manage the maintenance of apartment housing stock, for which 127 state-owned enterprises with the repair function operate. Financing expenses for the maintenance of apartment housing stock are carried out both by owners and at the expense of bank loans, state and local budgets and other financial institutions [20]. And the results of Davletov’s research—recommendations for the formation of a system of professional management organizations, creation of cooperation mechanisms between state bodies and management organizations, development of new standards for the management, maintenance and operation of apartment houses, are aimed at the activities of these bodies [20]. In general, Ministry of Construction, Housing and Utilities in Russia, the Swedish National Board of Housing, the Government Housing Loan Corporation in Japan, the Building and Construction Authority of Singapore, the Ministry of Housing and Urban-Rural Development in China, the Homes and Communities Agency in the UK also serve the same purposes [1, 15]. But in Armenia, the institutional frameworks of housing management are currently not clearly defined. There is no high authority government agency responsible for housing construction (Figure 2). The field is coordinated by the Department of Housing Stock Management and Communal Infrastructures of the Urban Development Committee,
defined as development of plans for the improvement of the maintenance, safe operation and management system of apartment houses, participation in the passporting of buildings, development of draft laws and legal acts regarding issues subject to regulation, submission of proposals regarding normative-technical and program documents, analysis of issues raised by citizens. Despite the variety of functions, the department does not have functions for the development and periodic revision of housing policy, as well as the management of housing stock. And we have in fairness to say, that one department within the committee under the government cannot have such powers in practice. The following are among the departments that have some relation to housing issues.

In the Urban Development Committee:
Architecture and Urban Development Department, whose functions are limited to the development of programs for the sustainable development of settlements, land use and urban planning norms for construction, improvement of the ecological condition of cities, resettlement of the country and development of territorial organization projects;

In the Yerevan Municipality:
Real Estate Management Department, which develops projects for the management of the municipal property, is engaged in the registration of programs implemented for social purposes to improve housing conditions;
Development and Investment Programs Department, whose function assessing the socio-economic condition of the city, available resources and main directions of development, does not even include the term "housing;"
Architecture and Urban Development Department, which deals with the provision of land in accordance with the master plan and urban development program documents, the development of architectural and planning design tasks, the coordination of projects and the issues of legalization of self-constructed structures in apartment houses;
Division of the Programs of Special Regulation of Urban Development Activity, which almost completely repeats the functions of the Architecture and Urban Development Department;
Construction and Improvement Department, which organizes the restoration-strengthening works of apartment houses of the third degree of emergency;
Urban Development and Land Inspection Department, which carries out general control of urban development activities and in whose functions housing is not distinguished (Information about the departments according to the official websites of the Urban Development Committee of Armenia (link: http://www.minurban.am/am/) and Yerevan Municipality (link: https://www.yerevan.am/am/)).

Without referring to the fact that these bodies are too extended, in any case, it should be noted that in the goals and objectives of none of the mentioned structures, we do not find comprehensive powers on housing policy and management. They deal with local, limited issues. Moreover, the boundaries of activities and powers, the implementation mechanisms and the cooperations are not clear. In fact, we can say that there is no institution coordinating housing policy. And the speedy settlement of this problem at the highest, national level, should be an important step in the country, and in particular, in the regulation of housing policy in the city of Yerevan and its further sustainable development.
The most important task of housing policy is to meet the demand of the population for housing and the needs of all its strata. The solution to the above-mentioned problems depends on its effectiveness. In his analysis of housing policy, Monkkonen addresses the problems that an ineffective housing policy can create. He finds that sometimes it deepens the problems, and sometimes it even causes new ones. In particular, he cites as an example the mass housing construction projects developed to solve the housing shortage problem in the cities of the Global South, which led to the creation of new neighborhoods cut off from services and the city center, thereby contributing to the formation of the uninhabited housing.

He also points out another problem. The policy of reconstruction sometimes leads to the fact that the inequality of political power in different cities causes an uneven distribution of reconstruction. He addresses the problems of the urban renewal program in Thailand, where due to the principle of crediting at the community level, it turns out that the poorest communities with a greater need for reconstruction have fewer opportunities to participate. The mentioned analyzes show that the regulation of housing policy should include the development of clear, well-planned programs and the determination of their implementer. The governing body should look at the issue in the most general, wide scope and take clear responsibility for its implementation.

Among the important issues facing housing scholars, Monkkonen addresses social equality. He says that housing policy is a political problem, and that policy often fails to take into account the diversity of population groups, and as a result, it is possible for the powerful to gain an advantage over the less affluent. At the same time, contradicting many accepted opinions, he demonstrates the opposite side of the problem. Within the framework of projects under public administration, he gives the example of Cambodia, where there is a fact of exclusion from the process of certain strata, in particular the most affluent.

Fig. 2. Housing policy in the administration system of Armenia
Monkkonen also looks at the importance of public participation in the housing modernization process in Das and Mukherji’s research, where the authors argue that such an approach produces fairer and more efficient outcomes than top-down policies. Das argues that policies are more successful when several local institutions, such as civil society groups, universities, as well as state institutions, can play a significant role in the modernization process.\[21\]

Accepting a certain fairness of such an approach, at the same time, one should try to understand whether that society has sufficient knowledge to make such decisions and whether it is capable of looking at issues within the framework of the general interests of the state, city, and society? And after all, why does society form state and local government bodies, if they are not to be trusted with the processes of management? In the same context, Petrović states that “housing policy, as a complex activity that deals with both social and economic policy issues, is a good indicator of society’s organizing patterns, structures and strategies”\[23, p. 212\]. Here it is necessary to add that this indicator also refers to the state in a no less way. Society by itself cannot implement it, and the role of the state is to conduct a policy that meets the requirements of society. Decision-making should be a function of the state and be based on professional analysis, where, of course, the opinions of the public will also be taken into account. In this context, universities can contribute to the development of scientifically based proposals. However, we should not forget that all these processes are aimed at improving the quality of life of the people. So, what should be the participation of the population? We believe that the awareness of residents about the expected changes in housing and the environment, in general, is extremely important. Dan and Shiozaki, referring to surveys conducted in Hanoi, note that the majority of residents are positive about modernization projects because they see opportunities to improve their living conditions. However, some residents wanted to be sure that the city would solve the various problems that arise after the modernization, and in this sense, they value that the city provides clear information about the modernization plans.\[10\]

The bodies implementing the programs must provide clear information about the goals of the processes, the work itself, the final results and deadlines. To ensure an appropriate level of provision of this information, it is necessary that all issues related to it are considered and clarified precisely at the programming stage. Ensuring such an approach will guarantee the formation of sufficient public confidence in the projects being implemented. The question of financing the process is also important. It does not have to be exclusively by state bodies and can be organized with the involvement of various sources. As Alenicheva and Kozhukhina note, international experience shows that the sources of reconstruction can be both the state budget and individual investors, as well as the funds of residents.\[26\] Nevertheless, the state should also play a regulatory role here. For example, in Hanoi, in the process of a complete modernization of districts, the state budget finances only social and technical infrastructure facilities, but the preparation and coordination of all investments are carried out by state bodies.\[10\] Such an approach will allow keeping the interests of the state and the public, not a business, at the core of the processes.

7 Conclusions

In this study, an attempt was made to reveal the importance of modernization in the prospects of the development of Yerevan’s housing stock and to determine its main directions. The research on the current situation of Yerevan’s apartment housing stock and the analysis of parallels with international experience allow us to conclude that a large reserve of housing has been formed in the city and existing structures are of significant importance in the prospects for the development of the housing stock since the area of newly built residential buildings does not even reach 1% of the total stock. This substantiates the need to preserve the existing development. At the same time, based on the structural, energy-efficient
and artistic problems that have arisen in the current situation, as well as taking into account the goals of social safety, protection of cultural heritage, and environmental goals, the preservation of buildings is possible only through their modernization.

It should be noted that, although the results of various studies show that in most cases reconstruction is an appropriate option, nevertheless, modernization should have a program based on a clear methodology, analysis, and calculations, which should give a final answer to the question in which case to demolish, preserve or reconstruct.

Unlike many other cities, in Yerevan, due to the age of the majority of buildings and non-compliance with normative requirements, the primary goal of reconstruction should be the structural support of buildings. The focus should also be on the problems of energy efficiency, life comfort and artistic image. The process of modernization and reconstruction should cover a wide range, using the principle: from the general to the private-city, region, district and buildings, to obtain the most effective results.

In the processes of modernization of the housing stock, the responsibility for strategies and management should be assumed by the state. Because of the absence, first of all, a housing stock management system should be formed with its respective departments, within the framework of which the entire process of preserving the existing housing stock will be carried out. Various private organizations can be the implementers and investors of the processes, the resources of the population and the potential of the scientific field can be involved in the programs. But for all interests to be dominated by the demands of the public, and not of individuals, management policy and coordination should be carried out by the state.

At the same time, the results of the performed work raise several new questions. It is necessary to pay attention to the employment level of the housing stock and the issues arising from it. It is a fact that there are many empty apartments, but what is their number? What impact can its clarification have on the further development of the housing stock and, in particular, on the reconstruction process? If the number is small, the problem will not be significant, but what if it is big? How will it affect the demand, and what mechanisms can be formed to increase the efficiency of using this resource?

It is necessary to analyze in more detail the problems of the housing stock according to different districts of the city. A certain separation of the center quarters in the work does not mean that the same situation prevails in the rest of the districts. Each district may have its peculiarities, and they should be taken into account. Factors such as economic structure and population size, which change regularly, can contribute to the differences between districts. In districts with increasing indicators, there may be a demand for new construction, and in decreasing ones—an empty housing stock. And, most likely, this will arise in old buildings. What solutions can be in cases like that? Is it possible for this resource to be concentrated, modernized and transformed into a state social housing stock, which is needed in the city? The answer to these questions involves separate studies and the generalization of all administrative districts of the city.

Research should be conducted not only at the level of problems of quarters and districts but also at the level of individual buildings according to their types. Although the variety of types is not great, due to fundamental differences, significantly different approaches may arise. We should also add that in this direction there are several engineering-construction studies and proposals made by various specialists, the results of which can also be useful. They may make additional and possibly significant adjustments to modernization and reconstruction programs.

By a separate research, it will be necessary to address the problems of the formation of the housing stock management system at the state level. In this sense, the research work already done implies a more detailed study of the systems operating in different countries and the formulation of clear proposals through their analysis for local conditions.
We believe that the results of the work can be useful for the processes carried out for the modernization and reconstruction of residential development in Yerevan, as well as for future research covering a wider scope of prospects for the development of the housing stock as a whole.

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