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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

INFLUENCE OF CLIMATIC FACTORS ON THE ARCHITECTURAL AND PLANNING DEVELOPMENT OF LOW-RISE RESIDENTIAL BUILDINGS IN BAKU

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INTRODUCTION

Relevance of the research.

The architectural evolution of residential houses in Azerbaijan is intrinsically linked to the development of the country's material culture. These structures have undergone a centuries-long transformation, ranging from caves and earthen-roofed dwellings to modern houses equipped with contemporary amenities. Reflecting the construction achievements of their respective eras, they have advanced in architectural and planning aspects in alignment with the demands of their time. In the architecture of Absheron and Baku, low-rise residential houses are directly linked to the region's natural-geographical, socio-economic, and material-technical requirements, as well as the lifestyle, financial status, and aesthetic preferences of the population. One of the ways to preserve and enhance Baku's artistic and architectural appearance is through a comprehensive study of this residential architecture. In this regard, studying the design practices of low-rise houses under the influence of natural and climatic factors holds both theoretical and practical significance. The relevance of the dissertation topic is determined by the necessity of examining the continuity mechanisms of low-rise houses and the sustainable architectural-planning methods used in them.

Presentation of the issue. Numerous issues related to residential buildings constructed across different periods, and the residential structures they form part of, have been analyzed in the scientific works of several authors, including M.A. Huseynov, L.S. Bretanitsky, A.V. Salamzade, D.A. Akhundov, G.A. Alizade, S.A. Dadashev, Sh.Sh. Fatullaev-Figarov, A.P. Ivanitsky, L.A. Ilyin, Sh.N.A. Sadygzade, J.A. Giyasi, V.N. Kerimov, A.A. Gasimzade, G.H. Mammadova, E.V. Avalov, R.M. Efendizade, A.M. Mekhtiev, K.M. Mamedzade, R.B. Amanzade, Sh. Alieva, V.N. Muradov, R.M. Bayramov, Kh.N. Nasirli, N.K. Rzaev, and others.

The development of modern Azerbaijani urban planning and the formation of the residential environment within the urban planning structure, as well as the study of the impact of climatology on architecture and urban planning, have been advanced by the scientific

works of researchers such as F.M. Huseynov, N.H. Naghiyev, R.H. Abdulrahimov, Sh.Sh. Kakhramanova, A.A. Hasanova, A.T. Gasimov, N.A. Aliyev, Y.A. Haciyeva, S.H. Orujov, and others.

The purpose and objective of the research is to determine the status and development principles of the architectural-planning solutions of low-rise residential buildings in Baku under the influence of Absheron's natural-climatic factors, to study the changes that have occurred in the process of architectural development, and to propose ways of improvement that align with modern requirements by highlighting the progressive aspects of architecture.

The research addresses the following key issues:

- Analysis of the impact of historical urban planning processes in Baku on the formation of low-rise residential buildings and the study of development principles in the city's residential complexes;

- Investigation of the influence of Absheron's natural climate on the formation of architectural-planning solutions for low-rise residential buildings;

• Analysis of artistic-architectural solutions according to the types of low-rise houses in Baku and their respective geographical locations;

• Examination of the impact of climatic factors on the structural schemes and elements of low-rise residential buildings;

• Study of the application and design methods of modern materials and constructions used in low-rise houses, villas, and cottages in Absheron, according to the climate;

• Identification of the progressive aspects and improvement principles of the types of historical low-rise houses in Baku.

The subject of the research is the study of architectural and planning solutions of low-rise residential buildings of various periods in Absheron, including Baku, under the influence of climatic factors.

The object of the research is public and monumental low-rise residential houses formed under the influence of natural climatic factors in Baku.

Chronological and geographical boundaries of the study. The chronological scope of the study spans from several millennia BCE to the beginning of the 21st century. The geographical boundaries encompass the city of Baku and parts of the Absheron Peninsula.

The theoretical and methodological foundations of the research are based on scientific studies and archival documents regarding the architectural-planning solutions of low-rise houses built in various periods in Baku and the Absheron region, as well as materials from design institutes. These include the historical-cultural potential of residential architecture, the architectural environment shaped under the influence of natural-climatic factors, and the systematic analysis and photographic fixation of more characteristic residential house planning and composition schemes, as well as their artistic-aesthetic qualities. The scientific work references written academic sources from several scholars who have studied the country's residential houses over different periods.

The scientific novelty of the research lies in the first comprehensive study of the structural, planning, and artistic-aesthetic solutions of residential buildings from various periods in Absheron's natural-climatic conditions, as well as the historical evolution of their development. As a result of the research, new information was obtained about the evolution of architectural solutions for residential houses in Baku and its surroundings from ancient times to the present, and effective suggestions were made for their improvement. For the first time, the similarities and differences in residential architecture under the influence of the region's socio-economic and natural-climatic factors were revealed, and historically-ethnographically more sustainable traditional construction methods were identified.

The practical significance of this research is reflected in its contributions to contemporary residential construction design, particularly in how local natural climate and building materials influence low-rise residential houses in Baku. With the increase in the construction of multi-story buildings in the outer regions of Baku, the study confirms the practicality of their maintenance.

Approbation of the research. The author has presented the key findings of this research at various scientific and practical conferences, and the primary results have been published in scientific journals. The research and recommendations developed, which pertain to architectural and planning solutions for low-rise residential buildings in Baku and other areas of Absheron, are included in the dissertation and are intended

for application in design work by organizations such as the Baku Design Institute, the Azerbaijan Architectural and Construction Research Institute, and the Azerbaijan Research Project Institute.

Structure and scope of the research. The dissertation is structured into an introduction, three chapters, a general conclusion, a list of references, and 56 illustrative tables. The total length of the dissertation, including annotations, is 135 pages (244027 characters), with a separate volume dedicated to the structural section of the dissertation.

THE MAIN CONTENT OF THE DISSERTATION

Chapter I. Formation of architecture of low-rise residential buildings in the city of Baku

1.1. The impact of historical urban development process on the formation of low-rise residential development in Baku

The development of housing construction in Baku can be categorized into five distinct stages: primitive dwellings of ancient communities; residential structures of early ancient civilizations; medieval residential neighborhoods; low-rise residential buildings in neighborhoods from the 19th to the early 20th century; low-rise houses and villas during the period of urban expansion.

The presence of a natural bay in the southern part of Absheron, combined with the strategic use of local materials such as natural limestone, rubble stone, and clay, facilitated the establishment of a permanent settlement. The region's topography, climate, natural water resources, and caravan routes played a significant role in shaping both its settlement patterns and architectural character. Additionally, Absheron's robust economic production capacity contributed to an increase in employment opportunities, fostering the growth and development of residential construction in Baku.

During the Middle Ages, Baku's expanding trade relations with other countries led to the widespread construction of civilian buildings, notably caravanserais, integrated into the city’s structure. Following the 17th century, the pace of construction in the Baku Fortress accelerated,

with new houses built along main streets. These buildings also served multiple functions. Due to a sharp population increase at the end of the 19th and early 20th centuries, residential construction extended beyond the fortress. The architectural and planning approach for these buildings was organized in the form of small neighborhoods, designed with consideration for local climatic conditions. Depending on their position within the urban fabric, apartments were oriented in one, two, or occasionally four directions.

In the citadel and coastal areas of the city, 1-2-story mansion-style houses were constructed, influenced by urban planning and architectural concepts from European countries, yet adapted to local climatic conditions. Notable examples include the mansion-style residences of H.Z. Tagiyev, De-Bur, A. Guliyev, and others. This period was marked by the development of dense residential quarters featuring medium- and low-rise houses. Climatic factors played a crucial role in shaping the planning layout. Glass galleries were added to the courtyards of apartments, offering protection from the sun and wind, and thus becoming a traditional feature in Baku's residential architecture.

The master plan developed by A.P. Ivanitsky in 1927 featured a wide, elongated green boulevard along the northern side of the residential area. It also proposed workers' settlements composed of single- and double-storey houses of uniform design, which contributed to the development of low-rise residential architecture in the Baku vicinity and near the oil fields.

In 1932, the master plan, implemented under the supervision of Professor V.H. Semenov, adopted a comprehensive approach to territorial settlement and greening in Absheron. This plan included the establishment of a network of cultural and household services for cities and settlements in the region.

The master plan for Baku developed by Professor L.A. Ilyin in 1937 presented a zoning scheme that accounted for the city's amphitheater-shaped layout. In this zoning scheme, which highlighted the natural amphitheater, the first stage of construction, consisting of 3-4-story buildings, was located on the seafront. This gradually transitioned into a second stage of 6-8-story buildings in the middle part of the amphitheater, and finally to a third stage of 7-10-story buildings

on the highest terrace[1].

The 1974 master plan for Baku divided the city into ten planning districts. Key considerations in this plan included transportation connectivity, functional zoning, the relocation of residential areas away from industrial zones, maximizing the city's accessibility to the sea, adherence to sanitary and hygienic standards, effective greening, and other ecological principles.

The 1985 master plan for the Baku-Absheron region prioritized the creation of comfortable living conditions for residents. The current master plan addresses the optimal regulation of transportation flows, one of the city's most critical challenges.

1.2. Principles of development of architectural and planning solutions for low-rise residential houses in Baku. In the Middle Ages, the "shahristan" or fortress area of Baku was primarily inhabited by nobles, clergy, and merchants, while artisans, workers, and other lower-class individuals settled in the outer "rabad" part of the city. Due to the diverse social structure, the condition and composition of residential areas evolved over time. The fortress walls and towers, constructed between the 12th and 15th centuries, facilitated the development of densely populated neighborhoods within the fortress. In the 16th century, the growth of various crafts led to the establishment of distinct neighborhoods for artisans. By the 18th century, the expansion of craftsmanship prompted the construction of new residential areas, along with mosques, caravanserais, and shops.

In addition to the residential areas within the Baku fortress, new neighborhoods began to emerge and develop outside the fortress, particularly to the east and northwest. The early neighborhoods of Baku were characterized by 1-2-story houses with small inner courtyards. The alleys in which these houses were situated provided access to the exterior, while the windows facing the alleys allowed for natural light and proper ventilation of the rooms.

Since 1806, following Baku's designation as the "provincial capital" of the Russian Empire, the city expanded in all directions, with construction increasingly focused on the outskirts.

[1] Aliyev, I.O. Development of urban planning science in Azerbaijan in the Soviet period. Journal of Architecture and Construction of Russia. No. 4. Moscow-2021, p. 16.

Within the confined area of Icherisheher, some residential buildings reached up to three stories in height. The influx of a large workforce to Baku in the second half of the 19th century spurred the construction of medium-rise residential buildings, which introduced new planning trends to the city. The steep topography of the upper part of Baku's former Sovet Street resulted in the arrangement of residential clusters in a descending, stepped pattern. By the end of the 19th century, streets composed of 2-3-story houses were established in residential neighborhoods located in the mountainous western, eastern, and northwestern zones.

In the city's commercial center, along Istiglaliyyat Street, 2-3-story estate-type houses were built, alongside "income houses." These buildings were distinguished by the optimal integration of form and function, rich artistic decoration, and a blend of architectural styles. In the central area of the city, detached country-house-style residences were arranged in small courtyard neighborhoods. In neighborhoods with a perimeter plan, apartments and shops occupied the ground floor, while the upper floors contained 4 to 5 apartments each. Some of the residential buildings from this period were luxurious, while others were modest homes for low-income families.

Following the establishment of Soviet power in Azerbaijan in 1920, addressing the housing needs of city residents became a critical issue, particularly in the context of industrial development. The housing shortage in Baku's industrial districts prompted the construction of new workers' settlements, which consisted of single-story houses with simple, functional design solutions[2].

In the 1930s, a new residential district consisting of 2-3-story houses was developed in the Bakikhanov settlement, located in the northwest of Baku. However, the number of these buildings was insufficient to meet the growing population's housing needs. As a result, there was a pressing demand to establish "new workers' settlements" closer to industrial workplaces.

In the newly constructed districts of the Soviet era, residential

[2] Aliyev, I.O. Influence of natural and climatic factors of the Absheron Peninsula on the architectural and planning features of low-rise buildings in Baku. AMIT MARCHI Journal. No. 2 (51). Moscow-2020, p. 298.

buildings were designed with favorable ventilation and orientation, and their facades were enhanced with features such as verandas, balconies, and loggias. The planning scheme, reminiscent of a semi-enclosed quarter, was aligned with the climatic conditions of Baku and the social needs of its inhabitants. In subsequent years, urban-type houses began to be built in the mountainous northwestern part of Baku, while low-rise, village-style houses with small yards were constructed around Ganly Lake.

After the 1930s, over 35,000 low-rise residential buildings were erected in Baku's suburban residential areas. In the 19th century, the construction of low-rise housing primarily expanded within the castle and surrounding suburban areas, and later, beyond the castle walls to the west and northwest.

1.3. Natural-climatic indicators of Absheron and their characteristics. The architectural character of Baku is shaped by its amphitheater-like geography, the surrounding Caspian Sea landscape, and the local climate. The climate is influenced by the region's hot, dry conditions. The city is arranged in the form of an amphitheater, with three terraces surrounding the bay and facing the sea. The transition between the first and second terraces has facilitated the development of a specific volume-spatial design that responds to the region's climatic conditions. Approximately two-thirds of Baku's residential areas are located on the second terrace. The climatic conditions of the selected construction sites play a significant role in determining the architectural and planning solutions for residential buildings.

In Baku, where strong Khazri winds prevail year-round, two-way ventilation of houses is optimal. However, low-rise houses are unable to alter the direction of the wind. Greening efforts in settlements such as Rasulzade, Bilajari, and Badamdar have influenced the perimeter and grid-like structure of the residential areas. Greenery in microdistricts 7 and 8, as well as in the Black City, contributes to a more moderate microclimate. The natural and climatic conditions play a key role in shaping the grid-based neighborhood layout of the Baku Fortress, addressing critical issues related to insulation and aeration.

In Absheron, high stone fences were constructed to protect against dust carried by strong winds. The intense summer heat prompted

residents to retreat to their courtyards, and houses were oriented to maximize comfort, with the most favorable orientations being south, east, and southeast to align with the wind and sun. Typically, Absheron houses consisted of two main rooms, one of which served as a ceremonial living room. The kitchen, hallway, and utility rooms were typically located in separate buildings attached to the main dwelling.

Absheron houses lacked the covered balconies typical of other regions of Azerbaijan. Instead, simple, flat platforms, raised 30-50 cm above the ground, replaced balconies. Most houses were single-story, though in some cases, a second floor housed the living room. The rear facade, which was windowless, faced the street, while the main facade, oriented towards the courtyard, featured only an entrance and a window. The rectangular courtyard often faced the street along its narrow side. A water well was typically located within the courtyard. The region's abundance of limestone influenced the widespread use of arched roofs and domed structures. Both external and internal walls were constructed with crushed stone, 70-80 cm thick, and plastered with lime. The flat roofs, with slight slopes, were covered with clay or oily clay.

Natural and climatic factors, such as the region's hot and dry climate, strong northern and southern winds, scarcity of forests, and the abundance of building stone and bitumen, have significantly influenced the development of traditional dwellings in Absheron villages. A distinctive feature of the local vernacular architecture is the use of flat roofs on densely packed, stepped houses, which serve as summer resting areas.

Even today, despite the widespread construction of low-rise estate-type houses on the outskirts of Baku, their architectural and planning solutions continue to follow traditional practices. The houses constructed in settlements such as Yeni Yasamal, Bakikhanov, Ahmadli, and Garachukhur serve as prime examples of this ongoing architectural continuity.

Chapter II. Analysis of the current situation with low-rise residential houses in Baku.

2.1. Typological bases of low-rise residential houses.

The architecture of residential buildings in Baku and its

surrounding villages was influenced not only by the region's natural conditions but also by the occupations of its inhabitants. The organization and placement of residential buildings within the dense neighborhood system were based on the closure of courtyards, close-knit community interactions, and an efficient layout of alleys and passages. This design approach facilitated optimal conditions for natural insulation and ventilation.

Due to the severity of the northern winds, the entrance doors of houses in this region were primarily positioned to face the southeast or south. Unlike other regional houses, where balconies with summer spaces were typically located on one or two sides, here they were incorporated on all four sides. The neighborhood-dalan system, essential for the hot climate, provided shade and minimized the impact of direct sunlight. Additionally, sheds in small courtyards and surrounding walkways were considered essential features.

The scarcity of forests, limited water resources, and the high density of construction sites in Absheron significantly influenced the architecture of residential buildings, leading to the development of diverse planning structures. In Absheron, the construction of "double-roofed" and "dome" houses, in subtropical regions the "lam" type, and in high mountainous areas the "yarigaradam" and "tower-shaped" houses, were optimal architectural responses to the region's environmental and climatic conditions.

The low-rise residential buildings in Baku initially featured a simple layout. Over time, these areas evolved into more complex volumetric and spatial structures, transitioning into a courtyard grouping system. This development led to the formation of linear plans along the street. The typical layout of Absheron houses was generally L-shaped, consisting of a single row of rooms along the courtyard or forming an "L" configuration, with instances of two rows of rooms being relatively rare. One-, three-, or four-room houses with household spaces were commonly found. Initially, residential houses were single-room structures; however, from the second half of the nineteenth century onward, two- or three-room houses, often grouped around a central

courtyard, became more prevalent[3].

Domed houses in Absheron were primarily constructed using local idol stone. The design often incorporated deep niches in the walls, creating an interior ceiling that resembled a half-dome. Both the architectural details and masonry in Baku and Absheron houses were typically made of limestone, with wall thickness occasionally reaching 0.5 to 1 meter. In the villages of Mashtaga, Bilgah, Buzovna, and Shuvalan, houses were predominantly oriented to the east. Approximately half of these houses featured flat roofs, while the other half had domed roofs. Arched galleries were sometimes added to the courtyard side of the house, which opened to the street through blind walls.

In Icherisheher, groups of houses for multiple families are arranged along the perimeter around a central courtyard, resembling a closed quarter. In other instances, the houses form narrow streets that follow the stepped relief of the terrain. In some cases, particularly in houses located between two streets, larger quarters were created, as the apartments were arranged unilaterally, with the rear walls merging into one another.

2.2. Influence of climate on the formation of volume-spatial and planning structure of low-rise residential buildings.

The era of capitalism was characterized by the construction of residential buildings with simple architectural designs, particularly in areas near oil fields in Baku and Absheron. These houses were primarily associated with the oil industry. In contrast, mansion-type houses were constructed in the city center, reflecting the economic prosperity of the time.

For example, part of the housing in the settlement was established for the employees of the "Villa Petrolia" company consisted of family homes for workers, while the other part consisted of barracks for single workers. In the mining areas near Sabunchu, Balakhani, Surakhani, and Bayil, small settlements were built that reflected local traditions, featuring low-cost dwellings. The volume and spatial planning solutions of residential buildings located near the

[3] Aliyev, I.O. Architecture of Absheron vernacular dwellings. Architecture and Modern Information Technologies Magazine. No. 1(66). Moscow-2024, p.104.

industrial zone in the "Black City" were suboptimal. Some elements of "garadam" structures were incorporated into these two- and three-story houses, which were organized in small clusters.

At the end of the 19th century, Baku mansions, constructed in various European architectural styles, primarily consisted of two- and three-story volume-spatial structures. The layout of these mansions typically featured quadrangular rooms on one side, while the “U”-shaped mansion type had a quadrangular floor plan with multiple facades and closed balconies at the front. The first floor mirrored the layout of the second floor. The living rooms and bedrooms in these homes were often surrounded by balconies on two, and sometimes three, sides.

In Absheron, the entrances were open, and houses with balconies, accessed by stairs from the street, lacked shading. On the first floor, rooms were arranged in a “T” shape, with other rooms grouped around a central living room. The second floor was typically surrounded by a loggia. A distinctive feature of these houses was the use of wooden window frames.

The mansions, varying in their location within different streets and neighborhoods, followed different layout schemes, such as houses facing all four sides of a block, those facing three facades of a block, houses placed at the beginning of a street for emphasis, houses occupying central positions within a block with two facades facing the street, and houses facing only one street. Notable examples include the mansions of H.Z. Tagiyev, M. Mukhtarov, A. Guliyev, and A. Nagiyev.

In addition to these grand mansions, semi-urban, semi-rural residential houses were built along the streets in the upper western part of Baku’s residential district. While simpler in their artistic design and planning structure, these houses contributed to the architectural character of the streets by creating a distinct impression.

The placement of summer areas, a key architectural feature in residential buildings, was influenced by the building's shape and the materials used in its construction. In Absheron, lattice windows were sometimes employed in place of balconies to shield the interior spaces from the intense heat of the sun. To optimize the beneficial effects of

the climate, it was essential for the houses to incorporate internal courtyards.

The placement of summer areas, a crucial architectural feature in residential buildings, was influenced by the building's form and material choices. In Absheron, lattice windows were occasionally used in place of balconies to shield interior spaces from the intense sun. To ensure the climate's positive impact, it was essential for the houses to include internal courtyards. In the linear arrangement of rooms, balconies facilitated proper insulation by creating a direct connection with the courtyard. In some cases, instead of a balcony, an additional square extension was incorporated in front of the rooms. These extensions often featured arched galleries made of stone, a material abundant in the region. The site's topography played a significant role in determining the house locations, with a single-row arrangement being prevalent in the orientation of rooms. Innovations in architectural design included the addition of balconies and bay windows to facades, the replacement of loggias with balconies, and the asymmetrical placement of windows, all of which contributed to a distinctive architectural appearance.

2.3. Structural designs and elements of the decoration of low-rise residential houses. The larger spatial area of low-rise houses and their proximity to nature offer several advantages, including the ability to increase the number of rooms and expand service, kitchen, and living areas. Additionally, these houses allow for the efficient organization of insolation and ventilation regimes.

The construction forms of low-rise residential buildings in Baku can be categorized into three groups:

- Houses with courtyards in suburban areas;
- Houses located within the small-scale quarter system that constitutes the historical part of Baku;
- Multi-apartment block buildings.

In Yasamal district, the inclusion of small yards around houses often facilitates the creation of recreational spaces for apartments. Alongside linear grouping, the flexible placement of certain houses within the area enhances the spatial configuration of the apartments. This arrangement allows for the development of various structural

schemes for low-rise houses, which differ in layout, types of houses, and building materials. Load-bearing structures can be classified into three categories: monolithic, frame-based longitudinal, or load-bearing wall systems.

A key factor in the construction of these houses is the choice of roofing structure. Among the various architectural schemes, houses with domed roof elements, which have developed historically in the Baku-Absheron region, are the most prevalent. The construction of Absheron houses is characterized by simplicity, with flat ceilings being the predominant design.

The walls of some houses with courtyards were constructed using wooden ribs, each 2-3 cm thick, and plastered with clay mixed with straw on both sides. This lightweight wall construction method was commonly used in the residential district of “Sovetsky,” which emerged in the mid-20th century. The foundations and base structures were made of broken "but" stone, while the upper walls were constructed from limestone. In the construction of a few grand 2-4-story buildings in the central districts of the city, "but" stone was used in combination with one-sided hewn local stone.

Limestone was employed in various decorative forms for the artistic embellishment of two- and three-story mansion houses. The entrance doors and their frames were adorned with decorative patterns featuring carved motifs. Architectural elements of diverse shapes were crafted from polished and inlaid stones.

The architecture of Absheron houses is characterized by its simplicity and austerity. Typically, the rear facade, which faces the stern, was minimally decorated, with artistic elements and arches appearing only on rare occasions. The main facade, which faces the inner courtyard of the house, was often devoid of intricate decoration, with the entrance and window openings being the primary features of note.

With the introduction of new materials and construction techniques inspired by European architectural styles, along with local motifs, a variety of interesting decorative elements emerged. This is particularly evident in the carved stone patterns used on portals, entrances, and windows, which embellish the facades of these homes.

2.4. Comparison of low-rise residential buildings in Absheron with low-rise residential houses in other regions of Azerbaijan. The architectural features of residential buildings in various geographical regions of Azerbaijan have evolved in response to the natural and climatic conditions, cultural traditions, and locally available construction materials of each area. Throughout the Middle Ages and subsequent periods, these factors were reflected in the spatial organization of homes, their positioning within the landscape, and their structural design solutions.

The residential architecture in the northwestern cities of Azerbaijan, located in mountainous regions, often adopted a more fortress-like form, resembling towers. Due to the lower population density compared to other areas, these houses, characterized by their taller structures relative to their rectangular floor plans, were constructed at greater distances from one another, fostering a distinctive living environment. Such houses are most found in the Zagatala region.

The transformation of Lankaran's fortress structure into a coastal urban layout resulted in a linear arrangement of residential buildings along both banks of the Lankaran River. Within the former fortress area, the construction of barrack-style housing commenced, while the vicinity of the marketplace saw the development of mansions characterized by distinctive architectural and spatial planning features. In the historic part of the city, along the main thoroughfare, there are pavilions known as “lam”, which are structurally integrated with the primary residential buildings and function as semi-open summer spaces.

In mountainous regions, fortress-like houses with integrated pavilions are a common architectural feature. In Zagatala, guest rooms served as the focal point of residential compositions, while traditional wooden “Bagdadi” houses were widely prevalent. These structures were typically elevated on high platforms to mitigate the impact of precipitation. Their second floors featured a unified column-post framework, with balconies opening directly into the interior spaces and connecting to a pavilion-like area known as “lam”.

In large urban centers, the advancement of emerging

technologies introduced increased structural and functional requirements for residential buildings. Middle-class homes typically featured up to four rooms on a single floor, whereas affluent households incorporated additional rooms, resulting in more complex floor plans with *L*- and *U*-shaped layouts. These designs integrated both open balconies and glass-enclosed verandas, enhancing spatial organization and environmental adaptability. In the Sheki region, architect A. Mehdiyev designed a single-story mansion in which the household and kitchen block were physically separated yet functionally connected through an adjoining balcony.

In the early 20th century, traditional architectural elements characteristic of vernacular architecture was intricately integrated into the interiors of mansions, reflecting a fusion of heritage and innovation. For instance, stained glass with elaborate *shabaka* patterns was employed not only in the windows of glass-enclosed verandas but also in various household furnishings of different scales. Fireplaces, replacing traditional stoves between adjoining rooms, served both functional and decorative purposes, enhancing the interior aesthetic.

In the mansions of Ordubad, where the number of living rooms exceeded six, a hexagonal vestibule connected to the entrance was crowned with a dome, creating a grand spatial transition. The facades of these mansions were distinguished by large decorative arches and intricate *shabaka* latticework.

While the architectural variations in residential houses across Ordubad, Sheki-Zagatala, and Lankaran were primarily shaped by natural and climatic conditions, geographical location, local construction materials, and building traditions, in the Baku-Absheron region, social factors played a more pronounced role alongside these influences, contributing to distinct urban housing typologies.

Chapter III. Considering climatic factors in the architectural and planning decisions of low-rise residential houses, which are being built in Baku and on Absheron in the modern period.

3.1. Design of low-rise country-type houses considering the climate. In the northwestern areas of Baku, mixed-level and low-rise

villa-style houses have been designed to meet the needs of a diverse population. Equipping them with small private yards and placing daily service facilities nearby is considered practical. Low-rise houses, being closer to nature and having more spacious plots, offer greater comfort compared to others. Along with their structural simplicity, they are also convenient for use. In the planning of low-rise developments, factors such as temperature, wind, precipitation, terrain, greenery, and soil fertility play a key role.

Considering the local natural and climatic conditions, several characteristic low-rise residential complexes have been developed in Baku, including the Sharq Residential Area, Garachukhur Residential District, Central District, Yasamal Residential District, and the housing complex on the left bank of "Ganlı Göl," among others. Since these residential complexes are located within the planning boundaries of Baku, they share many similarities. However, differences in microenvironment, terrain, and location across various parts of the city influence their orientation, apartment layout structures, and the expression of new architectural elements.

In terms of site selection, houses in Baku are primarily positioned in areas that are wind-exposed and cooler, to take advantage of the climate. However, the north-facing walls of the houses are more exposed to moisture due to the harsh effects of the wind. The influence of the eastern wind facilitates air circulation between buildings, ensuring comfort in the internal environment. The eastern wind can be considered a factor that provides natural ventilation in Baku's conditions. To highlight the aspects that correspond to the main architectural solution of residential houses, it is crucial to build them in accordance with their functional content, climatic conditions, and artistic expression.

Due to the varying terrain features of the northwestern residential area of Baku, different planning methods such as linear, strip, clustered, and scattered layouts have been applied here. The villa-type residential houses designed for this area are low-rise and mid-rise buildings. On the other hand, the proper placement of villa-type houses creates an interesting composition, thanks to the individual form of the buildings, alongside the creation of an aeration regime. Villa-type low-rise

buildings, designed based on individual planning, are located around medium and high-rise neighborhoods. Since high-rise buildings are widespread in the city center, the density of the population has increased, and as a result, low-rise houses have sometimes been moved to peripheral zones.

Today, new residential complexes consisting of low-rise houses have been established in the suburban areas of Baku, such as Sulutapa, Mehdiabad, Mushfig, and Masazyr. The fact that these complexes are located on higher slopes compared to Baku is an advantage. However, excessive construction density, a lack of greenery, and the disruption of the planning structure are factors that negatively impact the natural and climatic conditions of these areas.

3.2. Considering climatic factors in the architecture of the country houses of Absheron. The northern coast of Absheron was once the area for residents' gardening plots. “Until the end of the 19th century, the architectural and planning organization of this zone was more scattered; however, starting from the 1890s, the large-scale construction process in Baku and urban development related to oil refining stimulated the construction of many garden estates in the northern region of Absheron.”. In terms of recreational forms, the garden houses of Absheron can be categorized into I and II level estate-type houses and simple garden houses intended for mass recreation. Some of the low-rise houses built along the southern and southeastern coasts of Absheron and in nearby settlements also fall into this category.

Since ancient times, wealthy people of Baku have built houses along the shores of Absheron for their recreation and have landscaped the surrounding areas. These buildings were known as estate houses for summer recreation. From the late 19th century onwards, such garden houses became more widespread in villages like Mardakan, Buzovna, Bilgah, and Pirshaghi. The architecture of these houses reflected both local and European architectural styles, which can be seen in their main architectural elements, details, and the decoration of balconies and glass verandas. Personal estate houses of notable figures like H.Z. Taghiyev, M. Muhtarov, Sh. Asadullayev, and others are examples of this. Several other estate houses in Mardakan (such as those of A. Ashurbayov, T. Safaraliyev, etc.) are distinguished by their dome-

shaped towers. They “resembled small palace complexes because, in addition to the large main building, the area also included a landscaped park, water reservoirs, pools, and several farm buildings.

The architectural and planning solution of estate-type houses and simple garden houses designed for mass recreation in the villages of Absheron has been adapted to the regional and climatic characteristics. Considering the hot climate, these houses are equipped with balconies and open terraces. Pools located near the buildings help to soften the microclimate and provide an aesthetic effect. The open balcony above the central entrance of the house, located in front of the main hall, creates good lighting opportunities. The distribution of coastal areas to Baku residents led to the construction of many 1-2 story garden houses in the coastal areas of Absheron. Typological analysis of the garden houses in Absheron allows for their division into three types based on the following features:

Type I - Estate-type houses dating back to the late 19th and early 20th centuries, representing various architectural styles. Their placement and architectural solutions consider local climatic factors.

Type II - Garden houses built in individual small plots in the coastal villages of Absheron, which were abandoned and disturbed by anthropogenic influences starting from the second half of the 20th century. These houses are constructed in accordance with the natural climatic conditions. Depending on the location, some of these garden houses are surrounded by verandas on all four sides, protecting them from the strong khazri wind. This allows for shaded areas to be created at any time of the day.

Type III - Houses of horticultural farms distributed by various organizations. These houses, designed to provide family recreation with efficient technological and structural solutions, were built on the southern coast of Absheron. In the Gobustan-Shikhlar settlement, holiday homes of the same size were constructed based on a unified planning method, oriented towards the east and southeast, protecting them from the sun and northern winds.

After the 1950s, houses built within linear micro-areas on the northern and southern shores of Absheron are advantageous in terms of insulation and aeration regimes. Although sun and wind are strong

natural climatic factors on the peninsula, the creation of comfort in low-rise garden houses is possible by artificially controlling these factors when necessary. Thus, the efficient use of wind and solar energy in the region has been effectively implemented as a favorable factor.

3.3. Selection of materials and structures used in buildings depending on the climate. In the low-rise residential buildings of Baku-Absheron, attention has been paid to the suitability of construction materials and rational structures used in accordance with the requirements. Limestone and brick have been preferred as masonry materials in the region. In the Baku-Absheron area, locally sourced "cube" limestone, which is environmentally friendly, has been mainly used for masonry, and architectural elements and complex structures have also been built with this material.

In the Absheron gardens, some houses have been built based on a frame-bearing system, taking seismicity into account. The walls of the low-rise houses are made using a frame monolithic reinforced concrete strip and mixed construction methods, with foundations made of but concrete. The use of polished natural stone in the facades of several low-rise houses has given these buildings a more impressive appearance. Along with houses built from local stone, the use of materials developed based on new technology with high moisture content for Baku is also notable. Considering the natural-climatic conditions of Baku, the moisture resistance of the materials should be considered. This idea is reflected in the sketch project proposed by the author.

The use of modern materials in low-rise residential buildings plays a significant role in their structural solutions. To enhance the technological level of the construction process, the use of both new and traditional building materials that allow for a more rational approach has proven to be effective. This is because local building materials (limestone) can be easily combined with artificially produced materials (expanded clay, ceramic fillers, their combinations, etc.). During the restoration and reconstruction of low-rise houses, appropriate structures should be proposed. For this purpose, principles such as increasing the thermal resistance of the

structures, eliminating their dependence on the environment, protecting the structure and rooms from solar radiation, and utilizing the structural solutions of smart homes should be applied.

THE MAIN RESULTS OF THE RESEARCH:

The characteristics of low-rise houses in the Baku-Abşeron region have been studied, and the following conclusions have been drawn:

1. The impact of natural and climatic factors on the development of low-rise residential buildings in Baku has been a leading factor from ancient times to the present. In the urban planning history of Baku, these types of residences have gone through development stages, influencing the creation of modern residential buildings, their architectural solutions, artistic design, construction, and compositional structures.

2. The architecture of the houses formed in Baku-Absheron has been influenced by the region's natural climate, religious, and domestic traditions. Solar radiation, temperature changes, humidity, and rainfall have been leading factors that manifested in the area's layout, interior organization, and the typological features of the houses. These houses, with small courtyard formations, have created neighborhoods that form a maze-like structure. The quarters consisting of low-rise residential buildings differ in terms of size, orientation, arrangement of houses, and architectural style.

3. In addition to ordinary residential houses, low-rise summer houses were also constructed in several types in the Baku-Absheron region. The first type consists of houses allocated for seasonal use, intended for the mass summer recreation of the population. The second type includes estate-style villa houses built in the late 19th and early 20th centuries. The third type features villa-type houses with free planning solutions, favorable orientation, large sizes, and high comfort levels.

4. The formation of the volumetric-spatial and planning structure of Baku's low-rise houses developed in accordance with the

level of societal development, the city's status, and the economic urban planning essence (such as neighborhood, block, microdistrict, and grouped complex structures). Their planning structure was shaped by factors such as the number of rooms in the apartments, and the various forms of recreational areas like balconies, loggias, etc., in the layouts of rooms that opened to one or two sides.

5. Research on the materials and constructions used in low-rise houses shows that both local limestone and artificially produced materials are used in the low-rise houses of Baku-Absheron. Due to the influence of the Caspian Sea and the high humidity in the Baku-Absheron region, materials such as foam polystyrene and foam concrete are used for cladding wall surfaces, while glass concrete and multi-layered polystyrene materials are used in the wall masonry to provide thermal insulation. Among the proposed structural schemes, the most efficient are frame-based houses, which are more durable and have a longer lifespan.

6. The structural schemes of low-rise houses have been developed based on climate, the number of floors, the characteristics of local building materials, and technological processes. In addition to load-bearing wall constructions in the transverse and longitudinal directions, frame-structured buildings were also erected. In the walls of these buildings, several layers of lightweight materials could be used as fillers. These materials, with relatively low thickness, have high resistance to heat and cold.

7. The comparison of low-rise houses in Baku-Absheron with residential buildings in other regions shows more differences than similarities. This difference is evident in the complex floor plans of Ordubad houses, the arrangement of sunlit areas, the use of courtyards, the placement of open verandas in front of one-sided rooms in houses in the warm subtropical conditions of Lankaran, the inclusion of several-story "lam" attached to the houses, and the cylindrical appearance of houses in Zagatala, which are built from rock fragments, adapting to the natural climate and terrain. It is also reflected in the scattered layout of the area.

8. In the formation of the architectural planning and structural bearing systems of low-rise houses, villas, and garden houses built in

Baku city and its surroundings, considering the natural climate is essential. By efficiently utilizing the impact of the climate, more comfortable and convenient low-rise houses can be constructed. The modern materials, structural bearing systems, and technological processes chosen here to play a key role.

9. The concept of sustainable development plays a crucial role in the architecture of modern residential buildings. Currently, the construction of low-rise residential buildings based on the application of advanced technologies is becoming increasingly popular worldwide. The construction concept of "eco-villages," developed using innovative "clean" technologies, has also gained widespread attention. Under the conditions of sustainable development, low-rise houses are more in line with these principles. Through the study of historical construction practices, elements characteristic of low-rise residential buildings has been identified, and patterns involved in the formation of the architectural features of traditional residential houses in Absheron have been observed.

10. When planning low-rise houses, open spaces such as terraces, verandas, balconies, logging areas, and yard areas should be considered. Natural lighting and ventilation should be provided through the application of architectural planning methods.

11. Today, the main and essential condition for the formation of low-rise residential houses in Absheron is priority to energy-efficient buildings that make effective use of solar energy for heating, energy consumption, and other purposes. To minimize environmental damage and reduce energy operation costs, it has been concluded that passive construction with passive technologies, considering natural climate factors, should be preferred.

Published scientific works on the subject of the dissertation:

1. Влияние деловой активности на транспортную структуру Баку. Müasir şəhərin davamlı inkişaf problemləri adlı beynəlxalq konfrans, Bakı-2015. s.111-115
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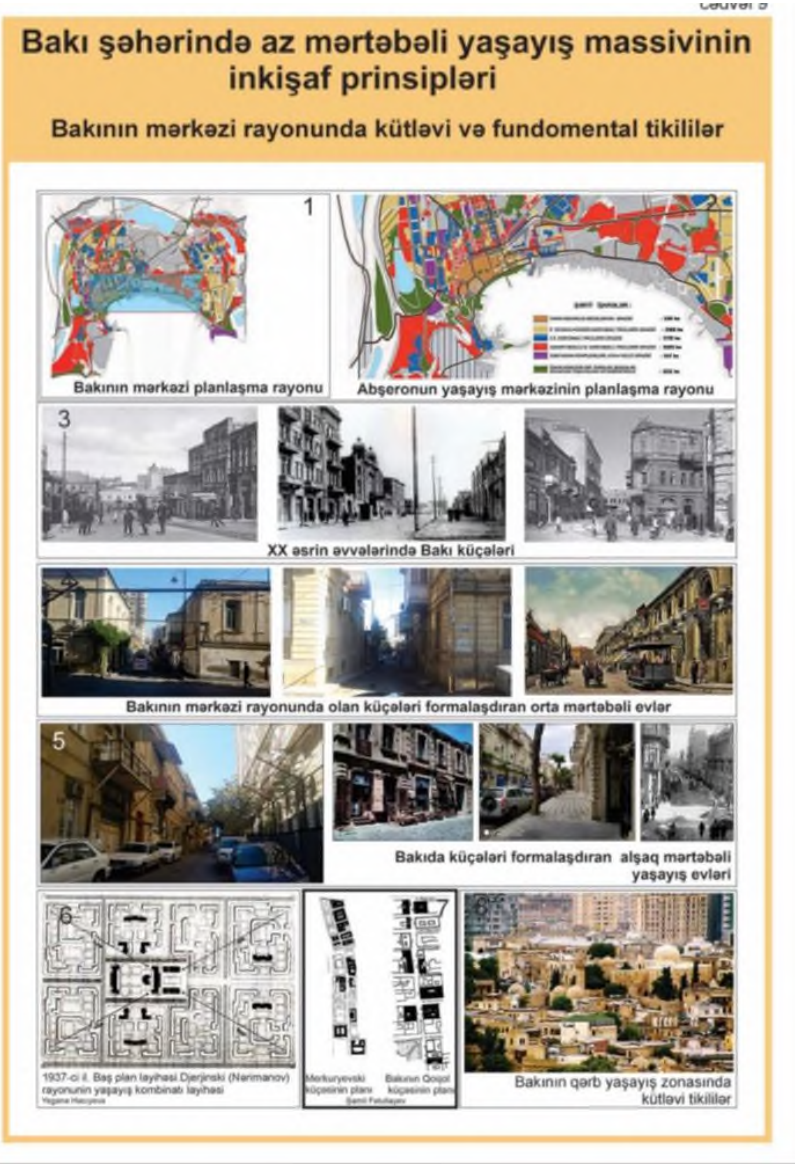
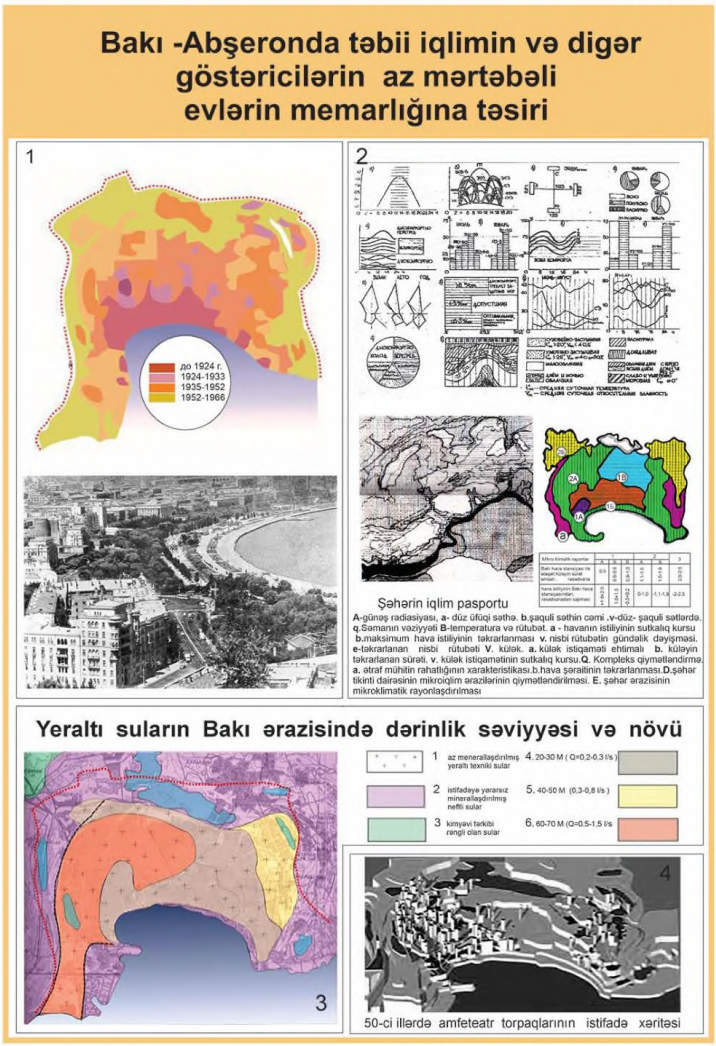
3. Формирование жилой среды развивающихся малых городов Азербайджанской Республики. Наука, образование и экспериментальное проектирование, международная конференция, Москва – 2016, s. 274-275.
4. Bakının azmərtəbəli yaşayış evlərinin bədii tərtibatında müasir material və konstruksiyaların rolu. Dizaynın müasir problemləri elmi-praktik konfrans. №2. Bakı- 2018, s. 239-246
5. İqlimin memarlıq və şəhərsalmada təzahürü. AzMIU-nun "Elmi əsərlər" jurnalı. №2. Bakı- 2018, s. 13-16
6. Bakının ekoloji durumuna təsir edən təbii amillər (iqlim, su, relyef, yeraltı və yerüstü sərvətlər). AzMİU-nun "Ekologiya və su təsərrüfatı" jurnalı, №3. Bakı-2018, s. 3-5.
7. Малоэтажная застройка в условиях жаркого климата реконструируемого крупного города. Проблемы градостроительной реконструкции, Сборник статей, Самарский Государственный Технический Университет, Самара-2019: s.255-260
8. Abşeronun bağ evlərinin bədii-memarlıq həllinə külək və günəşin təsir dairəsi. AzMIU-nun "Elmi əsərlər" jurnalı. №1. Bakı- 2019, s. 32-36.
9. Планирование жилых зданий Баку в зависимости от природно-климатических условий, современных материалов и конструкций. Beynəlxalq Ukrayna-Azərbaycan elmi konfrans, Poltava- 2019, s. 217-223.
10. Влияние природно-климатических факторов Апшеронского полуострова на архитектурно-планировочные особенности малоэтажной застройки Баку. Журнал АМІТ МАРХИ. №2(51). Москва-2020, s. 289-305.

11. Развитие градостроительной науки Азербайджана в советский период. Журнал Архитектура и Строительство России. №4. Москва-2021, s. 14-22.
12. Архитектура народных жилищ Абшерона. Журнал Architecture and Modern Information Technologies. №1(66). Москва-2024, s. 101-111.



Principles of development of low-rise residential complex in Baku city

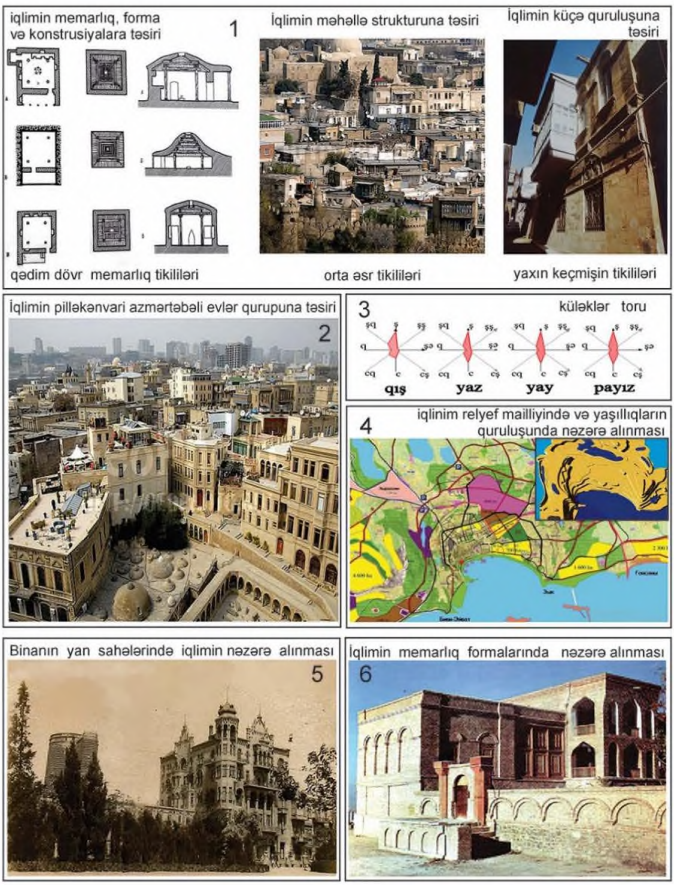
cədvəl 13



The influence of the natural climate and other factors on the architecture of low-rise houses in the Baku-Absheron region

cədvəl 14

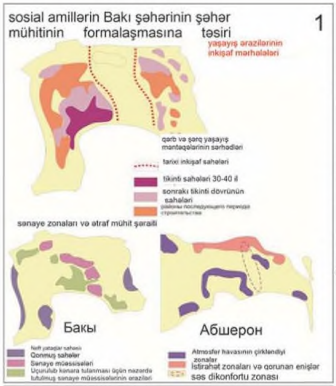
Bakının müxtəlif mövsümlərdə yaşayış rayonları üzrə temperatur rejiminin memarlığa təsiri

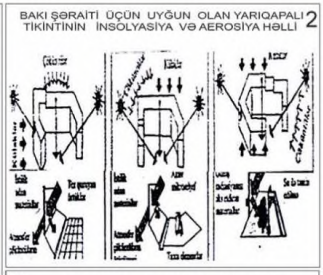


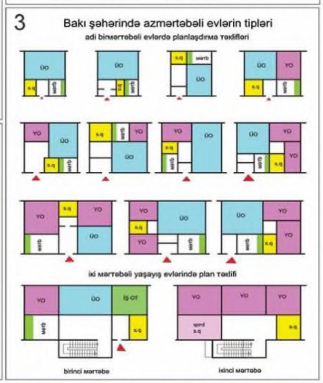
The impact of the temperature regime on the architecture of Baku's residential districts across different seasons

cədvəl 17

Təbii və sosial faktorların şəhər mühitinə təsiri və azmərtəbəli evlərin plan quruluşunda onların nəzərə alınması







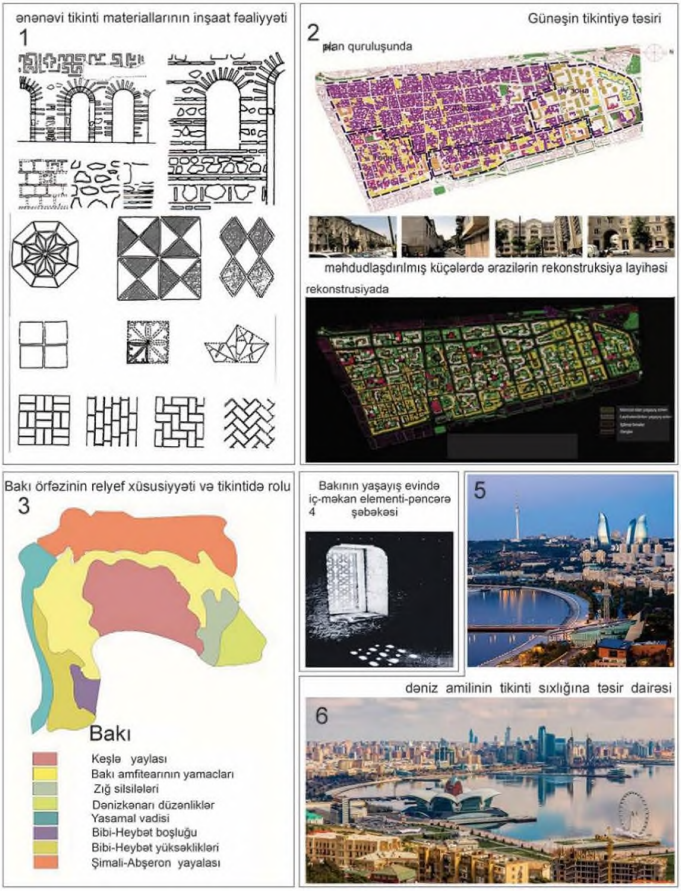
İnzibati bölgəyə görə Bakı əhalisi (min nəfər) 6

İnzibati rayonlar	yanvar ayına									
	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008
Ümumilikdə Bakı şəhəri	1807.8	1765.3	1796.8	1807.3	1817.9	1828.8	1839.8	1855.3	1873.6	1893.5	1917
rayonlar daxil olmaqla											
Binəqədi	183.3	189.9	210.3	211.7	213.3	213.1	216.8	218.9	221.1	221.6	224.5
Əzizbəyov	117.8	114.1	117.1	117.8	118.6	119.3	120.1	121	121.9	123.3	124.8
Xətai	232.2	217	216.6	217.8	219.6	221.5	223.3	225.9	229	231.3	235.9
Qaradağ	89.4	94.3	95.3	96.3	97.1	97.7	98.6	99.8	101	102.2	104.4
Nərimanov	160.6	150.1	148.5	149.4	150.1	150.7	151.2	152.4	153.6	155.1	156.7
Nəsimi	204.5	202.4	196.4	197.4	197.9	198.8	199.4	200.1	200.8	202.1	203.5
Nizami	169.2	161.1	159.8	160.7	161.8	162.9	163.9	165.3	167.5	170.4	172.8
Səbunçu	198.8	190.5	189.5	190.8	192	193.1	194.3	195.8	197.4	199.5	201.7
Səbail	90.7	75	74.4	74.8	75.3	75.8	76.4	77.2	78.5	79.7	81
Suraxanı	140.9	151.1	166	169	169.2	170.3	171.6	173.1	173.1	177.5	179.9
Yasamal	220.2	220	222	222.6	223	223.6	224.2	225.6	227.6	229.4	231.8

The impact of natural and social factors on the urban environment and their consideration in the planning of low-rise housing structures

cədvəl 18

Tikinti materialları və küləklənmənin azmərtəbəli yaşayış evinin tikintisində rolu



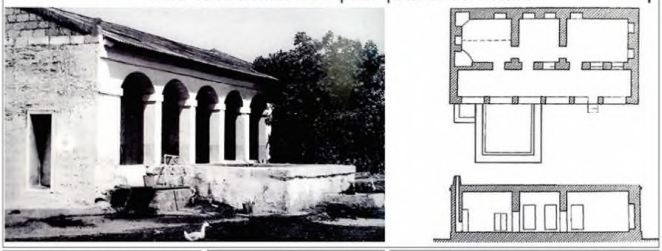
Building materials and the role of ventilation in the construction of low-rise residential houses

cədvəl 19

Bakı şəhərinin az mərtəbəli evlərinin yerli amillərinin təsirində tipoloji xüsusiyyətləri

Qədim və orta əsrlərdə təbii iqlimin təsirində formalaşan evlərin tipoloji növləri

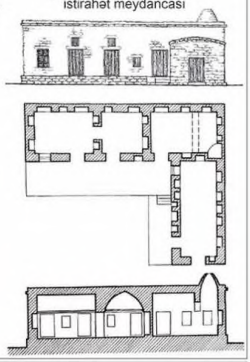
Bakı kəndlərinin ev tipləri planda və asadda 1



şəhər qalasının məhəllə ev tipi 2

3 əhmədli qala evi

4 Abşeron kənd evi daxilindəki istirahət meydancası



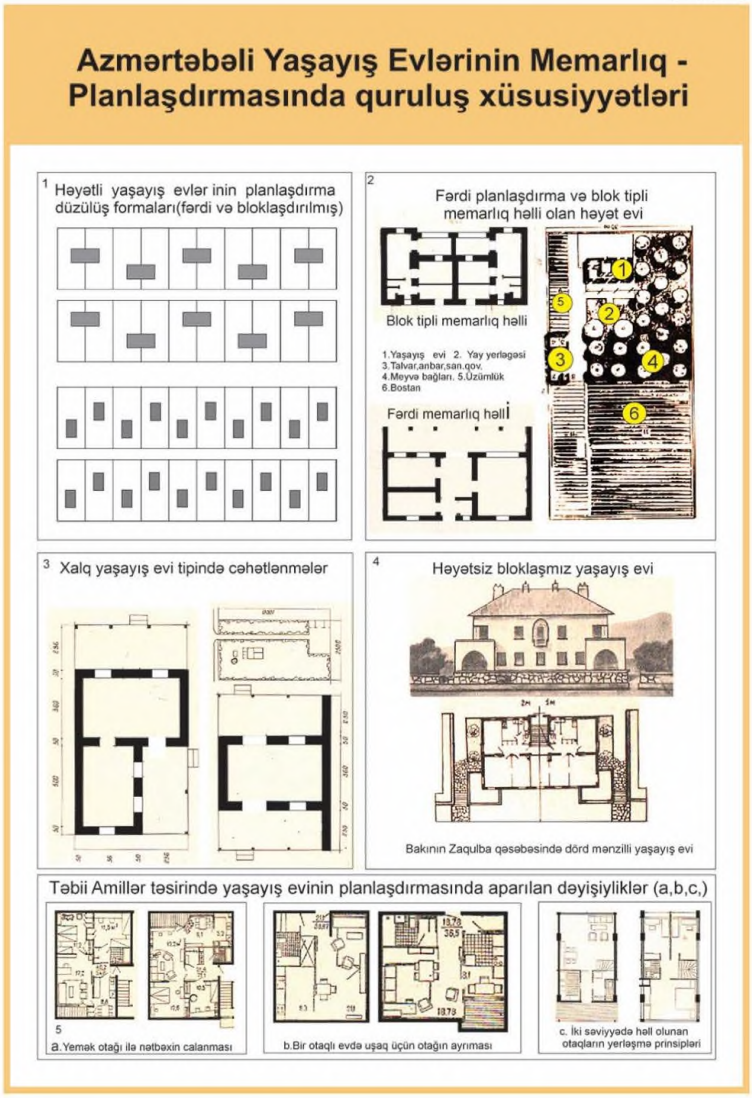
5 Əhmədli yaşayış evi qarşısında sərinlikvermə xüsusiyyəti

6 ƏN BÖYÜK ŞƏHƏRİN YAŞAYIŞ FONDU

illər	Azərbaycan üzrə	Bakı	Gəncə	Sumqayıt
2000	486.000 m2	153.5000 m2	7 7000 m2	3 9000 m2
2001	560 000 m2	119.8000 m2	9 7000 m2	2 9000 m2
2002	803 000 m2	152 90093 m2	91. 55 m2	5493 m2
2003	1339 000 m2	376 112 m2	30 339 m2	12 354 m2
2004	1359 000 m2	518 535 m2	22 145 m2	16 409 m2
2007	1610 000 m2	650 192 m2	29 253 m2	736 79m2
2010	1745 000 m2	847 340 m2	33 340 m2	77250 m2
2017	1828 000 m2	1679400 m2	39750 m2	108 500 m2

Typological characteristics of low-rise houses in Baku city influenced by local factors

cədvəl 25



Structural features in the architectural design and planning of low-rise residential houses

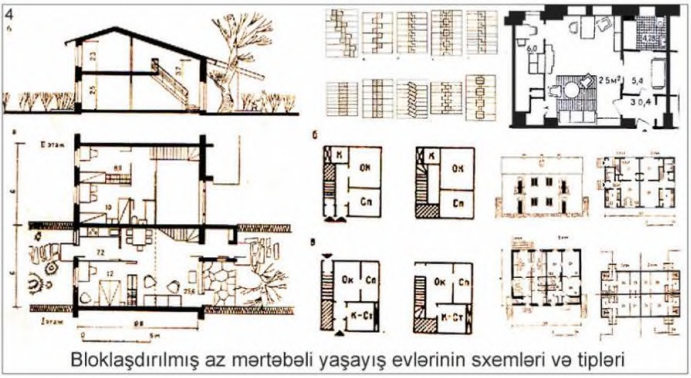
cədvəl 27

Bakıda yaşayış evlərinin və mənzillərinin düzülüş formaları (fərdi, sərbəst, koridor əsasında və bloklaşdırılmış

Ala-tava (şimal qərb yaşayış rayonu)massivindəfərdi yaşayış evlərinin düzülüşü

Şərifzadə küçəsində (şimal-qərb massivi) koridor əsasında

yığılan mənzillər (Mehmanxana tipində)



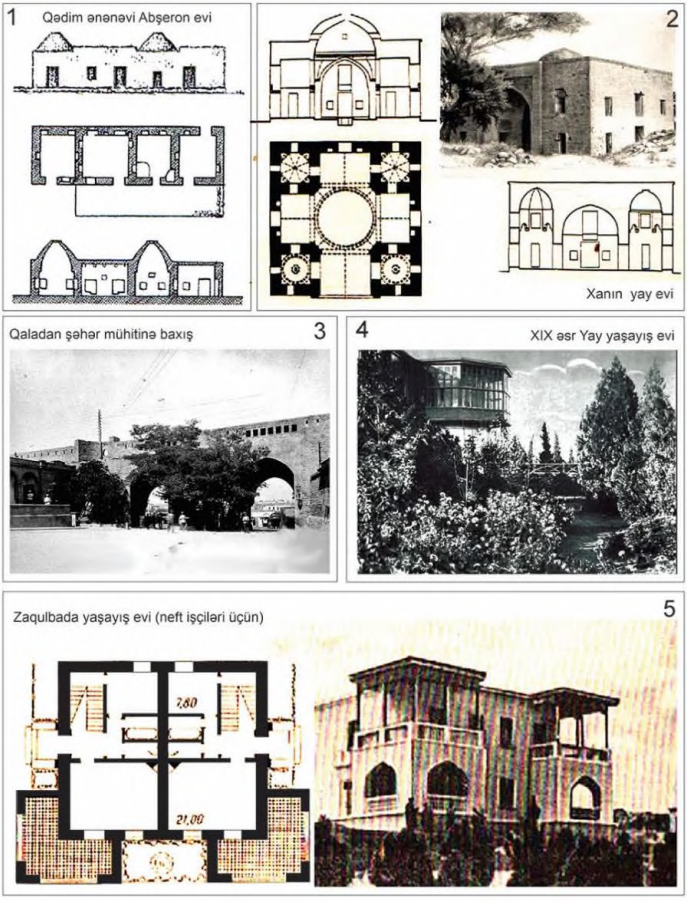
Bloklaşdırılmış az mərtəbəli yaşayış evlərinin sxemləri və tipləri

Layout types of residential houses and apartments in Baku (individual, open-plan, corridor-based, and block-style)

cədvəl 31

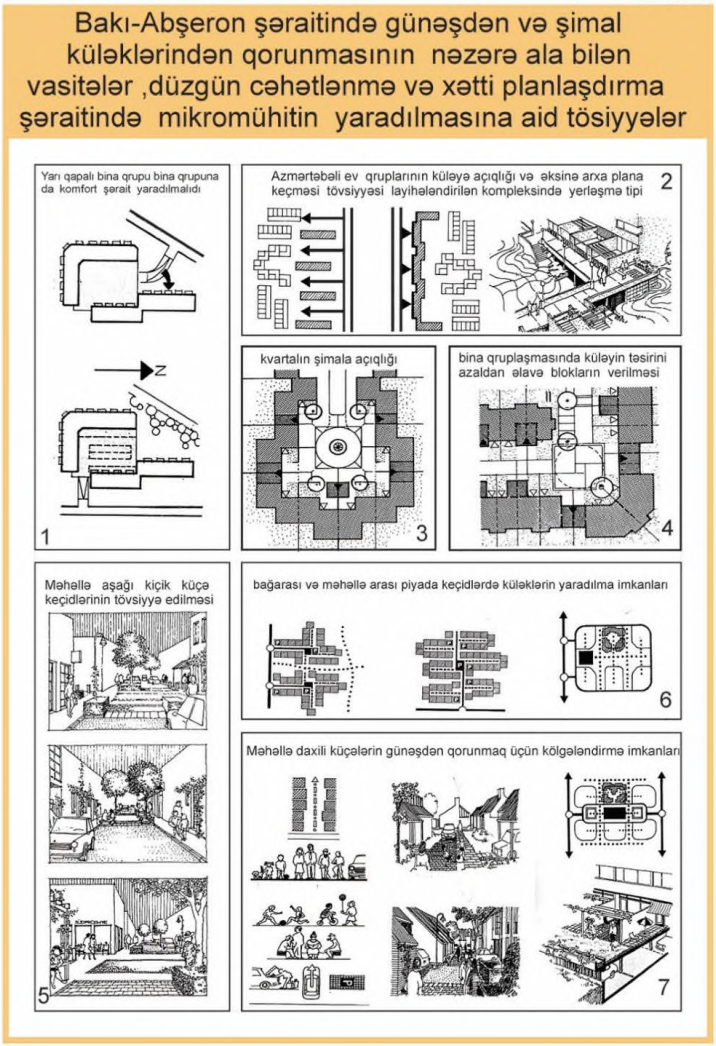
Abşeronun azərmərtəbəli binalarının Azərbaycanın digər bölgələrinin ənənəvi yaşayış binaları ilə müqayisəsi

Abşeronun qədom,orta və XX əsrdə ənənəyə uyğunlaşdırılmış yaşayış evləri



Comparison of low-rise buildings in Absheron with traditional residential buildings from other regions of Azerbaijan

cədvəl 42

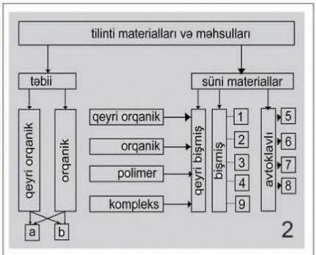


Effective methods of protection from the sun and north winds in the Baku-Absheron region, with recommendations for creating a microenvironment through proper orientation and linear planning

Cədvəl 44

Az mərtəbəli yaşayış evlər qrupunda inşaat materallarının təkmilləşdirilmiş tipləri. Karkas əsaslı qurulan bloklaşdırılmış evlər

1 Fasad həlli forması



2 Tikinti materiallarının zəyif və üstün tərəfləri

3 Az mərtəbəli yaşayış evlərinin örtük həlli formaları

4 Az mərtəbəli yaşayış evlərinin fasad və plan həlli formaları

5 Az mərtəbəli yaşayış evlərinin karkas əsaslı qurulan bloklaşdırılmış evlərinin plan və gönüş həlli

Enhanced types of building materials for low-rise residential houses, including block houses constructed with a frame structure

The defence will be held on 04 04 2025 at 11 00 at the meeting of Dissertation council BFD 2.29 operating at Azerbaijan University of Architecture and Construction.

Address: Az-1073, Baku, A. Sultanova str. 11.

Dissertation is accessible at the library of Azerbaijan University of Architecture and Construction.

Electronic versions of the dissertation and its abstract are available on the official website of AUAC.

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