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IMPACT OF CO-BENEFITS OF GREEN BUILDING ON SUSTAINABLE URBANISM

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ABSTRACT

It is now universally recognized that human-induced climate change could have major adverse consequences for the world's ecosystems and societies. Climate change is caused by the emission of greenhouse gases, which trap long-wave radiation in the upper atmosphere and consequently raise atmospheric temperatures. This also produces other changes in the climate system. Buildings consume nearly 40% of primary energy production globally. Certified green buildings substantially reduce energy consumption on a per square foot basis and they also focus on indoor environmental quality. However, the co-benefits from green building and the factors of reductions in energy and concomitant reductions in air pollution have not been examined. Carbon dioxide is the most important of these gases and its atmospheric concentration has increased exponentially since the beginning of the industrial revolution as a result of fossil fuel combustion and land-use change. Health co-benefits of living in green building enhance sustainability of urban area: improving the interface between humans and wildlife and reducing the risk of climate change.

In this aspect, the systematic review considered evidence linking green building strategies in the Leadership in Energy and Environmental Design Rating System with the potential to reduce negative health outcomes following exposure to urban flooding events.

Some paper propose that green development can result in raising the investment funds by progressing representative efficiency, expanding benefits from advancements in better quality of life and health space, and giving reserve funds from vitality, communal consumption, and operational costs. This paper represent a set of the features emphases the important factors which affects sustainability in urban scale.

Keywords: green building, environment, urban development, sustainable, urbanism, regional

INTRODUCTION

One of the main problems of humanity in the 21st century is Climate change. The main reason for that is CO2 emission which is created by the several anthropogenic factors.

One of the major culprits is building construction. According to the 2019 Global Status Report coordinated by the United Nations Environment Programme, the building and construction sector accounted for 36% of final energy use and 39% of energy and process-related CO2 emissions in 2018. Despite the Paris Agreement and the United Nations (UN) Sustainable Developments Goals report, according to which energy efficiency of buildings must be improved by 3 percent each year in order to meet the benchmarks set, global emissions from buildings increased for the second year in a row starting from 2016. One of the ways to prevent further increase of CO2 emission in buildings and construction sectors is implementing of Sustainable Urbanism conceptual model.

WHAT IS SUSTAINABLE URBANISM?

Sustainable Urbanism is a conceptual model for zero-emission and zero-waste urban design, which arose in the 1990s, promoting compact energy-efficient urban development, seeking to transform and re-engineer existing city districts and regenerate the post-industrial city center. It promotes the development of socially and environmentally sustainable city districts.

Sustainable Urbanism is by definition interdisciplinary; it requires the collaboration of landscape architects, engineers, urban planners, ecologists, transport planners, physicists, psychologists, sociologists, economists and other specialists, in addition to architects and urban designers. Sustainable Urbanism makes every effort to minimize the use of energy, water and materials at each stage of the city's or district's life-cycle, including the embodied energy in the extraction and transportation of materials, their fabrication, their assembly into the buildings and, ultimately, the ease and value of their recycling when an individual building's life is over.

There are following factors which define sustainable urbanism:

- Compactness
- Biophilia and Biophilic Cities
- Sustainable corridors
- Green buildings

Compactness

Compactness, or density, plays an important yet limited role in sustainable urban development because it can support reductions in per-capita transport energy use by increasing walking, cycling, active transport and public transit use. The relatively low density of some urban and especially suburban and exurban development is too low to support efficient transit and walk-to destinations. Such low-density development is a characteristic of urban sprawl, which is the major cause of high dependence on private automobiles, inefficient infrastructure, increased obesity, loss of farmlands and natural habitats, pollution, and so on. For these reasons, sustainable urbanism tends to promote more compact development with greater intensities of use and greater variety of uses and activities in a given urban area.

Research has shown that low-density development can exacerbate nonpoint source pollutant loadings by consuming absorbent open space and increasing impervious surface area relative to compact development. While increasing densities regionally can better protect water resources at a regional level, higher-density development can create more impervious cover, which increases water quality problems in nearby or adjacent water bodies.

Increasing neighborhood population density also supports improved public transit service. Concentrating development density in and around transit stops and corridors maximizes people's willingness to walk and thus reduces car ownership and use. Sustainable urbanism seeks to integrate infrastructure design increase with density, because a concentrated mixed-use development required less per capita infrastructure usage compared to detached single-family housing.

Biophilia and Biophilic Cities

The Biophilia hypothesis was introduced by E. O. Wilson. It refers to the connection between humans and other living systems. Within this concept, humans are biologically predisposed to caring for nature. Biophilic cities are those that bring nature into the city by increasing parks and open spaces, green and blue corridors, and networks that link them. Increasingly, biophilia refers to habitats that support other species, sustainable food production and urban agriculture. Thus, biophilia and biophilic cities are an underlying component of sustainable urbanism.

SUSTAINABLE CORRIDORS

Sustainable corridors are similar to a wildlife corridor in that they connect one area to another efficiently, cheaply, and safely. They allow people to pass from their immediate proximity to another without relying on cars or other wasteful and inefficient products. It also relies on accessibility to all people in the community so

that the mode of transportation is the most convenient and easiest to use for everyone. Sustainable Corridors also include biodiversity corridors to allow animals to move around communities so that they may still live in and around cities.

Green buildings

Green buildings are designed and constructed to maximize operational energy savings and minimize environmental impacts of the construction and operation of the buildings. Building construction and operation generates a great deal of 'externalized costs' such as material waste, energy inefficiencies and pollution. Green buildings aim to minimize these and make the process much more efficient and less harmful. New York City Department of Design & Construction put out a set of guidelines in April 1999 on Green buildings buildings that have broad application to sustainable urbanism as a whole worldwide.

Benefits of Green Buildings on sustainable urbanism

By incorporating environmentally sound materials and systems, improving indoor air quality and using natural or high efficiency lighting, it minimizes a building impact on its natural surroundings; additionally, those who work or live in these buildings directly benefit from these differences. Some building owners have even reported increased worker productivity as a result of the improved conditions. However, because these other benefits are more difficult to quantify than direct energy savings, the real value of green buildings can easily be underestimated by traditional accounting methods that do not recognize 'external' municipal and regional costs and benefits.

According to World Green Building Council the benefits of green buildings can be grouped within three categories in urban scale:

- Environmental
- Economic
- Social

Environmental benefits **-** consist of global and building level benefits**.**

The global level environmental benefits are the following:

- Green buildings can reduce or eliminate negative impacts on the environment, by using less water, energy or natural resources, and they can - in many cases - have a positive impact on the environment (at the building or city scales) by generating their own energy or increasing biodiversity.
- The building sector has the largest potential for significantly reducing greenhouse gas emissions compared to other major emitting sectors – UNEP, 2009.
- This emissions savings potential is said to be as much as 84 gigatonnes of CO2 (GtCO2) by 2050, through direct measures in buildings such as energy efficiency, fuel switching and the use of renewable energy – UNEP, 2016.
- The building sector has the potential to make energy savings of 50% or more in 2050, in support of limiting global temperature rises to 2°C (above pre-industrial levels) – UNEP, 2016.
- At a building level we can determine the next benefits:
- Green buildings achieving the Green Star certification in Australia have been shown to produce 62% fewer greenhouse gas emissions than average Australian buildings, and 51% less potable water than if they had been built to meet minimum industry requirements.
- Green buildings certified by the Indian Green Building Council (IGBC) results in energy savings of 40 - 50% and water savings of 20 - 30% compared to conventional buildings in India.
- Green buildings achieving the Green Star certification in South Africa have been shown to save on average between 30 - 40% energy and carbon emissions every year, and between 20 - 30% potable water every year, when compared to the industry norm.
- Green buildings achieving the LEED certification in the US and other countries have been shown to consume 25 per cent less energy and 11 per cent less water, than non-green buildings.

Economic benefits - is a number of economic or financial benefits, which are relevant to a range of different people or groups of people. These include cost savings on utility bills for tenants or households (through energy and water efficiency); lower construction costs and higher property value for building developers; increased occupancy rates or operating costs for building owners; and job creation. Since the publication of WorldGBC's

groundbreaking 2013 report, The Business Case for Green Building, we have sought to strengthen the link between green buildings and the economic benefits they can offer. Economic benefits are also divided into global level benefits, country level benefits and building level benefits.

The global level benefits is:

- Global energy efficiency measures could save an estimated €280 to €410 billion in savings on energy spending (and the equivalent to almost double the annual electricity consumption of the United States) – European Commission, 2015.

Country level benefit mainly consist of the following 2:

- Canada's green building industry generated $23.45 billion in GDP and represented nearly 300,000 full-time jobs in 2014 – Canada Green Building Council / The Delphi Group, 2016.
- Green building is projected to account for more than 3.3 million U.S. jobs by 2018 – US Green Building Council / Booz Allen Hamilton, 2015.

At a building level we have the following benefit;

- Building owners report that green buildings - whether new or renovated - command a 7 per cent increase in asset value over traditional buildings – Dodge Data & Analytics, 2016.

Social benefits go beyond economics and the environment, and have been shown to bring positive social impacts too. Many of these benefits are around the health and wellbeing of people who work in green offices or live in green homes. The main social benefits of green buildings are:

- Workers in green, well-ventilated offices record a 101 per cent increase in cognitive scores (brain function) - Harvard T.H. Chan School of Public Health / Syracuse University Center of Excellence / SUNY Upstate Medical School, 2015.
- Employees in offices with windows slept an average of 46 minutes more per night - American Academy of Sleep Medicine, 2013.
- Research suggests that better indoor air quality (low concentrations of CO2 and pollutants, and high ventilation rates) can lead to improvements in performance of up to 8 per cent–Park and Yoon, 2011.

CONCLUSION

Green buildings are one of the important factors which affects sustainability in urban scale. Some of the benefits of green buildings were analyzed. From the presented facts green buildings have a positive impact on the environment (at the building or city scales) by generating their own energy or increasing biodiversity as well as reducing greenhouse gas emissions. It will help to save fossil fuels for future generations The same time it can affect limiting rising temperatures by the potential of energy savings.

One important drawback for this research was the collection of typical items of benefits form green building, especially for the frame of urbanized area. For the literature review and to reduce the variance of statement, of data collection are especially important for similar uncontrolled studies. More sources also advise with understanding of the impacts other aspects on the examined areas since the influence from stabilization in general area of city.

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EVOLUTION OF HISTORICAL URBAN STRUCTURE: A CASE OF GANJA CITY, AZERBAIJAN

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ABSTRACT

Time and people life transform urban structure according to their needs, principles and mentality. This process occurs either as entirely evaluate the space, or as build the remaining texture. Thus, several layers of heritage generate structural mosaic within the same urban cores. The purpose of this study is to reconstruct the evaluation structural stage of Ganja's urban structure. The history of Azerbaijan in the 18th century is riddled with internal clashes and outside invasions. The cities of Azerbaijan were ravaged and devastated to a varying extent, and there was a significant reduction in productive forces, foreign and domestic trade. Characteristic of the period was prolonged political instability with permanent infighting and economic stagnation. With the determinations obtained by previous masterplans, the transformation ratio in morphological structure has been examined comparatively via urban fabric and its elements. This research collect archive data and emphasize major edition of prior city plans.

Keywords: urban socio-spatial structure, factor evolutional development

Ganja, one of the major cities of Azerbaijan, is located at the junction of the Caucasian mega-region, on a vast lowland at the North-Eastern foothills of the Lesser Caucasus. The city, existing many centuries, continually amazes with its incontestable beauty and extraordinary fortitude. In the article, the author attempts to highlight the issue of the structure of Ganja, fixed on topographical plans of the 18th and 19th centuries, which were taken at different times and certain stages of its consolidation.

As early as 60s of the 18th century, the restoration process of cities was renewed, "Ganja was slowly regaining its former glory" (1, p.294). The number of buildings under construction was decreasing significantly, although this did not affect the utility buildings. Traditionally, the population continued to be engaged in crafts; tailoring, blacksmithing, pottery, saddlery, jewellery, but mainly the production of silk, cotton and woolen fabrics.

Topographic plans of the 18th and 19th centuries recorded structure of Ganja are of great interest. They were prepared at different times, at certain stages of its consolidation, which made it possible to trace the phases of urban formation and the dynamics of the city. Plans of 1797 and 1804 are the actual document that recorded in detail the urban planning situation in Ganja, although it should be said that there were no substantial changes in the urban structure even much later. The inner-city development appears quite clearly, and its composite frame, fortress, buildings, grid of streets, highway direction are indicated.

There is no doubt that engineers have made basic plans of Ganja as well as other cities of Azerbaijan solely on military purposes. They were multidimensional and include, but not limited to clarification of the location of military means, and strategic characteristics and fortifications, social aspects and contrasts are quite convincing. They interpret absolutely both general and specific features of the structural organization of historical cities, their individual characteristics, including the value of historical and artistic content (2, p.15).

The plan of Ganja of February 24, 1797 (engineer, Major Ivan Harting) entitled "Plan of Ganja Fortress with nearby esplanade and parts of suburb" recorded the city covering extensive areas with fortress and part of suburb. The latter includes the central city complex as well as numerous residential buildings and gardens. The irregular hexagon of the fortress with bastions on the corners and with gates that led to the fortress was surrounded by two rows of walls, separated from each other at a distance of 70-80 m (3, p.125). The inner wall had six bastions, the outer wall, which in turn with rarely built towers, was less protected.

Buildings and gardens within the fortress were surrounded by a mud wall with towers (4, p. 125). External relations were carried out by roads designated as "the way to Shusha", "the way to Kur and Tbilisi", "the way to Yerevan". The by-pass arterial road around the fortress connected all three roads (4, p. 126).

The central part of the fortress was engaged by the Khan's residence - the citadel, marked as Abandoned Citadel in the map explication (3, p.125). The Khan's residence included a complex of residential buildings, as well as elongated within building plan. Marked here as "stone vaulted gallery leading to the Khan's building", another marked as "old ruined stone Palace", clearly marked courtyards with several reservoirs and fountains, as well as the gate leading to the citadel. The direction of the main streets is clearly visible in the plan, according to the authors, some have acquired the character of a rectangular grid, others "... the nature of the radii, which was an outstanding achievement of urban design" (5, p. 14). The main highway laid along the river, however was "adapted" to the topography of the area, like tracing the streets in Lahij and Sheki (45, p. 14). Such a compact formation of the street system has remained almost intact to this day, and this despite of changes in the structure and appearance of the city (5, p.14). Another layout by engineer, Major I. Harting, also dated February 24, 1797, contains a plan of a "Khan's menagerie" and a regular rectangular planned khan's park with straight like an arrow alleys (3, p. 126).

A major addition to the Plan of Ganja in 1797 should be considered the Plan of Ganja Fortress in 1804 that appeared a bit later (3, p.126). The map indicates fortifications with closely spaced Bastion Towers, which were supposed to be attached to the fortress, and their names were also indicated. The distance between the mud walls around the city varied between 200 m and 500 m (3, p. 126).

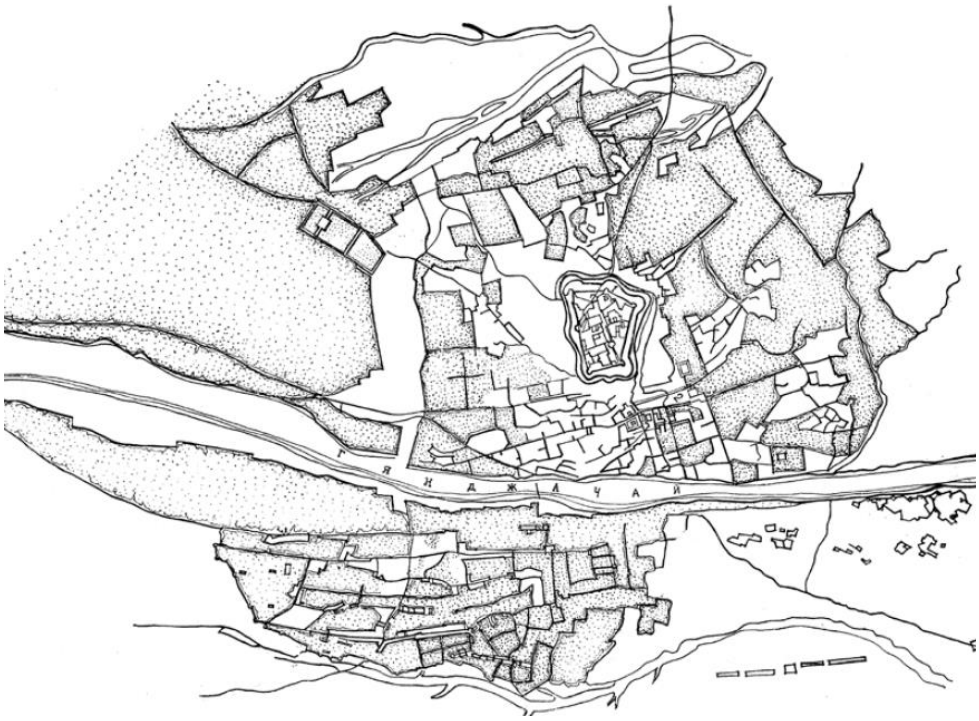

Figure 1: Map of Ganja, 1797

At the very beginning of the 19th century, there were up to 2300 houses, 5 caravanserais and 24 mills.... in Ganja. The length of the city increased to 21 km, 18 streets were laid, and 2 squares were there. Numerous city gardens were irrigated with the waters of 21 ditches (6, p. 14). In the 60-70s of the same century, the city had up to 600 trade stores, 11 caravanserais, 7 hamams, 44 mills, 50 drinking water wells, 2 squares and 38 streets (6, p. 14).

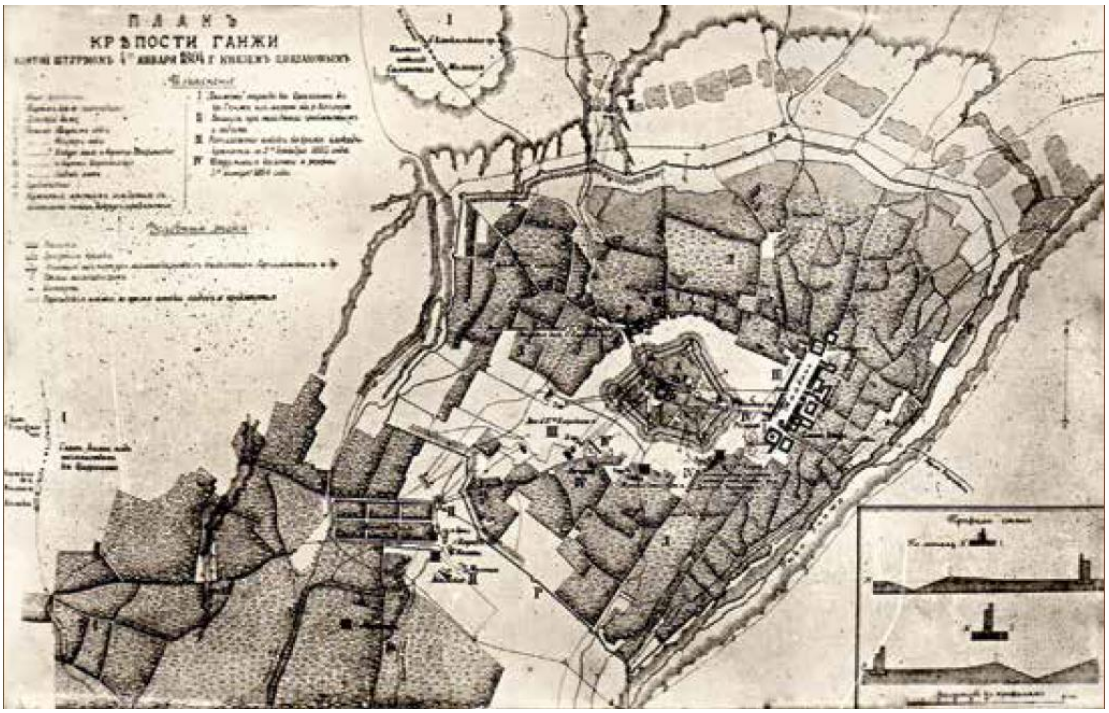

Figure 2: Map of Ganja, 1804

In 1856, according to the order of military governor of Tbilisi, work on drawing up a new plan for Ganja had started (Elisabethpol from 1804 to 1918). Already in the period of its preparation, the existing position of the grid of streets and mahalla was recorded, and 2,500 country seats were observed. However, a certain settlement of the existing situation was made only in the territories that belonged to the Treasury. Therefore, streets and in particular, the central ones were expanded, and the quarters were enlarged (7, p. 91). In the city there were dozens of mills, caravanserais, hamams, city gardens were irrigated with numerous ditches, and dozens of wells provided the population with drinking water. Ganja had become the center of a huge region, predominantly agricultural.

Since 1868, when Ganja became the governorate center (Elisabethpol Governorate), it developed as the major city of the region. By order of the authorities, a new city plan is being prepared, presented to Emperor Alexander II for consideration and signature by 1873 (Civil Architect Ignacy Krzyształowicz) .

The plan Ganja of 1873 became a practical guide to the restoration of the city, with the straightening of streets, "the establishment of relatively simple and geometrically clear forms of neighborhoods" (5, p. 16). The 1873 plan also envisaged the development of the city in a southerly direction, at the expense of the territory of some villages (Baghmanlar village), as well as the southern part of the right bank (5, p.16). In this regard, the population of the city expressed "willingness to contribute" to the reconstruction of the city with free concession up to one-fifth of the areas, which should go for the streets (30, p.173). The city center was undergoing radical changes, the fortress was demolished, including the citadel, although the authorities formally forbade its destruction (7, p.93). The result of the imperial rescript was the loss of a valuable monument of architecture. In this regard, "the city has lost important historical and architectural features that preserved Baku, Sheki and Shusha", rightly pointed put by researchers (7, p. 93). The development of the city was facilitated by the opening of the Transcaucasian railway in 1883, and with numerous structures of different nature and purpose. Ganja was thus linked by railway with Baku, Tbilisi and Batumi.

Figure 3: Map of Ganja, 1873

The planning solution of cities had become of utmost importance, general plans of Shusha (1855), Ganja (1873), Baku (1897) appeared, where main attention was paid to tracing of streets with formation of transport junctions that influenced to known order and led to significant compositional achievements. Ganja was intensively developing, construction works on improvement of urban planning were increasing, educational, provincial and judicial institutions, libraries were being opened, and presentable houses with new "European" motives were being built.

5. CONCLUSION

Topographic plans of 18th and 19th centuries that recorded structure of Ganja are of great interest. These are actual documents that recorded in detail the urban planning situation of the city with intra-urban development, where its composite frame, buildings, grid of streets, the direction of highways is quite clearly outlined. The basic plans of Ganja as well as other cities of Azerbaijan executed during this period are multi-dimensional, and include, but not limited to clarification of the location of military means, strategic

characteristics and fortifications, social aspects and contrasts are quite convincing. They interpret both general and specific features of the structural organization of historical cities of Azerbaijan, their individual characteristics, including the value of historical and artistic content.

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MEGAPROJECTS' FINANCE IN THE POST-COVID-19 PERIOD: CASE STUDIES OF EURASIA TUNNEL AND YAVUZ SULTAN SELIM BRIDGE

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ABSTRACT

A new coronavirus pandemic as known as the COVID-19 impacted on every aspect of daily life. The priority of the states in the second quarter of 2020 was to protect their citizens from COVID-19 outbreak due to uncontrolled spread. The study was undertaken at a time when all the world is still struggling to take the COVID-19 outbreak under control. The states took precautions to control the virus such as restriction on travelling and curfews for every citizen or age specifically. This research is focused on the COVID-19 measures adopted by the Turkish government and their effect on the case study megaprojects' finance at operational phases. Based on these, this research provides a new set of data to the existing body of literature on megaprojects with 'uncertainty and finance relation' through the COVID-19's impact. The research methodology is based on a mixed method and multiple-case study approach with two mega projects in Istanbul, Turkey (Eurasia Tunnel and Yavuz Sultan Selim Bridge) which was financed with the Build-Operate-Transfer (BOT) method. The data consists of a detailed primary source documents and secondary data. The data is collected through the official statement of public administrations, ministries, and statistic offices. This research uncovers how the COVID-19 precautions between March 11 to May 31 in Turkey affected the megaprojects' finances at their operational phases with an exogenous factor, COVID-19 and decrease the guaranteed incomes up to 94%.

Keywords: Megaprojects, Turkey, COVID-19, Finance, Build-Operate-Transfer (BOT).

1. MEGAPROJECT'S COMPLEXITY, UNCERTAINTY AND RISK

Megaprojects are known as large-scale and high-cost infrastructure investments (Flyvbjerg et al., 2003; Lehrer & Laidley, 2008). In addition to these features, complexity, uncertainty and risk are distinctive characteristics of megaprojects' management processes (Bruzelius et al., 2002; Haynes, 2002). These three key features can be observed at different stages of megaproject from decision-making to operation processes of megaprojects.

Complexity can be explained as long and controversial procedures not only in the decision-making but also construction and management phases (Giezen, 2012). Uncertainty is usually affiliated with demand forecasts and cost estimates (Bruzelius et al., 2002). Uncertainty should not be mixed with risk. They are two different features. While risk is known due to the potential problems and statistics; however, uncertainty is unknown or unexpected issues (Giezen, 2012). Uncertainties might be endogenous factors which is internal planning or management issues or exogenous factors which are external issues and they might cause direct or indirect impact on the projects.

Endogenous uncertainties are usually seen at planning periods of the projects but how about uncertainties which are created by exogenous factors (Haynes, 2002). When megaprojects become the subject, unforeseeable changes can come on the scene at any phase due to their scale, long time periods and complexity (Salet et al., 2013). As Flyvbjerg et al. (2003, pp. 28-29) explained 'the reasons for demand predictions' under seven points. One of them is 'unexpected changes of exogenous factor'. Unexpected changes of exogenous factors are not predictable or hard to predict (Flyvbjerg et al., 2003);

such as a sudden and unforeseeable changes like COVID-19 pandemic and its possible impact on the megaprojects' finance.

In this case, the COVID-19 has affected day to day life and, with a snowball effect, the case study megaprojects. A question rises at this point, how did megaprojects are immediately affected by the COVID-19? Therefore, this research concentrated on the COVID-19 measures adopted by the Turkish government and their effect on the case study megaprojects' finance at operational phases in the post-COVID-19 period.

2. METHODOLOGY

The levels of risk and uncertainty can be affected by exterior circumstances such as COVID-19 outbreak. How COVID-19 affected the megaprojects can be categorized in two main groups (1) the COVID-19 measures adopted by the Turkish government and (2) human behaviors such as not prefer to travel for pleasure. This research focuses on only how the measures adopted by the Turkish government prevent the spread of the COVID-19 have influence over the case study megaproject's finances. Regarding this, the research is designed in two stages; (1) to reveal what kind of COVID-19 measures are adopted and (2) how these COVID-19 measures affected the case study megaprojects' finances which are in operational phases of the BOT method.

The research is based on the primary source documents to reveal the measures adopted by the government and performance of the megaprojects in the post-COVID-19 period. Primary source is different than primary data. Both of them were collected by the researcher; however, primary sources do not consist of interpretation anyone (Chatterjee, 2000). These primary source documents include the official statement of the following; Council of Higher Education, Directorate General of Civil Aviation, Directorate General of Highway, Ministry of Education, Ministry of Health, and Ministry of Interior. In addition to these, the statistics are also collected from the Istanbul Metropolitan Municipality Statistics Office. In addition to these, the EIAs of the case study projects are considered as the secondary data sources. When this research has been initiated, the first day of the normalization period (easing the lockdown measures) of COVID-19 was considered as the cut-off point of data collection which was on 1 June 2020. After that point, the collected data is analysed to understand the change between 11 March and 31 May 2020.

The case study projects, Eurasia Tunnel and YSS Bridge fit the definition of megaproject phenomenon as being large-scale and cost over US$1 billion infrastructure investments (Omega, 2012). In addition to these features, their finances and BOT process should be explained in more detail.

The Eurasia Tunnel is located in the southern part of Bosporus Strait in Istanbul. The Strait has three more crossings as well. The Eurasia Tunnel was opened to traffic on 22 December 2016. The Tunnel is financed through BOT method and the consortium is responsible for the operation and maintenance of the tunnel for 25 years, 11 months and 9 days (ELC, 2011). The demand guarantee for the Eurasia Tunnel case is 25 million vehicles per year (68,500 vehicles per day) (CUP, 2011). During the operational phase, the toll for an automobile is decided as 4 US Dollars plus VAT for one way. It needs to be underlined that tolls are not fixed throughout the operational phase and it will increase based on the US Consumer Price Index (ELC, 2011). The toll was increased to 36,40 TL (approx. 6 USD) on February 1st, 2020 for one way1. The Eurasia Tunnel and YSS Bridge are the crossings which charge either way.

The YSS Bridge is the latest constructed bridge which is located at the northern part of Bosporus. The bridge was planned as a part of the northern Marmara motorway system to connect European and Asian continents and serve as a transit route. The YSS Bridge is financed by the BOT method (Cuthbert, 2013) and its building and operation processes are 10 years, 2 months and 20 days based on the tender. The Ministry of Transportation, Maritime, and Communication has announced that the toll for an automobile is decided as 3 USD plus VAT for one way throughout the operational phase (MOT, 2016).3.

1 February 1st was a Saturday. Therefore, the exchange rate on February 3rd, 2020 is indicated USD/TRY (Banknote Buying) 5.9713 on February 3rd, 2020

https://www.tcmb.gov.tr/wps/wcm/connect/tr/tcmb+tr/main+menu/istatistikler/doviz+kurlari/gosterge+niteligindeki+merkez+bankasi+kurlarii

FINANCING OF MEGAPROJECTS

The financing is a critical topic due to megaproject's high cost and cost-effectiveness concerns. Megaprojects are financed with various methods and the responsible authorities may be a government or a coalition of government and private-sector actors (Haynes, 2002). The Turkish government adopted the BOT method for most of the large-scale projects all over Turkey. In parallel with that, the case study projects are financed through BOT method.

BOT method is one of the public-private partnership (PPP) funding tool. BOT contracts play a key role not only for engineering and design but also the finance due to aiming the cost-effective projects. Based on the contract, the private partner might get the payments either from government-pay or user-pay system. Also, contracts can have a performance system for bonus or provisions at different phases of megaprojects (Koppenjan, 2008).

As can be seen in the table below, the case study megaprojects, the Eurasia Tunnel and YSS Bridge have user-pay systems with their demand guarantees for vehicles. The table also summarizes financing methods, tender dates, and construction and operation time the case study projects.

Table 1. Case Study Projects and BOT Agreement (Cuthbert, 2013; CUP, 2011; ELC, 2011; MOT, 2020)

Type of construction	*Construction Cost*	*Tender Date*	*Construction and Operation Time*	*Demand Guarantees*
Eurasia Tunnel	US$1.2 billion	October 2008	4 years and 7 months for construction; 25 years, 11 months and 9 days for the operation and maintenance	25 million vehicles per year 68,500 vehicles per day
YSS Bridge	US$2.5 billion	29 May 2012	10 years, 2 months and 20 days for construction and operation	135,000 in each direction per day

4. MEGA PROJECTS CURRENT STRUGGLE WITH COVID-19 AT OPERATION PERIOD

The COVID-19 outbreak started in the People's Republic of China in December 2019 and spread all over the world in 2020 (WHO, 2020). The life and in parallel with that all investments and constructions have been affected due to the COVID-19 outbreak.

The measures adopted by the Turkish government after the first COVID-19 case are flight restriction, education recess, and curfews (see Table 2). The first precaution which was announced by the government was related to international flights to prevent to have the virus in the country.

Table 2. The COVID-19 Turkish Government Measures (MOI, 2020; WHO, 2020)

Date	Government Measures
31/12/2019	COVID-19 Outbreak in China reported to WHO Country office in China
11/03/2020	First case in Turkey
11/03/2020	WHO announced COVID-19 as pandemic
16/03/2020	Recess at schools and universities in Turkey
21/03/2020	Curfew for age 65+ and chronically ill
22/03/2020	Flexible or remote working for public institutions and organizations
03/04/2020	15-day entry ban to the 30 metropolitan cities and Zonguldak
03/04/2020	Curfew for age 20 and younger
11-12/04/2020	Curfew for 30 metropolitan cities and Zonguldak at the weekend
18-19/04/2020	Curfew for 30 metropolitan cities and Zonguldak at the weekend
23-26/04/2020	Curfew for 30 metropolitan cities and Zonguldak for 4 days
01-03/05/2020	Curfew for 30 metropolitan cities and Zonguldak for 3 days
09-10/05/2020	Curfew for 30 metropolitan cities and Zonguldak at the weekend
16-19/05/2020	Curfew for 30 metropolitan cities and Zonguldak for 4 days
23-26/05/2020	Curfew for 30 metropolitan cities and Zonguldak for 4 days
30-31/05/2020	Curfew for 30 metropolitan cities and Zonguldak at the weekend
01/06/2020	The start of normalization process

Secondly, the government took immediate action and issued the nationwide school and university closure on 16 March 2020. First of all, it was announced as three-weeks break. However, the spring

semester has not been resumed due to the increasing number of new cases. The rest of the semester was continued with remote teaching during the COVID-19 outbreak. Thus, the student circulation in and between cities was prevented.

Curfews as precautions have started on 21 March 2020 in Turkey. Curfews have been experienced in three different ways in Turkey; (1) all people living within the city borders of 30 metropolitan cities[2] and Zonguldak, (2) people over the age of 65 and those with chronic illnesses, and (3) people under 20 years old. In addition to the age specific precautions, there was location specific ones as well. Based on the 2019 data, the 30 metropolitan cities and Zonguldak had curfews which have 78,49% of overall the population of Turkey (TUIK, 2020). Also, these cities have higher population destinies and COVID-19 transmission risk might be higher due to the high interaction among the population. As mentioned in the methodology section, the case study projects are located in Istanbul which the most populous metropolitan city in Turkey with over 15.5 million residents (TUIK, 2020). In addition to these, the government has decided to arrange flexible or remote working for public institutions and organizations on March 22nd, 2020. Therefore, all of these precautions automatically have reduced the daily commute in Istanbul.

Table 3. Average (Daily) Vehicle Numbers on Bosphorus Crossing (IBB, 2020)

		Pre-Covid-19	**Post-Covid-19**			**Impact of Covid-19**		
		March		**April**	**May**	**March**	**April**	**May**
The 15 July Martyrs Bridge	Anatolia=>Europe	92,070	71,112	49,161	46,581	-23%	-47%	-49%
	Europe=>Anatolia	92,045	69,967	45,590	49,273	-24%	-50%	-46%
	Total	**184,115**	**141,078**	**94,752**	**95,854**	**-23%**	**-49%**	**-48%**
FSM Bridge	Anatolia=>Europe	79,318	58,706	31,041	37,406	-26%	-61%	-53%
	Europe=>Anatolia	75,417	59,347	32,673	36,561	-21%	-57%	-52%
	Total	**154,735**	**118,053**	**63,713**	**73,967**	**-24%**	**-59%**	**-52%**
YSS Bridge	Anatolia=>Europe	13,326	14,711	5,299	5,131	10%	-60%	-61%
	Europe=>Anatolia	16,780	16,836	6,615	7,256	0%	-61%	-57%
	Total	**30,107**	**31,547**	**11,914**	**12,387**	**5%**	**-60%**	**-59%**
Eurasia Tunnel	Anatolia=>Europe	22,029	10,320	2,788	5,069	-53%	-87%	-77%
	Europe=>Anatolia	9,157	15,559	2,796	6,543	70%	-69%	-29%
	Total	**31,186**	**25,880**	**5,584**	**11,613**	**-17%**	**-82%**	**-63%**
TOTAL	Anatolia=>Europe	206,743	154,850	22,072	23,547	-25%	-57%	-54%
	Europe=>Anatolia	193,399	161,709	21,919	24,908	-16%	-55%	-48%
	ALL	**400,142**	**316,559**	**175,963**	**193,820**	-21%	-56%	-52%

The table displays the average (daily) vehicle numbers on Bosphorus crossing and how COVID-19 impacted the crossing. To understand the BOT and guaranteed vehicles for the tunnel, all the Bosporus strait crossings should be investigated. It can be said that all the crossing option have been negatively impacted by the pandemic. The total number of every bridge has impacted over 50% in April and May. The YSS Bridge and Eurasia Tunnel should be investigated deeply due to being the case study projects of this research. Both of the case studies are impacted a great degree but based on the figures, while the Eurasia Tunnel had a massive drop in April with 82% and in May 63%, the YSS Bridge had similar drop with 60% and in May 59% at the same period. The table also displays that YSS Bridge and the Eurasia Tunnel have lower vehicle crossing than the 15 July Martyrs and FSM Bridges not only post- but also pre-COVID-19 period. The reason behind these might be having higher tolls than other two bridges in the strait[3]. However, to understand how the government precautions have influence over the financing of the case study megaprojects at operational phases, pre- and post-COVID-19 period should be investigated comprehensively. Therefore, the daily crossing on the Bosporus between 1 March and 31 May 2020 are studied.

[2] Turkey has 81 provinces and 30 of them is entitled as metropolitan cities.

[3] Tolls for automobiles in the post-COVID-19 period are; 36,40 TL (one way) for Eurasia Tunnel; 21,90 TL (one way) for YSS Bridge; 10,50 TL (both ways) for the 15 July Martyrs Bridge and Fatih Sultan Mehmet Bridge (KGM, 2020a; KGM 2020b).

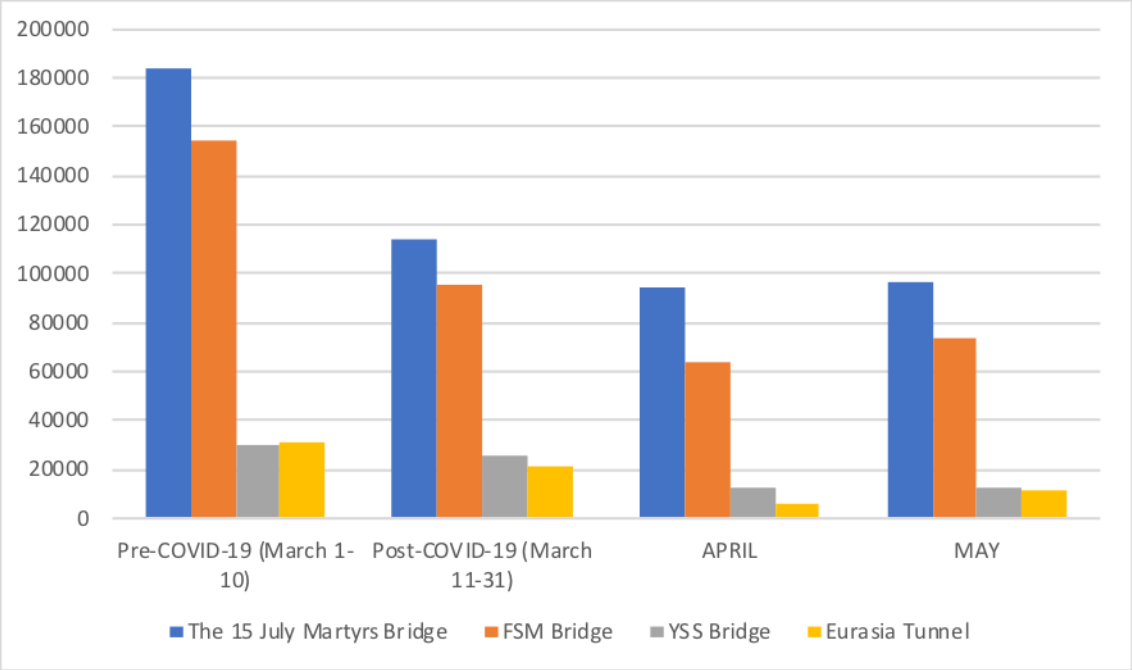

Figure 1. Average (Daily) Vehicle Numbers on Bosporus Crossing (IBB, 2020)

As can be seen in the figure 1, the average number of daily vehicles at the strait crossing has declined during the post-COVID-19 period for all the crossing options after the first COVID-19 case was announced in Turkey. However, the dramatic change has happened during April and May which overlap with remote teaching, flexible or remote working for public institutions and private companies, curfews, and entry ban to the 30 metropolitan cities. In addition to these, the figure 2 unravels that the two case studies had the lowest average daily traffic than the others.

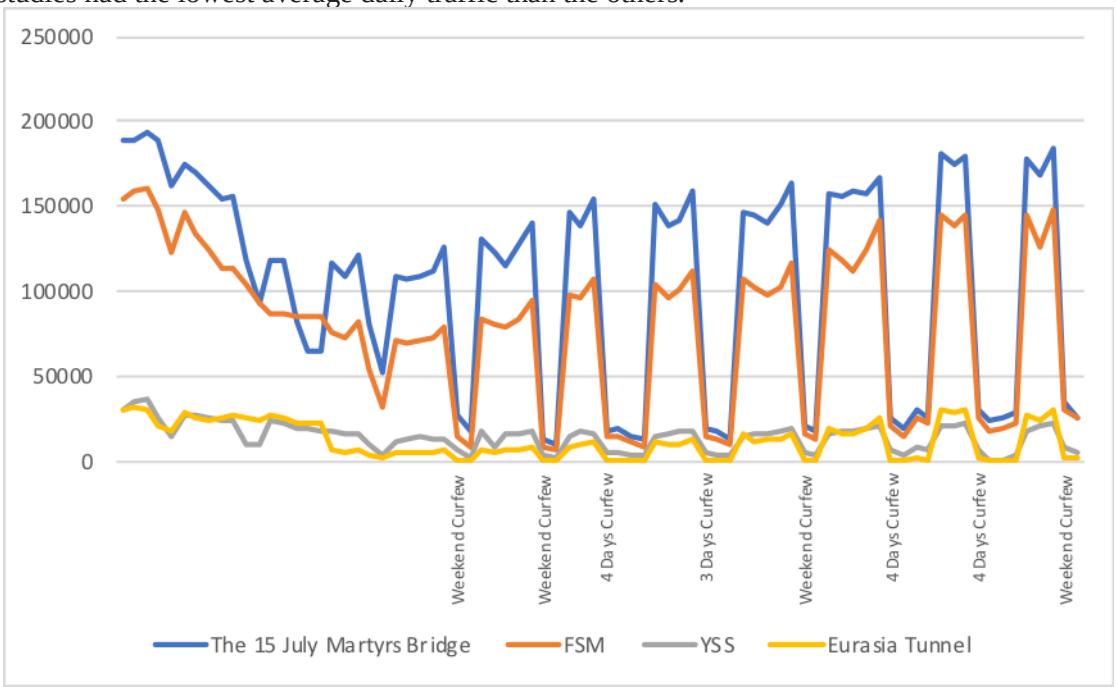

Figure 2. Daily vehicle crossing over the Bosphorus between March 1 May 31 (IBB, 2020)

Figure 2 displays the actual daily vehicle crossing in both directions. This figure explicitly illustrates how the weekend curfews impacted the crossing on the straits. The citywide curfews decreased inner-city traffic especially at the weekends and public holidays. The fluctuation between weekdays and weekend has been continued between 11 April and 31 May 2020. In addition to the curfews, the 15-day entry ban to the 30 metropolitan cities and Zonguldak was started on 3 April 2020. As mentioned before Istanbul is one of the metropolitan cities in Turkey and it might be claimed that this ban has made the number of vehicles drop across the strait. It can be easily seen in the figure that the measures almost flatten the curves of the tunnel and YSS bridge in April. The data has shown how the continental crossings are

affected until this point. However, the Eurasia Tunnel and YSS Bridge should be studied deeply to understand how their finance affected on the light of these numbers. Therefore, the difference between the guaranteed income and the actual vehicle numbers are compared in the post-COVID-19 period between 11 March and 31 May 2020.

As mentioned before in the Table 1, the demand guarantee for the Eurasia Tunnel case is 25 million vehicles per year 68,500 vehicles per day (CUP, 2011). Before the COVID-19 outbreak in Turkey, the tunnel served approximately 30,000 vehicle per day in March (IBB, 2020). Based on the Istanbul Metropolitan Municipality statistics, the total number of vehicles passing through the Eurasia Tunnel crossing between 11 March and 31 May 2020 is 967,480 (IBB, 2020). Pre- and post-COVID-19 period figures in the Table 4 show us that the tunnel cannot reach the guaranteed vehicle number between March and May 2020. Based on the agreement, the expected vehicles for post-COVID-19 period (82 days) is 5,617,000 vehicles.

Based on the EIS of the YSS Bridge, the expected number of vehicles is 135,000 in each direction per day (Cuthbert, 2013). The total number of vehicles passing through the YSS Bridge crossing between 11 March and 31 May 2020 is 1,277,733 (IBB, 2020). However, the expected vehicles for post-COVID-19 period (82 days) is 22,140,000.

Table 4. How much the case study projects have been economically affected between 11 March and 31 May (DHMI, 2020; IBB, 2020)

	The guaranteed number of vehicles	Actual crossing	Economic burden	Difference between the guaranteed and actual revenues at the post-COVID-19 period
Eurasia Tunnel[4]	5,617,000 vehicles[5]	967,480	(5,617,000-967,480) * 36,40= 169,242,528 TL	-82.78%
YSS Bridge[6]	22,140,000 vehicles	1,277,733	(22,140,000-1,277,733) *21,90= 456,883,647 TL	-94.22%

The table unearths how the COVID-19 measures affected the case study megaprojects' finances which are *in operational phases* of the BOT method. The revenues of three case study projects are less than expected. These numbers clarify how the COVID-19 put an additional burden on the government due to the demand guarantees for the case study projects. Traffic forecasts are often over-optimistic and forecasts and actual revenues of the projects can be different between 20 to 70% (Bruzelius et al., 2002). In the case study aspect, the difference between the guaranteed and actual revenues in the post-COVID-19 period is 82% for the Eurasia tunnel and 94.22% for the YSS Bridge.

5. CONCLUDING COMMENTS

Megaprojects' financial situations have been discussed in the literature by various academics under complexity, uncertainty and risk (Dimitriou et al., 3013; Giezen, 2012). However, an effect of a pandemic has not been thought until the COVID-19 outbreak which has impacted daily life and many industries including construction industry all over the world. This research tried to shed a light on how the megaprojects in operational phases have being impacted by an exogenous factor, COVID-19. Therefore, pre- and post- COVID-19 statistics are compared to recognize the breakpoints during the outbreak.

Based on the Flyvbjerg et al. (2003)'s research, they mention that nine out of ten megaprojects were ended up with cost overruns (Flyvbjerg et al., 2003). As can be seen in the Table 6, the difference between demand income and actual revenues of the projects in the post-COVID-19 period is between 82 to 94.22%. All of the case study projects are highly affected based on the Istanbul Metropolitan Municipality statistics data. The post-COVID-19 period is still full of uncertainties. Therefore, these figures might be fluctuated with new measures until the pandemic has no impact on day to day life. In addition to these, it should be highlighted that this research does not focus on the human behaviour post-COVID-19 period. Therefore, even though the restrictions are removed loosened or lifted, it might be claimed that declining numbers might be observed from June onwards when it is compared with previous years. All of these mean that operational phase of the BOT came across with an unexpected situation, in this case pandemic, and exogenous uncertainty regarding the future.

[4] The data do not classify the vehicles. Therefore, all of the vehicles are accepted as automobiles.
[5] The expected number of vehicles and the actual numbers represent the date between 11 March and 31 May 2020. Therefore, the data is based on 82 days.
[6] The data do not classify the vehicles. Therefore, all of the vehicles are accepted as automobiles.

The post-COVID-19 period might enlighten exogenous uncertainty over the megaprojects' finance. Therefore, not only the case study projects in Turkey but also most of the megaprojects in the world are likely to come across with greater financial burdens at operational level due to the agreements between private and public partners. Even though, these are not cost overruns at the construction phases but they still create burden for tax-payers. Consequently, re-shaping of BOT agreement is highly possible in the post-COVID-19 world to avoid unexpected financial burdens and be more prepared for crisis management.

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MODERN POTTERY: EVALUATION ACCORDING TO THE SUSTAINABILITY OF TRADITIONAL IN AVANOS (CAPPADOCIA)

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ABSTRACT

Avanos is one of the towns in Cappadocia where is very famous with fairy chimneys and incredible natural beauty. Ürgüp, Göreme and Uçhisar, that are other towns in Cappadocia, are more famous than Avanos, because of the success of management methods of cultural wealthiest. Cappadocia region has natural, historical and cultural site such as fairy chimneys, underground cities, historical buildings from Byzantines, Romans, Seljuk's and Ottoman Period are the most important values of region.
Avanos is also located in this region and it has historical buildings, cultural values like as traditional pottery production, carpet weaving, and natural beauty as fairy chimneys. Town has not been devastated for the tourism. Traditional pottery ateliers are located in center of Avanos and use historical caves for production, selling and exhibition. Municipality of Avanos and local investor want to use this conventional life style in modern pottery ateliers for development of tourism. But they don't want to lose their traditional lifestyle and historical site. So they develop new method to sustain of the traditional handicraft. They interpret new construction techniques and new material according to traditional pottery ateliers. They construct atelier under the ground, use caves as a historical life style but with modern materials. So today's comfort condition is not forced to the historical caves. In this way traditional life style is sustain in modern, new ateliers. This paper aim is making evaluation and research of some cases in Anavos. They are constructed in modern style but use traditional pottery production.

Key Words; Tourism, Cappadocia, Avanos, Traditional Life Style, Traditional Pottery Production

1. INTRODUCTION

Cappadocia, with important cultural richness and natural beauty, covers Nevşehir, Aksaray , Nigde, Kayseri and Kırşehir, in the Central Anatolia of Turkey. However, the most visited and well-known parts of the region are Urgup, Avanos, Göreme, Derinkuyu, Nevsehir, Ihlara, Mustafa Pasha, Kaymaklı and Ortahisar districts, which are located in Nevşehir border. Especially, fairy chimneys, which were formed by nature, are one of the important cultural and natural heritage in Turkey.

In this study, Avanos, where is an important residential area of Cappadocia, is examined in respect of discussion of the cultural and spatial sustainability on new ceramic museum and pottery atelier which was designed to sustain of localities. Also tourism will be discussed on private museum. In addition, local people and local investor, who are very significant of the cultural continuity, are investigated according to conservation criteria of cultural heritage.

Figure. 1[1] Location of Cappadocia in Turkey

2. AVANOS

2.1. Avanos

Avanos history, which goes back to the Bronze and Iron Ages, is known by excavations which are ongoing today. The exact date cannot be determined with certainty, but traces which are found in investigations are from Paleolithic period. Avanos was conquered by Med between 610-550 years BC, then Kingdom of Cappadocia came under the sovereignty of region between BC 332-AD 17. From some references, Avanos was seen as a third in political and religious significance during The Kingdom of Cappadocia period. Cappadocia became a Roman territory in Anatolia in A.D. 17.2 According to Strabo's description, Avanos was very wealthiest and developed city in this period.3 It came under Byzantine A.D. 395 due to the separation of the Roman Empire. This process continued until the 1071 Malazgirt Victory. Sultan Alparslan, who was sultan of Great Seljuk Empire, conquered town in 1071, then Avanos was governed by Karamanoğulları until of Ottoman Empire conquer by Sultan Mehmet in 1466. Avanos was joined to Nevsehir in 1838, to Urgup in 1853, to Kırşehir in 1888 and at last to Nevşehir in 1954.4 It, that was located in two sides of Kızılırmak, was developed and grown since then, and it has become a tourist town with a population of 12,000.

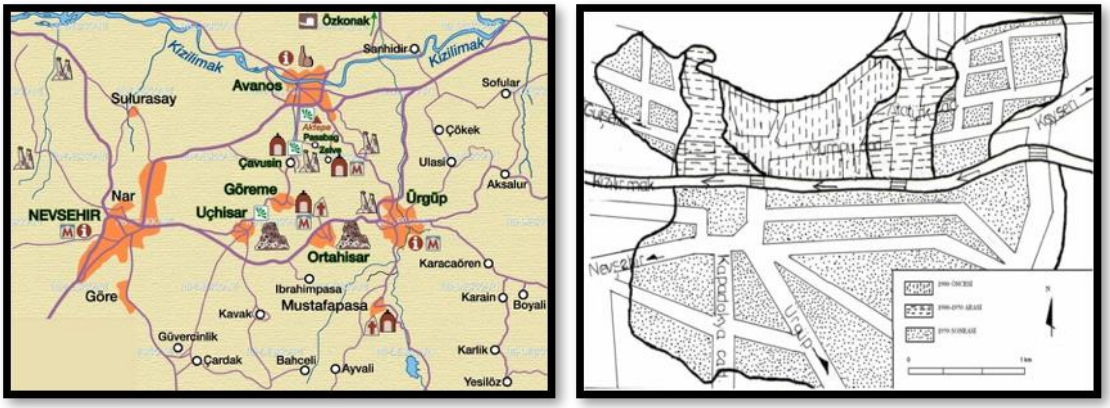

Figure. 2 Location of Avanos[5], Historical Development of Avanos[6]

[1] http://kesfetsene.com/kapadokyaya-nasil-gidilir/
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[4] http://avanos.bel.tr/avanos/blog
[5] http://www.resimbul.com/kapadokya/kapadokya-haritasi.xhtml
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Avanos is separated in two parts by Kızılmırmak, southern slopes of it still conserve historical authenticity and other side represents modern face of town. A large part of the southern slopes of the traditional area is preserved today and has been declared a protected area in legal procedure. Monumental buildings and traditional residential still exists in this part. South part of Avanos has organic street pattern with houses which were mostly built on two floors above ground. Houses generally have one or two floor underground basement. Generally houses have wide doors which are opened to the courtyard, service spaces like as kitchen are located on ground floor and living areas as a bedroom or a living room are located on the top floor. Traditional buildings were built by masonry techniques on rock foundations with stone and wood. The tuff stone, which is one of the most important values of Cappadocia, is seriously used in Avanos. Especially underground cave system has different levels in the basement because of tuff's easily working. Dwellings, which are approximately 100 or 150 years old, are deteriorated due to time. Also land erosion caused serious deformation to the buildings and most of them not used because of these reasons. Because of the erosion, users were forced to move to disasters houses which were built on the opposite side of the river in 1968.One of the most important traditional structures is stone bridge that connected north and south side of Avanos. Its construction was started in 1898 and finished in 1900.

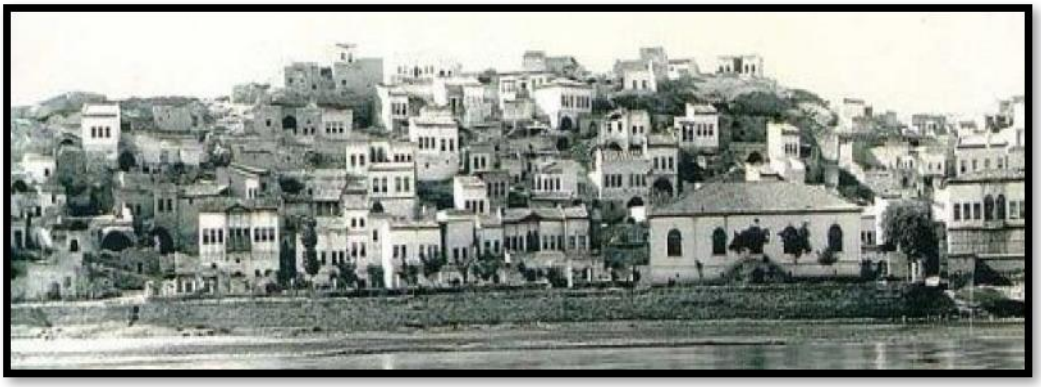

Figure. 3[7] Avanos in 1937

The word of Avanos came from Seljuks period. When "Avanos/Evenuz" is separated as "Evan" and "-uz", "Evan" means requirements that used in the kitchen and "-uz" means place so when it used totally it means the place where the kitchen requirements formed. In this context, pottery which is always important in history of town, gave name of the town as Avanos.8 That is known, producing of pottery is traditional handicraft since Hittites. Ceramic clay, that was formed by red soil, which was brought from Kızılırmak, and the shaft takes shape in the hands of artists. As well as pottery, a variety of traditional crafts (dish / pot crafting, carpet weaving, wine production, etc.) has been in existence in Avanos. 9 Cappadocia as a region, tourism potential is quite high. Region with natural beauty, fairy chimneys, topographic features and cultural wealth is preferred by the both foreign tourists and domestic tourist. This potential has experienced after 1950 in Cappadocia but it was realized in Avanos later. Tourism potential was began to uncovering from 1960.10 Especially hotel investor has led to a boom in tourism potential of the area. However, the rapid deterioration was not lived in Avanos like as towns (Ürgüp, Göreme vb). Both of the conservation conscious cultural heritage of people and conscious investor, who constructed hotel outside of town, that has been partially effective in protecting the area. Cultural continuity and also spatial continuity, were ensured by local people and cultural heritage is tried to conserved, but because of the economic problems caused, the sustainability conservation process have hampered in Avanos.

2.2. Pottery Art in Avanos

In the early 1900s the sector had 250-300 pottery ateliers and master, but nowadays it lost importance in spite of the people conscious and administration support. The economic benefits sourced on tourism sector, so it has led to a shift in another direction. One of the negative effect of Tourism, has changed the

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traditional manufacturing sector, so craft buy-sell system, which is directed the feature to be more practical. This is caused reduction of labor amount, also has not led to the growth of new masters. Despite of the contraction in the industry, the majority of conventional methods currently are continues around 50 atelier in Avanos.[11] Most of the pottery ateliers, that are located in the center of Avanos, are in the natural rock-hewn cave, and also are focus of attention of the visitors. Traditional ateliers are also located in southern slope of town.

Suitable soil structure comes together with the workmanship, that makes perfect pottery art and this art has become known all over the world and Turkey today. Avanos pottery history withstands back to the 13th century. Throughout history, this activity was being used in the center of the town.[12] It is also done in traditional methods.[13] Terracotta production, used in the daily usage, changed today. Terracotta production began to use for oriented souvenirs to the tourist more than a quarter century. These changes can be determined simultaneously by the mobility of tourism.

In this context, Cappadocia's historical and natural structure changes are evaluated for the tourism, Avanos can be determined as a “Cappadocia Crafts Centre”. Traditional pottery production, especially with changes, has been reorganized in new approaches for the spatial and production system.[14]

3. SUSTAINABILITY OF CULTURAL AND HISTORICAL VALUES; CASE GÜRAY MUSEUM

"Avanos Underground Pottery and Ceramic Museum", which was began construction in 2009, build by the Güray Ceramic, was completed and opened in 2014. The museum's investor stated that, their target is to showing of the evolution of pottery and ceramics in Anatolia with the original ceramics works from earliest times to the present day and to release of these cultural values for future generations. Museum, which will serve as a cultural center, located on 1300 square meters area. Different sections are planned in the museum. First part is exhibited artifacts which dated from the earliest times until the 20th century. In the second part, there are 20th century artifacts and also private works which painted by the artist. The third part is designed as cultural center. Periodically, works of sculpture and ceramics, pictures, which made by artist, can be exhibited there and this section also used as a conference hall for a variety of meetings and events. A library and a cafeteria is also in the museum.[15] The function of the museum as well as in ceramics production was well maintained. This part of the museum is show how to produce pottery in traditional system. Also visitors can be examined their experience in this part. Besides of the traditional production method, modern system production can be seen in the building. Also there is a production sales unit for visitors who want to buy.

Avanos is a residential area, where underground had been used extensively throughout history. There are many underground cities around the settlement.

[11] Çobanlı, Zehra ve Canbolat Ayşe “Avanos Çölekçiliği”, Eskişehir: Pişmiş Toprak Sempozyumu Bildiriler Kitabı, 2010.

[12] Aslan Emet Egemen, Avanos Çömlekçiliğinde Kaybolan Bir Değer: Kara Fırın, İdil Dergisi, Cilt 1, Sayı 4, 2012,Ankara.

[13] Yıldırım Y., Avanos Kent, Y.l. Tezi, Sosyal Bil. Ens. Atatürk Ün. Erzurum, 2006

[14] Hovardaoğlu S. Ç., Geleneksel Üretimin Ekonomik Odaklı Yeniden Biçimlenişi: Avanos ve Çömlekçilik, 4. Uluslararası Eskişehir Pişmiş Toprak Sempozyumu, 2010, Eskişehir.

[15] http://www.fibhaber.com/nevsehir/sarkozyye-cevapnevsehir/gazeteci-ile-kavga-ettigundem/fatih-altaylinin-en-uzun-gunuteknoloji/iphone-4s-ne-kadarnevsehir/suriye-ile-savasa-hazirizgundem/pkk-ile-gorusulecek-mispor/milli-takimin-rakibi-almanya-canliekonomi/ispanya-ve-italyaya-fitch-h1584.html

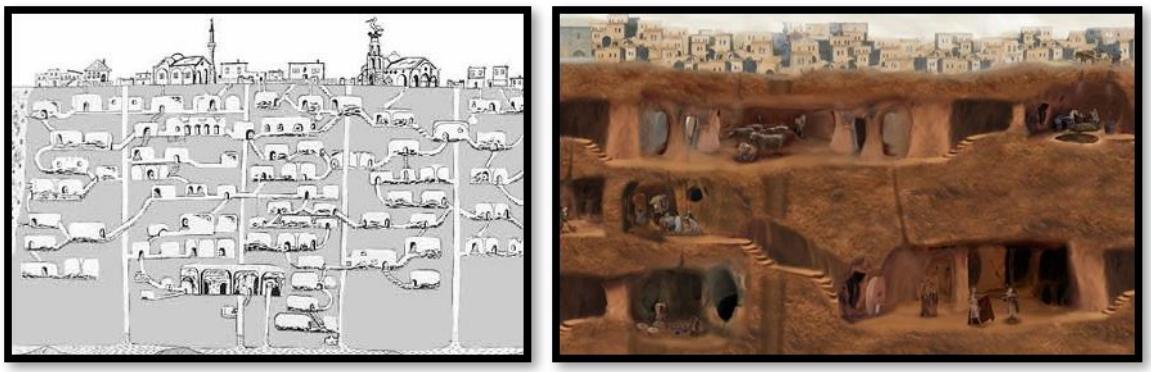

Fig. 4[16] [17] Derinkuyu Underground City

The starting point of the museum design had been built an underground city. Natural stone material, which is very important advantage of the field, has been easily processed and the masters of the masons, who know the capacity and possibilities of stone, has enabled the realization of such an initiative. Showing of the modern living conditions, the usage of traditional methods, to show itself as an exhibition place of the underground and also pottery, which is an important cultural value of Avanos , shown as visual arts and supplied its production has been an important gain for town.

Fig. 5 Plan of Güray Museum

Museum is providing cultural richness as well as the transfer of these values for future generations. Also it want to supply traditional spatial continuity and construction systems, also has been to ensure continuity. A museum and production sites, which has intertwined both cultural and spatial development also traditional context, is built.

Fig. 6[18] Construction details of Museum

[16]http://avanosevi.com/avanos

[17] http://www.mailce.com/wp-content/uploads/2013/05/derinkuyu-yer-alt%C4%B1-%C5%9Fehri-e1368820182885.jpg

[18] http://www.guraymuze.com/foto-galeri.php

Fig. 7 [19] Details of Museum

4. CONCLUSION

In the Cappadocia region, Avanos is separated from other settlement with traditional crafts sustainability and conservation. In traditional conservation approach, local user participation is the most important factor to the true conservation. If local people aware of its cultural heritage and try to conserve, conservation process will be shorted. This consciousness is very important to true conservation decisions and sustainability of conservation.

In this context, experienced in Avanos, that is recognizing as local values to create modern spaces according to today comfort conditions, using by traditional techniques and materials. Many settlement in Cappadocia, lost its original values and transformed as a decor, for the sake of tourism rent

Buildings must be conserved with their authenticity, must be evaluated in today's condition and must be applied by correct approaches. These are the most important criteria to supply true conservation. But accomplishment of this requirement is difficult to practice especially in some areas. Generally, Avanos is dealing with traditional values and adapting to the today with individual applications. In this context, Güray Ceramic Museum and Production Center is highly successful practiced. Avanos will be moved to other level in conservation process with this project, which was started by individual initiatives then completed with public support. Unfortunately, today, Avanos have two different users, one is conscious of cultural heritage and try to conserved, other in not aware of this wealth. But with this museum project process is accelerating towards to the conscious conservation for Avanos.

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[9] http://avanos.bel.tr/avanos/blog

[19] http://www.guraymuze.com/foto-galeri.php

[10] http://www.resimbul.com/kapadokya/kapadokya-haritasi.xhtml
[11] http://wowturkey.com/forum/viewtopic.php?t=99552
[12] http://www.fibhaber.com/nevsehir/sarkozyye-cevapnevsehir/gazeteci-ile-kavga-ettigundem/fatih-altaylinin-en-uzun-gunuteknoloji/iphone-4s-ne-kadarnevsehir/suriye-ile-savasa-hazirizgundem/pkk-ile-gorusulecek-mispor/milli-takimin-rakibi-almanya-canliekonomi/ispanya-ve-italyaya-fitch-h1584.html
[13] http://avanosevi.com/avanos
[14] http://www.mailce.com/wp-content/uploads/2013/05/derinkuyu-yer-alt%C4%B1-%C5%9Fehri-e1368820182885.jpg
[15] http://www.guraymuze.com/foto-galeri.php

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URBAN DEVELOPMENT AS A DIALECTIC BETWEEN TRANSPORT SYSTEM AND LAND-USE: THE CASE OF TEHRAN'S PARCEL STRATEGIES

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ABSTRACT

The rapid population growth and urban transformation occurring in cities across the world is leaving its imprint across distinct geographic, socio-political and cultural local variations. Within diversity of situation and a complex context urbanism scholar recognize the common denominator; a process of urbanization without form, limits and consideration for the natural environment in cities.

Iran's capital city; Tehran is not an exception being impacted by the rapid urbanization process within the last 3 decades that has been exacerbating existing dynamics of sprawl and urban fragmentation. The metropolis of 9million has known rapid development in a relatively short period of time. Major areas of the city are developed according to different land subdivision models for construction of villas and residential and commercial buildings based on plans and measure if early XXth century. The city of Tehran was developed on latter model until the end of the Iran-Iraq war in 1987. To face the surge of population as a result of internal migration waves, Tehran's municipality authorized new higher constructions. The densification strategies, which were carefully conceptualized by city authorities, led in practice to the reduction of quality of life in transformed spaces. Indeed, this latest trend of urbanization in the capital unfolded with no adaptation on the urban transport policy side still predominately driven by the use of individual cars resulting in increasing congestion and air pollution. Meanwhile to face the increasing demand for parking space, urban designers and architects advocated for the easy and unsustainable practice of retrofitting vacant land and greenspaces into parking spaces. The resulting concretization of the land engulfed greenspace into grey spaces with the immediate result of increasing temperature and sealing-off the soil in many areas, expansion of heat islands and generally speaking disrupting natural dynamics including harvesting rain water run offs across the city in favor of a land use logic based on densification and expansion of the built areas.

Based on this context this article aims to describe some of the new devised strategies such as Transit-Oriented Development (TOD) and redesign of Parcel Plans, to better decipher new strategies and tools to transform and retrofit existing urban interstices, with limited environmental and social value, into higher quality urban areas. As such the right compromise between mobility needs of growing population and land use through the generalization of Transit Oriented Development model can participate in improving urban life through connecting transport networks with the built environment while reducing the use of individual cars. Further, the use of both models by scaling down mobility and land use to neighborhood and street level also enables the municipality to develop greater resilience of metropolitan area towards future shocks such as pandemics while mitigating negative environmental externalities at smaller yet more implementable scale of parcels, streets and neighborhoods.

Keywords: Transit-Oriented Development (TOD), Parcel Plan, Unqualified Urban Densification, Greenspace, the City of Tehran

1. INTRODUCTION

Rapid population growth and transformation are occurring in cities across the world. Urbanism scholars recognize the general process of urbanization - without form, limits and consideration for the natural environment – as the fourth urban revolution, termed metropolitization [18]. This trend is the result of various complex processes of urban transformation and transition, which need to be studied in the historical context of spatial planning and policy formulation. Accordingly, many neologisms have emerged, clearly reflecting changing boundaries, morphologies and scales of human settlement patterns [13]. These processes are characterized by a completely new ratio between built environment and open urban spaces, as well as between permeable and impermeable land surfaces [44], all connected in different ways with the transportation system.

The Tehran metropolitan area has not been the exception to the global trend, being a sprawling and fragmented megalopolis [28]. The roots of the Tehran's urban predicaments can be traced back to the political systems driving development trends, with massive impacts on the population and the environment. In particular, the transport system development has not been kept in coherence with the population surge and the increasing demand for interurban and periurban mobility. Neglecting public transport, in favour of the continuation of design and planning practices putting the individual car at the heart of urban development model with expansion of freeways has been perceived as the way forward for increasing demands to face mobility needs and the consequent problems. In this context, the analysis of interactions and gaps between urban policies and visions with practices on the ground will provide us with a new reading of transformations at play in modern Tehran and real needs in terms of transition to greater sustainability and better urban life for the population.

Some of the answers to our inquiry lies in modern Tehran's planning. Indeed, departing from previous development practices 1940s presented a turning point in the capital's development. The then devised urban policy legalized 60 percent of the parcels for construction and the rest were designated freed areas to be utilized by the population for developing green space. This model of urbanization resulted in an unplanned system of greenway which treated by property of the land, with no financial input by the municipality. Tehran was developed according to this model until late 1980s and the end of the war between Iran and Iraq. This episode was marked by massive internal migration brining the population to Tehran in search of employment and shelter. At this time, the municipality authorized the construction of new buildings in the majority of areas of up to five floors as an alternative to urban sprawl. In addition, from 1990 onwards, to increase its budget and revenues, the municipality offered developers the possibility of "buying density" above the existing limitations in the development plan. The densification strategies were effective, but not coordinated with other elements of urban development, such as transport and environmental strategies. To answer to the increasing demand from parking spaces and inadequacy of parking areas, Planner and architects had to devise plans to transform free and vacant spaces into new parking spaces. This urban development model encroached upon the green space that had tended by the population, thus contributing to increasing environmental externalities, reducing the biomass, seeling-off soil on built areas and as a result lowered quality of life for urban dwellers.

The densification policies associated with the expansion of individual cars usage, led to an urban context characterized by severe traffic congestion and air pollution compounded with impacts of Climate Change such as increasing temperatures and consequently the expansion of heat islands in built and densified areas. Given this trend, Tehran's metropolitan area can only benefit from a new coordinated urban development plan to promote a type of densification that also produces a higher quality of life for the population by reducing environmental externalities and creates new co-benefits. Thus, this article attempts to explore the interactions between spatial, social and environmental aspect of urban development processes that can be reinforced through the deployment of TOD based on the experience of Tehran. With that goal this paper while revisiting well documented urban development models such as TODs in connection with the new parcel plan localizes those concepts within the new reality of the Iran's capital megalopolis.

2. URBAN DEVELOPMENT CAUGHT BETWEEN QUALITY DENSIFICATION AND URBAN TRANSPORT SYSTEM

Often density has been perceived as limited technical capacity and the materials of construction. From the planning perspective density is often put in coherence with the modes of transport, often driven by the various mobility needs and scales as well as means of transport from use of carriages and horses to modern times automotive vehicles and public transport. Technological developments, in the form of elevators and motorized vehicles, allowed for density to change through vertical development (skyscrapers) and also horizontal (suburban neighbourhoods accessible by transport) [4]. However, it should be emphasized that the height of buildings is not in the true sense a density indicator and as a consequence, the large presence of collective buildings does not necessarily correspond to high levels of density. Similarly, density does not automatically mean a decrease in urban sprawl because the demand in the real estate market that refers to dense or scattered areas do not correspond to the same types of clientele [39]. To better analyse densification, some authors [16] have highlighted the importance of population density levels. This indication can be associated with different urban planning systems like transport systems[1].

It is widely accepted that densification and sprawl, as two models of urban development, cannot be considered and dealt with in isolation in separation from mobility needs and conditions across the metropolitan area and the transport system need to be integrated within any urban development strategy including those driven by density. Privileging public transport development within greater urban development strategy has become the canon of urban planning and retrofitting even in sprawling urbanized areas across the planet. In this respect Brinckerhoff has established that if a residential area has a performant public transport system, where residential density increases by 10%, the use of public transport increases by 5% while the number of people with a car decreases by 0.5% [39]. Density is hence an intermediate variable and not always a determining factor in mobility choices [53]. Within this vision, the quality and effectiveness of the offer and the average distance between places of residence and access points to the public transport network also influence its usage [32]. Cervero [16] stated that the idea is not only to have more densification of population, but also to adapt design and management of offer and demand in term of public transport to better coordinate urban development with the transport system capacity and reality. Indeed, the reality on the ground is indeed heavily influenced by the legacy of an urban development based on individual transport system often equated to economic and social progress in a majority of cities in the world like Tehran.

Increasingly, driven by acknowledgement of urban transport's share in localized environmental externalities such as urban air pollution or more global ones in the case of CO2 emissions, the general trend in urban development and management has moved towards a vision of transport system that can be part of the quest for co-benefits and not pointed-out as the source of the problem. From this point of view, with a wide body of literature Bonnet [8] notes that the increasing share of individual transport system within urban areas is behind nuisances (noise and atmospheric pollution), hazards and risks (insecurity linked mainly to the automobile), and a threat to the environment. These problems being even more serious when the population density increases in the city as the newly arrived population also uses individual car for mobility. Further they also need more places for parking purposes. The result is a degradation of the quality of urban life by reducing the natural urban spaces, limiting benefits of traditional urban mixity added to obvious environmental negative impacts at the metropolitan scale.

In this context the concept of Transit Oriented Development or TOD that emerged in 1990 showed its capacity to mitigate some of externalities and be an essential tool in the urban planning as it was deployed across North American cities [16]. Peter Calthorpe, in his seminal publication, The Next Metropolis, describes TOD as a concept encouraging the creation of mixed-use living spaces (Shops, Jobs, Residences) that are located close to public transit services; an average radius of 2000 feet and at the heart of better living urban models [15]. According to him, the concept of TOD is based on simple principles for solving the problems arising from density and the individual transport system. The strategies supported by the TOD concept emphasize the "3 Ds":

[1] For example, in terms of public transportation, in the case of Stockholm, which is a good example of densification around public transport, the average number of people per urban core along the commuter train is 35,000 persons per hectare. Suburban train stations in the Montreal area have a target of approximately 1,000 residential units within 750 meters from the station.

- Density: dense urban development;
- Diversity: multifunctional and mix social development;
- Design: The public transport stations should be areas that are attractive to the user. For that reason, the influence area needs the new design in different urban aspect particularly in terms of walking and cycling. Principles of quality in this development have been detailed as atmosphere, fluidity, safety, service offer, and readability [45].

The underlying principle is to improve the connectivity of the different urban functions and to concentrate residential density and employment in the neighbourhood of public transport nodes in an intermodal context [47]. This public transportation hub has to be located at the heart of the district to play a central role in the neighbourhood [11]. Effectively implemented TOD strategies can reduce the negative externalities of the individual transport system in urban transformation as mentioned previously. For example, households turn to public transportation as they do not need to use the car, which reduces motorized travel [46]. Reducing motorization travel induces the decrease in demand of space to be associate to individual cars. Thus, the city can use the freed up space to deploy urban greening strategies, expansion of public spaces and better respond to and anticipate the demographic push in urban areas. It is important to understand that the nodes of public transportation must be part of a strategic and complementary plan at different scales, as the TOD model can hardly live in and of itself. With this perspective, each TOD based neighbourhood is complementing others linked through transport corridors [48]. This model of planning reverses the dynamic of sprawl, urban fragmentation, pollution and more importantly it provides an alternative to automobile dependency reducing its many negative impacts [19]. These outcomes are possible if within TOD deployment, the government and municipality promote and prepare the necessary conditions accompanying urban transformation (often in consultation with the end-users). For example, the public transport service must be able to provide a competitive offer against the car in term of accessibility in origins and destination as well as pricing to ensure inclusiveness and fair access to mobility [38]. The government must also consider measures to reduce the attractiveness of the automobile, such as limiting access to parking by reducing the number of spaces and increasing costs. To reap the full benefits of TOD, delivering well-designed urban forms is key. For that reason, the new urban morphology influences the attraction of public transport system. One parameter in urban morphology is parcel plans, in particular, regarding the relation between the public space and roads. The parcel plan which is closed by the walls and building create a spatial fragmentation in the city but, on the other hand, the parcel plan which has the relation with public space improve the pedestrian circulation and accessibility in the neighbourhood. The new urban morphology needs the planning and the municipality support to encourage the population and developer to participate in new morphology adaptation.

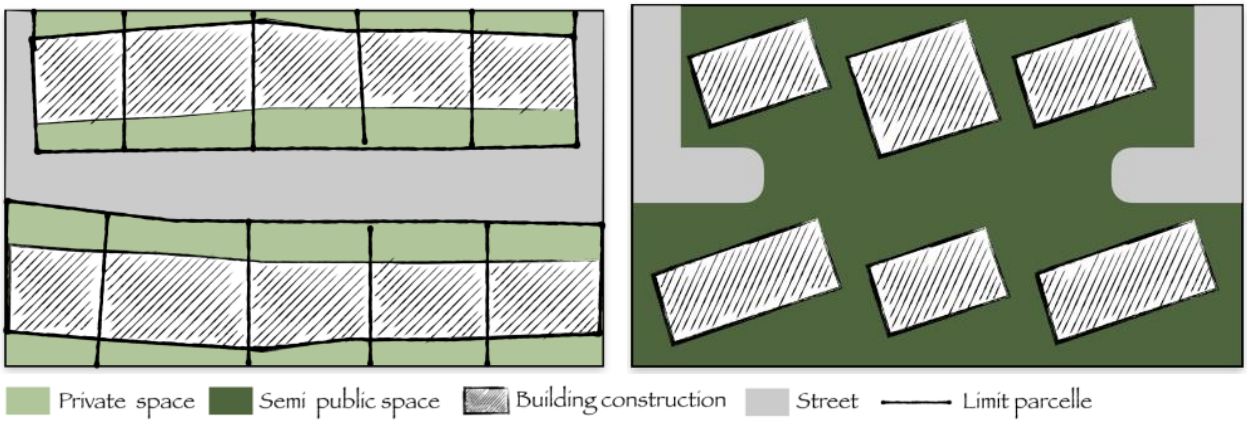


Figure 1: Morphology to favorize private space
Source : Alireza Hashemi Behramani (2019)

Figure 2: Morphology to favorize semipublic space
Source: Alireza Hashemi Behramani (2019)

Successful TOD requires careful coordination between transportation planning and land use planning choices starting with a careful mapping of neighbrhoods that connects the movement patterns of end-users in that area with the parcels configuration hence juxtaposition of two sets of urban spatialization. In other terms as Da Cunha [18] notes “the reconstruction of the city on the city is a central strategy in urban development”. This duality needs to aim the production of an urban space with higher density of population in correlation with an efficient public transport system that encourages walking and which proposes a mix of functions and social mix [14].

3. LOCALIZING TEHRAN'S DEVELOPMENT CAUGHT BETWEEN SPRAWL, DENSIFICATION AND ENVIRONMENTAL DEGRADATION

Tehran, as the political and economic capital of Iran, enjoys a central position in the Iranian urban network. It is a relatively new city compared to other major Iranian ones, being originally a small village in the north of the ancient city of Rey. Until the eighteenth century, Tehran was a large village characterized by farms, orchards, springs, streams and wonderful landscapes. The decisive moment in the evolution of the city occurred in 1789, when it was established as the capital of Iran due to military reasons given its strategic position. In 1842, the first map created by Mr. Berezine, a Russian tourist, shows the urban organization of Tehran. It is surrounded by a fort and gats that assure the connection of the city to other parts of the country. The citadel (political power), the mosque (religious power) and the different neighborhoods characterized the city, which was developed in the interior of the fort. Motorized cars were brought to Tehran in 1890 by wealthy families. Like elsewhere the increasing number of motorized cars created the need to have dedicated spaces within the urban fabric altering existing street and alley patterns. This, new street were built and modified the structure of historical fabric of the city. In addition, the demand for housing for new inhabitants led to the city manager demolishing the fort in order to erase the physical limitation to grow. From this period the city started sprawling out, which has continued since. From 1923 to 1941 during the period when western urban planning was perceived as emblematic of progress, Tehran's development followed those patterns. The first urban development policies were underpinned with a strong ambition to modernize the city in the same style that Haussmann had laid out in Paris [28]. Tehran's ancient fort was replaced in 1930 by boulevards to improve the connection with the new urban area around Tehran. The urban development based on land division, which was started under the centralized and pro-western state was one of the pillars of modern Tehran's development model. Within the next few decades oil wealth greatly enhanced the national economy including within the capital attracting people from rural areas and other cities for work and other opportunities. Tehran always appeared as a symbol of the rapid modernization of Iran, as a tangible sign of the modernization of the country [25]. This phenomenon and the desire to show case the country's progress reinforced the rapid and as a result uncontrolled urban growth outside the traditional limits. This trend was mainly characterized by the demolition of the old "bâghs" (orchards) and gardens to the benefit of rapid expansion of industrial and residential areas.

1930, Source: Tehran municipality

1938, Source: Tehran municipality

1960, Source: Tehran diroz

2001, Source: Memari onlin

Figure 3: Imam Khomeini square (Topkhaneh square)
Source: Alireza Hashemi Behramani (2019)

Figure 4 : Av Vali Asr, Photo source : Gozare Panjom, Source : Alireza Hashemi Behramani (2019)

To check the accelerating expansion of Tehran, a master plan was developed in 1960s with the vision of creating a world class metropolis. This plan was launched in the early 1960s and implemented in 1969. Due to topographic constraints (mountainous regions of the east and north), it provided a linear city development at the foot of the Alborz mountains, from west to east. However, the development of the city was reversed with an increase in north-south axis as historical development which was based on ecological axes in Tehran. The modernist plan[2] was a motorized development based on the creation of intra and inter-urban highways.

[2] The first comprehensive plan was prepared by a collaboration between the Iranian company Farman Farmayan and an American company managed by Victor Gruen. Abdol Aziz Farmanfarmaian was born in Shiraz at 1920 and he died at 2013 in Spain. He was

In the same period, the Planning and Budget Organization collaborated with the Municipality of Tehran to start the development of the metro network more as a part of the World City vision of Tehran than emancipation from the all individual car dependency . Eventually, the French company Sofretu was mandated to prepare for its development. The first preliminary studies in 1974 proposed the construction of seven lines. Despite the existence of the metro development plan, the city continued its expansion around the omnipresence of individual cars supported by cheap gas enabling all social groups to benefit from this means of mobility in the newly expanded polycentric capital. The consequent freeway network development facilitated the migration of part of the population to the outskirts far from the city center, thus accelerating the sprawl as job opportunities remained contained within the city with a local particularity. Indeed, Tehran followed two urban development models driven by the public and private sector.

Model 1: Urban development by government and the public sector

To respond to the new demand for habitation the government and municipality constructed new neighbourhoods.

Ekbatan: The new master plan of Tehran changed the boundaries of the city and proposed new neighbourhood development. In this context, the American developed the first mega habitation project in Tehran behind the first regional highway and international airport. The planification of the project was started in 1967. The project comprised a U-shaped block occupied by apartments blocks of three different heights (five, nine and twelve floors). Gruen, the American architect, proposed a modern shopping mall mixed with residential areas surrounded by greenery. The Ekbatan neighbourhood was the first urban development made on a large scale.

Shahrak Gharb: This urban area was developed in the vicinity of the freeway that linked the center of Tehran to north. The idea was to develop a modern area to be settled by the new elite planend according the then desired urban life of north American cities organized around individual cars. The project prepared the land for construction of high-end individual villas and residential high-rises. The modern shopping malls, heath and leisure facilities completed this new area of Tehran as in most north American cities.

Project development in 1975,
Source: https://disamag.com/پاورپوینت-تحلیل-شهرک-اکباتان-تهران/

A project in 2018,
Source: www.ekbatanonline.com/fa/news/6741

A site of urban development in 1964
Source: https://www.mashreghnews.ir

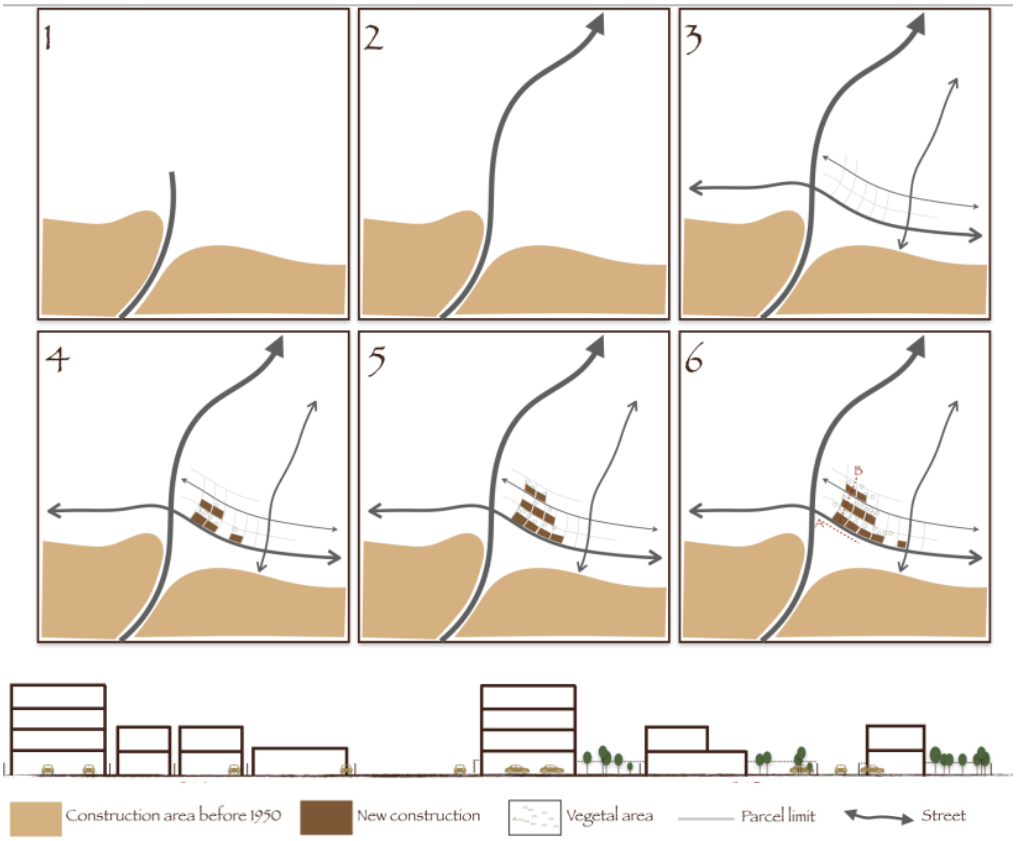
A site of urban development in 2010
Source: http://www.bartarinha.ir

Figure 5: The most important habitation project was undertaken with the support of the government
Source: Alireza Hashemi Behramani (2019)

an Iranian architect who was educated in France, being a member of the Qajar dynasty. Victor David Gruen was an Austrian-born architect, 1903-1980. He was known as a pioneer in shopping mall design as a symbol of modernity in the United States.

Model 2: Urban development by the private sector.

Large landowners subdivided land to profit from the added value. The subdivision was adopted by a road system that defined in a comprehensive plan. The city was divided into small parcels next to the streets either parallel or perpendicular to the road. The new subdivision mostly was occupied by the villa and also the small building with four maximum levels. The new urban law of 1900 set the limit in terms of land occupation and continues to exist today in Tehran's urban development: 60% for building construction and the rest being considered as free space, much of which was turned into green space by the local population. As aforementioned, this model of urbanization led to a system of green roads being developed across the city. It is an unconscious step with a perfect result. This model of the green road is treated by each owner of the plot without the expense of the municipality. The urban development laws did not define any conditions in terms of parking places per apartment. For this reason, the architect just only used the place that existed in sixty percent part to prepare the place for parking the car. The street was seen as the parking area for additional cars. As there were not many cars when this urban development model was introduced, this did not cause problems in the beginning.



The new subdivision of land developed parallel to road system development. The new villa or small building was constructed in a new parcel. The subdivision of land into small parcels between 300 and 400 m^2 became the general model of urban development in Tehran.

Figure 6: Urban development in Tehran, Source: Alireza Hashemi Behramani (2019)

The unplanned growth of the metropolis intensified with the 1979 revolution and the subsequent 10 year long war with Iraq. The new municipality was now managed by revolutionary bureaucrats with radical views abandoning the first master plan. The population was given the freedom to build with little constraints, wherever they could find suitable land. Meanwhile Tehran continued to attract the middle-class population choosing living in the capital mostly motivated by employment opportunities. The urbanization of the capital region intensified until 1992, when a new master plan was ultimately finalized after a long revolutionary hiatus. It tried to limit the sprawl of the metropolis by creating a green belt.

Meanwhile the transport network was set to keep the same structure of the first master plan, which was not accepted by the municipality. Given the lack of a development plan that was accepted by the municipality and the change in urban structure in terms of Tehran Province's scale, the housing ministry quickly prepared a plan entitled "Tehran 80". The Tehran 80 plan (the map of Tehran Metropolitan Area) envisioned the city and also, for the first time, all the peripheral urbanized area as the greater Tehran. This plan was endorsed by the government and the municipality, but lack of regulation resulted in its rejection by parliament [42]. Finally, in 2006, the new master plan was established, proposing the realization of big

infrastructure projects, in particular, in the city of Tehran. It envisaged the city with an area of about 800 km^2 as a polycentric city, with a strong and attractive city center. Tehran development continued in two different contexts that existed before the revolution. From 1985 the municipality, which was depended on financial support by the government, was asked to develop new financial resource to support municipal services. The economic difficulties of the municipality opened up a new horizon for the private sector to play an important role in Tehran's development.

DEVELOPMENT BY THE PUBLIC SECTOR

Within the multiple experimentations in Tehran's latest trend of expansion the municipality also supported various operations in the city such as much heralded urban renovation project called Navvab. The project was launched to improve the connectivity of Tehran highway network on the north-south axis in connection with less prominent residential areas whilst at the same time offering an opportunity to improve housing and formalizing some of the informal settlements.

Site of urban development in 1974,
Source: Aminzadeh, Bahraini, 2007

Site of urban development in 2008
Source: http://kusarevelayat.parsiblog.co m

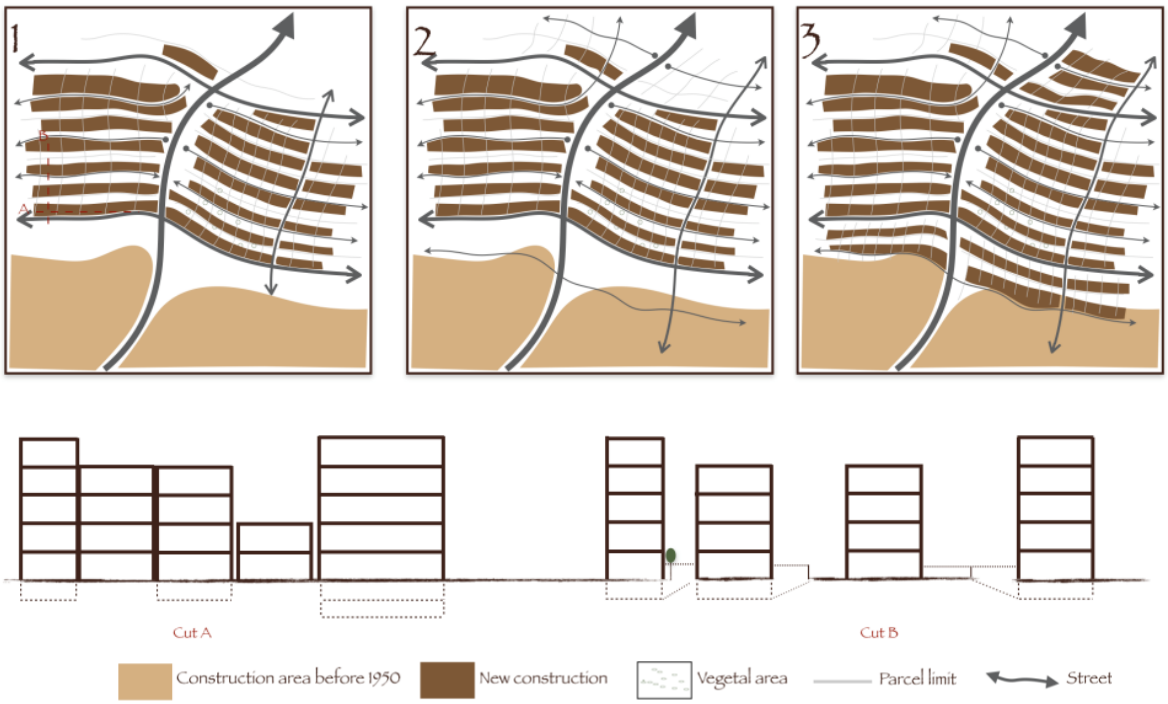
Figure 7: The urban development project after revolution, Source: Alireza Hashemi Behramani (2019)

The Navvab project was the last operation that was financed by the municipality in terms of habitation development. The government, instead of investing in urban transformation in Tehran, financed a new urban development project 40k outside the boundaries of the city.

DEVELOPMENT BY THE PRIVATE SECTOR

From the 1990s onwards, the private sector became the principal actor of urban developers in Tehran. As mentioned previously, in response to demographic change, the municipality authorized the construction of new buildings up to four or five floors in much of the city. The sixty percent land uses for building construction and forty percent as free area also remained unchangeable. Following this change, the owner of the villa and the land, to profit from advantage of added value started the construction of 4 and 5-floor building. As is evident, the private sector strategy was to secure its financial interest. The villas and gardens, mostly in the northern districts, gave way to the building of residential high-rises. During Mayor Karbaschi[3] tenure, the municipality launched the sale of density to expand its revenue stream in favor of city development. This strategy induced new challenges within the urban landscape and also indirectly accelerated urban densification policies.

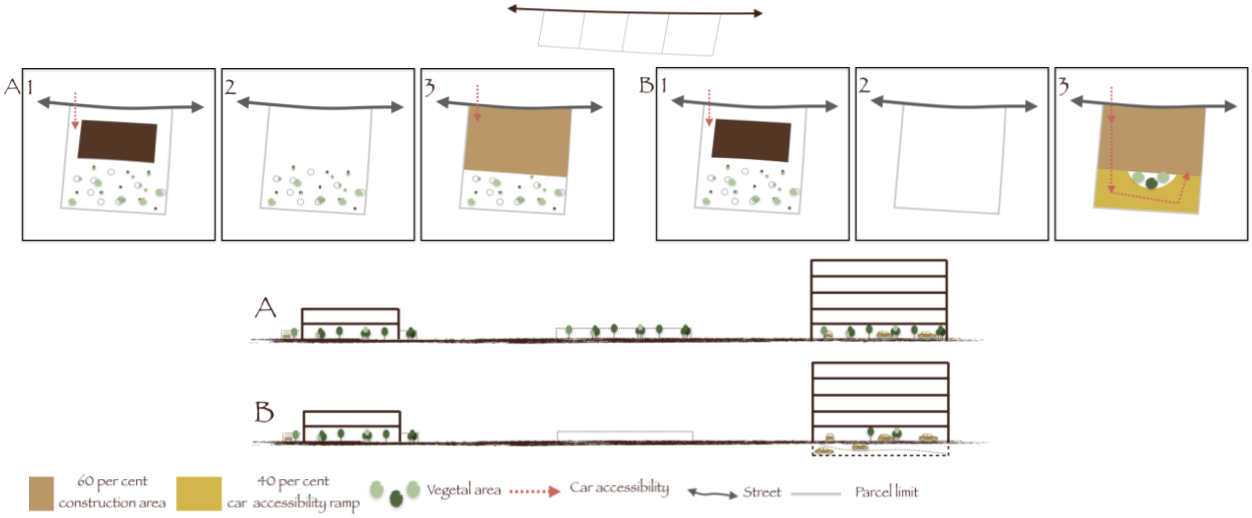
[3] Karbaschi was mayor of Tehran between 1990-1998, who was a reformist politician. He managed the city after the country was emerging from the financial and political problems driven by sanctions imposed by western countries on Iran. He had lots of success in developing Tehran, a key reason for this being the patronage of Hashemi the Iranian president, who helped prepare effective coordination between the government and the municipality.



Villa areas faded away, with developers constructing buildings of four or five levels in their place. Individual mobility by car became the principal mode of transport in the city. For that reason, the building must prepare the enough place for parking the car which is in relation with the number and surface of apartments.

Figure 8: The urban development of Tehran, Source: Alireza Hashemi Behramani (2019)

In parallel with the authorization of densification, as urban development based on individual motorized transport system, the master plan asked a parking space per apartments and two parking spaces for apartments that are greater than 200 m^2. In this respect, the provision of parking space for individual cars reinforces the symbolic of freedom and prosperity, nevertheless a real challenge for architects in space scarce densified city. In the absence of a legal framework regarding free land (40% of urban areas), architects had to consider the best option to address the parking space demand from the real-estate developers. In this perspective, the densification began to erase the green space allocated to each parcel. Hence, green spaces of the parcels are being substituted by parking space and in most cases the area used for ramps to give access to the underground parking.



A: The new buildings construct in place the villa. 40 percent of land has remained as yards. This model of construction saves the greenways. The building has one apartment on each floor mostly. This is normally the case in the neighbourhoods with economically better off inhabitants.

B: By construction of the new building, 40 percent of land used as a ramp for cars to access underground parking. This model became the preference for construction by the developer because it delivered the maximum added value.

Figure 9: The revolution of the construction in each parcel, Source : Alireza Hashemi Behramani (2019)

Urban policy, despite its aim of improving the quality of life by responding to the housing demands in the city, indirectly erased the greenways developed across the city which where the pillars of quality urban spaces that were relegated to mere esthetical value mostly in the peripheries of freeways. Here, densification was devised from public transportation development. As a result, the individual car lifestyle is continuing to contribute to the worsening of air and noise pollution. The phenomenon is pounded by the impact of climate change in the city where heat islands and other environmental externalities such as reduction of soil permeability negatively impacts water harvest during the seasonal precipitation episodes or melting of the snow in winter.

Figure 10: The usage of 40 per cent of land: Parking and Ramps, Source: Alireza Hashemi Behramani (2019)

Figure 11: The usage of 40 per cent of land: Yards, Source: Alireza Hashemi Behramani (2019)

The development of Tehran's underground or Metro was also driven by urban growth and the significant increase in automobile dependency. The construction of the first metro line started in 1978 in the north of Tehran and progressed at a snail's pace. The metro didn't have any place in the strategic development plan as individual cars imprint on the city's fabric and mobility strategy heavily influenced planning and mobility strategies for years to come. Following the Islamic Revolution and the war between Iran and Iraq, metro development was scrapped. The financial priorities of a war economy and hostilities to revolutionary government development plan from western powers and their lead companies slowed further Tehran metro's development.

At the head of government Hashemi Rafsanjani[4], restarted the metro development using the plans already drawn up in 1970s prior to the revolution. At last, the first metro line connecting Tehran to Karaj (satellite city) was inaugurated in March 1999 and opened a new horizon for the latter. Twenty-five years on from the first rail master plan for metro development, following the metropolitan change and urban sprawl, the French company Systra accompanied by the Metro Company of Tehran carried out studies on the new modalities of extension for the rail transport network in the perspective of 2030. The integration of the metropolitan area into a cohesive urban environment and fabric was the central objective of this plan. It is the structure of the sustainable urban mobility for the metropolitan area. This was completed by four express lines connecting Tehran with satellite cities as well as eight urban lines and five Bus Rapid Transit (BRT) routes for Tehran.

REVISITING TRANSPORT– LAND-USE DUALITY IN RESPONSE TO CURRENT URBAN CHALLENGES

Besides its high majestic mountains, 2020's Tehran has very little in common with the dormant city of early XXth century. A metropolis of 12 million people is one of the 20 largest municipalities in the world in terms of size and population. This change of scale is the result of urban planning intention and a consequence of the geopolitical context. The rail transport infrastructure development has not kept pace with the city's population explosion. The evolution of the individual transport system happened at a much greater pace than public transport development, such as the metro. With the change of government in 2014, the Ministry of Urbanism presented a new strategy for urban development. It was then declared that, "from 2017, Transit-Oriented-Development (TOD) will become the guide for the city" (2017, TOD Conference, Tehran). TOD policies as financial sources for developing metro by the construction of the complex project had been proposed by the director of metro in 2000. It was anticipated that TOD implementation will decrease demand for of mobility based on individual cars, which will lessen the demand for parking places and free up land for other usage such as green interstices. In this context the future metro network in Tehran metropolitan area in projected to follow the expansion shown in the map below. The red circles represent the main exchange stations that will be used as a central hub in the corridor and TOD strategies.

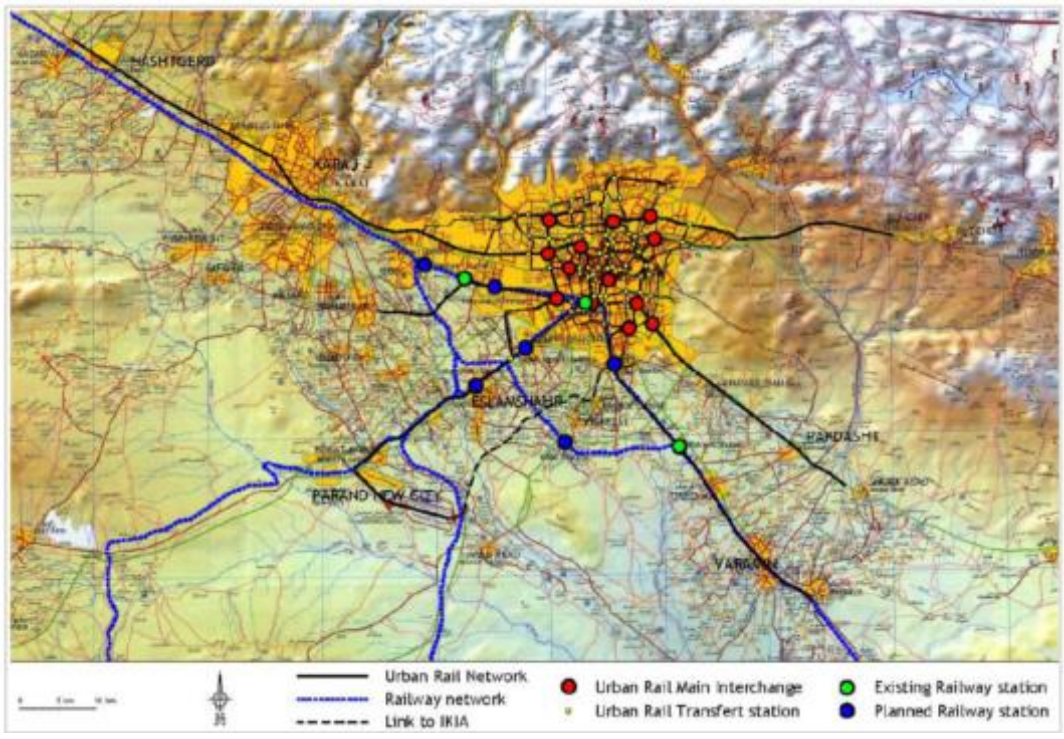
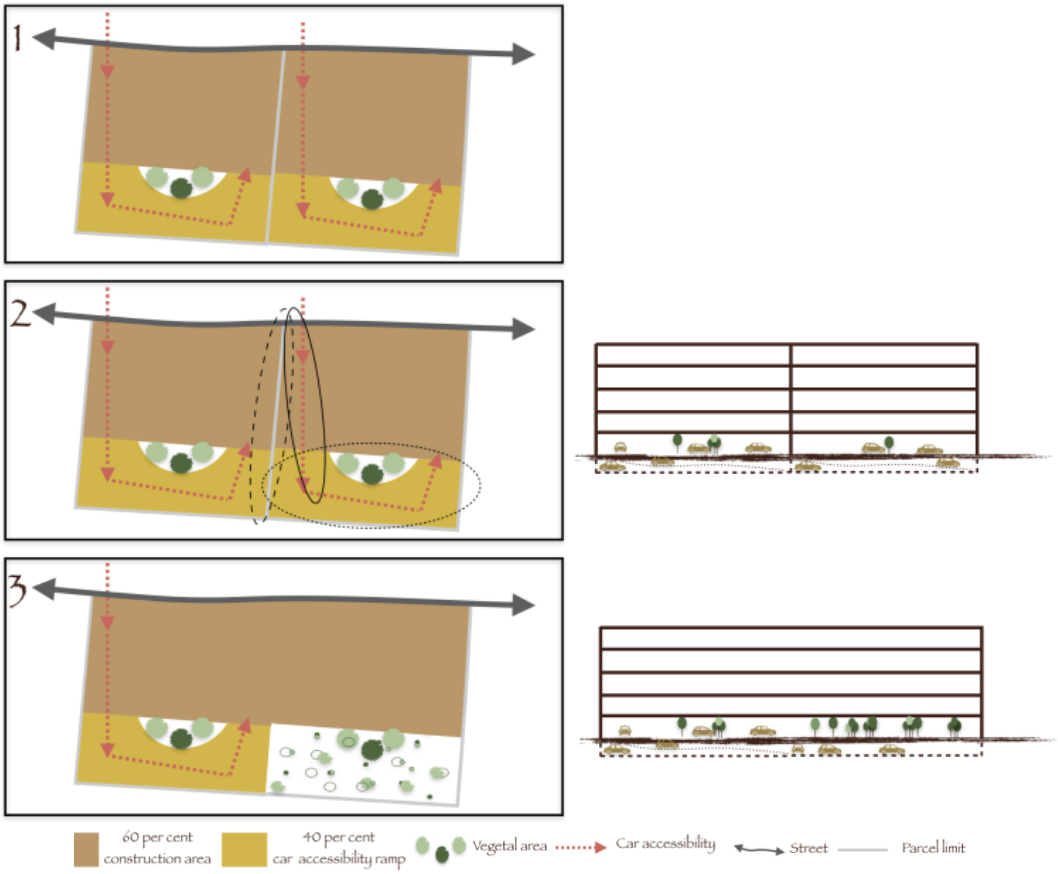


Figure 12: The master plan for the public transport network
Source: Metro of Tehran, 2006

[4] Hashemi Rafsanjani is reform politician and the Tehran metro development were restarted with his support. He is well aware of how the metro development will have a positive influence on the social, economic and environmental fortune of the city.

The successful TOD strategy would integrate built environment and transport system within Tehran's new urban transition and new morphology. The strategy of land subdivision promoted for development in Tehran need to factor many examples of successful strategies parcel merging, improving the integration of public spaces and residential areas. The new urban morphology could hence free more space for the much needed environmental and ecological retrofitting of the city as well as reinstituting population connection with once cherished urban mixity and connectivity. As the figure 11 shows the new parcel distribution in minimum reduces the space that needed to have access to under-ground.



The accessibility to under floor is existing in each parcel, if the developer fusion the small parcel to create the bigger parcel, in minimum can reduce the place that is necessary to accessibility. The result will be that at least 40% of land that was used for accessibility will be usable as yards and garden. Fisher, the parcel, can bring the new quality constructed soon.
Figure 13: The allocation of vegetal space, Source: Alireza Hashemi Behramani (2019)

As mentioned previously, TOD can reduce environmental externalities such as reduction of CO2 emissions and other pollutants and promote sustainable mobility. This is extremely important within the context of climate emergency, the importance of setting the priorities in cities to mitigate climate change and environmental degradation. In finding the alternative ways to act in responding to the climate emergency and environmental degradation, the cities from Paris to Portland are also trying to implement '15-minute city' plan which is based on reducing the scale of urban life and the travels demands [50]. Based on "urban proximity" and "segmented city", these new model aim to offer what the population need on or near their doorstep (amenities, jobs and shopping close to home) to ensure the reduction of urban trips hence the associated pollution and stress, the creating of socially and economically mixed districts to improve overall quality of life for population [45]. TOD can be a lever and center of gravity within the neighborhoods of the '15-minute city'.

Finally, the current COVID sanitary crisis has shown the importance of finding the new approaches in cities toward urban resilience by enabling the population to prevent future crisis and better respond and follow the protection measures such as distancing practices during a confinement period. Latter social organization can minimize risk exposure of vulnerable population if smart density and housing improvement is accompanied with development of public green space to practice public health measures. Here, TOD plots allow us to update the dialectic between mobility and land use in the transition to a healthy city and sustainable urban future for all. Tehran's upcoming is at a very crucial crossroad that leads to either ways based on the mobility and land use choices to be made by involved stakeholders.

4. CONCLUDING REMARKS

Tehran is not an exception to the many challenges metropolitan areas have been facing for last few decades. The capital city has been impacted by the rapid urbanization process within the last 3 decades that has been exacerbating existing dynamics of sprawl and urban fragmentation. Major areas of the city are developed according to different land subdivision models for construction of residential buildings. But the densification strategies, which were carefully conceptualized by city authorities, led in practice to the reduction of quality of life in transformed spaces.

Indeed, urban development strategies were not followed by adapted transport strategies and this latest trend of urbanization in the capital unfolded with no adaptation on the urban transport policy side still predominately driven by individual cars resulting in increasing congestion and air pollution. Meanwhile to face the increasing demand for individual cars and parking space, urban designers and architects advocated for the easy and unsustainable practice of retrofitting vacant land and greenspaces into parking spaces. The resulting concretization of the land engulfed greenspace into greyspaces which the immediate result of increasing temperature and sealing-off the soil, expansion of heat islands and generally speaking disrupting natural dynamics including water harvest during the seasonal rain across the city in favor of a land use logic based on densification and expansion of the built areas.

Generally speaking, the case of Tehran's development proves that within the ongoing dialectic between land use and transport systems, urban utopia highlights new modes of urban regulation based on modalities of mobility that are more respectful of the environment while promoting novel land-use practices. As such, the coordination between transport and urban policies in implementing controlled sustainable urban development is central in achieving better living conditions for urban dwellers. In respect to transport, the demand management must improve transport supply, which should facilitate the use of alternative modes of transport to the car by reversing the current hierarchy of urban transport. That is, priority should be given to a pedestrian and soft mobility infrastructure, then to public transit, and lastly, to the car [54]. According to Bouni [8], this reversal of the transport hierarchy can be achieved through acknowledgment of the social and environmental costs of transport systems. In addition, policies need to reduce the cost of public transit by increasing the subsidy to it. This kind of policy will challenge the dominance of the individual transport system in the form of the car. With this perspective, the crucial role of institutional structures that manage transport planning should be to work in coordination with other aspects of urbanism [9]. The various forms of coordination are as follows:

- Between scales of planning (vertical coordination);
- Between planning sectors (horizontal coordination);
- Between public and private sectors as well as between different modes of transport.

In terms of urbanization, management policies that promote a mix of functions as well as a dense and connected urban fabric are required, making it possible to reduce both the distance and frequency of travel, whilst ensuring that alternative modes of transport to the car are made more attractive [5]. This strategy is underpinned by the need to rebuild the link between development and transport.

There are several alternative models of development to follow. For instance, an example of alternative transportation-friendly development is the Transit-Oriented Development (TOD) model which promotes urban development along transit corridors [49]. This new paradigm based on the concepts of accessibility, connectivity and multimodality [37], influence the urban morphology and provide the quality in urban areas.

In the quest for solutions to current challenges of cities old successful models suchas TOD can enable and accelerate benefits from more environmental and social friendly planning models such as the '15-minute city' plan initiated by Carlos Moreno [45]. This latest attempt to improve urban life quality is based on "urban proximity" and "segmented city". The vision aims to offer what the population need on or near their doorstep to ensure an "ecological transformation": amenities, jobs and shopping close to home. This approach would reduce pollution and stress, creating socially and economically mixed districts to improve overall quality of life for population. By deploying TODs in coherence with the 15mn city logic, Tehran's future population would be able to harvest the many benefits of both planning tools and take advantage of the many assets of the capital's surrounding Alborz high mountain ecosystem added to its unparalleled beauty.

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MINARETS AS EXISTENCE OF THE ISLAMIC ARCHITECTURE IN URBAN ENVIRONMENT OF AZERBAIJAN CITIES

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ABSTRACT

Azerbaijan is a country of rich artistic and architectural heritage with the sources in remote past. The country has been at the crossroads of important trade routes, leading from Asia to Europe for long times. Islam spread on the territory of Azerbaijan in 7th -8th centuries. There were Muslim states on the territory of Azerbaijan such as Shirvanshahs with the capital in Shamakhi and Ravvadids (979-1054) with the capital Tabriz, Sheddadids (951-1088) with the capital Ganja. At the same time, there were a large number of worshipers - Yaqut al-Hamavi (8th century), he noted that there were major temples of fire worshipers in the cities of South Azerbaijan (in present-day Iran), in Shize and Kazna. The main idea of this abstract is to show how different schools of architecture influenced to all minarets for mosques in all these territories. Arran, Shirvan-Apsheron, Nakhichevan and Tabriz architectural schools of Azerbaijan - four regional architectural schools have developed on the territory of Azerbaijan that were formed around major centers of the country. In the typology of Islamic architecture, we can establish the following structures of the group such as: the mosque; minaret, holy; madrasah; khanege, tekie. The minaret is one of the features of Islamic architecture. According to the principle of minaret locations we can distinguish different types of mosques with minarets here and the results of all these researches provide clear information about how these different schools influenced in the territory. Analysis of the planning and compositional features of Azerbaijan minarets revealed compositional differences of monuments around regions.

Keywords: Islamic, architectural school, minaret, compositional features, Azerbaijan

1 INTRODUCTION

Islam spread on the territory of Azerbaijan in 7th -8th centuries. There were Muslim states on the territory of Azerbaijan such as Shirvanshahs with the capital in Shamakhi and Ravvadids (979-1054) with the capital Tabriz, Sheddadids (951-1088) with the capital Ganja. At the same time, there were a large number of worshipers - Yaqut al-Hamavi (8th century), he noted that there were major temples of fire worshipers in the cities of South Azerbaijan (in present-day Iran), in Shize and Kazna. The northern part of Azerbaijan differed from predominance of Christians, and in 886, the residents of Barda, the former capital of the Caucasian Albania (Arran), converted to Islam. Four regional architectural schools have developed on the territory of Azerbaijan that were formed around major centers of the country: the Shirvan-Absheron (north-east), Aran (north-west), Maragha and Nakhichevan-Tebriz. The architecture of the Muslim countries is rich and diverse. Considering the history of Islamic architecture, we can talk about the difference of religious architecture around the countries and regions.

2 MAIN LEVEL HEADING

In the typology of Islamic architecture, we can establish the following structures of the group such as: the mosque; minaret, holy; madrasah; khanege, tekie. Shrines, the places of worship, are the basis of all religious systems; "their origin, hierarchical subordination, the functions, the ability to adapt with the changing of religious movements indicate the presence of undeveloped information reservoir that stores a variety of information, not only religious content." In this article, we consider the minarets as symbolic element of Islamic architecture in Azerbaijan.

The main function of the minaret

As we know the main function of the minaret is considered to be the convening of the faithful to prayer. In small villages, as well as in the quarterly mosques of small size usually did not have minarets or had one. In the villages of Absheron there is a mosque without a minaret very often, which had a ladder to climb the roof for the announcement of the azan. This was typical for Ordubad mosques (Upper Ambaras mosque located in the western part of the area of Upper Ambaras Ordubad). Minaret was usually absent in all Ordubad mosques. Tabasaran mosques (southern Dagestan), also had a flat roof. Minarets were built also in the construction of madrasahs as the traditional architectural elements that have their own, sometimes a small mosque. Such minarets also "were widely used for announcements of early training, lunch break, the news and extraordinary meetings." According to the principle of minaret locations we can distinguish the following types of mosques with minarets - with a minaret on the roof, with a minaret at the corner, with a minaret at the entrance, with a minaret in the center, etc. They may be one- and many-tier, with internal and external stairs, with one or two, three sherefe. Minarets are also classified according to their position in the space of the city - villages, there are stand-alone or built; in the shape of the crowns; by the method of architectural decoration barrel: vertical - corrugated, horizontal; by type of figured brickwork and cladding - smooth or netted. Along the perimeter of the tower minaret has curtain circling balcony "sherefe", which is based on the stalactites “mukarni”- rows of hanging over each other decorative protrusions resembling cells of honeycombs. Resistance of minarete is provided, primarily due to an internal staircase. Gravel and other supporting materials are used for the construction of the foundation. It should be noted, the number of minarets at the mosque may be different but the condition must be observed so that the quantity would not exceed nine - no more than Al-Haram (Mecca), which is in the yard. Mosques with two, four or even six minarets were built. For a long time the mosques with several minarets were characteristic only for the Osman Empire. In addition, the presence of premises is also characterized for this type of mosques where sultans prayed.

3. ARRAN ARCHITECTURAL SCHOOL OF AZERBAIJAN

Arran architectural school of Azerbaijan. Shamkir minaret (end of 11th century) differed in its size: Height -60 m and a diameter of 2.4 to 3.6 m. It was built of brick. M. Neymat said that Shamkir minaret served for the defense of the city and was "a watchtower from which it was possible to trace the whole neighborhood." The base of the minaret was the amount in the form of a prism with a lancet entrance doorway, wedge-shaped bevels created a transition to an octahedron. N.Florovsky [1] left a precise description of the minaret structure and its size "Column base is the cubic shape and has seven yards in diameter and six and a quarter of the height; on this basis, there has been arranged another foot of the same figure, comprising six yards of width and five yards of height. There is a round column that has five at the base and to four at the top yards in a diameter, a height of eighteen fathoms with the base of twenty-two yards. Its upper part is enclosed by a quadrangular cornice which parts conclude 5 yards; under cornice there is a visible inscription, believed to be in kufic language. Above the cornice there is another round column in six fathoms height, at the top it is already destroyed; its diameter is no more than one fathom at the base. The whole column has up to 28 yards high. In the middle of the column there is a spiral staircase consisting of 124 large, almost destroyed stairs which is very difficult to climb. At the top of cornice there was also apparently a ladder, as judged by the recesses in the wall which are probably reinforced into stairs.” According to the figure on the balcony by Gagarin [2] there was elongated pommel with a lancet opening. **As** L.S.Bretanitsky [3] notes, this image is an interest for the "simultaneous recovery of minarets in Karabaglar and Nakhichevan." Among the analogues we can call a 65-meter minaret in Jam (1194) in the north-west of Afghanistan, Tatartupskiy in North Ossetia. Their similarity is the use of brick and geometric features - the proportion of stem, pedestal shape and structure of the stem. I would also like to note that the spiral staircases in the stems of minarets of Shirvan-Absheron region were usually ended at the level of sherefe, while the staircase leads to the top in Shamkir and Tatartup minarets. V.A.Kuznetsov [4] also points the similarity of architecture of Shamkir and Tatartup pillars. In 14th century the twin ornamented minarets occured which were symmetrically located on both sides of the entrance portal - the minarets in the village Karabaglar (12th century.). Such minarets flanking the small portal became widespread in the 14th century and also in Iran. “Juma” Mosque in Shamakhi (743-744) is the earliest mosque in the Caucasus after Derbent (734). The mosque with two minarets in the main facade. In Ashagi Gëvharaga mosque (Karabag, Shusha, 1832) minarets were set on the sides of the rear facade and this was due to the location of mosques in the city plan: its rear facade faced the shopping area. Minarets of cylindrical form are laid out on a plinth of natural limestone. The

minarets are decorated with re-writing of the word "Allah". “Juma” mosque in Aghdam, Karabah (1868-1870) as in the Shusha mosque minarets are set at the corners of the northern facade of the mosque completing symmetrical plan of the structure. Cylindrical minarets were built of brick,are divided into parts with horizontal zones and each piece is encrusted with simple brick patterns that makes minarets dominate composition. Kerbelai Sefihan Garabagi continued the tradition of architecture for the construction of two-minaret mosques which was widespread in medieval Azerbaijan.

In the mosques of Gabala and Oguz the minaret is close at end. Minarets are located at the end in Gakh-mugal mosques and mosque in Sarybash. A similar solution could be seen in Saatli mosque in Shusha , Karabah . Saatli mosque was built in 1883 by Kerbelai Sefihan Garabagi architect. High minaret has an isolated input on the end. Minaret of the Gileyli mosque according to an inscription discovered in 1936: "He built this high Mosque al-Haji Chelebi, Sultan b. Kurban is the ruler of Sheki, Amir Shirvan in the blessed month of Allah, Ramadan, 1162. "The brick minaret (minaret’s height without the tower is 13.5 m) narrows towards the top and is decorated with relief brickwork patterns. The minaret is ended by balcony with a dome. A group of one-mosques of quarterly type mosques with minaret on the roof is interesting and has the form of a small rotondas called "guldeste". This composition is typical for Central Asia, as well as for Tatarstan and Bashkiria. The mosque is located in Eregit quarter in Lahij village of Ismayilli region. Its foundation is laid in 1843. Minaret is set on the roof of the center. Bedeyun Mosque (Ismayilli district) was built in 1295 (19th century). The inner area is 16x16 meters. The minaret stands on the roof of the center. We see the detached minaret in composition of the D”Juma” mosque composition (Khan's Mosque) built in Sheki, 1745-1750. Among detached minarets we can call a minaret of the mosque in the village of Khachmaz (Oguz district), the minaret of the mosque Chudulu (Gakh region); Aliabad and Mosul (Zagatala region); mosque in Balakend. An interesting solution of detached minaret in Balakend (1867), is a minaret of 40m height, three-part - octagonal, tapering towards the top with sheref.

4. SHIRVAN-ABSHERON SCHOOL OF AZERBAIJAN

Shirvan-Absheron school of Azerbaijan. Minarets of Shirvan and Absheron chronologically can be divided into three groups – 11th and 14th centuries; 15th -20th centuries, 19th-21st centuries. Among the first group of minarets are detached minarets - "Mil minare" Save (1061), Shamkir (end of 11th century.) and adjacent to the building of the mosque - Siniggala, Pirsaat. 3 partially destroyed (without tops) minarets were preserved - in the complex Khanega (Adzhikabul region), at the minaret-mosque (in Derbent) and "Tatartup minaret" (in the northwest of North Ossetia). These minarets were extended to the territory of Iran in the eleventh and twelfth centuries: in Damgane, Bestame, Isfahan. You can select the following general composition feature minarets of Shirvan-Apsheron circle they are of a relatively small size (diameter of no more than 3 m and a height of not more than 20m.), stockiness, used as a building stone material, a spiral staircase in the barrel of the minaret protruding sherefe supported by belt stalactites. A small, dome-shaped cell with aperture was arranged above the balcony. Type of minarets spread out in the construction of Shirvan and Absheron at the end of 13th century represents a slightly tapered at the top of the cylindrical tower, built of carefully cut stone, in which the steam waves spiral staircase. For this type of minarets,in Bibi-Heybat mosque in 1300 in Molla-Ahmed mosque in the Old City, is characterized by a three-part division, a number of "squat" architecture, stonework. The creator of this type of minarets is Saad’s son Mahmud. On three of considred minarets the inscription was preserved on the building by the architect Mahmoud, Saad’s son, in Bibi-Heybat mosque with a minaret, the mosque Molla-Ahmed in the Old City and Nardaran Tower. First, he built in 680 of hijra (1281-1282), while the other two were built in 700 of hijra. The first minaret of this type with Bibi –Heybat mosque, 1300, Bibi-Heybat was built in 2nd half of 13th century over the tomb of the daughter of the seventh shiit Imam Musa al Kazim. Unfortunately, in 1936, the Bibiheybat cult complex was completely destroyed. Minaret of the Bibi-Heybat mosque is dated 680 hijra (1281-1282) was built by Mahmud ibn Saad (1281-1282). According to the extant image, the upper part of the minaret about 22 meters high, was decorated with carvings and stalactites. To the first group of minarets refers the minaret (1294) from Khanega complex on Pirsagat River. The stem of the minaret was preserved up to 15 m (partially balcony part survived), which was a three-part composition, wherein the lower part has a height of about 6m in a quadrangular prism with beveled corners.; average was an octagonal prism of more than 3m height, the third has a cylindrical shape up to 8m. This three-part composition is a distinguishing feature of the minarets of Shirvan. Minaret of Sinig Gala mosque belongs to the first group of minarets. The inscription

on the wall at the entrance to the mosque said that " Ustad Rais al-Mohammed Abubakr's son ordered the construction of the building of the mosque " in 471hijra, i.e in 1078-1079. By its projection (building of 22.46 m height and a stem diameter is from 4.16 to 3.8 m). Also, below the stalactite belt of the minaret at the Sinig gala around the entire stem there is an inscription, similar to those on minarets “Juma” Mosque and the Palace of Shirvanshahs in the Old City. As noted by **S.A.** Dadashev and M.A.Useynov [5] "If we compare with this minaret with the later built ones (e.g. Shah Mosque minaret), it turns out that it is their prototype. Only the size changes, inscriptions’ handwriting chang, stalactites become more graceful, ornamental balcony fence becomes more subtle and complex. This type of minaret is completely different from the brick minarets of other regions of the republic.” Considering the architectural and compositional features of the minaret can say that it was the prototype for the creation of a whole group of minarets of Shirvan type. Monuments of Shirvan-Absheron school of 15th century have simple architectural forms and decorative carved decorations. We can trace how the type of minarets, developed by Mahmoud, Saad’s son, he has evolved over time, so minarets of 15th century acquired a great height and thickness: the minaret of “Juma” mosque in the Old City (Baku, (1437-1438)) and the minaret from the complex of the Shirvanshahs Palace (Baku (1441-1442). Their main compositional features is simplicity, proportionality and geometric shapes, slim silhouette, grace of sherefe, stone ligature of ornament and stalactites. Height of the two considered minarets reaches 24.5 and 24 m respectively, and the diameter is 5.4 and 4-3,5m. It should be noted that these two constructions have played a special role in the architecture of Baku and Apsheron, and served as analogues for further minarets of Absheron. [6] Comparative analysis of Shirvan minarets, from Khanegah complex in Pirsagat (1256), Bibi-Heybat (the beginning of 14th century), the minaret mosques in Derbent (14th century), Palace (15th century) and the “Juma” mosque (15th century) Baku) allows you to trace the evolution of minarets and to identify compositional features. Minarets of Baku of 15th century affected the minarets which were built in the later period at the end of 19th - beginning of the 20th centuries: Ashumova Mosque, Haji Sultanali mosque, “Juma” mosque in Binagadi (1909-1914, the mosque of Haji Ajdar bey Ashurbekov -The Blue Mosque (1912).

5. NAKHCHIVAN SCHOOL

Nakhchivan School. Evliya Chelebi says that in the city of Nakhchivan, there are thirty-three minarets. From preserved monuments with the minarets we can call the two 20-meter high minaret of 12th century from brick in Karabaglar village (Sharur district). Cylinder minaretes with narrow spiral staircases which are square at the base and then they turn into octagons, and gain higher cylindrical shape. Bases of the two connected portal minarets "elongated rectangular prism”, facades are treated with patterned brickwork, framed by three-blade pointed arches; low octagonal volume serves as a transition to the barrel of minarets, built from radial bricks. [6] The entrance portal with two symmetrically arranged on its sides with minarets are seen in “Juma” mosque in Ganja, in the twin minarets in “Juma” mosque, in Shusha. We can say that the idea of pair minarets flanking the portal, was owned to Ajami Nakhichevani, and subsequently influenced on the architecture of the neighborhood countries. Twin minarets flanking a small portal were built in Iran in the 14th century. Portal flanked by round minarets can be seen in the mosque of the city Otrar (Kazakhstan), in Bibi-Khanum mosque (1399-1404.), the portal of Ulugbek madrasah (1417-1420 gg.), Shirdor madrasah (1619-1636.). An interesting solution was in Hasar mosque (18th century; Nehram village), where the rotunda on the roof was transformed into a small square-shaped lantern. Ordubad mosques were built without minarets and some researchers have attributed this fact that in medieval period "in the local construction and later raw brick was widely used, which was unsuitable for the construction of high-rise structures. Firing of sun-dried bricks and its use became widespread in Ordubad much later.

Minarets of Iranian Azerbaijan

Minarets of Iranian Azerbaijan are slender cylindrical towers on a stone plinth, decorated with tiles. The upper part of the minaret belted “sherefe” in the form of a lantern. These minarets are typical for Azerbaijan, Central Asia and Iran. Considering the cult - the memorial architecture of Azerbaijan and Iran, we can talk about mutual influence. [7] For example, detached cylindrical Mil minare from Save (Merkezi provinces) was built during the reign of the Seljuks in the 1061. It has similarities with a minaret in Shamkir. It was built of brick. The minarets of a mosque in Urmia and minaret of the Hamza mosque in Tabriz have a cylindrical bore.[8] Minaret of the mosque (Urmia) was built in the era of the

Khadjar in 1328.The cylindrical minaret slightly converges towards the top. It is placed on the corner of the mosque. Sultaniye mosque (north-west of Iran) had four minarets, two on each side of the portal and two at the main facade.[9] Three-tier twin minarets decorate the portal of the mosque in Tabriz. These are characteristic of the architecture of Central Asia - the minaret of Bibi Khanum mosque (Samarkand), Shir-Dor (Samarkand). Analysis of the planning and compositional features of Azerbaijan minarets revealed compositional differences of monuments around regions.[10] Minarets of the northern regions of Azerbaijan (Absheron) differ significantly from the minarets of the southern regions of the country. In addition, a comparison of the minarets of Shirvan-Absheron - Sinik-kala (1078- 1079), khanega on Pirsagat (1256), Bibi-Heybat mosque (the beginning of 14th century), the minaret mosque in Derbent (14th century), Palace (1441-1442) and Friday (15th century.) in Baku, allows us to trace the evolution of the traditional type architectural structures and characterize the features of the creative personality of their builders.[11] These features are shown in the improvement of the already existing spatial compositions, the interpretation of identical elements, the variety of decoration, and all this within the not frequently canonized architectural solutions and forms. It may be noted that the technique of the brickwork has been popular in the south of Azerbaijan while the masonry dominated in the north. On the territory of Azerbaijan minarets were built with one sherefe. Minarets with two sherefe were not preserved, but we can talk about the use of this technique for restoring the monuments of historical reports and sketches of artists. According to R.Amenzade, minarets with two sherefe were at Sultaniye mosques; "closed the facade plane" of the mosque Majid-e Shah, 1451, in Meshhede. According to composite construction we can divide into:

- freestanding – Shamkir,Azerbaijan. 11th century; Khoy (South Azerbaijan) or close established and not structurally related to the mosque – Mohammed mosque, 1078, Baku. Free-standing minarets of Azerbaijan have cubic or prismatic base which becomes into octagonal prism with the help of external ramps. This is followed by a cylindrical, slightly tapering upward stem. Detached minaret could be included into the building which was built later.
- embedded in the religious structure (the mosque of the Palace of the Shirvanshahs, 1441, Baku). At the base of the embedded minarets of Azerbaijan there is a polyhedron, base minarets are built of stone or burnt brick. The stem is usually brick, decorated with ornamental bands.
- flanking portal of iconic buildings - the Uzun Hasan mosque, 15th century, Tabriz, is not preserved) • with socket, built into the wall volume, closing facade plane of iconic buildings
- in the form of a small rotunda - "guldeste" on the roof. Wooden minarets are octagonal, cylindrical or combined.
- closing the facade plane of the iconic buildings Gay Mosque in Tabriz. 1465 (not preserved.);
- minarets flanking the portal of iconic buildings - twin minarets symmetrically located on both sides of the entrance portal – “peshtaka”.

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CITY DEVELOPMENT IN THE REPUBLIC OF AZERBAIJAN IN CONDITIONS OF FORMATION OF RELATED SYSTEMS OF SETTLEMENTS

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ABSTRACT

The established network of localities of the Republic of Azerbaijan despite the relatively small territory of the Republic (86.6 thousand square kilometres) includes all the types of settlements - from narrow-profile villages and small towns to multifunctional big cities (Ganja, Sumgait) and the largest city of Baku. The network of populated areas of the Republic of Azerbaijan consists of 60 cities, 125 urban-type villages and 4,256 settlements which allows considering it due to enough density, as the basis for the formation of prospective settlement.

In the context of the rapid recovery of the agricultural economy of the Republic of Azerbaijan significant changes are taking place in the network of rural settlements consisting of a settlement of different industrial specialization. Work is underway to reorganize the existing dispersed network of rural settlements based on selected promising villages, a system of large comfortable rural settlements of the republic is being created. Today, the trends of inter-settlement ties between the population of the villages of Azerbaijan and the centres of social amenities and agro-industrial production that predeterminate in general terms the urban planning directions of the transformation of rural settlements of the Republic are increasingly evident.

Therefore, in the conditions of Azerbaijan, certain difficulties arise in the urban planning order, which must be overcome in the foreseeable future.

The experience of construction in the Republic of Azerbaijan shows that the development of cities and inhabited settlements systems is a process that can be consciously and purposefully influenced by society. Improving the management of the urban development of the Republic is a necessary condition for realizing the advantages and opportunities of the developed society in further improving the working, living and recreation conditions of people.

Based on the above, at the present stage of development of the historically established settlement of the Republic of Azerbaijan, it seems necessary to take into account the importance of a comprehensive solution of urban development problems and the need to develop provisions that contain the real prerequisites for their consistent implementation.

The transformation of the resettlement of the Republic of Azerbaijan is aimed at achieving several basic goals, predetermined by the steadily expanding practise of modern construction and the prospects for developing a network of populated places in the republic.

The first main purpose of the transformation of the settlement of the Republic of Azerbaijan is to create urban planning prerequisites for the formation of a republican perspective system of inhabited places ensuring the best living conditions and comprehensive human development. This is the main social goal of prospective settlement in the territory of Azerbaijan. The second main goal of the transformation of the settlement of the Republic of Azerbaijan is aimed at creating urban planning prerequisites and conditions of the settlement, actively contributing to further rational development and placement of productive forces of the Republic. This is the main economic goal of prospective settlement in the territory of Azerbaijan. The third main goal of the transformation of the settlement of the Republic of Azerbaijan.

This main ecological goal of prospective settlement in the territory of the Republic of Azerbaijan is determined by the need to maintain ecological balance and preserve a favourable natural environment in different regions of the Republic, meeting the needs in a healthy natural environment, in creating an optimal microclimate in attractive landscapes. By the goals, results of the state analysis and the conditions for the transformation of resettlement in the Republic of Azerbaijan, the main options for the development of the regional system of populated areas of the republic for the long term are proposed. The development options are based on the concept of formation of group systems of settlements (GSS), which provides for a systematic transition from relatively separate autonomous development of cities and villages of the Republic to their interconnected spatial development.

Keywords: settlements, small and medium-sized towns, inter-settlement ties, republic, town-planning, development

1. INTRODUCTION

The existing network of settlements of the Republic of Azerbaijan despite the relatively small territory of the republic (86.6 thousand sq. km) includes all the types of settlements - from narrow-purpose settlements and small towns to multifunctional big cities (Ganja, Sumgait) and the largest city of Baku. The network of settlements of the Republic of Azerbaijan consists of 60 cities, 125 urban-type villages and 4,256 villages, which allows considering them due to enough density as the basis for the formation of promising settlement [6].

In recent years, as a result of an active policy of equal placement of productive forces in the territory of the Republic, positive results have been achieved in the development of the network of settlements. Some containment of the growth of the largest city of Baku and the development of small and medium-sized cities in the interior (western and central) of Azerbaijan have been ensured. In recent years, among the small cities of the republic, there were no cities that would "lose" their population. A promising group of cities with a population of 20-50 thousand people developed especially quickly, the total population of which increased 3.7 times, while the population of all other small cities - 1.7 times. During this period new urban settlements emerged, which was motivated by the improvement of the territorial and production structure of the industry, the better use of recreational resources and the performance of administrative and other functions. Thus, on an industrial basis about 20% of new cities were formed, on - administrative - 60%, transport - 15% and health - 5%.

In the conditions of the rapid economic recovery of agriculture of the Republic of Azerbaijan significant changes are taking place in the network of rural settlements, consisting of settlements of different sectoral specialization. Today, the trends of inter-settlement ties between the population of the villages of Azerbaijan and the centres of social and domestic services and agro-industrial production are being more clearly manifested, which in general outline urban development directions for the transformation of rural populated areas of the republic. However, the current trends in the development of cities and other settlements of Azerbaijan, as well as the currently used methods of reconstruction of settlement, still do not adequately meet the modern growing needs of society and the requirements of progress. As a result, in the conditions of Azerbaijan, certain difficulties arise in the urban planning order, which must be overcome in the observed perspective. The excessive growth of the city of Baku, which leads to overcrowding of settlements and concentration of the population in the limited territory of Absheron (3.7 thousand km2), contributes to the emergence of complex urban planning and environmental problems.

The excessive growth of the capital is accompanied by a further concentration of productive forces on the territory of the peninsula. As a result, in Absheron, which accounts for only 7.1% of the territory of Azerbaijan currently hosts ⅘ of the country's main industrial and production funds. This situation limits the possibilities of activation of small settlements, the formation of new "growth poles" - supporting centres of settlement and thus creates difficulties of the rational spatial organization of settlement and productive forces of the Republic [15].

Construction experience in the Republic of Azerbaijan shows that the development of cities and systems of settlements is a process that can be consciously and purposefully influenced by society. Improvement of management of urban development of the republic is a necessary condition for the realization of the advantages and opportunities of a developed society in the further improvement of working, living and recreation conditions of people.

In Azerbaijan, urban development is generally commensurate with the development and deployment of productive forces. This creates objective prerequisites for the regulation of the growth of cities of various size and economic profiles, the strengthening of national, social and cultural integration of different population groups, the progressive transformation of the network of urban and rural settlements, and the convergence of living conditions in these settlements.

In the implementation of the urban development program of the system of settlements of the Republic of Azerbaijan, it is necessary to consider a wide range of area differences, the contrast of physical, geographical and natural conditions in the territory of the republic. According to this, the task is to focus on reconstruction issues of cities formed by centuries in the anciently cultured regions during the 19th-20th centuries and the nature of the development of new districts of the republic, the traditions of the local population, the specifics of construction, taking into account various climatic factors, complex rugged terrain conditions and other general and regional features [12].

The rearrangement of settlements in the Republic of Azerbaijan is an integral part of the implementation of the purposes and decisions of the leadership of the republic aimed at the constant improvement of the well-being of the people, the ability and satisfaction of the material and spiritual needs of the population.

Based on the above, at the present stage of the development of the historically formed settlement of the Republic of Azerbaijan, it seems necessary to consider the importance of complex solution of urban development problems and the need to develop provisions that contain the following real prerequisites for their consistent implementation.

- strengthening the capacity of society to implement the complex economic and social challenges allow more widely and comprehensively address the issues of resettlement;
- increasing requirements of the industrial and production complex of the republic for the rational organization of the network of settlements, providing stimulation of the process of intensification of production;
- the introduction of new economic solutions in the process of systematic, proportional development of the economic base of both formed and new cities of the republic;
- acceleration of the pace of social and scientific and technological progress, which determines fundamental structural changes in the system of productive forces and consequently in the system of populated places of the republic.

2. FIELD OF RESEARCH

Studying the problem of urban development in the Republic of Azerbaijan in the context of the formation of interconnected systems of settlements, i.e. group systems was actively carried out by scientists of the republic in the second half of the 20th century. However, the change of the political system in Azerbaijan at the end of the 20th century, major economic reforms, active development of oil fields with access to the world market, the transformation of Azerbaijan into the largest transport hub connecting east and west increased the need for new consideration of the development of cities and the entire system of settlements of the republic.

Several objectives are presented for this purpose:

- creation of town planning prerequisites for the formation of links between the system of settlements, ensuring the best living conditions and comprehensive human development;
- further strengthening of factors of intensification and concentration of production, changes of sectoral and territorial proportions of development of the economy of the republic, in the structure of employment of the population, progress of vehicles and development of communications, increase of productivity of agriculture and other factors, which are closely connected with scientific and technical revolution in the conditions of the Azerbaijan Republic;
- the solution of issues of ecological balance maintenance and preservation of the favourable natural environment in different areas of the republic, satisfaction of needs in a healthy, natural environment, creation of optimal microclimate in attractive landscapes.

3. AIMS OF STUDY

The transformation of the settlement of the Republic of Azerbaijan is aimed at achieving several main goals determined by the steadily expanding practise of modern construction and the prospects for the development of a network of settlements in the republic.

The first main goal of transformation of the settlement of the Republic of Azerbaijan is to create town planning prerequisites for the formation of a republican perspective system of settlements, ensuring the best living conditions and comprehensive human development.

This main social goal of prospective settlement in the territory of Azerbaijan is determined by profound changes in the conditions of our society, which lead under the influence of the scientific and technical revolution to changes in the social content of the necessary free time, expansion of human, the sphere of his activity, strengthening of spatial and social mobility.

Therefore, there is a need to improve the settlement system in the Republic of Azerbaijan, to provide everyone residing within its wide range of career choices, education, objects of employment and advanced training.

Social trends in the growth of the needs of the population of Azerbaijan in material goods and services significantly affect the development of the network of settlements of the republic. The process of industrial specialization in Azerbaijan's economy, which is expanding under conditions of progress, inevitably reduces the functional content of autonomous small settlements, creates prerequisites for achieving

affordable diversity in the choice of the sphere of activity and contributes to the strengthening of migration of the population in the direction of more developed and large cities like Baku, Ganja, Sumgait, etc. Thus, under the characteristic conditions of Azerbaijan, a transition is planned from a separate isolated development of settlements to their spatial, interconnected development throughout the territory of the republic.

To achieve the social goal of prospective resettlement in the Republic of Azerbaijan, the following main tasks are envisaged:

- ensuring accessible diversity in the choice of places of employment, service centres, cultural leisure, education and recreation areas for the population of cities, towns and rural settlements;
- overcoming significant differences in living conditions in urban and rural settlements of different economic profiles and locations;
- rational use of the existing capital housing and communal fund of settlements and restoration of historical monuments of culture and architecture.

The second main goal of the resettlement of the Republic of Azerbaijan is aimed at creating urban development prerequisites and conditions of resettlement, actively contributing to the further rational development and placement of the productive forces of the republic.

This main economic goal of prospective settlement on the territory of Azerbaijan is determined by further strengthening of factors of intensification and concentration of production, changes in sectoral and territorial proportions of development of the economy of the republic, in the structure of employment of population, progress of vehicles and transport communications, increase of agricultural productivity and other factors, which are largely related to the specifics of manifestation of scientific and technical revolution in specific climatic conditions of Azerbaijan.

The economy of the Republic of Azerbaijan is characterized primarily by the intensive growth of oil production, mining, metallurgical, chemical, electromechanical, light, food, industry and the production of construction materials as well. Under the influence of scientific and technological progress, science is continuously introduced into production (including along with technology, the sphere of organization, management and service sector), the requirement for the skills of the workforce is increased, and in general to the role of the human as a major productive force. The decrease of employment as mechanization and automation increase in labour-intensive sectors of the extractive industry of the republic significantly reduces its city-forming role. Accordingly, the city-forming functions of the final sectors of manufacturing, science, education, culture and service sectors are growing. Their advanced development leads to qualitative structural and sectoral changes in the economy of the Republic of Azerbaijan, which has an active influence on the process from the historically formed relatively autonomous forms of development of settlements to the interconnected, integrated settlement in the territory of the Republic.

To achieve the economic goal of organizing resettlement in Azerbaijan the following basic tasks are envisaged:

- creation of group systems of settlements contributing to the formation of local clusters;
- creation of conditions for settlement, including the development of small and medium-sized cities, considering the full use of the labour resources of each settlement, regulation and streamlining of commuting of the population in group systems;
- formation of group systems of settlements, allowing to overcome excessive concentration of production in the republican centre of Baku;
- determination of directions of urban development contributing to the saving of agricultural land;
- providing conditions for consolidation and unification of rural settlements conducive to the concentration, specialization and intensification of agricultural production, the formation of agro-industrial complexes.

The third main goal of the transformation of the settlement of the Republic of Azerbaijan is to determine the directions of development of the settlements of the Republic, which contribute to improving, rehabilitation and protecting the environment.

This main ecological goal of prospective settlement in the territory of the Republic of Azerbaijan is determined by the need to maintain ecological balance and preserve a favourable natural environment in different regions of the Republic, to meet the needs for a healthy natural environment, to create an optimal microclimate, in attractive landscapes, which are created not only by the natural, biological and hygienic needs of human but also by his increasing cultural needs.

Azerbaijan, due to its geographical location, terrain and historical climatic factors, has an extremely diverse and rich nature.

Suffice it to say that of the eleven major types of climate available on the globe nine occur within

Azerbaijan due to vertical zoning.

The relief is extremely diverse and has significant differences throughout the republic (its elevations range from 28 m below sea-level to 4480 m above sea-level). Azerbaijan's subsoil is saturated with a variety of ore and non-metallic, as well as oil, natural gas and building material [1].

This diversity of natural conditions stimulated the development of industry, multisectoral agriculture and as a result, has increased the impact of human economic activities on the natural environment and the natural resources of the republic.

At the same time, the development of the settlements of Azerbaijan and the urban environment leads to a significant change in nature and poses many environmental issues for the city planners. In this regard, in the conditions of the Republic of Azerbaijan, in all its acuteness arise the problem of integrated consideration of environmental factors, assessment of ties in the natural complex and the consequences that arise in it under the influence of human activity, the process of urbanization and the development of a network of human settlements.

This goal includes solving the following tasks:

- determination of scales of development of the cities and other inhabited places considering prevention of pollution of the air and water basins, soil and plant cover of the republic.
- providing conditions for restoration and maintenance of ecological balance based on balanced development in the region of zones of active urban development, mainly agricultural development, protected natural landscapes.

The system of social economic and environmental objectives identified in the transformed settlement system of the Republic of Azerbaijan ensures full harmonization with the decisions of the governing bodies of the republic. At the same time, taking into account the characteristic features of Azerbaijan, the social goals of prospective resettlement are included as an additional task of restoring historical monuments of culture and architecture, and from the economic goals the task of concentrating resettlement in areas of new development has been developed. Both revisions are interdependent and explained, in the first case, by the need to create town-planning conditions for the active inclusion of ancient historical monuments and structures in the system of socio-cultural values of microregions, in the second case, by the existence of a dense network of settlements, especially urban ones (22 units per 10 thousand square meters), which eliminates the problem of developing new areas here.

Between 1920 and 1976 the population of the Azerbaijan Republic increased from 1.95 million to 5.69 million, or 2.9 times, the urban population from 1 million to 2.94 million, the rural population increased from 1.55 million to 2, 75 million people or 1.8 times. The proportion of the urban population of the republic in the total increased from 21 to 52%. This trend has continued to date.

4. PROBLEMS

The population growth characteristic of the Republic of Azerbaijan, along with the location of new and reconstruction of existing industrial enterprises, the expansion of rural areas and the development of transport, significantly exacerbates the problem of its territorial development. There is a real threat to the development of valuable suburban landscapes, the increasing impact of anthropogenic factors on the natural environment and, as a result, the possibilities of disturbing the ecological balance are increasing. In Absheron, this is manifested primarily in the development of valuable landscapes of the coastal strip of the Caspian Sea, pollution of the air basin and water area, in Ganja - in the deterioration of the condition of the air basin, surrounding green spaces and landscape complexes.

At the same time, certain demographic problems have been identified that affect the distribution and structure of the labour force of the Republic. In Baku there was a drop in the natural population growth rate: from 17.7 to 10.4 per 1000 people. Consequently, the share of the working-age population in the capital decreased by 3.5%. However, the Republic of Azerbaijan is characterized by a high rate of natural population growth. This circumstance is explained by the high level of natural population growth of small towns and especially rural settlements in Azerbaijan. Therefore, if the demographic development of the Baku settlement district requires increasing coverage of the labor shortage, in other regions of the republic - in Lankaran, Aghdam, Gazakh, etc. there is a problem of their involvement.

In recent years, positive results have been achieved in the development of the network of small urban settlements in the Republic of Azerbaijan. However, despite many cities (58 units, or 95% of all cities), they currently account for only 48% (546.3 thousand people) of the urban population growth of the republic.

In the current conditions, the urgent problem is the accelerated development of the link of medium-sized

cities and the creation of new large cities in the republic. The underdevelopment of small settlements of Azerbaijan is largely due to the poor development of social, cultural and economic ties with more developed centres of the settlement system. Despite a fairly dense network of transport roads (27 km per 1000 sq. km. territory), the Republic is characterized by a high degree of settlement and low mobility of the population, which leads to difficulties in implementing the program of improving the level of education, qualification and culture of employees. The rural settlement of Azerbaijan is still characterized by an irrational shredded, small-village structure. About 60% of the villages of the republic belong to the category of small ones with a population of up to 600 people, about 80% of the village with a population of up to 1000 people. Thus, more than half of the rural population of the republic lives in villages of over 1000 people, comprising less than ⅕ of all settlements. The development of agglomerative forms of settlement is very specific for many agrarian regions of Azerbaijan: the chain of rural settlements in several districts (Sabirabad, Saatly, Imishly, Zardob, etc.) reaches a length of 20 km, which significantly impairs the conditions of their territorial development and increases the unproductive time of the population to travel to mass service centres.

Despite the increasing scale of cultural construction in the countryside, the level of provision for many important types of services is still behind the normative. Only about 20% of villages are in the area of 10 km of accessibility of district centres, 40% - in the area of 15 km, 60% in the area of 20 km of availability: approximately 40% of rural settlements of Azerbaijan are located in a zone of remoteness from district centres with a radius of 30 km and above. Such structure of settlement in rural areas creates obstacles to meet the growing needs of the population and leads to the economically unjustified, dispersed placement of institutions in a multi-stage network of service centres.

The migratory movement of the population from villages to cities observed in the Republic of Azerbaijan under conditions of rapid reproduction of the rural population does not remove the problem of underutilization of labour resources. The share of unemployed people in social production is about 40% (mostly women) in rural areas, which is due to the underdevelopment of social infrastructure enterprises and the narrow specialization of human settlements. In the functional structure of rural settlements of the Republic of Azerbaijan, a significant proportion is made up of settlements directly related to agricultural production (76%, or 3271 settlements) and administrative and management functions (22% -962 settlements). The share of non-agricultural rural settlements is insignificant and is only 1.4%. Furthermore, due to the slow consolidation of rural settlements, Azerbaijan still has significant number (497) of rural settlements that have lost the basic productive functions in settlement systems, as well as the lack of effective links between villages and developed labour sites and low mobility of the population creates an imbalance in settlement and disproportion in the development of productive forces of the republics.

Analysis of peculiarities of territorial development of cities of the Republic of Azerbaijan showed heterogeneity of use of urban areas, availability of development-free plots within many cities. For example, only 12.1 thousand hectares are used for building from the total area of urban lands of Baku, which occupies 21.3 thousand hectares. In the small and medium-sized cities of the Republic, the use of urban land is even more extensive; the extent of use of the territory of these cities is still 1.2-1.4 times slower than the normative one. The areas within urban development are also insufficiently developed. Within the city limits, there are many (up to 20%) empty plots with a complex relief of alkaline soil, achmazes, etc.

As a result of the unjustified expansion of the territory of cities, the time spent by the population on daily trips increases, accessibility to places of employment, service centres, recreation areas are hampered, and the architectural and spatial appearance of settlements is deteriorating. Every year, the urban lands of the republic increased by an average of 5.1 thousand hectares, despite the presence of territorial reserves in the cities themselves. The territorial growth of developing cities is accompanied by the alienation of valuable agricultural land (occupied by plantations of tobacco, cotton, grapes, tea, etc.), the restoration of which is slower than the alienation, which causes economic losses to the economy of the republic.

In the cities of Azerbaijan with a valuable historical and architectural heritage that has evolved over the centuries, as well as in the surrounding areas, a significant number of monuments remain in need of rehabilitation, reconstruction and restoration. Many ancient, medieval fortress (defensive) structures, palaces and public buildings, donjons towers, mausoleum, mosques, bridges, as well as complexes with ancient rock images in the area of Absheron, Nahchivan, Kalbajar are subjected to a process of natural "corrosion".

Zones of concentration of valuable monuments of architecture and many of the most viewing sites are often uncarefully built, littered with chaotic buildings; several monuments in the old construction are misused, for the economic needs of individual departments and need to be regenerated. At the same time, the task of overcoming the known shortcomings of many cities (especially small and medium cities), due to their very limited socio-cultural potential, requires the restoration of the historically established

"substance" and the active inclusion of ancient monuments of Azerbaijani architecture in the overall process of improving the social quality of the living environment. Based on the analysis of the current settlement of the Republic of Azerbaijan, the main problems of the development of settlements are formed as a discrepancy between the modern state and the goals of the updated settlement system. The main problems of the updated resettlement are:

- unilateral, accelerated development of the republican centre of Baku, accompanied by a concentration of productive forces on the Absheron peninsula and a potential break with the interior regions of the republic;
- the presence of a dense network of small settlements and, in contrast, the absence of the main developed link in medium and large cities capable of sufficiently fulfil the functions of the main supporting centres;
- the presence of intraregional imbalances in the development of settlements and a many of sub-centres (without a clear specialization), which necessitates synchronization of directions, scales and growth rates;
- extensive expansion of urban areas, accompanied by the alienation of valuable agricultural lands occupied by plantations of cotton, grape, tea and other valuable crops;
- insufficient interaction of complexes of urbanized territories and the environment, including the Caspian Sea;
- inconsistency of several urban planning decisions with the natural-economic and socio-demographic features of the republic, the conditions of settlement in its regions and forecasts of the development of productive forces;
- insufficiently ordered development of urban agglomerations (including small rural agglomerations) in densely populated areas of the republic;
- the unsatisfactory state of transport infrastructure and communication channels and, as a result, a poor connection of rural settlements with urban socio-cultural centres;
- the uneven distribution of labour resources, the imbalance of migration processes, the parallel of the absolute growth of the urban and rural population raise simultaneously the issues of stabilization of the rural population, the diversity of places of employment and the elimination of the small-scale network;
- extensive use of the territorial resources of the republic necessary to produce the social needs of the population, including the low level of urban development of recreational areas and the regeneration of ancient historical monuments.

Most of the above-mentioned problems of the settlement are associated with accelerated economic growth of the Republic of Azerbaijan, social progress and structural changes in the development of social production. As evidence of the success of the development of the entire economic complex of the republic, the rapid growth of settlements at the same time puts forward complex specific problems. Some of them, reflecting the general contradictions between the historically established network of settlements and the requirements of dynamic development of productive forces, due to the known inertia of the settlement system, can be eliminated only in the long term. Other, caused by insufficient consideration of real product development trends in city planning and design, manifestations of a narrow departmental approach to the development of settlements, underestimation of urban planning factors in territorial planning and inadequacy of rational resettlement requirements in the allocation of production and social infrastructure, are already waiting for their urgent solution.

In the conditions of the Republic of Azerbaijan, the solution of the problems requires further improvement of development management methods, spatial organization and systematic transformation of the historically established network of settlements, the creation of a holistic integrated system of settlement, comprehensive consideration of urban factors and natural resources of specific areas of the republic.

5. SOLUTION.

Under the objectives, results of the analysis of the state and conditions of the transformation of resettlement in the Republic of Azerbaijan, the main options for the development of the regional system of settlements of the Republic for the long term are proposed. The development options are based on the concept of formation of group systems of settlements (GSS), which provides for a systematic transition from relatively separate autonomous development of cities and township of the republic to their interconnected spatial development. Group systems are considered in the conditions of Azerbaijan as closely interconnected urban and rural settlements of different size and economic profile, united by developed territorial and production ties, common transport and engineering infrastructure, a single network of public centres of socio-cultural services and recreation zones of the population as a common area of

perspective 2 hours accessibility of the central city and joint use of inter-village territories.

Drafting options introduced a process of sequential operations conducted at the following three levels:

The first level is the development of the regional capital centre - Baku;

The second level is the development of the zone of influence of the city of Baku (the outer zone of the Baku system of settlements);

The third level is the development of the regional system of settlements of the Republic of Azerbaijan, based on a combination of mutually complementary (but not geographically overlapping) large, medium and small group systems.

At the first level, two factors were of great importance in determining the extent of the development of the city of Baku as a regional centre. On the one hand, the development of the city of Baku must meet the requirement of enhancing its specialized scientific, production and socio-cultural functions and ensure the highest possible level of satisfaction of the needs of the population of the whole republic is unique of culture, science, socio-cultural facilities. On the other hand, it is necessary to restrain the development of the city-forming and, first, the industrial base of the regional centre to limit the growth of its population.

Accordingly, at the first level, three possible options for the development of the Baku regional centre were considered:

- maximum development: based on extrapolation for the estimated period of population growth rate in the period 1959-1976 and 1977-2005, maintaining significant mechanical growth;
- this option is due to the trends of the continued expansion of the city-forming base of the capital, including objects of non-republican importance; allows significant territorial growth of the city;
- moderate development: proceeds from the gradual cessation of the growth of personnel in the branches of industrial production, with the assumption of an increase in employment in objects of republican significance; this option provides a moderate control of the growth of the population of the capital, considering the demographic situation characteristic of the republic; allows slight territorial growth of the city.
- minimal development: based on the complete cessation of personnel growth in all sectors of the economy, with the assumption of their redistribution in favour of objects of republican importance; the population growth of the capital fits mainly in the framework of natural growth; this option focuses on severe restrictions on population growth and preserving the existing boundaries of urban development.

A multivariate comparison of different alternatives of Baku development on the estimated perspective points to the advantages of the option providing for moderate development of the capital. By 1976, the population of Baku reached 943.4 thousand people, and by 2005 more than 2.0 million people, and amounted to more than a quarter of the urban population, or a fifth of the total population of the republic. Despite some decline in the share of the nucleus relative to other settlement of the Baku agglomeration, its absolute growth remains quite intensive. This contributed by the constant inflow of population from other parts of the Republic. The number of arrivals in Baku is about 50 thousand people annually and tends to increase. The rapid population growth of Baku significantly accelerates the pace of its territorial expansion, which outpaces the population pace. Given the lack of territorial resources of the city and the current demographic situation, the option of maximum development extrapolating the noted phenomena for the future and providing for the increasing of the city-forming base of non-regional importance seems ineffective, as its implementation could lead to many undesirable consequences in the future. Another extreme option - minimal development - has its negative aspects in the conditions of Azerbaijan. They are expressed in the contradiction which in case of implementation may arise between the historical economic and socio-cultural infrastructure of the city and the requirements presented for its improvement by social progress and the development of the entire economy of the republic. The presence of highly qualified personnel, a significant number of unique objects, important centres of science, culture and education in Baku necessitates the renewal modernization and reconstruction of urban areas, the regulated expansion of service complexes of republican significance and excludes the alternative of total containment, which contradicts the dialectic of the city development.

At the second level, two possible options for the development of the Baku outer zone are considered about the selected moderate variant of the development of the regional centre itself:

- accelerated development, based on favourable territorial, environmental, urban and other resources of the zone with the formation of significant sub-centres capable to accept part of the functions of the republican centre

- restrained development caused by the restriction of territorial, ecological and other order, continuing modern trends

As a result of the regulation of the growth of Baku and other settlement of Absheron, there have been

some positive changes in their spatial development in recent years.

In recent decades, the average growth rate of settlements located in the zone of influence of Baku slightly exceeded the core growth. During the period under consideration, the annual growth of the population of Baku was 2.7%, in its agglomeration - 3.2%, with the average growth rate of the urban population of the republic about 3.9% per year. However, most of the population growth of the Baku system was in the satellite city Sumgait and urban-type villages (49.5% and 4.8%, respectively) located mainly in the north-eastern part of the peninsula. The research shows that more than 45% of the total number and 72% of the population of all urban-type settlements of the republic were concentrated in Baku settlement area. If the satellite city of Sumgait, due to the dynamic development of its production base, has switched to a relatively closed labour balance, then, in contrast, a wide network of urban-type settlements still plays the role of typical settlements - "outlining zones" of the city of Baku. This entail by a high level of a pendulum, "shuttle" connections of residents of small urban agglomeration settlements with the core. According to the data for 2000, the volume of centripetal labour flows in the "crown-core" direction was about 9.7 million movements per year. Even more, movements are caused by social and domestic trips of the population of the suburban zone, which is caused by the low development of its service centres, monotony of places of employment.

Accordingly, the best option for improving the proportions of the development of the settlements of the Baku system and the reproduction of the vital needs of the Absheron population is to provide for the accelerated development of the external zone of Baku with the formation of significant sub-centres in it capable to assume part of the functions of the republican centre. The option is based on the following assumptions: 1) curtailment of construction of new urban villages in Absheron; 2) concentration of the main production and non-production infrastructure mainly in the east and south-west from the core; 3) the creation at the extreme points of the "development corridors" of new, more powerful focuses of mass gravitation of the population; 4) improvement of urban and environmental conditions of settlement on the peninsula by regeneration of the spent oil-and-gas-bearing territories; 5) expansion of the spatial boundaries of the Baku system in the western part. Subject to these conditions, the implementation of the urban development program envisaged by the option of accelerated development of the external zone of Baku with moderate core development will allow, as shown to expert estimates, to ensure the most rational, balanced distribution of resettlement potentials not only between the republican centre and its external zone but also between the Baku system and other group systems of settlements of the republic. Approximately, for prospective calculations, the following population ratio is taken as optimal: Baku system of settlements - 32%, including the republican centre - 17%, the outer zone - 15%, the rest of the GSS of the Republic of Azerbaijan - 68% of the total population of the republic.

At the third level, 4 options for the development of the regional system of settlements of Azerbaijan were considered:

Option I ("Inertial") - preservation for the estimated perspective of the existing structure of distribution of functions of settlements, proportions and scale of their development; formation of mainly small group systems of settlements in the region based on formed small and medium-sized cities of the republic; preservation of the prevailing importance of the Baku system of settlements on the rest of the territory of the republic.

Option II ("Organic") - the development in the republic of all types of group systems of settlements to maximize the involvement of the population of the republic in their borders; the formation of medium and small group systems proceeds from the limited prospects of including all settlements in the zone of influence of Baku and Ganja - the centres of large group systems of settlements.

Option III ("Polar") - the predominant development in the region of two large group systems based on the largest city of Baku and the big city of Ganja, moving to the rank of the largest; involvement in the limits of diametrically located large group systems of the maximum number of the population of the republic; auxiliary character of the formation of small and medium-sized group systems as a means of involving peripheral settlements.

Variant IV ("Extreme") - development of only large group systems in the region based on the largest city of Baku, as well as the cities of Ganja and Aghdam with subsequent transfer of them to the rank of large; fully engaging of the population of the republic within the framework of large group systems; refusal to form medium and small group systems of settlements.

The main urban development idea of the "inertial" option is to extrapolate to the perspective of the established forms of development of the settlements of Azerbaijan, without significantly changing the hierarchically branched settlement structure, the existing distribution of socio-cultural and economic potentials between a large number of centres to ensure their convenient access to residential formations of

group systems. The option provides for the creation of 8 group systems of settlements in the territory of the Republic, including:

1 large GSS (Group Systems of Settlement) (with regional centre - Baku), 1 medium GSS (with support centre - Ganja) and 16 small GSS with support centres: Mingachevir, Shirwan, Guba, Goychay, Shamakhi, Salyan, Shaki, Zaqatala, Lankaran, Nakhchivan, Aghdam, Khankendi, Lachin, Kalbajar, Beylagan, Gazakh. The basic idea of the "organic" option of settlement organization is to create conditions for dynamic, accelerated development of cities located in the main channels of urbanization of Azerbaijan and representing the most important from the position of the entire republican system of settlements. The version is based on organic interaction of group systems of different sizes and ensures the preservation of "uniqueness" of Baku concerning other settlements of the republic. It is planned to create II group systems of settlements, including 2 large, 7 medium and 2 smalls. The republican centre is Baku, the republican sub-centre - Ganja: the support centres of the middle GSS - Shirwan, Siazan, Lankaran, Goychay, Aghdam, Shaki, Nakhchivan; small GSS support centres - Khankendi and Lachin. The "polar" version of development is based on the rapid growth of large group systems of the settlement of Azerbaijan, the creation along with Baku of another major city - Ganja. The sharp increase in the pace of development of the city of Ganja and its role compared to other cities is explained by the need to create a strong "counterweight" in the western part of the republic, which can significantly relieve the republican functions of Baku. According to this variant, 9 group systems of settlements are formed, including 2 large, 2 medium, 5 small GSS. The centres of the middle GSS are Goychay, Aghdam, Shaki, Khankendi, Lachin.

The "Extreme" option of the prospective settlement reflects the idea of radical transformation of the scattered, multi-centric network of settlements of Azerbaijan and its translation into an enlarged zonal form of organization. The implementation of the option requires the concentration of the overwhelming number of new production and non-production facilities in the limited but highly developed centres, the direction of the main investments for the creation of ultrafast, express communication lines between the supporting centres of large GSS, which has republican significance.

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REVIEW OF BIOCLIMATIC ARCHITECTURE FEATURES IN TRADITIONAL URBAN SETTLEMENTS IN AZERBAIJAN

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ABSTRACT

As known, throughout history architecture has always aimed at providing best comfort and protection for humans. Traditional architecture of any place in the world developed based on characteristics of the local climate, with shortage in means and technology. Understanding of bioclimatic methods of providing thermal comfort with minimum impact in traditional architecture is critical for developing modern energy-efficient strategies for new buildings.
The aim of this article is to discuss the similarities and differences of sustainable methods implemented in traditional architecture in different zones of Azerbaijan, in terms of the effect of climatic factors. The literature review was conducted to reveal similar research studies of neighboring countries as well as the countries with similar climate profile. This research was carried out to define architectural characteristics of traditional architecture based on several factors of criteria. According to the study, vernacular architecture of different regions of Azerbaijan should be looked at for guidance in creating inner comfort in modern buildings without extensive use of energy.

Keywords: bioclimatic architecture, vernacular architecture, climatic design, passive strategies, thermal comfort

1. INTRODUCTION

1.1. Bioclimatic architecture

Ever since the beginning of the history of mankind, the main mission of primitive architecture has been to protect people from adverse environmental factors by controlling these factors. There are two levels of environmental management when creating a suitable internal environment: the first is the creation of architecture and structures that can independently treat the parameters of the external climate (in other words, passive methods), the second is to regulate these parameters by artificial methods (active) [11]. In nowadays architects usually rely on the abundance of fuel and choose active strategies, thus leading to excessive energy consumption in buildings and greenhouse gas (GHG) emissions. Buildings are designed contrary to climate as opposed to with it in mind. According to Manzano-Agugliaro et al. [8] “heating, ventilation and air conditioning (HVAC) are the largest energy consumers in buildings”. To reduce the dependence on equipment, and consequently, to solve the problem of minimizing energy consumption, architects need to review the positive role of the relationship between the external and internal climate.

In this case, the bioclimatic method of building design is carried out as an analysis of the qualitative, and subsequently quantitative, correlation between the building environment, thermal comfort and architectural elements, while studying the regional characteristics of the external climate. This method is based on local climatic characteristics and passive construction technologies and provides comfort for a person, dependent on such environmental factors as ambient temperature, humidity, wind speed, solar radiation intensity, etc. [11]. The main goal is to develop the sensitivity of the building envelope to the surrounding environment.

The best example of bioclimatic architecture can be traditional architecture at any location and climate in the world, which has been changing throughout the history of mankind, to achieve the suitable level of internal thermal comfort. In the absence of the necessary resources, architects of the past were keenly aware of the restrictions, but also the opportunities presented in the local climate.

When designing bioclimatic architecture, one should start with a complete understanding of the local conditions, such as climate, topography, available materials, moving from a macroclimate to a microclimate around the building itself. The architect should consider maximizing solar potential, using winds, rainwater,

and even the heat capacity of the earth. It is necessary to consider human thermal comfort as the focal criteria apart from the energy use, while applying bioclimatic strategies.

2. LITERATURE REVIEW

2.2. Factors affecting formation of vernacular architecture

Local climate, cultural, social and political conditions of different locations influence the design of vernacular architecture in any region. Studying the development of traditional housing allows us to trace in detail the difference in residential buildings of different regions in their national architectural features, techniques and principles, which are dictated by local characteristics, traditions, as well as the presence of building materials that affect the artistic image and plasticity of materials [3].

Natural and climatic conditions largely determine the nature of the development of vernacular architecture. The architecture of any nation is impossible in isolation from the natural environment - the terrain, landscape, greenery, bay, lake, river or sea. Clearly, such climatic factors as external temperature conditions, precipitation, winds, etc. - directly affect not only the solution of urban development problems, but also such architectural features as building layout, orientation, envelope design, heating systems, ventilation use, and etc. These parameters subsequently lead to different internal thermal conditions and energy performance in buildings.

While difference in climatic conditions, building materials and manufacturing activities governed the formation of the main typological features and the characteristics of the architecture of residential buildings, the class stratification of the population determined mainly the number of rooms and the intensity of the architectural decoration. Moreover, the human factor plays significant role in defining the design features of buildings. According to analyses it was found that human behavior largely affects energy output of the buildings.

Hence, three main architectural features – construction (high mass or lightweight, material type), design (building shape, orientation, envelope) and layout (compactness) are affected by climate, topography, materials accessibility and socio-cultural and economic factors [3].

Desogus et al. [4], studied bioclimatic strategies applied in the traditional architecture in Mediterranean climate. The analysis was carried out using the adaptive thermal comfort method and the climate and vernacular architecture of Sardinia island as a case study. The research revealed the implementation of various bioclimatic strategies to control thermal comfort, as well as the strong connection of some architectural features to the climatic background.

Ebrahimi et al. [5], conducted field and desktop research of sustainable methods used by architects for achieving thermal comfort and saving energy in different parts of Iran with varying climatic context. The authors discussed the resemblances and distinctions of adopted methods in each location and analyzed the results in terms of various environmental factors.

Varzaneh et al. [16] assessed the effect of climate on local architecture and construction in hot and arid regions of Iran specifically in Varzaneh city. During the study it was found out that the traditional buildings in the city were designed according to the local climate, as well as economic and cultural environment.

2.3. Thermal comfort and energy efficiency in traditional architecture

Vernacular architecture developed to provide comfortable shelters for human creating thermal comfort. Thermal comfort characterizes the degree of human satisfaction with the thermal environment. It involves taking into account specific conditions in which most people feel comfortable. Thermal comfort is directly affected by four variables: temperature, relative humidity, radiation and air movement (winds) [14], as well as human activity and clothing.

There are different bioclimatic diagrams used to define comfort levels in indoor environment. One commonly known diagram was introduced by V. Olgyay [12], where interior comfort zone and comfort index - effective temperature - are indicated [8]. Another bioclimatic chart by B. Givoni, is a psychrometric diagram (Fig. 1), which is divided into different boundaries of comfort zone and various passive design strategies which provide indoor comfort when external climate conditions are within these boundaries [6]. In this diagram the x-axis signifies the dry-bulb temperature and the y-axis represents absolute humidity in the air. Out of 14 zones shown on the graph, 2 indicate the comfort zones. The Givoni diagram is used to determine which zones does the current climatic condition at the selected location falls into, and the design strategies to change the indoor conditions into the correct zone of comfort. The strategies include both passive and active methods.

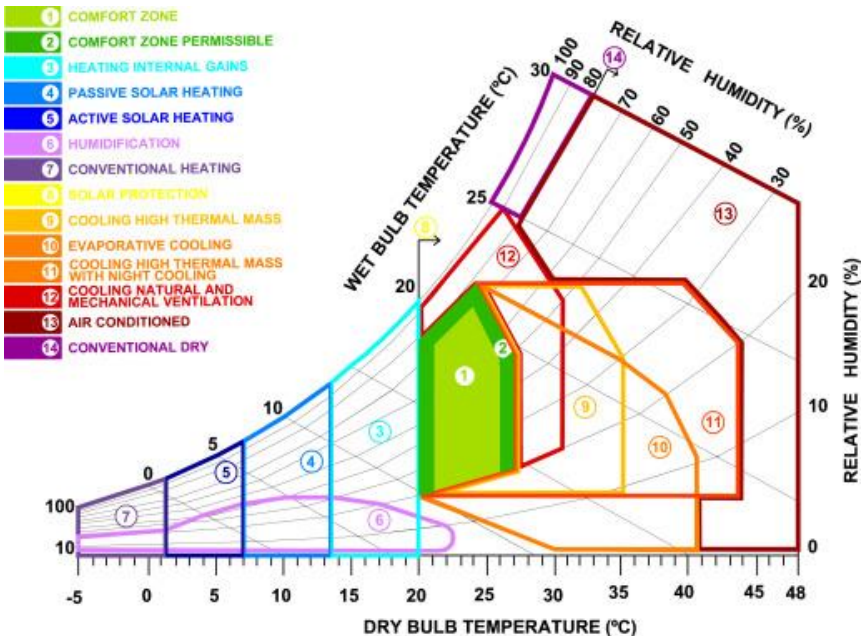


Fig. 1. Bioclimatic chart adapted from Givoni (source: Manzano-Agugliaro et al. 2015 [8])

Many researches have found that passive strategies very often used in traditional architecture are effective in achieving comfortable indoor conditions and energy saving. Passive design features are mostly applied for solar heating, cooling and natural ventilation in buildings. Some researchers even indicate that vernacular buildings have better thermal comfort and energy output that modern buildings [3].

While thermal comfort relates to the human sensations the energy-efficiency indicates the minimal amount of energy used for providing the necessary indoor conditions [8]. Building shape, orientation, construction type and other factors affect the energy consumption in buildings. For example, the research by Bostancioğlu [2], revealed that the orientation of building and its shape in conditions of Turkey have major impact not only on energy consumption, but also on construction and life cycle costs in buildings.

3. RESEARCH METHODOLOGY

3.1. Climate of Azerbaijan

Climate can be determined as a combination of weather conditions and geographical characteristics of a certain location in a period of time. Main climate parameters measured regularly by meteorological stations are [14]:

1. Dry Bulb Temperature (DBT)
2. Humidity, which is expressed as Relative Humidity (RH) and Absolute Humidity (AH), or as Dew Point Temperature (DPT)
3. Air movement – i.e. wind, expressed in velocity and direction
4. Precipitation – total amount of rain, snow, dew, expressed in mm per unit of time
5. Cloud cover, expressed as fraction of the sky hemisphere covered by clouds
6. Sunshine duration – period of clear sunshine, expressed in hours per day or month
7. Solar radiation, expressed as constantly changing irradiance (W/m^2) or as irradiation in one hour or day

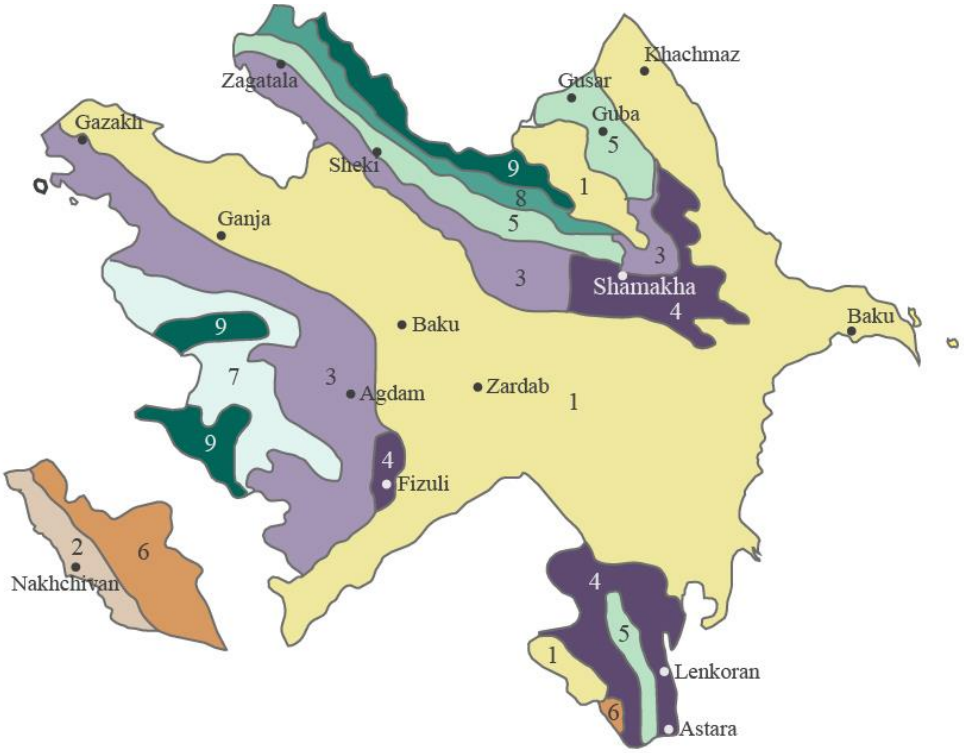
Out of these climate variables the most important ones for the bioclimatic design method are temperature, humidity, wind and solar radiation.

The geographical location of Azerbaijan directly affects the formation of the country's climate. Thus, being surrounded by the Caucasus Mountains - the Greater Caucasus, stretching from the northwest to the southeast, the Lesser Caucasus in the west - and the Caspian Sea in the east, affects the circulation of air masses and, accordingly, the climate diversity. In addition, the complex terrain throughout the country also contributes to the formation of vertical climatic zones. As a result, 9 out of 11 climatic types are observed according to the Köppen classification in Azerbaijan. These include the semi-desert climate, temperate, cold and their subtypes and the climate of the tundra (Fig. 2).

3.2. Methodology

The aim of this research is to evaluate the relationship of climate and the characteristics of vernacular dwellings in different regions of Azerbaijan. The study adapted the research method through literature review and desk-based analysis as well as building surveying. The work covered the traditional dwellings of

pre and post XIX century and modern residential buildings in major regions with different climate conditions. The analysis was based on comparing the environmental factors with the thermal and energy management strategies implemented in each region. The results were analyzed in terms of following factors of criteria: Building Shapes and Design Elements, Construction Materials, Urban Planning and Orientation for Solar Use and Ventilation.



1 - Climate of semi-deserts and dry steppes with mild winters and dry hot summers
2 - Climate of semi-deserts and dry steppes with cold winters and dry hot summers
3 - Moderately warm climate with moderate winters
4 - Moderately warm climate with dry summers
5 - Moderately warm climate with even distribution of precipitation.
6 - Cold climate with dry summers
7 - Cold climate with dry winters
8 - Cold climate with high rainfall
9 - Mountain climate tundra

Fig. 2. Climate Types of Azerbaijan

4. ANALYSIS AND DISCUSSION

4.1. Traditional dwellings in different climatic zones of the country

The architecture of dwellings of the regions of Azerbaijan was already fully formed by the 19th century. Much attention was paid to the microclimate not only indoors, but also from the outside, the correct orientation of the dwellings, the location of window and doorways, and the selection of roof shapes, wall thickness, the use of local building materials, the placement of pools, ponds or fountains in the yard, surrounded by fruit trees, etc.

Azerbaijan can be divided into following regions according to the type of built environment, terrain, geographical location, natural and climatic features, local building materials, planning and compositional principles: Absheron, Sheki-Zagatala, Ganja-Gazakh, Guba-Khachmaz, Aran, Talish-Lenkoran, Karabakh and Nakhchivan (Fig. 3).

Fig. 3. Regions of Azerbaijan

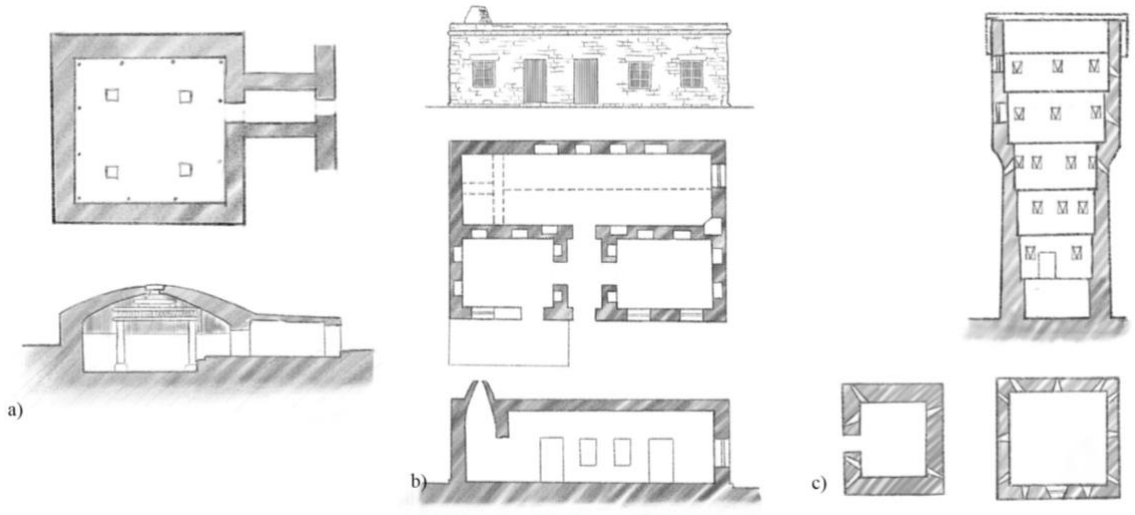


Fig. 4. Main typologies of vernacular dwellings in Azerbaijan: a - karadam, b - dublali ev, c - gala ev

Vernacular architecture of dwellings in all regions were divided into six main typologies

1) dwellings with wooden-stepped vault – *karadams*
2) wooden houses – *takhta ev*
3) domed houses – *gumbezli ev*
4) tower houses – *gala ev*
5) dwellings with conical domed chimneys – *dublali ev*
6) mansion - *imaret*

Due to lack of building materials, residential houses in lowland areas are distinguished by a simple plan form, modesty of architectural decoration. Typically, houses did not exceed two floors, open stairs were arranged for communication through eyvans (balconies) with the premises of the second floor. The walls were composed mainly of burnt bricks, rubble stone, and sometimes had a combined masonry - of stone and brick. The roofs in most cases were flat, coated with clay mixed with straw.

Dwellings of mountainous and forest regions of Caucasus have relatively high rainfall. Housing in these areas in most cases was built on 1.5 or 2.5 floors. The walls are made of local stones, usually without treatment, sometimes in combination with wood. Due to the relatively mild climate and high rainfall, roofs in these areas are pitched along wooden rafters and covered with tiles.

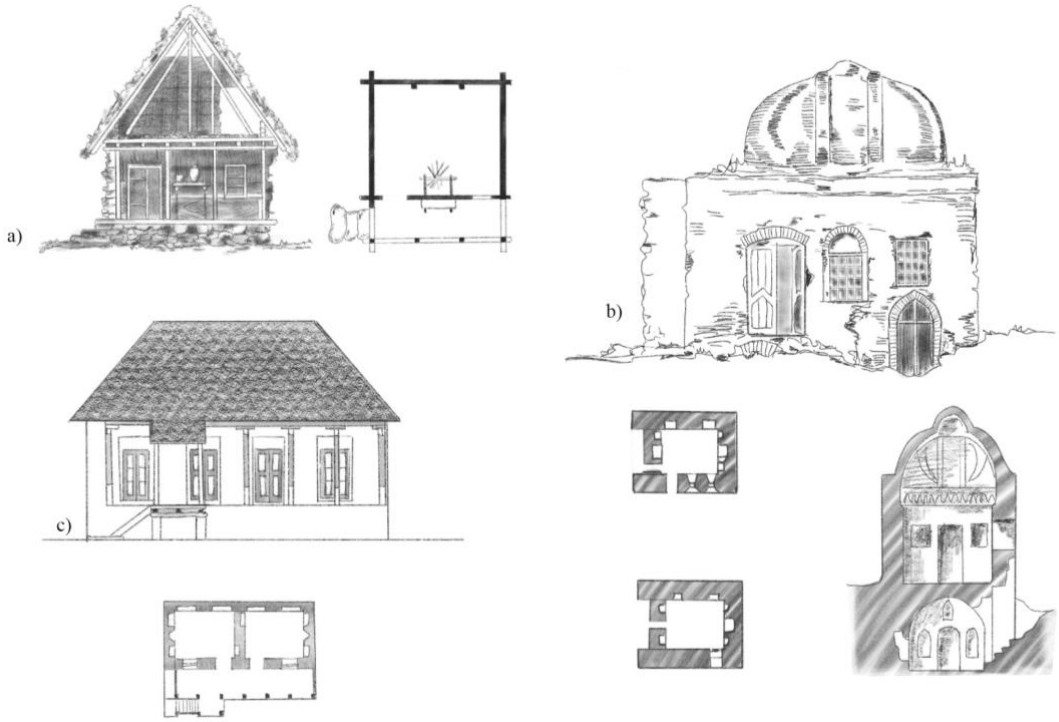


Fig. 5. Main typologies of vernacular dwellings in Azerbaijan: a - takhta ev, b – gumbezli ev, c - imaret

Building shape and design elements

Very specific climatic conditions and local material availability, as well as the socio-economic development and the population's activity led to the formation of the 'dublali ev' house type in Absheron region. This dwelling type was only common in this territory. Summer heats, water shortages, strong northern winds and lack of timber material and the abundance of sandstone defined the size, shape, layout of the houses as well as the size of windows and doors. The layout of the houses here was mainly compact to prevent heat losses due to the infiltration because of the strong winds. Same approach was considered in designing very small openings on the façade, especially oriented on the prevailing winds.

Fig. 6. Dublali ev in Absheron

The domed house type – 'gumbezli ev', prevailed in the Ganja-Gazakh region of Azerbaijan in XVII-XVIII cc. In all dwellings of this type in Ganja, domed ceilings in the center are closed by a second small dome. The origin of second domes is probably due to the presence of light holes in the most ancient houses of this type, which later began to be closed by these domes because of the lighting of rooms through other windows [13].

Due to steep topography of the region of Guba-Khachmaz increasing the number of premises in the houses was preferably achieved by adding more stories. Architects used different methods of façade design in this region, regarding the location of the summer premises. One method involved the loggia-eyvan as the

compositional center of the façade, the other – a bypass balcony, surrounding the houses on two or three sides [9]. Deep eyvans on the second floor of the houses was the main premise of the house in the summer months. Considerable decorative elements in the design of residential buildings of this region involved eaves and overhangs for the protection from sun and rain, also used for the play of shadow and light. By the end of the XIX century in Guba, Ganja and some parts of Karabakh region the imarets (mansions) began including 'shushebends' – glass wall systems, in the house planning, and some replace the traditional eyvans.

Fig. 7. House in Guba with shushebend

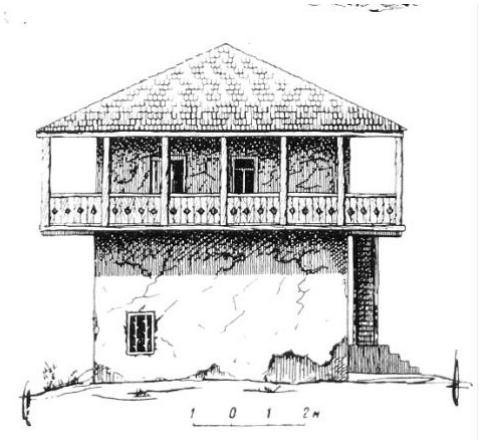
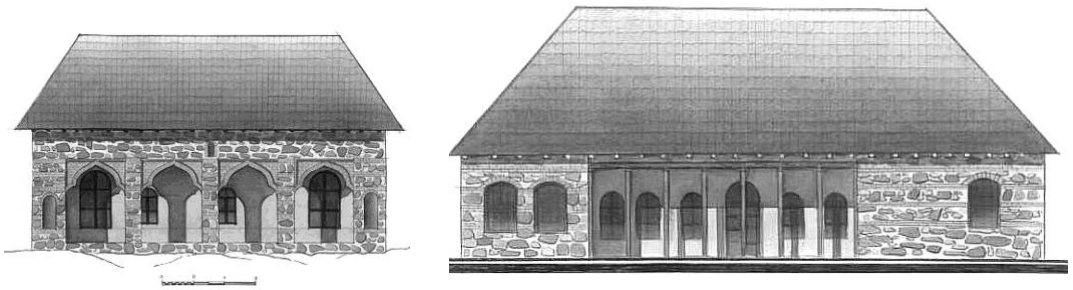


Fig. 8. House in Guba with deep cantilevered eyvan

Apart from traditional wooden houses, tower houses - 'gala ev', which were essentially defensive buildings, were spread in the Sheki-Zagatala region of Azerbaijan. In more traditional domed houses the main living premise was covered by the clay and raw brick dome with upper light-smoke hole. Bigger mansions – 'imarets' emerged in later periods were characterized by the massive arcades of verandas, external staircases, a specific pattern of mixed masonry made of combination of bricks and cobblestones. The arcade with colossal supports holding the balcony portico removes the open air space and creates a rather closed room, which is also inherent to this region. Apart from the climatic environment with the abundance of rainfalls, particular socio-economic environment and the activity of the population required high pitched roof design and high attics for drying and storing fruits and keeping silkworms. Therefore the wall height to roof height ratio was 1:1 in houses in Sheki-Zagatala [9].

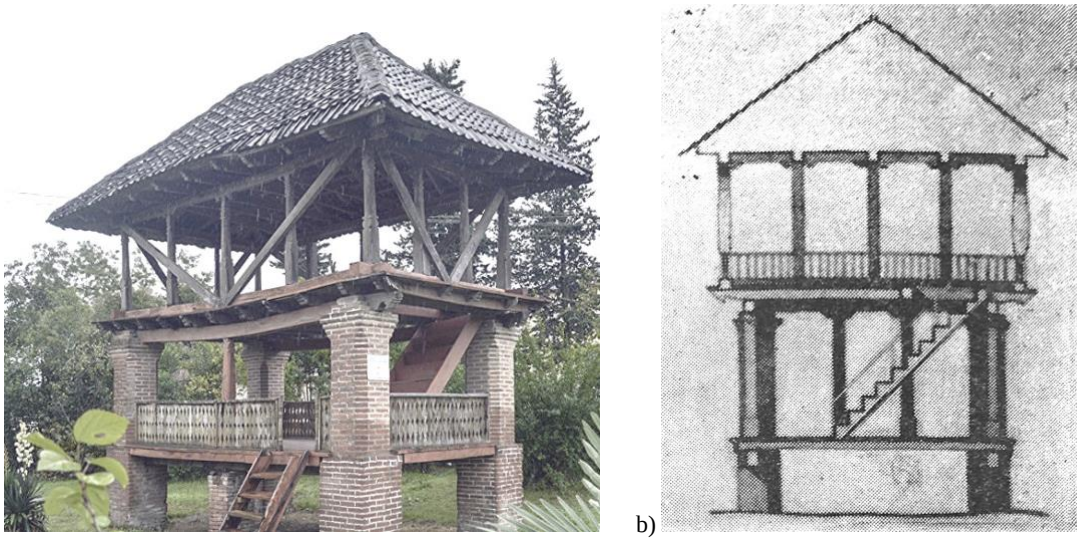


a) b)

Fig. 9. Houses in Sheki-Zagatala region, a – 1-2 premise house, b – multi-premise house

Particular location and climate type of Talysh-Lenkoran region drastically differing from other regions of the country, led to development of different building strategies. The region is divided into two subregions: coastal areas along the Caspian sea (the Talysh lowlands) and the Talysh mountains. Differences in natural and climatic characteristics between each subregion led to some variety in the layout and architecture of traditional dwellings. The lowland of Talysh are subtropical regions of the republic. This zone is characterized by an abundance of air moisture and swamps, which created favorable conditions for the reproduction of a lot of mosquitoes. This, combined with the high temperature during the summer period, created uncomfortable microclimatic conditions in the dwellings of these areas. One of the options of solving this problem was the construction of structures like towers, called "lyam" by the locals. Lyam was located on the territory of the courtyard in the immediate vicinity of the house and compositionally in harmony with it. Typically a square two-three stories lyam had the first floor raised from ground level to a height of 1-1.5 m resting on columns of red brick. This strategy allowed the families to stay here in summer avoiding the moisture and mosquitos. In the mountainous areas on the other hand had heavy rainfalls, and the houses were designed with pitched tile roofs.

a) b)



c)

Fig. 10. Lyams in Lenkoran, a – existing view, b – section, c – plans

Domed houses (gumbezli ev) consisting of several premises were common in Jebrail and Fizuli districts of Karabakh region in XV-XIX cc. The living room in such houses was covered by a dome with an upper light-smoke opening. The architecture of the main façade of the imarets in Karabakh zone was characterized by a smooth wall with small cut window openings, without any facings. On the other hand, the façade facing the courtyard was distinguished by an eyvan balcony, as well as stained-glass windows-shebeke.

Fig. 11. Mansion (imaret) of U. Hajibeyov in Shusha (Karabakh region)

Mansion typed dwellings in Nakhchivan had very distinct feature from any other region in Azerbaijan. They had a front vestibule which was a distribution room from which residents could access main rooms of the house. It had a separate exit to eyvan and connected the living room to the eyvan. Traditional houses in Ordubad district, which commonly had this vestibule, were mainly two-story and semi-urban type. The vestibules were usually a hexagon or octagon in the plan, and were covered by vaulted or spherical dome.

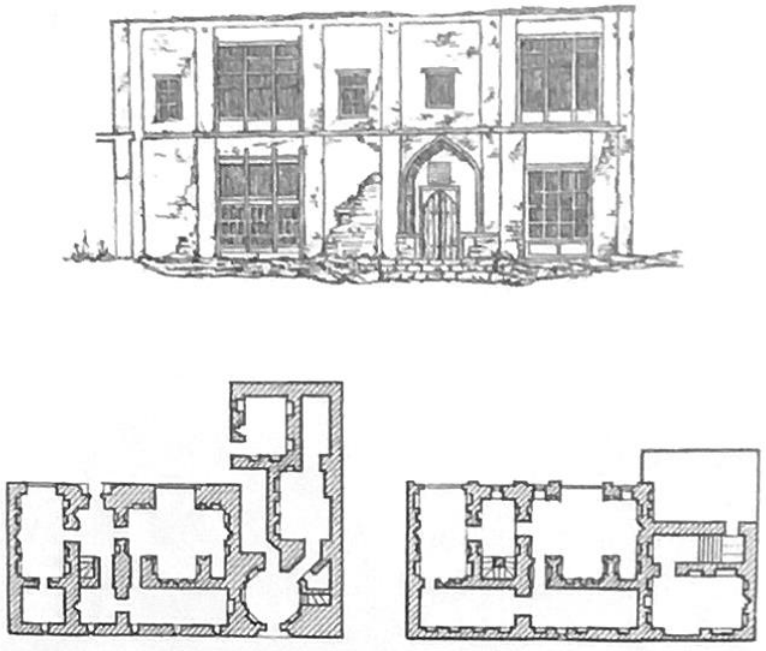


Fig. 12. Mansion (imaret) with octagonal vestibule in Ordubad (main facade and plans)

Construction materials

Materials availability and topography heavily influenced the development of various construction types in different regions of Azerbaijan. Residential construction clearly express the centuries-old wisdom of the craftsmen who made the most of all the possibilities of local materials: different building stones, brick, clay and timber. However, in should be noted that since the second half of the XIX century due to the import of timber in all regions, other types of building construction were replaced by wooden-beam structure. Nevertheless, each region's architectural heritage features were characterized by the materials used in its construction.

In Absheron, 70-80cm thick walls were laid out mainly of rubble stone on lime or clay mortar, and plastered with clay mortar finished by lime whitewash. The roofs of the houses of the region had very slight slope and were covered with a compacted clay layer and smeared with greasy clay.

In central region of Azerbaijan – Aran, with similar dry climate type, houses were built of adobe bricks and the wall thickness was 0.5-1m. The floor of the living rooms were paved with bright red square bricks.

A different construction technique was used in Shirvan region. The building material of the walls was river stone which was used after being splintered. In the walls masonry wooden beams were laid in longitudinal direction in every 8-10 rows.

Unburnt clay bricks were used in construction of houses in Ganja-Gazakh, Guba-Khachmaz, Karabakh and Nakhchivan, in walls, domed ceilings and roofs. Wall thicknesses ranged from 0.7-1.1 m. High-thermal mass of the walls allowed to keep the houses warm in winter, and cooler in summer.

Specific construction technique characteristic to Sheki-Zagatala region was using wooden frame laid in the walls to provide stability against seismic shocks, due to high seismicity this region. Moreover, as was mentioned, a specific combination of river stone and brick masonry was used in walls construction in this region.

Pitched roofs made of tile and earth were covered with kira (asphalt rock) layer to protect from destruction by atmospheric precipitation in mountainous Talysh-Lenkoran and Sheki-Zagatala, where precipitation was heavy.

In the lowlands of Nakhchivan main building material was clay soil mixed with chopped straw and small cobblestones. In the mountains, houses were built of wild stone and sand-slate, and were recessed into the ground by almost ayard. Roofs were mainly flat.

Orientation for passive solar use and ventilation

Building orientation has huge impact on the thermal comfort and energy output in building as it directly affects the amount of solar energy and air masses entering the building. Several studies revealed that the amount of direct solar radiation on different building surfaces varies depending on the side. It was found that while north facades receive lowest solar radiation, and it is high on the south surface in spring and autumn, average daily amount of solar radiation is highest on the western and eastern facades, specifically on the west it is the highest during the hottest days of the year. This is related to the solar altitude angle, as it is higher in summer and on south, and lower sun heat the western and eastern sides of the building. Moreover, building orientation affects the air infiltration and heat losses, which depend on the prevailing winds directions and speed. Therefore, it is crucial to consider orientation of the building during design process to utilize solar heat while avoiding overheating. As a rule of thumb, at the first stage of designing the best direction of the building for obtaining favorable solar energy in the northern hemisphere is +/- 30 ° from the south. But to determine the optimal direction, it is recommended to rely more on dynamic simulations and calculations than on the general rule [7].

Local architects considered southern orientation as optimal in building design in Azerbaijan. It allowed to create the most favorable microclimate not only inside the houses but also in the courtyards. Southern orientation protected against overheating by avoiding direct sunlight (as on western and eastern sides), keeping the rooms cool during hot summer months. Hot summer almost all over the country forced the population to leave closed spaces and to be outdoors in warmest months: this resulted in the design of eyvans, loggias and etc. Architects aimed at isolating the eyvans from streets, noise and dust. They were never oriented toward the west and the strongest winds. In the U-shaped imarets, rooms on the sides of the house facing west and east had no windows. And in case there were, then additional eyvan-balconies were arranged to protect the side rooms from overheating.

This principle was presented in all regions of the country except the Sheki-Zagatala region, where compared to the rest of the country, orientation of the building was irregular, mostly based on the terrain and topography of the site. In hot and humid lowlands of Talysh-Lenkoran the orientation of lyams was more considered than the main house, as they were designed for summer stays for the residents and guests. The eastern orientation was found to be most favorable there.

Various shading devices also contributed to the improvement of the microclimate of the home. Large overhangs of the roofs above the balconies were designed in order to create additional shade and protection from rain, especially in Shusha houses in Karabakh region. Natural lighting played a large role in the design of buildings as well, and it affected the size of the openings, the arrangement of eyvans, loggias and balconies.

Much attention was also paid to the organization of natural ventilation and constant air circulation in the premises, and to the location of doors and windows in the houses. Although, natural ventilation was utilized, the openings were not place on the north, due to strongest northern winds and high infiltration risks. Often high fence or wall served as a protection from the strong winds for the house and the courtyard. In Absheron, the layout of premises and the orientation of houses was especially important, and architects paid further attention to wind protection more than in any other regions of the country. This was due to very strong north winds prevailing in this area. While in other regions the enclosed type of courtyard organization and isolation of houses were mainly historically established habit and religious prejudices, here in Absheron it was largely caused by strong winds carrying whirlwinds of dust and sand. Almost in every house in Absheron the wall facing north had no openings, and there were no entrances into the house and the site from the windy side.

Urban planning

The settlements of Azerbaijan were usually divided into two types: “yaylaks” and “kishlaks”. Kishlaks were mainly created in hot steppe regions, and yaylaks in the mountainous regions of the country. There were frequent cases when in the summertime all kishlaks were completely empty, and in the wintertime - all the yaylaks.

A specific feature of the position of buildings in Azerbaijani settlements was the consideration of the terrain and good orientation of the summer premises. Setting buildings along the terrain, especially in mountainous areas, was economical and beautiful, architecture was in harmony with nature. Stronger relief and mountainous areas were preferred not only for protection from sun, but also for protection from snow blockages and for the construction of water channels [1]. On a large slope, houses usually had one and a half or two and a half floors. In these cases, the first floors were used for household and storage premises. The mountainous regions with cold climate were characterized by a compact, compressed and closed housing

organization, while for areas with hot and mild climate - by the disclosure of the internal space of the house with good ventilation, an eyvan-balconies.

A unique microclimate was created in the closed courtyards of Azerbaijani dwellings. In such courtyards cold masses passed at night and during hot days they gave coolness not only to premises of the house but the entire surrounding area. High-mud walls isolating houses from the street provided favorable microclimate and shading of the yard. Most residential sites in Aran, Nakhchivan and Karabakh regions had small pools called “cheshme”, fountains or wells for utilizing evaporation for cooling.

In Shamakhi district of Shirvan region urban planning was characterized by single-row development of houses [13]. Due to high seismicity houses were single-story. A typical residential complex in Shamakhi would be a small square or quadrangular courtyard surrounded on all sides by living premises. Residential buildings of Guba-Khachmaz regions were interesting regarding the formation of a semi-urban type. Main façade of these buildings was facing the street and the eyvans disappeared, replaced by conventional balconies. In Sheki-Zagatala houses in residential settlements were usually scatted at a considerable distance from one another and sometimes protected by a tower or a small fortress wall.

In Absheron urban planning was represented by a mass of gray houses with flat roofs covered with black tar. There were no windows facing the street. The entire internal side of the house facing the courtyard or the garden consisted of solid wooden lattice, from which individual parts were taken out creating holes for windows and door [13]. In spite of warm climate, Old City of Baku presents compact development of houses and streets due strong northern winds which brought cold air in winter and dust and sand in summer.

Table 1. Summary of traditional architectural features of all regions of Azerbaijan

Region	Climate	Constr. Materials	Constr. Elements		Arch. Elements	Type of dwelling
			Walls	Roofs		
Absheron	• Climate of semi-deserts and dry steppes with mild winters and dry hot summers	Soft limestone Rubble stone	Thick stone walls, small openings	Stone domes or flat roofs	• Shushebendi	Dublali ev Gumbezli ev Imarets
Shirvan	• Moderately warm climate with dry summers	Soft limestone Timber		Flat		Wooden houses
Guba-Khachmaz	• Moderately warm climate with even precipitation	Raw/burnt brick Timber	Thick walls, rarely spaced windows	Flat or pitched	• Shushebendi • Bypass balcony	Karadam Wooden h. Imarets
Sheki-Zagatala	• Moderately warm climate with mild winters	Mountain stone Cobblestone Timber Adobe	Combined brick and cobblestone masonry	Clay domes or high-pitched roofs	• Stained glass (shebeke) • Eyvan with big arcade	Karadams Gumbezli ev Wooden h. Tower h. Imarets
Ganja-Gazakh	• Climate of semi-deserts and dry steppes with mild winters and dry hot summers	Raw/burnt brick Adobe Cobblestone	0.7-1.1m thick brick walls	Brick domes	• Shushebendi • Eyvans	Gumbezli ev Imarets
Aran	• Climate of semi-deserts and dry steppes with mild winters and dry hot summers	Raw/burnt brick Reeds Straw	Raw brick walls	Flat	• Eyvans	Karadams Imarets
Talysh-Lenkoran	• Moderately warm climate with dry summers	Raw/burnt brick Timber		Earthen pitched roofs	• Eyvans • Lyams	Wooden h. Lyams Imarets
Karabakh	• Moderately warm climate with mild winters • Cold climate with dry winters	Hard limestone Timber	Smooth walls with small cut openings	Stone domes or pitched roofs	• Shushebendi • Eyvans/logia • Shebeke	Karadams Gumbezli ev Imarets
Nakhchivan	• Climate of semi-deserts and dry steppes with cold winters and dry hot summers • Cold climate with dry summers	Raw/burnt brick Slate Straw Stone		Mostly flat	• Eyvans • Vestibules	Tower h. Karadams Imarets

4.2. Soviet time residential buildings

During the Soviet-era in 1950s mass construction of residential building was carried out. The construction was most developed in Baku and Absheron, but it was also carried out in large volumes in Sumgait, Mingechevir, Ganja, Nakhchivan and other towns. In the early years, typical low-rise, 4-5 story buildings were predominantly built by using typical section houses.

Although building regulations of that period considered building orientation, solar radiation and insulation of building for keeping internal thermal comfort, the standards were divided into climate types of each republic in the Soviet Union. However, specific environmental conditions and characteristics of each region in the country were less considered, and the residential housing was similar everywhere, characterized by prefabricated concrete blocks, thin walls, flat roofs and similar openings on all sides.

5. CONCLUSION

Analysis and comparison of architectural features of dwellings in different parts of Azerbaijan, revealed the impact of climate, environment, topography and social factors of each region on formation of vernacular architecture and bioclimatic features implemented by architects in the past. Architecture of regions were compared and discussed based on four factors: Building Shapes and Design Elements, Construction Materials, Urban Planning and Orientation for Solar Use and Ventilation. Particular distinctions in architecture of each regions were influenced by specific conditions, social activities and nature. However there are common features in architectural design, layout, urban planning and bioclimatic strategies in all regions of Azerbaijan, and they are summarized below:

- Compact layout of buildings and premises in cold mountainous regions protected from heat loss, while disclosed position of rooms in houses with implementation of eyvans and balconies in warmer lowlands created favorable conditions for people in summer heat
- Materials usage of all regions were based on the availability and topography. Raw or burnt brick and rubble stone were used in construction in flatlands. Roofs were flats and covered with clay or straw. In mountains, houses were built of local stones, usually not processed and sometimes combined with timber, if available. Pitched roofs were made of stone or timber and covered with tiles.
- Orientation of buildings was crucial in traditional architecture in almost all regions of the country. South or south-eastern orientation was considered optimal to avoid overheating from western sun, and for protecting from north winds in some regions.
- High thermal mass strategy adopted in building in almost all regions utilized thermal mass to effectively store and release heat during the day and night to achieve uniform air temperature inside the buildings
- Specific architectural elements each on their own contributed to achieving thermal comfort for residents of buildings: eyvans, balconies, shushebendi, additional structures like lyams, different sizes of windows on different sides of the building, shading devices and others.
- Planning of courtyards was also essential to created specific microclimate for human comfort outdoors. The strategies included orientation of main houses and external constructions on the territory, usage of evaporation for cooling by locating pools or fountains on the courtyard and greenery for shading from solar heat.

With the development of technology, new emerging materials, such as steel and concrete, influence of Western style and culture, changed the approach and methods of architectural planning and construction in Azerbaijan. Fail of consideration of building orientation, local materials availability and environmental features, leads to poor thermal performance of in buildings and excessive energy consumption all year round.

Implementing bioclimatic strategies of vernacular architecture, which has been developing for centuries, with new innovative approach and technologies should be considered to create energy-efficient buildings with optimal indoor thermal comfort.

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