

Planning and Design Criteria to Make Urban Transport More Sustainable: The Case of Baku

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Abstract—Since the industrial revolution, technological developments and increased population have caused environmental damages. To protect the nature and architectural environment, firstly, green architecture, ecological architecture and then sustainability occurred. This term has been proposed not to be a new term but a response to environmental disturbances caused by human activities and it is re-conceptualization of architecture. Sustainable architecture or sustainability is lot more extensive than ecological and green architecture. It contains the imbalance between environmental problems that is natural environment and consumption that occurred all around the world.

An important part of sustainability debate focused on urban planning and design for more sustainable forms and patterns. In particular, it is discussed that planning and design of urban areas have a major effect on transport and therefore can help reduce car usage, emissions, global warming and climate change. There are many planning and design approaches and movement that introduce certain criteria and strategies to prevent car dependency and encourage people to use public transportation and walking. However, when review the literature, it is seen that planning movements, such as New Urbanism and Transit Oriented Development originated and were implemented mostly in West European and North American Cities. The purpose of this study is to find out whether all those criteria, principles and strategies are also relevant planning approaches for more non-western cities like Baku, which has a very different planning background and therefore possibly different urban form and transport issues. In order to answer the abovementioned question, planning and design approaches in the literature and these recent planning movements were studied and a check list was formed which indicate planning and design approaches that can help attain a more sustainable transport outcome. The checklist was then applied to the case of Baku.

Keywords—Sustainability, Transport, Urban Design.

I. INTRODUCTION

THERE is a vast literature about sustainability, sustainable development and sustainable transportation. All those issues have an impact on urban form and design. There are various planning and neighborhood design movements today that have their own strategies and principles which have common ideas to create more sustainable urban areas, particularly to create sustainable urban transport system that is not car-dependent. The other common feature of those movements is that they all studied and were developed based on the West European and North American cities. This situation brings the question of whether all those principles are universal or not. In other words it should be clarified whether these approaches and principles can also be valid planning

tools for cities in “non-western” countries, such as those in developing country cities in Asia. In order to attain the main aim and to answer the main research questions some objectives and further research questions were identified. For this purpose, Baku was selected as a case study because it has a different planning background because of its Soviet history, which is much different than Europe and North America. Baku urban planning has never been analyzed after the independency of the Azerbaijan although it has a very consuming planning history at the beginning of the 19th century. In fact Baku did not produce a Master plan after the 1987 plan. This brings the question of whether they continue to apply the principles of the old urban plan strategies, whether this old planning strategy y include the sustainable urban design principles or not. The research question specific to Baku is whether planning and design principles for creating more sustainable transport outcomes can be a valid and useful guideline for planning in Baku or whether the specific planning background and resulting urban and transport structure in Baku make these design guidelines inapplicable or unnecessary in this city’s context. These two basic questions make Baku an appropriate case study for this thesis in the concept of sustainable urban development principles.

II. LITERATURE REVIEW

A. Urban Design and Sustainability

Sustainability simply means in the global context the development that should improve economically and socially without harming environment. It is related with many disciplines and professions, which has therefore developed many complexities [1].

‘Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs’ [2].

When we ask under the heading ‘what is to be sustained’ there are three major categories identified; nature, life support systems and community which has the intermediate categories of each such as earth, environment and cultures. The question of ‘what should be developed’ has again three ideas, which are; people, economy and society [3]. All those instructions conclude of the same three pillars of the Sustainable Development, which are economically, socially, and environmentally sustainable developments, (Fig. 1).



Fig. 1 Three Pillars of Sustainability

Automobile usage increased over the 20th century parallel to the growth of income per capita. Both the increase in automobile usage and the division of land use functions caused the low density and fragmented land use development. As a result, a problem occurred as a planning issue known as urban sprawl. Today urban sprawl is a major source of environmental degradation. To solve this problem, many planning concepts have been introduced such as smart growth, transit oriented development and the most popular new urbanism.

When all these concepts are analyzed basic sustainable urban area planning and design principles can be summarized fewer than four main areas, which are, Land Use Management, Transportation, Social Interaction and Environment, (Fig. 2).



Fig. 2 Sustainable Urban Area Principles Relation with Four Pillars

Sustainability is a concept that was discussed after the world war to create livable urban areas. All those discussed urban principles and trends designed to reduce the distances within and between communities. Walking and cycling can be viable options only in reduced distances, while urban sprawl with increased distances results in car-dependent lifestyles. Therefore, the purpose is to reduce the travel distances between the daily facilities while saving time, design green and walk-able spaces and present quality of life by reducing traffic and accordingly reduce stress. Besides, to complete the sustainable urban idea, designing sustainable building is also thought. All written and discussed literature about the sustainable urban or city has a common approach, which is Land Use Management. Land Use Management became important to succeed social, economical and environmental actions such as closer activities, more accessible centers, time saving from travelling, mixed-use neighborhoods, walk-able

communities. However, to achieve successful Land Use Management there should be successful transportation system. If an efficient transportation system is not designed, land use management will not properly work. As a result, to achieve a sustainable urban area we should make the transportation infrastructure more sustainable too.

B. Sustainable Transportation

Sustainable transportation is the expression of the Sustainable Development concept within the transport sector and it refers to any kind of low impact transport, which includes walking, cycling, transit oriented development, green transportation and fuel-efficient transport systems. Sustainable transportation has positive effects on the environmental, social and economical sustainability of the communities they serve [4].

Transport is one of the major global consumers of energy, currently representing between 20% and 25% of aggregate energy consumption and CO₂ emissions [5]. According to the IPCC Fourth Assessment Report (Transport and Its Infrastructure), in 2004, transport was responsible for 23% of world energy-related Greenhouse Gas (GHG) emissions with three quarters coming from road vehicles. Over the past decade, transport's GHG emissions have increased at a faster rate than any other energy-using sector.

The social and environmental costs of transport include road accidents, air pollution, physical inactivity, absent of livability of areas. Traffic congestion also causes economic costs by wasting people's time and delivery options of goods and services. The real purpose of transport planning should be accessibility, access to work, education, goods and services etc., instead of improving mobility for vehicles. Communities, which are successful in improving the sustainability of their transport network, can achieve sustainable urban development [6].

There is a vast literature on the use of urban planning and design tools to make transport systems more sustainable. How we plan the macro form of cities, how we plan different land-uses and densities, how we design neighborhoods have an effect on travel behavior. A set of planning and design criteria can change people's decisions on whether to make a journey by car, public transport, bicycle or walking.

For the strategies of New Urbanism, Smart Growth and Transit Oriented Development to be successfully implemented, the transport infrastructure must support sustainable transportation. When we focus on the question of "how can a sustainable transportation network be created?" it is seen that strategies fall under four categories:

- Improving and investing in public transport
- Improving and encouraging walking and cycling
- Restraining private automobile
- Supporting clean energy in public and private vehicles

All those principles related to the strategies and policies of sustainable transport, but encouraging more usage of public transport, walking and cycling needs more than that. None of these policies can be effective if an urban area has developed extremely car-oriented with low density and sprawl because

public transport usage, walking and cycling cannot be effective alternatives in long distances. This brings us back to the policies and strategies of sustainable urban design, which help to create public transport friendly and walk-able cities that are not automobile-dependent.

To summarize, policies for sustainable transport can be categorized under four headings as mentioned above. One of the most important aspects is to implement urban planning and design approaches to encourage more usage of public transport, walking and cycling. Hence; transport policies can make the transport infrastructure more effective, but transport policies alone cannot change travel behavior and create more sustainable travel patterns. For sustainable transport, land-use and urban design have to support public transport and walking and cycling. Transportation policies can work effectively only after such a management of the land use. Considering the review of the literature described throughout this chapter, it can be concluded that for achieving sustainable transportation, creating a sustainable urban form and therefore planning and neighborhood design are extremely important. This means that for sustainable urban areas, the operations must be performed in three scales of planning and urban design that can be classified as Macro, Mezzo and Micro scales (Table I).

TABLE I
DESIGN APPROACHES FOR SUSTAINABLE URBAN FORM
SUSTAINABLE URBAN DESIGN INDICATOR

| MACRO SCALE | MEZZO SCALE |
|---|------------------------------------|
| -Compactness; | -Mixed-land-use |
| -Mixed-land-use, high density and | -Grid system plan |
| -Non-sprawl | -Well served public transportation |
| -Existence of sub-centers | -Pedestrian friendly |
| -Public transport infrastructure | -walk-able development |
| MICRO SCALE | |
| -Intensity of street network | |
| -Mixed-use | |
| -Well served with public transport | |
| -Grid system plan | |
| -Pedestrian friendly and walk-able street sections | |
| -A hierarchy of narrow streets, boulevards and alleys | |
| -Interface with Parking | |
| -Neighborhoods accessible on foot | |
| -Car-free public areas | |

These principles are derived and originate from studies and planning experiences from the West European and North American cities, and this situation brings the question of whether all these principles are universal or not. A primary concern of this study is therefore to explore whether the abovementioned planning and design principles for creating more sustainable transport outcomes can be a valid and useful guideline for planning in developing country cities too. Such cities often have already high development densities but also they face with sprawl problems and increasing car-dependency. However with their much different planning backgrounds and different urban structures can these cities in developing countries also benefit from these design principles?

III. METHODOLOGY

A. Aim and Objectives

With respect to the main focus are of the thesis, which is the sustainable development, there occurred three main questions, which are tried to be answered:

- What are the key elements to make an urban area sustainable?
- What are the planning and design principles to make urban transportation more sustainable?
- Can those principles be a framework for all the countries in the world (or can those principles be considered as universal)?

One particular point of discussion was raised: all these sustainable urban design and sustainable transportation principles originated from experiences in the American and European countries.

The underlying objective is to examine whether the above framework of criteria is applicable to a city like Baku, which has a different planning history and background compared to North America and west European cities.

An expected outcome of this analysis is whether this framework of criteria can be a mainstream checklist or guideline or whether there are certain cities, due to their own context, history and background, where these guidelines become inapplicable.

Depending on these arguments main tasks of the study are listed below:

- Application/assessment of the above criteria for the case of Baku to examine whether such plan and design approaches are relevant to this City
- Through interviews with experts from Baku planning agencies, assessment of planning and transport problems and potentials in Baku
- Assessment of issues specific to the Baku context with a view to explore whether they can be addressed by the above mainstream criteria or approaches

B. Case Study Selection

Baku was selected as the main case study. It is important to examine whether the planning and design strategies and guidelines for making urban transport more sustainable are relevant and applicable for cities with an entirely different context and planning background. Baku is a city that has a different planning and development background because of its history.

Azerbaijan, strategically located between Europe and Asia, has significant natural resources particularly oil and gas. The oil and gas sector has been consistently leading all other economic sectors. The non-oil sector - led by construction, services and agriculture - has also been growing but at lower pace. Today, the expanding range of economic activity and increasing cultural strength is increasing the region's popularity. Baku Metropolitan Region (BMR) is confronted with a number of challenges in order to maintain its livability.

There is a high employment rate. BMR is an internationally connected region, integrated with global markets and equipped

with a world-class infrastructure in all sectors. BMR is a leading center of education and training in transport, a center of excellence, within the region. Environmental awareness, health and safety, are high among residents, public authorities and the private sector [7].

Baku was the ancient city of the Soviet Union and has a variable history. Azerbaijan that lived under four states;

- 1918 Tsarist Russia
- 1918-1920 Republic of Azerbaijan (Mehmet Emin Resulzade)
- 1920-1991 The Union of Soviet Socialist Republics
- 1991 Republic of Azerbaijan (Heyder Aliyev)

As a result, it has a different urban planning history. The main Master Plan of the Baku is taking a shape according to the plan that was approved in 1987. Up to 1987 plan Baku had 5 different Master Plans (Table II)

- A. İvaniski 1927
- Semyenov 1932
- L. İlyin 1937
- Bakqipogor 1954
- Bakqipogor 1986

C. Method for Data Collection






In this study, the data for Baku Urban Planning was considered a primary source. To access these data and documents, interviews were conducted with the Professors in Baku Architecture and Construction University, Department of City and Regional Planning and Department of Architecture and also Architects and Urban Planners in The State Committee on Urban Planning and Architecture and also the experts in The State Statistical Committee. Aim of these interviews was to get the correct information about the Baku Urban Planning Strategies with the experts and the academicians. Besides, individual analyses were also made by field trips around the selected there main study areas in the city, and sketches and photographs were taken.

IV. HISTORY OF BAKU URBAN PLANNING

A. Baku Urban Planning Between 19th and the Beginning of 20th Centuries

Baku was the ancient city of the Soviet Union. Baku the capital city of the Azerbaijan settled on the west coast of the Caspian Sea. The specialty of the Baku was its thin and long streets within the wall of the Castle. Baku was the biggest industry and economy center of the Caucasian with its architecture and city planning. After discovery of the oil deposits in Absheron, Baku became the most important center for the Russian Empire during the second period of the 19th century. Lots of foreigners came for that oil deposits. Area of the Baku started to grow with the developments of industry and economy. With respect to those improvements, monuments, boulevards, and squares began to be built [8].

TABLE II
MASTER PLAN DEVELOPMENT OF BAKU

| MASTER PLANS | DATE and ARCHITECT |
|---|--|
|  | Master Plan of the Baku City, 1898-1900 Architect; Fon-der-Nonne Date; Approved 18 January 1898 |
|  | Master Plan of the Baku City; 1915-1918, Architect; Hacinski |
|  | Master Plan of the Baku City, 1924-1927, Architect; A.P. Ivaniskiy, Settled SHEME of the Azerbaijan Settlements |
|  | Master Plan of the Baku City, 1934-1937, Architect; L.A. İlyin |
|  | Master Plan of the Baku City, 1986, Architect; University of Baku State Project |

When Baku entered under the protection of the Tsarist Russia, the city came out of the Castle walls/borders in 1806. It was geographically important because of the seaport that it had the trade route passing through Baku between Russia and Iran. After 1840, the highway developed and connected with all roads of Absheron Peninsula.

Intersection of those roads created a square and around that square there were caravanserais and one-two storied houses, which created a trade street under them. With those developments, traders and artisans began to arrive to the city and population grew. Growth process of Baku started therefore in 1806 when the city entered under the protection of Russian Empire and continued till 1914 and it was actualized in 4 phases. The first phase was in 1843, the second was between the years of 1843-1878, the third growth phase was from 1878 to 1900 and the last one was in between 1900 and 1914 [8]. The seaside in front of the castle was used as a warehouse for the port. Sea shore/port became used as a trade center. It was growing through the east and pedestrians were not allowed to enter the seashore. Although the plan drawn in 1854 was designed in rectangular/grid form, with the beginning of the use of seashore, plan was designed according to the coast-line [8].

Population was increasing while the city was growing and port was getting more important because it allowed the transition between Iran and Russia. After that government

took the control of the unbounded ports and in 1858, harbor/port city was designed in Bayıl District. According to the plan, there were shops, stores and lodgings. The area was 4 km² and the plan was designed in a grid form and all the streets were open to the seaside. [8]. The biggest development of Baku was the openings of the oil factories. At the beginning oil factories and deposits were built unplanned. After 1870, because of the air pollution, government decided to collect them in one place. As a result, Qara Şehir/Black City was constructed. In 1876, no one could build an oil factory anywhere else except Qara Şehir/Black City. Like Bayıl, stores, shops and residential buildings were again designed in a grid plan [8]. In 1878 a new plan started to be developed. The new plan consisted of 3 parts, which were Bayıl the port/harbor town, city itself, meaning the castle and the area around it, and the Black City, the oil town. Although the area of Bayıl and the area of the Black City were located in a contrary side of each other, there were highways planned for the connection/transition. 300m swamp area in the seaside was designed as a promenade. In 1880 the first railway station was designed and constructed. It was located on the intersection point of all the roads of Absheron and also it connected with the three main areas of the Baku, which were Bayıl, City Center and Black City (Fig. 3) [8].



Fig. 3 General Plan of Bayıl, City Center and Black City, 1878 [8]

New towns were designed wider because the city was getting crowded and again the grid plan was used for their design (Fig. 4). The main consideration was the wind of the Baku while planning those areas. As a result, all the buildings were located facing the south. During the time period, when those towns started to connect with cities, street design and relationship between residential areas and railway system became an important issue. The main important issue considered was the topographic contours while planning. City center became the center of shops, stores, hotels, clubs, education and palaces of both foreign and local people [8].

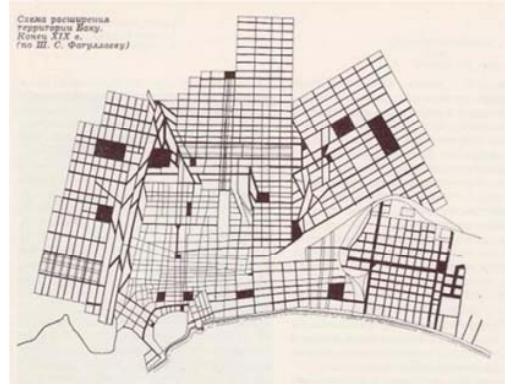


Fig. 4 Expansion Plan of Baku [8]

In 1908 Hacinski with his new plan development opened a water channel 190km far from Baku and this effected the industrial and economical developments of the city. Moreover drainage and green area developments of the city also changed. With this plan, a tram project began to be constructed and 270 ha new development areas were planned. Grid plan form was used from north to south and he developed narrow and uneven streets and inadequate green areas.



Fig. 5 Baku plan, 1918 [8]

City assimilated its developments from 1806 to 1918. All political and economical situations affected those developments in each time. As a result there were ups and downs during the improvements. After all those developments and expansions Baku became one of the most important cities of the Russian and Caucasians while it was a significant city for only Caucasians during the first half of the 199th century [8].

B. Baku Urban Planning Through the Soviet Azerbaijan

In the Soviet Period planners enhanced the grid system of current master plan and achieve the 1924 Master Plan by infill development of the non-designed plots as showed in Fig. 6.



Fig. 6 Baku Planning Design, 1924, [9]

According to that plan, architects developed the city borders to the natural borders of the amphitheater, in other words main Baku borders. This plan was 13 300 hectares and consisted of the sea in the south, 'Yasamal' hill in the west, great 'Shor Lake' and 'Oil' area in the east. It mainly had two areas, center and the industrial area, which had its own residential districts/quarters. This land use plan was protected in the other Master Plans. Besides those land use planning, there also designed highways that appropriate to the lands infrastructure to make a connection between the other regions and industrial area. Planner also gave importance to grow green areas, by designing parks and leisure spaces. As a result boulevard, which is 3km length and 68m wide, was designed as a leisure and commercial area in 1967 [9]. In the current situation, 2011 Boulevard is still 3km length but it is approximately 170m wide and it is the most important leisure place of Baku.

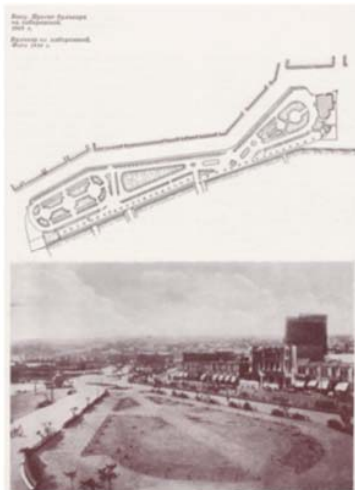


Fig. 7 Plan in 1909 and View of the Promenade/Seaside in 1910 [8]

Planners started to use the current plan and developed the areas, which are not designed of that plan schema. There were designed neighborhoods, streets and architectural buildings. The main idea of the planning system, as seen in Fig. 8, is to create streets and clusters, which have courtyard in between.

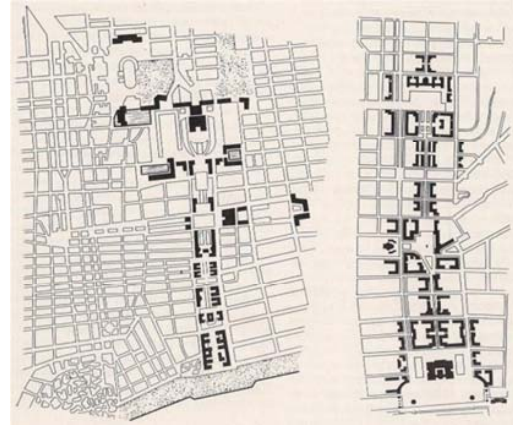


Fig. 8 Baku Downtown Layout, 1932 and Planning Schema of City Centers, 1937 [9]

In 1950s architect M. Huseyinov made the revision plan as shown in the Fig. 9. He planned the different functional building like as, administrative buildings, social buildings, and cultural buildings as theaters and residential buildings along the main streets. This attitude made the Baku center multi-functional use.



Fig. 9 Baku Layout of Main Ensembles [9]

Planning system of Baku will continue to with those aspects, which gave the importance to the multi-functional use of the land, highways and main street layouts to make a connection between regions within and outside of the city.

V. ANALYSIS OF BAKU IN TERMS OF SUSTAINABLE DESIGN AND TRANSPORT

In this chapter of the study, the selected case area, Baku, is analyzed with regards to the approaches of sustainable planning, design, and transport that were discussed in the literature above. In particular, the relevance of approaches, such as new urbanism, smart growth, etc., is to be questioned in the context of Baku. The case area is studied in three scales of urban design, which are macro, mezzo, and micro scales.

For the macro and mezzo scale analysis interviews were conducted with the urban planners, urban professors and architects to understand the design idea of the Baku urban planning. Experts from City Statistical Committee helped for the some statistical data's and also map analysis are done. For micro scale analysis three selected routes were analyzed by walking trips with drawing sketches and taking photographs. The main idea is to understand how Baku performs in terms of the criteria of creating a sustainable urban form and pattern; whether Baku has a problem in terms of unsustainable forms, design and transport; whether it can benefit from the approaches such as new urbanism, or whether such approaches are irrelevant in the case of Baku. In order to make a conclusion, all three scales were studied according to the principles, which had been studied in the literature.

Baku, being 2130 km², has started from the intersection of the three main highway of Azerbaijan: Sumgait Highway, Shamakhi Highway and the Silk Road.



Fig. 10 General Map of Baku Relation with the Main Road System of the Azerbaijan

Baku has 11 administrative regions. The population of Baku is said to be 2 246 000 with refugees but the experts said that the actual population is approximately 4 million. Baku consists of three main zones. The first one is Absheron district, which called Great Baku, the second one is Baku administrative, which occurred with industrial, residential and administrative areas and the last zone is the Private Baku, which was designed as a residential area but currently has a huge mixed-use development. In this thesis these three zones were used as a reference for the three main scales of analysis.



Fig. 11 Three Zone of the Baku Region

A. Macro Scale Analysis

In this part of the analysis Great Baku was examined to find out the compactness of the city. The analysis of macro-scale criteria regarding sustainable form and transport reveals a mixed performance for Baku. According to Macro Scale

Planning Policies planning for sustainable city and sustainable transport outcomes requires three main approaches (criteria): Compactness and prevention of urban sprawl; existence of sub-centers that can provide a mix of different land-uses and hence reduce the need to travel or reduce the distances to be travelled; and an extensive public transportation system.

- In terms of compactness, there is a mixed performance: the city used to be compact with a high density; however, it is experiencing sprawl now and compactness cannot be preserved as well as before.
- Sub-centers can help creating a mix of different land-uses and this issue is recognized as an important strategy in the plan document as cited above. On the other hand, these are not implemented yet; and the existing city center of Baku is still extremely strong where most residents travel to work.
- The city performs well in terms of public transport infrastructure. It has a good subway system and extensive bus services and they are studying to develop the transportation infrastructure to make it more sustainable.

It can be said that all these macro scale policies are important and relevant issues that should be considered in the planning of Baku. Apart from the transport infrastructure, the city does not perform that well in terms of the two issues regarding compactness and sub-centers.

B. Mezzo Scale Analysis



Fig. 12 Amphitheater Plan Scheme of the Baku, 1927

Baku is evaluated against the mezzo scale criteria and policies as shown in Table I. Accessibility is high due to the extensive metro and bus network. The grid plan system also increases pedestrian accessibility. Mixed-use development is encouraged and grid system is a positive feature of the Baku development pattern since it supports walkability. In terms well served public transportation, as there are at least two modes of transport stations around the neighborhoods or activity areas, there is an effective public transportation system. All those modes are close enough to walking, for example there are bus stations in each 350m, and all designed pavements provide the needs of pedestrians by being at least 5 meter wide and divided with the green borders from the roads (as described below in the Micro Scale Analysis). Therefore it performs well enough in the aspect of the pedestrian friendly and walk-able development.

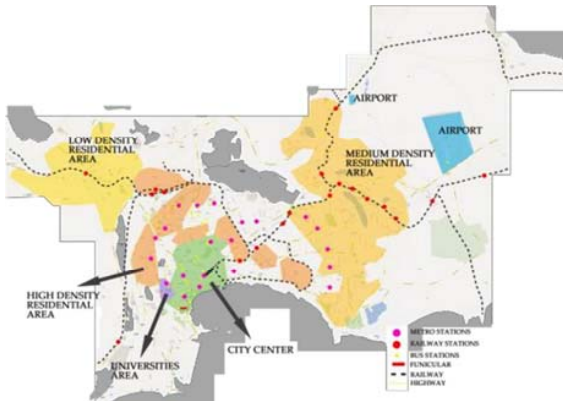


Fig. 13 Accessibility of Transportation Modes of Baku

C. Micro Scale Analysis

In this part of the analysis Baku Center is examined. Private Baku or Baku Center is the oldest development area of Baku.

For a more comprehensive study, three routes were selected for an in-depth analysis as shown in Fig. 14.

1st Route; Yeni Yasamal Residential Area: Yeni Yasamal is the oldest residential area of Baku. While city center was designed for the higher income residents in the first plan, Yasamal was designed for the middle-income population. Planned with courtyards in the middle and not being more than 5 stores, these buildings also consist of commercial usage in facades facing the street.

2nd Route; New Residential Area to the City Center: Baku does not have a new Master Plan. That is why all new buildings are constructed in the empty areas of the 1987 plan (infill development) or in the old building areas, which are about to collapse.

3rd Route; From Train Station to City Center: Baku railway system was the most used transportation system but today it is not used as much as it is used to be. Around the main station there are residential, commercial and educational areas.

Areas were analyzed according to the sustainable urban design indicators that were studied before. The study tries to answer the following questions: how is the intensity of the street network; is there an approach on mixed-use area development; is the area well served by public transportation; is there any awareness regarding pedestrian friendly design; how is the interface with car parking handled; is there a grid system plan to enhance connectivity for pedestrians; are there any car-free pedestrian areas and is the majority of the city walk-able?

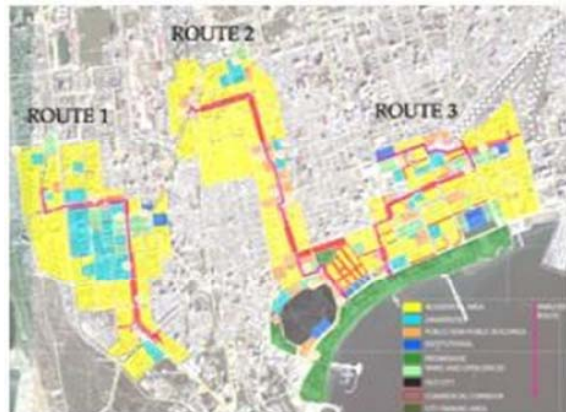


Fig. 14 Three Routes for Micro Scale Analysis

D. Main Findings for the case Study of Baku

The findings of sustainability analysis of Baku showed that Baku has retained its original development pattern which was based on grid and provided walk-ability as well as good public transport accessibility to a certain extent. The main findings are as follows:

- Baku has a **mixed-use development**. In earlier plans the city had a distinct zoning of residential areas and industry. However; there have always been local services and amenities within the residential developments. In addition, there has always been residential areas within the city center and administrative core area. Even within the castle there are both commercial and residential uses. After city began to grow it continued to consist of industrial areas, educational areas, business areas and institutional areas, recreation areas in close proximity to each other and in a mixed-use pattern.

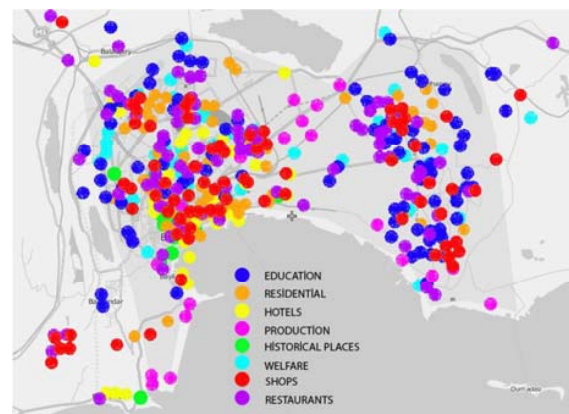


Fig. 15 Mixed-Used Development

- Baku traditionally had very **high-density development** and this can be seen in both the city center (82.6 person/ha) and the housing areas (Yasamal District 115.7 person/ha). On the other hand, both experts interviewed and the Strategic Transportation Plan indicates that the current trend is for low-density housing and that low-density development at the outskirts of the city is a major

problem. Therefore; in terms of the density analysis, it can be said while Baku has a fairly high-density built-up area in its inner city sections, the new developments at the fringes suffer significantly from low-density growth. Nevertheless; the overall average density of 82.6 person/ha for the whole metropolitan regions is still higher than the 35 to 40 person/ha threshold suggested by [10] and [11] as described earlier in the literature review section.

- Baku has an **effective public transportation system**:
 - It has had an electrified railway system since the 1960s (it is used as railway today) and it has been operating an underground subway (metro) since 1967. The metro system, which has 23 stations and 34.6km length, efficiently serves the Baku administrative. Today, the government developed a new strategy for Great Baku by planning another 45 stations.
 - It has also an effective and extensive bus system, as there are stops in every 350m approximately.
- In planning of the Baku street layout there is a concern for the **pedestrian friendly design**:
 - All pavements are wide enough for walking and separated with green Border from the vehicle road.
 - There are commercial and leisure activities along the street, which encourages the walking.
 - Even though there are huge boulevards formed by the intersections of the main axes of the transport infrastructure, huge public spaces as cultural activities and parks and underground passages reduce the negative effect of those boulevards
- Baku has had the **grid plan** system, which is often described as one of the most important approaches for the sustainable urban design form. The city has had this approach since the 1898 Master Plan and protected its grid plan approach while enhancing the plan.
- All neighborhoods and special development areas like educational areas have at least two kinds of **transportation modes** like bus stops and underground subway station **close enough to walk**.
- City center layout is designed well enough to walk. Indeed three routes for the case study, which are 2km long, were analyzed by easily walking.
- There are huge pedestrian areas like boulevards and Tarqovı Street as leisure and commercial areas. These areas are completely **car-free areas**.

After an in-depth analysis of Baku, the following results can be shown:

TABLE III
ANALYSIS RESULT OF THE BAKU CASE

| MACRO SCALE ANALYSIS | |
|---|-----|
| Compactness of the urban form in metropolitan scale (restraining urban sprawl, setting growth boundaries, growth management, etc) and prevention of sprawl | +/- |
| Existence of sub-centers (a polycentric form that enables a mix of land-uses at macro scale and eliminates the need to travel to the city centre for daily needs or even for work purposes) | + |
| An extensive public transport infrastructure: efficient public transportation system | + |

MEZZO SCALE ANALYSIS

| | |
|--|---|
| Mixed-land use | + |
| Pedestrian friendly, walkable development | + |
| Well served public transportation: efficient public transportation system and urban development focused on public transport stations | + |
| Grid system plan (to ensure high connectivity and walkability in the micro scale) | + |

MICRO SCALE ANALYSIS

| | |
|--|-----|
| Intensity of street network (to ensure high connectivity) | +/- |
| Existence of local services and amenities (mixed use) | + |
| Areas being well served with Public Transport | + |
| Grid Plan for high connectivity | + |
| Pedestrian friendly and walkable street sections | + |
| A hierarchy of narrow streets, boulevards and alleys | +/- |
| Interface with parking: parking areas should not be barriers for pedestrians | - |
| Having majority of the neighborhood accessible on foot | + |
| Car-free public areas | + |

VI. CONCLUDING REMARKS

According to this analysis, it can be said for certain planning principles and approaches, that Baku always had adopted those and preserved them, and therefore has a relatively more sustainable urban form and transport system. For example, mixed-use development has always been an important strategy, and throughout its planning history, new developments in Baku have always been planned with their local services and amenities. In addition, boulevards with large sidewalks and protection of pedestrian pavements from the traffic with landscaping and green belts have been a long-lasting approach in planning in Baku. The adoption of grid-street patterns in most neighborhoods was another advantage that increased THE interconnectivity and walkability, although some residential areas such as Yasamal, which were designed in the period of Soviet Azerbaijan, had less connectivity with large mass-housing style parcels and plots.

From all these perspectives, it could be said that the new urbanism, transit oriented design and similar approaches are not as relevant to Baku as they are to the cities of North America because Baku planners have always been aware of the advantages of these approaches and implemented them throughout the planning history of the city. On the other hand, there are certain criteria or approaches that the analysis showed to be important for Baku:

Although development until recently has been in high-density, this is changing with the low-density development in new residential areas. Hence there is the problem of sprawl; and therefore growth management should be an important strategy for Baku. The Transportation Strategic Plan also emphasizes this. In addition to that the interface of parking with sidewalks and pedestrians is a huge problem in Baku.

There are many large boulevards in the city and the city center remaining from the Soviet period which are being further invested in today with flyovers and junctions to create better accessibility for cars. Hence there is the danger of creating a car-dominated system in spite of the advantages of the current urban form and design.

Car ownership and usage are high as described. Car ownership ratio is growing day by day because of the cheap sales of car industry. The city center is not designed in a car oriented way and this is a positive thing. However, there are not enough traffic management approaches to prevent cars entering the city center. Therefore in spite of the good design of the urban core, congestion and traffic problems are increasing. As a result, approaches, such as growth management and the design of car parking areas may be important and relevant strategies for the Baku case.

What the Baku case shows, however, is that with the strong planning background of this city, planning and designing the city to make it more public transport friendly or walk-able is not the priority. The city is already like this. It is the lack of any control on car traffic that is the problem. This problem can be solved with further design and pedestrianisation actions, but also with good traffic management including traffic calming measures.

However, sustainability is a much extensive issue as it is related to economy, environment and social life. As a result to achieve sustainable urban area, there need be sustainable in all three pillars of sustainability. But, as cities are the core areas of the development, in the first step, they need to be designed according to the sustainable urban design approaches. There is a vast literature, again, about that issue and the transportation is the key element to design a city. Although there are many policies to achieve more appropriate and sustainable transportation they are not well served if there is not an appropriate urban planning and design approach that encourages the use of sustainable modes of transport, such as walking, cycling and public transport.

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